X-8432

GMC

1984 LIGHT DUTY TRUCKS

SERVICE MANUAL

FOREWORD

This manual includes procedures for diagnosis, maintenance and adjustments, minor service operations, removal disassembly and installation for components of GMC Series 1500-3500 Light Duty Trucks. Procedures for "S-15" and Caballero are contained in separate service manuals.

The Section index on the contents page enables the user to quickly locate any desired section. At the beginning of each section containing more than one major subject is a Table of Contents, which gives the page number on which each major subject begins. An index is placed at the beginning of each major subject within the section.

Summaries of Special Tools, when required, and specifications are found at the end of major sections.

When reference is made in this manual to a brand name, number, or specific tool an equivalent product may be used in place of the recommended item.

This manual should be kept in a handy place for ready reference. If properly used, it wil enable the technician to better serve the owners of GMC built vehicles.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

GMC TRUCK & COACH OPERATION
TRUCK & BUS GROUP
General Motors Corporation
Pontiac, Michigan

CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these 'Cautions' and 'Notices' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

1984
LIGHT DUTY TRUCK
(Series 10-35)
SHOP MANUAL

Any reference to brand names in this manual is intended mereiy as an example of the types of lubricants, tools, materials, etc., recommended for use. In all cases, an equivalent may be used.

The Table of Contents on this page indicates the sections covered in this manual. At the beginning of each individual section is a Table of Contents which gives the page number on which each major subject begins.

CAUTION

This vehicle contains many parts dimensioned in the metric system. Most fasteners are metric and many are very close in dimension to familiar customary measurements in the inch system. However, it is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements as those removed, whether metric or customary. Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Additional information concerning this subject will be found following the specifications section at the end of this manual.

GMC TRUCK & COACH OPERATION
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SECTION 0A

GENERAL INFORMATION

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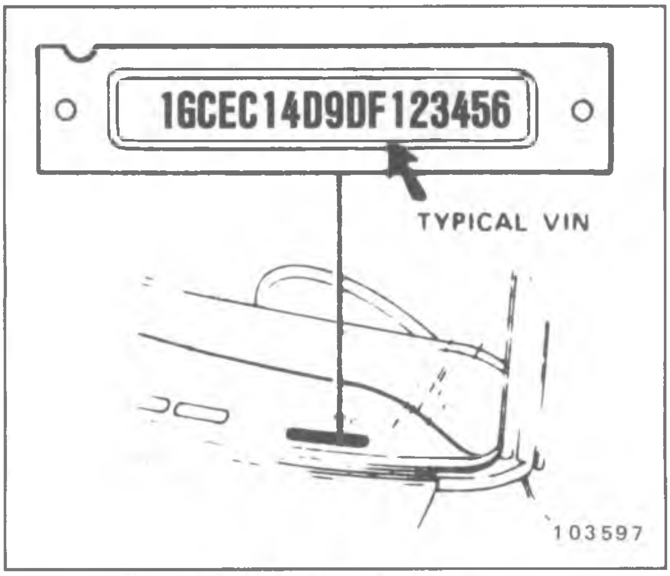


Fig. 0A-1 -- V.I.N. Location

GENERAL INFORMATION

Information to identify the vehicle and vehicle components appears in this section. Detailed specifications on major units are given at the end of each respective section in this manual.

VEHICLE IDENTIFICATION NUMBER (VIN)

This is the legal identification of the vehicle. It appears on a plate which is attached to the left top of the instrument panel on CK and G truck and can be easily seen through the windshield from outside the vehicle (Fig. 0A-1). On P10-20-30 models, the plate is attached to the front of the dash and toe panel to the left of steering column (Fig. 0A-2). The VIN (Fig. 0A-3) also appears on the Vehicle Certificates of Title and Registrations.

SERVICE PARTS IDENTIFICATION STICKER

The Service Parts Identification Sticker (Fig. 0A-4) is provided on all Truck models. On C and K models, the identification sticker is located on the inside of the glove box door or on G model, the sticker will be located on an inner hood panel surface. On P models, the sticker is located on an inner body panel.

The plate lists the vehicle identification number, wheelbase, and all Production options or Special Equipment on the vehicle when it was shipped from the factory including paint information. **ALWAYS REFER TO THIS INFORMATION WHEN ORDERING PARTS.**

VEHICLE LOADING

Vehicle loading must be controlled so weights do not exceed the numbers shown on the Vehicle Identification Number and/or Rating Plate for the vehicle.

A typical example of a truck in a loaded condition is shown in Figure 0A-5. Note that the axle or GVW capabilities are not exceeded.

ENGINE CODE NUMBER

The engine code number indicates manufacturing plant, month and day of manufacture, and transmission type. A typical engine number would be F1210TTBB, which would breakdown thus:

F - Manufacturing Plant (F-Flint, T-Tonawanda)
12 - Month of Manufacture (December)
10 - Day of Manufacture (tenth)
T - Truck
TBB - Transmission and engine type

UNIT AND SERIAL NUMBER LOCATIONS

For the convenience of service technicians and engines when writing up certain business papers such as Warranty Reports, Product Information Reports, or reporting product failures in any way, the location of the various unit numbers have been indicated. These unit numbers and their prefix or suffix are necessary on these papers for various reasons - such as accounting, follow-up on production, etc.

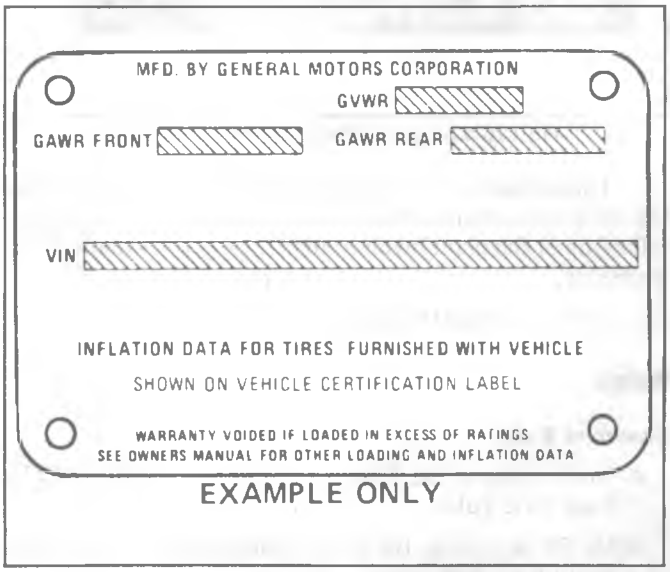


Fig. 0A-2 -- V.I.N. Rating Plate (P Model)

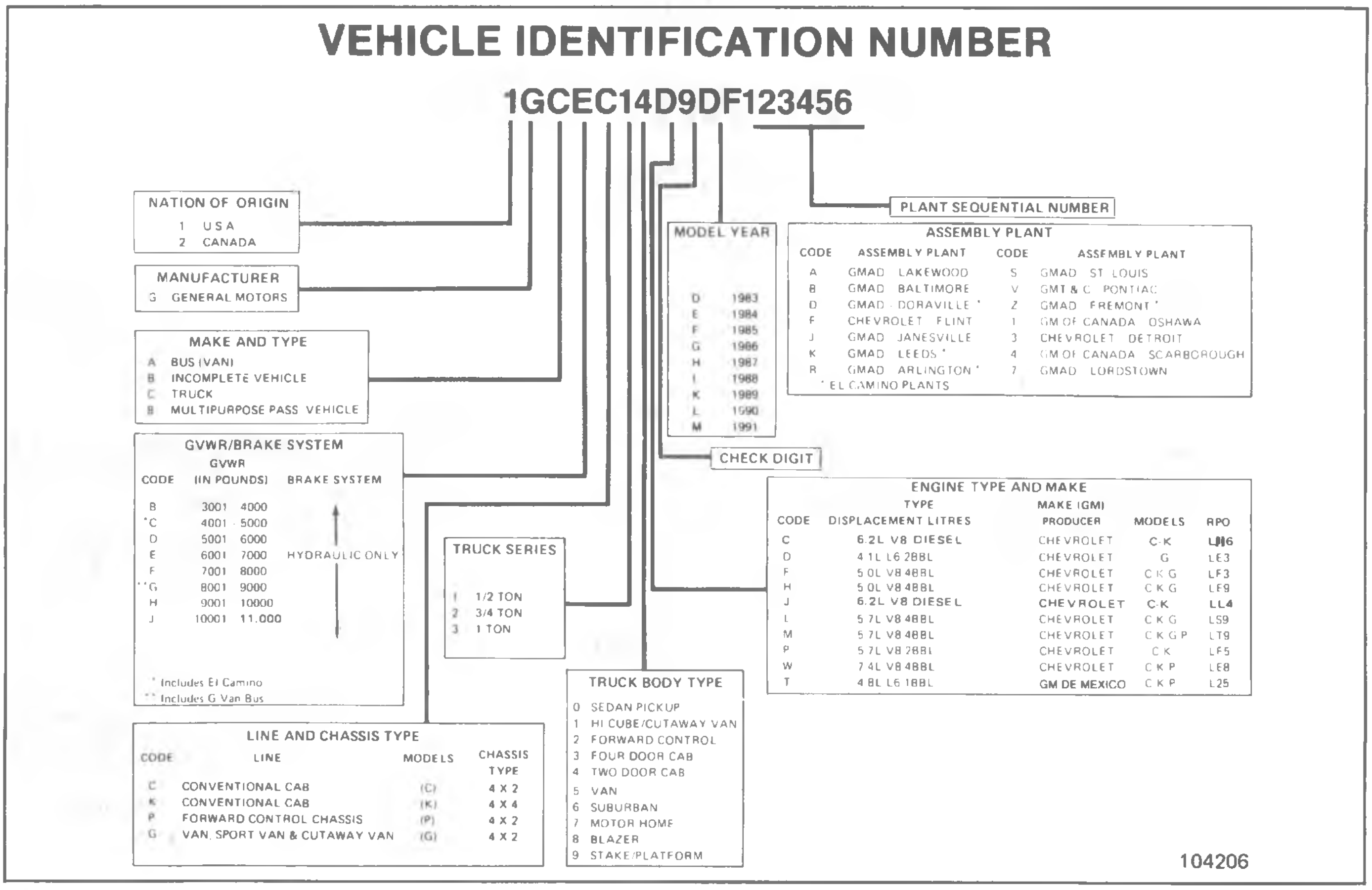


Fig. 0A-3 -- Vehicle Identification Number Codes, CKGP, Truck

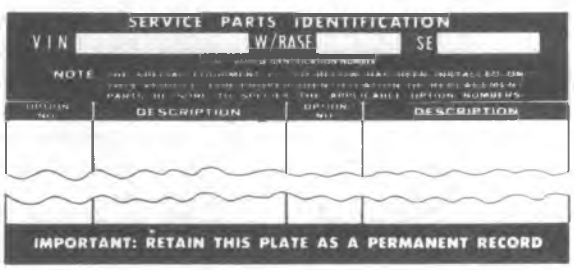


Fig. 0A-4 -- Service Parts Identification Plate

The prefixes on certain units identify the plant in which the unit was manufactured and thereby permits proper follow-up of the plant involved to get corrections made when necessary.

Always include the prefix in the number.

Axles

Chevrolet Built

- On 10 Series, the Code is stamped on Top of Right Rear Axle Tube.
- On 20-30 Series, the Code is stamped on Top of the Right Rear Axle Tube.

Dana Built

- On Front Axles, code is stamped on Top Rear of Left Axle Tube.
- On Rear Axles, code is stamped on Rear Surface of Right Axle Tube.

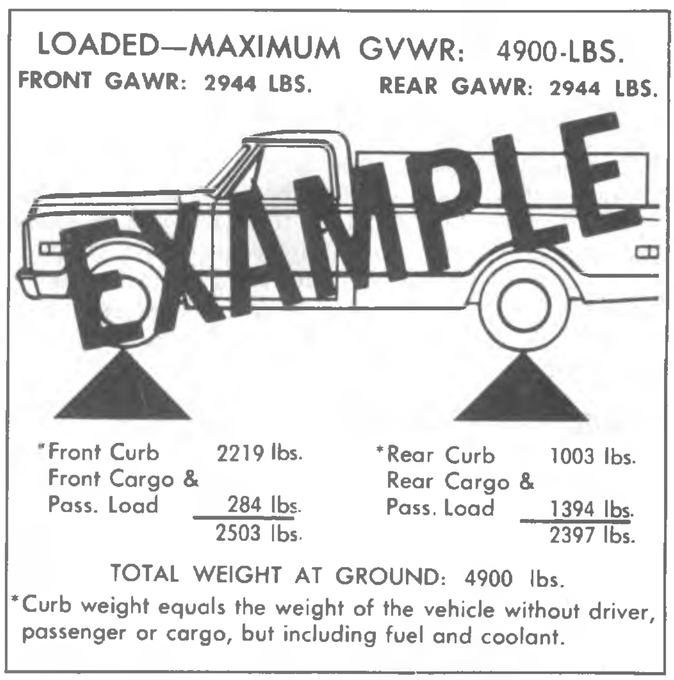


Fig. 0A-5 -- Typical Vehicle Loading Condition

Transmissions (Fig. 0A-6)

- On 3-Speed Transmissions (except Tremec), the Unit Number is located on Lower Left Side of Case Just Below Cover.
- On Tremec Transmission, Unit Number is located on Upper Left Attachment Case (Top Side).
- On Muncie 4-Speeds, Unit Number is located on Rear Face of Case below Retainer.
- On New Process 205 model 4-wheel drive transfer case, a build date is on tag attached to front face of transfer case.
- On Automatic 350 Transmission, Unit Number is located on Right Rear Vertical Surface of Oil Pan.
- On the Automatic 400 Transmission, Serial Number is location on the Light Blue Plate on the Right Side of the Transmission.

Engines (Fig. 0A-7)

- 6-Cylinder Engine Unit Number Located on Pad at Right Hand Side of Cylinder Block at Rear of Distributor.
- 8-Cylinder Gasoline Engine Code is (305, 350, 400 CID) Located on Pad immediately forward of right hand cylinder head.
- 8-Cylinder Gasoline Engine (454 CID) Code is located on a pad of the front top center of the engine block immediately forward of the inlet manifold.
- 8-Cylinder Diesel Engine Code is on a label located on rear face of the left valve cover.

Generators

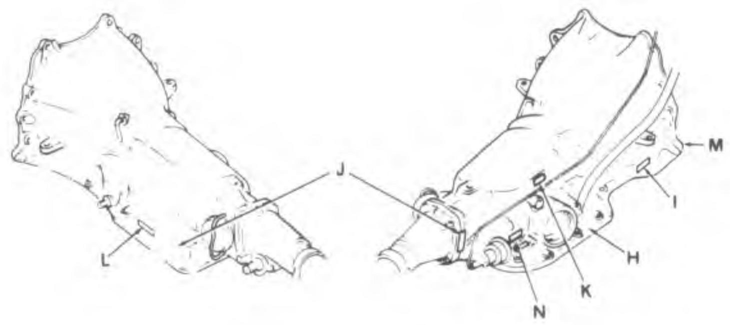
Generator Unit Serial Number is located on the Drive End Frame Below the Part Number.

Batteries

Battery Code Number is Located on Cell Cover Top of Battery.

Starters

Starter Serial Number and Production Date are Stamped on Outer Case, Toward Rear.



TYPICAL TRANSMISSION – I.D. LOCATIONS

H THM 350C STAMPED I.D. LOCATION
I. THM 350C VIN LOCATION
J THM 350C OPTIONAL VIN LOCATIONS

K THM 400 I.D. TAG LOCATION
L THM 400 VIN LOCATION
M THM 700 R4 STAMPED I.D. LOCATION
N THM 700 R4 VIN LOCATION

H 7A 1 6/81

TRANSMISSION IDENTIFICATION

FOR: THM 350C – TOLEDO PLANT, OHIO

Y	3	E	03	D

Y = SOURCE (Y = TOLEDO B = PARMA)
3 = MODEL YEAR
E = MONTH (A = JAN B = FEB)
84 = DAY
D = SHIFT (D = DAY SHIFT N = NIGHT SHIFT)

H 7A-8-6/81

TRANSMISSION NAMEPLATE
YPSILANTI PLANT, MICHIGAN

THM 400

P • Z
84 -PZ 86992

84 = MODEL YEAR
PZ = MODEL
86992 = SERIAL NO.

H 7A-12-6/81

TRANSMISSION NAMEPLATE
BUICK FLINT PLANT, MICHIGAN
THM 350C

L • D
9LD 001D 83

9LD = MODEL CODE (1982 LO)
001 = PRODUCTION BUILD DATE
D = SHIFT (D = DAY SHIFT)
84 = YEAR

H 7A-9-6/81

TRANSMISSION IDENTIFICATION
THM 700R4 – TOLEDO PLANT, OHIO

9	TA	Y	83	M	12	D

9 = MODEL YEAR
TA = MODEL
Y = TOLEDO
84 = YEAR
M = MONTH
12 = DAY
D = SHIFT (D = DAY N = NIGHT)

H 7A-7-6/81

Fig. 0A-6 -- Transmission V.I.N. Location

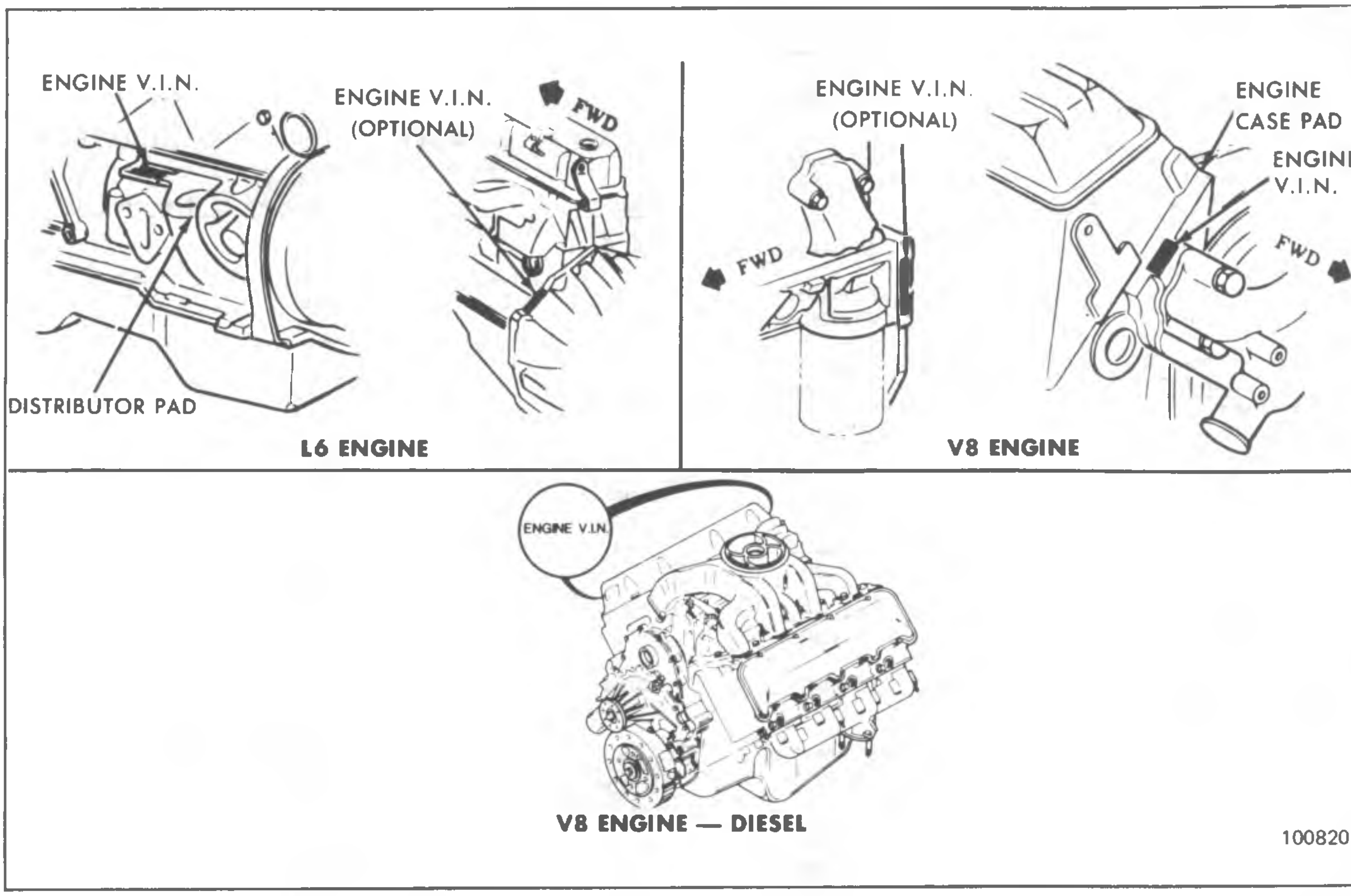


Fig. 0A-7 -- Engine V.I.N. Location

APPROXIMATE CAPACITIES – PICKUP MODELS

ITEMS	Metric Measure	U.S. Measure
Cooling System (approx.)		
All L-6		
Without A/C	14 Liters	15 Quarts
With A/C	14.7 Liters	15.5 Quarts
Code F,H,L & M – V-8		
Without A/C	16.6 Liters	17.5 Quarts
With A/C	17 Liters	18 Quarts
Code W – V-8		
Without A/C	22 Liters	23 Quarts
With A/C	23 Liters	24.5 Quarts
Diesel		
Without A/C	22 Liters	23 Quarts
With A/C	23 Liters	24.5 Quarts
Crankcase ♦		
Gasoline Engines		
Codes: D,F,H,L,M		
Without Filter	3.8 Liters	4 Quarts
With Filter	4.8 Liters	5 Quarts
Code: T		
Without Filter	4.8 Liters	5 Quarts
With Filter	5.7 Liters	6 Quarts
Code: W +		
Without Filter	5.7 Liters	6 Quarts
With Filter	6.5 Liters	7 Quarts
Diesel Engines		
Code: C,J †	6.5 Liters	7 Quarts
Fuel Tank (approx.)		
Short Bed –		
Single Tank, Gas, Diesel	61 Liters	16 Gallons
*Dual Tanks, Gas, Diesel	61 Liters	16 Gallons
Long Bed –		
Single Tank, Gas	76 Liters	20 Gallons
@*Dual Tanks, Gas	61 Liters	16 Gallons
Single Tank, Diesel	76 Liters	20 Gallons
*Dual Tanks, Diesel	76 Liters	20 Gallons
Front Axle	2.4 Liters	2.5 Quarts
Transfer Case		
10-20 Series	4.8 Liters	5 Quarts
30 Series	2.4 Liters	2.5 Quarts

♦ After refill, fluid level must be checked.
+ K30 Models – 5 U.S. Quarts (4.8 Liters)
† Oil Filter should be changed at EVERY oil change.
* Listed quantity if for each tank.
@ Above 8600 GVWR–Both tanks 20 gallons (76 Liters)

APPROXIMATE CAPACITIES – BLAZER, SUBURBAN

ITEMS	Metric Measure	U.S. Measure
Cooling System (approx.)		
Code: H, L, M		
Without A/C	16.5 Liters	17.5 Quarts
With A/C	17 Liters	18 Quarts
Code: W		
Without A/C	22 Liters	23 Quarts
With A/C	23 Liters	24.5 Quarts
Diesel Engines		
Code: C, J		
Without A/C	23 Liters	24.5 Quarts
With A/C	23 Liters	24.5 Quarts
Crankcase ♦		
Gasoline Engines		
Code: H, L and M		
Without Filter	3.8 Liters	4 Quarts
With Filter	4.8 Liters	5 Quarts
Code: W +		
Without Filter	5.7 Liters	6 Quarts
With Filter	6.5 Liters	7 Quarts
Diesel Engines †		
Code: C, J		
With Filter	6.5 Liters	7 Quarts
Front Axle	2.4 Liters	2.5 Quarts
Transfer Case	4.8 Liters	5.0 Quarts
Fuel Tank		
Standard, All – Gas	95 Liters	25 Gallons
– Diesel	102 Liters	27 Gallons
NK7 Option, All – Gas	117 Liters	31 Gallons
– Diesel	121 Liters	32 Gallons
NE2 Option, Suburban Only		
– Gas	151 Liters	40 Gallons
– Diesel	155 Liters	41 Gallons

♦ After refill, fluid level must be checked.
+ K30 Models – 5 U.S. Quarts (4.8 Liters).
† Oil Filter should be changed at EVERY oil change.

APPROXIMATE CAPACITIES – ALL MODELS

ITEMS	Metric Measure	U.S. Measure
Differential		
8½" Ring Gear	1.9L	4¼ pts.
8-7/8" Ring Gear		3½ pts.
10½" Ring Gear (Chev.)	2.8L	6½ pts.
10½" Ring Gear (Dana)	3L	7.2 pts.
9¾" Ring Gear (Dana)	2.6L	6.0 pts.
12¼" Ring Gear (Dana)	11.7L	26.8 pts.
Transmission		
Automatic		
350 – Total	9.5L	10 qts.
– Refill	2.8L	3 qts.
400 – Total	10.4L	11 qts.
– Refill	3.8L	3.5 qts.
700R4 – Total	10.9L	11.5 qts.
– Refill	4.7L	5 qts.
Manual		
4 Speed 117mm	3.8L	4 qts.
3 Speed 76mm	1.4L	1.5 qts.
3 Speed 77mm	1.4L	1.5 qts.

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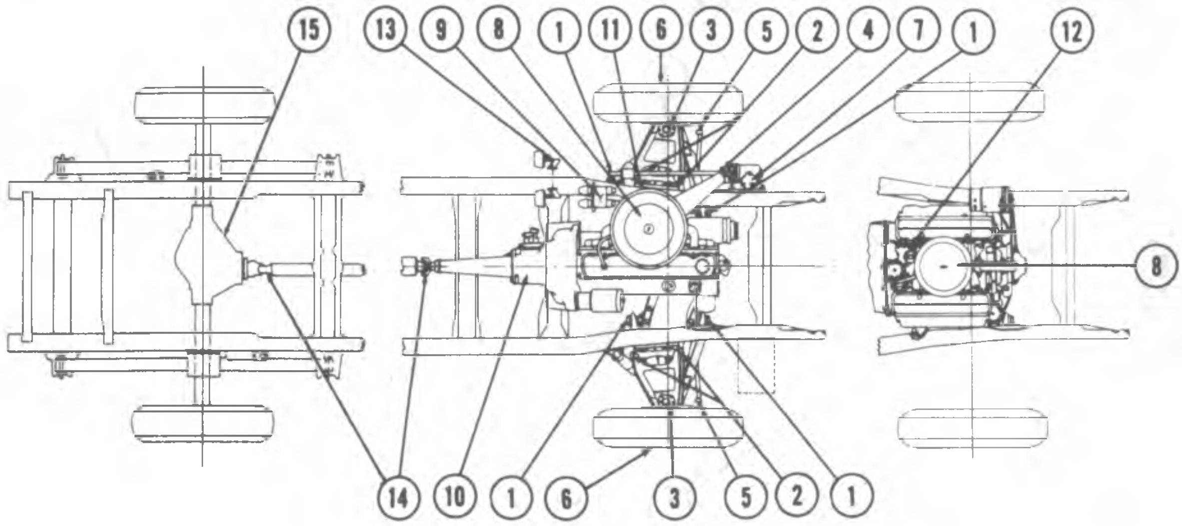
Fig. 0A-8 -- Capacities Chart

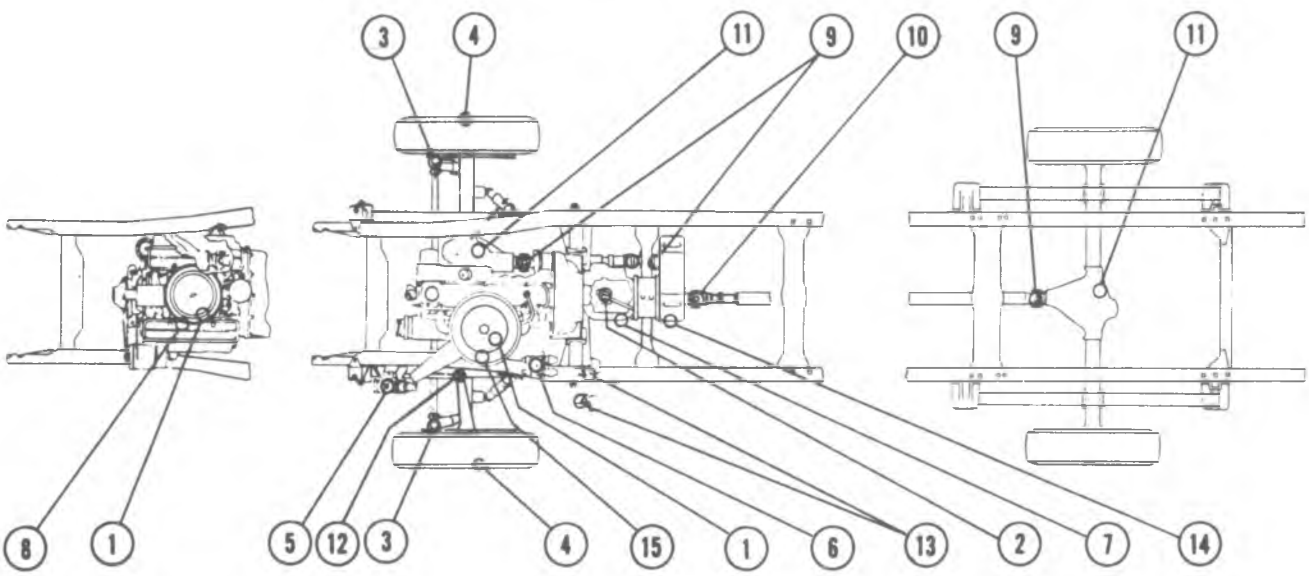
CONVENTIONAL AND FORWARD CONTROL MODELS



LUBRICATION POINTS

1 Lower Control Arms
2 Upper Control Arms
3 Upper and Lower Control Arm Ball Joints
4 Intermediate Steering Shaft (PA10)
5 Tie Rod Ends
6 Wheel Bearings
7 Steering Gear
8 Air Cleaner – Element
9 Master Cylinder
10 Transmission – Manual – Automatic
11 Throttle Bell Crank – L-6
12 Carburetor Linkage – V-8
13 Brake and Clutch Pedal Springs
14 Universal Joints
15 Rear Axle

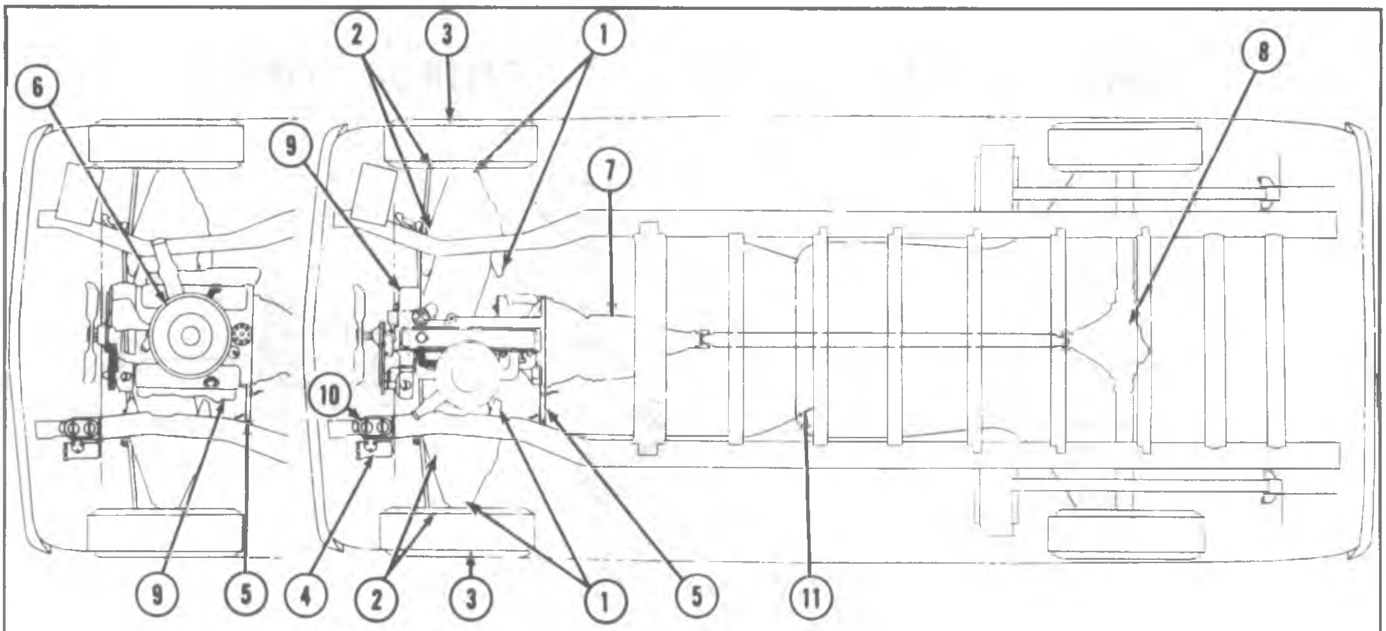
FOUR WHEEL DRIVE MODELS



LUBRICATION POINTS

1 Air Cleaner
2 Control Linkage Points
3 Tie Rod Ends
4 Wheel Bearings
5 Steering Gear
6 Master Cylinder
7 Transmission – Manual – Automatic
8 Carburetor Linkage – V-8
9 Universal Joints
10 Propeller Shaft Slip Joints
11 Front and Rear Axle
12 Drag Link
13 Brake and Clutch Pedal Springs
14 Transfer Case
15 Throttle Bell Crank – L-6

Fig. 0A-9 -- Lubrication Points, CK



LUBRICATION POINTS

1	Control Arm Bushings and Ball Joints	5	Trans. Control Shaft	8	Rear Axle
2	Tie Rod Ends	6	Air Cleaner – Element	9	Oil Filter
3	Wheel Bearings	7	Transmission – Manual – Automatic	10	Brake Master Cylinder
4	Steering Gear Clutch Cross-Shaft			11	Parking Brake Linkage

Fig. 0A-10 -- Lubrication Points, G

USE OF METRIC AND CUSTOMARY NUTS, BOLTS AND SCREWS

Some vehicles present special service requirements to the technician due to the use of both metric and customary (inch) type nuts, bolts and screws. Many are metric and some are very close in dimension to customary nuts, bolts and screws in the inch system. Mismatched or incorrect nuts, bolts and screws can result in damage, malfunction or possible personal injury. Nuts, bolts and screws removed from the vehicle should be saved for re-use whenever possible. If they are not re-usable, care should be taken to select a replacement that matches the original.

General Motors Engineering Standards have adopted a portion of the standard metric fastener sizes defined by SI (Systeme International). This was done to reduce the number of sizes used and yet retain the best strength characteristics in each thread size. For example, the customary 1/4-20 and 1/4-28 screws are replaced by the metric M6.3 x 1 screw which has nearly the same diameter and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is illustrated below.

CUSTOMARY	METRIC
1/4	M6.3
Thread Major Diameter in Inches	Thread Major Diameter in Millimeters
20	1
Number of Threads per Inch	Distance Between Threads in Millimeters

Care should be taken when servicing the vehicle to guard against cross threading or improper retention due to interchanged metric and inch nuts and bolts.

When obtaining metric or customary nuts, bolts, and screws locally for servicing the vehicle, care must be exercised in selecting parts that are equivalent to the original parts in dimensions, strength, and pitch of threads.

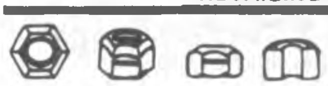
Fig. 0A-11 -- Metric Information, Chart A

REUSE OF PREVAILING TORQUE NUT(S) AND BOLT(S)

PREVAILING TORQUE NUTS ARE THOSE NUTS WHICH INCORPORATE A SYSTEM TO DEVELOP AN INTERFERENCE BETWEEN NUT AND BOLT THREADS INTERFERENCE IS MOST COMMONLY ACHIEVED BY DISTORTING TOP OF ALL-METAL NUT, BUT ALSO MAY BE ACHIEVED BY DISTORTING AT MIDDLE OF HEX FLAT, BY NYLON PATCH ON THREADS, BY NYLON WASHER INSERT AT TOP OF NUT AND BY NYLON INSERT THROUGH NUT.

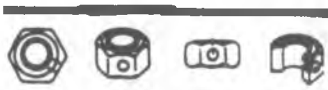
PREVAILING TORQUE BOLTS ARE THOSE BOLTS WHICH INCORPORATE A SYSTEM TO DEVELOP AN INTERFERENCE BETWEEN BOLT AND NUT OR TAPPED HOLE THREADS. INTERFERENCE IS ACHIEVED BY DISTORTING SOME OF THE THREADS (SEVERAL METHODS EXIST), BY APPLYING A NYLON PATCH OR STRIP OR BY ADHESIVE COATING ON THREADS.

PREVAILING TORQUE NUTS



TOP LOCK MANY TYPES

CENTER LOCK

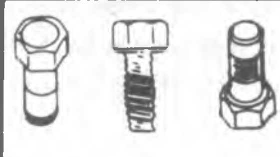


NYLON INSERT

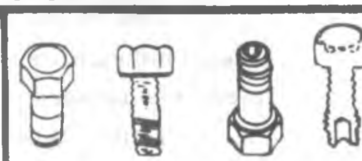
NYLON PATCH

NYLON WASHER INSERT

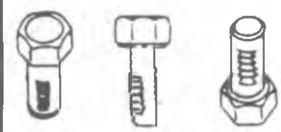
PREVAILING TORQUE BOLTS



DRY ADHESIVE COATING



OUT OF ROUND THREAD AREA



NYLON STRIP OR PATCH

THREAD PROFILE DEFORMED

RECOMMENDATIONS FOR REUSE

A. CLEAN, UNRUSTED PREVAILING TORQUE BOLTS AND NUTS MAY BE REUSED AS FOLLOWS

1. CLEAN DIRT AND OTHER FOREIGN MATERIAL OFF NUT AND BOLT.
2. INSPECT BOLT AND NUT TO ASSURE THERE ARE NO CRACKS, ELONGATION OR OTHER SIGNS OF ABUSE OR OVERTIGHTENING LIGHTLY LUBRICATE THREADS (IF ANY DOUBT, REPLACE WITH NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH.)
3. ASSEMBLE PARTS AND START BOLT OR NUT
4. OBSERVE THAT BEFORE FASTENER SEATS, IT DEVELOPS PREVAILING TORQUE PER CHART BELOW (IF ANY DOUBT, INSTALL NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH).
5. TIGHTEN TO TORQUE SPECIFIED IN SERVICE MANUAL.

B. BOLTS AND NUTS WHICH ARE RUSTY OR DAMAGED SHOULD BE REPLACED WITH NEW PARTS OF EQUAL OR GREATER STRENGTH

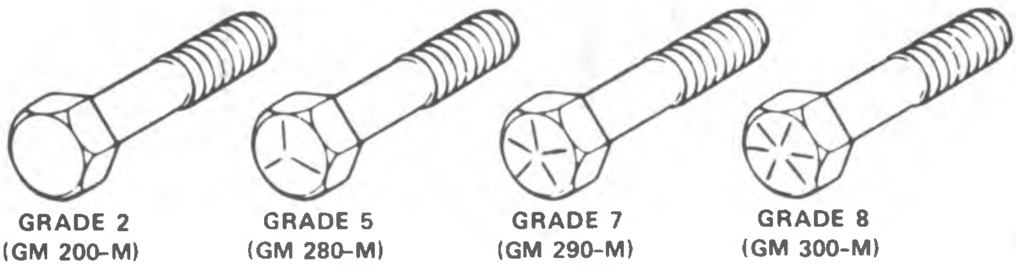
METRIC SIZES		6 & 6.3	8	10	12	14	16	20
NUTS AND ALL METAL BOLTS	N·m	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	In. Lbs.	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	N·m	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	In. Lbs	4.0	5.0	10	14	20	28	46

INCH SIZES		.250	.312	.375	.437	.500	.562	.625	.750
NUTS AND ALL METAL BOLTS	N·m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	In. Lbs.	4.0	5.0	12	15	20	27	35	51
ADHESIVE OR NYLON COATED BOLTS	N·m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	In. Lbs.	4.0	5.0	9.0	12	15	22	28	43

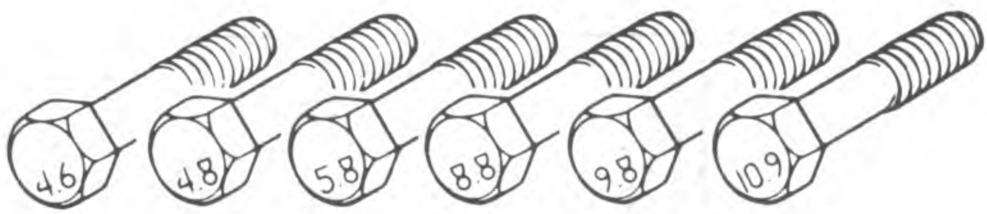
Fig. 0A-12 -- Metric Information, Chart B

METRIC BOLT AND NUT IDENTIFICATION

Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. The following figure illustrates the different strength markings.



Customary (inch) bolts - Identification marks correspond to bolt strength - Increasing numbers represent increasing strength.



Metric Bolts - Identification class numbers correspond to bolt strength - Increasing numbers represent increasing strength.

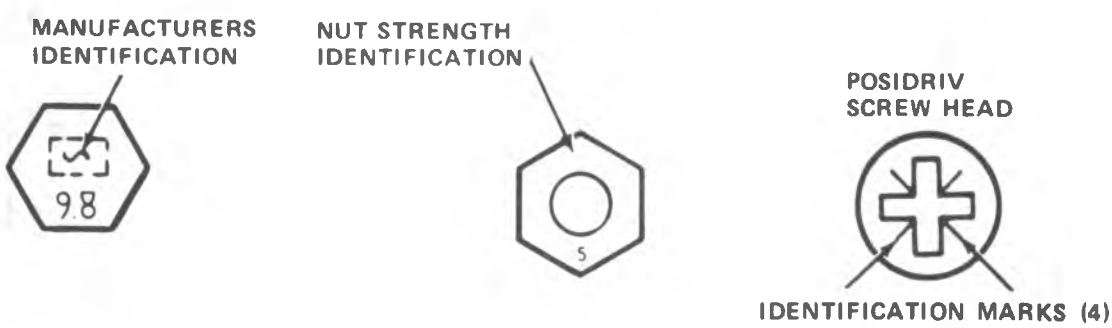
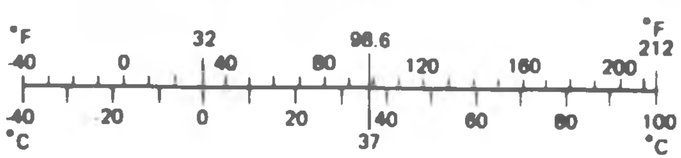


Fig. 0A-13 -- Metric Information, Chart C

SI METRIC-CUSTOMARY CONVERSION TABLE

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimeters (mm)
Foot	0.304 8	meters (m)
Yard	0.914 4	meters
Mile	1.609	kilometers (km)
AREA		
Inch^2	645.2	millimeters2 (mm2)
	6.45	centimeters2 (cm2)
Foot^2	0.092 9	meters2 (m2)
Yard^2	0.836 1	meters
VOLUME		
Inch^3	16 387	mm^3
	16.387	cm^3
	0.016 4	liters (l)
Quart	0.946 4	liters
Gallon	3.785 4	liters
Yard^3	0.764 6	meters3 (m3)
MASS		
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(°F-32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
ACCELERATION		
Foot/sec^2	0.304 8	meter/sec2 (m/s2)
Inch/sec^2	0.025 4	meter/sec2
TORQUE		
Pound-inch	0.112 98	newton-meters (N·m)
Pound-foot	1.355 8	newton-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of mercury	3.377	kilopascals (kPa)
Pounds/sq in	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000 or 3.6x10^6	joules (J = one W's)
LIGHT		
Foot candle	10.764	lumens/meter2 (lm/m2)
FUEL PERFORMANCE		
Miles/gal	0.425 1	kilometers/liter (km/l)
Gal/mile	2.352 7	liters/kilometer (l/km)
VELOCITY		
Miles/hour	1.609 3	kilometers/hr. (km/h)

Fig. OA-14 -- Metric Information, Chart D

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

Fig. 0A-15 -- Metric Information, Chart E

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

A - Ampere(s)
A-6 - Axial 6 Cyl. A/C Compressor
A/C - Air Conditioning
ACC - Automatic Climate Control
Adj. - Adjust
A/F - Air/Fuel (As in Air/Fuel Ratio)
AIR - Air Injection Reaction System
ALC - Automatic Level Control
ALCL - Assembly Line Communications Link
Alt. - Altitude
APT - Adjustable Part Throttle
AT - Automatic Transmission
ATC - Automatic Temperature Control
ATDC - After Top Dead Center

BARO - Barometric Absolute Pressure Sensor
Bat. - Battery
Bat. + - Positive Terminal
Bbl. - Barrel
BHP - Brake Horsepower
BP - Back Pressure
BTDC - Before Top Dead Center

Cat. Conv. - Catalytic Converter
CC - Catalytic Converter
- Cubic Centimeter
- Converter Clutch
CCC - Computer Command Control
C-4 - Computer Controlled Catalytic Converter
CB - Citizens Band (Radio)
CCOT - Cycling Clutch (Orifice) Tube
CCP - Controlled Canister Purge
C.E. - Check Engine
CEAB - Cold Engine Airbleed
CEMF - Counter Electromotive Force
CID - Cubic Inch Displacement
CLOOP - Closed Loop
CLCC - Closed Loop Carburetor Control
CLTBI - Closed Loop Throttle Body Injection
Conv. - Converter
CP - Canister Purge
Cu. In. - Cubic Inch
CV - Constant Velocity
Cyl. - Cylinder(s)

DBB - Dual Bed Bead
DBM - Dual Bed Monolith
DEFI - Digital Electronic Fuel Injection
DFI - Digital Fuel Injection
Diff. - Differential
Distr. - Distributor

EAC - Electric Air Control Valve
EAS - Electric Air Switching Valve
ECC - Electronic Comfort Control
ECM - Electronic Control Module
ECS - Emission Control System
ECU - Engine Calibration Unit
EEC - Evaporative Emission Control
EEVIR - Evaporator Equalized Valves in Receiver
EFE - Early Fuel Evaporation
EFI - Electronic Fuel Injection
EGR - Exhaust Gas Recirculation
ELC - Electronic Level Control
EMF - Electromotive Force
EMR - Electronic Module Retard
EOS - Exhaust Oxygen Sensor
ESC - Electronic Spark Control
EST - Electronic Spark Timing
ETC - Electronic Temperature Control
ETCC - Electronic Touch Comfort Control
ETR - Electronically Tuned Receiver
Exh. - Exhaust

FMVSS - Federal Motor Vehicle Safety Standards
Ft. Lb. - Foot Pounds (Torque)
FWD - Front Wheel Drive
- Four Wheel Drive
4 x 4 - Four Wheel Drive

HD - Heavy Duty
HEI - High Energy Ignition
Hg. - Mercury
Hi. Alt. - High Altitude
HVAC - Heater-Vent-Air Conditioning
HVACM - Heater-Vent-Air Conditioning Module
HVM - Heater-Vent-Module

IAC - Idle Air Control
IC - Integrated Circuit
ID - Identification
- Inside Diameter
ILC - Idle Load Compensator
I/P - Instrument Panel
ISC - Idle Speed Control

km - Kilometers
km/hr - Kilometers Per Hour
KV - Kilovolts (Thousands of Volts)
km/L - Kilometers/Liter (mpg)
kPa - Kilopascals

L - Liter
L-4 - Four Cylinder In-Line (Engine)
L-6 - Six Cylinder In-Line (Engine)
LF - Left Front
LR - Left Rear

Man. Vac. - Manifold Vacuum
MAP - Manifold Absolute Pressure
MAT - Manifold Air Temperature Sensor
M/C - Mixture Control
MPG - Miles Per Gallon
MPH - Miles Per Hour
MT - Manual Transmission

N·m - Newton Metres (Torque)

OD - Outside Diameter
OHC - Overhead Cam
OL - Open Loop
OXY - Oxygen

PAIR - Pulse Air Injection Reaction System
P/B - Power Brakes
PCV - Positive Crankcase Ventilation
PECV - Power Enrichment Control Valve
P/N - Park, Neutral
PROM - Programmable, Read Only Memory
P/S - Power Steering
PSI - Pounds Per Square Inch
Pt. - Pint
PTO - Power Takeoff

Qt. - Quart

R - Resistance
R-4 - Radial Four Cyl. A/C Compressor
RF - Right Front
RPM - Revolutions Per Minute
RR - Right Rear
RTV - Room Temperature Vulcanizing (Sealer)
RVR - Response Vacuum Reducer
RWD - Rear Wheel Drive

SAE - Society of Automotive Engineers
SI - System International
Sol. - Solenoid

TAC - Thermostatic Air Cleaner
TACH - Tachometer
TBI - Throttle Body Injection
TCC - Transmission Converter Clutch
TCS - Transmission Controlled Spark
TDC - Topdead Center
TPS - Throttle Position Sensor
TURB - Turbocharger
T/V - Throttle Valve
TVBV - Turbocharger Vacuum Bleed Valve
TVRS - Television & Radio Suppression
TVS - Thermal Vacuum Switch

UJT - Universal Joint

V - Volt(s)
V-6 - Six Cylinder Engine - Arranged in a "V"
V-8 - Eight Cylinder Engine - Arranged in a "V"
Vac. - Vacuum
VATS - Vehicle Anti-Theft System
VIN - Vehicle Identification Number
VIR - Valves in Receiver
VSS - Vehicle Speed Sensor
VMV - Vacuum Modulator Valve

W/ - With
W/B - Wheel Base
W/O - Without
WOT - Wide Open Throttle

X-Valve - Expansion Valve

Fig. 0A-16 -- Common Abbreviations

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GM PRODUCTION OPTIONS

AA3 ... Glass — Deep Tint (Rr. Wdo.)
AB3 ... Seating Arrangement, Six Passenger
AB5 ... Lock — S. Dr. Elec. (Key Activated)
AB6 ... Window — Rr. Insert
AB7 ... Window — Louvered Quarter
AB8 ... Window — Rear Quarter Formal Style
AC1 .... Seat Adj. — 6 way Pwr. Pass.
AC2 .... Glass-Sliding Window, Right Front Door
AC3 ... Seat Adj-6 Way Power, Bkt. Seat Type — Driver
AC6 .... St. Adj-6 Way Power, Bucket-Passenger
AD2 ... Prop-Hold Open, Rear Compartment Floor
AD3 ... Glass-Hinged, Roof Window
AD5 ... Glass-Side, Window, Rear Sliding
AD7 ... Window — Rear Quarter Tear Drop Less Louvers
AD8 ... Door Check — Rear
AD9 ... Seat Adj. — 2 Way Power — Driver
AE1 .... Glass — Roof Panel, Removable
AE2 .... Glass — Roof Panel, Removable, w/Mldg. & Man. Gls.
AF2 ... Glass, Fixed Side-LH (Utility Body)
AF3 ... Glass, Fixed Side-RH (Utility Body)
AF4 ... Adjuster — 6 Way Man. Dr. & Pass.
AF5 .... Seat ASM — Easy Entry Pass
AF6 ... Seat Asm., Front Bench, 2 Pass.
AF7 ... Seat Asm., Frt Bench, Split Back, w/Ctr. A/Rst., 2 Pass.
AF9 ... Seat Asm., Reclining Bucket, Pass & Dr.
AG1 ... Seat Adj. — 6 Way Pwr., Dr Only/60-40
AG2 ... Seat Adj. — 6 Way Pwr., Pass./60-40
AG3 ... Seat Adj. — 6 Way Power — 2 Posn. Memory
AG6 ... Seat Adj. — 2 Way Manual — Pass
AG7 ... Seat Adj. — 6 Way Pwr., Drivers/50-50
AG8 ... Seat Adj. — 2 Way Manual — Driver
AH4 ... Seat Asm. — Easy Entry — Driver
AH5 ... Seat Asm. — Easy Entry — Pass.
AH6 ... Glass — Bk. Dr. — Commercial Body
AH7 ... Glass — Frt. Wdo. — Commercial Body
AH8 ... Glass — Si. Access LH Dr. — Commercial Body
AH9 ... Glass — Si. Access RH Dr. — Commercial Body
AJ1 .... Glass — One Way
AJ2 .... Seat Asm. — Jump
AJ4 .... Seat Belt Guide Loop (Export)
AJ8 .... Center Frt. St. Asm. Travel Bed
AJ9 .... Center Rr. St. Asm. Travel Bed
AK1 .... Belts — Front Ctr., R/Seat & Frt. Shldr., Dlx.
AL4 .... Rear Bucket Swivel Seat
AM6 ... Seat Asm. — Frt. St. Split 60/40 w/Ctr. Arm Rest
AM7 ... Seat Assembly — Rear Folding
AM8 ... Seat Assembly — Rear Folding Auxiliary
AM9 ... Seat Asm.— Rr. Seat Split Back Folding
AN1 ... Seat Assembly — Bench, Folding Rear
AN5 ... Seat Asm. — Frt. Split — 40/40 w/Pass. Recl.
AN6 ... Seat Bk. — Adj. — Driv. Side
AN7 ... Seat Asm. — Frt. Bkt. — Swivel
AO2 ... Tinted Windshield (Export)
AP7 .... Partition — Sliding /Plywood/Union City Body
AQ3 ... Seat — Center Rear
AQ4 ... Seat — Rear
AQ9 ... Seat — Frt. Bkt. — w/Pass. Recl.
AR3 .... Air Cush. Restraint
AR4 .... Restraint Sys. Seat Belt & Shldr Harness
AR5 .... Seat — Frt. Bkt. w/Recl
AR6 .... Front Seat Restraint (Export)
AR7 .... Seat Asm — Bucket
AR9 .... Seat — Frt. Bkt. w/Recl.
AS1 .... Seat Asm. — High Back Bucket — Driver
AS2 .... Seat Asm. — High Back Bucket — Pass.
AS3 .... Seat — Rear
AS5 .... Seat Asm., Frt. Bucket Deluxe
AS7 .... Seat — Frt. Split 45/45
AS8 .... Belts F/Seat & Shldr. w/Retractor
AT5 .... Seat Asm. — Sub. Ctr. Fldg.
AT6 .... Seat Back — Reclining, Passenger Manual
AT8 .... Seat — F/Split 50/50 w/Recl.
AU2 ... Lock — Cargo Door
AU3 ... Lock — Side Door Electric
AU4 ... Lock — Side Dr. Auto Electric
AU5 ... Lock — Elect. — F/St Back & Door
AU6 ... Lock — Tailgate/ Electric
AV2 .... Camper Hold Down Package
AV3 .... Fastener, Cargo Tie Down
AV5 .... Seat — High Back Bucket
AV7 .... Seat — Frt. Split 50/50
AV9 .... Seating Requirements (Export) (Japan)
AW4 ... Link Si R/D Ext
AW5 ... Seating Requirements — Export Relocation
AW9 ... Security Group — Qtr. Stow & Lug. Compt.
AX3 .... Key Less Entry System
AX4 ... Belts — Seat & Frt. Shldr. Harn. — Export
AX5 .... Partition — Expanded Metal — Drivers Side
AX6 .... Partition — Expanded Metal — w/RH Sldg. Dr.
AX7 .... Partition — Expanded Metal — w/Ctr. Sldg. Dr.
AX8 .... Seat Am. — Bkt. Pedestal — w/St. Belts — Driver
AX9 .... Latch — Rr Cargo Dr.
AY9 .... Seat Adj. — 6 Way Pwr. — Split St.
A01 .... Tinted Glass — All Windows
A02 .... Tinted Glass — W/S Shaded Upr.
A07 .... Body Glass
A08 .... Body Glass — Right Side
A12 .... Glass — Back Door
A13 .... Glass — Side Door Fixed
A17 .... Glass — LH Swing Out
A18 .... Door Glass — Swing Out-Rear
A19 .... Glass — Swing Out side — Rear Door
A20 .... Window — Swing Out Rear Quarter
A26 .... United Kingdom & European Glazing
A28 .... Window — Sliding Rr.
A31 .... Window — Electrical Control
A32 .... Window — Power Operated Frt. Door
A33 .... Window — Tailgate Electrical Control
A40 .... Window — Power Operated Rr Vent
A42 .... Seat Adj. — 6 Way Power
A44 .... Seat Adj. — 2 Way Man. — Bkt Seat
A51 .... Seat — Frt. Bkt.
A52 .... Seat — Frt. Bench

GM PRODUCTION OPTIONS

A57 .... Seat Asm. — Aux. Pass.
A58 .... Belts Frt. Seat & Shoulder w/Retractor
A65 .... Seat Back — Frt. Seat Split With Ctr. Arm Rest
A70 .... Rear Qtr. Vent Wdo. — Remote Control
A75 .... Cush. & Bk. Spr. — Hvy. Duty Frt. St.
A76 .... Cush. & Bk. Spr — Hvy. Duty R/Seat
A77 .... Auto Seat Belt Restr. System (3 Point)
A78 .... Seat Back — Recl/Pass. & Driver Man.
A79 .... Seat Back — Recl/Driver Man.
A80 .... Seat Back Recl. — Driver/Elec.
A81 .... Seat Back Recl. — Pass/Elec.
A90 .... Lock — RR Compt. Lid Rem. Cont. — Elec.
A91 .... Pull Down — Rr Compt Lid
A93 .... Lock — Quarter Stow Compt.
A95 .... Seat ASM — Frt. Bkt-Hi. Bk. Recl, Dr & Pass.
A96 .... Lock — Luggage & Spare Tire Compt.
A99 .... Lock — Inst. Pnl. Compt.

BA8 .... Front Seat Storage Compt.
BB4 .... Inter. Orna. — Door Trim Panel Map Pocket
BB5 .... Inter Orna. — Headliner/Truck
BB8 .... Inter. Orna. — Door Trim Mldg.
BC1 .... Interior Orna. — Brushed Alum
BC2 .... Inter. Orna. — Wood Grain Inst. Cluster Insert
BC3 .... Interior Orna. — Instrument Panel/Deluxe
BC5 .... Interior Orna. — Load Compt. Pnls. — Carpeted
BD1 .... Molding, Rocker Pnl. (Delete)
BF2 .... Floor Covering — Carpet Deluxe
BF3 .... Mats — Stepwell
BF9 .... Insulator & Pad. Flr Mat
BG3 .... Filler — Rr. Flr Pnl.
BG7 .... Carpet — Wheelhouse
BG9 .... Mat. — Rubber — Frt. & Rr.
BS1 .... Pkg. — Acoustical Insulation
BS2 .... Package — Acoustical Insulation/Special
BS4 .... Insulator, Cab Back Panel
BT1 .... Police Car
BV1 .... Side Window Rvl. Mldg Bright & Painted
BV2 .... Compt Lid Mldg
BV3 .... Interior Ornamentation, I/P (Black)
BV6 .... Cylinder, Painted Door Lock
BV7 .... Applique, Pillar (Delete)
BV8 .... Handle — Dr. — Deluxe
BV9 .... Molding — Si. — Deluxe
BW1 .... Ornamentation — Rear End Exterior
BW2 .... Exter. Orna. — Body Side Mldg — Deluxe
BW5 .... Ext. Orna. — Simulated Roll Bar Mdg. — Roof
BW6 .... Exter. Orna. — body Side Decor
BW7 .... Exter. Pillar Applique
BX1 .... Exterior Ornament — Frt. End Special
BX2 .... Exter. Orna. — Body Side Wide Lower Mldg.
BX3 .... Exter. Orna. — Wood Grain
BX4 .... Exter. Orna. — Body Side Molding
BX5 .... Exter. Orna. — Roof Drip Mldg — Painted
BX6 .... Exter. Orna. — Molding & Applique
BX8 .... Molding — Body Side & T/Gate
BX9 .... Ornament — Frt End Panel & Mldg Hood
BY1 .... Exter. Orna. — body Emblem
BY3 .... Headliner — Hardboard Foam & Perforated Vinyl
BY8 .... Exterior Orna — Mdlg.
B1Q .... Lock — Tailgate/Power
B3D .... School Bus Equipment
B3J .... Diesel Equipment Pkg.
B3M .... Deluxe School Bus
B4Q .... Steering Column, Tilt (Delete)
B4T .... Glass, European (Delete)
B4W .... Window, Power Operated
B4X .... Sports Appear Pkg.
B5Q .... Emission System — Calif. Back Up
B5T .... Emission System — Back Up
B5Y .... Cluster — Elec. — Back Up System
B7K .... Injection — Elec. Fuel — 2 Port, w/o Convr.
B7L .... Injection — Elec. Fuel — 8 Port, w/o Convr.
B7M .... Injection — Elec. Fuel — 8 Port, w/o Convr.
B02 .... Spcl Body — Taxi Cab
B05 .... Armored Vehicle Modifications
B07 .... Special Body — Police Car
B09 .... Police Group — Freeway Enforcer
B18 .... Int. Ornament Deluxe
B19 .... Int Ornament Custom
B20 .... Int Ornament Luxury
B2Z .... Appearance Package
B22 .... Inter. Orna. — Dr. Inr. Pnl. Emblem
B23 .... Spoiler, Rr. Whl. Opening
B24 .... Molding, Si Wdo. Rvl.
B25 .... Trim — Luggage Compt. — Deluxe
B26 .... Inter. Orna. — Door Pull Handle
B28 .... Flr. Mats — Frt. Rr.
B29 .... Ornament, Interior Rr. Door Handle
B30 .... Carpeting — Floor and Wheelhouse
B32 .... Mat — Floor/Frt.
B33 .... Mat — Floor /Rr.
B34 .... Frt. Flr. Mats & Carpet Insert
B35 .... Rr. Flr. Mats & Carpet Insert
B36 .... Mat — Luggage Compt.
B37 .... Mat — Floor/Frt. & Rr.
B39 .... Floor Covering — Load Floor Carpet
B42 .... Mat — Luggage Compt. Flr. Cvr.
B44 .... Carpet — Load Floor Loose/
B46 .... Spl Trim
B48 .... Trim — Luggage Compt. — Deluxe
B49 .... Floor Cvgr. — Carpet Frt. & Rr. — Deluxe
B51 .... Exter. Orna. — Rkr. Pnl. Mldg. — Extra Wide
B53 .... Mat Frt. Flr. Carpeted Insert — Deluxe
B54 .... Mat — Rr. Flr. — Carpet Insert — Deluxe
B56 .... Ext Orna. — Rkr Pnl. Mldg. — Extra Wide (Black)
B57 .... Exterior Trim — Deluxe
B65 .... Floor & Side Wall Covering — Trunk Compt.
B69 .... Insulator — Roof
B71 .... Mldg. — W/Opg. — Custom
B72 .... Mldg — Blt. Rvl. — Painted
B74 .... Exter. Orna. — Wheel Opening Wide Mldg. (Black)
B75 .... Lining — Luggage Compartment
B77 .... Mldg — W/Shield Reveal
B79 .... Exter. Orna. — Rr. End
B80 .... Mldg — Roof Drip
B81 .... Molding, Body Si (Delete)
B82 .... Emblem, Body (Delete)
B83 .... Mldg./Rkr Pnl.
B84 .... Mldg — Body Side Black
B85 .... Mldg — Body Side Bright
B86 .... Mldg — Body Rr
B88 .... Body Side Mldg Custom
B89 .... Mldg. — Back Window Reveal
B90 .... Mldg — Side Wdo Revl.
B91 .... Mldg Door Edge Guard

GM PRODUCTION OPTIONS

B93 .... Guard — Door Edge
B94 .... Emblem — Body
B95 .... Louver — Body Side
B96 .... Mldg. — W/Opg.
B97 .... Spoiler — Rr. Fender
B98 .... Mldg. — Side Trim — Truck
B99 .... Molding, Whl. Opg. (Delete)
B5R .... Alum Manifold

CA1 .... Roof — Steel Siding Sun, Electric
CA2 .... Covering — Ext. Soft Trim Rf. W/Pad Delete
CA9 .... Cvr. — Exter. Soft Trim Roof — With Pad Full Top
CB4 .... Cvr. — Exter. Soft Trim — Rr. Half
CB5 .... Cvr. — Exter. Soft Trim Roof — With Pad Full Top
CB6 .... Cvr. — Exter. Soft Trim Roof — Halo Mldg. — Full Top
CB7 .... Cvr. — Exter. Soft Trim — Front Half
CB8 .... Top — Removable
CC1 .... Panels — Removable Roof Hatch
CC2 .... Cvr. — Exter. Soft Trim — W/Pad — Rear Half
CC3 .... Panels — Removable Hatch Roof — Plastic
CD2 .... Low Washer Fluid Indicator
CD4 .... Washer & Wiper Pulse Windshield
CE4 .... Washer, Headlamp High Pressure
CF4 .... Roof — Glass Sliding Sun — Manual
CF5 .... Astro Roof /Sliding
CF8 .... Roof — Vinyl — Simulated Convertible
CG1 .... Narrow Body Lock Pillar
CH1 .... Compressor — Axial 6 Cyl.
CH2 .... Compressor — Radial 4 Cyl.
CO1 .... Ext. Orna. — Turbo-Frt. End Pnl
CO4 .... Cvr. — Exter. Soft Trim — With Pad — Rear Half
CO5 .... Top — Convertible Folding
CO6 .... RF Astro View & Simulated Roll Bar RF Mldg
CO9 .... Cvr. — Exter. Soft Trim Roof — Full Top
C10 .... Roof Vinyl Padded Special Landau
C18 .... W Shield Wiper & Blade — Black
C21 .... W Shield Wiper & Blade — Painted
C25 .... Washer & Wiper — RR Wind.
C36 .... Heater — Auxiliary
C40 .... Heater, Standard (Electronic)
C41 .... Heater — & Defroster
C42 .... Heater & Defroster — Heavy Duty
C43 .... Steel T/Gate
C44 .... Plastic T/Gate
C46 .... Heater — High Capacity
C47 .... Rear Window Defogger — Delete
C49 .... Defogger — Rr. Wdo. Electric
C50 .... Defogger — Rr. Wdo., Blower
C51 .... Deflector — Air
C55 .... Ventilator — Roof
C56 .... Ventilator, Forced Air Right Side
C60 .... Air Cond. — Manual Control
C61 .... Air Cond. — Automatic Control
C62 .... Air Cond. — Frt. Instal — Flr. Mtd.
C65 .... Air Cond. — Tempmatic Control
C67 .... Air Conditioning, All Weather (Electronic)
C68 .... Air Cond. Electronic Climate Control
C69 .... Air Conditioning /Overhead System/
C71 .... Lamp-Frt. Dr. Ctsy.
C72 .... Lamp-Rr. Dr. Ctsy.
C73 .... Lamp, Man Operated Int. (Utility Body)
C80 .... Switch — Frt. Dr. Jamb — Rt. Side
C81 .... Switch — Rear Door Jamb
C87 .... Lamp — Rr. Qtr. Courtesy
C88 .... Lamp — Rear Compt. Courtesy
C89 .... Lamp — Sail Panel Reading
C90 .... Lamp — Comb Courtesy & Warning — Door
C91 .... Lamp — Dome
C92 .... Lamp — Dome & Cargo
C93 .... Opera Lamps — Ext. Lk. Plr. or Sail Pnl.
C94 .... Lamp — Delayed Dome
C95 .... Lamp Asm — Dome & Reading
C96 .... Qtr Rdg. Lamp
C97 .... Door Lock — Courtesy Light

DB2 .... Arm Rest — Delete
DB3 .... Sunshade, W/S, w Extension
DD3 .... Mirror — Outside R/View — Custom — Chrome
DD4 .... Mirror — Rem Cont O/S RR View — Elec RT Side
DD5 .... Mirror — Rem Cont O/S RR View — Elec LT Side
DD7 .... Mirror — Rem Cont O/S RR View — Elec w/Therm
DD8 .... Mirror, I/S Rr. View Day/Night Auto.
DD9 .... Mirror — O/S Rr. View Elec. Rem. — Export
DE1 .... Louver — Sunshield
DE7 .... Mirror — O/S Rr. View Rem Breakway — Export
DE9 .... Console — Non Shifting, Non Operating Type
DF1 .... Mirror — Camper/Painted
DF2 .... Mirror — Camper/Stainless/ LH & Rr. Ld.
DF3 .... Mir. — Rem. Cont. O/S Rr. View — Pass Side — Chrome
DF4 .... Mir. — Rem. Cont. O/S Rr. View Pass Side — Sport
DF5 .... Mir. — Rem. O/S Rr. View Elec. Rt. & Lt. Therm. Illus.
DG1 .... Mirror — Outside Rr. View/ Pass Side
DG2 .... Mir. — Rem. O/S Rr. View Elec. Rt. & Lt.
DG4 .... Mirror — West Coast Type Small
DG5 .... Mir. — Senior/West Coast/ Drivers & Pass. Ld.
DG6 .... Mir. — Rem. O/S Rr. View Elec. Rt. & Lt. Therm.
DG7 .... Mirror — Rem Cont O/S RR View — Elec Sport
DG8 .... Mirror — Breakaway — Export
DH6 .... Mirror-Visor Vanity-Dr. & Pass.
DJ9 .... Mirror — O/S Rr. View — Custom — Pass Side
DK2 .... Mirror, O/S Rr. View Elec. Remote
DK4 .... Console — Front Floor Compartment — Non Shifting — Mini
DK7 .... Decal, Window (Delete)
DL1 .... Decals and Stripes
DL2 .... Decals and Stripes
DL4 .... Decals — Two Tone Paint Scheme
DL6 .... Decal & Stripes
DL8 .... Mirror — O/S Rr. View Elec. Cont. — Heated Element
DL9 .... Decal, Frt. Fdr. & Rr. Qtr. Blackout
DO1 .... Paint — Lacquer Master
DO2 .... Paint — Enamel Master
DO3 .... Paint, Water Master
DO5 .... Handle, Inside
DO6 .... Rest — Frt. Cnsl. Arm
DO7 .... Console, Frt. Floor (Custom)
DO9 .... Rest — Frt. St. Arm
DT4 .... Ash Receptacle & Cigarette Lighter
DX1 .... Decal — Hood Applique

GM PRODUCTION OPTIONS

DX4 .... Stripe — Body Si Freespirit
DX5 .... Stripe, Body Side/Buick
DX5 .... Stripe-Body Side/Chevy
DX6 .... Stripe — Body Side/3 Multi-Tone
DX9 .... Tape — Accent Strip
DY1 .... Decals and Stripes
DY5 .... Decals and Stripes (Deck Lid)
D12 .... Shelf & Rr. Compt. W/H Trim Pkg.
D20 .... Sunshade — Pass. Si.
D24 .... Container — Litter
D26 .... Tray — Stowage on Spare Tire
D27 .... Rr. Comp. Stowage Cvr.
D28 .... Mirrors — Outside RR View — Delete
D29 .... Mirror — Below Eyeline/ Junior/Painted
D31 .... Mirror — I/S Rr. View/ Tlt.
D33 .... Mirror — Remote Cont Outside Rr. View LH
D34 .... Mirror — Visor Vanity
D35 .... Mirror — Outside Rr. View/ Custom
D36 .... Mirror Inside Rear View (10" Tilt) (Export)
D41 .... Ash Tray — Rear Quarter
D42 .... Cover — Rr. Compt Security
D43 .... Mirror Inside Rear View (12" Tilt) (Export)
D44 .... Mirror-Below Eyeline Outside/Painted
D45 .... Mirror-Below Eyeline Outside/Stnls. Stl.
D46 .... Mirror — w/Clearance Lights — West Coast Type
D49 .... Mirror-Outside
D50 .... Console — Frt. Compt. (Delete)
D53 .... Applique-Hood (Bird)
D55 .... Console — Frt. Compt. Flr.
D57 .... Paint Special Two Tone
D58 .... Console — Frt. Compt. Flr. — Extra Long
D64 .... Mirror — Visor Vanity, Illuminated — Rt. Side
D65 .... Mirror — Outside Rr. View/ with Therm. — Lt. Si.
D66 .... Mirror — O/S R/View/with Illum. Thermo. — Lt. Si.
D68 .... Mirror — Rem. Cont. O/S Rr. View — Drivers & Pass. (Sport)
D69 .... Mirror — Outside Rr. View — Remote Drivers Side
D73 .... Rail — Hand/Pick-Up Box
D74 .... Mirror — Visor Vanity, Illuminated — Lt. Side
D75 .... Front Air Deflector
D78 .... Mirror — O/S Rr. View Wide Angle — Dual System
D80 .... Spoiler — Deck Lid
D84 .... Paint — Custom Two-Tone
D85 .... Stripe — Body Side Lwr. Accent
D86 .... Paint — Two Tone — Designers Accent
D88 .... Decal Stripe — Hood and Deck Lid
D89 .... Paint — Two Tone Special Decor
D90 .... Stripe, Frt. End & Body Side
D91 .... Paint — Special Two-Tone
D92 .... Tape — Decor./at Frt. Dr. Handle
D93 .... Paint — Dr. & Wdo. Frms
D98 .... Stripe — Tape
D99 .... Paint — Two-Tone Special Order

E24 .... Doors, Hinged Cargo Side
E26 .... Door, LH Side Access (Utility Body)
E27 .... Door, RH Side Access (Utility Body)
E28 .... Handle — Assist
E31 .... Body — Steel/10 Ft./Hi-Cube Van
E32 .... Body — Steel/Square/F/C Panel
E33 .... Body — Aluminum/Square/ F/C Panel
E34 .... Body — Steel/10 Ft./Hi-Cube Van
E35 .... Body — Steel/12 Ft./Hi-Cube Van
E35 .... Pickup Box, Less Tailgate (Fleetside) (1984)
E36 .... Body — Aluminum/10 Ft./ Hi-Cube Van
E37 .... Body — Aluminum/12 Ft./ Hi-Cube Van
E38 .... Body — Steel/12 Ft./Hi-Cube Van
E39 .... Body — Aluminum/12 Ft./ Hi-Cube Van
E46 .... Door — w/Gls. — Trk. Body Overhead Rr. — 66 inch
E50 .... Bar — Roll
E52 .... Doors — Rr. Wraparound — 83 inch
E53 ... Doors — Rr. Wraparound — 87 inch
E55 .... End Gate — Suburban
E56 .... Platform & Skate Rack
E62 .... Pickup Box — Stepside
E63 .... Pickup Box — Fleetside
E65 .... Body Height, Increased
E67 .... Body Length, 12 In. Increase
E70 .... Housing — Whl — For Dual Rr Whls.
E71 .... Floor — Cargo — Smooth STL
E72 .... Body Length, 18 In. Increase
E73 .... Body Width Increased — Int. (86.4 In.)
E74 .... Body Width Increased — Int. (90.5 In.)
E76 .... Doors — Rr. — 60 Inch
E79 .... Doors — Rr. — Strap Hinges — 74 inch
E81 .... Floor Board Equipment — Wood
E82 .... Steel Deck Lid
E83 .... Aluminum Deck Lid
E86 .... Cover — Tonneau Cargo Box/Snap-On
E89 .... Panel — Cab — Driver — Dr. Opg
E94 .... Beauville Equip. (Chev.) or Rally Stx. Equip. (GMC)

FE1 .... Rally Susp. Pkg.
FE2 ... Rally Suspension Package
FE3 .... Suspension System — Special, Less Stab. Shf.
FE5 .... Suspension, Spl. Perf. Frt. & Rr. (Delete)
FE7 .... Suspension — Frt. and Rr., H.D., Var. 3
FG2 .... Shock Abs. — Frt. & Rr. — Firm Ride
FK2 .... Anchor — Torsion Bar Rr. — 57 Degree
FK3 .... Anchor — Torsion Bar Rr. — 63 Degree
FL2 .... Axle Front — Dana
FL3 .... Axle Front — Chevrolet
F16 .... Axle — Front/2.53 Ratio
FW2 ... Axle — Front 3.06 Ratio
FW3 ... Axle — Front/2.33 Ratio
FW4 ... Axle — Front/3.36 Ratio
FW5 ... Axle — Front/4.10 Ratio
FW6 ... Axle — Front/2.14 Ratio
FW7 ... Axle — Front/3.83 Ratio
FW8 ... Axle — Front 1.99 Ratio
FW9 ... Axle — Front 3.43 Ratio
FX2 .... Axle — Front 2.66 Ratio
F01 .... Frame — H.D.
F16 .... Axle — Front 2.53 Ratio
F17 .... Axle — Front/2.84 Ratio
F25 .... Axle — Front/3.34 Ratio
F29 .... Axle — Frt./2.41 Ratio
F36 .... Axle — Frt./2.19 Ratio
F40 .... Suspension — Heavy Duty Front & Rear
F41 .... Suspension — Special Performance Frt. & rr.
F42 .... Suspension — Heavy Duty Frt.
F44 .... Chassis Equipment Heavy Duty
F45 .... Axle — Frt.2.93 Ratio
F47 .... Axle — Front/2.73 Ratio
F51 .... Absorber — Heavy Duty Shock
F57 .... Axle — Front/3.15 Ratio
F58 .... Stabilizer Shaft — Front/ Heavy Duty
F59 .... Stabilizer — Frt.
F60 .... Spring — Heavy Front on Var. 1

GM PRODUCTION OPTIONS

F61 . . . Shaft — Stab. Rr.
F62 . . . . Axle — Front/2.39 Ratio
F65 . . . . Suspension — Frt. Air
F66 . . . . Suspension (H.D. Frt. Air Susp.)
F67 . . . . Axle — Front/3.19 Ratio
F68 . . . . Axle — Front/3.45 Ratio
F71 . . . . Spring — w/Shk. Abs. — H.D. — Var. 1
F72 . . . . Spring — w/Shk. Abs. — H.D. — Var. 2
F75 . . . . Axle — Front 3.18 Ratio
F77 . . . . Axle — Front/3.18 Ratio
F79 . . . . Axle — Front/2.97 Ratio
F85 . . . . Stabilizer Shaft — Front/ Heavy Duty
F89 . . . . Panel — Cab — Drivers Door Opening
F90 . . . . Axle — Front/2.73 Ratio

GH1 . . . Axle — Rear/2.24
GH2 . . . Axle — Rear/2.29/Ratio
GH4 . . . Axle — Rear/2.28 Ratio
GL1 . . . . Diff. Carrier — Rr. Axle/Alum.
GM7 . . . Axle — Rear/2.39 Ratio
GM8 . . . Axle — Rear — 2.56 Ratio
GN1 . . . Stabilizer Shaft — Rear
GN3 . . . Driver Control Leveling
GQ1 . . . Axle Ratio — Stud Rr.
GR4 . . . . Axle — Rear/3.73 Ratio
GS4 . . . . Axle — Rear/3.70 Ratio
GT4 . . . . Axle — Rear/3.73/Ratio
GT5 . . . . Axle — Rr./4.10 Ratio
GT8 . . . . Axle — Rear 4.10 Ratio Heavy Duty
GUX . . . Axle — Rear/3.08 Ratio
GU1 . . . Axle — Rear/2.41 Ratio
GU2 . . . Axle — Rear/2.73 Ratio
GU3 . . . Axle — Rear/2.93 Ratio
GU4 . . . Axle — Rear/3.08 Ratio
GU5 . . . Axle — Rear/3.23 Ratio
GU6 . . . Axle — Rear/3.42 Ratio
GV8 . . . Axle — Rear/2.72 Ratio
GV4 . . . Axle — Rear/3.36 Ratio
GW4 . . . Axle — Rear 3.31 Ratio
GW9 . . . Axle — Rear/2.93 Ratio
GX3 . . . Axle — Front/3.33 Ratio
GX4 . . . . Axle — Rear/3.75 Ratio
GX5 . . . Axle — Rear/4.09 Ratio
GX9 . . . . Axle — Rear/2.92 Ratio
GY5 . . . . Axle Front/3.65 Ratio
G50 . . . . Spring — Hevy Rr Var. 1
G51 . . . Spring — Special Heavy Rr. Var. 2
G52 . . . Spring — Extra Capacity — Rr.
G60 . . . Spring Auxiliary
G66 . . . Shock Abs. — Air Booster Rr.
G67 . . . Shock Abs. — Auto Lvlg. Cont. Sys. (1977 & Prior)
G67 . . . . Shock Abs. — Elec Lvlg Cont Sys (1978)
G72 . . . Rear Axle (2.14:1)

G75 . . . . Axle — Rear/3.62 Ratio
G80 . . . . Axle — Rear/Locking Type
G83 . . . . Ring Gear (8¾)
G87 . . . . Ring Gear (8½")
G88 . . . . Ring Gear (8⅞")
G89 . . . . Ring Gear (7½")
G92 . . . . Axle — Rear/Performance
G95 . . . . Axle — Rear/Economy

HA3 . . . Axle — Rear/5.29 Ratio
HC2 . . . . Axle — Rear/2.76 Ratio
HC4 . . . . Axle — Rear/4.56 Ratio
HC7 . . . . Axle — Rear/5.13 Ratio
HC8 . . . . Axle — Rear/3.21 Ratio
HD1 . . . Axle — Rear/5.83 Ratio
HE3 . . . . Axle — Rear/3.07 Ratio
HE4 . . . . Axle — Rear/3.40 Ratio
HF7 . . . . Axle — Rear/4.56 Ratio/ Heavy Duty
HF8 . . . Axle — Rear/4.88 Ratio
HK1 . . . . Axle — Rear/2.87 Ratio
HK9 . . . Axle — Rear — 5.86 Ratio
HO4 . . . Axle — Rear/4.11 Ratio
H22 . . . . Axle — Rear/6.17 Ratio
H23 . . . . Axle — Rear/5.43 Ratio

JA1 . . . Brake System/Disc/Drum Lt. Duty 11x1 Frt. 9½ x 2 Rr.
JA2 . . . . Brake System Disc/Drum Heavy Duty
JA3 . . . . Brake System Disc/Drum 12x1 Frt. 11x2 Rr.
JA4 . . . . Brake-Disc/Drum
JA5 . . . . Brake-Disc/Drum 12x1 Frt. 11x2 Rr.
JA6 . . . . 4 Wheel Disc
JA8 . . . . Brake System Disc/Drum — Med. Duty
JB1 . . . Brake — Man. Disc/Drum
JB2 . . . Brake-Disc/Drum
JB3 . . . . Brake — Vacuum Power Disc/Drum/Type A
JB5 . . . Brake — Vacuum Power Disc/Drum Type B
JB6 . . . Brake — Vacuum Power Disc/Drum/Type C
JB7 . . . . Brake — Vacuum Power Disc/Drum/Type D
JB8 . . . Brake — Hydraulic Pwr. Disc/Drum/Type A
JC4 . . . Brake — Front Vented Rotor
JD3 . . . Brake — Vacuum Power Disc/Drum
JD5 . . . Brake System 11x1 Pwr. Disc
JD6 . . . Brake System 12x1 Pwr Disc
JD7 . . . Brake System 12x1 Pwr Disc/Hvy. Duty
JE1 . . . Brake System (Europe)
JF9 . . . Brake — Hydraulic Power 4 Wheel Disc

JL1 . . . . Pads — Cust. Ped. Trim
JL2 . . . . Brake Sys. — Frt. Pwr. Disc
JL5 . . . . Brake — Front Solid Disc
JL6 . . . . Brake Sys. — Man. Disc
JM5 . . . Power Brake Booster — Tandem
JM7 . . . Power Brk. Boos. (Single)
JM8 . . . Brake — Rr./Disc
J50 . . . . Brake — Vacuum Power
J41 . . . . Drums — Brake — Cast Iron
J42 . . . . Drums — Brake — Aluminum
J50 . . . . Brake System — Vac. Pwr.
J55 . . . . Brake — Heavy Duty Pwr.
J65 . . . Brake, Pwr. Disc Frt. & Rr.
J90 . . . Brakes — Rr. Drum Hvy. Dty.

KA5 . . Vacuum System — Cam Driven
KA6 . . Vacuum System — Belt Driven
KB1 . . . Exhaust Manifold — Sheet Metal
KB3 . . . . Water Pump — Aluminum
KB7 . . . . Head — Cast Iron
KB8 . . . Head — Aluminum
KC4 . . . Cooler — Engine Oil
KD2 . . . . Pump — Fuel Injection (Stanadyne)
KD3 . . . Pump — Fuel Injection (C.A.V.)
KE1 . . . Electronic Spark Selection
KF3 . . . . Electronic Fuel Injection
KJ5 . . . . Starter Motor Japanese Export
KL7 . . . LP Gas Preparation
KM5 . . . Glow System-Slow Start
KM6 . . . Glow System-Fast Start
KM7 . . . Cast Iron Intake Manifold
KM9 . . . Al. Intake Manifold
KO2 . . . . Fan Drive Thermostatically Controlled
KO5 . . . Heater — Engine Block/ Canadian Use Only
KO7 . . . . Heater Diesel Fuel
K15 . . . Line — Fuel Vapor Return
K19 . . . Air Injection System
K22 . . . Delcotron — 94 Amp.
K30 . . . Control — Speed & Cruise (Auto)
K34 . . . Control — Speed & Cruise w/Resume Electronic)
K35 . . . Control — Speed & Cruise w/Resume
K43 . . . Air Cleaner -- Heavy Duty Dry Type
K46 . . . Cleaner — Air Pre Chamber
K64 . . . Delcotron — 78 Amp.
K70 . . . Pulsair — Air Inj. Eng
K71 . . . Emission Control — Not Certified — Export
K73 . . . Generator/70 Amp.
K74 . . . Early Fuel Evaporation
K76 . . . Generator — AC/61 Amp

GM PRODUCTION OPTIONS

K77 .... Generator — AC/55 Amp.
K79 .... Generator — AC/42 Amp.
K80 .... Delcotron — 92 Amp.
K81 .... Generator — AC/63 Amp.
K85 .... Delcotron — 37 Amp.
K92 .... Generator — AC/105 Amp
K97 .... Generator — 80 Amp.
K99 .... Generator — AC/85 Amp.

LA5 .... Engine — L4 1.8L
LC1 .... Engine — V6 2.8-1
LC3 .... Engine — V6 229 CID
LC4 .... Engine — V6/4.1-4 4 Bbl.
LC5 .... Engine — V6 231 2 Bbl.
LC6 .... Engine — V6 231 2 Bbl.
LC8 .... Engine — V6 231 4 Bbl.
LC9 .... Engine — V6 196 2 Bbl.
LD4 .... Engine — Standard 6 Cyl. — 250 CID Truck
LD5 .... Engine — V6 231 2 Bbl.
LD7 .... Engine — V6 231 — 2 Bbl. Carb.
LE2 .... Engine V6/2.8 Litre 2 Bbl.
LE3 .... Engine — L6/250 — 2 Bbl. Varajet
LE4 .... Engine — V8/400 CID/4 Bbl. Carb./Truck
LE8 .... Engine — V8/454 CID/4 Bbl. Carb./Truck
LE9 .... Engine — V8 305 CID
LF3 .... Engine — V8 305 CID
LF4 .... Engine — V8/400 CID/4 Bbl.
LF5 .... Engine — V8 350 CID
LF7 .... Engine — V8/260 Diesel
LF8 .... Engine — V8/454 CID/4 Bbl. Carb. M4/Truck
LF9 .... Engine — V8 350 Diesel
LG3 .... Engine — V8/305/2 Bbl.
LG4 .... Engine — V8 305 4 Bbl.
LG9 .... Engine — V8/305 CID/2 Bbl.
LH6 .... Engine — V8/6.2C Diesel
LH7 .... Engine — V6 2.8L
LH8 .... Engine — L4 1.8-0
LH9 .... Engine — V6 2.8L
LJ5 .... Engine — L4 1.8D
LJ9 .... Engine — L4 1.8L
LK6 .... Engine — V6 2.8L
LK9 .... Engine — V6 3.0
LL1 .... Engine — V6 2.8L
LL4 .... Engine — V8/6.2J Diesel
LM1 .... Engine — V8/350 4 Bbl.
LM9 .... Engine — V6 3.8L
LN3 .... Engine — V6 3.8L
LP1 .... Engine — V6 3.2L
LP9 .... Engine — V8 5.7L
LQ2 .... Engine — L4 2.0L
LQ5 .... Engine — L4 2.0L
LQ7 .... Engine — L4 2.2L Diesel
LQ8 .... Engine — L4 2.5L
LQ9 .... Engine — L4 2.5L
LR1 .... Engine — L4 1.9-5
LR2 .... Engine — V6 2.8
LR8 .... Engine — L4 2.5L
LR9 .... Engine — L4 2.0L

LS6 .... Engine — L4 151 2 Bbl.
LS8 .... Engine — L4/151 — 2 Bbl.
LS9 .... Engine — V8/350 CID/4 Bbl.
LT5 .... Engine Performance Pkg. — High Alt.
LT6 .... Engine — V6 4.3V Diesel
LT7 .... Engine — V6 4.3T Diesel
LT8 .... Engine — V8 4.1L
LT9 .... Engine — V8/350 4 Bbl./Trk.
LU5 .... Engine — V8 5.0-7
LV2 .... Engine — V8/307 CID 4 Bbl. Carb.
LV5 .... Engine L4/151 CID/2 Bbl. Carb.
LV6 .... Engine — V8/4.3 2 Bbl.
LV8 .... Engine — V8/260 CID/2 Bbl. Carb.
LW5 .... Engine — L4 1.6 1 Bbl.
LW9 .... Engine L4/151 CID/2 Bbl. Carb.
LX3 .... Engine — L4 1.4 Litre/1 Bbl.
LX6 .... Eng. — 151 2 Bbl. Carb.
LX8 .... Engine — L4/151 — 2 Bbl.
LY5 .... Engine/L4/1.6 Litre/1 Bbl.
L02 .... Delcotron — 100 Amp.
L03 .... Delcotron — 110 Amp.
L04 .... Delcotron — 145 Amp.
L05 .... Delcotron — 130 Amp.
L07 .... Delc. — 145 Amp., Dynamote Pwr. Inverted
L11 .... Engine — 140 CID L4 OHC — 2 Bbl. Carb.
L13 .... Engine — 140 1 Bl. Carb.
L17 .... Engine — L4 1.6L
L22 .... Engine — L6/250 CID/Pass.
L25 .... Engine — L6/292 CID
L26 .... Engine — V6 200 2 Bbl.
L27 .... Engine — V8 301 2 Bbl. Carb.
L32 .... Engine — V8 350 2 Bbl.
L33 .... Engine — V8/425 4 Bbl.
L34 .... Engine — V8 350 4 Bbl. Carb.
L35 .... Engine — 8 Cyl., E.F.I. 425
L37 .... Engine — V8 301 4 Bbl.
L39 .... Engine — V8/267 2 Bbl.
L46 .... Engine — L4 1.8G
L48 .... Engine — V8/350 CID/4 Bbl. Carb.
L49 .... Engine — 8 Cyl., E.F.I. 350
L61 .... Engine — V8 368-6
L62 .... Engine — V8 368-9
L65 .... Engine — V8 350 2 Bbl.
L69 .... Engine — V8 5.0L
L76 .... Engine — 350 4 Bbl. Carb.
L77 .... Engine — V8 350 — 4M
L78 .... Engine — 400 4 Bbl. Carb
L80 .... Engine — V8 403 — 4 Bbl. Carb
L82 .... Engine —V8/350 CID/Spec. High Perf.
L83 .... Engine — V8 5.7-8
L91 .... Export Engine
L92 .... Export Engine
L93 .... Export Engine/Venezuala

MB4 ... Trans. — 5 Spd. Manual 3.76:1 1st Gear Ratio
MB6 ... Trans. — 5 Spd. Manual
MC1 ... Transmission — Heavy Duty/3 Spd./Manual/ Tramac
MC4 ... Transmission — Sport Shift
MD2 ... Trans. — 3 Spd. Automatic/ Strasbourg
MD3 ... Trans. — Automatic/ Strasbourg AT 180
MD8 ... Trans. — 4 Spd. Auto. — 700 R4
MD9 ... Trans. — 3 Spd. Auto. — TH 125C
ME9 ... Trans. — 4 Spd. Auto — 440 — T4
MG1 ... Block — Trans. Low Gear
MK2 ... Trans. — 4 Spd. Manual 2.88:1 1st Gear
MK4 ... Trans. — 5 Spd. Manual
MK5 ... Trans. — 5 Spd. Manual 3.50:1 1st Gear
MK6 ... Trans. — 5 Spd. Manual 2.90:1 1st Gear
MK7 ... Trans. — 5 Spd. Manual
MM3 ... Trans. — 3 Spd. Manual — Merchandising Option Only
MM4 ... Trans. — 4 Speed Manual Merchandising Option Only
MM5 ... Trans. — 5 Spd. Manual — Merchandising Option Only
MM7 ... Trans. — 4 Spd. Manual — Merchandising Option Only
MV4 ... Trans. — 3 Speed Automatic/ Chevy Built/THM 350
MV9 ... Trans. — 3 Speed Automatic (THM 200C)
MW9 ... Trans. — 4 Spd. Auto. — TH 200 4R
MX0 ... Trans. — 4 Spd. Auto. — Merchandising Option Only
MX1 ... Trans. — 3 Spd. Auto. — Merchandising Option Only
MX2 ... Trans. 3 Spd. Auto.
MX3 ... Trans. 3 Spd. Auto. — TH 350 C
MX5 ... Trans. — Auto. — TH 350C
MY1 ... Trans — 4 Speed — Brazil/ Manual
MY6 ... Trans. — 4 Speed Manual — Overdrive — 3.09:1 1st Gear
MY7 ... Trans. — 5 Spd. Manual — 3.92:1 1st Gear
MY8 ... Trans. — 4 Spd. Manual — 3.53:1 1st Gear
M08 ... Trans. — 4 Spd. Manual — 3.76:1 1st Gear
M11 ... Shift — Floor
M15 ... Transmission — Three Speed Manual
M16 ... Transmission — Three Speed Auto.

GM PRODUCTION OPTIONS

M17 . . . Trans. — 4 Speed Manual — 3.31:1 1st Gear
M18 . . . Trans. 4 Spd. Manual — 2.88:1 1st Gear
M19 . . . Trans. — 4 Speed Manual — 3.53:1 1st Gear
M20 . . . Trans. — 4 Speed Manual/ Saginaw
M21 . . . Trans. — 4 Speed Manual/ Warner
M24 . . . Trans. — 4 Speed Manual — 3.42:1 1st Gear
M26 . . . Trans. — 4 Spd. Manual — 3.50:1 1st Gear
M27 . . . Trans. — 4 Speed Manual
M29 . . . Trans. — 3 Speed Auto. (THM 200)
M31 . . . Trans. — 3 Speed Auto./ CBC 250C
M32 . . . Trans. — 3 Speed Auto. (THM 325)
M33 . . . Trans. — 3 Speed Auto./ Buick Built (12.2 Converter)
M34 . . . Trans. — 3 Speed Auto. (THM125)
M38 . . . Trans. — 3 Speed Auto./ Chev. Built (11.75 Converter)
M40 . . . Trans. — 3 Speed Auto. (THM 400)
M51 . . . Strg. Sys. — Manual
M57 . . . Trans. — 4 Spd. Auto. — TH 325
M62 . . . Trans. — 3 Speed Manual — 2.85:1 1st Gear
M63 . . . Trans. — 3 Speed Manual
M64 . . . Trans. — 3 Speed Manual — 3.50:1 1st Gear
M67 . . . Trans. — 4 Speed Manual — 2.85:1 1st Gear
M73 . . . Trans. — 4 Spd. Manual
M75 . . . Transmission Asm. — 5 Speed
M77 . . . Trans. — 4 Spd. Manual

NA2 . . . Emission Sys. Std.
NA5 . . . Emission System — Federal
NA6 . . . High Altitude Perf. Emission System
NA9 . . . Emission System Evaporative
NB1 . . . Emission Control — Closed Loop
NB2 . . . California Emission System
NB5 . . . Exhaust System Single
NC6 . . . Exhaust System — Sporty
NC8 . . . Diesel Emission System/ Internal EGR
ND1 . . . Fuel Tank — 86 Litre
NE2 . . . Fuel Tank — 40 Gallon
NF1 . . . Fuel Tank — 69 Litre
NF2 . . . Fuel Tank — 75 Litre
NG1 . . . Fuel Tank — 76 Litre
NH1 . . . Fuel Tank — 83 Litre
NH7 . . . Fuel Tank — 103 Litre
NH8 . . . Fuel Tank — 69 Litre
NK1 . . . Fuel Tank — 69 Litre
NK2 . . . Fuel Tank — 76 Litre
NK3 . . . Wheel — Steering Formula
NK4 . . . Strg. Wheel Sport Leather
NK5 . . . Strg. Whl. — Std.
NK6 . . . Fuel Tank — 83 Litre
NK7 . . . Fuel Tank — 31 Gallon
NK8 . . . Fuel Tank — 96 Litre
NL2 . . . . Fuel Tank — Auxiliary
NL7 . . . . Fuel Tank — 33 Gallon
NL8 . . . . Fuel Tank — 2K Gallon Rear Mounted
NM4 . . . Emission Control — Non Closed Loop (Export)
NM5 . . . Emission Control — Non Closed Loop — Canada
NM6 . . . Emission Control — Canada Recalibration — Non Closed Loop
NM8 . . . Unleaded Gas Conversion/ Export
NM9 . . . Diesel Emission System/ External EGR
NN1 . . . Emission System — Dual Bed Monalithe Conv.
NN2 . . . Emission — Single Bed Monalithe Conv.
NN3 . . . Emission System — Single Bed Bead Conv.
NN4 . . . Fuel Tank — 60 Gallon
NN6 . . . EGR Reverse Flow
NN7 . . . Fuel Filler Door — Delete Lock
NN9 . . . Emission System — Leaded Fuel — Export
NP1 . . . V6 — Economy Equip
NP5 . . . Leather Wrapped Str. Whl.
NP7 . . . Steering Column
NV5 . . . Shield, Differential Carrier
NY1 . . . Shield & Skid Plate — Fuel Tank
NY6 . . . Type 605/P.S.
NY7 . . . Shield Transfer Case
NY8 . . . Type 800/P.S.
NX1 . . . Wheel — 13 x 5 PA (HSLA Stl)
N04 . . . Lock — Gas Cap/Remote Control
N05 . . . Locking Gas Cap
N08 . . . Rem. Cont. Fuel Filler Dr. Lk.
N09 . . . Lock-Fuel Filler Dr.
N10 . . . . Exhaust System — Dual
N16 . . . . Internal EGR w/EPR Emission Standard
N18 . . . . Locking Kit — Simulated Wire Whl Cvr
N20 . . . . Fuel Tank — 50 Gallon
N23 . . . . Fuel Tank — 83 Litre (22 Gal.)
N24 . . . . Wheel — Cast Alum. — 15 x 7
N30 . . . . Wheel — Steering Deluxe
N31 . . . . Wheel — Steering Custom
N32 . . . . Wheel-Steering Custom
N33 . . . . Wheel — Steering/Tilt Type
N34 . . . . Wheel — Steering Custom Sport
N36 . . . . Wheel — Steering — Sport
N37 . . . . Wheel — Strg./Tilt & Telescopic
N40 . . . . Steering — Hydraulic/Non-Variable
N41 . . . . Steering — Hydraulic/ Variable Ratio
N46 . . . . Wheel, Strg (4 Spoke) (Vinyl)
N49 . . . . Wheel Strg./Cap Only/ Sporty
N51 . . . . Manual Steering
N60 . . . . Wheel Aluminum
N65 . . . . Wheel & Tire — Stowaway Spare
N66 . . . . Wheel Equip. — Styled Sport
N67 . . . . Wheels — Rally
N68 . . . . Spare Tire & Whl. — Conventional
N69 . . . . Wheel — Gold Styled 13 x 6.00
N70 . . . . Wheel — Painted — 13 x 5.5
N71 . . . . Wheel — Cust. Sport
N72 . . . . Wheel — Custom Sport 15 Inch
N73 . . . . Wheel Equip./Custom Sport
N77 . . . . Wheels 13 x 6 /Alum. Hub Caps & Whl. Nuts
N78 . . . . Wheel — Al Cast w/Die Cast Orna./14 x 6
N81 . . . . Tire — Spare Radial
N82 . . . . Wheel Equip. — Cust. Sport/15 x 6.00
N83 . . . . Wheel Equip. — Cust. Sport/15 x 7.00 (Chr. Styled)
N84 . . . . Spare Tire (Delete)
N85 . . . . Wheel — H.D. — 14 x 6
N86 . . . . Wheel — Polycast — 13 x 5.5
N89 . . . . Wheel Turbo Alum.
N90 . . . . Wheel — Aluminum
N91 . . . . Cover — Simulated Wire Wheel w/Locks
N92 . . . . Cover — Simulated Wire Whl/Color Coded
N94 . . . . Simulated Wire Whl disc (14")
N95 . . . . Cover — Simulated Wire Wheel
N96 . . . . Cover — Simulated Chrome Wheel 15 In. (1981)
N96 . . . . Wheel, Alum Cast 16x8 (1984)
N97 . . . . Wheels — Hvy. Dty. — 15 x 7
N98 . . . . Wheel Asm. — Rally 11 Road (Chr.)
N99 . . . . Wheels — Hvy. Duty — (15 x 6)

PA1 . . . Cover — Wheel Trim/ Deluxe/15 In./Olds
PA1 . . . Cover — Wheel Trim/Wire/ 15 In./Buick
PA3 . . . Cover — Deluxe Wheel Trim/13, 14 or 15 In.

GM PRODUCTION OPTIONS

PA4 .... Hub — Wheel Cover, Painted
PA5 .... Cap — Hub — Sport
PA6 .... Styled Wheel
PB1 .... Disc — Whl./15 In.
PB2 .... Cover — Wheel Trim/Abs. Plastic/15 In.
PB4 .... Lock Kit — Aluminum Whl
PB5 .... Wheel — 13 x 5.5 Mild Stl
PB6 .... Wheel — Increased Size — 14 inch
PB7 .... Wheel, 14 x 6 (Painted Style)
PC1 .... Wheel 14 x 6.00 Color Coded
PC3 .... Wheel — 14 x 6JJ Polycast
PC6 .... Wheel — 14 x 5.5
PD7 .... Wheel, 14 x 6.5 (Cast Aluminum)
PE1 .... Wheel — 14 x 7.00 Polycast/Color Coded
PE2 .... Wheel — 15 x 7.00 Polycast/Color Coded
PE3 .... Wheel Asm. 14 x 7 Polycast/Color
PE4 .... Wheel 14 x 7 Polycast/ Turbine DES
PE5 .... Wheel — Rally V
PG3 .... Wheel — 14 x 6.5 Forged Alum
PG4 .... Wheel — 14 x 5.5 Cast Alum
PG5 .... Wheel — 15 x 6 Cast Alum
PG9 .... Wheel — Light Metal Alloy
PH1 .... Wheel — 15 x 7 JJ
PH2 .... Wheel — 15 x 6 00 JJ
PH4 .... Wheel — 15 x 7, Steel Styled
PH5 .... Wheel, 14 x 6 (Forged Aluminum)
PH6 .... Wheel — 15 x 6
PH7 .... Wheel — 15 x 7 Forged Aluminum
PH8 .... Wire Whls.
PX1 .... Wheel, 13 x 5.5 (Cast Aluminum)
PX2 .... Wheel — Rear — Aluminum
P01 .... Cover — Wheel Trim/ Deluxe/13, 14 or 15 In.
P02 .... Cover — Wheel Trim/ Custom/13 or 15 In.
P03 .... Cap — Bright Medal Hub
P05 .... Wheels — Chrome/Buick
P05 .... Wheels — Honeycomb/ Pontiac
P06 .... Ring — Wheel Trim
P08 .... Cover — Wheel Super Deluxe
P10 .... Carrier — Wheel
P11 .... Carrier — Glide Out Spare Tire
P12 .... Wheel — 14 x 6 Chrome
P13 .... Carrier — Wheel/Side Mounted
P14 .... Carrier — Inside Mounted, Spare Tire — Lt Si.
P15 .... Carrier — Inside Mount Spare Tire Rr.

P17 .... Cover — Spare Wheel & Tire
P20 .... Cap — Bright Alum. Hub
P41 .... Tire — Export
P42 .... Tire — Self Sealing

QE2 .... Wheel — 16 x 6.00 K/Truck
QE6 .... Wheel — 16.5 x 6/Truck
QE7 .... Wheel — 16.5 x 6.75
QE8 .... Wheel — 16 x 6.50L/Truck
Q18 .... Wheel — 16 x 5K/Truck
Q28 .... Wheel — 16 x 5K/Truck
Q34 .... Wheel — 19.5 x 6.00/Truck

R04 .... Wheels — Single Rear
R05 .... Conversion — Dual Rear Wheel

S89 .... Wheel — 16.5 x 8.25/Truck

TL1 .... Grille — Special
TL4 .... Grille — Custom
TL6 .... Grille — Black
TN4 .... Rod — Hood Hold Open Assist
TP1 .... High Capacity Battery
TP2 .... Battery — Auxiliary — Camper
TR9 .... Lamp Group
TT4 .... Headlamps — Tungsten Quartz Halogen
TT5 .... Tungsten Quartz Halogen Hdlp
TU2 .... Lamp, RR Marker
T38 .... Park & Turn Lamp Lens (Amber)
T41 .... Sheet Metal, Frt End Special
T44 .... Lock — Interior Operated Hood
T45 .... Aluminum Hood
T46 .... Steel Hood
T47 .... Hood Turbo Alum
T48 .... Ram Air — Hood Sport Steel
T52 .... Ornament — Frt. Fdr.
T58 .... Skirt — Rr Whl. Opg.
T63 .... Buzzer — Headlamp Warning
T70 .... Export Headlamps LHR — Round
T72 .... Export Headlamps LHR — 2 — Rectangular
T79 .... Lamps — Rear Fog — Export
T80 .... Beam Control — Headlamp Automatic
T81 .... Lamp — Deluxe Tail & Stop
T82 .... Twilight Sentinel
T83 .... Headlamp Door — Spl.
T84 .... Headlamps — Right Rule of Road — E Mark
T85 .... Headlamp — Left Rule of Road/Export
T87 .... Lamps — Cornering
T89 .... Lamp — Signal & Marking — Export
T90 .... Signaling and Marking Lamps (Export)

T93 .... Tail & Stop Lamp Special
T96 .... Lamps — Frt. Fog

UA1 .... Heavy Duty Battery
UA2 .... Miles Per Gallon Sentinel Digital Readout
UA6 .... Theft Deterrent System
UA8 .... Battery System — Resv. Pwr.
UB7 .... Cluster Asm. — Trip Odometer
UB8 .... Horn Package
UD1 .... Cluster — Instrument Pnl. — Oil & Water
UD8 .... Clock — Vac. Floresent/ Digital
UE8 .... Clock — Electric/Digital
UE9 .... Switch — Rr. Compt. Lp. Mercury
UF2 .... Lamp — Cargo
UF3 .... Lamp — Map/On Sun Visor Support
UF7 .... Gauge — Instrument Pnl./ Less Tachometer
UH1 .... Electronic Lamp Monitoring System
UH9 .... Cluster, I/P (Wat. Temp., Trip Odo., Turbo Boos.)
UJ1 .... Indicator — Brake Warning System
UJ3 .... Indicator — Water and Fuel
UJ5 .... Cluster — I/P (Wat. Temp., Trip Odometer & Voltmeter)
UJ9 .... Cluster, I/P (Cool Temp., Volt, Tach.)
UK1 .... Radio Frequency — (Japanese)
UK2 .... Lever — Dir Sig. (Export)
UL1 .... Radio — AM/FM Stereo — Without Seek/Scan
UL2 .... Radio Frequency — (European)
UL3 .... Radio — w/Digital Clock — AM/FM Stereo
UL5 .... Radio — Delete
UL6 .... Radio — w/Clock — AM Push Button
UL7 .... Radio — AM/FM Pushbutton — With Digital Clock
UL8 .... Radio — w/Digital Clock — AM/FM Stereo Tape
UL9 .... Radio — w/Digital Clock — AM/FM Stereo Cassette
UM1 .... Radio — AM Pushbutton & Tape Player
UM2 .... Radio — AM-FM Stereo Pushbutton & Tape Plyr.
UM3 .... AM/FM Clock & CB/Stereo
UM4 .... Radio — AM/FM Stereo w/Tape — Sig. Skg. w/Dig. Clk.
UM5 .... AM/FM 8 Track Clock Remote CB/Stereo
UM6 .... AM/FM Stereo Sig. Skg Cassette Player

GM PRODUCTION OPTIONS

UM7 ... AM/FM Stereo w/Digital Readout
UM8 ... AM/FM Stereo Sig. Skg. Remote Control 8 Track
UN1 ... AM/FM Stereo & Tape Player/Cassette/CB
UN2 ... Radio — AM/FM-Stereo — Signal Seeking
UN3 ... Radio — AM/FM Stereo Tape Cassette
UN4 ... Tape Cartridge (Delete) (Export)
UN5 ... AM/FM Stereo, Sig. Seeking, Cassette, T/Plyr., CB
UN8 ... Radio — Citizens Band
UN9 ... Radio Suppression Equip.
UP1 .... Radio — AM/FM Stereo Tape & C.B.
UP4 .... Radio — AM/FM Stereo and C.B./23 Band
UP5 .... Radio Combo. AM/FM Mono. w/C.B.
UP6 .... Radio — AM/FM Stereo and C.B./40 Band
UP7 .... Installation Provisions — Radio — Monuaral
UP8 .... Installation Provisions — Radio — Stereo
UQ1 ... High Perf. Rr. Shelf Spkrs.
UQ2 ... Concert Sound Stereo
UQ3 ... Audio Pwr. Booster
UQ4 ... Speaker Sy tem — Bose 4-Spkr. w/Amps.
UQ5 ... Speaker, 4 Frt. Door Coax Rr. 1/4 E.R.
UQ7 ... Speaker System, Sub Woofer
UQ9 ... Speaker System (Delete)
UR1 .... Gage Fuel Economy
UR3 .... Fuel Econ. Indicator Lamp
UR4 .... Turbo. Boost Gauge
US6 .... Antenna, Fixed Mast (Black)
US7 .... Antenna, Power (Black)
UT1 .... Buzzer — Tone Generator Warning
UT2 .... Radio, AM/FM Stereo ETR (Remote Control)
UT3 .... Radio, AM/FM Stereo ETR Cassette (Remote Control)
UT4 .... Radio, AM/FM Stereo ETR Cassette w/Eq (Remote Control)
UU1 ... Radio — AM/FM Stereo — Full Feature/Mtr.
UU2 ... Radio — AM/FM Stereo — Full Feature/Mtr/Cassette
UU3 ... Radio — AM/FM Stereo — Full Feature/Mtr/8 Track
UU4 ... Stereo w/Digit Display
UU5 ... Graphic Equalizer
UU6 ... Radio — AM/FM Stereo Cassette ETR w/Clock
UU7 ... Radio — AM/FM Stereo Cassette ETR
UU8 ... Radio — AM/FM Stereo Cassette Etr. — Dolby
UU9 ... Radio — AM/FM Stereo, ETR, without Seek/Scan & Clock
UV1 .... Reminder, Voice Synthesis
UW1 ... System Cluster — (Diagnostic)
UW6 ... Shelf, Dual Ext. Range Pkg.,
UW8 ... Retainer — Garage Dr. Transmitter
UW9 ... Opener — Garage Dr. Rem. Cont.
UX6 .... Speakers — Dual Frt.
UX7 .... Speaker System — Dual Frt. Dr & Dual Extended Range RR
UX9 .... Speaker — Front
UY1 .... Wiring — Camper
UY7 .... Wiring Harness — Heavy Duty/Truck
UY8 .... Radio — AM/FM Stereo w/Digital Clock
UY9 .... Speedo Kilo/Miles Mechanical Display
U01 ... Lamp — Roof Marker/Truck
U02 ... Speed Kilo/Miles Digital
U03 ... Horn — Noise Reg. — Export
U05 ... Horn — Dual
U09 .... Horn — Four Note
U11 .... Cluster — Spl. Calibrated
U14 .... Gauge — Instrument Panel
U16 .... Tachometer Ld.
U17 .... Cluster — Instr./Oil, Water, Amm., Clock, Gas, Tach
U18 .... I/P Cluster — Kilo/Tach
U19 .... I/P Cluster M. & Kilo Odom./Canadian
U21 .... Cluster, Instr. (Oil-Water-Battery-Tach)
U22 .... Cluster, Instr. (Oil-Water-Battery-Clock)
U23 .... Speedo., w/Trip Odometer
U25 .... Lamp — Luggage Compt.
U26 .... Lamp — Engine Compartment
U27 .... Lamp — Instrument Panel Compartment
U28 .... Lamp — Ash Tray
U29 .... Lamp — Courtesy
U30 .... Gages — Aux. Inst.
U32 .... Cluster — Specially Calibrated
U35 .... Clock — Electric (Non Digital)
U37 .... Lighter — Cigarette
U38 .... Low Coolant Warning Sys.
U40 .... Trip Monitor — Digital Readout
U41 .... Indicator — Low Fuel
U46 .... Monitor — External Lamp
U52 .... Cluster — I/P (Electronic)
U57 .... Player — Tape
U58 .... Radio — AM/FM Stereo
U63 .... Radio — Push Button
U64 .... Speaker System — Dual Frt. Dash & Dual STD Range RR
U65 .... Speaker System — Dual Frt. Dr. & Dual STD Range RR
U66 .... Speaker System — Dual Frt. Dash & Dual Extended Range RR
U67 .... Radio — Rear Control
U69 .... Radio — AM-FM w/Mono
U72 .... Automatic — Power Antenna
U73 .... Antenna — Standard (Fixed Mast)
U74 .... Antenna — Power Rdo. — Citizens Band
U75 .... Antenna — Power FDR
U76 .... Antenna W/S Embedded
U79 .... Speaker, 4 Dual Frt. Coax, Dual ETR Rr.
U80 .... Spkr. — Rr. Aux. All locations
U81 .... Speakers — Rear Dual
U83 .... Antenna — Power — Radio and 40 Chnl. C.B.
U88 .... Hole — Roof Flasher Wiring Harness
U89 .... Wiring Harn. — Car Trailers — 5 Wire
U90 .... Wiring Harn. — Spl. — Rf. Flasher w/Rf. Pnl.
U92 .... Speakers — Front Dual & Rear Dual
U93 .... Antenna — Man AM/FM C.B. Tri. Band
U94 .... Light Cable — Trailer 7-Wire
U95 .... Speakers — Door
U96 .... Speaker System/6 Speaker Concert Sound

VA2 .... Miles Per Gal Sentinal — Export Canada (1981)
VA2 .... Support — Radiator — Steel (1982)
VA3 .... Support — Radiator — Aluminum
VB2 .... Bumper — w/Impact Strip — Rear Step — Painted
VB3 .... Bumper — w/Impact Strip — Rear Step — Chrome
VB4 .... Saudi Arabia Pkg. Export
VD1 .... Radio Provisions (Export) (Europe)
VD2 .... Bumper Mldg.
VD4 .... Reinforcement — Frt. Bpr. (Steel)
VD5 .... Reinforcement — Rear Bumper — Steel
VD6 .... Reinforcement — Front Bumper — Aluminum
VD7 .... Reinforcement — Rear Bumper — Aluminum

GM PRODUCTION OPTIONS

VE1 .... Japanese Modification Export
VE5 .... Strip — Frt. and Rr. Bumper, Impact
VE6 .... Bumper — Frt. & Rr. Painted (w/Impact Strips)
VF1 .... Bumper — Chrome/Rr.
VF5 .... Bumper — Car Color
VF6 .... Bumper — Rr. Step
VF9 .... Bumper — Frt. and Rr. Rbr. Protected w/Grds.
VG3 .... Strip, Frt Bumped Impact
VG5 .... Strip Rear Bumper Impact
VG7 .... Bumper — Reinforcement, Front
VG8 .... Bumper — Reinforcement Rr./Calif. & Florida
VG9 .... Frt. Bumper Guards
VH6 .... Black Bumper
VH7 .... Bumper, Custom
V1D .... AM/FM Stereo & Tape Player w/o Eject
VJ5 .... Mounting, License Plate
VJ6 .... Pocket — Lic. Plt. Rear
VJ7 .... Bracket — w/Lamp Rear Lic Plt.
VJ9 .... California Emission Compliance Information
VK1 .... License Plate — Frt. Mounting Pkg.
VK3 .... Mounting — License Plate/ Front
VL4 .... Plate, Frt. Mtg. Lic.
VN1 .... Modifications — Calif. Reqmts.
VN2 .... Modifications — Georgia Reqmts.
VN3 .... Modifications — Florida Reqmts.
VP1 .... Spoiler — Lower Front
VR2 .... Hitch — Trailer/Dead Weight
VR4 Hitch — Trailer/Weight Distributing Platform
VR5 .. Ball — Trailer Hitch/1-7/9 Inch
VR6 ... Ball — Trailer Hitch/2 Inch
VT3 ... Deluxe w/Impact Strips Frt. Bmpr.
VT4 ... Deluxe w/Impact Strips RR Bmpr.
VT7 ... Export — Unregulated Countries
VU9 ... Flashlite Mtg.
V1H .. Special Paint-Two Tone
V1L ... Special Trim
V1T ... Spare Whl Conventional
V01 ... Radiator — Heavy Duty
V02 ... Radiator — H.D with HD .Trans. Oil Cooler
V03 ... Radiator — Extra Capacity Cooling
V05 .... Radiator — Heavy Duty — Truck

V08 .... Cooling System, Heavy Duty
V10 .... Cold Climate Package
V13 .... Cold Climate Package Delete
V22 .... Grille — Front Bumper/ Chrome
V28 .... Guards — Front Bumper/ Painted
V30 .... Guards — Frt. & Rr. Bumper
V31 .... Guard — Frt. Bpr./Chr
V32 .... Guard — Rr. Bumper
V35 .... Bumper, Rr. w/Recessed Lights
V37 .... Bumper — Chrome/Frt. & Rr./Truck
V38 .... Bumper — Rr./Painted/ Truck
V58 .... Carrier — Deck Lid Luggage
V4S .... Delegance
V4T .... Delegance
V4W .... Wheel Disc
V42 .... Bumper — Rear Step/ Chrome/Truck
V43 .... Bumper Rear Step Painted Truck
V46 .... Bumper — Chrome/Frt./ Truck
V50 .... Frame — Rear Lic. Plt.
V51 .... Frame — Front & Rear Lic. Plt.
V54 .... Carrier — Luggage and Roof Panel
V55 .... Carrier — Roof Luggage
V56 .... Luggage Compt. — Lock & Trim
V62 .... Jack — Auto
V65 .... Bumper — Lt. Duty
V69 .... Trailer Provisions
V70 .... Hooks — Towing — Export
V76 .... Hook — Front Tow
V78 .... Plate — Less Certificate of Compliance
V81 .... Trailer Provisions
V82 .... Trailer Prov. — Class 2 2000-3500
V83 .... Trailer Provisions — Class 3 3500-5000

WA3 ... Seat Adj. — 6 Way Driver & Pass.
WA5 ... Speaker — Dual — Frt. & Rear
WB2 ... Promotional Package
WB5 ... Estate Wagon Group
WB7 ... Landau Top and Formal Window Group
WB9 ... Palm Beach Opt.
WC2 ... Molding Package
WC3 ... Moldings — Rkr. — Rr. Qtr & w/Opg.
WC4 ... Convenience Group
WD3 ... Appearance Group
WD4 ... Accessory Package
WF5 ... Custom Trim Group
WF6 ... Molding Group

WF8 ... Apollo XB-27 Package
WH2 ... Free Spirit Skyhawk Design 11
WH3 ... Appearance Group
WH4 ... Tachometer & Clock
WH5 ... Handling Package
WH6 ... Night Hawk Decor. Package
WJ4 ... Firenza Coupe, Special Edition
WJ5 ... Cierra Coupe, Special Edition
WJ7 ... Trim, Interior Leather
WJ8 ... Starfire SX Package
WJ9 ... F85 Deluxe Package
WK1 ... Roof Panel Stowage Brackets
WK2 ... Special Trim/Delta Royale Brougham
WK9 ... Regency Brougham Sedan Option
W05 ... Regal Limited Option
W06 ... Century Estate Wagon (1984)
WS4 ... Trans. Am Option
WS6 ... Special Performance Package
WS7 ... Special Handling Pkg.
WS9 ... Phoenix Appearance Package
WS9 ... Leader — Fuel Economy (1982-83)
WT1 ... Suspension — Bias Belted Tire
WU2 ... GT Option
WU7 ... Custom Third Stea
WU9 ... Window Reveal Mldgs.
WV6 ... Graphics Pkg./Gold
WV7 ... Graphics Pkg./Charcoal
WV8 ... Graphics Pkg./Blue
WV9 ... Graphics Pkg./Red
WW1 ... Less Console
WW2 ... Custom Safari
WW3 ... Can Am Option
WW7 ... Aplq. — Hood/Firebird
WW8 ... Gages — Rally with I/P Tach. and Clock
WX3 ... Ram Air — Shaker Hood
WY5 ... Suspension — Radial Tuned
W02 ... Wood Grain Applique
W03 ... Regal Limited Sedan
W04 ... Century Limited Coupe
W06 ... Custom Trim Group
W07 ... Century — Sport Coupe
W08 ... Custom Trim Group
W09 ... Century Limited Sedan
W10 ... Park Avenue Option
W11 ... Regal Sport Coupe
W12 ... Skyhawk Package
W13 ... Century — Turbo Coupe
W14 ... LeSabre Sport Coupe
W15 ... Custom Trim Group
W17 ... Interior Trim Deluxe
W18 ... Sport Option
W19 ... Custom Trim Group
W20 ... Convenience Group
W21 ... Custom Trim Group
W22 ... Custom Trim Group
W24 ... Custom Trim Group

GM PRODUCTION OPTIONS

W29 ... 442 Appearance Package
W30 ... Hurst — Olds Pkg.
W40 ... Hurst — Olds Specialty Car
W44 ... Simulated Convertible Top
W45 ... European Sedan
W47 ... Firenza "ES"
W48 ... European Styling
W49 ... C-4 Closed Loop (1980-81 Models Only)
W50 ... Appearance Group Special
W51 ... Appearance Option, Black Extr.
W52 ... Japanese Modification/ Export
W53 ... Special Appearance-Grp. II Two-Tone
W55 ... Exhaust System — Light Weight
W56 ... Exhaust System — Standard
W59 ... Special Applications Group
W60 ... Esprit Special Appearance
W62 ... Aero Package
W63 ... Gauge & Clock — Rally
W64 ... Sunbird Wagon, Spec. Parts Group
W65 ... Stereo Spkr. w/Monaural Rdo. (1981)
W65 ... Lock Pkg., Security (1984)
W66 ... Formula Option Group
W67 ... Esprit — Lux. Opt.
W68 ... Esprit Special Appearance Red Bird
W69 ... Firebird S/E
W70 ... LeMans Sport Option
W71 ... Custom Seat Group
W72 ... Performance Opt.
W73 ... Esprit — Special Appearance
W84 ... Gas — Additional Fuel (Canada)
W85 ... Diesel — Additional Fuel (Canada)

YA1 .... Decore Pkg. — Luv Truck
YB9 .... Insulator — Cab Back Panel
YC1 .... Durango Equipt.
YC2 .... Tahoe Equipt.
YC3 .... Sport Equipt.
YC6 .... Custom Estate/Woodgrain
YD1 .... Trailer Package — Heavy Duty
YE4 .... Interior & Exterior Deluxe
YE7 .... Spec. Sport Equip. (GMC)
YE9 .... Silverado/Sierra Classic
YG1 .... Moldings — Bdy. Si. Upr. & Lwr. Whl. Opg./Less Insert
YG2 .... Woodgrain, Insert & Name Plate
YG3 .... Molding — Body Side & Whl Opening — Bright
YG5 .... "SS" Sport Package Modification
YG6 .... Bonanza Pkg. A/Royal Sierra Pkg. A
YG7 .... Bonanza Pkg. B/Royal Sierra Pkg. B
YG8 .... Bonanza Pkg. C/Royal Sierra Pkg. C
YG9 .... Special Components, Celebrity Z
YH9 .... Interior — Deluxe
YJ8 .... Wheel — Cast Aluminum
YK3 .... Package — Frt. & Rr. Shk. Abs. & Elim Pitch
YL1 .... Upholstery — Leather — Vinyl
YL2 .... Paint — Firemist
YL4 .... Rub Stripe Insert (White)
YM5 .... Stripe — Accent — Delete
YM6 .... Headrest Export (Japan)
YP3 .... Eldorado Cust., Biarritz Opt.
YP4 .... Elegante
YP5 .... Eldorado — Touring Coupe Option
YP6 .... Cimarron — Special Edition
YP7 .... Cimarron Limited Edition
YR1 .... Custom F/Seat
YR2 .... Deluxe F/Seat
YR3 .... Luxury F/Seat
YS1 .... Custom R/Seat
YS2 .... Deluxe R/Seat
YS3 .... Luxury R/Seat
YT1 .... Custom Build-Up Dr and Qtr.
YT2 .... Cust Dr and Qtr Deluxe
YT3 .... Luxury Build Up Dr & Qtr.
YT6 .... Special Interior Build Up
YT7 .... Reminder Group
Y02 .... Seat — Front Custom
Y03 .... Seat — Rear Custom
Y06 .... Panel — Cowl Kick — Carpeted
Y07 .... Mldg. — Side Wdo. Rvl. Painted
Y10 .... Custom Build-Up Dr. & Qtr.
Y11 .... Seat — Front — Special Design
Y12 .... Seat — Rear — Special Design
Y13 .... Trim — Door Special Design
Y17 .... Fdtn. Compt. Shelf Custom
Y19 .... Mldg. — Body Side Lwr.
Y40 .... Cooling — Hvy. Duty
Y41 .... Extra Cost Trim
Y43 .... Road Hawk Package
Y44 .... Regal Sport Coupe Decor
Y48 .... Regal — Sr. — Package (1981)
Y48 .... Electra "T" Type (1984)
Y49 .... Designer Concept Car/ Somerset II
Y5A .... Body, Military 5250 Comm Shelter (Type E)
Y5B .... Body, Military Ambulance (Type C)
Y5C .... Body, Military Trp. & Cargo Carrier (Type B)
Y5D .... Body, Ambulance (Complete Pkg.)
Y5E .... Generator, Dual Delco 66 Amp.
Y5F .... Generator, Dual Delco 100 Amp.
Y5G .... Generator, Dual Delco 200 Amp.
Y5J .... Radio Provision, Special Military
Y5P .... Military Troop Seats Pkg.
Y5R .... Cab/Chassis, Military (Type D)
Y50 .... Riveria — Sporty "T" Type
Y51 .... Protective Molding Group
Y52 .... Regal Decor
Y54 .... Carpet Savers — Mats
Y55 .... Reminder Package Group
Y56 .... Accessory Group
Y57 .... Lamp and Indicator Group
Y59 .... V6 — Economy Package
Y60 .... Accessory Group Package
Y61 .... Omega LS
Y62 .... Inst. Cluster Spl. Features
Y64 .... Starfire GT Package
Y65 .... Firenz Package
Y66 .... Omega SX Package
Y67 .... Reminder Pkg.
Y68 .... Custom Appearance Package
Y69 .... Diesel Econ. Package (350 Diesel)
Y70 .... Stripe — Body Side Decal
Y71 .... Lower Body Paint Scheme
Y72 .... Trailer Towing Cooling & Gen. Pkg.
Y73 .... XS Appearance Opt.
Y74 .... Exterior Molding Option
Y75 .... Cutlass Value Package
Y76 .... Marketing Group Option
Y77 .... Diesel Econ. Package (260 Diesel)
Y78 .... Cutlass Calais Opt. (1978) (1984)
Y78 .... Cutlass Salon Option (1973-1977)
Y78 .... 88 Holiday Coupe
Y78 .... Sport Omega Pkg.
Y79 .... Appearance Option
Y80 .... Custom — Exterior
Y81 .... Spl. Edition — Trans. AM Less Hatches
Y81 .... Convertible Conversion Package (1982)
Y82 .... Special Edition Trans. AM
Y83 .... Appointments Option — LJ Luxury
Y84 .... Special Edition — Trans. AM Black
Y85 .... Special Edition Trans. Am
Y87 .... Brougham Option
Y88 .... Special Edition — Trans. AM Gold (1978)
Y88 .... Sedan — 6000 STE (1983-84)

GM PRODUCTION OPTIONS

Y89 .... Silver Anniversary Trans AM (1978)
Y89 .... Landau — Brougham (1982)
Y90 .... Custom Trim Group (1980)
Y90 .... Special Sport and Handling Pkg. (1984)
Y91 .... J2000 LE
Y92 .... Lamp Group (1978)
Y92 .... J2000 SE
Y94 .... J2000 S
Y95 .... Rally Option
Y96 .... Firm Ride Option
Y97 .... SJ Option (1982-83)
Y97 .... "SE" Option (1984)
Y98 .... Ride Control System, Electronic
Y99 .... Handling Package

ZE1 .... Stripe-Body Si Lw-Acadian
ZE7 .... Restraint — ST Belt & Shldr. Harn. — Canadian
ZE8 .... LeMans — G.T. Package
ZE9 .... Stripe — Body Si. Lwr. — Canadian
ZF2 .... Cavalier Sports Pkg. Canadian
ZF3 .... Sport Package — Canadian
ZF4 .... Acadian
ZF5 .... Acadian
ZJ1 .... Custom Interior — Two Tone
ZJ2 .... Exterior — Custom Molding
ZJ3 .... Interior Decor and Convenience Package
ZJ5 .... Molding — Exterior/Lower
ZJ6 .... Fuel Economy Package
ZJ7 .... Wheel — Special Hub Cap & Trim Ring
ZJ9 .... Lighting Group — Auxiliary
ZK3 .... Special Interior Package — Export
ZL9 .... Interior — Luxury
ZM1 .... Caravan Pkg.
ZM2 .... Bonaventure Trim
ZM4 .... Nomad/Gypsy
ZM8 .... Beauville Trim/Rally Stx
ZN1 .... Trailering Package
ZN5 .... Wheel — Rally/Painted Body Color
ZQ2 .... Operating Convenience Group
ZQ8 .... Sport Chassis Pkg.
ZY7 .... Paint — Lower Accent
ZY8 .... Paint — Mid Accent
ZW2 .... Heavy Duty Emission Eng.
ZW9 .... Base Body or Chassis
ZX2 .... Convenience Package
ZX4 .... Landau Roof Package
ZX5 .... Value Appearance Package
ZX6 .... Heavy Duty Chassis Equipment
Z01 .... Monza Spyder
Z02 .... Monza — Spyder — Appearance Package
Z03 .... Landau Equipment
Z04 .... Monte Carlo Classic

Z05 .... Special 2-Tone & Striping
Z06 .... Luxury Interior Equipment
Z07 .... Economy Truck
Z08 .... Convertible Equipment Pkg.
Z11 .... Cadet
Z12 .... Appearance Pkg.
Z13 .... Ornamentation — Sport Exterior
Z14 .... Trim — Cust. Intr.
Z15 .... Spec. Sport Equip. SS — 454
Z16 .... Sport Decor/Black Knight
Z18 .... Sport Decor
Z19 .... Sport Pkg. XII
Z20 .... Limited Edition Monte Carlo
Z21 .... Molding — Exterior
Z24 .... Rally Decor Group
Z25 .... Laguna Type S3
Z26 .... Nova Rally
Z28 .... Special Performance Package
Z29 .... GT — Sport
Z29 .... Spyder Equipment
Z32 .... Canadian Parisienne Pontiac
Z33 .... Canadian Pontiac, Parisienne Brougham
Z36 .... Pontiac Conversion Package
Z44 .... Additional Coolant Protection
Z46 .... P.J. Package "X" Car Merchandising
Z47 .... K.C. Package "X" Car Merchandising
Z48 .... F.X. Package "X" Car Merchandising
Z49 .... Mandatory Canadian Base Equip. Modifications
Z5B .... SEO Override of MV4 for Police and Taxi
Z5J .... SEO Override of RPO U25 Lugg. Compt. LP
Z5K .... California Merchandising Package
Z5S .... California Merchandising Package
Z5T .... SEO Override of LM1 for Police and Taxi
Z50 .... Indianapolis Commemorative Package
Z52 .... Seat — Full Foam
Z53 .... Gauge — Voltmeter/Oil Pressure & Temp.
Z54 .... Interior Decor./Silent Sound Group, Cust. Tr.
Z55 .... Top — Removable/Lt. Slate — Textured
Z56 .... Top — Removable/Dk. Bronze — Textured
Z57 .... Top — Removable/Dk. Blue — Textured
Z58 .... Top — Removable/White — Textured
Z59 .... Top — Removable/Black — Textured

Z6B .... SEO Override of RPO JA2 H.D. Brake
Z60 .... Top — Removable/Almond — Textured
Z61 .... Custom Group
Z62 .... Scottsdale/Sierra Grande
Z64 .... Cutaway Van
Z65 .... Sport Package — Merchandising Option (Consists of YG5)
Z66 .... Conversion — Van Camper
Z71 .... Off Road Chassis Pkg.
Z72 .... Trailering Package — Light Duty
Z73 .... Special Interior Trim
Z75 .... Frt. Quad. Shocks
Z76 .... Special Commerical Chassis
Z77 .... Chevy Sport or Street Coupe/GMC
Z78 .... Appearance Package — Pace Car (Limited Edition)
Z79 .... Sandpiper Appearance Package
Z80 .... Trim — Special
Z81 .... Camper — Special
Z82 .... Trailering Special
Z83 .... Camper — Package/Deluxe
Z84 .... Cheyenne/High Sierra
Z85 .... Sport Package — Rally
Z87 .... Flexible Facia Front End
Z88 .... Conversion — GMC
Z94 .... Canadian Oxidizing Converter System
Z95 .... Emission Control Equip. (Delete)
Z98 .... Canadian Pontiac Version of 1TB08 — Acadian

SECTION OB

MAINTENANCE AND LUBRICATION

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SECTION A — Scheduled Maintenance Services For Your 1984 Gasoline-Fueled Vehicle

SCHEDULE I Follow Schedule I if you mainly operate your vehicle under one or more of the following conditions:

- Operating when outside temperatures remain below freezing and when most trips are less than 4 miles (6 km); or
- Idling for extended periods and/or low speed operation such as in door-to-door delivery;

Also follow Schedule I when:

- Towing a trailer;
- Operating in dusty areas; or
- Using your vehicle in hard, police car, delivery or daily rental service.

SCHEDULE I

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (Kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 48,000 miles (60 000 km) are to be performed after 48,000 miles of the same intervals															
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
1	Engine Oil and Oil Filter Change*	Every 3,000 mi. (5 000 km) or 3 months.	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
2	Chassis Lubrication	Every other oil change		•		•		•		•		•		•		•		•
3	Carburetor Choke and Hoses*	Check at 6,000 miles (10 000 km), then at 30,000 Miles (50 000 km). Also check item 3 at 45,000 Miles (75 000 km).		•								•					•	
4	Carb. or Throttle Body Mounting*2			•								•						
5	Eng. Idle Speed (See Explanation)*			•								•						
6	Vacuum or AIR Pump Drive Belts*	Inspect every 12 Months or 15,000 Miles (25 000 km)					•					•					•	
7	Cooling System Refill*	Every 24 Months or 30,00 Miles (50 000 km)										•						
8	Wheel Bearing Repack	Every 15,000 Miles (25 000 km)					•					•					•	
9	Transmission Fluid	See Explanation for service intervals																
10	Vacuum Advance System*	Check at 6,000 Miles (10 000 km), then at 30,000 Miles (50 000 km), and at 45,000 Miles (75 000 km)		•								•					•	
11	Spark Plugs*	Replace every 30,000 Miles (50 000 km)										•						
12	PCV System Check and Service*	See explanation for service intervals																
13	EGR System*	Service every 36 Months or 30,000 Miles (50 000 km)										•						
14	Air Cleaner and PCV Filter*	See Explanation for service intervals																
15	Engine Timing*	Adjust every 30,000 Miles (50 000 km)										•						
16	Spark Plug Wires and Distributor*	Inspect every 15,000 Miles (25 000 km)					•					•					•	
17	Fuel Tank, Cap and Lines*	Inspect every 12 Months or 15,000 Miles (25 000 km)					•					•					•	
18	Early Fuel Evaporation System*2	Check at 6,000 Miles (10 000 km) then at 30,000 Miles (50 000 km)		•								•						
19	Evaporative Control System*	Check at 30,000 miles (50 000 km)										•						
20	Idle Stop Solenoid*											•						
21	Fuel Filter*	Service every 15,000 Miles (25 000 km)					•					•					•	
22	Valve Lash Adjustment*1						•					•					•	
23	Thermostatically Controlled Air Cleaner	Every 30,000 Miles (50 000 km)										•						

Fig. OB-1--Maintenance Schedule I, Gasoline L.D. Emission, 49 States

SCHEDULE II Follow Schedule II if, as a general rule, you drive your vehicle on a daily basis for several miles (km) and none of the above conditions apply.

SCHEDULE II

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 45,000 miles (75 000 km) are to be performed after 45,000 miles at the same intervals					
		MILES (000)	7.5	15	22.5	30	37.5	45
		KILOMETERS (000)	12.5	25	37.5	50	62.5	75
1	Engine Oil Change	Every 7,500 mi. (12 500 km) or 12 months	•	•	•	•	•	•
	Filter Change	At first and every other oil change	•		•		•	
2	Chassis Lubrication	Lubricate every 12 Months or 7,500 Miles (12 500 km)	•	•	•	•	•	•
3	Carburetor Choke and Hoses*	Check at 6 Months or 7,500 Miles (12 500 km), then at 30,000 Miles (50 000 km). Also check Item 3 at 45,000 Miles (75 000 km).	•			•		•
4	Carburetor or Throttle Body Mounting*[2]		•			•		
5	Engine Idle Speed (See Explanation)*		•			•		
6	Vacuum or AIR Pump Drive Belts*	Inspect every 12 Months or 15,000 Miles (25 000 km)		•		•		•
7	Cooling System Refill*	Every 24 Months or 30,000 Miles (50 000 km)				•		
8	Wheel Bearing Repack	Every 30,000 Miles (50 000 km)				•		
9	Transmission Fluid	See Explanation for service intervals						
10	Vacuum Advance System*	Check at 6 Months or 7,500 Miles (12 500 km) then at 30,000 Miles (50 000 km), and at 45,000 Miles (75 000 km)	•			•		•
11	Spark Plugs*	Replace every 30,000 Miles (50 000 km)				•		
12	PCV System Check and Service*	See explanation for service intervals						
13	EGR System*	Service every 36 Months or 30,000 Miles (50 000 km)				•		
14	Air Cleaner and PCV Filter*	See Explanation for service intervals						
15	Engine Timing*	Adjust every 30,000 Miles (50 000 km)				•		
16	Spark Plug Wires and Distributor*	Inspect every 15,000 Miles (25 000 km)		•		•		•
17	Fuel Tank, Cap and Lines*	Inspect every 12 Months or 15,000 Miles (25 000 km)		•		•		•
18	Early Fuel Evaporation System*[2]	Check at 7,500 Miles (12 500 km) then at 30,000 Miles (50 000 km)	•			•		
19	Evaporative Control System	Check at 30,000 miles (50 000 km)				•		
20	Idle Stop Solenoid*					•		
21	Fuel Filter	Service every 15,000 Miles (24 000 km)		•		•		•
22	Valve Lash Adjustments*[1]			•				•
23	Thermostatically Controlled Air Cleaner*	Every 30,000 Miles (50 000 km)				•		

FOOTNOTES:
[1]Only applicable to 1.9L engine, Engine Family E1G1.9T2HEC9.
[2]All engines EXCEPT 1.9L Engine Family E1G1 9T2HEC9.
*Also an Emission Control Service

Fig. 0B-2--Maintenance Schedule II, Gasoline, LD Emissions, 49 States

GASOLINE ENGINE, L.D. EMISSION, 49 STATES

NORMAL VEHICLE USE

The maintenance instructions contained in this section are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the Tire Placard located on the edge of the driver's door.
- on reasonable road surfaces within legal operating limits.
- on a daily basis, as a general rule, for at least several miles (km), and
- on unleaded gasoline.

Unusual operating conditions will require more frequent vehicle maintenance as specified.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

Item 1 Engine Oil and Oil Filter Change*

Always use SF-QUALITY OILS OF PROPER VISCOSITY. Also always change oil and filter as soon as possible after driving in a dust storm. See Owner's Manual for further details.

Item 2 Chassis Lubrication

Every 12 months or 7,500 miles (12 500 km), lubricate transmission shift linkage, hood latch and door hinges, parking brake cable guides, underbody contact points and linkage, clutch linkage, propshaft, transfer case shift lever and clutch pedal springs. Lubricate clutch cross-shaft ever 30,000 miles (50 000 km).

Item 3 Carburetor Choke and Hoses*

Verify that choke and vacuum break work properly and are within specifications. Correct any binding caused by damage or gum on the choke shaft. Inspect hoses for proper hookup, cracks, rubbing, or decay. Correct as necessary.

Item 4 Carburetor Mounting Torque*

Check torque of mounting bolts and/or nuts.

Item 5 Engine Idle Speed Adjustment*

Adjust to the specifications shown on the underhood label. You must use calibrated test equipment.

Item 6 Vacuum or AIR Pump Drive Belts*

Inspect belts driving the vacuum or AIR pump. Look for cracks, fraying, wear and proper tension. Adjust or replace as needed.

Item 7 Cooling System Refill *

Drain, flush and refill system with new coolant.

Item 8 Wheel Bearing Repack

Clean and repack front wheel bearings at each brake relining or 15,000 miles (25 000 km), whichever comes first, when vehicle is used in such service as police, taxi or door-to-door delivery. If you do not use your vehicle in such service, clean and repack bearings at each brake relining or 30,000 miles (50 000 km), whichever comes first.

Item 9 Transmission Fluid

Automatic Transmission - Change the transmission fluid and change the filter (or service the screen) every 15,000 miles (25 000 km) if the vehicle is mainly driven underone or more of these hot conditions.

- In heavy city traffic where the outside temperature regularly reaches 90°F (32°C).
- In hilly or mountainous terrain.
- Frequent trailer pulling.
- Uses such as taxi, police or delivery service.

If vehicle is not used under any of these conditions, change the fluid and filter (or service the screen) every 100,000 miles (160 000 km).

See Owner's Manual for further details.

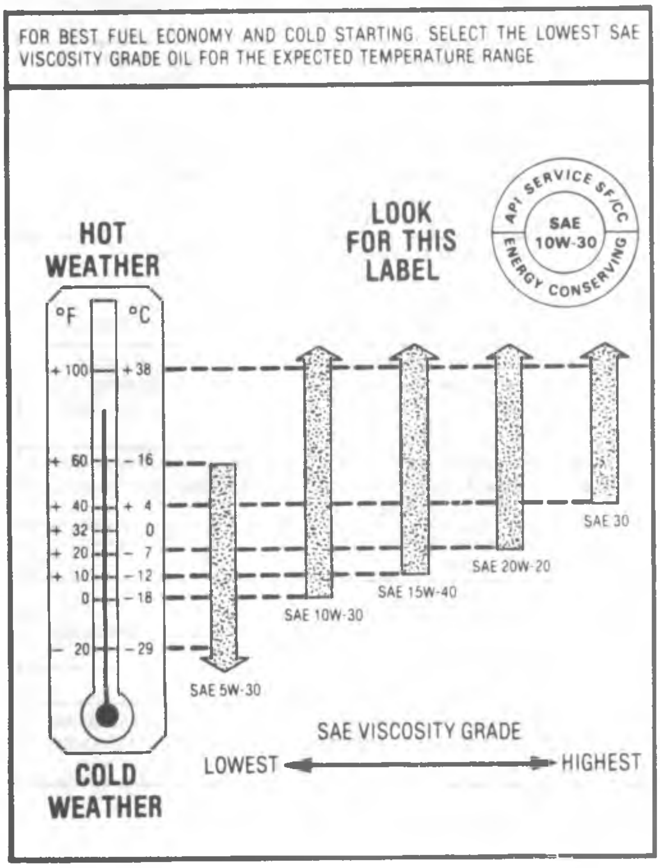


Fig. 0B-3--Oil Viscosity Chart, Gasoline, LDX, 49 States

Item 10 Vacuum Advance System and Hoses

Check system for proper operaion. Check hoses for proper hookup, cracks, rubbing or decay. Replace parts as needed.

Item 11 Spark Plug Replacement

Replace with the type listed in your Owner's Manual.

Item 12 PCV Valve Inspection

Check that system works properly each 15,000 miles (25 000 km).

Replace the valve and any worn, plugged or collapsed hoses at 30,000 miles (50 000 km).

Item 13 Exhaust Gas Recirculation System (EGR)

Conduct EGR operation system check as covered later in this manual. Replace or clean parts as required.

Item 14 Air Cleaner and PCV Filter

Replace every 30,000 miles (50 000 km). Replace more often under dusty conditions. Ask your dealer for the proper replacement intervals for your driving conditions.

Item 15 Engine Timing Check

Adjust timing to underhood label specifications.

Item 16 Spark Plug Wires and Distributor Inspection

Clean wires. Inspect for burns, cracks or other damage. Check the boot fit at distributor cap and spark plugs. Inspect inside and outside of the cap and rotor for cracks, carbon tracking and corrosion. Replace as needed.

Item 17 Fuel Tank, Cap and Lines

Inspect the fuel tank, cap and lines for damage or leaks. Remove cap, inspect gasket for an even filler neck imprint, and any damage. Replace parts as needed.

Item 18 Early Fuel Evaporation (EFE) System

Check that valve works properly; correct any binding. Check that thermal vacuum switch works properly. Check hoses for cracks, rubbing or decay. Replace parts as needed.

Item 19 Evaporative Control System (ECS)

Check all fuel and vapor lines and hoses for proper hookup, routing and condition. Check that bowl vent and purge valves work properly, if equipped. Remove canister, check for cracks or damage. Replace as needed.

Item 20 Idle Stop Solenoid, and/or Dashpot

Check that parts work properly. Replace them as needed.

Item 21 Fuel Filter

Replace carburetor fuel filter at mileage shown on Maintenance Schedule or sooner if clogged.

Item 22 Valve Lash Adjustment

Incorrect valve clearance will result in increased engine noise and lower engine output, thereby adversely affecting engine performance. Retorque rocker shaft bracket nuts before checking and adjusting valve clearance. Check and adjust valve clearance every 15,000 miles (24 000 km).

Item 23 Thermostatically Controlled Air Cleaner*

Inspect all hoses and ducts for proper hookup. Make sure valve works properly.

OWNER INSPECTIONS AND SERVICES

Listed in Figs. 0B-4 through 0B-6 are vehicle inspections and services which should be made by either you or a qualified tehcnician at the frequencies indicated to help ensure proper safety emission performance and dependability of your vehicle. Take any problems promptly to your dealer or a qualified technician for service advice. Whenever repairs are necessary, have them completed at once. For your safety and that of others, any safety related components that could have been damaged in an accident should be inspected. All needed repairs should be performed before operating your vehicle.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
BEFORE OPERATING YOUR VEHICLE	Warning light, buzzer tone and chime operation.	Check operation of all warning lights, buzzers, tone generators and chimes — also all interior lights. See your Owner's Manual for details.
	Glass, light or reflector condition	Look for broken, scratched, dirty or damaged glass that could reduce vision or visibility or cause injury. Replace, clean or repair promptly.
	Seat adjuster operation	When adjusting a manual seat, be sure seat adjusters latch by pushing seat forward and backward.
	Rearview mirror and sun visor operation	Make sure friction joints hold mirrors and sun visors in place.
	Door and gate latch operation	Make sure that all doors and wagon or hatchback gates close, latch and lock tightly.
WHILE OPERATING YOUR VEHICLE	Automatic transmission shift indicator operation	Make sure the indicator points to the gear chosen.
	Windshield wiper and washer operation	Note the operation and condition of the wiper blades and the flow and aim of the washer spray.
	Defroster operation	Periodically check the air flow from the ducts at the inside base of the windshield. Do this with the heater control lever in "defrost" position and fan lever in "high".
	Horn operation	Blow the horn occasionally to make sure it works. Check all button locations.
	Brake system operation	Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning light goes on, something may be wrong. See your Owner's Manual.
	Exhaust system operation	Be alert to any changes in the sound of the system or any smell of fumes. These are signs the system may be leaking or overheating. Have it inspected and repaired at once. Also see "Engine Exhaust Gas Caution (Carbon Monoxide)" and "Catalytic Converter" in your Owner's Manual.
	Tires, Wheels and Alignment	Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or wheel alignment.
	Steering system operation	Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn, or has too much free play, or if unusual sounds are noted when turning or parking.
	Headlight aim	Take note of light pattern occasionally. If beams seem improperly aimed, headlights should be adjusted.
AT EACH FUEL FILL	Engine oil level†	Check level and add if necessary. See Owner's Manual. Section 5.
	Engine coolant level and condition†	Check level in coolant reservoir tank and add if necessary. Inspect coolant and replace if dirty or rusty. See Owner's Manual. Section 5.
	Windshield washer fluid level	Check level in reservoir and add if necessary.
	Hood latch operation	When opening hood, note the operation of secondary latch. It should keep hood from opening all the way when primary latch is released. Make sure that hood closes firmly after services are performed.

Fig. 0B-4--Owner Inspections and Services, Chart A

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
AT LEAST MONTHLY	Tire pressure check	Maintain pressures as shown on Tire Placard on the driver's door (include spare). Pressure should be checked when tires are "cold"
	Light operation	Check operation of license plate light, sidemarker lights, headlights, including high beams, parking lights, taillights, brake lights, turn signals, backup lights and hazard warning flashers.
	Fluid leak check	Periodically, after the vehicle has been parked for a while, inspect the surface beneath the vehicle for water, oil, fuel or other fluids. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, the cause should be found and corrected at once
AT LEAST SEMI-ANNUALLY (FOR EXAMPLE, EVERY SPRING AND FALL)	Power steering pump reservoir level†	Check level in accordance with Owner's Manual instructions (Section 5) and keep at proper level
	Brake master cylinder reservoir level†	Check fluid level. Note: A low fluid level can indicate worn disc brake pads and should be checked.
	Clutch Pedal free travel	Note the clutch pedal free travel. It should be about 1". Adjust linkage whenever there is little or no free travel.
AT LEAST ANNUALLY	Parking brake and transmission "Park" mechanism operation	Park on a fairly steep hill and hold the vehicle with the parking brake only. This checks holding ability. For automatic transmission, check "Park" by releasing all brakes after shifting the transmission to "P" (Park).
	Steering column lock operation	While parked, try to turn key to "Lock" in each gear range. The key should turn to "Lock" only when gear is in "Park" on automatic or "Reverse" on manual transmission. On vehicles with key release lever, try to turn key to "Lock" without depressing the lever. The key should turn to "Lock" only with the key lever depressed. On all vehicles, the key should come out only in "Lock".
	Starter safety switch operation	**Caution:** Before performing the following safety switch check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake (see Owner's Manual for procedure) and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage
		On automatic transmission vehicles, try to start the engine in each gear. The starter should crank only in "P" (Park) or "N" (Neutral).
		On manual transmission vehicles place the shift lever in "Neutral" push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed
	Seatback latch operation	Be sure seatbacks latch on those vehicles with folding seats using mechanical latches. See Owner's Manual for latch operating information.
	Lap and shoulder belts condition and operation	Inspect belt system, including: webbing, buckles, latch plates, retractors, guide loops and anchors.
	Movable head restraint operation	On vehicles with movable restraints, make sure restraints stay in the desired position. (See adjustment instructions in Owner's Manual.)
	Seatback recliner operation (if equipped)	Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.
	Spare tire and jack storage	Be alert to rattles in rear of vehicle. Make sure the spare tire, all jacking equipment, and any covers or doors are securely stowed at all times. Oil jack ratchet mechanism after each use.
	Underbody flushing	At least every spring, flush from the underbody with plain water any corrosive materials used for ice and snow removal and dust control. Take care to thoroughly clean any areas where mud and other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.
	Engine cooling system*	Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant. Keep coolant at the proper mixture as specified in your Owner's Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. Inspect hoses and replace, if cracked, swollen or deteriorated. Tighten hose clamps. Clean outside of radiator and air conditioning condensor. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended.

Fig. 0B-5--Owner Inspections and Services, Chart B

†NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
EACH TIME OIL IS CHANGED (WHEN VEHICLE IS ON HOIST)		Maintain level within operating range on dipstick. Refer to Owner's Manual.
	Tire and wheel inspection and rotation	Check tires for abnormal wear or damage. Also, check for damaged wheels. To equalize tire wear and obtain maximum tire life, it is suggested that tires be rotated at about 7,500 miles (12 500 km) then each 15,000 miles (25 000 km) thereafter. See "Tires" in Owner's Manual, for further information.
	Manual transmission	Check fluid level and add as required.
	Brake systems inspection	For convenience the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc. at the same time. Check parking brake adjustment. INSPECT BRAKES MORE OFTEN IF HABIT OR CONDITIONS RESULT IN FREQUENT BRAKING.
	Steering and suspension	Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. (On vehicles equipped with manual steering gear, check for seal leakage.) Inspect final drive axle output shaft seals for leaking. ● Front Suspension and Steering Linkage (a) On C20 and G30, lubricate every 4 months or 6,000 miles (9 000 km). (b) On all other vehicles, lubricate every 12 months or 7,500 miles (12 000 km). (c) Lubricate suspension and steering linkage every 3 months or 3,000 miles (4 800 km) when operating under dusty or muddy conditions and in extensive off-road use.
	Exhaust system inspection*	Inspect complete system including catalytic converter. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections or other conditions which could cause a heat build up in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.
	Throttle linkage inspection	Inspect for damaged or missing parts, interference or binding.
	Engine drive belts	Inspect all belts for cracks, fraying wear. Adjust or replace as needed.
	Rear axle/front axle/transfer case	Check fluid level and add if needed. ● Locking Differential - In general service, drain fluid at 7,500 miles (12 000 km) and refill. Check fluid level and add as needed at subsequent 7,500 mile (12 000 km) intervals. In severe operating conditions, or trailer towing applications, drain fluid every 7,500 miles, (12 000 km) and refill. ● Standard Differential - In general service, check fluid level and add as needed every 7,500 miles (12 000 km). In severe operating conditions, trailer towing applications, drain fluid every 7,500 miles (12 000 km) and refill. ● Four Wheel Drive - Every 12 months or 7,500 miles (12 000 km), check front axle and transfer case and add lubricant when necessary. Lubricate propeller shaft slip joint, constant velocity universal joint and steering linkage. Oil control lever pivot point and exposed control linkage. Check vent hose at front axle transfer case for kinks and proper installation. More frequent lubrication may be required on heavy duty off-road operation. See Owner's and Driver's Manual for further information.

Fig. 0B-6--Owner Inspections and Services, Chart C

USAGE	FLUID/LUBRICANT
Engine	"SF" or "SF/CD" or "SF/CC" Engine Oil conforming to GM spec. 6048-M
Engine Coolant	Mixture of water and a high quality Ethylene Glycol base type antifreeze conforming to GM spec. 1825-M (GM Part No. 1052753) or equivalent
Brake System	Delco Supreme 11 fluid or DOT-3
Parking Brake Cables	Chassis grease meeting requirements of GM spec. 6031-M
Power Steering System	GM power steering fluid Part No. 1050017 or equivalent
Manual Steering Gear	Lubricant GM Part No. 1051052 or equivalent
Automatic Transmission 4-Speed Manual Trans. w/O.D. S10 Truck with Manual Trans. Transfer Case	DEXRON® II Automatic Transmission Fluid
Differential—Standard Manual Transmission (Except: 4-Speed with O.D., and S10 Truck)	SAE-80W, GL-5 or SAE-80W-90 GL-5 gear lubricant (SAE-80W—GL-5 in Canada)
Differential—Locking	Lubricant GM Part No 1052271
Manual Transmission Shift Linkage, Column Shift, Propeller Shaft Slip Joint	Chassis grease meeting requirements of GM spec. 6031-M
Key Lock Cylinders	(GM Part No. 1052276)* Light Oil or General Purpose Silicone Lubricant.
Clutch Linkage (Man. Trans. only) a. Pivot points b. Push rod to clutch fork joint, and cross shaft pressure fitting	a. Engine oil b. Chassis grease meeting requirements of GM spec. 6031-M
Chassis Lubrication	Chassis grease meeting requirements of GM spec. 6031-M
Windshield Washer Solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	a. Engine oil b. Chassis grease
Front Wheel Bearings	Lubricant GM Part No. 1051344 or equivalent*
Constant Velocity Universal Joint	GM Lubricant Part No 1052497 or equivalent
Automatic Transmission Shift Linkage, Floor Shift Linkage, Hood and Door hinges, body door hinge pins, tailgate hinge and linkage, folding seat, fuel door hinge	Engine Oil

* Fluids and lubricants identified with GM part numbers or GM specification numbers may be obtained from your GM dealer.

Fig. 0B-7--Recommended Fluids and Lubricants

SECTION A — Scheduled Maintenance Services For Your 1984 Gasoline-Fueled Vehicle

SCHEDULE I Follow Schedule I if you mainly operate your vehicle under one or more of the following conditions:

- Operating when outside temperatures remain below freezing and when most trips are less than 4 miles (6 km); or
- Idling for extended periods and/or low speed operation such as in door-to-door delivery;

Also follow Schedule I when:
- Towing a trailer;
- Operating in dusty areas; or
- Using your vehicle in hard, police car, delivery or rental service.

SCHEDULE I

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (Kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 48,000 miles (60 000 km) are to be performed after 48,000 miles of the same intervals															
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
1	Engine Oil and Oil Filter Change*	Every 3,000 mi. (5 000 km) or 3 months.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Chassis Lubrication	Every other oil change		●		●		●		●		●		●		●		●
3	Carburetor Choke and Hoses*	Check at 6,000 miles (10 000 km), then at 30,000 Miles (50 000 km). Also check item 3 at 45,000 Miles (75 000 km).		●								●					●	
4	Carb. or Throttle Body Mounting*3			●								●						
5	Engine Idle Speed (See Explanation)*			●								●						
6	AIR Pump Drive Belts*	Inspect every 12 Months or 15,000 Miles (25 000 km)					●					●					●	
7	Cooling System Refill*	Every 24 Months or 30,00 Miles (50 000 km)										●						
8	Wheel Bearing Repack	Every 15,000 Miles (25 000 km)					●					●					●	
9	Transmission Fluid	See Explanation for service intervals																
10	Vacuum Advance System*	Check every 30,000 Miles (50 000 km)										●						
11	Spark Plugs*	Replace every 30,000 Miles (50 000 km)										●						
12	PCV System Check and Service*	See explanation for service intervals																
13	EGR System*	Service every 36 Months or 30,000 Miles (50 000 km)										●						
14	Air Cleaner and PCV Filter*	See Explanation for service intervals										●						
15	Engine Timing*	Adjust every 30,000 Miles (50 000 km)										●						
16	Spark Plug Wires & Distributor*	Inspect every 30,000 Miles (50 000 km)										●						
17	Fuel Tank, Cap & Lines*	Inspect every 12 Months or 15,000 Miles (25 000 km)					●					●					●	
18	Early Fuel Evaporative System*3	Check at 6,000 Miles (10 000 km) then at 30,000 Miles (50 000 km)		●								●						
19	Idle Stop Solenoid*	Check at 30,000 Miles (50 000 km)										●						
20	Valve Lash Adjustment*2	Adjust every 15,000 Miles (25 000 km)					●					●					●	
21	Thermostatically Controlled Air Cleaner	Every 30,000 Miles (50 000 km)										●						

Fig. 0B- 8--Maintenance Schedule I, Gasoline, LDX, California

<u>SCHEDULE II</u> Follow Schedule II if, as a general rule, you drive your vehicle on a daily basis for several miles (km) and none of the above conditions apply.

SCHEDULE II

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 45,000 miles (75 000 km) are to be performed after 45,000 miles at the same intervals					
		MILES (000)	7.5	15	22.5	30	37.5	45
		KILOMETERS (000)	12.5	25	37.5	50	62.5	75
1	Engine Oil Change	Every 7,500 mi. (12 500 km) or 12 months	●	●	●	●	●	●
	Filter Change	At first and every other oil change	●		●		●	
2	Chassis Lubrication	Lubricate every 12 Months or 7,500 Miles (12 500 km)	●	●	●	●	●	●
3	Carburetor Choke and Hoses*	Check at 6 Months or 7,500 Miles (12 500 km), then at 30,000 Miles (50 000 km). Also check Item 3 at 45,000 Miles (75 000 km).	●			●		●
4	Carburetor or Throttle Body Mounting*3		●			●		
5	Engine Idle Speed (See Explanation)*		●			●		
6	AIR Pump Drive Belts*	Inspect every 12 Months or 15,000 Miles (25 000 km)		●		●		●
7	Cooling System Refill*	Every 24 Months or 30,000 Miles (50 000 km)				●		
8	Wheel Bearing Repack	Every 30,000 Miles (50 000 km)				●		
9	Transmission Fluid	See Explanation for service intervals						
10	Vacuum Advance System*	Check every 30,000 Miles (50 000 km)				●		
11	Spark Plugs*	Replace every 30,000 Miles (50 000 km)				●		
12	PCV System Check and Service*	See explanation for service intervals						
13	EGR System*	Service every 36 Months or 30,000 Miles (50 000 km)				●		
14	Air Cleaner and PCV Filter*	See Explanation for service intervals				●		
15	Engine Timing*	Adjust every 30,000 Miles (50 000 km)				●		
16	Spark Plug Wires and Distributor*	Inspect every 30,000 Miles (50 000 km)				●		
17	Fuel Tank, Cap and Lines*	Inspect every 12 Months or 15,000 Miles (25 000 km)		●		●		●
18	Early Fuel Evaporative System*3	Check at 7,500 Miles (12 500 km) then at 30,000 Miles (50 000 km)	●			●		
19	Idle Stop Solenoid*	Check at 30,000 miles (50 000 km)				●		
20	Valve Lash Adjustments*2	Adjust every 15,000 Miles (25 000 km)		●		●		●
21	Thermostatically Controlled Air Cleaner	Every 30,000 Miles (50 000 km)				●		

FOOTNOTES: *An Emission Control Service.
**In California, these are the minimum Emission Control Maintenance Services an owner must perform according to the California Air Resources Board. General Motors, however, urges that all Emission Control Maintenance services shown above be performed. To maintain your other new car warranties, all services shown in this folder should be performed.

[1]Only these emissions control maintenance items are considered to be required maintenance as defined by the California Air Resources Board (ARB) regulations and are, according to such regulations, the minimum maintenance an owner in California must perform to fulfill the minimum requirements of the emission warranty. All other emission maintenance items are recommended maintenance as defined by such regulations. General Motors urges that all emission control maintenance items be performed.

[2]Only applicable to 1.9L engine, Engine Family E1G1.9T2TBA8.

[3]Not applicable to 1.9L engine, Engine Family E1G1.9T2TBA8.

Fig. 0B- 9 --Maintenance Schedule II, Gasoline LDX California

GASOLINE ENGINE, L.D. EMISSION, CALIFORNIA

NORMAL VEHICLE USE

The maintenance instructions contained in this section are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitation indicated on the Tire Placard located on the edge of the driver's door,
- on reasonable road surfaces within legal operating limits,
- on a daily basis, as a general rule, for at least several miles (km), and
- on unleaded gasoline.

Unusual operating conditons will require more frequent vehicle maintenance as specified.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

Item 1 Engine Oil and Oil Filter Change*

Always use SF-QUALITY OILS OF PROPER VISCOSITY. Also always change oil and filter as soon as possible after driving in a dust storm.

Item 2 Chassis Lubrication

Every 12 months or 7,500 miles (12 500 km), lubricate transmission shift linkage, hood latch, hood and door hinges, parking brake cable guides, underbody contact points and linkage, clutch linkage, propshaft, transfer case shift lever and clutch pedal springs. Lubricate clutch cross-shaft every 30,000 miles (50 000 km).

Item 3 Carburetor Choke and Hoses*

Verify that choke and vacuum break work properly and are within specifications. Correct any binding caused by damage or gum on the choke shaft. Inspect hoses for proper hookup, cracks, rubbing or decay. Correct as necessary.

Item 4 Carburetor Mounting Torque*

Check torque of mounting bolts and/or nuts.

Item 5 Engine Idle Speed Adjustment*

Adjust to the specifications shown on the underhood label. You must use calibrated test equipment.

Item 6 AIR Pump Drive Belts*

Inspect belts driving the AIR pump. Look for cracks, fraying, wear and proper tension. Adjust or replace as needed.

Item 7 Cooling System Refill

Drain, flush and refill system with new coolant.

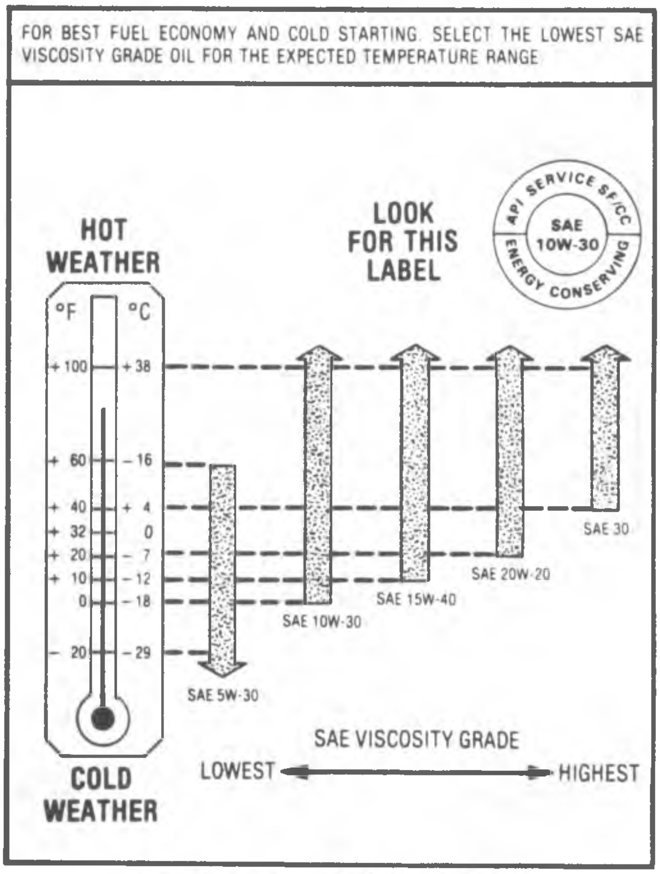


Fig. 0B-10--Engine Oil Viscosity Chart

Item 8 Wheel Bearing Repack

Clean and repack front wheel bearings at each brake relining or 15,000 miles (25 000 km), whichever comes first, when vehicle is used in such service as police, taxi or door-to-door delivery. If you do not use your vehicle in such service, clean and repack bearings at each brake relining or 30,000 miles (50 000 km), whichever comes first.

Item 9 Transmission Fluid

Automatic Transmission -- Change the transmission fluid and change the filter (or service the screen) every 15,000 miles (25 000 km) if the vehicle is mainly driven under one or more of these hot conditions:

- In heavy city traffic where the outside temperature regularly reaches 90° (32°C).
- In hilly or mountainous terrain.
- Frequent trailer pulling.
- Uses such as taxi, police or delivery service.

If vehicle is not used under any of these conditions, change the fluid and filter (or service the screen) every 100,000 miles (160 000 km).

Manual Transmission (S10 with 4-speed only) -- Change transmission fluid at 7,500 miles (12 500 km), then every 30,000 miles (50 000 km).

Item 10 Vacuum Advance System and Hoses*

Check system for proper operation. Check hoses for proper hookup, cracks, rubbing or decay. Replace parts as needed.

Item 11 Spark Plug Replacement*

Replace with the type listed in your Owner's and Driver's Manual.

Item 12 PCV Valve Inspection*

Check that system works properly each 15,000 miles (25 000 km).

For all engines except 1.9L, replace the valve and any worn, plugged or collapsed hoses at 30,000 miles (50 000 km).

For 1.9L engine, clean the PCV orifice every 30,000 miles (50 000 km).

Item 13 Exhaust Gas Recirculation System (EGR)*

CONDUCT EGR OPERATION system check as covered in Service Manual. Replace or clean parts as required.

Item 14 Air Cleaner and PCV Filter*

Replace every 30,000 miles (50 000 km). Replace more often under dusty conditions. Ask your dealer for the proper replacement intervals for your driving conditions.

Item 15 Engine Timing Check*

Adjust timing to underhood label specifications.

Item 16 Spark Plug Wires and Distributor Inspection*

Clean wires. Inspect for burns, cracks or other damage. Check the boot fit at distributor cap and spark plugs. Inspect inside and outside of the cap and rotor for cracks, carbon tracking and corrosion. Replace as needed.

Item 17 Fuel Tank, Cap and Lines*

Inspect the fuel tank, cap and lines for damage or leaks. Remove fuel cap, inspect gasket for an even filler neck imprint, and any damage. Replace parts as needed.

Item 18 Early Fuel Evaporation (EFE) System

Check that valve works properly; correct any binding. Check that thermal vacuum switch works, properly. Check hoses for crakcs, rubbing or decay. Replace parts as needed.

Item 19 Idle Stop Solenoid, and/or Dashpot*

Check that parts work properly. Replace them as needed.

Item 20 Valve Lash Adjustment*

Incorect valve clearance will result in increased engine noise and lower engine output, thereby adversely affecting engine performance. Replace rocker shaft bracket nuts before checking and adjusting valve clearance. Check and adjust valve clearance every 15,000 miles (25 000 km).

Item 21 Thermostatic Controlled Air Cleaner*

Inspect all hoses and ducts for proper hook-up. Make sure valve works properly.

OWNER INSPECTIONS AND SERVICES

Listed below are vehicle inspections and services which should be made by either you or a qualified technician at the frequencies indicated to help ensure proper safety, emission performance and dependability of your vehicle. Take any problems promptly to your dealer or a qualified technician for service advice. Whenever repairs are necessary,have them completed at once. For your safety and that of others, any safety related components that could have been damaged in an accident should be inspected. All needed repairs should be performed before operating your vehicle.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
BEFORE OPERATING YOUR VEHICLE	Warning light, buzzer tone and chime operation.	Check operation of all warning lights, buzzers, tone generators and chimes — also all interior lights. See your Owner's Manual for details.
	Glass, light and reflector condition	Look for broken, scratched, dirty or damaged glass, light or reflector that could reduce vision or visibility or cause injury. Replace, clean or repair promptly.
	Seat adjuster operation	When adjusting a manual seat, be sure seat adjusters latch by pushing seat forward and backward
	Rearview mirror and sun visor operation	Make sure friction joints hold mirrors and sun visors in place
	Door and gate latch operation	Make sure that all doors and wagon or hatchback gates close, latch and lock tightly
WHILE OPERATING YOUR VEHICLE	Automatic transmission shift indicator operation	Make sure the indicator points to the gear chosen
	Wiper and washer operation	Note the operation and condition of the wiper blades and the flow and aim of the washer spray
	Defroster operation	Periodically check the air flow from the ducts at the inside base of the windshield. Do this with the heater control lever in "defrost" position and fan lever in "high"
	Horn operation	Blow the horn occasionally to make sure it works. Check all button locations.
	Brake system operation	Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning light goes on, something may be wrong.
	Exhaust system operation	Be alert to any changes in the sound of the system or any smell of fumes. These are signs the system may be leaking or overheating. Have it inspected and repaired at once. Also see "Engine Exhaust Gas Caution (Carbon Monoxide)" and "Catalytic Converter" in your Owner's Manual.
	Tires, Wheels and Alignment	Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or wheel alignment
	Steering system operation	Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn, or has too much free play, or if unusual sounds are noted when turning or parking.
	Headlight aim	Take note of light pattern occasionally. If beams seem improperly aimed, headlights should be adjusted.
AT EACH FUEL FILL	Engine oil level†	Check level and add if necessary. See Owner's Manual.
	Engine coolant level and condition†	Check level in coolant reservoir tank and add if necessary. Inspect coolant and replace if dirty or rusty. See Owner's Manual.
	Windshield washer fluid level	Check level in reservoir and add if necessary.
	Hood latch operation	When opening hood, note the operation of secondary latch. It should keep hood from opening all the way when primary latch is released. Make sure that hood closes firmly after services are performed.

Fig. 0B-11 --Owner Inspections and Services, Chart A

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
AT LEAST MONTHLY	Tire pressure check	Maintain pressures as shown on Tire Placard on the driver's door (include spare). Pressure should be checked when tires are cold.
	Light operation	Check operation of license plate light, sidemarker lights, headlights, including high beam, parking lights, taillights, brake lights, turn signals, backup lights and hazard warning flashers.
	Fluid leak check	Periodically, after the vehicle has been parked for a while, inspect the surface beneath the vehicle for water, oil, fuel or other fluids. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, the cause should be found and corrected at once.
AT LEAST SEMI-ANNUALLY (FOR EXAMPLE, EVERY SPRING AND FALL)	Power steering pump reservoir level†	Check level in accordance with Owner's Manual instructions (Section 5) and keep at proper level.
	Brake master cylinder reservoir level	Check fluid level. Note: A low fluid level can indicate worn disc brake pads and should be checked.
	Clutch Pedal free travel	Note the clutch pedal free travel. It should be about 1". Adjust linkage whenever there is little or no free travel.
AT LEAST ANNUALLY	Parking brake and transmission Park mechanism operation	Park on a fairly steep hill and hold the vehicle with the parking brake only. This checks holding ability. For automatic transmission, check "Park" by releasing all brakes after shifting the transmission to "P" (Park).
	Steering column lock operation	While parked, try to turn key to "Lock" in each gear range. The key should turn to "Lock" only when gear is in "Park" on automatic or "Reverse" on manual transmission. On vehicles with key release lever, try to turn key to "Lock" without depressing the lever. The key should turn to "Lock" only with the key lever depressed. On all vehicles, the key should come out only in "Lock".
	Starter safety switch operation	**Caution:** Before performing the following safety switch check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake (see Owner's Manual for procedure) and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage. On automatic transmission vehicles, try to start the engine in each gear. The starter should crank only in "P" (Park) or "N" (Neutral). On manual transmission vehicles place the shift lever in "Neutral", push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed.
	Seatback latch operation	Be sure seatbacks latch on those vehicles with folding seats using mechanical latches. See Owner's Manual for inertial latch operating information.
	Lap and shoulder belts condition and operation	Inspect belt system, including: webbing, buckles, latch plates, retractors, guide loops and anchors.
	Movable head restraint operation	On vehicles with movable restraints, make sure restraints stay in the desired position. (See adjustment instructions in Owner's Manual.)
	Seatback recliner operation (if equipped)	Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.
	Spare tire and jack storage	Be alert to rattles in rear of vehicle. Make sure the spare tire, all jacking equipment, and any covers or doors are securely stowed at all times. Oil jack ratchet mechanism after each use.
	Underbody flushing	At least every spring, flush from the underbody with plain water any corrosive materials used for ice and snow removal and dust control. Take care to thoroughly clean any areas where mud and other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.
	Engine cooling system*	Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant as shown in your Owner's Manual. Keep coolant at the proper mixture as specified in your Owner's Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. Inspect hoses and replace if cracked, swollen, deteriorated. Tighten hose clamps. Clean outside of radiator and air conditioning condensor. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended.

Fig. 0B-12--Owner Inspection and Services, Chart B

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
EACH TIME OIL IS CHANGED (WHEN VEHICLE IS ON HOIST)	Automatic transmission fluid level†	Maintain level within operating range on dipstick. Refer to Owner's Manual. Section 5.
	Tire and wheel inspection and rotation	Check tires for uneven or abnormal wear. Check for damaged wheels. To equalize wear and obtain maximum tire life, it is suggested that tires be rotated at about 7,500 miles (12 500 km) then each 15,000 miles (25 000 km) thereafter. See "Tires" in Owner's Manual. Section 5, for further information
	Brake systems inspection	For convenience the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc. at the same time. Check parking brake adjustment. INSPECT BRAKES MORE OFTEN IF HABIT OR CONDITIONS RESULT IN FREQUENT BRAKING.
	Steering and suspension	Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. (On vehicles equipped with manual steering gear, check for seal leakage.) Inspect final drive axle output shaft seals for leaking. ● Front Suspension and Steering Linkage (a) On C20 and G30, lubricate every 4 months or 6,000 miles (10000 km). (b) On all other vehicles, lubricate every 12 months or 7,500 miles (12 500 km). (c) Lubricate suspension and steering linkage every 3 months or 3,000 miles (5 000 km) when operating under dusty or muddy conditions and in extensive off-road use.
	Exhaust system inspection*	Inspect complete system including catalytic converter. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections or other conditions which could cause a heat build up in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.
	Throttle linkage inspection	Inspect for damaged or missing parts, interference or binding.
	Engine drive belts	Inspect all belts for cracks, fraying wear and proper tension. Adjust or replace as needed.
	Rear axle/front axle/transfer case	Check fluid level and add if needed. ● Locking Differential - In general service, drain fluid at 7,500 miles (12 500 km) and refill. Check fluid level and add as needed at subsequent 7,500 mile (12 500 km) intervals. In severe operating conditions, or trailer towing applications, drain fluid every 7,500 miles, (12 500 km) and refill. ● Standard Differential - In general service, check fluid level and add as needed every 7,500 miles (12 500 km). In severe operating conditions, trailer towing applications, drain fluid every 7,500 miles (12 500 km) and refill. ● Four Wheel Drive - Every 12 months or 7,500 miles (12 000 km), check front axle and transfer case and add lubricant when necessary. Lubricate propeller shaft slip joint, constant velocity universal joint and steering linkage. Oil control lever pivot point and exposed control linkage. Check vent hose at front axle transfer case for kinks and proper installation. More frequent lubrication may be required on heavy duty off-road operation. See Owner's and Driver's Manual for further information.
	Manual transmission	Check fluid level and add as required.

Fig. 0B-13--Owner Inspections and Services, Chart C

***An emission service**

†NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

USAGE	FLUID/LUBRICANT
Engine	"SF" or "SF/CD" or "SF/CC" Engine Oil conforming to GM spec. 6048-M
Engine Coolant	Mixture of water and a high quality Ethylene Glycol base type antifreeze conforming to GM spec. 1825-M (GM Part No. 1052753) or equivalent
Brake System	Delco Supreme 11 fluid or DOT-3
Parking Brake Cables	Chassis grease meeting requirements of GM spec. 6031-M
Power Steering System	GM power steering fluid Part No. 1050017 or equivalent
Manual Steering Gear	Lubricant GM Part No. 1051052 or equivalent
Automatic Transmission 4-Speed Manual Trans. w/O.D. S10 Truck with Manual Trans. Transfer Case	DEXRON® II Automatic Transmission Fluid
Differential—Standard Manual Transmission (Except: 4-Speed with O.D., and S10 Truck)	SAE-80W, GL-5 or SAE-80W-90 GL-5 gear lubricant (SAE-80W—GL-5 in Canada)
Differential—Locking	Lubricant GM Part No. 1052271
Manual Transmission Shift Linkage, Column Shift, Propeller Shaft Slip Joint	Chassis grease meeting requirements of GM spec. 6031-M
Key Lock Cylinders	Light Oil or General Purpose Silicone Lubricant (GM Part No. 1052276)
Clutch Linkage (Man. Trans. only) a. Pivot points b. Push rod to clutch fork joint, and cross shaft pressure fitting	a. Engine oil b. Chassis grease meeting requirements of GM spec. 6031-M
Chassis Lubrication	Chassis grease meeting requirements of GM spec. 6031-M
Windshield Washer Solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	a. Engine oil b. Chassis grease
Front Wheel Bearings	Lubricant GM Part No. 1051344 (one pound) or equivalent*
Constant Velocity Universal Joint	GM Lubricant Part No. 1052497 or equivalent
Automatic Transmission Shift Linkage, Floor Shift Linkage, Hood and Door hinges, body door hinge pins, tailgate hinge and linkage, folding seat, fuel door hinge	Engine Oil

* Fluids and lubricants identified with GM part numbers or GM specification numbers may be obtained from your GM dealer.

Fig. 0B-14--Recommended Fluids and Lubricants

SECTION A—Scheduled Maintenance Services For Your 1984 Gasoline-Fueled Vehicle

SCHEDULE I Follow Schedule I if you mainly operate your vehicle under one or more of the following conditions:

- Operating when outside temperatures remain below freezing and when most trips are less than 4 miles (6 km); or
- Idling for extended periods and/or low speed operation such as in door-to-door delivery;

Also follow Schedule I when:
- Towing a trailer;
- Operating in dusty areas; or
- Using your vehicle in hard, police car, delivery or rental service.

SCHEDULE I

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (Kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 48,000 miles (80 000 km) are to be performed after 48,000 miles of the same intervals															
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
1	Engine Oil and Filter* Intervals	Every 6,000 Miles (10 000 km) or 2 Months	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
2	Chassis Lubrication	Every 4 Months or 6,000 Miles (10 000 km)		•		•		•		•		•		•		•		•
3	Carburetor Choke Check*	Every 24 Months or 24,000 Miles (40 000 km)								•								•
4	Carburetor Mounting Torque*	Every 12 Months or 12,000 Miles (20 000 km)				•				•				•				•
5	Engine Idle Speed Adjustment*	At 1st 4 Months or 6,000 Miles (10 000 km) — then at 12 Month/ 12,000 Mile (20 000 km) intervals		•		•				•				•				•
6	AIR Pump Drive Belts	Every 12,000 Miles (20 000 km)				•				•				•				•
7	Cooling System Refill					•				•				•				•
8	Wheel Bearing Repack					•				•				•				•
9	Transmission Service					•				•				•				•
10	Vacuum Advance System Check*	Every 24 Months or 24,000 Miles (40 000 km)								•								•
11	Fuel Tank, Cap and Lines*									•								•
12	Idle Stop Solenoid Check*	At 1st 4 Months or 6,000 Miles (10 000 km) — then at 12 Month/ 12,000 Mile (20 000 km) intervals		•		•				•				•				•
13	Spark Plug Wire Check & Plug Replacement*	Every 12,000 Miles (20 000 km)				•				•				•				•
14	Engine Timing Adjust. & Distributor Check▲*					•				•				•				•
15	Air Cleaner Element Replacement▲*					•				•				•				•
16	Thermo. Controlled Air Cleaner Check▲*	Every 12 Months or 12,000 Miles (20 000 km)				•				•				•				•
17	Manifold Heat Valve Check▲*					•				•				•				•
18	Carburetor Fuel Filter Replacement*					•				•				•				•
19	Throttle Return Control Check*					•				•				•				•
20	PCV System Check*					•				•				•				•
21	ECS System Check*	Every 24 Months or 24,000 Miles (40 000 km)								•								•
22	Engine Idle Mixture Adjust (4.8L. L-6 only)*									•								•
23	EFE System Check*									•								•
24	Thermostatically Controlled Engine Cooling Fan▲†	Every 12 Months or 12,000 Miles (20 000 km)				•				•				•				•
25	Shields and Underhood Insulation▲†	Every 12,000 Miles (20 000 km)				•				•				•				•
26	Air Intake System▲†					•				•				•				•
27	Governor▲†	Every 48 Months or 48,000 Miles (80 000 km)																•
28	EGR System	Every 36 Months or 36,000 Miles (60 000 km)												•				

Fig. 0B-15--Maintenance Schedule I, Gasoline, H.D. Emission

SCHEDULE II Follow Schedule II if, as a general rule, you drive your vehicle on a daily basis for several miles (km) and none of the above conditions apply.

SCHEDULE II

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 48,000 miles (80 000 km) are to be performed after 45,000 miles at the same interval							
		MILES (000)	6	12	18	24	30	36	42	48
		KILOMETERS (000)	10	20	30	40	50	60	70	80
1	Engine Oil Change*	Every 6,000 mi. (10 000 km) or 4 months	•	•	•	•	•	•	•	•
	Filter Change	At first and every other oil change	•		•		•		•	
2	Chassis Lubrication	Every 4 Months or 6,000 Miles (10 000 km)	•	•	•	•	•	•	•	•
3	Carburetor Choke Check*	Every 24 Months or 24,000 Miles (40 000 km)				•				•
4	Carburetor Mounting Torque*	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
5	Engine Idle Speed Adjustment*	At 1st 4 Months or 6,000 Miles (10 000 km) — then at 12 Month/12,000 Mile (20 000 km) intervals	•	•		•		•		•
6	AIR Pump Drive Belts	Every 12,000 Miles (20 000 km)		•		•		•		•
7	Cooling System Refill	Every 12,000 Miles (20 000 km)		•		•		•	•	
8	Wheel Bearing Repack	Every 12,000 Miles (20 000 km)	•		•		•		•	
9	Transmission Service	Every 24,000 Miles (40 000 km)				•			•	
10	Vacuum Advance System Check*	Every 24 Months or 24,000 Miles (40 000 km)				•				•
11	Fuel Tank, Cap and Lines*	Every 24 Months or 24,000 Miles (40 000 km)			•				•	
12	Idle Stop Solenoid Check*	At 1st 4 Months or 6,000 Miles (10 000 km) — then at 12 Month/12,000 Mile (20 000 km) intervals	•	•		•		•		•
13	Spark Plug Wire Check & Plug Replacement*	Every 12,000 Miles (20 000 km)		•		•		•		•
14	Engine Timing Adjust. & Distributor Check▲*	Every 12,000 Miles (20 000 km)		•		•		•		•
15	Air Cleaner Element Replacement▲*	Every 12,000 Miles (20 000 km)		•		•		•		•
16	Thermo. Controlled Air Cleaner Check▲*	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
17	Manifold Heat Valve Check▲*	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
18	Carburetor Fuel Filter Replacement*	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
19	Throttle Return Control Check*	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
20	PCV System Check*	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
21	ECS System Check*	Every 24 Months or 24,000 Miles (40 000 km)				•				•
22	Engine Idle Mixture Adjust (4.8L. L-6 only)*	Every 24 Months or 24,000 Miles (40 000 km)				•				•
23	EFE System Check*	Every 24 Months or 24,000 Miles (40 000 km)				•				•
24	Thermostatically Controlled Engine Cooling Fan▲†	Every 12 Months or 12,000 Miles (20 000 km)		•		•		•		•
25	Shields and Underhood Insulation▲†	Every 12,000 Miles (20 000 km)		•		•		•		•
26	Air Intake System▲†	Every 12,000 Miles (20 000 km)		•		•		•		•
27	Governor▲†	Every 48 Months or 48,000 Miles (80 000km)								•
28	EGR System	Every 36 Months or 36,000 Miles						•		

FOOTNOTES:
*An Emission Control Service
▲Also a Noise Emission Control Service
†Applicable only to vehicles sold only in the United States

Fig. OB-16--Maintenance Schedule II, Gasoline, H.D. Emission

GASOLINE ENGINE, H.D. EMISSION

NORMAL VEHICLE USE

The maintenance instructions contained in this section are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the Tire Placard.
- on reasonable road surfaces within legal operating limits, and
- on a daily basis, as a general rule, for at least several miles (km).
- on leaded gasoline.

Unusual operating conditions will require more frequent vehicle maintenance as specified.

Item 1 Engine Oil and Oil Filter Change*

Always use SF-QUALITY OILS OF PROPER VISCOSITY. Also always change oil and filter as soon as possible after driving in a dust storm.

Item 2 Chassis Lubrication

Lubricate all grease fittings in front suspension, steering linkage, and constant velocity universal joint. Lubricate transmission and transfer case shift linkage, hood latch, hood and door hinges, parking brake cable guides, clutch linkage, propeller shaft slip joint, transfer case shift lever, universal joints, and brake and clutch pedal springs. Lubricate suspension and steering linkage every 3 months or 3,000 miles (5 000 km) when operating under dusty or muddy conditions and in extensive off-road use. Also, lubricate clutch cross-shaft lever every 36,000 miles (60 000 km).

Item 3 Carburetor Choke and Hoses*

Verify that choke and vacuum break work properly. Correct any binding caused by damage or gum on the choke shaft. Inspect hoses for proper hookup, cracks, rubbing or decay. Correct as necessary.

Item 4 Carburetor Mounting*

Torque mounting bolts and/or nuts at mileage shown in Maintenance Schedule.

Item 5 Engine Idle Speed Adjustment*

Adjust to the specifications shown on the underhood label. You must use calibrated test equipment.

Item 6 AIR Pump Drive Belts*

Inspect belts driving the AIR pump. Look for cracks, fraying wear, and proper tension. Adjust or replace as needed.

Item 7 Cooling System Refill

Drain, flush and refill system with new coolant as shown in your Owner's Manual.

Item 8 Wheel Bearing Repack

Clean and repack front wheel bearings at each brake relining or 12,000 miles (20 000 km), whichever comes first.

BE SURE TO USE LUBRICANT AS SPECIFIED IN THE "RECOMMENDED FLUIDS & LUBRICANTS" CHART IN FIG. 0B-21.

Item 9 Transmission Fluid

Automatic Transmission - Change the transmission fluid and change the filter (or service the screen) every 12,000 miles (19 200 km) if the vehicle is mainly driven under one or more of these hot conditions:

- In heavy city traffice where the outside temperature regularly reaches 90°F (32°C).
- In hilly or mountainous terrain.
- Frequent trailer pulling.
- Uses such as taxi, police or delivery service.

If vehicle is not used under any of these conditions, change the fluid and filter (or service the screen) every 24,000 miles (40 000 km).

See Owner's Manual for further details.

Item 10 Vacuum Advance System and Hoses*

Check that system works properly. Check hoses for proper hookup, cracks, rubbing or decay. Replace parts as needed.

Item 11 Fuel Tank, Cap and Lines*

Inspect for damage or leaks. Remove fuel cap, and inspect gasket for an even filler neck imprint, and any damage. Replace as needed.

Item 12 Idle Stop Solenoid and/or Dashpot*

Check that parts work properly. Replace them as needed.

Item 13 Spark Plug Wires and Plug Replacement*

Clean wires. Remove corrosion on terminals. Inspect the wires for checks, burns, cracks or other damage. Check

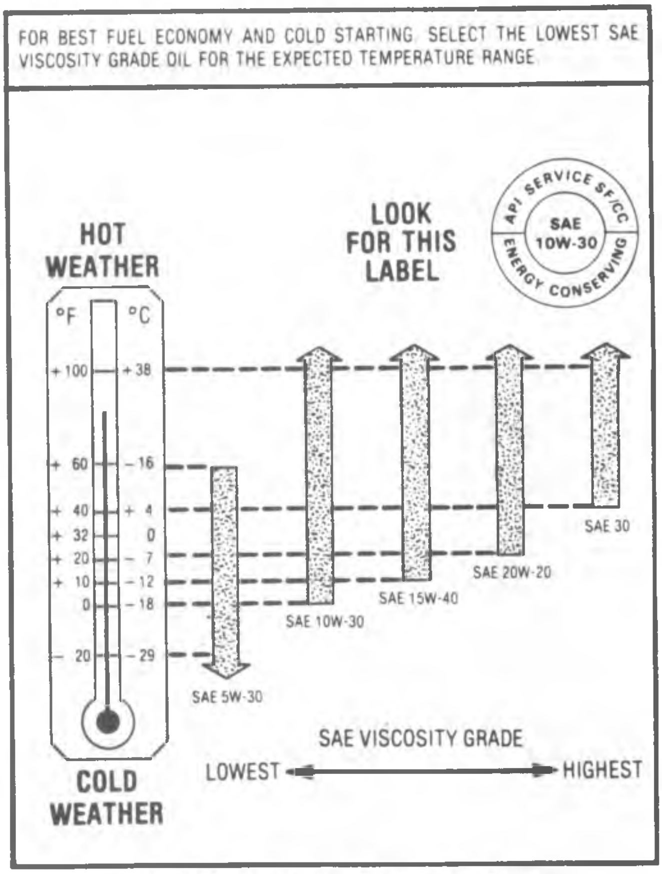


Fig. OB-17 --Engine Oil Viscosity Chart

the boot fit at distributor cap and spark plugs. Replace wire if damaged or if corrosion cannot be cleaned. Replace spark plugs as shown on Schedule. Use the type listed in your Owner's Manual.

Item 14 Timing and Distributor Cap*

Adjust timing to underhood label specifications. Inspect the inside and outside of the cap and rotor for cracks, carbon tracking and corrosion. Clean or replace as needed.

Item 15 Air Cleaner Element*

Replace at mileage shown on Schedule. Replace more often under dusty conditions. Ask your dealer for the proper replacement times for your driving conditions.

Item 16 Thermostatically Controlled Air Cleaner*

Inspect all hoses and ducts for correct hookup. Be sure valve works properly.

Item 17 Manifold Heat Valve*

Some engines are equipped with a manifold heat valve which should be inspected and repaired as necessary to insure free operation.

Item 18 Carburetor Fuel Filter*

Replace at mileage shown on Maintenance Schedule or sooner if clogged.

Item 19 Throttle Return Control (TRC) System*

Check hoses for proper connections, cracking, abrasion, or deterioration and replace as necessary. Check for proper operation of system. Check for shorted or broken wires and ensure electrical connectors are fully engaged at distributor, speed switch and vacuum solenoid.

Item 20 Positive Crankcase Ventilation System*

Check that system works properly each 12,000 miles (19 200 km). Each 24,000 miles (38 400 km): replace the valve, replace any worn, plugged or collapsed hoses and replace filter.

Item 21 Evaporation Control System (ECS)*

Check all fuel and vapor lines and hoses for proper hookup, routing, and condition. Check that bowl vent and purge valves work properly if equipped. Remove canister, check for cracks or damage. Replace as needed.

Item 22 Engine Idle Mixture (4.8L; L6 Only)*

At designated intervals or in case of a major carburetor overhaul, or when poor idle quality exists, adjust mixture by a mechanical method (lean drop), following the specifications shown on the label under the hood.

Item 23 Early Fuel Evaporation (EFE) System*

Check that valve works properly; correct any binding. Check that thermal vacuum switch works properly. Check hoses for cracks, rubbing or decay. Replace part as needed.

Item 24 Thermostatically Controlled Engine Cooling Fan

(If so equipped) With the engine off and below normal operating temperature, check to see that the fan can be rotated by hand on fluid coupling, viscous and air operated drives. Replace as necessary. For air-operated fan drives, the air pressure must be up to the normal operating range to perform the above check, as designated in this shop manual.

Item 25 Shields and Underhood Insulation

(If so equipped) Inspect shields and underhood insulation for damage or looseness. Adjust or replace as required.

Item 26 Air Intake System

Check the air intake system installation to see that gaskets are seated properly and all hose connections, fasteners, and other components are tight. For gasoline engines, also check to be sure air cleaner housing is properly seated on the carburetor, that the cover fits tightly, and that the wing nut is tight. Tighten connections and fasteners or replace damaged parts as required.

Item 27 Governor

(If so equipped) Check the engine no-load governed speed and reset to specifications as required.

Item 28 Exhaust Gas Recirculation System (EGR)*

Conduct EGR operation system check as covered in service manual. Replace or clean parts as required.

OWNER INSPECTIONS AND SERVICES

Listed in Figs 0B-18 through 0B-20 are vehicle inspections and services which should be made by either you or a qualified technician at the frequencies indicated to help ensure proper safety, emission performance and dependability of your vehicle. Take any problems promptly to your dealer or a qualified technician for service advice. Whenever repairs are necessary, have them completed at once. For your safety and that of others, any safety related components that could have been damaged in an accident should be inspected. All needed repairs should be performed before operating your vehicle.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
BEFORE OPERATING YOUR VEHICLE	Warning light, buzzer tone and chime operation.	Check operation of all warning lights, buzzers, tone generators and chimes — also all interior lights. See your Owner's Manual for details.
	Glass, light and reflector condition	Look for broken, scratched, dirty or damaged glass, light or reflector that could reduce vision/visibility or cause injury. Replace, clean or repair promptly.
	Seat adjuster operation	When adjusting a manual seat, be sure seat adjusters latch by pushing seat forward and backward.
	Rearview mirror and sun visor operation	Make sure friction joints hold mirrors and sun visors in place.
	Door and gate latch operation	Make sure that all doors and wagon or hatchback gates close, latch and lock tightly.
WHILE OPERATING YOUR VEHICLE	Automatic transmission shift indicator operation	Make sure the indicator points to the gear chosen.
	Wiper and washer operation	Note the operation and condition of the wiper blades and the flow and aim of the washer spray.
	Defroster operation	Periodically check the air flow from the ducts at the inside base of the windshield. Do this with the heater control lever in "defrost" position and fan lever in "high".
	Horn operation	Blow horn occasionally to make sure it works. Check all button locations.
	Brake system operation	Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning light goes on, something may be wrong. See your Owner's Manual.
	Exhaust system operation	Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn, or has too much free play, or if unusual sounds are noted when turning or parking.
	Tires, Wheels and Alignment	Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or wheel alignment.
	Steering system operation	Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn, or has too much free play, or if unusual sounds are noted when turning or parking.
	Headlight aim	Take note of light pattern occasionally. If beams seem improperly aimed, headlights should be adjusted.
AT EACH FUEL FILL	Engine oil level†	Check level and add if necessary. See Owner's Manual.
	Engine coolant level and condition†	Check level in coolant reservoir tank and add if necessary. Inspect coolant and replace if dirty or rusty. See Owner's Manual.
	Windshield washer fluid level	Check level in reservoir and add if necessary.
	Hood latch operation	When opening hood, note the operation of secondary latch. It should keep hood from opening all the way when primary latch is released. Make sure that hood closes firmly after services are performed.

Fig. 0B-18 -Owner Inspections and Services, Chart A

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
AT LEAST MONTHLY	Tire pressure check	Maintain pressures as shown on Tire Placard on the driver's door (include spare). Pressure should be checked when tires are "cold".
	Light operation	Check operation of license plate light, sidemarker lights, headlights including high beams, parking lights, taillights, brake lights, turn signals, backup lights and hazard warning flashers.
	Fluid leak check	Periodically, after the vehicle has been parked for a while, inspect the surface beneath the vehicle for water, oil, fuel or other fluids. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, the cause should be found and corrected at once.
AT LEAST SEMI-ANNUALLY (FOR EXAMPLE, EVERY SPRING AND FALL)	Power steering pump reservoir level†	Check level in accordance with Owner's Manual instructions (Section 5) and keep at proper level.
	Brake master cylinder reservoir level†	Check fluid level. Note: A low fluid level can indicate worn disc brake pads and should be checked.
	Clutch Pedal free travel	Note the clutch pedal free travel. It should be about 1". Adjust linkage whenever there is little or no free travel.
AT LEAST ANNUALLY	Parking brake and transmission "Park" mechanism operation	Park on a fairly steep hill and hold the vehicle with the parking brake only. This checks holding ability. For automatic transmission, check "Park" by releasing all brakes after shifting the transmission to "P" (Park).
	Steering column lock operation	While parked, try to turn key to "Lock" in each gear range. The key should turn to "Lock" only when gear is in "Park" on automatic or "Reverse" on manual transmission. On vehicles with key release lever, try to turn key to "Lock" without depressing the lever. The key should turn to "Lock" only with the key lever depressed. On all vehicles, the key should come out only in "Lock".
	Thermostatically controlled air cleaner*	Inspect all hoses and ducts for proper hookup. Be sure valve works properly.
	Starter safety switch operation	**Caution:** Before performing the following safety switch check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake (see Owner's Manual for procedure) and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage. On automatic transmission vehicles, try to start the engine in each gear. The starter should crank only in "P" (Park) or "N" (Neutral). On manual transmission vehicles place the shift lever in "Neutral" push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed.
	Seatback latch operation	Be sure seatbacks latch on those vehicles with folding seats using mechanical latches. See Owner's Manual for latch operating information.
	Lap and shoulder belts condition and operation	Inspect belt system, including: webbing, buckles, latch plates, retractors, guide loops and anchors.
	Movable head restraint operation	On vehicles with movable restraints, make sure restraints stay in the desired position. (See adjustment instructions in Owner's Manual.)
	Seatback recliner operation (if equipped)	Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.
	Spare tire and jack storage	Be alert to rattles in rear of vehicle. Make sure the spare tire, all jacking equipment, and any covers or doors are securely stowed at all times. Oil jack ratchet mechanism after each use.
	Underbody flushing	At least every spring, flush from the underbody with plain water any corrosive materials used for ice and snow removal and dust control. Take care to thoroughly clean any areas where mud and other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.

Fig. OB-19--Owner Inspection and Services, Chart B

*An emission control service

†NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
AT LEAST ANNUALLY	Engine cooling system	Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant. Keep coolant at the proper mixture as specified in your Owner's Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. Inspect hoses and replace if cracked, swollen or deteriorated. Tighten hose clamps. Clean outside of radiator and air conditioning condensor. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended.
EACH TIME OIL IS CHANGED (WHEN VEHICLE IS ON HOIST	Automatic transmission fluid level†	Maintain level within operating range on dipstick. Refer to Owner's Manual.
	Tire and wheel inspection and rotation	Check tires for abnormal wear or damage. Check for damaged wheels. To equalize wear and obtain maximum tire life, it is suggested that tires be rotated at about 7,500 miles (12 500 km). then each 15,000 miles (24 000 km) thereafter. See "Tires" in Owner's Manual, Section 5, for further information. For dual wheels, whenever the truck, or wheel or fasteners are new, also have the wheel fastener torque set at the first 100, 1,000 and 6,000 miles (160, 1 600 and 10 000 km).
	Brake systems inspection	For convenience the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc. at the same time. Check parking brake adjustment. INSPECT BRAKES MORE OFTEN IF HABIT OR CONDITIONS RESULT IN FREQUENT BRAKING
	Steering and suspension	Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. (On vehicles equipped with manual steering gear, check for seal leakage.) Inspect final drive axle output shaft seals for leaking. ● Front Suspension and Steering Linkage (a) On C20 and G30, lubricate every 4 months or 6,000 miles (10 000 km). (b) On all other vehicles, lubricate every 12 months or 7,500 miles (12 500 km). (c) Lubricate suspension and steering linkage every 3 months or 3,000 miles (5 000 km) when operating under dusty or muddy conditions and in extensive off-road use.
	Exhaust system inspection*	Inspect complete system. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of- position parts as well as open seams, holes, loose connections or other conditions which could let exhaust fumes seep into the trunk or passenger compartment.
	Throttle linkage inspection	Inspect for damaged or missing parts, interference or binding.
	Engine drive belts	Inspect all belts for cracks, fraying wear and proper tension. Adjust or replace as needed.
	Rear axle/front axle/transfer case	Check fluid level and add if needed. ● Locking Differential - In general service, drain fluid at 6000 miles (10 000 km) and refill. Change fluid at 12,500 mile intervals, and check fluid and add as needed at 6000 mile intervals thereafter. In severe operating conditions, or trailer towing applications, drain fluid every 6000 miles (10 000 km) and refill. ● Standard Differential - In general service, drain fluid level every 24,000 miles (40 000 km) and refill. Check fluid level and add as needed at 6000 mile (10 000 km) intervals. In severe operating conditions, or trailer towing applications, drain fluid every 12,500 miles (20 000 km) and refill. Check fluid level and add as needed at 6000 mile (10 000 km) intervals. ● Four Wheel Drive - Every 4 months or 6,000 miles (10 000 km), check front axle and transfer case and add lubricant when necessary. Lubricate propeller shaft slip joint and constant velocity universal joint. Oil control lever pivot points and exposed control linkage. Check vent hose at front axle and transfer case for kinks and proper installation. More frequent lubrication may be required on heavy duty off-road operations. See Owner's and Driver's Manual for further information.
	Manual transmission	Check fluid level and add as required.

Fig. OB-20--Owner Inspections and Services, Chart C

*An emission control service

†NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

USAGE	FLUID/LUBRICANT
Engine	"SF" or "SF/CD" or "SF/CC" Engine Oil conforming to GM spec 6048-M
Engine Coolant	Mixture of water and a high quality Ethylene Glycol base type antifreeze conforming to GM spec 1825-M (GM Part No 1052753) or equivalent
Brake System	Delco Supreme 11 fluid or DOT-3
Parking Brake Cables	Chassis grease meeting requirements of GM spec. 6031-M
Power Steering System	GM power steering fluid Part No. 1050017 or equivalent
Manual Steering Gear	Lubricant GM Part No. 1051052 or equivalent
Automatic Transmission Transfer Case	DEXRON®II Automatic Transmission Fluid
Differential—Standard Manual Transmission	SAE-80W, GL-5 or SAE-80W-90 GL-5 gear lubricant (SAE-80W—GL-5 in Canada)
Differential—Locking	Lubricant GM Part No. 1052271
Manual Transmission Shift Linkage, Column Shift, Propeller Shaft Slip Joint	Chassis grease meeting requirements of GM spec. 6031-M
Key Lock Cylinders	Light oil or general purpose silicone lubricant (GM Part No. 1052276)
Clutch Linkage (Man. Trans. only) a. Pivot points b. Push rod to clutch fork joint, and cross shaft pressure fitting	 a. Engine oil b. Chassis grease meeting requirements of GM spec. 6031-M
Chassis Lubrication	Chassis grease meeting requirements of GM spec. 6031-M
Windshield Washer Solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	 a. Engine oil b. Chassis grease
Front Wheel Bearings	Lubricant GM Part No. 1051344 (one pound) or equivalent*
Constant Velocity Universal Joint	GM Lubricant Part No 1052497 or equivalent
Automatic Transmission Shift Linkage, Floor Shift Linkage, Hood and Door hinges, body door hinge pins, tailgate hinge and linkage, folding seat, fuel door hinge	Engine Oil

* Fluids and lubricants identified with GM part numbers or GM specification numbers may be obtained from your GM dealer

Fig. 0B-21--Recommended Fluids and Lubricants

SECTION A—Scheduled Maintenance Services For Your 1984 6.2L Diesel-Fueled Vehicle

SCHEDULE I Follow Schedule I if you mainly operate your vehicle under one or more of the following conditions:

- Operating when outside temperatures remain below freezing and when most trips are less than 4 miles (6 km); or
- Idling for extended periods and/or low speed operation such as in door-to-door delivery;

Also follow Schedule I when:

- Towing a trailer;
- Operating in dusty areas; or
- Using your vehicle in hard, police car, delivery or daily rental service.

SCHEDULE I

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The service shown in this schedule up to 47,500 miles (76000 km) are to be performed after 47,500 miles of the same intervals																		
		MILES (000)	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5
		KILOMETERS (000)	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76
1	Engine Oil & Oil Filter*	Change Oil and Oil Filter every 2 500 miles (4 000 km), or 3 months	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
2	Chassis Lubrication	Lubricate every other oil change		•		•		•		•		•		•		•		•		•	
3	Exhaust Pressure Regulator Valve*	Inspect at 5,000 Miles (8 000 km) then every 15,000 Miles (48 000 km)		•				•						•						•	
4	Engine Idle Speed Check*	Check at 5,000 Miles (8 000 km), then at 30,000 Miles (48 000 km)		•**										•**							
5	Crankcase Ventilation System*	Service every 12 Months or 15,000 Miles (24 000 km)						•						•						•	
6	Cooling System Refill*	Every 24 Months or 30,000 Miles (48 000 km)												•							
7	Front Wheel Bearings Repack	Every 30,000 Miles (48 000 km)						•						•						•	
8	Transmission Service	Every 15,000 Miles (24 000 km)						•						•						•	
9	Air Cleaner*	Replace every 30,000 Miles (48 000 km)(1)												•**							
10	Thermostatically Controlled Engine Cooling Fan▲	Every 12 Months or 10,000 Miles (16 000 km)				•				•				•				•			
11	Shields and Underhood Insulation▲	Every 10,00 Miles (16 000 km)				•				•				•				•			
12	Air Intake System▲					•				•				•				•			

Fig. OB-22 -- Maintenance Schedule, Diesel -- Schedule I

*Also An Emission Control Service
▲Also a Noise Emission Control Service (Applicable only to vehicles with Engine Family EGM06.2DAB17 and sold only in the United States)
(1)For engines with Engine Family EGM06.2DAB17, replace element every 15,000 miles (24 000 km).
**(2)Only these emissions control maintenance items are considered to be required maintenance as defined by the California Air Resources Board (ARB) regulations and are, according to such regulations, the minimum maintenance an owner in California must perform to fulfill the minimum requirements of the emission warranty. All other emission maintenance items are recommended maintenance as defined by such regulations. General Motors urges that all emission control maintenance items be performed. (Only applicable to Engine Family E166.2K7ZZ74.)

SCHEDULE II Follow Schedule II if, as a general rule, you drive your vehicle on a daily basis for several miles (km) and none of the above conditions apply.

SCHEDULE II

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 45,000 miles (72 000 km) are to be performed after 45,000 miles at the same interval								
		MILES (000)	5	10	15	20	25	30	35	40	45
		KILOMETERS (000)	8	16	24	32	40	48	56	64	72
1	Engine Oil & Filter*	Change Oil and Oil Filter every 5,000 Miles (8 000 km) or 12 Months	•	•	•	•	•	•	•	•	•
2	Chassis Lubrication	Lubricate every 12 Months or 5,000 Miles (8 000 km)	•	•	•	•	•	•	•	•	•
3	Exhaust Pressure Regulator Valve*	Inspect at 5,000 Miles (8 000 km), then every 15,000 mi. (24 000 km)	•		•			•			•
4	Engine Idle Speed Check*	Check at 5,000 Miles (8 000 km), then at 30,000 Miles (48 000 km)	•**					•**			
5	Crankcase Ventilation System*	Service every 12 Months or 15,000 Miles (24 000 km)			•			•			•
6	Cooling System Refill*	Every 24 Months or 30,000 Miles (48 000 km)						•			
7	Front Wheel Bearings Repack	Every 30,000 Miles (48 000 km)						•			
8	Transmission Service	Every 100,000 Miles (160 000 km)									
9	Air Cleaner*	Replace every 30,000 Miles (48 000 km)(1)						•**			
10	Thermostatically Controlled Engine Cooling Fan▲	Every 12 Months or 10,000 Miles (16 000 km)		•		•		•		•	
11	Shields and Underhood Insulation▲	Every 10,000 Miles (16 000 km)		•		•		•		•	
12	Air Intake System▲			•		•		•		•	

FOOTNOTES:
*An Emission Control Service
**In California, these are the minimum Emission Control Maintenance Services an owner must perform according to the California Air Resources Board. General Motors, however, urges that all Emission Control Maintenance Services shown above be performed. To maintain your other new vehicle warranties, all services shown in this folder should be performed.

Fig. OB-23--Maintenance Schedule, Diesel--Schedule II

6.2L DIESEL ENGINE

NORMAL VEHICLE USE

The owner's or driver's maintenance instructions contained in this section are based on the assumption that your vehicle will be used as designed:

- to carry passengers and cargo within the limitations indicated on the Tire Placard.
- on reasonable road surfaces within legal operating limits.
- on a daily basis, as a general rule, for at lease several miles (km) and
- on No. 1 blend or No. 2 grade diesel fuel.

Unusual operating conditions will require more frequent vehicle maintenance as specified.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

Item 1 Engine Oil and Filter

ALWAYS USE SF-CD OR SF/CC OIL OF THE PROPER VISCOSITY. Also always change oil and filter as soon as possible after driving in a dust storm. See Owner's Manual for further details.

Item 2 Chassis Lubrication

Lubricate all grease fittings in front suspension, steering linkage. Lubricate transmission shift linkage, hood latch, hood and door hinges, parking brake cable guides, clutch linkage, propeller shaft slip joint, universal joints, brake pedal springs, underbody contact points and linkage.

Lubricate suspension and steering linkage every 2 months or 2,500 miles (4 000 km) when operating under dusty or muddy conditions and extensive off-road use.

Item 3 Exhaust Pressure Regulator Valve*

Check that valve works properly. Correct any binding. Check hoses for cracks, rubbing or decay. Replace parts as needed.

Item 4 Engine Idle Speed*

Adjust to the specifications shown on the underhood label. You must use calibrated test equipment.

Item 5 Crankcase Ventilation System*

Inspect rubber fittings, hoses and regulator every 30,000 miles (48 000 km). Replace as required.

Item 6 Cooling System Refill*

Drain, flush and refill system with new coolant.

Item 7 Wheel Bearings

Clean and repack front wheel bearings at each brake relining or 15,000 miles (24 000 km), whichever comes first, when vehicle is used in such service as police, taxi or door-to-door delivery. If you do not use your vehicle in such service, clean and repack bearings at each brake relining or 30,000 miles (48 000 km), whichever comes first. Be sure to use proper lubricant as shown in the "Recommended Fluids and Lubricants" chart in this section.

Item 8 Automatic Transmission Fluid

Change the transmission fluid and filter (or service the screen) every 15,000 miles (24 000 km) if the vehicle is mainly driven under one of more of these hot conditions:

- In heavy city traffic where the outside temperature regularly reaches 90°F (32°C).
- In hilly or mountainous terrain.
- Frequent trailer pulling.
- Uses such as taxi, police or delivery service.

If vehicle is not used mainly under any of these conditions, change the fluid and filter (or serice the screen) every 100,000 miles (160 000 km).

See Section 7 of this Manual for further details.

Item 9 Air Cleaner Element*

Replace at 30,000 miles (48 000 km). Replace more often under dusty conditons. Ask your delaer for the proper replacement times for your driving conditions.

Item 10 Thermostatically Controlled Engine Cooling Fan

If so equipped) With the engine off and below normal operating temperature, check to see that the fan can be rotated by hand on fluid coupling, viscous and air operated

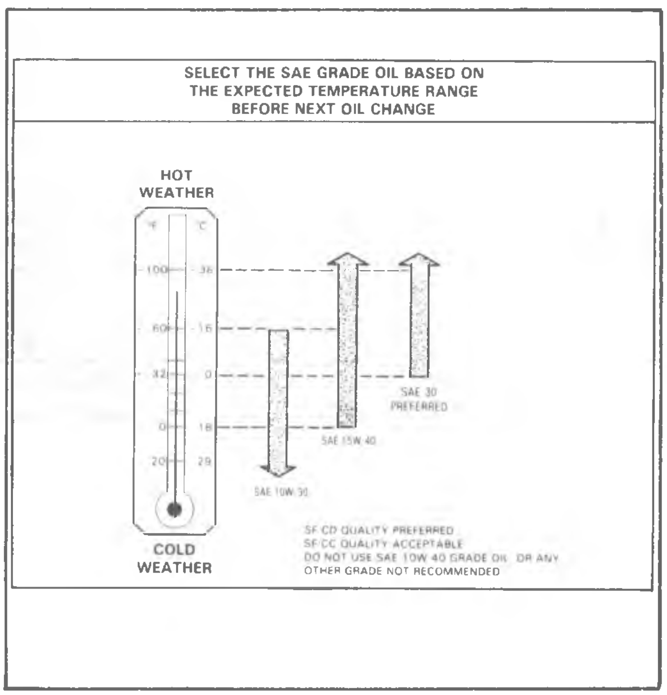


Fig. OB-24--Oil Viscosity Chart

drives. Replace as necessary. For air-operated fan drives, the air pressure must be up to the normal operating range to perform the above check.

Item 11 Shields and Underhood Insulation

(If so equipped) Inspect shields and underhood insulation for damage or looseness. Adjust replace as required.

Item 12 Air Intake System

Check the air intake system installation to see that gaskets are seated properly and all hose connections, fasteners, and other components are tight. Tighten connections and fasteners or replace damaged parts as required.

OWNER INSPECTIONS AND SERVICES

Listed in Figs. OB-25 through OB-27 are vehicle inspections and services which should be made by either you or a qualified technician at the frequencies indicated to help ensure proper safety, emission performance and dependability of your vehicle. Take any problems promptly to your dealer or a qualified technician for service advice. Whenever repairs are necessary, have them completed at once. For your safety and that of others, any safety related components that could have been damaged in an accident should be inspected. All needed repairs should be performed before operating your vehicle.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
BEFORE OPERATING YOUR VEHICLE	Warning light, buzzer tone and chime operation	Check operation of all warning lights, buzzers, tone generators and chimes — also all interior lights. See your Owners Manual for details.
	Glass, lights, and reflector condition	Look for broken, scratched, dirty or damaged glass, lights, or reflectors that could reduce vision or visibility or cause injury. Replace, clean or repair promptly
	Seat adjuster operation	When adjusting a manual seat, be sure seat adjusters latch by pushing seat forward and backward
	Rearview mirror and sun visor operation	Make sure friction joints hold mirrors and sun visors in place
	Door, trunk and gate latch operation	Make sure that all doors, trunk lid and wagon or hatchback gates close, latch and lock tightly
WHILE OPERATING YOUR VEHICLE	Automatic transmission shift indicator operation	Make sure the indicator points to the gear chosen.
	Wiper and washer operation	Note the operation and condition of the wiper blades and the flow and aim of the washer spray
	Defroster operation	Periodically check the air flow from the ducts at the inside base of the windshield. Do this with the heater control lever in "defrost" position and fan lever in "high."
	Horn operation	Blow the horn occasionally to make sure it works. Check all button locations.
	Brake system operation	Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if the brake warning light goes on, something may be wrong. See your Owner's Manual.
	Exhaust system operation	Be alert to any changes in the sound of the system or any smell of fumes. These are signs the system may be leaking. Have it inspected and repaired at once. Also see "Engine Exhaust Gas Caution (Carbon Monoxide)" in your Owners Manual.
	Tires, Wheels and Alignment	Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or wheel alignment.
	Steering system operation	Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn or has too much free play or if abnormal sounds are noted when turning or parking.
	Headlight aim	Take note of light pattern occasionally. If beams seem improperly aimed, headlights should be adjusted
AT EACH FUEL FILL	Engine oil level†	Check level and add if necessary. See Owner's Manual.
	Engine coolant level and condition†	Check level in coolant recovery tank and add if necessary. Inspect coolant and replace if dirty or rusty. See Owners Manual.
	Windshield washer fluid level	Check level in reservoir and add if necessary.
	Hood latch operation	When opening hood, note the operation of secondary latch. It should keep hood from opening all the way when primary latch is released. Make sure that hood closes firmly after services are performed.

Fig. OB-25 — Owner Inspection and Services Chart A

† *NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.*

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
AT LEAST MONTHLY	Tire pressure check	Maintain pressures as shown on Tire Placard on the drivers door (include spare). Pressure should be checked when tires are "cold."
	Light operation	Check operation of license plate light, sidemarker lights, headlights including high beams, parking lights, taillights, brake lights, turn signals, backup lights and hazard warning flashers.
	Fluid leak check	Periodically, after the vehicle has been parked for a while, inspect the surface beneath the vehicle for water, oil, fuel or other fluids. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, the cause should be found and corrected at once.
AT LEAST SEMI-ANNUALLY (FOR EXAMPLE, EVERY SPRING AND FALL)	Power steering pump reservoir level†	Check level in accordance with Owners Manual instructions and keep at proper level.
	Brake master cylinder reservoir level†	Check fluid level. Note: A low fluid level can indicate worn disc brake pads and should be checked.
	Clutch Pedal free travel	Note the clutch pedal free travel. It should be about 1". Adjust linkage whenever there is little or no free travel.
AT LEAST ANNUALLY	Parking brake and transmission "Park" mechanism operation	Park on a fairly steep hill and hold the vehicle with the parking brake only. This checks holding ability. For automatic transmission, check "Park" by releasing all brakes after shifting the transmission to "P" (Park).
	Steering column lock operation	While parked, try to turn key to "Lock" in each gear range. The key should turn to "Lock" only when gear is in "Park" on automatic or "Reverse" on manual transmission. On vehicles with key release lever, try to turn key to "Lock" without depressing the lever. The key should turn to "Lock" only with the key lever depressed. On all vehicles, the key should come out only in "Lock."
	Starter safety switch operation	**Caution:** Before performing the following safety switch check, be sure to have enough room around the vehicle. Then, firmly apply both the parking brake (see Owners Manual for procedure) and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the vehicle could move without warning and possibly cause personal injury or property damage. On automatic transmission vehicles, try to start the engine in each gear. The starter should crank only in "P" (Park) or "N" (Neutral). On manual transmission vehicles, place the shift lever in "Neutral," push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed.
	Seatback latch operation	Be sure seatbacks latch on those vehicles with folding seats using mechanical latches. See Owners Manual for latch operating information.
	Lap and shoulder belts condition and operation	Inspect belt system, including webbing, buckles, latch plates, retractors, guide loops and anchors.
	Movable head restraint operation	On vehicles with movable restraints, make sure restraints stay in the desired position. (See adjustment instructions in Owners Manual.)
	Seatback recliner operation (if equipped)	Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.
	Spare tire and jack storage	Be alert to rattles in rear of vehicle. Make sure the spare tire, all jacking equipment, and any covers or doors are securely stowed at all times. Oil jack mechanism after each use.
	Underbody flushing	At least every spring, flush from the underbody with plain water any corrosive materials used for ice and snow removal and dust control. Take care to thoroughly clean any areas where mud and other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.
	Engine cooling system*	Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant. Keep coolant at the proper mixture as specified in your Owners Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. Inspect hoses and replace if cracked, swollen or deteriorated. Tighten hose clamps. Clean outside of radiator and air conditioning condensor. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended.

Fig. 0B-26 — Owner's Inspection and Services Chart B

** An Emission Control Service*

† NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

FREQUENCY	INSPECTION OR SERVICE	WHAT TO DO
EACH TIME OIL IS CHANGED (WHEN VEHICLE IS ON HOIST)	Tire and wheel inspection and rotation	Check tires for abnormal wear or damage. Check for damaged wheels. To equalize tire wear and obtain maximum tire life, it is suggested that tires be rotated at about 5,000 miles (8 000 km), then each 15,000 miles (24 000 km) thereafter. See "Tires" in Owner's Manual for further information. For dual wheels, whenever the truck, or wheels or fasteners are new, also have the wheel fastener torque set at the first 100, 1,000 and 5,000 miles (160, 1 600 and 8 000 km).
	Brake systems inspection	For convenience the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc. at the same time. Check parking brake adjustment. INSPECT BRAKES MORE OFTEN IF HABIT OR CONDITIONS RESULT IN FREQUENT BRAKING.
	Steering and suspension inspection	Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. On vehicles equipped with manual steering gear, check for seal leakage. Inspect final drive axle output shaft seals for leaking.
	Exhaust system inspection	Inspect complete system. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections or other conditions which could cause a heat build up in the floor pan or could let exhaust fumes seep into the passenger compartment.
	Throttle linkage inspection	Inspect for damaged or missing parts, interference or binding.
	Engine drive belts	Inspect all belts for cracks, fraying and wear. Adjust or replace as needed.
	Rear axle front axle transfer case	Check fluid level and add if needed. • Locking Differential in vehicles less than 8600# GVW — In general service, drain fluid at 5,000 miles (8 000 km) and refill. Check fluid level and add as needed at subsequent 5,000 mile (8 000 km) intervals. In severe operating conditions, or trailer towing applications, drain fluid every 5,000 miles (8 000 km) and refill. • Locking Differential in vehicles of 8600# GVW and above — In general service, drain fluid at 5,000 miles (8 000 km) and refill. Change fluid at 10,000 mile (16 000 km) intervals and check fluid and add as needed at 5,000 mile (8 000 km) intervals thereafter. In severe operating conditions, or trailer towing applications, drain fluid every 5,000 miles (8 000 km) and refill as specified. • Standard Differential in vehicles less than 8600# GVW — In general service, check fluid level and add as needed every 5,000 miles (8 000 km). In severe operating conditions, or trailer towing applications, drain fluid every 5,000 miles (8 000 km) and refill as specified. • Standard Differential in vehicles of 8600# GVW and above — In general service, drain fluid every 25,000 miles (40 000 km) and refill. Check fluid level and add as needed at 5,000 mile (8 000 km) intervals. In severe operating conditions, or trailer towing applications, drain fluid every 10,000 miles (16 000 km) and refill. • **Four Wheel Drive** — Every 12 months or 5,000 miles (8 000 km), check front axle and transfer case and add lubricant when necessary. Lubricate propeller shaft slip joint, constant velocity universal joint and steering linkage. Oil control lever pivot point and exposed control linkage. Check vent hose at front axle transfer case for kinks and proper installation. More frequent lubrication may be required on heavy duty off-road operation. See Owners and Drivers Manual for further information.
	Automatic transmission fluid level †	Maintain level within operating range on dipstick. Refer to Owners Manual.
	Manual transmission	Check fluid level and add as required.

Fig. 0B-27 — Owner's Inspection and Services Chart C

*An Emission Control Service

† NOTE: A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

USAGE	FLUID LUBRICANT
Engine Oil	"SF CD" or "SF CC" Engine Oil
Engine Coolant	Mixture of water and a high quality Ethylene Glycol base type antifreeze conforming to GM spec. 1825-M (GM Part No. 1052753) or equivalent
Brake System	Delco Supreme 11 fluid or DOT-3
Parking Brake Cables	Chassis grease meeting requirements of GM spec. 6031-M
Power Steering System	GM Power Steering Fluid Part No. 1050017 or equivalent
Manual Steering Gear	Lubricant GM Part No. 1051052 or equivalent
Automatic Transmission 4-Speed Manual Trans. w O.D. S10 Truck with Manual Trans. Transfer Case	DEXRON® II Automatic Transmission Fluid
Differential — Standard or Manual Transmission (Except: 4-Speed with O.D., and S10 Truck)	SAE-80W, GL-5 or SAE-80W-90 GL-5 gear lubricant (SAE-80W—GL-5 in Canada)
Differential — Locking	Lubricant GM Part No. 1052271
Manual Transmission Shift Linkage, Column Shift, Propeller Shaft Slip Joint	Chassis grease meeting requirements of GM spec. 6031-M
Key Lock Cylinders	Light oil or general purpose silicone lubricant (GM Part No. 1052276)
Clutch Linkage (Manual Transmission Only) a. Pivot points b. Push rod to clutch fork joint and cross shaft pressure fitting	 a. Engine Oil b. Chassis Grease meeting requirements of GM spec. 6031-M
Chassis Lubrication	Chassis grease meeting requirements of GM spec. 6031-M
Windshield Washer Solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	 a. Engine Oil b. Chassis Grease
Front Wheel Bearings	Lubricant GM Part No. 1051344 (one pound) or equivalent*
Constant Velocity Universal Joint	GM Lubricant Part No. 1052497 or equivalent
Automatic Transmission Shift Linkage, Floor Shift Linkage, Hood and Door Hinges, Body Door Hinge Pins, Tailgate Hinge and Linkage, Folding Seat, Fuel Door Hinge	Engine Oil

*Fluids and Lubricants identified with GM part numbers or GM specification numbers may be obtained from your GM dealer.

Fig. 0B-28 — Recommended Fluids and Lubricants

SECTION 1A
HEATER

CONTENTS

Standard Heater 1A-1
Auxiliary Heater 1A-15
Specifications 1A-20

STANDARD HEATER

INDEX

General Description 1A-1
System Components 1A-1
System Controls 1A-1
Diagnosis 1A-4
On Vehicle Service
Blower Motor 1A-8
Heater Distributor and Core Assembly 1A-8
Heater Hoses 1A-9
Center Distributor Duct 1A-9
Defroster Duct 1A-9
Control Assembly 1A-9
Control Cables 1A-11
Blower Switch 1A-11
Resistor Unit 1A-11

GENERAL DESCRIPTION

Heating components are attached to the dash panel on the right side of the vehicle. The blower and air inlet assembly and water hoses are located on the forward side of the dash panel while the heater core and distributor duct are on the passenger side.

The heater system is an air mix type system in which outside air is heated and then mixed in varying amounts with cooler outside air to attain the desired air temperature. The system consists basically of three parts: (1) the blower and air inlet assembly, (2) the heater distributor assembly and (3) the heater control assembly.

HEATER AIR FLOW SCHEMATIC

C-K Series heater airflow is shown in Fig. 1A-1.

BLOWER AND AIR INLET ASSEMBLY

The blower and air inlet assembly draws outside air through the outside air inlet grille located forward of the windshield reveal molding and channels the air into the heater distributor assembly. The operation of the blower motor is controlled by the FAN switch on the heater control. The motor is connected in series with the FAN switch and also the blower resistor assembly.

HEATER DISTRIBUTOR ASSEMBLY

The heater distributor assembly houses the heater core and the doors necessary to control mixing and channeling of the air. Since the unit has no water valve, water circulation keeps the core hot at all times. That portion of the air passing through the core receives maximum heat from the core. Air entering the distributor assembly is channeled as follows:

C-K Models

Air entering the distributor can be directed out the purge door opening, on the right end of the distributor assembly, by the purge door. If the purge door is closed, then air is directed through and/or around the heater core by the temperature door. Air is then directed into the passenger compartment through the heater (floor) outlets and/or the defroster (dash) outlets by the defroster door. The temperature of the outlet air is dependent on the ratio of heated to unheated air (controlled by the temperature door).

G Models

Air flow is controlled by doors in the distributor assembly. The air door can be adjusted to vary airflow. If air is allowed to enter the distributor assembly, it is then directed through and/or around the heater core by the temperature door. Air is directed into the passenger compartment through the heater (floor) and/or defroster (dash) outlets by the defroster door. The temperature of the outlet air is dependent of the ratio of heated to unheated air (controlled by the temperature door).

CONTROLS

Heater controls for C-K and G Models are shown in Fig. 1A-2.

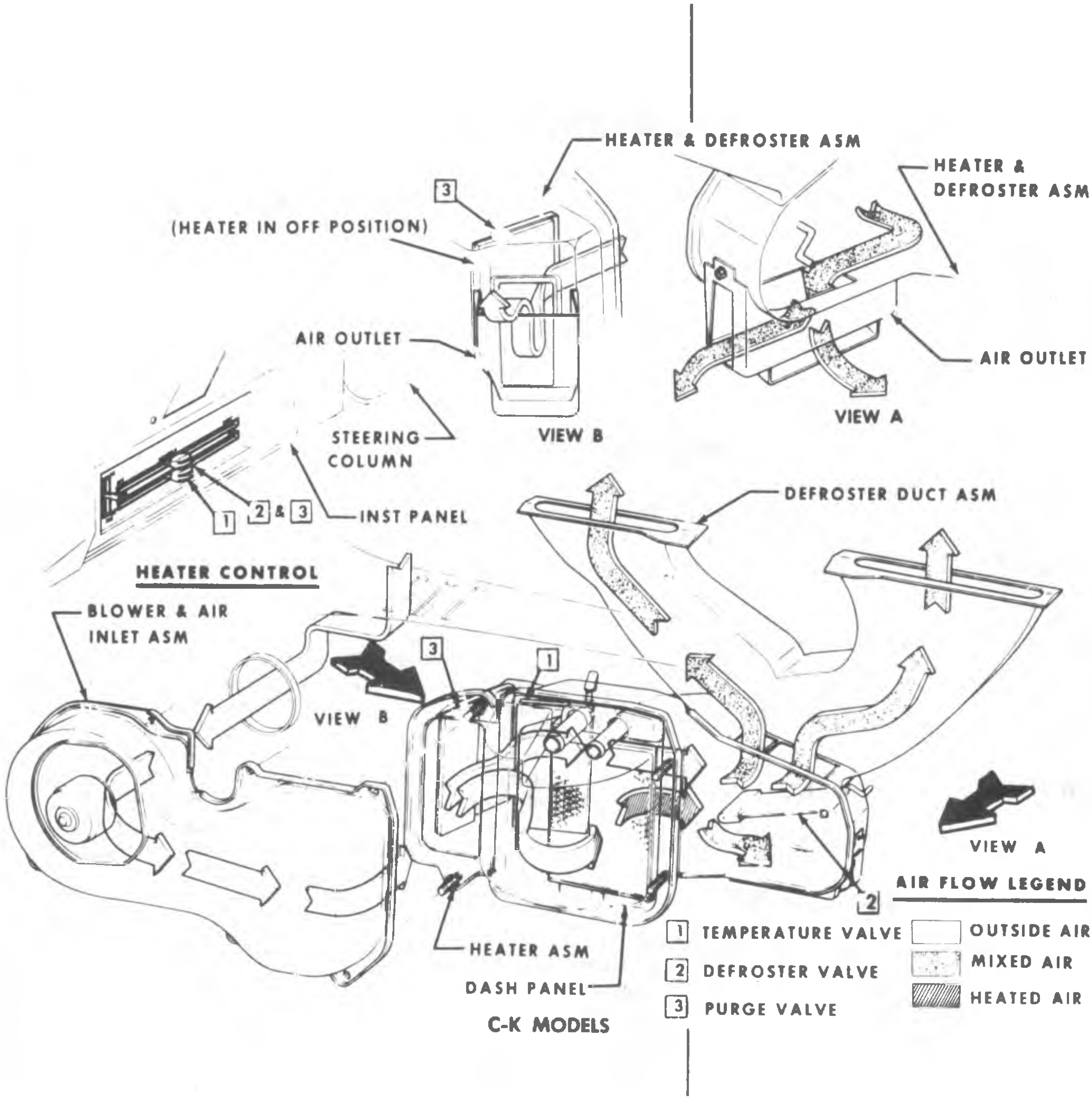


Fig. 1A-1--Heater Air Flow Schematic--C-K Models

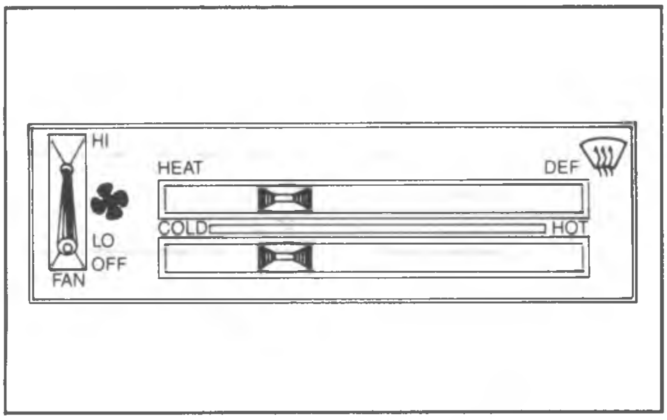


Fig. 1A-2--Heater Control-C-K Models

DIAGNOSIS

TROUBLE	CAUSE AND CORRECTION
Temperature of heater air at outlets too low to heat up passenger compartment.	1. See "Insufficient Heat Diagnostic Chart".
Temperature of heater air at outlets adequate but the vehicle will not build up sufficient heat.	Check for body leaks such as: 1. Floor side kick pad ventilators partially open. 2. Leaking grommets in dash. 3. Leaking welded seams along rocker panel and windshield. 4. Leaks through access holes and screw holes. 5. Leaking rubber molding around door and windows. 6. Leaks between sealing edge of blower and air inlet assembly and dash, and between sealing edge of heater distributor assembly and dash.
Inadequate defrosting action.	1. Check that DEFROST lever completely opens defroster door in DEF position - Adjust if necessary. 2. Insure that temperature and air doors open fully - Adjust. 3. Look for obstructions in defroster ducts - Remove any obstructions. 4. Check for air leak in ducting between defroster outlet on heater assembly and defroster duct under instrument panel - Seal area as necessary. 5. Check position of bottom of nozzle to heater locating tab - Adjust. 6. Check position of defroster nozzle openings relative to instrument panel openings. Mounting tabs provide positive position if properly installed.
Inadequate circulation of heated air through vehicle.	1. Check heater air outlet for correct installation - Reinstall. 2. Inspect floor carpet to insure that carpet lies flat under front seat and does not obstruct air flow under seat, and also inspect around outlet ducts to insure that carpet is well fastened to floor to prevent cupping of air flow - Correct as necessary.
Erratic heater operation.	1. Check coolant level - Fill to proper level. 2. Check for kinked heater hoses - relieve kinks or replace hoses. 3. Check operation of all bowden cables and doors - Adjust as necessary. 4. Sediment in heater lines and radiator causing engine thermostat to stick open - flush system and clean or replace thermostat as necessary. 5. Partially plugged heater core - backflush core as necessary.
Hard operating or broken controls.	1. Check for loose bowden cable tab screws or mis-adjusted bowden cables - Correct as required. 2. Check for sticking heater system door(s) - Lubricate as required using a silicone spray.

INSUFFICIENT HEAT DIAGNOSIS

Position the controls so that the:

Temperature lever is on full heat.
Selector or heater lever is on Heater.
Fan switch is on Hi.

*CHECK DUMP DOOR OUTLET FOR AIR FLOW

NO AIR FLOW

CHECK DEFROSTER OUTLETS FOR AIR FLOW
(If in doubt as to High or Low air flow set selector on DEF which is High and compare. Reset selector on Heater)

NO OR LOW AIR FLOW

CHECK HEATER OUTLET AIR FLOW
(If in doubt, switch fan switch from Hi to Lo)

CHANGE IN AIR FLOW

NORMAL AIR FLOW

Check heater outlet temperature with 220° F range thermometer.

(approximate outlet air temperatures)

Outlet Air	145	150	155	165
Ambient Air	0	25	40	75

NORMAL TEMPERATURE

Remove all obstructions under front seat.

Car does not build up heat - operate vent controls and see that the air vent doors close completely, if not, adjust.

LOW TEMPERATURE

(Check the system temperature after repairing the item checked to complete the diagnosis.)

Check coolant level; if low, fill. Look for or feel all radiator and heater hoses and connections for leaks. Repair or replace. Check the radiator cap for damage and replace if required.

Check heater and radiator hoses for kinks - straighten and replace as necessary.

Check temperature door for max heat position. Adjust if necessary.

HEATER CORE

Feel temperatures of heater inlet and outlet hoses.

WARM INLET AND OUTLET HOSES

Check engine thermostat.

HOT INLET AND WARM OUTLET HOSES

Check pulleys, belt tension, etc., for proper operation. Replace or service as necessary.

Remove hoses from heater core. Reverse flush with tap water. If plugged, repair or replace.

LITTLE OR NO CHANGE IN AIR FLOW

LOW OR NO AIR FLOW

**Check shutoff door position for full system air flow. Adjust if necessary.

LOW AIR FLOW

Check heater outlet for obstruction - remove.

Check motor voltage at closest motor line connection with a voltmeter.

UNDER 10 VOLTS

Check battery volts - under 10 volts, recharge then recheck motor voltage.

Check wiring and connections for under 10 volts from motor to fan switch. Repair or replace last point of under 10 volt reading.

OVER 10 VOLTS

Apply external ground, (jumper wire) to motor case. INCREASED AIR FLOW - repair ground.

SAME AIR FLOW - remove motor and check for obstruction in system opening. If none, REPLACE MOTOR. If obstruction, remove material and re-install motor.

NO AIR FLOW

CHECK FUSE

FUSE BLOWN - replace fuse.

AIR FLOW - system okay.

BLOWS FUSE

Remove positive lead from motor and replace fuse.

FUSE REMAINS OK - remove motor and check for obstruction in system opening, if none, REPLACE MOTOR. If obstruction, remove material and re-install motor.

BLOWS FUSE - check for shorted wire in blower electric circuit - See Heater Circuit Diagnostic Chart.

FUSE OK

FUSE OK - See Heater Circuit Diagnostic Chart.

AIR FLOW

Adjust dump door for no air flow.

HIGH AIR FLOW

Adjust defroster door for low air flow.

*CHECK FOR C K MODELS ONLY

**CHECK FOR G MODELS ONLY

HEATER CIRCUIT DIAGNOSIS*

BLOWER MOTOR INOPERATIVE (ANY SPEED)

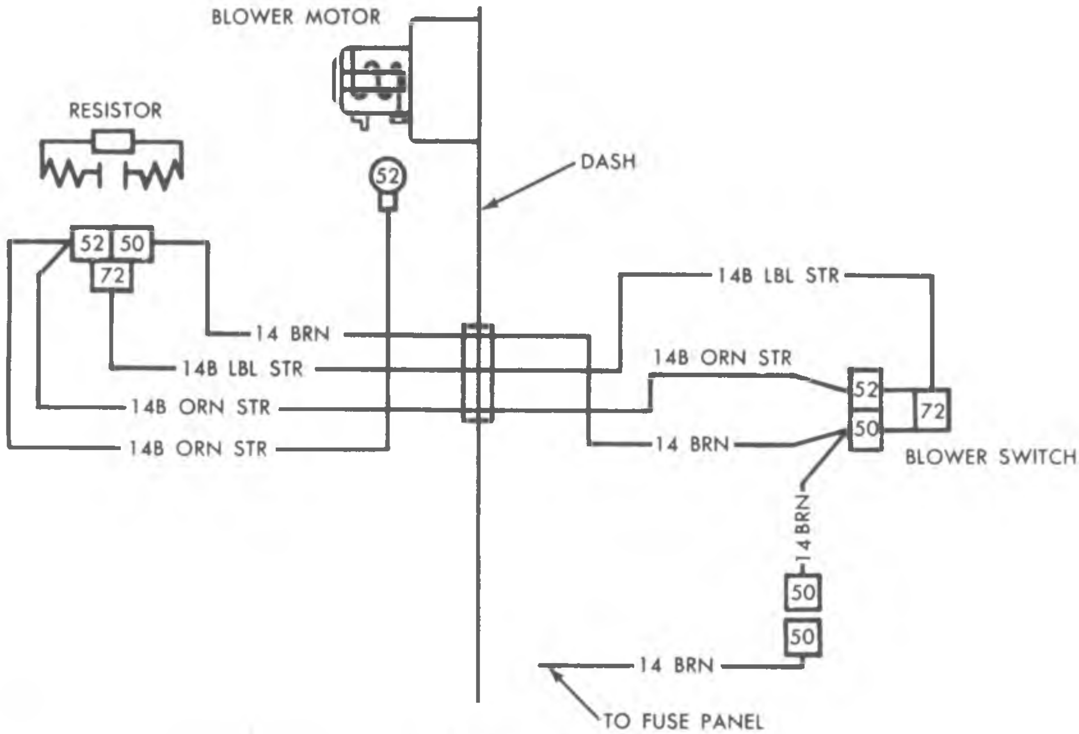
- Check fuse in fuse panel.
  - **FUSE BLOWN**
    - With Ignition switch in "RUN" position and blower speed switch "ON" use meter to locate short in one of the following wires:
      1. From fuse panel to blower speed switch.
      2. From blower speed switch to heater resistor.
      3. From heater resistor to blower.

      Note: Short circuit may be intermittent. If meter does not indicate a short circuit, move harness around as much as possible to re-create short circuit. Watch and listen for arcing.
  - **FUSE OK**
    - The following tests should be made with the ignition switch in "RUN" position the blower speed switch "ON" and the lever on heat position.
    - Check blower motor ground
      - **POOR OR NO GROUND**
        - Repair ground
      - **GROUND OK**
        - Check motor connector with 12 volt test light.
          - **LAMP LIGHTS**
            - Replace Motor
          - **LAMP DOES NOT LIGHT**
            - Check blower feed wire in connector on resistor with 12 volt test light.
              - **LAMP DOES NOT LIGHT**
                - Use 12 volt test light and check feed terminal (brown) on blower speed switch.
                  - **LAMP DOES NOT LIGHT**
                    - Repair open in brown wire from blower speed switch to fuse panel.
                  - **LAMP LIGHTS**
                    - Replace switch
              - **LAMP LIGHTS**
                - Repair open in feed wire from resistor to blower motor.

BLOWER MOTOR INOPERATIVE (CERTAIN SPEEDS)

- Disconnect resistor connector, connect one lead of a self powered test light to any one terminal and use the other lead to probe each of the other two terminals.
  - **TEST LIGHT DOES NOT LIGHT ON ALL TERMINALS**
    - Replace resistor
  - **TEST LIGHT LIGHTS ON ALL TERMINALS**
    - With ignition "OFF", disconnect 3 wire connector from resistor. Connect a jumper lead from battery positive terminal to any wire terminal in connector. Use 12 volt test light to check for voltage at the corresponding wire on blower speed switch. Repeat same test on other wires.
      - **LAMP LIGHTS ON ALL THREE WIRES**
        - Replace blower speed switch
      - **LAMP DOES NOT LIGHT ON ALL THREE WIRES**
        - Repair open in affected wire

* See heater circuit diagrams



C-K MODELS

	CIRCUIT
OFF	BAT-ONLY
LO	BAT-LO
MED	BAT-MED
HI	BAT-HI

HEATER OPERATION	
LO	BAT-BLO SW-RES RI R2-BLO MTR-GRD
MED	BAT-BLO SW-RES RI-BLO MTR-GRD
HI	BAT-BLO SW-BLO MTR-GRD

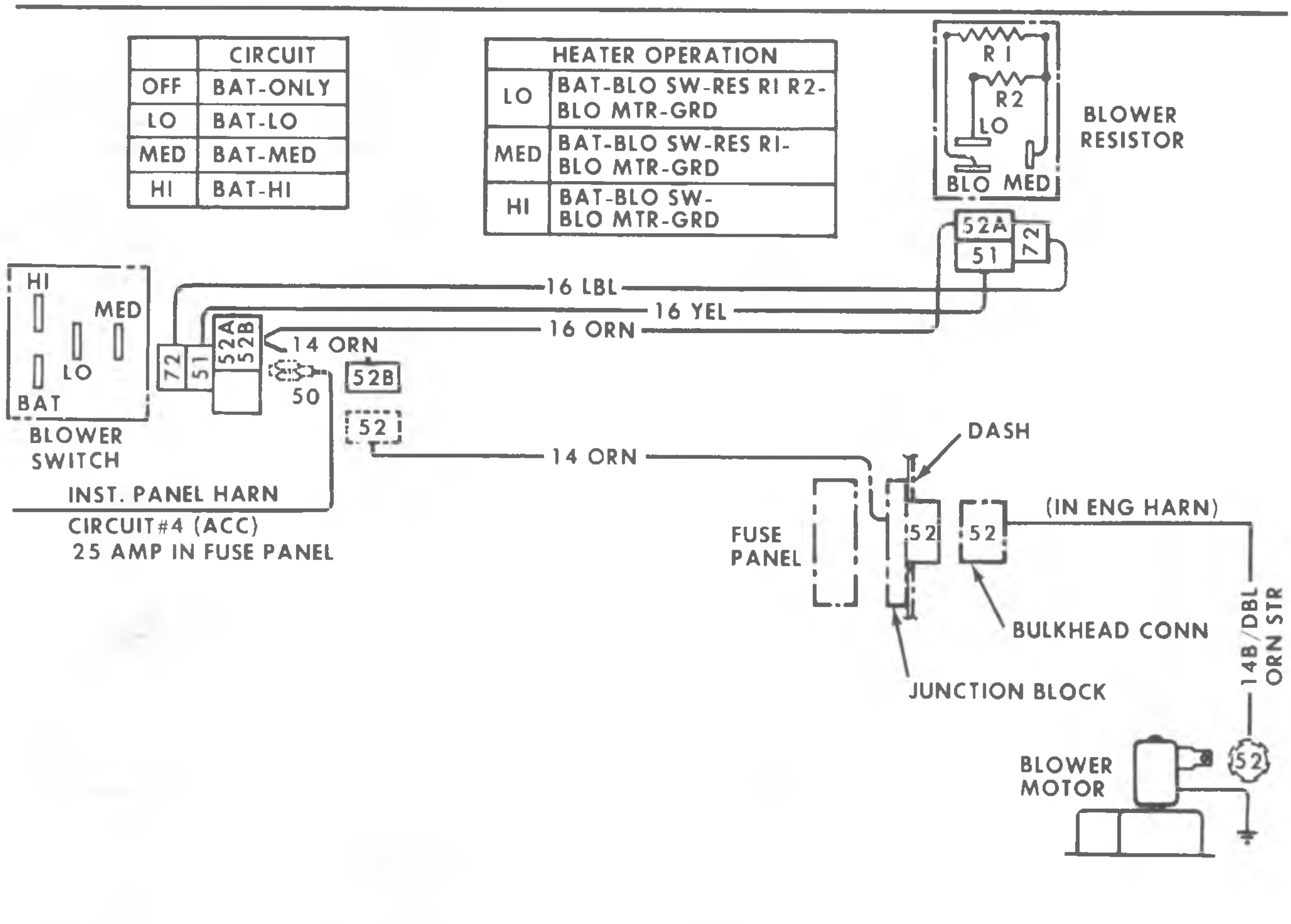


Fig. 1A-4--Heater Wiring Diagrams

ON VEHICLE SERVICE

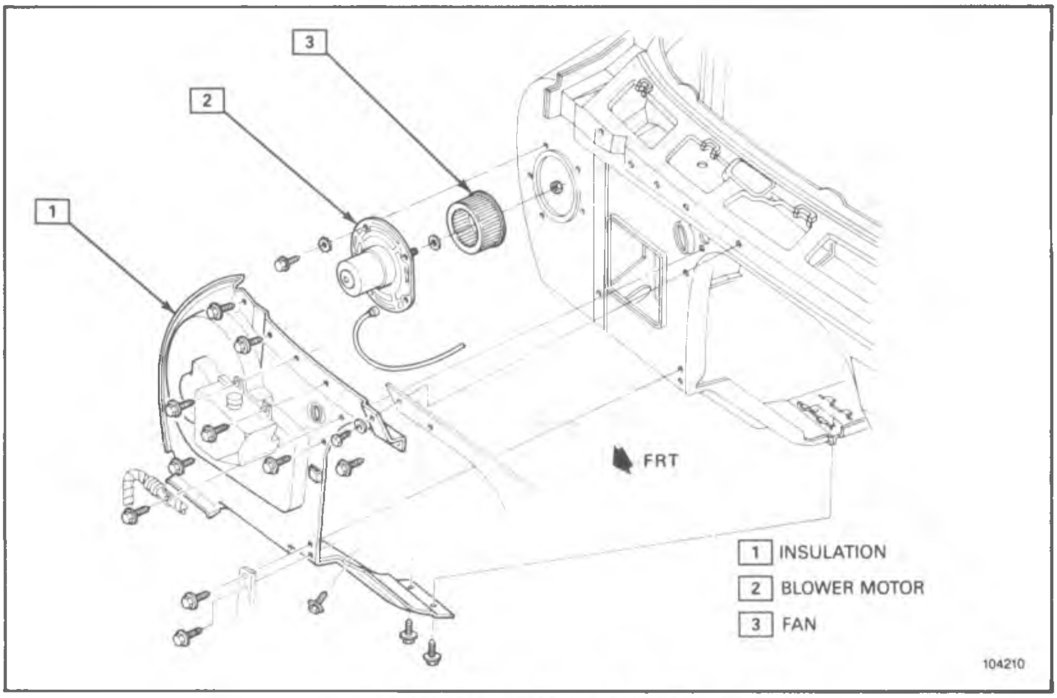


Fig. 1A-5--Blower Motor Assembly - G Models

BLOWER MOTOR

Removal (Fig. 1A-5)

1. Disconnect battery ground cable.
   G Models - Remove the coolant recovery tank, and power antenna as outlined in Sections 6 and 9.
2. Disconnect the blower motor lead wire.
3. Remove the five blower motor mounting screws and remove the motor and wheel assembly. Pry gently on the blower flange if the sealer acts as an adhesive.
4. Remove the blower wheel to motor shaft nut and separate the wheel and motor assemblies.
5. To install a new motor, reverse Steps 1-4 above.
   The following steps should be taken to assure proper installation:
   a. Assemble the blower wheel to the motor with the open end of the wheel away from the blower motor.
   b. If the motor mounting flange sealer has hardened, or is not intact, remove the old sealer and apply a new bead of sealer to the entire circumference of the mounting flange.
   c. Check blower operations: blower wheel should rotate freely with no interference.

HEATER DISTRIBUTOR AND CORE ASSEMBLY

C-K Models

Replacement (Fig. 1A-6)

1. Disconnect the battery ground cable.
2. Disconnect the heater hoses at the core tubes and drain engine coolant into a clean pan. Plug the core tubes to prevent coolant spillage at removal.
3. Remove the nuts from the distributor duct studs projecting into the engine compartment.
4. Remove the glove box and door assembly.
5. Disconnect the Air-Defrost and Temperature door cables.
6. Remove the floor outlet and remove the defroster duct to heater distributor duct screw.
7. Remove the heater distributor to dash panel screws. Pull the assembly rearward to gain access to wiring harness and disconnect all harnesses attached to the unit.
8. Remove the heater-distributor from the vehicle.
9. Remove the core retaining straps and remove the core.
10. To install, reverse Steps 1-9 above. Be sure core to case and case to dash panel sealer is intact before assembling unit.

G Models

Replacement (Fig. 1A-7)

1. Disconnect the battery ground cable.
2. Remove coolant recovery tank and lay aside.

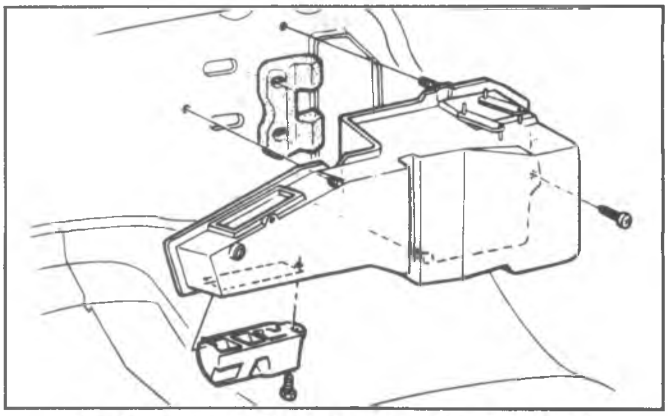


Fig. 1A-6--Heater Distributor Assembly--C-K Models

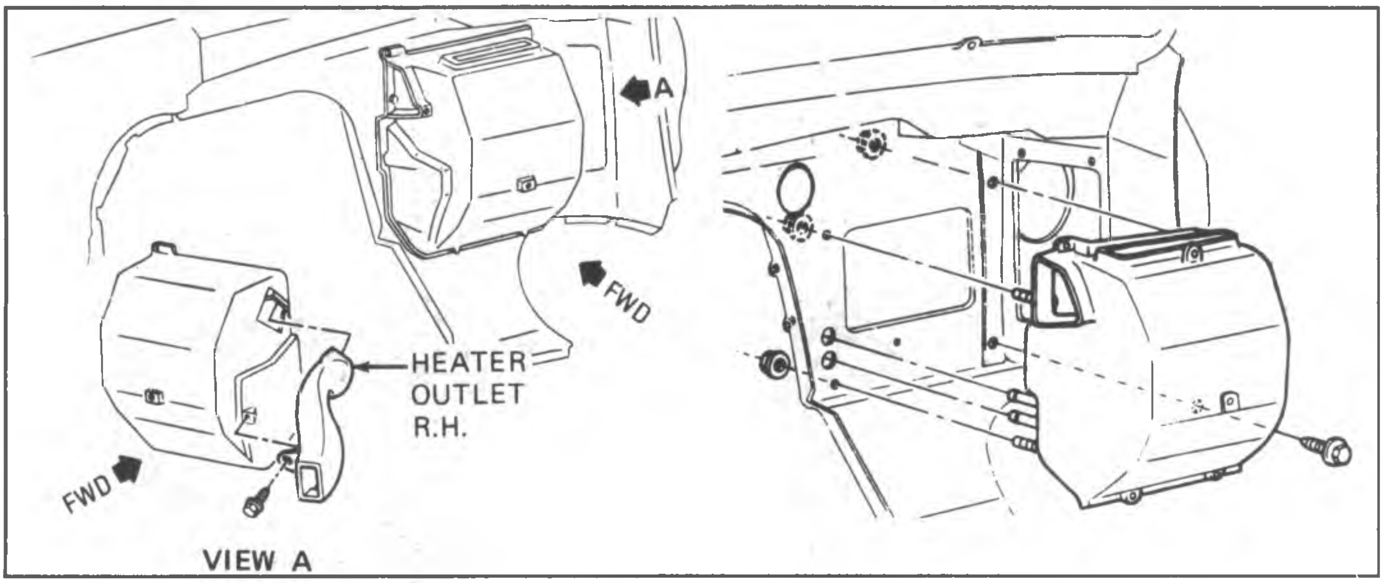


Fig. 1A-7--Heater Distributor - G Models

3. Place a clean pan under the vehicle and then disconnect the heater core inlet and outlet hoses at the core connections (see "Heater Hoses-Replacement" later in this section). Quickly plug the heater hoses and support them in a raised position. Allow the coolant in the heater core to drain into the pan on the floor.
4. Remove heater distributor duct to distributor case attaching screws and distributor duct to engine cover screw and remove duct.
5. Remove engine housing cover.
6. Remove instrument panel attaching screws: above, at windshield, all lower screws and right lower I.P. support bracket at door pillar and engine housing.
7. Lower steering column, and raise and support right side of I.P.
8. Remove defroster duct to distributor case attaching screw, and 2 screws attaching distributor to heater case.
9. Disconnect temperature door cable and fold cable back for access (Refer to Fig. 1A-17).
10. Remove three (3) nuts at engine compartment side of distributor case and one (1) screw on passenger side.
11. Remove the heater case and core as an assembly. Tilt the case assembly rearward at the top while lifting up until the core tubes clear the dash openings.
12. Remove the core retaining strap screws and remove the core.
13. To install a new core, reverse Steps 1-10 above. Be sure core to case and case to dash panel sealer is intact before assembling unit.

HEATER HOSES

Heater hoses are routed from the thermostat housing or inlet manifold and water pump (radiator on some automatic transmission vehicles) to the core inlet and outlet pipes as shown in Figures 1A-8 thru 1A-11. Hoses are attached at each end with screw type clamps.

Replacement

The heater core can be easily damaged in the area of the core tube attachment seams whenever undue force is exerted on them. Whenever the heater core hoses do not readily come off the tubes, the hoses should be cut just forward of the core tubes. The portion of the hose remaining on the core tube should then be split longitudinally. Once the hoses have been split, they can be removed from the tubes without damaging to the core.

DISTRIBUTOR DUCTS - G Models

Replacement (Fig. 1A-12)

1. Disconnect the battery ground cable.
2. Raise I.P. at right side as outlined under heater distributor removal.
3. Unsnap the engine cover front latches. Remove the two cover to floorpan screws and remove the cover.
4. Remove the heater distributor duct to case attaching screws as shown in Fig. 1A-12.
5. Remove one (1) screw at left center of distributor duct.
6. Pull the center distributor duct to the right and remove it from the vehicle.
7. To install, reverse Steps 1 thru 5. Check cable and door operation; cables should be free from kinks or binding and doors should close properly. If cable adjustment is necessary, refer to "Bowden Cable-Adjustment."

DEFROSTER DUCT

Defroster assemblies attachment are shown in Fig. 1A-13.

CONTROL ASSEMBLY

C-K Models

Replacement (Fig. 1A-14)

1. Disconnect the battery ground cable.
2. Remove the instrument panel bezel.
3. Disconnect the bowden cables and the blower switch

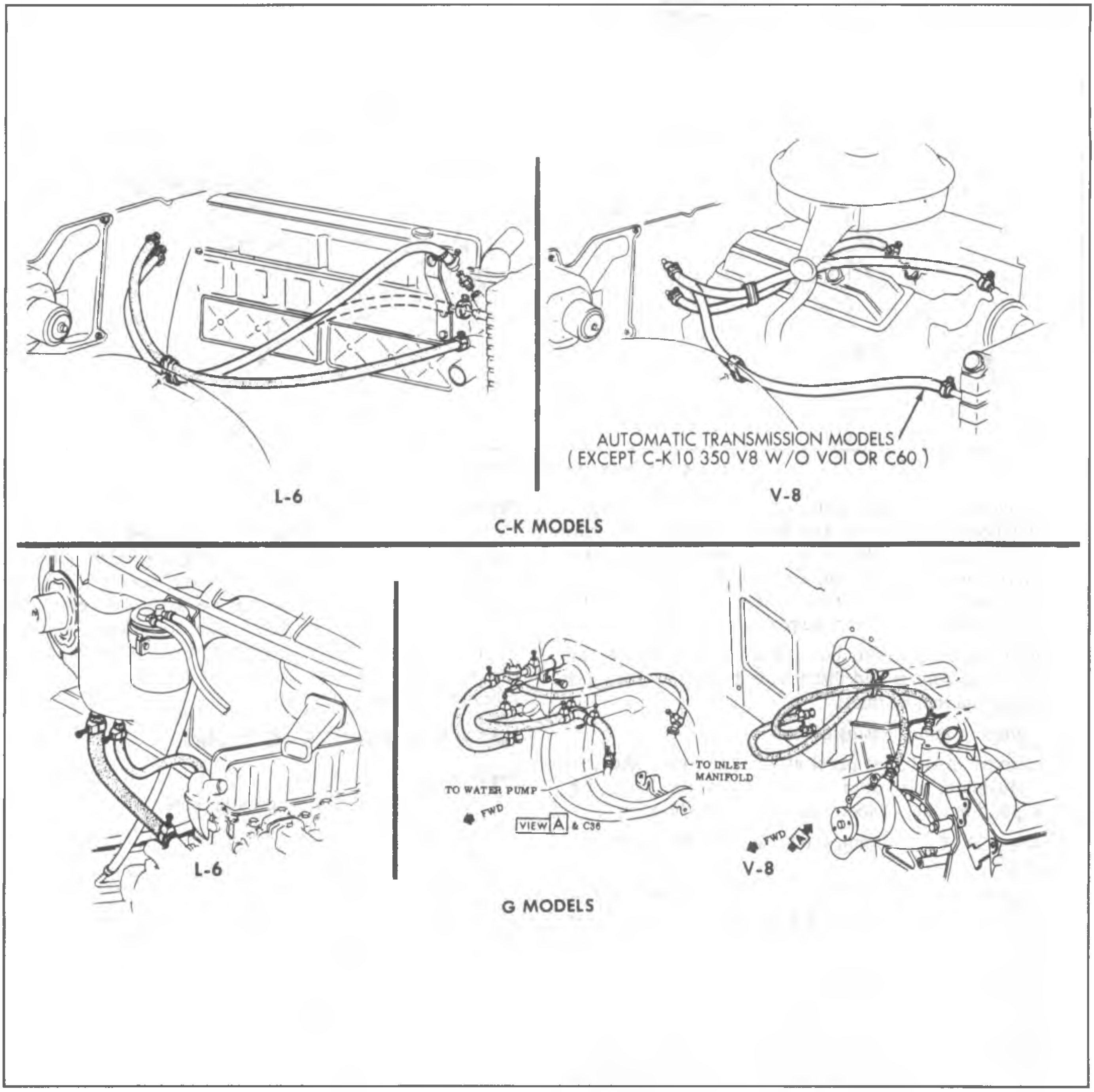


Fig. 1A-8--Heater Hose Routings

wiring harness. Be careful not to kink the bowden cables.

4. Remove the control through the opening above the control.
5. If a new unit is being installed, transfer the blower switch to the new unit.
6. To reinstall, reverse Steps 1 thru 4.

G Models

Replacement (Fig. 1A-15)

1. Disconnect the battery ground cable.
2. Remove I.P. bezel as outlined in Section 8C of this manual.
3. Remove the control to instrument panel mounting screws (3) and carefully pull the control rearward far enough to gain access to the bowden cable attachments. Care should be taken to prevent kinking the bowden cables while lowering the control.
4. Disconnect the bowden cables, the control illumination bulb, the blower switch connector and remove the control from the vehicle.
5. Remove the blower switch screws and remove the blower switch.
6. To install, reverse Steps 1 thru 4.

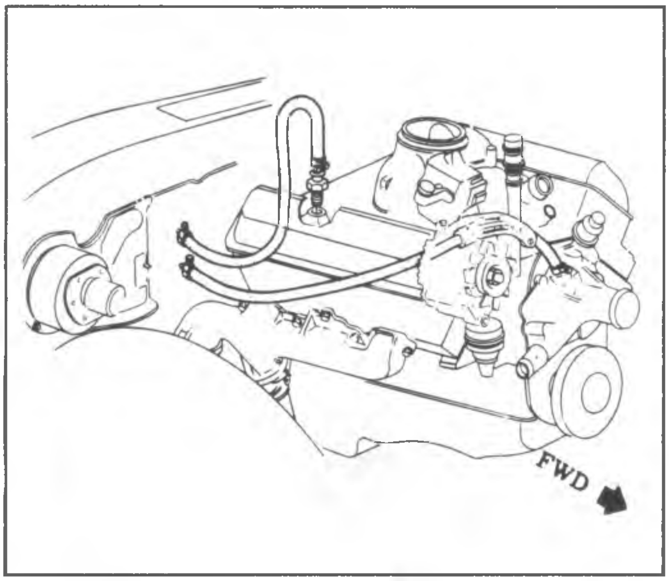


Fig. 1A-9--Heater Hose Routing-Diesel

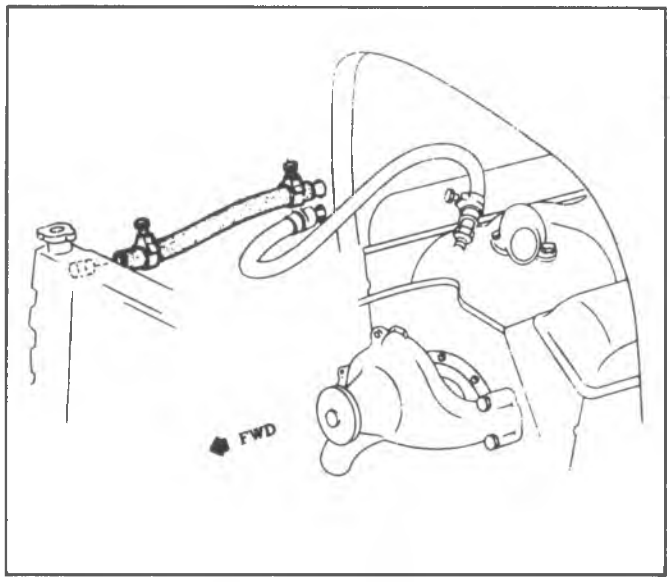


Fig. 1A-10--Heater Hose Routing V8

CONTROL CABLES (Fig. 1A-16, 1A-17)

C-K Models

Replacement

1. Disconnect the battery ground cable.
2. Remove the instrument panel bezel.
3. Remove the control to instrument panel screws.
4. Raise or lower control as necessary to remove cable push nuts and tab attaching screws.
5. Remove glove box and door as an assembly.
6. Remove cable push nut and tab attaching screw at door end of cable.
7. Remove cable from retaining clip and remove cable assembly.
8. To install, reverse Steps 1 thru 7. Be careful not to kink the cable during installation. Be sure to route the cable as when removed. Check cable adjustment.

G Models

Replacement (Fig. 1A-17)

Heater and defroster cable routing and attachment to control and to distributor case is shown in Fig. 1A-17.

If cable adjustment is required, refer to Adjustment, C-K Series.

Adjustment - C-K Series

1. Disconnect the battery ground cable.
2. Remove glove box and door as an assembly.
3. Pry off the appropriate cable eyelet clip and disconnect the cable from the door.
4. Remove the cable retaining screw.
5. While holding the cable with pliers, rotate the mounting tab on the cable to lengthen or shorten the cable, whichever is required.

   NOTICE: Do not pinch the cable too tightly or damage to the cable could result.
6. Install the cable, reversing Steps 1-4 above.

Adjustment - G Van

1. Attach inner cable and sheath to I.P. Control.
2. With I.P. installed, move temperature cable to cold and attach loop on inner cable to temperature door on heater case.
3. Attach cable sheath to heater case.
4. Move temperature lever to full heat. This will require some effort due to force required to slide inner cable clip to its proper position.

BLOWER SWITCH

C-K Models

Replacement (Fig. 1A-14)

1. Disconnect the battery ground cable.
2. Remove the instrument panel bezel.
3. Remove the control to instrument panel screws and lower the control onto the radio.
4. Disconnect the switch electrical harness.
5. Remove the switch attaching screws and remove the switch.
6. To install, reverse Steps 1-5 above.

G Models

Replacement (Fig. 1A-15)

1. Disconnect the battery ground cable.
2. Disconnect the blower switch wiring harness connector at the switch.
3. Remove the two switch attaching screws and remove the switch assembly.
4. To install a new switch, reverse Steps 1 thru 3.

RESISTOR

Replacement (Figs. 1A-5 and 1A-18)

1. Disconnect the wiring harness at the resistor connector.
2. Remove the two resistor mounting screws and remove the resistor.
3. To install a new resistor, reverse Steps 1 and 2 above.

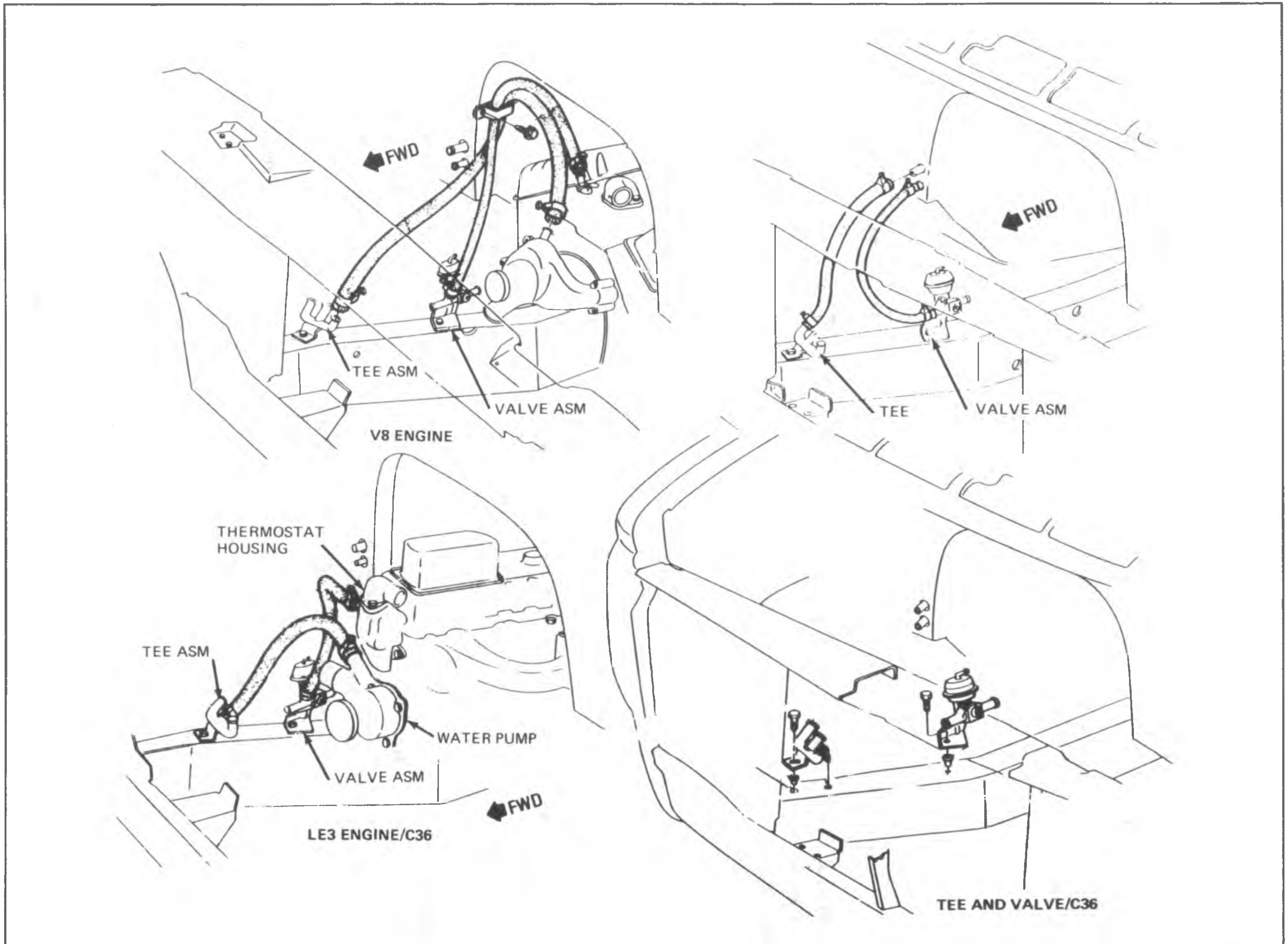


Fig. 1A-11--Heater Hose Routing G Series

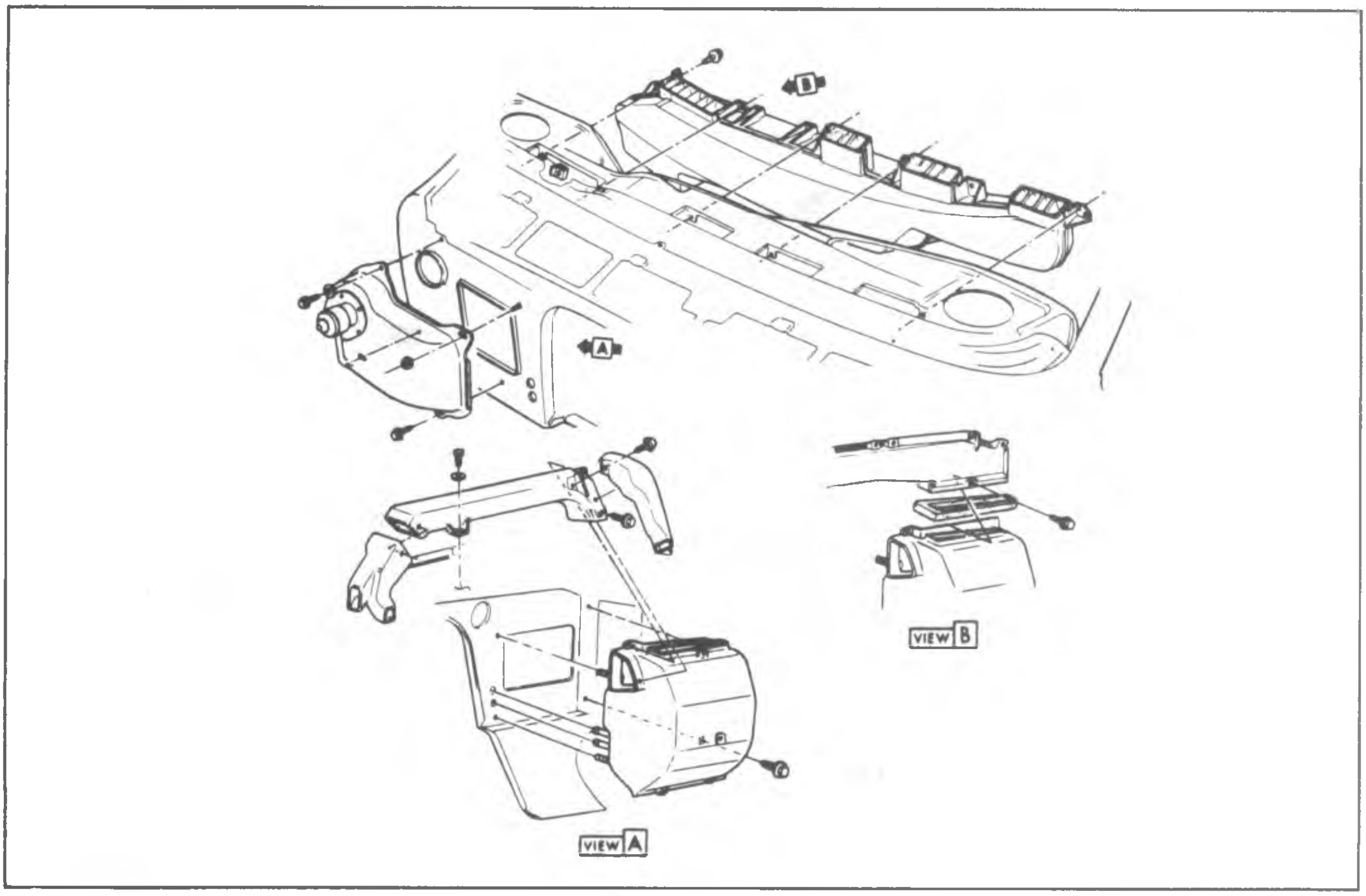


Fig. 1A-12--Distributor Ducts--G Models

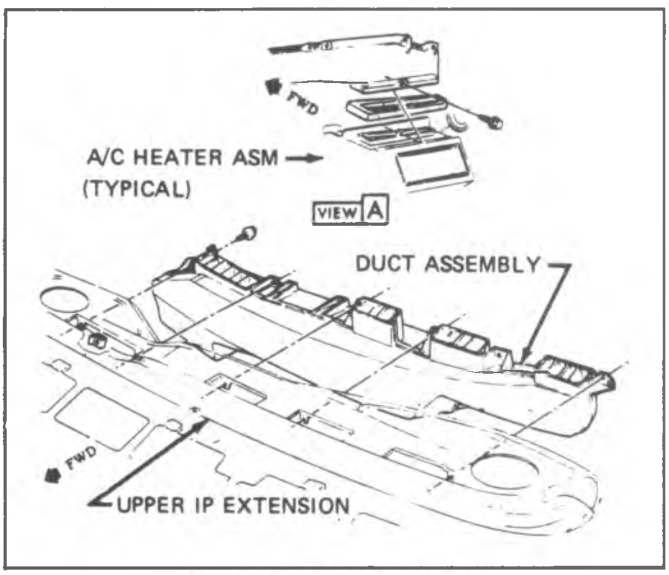


Fig. 1A-13--Defroster Outlets

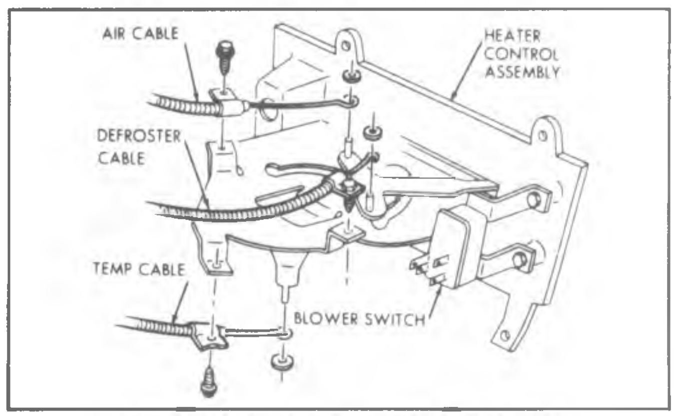


Fig. 1A-14--Control Assembly, C-K Models

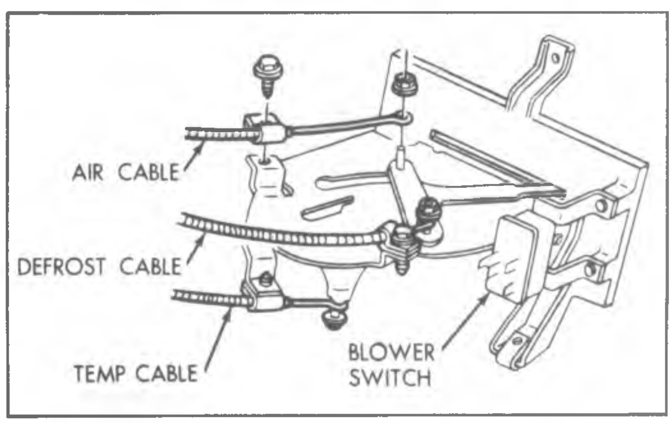


Fig. 1A-15--Control Assembly, G Models

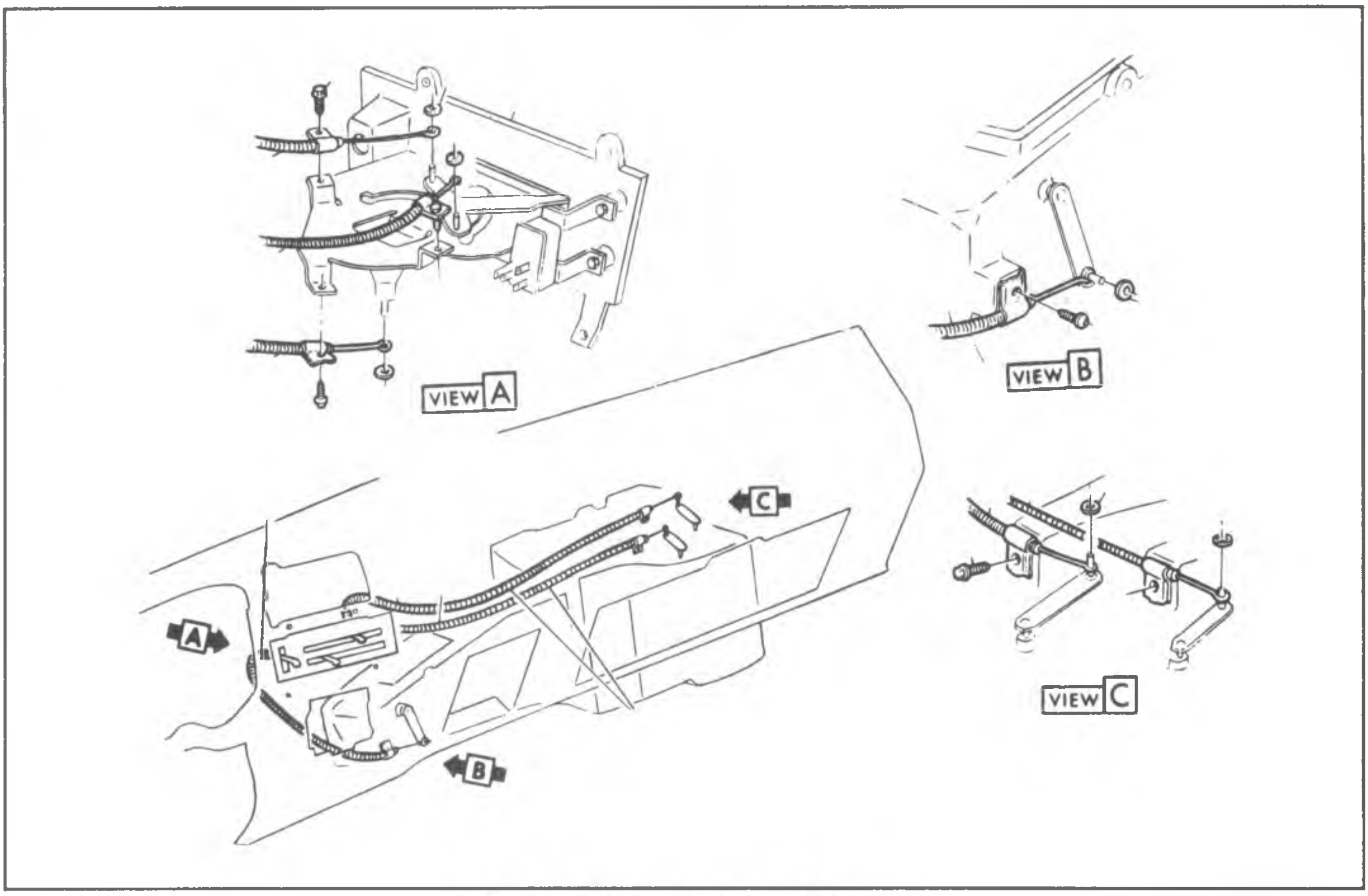


Fig. 1A-16--Control Cables, C-K Series

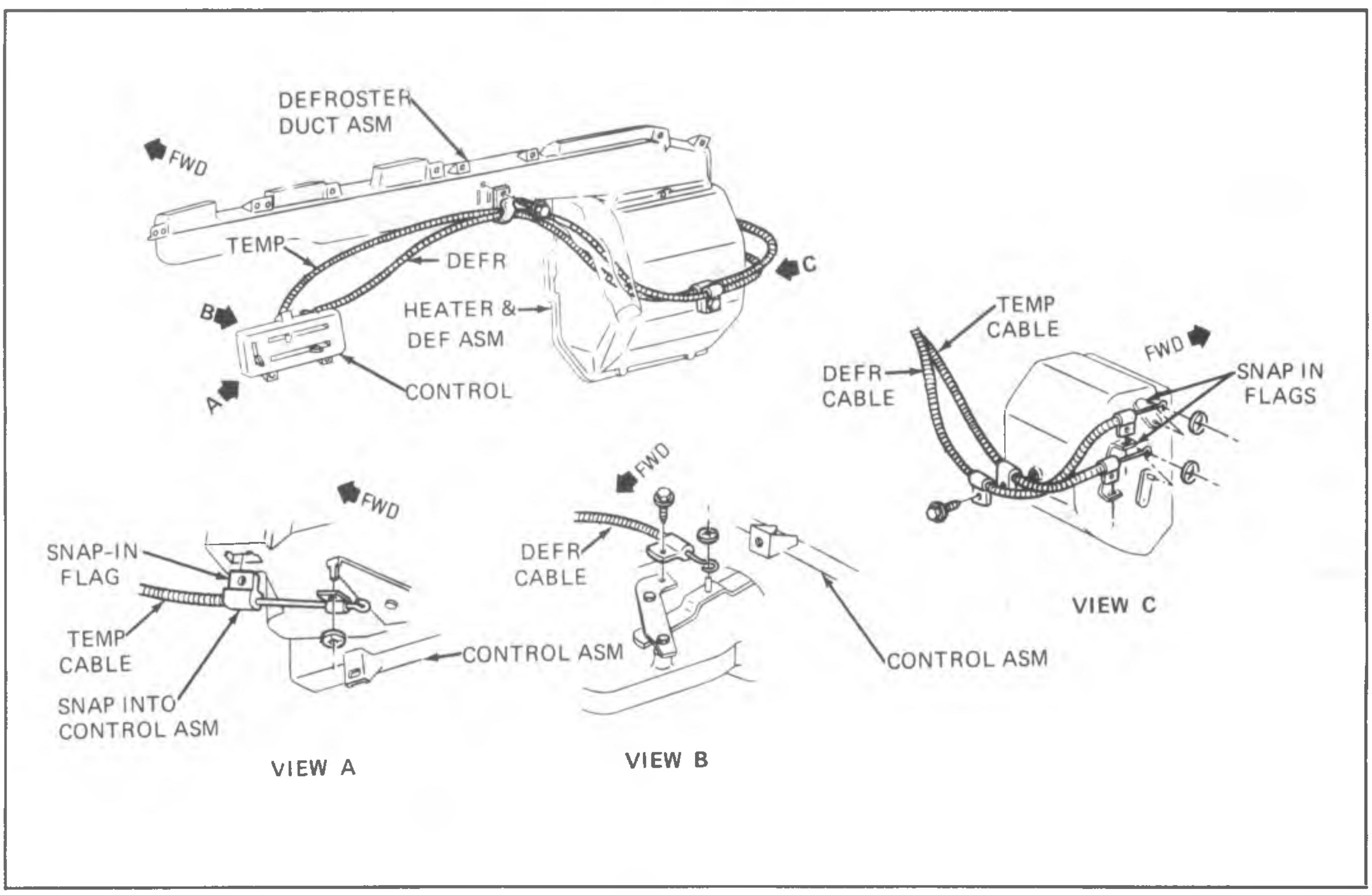


Fig. 1A-17--Control Cable Routing, G Models

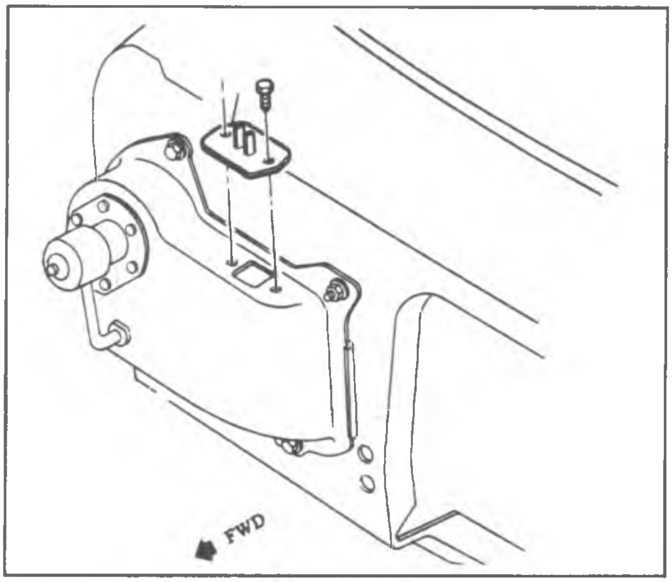


Fig. 1A-18--Resistor - G Models

AUXILIARY HEATER

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GENERAL DESCRIPTION

An auxiliary heater is available accessory to provide additional heating capacity for the rearmost extremities of the certain modles.

This unit operates entirely independent of the standard heater and is regulated through its own controls at the instrument panel.

This system consists of a separate core and fan unit mounted as shown in Fig. 1A-19.

Heater hoses extend from the unit to the front of the vehicle where they are connected to the standard heater hoses with "tees". An "on-off" vacuum operated water valve is installed in the heater core inlet line in the engine compartment. The purpose of the valve is to cut off coolant flow to the auxiliary core during warm weather and eliminate the radiant heat that would result.

CONTROLS

Two methods of control are employed with this system:

Water Valve (Refer Fig. 1A-11)

When heat is desired, and the fan switch is any position except off, a vacuum operated water valve controlled by the switch, opens the water line to permit hot water circulation through the heater core. In the OFF position the valve is closed to prevent unwanted heat during warm weather.

Fan Switch (Fig. 1A-20)

The three speed fan switch (LOW-MED-HI) is located in the instrument panel, to the right of the steering column.

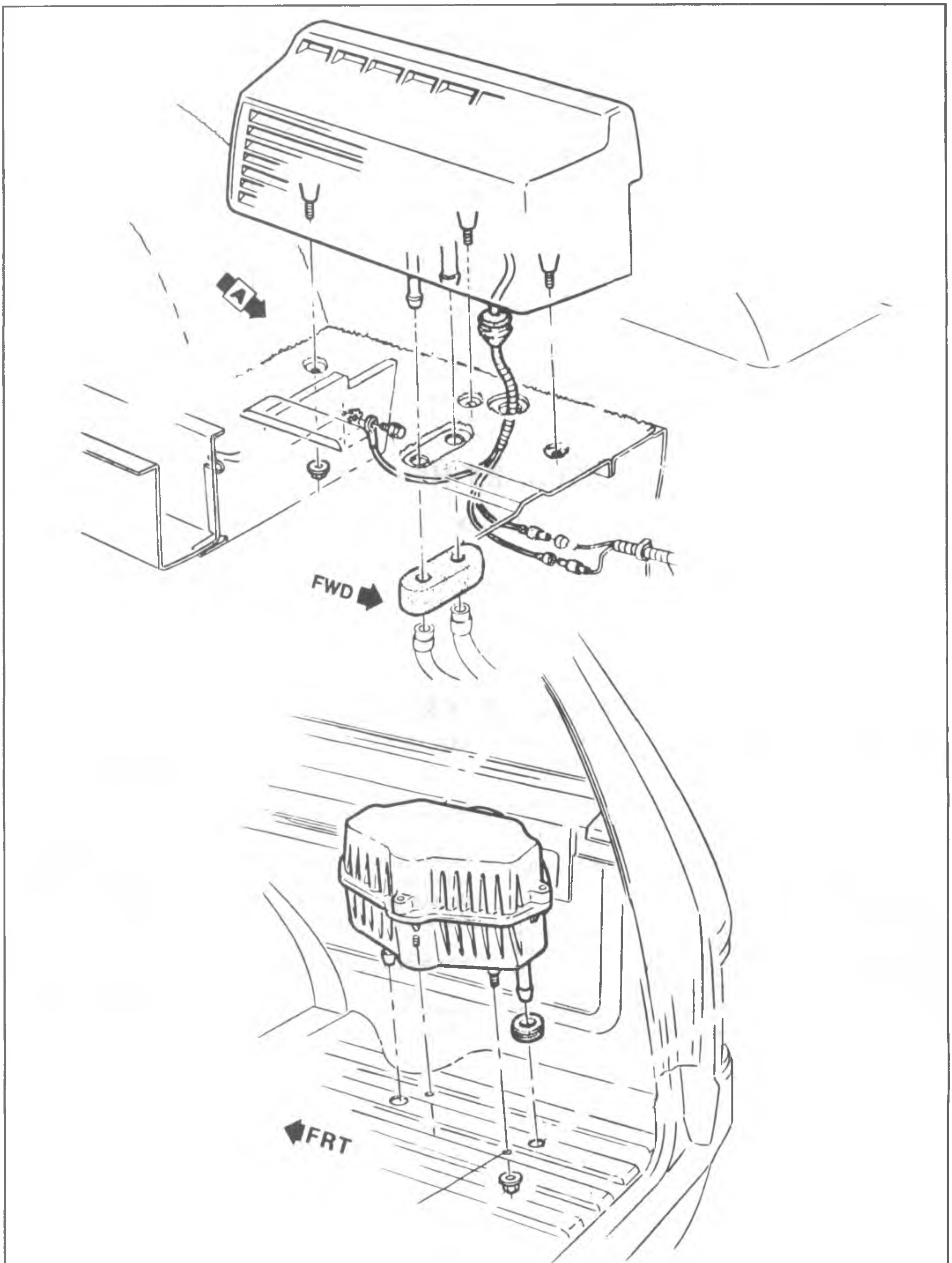

Fig. 1A-19--Auxiliary Heater Installation

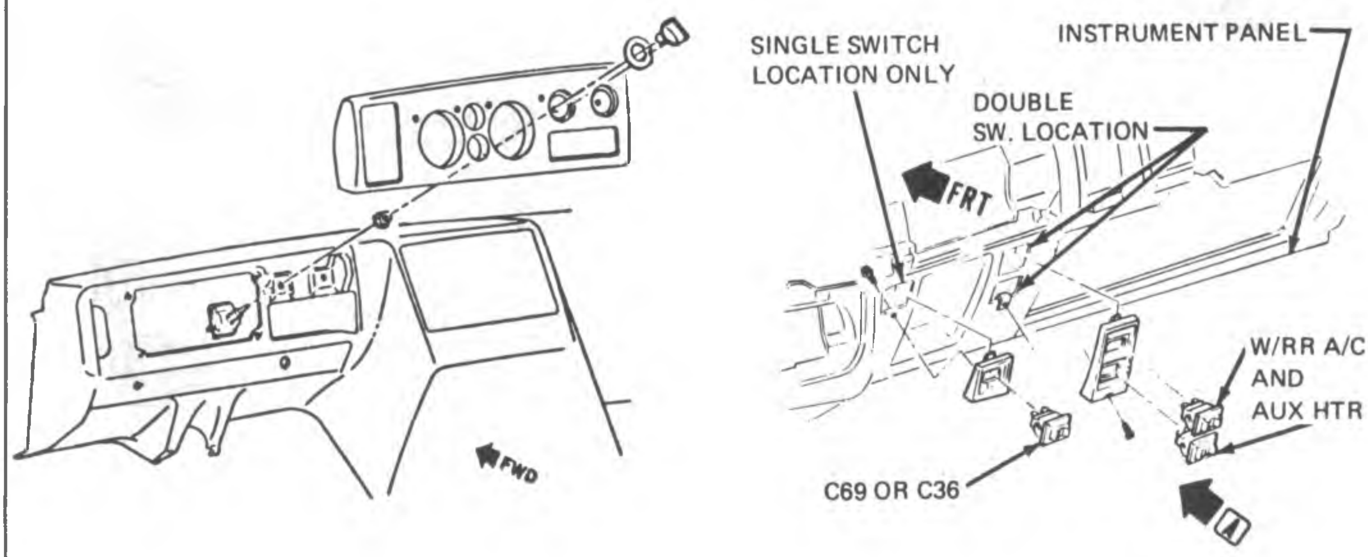

Fig. 1A-20--Auxiliary Heater Control

DIAGNOSIS

Refer to the "Standard Heater" section of this manual for diagnostic information; Refer to Electrical Diagram Fig. 1A-21.

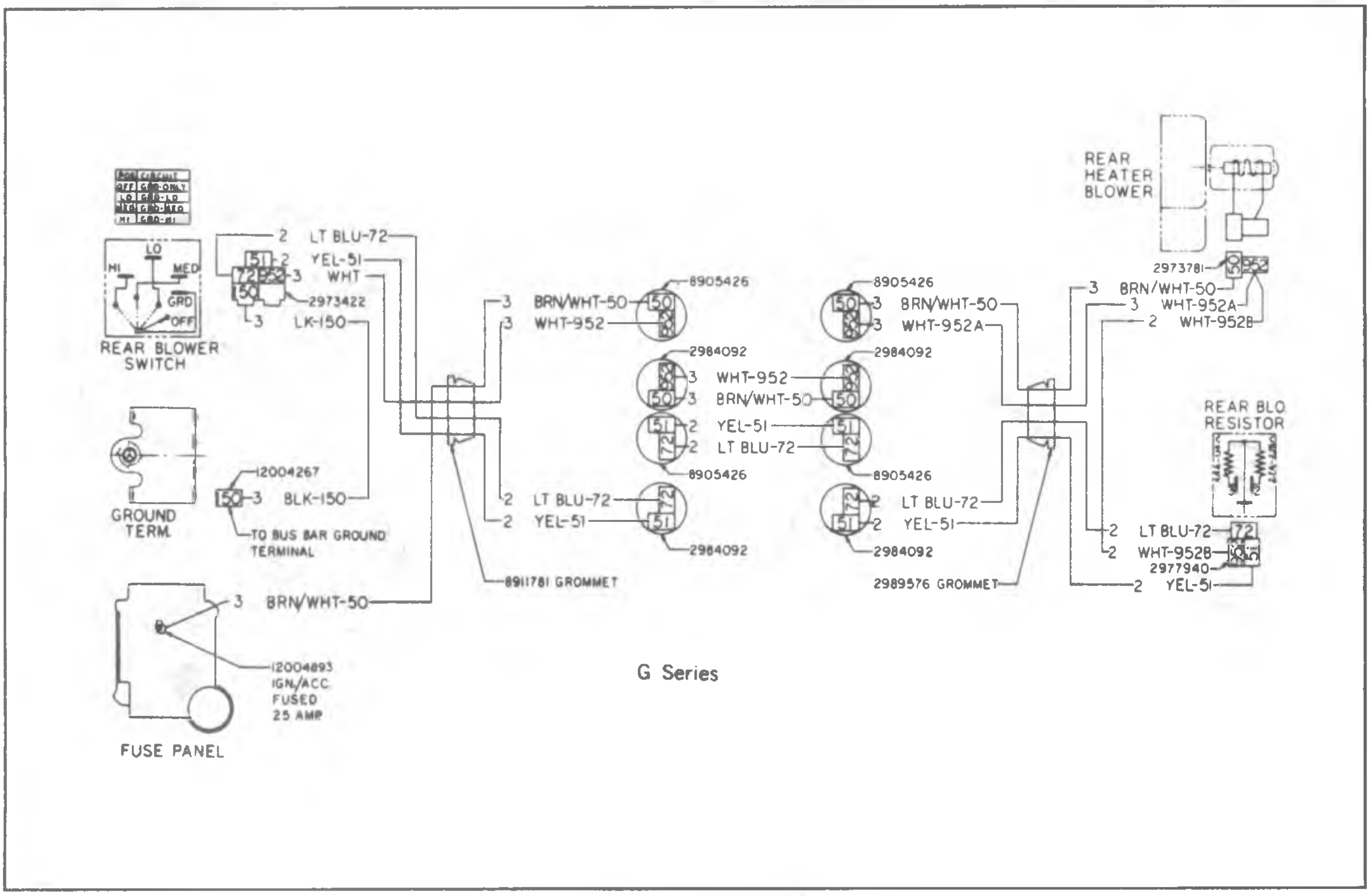

Fig. 1A-21--Electrical Diagram

ON VEHICLE SERVICE

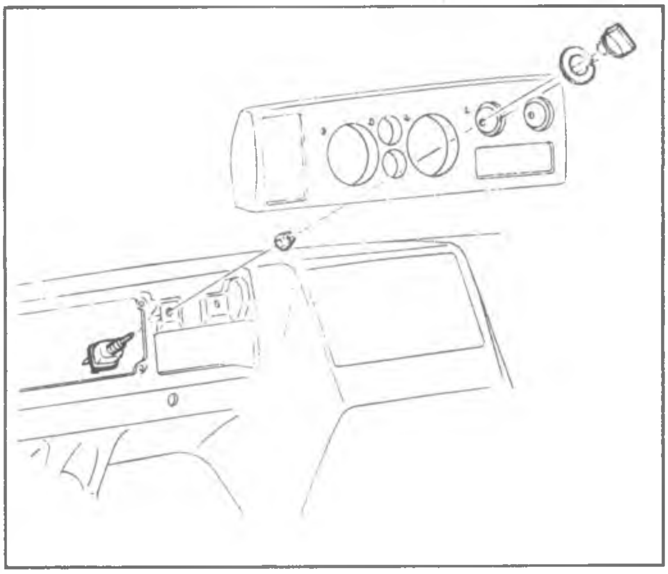

Fig. 1A-22--Control Mounting

Since a detailed list of installation instructions is included with the auxiliary heater unit, replacement procedures will not be repeated in this section.

On G Models--When replacing heater hoses, maintain a 1/2 in. minimum clearance between hose clip and upper control arm, a 1-1/2 in. minimum clearance between hoses and propshaft and a 1-1/4 in. minimum clearance between the auxiliary heater core lines and the exhaust pipe as shown in Fig. 1A-24. All Models--Draw hoses tight to prevent sag or rub against other components. Be sure to route hoses through all clamps as originally installed.

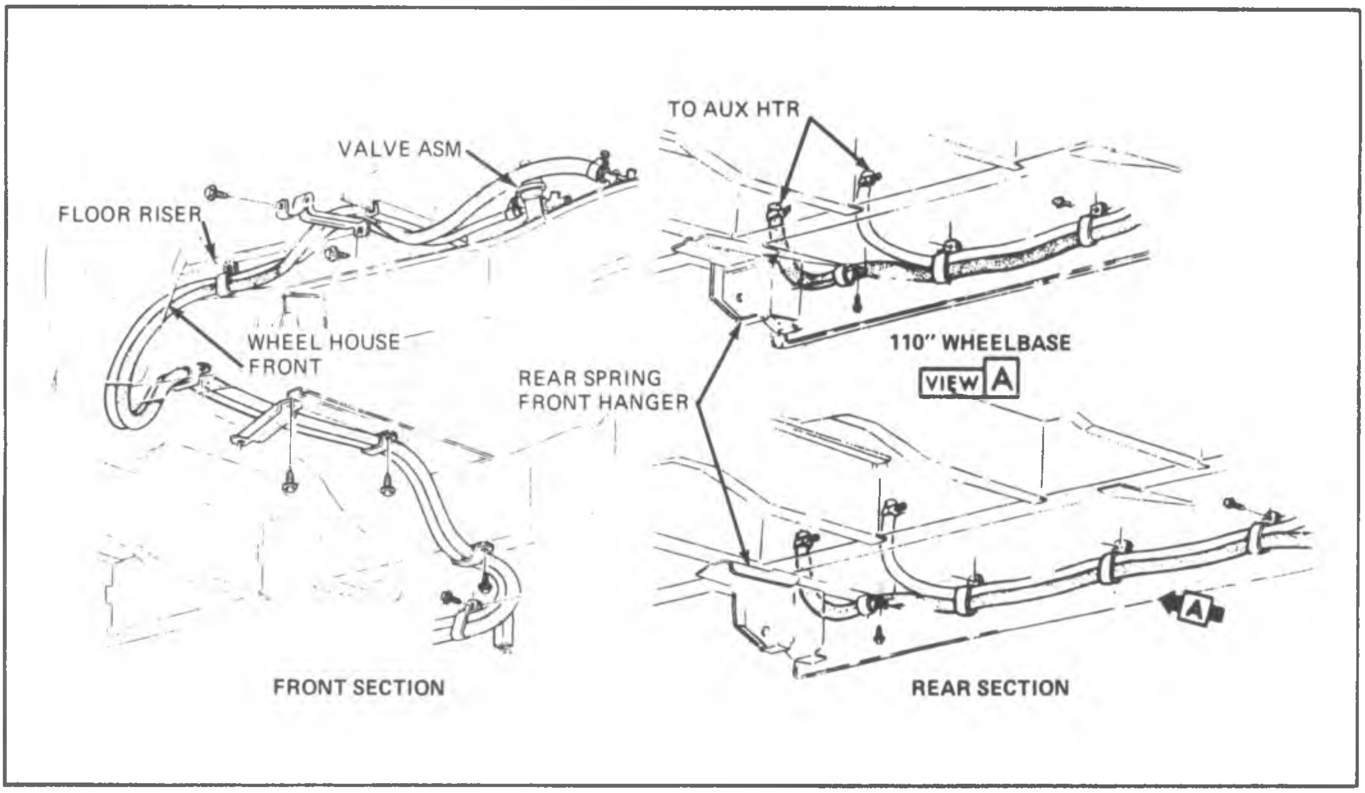

Fig. 1A-23--Auxiliary Heater Hose Routing

SPECIFICATIONS

SECTION 1A

HEATER

	Volts	Amps. (Cold)	RPM (Cold)
Blower Motor			
C-K Models	13.5	6.25 Max.	2550 Min. 2950 Max.
G Models	13.5	7.1 Max.	2850 Min. 3250 Max.

Fuses

C-K Models	20 Amp.
G Models	20 Amp.

AUXILIARY HEATER

	Volts	Amps. (Cold)	RPM (Cold)
Blower Motor	13.5	9.6 Max.	2700 Min.

SECTION 1B

AIR CONDITIONING

NOTICE: When performing air conditioning diagnosis on vehicles equipped with a catalytic converter, it will be necessary to warm the engine to a normal operating temperature before attempting to idle the engine for periods greater than five (5) minutes. Once the choke is open and fast idle speed reduced to a normal idle, diagnosis and adjustments can be made.

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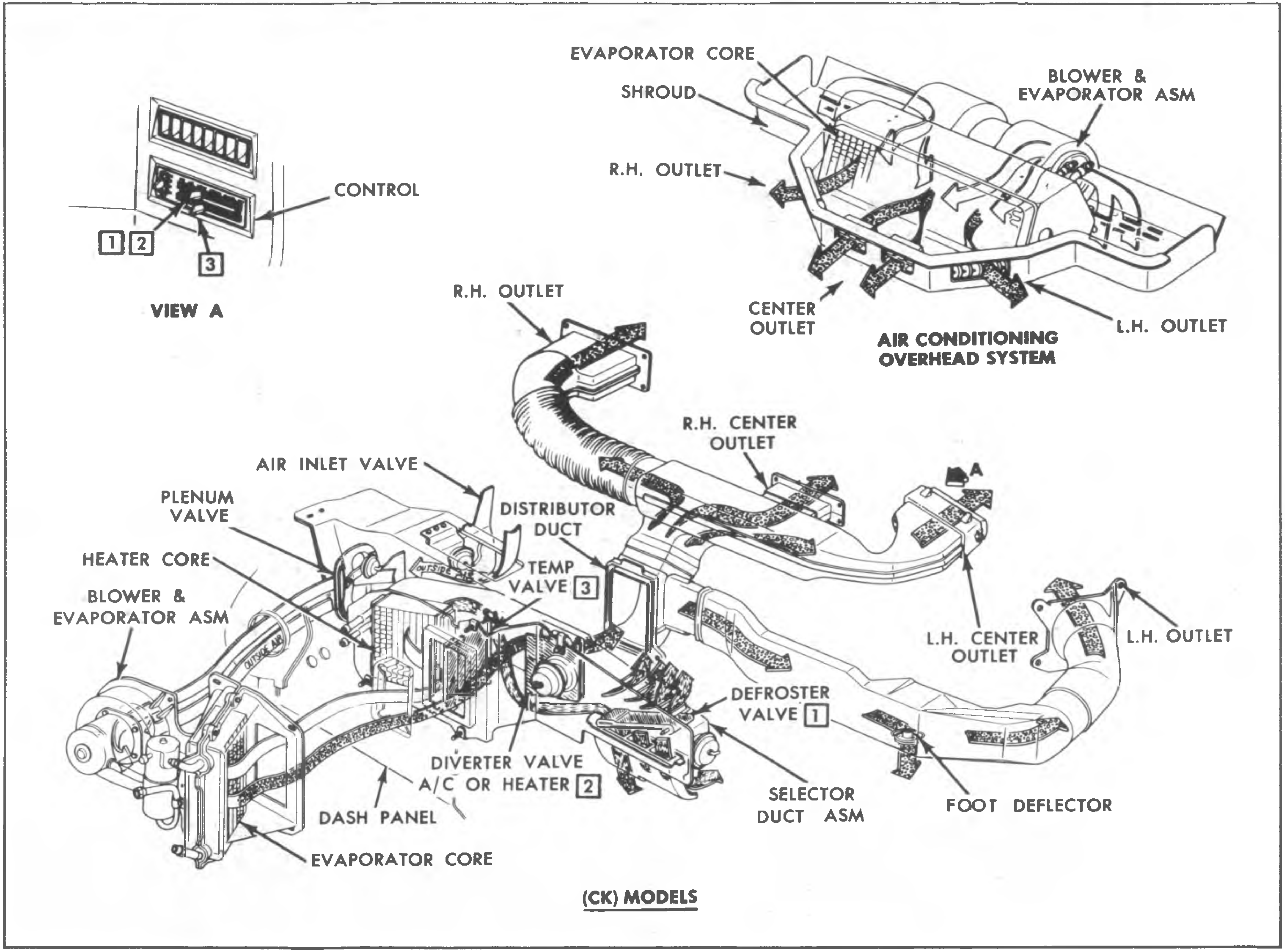


Fig. 1B-1--Airflow Chart - C-K Models

GENERAL DESCRIPTION

C60 A/C SYSTEM

Both the heating and cooling functions are performed by this system. Air entering the vehicle must pass through the cooling unit (evaporator) and through (or around) the heating unit, in that order, and the system is referred to as a "reheat" system.

The evaporator provides maximum cooling of the air passing through the core when the air conditioning system is calling for cooling.

On C-K and G Series, compressor operation is controlled by a pressure sensing switch, located near the top of the accumulator. The switch responds to pressure changes to turn the compressor ON or OFF, as required.

System operation is as follows:

Air, either outside air or recirculated air, enters the system and is forced through the system by the blower. As the air passes through the evaporator core, it receives maximum cooling if the air conditioning controls are calling for cooling. After leaving the evaporator, the air enters the heater and air conditioner selector duct assembly where, by means of diverter doors, it is caused to pass through or to bypass the heater core in the proportions necessary to provide the desired outlet temperature. Then conditioned air enters the vehicle through either the floor distributor duct or the dash outlets. During cooling operations, the air is cooled by the evaporator to below comfort level, it is then warmed by the heater to the desired temperature. During "heating only" operations, the evaporator will not be in operation and ambient air will be warmed to the desired level in the same manner.

AIR DISTRIBUTION OUTLETS

C-K Series

The dash outlets are rectangular in design. The outlets can be rotated horizontally or vertically to direct air as desired. Under the left distributor duct is located a floor cooler which can be rotated to provide cooling air or shut off completely.

G-Van

The dash outlets are rectangular in design and can be rotated horizontally or vertically to direct air as desired. Foot coolers are provided on both driver and passenger side.

In the heater-defrost modes, the air conditioning outside air door is closed. The heater air door is open and outside air is allowed to pass through the heater core (receiving maximum heating) and is then directed into the passenger compartment through the heater and/or defroster outlets.

OVERHEAD SYSTEMS (C-K & G SERIES)

These systems (C69 on C-K & G Series) operate in conjunction with the C60 System--they do not operate independently. However, control of rear blower motor speed is possible even when the front system is OFF, thus, rear air circulation without the refrigerant function may be had by operating the rear blower control switch.

These units are self contained, operating on inside (recirculated) air only. Air is drawn into the unit, passed through the evaporator core and then directed into the passenger compartment through the air distributor duct.

System control is through the front system. The only control on the overhead system is a three speed blower switch.

MOTOR HOME CHASSIS SYSTEM

This system performs the cooling functions only. When heating (above ambient temperatures) is desired, the vehicle heater must be used. When air conditioning is desired, the heater should be completely shut OFF.

This self-contained unit is bracket mounted to the dash by the body manufacturer. It operates on inside (recirculated) air only. Air is drawn into the unit, passed through the evaporator core (receiving maximum cooling) and then directed into the vehicle through adjustable outlets.

A thermostatic switch, located on the face plate is used to control compressor operation by sensing air temperature as it leaves the evaporator core.

SYSTEM COMPONENTS

Receiver-Dehydrator (Motor Home Chassis Models)

The receiver-dehydrator, serving as a reservoir for storage of high pressure liquid produced in the condenser, incorporates a screen sack filled with the dehydrating agent.

The receiver-dehydrator, used primarily as a liquid storage tank, also functions to trap minute quantities of moisture and foreign material which may have remained in the system after installation or service operations. A refrigerant sight glass is built into the receiver-dehydrator to be used as a quick check of the state and condition of charge of the entire system. The receiver-dehydrator is mounted near the condenser.

Sight Glass (Motor Home Chassis Models Only)

While having no real function to perform in the system, the sight glass is a valuable aid in determining whether or not the refrigerant charge is sufficient and for eliminating some guess work in diagnosing difficulties. The sight glass, is built into the receiver-dehydrator outlet connection and is designed and located so that a shortage of refrigerant at this point will be indicated by the appearance of bubbles beneath the glass. The dust cap provided should be kept in place when the sight glass is not in use.

Thermostatic Expansion Valve (Fig. 1B-2)

C-K and G overhead, and motor home chassis systems use a thermostatic expansion valve in place of a float system.

The valve consists primarily of the power element, body, actuating pins, seat and orifice. At the high pressure liquid inlet, is a fine mesh screen which prevents dirt, filings or other foreign matter from entering the valve orifice.

When the valve is connected in the system, high pressure liquid refrigerant enters the valve through the screen from the receiver-dehydrator or condenser and passes

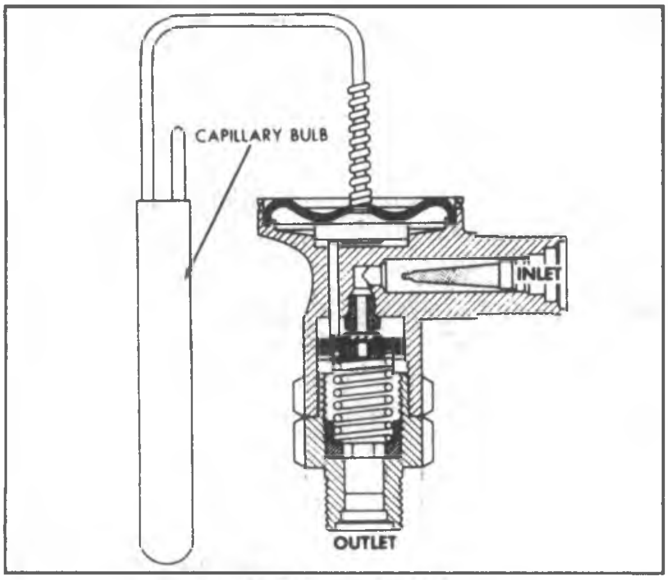


Fig. 1B-2--Expansion Valve

on to the seat and orifice. Upon passing through the orifice the high pressure liquid becomes low pressure liquid. The low pressure liquid leaves the valve and flows into the evaporator core where it absorbs heat from the evaporator core and changes to a low pressure vapor, and leaves the evaporator core as such. The power element bulb is clamped to the low pressure vapor line just beyond the outlet of the evaporator (Fig. 1B-2).

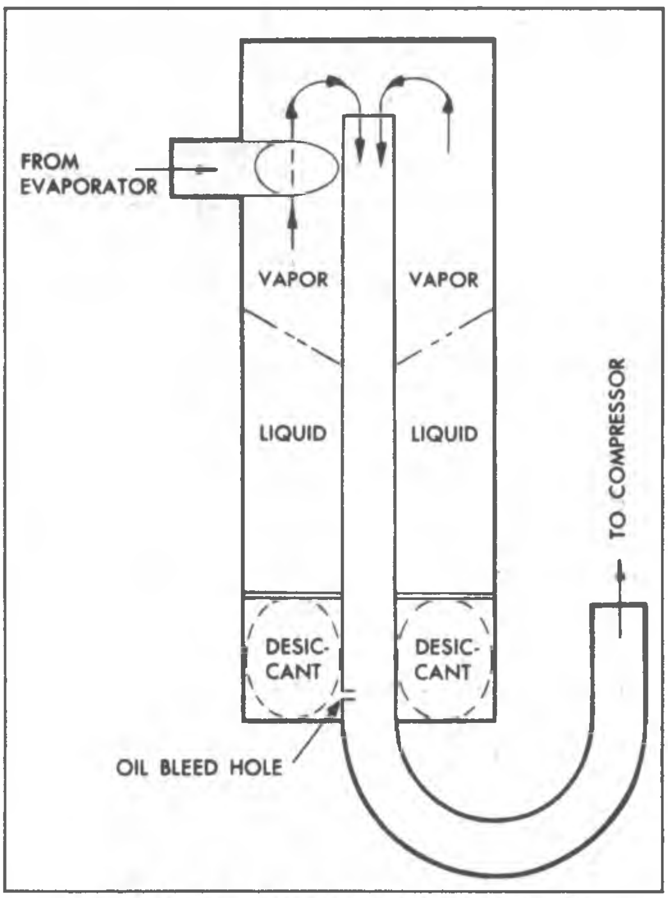


Fig. 1B-3--Accumulator-C-K, & G Series With C60

Accumulator--C-K, & G Series (Fig. 1B-3)

The accumulator is located at the evaporator outlet. Its most important function is not to "accumulate" although this too is important. Its primary function is to separate liquid retained from vapor, retain the liquid and release the vapor to the compressor.

Thus, in an ideal accumulator with no oil bleed hole, and in a correctly designed system, no liquid can get to the compressor.

In an actual accumulator, there is some entrained liquid in the vapor stream to the compressor.

Flow out of the accumulator to the compressor consists mostly of vapor with the addition of entrained liquid, and liquid flow through the oil bleed hole.

A bag of desiccant (dehydrating agent) is located in the accumulator as a moisture collecting device.

There is no sight glass in the accumulator-clutch cycle system.

Expansion Tube--C-K, & G Series

Expansion tube flow rate depends on pressure difference and on subcooling; however, the flow rate is more sensitive to subcooling.

The expansion tube is located in the evaporator inlet line (Fig. 1B-4).

Thermostatic Switch - Motor Home Chassis Units Only

System temperature is controlled by running the compressor intermittently, automatically turning it on and off as necessary to maintain proper temperatures. The compressor is started and stopped through the use of an electro-magnetic clutch and a thermostat affected by variations in temperature.

The thermostatic switch incorporates a metallic tube which contains a highly expansive gas. This tube is located in the air stream as it leaves the evaporator. The tube leads to a bellows operated switch. As air temperature rises, the gas inside the tube expands, travels through the tube to the bellows and closes the electrical switch which

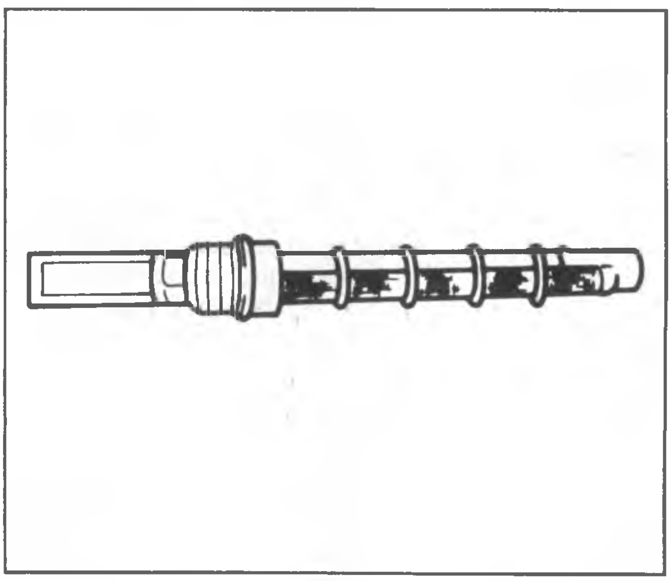


Fig. 1B-4--Expansion Tube

engages the compressor clutch.

As soon as the compressor starts running, the temperature begins to go down. As the air being cooled gets colder, the gas in the thermostatic tube begins to reduce the pressure on the switch bellows. This allows the switch contact to open and the compressor clutch disengages.

Pressure Cycling Switch - Low Refrigerant Charge

Protection System - C-K&G Series

Low refrigerant charge protection is afforded by the pressure cycling switch as a secondary function. When refrigerant pressure drops below a certain predetermined level, the switch opens the compressor clutch circuit, shutting the system OFF.

SYSTEM CONTROLS

C60 SYSTEM (C-K & G SERIES) - FIG. 1B-5

System Operation - C-K Truck

System operation is shown in Fig. 1B-6.

Vacuum Schematic - C-K Truck

The C-K Truck air conditioning vacuum schematic is shown in Fig. 1B-7.

System Operation - G Models

System operation is shown in Fig. 1B-8.

OVERHEAD SYSTEM (C-K SERIES)

This system operates in conjunction with the C60 system. Since refrigerant flow is controlled by the front system, the only control provided for on the overhead system is a three-speed fan switch (LOW, MED, HI). The fan switch is mounted in the instrument panel, to the right of the steering column (Fig. 1B-9).

In the OFF position, the blower is inoperative; however, refrigerant is circulating in the system if the C60 System is ON. In any of the three blower positions (LOW, MED, HI), the blower will be operative regardless if the Four-Season system is ON.

To obtain maximum cooling, the Four-Season System should be on A/C, temperature lever on COLD, blower switch on HI and the overhead unit blower switch should be on HI.

OVERHEAD SYSTEM (G MODELS)

This system operates in conjunction with the C60 system. Since refrigerant is controlled by the C60 system, the only control provided on the rear overhead system is a three speed blower switch (Fig. 1B-10).

In the OFF position, the blower is inoperative; however, refrigerant is circulating in the system if the front system is ON. To operate the rear overhead system, simply select the desired blower speed (LOW, MED, HI).

When air circulation only is desired, the rear A/C blower motor may be operated independent of the front A/C blower motor and without the cooling function.

DASH MOUNTED UNIT (MOTOR HOME CHASSIS UNITS)

This system is self contained and is mounted below the dash by the body manufacturer. System controls consist of an AIR knob and TEMP knob located in the center of the unit face plate (Fig. 1B-11).

Air Knob

Turning the AIR knob clockwise operates a three speed (LOW-MED-HI) blower motor.

Temp Knob

This knob is used to control the degree of cooling desired. Fully clockwise at CITY provides maximum cooling, while turning the knob to HIWAY provides adequate cooling for highway operation.

Reduced cooling could be encountered when operating at highway speeds with the controls at the CITY setting. The heater must be fully off to obtain maximum cooling.

CCOT SYSTEM COMPONENTS

CCOT Refrigerant System components and refrigerant flow are shown in Fig. 1B-12. Fig. 1B-13 shows pressure temperature relationships of R-12.

Refrigerant Capacities

Refrigerant charge is shown in Fig. 1B-14.

HANDLING REFRIGERANT-12

Air conditioning systems contain Refrigerant-12. This is a chemical mixture which requires special handling procedures to avoid personal injury.

Always wear goggles and wrap a clean cloth around fittings, valves and connections when performing work that involved opening the refrigerant system. Always work in a well ventilated area and do not weld or steam clean on or near any car installed air conditioning lines or components.

If Refrigerant-12 should come in contact with any part of the body, flush the exposed area with cold water and immediately seek medical help.

All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for this same reason.

If it is necessary to transport or carry any container of Refrigerant-12 in a vehicle, do not carry it in the passenger compartment.

If the occasion arises to fill a small Refrigerant-12 drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion.

1. Do not leave drum of Refrigerant-12 uncapped.
2. Do not carry any container of Refrigerant-12 in passenger compartment of car.
3. Do not subject any container of Refrigerant-12 to high temperature.
4. Do not weld or steam clean on or near system.
5. Do not fill drum of Refrigerant-12 completely.
6. Do not discharge vapor into area where flame is exposed.
7. Avoid breathing smoke and fumes produced by the burning of the Refrigerant-12. Such fumes may be hazardous.
8. One of the most important cautions concerns the eyes. Any liquid Refrigerant-12 which may

1 CONDITIONED AIR IS DIRECTED THROUGH W/SHLD. I.P. & FLOOR DISTRIBUTOR OUTLETS.

CONDITIONED AIR IS DIRECTED THROUGH I.P. OUTLETS.

2 IN THIS MODE LEVER POSITION, MAXIMUM COOLING IS OFFERED WITH THE CONDITIONED AIR DISTRIBUTED THROUGH I.P. OUTLETS AT ANY BLOWER SPEED.

3 A NON-COMPRESSOR OPERATING POSITION, WITH OUTSIDE AIR DELIVERED THROUGH I.P. OUTLETS.

4 A NON-COMPRESSOR OPERATING POSITION, WITH OUTSIDE AIR DISTRIBUTED ABOUT 80% TO FLOOR & 20% TO W/SHLD.

5 CONDITIONED AIR DISTRIBUTED ABOUT 80% TO W/SHLD. & 20% TO FLOOR.

6 VACUUM OPERATED SYSTEM SELECTOR (MODE) LEVER.

7 TEMPERATURE LEVER POSITION REGULATES TEMPERATURE OF THE AIR ENTERING THE PASSENGER COMPARTMENT BY CABLE OPERATION OF THE HEATER CORE TEMPERATURE DOOR.

8 4-SPEED FAN CONTROL LEVER.

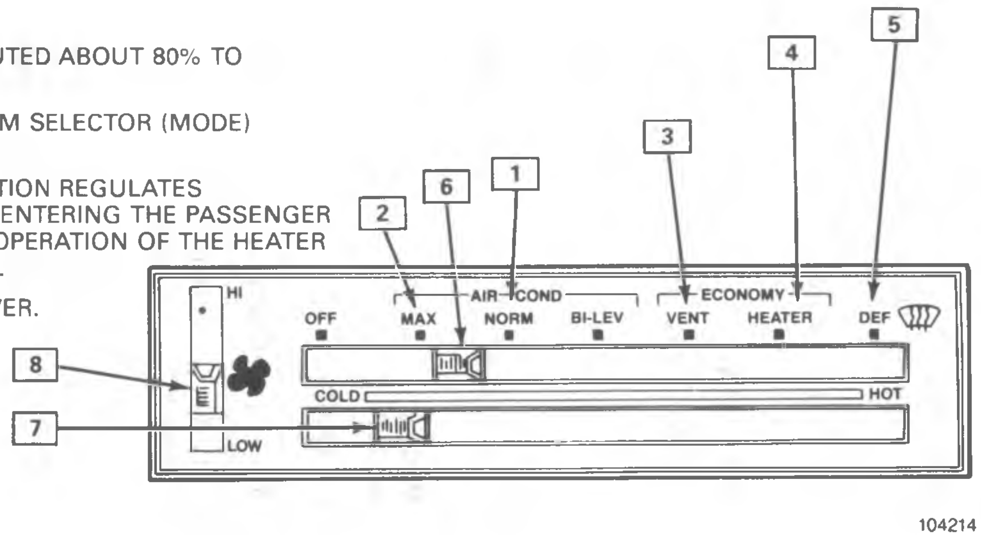


Fig. 1B-5--C60 System Controls (C-K & G Series)

SELECTOR LEVER POSITION	COMPRESSOR	BLOWER SPEEDS AVAIL	AIR SOURCE	AIR ENTERS VEHICLE	HEATER A/C DOOR-OPEN TO:	HEATER DEFROSTER DOOR-OPEN TO:
OFF	OFF	LOW	OUTSIDE	FLOOR OUTLETS	HEATER	HEATER
MAX A/C	ON	HI	INSIDE%	DASH OUTLETS	A/C	HEATER
NORM A/C	ON	ALL	OUTSIDE	DASH OUTLETS	A/C	HEATER
BI-LEVEL	ON	ALL	OUTSIDE	FLOOR AND DASH OUTLETS	A/C & HEATER	HEATER
VENT	OFF	ALL	OUTSIDE	DASH OUTLETS	A/C	HEATER
HTR	OFF	ALL	OUTSIDE	FLOOR OUTLETS	HEATER	HEATER
DEF	ON	ALL	OUTSIDE	DEFROST OUTLETS	HEATER	DEFROST

NOTE % 100% Inside air is not available, some bleed through of outside air is allowed.

Fig. 1B-6--System Operation - C-K Truck

accidentally escape is approximately 21°F (-6°C) below zero. If liquid Refrigerant-12 should touch the eyes, serious damage could result. Always wear goggles to protect the eyes when opening refrigerant connections. If Refrigerant-12 liquid should strike the eye:

a. Call a doctor or eye specialist immediately and obtain treatment as soon as possible.

b. DO NOT RUB THE EYE. Splash the affected area with quantities of cold water to gradually get the temperature above the freezing point.

c. The use of an antiseptic oil is helpful in providing a protective film over the eyeball to reduce the possibility of infection. Should liquid Refrigerant-12 come into contact with the skin, the injury should be treated the same as skin which has been frostbitten or frozen.

All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for the same reason.

If it is necessary to transport or carry any container of Refrigerant-12 in a car, keep it in the luggage compartment. If the drum is exposed to the radiant heat of the sun, the resultant increase in pressure may cause the safety plug to release or the drum to burst.

Welding or steam cleaning near any of the refrigerant lines or components of the air conditioning system could build up dangerous and damaging pressures in the system.

If the occasion arises to fill a small Refrigerant-12

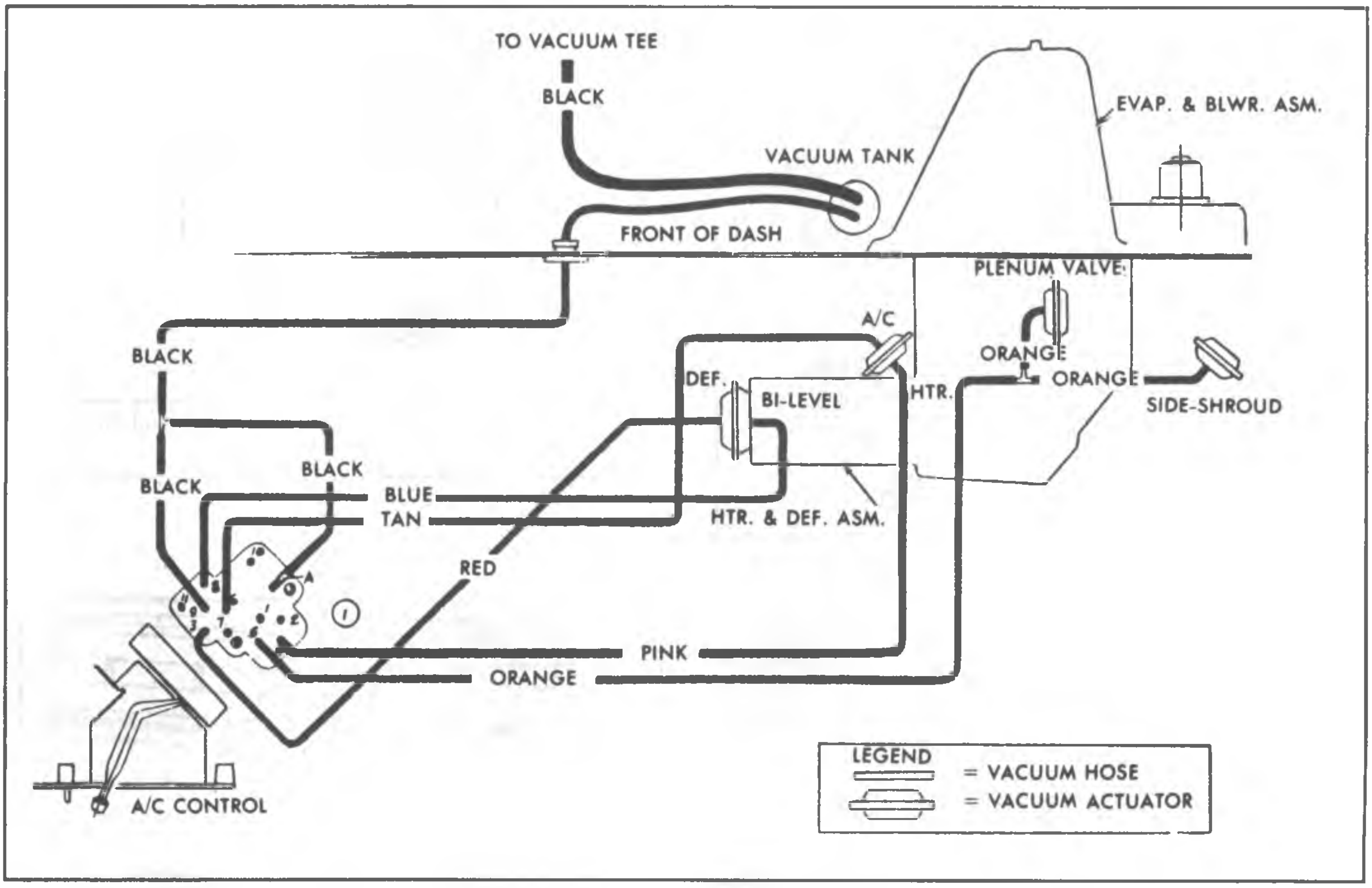


Fig. 1B-7--Air Conditioning Vacuum Schematic - C-K Truck

COMPRESSOR		BLOWER SPEEDS AVAIL	AIR SOURCE	AIR ENTERS VEHICLE	HEATER DEFROSTER DOOR	HEATER A/C DOOR
					OPEN TO	OPEN TO
OFF	OFF	NONE	OUTSIDE	FLOOR OUTLETS	HEATER	HEATER-DEF
MAX	ON	ALL	INSIDE %	DASH OUTLETS	HEATER	A/C
NORM	ON	ALL	OUTSIDE	DASH OUTLETS	HEATER	A/C
BI LEV	ON	ALL	OUTSIDE	DASH OUTLETS FLOOR OUTLETS	HEATER	A/C & HEATER
VENT	OFF	ALL	OUTSIDE	DASH OUTLETS	HEATER	A/C
HEATER	OFF	ALL	OUTSIDE	BLEED TO DEFROST & FLOOR OUTLETS	HEATER	HEATER
DEFR	ON*	ALL	OUTSIDE	DEFROST OUTLETS	DEFROST	HEATER

*PROVIDED COMPRESSOR PRESSURE SWITCH CLOSED

Fig. 1B-8--System Operation - G Models

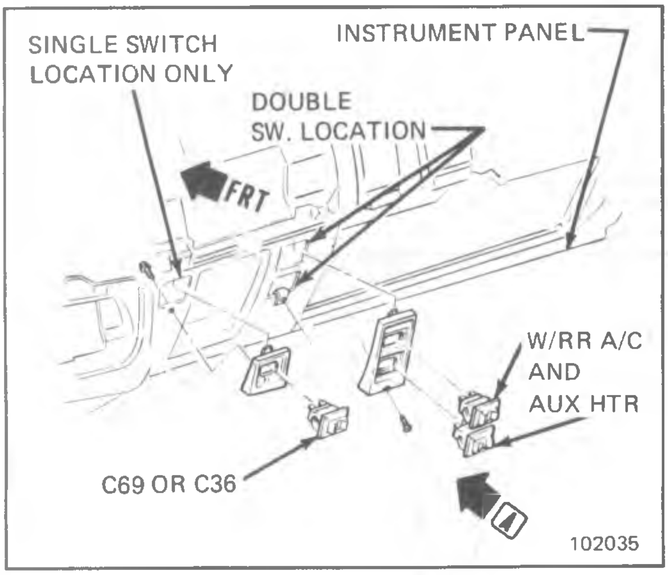


Fig. 1B-9--Overhead Unit Control (C-K Series)

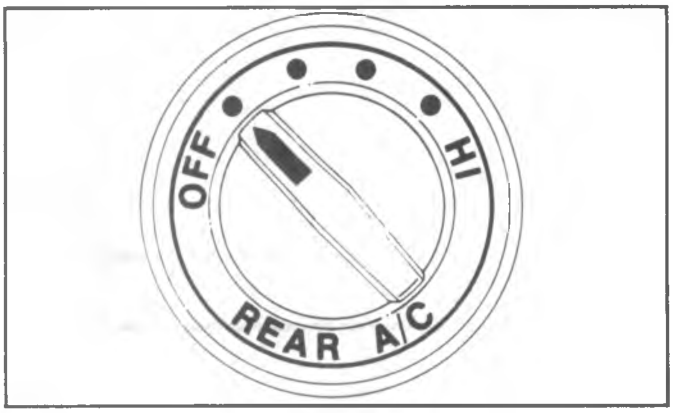


Fig. 1B-10--Overhead Unit Control (G Models)

drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the Refrigerant-12 drum were completely full and the temperature was increased, tremendous hydraulic force could be developed.

HANDLING OF REFRIGERANT LINES AND FITTINGS

Tighten all tubing connections as shown in torque chart 1B-15. Insufficient or excessive torque when tightening can

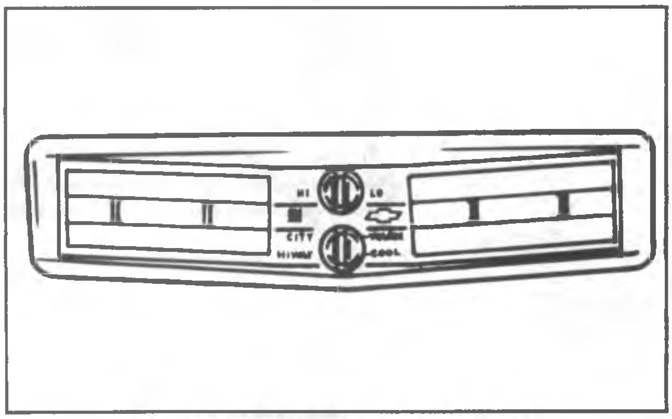
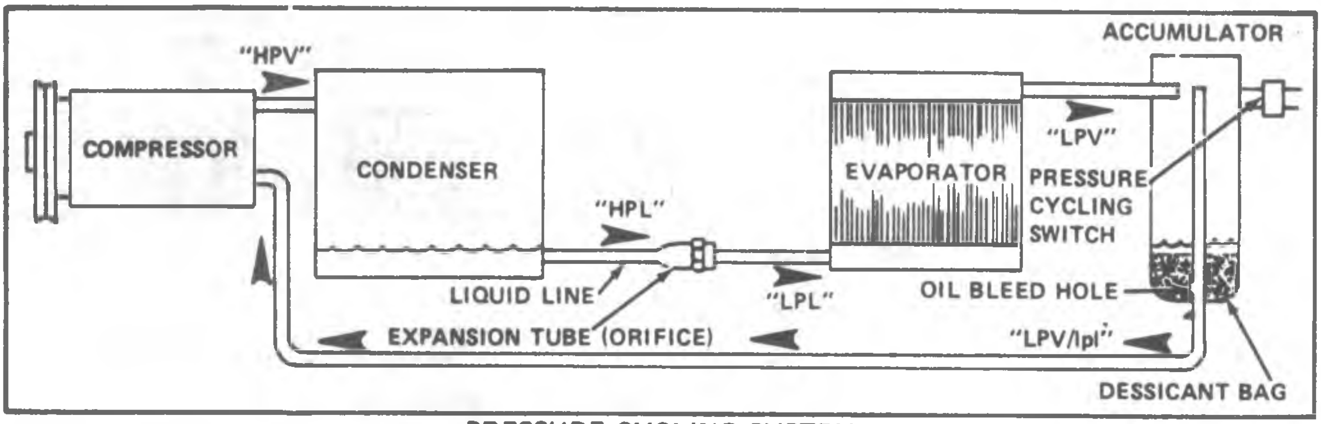


Fig. 1B-11--Motor Home Unit Control



PRESSURE CYCLING SYSTEM

"HPV" – HIGH PRESSURE VAPOR LEAVING COMPRESSOR.

"HPL" – VAPOR IS COOLED DOWN BY CONDENSER AIR FLOW AND LEAVES AS HIGH PRESSURE LIQUID.

"LPL" – ORIFICE METERS THE LIQUID R-12, INTO EVAPORATOR, REDUCING ITS PRESSURE, AND WARM BLOWER AIR ACROSS EVAPORATOR CORE CAUSES BOILING OFF OF LIQUID INTO VAPOR.

"LPV" – LEAVES EVAPORATOR AS LOW PRESSURE VAPOR AND RETURNS WITH THE SMALL AMOUNT OF . . .

"lpl" – . . . LOW PRESSURE LIQUID THAT DIDN'T BOIL OFF COMPLETELY BACK TO THE COMPRESSOR TO BE COMPRESSED AGAIN.

Fig. 1B-12--CCOT System Components

result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

- All metal tubing lines should be free of dents or kinks to prevent loss of system capacity due to line restriction.
- The flexible hose lines should never be bent to a radius of less than 4 times the diameter of the hose.
- The flexible hose lines should never be allowed to come within a distance of 63.5mm (2-1/2 in.) of the exhaust manifold.
- Flexible hose lines should be inspected regularly for leaks or brittleness and replaced with new lines if deterioration or leaking is found.
- When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant-12. However, proceed very cautiously regardless of gage readings. Open very slowly, keeping face and hands away so that no injury can occur if there happens to be liquid Refrigerant-12 in the line. If pressure is noticed

REFRIGERANT — 12 PRESSURE — TEMPERATURE RELATIONSHIP

The table below indicates the pressure of Refrigerant — 12 at various temperatures. For instance, a drum of Refrigerant at a temperature of 80°F (26.6°C) will have a pressure of 84.1 PSI (579.9 kPa). If it is heated to 125°F (51.6°C), the pressure will increase to 167.5 PSI (1154.9 kPa). It also can be used conversely to determine the temperature at which Refrigerant — 12 boils under various pressures. For example, at a pressure of 30.1 PSI (207.5 kPa), Refrigerant — 12 boils at 32°F (0°C).

(°F)	(°C)	(PSIG)	(kPa)
-21.7	-29.8C	0(ATMOSPHERIC PRESSURE)	0(kPa)
-20	-28.8C	2.4	16.5
-10	-23.3C	4.5	31.0
-5	-20.5C	6.8	46.9
0	-17.7C	9.2	63.4
5	-15.0C	11.8	81.4
10	-12.2C	14.7	101.4
15	- 9.4C	17.7	122.0
20	- 6.6C	21.1	145.5
25	- 3.8C	24.6	169.6
30	- 1.1C	28.5	196.5
32	0C	30.1	207.5
35	1.6C	32.6	224.8
40	4.4C	37.0	255.1
45	7.2C	41.7	287.5
50	10.0C	46.7	322.0

(°F)	(°C)	(PSIG)	(kPa)
55	12.7C	52.0	358.5
60	15.5C	57.7	397.8
65	18.3C	63.7	439.2
70	21.1C	70.1	482.7
75	23.8C	76.9	530.2
80	26.6C	84.1	579.9
85	29.4C	91.7	632.3
90	32.2C	99.6	686.7
95	35.0C	108.1	745.3
100	37.7C	116.9	806.0
105	40.5C	126.2	870.2
110	43.3C	136.0	937.7
115	46.1C	146.5	1010.1
120	48.8C	157.1	1083.2
125	51.6C	167.5	1154.9
130	54.4C	179.0	1234.2
140	60.0C	204.5	1410.0

Fig. 1B-13--Pressure Temperature Relationships of R-12

Refrigerant Charge

	C60 System
C-K Models	3 lbs.
G Models	3 lbs.
	Overhead System
C-K Models	5 lbs. 4 oz.
G Models	4 lbs. 8 oz.

Fig. 1B-14--A/C System Refrigerant Capacities

when fitting is loosened, allow it to bleed off as described under DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.

- In the event any line is opened to atmosphere, it should be immediately capped or taped to prevent entrance of moisture and dirt, which can cause internal compressor wear or plugged lines, condenser and evaporator core, expansion tubes (orifice) or compressor inlet screens.
- The use of the proper wrenches when making connections on "O" ring fittings is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
- "O" rings and seats must be in perfect condition. A burr or piece of dirt may cause a refrigerant leak.

Always replace the "O" ring when a connection has been broken. When replacing the "O" ring, first dip it in clean 525 viscosity refrigeration oil.

- Where steel to aluminum connections are being made, use torque for aluminum tubing (Refer to Fig. 1B-15).

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation of the air conditioning refrigeration system is dependent upon the chemical

METAL TUBE OUTSIDE DIAMETER	THREAD AND FITTING SIZE	STEEL TUBING TORQUE		ALUMINUM OR COPPER TUBING TORQUE		NOMINAL TORQUE WRENCH SPAN
		LB. FT.	N·m	LB. FT.	N·m	
1/4	7/16	10-15	14-20	5-7	7-9	5/8
3/8	5/8	30-35	41-48	11-13	15-18	3/4
1/2	3/4	30-35	41-48	15-20	20-27	7/8
5/8	7/8	30-35	41-48	21-27	29-37	1 1/16
3/4	1 1/16	30-35	41-48	28-33	38-45	1 1/4

Fig. 1B-15--Pipe and Hose Connection-Torque Chart

stability of the refrigeration system.

When foreign materials, such as dirt, air or moisture contaminate the system, they will change the stability of Refrigerant-12. They will also affect pressure-temperature relationships, reduce efficient operation, possibly cause interior corrosion and abnormal wear of moving parts.

The following general practices should be observed to ensure chemical stability in the system:

1. Before disconnecting a refrigerant connection, wipe away any dirt or oil at and near the connection to reduce the possibility of dirt entering the system. Both sides of the connection should be capped, plugged or taped as soon as possible to prevent the entrance of dirt, foreign material and moisture.
2. Keep tools clean and dry. This includes the manifold gage set and replacement parts.
3. When adding 525 viscosity refrigerant oil (Refer to ADDING OIL in the Discharging, Adding Oil, Evacuating and Charging Procedures for CCOT A/C Systems), the transfer device and container should be clean and dry to assure that refrigeration oil remains as moisture free as possible.
4. When it is necessary to "open" an A/C system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the A/C system open any longer than is necessary.
5. Any time the A/C system has been "opened," it should be properly Evacuated before recharging with Refrigerant-12 according to the DISCHARGING ADDING OIL, EVACUATING & CHARGING PROCEDURES FOR CCOT A/C SYSTEMS.

All service parts are dehydrated and sealed prior to shipping. They should remain sealed until just prior to making connections. All parts should be at room temperature before uncapping (this prevents condensation of moisture from the air entering the system). If, for any reason, caps are removed, but the connections are not made, parts should be resealed as soon as possible.

DIAGNOSIS

TESTING THE REFRIGERANT SYSTEM

If a malfunction in the refrigerant system is suspected due to abnormal system pressures, check the following:

1. Check outer surfaces of radiator and condenser cores to be sure they are not plugged with dirt, leaves or other foreign material. Be sure to check between the condenser and radiator as well as the outer surfaces.
2. Restrictions or kinks in evaporator core or condenser core, hoses, tubes, etc.
3. Refrigerant leaks.
4. Check all air ducts for leaks or restrictions. Air restriction may indicate a plugged (or partially plugged) evaporator core.
5. Compressor clutch slippage.
6. Improper drive belt tension.
7. Plugged accumulator, expansion tube (orifice) or plugged suction inlet screen (A6 Compressor).
8. Excessive moisture in refrigerant system.

LEAK TESTING THE REFRIGERANT SYSTEM

Liquid Leak Detectors

There are a number of locations (fittings, valves, etc.) on the air conditioning system where a liquid leak detector solution may be used to pinpoint refrigerant leaks.

By applying test solution to the area in question with the swab that is attached to the bottle cap, bubbles will form within seconds if there is a leak.

For restricted access areas, such as sections of the evaporator and condenser, a Leak Detector such as J-6084 or equivalent is more practical for determining and locating leaks.

J-6084 Leak Detector

Tool J-6084 is a propane gas-burning torch which is used to locate a leak in any part of the system. Refrigerant gas drawn into the sampling tube attached to the torch will cause the torch flame to change color in proportion to the size of the leak. Propane gas fuel cylinders used with the torch are readily available commercially throughout the country.

CAUTION: Do not use a lighted detector in any place where combustible or explosive gases, dusts or vapors may be present.

Operating Detector

1. Determine if there is sufficient refrigerant in the system for leak testing.
2. Open control valve only until a low hiss of gas is heard, then light gas at opening in chimney.
3. Adjust flame until desired volume is obtained. This is most satisfactory when blue flame is approximately 3/8 in. above reactor plate. The reaction plate will quickly heat to a cherry red.
4. Explore for leaks by moving the end of the sampling hose around possible leak points in the system. Do not pinch or kink hose.

   Since Refrigerant-12 is heavier than air, it is good practice to place open end of sampling tube immediately below point being tested, particularly in cases of small leaks.

   CAUTION: Do not breathe the fumes that are produced by the burning of Refrigerant-12 gas in the detector flame, since such fumes can be toxic in large concentrations.

5. Watch for color changes. The color of the flame which passes through the reaction plate will change to green or yellow-green when sampling hose draws in very small leaks of Refrigerant-12. Large leaks will be indicated by a change in color to a brilliant blue or purple; when the sampling hose passes the leaks, the flame will clear to an almost colorless pale-blue again. Observations are best made in a semi-darkened area. If the flame remains yellow when unit is removed from leak, insufficient air is being drawn in or the reaction plate is dirty.

   A refrigerant leak in the high pressure side of the system may be more easily detected if the system is operated for a few minutes, then shut off and checked immediately (before system pressures equalize). A leak on the low pressure side may be more easily detected after the engine has been shut off for several minutes (system pressures equalized); this applies particularly to the front seal.

PRESSURE CYCLING CCOT SYSTEM

C60, C-K and G MODELS

Compressor clutch cycling on C-K&G Series C60 CCOT A/C Systems is accomplished through the use of a pressure sensing switch, located near the top of the accumulator. The switch performs two functions in the system. In addition to cycling the compressor on and off to control refrigerant flow, the switch shuts off the compressor clutch when pressure falls to a predetermined level, indicating low refrigerant charge in the system.

When diagnosis (Refer to Fig. 1B-16 & 1B-17) indicates replacement of the switch is necessary, it should be noted that it will not normally be necessary to discharge the A/C system, as the pressure switch fitting on the accumulator is equipped with a schrader type valve.

When replacing the pressure cycling switch, a new oiled "O" ring must be installed and the switch must be torqued to 10 N·m (7.5 ft lb). Do not exceed this torque, as the threads in the accumulator may be stripped.

ELECTRICAL/VACUUM TROUBLE DIAGNOSIS

When diagnosing problems in the electrical and vacuum systems of the air conditioning system, consult electrical wiring diagrams and vacuum diagrams.

Ports on rotary vacuum valves are illustrated in a manner to provide simplicity in following vacuum schematic lines but are numbered in consecutive order on the actual valve.

OPERATIONAL TEST

To aid in determining whether or not the air conditioning electrical, vacuum and refrigeration systems are operating properly and efficiently, proceed with the following steps.

1. Operation of the air conditioning blower at all four speeds and engagement of the compressor clutch would indicate that electrical circuits are functioning properly.
2. The same hand-felt temperature of the evaporator inlet pipe and the accumulator can surface of an operating system would indicate a properly charged R-12 system.
3. Operation of the A/C control selector (mode) lever to distribute air from designed outlets would indicate proper vacuum and diaphragm function.

VACUUM SYSTEM DIAGNOSIS

C-K and G, C60 SYSTEM

Start the engine and allow it to idle - move the selector lever to each position and refer to the vacuum diagrams and operational charts for proper airflow, air door functioning and vacuum circuits. If air flow is not out of the proper outlets at each selector lever position, then proceed as follows:

1. Check for good hose connections--at the vacuum actuators, control head valve, reservoir, tees, etc.
2. Check the vacuum source circuit as follows:

   Install vacuum tee and gage (with restrictor) at the vacuum tank outlet. Idle the engine and read the vacuum (a normal vacuum is equivalent to manifold vacuum) at all selector lever positions.

   a. Vacuum Less Than Normal At All Positions -

      Remove the tee and connect the vacuum gage line directly to the tank - read the vacuum. If still low, then the problem lies in the feed circuit, the feed circuit to the tank or in the tank itself. If vacuum is now normal, then the problem lies downstream.

   b. Vacuum Less Than Normal at Some Positions.

      If vacuum was low at one or several of the selector lever positions, a leak is indicated in these circuits.

   c. Vacuum Normal at All Positions;

      If vacuum was normal and even at all positions, then the malfunction is probably caused by improperly connected or plugged lines or a defective vacuum valve or valves.

3. Specific Vacuum Circuit Check

   Place the selector lever in the malfunctioning position and check for vacuum at the pertinent vacuum actuators. If vacuum exists at the actuator but the door does not move, then the actuator is defective or the door is mechanically bound. If low or no vacuum exists at the actuator, then the next step is to determine whether the cause is the vacuum harness or the vacuum valve. Check the vacuum harness first.

4. Vacuum Harness Circuit Check

   a. Disconnect the vacuum harness at the control head.

   b. The black line (#1) should show engine vacuum - if not, trace back through connector to vacuum tank.

   c. To check any individual circuit place the selector lever at the involved circuit position and check for vacuum presence.

A/C REFRIGERANT SYSTEM DIAGNOSIS

INSUFFICIENT COOLING "QUICK-CHECK" PROCEDURE

The following CCOT "Hand-Feel" procedure can be used to quickly determine whether or not the A/C system has the proper charge of Refrigerant-12 (providing ambient temperature is above 21°C (70°F) This check can be made in a matter of minutes, simplifying system diagnosis by pinpointing the problem to the amount of Refrigerant-12 charge in the system or by eliminating this possibility from the over-all checkout.

1. Engine must be warm (CHOKE OPEN and OFF FAST IDLE SPEED CAM) and at normal idle speed.
2. Hood and body doors open.
3. Selector (mode) lever set at NORM.
4. Temperature lever at COLD.
5. Blower on HI.
6. "Hand-Feel" temperature of evaporator inlet pipe after orifice and accumulator can surface with compressor engaged.

   a. BOTH SAME TEMPERATURE AND SOME DEGREE COOLER THAN AMBIENT--Proper condition: check for other problems (Refer to A/C System Diagnostic Procedure).

   b. INLET PIPE COOLER than accumulator surface low refrigerant charge.

      - Add slight amounts 120 ml (1/4 lb.) of refrigerant UNTIL BOTH feel the same temperature. Allow stabilization time between additions.
      - Then add 420 ml (.88 lbs.) one can additional refrigerant. (The 420 ml/14 oz. disposable can of Refrigerant-12 is the equivalent to .88 lbs.)

   c. INLET PIPE HAS FROST ACCUMULATION-Accumulator surface warmer; proceed as in Step b above.

INSUFFICIENT COOLING — A/C SYSTEMS WITH CYCLING CLUTCH — EXPANSION TUBE (PRESSURE SENSING)

MOVE TEMP. LEVER RAPIDLY BACK AND FORTH FROM HOT TO COLD. LISTEN FOR DOOR HITTING AT EACH END

HITTING

NOT HITTING

Adjust Temp. Door

1. SET TEMP. LEVER FULL COLD
2. SET SELECTOR LEVER NORM A/C
3. SET BLOWER SWITCH ON HIGH
4. OPEN DOORS AND HOOD
5. WARM ENGINE
6. RUN ENGINE AT IDLE

Feel for Air Flow at Heater and A/C Outlets

SOME OR ALL AIR FLOW FROM HEATER OUTLET

Repair as per Service Manual

AIR FLOW FROM A/C OUTLETS ONLY

Check Visually for Compressor Clutch Operation

ENGAGED OR CYCLING

This System Does Not Have a Sight Glass. Under No Circumstances Should a Sight Glass Be Installed

Feel Liquid Line Before Expansion Tube

COLD

Restriction in High Side of System. Visually Check for Frost Spot to Locate Restriction. Repair as Necessary

Evacuate & Charge

System (O.K.)

WARM

Feel Evaporator Inlet and Outlet Pipes

INLET PIPE AND OUTLET PIPE SAME TEMPERATURE OR OUTLET COLDER THAN INLET

Install Gage Set and Check Compressor Cycling Press.

ON at 282.6-351.6 kPa (41-51 PSI)
OFF at 138-193 kPa (20-28 PSI)

RUNS CONTINUOUSLY WITHIN LIMITS

Disconnect Blower Wire and Check For Cycling Off at 138-193 kPa (20-28 PSI)

PRESSURE FALLS BELOW 20 PSI

Defective Pressure Switch

Replace. *Do Not Discharge System. There is a Schrader Valve in the Fitting

System (O.K.)

CYCLES OFF AT 138-193 kPa (20-28 PSI) OR DOES NOT PULL DOWN TO PRESS.

CYCLES WITHIN LIMITS

CYCLES HIGH OR LOW (ON ABOVE 51 PSI OR OFF BELOW 20 PSI)

Defective Pressure Switch

Replace. *Do Not Discharge System. There Is a Schrader Valve in the Fitting

System (O.K.)

Install Thermometer in A/C Outlet and Check Performance

1. SET TEMP. LEVER TO FULL COLD
2. SET SELECTOR LEVER TO MAX A/C
3. SET BLOWER SWITCH ON HI
4. CLOSE DOORS AND WINDOWS
5. RUN ENGINE AT 2000 R.P.M.
6. USE AUX. FAN IN FRONT OF GRILL

AMBIENT TEMP		21°C (70°F)	27°C (80°F)	32°C (90°F)	38°C (100°F)	43°C (110°F)
A/C OUTLET TEMP.	PICK UP	5-8°C (41-47)	5-8°C (41-47)	6-10°C (42-50)	6-11°C (43-57)	6-11°C (43-51)
	SUBURBAN	6-9°C (42-48)	6-9°C (42-48)	10-14°C (50-58)	12-17°C (54-62)	14-19°C (57-67)

OUTLET TEMPERATURE WITHIN LIMITS

System (O.K.)

OUTLET TEMPERATURE HIGH AS PER CHART

Check Compressor Cycling

ON CONTINUOUSLY

**Discharge System and Check For Missing Expansion Tube

MISSING

Install Expansion Tube

Evacuate & Charge

System (O.K.)

IN PLACE

Check Compressor Inlet Screen

PLUGGED

Repair or Replace Screen

Evacuate & Charge

System (O.K.)

CLEAN

System Over Charged

Evacuate & Charge

System (O.K.)

CYCLE ON AND OFF OR REMAINS OFF FOR LONG PERIOD OF TIME

Discharge System and Check for Plugged Expansion Tube

Replace

Evacuate & Charge

System (O.K.)

Fig. 1B-16--Pressure Cycling CCOT System Diagnosis

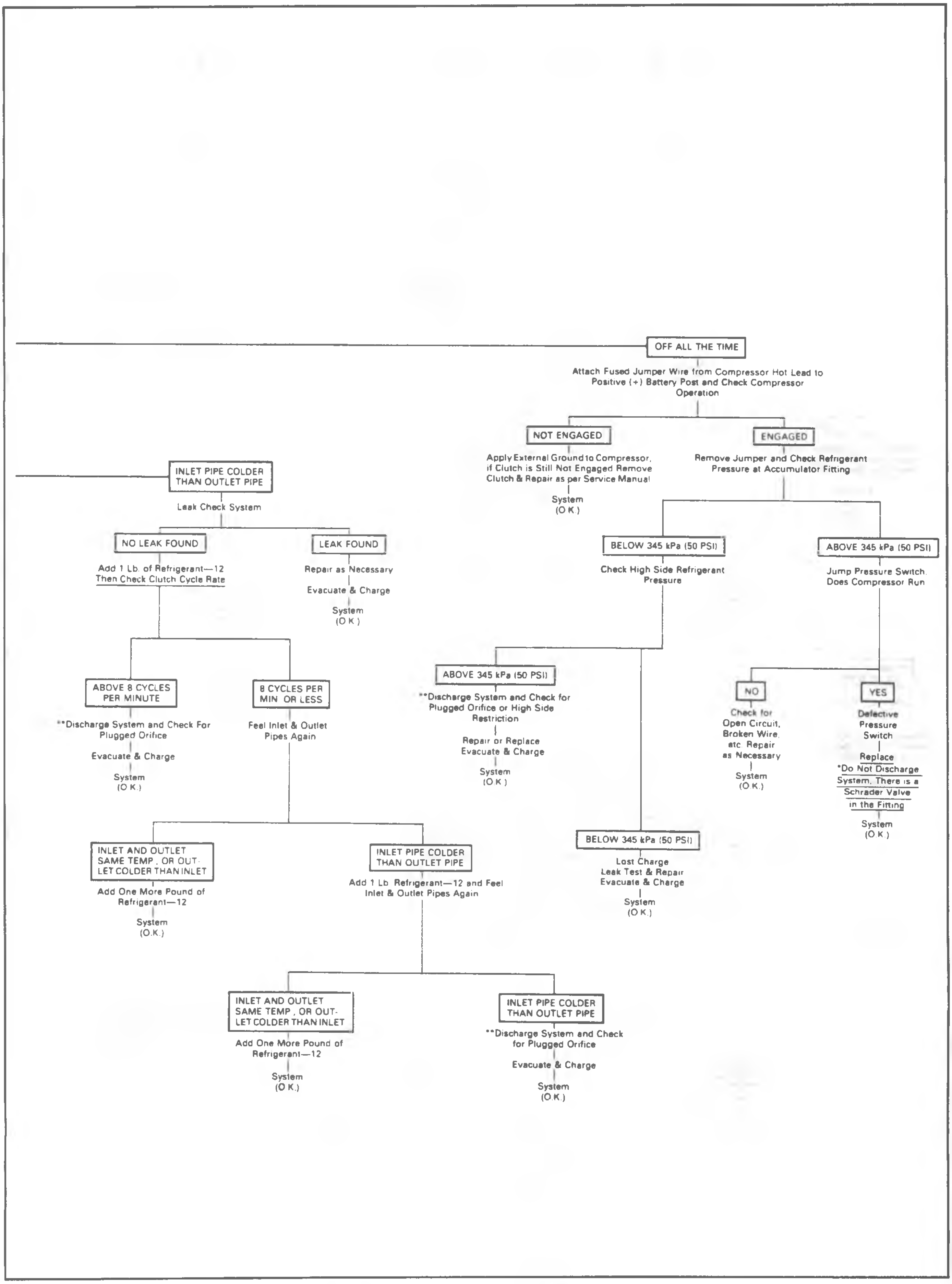


Fig. 1B-17--Pressure Cycling CCOT System Diagnosis (Cont.)

INSUFFICIENT COOLING DIAGNOSIS CHART

DASH MOUNTED UNIT (MOTOR HOME CHASSIS UNITS)

The following procedures should be applied before performance testing an A/C System.

1. Check for proper belt installation and tension with J-23600.
2. Check for proper clutch coil terminal connector installation.
3. Check for clutch air Gap (.022 - .057).
4. Check for broken, burst, or cut hoses. Also check for loose fittings on all components.
5. Check for condenser air blockage due to foreign material.
6. Check for proper air ducting hose connections.
7. Check heater temperature door adjustment, adjust if incorrect.
8. Check evaporator sealing for air leak, repair if leaking.
9. Install pressure gages and thermometer and make performance test.

CHECK AIR FLOW

NORMAL AIR FLOW

CHECK DISCHARGE AIR TEMPERATURE (SEE PERFORMANCE DATA)

DISCHARGE TEMPERATURE AT OUTLET COLD

CHECK FOR AIR LEAKS THROUGH DASH PANEL, DOORS, WINDOWS, OR FROM HEATER.

HIGH OUTLET AIR TEMPERATURE

CHECK SIGHT GLASS

FOAMING

SYSTEM IS PROBABLY LOW ON REFRIGERANT. CHECK FOR LEAKS, REPAIR, AND ADD REFRIGERANT. IF FOAMING STILL OCCURS, CHECK FOR RESTRICTION IN REFRIGERANT SYSTEM BETWEEN CONDENSER AND SIGHT GLASS.

NO FOAMING

1. SYSTEM MAY BE EITHER FULLY CHARGED OR EMPTY. FEEL HIGH AND LOW PRESSURE PIPES AT COMPRESSOR. HIGH PRESSURE PIPE SHOULD BE WARM. LOW PRESSURE PIPES SHOULD BE COLD.
2. IF PIPES ARE NOT INDICATING PROPER TEMPERATURES, RECHARGE SYSTEM AS RECOMMENDED. IF NOZZLE AIR TEMPERATURE IS STILL HIGH, CHECK EVAPORATOR PRESSURE.

*CHECK EVAPORATOR PRESSURE

LOW EVAPORATOR *PRESSURE

CHECK EVAPORATOR OUTLET LINE

EVAPORATOR OUTLET LINE WARM

1. CHECK FOR LIQUID LINE RESTRICTION (FROST SPOT ON LINE). IF NOT,
2. CHECK FOR PLUGGED INLET SCREEN IN EXPANSION VALVE. IF NOT,
3. CHECK FOR DEFECTIVE EXPANSION VALVE BY REMOVING VALVE AND BLOWING THROUGH VALVE. IF UNABLE TO BLOW THROUGH VALVE, BULB IS DISCHARGED. REPLACE EXPANSION VALVE.

HIGH EVAPORATOR * PRESSURE

CHECK COMPRESSOR DISCHARGE PRESSURE

LOW DISCHARGE * PRESSURE

Check for malfunctioning expansion valve-See Component Diagnosis.

* HIGH DISCHARGE PRESSURE

1. Check engine cooling system, fan clutch and check for restricted air flow thru condenser.
2. Check expansion valve bulb contact. Correct if necessary.
3. Check for refrigerant restriction in condenser. Return bends at equal elevation should be approximately same temperature. If temperature of bends is appreciably different, the cooler bend indicates a restricted circuit, replace condenser if restriction is found. If condenser is OK, check for air in system. To check observe outlet air temperature and compressor discharge pressure while slowly discharging system at receiver inlet connection.

OUTLET AIR TEMPERATURE DROPS AS COMPRESSOR DISCHARGE PRESSURE DROPS

LEAK TEST SYSTEM, REPAIR AS NECESSARY, DISCHARGE, EVACUATE, AND RECHARGE.

OUTLET AIR TEMPERATURE INCREASES AS COMP[illegible]R DISCHARGE PRESSURE DROPS

REPLACE EXPANSION VALVE

NORMAL EVAPORATOR PRESSURE

Check Compressor Discharge Pressure.

LOW DISCHARGE PRESSURE

Check for restriction in liquid line, partially plugged inlet screen at expansion valve, or defective expansion valve, replace valve if defective.

NORMAL DISCHARGE PRESSURE

Refrigeration System is ok
1. Check for proper function of heater TEMPERATURE door.
2. Check for proper sealing of evaporator case.
3. Check for proper operation and seal around temperature door.
4. Non-Foaming sight glass does not always indicate a fully charged system. Add 1/2 lb. refrigerant and observe performance.
5. Check for excess oil in system. A symptom of excess oil is a slipping clutch or belt or broken belt. To remove excess oil in system see "CHECKING COMPRESSOR OIL CHARGE".

NO OR LOW AIR FLOW

CHECK BLOWER OPERATION

BLOWER NOT OPERATING

CHECK FOR BLOWN FUSE, DEFECTIVE BLOWER SWITCH, BROKEN WIRE, LOOSE CONNECTIONS, LOOSE BLOWER MOTOR GROUND WIRE OR INOPERATIVE BLOWER MOTOR.

NORMAL BLOWER OPERATION

Check for loose or disconnected air distribution ducts, restricted or leaking air ducts, partially closed air outlet valve or clogged evaporator core, if above check is OK, check for ice blocking evaporator.

ICE BLOCKING EVAPORATOR

CHECK FOR LOW EVAPORATOR PRESSURE
1. ALLOW SYSTEM TO WARM UP.
2. STOP AND RESTART ENGINE.
3. CHECK EVAPORATOR PRESSURE IMMEDIATELY AFTER RESTART AND PULL DOWN OF EVAPORATOR PRESSURE.

NORMAL EVAPORATOR * PRESSURE

SYSTEM HAS EXCESS MOISTURE. REPLACE RECEIVER DEHYDRATOR AND EVACUATE THOROUGHLY. RECHARGE SYSTEM.

LOW EVAPORATOR * PRESSURE

Check for malfunctioning expansion valve-See Component Diagnosis.

*REFER TO PERFORMANCE CHART FOR CORRECT PRESSURES

Dash Mounted Unit (Motor Home Chassis)

(Refrigerant Charge — 3 lbs. 4 oz.)						
Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure*	110-120	135-145	160-170	190-200	220-230	260-270
Suction Pressure psi*	6	7	9	10	10	13
Discharge Air Temperature*	40-45	41-46	41-46	42-47	44-49	44-49

*Just prior to compressor clutch disengagement

Fig. 1B-18--System Diagnosis (Dash Mounted Unit)

COMPRESSOR DIAGNOSIS

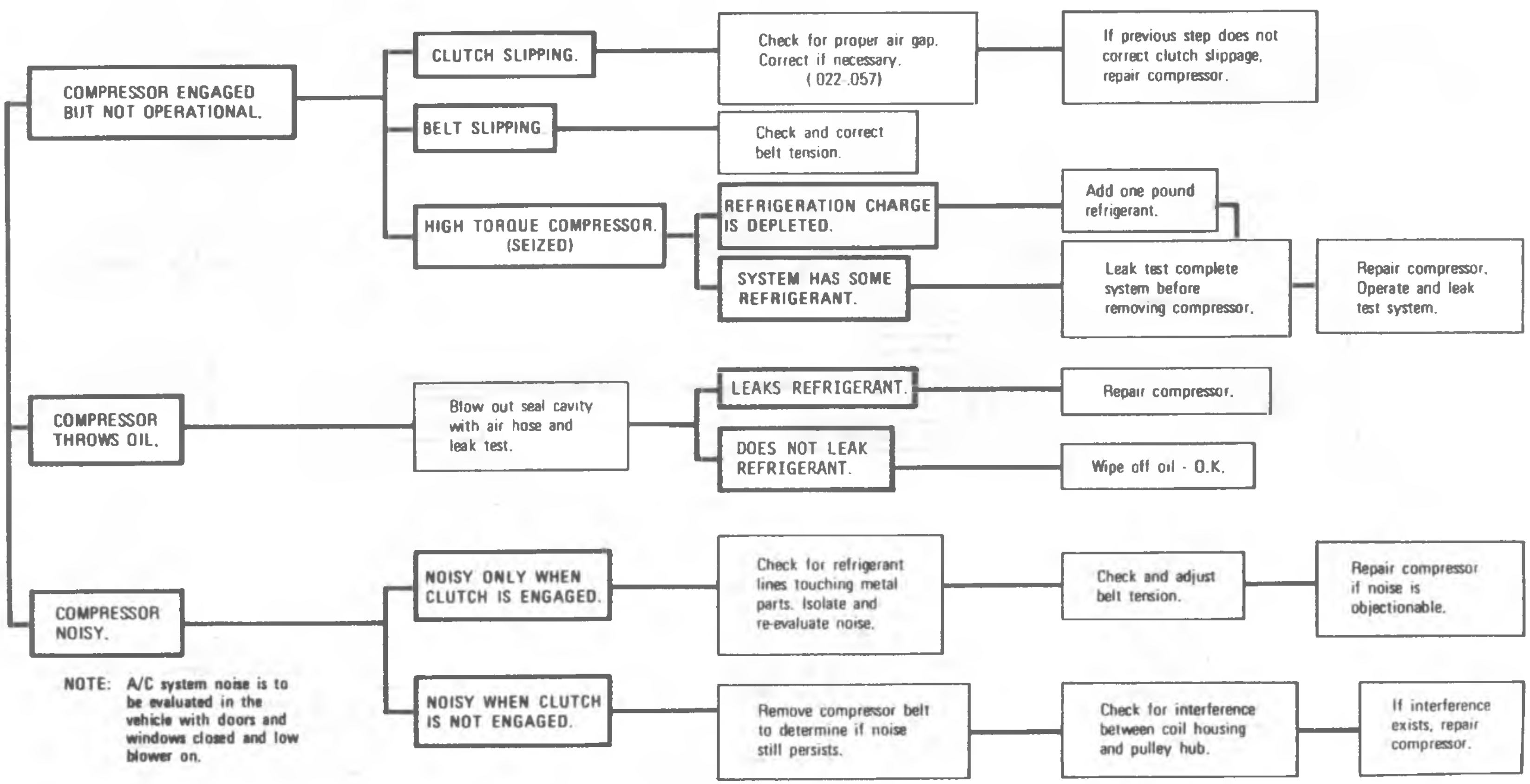


Fig. 1B-19--Compressor Diagnosis

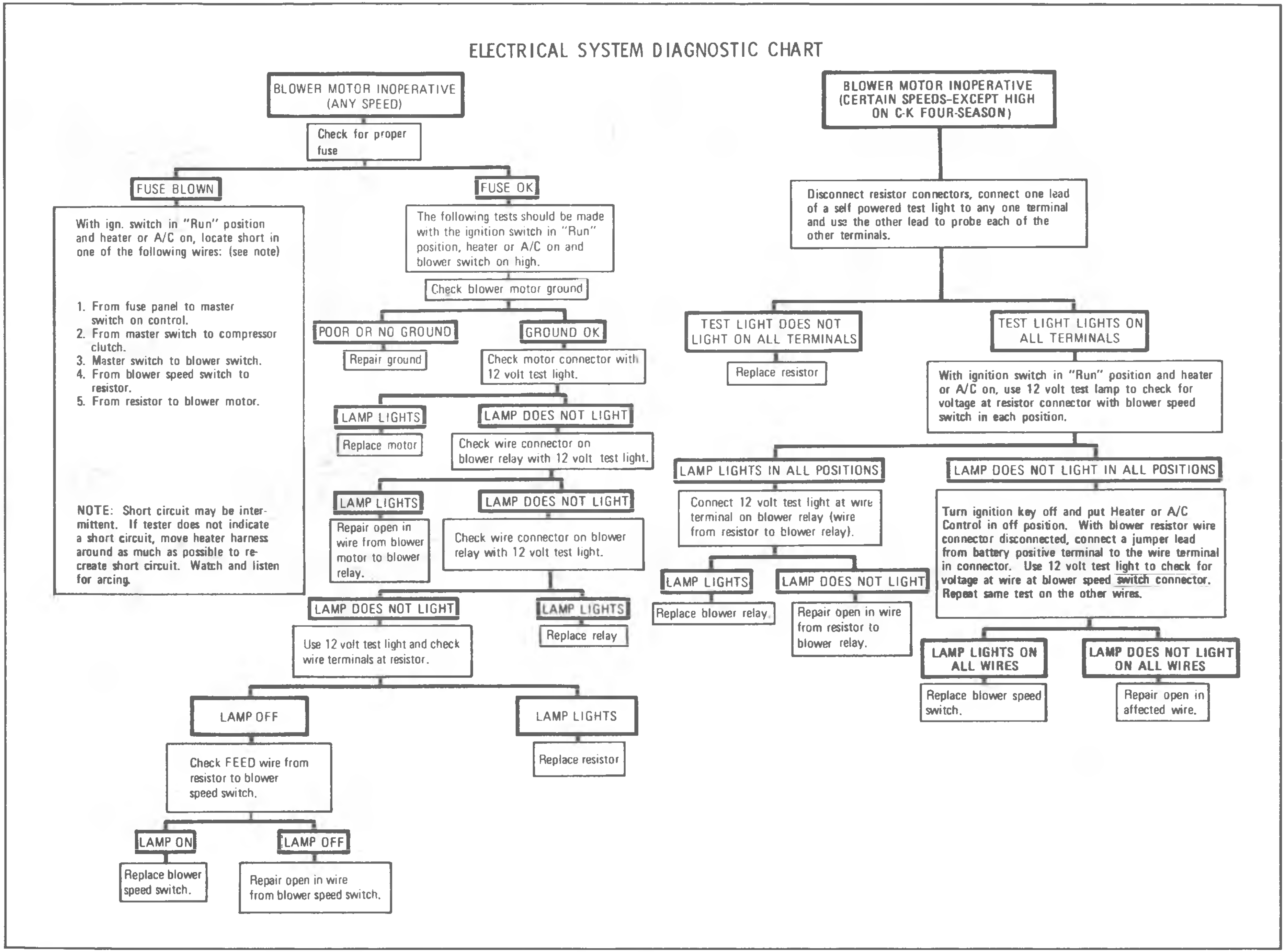


Fig. 1B-20--Electrical Diagnosis

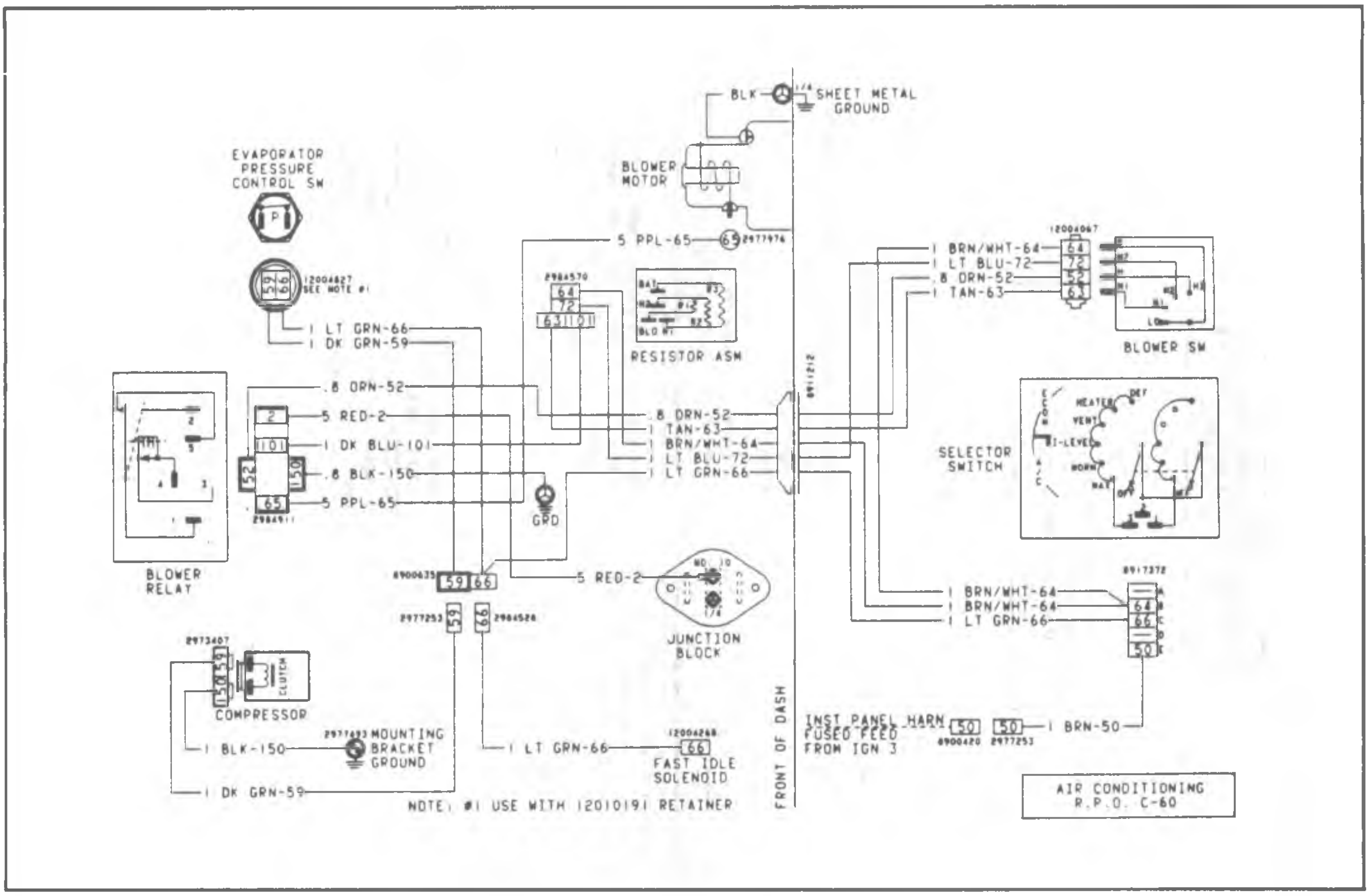


Fig. 1B-21--C60 System Wiring Diagram (C-K Series)

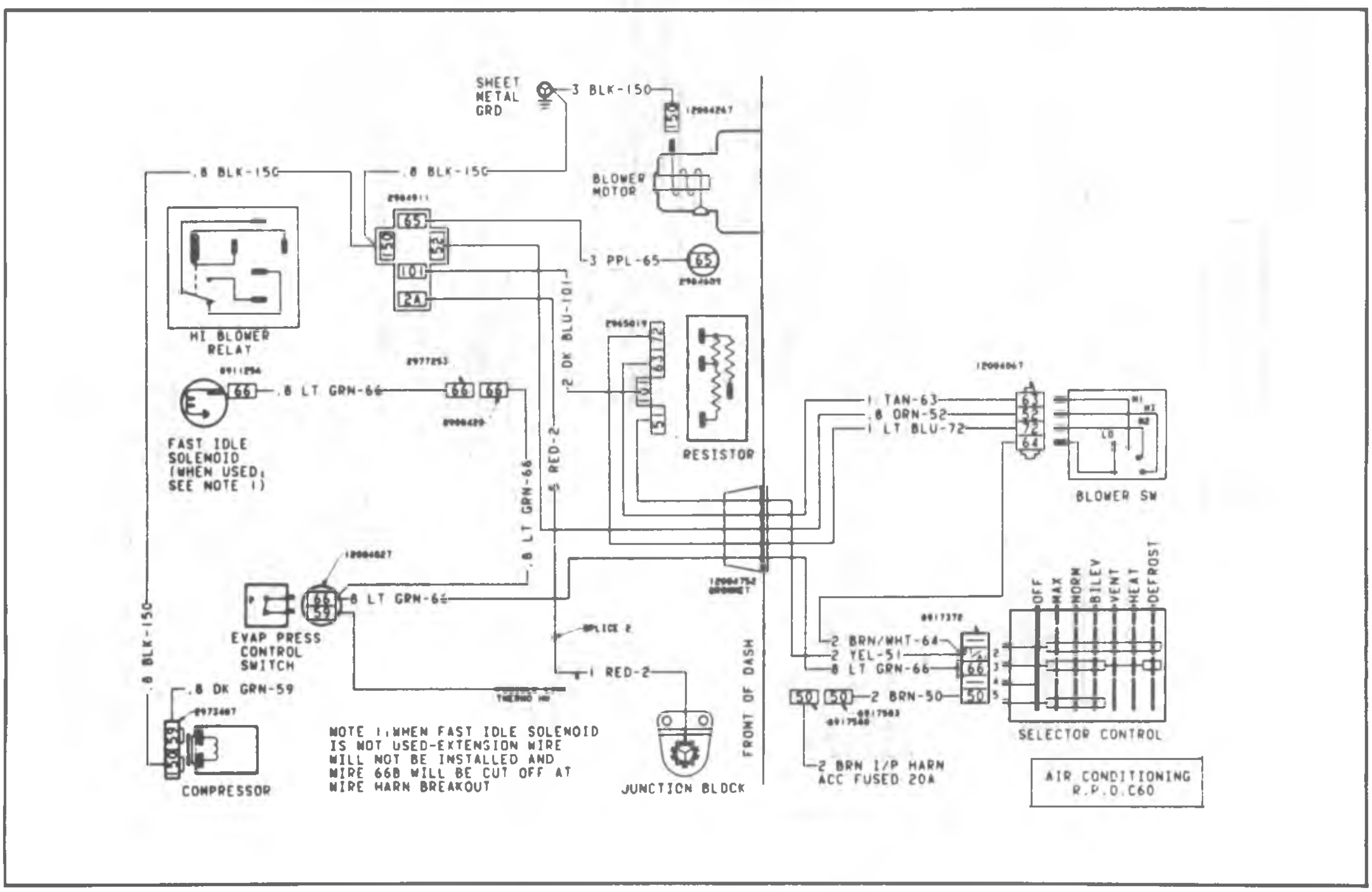


Fig. 1B-22--C60 System Wiring Diagram (G Series)

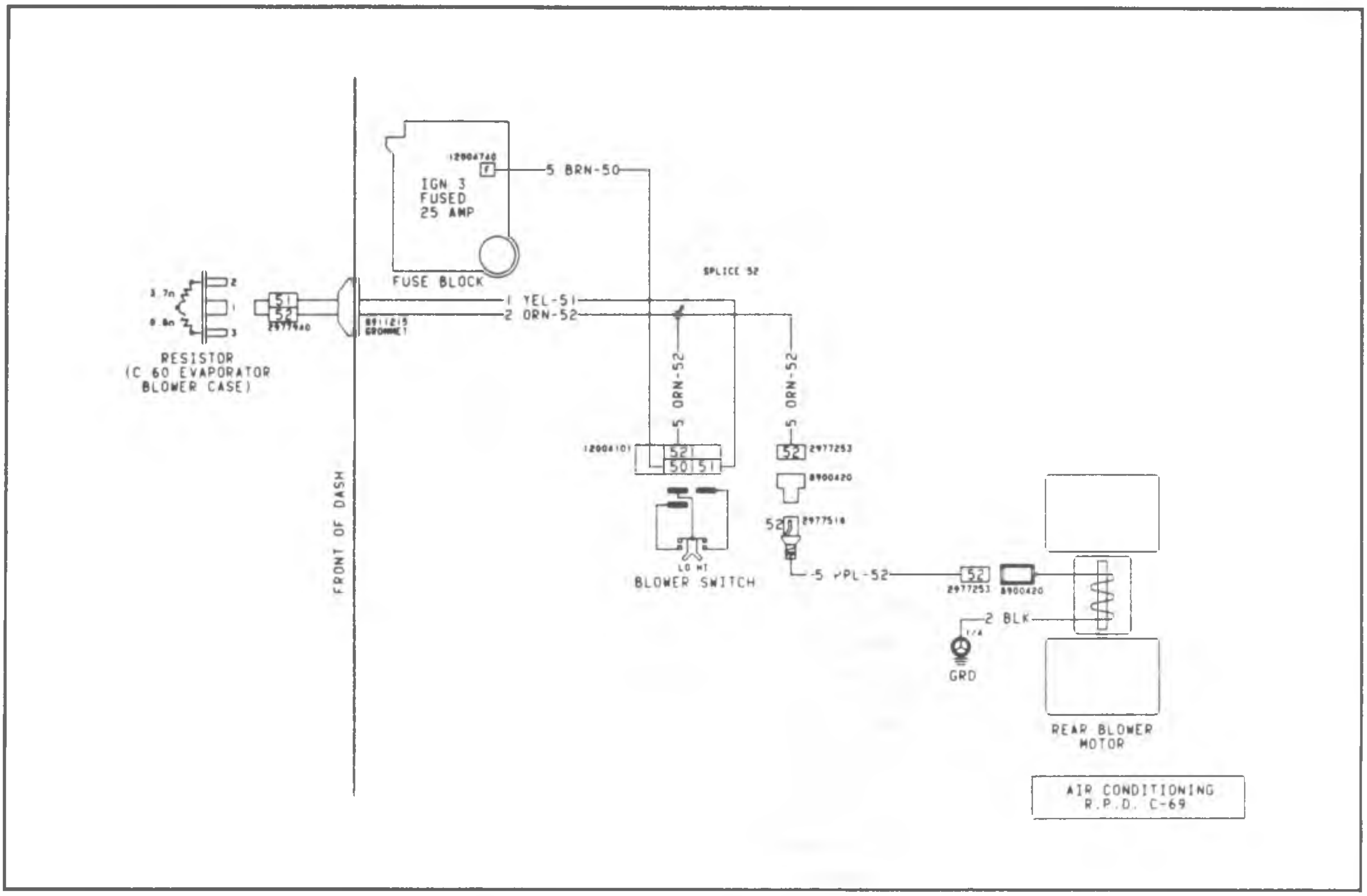
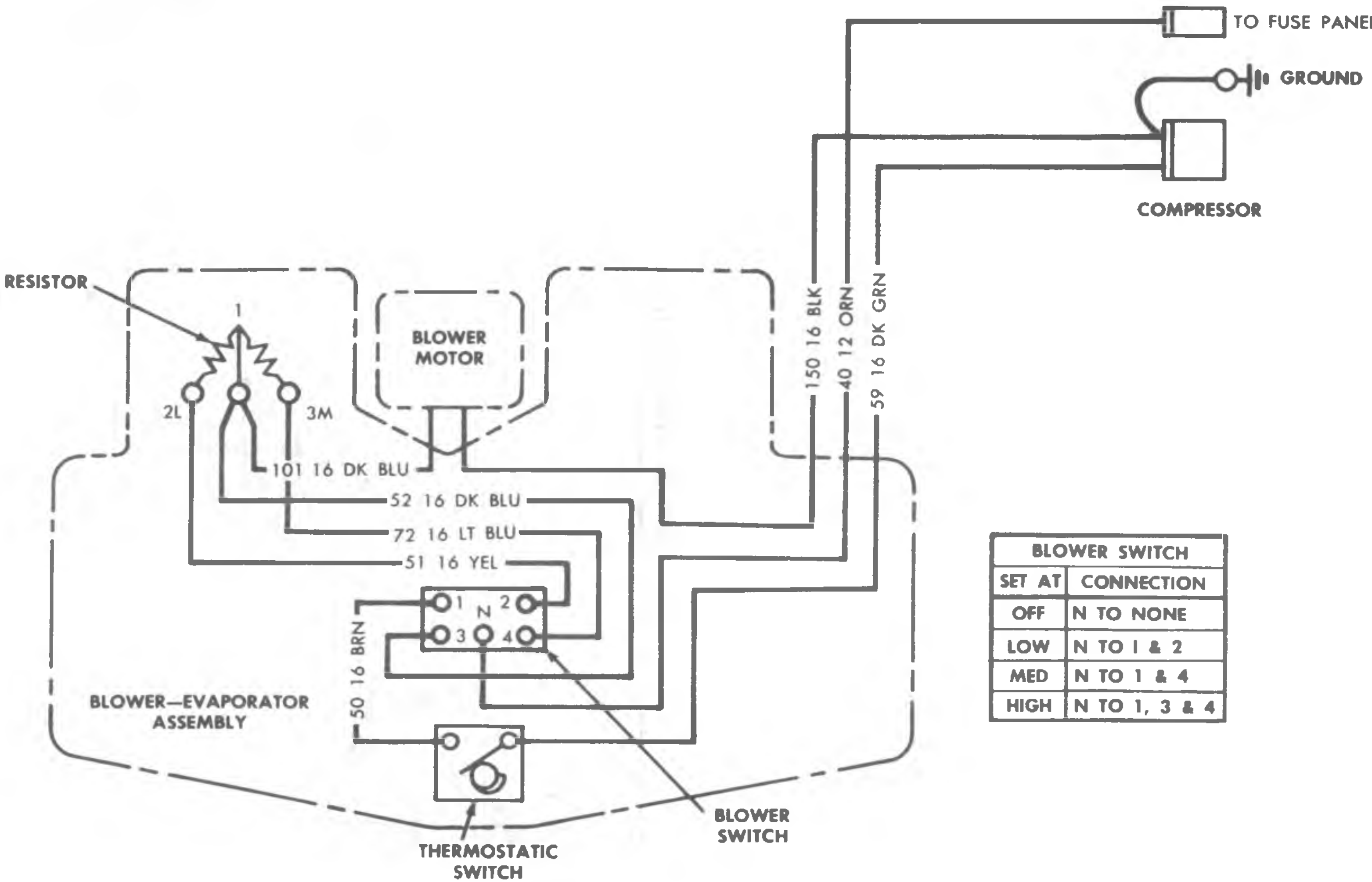


Fig. 1B-23--Overhead Wiring Diagram



BLOWER SWITCH	
SET AT	CONNECTION
OFF	N TO NONE
LOW	N TO I & 2
MED	N TO 1 & 4
HIGH	N TO 1, 3 & 4

Fig. 1B-24--C60 Motor Home Chassis Wiring Diagram

EVACUATING AND CHARGING PROCEDURES

PRECAUTIONARY SERVICE MEASURES

Before any service is attempted which requires opening of refrigerant lines or components, the person doing the work should be thoroughly familiar with the information under PRECAUTIONS IN HANDLING Refrigerant-12, PRECAUTIONS IN HANDLING REFRIGERANT LINES AND FITTINGS MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM, AND REFRIGERANT CHARGING PRECAUTIONS and should follow very carefully the DISCHARGING, EVACUATING, OIL ADDITION AND CHARGING THE REFRIGERANT SYSTEM instructions given on the following pages for the unit being serviced.

Sealing caps should be removed from subassemblies just prior to making connections for final assembly. Use a small amount of clean 525 viscosity refrigerant oil on all tube and hose joints. Always use new "O" rings dipped in the clean 525 viscosity refrigerant oil when assembling joints. The oil will aid in assembly and help provide a leak-proof joint. When tightening joints, use a second wrench to hold stationary part of connection so that a solid feel can be attained. This will indicate proper assembly.

Tighten all tubing connections, as shown in torque chart, see Fig. 1B-15. Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

DISCHARGING EVACUATING ADDING OIL AND CHARGING PROCEDURES FOR CCOT A/C SYSTEMS

The refrigerant system may be Discharged, Evacuated and Charged using J-23500-01 air conditioning service Charging Station or the J-5725-04 Manifold and Gage Set, and 420 ml-14 oz. disposable cans of Refrigerant-12.

Charging lines from the Charging Station or Manifold and Gage Set require the use of gage adapters to connect to the system service fittings. A straight gage Adapter J-5420 and a 90° angle gage Adapter J-9459 is available.

Always wear goggles and wrap a clean cloth around fittings and connections when doing work that involves opening the refrigeration system. If liquid refrigerant comes into contact with the skin or eyes injury can result.

- Before removing and replacing any of the air conditioning refrigeration lines or components, the system must be completely discharged of Regrigerant-12.
- Always use service valve and pressure gage sets during evacuation and charging procedures.
- Do not charge while compressor system is hot.
- Always discharge system at low-side service fitting and perform the entire evacuate and charging procedure through the low-side service fitting.
- Do not connect high pressure line or any line to the high-side service fitting during discharging and charging procedures.

CAUTION: Never remove a gage line from its adapter when line is connected to A/C system. Always remove the line adapter from the service fitting to disconnect a line. Do not remove charging hose at gage set while attached to service low-side fitting. This will result in complete discharge of system due to the depressed schrader valve in service low-side fitting and may cause personal injury due to escaping Refrigerant-12.

DISCHARGING THE CCOT A/C SYSTEM

In replacing any of the air conditioning refrigeration components the system must be completely discharged of Refrigerant-12.

Always discharge system at low side service fitting.

1. With ignition turned OFF, remove protective cap from LOW-SIDE service fitting and connect Charging Station J-23500-01 Gage Set as indicated in Figure 1B-25.

   If charging station J-23500-01 is not being used, discharge system by slowly connecting a gage hose to low-side service fitting on Accumulator and discharging into oil bottle (Fig. 1B-26). As hose is SLOWLY tightened down onto schrader valve, Refrigerant-12 will be in to discharge from the system into the container. If no discharge occurs, check for missing or defective schrader depressor in hose fitting.
2. With the low-side of system fully discharged, check high-side system fitting (on liquid line or muffler) for remaining pressure.
3. If pressure is found, attempt to discharge high-side using same procedure as used for low-side. (This condition indicates a restriction on the high-side and the cause must be diagnosed and corrected before evacuating and charging the system).
4. When the system is completely discharged (no vapor escaping with hose fully-tightened down), measure, record amount and discard the collected refrigerant oil. If this quantity is 15 ml (1/2 oz.) or more, this amount of new 525 viscosity refrigerant oil must be added to system, plus any quantity in removed parts before evacuation and charging with Refrigerant-12 (Refer to CCOT Refrigerant Oil Distribution for specific quantity of oil normally retained in removed parts).
5. If adding oil is necessary, remove the suction hose at the accumulator outlet pipe connection and pour the correct quantity of refrigerant oil into the hose or pipe and then properly reconnect hose or pipe. (See Discharging Step No. 4 and C.C.O.T. Refrigerant Oil Distribution for specific quantity instructions).

CCOT REFRIGERANT OIL DISTRIBUTION

A-6 COMPRESSOR -- requires 300 ml (10 oz.) of 525 viscosity refrigerant oil.

R-4 COMPRESSOR -- requires 6 oz. (180 ml) of 525 viscosity refrigerant oil.

New oil quantities must be added to the system during Service component replacement and conditions stated as follows:

A. WHEN THERE ARE NO SIGNS of excessive oil leakage, for:

- Compressor - Remove, drain oil, measure, replace same amount of new oil plus 1 oz. (30 ml). On A-6 compressor, if amount of oil drained is 240 ml (8

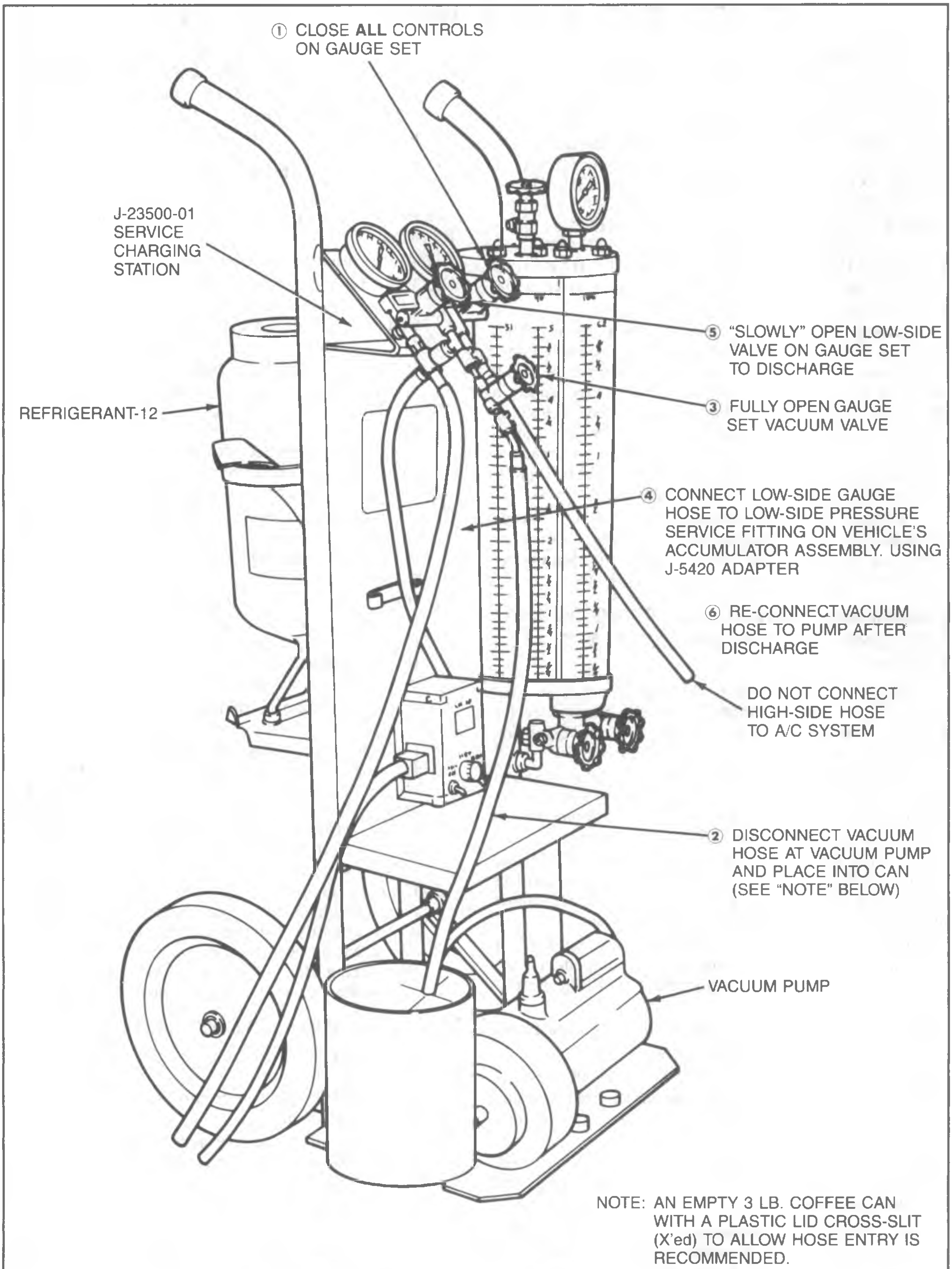


Fig. 1B-25--Discharging The CCOT System With J-23500-01 Charging Station

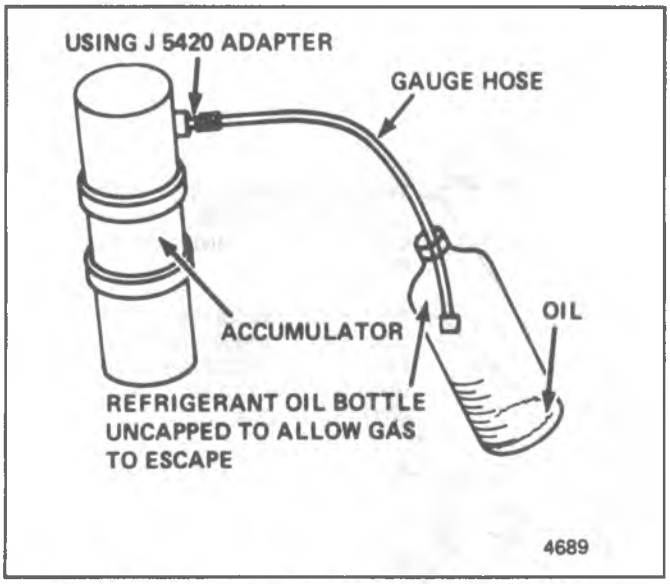


Fig. 1B-26--Discharging the CCOT A/C System Without Charging Station J-23500-01

oz.) or more, an oil overcharge should be suspected.

- Evaporator - Add 90 ml (3 oz.).
- Condenser - Add 30 ml (1 oz.).
- Accumulator - Remove, drain oil, measure, replace same amount of new oil plus 60 ml (2 oz.) to compensate for that retained by the original accumulator dessicant.

B. WITH SIGNS OF EXCESSIVE OIL LEAKAGE, for:

A-6 Compressor Systems

Remove Compressor AND Accumulator. Drain, measure and record TOTAL oil from both components. Discard old oil.

If less than 180 ml (6 oz.), add 180 ml (6 oz.) of new oil to system.

If more than 180 ml (6 oz.), add same amount of new oil as drained.

If a new Accumulator must be added to A-6 system, add 2 additional ounces (60 ml) of oil to compensate for that held/absorbed by the original accumulator dessicant.

R-4 Compressor Systems

A. With no signs of excessive oil leakage, add:
- Compressor - Remove, drain oil, measure, replace same amount of new oil plus 30ml (1 fl. oz).
- Evaporator - Add 90ml (3 fl. oz).
- Condenser - Add 30 ml (1 fl. oz).
- Accumulator - Remove, drain oil, measure, replace same amount of new oil plus 60ml (2 fl. oz) to compensate for that retained by the original accumulator dessicant.

B. With signs of excessive oil leakage:
- Remove only the Accumulator. Drain, measure and record quantity of oil in Accumulator. It is not necessary to remove and drain the R-4 Compressor because the Compressor only retains a minimum quantity of oil.
- If less than 90ml (3 fl. oz), add 90ml (3 fl. oz) of new oil to system.
- If more than 90ml (3 fl. oz), add same amount of new oil as drained.
- If a new Accumulator must be added to R-4 system, add 60ml (2 fl. oz) additional oil, to compensate for that held/absorbed by the original Accumulator dessicant.

EVACUATING AND CHARGING THE CCOT A/C SYSTEM

If the system has been opened for any repair, or the Refrigerant-12 charge lost, the system must be evacuated prior to charging.

Evacuation and Charging is a combined procedure, and all gage lines must be purged with Refrigerant-12 prior to charging.

There are three standard Refrigerant-12 evacuate and charge procedures:

- J-23500-01 Charging Station Method
- Disposable Can Method
- Drum Method

NOTICE: Under no circumstances should alcohol be used in the system in an attempt to remove moisture. Damage to the system components could occur.

GAGE CALIBRATION

Prior to Evacuation, check the low pressure gage for proper calibration and determine if vacuum system is operating properly. With the gage disconnected from the refrigeration system, be sure that the pointer indicates to the center of "O". Lightly tap gage a few times to be sure pointer is not sticking. If necessary, calibrate as follows:

a. Remove cover from gage.
b. Holding gage pointer adjusting screw firmly with one hand, carefully force pointer in the proper direction to position pointer at the "O" position. Tap gage a few times to be sure pointer is not sticking. Replace gage cover.

VACUUM SYSTEM CHECK

Before connecting vacuum pump to the A/C system, run pump connected to the low pressure gage to determine the vacuum pump capability. If the vacuum system is unable to reach 711.2-736.6mm (28"-29") or more vacuum, the system should be checked for leaks. If no leaks are found, the vacuum pump may require repair.

J-23500-01 CHARGING STATION METHOD

Follow Charging instructions provided with the J-23500-01 Charging Station in use with the following exceptions:

1. Do not connect the high pressure line to the air conditioning system.
2. Keep the high pressure valve on the charging station closed at all times.
3. Perform the entire evacuate and charge procedure through the accumulator low-side pressure service fitting.
4. Following these procedures will prevent accidental high-side vehicles system pressure being subjected to the Charging Station in the event an error is made in valve sequence during compressor operation to pull in the Refrigerant-12 charge.

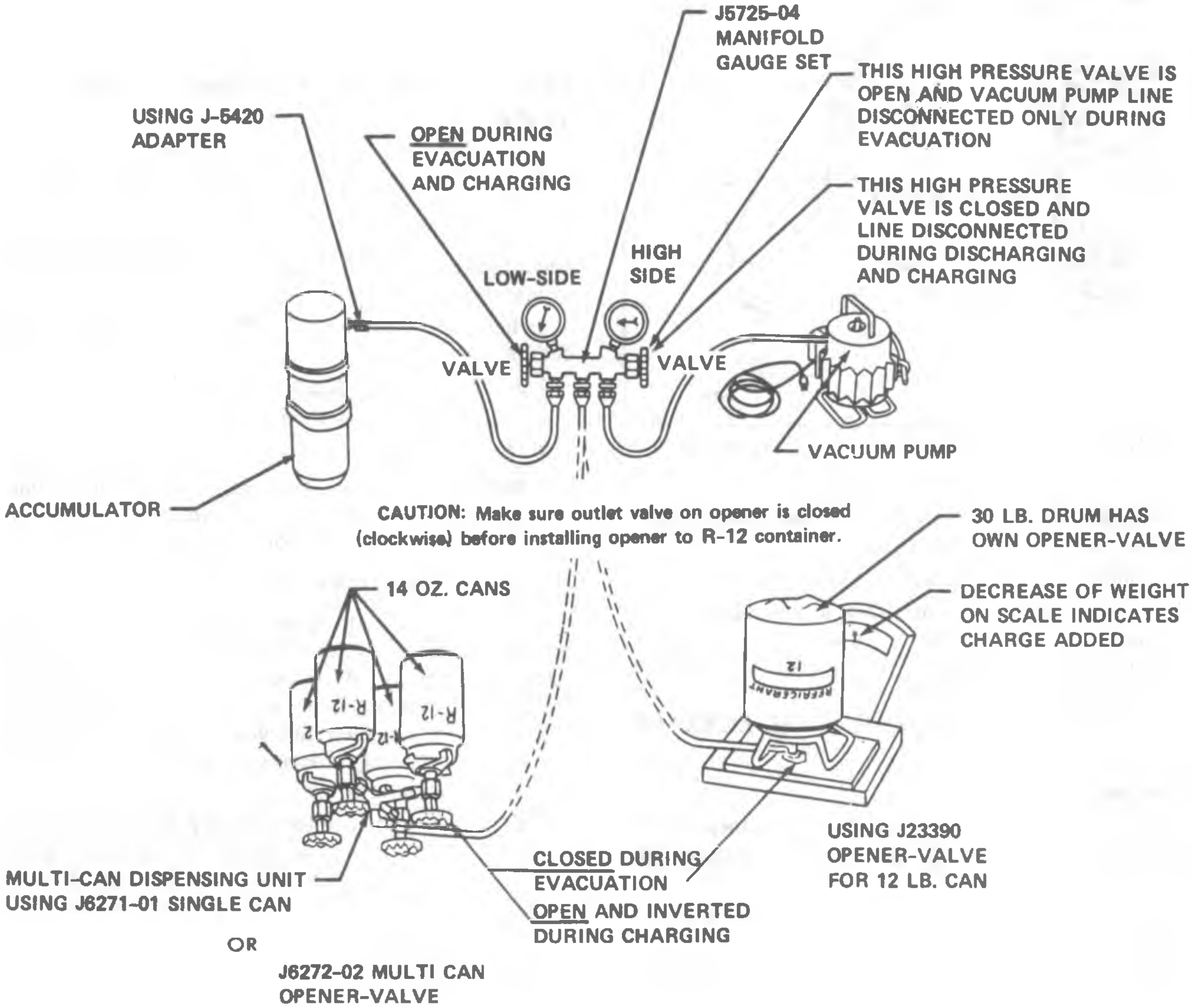


Fig. 1B-27--Charging the CCOT A/C System with Disposable Can or Refrigerant Drum.

DISPOSABLE CAN OR REFRIGERANT DRUM METHOD

- If the Refrigerant-12 drum is used, place it on a scale and note the total weight before Charging. Watch the scale during Charging to determine the amount of Refrigerant-12 used.
- If disposable 420 ml (14 oz.) Refrigerant-12 cans are used, close the tapping valve and then attach can(s) following instructions included with the tapping valve or tapping manifold adapter.

1. Connect Manifold Gage Set J-5725-04 as follows. Also see Fig. 1B-27.
   - Low pressure gage set valve to Accumulator fitting
   - Gage set center hose to Refrigerant-12 source
   - High pressure gage to vacuum pump
2. To begin evacuation of the A/C system, with Manifold Gage Set and Vacuum Pump as illustrated in Fig. 1B-27, SLOWLY open high and low-side gage valves and begin vacuum pump operation. Pump the system until the low-side gage reaches 711.2 - 736.6mm (28 to 29 in.) mercury (vacuum) or more.

   Note that in all Evacuation procedures, the specification of 711.2 - 736.6mm (28 to 29 in.) of mercury vacuum is used. This specification can only be reached at or near sea level. For each 304.8m (1,000 feet) above sea level, specification should be lowered by one inch of vacuum. At 1524m (5,000) feet elevation only 584.2 - 609.6mm (23 to 24 in.) of mercury (vacuum) is required.

If prescribed mercury (vacuum) cannot be reached, close vacuum control valve, shut off pump and look for a leak at connections or pump.

3. When the gage reaches prescribed vacuum, the system is fully evacuated. Close the high-side gage set valve and turn OFF the vacuum pump.
4. Watch low-side gage to be sure vacuum holds for five (5) minutes. If vacuum is held, disconnect vacuum hose at gage set and then proceed to charging.
5. If vacuum does not hold for five (5) minutes, charge system with 420 ml (1/2 lb.) Refrigerant-12 and and leak check. Discharge system again then repair leak as necessary. Repeat Evacuation procedure.

CHARGING OF THE CCOT A/C SYSTEM

1. Start engine, run with choke open and fast idle speed reduced to normal idle, set A/C control lever on OFF.
2. With the Refrigerant-12 drum or 420 ml (14 oz.) can(s) inverted, open Refrigerant-12 source valve(s) and allow 480 ml (one (1) pound) or one 420 ml (14 oz.) can of liquid Refrigerant-12 to flow into system through low-side Service fitting on Accumulator (Refer to Fig. 1B-27).
3. As soon as 480 ml (1 lb.) or one 420 ml (14 oz.) can of liquid Refrigerant-12 has been added to system, immediately engage the compressor, by setting the A/C control lever to NORM and blower speed on HI, to draw in the remainder of the Refrigerant-12 charge.

   The Charging operation can be speeded up by using a large volume fan to pass air over the condenser. If condenser temperature is maintained below charging cylinder temperature, Refrigerant-12 will enter system more rapidly.
4. Shut off Refrigerant-12 source valve and run engine for 30 seconds to clear lines and gages.
5. With the engine running, remove the charging low-side hose adapter from the Accumulator Service fitting. Unscrew rapidly to avoid excess Refrigerant-12 escape from system.

   CAUTION: Never remove a gage line from its adapter when line is connected to A/C system. Always remove the l'ne adapter from the service fitting to disconnect a line. Do not remove charging hose at gage set while attached to accumulator. This will result in complete discharge of system due to the depressed schrader valve in service low-side fitting, and may cause personal injury due to escaping Refrigerant-12.
6. Replace protective cap on Accumulator fitting.
7. Turn engine off.
8. Leak check system with J-6084 Leak Detector.
9. Start engine.
8. With system fully Charged and leak-checked, continue to operate system and test for proper system pressures as outlined under PERFORMANCE CONDITIONS AND PERFORMANCE PRESSURE-TEMPERATURE DATA in Figs. 1B-16 and 1B-17.

ACCUMULATOR ASSEMBLY

The accumulator assembly for the CCOT system has a service replacement which includes two "O" rings (for the inlet and outlet connections). The desicant within the shell is **NOT** serviced separately - it is part of the sealed accumulator assembly. See CCOT Refrigerant Oil and Distribution for presence of refrigerant oil and service conditions when the accumulator must be removed from the vehicle to measure the amount of oil present inside the accumulator.

The accumulator assembly should ONLY be replaced when:

1. A physical perforation to the accumulator is found resulting in a leak.
2. The expansion (orifice) tube screen experiences continued or repeated plugging.
3. The compressor inlet screen is plugged (A6 compressor).
4. An evaporator fails because of inside-out internal corrosion.

DO NOT REPLACE the accumulator assembly where:

1. Merely a dent is found in the outer shell of the accumulator.
2. A vehicle is involved in a collision and no physical perforation to the accumulator is found. An open refrigerant line should be capped or have a plastic bag tightly taped around it.

ACCUMULATOR REPLACEMENT

1. Disconnect battery ground cable.
2. Discharge system of refrigerant.
3. Disconnect accumulator inlet and outlet connections. Cap or plug open lines immediately.
4. Remove accumulator attaching screws and check amount of oil in accumulator and install this amount of fresh 525 viscosity refrigerant oil into new accumulator plus 60 ml (2 oz.)
5. Install new accumulator, using clean 525 viscosity refrigerant oil on "O" rings.
6. Evacuate and recharge system.

EXPANSION TUBE (ORIFICE)

Removal and Installation

1. Discharge the refrigerant from the system.
2. Disconnect liquid line at evaporator inlet and remove expansion tube (orifice) from the inlet pipe.
3. To install, reverse the above procedure. When installing the expansion tube (orifice) inside the evaporator inlet pipe, it MUST be installed with "shorter screen end" inserted first.

SPECIFIC COMPONENT DIAGNOSIS

The following is a description of the type of symptom each refrigerant component will evidence if a defect occurs:

COMPRESSOR

A compressor defect will appear in one of four ways: Noise, seizure, leakage, or low discharge pressure.

NOTICE: Resonant compressor noises are not cause for alarm; however, irregular noise or rattles may indicate broken parts or excessive clearances due to wear. To check seizure, de-energize the magnetic clutch and check to see if drive plate can be rotated. If rotation is impossible, compressor is seized. To check for a leak, refer to leak testing. Low discharge pressure may be due to a faulty internal seal of the compressor, or a restriction in the compressor. Furthermore, low discharge pressure may be due to an insufficient refrigerant charge or a restriction elsewhere in the system. These possibilities should be checked prior to servicing the compressor. If the compressor is inoperative, but is not seized, check to see if current is being supplied to the magnetic clutch coil terminals.

CONDENSER

A condenser may be defective in two ways: it may leak, or it may be restricted. A condenser restriction will result in excessive compressor discharge pressure. If a partial restriction is present, sometimes ice or frost will form immediately after the restriction as the refrigerant expands after passing through the restriction. If air flow through the condenser or radiator is blocked, high discharge pressures will result. During normal condenser operation, the outlet pipe will be slightly cooler than the inlet pipe.

RECEIVER-DEHYDRATOR - MOTOR HOME CHASSIS

A defective receiver-dehydrator may be due to a restriction inside the body of the unit. A restriction at the inlet to the receiver-dehydrator will cause high head pressures. Outlet tube restrictions will be indicated by low head pressures and little or no cooling. An excessively cold receiver-dehydrator outlet may be indicative of a restriction.

EXPANSION VALVE

A malfunction of the expansion valve will be caused by one of the following conditions: valve stuck open, valve stuck closed, broken power element, a restricted screen or an improperly located or installed power element bulb. The first three conditions require valve replacement. The last two may be corrected by replacing the valve inlet screen and by properly installing the power element bulb.

Attachment of the expansion valve bulb to the evaporator outlet line is very critical. The bulb must be attached tightly to the line and must make good contact with the line along the entire length of the bulb. A loose bulb will result in high low side pressures and poor cooling.

Indications of expansion valve trouble are provided by performance tests; consult diagnostic charts.

1. VALVE STUCK OPEN
   a. Noisy Compressor
   b. No Cooling - Freeze Up.
2. Valve stuck closed, broken power element or plugged screen
   a. Very Low Suction Pressure.
   b. No Cooling.
3. POORLY LOCATED POWER ELEMENT BULB
   a. Normal Pressure.
   b. Poor Cooling.

Diagnosis for Defective Valve

The following procedure must be followed to determine if a malfunction is due to a defective expansion valve.

1. Check to determine if the system will meet the performance test as outlined previously. If the expansion valve is defective, the low pressure readings (evaporator pressure) will be above specifications.
2. The loss of system performance is not as evident when the compressor head pressure is below 1379 kPa (200 psi). Therefore, it may be necessary to increase the system head pressure by partially blocking the condenser. Disconnect the blower lead wire and repeat the "performance check" to determine if the evaporator pressure can be obtained.
3. The system will also indicate a low refrigerant charge by bubbles occurring in the sight glass (Motor Home Chassis Systems).

EVAPORATOR

When the evaporator is defective, the trouble will show up as an inadequate supply of cool air. A partially plugged core due to dirt, a cracked case, or a leaking seal will generally be the cause.

REFRIGERANT LINE RESTRICTIONS

Restrictions in the refrigerant lines will be indicated as follows:

1. Suction Line - A restricted suction line will cause low suction pressure at the compressor, low discharge pressure and little or no cooling.
2. Discharge Line - A restriction in the discharge line generally will cause the pressure relief valve to open.
3. Liquid Line - A liquid line restriction will be evidenced by low discharge and suction pressure, and insufficient cooling.

SIGHT GLASS DIAGNOSIS (MOTOR HOME CHASSIS UNITS)

At temperatures higher than 70°F (21°C), the sight glass may indicate wheter the refrigerant charge is sufficient. A shortage of liquid refrigerant is indicated after above five minutes of compressor operation by the appearance of slow-moving bubbles (vapor) or a broken column of refrigerant under the glass. Continuous bubbles may appear in a properly charged system on a cool day. This is a normal situation. If the sight glass is generally clear and performance is satisfactory, occasional bubbles do not indicate refrigerant shortage.

If the sight glass consistently shows foaming or a broken liquid column, it should be observed after partially blocking the air to the condenser. If under this condition the sight glass clears and the performance is otherwise satisfactory, the charge shall be considered adequate.

In all instances where the indications of refrigerant shortage continues, additional refrigerant should be added in 120 ml (1/4 lb.) increments until the sight glass is clear. An additional charge of 240 ml (1/2 lb.) should be added as a reserve after the glass clears. In no case should the system be overcharged.

ON VEHICLE SERVICE

COMPRESSOR

C-K Series

Removal (Fig. 1B-28)

1. Discharge the system.
2. Remove connector attaching bolt and connector. Cap or plug open connections at once.
3. Disconnect electrical lead to clutch actuating coil.
4. Loosen brace and pivot bolts and detach belt.
5. Remove the nuts and bolts attaching the compressor brackets to the mounting bracket. Remove the compressor.
6. Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing.

Installation

1. If oil previously drained from the compressor upon removal shows no evidence of contamination, replace the same amount of fresh refrigeration oil into the compressor before reinstallation. If it was necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil into the compressor.
2. Position compressor on the mounting bracket and install all nuts, bolts and lock washers.
3. Install the connector assembly to the compressor rear head, using new "O" rings coated with clean refrigeration oil.
4. Connect the electrical lead to the coil and install and adjust compressor belt.
5. Evacuate, charge and check the system.

G and Motor Home Chassis Models

Removal (Fig. 1B-28)

1. Disconnect battery ground cable.
2. Disconnect compressor clutch connector.
3. Purge the system of refrigerant.
4. Release the belt tension at the idler pulley and remove the belt from the compressor pulley. On some vehicles it may be necessary to remove the crankshaft pulley in order to remove the belt.
5. **G Series**--Remove the two bolts and two clamps that hold the engine cover and remove the cover.
6. Remove the air cleaner to aid access to the compressor.
7. Remove fitting and muffler assembly and cap or plug all open connections.
8. Remove the nuts and bolts attaching the compressor to the bracket.
9. Remove the engine oil tube support bracket bolt and nut from the compressor, and the compressor clutch ground lead.

Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing.

Installation

1. If the oil drained from the compressor showed no evidence of contamination replace the same amount of fresh refrigeration oil into the compressor before reinstallation. If it is necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil in the compressor.
2. Position compressor on the mounting bracket and install the nuts, bolts, lock washers, and ground wire.
3. Install the connector assembly to the compressor rear head, using new "O" ring coated with clean refrigeration oil.
4. Connect the electrical lead to the coil and install and adjust compressor belt, using idler pulley. Refer to "Compressor Belt Tension Adjustment."
5. Evacuate, charge and check the system.
6. Replace air cleaner. On G series, replace the engine cover.
7. Connect the battery ground cable.

COMPRESSOR BELT TENSION ADJUSTMENT

Adjust the compressor belt to the specifications shown in the Engine section of the Service Manual.

On some G and Motor Home Chassis units it may be necessary to increase idler pulley slack adjustment. This may be accomplished by (1) Remove and discard the idler adjustment bolt. (2) Remove the idler backing plate and elongate all 3 adjusting slots 1/2 in. inboard or outboard as required. (3) Reinstall the idler assembly and adjust belt tension using a lever (screwdriver, etc.) to move the pulley outboard until proper belt tension is reached. If the belt is being replaced it may be necessary to remove and replace the throttle cable during the belt replacement. If so check throttle cable adjustment upon completion. It may also be necessary to remove the crankshaft pulley to install a new compressor belt.

C60 SYSTEM--C-K SERIES

CONDENSER - C-K SERIES

Replacement (Fig. 1B-29)

1. Disconnect battery ground cable.
2. Discharge system.
3. Remove the grille assembly.
4. Remove the radiator grille center support.
5. Remove the left grille support to upper fender support (2) screws.
6. Disconnect the condenser inlet and outlet lines and the outlet tube line at the right end of the condenser. Cap or plug all open connections at once.
7. Remove the condenser to radiator support screws.
8. Bend the left grille support outboard to gain clearance for condenser removal.
9. Remove the condenser assembly by pulling it forward and then lowering it from the vehicle.
10. To install a new condenser, reverse Steps 1 thru 9 above. Add one fluid ounce of clean refrigeration oil to a new condenser.

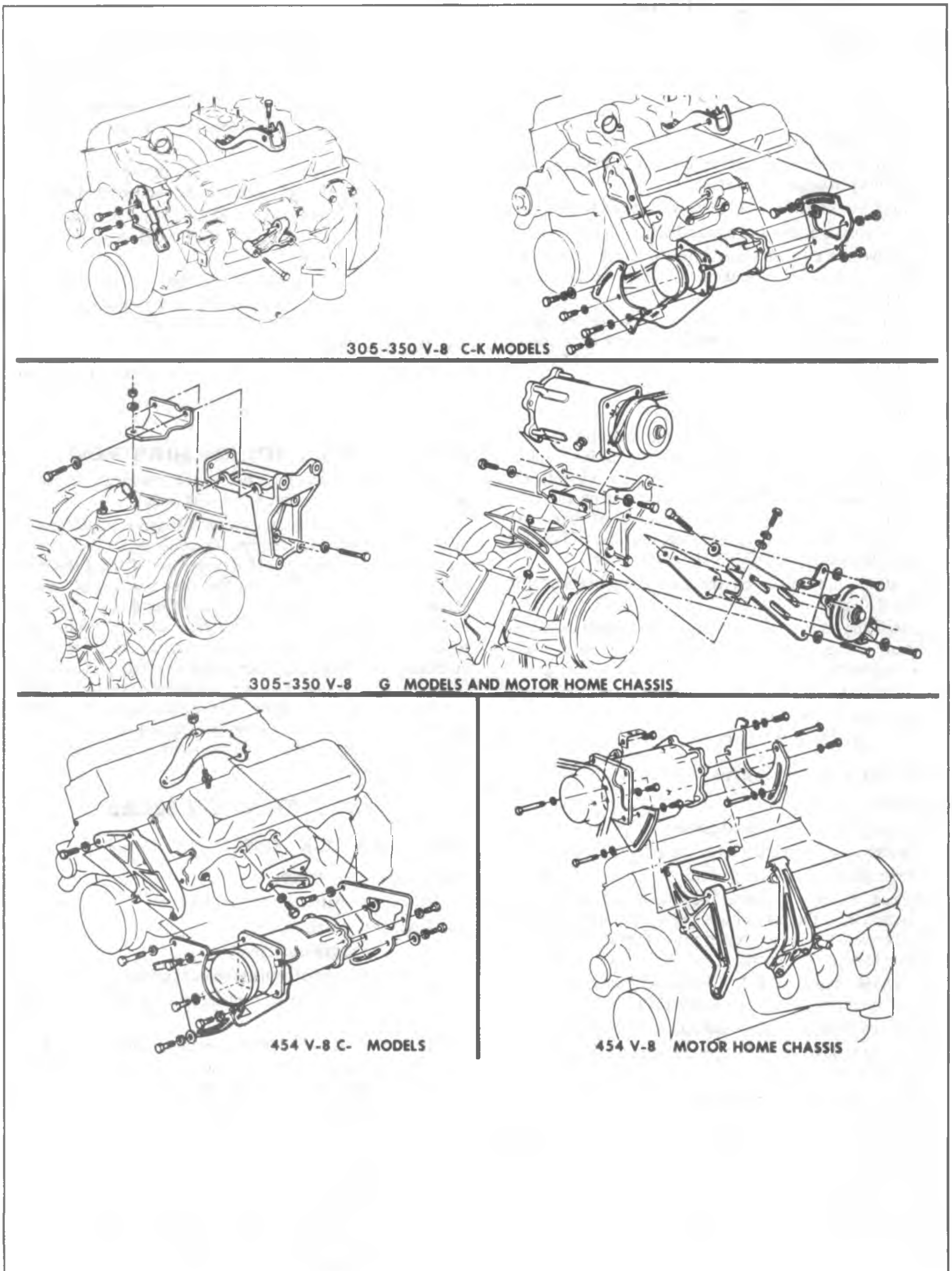
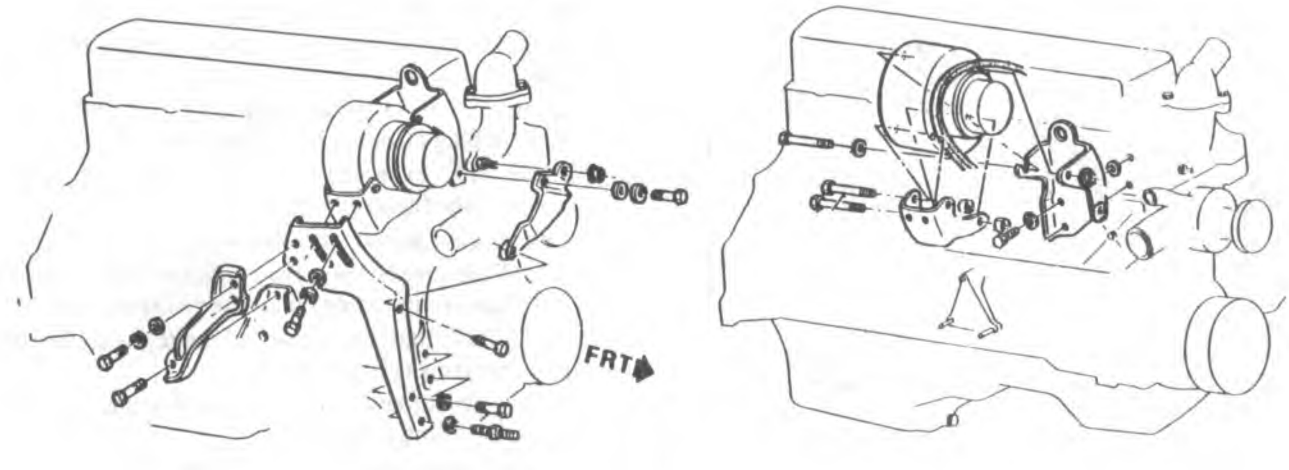
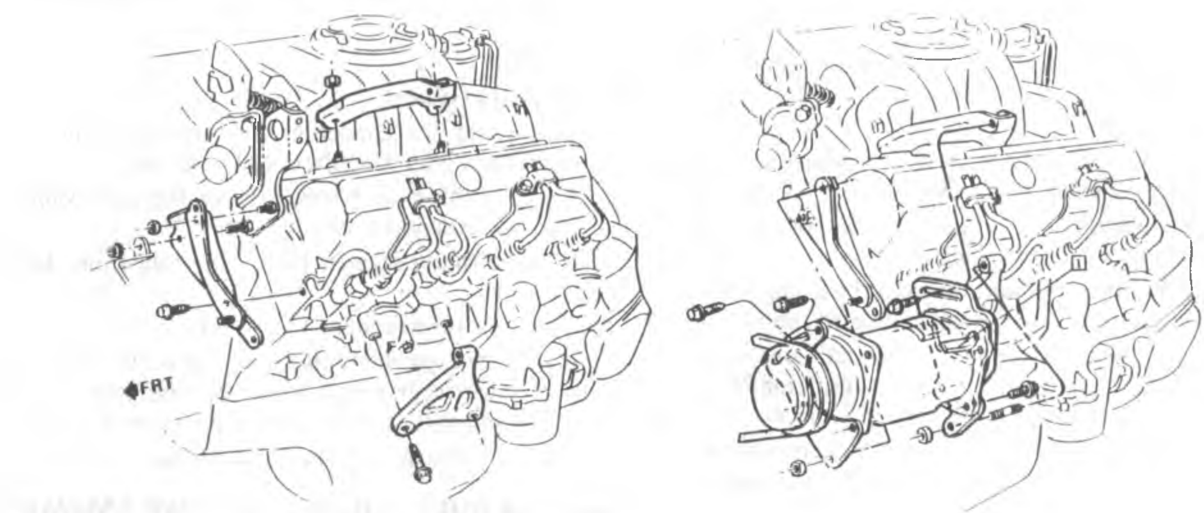


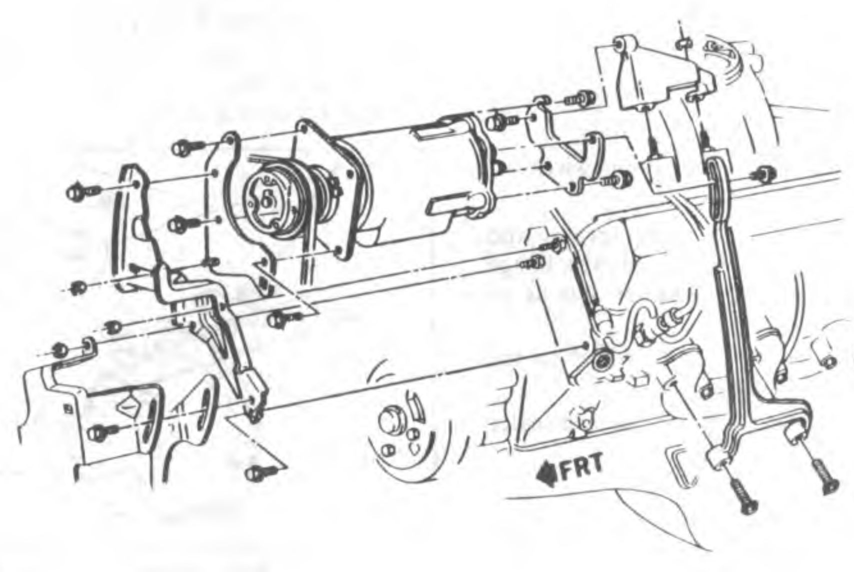
Fig. 1B-28A--Compressor Mounting



L-6 C-K MODELS



6.2L C-K MODELS



6.2L G MODELS

Fig. 1B-28B--Compressor Mounting (Cont.)

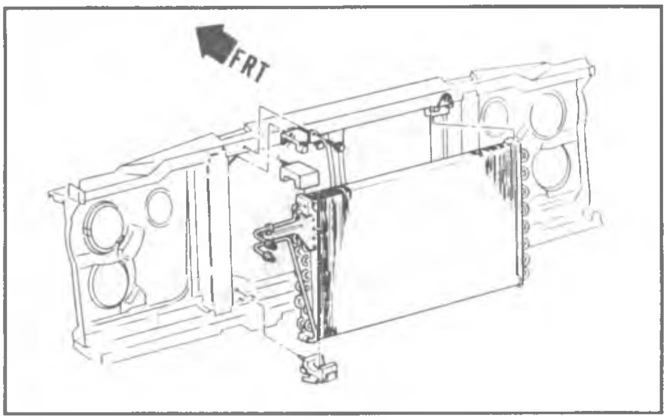


Fig. 1B-29--Condenser Installation (C-K Series)

Use new "O" rings, coated with clean refrigeration oil, when connecting all refrigerant lines.

11. Evacuate, charge and check the system.

ACCUMULATOR - ALL

Replacement

1. Disconnect the battery ground cable and the compressor clutch connector.
2. Discharge system.
3. Disconnect the accumulator inlet and outlet lines and cap or plug the open connections at once.
4. Remove the accumulator bracket screws and remove the accumulator from the vehicle.
5. Drain any excess refrigerant oil from the accumulator into a clean container. Measure and discard the oil.
6. If a new accumulator is being installed, add one ounce of clean refrigeration oil to the new accumulator **PLUS** an amount equal to that drained in Step 5 above.
7. To install the new accumulator, reverse Steps 1 thru 4 above. Connect all lines using new "O" rings, coated with clean refrigeration oil.
   Do not uncap the new unit until ready to fasten the inlet and outlet line to the unit.
8. Evacuate charge and check the system.

BLOWER ASSEMBLY - C-K SERIES

Replacement

1. Disconnect the battery ground cable.
2. Disconnect the blower motor lead and ground wires.
3. Disconnect the blower motor cooling tube.
4. Remove the blower to case attaching screws and remove the blower assembly. Pry the blower flange away from the case carefully if the sealer acts as an adhesive.
5. Remove the nut attaching the blower wheel to the motor shaft and separate the assemblies.
6. To install, reverse Steps 1 thru 5 above; replace sealer as necessary.

EVAPORATOR CORE

Replacement (Fig. 1B-30)

1. Disconnect the battery ground cable.
2. Discharge system.
3. Remove the nuts from the selector duct studs projecting through the dash panel.
4. Remove the cover to dash and cover to case screws and remove the evaporator case cover.
5. Disconnect the evaporator core inlet and outlet lines and cap or plug all open connections at once.
6. Remove the expansion tube as outlined under expansion tube replacement.
7. Remove the evaporator core assembly.
8. To install, reverse Steps 1 thru 7 above. Add 90 ml (3 oz.) of clean refrigeration oil to a new evaporator core.
   Use new "O" rings, coated with clean regrigeration oil, when connecting refrigerant lines.
   Be sure cover to case and dash panel sealer is intact before reinstalling cover.
9. Evacuate, charge and check the system.

EXPANSION TUBE-C-K,& G

The expansion tube is located in the evaporator core inlet line.

Replacement

1. Discharge system.
2. Disconnect the condenser to evaporator line at the evaporator inlet. Cap the open line at once.
3. Using needle-nose pliers, remove the expansion tube from the evaporator core inlet line.
4. Remove the expansion tube "O" ring from the core inlet line.
5. To install, reverse Steps 1 thru 4 above.
   Install the expansion tube using a new "O" ring coated with clean regrigeration oil, by inserting the short screen end of the tube into the evaporator inlet line.
6. Evacuate, charge and check the system.

SELECTOR DUCT AND HEATER CORE ASSEMBLY-C-K

Replacement (Fig. 1B-31)

1. Disconnect the battery ground cable.
2. Drain the radiator and remove the heater hoses from the core tubes. Plug the core tubes to prevent coolant spillage during removal.

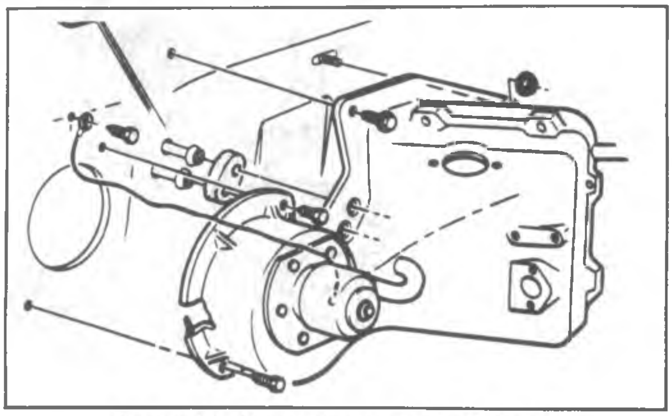


Fig. 1B-30--Blower-Evaporator (C-K Series)

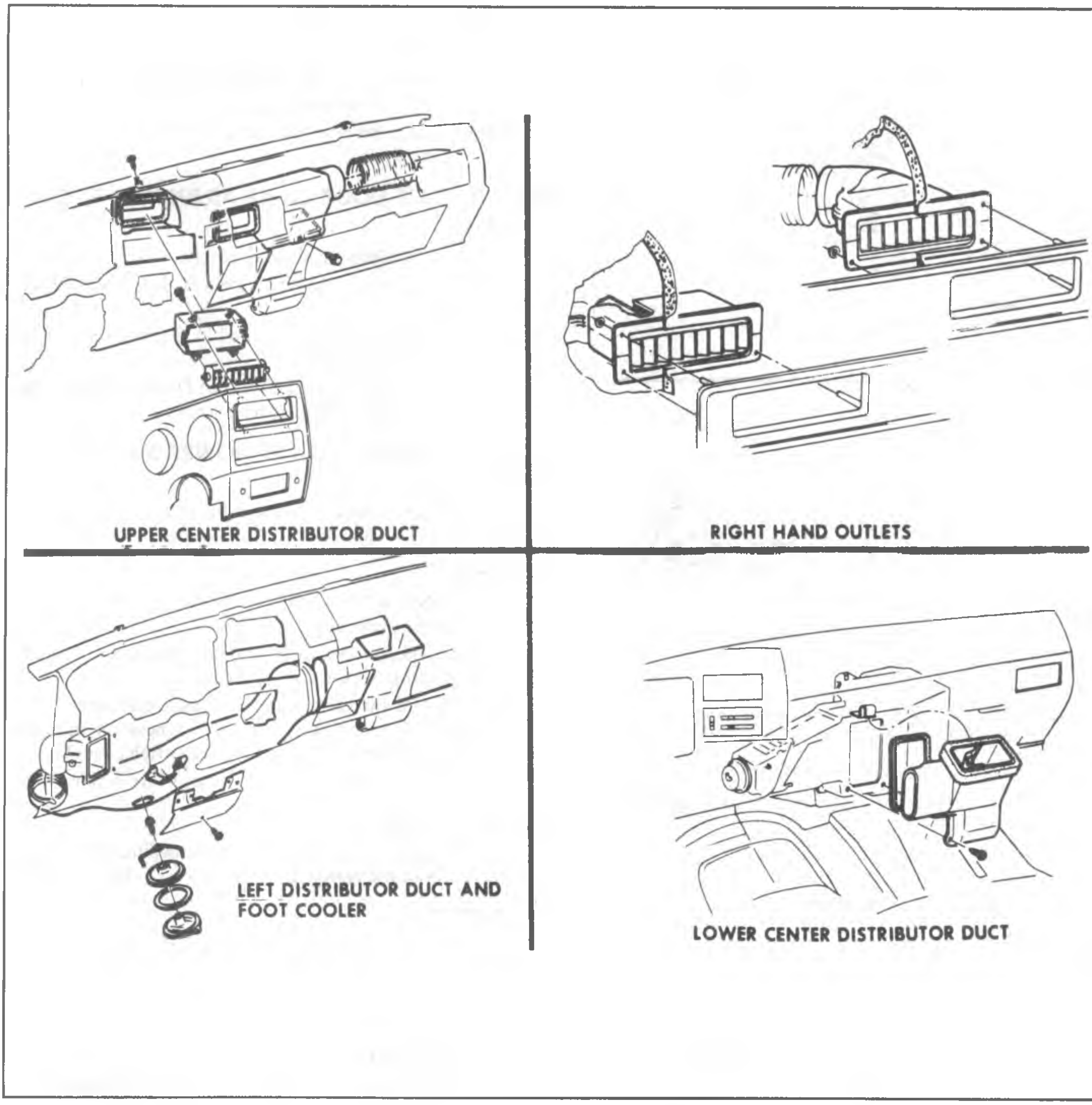


Fig. 1B-31--Air Selector and Ducts (C-K Series)

3. Remove the glove box and door as an assembly.
4. Remove the center duct to selector duct and instrument panel screws and remove the center lower and center upper ducts.
5. Disconnect the bowden cable at the temperature door.
6. Remove the nuts from the three selector duct studs projecting through the dash panel.
7. Remove the selector duct to dash panel screw (inside vehicle).
8. Pull the selector duct assembly rearward until the core tubes clear the dash panel. Lower the selector assembly far enough to gain access to all vacuum and electrical harnesses.
9. Disconnect the vacuum and electrical harness and remove the selector duct assembly.
10. Remove the core mounting strap screws and remove the core.
11. To install, reverse Steps 1 thru 10 above.
12. Refill coolant system and connect the battery ground strap. Check temperature door cable adjustment.

KICK PAD VALVE - C-K SERIES

Replacement (Fig. 1B-32)

1. Disconnect the vacuum hose at the actuator.
2. Unhook the valve return spring at the actuator end.
3. Remove the actuator bracket mounting screws.
4. Remove the cam to actuator arm screw and separate

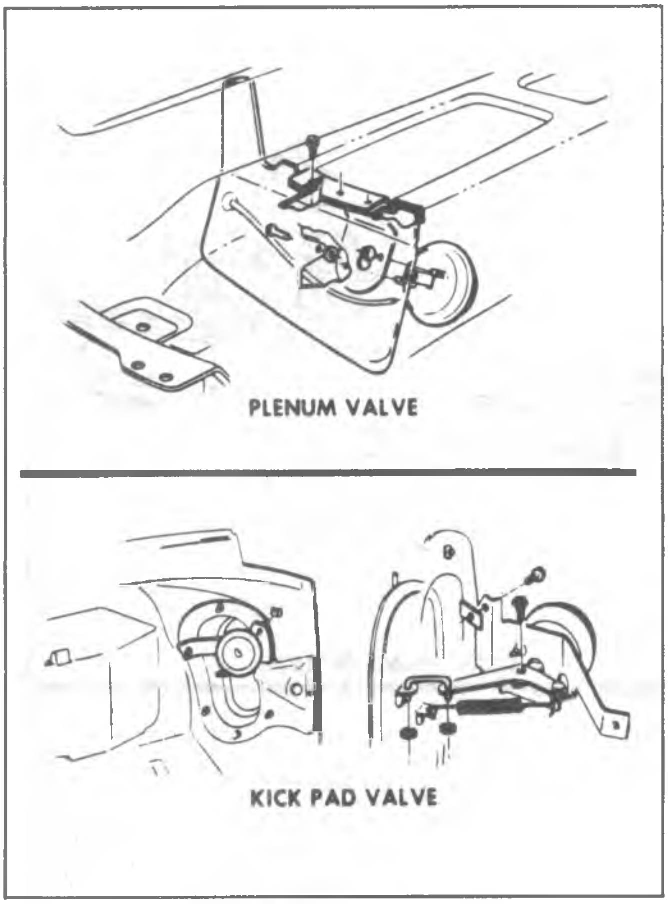


Fig. 1B-32--Air Inlet Valves (C-K Models)

the actuator and bracket from the cam.

5. Remove the actuator to bracket nuts and separate the actuator and bracket.
6. To install reverse Steps 1 thru 5 above.

PLENUM VALVE - C-K SERIES

Replacement (Fig. 1B-32)

1. Raise the hood.
2. Remove the cowl plastic grille.
3. Remove the three cowl to valve assembly screws and remove the valve assembly from the vehicle.
4. Remove the actuator arm pushnut.
5. Remove the actuator to valve nuts and separate the valve and actuator.
6. To install, reverse Steps 1 thru 5 above.

CONTROL ASSEMBLY - C-K SERIES

Removal (Fig. 1B-33)

1. Disconnect the battery ground cable.
2. Remove the radio as outlined in Section 8 of this manual.
3. Remove the instrument panel bezel.
4. Remove the control to instrument panel screws and lower the control far enough to gain access to the control assembly.

   Be careful not to kink the bowden cable.
5. Disconnect the bowden cable, vacuum harness and electrical harness at the control.
6. Remove the control.
7. If a new unit is being installed, transfer the master blower switches to the new control.
8. To reinstall, reverse Steps 1 thru 6 above. Check control operation.

TEMPERATURE DOOR CABLE ADJUSTMENT - C-K MODELS

1. Remove glove box and door assembly.
2. Loosen the cable attaching screw at the selector duct assembly.
3. Make sure the cable is installed in the bracket on the selector duct assembly.
4. Place temperature lever in full COLD position and hold while tightening cable attaching screw.

MASTER SWITCH AND/OR BLOWER SWITCH - C-K SERIES

The master switch is located on rear of the control assembly.

Replacement

1. Disconnect the battery ground cable.
2. Remove the instrument panel bezel.
3. Remove the control to instrument panel screws and allow control to rest on top of the radio.
4. Remove the switch to control screws, disconnect the electrical harness (and vacuum harness on master switch) at the switch and remove the switch assembly.
5. To install a new switch, reverse Steps 1 thru 4 above.

VACUUM TANK

The vacuum tank is mounted to the engine side of the dash panel above the blower assembly (Fig. 1B-34).

Replacement

1. Disconnect the vacuum lines at the tank.
2. Remove the tank to dash panel screws and remove the tank.
3. To install, reverse Steps 1 and 2 above.

BLOWER MOTOR RESISTOR

The blower motor resistor is located in the blower side of the blower-evaporator case (Fig. 1B-36).

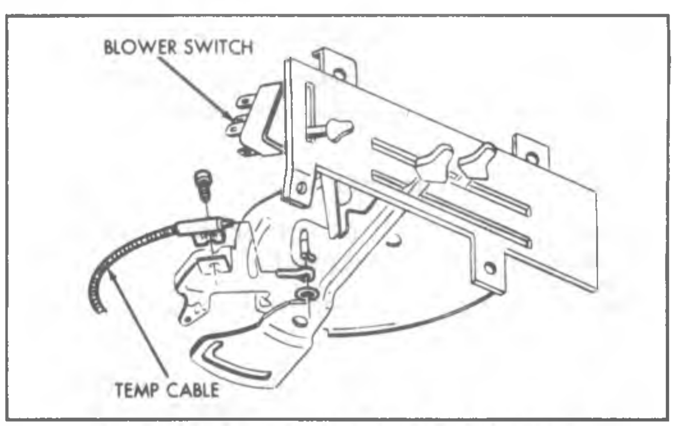


Fig. 1B-33--Control Assembly C-K, C60 System

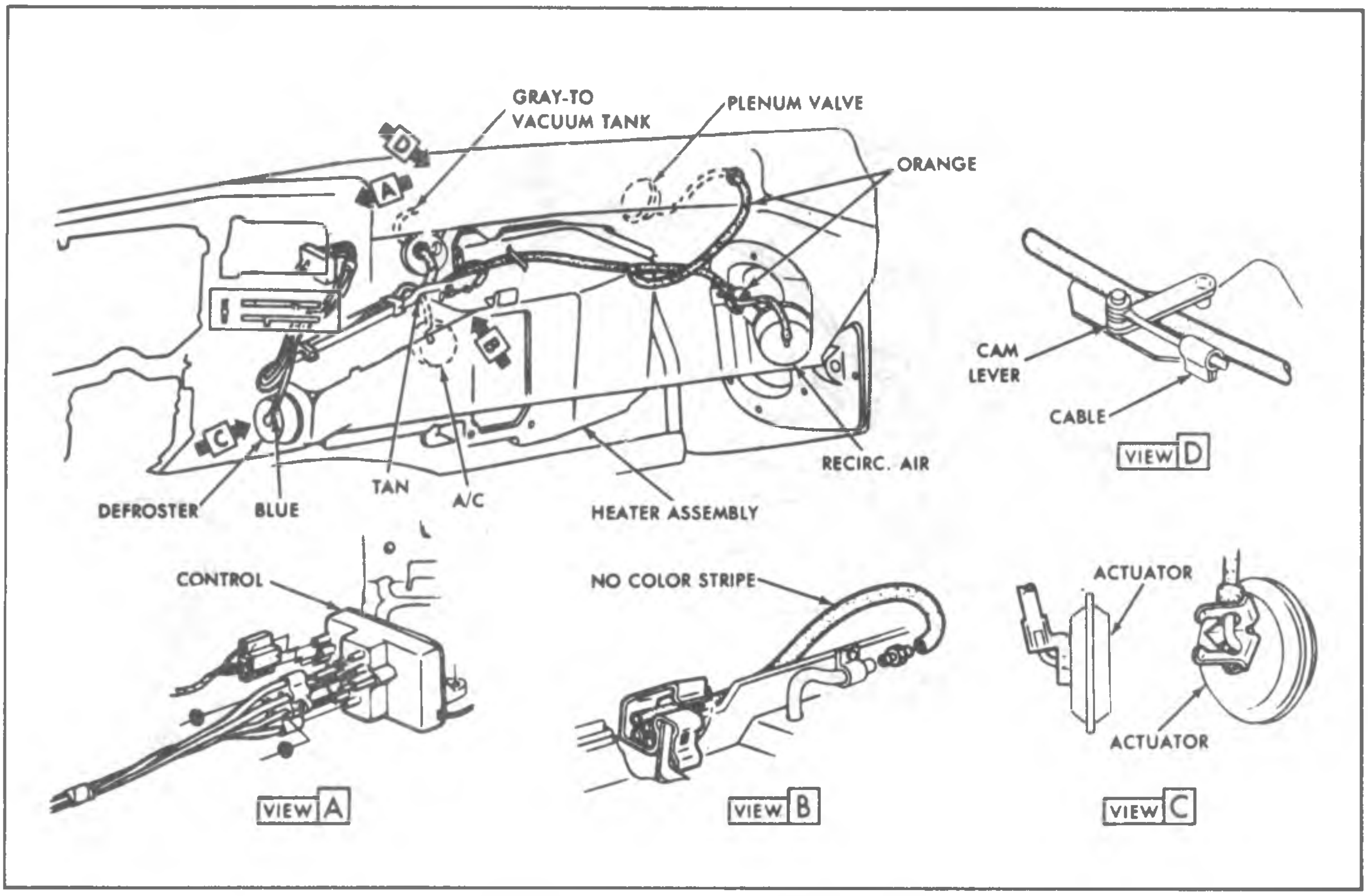


Fig. 1B-35--Vacuum Line Routing - C-K Models

Replacement

1. Disconnect the wiring harness at the resistor.
2. Remove the resistor to case attaching screws and remove the resistor.
3. Place the new resistor in position and install the attaching screws.
4. Connect the resistor wiring harness.

BLOWER MOTOR RELAY - ALL

The blower motor relay is located on the blower side of the blower-evaporator case (Fig. 36).

Replacement

1. Disconnect the wiring harness at the relay.
2. Remove the relay to case attaching screws and remove the relay.
3. Place the new relay in position and drive the mounting screws.
4. Connect the relay wiring harness.

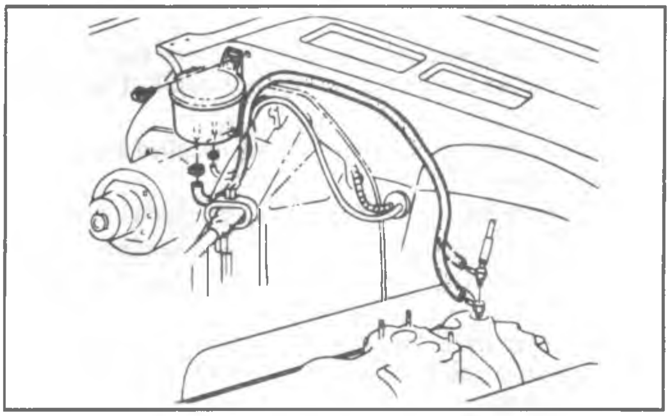


Fig. 1B-34--Vacuum Tank C-K Models

FUSE

A 25 amp fuse, located in the junction block protects the entire air conditioning system except for the blower circuit, the fuse for the blower circuit is located in the electrical wiring between the junction block and the blower relay.

OVERHEAD SYSTEM--C-K MODELS

The Overhead System is used in conjunction with the C60 System. Since replacement of C60 System components has been covered previously, only those components peculiar to the Overhead System will be covered in this section.

REAR DUCT

This duct covers the blower-evaporator assembly, at the rear of the vehicle, and incorporates four adjustable air outlets (Fig. 1B-37).

Replacement

1. Disconnect the battery ground cable.
2. Disconnect the drain tube from the rear duct.
3. Remove the screws securing the duct to the roof panel and rear header brackets.
4. Remove the duct.

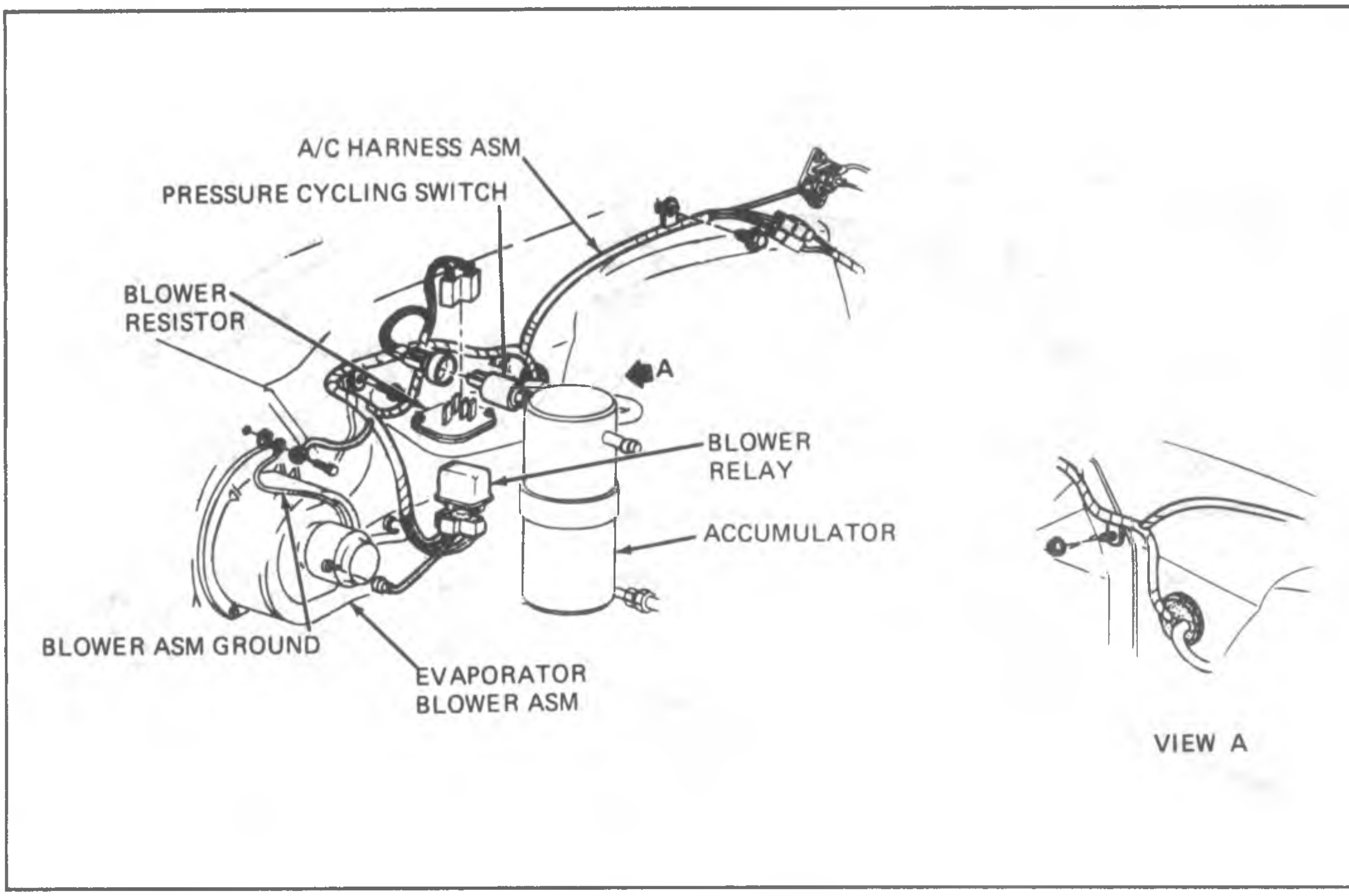


Fig. 1B-36--Engine Compartment Wiring Harness (C-K Models)

5. To install, reverse Steps 1 thru 4 above.

BLOWER MOTOR RESISTOR

The blower motor resistor is located on the cover side of the C60 System blower-evaporator as shown in Fig. 1B-38.

Replacement

1. Disconnect battery ground cable.
2. Disconnect the electrical harness at the resistor.
3. Remove the resistor attaching screws and remove the resistor.
4. To install a new resistor, reverse Steps 1 thru 3 above.

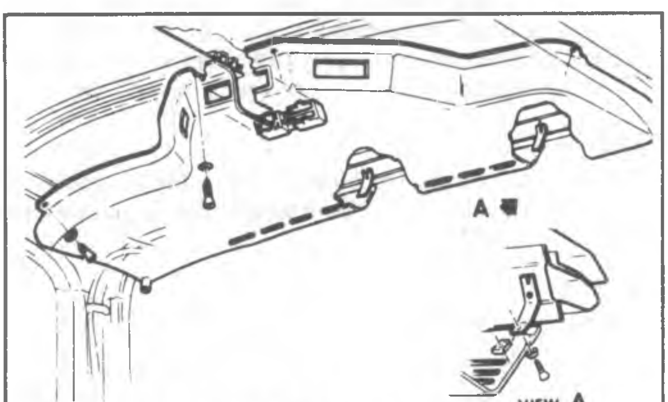


Fig. 1B-37--Rear Duct C-K & G Overhead System

BLOWER MOTOR ASSEMBLY

Removal (Fig. 1B-39)

1. Disconnect the battery ground cable.
2. Remove the rear duct as outlined previously.
3. Disconnect the blower motor ground strap.
4. Disconnect the blower motor lead wire.
5. Remove the lower to upper blower-evaporator case screws and lower the lower case and motor assembly.

   NOTICE: Before removing the case screws, support the lower case to prevent damage to the case or motor assemblies.
6. Remove the motor retaining strap and remove the motor and wheels. Remove the wheels from the motor shaft.

Installation

1. Place the blower wheels onto the motor shaft making sure the wheel tension springs are installed on hub of wheels.

   Be sure that the blower wheels are installed as shown in Fig. 1B-40.
2. Install the blower motor retaining strap and foam.
3. Place the blower motor and wheel assembly into the lower case. Align the blower wheels so that they do not contact the case.
4. Place the lower case and blower motor assembly in position in the vehicle and install the lower to upper case screws.

   NOTICE: Rotate the blower wheels to make sure that

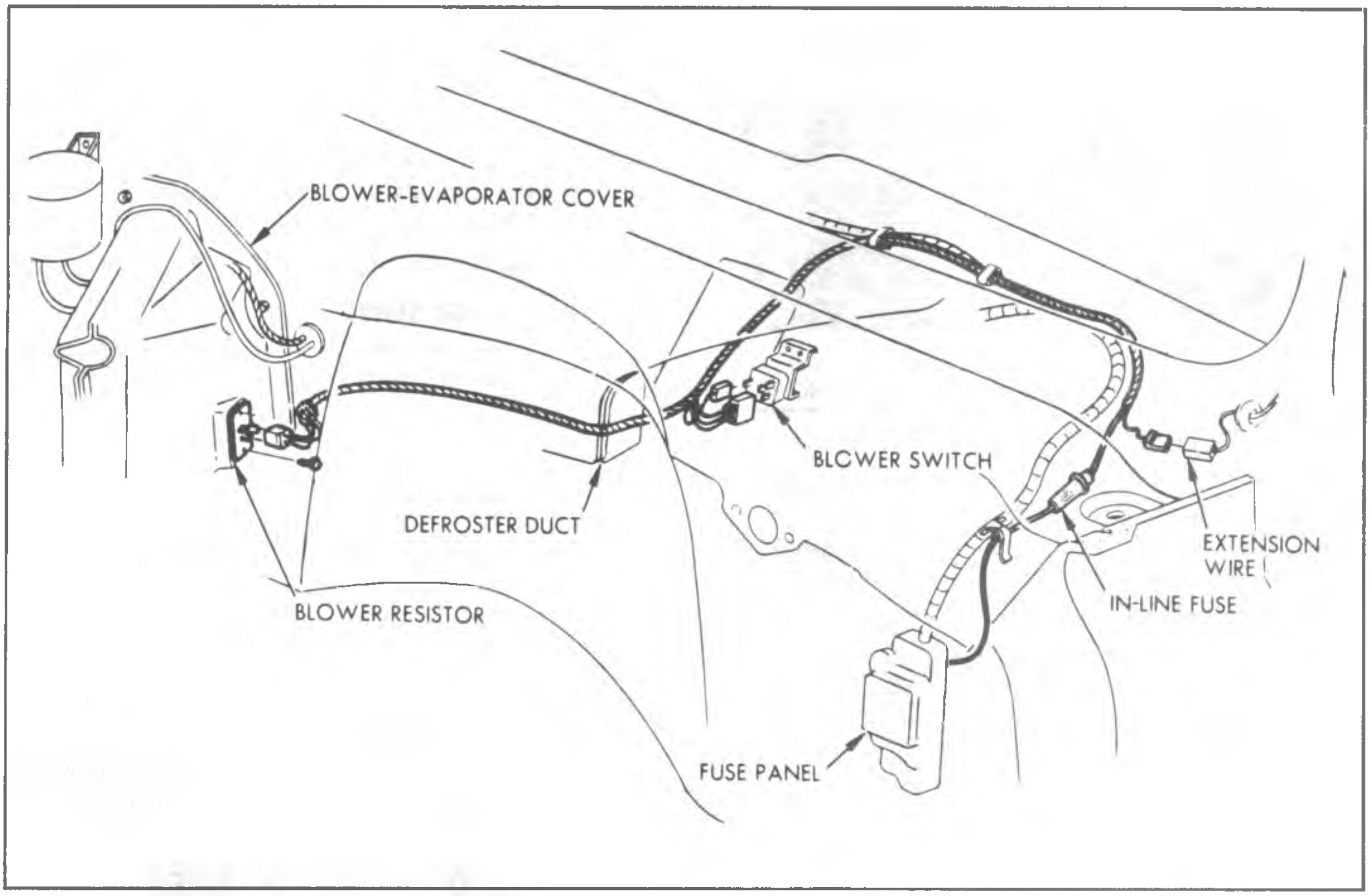


Fig. 1B-38--Overhead System Front Wiring (C-K Models)

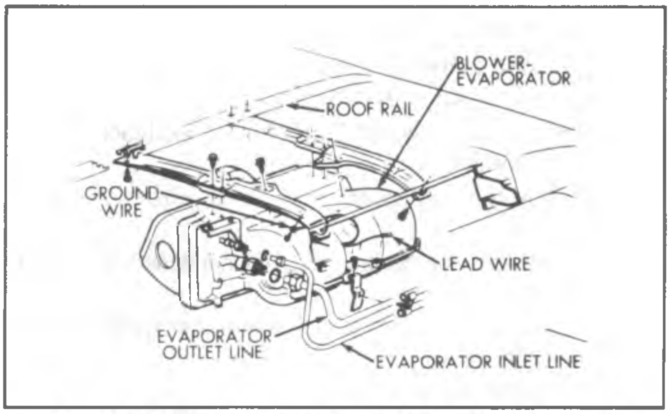


Fig. 1B-39--Blower-Evaporator (C-K Overhead System)

they do not rub on the case.

5. Install the center ground wire and connect the blower lead wire.
6. Install the rear duct assembly as described previously.
7. Connect the battery ground cable.

EXPANSION VALVE

This sytem incorporates an expansion valve which does not utilize and external equalizer line (Fig. 1B-41).

Removal

1. Disconnect battery ground cable.
2. Purge the system of refrigerant.
3. Remove the rear duct as outlined previously.
4. Disconnect the blower motor lead and ground wires.
5. Remove the lower to upper blower-evaporator case screws and lower the lower case and motor assembly.

   NOTICE: Before removing the case screws, support the lower case and motor assemblies to prevent damage to the case or motor assemblies.

6. Remove the expansion valve sensing bulb clamps.
7. Disconnect the valve inlet and outlet lines and remove the expansion valve assembly. Cap or plug the open connections at once.

Installation

1. Remove caps or plugs from system connections and install the new valve assembly using new "O" rings coated with clean refrigeration oil.

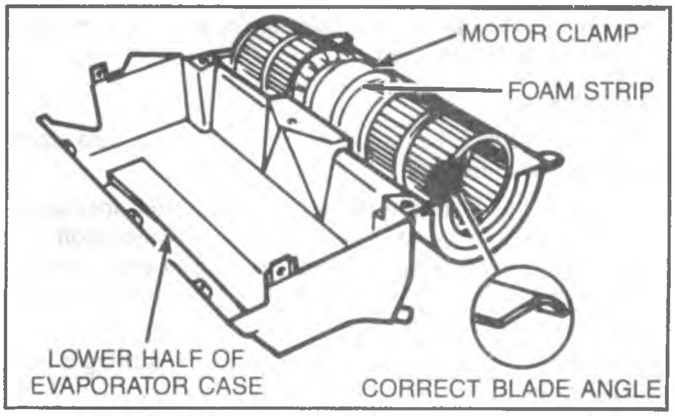


Fig. 1B-40--Blower Motor (C-K Overhead System)

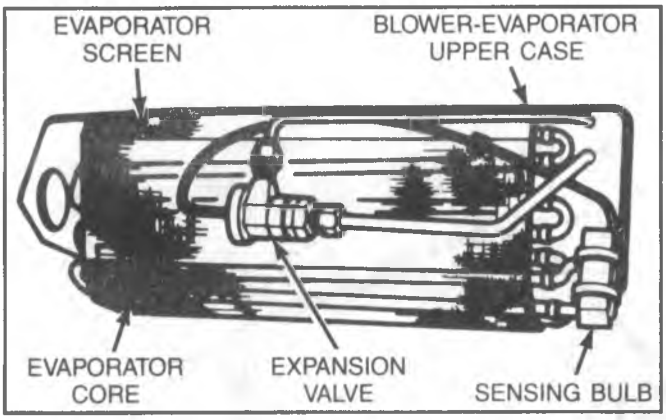


Fig. 1B-41--Expansion Valve C69 System

2. Install the sensing bulb, making sure that the bulb makes good contact with the core outlet line.
3. Install the lower case and blower motor assemblies. Connect the blower motor lead and ground wires.
4. Install the rear duct as outlined previously.
5. Connect the battery ground cable.
6. Evacuate, charge and check the system.

EVAPORATOR CORE

Removal

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Remove the rear duct as outlined previously.
4. Disconnect the blower motor lead and ground wire connections.
5. Disconnect the refrigerant lines at the rear of the blower-evaporator assembly. Cap or plug the open connections at once.
6. Remove the blower-evaporator support to roof rail screws, lower the blower-evaporator assembly and place it on a work bench upside down.
7. Remove the lower to upper case screws and remove the lower case assembly. Remove the support to upper case screws and remove the upper case from the evaporator core.
8. Remove the expansion valve inlet and outlet lines and cap or plug the open connections at once. Remove the expansion valve capillary bulb from the evaporator outlet line and remove the valve.
9. Remove the plastic pins holding the screen to the core and remove the screen.

Installation

1. Install the wire screen to the front of the core and insert the plastic pins.
2. Install the expansion valve inlet and outlet lines using new "O" rings coated with clean refrigeration oil. Install the sensing bulb to the evaporator outlet line as shown in Fig. 1B-41; make sure the bulb has good contact with the line.

   Add 3 oz. clean refrigeration oil when installing a new core.
3. Install the upper case and supports to the core.
4. Install the lower core case and blower assembly.
5. Install the blower-evaporator assembly to the roof and install the support to roof rail screws.
6. Connect the refrigerant lines to the blower-evaporator unit using new "O" rings coated with clean refrigeration oil.
7. Connect the blower lead and ground wires.
8. Install the rear duct as outlined previously.
9. Connect the battery ground cable.
10. Evacuate, charge and check the system.

BLOWER MOTOR SWITCH

The three-speed (LO-MED-HI) blower motor switch is located in the instrument panel, just to the left of the ash tray.

Replacement

1. Disconnect the battery ground cable.
2. Remove the switch retaining screws.
3. Disconnect the wiring harness at the switch and remove the switch.
4. To install, reverse Steps 1 thru 3 above.

FUSE

The Four Season portion of this system is protected by a 25 amp fuse in the junction block.

The rear blower high speed circuit is protected by a 20 amp in-line fuse, located between the junction block and the rear blower motor switch.

C60 SYSTEM--G SERIES

CONDENSER - G Series

Replacement (Fig. 1B-42)

1. Disconnect battery ground cable.
2. Purge the system of refrigerant.
3. Remove grille, hood lock, and center hood lock support as an assembly.
4. Disconnect condenser inlet and outlet lines at condenser.
5. Remove screws attaching left side condenser bracket to radiator.
6. Remove screws attaching right side condenser bracket to condenser.
7. Remove condenser from vehicle.
8. Remove left hand bracket from condenser.
9. To install new condenser, reverse steps 3 thru 8 above.

   Add 30 ml (1 oz.) of clean refrigeration oil to a new condenser.
10. Evacuate charge and test the system.

HEATER CORE - G SERIES

Replacement

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove steering column to instrument panel attaching bolts and lower column.
4. Remove upper and lower instrument panel attaching screws and radio support bracket attaching screw.
5. Raise and support right side of instrument panel.
6. Remove right lower instrument panel support

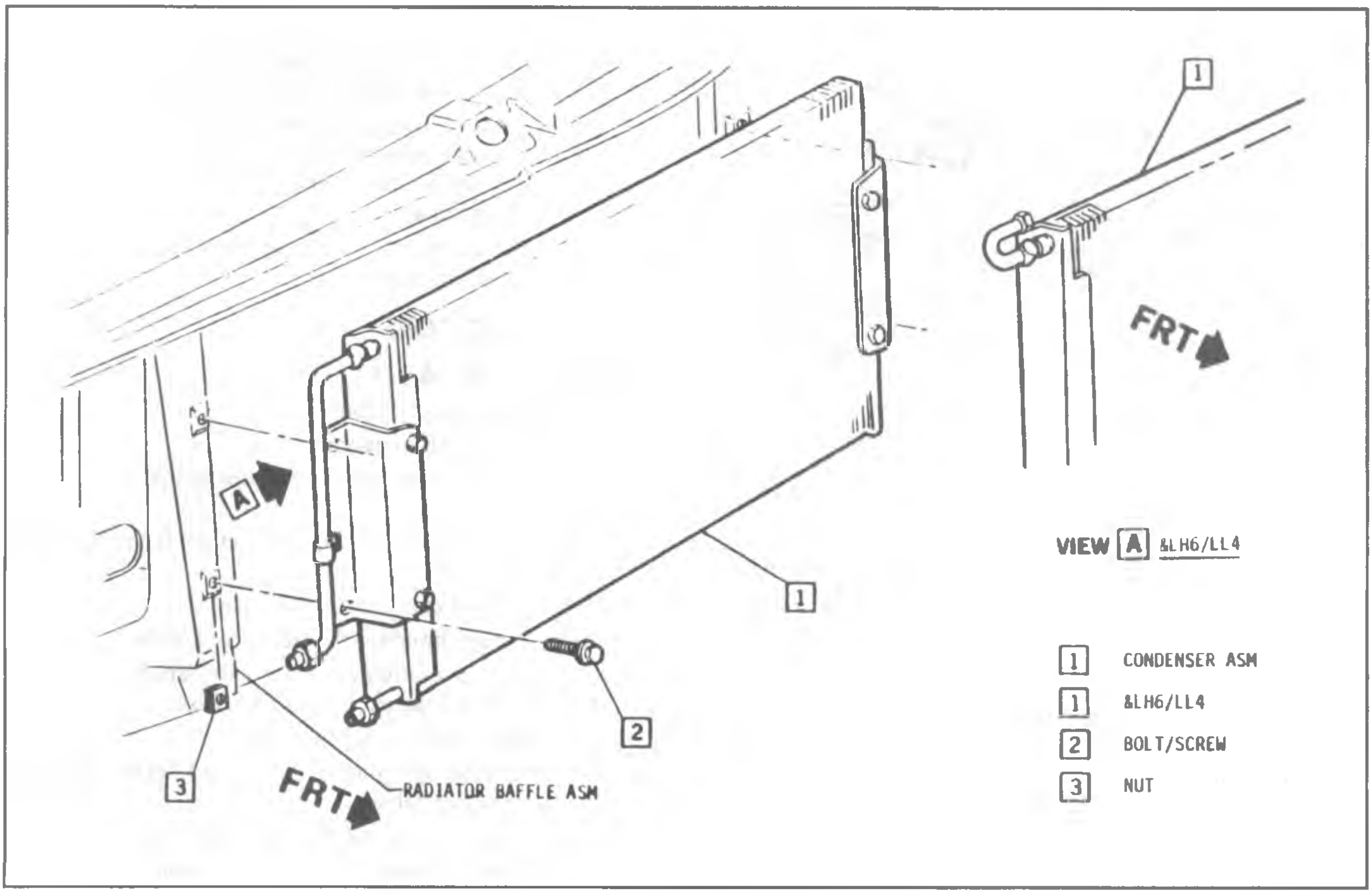


Fig. 1B-42--Condenser-G Series

bracket.

7. Remove recirculating air door vacuum actuator. Refer to Fig. 1B-43.
8. Disconnect temperature cable and vacuum hoses at distributor case.
9. Remove heater distributor duct, refer to Fig. 1B-44.
10. Remove 2 defroster duct to dash panel attaching screws (below windshield).
11. Working from the engine compartment, disconnect heater hoses and plug to prevent water spillage.

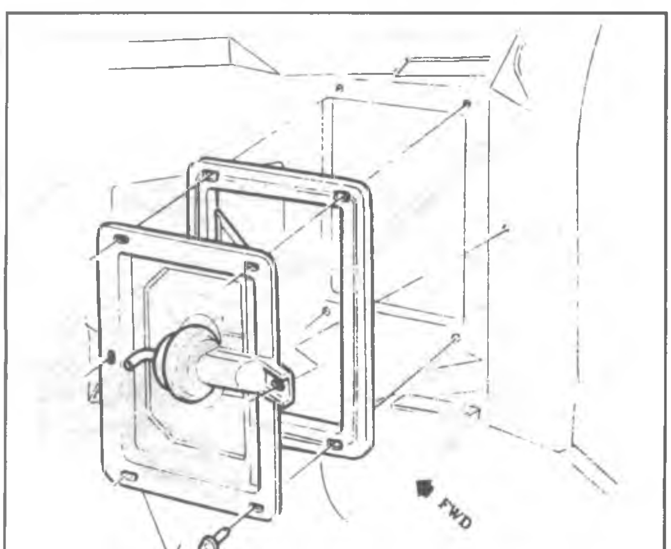


Fig. 1B-43--Recirculating Air Door Vacuum Actuator

12. Remove three (3) nuts from bolts attaching heater core case to dash panel and one (1) screw at lower right corner (inside).
13. Remove distributor assembly from vehicle.
14. Remove gasket to expose screws attaching case sections together as shown in Fig. 1B-45.
15. Remove temperature cable support bracket.
16. Remove case attaching screws and separate case.
17. Remove heater core.
18. To install new heater core, reverse Steps 2 thru 17 above.

BLOWER MOTOR INSULATION (W/DIESEL)

The 6.2 Liter Diesel Engine has extra insulation around the blower motor on vehicles without C60 and around the blower motor and evaporator core with C60 option.

Removal

1. Remove parking lamp assembly.
2. Remove the radiator overflow tank.
3. See Fig. 1B-46 for location of the screws.
4. Remove insulation through the hood opening.
5. Proceed with normal blower motor removal.
6. To install, reverse the above procedure.

EVAPORATOR CORE (W/DIESEL)

1. Remove cold air intake.
2. Disconnect hood latch assembly and cable retainer and place it out of the way.

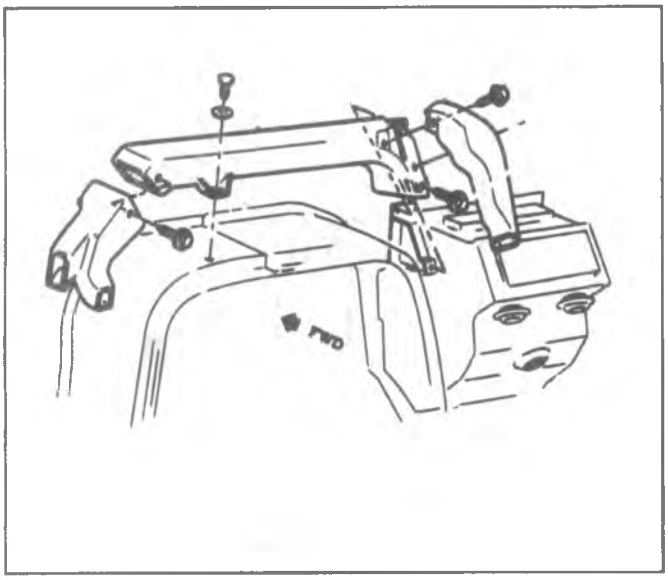


Fig. 1B-44--Heater Distributor Duct

3. Remove windshield solevent tank.
4. Discharge the A/C system.

NOTICE: When removing any A/C components, make sure that the component is capped to prevent contamination.

5. Disconnect the low pressure vapor line and move it out of the way.
6. Remove accumulator.
7. Disconnect and remove high pressure line inlet to the evaporator and the connecting bracket.
8. Remove the wiring harnesses going to the blower motor relay and resistors.
9. Remove the blower motor relay and resistors.
10. Remove the fan shroud upper half.
11. Remove the radiator.
12. Disconnect the heater valve assembly bracket and move it out of the way.
13. Remove the upper screws of the lower section, see Fig. 1B-46, and push it down and out of the way.
14. See Fig. 1B-46 for the location of the insulation mounting screws.
15. Remove insulation through the hood opening.
16. Proceed with the A/C evaporator procedure.
17. Reverse the above procedure for installation.

BLOWER MOTOR - G SERIES

Replacement

1. Disconnect battery ground cable.

G Series - Remove the coolant recovery tank, and power antenna.

2. Disconnect the blower motor lead wire.
3. Remove the five blower motor mounting screws and remove the motor and wheel assembly. Pry gently on the blower flange if the sealer acts as an adhesive.
4. Remove the blower wheel to motor shaft nut and separate the wheel and motor assemblies.
5. To install a new motor, reverse Steps 1 thru 4 above.

The following steps should be taken to assure proper installation:

a. Assemble the blower wheel to the motor with the open end of the wheel away from the blower motor.
b. If the motor mounting flange sealer has hardened, or is not intact, remove the old sealer and apply a new bead of sealer to the entire circumference of the mounting flange.
c. Check blower operations: blower wheel should rotate freely with no interference.

EVAPORATOR CORE

Replacement (Fig. 1B-51)

1. Disconnect battery ground cable.
2. Purge system of refrigerant.
3. Remove coolant recovery tank and bracket as outlined earlier.
4. Disconnect all electrical connectors from core case assembly.
5. Remove bracket at evaporator case.
6. Remove right hand marker lamp for access.
7. Disconnect accumulator inlet and outlet lines and 2 brackets attaching accumulator to case.
8. Disconnect evaporator inlet line.
9. Remove three (3) nuts and one (1) screw attaching module to dash panel.
10. Remove core case assembly from vehicle.
11. Remove screws and separate case sections.
12. Remove evaporator core.
13. To install new core, reverse Steps 3 thru 14 above.
14. Add 90 ml (3 oz.) 525 viscosity refrigeration oil to a new condenser.
15. Evacuate charge and check the system.

CONTROL ASSEMBLY - G SERIES

Replacement

1. Disconnect the battery ground cable.
2. Remove the headlamp switch control knob.
3. Remove the instrument panel bezel.

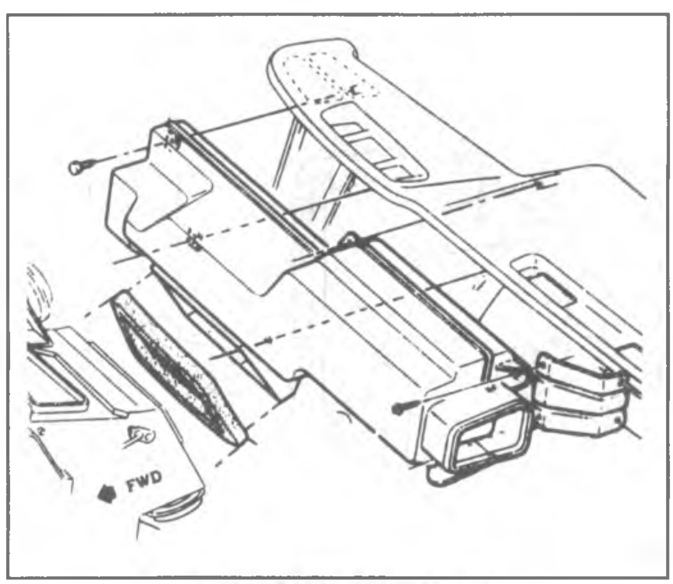


Fig. 1B-45--Distributor Gasket

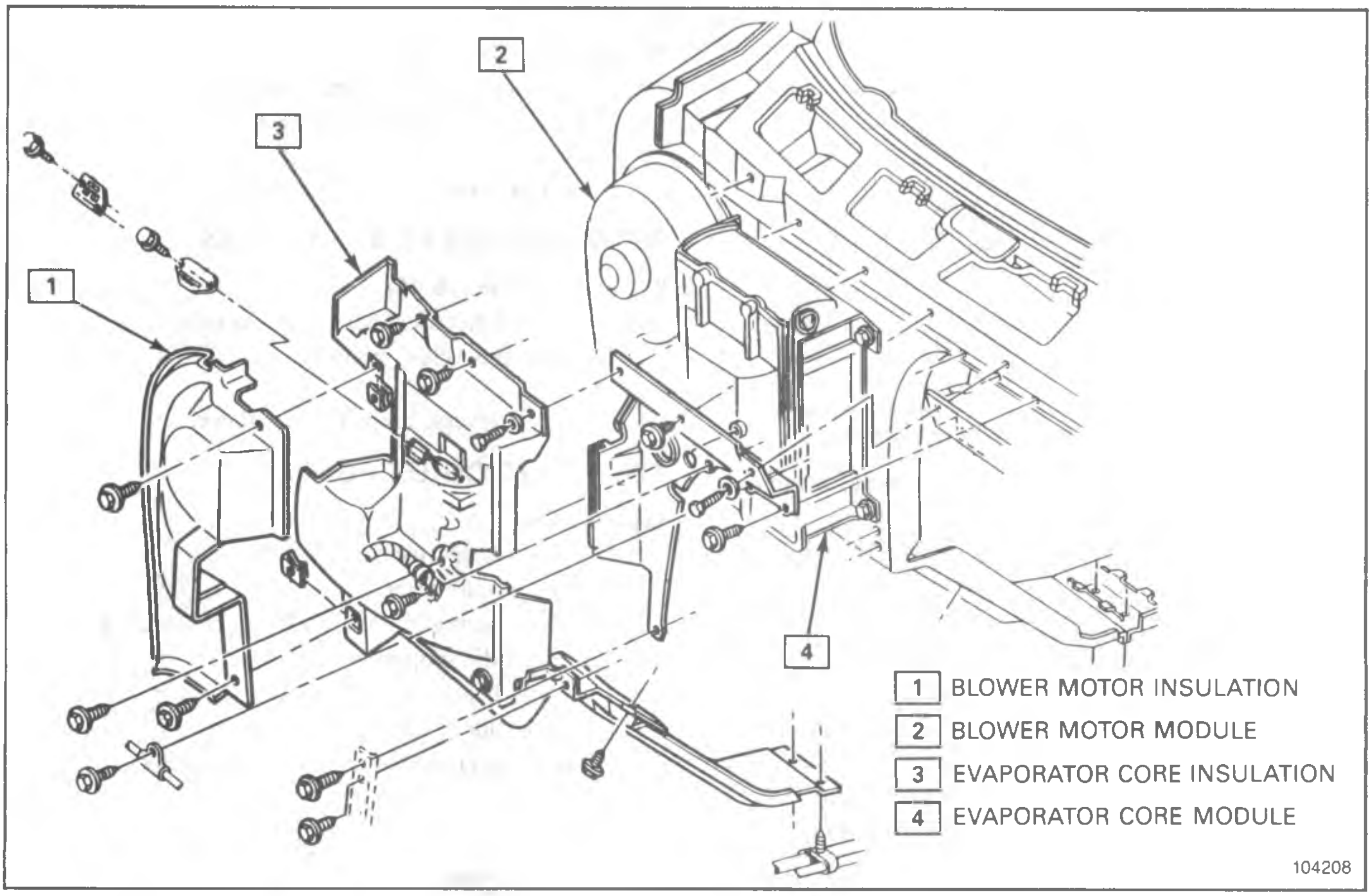


Fig. 1B-46--G Van Blower Motor (Diesel Only)

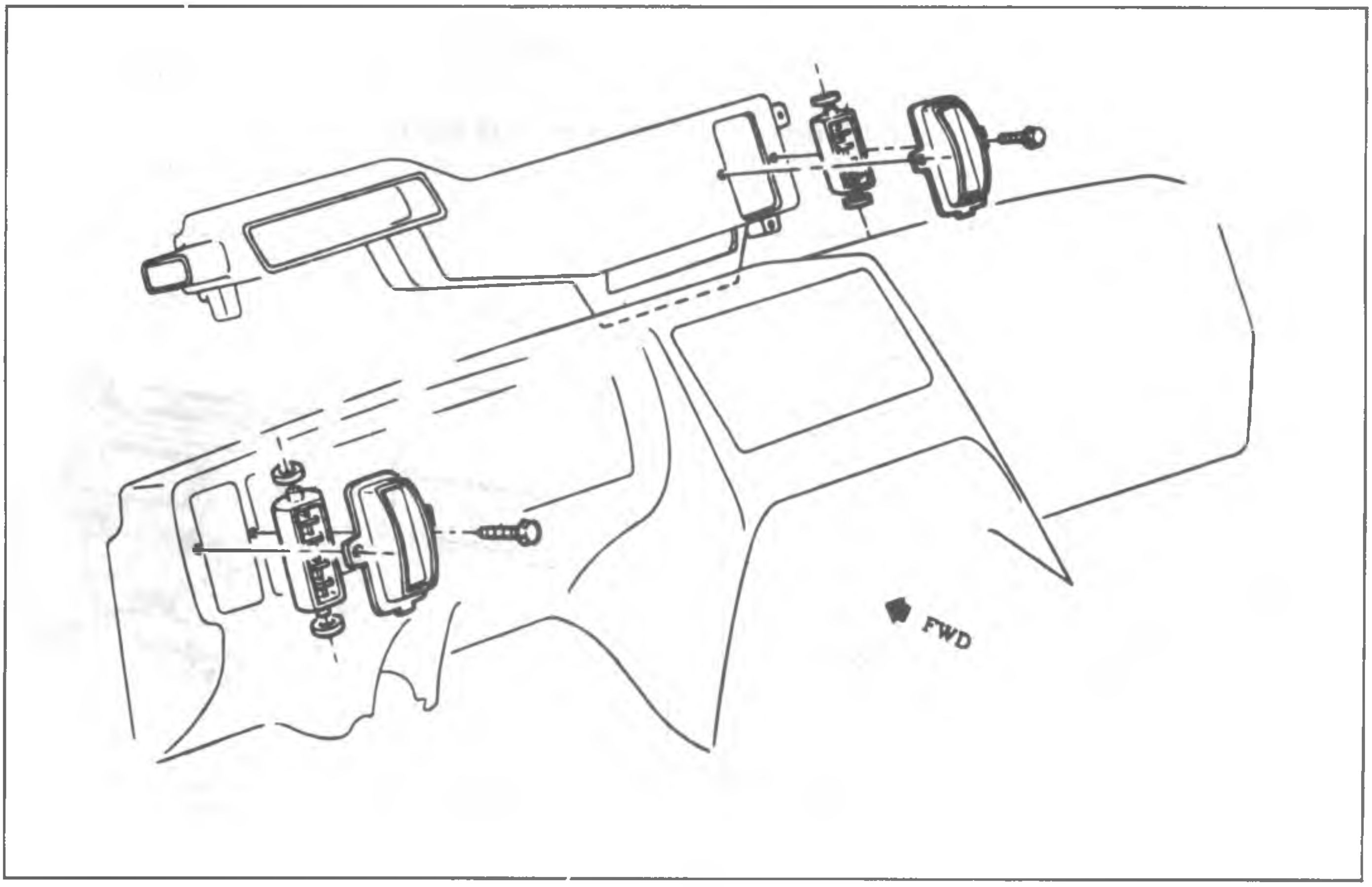


Fig. 1B-47--Air Deflector Outlets (G Series-C60 System)

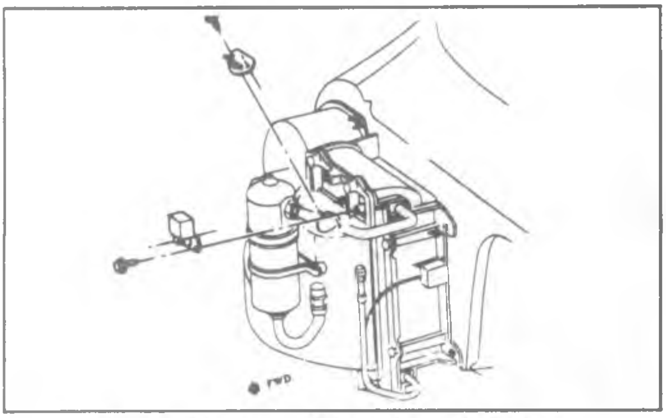


Fig. 1B-48--Blower Motor Relay and Resistor

4. Remove the control to instrument panel attaching screws.
5. Remove the temperature cable eyelet clip and mounting tab screw.
6. Pull the control through the instrument panel opening as follows: First pull the lower right mounting tab through the opening, then the upper tab and finally the lower right tab.
7. Disconnect electrical and vacuum connections and remove the control assembly.
8. To install, reverse Steps 1 thru 7 above. Check temperature door operation; adjust if necessary.

BLOWER SWITCH

Replacement

1. Disconnect the battery ground cable.
2. Remove the left foot cooler outlet assembly at the instrument panel attachment.
3. Disconnect the switch electrical harness.
4. Remove the switch mounting screws and remove the switch.
5. To install, reverse Steps 1 thru 4 above.

RESISTORS

Replacement (Fig. 1B-48)

1. Disconnect electrical harness at the resistor.
2. Remove the resistor mounting screws and remove the resistor.
3. To install, reverse Steps 1 thru 3 above.

BLOWER MOTOR RELAY - G SERIES

Replacement (Fig. 1B-48)

1. Disconnect electrical harness at the relay.
2. Remove the relay mounting screw and remove the relay.
3. To install, reverse Steps 1 thru 3 above.

CENTER A/C OUTLET - G SERIES

Replacement

1. Disconnect negative battery cable.
2. Remove engine cover.
3. Remove steering column to I.P. attaching screw.
4. Remove radio support bracket screw.
5. Remove I.P. attaching screws.
6. Pull right side of I.P. rearward.
7. Remove duct (distributor) attaching screws.
8. Remove center deflector.
9. To replace, reverse Steps 1 thru 8 above.

A/C DUCTWORK

Air Conditioning duct attachment is shown in Fig. 1B-57.

DEFROSTER DUCT

Defroster duct mounting is shown in Fig. 1B-58.

TEMPERATURE DOOR CABLE

Temperature cable attachment and routing is shown in Fig. 1B-59.

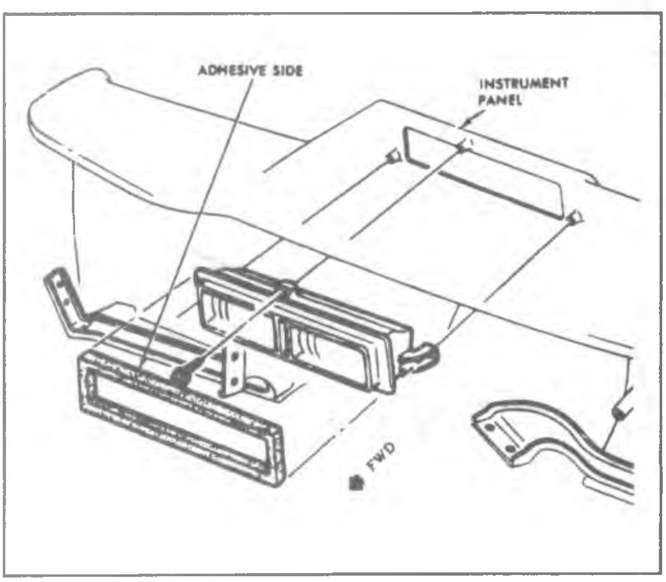


Fig. 1B-49--Center A/C Outlet Assembly-G Series

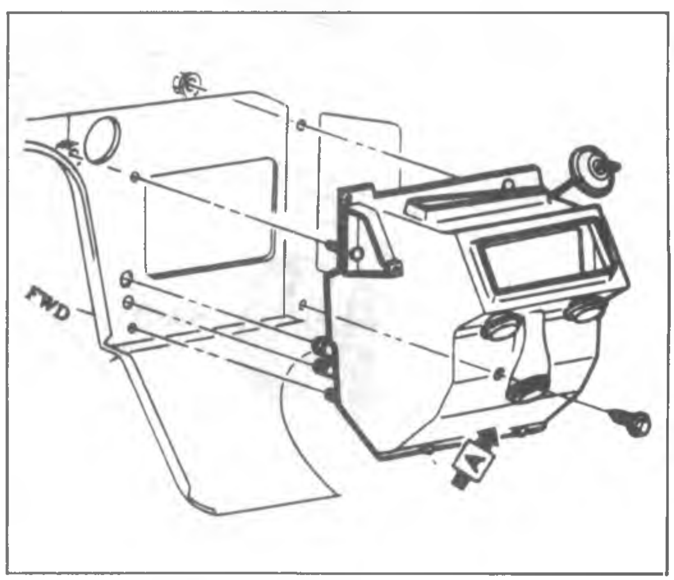


Fig. 1B-50--Heater Defroster Assembly-G Series

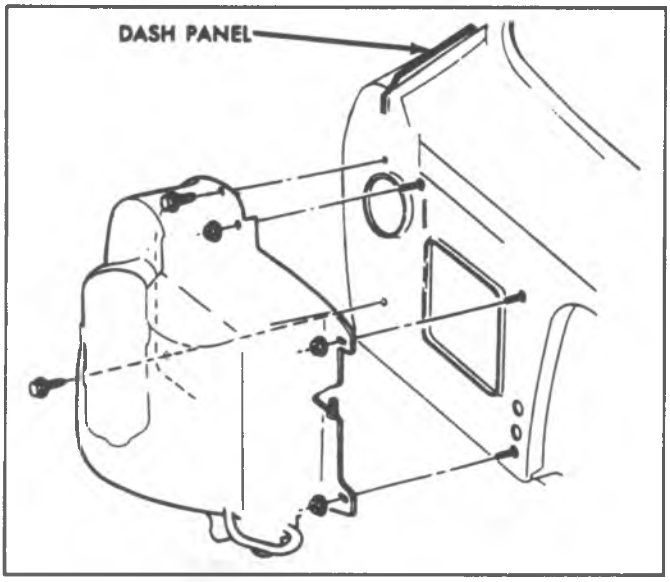


Fig. 1B-51--Evaporator Blower Assembly-G Series

VACUUM TANK - G SERIES

Replacement

1. Raise the hood.
2. Disconnect the vacuum harness at the tank.
3. Remove the tank attaching screws and remove the tank.
4. To install, reverse Steps 1 thru 3 above.

OVERHEAD SYSTEM--G SERIES

This system is used in conjunction with the C60 system. The G Van C69 system is almost identical to the C-K Models overhead system Refer to CK Series overhead system service procedures.

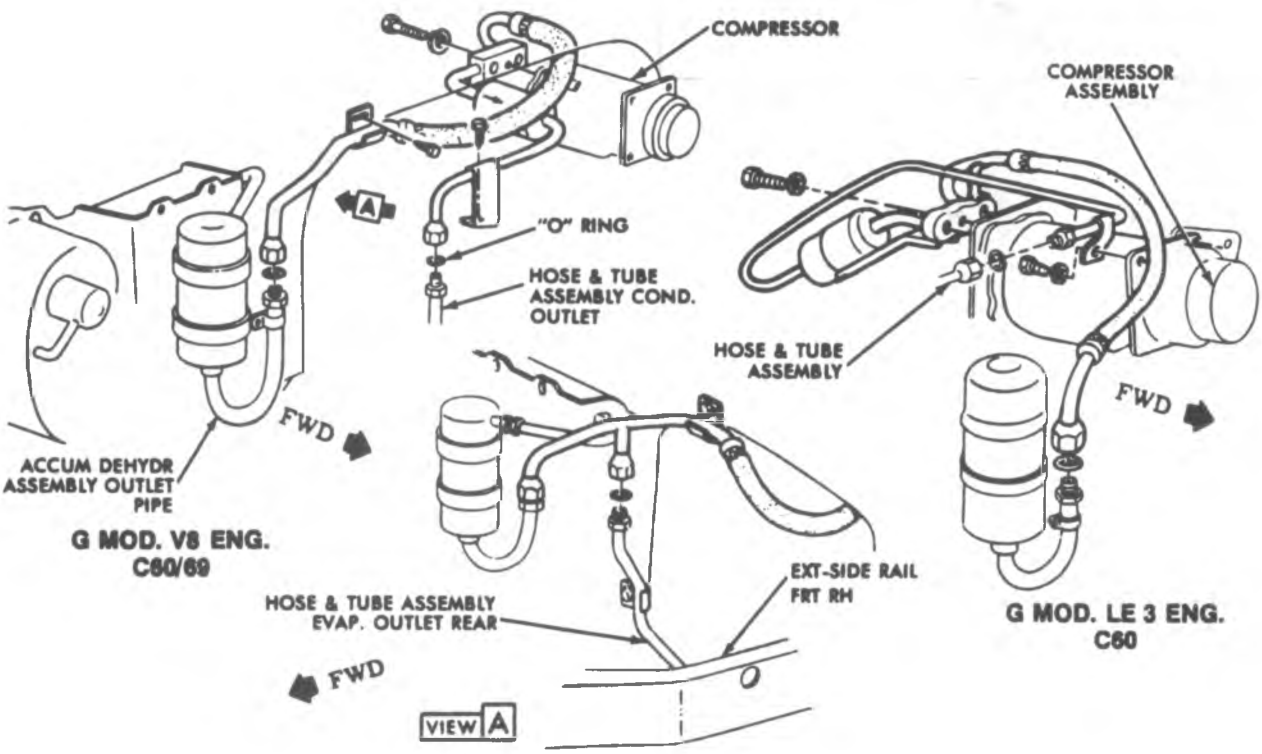


Fig. 1B-52--Refrigerant Lines - G Series

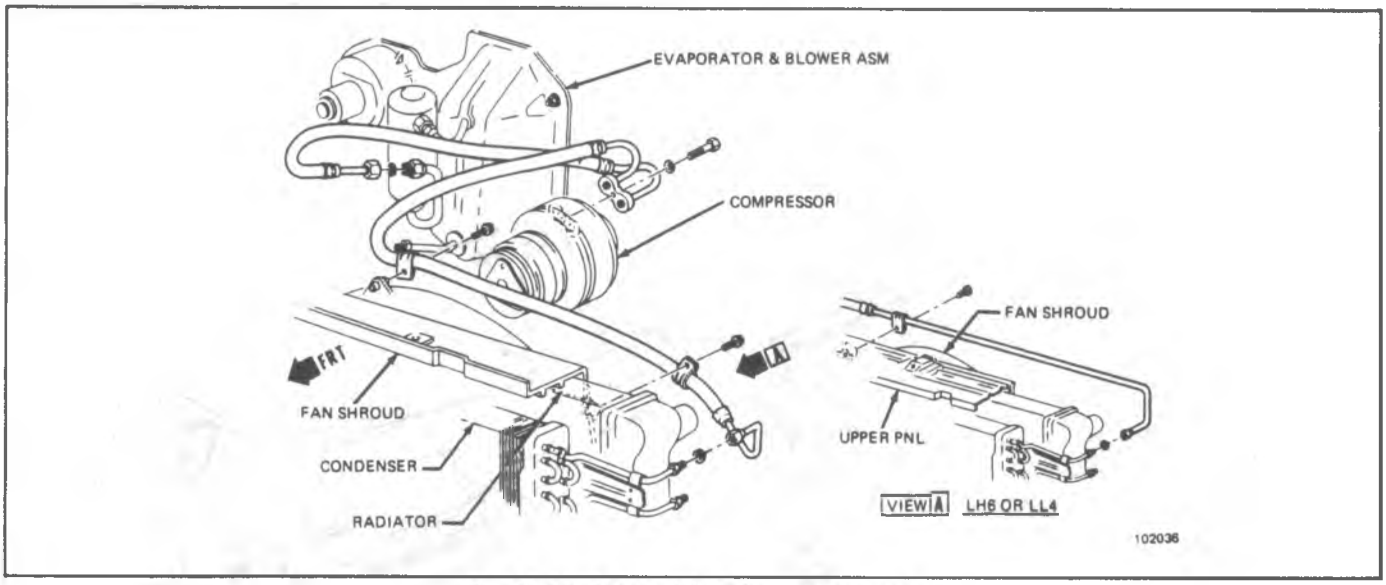


Fig. 1B-55--C-K Models Refrigerant Lines-L6

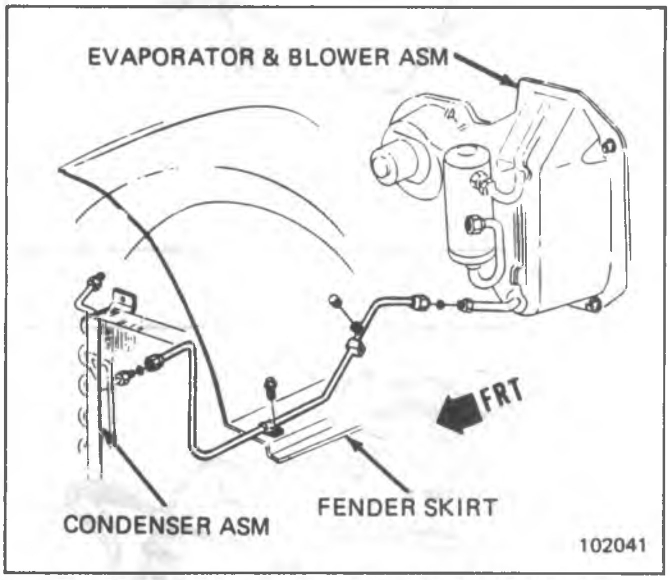


Fig. 1B-53--Refrigerant Lines-Diesel Engine (C-K Series)

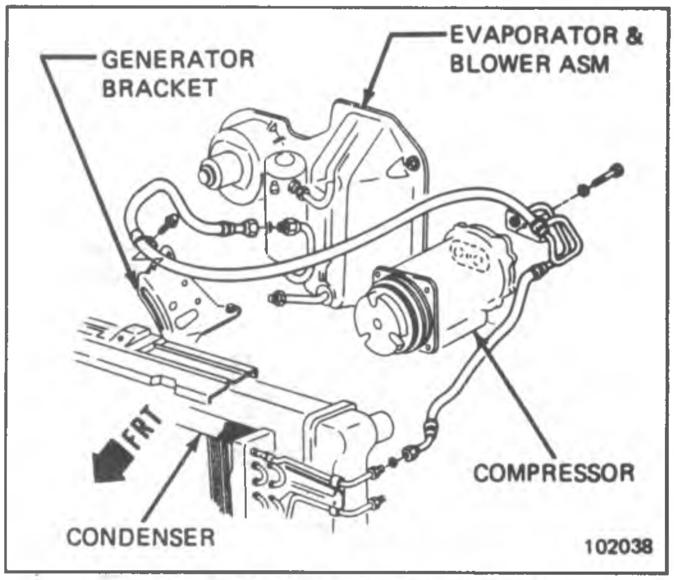


Fig. 1B-54--C-K Models Refrigerant Lines-V8

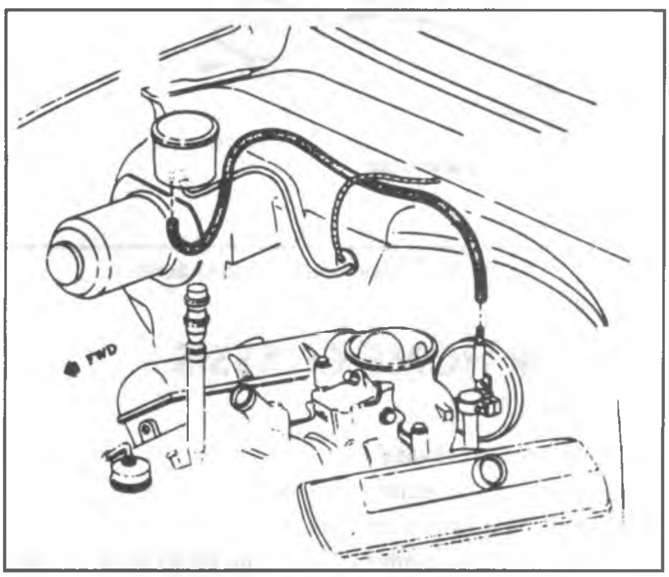


Fig. 1B-56--Vacuum Tank C-K Series-Diesel Engine

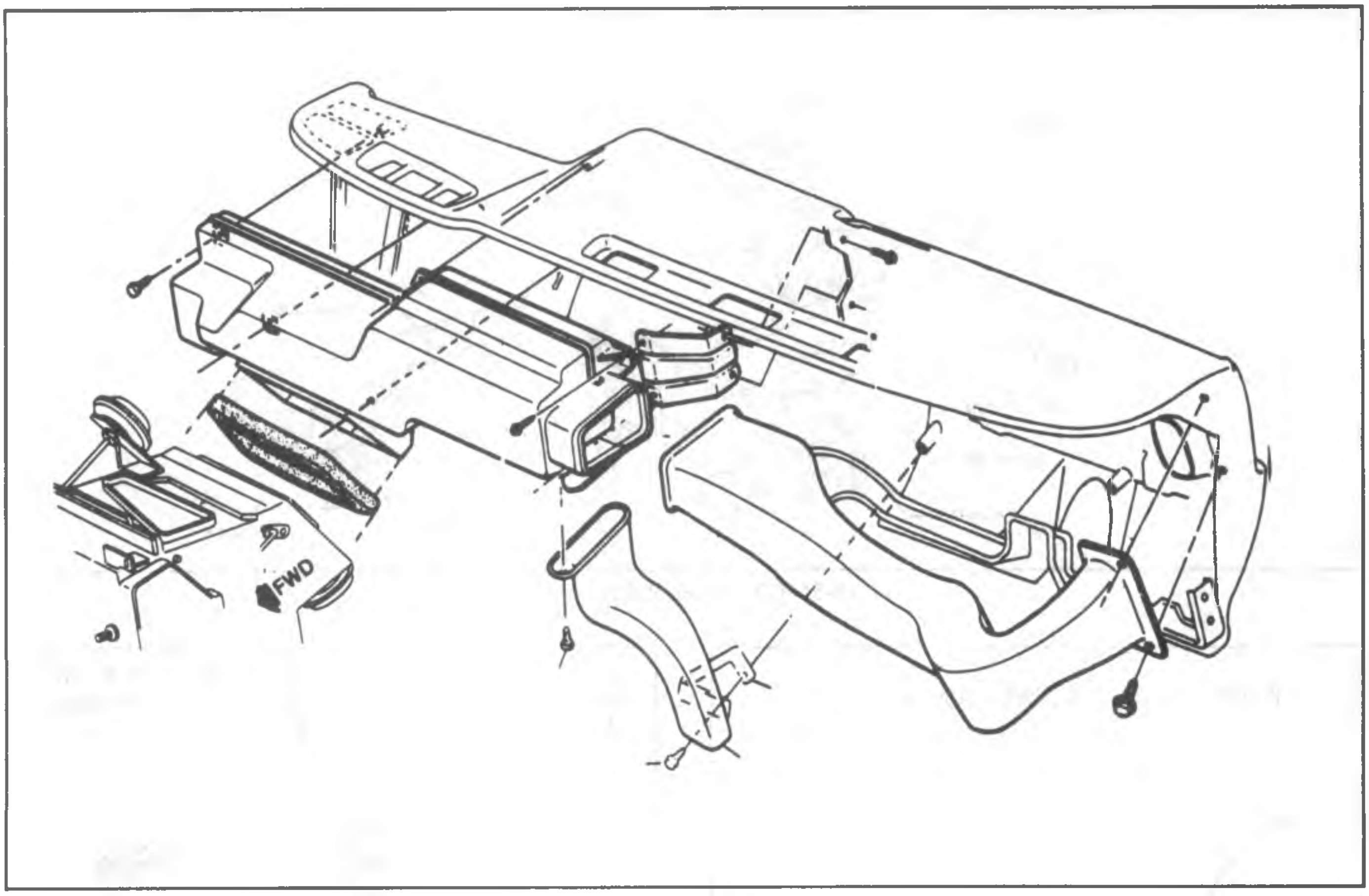


Fig. 1B-57--A/C Ducts-G Series

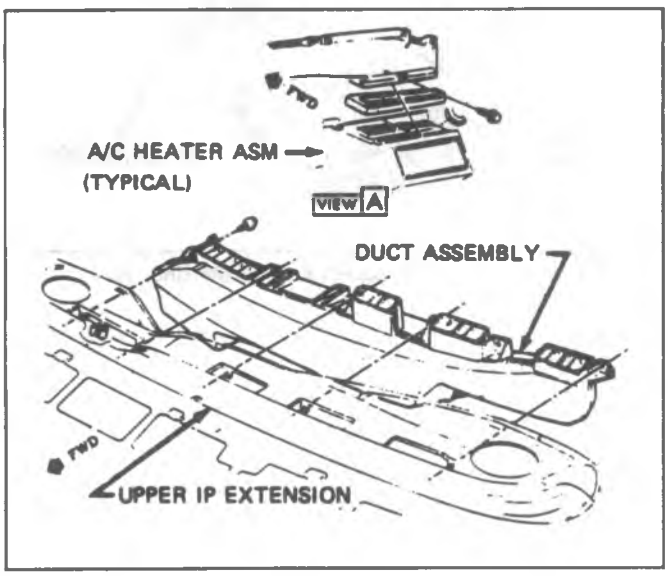


Fig. 1B-58--Defroster Duct-G Series

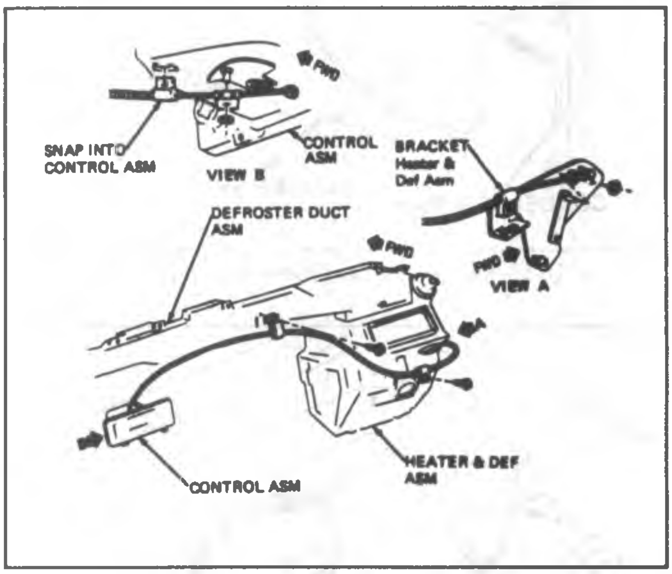


Fig. 1B-59--Temperature Cable-G Series

DASH MOUNTED SYSTEM--MOTOR HOME CHASSIS

This system is installed on the vehicle and checked at assembly. The blower-evaporator is then disconnected and shipped with the chassis unit to the body supplier. For this reason, it will only be possible to give basic replacement procedures on some components.

CONDENSER

Replacement (Fig. 1B-60)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Disconnect the condenser inlet and outlet lines and cap or plug all open connections at once.

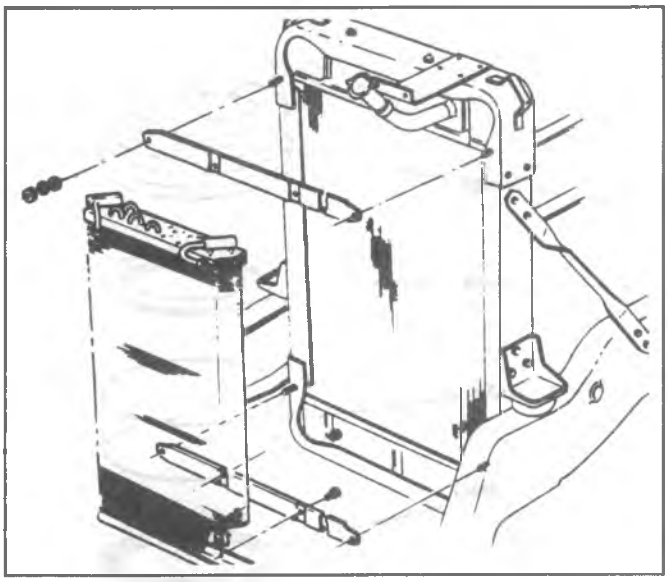


Fig. 1B-60--Condenser (Motor Home Chasis Unit)

4. Remove the condenser to radiator support screws and remove the condenser.
5. To install a new condenser, reverse Steps 1 thru 4 above. Add one fluid ounce of clean refrigeration oil to a new condenser.

   NOTICE: Use new "O" rings, coated with clean refrigeration oil, when connecting all refrigerant lines.
6. Evacuate, charge and check the system.

RECEIVER-DEHYDRATOR

Replacement (Fig. 1B-61)

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Disconnect the inlet and outlet lines at the receiver-dehydrator and cap or plug the open lines at once.
4. Remove the receiver-dehydrator bracket attaching screws and remove the bracket and receiver-dehydrator.
5. To install a new receiver-dehydrator, reverse Steps 1 thru 4 above. Add one fluid ounce of clean refrigeration oil to a new receiver-dehydrator.

   NOTICE: Use new "O" rings, coated with clean refrigeration oil, when connecting all refrigerant lines.
6. Evacuate, charge and check the system.

SIGHT GLASS REPLACEMENT

If damage to the sight glass should occur, a new sight glass kit should be intalled. The kit contains the sight glass, seal and retainer. (Refer to Fig. 1B-62).

1. Purge system.
2. Remove the sight glass retainer nut using a screwdriver and remove old glass and "O" ring seal.
3. Install the new glass and seal and retainer nut, being careful not to turn the nut past the face of the housing. To do so may damage the "O" ring seal.
4. Evacuate, charge and check the system.

BLOWER-EVAPORATOR ASSEMBLY

Removal (Fig. 1B-63)

1. Disconnect battery ground cable.
2. Purge system of refrigerant.
3. Disconnect inlet and outlet refrigerant lines from the back of unit. Cap or plug all open connections at once.
4. Disconnect drain tubes from evaporator case.
5. Disconnect electrical connector from compressor. Remove the terminal (Refer to Fig. 1B-64) and allow connector to hang on ground wire.
6. Remove screws securing grommet retainer to dash panel. Remove wire from grommet through slit.
7. Disconnect electrical lead at connector.
8. Remove unit mounting bolts. Remove unit from vehicle, carefully pulling compressor electrical lead through dash panel.

Once the unit has been removed from the vehicle, continue with component replacement as follows:

BLOWER ASSEMBLY

Removal (Fig. 1B-65)

1. Remove the cover plate and separate the upper and lower case halves. Remove blower motor mounting strap screw and remove strap.
2. Remove blower assembly. Remove the wheels from the motor shaft.

Installation

1. Install the blower wheels on the motor so that the lower blades curve toward the dash panel side of the unit when the motor is placed in the case as shown in Fig. 1B-65.
2. Place the motor in the bracket with the electrical connector side of the motor to the right side of the bracket. Attach the mounting strap. Align blower wheels so that they do not contact case.
3. Assemble the case halves and attach the cover

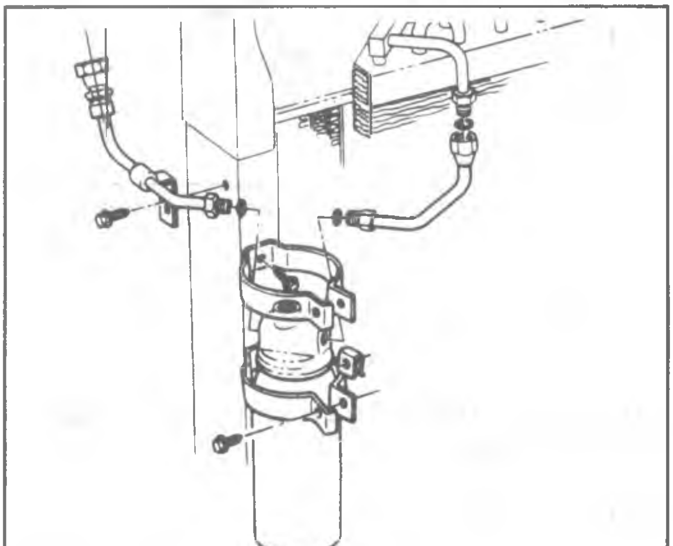


Fig. 1B-61--Receiver-Dehydrator (Motor Home Chassis Unit)

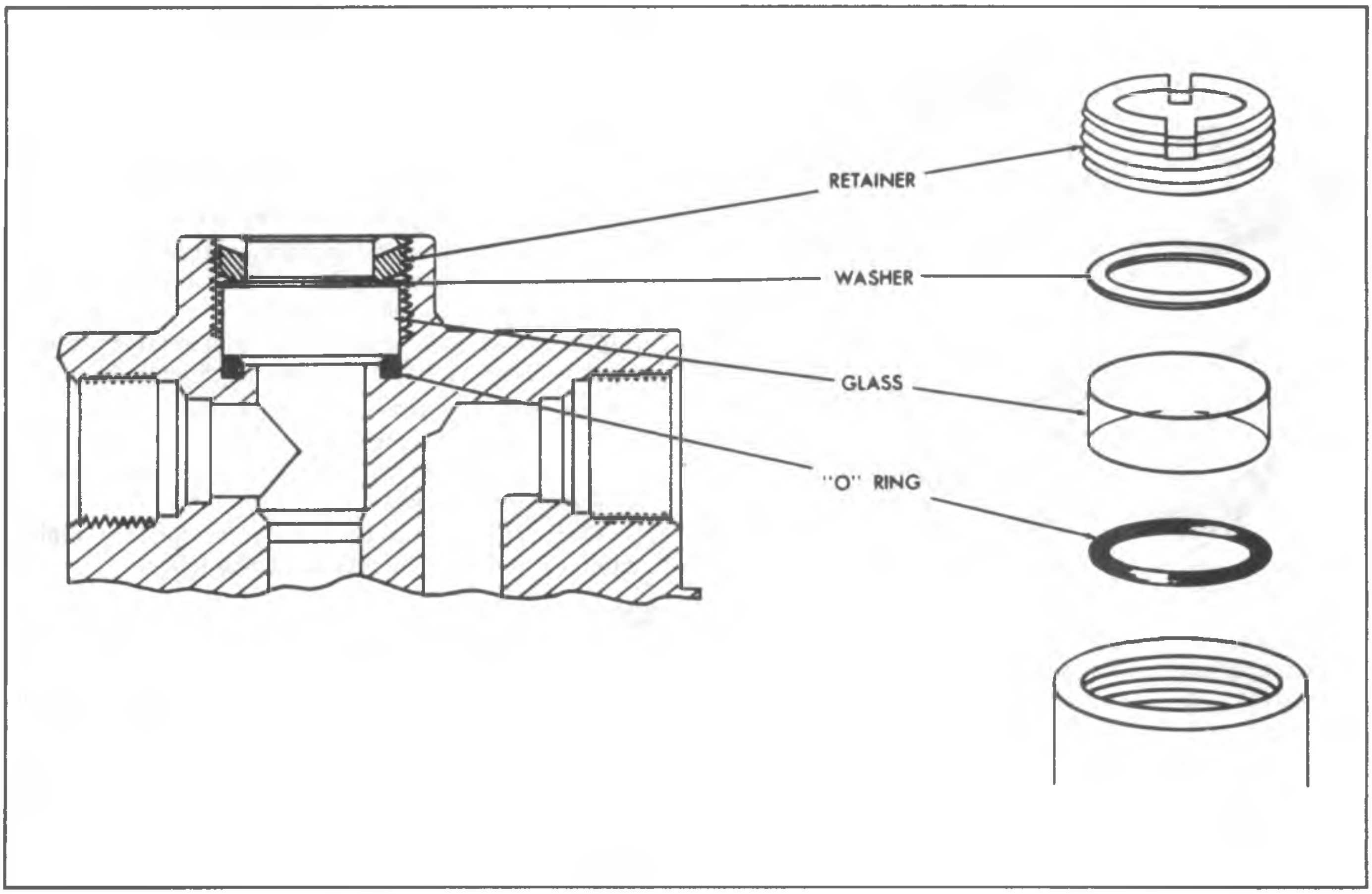


Fig. 1B-62--Sight Glass Replacement

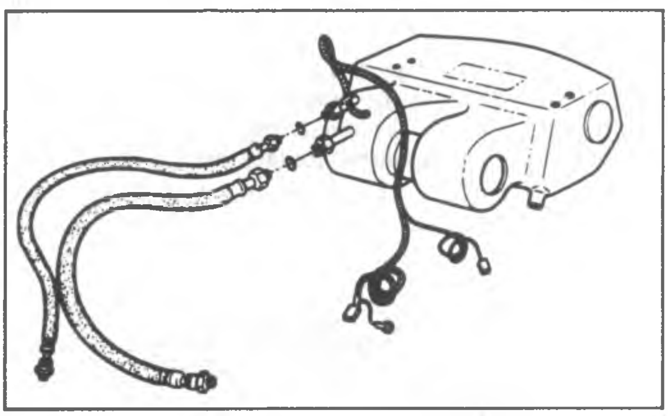


Fig. 1B-63--Blower-Evaporator (Motor Home Chassis Units)

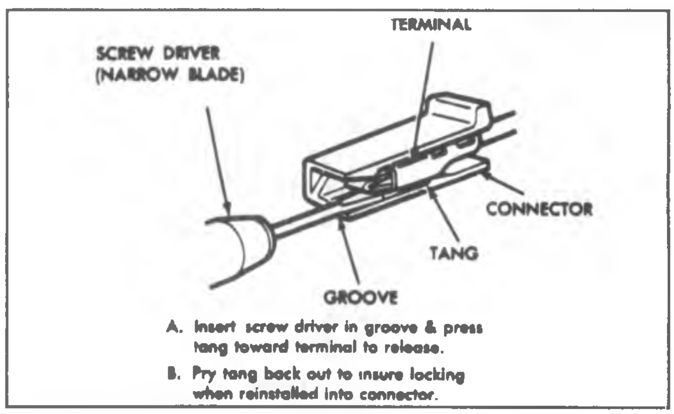


Fig. 1B-64--Terminal Removal

plate.

4. Reverse Steps 1-8 on the "Blower-Evaporator Assembly" removal procedure.
5. Evacuate, charge and check the system.

EXPANSION VALVE, EVAPORATOR AND/OR EVAPORATOR CASE

Removal (Fig. 1B-65)

1. Remove the cover plate and separate upper and lower case halves.
2. Remove inlet and outlet lines from the expansion valve. Remove sensing bulb from the evaporator outlet manifold. Remove expansion valve. Cap or plug open connections at once.

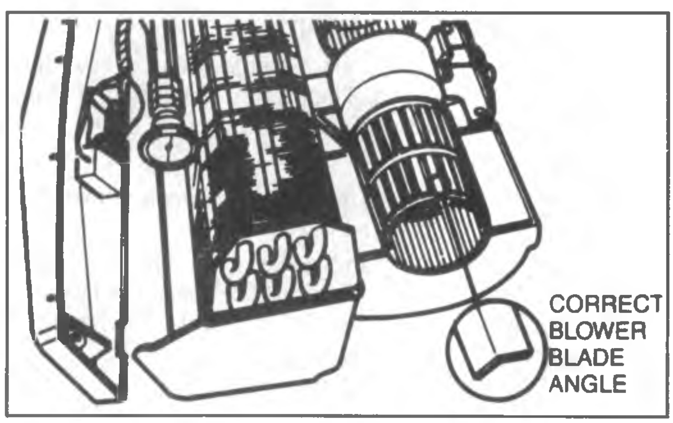


Fig. 1B-65--Blower Assembly (Motor Home Chassis Unit)

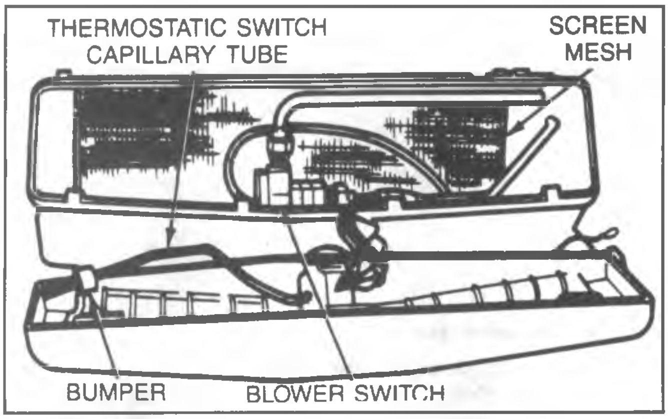


Fig. 1B-66--Expansion Valve (Motor Home Chassis Unit)

3. Remove evaporator core retaining screws and remove core.
4. Remove blower motor and harness assembly from case.

Installation

1. Reverse applicable steps in the removal procedure.

   NOTICE: Use new "O" rings coated with clean refrigeration oil when connecting lines. Add 3 oz. of new refrigeration oil to a new core.
2. Reverse steps 1 thru 8 of the "Blower Evaporator Assembly" removal procedure.
3. Evacuate, charge and check the system.

THERMOSTATIC AND/OR BLOWER SWITCHES

Replacement

1. Remove the cover plate assembly from the evaporator case.
2. Remove two screws securing either switch to the cover plate and remove appropriate switch (Fig. 1B-67).

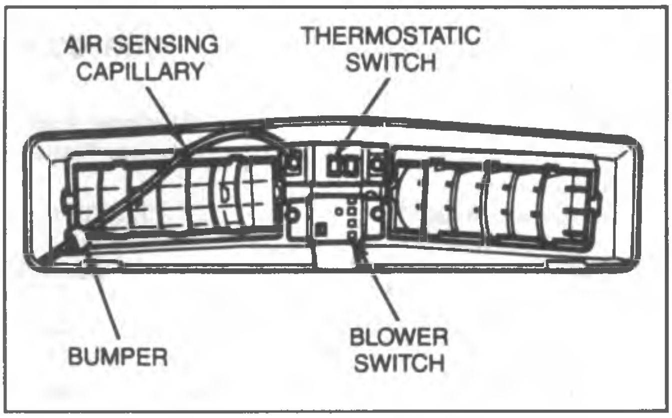


Fig. 1B-67--Thermostatic and Blower Switches

3. Install replacement switch, reinstall cover plate and reverse steps 1-8 of the "Blower-Evaporator Assembly" removal precedure.

   When installing thermostatic switch, be sure to position sensing capillary as when unit was removed.

RESISTOR

The blower motor resistor is located on the top of the unit. The entire unit must be removed to replace the resistor.

FUSE

This Unit does not incorporate an in-line fuse. The lead wire is connected to the Heater Wiring Harness and operates off the 20 amp Heater Fuse.

AIR CONDITIONING

Compressor

Type . . . . 6 Cylinder Axial
4 Cylinder Radial

Displacement
6 Cylinder Axial . . . . .12.6 Cu. In.
4 Cylinder Radial . . . . .10.0 Cu. In.
Rotation . . . . Clockwise

	Volts	Amps. (Cold)	RPM (Cold)
Blower Motor			
C-K Four Season . .	12.0	12.8 Max.	3400 Min.
C-K-G Overhead, G Floor and Motor Home Units	12.0	13.7 Max.	3400 Min.

Compressor Clutch Coil

Ohms (at 80°F) 3.70
Amps. (at 80°F) . . . . 3.33 @ 12 volts

Torque Specifications

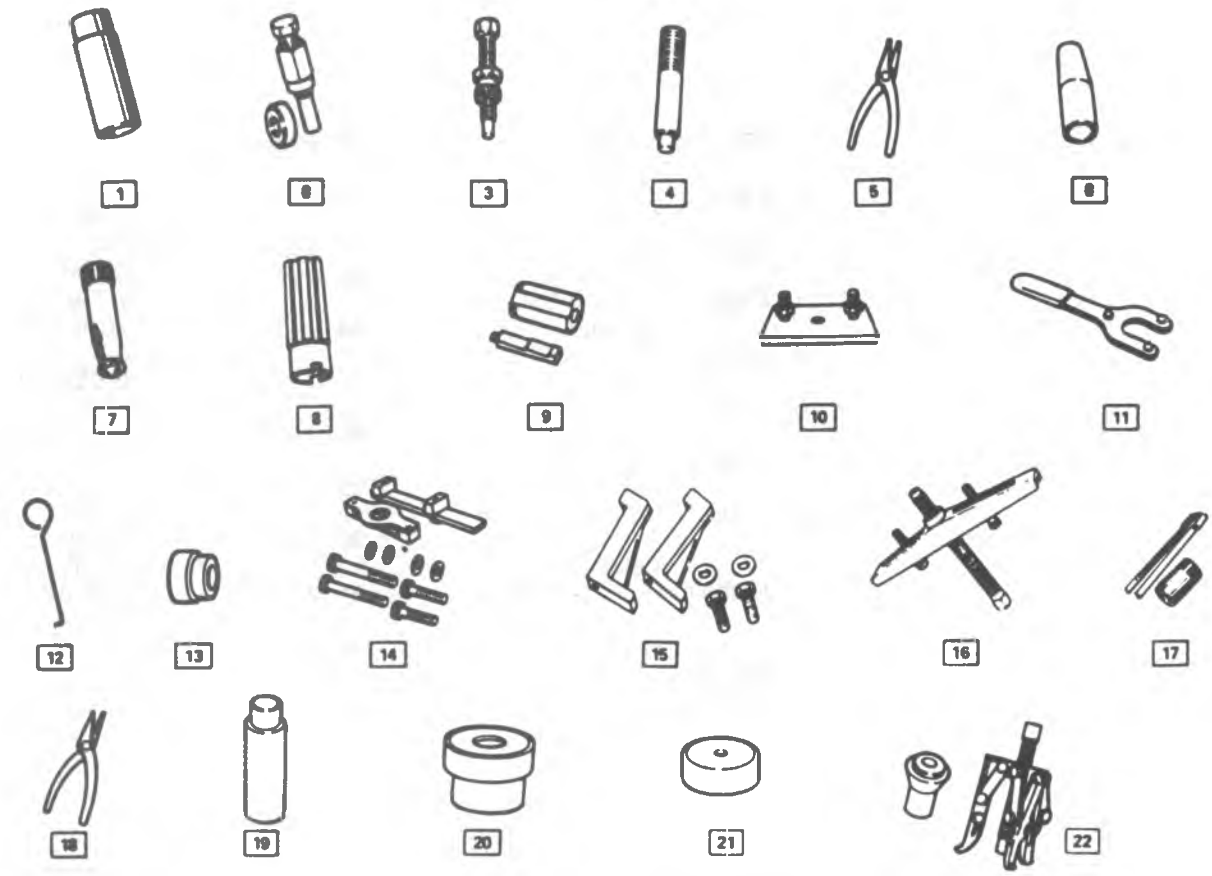
Compressor Suction and Discharge
Connector Bolt . . . . 25 ft. lbs.
Rear Head to Shell Stud Nuts (6 Cyl.) . . . . . 23 ft. lbs.
Shaft Mounting Nut (6 Cyl.) . . . . 20 ft. lbs.
Shaft Mounting Nut (4 Cyl.) . . . . 8-12 ft. lbs.
High Pressure Relief Valve (6 Cyl.) . . . . . 12 ft. lbs.
Oil Charge Screw (6 Cyl.) . . . . 14 ft. lbs.
Air Gap on Clutch (6 Cyl.) . . . . .022 to .057 in.
Compressor Mounting Bracket . . . . 35 ft. lbs.
Compressor to Front Bracket Bolts . . . . . 25 ft. lbs.
Belt Tension . . . . See Tune-Up Chart

Fuse Block–
C-K Systems . . . . 25 Amp.
Motor Home Chassis Unit. . . . . 20 Amp.

In-Line–
C-K Systems . . . . 25 Amp.
Motor Home Chassis Unit . . . . None

Circuit Breaker
G Model Systems. . . . . 45 Amp.

Fig. 1B-68--Specifications



1	J 9399	9/16" THIN WALL SOCKET
2	J 9480-01	HUB AND DRIVE PLATE ASSEMBLY INSTALLER
3	J 9401	HUB AND DRIVE PLATE ASSEMBLY REMOVER
4	J 8092	DRIVER HANDLE
5	J 5403	SNAP RING PLIERS (#21 INTERNAL)
6	J 22974	SHAFT SEAL PROTECTOR
7	J 23128	SEAL SEAT REMOVER AND INSTALLER
8	J 9392	SHAFT SEAL REMOVER AND INSTALLER
9	J 21508	SEAL SEAT O-RING INSTALLER
10	J 9625	PRESSURE TEST CONNECTOR
11	J 25030	CLUTCH HUB HOLDING TOOL
12	J 9553-01	O-RING REMOVER
13	J 9398	ROTOR BEARING REMOVER
14	J 25008	COMPRESSOR HOLDING FIXTURE
15	J 24092	PULLEY HUB ADAPTER SET (USED WITH J 8433)
16	J 8433	COMPRESSOR PULLEY PULLER
17	J 9393	SEAL SEAT REMOVER & INSTALLER
18	J 6083	SNAP RING PLIERS (# 24 EXTERNAL)
19	J 24896	BEARING REMOVER (FRONT HEAD)
20	J 26271	ROTOR AND BEARING INSTALLER (WITHOUT HANDLE)
21	J 24895	BEARING INSTALLER (FRONT HEAD)
22	J 25031-2	ROTOR AND BEARING PULLER WITH GUIDE

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Fig. 1B-69--Air Conditioning Special Tools

1. J-8393 CHARGING STATION
2. J-24095 OIL INDUCER
3. J-5453 GOGGLES
4. J-9459 7/16"-20 90° GAUGE LINE
   J-25499 3/8"-24 ADAPTER
5. J-5420 7/16"-20 STRAIGHT GAUGE LINE
   J-25498 3/8" ADAPTER
6. J-6084 LEAK DETECTOR
7. J-8433 PULLER
8. J-9395 PULLER PILOT
9. J-23595 REFRIGERANT CAN VALVE (SIDE-TAP)
10. J-6271-01 REFRIGERANT CAN VALVE (TOP-TAP)
11. J-5421-02 POCKET THERMOMETERS (2)
12. J-5403 NO. 21 SNAP RING PLIERS
13. J-6435 NO. 26 SNAP RING PLIERS
14. J-9396 COMPRESSOR HOLDING FIXTURE
15. J-25030 COMPRESSING FIXTURE
16. J-9403 CLUTCH HUB HOLDING TOOL
17. J-9399 9/16" THIN WALL SOCKET
18. J-9401 HUB AND DRIVE PLATE ASSEMBLY REMOVER
19. J-9480-01 HUB AND DRIVE PLATE ASSEMBLY REMOVER
20. J-9392 SEAL REMOVER
21. J-23128 SEAL SEAT REMOVER
22. J-9398 PULLEY BEARING REMOVER
23. J-9481 PULLEY AND BEARING INSTALLER
24. J-8092 HANDLE
25. J-21352 INTERNAL ASSEMBLY SUPPORT BLOCK
26. J-5139 OIL PICKUP TUBE REMOVER
27. J-9432 NEEDLE BEARING INSTALLER
28. J-9553-01 SEAL SEAT "O" RING REMOVER
29. J-21508 SEAL SEAT "O" RING INSTALLER
30. J-22974 SHAFT SEAL PROTECTOR
31. J-9625 PRESSURE TEST CONNECTOR
32. J-9402 PARTS TRAY

Fig. 1B-70--Air Conditioning Special Tools

SECTION 1D

AIR CONDITIONING COMPRESSOR OVERHAUL

For Compressor REMOVAL AND INSTALLATION, see Air Conditioning Section. For DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS, see Air Conditioning Section.

CONTENTS OF THIS SECTION

Minor Repair Procedures for the A-6 Compressor 1D-2
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A-6 Compressor Pulley and Bearing Assy. 1D-5
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For all practical purposes, all vehicles make use of the same air conditioning 4 and 6-cylinder compressors. Actual differences between compressors are found in their mounting brackets, pulleys, connector assemblies and compressor capacities, none of which will affect the following Overhaul Procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly of the compressor. Clean tools and clean work area are very important for proper service. The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any "on car" repairs or removal of the compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with naphtha, stoddard solvent, kerosene or equivalent solvent and dried off with dry air. When necessary to use a cloth on any part, it should be of a non-lint producing type.

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described herein are based on bench over-haul with the compressor removed from the vehicle. They have been prepared in sequence in order of accessibility of the components. Pad fender/skirt and secure compressor near top of fender skirt with wire, rope, etc. when performing on-car service.

When an A-6 or R-4 compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (See Fig. 1D-1, and "C.C.O.T. Refrigerant Oil Distribution" in the Air Conditioning section).

Should an A-6 compressor, it's compressor shaft seal or any other component ever be removed for servicing because it was determined to be the cause of excessive signs of oil leakage in the A/C system, then the oil in the A-6 compressor must be drained, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the Air Conditioning section to determine oil loss. The accumulator in this A-6 system then must also be removed - oil drained - measured, etc. according to same section.

NOTICE: To avoid possible damage do not kink or place excessive tension on refrigerant lines or hoses.

MINOR REPAIR PROCEDURES FOR THE A-6 COMPRESSOR

THE FOLLOWING OPERATIONS TO THE A-6 COMPRESSOR CLUTCH PLATE AND HUB, PULLEY AND BEARING, AND COIL AND HOUSING ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.

The Compressor Shaft Seal assembly and Pressure Relief Valve may also be serviced without removing the compressor from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system must first be purged of Refrigerant-12.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

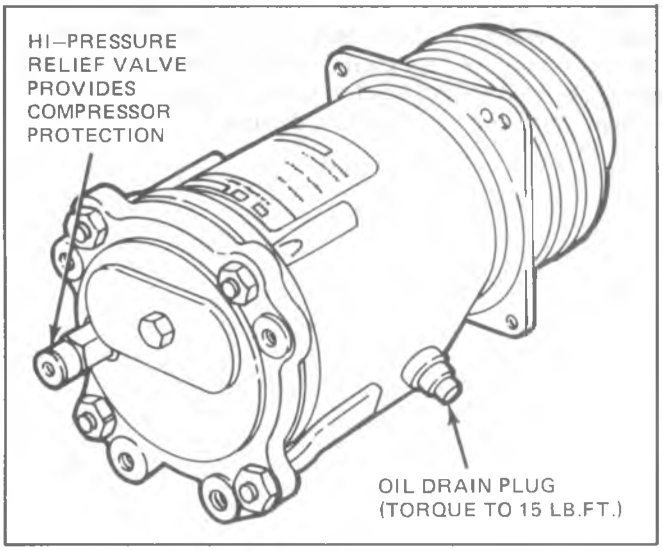


Fig. 1D-1 A-6 Compressor

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the AIR CONDITIONING section and Fig. 1D-2 and Fig. 1D-3 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. **The work area, tools, and parts must be kept clean at all times.** Parts Tray J 9402 (Fig. 1D-33) should be used for all A-6 internal compressor parts being removed, as well as for replacement parts.

A-6 COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

Remove

1. Place Holding Fixture J 9396 in a vise and clamp the compressor in the Holding Fixture.

2. Keep clutch hub from turning with Clutch Hub Holder J 25030 or J 9403, and remove locknut from end of shaft using Thin Wall Socket J 9399 (Fig. 1D-3).

NOTICE: To avoid internal damage to the compressor, DO NOT DRIVE OR POUND on the Clutch Plate and Hub assembly OR on the end of the shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of the axial plate (keyed to the main shaft), resulting in compressor damage and seal leakage due to shifting of the crankshaft.

3. Thread Clutch Plate and Hub assembly Remover J 9401 into hub. Hold body of Remover with a wrench and tighten center screw to remove Clutch Plate and Hub assembly (Fig. 1D-4).

4. Remove square drive key from shaft or drive plate hub.

5. Inspect driven plate for cracks or stresses in the drive surface. Do not replace driven plate for a scoring condition (Fig. 1D-5).

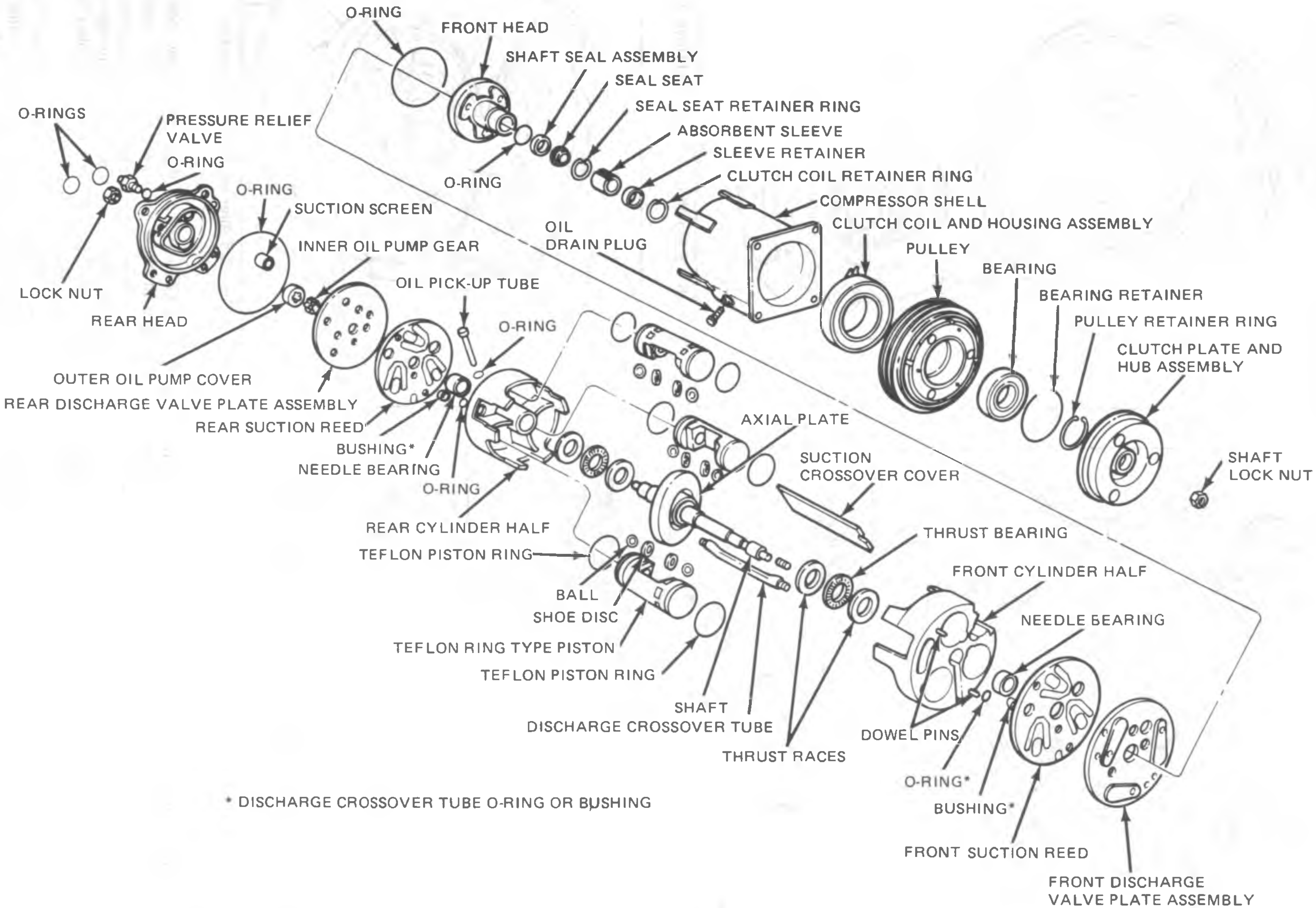


Fig. 1D-2 Exploded View of A-6 Compressor

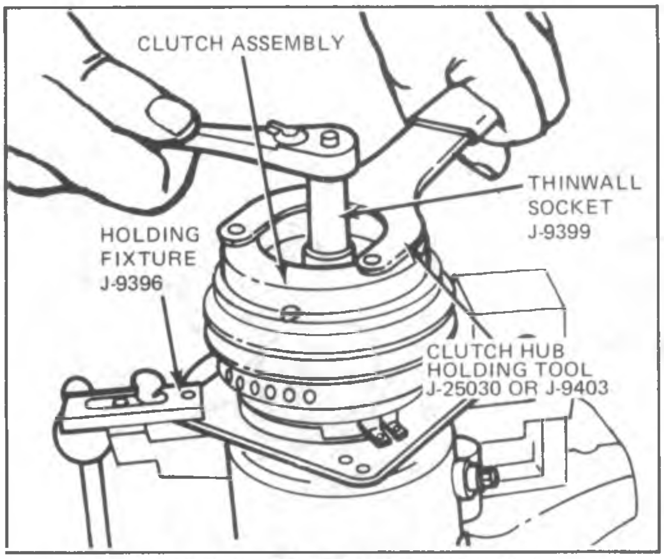


Fig. 1D-3 Removing A-6 Shaft Lock Nut

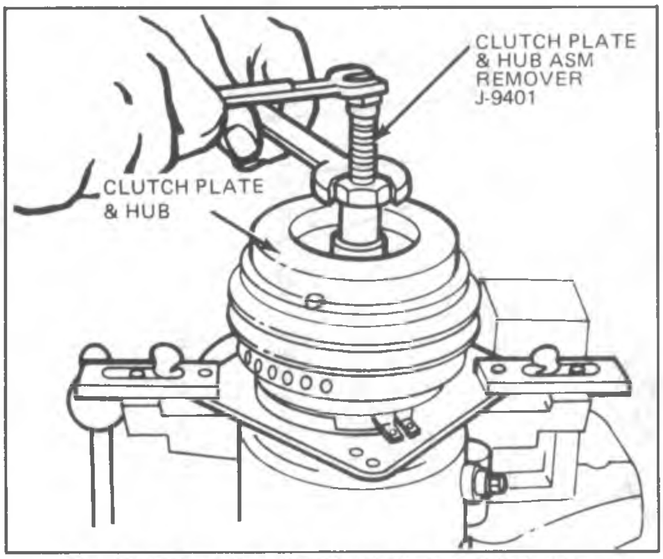


Fig. 1D-4 Removing A-6 Clutch Plate and Hub Asm.

If the frictional surface shows signs of damage due to excessive heat, the Clutch Plate and Hub and Pulley and Bearing should be replaced. Check further for the underlying cause of the damage (i.e. low coil voltage, coil should draw 3.2 amps at 12 volts) binding of the compressor internal mechanism (cylinder and shaft assembly), clutch air gap too wide (see Fig. 1D-8), broken drive plate to hub asm. springs, etc.

Replace

1. Insert the square drive key into the hub of driven plate; allow it to project approximately 4.8mm (3/16") out of the keyway. The key has a slight curve for interference fit into hub keyway.

2. Line up the key in the hub with keyway in the shaft (Fig. 1D-6).

3. Install the Drive Plate Installer J 9480-1 as illustrated. This Installer has a left hand thread on the body (Fig. 1D-7).

4. Press the driven plate onto the shaft until there is approximately 2.4mm (3/32") space between the frictional faces of the Clutch Drive Plate and Pulley. Make certain key remains in place when pressing hub on shaft.

A zero thrust race is approximately 2.4mm (3/32") thick and may be used to roughly gage this operation. Use Clutch Hub Holder J 25030 or J 9403 to hold Clutch Plate and Hub if necessary.

6. Using Thin-Wall Socket J 9399 and Clutch Hub Holder J 25030 or J 9403 to install a new shaft locknut. Tighten the nut to 19 to 35 N·m (14-26 lb.ft.) torque. Air gap between the frictional faces should now be .6 to 1.4mm (.022" to .057") (Fig. 1D-8). If not, check for mispositioned key or shaft.

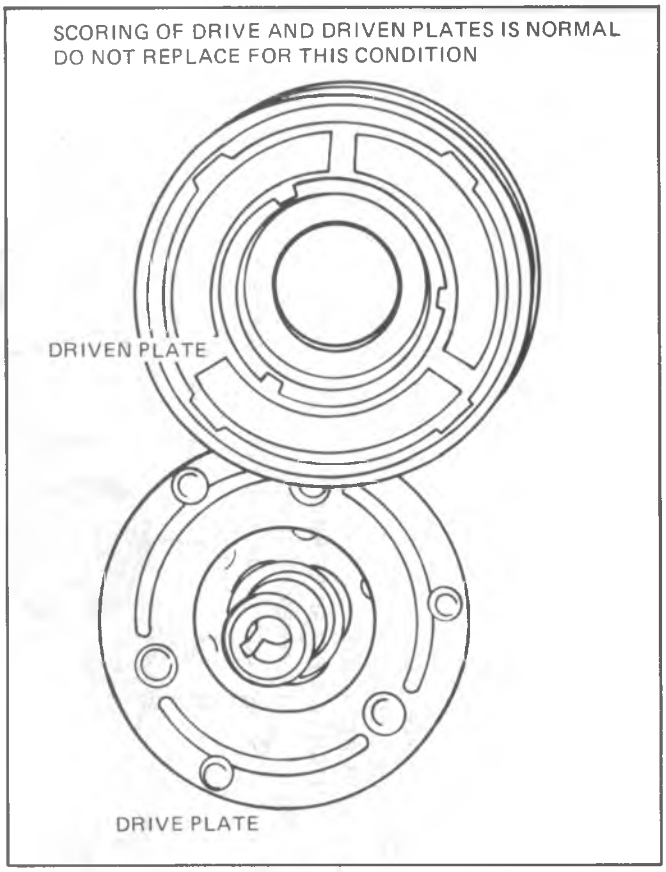


Fig. 1D-5 A-6 Clutch Driven Plate and Drive Plate

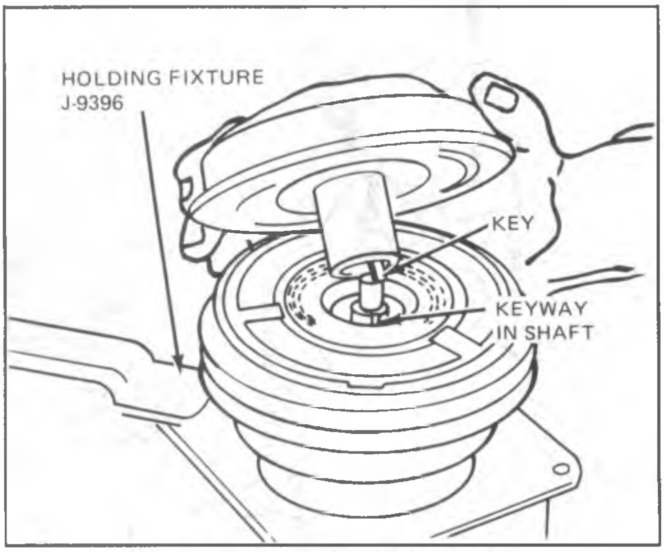


Fig. 1D-6 Aligning A-6 Drive Plate Key

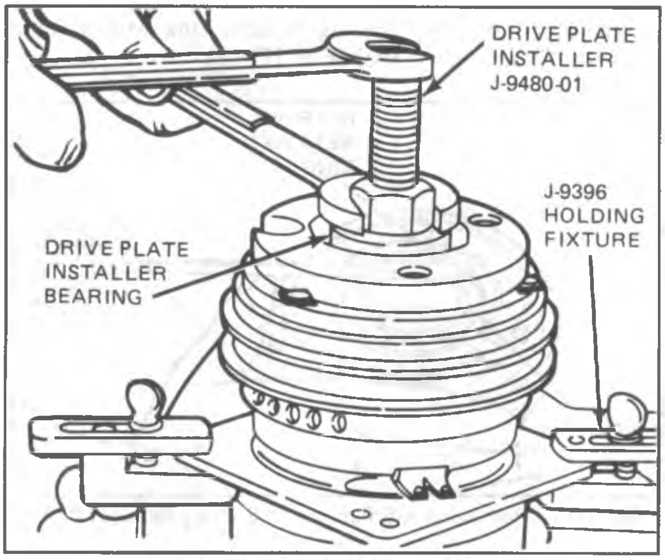


Fig. 1D-7 Installing A-6 Drive Plate

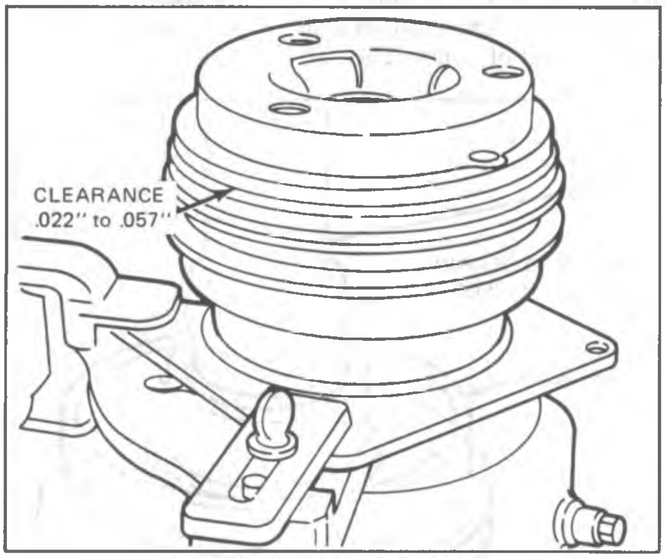


Fig. 1D-8 Checking A-6 Air Gap

7. The pulley should now rotate freely.

8. Operate the refrigeration system in the MAX A/C control selector (mode) lever position and warm engine (off fast idle) speed at 2000 RPM. Rapidly cycle the compressor clutch by turning the A/C control selector (mode) lever from OFF-to-MAX at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

A-6 COMPRESSOR PULLEY AND BEARING ASSEMBLY

Remove

1. Remove Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove pulley retainer ring, using Snap-Ring Pliers J 6435, Fig. 1D-9.

3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.

4. Place Puller Pilot J 9395 over end of compressor shaft.

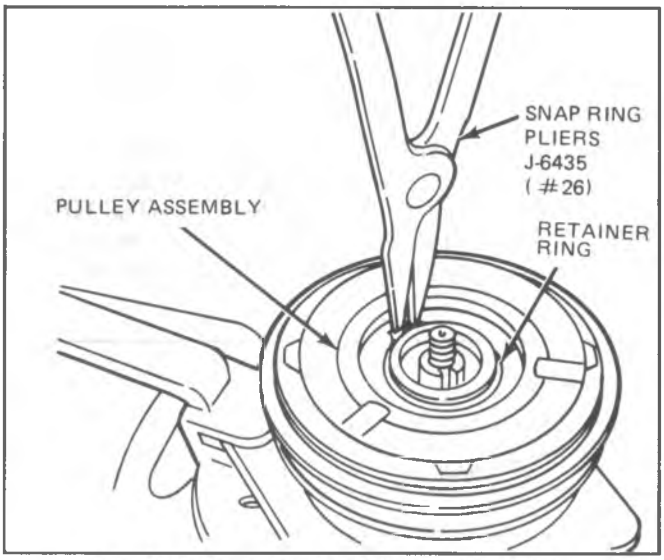


Fig. 1D-9 Removing A-6 Pulley Retainer Ring

NOTICE: It is important that Puller Pilot J 9395 be used to prevent internal damage to compressor when removing pulley. Under no circumstances should puller be used directly against threaded end of shaft.

5. Remove Pulley and Bearing Assembly, using Pulley Puller J 8433 (Fig. 1D-10).

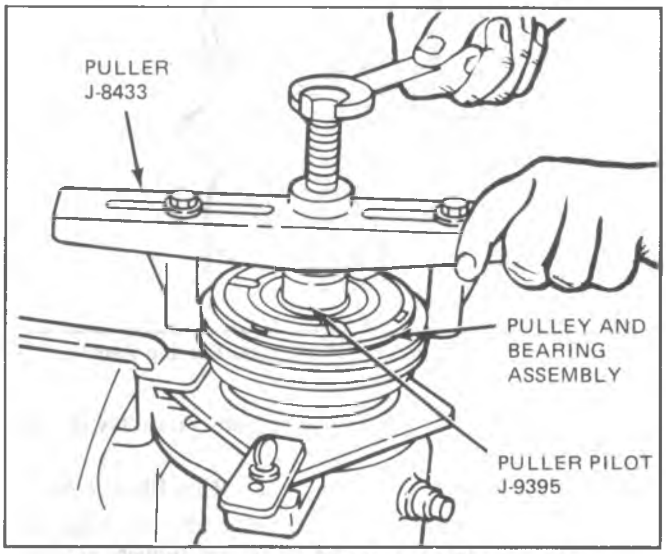


Fig. 1D-10 Removing A-6 Pulley and Bearing Asm.

Inspection

Check the appearance of the Pulley and Bearing assembly (see Fig. 1D-5). The frictional surfaces of the Pulley and Bearing assembly should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvent before reinstallation.

Replace

1. If original Pulley and Bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the Pulley and Bearing assembly should be replaced.

2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exist, bearing should be replaced. See "A-6 Compressor Pulley Bearing" Replacement procedure.

3. Press or tap Pulley and Bearing assembly on neck of compressor until it seats, using Pulley and Bearing Installer J 9481 with Universal Handle J 8092 (Fig. 1D-11). The Installer will apply force to inner race of bearing and prevent damage to bearing if tool is installed on handle as shown.

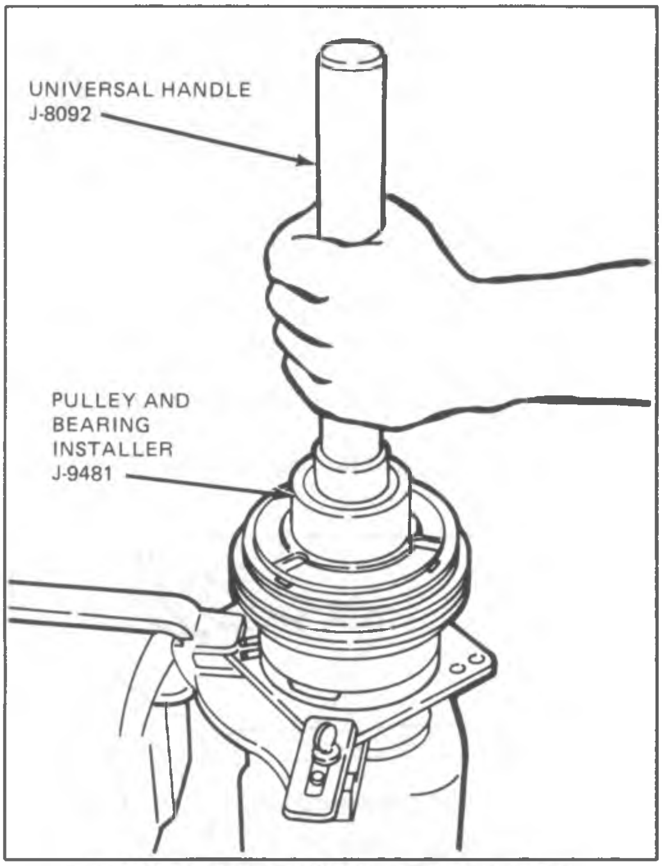


Fig. 1D-11 Installing A-6 Pulley and Bearing Asm.

4. Check pulley for binding or roughness. Pulley should rotate freely.

5. Install retainer ring, using Snap Ring Pliers J 6435.

6. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover-Installer J 9393, install retainer so that outer edge is recessed .8mm (1/32") from compressor neck face.

7. Install Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

A-6 COMPRESSOR PULLEY BEARING

Remove

1. Remove Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Removal procedure.

3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool (Fig. 1D-12).

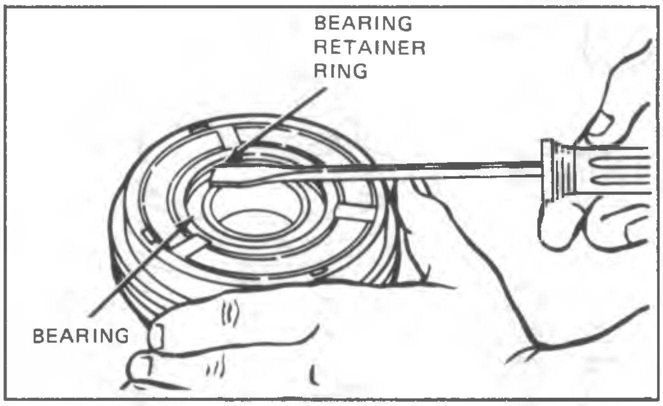


Fig. 1D-12 Removing A-6 Pulley and Bearing Retainer Ring

4. Place Pulley and Bearing assembly on inverted Support Block J 21352 and, using Pulley Bearing Remover J 9398 with Universal Handle J 8092, drive Bearing assembly out of pulley (Fig. 1D-13).

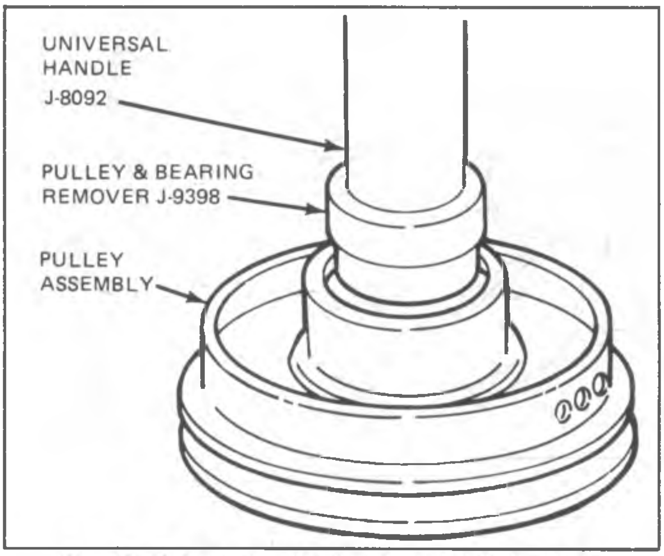


Fig. 1D-13 Removing Bearing From A-6 Pulley Asm.

Replace

1. Install new bearing in pulley using Pulley and Bearing Installer J 9481 with Universal Handle J 8092 (Fig. 1D-14). The Installer will apply the force to the outer race of the bearing when tool is used as shown.

NOTICE: Do not clean new bearing assembly with any type of solvent. Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.

2. Install bearing retainer ring, making certain that it is properly seated in ring groove.

3. Install Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Replacement procedure.

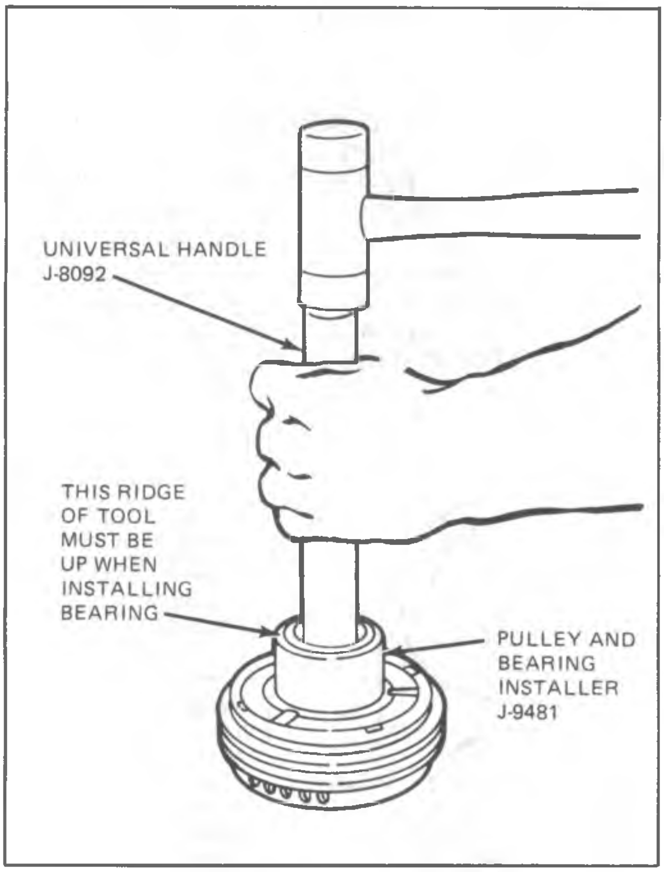


Fig. 1D-14 Installing Bearing on A-6 Pulley

4. Install Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

A-6 COMPRESSOR CLUTCH COIL AND HOUSING ASSEMBLY

Remove

1. Remove Clutch Plate and Hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.
2. Remove Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Removal procedure. Note position of terminals on coil housing and scribe location on compressor front head casting.
3. Remove coil housing retaining ring, using Snap-Ring Pliers J 6435 (Fig. 1D-15).
4. Lift Coil and Housing assembly off compressor front head.

Replace

1. Position coil and housing assembly on compressor front head casting so that electrical terminals line up with marks previously scribed on compressor (Fig. 1D-16).

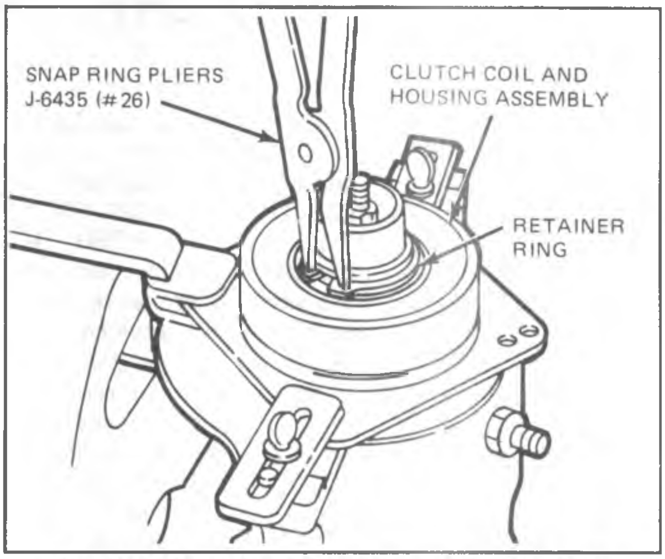


Fig. 1D-15 Removing A-6 Coil Housing Retainer Ring

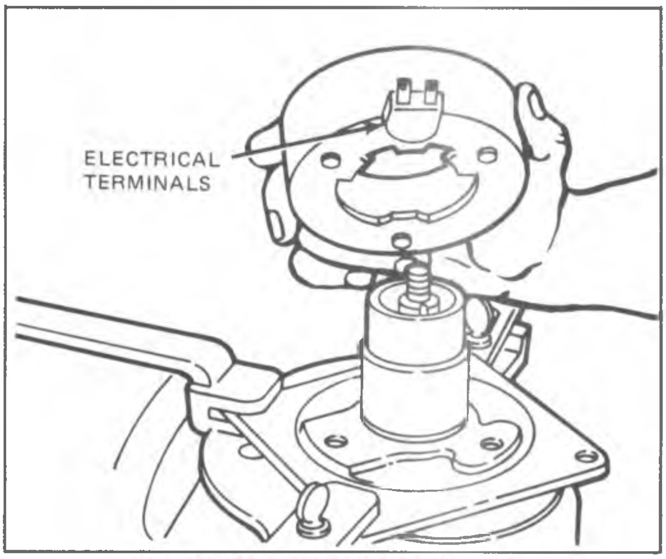


Fig. 1D-16 Installing A-6 Coil Housing

2. Align locating extrusions on coil housing with holes in front head casting.

3. Install coil housing retainer ring with flat side of ring facing coil, using Snap-Ring Pliers J 6435.

4. Install Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing Asm." Replacement procedure.

5. Install Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

MAJOR A-6 COMPRESSOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal, Pressure Relief Valve, or disassembly of the Internal Compressor Cylinder and Shaft Assembly are considered "MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE COMPLETELY PURGED OF REFRIGERANT before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

Should an A-6 compressor, it's compressor shaft seal, or any other component ever be removed for servicing because it was determined to be the cause of excessive signs of oil leakage in the A-6 A/C system, then the oil in the compressor must be drained, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the Air Conditioning section to determine oil loss. The accumulator in this A-6 system must then also be removed - oil drained - measured, etc. according to same section.

When replacing the shaft seal assembly (Fig. 1D-17), pressure relief valve (Fig. 1D-23), even if the compressor remains on the vehicle during the operation, it will be necessary to purge the system of refrigerant as outlined in the Air Conditioning section (see "Discharging, Adding Oil, Evacuating and Charging Procedures for C.C.O.T. A/C Systems"). The same holds true for any disassembly of the internal A-6 compressor cylinder and shaft assembly.

If the A-6 Compressor Internal Cylinder and Shaft Assembly is to be serviced or replaced, then the oil in the compressor must be drained, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the Air Conditioning section to determine addition of proper oil quantity to new assembly.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available. All parts required for servicing the internal compressor are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the internal assembly just as they are removed from the service package.

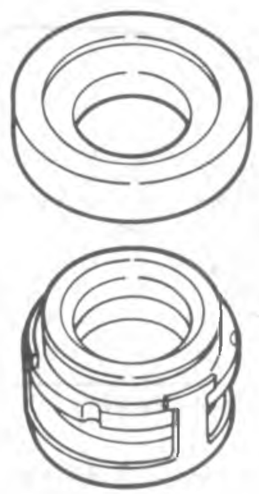
Piston shoe discs and shaft thrust races will be identified by "number" on the parts themselves for reference to determine their size and dimension (see Fig. 1D-41).

A-6 COMPRESSOR SHAFT SEAL

SEAL LEAK DETECTION

A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR. The Seal is designed to seep some oil for lubrication purposes. Only change a Shaft Seal when a leak is detected by evidence of oil sprayed in LARGE AMOUNTS and then only after actual refrigerant leakage is determined by testing with a Leak Detector J 23400.

SHOULD AN A-6 COMPRESSOR SHAFT SEAL EVER HAVE TO BE REPLACED BECAUSE IT WAS DETERMINED TO BE **THE CAUSE OF EXCESSIVE SIGNS OF OIL LEAKAGE** IN THE A/C SYSTEM, THEN THE OIL IN THE A-6 COMPRESSOR MUST BE DRAINED, measured and replaced according to "C.C.O.T. Refrigerant Oil Distribution" in the AIR CONDITIONING section to determine oil loss. THE ACCUMULATOR IN THIS A-6 SYSTEM MUST THEN ALSO be removed - oil drained - measured, etc. according to same section.



SPECIFICATION PARTS	
SEAL	CARBON MATERIAL LARGE CHAMFER ON INSIDE DIAMETER.
SEAT	CERAMIC MATERIAL WITH POLISHED FACE.
O-RINGS	NEOPRENE, THUS CAPABLE OF GIVING HEAT RESISTANCE AND LIFE EXPECTANCY.

Fig. 1D-17 Specification A-6 and R-4 Compressor Shaft Seal Kit

Remove

1. "Discharge the Refrigerant System" according to the discharging, adding oil, evacuating and charging procedures for C.C.O.T. A/C systems in the Air Conditioning section.

2. Remove the clutch plate and hub assembly and shaft key as described in "A-6 Compressor Clutch Plate and Hub Asm." removal procedure.

3. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the shaft seal seat retaining ring, using Snap-Ring Pliers J 5403. See Fig. 1D-18.

4. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.

5. Place Seal Protector J 22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J 23128 into the recessed portion of the seal seat by turning the handle clockwise. Remove the Seal Seat from the compressor with a rotary-pulling motion (Fig. 1D-19). Discard the Seat.

Do not tighten the handle with a wrench or pliers; however, the handle must be hand-tightened securely to remove the Seat.

6. With Seal Protector J 22974 still over the end of the shaft, set Seal Remover-Installer J 9392 down over shaft

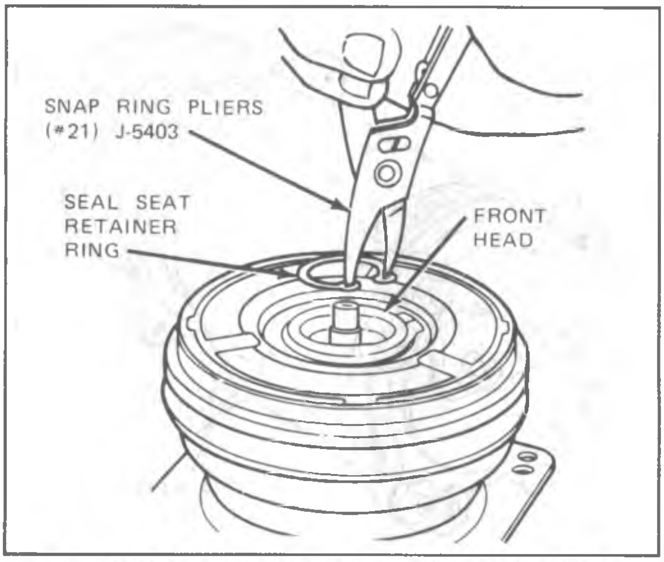


Fig. 1D-18 Removing or Installing A-6 Shaft Seal Seat Retaining Ring

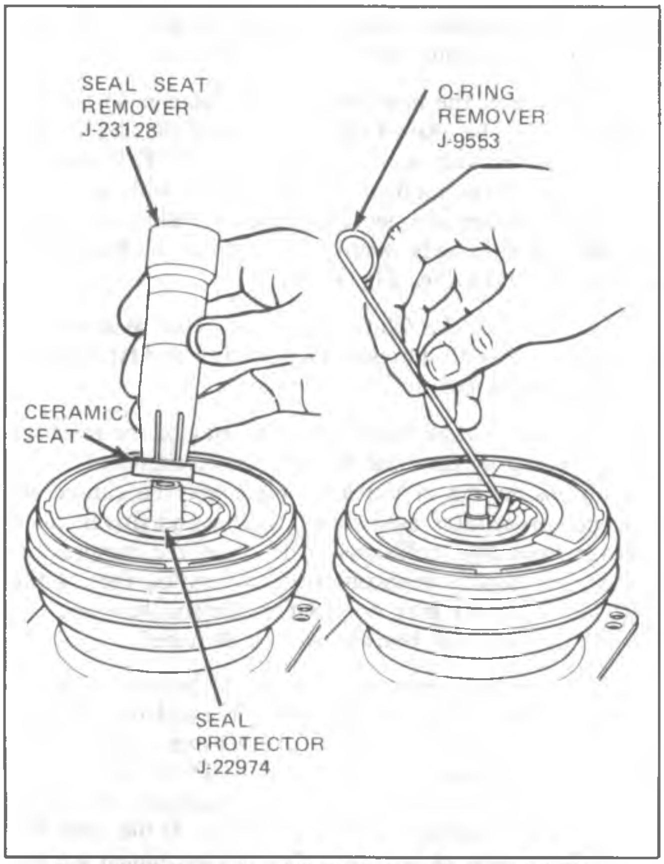


Fig. 1D-19 Removing A-6 Shaft Seal Seat and O-Ring

end, turning clockwise, while pressing down, to engage Remover tangs with the tabs on the Seal assembly. Then lift the Shaft Seal assembly out (see Fig. 1D-20). Discard the Seal.

7. Remove and discard the seal seat O-ring from the compressor neck, using O-Ring Remover J 9533 (see Fig. 1D-19).

8. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

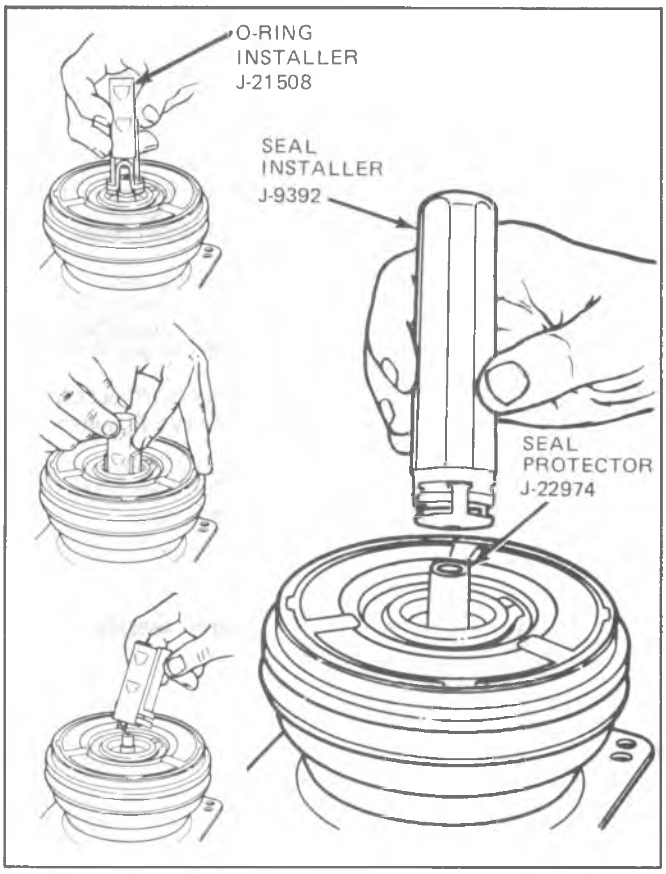


Fig. 1D-20 Replacing A-6 Seal and O-Ring

Inspection

Seals should not be reused. Always use a new seal kit on rebuild (see Fig. 1D-17). Be extremely careful that the face of the Seal to be installed is not scratched or damaged in any way. Make sure that the Seal Seat and Seal are free of lint and dirt that could damage the seal surface or prevent sealing.

Replace

1. Coat the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J 21508 (see Fig. 1B-20).

2. Insert the O-Ring Installer J 21508 completely down into the compressor neck until the Installer "bottoms." Lower the movable slide of the O-Ring Installer to release the O-ring into the seal seat O-ring lower groove. (The compressor neck top groove is for the shaft seal seal retainer ring.) Rotate the Installer to seat the O-ring and remove Installer (See Fig. 1D-21).

3. Dip the O-ring and seal face of the new Seal assembly into clean 525 viscosity refrigerant oil. Carefully mount the Seal assembly to Seal Installer J 9392 by engaging the tabs of the Seal with the tangs of the Installer (Fig. 1D-20).

4. Place Seal Protector J 22974 (Fig. 1D-20) over end of compressor shaft and carefully slide the new Seal assembly down onto the shaft. Gently twist the Installer J 9392 CLOCK-WISE, while pushing the seal assembly down the shaft until the Seal assembly engages the flats on the shaft and is seated in place. Disengage the Installer by pressing downward and twisting counter-clockwise.

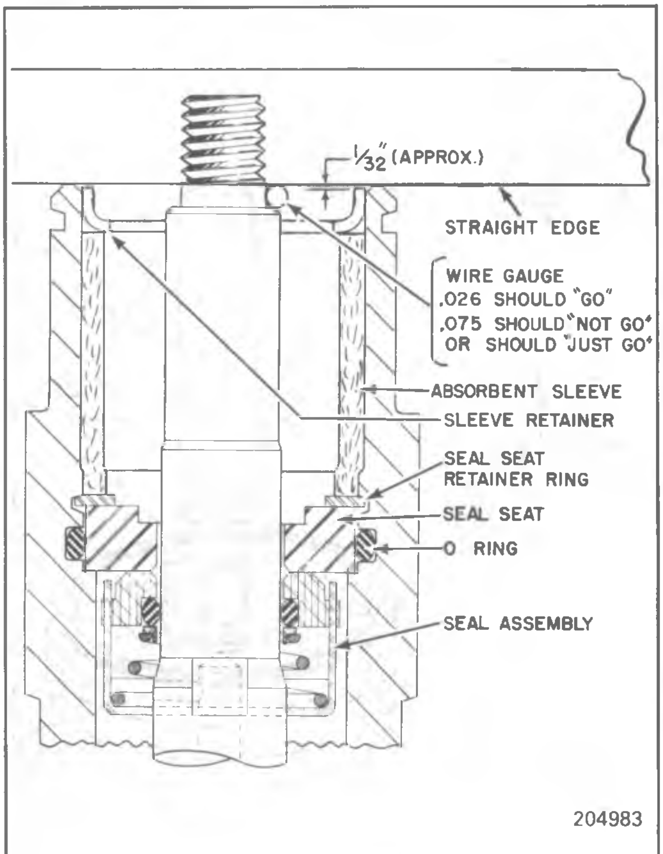


Fig. 1D-21 A-6 Compressor Shaft and Seal

5. Attach the ceramic Seal Seat to the Seal Seat Remover and Installer J 23128 and dip the ceramic Seat in clean 525 viscosity refrigerant oil to coat the seal face and outer surface. Carefully install the Seat over the compressor shaft end and Seal Protector J 22974 and push the Seat into place with a rotary motion. Take care not to dislodge the seat O-ring. However, be sure Seal Seat makes a good seal with O-ring. Remove Installer J 23128 and Seal Protector J 22974 (Fig. 1D-19).

6. Install the new seal seat retainer ring with its flat side against the Seal Seat, using Snap-Ring Pliers J 5403. See Fig. 1D-18. Use the sleeve from Seal Seat Remover-Installer J 9393 to press in on the seal seat retainer ring so that it snaps into its groove.

7. Install Compressor Leak Test Fixture J 9625 (Fig. 1D-22) on rear head of compressor and connect gage charging lines or pressurize suction side (low-pressure side) of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and oil sump down, rotate the compressor shaft in normal direction of rotation several times by hand then leak test the Seal. Correct any leak found. Remove, discard and later replace the shaft nut.

8. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

9. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and then slipping the sleeve into the compressor neck with the overlap towards the top of the compressor. With a small screwdriver

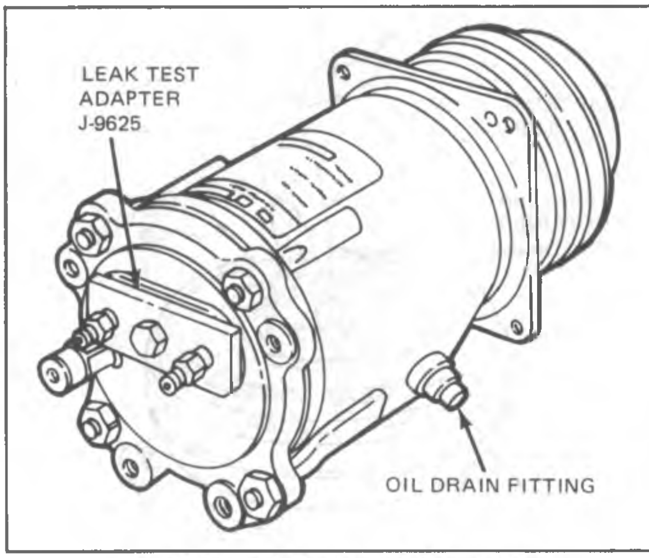


Fig. 1D-22 Leak Testing A-6 Compressor

or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.

10. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. The sleeve from seal seat remove installer tool J 9393 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer should be recessed approximately .8mm (1/32") from the face of the compressor neck). (See Fig. 1D-21.)

11. Reinstall the Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

Some compressor shaft seal leaks may be the result of mispositioning of the axial plate on the compressor shaft. The mispositioning of the axial plate may be caused by improper procedures used during pulley and driven plate removal, pounding, collisions or dropping the compressor. If the axial plate is mispositioned, the carbon face of the shaft seal assembly may not contact the seal seat and the rear thrust races and bearing may be damaged.

To check for proper positioning of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft as shown in Fig. 1D-21. To measure this distance, use a wire gage (the clearance should be between .7 and 1.9mm (.026" and .075")). If the shaft has been pushed back in the axial plate (measurement greater than 1.9mm (.075")), disassemble the compressor and replace the shaft and axial plate assembly rear thrust races and thrust bearing.

If there also appears to be too much or insufficient air gap between the drive and driven plates, dislocation of the shaft should be suspected. If the carbon seal is not seating against the seal seat, it will not be possible to completely "Evacuate the System" as outlined under discharging, adding oil, evacuating and charging procedures for C.C.O.T. A/C systems in the Air Conditioning section.

12. "Add Oil, Evacuate and Charge System" (see discharging, adding oil, evacuating and charging procedures for C.C.O.T. A/C systems in the air conditioning section).

A-6 COMPRESSOR PRESSURE RELIEF VALVE

When necessary to replace the Pressure Relief Valve located in the compressor rear head casting (Fig. 1D-23), the valve assembly should be removed after purging the system of refrigerant. A new valve and O-ring coated with 525 viscosity refrigerant oil should be installed (see discharging, adding oil, evacuating and charging procedures for C.C.O.T. A/C systems in the air conditioning section).

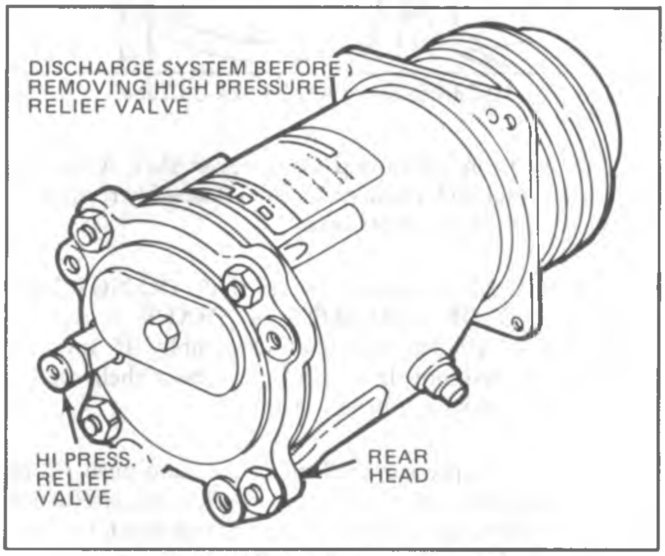


Fig. 1D-23 A-6 High Pressure Relief Valve

A-6 COMPRESSOR INTERNAL MECHANISM (CYLINDER AND SHAFT ASM.)

Service operations to the A-6 compressor Rear Head or Internal Mechanism (Cylinder and Shaft) of the compressor should be performed with the system purged of refrigerant according to the discharging, adding oil, evacuating and charging procedures for C.C.O.T. A/C systems in the Air Conditioning section. The compressor must also be removed from the vehicle to insure that the necessary degree of cleanliness may be maintained. Additionally, "Compressor Clutch Plate and Hub, Pulley and Bearing, Clutch Coil and Housing and Shaft Seal" Removal procedures, as described earlier in the OVERHAUL section, all are to have been followed. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

An inspection should be made of the Internal Mechanism (Cylinder and Shaft) assembly to determine if any service operations should be performed. A detailed inspection of parts should be made to determine if it is necessary to replace them.

Removal

1. Before proceeding with disassembly, wipe exterior surface of compressor clean.

2. All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down. Record the amount of oil drained from the compressor (See " C.C.O.T. Refrigerant Oil Distribution" in the Air Conditioning section).

3. Invert compressor and Holding Fixture J 9396, with front end of compressor shaft up, suction - discharge ports now facing downward (Fig. 1D-24).

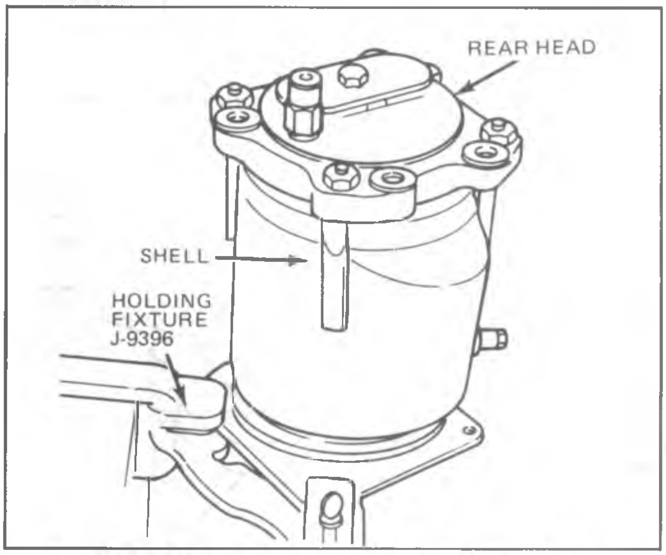


Fig. 1D-24 A-6 Compressor Installed in Holding Fixture

Additional oil may drain from the compressor at this time. All oil must be drained into a container so that total amount can be measured. (SEE STEP 2 ABOVE.) A liquid measuring cup may be used for this purpose. Drained oil should then be discarded.

4. Remove four locknuts from threaded studs on compressor shell and remove rear head. Tap uniformly around rear head if head is binding (Fig. 1D-24).

5. Wipe excess oil from all sealing surfaces on rear head casting webs, and examine sealing surfaces (Fig. 1D-25). If any damage is observed, the Rear Head should be replaced.

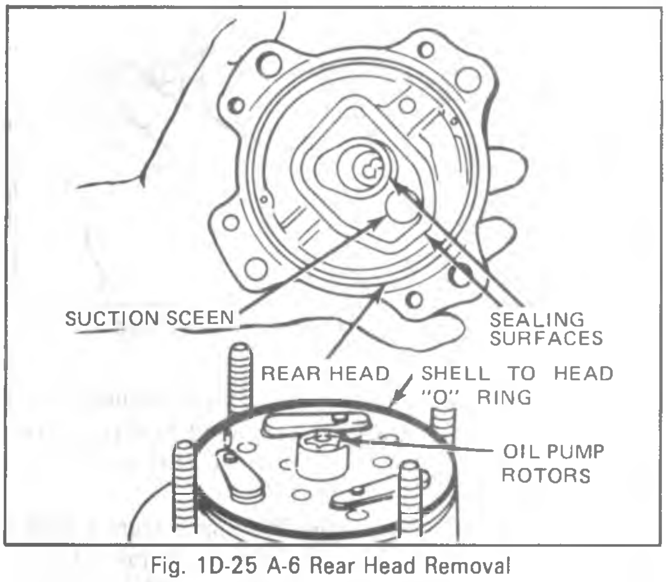


Fig. 1D-25 A-6 Rear Head Removal

6. Remove Suction Screen and examine for any damage or contamination. Clean or replace if necessary.

7. Make an identifying mark on exposed face of inner and outer Oil Pump Gears and then remove gears. Identifying marks are to assure that gears, if re-used, will be installed in identical position.

8. Remove and discard rear head to shell O-ring.

9. Carefully remove Rear Discharge Valve Plate assembly. Use two small screwdrivers under reed retainers to pry up on assembly (Fig. 1D-26). Do not position screwdrivers between reeds and reed seats.

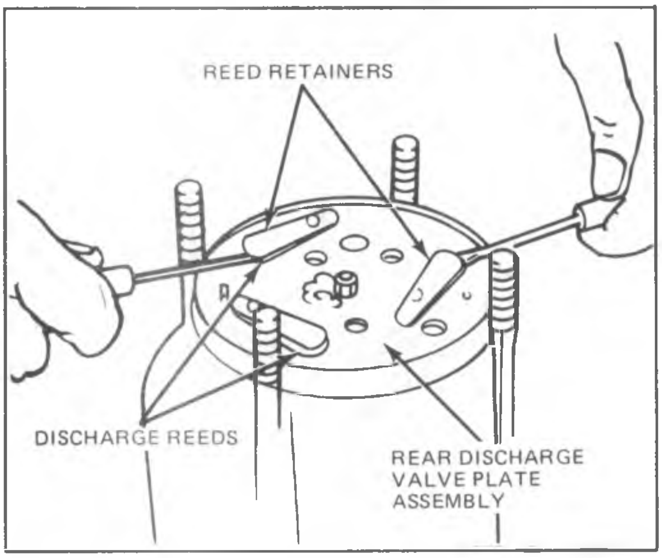


Fig. 1D-26 Removing A-6 Rear Discharge Valve Plate

10. Examine Valve Reeds and Seats. Replace entire assembly if any reeds or seats are damaged.

11. Using two small screwdrivers, carefully remove Rear Suction Reed (Fig. 1D-27). Do not pry up on horseshoe-shaped reed valves.

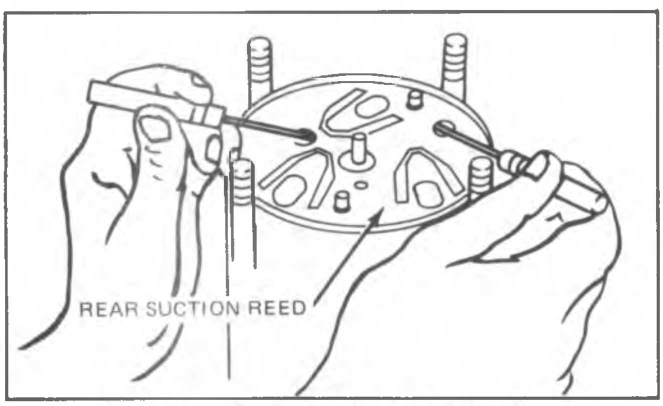


Fig. 1D-27 Removing A-6 Rear Suction Reed

12. Examine reeds for damage, and replace if necessary.

13. Using Oil Pick-Up Tube Remover J 5139 (Fig. 1D-28), remove Oil Pick-Up Tube. Remove O-ring from oil inlet.

14. Loosen compressor from Holding Fixture J 9396, place Internal Cylinder and Shaft Assembly Support Block J 21352 over oil pump end of shaft and, while holding Support Block in position with one hand, lift compressor from Holding Fixture with other hand. Invert compressor (shaft will now be facing upward) and position on bench with Internal Assembly Support Block resting on bench.

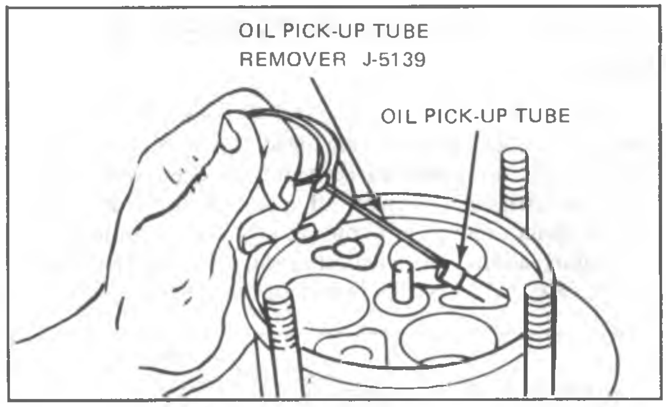


Fig. 1D-28 Removing A-6 Oil Pick-Up Tube

15. Lift Front Head and Compressor Shell Assembly up, leaving Internal Cylinder and Shaft Assembly resting on Internal Assembly Support Block.

NOTICE: To prevent damage to shaft, DO NOT TAP ON END OF COMPRESSOR SHAFT to remove Internal Cylinder and Shaft Assembly. If Internal Assembly will not slide out of compressor shell, tap on Front Head with a plastic hammer.

16. Rest compressor shell on its side and push Front Head assembly through Compressor Shell, being careful not to damage sealing areas on inner side of front head. Discard O-ring.

It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.

17. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any surface damage is observed, the head should be replaced.

18. Remove Front Discharge Valve Plate assembly and Front Suction Reed Plate. Examine reeds and seats. Replace necessary parts.

19. Remove Suction Cross-Over Cover by prying with screwdriver between cylinder casting and cover (Fig. 1D-29).

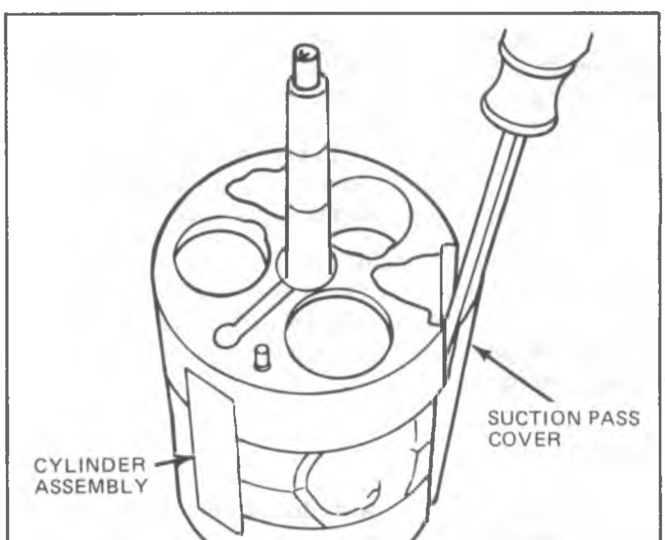


Fig. 1D-29 Removing A-6 Suction Cross-Over Cover

20. Examine Internal Cylinder and Shaft Assembly for any obvious damage. If Internal Assembly has sustained major damage, due to loss of refrigerant or oil, it may be necessary to use the Service Internal Cylinder and Shaft Assembly rather than replace individual parts.

A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM

Disassembly

Use Parts Tray J 9402 (Fig. 1D-33) to retain compressor parts during disassembly.

1. Remove Internal Cylinder and Shaft Assembly from compressor as described in "A-6 Compressor Internal Mechanism (Cylinder and Shaft Asm.)" Removal procedure.

2. Identify by pencil mark, or some other suitable means, each piston numbering them as 1, 2 and 3 (Fig. 1D-30).

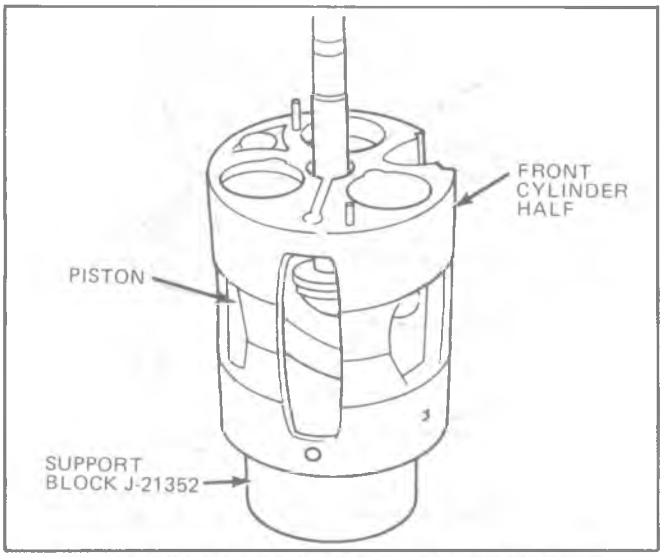


Fig. 1D-30 Numbering A-6 Piston and Cylinder Bores

Number the piston bores in the front cylinder half in like manner, so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet (Fig. 1D-31). Make certain that discharge cross-over tube does not contact axial plate when separating cylinder halves (a new Service Discharge Cross-Over Tube will be installed later - see Step 5 of Internal Cylinder and Shaft Assembly procedure).

NOTICE: UNDER NO CIRCUMSTANCES SHOULD SHAFT BE STRUCK AT EITHER END in an effort to separate upper and lower cylinder halves because the shaft and the axial plate could be damaged.

4. Carefully remove the Rear Half of the cylinder from the pistons and set the Front Cylinder Haif, with the piston, shaft and axial plate in Compressing Fixture J 9397.

5. Pull up on compressor shaft and remove piston previously identified as No. 1, with balls and shoe discs, from axial plate.

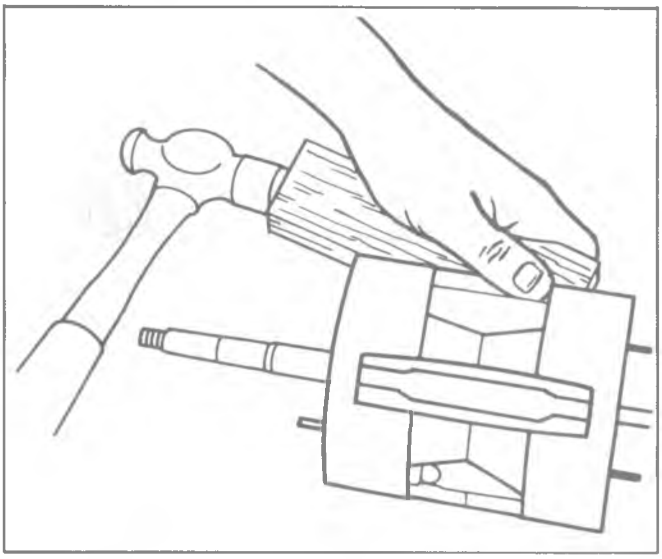


Fig. 1D-31 Separating A-6 Cylinder Halves

a. Inspect the Teflon piston rings for nicks, cuts or metal particles imbedded in exposed ring surface and replace the piston rings as required if either condition exists. See "A-6 Teflon Piston Ring" Replacement procedure.

6. Remove and discard the piston shoe discs.

7. Remove and examine piston balls, and if satisfactory for re-use, place balls in No. 1 compartment of Parts Tray J 9402 (Fig. 1D-33).

8. Place piston in No. 1 compartment of Parts Tray J 9402, with notch in casting web at front end of piston (Fig. 1D-32) into the dimpled groove of Parts Tray compartment.

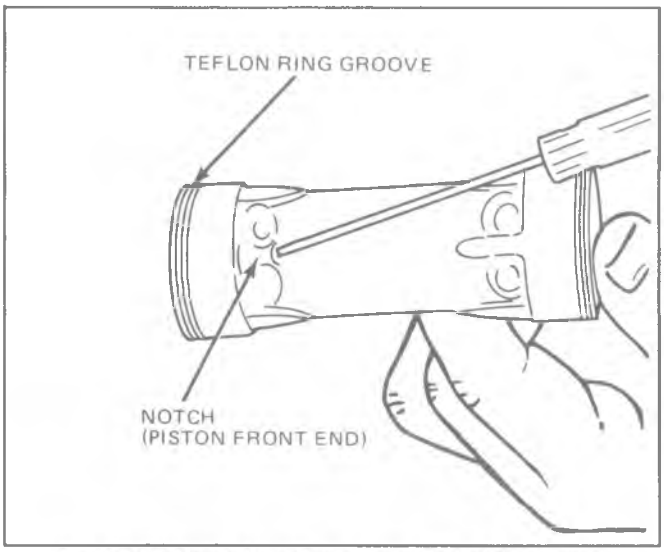


Fig. 1D-32 Notch Identifying Front End of A-6 Piston

9. Repeat Steps 5 through 9 for Pistons No. 2 and No. 3.

10. Remove rear combination of thrust races and thrust bearing from shaft. Discard races and bearing.

11. Remove shaft assembly from front cylinder half. If the Discharge Cross-Over Tube remained in the front cylinder half, it may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

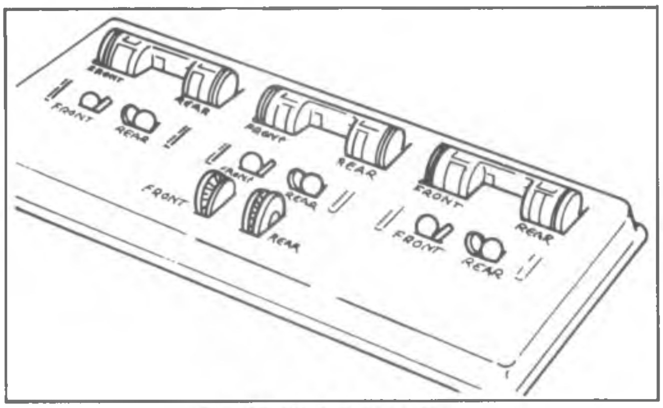


Fig. 1D-33 A-6 Parts Tray

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing (Fig. 1D-34).

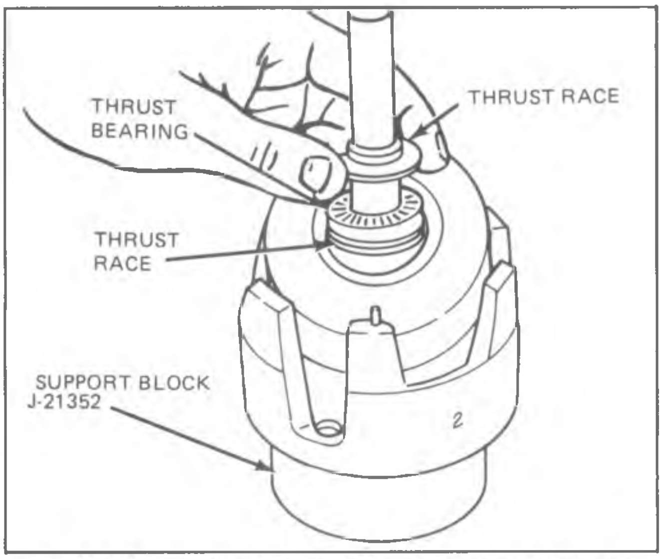


Fig. 1D-34 Removing A-6 Front Thrust Races and Bearings

13. Examine surface of Axial Plate and Shaft. Replace as an assembly, if necessary.

A certain amount of shoe disc wear on axial plate is normal, as well as some markings indicating load of needle bearings on shaft.

14. Remove Discharge Cross-Over Tube from cylinder half, using self-clamping pliers.

This is necessary only on original factory equipment, as ends of the tube are swedged into cylinder halves. The discharge cross-over tube in Internal Cylinder and Shaft Assemblies that have been previously serviced have an O-ring and bushing at each end of the tube, and can be easily removed by hand (see Fig. 1D-53).

15. Examine piston bores and needle bearings in front and rear cylinder halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

16. Needle bearings may be removed if necessary by driving them out with special Thin-Wall Socket J 9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out.

To install needle bearing, place cylinder half on Support Block J 21352, and insert bearing in end of cylinder head with bearing identification marks up. Use Needle Bearing Installer J 9432 and drive bearing into cylinder head (Fig. 1D-35 until Installer "bottoms" on the cylinder face.

Two different width needle bearings are used in Production compressors - a 13mm (1/2") size and a **16mm** (5/8") size. The bearings are interchangeable. Service replacement bearings are all 12.7mm (1/2").

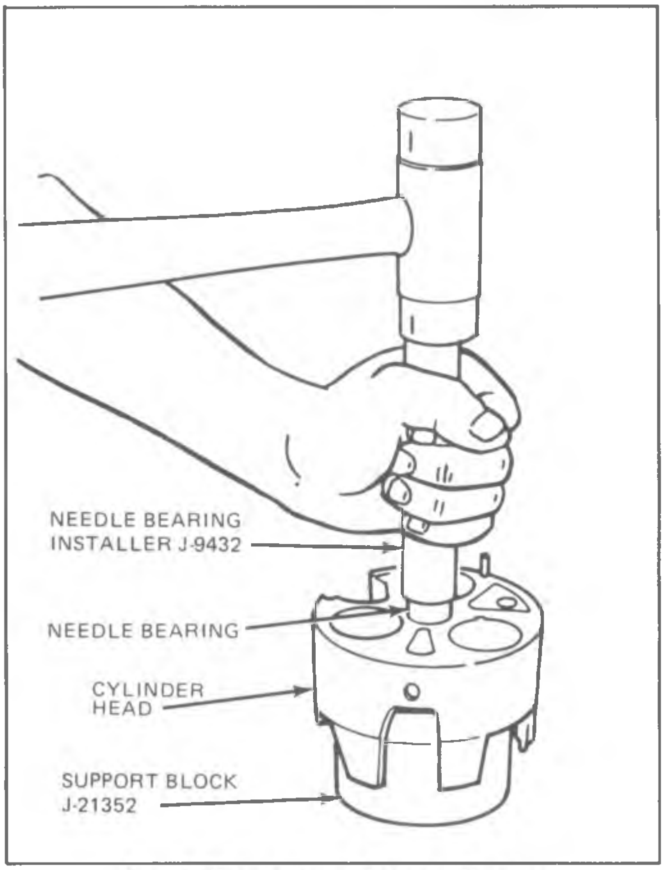


Fig. 1D-35 Installing A-6 Needle Bearing

17. Wash all parts to be re-used with trichloroethane, naphtha, stoddard solvent, kerosene, or a similar solvent. Air-dry parts using a source of clean, dry air.

A-6 compressor internal components may be identified by referring to Fig. 1D-2.

A-6 COMRESSOR INTERNAL CYLINDER AND SHAFT ASM

Gaging Operation

1. Install Compressing Fixture J 9397 on Holding Fixture J 9396 in vise. Place front cylinder half in Compressing Fixture, flat side down. Front cylinder half has long slot extending out from shaft hole. "Legs" of front cylinder half will be pointed upward.

2. Secure from Service parts stock four zero thrust races, two thrust bearings and three zero shoe discs.

3. Now install a zero thrust race, then one thrust bearing, and a second zero thrust race onto front end of compressor shaft.

4. Insert threaded end of axial shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly (race-bearing-race) to rest on hub of cylinder.

5. Now install a zero thrust race on rear end of compressor axial shaft (Fig. 1D-36), so that it rests on hub of axial plate. Then add one thrust bearing and a second zero thrust race onto shaft.

At this point, both front end and rear end of axial shaft will have a stack-up of one zero race-one bearing-one zero race.

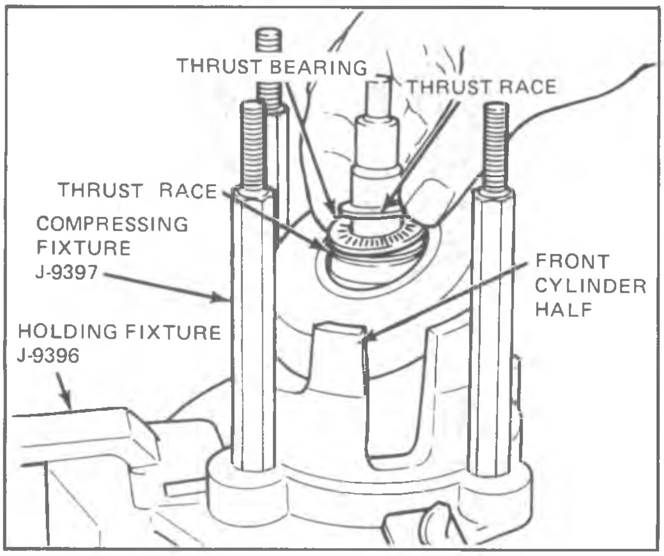


Fig. 1D-36 Installing A-6 Rear Thrust Races and Bearings

6. Lubricate ball pockets of the No. 1 Piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they were considered acceptable for re-use.

7. Lubricate cavity of a zero shoe disc with 525 viscosity refrigerant oil and place shoe disc over ball in front end of piston (Fig. 1D-37). Front end of piston has an identifying notch in casting web (Fig. 1D-32).

NOTICE: Exercise care in handling the Piston and Ring Assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.

Shoe discs should not be installed on rear of piston during following "Gaging" operation.

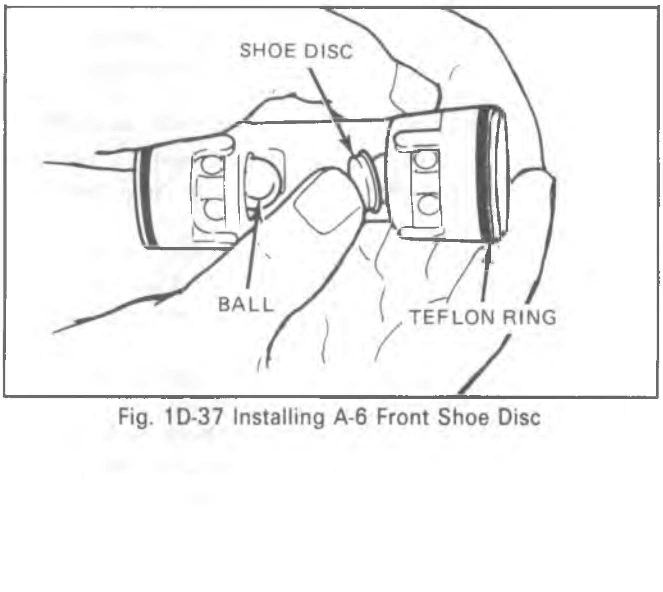


Fig. 1D-37 Installing A-6 Front Shoe Disc

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 Piston cylinder bore.

9. Lift the axial shaft assembly up a little out of front cylinder half and hold front thrust race and bearing assembly ("zero" race-bearing-"zero" race) against axial plate hub.

10. Position No. 1 Piston over No. 1 cylinder bore (notched end of piston being on bottom and piston straddling axial plate) and lower the shaft to allow No. 1 Piston to drop into its bore (Fig. 1D-38). If ball and shoe will not remain in front socket of piston during assembly use a light smear of petrolatum on the piston and shoe ball socket surfaces.

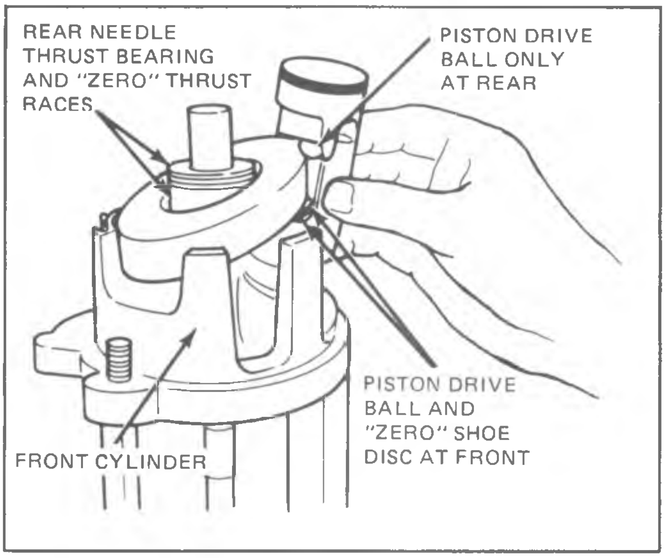


Fig. 1D-38 Installing A-6 Piston During Gaging Operation

11. Repeat Steps 6 through 10 for Pistons No. 2 and No. 3.

12. Now install rear cylinder half onto pistons, aligning cylinder with discharge cross-over tube hole in front cylinder half.

Tap into place using a plastic mallet or piece of clean wood and hammer (Fig. 1D-39).

13. Position discharge cross-over tube opening between a pair of Compressing Fixture J 9397 bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture J 9397. Tighten nuts to 20 N·m (15 lb. ft.) torque using a 0-60 N·m (0-25 lb.ft.) torque wrench.

Gaging Procedure (Steps 15 thru 18)

The gaging operations which follow have been worked out on a simple basis to establish and provide necessary running tolerances. Two gaging procedures are necessary.

The first is made to choose the proper size shoe discs to provide, at each piston, a .04 to .06mm (.0016" to .0024") total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate. The bronze shoe discs are provided in .01mm (.0005") variations, including a basic ZERO shoe.

The second, performed at the rear shaft thrust race and bearing stack-up, is designed to obtain .06 to .08mm (.0025" to .0030") preload between the hub surfaces of the axial plate and the front and rear hubs of the cylinder. A total

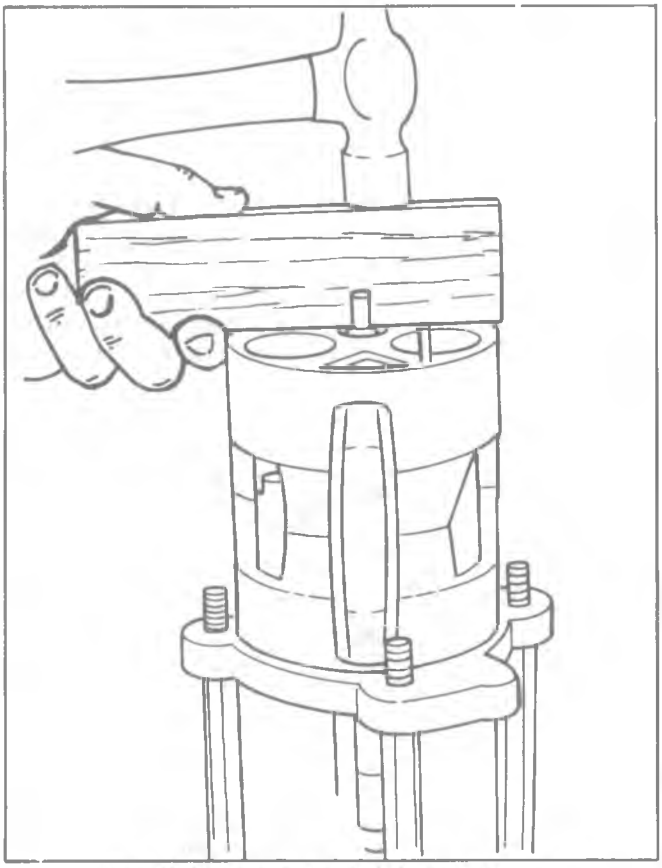


Fig. 1D-39 Assembling A-6 Cylinder Halves

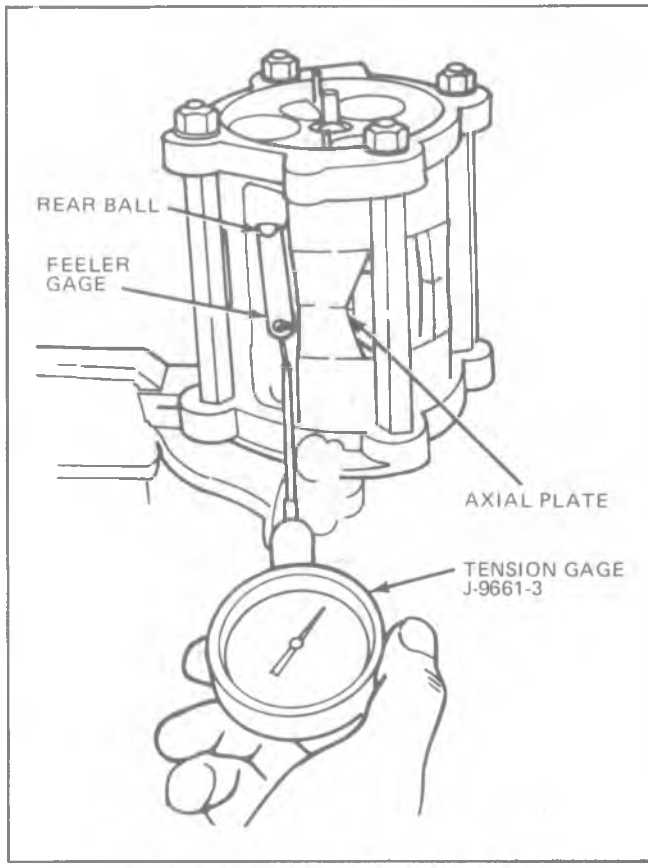


Fig. 1D-40 Gaging A-6 Rear Piston Ball

of 14 steel thrust races, including a basic ZERO race, are provided in increments of .01mm (.0005") thickness to provide the required fit.

Feeler and Tension Gage Set J 9564-01 or J 9661-01 may be used for gaging proper shoe disc size. Feeler Gage Set J 9564-01 or Dial Indicator Set J 8001 may be used to determine proper thrust race size.

Proper selection of thrust races and ball seats is of extreme importance.

15. Measure clearance between rear ball of No. 1 Piston and axial plate, in following manner:

a. Select a suitable combination of well-oiled Feeler Gage leaves to fit snugly between ball and axial plate.

b. Attach Tension Gage J 9661-3 to the feeler gage. A distributor point checking scale or Spring Scale J 544 may be used.

c. Pull on Spring Scale to slide Feeler Gage stock out from between ball and axial plate, and note reading on Spring Scale as Feeler Gage is removed (Fig. 1D-40). Reading should be between 4 and 8 ounces.

d. If reading in Step "c" above is under 4 OR over 8 ounces, reduce or increase thickness of Feeler Gage leaves and repeat Steps a. through c. above until a reading of 4 to 8 ounces is obtained. Record the clearance between ball and axial plate that results in the desired 4 to 8 ounce pull on Spring Scale.

16. Now rotate shaft 120° and repeat Step 15 between this same No. 1 Piston Rear Ball and axial plate. Record this measurement.

If shaft is hard to rotate, install shaft nut onto shaft and turn shaft with wrench.

17. Rotate shaft another 120° and again repeat Step 15 between these same parts and record measurements.

18. Select a "numbered" shoe disc corresponding to minimum feeler gage reading recorded in the three checks just made above. (See example in Fig. 1D-42). Place the selected shoe discs in Parts Tray J 9402 compartment corresponding to Piston No. 1 and Rear Ball pocket position.

Shoe discs are provided in .01mm (.0005") (one-half thousandths) variations. There are a total of 11 sizes available for field servicing. All shoe discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. (See Shoe Disc Size Chart in Fig. 1D-41.)

Once a proper selection of the shoe has been made, the matched combination of shoe disc to rear ball and spherical cavity in piston must be kept in proper relationship during disassembly after Gaging operation, and during final assembly into the Internal Cylinder and Shaft Assembly.

19. Repeat in detail the same Gaging Procedure outlined in Steps 15 through 18 for Piston No. 2 and No. 3.

20A. Mount Dial Indicator J 8001 on edge of Compressing Fixture J 9397 with Clamp J 8001-1 and Sleeve J 8001-2 (Fig. 1D-43). Position Dial Indicator on rear end of axial shaft and adjust to "zero."

From bottom, apply full hand-force at end of shaft a few times before reading clearance. This will help squeeze the oil out from/between mating parts. Now push upward again and record measurement. Dial Indicator increments are .03mm (.001"); therefore, reading must be estimated to nearest .01mm (.0005".).

SHOE DISC			THRUST BEARING RACE		
PART NO. ENDING IN	IDENTIFICATION STAMP	MIN. FEELER GAGE READING	PART NO. ENDING IN	IDENTIFICATION STAMP	DIAL INDICATOR READING
000	0	.0000	000	0	.0000
175	17-1/2	.0175	050	5	.0050
180	18	.0180	055	5-1/2	.0055
185	18-1/2	.0185	060	6	.0060
190	19	.0190	065	6-1/2	.0065
195	19-1/2	.0195	070	7	.0070
200	20	.0200	075	7-1/2	.0075
205	20-1/2	.0205	080	8	.0080
210	21	.0210	085	8-1/2	.0085
215	21-1/2	.0215	090	9	.0090
220	22	.0220	095	9-1/2	.0095
			100	10	.0100
			105	10-1/2	.0105
			110	11	.0110
			115	11-1/2	.0115
			120	12	.0120

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Fig. 1D-41 Available A-6 Service Shoes and Thrust Races

	POSITION 1	POSITION 2	POSITION 3	SELECT AND USE SHOE NO.
PISTON NO. 1	.019"	.0195"	.019"	19
PISTON NO. 2	.020"	.020"	.020"	20
PISTON NO. 3	.021"	.021"	.022"	21

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Fig. 1D-42 Selection of Proper A-6 Shoe Disc

20B. An alternate method of selecting a proper race is to use Gage Set J 9661-01 selecting a suitable feeler gage leaf until the result is a 4 to 8 ounce pull on the scale between the rear thrust bearing and upper (which also happens to be the outer rear) thrust race (Fig. 1D-44). If the pull is just less than 4 ounces, add .01mm (.0005") to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ounces, then subtract .01mm (.0005") from the thickness of the feeler stock.

21. For either method used, select a thrust race with a "number" corresponding to two (2) full sizes larger than Dial Indicator or Feeler Gage measurement of the amount of end play shown. (If measurement is .17mm (.007"), select a No.9 or 090 race.)

Place thrust race in right-hand slot at bottom center of parts tray J 9402.

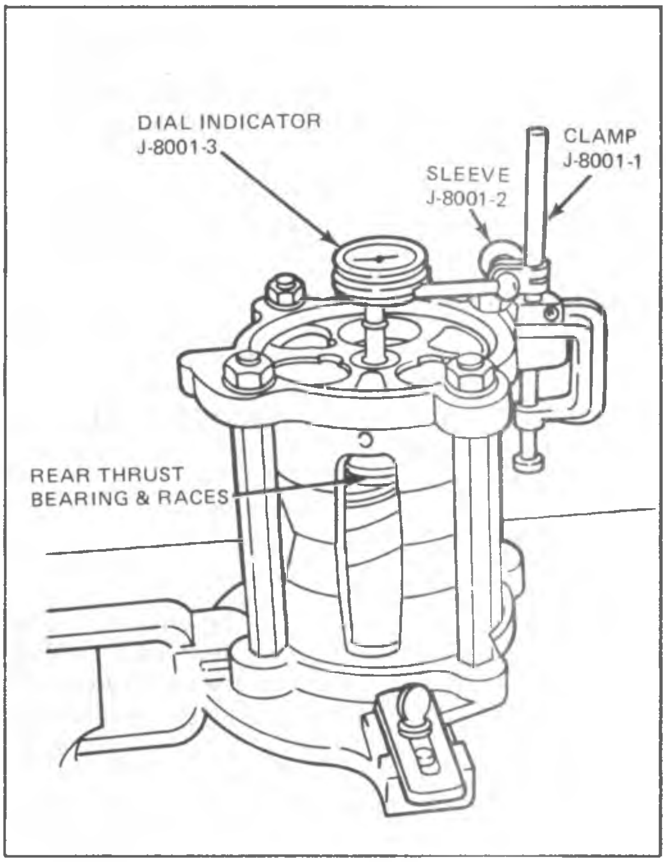


Fig. 1D-43 Gaging A-6 Rear Thrust Race

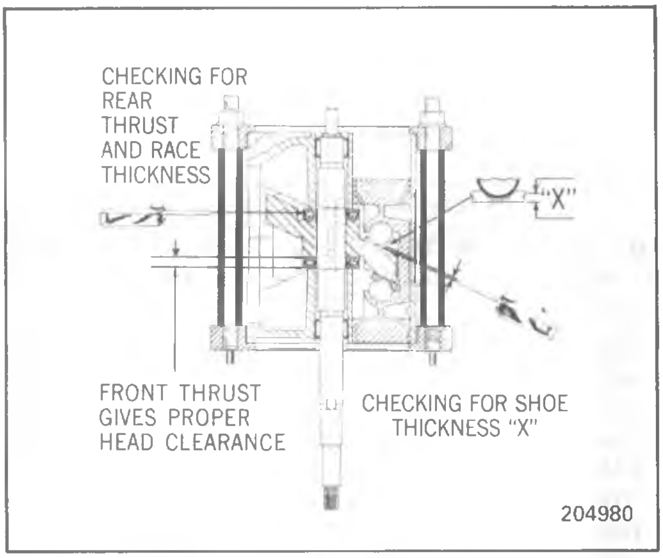


Fig. 1D-44 Checking A-6 Piston and Shaft End Play

Fifteen (15) thrust races are provided in increments of .01mm (.0005") (one-half thousandths) thickness and one ZERO gage thickness, providing a total of 16 sizes available for field service. The thrust race "number" also corresponds to the last three digits of the piece part number. See Thrust Race Size Chart in Fig. 1D-41.

22. Remove nuts from top plate of Compressing Fixture J 9397, and remove top plate.

23. Separate cylinder halves while unit is in Fixture. It may be necessary to use a wooden block and mallet.

24. Remove Rear Cylinder Half and carefully remove one piston at a time from axial plate and front cylinder half. Do not lose the relationship of the front ball and shoe disc and rear ball. Transfer each piston, ball and shoe disc to its proper place in Parts Tray J 9402.

25. Now remove rear outer zero thrust race (it will be on top) from shaft and install the thrust race just selected in Steps 20 and 21 that is presently setting in the right-hand slot at bottom center of Parts Tray J 9402.

The removed zero thrust race may be put aside for re-use in additional Gaging or rebuilding operations.

A-6 COMPRESSOR CYLINDER AND SHAFT ASSEMBLY

A-6 Teflon Piston Ring Replacement

The Teflon piston ring installing, sizing and gaging tools are shown in Fig. 1D-45.

1. Remove the old piston rings by carefully slicing through the ring with a knife or sharp instrument, holding the blade almost flat with the piston surface. Be careful not to damage the aluminum piston or piston groove in cutting to remove the ring. Exercise personal care in cutting the piston ring for removal to prevent injury.

2. Clean the piston and piston ring grooves with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvent and blow the piston dry with DRY air.

3. Set the piston on-end on a clean, flat surface and install the Ring Installer Guide J 24608-2 on the end of the piston (Fig. 1D-46).

4. Install a Teflon ring on the Ring Installer Guide J 24605-2 as shown in Fig. 1D-47, with the dished or dull-side down and glossy-side up.

5. Push the Ring Installer J 24608-5 down over the Installer Guide J 24608-2 to install the Teflon ring in the piston ring groove (Fig. 1D-47). If the Teflon ring is slightly off position in the ring groove, it can be positioned into place by fingernail or blunt-edged tool that will not damage the piston.

The Ring Installer J 24608-5 will retain the Installer Guide J 24608-2 internally when the Teflon ring is installed on the piston. Remove the Installer Guide from the Ring Installer and do not store the installer guide in the ring installer, as the Ring Installer Segment Retainer O-Ring J 24608-3 will be stretched and possibly weakened during storage. This could result in the O-Ring J 24608-3 not holding the Ring Installer segments tight enough to the Installer Guide J 24608-2 to properly install the Teflon ring on the piston.

6. Lubricate the piston ring area with 525 viscosity refrigerant oil and rotate the Piston and Ring Assembly into the Ring Sizer J 24608-6 at a slight angle (Fig. 1D-48). Rotate the piston, while pushing inward, until the piston is inserted against the center stop of the Ring Sizer J 23608-6.

NOTICE: DO NOT push the Piston and Ring Assembly into the Ring Sizer J 24608-6 without proper positioning and rotating as described above, as the ends of the needle bearings of the Ring Sizer may damage the end of the piston.

7. Rotate the Piston and Ring Assembly in the Ring Sizer J 24608-6 several complete turns, until the Assembly rotates relatively free in the Ring Sizer (Fig. 1D-48).

8. Remove the Piston and Ring Assembly, wipe the end of the piston and ring area with a clean cloth and then push the Piston and Ring Assembly into the Ring Gage J 24608-1 (Fig. 1D-49). The piston should go through the Ring Gage with a 2 to 8 lb. force or less without lubrication. If not, repeat Steps 6 and 7.

9. Repeat the procedure for the opposite end of the piston (Fig. 1D-50).

NOTICE: DO NOT lay the piston down on a dirty surface where dirt or metal chips might come into contact and become imbedded in the Teflon ring surface.

10. Lubricate both ends of the piston with 525 viscosity refrigerant oil before inserting the piston into the cylinder bore.

NOTICE: Reasonable care should be exercised in installing the piston into the cylinder bore to prevent damage to the Teflon ring.

A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM.

Assembly

After properly performing the "Gaging Procedure," choosing the correct shoe discs and thrust races, and

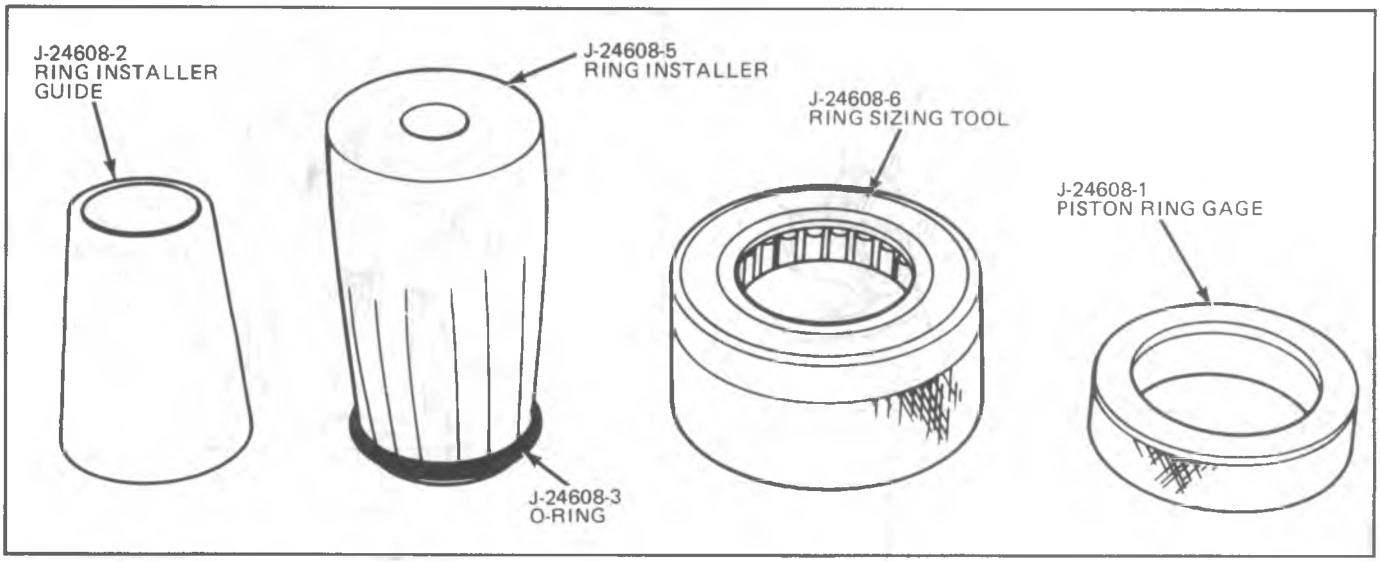


Fig. 1D-45 A-6 Teflon Piston Ring Installing, Sizing and Gaging Tools

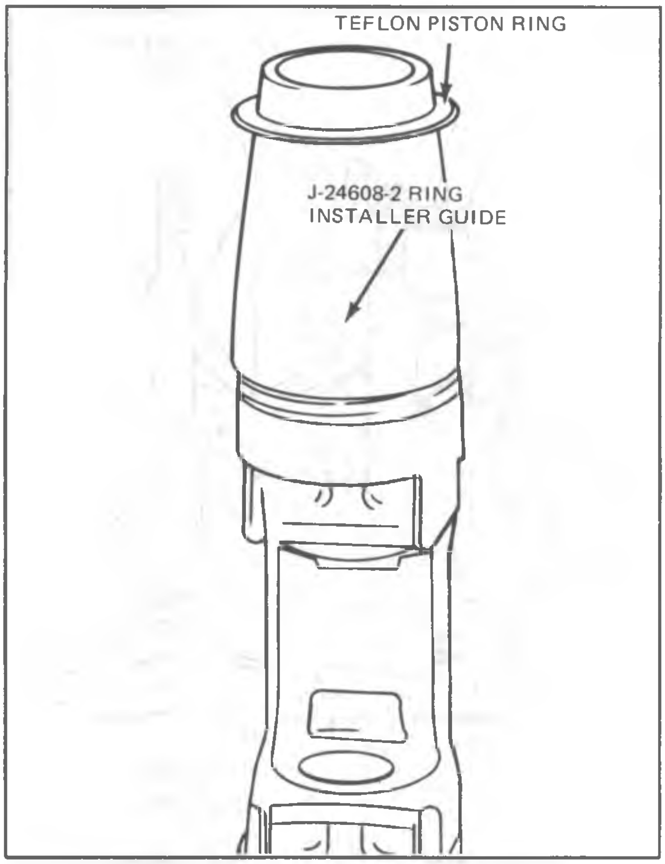


Fig. 1D-46 A-6 Teflon Piston Ring Positioned on Ring Installer Guide

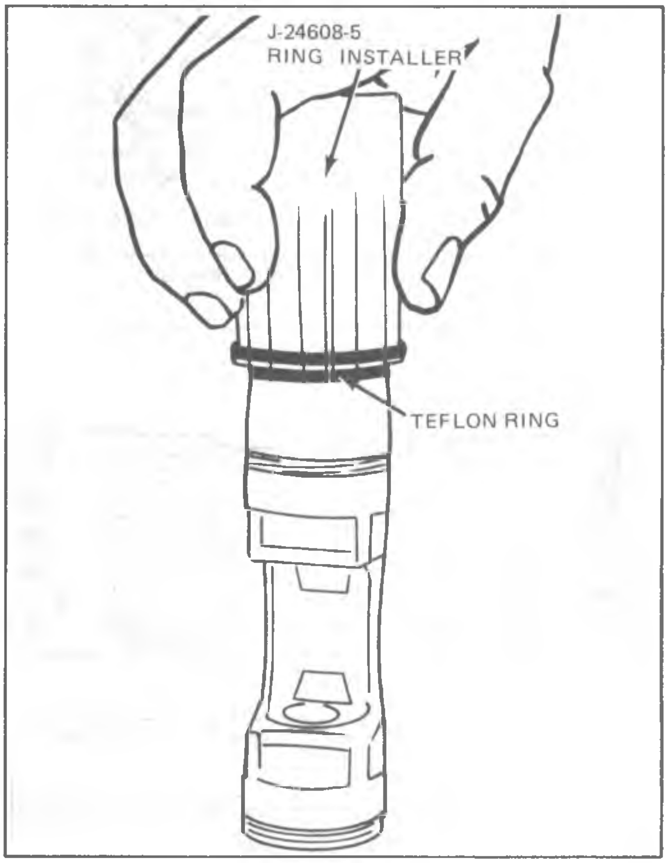


Fig. 1D-47 Installing A-6 Teflon Piston Ring

installing any needed Teflon piston rings, the cylinder assembly may now be reassembled. Be sure to install all new seals and O-rings. All are included in the compressor O-Ring Service Kit.

Assembly procedure is as follows:

1. Support the front half of the cylinder assembly on Compressing Fixture J 9397. Install the shaft and axial plate, threaded end down, with its front bearing race pack (ZERO race-bearing-ZERO race), if this was not already done at the end of the "Gaging Procedure." Install rear bearing race pack (ZERO race-bearing-NUMBERED race).

2. Apply a light smear of petroleum jelly to the shoe discs and piston ball sockets and install all balls and shoe discs in their proper place in the piston assembly.

3. Rotate the axial plate so that the high point is above cylinder bore No. 1.

a. Carefully assemble Piston No. 1, complete with ball and "zero" shoe disc on the front and ball and "numbered" shoe disc on the rear, over the axial plate.

b. Hold front thrust bearing pack tightly against axial plate hub while lifting shaft and axial plate to install piston asm.

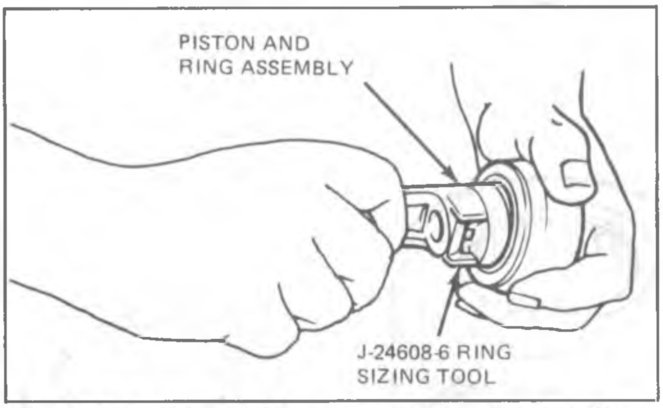


Fig. 1D-48 Turning A-6 Piston and Ring Asm. Into Ring Sizing Tool

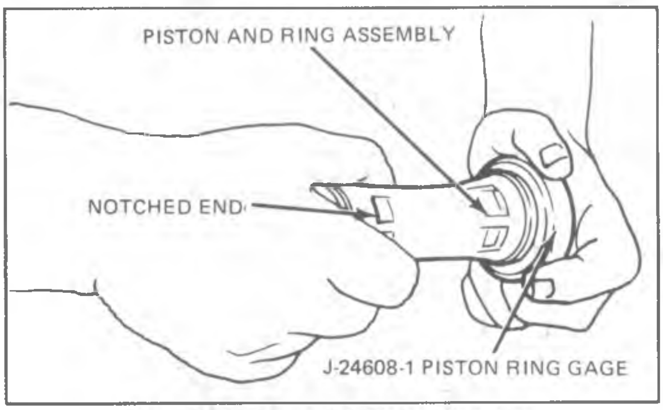


Fig. 1D-49 Gaging A-6 Piston Ring Size

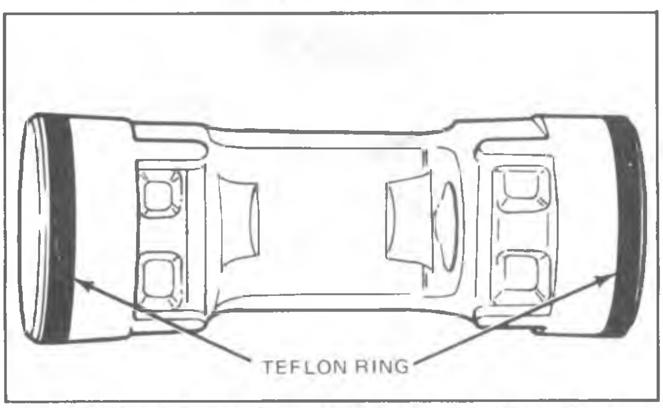


Fig. 1D-50 A-6 Teflon Piston Ring Installed in Piston Groove

c. Insert the Piston Assembly into the Front Cylinder Half (Fig. 1D-51).

4. Repeat this operation for Pistons No. 2 and No. 3 (Fig. 1D-52).

5. Without installing any O-rings or bushings, assemble one end of the new Service Discharge Cross-Over Tube into the hole in the front cylinder half (Figs. 1D-53 and 1D-54).

Be sure the flattened portion of this tube faces the inside of the compressor to allow for axial plate clearance (Fig. 1D-54).

6. Now rotate the shaft to position the pistons in a stair-step arrangement; then carefully place the Rear Cylinder Half over the shaft and start the pistons into the cylinder bore (Fig. 1D-55).

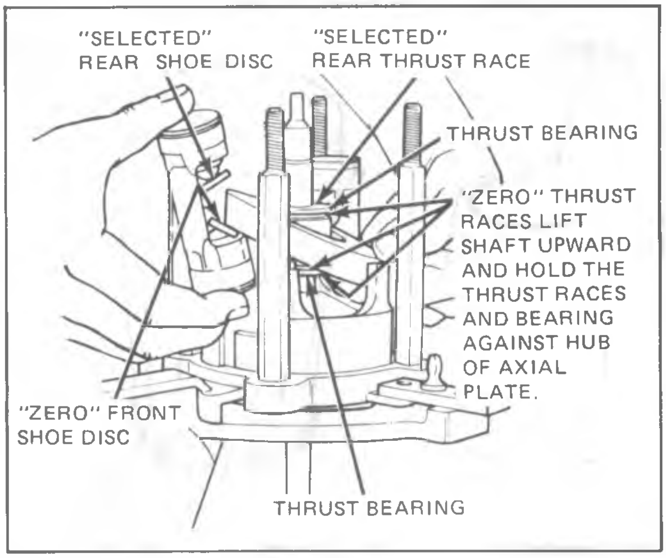


Fig. 1D-51 Installing 1st A-6 Piston Assembly Into Front Cylinder Half

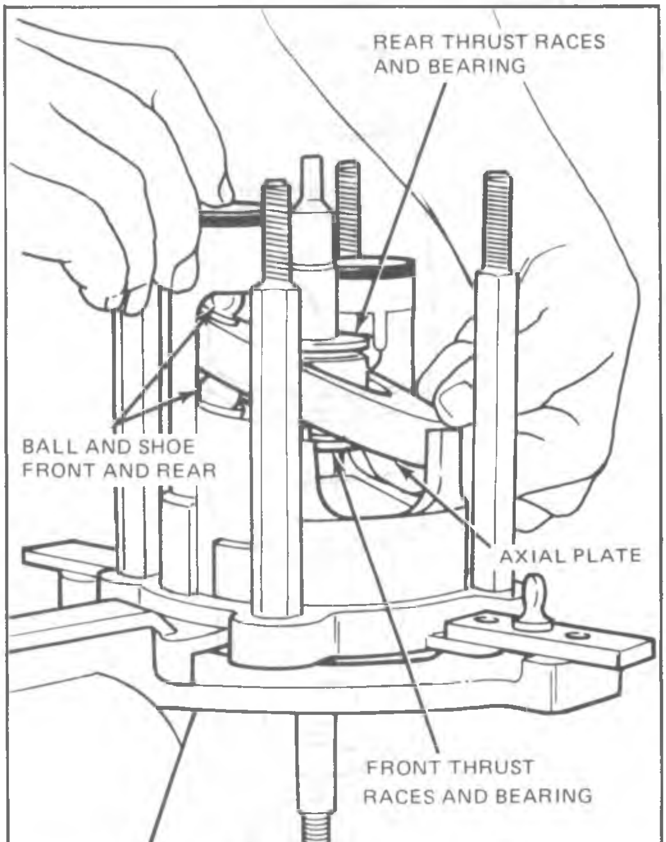


Fig. 1D-52 Installing 2nd A-6 Piston

7. When all three Piston and Ring assemblies are in their respective cylinders, align the end of the discharge cross-over tube with the hole in the rear half of the cylinder.

8. When all parts are in proper alignment, tap with a clean wooden block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in Compressing Fixture J 9397, to complete drawing the cylinder halves together.

9. Generously lubricate all moving parts with clean 525 viscosity refrigerant oil and check for free rotation of the parts.

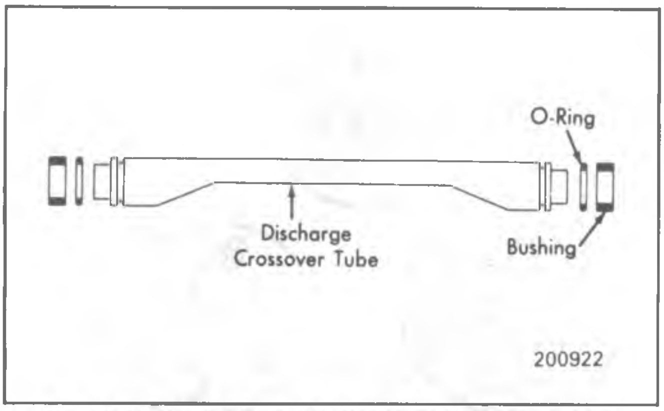


Fig. 1D-53 Service-type A-6 Discharge Cross-Over Tube

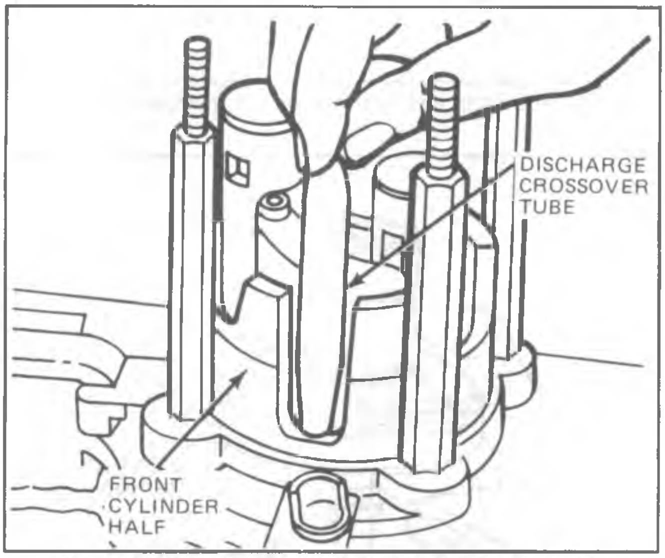


Fig. 1D-54 Installing A-6 Discharge Cross-over Tube

10. Replace the Suction Cross-Over Cover (Fig. 1D-56). Compress the cover as shown to start it into the slot, and then press or carefully tap it in until flush on both ends.

A-6 COMPRESSOR INTERNAL CYLINDER AND SHAFT ASM

Re-Install

1. Place Internal Cylinder and Shaft Assembly on Internal Assembly Support Block J 21352,with rear-end of shaft in Support Block hole.

2. Now install new O-ring and bushing in front-end of discharge cross-over tube (Fig. 1D-57). The O-ring and bushing are Service parts only for Internal Cylinder and Shaft Assemblies that have been disassembled in the field (Also see Fig. 1D-53).

3. Install new dowel pins in front cylinder half, if previously removed.

4. Install Front Suction Reed Plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge cross-over tube (Fig. 1D-58).

5. Install Front Discharge Valve Plate assembly (it has a large diameter hole in the center), aligning holes with dowel pins and proper openings in front suction reed plate (Fig. 1D-59 and Fig. 1D-60.)

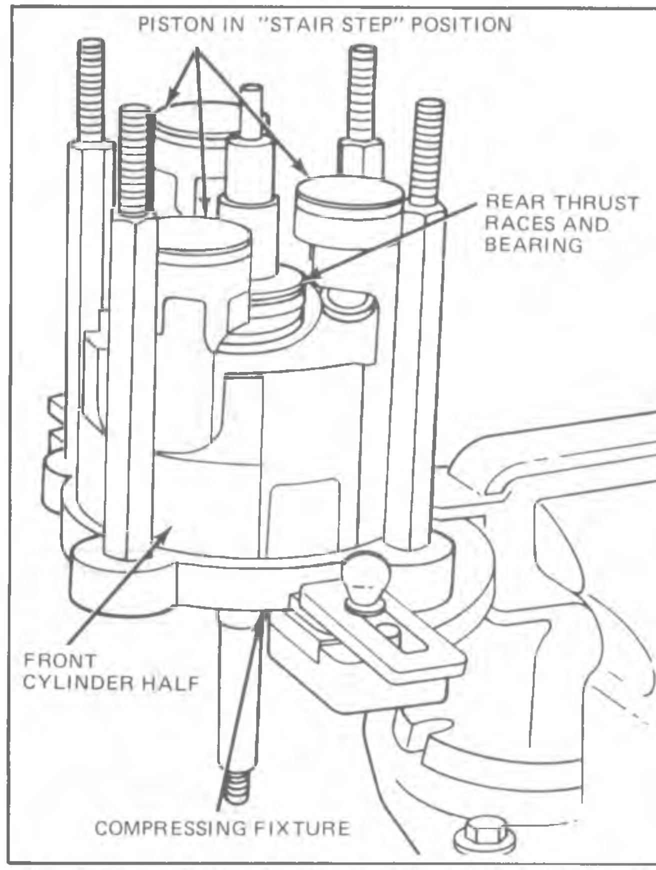


Fig. 1D-55 A-6 Pistons Positioned in Stair-Step Arrangement

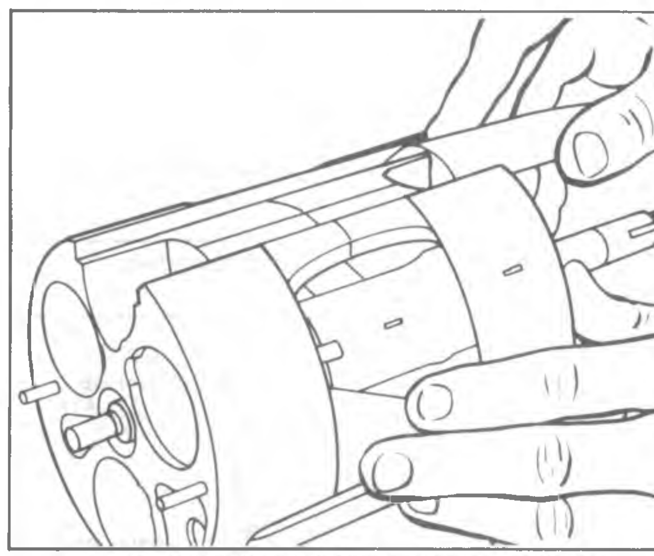


Fig. 1D-56 Installing A-6 Suction Cross-over Cover

6. Coat sealing surfaces on webs of compressor front head casting with clean 525 viscosity refrigerant oil.

7. Determine exact position of Front Head casting in relation to dowel pins on Internal Cylinder and Shaft Assembly. Mark position of dowel pins on sides of Front Head assembly and on sides of Internal Cylinder and Shaft Assembly with a grease pencil. Carefully lower Front Head casting into position (Fig. 1D-61), making certain that sealing area around center bore of head assembly does not contact shaft as head assembly is lowered. Do not rotate head assembly to line up with dowel pins, as the sealing areas would then contact the reed retainers.

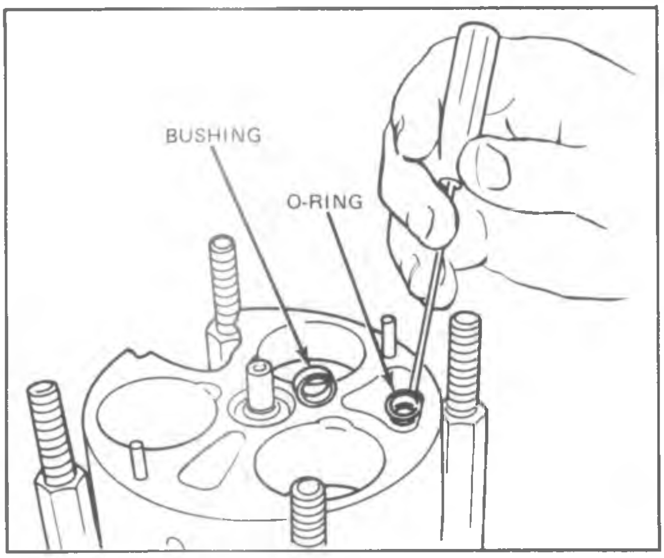


Fig. 1D-57 Installing O-Ring On A-6 Discharge Cross-Over Tube

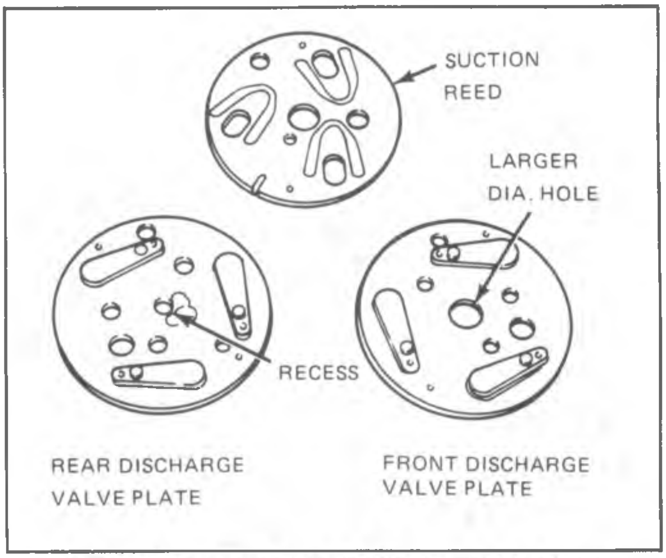


Fig. 1D-60 Front and Rear A-6 Discharge Valve Plates

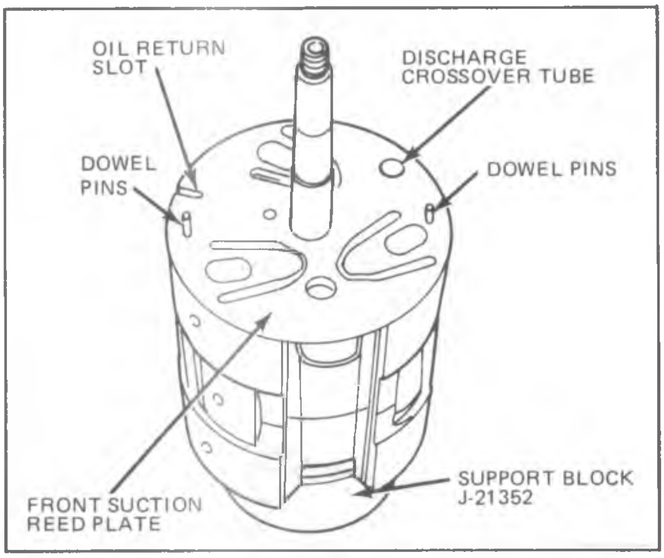


Fig. 1D-58 Installing A-6 Front Suction Reed

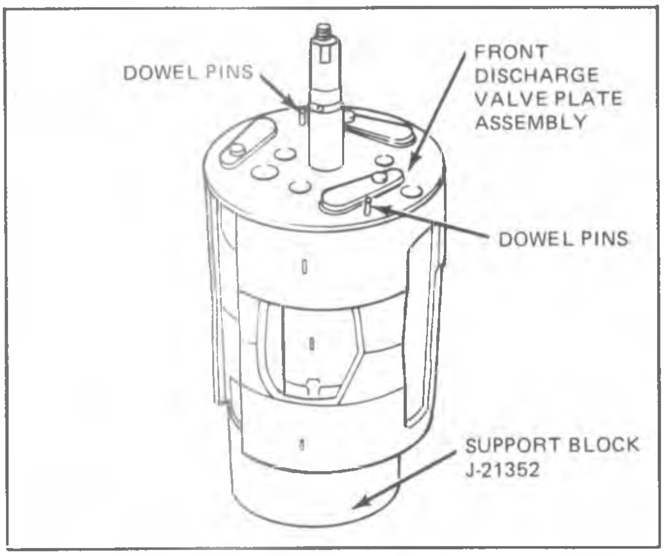


Fig. 1D-59 Installing A-6 Front Discharge Valve Plate

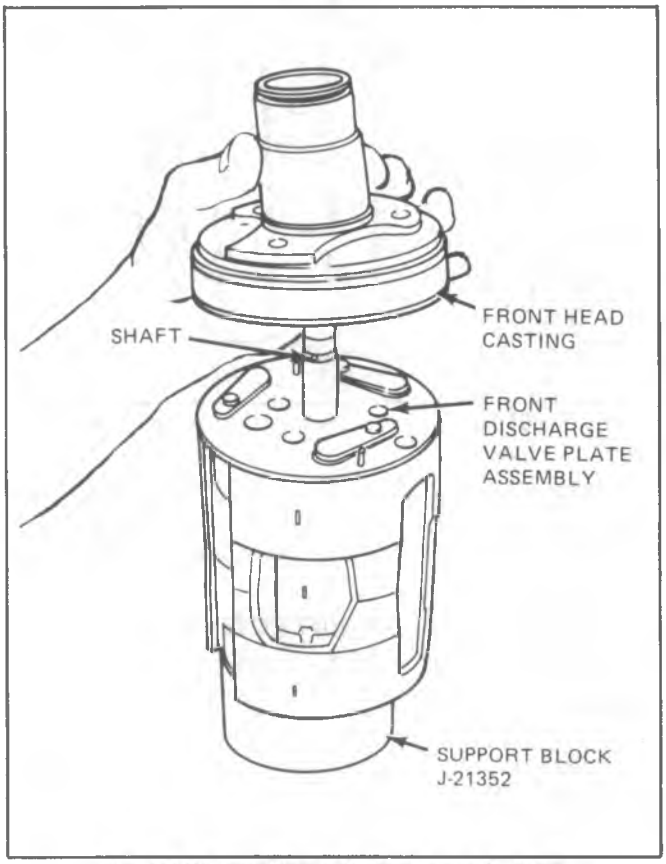


Fig. 1D-61 Installing A-6 Front Head Casting

8. Generously lubricate new O-ring and angled groove at lower edge of front head casting with 525 viscosity refrigerant oil and install new O-ring into groove (Fig. 1D-62).

9. Coat inside machined surfaces of compressor shell with 525 viscosity refrigerant oil and position shell on Internal Cylinder and Shaft Assembly, resting on J21352 support block.

10. Using flat-side of a small screwdriver, gently position O-ring in around circumference of Internal Cylinder and Shaft Assembly until Compressor Shell slides down over Internal Cylinder and Shaft Assembly. As shell

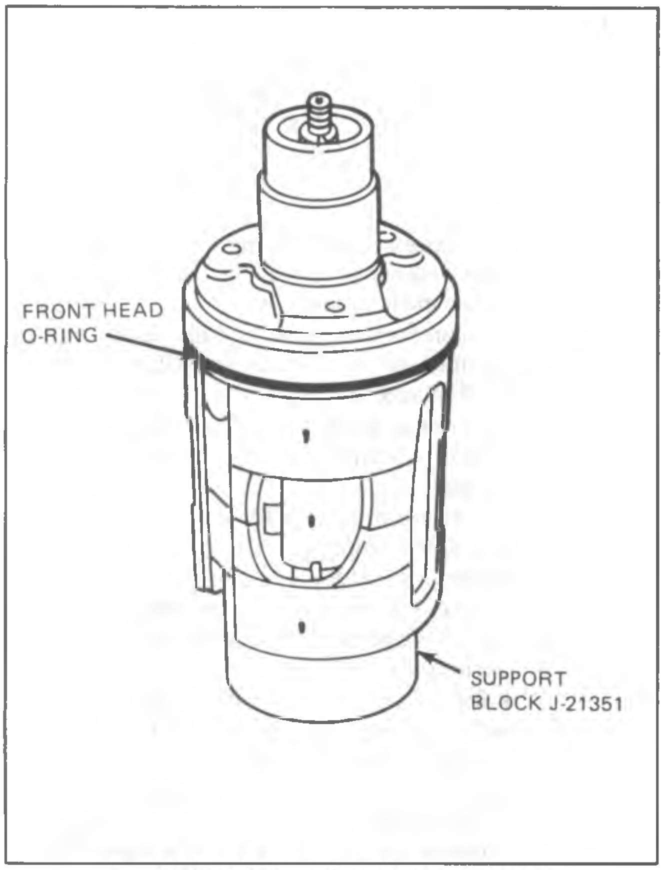


Fig. 1D-62 A-6 Front Head O-Ring Installed

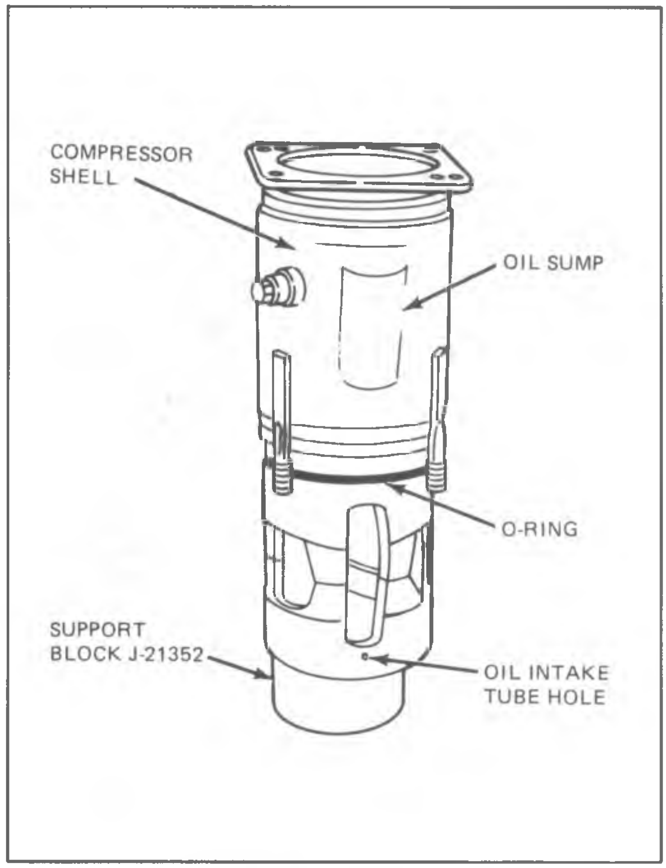


Fig. 1D-63 Installing A-6 Compressor Shell

slides down, line up oil sump with oil intake tube hole (Fig. 1D-63).

11. Holding Support Block J 21352 with one hand, invert Internal Cylinder and Shaft Assembly and place back into Holding Fixture J9396 with front end of shaft now facing downward. Remove Support Block.

12. Install new dowel pins in rear cylinder half, if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate Oil Pick-Up Tube with 525 viscosity refrigerant oil and install into cavity, rotating compressor mechanism to align tube with hole in shell baffle (Fig. 1D-64).

15. Now install new O-ring and bushing on rear-end of discharge cross-over tube (See Fig. 1D-53).

16. Install Rear Suction Reed over dowel pins, with slot towards sump.

17. Install Rear Discharge Valve Plate assembly over dowel pins, with reed retainers UP.

18. Position Inner Oil Pump Gear over shaft with previously applied identification mark UP.

19. Position Outer Oil Pump Gear over inner gear with previously applied identification mark up and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9-o'clock position. The resulting cavity between gear teeth is then at 3-o'clock position (Fig. 1D-65).

20. Generously oil Rear Discharge Valve Plate assembly with 525 viscosity refrigerant oil around outer edge where large diameter O-ring will be placed. Oil the valve reeds, pump gears, and area where sealing surface will contact Rear Discharge Valve Plate.

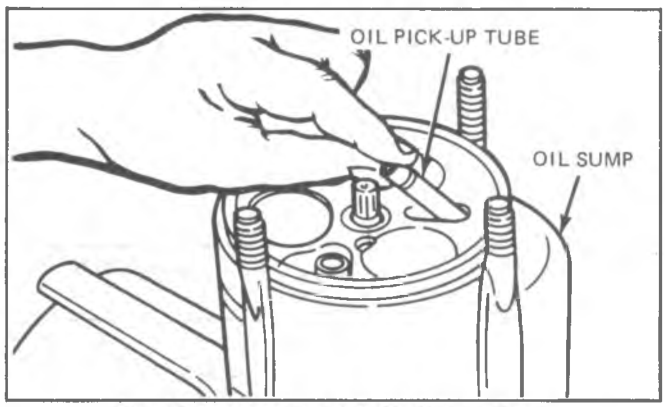


Fig. 1D-64 Installing A-6 Oil Pick-up Tube

21. Using the 525 oil, lubricate new head to-shell O-ring and install on rear discharge valve plate, in contact with shell (Fig. 1D-66).

22. Install Suction Screen in rear head casting, using care not to damage screen.

23. Coat sealing surface on webs of compressor rear head casting with 525 viscosity refrigerant oil.

24. Install Rear Head assembly over studs on compressor shell. The two lower threaded compressor mounting holes should be in alignment with the compressor sump.

Make certain that suction screen does not drop out of place when lowering rear head into position (Fig. 1D-67).

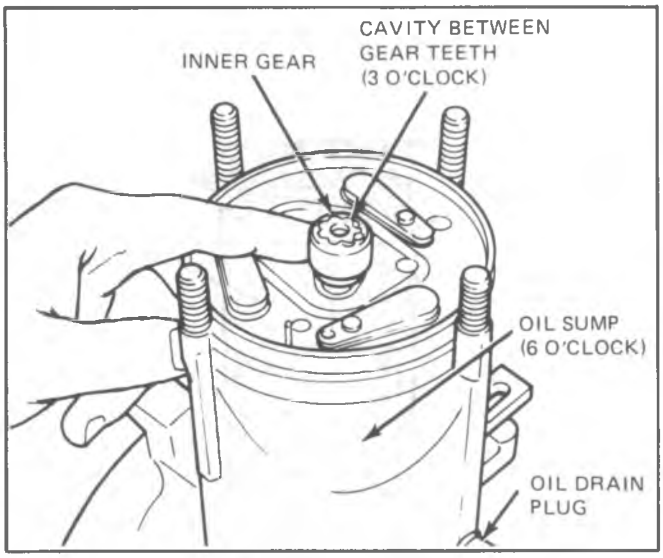


Fig. 1D-65 Positioning A-6 Oil Pump Gears

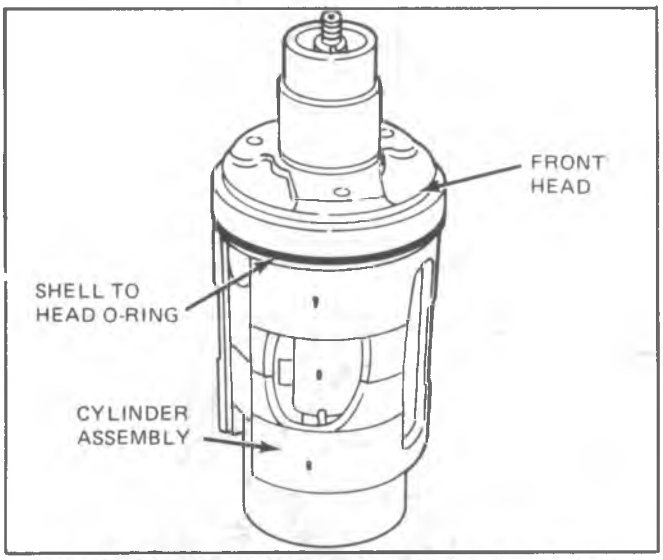


Fig. 1D-66 A-6 Shell-To-Front Head O-Ring Installation

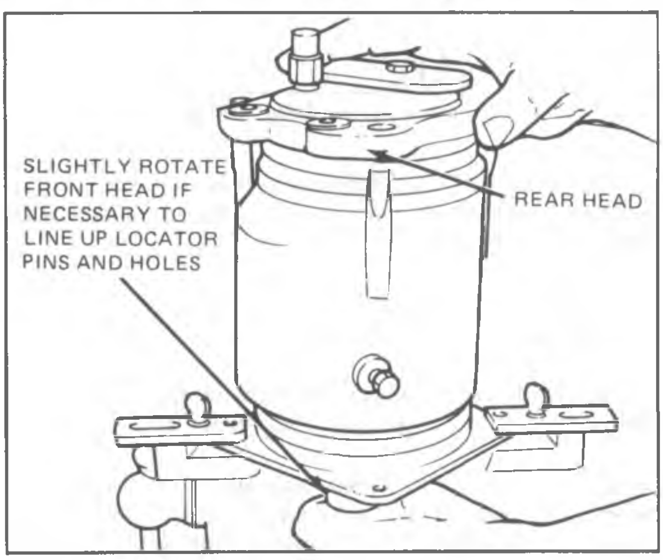


Fig. 1D-67 Installing A-6 Rear Head

If Rear Head assembly will not slide down over dowels in Internal Cylinder and Shaft Assembly, twist Front Head assembly back-and-forth very slightly by-hand until Rear Head drops over dowel pins (Fig. 1D-67).

25. Install nuts on threaded shell studs and tighten evenly to 34 N·m (25 lb. ft.) torque using a 0-60 N·m (0-50 lb. ft.) torque wrench.

26. Invert compressor in Holding Fixture and install compressor Shaft Seal as described in "A-6 Compressor Shaft Seal" Replacement procedure.

27. Install compressor Clutch Coil and Housing assembly as described in "A-6 Compressor Clutch Coil and Housing Asm." Replacement procedure.

28. Install compressor Pulley and Bearing assembly as described in "A-6 Compressor Pulley and Bearing" Replacement procedure.

29. Install compressor Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Replacement procedure.

30. Add required amount of 525 viscosity refrigerant oil (see "C.C.O.T. Refrigerant Oil Distribution" in the Air Conditioning section).

31. Check for external and internal leaks as described in the following "A-6 Compressor Leak Testing" procedure found at the end of this over-haul section.

32. "Evacuate and charge the refrigerant system" according to the Discharging, Adding Oil, Evacuating and Charging Prcoedures for C.C.O.T. A/C Systems in the Air Conditioning section.

A-6 COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

Bench-Check Procedure

1. Install Test Plate J 9625 on Rear Head of compressor.

2. Attach center hose of Manifold Gage Set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.

3. Connect Charging Station high and low pressure lines to corresponding fittings on Test Plate J 9625, using J 5420 Gage Adapters if hoses are not equipped with valve depressors.

- Suction port (low-side) of compressor has large internal opening. Discharge port (hi-side) has smaller internal opening into compressor.

4. Open low pressure control, high pressure control and refrigerant control on Charging Station to allow refrigerant vapor to flow into compressor.

5. Using a Leak Detector, check for leaks at Pressure Relief Valve, compressor Shell to cylinder, compressor front head seal, and compressor Shaft Seal. After checking, shut off low pressure control and high pressure control on Charging Station.

6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.

7. Loosen the Manifold Gage hose connections to the Gage Adapters J 5420 connected to the low and high sides and allow the vapor pressure to release from the compressor.

8. Disconnect both Gage Adapters J 5420 from the Test Plate J 9625.

9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.

10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.

11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.

12. Connect the Charging Station high pressure line or a high pressure gage and Gage Adapter J 5420 to the Test Plate J 9625 high side connector.

13. Attach an Adapter J 5420 to the suction or low pressure port of the Test Plate J 9625 to open the schrader-type valve.

Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.

14. Attach the compressor to the J 9396 Holding Fixture. Clamp the compressor Holding Fixture in a vise so that the compressor can be manually turned with a wrench.

15. Using a wrench, rotate the compressor crankshaft or drive plate hub 10-complete revolutions at a speed of approximately one-revolution per second.

Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.

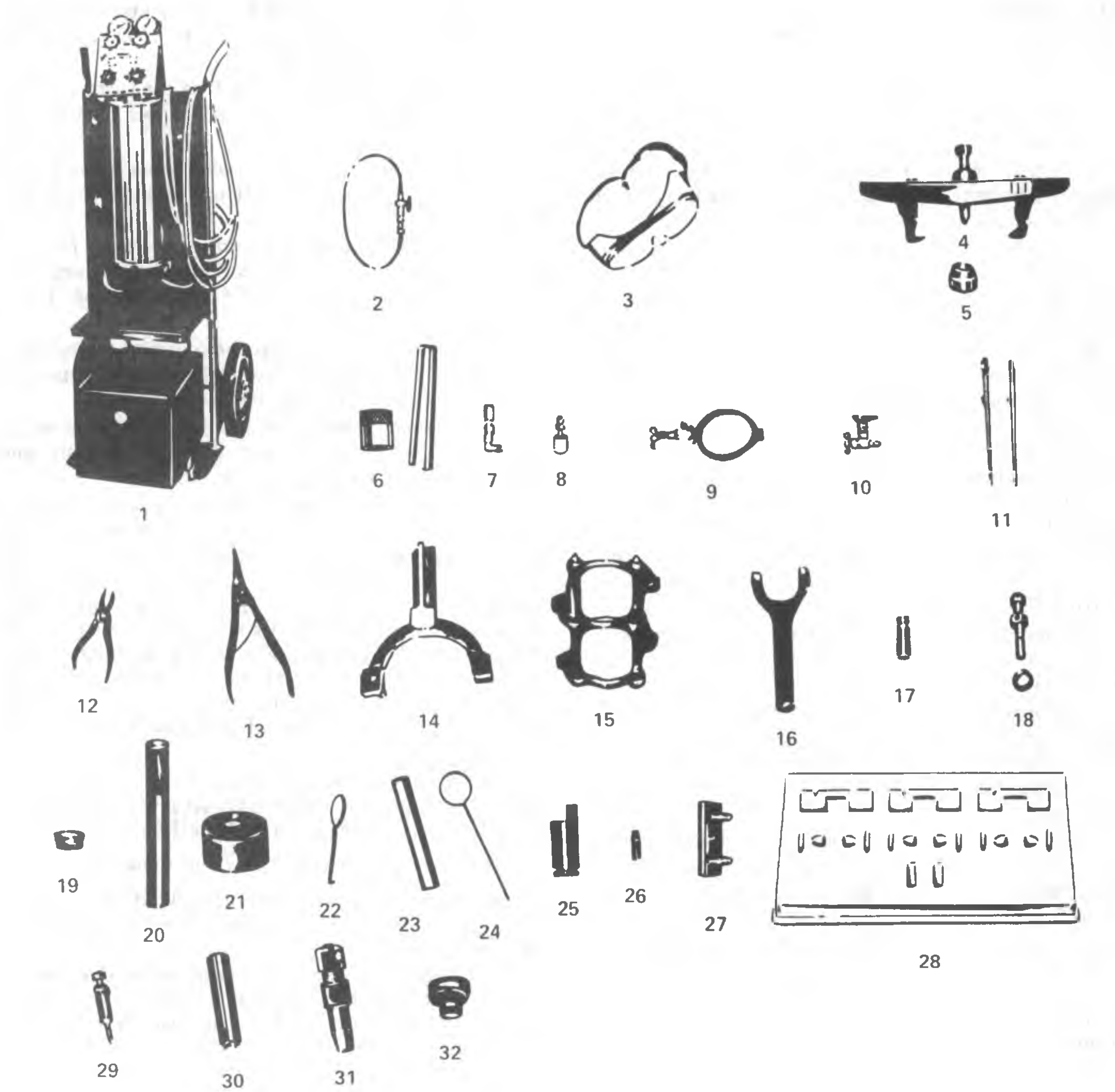
16. Observe the reading on HIGH pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 413.7 kPa (60 P.S.I.) or above for the A-6 compressor. A pressure reading of less than 344.75 kPa (50 p.s.i.) for the A-6 would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.

17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J 5420 and Test Plate J 9625.

18. Remove oil charge screw and drain the oil sump.

19. Allow the comprtssor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

If further assembly or processing is required, a shipping plate or Test Plate J 9625 should be installed to keep out air, dirt and moisture until the compressor is installed.



1.	J 23500	Charging Station
2.	J 24095	Oil Inducer
3.	J 5453	Goggles
4.	J 8433	Puller
5.	J 9395	Puller Pilot
6.	J 9393-1 J 9393-2	Seal Seat Remover + Installer
7.	J 9459 — 7/16"–20 J 25499 — 3/8"–24	90° Gauge Line Adapter
8.	J 5420 — 7/16"–20 J 25498 — 3/8"–24	Straight Gauge Line Adapter
9.	J 23595	Refrigerant Can Valve (Side-Tap)
10.	J 6271-01	Refrigerant Can Valve (Top-Tap)
11.	J 5421-02	Pocket Thermometers (2)
12.	J 5403	No. 21 Snap Ring Pliers
13.	J 6435	No. 26 Snap Ring Pliers
14.	J 9396	Compressor Holding Fixture
15.	J 9397	Compressing Fixture
16.	J 25030	Clutch Hub Holding Too
17.	J 9399	9/16" Thin Wall Socket
18.	J 9401	Hub and Drive Plate Assembly Installer
19	J 9398	Pulley Bearing Remover
20.	J 8092	Handle
21.	J 21352	Internal Assembly Support Block
22.	J 5139	Oil Pickup Tube Remover
23.	J 9432	Needle Bearing Installer
24.	J 9553-01	Seal Seat "O" Ring Remover
25.	J 21508	Seal Seat "O" Ring Installer
26.	J 22974	Shaft Seal Protector
27	J 9625	Pressure Test Connector
28.	J 9402	Parts Tray
29.	J 9480-01	Hub and Drive Plate Assembly Remover
30.	J 9392	Seal Remover—Installer
31.	J 23128	Seal Seat Remover—Installer
32.	J 9481	Pulley Bearing and Pulley Installer

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Fig. 1D-105 Special Tools, A/C Refrigerant System and A-6 Compressor

SECTION 1D1

R-4 AIR CONDITIONING COMPRESSOR OVERHAUL

For Compressor REMOVAL AND INSTALLATION, see Air Conditioning Section. For DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS, see Air Conditioning Section.

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GENERAL DESCRIPTION

For all practical purposes, all vehicles make use of the same 4-cylinder air conditioning compressor. Actual differences between compressor installations are in their mounting brackets, drive system, pulleys, connector assemblies and system capacities, none of which will affect the following Overhaul Procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly. Clean tools and clean work area are very important for proper service. The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any "on car" repairs or removal of the compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvent and blown dry with dry air. When necessary to use a cloth on any part, it should be of a nonlint producing type.

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described are based on bench over-haul with the compressor removed from the vehicle. They have been prepared in sequence in order of accessibility of the components. If compressor is removed from brackets but not disconnected from lines and hoses, the system is not discharged. Pad fender skirt and secure compressor near top of fender skirt with wire, rope, etc. when performing on-car service.

When the R-4 compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (See Refrigerant Oil Distribution" in the Air Conditioning Section 1B1).

SERVICE PROCEDURES

MINOR REPAIR PROCEDURES, R-4 COMPRESSOR

THE FOLLOWING OPERATIONS TO THE R-4 COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL & PULLEY RIM ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

Two types of drive systems are used on the R-4 Compressor: V-groove type and poly-groove type. The drive system affects only minor repair procedures and is so noted where required. Major repair procedures are not affected by the type of drive system.

The Compressor Shaft Seal assembly, and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as MAJOR REPAIR PROCEDURES because the system must be discharged, evacuated and recharged to complete service.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

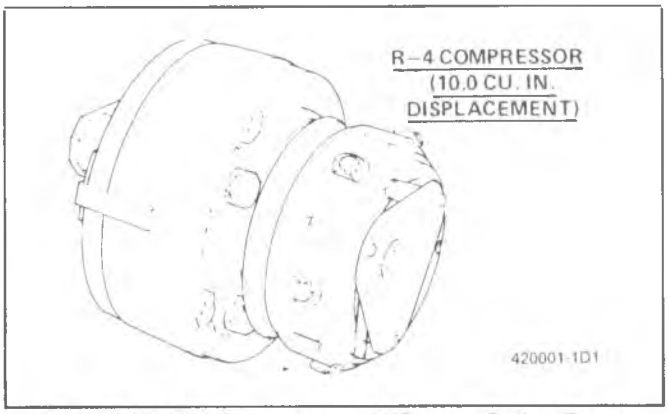


Fig. 1D1-1 R-4 Compressor, V-Groove Pulley Type

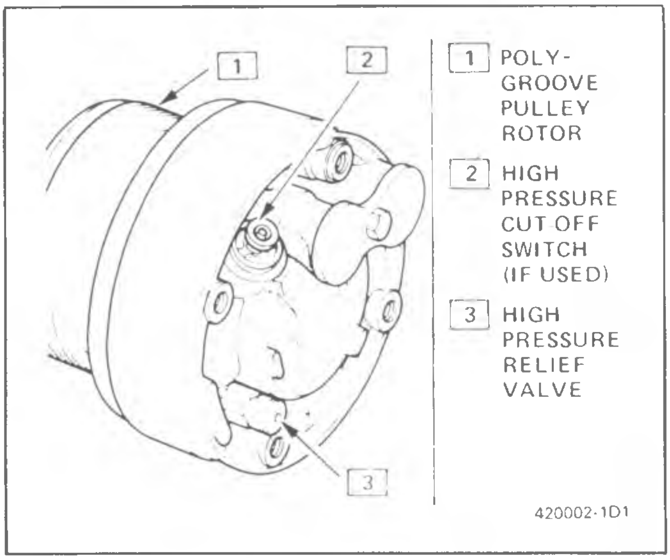


Fig. 1D1-2 R-4 Compressor, Poly-Groove Pulley Type

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the AIR CONDITIONING section and Fig. 1D1-3 and Fig. 1D1-4 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

R-4 COMPRESSOR CLUTCH PLATE AND HUB ASM.

Remove

1. If compressor is on the car, loosen compressor mounting brackets, disconnect the compressor drive belt and reposition the compressor for access, if necessary.

   If compressor has been removed from the car, attach the compressor to Holding Fixture J-25008-A and clamp the Holding Fixture in a vise (Fig. 1D1-7).

   - Compressor mounting holes are metric. Use proper metric bolts with holding fixture J-25008-A.
2. Keep the clutch hub from turning with the Clutch Hub Holding Tool J-25030, remove, and discard the shaft nut, using Thin Wall Socket J-9399, Fig. 1D1-8.
3. Thread the Clutch Plate and Hub Assembly Remover J-9401-A, into the hub. Hold the body of the Remover with a wrench and turn the center screw into the Remover body to remove the Clutch Plate and Hub assembly (Fig. 1D1-9).
4. Remove the shaft key.

Replace

1. Install the shaft key into the hub key groove (Fig. 1D1-10). Allow the key to project approximately 4.8mm (3/16") out of the keyway.

   The shaft key is curved slightly to provide an interference fit in the shaft key groove of the hub.
2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the Clutch Plate and Hub assembly.
3. Align the shaft key with the shaft keyway and place the Clutch Plate and Hub assembly onto the compressor shaft.

NOTICE: To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.

4. Install the Clutch Plate and Hub Installer J-9480-B as illustrated in Fig. 1D1-11.
5. Hold the hex portion of the Installer Body J-9480-B with a wrench and tighten the center screw to press the hub onto the shaft until there is a .5mm - 1.0mm (.020"-.040") inch air gap between the frictional surfaces of the clutch plate and clutch rotor.
6. Install a new shaft nut with the small diameter boss of the nut against the crankshaft shoulder, using Thin Wall Socket J-9399. Hold the Clutch Plate and Hub assembly with Clutch Hub Holding Tool J-25030, and tighten to 14 N·m (10 lb. ft.) torque, using a 0-60 N·m (0-25 lb.ft.) torque wrench.
7. If operation is performed with compressor on car, connect drive belt, tighten mounting brackets and adjust belt tension.

1–RETAINER RING
2–SEAL SEAT
3–SHAFT SEAL
4–O RING, SEAL SEAT
5–SHAFT SEAL KIT
6–SCREW AND WASHER ASSEMBLY FRONT HEAD MOUNTING
7–FRONT HEAD
8–MAIN BEARING
9–RING SEAL, FRONT HEAD TO CYLINDER
10–SHELL
11–O-RING, CYLINDER TO SHELL
12–THRUST WASHER
13–BELLEVILLE WASHER
14–THRUST WASHER KIT
15–CYLINDER AND SHAFT ASSEMBLY
16–RETAINER RING
17–VALVE PLATE
18–SHIPPING PLATE
19–SCREW
20–O-RING SUCTION-DISCHARGE PORTS
21–PRESSURE RELIEF VALVE
22–O-RING, PRESSURE RELIEF VALVE
23–SHAFT NUT
24–CLUTCH HUB KEY
25–CLUTCH DRIVE ASSEMBLY
26–RETAINER RING
27–ROTOR
28–ROTOR BEARING
29–ROTOR AND BEARING ASSEMBLY
30–COIL AND HOUSING ASSEMBLY
31–PULLEY RIM MOUNTING SCREW
32–SPECIAL WASHER-PULLEY RIM MOUNTING SCREW LOCKING
33–PULLEY RIM

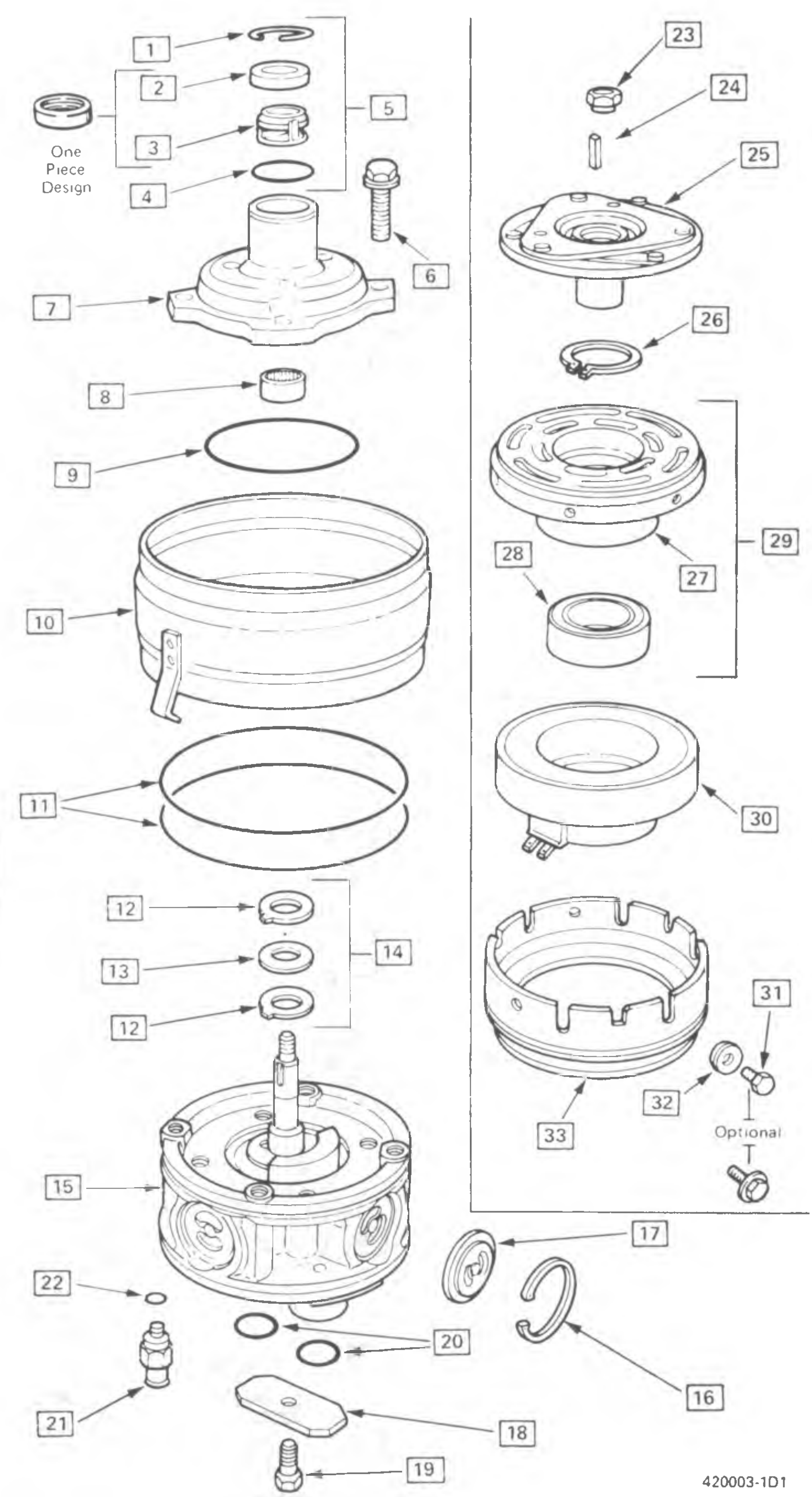
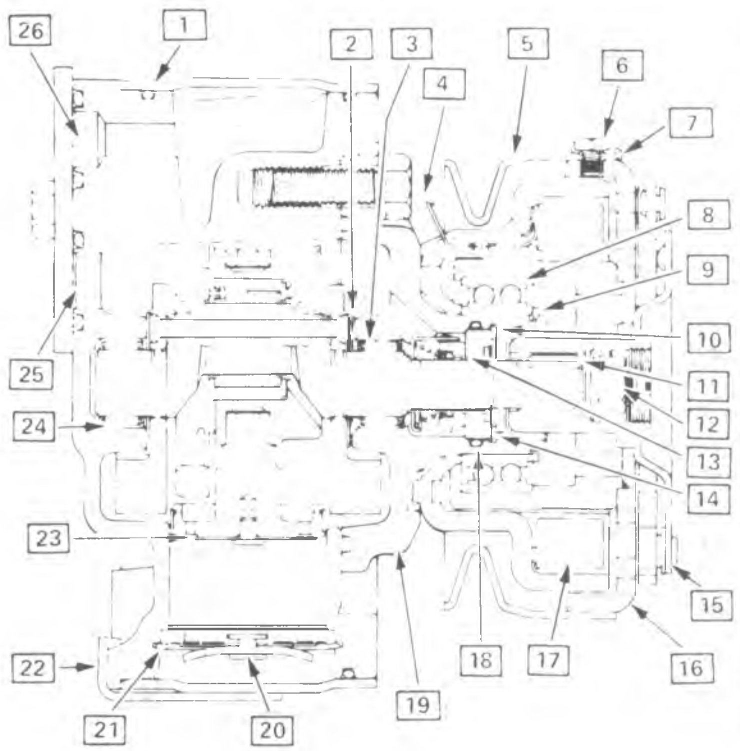


Fig. 1D1-3 Exploded View of R-4 Compressor



1 COMPRESSOR SHELL
2 THRUST AND BELLEVILLE WASHER
3 MAIN BEARING FRONT
4 CLUTCH COIL TERMINALS
5 PULLEY RIM
6 PULLEY RIM MTG. SCREW
7 PULLEY RIM MTG. SCREW LOCKWASHER
8 ROTOR BEARING
9 ROTOR BEARING RETAINER
10 SEAL SEAT RETAINER
11 SHAFT KEY
12 SHAFT NUT
13 SHAFT SEAL
14 SEAL SEAT
15 CLUTCH DRIVE ASSEMBLY
16 ROTOR AND HUB ASSEMBLY
17 CLUTCH COIL AND HOUSING ASSEMBLY
18 SEAL SEAT O-RING
19 FRONT HEAD
20 VALVE PLATE ASSEMBLY
21 VALVE PLATE RETAINER RING
22 SHELL RETAINER
23 PISTON ASSEMBLY
24 MAIN BEARING-REAR
25 SUCTION PORT
26 DISCHARGE PORT

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Fig. 1D1-4 R-4 Compressor Cross Section - Early Design

1–COMPRESSOR SHELL
2–ROLL PINS
3–THRUST AND BELLEVILLE WASHER
4–MAIN BEARING - FRONT
5–CLUTCH COIL TERMINALS
6–PULLEY RIM
7–PULLEY RIM MOUNTING SCREW AND LOCKWASHER
8–ROTOR BERAING
9–ROTOR BEARING RETAINER
10–SEAL SEAT RETAINER
11–SHAFT KEY
12–SHAFT NUT
13–SHAFT SEAL
14–CLUTCH DRIVE ASSEMBLY
15–ROTOR AND HUB ASSEMBLY
16–CLUTCH OIL AND HOUSING ASSEMBLY
17–SEAL SEAT O-RING
18–FRONT HEAD
19–VALVE PLATE ASSEMBLY
20–VALVE PLATE RETAINING RING
21–SHELL RETAINER
22–PISTON ASSEMBLY
23–MAIN BEARING - REAR
24–SUCTION PORT
25–DISCHARGE PORT

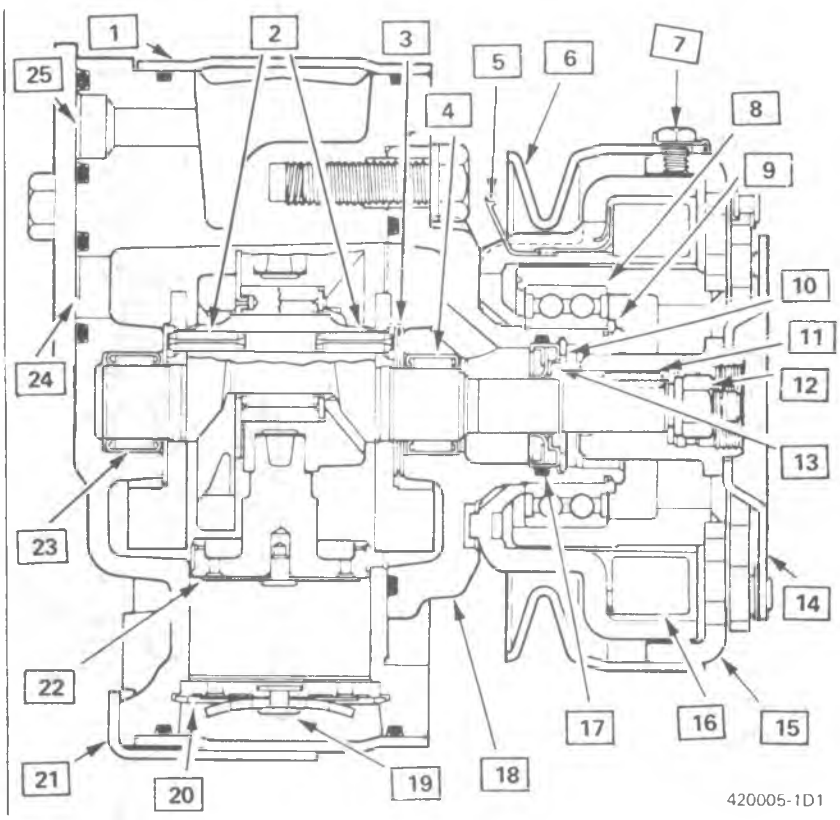

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Fig. 1D1-5 R-4 Compressor Cross Section - Late Design

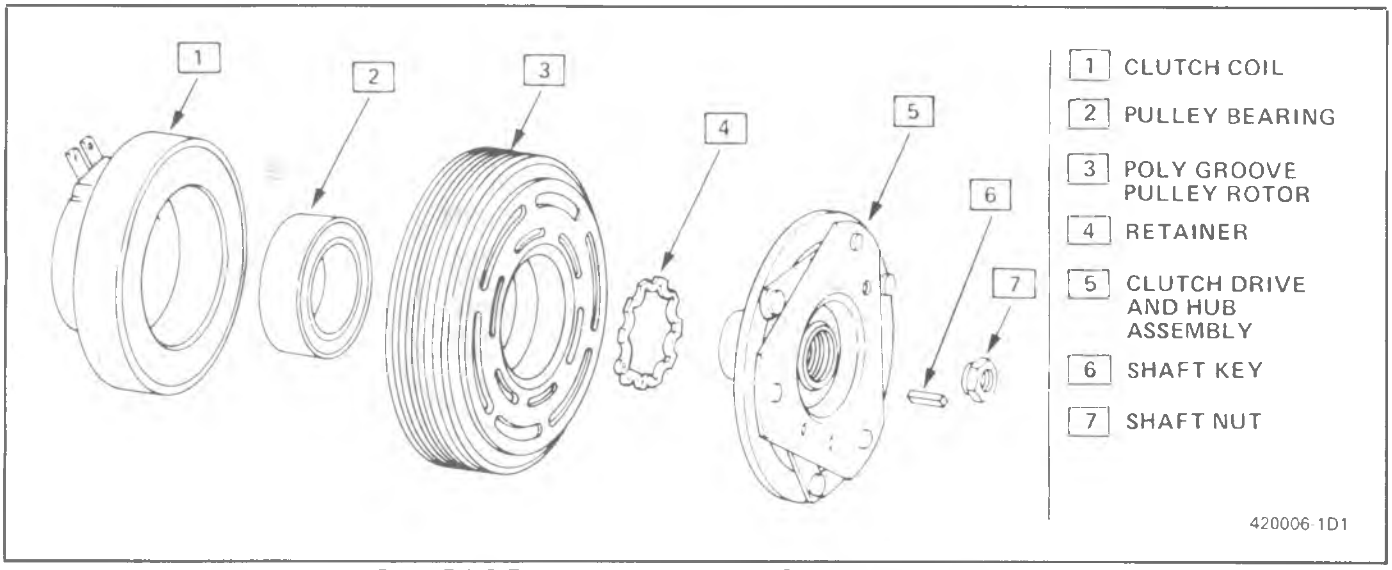


Fig. 1D1-6 Exploded View of Poly Groove Pulley Drive

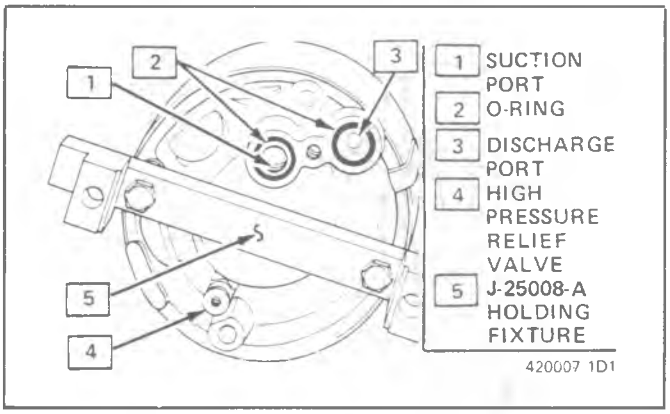


Fig. 1D1-7 Compressor In Holding Fixture

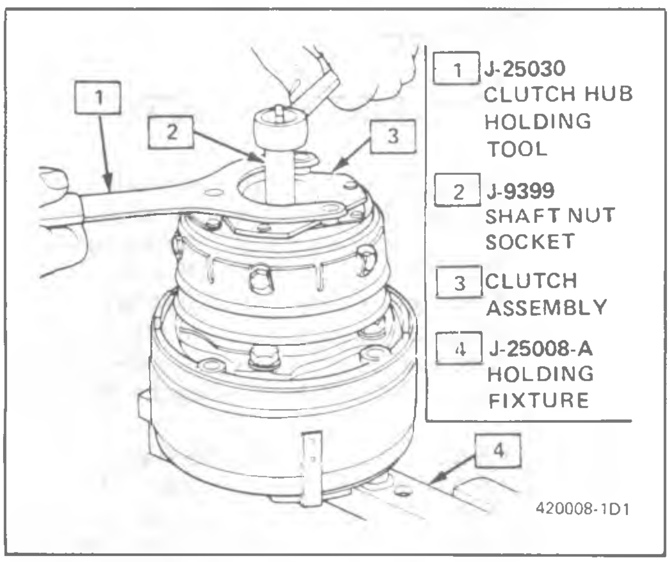


Fig. 1D1-8 Removing Shaft Nut

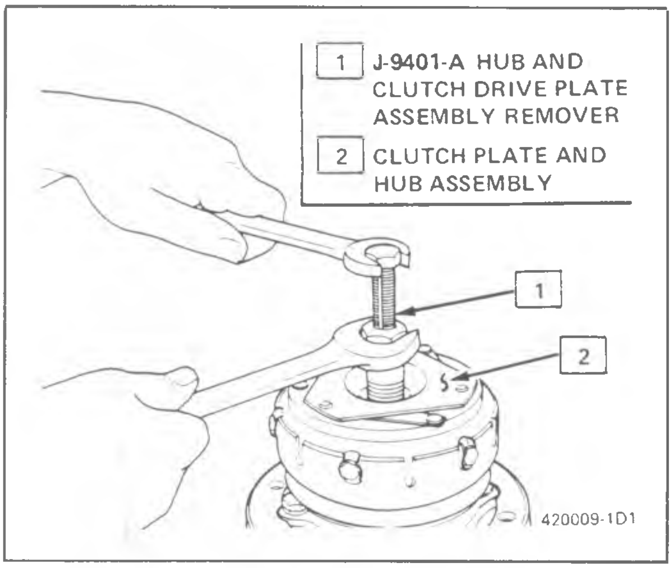


Fig. 1D1-9 Clutch Plate & Hub Asm. Removal

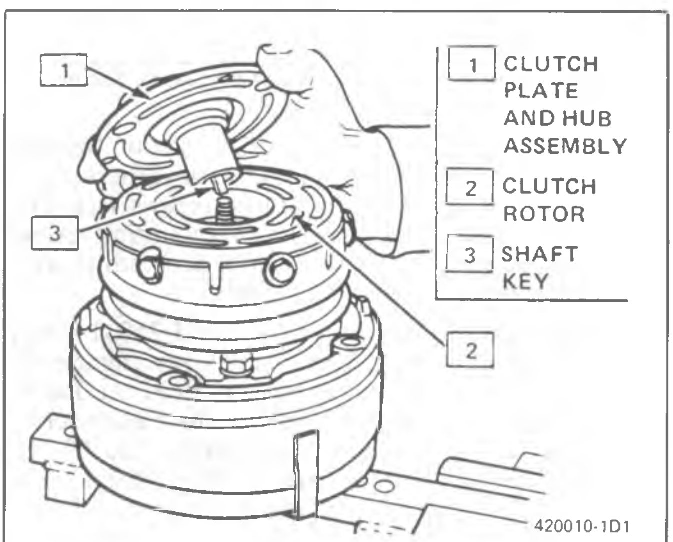


Fig. 1D1-10 Installing Shaft Key

R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING - V-GROOVE TYPE

Remove

1. Remove the Clutch Plate and Hub assembly as described in R-4 COMPRESSOR CLUTCH PLATE & HUB ASM. removal procedure.

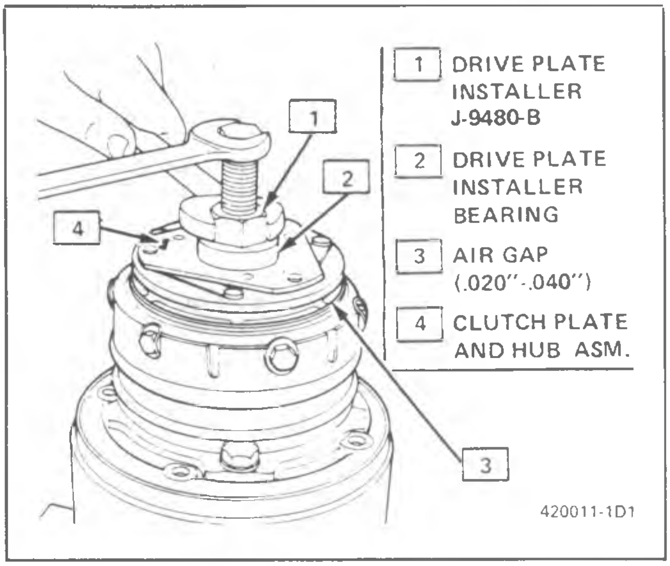


Fig. 1D1-11 Installing Clutch Plate & Hub Asm.

2. Remove Rotor and Bearing assembly retaining ring, using Snap Ring Pliers J-6083, Fig. 1D1-12. Mark the location of the clutch coil terminals.

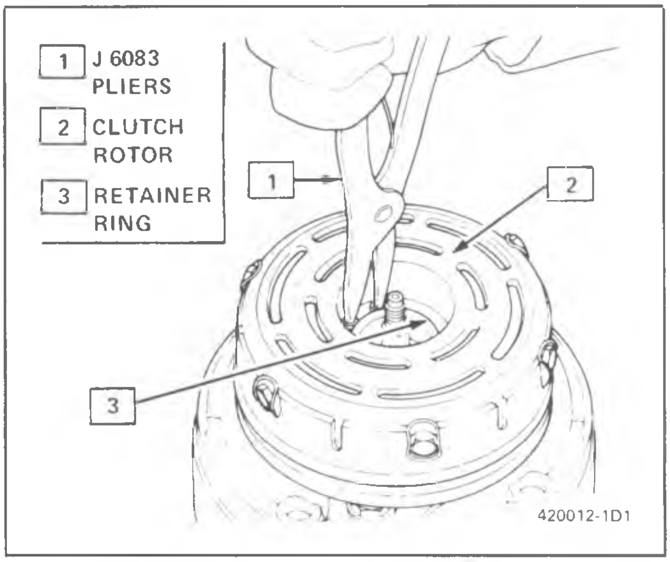


Fig. 1D1-12 Removing Rotor & Bearing Asm. Retainer Ring

If only the Clutch Rotor and/or Rotor Bearing are to be replaced, bend the lockwashers away from the pulley rim mounting screws (see Fig. 1D1-13), and remove the six (6) mounting screws and special lock washers before proceeding with Step 3. Discard the lock washers.

3. Install Rotor and Bearing Puller J-25031 down into the rotor until the Puller arms engage the recessed edge of the rotor hub. Hold the Puller and arms in place and tighten the Puller screw against the Puller Guide to remove the Clutch Rotor and Bearing assembly (Fig. 1D1-13 and 1D1-14), being careful not to drop the Puller Guide.

4. If the pulley rim mounting screws and washers were removed in Step 2, only the Clutch Rotor and Bearing assembly will be removed for replacement. The Clutch Coil and Housing assembly is pressed onto the Front Head of the

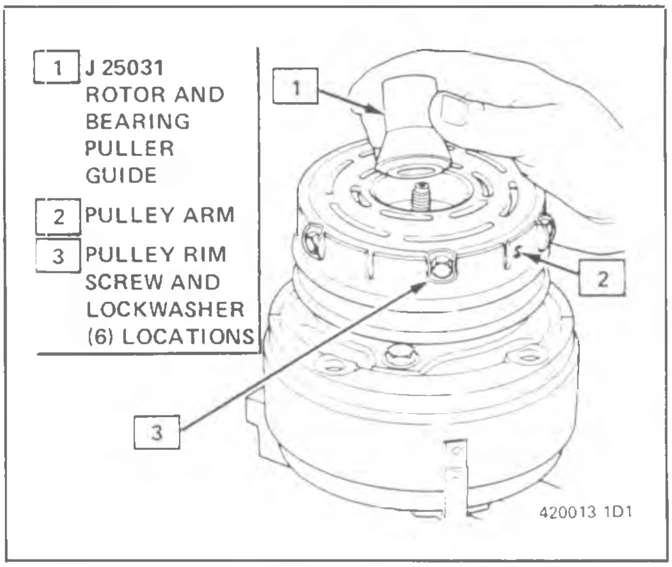


Fig. 1D1-13 Installing Rotor & Bearing Puller Guide

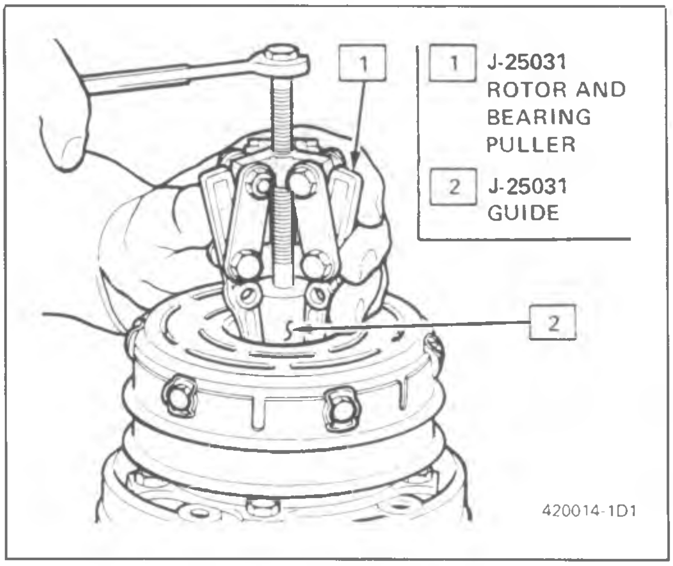


Fig. 1D1-14 Removing Clutch Rotor Asm.

compressor with a press fit and will not be removed unless the pulley rim mounting screws are left securely in place and the pulley rim pulls the Coil and Housing assembly off with the total Clutch Rotor and Pulley Rim Assembly.

5. Place the Rotor and Bearing assembly on blocks as shown in Fig. 1D1-15. Drive the bearing out of the rotor hub with Rotor Bearing Remover J-9398.

It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing. However, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore, or the bearing may be damaged (see Fig. 1D1-16).

Replace

1. Place the Rotor and Hub assembly face down on a clean, flat and firm surface.
2. Align the new bearing squarely with the hub bore and using Pulley and Bearing Installer J-9481-A with Universal Handle J-8092, drive the bearing fully into the hub (Fig. 1D1-17). The Installer

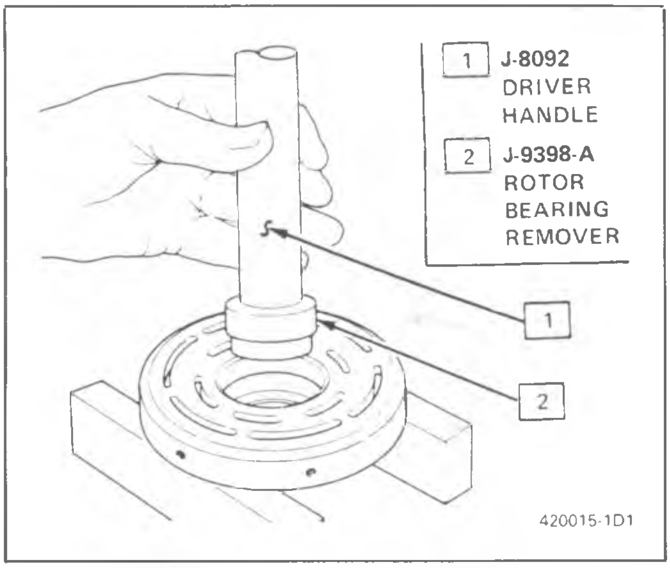


Fig. 1D1-15 Clutch Rotor Bearing Removal

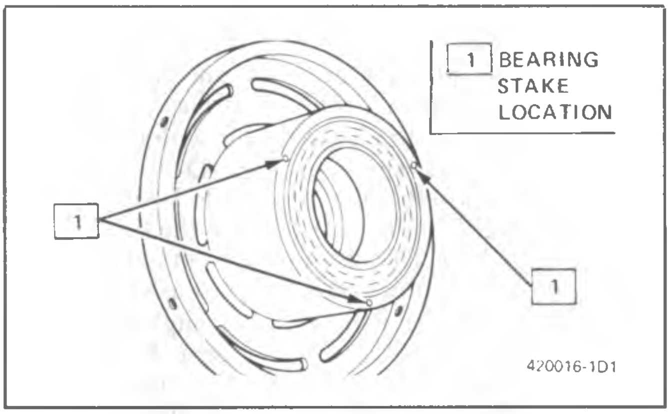


Fig. 1D1-16 Rotor & Bearing Asm.

will apply force to the outer race of the bearing if used as shown.

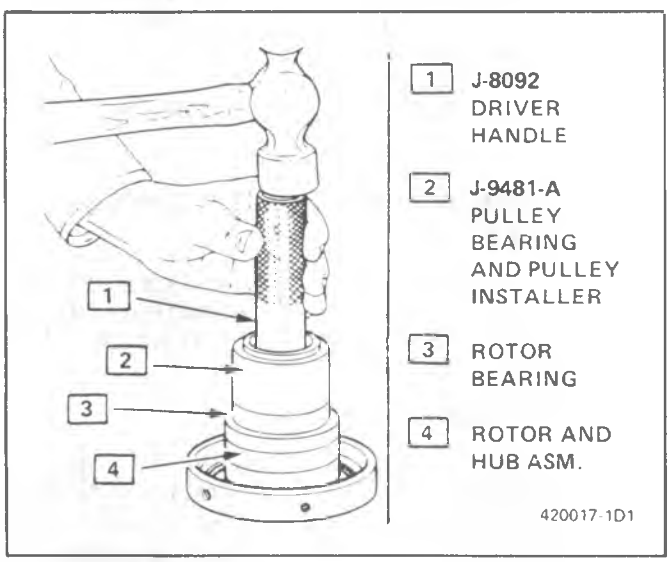


Fig. 1D1-17 Installing Clutch Rotor Bearing

3. Using a center punch with a 45° angle point, stake 1.1 - 1.4mm (.045"-.055" deep) the bearing in three places 120° apart as shown in Fig. 1D1-16, but do not stake too deeply to avoid distorting the outer race of the bearing.

4. Replace rotor and bearing assembly.

On Car

A. Position the Rotor and Bearing assembly on the front head.

B. With Rotor & Bearing Installer J-26271-A (without driver handle) in position and Rotor and Bearing assembly aligned with the Front Head as shown in (Fig. 1D1-18), drive the assembly part way onto the head.

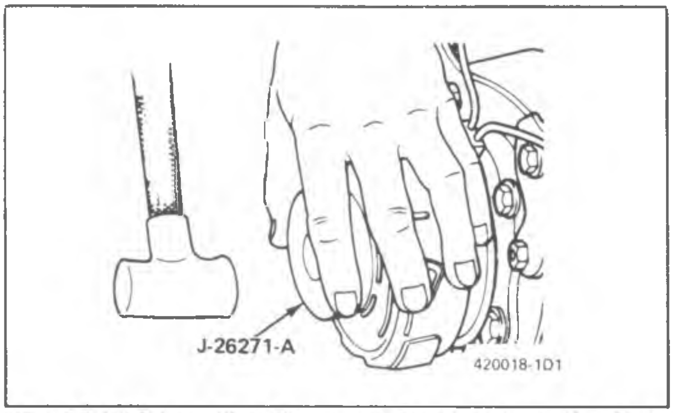


Fig. 1D1-18 Installing Rotor and Bearing Asm. (On Car)

C. Plug clutch coil connector onto Clutch Coil.

D. Position the Clutch Coil so the three (3) locating tabs will align with the holes in the head and continue to drive the Rotor and Bearing assembly onto the front head.

E. Install the retainer ring (Fig. 1D1-12).

F. Reassemble the Clutch Plate and Hub with the shaft key onto the shaft with Installer J-9480-B until .5 to 1.0mm (.020" to .040") air gap is obtained.

G. Install shaft lock nut. Torque to 14 N·m (10 lb. ft.).

On Bench

Reassemble the Rotor and Bearing assembly to the front head of the compressor using Rotor & Bearing Installer J-26271-A. With Installer assembled to the Universal Handle J-8092, as shown in Fig. 1D1-19, force will be applied to the inner race of the bearing and the face of the rotor when installing the assembly onto the front head of the compressor.

5. Install rotor and bearing assembly retainer ring, using Snap Ring Pliers J-6083 (see Fig. 1D1-12).

6. Apply sealer (Loctite RC-75, Loctite 601 or equivalent) to threads of pulley rim mounting screws. Install screws and new special lock washers but do not torque the screws.

7. Rotate the pulley rim and rotor to insure that pulley rim is rotating "in-line." If pulley rim is distorted (does not rotate in-line), adjust or replace pulley rim.

8. Tighten pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock screw heads in place by bending special lock washers (Fig. 1D1-19), similar to original crimp and lock bends on washers.

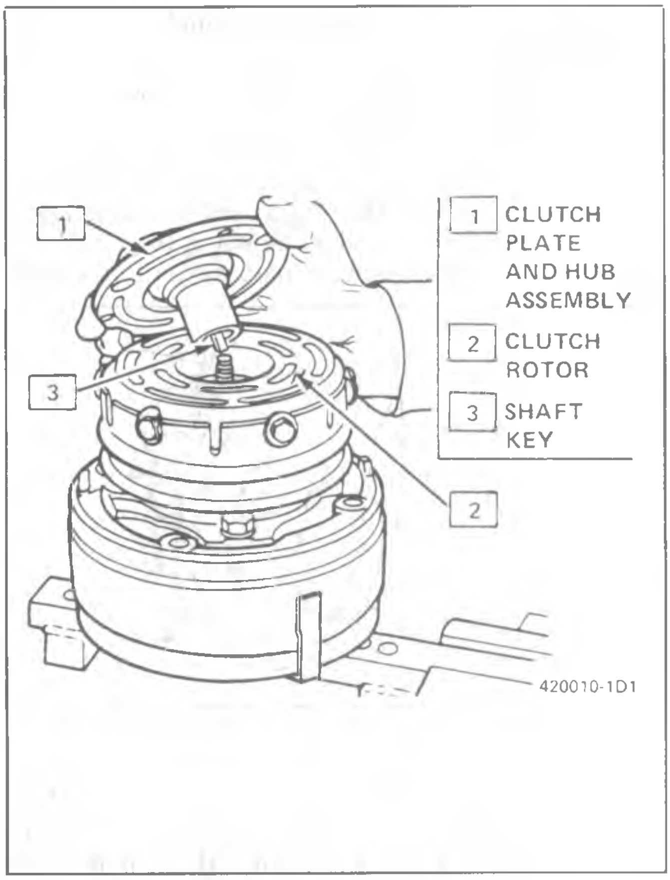


Fig. 1D1-19 Installing Rotor & Bearing Asm. V-Groove Type

9. Reinstall Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub" Replacement procedures.

R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING - POLY GROOVE TYPE

Remove

1. Remove the clutch plate and hub assembly as described previously.
2. Remove the pulley-rotor and bearing assembly retaining ring, using Snap Ring Pliers J-6083 (Fig. 1D1-12).
3. Install Rotor and Bearing Puller Guide J-25031 to the front head and install Rotor and Bearing Puller J-25031 down into the rotor until the puller arms engage the recessed edge of the rotor hub. Hold the Puller and arms in place and tighten the Puller screw against the Puller Guide to remove the clutch pulley-rotor and bearing assembly (Figs. 1D1-13 and 1D1-20), being careful not to drop the Puller Guide.
4. Place the pulley-rotor and bearing assembly on blocks similar to that shown in Fig. 1D1-15. Drive the bearing out of the rotor hub with Rotor Bearing Remove J-9398.

   It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing. However, it will be necessary to file away the old staked metal for proper clearance for the new bearing to be installed into the rotor bore, or the bearing may be damaged (see Fig. 1D1-16).

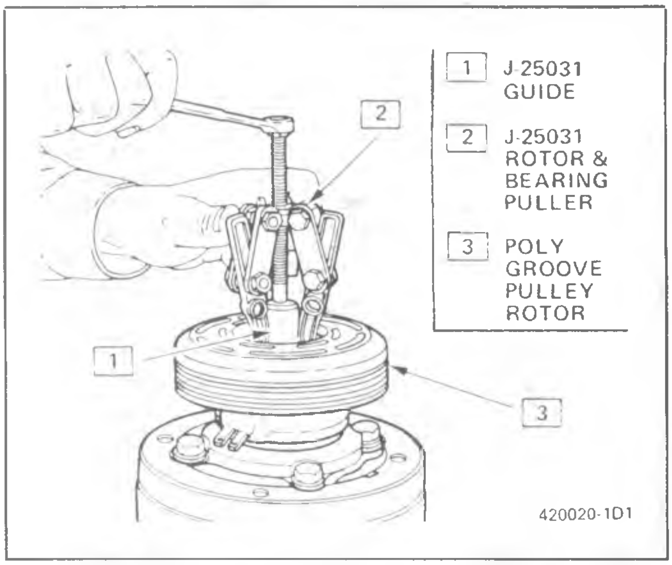


Fig. 1D1-20 Removing Clutch Rotor Asm. - Poly-Groove Drive

Replace

1. Place the pulley rotor and hub assembly face down on a clean, flat, firm surface.
2. Align the new bearing squarely with the hub bore similar to that shown in Fig. 1D1-17, and using Pulley and Bearing Installed J-9481-A with Universal Handle J-8092, drive the bearing fully into the hub. The installer will apply force to the outer race of the bearing if used as shown.
3. Using a center punch with a 45° angle point, stake 1.1 - 1.4mm (0.45" - 0.55" deep) the bearing in three places 120° apart similar to that shown in Fig. 1D1-16. **Do Not** stake too deeply to avoid distorting the outer race of the bearing.
4. Position the pulley rotor and bearing assembly on the front head. With Rotor and Bearing installer J-26271-A and Universal Drive Handle J-8092 aligned in position with the pulley rotor and bearing assembly, Fig. 1D1-21, drive the assembly onto the front head.
5. Install the retainer ring (Fig. 1D1-12).
   Bench)

R-4 COMPRESSOR CLUTCH COIL AND/OR PULLEY RIM

- If original pulley rim was equipped with an inertia ring, either bolted or welded on, or if a ring is to be added, refer to INERTIA RING INSTALLATION.

Remove - V-Groove Drive

1. Perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure but do not loosen or remove the pulley rim mounting screws until the Clutch Rotor, Coil and Pulley Rim assembly have been removed from the Front Head. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
2. Remove the pulley rim mounting screws and special lock washers. Discard the lock washers and screws.

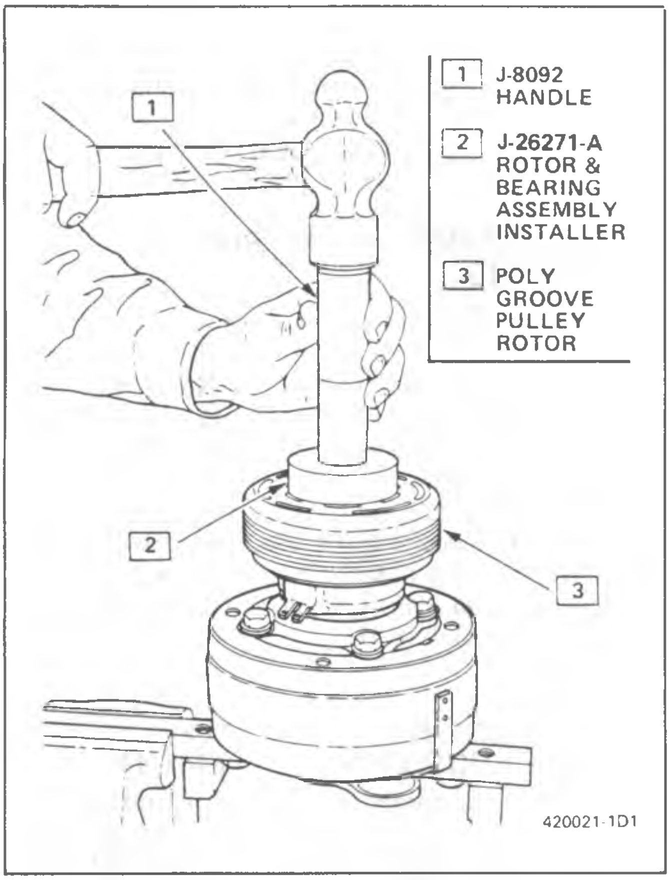


Fig. 1D1-21 Installing Rotor & Bearing Assembly, Poly-Groove Type (On

3. Slide the pulley rim off the Rotor and Hub assembly. The Pulley Rim and the Clutch Coil (Fig. 1D1-22) are replaceable at this point.

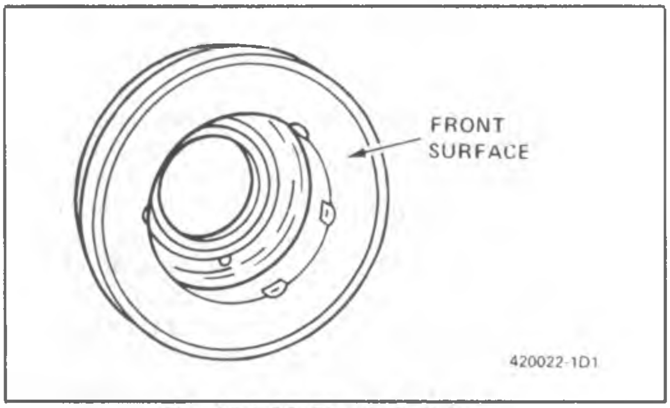


Fig. 1D1-22 Clutch Coil Asm.

Remove - Poly-Groove Drive

1. Remove the clutch plate and hub assembly as described previously.

2. Remove the pulley rotor and bearing assembly as described previously. Mark the location of the clutch coil terminals on the compressor.

3. Install Rotor and Bearing Puller Guide J-25031 (Fig. 1D1-13) to the front head and install Puller J-8433 with Poly-V-Belt Puller Leg Set J-24092 and remove the clutch coil from the front head (Fig. 1D1-23). Clutch coil may also be removed by using rotor and bearing puller guide J-25031 (Fig. 1D1-13) with puller tool J-25287 (Fig. 1D1-24).

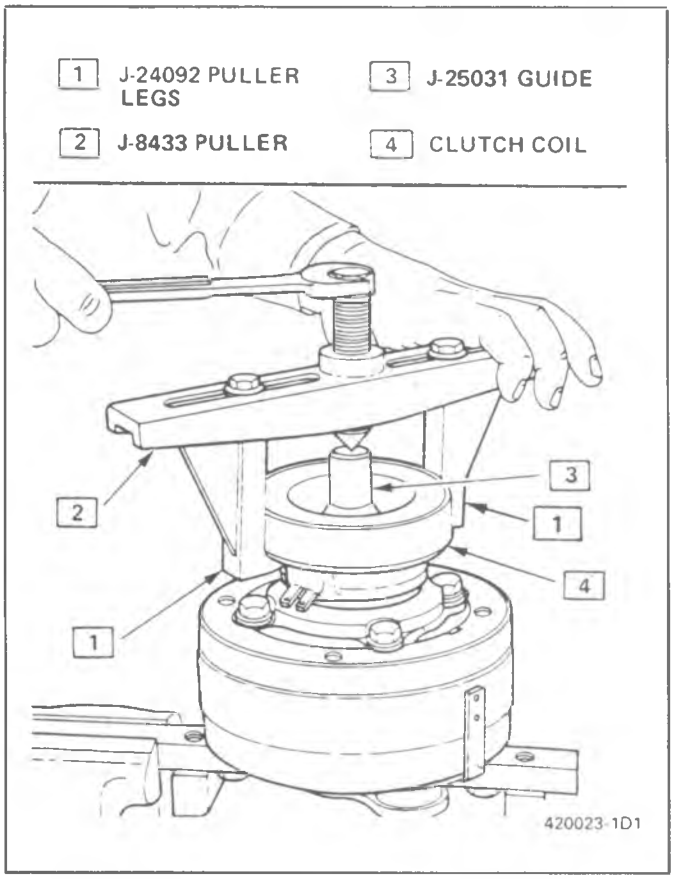


Fig. 1D1-23 Removing Poly-Groove Clutch Coil

Replace - V-Groove Drive

1. Assemble the Clutch Coil, Pulley Rim and the Clutch Rotor and Bearing assembly as shown in Fig. 1D1-25. Use new screws and special lock washers and apply sealer (Loctite RC-75, Loctite 601, or equivalent) to screw threads but do not lock the screws in place.
2. Place the assembly on the neck of the Front Head and seat into place using Rotor & Bearing Installer J-26271-A (Fig. 1D1-19).

   Before fully seating the assembly on the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.
3. Install the rotor and bearing assembly retaining ring and reassemble the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub Asm." Replacement procedure. Check to see that the clutch plate to clutch rotor air gap is .5 to 1.0mm (.020 to .040 inches).

   Rotate the Pulley Rim and Rotor to be sure the Pulley Rim is rotating "in-line" and adjust or replace as required.
4. Tighten the pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock the screw heads in place by bending lock washers

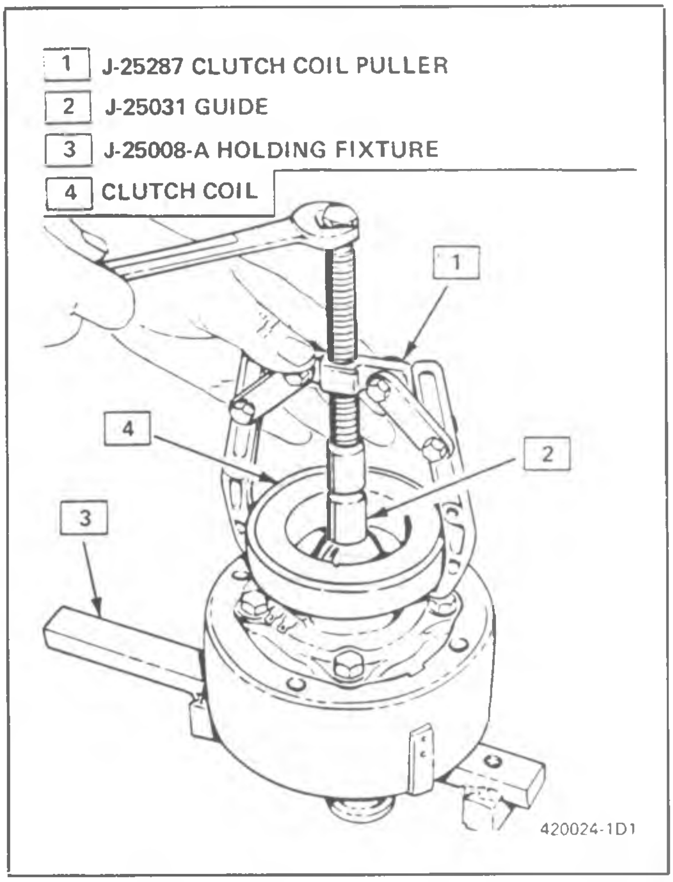


Fig. 1D1-24 Removing Poly-Groove Clutch Coil (Optional Method)

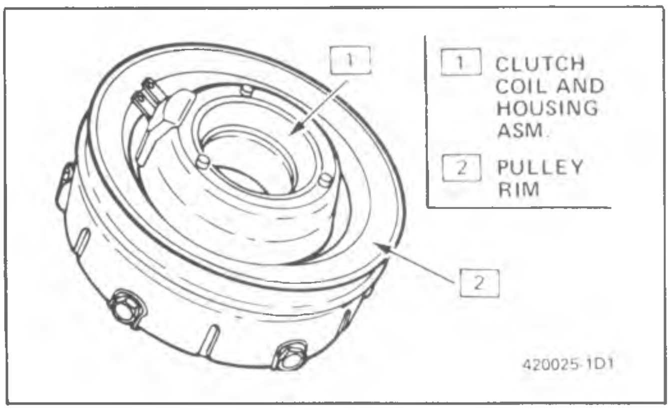


Fig. 1D1-25 Assembling Clutch Coil, Pulley Rim, Rotor & Bearing

(Fig. 1D1-19), similar to original crimp and lock bends on washers.

Replace - Poly-Groove Drive

1. Place the clutch coil assembly on the neck of the front head with clutch coil terminals in line with mark scribed in Step 2 of the removal procedure.
2. Place the pulley rotor and bearing assembly on the neck of the front head and seat the clutch coil and pulley rotor in place using Rotor and Bearing Installer J-26271 (Fig. 1D1-19).

   Before fully seating the assembly on the front head, be sure the clutch coil terminals are in proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil housing align with the locator holes in the front head.
3. Install the pulley-rotor and bearing assembly retaining ring and reassemble the clutch plate and hub assembly as described in "Clutch Plate and Hub Assembly - Replace."
4. Check to see that the clutch plate to clutch rotor air gap is 0.5 - 1.0mm (0.020" - 0.040").

R-4 COMPRESSOR INERTIA RING INSTALLATION

R-4 compressors will be built with one of three conditions:

1. No Inertia Ring Installed - No installation is required unless directed by a diagnostic procedure. If a ring is to be added, use Procedure I.
2. Bolted-On Inertia Ring Is Installed - Replace using Procedure I. All new screws, washers, and Loctite 601 (or equivalent) must be used.
3. Welded-On Inertia Ring Is Installed - Replace using Procedure II.

Procedure I

BOLTED-ON INERTIA RING: INSTALLATION OR REPLACEMENT

1. Loosen the compressor drive belt and rotate the compressor pulley as required to locate one (1) screw and lock washer mounted through a "mounting hole" of the Pulley Rim, Figure 1D1-26, rather than a "mounting notch" screw location. Do not remove the drive belt unless necessary. For identification purposes, washers locked over the edge of the Pulley Rim at the "mounting hole" locations will not usually dimple down in the center like the indentation of the lockover at a "mounting notch" screw location.
2. Remove the three (3) mounting screws and lockwashers at the pulley rim "mounting hole" locations. (The pulley rim "mounting holes" are located 120° apart radially around the rim or every other mounting screw location.) Do not remove the screws in the "mounting notches."
3. Temporarily make a trial fit of the Inertia Ring to the Pulley Rim. If any portion of the sheer edge of the Pulley Rim prevents the installation of the Inertia Ring, the raised edge may be filed off to remove the excess metal and facilitate installation. Do not use undue force or cock the ring in assembling the Inertia Ring in place over the Pulley Rim that could cause ring distortion or stress.
4. Assemble the Inertia Ring onto the Pulley Rim, being careful to align the inertia ring mounting holes with the mounting holes in the pulley rim. If the Inertia Ring must be rotated on the Pulley Rim for centering the mounting holes and cannot be shifted by hand, use a drift punch or blunt tool and a hammer to carefully tap the Inertia Ring at a clearance notch, Figure 1D1-28, to move the ring into position.

   Design
5. Install Lockwasher:

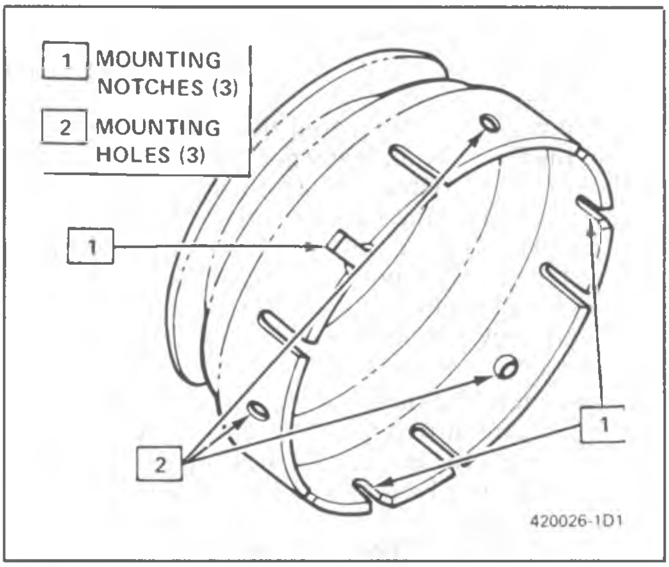


Fig. 1D1-26 Pulley Rim Mounting Location Detail

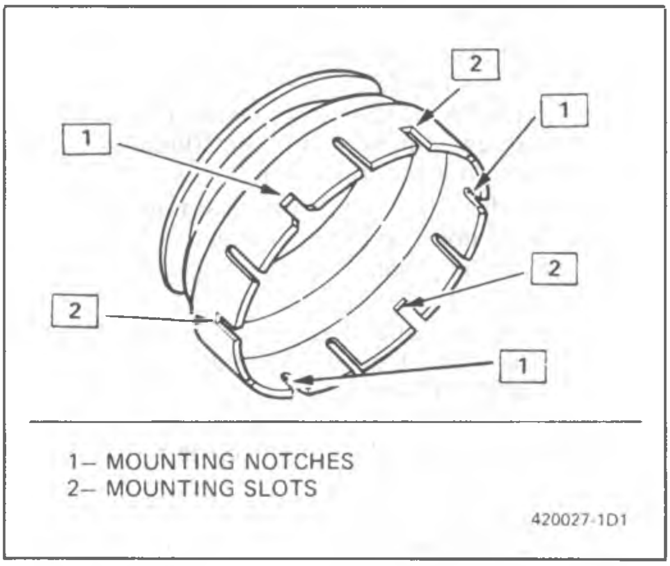


Fig. 1D1-27 Pulley Rim Mounting Location Detail - Optional Desgin

- With separate washer design: Install a special lockwasher onto each 6.4mm-28 x 13.5mm (1/4"-28 X 17/32") mounting screw.
- With integral bolt/washer: Proceed to Step 6.

6. Apply Loctite 601 (or equivalent sealer) to the screw threads of each mounting screw and threads of the mounting holes in the Clutch Rotor. Wet the threads thoroughly to ensure complete thread coverage.
7. Install the screws into the mounting holes and tighten finger-tight. Torque each screw to 11 N·m (100 in. lbs.) torque.
8. Install Screws:

- With separate washer design: Lock the three (3) screws in place by flattening the special washer against two sides of the hex head screw using vise grip pliers and one portion of the lockwasher bent down over the edge of the inertia ring slot, Fig. 1D1-28. Do not move the screw heads from the torqued position. Locking of the screws must be similar to the production forming of the lockwasher in order to effectively retain the screw.

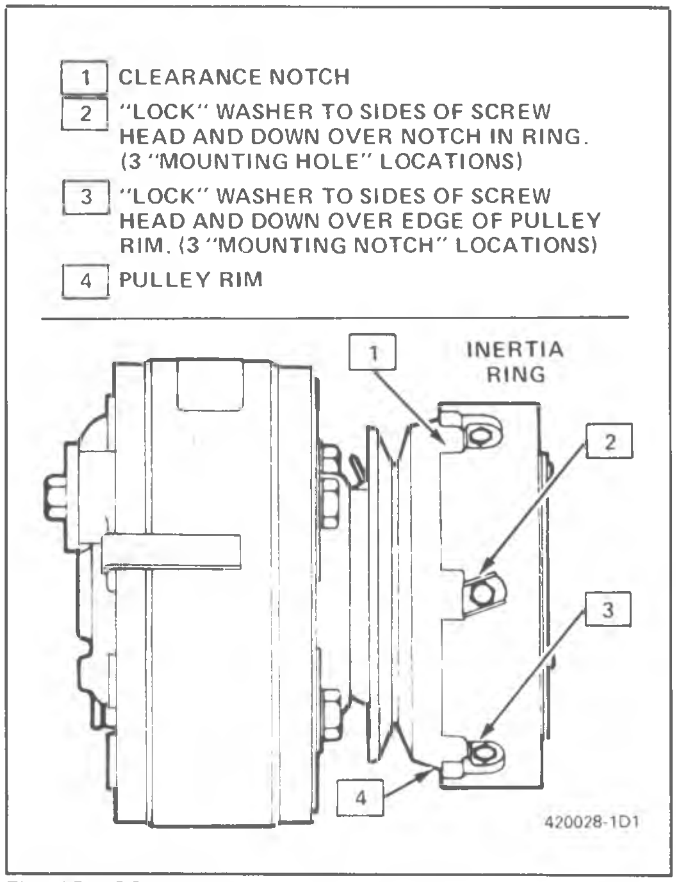


Fig. 1D1-28 Pulley Rim and Inertia Ring Mounting Detail

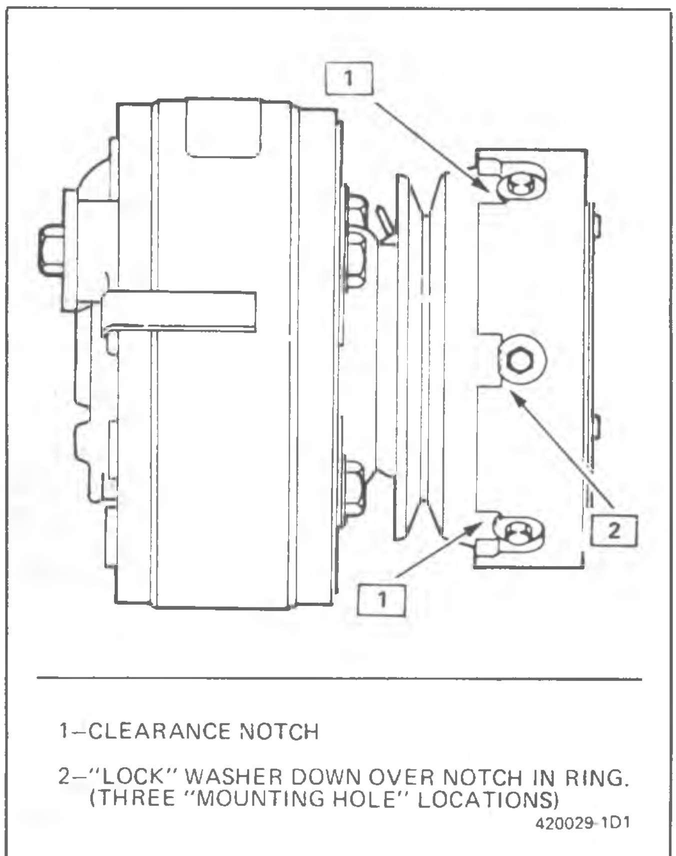


Fig. 1D1-29 Pulley Rim and Inertia Ring Mounting Detail - Optional

- With optional inertia ring design and integral bolt/washer: Lock the three (3) screws in place using vice grip pliers and bending a portion of the lockwasher down over the edge of the inertia ring slot (Fig. 1D1-29).

9. Retighten the compressor drive belt to proper belt tension.
10. Check compressor and system operation.
    - If "mounting notch" screws must be replaced for any reason, the screws should be torqued into place 11 N·m (100 in. lbs.) torque using Loctite 601 (or equivalent sealer) on the threads and locked into place similar to the original locking method.

Procedure II

INERTIA RING AND PULLEY RIM WELDED ASSEMBLY; REPLACEMENT (NEW PULLEY RIM AND INERTIA RING KIT REQUIRED)

1. Loosen the compressor mounting bracket and remove the compressor drive belt.
2. Remove the Clutch Hub and Drive Plate assembly as described in R-4 COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY removal procedure.
3. To remove as an assembly, perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedures, but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil, Pulley Rim and Inertia Ring as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
4. Remove all six (6) pulley rim mounting screws and lockwashers from the assembly and discard.
5. Separate the Pulley Rim and Inertia Ring assembly away from the Rotor and Bearing assembly.
6. Inspect the drive surfaces of the Rotor and Drive Plate to be sure they are still in good condition. Replace as required.
7. Assemble a new Pulley Rim over the Clutch Coil and mount the Pulley Rim to the Rotor and Bearing assembly, using the short notch mounting locations, Figure 1D1-26. The mounting notches are located 120° apart radially around the Pulley Rim.
8. Assemble three (3) new lockwashers on the three (3) new 6.4mm-28 x 13.5mm (1/4-28 X 5/16") mounting screws and apply Loctite 601 (or equivalent sealer) to the entire thread surface of the mounting screws and the mounting hole threads in the Rotor. Assemble the three (3) screws into the short notch mounting hole locations and tighten finger tight.
9. Align the Pulley Rim so that the bottom of the rim notches touch the mounting screws at all three (3) mounting locations. Also center the drilled holes in the Pulley Rim with the remaining mounting holes in the Rotor. When the rim is positioned properly, tighten the three (3) mounting screws to 11 N·m (100 in. lbs.) torque.
10. Temporarily make a trial fit of the Inertia Ring to the Pulley Rim. If any portion of the sheer edge of the Pulley Rim prevents the installation of the Inertia Ring, the raised edge may be filed off to remove the excess metal and facilitate installation. Do not use undue force or cock the ring in assembling the Inertia Ring in place over the Pulley Rim that could cause ring distortion or stress.
11. Assemble the Inertia Ring onto the Pulley Rim being careful to align the Inertia Ring mounting holes with the mounting holes in the Pulley Rim. If the Inertia Ring cannot be moved by hand and must be rotated for centering the mounting holes, use a drift punch or blunt tool and a hammer to carefully tap at one of the large clearance notches in the inertia ring to rotate the ring into position, Fig. 1D1-28.
12. Install the special lock washers onto the 13mm-28 x 13.5mm (1/4-28 X 17/32") mounting screws and apply Loctite 601 (or equivalent sealer) to the total screw thread and the threads of the mounting holes in the rotor.
13. Install the screw and washers into the rotor mounting holes and tighten finger tight. When all screws are in place, torque each screw to 11 N·m (100 in. lbs.) torque.
14. Using Rotor and Bearing assembly Installer J-26271-A and Universal Handle J-8092, install the Pulley, Clutch Coil, Rotor and Bearing assembly onto the Front Head of the compressor. Be sure to locate the clutch coil terminals in the proper position.
15. Spin the Rotor and Pulley assembly to assure that the pulley runs "in line." If not, the mounting screws will have to be loosened and the parts aligned.
16. When all screws are torqued in place, lock all mounting screws in position by flattening the special washer against two opposite sides of the hex head screw, using vise-grip pliers. Form a portion of the lock washer down over the pulley rim or over the Inertia Ring slot to secure the screws in place. Do not move the screw heads from the torqued position. See Fig. 1D1-28.
17. Install the Clutch Hub and Drive Plate as described in R-4 COMPRESSOR CLUTCH PLATE AND HUB ASM. Replacement procedures.
18. Install the compressor drive belt and adjust for proper tension.
19. Operate the air conditioning system to check for proper operation.

MAJOR REPAIR PROCEDURES, R-4 COMPRESSOR

Service repair procedures to the Compressor Shaft Seal, Pressure Relief Valve or disassembly of the Internal Compressor Cylinder and Shaft Assembly are considered

"MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE DISCHARGED, EVACUATED AND RECHARGED to complete service and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

When replacing the shaft seal assembly (see Fig. 1D1-35) or pressure relief valve (see Fig. 1D1-3), even if the compressor remains on the vehicle during the operation, it will be necessary to purge the system of refrigerant (see Section 1B1). Other than clutch repair procedures, the same holds true for any disassembly of the compressor.

If the compressor shell, front head or cylinder and shaft assembly are to be serviced or replaced, the oil in the compressor must be drained, measured and replaced (see Section 1B1) to determine addition of proper oil quantity to new assembly.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools.

> **NOTICE:** Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

All parts required for servicing the internal compressor are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the internal assembly just as they are removed from the service package. *Seals and protective packaging should be left intact until just prior to installation* .

R-4 COMPRESSOR SHAFT SEAL

Shaft Seal Design

Shaft seal design may be one or two piece.

When replacing shaft seals, it is important that a two piece (face) seal be serviced only with a two piece seal.

When a one piece (lip) seal is replaced either one or two piece seals may be used.

Damage to the one piece seal may occur and result in a seal leak, if this procedure is not followed.

Seal Leak Detection

A shaft seal should not be changed because of an oil-line on the hood insulator. The Seal is designed to seep some oil for lubrication purposes. Only change a Shaft Seal when a leak is detected by evidence of oil sprayed in large amounts and then only after actual refrigerant leakage is found by using an approved leak Detector such as J-29547 or equivalent.

Should an R-4 compressor shaft seal ever have to be replaced, the accumulator in this R-4 system must also be removed from the vehicle. The oil in the accumulator then must be drained, measured and replaced according to the directions in Section 1B1 to determine oil loss.

Remove (On Car)

1. "Discharge the Refrigerant System" according to the direction in Section 1B1.
2. Loosen and reposition compressor in mounting brackets, if necessary.
3. Remove Clutch Plate and Hub assembly from compressor as described in Minor Repairs.
4. Remove the shaft seal seat retainer ring, using Snap Ring Pliers J-5403-A.
5. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. Any dirt or foreign material getting into compressor may cause damage.
6. Remove Two Piece Seal Seat or Lip Seal:
   - One Piece Seal: Fully engage the knurled tangs of Seal Remover-Installer J23128-A into the recessed portion of the Seal by turning the handle clockwise. Remove the Seal from the compressor with a rotary-pulling motion. Discard the Seal. The handle must be hand-tightened securely. Do not use a wrench or prier.
   - Two Piece Seal: Place Seal Protector J-22974-A or J-34614 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J-23128-A into the recessed portion of the seal seat by turning the handle clockwise. Remove the Seal Seat from the compressor with a rotary-pulling motion (Fig. 1D1-31). Discard the Seat. The handle must be hand-tightened securely. Do not use a wrench or plier.
7. Remove Two Piece Seal:
   - One Piece Seal: Proceed to Step 8.
   - Two Piece Seal: With Seal Protector J-22974-A or J-34614 still over the end of the shaft, set Seal Remover-Installer J-9392-01 down onto shaft end, turning clockwise, while pressing down to engage Remover tangs with the tabs on the Seal assembly. Then lift the Shaft Seal assembly out (see Fig. 1D1-33). Discard the Seal.
8. Remove and discard the seal seat O-ring from the compressor, neck using O-Ring Remover J-9553-01 (Fig. 1D1-31).
9. Recheck the shaft and inside of the compressor neck and "O" ring groove for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Inspection

Seals should not be reused. Always use a new specification service seal kit on rebuild (see Fig. 1D1-35). Be extremely careful that the face of the two piece Seal to be installed is not scratched or damaged in any way. Similar care should be taken to prevent damage to the lip of the one piece seal. Make sure that the Seal Seat and Seal Lip are free of lint and dirt that could damage the seal surface or prevent sealing.

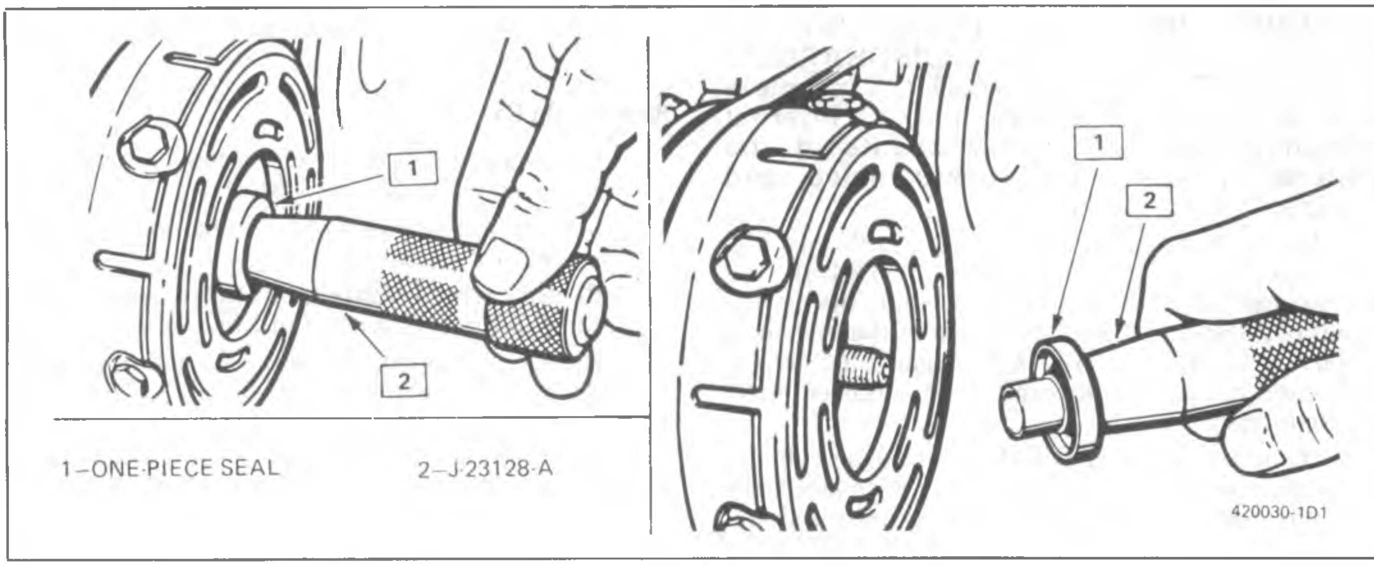


Fig. 1D1-30 Removing and Installing Seal(One Piece)

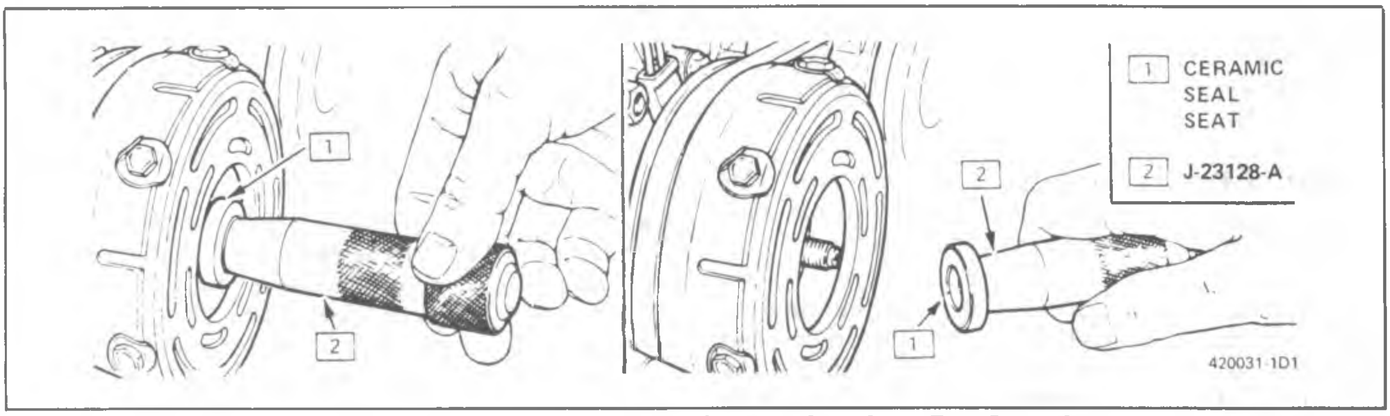


Fig. 1D1-31 Removing and Installing Ceramic Seal Seat (Two Piece Seal)

Replace (On Car)

1. Dip the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J-21508-A (Fig. 1D1-33).
2. Insert the O-Ring Installer J-21508-A completely down into the compressor neck until the Installer "bottoms." Lower the moveable slide of the O-Ring Installer to release the O-Ring into the seal seat O-ring lower groove. (The compressor neck top groove is for the shaft seal retainer ring.) Rotate the Installer to seat the O-ring and remove the Installer.
3. Prepare Seal:

- One Piece Seal: Assemble seal to Seal Installer J-23128-A, by turning handle clockwise, and then push Seal Protector J-34614, into seal lip.

NOTICE: HANDLING AND CARE OF SEAL PROTECTOR IS IMPORTANT. IF SEAL PROTECTOR IS NICKED OR THE BOTTOM FLARED, THE NEW SEAL MAY BE DAMAGED DURING INSTALLATION.

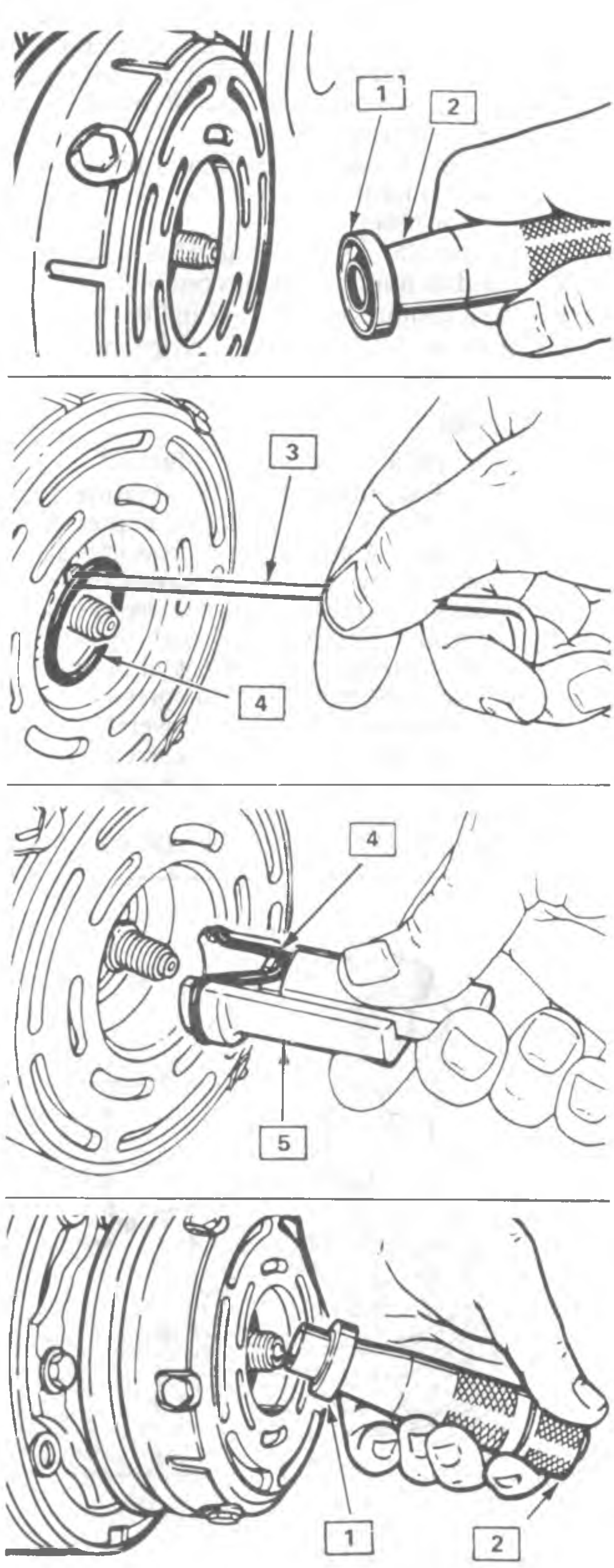
- Two Piece Seal: Dip the O-Ring and seal face of the new Seal assembly into clean 525 viscosity refrigerant oil. Carefully mount the Seal assembly to Seal Installer J-9392-01 by engaging the tabs of the seal with the tangs of the Installer (Fig. 1D1-28).

4. Install Seal:

- One Piece Seal: Place seal protector J-34614 over end of compressor shaft and slide new seal onto the shaft until it stops. Disengage installer from seal.
- Two Piece Seal: Place Seal Protector J-22974-A or J-34614 over end of compressor shaft and slide the new Seal assembly onto the shaft. Twist the Installer J-9392-01 clockwise, while pushing the Seal assembly down the shaft until the Seal assembly engages the flats on the shaft and is seated in place. Disengage the Installer by pressing downward and twisting counterclockwise.

5. Install Two Piece Seal Seat:

- One Piece Seal: Proceed to Step 6
- Two Piece Seal: Attach the ceramic Seal Seat to the Seal Seat Remover and Installer J-23128 and dip the ceramic Seat in clean 525 viscosity refrigerant oil to coat the seal face and outer surface. Install the Seat over the compressor shaft and J-22974-A or J-34614 Seal Protector and push the Seat into place with a rotary motion (Fig. 1D1-31). Take care not to dislodge the seat O-ring. Be sure Seal Seat makes a good seal with

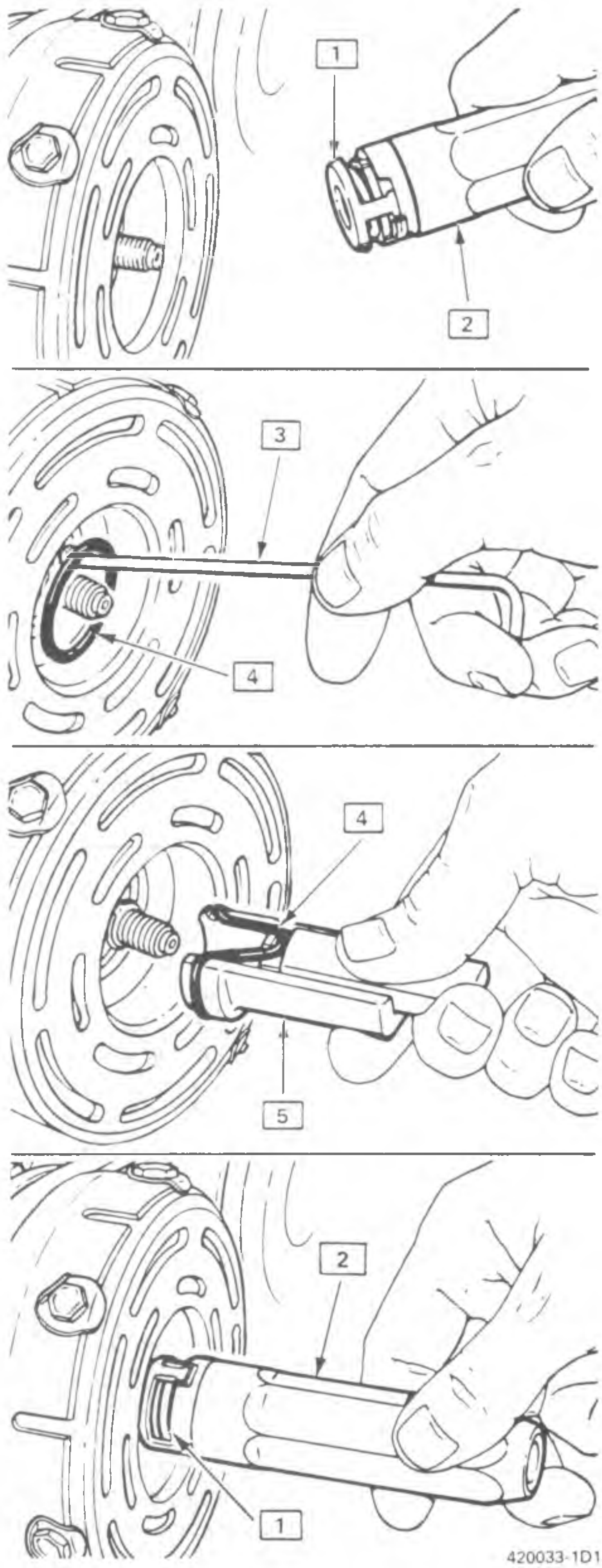


1—SEAL
2—J-23185-A
3—J-9553-01
4—O-RING
5—J-21508

420032-1D1

Fig. 1D1-32 Removing and Installing Seal and O-Ring (One Piece Seal)

1 SEAL
2 J-9392-01
3 J-9553-01
4 "O" RING
5 J-21508
6 J 9392



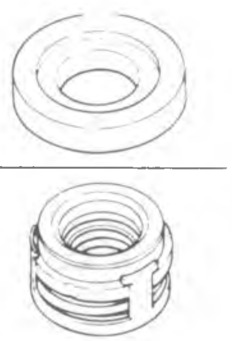
420033-1D1

Fig. 1D1-33 Removing and Installing Seal and O-Ring (Two Piece Seal)

1–STEEL SHELL
2–LIP SEAL

420034-1D1

Fig. 1D1-34 One Piece Shaft Seal



SPECIFICATION PARTS	
SEAL	CARTON MATERIAL LARGE CHAMFER ON INSIDE DIAMETER
SEAT	CERAMIC MATERIAL WITH POLISHED FACE
O RINGS	NEOPRENE, THUS CAPABLE OF GIVING HEAT RESISTANCE AND LIFE EXPECTANCY

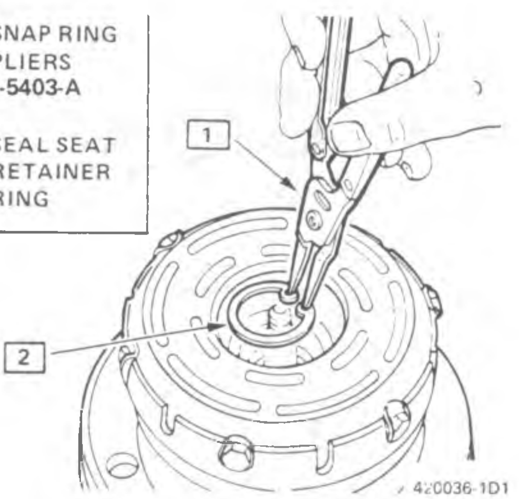
420035-1D1

Fig. 1D1-35 Two Piece Compressor Shaft Seal and O-Rings

O-ring. Remove Installer J-23128 and Seal Protector J-22974-A or J-34614.

1 SNAP RING PLIERS J-5403-A

2 SEAL SEAT RETAINER RING



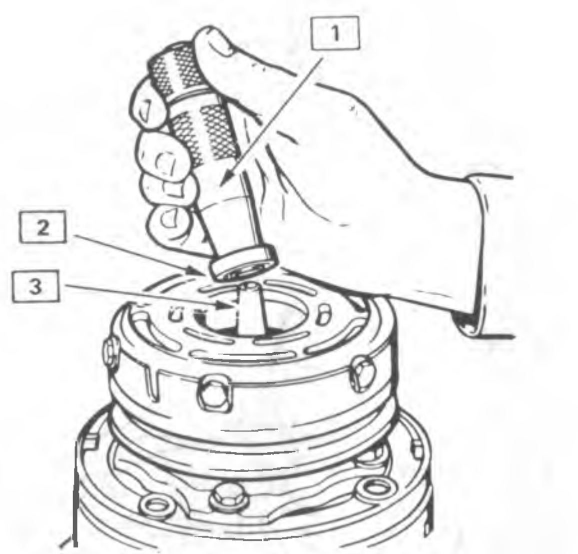
420036-1D1

Fig. 1D1-36 Removing and Installing Shaft Seal Seat Retaining Ring

6. Install the new seal seat retainer ring with its flat side against the Seal Seat, using Snap-Ring Pliers J-5403. See Fig. 1D1-36. Use the sleeve from Seal Seat Remover-Installer J-9393-A to press in on the seal seat retainer ring so that it snaps into its groove.
7. For Leak Test, pressurize suction side (low-pressure side) of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the Seal and correct any leak found. Remove, discard and later replace the shaft nut.
8. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.
9. Install the Clutch Plate and Hub assembly as described in minor repair procedures.
10. Reinstall compressor belt and tighten bracketry.
11. Evacuate and Charge the Refrigerant System according to directions in Section 1B1.

Replace (Off Car)

1. Follow applicable on-car procedures.
2. To Leak Test, install leak Test Fixture J-9625 (Fig. 1D1-41) on rear head of compressor and connect gage charging lines, or pressurize suction side (low pressure side) of compressor on car with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and using a wrench, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal and correct any leak found. Remove, discard and later replace with a new shaft nut.
3. See Figs. 1D1-38, 1D1-39 and 1D1-40.



1–J-23128-A

2–ONE-PIECE SEAL

3–J-34614 - SHAFT SEAL PROTECTOR

420037-1D1

Fig. 1D1-37 Removing & Installing One Piece Seal (Off Car)

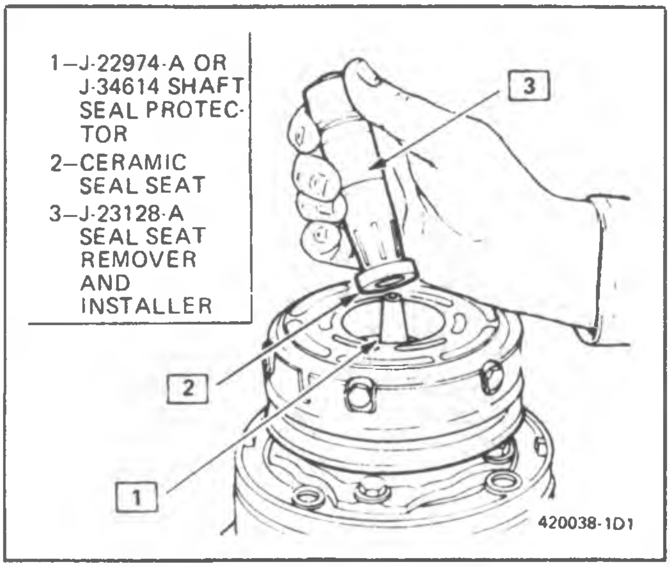


Fig. 1D1-38 Removing & Installing Two Piece Seal Seat (Off Car)

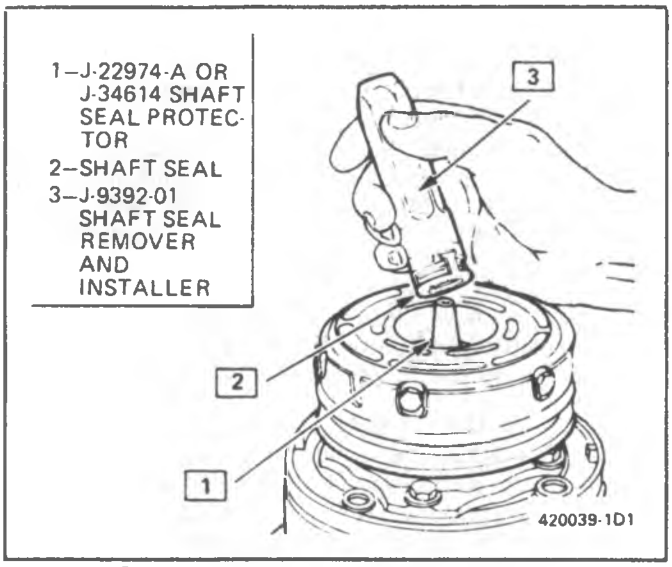


Fig. 1D1-39 Removing & Installing Two Piece Seal (Off Car)

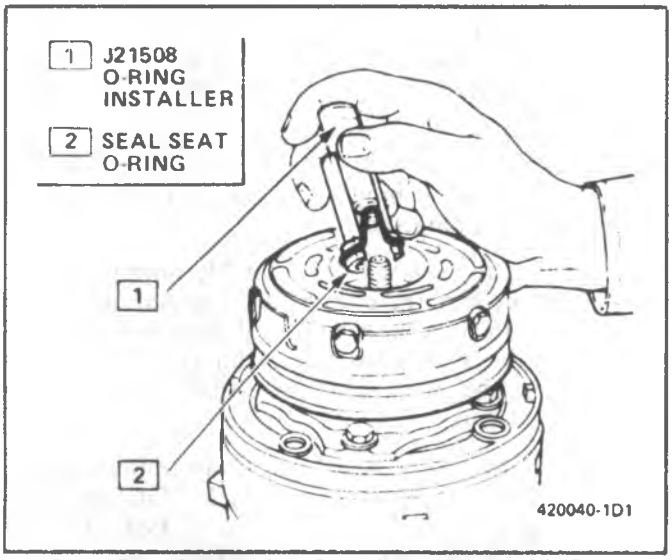


Fig. 1D1-40 Installing Seal Seat O-Ring (Off Car)

R-4 COMPRESSOR PRESSURE RELIEF VALVE

The Pressure Relief Valve, located in the compressor rear head casting (Fig. 1D1-3), should only be replaced after purging the system of refrigerant. A new valve and O-ring coated with 525 viscosity refrigerant oil should be installed.

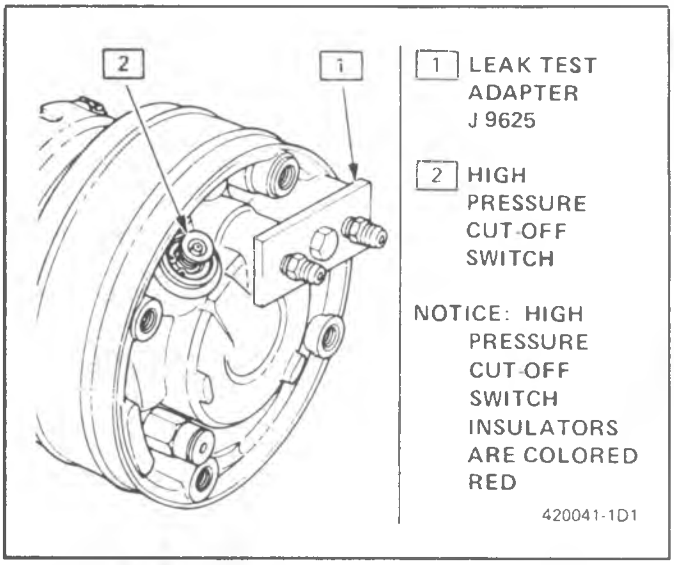


Fig. 1D1-41 Compressor Leak Testing Fixture

HI-SIDE HIGH PRESSURE CUT-OFF SWITCH (IF USED)

Remove and Replace

1. Discharge the refrigerant system according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS in the Air Conditioning Section 1B1.
2. Disconnect the electrical connector from the Hi Pressure cut-off switch in the rear head of the compressor (Fig. 1D1-42).
3. Remove the high pressure cut-off switch retaining ring (Fig. 1D1-42) using J-5403-A internal snap ring pliers.
4. Remove high pressure cut-off switch from compressor by pulling on terminal housing.
5. Remove old O-ring seal from switch cavity using J-9553 O-ring removal tool or equivalent.

   If high pressure cut-off switch will be reinstalled in compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used. A new switch kit has the O-ring and retainer ring included.
6. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary. Install new O-ring coated with clean 525 viscosity refrigerant oil into groove in switch cavity.
7. Lubricate the high pressure cut-off switch housing with clean 525 viscosity refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
8. Using J-5403-A snap ring pliers, install switch retaining ring with high point of curved sides adjacent to the switch housing. Be sure retaining

ring is properly seated in the switch cavity retainer ring groove.

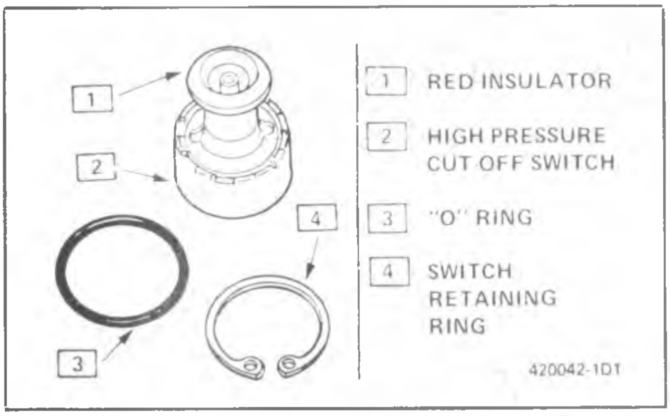


Fig. 1D1-42 High Pressure Cut-Off Switch and Retainer

R-4 COMPRESSOR FRONT HEAD AND/OR O-RING

Remove

1. Discharge the **Refrigerant System according** to the directions in Section 1B1.
2. Perform steps 1 **through** 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure, but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
3. Remove and discard the Shaft Seal parts as described in R-4 COMPRESSOR SHAFT SEAL removal procedure.
4. Remove the four front head mounting screws (Fig. 1D1-43) and remove the Front Head assembly (Fig. 1D1-44).

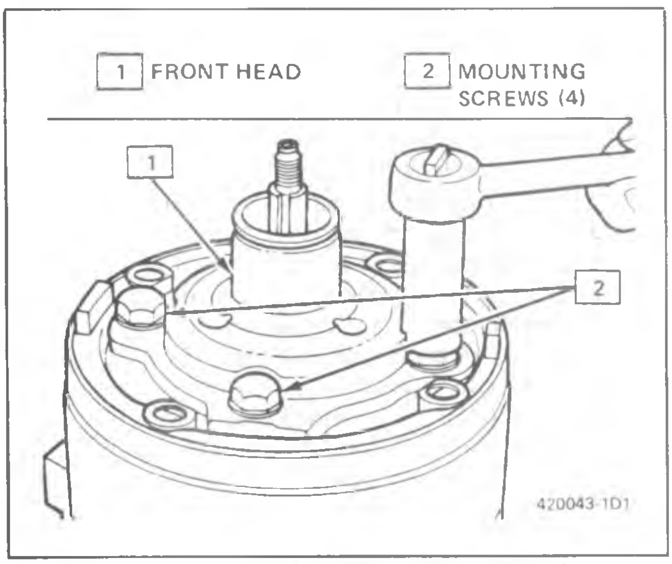


Fig. 1D1-43 Removing Front Head Mounting Screws

5. Remove and discard the front head O-ring.

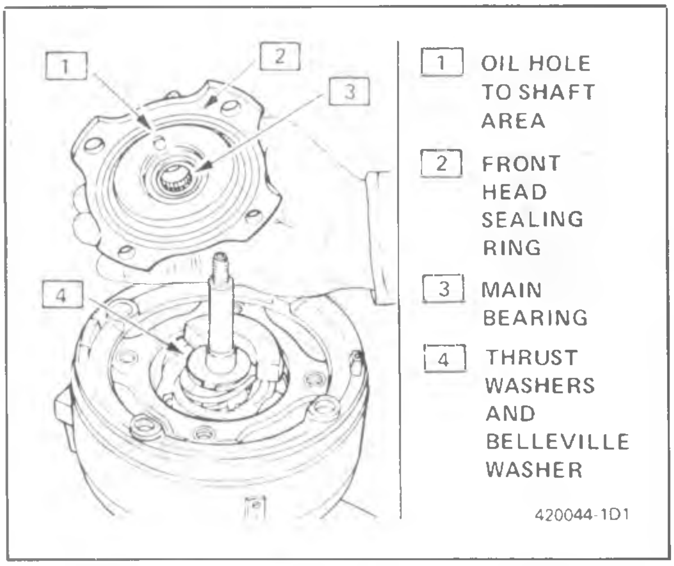


Fig. 1D1-44 Removing Front Head Assembly

Replace

1. Check the Front Head and compressor cylinder area for any dirt, lint, etc. and clean if necessary. Install a new Service thrust washer kit, if required, as described in R-4 COMPRESSOR THRUST AND BELLEVILLE WASHERS REMOVAL AND REPLACEMENT procedures.
2. Dip the new front head O-ring in clean 525 viscosity refrigerant oil and install in the seal groove on the front head (Fig. 1D1-44).
3. Position the oil hole in the Front Head to be "UP" when assembled to the compressor cylinder to correspond with the "UP" position of the compressor. Install the Front Head and tighten the front head mounting screws to 27 N·m (20 lb. ft.) torque.
4. Install new specification Service Shaft Seal kit (Fig. 1D1-35) as described in R-4 COMPRESSOR SHAFT SEAL REPLACEMENT PROCEDURE.
5. Install the Clutch Rotor and Bearing assembly, Clutch Coil and Pulley Rim assembly to the Front Head, using Rotor and Bearing Installer J-26271-A (Fig. 1D1-19).

   Before fully seating the assembly onto the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.
6. Install the rotor and bearing assembly retainer ring and reassemble the Clutch Plate and Hub assembly as described in R-4 COMPRESSOR CLUTCH PLATE AND HUB" replacement procedure. Check to see that the clutch plate to clutch rotor gap is .5 - 1.0mm (.020 - .040 inches).
7. Evacuate and charge the refrigerant system according to the directions in Section 1B1.

R-4 COMPRESSOR THRUST AND BELLEVILLE WASHERS

Remove and Replace

1. Discharge the refrigerant system according to the directions in Section 1B1.
2. Remove the Front Head assembly as described in "Front Head Removal Procedure." Remove and discard the front head O-ring seal.
3. Remove the two thrust washers and one belleville washer from the compressor shaft. Note the assembled position of the washers.
4. Install a new thrust washer on the compressor shaft with the thrust washer tang pointing "UP" (Fig. 1D1-45).

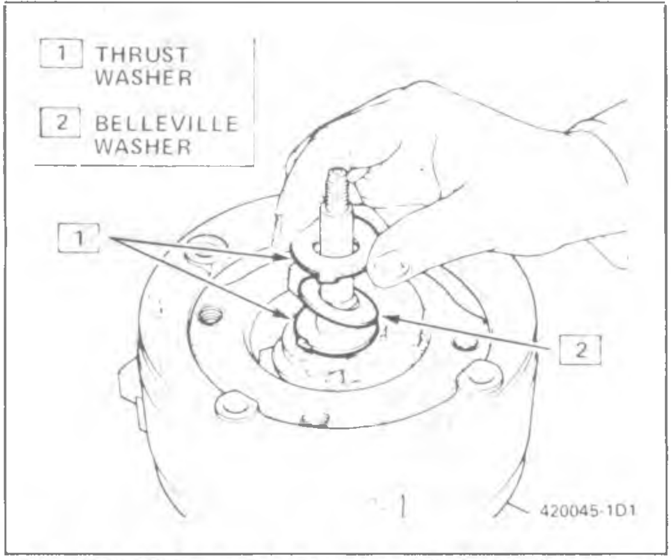


Fig. 1D1-45 Replacing Thrust and Belleville Washers

5. Install the new belleville washer on the shaft with the high center of the washer "UP."
6. Install the remaining thrust washer on the shaft with the tang pointing "DOWN" (Fig. 1D1-45).
7. Lubricate the three washers with clean 525 viscosity refrigerant oil and assemble the Front Head and new O-ring onto the compressor as described in R-4 COMPRESSOR FRONT HEAD replacement procedure.

R-4 COMPRESSOR MAIN BEARING

Remove

1. Discharge the refrigerant system according to the direction in Section 1B1.
2. Remove the Front Head assembly as described in FRONT HEAD REMOVAL PROCEDURE. Discard front head O-ring.
3. Place the Front Head assembly on two blocks, as shown in Fig. 1D1-46, and use Main Bearing Remover J-24896 to drive the Main Bearing out of the Front Head.

Replace

1. Place the Front Head "with neck-end down" on a flat, solid surface.

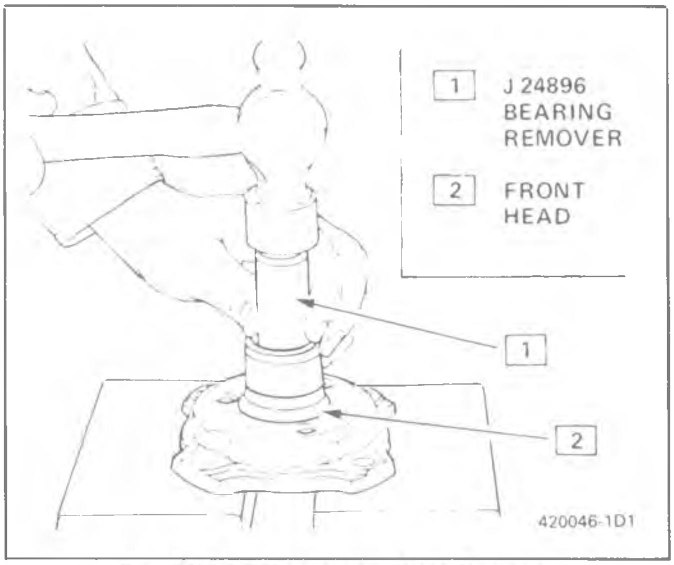


Fig. 1D1-46 Removing Main Bearing

2. Align the new Main Bearing and the Bearing Installer J-24895 squarely with the bearing bore of the Front Head and drive the bearing into the Front Head. The Installer J-24895 must seat against the Front Head to insert the bearing to the proper clearance depth (see Fig. 1D1-47).

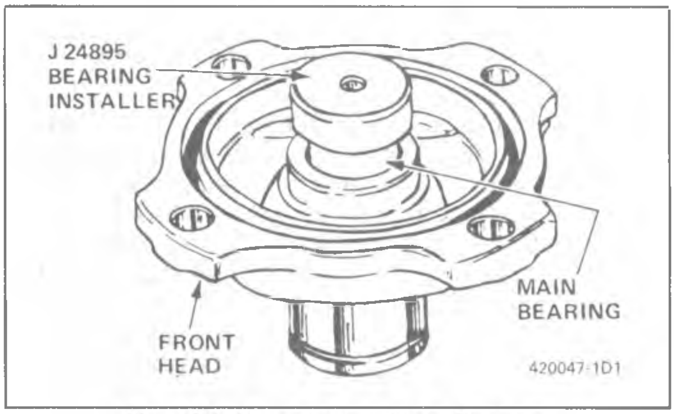


Fig. 1D1-47 Installing Main Bearing

3. Assemble the Front Head to the cylinder, using a new O-ring as described in R-4 COMPRESSOR FRONT HEAD replacement procedure.
4. Evacuate and charge the refrigerant system according to the directions in Section 1B1.

R-4 COMPRESSOR SHELL AND/OR O-RINGS

Remove

1. Discharge the refrigerant system according to the directions in Section 1B1.
2. Thoroughly clean exterior of compressor to prevent dirt from getting into compressor during shell removal.
3. Remove the Clutch Plate and Hub assembly as described in COMPRESSOR CLUTCH PLATE AND HUB removal procedures.
4. Perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure but do not loosen

or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.

5. Pry the shell retaining strap away from the cylinder and position the strap high enough to clear the cylinder as the Shell is removed (Fig. 1D1-48).

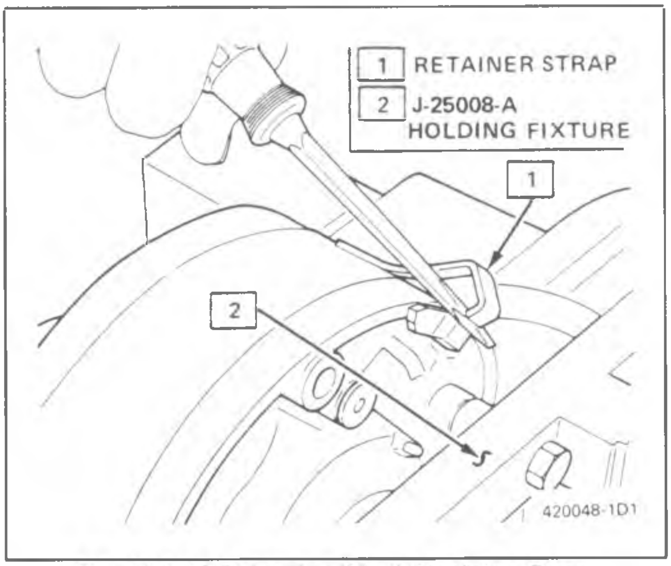


Fig. 1D1-48 Releasing Shell Retaining Strap

6. Remove Compressor Holding Fixture J-25008-A, and reverse Holding Fixture with step block protrusions engaging the compressor Shell. Install the medium-length metric thread mounting bolts through the Holding Fixture and thread them finger-tight on both sides into the compressor cylinder until the step of the fixture protrusions contact the compressor Shell (Fig. 1D1-48). Check to be sure the step protrusions do not overlap the cylinder but will pass both sides. Allow compressor to cool to room temperature before removing compressor shell.

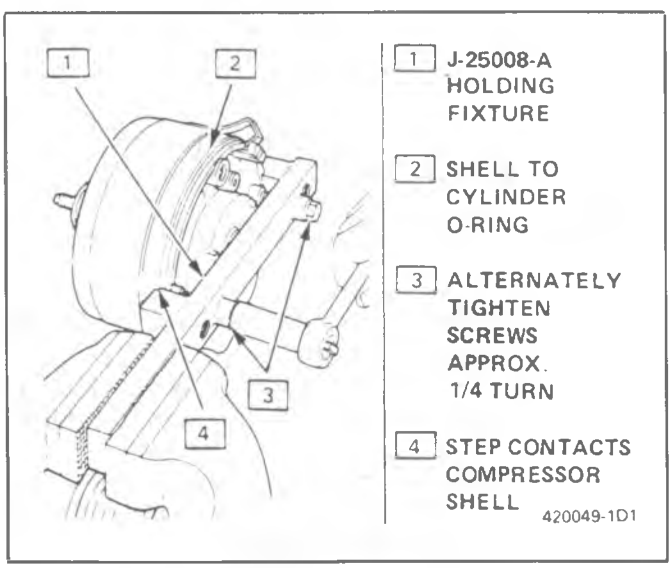


Fig. 1D1-49 Removing Shell

7. Alternately tighten each bolt approximately 1/4 turn to push the Shell free of the O-rings on the cylinder (Fig. 1D1-49).

   If one (1) screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the Shell will be cocked and made more difficult to remove. Normal removal does not require much force on the wrench if the screws are kept in-step while turning. The Shell can be removed by hand as soon as the Shell is free of the shell to cylinder O-rings. Do not turn the screws any further than necessary to release the Shell.

8. Remove the compressor Shell and remove the Holding Fixture J-25008-A from the compressor. Reverse the Holding Fixture to again hold the compressor by the opposite side, using the short-length screws with metric threads.

9. Remove and discard both cylinder to Shell O-rings.

Replace

1. Check the compressor cylinder assembly and interior of the compressor Shell to be sure they are free of lint, dirt, etc.

2. Dip a new cylinder-to-shell O-ring in clean 525 viscosity refrigerant oil and install in the rear O-ring groove of the cylinder. Be careful in moving the O-ring across the cylinder surface to prevent damaging the O-ring.

3. Dip the remaining cylinder-to-shell O-ring in the 525 oil and install it in the front O-ring groove of the cylinder.

4. Also coat inner O-ring surface of compressor Shell with oil. Place the compressor Shell on the cylinder and rotate the retaining strap to its original location.

5. Attach the Shell Installing Fixture J-25008-A to the Holding Fixture J-25008-A, using the long-bolts and plate washers of the set. Align the step projections of the Installing Fixture J-25008-A, to contact the compressor Shell evenly on both sides.

6. Push the compressor shell as close to the O-ring, Fig. 1D1-50, as possible by hand and check for equal alignment of the shell around the cylinder. Tighten the Fixture screws finger tight.

7. Alternately tighten each bolt approximately 1/4 turn to push the compressor Shell over the O-rings and back against the shell stop flange at the rear of the compressor cylinder.

   If one (1) screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the shell will be cocked and made more difficult to install. Normal installation does not require much force on the wrench if the screws are kept in-step while turning.

8. When the shell is seated against the stops, bend the shell retaining strap down into place by tapping gently with a hammer. Remove the Shell Installing Fixture J-25008-A.

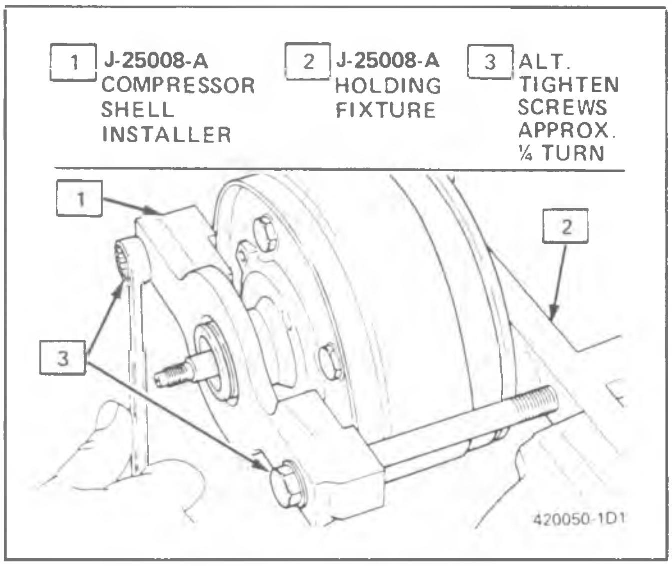


Fig. 1D1-50 Installing Shell

9. Reinstall Clutch Rotor and Bearing Asm., Clutch Coil and Pulley Rim as an assembly with Installer J-26271-A (Fig. 1D1-12), and the Clutch Plate and Hub Assembly with Installer J-9480-B (Fig. 1D1-11).

10. "Evacuate and Charge the Refrigerant System" according to the directions in Section 1B.

R-4 COMPRESSOR DISCHARGE VALVE PLATE AND/OR RETAINER

Remove and Replace

1. Discharge the refrigerant system according to the directions in Section 1B1.

2. Perform Steps 1 through 9 of R-4 COMPRESSOR SHELL AND/OR O-RINGS removal procedure.

3. Remove valve plate retainer ring, using Internal Snap Ring Pliers J-4245, Fig. 1D1-51. Remove Compressor Discharge Valve Plate (Fig. 1D1-52) for valve plate replacement and/or piston inspection.

   Repeat this operation for additional valve plates and retainer rings. If all four valve plates and retainers are to be removed, remove two sets and then rotate compressor and Holding Fixture J-25008-A in vise for access to the remaining two valve plates and retainers.

4. Install Discharge Valve Plates and/or Retainers as shown in Figs. 1D1-51 and 1D1-52. Reposition compressor and Holding Fixture in vise as necessary for access.

5. Reinstall compressor Shell as described in R-4 COMPRESSOR SHELL AND/OR O-RINGS replacement procedures.

6. Evacuate and charge the refrigerant system according to the directions in Section 1B1.

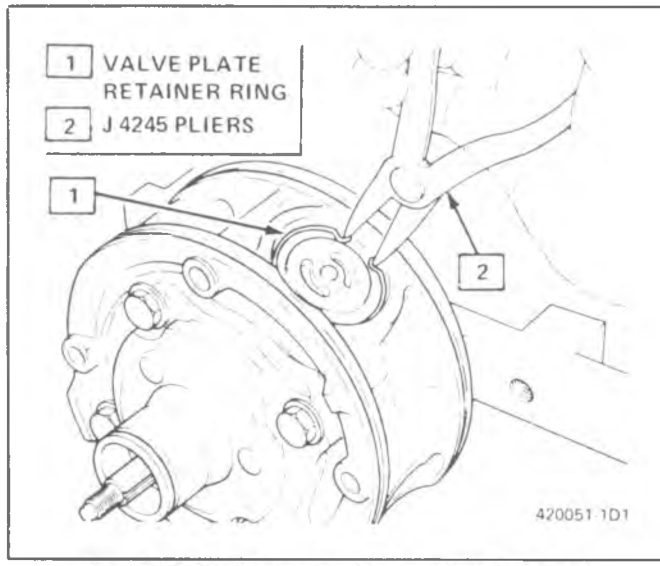


Fig. 1D1-51 Replacing Valve Plate Retainer

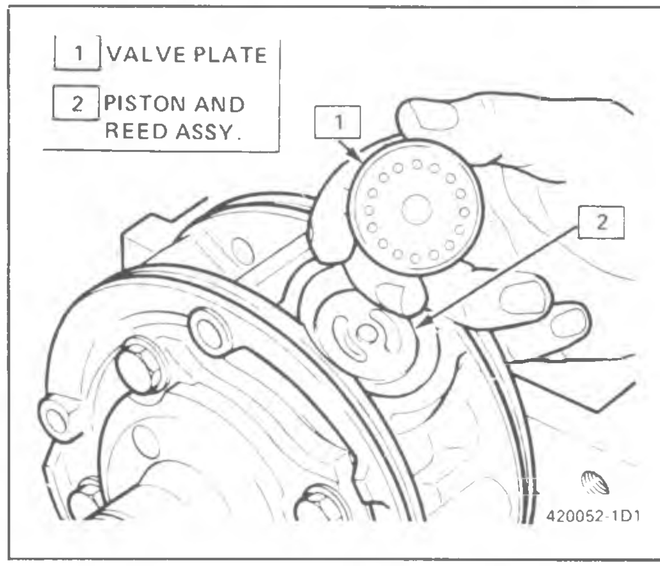


Fig. 1D1-52 Replacing Discharge Valve Plate

R-4 COMPRESSOR CYLINDER AND SHAFT ASM.

Remove

1. Discharge the refrigerant system according to the directions in Section 1B1.

2. Remove the Clutch Plate and Hub assembly as described in COMPRESSOR CLUTCH PLATE AND HUB removal procedure.

3. Perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure but do not loosen or remove the pulley rim mounting screws. Remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as an assembly. Be careful not to drop the Puller Guide J-25031, when removing the assembly.

4. Remove the shaft seal as described in SHAFT SEAL removal procedure.

5. Remove the front head as described in FRONT HEAD REMOVAL procedure.

6. Remove the thrust and belleville washers as described in THRUST AND BELLEVILLE WASHERS removal procedures.
7. Remove the compressor shell as described in SHELL removal procedure.
8. Remove the discharge valve plate and retainer as described in DISCHARGE VALVE PLATE AND/OR RETAINER removal procedure.
9. Remove the high pressure relief valve as described in HIGH PRESSURE RELIEF VALVE REMOVAL PROCEDURE.

Replace

1. Replace above parts in opposite order.
2. Evacuate and charge the refrigerant system according to the directions in Section 1B1.

R-4 COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

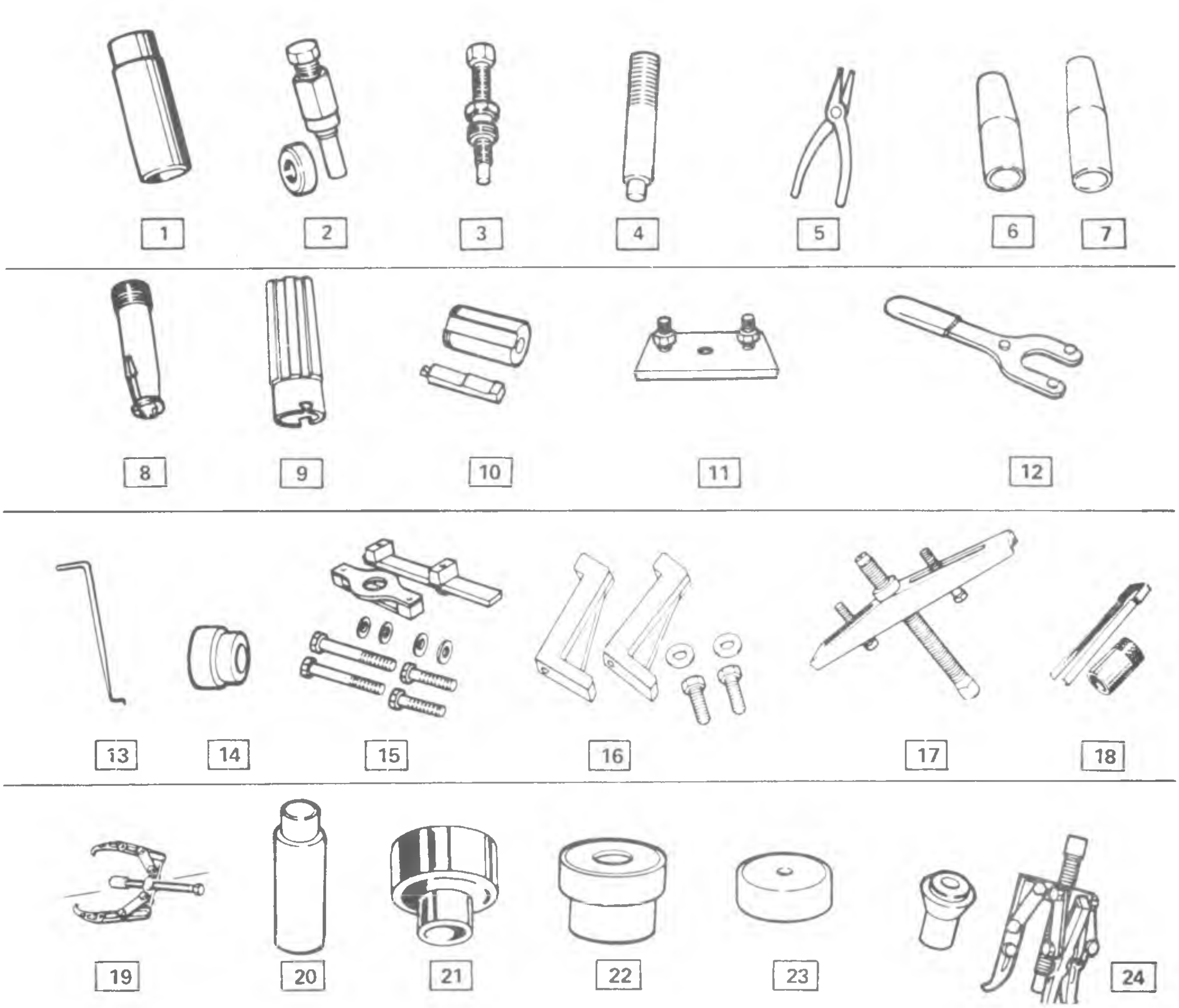
Bench-Check Procedure

1. Install Test Plate J-9625 on Rear Head of compressor.
2. Attach center hose of Manifold Gage Set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.
3. Connect Charging Station high and low pressure lines to corresponding fittings on Test Plate J-9625, using J-5420 Gage Adapters if hoses are not equipped with valve depressors.
   - Suction port (low-side) of compressor has large internal opening. Discharge port (hi-side) has smaller internal opening into compressor.
4. Open low-pressure control, high-pressure control and refrigerant control on Charging Station to allow refrigerant vapor to flow into compressor.
5. Using a Leak Detector, check for leaks at Pressure Relief Valve, compressor shell to cylinder, compressor front head seal, and compressor Shaft Seal. After checking, shut off low pressure control and high pressure control on Charging Station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Loosen the Manifold Gage hose connections to the Gage Adapters J-5420 connected to the low and high sides and allow the vapor pressure to release from the compressor.
8. Disconnect both Gage Adapters J-5420 from the Test Plate J-9625.
9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.
12. Connect the Charging Station high pressure line or a high pressure gage and Gage Adapter J-5420 to the Test Plate J-9625 high side connector.
13. Attach an Adapter J-5420 to the suction or low pressure port of the Test Plate J-9625 to open the Schrader-type valve.

    Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.
14. Attach the compressor to the Holding Fixture J-25008-A using metric mounting screws. Clamp the compressor Holding Fixture in a vise so that the compressor can be manually turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub ten (10) complete revolutions at a speed of approximately one-revolution per second.

    Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.
16. Observe the reading on HIGH pressure gage at the completion of the tenth (10th) revolution of the compressor. The pressure reading for a good pumping compressor should be 344.75 kPa (50 p.s.i.) or above. A pressure reading of less than 310.275 kPa (45 p.s.i.) would indicate one or more suction and/or discharge valves leaking, an internal leak or an inoperative valve, and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.
17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J-5420 and Test Plate J-9625.
18. On the R-4 compressor, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.
19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

    If further assembly or processing is required, a shipping plate or Test Plate J-9625 should be installed to keep out air, dirt and moisture until the compressor is installed.



1—J-9399	9/16" THIN WALL SOCKET
2—J-9480-B	HUB AND DRIVE PLATE ASSEMBLY INSTALLER
3—J-9401-A	HUB AND DRIVE PLATE ASSEMBLY REMOVER
4—J-8092	DRIVER HANDLE
5—J-5403-A	SNAP RING PLIERS (#21 INTERNAL)
5—J-4245	SNAP RING PLIERS (#23 INTERNAL)
5—J-6083	SNAP RING PLIERS (#24 INTERNAL)
6—J-22974-A	SHAFT SEAL PROTECTOR (FACE SEAL ONLY)
7—J-34614	SHAFT SEAL PROTECTOR (FACE SEAL AND LIP SEAL)
8—J-23128-A	SEAL SEAT REMOVER AND INSTALLER
9—J-9292-01	SHAFT SEAL REMOVER AND INSTALLER
10—J-25108	SEAL SEAT O RING INSTALLER
11—J-9625	PRESSURE TEST CONNECTOR
12—J-25030	CLUTCH HUB HOLDING TOOL
13—J-9553-01	O-RING REMOVER
14—J-9398-A	ROTOR BEARING REMOVER
15—J-25008-A	COMPRESSOR HOLDING FIXTURE
16—J-24092	PULLEY HUB ADAPTER SET (USED WITH J-8433)
17—J-8433	COMPRESSOR PULLEY PULLER
18—J-9393-A	SEAL SEAT REMOVER AND INSTALLER
19—J-25287	CLUTCH COIL PULLER
20—J-24896	BEARING REMOVER (FRONT HEAD)
21—J-9481-A	PULLEY BEARING AND PULLEY INSTALLER
22—J-26271-A	ROTOR AND BEARING INSTALLER (WITHOUT HANDLE)
23—J-24895	BEARING INSTALLER (FRONT END)
24—J-25031	ROTOR AND BEARING PULLER WITH GUIDE

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Fig. 1D1-53 Special Tools, R-4 A/C Compressor Overhaul

SECTION 2A

FRAME

CONTENTS

General Description 2A-1
On Vehicle Service 2A-1
Maintenance and Inspection 2A-1
Underbody Inspection 2A-1
Frame Inspection 2A-1
Frame Alignment 2A-1
Underbody Alignment 2A-4
Excessive Body Damage 2A-4

GENERAL DESCRIPTION

Light duty 10-30 Series frames are of the ladder channel section riveted type.

Figure 2A-1 thru 2A-4 illustrates typical light duty truck frames with crossmembers, body mounts and suspension attaching brackets. This section also includes general instructions for checking frame alignment and recommendations on frame repair.

The G-Van frame side rails, cross sills and outriggers are part of the underbody assembly which is a welded unit.

Misalignment of the underbody can affect door opening fits and also influence the suspension system, causing suspension misalignment. It is essential, therefore, that underbody alignment be exact to within - 1/16 in. (1.9mm) of the specified dimensions.

ON VEHICLE SERVICE

MAINTENANCE AND INSPECTION

UNDERBODY INSPECTION

Raise the vehicle on a hoist (preferably a twin-post type).

Check for obvious floor pan deterioration.

Check for loose dirt and rust around the inside of the floor pan reinforcement member access holes. This is the first indication that corrosion may exist in hidden areas, and that repairs might be required before the final cleaning and protective treatment is performed.

Using a chisel, ensure that the drain provisions in the floor pan reinforcement members are open.

There are drain holes in the body side panels also. These holes can be opened by using a punch or drift. The side panel drain holes are in the rear section of the rocker panels, and in the lower rear quarter panels.

FRAME INSPECTION

Raise the vehicle on a hoist (preferably a twin-post type).

Check for obvious floor pan deterioration.

Check for loose dirt and rust around the inside of the frame rails, on top and at the ends where corrosion may exist in hidden areas. Check especially in the frame box sections for accumulation of debris.

FRAME ALIGNMENT

Horizontal frame checking can be made with tramming gages applied directly to the frame or by transferring selected points of measurement from the frame to the floor by means of a plum bob and using the floor layout for measuring. Fig. 2A-2 or 2A-4 may be used as a general guide in the selection of checking points; however, selection of these points is arbitrary depending on accessibility and convenience. An important point to remember is that for each point selected on one side of the frame, a corresponding point on the opposite side of the frame must be used for vertical checks, opposite and alternate sides for horizontal checks.

Vehicle Preparation

Points to remember when preparing vehicle for frame checking:

1. Place vehicle on a level surface.
2. Inspect damaged areas for obvious frame misalignment to eliminate unnecessary measuring.
3. Support vehicle so that frame sidemembers are parallel to the ground.

Tramming Sequence (Fig. 2A-1)

1. Dimensions to bolts and/or holes in frame extend to dead center of the hole or bolt.
2. Dimensions must be within 3/16 in. (4.7 mm).
3. If a tram bar is used, for horizontal alignment "X" - check from opposite and alternate reference points AA, BB and CC, as illustrated by the lines in Fig. 2A-1.

Error will result if a tram bar is not level and centered at the reference points.

4. Obtain vertical dimensions and compare the differences between these dimensions with the dimensions as shown in Fig. 2A-3 or 2A-4.

Horizontal Check

1. Measure frame width at front and rear. If widths correspond to specifications, draw centerline full length of vehicle halfway between lines indicating front and rear widths. If frame widths are not correct, layout centerline as shown in Step 4.
2. Measure distance from centerline to corresponding points on each side of frame layout over entire length. Opposite side measurement should correspond within 3/16 in. (4.7 mm).
3. Measure diagonals marked A, B and C. If the lengths of intersecting diagonals are equal and these diagonals intersect the centerline, frame area included between these points of measurement may be considered in alignment.
4. If front or rear end of frame is damaged and width is no longer within limits, frame centerline may be drawn through the intersection of any two previously drawn pairs of equal, intersecting diagonals.

Vertical Check

Vertical dimensions are checked with a tramming bar from indicated points on the frame (Figs. 2A-2 and 2A-4). For example, if the tram bar is set at point B with a vertical pointer length of 8-1/4 in. (206 mm), and at point E with a vertical pointer length of 5-1/4 in. (131 mm) (a height difference of 3 in. (75 mm), the tram bar should be parallel with the frame. If the area is twisted or misaligned in any way, tram bar will not be parallel. Placing the tram bar vertical pointers on opposite sides of the frame side rail is preferable in that frame twist will show up during this vertical check. Fig. 2A-2 and 2A-4 show typical checking points, with dimensions for various frames shown in Fig. 2A-3.

Frame Repair

Welding

Before welding up a crack in frame, a hole should be drilled at the starting point of the crack to prevent spreading. Widen V groove crack to allow complete weld penetration.

NOTICE: Do not weld into corners of frame or along edges of side rail flanges. Welding at these points will tend to weaken the frame and encourage new cracks.

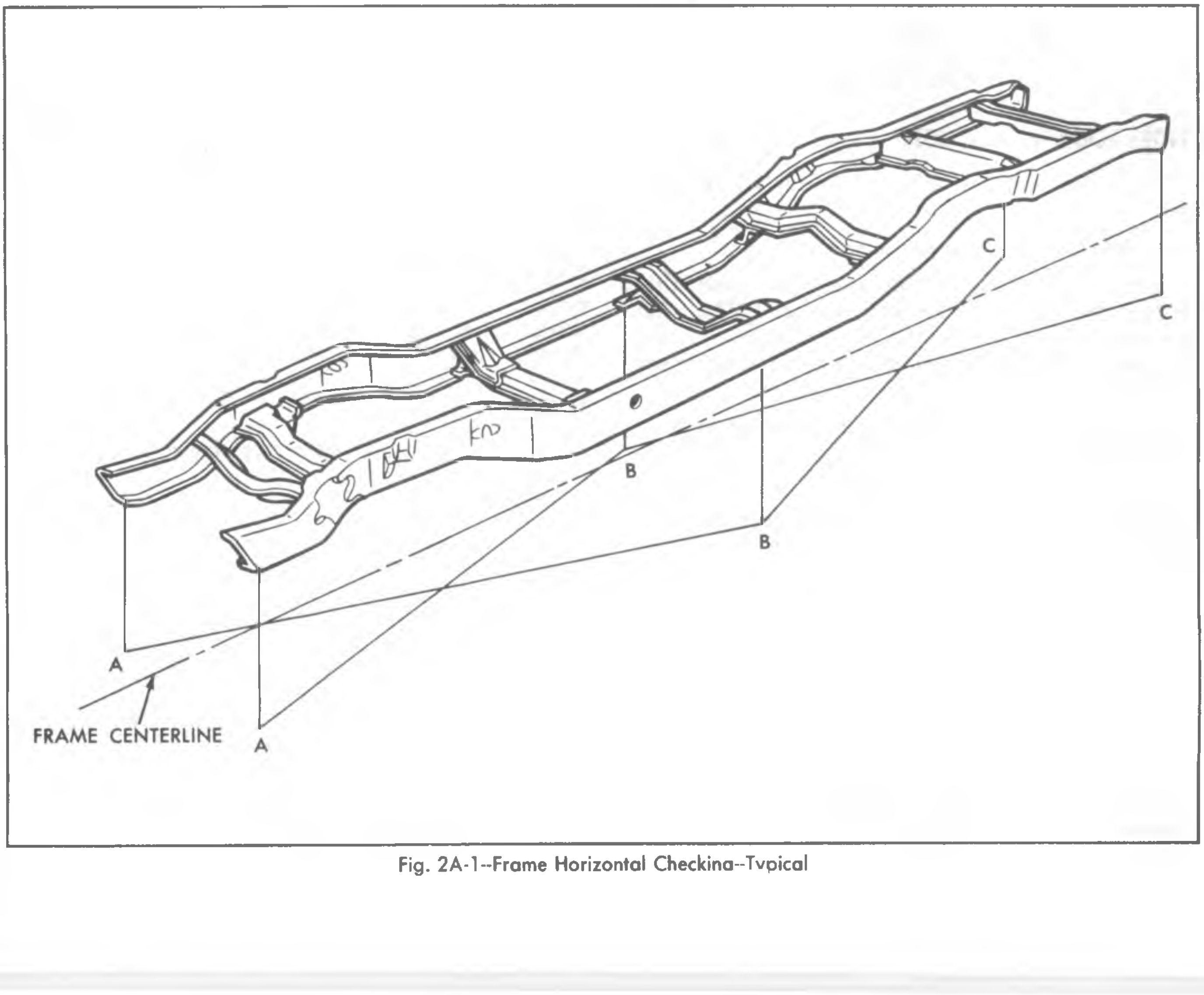

Fig. 2A-1--Frame Horizontal Checking--Typical

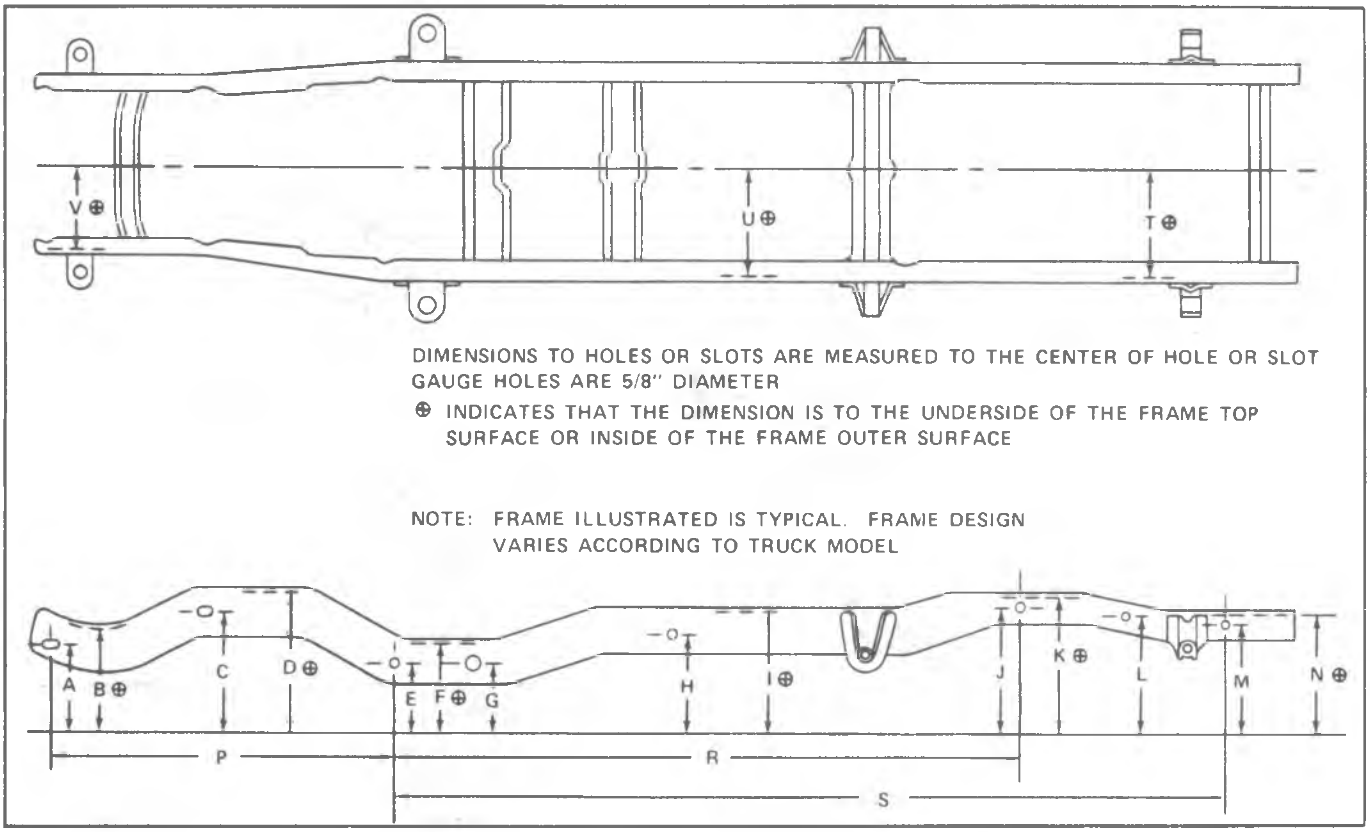

Fig. 2A-2--C-K-P Series Truck Frame

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	R	S	T	U	V
CA107	13-3/8	15-1/4	16	19-7/8	12	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17 3/4	68 -1/2	76-1/2	110	16-7/8	16-7/8	14
CA109	13-3/8	15-1/4	16	19-7/8	12	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	86-1/2	120	16-7/8	16-7/8	14
CA209	13-3/8	15-1/4	17	19-7/8	12	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	69-5/8	86-1/2	120	16-7/8	16-7/8	14
CA 210/310	13-3/4	15-1/4	16	18-1/2	10	13	10	14-1/4	17-3/4	17-3/4	19-7/8		15-5/8	17-3/4	68 -3/4	105	131	16-7/8	16-7/8	14
CA314	13-3/8	14 7/8	16	18-1/2	10	13	10	14-1/4	17-3/4	17-3/4	19-7/8		15-5/8	17-3/4	69-7/8	129	155-1/2	16-7/8	16 7/8	14
KA107	13-3/8	15-1/4	17	19-7/8	12-1/2	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	68 - 1/2	76-1/2	110	16-7/8	16-7/8	14
KA 109/209	13-3/8	15-1/4	17	19-7/8	12-1/2	13	10	14-7/8	17-3/4	17-3/4	19-7/8	16-3/4	15-5/8	17-3/4	68 -1/2	86-1/2	120	16-7/8	16-7/8	14
PA100	7-5/8	9-3/8	11	14-5/8	9-1/2	13	10			9-1/2	13		10-7/8	13	71-7/8	36	89	16-7/8	16-7/8	14
PA 208/308	7-5/8	9-3/8	11-5/8	14-5/8	9-1/2	13	10	9-1/2	13	9-1/2	13		10-7/8	13	72-1/4	59	131	16-7/8	16-7/8	14
PA 210/310	7-5/8	9-3/8	11-5/8	14-5/8	9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	71-7/8	67	153	16-7/8	16-7/8	14
PA314	7-5/8	9-3/8	11-5/8	14-5/8	9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	71-7/8	91	177	16-7/8	16-7/8	14
CA105	13-3/8	15 1/4	17	19-7/8	12	13	10			14-1/4	20	17-3/4	15-5/8	17-3/4	69-5/8	46	88	16-7/8	16-7/8	14
KA105	13-3/8	15-1/4	17	19-7/8	12-1/2	13	10			14-1/4	20	17 3/4	15-5/8	17 3/4	69-5/8	46	88	16-7/8	16-7/8	14
PE 31132 (137)	9-1/8	11-1/2	10-7/8		9-1/2	13	10	9-1/2	13	9-1/2	13	10-7/8	10-7/8	13	68-1/2	71	157	16-7/8	16-7/8	14
PE 31432 (157)	9-1/8	11-1/2	10-7/8		9-1/2	13	10	9-1/2	13	9-1/2	13	9-7/8	10-7/8	13	68-1/2	92-1/2	178-1/2	16-7/8	16-7/8	14
PE 31832	9-1/8	11-1/2	10-7/8		9-1/2	13	10	9-1/2	13	9 1/2	13	10-7/8	10-7/8	13	68-1/2	112	240-3/16	16-7/8	16-7/8	14

Fig. 2A-3--C-K-P Series Frame Reference Dimensions

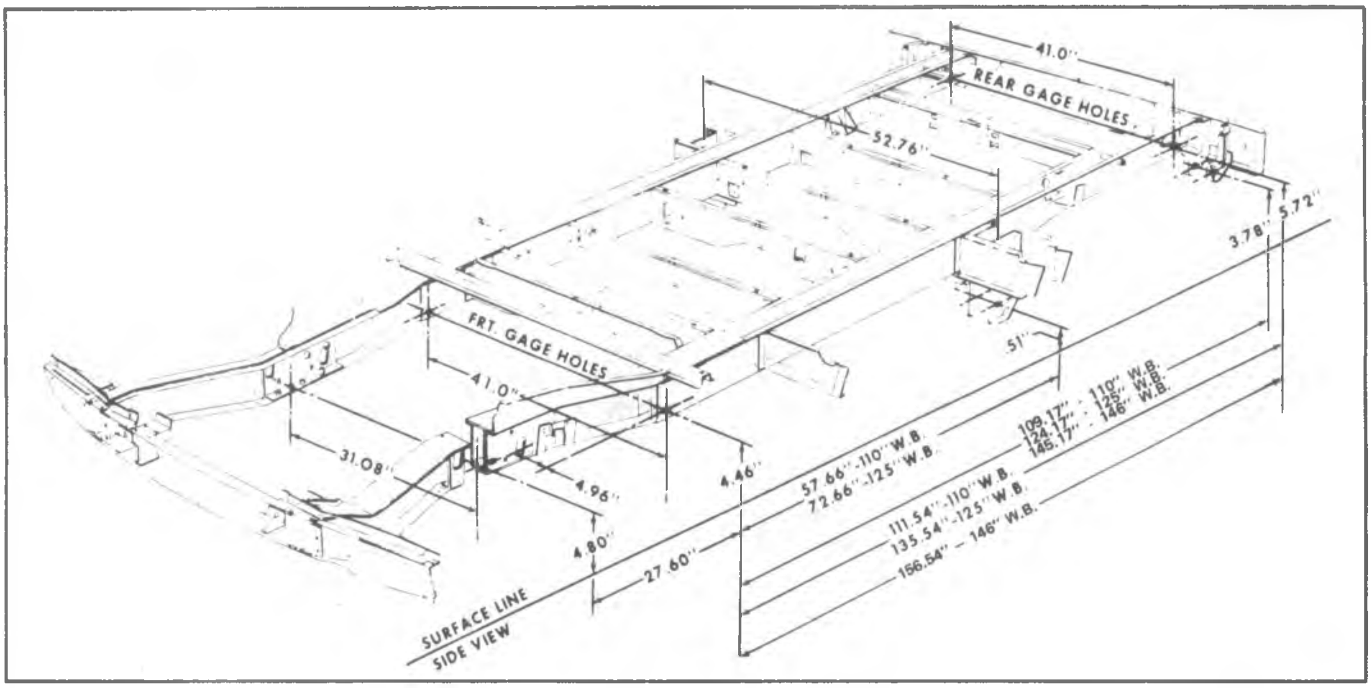

Fig. 2A-4--G Van Truck Reference Dimensions

Bolting

Wherever rivets or failed bolts are replaced, bolt hole must be as near the O.D. of the bolt as possible to prevent bolt from working and wearing. Drill out and line ream hole (or holes) to the bolt O.D.

UNDERBODY ALIGNMENT

One method of determining the alignment of the underbody is with a tram gage which should be sufficiently flexible to obtain all necessary measurements up to three quarters the length of the vehicle. A good tramming tool is essential for analyzing and determining the extent of collision misalignment present in underbody construction.

MEASURING

To measure the distance accurately between any two reference points on the underbody, two specifications are required.

1. The horizontal dimension between the two points to be trammed.
2. The vertical dimension from the datum line to the points to be trammed.

The tram bar should be on a parallel to that of the body plane. The exception to this would be when one of the reference locations is included in the misaligned area; then the parallel plane between the body and the tram bar may not prevail. After completion of the repairs, the tram gage should be set at the specified dimension to check the accuracy of the repair operation.

EXCESSIVE BODY DAMAGE

If damage is so extensive that key locations are not suitable as reference points, repair operations should always begin with the underbody area. All other components should be aligned progressively from this area. Unlike the conventional type of frame design, the unitized type of body construction seldom develops the two conditions of "twist" and "diamond" in the underbody area as a result of front or rear end collisions, therefore, there usually is an undamaged area suitable as a beginning reference point.

SECTION 2B

BUMPERS

NOTICE: Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 10.

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Rear Bumper G Series 2B-3

GENERAL DESCRIPTION

All truck front and rear bumpers are of a single piece design. Bumper attachments are the standard bracket and brace to frame mountings. This section contains procedures for the removal and installation of face bar, brackets, braces and license plate brackets.

SERVICE PROCEDURES-10 THRU 30 SERIES

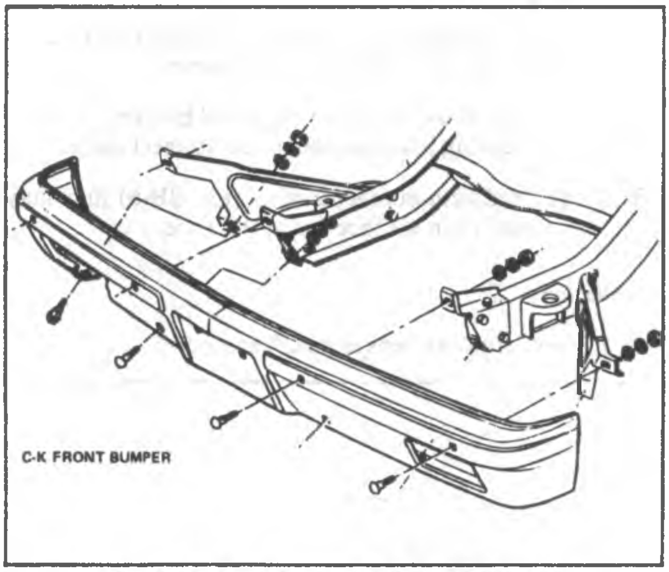

Fig. 2B-1--Front Bumper-C, K and P Models

FRONT BUMPER-C, K AND P MODELS

Removal Fig. 2B-1, 2B-2

1. Remove bolts securing bumper face bar to left and right bumper brackets.
2. Remove bolts securing bumper face bar to left and right bumper braces and remove bumper from vehicle.
3. If necessary, remove the brackets and braces from frame by removing the bolt attachments.
4. If equipped with bumper guards, the bumper is removed in same manner as above.

Installation

Assemble and install front bumper following the removal procedure in reverse order.

REAR BUMPER-C AND K MODELS (FIG 2B- 3)

Removal

1. Remove bolts attaching bumper face bar to left and right bumper brace. Disconnect license lamp wiring on suburban, panel and pickup models.
2. Remove bolts attaching bumper face bar to left and

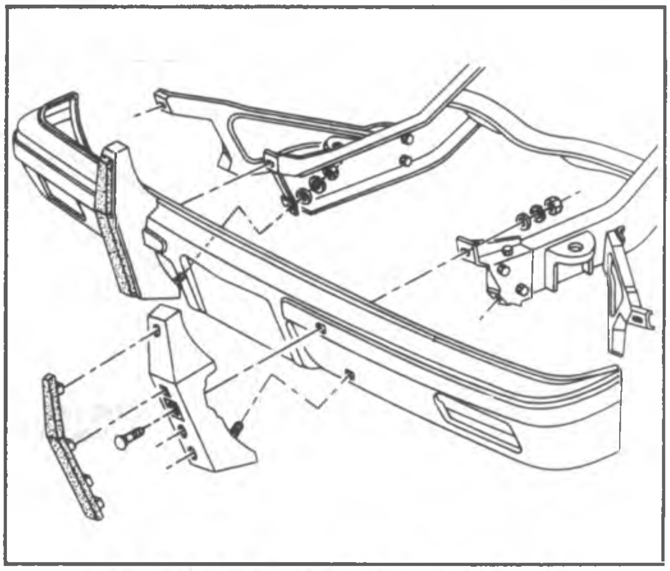

Fig. 2B-2--C, K Model Front Bumper Guards

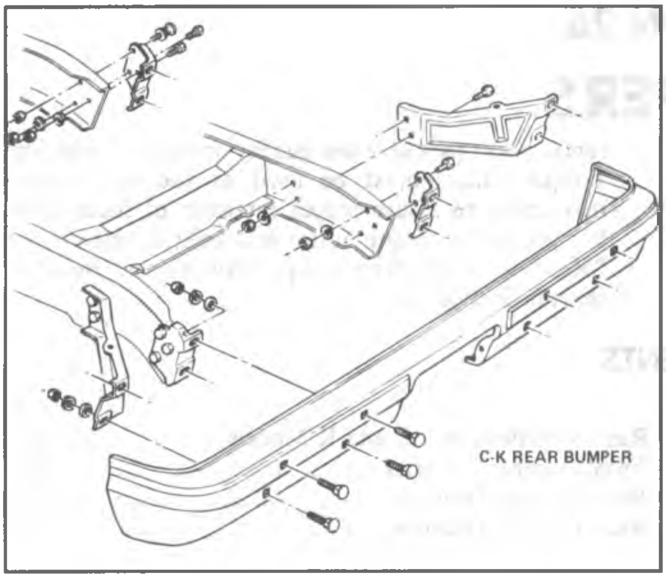

Fig. 2B-3--Rear Bumper - C, K Models

right bumper bracket.

3. Remove bumper from vehicle.
4. If necessary, remove the rear stone shields and the bumper brackets and braces from frame by removing bolt attachments.

Installation

Install rear bumper following removal procedure in reverse order. Connect license lamp wiring on suburban, panel, and pickup models.

REAR STEP BUMPER C AND K MODELS

Removal (Fig. 2B-4)

1. Disconnect license lamp wiring.
2. Remove bolts connecting bumper to braces.
3. Remove bolts retaining bumper to brackets.
4. Remove bumper assembly.
5. Remove bolts securing bumper brace to frame and bumper brackets and reinforcements to frame if necessary.

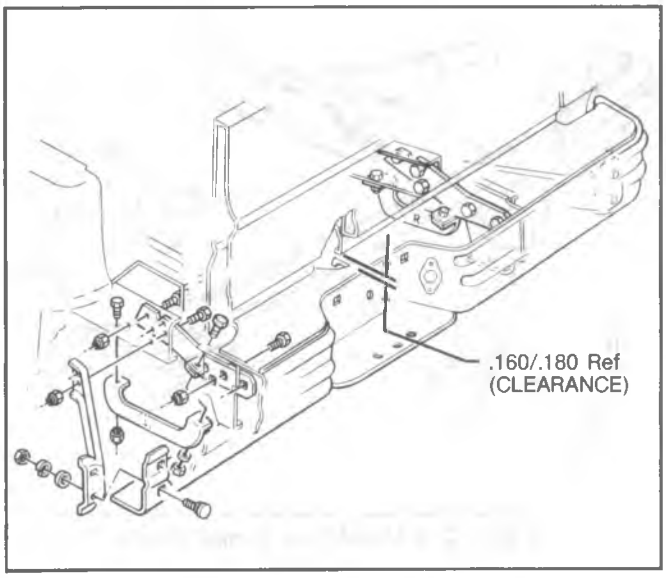

Fig. 2B-4--Rear Step Bumper C and K Models

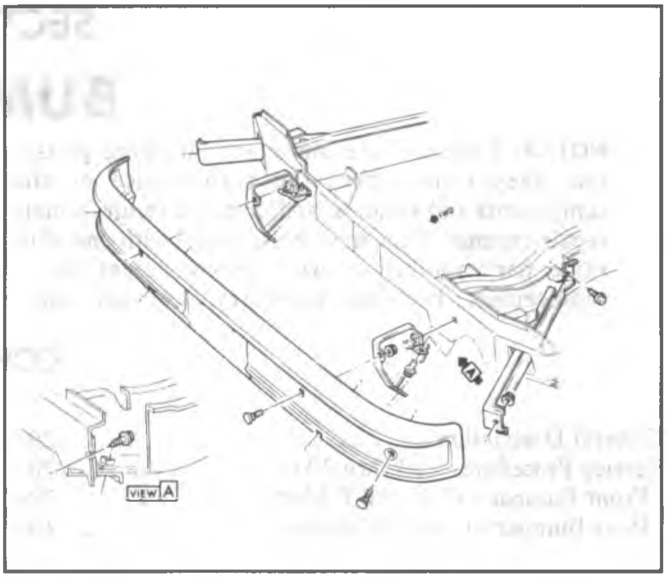

Fig. 2B-5--Front Bumper - G Models

Installation

Install rear step bumper by reversing removal procedure. Connect license lamp wiring.

FRONT BUMPER - G MODELS

Removal Fig. 2B-5, 2B-6

1. Remove nuts securing bumpers to brackets and braces from left and right side. Remove bumper.
2. If necessary to remove the braces and brackets, remove screws securing brackets and braces to sheet metal.
3. If equipped with bumper guards (Fig. 2B-6) they may be removed from the face bar at this time.

Installation

Reverse removal steps to install bumpers.

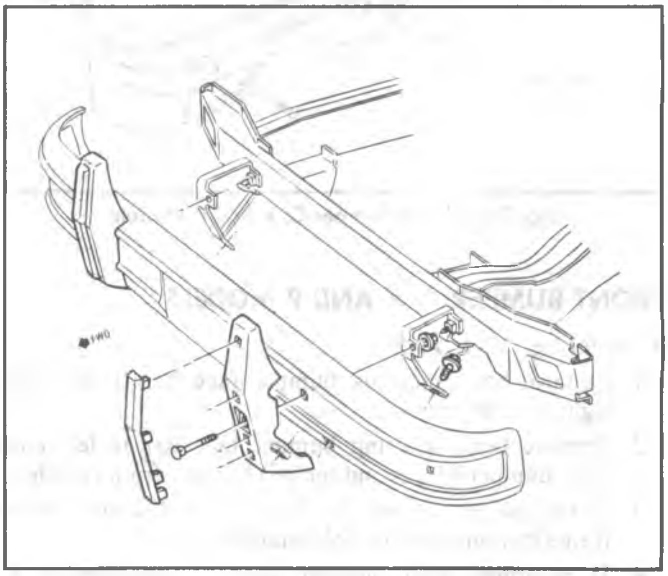

Fig. 2B-6--G-Models Front Bumper Guards

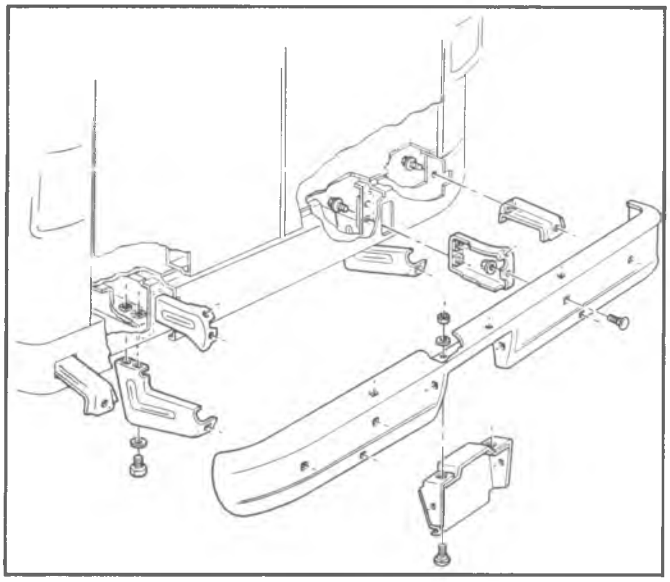

Fig. 2B-7--Rear Bumper-G Models

REAR BUMPER-G MODELS

Removal Fig. 2B-7

1. Remove nuts securing bumper to left hand and right hand brackets and braces and remove the bumper.
2. Remove the license plate support nut and bolts.
3. Remove bolts securing left hand and right hand brackets and braces to body.

   The bumper may be removed with brackets and braces attached if necessary.

Installation

Install in reverse order of removal.

SPECIFICATIONS

TORQUE SPECIFICATIONS C, P AND K

Front Bumper	35 ft.-lbs.
Front Bumper Bracket and Brace	70 ft.-lbs.
Rear Bumper to Outer Bracket	35 ft.-lbs.
Rear Bumper Outer Bracket and Brace	50 ft.-lbs.
License Plate Bracket	18 ft.-lbs.
Gravel Deflector	85 in.-lbs.
Rear Step Bumper to Bracket or Frame	40 ft.-lbs.

TORQUE SPECIFICATIONS G

Front Face Bar to Bracket	24 ft.-lbs.
Bracket to Cross Sill	24 ft.-lbs.
License Plate Bracket to Face Bar	100 in.-lbs.
Rear Face Bar to Brackets	55 ft.-lbs.
Bracket to Floor	55 ft.-lbs.

Fig. 2B-ST--Specifications

SECTION 2C

SHEET METAL

NOTICE Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 10.

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GENERAL DESCRIPTION

CK MODELS

The chassis sheet metal assembly is attached to the frame and body at adjustment points. The front of the assembly is supported by two mounts located at the frame side rails. Fore and aft and side adjustment is allowed by oversize holes at the fender rear attaching point and chassis sheet metal mounts. Special shims at the rear locations allow adjustment of the rear of the assembly. The lower rear edge of the assembly is attached to the body at the rocker panel by bolts on each side. Shims are used at this location to provide in and out adjustment at the rear of the fender. The bolts that retain the sheet metal braces must be torqued to the required torques. If these bolts are loose, the braces will not provide additional support for the sheet metal assembly.

G MODELS

The front end sheet metal design does not include the radiator support and fenders as loose items inasmuch that these items are welded together as an integral part of the body.

Front end sheet metal includes the hood assembly, hood hinges, hood lock catch and support, a hood rod assembly which supports the hood, a bolted radiator-upper tie bar, and series designation plates and hoods emblems.

Anti-Corrosion Information

"Anti-corrosion materials have been applied to the interior surfaces of some metal panels to provide rust resistance. When servicing these panels, areas on which this material has been disturbed should be properly recoated with service-type anti-corrosion material."

ON VEHICLE SERVICE

HOOD - CK MODELS

Cowl Top Vent Panel (Fig. 2C-1)

Replacement

1. Remove wiper arms.
2. Open hood and remove two screws at each wiper nozzle attachment.
3. Remove four screws at front of cowl panel.
4. Pry the five plastic fasteners loose from windshield frame. Remove the panel.
5. Reverse the above listed procedure to replace.

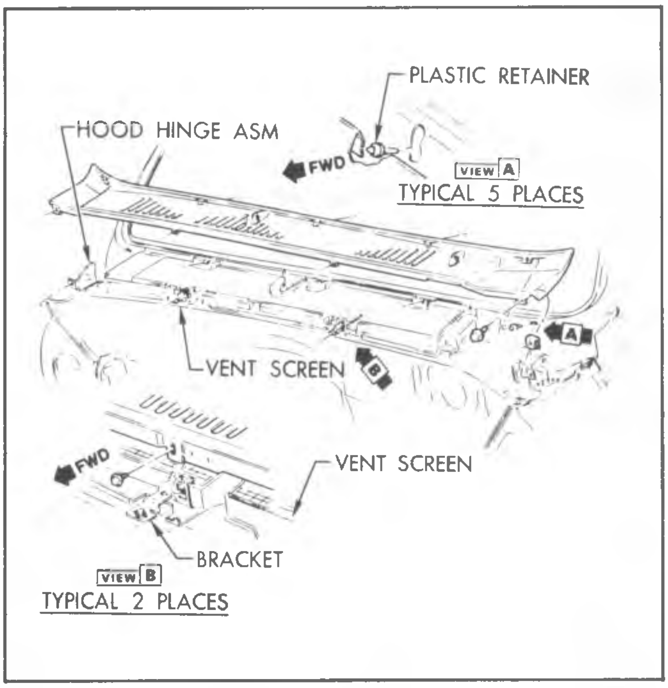

Fig. 2C-1--Cowl Top Vent Panel

Hood Hinge (Fig. 2C-2)

Replacement

1. Prop the hood in the extreme open position and place protective covering over the cowl and fenders. Scribe position of hinge attachment to hood.
2. Remove two bolts link assembly to hood and two bolts at hinge to the hood.
3. Remove two bolts link assembly to fender inner, remove link.
4. Remove wiper arms and at the cowl cover panel remove four screws and lift up without removing for access.

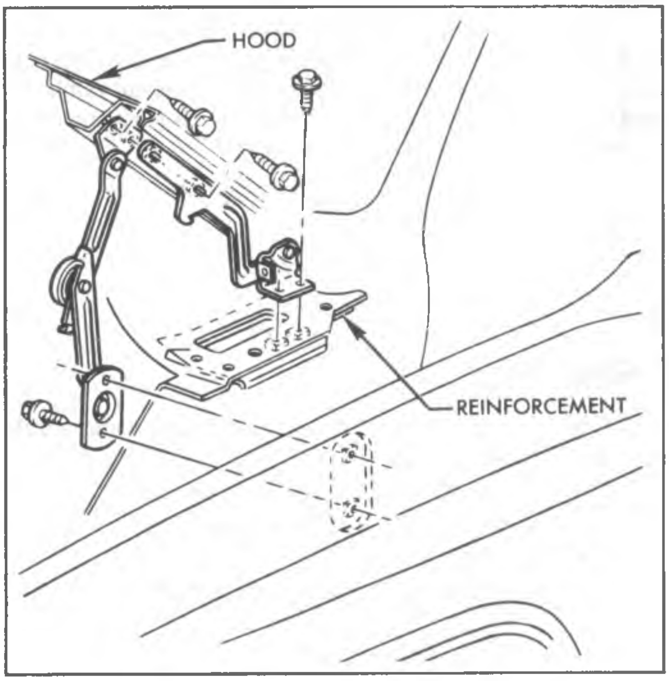

Fig. 2C-2--Hood Hinge -CK Models

5. Remove two bolts hinge to rear reinforcement at the body and remove hinge.
6. Replace by reversing the above procedure.

Hood Lock Mechanism

The hood latch assembly and bracket are mounted to the Radiator Support. Elongated holes in the bracket are provided for alignment purposes. A separate secondary latch is mounted to the striker plate in the hood. See Fig. 2C-3 and 2C-4.

Replacement

1. Open hood and remove the two bolts holding the hood latch to the bracket.

   If original hood lock assembly is to be replaced, scribe a line around lock for alignment on installation.
2. Replace hood latch assembly and bolts loosely.
3. Align within scribe marks and tighten bolts.

Hood Bumper Adjustment

Hood Bumpers must be adjusted until hood and fender line up flush at front corner.

Hood

Removal

1. Open hood and prop in full open position.

   If hood is to be reinstalled and present alignment is satisfactory, mark each hinge in relation to hood, to assure original alignment.
2. Remove two (2) cap screws which attach each hinge

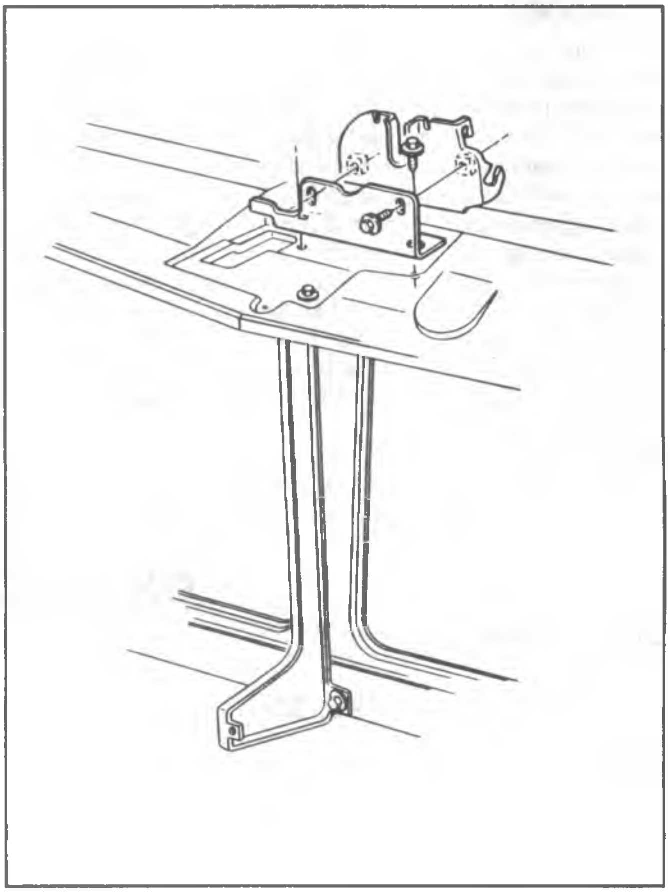

Fig. 2C-3--Primary Hood Latch -CK Models

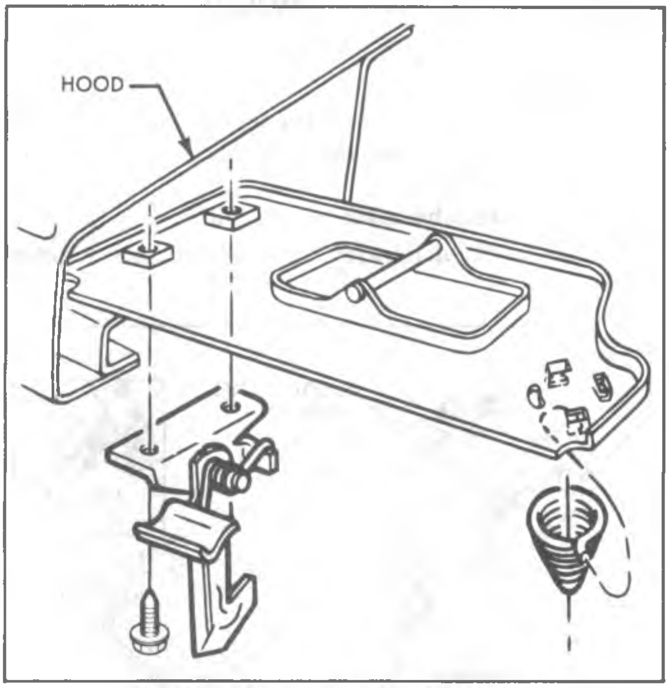

Fig. 2C-4--Secondary Latch -CK Models

and link to hood; then with a helper remove hood from vehicle.

Installation

1. If original hood is to be installed, position hood to hinges and links and install four cap screws snug which attach hinges and links to hood.

   If a new hood is to be installed, perform procedures as outlined under Alignment, directly below.
2. Shift hood on hinges to location marks made before removal of hood, then tighten attaching cap screws at hinges firmly. Close hood and check fit. If necessary to align hood perform procedure as outlined under "Alignment" which follows.

Alignment

1. Loosen hood hinge bolts.

   Note that the rear most bolt holes in hinge are slotted to allow hood to move back and forth.
2. Adjust bracket at hood latch, as necessary. Slotted hole in the bracket allow movement up or down at the latch, and right or left at the radiator support.
3. Adjust hood bumper as necessary in proportion to the latch.

Hood - G Model

The alignment of the hood is controlled by the position of the hood hinges and the height of the two bumpers located one at each side of the radiator support. The adjustment at the hood lock must be made after the hinges and bumpers are properly adjusted (Refer to Hood Lock Adjustment Fig. 2C-7). To align the hood and lock proceed as follows:

Hood Hinge (Fig. 2C-5)

Hood Lock

A bolt-type hood lock is used as shown in Fig. 2C-7. The lock bolt, located on the hood, dovetails with the mounted striker plate, preventing upward or downward movement of the hood while the vehicle is in motion. Integral with the striker plate is the combination lock release lever and safety catch.

1. Scribe a line around the entire hinge plate to be repositioned.
2. Loosen the appropriate screws and shift the position of the hood into correct alignment using the scribe marks to check amount of movement. Check alignment by tightening screws and closing the hood.

Replacement

1. Open hood and remove the four bolts holding the combination lock catch and lock bolt.

   If original hood lock assembly is to be replaced, scribe a line around lock for alignment on installation.
2. Place hood lock assembly in position.
3. Adjust as outlined under Adjustments.

Adjustment

Hood lock assembly to be adjusted fore and aft until hood lock bolt enters center of elongated guide. Bending bolt to accomplish this adjustment may seriously effect lock operation and safety catch engagement and is, therefore not recommended.

1. Adjust lock bolt as shown in Fig. 2C-7.
2. Open hood and adjust tightness of catch assembly so that it is just "snug" enough to hold lock bolt in position.
3. Close hood in a normal manner.
4. Raise hood again; lock bolt assembly will have shifted to operating position. Tighten bolts fully. Further adjustment may be made at lock bolt support, if necessary.
5. Adjust lock bolt to obtain a secure hood closure and reasonable lock release effort.

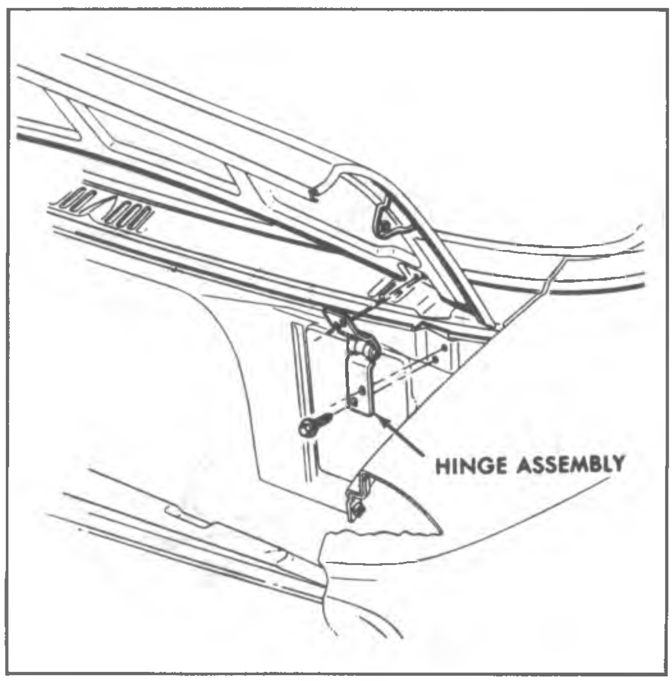

Fig. 2C-5--Hood Hinge-G Model

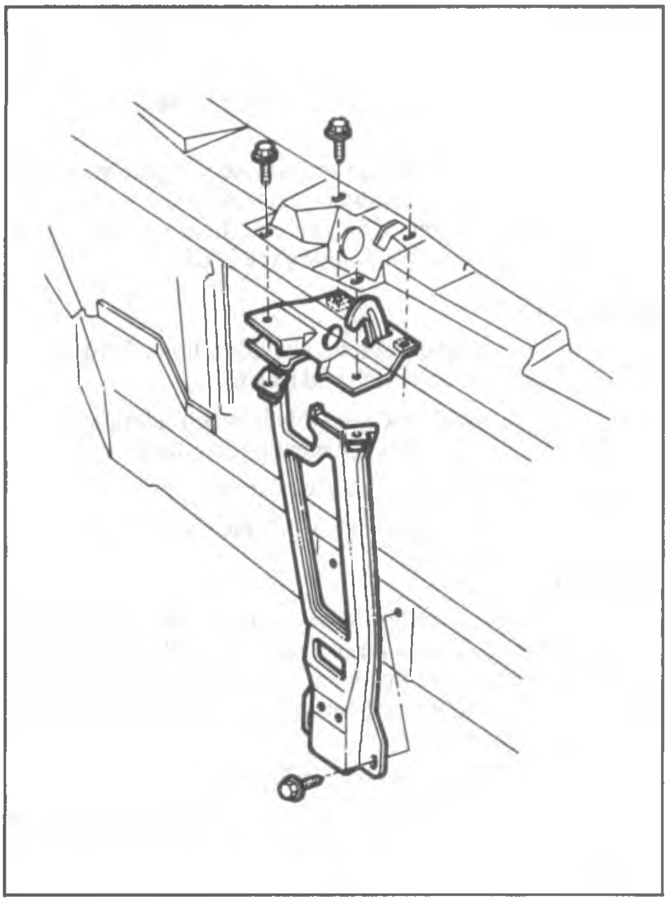

Fig. 2C-6--Hood Lock Catch Assembly-G Model

HOOD CABLE RELEASE - CK MODELS (FIG. 2C-8)

Replacement

1. Release the hood from below, using a suitable rod, by pressing on the hood release tab at the right side of the lock assembly.
2. Remove the cable at the lock assembly.
3. Remove hood release handle to kickpad attaching screws.

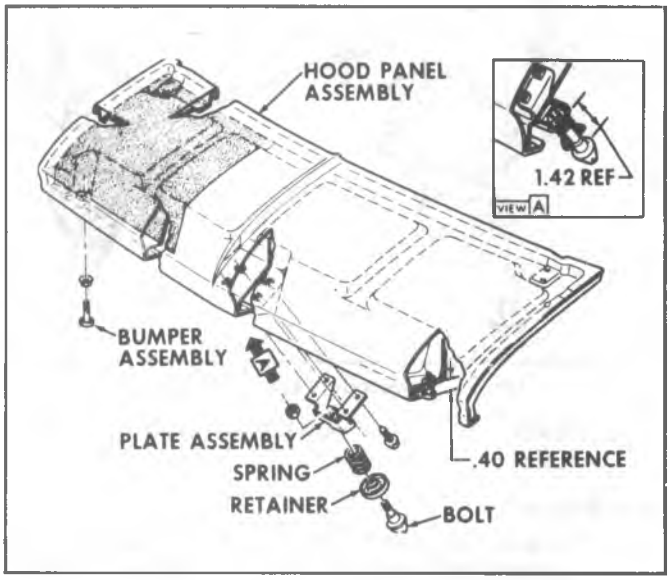

Fig. 2C-7--Hood, Bumpers and Latch-G Model

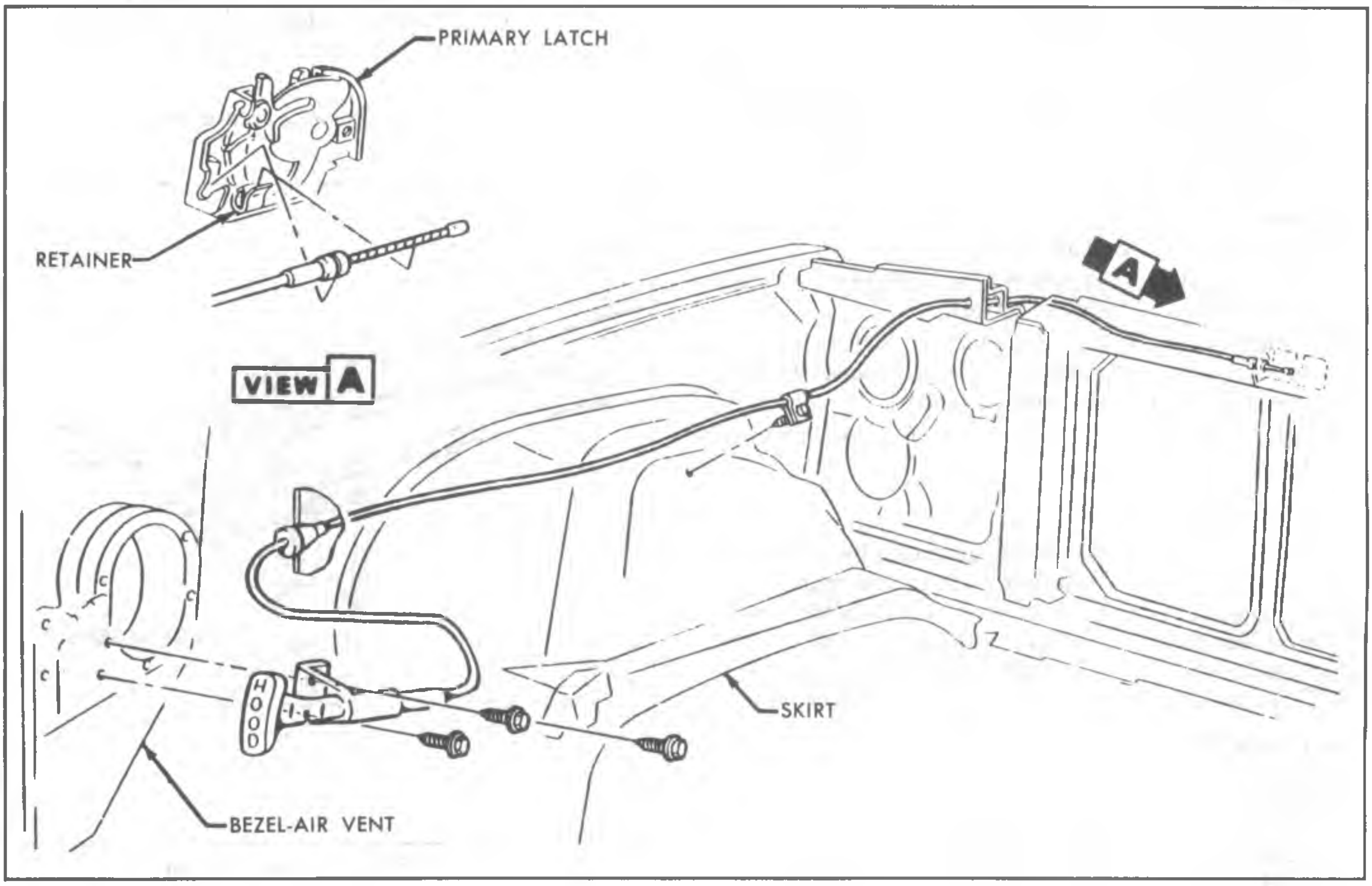

Fig. 2C-8--Hood Release Cable - CK Models

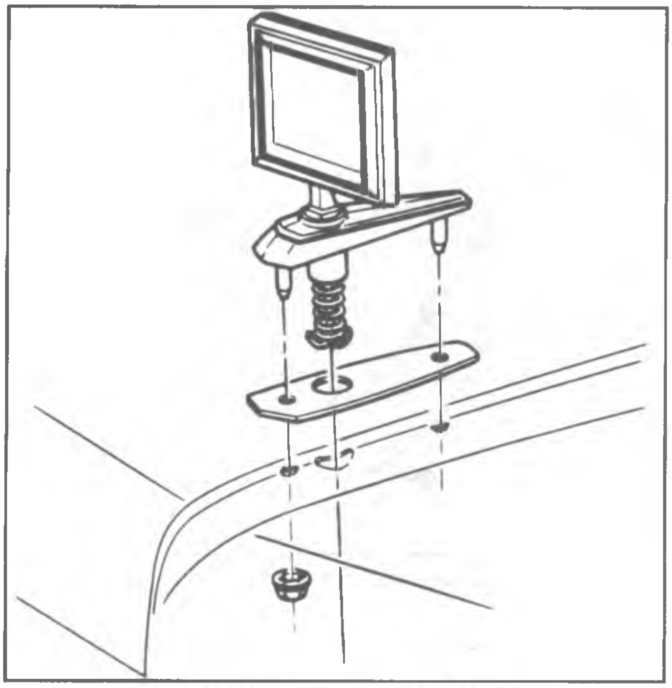

Fig. 2C-9--Hood Emblem - CK Models

4. Remove hood release cable.
5. To install, reverse Steps 2 through 4.

HOOD EMBLEM - CK MODELS (FIG. 2C-9)

Hood Bumper

Adjust hood bumpers so that hood top surface is flush with the fender and grille top surfaces.

Hood - G Model (Fig. 2C-7)

Removal

1. Lay a fender cover along cowl top to prevent hood from scratching painted surfaces.
2. Open hood and prop in full open position.

   If hood is to be reinstalled and present alignment is satisfactory, mark each hinge in relation to hood, to assure original alignment.
3. Remove two cap screws which attach each hinge to hood; (Fig. 2C-5) then with a helper remove hood from vehicle.

Installation

1. If original hood is to be installed, position hood to hinges with helper and install four cap screws snug which attach hinges to hood.
2. Install rod assembly.

   If a new hood is to be installed, perform procedures as outlined under Alignment, directly below.
3. Shift hood on hinges to location marks made before removal of hood, then tighten attaching cap screws at hinges firmly. Close hood and check fit. If necessary to align hood perform procedure as outlined under "Alignment" which follows.

Alignment

1. Loosen hood hinge bolts.

   Note that the rear bolt holes in hinge is slotted to allow hood trailing edge to move up and down.
2. Adjust hood bumpers so that hood and adjacent surfaces are flush.
3. Perform hood lock adjustment as outlined in this section if necessary.

   Hood Lock Assembly to be adjusted fore and aft until nubble (part of Hood Lock Bolt Support Assembly) enters center of elongated guide (Socket). Bending nubble to accomplish this adjustment may seriously effect lock operation and safety catch engagement and is, therefore, NOT RECOMMENDED.

Hood Support Rod - G Model

Refer to Fig. 2C-10 for removal and installation of hood support rod.

CARBURETOR OUTSIDE AIR INLET

SNORKELS (Fig. 2C-11)

Removal

1. Raise hood and remove carburetor air duct from air snorkel by sliding duct rearward.
2. Disconnect the attachment incorporated in the duct attaching the air snorkel to radiator support turn and remove from vehicle.

LOWER RADIATOR GRILLE (FIG. 2C-12)

RADIATOR GRILLE PANEL OR BRACKETS (FIG. 2C-13)

GRILLE MOLDING (FIG. 2C-14)

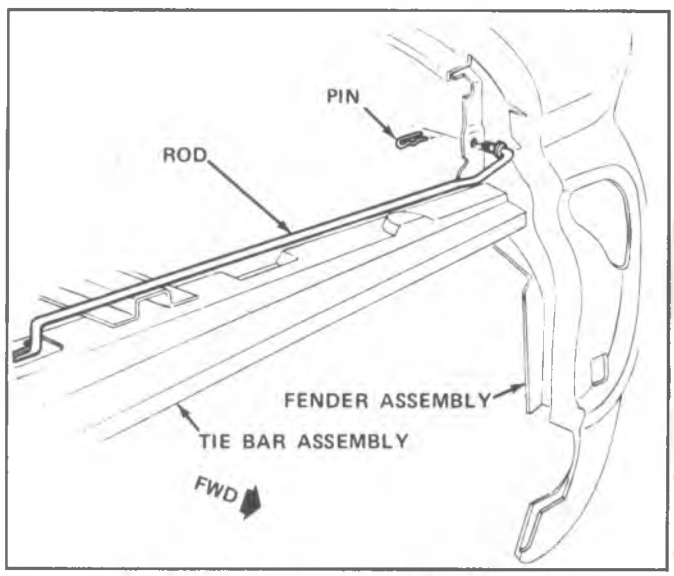

Fig. 2C-10--Hood Rod Support - G Model

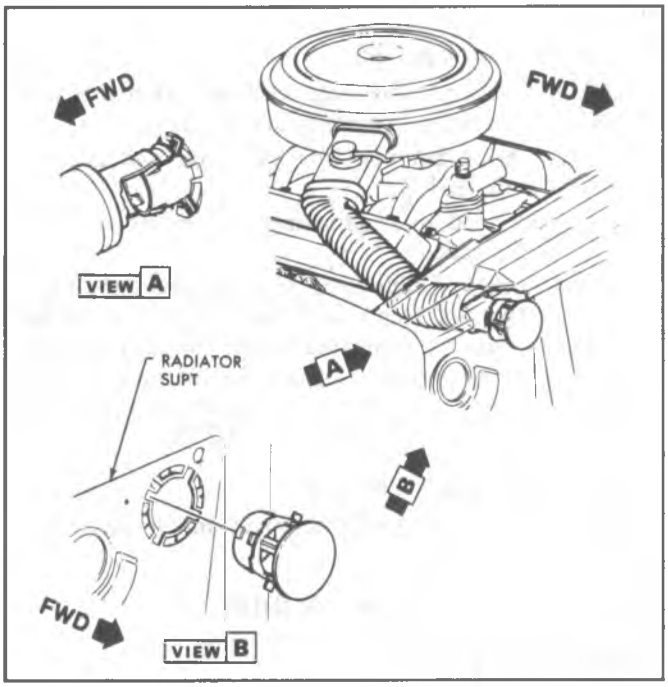

Fig. 2C-11--Typical Carburetor Air Inlet Snorkel - CK Model

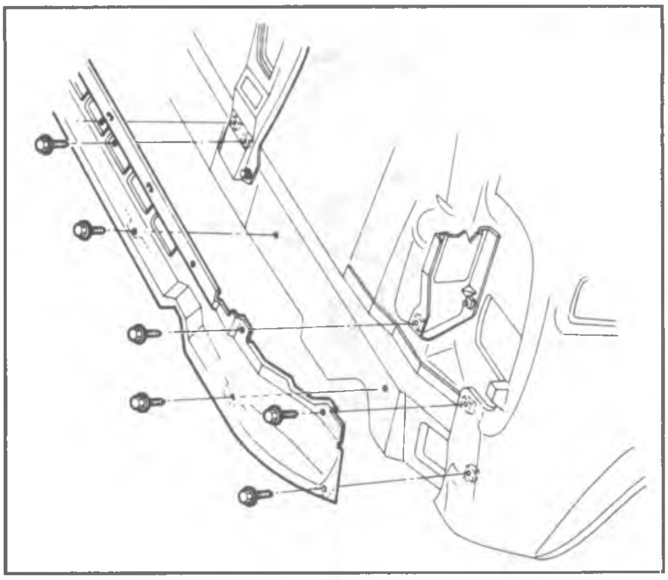

Fig. 2C-12--Lower Radiator Grille - G Models

FRONT SHEET METAL - CK MODEL

Shims which are found at various locations should be recorded to ease installation of sheet metal assembly.

Removal

1. Remove bolts at hood hinge and link. Remove hood assembly.

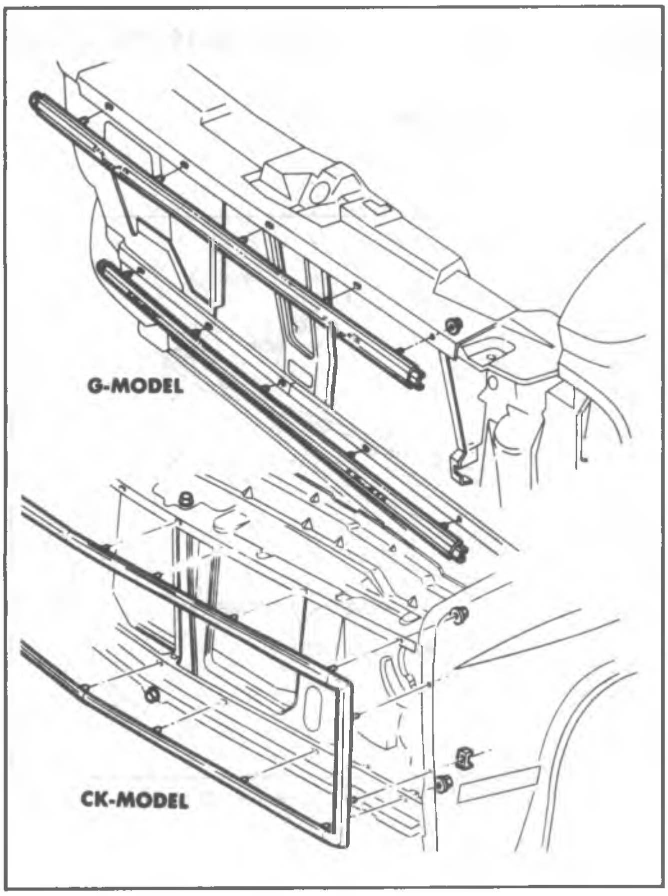

Fig. 2C-14-- Grille Moldings - CK, G Models

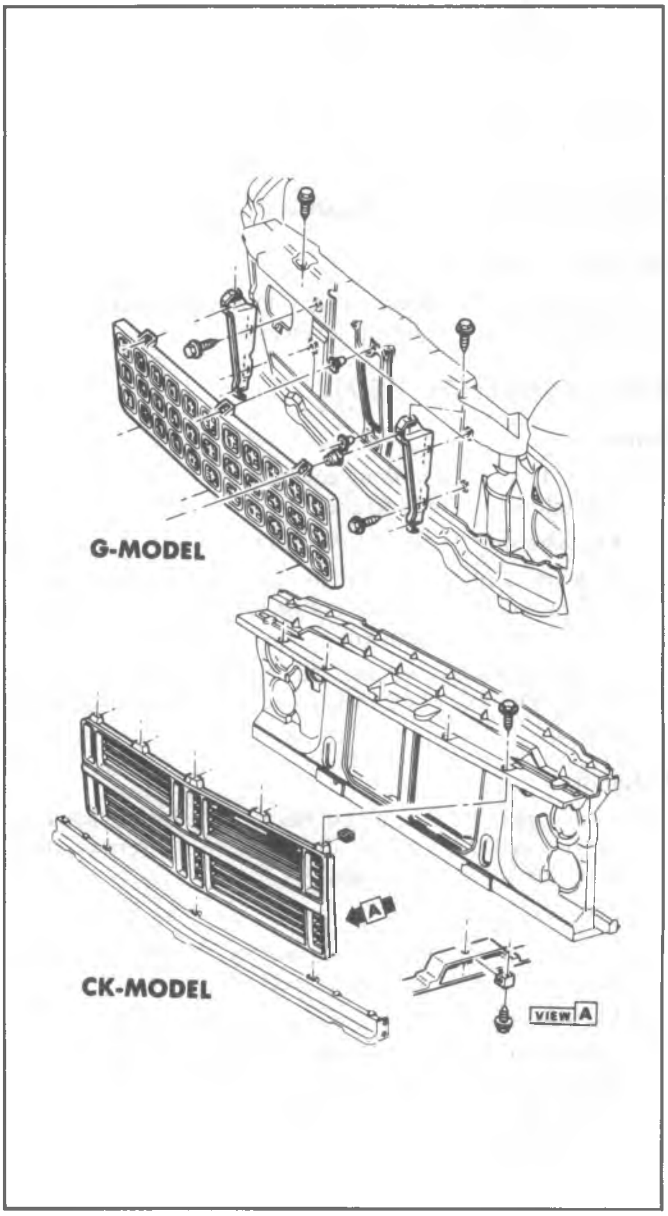

Fig. 2C-13--Grille Panel or Brackets

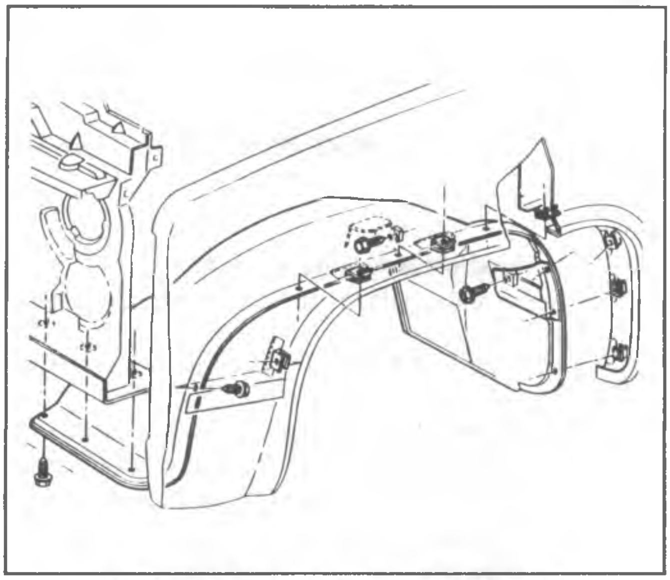

Fig. 2C-15--Fender Skirt Assembly-CK Model

2. Drain radiator and remove radiator hoses. Disconnect oil cooler lines if so equipped.
3. Disconnect wire connectors at the dash and toe panel and wire connector to horn and voltage regulator.
4. Disconnect battery and generator wires.
5. Remove front bumper bolts and remove bumper.
6. Remove bolts attaching fender upper edge to cowl door frame.
7. Remove fan shroud.
8. Working from underneath rear of fender, remove attachment from each fender at the hinge pillar.
9. Remove bolt from each radiator support mounting.
10. Remove bolts at each fender skirt to cab underbody (Fig. 2C-15).
11. With a helper, remove front sheet metal assembly, with radiator, battery, horn and voltage regulator attached.

Installation

1. With a helper place sheet metal assembly in position. Install all bolts loosely to facilitate aligning after complete installation.
2. Install fender bolts at cowl.
3. Install combination bolt and flat washer assembly into each fender reinforcement while inserting shims required between fender reinforcement and body (Refer to Fig. 2C-16).
4. Install two bolts and shims required at each fender rear lower edge to hinge pillar.
5. Install bolt in each fender skirt to underbody.
6. Install bolts at steering column skirt reinforcement, final torque 25 ft. lb. (33 N·m).
7. Tighten each radiator support mounting bolt 33 ft. lb. (44 N·m).
8. Torque bolts at fender to cowl 25 ft. lb. (33 N·m)
9. Install front bumper.
10. Connect wire connectors at dash and toe panel. Attach generator and regulator wires.
11. Connect upper and lower radiator hoses. Connect oil cooler lines to the radiator on models so equipped.
12. Connect battery and fill radiator. Start engine and check for leaks.
13. Install Hood.

Radiator Support

Removal

1. Drain radiator, saving coolant, loosen attachments and remove radiator and coolant recovery tank.
2. Disconnect and remove battery.
3. Remove wiring from radiator support.
4. Disconnect fan shroud and lay back on engine.
5. Remove both head lamp assemblies.
6. Remove grille assembly.
7. Remove lower radiator grille panel. (Fig. 2C-13).
8. Remove screws securing front fenders to radiator support.
9. Remove screws securing fender skirts to radiator support bottom. (Fig. 2C-15).
10. Remove bolt securing center support to radiator support.
11. Remove bolts securing hood latch assembly to radiator support.
12. Remove radiator support bolts secured to frame.
13. Tilt radiator support rearward and lift up and off.

Installation

1. Rotate radiator support into position and loosely install attachments to frame.
2. Connect center support to radiator support.
3. Connect hood latch plate.
4. Connect radiator support brackets to fenders.

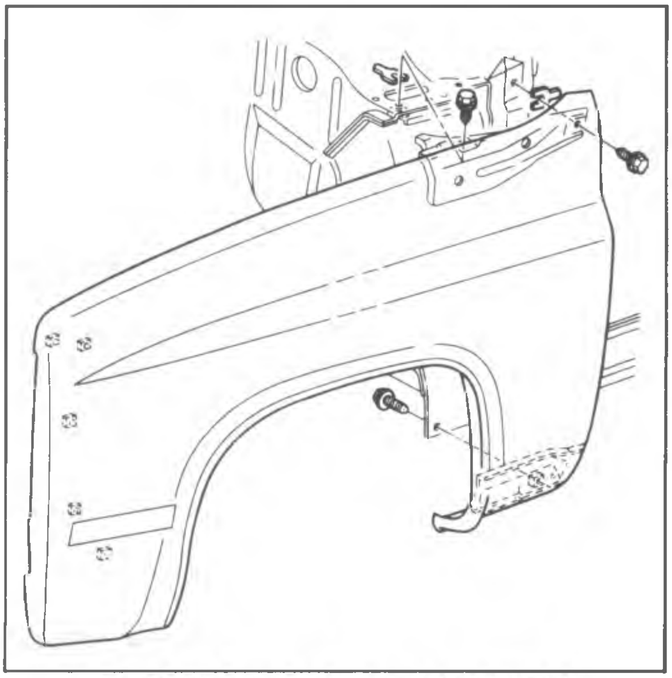

Fig. 2C-16--Front Fender Assembly-CK Model

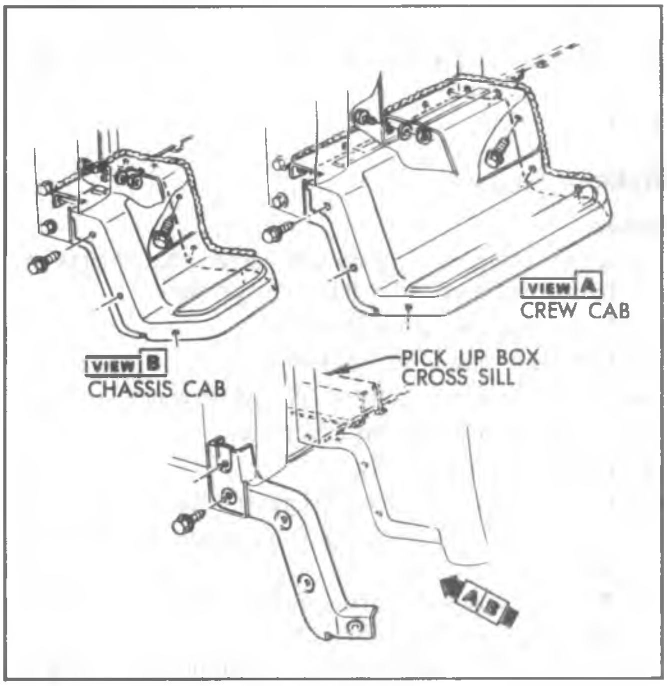

Fig. 2C-17--Running Boards-CK Models

5. Connect support to fenders.
6. Connect screws from underside of fender skirts to support bottom.
7. Attach grille lower panel to fenders.
8. Tighten radiator support bolts.
9. Install radiator coolant recovery tank hoses and shroud.
10. Connect removed wiring to radiator support.
11. Install both head lamp assemblies.
12. Tighten all previously installed bolts and screws.
13. Install battery and connect leads and wires.
14. Install grille assembly.
15. Fill radiator with coolant as specified in Section 6B.

FRONT FENDER (FIG. 2C-16)

Removal

1. Remove hood and hinge assembly.
2. Remove head lamp bezel, wiring and attachments from fender.
3. Remove screws attaching lower radiator grille panel.
4. Remove screws attaching fender wheel opening flange to skirt.
5. Remove skirt to fender bolts, located inboard on underside of skirt.
6. Remove two (2) screws attaching battery support bracket to fender.
7. Remove five (5) screws attaching radiator support to front fender.
8. Remove bolt and shim attaching trailing edge of fender to hinge pillar.
9. Remove two bolts and shims at top rear of fender attaching to cowl.

Installation

To install, reverse the removal procedure using sealing tape between filler panel and fender. Check sheet metal alignment.

FRONT FENDER AND SKIRT (FIGS. 2C-15 AND 2C-16)

Removal

1. Remove hood and hood hinge assembly.
2. Disconnect and remove battery (right side or auxiliary left side).
3. Remove head lamp bezel, wiring and attachments from fender.
4. Remove screws attaching lower radiator grille panel.
5. Remove screws attaching skirt to radiator support.
6. Remove two (2) top rear fender bolts and shims.
7. Remove bolt and shims at bottom of fender.
8. Remove bolts attaching skirt to underbody.
9. Remove two (2) screw attaching support bracket to fender.
10. Remove five (5) screws attaching radiator support to front fender.
11. Lift fender and skirt from truck.

Installation

Install front fender and skirt assembly in reverse order of removal.

RUNNING BOARDS

Refer to Fig. 2C-17 for removal and installation of running boards.

Fender Skirt - P Model

Refer to figure 2C-18 for removal and installation of fender skirt, brackets, rear supports and hangers.

ADHESIVE BODY SIDE MOLDING

Body side moldings are attached to body panels with butyl adhesive tape. To insure a good molding replacement (new or old moldings), the panel surface should be warm (21 to 32°C or 70 to 90°F), clean and free of any wax or oily film residue. Two methods are listed for attaching loose molding ends and completely removed moldings.

Molding End Loose

1. Wash affected area with detergent and water and wipe dry. Wipe panel and adhesive side of molding with clean naphtha or alcohol.

   If molding has separated from adhesive backing (tape remains on body panel), do not remove tape from body. Clean back of molding and tape on body with naphta or alcohol and proceed with step 3.
2. If needed, apply a length of masking tape as a molding guideline. A suitable straightedge may also be used in most cases.
3. Apply adhesive to back of molding and press in place.
   a. If Loctite 414 adhesive (part no. 1052283) or equivalent is used, apply constant pressure to molding for 30 seconds or until a firm bond has been established.

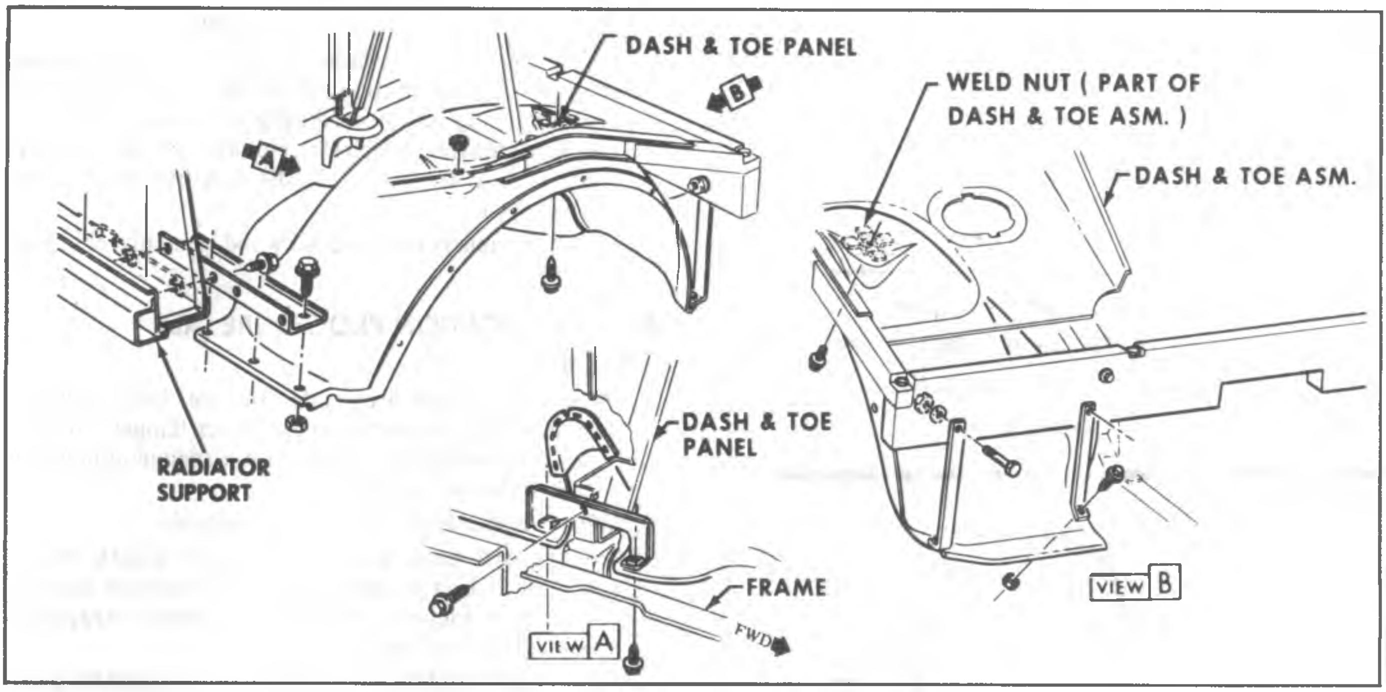

Fig. 2C-18--Fender Skirt, Dash and Toe Pan-P Series

b. If 3M Super Weatherstrip Adhesive (or equivalent) is used, tape molding in place for 15 minutes. Use naphtha for clean-up.

c. If 3M Plastic and Emblem Adhesive (or equivalent) is used, follow package instructions for apply adhesive and tape molding in place for 30 minutes.

Molding Completely Removed

1. Wash affected panel area with soap and water and wipe dry. Remove all traces of adhesive from body panel and back of molding using oil-free naphtha or alcohol.
2. Mark proper alignment position of molding with a length of masking tape. Use adjacent moldings as a guide, if applicable (view A, Fig. 2C-19.)
3. If body is below 70°F (21°C) due to shop temperature or prior outside temperature, warm body panel with heat lamp or heat gun while proceeding with step 4.
4. Apply 3M Neoprene Fame Tape, Part No. 06377 or 06378 or equivalent to molding.
5. Align molding to previously installed tape guideline and firmly press in place.

WOOD GRAIN APPLIQUE

General

The wood grain applique (transfer film) is a vinyl material with a pressure sensitive adhesive backing. The transfers are serviced in precut panels. The transfers are designed with an appealing wood grain pattern and a 50 degree or semigloss finish.

Preparation of the surface to which the transfer will be applied is very important. In cases where body metal repair has been made it is necessary to prime and color coat these areas to blend with the undamaged surface. Apply the transfer film to color coated panels only, never to bare metal or primer.

The surface must be free of any imperfections that might high-light through the film. Remove dirt nibs and other foreign material in the paint by light sanding with 600 grit sandpaper.

The temperature of the body must be maintained at a moderate level between approximately 70 and 90°F (21 and 32°C). Too warm a body will cause the wood grain film to stick prematurely while too cool a body will reduce the adhesion of the wood grain film. Cool the body panel with cool water when too warm and heat the body panel with a heat gun or a heat lamp when too cold.

Transfers should not be replaced in temperatures below 65 ° F (18°C). The transfer should not be subjected to temperature greater than 175°F (79°C) and should not be left at or near this temperature for extended periods of time.

Shelf life of the transfer material is 90 days at a temperature not to exceed 105°F (40°C).

Removal

Remove the moldings from the affected panel. The transfer film may then be removed by lifting an edge and peeling the material from the painted surface. Exercise care so as not to damage the paint. Application of heat to the transfer and the panel by means of a heat gun or heat lamp will aid in the removal.

Installation

1. With a solvent dampened sponge, clean entire surface to be covered with applique.
2. Wipe area dry with a clean cloth.
3. Prior to application of transfer, wet down the complete transfer surface of the fender with a solution of 1/4 oz. of neutral detergent cleaner (must not contain oils, perfumes, or bleaches) per gallon of clear water. It is essential that no substitute for this solution be used and that the specified proportions be maintained.
4. While entire area is still wet with solution, remove paper backing from transfer and align upper

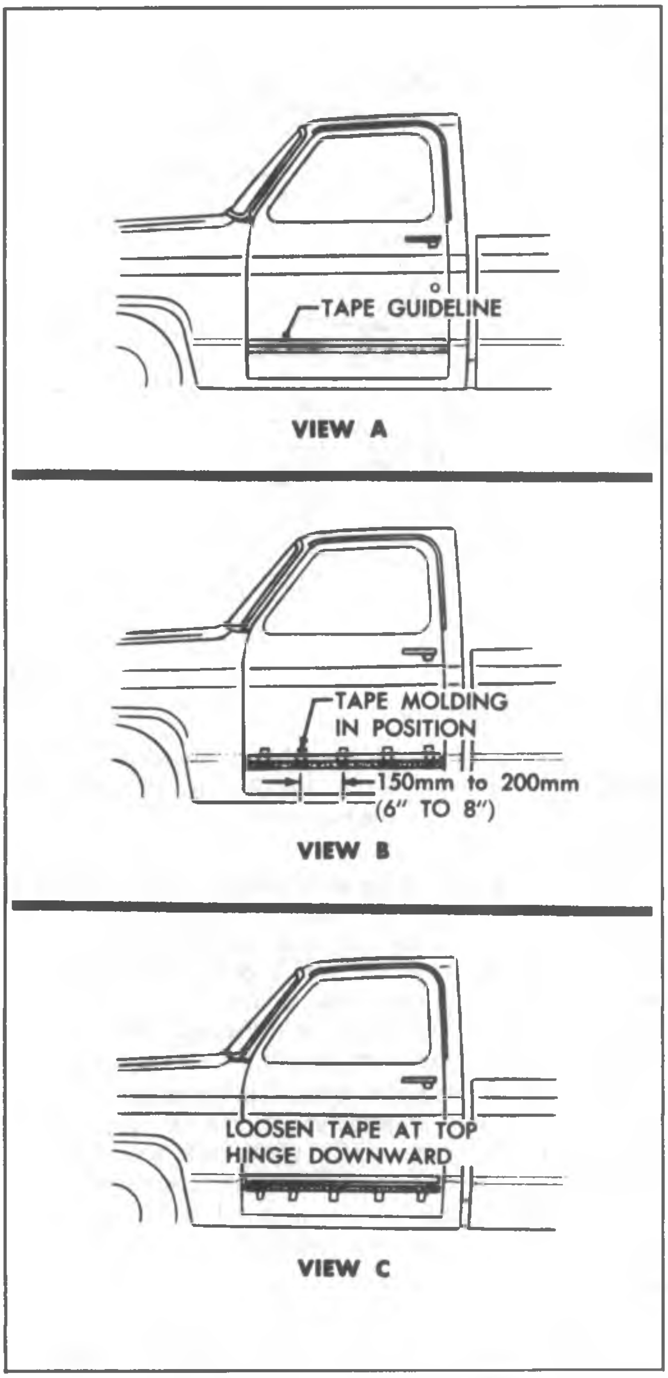

Fig. 2C-19--Molding Application

edge with pierced holes in fender and press on lightly.

5. Start at center of transfer and squeeze outboard from middle to edges removing all air bubbles and wetting solution to assure a satisfactory bond. Use teflon-backed plastic squeegee only.
6. Notch applique at fender rear contour bend areas with scissors. Also notch out front marker lamp.
7. Fold ends of applique over fender flanges using squeegee. Heat the wrap-around area of applique with a heat lamp or gun to approximately 90°F (32°C) and press with squeegee to secure entire edge surface.
8. If the wrap-around of the transfer has trouble sticking to fender edges, brush vinyl adhesive onto the fender or transfer area. Allow the adhesive to set for one minute then press transfer to fender for adhesion.
9. Inspect transfer installation from critical angle using adequate light reflection to detect any irregularities that may have developed during installation. Remove all air or moisture bubbles by piercing each at an acute angle with a fine pin or needle and by pressing the bubble down.
10. Install previously removed parts and clean up vehicle as required.

DECAL APPLICATION PROCEDURE (ALL VEHICLES)

1. Wipe clean the entire fender surface, body surface, door jam flanges, door facings, fender flanges, etce, to be covered with the transfer with a sponge dampened with Naptha or equivalent.
2. Wipe cleaned surface dry with clean cloth.
3. Starting with front fender, cut stripe to length. Allow excess at ends if necessary to avoid handling ends of stripe with fingers. Trim excess before wrapping around or tucking ends.
4. Remove about 6.00 in. (152.4mm) of the paper backing from stripe and align stripe on vehicle. Fender stripe should bridge the gap at the fender extension, be tucked in with the edge of the squeegee and then trimmed with a razor blade.
5. Pressurize stripe with a soft squeegee or a felt pad. Do not use thumbs or fingers as adequate pressure cannot be applied.
6. Remove the decal backing about 12.00 in. (304.8mm) at a time careful not to touch adhesive with fingers and repeat step no. 5.
7. After complete pressurization, remove the protective premask from the stripes at 180° angle.
8. Repeat above steps no. 4 thru 7 for the doors, quarter panels, and end caps.
9. Fold material around wrap areas, pressurize, heat to approximately 90°F (32°C) with heat gun, and repressurize.
10. Heat all areas at ends of stripes (end caps, front of fender, rear of quarter panel, etc.)
11. Reinspect entire stripe, especially ends and wraps and re- pressurize and heat where necessary to insure entire stripe is down.
12. Best results are obtained when metal temperature is 70°90°F (21°32°C). Use heat gun or allow cooling time when metal is outside approximate temperature range.
13. The maximum temperature that the tape should be subjected to is 175°F (79°C) (paint repair oven temperature). No tape stripe job should be left in a paint repair oven as damage to the tape may occur.
14. The tape will not be affected by any of the cleaning solvents, waxes or detergents now being used at the assembly plants. Acrylic lacquer solvents will affect the clear coating over the vinyl.
15. This tape stripe highlights metal imperfections so that all dings and rough metal must be repaired before applying the tape.
16. If after application of stripes, there appears to be bubbles in the surface of the tape stripes,

piercing them with an ordinary safety pin will relieve the en- trapped air so that the bubble can be smoothed out.

17. Shelf life of the vinyl tape is 90 days at a maximum temperature of 105°F (40°C).

REPAIR

Repair is required when:

1. If the tape is damaged.
2. The paint is damaged as the tape is pulled back for realignment or releasing traped air.

The following repair procedure is recommended:

1. If the tape is ruined with no paint being removed, the surface should be wiped with a prep-sol to insure a smooth and clean surface. Another section of tape would then be applied according to the application procedure.
2. If a section of paint is removed when the tape is pulled away, the area must be repainted and feathered into the adjoining surfaces. Another section of tape should be applied according to the application procedure.

REMOVAL

Removal of decal should cause it to be permanently damaged. Test to be conducted at an ambient temperature not to exceed 90°F (32°C) and after a minimum of 72 hours aging.

For Large Decals

1. Prior to application of transer, wet down the complete transfer surface with a solution of 0.25 oz. of neutral detergent cleaner (must not contain oils, perfumes, or bleaches) per gallon of clear water. It is essential that no substitute for this solution be used and that the specified proportions be maintained.
2. While entire area is still wet with solution, remove paper backing from transfer, locate and press on lightly.
3. Start at center of transfer and squeegee outboard from middle to edges, removing all air bubbles and wetting solution to assure a satisfactory bond. Use teflon-backed plastic squeegee only.

TORQUE SPECIFICATIONS

	CK	G
Lock to Bracket & Rad. Support	27 N·m (20 ft. lbs.)	
Lock Support to Hood		17 N·m (150 in. lbs.)
Lock Bolt Nut		54 N·m (40 ft. lbs.)
Bumper Bolt Nut		17 N·m (150 in. lbs.)
Hood Hinge	24 N·m (18 ft. lbs.)	24 N·m (18 ft. lbs.)
Hood Lock Catch	27 N·m (20 ft. lbs.)	24 N·m (18 ft. lbs.)
Lock Support to Rad. Support	17 N·m (150 in. lbs.)	24 N·m (18 ft. lbs.)
Rad. Support to Frame	48 N·m (35 ft. lbs.)	
Rad. Support to Fender	17 N·m (150 in. lbs.)	
Fender Skirt to Fender	17 N·m (150 in. lbs.)	
Fender to Cowl	48 N·m (35 ft. lbs.)	
Rad. Grille Panel Lower	17 N·m (150 in. lbs.)	

SECTION 3
STEERING, SUSPENSION, WHEELS AND TIRES

DIAGNOSIS 3-1

FRONT END ALIGNMENT 3A-1

STEERING LINKAGE 3B1-1

MANUAL STEERING GEAR 3B2-1

POWER STEERING SYSTEM 3B3-1

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WHEELS AND TIRES 3E-1

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Ball Joints 3-26
Bearings and Races 3-27

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Play or Looseness in Steering System.	Front wheel bearings loosely adjusted.	Adjust bearings to obtain proper end play.
	Worn steering shaft couplings.	Replace part.
	Worn upper ball joints.	Check and replace if necessary.
	Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.	Tighten to specified torque, or replace if necessary.
	Steering gear thrust bearings loosely adjusted.	Adjust preload to specification.
	Excessive over-center lash in steering gear.	Adjust preload to specification.
	Worn intermediate rod or tie rod sockets.	Replace worn part.
Excessive looseness in tie rod or intermediate rod pivots, or excessive vertical lash in idler support.	Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear.	Replace damaged parts as necessary. Properly position upon reassembly.
Excessive vertical lash in idler arm (P Series Motorhome)	Excessive end play in support assembly.	Adjust end play.

Fig. 3-1--Steering Linkage Diagnosis A

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Steering – Excessive Effort Required at Steering Wheel.	Low or uneven tire pressure.	Inflate to specified pressures.
	Steering linkage or bolt joints need lubrication.	Lube with specified lubricant.
	Tight or frozen intermediate rod, tie rod or idler socket.	Lube replace or reposition as necessary.
	Steering gear to column misalignment.	Align column.
	Steering gear adjusted too tightly.	Adjust over-center and thrust bearing preload to specification.
	Front wheel alignment incorrect. (manual gear)	Check alignment and correct as necessary.
Poor Returnability.	Steering linkage or ball joints need lubrication.	Lube with specified lubricant.
	Steering gear adjusted too tightly.	Adjust over-center and thrust bearing preload to specifications.
	Steering gear to column misalignment.	Align column.
	Front wheel alignment incorrect. (Caster)	Check alignment and correct as necessary.

Fig. 3-2--Steering Linkage Diagnosis B

CONDITION	POSSIBLE CAUSE	CORRECTION
Rattle or Chuck in Steering Gear.	Insufficient or improper lubricant in steering gear.	Add lube specified.
	Pitman arm loose on shaft or steering gear mounting bolt loose.	Tighten to specified torque.
	Loose or worn steering shaft bearing.	Replace steering shaft bearing.
	Excessive over-center lash or worm thrust bearings adjusted too loose. NOTE: On turns a slight rattle may occur, due to the increased lash between ball nut and pitman shaft as gear moves off the center of "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.	Adjust steering gear to specified preloads.
Poor Returnability	Steering column misaligned.	Align column.
	Insufficient or improper lubricant in steering gear or front suspension.	Lubricate as specified.
	Steering gear adjusted too tight.	Adjust over-center and thrust bearing preload to specifications.
	Front wheel alignment incorrect (Caster)	Adjust to specifications.

Fig. 3-3--Manual Steering Gear Diagnosis A

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Play or Looseness in Steering System.	Front wheel bearings loosely adjusted.	Adjust to obtain proper end play.
	Worn upper ball joints.	Check and replace ball joints if necessary.
	Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball nuts.	Tighten to specification, replace if worn or damaged.
	Excessive over-center lash.	Adjust over-center preload to specifications.
	Worm thrust bearings loosely adjusted.	Adjust worm thrust bearing preload to specifications.
Hard Steering – Excessive Effort Required at Steering Wheel	Low or uneven tire pressure.	Inflate to specified pressures.
	Insufficient or improper lubricant in steering gear or front suspension.	Lubricate as specified. Re-lubricate at specified intervals.
	Steering shaft flexible coupling misaligned.	Align column and coupling.
	Steering gear adjusted too tight.	Adjust over-center and thrust bearing preload to specifications.
	Front wheel alignment incorrect. (Manual Gear)	Adjust to specifications.

Fig. 3-4--Manual Steering Gear Diagnosis B

CONDITION	POSSIBLE CAUSE	CORRECTION
SYSTEM NOISE There is some noise in all power steering systems. Common complaints are listed as follows:		
Pump noise-"chirp".	Loose belt.	Adjust belt tension to specification.
Belt squeal.	Loose belt.	Adjust belt tension to specification.
Gear noise ("hissing" sound)	There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill.	Do not replace valve unless "hiss" is extremely objectionable. Slight "hiss" is normal and in no way affects steering. A replacement valve will also exhibit slight noise and is not always a cure for the objection. Investigate clearance around flexible coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit "hiss" into passenger compartment. Also, check for proper sealing between steering column and toe pan.
Rattle.	Pressure hose touching other parts of car.	Adjust hose position.
	Loose pump pulley nut	Replace nut, torque to specs.
	Pump vanes not installed properly.	Install properly.
	Pump vanes sticking in rotor slots.	Free up by removing burrs, varnish or dirt.
Gear noise (rattle or chuckle).	Improper over-center adjustment NOTE: A slight rattle may occur on turns because of increased clearance off the "high point". This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	Adjust to specifications.
	Loose pitman arm.	Tighten to specifications
	Gear loose on frame.	Check gear-to-frame mounting bolts. Tighten bolts to 70 foot-pounds.
Rattle or chuckle.	Steering linkage looseness.	Check linkage pivot points for wear. Replace if necessary.
Groan.	Low oil level.	Fill reservoir to proper level.
Groan.	Air in the oil. Poor pressure hose connection.	Bleed system by operating steering from right to left – full turn. Check connections, torque to specs.
Growl.	Excessive back pressure caused by hoses or steering gear. (restriction)	Locate restriction and correct. Replace part if necessary.

Fig. 3-5--Power Steering System Diagnosis A

CONDITION	POSSIBLE CAUSE	CORRECTION
Pump growl Note: Most noticeable at full wheel travel and stand still parking	Scored pump pressure plates, thrust plate or rotor.	Replace affected parts, flush system.
	Extreme wear of pump cam ring.	Replace affected parts.
Swish in pump	Defective pump flow control valve	Replace valve
Whine in pump	Pump shaft bearing scored.	Replace housing and shaft, flush system
Squawk in gear (not belt)	Damper "O" ring on valve spool cut	Replace "O" ring.
SYSTEM OPERATION		
Excessive wheel kick-back or loose steering.	Backlash in steering linkage.	Adjust parts affected or replace worn parts.
	Air in system.	Add oil to pump reservoir and bleed by operating steering. Check all connections.
	Excessive "over-center" lash.	Adjust to specification.
	Loose thrust bearing preload adjustment.	Adjust to specification.
	Worn poppet valve (Gear)	Replace poppet valve.
	Steering gear loose on frame.	Tighten attaching bolts to 70 foot-pounds.
	Steering gear flexible coupling too loose on shaft or rubber disc mounting screws loose.	Tighten flange pinch bolts to 30 foot-pounds, if serrations are not damaged. Tighten upper flange to coupling nuts to 20 foot-pounds.
	Steering linkage ball studs worn enough to be loose.	Replace loose components.
	Front wheel bearings incorrectly adjusted or worn.	Adjust bearings or replace with new parts as necessary.
Poor return of steering.	Tires under-inflated.	Inflate to specified pressure.
	Lower coupling flange rubbing against steering gear adjuster plug.	Loosen pinch bolt and assemble properly.
	Steering wheel rubbing against directional signal housing.	Adjust steering jacket.
	Tight or frozen steering shaft bearings.	Replace bearings.
	Steering linkage or ball joints binding.	Replace affected parts.
	Steering gear to column misalignment.	Align steering column.
	Tie rod pivots not centralized.	Adjust tie rod ends as required to center pivots.
	Lack of lubricant in suspension ball joints and steering linkage	Lubricate and relubricate at proper intervals

Fig. 3-6--Power Steering System Diagnosis B

CONDITION	POSSIBLE CAUSE	CORRECTION
Poor return of steering. (Cont'd.)	Steering gear adjustments over specifications.	Check adjustment with pitman arm disconnected. Readjust if necessary.
	Sticky or plugged valve spool.	Remove and clean or replace valve.
	Rubber spacer binding in shift tube.	Make certain spacer is properly seated. Lubricate inside diameter with silicone lubricant.
	Improper front suspension alignment.	Check and adjust to specifications.
	Tight steering shaft bearings.	Replace bearings.
Car leads to one side or the other. (Keep in mind road condition and wind. Test car on flat road going in both directions)	Front suspension misaligned	Adjust to specifications.
	Steering shaft rubbing ID of shift tube.	Align column.
	Unbalanced or badly worn steering gear valve. **NOTE:** If this is cause, steering effort will be very light in direction of lead and heavy in opposite direction.	Replace valve.
	Steering linkage not level.	Adjust as required.
Steering wheel surges or jerks when turning with engine running especially during parking.	Low oil level in pump.	Check oil level, add as necessary.
	Loose pump belt.	Adjust tension to specification.
	Sticky flow control valve.	Inspect for varnish or damage, replace if necessary.
	Insufficient pump pressure.	Check pump pressure. (See pump pressure test). Replace relief valve if defective.
	Steering linkage hitting engine oil pan at full turn.	Correct clearance.
Momentary increase in effort when turning wheel fast to right or left.	Pump belt slipping.	Tighten or replace belt.
	Low oil level in pump.	Check oil level, add as necessary.
	High internal leakage.	Check pump pressure (Test)
Hard steering or lack of assist.	High internal leakage. (Gear or pump)	Check pump pressure. (See pump pressure test).
	Loose pump belt.	Adjust belt tension to specification.
	Low oil level in reservoir.	Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage, torque to specs.

Fig. 3-7--Power Steering System Diagnosis C

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Steering or lack of assist (Continued)	Lack of lubricant in suspension or ball joints.	Lubricate, relubricate at proper intervals.
	Tires not properly inflated.	Inflate to recommended pressure.
	Steering gear to column misalignment.	Align steering column.
	Steering gear adjusted too tight.	Test steering system for binding with front wheels off floor. Adjust as necessary.
	Excessive friction in steering linkage.	Check tie rod pivot points for excessive friction. Replace the affected pivot.
	Lower coupling flange rubbing against steering gear adjuster plug.	Loosen pinch bolt and assemble properly.
	Sticky flow control valve.	Replace or clean valve.
	Frame bent.	Check frame for proper alignment or cracking. Repair or replace as necessary.
	Front springs weak and sagging.	Check standing height. Weak or sagging springs should be replaced with new ones.
	Insufficient oil pressure.	If above checks do not reveal cause of hard steering, diagnose hydraulic system to determine problem.
Low oil pressure due to restriction in hoses:	Check for kinks in hoses.	Remove kink.
	Foreign object stuck in hose.	Remove hoses and remove restricting object or replace hose.
Low oil pressure due to steering gear:	Pressure loss in cylinder due to worn piston ring or scored housing bore.	Remove gear from car for disassembly and inspection of ring and housing bore. Replace affected parts.
(See pump pressure test)	Leakage at valve rings, valve body to worm seal.	Remove gear from car for disassembly and replace seals.
	Loose fit of spool in valve body or leaky valve body.	Replace valve.
	Damaged poppet valve.	Replace valve.

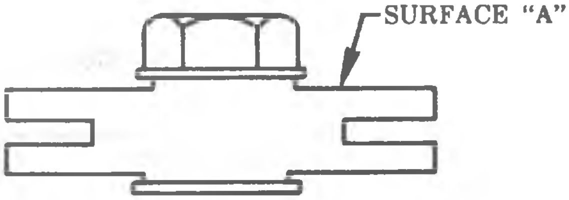
Fig. 3-8--Power Steering System Diagnosis D

CONDITION	POSSIBLE CAUSE	CORRECTION
Low oil pressure due to steering pump: (See pump pressure test.)	Loose belt.	Adjust tension to specification
	Low oil level.	Fill reservoir to proper level.
	Air in the oil.	Locate source of leak and correct. Bleed system.
	Defective hoses or steering gear.	Correct as necessary.
	Flow control valve stuck or inoperative.	Remove burrs or dirt or replace.
	Loose screw in end of flow control valve.	Tighten.
	Cracked or broken thrust or pressure plate.	Replace part.
	Pressure plate not flat against cam ring.	Replace pressure plate.
Note: Steering system external leakage	Extreme wear of cam ring.	Replace parts, flush system
	Scored pressure plate, thrust plate or rotor.	Replace parts. (If rotor, replace with rotating group kit), flush system
	Vanes not installed properly.	Install properly. Radius edge to outside.
	Vanes sticking in rotor slots.	Free-up by removing burrs, varnish or dirt.
Foaming milky power steering fluid, low level and possible low pressure.	Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeriation should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.

Fig. 3-9--Power Steering System Diagnosis E

Instrument Panel Bracket Capsule Damage

NOTE: The bolt head must not contact surface "A". If contact is made, the capsule shear load will be increased. If this condition exists replace the bracket.



AUTOMATIC TRANSMISSION COLUMNS

LOCK SYSTEM – WILL NOT UNLOCK

Cause	Solution
A. Lock bolt damaged.	A. Replace lock bolt.
B. Defective lock cylinder.	B. Replace or repair lock cylinder.
C. Damaged housing.	C. Replace housing.
D. Damaged or collapsed sector.	D. Replace sector.
E. Damaged rack.	E. Replace rack.
F. Shear Flange on sector shaft collapsed.	F. Replace.

LOCK SYSTEM WILL NOT LOCK

Cause	Solution
A. Lock bolt spring broken or defective.	A. Replace spring.
B. Damaged sector tooth, or sector installed incorrectly.	B. Replace, or install correctly.
C. Defective lock cylinder.	C. Replace lock cylinder
D. Burr or lock bolt or housing.	D. Remove Burr.
E. Damaged housing.	E. Replace housing.
F. Transmission linkage adjustment incorrect.	F. Readjust (see Sec. 7).
G. Damaged rack.	G. Replace rack.
H. Interference between bowl and coupling (tilt).	H. Adjust or replace as necessary.
I. Ignition switch stuck.	I. Readjust or replace.
J. Actuator rod restricted or bent.	J. Readjust or replace.

LOCK SYSTEM – HIGH EFFORT

Cause	Solution
A. Lock cylinder defective.	A. Replace lock cylinder.
B. Ignition switch defective.	B. Replace switch.
C. Rack preload spring broken or deformed.	C. Replace spring.
D. Burrs on sector, rack, housing, support, tang of shift gate or actuator rod coupling.	D. Remove Burr.
E. Bent sector shaft.	E. Replace shaft.
F. Distorted rack.	F. Replace rack
G. Misalignment of housing to cover (tilt only).	G. Replace either or both.

Fig. 3-10--Auto Transmission Column Diagnosis A

LOCK SYSTEM – HIGH EFFORT (CONT'D.)

Cause	Solution
H. Distorted coupling slot in rack (tilt).	H. Replace rack.
I. Bent or restricted actuator rod.	I. Straighten remove restriction or replace.
J. Ignition switch mounting bracket bent.	J. Straighten or replace.

HIGH EFFORT LOCK CYLINDER – BETWEEN "OFF" AND "OFF-LOCK" POSITIONS

Cause	Solution
A. Burr on tang of shift gate.	A. Remove burr.
B. Distorted rack.	B. Replace rack.

STICKS IN "START" POSITION

Cause	Solution
A. Actuator rod deformed.	A. Straighten or replace.
B. Any high effort condition.	B. Check items under high effort section.

KEY CAN NOT BE REMOVED IN "OFF-LOCK" POSITION

Cause	Solution
A. Ignition switch is not set correctly.	A. Readjust ignition switch.
B. Defective lock cylinder.	B. Replace lock cylinder.

LOCK CYLINDER CAN BE REMOVED WITHOUT DEPRESSING RETAINER

Cause	Solution
A. Lock cylinder with defective retainer.	A. Replace lock cylinder.
B. Lock cylinder without retainer.	B. Replace lock cylinder.
C. Burr over retainer slot in housing cover.	C. Remove burr.

LOCK BOLT HITS SHAFT LOCK IN "OFF" AND "PARK" POSITIONS

Cause	Solution
A. Ignition switch is not set correctly.	A. Readjust ignition switch.

IGNITION SYSTEM – ELECTRICAL SYSTEM WILL NOT FUNCTION

Cause	Solution
A. Defective fuse in "accessory" circuit.	A. Replace fuse.
B. Connector body loose or defective.	B. Tighten or replace.
C. Defective wiring.	C. Repair or replace.

Fig. 3-11–Auto Transmission Column Diagnosis B

IGNITION SYSTEM – ELECTRICAL SYSTEM – WILL NOT FUNCTION (CONT'D.)

Cause	Solution
D. Defective ignition switch.	D. Replace ignition switch.
E. Ignition switch not adjusted properly.	E. Readjust ignition switch.

SWITCH WILL NOT ACTUATE MECHANICALLY

Cause	Solution
A. Defective ignition switch.	A. Replace igntion switch.

SWITCH CAN NOT BE SET CORRECTLY

Cause	Solution
A. Switch actuator rod deformed.	A. Repair or replace switch actuator rod.
B. Sector to rack engaged in wrong tooth (tilt).	B. Engage sector to rack correctly.

NOISE IN COLUMN

Cause	Solution
A. Coupling bolts loose.	A. Tighten pinch bolts to specified torque.
B. Column not correctly aligned.	B. Realign column.
C. Coupling pulled apart.	C. Replace coupling and realign column.
D. Sheared intermediate shaft plastic joint.	D. Replace or repair steering shaft and realign column.
E. Horn contact ring not lubricated.	E. Lubricate with lubriplate.
F. Lack of grease on bearings or bearing surfaces.	F. Lubricate bearings.
G. Lower shaft bearing tight or frozen.	G. Replace bearing. Check shaft and replace if scored.
H. Upper shaft tight or frozen.	H. Replace housing assembly.
I. Shaft lock plate cover loose.	I. Tighten three screws or, if missing, replace. CAUTION: Use specified screws. (15 in. lbs.)
J. Lock plate snap ring not seated.	J. Replace snap ring. Check for proper seating in groove.
K. Defective buzzer dog cam on lock cylinder.	K. Replace lock cylinder.
L. One click when in "off-lock" position and the steering wheel is moved.	L. Normal condition - lock bolt is seating.

Fig. 3-12–Auto Transmission Column Diagnosis C

HIGH STEERING SHAFT EFFORT

Cause	Solution
A. Column assembly misaligned in vehicle.	A. Realign.
B. Improperly installed or deformed dust seal.	B. Remove and replace.
C. Tight or frozen upper or lower bearing.	C. Replace affected bearing or bearings.
D. Flash on I.D. of shift tube from plastic joint.	D. Replace shift tube.

HIGH SHIFT EFFORT

Cause	Solution
A. Column not aligned correctly in car.	A. Realign.
B. Improperly installed dust seal.	B. Remove and replace.
C. Lack of grease on seal or bearing areas.	C. Lubricate bearings and seals.
D. Burr on upper or lower end of shift tube.	D. Remove burr.
E. Lower bowl bearing not assembled properly (tilt).	E. Reassemble properly.
F. Wave washer with burrs (tilt only).	F. Replace wave washer.

IMPROPER TRANSMISSION SHIFTING

Cause	Solution
A. Sheared shift tube joint.	A. Replace shift tube assembly.
B. Improper transmission linkage adjustment.	B. Readjust linkage.
C. Loose lower shift lever.	C. Replace shift tube assembly.
D. Improper gate plate.	D. Replace with correct part.
E. Sheared lower shift lever weld.	E. Replace tube assembly.

LASH IN MOUNTED COLUMN ASSEMBLY

Cause	Solution
A. Instrument panel mounting bolts loose.	A. Tighten to specifications. (20 ft. lbs.)
B. Broken weld nuts on jacket.	B. Replace jacket assembly.
C. Instrument panel bracket capsule sheared.	C. Replace bracket assembly.
D. Instrument panel to jacket mounting bolts loose.	D. Tighten to specifications. (15 ft. lbs.)
E. Loose shoes in housing (tilt only).	E. Replace.
F. Loose tilt head pivot pins (tilt only).	F. Replace.
G. Loose shoe lock pin in support (tilt only).	G. Replace.

MISCELLANEOUS

Cause	Solution
A. Housing loose on jacket - will be noticed with ignition in "Off-Lock" and a torque applied to the steering wheel.	A. Tighten four mounting screws - (60 in. lbs.)
B. Shroud loose on shift bowl.	B. Bend tabs on shroud over lugs on bowl.

Fig. 3-13--Auto Transmission Column Diagnosis D

MANUAL TRANSMISSION COLUMNS

GENERAL INFORMATION

All of the preceding diagnosis information for automatic transmission will apply to the manual transmission. The following information is supplied in addition to and specifically for manual transmission columns.

DRIVER CAN LOCK STEERING IN SECOND GEAR

Cause	Solution
A. Defective upper shift lever.	A. Replace shift lever.
B. Defective shift lever gate.	B. Replace shift lever gate.
C. Loose relay lever on shift tube.	C. Replace shift tube assembly.

HIGH SHIFT EFFORT

Cause	Solution
A. Column not aligned correctly in car.	A. Realign column.
B. Lower bowl bearing not assembled correctly.	B. Reassemble correctly.
C. Improperly installed seal.	C. Remove and replace.
D. Wave washer in lower bowl bearing defective.	D. Replace wave washer.
E. Improper adjustment of lower shift levers.	E. Readjust (see Sec. 7).
F. Lack of grease on seal. bearing areas or levers.	F. Lubricate seal, levers and bearings.
G. Damaged shift tube in bearing areas.	G. Replace shift tube assembly.

IMPROPER TRANSMISSION SHIFTING

Cause	Solution
A. Loose relay lever on shift tube.	A. Replace shift tube assembly.

Fig. 3-14--Manual Transmission Column Diagnosis

TILT COLUMNS

GENERAL INFORMATION

All of the preceding diagnosis will generally apply to tilt columns. The following is supplied in addition to and specifically for tilt columns.

HOUSING SCRAPING ON BOWL

Cause	Solution
A. Bowl bent or not concentric with hub.	A. Replace bowl.

STEERING WHEEL LOOSE

Cause	Solution
A. Excessive clearance between holes in support or housing and pivot pin diameters.	A. Replace either or both.
B. Defective or missing anti-lash spring in spheres.	B. Add spring or replace both.
C. Upper bearing seat not seating in bearing.	C. Replace both.
D. Upper bearing inner race seat missing.	D. Install seat.
F. Loose support screws.	F. Tighten to 60 in. lbs.
G. Bearing preload spring missing or broken.	G. Replace preload spring.

STEERING WHEEL LOOSE EVERY OTHER TILT POSITION

Cause	Solution
A. Loose fit between shoe and shoe pivot pin.	A. Replace both.

NOISE WHEN TILTING COLUMN.

Cause	Solution
A. Upper tilt bumper worn.	A. Replace tilt bumper.
B. Tilt spring rubbing in housing.	B. Lubricate.

STEERING COLUMN NOT LOCKING IN ANY TILT POSITION

Cause	Solution
A. Shoe seized on its pivot pin. ivot pin.	A. Replace shoe and. pivot pin.
B. Shoe grooves may have burrs or dirt.	B. Replace shoe.
C. Shoe lock spring weak or broken.	C. Replace lock spring.

STEERING WHEEL FAILS TO RETURN TO TOP TILT POSITION

Cause	Solution
A. Pivot pins are bound up.	A. Replace pivot pins.
B. Wheel tilt spring is defective.	B. Replace tilt spring.
C. Turn signal switch wires too tight.	C. Reposition wires.

Fig. 3-15--Tilt Column Diagnosis

SIGNAL SWITCH DIAGNOSIS		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
Turn signal will not cancel	A. Loose switch mounting screws B. Switch or anchor bosses broken C. Broken, missing or out of position detent, return or cancelling spring D. Uneven or incorrect cancelling cam to cancelling spring interference. (.120)/side	A. Tighten to specified torque (25 in-lbs) B. Replace switch C. Reposition or replace springs as required D. Adjust switch position 1. If interference is correct and switch will still not cancel, replace switch. 2. If interference cannot be corrected by switch adjustment, replace cancelling cam.
Turn signal difficult to operate	A. Actuator rod loose B. Yoke broken or distorted C. Loose or misplaced springs D. Foreign parts and/or materials E. Switch mounted loosely	A. Tighten mounting screw (12 in-lb) B. Replace switch C. Reposition or replace springs D. Remove foreign parts and/or material E. Tighten mounting screws (25 in-lbs)
Turn signal will not indicate lane change	A. Broken lane change pressure pad or spring hanger B. Broken, missing or misplaced lane change spring C. Jammed base or wires	A. Replace switch B. Replace or reposition as required C. Loosen mounting screws, reposition base or wires and retighten screws (25 in-lbs)
Turn signal will not stay in turn position	A. Foreign material or loose parts impeding movement of yoke B. Broken or missing detent or cancelling springs C. None of the above	A. Remove material and/or parts B. Replace spring C. Replace switch
Hazard switch cannot be turned off	A. Foreign material between hazard support cancelling leg and yoke	A. Remove foreign material 1. No foreign material impeding function of hazard switch – replace turn signal switch

Fig. 3-16--Turn Signal Switch Diagnosis A

SIGNAL SWITCH DIAGNOSIS		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
Hazard switch will not stay on or difficult to turn off	A. Loose switch mounting screws B. Interference with other components C. Foreign material D. None of the above	A. Tighten mounting screws (25 in-lbs) B. Remove interference C. Remove foreign material D. Replace switch
No turn signal lights	A. Defective or blown fuse B. Inoperative turn signal flasher C. Loose chassis to column connector D. Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand. If vehicle lights now operate normally, signal switch is inoperative E. If vehicle lights do not operate check chassis wiring for opens, grounds, etc.	A. Replace fuse and check operation B. Replace turn signal flasher C. Connect securely, check operation D. Replace signal switch E. Repair chassis wiring as required using manual as guide
Turn indicator lights on, but not flashing	A. Inoperative turn flasher B. Loose chassis to column connection C. Inoperative turn signal switch D. To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand. If the vehicle's lights operate normally, signal switch is inoperative E. If the vehicle's lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.	A. Replace turn flasher Note: There are two flashers in the system. Consult manual for location. B. Connect securely and check operation C. Replace turn signal switch D. Replace signal switch E. Repair chassis wiring as required using manual as guide

Fig. 3-17--Turn Signal Switch Diagnosis B

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Front or rear turn signal lights not flashing	A. Burned out fuse B. Burned out or damaged turn signal bulb C. High resistance connection to ground at bulb socket D. Loose chassis to column connector E. Disconnect column to chassis connector. Connect new switch into system and operate switch by hand. If turn signal lights are now on and flash, turn signal switch is inoperative. F. If vehicle lights do not operate, check chassis wiring harness to light sockets for opens, grounds, etc.	A. Replace fuse and check operation B. Replace bulb C. Remove or repair defective connection and check operation D. Connect securely and check operation E. Replace turn signal switch. F. Repair chassis wiring as required using manual as guide
Stop light not on when turn indicated	A. Burned out fuse B. Loose column to chassis connection C. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If brake lights work with switch in the turn position, signal switch is defective D. If brake lights do not work check connector to stop light sockets for grounds, opens, etc.	A. Replace fuse and check operation B. Connect securely and check operation C. Replace signal switch D. Repair connector to stop light circuits using manual as guide.
Turn indicator panel lights not flashing	A. Burned out bulbs B. High resistance to ground at bulb socket C. Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights	A. Replace bulbs B. Replace socket C. Locate and repair as required. Use shop manual as guide.

Fig. 3-18--Turn Signal Switch Diagnosis C

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal lights flash very slowly	A. Inoperative turn signal flasher B. System charging voltage low C. High resistance ground at light sockets D. Loose chassis to column connection E. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective. F. If the flashing rate is still extremely slow, check chassis wiring harness from the connector to light sockets for grounds, high resistance points, etc.	A. Replace turn signal flasher B. Increase voltage to specified. See Sec. 6Y C. Repair high resistance grounds at light sockets D. Connect securely and check operation E. Replace signal switch F. Locate and repair as required. Use manual as guide. See Section 12
Hazard signal lights will not flash — turn signal functions normally	A. Blown fuse B. Inoperative hazard warning flasher C. Loose chassis to column connection D. Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is defective. E. If the lights do not flash, check wiring harness "K" lead (brown) for open between hazard flasher and harmonica connector. If open, fuse block is defective.	A. Replace fuse and check operation B. Replace hazard warning flasher C. Connect securely and check operation D. Replace the turn signal switch E. Replace fuse block (See Sec. 12)

Fig. 3-19--Turn Signal Switch Diagnosis D

FRONT SUSPENSION DIAGNOSIS

HARD STEERING

Probable Cause	Probable Remedy
a. Ball joints and steering linkage need lubrication	a. Lubricate ball joints and linkage
b. Low or uneven front tire pressure	b. Inflate tires to the proper recommended pressure
c. Power steering partially or not operative	c. Check power steering components for proper operation
d. Steering gear not properly adjusted	d. Adjust steering gear
e. Incorrect front wheel alignment (manual steering)	e. Check and align front suspension

POOR DIRECTIONAL STABILITY

Probable Cause	Probable Remedy
a. Ball joints and steering linkage need lubrication	a. Lubricate at proper intervals
b. Low or uneven front or rear tire pressure	b. Inflate tires to the proper recommended pressure
c. Loose wheel bearings	c. Adjust wheel bearings
d. Steering Gear not on high point	d. Adjust steering gear
e. Incorrect front wheel alignment (caster)	e. Check and align front suspension
f. Broken springs	f. Replace springs
g. Malfunctioning shock absorber.	g. Diagnose shock absorbers.
h. Broken stabilizer bar, or missing link	h. Replace stabilizer or link

FRONT WHEEL SHIMMY (SMOOTH ROAD SHAKE)

Probable Cause	Probable Remedy
a. Tire and wheel out of balance, or out of round	a. Balance tires, check run-out
b. Worn or loose wheel bearings	b. Adjust wheel bearings
c. Worn tie rod ends	c. Replace tie rod end
d. Worn ball joints	d. Replace ball joints
e. Malfunctioning shock absorber	e. Diagnose shock absorbers

VEHICLE PULLS TO ONE SIDE (NO BRAKING ACTION)

Probable Cause	Probable Remedy
a. Low or uneven tire pressure	a. Inflate tires to the proper recommended pressure
b. Front or rear brake dragging	b. Adjust brakes
c. Broken or sagging front spring	c. Replace spring
d. Incorrect front wheel alignment (camber)	d. Check and align front suspension

EXCESSIVE PLAY IN STEERING

Probable Cause	Probable Remedy
a. Incorrect steering gear adjustment	a. Adjust steering gear
b. Worn steering gear parts	b. Overhaul gear

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Fig. 3-20--Front Suspension Diagnosis A

NOISE IN FRONT END

Probable Cause	Probable Remedy
a. Ball joints and steering linkage need lubrication	a. Lubricate at recommended intervals
b. Shock absorber loose or bushings worn	b. Tighten bolts and/or replace bushings
c. Worn control arm bushings	c. Replace bushings
d. Worn tie rod ends	d. Replace tie rod ends
e. Worn or loose wheel bearings	e. Adjust or replace wheel bearings
f. Loose stabilizer bar	f. Tighten all stabilizer bar attachments
g. Loose wheel nuts	g. Tighten the wheel nuts to proper torque
h. Spring improperly positioned	h. Reposition
i. Loose suspension bolts	i. Torque to specifications or replace

WHEEL TRAMP

a. Tire and wheel out of balance	a. Balance wheels
b. Tire and wheel out of round	b. Replace tire
c. Blister or bump on tire	c. Replace tire
d. Improper shock absorber action	d. Replace shock absorber

EXCESSIVE OR UNEVEN TIRE WEAR

a. Underinflated or overinflated tires	a. Inflate tire to proper recommended pressure
b. Improper toe-in	b. Adjust toe-in
c. Wheels out of balance	c. Balance wheels
d. Hard Driving	d. Instruct driver
e. Overloaded vehicle	e. Instruct driver

SCUFFED TIRES

a. Toe-in incorrect	a. Adjust toe-in to specifications
b. Excessive speed on turns	b. Advise driver
c. Tires improperly inflated	c. Inflate tires to proper recommended pressure
d. Suspension arm bent or twisted	d. Replace arm

CUPPED TIRES

a. Front shock absorbers defective	a. Replace shock absorbers
b. Worn ball joints	b. Replace ball joints
c. Wheel bearings incorrectly adjusted or worn	c. Adjust or replace wheel bearings
d. Wheel and tire out of balance	d. Balance wheel and tire
e. Excessive tire or wheel runout	e. Compensate for runout

Fig. 3-21--Front Suspension Diagnosis B

SHOCK ABSORBER DIAGNOSIS

ON VEHICLE CHECKS

(Follow the Procedures Outlined Below in the Order Indicated.)

Preliminary Inspection and Ride Test:

Tire Pressure

Check tire pressure, compare to vehicle specifications and adjust as required. Poor vehicle control and ride complaints are caused in many cases by improper tire inflation.

Special Suspension Equipment

Check Service Parts Identification Sticker for any special suspension equipment; such as, a heavy duty suspension. Vehicles equipped with this type of option have a somewhat stiffer or harsh ride, and this should be kept in mind during the following tests. If complaint about stiffness should occur while vehicle is still new (under 5,000 miles) (8 000 km), owner should be advised to have ride re-checked after 7,000 to 8,000 miles (11 200 to 12 800 km).

Vehicle Load Conditions

Note any exceptional load conditions under which the owner normally operates the vehicle; such as, large tool boxes full of tools, pick up bed full etc. If exceptional loading is apparent, check the distribution of this weight. Note if it is all toward one side of the vehicle or at the extreme rear of the vehicle. Reposition load as required to obtain a more uniform weight distribution.

Check Vehicle Ride and Handling

After completing previous checks, ride vehicle with owner to determine if problem has been corrected or to definitely establish type of problem that still exists. If problem still exists (poor handling, bottoming, noise, ride sway, etc.), proceed.

Inspecting and Testing the Shocks

Three procedures are included in this step. They are (a) Bounce Test, (b) Inspecting Shock Mountings for Noise (Looseness) and (c) Manually Operating Shocks to Determine if Shocks are Weak, Leaking Hydraulic Fluid, and/or if Shocks have an Internal Noise Condition.

Test procedures (b) and (c) require vehicle to be on a hoist that supports wheels or rear axle housing and front lower control arms.

Bounce Test

This is only a comparison type test to help locate the suspected shock or noise condition before proceeding.

Test each front and rear shock by bouncing each corner of the vehicle. This can usually be done by lifting up and pushing down on the end of the bumper near each corner of the vehicle until maximum movement up and down is reached. Then let go of bumper and observe if the up and down motion stops very quickly. If up and down motion continues longer at one corner when compared to opposite corner (example, both front shocks), the one having the longer up and down motion may be suspect. **Do Not** compare front to rear. If complaint is noise, this test should help to locate the suspected area.

Inspecting Shock Mountings

If noisy and/or loose shock mountings are suspected, place vehicle on hoist that supports wheels and check all mountings for the following conditions:

(1) Worn or defective grommets

(2) Loose mounting nuts

(3) Possible interference condition

(4) Bump stops missing

If no apparent defects are noted in this step but noise condition still exists when vehicle is bounced up and down, proceed.

Inspecting Shocks for Leaks and

Manually Operating Shocks

This procedure is subdivided into two general areas, (1) Inspecting Shocks for Loss of Hydraulic Fluid and (2) Manually Operating Shock. It should aid the technician to localize defective shocks caused by internal noise in the shock, weakness, leaking etc.

1. **Inspecting Shocks for Possible Loss of Hydraulic Fluid.**

(a) Disconnect each shock lower mounting as required and pull down on the shock until it is fully extended.

(b) Inspect shocks for leaks in seal cover area. Shock fluid is a very thin hydraulic fluid and has a characteristic odor and dark brown tint.

Certain precautions should be observed when inspecting shocks for leaks:

• shocks may have glossy paint on them. Do not confuse this paint with a leak condition.

• a slight trace of shock fluid around the seal cover area is **not** cause for replacement. The shock seal is engineered to permit a slight seepage to lubricate the rod. The shock absorber has reserve fluid to compensate for the slight seepage.

• shocks are sometimes incorrectly diagnosed as leakers due to oil spray originating from some other source. If in doubt, wipe the wet area from and manually operate shock as described in Step (2). Fluid will reappear if shock is leaking.

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Fig. 3-22--Shock Absorber Diagnosis

2. **Manually operating shocks.**

It may be necessary with certain types of shock mountings to fabricate a bracket that can be installed on a shock to enable a technician to securely grip the shock when manually operating the shock. See Figure 3C-9 for suggested methods of providing temporary grip.

This test should help the mechanic to isolate the following shock defects:

- binding condition internally
- verify leaking shock
- improper or defective valving

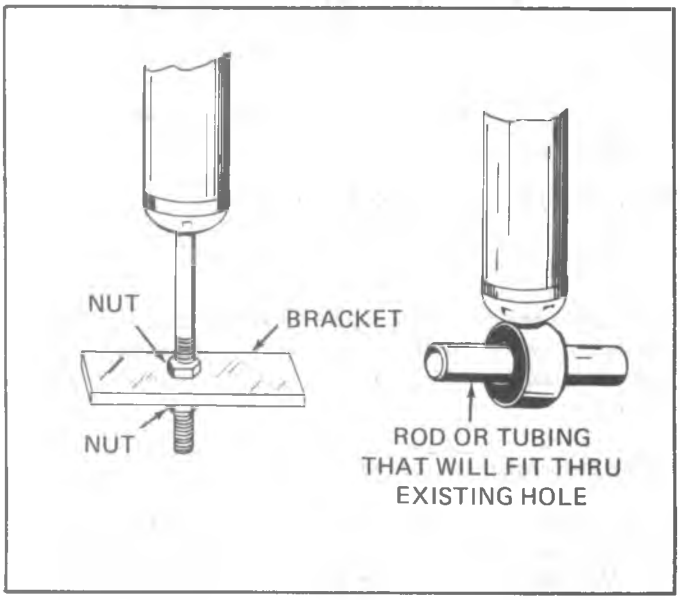
(a) If suspected problem is in front shocks, disconnect both front shock lower mountings and stroke each shock as follows: Grip the lower end of the shock securely and pull down (rebound stroke) then push up (compression stroke). The control arms will limit the movement of the front shocks during the compression stroke. Compare the rebound resistance between both front shocks, then compare the compression resistance. If a noticeable difference can be felt during either stroke, usually the shock having the least resistance is at fault.

(b) If shock has an internal noise condition, extend shock fully, then exert an extra pull. If noisy, shock should be replaced.

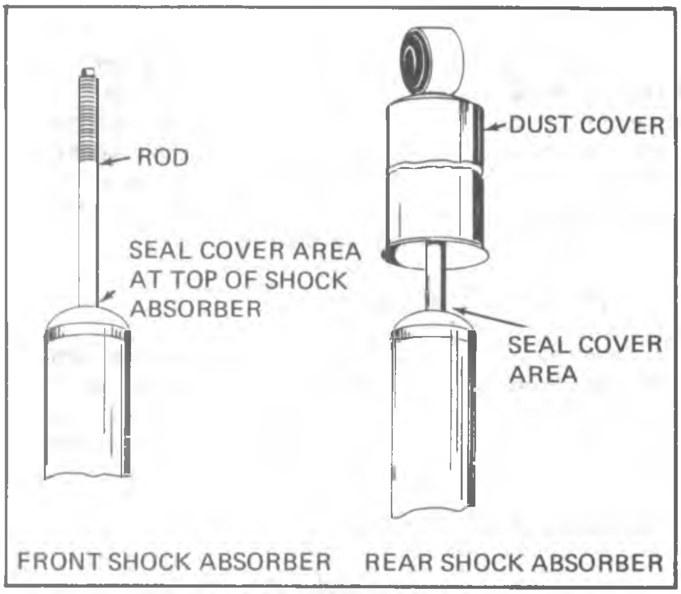
Other noise conditions that require shock replacement are:

- a grunt or squeal after one full stroke in both directions
- a clicking noise on fast reverse
- a skip or lag at reversal near mid-stroke

When air adjustable shocks are being manually operated, the air line must be disconnected at the shock absorber.



Gripping Methods



Seal Cover Area of Shock

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Fig. 3-22A--Shock Absorber Diagnosis

BENCH CHECKS

The bench checks are recommended if the proper type hoist is not available to perform the "on vehicle" tests, or if there is still some doubt as to whether the shocks are defective. In addition, the bench test allows a more thorough visual inspection.

Bench check procedures are discussed for three general types of shocks.

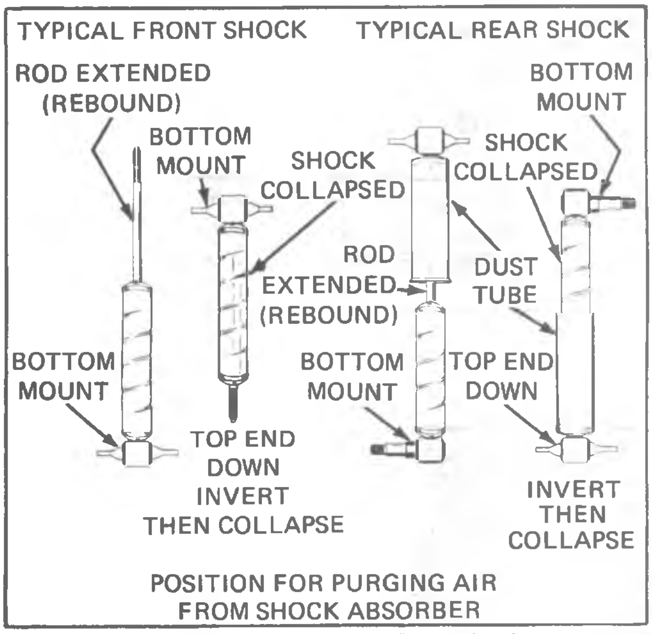
SPIRAL GROOVE RESERVOIR

If this type of shock has been stored or allowed to lay in a horizontal position for any length of time, an air void will develop in the pressure chamber of the shock absorber. This air void if not purged, can cause a technician to diagnose the shock as defective. To purge the air from the pressure chamber, proceed as follows:

(a) Holding the shock in its normal vertical position (top end up), fully extend shock.

(b) Hold the top end of the shock **down** and fully collapse the shock.

(c) Repeat Steps (a) and (b) at least five (5) times to assure air is purged.



Position for Purging Air From Shocks

Bench Test Procedure

1. This is a comparison type test. If possible, obtain a new or known good shock with same part number as shock under test.

2. With shocks in vertical position (top end up), clamp bottom mounts in vise. Do not clamp on reservoir tube or mounting threads.

3. Manually pump each shock by hand at various rates of speed and compare resistance of suspected shock with the new one.

   Rebound resistance (extending the shock) is normally stronger than the compression resistance (approximately 2:1). However, resistance should be smooth and constant for each stroking rate.

4. Observe or listen for the following conditions that will indicate a defective shock:

   - a skip or lag when reversing stroke at mid travel.
   - seizing or binding condition except at extreme end of either stroke.
   - a noise, such as a grunt or squeal, after completing one full stroke in both directions.
   - a clicking type noise at fast reversal.
   - fluid leakage.

5. To check for a loose piston, completely extend shock to full rebound; then exert an extra hard pull. If a give is felt, a loose piston is indicated and shock should be replaced.

PLIACELL OR GENETRON

Pliacell and Genetron are some of the trade names used to indicate a gas-filled cell in the shock reservoir. The reservoirs of Pliacell and Genetron shocks are smooth, compared to the spiral groove type. The cell takes the place of air in the reservoir. Thus, aeration or foaming of the fluid is eliminated, as air and fluid cannot mix.

Due to this feature, these shocks should be bench checked in an **inverted position** (top end down). If, when stroked, a lag is noticed, it means the gas-filled cell has been ruptured, and the shock should be replaced. If no lag is noticed, the remainder of the bench check is the same as given in the Spiral Groove Reservoir, Section 1, Bench Check Procedure.

AIR ADJUSTABLE SHOCKS

This type of shock contains an air chamber like the spiral groove reservoir type, and must have the air purged from the working chamber. See Section 1, Spiral Groove Reservoir. After air has been purged from shock, proceed as follows:

(a) Clamp lower shock mounting ring in vise in vertical position with larger diameter tube at the top.

(b) Pump unit by hand at different rates of speed. Smooth resistance should be felt through the length of the stroke. Since the units are normally pressurized, the sound of air bubbles or a gurgling noise is **normal.**

(c) The remainder of the bench check is the same as given in the Spiral Groove Reservoir, Section 1, Bench Check Procedure.

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Fig. 3-22B--Shock Absorber Diagnosis

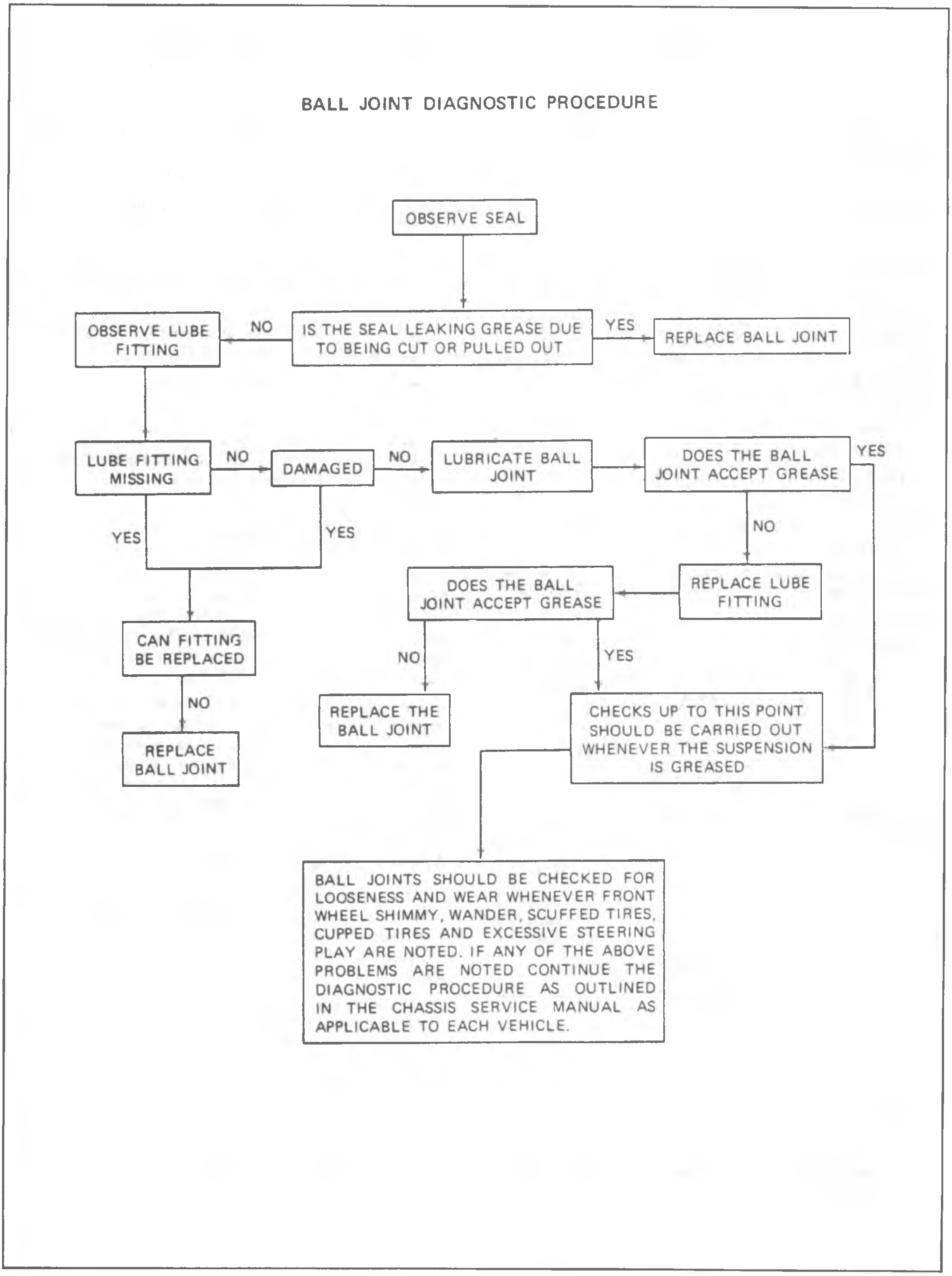


Fig. 3-23--Ball Joint Diagnosis

BEARINGS AND RACES
BENCH DIAGNOSTIC PROCEDURE

This section describes common types of bearing distress and their causes. Illustrations are included to help diagnose the cause of distress and comments are provided to help make effective repairs.

Consider The Following Factors When Diagnosing Bearing Distress:

1. Note General Condition of all parts during teardown and examinations.
2. Classify the failure with the aid of these illustrations where possible.
3. Determine the cause. Recognizing the cause will permit correction of the problem and prevent a repeat failure of the same type.
4. Make all repairs following recommended procedures.

Common Causes For Bearing Distress Include The Following:

1. Improper adjustment or preloading.
2. Mounting or teardown abuse.
3. Improper mounting methods.
4. Inadequate or wrong lubricants.
5. Entrance of dirt or water.
6. Wear from dirt or metal chips.
7. Corrosion or rusting.
8. Overload.
9. Overheating causing tempering.
10. Frettage of bearing seats.
11. Brinelling from impact loads and shipping.
12. Manufacturing defects.

FRONT WHEEL, PINION, DIFFERENTIAL SIDE AND REAR WHEEL ROLLER BEARINGS
DIAGNOSIS

	EXCESS NOISE COMPLAINT DIAGNOSTIC PROCEDURE
Road Test	1. Check tires for irregular wear 2. Check tire pressure 3. Check lubricant level 4. Drive to warm-up rear axle 5. Test at various speeds in drive, float, coast and cornering
Tire Noises	1. Change tire pressure to minimize noises 2. Drive over different road surfaces 3. Smooth black-top minimizes tire noise 4. Cross switch tires, if necessary 5. Snow tire treads and studs caused added noises
Engine or Exhaust Noises	1. Drive slightly above speed where noise occurs, place transmission in neutral 2. Let engine speed drop to idle 3. Stop car 4. Run engine at various speeds
Test for Wheel Bearing Noise	1. Drive car at low speed on a smooth road 2. Turn car to develop left and right motions, traffic permitting 3. Noise should change due to cornering loads 4. Jack-up wheels to verify roughness at wheels
Test for Differential Bearing Noise	1. Drive car at low speed on a smooth road 2. Constant low pitch bearing noise may be heard 3. Noise should not change in reversing turns 4. Noise pattern should vary with wheel speed
Test for Pinion Bearing Noise	1. Roughness or whine noise should increase with speed 2. Noise pitch should be higher than differentials 3. Test on smooth road to minimize tire noises 4. Test at various speeds in drive, float, and coast 5. Rear pinion bearing noise may be louder on acceleration 6. Front pinion bearing noise may be louder on deceleration 7. Gear noises tend to peak in a narrow speed range

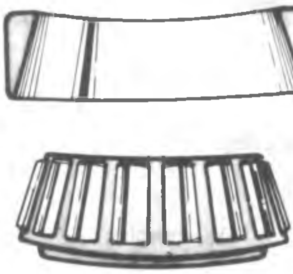
103407

Fig. 3-24--Bearing Diagnosis Chart A

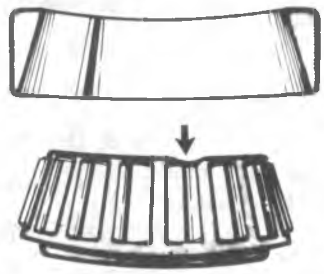
FRONT WHEEL BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.



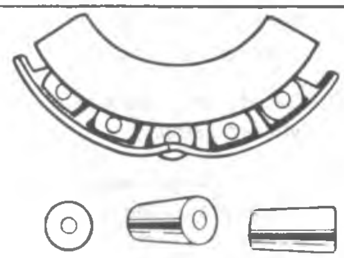
GOOD BEARING



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

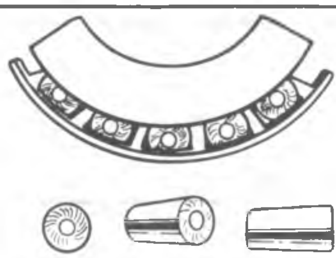
REPLACE BEARING.



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

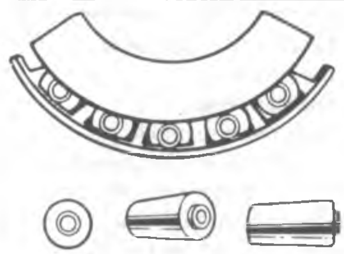
REPLACE BEARING.



GALLING

METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD.

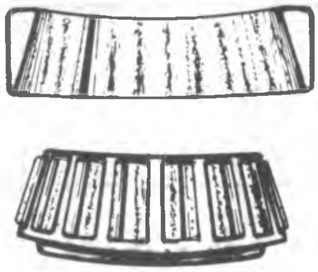
REPLACE BEARING – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



ABRASIVE STEP WEAR

PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.

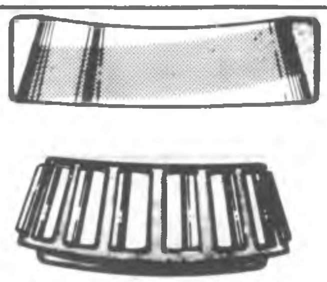
CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



ETCHING

BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.

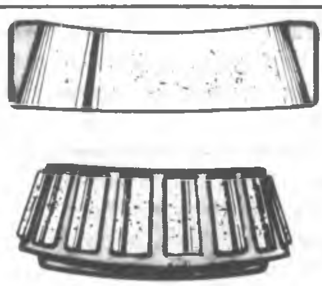
REPLACE BEARINGS – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



MISALIGNMENT

OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.

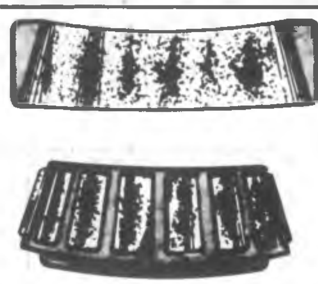
CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.



INDENTATIONS

SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.



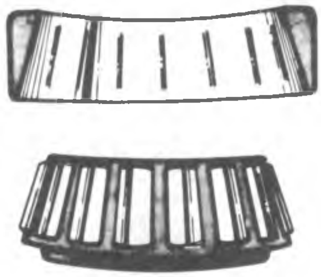
FATIGUE SPALLING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.

REPLACE BEARING – CLEAN ALL RELATED PARTS.

Fig. 3-25--Bearing Diagnosis Chart B

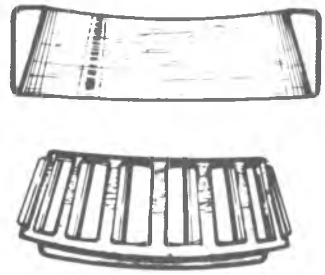
FRONT WHEEL BEARING DIAGNOSIS (CONT'D)



BRINELLING

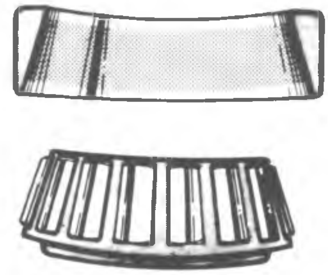
SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.



CAGE WEAR

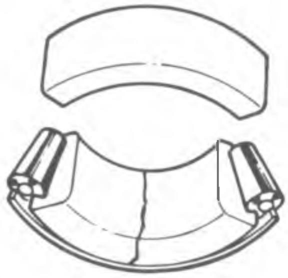
WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION. CHECK SEALS AND REPLACE BEARINGS.



ABRASIVE ROLLER WEAR

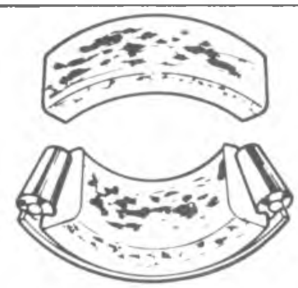
PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



CRACKED INNER RACE

RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.

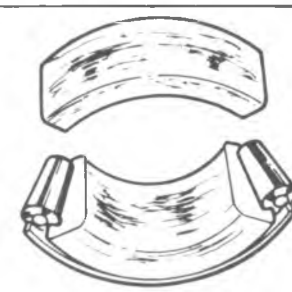


SMEARS

SMEARING OF METAL DUE TO SLIPPAGE, SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FIT AND LUBRICATION.

REPLACE SHAFT IF DAMAGED.



FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.

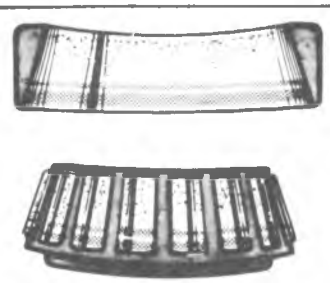
HEAT DISCOLORATION

HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVERLOAD OR INCORRECT LUBRICANT.

EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.

TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT META, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.

REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.



STAIN DISCOLORATION

DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.

RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVERHEATING IS OBSERVED.

CHECK SEALS AND RELATED PARTS FOR DAMAGE.

Fig. 3-26--Bearing Diagnosis Chart C

SECTION 3A

FRONT ALIGNMENT

CONTENTS

General Description 3A-1
Maintenance and Adjustments 3A-2
Specifications 3A-5

GENERAL DESCRIPTION

FRONT ALIGNMENT

The term "front alignment" refers to the angular relationships between the front wheels, the front suspension attaching parts and the ground.

The pointing in or "toe-in" of the front wheels, the tilt of the front wheels from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from vertical (when viewed from the side of the vehicle), all these are involved in front alignment. The various factors that enter into front alignment are covered here each one under its own heading.

CASTER

Caster is the tilting of the front steering axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is said to be positive (+) and a forward tilt is said to be negative (-).

On the short and long arm type suspension you cannot see a caster angle without a special instrument, but you can understand that if you look straight down from the top of the upper control arm to the ground you would find that the ball joints do not line up (fore and aft) when a caster angle other than 0° is present. If you had a positive caster angle the lower ball joint would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line. In short then, caster is the forward or backward tilt of the steering axis as viewed from a side elevation. Caster is designed into the front axle assembly on all K series vehicles (four-wheel drive), and is non-adjustable. See caster copy under ADJUSTMENTS.

CAMBER

Camber is the tilting of the front wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle. Camber is designed into the front axle assembly of all K series vehicles and is non-adjustable. See camber copy under ADJUSTMENTS.

TOE-IN

Toe-in is the turning in of the front wheels. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe specification is to ensure parallel rolling of the front wheels. (Excessive toe-in or toe-out will cause tire wear). Toe-in also serves to offset the small deflections of the wheel support system which occurs when the vehicle is rolling forward. In other words, even when the wheels are set to toe-in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. See toe-in copy under ADJUSTMENTS.

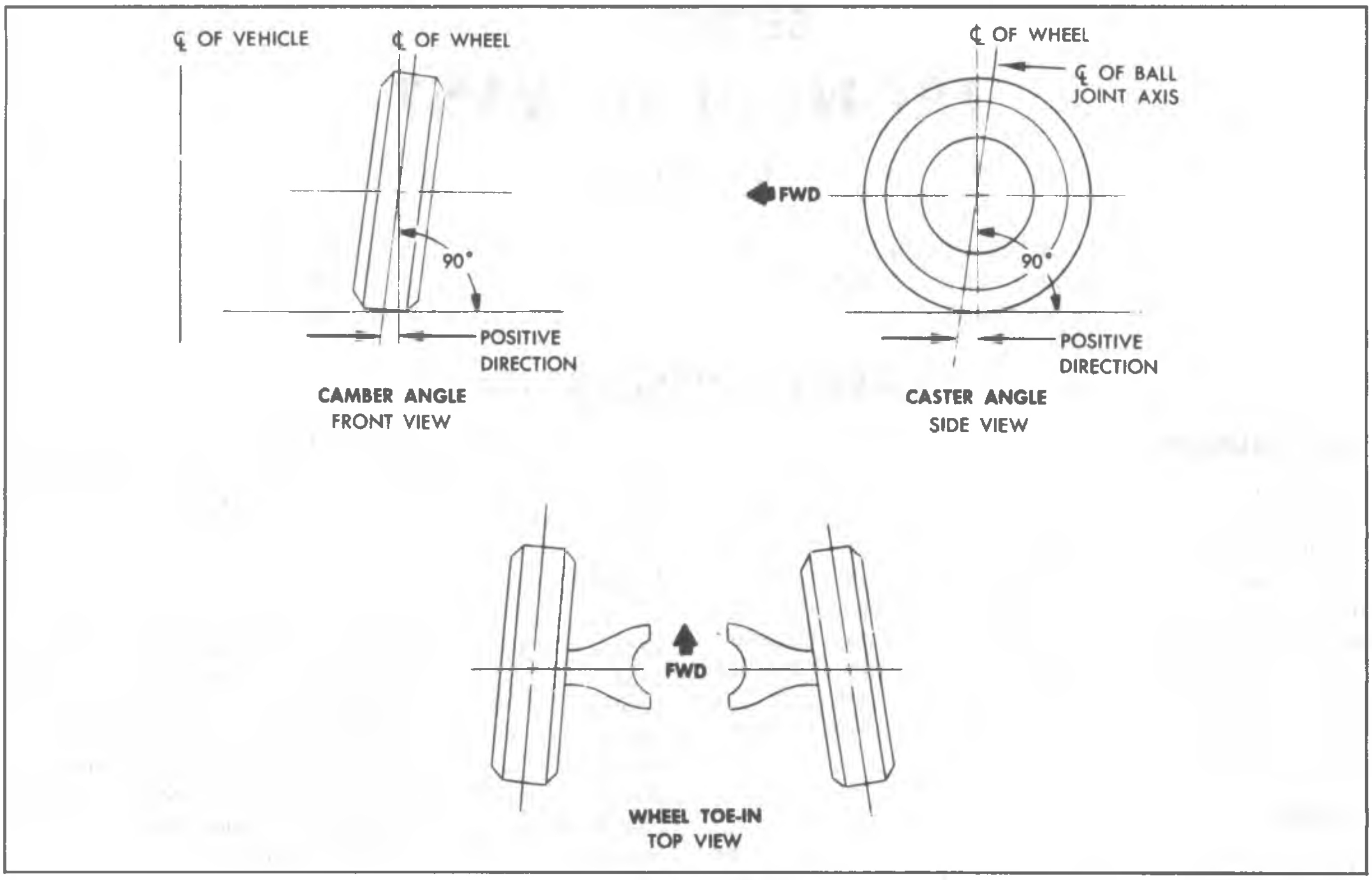


Fig. 3A-1--Caster - Camber - Toe-In

MAINTENANCE AND ADJUSTMENTS

PRELIMINARY CHECKS PRIOR TO ADJUSTING FRONT ALIGNMENT

Before making any adjustment affecting caster, camber or toe-in, the following checks and inspections should be made to insure correctness of alignment readings and alignment adjustments.

1. Check all tires for proper inflation pressures and approximately the same tread wear.
2. Check front wheel bearings for looseness (.001-.008 end play is correct) and adjust if necessary.
3. Check for looseness of ball joints, tie rod ends and steering relay rods; if excessive looseness is noted, it must be corrected before adjusting.
4. Check for run-out of wheels and tires.
5. Check dimension A in Fig. 3A-4; if out of specifications and a correction is to be made, the correction must be made before adjusting caster.
6. Check for steering gear looseness at frame.
7. Check for improperly operating shock absorbers.
8. Check for loose control arms.
9. Check for loose or missing stabilizer bar attachments.
10. Consideration must be given to excess loads, such as tool boxes. If this excess load is **normally** carried in the vehicle, it should remain in the vehicle during alignment checks.
11. Consider the condition of the equipment being used to check alignment and follow the manufacturer's instructions.
12. Regardless of equipment used to check alignment, the vehicle must be on a level surface both fore and aft and transversely.
13. Steering and vibration complaints are not always the result of improper alignment. An additional item to be checked is the possibility of tire lead due to worn or improperly manufactured tires. "Lead" is the deviation of the vehicle from a straight path on a level road without hand pressure on the steering wheel. Section 3E of this manual, "Wheels and Tires", contains a procedure for determining the presence of a tire lead problem.

FRONT ALIGNMENT REQUIREMENTS

Satisfactory vehicle operation may occur over a wide range of front end wheel alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustments of alignment is advisable. The specifications stated in column 1 of the chart in the specifications section of this manual should be used by owners, dealers and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of the wheel alignment chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 1 or 2 (whichever is applicable), or whenever for other reasons the alignment is being reset, the specifications given in column 3 of the wheel alignment chart should be used.

It is good practice to set front end alignment to specifications while the vehicle is in its **normally loaded** condition. Trucks which are **consistently operated with heavy loads should have toe-in adjusted with the truck under heavy load.** This procedure should result in longer tire life.

ALIGNMENT ADJUSTMENTS

A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. If two (2) threads cannot be obtained, check for damaged control arms and related parts. The difference between front and rear shim packs must not exceed 7.62mm (.30 inches). Front shim pack must be at least 2.54mm (.10 inches).

Access to Shim Packs

G10-20 Models, C10 Models with 3/4" Nut:

With vehicle on front end rack, jack at frame and raise the wheel off the ground. This will allow the upper control arm to pivot down far enough to use a socket on the nuts and permit shim removal.

G30 Models, C20 and 30 Models with 7/8" Nut:

Remove the upper control arm bumper; then follow the same procedure as above. Reinstall the upper control arm bumper when alignment is completed.

Caster

All caster specifications are given assuming a frame angle of zero. Therefore, it will be necessary to know the angle of the frame (whether "up" in rear or "down" in rear) before a corrected caster reading can be determined. Camber and toe can be read "as is" from the alignment equipment.

How to Determine Caster (Fig. 3A-4)

All caster specifications are given assuming vehicle frame angle is zero. Therefore, it is necessary to adjust specifications when applying them to vehicles with any frame angle other than zero.

1. With vehicle on a level surface, determine frame angle (whether up or down in rear) with the use of a bubble protractor or inclinometer. Record this measurement (See Figure 4).
2. Measure dimension "A" (See Figure 4).
3. Check and record specifications for caster under that column related to dimension "A" as measured in step 2.
4. Using one of the following rules, add or subtract frame angle found in step 1 to or from specification found in step 3.
   a. A down-in-rear frame angle must be added to a positive caster specification.
   b. An up-in-rear frame angle must be subtracted from a positive caster specification.
   c. A down-in-rear frame angle must be subtracted from a negative caster specification.
   d. An up-in-rear frame angle must be added to a negative caster specification.

Vehicle caster specification should be adjusted to answer arrived at in step 4.

Camber

1. Determine the camber angle from the alignment equipment.
2. Add or subtract shims from both the front and rear bolts to affect a change.

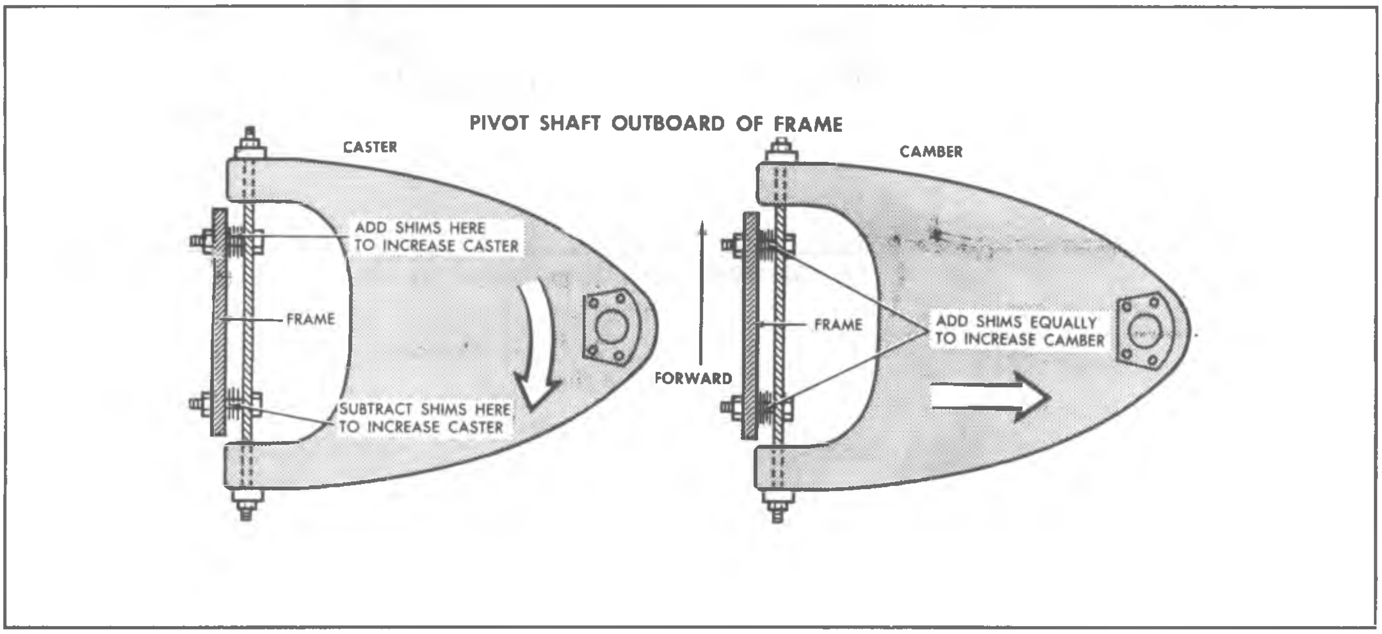


Fig. 3A-2--Caster - Camber Adjustment

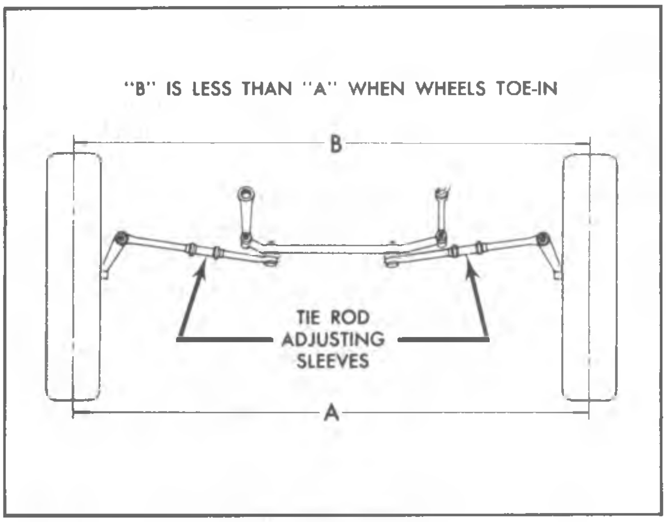


Fig. 3A-3--Toe-In Adjustment

Toe-In

1. Determine the wheel toe-in from the alignment equipment.
2. Change the length of both tie rod sleeves to affect a toe change.

Toe-in can be increased or decreased by changing the length of the tie rods. A threaded sleeve is provided for this purpose.

When the tie rods are mounted ahead of the steering knuckle they must be decreased in length in order to increase toe-in. When the tie rods are mounted behind the steering knuckle they must be lengthened in order to increase toe-in.

See Section 3B for proper tie rod clamp orientation and positioning.

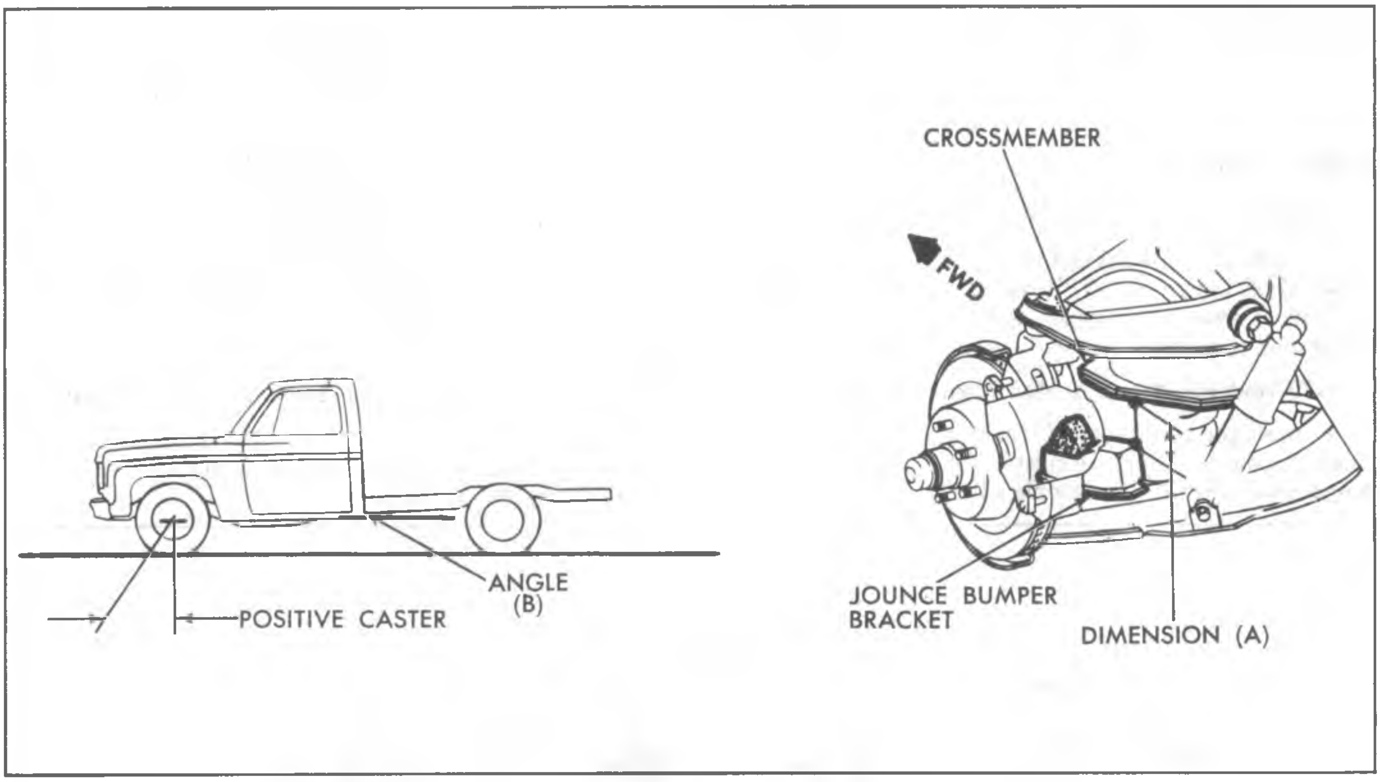


Fig. 3A-4--Determining Caster

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS
CASTER

DIMENSION "A"

MODELS (mm)	2½" 63.5	2¾" 69.8	3" 76.2	3¼" 82.5	3½" 89.0	3¾" 95.2	4" 102.0	4¼" 107.9	4½" 114.3	4¾" 121.6	5" 127.0	
C10 C20, 30	3.6° 1.5°	3.4° 1.2°	3.1° 0.9°	2.8° 0.6°	2.6° 0.3°	2.4° 0.1°	2.0° 0°	1.8° -0.1°	1.5° -0.7°	1.2° -1.0°	1.0° -1.2°	
K10,20,30	(8°) (NO ADJUSTMENT PROVISION)											
(mm)	1½" 38.0	1¾" 44.4	2" 51.0	2¼" 57.1	2½" 63.5	2¾" 69.8	3" 76.2	3¼" 82.5	3½" 89.0	3¾" 95.2	4" 102.0	4¼" 107.9
G10, 20 G30	3.5° 2.8°	3.3° 2.5°	3.1° 2.2°	2.9 1.9°	2.7° 1.6°		2.4° 1.0°	2.2 .7	2.1 .5	1.9 .2	1.8 0	1.6 -0.2
(mm)	2½" 63.5	2¾" 69.8	3" 76.2	3¼" 82.5	3½" 89.6	3¾" 95.2	4" 102.0	4¼" 107.9	4½" 114.3	4¾" 120.6	5" 127.0	
P10	2.3°	2.0°	1.7°	1.5°	1.2°	0.9°	0.6°	0.4°	0.1°	-0.1°	-0.3°	
(mm)	2" 51.0	2¼" 57.1	2½" 63.5	2¾" 69.8	3" 76.2	3¼" 82.5	3½" 89.0	3¾" 95.2	4" 102.0	4¼" 107.9	4½" 114.3	4¾" 120.6
*P20, 30	2.9°	2.6°	2.3°	2.0°	1.7°	1.4°	1.2°	0.9°	0.6°	0.4°	0.2°	0.1°
* ADD .3° WITH JB8 OR JF9 SUBTRACT .4° WITH R05												
MOTOR HOME (32) (mm)	2½" 63.5	2¾" 69.8	3" 76.2	3¼" 82.5	3½" 89.0	3¾" 95.2	4" 102.0	4¼" 107.9	4½" 114.3	4¾" 120.6	5" 127.0	
	5.5°	5.3°	5.0°	4.7°	4.4°	4.1°	3.8°	3.6°	3.3°	3.1°	2.9°	

MODEL	CAMBER
C10	.7°
C20,30	.2°
K10, 20	1.0° (NO ADJUSTMENT PROVISION)
K30	.5° (NO ADJUSTMENT PROVISION)
G10, 20	5°
G30	.2°
P10, 20, 30	.2°
MOTOR HOME (32)	.2°

ALIGNMENT TOLERANCES	Warranty Repair Checking	Resetting Target	Periodic Motor Vehicle Inspection
Caster	± 1°	± 0.5°	± 2°
Camber	± 0.7°	± 0.5°	± 1.5°
Toe-In	± 1/8" (3.2 mm)	± 1/16" (1.6 mm)	± 3/8" (9.5 mm)

TOE-IN		
C10, C20, C30	3/16"	(4.7 mm)
K10, K20, K30	3/16"	(4.7 mm)
G10, G20, G30	3/16"	(4.7 mm)
P10, P20, P30	3/16"	(4.7 mm)
MOTOR HOME P30 (32)	5/16"	(7.9 mm)

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Specifications

SECTION 3B5

STEERING COLUMNS

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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On-Vehicle Service 3B5-4
C-Series, K-Series 3B5-4
G-Series, P-Series 3B5-20
Specifications 3B5-35
Special Tools 3B5-36

GENERAL DESCRIPTION

FUNCTION LOCKING COLUMNS

The function locking energy absorbing steering column includes three important features in addition to the steering function:

1. The column is energy absorbing, designed to compress in a front-end collision to minimize the possibility of injury to the driver of the vehicle.

2. The ignition switch and lock are mounted conveniently on the column.

3. With the column mounted lock, the ignition, steering and gearshifting operation can be locked to inhibit theft of the vehicle.

The function locking energy abosrbing column may be easily disassembled and reassembled. It is important that only the specified screws, bolts and nuts be used as designated and that they are tightened to their specified torque. This precaution will insure the energy absorbing action of the assembly. Over-length bolts should not be used, as they may prevent a portion of the assembly from compressing under impact. Equally as important is correct torque of bolts and nuts. Care should be taken to assure that the bolts or nuts securing the column mounting bracket to the instrument panel are torqued to the proper specification in order that the bracket will break away under impact.

When the function locking energy absorbing column assembly is installed in a vehicle, it is no more susceptible to damage through usage than an ordinary column; however, when the column is removed, special care must be taken in handling this assembly. Only the specified wheel puller should be used. When the column is removed from the vehicle, such actions as a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity. It is, therefore, important that the removal and installation and the disassembly and reassembly procedures be carefully followed when servicing the assembly.

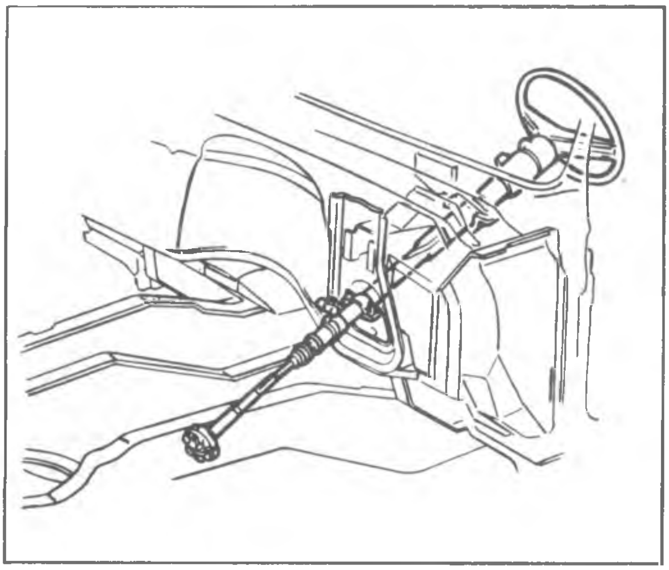

Fig. 3B5-1--Steering Column

GENERAL INFORMATION

This section contains diagnostic information to help locate the cause of the problem in the column. Reference should be made to the correct method of column disassembly,
repair, adjustment and reassembly. Damaged, broken or deformed parts must be replaced with the correct replacement.

To perform diagnostic procedures on the steering column upper end components, it is not necessary to remove the column from the vehicle.

The steering wheel, horn components, directional signal switch, ignition switch and lock cylinder may be removed with the column remaining in the vehicle as described in the Service Manual under "Component Part Replacement".

CAUTION: The outer mast jacket shift tube, steering shaft and instrument panel mounting bracket are designed as energy absorbing units. Because of the design of these components, it is absolutely necessary to handle the column with care when performing any service operation. Avoid hammering, jarring, dropping or leaning on any portion of the column. When reassembling the column components, use only the specified screws, nuts and bolts and tighten to specified torque. Care should be exercised not to use over-length screws or bolts as they may prevent a portion of the column from compressing under impact. Personal injury could result from lack of care when servicing the steering column.

STEERING COLUMN ELECTRICAL ANALYZER J-23980

For C-Series and K-Series

Tool J-23980 will help the technician analyze the steering column wiring harness for electrical problems. The tool in actuality eliminates the steering column, related wiring and components; and replaces them with the tool itself. In this way disassembly of the column is not performed until the problem has been determined to be **in** the column. By moving the tester switch, (with the key in the "on" position), the various functions may be checked. The switch positions are "OFF", "HORN", "LEFT TURN", "RIGHT TURN", "KEY BUZZER", and "HAZARD". (Trucks do not incorporate a Key Buzzer Switch) if the systems function properly while using the tester, then the malfunction has been narrowed to the column wiring or components. When this has been determined then the column may be serviced to correct the malfunction.

To use the tool just unfasten the harmonica connector on the column and plug the harness from J-23980 into the vehicle chassis harness. The "A", "B", and "C" terminals on the tester will overhang the chassis connector. This does not affect the test results. These terminals are for vehicles with cornering lights. Connect the single black jumper to a good ground. The tester is now ready for use.

COLLISION DIAGNOSIS

To determine if the energy absorbing steering column components are functioning as designed, or if repairs are required, a close inspection should be made. An inspection is called for in all cases where damage is evident or whenever the vehicle is being repaired due to a front end collision. Whenever a force has been exerted on the steering wheel or steering column, or its components, inspection should also be made. If damage is evident, the affected parts must be replaced. See Section 3 for Diagnosis.

The inspection procedure for the various steering column components on C and K trucks is as follows:

Column Support Bracket

Damage in this area will be indicated by separation of the mounting capsules from the bracket. The bracket will have moved forward toward the engine compartment and will usually result in collapsing of the jacket section of the steering column.

COLUMN JACKET

Inspect jacket section of column for looseness, and/or bends.

SHIFTER SHAFT

Separation of the shifter shaft sections will be internal and cannot be visually identified. Hold lower end of the "shifter shaft" and move "shift lever" on column through its ranges and up and down. If there is little or no movement of the "shifter shaft", the plastic joints are sheared.

Steering Shaft

If the steering shaft plastic pins have been sheared, the shaft will rattle when struck lightly from the side and some lash may be felt when rotating the steering wheel while holding the rag joint. It should be noted that if the steering shaft pins are sheared due to minor collision with no appreciable damage to other components, that the vehicle can be safely steered; however, steering shaft replacement is recommended.

Because of the differences in the steering column types, be sure to refer to the set of instructions below which apply to the column being serviced.

METHOD TO DETERMINE COLUMN COLLAPSE

Measure distance between top of neutral-start switch window opening and the bottom of the upper jacket. The correct value is shown below:

a. C-Truck 5 11/16" to 5 1/2".

b. K-Truck 5 11/16" to 5 1/2".

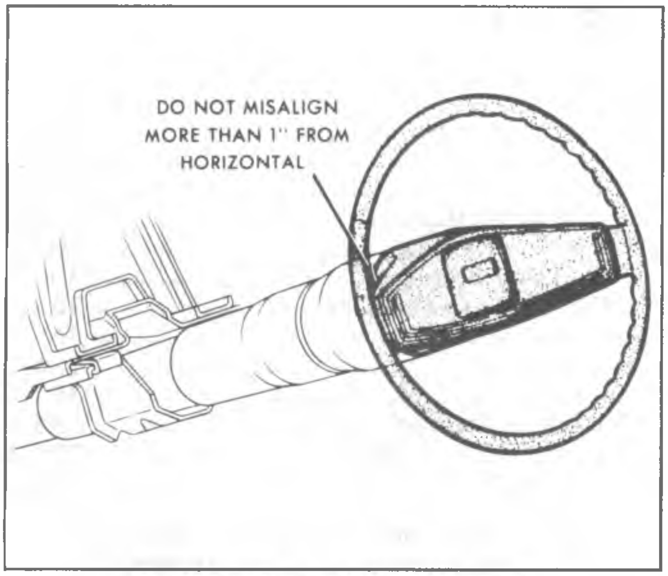

Fig. 3B5-2--Steering Wheel Alignment

MAINTENANCE AND ADJUSTMENTS

STEERING WHEEL ALIGNMENT

On all series vehicles, check steering gear for high point centering as shown in Sections 3B8 and 3B7 before checking steering wheel alignment.

1. Set wheels in straight ahead position by driving vehicle a short distance.
2. Note steering wheel position. If off more than 1 inch from center (Fig. 3B5-2), remove steering wheel as outlined under "Steering Wheel - Removal", center high point on gear, reposition and reinstall the wheel.

STEERING COLUMN LOWER BEARING ADJUSTMENT

G and P Series Only

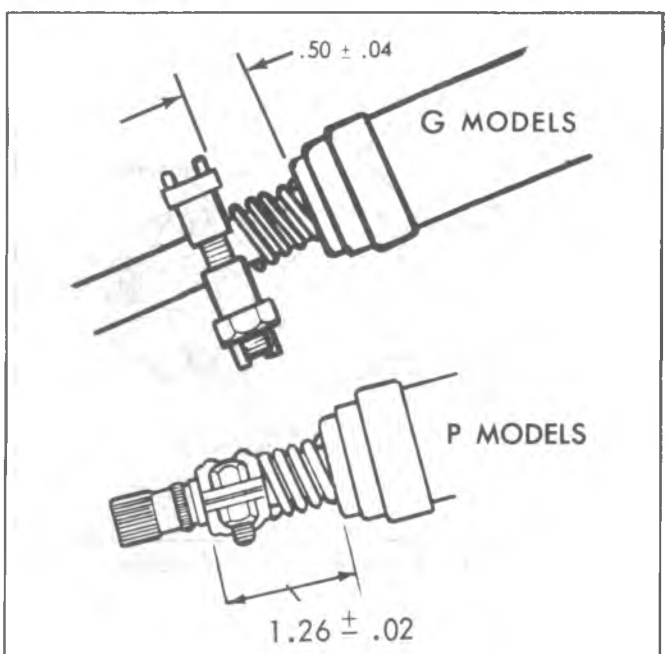

Fig. 3B5-3--Steering Column Lower Bearing Adjustment

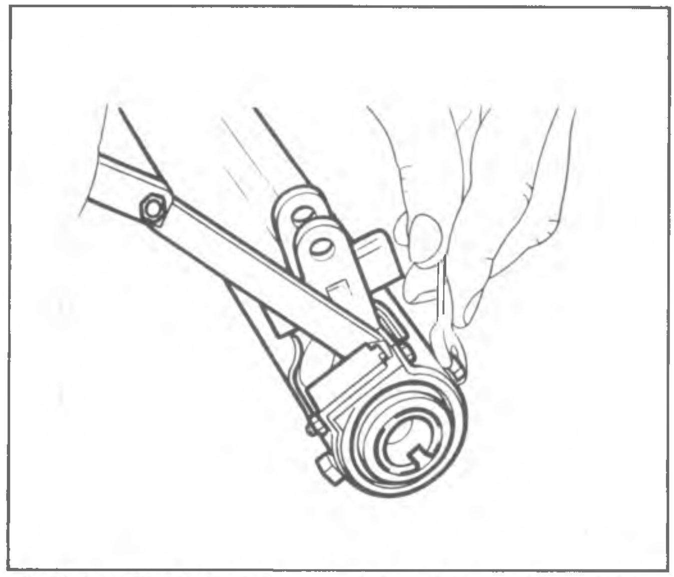

Fig. 3B5-4--Shift Tube Adjustment 3 Speed Manual Transmission

1. Loosen clamp on steering shaft.
2. Applying 50 lb. force to the steering wheel end of the steering shaft, adjust clamp to obtain clearances indicated in Figure 3B5-3.
3. Tighten clamp bolt to specified torque.

SHIFTER TUBE ADJUSTMENT
G and P Series Only

3-Speed Transmission

1. Loosen adjusting ring attaching screws and clamp bolt.
2. Rotate adjusting ring to give .005" end play between adjusting ring and first and reverse shifter lever (Fig. 3B5-4).
3. Tighten attaching screws and clamp bolt.

Automatic Transmission

1. Place the shift tube lever in "Neutral" or "Drive".
2. Loosen adjusting ring clamp screws and rotate the shift tube adjusting ring to obtain .33" to .36" clearance between the shift tube lever and adjusting ring (Fig. 3B5-5).
3. Tighten the adjusting ring clamp screws to 70 in. lbs.

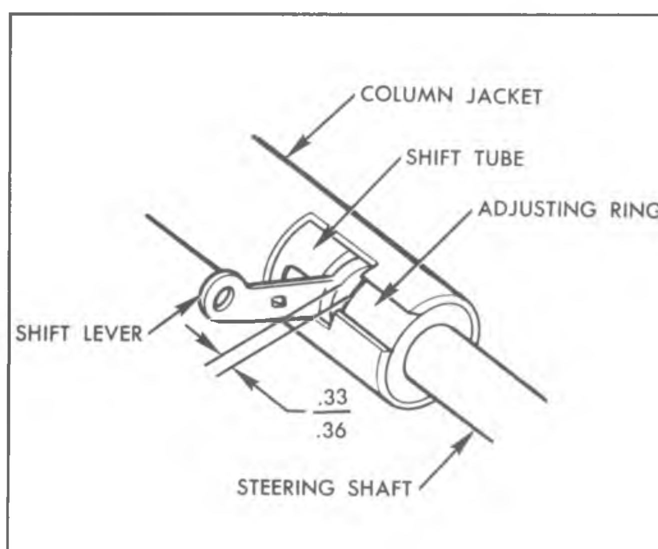

Fig. 3B5-5--Shift Tube Adjustment-Automatic Transmission

ON-VEHICLE SERVICE

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STEERING WHEEL

Removal

1. Disconnect battery ground cable.
2. Remove horn button cap.
3. Remove snap ring and steering wheel nut.
4. Using tool J-1859-03, thread puller anchor screws into holes provided on steering wheel. See Fig. 3B5-6. Turn center bolt of tool clockwise to remove wheel.

   NOTICE: Do not hammer on puller, or damage could occur to the components. The tool centering adapters need not be used.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 1.

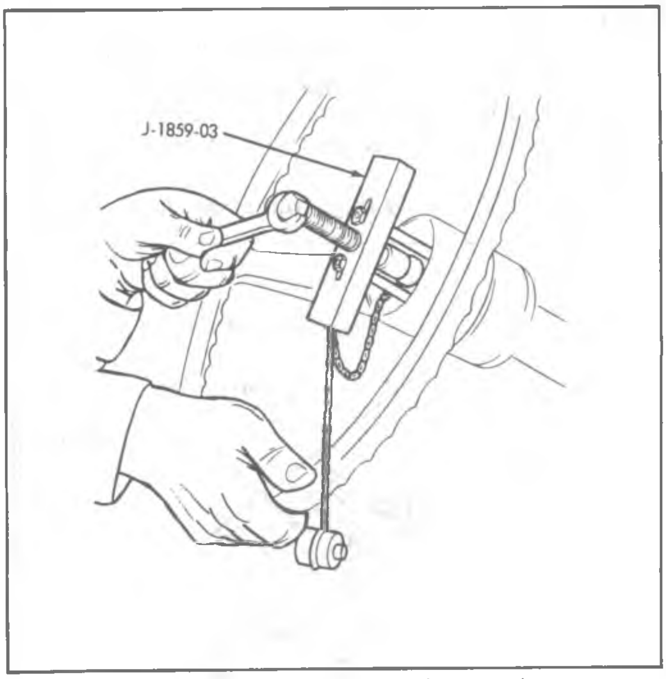


Fig. 3B5-6--Steering Wheel Removal

1. With turn signal in neutral position, align marks and set wheel onto steering shaft. Torque steering shaft nut to specifications and install snap ring.

   NOTICE: Do not over torque shaft nut or steering wheel rub may result.
2. Place steering wheel horn button on wheel and snap into proper position.
3. Connect battery ground cable.

STEERING COUPLING (FLEXIBLE TYPE)

Removal

1. Remove the coupling to steering shaft flange bolt nuts.
2. Remove the coupling clamp bolt. This is a special bolt and will require a 12 pt. socket or box wrench.
3. Remove the steering gear to frame bolts and lower the steering gear far enough to remove the flexible coupling. It is not necessary to disconnect the pitman arm from the pitman shaft.
4. Tap lightly on the flexible coupling with a soft mallet to remove the coupling from the steering gear wormshaft.

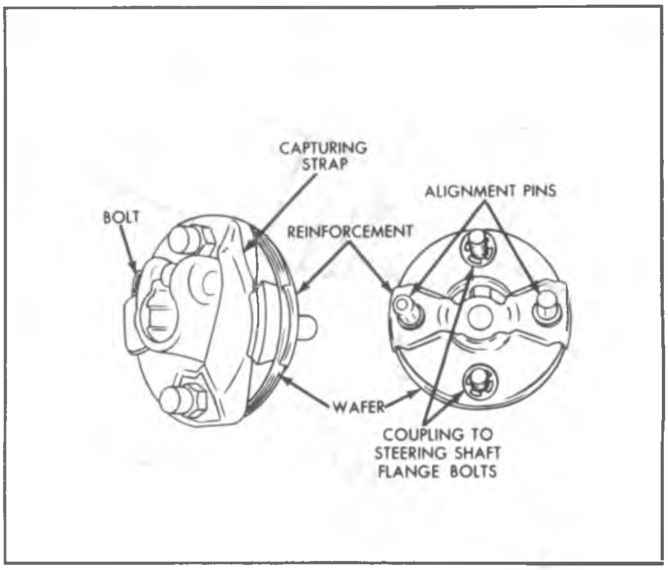


Fig. 3B5-7--Flexible Type Steering Coupling

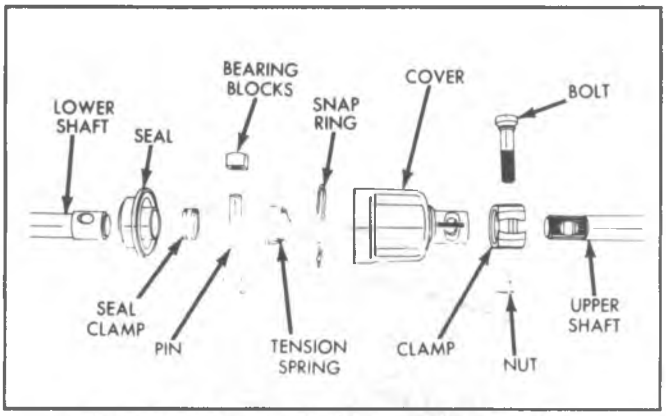


Fig. 3B5-8--Steering Shaft Intermediate Coupling

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 2, 4 and 5.

1. Install the flexible coupling onto the steering gear wormshaft, aligning the flat on the shaft with the flat in the coupling. Push the coupling onto the wormshaft until the coupling reinforcement bottoms against the end of the worm.
2. Install the special bolt into the split clamp and torque to specifications.

   NOTICE: The bolt must pass through the shaft undercut, or damage could occur to the components.
3. Place the steering gear into position, guiding the flexible coupling bolts into the proper holes in the steering shaft flange.
4. Install and tighten the steering gear to frame bolts.
5. Install the coupling to flange bolt nuts and washers and torque to specifications. Be sure to maintain a coupling to flange dimension of .250" to .375". The coupling alignment pins should be centered in the flange slots.

INTERMEDIATE STEERING SHAFTS WITH POT JOINT COUPLINGS

Removal

1. Remove the lower shaft flange to flexible coupling bolts.
2. Remove upper shaft to intermediate coupling bolt.
3. If necessary, remove the steering gear to frame bolts and lower the steering gear far enough to remove the intermediate shaft assembly. It is not necessary to remove the pitman arm from the pitman shaft.

Disassembly

1. Mark cover to shaft relationship. Pry off snap ring and slide cover from shaft.
2. Remove bearing blocks and tension spring from pivot pin.
3. Clean grease off pin and end of shaft. Scribe location mark on pin on same side as chamfer in shaft.
4. Supporting shaft assembly securely, with chamfer up, press pin out of shaft with arbor press.

   NOTICE: Do not drive pin out with hammer. This could cause sticky or binding bearings when reassembled.
5. Remove seal clamp and slide seal off end of shaft.

Assembly

1. Be sure all parts are free of dirt. Slide seal onto steering shaft. With lip of seal against step in shaft clamp seal.
2. Press pin back into shaft from chamfered side. Locate pin in shaft using scribe mark as reference.

   NOTICE: Pin must be centered within .012 in. or binding in the coupling could result.
3. Check centering of pin (Fig. 3B5-9).
   a. Place just enough 3/8" flat washers on pin to prevent bearing block from bottoming when installed.
   b. Measure distance from end of pin to top of bearing with micrometer.
   c. Remove bearing and washers and place same bearing and washers on other end of pin. Measure distance from end of pin to top of bearing. If micrometer readings in Steps b and c differ more than .012, repeat last part of Step 2 and recheck.
4. Apply a liberal amount of wheel bearing grease to inside and outside of bearing blocks and inside of cover.
5. Position tension spring and bearing blocks on pin.
6. Slide cover over bearing blocks aligning reference mark on cover with mark on shaft. Install seal into end of cover and secure with snap ring retainer.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 4.

1. Install the intermediate shaft assembly onto the

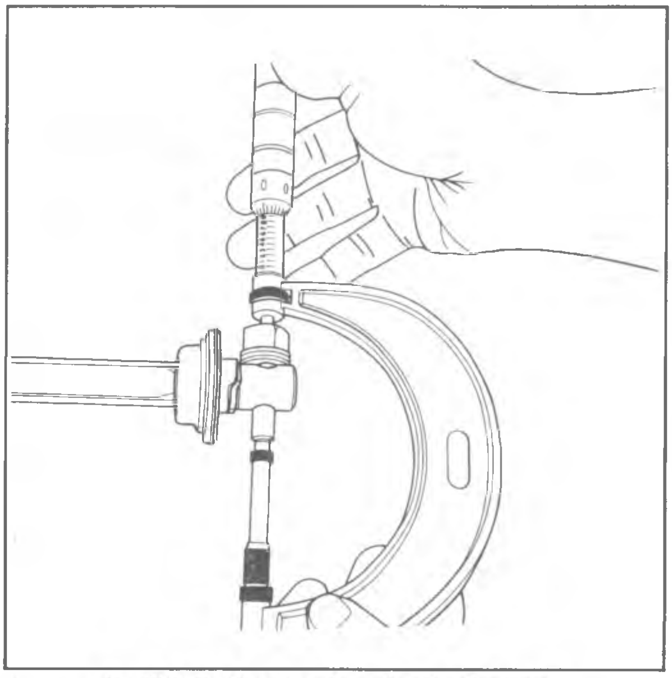


Fig. 3B5-9--Checking Coupling Pin Centering

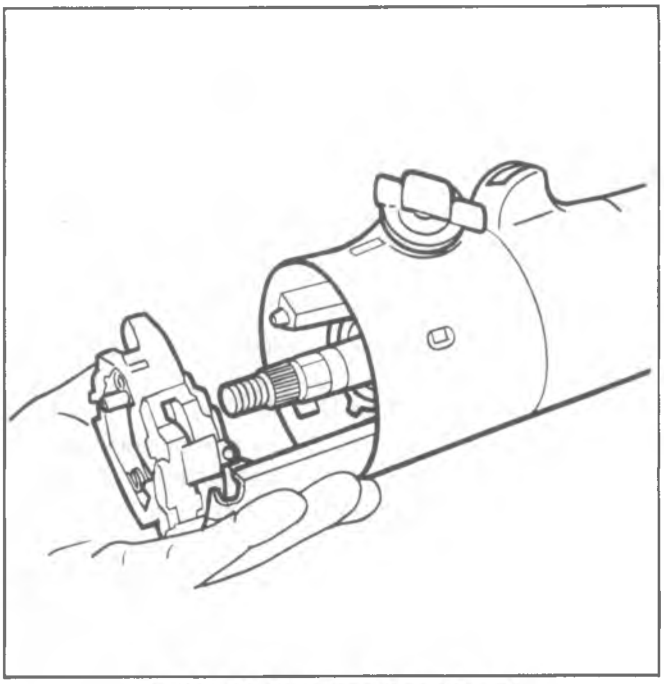


Fig. 3B5-10--Directional Signal Switch

steering shaft, aligning the flat on the shaft with the flat in the coupling. Install the pot joint clamp bolt and torque to specifications.

2. Lift the steering gear into position, guiding the flexible coupling bolts into the shaft flange holes.
3. Install the steering gear to frame bolts and torque to specifications.
4. Install the flexible coupling to steering shaft flange bolt lockwashers and nuts. Check that the coupling alignment pins are centered in the flange slots and then torque the coupling bolts to specifications.

DIRECTIONAL SIGNAL SWITCH

The directional signal switch can be removed with the steering column in the vehicle and without disturbing any of the column mountings.

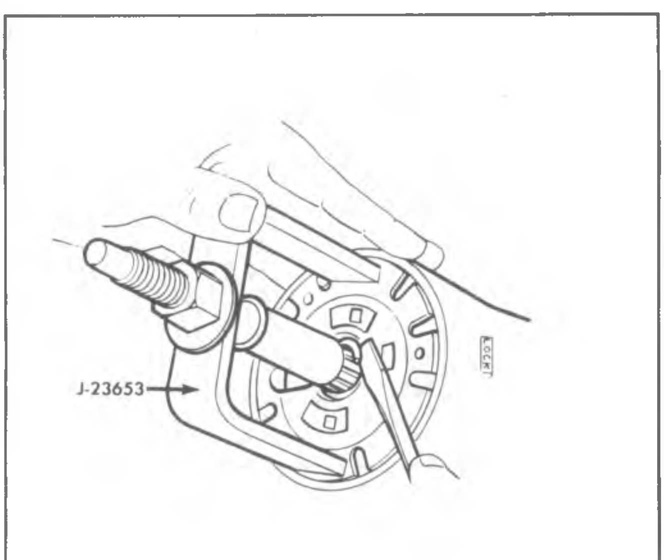


Fig. 3B5-11--Removing Lock Plate Retaining Ring

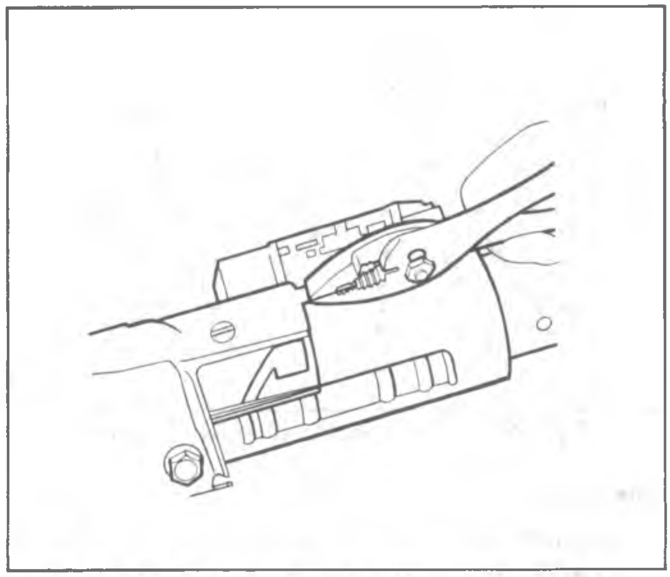


Fig. 3B5-12--Removing Directional Signal Wire Protector

Removal (Fig. 3B5-10)

1. Remove the steering wheel as outlined under "Steering Wheel - Removal".
2. Remove the column to instrument panel trim cover.
3. Position screwdriver blade into cover slot. Pry up and out to free cover from lock plate.
4. Screw the center post of Lock Plate Compressing Tool J-23653 onto the steering shaft as far as it will go. Compress the lock plate by turning the center post nut clockwise (Fig. 3B5-11). Pry the round wire snap ring out of the shaft groove and discard the ring. Remove Tool J-23653 and lift the lock plate off the end of the shaft.

   NOTICE: If the column is being disassembled on the bench, with the snap ring removed the shaft could slide out of the lower end of the mast jacket, damaging the shaft assembly.
5. Slide the directional signal cancelling cam, upper bearing preload spring and thrust washer off the end of the shaft.

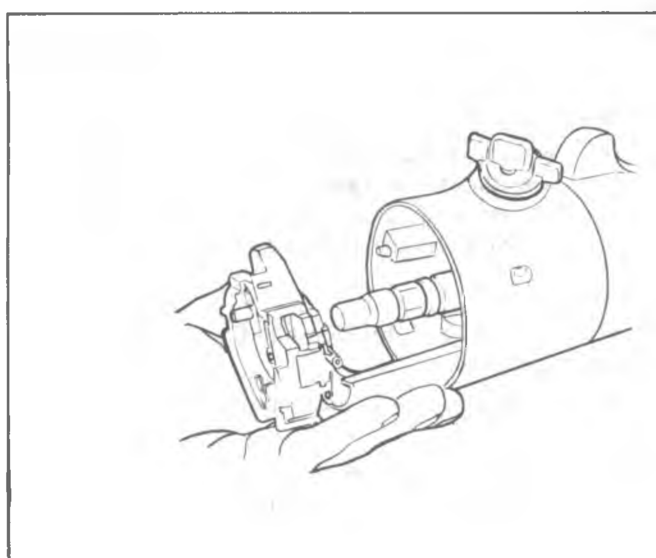


Fig. 3B5-13--Removing Directional Signal Switch Assembly

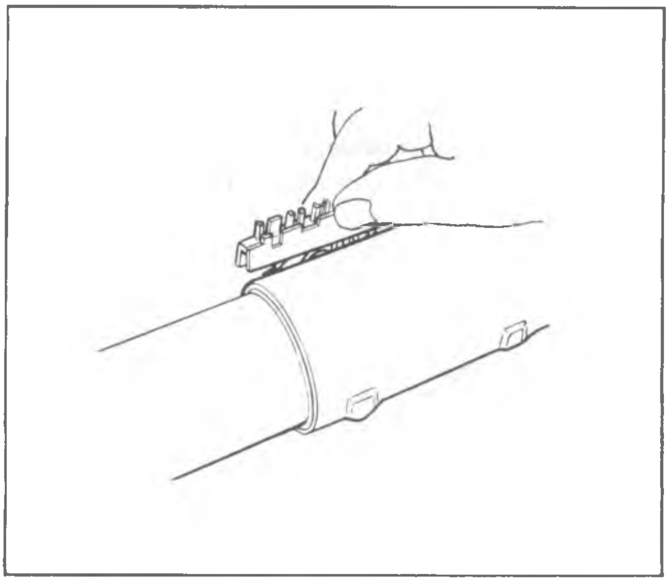


Fig. 3B5-14--Installing Switch Connector Onto Jacket Clips

6. Remove the directional signal lever screw and remove the lever.
7. Push the hazard warning knob in and unscrew the knob.
8. Remove the three switch mounting screws.
9. **All Columns** - Pull the switch connector out of the bracket on the jacket and feed switch connector through column support bracket and pull switch straight up, guiding the wiring harness through the column housing and protector.
10. Remove wire protector by pulling downward out of column with pliers using tab provided (Fig. 3B5-12).

    Tilt Column - Position the direction signal and shifter housing in the "low" position. Remove the harness cover by pulling toward the lower end of the column, be careful not to damage the wires.
11. Remove the three switch mounting screws and pull the switch straight up, guiding the wiring harness and cover through the column housing (Fig. 3B5-13).

Installation

CAUTION: It is extremely important that only the specified screws, bolts and nuts be used at assembly, or personal injury could result. Use of overlength screws could prevent a portion of the assembly from compressing under impact.

1. **All except Tilt** - Be sure that the wiring harness is in the protector. Feed the connector and cover down through the housing and under the mounting bracket (column in vehicle).

    Tilt - Feed the connector down through the housing and under the mounting bracket. Then install the cover on the harness.
2. Install the three mounting screws and clip the connector to the bracket on the jacket (Fig. 3B5-14).
3. Install the column to instrument panel trim plate.
4. Install the hazard warning knob and directional signal lever.
5. Make certain that the switch is in "Neutral" and the hazard warning knob is out. Slide the thrust washer, upper bearing preload spring and cancelling cam onto the upper end of the shaft.
6. Place the lock plate onto the end of the shaft. Screw the center post of Lock Plate Compressing Tool J-23653 onto the steering shaft as far as it will go. Place a NEW snap ring over the center post. Place the "C" bar over the center post and then compress the lock plate by turning the nut clockwise. Slide the new snap ring down the tapered center post and into the shaft groove (Fig. 3B5-15). Remove Tool J-23653.

    Always use a new snap ring when reassembling.
7. Place cover on the lock plate and snap into position.
8. Install the steering wheel as outlined under "Steering Wheel-Installation".

LOCK CYLINDER

The lock cylinder is located on the upper right hand side of the column. The lock cylinder should be removed in the "RUN" position only.

Replacement

1. Remove the steering wheel as outlined under "Steering Wheel - Removal".
2. Remove the directional signal switch as outlined under "Directional Signal Switch - Removal".

    It is not necessary to completely remove the directional signal switch from the column. Pull the switch rearward far enough to slip it over the end of the shaft - do not pull the harness out of the column.
3. Refer to Fig. 3B5-16 for details on replacement of lock cylinder.

IGNITION SWITCH

The ignition switch is mounted on top of the column jacket near the front of the dash. For anti-theft reasons, the switch is located inside the channel section of the brake pedal support and is completely inaccessible without first lowering the steering column (see steering column removal).

The switch is actuated by a rod and rack assembly. A portion of the rack is toothed and engages a gear on the end

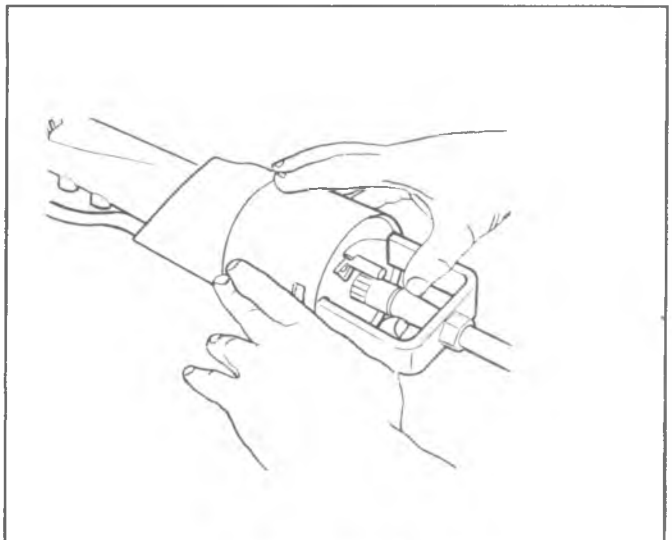


Fig. 3B5-15--Installing Snap Ring

LOCK CYLINDER INSTALLATION

DISASSEMBLE

1. Place lock in "run".
2. Remove lock plate, turn signal switch and buzzer switch (see service manual.)
3. Remove screw & lock cylinder. **CAUTION:** *If screw is dropped on removal, it could fall into the column, requiring complete disassembly to retrieve the screw.*

ASSEMBLE

1. Rotate as shown, align cylinder key with keyway in housing.
2. Push lock all the way in.
3. Install screw. Tighten to 4.5 N·m for regular columns—2.5 N·m for adjustable columns.

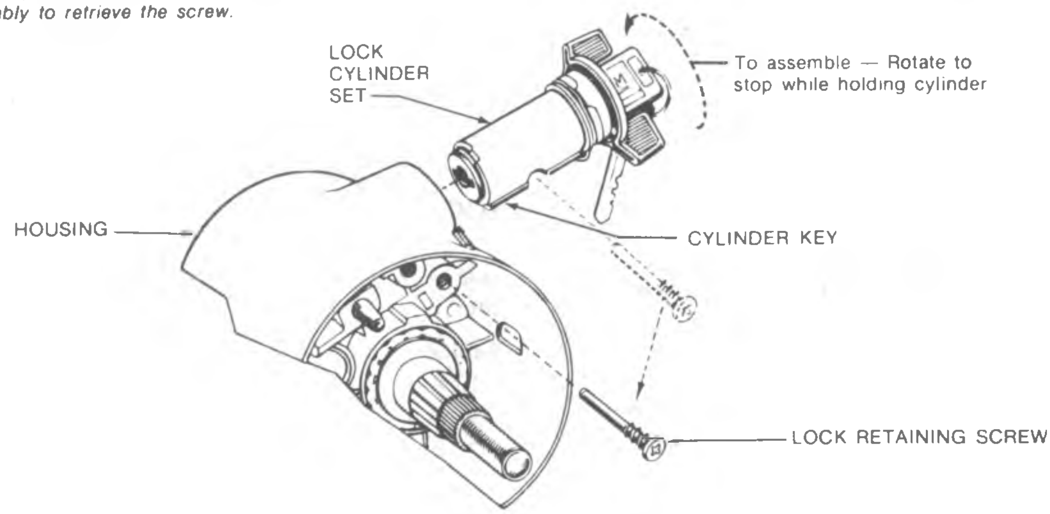


Fig. 3B5-16--Lock Cylinder Removal

of the lock cylinder, thus enabling the rod and rack to be moved axially (with respect to the column) to actuate the switch when the lock cylinder is rotated.

Removal

1. Lower the steering column as outlined under "Steering Column Removal" later in this section. It is not necessary to remove the steering wheel.

   If the steering column is not removed from the vehicle, be sure that it is properly supported, before proceeding.

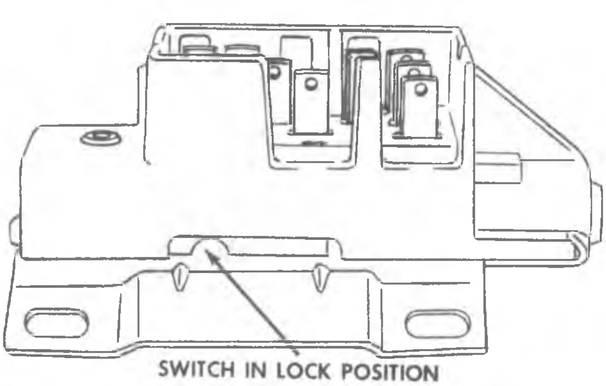


Fig. 3B5-17--Ignition Switch Assembly

2. The switch should be positioned in "Lock" position before removing. If the lock cylinder has already been removed, the actuating rod to the switch should be pulled up until there is a definite stop, then moved down one detent, which is the "Lock" position.
3. Remove the two switch screws and remove the switch assembly.

Installation

1. Before replacing the switch, be sure that the lock is in the ''Lock'' position (Fig. 3B5-17); if it is not, a screwdriver (placed in the locking rod slot) can be used to move the switch to "Lock".
2. Install the activating rod into the switch and assemble the switch on the column; tighten the mounting screws.

   CAUTION: Use only the specified screws since over-length screws could prevent a portion of the assembly from compressing under impact, which could result in personal injury.

3. Reinstall the steering column assembly following the "Mandatory Installation Sequence" outlined later in this section.

STEERING COLUMN

To perform service procedures on the steering column upper end components, it is not necessary to remove the column from the vehicle.

The steering wheel, horn components, directional signal switch, and ignition lock cylinder may be removed with the column remaining in the vehicle as described earlier in this section.

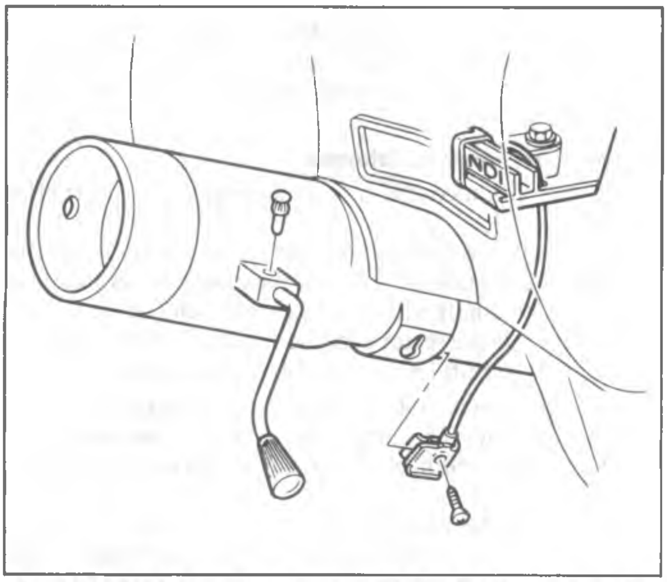


Fig. 3B5-18--Automatic Transmission Indicator Connection CK-Typical

CAUTION: The outer mast jacket shift tube, steering shaft and instrument panel mounting bracket are designed as energy absorbing units. Because of the design of these components, it is absolutely necessary to handle the column with care when performing any service operation. Avoid hammering, jarring, dropping or leaning on any portion of the column. When reassembling the column components, use only the specified screws, nuts and bolts and tighten to specified torque. Care should be exercised in using over-length screws or bolts as they may prevent a portion of the column from compressing under impact.

Inspection

To determine if the energy absorbing steering column components are functioning as designed, or if repairs are required, a close inspection should be made. Inspection is called for in all cases where damage is evident or whenever the vehicle is being repaired due to a front end collision. Whenever a force has been exerted on the steering wheel or steering column, or its components, inspection should also be made. If damage is evident, the affected parts must be replaced.

The inspection procedure for the various steering column components on all C and K Series Trucks is as follows:

Column Support Bracket

Damage in this area will be indicated by separation of the mounting capsules from the bracket. The bracket will have moved forward toward the engine compartment and will usually result in collapsing of the jacket section of the steering column.

Column Jacket

Inspect jacket section of column for looseness, and/or bends.

Shifter Shaft

Separation of the shifter shaft sections will be internal and cannot be visually identified. Hold lower end of the "shifter shaft" and move "shift lever" on column through its ranges and up and down. If there is little or no movement of the "shifter shaft", the plastic joints are sheared.

Steering Shaft

If the steering shaft plastic pins have been sheared, the shaft will rattle when struck lightly from the side and some lash may be felt when rotating the steering wheel while holding the rag joint. It should be noted that if the steering shaft pins are sheared due to minor collision the vehicle can be safely steered; however, steering shaft replacement is recommended.

Because of the differences in the steering column types, be sure to refer to the set of instructions below which apply to the column being serviced.

Removal

Front of dash mounting plates must be loosened whenever the steering column is to be lowered from the instrument panel.

1. Disconnect the battery ground cable.
2. Remove the steering wheel as outlined under "Steering Wheel Removal".
3. Remove the nuts and washers securing the flanged end of the steering shaft to the flexible coupling.
4. Disconnect the transmission control linkage from the column shift tube levers.
5. Disconnect the steering column harness at the connector. Disconnect the neutral-start switch and back-up lamp switch connectors if so equipped.
6. Remove the floor pan trim cover screws and remove the cover.
7. Remove the transmission indicator cable, if so equipped (Fig. 3B5-18).
8. Remove the screws securing the two halves of the floor pan cover; then remove the screws securing the halves and seal to the floor pan and remove the covers (Fig. 3B5-19).
9. Move the front seat as far back as possible to provide maximum clearance.
10. Remove the two column bracket-to-instrument panel

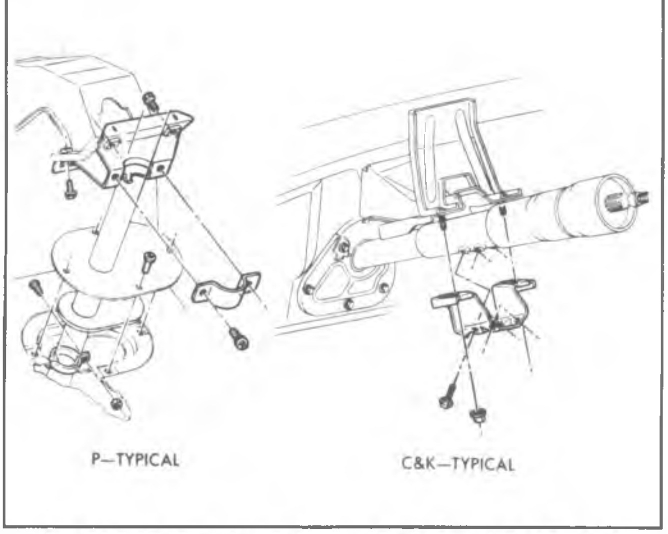


Fig. 3B5-19--Steering Column to Dash Panel-C, K Typical nuts and carefull remove from vehicle. Additional help should be obtained to guide the lower shift levers through the firewall opening.

C and K Series, Standard Column - (Fig. 3B5-21)

Disassembly

1. Remove the four dash panel bracket-to-column screws and lay the bracket in a safe place to prevent damage to the mounting capsules.
2. Place the column in a vise using both weld nuts of either Set A or B as shown in Figure 3B5-22. The vise jaws must clamp onto the sides of the weld nuts indicated by arrows shown on Set B.

   NOTICE: Do not place the column in a vise by clamping onto one weld nut of both sets A and B or by clamping onto the sides not indicated by arrows, since damage to the column could result.
3. Remove the Directional Signal Switch, Lock Cylinder, and Ignition Switch as outlined previously in this section.
4. **Column Shift Models** - Drive out the upper shift lever pivot pin and remove the shift lever.
5. Remove the upper bearing thrust washer. Remove the four screws attaching the turn signal and ignition lock housing to the jacket and remove the housing assembly (Fig. 3B5-23).
6. Remove the thrust cap from the lower side of the housing.
7. Lift the ignition switch actuating rod and rack assembly, the rack preload spring and the shaft lock bolt and spring assembly out of the housing (Fig. 3B5-24).
8. Remove the shift lever detent plate (shift gate).
9. Remove the ignition switch actuator sector through the lock cylinder hole by pushing firmly on the block tooth of the sector with a blunt punch or screwdriver (Fig. 3B5-25).
10. Remove the gearshift lever housing and shroud from the jacket assembly (transmission control lock tube housing and shroud on floor shift models).
11. Remove the shift lever spring from the gearshift lever housing (lock tube spring on floor shift models).
12. Pull the steering shaft from lower end of the jacket assembly.
13. Remove the two screws holding the back-up switch or neutral-safety switch to the column and remove the switch.
14. Remove the lower bearing retainer clip (Fig. 3B5-26).
15. **Automatic and Floorshift Columns** - Remove the lower bearing retainer, bearing adapter assembly, shift tube thrust spring and washer. The lower bearing may be removed from the adapter by light pressure on the bearing outer race. Slide out the shift tube assembly.

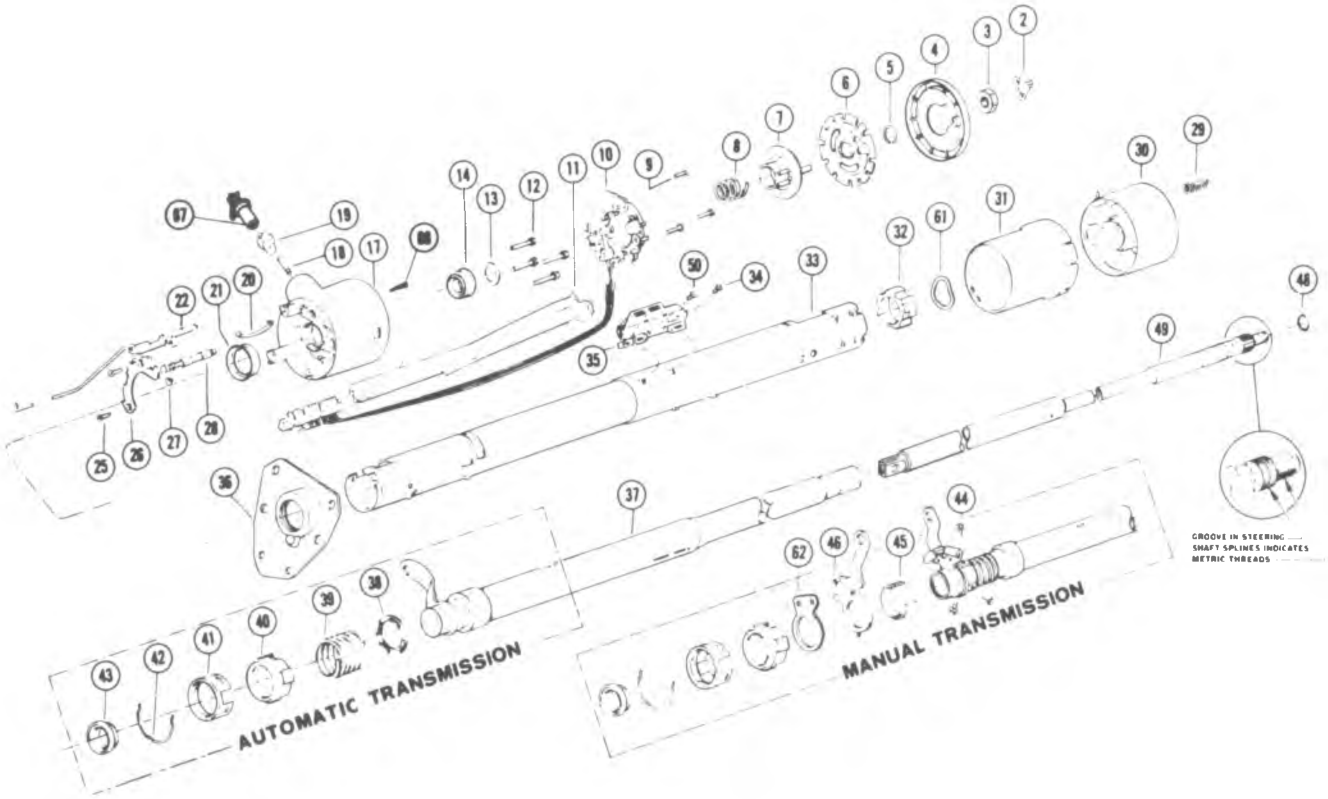
    Manual Transmission - Column Shift - Remove the lower bearing adapter, bearing and the first reverse shift lever. The lower bearing may be removed from the adapter by light pressure on the bearing outer race. Remove the three screws from bearing at the lower end and slide out the shift tube assembly. Remove the gearshift housing lower bearing from the upper end of the mast jacket.

Assembly of Standard Columns

Apply a thin coat of lithium soap grease to all friction surfaces.

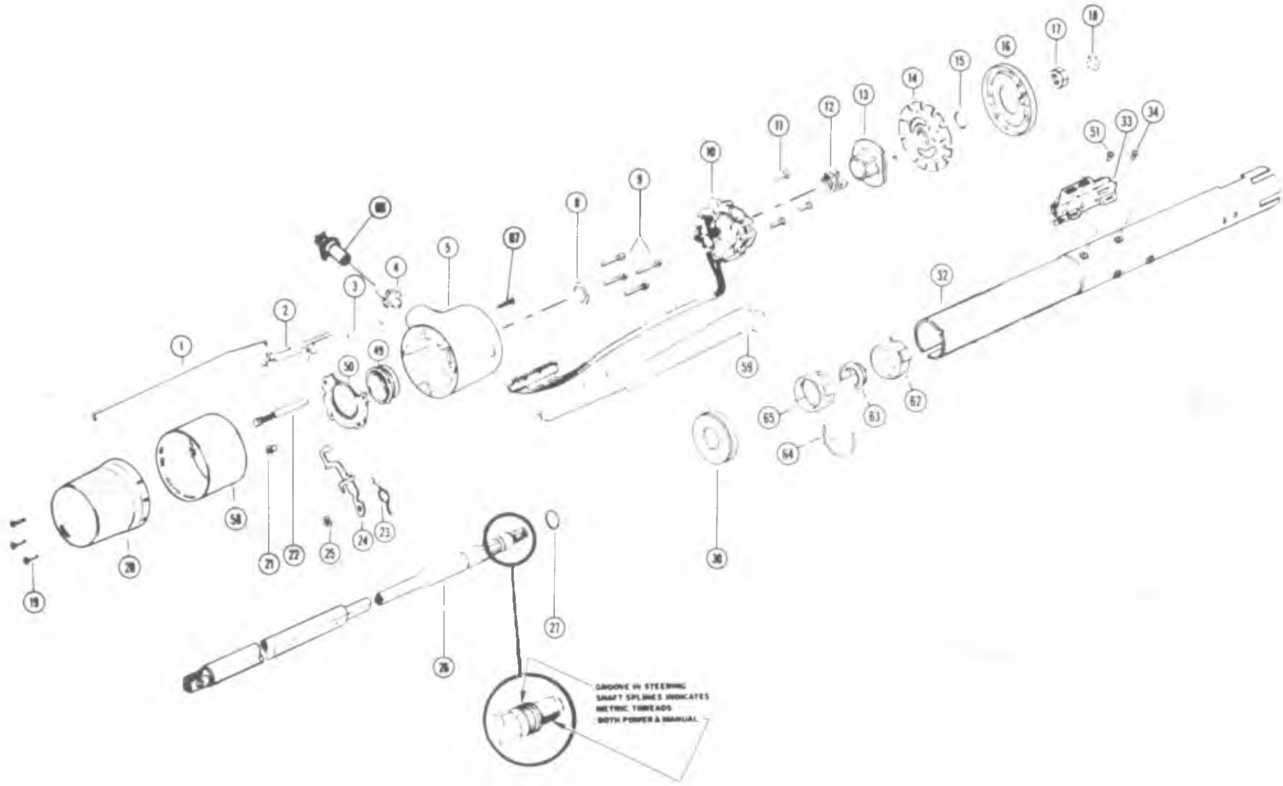
1. Install the sector into the turn signal and lock cylinder housing. Install the sector in the lock cylinder hole over the sector shaft with the tang end to the outside of the hole. Press the sector over the shaft with a blunt tool.
2. Install the shift lever detent plate onto the housing.
3. Insert the rack preload spring into the housing from the bottom side. The long section should be toward the handwheel and hook onto the edge of the housing (Fig. 3B5-27).
4. Assemble the locking bolt onto the crossover arm on the rack and insert the rack and lock bolt assembly into the housing from the bottom with the teeth up (toward hand-wheel) and toward the centerline of the column (Fig. 3B5-24). Align the 1st tooth on the sector with the 1st tooth on the rack; if aligned properly, the block teeth will line up when the rack assembly is pushed all the way in.
5. Install the thrust cup on the bottom hub of the housing.
6. Install the gearshift housing lower bearing. Insert the bearing from the very end of the jacket. Aligning the indentations in the bearing with the projections on the jacket (Fig. 3B5-28). If the bearing is not installed correctly, it will not rest on all of the stops provided.
7. Install the shift lever spring into the gearshift lever (or lock tube) housing. Install the housing and shroud assemblies onto the upper end of the mast jacket. Rotate the housing to be sure it is seated in the bearing.
8. With the shift lever housing in place, install the turn signal and lock cylinder housing onto the jacket. The gearshift housing should be in "Park" position and the rack pulled downward. Be sure the turn signal housing is seated on the jacket and drive the four screws.
9. Press the lower bearing into the adapter assembly.
10. Insert the shift tube assembly into the lower end of the jacket and rotate until the upper shift tube key slides into the housing keyway.
11. **Automatic and Floor shift Columns** - Assemble the spring and lower bearing and adapter assembly into the bottom of the jacket. Holding the adapter in place, install the lower bearing reinforcement and retainer clip. Be sure the clip snaps into the jacket and reinforcement slots.
12. **Manual Transmission - Column Shift** - Loosely attach the three screws in the jacket and shift tube bearing.

    Assemble the 1st-Reverse lever and lower bearing and adapter assembly into the bottom of the jacket. Holding the adapter in place, install the bearing reinforcement and retaining clip. Be sure the retaining clip snaps into the jacket and reinforcement slots. Refer to Fig. 3B5-29 for adjustment procedure.



1. STEERING COLUMN
2. RETAINER
3. NUT, Hexagon Jam
4. COVER, Shaft Lock
5. RING, Retaining
6. LOCK, Steering Shaft
7. CAM ASM, Turn Signal Cancelling
8. SPRING, Upper Bearing
9. SCREW, Pan Head Cross Recess
10. SWITCH ASM, Turn Signal
11. PROTECTOR, Wiring
12. SCREW, Hex Washer Head Tapping
13. WASHER, Thrust
14. BEARING ASM
17. HOUSING, Steering Column
18. SHAFT, Sector
19. SECTOR, Switch Actuator
20. SPRING, Rack Preload
21. CUP, Thrust
22. RACK ASM, Rod &
23. SCREW, Dimmer Switch Mounting
24. SWITCH ASM, Dimmer
25. SCREW, Flat Head Cross Recess
26. GATE, Shift Lever
27. WASHER, Spring Thrust
28. BOLT ASM, Spring &
29. SPRING, Upper Shift Lever
30. BOWL, Gearshift Lever
31. SHROUD, Shift Bowl
32. BEARING, Bowl Lower
33. JACKET ASM, Steering Column
34. SCREW, Washer Head
35. SWITCH ASM, Ignition
36. SEAL, Dash
37. TUBE ASM, Shift
38. WASHER, Spring Thrust
39. SPRING, Shift Tube Return
40. ADAPTER, Lower Bearing
41. RETAINER, Bearing Adapter
42. CLIP, Lower Bearing Adapter
43. BEARING ASM
44. SCREW ASM, Lockwasher &
45. SPACER, Lower Shift Lever
46. LEVER, Lower Shift
47. BUSHING ASM, Steering Shaft
48. RING, Retaining
49. SHAFT ASM, Steering
50. SCREW, Flat Head
51. ROD, Dimmer Switch Actuator
61. WASHER, Wave
62. PLATE, Support & Alignment
67. LOCK CYLINDER SET, Strg Column
68. SCREW, Lock Retaining

Fig. 3B5-20--Std. Column; Auto. Trans. or 3-Speed



1. ROD, Switch Actuator
2. RACK, Switch Actuator
3. SPRING, Rack Preload
4. SECTOR, Switch Actuator
5. HOUSING, Steering Column
8. WASHER, Thrust
9. SCREW, Hex Washer Head Tapping
10. SWITCH ASSEMBLY, Turn Signal
11. SCREW, Pan Head Cross Recess
12. SPRING, Upper Bearing
13. CAM ASM, Turn Signal Cancelling
14. LOCK, STEERING SHAFT
15. RING, Retaining
16. COVER, Shaft Lock
17. NUT, Hexagon Jam
18. RETAINER
19. SCREW, Pan Head Cross Recess
20. SHROUD, Steering Column
21. WASHER, Spring Thrust
22. BOLT ASSEMBLY, Spring
23. SPRING, Key Release
24. LEVER, Key Release
25. WASHER, Wave
26. SHAFT ASSEMBLY, Steering
27. RING, Retaining
30. SEAL, Jacket & Dash Bracket
32. JACKET ASSEMBLY, Sleeve
33. SWITCH ASSEMBLY, Ignition
34. SCREW, Washer Head
49. BEARING ASM
50. RETAINER, Upper Bearing
51. SCREW, Flat Head
58. BOWL. Floor Shift
59. PROTECTOR, Wiring
62. ADAPTER, Lower Bearing
63. BEARING ASM
64. CLIP, Lower Bearing Adapter
65. RETAINER, Bearing Adapter
66. LOCK CYLINDER SET, Strg Column
67. SCREW, Lock Retaining

Fig. 3B5-21--Std. Column, 4-Speed Trans.

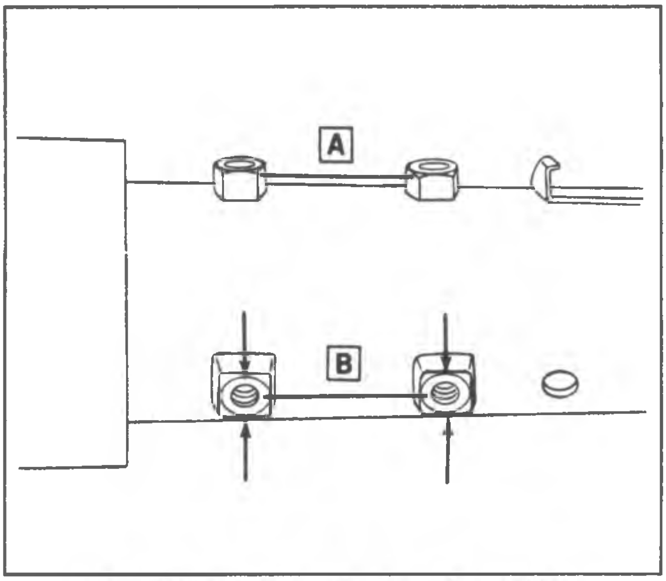


Fig. 3B5-22--Installing Steering Column in Vise

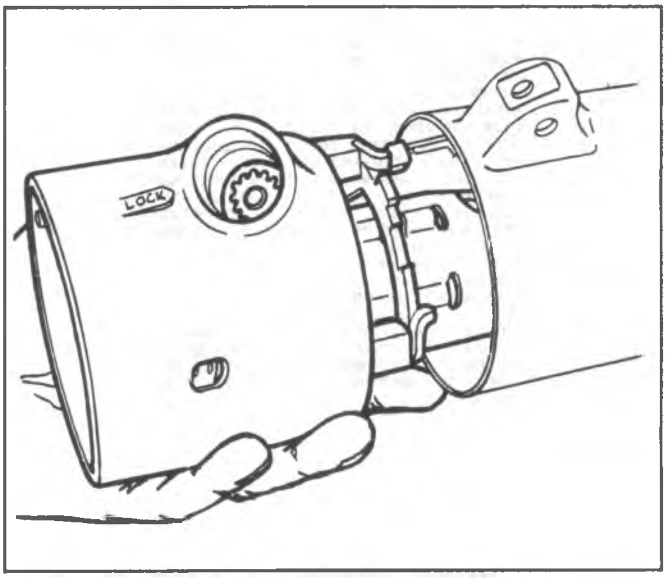


Fig. 3B5-23--Removing Turn Signal Housing

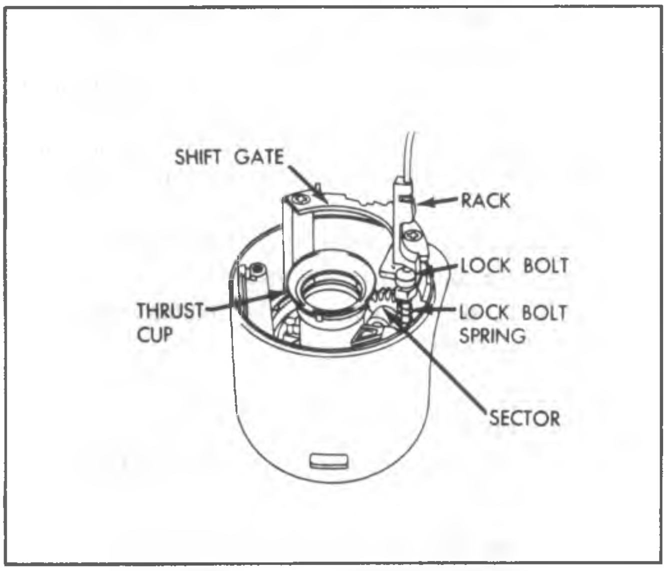


Fig. 3B5-24--Turn Signal Housing Assembly

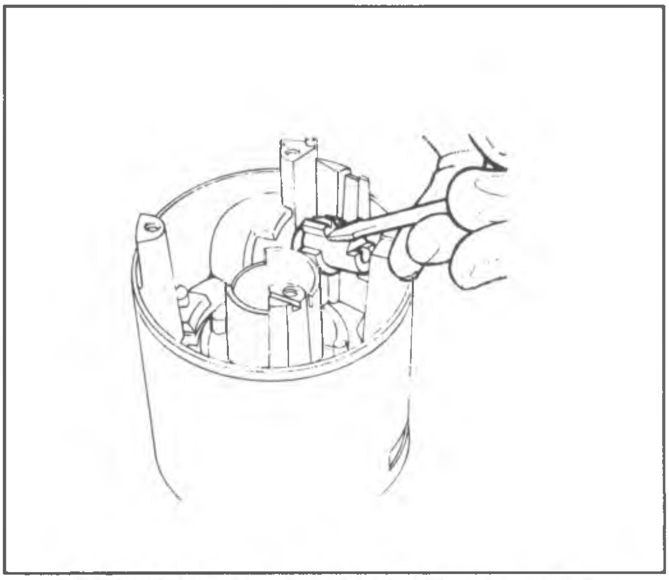


Fig. 3B5-25--Removing Ignition Switch Actuator Sector

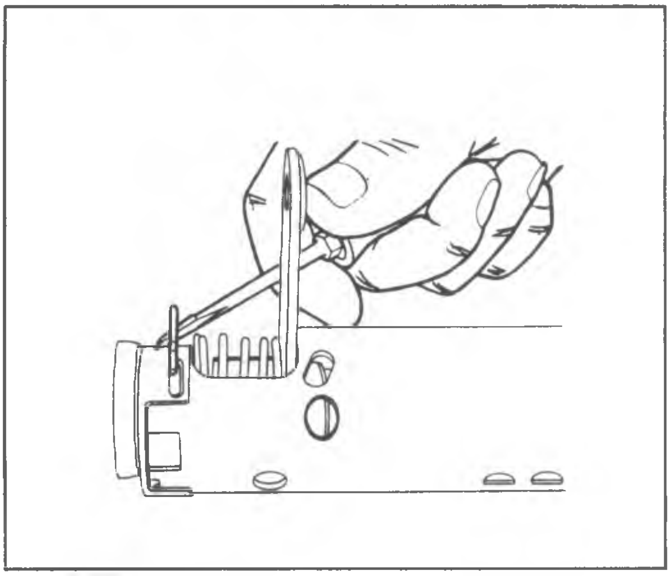


Fig. 3B5-26--Removing Lower Bearing Retainer

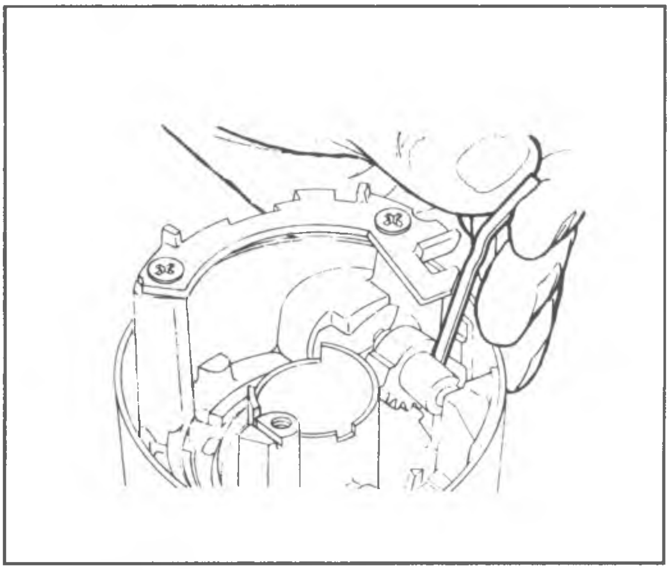
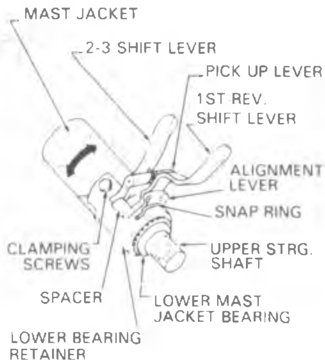


Fig. 3B5-27--Installing Rack Preload Spring

A. TO REDUCE CLEARANCE
SLIDE THE CLAMPING SCREWS AROUND THE MAST JACKET IN THE DIRECTION OF ARROW A

B. TO INCREASE CLEARANCE
SLIDE THE CLAMPING SCREWS AROUND THE MAST JACKET IN THE DIRECTION OF ARROW B



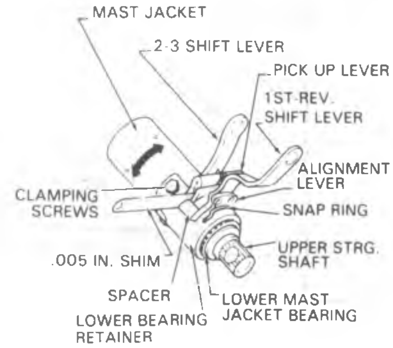
ADJUSTMENT PROCEDURE

1. WITH THE TRANSMISSION IN NEUTRAL DISCONNECT THE TRANSMISSION RODS.
2. TEST FOR ROTATIONAL DRAG BY TURNING THE SHIFT LEVER (INSIDE TRUCK) THROUGH THE 2-3 SHIFT ARC. DRAG, MEASURED AT THE SHIFT KNOB, MUST BE NO MORE THAN 2.0 LBS. IF DRAG IS MORE THAN 2.0 LBS. CORRECTIONS MUST BE MADE BEFORE PROCEEDING WITH THE ADJUSTMENT.
3. LOOSEN THE THREE CLAMPING SCREWS.
4. INCREASE CLEARANCE BY SLIDING THE CLAMPING SCREWS IN DIRECTION OF ARROW "B" ABOVE UNTIL THE 1ST-REV. SHIFT LEVER COMPLETELY FREE OF DRAG.
5. DECREASE CLEARANCE BY SLIDING THE CLAMPING SCREWS IN DIRECTION OF ARROW "A" ABOVE UNTIL A SLIGHT DRAG IS FELT AT THE 1ST REV. SHIFT LEVER.
6. TIGHTEN THE THREE CLAMPING SCREWS.
7. RECONNECT THE TRANSMISSION RODS

NOTE: IF NO PROBLEM WITH STEERING COLUMN DRAG IS INVOLVED, THIS ADJUSTMENT CAN BE MADE BY DISCONNECTING ONLY THE 1ST. REV. TRANSMISSION ROD AND OMITTING STEP 2.

A. TO REDUCE CLEARANCE
SLIDE THE CLAMPING SCREWS AROUND THE MAST JACKET IN THE DIRECTION OF ARROW A

B. TO INCREASE CLEARANCE
SLIDE THE CLAMPING SCREWS AROUND THE MAST JACKET IN THE DIRECTION OF ARROW B



ADJUSTMENT PROCEDURE

1. WITH THE TRANSMISSION IN NEUTRAL DISCONNECT THE TRANSMISSION RODS.
2. TEST FOR ROTATIONAL DRAG BY TURNING THE SHIFT LEVER (INSIDE TRUCK) THROUGH THE 2-3 SHIFT ARC. DRAG MEASURED AT THE SHIFT KNOB MUST BE NO MORE THAN 2.0 LBS. IF DRAG IS MORE THAN 2.0 LBS. CORRECTIONS MUST BE MADE BEFORE PROCEEDING WITH THIS ADMUSTMENT.
3. LOOSEN THE THREE CLAMPING SCREWS.
4. INSTALL A .005 IN. THICK SHIM BETWEEN THE SPACE AND EITHER OF THE SHIFT LEVERS. THE ABOVE ILLUSTRATION SHOWS THE SHIM BETWEEN THE SPACER AND THE 2-3 SHIFT LEVER.
5. SLIDE THE CLAMPING SCREWS IN DIRECTION OF ARROW B UNTIL THE SYSTEM IS LOOSE. THEN SLIDE THE SCREWS IN OPPOSITE DIRECTION UNTIL A DEFINITE DRAG IS FELT AT THE 1ST REV. SHIFT LEVER.
6. TIGHTEN THE CLAMPING SCREWS.
7. REMOVE THE SHIM.
8. REINSTALL THE TRANSMISSION RODS.

NOTE: IF THERE IS NO PROBLEM WITH STEERING COLUMN DRAG. THIS ADJUSTMENT CAN BE MADE BY DISCONNECTING ONLY THE 1ST. REV. TRANSMISSION ROD AND OMITTING STEP. 2.

Fig. 3B5-29--Adjusting Lower Bearing-Typical

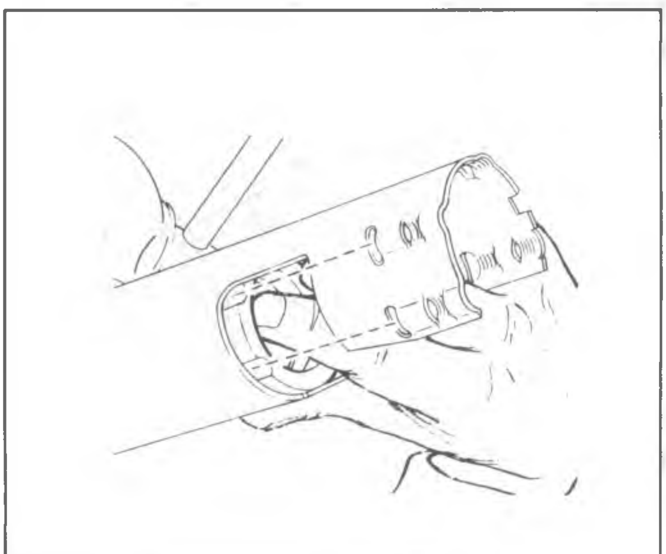


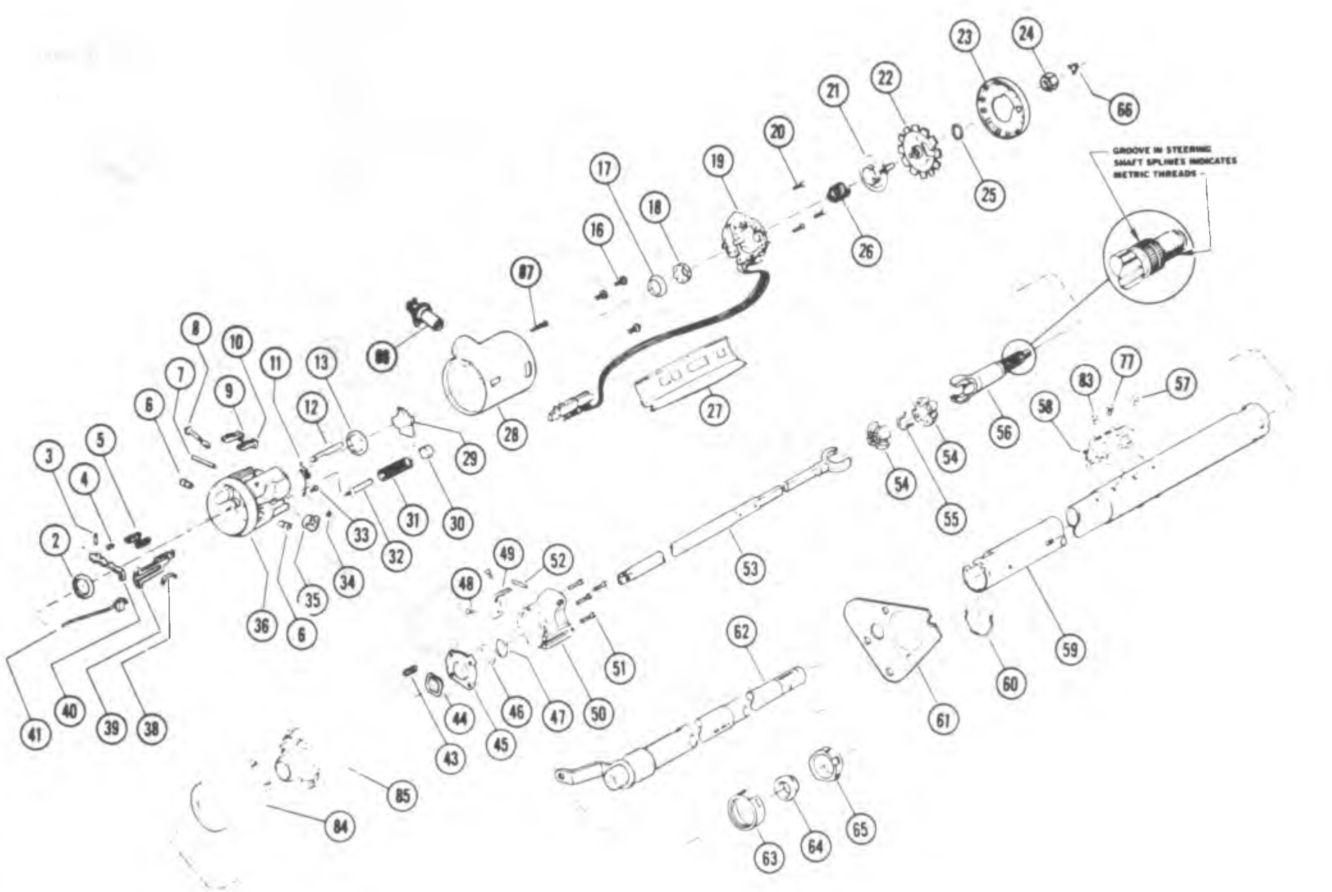
Fig. 3B5-28--Installing Gearshift Housing Lower Bearing

13. Install the neutral-safety or back-up switch as outlined in Section 8 of this manual.
14. Slide the steering shaft into the column and install the upper bearing thrust washer.
15. Install the turn signal switch, lock cylinder assembly and ignition switch as previously outlined in this section.
16. Install the shift lever and shift lever pivot pin.
17. Remove the column from the vise.
18. Install the dash bracket to the column; torque the screws to specifications.

Disassembly-Tilt Columns

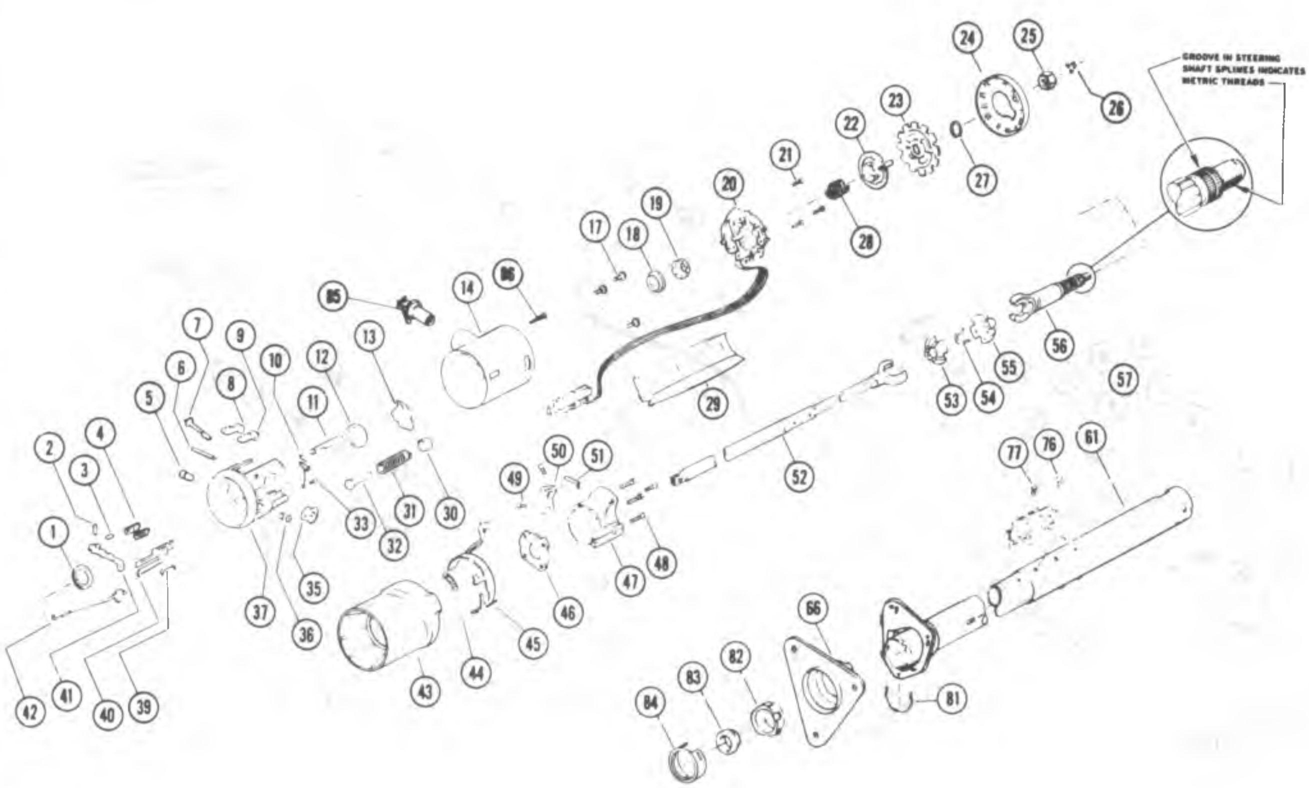
Steps 3-14 may be performed with the steering column in the vehicle.

1. Remove the four screws retaining the dash mounting bracket to the column and set the bracket aside to protect the breakaway capsules.



1. STEERING COLUMN
2. BEARING ASM
3. PIN, Release Lever
4. SPRING, Release Lever
5. SPRING, Shoe
6. PIN, Pivot
7. PIN, Dowel
8. SHAFT, Drive
9. SHOE, Steering Wheel Lock
10. SHOE, Steering Wheel Lock
11. SPRING, Lock Bolt
12. BOLT, Lock
13. BEARING ASM
16. SCREW, Oval Head Cross Recess
17. RACE, Inner
18. SEAT, Upper Bearing Inner Race
19. SWITCH ASM, Turn Signal
20. SCREW, Binding HD. Cross Recess
21. CAM ASM, Turn Sig. Cancelling
22. LOCK, Shaft
23. COVER, Shaft Lock
24. NUT, Hexagon Jam
25. RING, Retaining
26. SPRING, Upper Bearing
27. PROTECTOR, Wiring
28. COVER, Lock Housing (Painted)
29. SHIELD, Tilt Lever Opening
30. RETAINER, Spring
31. SPRING, Wheel Tilt
32. GUIDE, Spring
33. SCREW, Hex. Washer Head
34. RING, Retaining
35. SECTOR, Switch Actuator
36. HOUSING, Steering Column
38. SPRING, Rack Preload
39. RACK, Switch Actuator
40. LEVER, Shoe Release
41. ACTUATOR ASM, Ignition Switch
43. SPRING, Shift Lever
44. WASHER, Wave
45. PLATE, Lock
46. WASHER, Thrust
47. RING, Shift Tube Retaining
48. SCREW, Oval Head Cross Recess
49. GATE, Shift Lever
50. SUPPORT, Strg. Column Housing
51. SCREW, Support
52. PIN, Dowel
53. SHAFT ASM, Lower Steering
54. SPHERE, Centering
55. SPRING, Joint Preload
56. SHAFT ASM, Race & Upper
57. SCREW, Wash. Hd.
58. SWITCH ASM, Ignition
59. JACKET ASM, Steering Column
60. CLIP, Lower Bearing Adapter
61. SEAL, Dash
62. TUBE ASM, Shift
63. RETAINER, Bearing Adapter
64. BEARING ASM
65. ADAPTER, Lower Bearing
66. RETAINER
77. SCREW, Flat Head
84. SHROUD, Gearshift Bowl
85. BOWL, Gearshift Lever
86. LOCK CYLINDER SET, Strg Column
87. SCREW, Lock Retaining

Fig. 3B5-30--Tilt Column With Auto. Trans.



1. BEARING ASM
2. PIN, Release Lever
3. SPRING, Release Lever
4. SPRING, Shoe
5. PIN, Pivot
6. PIN, Dowel
7. SHAFT, Drive
8. SHOE, Steering Wheel Lock
9. SHOE, Steering Wheel Lock
10. SPRING, Lock Bolt
11. BOLT, Lock
12. BEARING ASM
13. SHIELD, Tilt Lever Opening
14. COVER, Lock Housing
17. SCREW, Oval Head Cross Recess
18. RACE, Inner
19. SEAT, Upper Bearing Inner Race
20. SWITCH ASM, Turn Signal
21. SCREW, Binding HD Cross Recess
22. CAM ASM, Turn Signal Cancelling
23. LOCK, Shaft
24. COVER, Shaft Lock
25. NUT, Hexagon Jam (9/16-18)
26. RETAINER
27. RING, Retainer
28. SPRING, Upper Bearing
29. PROTECTOR, Wiring
30. RETAINER, Spring
31. SPRING, Wheel Tilt
32. GUIDE, Spring
33. SCREW, Hex. Washer Head
35. SECTOR, Switch Actuator
36. PIN, Pivot
37. HOUSING, Steering Column
39. SPRING, Rack Preload
40. RACK, Switch Actuator
41. LEVER, Shoe Release
42. ACTUATOR ASM, Switch
43. SHROUD, Column Housing
44. SPRING, Key Release
45. LEVER, Key Release
46. PLATE, Lock
47. SUPPORT, Steering Column Housing
48. SCREW, Support
49. SCREW, Oval Head Cross Recess
50. PLATE, Shroud Retaining
51. PIN, Dowel
52. SHAFT ASM, Lower Steering
53. SPHERE, Centering
54. SPRING, Joint Preload
55. SPHERE, Centering
56. SHAFT ASM, Race & Upper
57. SWITCH ASM, Ignition
61. JACKET ASM, Sleeve &
62. BEARING ASM, Adapter &
63. BEARING ASM
64. SPACER, Steering Shaft
65. SEAL, Jacket & Dash Bracket
66. BRACKET ASM, Column Dash
76. SCREW, Washer Head (#10-24 x .25)
77. SCREW, Flat Head (#10-24 x .31)
81. CLIP, Lower Bearing Adapter
82. ADAPTER, Lower Bearing
83. BEARING ASM
84. RETAINER, Bearing Adapter
85. LOCK CYLINDER SET, Strg Column
86. SCREW, Lock Retaining

Fig. 3B5-31--Tilt Column With 4-Speed

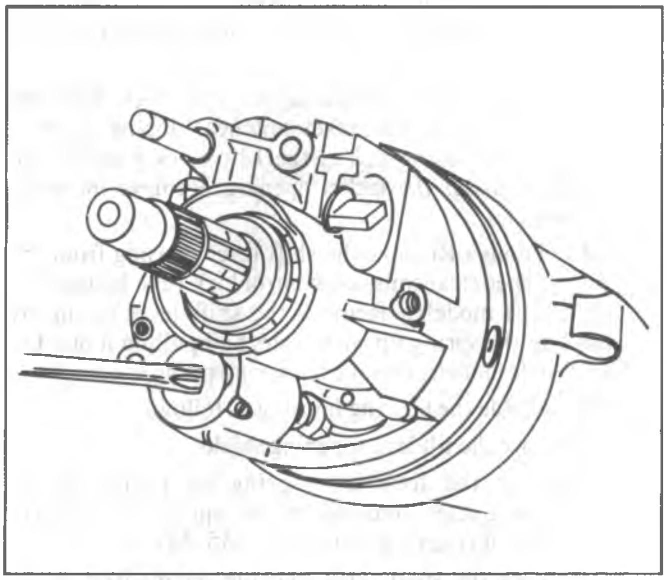


Fig. 3B5-32--Removing Tilt Lever Spring Retainer

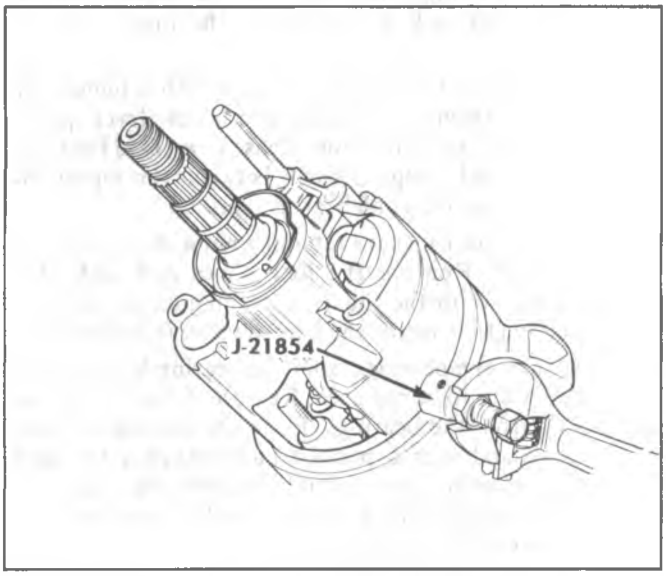


Fig. 3B5-33--Removing Bearing Housing Pivots Pins

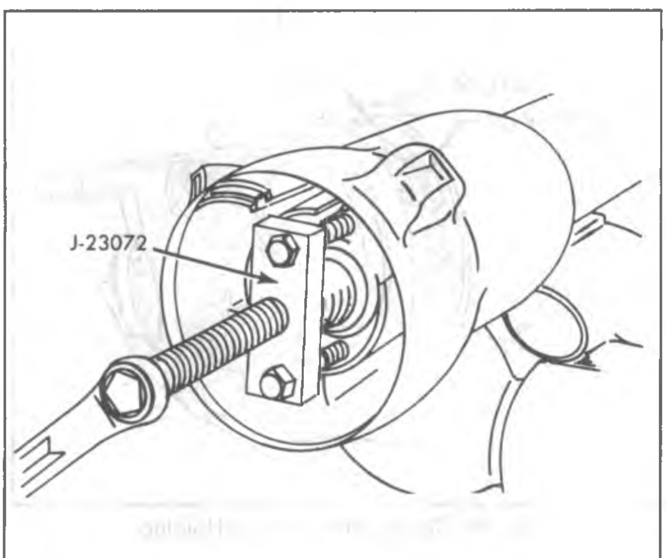


Fig. 3B5-34--Removing Shift Tube

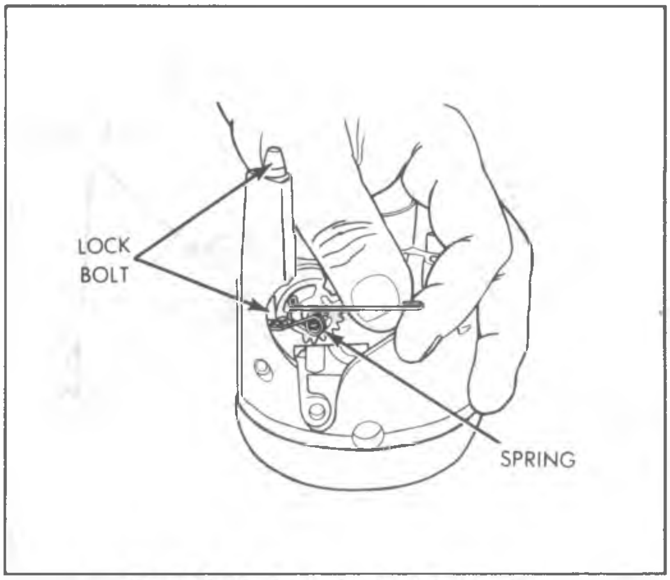


Fig. 3B5-35--Replacing Lock Bolt Spring

2. Mount the column in a vise using both weld nuts of either Set A or B as shown in Figure 3B5-22. The vise jaws must clamp onto the sides of the weld nuts indicated by arrows shown on Set B.

   NOTICE: Do not place the column in a vise by clamping onto only one weld nut, by clamping onto one weld nut of both Sets A and B or by clamping onto the sides not indicated by arrows, since damage to the column could result.

3. Remove the directional signal switch, lock cylinder and ignition switch as outlined previously in this section.
4. Remove the tilt release lever. Drive out the shift lever pivot pin and remove the shift lever from the housing.
5. Remove the three turn signal housing screws and remove the housing.
6. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring retainer using a #3 phillips screwdriver that just fits into the slot opening. Insert the phillips screwdriver in the slot,

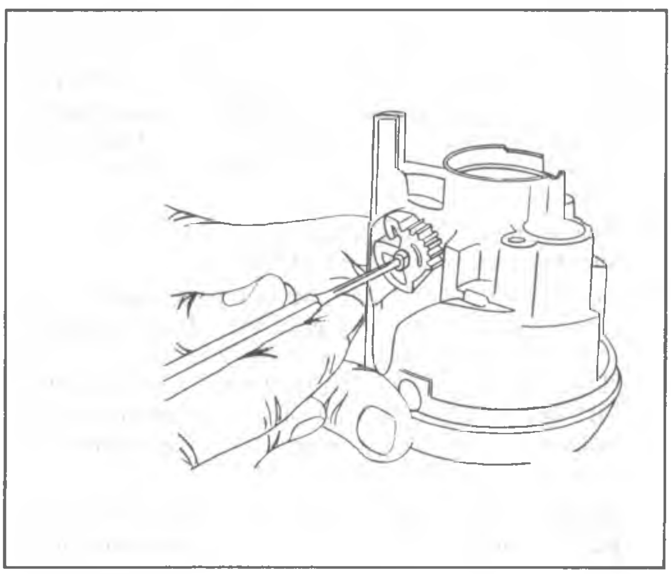


Fig. 3B5-36--Removing Sector Drive Shaft

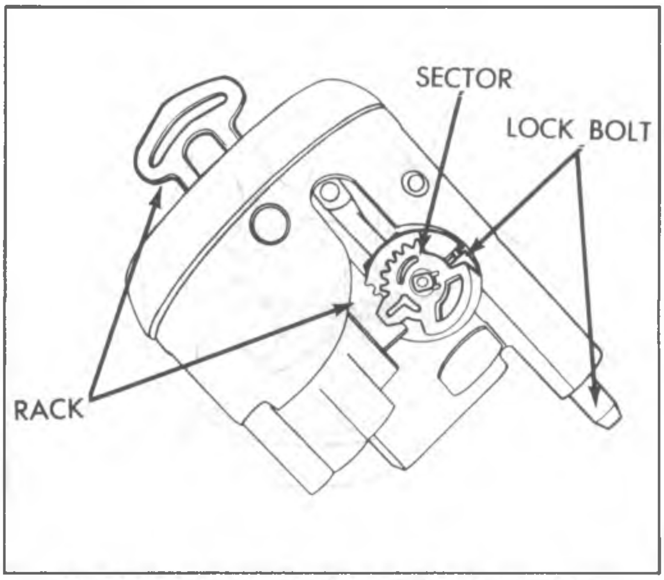


Fig. 3B5-37--Installing Lock Bolt and Rack Assemblies

press in approximately 3/16", turn approximately 1/8 turn counterclockwise until the ears align with the grooves in the housing and remove the retainer, spring and guide (Fig. 3B5-32).

7. Remove the pot joint to steering shaft clamp bolt and remove the intermediate shaft and pot joint assembly.

   Push the upper steering shaft in sufficiently to remove the steering shaft upper bearing inner race and seat. Pry off the lower bearing retainer clip and remove the bearing reinforcement, bearing and bearing adapter assembly from the lower end of the mast jacket.

8. Remove the upper bearing housing pivot pins using Tool J-21854-1 (Fig. 3B5-33).
9. Install the tilt release lever and disengage the lock shoes. Remove the bearing housing by pulling upward to extend the rack full down, and then moving the housing to the left to disengage the ignition switch rack from the actuator rod.
10. Remove the steering shaft assembly from the upper end of the column.
11. Disassemble the steering shaft by removing the centering spheres and the anti-lash spring.
12. Remove the transmission indicator wire, if so equipped.
13. Remove the four steering shaft bearing housing support to gearshift housing screws and remove the bearing housing support. Remove the ignition switch actuator rod.
14. Remove the shift tube retaining ring with a screwdriver and then remove the thrust washer.
15. Install Tool J-23072 into the lock plate, making sure that the tool screws have good thread engagement in the lock plate. Then, turning the center screw clockwise, force the shift tube from the housing (Fig. 3B5-34). Remove the shift tube (transmission control lock tube on floor shift models) from the lower end of the mast jacket. Remove Tool J-23072.

    NOTICE: When removing the shift tube, be sure to guide the lower end through the slotted opening in the mast jacket. If the tube is allowed to interfere with the jacket in any way, damage to the tube and jacket could result.

16. Remove the bearing housing support lock plate by sliding it out of the jacket notches, tipping it down toward the housing hub at the 12 o'clock position and sliding it under the jacket opening. Remove the wave washer.
17. **All Columns** - Remove the shift lever housing from the mast jacket (transmission control lock tube housing on floor shift models). Remove the shift lever spring by winding the spring up with pliers and pulling it out. On floor shift models, remove the spring plunger.
18. Disassemble the bearing housing as follows:
    a. Remove the tilt lever opening shield.
    b. Remove the lock bolt spring by removing the retaining screw and moving the spring clockwise to remove it from the bolt (Fig. 3B5-35).
    c. Remove the snap ring from the sector drive shaft. With a small punch, lightly tap the drive shaft from the sector (Fig. 3B5-36). Remove the drive shaft, sector and lock bolt. Remove the rack and rack spring.
    d. Remove the tilt release lever pin with a punch and hammer. Remove the lever and release lever spring. To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.
    e. Remove the lock shoe retaining pin with a punch and hammer. Remove the lock shoes and lock shoe springs. With the tilt lever opening on the left side and shoes facing up, the four slot shoe is on the left.
    f. Remove the bearings from the bearing housing only if they are to be replaced. Remove the separator and balls from the bearings. Place the housing on work bench and with a pointed punch against the back surface of the race, carefully hammer the race out of the housing until a bearing puller can be used. Repeat for the other race.

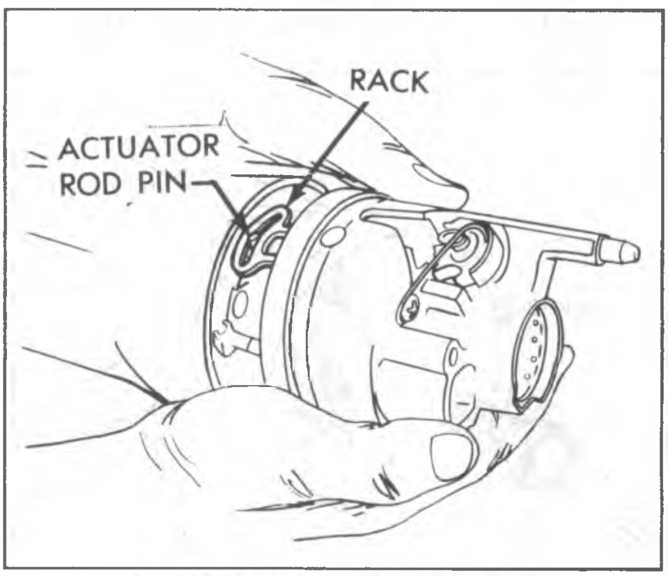


Fig. 3B5-38--Installing Bearing Housing

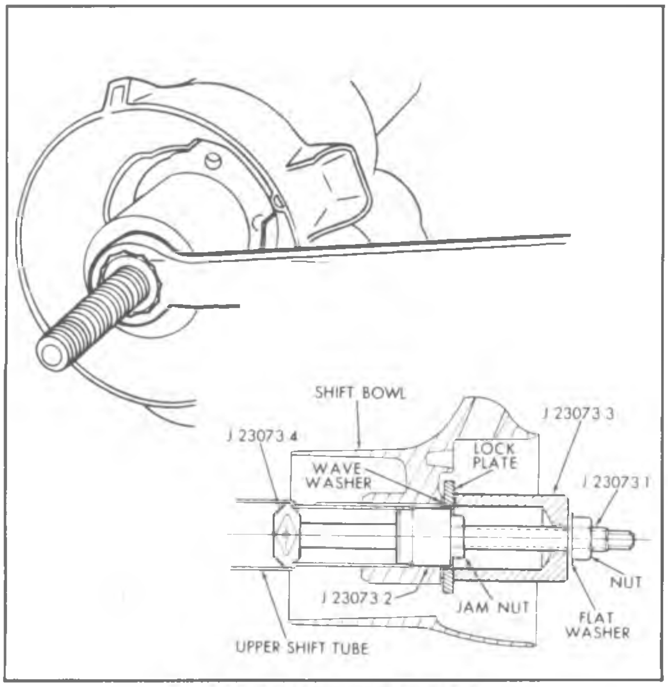


Fig. 3B5-39--Installing Shift Tube

Assembly-Tilt Columns

Apply a thin coat of lithium grease to all friction surfaces.

1. If the bearing housing was disassembled, repeat the following steps:
   a. Press the bearings into the housing, if removed, using a suitable size socket. Be careful not to damage the housing or bearing during installation.
   b. Install the lock shoe springs, lock shoes and shoe pin in the housing. Use an approximate .180" rod to line up the shoes for pin installation.
   c. Install the shoe release lever, spring and pin. To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.
   d. Install the sector drive shaft into the housing. Lightly tap the sector onto the shaft far enough to install the snap ring. Install the snap ring.
   e. Install the lock bolt and engage it with the sector cam surface. Then install the rack and spring. The block tooth on the rack should engage the block tooth on the sector (Fig. 3B5-37). Install the external tilt release lever.
   f. Install the lock bolt spring and retaining screw (Fig. 3B5-32). Tighten the screw to 35 in. lbs.
2. Install the shift lever spring into the housing by windng it up with pliers and pushing it into the housing. On floor shift models, install the plunger, slide the gearshift lever housing onto the mast jacket.
3. Install the bearing support lock plate wave washer.
4. Install the bearing support lock plate. Work it into the notches in the jacket by tipping it toward the housing hub at the 12 o'clock position and sliding it under the jacket opening. Slide the lock plate into the notches in the jacket.
5. Carefully install the shift tube into the lower end of the mast jacket. Align keyway in the tube with the key in the shift lever housing. Install the wobble plate end of Tool J-23073 into the upper end of the shift tube far enough to reach the enlarged portion of the tube. Then install the adapter over the end of the tool, seating it against the lock plate. Place the nut on the threaded end of the tool and pull the shift tube into the housing (Fig. 3B5-39). Remove Tool J-23073.

   NOTICE: Do not push or tap on the end of the shift tube. Be sure that the shift tube lever is aligned with the slotted opening at the lower end of the mast jacket or damage to the shift tube and mast jacket could result.
6. Install the bearing support thrust washer and retaining ring by pulling the shift lever housing up far enough to compress the wave washer.
7. Install the bearing support by aligning the "V" in the support with the "V" in the jacket. Insert the screws through the support and into the lock plate and torque to 60 lbs. in.
8. Align the lower bearing adapter with the notches in the jacket and push the adapter into the lower end of the mast jacket. Install lower bearing, bearing reinforcement and retaining clip, being sure that the clip is aligned with the slots in the reinforcement, jacket and adapter.
9. Install the centering spheres and anti-lash spring in the upper shaft. Install the lower shaft from the same side of the spheres that the spring ends protrude.
10. Install the steering shaft assembly into the shift tube from the upper end. Carefully guide the shaft through the shift tube and bearing.
11. Install the ignition switch actuator rod through the shift lever housing and insert in the slot in the bearing support. Extend the rack downward from the bearing housing.
12. Assemble the bearing housing over the steering shaft and engage the rack over the end of the actuator rod (Fig. 3B5-38).
13. With the external release lever installed, hold the lock shoes in the disengaged position and assemble the bearing housing over the steering shaft until the pivot pin holes line up.
14. Install the pivot pins.
15. Place the bearing housing in the full "up" position and install the tilt lever spring guide, spring and spring retainer. With a suitable screwdriver, push the retainer in and turn clockwise to engage in the housing.
16. Install the upper bearing inner race and race seat.
17. Install the tilt lever opening shield.
18. Remove the tilt release lever,install the turn signal housing and torque the three retaining screws to 45 lbs. in.
19. Install the tilt release lever and shift lever. Drive the shift lever pin in.
20. Install the lock cylinder, turn signal switch and ignition switch as outlined previously in this section.

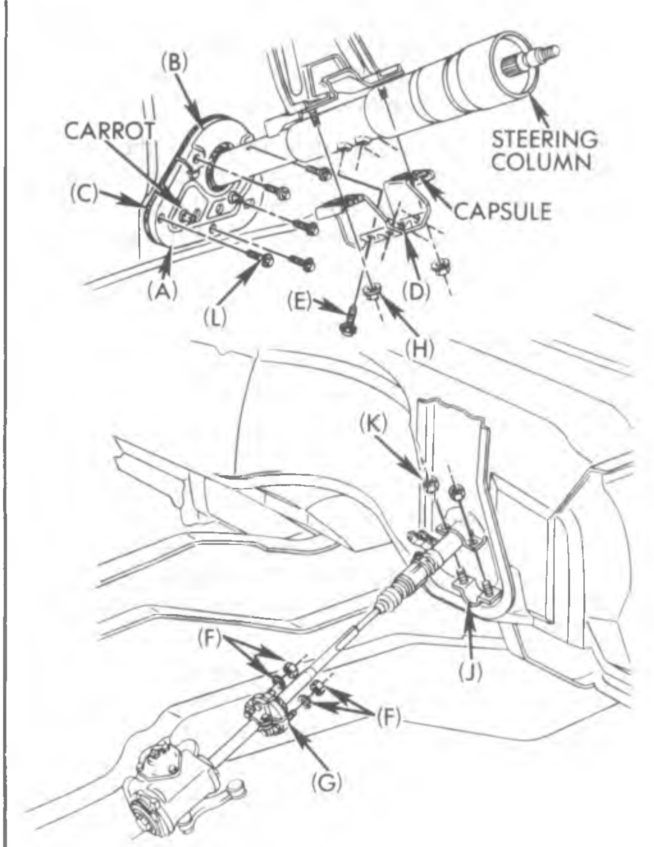


Fig. 3B5-40--Steering Column Installation-CK

21. Align the groove across the upper end of the pot joint with the flat on the steering shaft. Assemble the intermediate shaft assembly to the upper shaft. Install the clamp and bolt and torque the nut to specifications.

    NOTICE: The clamp bolt must pass through the shaft undercut, or damage may occur to the components.

22. Install the neutral-safety switch or back-up switch as outlined in Section 12 of this manual.
23. Install the four dash panel bracket to column screws and torque to specifications.

    CAUTION: Be sure that the slotted openings in the bracket (for the mounting capsules) face the upper end of the steering column.

COLUMN INSTALLATION-MANDATORY SEQUENCE

Mandatory Preliminary Instructions

1. Assemble lower dash cover (A) and upper dash cover (B) to seal (C) with "Carrots" (part of seal).
2. Attach bracket (D) to jacket and tighten four bolts (E) to specified torque.

Mandatory Installation Sequence

1. Position column in body and position flange to rag joint and install lock washers and nuts (F) (May be tightened to specified torque at this time). Coupling (G) on manual steering must be installed prior to column installation.
2. Loosely assemble (2) capsules nuts (H) at the instrument panel bracket (D).
3. Position lower clamp (J) and tighten attaching nuts (K) to specified torque.
4. Tighten two nuts (H) at capsules to specified torque.
5. Install seal (C) and covers (A and B) to dash.
6. Install attaching screws (L) and tighten to specified torque.
7. Tighten two nuts (F) at capsules to specified torque if not already done.
8. Remove plastic spacers from flexible coupling pins.
9. Install transmission indicator cable on column automatics.
10. Install the instrument panel trim cover.
11. Connect the transmission control linkage at the shift tube levers.
12. Install the steering wheel as outlined previously in this section.
13. Connect the battery ground cable.

Mandatory System Requirements

1. Pot joint operating angle must be 1 1/2° ± 4°.
2. Flexible coupling must not be distorted greater than ± .06 due to pot joint bottoming, in either direction.

STEERING COLUMN SERVICE FOR G AND P SERIES

STEERING WHEEL

Removal

1. Disconnect battery ground cable.
2. Remove horn button or shroud, receiving cup, belleville spring and bushing and mark steering wheel to steering shaft relationship.
3. Remove snap ring, and steering shaft nut.
4. Use Tool J-1859-03 to remove wheel (Fig. 3B5-41).

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fastener referred to in step 2.

NOTICE: Directional signal control assembly must be in neutral position when assembling steering wheel to prevent damage to cancelling cam and control assembly.

1. Place the steering wheel onto the steering shaft, aligning the marks made at removal.
2. Position into place and secure to proper torque with nut. Install snap ring.
3. Install horn button assembly.
4. Connect battery ground cable.

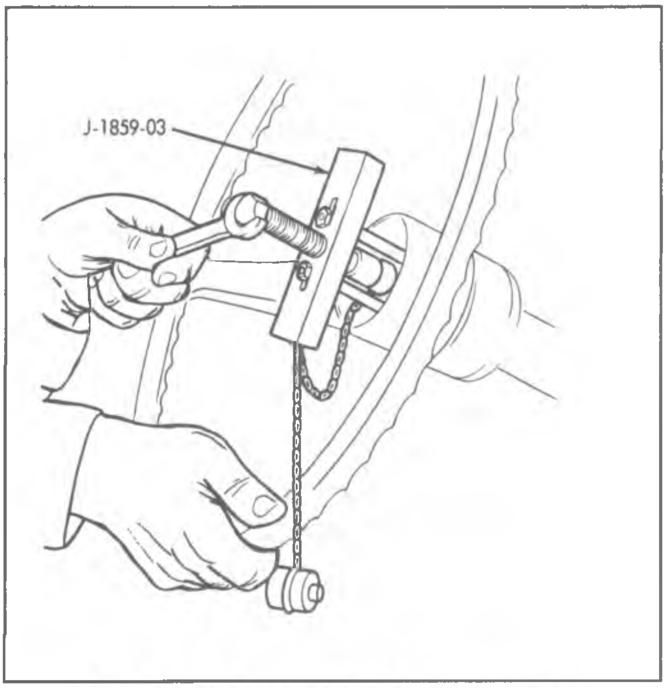


Fig. 3B5-41--Steering Wheel Removal-Typical

STEERING COUPLING (FLEXIBLE TYPE)

Removal (Fig. 3B5-42)

1. Remove the coupling to steering shaft flange bolt nuts.
2. Remove the coupling clamp bolt. This is a special bolt and will require a 12 pt. socket or box wrench.
3. Remove the steering gear to frame bolts and lower the steering gear far enough to remove the flexible coupling. It is not necessary to disconnect the pitman arm from the pitman shaft.
4. Tap lightly on the flexible coupling with a soft mallet to remove the coupling from the steering gear wormshaft.

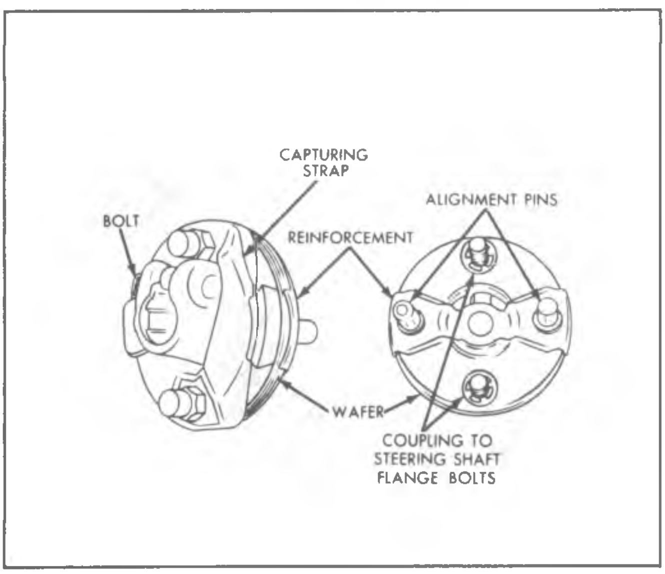


Fig. 3B5-42--Flexible Type Steering Coupling

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 2, 4 and 5.

1. Install the flexible coupling onto the steering gear wormshaft, aligning the flat on the shaft with the flat in the coupling. Push the coupling onto the wormshaft until the coupling reinforcement bottoms against the end of the worm.
2. Install the special bolt into the split clamp and torque to specifications.

   NOTICE: The bolt must pass through the shaft undercut,or damage may occur to the components.
3. Place the steering gear into position, guiding the flexible coupling bolts into the proper holes in the steering shaft flange.
4. Install and tighten the steering gear to frame bolts.
5. Install the coupling to flange bolt nuts and washers and torque to specifications. Be sure to maintain a coupling to flange dimension of .250" to .375". The coupling alignment pins should be centered in the flange slots.

INTERMEDIATE STEERING SHAFTS WITH POT JOINT COUPLINGS

Removal (Fig. 3B5-43)

1. Remove the lower shaft flange to flexible coupling bolts.
2. Remove upper shaft to intermediate coupling bolt
3. If necessary, remove the steering gear to frame bolts and lower the steering gear far enough to remove the intermediate shaft assembly. It is not necessary to remove the pitman arm from the pitman shaft.

Disassembly

1. Mark cover to shaft relationship. Pry off snap ring and slide cover from shaft.
2. Remove bearing blocks and tension spring from pivot pin.
3. Clean grease off pin and end of shaft. Scribe location mark on pin on same side as chamfer in shaft.
4. Supporting shaft assembly securely, with chamfer up, press pin out of shaft with arbor press.

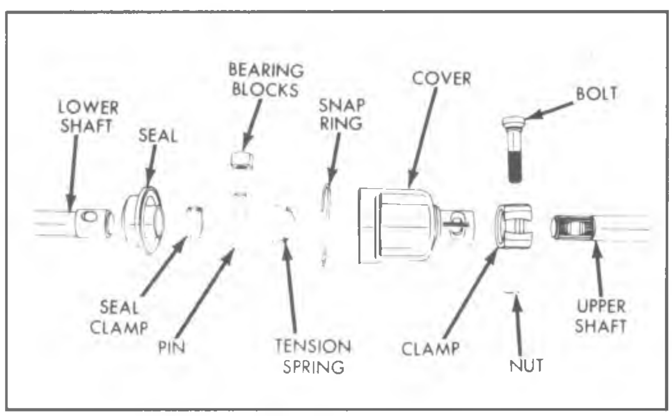


Fig. 3B5-43--Steering Shaft Intermediate Coupling

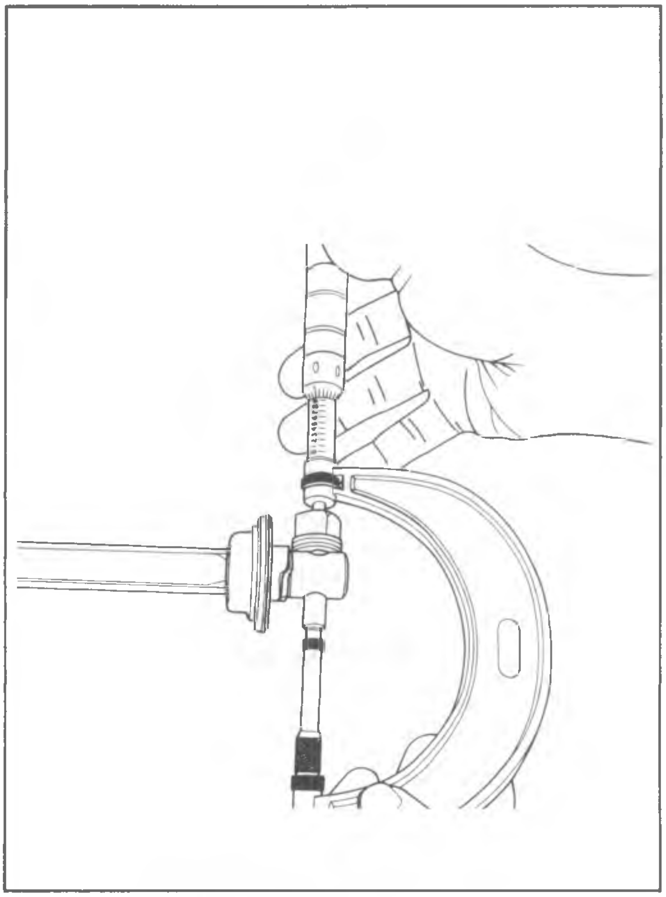


Fig. 3B5-44--Checking Coupling Pin Centering

NOTICE: Do not drive pin out with hammer. This may cause sticky or binding bearings when reassembled.

5. Remove seal clamp and slide seal off end of shaft.

Assembly

1. Be sure all parts are free of dirt. Slide seal onto steering shaft. With lip of seal against step in shaft clamp seal.
2. Press pin back into shaft from chamfered side. Locate pin in shaft using scribe mark as reference.

   NOTICE: Pin must be centered within .012 in. or binding in the coupling could result.
3. Check centering of pin (Fig. 3B5-44).
   a. Place just enough 3/8" flat washers on pin to prevent bearing block from bottoming when installed.
   b. Measure distance from end of pin to top of bearing with micrometer.
   c. Remove bearing and washers and place same bearing and washers on other end of pin. Measure distance from end of pin to top of bearing. If micrometer readings in Steps b and c differ more than .012, repeat last part of Step 2 and recheck.
4. Apply a liberal amount of wheel bearing grease to inside and outside of bearing blocks and inside of cover.
5. Position tension spring and bearing blocks on pin.
6. Slide cover over bearing blocks aligning reference mark on cover with mark on shaft. Install seal into end of cover and secure with snap ring retainer.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 4.

1. Install the intermediate shaft assembly onto the steering shaft, aligning the flat on the shaft with the flat in the coupling. Install the pot joint clamp bolt and torque to specifications.
2. Lift the steering gear into position, guiding the flexible coupling bolts into the shaft flange holes.
3. Install the steering gear to frame bolts and torque to specifications.
4. Install the flexible coupling to steering shaft flange bolt lockwashers and nuts. Check that the coupling alignment pins are centered in the flange slots and then torque the coupling bolts to specifications.

INTERMEDIATE STEERING SHAFT WITH UNIVERSAL JOINT COUPLINGS

Removal (Fig. 3B5-43)

1. Set front wheels in straight ahead position. This can be done by driving the vehicle a short distance on a flat surface.
2. Mark upper universal joint yoke to steering shaft relationship and lower yoke to steering gear wormshaft relationship.
3. Remove both upper and lower universal yoke pinch bolts.
4. Remove steering gear to frame bolts and lower the gear. It is not necessary to disconnect the pitman arm from the steering gear pitman shaft.
5. Remove the intermediate steering shaft and universal joint assembly.

Disassembly

1. If the upper or lower half of the intermediate steering shaft is to be replaced, proceed as follows:
   a. With the shaft assembly on a bench, straighten the tangs on the dust cap. Separate the upper and

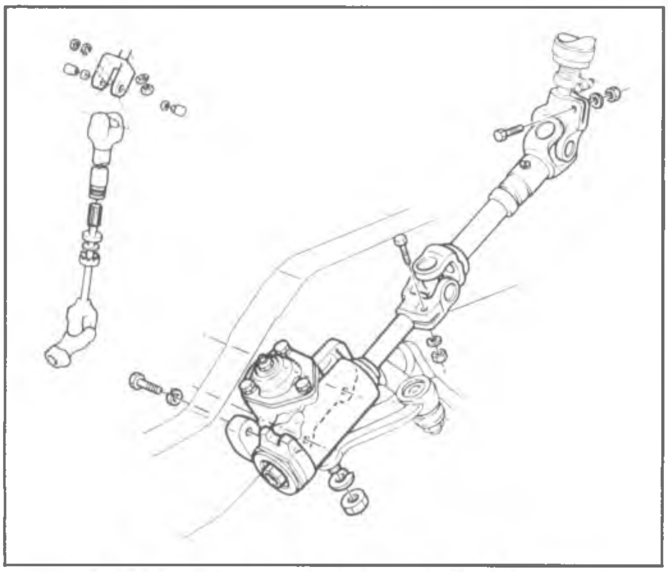


Fig. 3B5-45--Intermediate Steering Shaft-P Series

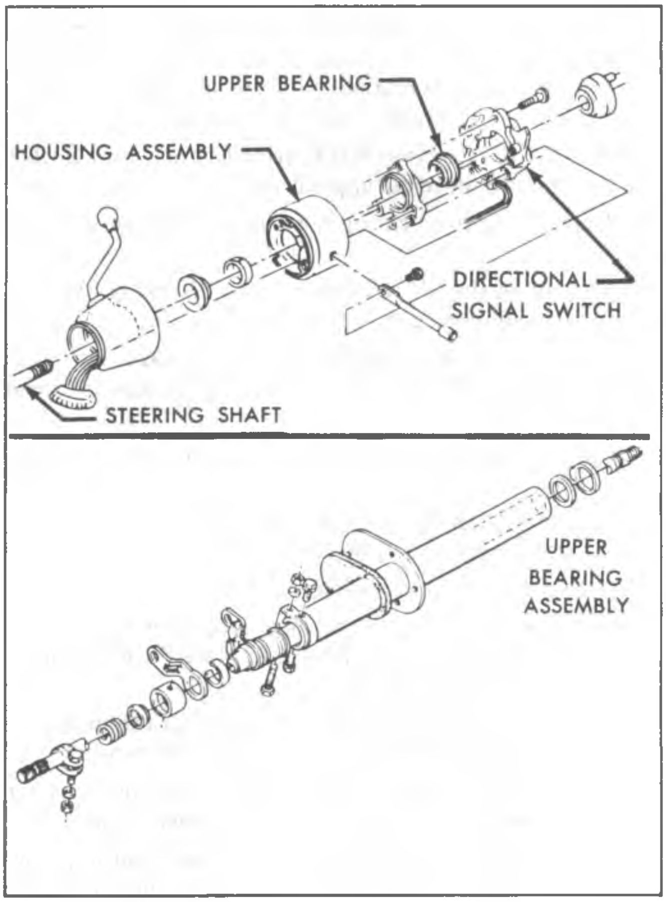


Fig. 3B5-46--Steering Column Upper Bearing

lower portions of the shaft assembly.

b. Remove the felt washer, plastic washer and dust cap. Discard the felt washer.

2. If the trunnion assemblies are to be replaced, proceed as follows:

a. Remove the snap rings retaining the trunnion bushings in one of the yokes.

b. Support the yoke on a bench vise and drive out one bushing by tapping on the opposite bushing using a soft drift and hammer.

c. Support the other side of the yoke and drive out the remaining bushing as in Step b above.

d. Move the yoke on the trunnion as necessary to separate the upper and lower yokes.

e. Remove the trunnion from the lower yoke as outlined in Steps a through d above. Remove and discard the seals.

Assembly

1. If the yoke trunnions were removed, reassemble as follows:

a. Place the new trunnion into the lower yoke.

b. Place new seals onto the trunnion and then press the new bushings into the yoke and over the trunnion hubs far enough to install the snap rings.

c. Install the snap rings.

d. Repeat Steps a through c to attach the upper yoke to the trunnion.

2. Reassemble the intermediate shaft assembly as follows:

a. Place the dust cap, plastic washer and a new felt seal over the shaft on the lower yoke assembly.

b. Align the arrow on the lower yoke assembly shaft with the arrow on the upper yoke assembly tube and push the two assemblies together.

c. Push the dust cap, plastic washer and felt washer into position on the lower end of the upper yoke assembly and bend the tangs of the dust cap down against the yoke tube.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 4.

1. Align the marks made at removal and assemble the intermediate shaft lower yoke onto the steering gear wormshaft. Install the pinch bolt and torque to specifications. The pinch bolt must pass through the shaft undercut. If a new yoke was installed, the slit in the yoke should be in the 12 o'clock position.
2. Raise the steering gear into position while guiding the upper yoke assembly onto the steering shaft.

   The marks on the coupling and steering shaft must align. If a new yoke was installed, assemble the upper yoke to the steering shaft with the steering wheel in straight ahead position (gear must be on high point).
3. Install the steering gear to frame bolts and torque to specifications.
4. Install the upper yoke to steering shaft pinch bolt and torque to specifications.

NOTICE: The pinch bolt must pass through the shaft undercut, or damage may occur to the components.

STEERING COLUMN UPPER BEARING-G AND P SERIES

Standard Column

Removal

1. Remove steering wheel as outlined in this section.
2. Remove directional signal cancelling cam.
3. Pry out upper bearing.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 1.

1. Replace all component parts in reverse order of removal making sure that directional switch is in neutral position before installing steering wheel. Torque steering wheel nut to specifications.

Tilt Column

The upper bearings on the tilt column are spun into the bearing housing assembly. If the bearings indicate need of replacement, the entire bearing housing must be replaced. See "Tilt Steering Column - Disassembly and Assembly" for the correct replacement procedure.

STEERING COLUMN LOWER BEARING P SERIES

Removal

1. Remove the intermediate steering shaft and universal joint assembly as outlined earlier in this section. Remove the preload spring clamp and spring

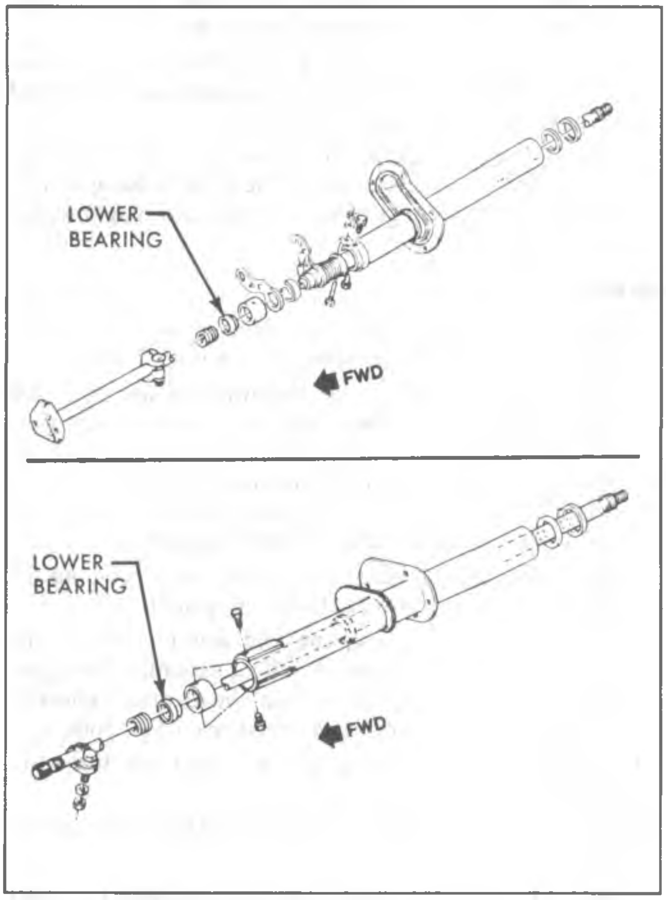


Fig. 3B5-47--Steering Column Lower Bearing

from the end of the steering shaft.

2. Pry out the lower bearing assembly.

Installation

NOTICE: See NOTICE not on page 1 of this section regarding fasteners referred to in step 2.

1. Place the new bearing over the end of the steering shaft and press into position in the column.
2. Install the preload spring and clamp and torque the clamp bolt nut to specifications. Refer to "Bearing Adjustment" in "Maintenance and Adjustment Section. Reinstall the intermediate shaft and universal joint assembly as outlined under "Intermediate Steering Shaft with Universal Joint Couplings - Installation".

TILT COLUMN BEARING HOUSING ASSEMBLY - G AND P SERIES

Removal (Column in Vehicle)

1. Disconnect the battery ground cable.
2. Remove the steering wheel as outlined under "Steering Wheel - Removal".
3. Remove the directional signal switch as outlined under "Directional Signal Switch - Removal".
4. **Column Shift Models** - Using a suitable size punch, drive out the shift lever pivot pin and remove the shift lever.
5. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring and retainer using a screwdriver that just fits into the slot opening. Insert the screwdriver into the slot, push in approximately 3/16", rotate clockwise approximately 1/8 turn until the retainer ears align with the grooves in the housing and remove the retainer and spring.
6. Remove the steering shaft bearing locknut using Socket J-22599. Remove the upper bearing race seat and race.
7. Remove the two bearing housing pivot pins using Tool J-21854.
8. Pull up on the tilt release lever (to disengage the lock shoes) and remove the bearing housing.

   If the bearing housing is being replaced or it is necessary to disassemble the bearing housing, proceed as follows:

   a. Press the upper and lower bearings out of the housing.
   b. Using Puller J-5822 and Slide Hammer J-2619, pull the bearing races from the housing.
   c. Remove the tilt release lever.
   d. Drive out the shoe release pivot pin using Tool J-22635 or a suitable punch. Remove the lever spring and remove the wedge.
   e. Using a suitable size punch, drive out the lock shoe retaining pin. Remove the shoes and shoe springs.

If the upper steering shaft, lower steering shaft, or centering spheres are being removed, proceed as follows:

9. To remove the steering shaft assembly through the upper end of the column. If it is necessary to

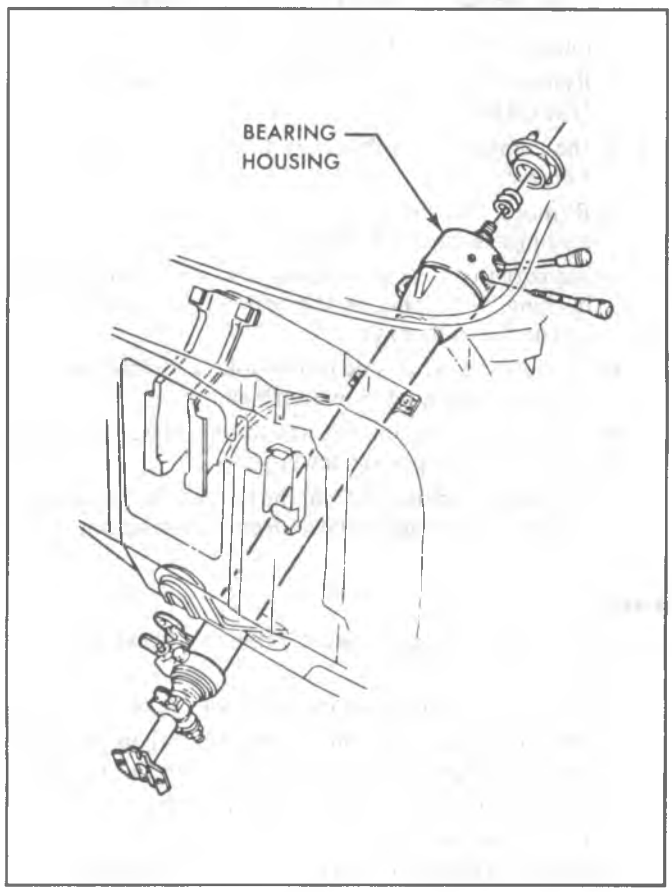


Fig. 3B5-48--Tilt Column Bearing Housing

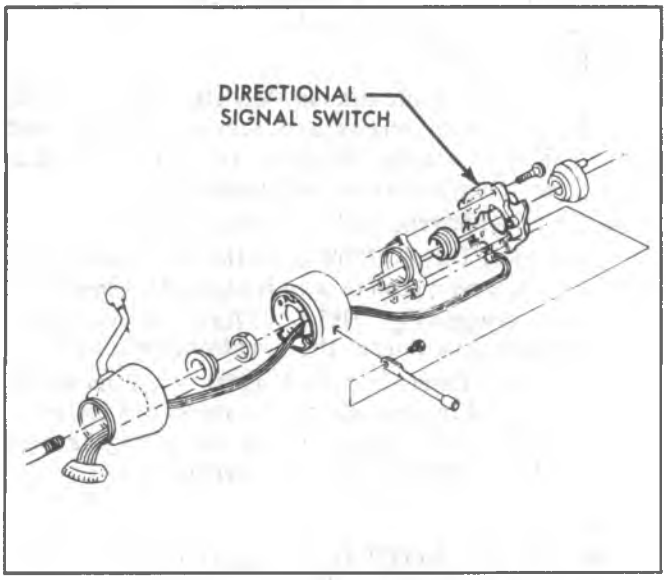


Fig. 3B5-49--Directional Signal Switch

disassemble the shaft, proceed as follows:

a. To remove the lower steering shaft first disconnect the shaft at the pot joint coupling clamp.

b. Turn the upper shaft 90° to the lower shaft and slide the upper shaft and centering spheres from the lower shaft.

c. Rotate the centering spheres 90° and remove the centering spheres and preload spring from the upper shaft.

If the bearing housing support is being replaced, proceed as follows:

10. Remove the four bearing housing support screws and remove the support.

Assembly

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 3, 9 and 11.

1. Assemble the steering shaft as follows:
   a. Lubricate and assemble the centering spheres and preload spring.
   b. Install the spheres into the upper (short) shaft and rotate 90°.
   c. Install the lower shaft 90° to the upper shaft and over the centering spheres. Slowly straighten the shafts while compressing the preload spring.
2. Install the shaft assembly into the housing from the upper end.
3. Install the lower shaft to the pot joint coupling clamp. Install the coupling clamp bolt and torque to specifications.

   NOTICE: The coupling bolt must pass through the shaft undercut, or damage may occur to the components.
4. Assemble the bearing housing as follows:
   a. Press the new upper and lower bearing races into the bearing housing.
   b. Lubricate and install the bearings into the bearing races.
   c. Place the lock shoe springs in position in the housing. Install each shoe in place and compress the spring until a suitable size straight punch can be used to hold the shoe in position (it may be necessary to acquire assistance to install the shoes). Once the shoes are in place, drive in the shoe retaining pin.
   d. Install the shoe release lever and drive in the pivot pin.
   e. Install the tilt release lever.
   f. Lubricate the shoes and release lever.
5. Install the bearing housing assembly to the support. Hold the tilt release lever in the "up" position until the shoes have fully engaged the support. Lubricate and install the bearing housing pivot pins. Press the pins in flush with the housing.
6. Place the housing in the full "up" position and then install tilt spring and retainer (tapered end of spring first). Push into the housing approximately 3/16" and rotate counterclockwise 1/8 turn.
7. Lubricate and install the upper bearing race, race seat and locknut. Tighten the locknut (using Socket J-22599) to remove the lash and then carefully further tighten 1/16 to 1/8 of a turn (column must be in straight ahead position).
8. Remove the tilt release lever.
9. Install the directional signal switch as outlined under "Directional Signal Switch - Installation".
10. Column Shift Models - Install the shift lever and pivot pin.
11. Install the steering wheel as outlined under "Steering Wheel - Installation".
12. Check electrical and mechanical functioning of column.

DIRECTIONAL SIGNAL SWITCH

If the directional signal switch must be replaced, the steering column does not have to be removed from the vehicle.

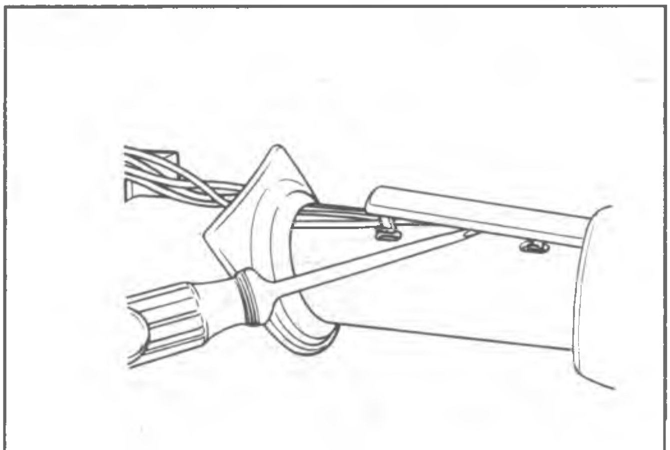


Fig. 3B5-50--Removing Wiring Harness Protector

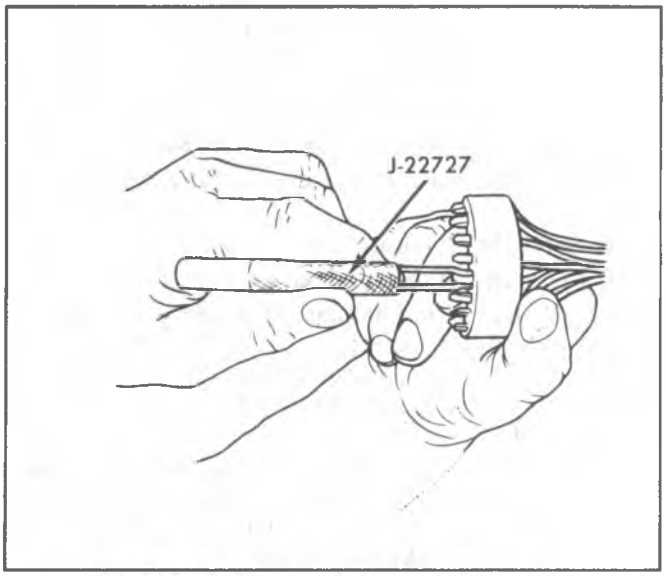


Fig. 3B5-51--Removing Wires from Connector

Removal

1. Remove the steering wheel as outlined under "Steering Wheel - Removal".
2. Remove the directional signal switch cancelling cam and spring.
3. Remove the column to instrument panel trim plate (if so equipped).
4. Disconnect the directional signal switch wiring harness at the half-moon connector.
5. Pry the wiring harness protector out of the column retaining slots as shown in Figure 3B5-50.
6. Mark the location of each wire in the half-moon connector and then remove each individual wire from the connector using Tool J-22727 (Fig. 3B5-51). Insert the tool into the lower end of the connector and push in until the tool bottoms on the connector. Remove the tool and then pull the wire from the connector.
7. Remove the directional signal lever screw and remove the lever.
8. Push in on the hazard warning light knob and then unscrew and remove the knob.
9. **Tilt Columns Only**
   a. Automatic Transmission Models - Remove the PRNDL dial screws and remove the dial and indicator needle. Remove the cap and dial illumination bulb from the housing cover.
   b. Unscrew and remove the tilt release lever.
   c. Assemble Tool J-22708 inside the directional signal housing cover; push in until the tangs lock inside the cover flange (Fig. 3B5-52). Turn the tool center screw clockwise to pull the cover from the housing.
10. Remove the three directional signal switch mounting screws and then carefully remove the switch assembly from the column while guiding the wiring harness through the opening in the shift lever housing.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 9.

1. Wrap the ends of the directional signal switch wires with tape and then guide them through the opening at the lower left hand side of the bearing housing (tilt columns), out the lower end of the shift lever housing and under the dash seal.
2. Place the directional signal switch in position and install the three mounting screws; torque to 25 lbs. in. after screw head has been firmly seated.
3. **Tilt Columns Only-**
   a. Align the openings in the directional signal switch cover with the proper lever positions and tap the cover into place using a plastic hammer.
   b. Install the tilt release lever.
   c. Automatic Transmission Model - Install the PRNDL dial, pointer, dial illumination bulb and cap.
4. Install the directional signal switch lever and hazard warning knob.
5. Bend the wire retaining tabs slightly outward on each wire in the wiring harness as shown in Figure

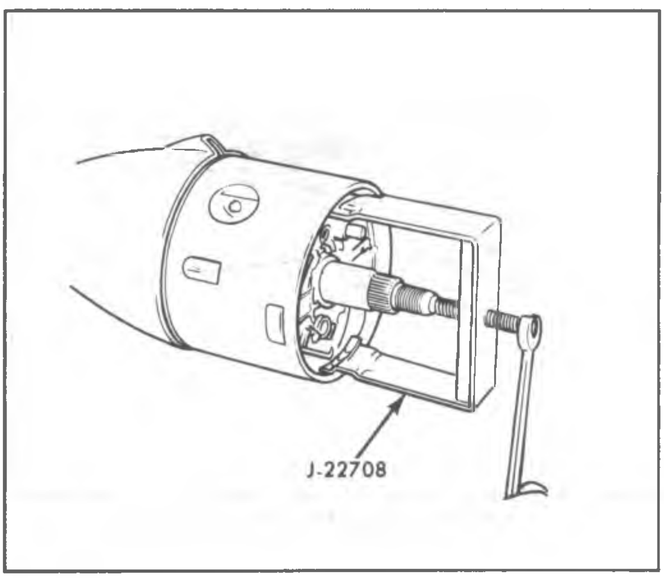


Fig. 3B5-52--Removing Directional Signal Housing Cover

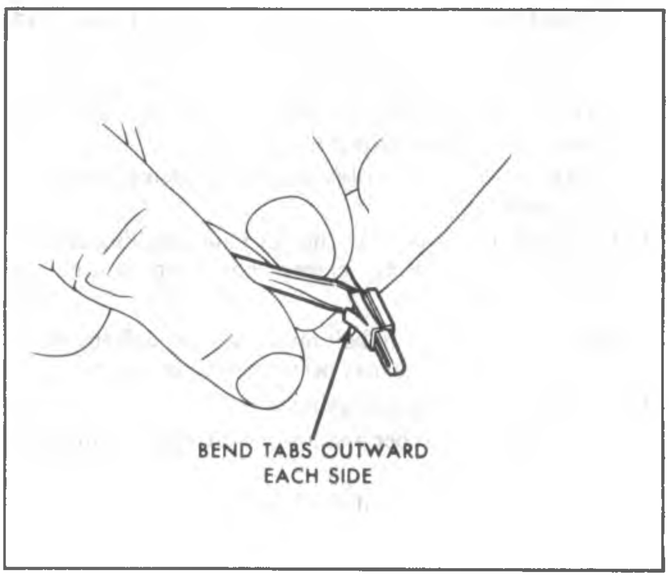
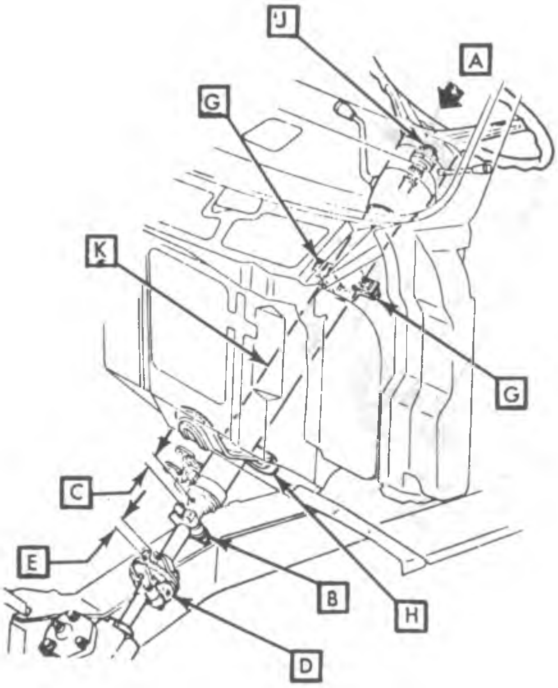


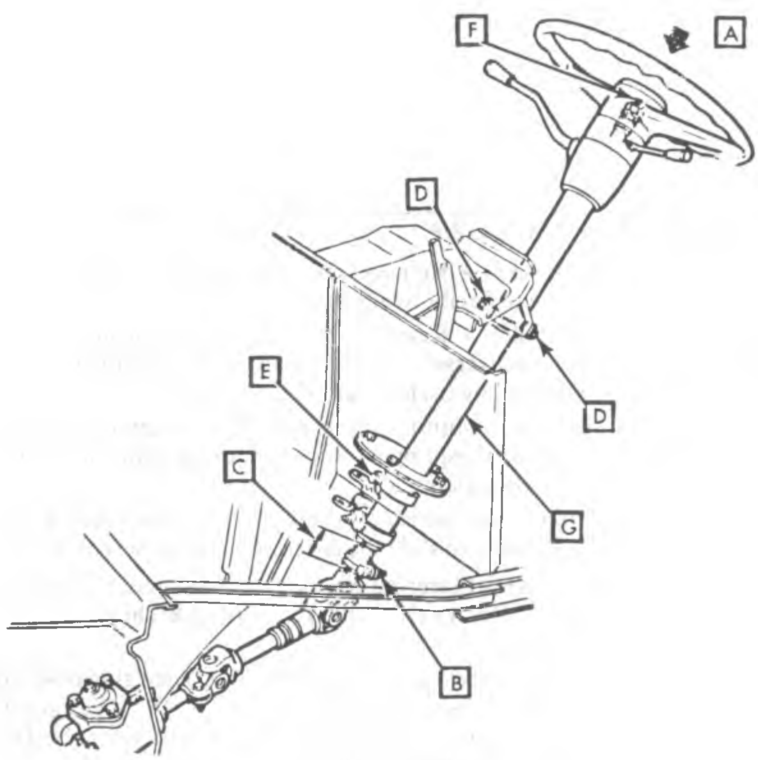
Fig. 3B5-53--Preparing Wire Retaining Tabs for Installation



STEERING SYSTEM MANDATORY REQUIREMENTS

1. Using a 50 lb. force applied to the steering wheel end of Shaft A, Lower Clamp Nut B must be tightened to the specified torque to give a compressed spring dimension C of .50 ±.04 after assembly.
2. Flexible Coupling D setup dimension E must be .250/.375. NOTICE This dimension must be held to prevent distortion of Flexible Coupling with resultant bind and harshness.
3. All Mast Jacket attachments G & H must be tightened to recommended torque.
4. Threaded portion of Steering Shaft J must be completely free of lubricant after Mast Jacket K assembly to maintain steering wheel clamping load and hub clearance.

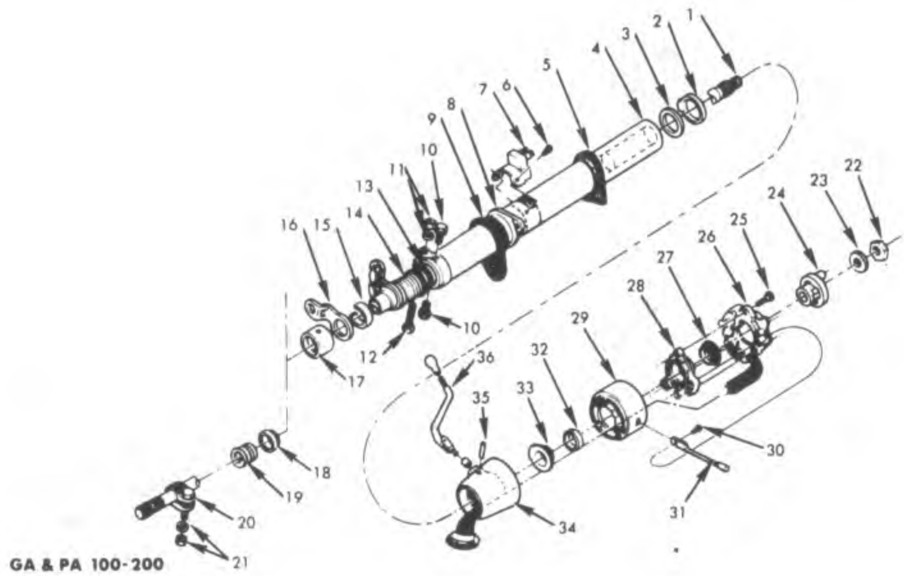
Fig. 3B5-54--Steering Column Attachment-G Series



STEERING SYSTEM MANDATORY REQUIREMENTS

1. Using a 50 lb. force applied to the steering wheel end of Shaft A, Lower Clamp Nut B must be tightened to the specified torque to give a compressed spring dimension C of 1.26 ±.02 after assembly.
2. All Mast Jacket attachments D & E must be tightened to recommended torque.
3. Threaded portion of Steering Shaft F must be completely free of lubricant after Mast Jacket G assembly to maintain steering wheel clamping load and hub clearance.

Fig. 3B5-55--Steering Column Attachment-P Series



1. Upper Steering Shaft
2. Shift Housing Bushing
3. Bushing Seat
4. Mast Jacket
5. Column Cover
6. Back-Up Lamp Switch Screw
7. Back-Up Lamp Switch
8. Toe Pan Seal Retainer
9. Toe Pan Seal
10. Adjusting Ring Clamp Screws
11. Nut and Lockwasher
12. Adjusting Ring Clamp Bolt
13. Shift Tube Felt Washer
14. Shift Tube Assembly
15. Shift Lever Spacer
16. 1st-Reverse Shift Lever
17. Adjusting Ring
18. Shaft Lower Bearing
19. Lower Bearing Preload Spring
20. Preload Spring Clamp
21. Nut and Lockwasher
22. Steering Shaft Nut
23. Lockwasher
24. Turn Signal Cancelling Cam
25. Turn Signal Switch Screw
26. Turn Signal Switch
27. Steering Shaft Upper Bearing
28. Switch Contact Support
29. Turn Signal Housing
30. Turn Signal Switch Lever Screw
31. Turn Signal Switch Lever
32. Rubber Ring
33. Plastic Thrust Washer
34. Shift Lever Housing
35. Shift Lever Pin
36. Shift Lever

Fig. 3B5-56--Standard Column-Typical G & P

3B5-53; this will provide proper retention of the wire in the half-moon connector.

6. Install each wire in its marked location in the half-moon connector. Push in until square part of clip is flush with the bottom side of the connector. Connect the directional signal switch wiring harness.
7. Snap the wiring harness protector into the column retaining slots.
8. Install the directional signal cancelling cam and spring.
9. Install the steering wheel as outlined under "Steering Wheel - Installation".
10. Install the column to instrument panel trim plate (if so equipped).

STEERING COLUMN G AND P SERIES

Removal

1. Disconnect the battery ground cable.
2. Column Shift Models - Disconnect transmission shifter rods at the lower end of the column.
3. **G Models** - Remove the intermediate steering shaft flange to flexible coupling bolts.

   P Models - Remove the intermediate steering shaft upper universal yoke to steering shaft pinch bolt. Mark the coupling to shaft relationship.
4. Remove column clamp screw(s) on engine side of firewall, if equipped, and remove or slide the clamp down the column.
5. From inside the vehicle, remove the screws from the toe pan cover and slide the cover and seal up the column.
6. Remove the steering wheel as outlined under "Steering Wheel-Removal", and reinstall the shaft nut and washer.
7. All Columns - Disconnect the directional signal wiring harness. Standard Column with Automatic Transmission - Disconnect the conductor tube (for transmission indicator) at the instrument panel.

   Tilt Column with Automatic Transmission - Disconnect the single wire at the fuse block and unclip it from the parking brake bracket.

8. Remove the cap screws from the column support bracket at the dash panel.
9. Carefully lower and then withdraw the column assembly, rotating so that the shift levers clear the toe pan opening.

Disassembly of Standard Column (Fig. 3B5-56)

For floor shift transmission models, omit Steps 4, 14, 15 and 16.

1. Remove the steering wheel nut and lock washer and then slide the steering shaft assembly from the lower end of the column.
2. G Models - Remove the lower bearing preload spring and clamp from the steering shaft.

   P Models - Remove the lower bearing preload spring and clamp.
3. Remove the back-up lamp switch.
4. Drive out the shift lever pivot pin and remove the shift lever.
5. Remove the directional signal cancelling cam. Remove the directional signal switch lever.
6. Remove the column wiring harness cover.
7. Remove the directional signal switch screws.
8. Rotate the directional signal switch housing counterclockwise and remove the housing from the column. The housing and switch cannot be fully removed from the column until the shift lever housing is removed.
9. Remove the plastic thrust washer assembly and then remove the shift lever housing (or extension housing) from the column.
10. Separate the directional signal switch, switch control support assembly, directional signal housing and shift lever housing (or housing extension) assemblies.
11. Press the steering shaft upper bearing out of the switch contact support.
12. Remove the shift lever housing (or extension housing) seat and bushing from the upper end of the column.
13. Remove the bolt and screws from the adjusting ring clamp and remove the clamp, adjusting ring and lower bearing. Press the lower bearing out of the adjusting ring.
14. 3-Speed Columns - Remove 1st-reverse shift lever and lever spacer.

    Automatic Columns - Remove the selector plate clamping ring screws (3).
15. Place the column upright on the floor, supporting it with two pieces of wood. Place a block of wood on the upper end of the shift tube. Press down on the shift lever with foot while tapping on the wood block to withdraw the tube from the column jacket.

    NOTICE: In some tolerance stack-up cases it may be necessary to use a press. Be careful not to damage the tube or jacket.
16. Remove the felt seal from the shift tube.
17. Remove firewall clamp, toe pan seal and dash panel seals from the jacket.

Assembly

In the following assembly sequence use any general purpose lithium soap grease for lubricating those components so indicated.

1. Install the dash panel seal, toe panel and firewall clamps over the end of the jacket.
2. Lubricate all bearing surfaces on the shift tube.
3. Place the felt seal onto the shift tube (next to spring) and then place the shift tube in the jacket.
4. 3-Speed Columns - Temporarily install spacer, 1st-reverse shift lever and lower adjusting ring. Place a block of wood on top of the adjusting ring and tap until the shift tube bottoms. Remove adjusting ring, shift lever and spacer.

   Automatic Columns - Align the three holes in the selector plate with the three holes in the jacket, position the clamping ring and install the three screws. The shift tube spring retainer must be bottomed against the jacket stops.
5. 3-Speed Columns-Lubricate and install the spacer and 1st-reverse shift lever (tang of lever towards top of column).
6. Install lower bearing in the adjusting ring and then install the adjusting ring, clamp and screws.
7. Install the shift lever housing (or extension housing) seat and bushing to upper end of housing.
8. Thread directional signal switch wiring harness through the switch and lever (or extension) housings, lubricate the inner diameter of the shift housing, and then place the shift lever (or extension) housing onto the upper end of the column.
9. Install the switch housing plastic washer assembly. Press the upper bearing into the switch contact support.
10. Install the directional signal switch housing, contact support, bearing and switch and torque the switch screws to 25 lbs. in.
11. Install the column wiring harness cover and back-up lamp switch.
12. Install the directional signal and gearshift levers.
13. Adjust the shift tube as outlined under "Shifter Tube Adjustment."
14. Loosely install the lower bearing preload spring and clamp.
15. Slide the steering shaft assembly up through the column assembly. Install the directional signal cancelling cam, steering shaft nut and lock washer.

Disassembly Of Tilt Column (Fig. 3B5-57)

1. If the column is removed from the vehicle, place the column in a bench vise using Holding Fixtures J-22573 (Fig. 3B5-58).

   NOTICE: Clamping the column directly in a vise, could result in a damaged column.
2. Remove the directional signal switch as outlined under "Directional Signal Switch-Removal".

3. Remove the lower steering shaft and pot joint assembly and lower bearing and adapter assembly as outlined under "Lower Bearing and Adapter-Removal".

4. Column Shift Models - Using a suitable size punch, drive out the shift lever pivot pin and remove the shift lever.

5. Install the tilt release lever and place the column in the full "up" position. Remove the tilt lever spring and retainer using a screwdriver that just fits into the slot opening (Fig. 3B5-59). Insert the screwdriver clockwise approximately 1/8 turn until the retainer ears align with the grooves in the housing and remove the retainer and spring.

6. Remove the steering shaft bearing locknut using socket J-22599. Remove the upper bearing race seat and race.

7. Remove the two bearing housing pivot pins using Tool J-21854 (Fig. 3B5-60).

8. Pull up on the tilt release lever (to disengage the lock shoes) and remove the bearing housing. If it is necessary to disassemble the bearing housing, proceed as follows:
   a. Press the upper and lower bearings out of the housing.
   b. Using Puller J-5822 and Slide Hammer J-2619 pull the bearing races from the housing (Fig. 3B5-61).
   c. Remove the tilt release lever.
   d. Drive out the shoe release lever pivot pin using Tool J-22635 or a suitable punch (Fig. 3B5-62). Remove the lever spring and remove the wedge.
   e. Using a suitable size punch, drive out the lock shoe retaining pin. Remove the shoes and shoe springs.

9. Remove the steering shaft assembly through the upper end of the column. If it is necessary to disassemble the shaft proceed as follows:
   a. Turn the upper shaft 90° to the lower shaft and slide the upper shaft and centering spheres from the lower shaft.
   b. Rotate the centering spheres 90° and remove the center spheres and preload spring from the upper shaft.

10. Remove the four bearing housing support screws and remove the support.

    Column Shift Models - If the shift tube index plate must be removed, remove the two retaining screws and remove the plate.

11. Remove the shift tube retaining ring with a screwdriver (Fig. 3B5-63). Remove the thrust washer.

12. Remove the neutral-safety or back-up lamp switch screws and remove the switch.

13. Rework Shift Tube Removing Tool J-22551 by removing 1/2" from the pilot end of the tool (Fig. 3B5-64). This allows the shift tube to be pushed further out of the housing and will not affect the use of the tool on other columns.

14. Remove the shift tube assembly using Tool J-22551 (Fig. 3B5-65). Insert the hooked end of the tool into the notch in the shift tube just below the shift lever housing key. Pilot the sleeve over the threaded end of the tool and into the upper end of the shift tube. Force the shift tube out of the housing by turning the nut onto the tool. If the shift tube is not completely free when the nut is bottomed on the threads, complete the removal by hand.

    NOTICE: Do not hammer or pull on the shift tube during removal. On column shift models, guide the lower shift lever through the slotted opening in the column to prevent damage to the tube or column.

15. Remove the lock plate by sliding out of the column notches, tipping the plate downward toward the housing (to compress the wave washer) and then removing as shown in Figure 3B5-66. Remove the wave washer.

16. Remove the shift lever housing.

17. Column Shift Models - Remove the shift lever spring by winding the spring up with pliers.

18. If necessary, remove the dash panel seal, mounting plate and the instrument panel seal from the column jacket.

Assembly of Tilt Column

When lubricating components during the following installation sequence, use any general purpose lithium soap grease.

1. Install the dash panel seal, mounting plate and the instrument panel seal on the column.

2. Column Shift Models - Press a new shift lever spring into the shift lever housing.

3. Slide the shift lever housing over the upper end of the column.

4. Place the wave washer and lock plate in position. Work the lock plate into the notches by tipping the plate toward the housing (compressing the wave washer) at the open side of the column. Lubricate the lock plate and upper end of the shift tube.

5. Carefully install the shift tube into the lower end of the column (make sure the foam seal is at lower end of the shift tube). Align the keyway in the tube with the key in the shift lever housing and complete installation of the shift tube using Tool J-22549 (Fig. 3B5-67). The shift lever housing key must bottom in the shift tube slot to be fully installed. Remove Tool J-22549 from the column. Lubricate and push foam seal in flush with column housing.

   NOTICE: Do Not hammer or force the tube when

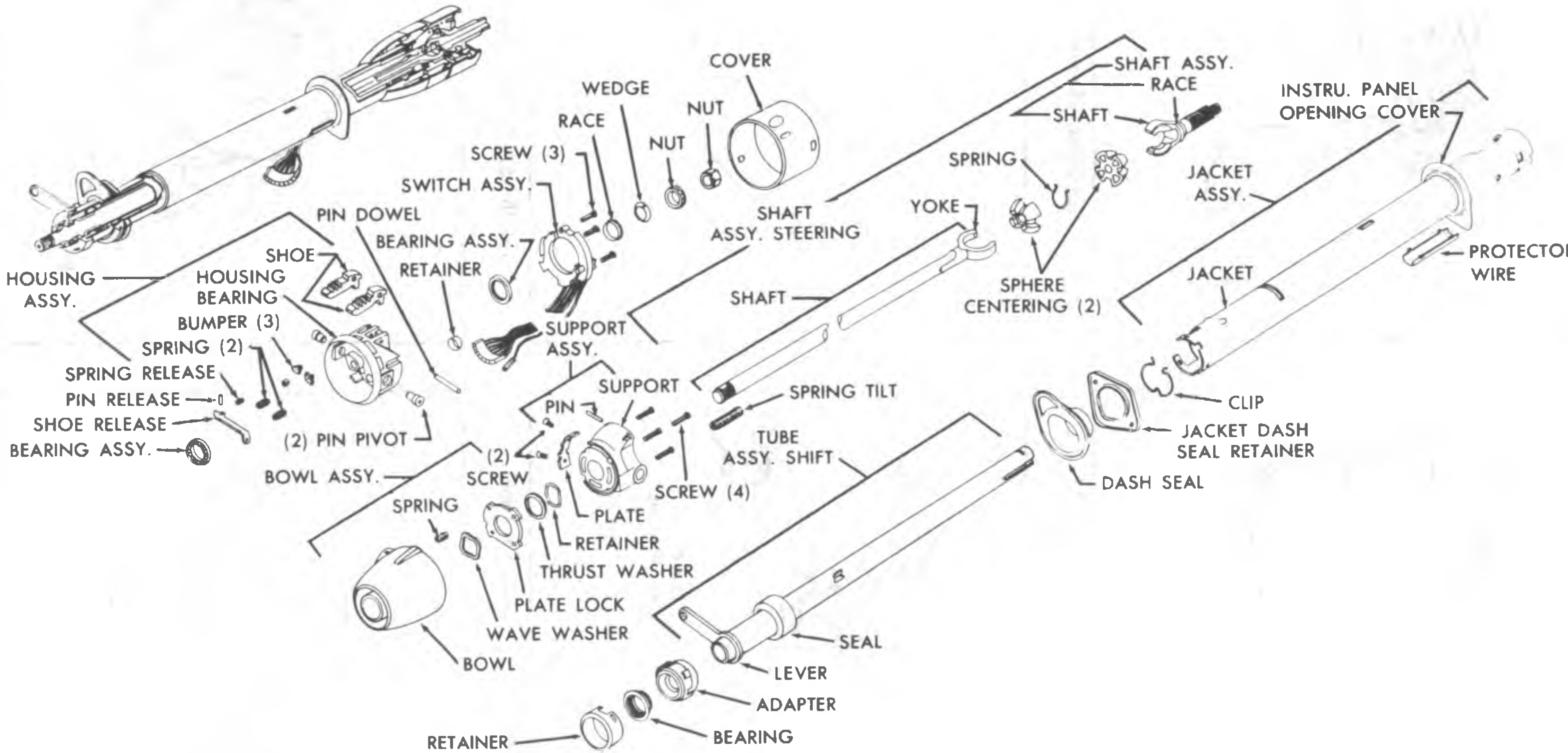


Fig. 3B5-57--Tilt Steering Column-G & P

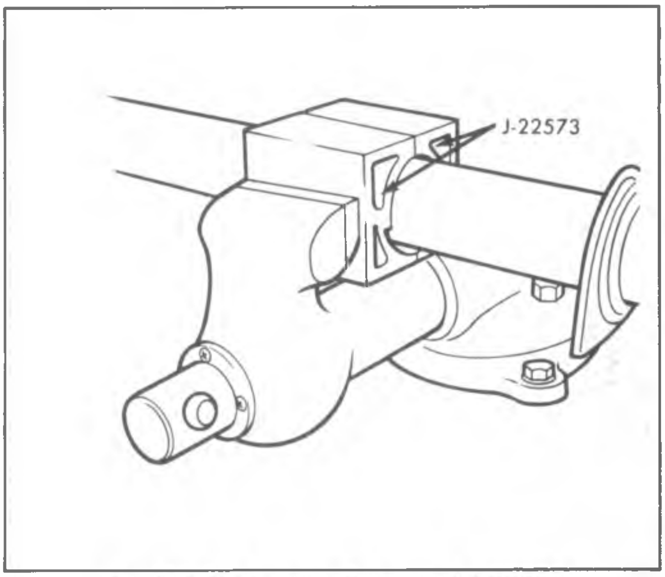


Fig. 3B5-58--Securing Column with J-22573

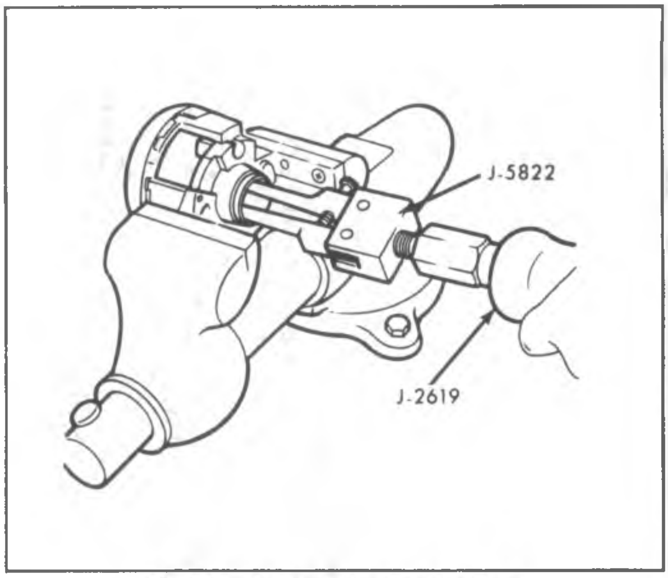


Fig. 3B5-61--Removing Bearing Race

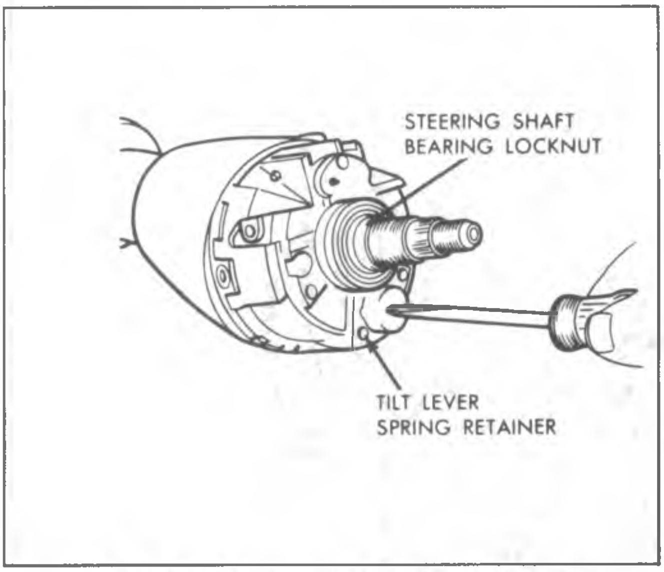


Fig. 3B5-59--Removing Tilt Spring and Retainer

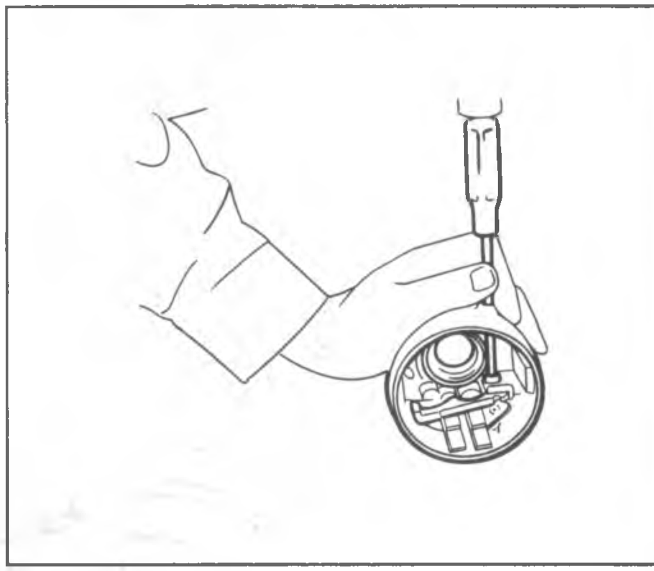


Fig. 3B5-62--Removing Release Lever Pivot Pin

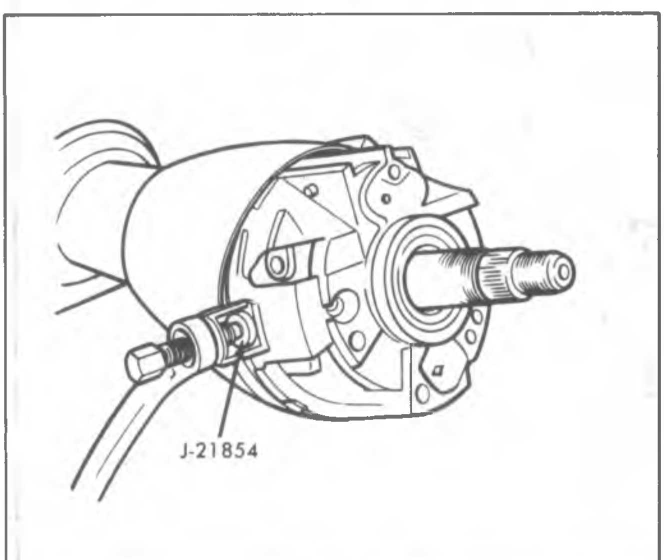


Fig. 3B5-60--Removing Bearing Housing Pivot Pin

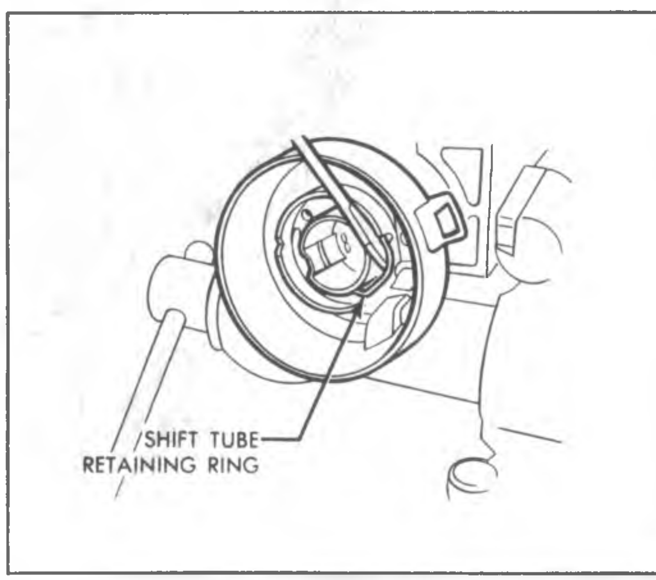


Fig. 3B5-63--Removing Shift Tube Retaining Ring

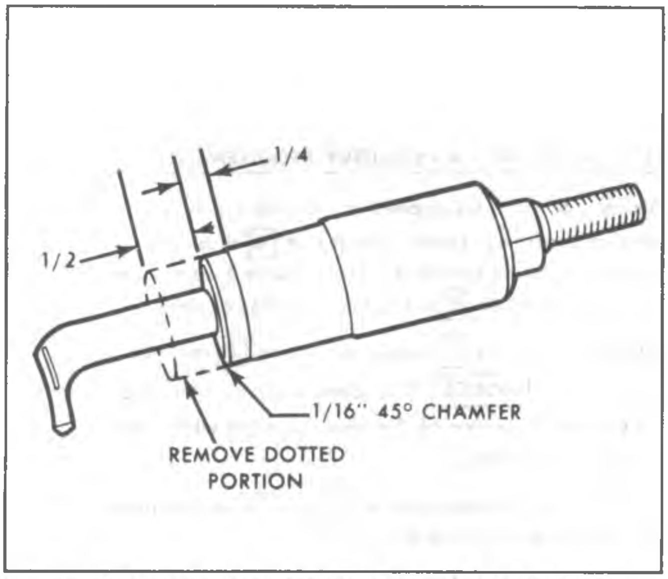


Fig. 3B5-64--Revised Shift Tube Removing Tool J-22551

The alignment pin plastic spacers must be removed before the vehicle can be driven.

installing in the column, or damage could occur to the components.

6. Pull up on the shift lever housing (to compress the wave washer) and install the thrust washer and retaining ring. Be sure the ring is seated in both slots of the shift tube.
7. Lubricate the I.D. of the bearing housing support and install the support, aligning the bolt holes in the support with the bolt holes in the lock plate. Install the four support screws and torque to 45 in. lbs.
8. Assemble the steering shaft as follows:
   a. Lubricate and assemble the centering spheres and preload spring.
   b. Install the spheres into the upper (short) shaft and rotate 90°.

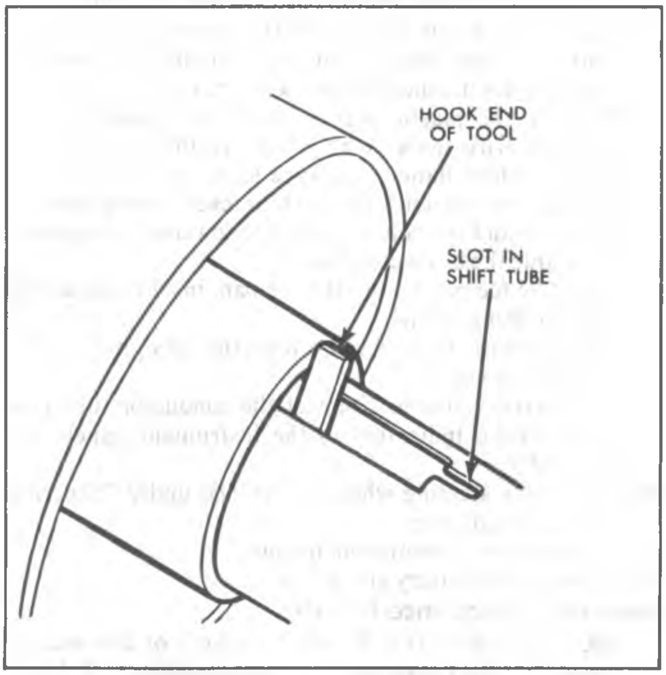


Fig. 3B5-65--Removing Shift Tube Assembly

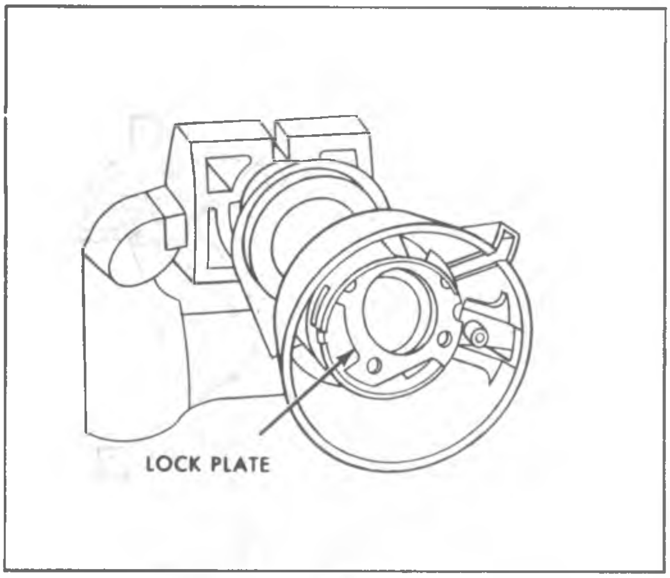


Fig. 3B5-66--Removing Lock Plate Assembly

   c. Install the lower shaft 90° to the upper shaft and over the centering spheres. Slowly straighten the shafts while compressing the preload spring.
9. Install the shaft assembly into the housing from the upper end.
10. Install the lower bearing and adapter, bearing reinforcement, wire clip, pot joint coupling and lower shaft as described under "Lower Bearing Installation".
11. Assemble the bearing housing as follows:
   a. Press the new upper and lower bearing races into the bearing housing.
   b. Lubricate and install the bearings into the bearing races.
   c. Place the lock shoe springs in position in the housing. Install each shoe in place and compress the spring until a suitable size straight punch can be used to hold the shoes in position (it may be necessary to acquire assistance to install the shoes). Once the shoes are in place, drive in the shoe retaining pin.

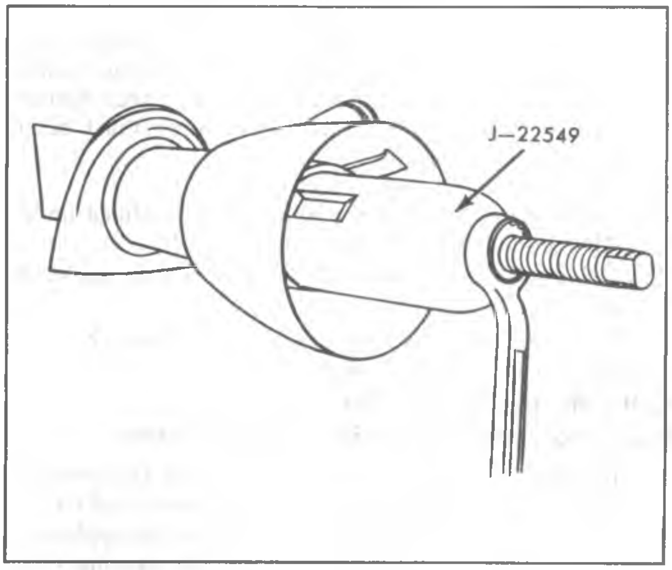
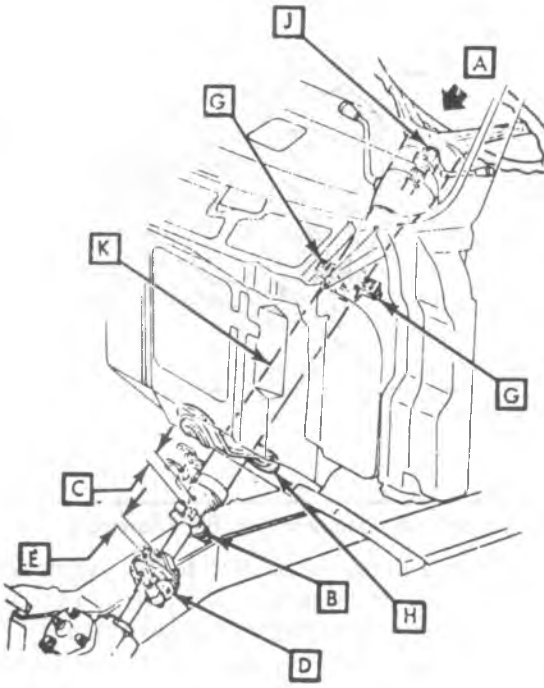


Fig. 3B5-67--Installing Shift Pin Tube



STEERING SYSTEM MANDATORY REQUIREMENTS

1. Using a 50 lb. force applied to the steering wheel end of Shaft [A], Lower Clamp Nut [B] must be tightened to the specified torque to give a compressed spring dimension [C] of .50 ±.04 after assembly.
2. Flexible Coupling [D] setup dimension [E] must be .250/.375. [NOTICE] This dimension must be held to prevent distortion of Flexible Coupling with resultant bind and harshness.
3. All Mast Jacket attachments [G] & [H] must be tightened to recommended torque.
4. Threaded portion of Steering Shaft [J] must be completely free of lubricant after Mast Jacket [K] assembly to maintain steering wheel clamping load and hub clearance.

Fig. 3B5-68--Mandatory Sequence For Installation Of G Series Column

d. Install the shoe release lever and drive in the pivot pin.
e. Install the tilt release lever.
f. Lubricate the shoes and release lever.

12. Install the bearing housing assembly to the support. Hold the tilt release lever in the "up" position until the shoes have fully engaged the support. Lubricate and install the bearing housing pivot pins. Press the pins in flush with the housing.
13. Place the housing in the full "up" position and then install tilt spring and retainer (tapered end of spring first). Push into the housing approximately 3/16" and rotate counter clockwise 1/8 turn.
14. Lubricate and install the upper bearing upper race, race seat and locknut. Tighten the locknut (using Socket J-22549) to remove the lash and then further tighten 1/16 to 1/8 of a turn (column must be in straight ahead position).
15. Remove the tilt release lever.
16. Install the directional signal switch as outlined under "Directional Signal Switch-Installation".
17. Column Shift Models - Install the shift lever and pivot pin.
18. Install the neutral-safety or back-up lamp switch.
19. Remove the column from the bench vise.

COLUMN INSTALLATION

Mandatory Installation Sequence G Series

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 3 and 10.

1. Adjust the column lower bearing preload by applying a force on the steering wheel end of the steering shaft (A). Position the spring and clamp to maintain the dimension as detailed under "Maintenance and Adjustments.
2. Install the plastic spacers onto the flexible coupling alignment pins.
3. From inside the vehicle, carefully insert the lower end of the column through the toe pan opening guiding the steering shaft flange onto the flexible coupling. Install and torque the glange to coupling bolts.
4. Locate the index slot in the column jacket with the protrusion on the clutch and brake pedal support.
5. Loosely install the column dash bracket and screws.
6. Push the column down until the steering shaft flange bottoms on the plastic spacers on the flexible coupling and then torque the dash bracket screws.
7. Remove the plastic spacer from the alignment pins using a wire hook. Check the flexible coupling to steering shaft flange clearance (.25" to .325"), if not within specifications, the dash bracket screws must be loosened and the column raised or lowered as required. Retorque the bracket screws.
8. Push the toe pan seal to the toe pan, install and torque the mounting screws.
9. All Columns-Connect the directional signal switch wiring harness.
   Automatic Columns-Connect the conductor tube (for transmission indicator) to the instrument panel. See Fig. 3B5-69.
10. Install the steering wheel as outlined under "Steering Wheel Installation".
11. Connect the transmission linkage.
12. Connect the battery ground cable.

Mandatory Sequence P Series

NOTICE: See NOTICE note on page 1 of this section regarding the fasteners referred to in steps 1, 2, 3 and 10.

1. Applying 50 lbs. force on the steering wheel end of the steering shaft, adjust the lower bearing preload to allow

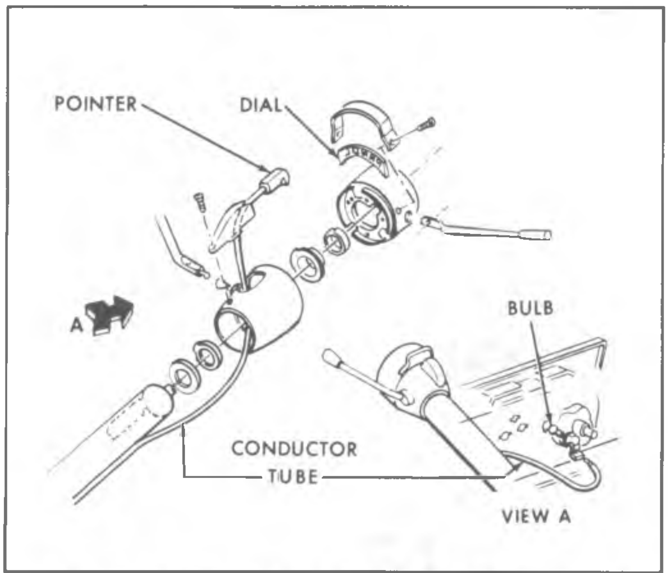


Fig. 3B5-69--Conductor Tube For Automatic Transmission Indicator

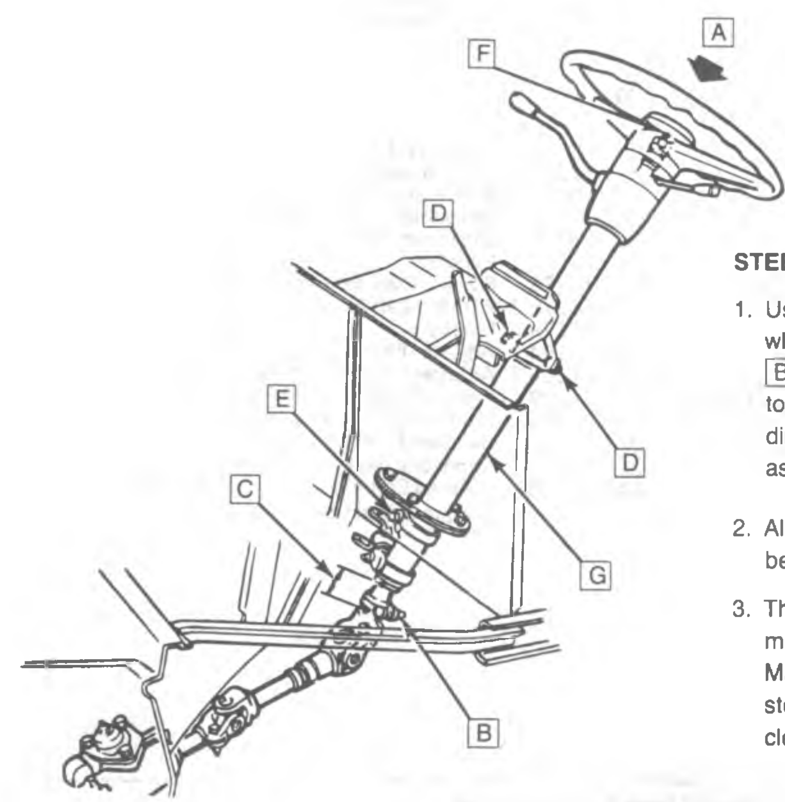
steering shaft end play as indicated in "Maintenance and Adjustments". Tighten the shaft clamp on pot joint bolt to specifications.

2. From the passenger side of the dash panel, carefully insert the lower end of the steering column through the toe panel opening.

   Guide the steering shaft into the universal yoke, lining up the marks made at removal. Install the yoke pinch bolt and torque to specifications. The pinch bolt must pass through the shaft undercut.

3. Position and attach the lower clamp mounting bracket to the firewall. Locate the steering column protrussions against the toe pan bracket while at the same time, aligning protrusion in brake and clutch pedal support with index slot in the steering column, as shown in Figure 3B5-69. Install the column to bracket clamp and torque the clamp bolt to specifications. The toe pan bracket must not override the protrusions on the steering column.
4. Position the steering column to dash panel bracket, install the attaching bolts and torque to specifications.
5. If plastic spacers were used on the flexible coupling alignment pins, remove the spacers after all bolts have been properly torqued.
6. Install the seal at the toe pan and then install the toe pan bracket screws; torque to specifications.
7. Install the dash panel trim plate (if so equipped).
8. Connect the transmission shift linkage on column shift models.
9. All Columns - Connect the directional signal wiring harness.

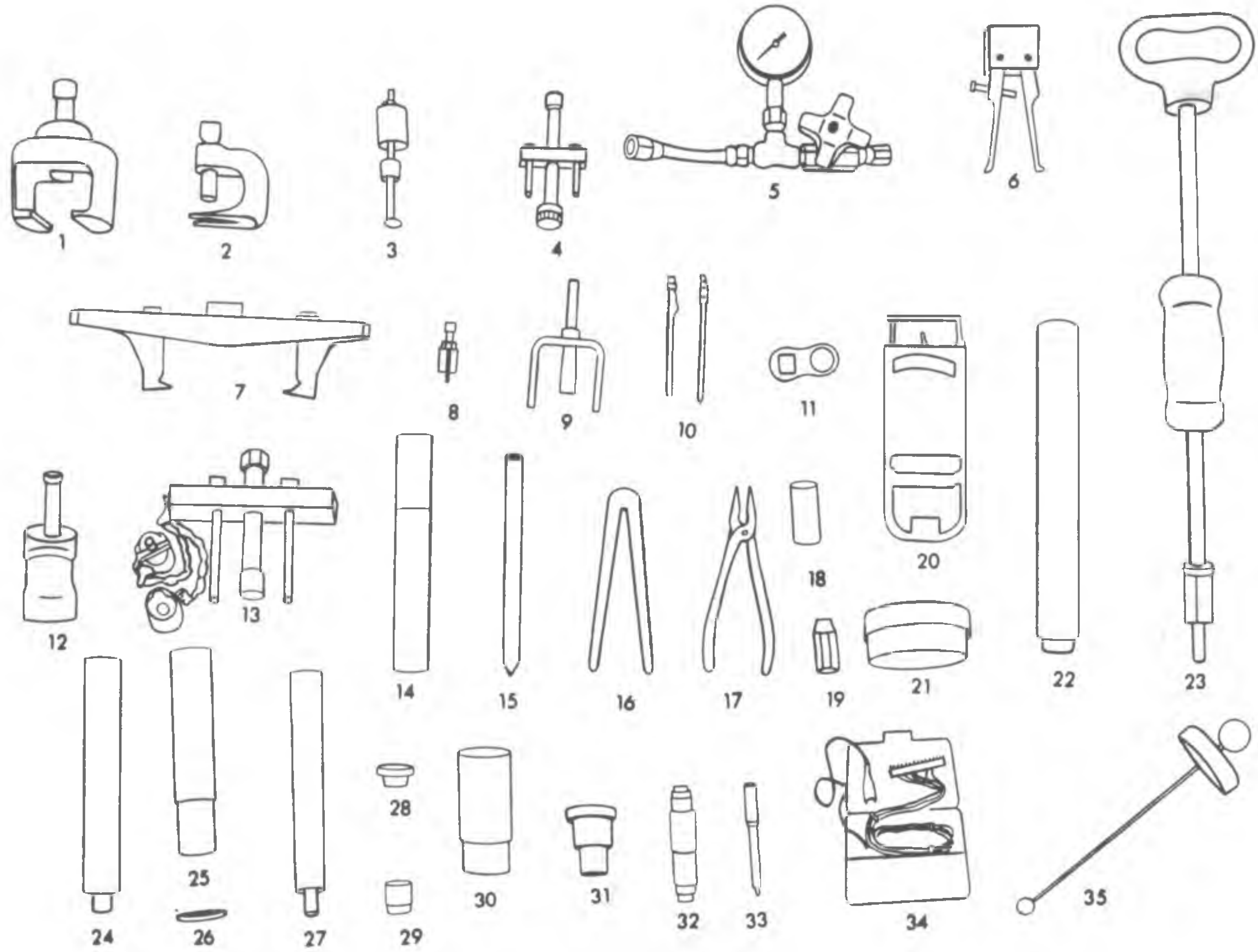
   Standard Column with Automatic Transmission - Connect the conductor tube (for transmission indicator) at the instrument panel (Fig. 3B5-70).
10. Install steering wheel as outlined under "Steering Wheel-Installation".
11. Connect battery ground cable.



STEERING SYSTEM MANDATORY REQUIREMENTS

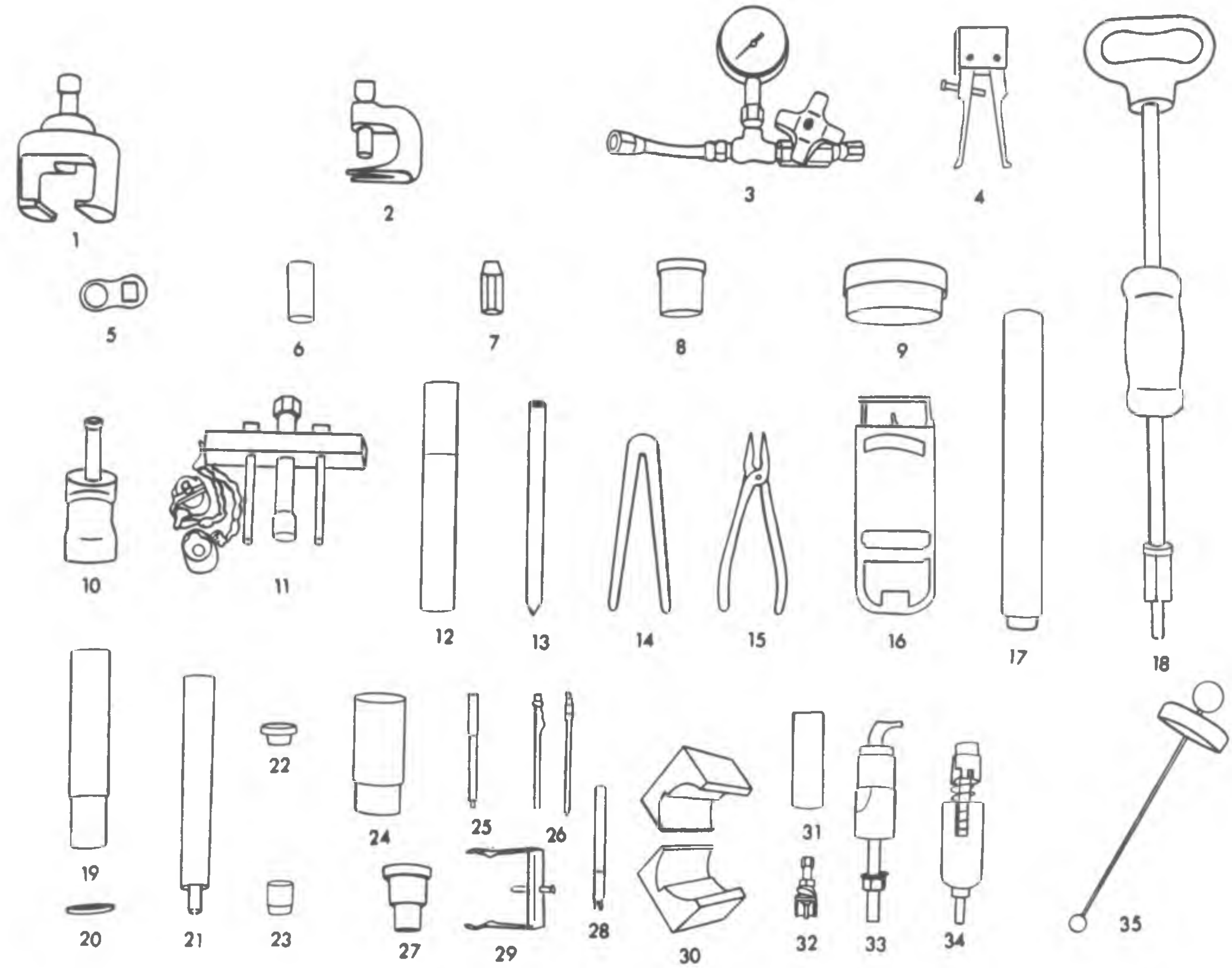
1. Using a 50 lb. force applied to the steering wheel end of Shaft [A], Lower Clamp Nut [B] must be tightened to the specified torque to give a compressed spring dimension [C] of 1.26 ± .02 after assembly.
2. All Mast Jacket attachments [D] & [E] must be tightened to recommended torque.
3. Threaded portion of Steering Shaft [F] must be completely free of lubricant after Mast Jacket [G] assembly to maintain steering wheel clamping load and hub clearance.

Fig. 3B5-70--Mandatory Sequence For Installation of P Series Column



1. J-6632 Pitman Arm Puller
2. J-5504 Pitman Arm Puller
3. J-23073 Shift Tube Installer
4. J-23072 Shift Tube Remover
5. J-5176 Oil Pressure Gauge
6. J-5822 Wormshaft Bearing Cup Remover
7. J-8433 Pump Pulley Remover (Cast Pulley)
8. J-21854 Column Pivot Pin Remover
9. J-23653 Lock Plate Compressor
10. J-5421 Thermometer
11. J-5860 Torque Wrench Adapter
12. J-21239 Pump Pulley Remover (Stamper Pulley)
13. J-2927 Steering Wheel Puller
14. J-1614 Sector Shaft Bushing Remover
15. J-7539 Ball Retainer
16. J-7624 Spanner Wrench
17. J-4245 #23 Internal Pliers
18. J-22670 Pump Shaft Seal Installer
19. J-6222 Shaft Seal Protector
20. J-23600 Belt Tension Gauge
21. J-8947 Rack-Piston Seal Compressor
22. J-5755 Wormshaft Bearing Race Installer
23. J-2619 Slide Hammer
24. J-8092 Handle
25. J-6278 Pitman Shaft Bearing Remover
26. J-6278-2 Pitman Shaft Bearing Installer
27. J-7079-2 Handle
28. J-8524-1 Adjuster Plug Bearing Installer
29. J-8524-2 Adjuster Plug Bearing Remover
30. J-6219 Pitman Shaft Seal Installer
31. J-22407 Pitman Shaft Bearing Installer
32. J-8937 Ball Seal Remover
33. J-6217 Connector Seat Installer
34. J-23980 Steering Column Electrical Analyzer
35. Torque Wrenches

Fig. 3B5-1ST--Special Tools C and K Models



1. J-6632 Pitman Arm Puller
2. J-5504 Pitman Arm Puller
3. J-5176 Pressure Gauge
4. J-5822 Wormshaft Bearing Cup Puller
5. J-5860 Torque Wrench Adapter
6. J-22670 Pump Shaft Seal Installer
7. J-6222 Shaft Seal Protector
8. J-9226 Pitman Shaft Bushing Replacer
9. J-7576 Rack-Piston Seal Compressor
10. J-21239 Pump Pulley Remover
11. J-2927 Steering Wheel Puller
12. J-1614 Sector Shaft Bushing Remover
13. J-7539 Ball Retainer
14. J-7624 Spanner Wrench
15. J-4245 #23 Internal Pliers
16. J-23600 Belt Tension Gauge
17. J-5755 Wormshaft Bearing Cup Installer
18. J-2619 Slide Hammer
19. J-6278 Pitman Shaft Bearing Remover
20. J-6278-2 Pitman Shaft Bearing Installer
21. J-7079-2 Drive Handle
22. J-8524-1 Adjuster Plug Bearing Installer
23. J-8524-2 Adjuster Plug Bearing Remover
24. J-6219 Pitman Shaft Seal Installer
25. J-6217 Connector Seat Installer
26. J-5421 Thermometer
27. J-22407 Pitman Shaft Bearing Installer
28. J-22727 Terminal Remover
29. J-22708 Turn Signal Cover Remover
30. J-22573 Steering Column Holding Fixture
31. J-22599 Lock Nut Socket
32. J-21854 Pivot Pin Remover
33. J-22551 Shift Tube Remover
34. J-22549 Shift Tube Installer
35. Torque Wrenches

Fig. 3B5-2ST--Special Tools G and P Models

SECTION 3B6

STEERING LINKAGE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 10.

CONTENTS

General Description 3B6-1
Maintenance and Adjustments 3B6-2
On-Vehicle Service 3B6-2
Tie Rods 3B6-2
Relay Rod 3B6-5
Idler Arm 3B6-6
Pitman Arm 3B6-6
Steering Connecting Rod 3B6-7

GENERAL DESCRIPTION

The steering linkage is located forward of the front crossmember. Refer to Fig. 3B6-1, for a typical system. Steering effort is transmitted to left and right hand adjustable tie rods through a relay rod. The relay rod is connected to an idler arm on the right and to the pitman arm on the left.

DIAGNOSIS

Reference should be made to the correct method of disassembly, repair, adjustment and reassembly. Damaged, broken or deformed parts must be replaced with the correct replacement. See Section 3.

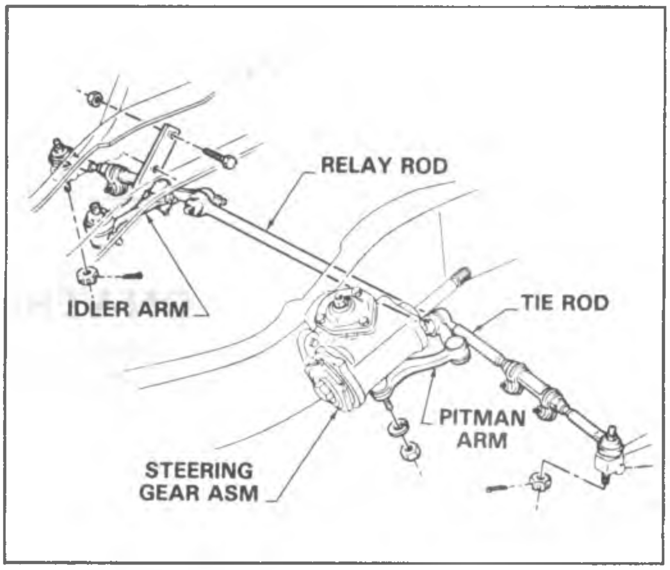


Fig. 3B6-1--Typical Steering Linkage

MAINTENANCE AND ADJUSTMENTS

LUBRICATION

LUBRICATION OF STEERING LINKAGE

The steering linkage under normal conditions should be lubricated with any water resistant EP type chassis lubricant every 7,500 miles (12 000 km) or six months, whichever occurs first. Lubricate every 3,000 miles (4 800 km) or two months whichever occurs first when operating in dusty or muddy conditions or if the vehicle is used "off-road". Lubrication points and additional information on the chassis lubricant recommended can be found in Section 0--General Information and Lubrication.

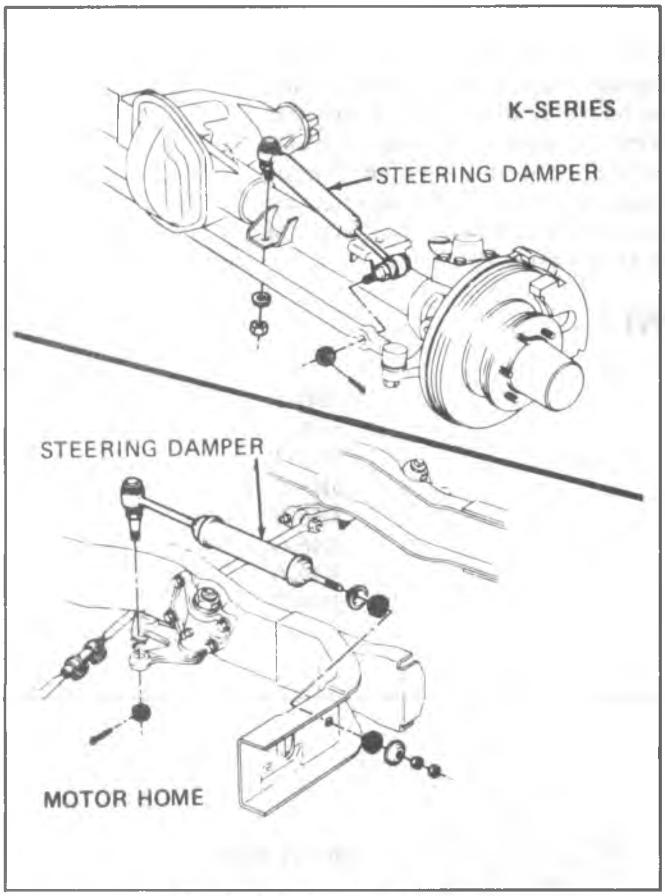


Fig. 3B6-2--Steering Dampers

STEERING DAMPER CHECK

(Fig. 3B6-2)

This type of steering damper is nonadjustable, nonrefillable and is not repairable. At each lubrication interval make check #1 and #2 on the steering damper system.

1. **Inspecting Damper Mountings**: Check the damper attachments to be sure they are properly and securely installed. (Tighten, if loose). Replace the damper assembly if the rubber bushings are badly worn.
2. **Inspecting Damper For Leaks**: Inspect the damper for evidence of fluid leakage. A light film of fluid is permissible on the body of the damper near the shaft seal. A dripping damper should be replaced.

If a Funtional or Noise Complaint is Reported, Make the Following Inspections:

3. **Inspecting Damper For Noise**: Disconnect the frame or axle end of the damper. Extend and compress the damper using as much travel as possible. The damper action should be smooth throughout each stroke.
4. **Inspecting Damper For Functioning:** While checking the damper in step (3) above, observe the operation of the damper for fluid leakage, effort and lag. Items from this check that require damper replacement are:
   a. Any fluid leakage during this check.
   b. Seizing or binding condition during travel of damper.
   c. A skip or lag at reversal near mid-stroke of damper.
5. **Reinstall Disconnected End of Damper Using Proper Torque.**

ON-VEHICLE SERVICE

NOTICE: See NOTICE on page 1 of this section regarding all fasteners referred to in servicing steering linkage components.

TIE RODS

Removal

1. Raise vehicle on hoist.
2. Remove nuts from ball studs. The inner tie rod ends use crimp nuts, while the outer ends use castellated nuts and cotter pins.
3. To remove outer ball stud, tap on steering arm at tie rod end with a hammer while using a heavy hammer or similar tool as a backing.
4. Remove inner ball stud from relay rod using same procedure as described in Step 3.
5. To remove tie rod ends from tie rod, loosen clamp bolts and unscrew end assemblies.

Installation

NOTICE: See the NOTICE on page 1 of this section regarding the fasteners referred to in steps 4 and 6.

Tie rod adjuster components often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceed 7 pounds, discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

As a guide to correct orientation of the inner tie rod end relative to the outer tie rod end, rotate both ends to the extremes of travel in the same direction before clamping. The position of each tie rod end must be maintained as the clamps are tightened to ensure free movement of each joint. Return the rod assembly to midposition of its travel. This should result in the inner and outer ball studs being retained in a parallel relationship with the intermediate (relay) rod and steering knuckle (arm) respectively. The following procedure should be used when installing tie rods.

1. If the tie rod ends were removed, lubricate the tie rod threads with EP Chassis lube and install ends on tie rod making sure both ends are threaded an equal distance from the tie rod.

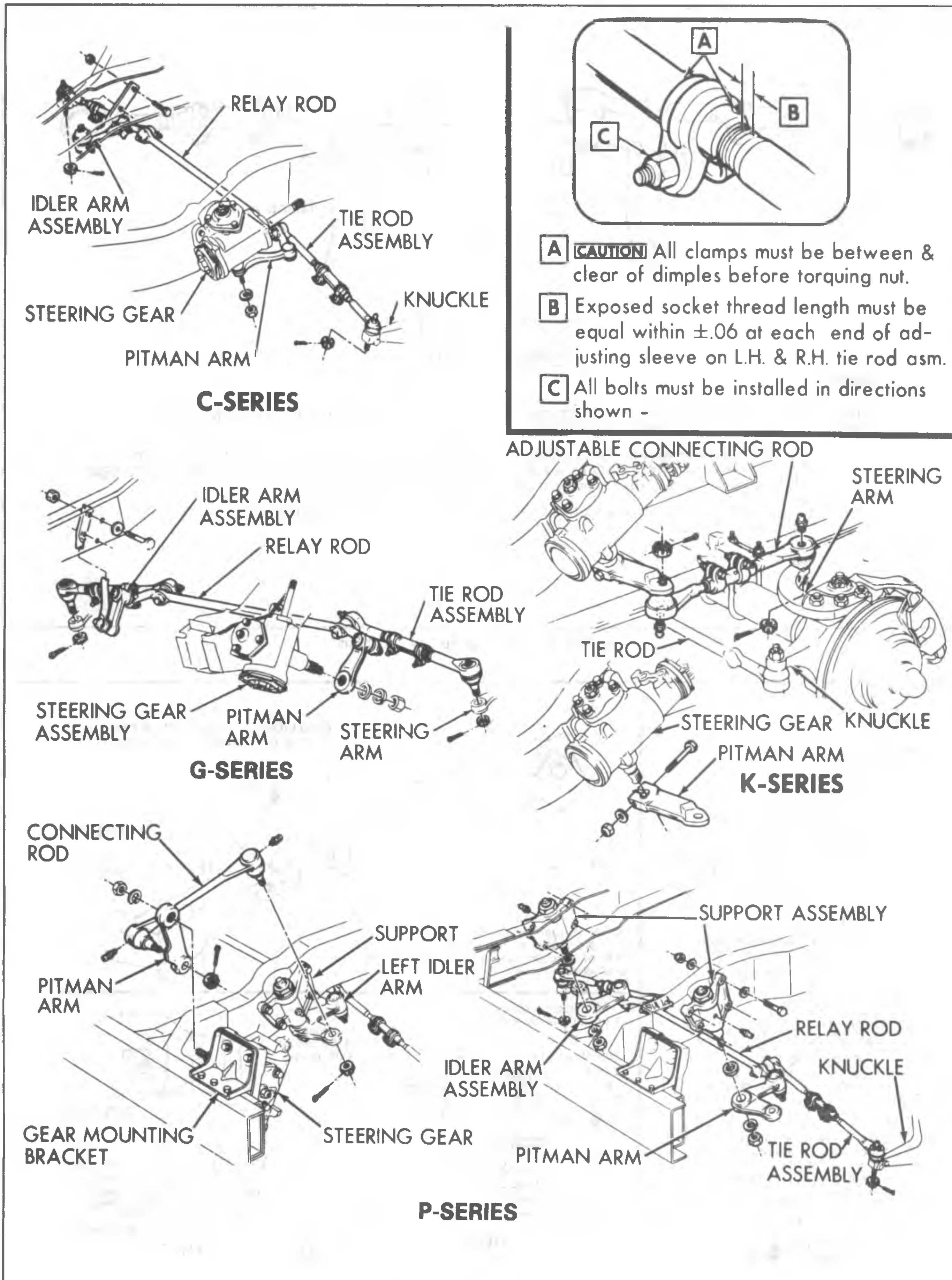
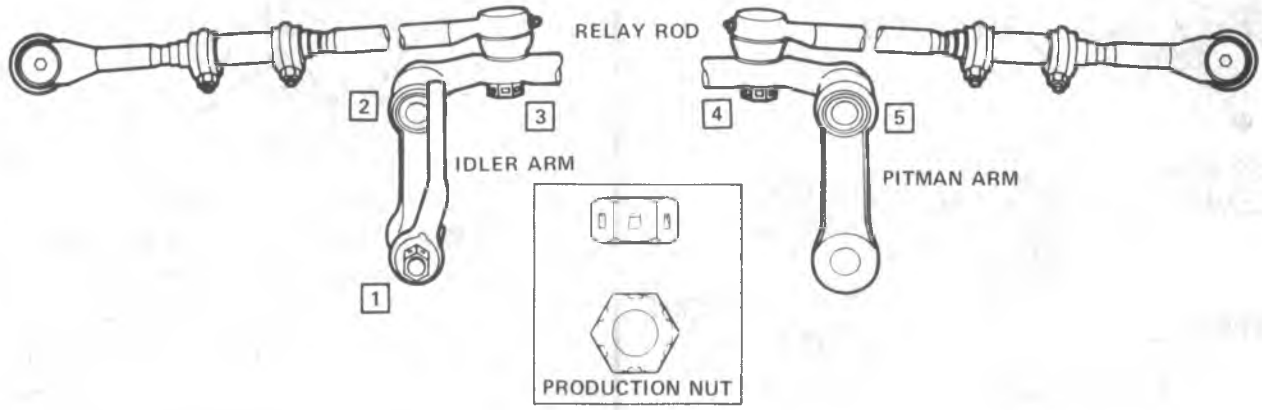


Fig. 3B6-3--Steering Linkage



IMPORTANT

WHENEVER ANY OF THE CRIMP NUTS OR STUDS AT THE (5) LOCATIONS SHOWN ARE LOOSENED OR REMOVED, THE FOLLOWING STEPS MUST BE TAKEN:

A. WHEN RE-ATTACHING ANY TWO COMPONENTS BY MEANS OF A BALL STUD, CAREFULLY POSITION THE TWO PARTS. THEN INSTALL A FREE-SPINNING NUT, AND DRAW THE ITEMS TOGETHER TO SEAT THE TAPER, TORQUE NUT TO 54 N·m (40 FT-LBS), THEN REMOVE NUT.

B. THEN USE A TORQUE PREVAILING SERVICE REPLACEMENT NUT (#351249) AND TORQUE TO 90 N·m (66 FT-LBS).

Fig. 3B6-4--Typical Crimp Nut Locations

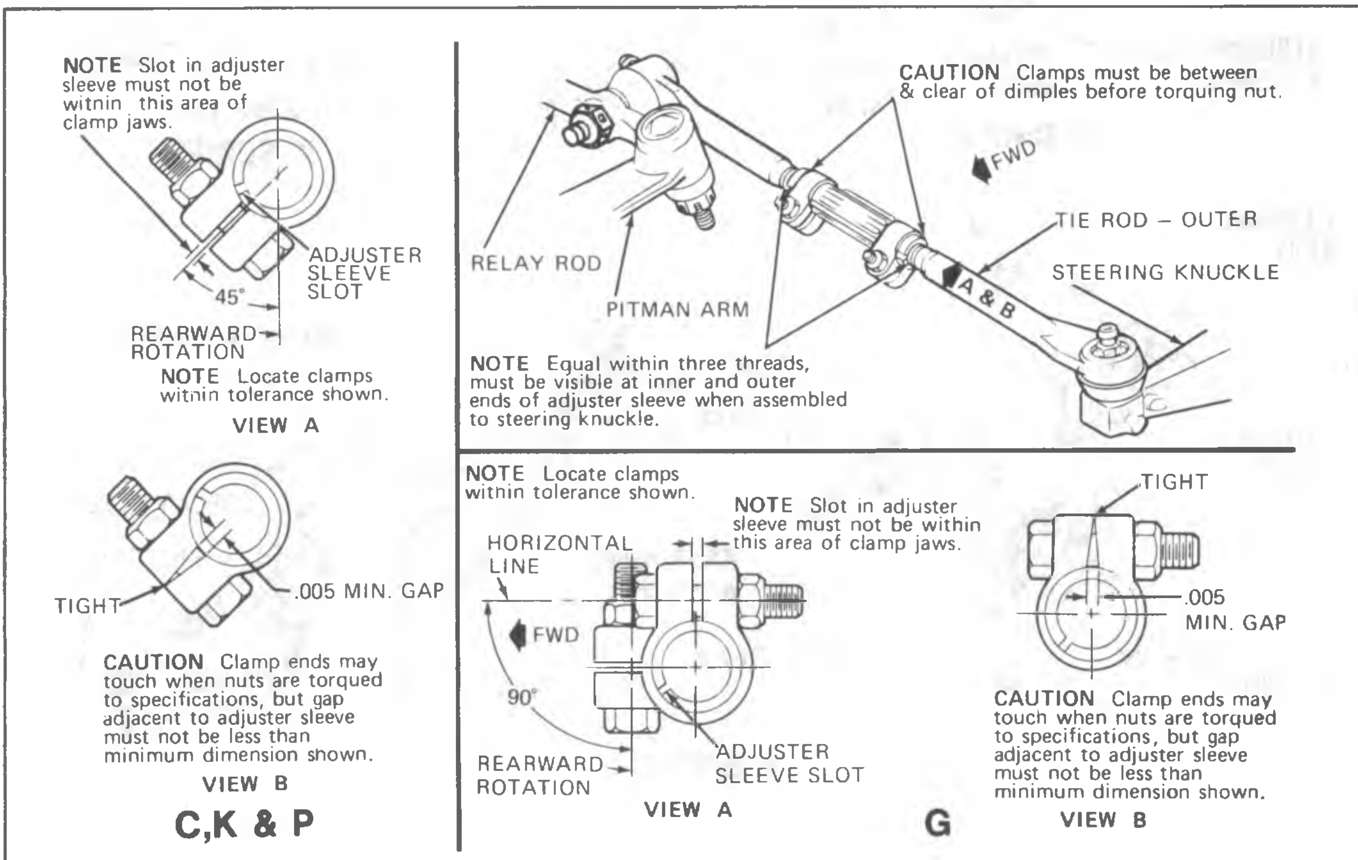


Fig. 3B6-5--Tie Rod Clamp Relationship

2. Make sure that threads on ball studs and in ball stud nuts are clean and smooth. If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut. Check condition of ball stud seals; replace if necessary. Tool J-24434 may be used to install ball stud seals.
3. Install ball studs in steering arms and relay rod. For the inner tie rod ends, use J-29193 or J-29194 to seat the tapers, as shown in Fig. 3B6-4.A torque of 20 N·m is required. With the tapers seated, remove the tool.
4. For the inner tie rod ends, install a torque prevailing ball stud nut, and tighten to 54 N·m (40 ft. lbs.). At the outer tie rod ends, install a ball stud nut, tighten to 70 N·m (50 lb. ft.), and install new cotter pins. Lubricate tie rod ends.
5. Adjust toe-in as described in Section 3A.

Before tightening the tie rod adjusting sleeve clamp bolts, be sure that the following conditions have been met:

a. The sleeve clamps must be positioned between the locating dimples at either end of the sleeve.
b. The clamps must be positioned within the angular travel indicated in Figure 3B6-5.
c. The relationship of the clamp slot with the slit in the sleeve should be maintained as shown in Figure 3B1-4.
d. Rotate both inner and outer tie rod housing rearward to the limit of ball joint travel before tightening clamps. Tighten clamps to 22 N·m, 16 ft. lbs. Return tie rod assembly to the center of travel.
e. All procedures for alignment, adjustment and assembly of tie rods applies to each side.
f. Check each assembly to be sure that a total travel of at least 35° can be obtained using a bubble protractor and a pair of vise grips.

Inspection

To ensure proper installation, it is necessary to perform the following inspection after any change of toe setting or removal of any ball stud:

1. Check the total rotation of the tie rod assembly using the following procedure:
   a. Lubricate inner and outer tie rod ends.
   b. Attach vise grip pliers to the outer tie rod end.
   c. Rotate outer tie rod end counterclockwise (up) to maximum position. Attach bevel protractor. Center protractor bubble indicator and record reading.
   d. Rotate tie rod end clockwise (down) to maximum position. Center protractor bubble indicator and record reading.
   e. Compare protractor readings obtained in Steps c and d. Total rotation of tie rod assembly should measure at least 35°.
   f. If rotation is less than 35°, loosen one tie rod sleeve clamp and rotate both tie rod ends to their maximum limit **both ends must be rotated in the same direction**.
   g. Tighten tie rod clamp and again rotate both ends to their maximum limits, repeating Steps c and d. This recheck of total rotation will result in a minimum of 35° travel.
   h. After obtaining the correct amount of rotation (35° or greater), position the outer tie rod end approximately midway in this travel.

If rotating checks, outlined above, reveal a rough or lumpy feel, the inner or outer tie rod end assembly may have excessive wear and should be replaced.

If all of the above mentioned conditions are met, proper tie rod installation is assured.

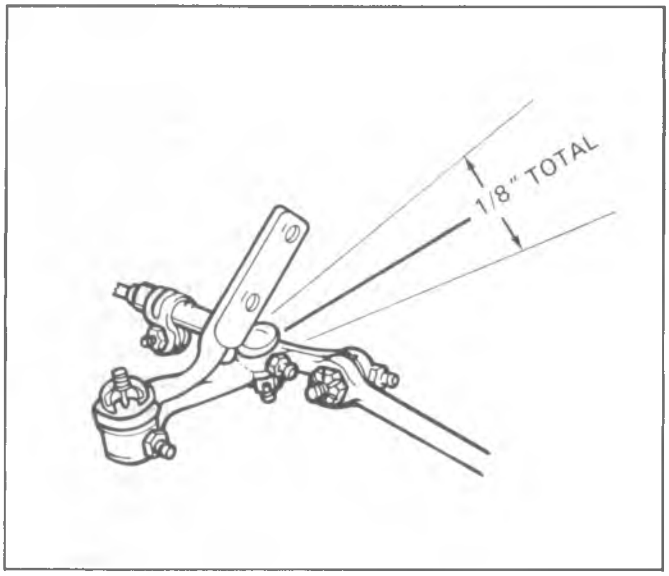


Fig. 3B6-6--Checking Idler Movement, Typical

RELAY ROD

Removal

1. Raise vehicle on hoist.
2. Remove inner ends of the tie rods from relay rod as described under "Tie Rod-Removal".
3. Remove the nuts from the pitman and idler arm ball studs at the relay rod.
4. Remove the relay rod from the pitman and idler arms by tapping on the relay rod ball stud bosses with a hammer, while using a heavy hammer as a backing (Fig. 3B6-4).
5. Remove the relay rod from the vehicle.

Installation

NOTICE: See the NOTICE on page 1 of this section regarding the fasteners referred to in steps 2 and 3.

1. Make sure that threads on the ball studs and in the ball stud nuts are clean and smooth. If threads are not clean and smooth, ball studs may turn in sockets when attempting to tighten nut. Check condition of ball stud seals; replace if necessary.
2. Install the relay rod to the idler arm and pitman arm ball studs, making certain the seals are in place. Use a free-spinning nut to seat the tapers, as shown in Fig. 3B6-4.
3. Install the tie rods to the relay rod as previously described under "Tie Rod- Installation". Lubricate the tie rod ends.
4. Lower the vehicle to the floor.
5. Adjust toe-in (see Section 3A) and align steering wheel as described previously in Section 3B4 under "Steering Wheel Alignment and High Point Centering".

IDLER ARM (EXCEPT P SERIES MOTORHOME)

Use of the proper diagnosis and checking procedure is essential to prevent needless replacement of good idler arms.

1. Raise the vehicle in such a manner as to allow the front wheels to rotate freely and the steering mechanism freedom to turn. Position the wheels in a straight ahead position.
2. Using a spring scale located as near the relay rod end of the idler arm as possible, exert a 25 lb. force upward and then downward while noticing the total distance the end of the arm moves. This distance should not exceed ± 1/16 inch for a total acceptable movement of 1/8 inch (Figure 3B6-6). It is necessary to ensure that the correct load is applied to the arm since it will move more when higher loads are applied. It is also necessary that a scale or ruler be rested against the frame and used to determine the amount of movement since observers tend to over-estimate the actual movement when a scale is not used. The idler arm should always be replaced if it fails this test.

Jerking the right front wheel and tire assembly back and forth, thus causing an up and down movement in the idler arm is not an acceptable method of checking since there is no control on the amount of force being applied.

Caution should be used in assuming shimmy complaints are caused by loose idler arms. Before suspecting suspension or steering components, technicians should eliminate shimmy excitation factors, such as dynamic imbalance, run-out or force variation of wheel and tire assemblies and road surface irregularities.

Removal

1. Raise vehicle on a hoist.
2. Remove the nut from ball stud at the relay rod. Remove the ball stud from the relay rod by tapping on the relay rod boss with a hammer, while using a heavy hammer as a backing.
3. Remove the idler arm to frame bolt and remove the idler arm assembly.

Installation

NOTICE: See the NOTICE on page 1 of this section regarding the fasteners referred to in steps 1 and 3.

1. Position the idler arm on the frame and install the mounting bolts (special plain washers under bolt heads); torque the nuts to 40 N·m, 30 ft. lbs.
2. Make sure that the threads on the ball stud and in the ball stud nut are clean and smooth. If threads are not clean and smooth, ball stud may turn in the socket when attempting to tighten nut. Check condition of ball stud seal; replace if necessary.
3. Install the idler arm ball stud in the relay rod, making certain the seal is positioned properly. Use a 5/8-18 free-spinning nut to seat the tapers, as shown in Fig. 3B6-4.
4. Lower the vehicle to the floor.

IDLER ARM--P SERIES MOTORHOME

The frame mounted idler support assembly is adjustable for support shaft end play. Check for idler arm movement at the relay rod end as indicated above. If the movement at the end of the arm exceeds ± 1/16 inch (1/8 inch total movement), readjust the support shaft end-play as follows:

1. Loosen the support assembly jam nut.
2. Tighten the adjusting plug to metal-to-metal contact.
3. Back off the adjusting plug 1/8 of a turn (1/2 of a flat on the square nut, or 45 °).
4. Retorque the jam nut to 25-35 ft. lbs., while taking care that the adjusting plug does not rotate.

PITMAN ARM

Removal

1. Raise vehicle on hoist.
2. Remove nut from pitman arm ball stud.
3. Remove pitman arm or relay rod from ball stud by tapping on side of rod or arm (in which the stud mounts) with a hammer while using a heavy hammer or similar tool as a backing. Pull on linkage to remove from stud.
4. Remove pitman arm nut from pitman shaft or clamp bolt from pitman arm, and mark relation of arm position to shaft.
5. Remove pitman arm, using Tool J-6632 or J-5504.

Installation

NOTICE: See the NOTICE on page 1 of this section regarding the fasteners referred to in steps 3 and 4.

1. Install pitman arm on pitman shaft, lining up the marks made upon removal.

   NOTICE: If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip arm onto pitman shaft. Do not spread pitman arm more than required to slip over pitman shaft with hand pressure. Do not hammer or damage to steering gear may result. Be sure to install the hardened steel washer before installing the nut.

2. Make sure that threads on ball studs and in ball stud nuts are clean and smooth. If threads are not clean and smooth, ball studs may turn in sockets when attempting to tighten nut. Check condition of ball stud seals; replace if necessary.
3. Install pitman shaft nut or pitman arm clamp bolt and torque to specifications; (C, G Series - 260 N·m (192 ft. lbs.), K Series - 125 N·m (92 ft. lbs.), P Series - 180 N·m (132 ft. lbs.).
4. Position ball stud onto pitman arm or relay rod. Use a 5/8-18 free spinning nut to seat the tapers, as shown in Fig. 3B6-4.
5. Lubricate ball studs.
6. Lower the vehicle to the floor.

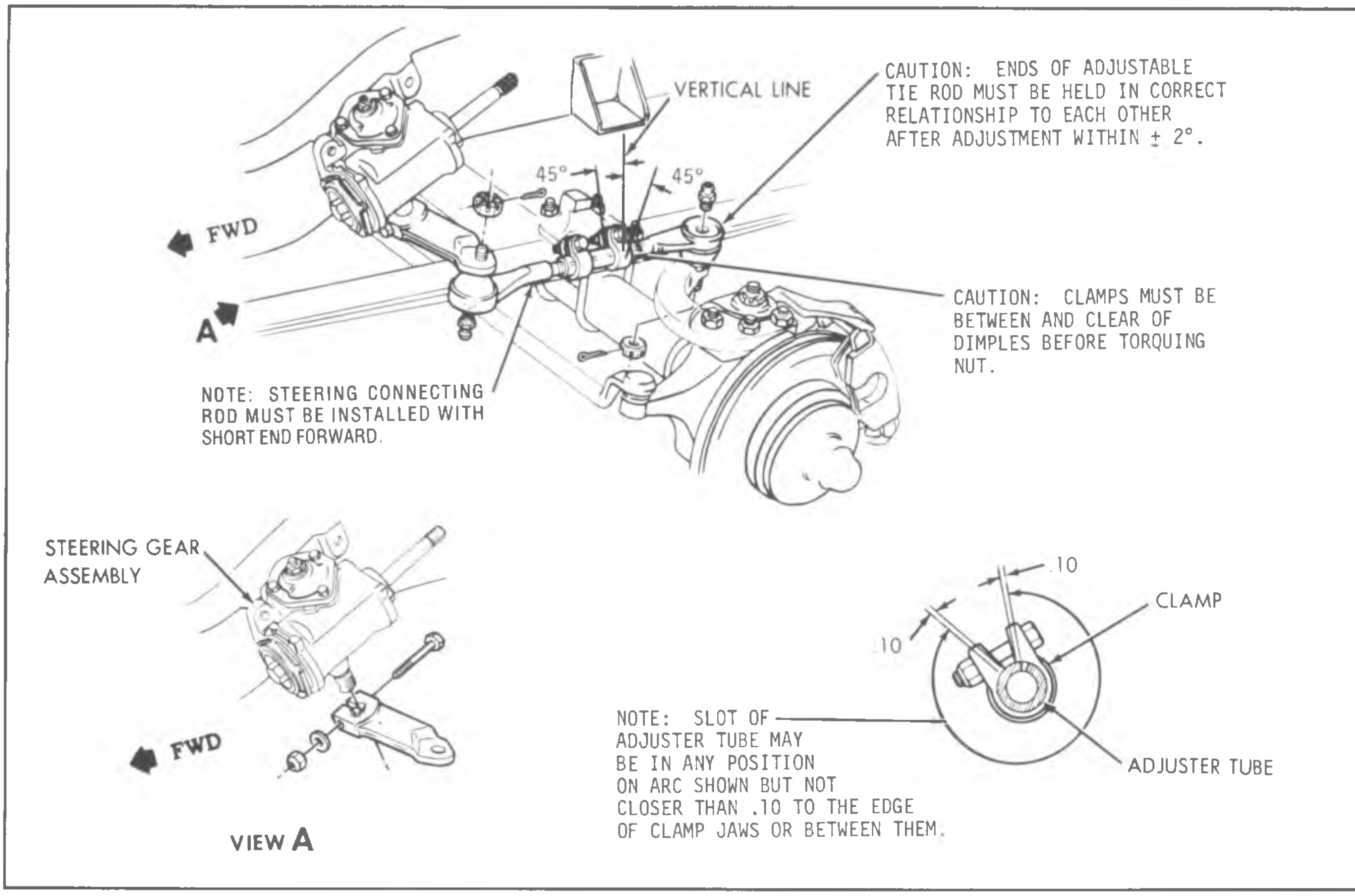


Fig. 3B6-7--Adjustable Connecting Rod Assembly - K Series

STEERING CONNECTING ROD (K MODELS ONLY)

Removal

1. Remove cotter pins from ball studs, and then remove the castellated nuts.
2. Remove ball studs from steering arm and pitman arm boss with a heavy hammer and striking other side of boss with lighter hammer .

Installation

NOTICE: See the NOTICE on page 1 of this section regarding the fasteners referred to in step 3.

1. Make sure that threads on ball studs and in ball stud nuts are clean and smooth. If threads are not clean and smooth, ball studs may turn in connecting rod when attempting to tighten nut. Check condition of ball stud seals-replace if necessary.
2. Install ball studs and torque to 120 N·m, 89 ft. lbs. Never back off nut to install cotter pin, always tighten nut to next slot that lines up with hole in stud.
3. Install ball stud nuts and to 95 N·m (70 ft. lbs.)
4. Install cotter pins and lubricate ball studs. For proper alignment and orientation of connecting rod clamps see Figure 3B6-7.

SPECIFICATIONS AND SPECIAL TOOLS

Refer to Specifications and Special Tools at end of Section 3B4.

POWER STEERING SYSTEM

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology. "See Notice on Page 1 of this section".

NOTICE This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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Power Steering Pump 3B7-4
Specifications 3B7-17
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GENERAL DESCRIPTION

The steering gear is of the recirculating ball type. This gear provides for ease of handling by transmitting forces from the wormshaft to the pitman shaft through the use of ball bearings.

MAINTENANCE AND ADJUSTMENTS

LUBRICATION OF POWER STEERING PUMP

Check the fluid level in the pump reservoir according to the intervals listed in Section 0B. Use only an approved power steering lubricant in the pump.

NOTICE: Never use brake fluid in the power steering pump, or damage may occur.

ADJUSTMENTS

Power Steering Gear Adjustment Procedure

Adjustment of the steering gear in the vehicle is not recommended because of the difficulty encountered in adjusting the worm thrust bearing preload and the confusing effects of the hydraulic fluid in the gear. Since a gear adjustment is made only as a correction and not as a periodic adjustment, it is better to take the extra time and make the adjustment correctly the first time.

Since a handling stability complaint can be caused by improperly adjusted worm bearings as well as an improper gear over-center adjustment, it is necessary that the steering gear assembly be removed from the vehicle and both thrust bearing and over-center preload be checked and corrected as necessary. An in-vehicle check of the steering gear will not pin-point a thrust bearing looseness.

Before any adjustments are made to the steering gear attempt to correct complaints of loose or hard steering, or other wheel disturbances, a careful check should be made of front end alignment, shock absorbers, wheel balance and tire pressure for possible steering system problems. See Diagnosis steps listed earlier in Section 3.

Once it is determined to make adjustments, refer to Section 3B of the Overhaul Manual for specific instructions.

STEERING GEAR HIGH POINT CENTERING

1. Set front wheels in straight ahead position. This can be checked by driving vehicle a short distance on a flat surface to determine steering wheel position at which vehicle follows a straight path.
2. With front wheels set straight ahead, check position of mark on wormshaft designating steering gear high point. This mark should be at the top side of the shaft at 12 o'clock position and lined up with the mark in the coupling lower clamp.
3. On C, G and P series, if gear has been moved off high point when setting wheel in straight ahead position, loosen the adjusting sleeve clamps on both left and right hand tie rods. Then turn both sleeves an equal number of turns in the same direction to bring gear back on high point.

   Turning the sleeves an unequal number of turns or in different directions will disturb the toe-in setting of the wheels.
4. On K series, if the gear has been moved off high point when setting wheels in straight ahead position, loosen the adjusting sleeve clamps on the connecting rod. Then turn sleeve to bring gear back on high point.

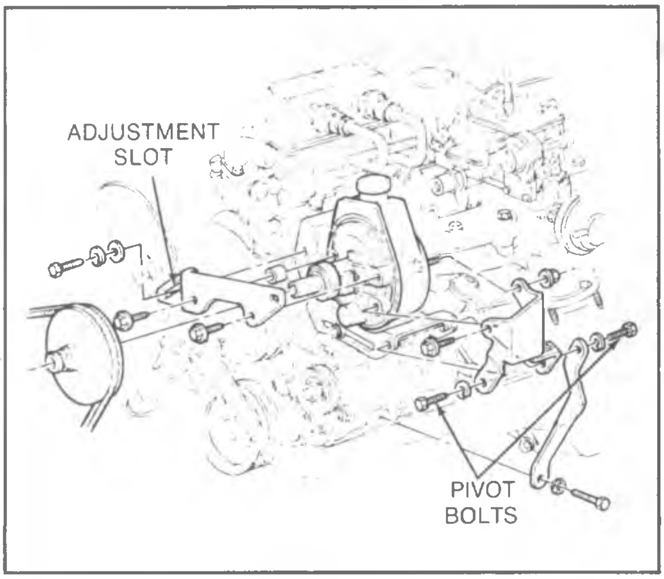


Fig. 3B7-1--Adjusting Pump Position

5. Readjust toe-in as outlined in Section 3A (if necessary).
6. Be sure to properly orient sleeves and clamps, as shown in Section 3B1, when fastening and torquing clamps to proper specifications.

PUMP BELT TENSION ADJUSTMENT

1. Loosen pivot bolt and pump brace adjusting nuts. See Fig. 3B7-1.

   NOTICE: Do not move pump by prying against reservoir or by pulling on filler neck, or damage to the pump could occur.
2. Move pump, with belt in place until belt is tensioned to specifications as indicated by Tool J-23600 (Fig. 3B7-2). See Figure 3B7-3.
3. Tighten pump brace adjusting nut. Then tighten pivot bolt nut.

FLUID LEVEL ADJUSTMENT

1. Check oil level in the reservoir by checking the dipstick when oil is at operating temperature. On models equipped with remote reservoir, the oil level should be maintained approximately 1/2 to 1 inch from top with wheels in full left turn position.
2. Fill, if necessary, to proper level with GM Power Steering Fluid or equivalent.

   NOTICE: Never use brake fluid in the power steering pump, or damage may occur.

BLEEDING HYDRAULIC SYSTEM

1. Fill oil reservoir to proper level and let oil remain undisturbed for at least two minutes.
2. Start engine and run only for about two seconds.
3. Add oil if necessary.
4. Repeat above procedure until oil level remains constant after running engine.
5. Raise front end of vehicle so that wheels are off the ground.
6. Increase engine speed to approximately 1500 rpm.
7. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
8. Add oil if necessary.
9. Lower the vehicle and turn wheels right and left on the ground.
10. Check oil level and refill as required.
11. If oil is extremely foamy, allow vehicle to stand a few minutes with engine off and repeat above procedure.
    a. Check belt tightness and check for a bent or loose pulley. (Pulley should not wobble with engine running.)
    b. Check to make sure hoses are not touching any other parts of the truck, particularly sheet metal except where design calls for a clamp.
    c. Check oil level, filling to proper level if necessary, following operations 1 through 10. This step and Step "d" are extremely important as low oil level and/or air in the oil are the most frequent causes of objectional pump noise.
    d. Check the presence of air in the oil. If air is present, attempt to bleed system as described in operations 1 through 10. If it becomes obvious that the pump will not bleed after a few trials, proceed as outlined under Hydraulic System Checks.

HYDRAULIC SYSTEM CHECKS

The following procedure outlines methods to identify and isolate power steering hydraulic circuit difficulties. The test provides means of determining whether power steering system hydraulic parts are actually faulty. This test will result in readings indicating faulty hydraulic operation, and will help to identify the faulty component.

Before performing hydraulic circuit test, carefully check belt tension, fluid level and condition of driving pulley.

Power Steering System Test

Engine must be at normal operating temperature. Inflate front tires to correct pressure. All tests are made with engine idling. Check idle adjustment and, if necessary, adjust engine idle speed to correct specifications listed in Section 6C and proceed as follows:

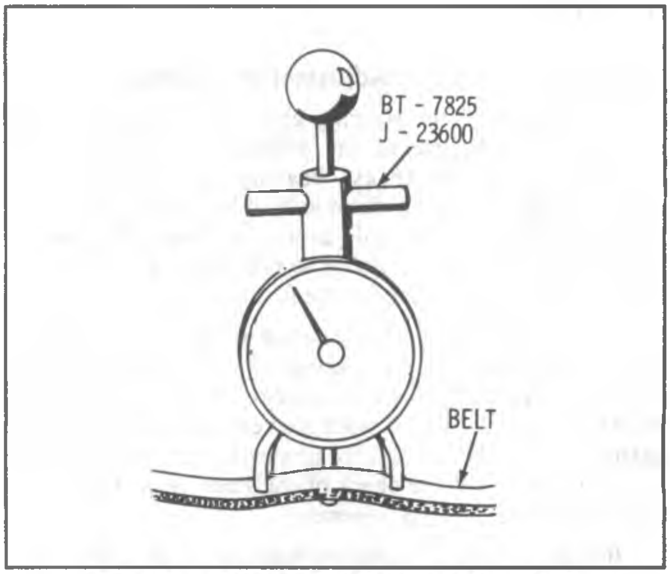


Fig. 3B7-2--Checking Belt Tension with J-23600

BELT TENSION

	5/16" WIDE	3/8" WIDE	15/32" WIDE
NEW BELT	350 N Max. 80 Lbs. Max.	620 N Max. 140 Lbs. Max.	750 N Max. 165 Lbs. Max.
USED BELT	200 N Min. 50 Lbs. Min.	300 N Min. 70 Lbs. Min.	400 N Min. 90 Lbs. Min.
USED COGGED BELT		250 N Min. 60 Lbs. Min.	

Fig. 3B7-3--Belt Tension Chart

1. With engine NOT running disconnect pressure hose from pump and install Tool J-5176 using a spare pressure hose between gage and pump. Gage must be between shut-off valve and pump (Fig. 3B7-4). Open shut-off valve.
2. Remove filler cap from pump reservoir and check fluid level. Fill pump reservoir to full mark on dipstick. Start engine and, momentarily holding steering wheel against stop, check connections at Tool J-5176 for leakage.
3. Bleed system as outlined under Maintenance and Adjustments.
4. Insert thermometer (Tool J-5421) in reservoir filler opening. Move steering wheel from stop to stop several times until thermometer indicates that hydraulic fluid in reservoir has reached temperature of 150° to 170°F.

   NOTICE: To prevent scrubbing flat spots on tires, do not turn steering wheel more than five times without rolling vehicle to change tire-to-floor contact area.
5. Start engine and check fluid level adding any fluid if required. When engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 80-125 PSI range. Should this pressure be in excess of 200 PSI, check the hoses for restrictions and the poppet valve for proper assembly.
6. Close gate valve fully 3 times. Record the highest pressure attained each time.

   NOTICE: Do not leave valve fully closed for more than

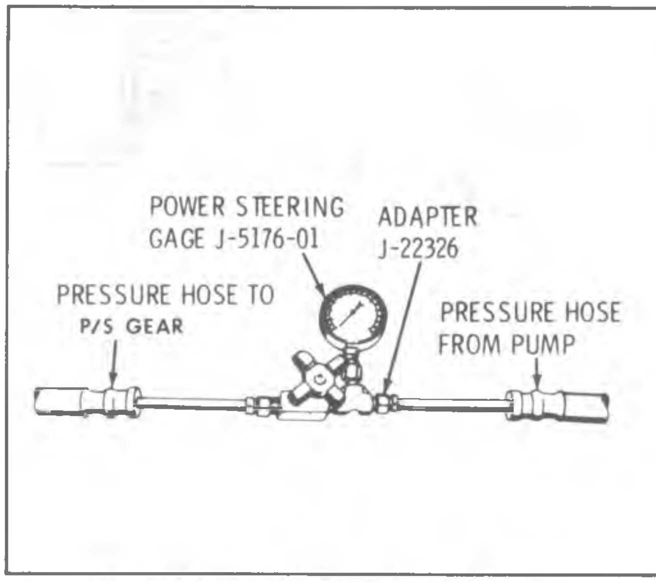


Fig. 3B7-4--Checking Power Steering Pressures

   5 seconds as the pump could be damaged internally.

   a. If the pressures recorded are within the listed specs and the range of readings are within 50 PSI, the pump is functioning within specs. (Ex. Spec. 1250-1350 PSI - readings - 1270-1275-1280).
   b. If the pressures recorded are high, but do not repeat with 50 PSI, the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled, cleaned, flushed and reassembled before further usage.
   c. If the pressures recorded are constant, but more than 100 PSI, below the low listed spec., replace the flow control valve and recheck. If the pressures are still low, replace the rotating group in the pump.
7. If the pump checks within specifications, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressures recorded. If this pressure cannot be built in either (or one) side of the gear, the gear is leaking internally and must be disassembled and repaired. See the current Overhaul Manual.
8. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level and/or make needed repairs.

ON-VEHICLE SERVICE

POWER STEERING GEAR

Removal

1. Disconnect hoses at gear. When hoses are disconnected, secure ends in raised position to prevent drainage of oil. Cap or tape the ends of the hoses to prevent entrance of dirt.
2. Install two plugs in gear fittings to prevent entrance of dirt.
3. Remove the flexible coupling to steering shaft flange bolts (G, C and K models) or the lower universal joint pinch bolt (P models). Mark the relationship of the universal yoke to the stub shaft.
4. Mark the relationship of the pitman arm to the

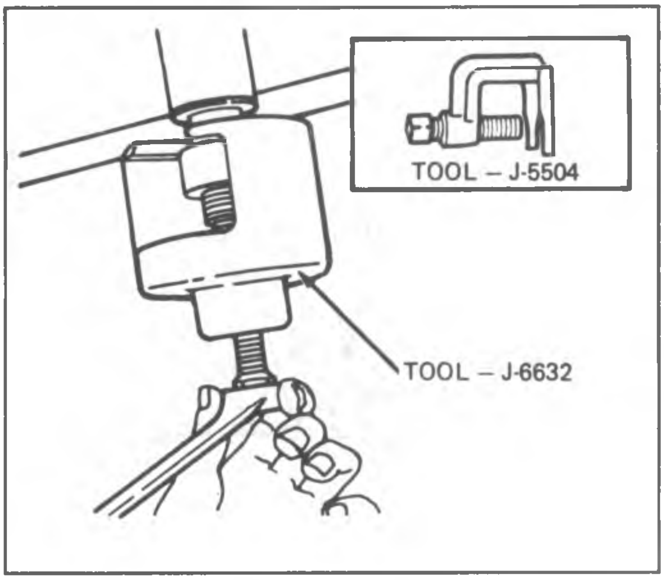


Fig. 3B7-5--Removing Pitman Arm

pitman shaft. Remove the pitman shaft nut or pitman arm pinch bolt and then remove the pitman arm from the pitman shaft using Puller J-6632 (Fig. 3B7-5).

5. Remove the steering gear to frame bolts and remove the gear assembly.
6. G, C and K Models - Remove the flexible coupling pinch bolt and remove the coupling from the steering gear stub shaft.

Installation (Fig. 3B7-6)

NOTICE: See NOTICE on Page 1 of this section regarding the fasteners referred to in Steps l, 3, 4 and 5.

1. Install the flexible coupling onto the steering gear stub shaft, aligning the flat in the coupling with the flat on the shaft. Push the coupling onto the shaft until the stub shaft bottoms on the coupling reinforcement. Install the pinch bolt and torque to specifications.

NOTICE: The coupling bolt must pass through the shaft undercut, or damage to the components could occur.

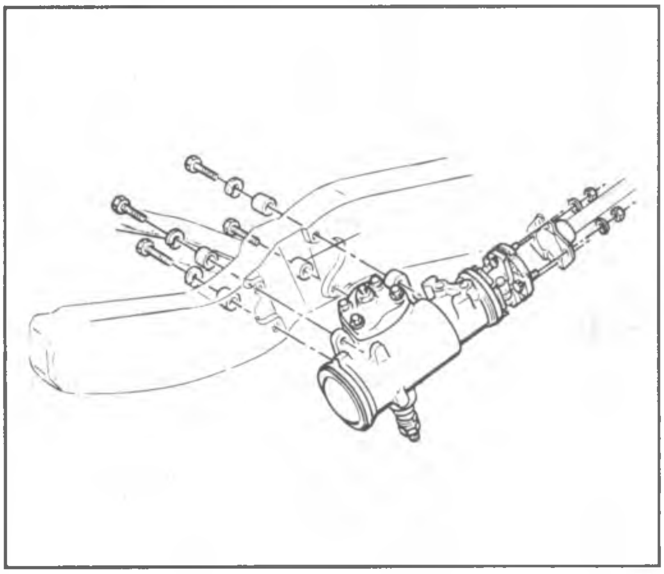


Fig. 3B7-6--Power Steering Gear Mounting-Typical

2. Place the steering gear in position, guiding the coupling bolt into the steering shaft flange.
3. Install the steering gear to frame bolts and torque to specifications.
4. If flexible coupling alignment pin plastic spacers were used, make sure they are buttomed on the pins, tighten the flange bolt nuts to specifications and then remove the plastic spacers.
5. If flexible coupling alignment pin plastic spacers were not used, center the pins in the slots in the steering shaft flange and then install and torque the flange bolt nuts to specifications.

P Models

a. Place the steering gear in position, guiding the stud shaft into the universal joint assembly and lining up the marks made at removal. If a new gear was installed, line up the mark on the stub shaft with the mark on the universal yoke.
b. Install the steering gear to frame bolts and torque to specifications.
c. Install the universal joint pinch bolt and torque to specification. The pinch bolt must pass through the shaft undercut.

All Models

6. Install the pitman arm onto the pitman shaft, lining up the marks made at removal. Install the pitman shaft nut or pitman arm pinch bolt and torque to specifications.
7. Remove the plugs and caps from the steering gear and hoses and connect the hoses to the gear. Tighten the hose fittings to specified torque.

POWER STEERING PUMP (3B7-7 THROUGH 3B7-17)

Removal

1. Disconnect hoses at pump. When hoses are disconnected, secure ends in raised position to prevent drainage of oil. Cap or tape the ends of the

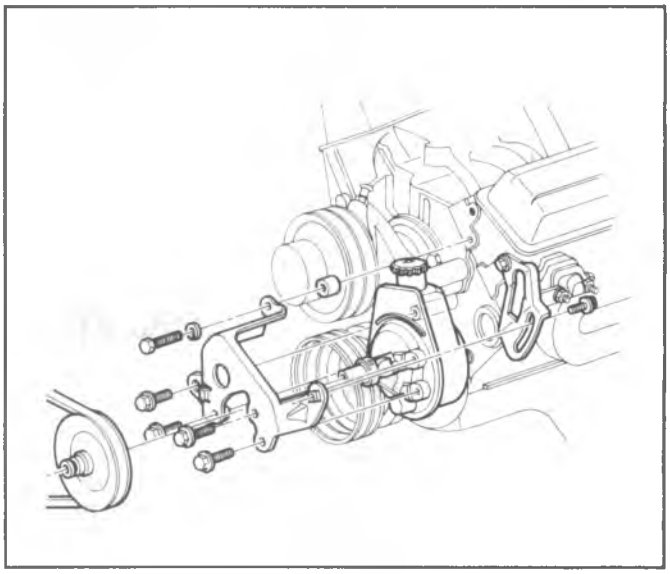


Fig. 3B7-7--P/S Pump Mounting, CK10,20,30 w/LE9/LF3/LS9 Exc. C60/C69

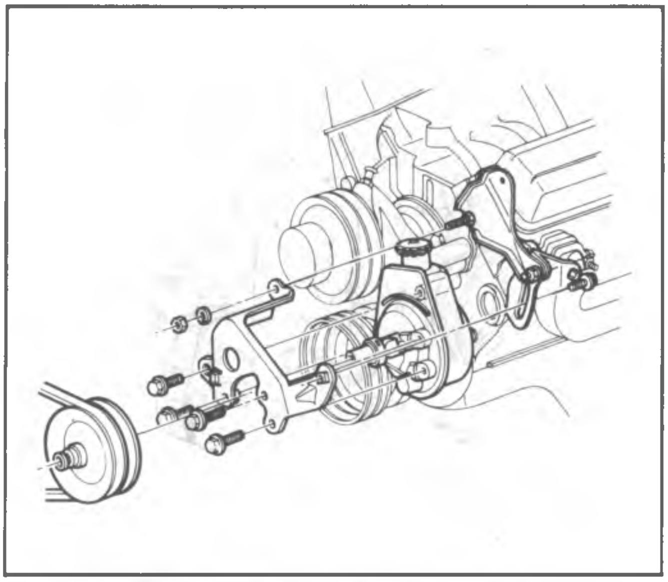


Fig. 3B7-8--P/S Pump Mounting, CK10,20,30 w/LE9/LS9/LT9 and C69

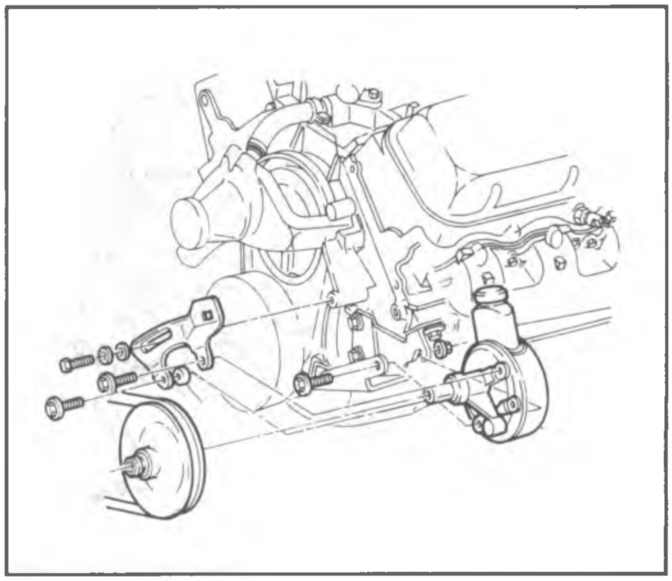


Fig. 3B7-10--P/S Pump Mounting, CK10,20,30 w/LE8

hoses to prevent entrance of dirt.

On Models with remote reservoir, disconnect reservoir hose at pump and secure in raised position. Cap hose pump fittings.

2. Install two caps at pump fittings to prevent drainage of oil from pump.
3. Loosen bracket-to-pump mounting nuts.
4. Remove pump belt.
5. Remove pump from attaching parts and remove pump from vehicle.

Installation

1. Position pump assembly on vehicle and install attaching parts loosely.
2. Connect and tighten hose fittings.
3. Fill reservoir. Bleed pump by turning pulley backward (counter-clockwise as viewed from front) until air bubbles cease to appear.
4. Install pump belt over pulley.
5. Tension belt as outlined under "Pump Belt Tension-Adjustment" in this section.
6. Bleed as outlined under "Bleeding Power Steering System".

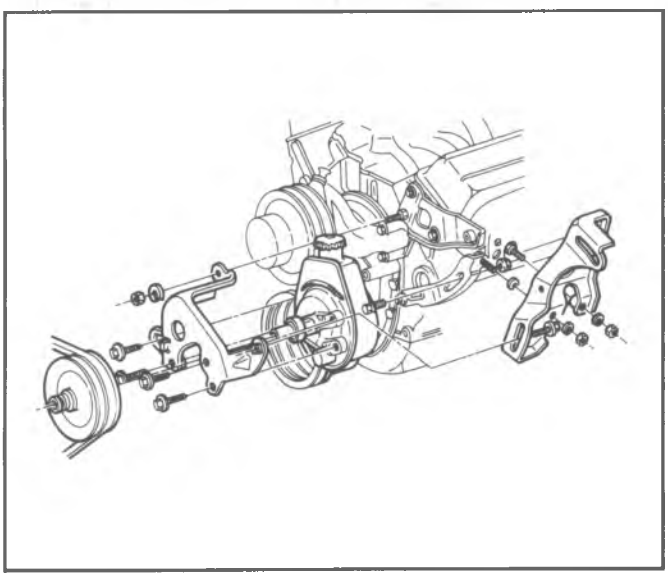


Fig. 3B7-9--P/S Pump Mounting, CK10,20,30 w/LE9/LF9/LS9/LT9 and C60

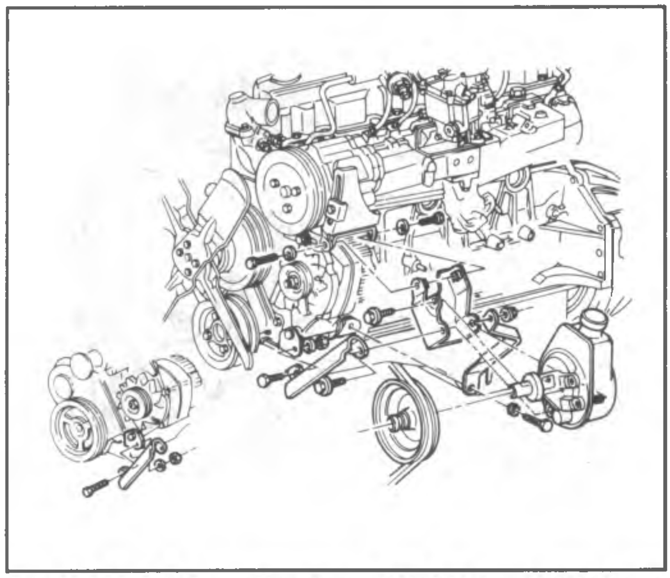


Fig. 3B7-11--P/S Pump Mounting, CK10,20,30 w/LE3/L25 and NB2

POWER STEERING HOSES

When servicing the power steering hoses be sure to align the hoses in their correct position as shown in the following figures.

It is important that the power steering hoses be installed correctly. Hoses installed out of position may be subjected to chafing or other abuses during sharp turns. Do not twist hoses unnecessarily during installation.

NOTICE: Do not start engine with any power steering hose disconnected, or damage to the components could occur.

SPECIFICATIONS SPECIAL TOOLS

Refer to Specifications and Special Tools at end of Section 3B5.

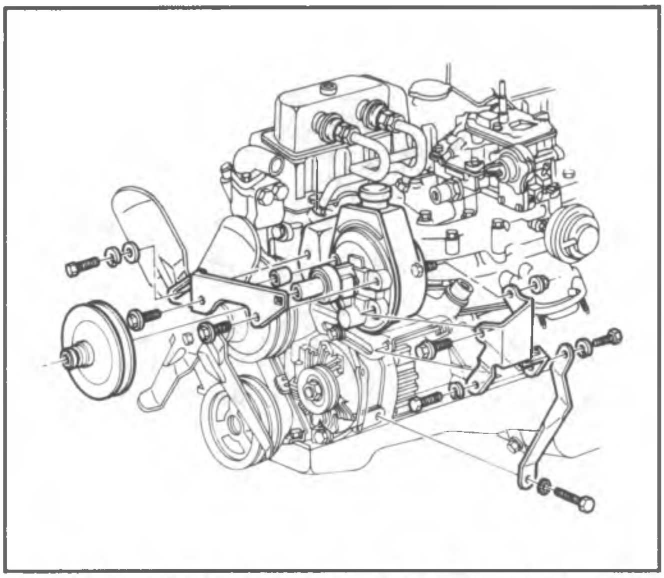


Fig. 3B7-12--P/S Pump Mounting, G10,20,30 w/LE3 Exc K19

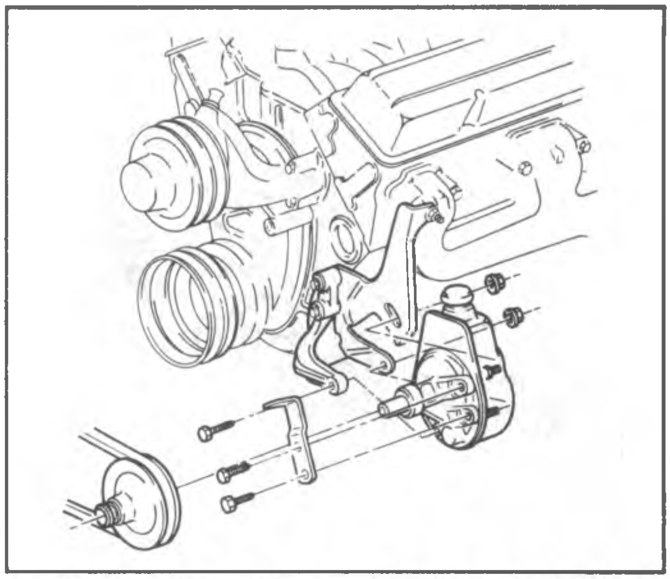


Fig. 3B7-14--P/S Pump Mounting, G10,20,30 w/LE9/LF3/LS9 and N40

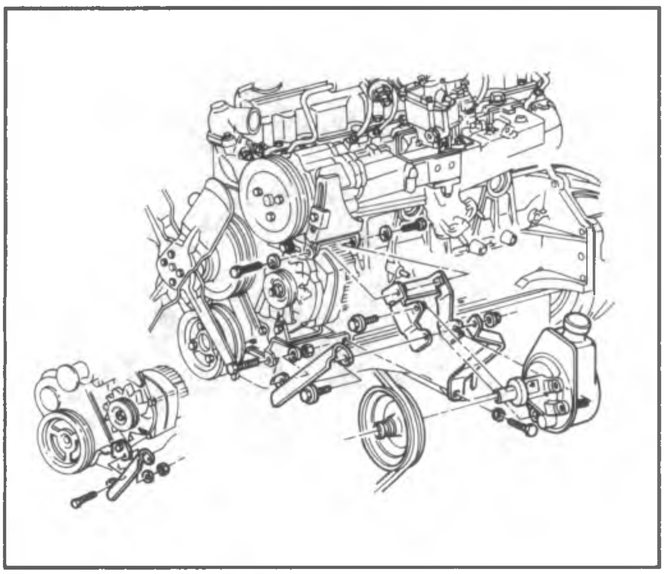


Fig. 3B7-13--P/S Pump Mounting, G10,20,30 w/LE3

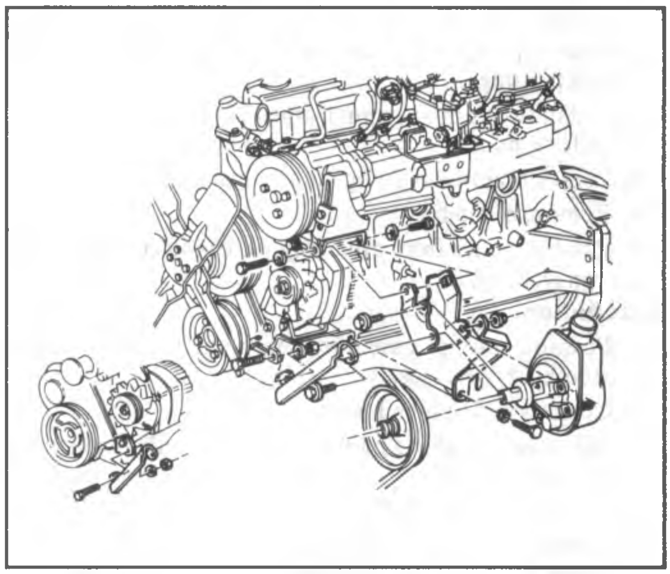


Fig. 3B7-15--P/S Pump Mounting, P10,20,30 w/L25 and JB7

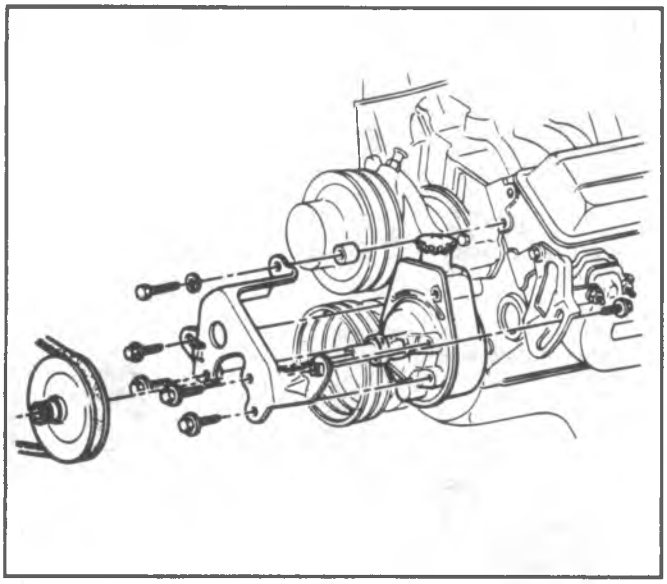


Fig. 3B7-16--P/S Pump Mounting, P10,20,30 w/LT9

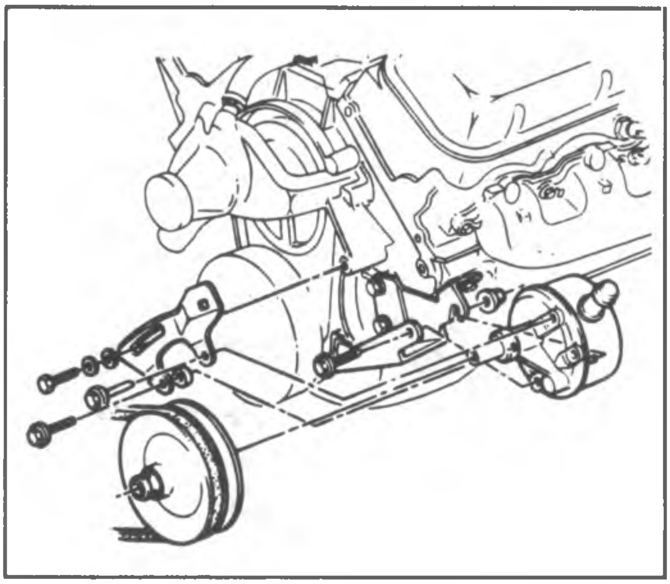


Fig. 3B7-17--P/S Pump Mounting, P30 w/LE8

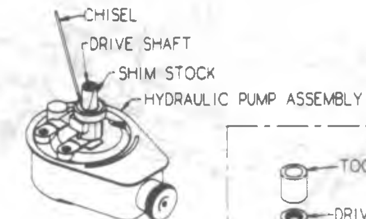
1. REMOVE AND INSTALL DRIVE SHAFT SEAL WITHOUT DISASSEMBLING THE PUMP.

REMOVE

1. PROTECT DRIVE SHAFT WITH SHIM STOCK.
2. USE CHISEL TO CUT SEAL AND REMOVE.

INSTALL

1. COAT DRIVE SHAFT SEAL WITH HYDRAULIC PUMP FLUID. REFER TO INSET FOR DRIVE SHAFT SEAL INSTALLATION.



INSTALL DRIVE SHAFT SEAL.

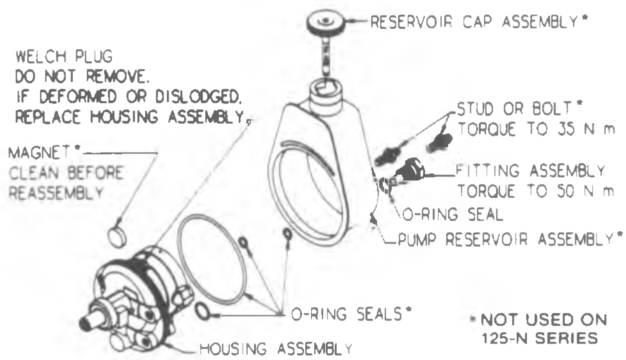
2. REMOVE AND INSTALL PUMP RESERVOIR ASSEMBLY

REMOVE

1. DRAIN OIL FROM RESERVOIR ASSEMBLY BEFORE REMOVAL.
2. REMOVE PARTS AS SHOWN

INSTALL

1. USE ALL NEW SEALS AND LUBRICATE WITH POWER STEERING FLUID BEFORE INSTALLATION
2. INSTALL PARTS AS SHOWN



*NOT USED ON 125-N SERIES

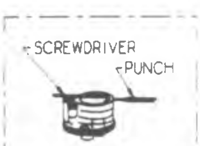
3. REMOVE AND INSTALL END PLATE.

REMOVE

1. REFER TO INSET FOR RETAINING RING REMOVAL

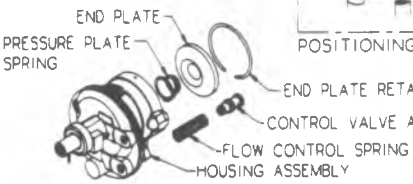
INSTALL

1. LUBRICATE END PLATE AND RETAINING RING, INSTALL PARTS AS SHOWN. REFER TO INSET FOR POSITIONING OF RETAINING RING IN HOUSING.



REMOVE RETAINING RING

POSITIONING OF RETAINING RING.



NOTICE: BEFORE PROCEEDING, EXAMINE THIS PART OF THE DRIVE SHAFT. IF IT IS CORRODED, CLEAN WITH CROCUS CLOTH BEFORE REMOVING. THIS WILL PREVENT DAMAGE TO THE SHAFT BUSHING WHICH MIGHT REQUIRE REPLACEMENT OF THE ENTIRE HOUSING.

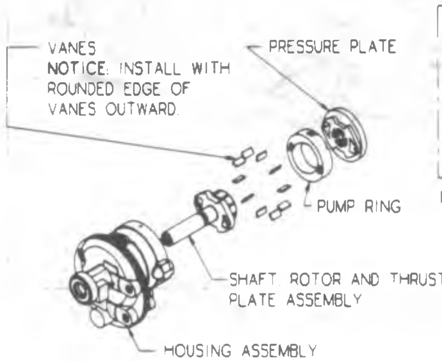
4. REMOVE AND INSTALL ROTATING GROUP.

REMOVE

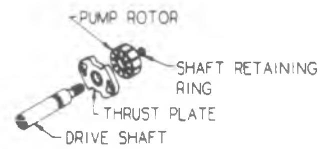
1. USING A RUBBER MALLET, TAP LIGHTLY ON DRIVE SHAFT UNTIL PRESSURE PLATE IS FREE.
2. REMOVE RETAINING RING FROM DRIVE SHAFT AND DISCARD. REMOVE PARTS AS SHOWN.

INSTALL

1. INSTALL PARTS AS SHOWN ON DRIVE SHAFT. INSTALL NEW RETAINING RING ON DRIVE SHAFT AND INSTALL IN PUMP HOUSING.
2. REFER TO INSET FOR POSITIONING OF PUMP RING IN HOUSING.



INSTALL PUMP RING.



RETAINING RING REMOVAL

5. REMOVE AND INSTALL DRIVE SHAFT AND O-RING SEALS.

REMOVE

1. REMOVE PARTS AS SHOWN.

INSTALL

1. REFER TO THE INSET FOR DRIVE SHAFT SEAL INSTALLATION. USE ALL NEW SEALS AND LUBRICATE SEALS WITH POWER STEERING FLUID BEFORE INSTALLATION.
2. INSTALL PARTS AS SHOWN.

INSTALL DRIVE SHAFT SEAL.

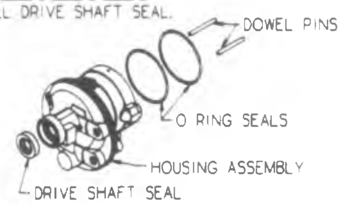


Fig. 3B7-18--P/S Pump Overhaul

POWER STEERING GEAR (800 MODEL)

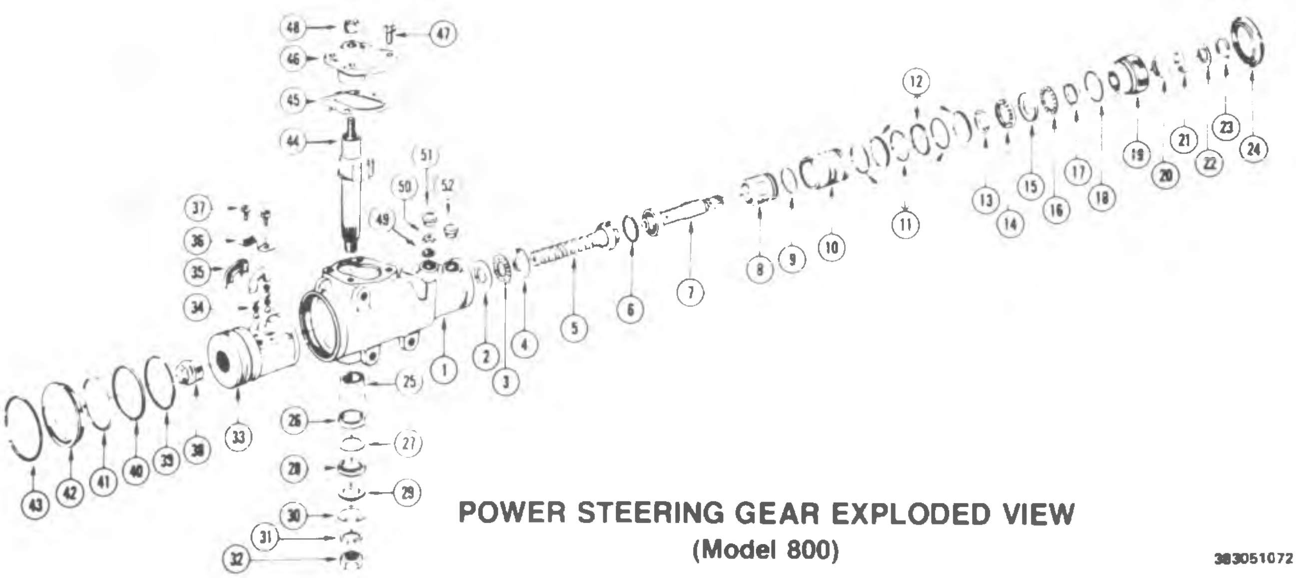
GENERAL DESCRIPTION

These Integral Power Steering Gears have a control valve which directs oil to either side of the rack piston. The rack piston converts hydraulic power into mechanical force. This force is transmitted to the mating pitman shaft teeth, through the pitman shaft to the steering linkage.

The model 800 incorporates a recirculating ball system in which steel balls act as a rolling thread between a steering worm-shaft and the rack-piston.

Whenever a part which forms a sealing surface for an "O" ring is removed, the "O" ring seal should also be removed and replaced with a new seal. Whenever one of the Pitman shaft or stub shaft seals are removed all adjacent seals should be removed and replaced with new seals. Lubricate all new seals with power steering fluid to ease assembly.

Key No.	Part Name	Key No.	Part Name	Key No	Part Name
1	HOUSING, STEERING GEAR	19	PLUG ADJUSTER	37	SCREW ASSY , LOCKWASHER & (2)
2	RACE, THRUST BEAPING (WORM)	20	BEARING, NEEDLE	38	PLUG RACK PISTON
3	BEARING ASSY , ROLLER THRUST (WORM)	21	SEAL, STUB SHAFT	39	SEAL "O" RING (RACK PISTON)
4	RACE, THRUST BEARING (WORM)	22	SEAL, STUB SHAFT DUST	40	RING, RACK PISTON
5	WORM, STEERING	23	RING, RETAINING	41	SEAL "O" RING (HOUSING END PLUG)
6	SEAL, "O" RING (STUB SHAFT)	24	NUT ADJUSTER PLUG LOCK	42	PLUG HOUSING END
7	SHAFT, STUB	25	BEARING ASSY NEEDLE (PITMAN SHAFT)	43	RING RETAINING (HOUSING END PLUG)
8	SPOOL, VALVE	26	SEAL, PITMAN SHAFT (SINGLE LIP)	44	GEAR ASSY PITMAN SHAFT
9	SEAL, "O" RING (SPOOL)	27	WASHER, SEAL BACK-UP (PITMAN SHAFT)	45	SEAL ASSY , GASKET
10	BODY, VALVE	28	SEAL, PITMAN SHAFT (DOUBLE LIP)	46	COVER ASSY , HOUSING SIDE
11	RING, VALVE BODY (3)	29	WASHER SEAL BACK-UP (PITMAN SHAFT)	47	BOLT HEX HEAD (SIDE COVER) (4)
12	SEAL, "O" RING (VALVE BODY) (3)	30	RING, RETAINING (PITMAN SHAFT SEAL)	48	NUT, LASH ADJUSTER
13	RETAINER, BEARING (ADJUSTER)	31	WASHER, PITMAN SHAFT LOCK	49	SPRING, CHECK VALVE
14	SPACER, THRUST BEARING	32	NUT, PITMAN SHAFT	50	POPPET CHECK VALVE
15	RACE, UPPER THRUST BEARING (SMALL)	33	NUT, RACK PISTON	51	CONNECTOR INVERTED FLARE
16	BEARING, UPPER THRUST	34	BALL	52	CONNECTOR INVERTED FLARE
17	RACE, UPPER THRUST BEARING (LARGE)	35	GUIDE, BALL RETURN (2)		
18	SEAL, "O" RING (ADJUSTER)	36	CLAMP, BALL RETURN GUIDE		



POWER STEERING GEAR EXPLODED VIEW
(Model 800)

383051072

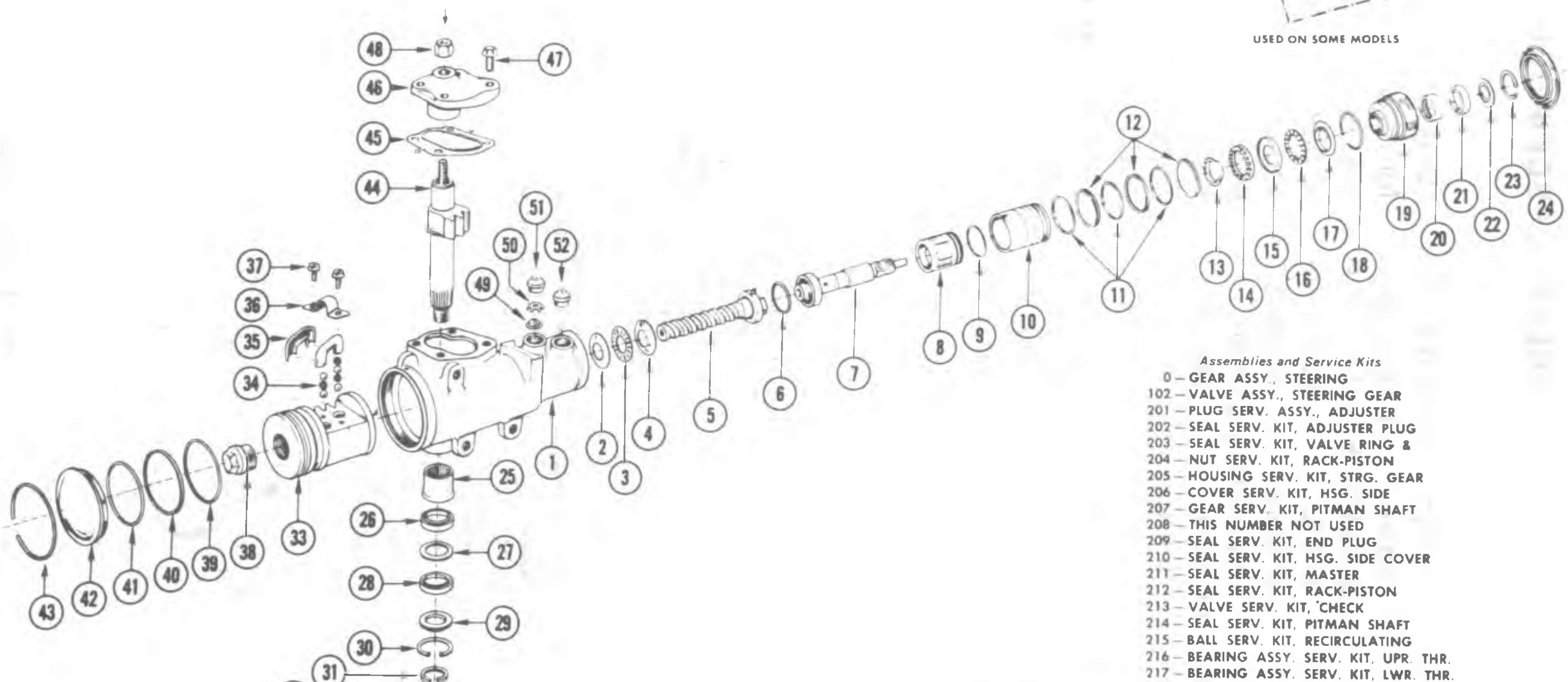
Fig. 3B7-19--Overhaul 800/808 Gear, Chart A

Key No.	Part Name
1	HOUSING, STEERING GEAR
2	RACE, THRUST BEARING (WORM)
3	BEARING ASSY., ROLLER THRUST (WORM)
4	RACE, THRUST BEARING (WORM)
5	WORM, STEERING
6	SEAL, "O" RING (STUB SHAFT)
7	SHAFT, STUB
8	SPOOL, VALVE
9	SEAL, "O" RING (SPOOL)
10	BODY, VALVE
11	RING, VALVE BODY (3)
12	SEAL, "O" RING (VALVE BODY) (3)
13	RETAINER, BEARING (ADJUSTER)
14	SPACER, THRUST BEARING
15	RACE, UPPER THRUST BEARING (SMALL)
16	BEARING, UPPER THRUST
17	RACE, UPPER THRUST BEARING (LARGE)
18	SEAL, "O" RING (ADJUSTER)

Key No.	Part Name
19	PLUG, ADJUSTER
20	BEARING, NEEDLE
21	SEAL, STUB SHAFT
22	SEAL, STUB SHAFT DUST
23	RING, RETAINING
24	NUT, ADJUSTER PLUG LOCK
25	BEARING ASSY., NEEDLE (PITMAN SHAFT)
26	SEAL, PITMAN SHAFT (SINGLE LIP)
27	WASHER, SEAL BACK-UP (PITMAN SHAFT)
28	SEAL, PITMAN SHAFT (DOUBLE LIP)
29	WASHER, SEAL BACK-UP (PITMAN SHAFT)
30	RING, RETAINING (PITMAN SHAFT SEAL)
31	WASHER, PITMAN SHAFT LOCK
32	NUT, PITMAN SHAFT
33	NUT, RACK PISTON
34	BALL
35	GUIDE, BALL RETURN (2)
36	CLAMP, BALL RETURN GUIDE

Key No.	Part Name
37	SCREW ASSY., LOCKWASHER & (2)
38	PLUG, RACK PISTON
39	SEAL, "O" RING (RACK PISTON)
40	RING, RACK PISTON
41	SEAL, "O" RING (HOUSING END PLUG)
42	PLUG, HOUSING END
43	RING, RETAINING (HOUSING END PLUG)
44	GEAR ASSY., PITMAN SHAFT
45	SEAL ASSY., GASKET
46	COVER ASSY., HOUSING SIDE
47	BOLT, HEX. HEAD (SIDE COVER) (4)
48	NUT, LASH ADJUSTER
49	SPRING, CHECK VALVE
50	POPPET, CHECK VALVE
51	CONNECTOR, INVERTED FLARE
52	CONNECTOR, INVERTED FLARE
53	BOLT, COUPLING PINCH
54	COUPLING, STEERING SHAFT

USED ON SOME MODELS



Assemblies and Service Kits

0	GEAR ASSY., STEERING
102	VALVE ASSY., STEERING GEAR
201	PLUG SERV. ASSY., ADJUSTER
202	SEAL SERV. KIT, ADJUSTER PLUG
203	SEAL SERV. KIT, VALVE RING &
204	NUT SERV. KIT, RACK-PISTON
205	HOUSING SERV. KIT, STRG. GEAR
206	COVER SERV. KIT, HSG. SIDE
207	GEAR SERV. KIT, PITMAN SHAFT
208	THIS NUMBER NOT USED
209	SEAL SERV. KIT, END PLUG
210	SEAL SERV. KIT, HSG. SIDE COVER
211	SEAL SERV. KIT, MASTER
212	SEAL SERV. KIT, RACK-PISTON
213	VALVE SERV. KIT, CHECK
214	SEAL SERV. KIT, PITMAN SHAFT
215	BALL SERV. KIT, RECIRCULATING
216	BEARING ASSY. SERV. KIT, UPR. THR.
217	BEARING ASSY. SERV. KIT, LWR. THR.

POWER STEERING GEAR EXPLODED VIEW

Fig. 3B7-20--Overhaul 800/808 Gear, Chart B

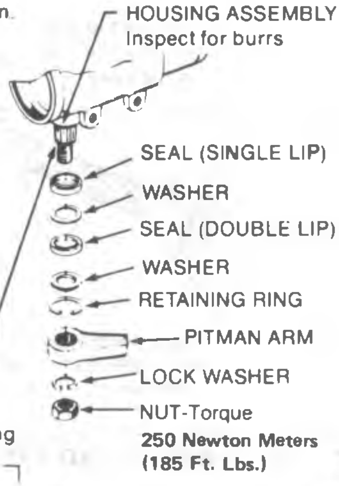
1. REMOVE AND INSTALL PITMAN SHAFT SEALS IN CAR

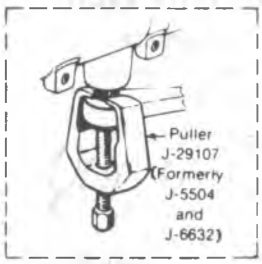
REMOVE

1. Clean exposed end of pitman shaft and end of housing after removing pitman arm.
2. Remove retaining ring with snap ring pliers J-4245.
3. Start engine and turn wheels fully to the left to force seals and washer out.
4. Turn off engine.
5. Inspect housing and shaft.

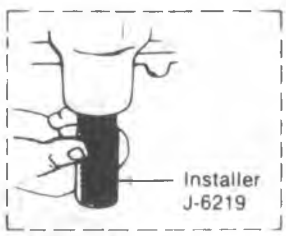
INSTALL

1. Install parts as shown.





Remove Pitman Arm



Install Seals

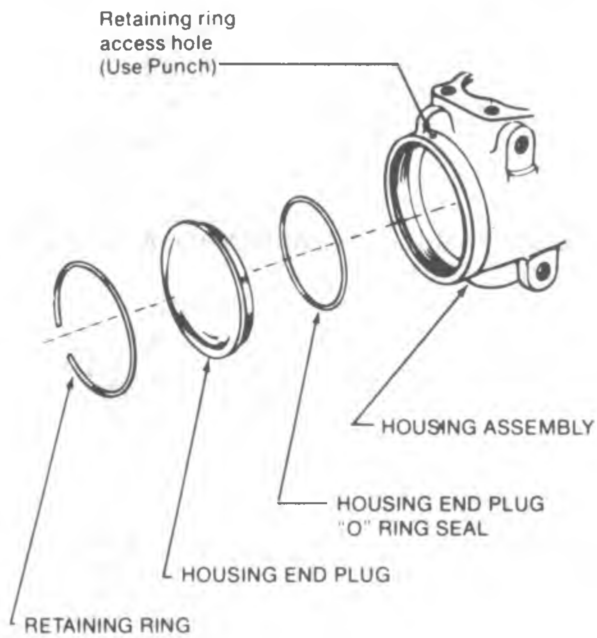
3. REMOVE AND INSTALL HOUSING END PLUG

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown. Open end of retaining ring to be approx. 25 mm (1 inch) from access hole.



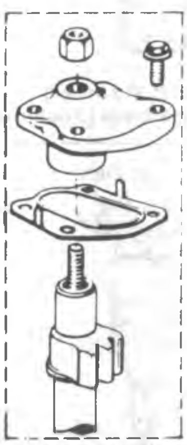
2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

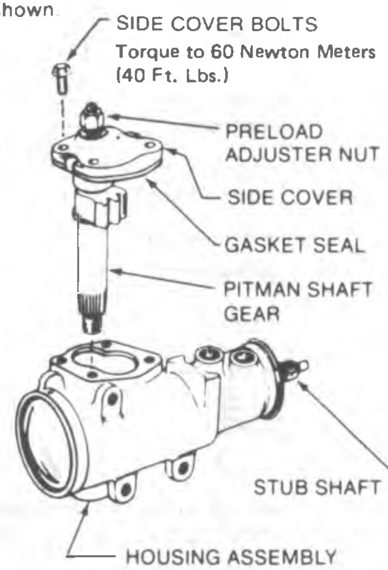
REMOVE

1. If pitman shaft and side cover are to be separated, remove preload adjuster nut.
2. Rotate stub shaft to center gear, then remove parts as shown.

INSTALL

1. If removed, install gasket seal by bending tabs around cover edges.
2. Install parts as shown.


Separate pitman shaft and gasket seal from side cover if required.



4. REMOVE AND INSTALL RACK PISTON

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.

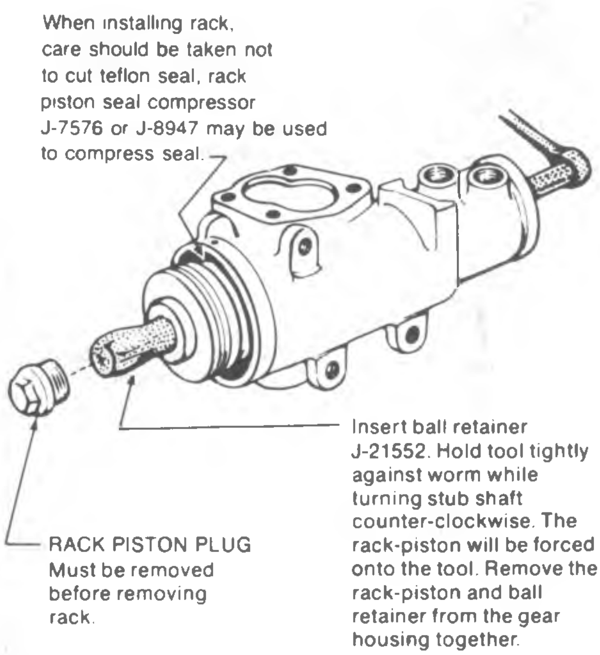


Fig. 3B7-21--Overhaul 800/808 Gear, Chart C

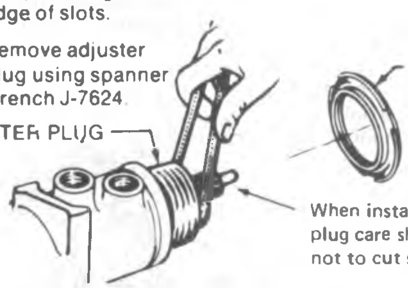
5. REMOVE AND INSTALL ADJUSTER PLUG ASSEMBLY

REMOVE

1. Loosen lock nut. Use punch against edge of slots.
2. Remove adjuster plug using spanner wrench J-7624.

INSTALL

1. Install parts as shown.



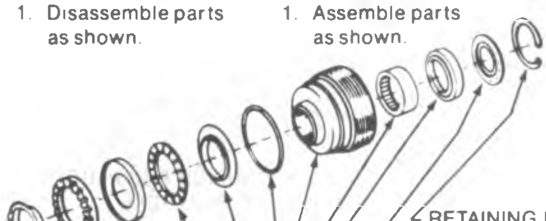
6. DISASSEMBLE AND ASSEMBLE ADJUSTER PLUG ASSEMBLY

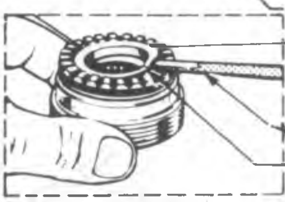
DISASSEMBLE

1. Disassemble parts as shown.

ASSEMBLE

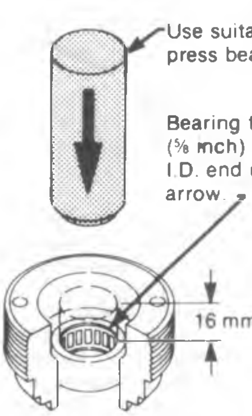
1. Assemble parts as shown.





* Use stub shaft seal protector J-29810 on stub shaft when installing stub shaft seal.

Remove bearing retainer.



Install bearing

7. REMOVE AND INSTALL BEARING, WORM, AND VALVE ASSEMBLY

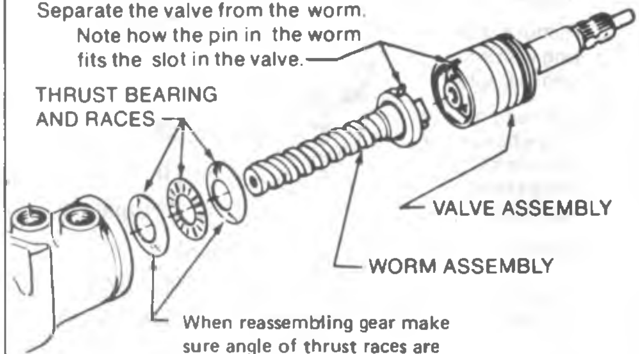
REMOVE

1. Grasp stub shaft and remove valve and worm assembly as a unit.

Separate the valve from the worm. Note how the pin in the worm fits the slot in the valve.

INSTALL

1. Install parts as shown.



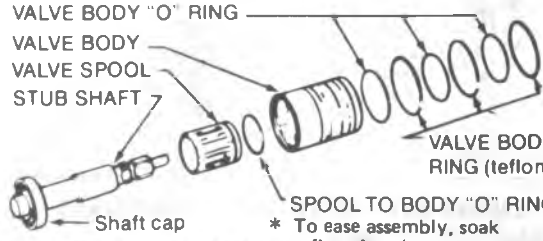
8. DISASSEMBLE AND ASSEMBLE VALVE

DISASSEMBLE

1. Disassemble parts as shown.

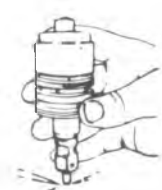
ASSEMBLE

1. Assemble parts as shown.

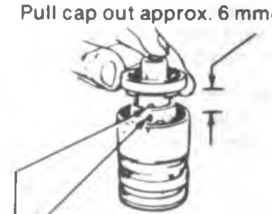


* To ease assembly, soak teflon rings in warm water.

A. Loosen shaft cap



B. Remove and install stub shaft.



C. Remove and install spool

Lubricate spool and body with power steering fluid.

D. Engage stub shaft

Fig. 3B7-22--Overhaul 800/808 Gear, Chart D

9. DISASSEMBLE AND ASSEMBLE RACK PISTON

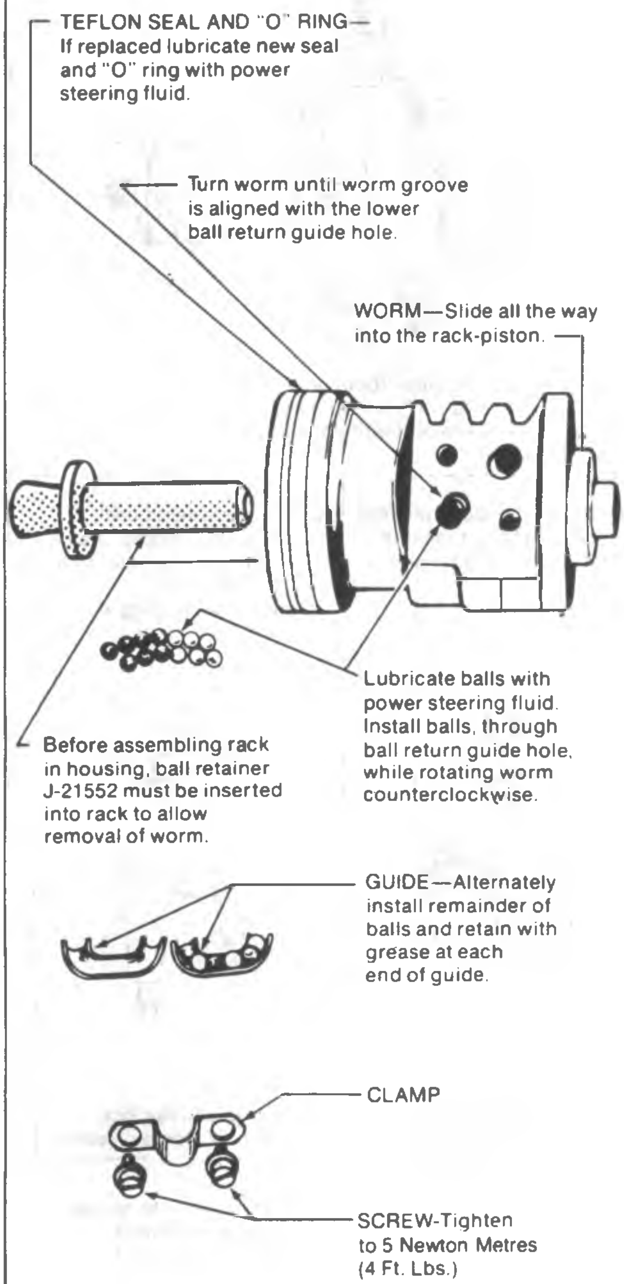
DISASSEMBLE

1. Disassemble parts as shown.
2. Clean and inspect all parts for excessive wear.

ASSEMBLE

1. Assemble parts as shown.

The black balls are smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide to maintain rack piston to worm gear preload.



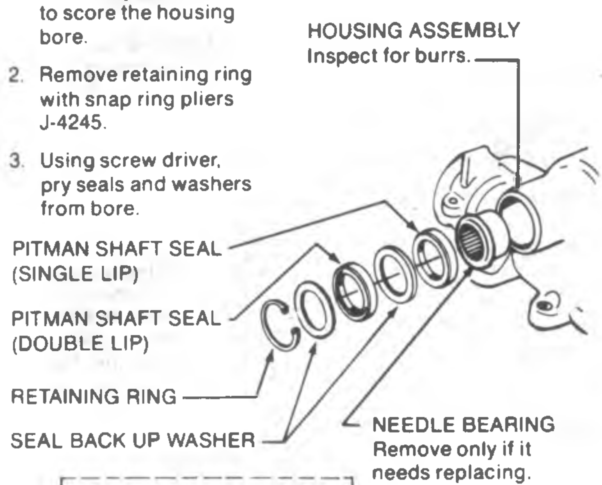
10. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

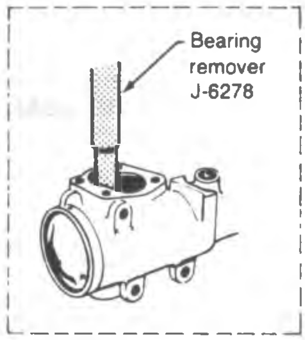
REMOVE

1. Clean end of housing thoroughly to prevent dirt from entering and be extremely careful not to score the housing bore.
2. Remove retaining ring with snap ring pliers J-4245.
3. Using screw driver, pry seals and washers from bore.

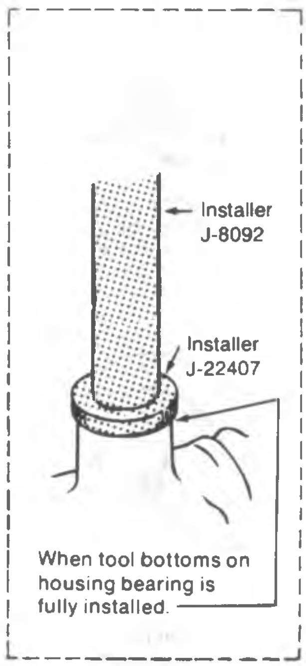
INSTALL

1. Coat seal lip and washer face with anhydrous calcium grease.
2. Install parts as shown.

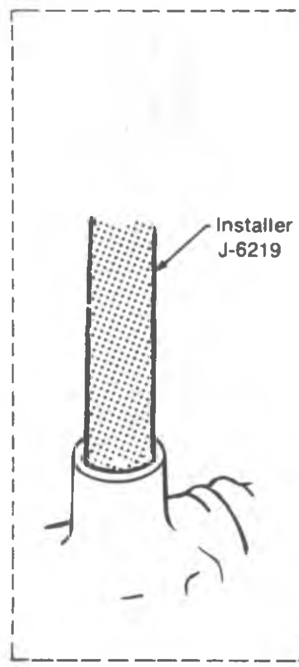




Removing bearing



Install Pitman shaft bearing.



Install Pitman shaft seals.

Fig. 3B7-23--Overhaul 800/808 Gear, Chart E

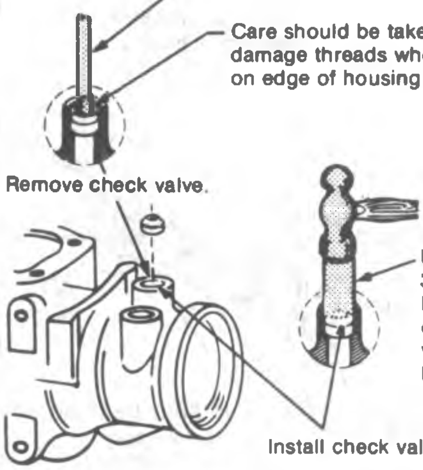
11. REMOVE AND INSTALL CHECK VALVE

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.



With small screwdriver, pry check valve from housing.

Care should be taken not to damage threads when prying on edge of housing.

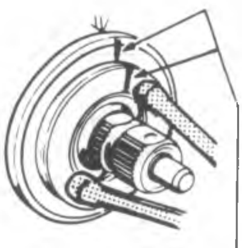
Remove check valve.

Using a piece of 3/8 tubing, 4 inches long, carefully drive the check valve into the housing.

Install check valve.

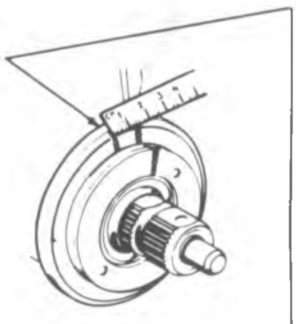
12. ADJUST THRUST BEARING PRELOAD

A. Using spanner wrench J-7624, tighten adjuster plug until thrust bearing is firmly bottomed, 27 Newton Metres (20 Ft. Lbs.)



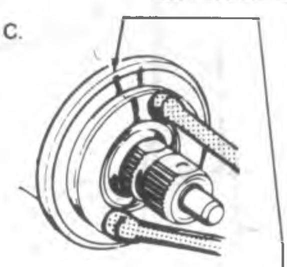
Mark housing and face of adjuster plug.

B.



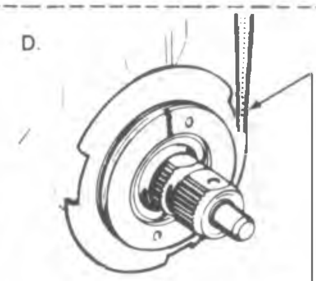
Measure back counterclockwise 13 mm (½") and place a second mark on housing.

C.



Turn adjuster counterclockwise until mark on face of adjuster lines up with second mark on housing.

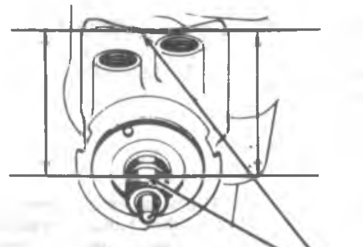
D.



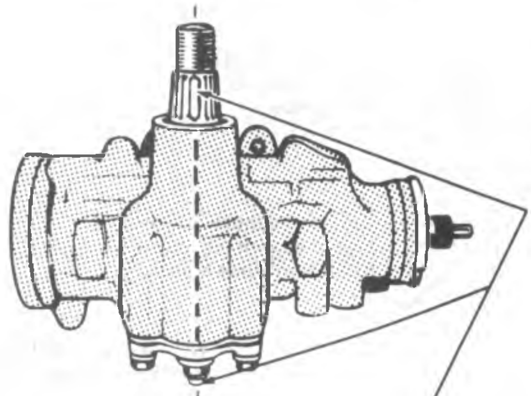
Using punch in notch tighten lock nut securely. Hold adjuster plug to maintain alignment of the marks.

13. PITMAN SHAFT "OVER-CENTER" SECTOR ADJUSTMENT

A.

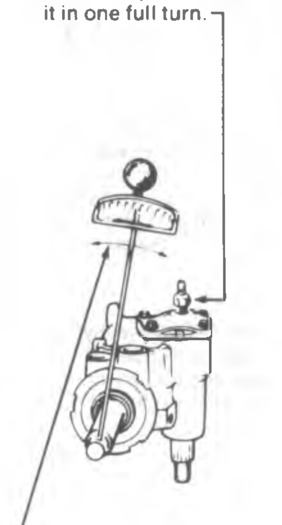


When gear is on center flat on stub shaft is normally on same side as, and parallel with, side cover.



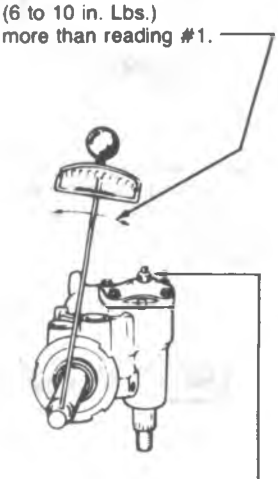
The block tooth on the Pitman shaft is in line with the over-center preload adjuster.

B. Back off preload adjuster until it stops, then turn it in one full turn.



With gear at center of travel, check torque to turn stub shaft (reading #1).

C. Turn adjuster in until torque to turn stub shaft is 0.6 to 1.2 Newton Metres (6 to 10 in. Lbs.) more than reading #1.



Torque adjuster lock nut to 27 Newton Metres (20 Ft. Lbs.)

Prevent adjuster screw from turning while torqueing lock nut.

Fig. 3B7-24--Overhaul 800/808 Gear, Chart F

GENERAL SPECIFICATIONS

LUBRICATION
Lubricant . . . . Power Steering Fluid No. 1050017 or equivalent

ADJUSTMENTS
Valve Assembly and Seal Drag . . . . 0.1 to 0.4 N•m (1 to 4 in. lbs.)
Thrust Bearing Pre-load . . . . 0.3 to 0.4 N•m (3 to 4 in. lbs.) in excess of valve assembly and seal drag.
Overcenter Adjustment . . . . 0.6 to 1.2 N•m (6 to 10 in. lbs.) (new gear) 0.4 to 0.5 N•m (or 4 to 5 in. lbs.) (used gear) in excess of combined thrust bearing pre-load.

Adjustment of the steering gear in the car is not recommended because of the difficulty encountered in adjusting the worm thrust bearing preload and the confusing effects of the hydraulic fluid in the gear. Since a gear adjustment is made only as a correction and not as a periodic adjustment, it is better to take the extra time and make the adjustment correctly the first time.

Since a handling stability complaint can be caused by improperly adjusted worm thrust bearings as well as an improper gear over-center adjustment, it is necessary that the steering gear assembly be removed from the car and both thrust bearing and over-center preload be checked and corrected as necessary. An in-car check of the steering gear will not show a thrust bearing adjustment error.

TORQUE SPECIFICATIONS

POWER STEERING PUMP	N•m	FT. LBS.
Reservoir Bolt	48	35
Flow Control Fitting	48	35
Pressure Hose	27	20

GENERAL SPECIFICATIONS

POWER STEERING

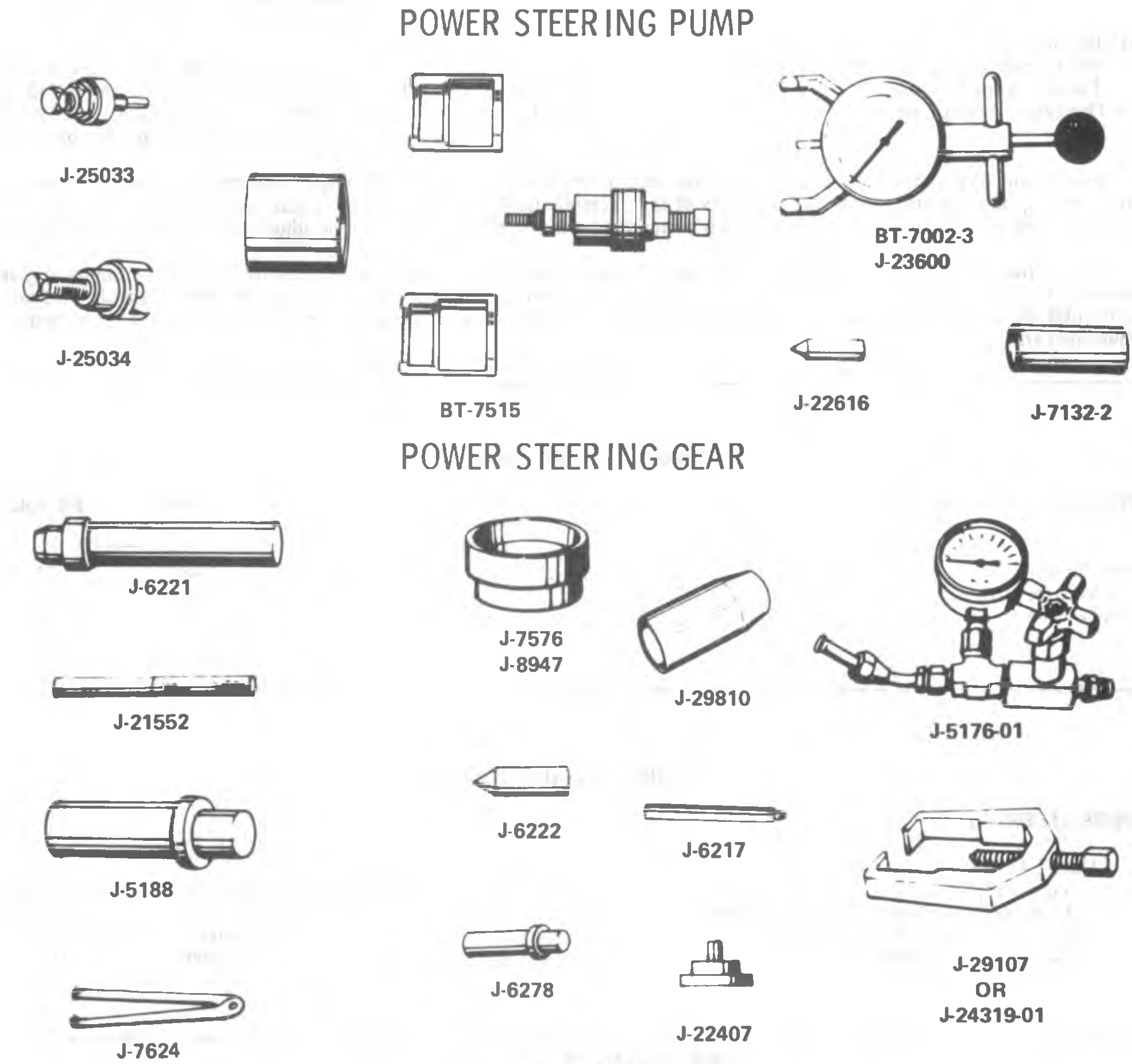
LUBRICATION

Lubricant	Power Steering Fluid No. 1050017 or equivalent	
Capacity (Exc. Diesel) - Complete System	1-1/4 Liters	1-1/4 Qts.
Capacity (Diesel) - Complete System	1-3/4 Liters	1-3/4 Qts.
Capacity - Pump Only	1/2 Liter	1/2 Qt.

STEERING GEAR
RECOMMENDED TORQUE SPECIFICATIONS

	NEWTON METERS	FOOT-POUNDS
Gear to Frame Bolts	110	80
High Pressure Line Fitting (At Gear)	27	20
Oil Return Line Fitting (At Gear)	27	20
Adjusting Screw Locknut	27	20
Side Cover Bolts	60	45
Adjuster Plug Locknut	110	80
Coupling Flange Nuts	27	20
Return Guide Clamp Screws	5	4
Rack-Piston Plug	100	75
Pitman Shaft Nut	240	185
Coupling Flange Bolt	40	30

Fig. 3B7-25--Overhual 800/808 Gear, Chart G



J-5176-01	Pressure Testing Manifold
J-5188	End Cover Seal and Needle Bearing Installer
J-6217	Hose Connector Installer
J-6221	Bearing Installer
J-6222	End Cover Seal Protector (Used for Installing Adjuster Plug)
J-6278	Pitman Shaft Bearing Remover and Installer
J-6278-2	Adapter (Used with J-6278 for Installing Pitman Shaft Seals and Bearing)
BT-7002-3	Belt Tension Gage
J-7132-2	Seal Installer
BT-7515	Pulley Remover and Installer
J-7576	Rack-Piston Teflon Ring Compressor
J-7624	Spanner Wrench
J-8947	Rack-Piston Teflon Ring Compressor
J-21552	Ball Retainer
J-24319-01	Puller
J-22407	Pitman Bearing Installer
J-22616	Seal Protector
J-23600	Belt Tension Gage
J-25033	Power Steering Pump Pulley Installer
J-25034	Power Steering Pump Pulley Remover
J-29107	Pitman Arm Puller
J-29810	Stub Shaft Seal Protector

Fig. 3B7-26--Special Tools

STEERING GEAR RATIOS

Vehicle	Manual		Power	
	Gear Ratio	Overall Ratio	Gear Ratio	Overall Ratio
G10-20	24:1	29.4:1 to 36.7:1	14:1	21.4:1 to 26.7:1
G30	24:1	29.4:1 to 36.4:1	14:1	21.4:1 to 26.5:1
P20-30	—	—	17.5:1	21.2:1 to 25.7:1
Motor Home	—	—	14:1	16.0:1 to 21.9:1
C10	24:1	29.1:1 to 37.0:1	16:1 to 13:1	16.9:1 to 20.2:1
C20-30	24:1	29.4:1 to 36.3:1	16:1 to 13:1	17.2:1 to 20.6:1
K10-20	—	—	16:1 to 13:1	13.2:1 to 17.2:1

MANUAL STEERING GEAR

Components	All C-G
Thrust Bearing Preload	5 to 8 lbs. in.
Adjuster Plug Lock Nut	85 lbs. ft.
Over Center Preload	4 to 10 lbs. in.*
Over Center Lock Nut	25 lbs. ft.
Total Steering Gear Preload	18 lbs. in. Max.

*In excess of thrust bearing preload.

POWER STEERING PUMP PRESSURES

Vehicle	Pressure	
C10-30		1200 - 1300 psi
G10-20-30	w/o Hydroboost	900 - 1000 psi
G30	with Hydroboost	1350 - 1450 psi
P10-30		1200 - 1300 psi
Motor Home & K		1350 - 1450 psi

Fig. 3B7--Specs

SECTION 3B8

MANUAL STEERING GEAR

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

CONTENTS

General Description 3B8-1
Maintenance and Adjustments 3B8-2
On-Vehicle Service 3B8-3
Manual Gear 3B8-3
Pitman Shaft Seal 3B8-4
Unit Repair 3B8-6

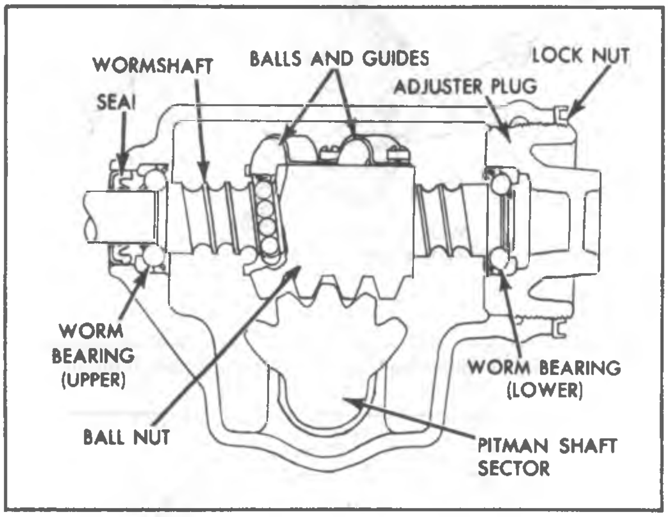


Fig. 3B8-1--Manual Steering Gear

GENERAL DESCRIPTION

The steering gear is of the recirculating ball type. This gear provides for ease of handling by transmitting forces from the wormshaft to the pitman shaft through the use of ball bearings.

MAINTENANCE AND ADJUSTMENTS

LUBRICATION OF MANUAL STEERING GEAR

The manual steering gear is factory-filled with steering gear lubricant. Seasonal change of this lubricant should not be performed and the housing should not be drained-**no lubrication is required for the life of the steering gear**.

According to the intervals listed in Section 0B, the manual gear should be inspected for seal leakage (**actual solid grease - not just oily film**). If a seal is replaced or the gear is overhauled, the gear housing should be refilled with **1051052 (13 oz. container) Steering Gear Lubricant which meets GM Specification GM 4673M, or its equivalent.**

NOTICE: Do not use EP Chassis Lube, which meets GM Specification GM 6031M, to lubricate the gear **DO NOT OVER-FILL** the gear housing, or damage may occur to the gear.

ADJUSTMENT OF MANUAL STEERING GEAR

NOTICE: See Notice on page one of this section regarding the fasteners referred to in steps 9d and 10.

Before any adjustments are made to the steering gear attempt to correct complaints of loose or hard steering, or other wheel disturbances, a careful check should be made of front end alignment, shock absorbers, wheel balance and tire pressure for possible steering system problems. See Diagnosis earlier in this section.

Correct adjustment of steering gear is very important. While there are but two adjustments to be made, the following procedure must be followed step-by-step in the order given.

1. Disconnect the battery ground cable.
2. Raise the vehicle.
3. Remove the pitman arm nut. Mark the relationship of the pitman arm to the pitman shaft. Remove the pitman arm with Tool J-6632 or J-5504 as shown in Figure 3B8-4.
4. Loosen the steering gear adjuster plug locknut and back the adjuster plug off 1/4 turn (Fig. 3B8-5).
5. Remove the horn shroud or button cap.

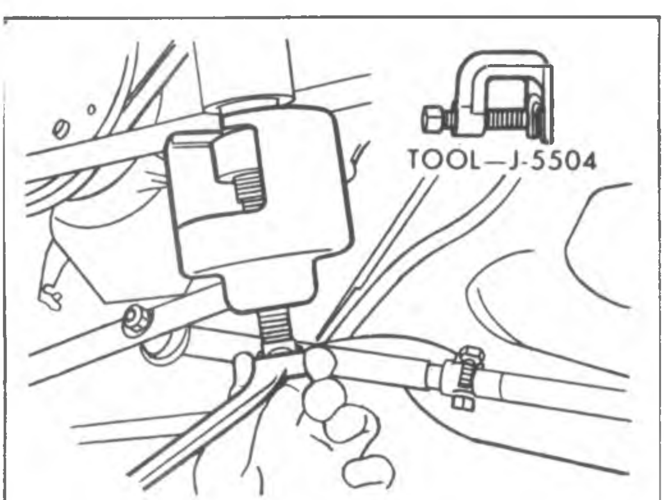


Fig. 3B8-4--Removing Pitman Arm

6. Turn the steering wheel gently in one direction until stopped by the gear; then turn back one-half turn.

   NOTICE: Do not turn the steering wheel hard against the stops when the steering linkage is disconnected from the gear as damage to the ball guides could result.

7. Measure and record "bearing drag" by applying a torque wrench with a socket on the steering wheel nut and rotating through a 90° arc (Fig. 3B8-6). Do not use a torque wrench having a maximum torque reading of more than 50 inch pounds.
8. Adjust "thrust bearing preload" by tightening the adjuster plug until the proper "thrust loading preload" is obtained (See specifications section). When the proper preload has been obtained, tighten the adjuster plug locknut to specifications and recheck torque. If the gear feels "lumpy" after adjustment, there is probably damage in the bearings due to severe impact or

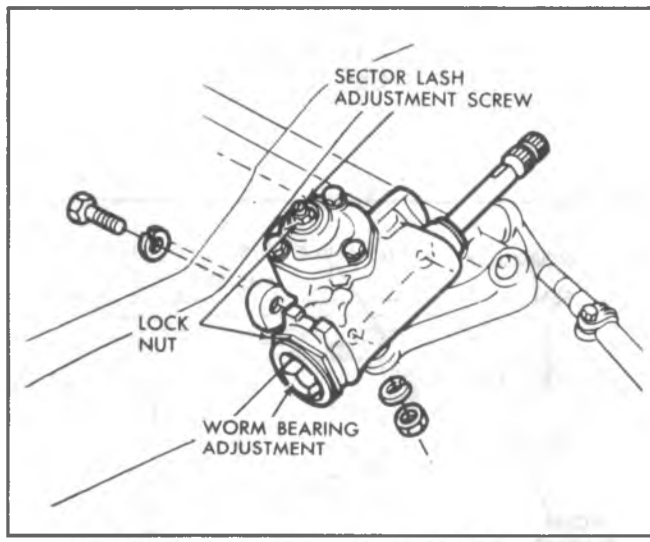


Fig. 3B8-5--Steering Gear Adjustment Points-Typical

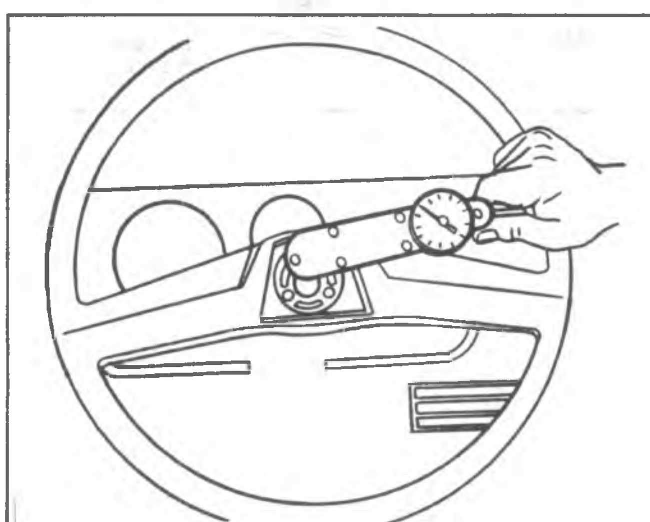


Fig. 3B8-6--Checking Torque at Steering Wheel improper adjustment; the gear must be disassembled and inspected for replacement of damaged parts.

9. Adjust "over-center preload" as follows:
   a. Turn the steering wheel gently from one stop all the way to the other carefully counting the total number of turns. Turn the wheel back exactly half-way, to center position.
   b. Turn the lash adjuster screw clockwise to take out all lash between the ball nut and pitman shaft sector teeth and then tighten the locknut.
   c. Check the torque at the steering wheel, taking the highest reading as the wheel is turned through center position. See Specifications for proper over-center preload.
   d. If necessary, loosen locknut and readjust lash adjuster screw to obtain proper torque. Tighten the locknut to specifications and again check torque reading through center of travel. If maximum specification is exceeded, turn lash adjuster screw counterclockwise, then come up on adjustment by turning the adjuster in a clockwise motion.
10. Reassemble the pitman arm to the pitman shaft, lining up the marks made during disassembly. Torque the pitman shaft nut to specifications.
    If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip the arm onto the pitman shaft. Do not spread the clamp more than required to slip over pitman shaft with hand pressure. Do not hammer the pitman arm onto the pitman shaft. Be sure to install the hardened steel washer before installing the nut.
11. Install the horn button cap or shroud and connect the battery ground cable.
12. Lower the vehicle to the floor.

STEERING GEAR HIGH POINT CENTERING

1. Set front wheels in straight ahead position. This can be checked by driving vehicle a short distance on a flat surface to determine steering wheel position at which vehicle follows a straight path.
2. With front wheels set straight ahead, check position of mark on wormshaft designating steering gear high point. This mark should be at the top side of the shaft at 12 o'clock position and lined up with the mark in the coupling lower clamp.
3. On C, G and P series, if the gear has been moved off high point when setting wheel in straight ahead position, loosen adjusting sleeve clamps on both left and right hand tie rods. Then turn both sleeves an equal number of turns in the same direction to bring gear back on high point.
   Turning the sleeves an unequal number of turns or in different directions will disturb the toe-in setting of the wheels.
4. On K series, if the gear has been moved off high point when setting wheels in straight ahead position, loosen adjusting sleeve clamps on the connecting rod. Then turn sleeve to bring gear back on high point.
5. Readjust toe-in as outlined in Section 3A (if necessary).
6. Be sure to properly orient sleeves and clamps when fastening and torqueing clamps to proper specifications.

ON-VEHICLE SERVICE

STEERING GEAR

Removal

1. Set the front wheels in straight ahead position by driving vehicle a short distance on a flat surface.
2. Remove the flexible coupling to steering shaft flange bolts (C-K models) or the lower universal joint pinch bolt (P models). Mark the relationship of the universal yoke to the wormshaft.
3. Mark the relationship of the pitman arm to the pitman shaft. Remove the pitman shaft nut or pitman arm pinch bolt and then remove the pitman arm from the pitman shaft using Puller J-6632 (Fig. 3B8-9).

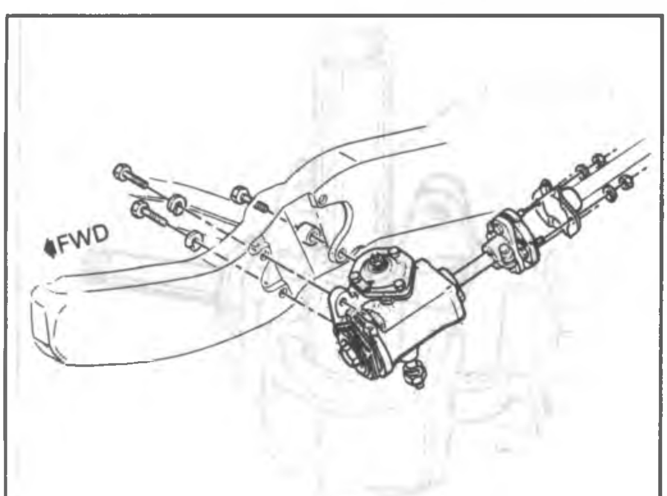


Fig. 3B8-7--Steering Gear Attachment, C-K Models

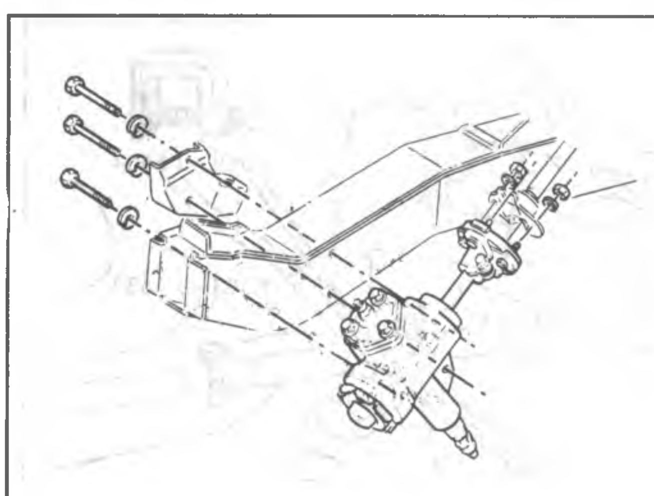


Fig. 3B8-8--Steering Gear Attachment, G-P Models

4. Remove the steering gear to frame bolts and remove the gear assembly.
5. **C-K Models** - Remove the flexible coupling pinch bolt and remove the coupling from the steering gear wormshaft.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1a, 1c, 1d, 1e, 2b, 2c and 3.

1. **C-K Models**
   a. Install the flexible coupling onto the steering gear wormshaft, aligning the flat in the coupling with the flat on the shaft. Push the coupling onto the shaft until the wormshaft bottoms on the coupling reinforcement. Install the pinch bolt and torque to specifications. The coupling bolt must pass through the shaft undercut.
   b. Place the steering gear in position, guiding the coupling bolt into the steering shaft flange.
   c. Install the steering gear to frame bolts and torque to specifications.
   d. If flexible coupling alignment pin plastic spacers were used, make sure they are bottomed on the pins, torque the flange bolt nuts to specifications and then remove the plastic spacers.
   e. If flexible coupling alignment pin plastic spacers were not used, center the pins in the slots in the steering shaft flange and then install and torque the flange bolt nuts to specifications.
2. **P Models**
   a. Place the steering gear in position, guiding the wormshaft into the universal joint assembly and lining up the marks made at removal. If a new gear was installed, line up the mark on the wormshaft with the slit in the universal joint yoke.
   b. Install the steering gear to frame bolts and torque to specifications.
   c. Install the universal joint pinch bolt and torque to specification. The pinch bolt must pass through the shaft undercut.
3. Install the pitman arm onto the pitman shaft, lining up the marks made at removal. Install the pitman shaft nut or pitman arm pinch bolt and torque to specifications.
   If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip the arm onto the pitman shaft. Do not spread the clamp more than required to slip over pitman arm onto the pitman shaft. Be sure to install the hardened steel washer before installing the nut.

PITMAN SHAFT SEAL REPLACEMENT

A faulty seal may be replaced without removal of steering gear from C, G and P trucks by removing pitman arm as outlined under Maintenance and Adjustments - Steering Gear Adjustments and proceed as follows:

On K series vehicles remove the gear from the vehicle first.

1. Rotate the steering wheel from stop to stop, counting the total number of turns. Then turn back exactly halfway, placing the gear on center (the wormshaft flat should be at the 12 o'clock position).
2. Remove the three self-locking bolts attaching side cover to the housing and lift the pitman shaft and side cover assembly from the housing.
3. Pry the pitman shaft seal from the gear housing using a screwdriver and being careful not to damage the housing bore. See Fig. 3B8-10.

   NOTICE: Inspect the lubricant in the gear for contamination If the lubricant is contaminated in any way, the gear must be removed from the vehicle and completely overhauled as outlined in the Unit Repair Manual, or damage to the gear could result.
4. Coat the new pitman shaft seal with Steering Gear Lubricant meeting GM Specification GM4673M (or equivalent). Position the seal in the pitman shaft bore and tap into position using a suitable size socket.
5. Remove the lash adjuster lock nut. Remove the side cover from the pitman shaft assembly by turning the lash adjuster screw clockwise.

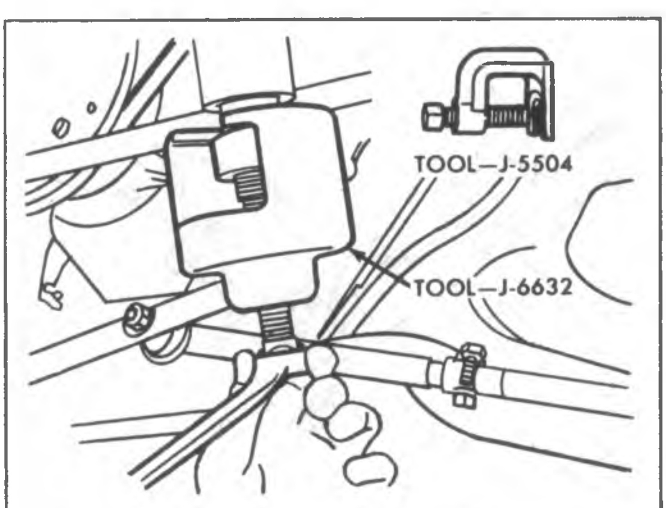


Fig. 3B8-9--Removing Pitman Arm-Typical

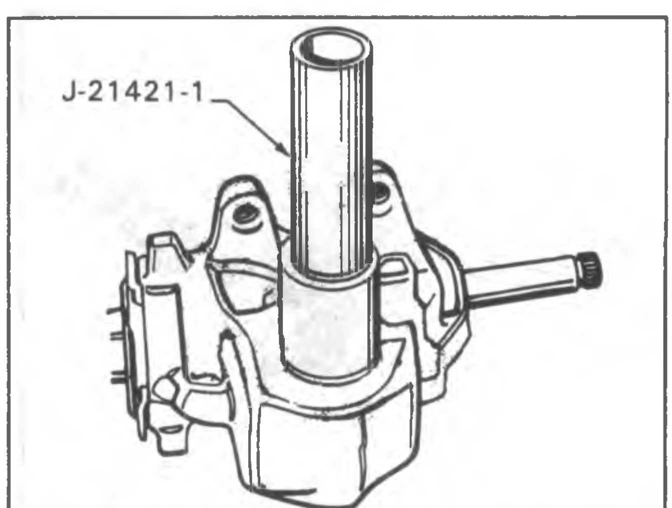


Fig. 3B8-10--Pitman Shaft Seal Replacement

6. Place the pitman shaft in the steering gear such that the center tooth of the pitman shaft sector enters the center tooth space of the ball nut.
7. Fill the steering gear housing with Steering Gear Lubricant meeting GM Specification GM4673M (or equivalent).
8. Install a new side cover gasket onto the gear housing.
9. Install the side cover onto the lash adjuster screw by reaching through the threaded hole in the side cover with a small screwdriver and turning the lash adjuster screw counter- clockwise until it bottoms and turns back in 1/4 turn.
10. Install the side cover bolts and torque to specifications.
11. Install the lash adjuster screw locknut, perform steerin gear adjustment and install the pitman arm as outllined under "Maintenance and Adjustments".

On K series install the gear into the vehicle using previously outlined procedure.

SPECIFICATIONS AND SPECIAL TOOLS

Refer to Specifications and Special Tools at end of Section 3B4.

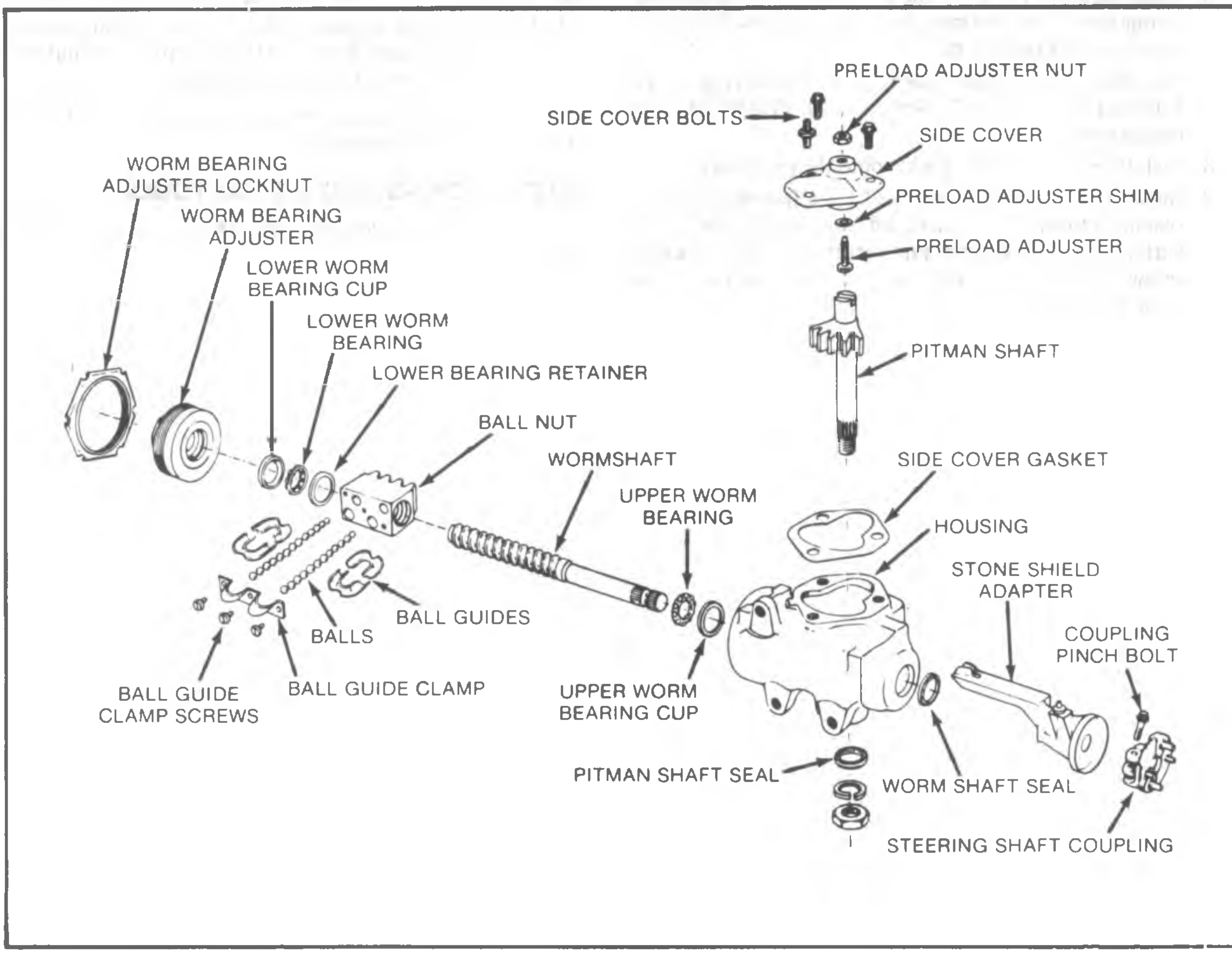


Fig. 3B8-11--Manual Steering Gear, Exploded View

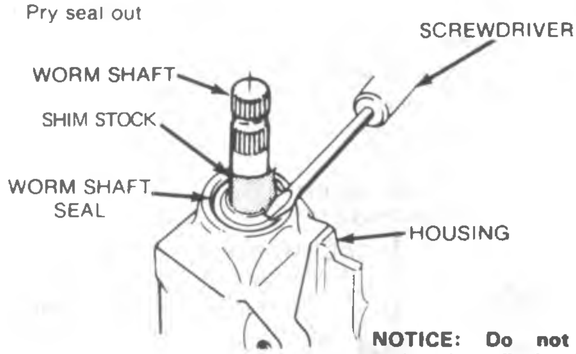
1. REMOVE AND INSTALL WORM SHAFT SEAL-GEAR ASSEMBLED

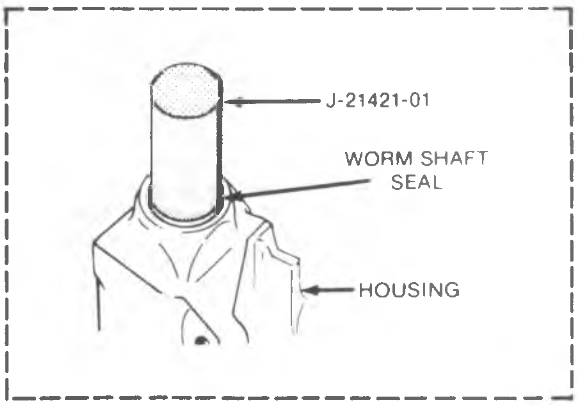
REMOVE

1. Wrap 0.1 mm to 0.2 mm (.005" to .008") shim stock around shaft and insert between shaft and seal. Pry seal out

INSTALL

1. Install parts as shown.





Install seal

NOTICE: Do not turn steering wheel hard against "stops" when linkage is disconnected, as damaged to the ends of ball guides may occur.

2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

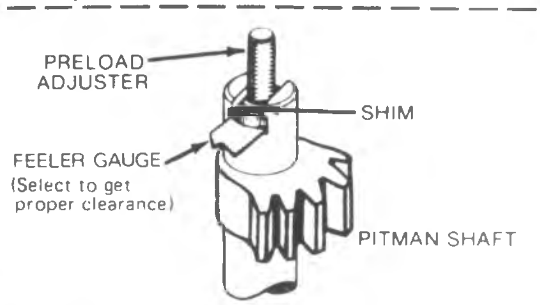
1. Center steering gear.
2. Remove parts as shown.

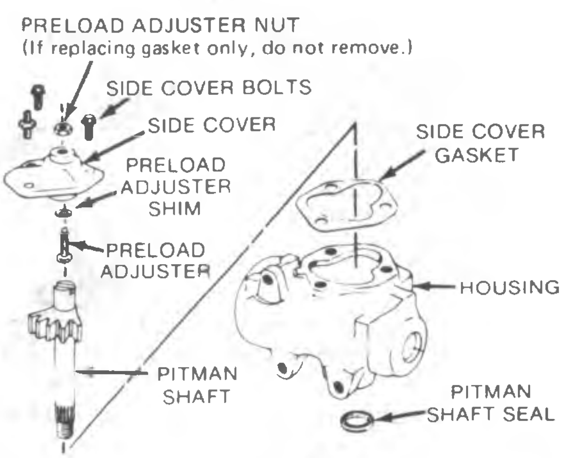
INSTALL

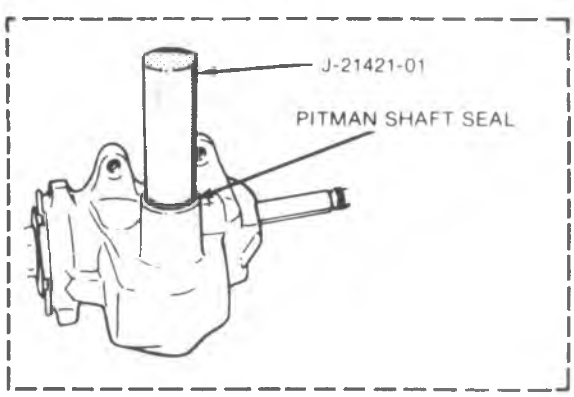
1. Before installing turn preload adjuster screw counter-clockwise until it bottoms, then back screw off one half turn.
2. Install parts as shown.

Checking end clearance

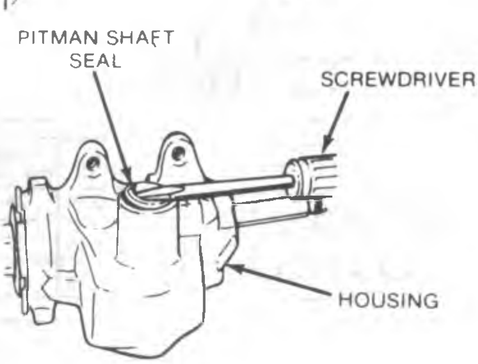
If clearance is greater than .05 mm (.002") a steering gear lash adjuster kit is available







Install seal



LUBRICATION

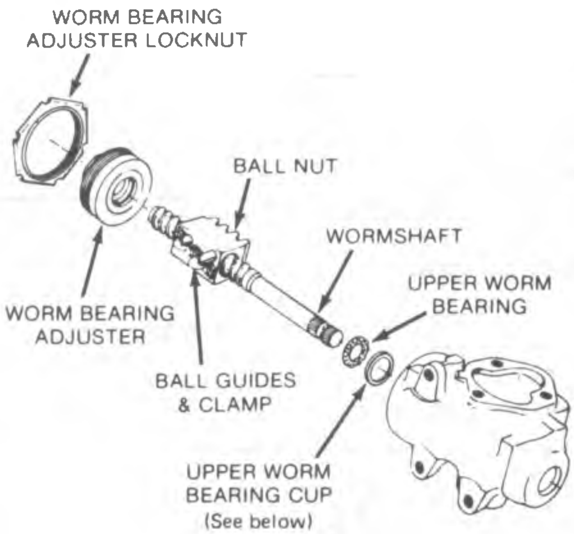
The steering gear requires .3118 kg (11 oz.) of lubricant GM4673M or equivalent

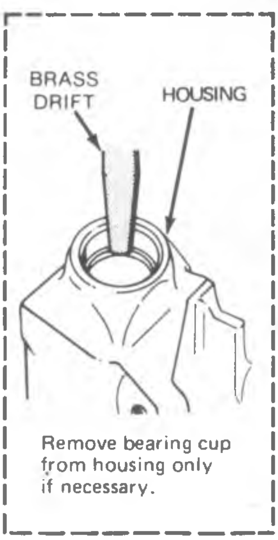
Fig. 3B8-12--Manual Gear Overhaul, Chart A

3. REMOVE AND INSTALL WORMSHAFT AND BALL NUT

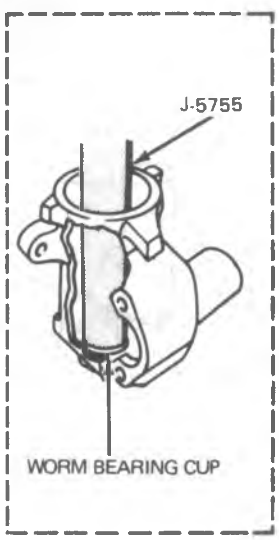
REMOVE	INSTALL
1. Loosen lock nut. Use punch against edge of slot.	1. Install parts as shown.
2. Remove parts as shown.	

NOTICE: Use care that the ball nut does not run down to either end of the worm. Damage may be done to the ends of the ball guides if the ball nut is allowed to rotate until stopped at the end of the worm.





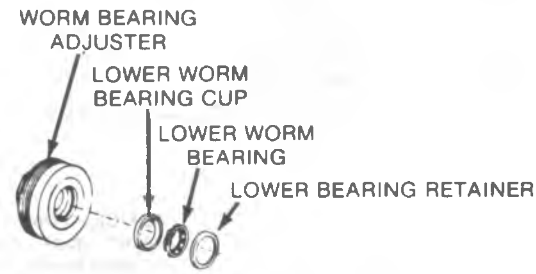
Remove Cup



Install Cup

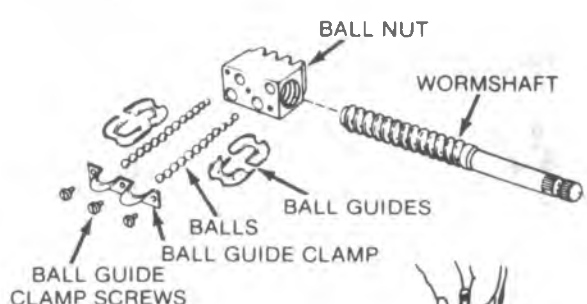
4. DISASSEMBLE AND ASSEMBLE WORM BEARING ADJUSTER

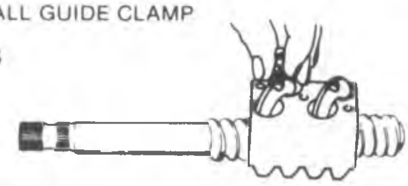
DISASSEMBLE	ASSEMBLE
1. Pry lower bearing retainer out with screwdriver	1. Press cup into adjuster using J-5755.
2. Remove cup using J-5822 puller and slide hammer.	2. Install parts as shown.



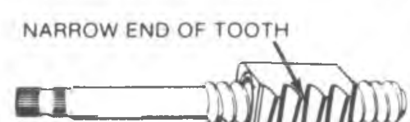
5. DISASSEMBLE AND ASSEMBLE WORMSHAFT AND BALL NUT

DISASSEMBLE	ASSEMBLE
1. Disassemble parts as shown	1. Assemble parts as shown
2. Clean and inspect all parts for excessive wear	2. Refer to Fig. A for number of balls used



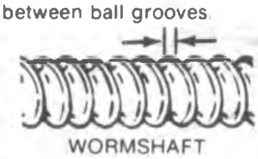


Installing Balls



Assemble wormshaft

Dimension A-Measure land between ball grooves



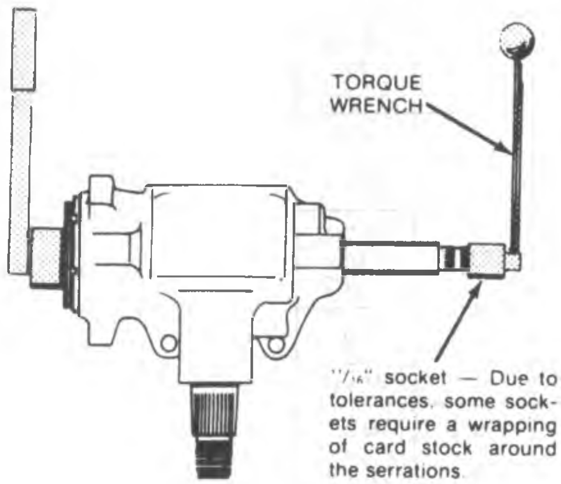
Dim A mm	Dim A in	Balls per circuit
1.0	0.04	25
2.5	0.10	27
5.0	0.20	27

Fig. A

Fig. 3B8-13--Manual Gear Overhaul, Chart B

6. ADJUST WORM BEARING PRELOAD

1. Tighten worm bearing adjuster until it bottoms then loosen one-quarter turn.
2. Carefully turn the wormshaft all the way to end of travel then turn back one-half turn.
3. Tighten adjuster plug until torque wrench reads 0.6 to 1.0 N.m (5 to 8 in. lbs.)
4. Tighten locknut using punch against edge of slot.



7. ADJUST "OVER CENTER" PRELOAD

A. Back off preload adjuster until it stops, then turn it in one full turn.

With gear at center of travel, check torque to turn stub shaft (reading #1)

B. Turn adjuster in until torque to turn stub shaft is 0.5 to 1.2 N.m (4 to 10 in. lbs.) more than reading #1.

Torque adjuster lock nut to 34 N.m (25 ft. lbs.) Prevent adjuster screw from turning while torqueing lock nut.

ADJUSTMENT SPECIFICATIONS – MANUAL STEERING

ADJUSTMENT		TORQUE TO TURN WORM SHAFT
Worm Bearing	0.6-1.0 N·m	5-8 In. Lbs.
Over Center Preload	0.5-1.2 N·m	4-10 In. Lbs. in excess of Worm Bearing Preload.
Total Steering Gear Preload	1.8 N·m	16 In. Lbs. Maximum

RECOMMENDED TORQUE SPECIFICATIONS

MANUAL STEERING GEAR	N·m	FT. LB.
Gear to Frame Bolts	95	70
Pitman Shaft Nut	251	185
Side Cover Bolts	40	30
Pitman Shaft Adjusting Screw Locknut	34	25
Coupling Flange To Gear Pinch Bolt	40	30
Coupling Clamp Nut (Starfire)	70	50
Clamp To Ball Nut Screw	5.5	4

TOOLS

J-21421-01

J-5755

J-5822

J-21421-01 Seal Installer
J-5755 Worm Bearing Cup Installer
J-5822 Worm Bearing Adjuster Cup Puller

Fig. 3B8-14--Manual Gear Overhaul, Chart C

STEERING GEAR RATIOS

Vehicle	Manual		Power	
	Gear Ratio	Overall Ratio	Gear Ratio	Overall Ratio
G10-20	24:1	29.4:1 to 36.7:1	14:1	21.4:1 to 26.7:1
G30	24:1	29.4:1 to 36.4:1	14:1	21.4:1 to 26.5:1
P20-30	—	—	17.5:1	21.2:1 to 25.7:1
Motor Home	—	—	14:1	16.0:1 to 21.9:1
C10	24:1	29.1:1 to 37.0:1	16:1 to 13:1	16.9:1 to 20.2:1
C20-30	24:1	29.4:1 to 36.3:1	16:1 to 13:1	17.2:1 to 20.6:1
K10-20	—	—	16:1 to 13:1	13.2:1 to 17.2:1

MANUAL STEERING GEAR

Components	All C-G
Thrust Bearing Preload	5 to 8 lbs. in.
Adjuster Plug Lock Nut	85 lbs. ft.
Over Center Preload	4 to 10 lbs. in.*
Over Center Lock Nut	25 lbs. ft.
Total Steering Gear Preload	18 lbs. in. Max.

*In excess of thrust bearing preload.

POWER STEERING PUMP PRESSURES

Vehicle	Pressure	
C10-30		1200 - 1300 psi
G10-20-30	w/o Hydroboost	900 - 1000 psi
G30	with Hydroboost	1350 - 1450 psi
P10-30		1200 - 1300 psi
Motor Home & K		1350 - 1450 psi

Fig. 3B8--Specs

SECTION 3C

FRONT SUSPENSION

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this section".

NOTICE This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

CONTENTS OF THIS SECTION

Front Suspension (C-G-P-Series) 3C-1
Front Suspension (K-Series) 3C-18

FRONT SUSPENSION, TWO-WHEEL DRIVE

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GENERAL DESCRIPTION

C-G-P Series

The C-G-P Series trucks incorporate an independent coil spring front suspension system, as shown in Figures 3C-1, 3 and 5. The control arms are of unequal length, S.L.A. (Short and Long Arm) Type.

This suspension system consists of upper and lower control arms pivoting on threaded steel or rubber bushings on upper and lower control arm shafts. The lower control arms are attached to the crossmember. The upper control arms are attached to a frame bracket. These control arms are connected to the steering knuckle through pivoting ball joints.

A coil spring is located between the lower control arm and a formed seat in the suspension crossmember, thus the lower control arm is the load carrying member. Double acting shock absorbers are also attached to the lower control arms and connect with the frame to the rear on the upper end. The front wheel bearings are tapered roller type.

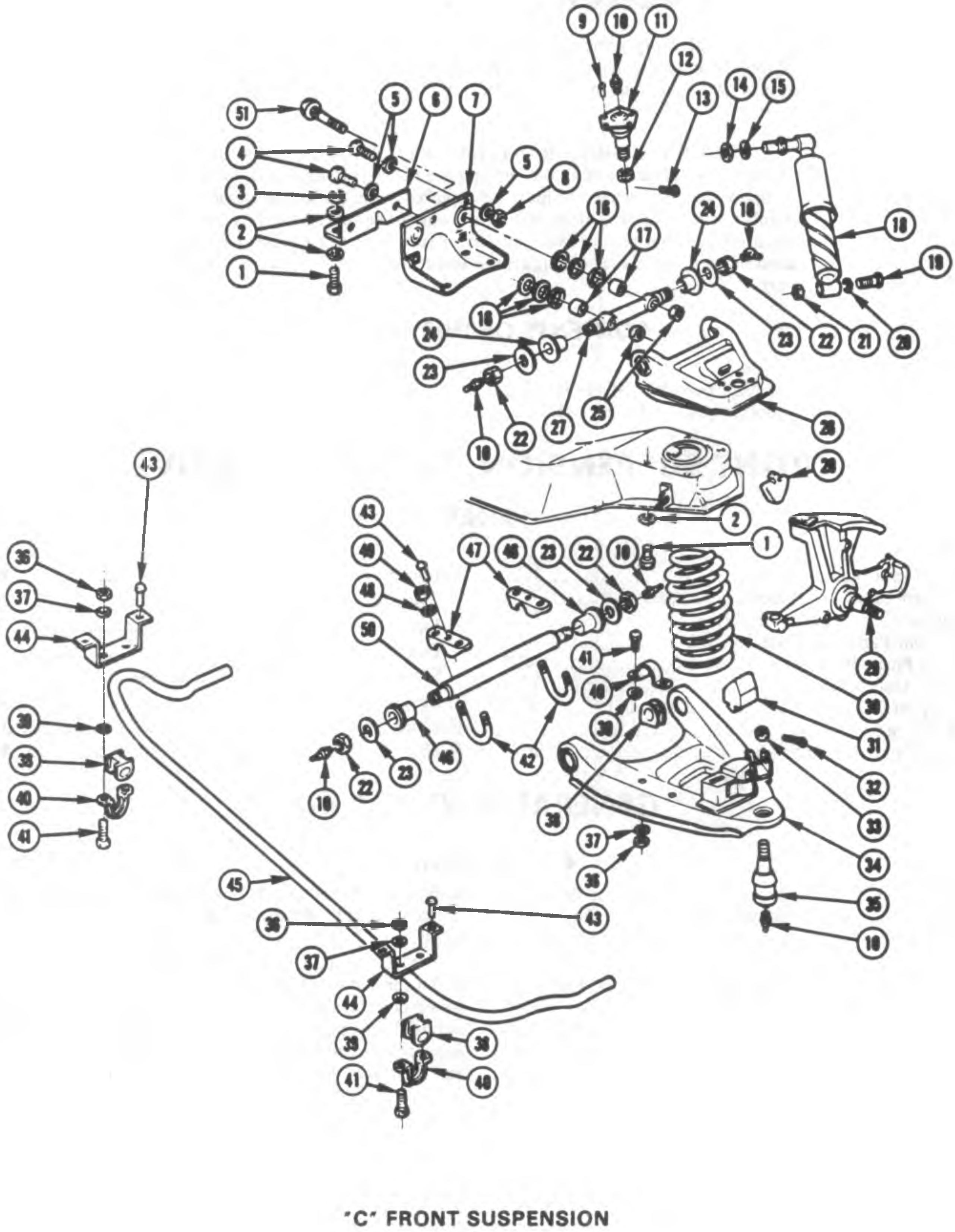


Fig. 3C-1--Front Suspension C-Series

"C" FRONT SUSPENSION

1. **BOLT**, Frame to Front C/Member Unit (1/2"-13 x 1 3/4")
2. **WASHER** (17/32" ID 1" OD 1/16" Thk)
3. **NUT** (1/2"-13)
4. **BOLT** (7/16"-14 x 1 1/2")
5. **WASHER** (7/16" ID 7/8" OD 1/8" Thk)
6. **BRACKET**, Front C/Member Reinf
7. **BRACKET ASM**, Strg Knu Upr Cont Arm
8. **NUT** (7/16"-14)
9. **RIVET** (5/16" X 7/8")
10. **FITTING**
11. **STUD KIT**, Strg Knu Upr Cont Arm
12. **NUT**, Strg Knu Upr Cont Arm Ball Stud
13. **PIN**, Cotter (1/8" x 1")
14. **NUT** (5/8"-18)
15. **WASHER** (5/8")
16. **SHIM**, Strg Knu Upr Cont Arm
17. **SPACER**, Strg Knu Upr Cont Arm (1 1/4" x 1 1/2")
18. **ABSORBER ASM**, Front Shock
19. **BOLT** (1/2"-13 x 2 1/2")
20. **WASHER** (1/2")
21. **NUT** (1/2"-13)
22. **NUT** (3/4"-16)
23. **RETAINER**, Strg Knu Upr Cont Arm Bushing
24. **BUSHING**, Strg Knu Upr Cont Arm
25. **NUT** (1/2"-20)
26. **ARM**, Strg Knu Upr Cont
27. **SHAFT UNIT**, Strg Knu Upr Cont Arm
28. **BUMPER**, Strg Knu Upr Cont Arm
29. **KNUCKLE ASM**, Strg
30. **SPRING ASM**, Front (Coil)
31. **BUMPER**, Strg Knu Lwr Cont Arm
32. **PIN**, Cotter (1/8" x 1 1/2")
33. **NUT**, Strg Knu Lwr Cont Arm
34. **ARM**, Strg Knu Lwr Cont
35. **STUD ASM**, Strg Knu Lwr Cont Arm
36. **NUT** (3/8"-16)
37. **WASHER** (3/8")
38. **BUSHING**, Stabilizer Shaft
39. **WASHER** (13/32" ID x 13/16" OD x 1/16" Thk)
40. **BRACKET**, Front Stabilizer Shaft
41. **BOLT** (3/8"-16 x 1 3/8") W/Frt Stab Bar
    BOLT (3/8"-16 x 1 1/2") W/H.D. Frt Stab Bar
42. **BOLT**, Strg Knu Lwr Cont Arm "U"
43. **RIVET** (3/8" x 1")
44. **BRACKET**, Front Stabilizer Shaft Frame
45. **SHAFT**, Front Stabilizer
46. **BUSHING**, Strg Knu Lwr Cont Arm Shaft
47. **BRACKET**, Strg Knu Lwr Cont Arm (Crossmember)
48. **WASHER** (9/16")
49. **NUT** (9/16"-12)
50. **SHAFT UNIT**, Strg Knu Lwr Cont Arm
51. **BOLT**, Strg Knu Upr Cont Arm Brkt

Fig.3C-2--Front Suspension C Series

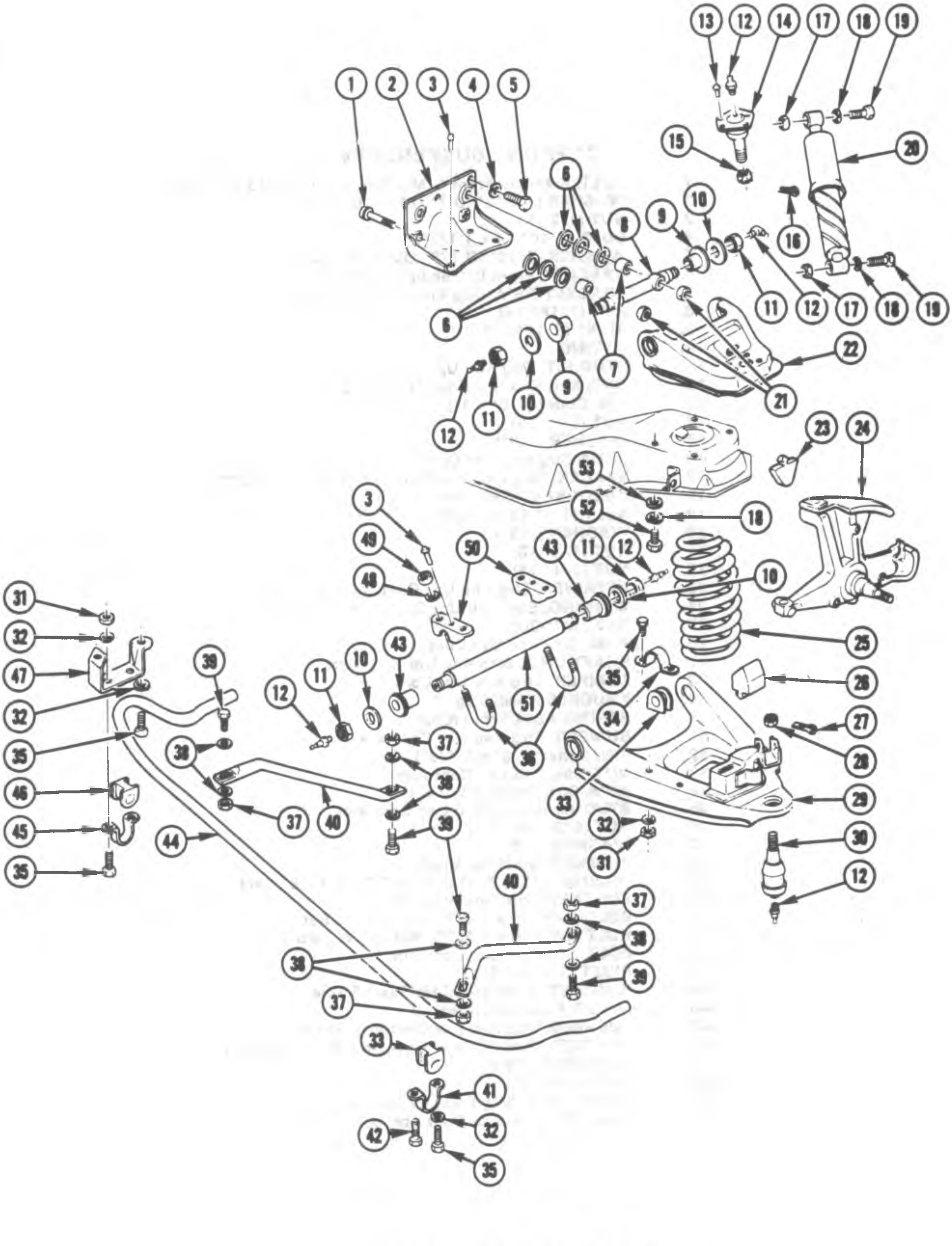
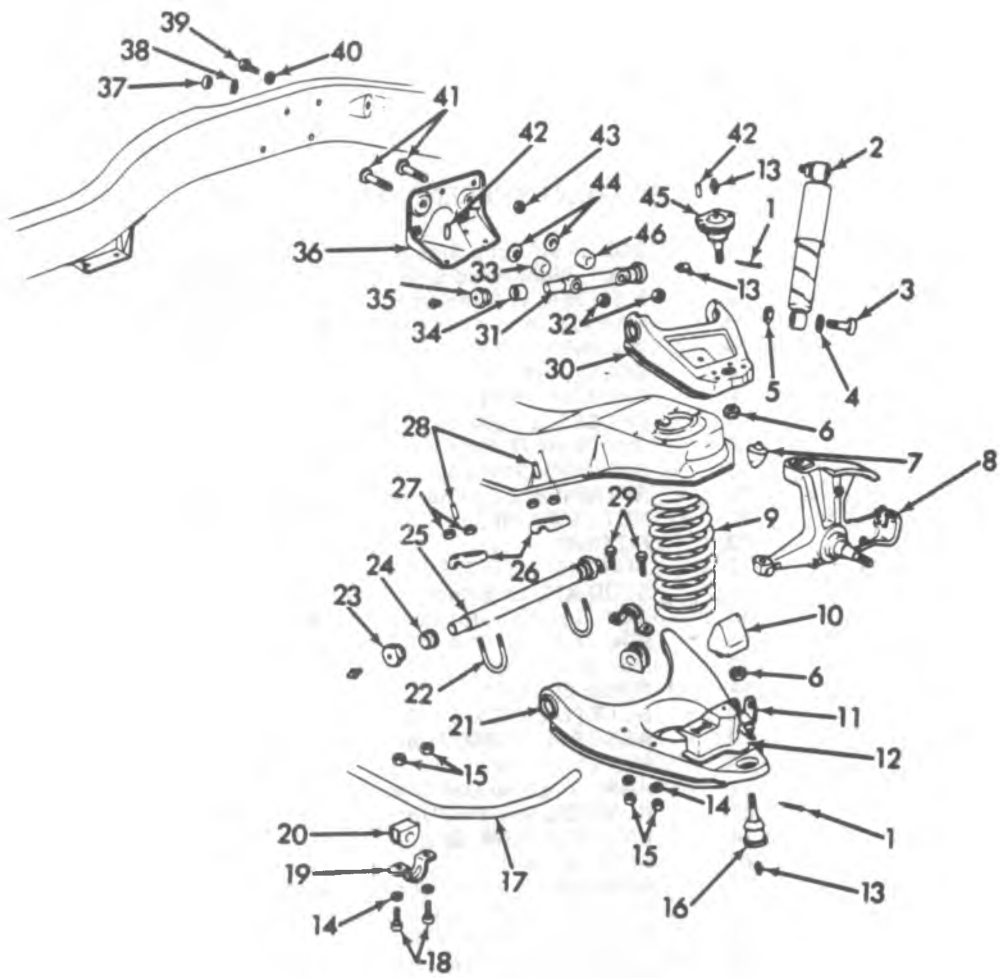


Fig. 3C-3--Front Suspension G-Series

"G" FRONT SUSPENSION

1. **BOLT**, Left Hand Side (7/16"-14 x 3 1/2")
   BOLT, Right Hand Side (7/16"-14 x 3 1/4")
2. **MEMBER**, W/Bracket Frt Susp Strg Knu Cont
3. **RIVET**, Button Head Chisel Point Solid (3/8" x 1")
4. **WASHER** (7/16")
5. **BOLT** (7/16"-14 x 1 3/4")
6. **SHIM**, Strg Knu Upr Cont Arm
7. **SPACER**, Strg Knu Upr Cont Arm (1 1/4" x 1 1/2")
8. **SHAFT UNIT**, Strg Knu Upr Cont Arm
9. **BUSHING**, Strg Knu Upr Cont Arm
10. **RETAINER**, Strg Knu Upr Cont Arm Bushing
11. **NUT** (3/4"-16)
12. **FITTING**
13. **RIVET** (5/16" x 7/8")
14. **STUD KIT**, Strg Knu Upr Cont Arm
15. **NUT**, Strg Knu Upr Cont Arm Ball Stud
16. **PIN**, Cotter (1/8" x 1")
17. **NUT** (1/2"-13)
18. **WASHER** (1/2")
19. **BOLT** (1/2"-13 x 2 1/2")
20. **ABSORBER ASM**, Front Shock
21. **NUT** (1/2"-20)
22. **ARM**, Strg Knu Upr Cont
23. **BUMPER**, Strg Knu Upr Cont Arm
24. **KNUCKLE ASM**, Strg
25. **SPRING ASM**, Coil
26. **BUMPER**, Strg Knu Lwr Cont Arm
27. **PIN**, Cotter (1/8" x 1 1/2")
28. **NUT**, Strg Knu Lwr Cont Arm
29. **ARM**, Strg Knu Lwr Cont
30. **STUD ASM**, Strg Knu Lwr Cont Arm
31. **NUT** (3/8"-16)
32. **WASHER** (3/8")
33. **BUSHING**, Stabilizer Shaft Front Bracket
34. **CLAMP**, Front Stab Shaft to Lwr Cont Arm
35. **BOLT** (3/8"-16 x 7/8")
    WASHER, Lk (3/8")
36. **BOLT**, Strg Knu Lwr Cont Arm "U"
37. **NUT** (1/2"-13)
38. **WASHER** (17/32")
39. **BOLT** (1/2"-13 x 1 3/4")
40. **STRUT**, Front Suspension
41. **CLAMP**, Front Stab Shaft to Frame Lower
42. **BOLT** (3/8"-16 x 7/8")
    WASHER, Lk (3/8")
43. **BUSHING**, Strg Knu Lwr Cont Arm Shaft
44. **SHAFT**, Front Stabilizer
45. **CLAMP**, Front Stab Shaft to Frame Lower
46. **BUSHING**, Front Bar to Frame
47. **BRACKET**, Frame Upper
48. **WASHER** (9/16")
49. **NUT** (9/16"-12)
50. **BRACKET**, Strg Knu Lwr Cont Arm (Crossmember)
51. **SHAFT UNIT**, Strg Knu Lwr Cont Arm
52. **BOLT** (1/2"-13 x 1 5/8")
53. **WASHER** (17/32" ID x 1" OD x 1/16" Thk)

Fig. 3C-4--Front Suspension G-Series



"P" FRONT SUSPENSION

1. **PIN** (1/8" x 1")
2. **SHOCK**
3. **BOLT** (1/2"-13 x 2 1/2")
4. **WASHER** (1/2")
5. **NUT** (1/2"-13)
6. **NUT**, Strg Knuckle
7. **BUMPER**, Strg Knuckle
8. **KNUCKLE ASM**, Strg
9. **SPRING**, Frt (Coil Type)
10. **BUMPER**
11. **BRACKET**, Part of item 21
12. **BRACKET**, Part of item 21
13. **FITTING**
14. **WASHER** (3/8")
15. **NUT** (3/8"-16)
16. **STUD**, Strg Knuckle
17. **SHAFT**, Stabilizer
18. **BOLT** (3/8"-16 x 1 1/8")
19. **BRACKET**, Stabilizer Shaft
20. **BUSHING**, Stabilizer Shaft
21. **ARM ASM**, Strg Knuckle
22. **BOLT**, Strg Knuckle
23. **BUSHING**, Strg Knuckle
24. **SEAL**, Strg Knuckle
25. **SHAFT**, Strg Knuckle
26. **CLAMP**, Part of item 36
27. **NUT** (1/2"-13)
28. **RIVET**
29. **BOLT** (3/8"-16 x 1 1/8")
30. **ARM ASM**, Strg Knuckle
31. **SHAFT**, Strg Knuckle
32. **NUT** (1/2"-20)
33. **SPACER**, Strg Knuckle
34. **SEAL**, Strg Knuckle
35. **BUSHING**, Strg Knuckle
36. **BRACKET**, Strg Knuckle
37. **NUT** (5/8"-18)
38. **WASHER** (5/8")
39. **BOLT** (1 1/4")
40. **WASHER** (7/16")
41. **BOLT** (1/2"-20 x 2 5/64")
42. **RIVET** (3/8" x 1")
43. **NUT** (7/16"-14)
44. **SPACER**, Strg Knuckle
45. **STUD**, Strg Knuckle
46. **SHIM**

Fig. 3C-5--Front Suspension P-Series

MAINTENANCE AND ADJUSTMENTS

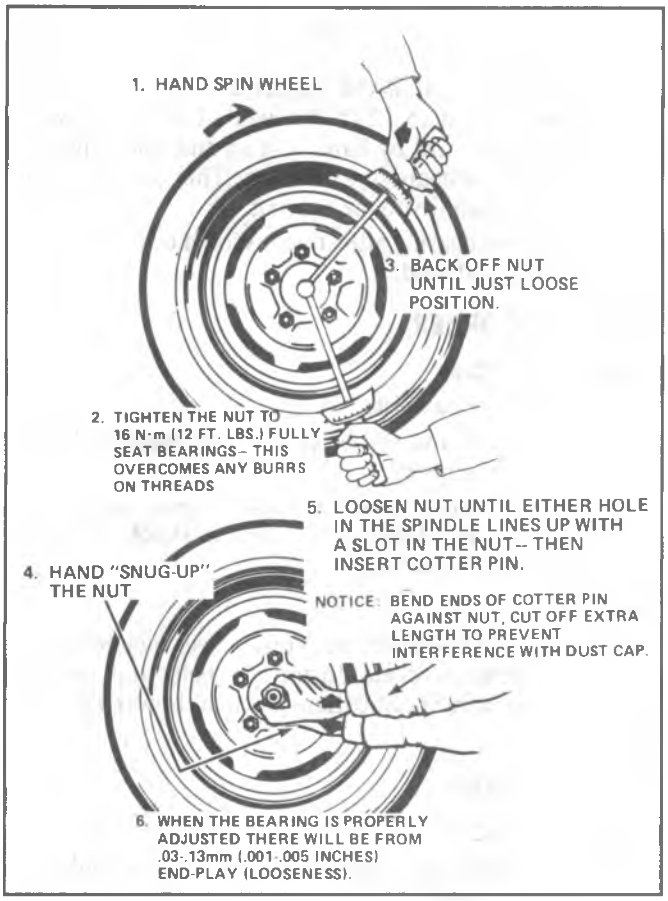


Fig. 3C-6--Wheel Bearing Adjustment

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in the maintenance and adjustment procedures below.

WHEEL BEARINGS-CHECK ADJUSTMENT

NOTICE: Tapered roller bearings have a slightly loose feel when properly adjusted. A design feature of front wheel taper roller bearings is that they must NEVER be pre-loaded. Damage can result by the steady thrust on roller ends which comes from preloading.

1. Raise vehicle and support at front lower control arm.
2. Spin wheel to check for unusual noise or roughness.
3. If bearings are noisy, tight, or excessively loose, they should be cleaned, inspected and relubricated prior to adjustment. If it is necessary to inspect bearings, see Section 3.

   To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. Measure movement of hub assembly. If movement is less than .025 mm (.001") or greater than .127 mm (.005"), adjust bearings per adjustment procedure.

ADJUSTMENT OF WHEEL BEARINGS (FIG. 3C-6)

1. Remove hub cap or wheel disc from wheel.
2. Remove dust cap from hub.
3. Remove cotter pin from spindle and spindle nut.
4. Tighten the spindle nut to 16 N·m (12 ft. lbs.) while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease or burrs which could cause excessive wheel bearing play later. See Fig. 3C-6.
5. Back off the nut to the "just loose" position.
6. Hand tighten the spindle nut. Loosen spindle nut until either hole in the spindle lines up with a slot in the nut. (Not more than 1/2 flat).
7. Install new cotter pin. Bend the ends of the cotter pin against nut, cut off extra length to ensure ends will not interfere with the dust cap.
8. Measure the looseness in the hub assembly. There will be from .025 mm (.001) to .127 mm (.005 inches) end play when properly adjusted.
9. Install dust cap on hub.
10. Replace the wheel cover or hub cap.
11. Lower vehicle to floor.
12. Perform the same operation for each front wheel.

COMPONENT PARTS REPLACEMENT

WHEEL HUBS, BEARINGS (Fig. 3C-7)

Removal C, G and P Series

1. Raise vehicle on hoist and remove wheel and tire assembly. Remove dust cap from end of hub and remove the cotter pin.
2. Remove the brake caliper, do not allow the caliper assembly to hang by the brake flex line, use a piece of wire to hang the caliper from the suspension.
3. Remove hub and disc assembly.
4. Remove outer bearing from hub. The inner bearing will remain in the hub and may be removed by prying out the inner grease seal.
5. Wash all parts in cleaning solvent.

Inspection

1. Check all bearings for cracked bearing cages, worn or pitted rollers. See Section 3.
2. Check bearing races for cracks or scoring, check brake discs for out-of-round or scored conditions and check bearing outer races for looseness in hubs. See Section 3.

Repairs

Replacement of Bearing Cups

If it is necessary to replace an outer race, drive out old race from the hub with a brass drift inserted behind race in notches in hub. Install new race by driving it into hub with the proper race installer J-8457, J-8458, J-8849 or J-9276-2. Remove and install the inner race in the same manner.

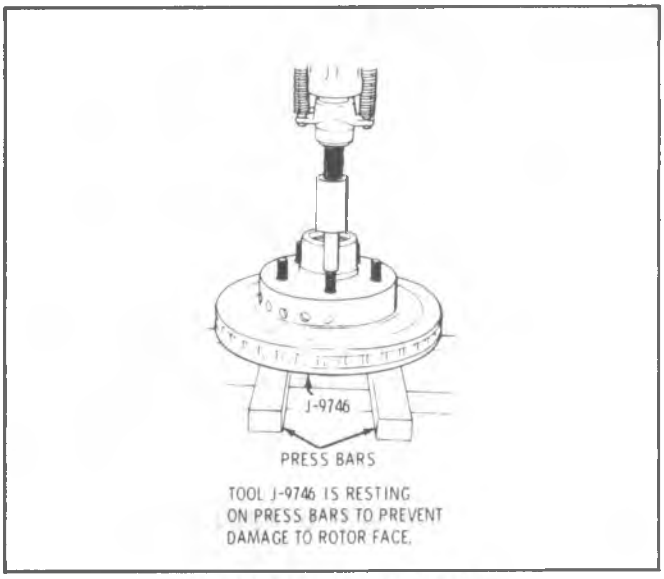


Fig. 3C-7--Pressing Hub Bolt

NOTICE: Use care when installing new race to start it squarely into the hub, to avoid distortion and possible cracking.

Wheel Stud Replacement (Fig. 3C-7)

Use a piece of water pipe or other similar tool to support the hub while pressing a wheel stud either in or out.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 8 and 9.

1. Clean off any grease in the hub and spindle and thoroughly clean out any grease in the bearings. Use cleaning solvent. Use a small brush with no loose bristles to clean out all old grease. Do not spin the bearing with compressed air while drying it or the bearing may become damaged.
2. Use a GM approved high temperature front wheel bearing grease or equivalent. Do not mix greases as mixing may change the grease properties and result in poor performance.
3. Apply a thin film of grease to the spindle at the outer bearing seat and at the inner bearing seat, shoulder, and seal seat.
4. Put a small quantity of grease inboard of each bearing cup in the hub. This can be applied with your finger forming a dam to provide extra grease availability to the bearing and to keep thinned grease from flowing out of the bearing.
5. Fill the bearing cone and roller assemblies 100% full of grease. A method for doing this is with a cone type grease machine that forces grease into the bearing. If a cone greaser is not available, the bearings can be packed by hand. If hand packing is used, it is extremely important to work the grease thoroughly into the bearings between the rollers, cone, and the cage. Failure to do this could result in premature bearing failure.
6. Place the inner bearing cone and roller assembly in the hub. Then using your finger, put an additional quantity of grease outboard of the bearing.
7. Install a new grease seal using a flat plate until the seal is flush with the hub. Lubricate the seal lip with a thin layer of grease.
8. Carefully install the hub and rotor assembly. Place the outer bearing cone and roller assembly in the outer bearing cup. Install the washer and nut and initially tighten the nut to 12 ft. lbs. while turning the wheel assembly forward by hand. Put an additional quantity of grease outboard the bearing. This provides extra grease availability to the bearing.
9. Final wheel bearing adjustment should be performed as previously outlined.

SHOCK ABSORBER

Removal (Fig. 3C-8)

1. Raise vehicle on hoist.
2. Remove nuts and eye bolts securing upper and lower shock absorber eyes.
3. Withdraw shock absorber and inspect rubber eye bushings. If defective, replace shock absorber assembly. See Section 3.

Installation

Place shock absorber into position over mounting bolts or into mounting brackets. Install eye bolts and nuts and torque as shown in Specifications Section. Lower vehicle to floor.

STABILIZER BAR

Removal (Fig. 3C-9)

1. Raise vehicle on hoist and remove nuts and bolts attaching stabilizer brackets and bushings at frame location.
2. Remove brackets and bushings at lower control arms and remove stabilizer from vehicle.

Inspection

Inspect rubber bushings for excessive wear or aging, replace where necessary. Use rubber lubricant when installing bushings over stabilizer bar.

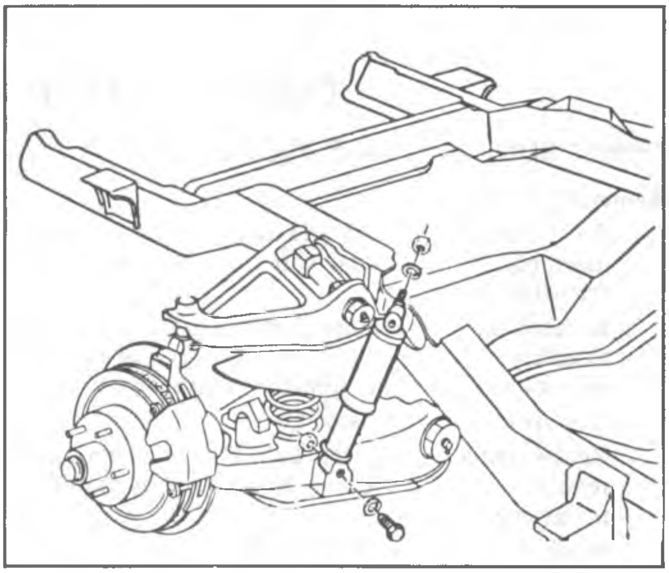


Fig. 3C-8--Shock Absorber Attachments

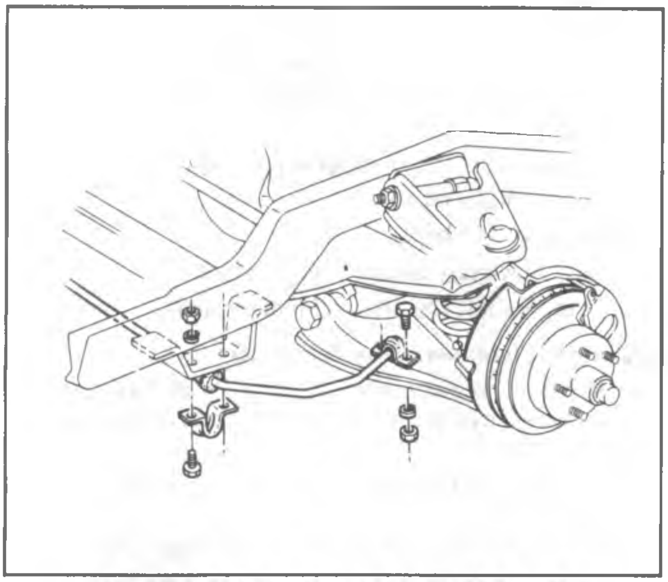


Fig. 3C-9--Stabilizer Bar - C, P and G Typical

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 2.

Slit in bar to frame bushings should be facing forward.

1. Place stabilizer in position on frame and install frame brackets over bushings. Install nuts and bolts loosely.
2. Install brackets over bushings at lower control arm location. Be sure brackets are positioned properly over bushings. Torque all nuts and bolts to specifications.
3. Lower vehicle to floor.

COIL SPRING

Removal (Fig. 3C-10)

1. Place vehicle on hoist and place jack stands under frame, allowing control arms to hang free.
2. Disconnect shock absorber at lower end and move aside.
3. Disconnect the stabilizer bar attachments to the lower control arm.
4. Bolt Tool J-23028 to a suitable jack.
5. Place tool under cross-shaft so that the cross-shaft seats in the grooves of the tool. As a safety precaution install and secure a chain through the spring and lower control arm.
6. Raise the jack to remove tension on the lower control arm cross-shaft and remove the two "U" bolts securing the cross-shaft to crossmember. The cross-shaft and lower control arm keeps the coil spring compressed. Use care when lowering.
7. Lower control arm by slowly releasing the jack until spring can be removed. Be sure all compression is relieved from spring.
8. Remove spring.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 3 and 4.

1. Properly position spring on the control arm, and lift control arm using jack and tool J-23028.

   Some models are equipped with air cylinders in the coil springs. These cylinders should be checked for leaks and damage at this time. Air pressure in these cylinders should be 40 PSI ± 10.
2. Position control arm cross-shaft to crossmember and install "U" bolts and attaching nuts. Make certain front indexing hole in cross-shaft is lined up with crossmember attaching saddle stud.
3. Torque nut to specifications.
4. Install shock absorber to lower control arm and install stabilizer bar.
5. Remove tool J-23028 and safety chain.
6. Lower vehicle to floor.

UPPER CONTROL ARM INNER PIVOT SHAFT AND/OR BUSHING REPLACEMENT

C20-30, G30 and P20-30 (Steel Bushings)

Pivot Shaft Removal

1. Raise vehicle and remove tire and wheel assembly.
2. Support the lower control arm with a floor jack. Position jack under the ball joint assembly or as near as possible and still have good support.
3. Loosen the upper control arm shaft end nuts before loosening the shaft to frame attaching nuts.
4. Loosen the shaft to frame nuts and remove the caster and camber shims. Tape the shims together as they are removed and mark for position.
5. Remove the pivot shaft to frame nuts but do not allow the arm to swing too far away from the frame.

   Use a safety chain to retain the arm in a close relationship to the frame. See Fig. 3C-11.
6. Remove the shaft end nuts and remove shaft from arm.

Bushing Replacement (Steel Bushings)

1. Remove grease fittings from bushing outer ends and unscrew bushings from control arm and shaft.

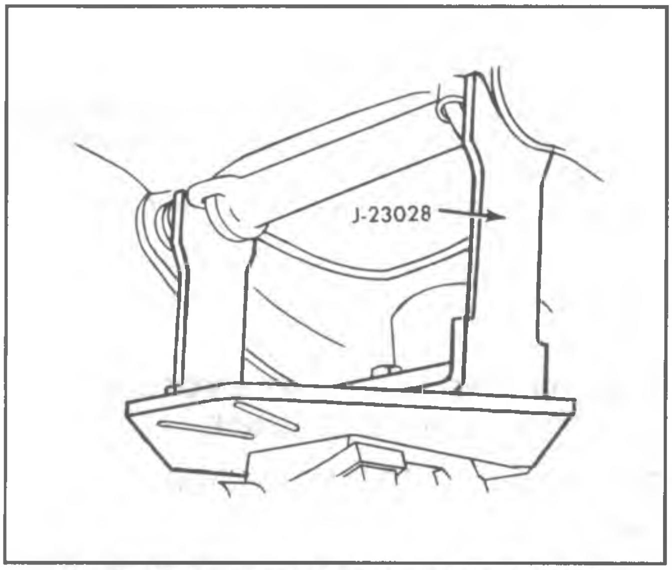


Fig. 3C-10--Removing Coil Spring with Tool J-23028

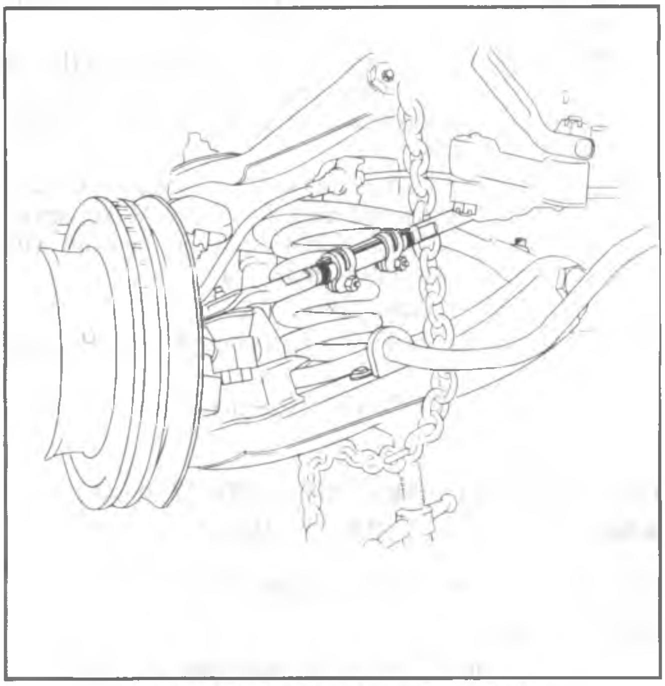


Fig. 3C-11--Removing Inner Pivot Shaft

2. Slide new seal on each end of shaft and insert shaft into control arm.
3. Start new bushings on shaft and into control arm. Adjust shaft until it is centered in control arm, then turn bushings in and torque to specifications. Figure 3C-12 shows correct final positioning of shaft. Check shaft for free rotation and install grease fittings.
4. Grease bushings.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 3, 5 and 6.

When installing the upper control arm be sure to properly position the special aligning washers to the pivot shaft with convex and concave sides together.

1. Install the shaft to the control arm and install end nuts. Do not torque nuts at this time.
2. Position cross-shaft to frame bolts and start cross shaft nuts.
3. Torque the shaft end nuts. See Fig. 3C-12 for proper spacing. The shaft should rotate by hand after the nuts are torqued.
4. Install caster and camber shim in their appropriate places.
5. Torque the cross-shaft to frame nuts.
6. Remove the safety chain and install the tire.
7. Lower vehicle to the floor.

LOWER CONTROL ARM INNER PIVOT SHAFT AND/OR BUSHING REPLACEMENT

C20-30, G30, P20-30 (Steel Bushings)

Lower-Removal (Fig. 3C-11)

1. Raise vehicle and support the frame so that control arms hang free.
2. Position an adjustable floor jack under the control arm inboard of spring and into depression in lower arm.
3. Install a chain over upper arm (Fig. 3C-11). Inboard of stabilizer and outboard of shock absorber as a safety measure.
4. Disconnect shock absorber at lower control arm.
5. Loosen shaft end nuts.
6. Remove "U" bolts.
7. Lower jack just enough to get at shaft.
8. Remove shaft end nuts and remove shaft.

Bushing Replacement (Steel Bushings)

1. Remove grease fittings from ends of bushings and unscrew bushings from shaft and control arm. Remove shaft and seals.
2. Slide new seal on each end of shaft and insert shaft into control arm.
3. Start new bushings on shaft and into control arm. Adjust shaft until it is centered in control arm, then turn bushings in and torque to specifications. Check shaft for free rotation. Figure 3C-13 shows correct final positioning of shaft.
4. Grease bushings.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 4 and 5.

1. Install shaft to control arm and install end nuts. Do not torque nuts at this time.
2. Raise jack and position shaft into crossmember saddle. Be sure to index hole in shaft to mate with bolt head in saddle.
3. Install "U" bolts. Do not torque nuts at this time.
4. Torque cross-shaft end nuts. The shaft should rotate by hand after the nuts are torqued.
5. Torque "U" bolt nuts.
6. Remove safety chain.
7. Lower vehicle to floor.

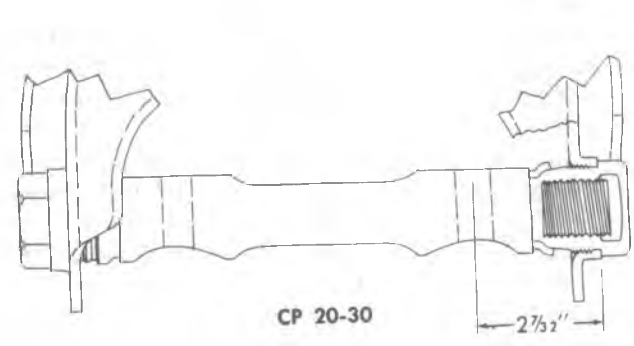


Fig. 3C-12--Positioning U.C.A. Shaft (Steel Bushings)

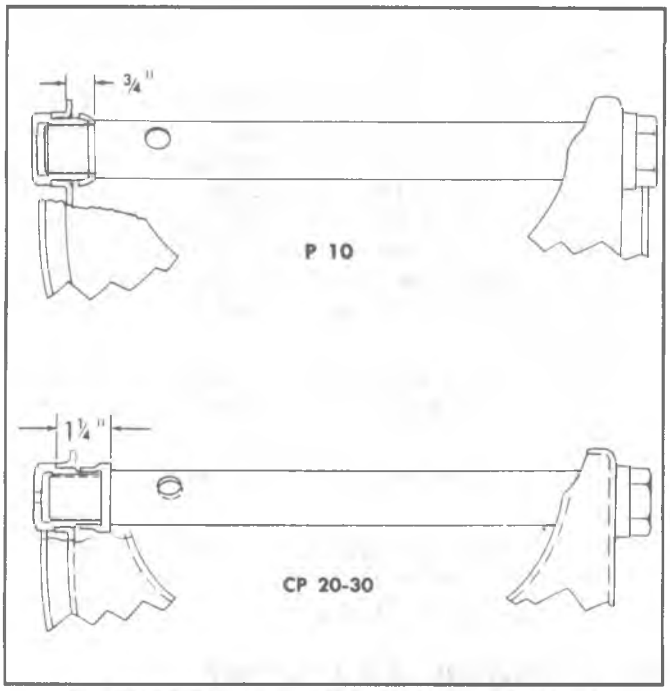


Fig. 3C-13--Positioning L.C.A. Shaft (Steel Bushings)

UPPER CONTROL ARM ASSEMBLY

All Removal

1. Raise vehicle on hoist, remove wheel and tire assembly and support lower control arm assembly with adjustable jackstand.
2. It is necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for proper procedure.
3. Remove cotter pin from upper control arm ball stud and loosen stud nut one turn.
4. Loosen upper control arm ball stud in steering knuckle, using Tool J-23742 position as shown in Figure 3C-14. Remove the nut from the ball stud and raise upper arm to clear steering knuckle.
5. Remove nuts securing control arm shaft to frame.

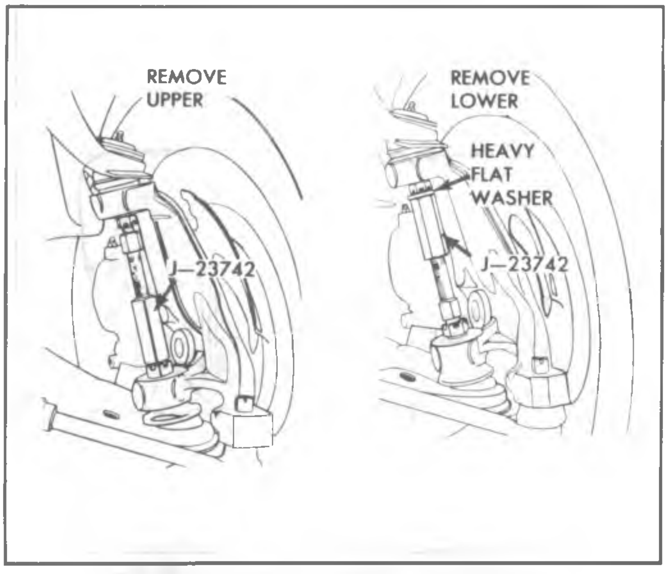


Fig. 3C-14--Disconnecting Ball Joints from Knuckle

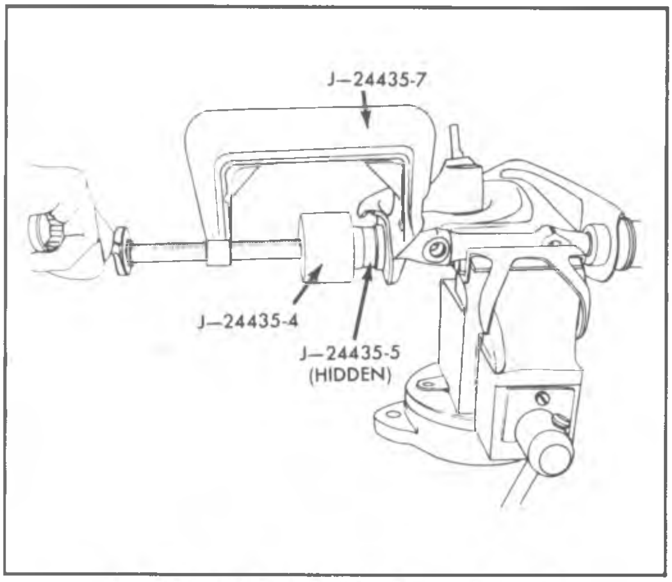


Fig. 3C-15--U.C.A. Rubber Bushing Removal

Withdraw control arm assembly. Tape shims together and tag for proper relocation when control arm is reinstalled.

Upper Control Arm Inner Pivot Shaft and/or Bushing Replacement

C10, G10-20, P10 (Rubber Bushings)

Removal (Fig. 3C-15)

1. Remove the upper control arm using the preceding procedure and mount the control arm in a vise.
2. Install remover J-24435-1, receiver J-24435-3 and "C" clamps J-24435-7 as shown in Figure 3C-15.
3. Tighten the clamp to draw out the old bushing. Discard old bushing.
4. The pivot shaft may now be removed from the control arm assembly.
5. Reposition the control arm in the vise and repeat the removal procedure on the remaining bushing.

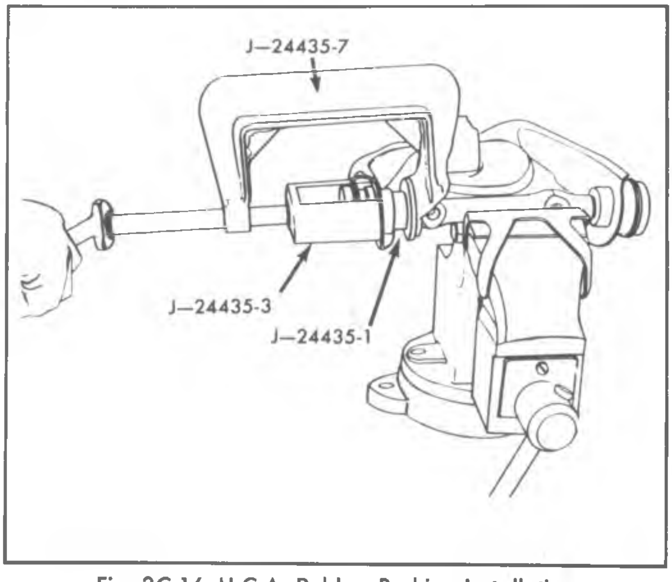


Fig. 3C-16--U.C.A. Rubber Bushing Installation

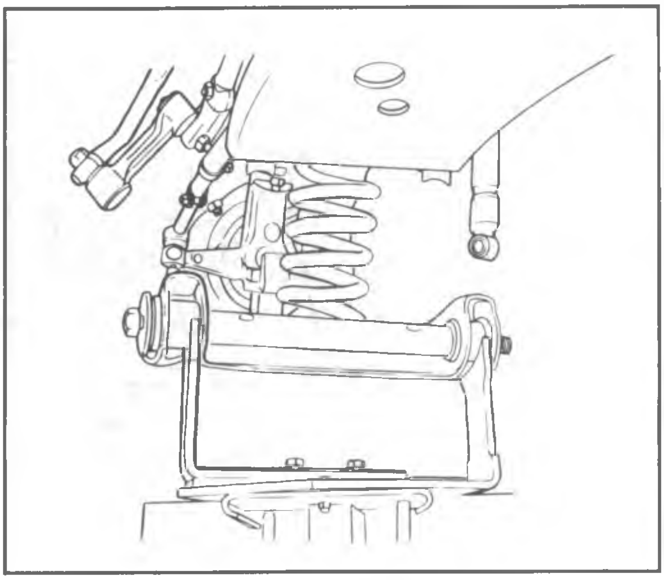


Fig. 3C-17--Lowering Control Arm for Bushing Replacement

Bushing Installation

1. Again using "C" clamp J-24435-7 and installers J-24435-4 (outer) and J-24435-5 (inner) tighten clamp to install bushing onto control arm.
2. Install pivot shaft into inside diameter of first installed bushing.
3. Install remaining bushing as shown in Figure 3C-16 and described in step 1.
4. Remove tools and install control arm on vehicle following procedure described below. Torque all fasteners to proper specifications.

Upper Control Arm Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 2 and 3.

When installing the upper control arm be sure to position the special aligning washers to the pivot shaft with concave and convex sides together.

1. Place control arm in position on bracket and install nuts. Before tightening nuts, insert caster and camber shims in the same order as when removed. Torque the nuts to specifications.

   A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. If two (2) threads cannot be obtained: Check for damaged control arms and related parts. Difference between front and rear shim packs must not exceed 7.62 mm (.30 inches). Front shim pack must be at least 6.09 mm (.24 inches). Always tighten the thinner shim packs' nut first for improved shaft to frame clamping force and torque retention.
2. Insert ball joint stud into steering knuckle and install nut. Torque stud nut to specifications and install cotter pin.
3. Install brake caliper assembly if removed (see section 5).
4. Remove adjustable support from under lower control arm. Install wheel and tire assembly.
5. Lower the vehicle to the floor.

LOWER CONTROL ARM ASSEMBLY

Removal

1. Raise vehicle on hoist and remove spring as outlined under spring removal. Support the inboard end of the control arm after spring removal.
2. Remove cotter pin from lower ball stud and loosen stud nut one turn.
3. Install Ball Stud Remover J-23742, position large cup end of the tool over the upper ball stud nut and piloting the threaded end of tool on end of the lower ball stud. Extend bolt from Tool J-23742 to loosen lower ball stud in steering knuckle. When stud is loosened, remove tool and nut from lower stud.

   It is necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for proper procedure.
4. Remove the lower control arm.

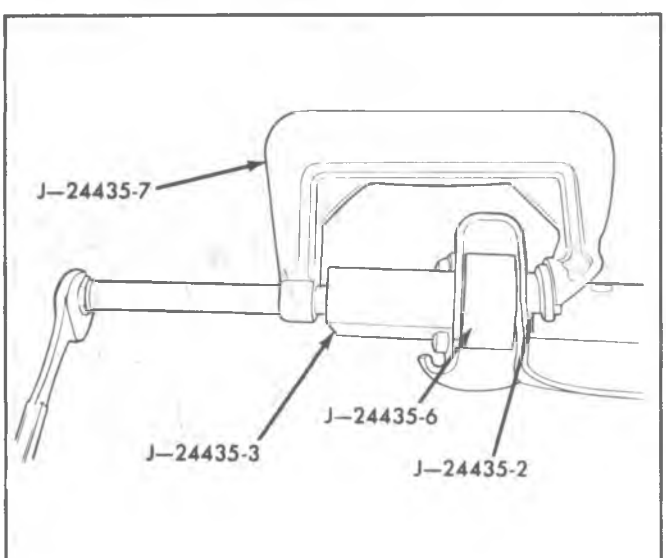


Fig. 3C-18--L.C.A. Rubber Bushing Removal

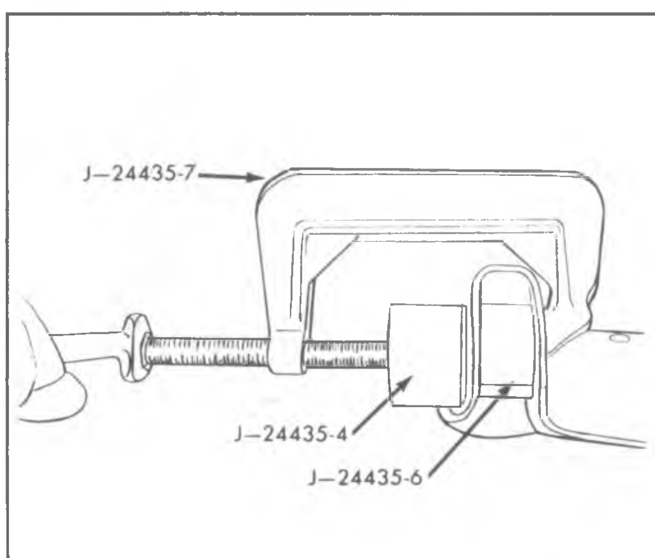


Fig. 3C-19--L.C.A. Rubber Bushing Installation

Lower Control Arm Inner Pivot Shaft and/or Bushing Replacement-On Vehicle

C10 (Rubber Bushings)

Removal (Figs. 3C-17, 3C-18)

If just bushings or pivot shaft are to be replaced the lower control arm does not have to be removed from the vehicle.

1. Raise vehicle on hoist and support the frame so that the control arms hang free.
2. Position an adjustable floor jack under the lower control arm inboard of spring and into depression of control arm.
3. Install a chain over the upper arm inboard of the stabilizer and outboard of shock absorber as a safety measure.
4. Disconnect shock and stabilizer bar attachments at lower control arm.
5. Loosen shaft end nuts.
6. Remove "U" bolts that retain the inboard end of the lower control arm.
7. Lower jack SLOWLY to release spring compression (Fig. 3C-17) and gain clearance to remove bushings. Be sure all compression is released from coil springs.
8. Remove the stakes on the front bushing using tool J-22717 or equivalent tool.
9. Bushings may now be replaced. Install "C" clamps J-24435-7 and receiver J-24435-3 with remover J-24435-2 and spacer J-24435-6 as shown in Figure 3C-18.
10. Tighten the "C" clamp to remove the bushing.
11. Remove tools and discard old bushing.
12. Pivot shaft may now be removed if necessary.
13. Remove second bushing (leave pivot shaft in to pilot tool) by the same method as in Steps 8 thru 12.

Bushing Installation (Fig. 3C-19)

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 5.

1. Install new bushings as shown in Figure 3C-19 using spacer J-24435-6, installer J-24435-4 and "C" clamp J-24435-7.
2. Turn clamp in until bushing seats firmly.

   NOTICE: Be sure spacer J-24435-6 is in position as shown in Figure 3C-19 to avoid collapsing control arm during assembly.
3. Install one bushing then insert the pivot shaft and install second bushing.
4. Stake front bushing at least in two places when installed.
5. Install the lower control arm to the vehicle as described under "Lower Control Arm - Installation", being sure to torque all fasteners to the proper specification.

Lower Control Arm Inner Pivot Shaft And Bushing Replacement-G10-G20 Models

Removal

1. Remove lower control arm as previously outlined.
2. Remove pivot shaft nuts.
3. Place control arm in an arbor press, press front end of pivot shaft to remove rear bushing, and pivot shaft assembly.
4. Remove the stakes on the front bushing using Tool J-22717 or equivalent tool.
5. Install "C" clamp J-24435-7 and receiver J-24435-3 with remover J-24435-2 and spacer J-24435-6 as shown in Figure 3C-28.
6. Tighten "C" clamp to remove the bushing.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 5.

1. Install new bushings as shown in Figure 3C-16 using spacer J-24435-6, installer J-24435-4 and "C" clamp J-24435-7.
2. Turn clamp in until bushing seats firmly.

   Be sure outer tube hole is to the front or forwards to the staked bushing.

   NOTICE: Be sure spacer J-24435-6 is in position as shown in Figure 3C-19 to avoid collapsing control arm during assembly.
3. Stake front bushing at least in two places when installed.
4. Insert the pivot shaft and install second bushing.
5. Install the lower control arm to the vehicle as described under "Lower Control Arm - Installation", being sure to torque all fasteners to the proper specification.

Lower Control Arm Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 2 and 3.

1. Install lower ball stud through steering knuckle and tighten nut.
2. Install spring and control arm as outlined under spring installation.
3. Torque lower control arm ball stud to specifications and install cotter pin.
4. Install brake caliper assembly if removed (see section 5).
5. Lower the vehicle to the floor.

BALL JOINT SERVICE-ON VEHICLE

Ball Joint-Inspection

The upper ball stud is spring loaded in its socket. This minimizes looseness at this point and compensates for normal wear, if the upper stud has any perceptible lateral shake, or if it can be twisted in its socket with the fingers, the upper ball joint should be replaced.

Ball Joint Seals-Inspection

Ball joint seals should be carefully inspected for cuts and tears. Whenever cuts or tears are found, the ball joint must be replaced.

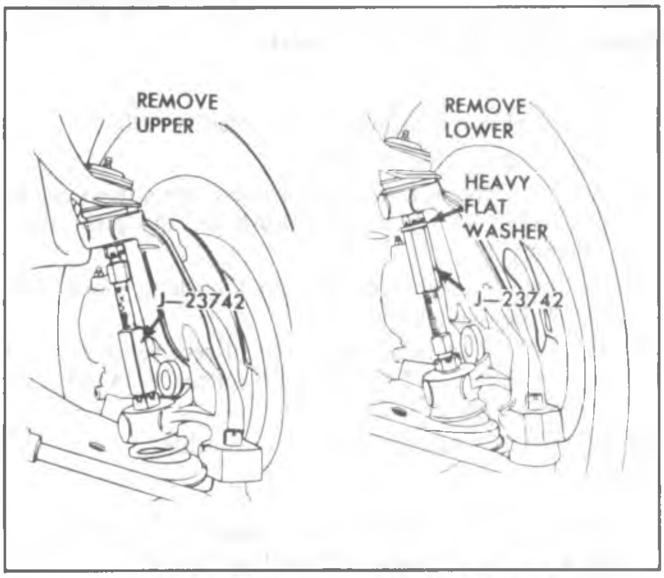


Fig. 3C-20--Disconnecting Ball Joints-Typical

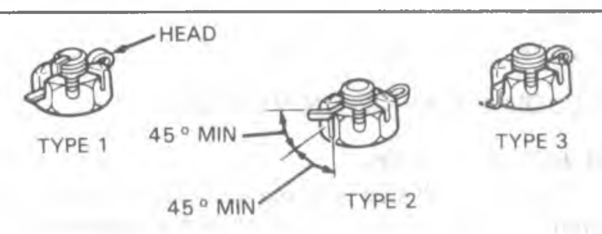
Upper-Removal

1. Raise vehicle on hoist. If a frame hoist is used, it will be necessary to support the lower control arm with a floor jack.
2. Remove cotter pin from upper ball stud and loosen stud nut (two turns) but do not remove nut.
3. Install J-23742 between the ball studs as shown in Figure 3C-20.
   It is necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for the proper procedure.
4. Be sure lower control arm is supported as pointed out in step 1. Extend bolt from Tool J-23742 to loosen ball stud in steering knuckle. When stud is loose, remove tool and stud nut.
5. Center punch rivet heads and drill out rivets.
6. Remove the ball joint assembly.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 3 and 6.

1. Install new service ball joint, using bolts and nuts supplied with joint, to upper arm. Torque nuts to 25 N·m (18 ft. lbs.).



TYPES 1, 2, & 3 ARE OPTIONAL INSTALLATIONS. AFTER REACHING TORQUE REQUIRED, INSTALL COTTER PIN. IF SLOT IN NUT IS NOT ALIGNED WITH PIN HOLE, NUT MUST ALWAYS BE TIGHTENED (UP TO 1/6 TURN) FURTHER, NEVER BACK-OFF, TO INSERT COTTER PIN. INSTALL COTTER PIN TIGHTLY INTO NUT SLOT WITH HEAD OF PIN SHOULDERED AND BEND ONE OR BOTH LEGS AS SHOWN ABOVE.

Fig. 3C-21--Cotter Pin Installation

2. Mate ball stud to steering knuckle and install stud nut.
3. Torque the ball stud nut as follows:
   A. 10 G20 Series 54-80 N·m (40-60 ft. lbs.) plus additional torque to align cotter pin not to exceed 120 N·m (90 ft. lbs.). Never back off to align cotter pin.
   B. 20-30 Series (except G20) 110-140 N·m (80-100 ft. lbs.) plus additional torque to align cotter pin not to exceed 175 N·m (130 ft. lbs.) Never back off to align cotter pin.
4. Install new cotter pin as shown in Figure 3C-21.
5. Install lube fitting and lube new joint.
6. Install brake caliper assembly if removed (see section 5).
7. Install tire and wheel assembly.
8. Lower the vehicle to the floor.

Ball Joint-Inspection

Lower

Lower ball joints are a loose fit when not connected to the steering knuckle. Wear may be checked without disassembling the ball stud, as follows:

1. Support weight of control arms at wheel hub and drum.
2. Accurately measure distance between tip of ball stud and tip of grease fitting below ball joint.
3. Move support to control arm to allow wheel hub and drum to hang free. Measure distance as in Step 2. If the difference in measurements exceeds 2.38 mm (.094" (3/32") for all models, ball joint is worn and should be replaced (Fig. 3C-22).

Lower-Removal

1. Raise vehicle on a hoist. If a frame hoist is used it will be necessary to support the lower control arm with a floor stand.
2. Remove the tire and wheel assembly.
3. Remove the lower stud cotter pin and loosen (two turns) but do not remove the stud nut.

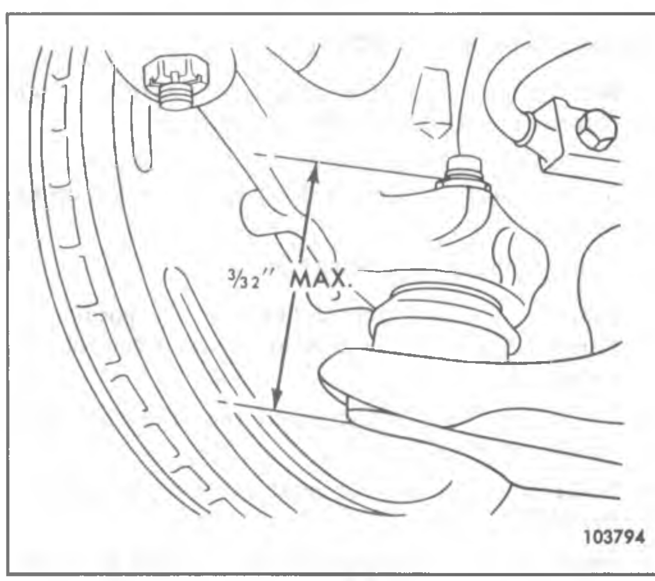


Fig. 3C-22--Checking Lower Ball Joint

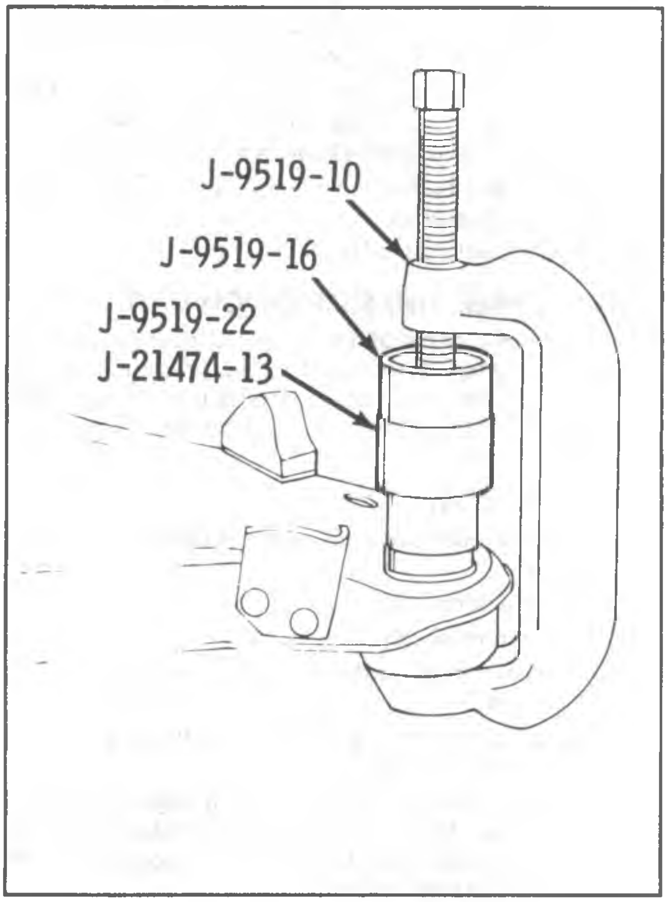


Fig. 3C-23--Ball Joint Removal

4. Install J-23742 between the ball studs as shown in Figure 3C-20.

   It may be necessary to remove the brake caliper assembly and wire it to the frame to gain clearance for tool J-23742. See section 5 for proper procedure.
5. Be sure lower control arm is supported as pointed out in Step 1. Extend bolt from Tool J-23742 to loosen ball stud in steering knuckle. When stud is loosened, remove tool and ball stud nut.
6. Pull the brake disc and knuckle assembly up off the ball stud and support the upper arm with a block of wood so that assembly is out of working area.

   NOTICE: Do not put stress on the brake line flex hose or damage to the brake line may result.
7. Install tools as shown in Fig. 3C-23.
8. Turn hex head screw until ball joint is free of control arm.
9. Remove tools and the ball joint.

Installation (Fig. 3C-24)

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 4, 5 and 7.

1. Start the new ball joint into the control arm and install tools as shown in Figure 3C-24. Position bleed vent in rubber boot facing inward.
2. Turn hex head screw until ball joint is seated in control arm.
3. Lower the upper arm and mate the steering knuckle to the lower ball stud.
4. Install brake caliper assembly if removed (see Section 5).
5. Install ball stud nut and torque as follows. All Series, 110 - 140 N·m (80-100 ft. lbs.) plus additional torque to align cotter pin hole not to exceed 175 N·m (130 ft. lbs.) maximum. Never back off to align cotter pin.
6. Install a lube fitting and lube the joint.
7. Install tire and wheel assembly and lower vehicle to floor.

STEERING KNUCKLE

It is recommended that vehicle be raised and supported as on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assembly remain accessible. If a frame hoist is used, support lower control arm with an adjustable jackstand to safely retain spring in its curb height position.

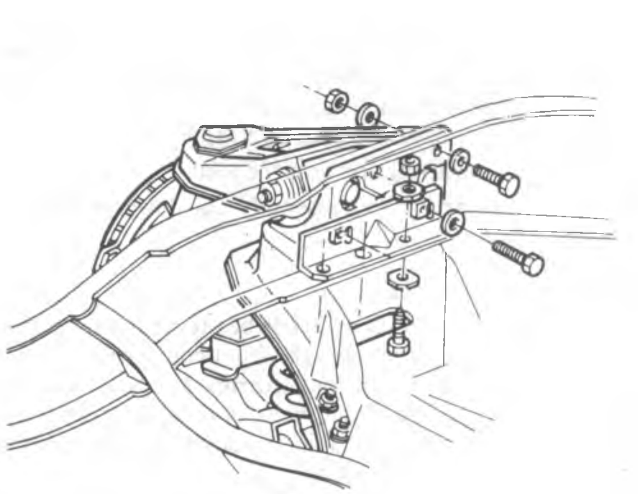
Steering Knuckle-Inspection

Inspect the tapered hole in the steering knuckle. Remove any dirt. If out-of-roundness, deformation or damage is noted, the knuckle **MUST** be replaced.

Removal

1. Raise vehicle on hoist and support lower control arm as noted above.
2. Remove wheel and tire assembly.
3. Remove caliper as outlined under "Front Wheel Hub - Removal".
4. Remove disc splash shield bolts securing the shield

Fig. 3C-24--Installing Ball Joint



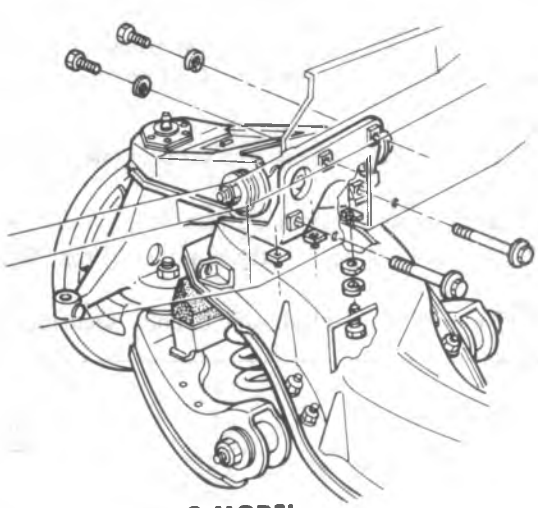


Fig. 3C-25--Suspension Unit to Frame

to the steering knuckle. Remove Shield.

5. Refer to Section 3B-Steering for service removal operations.
6. Remove upper and lower ball stud cotter pins and loosen ball stud nuts. Free steering knuckle from ball studs by installing Special Tool J-23742. Remove ball stud nuts and withdraw steering knuckle.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 2, 3, 4 and 5.

1. Place steering knuckle in position and insert upper and lower ball studs into knuckle bosses.

   Steering knuckle hole, ball stud and nut should be free of dirt and grease before tightening nut.

2. Install ball stud nuts and tighten nut to specifications. (See Specification Section.)

   If necessary, tighten one more notch to insert cotter pins. Do not loosen nut to insert cotter pin. Refer to Ball Joint text for proper nut installation sequence.

3. Reverse remaining removal procedure, and tighten splash shield mounting bolt. Tighten two caliper assembly mounting bolts to 48 N·m (35 ft. lbs.) torque.
4. Adjust wheel bearings as outlined under Front Wheel Bearing Adjustment.
5. Tighten wheel nuts to 100 N·m (75 ft. lbs.).

CROSSMEMBER AND SUSPENSION UNIT

Component parts of the front suspension may be serviced separately as outlined in the preceding service operations. However, if extensive service is to be performed to crossmember, frame, etc., the unit can be removed and installed as follows:

Removal (Fig. 3C-25)

1. Raise hood and disconnect negative battery cable from battery.
2. Raise vehicle on hoist.
3. Remove front wheels.
4. Disconnect front brake hose clip from each upper control arm.
5. Support front of vehicle with jack stands at frame side rails. Lower front hoist.
6. Clean area adjacent to brake hose fittings. Disconnect front brake hoses from calipers. Discard special washers (2 each hose). Cover disconnected end of each hose with suitable material.
7. Disconnect tie rod ends from steering knuckles. Discard cotter pins. Refer to Section 3B.
8. If equipped, disconnect front stabilizer from lower control arms.
9. Disconnect fron shock absorbers from lower control arms.
10. Remove brake line clip bolts from front suspension crossmember. On C-Models the clip is located under right hand engine mount support bracket.

    NOTICE: Failure to disconnect these clips from the front suspension unit will result in severe damage to the brake line when unit is lowered from vehicle.

11. Remove engine mount support bracket to front suspension crossmember bolts.
12. Remove crossmember to lower frame rail bolts.
13. Raise hoist to support front suspension unit.
14. Support engine. Engine must be supported adequately before front suspension unit is lowered from vehicle.
15. Remove upper control arm bracket to frame side rail bolts. Suspension unit is now disconnected from vehicle.
16. Lower hoist to lower front suspension unit from vehicle.

Installation

1. Raise hoist to align new suspension unit with frame rail holes.

   NOTICE: See NOTICE, on page 1 of this section regarding fasteners referred to in Steps 2 thru 14.

2. Assemble (finger-tight) upper control arm bracket bolts and crossmember bolts to frame rails.

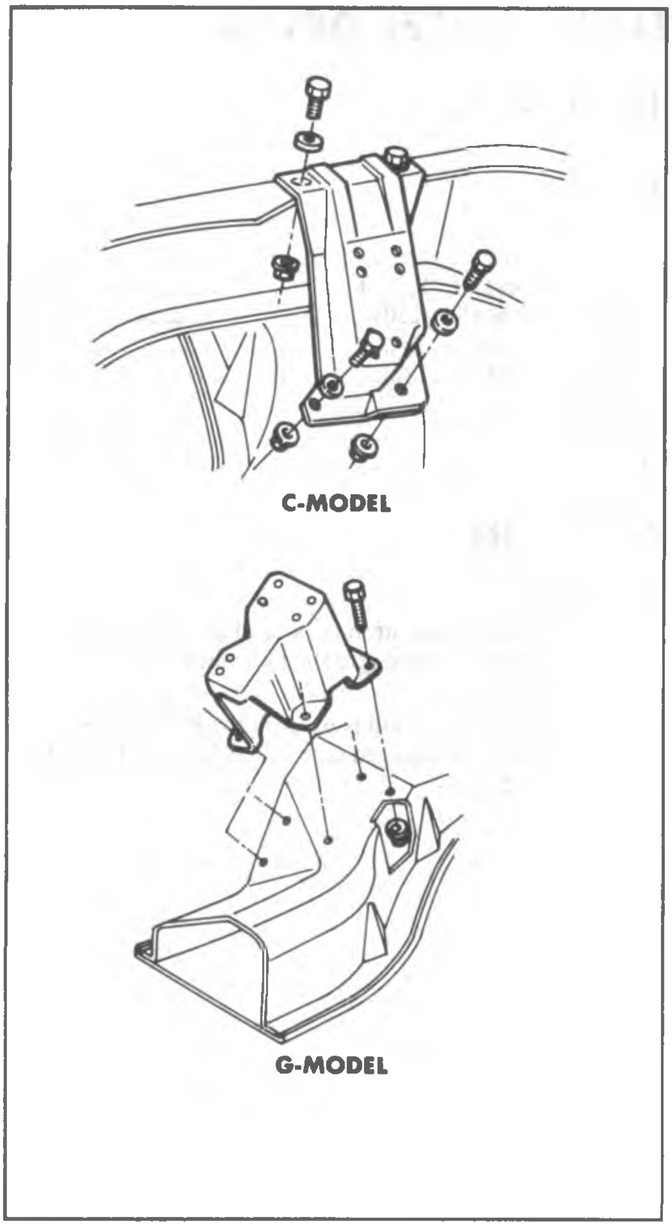


Fig. 3C-26--Engine Front Mounting Bracket

3. Torque upper control arm bracket bolts to frame side rails to 90 N·m (65 ft. lbs.). Control arm bracket bolts must be torqued before crossmember bolts are torqued. Crossmember must be in contact with siderails.
4. Torque crossmember bolts to frame lower rails 100 ft. lbs. Engine support can be removed at this time.
5. Lower hoist.
6. Assemble (finger-tight) engine mount support bracket to front suspension crossmember bolts.
7. Torque engine mount support bracket bolts to 48 N·m (35 ft. lbs.).
8. Install brake line clip bolt to front suspension crossmember. Torque to 17 N·m (150 in. lbs.) (C-models), 12 N·m (100 in. lbs.) (G-models).
9. Connect front shock absorbers to L.C.A.'s. Torque to 80 N·m (60 ft. lbs.) (C-models), 95 N·m (70 ft. lbs.) (G-models).
10. If equipped, connect front stabilizer to L.C.A.'s. Torque to 34 N·m (25 ft. lbs.).
11. Connect tie rod ends to steering knuckles. Refer to Section 3B.
12. Connect front brake hose to caliper, using new special washers. Refer to Section 5.
13. Connect front brake hose clips to upper control arms. Torque nuts to 17 N·m (150 in. lbs.).
14. Lubricate upper and lower ball joints.
15. Install front wheels.
16. Bleed brake system. Refer to Section 5 for correct bleeding procedures.
17. Lower vehicle.
18. Connect battery cable.

FRONT SUSPENSION, FOUR-WHEEL DRIVE

SERIES K10, K20, K30

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GENERAL DESCRIPTION

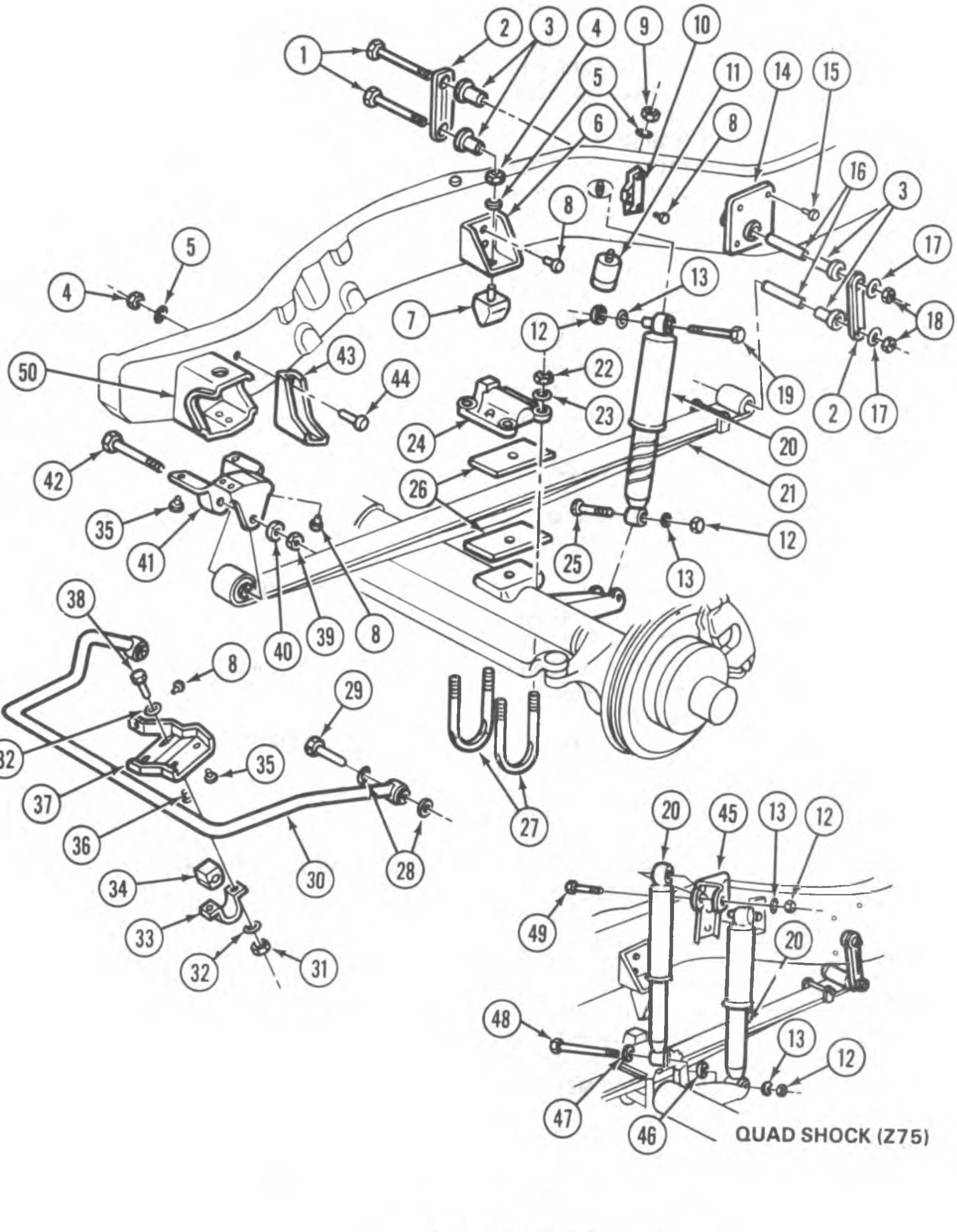
Knuckle Attachment

At the wheel ends of the axle tubes, two types of steering knuckle attachment are used. Figures 3C-1K and 3C-3K shows the K10 and K20 knuckle attached with ball joints. Figures 3C-2K, 4K and 5K shows the king-pin attachment used in K30. The tapered upper king pin fits in a tapered nylon bushing. The lower king pin is part of the bearing cap, and this king pin rides in a tapered roller bearing.

Hub Design

An automatic locking hub is used on all models. This system, automatically engages the hub whenever four-wheel drive is selected.

A manual locking hub is used on the K-30 Series only. This system must be engaged manually whenever four wheel drive is selected.



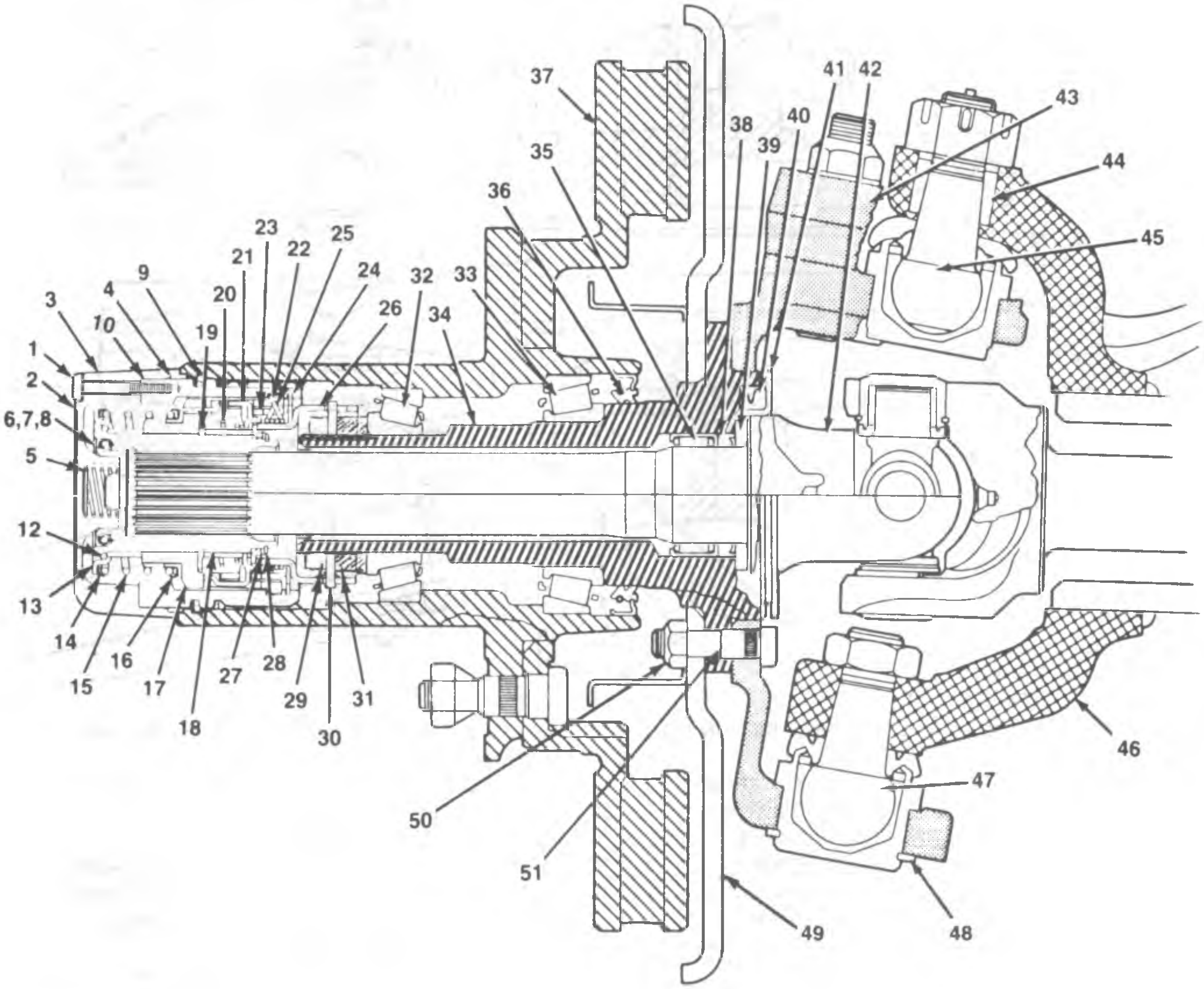
"K" FRONT SUSPENSION

Fig. 3C--K Front Suspension

"K" FRONT SUSPENSION

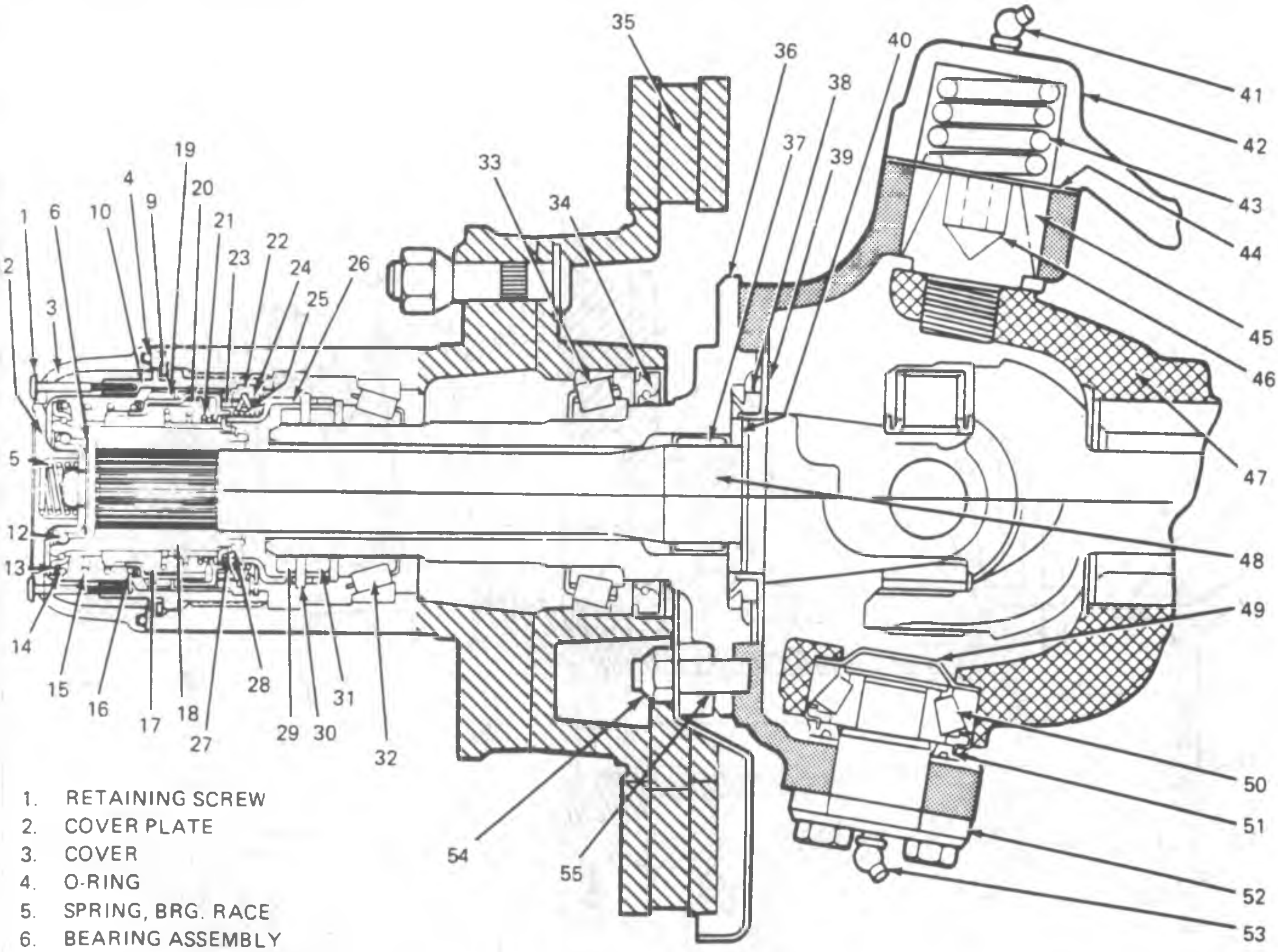
1. **BOLT** (7/16"-20 x 5")
2. **SHACKLE ASM**, Front Spring
3. **BUSHING**, Front Spring Shackle
4. **NUT** (3/8"-16)
5. **WASHER** (3/8")
6. **BRACKET**, Front Spring Bumper
7. **BUMPER**, Front Spring
8. **RIVET** (3/8" x 7/8")
9. **NUT** (3/8"-16)
10. **BRACKET**, Front Shock Absorber Frame
11. **BUMPER**, Front Spring
12. **NUT** (1/2"-13)
13. **WASHER** (1/2")
14. **HANGER**, Front Spring Rear
15. **RIVET** (3/8" x 1-1/4")
16. **SPACER**, Front Spring Shackle
17. **WASHER** (7/16")
18. **NUT** (7/16"-20)
19. **BOLT** (1/2"-13 x 3-1/2")
20. **ABSORBER ASM**, Front Shock
21. **SPRING ASM**, Front
22. **NUT** (5/8"-18)
23. **WASHER** (21/32" ID x 1-1/4" OD x 3/32" Thk)
24. **PLATE**, Front Spring Anchor
25. **BOLT** (1/2"-13 x 2-3/4")
26. **SPACER**, Front Spring (5-1/2" OL x 2-1/2" Thk)
27. **BOLT**, "U" Front Spring
28. **WASHER** (13/16")
29. **BOLT**, Front Stabilizer Shaft (3/4"-10 x 3-1/4")
30. **SHAFT**, Front Stabilizer
31. **NUT** (7/16"-14)
32. **WASHER** (15/32")
33. **BRACKET**, Front Stabilizer Shaft
34. **BUSHING**, Front Bar to Frame (1-1/4" ID x 1-1/2" High)
35. **RIVET** (3/8" x 1")
36. **RIVET** (3/8" x 1-1/8")
37. **BRACKET**, Front Stabilizer Shaft Frame
38. **BOLT** (7/16"-14 x 1-1/2")
39. **NUT** (9/16"-18)
40. **WASHER** (19/32")
41. **HANGER**, Front Spring Front
42. **BOLT** (9/16"-18 x 5")
43. **REINFORCEMENT**, Front Spring Front Hanger
44. **BOLT** (3/8"-16 x 1")
45. **BRACKET**, Frt S/Abs Upr
46. **SPACER**, Frt S/Abs
47. **WASHER** (17/32" ID 1-1/16" OD 3/32" Thk)
48. **BOLT**, Hex (1/2"-13 x 5")(300M)
49. **BOLT**, Hex (1/2"-13 x 2-7/8")(280M)
50. **BRACKET**, Rad Supt

Fig. 3C--K Front Suspension



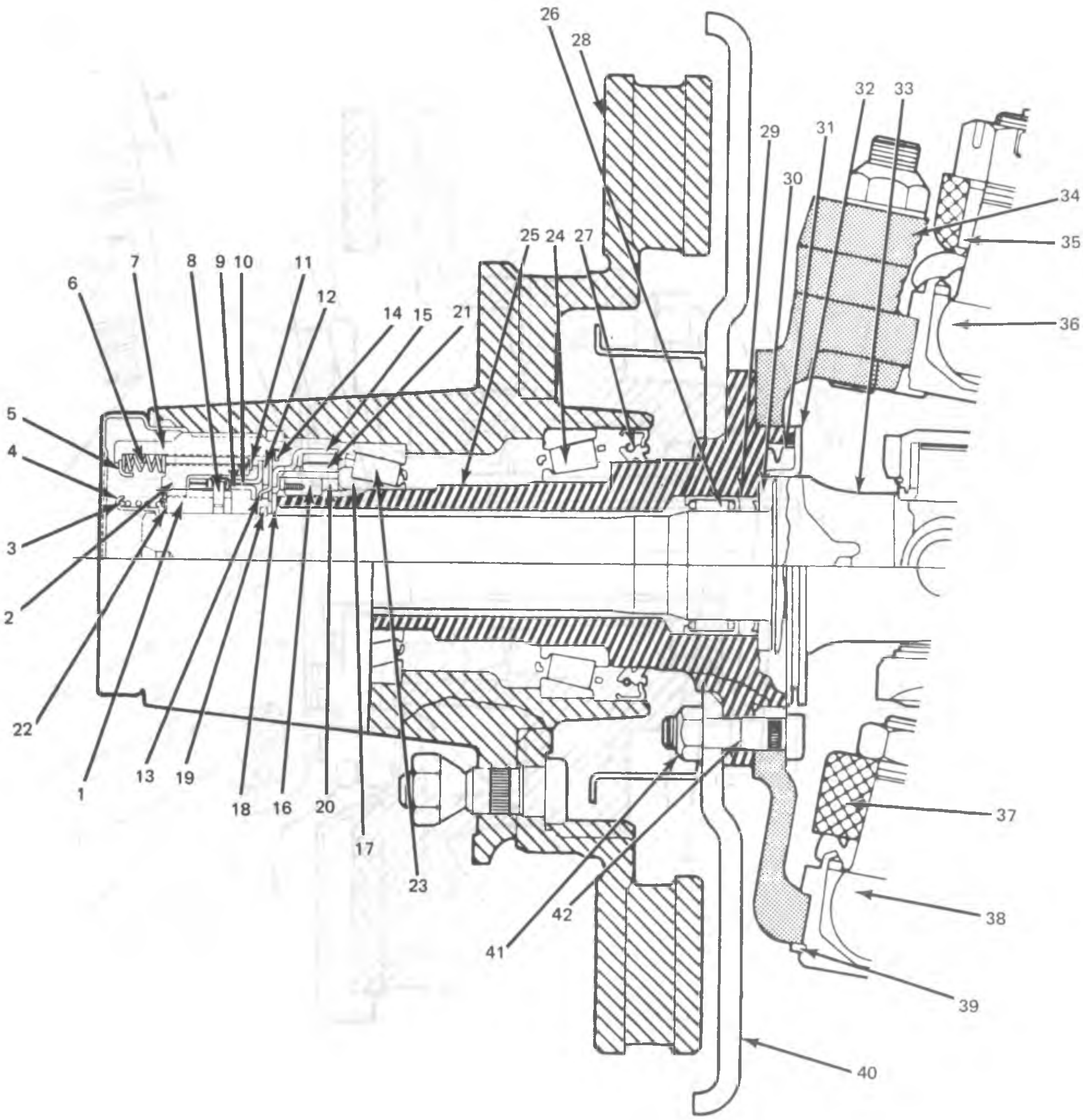
1. RETAINING SCREW
2. COVER PLATE
3. COVER
4. SEALING RING
5. SPRING, BEARING RACE
6. }
7. }BEARING ASSEMBLY
8. }
9. WIRE RETAINING RING
10. OUTER CLUTCH HOUSING
11. SEAL BRIDGE — RETAINER (NOT SHOWN)
12. RETAINING RING
13. SPRING SUPPORT WASHER
14. SPRING RETAINER
15. RETURN SPRING
16. SPRING RETAINER
17. CLUTCH GEAR
18. HUB SLEEVE
19. 'C' TYPE RETAINING RING
20. CONICAL SPRING
21. CAM FOLLOWER
22. OUTER CAGE
23. INNER CAGE
24. SNAP RING
25. BRAKE BAND
26. DRAG SLEEVE AND DETENT
27. SPACER
28. RETAINING RING
29. LOCK NUT
30. RETAINING WASHER
31. ADJUSTING NUT
32. OUTER-WHEEL BEARING
33. INNER-WHEEL BEARING
34. SPINDLE
35. SPINDLE BEARING
36. SEAL
37. HUB-AND-DISC ASSEMBLY
38. OIL SEAL
39. SPACER
40. DUST SEAL
41. DEFLECTOR
42. AXLE OUTER SHAFT
43. KNUCKLE
44. ADJUSTING SLEEVE
45. UPPER BALL JOINT
46. YOKE
47. LOWER BALL JOINT
48. RETAINING RING
49. CALIPER SUPPORT BRACKET
50. SPINDLE RETAINING NUT
51. SPINDLE RETAINING BOLT

Fig. 3C-1K--K10, K20 w/Warner Gear Automatic Hub and Ball Joints



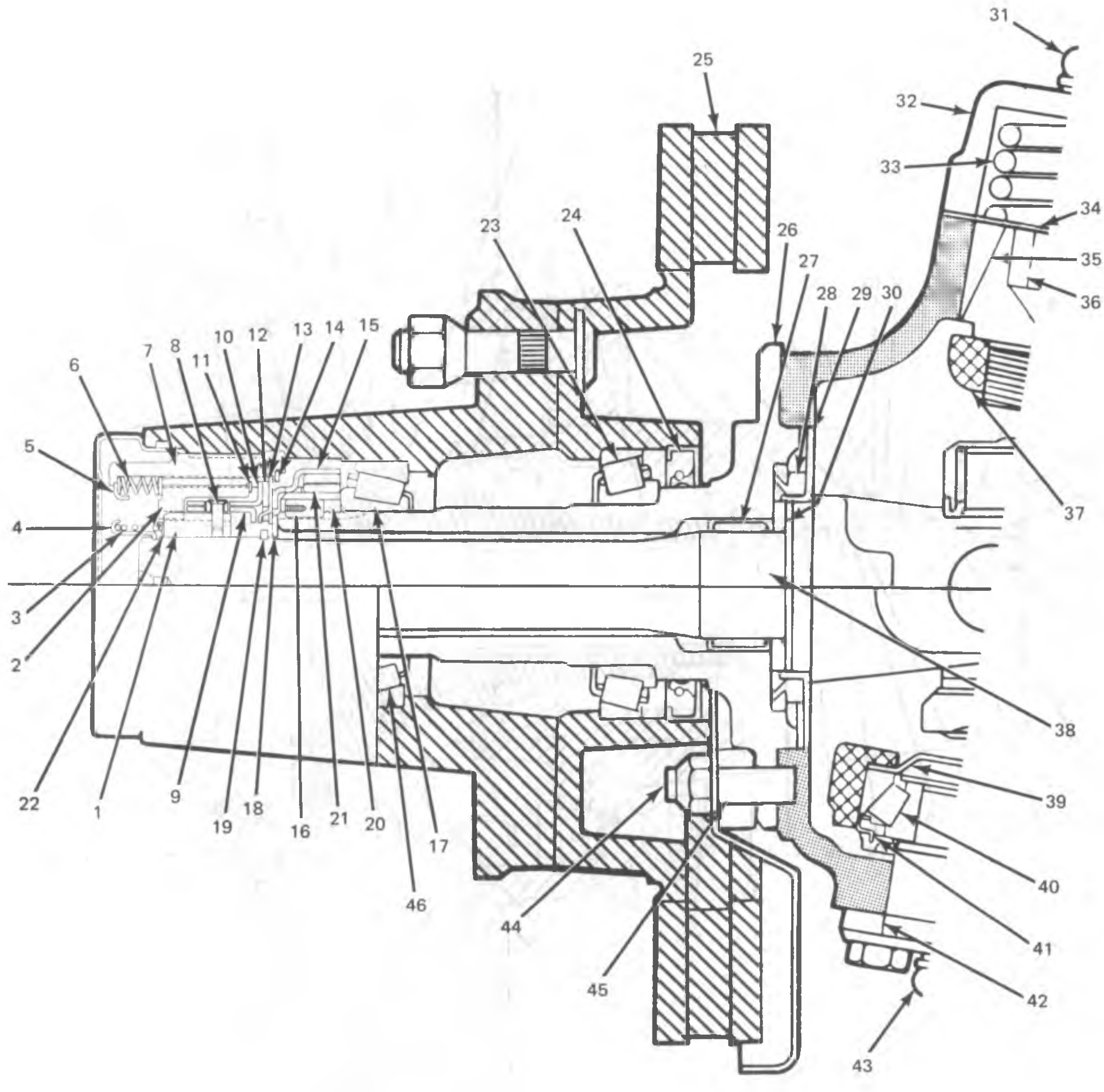
1. RETAINING SCREW
2. COVER PLATE
3. COVER
4. O-RING
5. SPRING, BRG. RACE
6. BEARING ASSEMBLY
9. WIRE RETAINING RING
10. OUTER CLUTCH HOUSING
11. SEAL BRIDGE – RETAINER (NOT SHOWN)
12. RETAINING RING
13. SPRING SUPPORT WASHER
14. SPRING RETAINER
15. RETURN SPRING
16. SPRING RETAINER
17. CLUTCH GEAR
18. HUB SLEEVE
19. 'C' TYPE RETAINING RING
20. CONICAL SPRING
21. CAM FOLLOWER
22 OUTER CAGE
23. INNER CAGE
24. SNAP RING
25. BRAKE BAND
26. DRAG SLEEVE AND DETENT
27. SPACER
28. RETAINING RING
29. LOCK NUT
30. RETAINING WASHER
31. ADJUSTING NUT
32. OUTER-WHEEL BEARING
33. INNER-WHEEL BEARING
34. SEAL
35. HUB–AND–DISC ASM
36. SPINDLE
37. SPINDLE BEARING
38. SEAL
39. DEFLECTOR
40. SPACER
41. LUBE FITTING
42. UPPER BEARING CAP
43. PRESSURE SPRING
44. GASKET
45. BUSHING, KING–PIN
46. KING–PIN
47. YOKE
48. OUTER AXLE SHAFT
49. GREASE RETAINER
50. LOWER BEARING
51. SEAL
52. BEARING CAP
53. LUBE FITTING
54. SPINDLE ATTACHING NUT
55. SPINDLE ATTACHING BOLT

Fig. 3C-2K--K30 w/Warner Gear Automatic Hub and King Pins



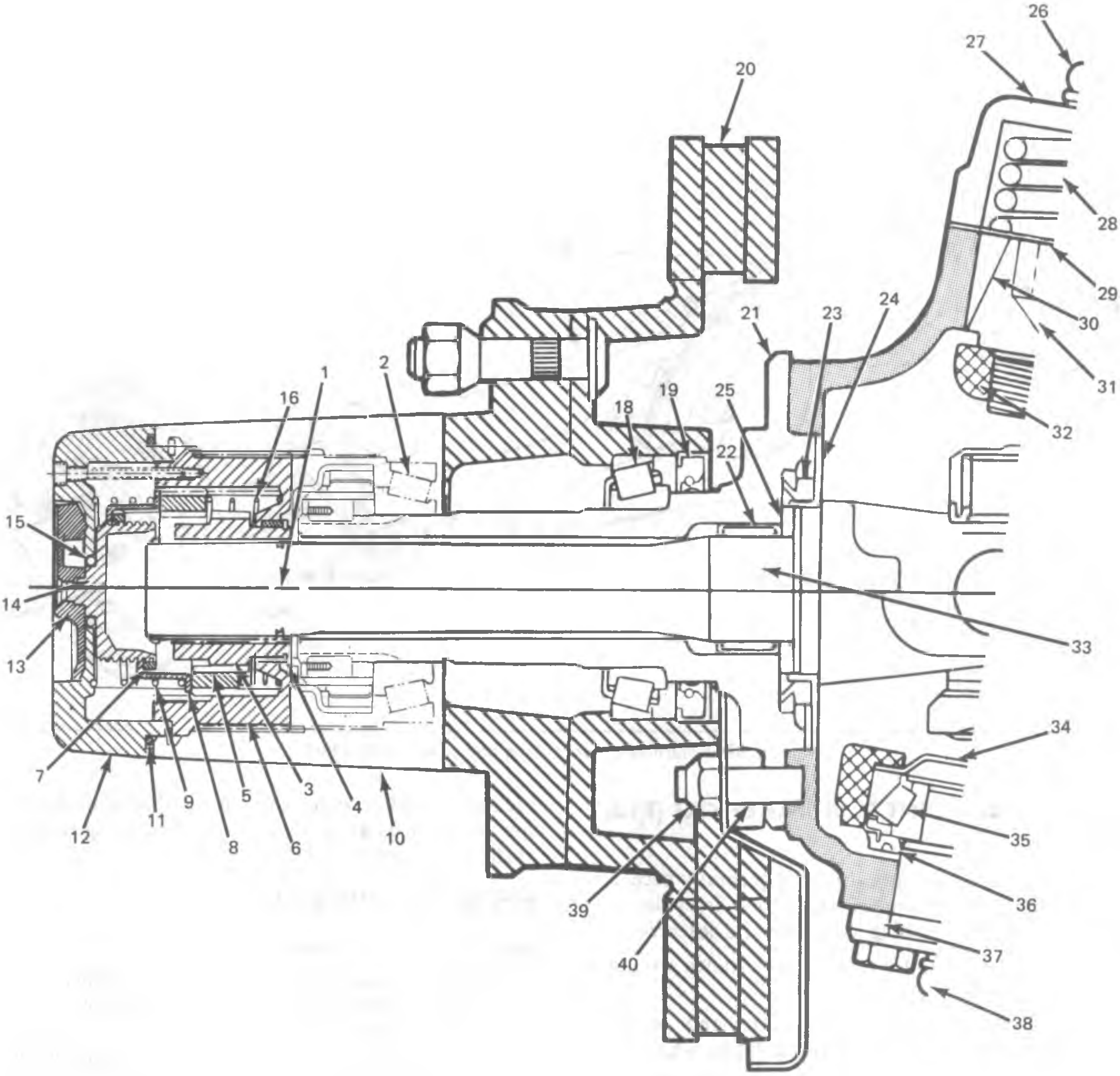
1 Drive Gear
2 Ring Gear
3 Gear Spring
4 Shaft Spring Retainer
5 Ring Gear Spring Retainer
6 Ring Gear Spring
7 Adapter
8 Pin Cam Follower
9 Camlock
10 Tri Cam
11 Gear Seat Retaining Ring
12 Thrust Bearing
13 Spindle Weldment
14 Retaining Ring
15 Cage
16 Key
17 Bearing Assembly, Outer
18 Thrust Washer
19 Lock Ring
20 Lock Nut
21 Spiral Pin
22 Spring Retainer K30 Only
23 Outer-Wheel Bearing
24 Inner-Wheel Bearing
25 Spindle
26 Spindle Bearing
27 Seal
28 Hub And Disc Assembly
29 Oil Seal
30 Spacer
31 Dust Seal
32 Deflector
33 Axle Outer Shaft
34 Knuckle
35 Adjusting Sleeve
36 Upper Ball Joint
37 Yoke
38 Lower Ball Joint
39 Retaining Ring
40 Caliper Support Bracket
41 Spindle Retaining Nut
42 Spindle Retaining Bolt

Fig. 3C-3K--K10, K20 w/Monroe Autolok Hub and Ball Joints



1 Drive Gear
2 Ring Gear
3 Gear Spring
4 Shaft Spring Retainer
5 Ring Gear Spring Retainer
6 Ring Gear Spring
7 Adapter
8 Pin Cam Follower
9 Camlock
10 Tri Cam
11 Gear Seat Retaining Ring
12 Thrust Bearing
13 Spindle Weldment
14 Retaining Ring
15 Cage
16 Key
17 Bearing Assembly, Outer
18 Thrust Washer
19 Lock Ring
20 Lock Nut
21 Spiral Pin
22 Spring Retainer K30 Only
23 Inner-Wheel Bearing
24 Seal
25 Hub-And-Disc Asm
26 Spindle
27 Spindle Bearing
28 Seal
29 Deflector
30 Spacer
31 Lube Fitting
32 Upper Bearing Cap
33 Pressure Spring
34 Gasket
35 Bushing, King Pin
36 King-Pin
37 Yoke
38 Outer Axle Shaft
39 Grease Retainer
40 Lower Bearing
41 Seal
42 Bearing Cap
43 Lube Fitting
44 Spindle Attaching Nut
45 Spindle Attaching Bolt
46 Outer Wheel Bearing

Fig. 3C-4K--K30 w/Monroe Autolok Hub and King Pins



1 Axle Shaft
2 Outer Bearing
3 Inner Drive Gear
4 Internal Snap Ring
5 Clutch Ring
6 Hub Body
7 Clutch Nut
8 Clutch Cup
9 Compression Spring
10 Hub
11 "O" Ring
12 Hub Cap
13 Dial Control
14 Dial Screw
15 "O" Ring
16 Spring
18 Inner-Wheel Bearing
19 Seal
20 Hub-And-Disc Asm
21 Spindle
22 Spindle Bearing
23 Seal
24 Deflector
25 Spacer
26 Lube Fitting
27 Upper Bearing Cap
28 Pressure Spring
29 Gasket
30 Bushing, King Pin
31 King Pin
32 Yoke
33 Outer Axle Shaft
34 Grease Retainer
35 Lower Bearing
36 Seal
37 Bearing Cap
38 Lube Fitting
39 Spindle Attaching Nut
40 Spindle Attaching Bolt

Fig. 3C-5K--K30 w/Warn Industries Manual Hublock and King Pins

MAINTENANCE AND ADJUSTMENTS

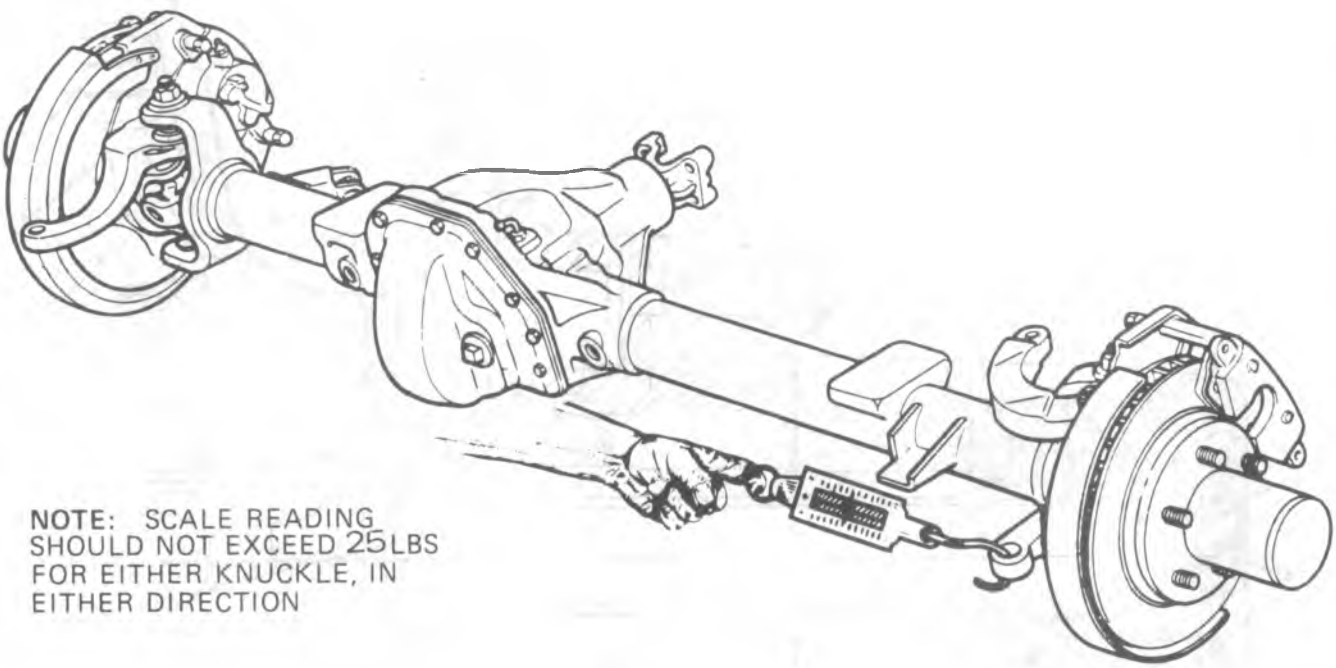


Fig. 3C-6K--Determining Front Axle Ball Joint Turing Effort

CHECKING BALL JOINT TURNING EFFORT (K10, K20)

Front axle ball joint adjustment is generally necessary only when there is excessive play in steering, irregular wear on tires or persistent loosening of the tie rod is observed.

1. Raise vehicle on hoist then place jack stands just inside of front springs.
2. Disconnect connecting rod and tie rod to allow independent movement of each steering knuckle.
3. Apply a fish-scale to the tie rod mounting hole of the steering knuckle arm. With the knuckle assembly in the straight-ahead position, determine the right angle pull required to keep the knuckle assembly turning after initial break-away. This pull should not exceed 25 lbs., for each knuckle assembly, in either direction. See Figure 3C-6K. Refer to Fig. 3C-42K for ball stud sleeve adjustment.

BEARING LUBRICATION

Front Wheel Bearings

Spindle Bearings

Whenever front wheel bearings are lubricated, the spindle needle bearings should also be lubricated, with the same chassis grease. Under normal conditions, the lubrication interval should be 12,000 miles; off-road use such as in mud or water will require shorter intervals. The spindle bearings are accessible after removing the spindle, as shown in Figure 3C-33K.

WHEEL BEARING ADJUSTMENT

Warner Gear Automatic Hub

1. After lubricating the wheel bearings and the spindle bearings, install the hub-and-disc, and the outer wheel bearing to the spindle.
2. Torque the inner adjusting nut to 50 foot pounds, (60 N·m) while rotating the hub-and-disc to seat the bearings. Use Tool J-6893 and Adapter J-23446 or J-6893-01 for K10, K20; use J-26878 for K30. Back off the inner adjusting nut and retorque to 35 ft. lbs. (47 N·m) while the hub is being rotated.
3. Back off the inner adjusting nut again 3/8 turn maximum. Assemble the drag sleeve retainer washer over the axle shaft against the bearing adjusting nut (Item #30, Fig. 3C-6K). The tang on the inside diameter of this washer is assembled in the keyway of the spindle. The pin on the inner nut (Item #31) MUST pass through one of the holes in the retainer washer. Assemble and tighten the outer lock nut to 217-310 N·m (160-205 lb. ft.).

   Hub assembly should have .025 to .254 mm (.001 to .010 inch) end play.
4. Install the locking hub assembly. Refer to hub assembly and installation procedures.

Warn Industries Manual Locking Hub

Monroe Auto-Lok Hub

1. After lubricating the wheel bearings and the spindle bearings, install the hub and disc, and the outer wheel bearing to the splindle.
2. Torque the locking nut to 95 N·m (70 ft. lbs.) with tool J-34616 for 10 and 20 series and J-34617 for 30 series while rotating the hub to seat the bearings.
3. Back off the lock nut and retorque to 47 N•m (25 ft. lbs.) while spinning the hub.
4. Back off the nearest slot and insert locknut key.
5. .001 to .010 end play should result from this adjustment. If the end play is less than. 002, hub turning torque should not exceed 25 in. lbs. with brake caliper removed. If you have more than 25 in. lbs., back off key one slot and recheck end play.
6. Install locking hub assembly.

COMPONENT REPLACEMENT

NOTICE: See NOTICE on page 1 of this section, regarding the fasteners in the following procedures for Locking Hub Replacement.

AUTOMATIC LOCKING HUBS

GENERAL DESCRIPTION

An automatic hub lock engages or disengages to connect the front axle shaft to the hub of the front wheel. Engagement occurs whenever the vehicle is operated in 4WD. Selection of 2WD permits the transfer case to disengage front auxiliary propshaft drive. Subsequent reversal of vehicle direction (after selection of 2WD) allows driveline torque to be relieved and disengagement of the automatic hub lock, approximately 10 ft. is required. Disengagement will not be maintained when the vehicle is moved back and forward during 4WD operation.

Warner Gear Automatic Hub

The outer clutch housing is splined to the wheel. The hub sleeve is splined to the front axle shaft. The clutch gear is splined to the hub sleeve. The drag sleeve is keyed to the wheel bearing retainer washer. Engagement occurs when the clutch gear is moved on the splines of the hub sleeve to engage the internal teeth of the outer clutch housing.

The cam surface of the steel inner cage forces the cam follower and clutch gear to move outward toward the cover and into engagement with the clutch teeth of the outer clutch housing. A lug on the inside of the drag sleeve retainer washer keys the washer to the spindle and two lock nuts retain this washer in position on the spindle. Cutouts in the drag sleeve engage the four tabs on the drag sleeve retainer washer to hold the drag sleeve in a fixed position with respect to the axle shaft. The one way clutch spring (called a brake band) is positioned over the serrated portion of the drag sleeve.

Engagement is accomplished (when four-wheel drive is selected) by the movement of the axle shaft, causing one of the tangs of the brake band to engage the steel outer cage and hold the cage while the cam follower moves the clutch gear into mesh with the outer clutch housing. One of the tangs of the brake band is used for engagement. The other tang is used to maintain free motion of the brake band relative to the drag sleeve during four-wheel drive operation (after the hub lock engages). Disengagement is accomplished (after two-wheel drive has been selected) by the reverse movement of the wheel causing the clutch gear, hub sleeve, and cam follower to rotate. The cam follower rotates away from the lugs of the plastic outer cage, allowing the follower to move to the disengaged condition. The release spring then moves the clutch gear out of mesh with the outer clutch housing to disengage the wheel from the axle shaft.

Monroe Auto-Lok

The adaptor housing is splined to the wheel hub. The drive gear is splined to the axle shaft. The ring (intermediate) gear is splined to the adaptor housing. Engagement occurs when the drive gear is moved along the rotating axle shaft, engaging the teeth of the ring gear.

When the vehicle is placed into four wheel drive (4H or 4L), this action directs power to the front axle, which turns the axle shaft, activating the tricam mechanism to move the drive gear outward into engagement with the ring gear. This completes the four wheel drive actuation.

Disengagement is accomplished (after 2WD is selected) by the reverse movement of the wheels causing the drive gear and tri-cam to rotate to the disengaged condition, moving the drive gear out of mesh with the hublock ring gear.

MANUAL LOCKING HUBS

GENERAL DESCRIPTION

The manual locking hub shown in Figure 3C-9K engages or disengages to lock the front axle shaft to the hub of the front wheel. Engagement occurs when the hubs are manually placed in the lock position. Disengagement occurs when the hubs are manually placed in the free position and the vehicle is moved rearward.

NOTE: Both manual hub locks must be locked to transfer torque to the front wheels when the transfer case is shifted to 4WD. Conversely maximum fuel economy will not be obtained unless both manual hub locks are disengaged during 2WD transfer case operation. Operation in 2WD with front hub locks engaged permits changing from 2WD to 4WD without stopping the vehicle to engage hub locks, however fuel economy will be reduced under this condition.

Warn Industries Manual Locking Hub

Gear #3 is splined to the hub of the wheel. Gear #1 is splined to the axle shaft. Gear #2 is able to spline with the internal splines of the gear #3 and the external splines of gear #1. Engagement occurs when the hub is placed in the lock position This slides the gear #2 into mesh with gear #1 and #3. Disengagement occurs when the hub is placed in the free position, spring pressure pushes the gear #2 away from gear #1 and #3.

Preliminary Checking

Before disassembling a unit for complaint of abnormal noise, read the following:

- To obtain all-wheel drive, the transfer case lever must be placed in (4L) or (4H), at which time the hub locks will automatically engage.
- To unlock (free wheel) the hubs, shift the transfer case lever to (2H), then slowly reverse vehicle direction approximately ten feet.
- Incomplete shift from 2WD to 4WD, or disengagement of only one hub lock may cause an abnormal sound from the front axle. Shift to 4WD to stop the noise, then unlock the hubs as described before.

HUB REPLACEMENT

Removal of Warner Gear Automatic Hub

1. Remove the five screws (item # 1, Figs. 3C-1K and 2K) which retain the cover (# 3) to the outer clutch housing (# 10).
2. Remove the cover, seal (#4), seal bridge (# 11), and bearing components (# 5, 6, 7, 8).
3. Use needle-nose pliers to compress the wire retaining ring (#9), and pull the remaining components from the wheel.

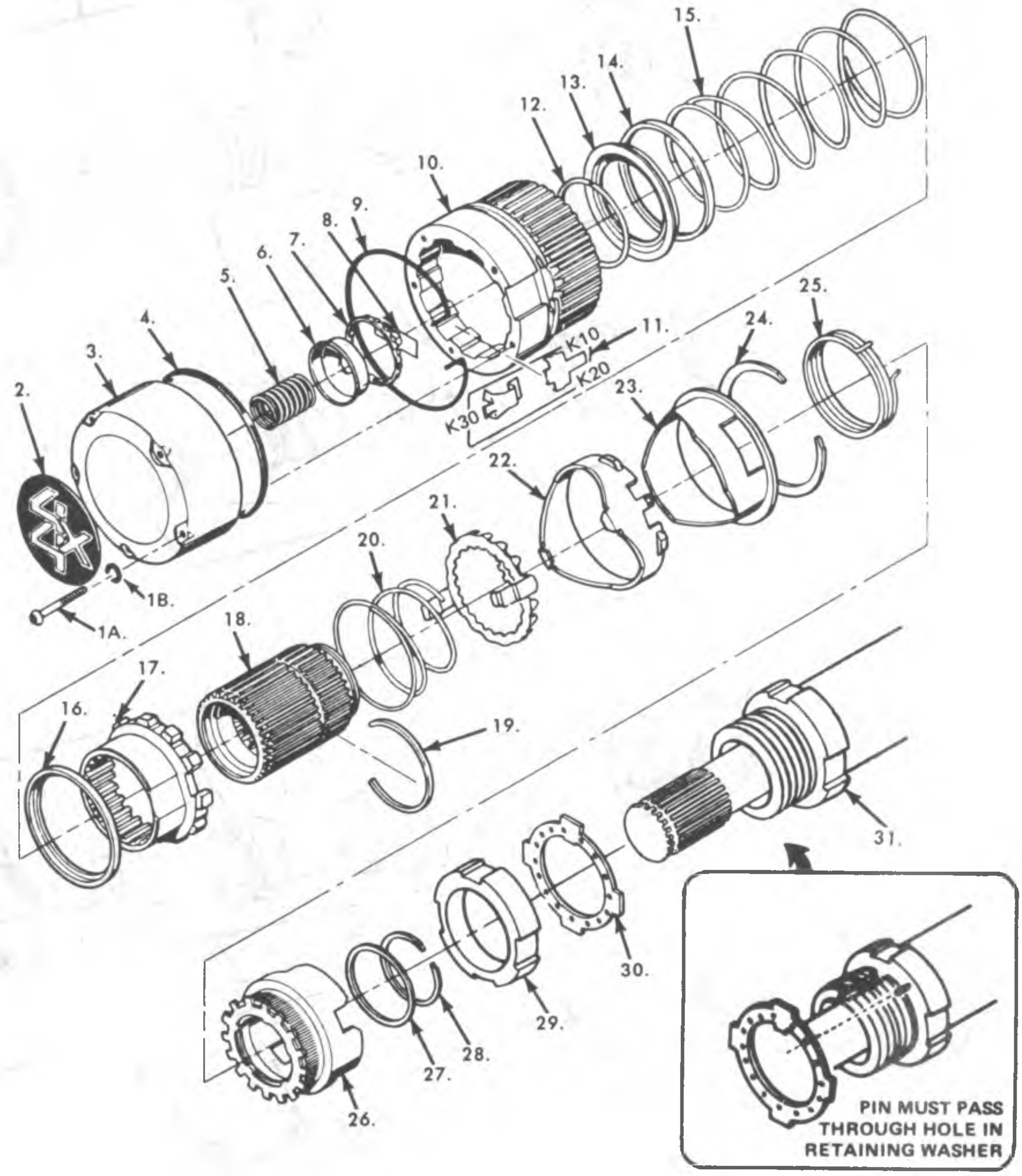
Disassemble Warner Gear Automatic Hub

1. Remove the snap ring (#28) from the groove of the hub sleeve (# 18).
2. Turn the clutch gear (# 17) until it drops into engagement with the outer clutch housing (# 10). Lift and cock the drag sleeve (#26) to unlock the tangs of the brake band (#25) from the window of the inner cage (#23) and remove drag sleeve and brake assembly.

   It is important that the brake band should never be removed from the drag sleeve. The spring tension of the brake band can be changed if the coils are over-expanded and this could affect the operation of the hub.
3. Remove the snap ring (#24) from the groove in the outer clutch housing.
4. Use a small screwdriver to pry the plastic outer cage (#22) free from the inner cage (#23) while the inner cage is being removed.
5. Use a small screwdriver to pry the plastic outer cage tabs free from the groove in the outer clutch housing. Remove outer cage.
6. Remove the clutch sleeve (#18) and attached components from the outer clutch housing.
7. Compress the return spring (# 15) and hold the spring in the compressed condition with fabricated clamps as shown in Fig. 3C-10K. After the clamps are installed, position the entire assembly in a bench vise so that the vise holds both ends of the clutch sleeve. Remove the retaining ring (# 12).
8. With the clutch sleeve assembly still in the vise, remove the clamps holding the return spring. Slowly open the vise to permit releasing of the return spring in a controlled manner. Remove the retainer seat, spring and spring support washers (# 13, 14) from the hub sleeve.
9. Remove the C-type retaining ring (# 19) from the clutch sleeve. It is necessary to position the sleeve assembly so that the C-ring ends are aligned with the legs of the cam follower, allowing removal between the two legs.
10. Remove the conical spring (#20) from between the cam follower and the clutch gear.
11. Separate the cam follower (#21) from the clutch gear (# 17).

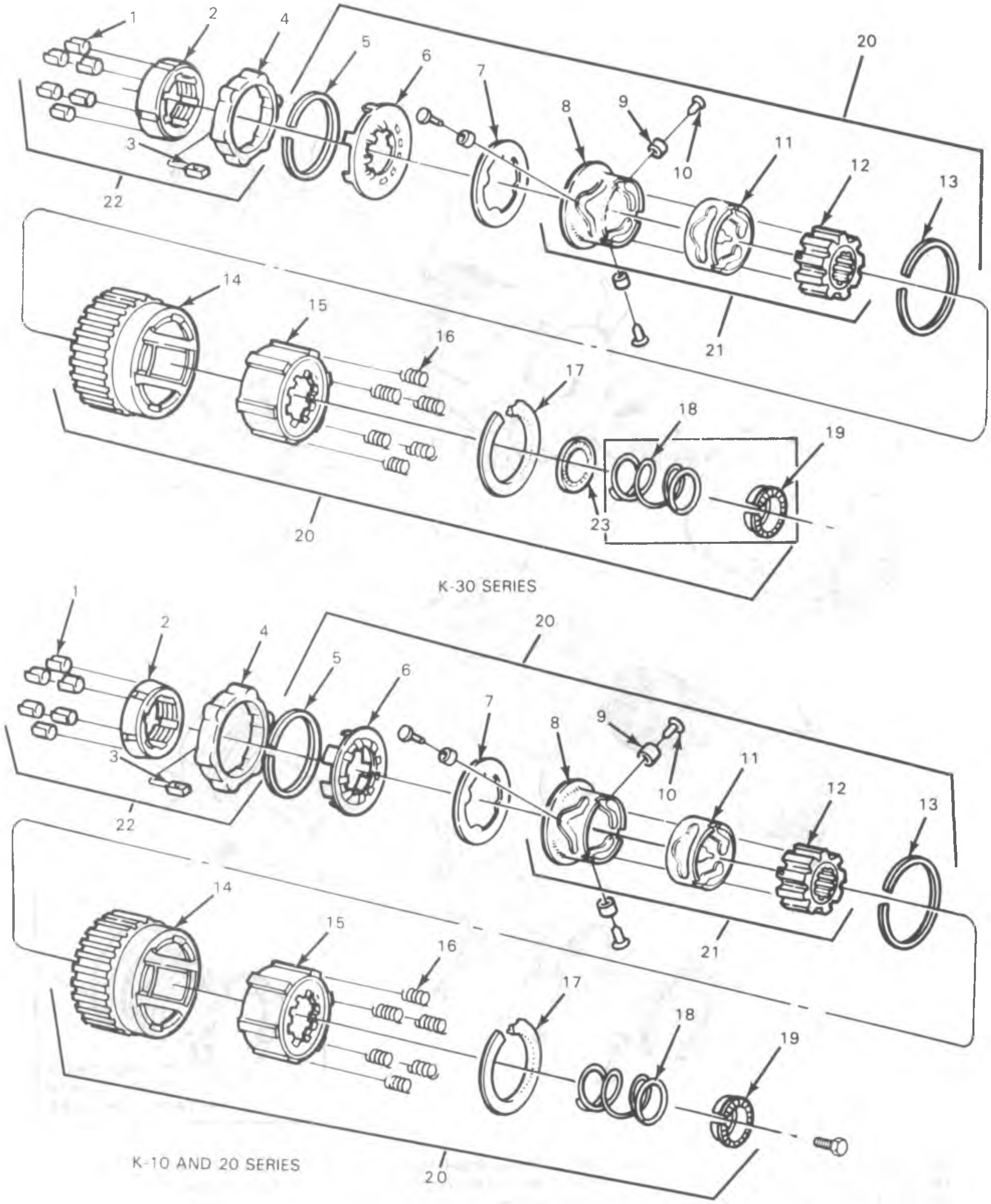
Reassemble Warner Gear Automatic Hub

1. Snap the tangs of the cam follower (#21) over the flats of the clutch gear (# 17).
2. Compress the conical spring (#20) and slide it into position with the large diameter of the spring located against the clutch gear.
3. Position the clutch gear assembly over the splines of the hub sleeve (# 18). The teeth of the cam follower should be located at the end of the hub sleeve which has no splines. The clutch gear and spring should slide freely over the splines of the hub sleeve.
4. Assemble the "C" shaped retainer ring (# 19) in the groove of the hub sleeve.
5. Assemble a spring retainer (# 14, 16) over each end of the return spring (# 15).
6. Position one end of the return spring with retainer (# 16) against the shoulder of the clutch gear.
7. Place the spring support washer (# 13) against the retainer on the end of the return spring. Compress the return spring and assemble the retainer ring (# 12) in the groove of the hub sleeve. Two "C" shaped clamps may be used to retain the return spring while the retainer ring is being assembled. Refer to Fig. 3C-7K.
8. The two "C" shaped clamps may be fabricated from 3/8" (9.5mm) wide by 3/32" or 1/8" (2.4-3.2mm) thick stock. The distance between the two legs of the clamps should be approximately 1-1/4" (31.8mm).
9. Place the components assembled in steps 1 through 7 into the outer housing (# 10). The cam follower should be positioned with the two legs directed outboard.
10. Screw three of the cover screws (# 1) into three holes of the outer clutch housing. These screws will support the component to permit the clutch hub to drop down so that the tangs of brake band (#25) may be assembled.
11. Carefully work the plastic outer cage (#22) into the outer clutch housing with the ramps facing toward the cam follower. The small external tabs of the plastic cage should be located in the wide groove of the outer clutch housing.
12. Assemble the steel inner cage (#23) into the outer cage, aligning the tab of the outer cage with the "window" of the inner cage.
13. Assemble the retaining ring (#24) into the groove of the outer clutch housing above the outer cage.
14. The brake band and drag sleeve are serviced as an assembly.



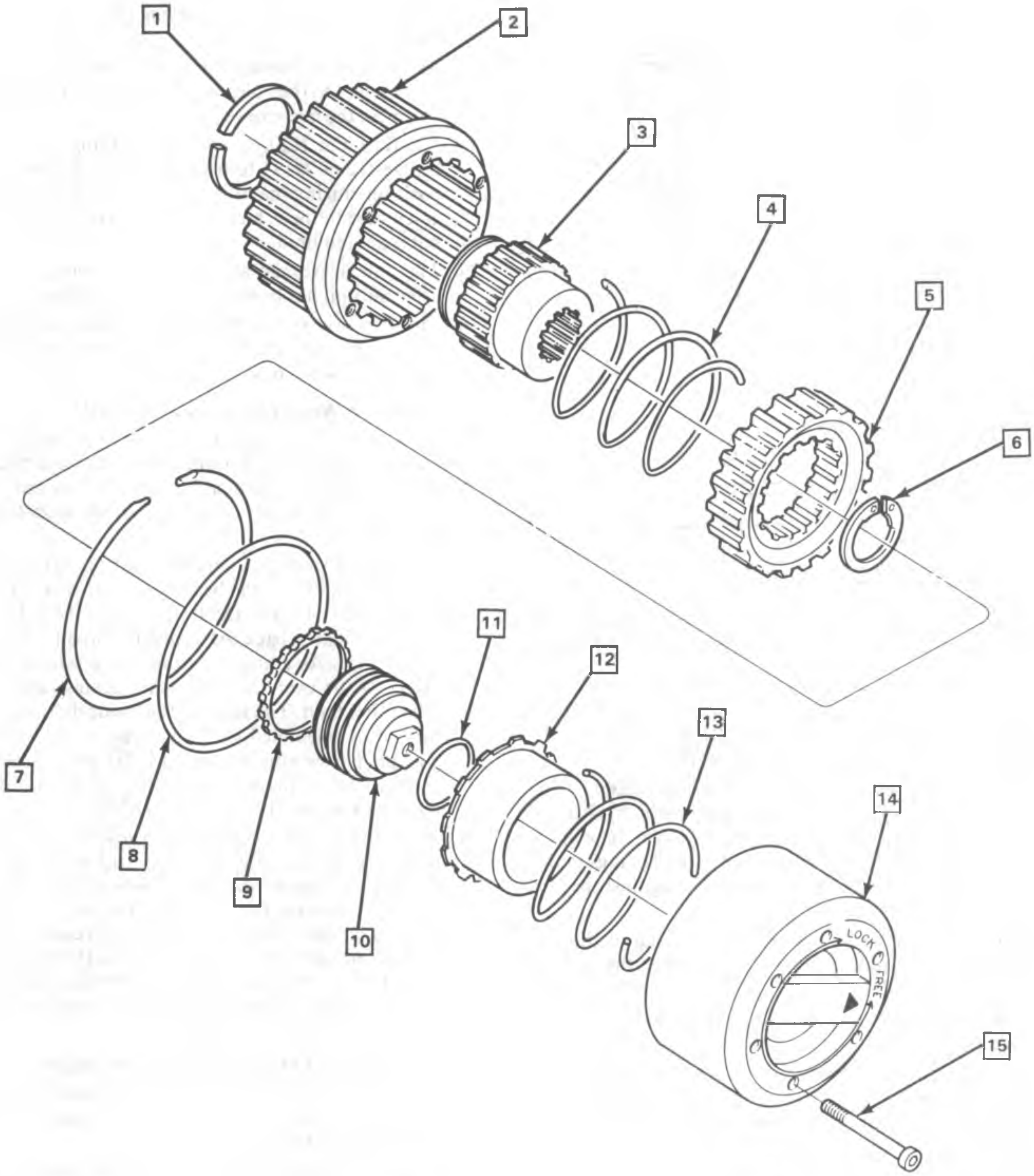
1A. Machine Screw
1B. O-Ring Seal
2. Cover Plate
3. Cover
4. Sealing Ring
5. Bearing Race Spring
6. Bearing Inner Race
7. Bearing
8. Bearing Retainer Clip
9. Wire Retaining Ring
10. Outer Clutch Housing
11. (K10-20) Seal Bridge-Retainer
(K30) Assembly Aid-Retainer
12. Retaining Ring
13. Spring Support Washer
14. Spring Retainer
15. Return Spring
16. Spring Retainer
17. Clutch Gear
18. Hub Sleeve
19. "C" Type Retaining Ring
20. Conical Spring
21. Cam Follower
22. Outer Cage
23. Inner Cage
24. Snap Ring
25. Brake Band
26. Drag Sleeve and Detent
27. Small Spacer
28. Retaining Ring
29. Lock Nut
30. Drag Sleeve Retainer Washer
31. Adjusting Nut, Wheel Bearing

Fig. 3C-7K--Warner Gear Automatic Hub



1 Spiral Pin
2 Lock Nut
3 Key
4 Cage
5 Inboard Retaining Ring
6 Spindle Lock Weldment
7 Thrust Bearing
8 Tri Cam
9 Roller-Cam Follower
10 Rim-Cam Follower
11 Camlock
12 Drive Gear
13 Gear Seat Retaining Ring
14 Adapter
15 Ring Gear
16 Ring Gear Spring
17 Ring Gear Spring Retainer
18 Drive Gear Spring
19 Drive Shaft Spring Retainer
20 Autolok Assembly
21 Cam Lock Assembly
22 Cage and Nut Assembly
23 Spring Retainer K-30 Series Only

Fig. 3C-8K--Tenneco Autolok Hub



1	Internal Snap Ring	6	Axle Shaft Snap Ring	11	"O" Ring
2	Hub Body	7	Lockring	12	Clutch Cup
3	Inner Drive Gear	8	"O" Ring	13	Compression Spring
4	Spring	9	Clutch Nut	14	Hub Cap
5	Clutch Ring	10	Dial Screw	15	Screw

Fig. 3C-9K--Warn Industries Manual Locking Hub, K30 Series

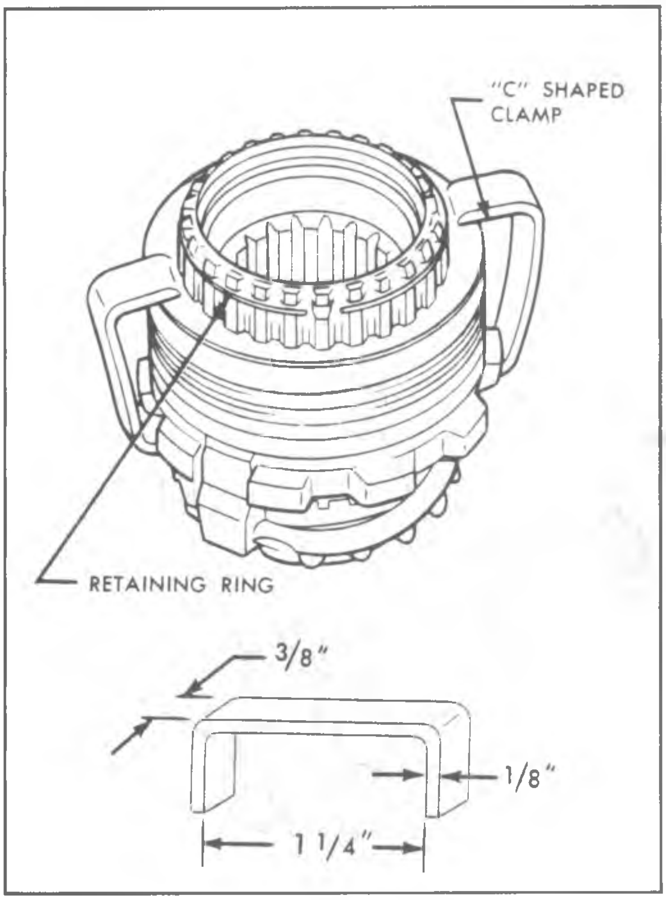


Fig. 3C-10K--Using Clamp and Vise to Compress Return Spring

In the event that the original lubricant has been removed or contaminated, Part No. 1052750 or equivalent, MUST be used to lubricate this assembly. DO NOT USE any other type lubricant.

15. Assemble one of the two tangs of the brake band (#25) on each side of the lug of the outer cage which is located in the window of the steel inner cage. It will be necessary to cock these parts to engage the tangs in this position as the drag sleeve is positioned against the face of the cam follower.
16. Remove the three screws and rest the end of the hub sleeve on a suitable support. Assemble the washer (#27) and snap ring (#28) above the drag sleeve.

The following steps may be completed as hub is assembled to vehicle.

17. Assemble the wire retaining ring (#9) in the groove in the unsplined end of the outer clutch housing. The tangs of the retainer ring should point away from the splined end of the clutch housing.
18. Hold the tangs of the wire retainer together and assemble Item #11 over the tangs. This holds the wire retainer ring in a clamped condition in the groove of the outer clutch housing. For K10 and K20, assemble the "O" ring in the groove of the outer clutch housing and over seal bridge.
19. Assemble the bearing (#7) over the inner race (#6). Lubricate the bearing as it is assembled with light wheel bearing grease. The steel balls should be visible when bearing is properly assembled.
20. Snap the bearing retainer clip (#8) into the hole in the outer race.
21. Assemble the bearing and retainer assembly in the end of the hub sleeve. Assemble the seal ring (#4) over the outer clutch housing.
22. Assemble the bearing race spring (#5) into the bore in the cover.
23. Assemble the cover and spring assembly. Align the hole in the cover to the holes in the outer clutch housing and assemble the five screws.
24. For K10 and K20, assemble the 0-ring over the seal bridge (Item #11) to prevent it from jumping out of position during handling prior to the hub bearing assembled to the vehicle. This "O" ring may be left on but is not required.
25. The hub sleeve and attached parts should turn freely after the unit has been completely assembled.
26. The five cover screws must be loosened to assemble the hub to the vehicle. Torque these screws after hub is installed to 4.5-5.6 N·m (40-50 in-lbs.).

Assemble New Warner Gear Hub to Wheel

27. A drag sleeve retainer washer (#30) is supplied with each new assembly. Assemble this washer between the wheel bearing adjustment nut and the lock nut. Adjust the inner nut to give proper bearing adjustment as follows.
28. Use J-6893 to torque adjusting nut (#31) to 60 N·m (50 ft. lbs.), to seat the bearings; then, back off the nut and torque to 47 N·m (35 ft. lbs.) while the hub is being rotated. Finally, back the adjusting nut off a maximum of 3/8 turn. Assemble the drag sleeve retainer washer (Item #30) over the axle shaft against the bearing adjustment nut. The tang on the inside diameter of this washer is assembled in the keyway of the axle shaft. The pin on the adjusting nut MUST pass through one of the holes in the washer. Assemble and tighten the outer lock nut to 217-310 N·m (160-205 lb-ft).
29. Align the cut-outs in the drag sleeve with tabs on the drag sleeve washer as the splines of the outer clutch housing are assembled into splines of the hub of the wheel. Loosen the cover screws three or four turns and push in on these screws, to allow the retaining ring to expand into groove in hub of wheel as the seal bridge is forced from position over the retaining ring as the tang of seal bridge contacts wheel hub. Torque the cover screws to 4.5-5.6 N·m (40-50 lb. in.)

Assemble a Rebuilt Warner Gear Hub to Wheel

30. Steps 1-17 in the assemble procedure are usually completed whenever the hub is rebuilt and then assembled to the wheel.
31. Hold the two tangs of the retaining ring in the clamped condition as the assembled components are assembled to the hub of the wheel. See step 29 for installation of drag sleeve washer.
32. Assemble the retainer (Item #11) in the cut-out of the outer clutch housing. For K10 and K20, assemble the sealing ring over the outer clutch housing.
33. Assemble the bearing and retainer assembly into the hub sleeve.
34. Assemble the bearing race spring to the cover.

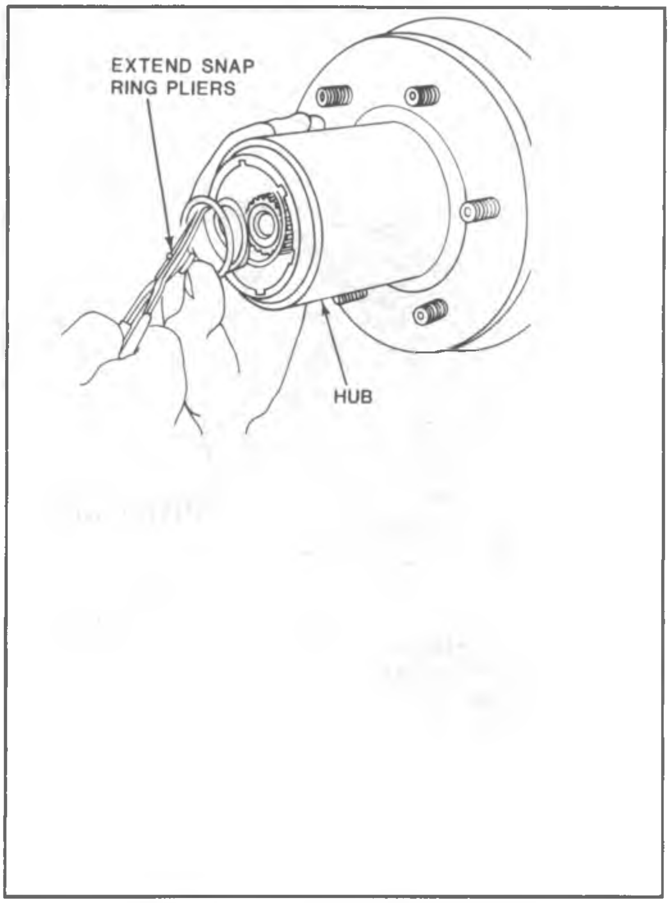


Fig.3C-11K--Removing Spring Retainer

35. Assemble the cover and cover bolts. Be sure that O-rings are in position under the bolts. Tighten cover screws to 4.5-5.6 N·m (40-50 lb. in.).

Removal of Monroe Auto-Lok Assembly

1. To remove hublock, remove tire and wheel, then remove hubcap from wheel hub.
2. Remove spring retainer using square shank tool (—Figure 3C-11K).
3. Remove loose spring (Figure 3C-12K).
4. Pull entire hublock assembly from wheel. NOTE - If hublock will not slide out freely, rotate wheel to free hublock (Figure 3C-13K).

   If wheel hub and spindle are to be removed,
5. Remove retaining ring from axle shaft groove (Figure 3C-14K).
6. Remove spacer from axle shaft (Figure 3C-15K).
7. Remove locknut key (use #4-40 threaded screw or needle nose pliers). NOTE - If key will not easily slide from keyway slightly rotate locknut to remove tension on key (Figure 3C-16K).
8. Remove wheel bearing locknut with J-34616 for 10 and 20 Series, J-34617 for 30 Series (Figure 3C-17K).

Monroe Auto-Lok Disassemble

1. Place hublock assembly face down (plastic bearing side down (Figure 3C-18K).
2. Pry inboard snap ring from assembly (Figure 3C-19K).
3. Remove spindlelock, thrust bearing and tricam assembly (Figures 3C-20K to 22K).
4. Clean, grease and replace worn parts as required.
5. Clean adaptor housing assembly as required. NOTE: If any part of this subassembly is damaged, the adaptor and ring gear assembly MUST totally be replaced (Figure 3C-23K). Cleaning this subassembly requires removal of the gear seat retaining ring (Figure 3C-24K). In most cases, it will not be necessary to disassemble and reassemble the ring and adaptor housing.
6. Slide the ring gear from the adaptor housing (Figure 3C-25K).
7. Remove (6) ring gear springs (Figure 3C-26K).
8. Remove ring gear spring retainer (Figure 3C-27K).

Monroe Auto-Lok Assembly

NOTE: In most cases, it will not be necessary to disassemble and reassemble the ring gear and adaptor housing. If this subassembly is complete; skip to Step 6.

1. Install ring gear spring retainer (Figure 3C-27K).
2. Place (6) springs in slots of adaptor houisng (Figure 3C-26K).
3. Grease outside surface of ring gear and slide into adaptor housing with the gear teeth closest to springs (Figure 3C-25K).
4. Insert and install ring gear retaining ring (Figure 3C-24K). NOTE - Check the (6) small springs to ensure they are properly seated.
5. Grease the tricam subassembly (Rollers and Campath) and install into housing assembly (Figure 3C-22K).
6. Install thrust bearing (Figure 3C-21K).
7. Install spindlelock (Figure 3C-20K).
8. Install inboard snap ring (Figure 3C-19K).
9. Turn spindlelock tangs in both directions to check for free movement.

If wheel hub and spindle were removed, refer to wheel bearing adjustment before installation of Monroe Auto-Lok Hub.

Installation of Monroe Auto-Lok

1. Install the hublock, by sliding the hub onto the axle shaft spline first and then by guiding the hub into the wheel hub spline. When the hublock bottoms out, rotate the entire wheel while pressing inward on the hub, until the hublock tangs engage with the wheel bearing locknut. Allow the hublock to slide inward and fully seat itself. Hublock should not protrude more than 3/8" from face of wheel hub (Figures 3C-28K and 29K).
2. Install spring into spring seat.
3. Unlock hublock by rotating wheel hub clockwise or counterclockwise while applying force to the drive gear with the spring (Figure 3C-30K hublock engaged, Figure 3C-31K, hublock disengaged.)
4. Install spring retainer and spring. NOTE - Do not pound the retainer on the axle, as damage to the retainer and axle will occur (Figure 3C-32K). (Use a block of wood to protect cup.)
5. Drive on hubcap.

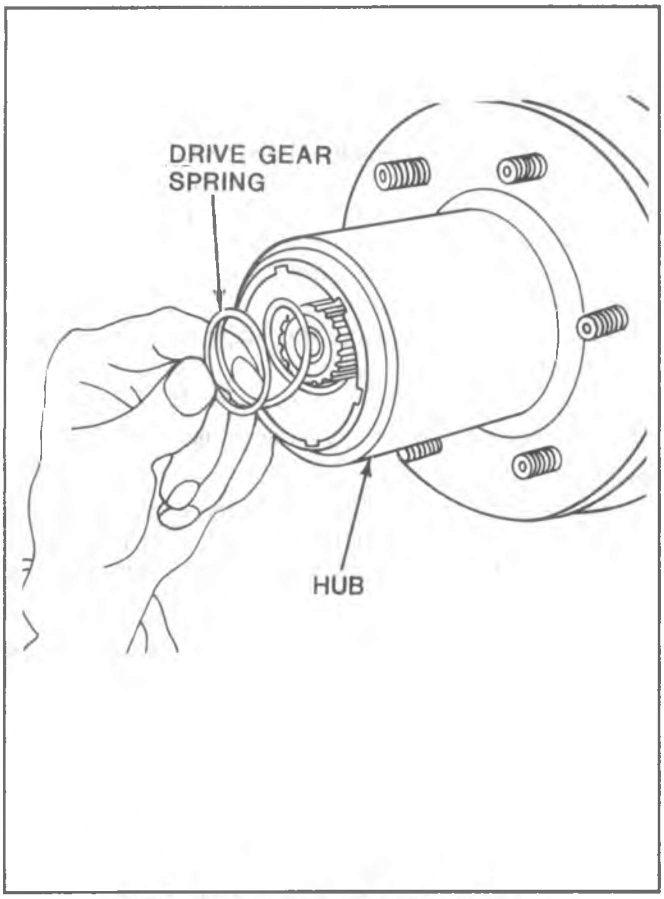


Fig. 3C-12K--Removing Drive Gear Spring

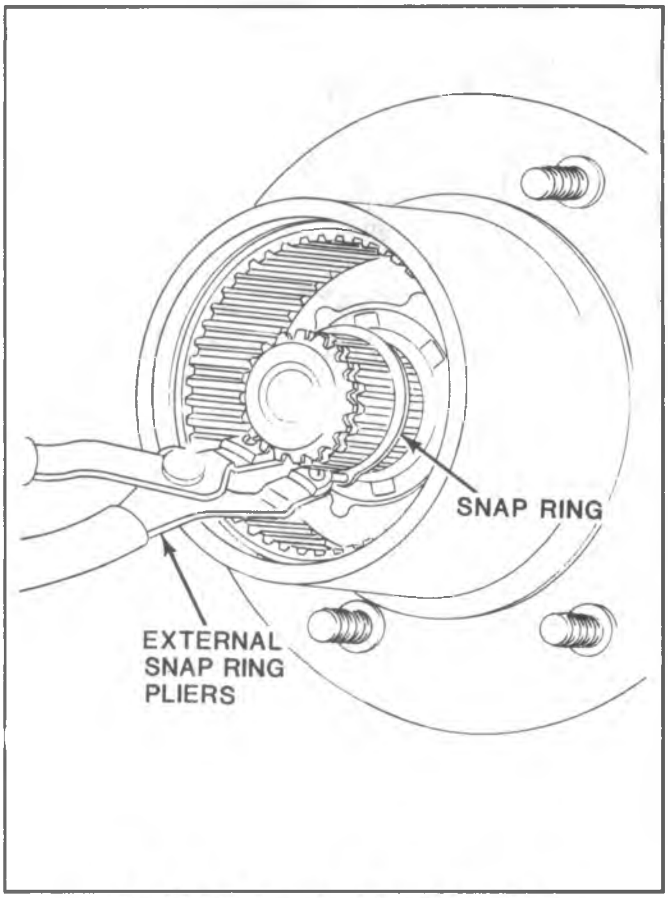


Fig. 3C-14K--Removing Inboard Snap Ring

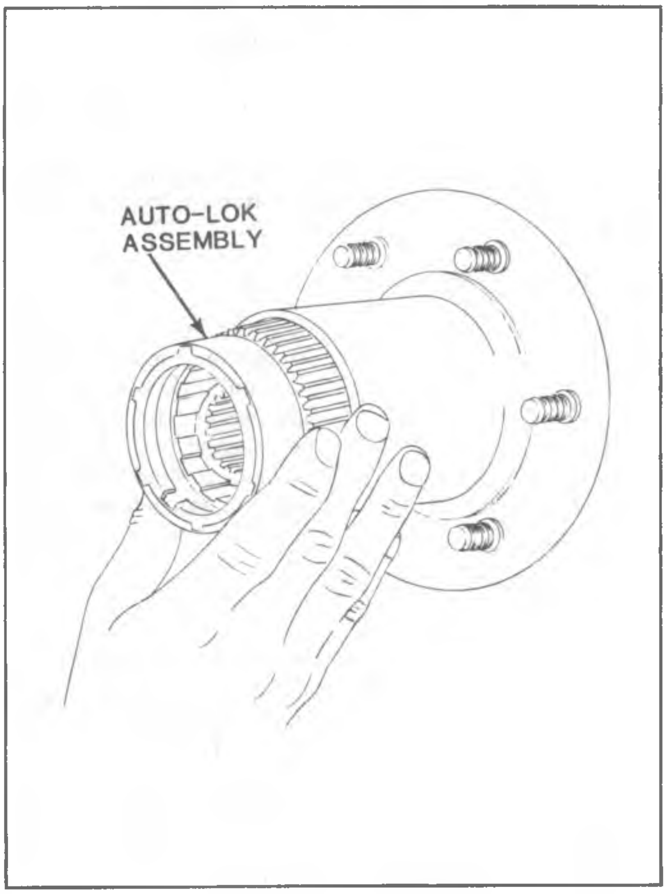


Fig. 3C-13K--Removing Auto-Lok Assembly

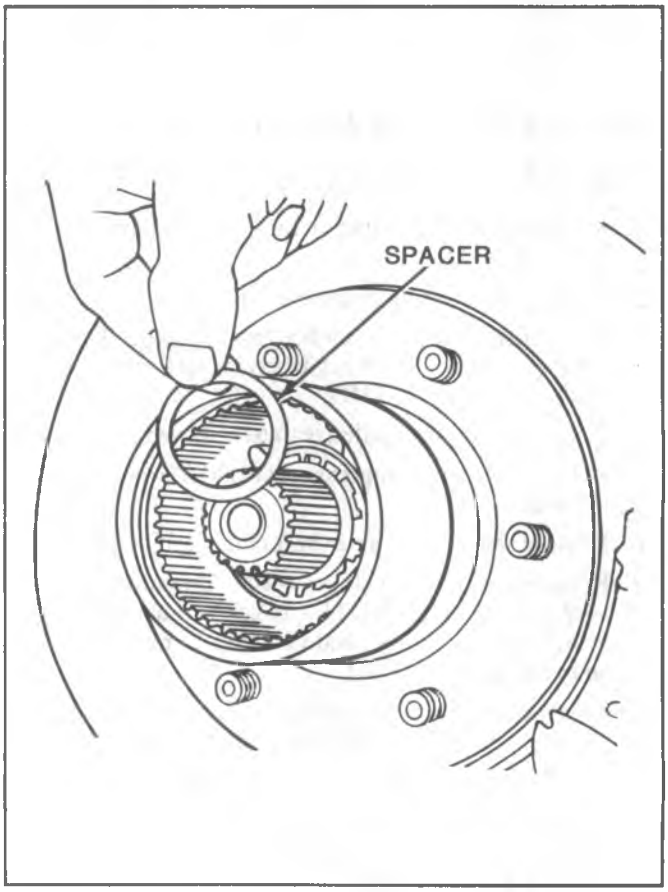


Fig. 3C-15K--Removing Spacer

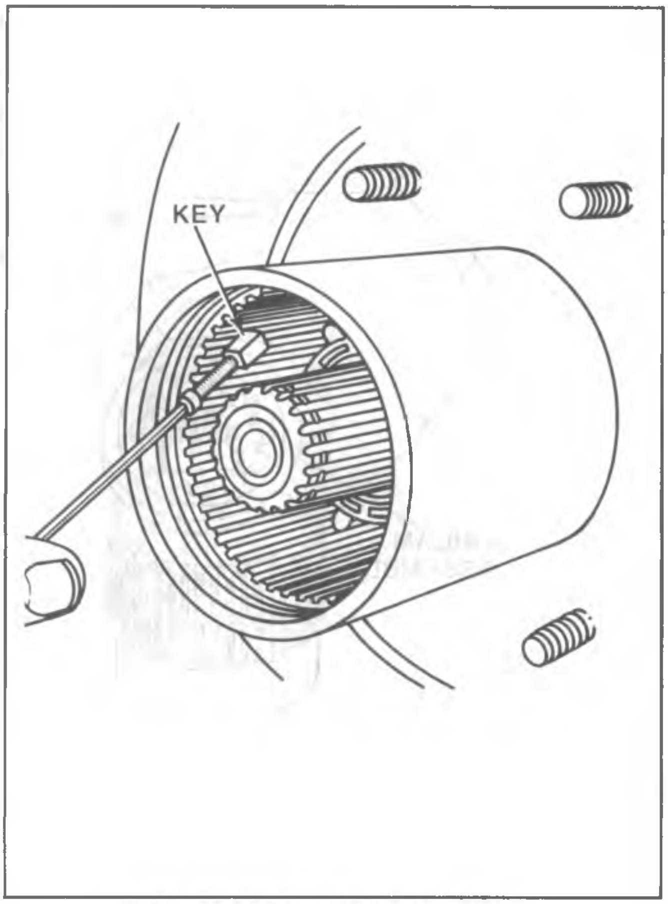


Fig. 3C-16K--Removing Locknut Key

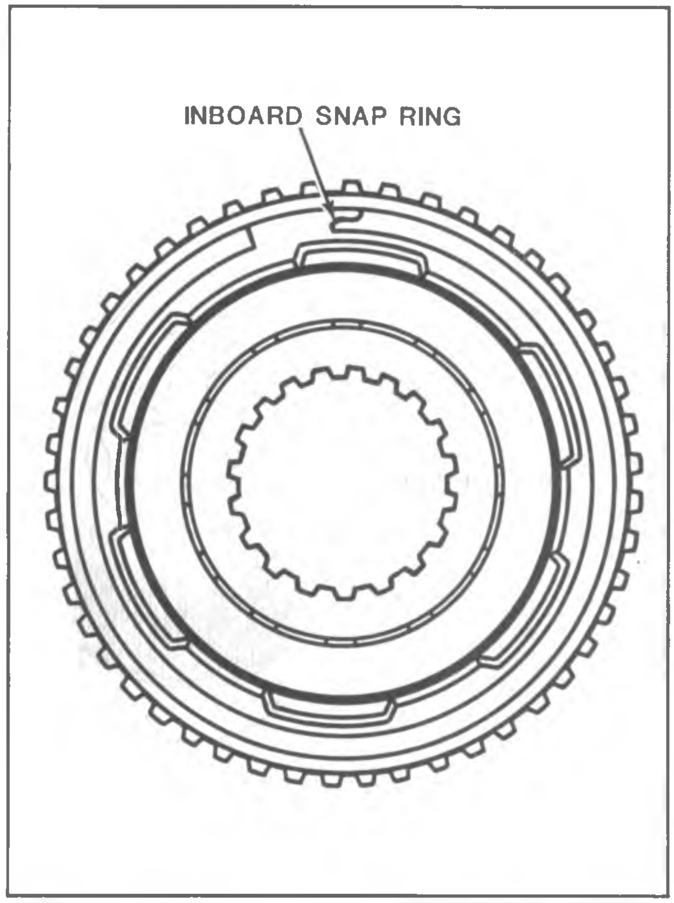


Fig. 3C-18K--Auto-Lok Assembly

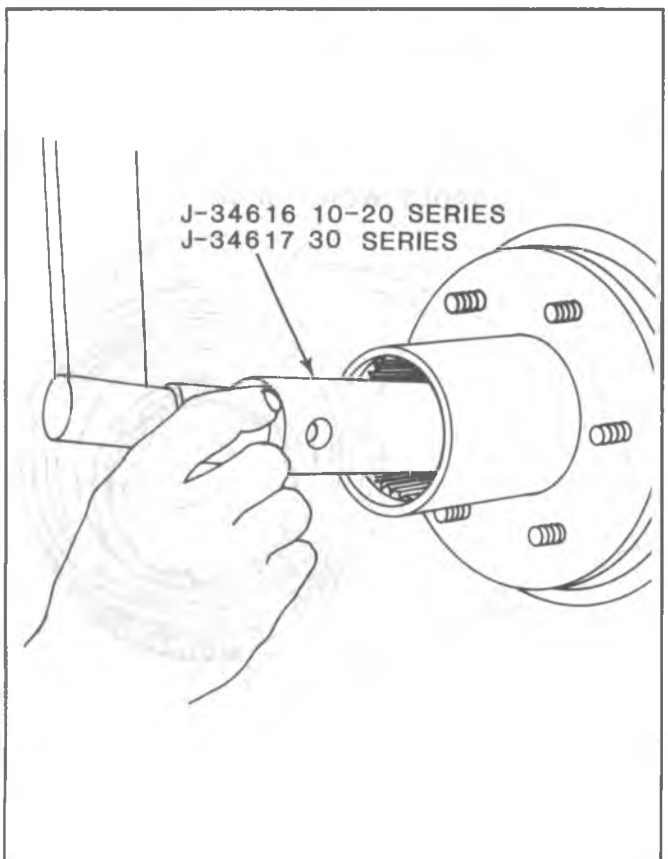


Fig. 3C-17K--Removing Lock Nut

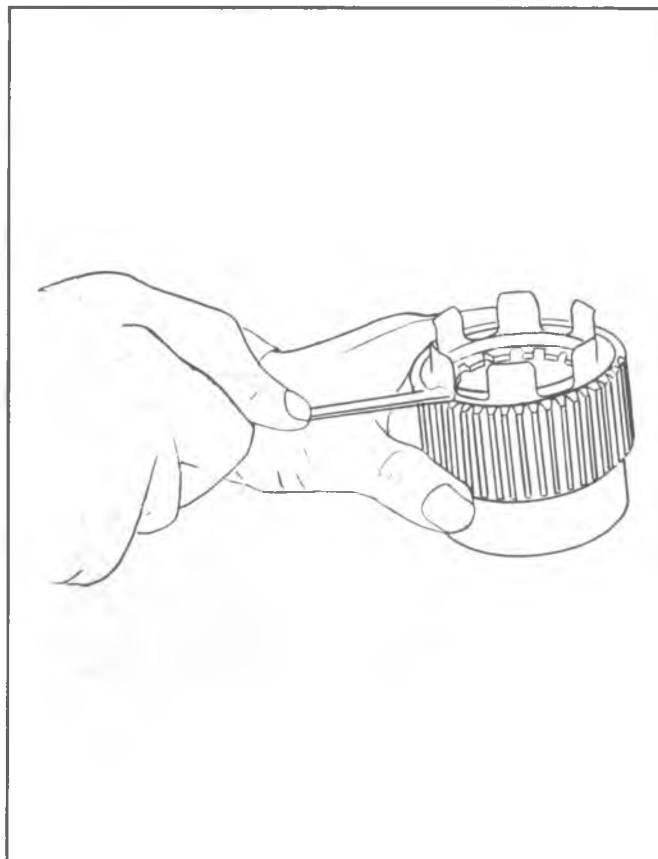


Fig. 3C-19K--Removing Inboard Snap Ring

Fig. 3C-20K--Removing Spindle Lock

Fig. 3C-22K--Removing Tricam Assembly

Fig. 3C-21K--Removing Thrust Bearing

Fig. 3C-23K--Badly Worn Gear

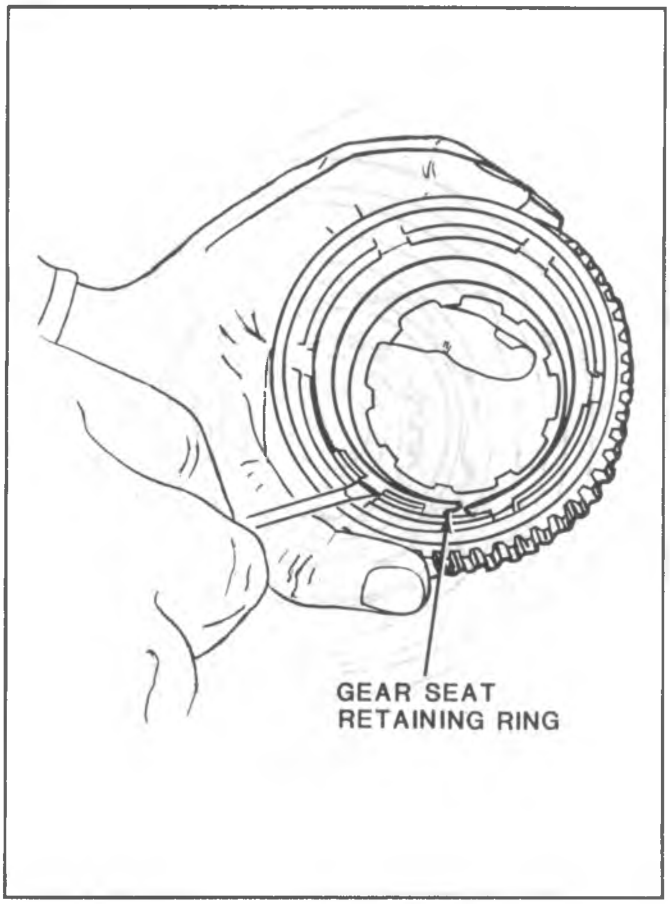


Fig. 3C-24K--Removing Gear Seat Retaining Ring

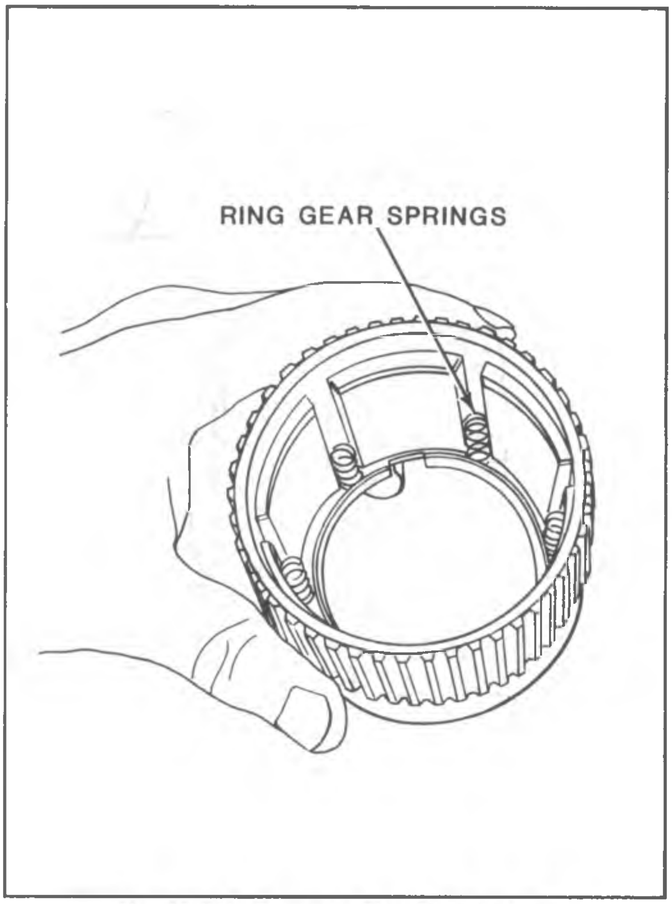


Fig. 3C-26K--Removing Ring Gear Springs

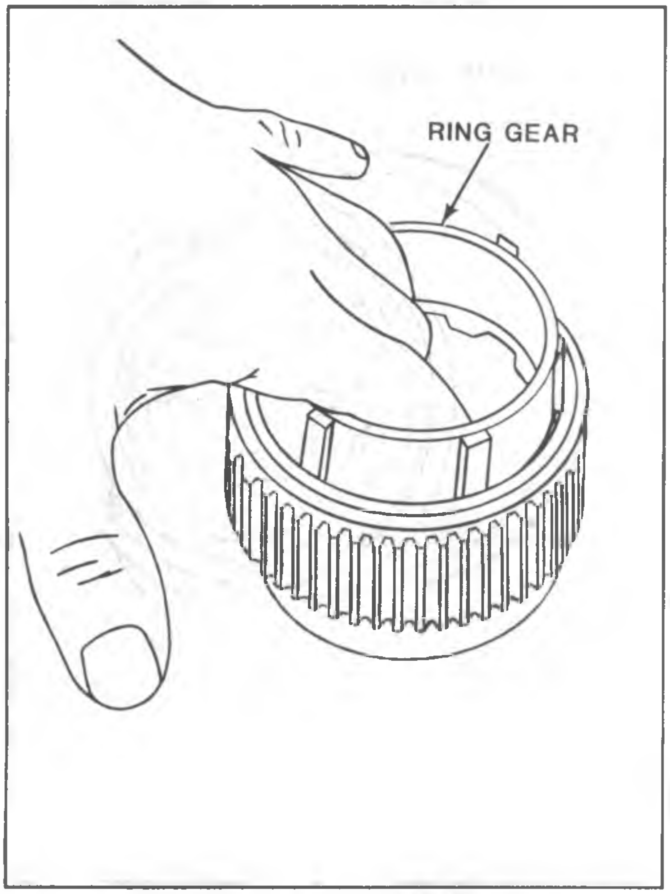


Fig. 3C-25K--Removing Ring Gear

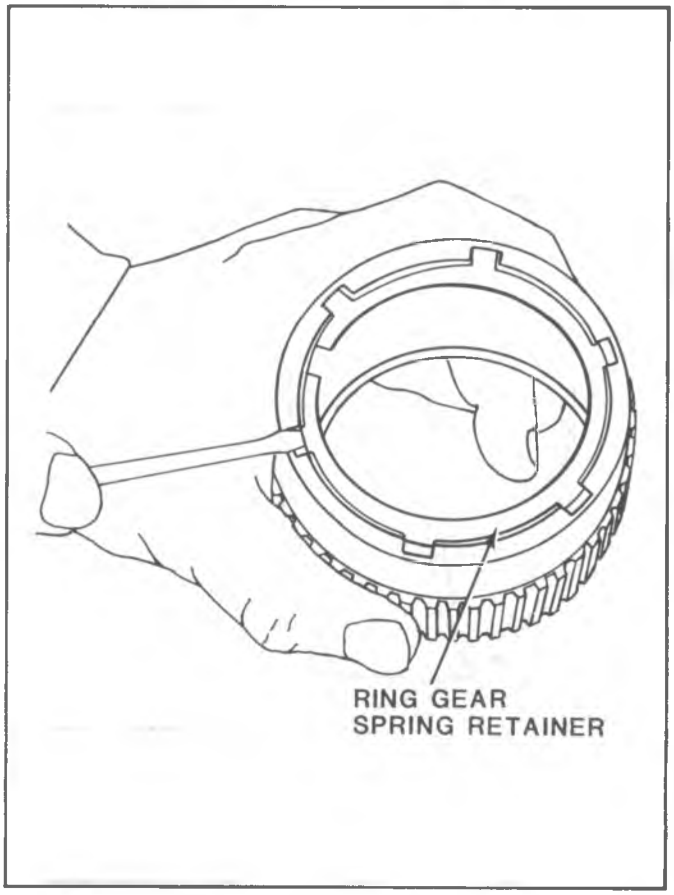


Fig. 3C-27K--Removing Ring Gear Spring/Retainer

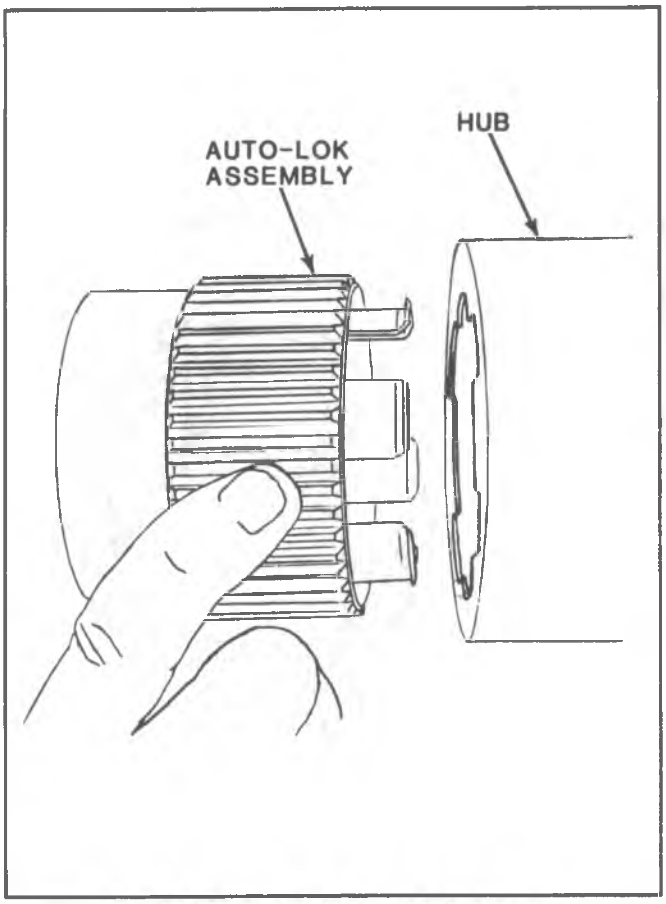


Fig. 3C-28K--Auto-Lok Assembly Installation

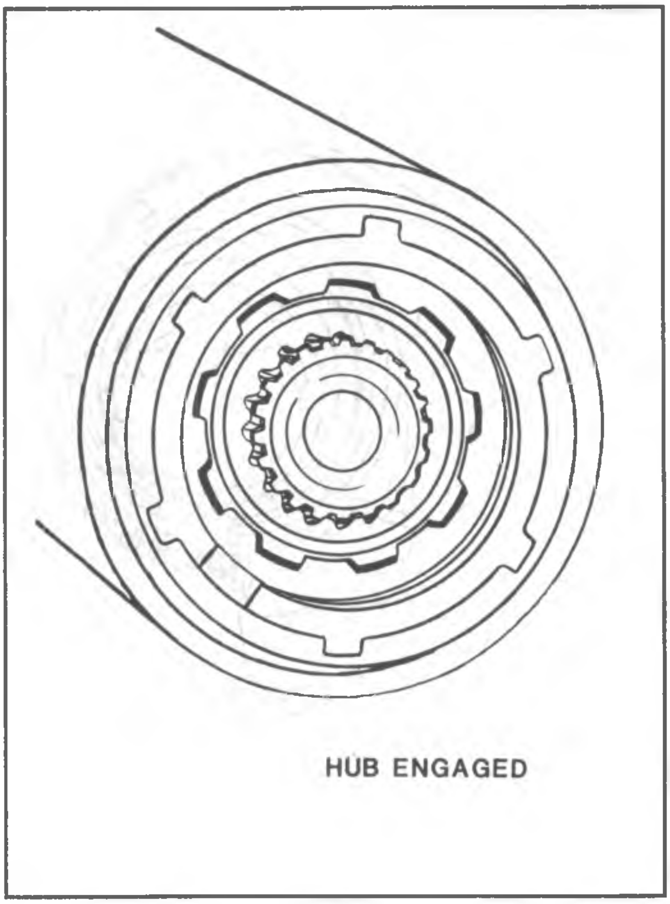


Fig. 3C-30K--Auto-Lok Engaged

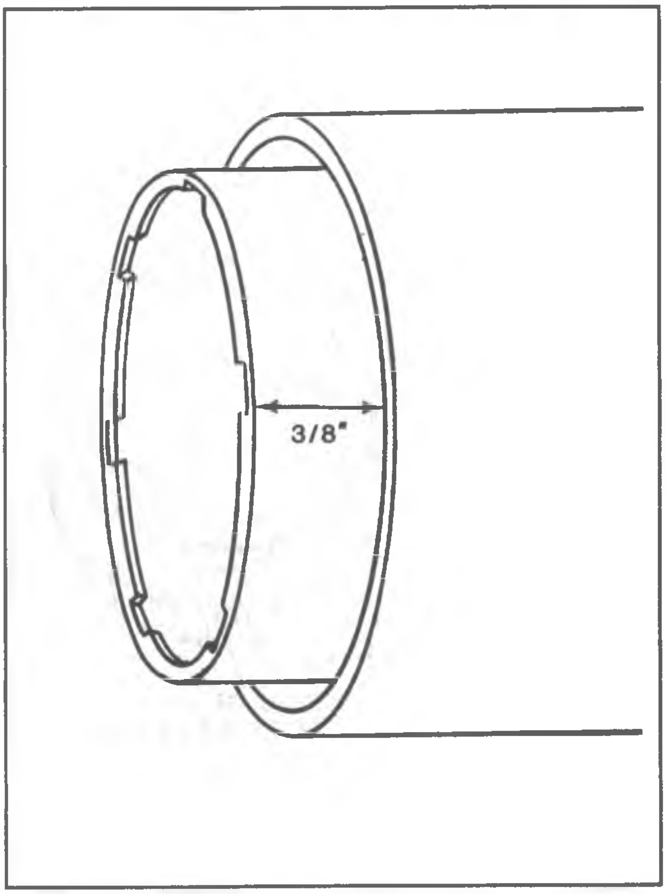


Fig. 3C-29K

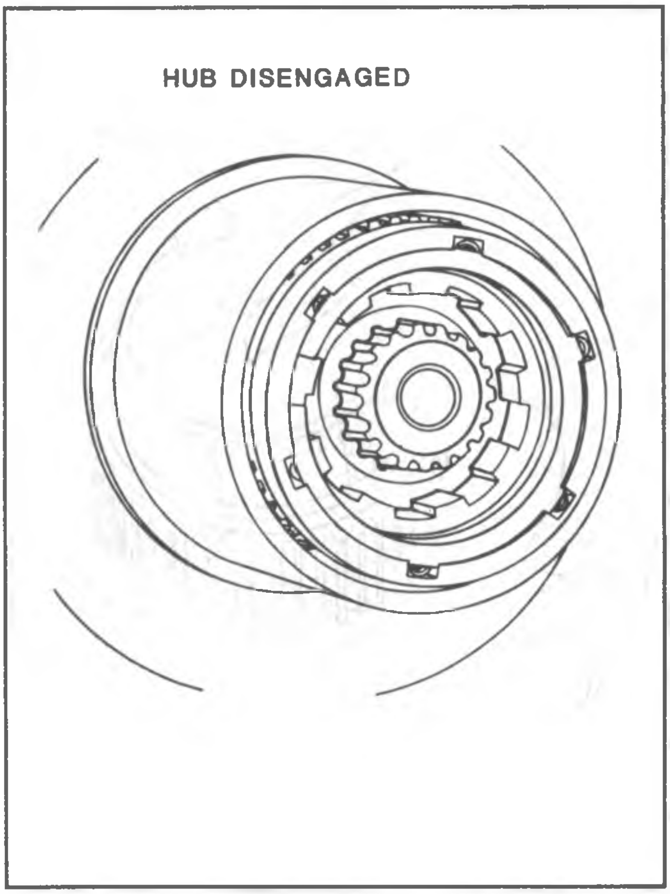


Fig. 3C-31K--Auto-Lok Disengaged

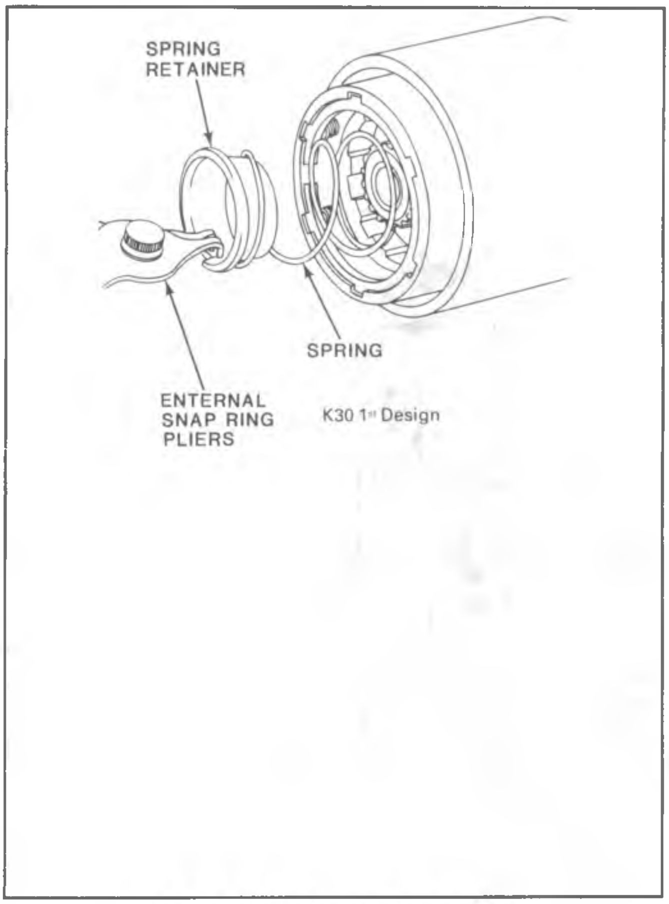


Fig. 3C-32K--Snap Ring Installation

Removal of Warn Manual Hub

1. Remove allen head screws.
2. Remove outer hub locking assembly.
3. Remove body assembly retaining screw.
4. Remove gear #2 and spring.
5. Remove snap ring from the end of the axle shaft.
6. Remove body assembly internal snap ring from hub.
7. Remove outer gear.

Installation of Warn Manual Hub

1. Install outer gear.
2. Install body assembly internal snap ring into hub.
3. Install snap ring on axle shaft.

   NOTICE: Make sure the inner gear concave side faces the spring.
4. Install inner gear and spring.
5. Install retainer screw.
6. Install outer hub assembly.
7. Install allen head screws.

HUB-AND-DISC

Removal

1. Remove locking hub as described earlier.
2. Remove the wheel bearing outer lock nut, retaining, and wheel bearing inner adjusting nut using Tool J-6893 and Adapter J-23446 or Tool J-6893-01 for Warner Gear. J-34616 or J-34617 for Monroe AutoLok.
3. Remove the hub-and-disc assembly and the outer wheel bearing.
   a. Remove the oil seal and inner bearing cone from the hub using a brass drift and tapping with a hammer. Discard the oil seal.
   b. Remove the inner and outer bearing cups using a brass drift and hammer.
   c. Clean, inspect and lubricate all parts as required.

Installation of Hub-and-Disc

NOTICE: All parts should be lubricated for normal operation during assembly with an ample amount of high speed grease. Lubrication MUST be applied to prevent deterioration before the unit is placed in service.

1. Assemble the outer wheel bearing cup into the wheel hub using Installer J-6368 and Driver Handle J-8092.
2. Assemble the inner wheel bearing cup into the wheel hub using Installer J-23448 and Driver Handle J-8092.
3. Pack the wheel bearing cone with a high melting point type wheel bearing grease and insert the cone into the cup.
4. After lubricating the wheel bearings, install the hub-and-disc and the bearings to the spindle.
5. Adjust wheel bearings as listed in "Maintenance and Adjustments".

SPINDLE

Removal

1. Remove the hub-and-disc assembly as outlined earlier.
2. Remove the spindle retaining bolts.
3. Remove the spindle and thrust washer by tapping the end of the spindle lightly with a soft hammer to break it loose from the knuckle as shown in Figure 3C-33K. Replace the thrust washer if excessive wear has occurred.

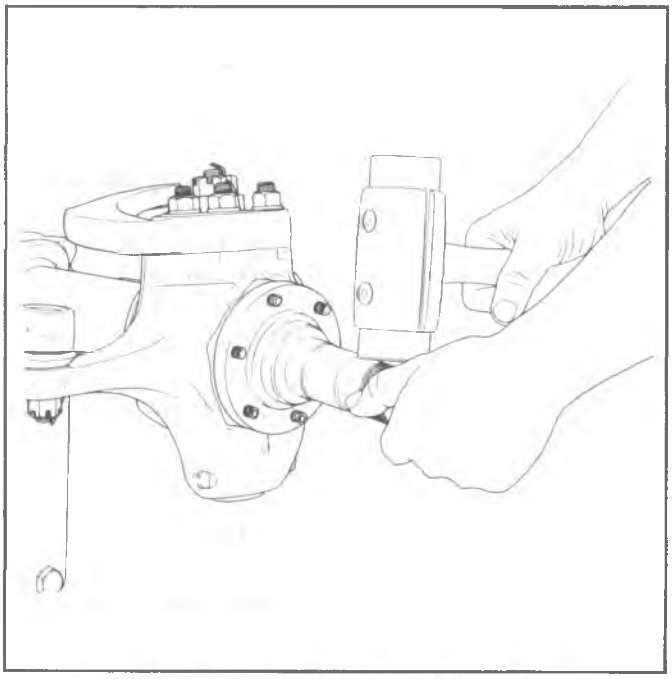


Fig. 3C-33K--Removing Spindle and Thrust Washer

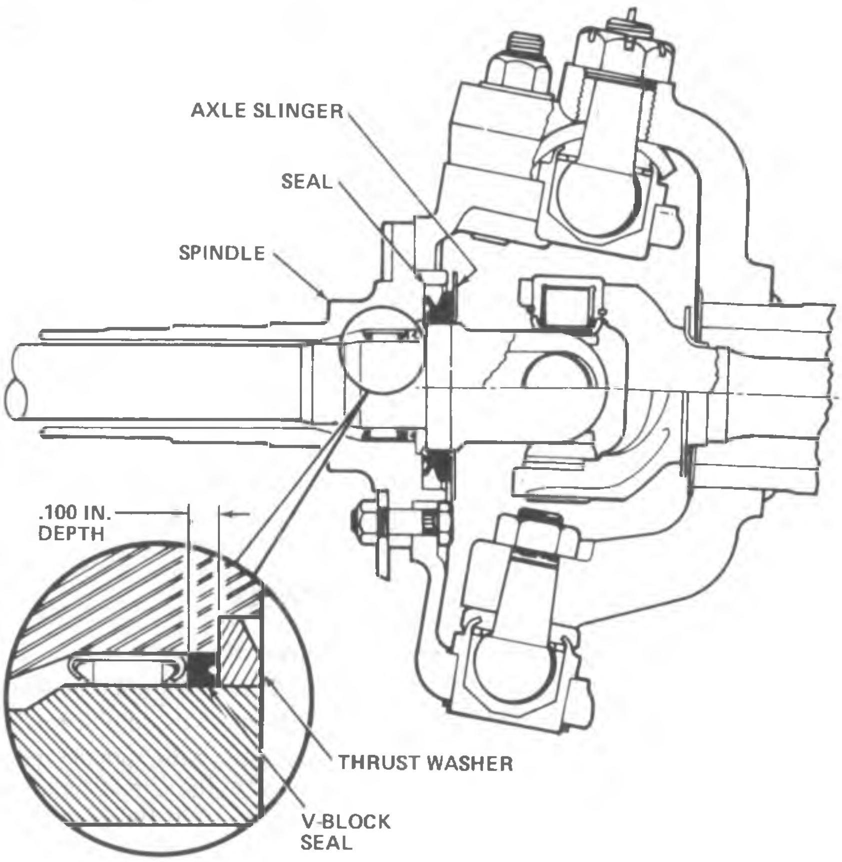


Fig. 3C-34K--Front Spindle Grease Seals

Servicing Spindle Components

When servicing the spindle check the spindle grease seals (Fig. 3C-34K).

1. Secure the spindle in a vise by locating on the high step diameter. Be sure that the machined surface of the spindle will not be damaged by the vise jaws.
2. Remove the oil seal.
3. Remove the needle roller bearing.
4. Place the spindle in a vise on the high step and install needle roller bearing.
   a. Use J-23445 and Drive Handle J-8092 for K10, K20.
   b. Use J-21465-17 for K-30.
5. Install grease seal onto slinger with lip toward spindle.
6. Relubricate the needle bearing and the spindle end with a high melting point type wheel bearing grease.

Installation

1. Install the thrust washer over the axle shaft with the chamfer toward the slinger and install the spindle as shown in Figure 3C-35K.
2. Assemble spindle to knuckle. Use **new** spindle nuts and torque to 88 N·m (65 lb. ft.).

NOTICE: See NOTICE on page 1 of this section.

KNUCKLE

K10, K20, (WITH BALL JOINTS)

Removal

1. Remove the automatic locking hub, hub-and-disc assembly, and spindle components as outlined earlier.
2. If the steering arm is to be removed, disconnect the tie rod.
   a. Remove cotter pin.
   b. Loosen tie rod nuts and tap on nut with a soft hammer to break the studs loose from the knuckle

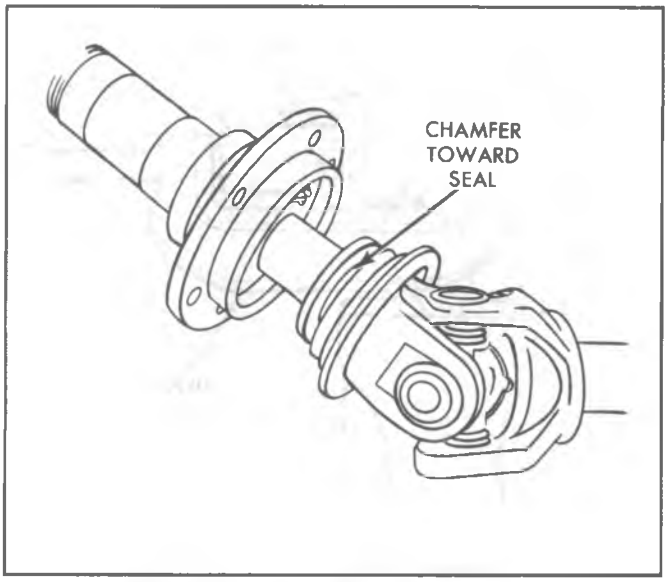


Fig. 3C-35K--Installing Spindle and Thrust Washer

arm.

c. Remove nuts and disconnect the tie rod. If it is necessary to remove the steering arm, discard the self-locking nuts (Fig. 3C-36K) and replace with new nuts at assembly.

3. Remove the cotter pin from the upper ball socket nut.
4. Remove the retaining nuts from the upper and lower ball sockets as shown in Figure 3C-37K.
5. Remove the knuckle assembly from the yoke by inserting a suitable wedge-shaped tool between the lower ball stud and the yoke and tapping on the tool to release the knuckle assembly. Repeat as required at the upper ball stud location.

Ball Joint Service

NOTICE: Do not remove the yoke upper ball stud adjusting sleeve unless new ball studs are being installed. If it is necessary to loosen the sleeve to remove the knuckle, do not loosen it more than two threads using Spanner J-23447 as shown in Figure

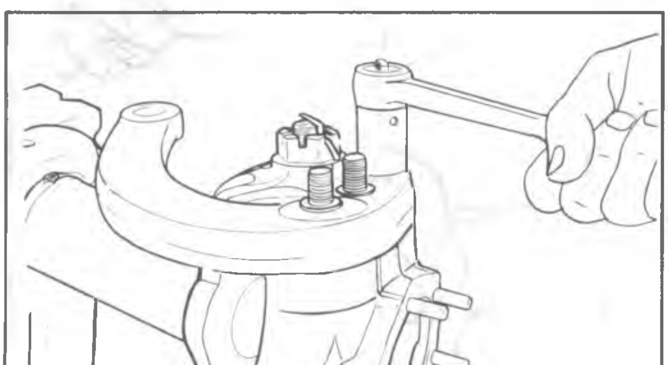


Fig. 3C-36K--Removing Steering Arm Nuts

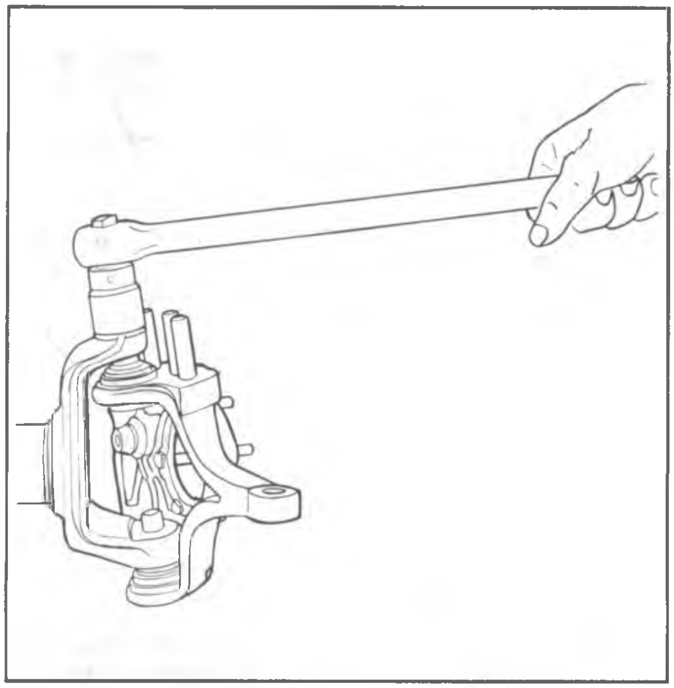


Fig. 3C-37K--Removing Ball Socket Retaining Nut

3C-40K. The nonhardened threads in the yoke can be easily damaged by the hardened threads in the adjusting sleeve if caution is not used during knuckle removal.

- On the LH knuckle, it is necessary to remove the steering arm before servicing the upper ball joint.

Remove the lower ball joint snap ring before beginning. Lower ball joint must be removed before any service can be performed on the upper ball joint.

1. Remove the lower ball joint using tools J-9519-10, J-23454-1, and sleeve J-23454-4 or equivalent as shown in Figure 3C-38K.

   If Tool J-23454-4 is not available, a suitable tool may be fabricated from 2-3/8" O.D. steel tubing with a minimum of 2-1/16" I.D., cut 63.50mm (2-1/2") long.

2. Remove the upper ball joint using tools J-9519-10, J-23454-1, and sleeve J-23454-4 or equivalent as shown in Figure 3C-39K.

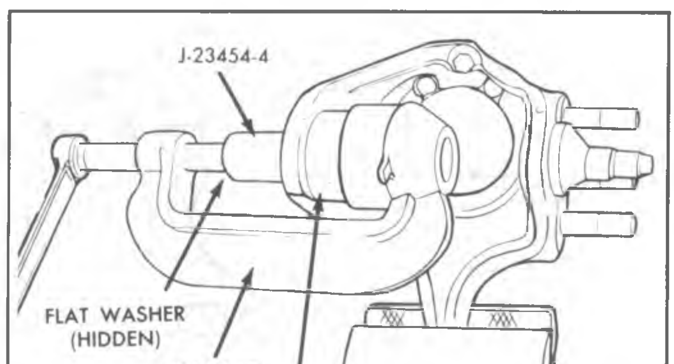


Fig. 3C-38K--Removing Lower Ball Joint

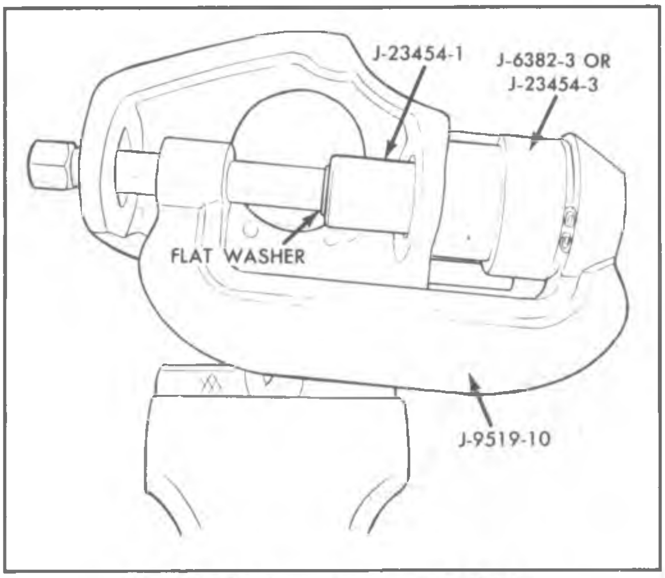


Fig. 3C-39K--Removing Upper Ball Joint

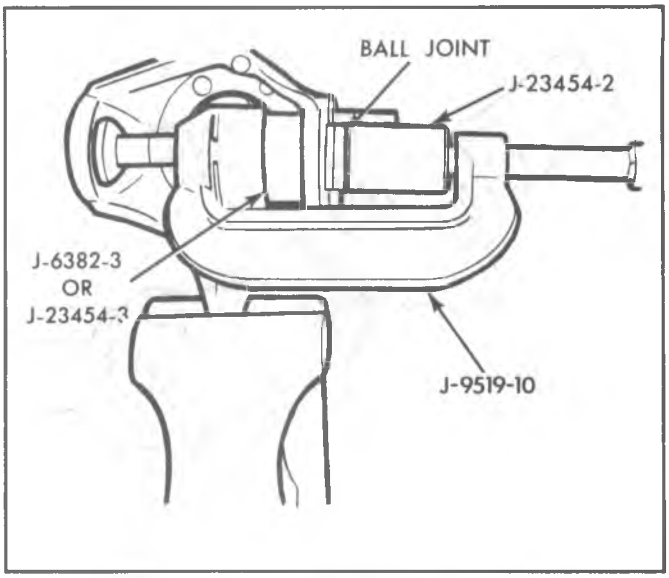


Fig. 3C-41K--Installing Upper Ball Joint

3. Install the lower ball joint into the knuckle. Make sure that the lower ball joint (the joint without cotter pin hole in the stud end) is straight. Press the stud into the knuckle until properly seated using tools J-9519-10, J-23454-2, and J-23454-4 or equivalent as shown in Figure 3C-41K and install snap ring.
4. Install the upper ball joint into the knuckle. Press the stud into the knuckle until properly seated using Tools J-9519-10, J-23454-2, and J-23454-4 or equivalent as shown in Figure 3C-41K.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners in the following steps.

1. Position the knuckle and sockets to the yoke. Install new nuts finger tight to the upper (the nut with the cotter pin slot) and lower ball socket studs.
2. Push up on the knuckle (to keep the ball socket from turning in the knuckle) while tightening the lower socket retaining nut. PARTIALLY TORQUE lower nut to 40 N·m (30 ft. lbs.).
3. Torque the yoke upper ball stud adjusting sleeve to 70 N·m (50 ft. lbs.) using Spanner J-23447. See Figure 3C-42K.
4. Torque the upper ball socket nut to 100 ft. lbs. as shown in Figure 3C-43K. After torquing the nut, do not loosen to install cotter pin, apply additional torque, if necessary, to line up hole in stud with slot in nut.
5. Apply FINAL torque to lower nut, 95 N·m (70 ft. lbs.).
6. If the tie rod and steering arm were removed:
   a. Assemble the steering arm using the three stud adapters and three new self-locking nuts. Torque the nuts to 120 N·m (90 ft. lbs.).
   b. Assemble the tie rod to the knuckle arm. Torque the tie rod nuts to 60 N·m (45 ft. lbs.) and install cotter pin.

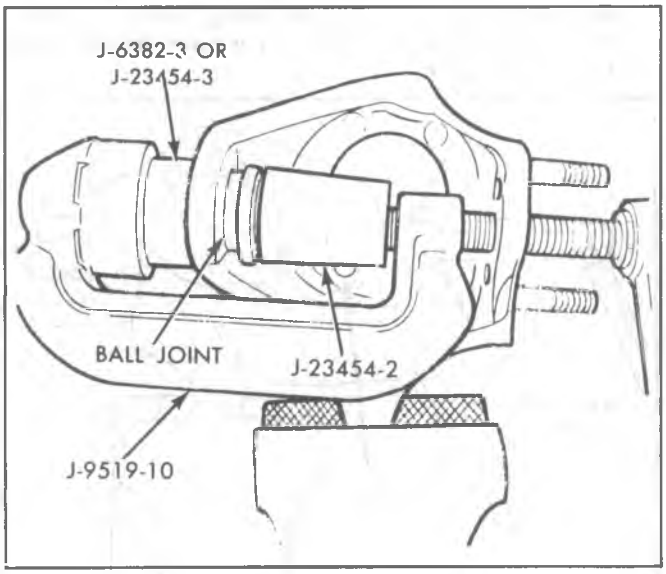


Fig. 3C-40K--Installing Lower Ball Joint

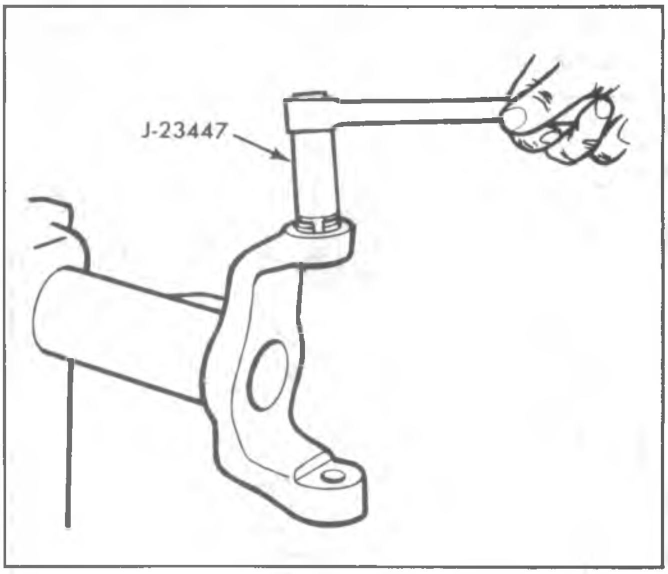


Fig. 3C-42K--Ball Stud Adjusting Sleeve

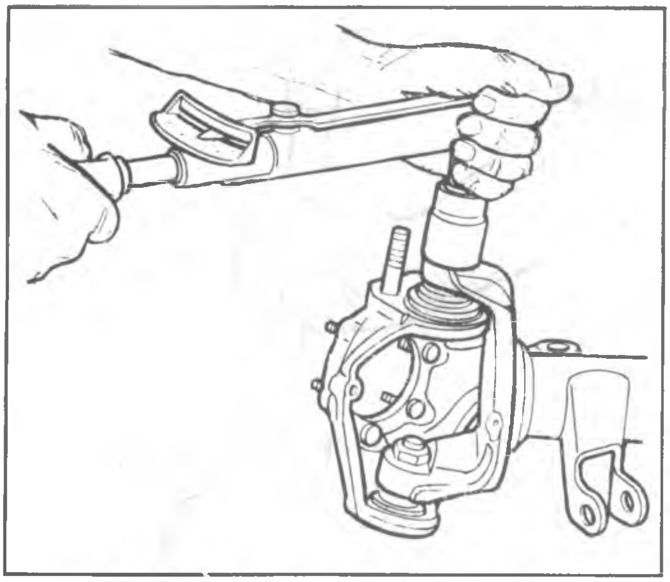


Fig. 3C-43K--Torquing Upper Ball Socket Nut

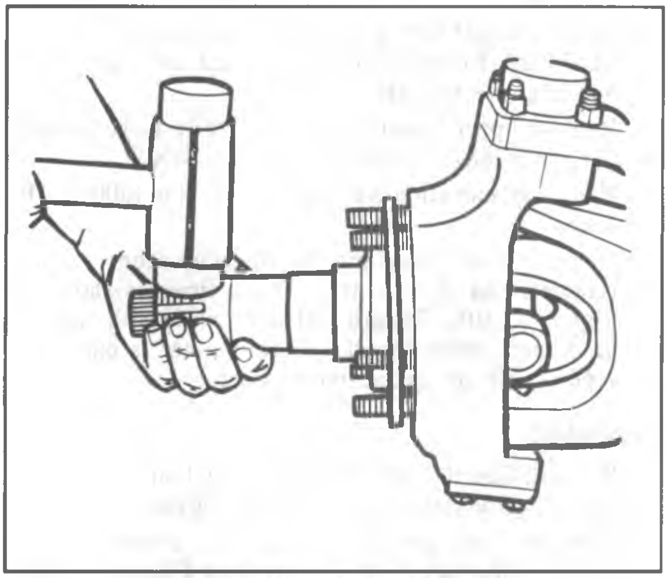


Fig. 3C-44K--Removing Spindle

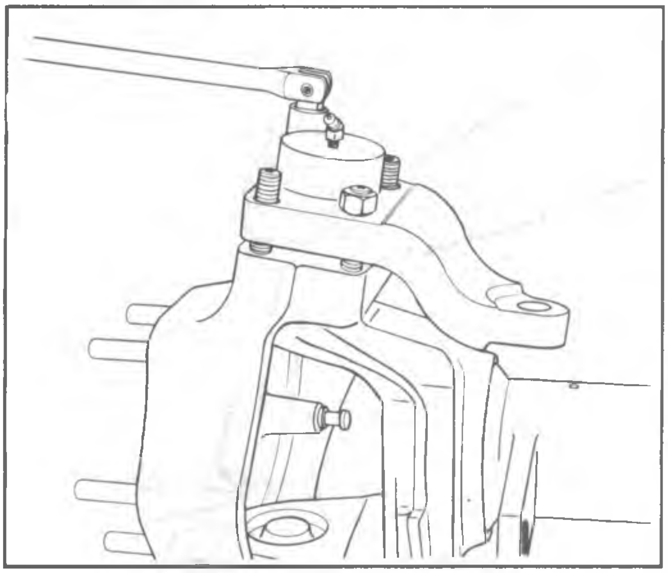


Fig. 3C-45K--Removing Nuts Alternately

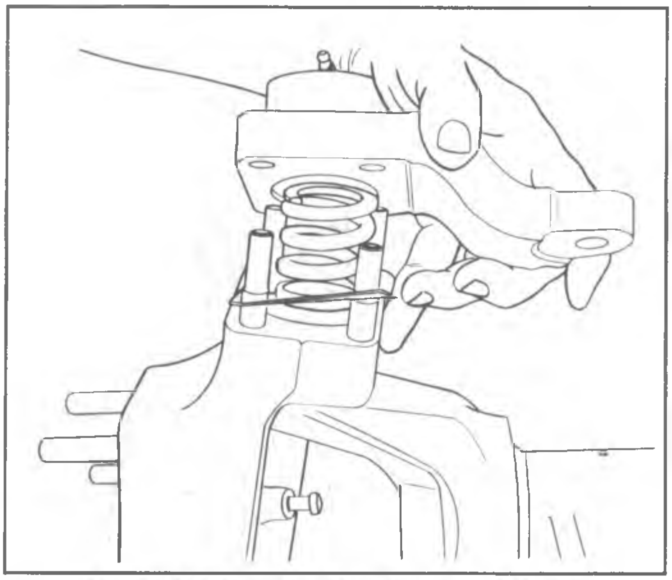


Fig. 3C-46K--Removing Cap, Spring and Gasket

KNUCKLE

K30 (WITH KING PINS)

Removal

1. Remove the hub and spindle as outlined earlier. If necessary, tap lightly with a rawhide hammer to free it from the knuckle. Check bronze spacer located between axle shaft joint assembly and bearing. If wear is evident, replace with a new one. See Figure 3C-44K.
2. Remove four nuts from upper king pin cap. Remove nuts alternately as compression spring will force cap up. Refer to Figure 3C-45K.
3. Remove cap, compression spring, and gasket, as shown in Figure 3C-46K. Discard gasket, replace with new one at time of assembly.
4. From the underside of the knuckle, remove four cap screws from the lower king pin bearing cap. Remove the bearing cap-and-lower king pin. See Figure

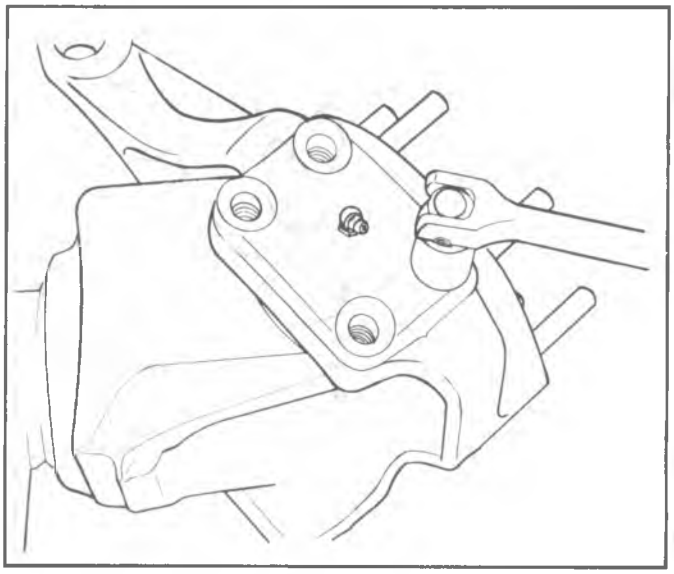


Fig. 3C-47K--Removing Lower Bearing Cap

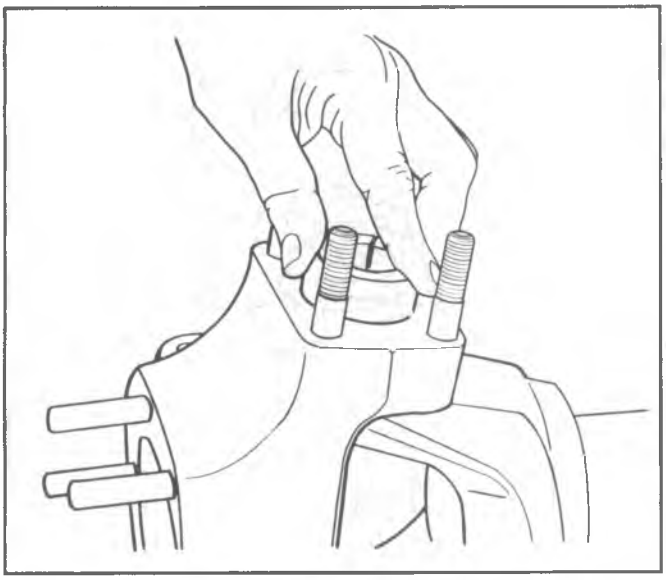


Fig. 3C-48K--Removing Tapered Bushing

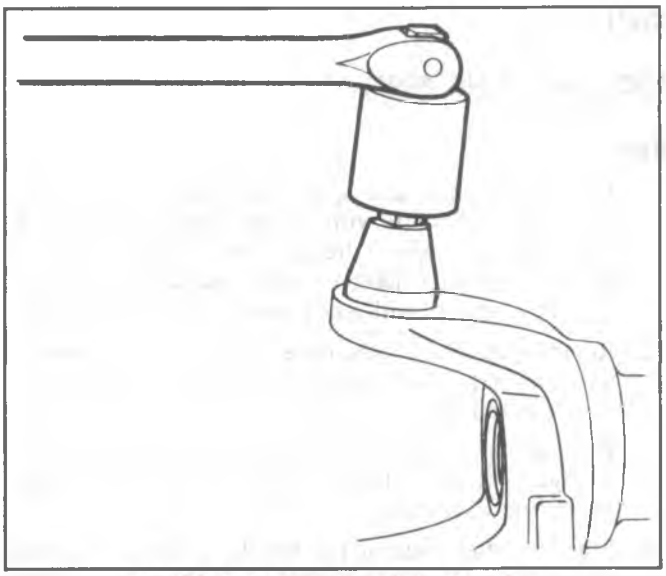


Fig. 3C-49K--Removing Upper King Pin

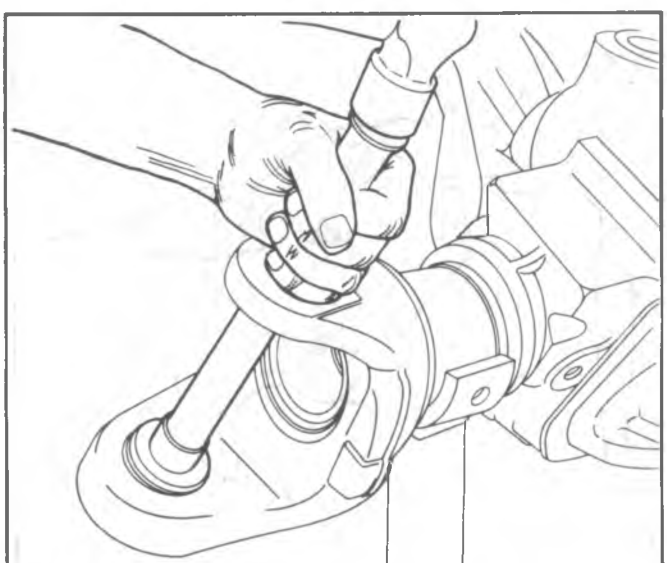


Fig. 3C-50K--Removing Cup, Cone and Seal

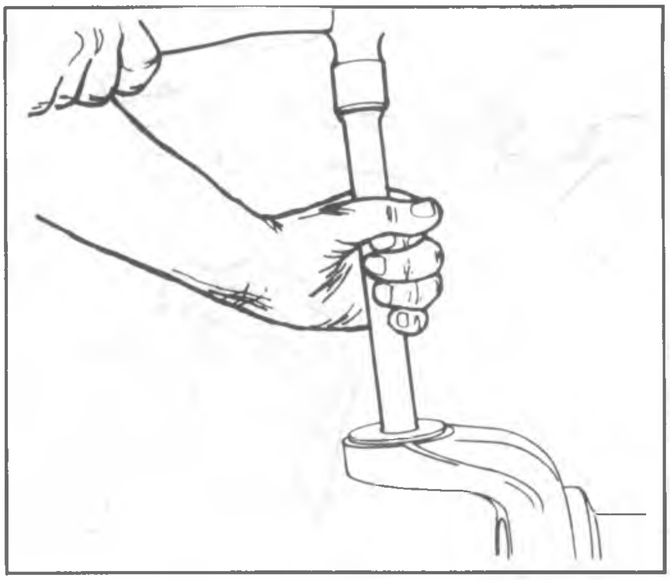


Fig. 3C-51K--Installing Grease Retainer

3C-47K.

5. Remove upper king pin tapered bushing and knuckle from yoke. Remove king-pin felt seal. See Figure 3C-48K. Remove knuckle.
6. Remove upper king-pin from yoke with large breaker bar and J-26871, as seen in Figure 3C-49K.

   Torque specification is 677.50-813.00 N·m (500-600 ft. lbs.).
7. Remove lower king pin bearing cup, cone, grease retainer, and seal all at the same time, as shown in Figure 3C-50K. Discard seal and replace with new one at time of assembly. If grease retainer is damaged, replace with new one at time of assembly.

Installation

NOTICE: See the NOTICE on page 1 of this section regarding the fasteners in the following steps.

1. Assemble new grease retainer and lower king pin bearing cup, using J-7817, as shown in Figure 3C-51K.
2. Fill the area in grease retainer with specified

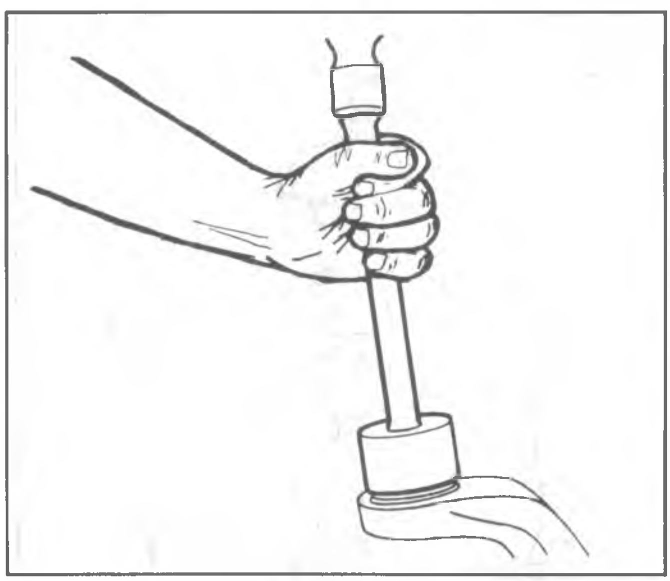


Fig. 3C-52K--Installing Oil Seal

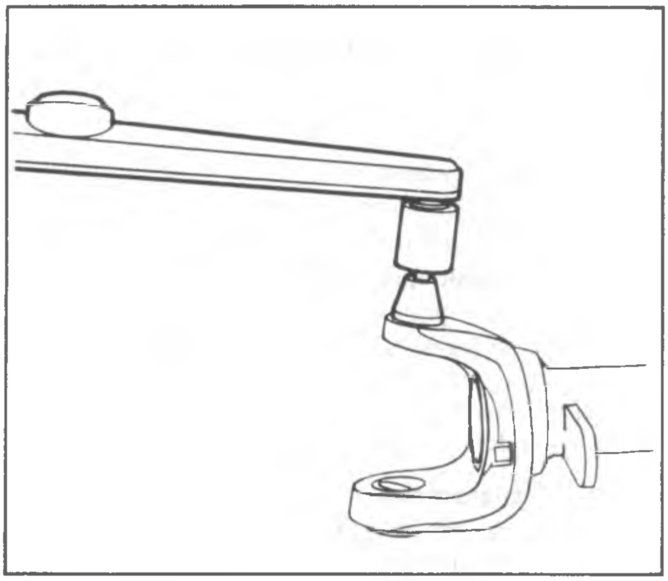


Fig. 3C-53K--Installing Upper King-Pin

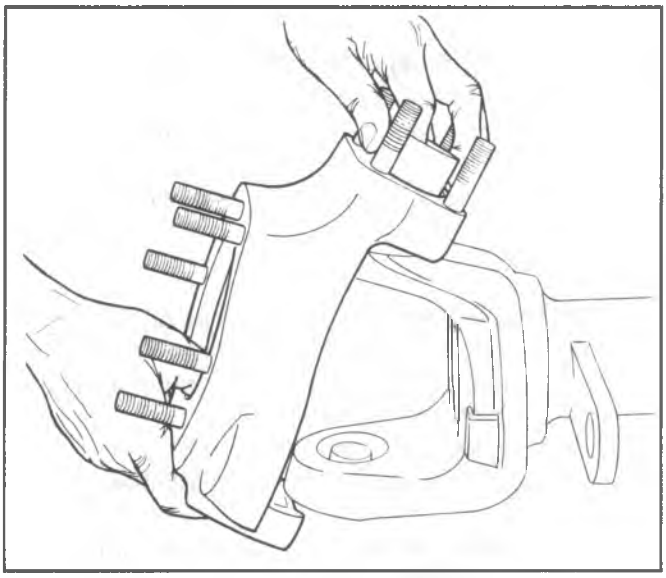


Fig. 3C-54K--Installing Knuckle to Yoke

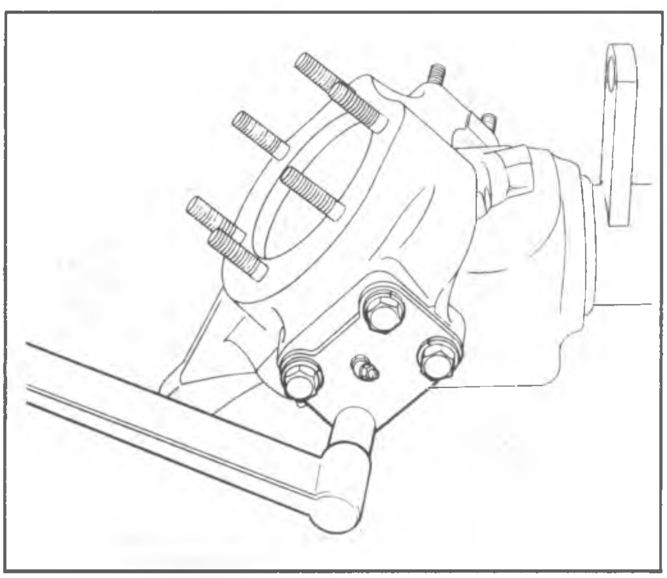


Fig. 3C-55K--Installing Lower Bearing Cap-and-King Pin

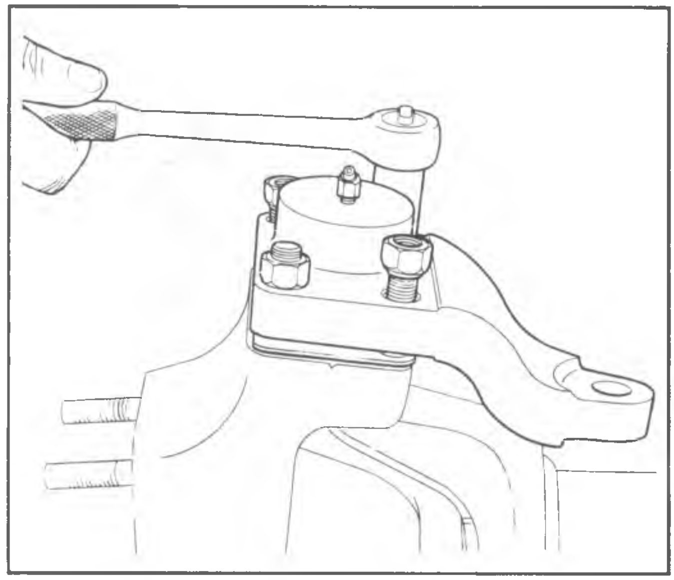


Fig. 3C-56K--Installing Bearing Cap/Steering Arm

grease, then grease the bearing cone and install. Install new lower king pin bearing oil seal, using J-22301, as shown in Figure 3C-51K.

Do not distort oil seal. It will protrude slightly from the surface of yoke flange when fully installed.

3. Install upper king-pin, using J-28871 as shown in Figure 3C-53K. Torque to 677.50-813.00 N·m (500-600 ft. lbs.).
4. Assemble felt seal to king pin, assemble knuckle, assemble tapered bushing over king pin, as shown in Figure 3C-54K.
5. Assemble lower bearing cap-and-king pin with four cap screws. Tighten cap screws alternately and evenly; see Figure 3C-55K. Torque cap screws to 95-120 N·m (70-90 ft. lbs.).
6. Assemble compression spring on upper king pin bushing. Assemble bearing cap, with new gasket, over four studs. Tighten nuts alternately and evenly. Torque nuts to 95-120 N·m (70-90 lb. ft.) See Figure 3C-56K.

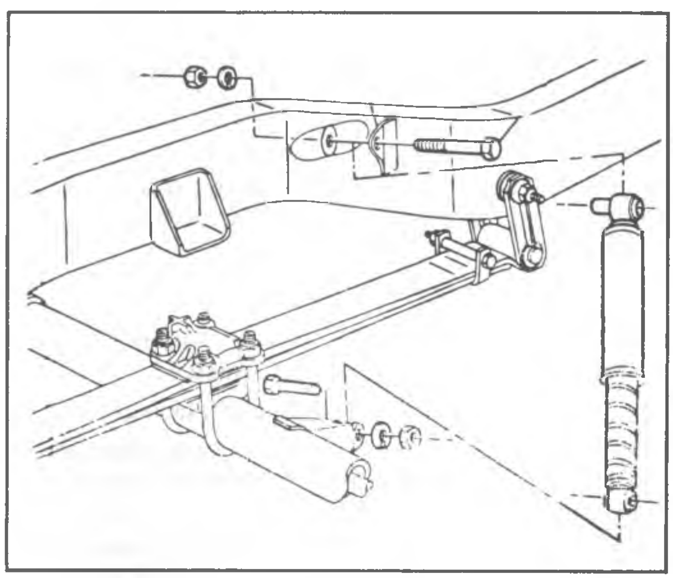


Fig. 3C-57K--Shock Absorber Attachment

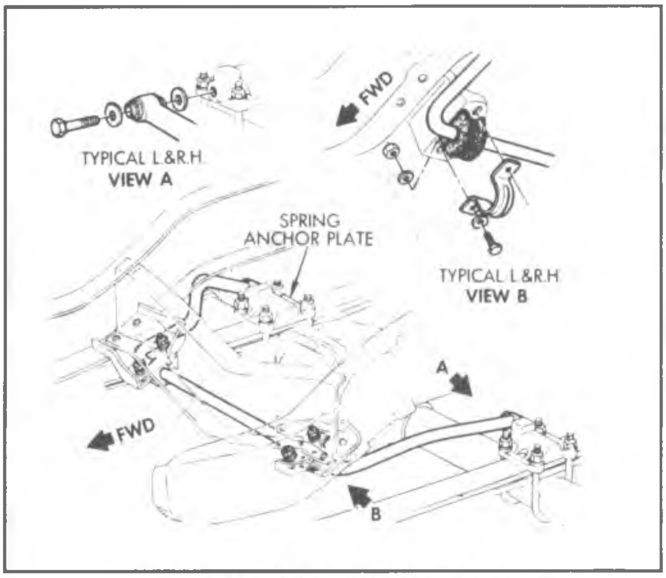


Fig. 3C-58K--Stabilizer Bar Attachment

SHOCK ABSORBER

Removal (Fig. 3C-57K)

1. Raise vehicle on hoist.
2. Remove nuts and eye bolts securing upper and lower shock absorber eyes.
3. Withdraw shock absorber and inspect rubber eye bushings. If defective, replace shock absorber assembly.

Installation

Place shock absorber into position over mounting bolts or into mounting brackets. Install eye bolts and nuts and torque as shown in Specifications Section. Lower vehicle to floor.

STABILIZER BAR-TYPICAL

Removal (Fig. 3C-58K)

1. Raise vehicle on hoist and remove nuts and bolts attaching stabilizer brackets and bushings at frame location.
2. Remove brackets and bushings at lower spring anchor plates and remove stabilizer from vehicle.

Inspection

Inspect rubber rushings for excessive wear or aging-replace where necessary. Use rubber lubricant when installing bushings over stabilizer bar.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 2.

Slit in bar to frame bushings should be facing forward.

1. Place stabilizer in position on frame and install frame brackets over bushings. Install nuts and bolts loosely.
2. Install brackets over bushings at lower control arm location. Be sure brackets are positioned properly over bushings. Torque all nuts and bolts to specifications.
3. Lower vehicle to floor.

LEAF SPRING AND BUSHINGS (Figs. 3C-59K and 3C-60K)

Removal

1. Raise vehicle on hoist.
2. Place adjustable lifting device under axle.
3. Position axle so that all tension is relieved from spring.
4. Remove shackle upper retaining bolt.
5. Remove front spring eye bolt.
6. Remove spring-to-axle u-bolt nuts and remove spring, lower plate and spring pads.
7. Remove shackle to spring bolt and remove bushings and shackle.

Bushing Replacement

1. Place spring on press and press out bushing using a suitable rod, pipe, or tool.
2. Press in new bushing; assure that tool presses on steel outer shell of bushing. Install until bushing protrudes an equal amount on each side of spring.

Spring Inserts (Liners) or Leaf Replacement

1. Place spring in vise and remove clips.
2. Remove center bolt. Open vise slowly, allowing spring to expand.
3. Wire brush, clean, and inspect for broken leaves.
4. Replace leaf or liners.

Installation

NOTICE: See NOTICE on page one of this section regarding the fasteners referred to in steps 5 and 6.

1. Install spring shackle bushings into spring and attach shackle. Do not tighten bolt.
2. Position spring upper cushion on spring.
3. Insert front of spring into frame and install bolt. Do not tighten.
4. Install shackle bushings into frame and attach rear shackle. Do not tighten bolt.

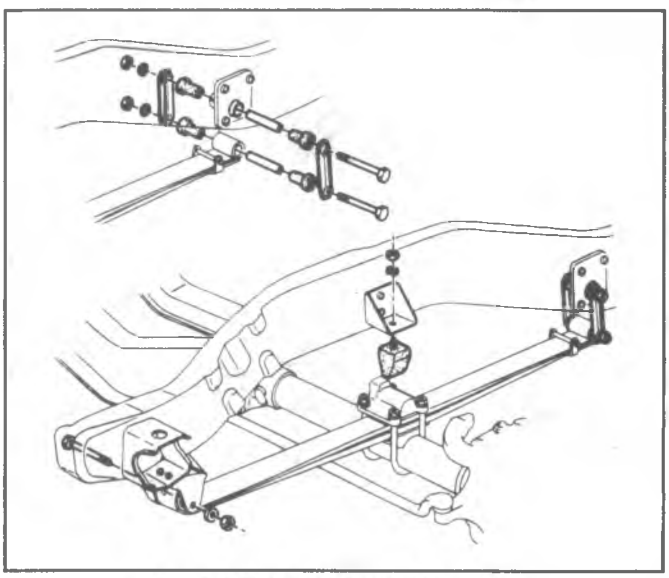


Fig. 3C-59K--Leaf Spring Assembly

TIGHTENING SEQUENCE

1. Install all four nuts to uniform engagement on 'U' Bolts to retain and position anchor plate in design position (perpendicular to axis of 'U' Bolts).
2. Torque nuts in positions 1 and 3 to 10-25 ft. lbs. (14-34 N·m).
3. Torque all nuts to full torque in following sequence: 2-4-1-3.

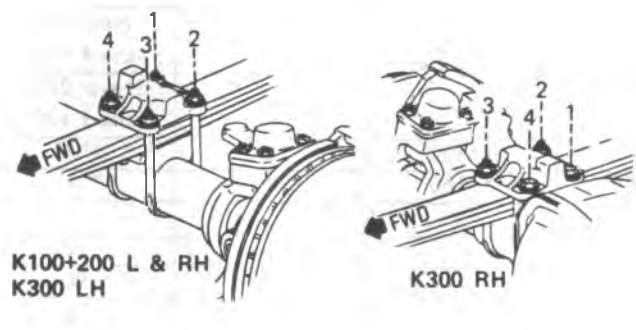


Fig. 3C-60K--U-Bolt Tightening Sequence

5. Install lower spring pad and spring retainer plate. Torque bolts to specifications, Fig. 3C-60K.
6. Torque front and rear spring eye and shackle bolts to specifications.
7. Remove stands and lower vehicle to floor.

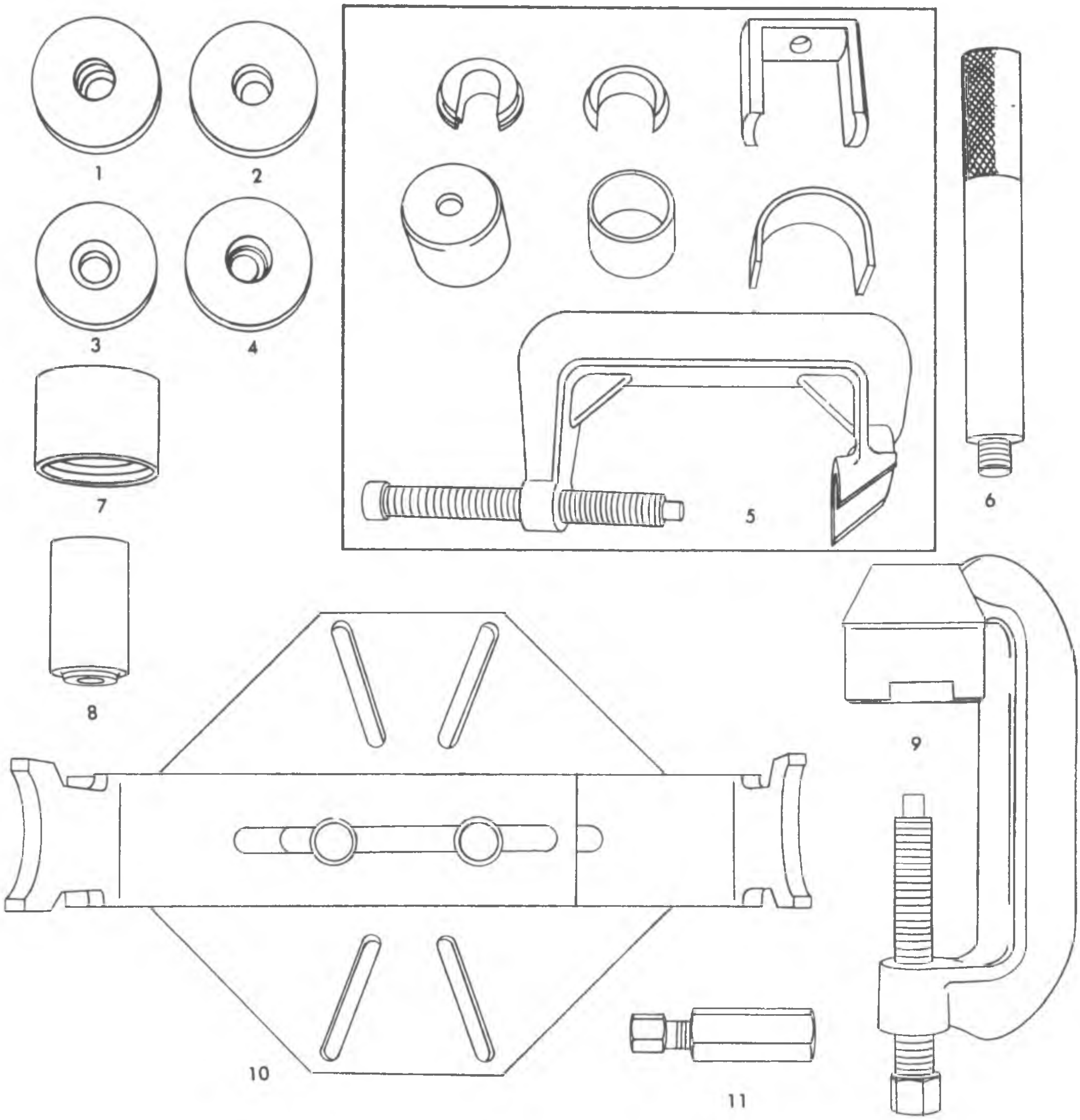
SPECIFICATIONS

FRONT SUSPENSION BOLT TORQUE (ft. lbs.) * †

	C -10	CP-20-30	K-All	G-10-20	G-30
Lower Control Arm Shaft U-Bolt	85	85	—	65	85
Upper Control Arm Shaft Nuts	70	105	—	70	105
Control Arm Rubber Bushings	115	—	—	115	—
Upper Control Arm Bushing Steel ††		New 190 Used 115	—	—	New 190 Used 115
Lower Control Arm Bushing Steel ††		New 280 Used 130	—	—	New 280 Used 130
Upper Ball Joint Nut	* 50	**90	**100	* 50	**90
Lower Ball Joint Nut	**90	**90	***80	**90	**90
Nut, Spindle-to-Knuckle	—	—	65	—	—
Crossmember to Side Rail ●	65	65	—	65	65
Crossmember to Bottom Rail ●●	90	90	—	90	90
Crossmember Brake Support Struts	60	60		60	60
Stabilizer Bar to Control Arm	25	25	Anchor Plate —130	25	
Stabilizer Bar to Frame	25	25	.55	25	
Shock Absorber Upper End	140	140	65	75	
Shock Absorber Lower End	60	60	65	75	
Brake Splash Shield to Knuckle	120 in. lbs.	120 in. lbs.	120 in. lbs.	120 in. lbs.	
Wheel Bearing Adjustment	—	—	60 N·m then 40 N·m	—	
Wheel Bearing End Movement	.001-.005"	.001-.005"	.001-.010"	.001-.005"	
Caliper Mounting Bolt	35	35	—	35	
Spring — Front Eye Bolt	—	—	90	—	
Spring — Rear Eye Bolt	—	—	50	—	
Spring — To Rear Shackle Bolt	—	—	50	—	
Spring — To Axle U-Bolt	—	—	150	—	
Spring — Front Support to Frame	—	—	25	—	
Suspension Bumper	15	15	25	15	
Stabilizer to Spring Plate	—	—	130	—	

* Plus additional torque to align cotter pin. Not to exceed 90 ft. lbs. maximum.
** Plus additional torque to align cotter pin. Not to exceed 130 ft. lbs. maximum.
*** Plus additional torque to align cotter pin.
† All specifications are given in foot pounds of Torque unless indicated otherwise.
†† C10, G10-20 Rubber Bushings; C20-30, P10-30 Steel Bushings.
● P300 (32), P300 (42) and JF9 — 100 ft. lbs.
●● P300 (32) — 215 ft. lbs., P300 (42) and JF9 — 130 ft. lbs.
●●● (K10-20) 205 ft. lbs., (K30) 65 ft. lbs.

SPECIAL TOOLS



1.	J-8457	Bearing Race Installer
2.	J-8458	Bearing Race Installer
3.	J-8849	Bearing Race Installer
4.	J-9276-2	Bearing Race Installer
5.	J-24435-1 thru 7	Bushing Replacement C 10, G 10-20
6.	J-8092	Driver Handle
7.	J-9519-9	Ball Joint Installer
8.	J-9519-7	Ball Joint Remover
9.	J-9519-10	"C" Clamp
10.	J-23028-01	Spring Remover
11.	J-23742-1	Ball Joint Remover

SECTION 3D

REAR SUSPENSION

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at the appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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General Description 3D-1
On Vehicle Service 3D-2
Shock Absorbers 3D-2
Stabilizer Shaft 3D-2
Leaf Spring Assembly 3D-3
Specifications 3D-9

GENERAL DESCRIPTION

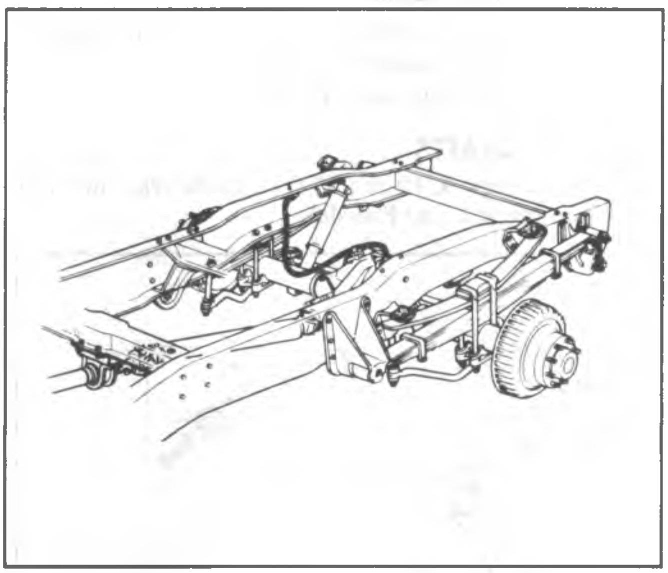


Fig. 1--Typical C-30 H.D. Truck Rear Suspension

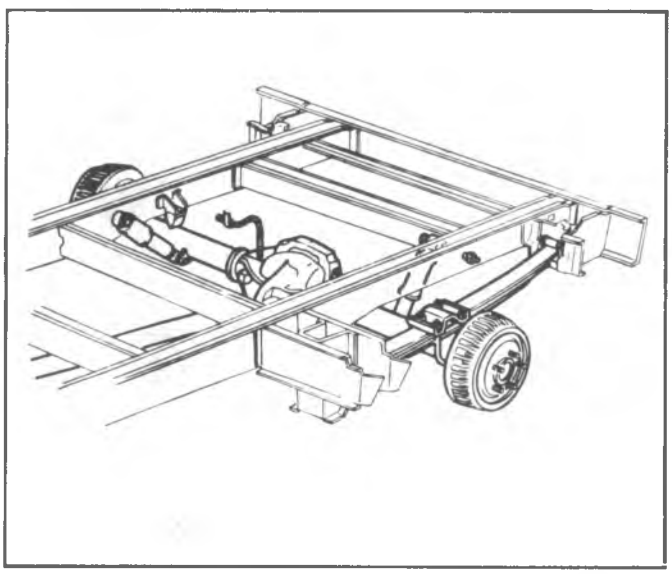


Fig. 2--Typical G-Truck Rear Suspension

All 10-30 series vehicles use a leaf spring/solid rear axle suspension system. Typical systems are illustrated in Figs. 1, 2 and 3.

The rear axle assembly is attached to multi-leaf springs by "U" bolts. The spring front eyes are attached to the frame at the front hangers, through rubber bushings. The rear ends of the springs are attached to the frame by the use of shackles which allow the spring to "change its length" while the vehicle is in motion. Control arms are not required with leaf springs.

Ride control is provided by two identical direct double acting shock absorbers angle-mounted between the frame and brackets attached to the axle tubes.

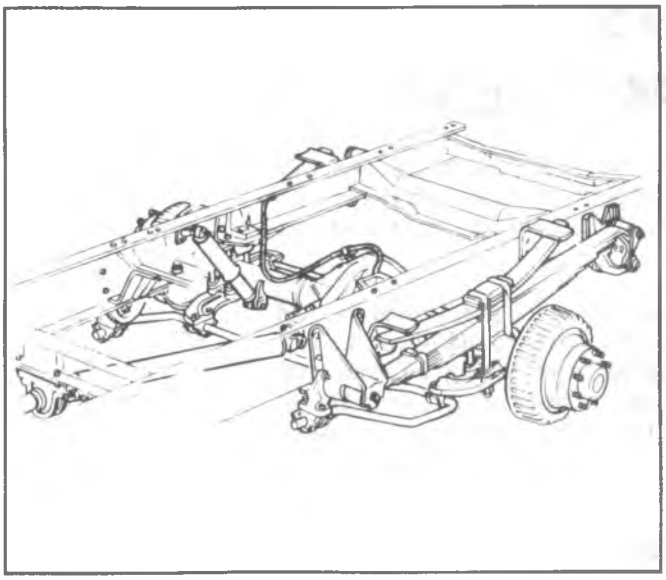


Fig. 3--Typical P-30 H.D. Truck Rear Suspension

ON VEHICLE SERVICE

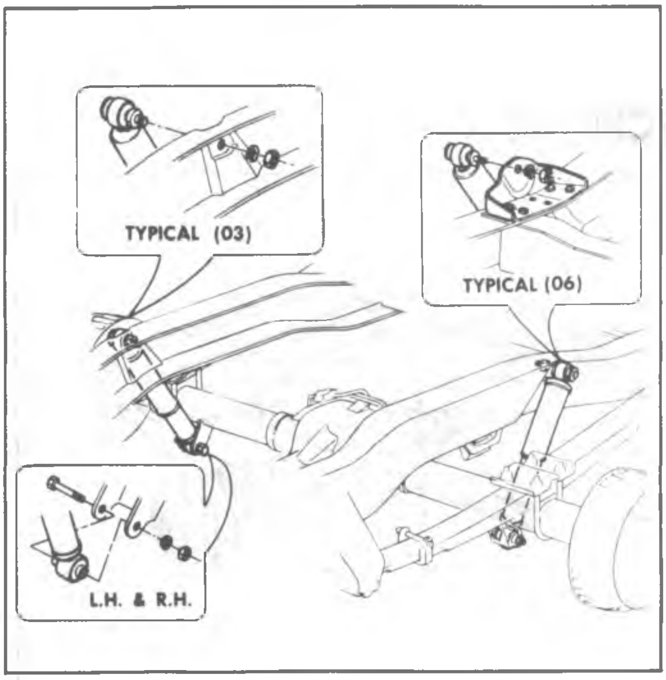


Fig. 4--Shock Absorber-CK-10, CK-20 (03, 06)

SHOCK ABSORBERS

Replacement

Refer to Figs. 4 through 8 for specific vehicle mounting provisions.

1. Raise vehicle on hoist, and support rear axle.
2. At the upper mounting location, disconnect shock absorber by removing nut and washers shown on C-K-P models, and bolt on G-models.
3. At the lower mounting location, remove nut, washers and bolt as shown.
4. Remove shock absorbers from vehicle.
5. To install shock absorber, place into position and reattach at upper mounting location. Be sure to install nuts and washers as shown.
6. Align lower end of shock absorber with axle bracket, and install bolt, washers and nut, as shown.
7. Tighten nuts to specifications.

   NOTICE: See NOTICE on page 1 of this section regarding shock absorber fasteners.
8. Lower vehicle and remove from hoist.

STABILIZER SHAFTS

Refer to Figs. 9, 10 and 11 for specific rear stabilizer shaft mounting on C and P models.

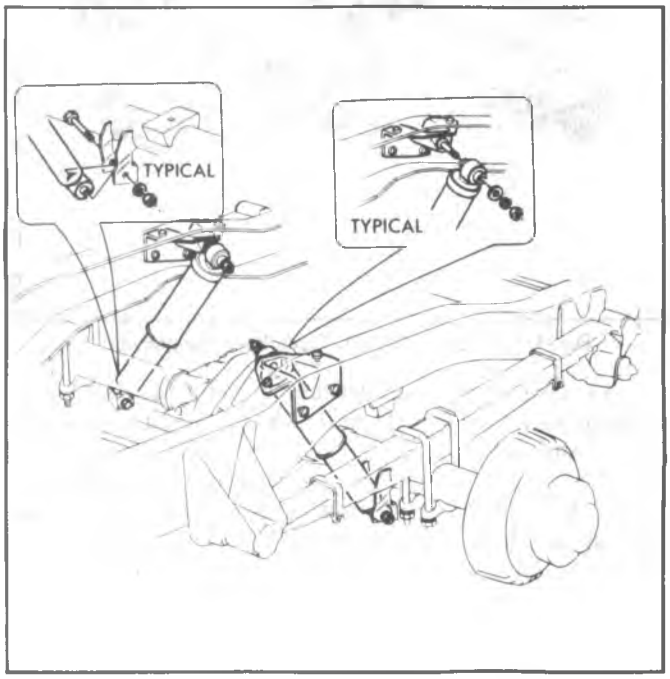


Fig. 5--Shock Absorber-CK-20 (43), CK30

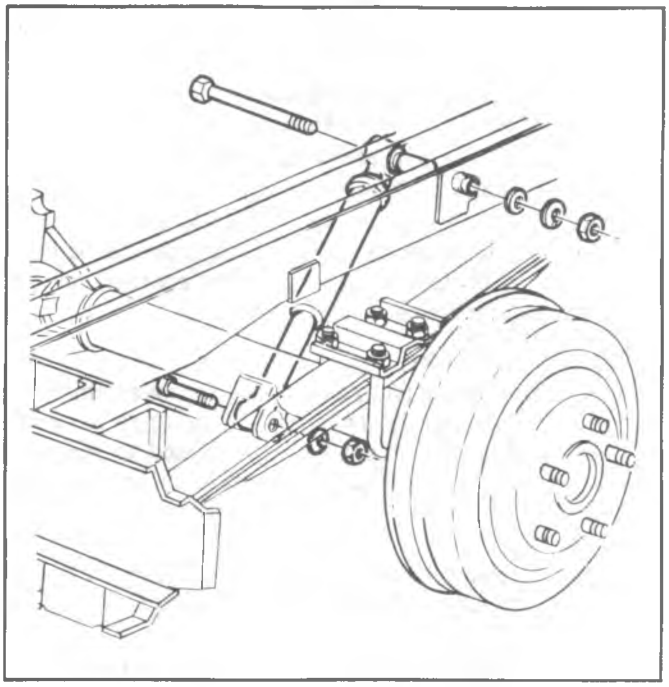


Fig. 6--Shock Absorber-G-10, 20, 30

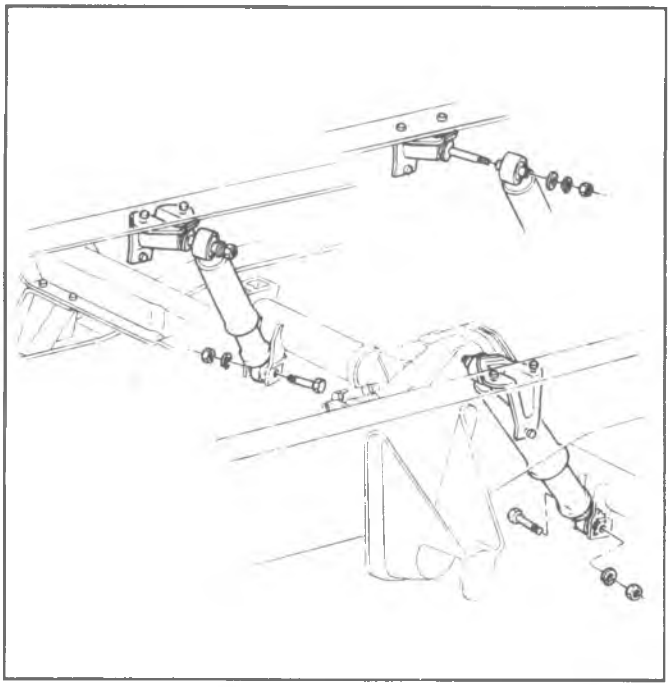


Fig. 8--Shock Absorber-P30

Replacement

1. Raise vehicle on hoist and support rear axle.
2. Remove nut, washer and grommet from link bolt at the frame side member on each side.

   On P300 (32) model, remove stabilizer bar bracket from rear spring stabilizer bar-to-frame bracket by removing attaching screws.
3. Withdraw link bolt, washers, grommets and spacer.
4. Remove brackets from anchor plates by removing attaching screws.
5. Remove stabilizer shafts.
6. Reverse above steps to install stabilizer shaft. On installation, position shaft so parking brake cable is routed over stabilizer.
7. Torque all bolts to specifications.

   NOTICE: See NOTICE on page 1 of this section, regarding stablizer fasteners.
8. Lower hoist and remove vehicle.

LEAF SPRING ASSEMBLY

Refer to Figs. 12 thru 21 for specific leaf spring mounting provisions of C, K, G and P models. Fig. 22 illustrates a typical U-bolt anchor plate installation with the mandatory tightening sequence.

NOTICE: See NOTICE on page 1 of this section,

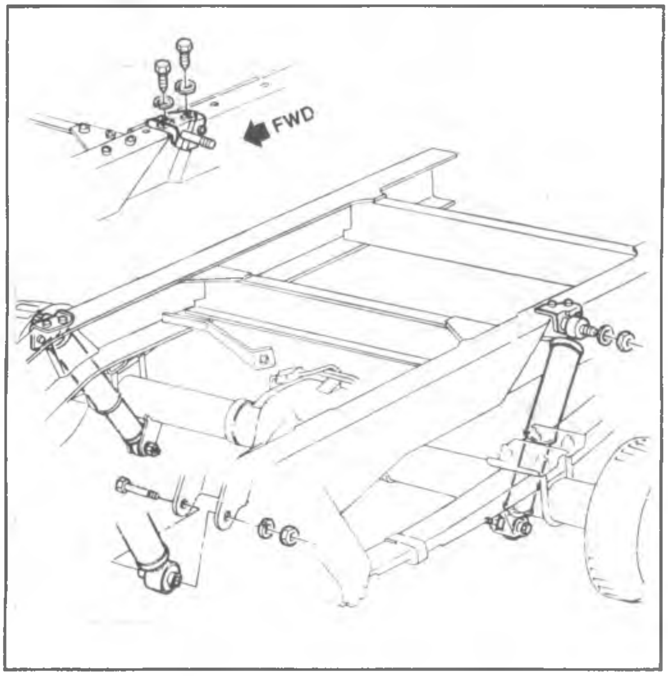


Fig. 7--Shock Absorber-P-10, 20

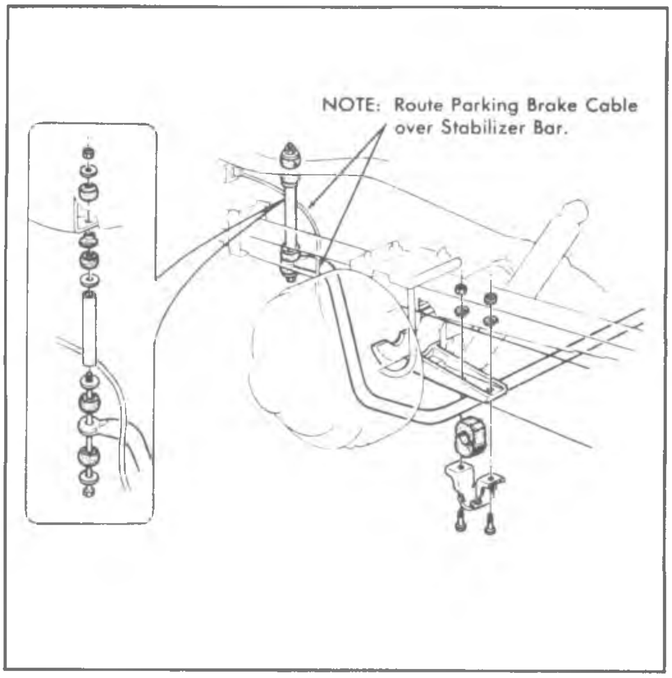


Fig. 9--Rear Stabilizer Shaft-C-20(03)

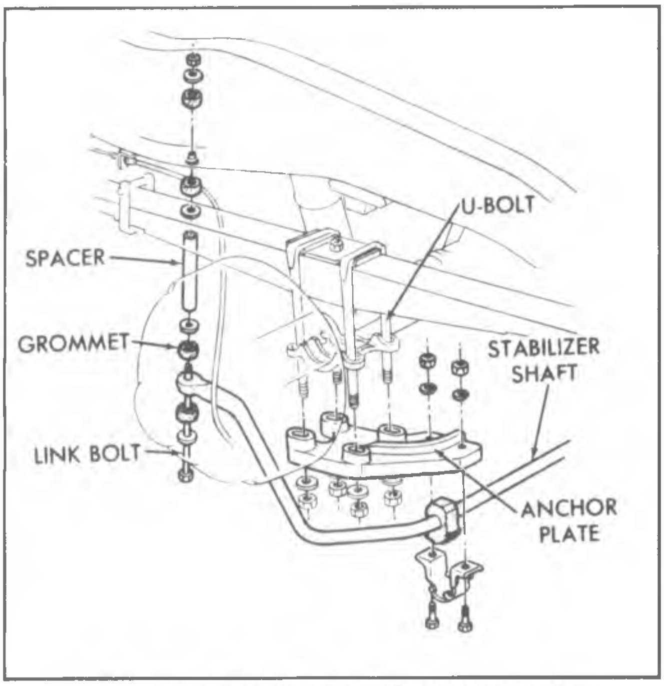


Fig. 10--Rear Stabilizer Shaft-C-20(43), C-30

regarding leaf spring fasteners.

Removal

1. Raise vehicle on hoist so that load in spring is relieved.
2. Loosen, but do not remove, spring-to-shackle retaining nut.
3. Remove nut and bolt securing shackle to spring hanger.
4. Remove nut and bolt securing spring to front hanger.
5. Remove "U" bolt retaining nuts, withdraw "U" bolts and spring plate from spring-to-axle housing attachment.
6. Withdraw spring from vehicle.
7. Inspect spring. Replace bushings, repair or replace spring unit as outlined in this section.

Bushing Replacement

1. Place spring on press and press out bushing using a suitable rod, pipe or tool as shown in Fig. 21.
2. Press in new bushing; assure that tool presses on steel outer shell of bushing.

   Rear Spring, Front Eye-Heavy Duty leaf springs on C20, CK30, and some P30 trucks use a staked- in-place flanged front eye bushing. Before this bushing is pressed out of the spring, the staked locations must be straightened with a chisel or drift. After a new bushing is installed, it must be staked in three equally spaced locations.

Spring Leaf Replacement

1. Place spring assembly in a bench mounted vise and remove spring clips or pry clips open.
2. Position spring in vise jaws, compressing leaves at center and adjacent to center bolt.
3. File peened end of center bolt and remove nut. Open vise slowly to allow spring assembly to expand.
4. Wire brush and clean spring leaves. Inspect spring leaves to determine if replacement is required; also replace defective spring leaf liners at this time.
5. Align center holes in spring leaves by means of a long drift and compress spring leaves in a vise.
6. Remove drift from center hole and install a new center bolt. Tighten nut and peen bolt to retain nut.
7. Align spring leaves by tapping with hammer, then reinstall alignment clips. Spring clips should be bent sufficiently to maintain alignment, but not tight enough to bind spring action.

Leaf Spring Installation

1. Clean axle spring pad and position spring assembly to axle. Position spring to insure clearance to hangers. The shackle assembly must be attached to the rear spring eye before installing shackle to rear hanger shackle must be positioned with arrow pointing forward.
2. Install spring retainer plate and "U" bolts. Loosely install retaining nuts evenly, but do not torque at this time.
3. Raise or lower suspension as required to align spring and shackle with spring hangers.
4. Install shackle bolt and nut and again reposition spring, if necessary to align front eye. Install front eye bolt and nut. Torque hanger and shackle nuts to specifications.

   Make certain that the bolts are free-turning in their bushings prior to torquing.
5. Lower vehicle so that weight of vehicle is on suspension components and torque U-bolt nuts to specifications.
6. Lower vehicle and remove from hoist.

U-Bolt and Anchor Plate Installation

Fig. 23 illustrates the mandatory sequence of tightening U-bolt nuts. Tighten diagonally opposite nuts to 40-50 foot pounds, then tighten all nuts as shown to specifications.

NOTICE: See NOTICE on page 1 of this section, regarding "U"-Bolt fasteners.

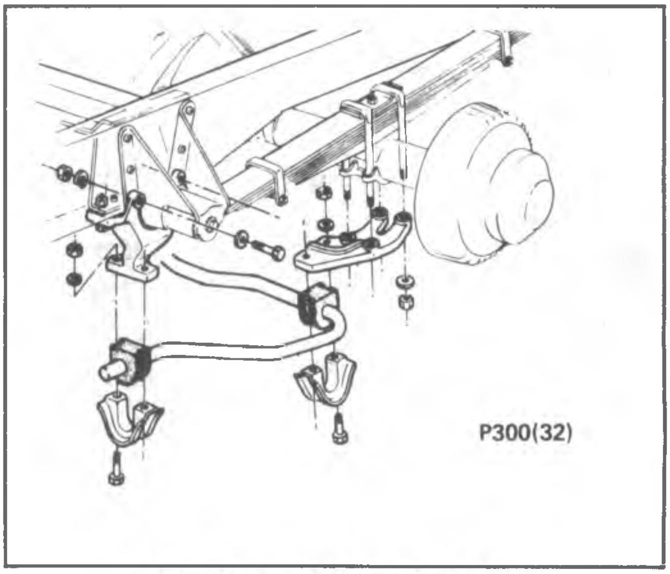


Fig. 11--Rear Stabilizer Shaft-P30

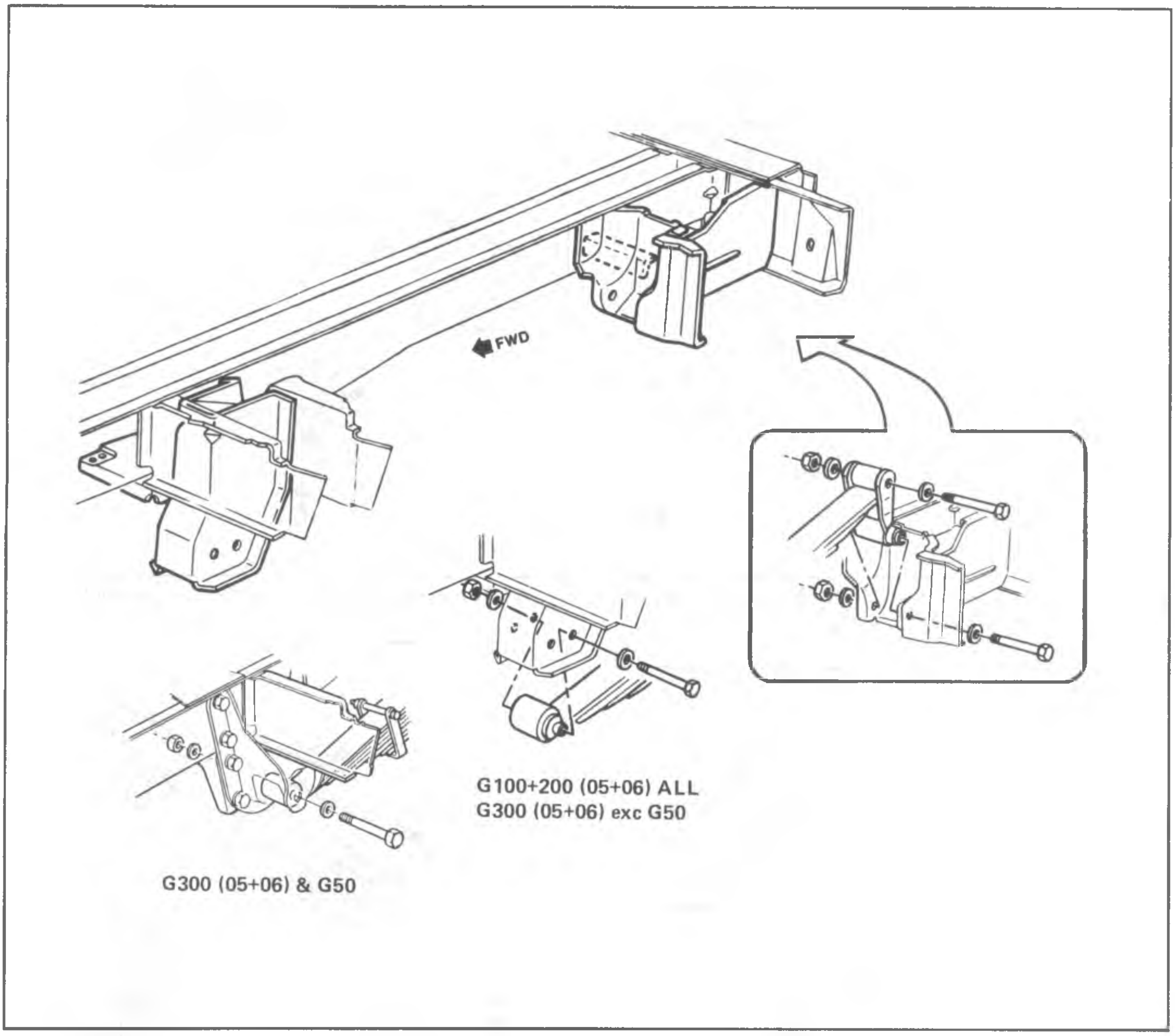


Fig. 12--Rear Spring Hangers And Installation-G Models

SHACKLE REPLACEMENT

1. Raise vehicle on hoist. Place adjustable lifting device under axle.
2. Remove load from spring by jacking frame.
3. Loosen spring-to-shackle retaining bolt, but do not remove.
4. Remove shackle-to-frame bracket retaining bolt then remove shackle bolt from spring eye.
5. Position shackle to spring eye and loosely install retaining bolt. Do not torque retaining bolt at this time.
6. Position shackle to frame bracket and install retaining bolt. Arrow stamped on shackle must point forward.
7. Rest vehicle weight on suspension components and torque both shackle bolt retaining nuts to specifications.

   NOTICE: See NOTICE on page 1 of this section, regarding these fasteners.
8. Lower vehicle and remove from hoist.

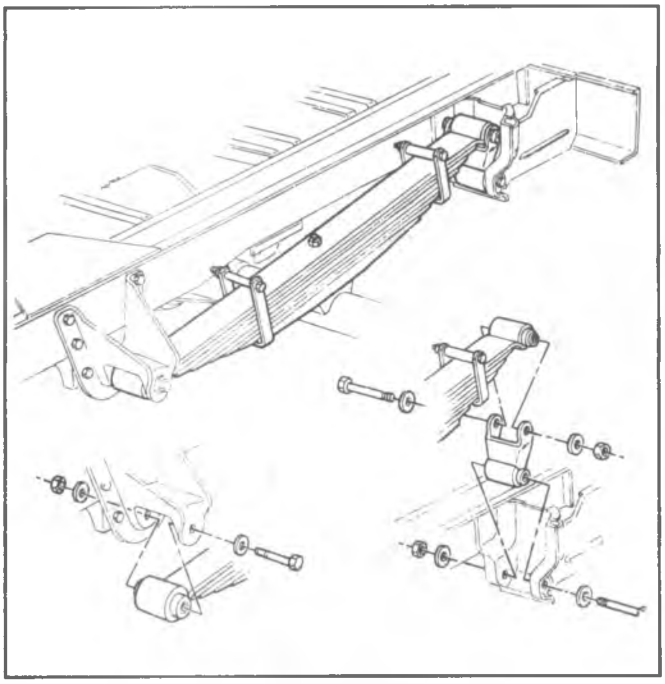


Fig. 13--Rear Spring Installation - G Models Cutaway Vans and G300 (05 and 06)

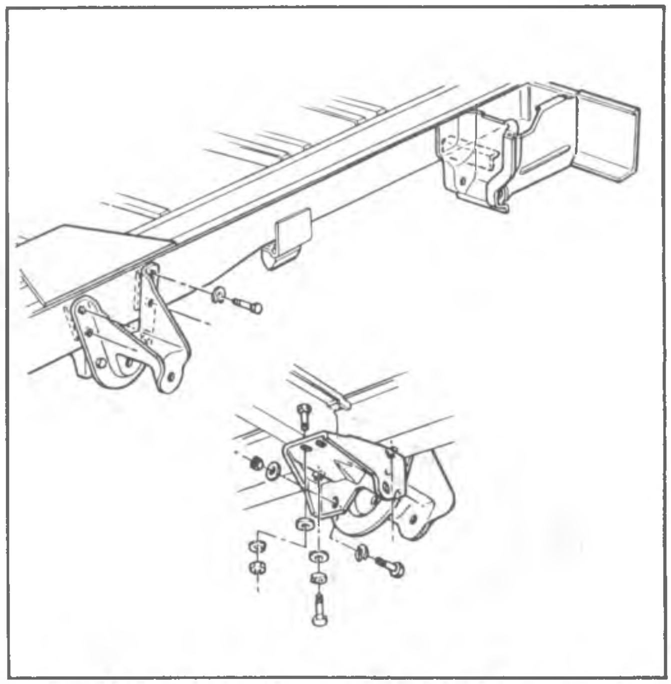


Fig. 15--Rear Spring Hangers-G Models (Cutaway Vans)

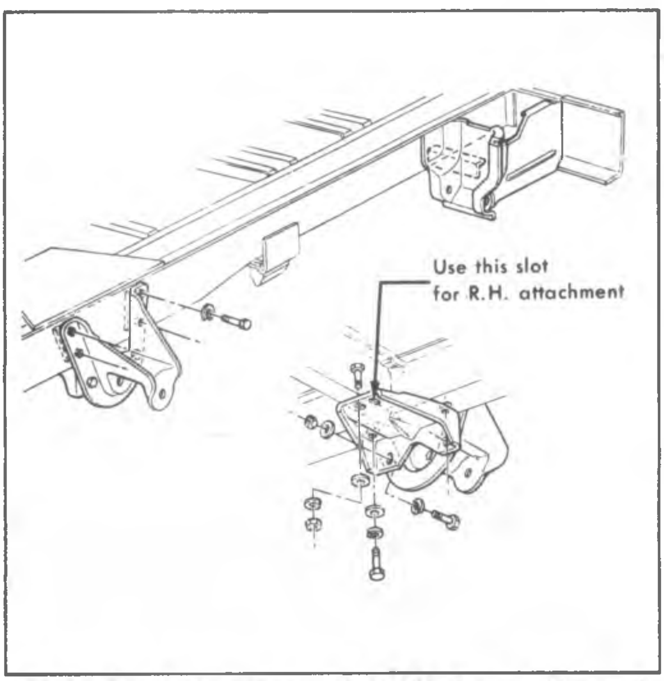


Fig. 14--Rear Spring Hangers - G Models Cutaway Vans and G300 (05 and 06)

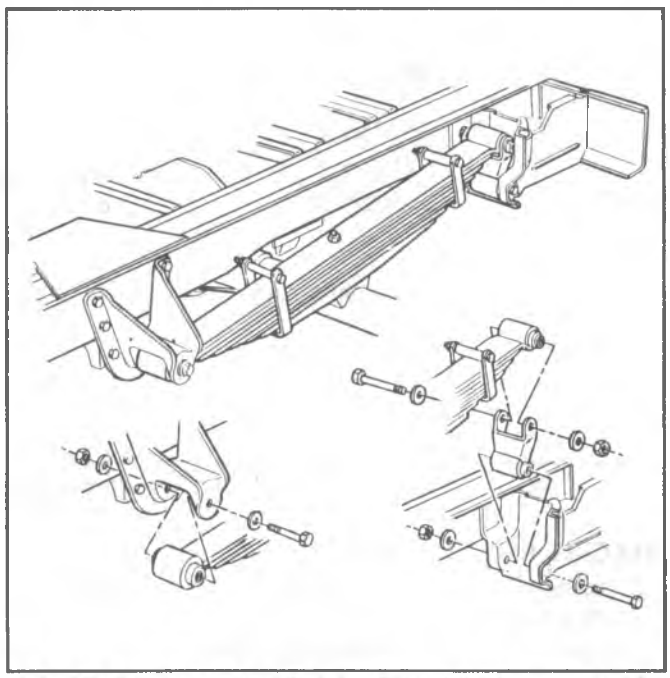


Fig. 16--Rear spring Installation - G Models (Cutaway Vans)

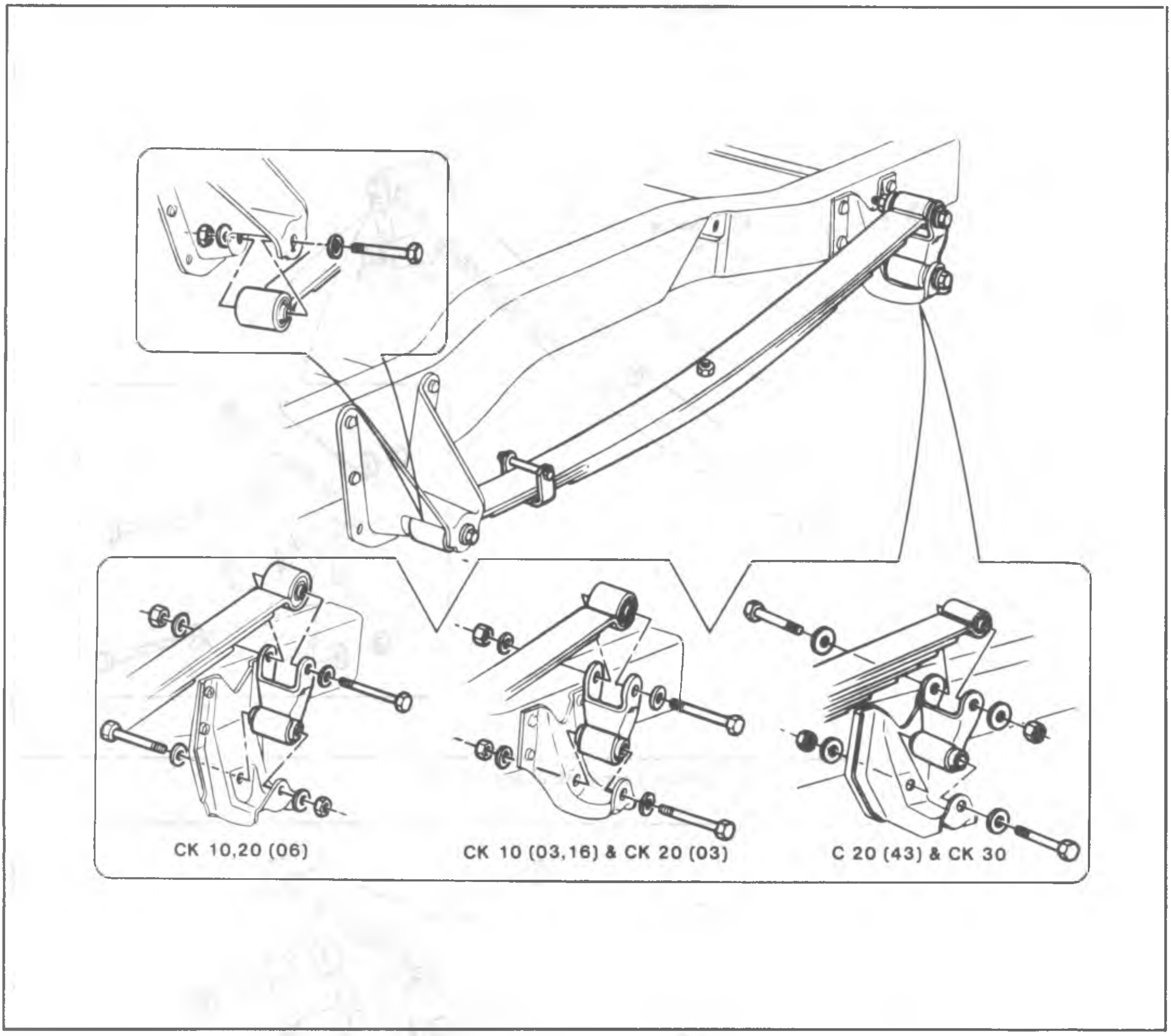


Fig. 17--Rear Spring Installation-C-K Models

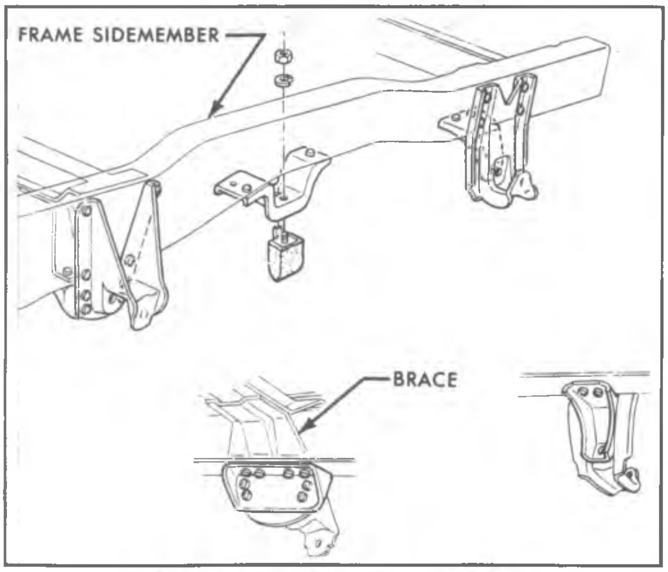


Fig. 18--Rear Spring Hangers (K30)

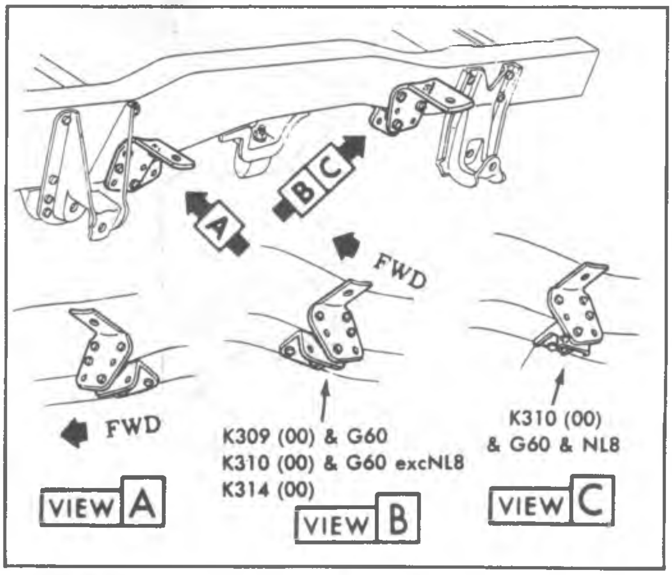


Fig. 19--Auxiliary Spring Bracket (K30)

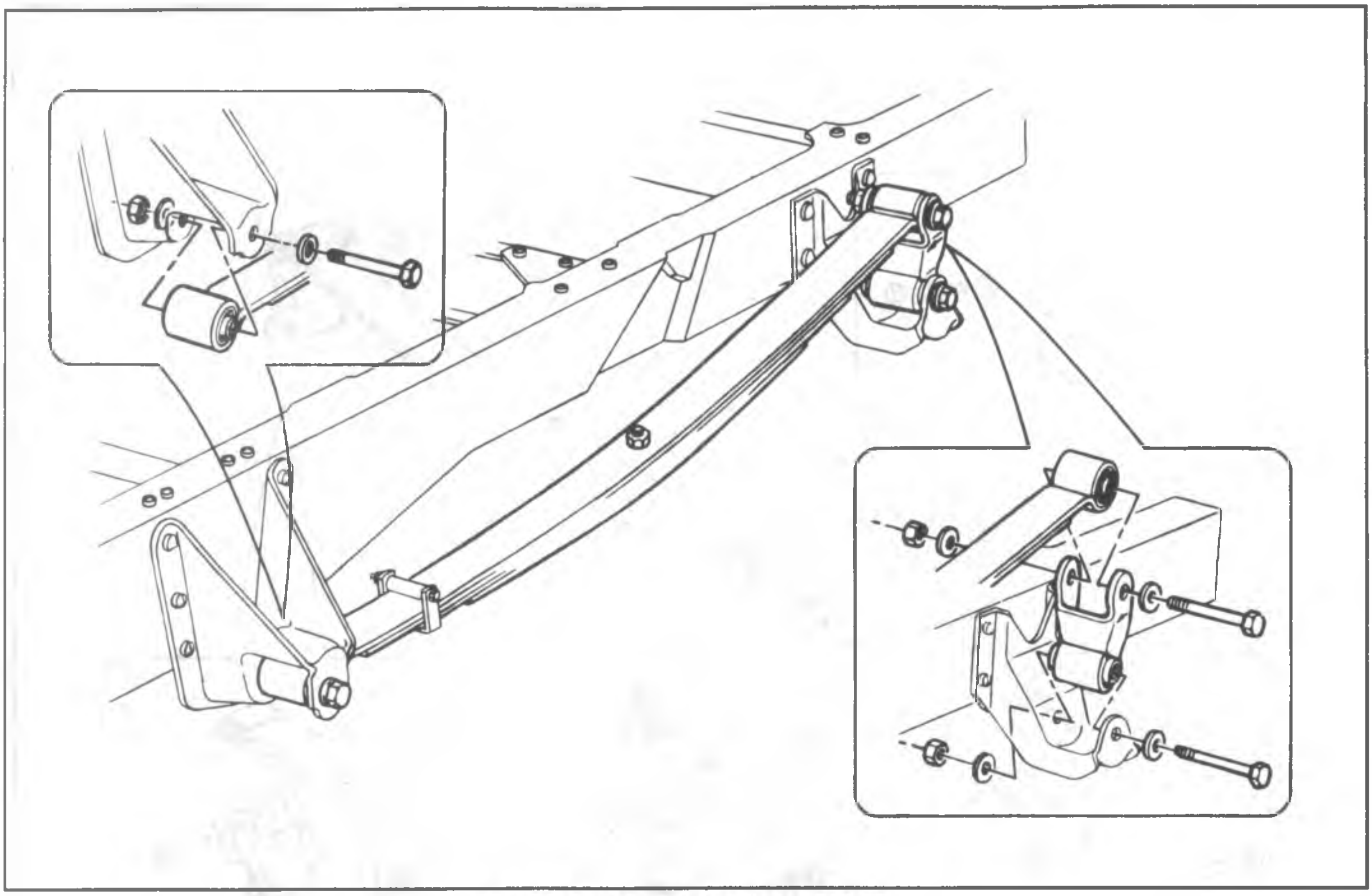


Fig. 20--Rear Spring Installation-P10,20

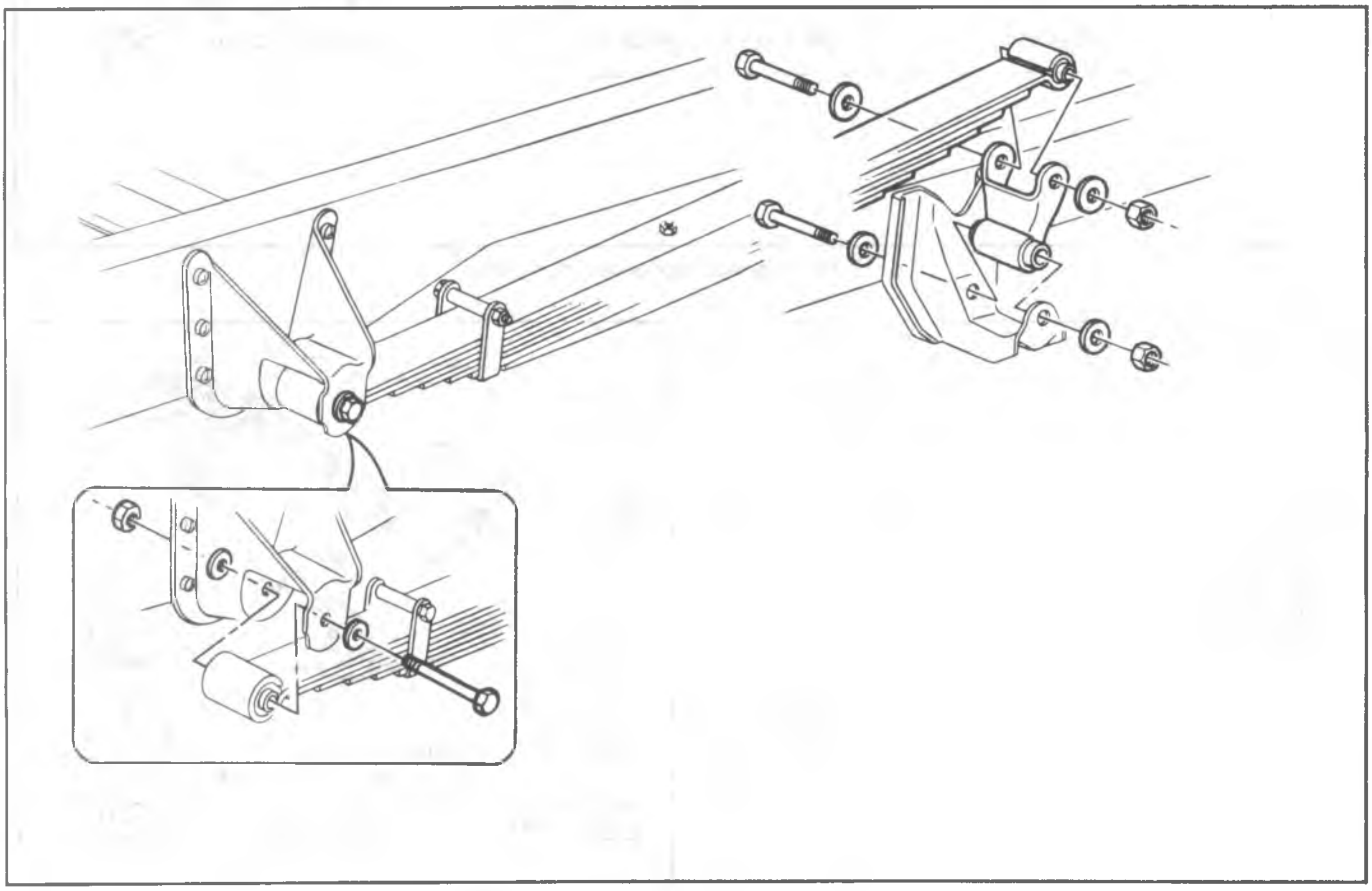
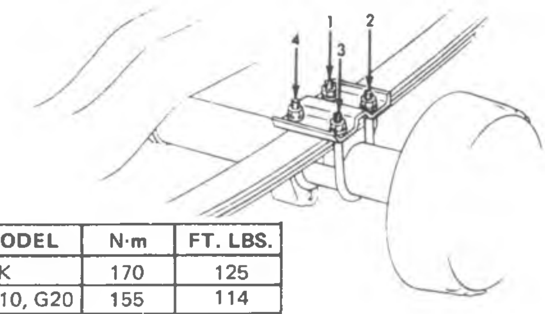
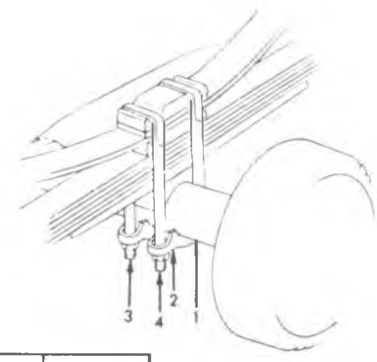


Fig. 21--Rear Spring Installation-P30

1. Install all four nuts to uniform engagement on 'U' Bolts to retain and position anchor plate in design position (perpendicular to axis of 'U' Bolts).
2. Torque all nuts in a diagonal sequence (e.g. 1-3-2-4) to 14-35 N•m.
3. Torque all nuts to full torque using a diagonal sequence.



MODEL	N·m	FT. LBS.
CK	170	125
G10, G20	155	114
G30	155	114



MODEL	N·m	FT. LBS.
CK	200	147
G	205	151

Fig. 22--U-Bolt Installation

	C-K	G	P
Spring-to-Axle "U" Bolt Nuts	Refer to Fig. 3D-22 for Torque Specifications	Refer to Fig. 3D-22 for Torque Specifications	P10 190 N·m (140 ft. lbs.) P20 190 N·m (140 ft. lbs.) P30 230 N·m &170 ft. lbs.) (Exc. W/3/4" Bolt) 272 N·m (20 ft. lbs.) (W/3/4" Bolt)
Leaf Spring			
—Front Bushing Bolt	150 N·m (110 ft. lbs.)	122/183* N·m (90/135* ft. lbs.) (G316 . . . 90)	195 N·m (144 ft. lbs.)
—Rear Shackle Bolt	150 N·m (110 ft. lbs.)	122/183* N·m (90/135* ft. lbs.) (G316 . . . 90)	195 N·m (144 ft. lbs.)
Shock Absorber			
—Upper Attachment	204 N·m (150 ft. lbs.)	100 N·m (75 ft. lbs.)	P10 34 N·m (25 ft. lbs.) P20 190 N·m (140 ft. lbs.) P30 68 N·m (50 ft. lbs.)
—Lower Attachment	156 N·m (115 ft. lbs.)	100 N·m (75 ft. lbs.)	156 N·m (115 ft. lbs.)
Propeller Shaft			
To Rear Axle (Strap)	20 N·m (15 ft. lbs.)	20 N·m (15 ft. lbs.)	20 N·m (15 ft. lbs.)
To Rear Axle ("U" Bolt)	28 N·m (20 ft. lbs.)	28 N·m (20 ft. lbs.)	28 N·m (20 ft. lbs.)
Bearing Support-to-Hanger	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)
Hanger-to-Frame	60 N·m (45 ft. lbs.)	—	—
Rear Stabilizer-to-Anchor Plate	34 N·m (25 ft. lbs.)	—	34 N·m (25 ft. lbs.)

Fig. SP-Specifications

SECTION 3E

WHEELS AND TIRES

NOTICE: The Wheel bolt and nut fasteners are an important attaching part in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

The factory installed tires and wheels are designed to operate satisfactorily with loads up to and including the full rated load capacity when inflated to the recommended inflation pressures.

Correct tire pressures and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear.

REPLACEMENT TIRES

CAUTION: Do not mix different types of tires on the same vehicle such as radial, bias, and bias-belted tires except in emergencies, because vehicle handling may be seriously affected and may result in loss of control.

Some truck-type tires and most passenger-car-type radial tires have a TPC Spec. No. (Tire Performance Criteria Specification Number) molded into the tire sidewall near the tire size marking. This shows that the tire meets rigid size and performance standards which were developed for the vehicle. The TPC Spec. No. assures a proper combination of endurance, load capacity, handling, and traction on wet, dry and snow covered surfaces. When replacing tires with tires having the same TPC Spec. No., tires will be compatible with the vehicle. When replacing tires with those not having a TPC spec. use the same size, load range, and construction type (bias, bias-belted, or radial) as the original tires on the vehicle (see the Certification Label Fig. 3E-3). Use of any other size or type tire may affect load carrying capacity, ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis. If replacing only a single tire, it should be paired on the same axle with the least worn tire of the others.

All tires on four-wheel drive vehicles must be of equal size (but not necessarily ply rating) and of same tread configuration.

Replace tires when:

1. Tires are worn to a point where 2/32 inch (1.6 millimetres) or less tread remains, or the cord or fabric is exposed. To help detect this, tires have built-in tread wear indicators (Fig. 3E-2) that appear between the tread grooves when the tread depth is 2/32 inch (1.6mm) or less. When the indicators appear in two or more adjacent grooves at three spots around the tire, the tire should be replaced.
2. Tire tread or sidewall is cracked, and, or snagged deep enough to expose the cord or fabric.
3. Tire has a bump, bulge, or split.
4. Tire sustains a puncture, cut, or other injury that can't be correctly repaired because of the size or location of the injury.

CAUTION: Mounting of wrong size tire can cause personal injury. To help avoid personal injury during mounting of tire to wheel, mount 16.5 inch diameter tire ONLY on 16.5 inch diameter wheel. Failure to do so could cause tire to explode during inflation and make the tire and wheel a dangerous flying object.

METRIC TIRES

Metric tires are available in two load ranges, Standard load and Extra load. Figure 3E-1 shows the meaning of the metric tire format. Most metric tire sizes do not have exact

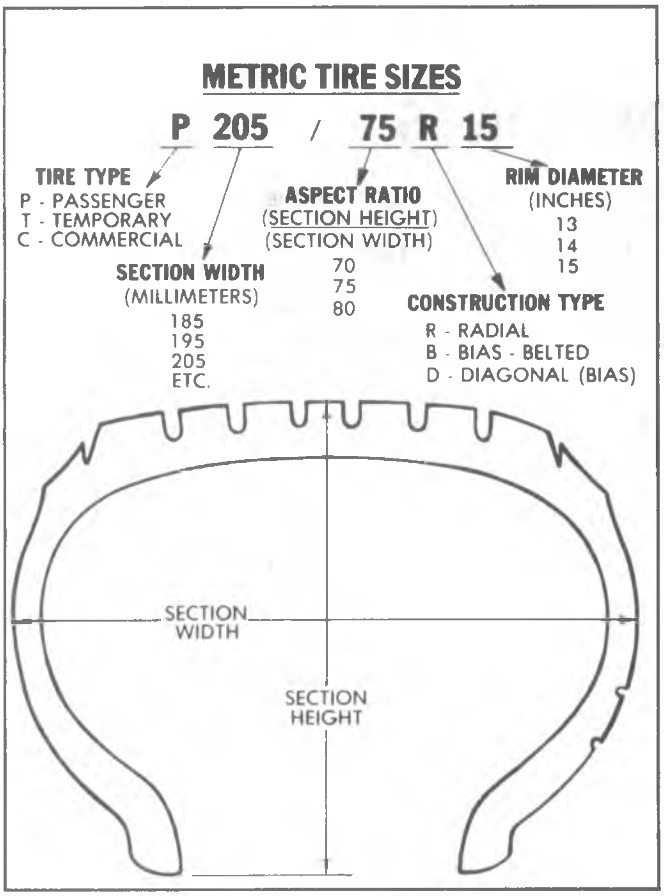

Fig. 3E-1--Metric Tire Size Format

corresponding alpha tire sizes. For example, a P205/75R15 is not exactly equal in size and load carrying capacity to an FR78-15. For this reason, replacement tires should be of the same size, load range, and construction as those originally on the car. If metric tires must be replaced with other sizes, such as in the case of snow tires, a tire dealer should be consulted. Tire companies can best recommend the closest match of alpha to metric sizes within their own tire lines.

The metric term for tire inflation pressure is the Kilopascal (kPa). Tire pressure will usually be printed in both kPa and psi. Metric tire gages are available from tool suppliers. The chart (Fig. 3E-2) converts commonly-used inflation pressures from kPa to psi.

INFLATION PRESSURE CONVERSION CHART
(KILOPASCALS TO PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60

Conversion: 6.9 kPa = 1 psi

Fig. 3E-2--Inflation Pressure Conversion

REPLACEMENT WHEELS

Wheels must be replaced if they become damaged (for example: bent, heavily rusted, leak air) or if wheel nuts often become loose. Do not use bent wheels which have been straightened, and do not use inner tubes in leaking wheels which are designed for tubeless tires. Such wheels may have structural damage and could fail without warning.

The wheels originally equipped on the vehicle will provide optimum life up to the maximum load and inflation pressures shown in the Wheel Code and Limits Chart. Maximum loads, maximum inflation pressures, wheel identification codes, and wheel sizes are stamped on each wheel. Service tested and approved wheels are available from service. When obtaining wheels for any reason from any other source, the replacement wheels should be equal in load capacity, inflation pressure capacity, diameter, width, offset and mounting configurations to those originally installed on the vehicle.

A wheel of the wrong size or type may adversely affect load carrying capacity, wheel and bearing life, brake cooling, speedometer/odometer calibration, stopping ability, headlight aim, bumper height, vehicle ground clearance, and tire clearance to the body and chassis. Replacement with "used" wheels is not advised: they may have been subjected to harsh treatment or very high mileage and could fail without warning.

The use of wheels and/or tires with higher load carrying limits than originally equipped on the vehicle does not in itself increase the GAWR or the GVWR of the vehicle.

Measuring Wheel Runout

Wheel runout should be measured with an accurate dial indicator graduated in thousands of an inch. Measurements may be taken with the wheel installed on the vehicle, or off the vehicle using an accurate mounting surface such as on a wheel balancer. Measurements may also be taken with or without the tire mounted on the wheel.

Radial runout and lateral runout should be measured on both the inboard and outboard rim flanges. Maximum runouts and recommended measurement locations are shown on Figure 3E-3. With the dial indicator firmly

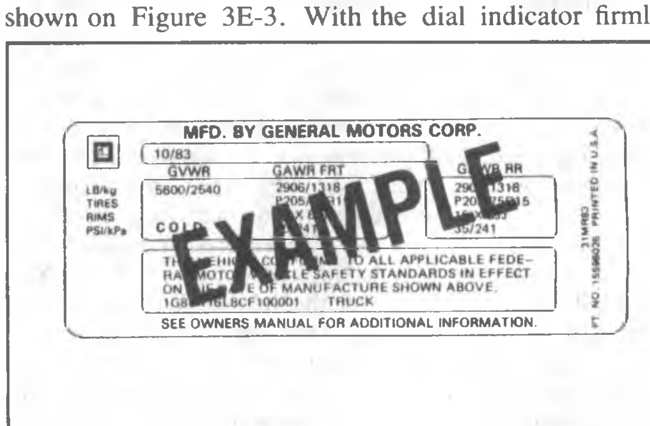

Fig. 3E-3--Certification Label

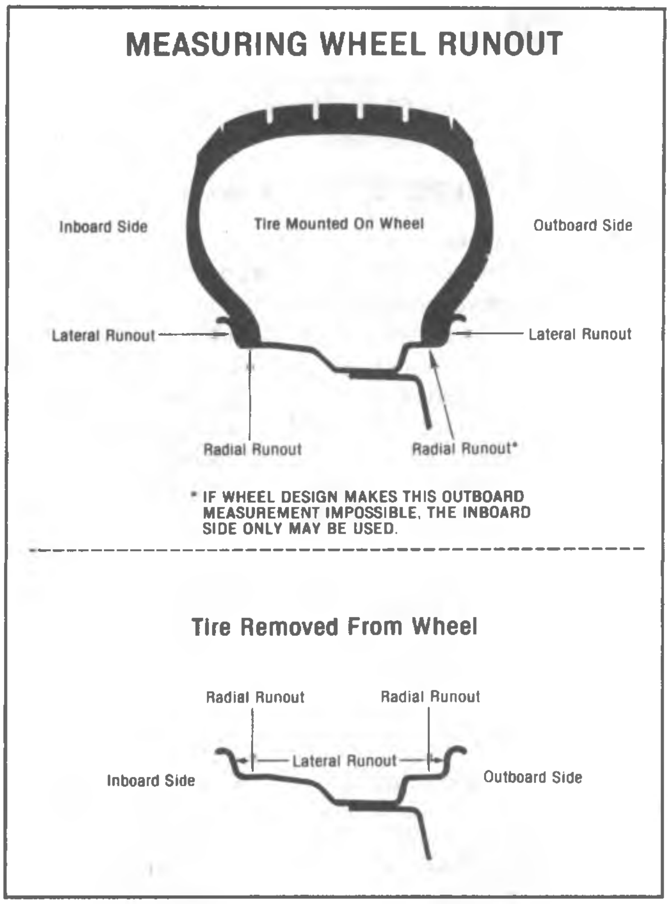

Fig. 3E-4--Measuring Wheel Runout

	Steel Wheels	Aluminum Wheels
Radial Runout	.040"	.030"
Lateral Runout	.045"	.030"

Fig. 3E-5--Wheel Runout Specs

in position, slowly rotate the wheel one revolution and record the T.I.R. (Total Indicator Reading). If any measurement exceeds these amounts, and the vehicle has a vibration that wheel balancing will not correct, the wheel should be replaced.

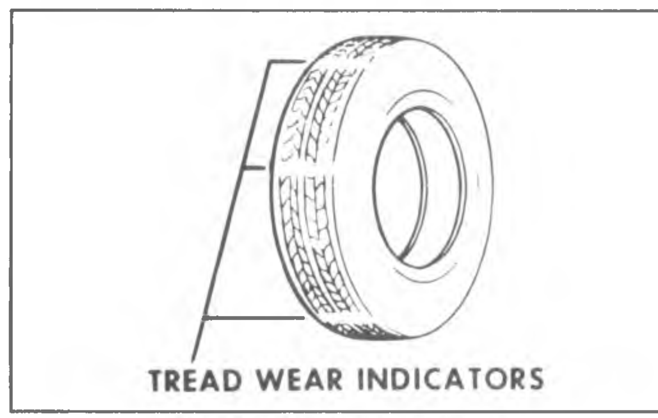

Fig. 3E-6--Tread Wear Indicators

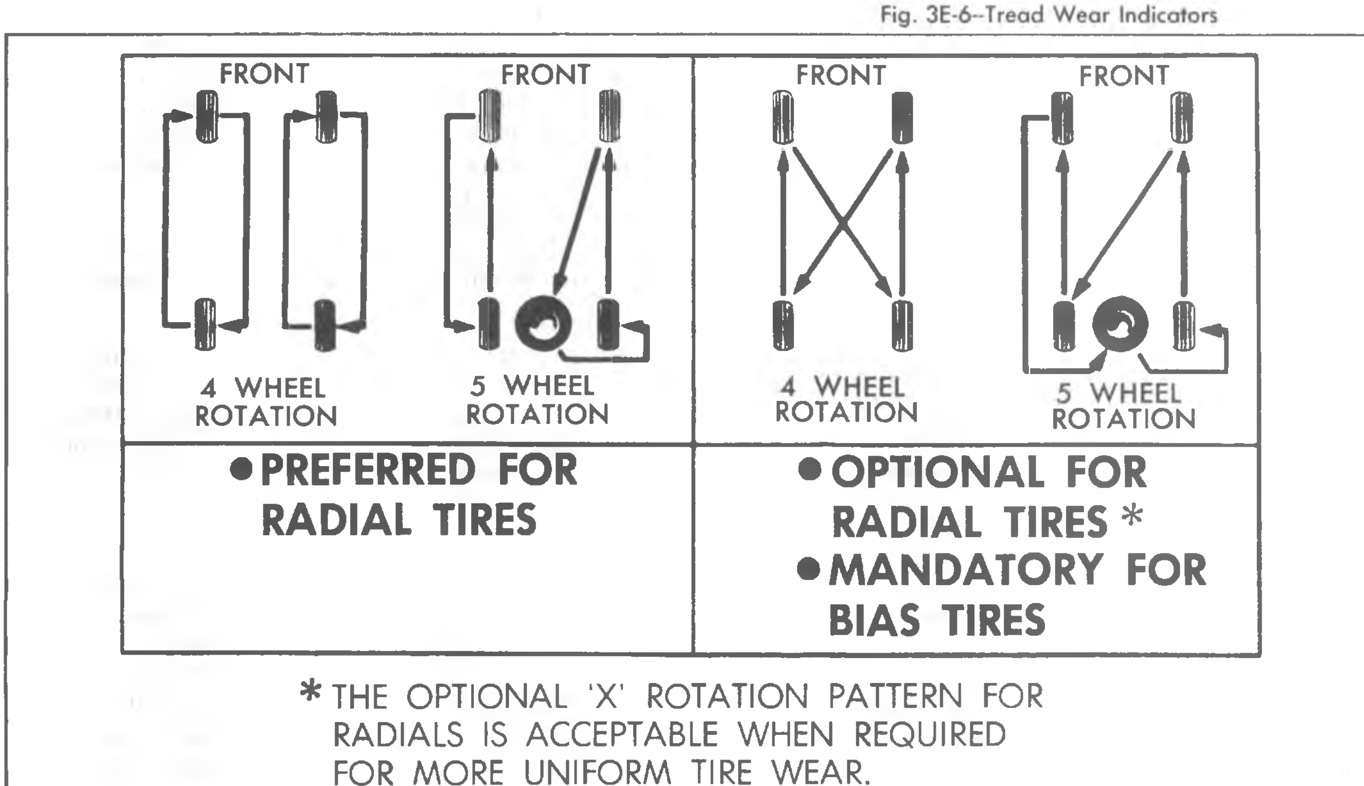

Fig. 3E-7--Tire Rotation

SERVICE OPERATIONS

CAUTION: Servicing of tires mounted on multi-piece rims requires proper tools, safety equipment and specialized training. Severe injuries can result from improper servicing techniques. It is recommended that tires on multi-piece rims be serviced only by competent personnel with proper equipment or by competent truck tire repair shops.

TIRE INSPECTION AND ROTATION (Figs. 3E-5, 3E-7)

Front and rear tires perform different jobs and can wear differently depending on the type of roads driven, individual driving habits, etc. To obtain maximum tire life, tires should be inspected at intervals shown in Section OB. For the longest tire life, any time irregular wear is noticed, the tires should be inspected and rotated and the cause of the uneven wear corrected. Be certain to check wheel nut tightness and to adjust the tire pressures, front and rear, after rotation to agree with those recommended in the tire inflation charts.

The outer tire on a dual wheel will skid or drag on a turn because of the difference in the turning radii of the inner and outer tires. This results in the outer tire wearing faster. In general, the tire with the largest diameter or least wear should be at the outside of each dual wheel. In addition, when trucks are operated continuously on high crown roads, an increase in air pressure of from 5 to 10 PSI in the outside tire of each dual produces maximum tire life.

As shown in Fig. 3E-7, the X method of rotation is allowed with radial tires if necessary. Due to their design, radial tires tend to wear faster in the shoulder area particularly in the front positions. This makes regular rotation especially necessary.

INFLATION PRESSURE

The maximum cold inflation pressures for the factory installed tires are listed on the Certification Label. Tires must be inflated to these pressures when the GVWR or an axle GAWR is reached. Improper tire inflation pressures for the load the vehicle is carrying can adversely affect tire life and vehicle performance.

For improved ride comfort in vehicles rated at 8600 GVWR, it is permissible to use the lower tire pressure values shown on the label located on the rear edge of the driver's door provided there is a maximum of 200 lbs. cargo, no slide in camper, and there are three or less occupants.

Too low an air pressure can result in tire overloading, abnormal tire wear, adverse vehicle handling, and reduced fuel economy. The tire flexes more and can build up excessive heat, weakening the tire and increasing susceptibility to damage or failure. Too high an air pressure can result in abnormal wear, harsh vehicle ride, and increased susceptibility to damage from road hazards. Lower inflation pressures should be used only with reduced vehicle loads and the rear tire pressure should be equal to or greater than the front pressure on single wheel application. After determining the load on each tire by weighing the vehicle on a scale, the correct cold inflation pressures for the actual tire loads can be obtained from the Tire/Wheel Load and Inflation Pressure Charts shown in this section. Refer to Section 0B for additional information on inflation pressure.

CORRECTING IRREGULAR TIRE WEAR

Heel and Toe Wear

This is a saw-toothed effect where one end of each tread block is worn more than the other. The end that wears is the one that first grips the road when the brakes are applied.

Heel and toe wear is less noticeable on rear tires than on front tires, because the propelling action of the rear wheels creates a force which tends to wear the opposite end of the tread blocks. The two forces, propelling and braking, make for more even wear of the rear tires, whereas only the braking forces act on the front wheels, and the saw-tooth effect is more noticeable.

A certain amount of heel and toe wear is normal. Excessive wear is usually due to high speed driving and excessive use of brakes. The best remedy, in addition to cautioning the owner on his driving habits, is to interchange tires regularly.

Side Wear

This may be caused by incorrect wheel camber, underinflation, high cambered roads or by taking corners at too high a rate of speed. The first two causes are the most common. Camber wear can be readily identified because it occurs only on one side of the treads, whereas underinflation causes wear on both sides. Camber wear requires correction of the camber first and then interchanging tires. There is, of course, no correction for high crowned roads. Cornering wear is discussed further on.

Misalignment Wear

This is wear due to excessive toe-in or toe-out. In either case, tires will revolve with a side motion and scrape the tread rubber off. If misalignment is severe, the rubber will be scraped off of both tires; if slight, only one will be affected. The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment. The remedy is readjusting toe-in, or rechecking the entire front end alignment if necessary.

Uneven Wear

Uneven or spotty wear is due to such irregularities as unequal caster or camber, bent front suspension parts, out-of-balance wheels, brake drums out of round, brakes out of adjustment or other mechanical conditions. The remedy in each case consists of locating the mechanical defect and correcting it.

Cornering Wear

When a truck makes an extremely fast turn, the weight is shifted from an even loading on all wheels to an abnormal load on the tires on the outside of the curve and a very light load on the inside tires, due to centrifugal force. This unequal loading may have two unfavorable results.

First, the rear tire on the inside of the curve may be relieved of so much load that it is no longer geared to the

TIRE AND WHEEL LOAD LIMIT CHARTS

(TIRE & WHEEL LOAD LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL OR TIRE INFLATION PRESSURE OR LOAD LIMITS ARE EXCEEDED)

RADIAL TIRE SIZE AND LOAD LIMITS - kg (LBS)

METRIC RADIAL TIRES USED AS SINGLES

Tire Size	Load Range	Inflation Pressure — kPa (PSI)						
		250 (36)	300 (44)	350 (51)	400 (58)	450 (65)	500 (73)	550 (80)
LT215/85R16	C	695 (1532)	790 (1742)	880 (1940)				
LT215/85R16	D	695 (1532)	790 (1742)	880 (1940)	965 (2127)	1050 (2315)		
LT235/85R16	D	790 (1742)	900 (1984)	1000 (2205)	1100 (2425)	1190 (2623)		
LT235/85R16	E	790 (1742)	900 (1984)	1000 (2205)	1100 (2425)	1190 (2623)	1290 (2844)	1380 (3042)

METRIC RADIAL TIRES USED AS DUALS

Tire Size	Load Range	Inflation Pressure — kPa (PSI)						
		250 (36)	300 (44)	350 (51)	400 (58)	450 (65)	500 (73)	550 (80)
LT215/85R16	C	630 (1389)	720 (1587)	800 (1764)				
LT215/85R16	D	630 (1389)	720 (1587)	800 (1764)	870 (1918)	955 (2105)		

BIAS TIRE SIZE AND LOAD LIMTS — kg (LBS)

BIAS TIRES USED AS SINGLES

Tire Size	Load Range	Inflation Pressure — kPa (PSI)									
		207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
7.50-16	C	735 (1620)	803 (1770)	875 (1930)	934 (2060)						
7.50-16	D	735 (1620)	803 (1770)	875 (1930)	934 (2060)	993 (2190)	1048 (2310)	1107 (2440)			
7.50-16	E	735 (1620)	803 (1770)	875 (1930)	934 (2060)	993 (2190)	1048 (2310)	1107 (2440)	1161 (2560)	1211 (2670)	1261 (2780)

BIAS TIRES USED AS DUALS

Tire Size	Load Range	Inflation Pressure — kPa (PSI)									
		207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
7.50-16	C	649 (1430)	710 (1565)	767 (1690)	823 (1815)						
7.50-16	D	649 (1430)	710 (1565)	767 (1690)	823 (1815)	875 (1930)	925 (2040)	971 (2140)			

WHEEL CODE AND LIMITS

Code*	Wheel Size	Max Load kg (Lbs)	Max Pressure kPa (PSI)
AA	16x6.5 L	1381 (3045)	621 (90)
AF	16x6 K	1107 (2440)	517 (75)
BF	16x6.5 L	1261 (2780)	586 (85)
BJ	15x8 JJ	866 (1910)	276 (40)
BK	15x7 JJ	757 (1670)	276 (40)
BM	15x8 JJ	921 (2030)	276 (40)
CF	15x7 JJ	757 (1670)	276 (40)

CK	15x8 JJ	866 (1910)	276 (40)
UW	15x7 JJ	921 (2030)	283 (41)
UX	15x7 JJ	921 (2030)	283 (41)
XH	15x6 JJ	719 (1585)	276 (40)
XW	15x6 JJ	866 (1910)	483 (70)
XX	15x6 JJ	925 (2040)	483 (70)
ZC	15x8 JJ	921 (2030)	276 (40)

* Wheel code is located on the wheel just to the right of the valve stem hole.

Fig. 3E-8--Tire/Wheel Load and Inflation Pressure for C-K Models

TIRE AND WHEEL LOAD LIMIT CHARTS

(TIRE & WHEEL LOAD LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL OR TIRE INFLATION PRESSURE OR LOAD LIMITS ARE EXCEEDED)

TIRE SIZE AND LOAD LIMITS — kg (LBS)

BIAS TIRE USED AS SINGLES

Tire	Load	Inflation Pressure — kPa (PSI)										
Size	Range	207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
8 00 16 5	C	617 (1360)	676 (1490)	730 (1610)	785 (1730)							
8 00 16 5	D	617 (1360)	676 (1490)	730 (1610)	785 (1730)	835 (1840)	882 (1945)	928 (2045)				
8 75 16 5	D	712 (1570)	780 (1720)	839 (1850)	903 (1990)	957 (2110)	1016 (2240)	1066 (2350)				
8 75 16 5	E	712 (1570)	780 (1720)	839 (1850)	903 (1990)	957 (2110)	1016 (2240)	1066 (2350)	1120 (2470)	1166 (2570)	1216 (2680)	

BIAS TIRES USED AS DUALS

Tire	Load	Inflation Pressure — kPa (PSI)										
Size	Range	207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
8 00 16 5	C	542 (1195)	594 (1310)	642 (1415)	689 (1520)							
8 00 16 5	D	542 (1195)	594 (1310)	642 (1415)	689 (1520)	735 (1620)	776 (1710)	816 (1800)				

RADIAL TIRES USED AS SINGLES

Tire	Load	Inflation Pressure — kPa (PSI)										
Size	Range	207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
8 75R16 5	E		712 (1570)	780 (1720)	839 (1850)	903 (1990)	957 (2110)	1016 (2240)	1066 (2350)	1120 (2470)	1166 (2570)	1216 (2680)

WHEEL CODE AND LIMITS

Code*	Wheel Size	Max Load kg (Lbs)	Max Pressure kPa (PSI)	Code*	Wheel Size	Max Load kg (Lbs)	Max Pressure kPa (PSI)
8R	15x7 JJ	767 (1690)	276 (40)	YD	16 5x6	1216 (2680)	586 (85)
CD	15x6 5 JJ	767 (1690)	276 (40)	YH	16 5x6	1216 (2680)	586 (85)
XH	15x6 JJ	719 (1585)	276 (40)	YJ	16 5x6.75	1216 (2680)	586 (85)
XW	15x6 JJ	866 (1910)	483 (70)	NO CODE	15x6 5 JJ	207 (1690)	767 (40)

*Wheel code is located on the wheel just to the right of the valve stem hole.

Fig. 3E-9--Tire/Wheel Load and Inflation Pressure-G Models

TIRE AND WHEEL LOAD LIMIT CHARTS

(TIRE & WHEEL LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEELS OR TIRE INFLATION PRESSURE OR LOAD LIMITS ARE EXCEEDED)

RADIAL TIRE SIZE AND LOAD LIMITS - kg (LBS)

METRIC RADIAL TIRES USED AS SINGLES

Tire Size	Load Range	Inflation Pressure — kPa (PSI)						
		250 (36)	300 (44)	350 (51)	400 (58)	450 (65)	500 (73)	550 (80)
LT215/85R16	C	695 (1532)	790 (1742)	880 (1940)				
LT215/85R16	D	695 (1532)	790 (1742)	880 (1940)	965 (2127)	1050 (2315)		
LT235/85R16	D	790 (1742)	900 (1984)	1000 (2205)	1100 (2425)	1190 (2623)		
LT235/85R16	E	790 (1742)	900 (1984)	1000 (2205)	1100 (2425)	1190 (2623)	1290 (2844)	1380 (3042)

METRIC RADIAL TIRES USED AS DUALS

Tire Size	Load Range	Inflation Pressure — kPa (PSI)						
		250 (36)	300 (44)	350 (51)	400 (58)	450 (65)	500 (73)	550 (80)
LT215/85R16	C	630 (1389)	720 (1587)	800 (1764)				
LT215/85R16	D	630 (1389)	720 (1587)	800 (1764)	870 (1918)	955 (2105)		

RADIAL TIRE USED AS SINGLES

Tire Size	Load Range	Inflation Pressure — kPa (PSI)							
		310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
8R19.5	D				1030 (2270)	1093 (2410)	1152 (2540)	1216 (2680)	1270 (2800)

RADIAL TIRES USED AS DUALS

Tire Size	Load Range	Inflation Pressure — kPa (PSI)							
		310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
8R19.5	D				1012 (2230)	1066 (2350)	1116 (2460)		

Fig. 3E-10--Tire/Wheel Load and Inflation Pressure-P Models

TIRE AND WHEEL LOAD LIMIT CHARTS

(TIRE & WHEEL LOAD LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL OR TIRE INFLATION PRESSURE OR LOAD LIMITS ARE EXCEEDED)

BIAS TIRE SIZE AND LOAD LIMITS — kg (LBS)

BIAS TIRES USED AS SINGLES

Tire Size	Load Range	Inflation Pressure — kPa (PSI) 207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
7.50-16	C	735 (1620)	803 (1770)	875 (1930)	934 (2060)						
7.50-16	D	735 (1620)	803 (1770)	875 (1930)	934 (2060)	993 (2190)	1048 (2310)	1107 (2440)			
7.50-16	E	735 (1620)	803 (1770)	875 (1930)	934 (2060)	993 (2190)	1048 (2310)	1107 (2440)	1161 (2560)	1211 (2670)	1261 (2780)
8-19.5	D, E					957 (2110)	1030 (2270)	1093 (2410)	1152 (2540)	1216 (2680)	1270 (2800)

BIAS TIRES USED AS DUALS

Tire Size	Load Range	Inflation Pressure — kPa (PSI) 207 (30)	241 (35)	276 (40)	310 (45)	345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
7.50-16	C	649 (1430)	710 (1565)	767 (1690)	823 (1815)						
7.50-16	D	649 (1430)	710 (1565)	767 (1690)	823 (1815)	875 (1930)	925 (2040)	971 (2140)			
8-19.5	D			839 (1850)	903 (1990)	957 (2110)	1012 (2230)	1066 (2350)	1116 (2460)		
8-19.5	E			839 (1850)	903 (1990)	957 (2110)	1012 (2230)	1066 (2350)	1116 (2460)	1166 (2570)	1216 (2680)

WHEEL CODE AND LIMITS

Code*	Wheel Size	Max Load kg (Lbs.)	Max Pressure kPa (PSI)
AA	16 x 6.5 L	1381 (3045)	621 (90)
AF	16 x 6 K	1107 (2440)	517 (75)
BF	16 x 6.5 L	1261 (2780)	586 (85)
ZT	19.5 x 6	1261 (2780)	655 (95)
ZY	19.5 x 6	1152 (2540)	552 (80)

*Wheel code is located on the wheel just to the right of the valve stem hole.

Fig. 3E-11--Tire/Wheel Load and Inflation Pressure-P Models

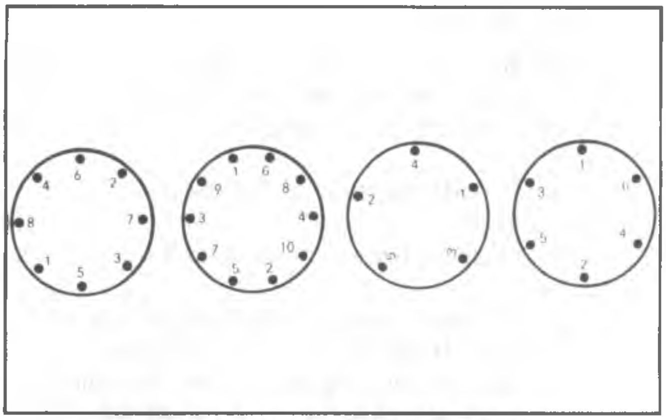

Fig. 3E-12--Wheel Nut Tightening Sequence

road and it slips, grinding off the tread on the inside half of the tire at an excessive rate. This type of tire shows much the same appearance of tread wear as tire wear caused by negative camber.

Second, the transfer of weight may also overload the outside tires so much that they are laterally distorted resulting in excessive wear on the outside half of the tire, producing a type of wear like that caused by excessive positive camber.

Cornering wear can be most easily distinguished from abnormal camber wear by the rounding of the outside shoulder or edge of the tire and by the roughening of the tread surface which denotes abrasion.

Cornering wear often produces a fin or raised portion along the inside edge of each row in the tread pattern. In some cases this fin is almost as pronounced as a toe-in fin, and in others, it tapers into a row of tread blocks to such an extent that the tire has a definite "step wear" appearance.

The only remedy for cornering wear is proper instruction of operators. Driving more slowly on curves and turns will avoid grinding rubber off tires. To offset normal cornering wear as much as possible tires should be interchanged at regular intervals.

Wheel and Tire Balancing

It is desirable from the standpoints of tire wear and vehicle ride and handling ease to maintain proper balance of wheel and tire assemblies on all models. This may be accomplished by either of the two types of balancing systems in correct use which balance wheels either on the vehicle or off. The "on the vehicle" type, however, is the more desirable in that all rolling components (brake drums, bearings, seals, etc.) are included in the balancing procedure and thereby have any existing unbalance corrected.

Truck Wheel Balance Weights

All wheels equipped with a tubular side ring (rolled flange rim), on the outboard side of the wheel rims require special design weights to fit. Dynamic balancing can be accomplished through the use of these special balance weights which are designed only for installations on the outboard side of these wheels. Conventional weights fit only the inboard side of these wheels.

Static Balance

Static balance (sometimes called still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with a chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out of balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often to wheel "tramp".

Dynamic Balance

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance, and also run smoothly at all speeds.

To insure successful, accurate balancing, the following precautions must be observed:

- Wheel and tire must be clean and free from all foreign matter.
- The tires should be in good condition and properly mounted with the balance mark on the tire, if any, lined up with the valve.
- Bent wheels that have runout over 1/16" should be replaced.
- Inspect tire and wheel assembly to determine if an eccentric or out-of-round condition exists. Note that this condition, if severe, cannot be "balanced out". An assembly which has an out-of-round condition exceeding 3/16" on tire sizes through 19.5" is not suitable for use on the front of the vehicle. Its use on the rear should be governed by its general condition and whether the roundness defect seriously detracts from overall ride quality.
- When balancing wheels and tires, it is recommended that the instructions covering the operation of the wheel balancer being used be closely followed.
- When balancing truck type nylon tires, tires must be hot (run for several miles) before raising vehicle to balance so that flat spot is elimated. A tire which is flat spotted will be incorrectly balanced.
- On 10 and 20 series trucks, do not attempt to externally drive the wheels with the transfer case in the neutral position. Although, the transfer case will be uncoupled from the transmission, the front and rear drive trains will be coupled through the transfer case. For example, attempting to balance a rear wheel on the vehicle will cause one or both of the front wheels to also be driven. The wheels may be dynamically balanced on the vehicle with the transfer case in the 2H position. The transfer case neutral position should only be used when it becomes necessary to uncouple the transmission from the transfer case.

WHEEL INSTALLATION

Single Wheels

When installing the tire and wheel on the vehicle, the following procedure should be followed:

After wheel nuts are on loosely, turn the wheel until one nut is at the top of the bolt circle; tighten the nut just snug. Snug up the remaining nuts criss-cross to minimize runout, then tighten the nuts to the recommended torque alternately, see Figure 3E-11, and evenly to avoid excessive runout.

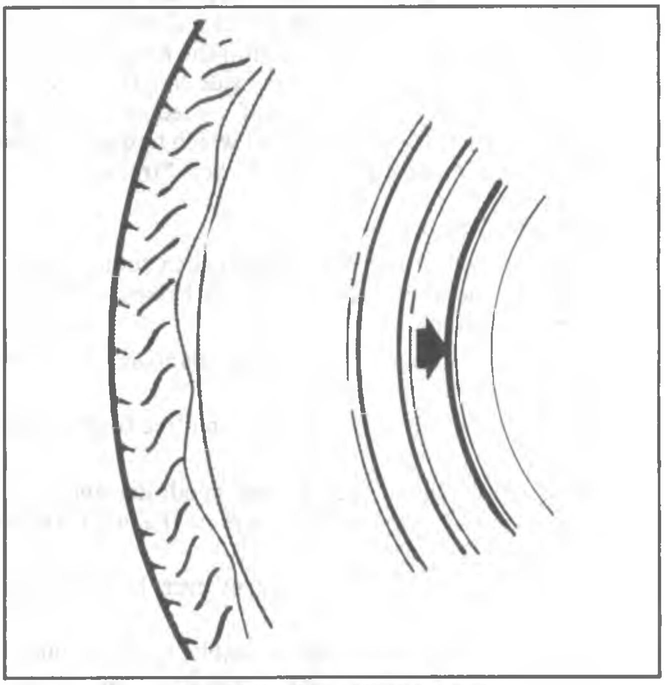

Fig. 3E-13--Tire Locating Rings

CAUTION: Before re-installing wheels, remove any build up of corrosion of the wheel mounting surface and brake drum or disc mounting surface by scraping and wire brushing. Installing wheels without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen which can later allow a wheel to come off while the vehicle is moving, possibly causing loss of control.

Dual Wheels

When installing wheels on vehicles with dual rear wheels:

1. Install inner and outer wheel and clamp ring on rear, or wheel and clamp ring on front (be sure pins on clamp ring face outboard).
2. Install and snug nuts finger tight.
3. Torque nuts to specified torque in sequence shown in Fig. 3E-11.

Lateral runout should not exceed 1/8" on front wheel or 3/16" on rear wheel.

Attachment of Dual Wheels On P30 Models

To assure secure attachment of the dual disc wheels, it is important that all dirt or rust scale be removed from the mating surface of the wheels, hub, and clamp ring as well as the stud and nut. POWER DRIVE NUTS THEN MANUALLY INSPECT TORQUE AT 130-180 FT. LBS. MANUAL TORQUE ONLY: 150-200 FT. LB.

Inspection for Leaks

1. With wheel assembly removed from vehicle, inflate the tire to recommended operating pressure.
2. Check for leaks at rim bead by placing wheel and tire horizontal and allowing water to stand in groove between rim and tire. Check for other leaks by lowering assembly into water tank or running water over tire.

Installing Synthetic Tubes

NOTICE: When tube and flap are not properly lubricated and mounted, they will stretch thin in the tire bead and rim region. This will cause premature failure.

1. Before installing tube in tire, clean inside of casing thoroughly.
2. Insert tube in tire and inflate until it is nearly rounded out.
3. Inspect rim for rust scale and bent flanges--clean rust scale and straighten flanges where necessary.
4. Using a brush or cloth swab, apply a solution of neutral vegetable oil soap to the inside and outside of tire beads and also the the rim side of the tube. Do not allow soap solution to run down into tire.
5. When mounting tire and tube on a drop center rim, follow the standard procedure. Be sure tire is centered on rim so that beads are out of rim well before inflating. Do not allow tire to hang loosely on wheel while inflating.
6. Center valve and pull it firmly against the rim. Hold in this position and inflate until tire beads are firmly seated on rim against flanges.
7. Completely deflate tire by removing valve core.
8. Reinflate tire to recommended pressure.

TUBELESS TIRES

Tubeless tires mounted on one piece full drop center rims are standard on most trucks.

Mounting and Demounting

Use a tire changing machine to mount or dismount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons alone to change tire as they may damage the tire beads or wheel rim.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, old rubber, and light rust. Before mounting or demounting a tire, the bead area should be well lubricated with an approved tire lubricant.

After mounting, inflate to 40 psi so that beads are completely seated.

CAUTION: Do not stand over tire when inflating. Bead may break when beads snaps over safety hump and cause serious personal injury.

CAUTION: Do not exceed 275 kPa (40 psi) pressure when inflating. If 275 kPa (40 psi) pressure will not seat beads, deflate, re-lubricate and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

Install valve core and inflate to proper pressure. Check the locating rings of the tire to be sure they show around the rim flanges on both sides (Fig. 3E-13).

RADIAL TIRES

Recommended truck tire mounting and inflation procedures are especially important with radial truck tires. Failure to follow these recommendations can cause bead deformation in both tube type and tubeless tires due to incorrect bead seating. Bead deformation may lead to chafing, lower sidewall and bead area cracking, demounting

WHEEL NUT TORQUES

Series	Description	Torque	
K	7/16" Bolts (6)	90 Ft. Lbs	120 N m
C10,P10,G10,G20	1/2" Bolts (5)	100 Ft. Lbs	140 N m
C20, P20 C30, P30 and K20, G30 Single Wheels	9/16" Bolts (5)	120 Ft. Lbs	160 N m
CKPG30 Dual Wheels	9/16" Bolts (8)	140 Ft. Lbs	190 N·m
	Heavy Duty Wheels 5/8" Bolts (10)	200 Ft. Lbs.	270 N m

Fig. 3E-14--Wheel Nut Torque

difficulties, eccentric wear, ride vibration and non-retreadable casing.

Mounting

To insure correct mounting and bead seating and to prevent bead deformation, the following steps must be taken:

A. Tube Type Tires

1. Only use rims approved for radial tire usage by rim manufacturer. Thoroughly clean rim parts, removing all rust and other foreign material. Make sure rim parts match and are not sprung or broken.
2. Thoroughly lubricate tire beads, portion of tube between beads, and flaps with an approved rubber lubricant. Radial tubes are identifiable by the letter "R" in the size designation. Example 100R20. Also, to further identify the radial tube, a red band on the valve stem has been required since March, 1975. Radial flaps are also identified by the letter "R". Example - 20R8.

NOTICE: Do not use silicone base lubricants - this could cause the tire to slip on the wheel.

3. Double inflate. Inflate to operating pressure, deflate completely and reinflate to operating pressure. This allows tube, flap and tire to fit together properly.
4. Check bead seating. Visually check slot and side ring gap (on two piece rim) to make sure bead is seated. The flange and one of the three lower sidewall rim line rings while the tire is laying flat (measurements should be taken each 90° around the circumference of the rim flange). If spacing is uneven around bead from side to side, repeat Step 1 through 3, and recheck.

B. Tubeless Tires.

1. Only use rims approved for radial tire usage by rim manufacturer. Thoroughly clean rim, removing all rust and other foreign material.
2. Thoroughly lubricate tire beads and rim bead seats with an approved rubber lubricant.

NOTICE: Do not use silicone base lubricants - this could cause the tire to slip on the wheel.

3. Inflation. Inflate tire to operating pressure. Due to the construction of radial truck tires, particularly in the lower sidewall and bead area, it may be difficult to get the tire to take air. An inflation aid may be necessary to help seat the bead of tubeless radial tires. Two types of inflation aids are commercially available, (1) metal rings which use compressed air to seat beads, and (2) rubber rings which seal between the tire bead and rim bead seat allowing the bead to move out and seat. Lubrication is mandatory with both items.
4. Check bead seating. This check is made by measuring the space between the rim flange and one of the three lower sidewall rim line rings while the tire is laying flat (measurements should be taken each 90° around the circumference of the rim flange). If spacing is uneven around the bead from side to side, repeat Steps 1 through 3, and recheck.

It's important that this procedure be followed to insure proper bead seating in order to prevent bead deformation.

Radial tires, as well as the bias tires, must be mounted and inflated in accordance with safety precautions noted in RMA Radial and Bias Truck Tire Service Manuals.

TIRE REPAIR

There are many different materials and techniques on the market to repair tires. As not all of these work on all types of tires, tire manufacturers have published detailed instructions on how and when to repair tires.

SECTION 4A

PROPELLER SHAFT

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

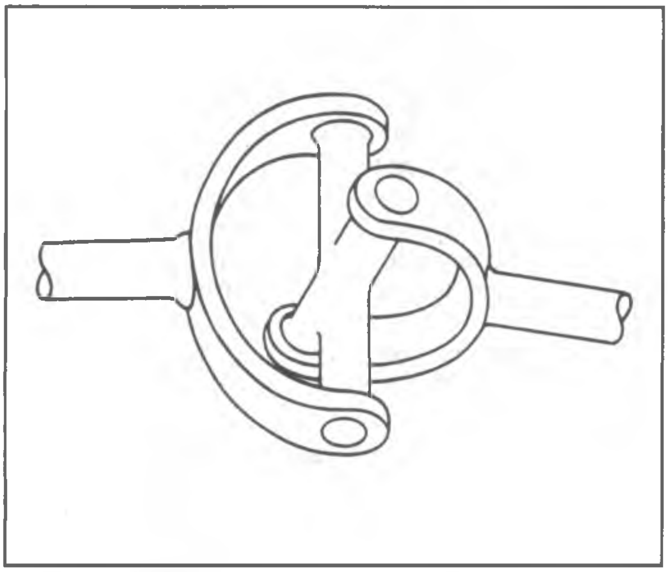

Fig. 1--Simple Universal Joint

Universal Joints

The simple universal joint is basically two Y-shaped yokes connected by a crossmember called a spider. The spider is shaped like an X and arms that extend from it are called trunnions (Fig. 1).

The spider allows the two yoke shafts to operate at an angle to each other. When torque is transmitted at an angle, through this type of joint, the driving yoke rotates at a constant speed while the driven yoke speeds up and slows down twice per revolution. This changing of velocity (acceleration) of the driven yoke increases as the angle between the two yoke shafts increases. This is the prime reason why single universal joints are generally not used for angles greater than three to four degrees. At four degrees, for example the change of velocity is .5%. At ten degrees it is 3%.

If the universal joint were set at 30 degrees and the driving yoke were turning at 1000 RPM the velocity of the driven yoke would change from 856 RPM to 1155 RPM in one quarter of a revolution. In the remaining quarter revolution the velocity would change from 1155 RPM to 866 RPM.

On a one-piece drive shaft this problem can be eliminated by arranging two simple universal joints so that the two driving yokes are rotated 90 degrees to each other. However the angle between the drive and driven yokes must be very nearly the same on both joints for this to work (Fig. 2). This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation can be rough and an objectionable vibration can be produced.

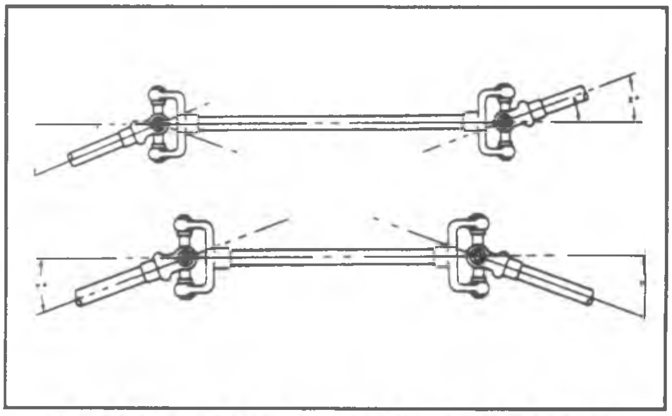

Fig. 2--Universal Joints Arranged for Constant Velocity

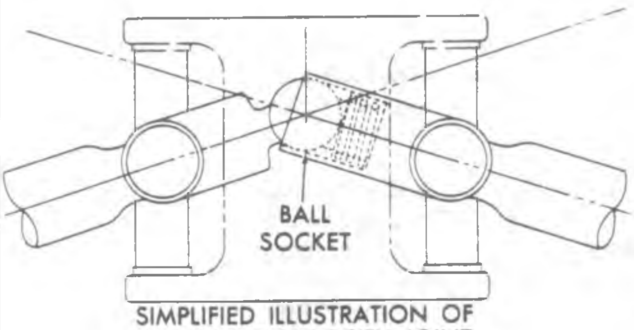

Fig. 3--Ball-Socket Location

Universal joints are designed to consider the effects of various loadings and rear axle windup, during acceleration. Within the design angle variations the universal joints will operate safely and efficiently. However, when the design angles are exceeded the operational life of the joints may decrease.

The bearings used in universal joints are the needle roller type. The needle rollers are held in place on the trunnion by round bearing cups. The bearing cups are held in the yoke by either (depending on the manufacturer) snap rings or plastic injection. These joints usually are lubricated for life and cannot be lubricated while on the vehicle.

Constant Velocity Joint-Double Cardan Joint

As mentioned previously, the simple universal joint will operate efficiently through small angles only. Also, two simple universal joints phased properly and operating through the same angle will transmit constant velocity. When a large angle is encountered in a driveline, a simple universal joint will introduce two vibrations in each revolution. It is in this situation that a constant velocity joint is used.

Essentially, the constant velocity joint is two simple universal joints closely coupled by a coupling yoke, phased properly for constant velocity.

A centering ball socket between the joints maintains the relative position of the two units. This centering device causes each of the two units to operate through one-half of the complete angle between the drive shaft and differential carrier (Fig. 3).

The ball/socket on this Constant Velocity joint requires periodic lubrication. A lubrication fitting is provided for this purpose, and is illustrated later in this section.

Propeller Shafts

The propeller shaft is a steel tube which is used to transmit power from the transmission output shaft to the differential. To accommodate various model, wheelbase and transmission combinations, drive shafts differ in length, diameter and the type of splined yoke. Each shaft is installed in the same manner. A universal joint and splined slip yoke are located at the transmission end of the shaft, where they are held in alignment by a bushing in the transmission rear extension. The slip yoke permits fore and aft movement of the drive shaft as the differential assembly moves up and down. The spline is lubricated internally by transmission lubricant or grease. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt and other harmful material.

Since the drive shaft is a balanced unit, it should be kept completely free of undercoating and other foreign material which would upset shaft balance.

Both one piece and two piece propeller shafts are used depending on the model. All are tubular and use needle bearing type universal joints.

On models that use a two piece shaft, the shaft is supported near its splined end in a rubber cushioned ball bearing which is mounted in a bracket attached to a frame crossmember. The ball bearing is permanently lubricated and sealed.

Four wheel drive models use a front propeller shaft incorporating a constant velocity joint.

PROPELLER SHAFT AND UNIVERSAL JOINT DIAGNOSIS

PROPELLER SHAFT UNBALANCE

Checking and Correcting

1. Place vehicle on a twin post hoist so that the rear wheels are free to rotate.
2. Remove both rear tire and wheel assemblies and brake drums.

   Use care not to apply brakes with drums removed.
3. Visually inspect propshaft, U-Joints and attachments for mud undercoating or other discrepancies. Make necessary corrections prior to running.
4. With vehicle running in gear at the indicated speed where disturbance is at its peak, observe the intensity of the disturbance.
5. Stop engine and disconnect drive shaft from companion flange. Reinstall shaft by rotating it 180° from its original position. Determine which position of the companion flange gives the best balance.
6. Install rear drums and wheels, and road test vehicle for final check of balance. If balance is still unacceptable, replace drive shaft.

CHECKING PROPELLER SHAFT RUN-OUT

If a noise or vibration is present at high speed which might be caused by a bent shaft, or if a shaft has been damaged through rough handling or a collision, it may be checked for straightness as follows:

1. Raise vehicle on a twin post hoist so that the rear is supported on the rear axle housing with wheels free to rotate.
2. Mount a dial indicator on a movable support that is

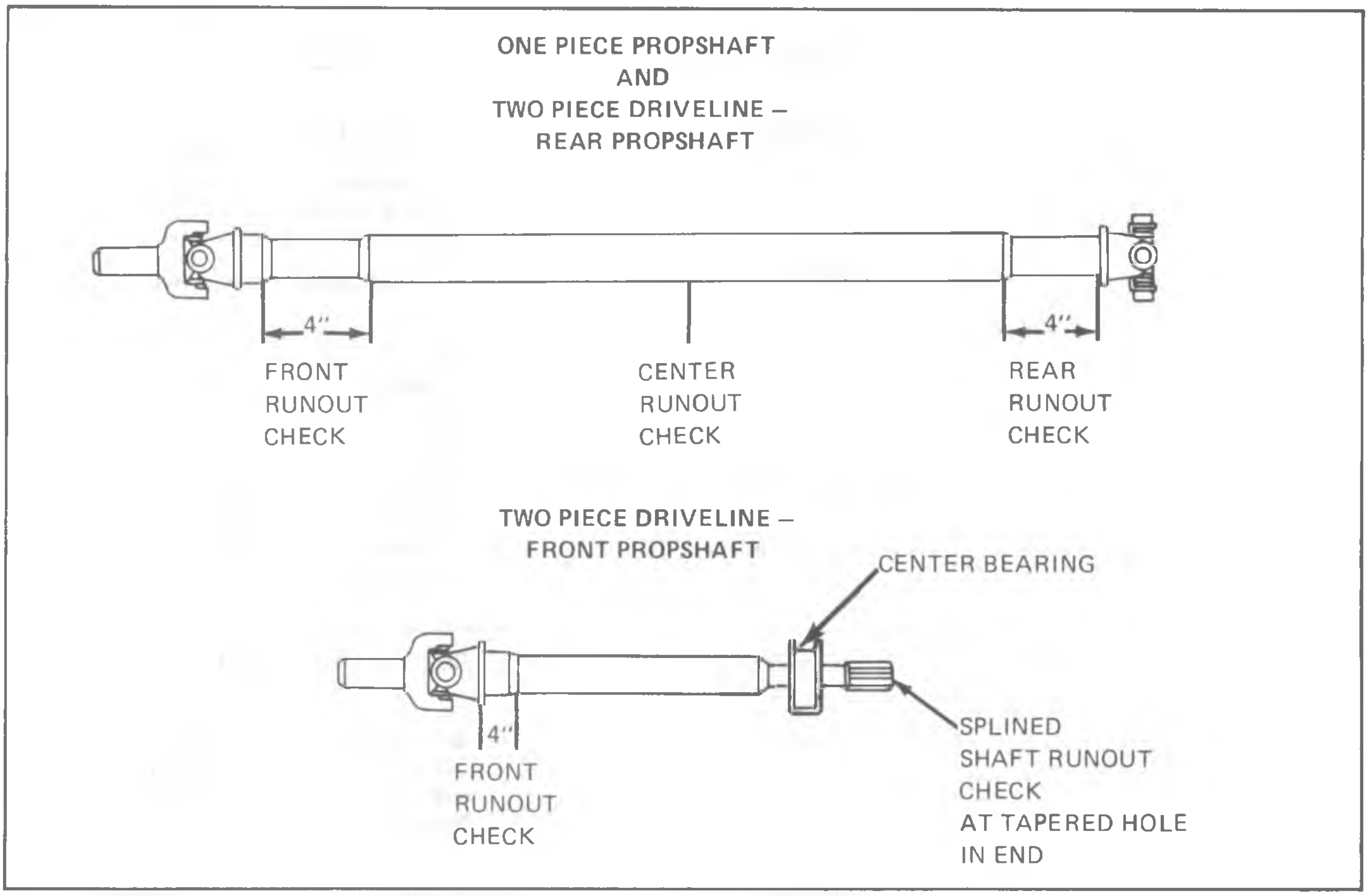

Fig. 4--Checking Prop Shaft Runout

high enough to permit contact of the indicator button with the propeller shaft, or mount dial indicator to a magnetic base and attach to a suitable smooth place on the underbody of the vehicle. Readings are to be taken at points indicated in Figure 4.

PROPELLER SHAFT	FRONT	CENTER	REAR
ONE PIECE	.040	.050	.055
TWO PIECE FRONT	.020		.008 Δ
TWO PIECE REAR	.030*	.030	.035

Δ NOTE: This measurement must be taken at center of splined shaft after rear prop shaft is removed.

* NOTE: This measurement must be taken with rear shaft mounted on front shaft which is within specifications.

Fig. 5--Runout Specifications

3. With transmission in neutral, check runout by rotating the axle pinion flange or transmission yoke.

   On models with One-Piece Propshaft, measure runouts at front-center-rear on tube. Refer to Fig. 4.

   On models with Two-Piece Propshaft, measure runouts on rear shaft at front-center-rear on its tube. Then, index position of rear propshaft in pinion flange and remove rear propshaft. Measure runouts of front propshaft at front on tube and at rear in tapered hole on end of splined shaft.

   NOTICE: The runout of splined shaft is critical to smooth operation of Two-Piece Driveline. If this runout exceeds specifications, the front propshaft must be replaced.

   Care must be taken not to include indicator variation caused by surface contamination, ridges, flat spots, or other variations in the tube.

4. If runout exceeds specifications, rotate the shaft 180° at companion flange and reinstall. Check runout again.
5. If runout is still over specifications at one or more locations, replace the drive shaft, but only after checking vibration or noise, replacement must be rechecked for runout also.
6. If the new drive shaft runout is still over specifications, check for a bent companion flange.

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Leak at front slip yoke. NOTE: An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.	a. Rough outside surface on splined yoke. b. Defective transmission rear oil seal.	a. Replace seal if cut by burrs on yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or burred badly. b. Replace transmission rear oil seal. c. Bring transmission oil up to proper level after correction.
Knock in drive line, clunking noise when car is operated under floating condition at 10 mph in high gear or neutral.	a. Worn or damaged universal joints. b. Side gear hub counterbore in differential worn oversize.	a. Disassemble universal joints, inspect and replace worn or damaged parts. b. Replace differential case and/or side gears as required.
Ping, Snap or Click in drive line. NOTE: Usually occurs on initial load application after transmission has been put into gear, either forward or reverse.	a. Loose upper or lower control arm bushing bolts. b. Loose companion flange.	a. Tighten bolts to specified torque. b. Remove companion flange, turn 180° from its original position, apply white lead to splines and reinstall. Tighten pinion nut to specified torque.

Fig. 6--Diagnosis Chart A

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Roughness, Vibration or Body Boom at any speed. NOTE: With tachometer installed in vehicle, determine whether propeller shaft is cause of complaint by driving through speed range and note the engine speed (rpm) at which vibration (roughness) is most pronounced. Then , shift transmission to a different gear range and drive vehicle at same engine speed (rpm) at which vibration was noted before. Note the effect on the vibration in each transmission gear range. If vibration occurs at the same engine speed (rpm) regardless of transmission gear range selected, drive shaft assembly is not at fault, since the shaft speed (rpm) varies. If vibration decreased, or is eliminated, in a different gear range but at the same engine speed (rpm), check the possible causes:	a. Bent or dented drive shaft. b. Undercoating on drive shaft. c. Tire unbalance. (30-80 mph, not throttle conscious) d. Worn universal joints. e. Burrs or gouges on companion flange. Check snap ring locating surfaces on flange yoke. f. Excessive drive shaft or companion flange unbalance, or runout. g. Excessive looseness at slip yoke spline. h. Drive shaft runout (50-80 mph throttle conscious)	a. Replace. b. Clean drive shaft. c. Balance or replace as required. * d. Overhaul, replacing necessary parts. e. Rework or replace companion flange. f. Check for missing balance weights on drive shaft. Remove and reassemble drive shaft to companion flange, 180° from original position. g. Replace necessary parts. h. Check drive shaft runout at front and rear. Should be less than specified. If above, rotate shaft 180° and recheck. If still above specified, replace shaft.
Scraping noise.	a. Slinger, companion flange, or end yoke rubbing on rear axle carrier.	a. Straighten slinger to remove interference.
Roughness — above 35 mph felt and/or heard.	a. Tires unbalanced or worn.	a. Balance or replace as required.

*NOTE: Out-of-round tires cannot be corrected with balance weights. If vehicle disturbance remains after tire balance, recheck with rear wheels and tires and brake drums removed.

Fig. 7--Diagnosis Chart B

ON VEHICLE SERVICE

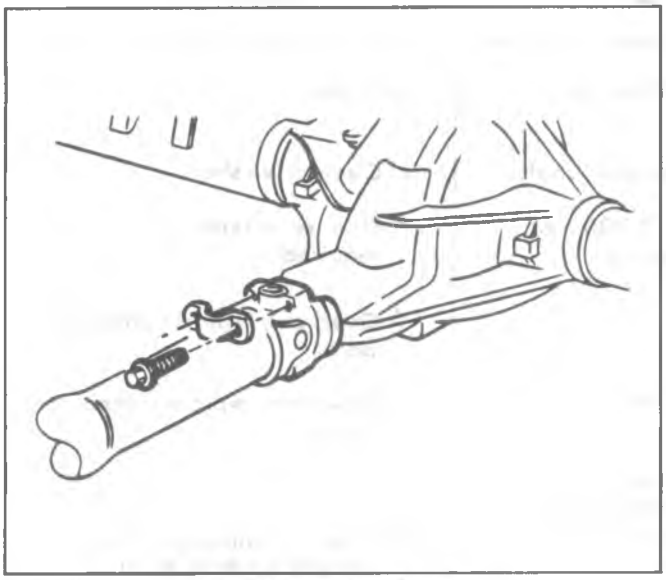

Fig. 8--Strap Attachment

PROPELLER SHAFT (REAR DRIVE)

The rear universal joint to propshaft bolt on some models requires a #10 "Six Lobed Socket" (J-33051), for proper removal and installation.

Removal

NOTICE: Do not pound on original propeller shaft yoke ears as injection joints may fracture.

1. Raise vehicle on hoist. Mark relationship of shaft to pinion flange and disconnect the rear universal joint by removing retainers. If bearing cups are loose, tape together to prevent dropping and loss of bearing rollers.
2. For models with two-piece shafts, remove bolts retaining center bearing support to hanger and disconnect spline grease seal and cap.
3. Slide propeller shaft forward disengaging trunnion from axle flange.
4. Withdraw propeller shaft slip yoke from transmission by moving shaft rearward, passing it under the axle housing. Do not allow drive shaft to drop or allow universal joints to bend to extreme angle, as this might fracture injected joint internally. Support propeller shaft during removal.

Installation

Inspect for the following conditions before reinstalling propeller shaft.

- Inspect outer diameter of splined yoke to ensure that it is not burred, as this will damage the transmission seal.
- Inspect splines of slip yoke for damage or wear.

The propeller shaft must be supported carefully during handling to avoid jamming or damaging any of the parts. Do not drive propeller shaft in place with hammer. Check for burrs on transmission output shaft spline, twisted slip yoke splines, or possibly the wrong U-joint yoke. Make sure the splines agree in number and fit. To prevent trunnion seal damage, do not place any tool between yoke and U-joint.

One Piece Propeller Shaft

1. Slide propeller shaft into transmission.
2. Position rear universal joint to rear axle pinion flange, making sure bearings are properly seated in pinion flange yoke.

   When making rear shaft connection, be sure to align mark on pinion flange with mark on drive shaft rear yoke.
3. Install rear joint fasteners and tighten evenly to torque specified.

Two Piece Propeller Shaft

1. Install front half into transmission and bolt center bearing support to crossmember or hanger.

   The front propeller shaft yoke must be bottomed out in the transmission (fully forward) before tightenin attachment bolts.
2. Torque center support bearing to crossmember attachment. Maintain alignment as shown in Fig. 10.
3. Rotate front propshaft, locate the "bridged" teeth on its output spline, and position at bottom-most (i.e. 6:00) position. Then, find missing tooth in slip yoke, and position yoke to slide over bridged teeth on front shaft.
4. Position rear U-joint to rear axle pinion flange, making sure bearings are properly seated in pinion flange yoke. When making rear shaft connection, be sure to align mark on pinion flange with mark on propshaft.
5. Install rear joint retainers and fasteners and tighten evenly to specified torque.
6. Attach seal and grease cap to center slip yoke. Tighten firmly.

PROPELLER SHAFT (FRONT DRIVE)

Removal

NOTICE: Do not pound on original proeller shaft ears as injection joints may fracture.

1. Raise vehicle on hoist. Mark relationship of shaft to front axle and transfer case flanges. Disconnect front U-Joint by removing retainers. Remove bolts at transfer case.
2. Collapse propshaft sufficiently to disengage front U-Joint from front axle.
3. Withdraw propshaft by moving shaft rearward between transfer case. Handle propshaft with care to avoid dropping cap assemblies from open ends of U-Joint. Wrap tape around loose caps, if required to hold them in position.

Installation

Inspect for the following conditions before reinstalling propeller shaft:

- Inspect slip yoke splines for damage or wear.
- Inspect propeller shaft for burrs on splines or twisted splines.

The propeller shaft must be supported and carefully handled to avoid jamming or damaging any of the parts. Do

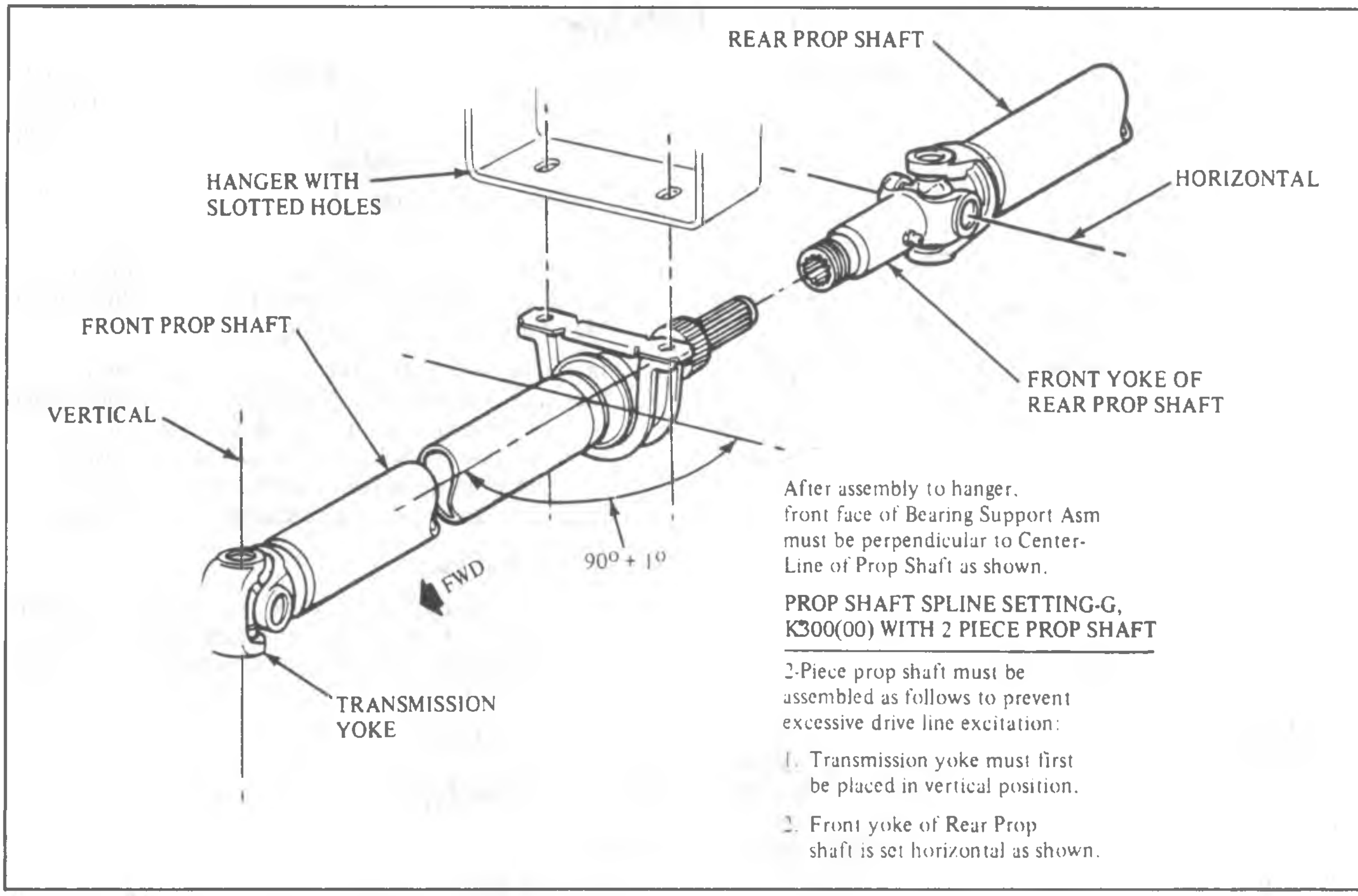

Fig. 10--Alignment For Phasing

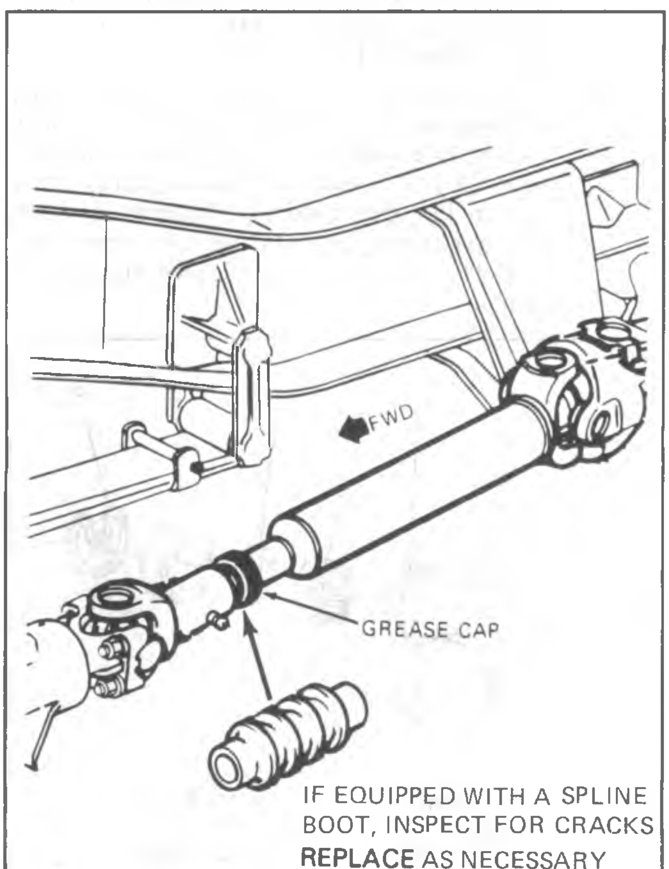

Fig. 9 -- Proper Alignment

not drive propeller shaft in place with a hammer. To prevent possible trunnion seal damage, do not place any tool between U-Joint and yoke.

1. Extend propshaft to full length, then compress it about half of its stroke.
2. Slide slip yoke end of propshaft towards front axle, fitting U-Joint caps within span of tabs on flange.
3. Install retainers and bolts and tighten evenly. U-Joint caps will draw into tabs if they are positioned on inside chamfer of tab, and retainers are tighten uniformly.
4. Torque bolts at front axle to specified amount.
5. Extend propshaft until it fits against transfer case flange.
6. Install bolts and tighten evenly.
7. Torque bolts at transfer case to specified amount.

UNIT REPAIR

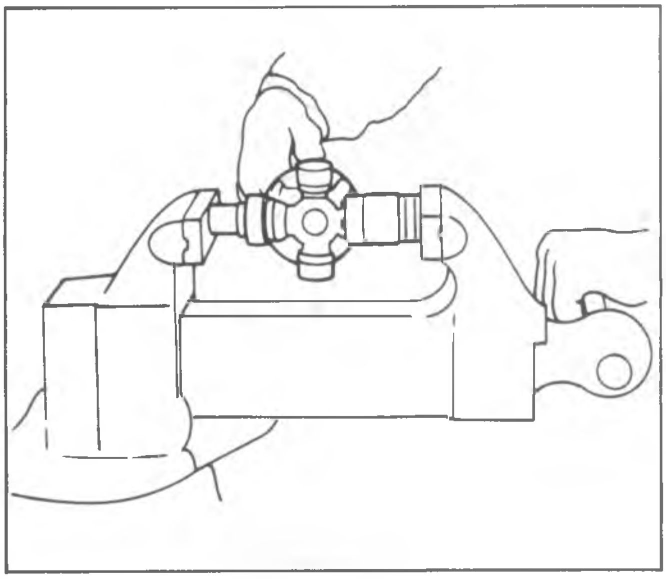

Fig. 11--Bearing Cup Removal with Vise

UNIVERSAL JOINTS

The universal joints are of the extended-life design and do not require periodic inspection or lubrication; however, when these joints are disassembled, repack bearings and lubricate reservoir at end of trunnions with high-melting point wheel bearing lubricant. Use care not to damage or dislodge seals from trunnion.

Snap Ring Type

Disassembly

1. Remove bearing lock rings from trunnion yoke.
2. Support trunnion yoke on a piece of 31.75 mm (1-1/4") I.D. pipe on an arbor bed.

   Due to length of the propeller shaft it may be more convenient to use a bench vise, for removal and installation, instead of an arbor press. In this case, proceed with disassembly and assembly procedure as with an arbor press Figs. 11 and 12.
3. Using a suitable socket or rod, press on trunnion until bearing cup is almost out. Grasp cup in vise and work cup out of yoke (Figs. 11 and 12). The bearing cup cannot be fully pressed out.
4. Press trunnion in opposite direction and remove other cup as in Step 3.
5. Clean and inspect dust seals, bearing rollers, and trunnion. Relubricate bearings as indicated in Maintenance and Lubrication Section.

   In addition to packing the bearings, make sure that the lubricant reservoir at the end of each trunnion is filled with lubricant. In filling these reservoirs, pack lubricant into the hole so as to fill from the bottom (use of squeeze bottle is recommended). This will prevent air pockets and ensure an adequate supply of lubricant.

Reassembly (Fig. 13)

1. Position trunnion into yoke. Partially install one bearing cup into yoke. Start trunnion into bearing cup. Partially install other cup. Align trunnion into cup, and press cups into yoke.
2. Install lock rings.

Injected Plastic Type

Disassembly

NOTICE: Never clamp drive shaft tubing in a vise as the tube may be dented. Always clamp on one of the yokes, and support the shaft horizontally. Avoid damaging the slip yoke sealing surface. Nicks may damage the bushing or cut the seal lip.

1. Support the drive shaft in a horizontal position in line with the base plate of a press. Place the universal joint so that the lower ear of the shaft yoke is supported on a 28.57 mm (1-1/8") socket. Place the cross press, J-9522-3, on the open horizontal bearing cups, and press the lower bearing cup out of the yoke ear as shown in Fig. 14. This will shear the plastic retaining the lower bearing cup.

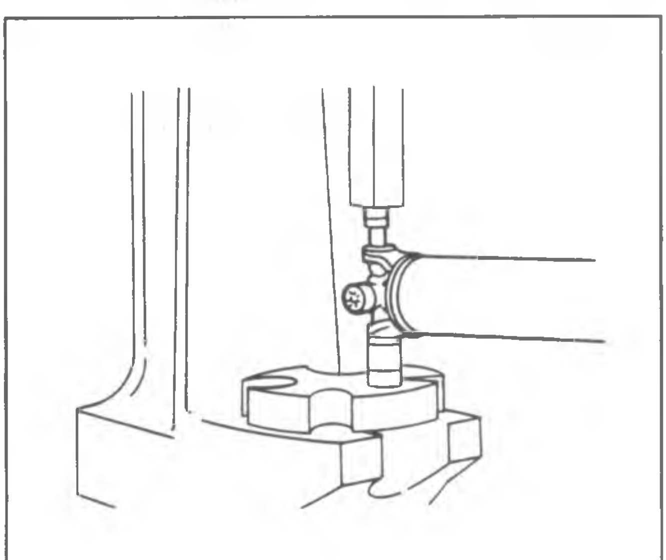

Fig. 12--Bearing Cup Removal with Press

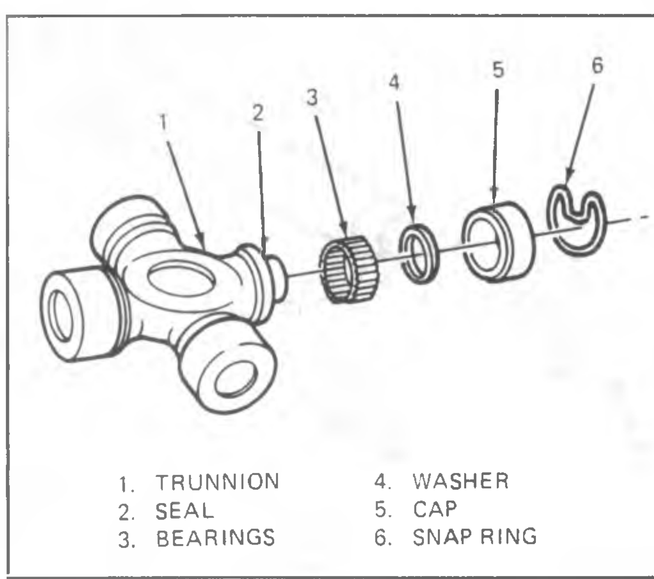

Fig. 13--Universal Joint Repair Kit

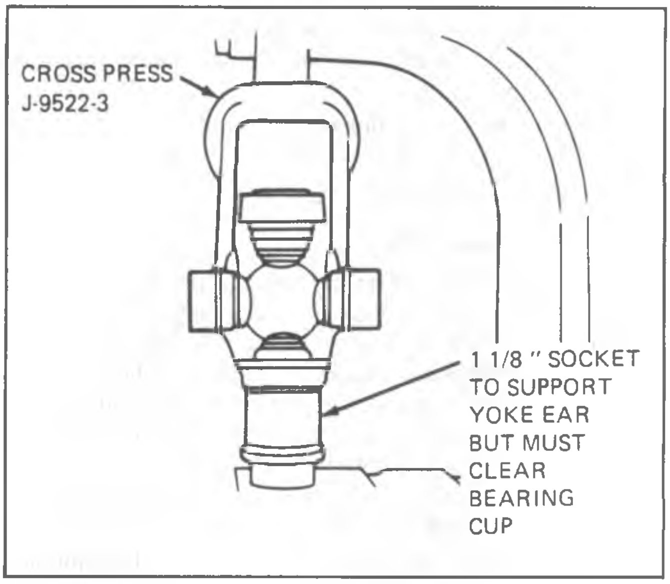

Fig. 14 -- Pressing Out Bearing Cup

2. If the bearing cup is not completely removed, lift the cross and insert Spacer J-9522-5 between the seal and bearing cup being removed, as shown in Fig. 15.

   Complete the removal of the bearing cup, by pressing it out of the yoke.
3. Rotate the drive shaft, shear the opposite plastic retainer, and press the opposite bearing cup out of the yoke as before, using Spacer J-9522.
4. Disengage cross from yoke and remove. Production universal joints cannot be reassembled. There are no bearing retainer grooves in production bearing cups. Discard all universal joint parts removed.
5. Remove the remains of the sheared plastic bearing retainer from the ears of the yoke. This will aid in reassembly of the service joint bearing cups. It usually is easier to remove plastic if a small pin or punch is first driven through the injection holes.
6. If the front universal joint is being serviced,

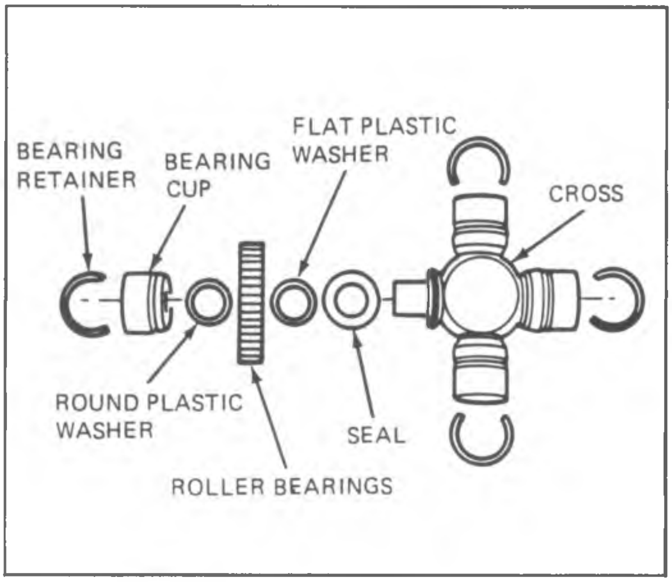

Fig. 16--Repair Kit

remove the pair of bearing cups from the slip yoke in the same manner.

Reassembly

A universal joint service kit (Fig. 16) is used when reassembling this joint. This kit includes one pregreased cross assembly, four service bearing cup assemblies with seals, needle rollers, washers, grease and four bearing retainers.

Make sure that the seals are in place on the service bearing cups to hold the needle rollers in place for handling.

1. Remove all of the remains of the sheared plastic bearing retainers from the grooves in the yokes. The sheared plastic may prevent the bearing cups from being pressed into place, and this will prevent the bearing retainers from being properly seated.
2. Install one bearing cup part way into one side of the yoke, and turn this yoke ear to the bottom.
3. Insert cross into yoke so that the trunnion seats freely into bearing cup as shown in Fig. 17.

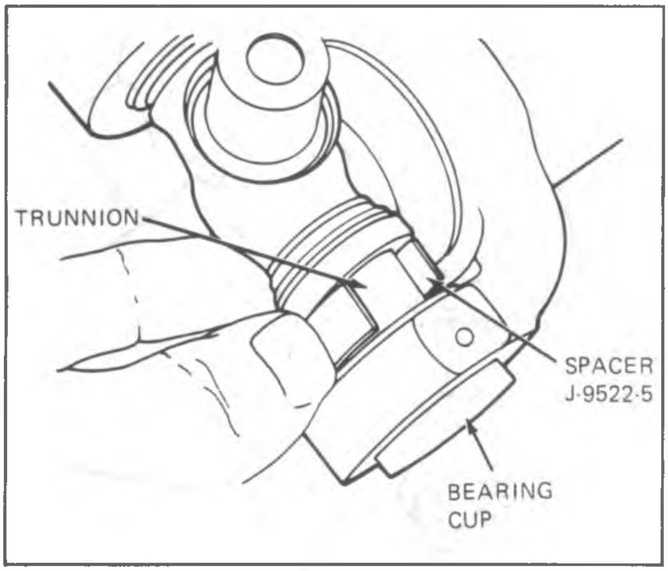

Fig. 15--Using Spacer to Remove Bearing Cup

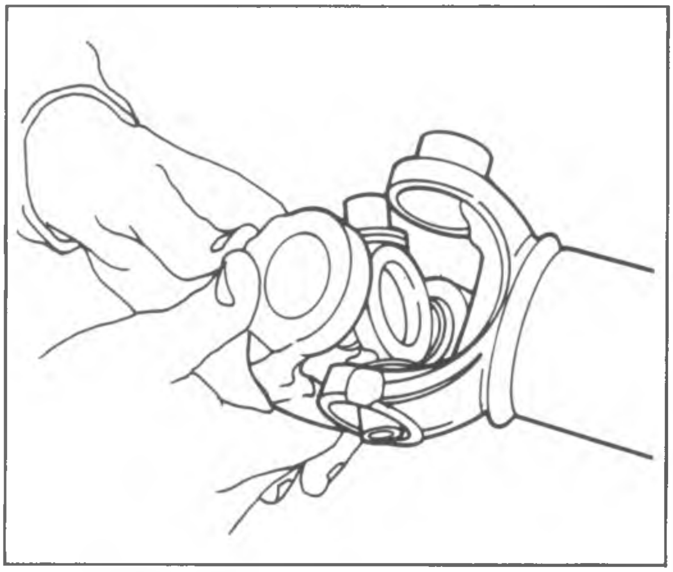

Fig. 17--Installing Trunnion into Yoke

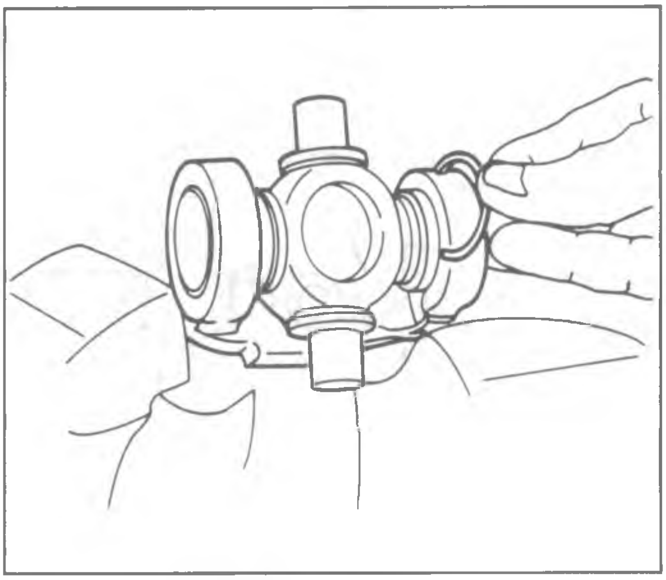

Fig. 18--Installing Snap Ring to Retain Trunnion

4. Install opposite bearing cup part way. Make sure that both trunnions are started straight and true into both bearing cups.
5. Press against opposite bearing cups, working the cross all of the time to check for free movement of the trunnions in the bearings. If there seems to be a hang-up, stop pressing and recheck needle rollers, to determine if one or more of them has been tipped under the end of the trunnion.
6. As soon as one bearing retainer groove clears the inside of the yoke, stop pressing and snap the bearing retainer into place as shown in Fig. 18.
7. Continue to press until the opposite bearing retainer can be snapped into place. If difficulty is encountered, strike the yoke firmly with a hammer to aid in seating bearing retainers (Fig. 19). This springs the yoke ears slightly.
8. Assemble the other half of the universal joint in the same manner.
9. Check the freedom of rotation of both sets of trunnions of the cross. If too tight, again rap the yoke ears as described above. This will loosen the bearings and help seat the bearing retainers.

CENTER SUPPORT BEARING-FIG (FIG. 20)

NOTICE: See NOTICE on page 1 of this section regarding Center Support Bearing fasteners.

1. Remove strap retaining rubber cushion from bearing support.
2. Pull support bracket from rubber cushion and pull cushion from bearing.
3. Pull bearing assembly from shaft.
4. Assemble bearing support as follows:
   a. Install inner deflector on propeller shaft, if removed, and prick punch deflector at two opposite points to make sure it is tight on shaft. b.?Fill space between inner dust shield and bearing with lithium soap grease.
   c. Start bearing and slinger assembly straight on shaft journal. Support propeller shaft and, using suitable length of pipe over splined end of shaft, press bearing and inner slinger against shoulder on shaft.
   d. Install dust shield over shaft, small diameter. Install bearing retainer.
   e. Install rubber cushion onto bearing.
   f. Install bracket onto cushion.
   g. Install retaining strap.

Installation of Propshafts

NOTICE: When reinstalling propshafts, it is necessary to place the shafts into particular positions to assure proper operation. This is called phasing. **All models with 32 splines** use an alignment key, as shown in Fig. 21, to obtain proper phasing. The shafts can mate only in the correct position. **G and K models with 16 splines** must be phased as shown in figure 10.

1. For models with one piece propeller shafts, slide shaft into transmission and attach rear U-joint to axle.

   On C models, equipped with automatic transmission and one piece shaft only, apply a small amount (approximately 18 grams) of lubricant P/N 9985038 inside the slip yoke before installing propshaft.

   On vehicles with two piece propshafts, the front propshaft yoke must be bottomed out in the transmission fully forward before installation to the hanger.
2. For C-P and most G models with two-piece propeller shafts, proper phasing is accomplished with the alignment key, shown in Fig. 21.
3. For G-K models with two piece shafts, install front half into transmission and bolt support to crossmember.
   a. Slide grease cap and gasket onto rear splines.
   b. Rotate shaft so front U-joint trunnion is in correct position (Fig. 10).
   c. Take rear propeller shaft and before installing, align U-joint trunnions as shown in Fig. 10. Attach rear U-joint to axle and then tighten grease cap on shaft. Tighten grease cap.
   d. Torque bearing support to crossmember and U-joint to axle attachments.

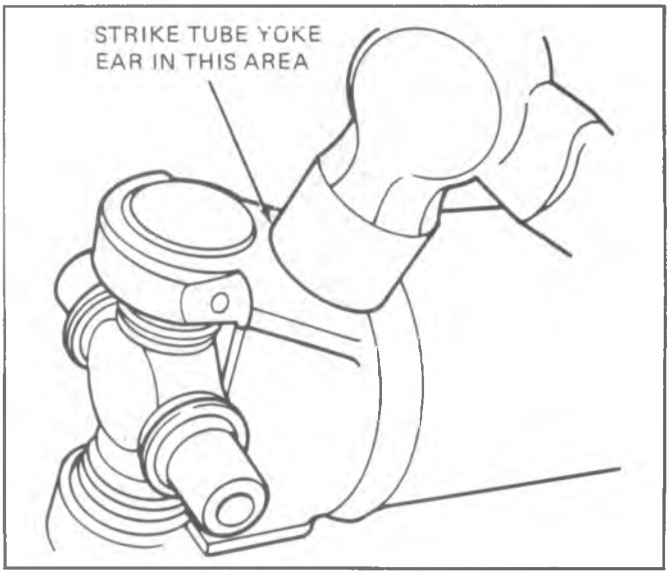

Fig. 19--Seating Snap Rings

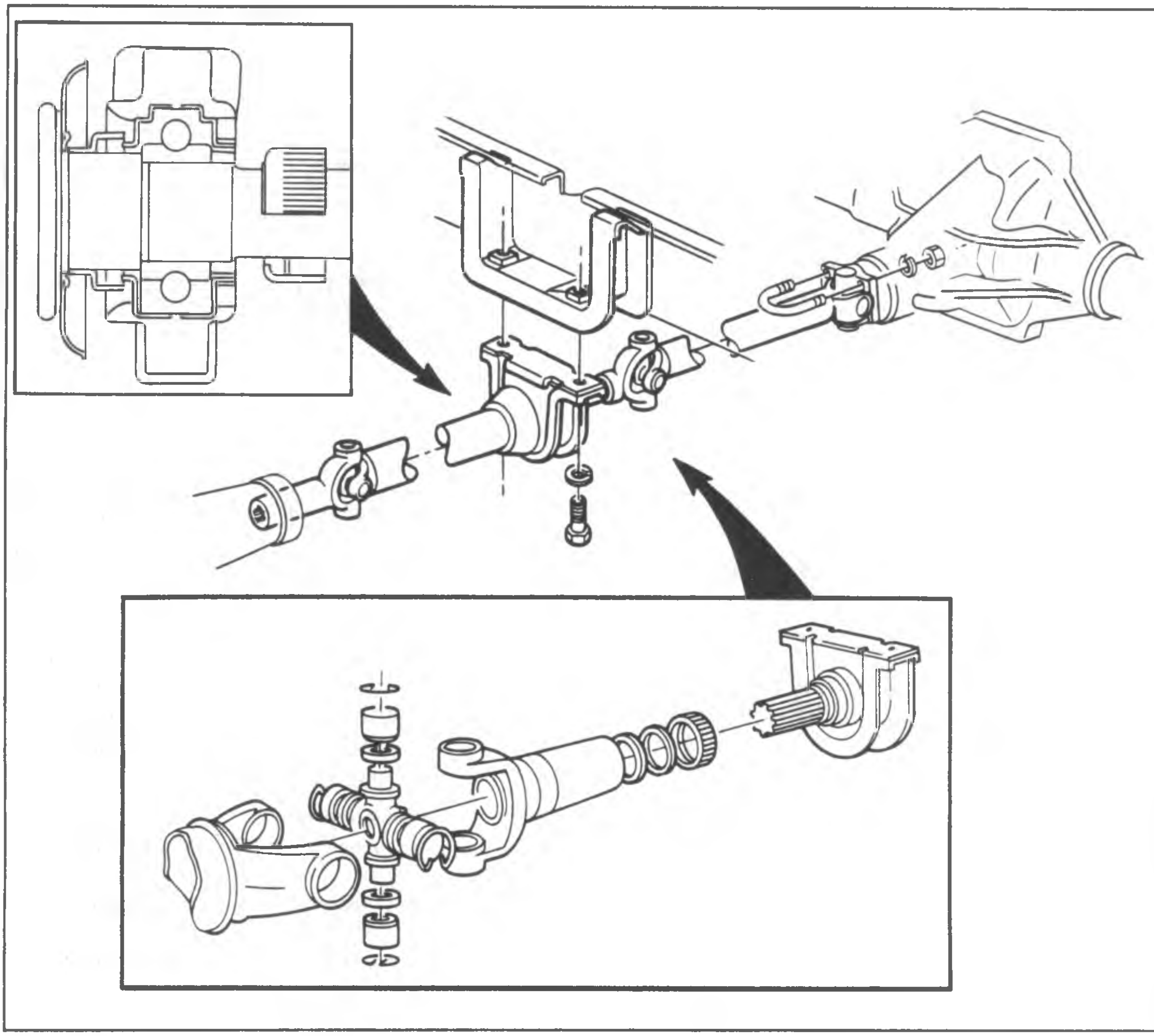

Fig. 20--Propeller Shaft, Universal Joint and Bearing Support

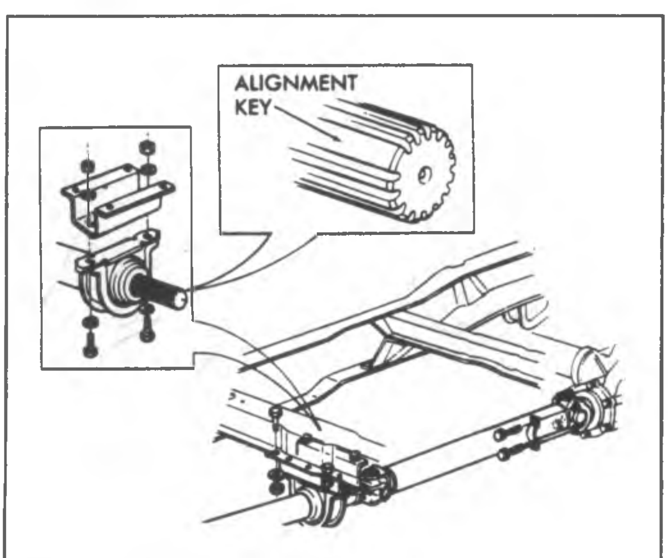

Fig. 21--Alignment Key

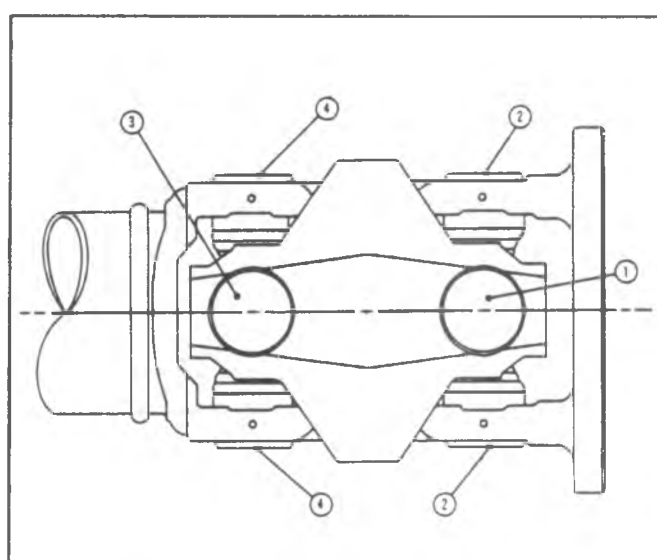

Fig. 22--Bearing Cap Removal Sequence

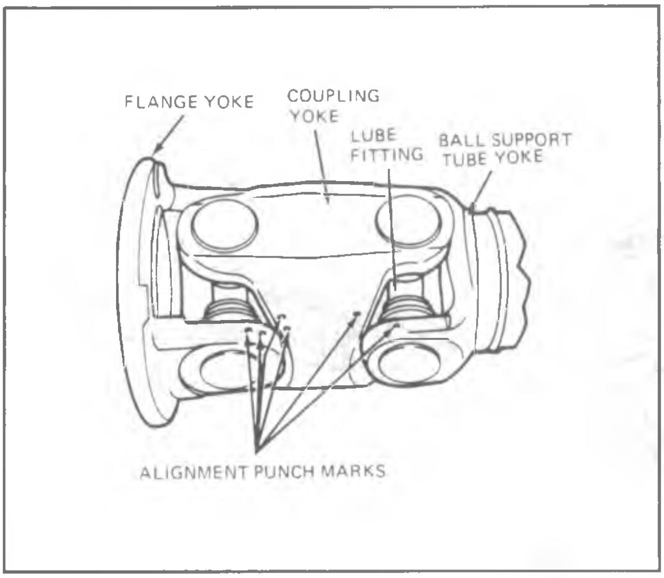

Fig. 23--Reassembling Coupling Yoke

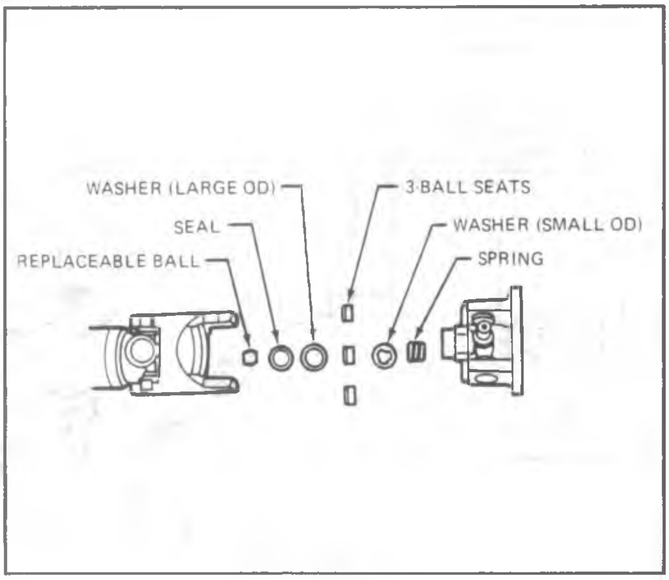

Fig. 25--Exploded View of Centering Ball Mechanism

CONSTANT VELOCITY UNIVERSAL JOINT

Inspection

An inspection kit including two bearing caps and two snap rings is available to allow the removal of the two trunnion caps shown at location **1, in Fig. 22. Mark the flange yoke and coupling yoke for reassembly in the same position, as shown in Fig. 23.**

To service the trunnion caps, use the appropriate procedures given in the beginning of this Section.

When both bearing cups are free, disengage the flange yoke and trunnion from the centering ball. Note that the ball socket is part of the flange yoke assembly, while the centering ball is pressed onto a stud and is part of the ball stud yoke (Fig.24). Pry the seal from the ball socket and remove washers, spring and the three ball seats as illustrated in Fig. 25.

1. Clean and inspect ball seat insert bushing for wear. If bushing is worn, replace flange yoke and cross assembly.
2. Clean and inspect seal and ball seats along with spring and washers. If any parts show indication of excessive wear or are broken, replace the entire set with a service kit.

   Whenever the seal is removed to inspect ball seat parts, it should be discarded and replaced with a new seal.
3. Remove all plastic from groove of coupling yoke.
4. Inspect the centering ball surface. If it shows signs of wear beyond smooth polish, replace it.

Centering Ball Replacement

1. Place fingers of inner part of Tool J-23996 under ball as shown in Fig. 26.
2. Place outer cylinder of Tool J-23996 over outside of ball as shown in Fig. 27.
3. Thread nut on Tool J-23996 and draw ball off stud, using wrench as shown in Fig. 29.
4. Place the replacement ball on stud.
5. Using Tool J-23996, drive ball onto stud as in Fig.

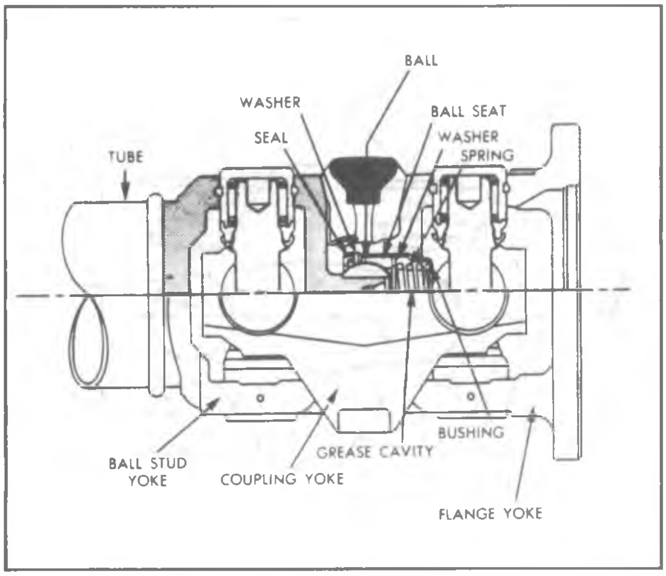

Fig. 24--Cross Sectional View of CV Joint

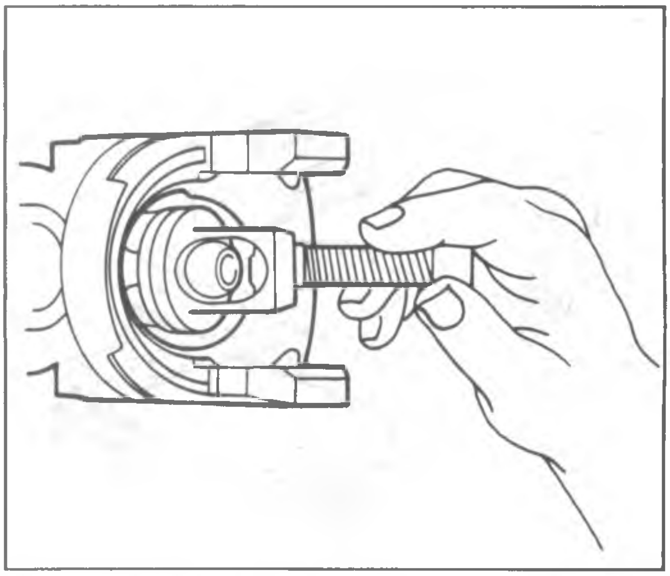

Fig. 26--Installing Tool J-23996 Over Ball

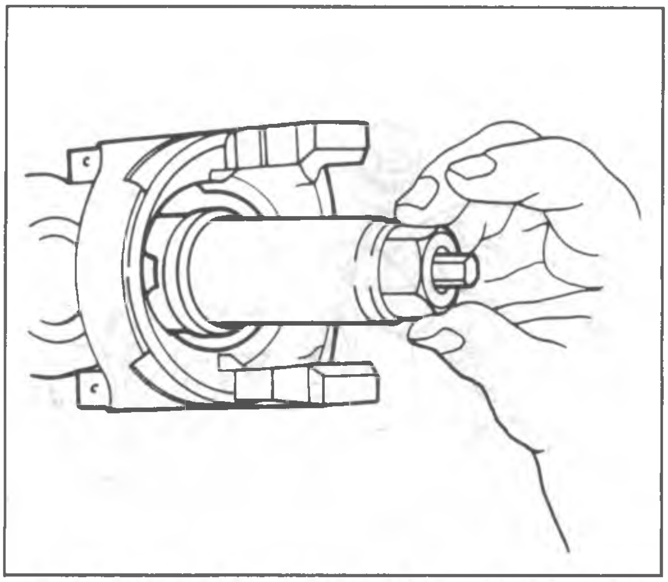

Fig. 27--Installing Outer Cylinder of Tool J-23996 Over Ball

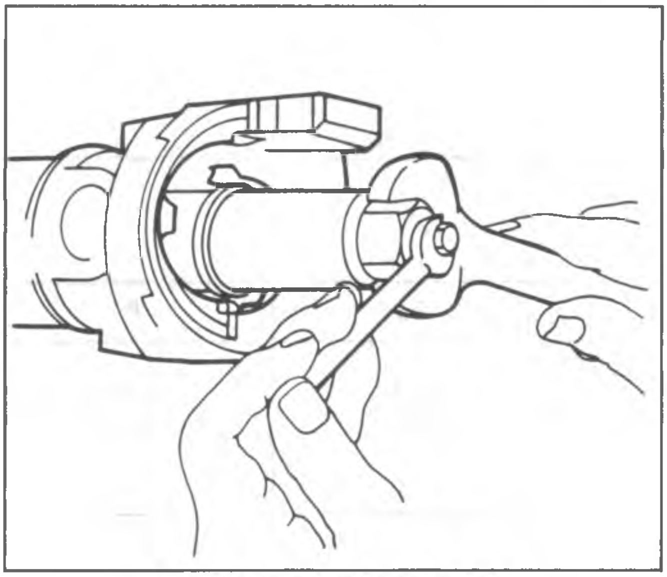

Fig. 28--Removing Centering Ball

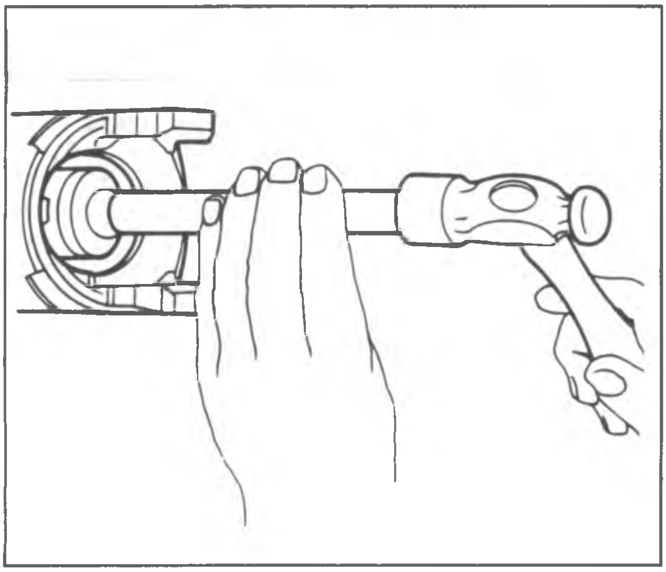

Fig. 29--Installing Centering Ball

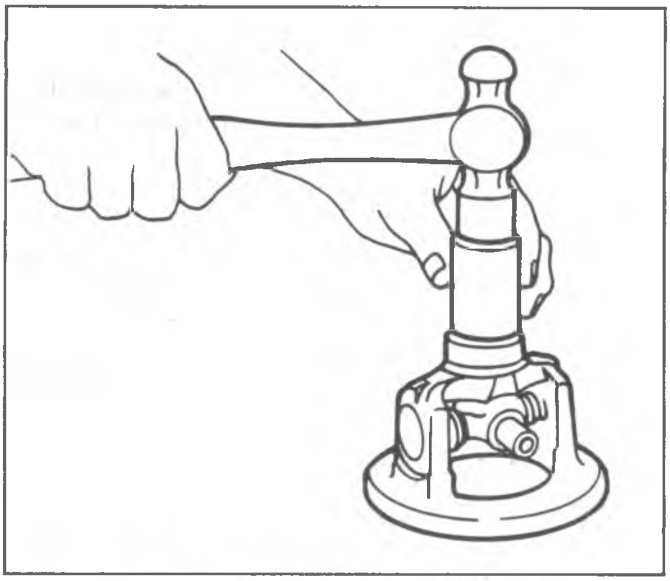

Fig. 30--Installing Centering Ball Seal

29, until the ball can be seen to seat firmly against the shoulder at the base of the stud. This is important as the center of the double Cardan joint is determined by the ball seating tightly in the proper location.

6. Using grease provided in the ball seat kit, lubricate all parts and insert them into the clean ball seat cavity in the following order: spring, washer (smallest OD), three ball seats (with largest opening outward to receive ball), washer (largest OD) and seal.
7. Lubricate seal lip and press seal flush with Tool J-23694, as shown in Fig. 30. Sealing lip should tip inward.
8. Fill cavity with grease provided in kit.
9. Install flange yoke to centering ball as shown in Fig. 31, making sure alignment marks are correctly positioned. Install trunnion and bearing caps as previously outlined.

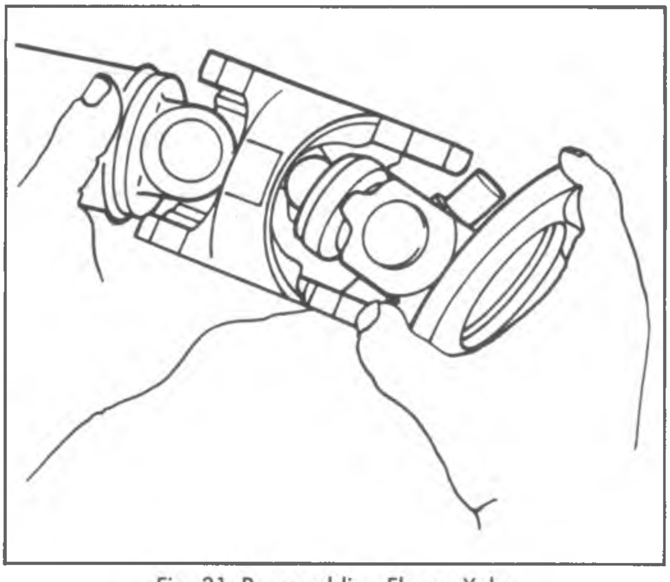

Fig. 31--Reassembling Flange Yoke

LUBRICATION

The front axle propshaft found on all four-wheel drive trucks requires special lubrication at two locations: The C/V joint, and the slip yoke.

Constant Velocity Joints (C/V)

The constant velocity (C/V) joint, located at the transfer case end of the front propshaft, must be lubricated periodically with special lubricant, #1050679, or equivalent. If the fitting cannot be seen from beneath the vehicle Figure 32 shows how the fitting may be lubricated from above the C/V joint, with a special adapter J-25512-2 on the end of a flex hose.

Slip Spline

Apply chassis lubricant at the fitting until grease begins to leave through the vent hole.

If the slip spline is dry or corroded, it may be necessary to disconnect the propshaft from the truck, remove the slip yoke, and wire brush the affected areas. Wipe clean before reinstallation. When installing the propshaft to transfer case front output flange attaching bolts, torque to specification 95-110 N·m (70-80 ft. lbs.).

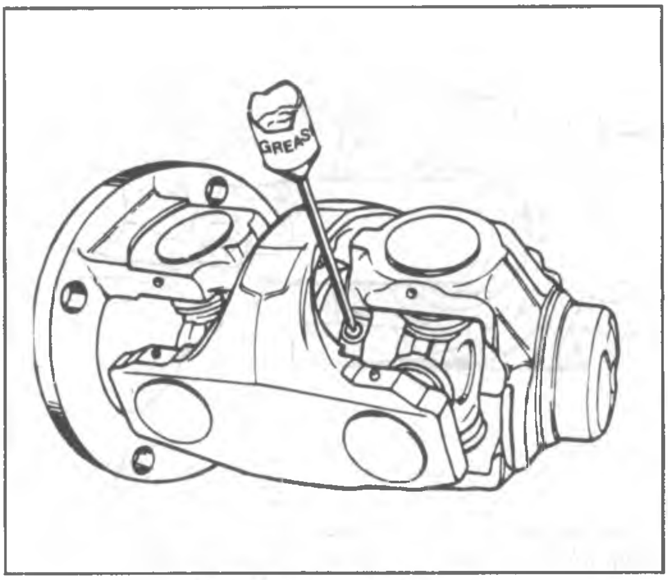

Fig. 32--Lubrication Fitting

PROPELLER SHAFT

	CK	G	P
Propeller Shaft			
To Rear Axle (Strap)	12-17*	12-17*	12-17
Bearing Support-to-Hanger	23-30	20-30	20-30
Hanger-to-Frame	40-50	—	—
To Front Axle (Strap)	12-17		
To Transfer Case (Front)	70-80	—	—
To Transfer Case (Rear)	12-17		

Torque Specifications (Ft.-Lbs.)
*Torque Spec. is for Hex Head Bolt, if Straps are Retained with Six Lobe Bolt, Torque to 22 to 30 Ft. Lbs.

Fig. - SP Specifications

SECTION 4B

REAR AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on Page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

The light duty truck line-up uses six different axles, categorized by ring gear diameter, they are as follows:

CHEVROLET 8-1/2" AND 9-1/2" RING GEAR AXLE

These axles, shown in figure 4B-1 and 4B-2 are the semifloating, fabricated constructed type consisting of a cast carrier with large bosses on each end into which two welded steel tubes are fitted. The carrier contains an overhung hypoid pinion and ring gear. The differential is a two pinion arrangement.

The axle housing is made up of two steel welded tubes pressed into the crossbore of the cast carrier. Each tube is puddle welded to the carrier. Welded-on brackets provide attachment points for suspension componenets such as shock absorbers and leaf springs. A welded flange is provided for brake flange plate attachment.

The overhung hypoid drive pinion is supported by two preloaded tapered roller bearings. The pinion shaft is sealed by means of a molded, spring loaded, rubber seal. The hypoid ring gear is bolted to a one-piece differential case which is supported by two preloaded tapered roller bearings.

On the 9 1/2" (Fig. 4B-2) ring gear side bearing preload is controlled by a side bearing adjusting nut threaded into the carrier near the axle tubes. Backlash is adjusted by increasing or decreasing shim thickness.

CHEVROLET 10-1/2" RING GEAR AXLE

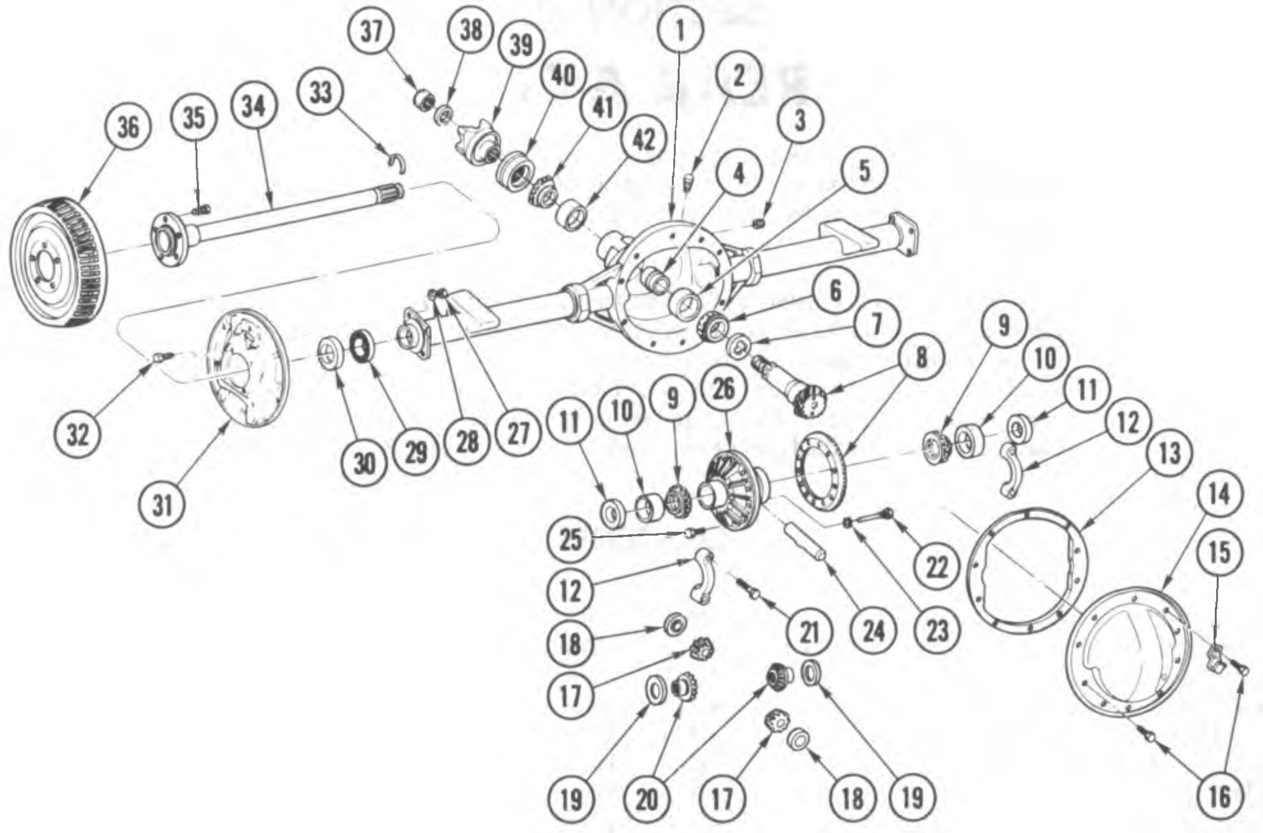
The axle shown in figure 4B-3 is of the full floating type with hypoid ring gear and drive pinion. The full floating construction enables easy removal of axle shafts without removing truck load and without jacking up the axle. The differential carrier is heavily ribbed to provide rigid support for the differential assembly.

The straddle-mounted drive pinion is supported at the front by two opposed tapered roller bearings. The pinion straddle bearing is a roller bearing assembly consisting of an outer race and roller assembly. A precision ground diameter on the pinion pilot functions as an inner race.

Side bearing preload and ring gear-to-pinion backlash are controlled by side bearing adjusting nuts threaded into the carrier near the axle tubes. Pinion depth is controlled by a shim located between the pinion bearing retainer assembly and the differential carrier.

DANA 10-1/2" RING GEAR AXLE

The Dana axle shown in figure 4B-4 is a Salisbury-type similar in design to the 8-7/8" ring gear axle. It does differ in several points, however. The axle shafts are full floating; the carrier must be spread to remove the differential; and the drive pinion incorporates two shim packs. The inner pack controls pinion depth, while the outer pack controls pinion bearing preload.



1. **HOUSING,** Rear Axle
2. **CONNECTOR,** Rear Axle Vent Hose
3. **PLUG,** Axle Filler and Drain (½"-14)
4. **SPACER,** Pinion Shaft Brg
5. **CUP,** Part of Bearing Asm
6. **CONE,** Part of Bearing Asm
7. **SHIM,** Pinion Shaft Brg
8. **GEAR ASM,** Ring and Pinion
9. **CONE,** Part of Bearing, Diff Side
10. **CUP,** Part of Bearing, Diff Side
11. **SHIM,** Differential Brg Adj
12. **CAP,** Diff Carrier Brg
13. **GASKET,** Axle Housing Cover
14. **COVER,** Axle Housing
15. **CLIP,** Rear Brake Crossover Pipe
16. **BOLT,** Gear Carrier Cover
17. **GEAR,** Diff Pinion
18. **WASHER,** Diff Pinion
19. **WASHER,** Diff Side Gear
20. **GEAR,** Diff Side
21. **BOLT,** Diff Carrier Cap (7/16"-14 x 2 1/4")
22. **SCREW,** Pinion Shaft Lock
23. **WASHER**
24. **SHAFT,** Differential Pinion
25. **BOLT,** Drive Gear (3/8"-24 x 25/32")
26. **CASE,** Rear Axle Diff
27. **NUT,** Hex (3/8"-24)
28. **WASHER,** Lock
29. **BEARING ASM,** Rear Wheel
30. **SEAL,** Rear Axle Shaft Brg
31. **PLATE ASM,** Brake Flange
32. **BOLT** (3/8"-24 x 1")
33. **LOCK,** Rear Axle Shaft
34. **SHAFT,** Rear Axle
35. **BOLT,** Rear Hub (1/2"-20 x 1 3/4")
36. **DRUM ASM,** Rear Wheel Brake
37. **NUT,** Pinion Flange (7/8"-14)
38. **WASHER,** Prop Shaft Pinion Flange
39. **FLANGE,** W/Deflector Prop Shaft Pinion
40. **SEAL,** Pinion Flange Oil
41. **CONE,** Pinion Shaft Front
42. **CUP,** Pinion Shaft Front

No attempt should be made to convert this axle to positraction. 104702

Fig. 4B-1--8-1/2" Ring Gear Axle Typical

DANA 9-3/4" RING GEAR AXLE

The Dana axle shown in figure 4B-5 is similar to the unit shown in 4B-4; however, the differential side bearing shims are located between the case and the side bearings.

ROCKWELL 12" RING GEAR AXLE

The 11,000 lb. capacity, single-speed hypoid axle, illustrated in figure 4B-5a, has a straddle mounted drive pinion which is supported at the rear by a straight roller bearing. The pinion front bearing consists of a double row ball bearing.

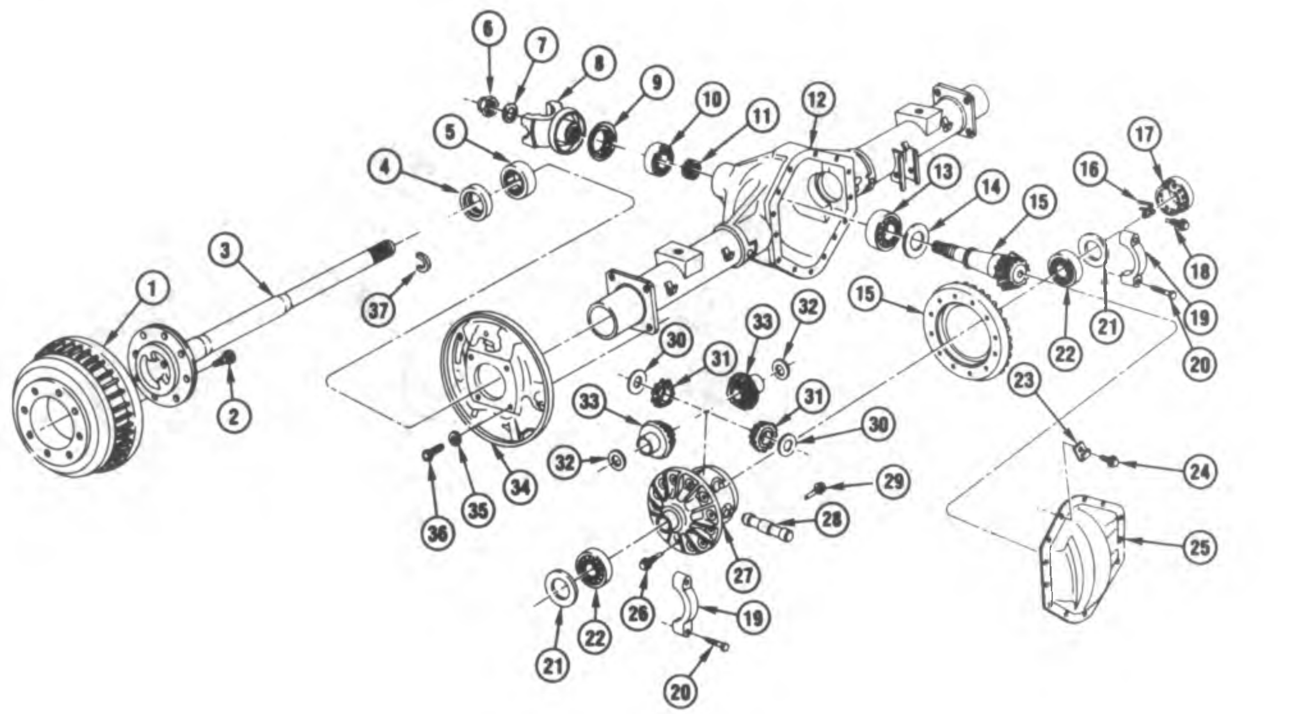
The differential is a conventional four-pinion type. Thrust washers are used between the side gears and case and also between differential pinions and the differential case.

A thrust pad mounted on the end of an adjusting screw threaded into the carrier housing limits deflection of the ring gear under high torque conditions.

Involute splines are incorporated in the axle shaft flange and in the wheel hubs. This design provides for the driving torque to be transmitted from the axle shaft to the hub through the mating splines.

REAR AXLE OPERATION

A basic differential consists of a set of four gears. Two of these gears are called differential side gears, and the other two are differential pinion gears. Some differentials have more than two pinion gears. Each side gear is splined to an axle shaft. Consequently, each axle shaft must turn when its side gear rotates.



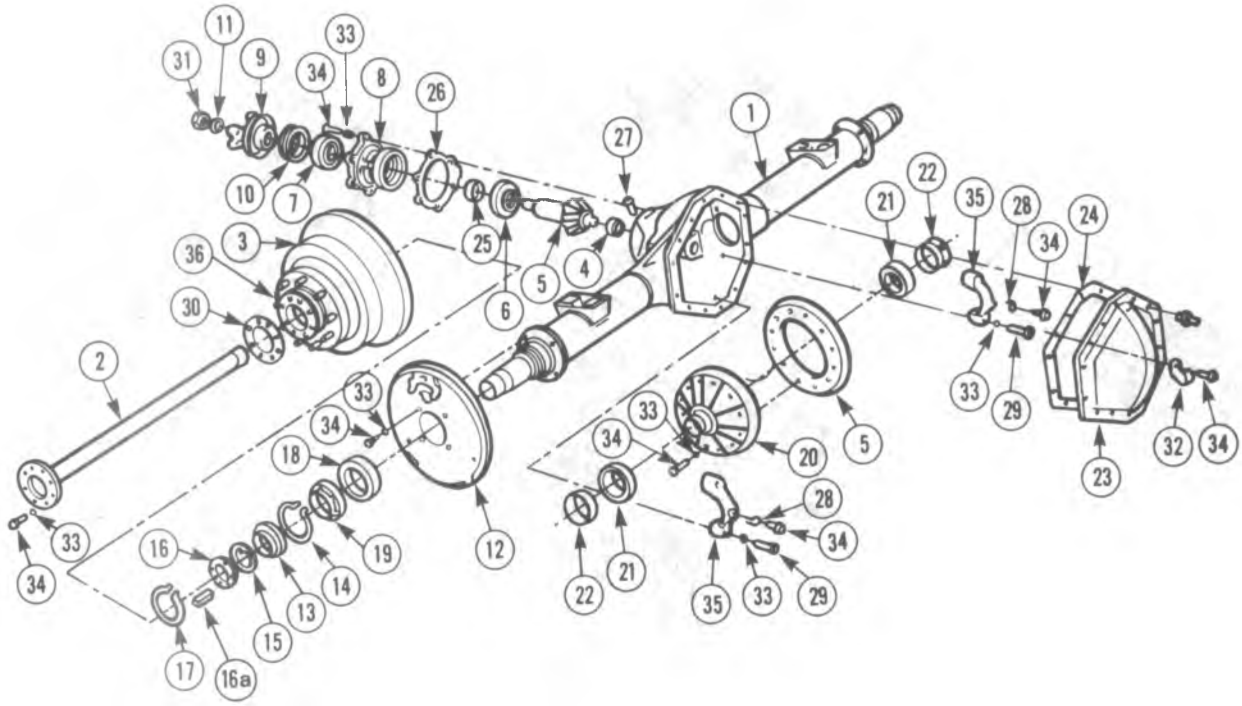
1. **DRUM**
2. **BOLT,** Rr Whl
3. **SHAFT,** Rr Axle
4. **SEAL,** Rr Axle Shaft
5. **BEARING,** Rr Axle Whl
6. **NUT,** Pinion Flange
7. **WASHER,** Pinion Flange
8. **FLANGE,** W/Defl, Pinion
9. **SEAL,** Pinion Flange
10. **BEARING,** Pinion Frt
11. **SPACER,** Pinion Bearing
12. **CARRIER & TUBE,** Diff
13. **BEARING,** Pinion Gear Rr
14. **SHIM KIT,** Pinion Brg
15. **GEAR,** Ring and Pinion
16. **LOCK**
17. **NUT,** Diff Brg Adj
18. **BOLT,** Adj Nut Lock
19. **CAP,** Diff Brg
20. **BOLT,** Diff Brg Cap
21. **SHIM,** Diff Brg
22. **BEARING,** Differential
23. **CLIP,** Rr Brk C/Ovr Pipe
24. **BOLT,** Diff Carrier Cover
25. **COVER,** Diff Carrier
26. **BOLT,** Hyp Drive Gear
27. **CASE,** Diff
28. **SHAFT,** Diff Pinion
29. **SCREW,** Diff Pinion Shaft
30. **WASHER,** Diff Png Thrust
31. **PINION,** Diff
32. **WASHER,** Si Gear Thrust
33. **GEAR,** Diff Side
34. **PLATE,** Rr Brk Flg
35. **WASHER,** Lk (1/2")
36. **BOLT,** Hex (1/2"-20 x 1")
37. **LOCK,** Axle Shaft

104703

Fig. 4B-2--9 1/2" Ring Gear Axle

The differential pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts.

Power flow through the differential is as follows: The drive pinion rotates the ring gear. The ring gear, being bolted to the differential case, rotates the case. The differential pinion, as it rotates with the case, forces the pinion gears against the side gears. When both wheels have equal traction, the pinion gears do not rotate on the pinion shaft because the input force on the pinion gear is equally divided between the two side gears. Consequently, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. The side gears, being splined to the axle shafts and in mesh with the pinion gears, rotate the axle shafts.



1. **HOUSING,** Rear Axle
2. **SHAFT,** Rear Axle
3. **DRUM,** Rear Wheel
4. **BEARING,** Drive Pinion
5. **GEAR,** Pinion
6. **BEARING,** Pinion (Inter)
7. **BEARING,** Pinion (Front)
8. **RETAINER,** Oil Seal
9. **FLANGE,** Prop Shaft
10. **SEAL,** Propshaft Pinion Flg Oil
11. **WASHER,** Propshaft Pinion Flange
12. **FLANGE,** Brake Plate
13. **BEARING,** Rear Wheel Outer
14. **RING,** Axle Shaft
15. **WASHER,** Hub Adjusting
16. **NUT,** Hub Adjusting

16a. **KEY,** Adj Nut Lock

17. **LOCK,** Key Retaining Ring
18. **SEAL,** Oil Deflector
19. **BEARING,** Rear Wheel Inner
20. **CASE,** Differential
21. **BEARING,** Diff Side
22. **NUT,** Diff Adj
23. **COVER,** Axle Hsg
24. **GASKET,** Axle Hsg
25. **SPACER,** Pinion Shaft Brg
26. **SHIM,** Pinion Shaft
27. **VENTILATOR,** Axle Housing
28. **LOCK,** Adj Nut
29. **BOLT,** Diff Cap
30. **GASKET,** Axle Shaft
31. **NUT,** Prop Shaft
32. **CLIP,** Axle Cover
33. **WASHER,** Cover Bolts
34. **BOLTS,** Cover (Hex)
35. **CAP**
36. **HUB,** Rear Wheel

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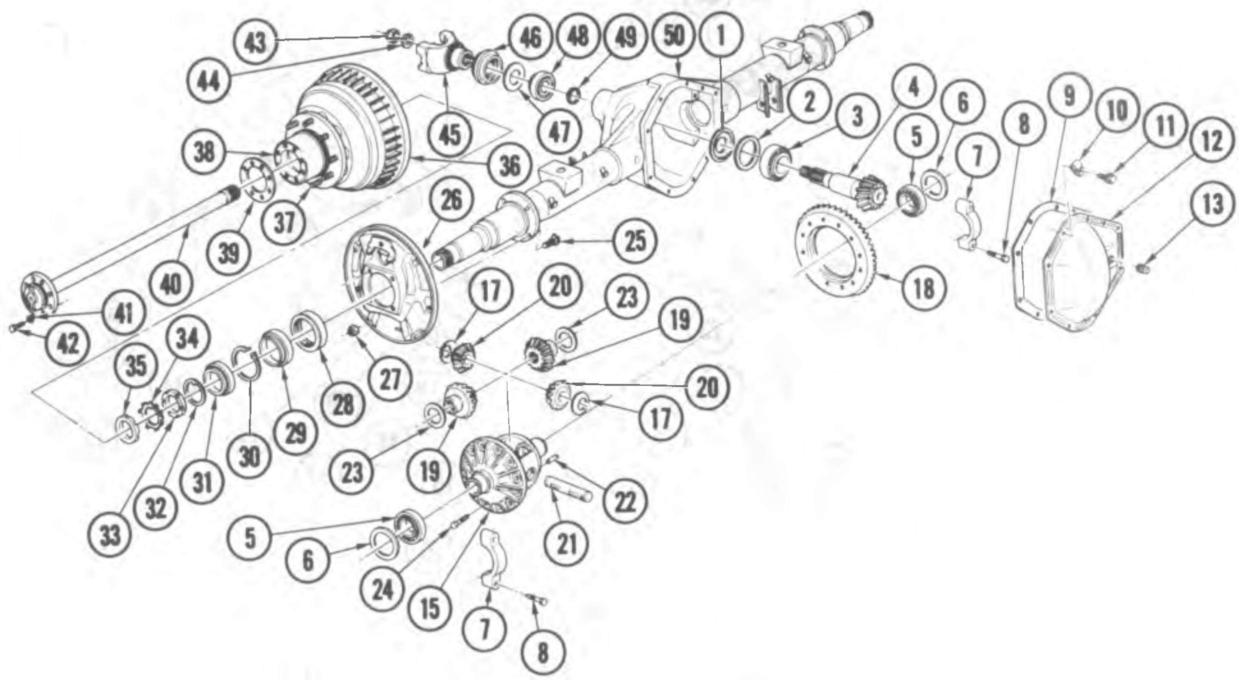
Fig. 4B-3--Chevrolet 10-1/2" Ring Gear Axle Cross-Section

If a vehicle were always driven in a straight line, the ring and pinion gears would be sufficient. The axle shaft could then be solidly attached to the ring gear and both driving wheels would turn at equal speeds.

However, if it became necessary to turn a corner, the tires would scuff and slide because the outer wheel would travel further than the inner wheel To prevent tire scuffing and sliding, the differential becomes effective and allows the axle shafts to rotate at different speeds.

When the car turns a corner, the outer rear wheel must turn faster than the inner wheel. The inner wheel, turning slower with respect to the outer wheel, slows its rear axle side gear (as the axle shaft is splined to the side gear) and the rear axle pinion gears will roll around the slowed rear axle side gear, driving the other rear axle side gear and wheel faster



1. **WASHER,** Pinion Brg Spacer
2. **SHIM,** Pinion Shaft Brg Inner
3. **BEARING ASM,** Pinion Rear
4. **PINION**
5. **BEARING,** Diff Side
6. **SHIM UNIT,** Diff Brg Adj
7. **CAP**
8. **BOLT,** Diff Cap
9. **GASKET,** Axle Housing Cover
10. **CLIP,** Axle Cover
11. **BOLT,** Gear Carrier Cover
12. **COVER,** Axle Housing
13. **PLUG**
14. **BOLT,** Diff Case
15. **CASE,** Diff
16. **PLATE & DISC UNIT,** Diff Clu
17. **WASHER,** Diff Pinion
18. **RING GEAR**
19. **GEAR,** Diff Side
20. **GEAR,** Diff Pinion
21. **SHAFT,** Diff Pinion (Exc P/Trac)
 SPIDER, Diff Pinion (W/P/Trac)
22. **PIN,** Pinion Shaft Lock
23. **WASHER,** Diff Side Rear
24. **BOLT,** Ring Gear
25. **BOLT,** Rear Flange Plate
26. **PLATE ASM,** Brg Flange
27. **NUT** (9/16"-18)
28. **SEAL,** Rear Axle Shaft
29. **BEARING,** Rear Wheel Inner
30. **RING,** Rear Axle Shaft Brg
31. **BEARING,** Rear Wheel Outer
32. **WASHER,** Hub Adjusting
33. **NUT,** Hub Adjusting
34. **LOCK,** Hub Adjusting
35. **NUT,** Hub Adjusting
36. **DRUM ASM,** Rear Wheel
37. **STUD,** Rear Hub
38. **HUB,** Rear Wheel
39. **GASKET,** Rear Axle Shaft
40. **SHAFT,** Rear Axle
41. **WASHER,** Flat
42. **BOLT,** Axle Shaft
43. **NUT,** Pinion Flange
44. **WASHER,** Pinion Flange
45. **FLANGE,** Pinion
46. **SEAL,** Pinion
47. **SLINGER,** Pinion Oil
48. **BEARING ASM,** Pinion Shaft Front
49. **SHIM,** Pinion Shaft Brg Outer
50. **HOUSING,** Rear Axle

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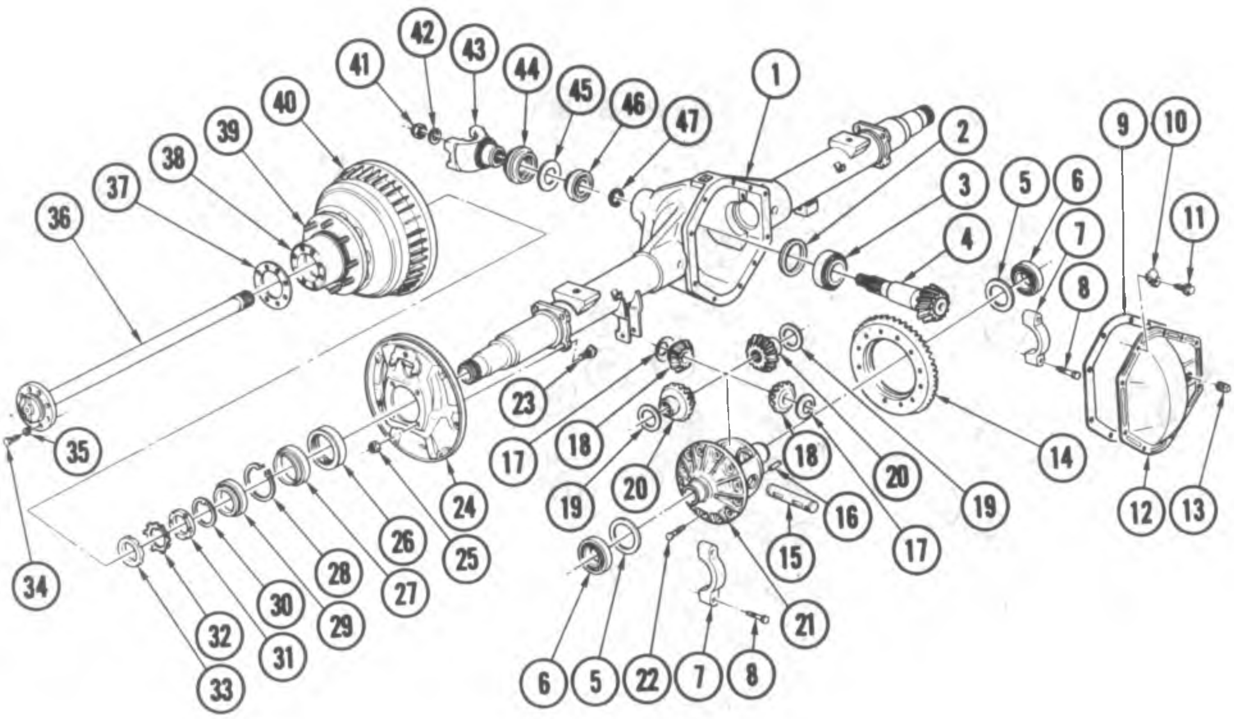
Fig. 4B-4--Dana 10-1/2" Ring Gear Axle Exploded View



1. **HOUSING,** Rear Axle
2. **SHIM,** Pinion Shaft Brg Inner
3. **BEARING ASM,** Pinion Rear
4. **PINION**
5. **SHIM UNIT,** Diff Brg Adj
6. **BEARING,** Diff Side
7. **CAP**
8. **BOLT,** Diff Cap
9. **GASKET,** Axle Housing Cover
10. **CLIP,** Axle Cover
11. **BOLT,** Gear Carrier Cover
12. **COVER,** Axle Housing
13. **PLUG**
14. **RING GEAR**
15. **SHAFT,** Diff Pinion
16. **PIN,** Pinion Shaft Lock
17. **WASHER,** Diff Pinion Thrust
18. **GEAR,** Diff Pinion
19. **WASHER,** Diff Side Gear Thrust
20. **GEAR,** Diff Side
21. **CASE,** Diff
22. **BOLT,** Diff Case
23. **BOLT,** Rear Flange Plate
24. **PLATE ASM,** Brk Flange
25. **NUT** (9;16"-18)
26. **SEAL,** Rear Axle Shaft
27. **BEARING,** Rear Wheel, Inner
28. **RING,** Rear Axle Shaft Brg
29. **BEARING,** Rear Wheel Outer
30. **WASHER,** Hub Adjusting
31. **NUT,** Hub Adjusting
32. **LOCK,** Hub Adjusting
33. **NUT,** Hub Adjusting
34. **BOLT,** Axle Shaft
35. **WASHER,** Flat
36. **SHAFT,** Rear Axle
37. **GASKET,** Rear Axle Shaft
38. **HUB,** Rear
39. **STUD,** Rear Hub
40. **DRUM ASM,** Rear Wheel
41. **NUT,** Pinion Flange
42. **WASHER,** Pinion Flange
43. **FLANGE,** Pinion
44. **SEAL,** Pinion
45. **SLINGER,** Pinion Oil
46. **BEARING ASM,** Pinion Shaft Front
47. **SHIM,** Pinion Shaft Brg Outer

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Fig. 4B-5--Dana 9-3/4" Ring Gear Axle Exploded View

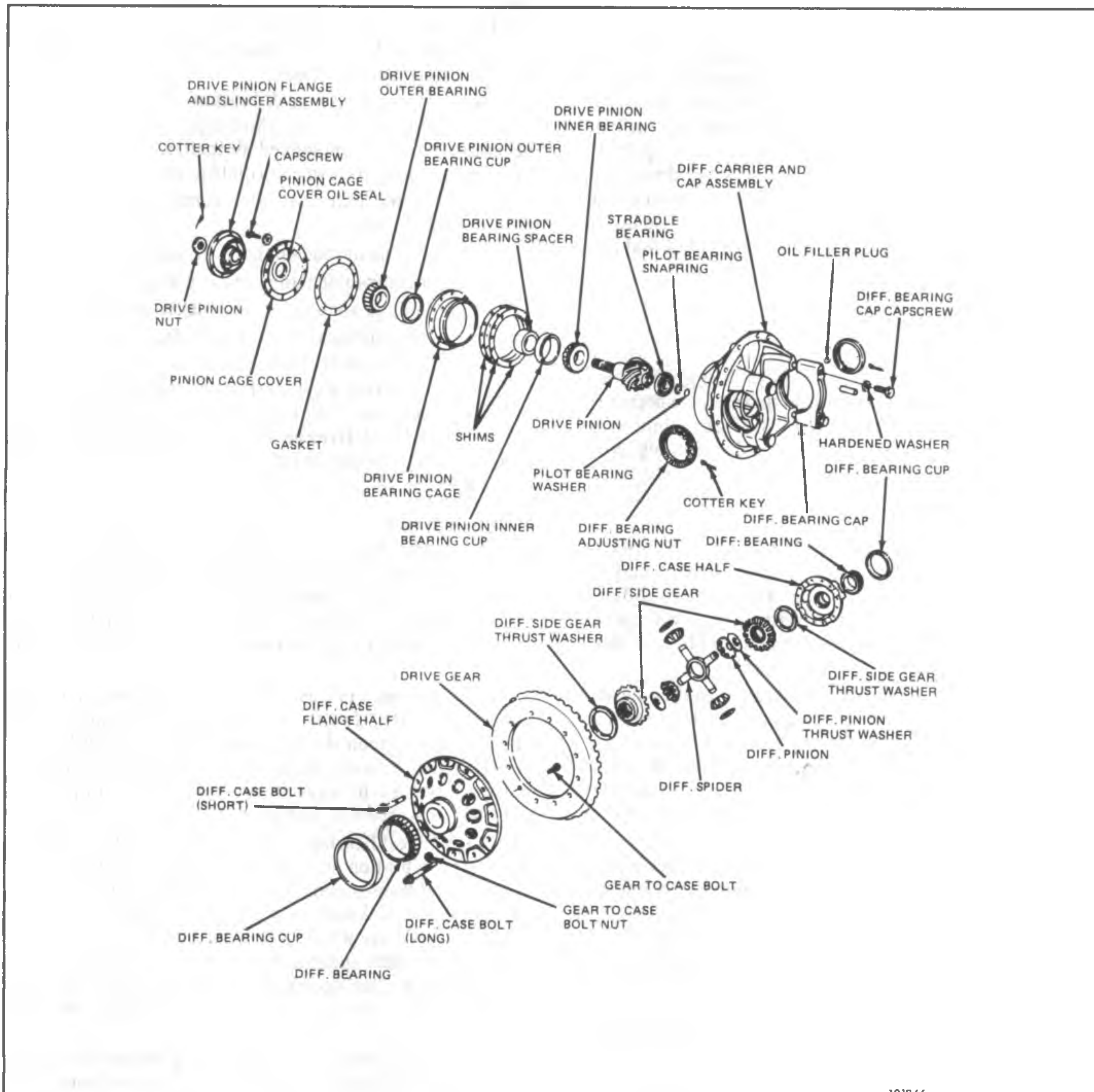


Fig. 4B-5a--Rockwell 12" Ring Gear Axle-11,000# Capacity

DIAGNOSIS

NOISE

The most essential part of rear axle service, as with any mechanical repair, is proper diagnosis of the problem, and, in axle work one of the most difficult areas to diagnosis is noise. Locating a broken axle shaft, or broken differential gear, presents little or no problem, but, locating and isolating axle noise can be an entirely different matter.

Degree of Noise

Any gear driven unit, and especially an automotive drive axle where engine torque multiplication occurs at a 90° turn in the drive line, produces a certain amount of noise. Therefore, an interpretation must be made for each vehicle to determine whether the noise is normal or if a problem actually exists. A normal amount of noise must be expected and cannot be eliminated by conventional repairs or adjustment.

Acceptable noise can be defined as a slight noise heard only at a certain speed or under unusual or remote conditions. For example, this noise tends to reach a "peak" at speeds from 40 to 60 miles per hour (60 to 100 km/h) depending on road and load conditions, or on gear ratio and tire size. This slight noise is in no way indicative of trouble in the axle assembly.

Drive line noises may baffle even the best diagnostician. Vehicle noises coming from tires, transmission, propeller shaft, universal joints, and front or rear wheel bearings, are often mistaken for axle noise. Such practices as: raising tire pressure to eliminate tire noise (although this will not silence tread noise of mud and snow tires), listening for the noise at varying speeds and road surfaces, on drive, float, and coast conditions will aid in locating the source of alleged axle noises. Thus, every effort should be made to isolate the noise to a specific drive line component instead of making a random guess that could be a costly waste of time.

Determining Type of Noise

External Noise

When a rear axle is suspected of being noisy, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

Road Noise-Some road surfaces, such as brick or rough-surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

Tire Noise-Tire noise may easily be mistaken for rear axle noise, even though the noisy tires may be located on the front wheels. Tires worn unevenly, or having surfaces on non-skid divisions worn in saw-tooth fashion, are usually noisy and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure.

Tire Noise Test-Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, **for test purposes only** will materially alter noise caused by tires but will not affect noise caused by the rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as vehicle speed is reduced. Rear axle noise usually changes when comparing "pull" and "coast" but tire noise remains about the same.

Engine and Transmission Noises-Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop vehicle in a quiet place to avoid interfering noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to vehicle speed at which the noise was most pronounced. If a similar noise is produced with vehicle standing, it is caused by the engine or transmission and not the rear axle.

Front Wheel Bearing Noise-Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing "pull" and "coast". Light application of brake, while holding vehicle speed steady, will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, and also be shaking wheels to determine if bearings are excessively loose.

Body Boom Noise or Vibration- Objectional "body boom" noise or vibration at 55-65 mph (90-100 km/h) can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft, causing unbalance.
2. Shaft or companion flange balance weights missing.
3. Shaft damage, such as bending, dents, or nicks.
4. Tire-type roughness. Switch tires from a known good car to determine tire fault.

If, after making a comprehensive check of the vehicle, all indications point to the rear axle, further diagnostic steps are necessary to determine the axle components at fault. True axle noises generally fall into two categories: gear noise and bearing noise.

Rear Axle Noises

If a careful test of vehicle shows that noise is not caused by external items it is then reasonable to assume that noise is caused by rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn differential side gears and pinions; noises may also be caused by mismatched, improperly adjusted, or scored ring and pinion gear set.

Rear Wheel Bearing Noise-A rough rear wheel bearing produces a vibration or growl which continues with vehicle coasting and transmission in neutral. A brinelled rear wheel bearing causes a knock or click approximately every two revolutions of rear wheel, since the bearing rollers do not travel at the same speed as the rear axle and wheel. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough or brinelled wheel bearing.

Differential Side Gear and Pinion Noise-Differential side gears and pinions seldom cause noise since their movement is relatively slight on straight ahead driving. Noise produced by these gears will be most pronounced on turns.

Pinion Bearing failures can be distinguished because they rotate at higher speeds than differential side bearings and axle shaft bearings. Rough or brinelled pinion bearings produce a continuous low pitched whirring or scraping noise starting at relatively low speed.

Side Bearings produce a constant rough noise of a lower pitch than pinion bearings. Side bearing noise may also fluctuate in the above wheel bearing test.

Gear Noise

There are two basic types of gear noise. The first type is produced by broken, bent, or forcibly damaged gear teeth and is usually quite audible over the entire speed range and presents no particular problem in diagnosis.

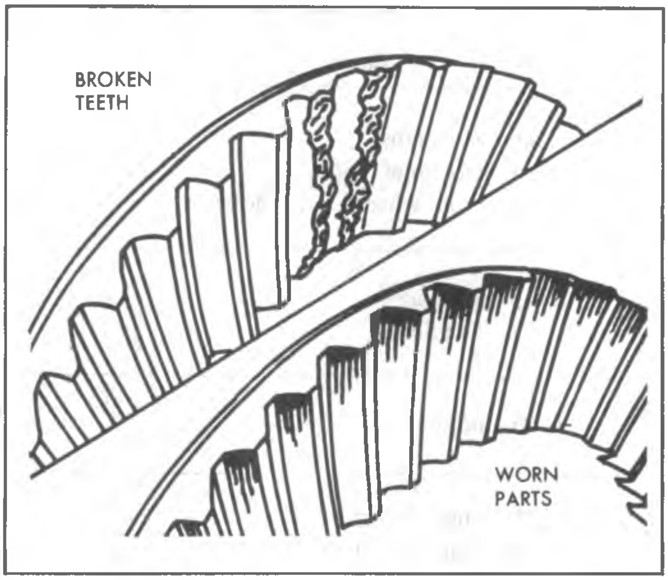


Fig. 4B-6--Two Causes of Gear Noise

For example, hypoid gear tooth scoring generally results from the following: insufficient lubricant improper breakin, improper lubricant, insufficient gear backlash, improper ring and pinion gear alignment, or loss of drive pinion nut torque. The scoring will progressively lead to complete erosion of the gear tooth, or gear tooth pitting and eventual fracture if the initial scoring condition is not corrected. Another cause of hypoid tooth fracture is extended overloading of the gear set which will produce fatigue fracture, or shock loading which will result in sudden failure.

Differential pinion and side gears rarely give trouble. Common causes of differential failure are shock loading, extended overloading, and seizure of the differential pinions to the cross shaft resulting from excessive wheel spin and consequent lubrication breakdown.

The second type of gear noise pertains to the mesh pattern of the gear teeth. This form of abnormal gear noise can be recognized as it produces a cycling pitch (whine) and will be very pronounced in the speed range at which it occurs, appearing under either "drive", "float" or "coast" conditions. "Drive" is acceleration or heavy pull. "Coast" is with a closed throttle and vehicle in gear and "float" is using just enough throttle to keep the car from driving the engine-the vehicle slows down gradually but engine still pulls slightly. Gear noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch. Bearing noise will vary in pitch with vehicle speeds. See figure 4B-7.

MAINTENANCE AND LUBRICATION

Refer to Section 0B for periodic maintenance and lubrication requirements.

OPERATIONAL CHECK AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 9 of 'Drive Pinion Reassembly'.

Side Bearing Preload is set to specifications in step 6 of 'Differential Case-Installation and Adjustment'.

Following service to the Differential assembly or to the Drive Pinion, the Pinion Depth and Ring-Gear-to-Pinion Backlash **must** be checked, using a Gear Tooth Contact Pattern Check as outlined below.

Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct realtionship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desireable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the 'drive' side. The concave side is the 'coast' side. The end of the tooth nearest center of ring gear is referred to as the 'toe-in' end. The end of the tooth farthest away from center is the 'heel' end. Toe end of tooth is smaller than heel end. See figure 4B-8.

Pattern Check

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture to ring gear teeth. When properly applied, the area of tooth contact will be clearly visible after load is applied.
3. Tighten bearing cap bolts to specifications.
4. Apply load to gears by expanding brake shoes or by wrapping a heavy rag around the companion flange to resist rotation.

   NOTICE: A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.
5. Observe pattern on ring gear teeth and compare with figure 4B-9. Make adjustments as outlined below.
6. The important thing to achieve in the pattern check and subsequent adjustments is to locate the contact pattern centrally on the face of the ring gear teeth.

Pinion Depth Adjustment

1. The pinion depth shim may be replaced as necessary to place the drive pinion at the correct depth. See figure 4B-9.
2. Depth shims are available from .006 inch to .024 inch, in increments of .001 inch.

Backlash Adjustment

1. Remove locking retainers from side bearing adjusting nuts.
2. Move adjusting nuts **an equal amount** in or out to achieve proper backlash.
   a. To increase backlash, loosen the left adjusting nut and tighten the right adjusting nut **an equal amount.**
   b. To decrease backlash, loosen the right adjusting nut and tighten the left adjusting nut **an equal amount.**

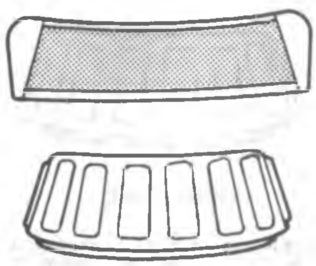
Problem	Cause
1. Noise is the same in drive or coast	1. a) Road noise b) Tire noise c) Front wheel bearing noise
2. Noise changes on a different type of road	2. a) Road noise b) Tire noise
3. Noise tone lowers as vehicle speed is lowered	3. Tire noise
4. Similar noise is produced with vehicle standing and driving	4. a) Engine noise b) Transmission noise
5. Vibration	5. a) Rough rear wheel bearing b) Unbalanced or damaged propeller shaft c) Tire unbalance d) Worn universal joint in propeller shaft e) Mis-indexed propeller shaft at companion flange f) Companion flange runout too great
6. A knock or click approximately every two revolutions of rear wheel	6. A brinelled rear wheel bearing
7. Noise most pronounced on turns	7. Differential side gear and pinion
8. A continuous low pitch whirring or scraping noise starting at relatively low speed	8. Pinion bearing
9. Drive noise, coast noise or float noise	9. Ring and pinion gear
10. Clunk on acceleration or deceleration	10. Worn differential cross shaft in case
11. Grunt on stops	11. No grease in propeller shaft slip yoke
12. Groan in Forward or Reverse	12. Wrong lube in differential
13. Chatter on turns (locking differential)	13. a) Lubricant contaminated b) Clutch plates worn
14. Clunk or knock on rough road operation	14. Excessive end play of axle shafts to differential cross shaft

Fig. 4B-7--Diagnosis of Noise Problems

DIFFERENTIAL AND REAR AXLE BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

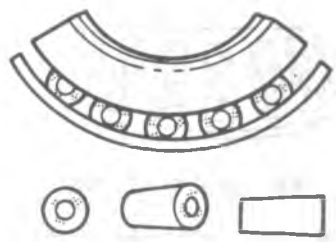
1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.



ABRASIVE ROLLER WEAR

PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES

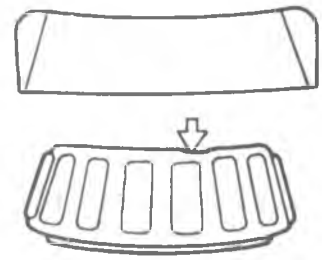
CLEAN ALL PARTS AND HOUSINGS CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



GALLING

METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD

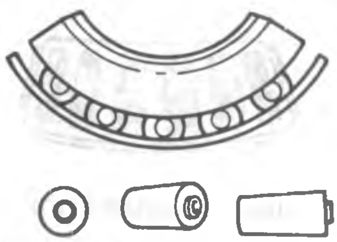
REPLACE BEARING CHECK SEALS AND CHECK FOR PROPER LUBRICATION



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE

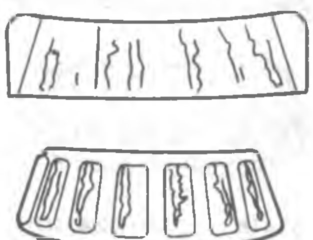
REPLACE BEARING



ABRASIVE STEP WEAR

PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.

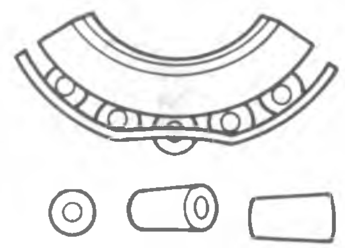
CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



ETCHING

BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING

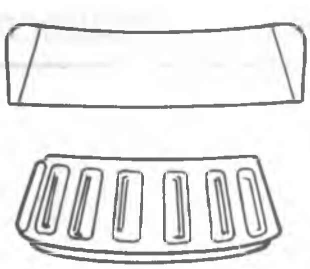
REPLACE BEARINGS CHECK SEALS AND CHECK FOR PROPER LUBRICATION



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE

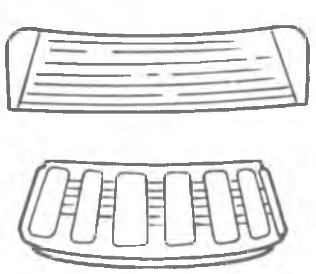
REPLACE BEARING



INDENTATIONS

SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL

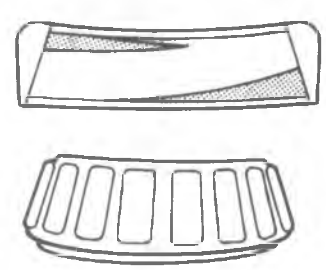
CLEAN ALL PARTS AND HOUSINGS CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY



CAGE WEAR

WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION

CLEAN RELATED PARTS AND HOUSINGS CHECK SEALS AND REPLACE BEARINGS



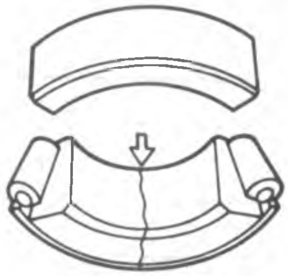
MISALIGNMENT

OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT

CLEAN RELATED PARTS AND REPLACE BEARING MAKE SURE RACES ARE PROPERLY SEATED

104718

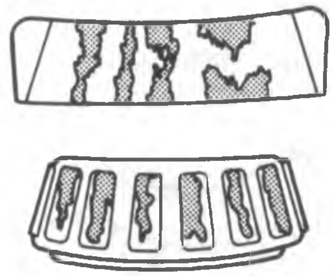
DIFFERENTIAL AND REAR AXLE BEARING DIAGNOSIS (CONT'D)



CRACKED INNER RACE

RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.

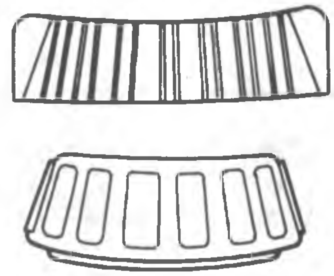
REPLACE BEARING AND CORRECT BEARING SEATS.



FATIGUE SPALLING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.

REPLACE BEARING — CLEAN ALL RELATED PARTS.



BRINELLING

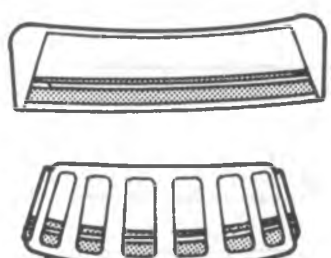
SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.

FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.

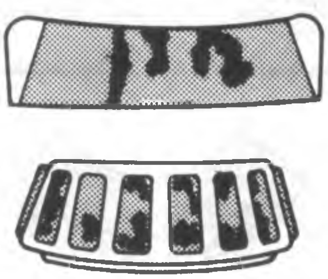


STAIN DISCOLORATION

DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.

RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVER HEATING IS OBSERVED.

CHECK SEALS AND RELATED PARTS FOR DAMAGE.



HEAT DISCOLORATION

HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVER LOAD (WAGON'S) OR INCORRECT LUBRICANT.

EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.

TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.

REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.

SMEARS

SMEARING OF METAL DUE TO SLIPPAGE. SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FITS AND LUBRICATION.

104719

LIGHT DUTY TRUCK REAR AXLE IDENTIFICATION

Chevrolet Light Duty Trucks use either Chevrolet or Dana produced rear axle assemblies. See examples of production codes below.

CHEVROLET AXLE

EXAMPLE:	RAC	G	001	1
	Axle & Vehicle Code	Source Code	Day Code	Shift Code
		C = Buffalo G = Gear & Axle	Jan. 1 = 001	1st Shift

Code is staped on top of right axle tube outboard of carrier.

DANA AXLE

EXAMPLE	603560-1	9	29	2	B	4
	DANA P/N	MONTH CODE	DAY CODE	MODEL YEAR	SHIFT CODE	PRODUCTION LINE CODE

Code is stamped on rear surface of right axle tube.

The Chevrolet produced axles use a prefix code stamped into the axle tube for axle ratio identification. Dana produced axles use the same prefix code as the Chevrolet axles but they display these codes on a strip of tape attached to the outboard end of the axle tube.

104720

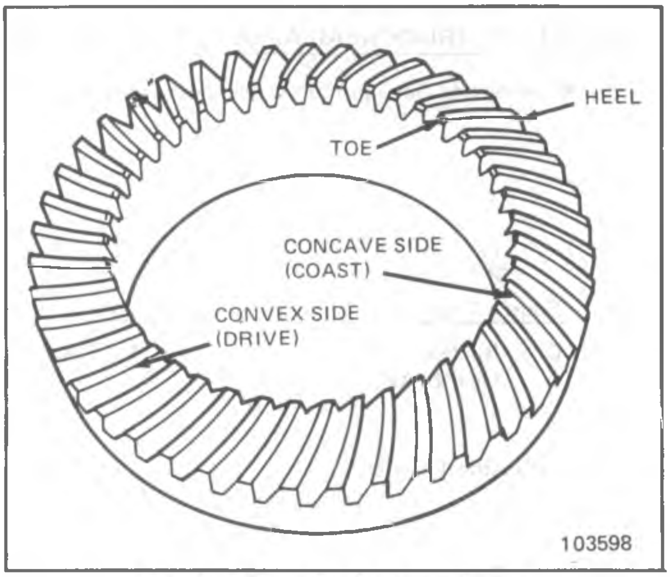


Fig. 4B-8--Gear Tooth Nomenclature

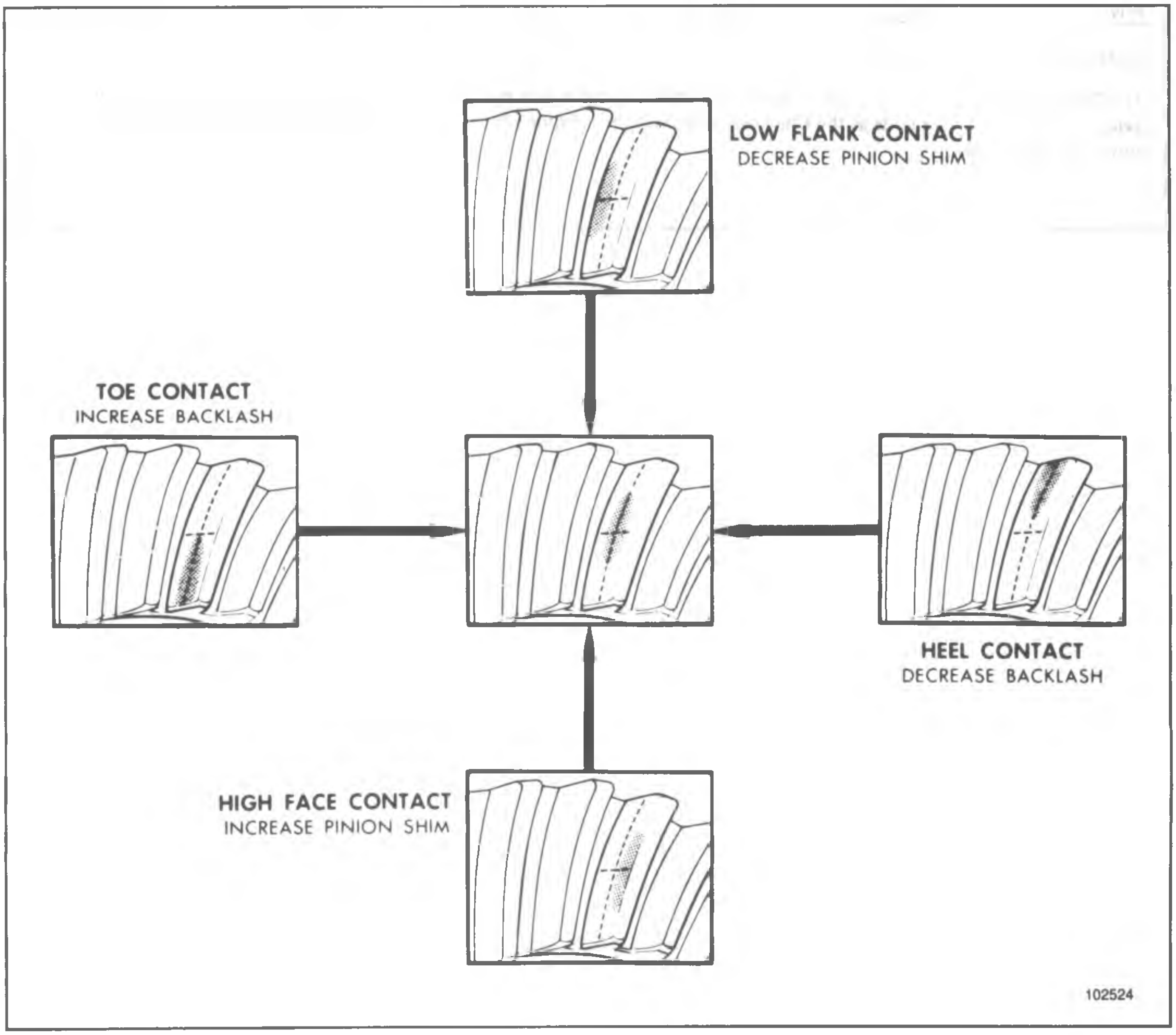


Fig. 4B-9--Gear Tooth Contact Pattern Check

SECTION 4B1

8-1/2" and 9-1/2" RING GEAR AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on Page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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ON-VEHICLE SERVICE

Construction of the axle assembly is such that service operations may be performed with the housing installed in the vehicle or with the housing installed in a holding fixture. The following removal and installation procedure is necessary only when the housing requires replacement.

NOTICE: See NOTICE on page 1 of this section, regarding Axle Assembly fasteners.

Removal

1. Raise vehicle on hoist.
2. Support rear axle assembly with suitable lifting device, so that tension is relieved in springs and shock absorbers.
3. Remove trunnion bearing "U" bolts from the axle companion flange, separate trunnion from flange, position propeller shaft to one side and tie it to frame side rail.

   Secure trunnion bearing caps to trunnion, using masking tape or a large rubber band, to prevent loss of bearings.
4. Disconnect shock absorbers at lower attachment points and position out of the way.
5. Disconnect axle vent hose from vent connector and position vent hose to one side.
6. Disconnect hydraulic brake hose at connector on axle housing. Remove brake drum, disconnect parking brake cable at actuating levers and at flange plate. Refer to Section 5 for cable removal and brake details. Remove axle "U" bolt nuts, "U" bolts, spacers and clamp plates.
7. Lower axle assembly and remove from vehicle.

Installation

1. Position axle assembly under vehicle and align with springs.
2. Install spacer, clamp plate and "U" bolts to axle assembly, loosely install retaining nuts to "U" bolts.
3. Position shock absorbers in lower attachment brackets and loosely install nut to retain shock.
4. Connect axle vent hose to vent connector at carrier.
5. Connect hydraulic brake hose to connector on axle housing, connect parking brake cable to actuating levers. Install brake drum and wheel and tire assembly-bleed brakes and adjust parking brake as outlined in applicable portion of Brake Section.
6. Reassemble the propeller shaft to companion flange, making sure that bearing caps are indexed in flange seat. Torque bearing cap retaining nuts to specifications.
7. Position vehicle so that weight is placed on suspension components and torque affected parts to specifications.
8. Lower vehicle and remove from hoist.

AXLE SHAFT

Removal

1. Raise vehicle on hoist. Remove wheel and tire assembly and brake drums.
2. Clean all dirt from around carrier cover.
3. Drain lubricant from carrier by removing cover.

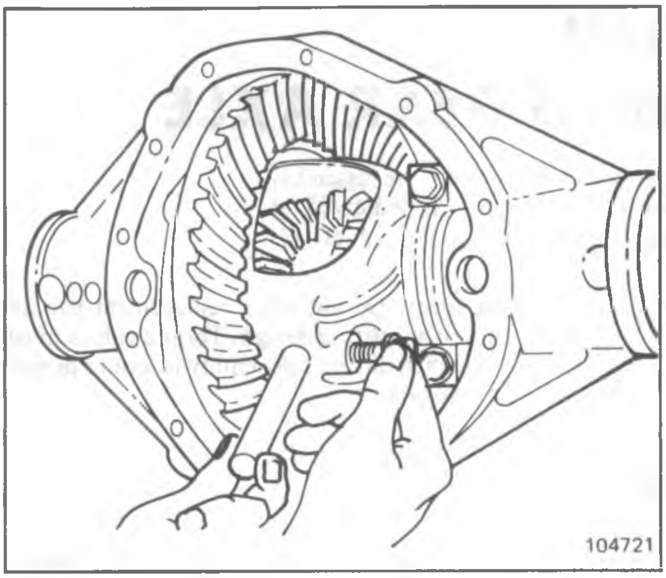


Fig. 4B1-1--Differential Pinion Shaft Removal

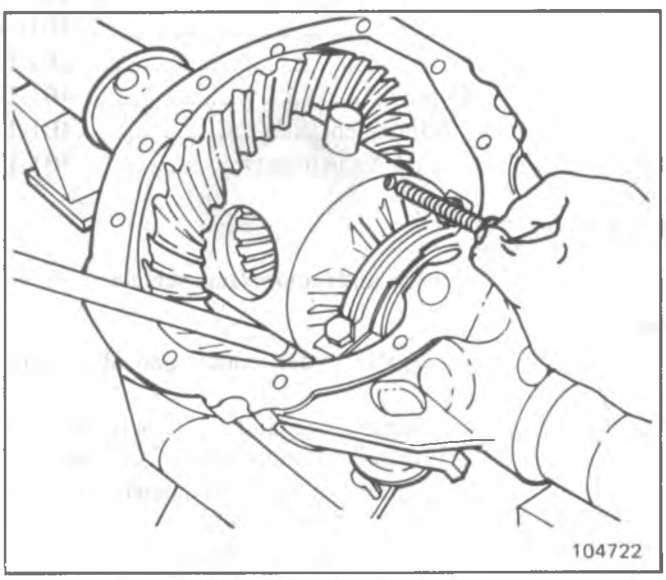


Fig. 4B1-2--Removing Lock Screw

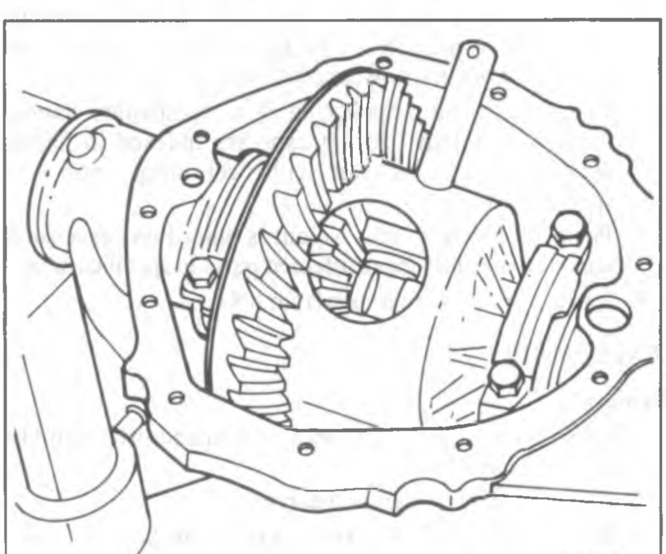


Fig. 4B1-3--Positioning Case For Best Clearance

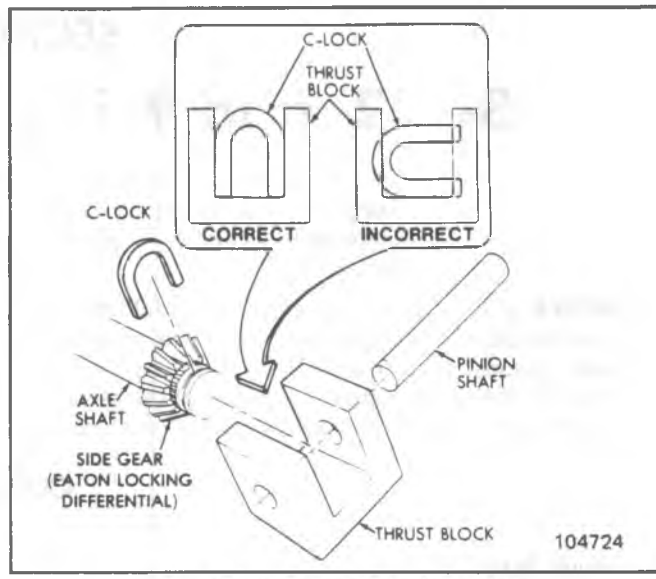


Fig. 4B1-4--Correct C-Lock Position

4. Remove the differential pinion shaft lock screw and the differential pinion shaft as shown in figure 4B1-1.
5. Push flanged end of axle shaft toward center of vehicle and remove "C" lock from button end of shaft.
6. Remove axle shaft from housing, being careful not to damage oil seal.

   When removing the axle shaft on the 9 1/2" ring gear axle, be sure the thrust washer in the differential case does not slid out.

Axles equipped with Eaton Locking differentials use a thrust block on the pinion shaft which affects the removal of axle shafts as noted below.

1. Raise the vehicle on a hoist. Remove both rear wheel and tire assemblies and both rear brake drums.
2. Remove the rear cover and drain the lubricant.
3. Rotate the case **to the position shown in figure 4B1-2.** Support the pinion shaft so that it cannot fall into the case, then remove the lock screw.

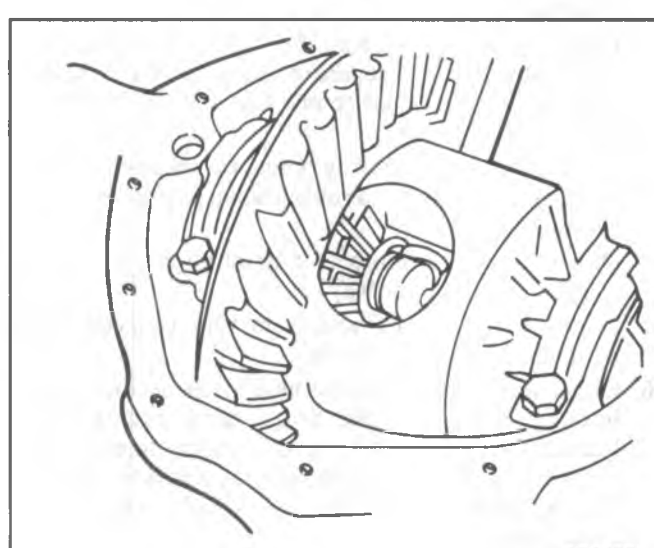


Fig. 4B1-5--Push Axle Shaft Inward

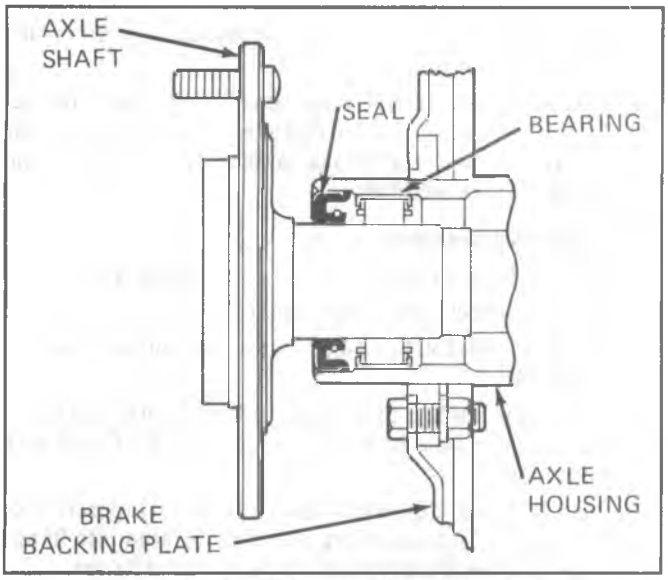


Fig. 4B1-6--Oil Seal and Wheel Bearing

4. Carefully withdraw the pinion shaft part-way out, as shown in figure 4B1-3. Rotate the case until the shaft touches the housing.
5. Reach into the case with a screwdriver or similar tool, and rotate the C-lock until its open end points directly inward, as shown in figure 4B1-4. The axle shaft cannot be pushed inward until the C-lock is properly positioned.

   Do not force or hammer the axle shaft in an attempt to gain clearance.
6. When the C-lock is positioned to pass through the end of the thrust block, push the axle shaft inward as shown in figure 4B1-5, and remove the C-lock. Remove the axle shaft and repeat steps 5 and 6 for the opposite axle shaft.

Oil Seal/Bearing-Replacement Fig. 4B1-6

1. Remove oil seal by using button end of axle shaft. Insert button end behind the steel case of the oil seal, then pry seal out of bore If both seal and bearing are being replaced proceed to step 2.
2. Using J-23689, insert into bore so that tool grasps behind the bearing. See figure 4B1-7. Slide washer against outside of seal (or bearing) and turn nut finger tight against washer. Attach Slide Hammer J-2619 and remove bearing and seal.

   On 9 1/2 inch ring gear axles, use tool J-29712. Insert (wobble plate) into axle tube so that it grasps behind the bearing. Center receiver on axle tube and tighten nut.
3. Back off nut and remove bearing and seal from tool.
4. Lubricate cavity between seal lips with wheel bearing lubricant and also lubricate new bearing with wheel bearing lubricant.
5. To reinstall bearing, use J-23690 Installer, or J-29709 for the 9 1/2 inch ring gear. Install bearing until tool bottoms against tube as illustrated in figure 4B1-8.
6. To install oil seal, place seal on J-21128 or J-29713 for the 9 1/2 inch ring gear and drive into bore until tool bottoms against end of tube. Refer to figure 4B1-9. This tool installs the seal flush with the end of the tube.

Axle Shaft-Installation

1. Slide axle shaft into place. Exercise care that splines on end of shaft do not damage oil seal and that they engage with splines of differential side gear.
2. Install axle shaft "C" locks as follows:

   a. With standard differntial, install axle shaft "C" lock on button end of axle shaft and push shaft outward so that shaft lock seats in counterbore of differential side gear. Then, position differential pinion shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw.

   b. With locking differntial, install "C" locks keeping the pinion shaft partially withdrawn. Place the "C" locks in the same position shown in Fig. 4B1-4. Carefully withdraw the axle shaft until the "C" lock is clear of the thrust block. When both locks are installed, install the pinion shaft aligning hole in shaft

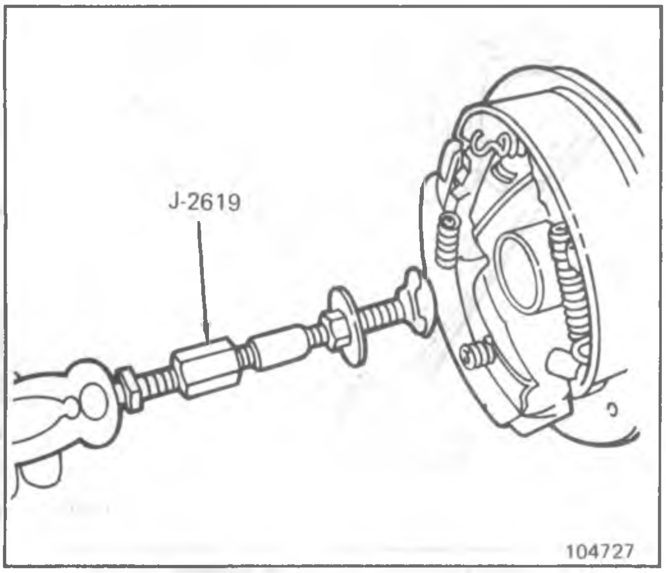


Fig. 4B1-7--Wheel Bearing Removal

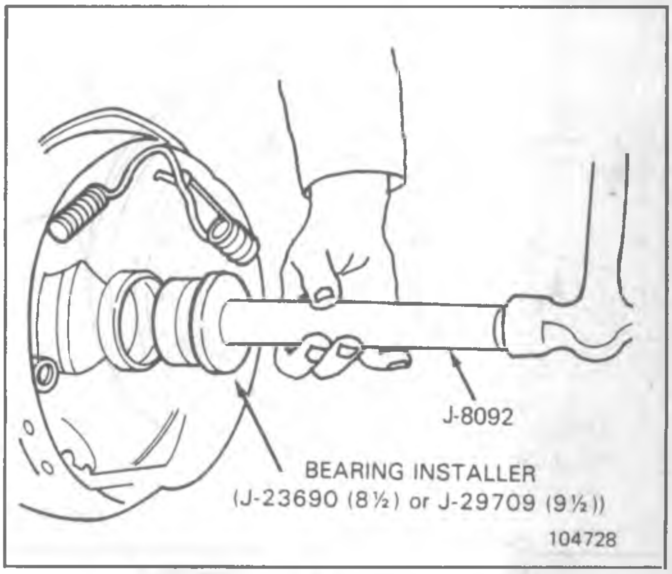


Fig. 4B1-8--Wheel Bearing Installation

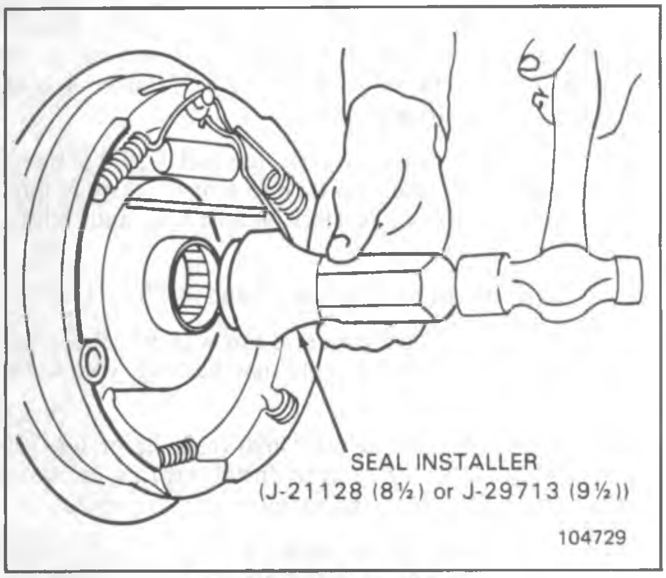


Fig. 4B1-9--Seal Installation

with lock screw hole. A new lock screw must be used when reassembling the differential case.

3. Torque locking screw to 18 N·m (25 ft. lbs.).
4. Using a new gasket, install carrier cover. Make sure both gasket surfaces on carrier and cover are clean before installing new gasket. Torque carrier cover bolts in a crosswise pattern to ensure uniform draw on cover gasket.
5. Fill axle with lubricant as specified in Maintenance and Lubrication Section to a level even with the bottom of filler hole when axle is at operating temperature.
6. Install brake drum and wheel and tire assembly.
7. Lower vehicle and remove from hoist.

Brake Backing Plate-Replacement

1. Remove brake line at wheel cylinder inlet and disassemble brake components from flange plate. Refer to the Brake Section for brake disassembly procedure.
2. Remove bolts retaining flange plate to axle, and remove flange plate.
3. Install new flange plate to axle housing and torque nuts to specifications.
4. Install brake components on flange and connect hydraulic line to wheel cylinder inlet. Refer to the Brake Section for brake assembly, bleeding and adjustment procedures.

Wheel Bolt-Replacement

1. Raise vehicle on hoist allowing axle to hang freely.
2. Remove wheel and tire and brake drum.
3. Using Tool J-5504 or J-6627 press out stud as shown in figure 4B1-10.
4. Place new stud in axle flange hole. Slightly start stud serrations in hole by firmly pressing back of stud with your hand.
5. Install a lug nut with flat side first (tapered face outboard). Tighten on lug nut drawing stud into flange until stud head is bottomed on back side of flange.
6. Remove lug nut.
7. Reinstall brake drum and wheel and tire.
8. Lower vehicle and remove from hoist.

PINION FLANGE, DUST DEFLECTOR AND/OR OIL SEAL

Removal

1. Raise vehicle on hoist.
2. Disconnect propeller shaft from axle.
3. Position propeller shaft to one side and tie it to frame side rail.
4. Measure the torque required to rotate the pinion, as shown in figure 4B1-11. Record the torque for later reference.
5. Scribe a line down pinion stem, pinion nut, and flange to aid on reinstallation. Make sure lines show the relationship of components accurately. Count the number of exposed threads on pinion stem, and record for later reference. Refer to figure 4B1-12.

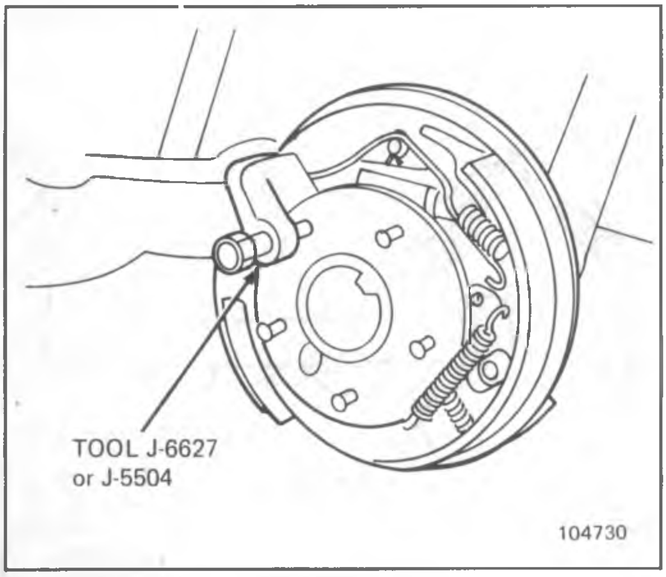


Fig. 4B1-10--Pressing Out Wheel Stud

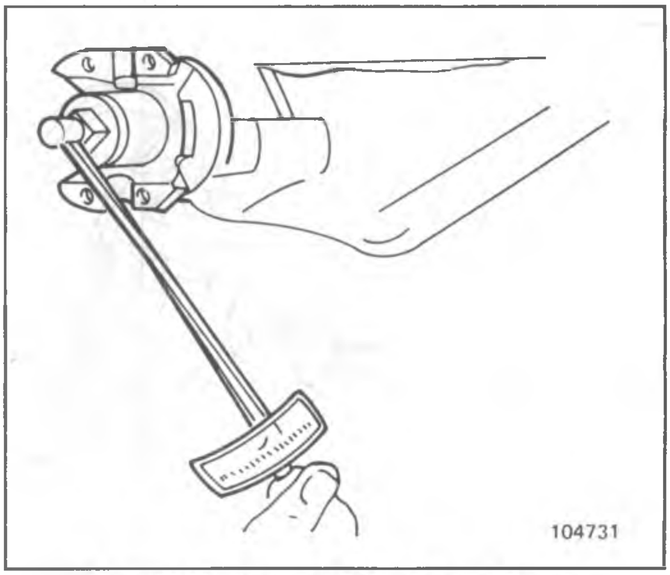


Fig. 4B1-11--Measuring Pinion Rotating Torque

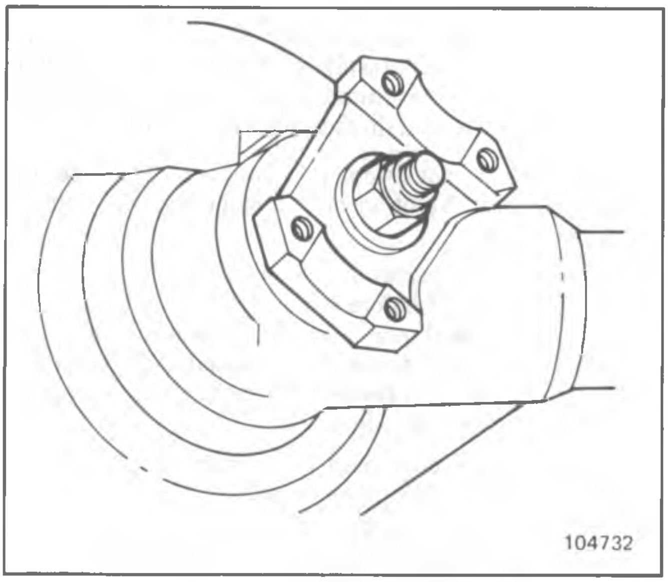


Fig. 4B1-12--Scribe Marks

6. Install Tool J-8614-11 on pinion flange and remove pinion flange self-locking washer faced nut as shown in figure 4B1-13. (Position J-8614-11 on flange so that the four notches are toward flange.) Save scribed nut for reinstallation.
7. Thread pilot end of Tool J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in Step 6, insert J-8614-2 into J-8614-11 and turn it 45 degrees to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 4B1-14.
8. Pry old seal out of bore, using a screw driver or a hammer and chisel.

Inspection

1. Inspect pinion flange for smooth oil seal surface, worn drive splines, damaged ears, and for smoothness of bearing contact surface. Replace if necessary.
2. If deflector requires replacement, remove by tapping from flange, clean up stake points; install new deflector, and stake deflector at three new equally spaced positions.

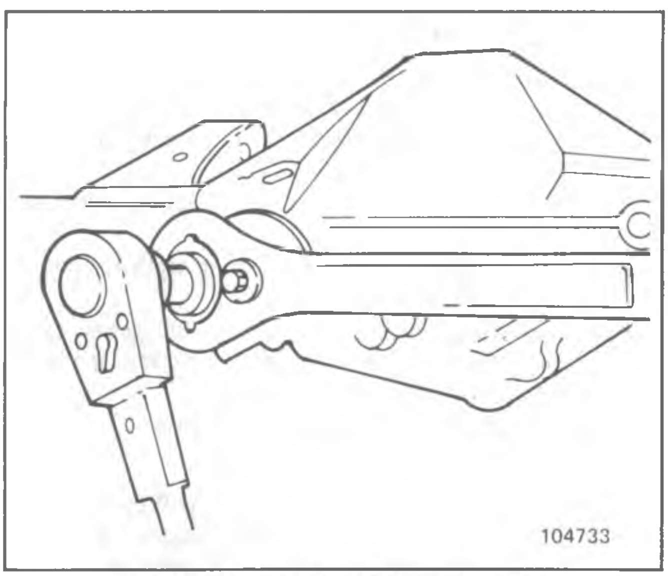


Fig. 4B1-13--Removing Nut from Drive Pinion

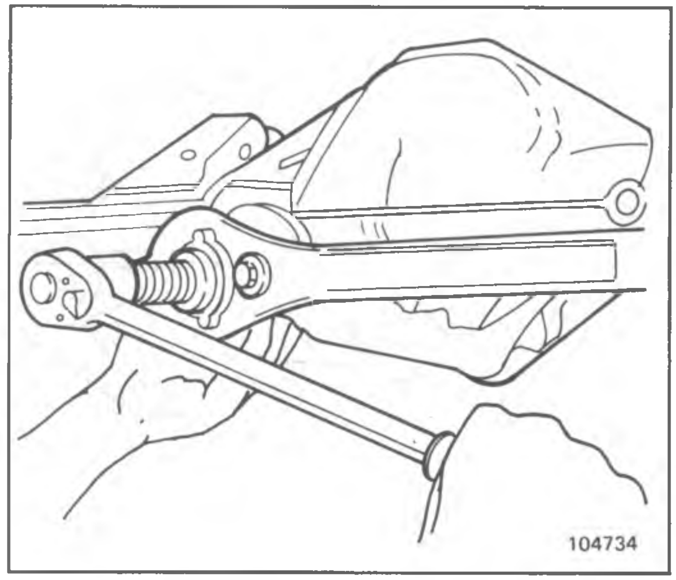


Fig. 4B1-14--Drive Pinion Flange Removal

Staking operation must be performed in such a manner that the seal operating surface is not damaged.

Installation

1. Lubricate cavity between the seal lips of the pinion flange oil seal with a lithium-base extreme pressure lubricant.
2. Position seal in bore and place gauge plate J-22804-1 over seal and against seal flange. The gauge plate assures proper seating of seal in carrier bore.
3. Use J-21057 or J-22388 for the 9 1/2 inch ring gear, as shown in figure 4B1-15, to press seal into carrier bore until gauge plate is flush with the carrier shoulder and seal flange. Turn gauge plate 180° from installed position; seal must be square in carrier bore to seal properly against pinion flange.
4. Pack the cavity between end of pinion splines and pinion flange with a non-hardening sealer (such as Permatex Type A or equivalent) prior to installing

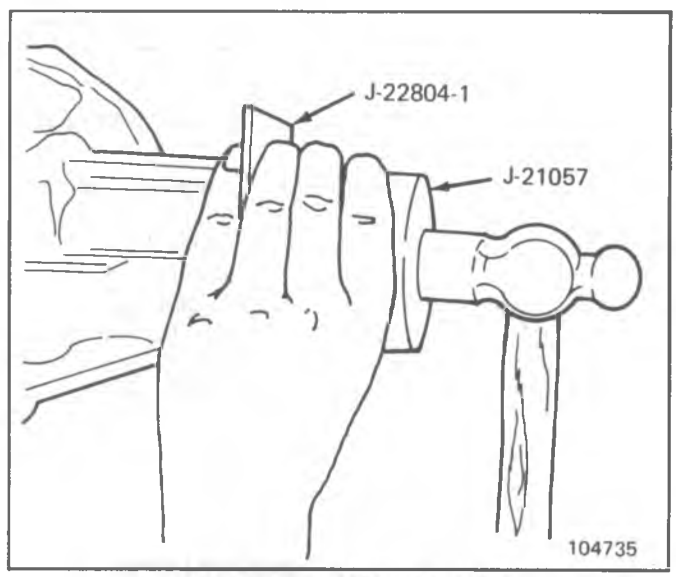


Fig. 4B1-15--Pinion Oil Seal Installation

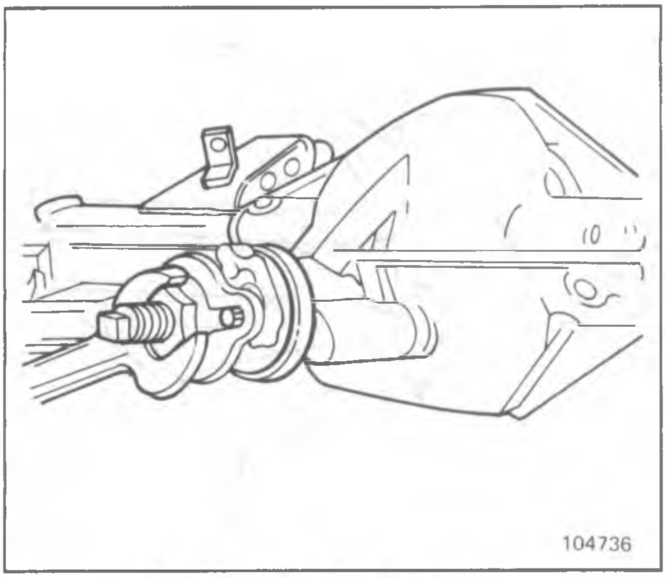


Fig. 4B1-16--Installing Pinion Flange

washer and nut on pinion.

5. Using J-8614-11 as shown in figure 4B1-16, install flange onto pinion. Install washer and nut, and tighten nut to original position. Refer to scribe marks and number of exposed threads, recorded earlier.

   NOTICE: Do not attempt to hammer the flange onto pinion shaft. To do so may damage the ring gear and pinion.

6. Measure rotating torque of pinion and compare with torque recorded before removal. Tighten pinion nut in additional **small** increments until the torque necessary to rotate the pinion exceeds the original figure by .1-.6 N·m 10-15 in. lbs.).**Do not** exceed the original torque by more than .6 N·m (5 in. lbs.).

7. Reattach propeller shaft and torque to specifications. Reinstall brake drums and wheels.

   NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 7.

8. Lower vehicle and remove from hoist.

UNIT REPAIR

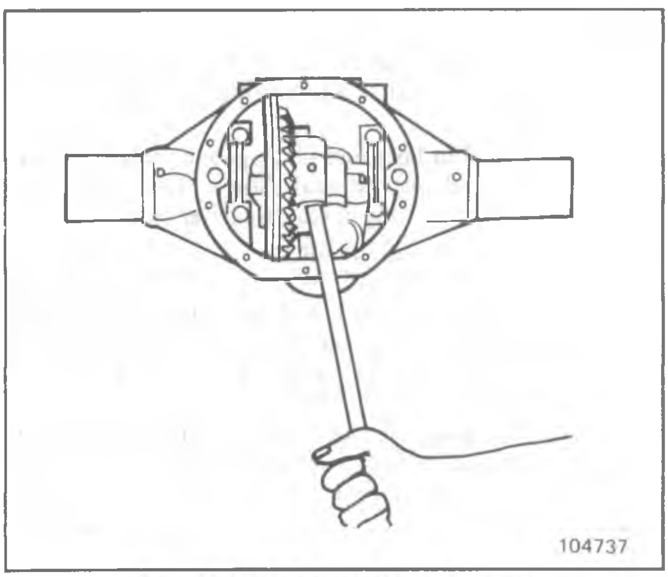


Fig. 4B1-17--Differential Case Removal

If equipped with a locking differential, also refer to Section 4B6.

Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Operational Checks and Adjustments" (Refer to Section 4B). This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft, and remove pinion shaft.
2. Remove rear axle shafts.
3. Roll out the differential pinions and thrust washers, then remove side gears and thrust washers. Mark pinions and side gears so that they can be reassembled in original position.
4. Mark the bearing caps and housing for reassembly in same position. Loosen bearing cap bolts. Tap surface of bearing caps to loosen.

   NOTICE: Do not attempt to pry caps off as this may damage machined face of caps.

5. Using a pry bar as shown in figure 4B1-17, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing caps may be loosely installed, as shown in figure 4B1-17, to prevent case from falling.
6. Place left and right bearing cups with bearing caps so that they may be reinstalled in original positions. Place shims with appropriate cups.

Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect axle shaft and side gear splines for evidence of excessive wear.
3. Inspect hypoid ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case, pinions side gears, thrust washers and pinion shaft for cracks, scoring, spalling or excessive wear.
5. Check fit of differential side gears in case.

Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-8107-4, J-8107-3 for the 9 1/2" ring gear, assuring puller legs are fitted securely in notches in case and against bearing cone, as shown in figure 4B1-18.

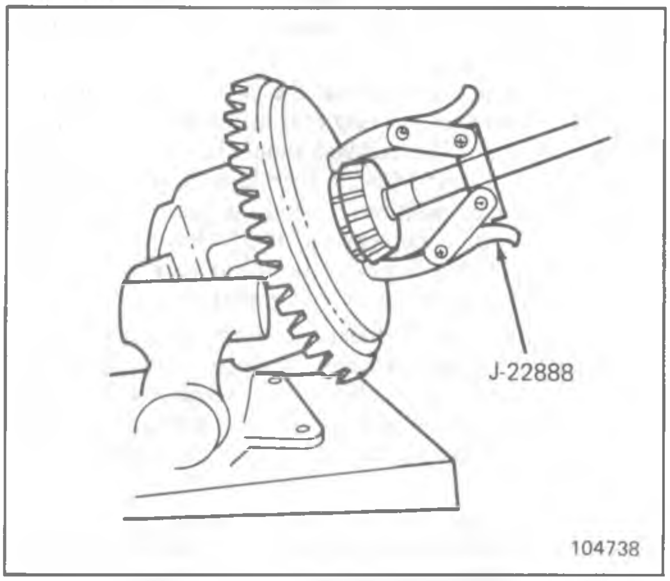


Fig. 4B1-18--Differential Bearing Removal

2. Tighten puller screw to remove bearing.
3. Place new bearing on hub with thick side of inner race toward case and drive into place, using J-22761 for 8-1/2" or J-29710 for the 9 1/2" ring gear and Driver Handle J-8092, as shown in figure 4B1-19.
4. Before bearing installation on opposite hub, support differential case on Adapter Plug J-8107-4 or J-8107-3. This allows differential case to rest on adapter instead of bearing cage. See figure 4B1-19. Install remaining bearing as instructed in step 3.

Ring Gear or Differential Case Replacement

1. Remove the ring gear bolts and, using a soft drift and a hammer, tap ring gear off the case.

   NOTICE: Do not attempt to pry ring gear from case. To do so may damage machined surfaces.
2. Remove any nicks or imbedded dirt from case flange surface which mates with ring gear. Clean all surfaces.
3. Liberally coat the differential case pilot with hypoid lubricant. Pre-align ring gear and differential case bolt holes, and press on adaptor plug J-8107-4 to initially start ring gear on case pilot, as shown in figure 4B1-20.
4. Start all ring gear bolts during initial assembly to maintain bolt hole adlignment. Draw up all bolts evenly, using a criss-cross pattern to avoid cocking the gear on the case.
5. Insure that the gear is seated firmly against the case, then torque the bolts to 145 N·m (105 ft. lbs.) for the 9 1/2" ring gear; 80 N·m (60 ft. lbs.) for the 8 1/2" ring gear.

Reassembly

1. Install thrust washers and side gears into case. If original parts are being reused, replace in original positions.
2. Position pinions and thrust washers through loading hole in case 180° apart so they engage side gears.
3. Rotate gears until the differential pinion bores and the case shaft holes are aligned.
4. Install pinion shaft and lock screw. It is not necessary to torque lock screw until axle shafts are installed.
5. Differential may be installed in carrier now, or after service is performed on the drive pinion.

Installation and Adjustment (8 1/2" Ring Gear)

1. Check condition of bearing, bearing cups, cup seat in carrier and carrier caps to make sure that they are free from nicks, burrs and foreign material.
2. Lubricate bearings with axle lubricant; position cups on proper bearing, then install differential assembly in carrier and support the assembly to prevent it from falling.
3. Install strap J-22779-6 on left bearing by tightening bearing bolts alternately and evenly to snug fit.
4. With the ring gear tight against the pinion gear (.000" to .001" backlash), insert gaging Tool J-22779 between the left bearing cup and carrier housing as shown in figure 4B1-21.

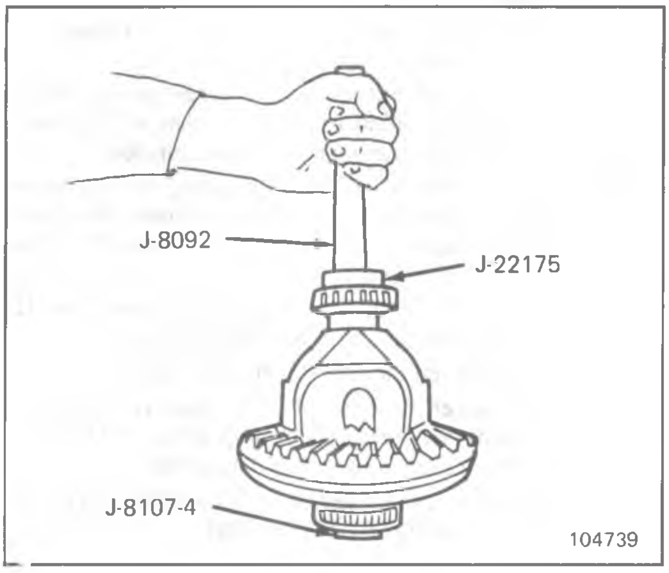


Fig. 4B1-19--Differential Bearing Installation

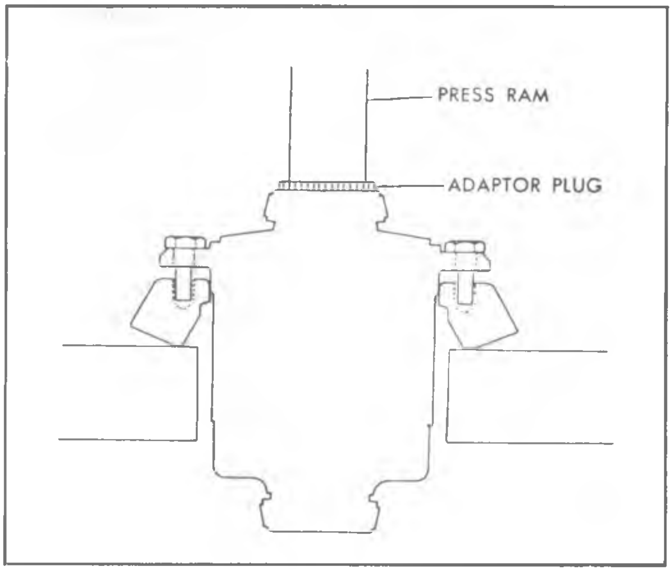


Fig. 4B1-20--Ring Gear-to-Case Installation

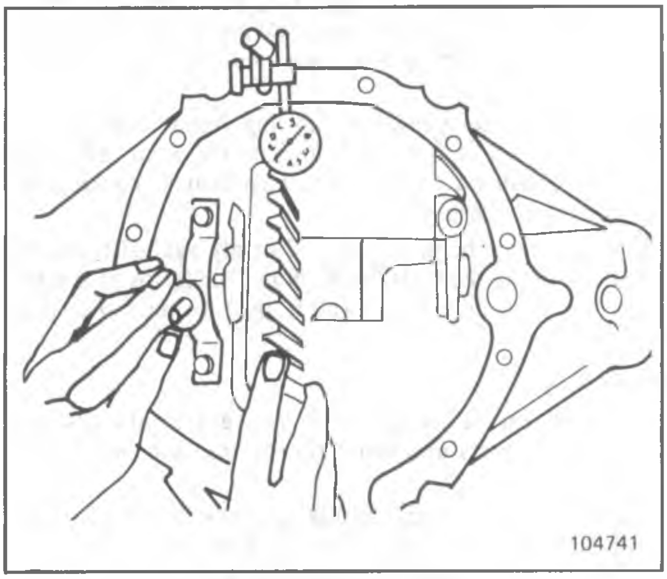


Fig. 4B1-21--Installing Gaging Tool

5. While oscillating tool, turn adjusting nut clockwise until a noticeable drag is produced.
6. Tighten lock bolt on side of tool.
7. Between the right bearing and carrier, install Service Spacer A (.170"), Service Shim B and Feeler Gage C. Thickness of Feeler Gage must be sufficient to produce a slight "drag" when moved between carrier and Service Shim.
8. Now measure the above dimensions as shown in figure 4B1-22.
   a. Using a micrometer as in figure 4B1-23, measure the thickness of J-22779 in a minimum of three places and average these readings. Record the result.
   b. Add together the dimensions of the Service Shim, Service Spacer and Feeler Gage. Record the result.
9. Use the sample procedure in figure 4B1-22 to determine the proper thickness for each shim pack.

   NOTICE: Production preloading of the differential bearings is accomplished by the use of cast iron preload shim. These shims cannot be used when rebuilding the carrier as they may break when tapped into place.
10. Install left shim first, then wedge right shim between bearing cup and spacer. Position shim so that chamfered side is outward or next to spacer. If shim does not have sufficient chamfer or lead around O.D. to allow easy installation without scraping spacer, file or grind chamfer before installing.
11. If difficulty is encountered in installing shim, partially remove case and slide case and shim into position. Tap shim into position, using a soft faced hammer, while rotating differential case with free hand as shown in figure 4B1-24.
12. Install bearing caps in original position and torque to 80 N·m (60 ft. lbs.).

    At this point, the differential side bearings are properly preloaded. If any adjustments are required in later procedures, make sure the preload remains as established in step 9. If backlash is changed in later steps, be sure the **total** thickness of the two shim packs does not change.
13. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in figure 4B1-25. The backlash should be within the range of 0.005"-0.008". Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed .001". Position the dial indicator so that indicator button is perpendicular to tooth angle and in line with gear rotation.
14. If variation in backlash readings exceeds .002"; measure ring gear and case runout as shown in figure 4B1-26. Gear runout should not exceed .003"; should runout exceed this limit, check ring gear and case for deformation and/or foreign matter between case and gear.
15. If gear lash is not within limits, correct by decreasing shim thickness on one side and increasing thickness of other shim **the same amount.** Total shim thickness must be maintained at all times to maintain proper preload.
16. Backlash changes approximately .002" for each .003" change in shim dimensions.

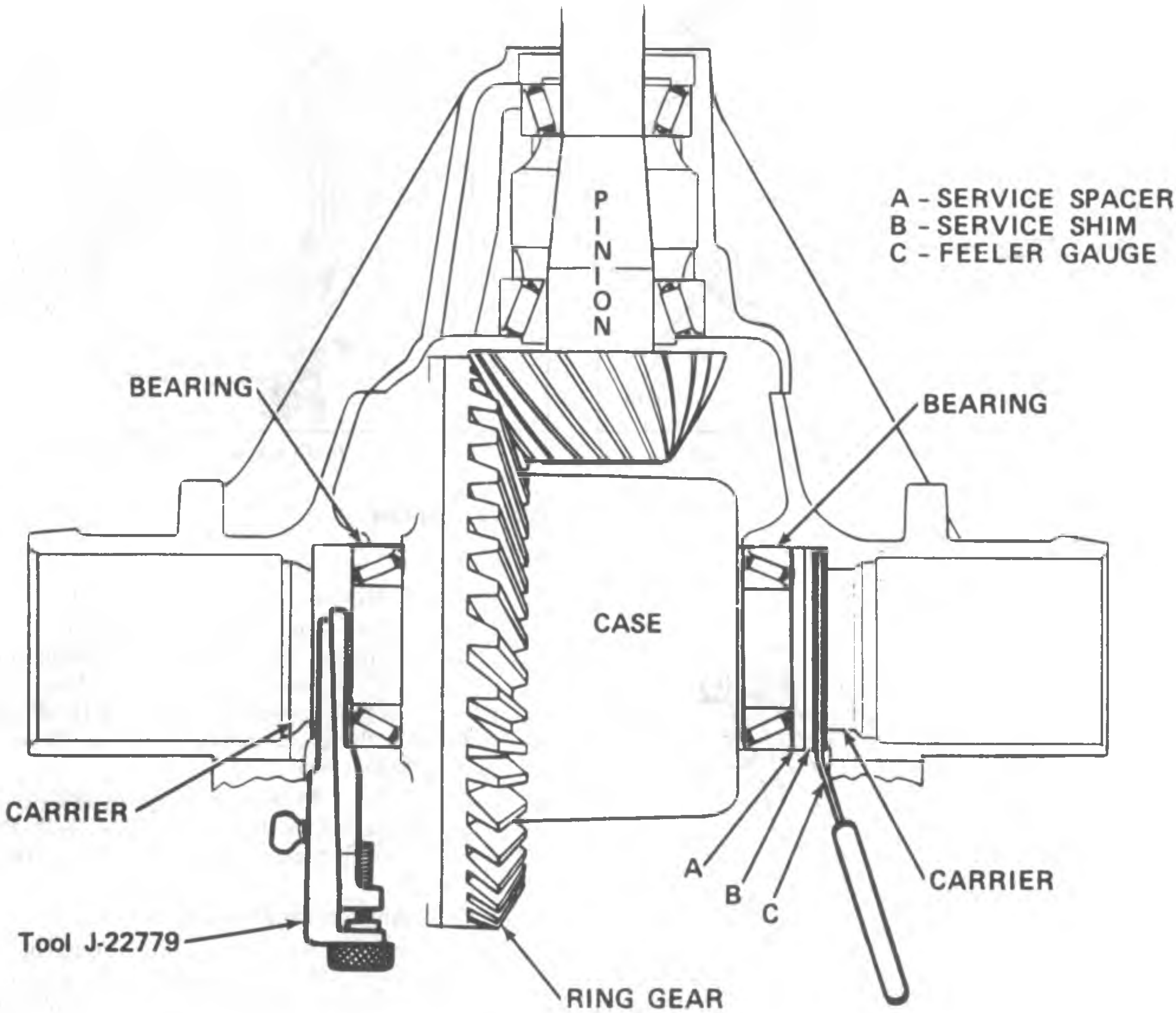
    •If backlash exceeds .008", increase the shim thickness on the ring gear side, while decreasing the shim thickness on the opposite side **an equal amount.**
    •If backlash is less than .005", decrease the shim thickness on the ring gear side, while increasing the shim thickness on the opposite side an equal amount.

Differential Backlash Adjustment (9 1/2" Ring Gear)

1. Place bearing cups over side bearings and lift the differential assembly into the carrier.
2. Install bearing shim.
3. Push case towards bearing shim side of carrier.
4. Tighten adjusting nut using tool J-24429 and rotate pinion to seat bearings as shown in Fig. 4B1-27.
5. Back adjusting nut off and install bearing cups loosely.
6. Turn adjusting nut until initial contact and index 3 additional slots.
7. Install bearing caps to 80 N·m (70 ft. lbs.).
8. Install locking retainers into holes and attach fingers to bearing cap loosely.
9. At this time, the differential bearings are properly preloaded. If any additional adjustment is required, make sure that the preload remains established.
10. Mount a dial indicator on the housing and measure backlash between the ring gear and pinion. Backlash should be .075 mm - .25 mm (.003 - .010) with .125 mm - .20 mm (.005 - .008) preferred.
11. If reading is too high, increase bearing shim size. If reading is' too low, decrease bearing shim size.
12. Torque locking retainer to 30 N·m (20 ft. lbs.).

    A service spacer 5.34 mm (.171) thick is available. Service shims are available from 1.278 - 2.256 mm (0.50 - .088) in increments of .050 mm (.002).

    Pinion shims are available from .5080 - .9398 mm (.020 - .037) in increments of .025 mm (.001).



EXAMPLE

RING GEAR SIDE		OPPOSITE SIDE	
.250"	Thickness of Tool J-22779 required to force ring gear into contact with pinion	Combined total of: Service Spacer (A) Service Shim (B) Feeler Gauge (C)	.265"
- .010" / .240"	TO MAINTAIN PROPER BACKLASH (.005" - .008"), ring gear is moved away from pinion by subtracting .010" shims from ring gear side and adding .010" shims to other side		+ .010" / .275"
+ .004"	TO OBTAIN PROPER PRELOAD on side bearings, add .004" shims to each side.		+ .004"
.244"	Shim dimension required for ring gear side	Shim dimension required for opposite side	.279"

Fig. 4B1-22--Determining Side Bearing Shim Requirements

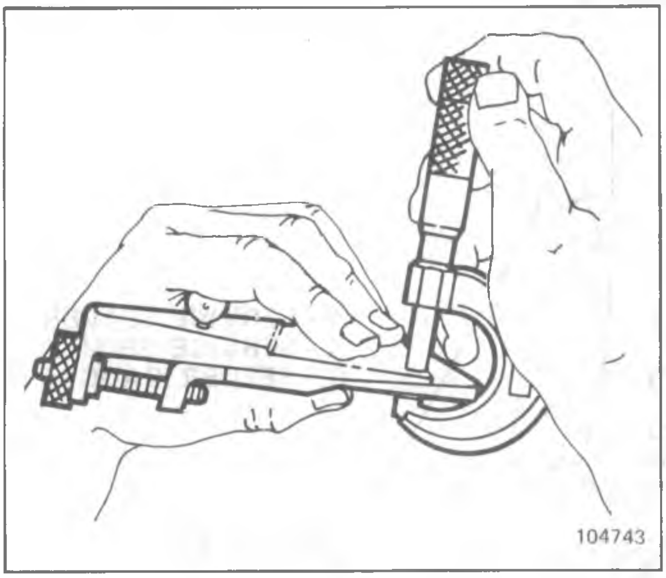


Fig. 4B1-23--Measuring Gage Plate Thickness

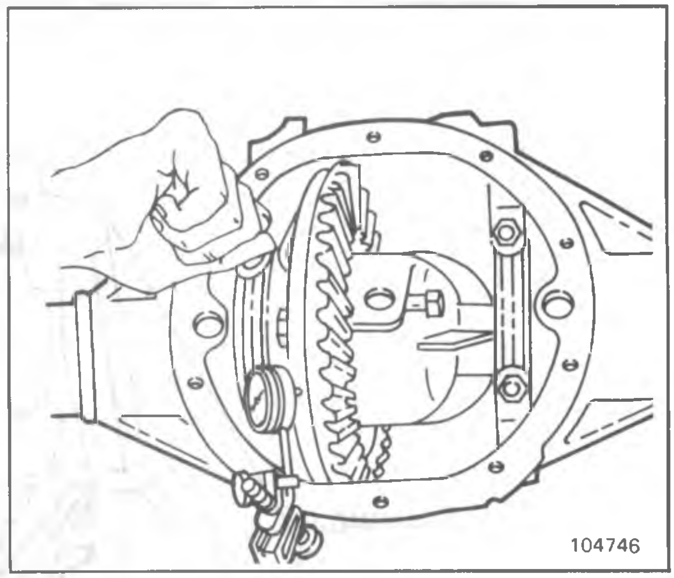


Fig. 4B1-26--Checking Ring Gear Runout

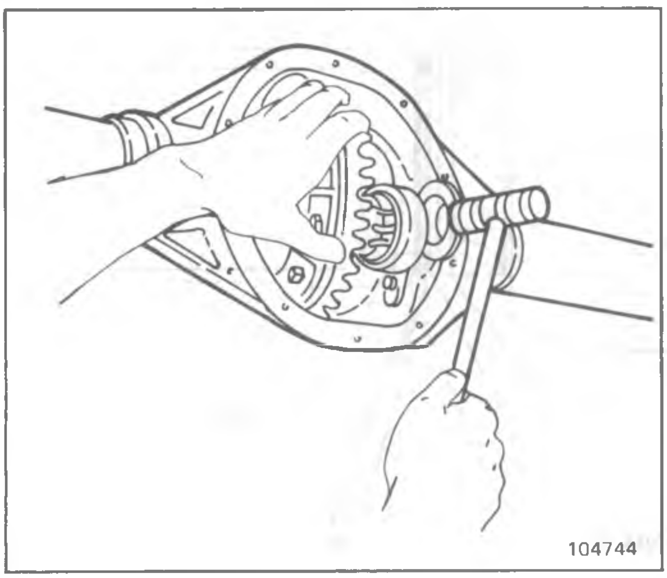


Fig. 4B1-24--Installing Differential Shim

DRIVE PINION

Removal

1. Remove differential as previously outlined.
2. Check torque required to rotate drive pinion, as described under "Drive Pinion - Installation and Adjustment". If there is no preload reading, check for looseness of pinion assembly by shaking (push-pull) the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 4B1-28. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 4B1-29.

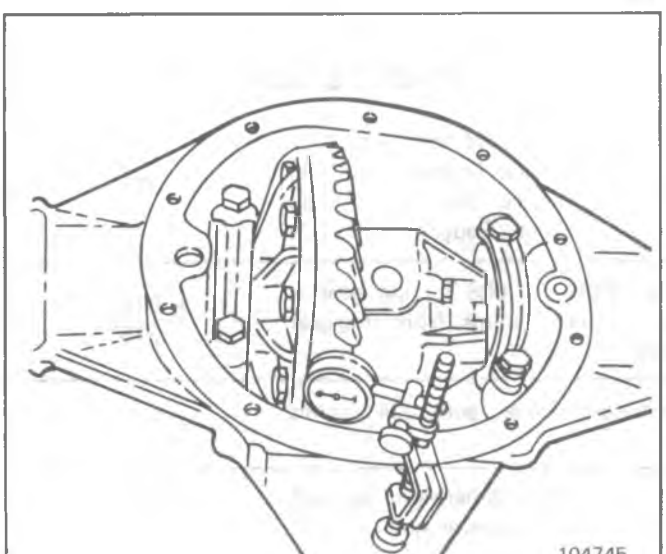


Fig. 4B1-25--Checking Ring Gear Backlash

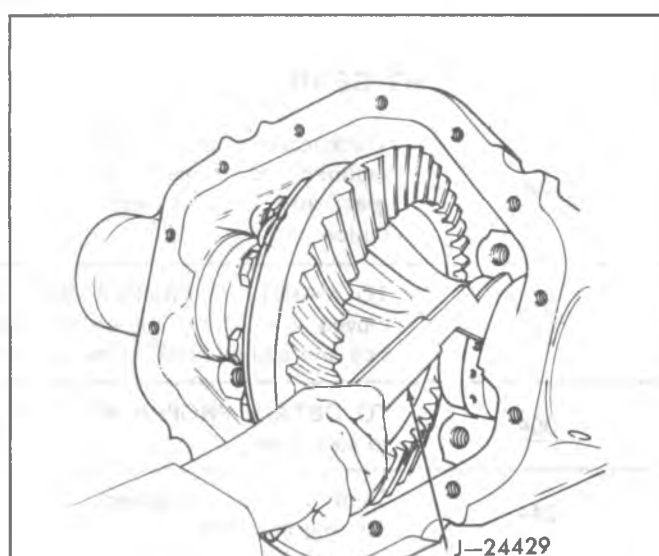


Fig. 4B1-27--Loosening Adjusting Nut

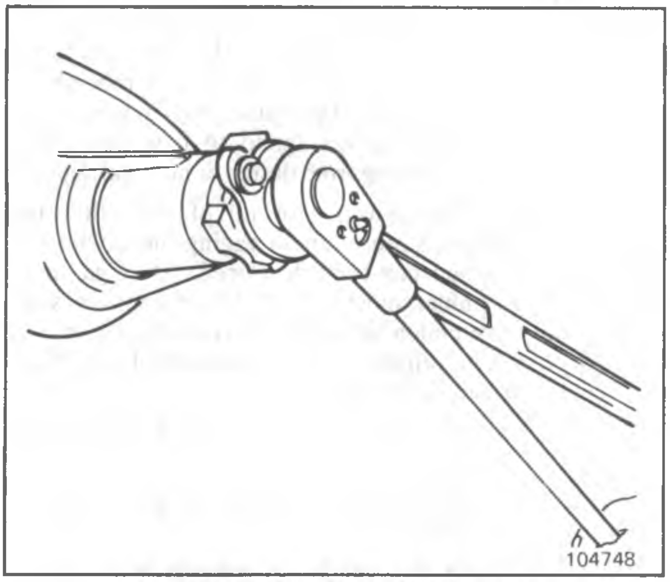


Fig. 4B1-28--Drive Pinion Nut Removal

6. To remove the drive pinion, first thread the original pinion nut half way on the pinion, for thread protection.
7. Place the differential cover temporarily back onto the housing, using two screws. This will prevent the pinion from falling to the floor during removal.
8. Tap the end of the pinion nut with a large hammer and a soft drift, as shown in figure 4B1-30.

   Care must be taken not to damage pinion bearings while removing pinion from carrier. Inspect bearings and cups for damage and replace if needed.
9. Remove the pinion oil seal and the front pinion bearing. Remove the cover and retrieve the drive pinion from the housing. Discard the pinion oil seal, nut, and collapsible spacer. Use a new oil seal, nut and spacer on reassembly.

Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer race from carrier using a drift in slots

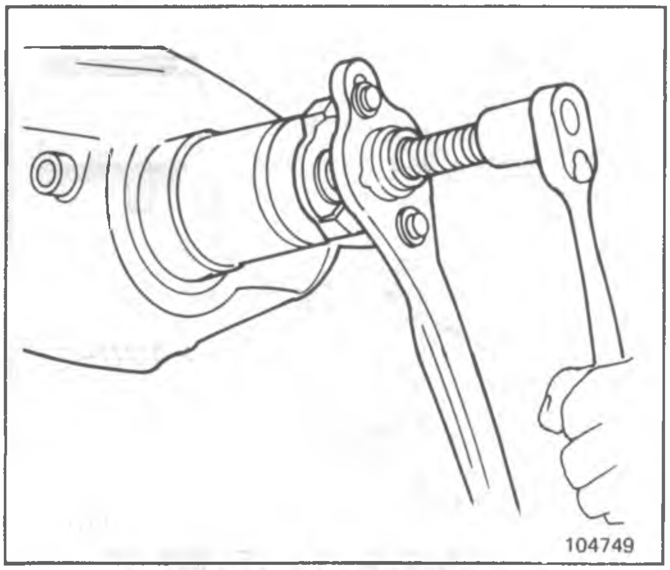


Fig. 4B1-29--Drive Pinion Flange Removal

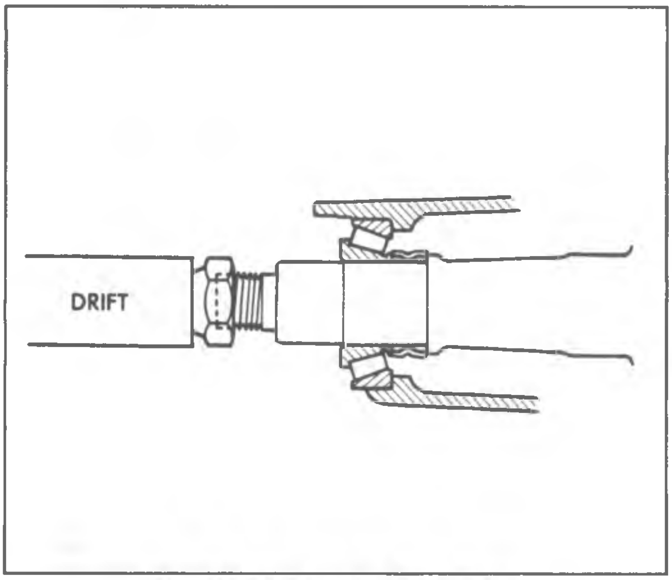


Fig. 4B1-30--Removing Drive Pinion

provided for this purpose. Tap alternately on opposite sides of the bearing cup to avoid cocking.

2. If rear pinion bearing is to be replaced drive outer race from carrier using a drift in slots provided for this purpose.
3. Remove rear pinion bearing from pinion shaft using press plate J-8612 for 8-1/2" ring gear and J-22912-01 for 9 1/2" ring gear as shown in Figure 4B1-31.

   Tighten nuts on tool until plates are under the bearing inner race. Then set the tool on a press. Make sure the plates straddle the opening on the press. Do not position bolts across the opening. To do so may bend the bolts when pressure is applied. Press bearing from pinion. Record the thickness of shim removed from between bearing and pinion head.
4. Inspect carrier pinion bearing bores and shoulders for nicks. Remove as necessary. Clean the bores and the installation tools.
5. Lubricate both bearing cups with liberal amounts of

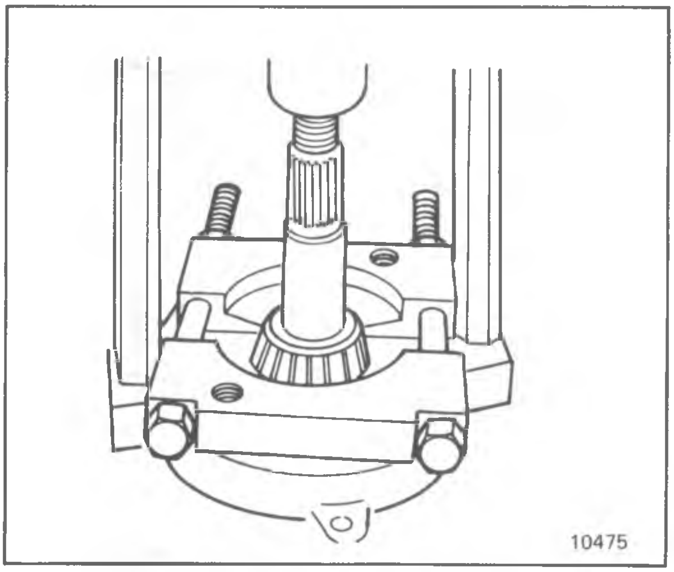


Fig. 4B1-31--Removing Drive Pinion Rear Bearing

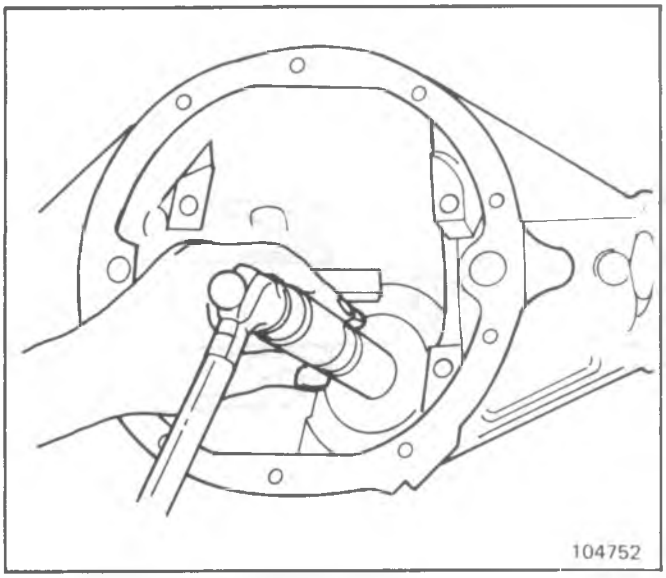


Fig. 4B1-32--Installing Pinion Rear Bearing Cup

hypoid lubricant.

6. Install the rear cup, with the large end against the bore shoulder, using Installer J-8608 for 8-1/2" ring gear and J-22306 for the 9 1/2" ring gear as shown in figure 4B1-32.
7. Install the front cup, with the large end against the bore shoulder, using Installer J-8611-01 for the 8-1/2" ring gear and J-7818 for the 9 1/2" ring gear as shown in figure 4B1-33.
8. Check both bores to make sure cups are fully seated.

Setting Pinion Depth and Installing Pinion Bearings

If the original ring gear and pinion and the pinion rear bearing assembly are to be reinstalled, the original shim thickness may be used.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal ‘ setting due to allowable variation in machining the parts. When a pinion is found haivng a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler must install the appropriate shim between the drive pinion shoulder and rear bearing so that pinion depth can be adjusted to the required position for best tooth contact in each axle assembly.

Proper pinion depth is determined with Pinion Setting Gage J-21777-01.

1. Clean the housing assembly and all gage parts to insure accurate measurements.
2. Lubricate front and rear pinion bearings which will be used in final assembly and position them in their respective races in the carrier.
3. Use cloverleaf gage plate J-21777-29 for 8-1/2" ring gear and J-21777-85 for 9 1/2" ring gear mounted on preload stud J-21777-43 insert stud through rear bearing and pilot J-21777-35, or J-21777-8 for the 9 1/2" ring gear. and through front bearing and pilot J-21777-42. Install the hex nut until snug and rotate the bearings to make sure they are properly seated. See figure 4B1-34 for illustration of proper positioning.
4. Hold the preload stud stationary with a wrench on the flats and tighten hex nut. Tighten until 2.2 N·m (20 in. lbs.) of torque are required to rotate the bearings, as shown in figure 4B1-35.
5. Mount the side beairng discs J-21777-45 or J-21777-86 on the ends of arbor J-21777-1, using the step of the disc that corresponds to the bore of the carrier.
6. Place the arbor and plunger assembly into the carrier, being sure the side bearing discs are seated properly.
7. Install the bearing caps finger tight to hold the

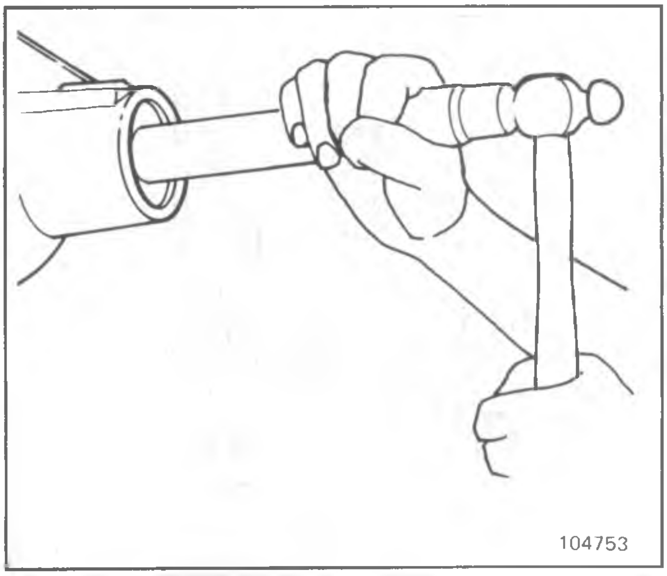


Fig. 4B1-33--Installing Pinion Front Bearing Cup

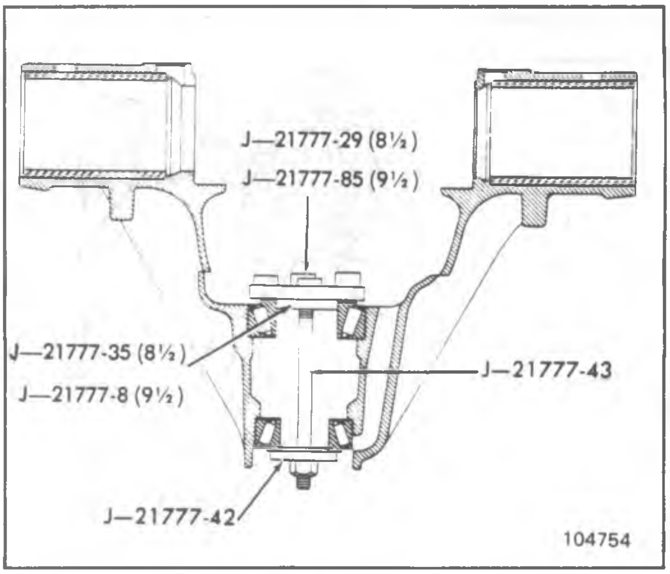


Fig. 4B1-34--Gage Plate Installed

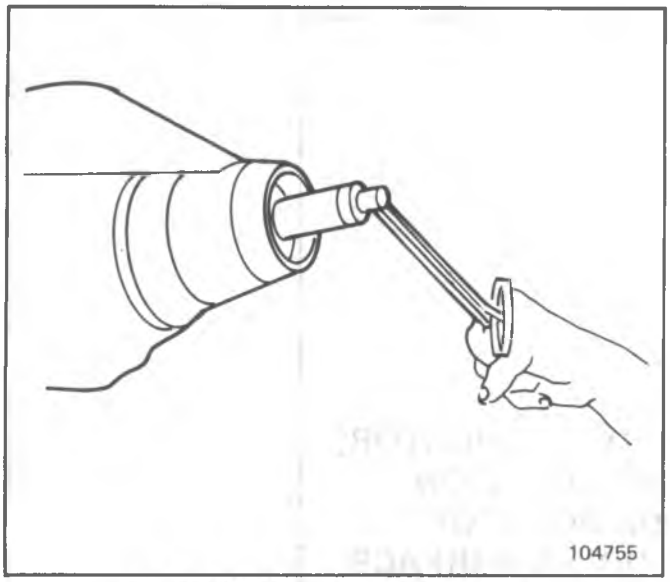


Fig. 4B1-35--Measuring Rotating Torque

discs from movement.

8. Position dial indicator J-8001 on the mounting post of the arbor with the contact button resting on the top surface of the plunger.
9. Preload the dial indicator one-half revolution, and tighten in this position.
10. Select the button on the gage plate or gage block that corresponds to the ring gear size and rotate the plate until the plunger rests directly upon that button.
11. Rock the plunger rod slowly back and forth across the button until the dial indicator reads the greatest deflection. At this point, set the dial indicator to zero. Tools will now be positioned as shown in figure 4B1-36.

    It is important to use a dial indicator correctly when determining pinion depth requirements. Be sure to record the number indicated by the indicator needle; do not record the amount of travel of the needle.

    After "zeroing" the dial indicator on the highest point of deflection on the gauge plate, the indicator probe is swung off the gauge plate, allowing the needle to move. The number which the needle points toward is the correct shim thickness required for a nominal pinion (Fig. 4B1-37).
12. Repeat the rocking action of the plunger several times to verify the setting.
13. Once the zero reading is obtained, swing the plunger until it is removed from the gaging plate button.

    The dial indicator will now read the required pinion shim thickness for a "nominal" pinion. Record this figure.
14. Check the rear face of the drive pinion being installed for a pinion code number. This number indicates the necessary alteration of the pinion shim thickness as determined in step 13.
    a. If the pinion is stamped with a plus (+) number, **add** that many thousandths to the indicator reading. For example, if indicator reading is .019, and pinion is marked (+2), the correct depth shim for installation will be .019 + .002 = .021 inch.
    b. If the pinion has no plus (+) or minus (-), use the indicator reading as the correct shim thickness.
    c. If the pinion is stamped with a minus (-) number, **subtract** that many thousandths from the indicator reading. For example, if the indicator reading is .031, and pinion is marked (-3), the correct depth shim for installation will be .031 - .003 = .028 inch.
15. Remove bearing caps and depth gaging tools from carrier.
16. Position the shim selected in step 14 on the pinion shaft against pinion head.
17. Lubricate the rear pinion bearing with liberal amounts of hypoid lubricant and install rear bearing. Use J-8609-01 for the 8-1/2" ring gear and J-6547 for the 9 1/2" ring gear, as shown in figure 4B1-38.

Installation and Adjustment

1. Lubricate the front bearing with liberal amounts of hypoid lubricant, and place into outer cup.
2. For 8-1/2" ring gear place a new seal into position in carrier bore. Tap lightly with a protective plate and a hammer until seal flange seats against carrier.

    For 9-1/2" ring gear use tool J-22388 pinion seal installer.
3. Coat lips of pinion oil seal and seal surface of pinion flange with hypoid lubricant.
4. Install a new pinion bearing spacer onto drive pinion.
5. Place drive pinion into position, and mount a suitable thick washer or sheet metal plate over the pinion stem. Install the original pinion nut and tighten sufficiently to draw pinion through the front bearing far enough to leave threads exposed when the companion flange is placed into position. Remove the washer and install the companion flange, using J-8614-11.

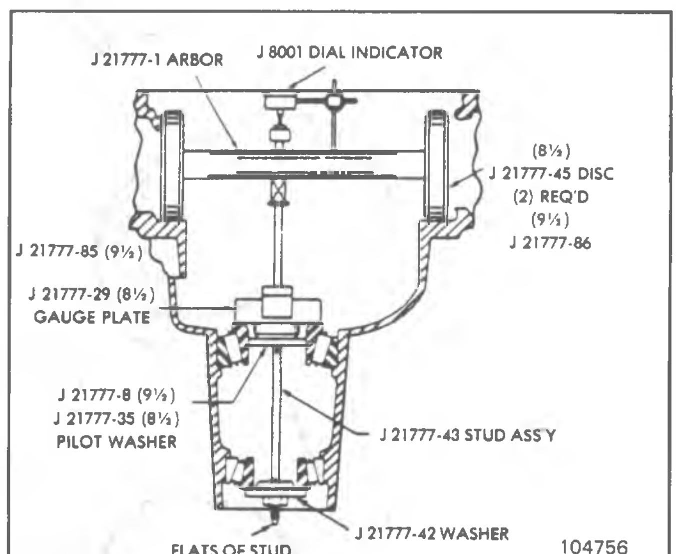


Fig. 4B1-36--Gaging Tools Installed in Carrier

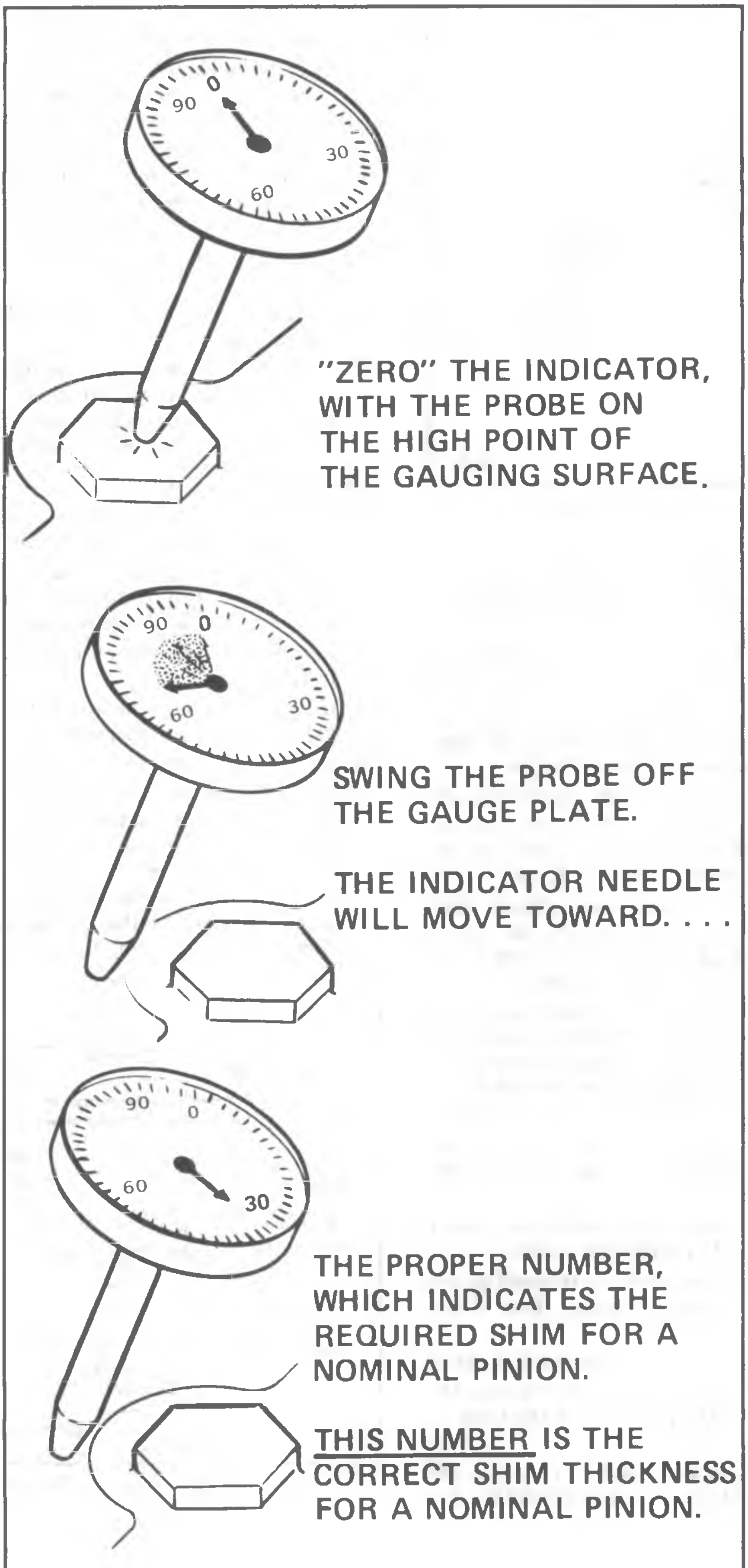


Fig. 4B1-37--Use of Dial Indicator

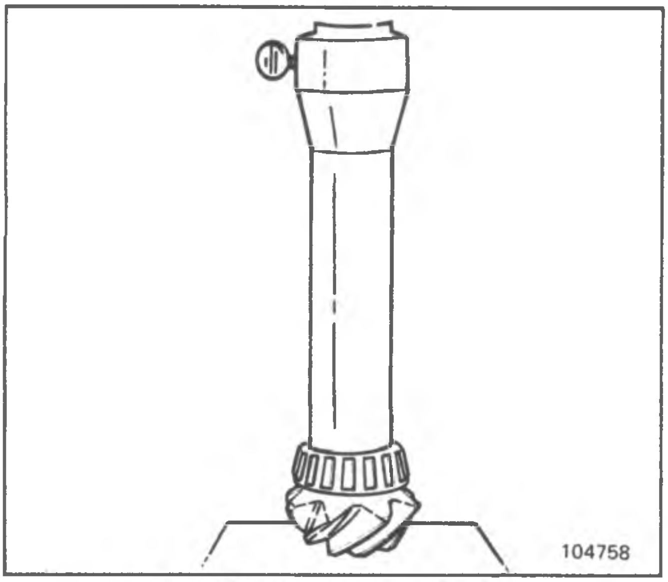


Fig. 4B1-38--Installing Rear Bearing

6. Tighten nut until all end play is removed from drive pinion.

   When no further end play is detectable, and when Holder J-8614-11 will no longer pivot freely as pinion is rotated, preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked.
7. While observing the preceding caution, carefully set preload drag at 20-25 inch pounds on new bearings, or 10-15 inch pounds on reused bearings. Use an inch-pound torque wrench such as J-5853 as shown in figure 4B1-40, to measure the rotating torque.

   After torque has been checked, final tightening should be done very carefully. For example, if when checking, torque was found to be 5 inch-pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

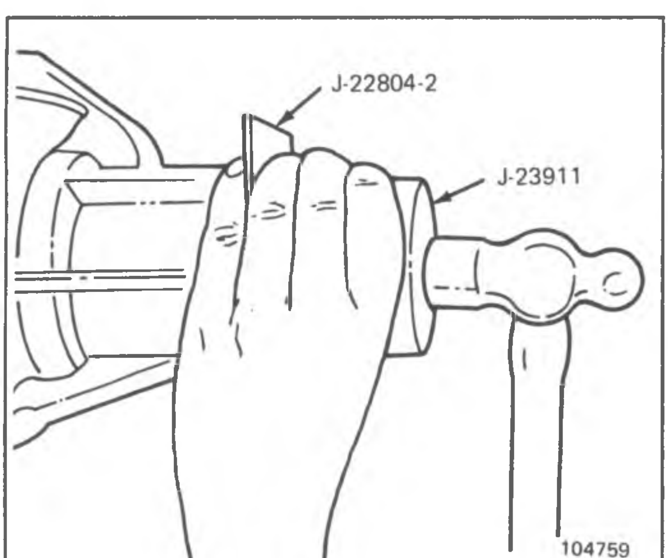


Fig. 4B1-39--Installing Pinion Oil Seal

8. Rotate the pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced, re-set preload to specifications.

OPERATIONAL CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinionn Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Refer to Section 4B for description of how to perform these checks and adjustments.

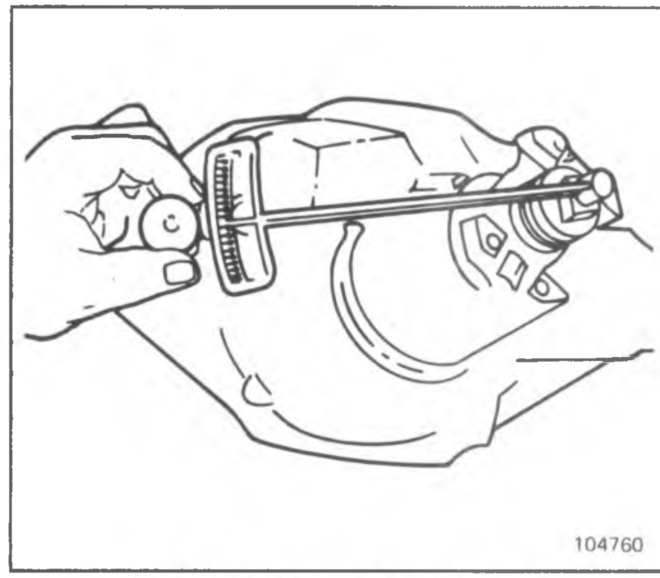


Fig. 4B1-40--Measuring Rotating Torque

SECTION 4B2

CHEVROLET 10-1/2" RING GEAR AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on Page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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ON-VEHICLE SERVICE

Service operations on these axle assemblies may be performed with the housing installed in the vehicle or with the housing installed in a holding fixture. There may be occasions, however, when it will be necessary to remove the complete housing assembly. The following axle assembly removal and installation procedure, therefore, is necessary only when housing replacement is required.

NOTICE: All axle attachments are important attaching parts. See NOTICE on page 1 of this section.

Removal

1. Raise vehicle, place stand jacks under frame side rails, and remove rear wheels.
2. Remove two trunnion bearing "U" bolts from the rear yoke, split rear universal joint, position propeller shaft to one side, and tie it to the frame side rail.

   The bearings can be left on the trunnion and held in place with tape.
3. Remove hub and drum assembly and disconnect parking brake cable at lever and at flange plate. See Section 5 for cable removal.
4. Disconnect hydraulic brake hose at connector on rear axle housing. Refer to Section 5.
5. Disconnect shock absorbers at axle brackets.
6. Support axle assembly with hydraulic jack, remove spring "U" bolts, and lower axle assembly to the floor.

Installation

1. Place axle assembly under vehicle, raise into position, install spring "U" bolts, anchor plates and nuts, and tighten securely.
2. Connect and secure shock absorbers to axle brackets.
3. Connect brake hose at connector on rear axle housing.
4. Connect parking brake cable at lever and flange plate. Install hub and drum assembly. Bleed brake hydraulic system and adjust parking brake.

   Before reinstalling wheel hub and drum assembly replace hub oil seal.
5. Reassemble the rear universal joint, making sure that "U" bolts are drawn up tight and locked properly. Caution should be taken not to overtighten "U" bolt nuts and cause bearing cups to become distorted.
6. Install rear wheels, remove stand jacks, and lower vehicle.
7. Test operation of brakes and rear axle.

AXLE SHAFT

Replacement

1. Remove bolts that attach the axle shaft flange to the wheel hub. See figure 4B2-1.
2. Rap on flange with a soft-faced hammer to loosen shaft. Grip the rib on end of flange with a pair of locking pliers and twist to start shaft removal.

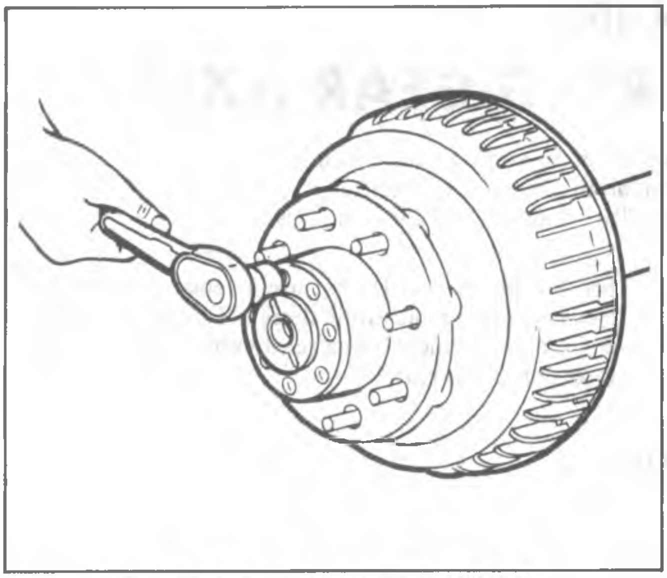
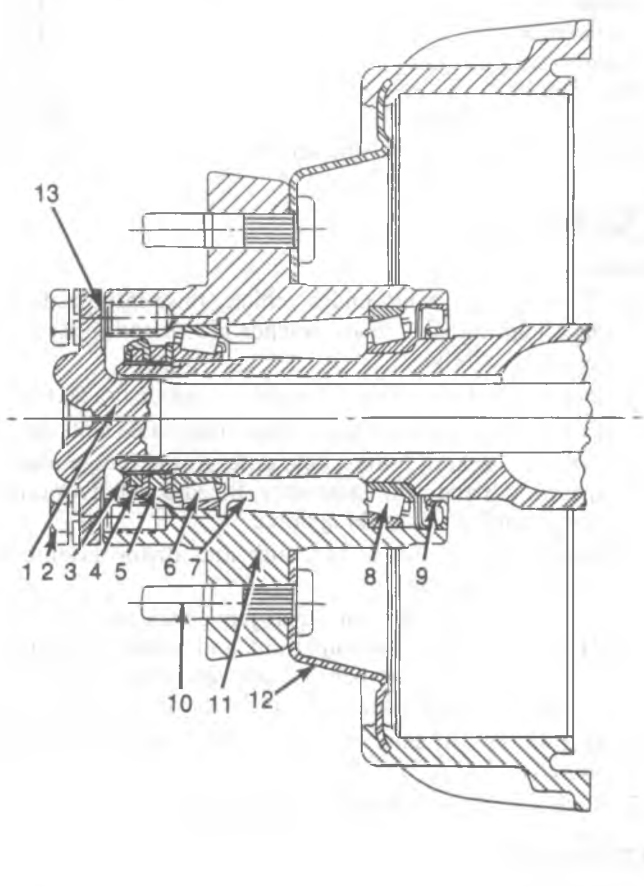


Fig. 4B2-1--Removing Flange-to-Hub Bolts



1. Axle Shaft
2. Shaft-to-Hub Bolt
3. Retainer
4. Key
5. Adjusting Nut
6. Hub Outer Bearing
7. Snap Ring
8. Hub Inner Bearing
9. Oil Seal
10. Wheel Bolt
11. Hub Assembly
12. Drum Assembly
13. R.T.V.

Fig. 4B2-2--Hub and Drum Assembly-10-1/2" Axle

Remove shaft from axle tube.

3. Thoroughly clean both the axle shaft flange and the end of the wheel hub. Any lubricant on these surfaces tends to loosen axle shaft flange bolts.
4. Place a new gasket over the axle shaft and position the axle shaft in the housing so that the shaft splines enter the differential side gear. Position gasket so that holes are in alignment and install flange-to-hub attaching bolts. Torque bolts to specifications.

HUB AND DRUM ASSEMBLY-FIG. 4B2-2

Removal

1. Remove axle shaft as outlined earlier.
2. Disengage tang of retainer from slot or flat of locknut, then remove locknut from housing tube, using J-2222, as shown in figure 4B2-3.
3. Disengage tang of retainer from slot or flat of adjusting nut and remove retainer from housing tube.
4. Use appropriate tool as specified in Step 2 to remove adjusting nut from housing tube. Remove thrust washer from housing tube.
5. Pull hub and drum assembly straight off axle housing.
6. Remove oil seal, and discard.

Bearing/Cup-Removal

1. Use a hammer and long drift to knock the **inner** bearing, cup and oil seal from the hub assembly.
2. Remove **outer** bearing snap ring with a pair of pliers.
3. With J-24426 on Handle J-8092, as shown in figure 4B2-4, drive **outer** bearing and cup from the hub assembly.

Inspection and Cleaning of Bearings

1. Inspect bearing rollers for excessive wear, chipped edges, and other damage. Slowly move rollers around cone to detect any flat or rough spots on rollers or cone.
2. Examine bearing cups in hub for pits, cracks and other damage.

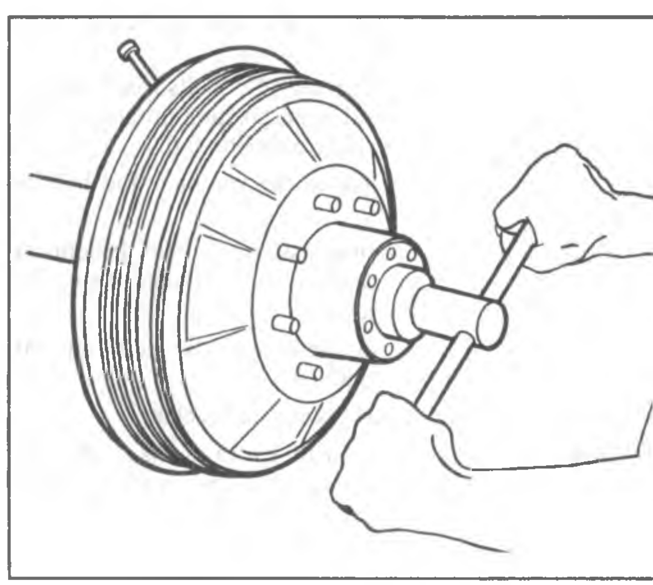


Fig. 4B2-3--Removing Lock Nut-Typical

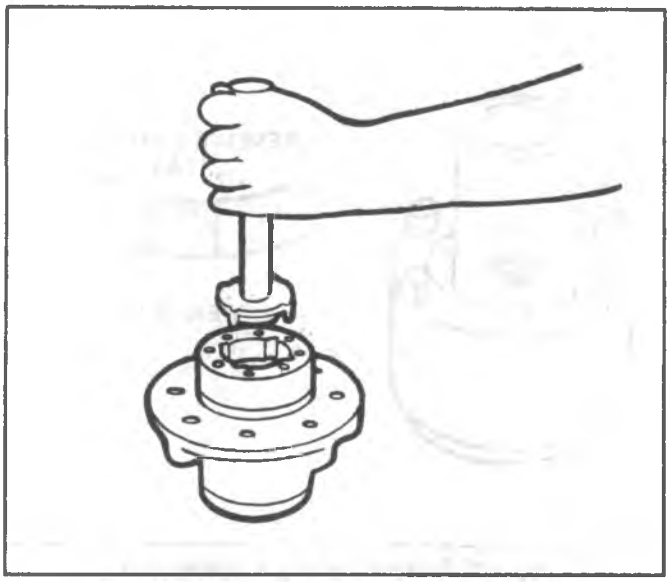


Fig. 4B2-4--Removing Outer Bearing and Cup

3. Examine axle shaft flange studs, wheel studs, hub splines, hub bore, and tapped holes for evidence of damage. Clean up threads or replace parts where required.
4. Examine oil seal sleeve for evidence of wear or roughness, check axle housing oil deflector and brake drum oil deflector for evidence of damage. Replace parts where required.
5. Examine brake drum for excessive scoring and other damage. To replace brake drum refer to "Brake Drum Replacement."
6. Immerse bearing cone and roller assemblies in cleaning solvent. Clean with stiff brush to remove old lubricant. Blow bearings dry with compressed air, directing air stream across bearing. Do not spin bearings while blowing them dry.
7. Thoroughly remove all lubricant from axle housing tube and from inside the hub, wipe dry. Make sure all particles of gasket are removed from outer end of hub, axle shaft, and hub cap.
8. Scrape old sealing compound out of oil seal bore in the hub.

Bearing/Cup-Installation

1. Place **outer** bearing into hub.
2. Install cup of outer bearing into hub by using Handle J-8092 and J-8608, **installed upside-down**. Be sure J-8608 is upside down on driver handle, so that chamfer does **not** contact bearing cup.
3. Drive cup **beyond** the snap ring groove.
4. Using a pair of pliers, install snap ring into its groove.
5. Drive cup back **against** snap ring by using J-24426, as shown in figure 4B2-4.
6. To install **inner** bearing cup, use J-24427 on Handle J-8092. Drive cup into place until it seats against shoulder of hub bore.
7. Install new oil seal with J-24428.

Drum-Non-Demountable-Type-Fig. 4B2-2

Replacement

Construction of the nondemountable-type hub and drum assembly is such that replacement cannot be accomplished with the hub assembly installed on the vehicle.

1. Separate the drum and hub by removing the drum-to-hub retaining bolts, hub stud nuts, or by pressing out the wheel studs, as applicable.
2. Position brake drum to hub assembly, making certain that all drain holes are in alignment.
3. Apply a light, even coating of sealing compound to the hub oil deflector contact surface, and position deflector to drum.
4. Install drum-to-hub retaining bolts, hub stud nuts, or press wheel studs into drum, as applicable.

Wheel Bolt

Replacement

Wheel bolts are serrated and may also be swaged in place; however, replacement procedure remains the same for both types of installation.

Press bolts out of hub flange and press new bolts into place, making sure they are a tight fit. If all bolts are removed, be sure that hub oil deflector is in position under bolt heads. See figure 4B2-5.

Installation of Hub and Drum Assembly

1. Using a high melting point EP bearing lubricant, liberally pack bearings and apply a light coat on I.D. of hub bearing contact surface and O.D. of axle housing tube.
2. Make sure inner bearing, oil seal, axle housing oil deflector, and inner bearing race and oil seal are properly positioned.
3. Install hub and drum assembly on axle housing, exercising care so as not to damage oil seal or dislocate other internal components.
4. Install thrust washer so that tang on I.D. of washer is in keyway on axle housing.

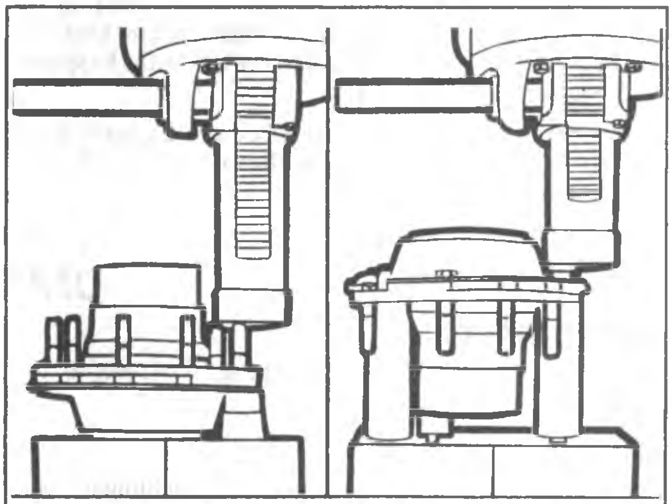


Fig. 4B2-5--Wheel Bolt Replacement

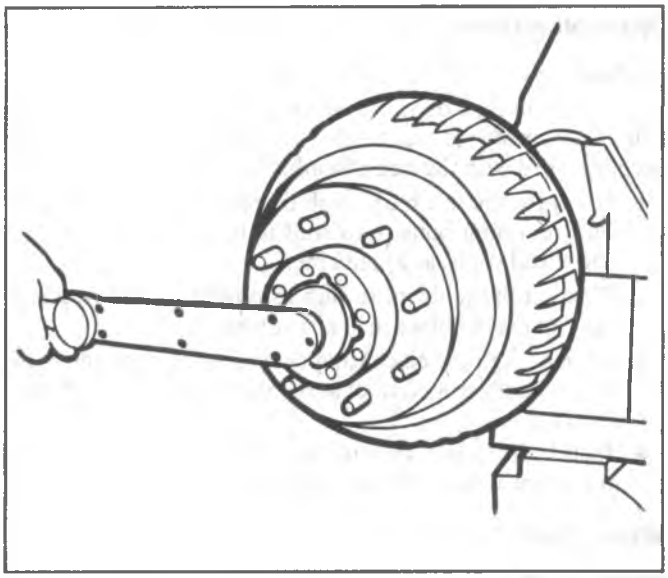


Fig. 4B2-6--Tightening Adjusting Nut-Typical

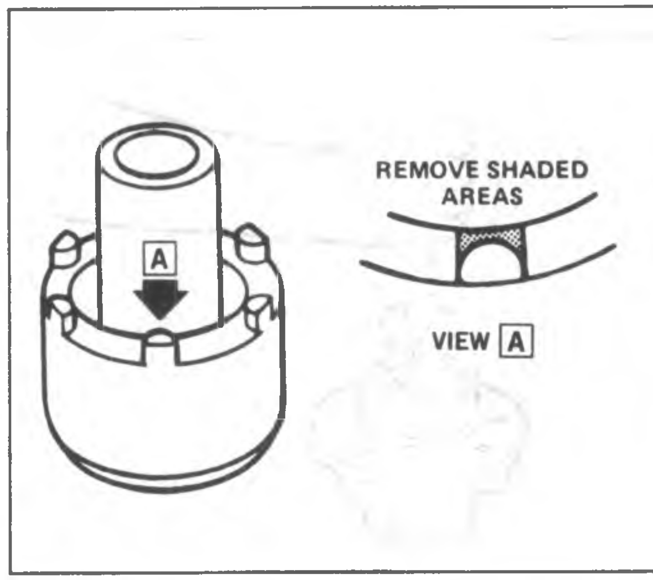


Fig. 4B2-7--Wheel Bearing Adjusting Tool

5. Install adjusting nut and complete the installation as directed under "Bearing Adjustment."

BEARING ADJUSTMENT

Before checking bearing adjustment, make sure brakes are fully released and do not drag.

Check bearing play by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, movement of brake drum in relation to brake flange plate will be barely noticeable and wheel will turn freely. If movement is excessive, adjust bearing as follows:

1. Remove axle shaft and raise vehicle until wheel is free to rotate.
2. Keyways and threads on tube and nut must be clean and free from chips, burrs and shavings.
3. Disengage tang of retainer and remove retainer from axle housing tube.
4. Torque adjusting nut to 70 N·m (50 ft. lbs.), at the same time rotating the hub assembly and making sure bearing cones are seated and in contact with the spindle shoulder (figure 4B2-6).

   Proper wheel bearing adjustment can be made using tool J-2222-02 with some modification or tool J-2222-L figure 4B2-7.
5. Back off nut until loose.
6. If adjusting nut slot in alignment with keyway in axle spindle, insert square key into slot. If adjusting nut slot is not aligned, back off nut a slight amount and insert square key into slot. Do not back off nut more than one slot to align key.
7. Assemble snap ring at end of spindle to retain key in position.

PINION OIL SEAL/COMPANION FLANGE

Replacement

The pinion oil seal may be replaced with the carrier assembly installed in the vehicle.

1. Disconnect propeller shaft.
2. Scribe a line down the pinion stem, pinion nut and companion flange.
3. Use J-8614-11 to remove the pinion nut and the companion flange.
4. Pry the oil seal from the bore, using care not to damage the machined surfaces. Thoroughly clean all foreign material from contact area.
5. Lubricate the cavity between the seal lips with a high melting point bearing lubricant.
6. Install a new pinion oil seal into the bore, using J-24434.
7. Reinstall the companion flange, pinion nut and propeller shaft.

   NOTICE: See NOTICE on page 1 of this section, regarding the above fasteners.

UNIT REPAIR

DIFFERENTIAL CASE

If equipped with a locking differential, also refer to Section 4B6.

Removal

1. Mount axle assembly in a bench vise or holding fixture.
2. Remove cover bolts and cover, as seen in figure 4B2-8, and allow lubricant to drain into pan.
3. Remove axle shafts.

   Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described in Step 9 of 'Differential Case - Installation.' This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, then may be reinstalled at original lash to avoid changing gear tooth contact.
4. Remove adjusting nut lock retainers from bearing caps.
5. Mark bearing caps for reinstallation in the same position, and remove caps.

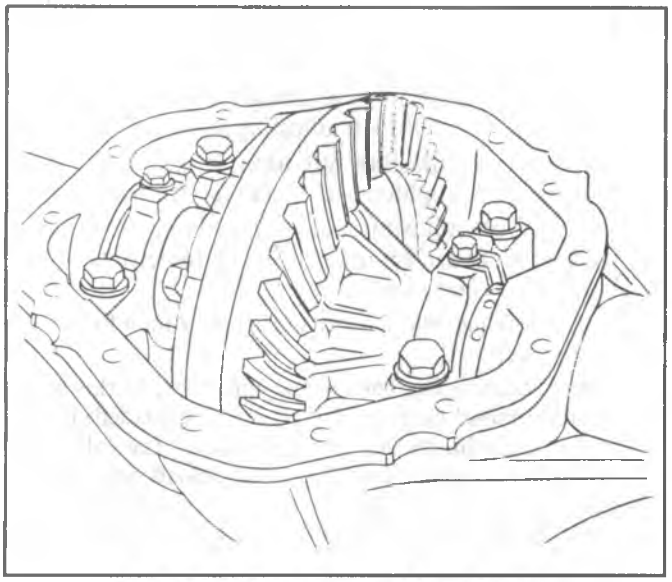


Fig. 4B2-8--Cover Removed from Carrier

6. Loosen side bearing adjusting nuts, using J-24429 as shown in figure 4B2-9.
7. Remove differential from carrier.

Side Bearing Replacement

1. Install bearing puller J-8107 onto one side bearing, with puller screw centered on pilot plug as shown in figure 4B2-10. Be sure to install puller fingers into notches of case, in order to pull on inner race only.
2. Tighten puller screw, while rotating bearing to insure that bearing cage is not being distorted.
3. Remove the other bearing in the same manner.
4. Inspect bearings and hub for nicks, burrs or evidence of abnormal wear.
5. To install bearings, place bearing onto hub, and use driver handle J-8092 and bearing installer J-24430 to drive bearing onto hub until it seats against the shoulder.

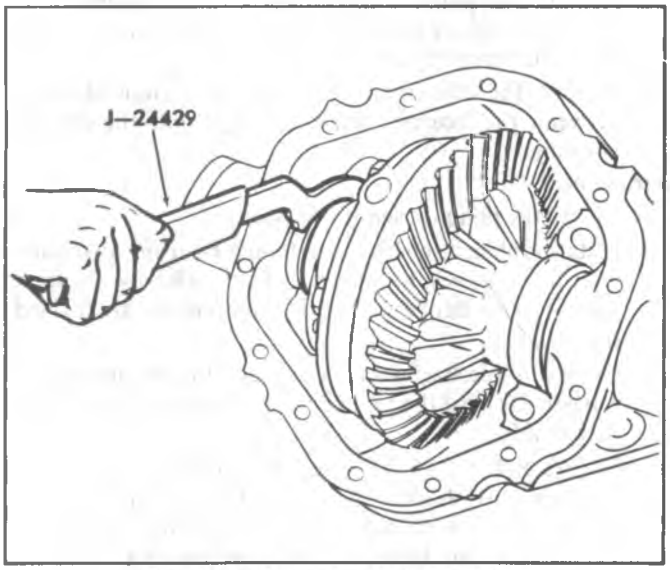


Fig. 4B2-9--Loosening Adjusting Nuts

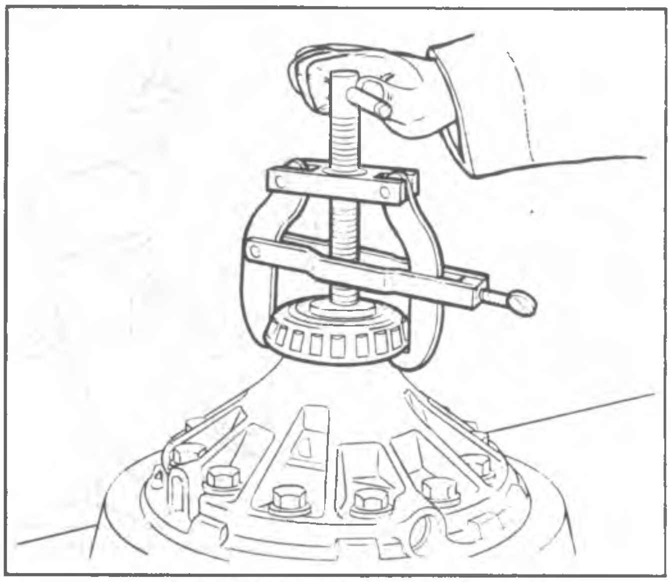


Fig. 4B2-10--Differential Bearing Removal

6. When installing the second bearing, support case on pilot plug as shown in figure 4B2-11 to prevent damage to first bearing installed.

Ring Gear Replacement

1. Remove the ring gear bolts and lock washers, and use a soft faced hammer to tap the ring gear from the case.
2. Place new ring gear into position on case and install lock washers and bolts.

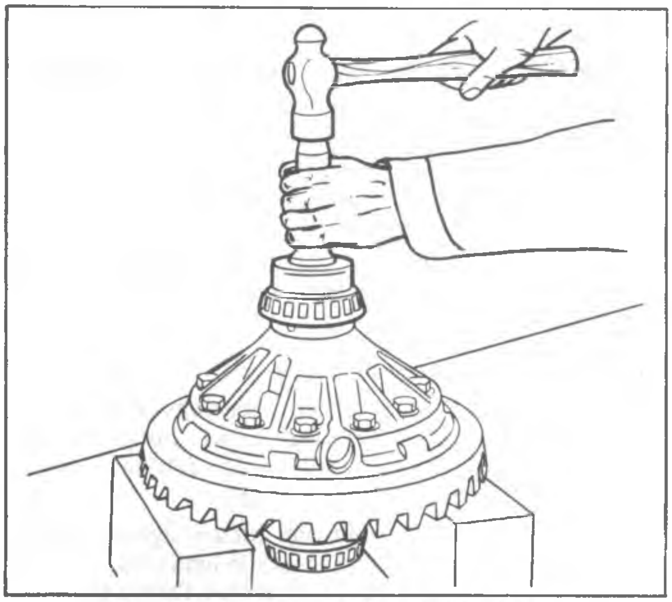


Fig. 4B2-11--Differential Bearing Installation

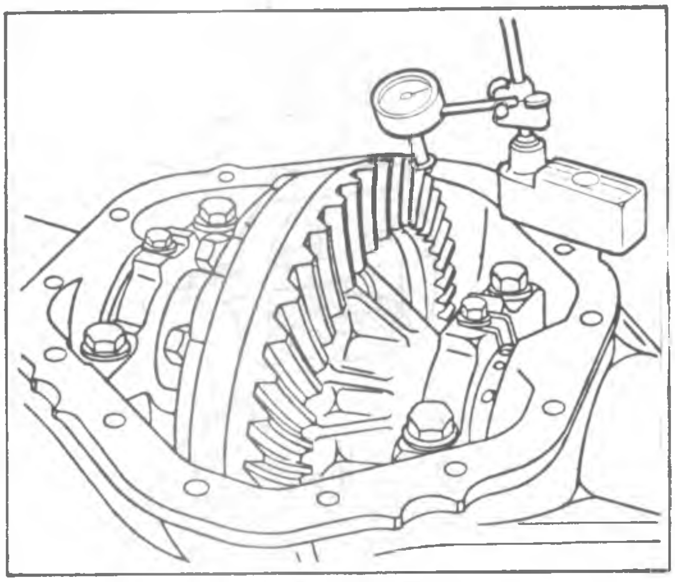


Fig. 4B2-12--Measuring Backlash

3. Torque bolts alternately to specifications.

Disassembly of Case

1. Mark the case and cover halves with a scribe line for reassembly in the same position.
2. With ring gear removed, separate case and cover.
3. Remove the internal parts and keep separated so they may be installed in the same relative positions.

Inspection

1. Inspect the differential gears, pinions, thrust washers, spider and all mating surfaces for evidence of abnormal wear.
2. Clean all parts thoroughly in suitable solvent.
3. Replace parts as necessary.

Reassembly of Differential

1. Lubricate internal parts with hypoid gear lubricant.
2. Place differential pinions and thrust washers onto spider.
3. Assemble differential gears and washers to case and cover.
4. Assemble differential case and cover making sure scribe marks align.
5. Install ring gear and attaching bolts and lockwashers and torque alternately to specifications.
6. The differential may be installed into the carrier at this point, or may be installed after servicing the drive pinion.

Installation and Adjustment

1. Place bearing cups over side bearings and lift the differential assembly into the carrier. Install bearing caps, making sure marked caps are installed in original positions. Secure the cap bolts snugly.
2. Loosen the right side adjusting nut and tighten the left side nut, using J-24429 as shown in figure 4B2-9, until the ring gear contacts the drive pinion. Do not force the gears into contact so as to bind them. At this point, zero lash is obtained.
3. Back off the left adjusting nut approximately two slots. Install locking fingers into holes and fasten fingers to bearing cap.
4. Tighten right adjusting nut firmly to force the case into solid contact with the left adjusting nut.
5. Loosen right adjusting nut until it is free from its bearing, then retighten until it contacts the bearing.
6. Tighten right adjusting nut approximately two slots if used bearings are being installed, or three slots if new bearings are being installed.
7. Install locking retainer into holes and attach fingers to bearing cap.
8. Torque bearing cap bolts to specifications. At this point the differential bearings are properly preloaded. If any additional adjustments are required in the following procedures, make sure that the preload remains as established. If one adjusting nut is loosened, the other nut must be tightened **an equal amount** to maintain this preload.
9. Mount a dial indicator on the housing and measure the backlash between the ring gear and pinion. Backlash should be from .003" to .012" with .005" to .008" preferred. Refer to figure 4B2-12.

   If backlash is more than .012", loosen the right adjusting nut one slot and tighten left adjusting nut one slot. If backlash is less than .003", loosen the left adjusting nut one slot and tighten the right adjusting nut one slot.

DRIVE PINION ASSEMBLY

Removal

1. Remove differential as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Reassembly". Record the result. If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Remove the pinion bearing retainer bolts from the housing as shown in figure 4B2-13.
4. Remove the pinion and bearing retainer assembly. It may be necessary to rap on the pilot end of the pinion to assist the assembly from the carrier.
5. Record the thickness of the shims removed from between the bearing retainer flange and the carrier housing.

Disassembly

1. Clamp the pinion assembly in vise.
2. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 4B2-14. Position J-8614-11 on flange so that the four notches are toward the flange.
3. Use a suitable sized socket to remove the pinion nut and washer. Discard the pinion nut and use a new one upon reassembly.
4. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as a step 2, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-11 as shown in figure 4B2-15.
5. Support the bearing retainer as shown in figure

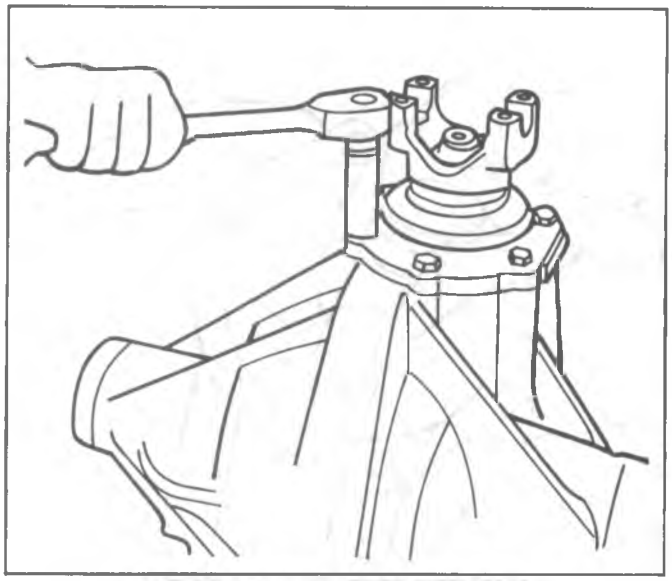


Fig. 4B2-13--Removing Retainer Bolts

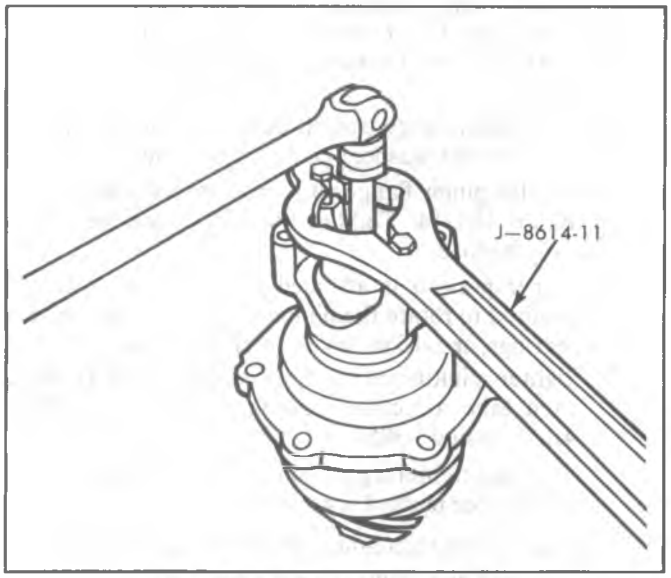


Fig. 4B2-14--Removing Pinion Nut

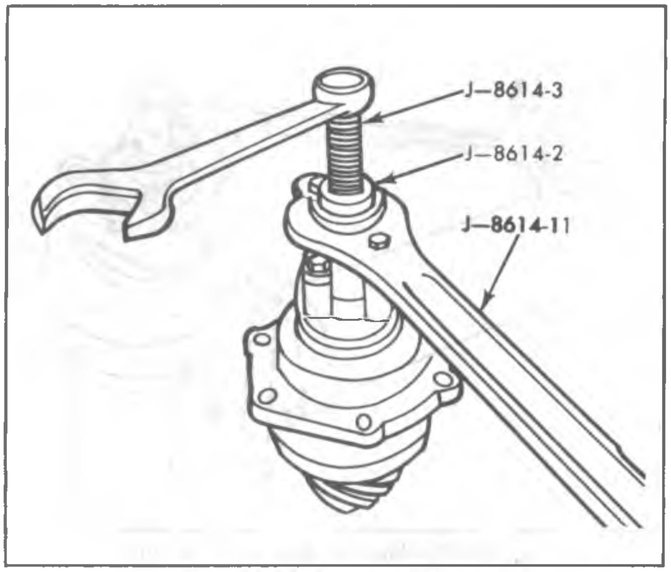


Fig. 4B2-15--Removing Flange

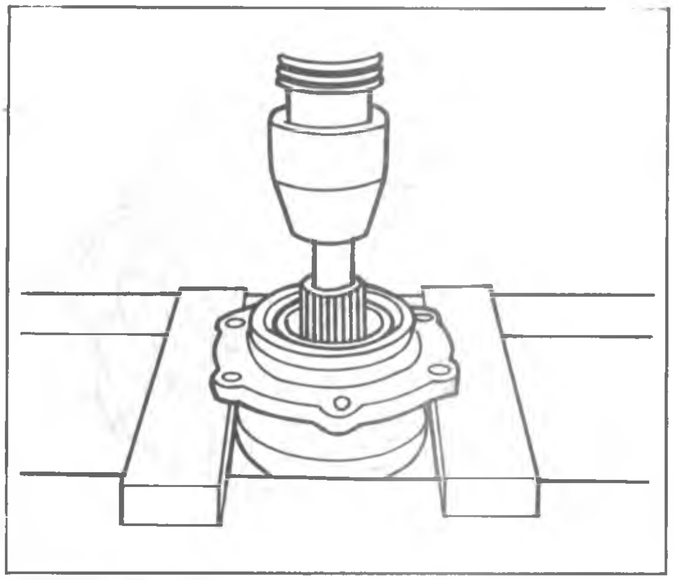


Fig. 4B2-16--Pressing Drive Pinion from Bearing Retainer

4B2-16 and press out the drive pinion. Do not allow drive pinion to fall onto the floor.

6. Separate the pinion flange, the oil seal, the front bearing and the bearing retainer. The oil seal may have to be driven from the bearing reatiner if it is being replaced.
7. Drive the pinion front and rear bearing cups from the bearing retainer, using a drift.
8. To remove the rear bearing, use J-22912 as shown in figure 4B2-17.
9. Drive the pinion straddle bearing from the carrier housing, using a drift as shown in figure 4B2-18.

Inspection

1. Clean all parts in a suitable solvent and dry with air.
2. Inspect the drive pinion for chipped, cracked or excessively worn teeth and inspect the splines for wear.
3. Inspect the bearings for worn or pitted rollers or races. Inspect the pinion flange splines for wear.

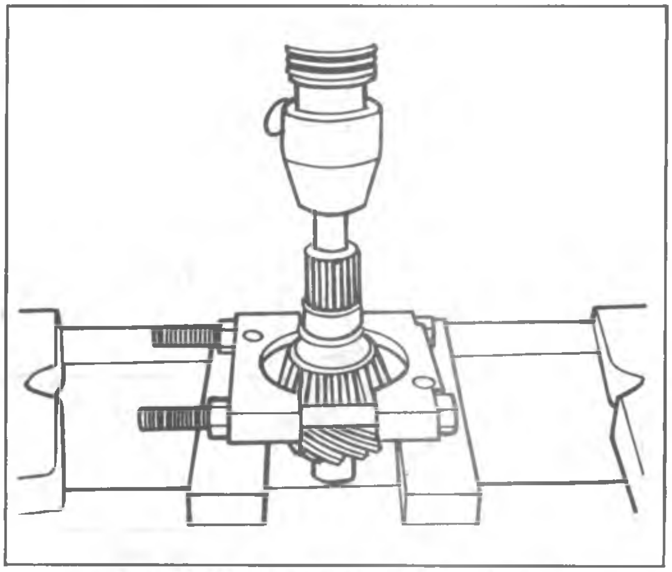


Fig. 4B2-17--Removing Pinion Rear Bearing

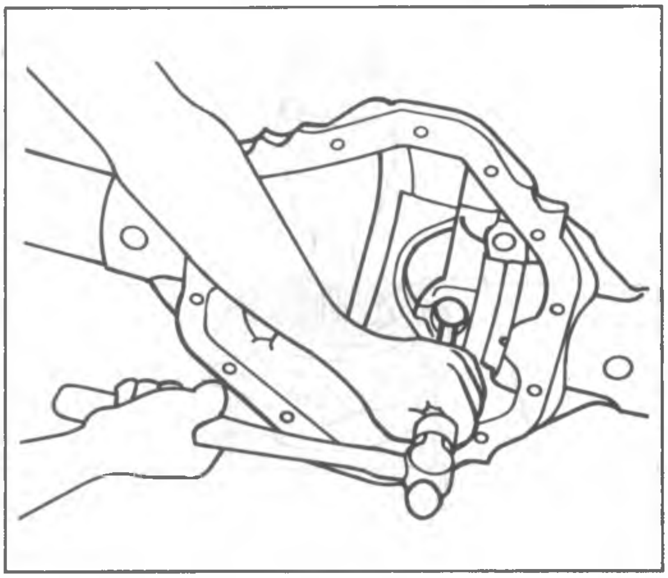


Fig. 4B2-18--Removing Straddle Bearing

4. Inspect the bearing retainer for cracks, imperfections, corrosion, pits and grooves.
5. Replace parts as required.

Reassembly

1. Lubricate all parts with hypoid lubricant.
2. Press pinion rear bearing onto drive pinion as shown in figure 4B2-19, using J-24433.
3. Install the front end rear pinion bearing cups into the bearing retainer, using driver handle J-8092 on J-8608 for the front cup, and on J-24432 for the rear cup.
4. Install the pinion straddle bearing into the carrier housing, using driver handle J-8092 and installer J-23322, as shown in figure 4B2-20.
5. Place bearing retainer, with cups in position, onto the drive pinion. Install a new collapsible spacer into position.
6. Press front bearing onto drive pinion.
7. Lubricate the oil seal lips with a lithium-base extreme pressure lubricant, and install the seal in the retainer bore. Use J-24434 with driver handle J-8092. Press the seal into the bore until it seats against internal shoulder.

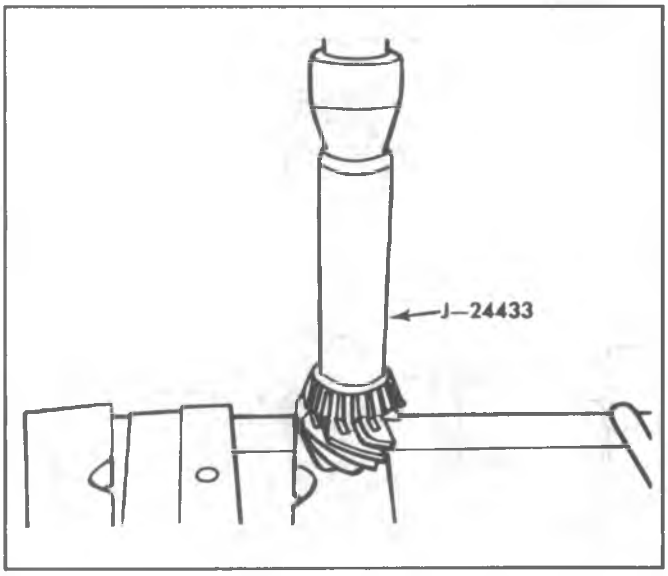


Fig. 4B2-19--Installing Pinion Rear Bearing

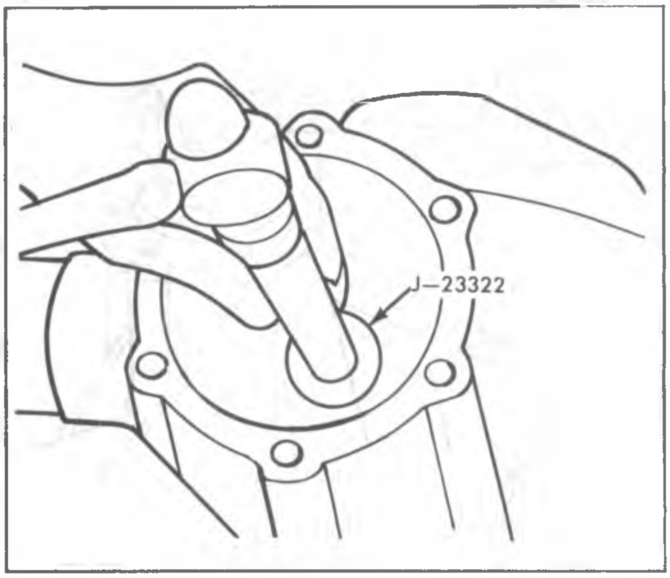


Fig. 4B2-20--Installing Straddle Bearing

8. Install pinion flange and oil deflector onto the splines, then install lock washer and new pinion nut.
9. Clamp the pinion flange into a vise. Install J-8614-11 as in figure 4B2-14. Tighten the nut to achieve proper bearing preload.
   a. Proper preload is attained when rotational torque required to rotate the pinion is 25-35 in. lbs. for new bearings, or 5-15 in. lbs. for used bearings.
   b. Tighten pinion nut to approximately 350 ft. lbs., then take a torque reading as shown in figure 4B2-21 using J-5853.
   c. Continue tightening pinion nut in small increments until proper preload is attained.

NOTICE: Over-tightening of pinion nut may collapse spacer too much, requiring its replacement.

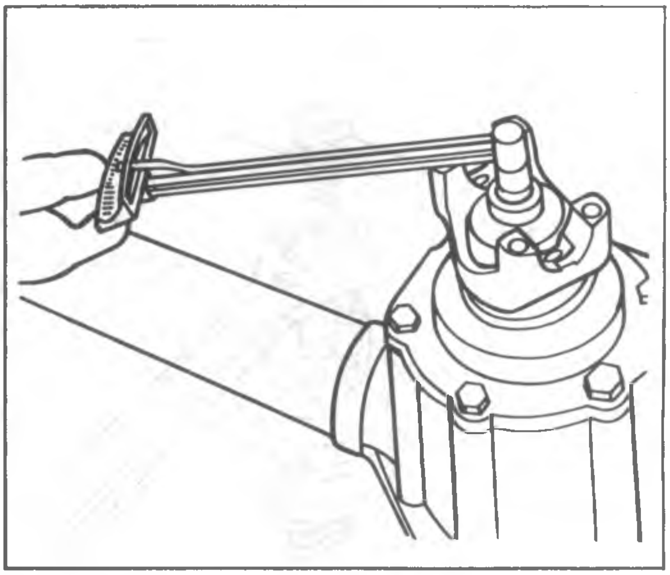


Fig. 4B2-21--Measuring Rotating Torque

		CODE NUMBER ON ORIGINAL PINION				
		+2	+1	0	-1	-2
CODE NUMBER ON SERVICE PINION	+2	–	ADD .001	ADD .002	ADD .003	ADD .004
	+1	SUBT. .001	–	ADD .001	ADD .002	ADD .003
	0	SUBT. .002	SUBT. .001	–	ADD .001	ADD .002
	-1	SUBT. .003	SUBT. .002	SUBT. .001	–	ADD .001
	-2	SUBT. .004	SUBT. .003	SUBT. .002	SUBT. .001	–

Fig. 4B2-22--Pinion Depth Codes

Installation and Adjustment

1. Examine the head of the drive pinion for a pinion depth code number.
2. Compare the depth code number with the number on the original pinion. Use the following chart to select the proper shim for preliminary setting of pinion depth.
3. Refer to the thickness of the shim recorded earlier in Pinion Removal procedures. Increase or decrease the shim dimension as indicated by the chart in figure 4B2-22.
   a. For example, if original shim measured .014 inch, original code was -1 and new code is +2, the correct shim would be .014 inch plus .003 = .017 inch.
   b. If original shim was .012 inch, original code +2, and new code is -2, the correct shim would be .012 minus .004 = .008 inch.
4. Place the pinion shim as determined in step 3 onto the carrier housing, making sure the bolt holes align with those of carrier, and that the mating surfaces are clean and free from foreign material.
5. Place the pinion retainer assembly into position, and align bolt holes to carrier. Install retaining bolts and tighten in a crosswise manner. Torque to specifications.
6. Following dirve pinion service, a Gear Tooth Contact Pattern Check must be made.

OPERATIONAL CHECK AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Refer to Section 4B for description of how to perform these checks and adjustments.

SECTION 4B3

DANA 10-1/2" RING GEAR AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on Page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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ON-VEHICLE SERVICE

Procedures for service to axle assembly, axle shafts, hub and drum components and bearing adjustments are identical to those described for "Chevrolet 10-1/2" Ring Gear Axle".

Drive pinion oil seal replacement requires different special tools for the Dana axles. Follow the same procedure listed for "Chevrolet 10-1/2" Ring Gear Axle"; use J-24384 for seal replacement on Dana 10-1/2" Ring Gear Axles.

UNIT REPAIR

This Dana Spicer axle is similar in design to other Salisbury type axles with the following exceptions:

- In order to remove the differential case, the carrier must be spread.
- The drive pinion assembly incorporates an inner and outer bearing shim. The inner shim is used to maintain proper pinion depth. The outer shim is used to maintain proper preload on the pinion bearing.

DIFFERENTIAL CASE

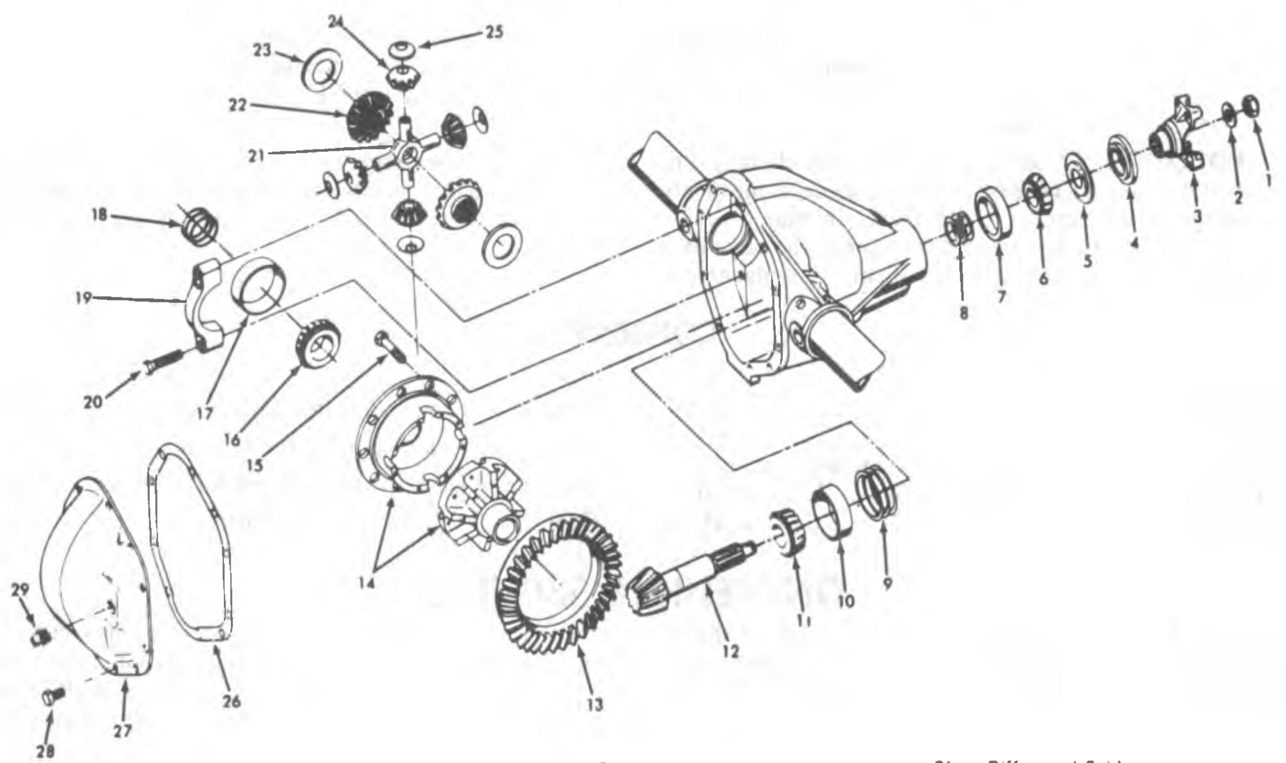
Removal

1. Place vehicle on hoist with rear axle hanging free.
2. Remove wheel and tire assemblies.
3. The axle shafts are full-floating type with flanged outer end of shaft attached to wheel hub by studs and nuts. Wheel is supported by tapered roller bearings at outer end of axle housing.
   a. Remove axle shaft to hub attaching nuts.
   b. Rap on axle shaft to loosen shaft from hub and remove shafts.
4. Remove plug in carrier and drain lubricant.
5. Remove cap screws and lock washers attaching cover to carrier. Remove cover and gasket.
6. Mark one side of carrier and matching cap for reassembly in the same position. Remove bearing caps.
7. Using spreader tool J-24385, and a dial indicator as shown in figure 4B3-2, spread carrier a maximum of .015 inch.

   NOTICE: Do not exceed this dimension, as carrier may be permanently damaged.
8. Remove the dial indicator and use a prybar to remove the differential case from the carrier. Record the dimensions and location of the side bearing shims. Remove the spreader tool.

Disassembly

1. Remove differential side bearings by using bearing puller J-29721.
   Use care not to damage bearings with tool J-29721.
2. Remove the ring gear bolts and the ring gear. Tap the ring gear with a soft-faced hammer to free it from the case.
3. Scribe both case halves for reassembly in same position.
4. Remove bolts holding case halves together, as shown in figure 4B3-3.
5. Tap lightly on top half of case to free it from the bottom half. Remove top half of case.
6. Lift out all internal parts.



1. Pinion Nut
2. Washer
3. Companion Flange
4. Oil Seal
5. Oil Slinger
6. Pinion Front Bearing
7. Front Bearing Cup
8. Preload Shim Pack
9. Pinion Depth Shim Pack
10. Rear Bearing Cup
11. Pinion Rear Bearing
12. Drive Pinion
13. Ring Gear
14. Differential Case
15. Ring Gear Bolt
16. Differential Side Bearing
17. Side Bearing Cup
18. Side Bearing Adjusting Shims
19. Bearing Cap
20. Bearing Cap Bolt
21. Differential Spider
22. Differential Side Gear
23. Washer
24. Pinion Gear
25. Washer
26. Gasket
27. Cover
28. Cover Screw
29. Drain Plug

Fig. 4B3-1--Dana Differential with 10-1/2" Ring Rear - Exploded View L

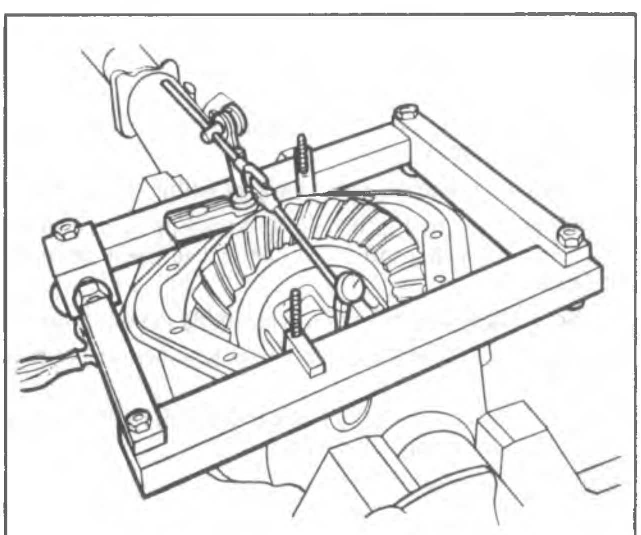


Fig. 4B3-2--Spreading the Carrier

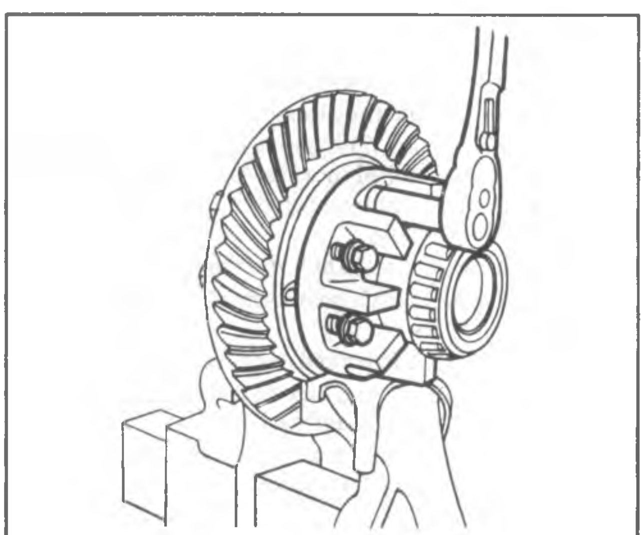


Fig. 4B3-3--Separating Case Halves

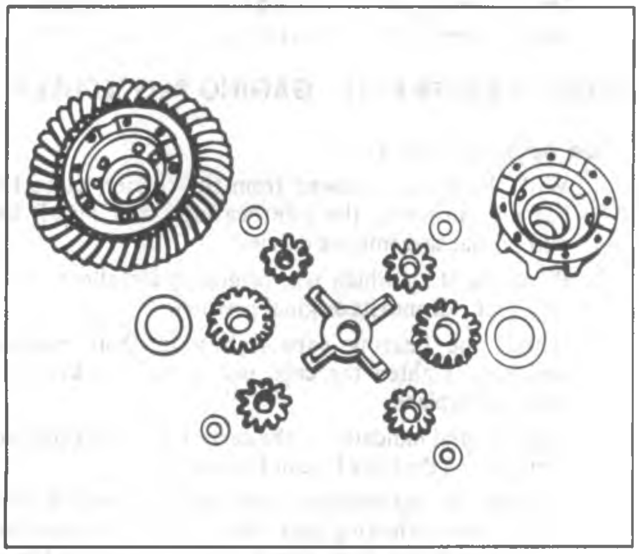


Fig. 4B3-4--Internal Parts Inspection

Inspection (Figure 4B3-4)

1. Clean all gears and bearings in solvent. Inspect cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect ring gear teeth and machined surfaces. Examine fit of internal gears.
3. Inspect pinion cross-shaft.
4. Replace parts as required.

DRIVE PINION

Removal and Disassembly

1. Remove differential as previously outlined.
2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment." If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.
3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 4B3-5. Position J-8614-11 on flange so that the four notches are toward the flange.
4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.
5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-22 as shown in figure 4B3-6.
6. Remove drive pinion from carrier. It may be necessary to tap on the pinion with a soft faced hammer.
7. With a long drift tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
8. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
9. Remove rear pinion bearing using J-22912, and an arbor press.

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.
2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case for cracks or scores or side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

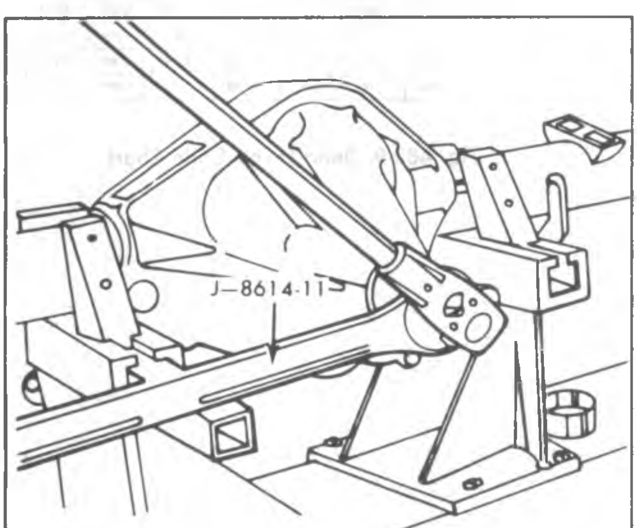


Fig. 4B3-5--Removing Pinion Nut

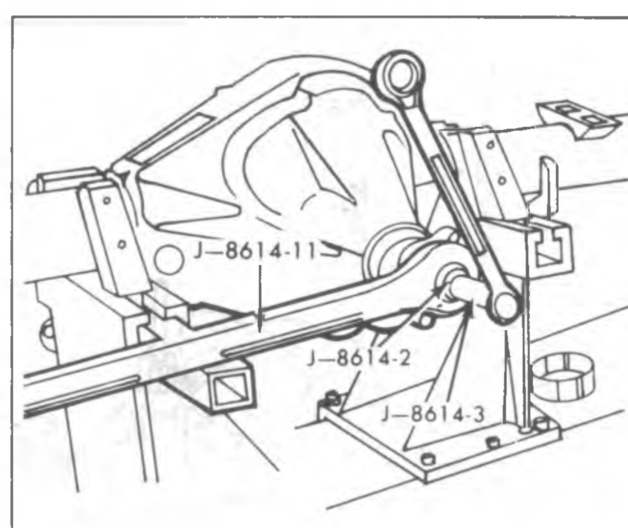


Fig. 4B3-6--Removing Companion Flange

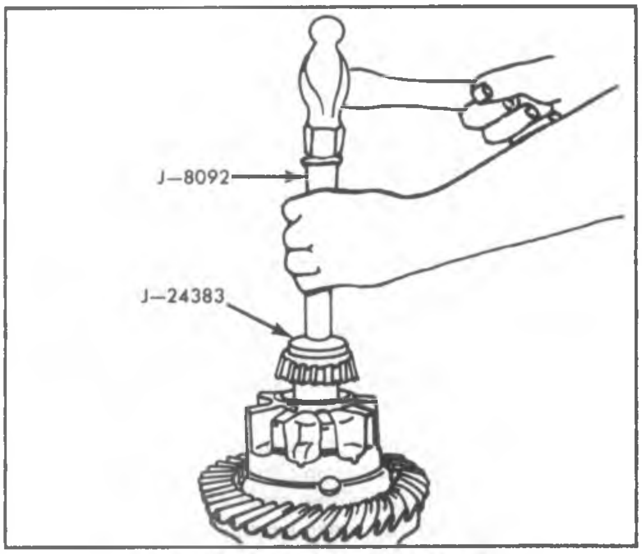


Fig. 4B3-7--Installing Side Bearing

DIFFERENTIAL CASE

Reassembly

1. Assemble new washers to side gears. Apply a small amount of hypoid lubricant on the side gear hubs.
2. Assemble pinion gears and new washers onto cross shaft.
3. Place side gears, pinion gears, cross shaft and washers into flanged half of case.
4. Assemble top half of case to bottom half, making sure scribe marks are aligned.
5. Assemble body bolts finger tight. Then tighten bolts alternately to specifications.
6. Install ring gear to differential case.
7. Install ring gear-to-case bolts finger tight, then tighten alternately to specifications.
8. Place side bearing into position and install, using tools J-8092 and bearing installer J-24383 as shown in figure 4B3-7.

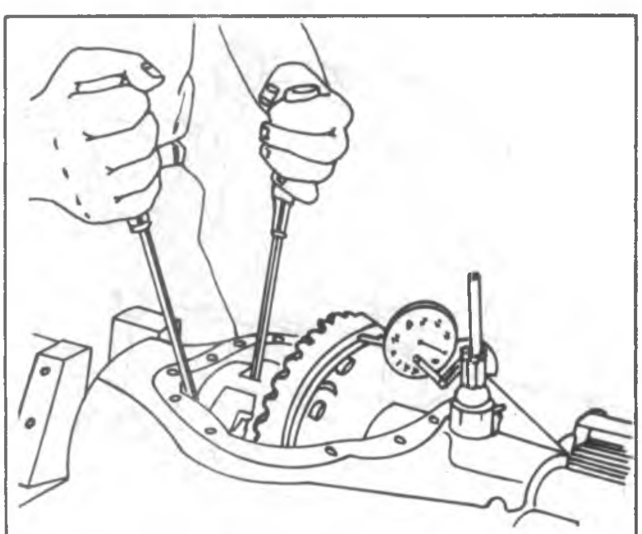


Fig. 4B3-8 -Screwdrivers Against Case L

9. Install bearing on opposite side in the same manner. Be sure to support differential case on pilot plug J-8107-3.

SHIM REQUIREMENTS - GAGING PROCEDURES

Side Bearing Shims

1. With the pinion removed from the carrier, place the bearing cups over the side bearings, and install the differential case into the carrier.
2. Place the shim which was originally installed on the ring gear side into its original position.
3. Install the bearing caps lightly in their marked positions. Tighten the caps just enough to keep the bearings in place.
4. Mount a dial indicator on the carrier with the tip of the indicator on the back face of the ring gear.
5. Position two screwdrivers between the bearing shim and carrier on the ring gear side of the case. Pull on the screwdrivers and force the differential case as far as possible away from the dial indicator.
6. With force still applied, set the indicator dial to "zero", being sure the probe is still in contact with the ring gear.
7. Reposition the screwdrivers to the opposite side of the differential case as shown in figure 4B3-8.
8. Pull on the screwdrivers and force the differential case back toward the dial indicator. Repeat several times until the same indicator reading is obtained.
9. To the dial indicator reading, add the thickness of the shim. Record the result, as. this figure will be used during determination of side bearing shim requirements.

Old Pinion Marking	New Pinion Marking								
	- 4	3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 4B3-9--Dana Pinion Code Chart

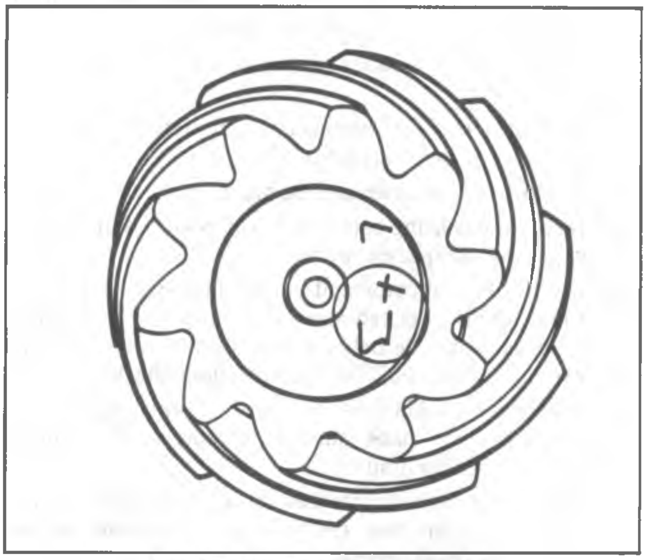


Fig. 4B3-10--Pinion Code Location

Pinion Shims

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verficiation. If a new gear set is being used, verify the numbers of each pinion and ring gear before proceeding with assembly.

On the rear face of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: if a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a + etching indicates. Or if a pinion is etched −3, we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased 003" which is just what a −3 etching indicated. Refer to figure 4B3-10.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickn ss of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the pinion is (-2), add .004" shims to the original shim pack.

DRIVE PINION

Assembly and Installation

1. Determine the correct pinion depth shim by using the chart in figure 4B3-9.
2. Install the pinion depth shim in rear cup bore.
3. Install rear bearing cup by using driver handle J-8092 and installer J-24381.
4. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.
5. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.
6. Press rear pinion bearing onto pinion shaft, using installer J-24433.
7. Install drive pinion and bearing into the differential carrier.
8. Install preload shims and front pinion bearing. Do not install oil seal at this time.
9. Install flange and holding bar J-8614-11 as shown in "Drive Pinion - Removal".
10. Install washer and nut onto pinion shaft. Torque nut to 350 N·m (250 lbs.) ft.
11. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

    Torque reading to start shaft turning must be disregarded.
12. If torque requirements (preload) are not to specifications, adjust shim pack as necessary.
    - To increase preload, decrease the thicknes of preload shims.
    - To decrease preload, increase the thickness of preload shims.
13. When bearing preload meets specifications, remove nut, washer and flange from pinion shaft.
14. Install new pinion oil seal into housing as shown in figure 4B3-11, using J-24384.
15. Install flange, washer and nut. Using holder bar

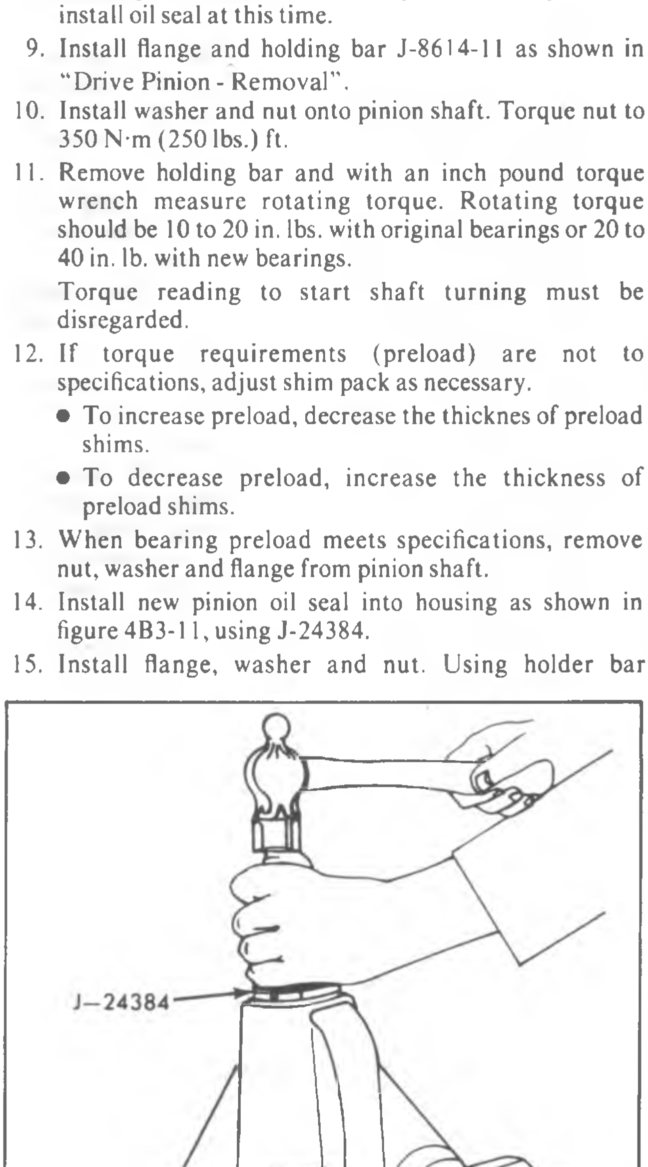


Fig. 4B3-11--Installing Pinion Oil Seal

J-8614-11, torque nut to 350 N·m (250 lbs. ft.).

DIFFERENTIAL CASE

Installation and Adjustment

1. Place the differential case, with side bearings and cups installed, into position in the carrier.
2. Select the smallest of the original shims as a "gaging" shim and place it between the bearing cup and the carrier on the ring gear side of the case.
3. Install bearing caps and bearing screws finger tight. Make sure bearing caps are in correct marked position.
4. Mount a dial indicator on the ring gear side of the carrier, with the indicator probe in contact with the back face of the ring gear.
5. Position two screwdrivers between the bearing cup and the carrier on the side opposite the ring gear.
6. Pull on the screwdrivers and force the differential case as far as possible toward the indicator. With force still applied, set the dial indicator to zero.
7. Reposition the screwdrivers on the ring gear side of the case. Force the ring gear into mesh with the drive pinion and observe the dial indicator. Repeat this operatio several times until the same reading is obtained.
8. Add the indicator reading to the 'gaging' shim thickness to determine the correct shim dimension for installation on the ring gear side of the case.

   For example, if the gaging shim was .155 inch, and the indicator reading in step 7 was .017 inch, the correct shim would be .155 + .017 = .172 inch.
9. Remove the "gaging" shim and install the correct size shim into position between the bearing cup and the carrier on the ring gear side of the case.
10. To determine the correct dimension for the remaining shim, first refer to the dimension obtained in step 8 of "Gaging Procedures and Side Bearing Shims". From that figure, subtract the size of the shim installed in step 9 above; then add .006 inch for preload and backlash.

    For example, if the reading in step 8 was .329 inch, and the shim just installed on the ring gear side of the case was .172 inch, the correct shim dimension would be .329 -.172 = .157 + .006 = .163 inch.
11. Spread the differential carrier as shown in figure 4B3-2.
12. Assemble the shim determined in step 10 into place between the bearing cup and the carrier.
13. Remove the spreader and the dial indicator.
14. Install the bearing caps in marked positions and torque cap screws to specifications.
15. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
16. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
    - Low backlash is corrected by decreasing the shim on the ring gear side and increasing the opposite side shim **an equal amount**.
    - High backlash is corrected by increasing the shim on the ring gear side and decreasing the opposite side shim **an equal amount**.
17. Check gear tooth contact, as described in 'Gear Tooth Contact Pattern Check' in Section 4B.
18. Using a new gasket, install housing cover and torque bolts to specifications.
19. Reinstall the rear universal joint, and torque 'U' bolt nuts to specifications.
20. Install axles into carrier and axle flange over hub studs.
21. Torque hub stud nuts to specifications.
22. Fill differential with lubricant.
23. Install wheel and tire assembly.

OPERATIONAL CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Refer to Section 4B for description of how to perform these checks and adjustments.

SECTION 4B4

DANA 9-3/4" RING GEAR AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on Page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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ON-VEHICLE SERVICE

AXLE ASSEMBLY

The axle assembly removal and installation is identical to the procedure given earlier for "Chevrolet 10-1/2" Ring Gear Axle".

Drive pinion oil seal replacement requires different special tools for the Dana axle. Use J-22281 for pinion oil seal replacement.

UNIT REPAIR

This Dana Spicer axle is similar in design to other Salisbury type axles with the following exceptions:

- The differential side bearing shims are located between the side bearing cone and roller assembly and the differential case. See figure 4B4-1. These bearings are of the tapered roller design and are preloaded. In order to remove the differential case the carrier must be spread.
- The pinion assembly incorporates an inner and outer bearing shim. The inner shim is used to maintain proper pinion depth. The outer shim is used to maintain proper preload on the pinion bearing.

DIFFERENTIAL CASE

Removal

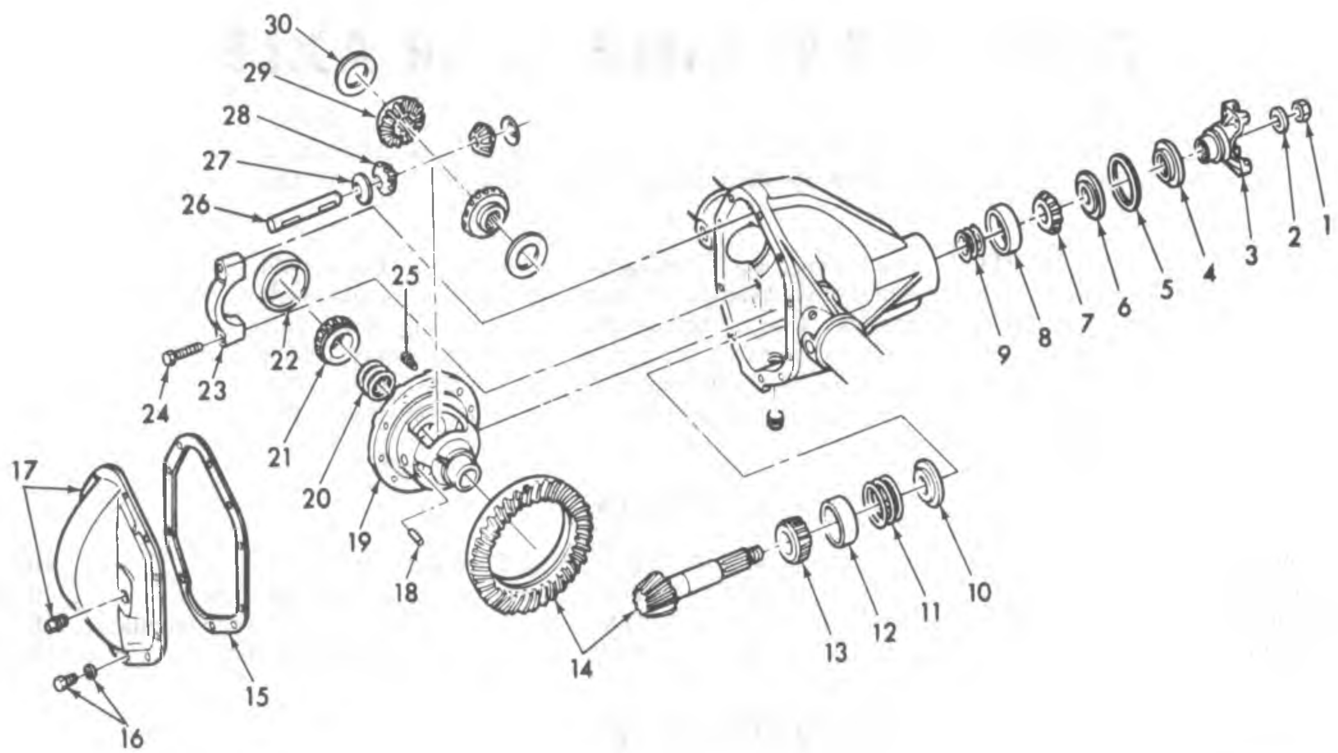
1. Place vehicle on hoist with rear axle hanging free.
2. Remove wheel and tire assemblies.
3. The axle shafts are full-floating type with flanged outer end of shaft attached to wheel hub by studs and nuts. Wheel is supported by tapered roller bearings at outer end of axle housing.
   a. Remove axle shaft to hub attaching nuts.
   b. Rap on axle shaft to loosen shaft from hub and remove shafts.
4. Remove plug in carrier and drain lubricant.
5. Remove cap screws and lock washers attaching cover to carrier. Remove cover and gasket.
6. Mark one side of carrier and matching cap for reassembly. Remove cap screws attaching bearing caps to carrier.
7. Using spreader Tool J-24385 and dial indicator as shown in figure 4B4-2, spread carrier a maximum of .015".

   NOTICE: Do not exceed this dimension as carrier may be permanently damaged.
8. Remove dial indicator and with the use of a pry bar remove differential case from carrier. Remove spreader.

Disassembly

1. Remove differential bearing cups and identify with a tag for reassembly.
2. Place differential in vise and drive out pinion shaft lock pin.
3. Remove differential bearing cone and roller using Puller J-29721 4B4-3. Tag cone and rollers for assembly.

   If ring gear and pinion are to be reassembled, note position of shims and replace accordingly.
4. Remove spacer, pinion shaft, pinions, side gears and thrust washers from differential case.
5. Remove screws attaching ring gear to differential case. Remove gear.



1. Nut
2. Washer
3. Companion Flange
4. Pinion Oil Seal
5. Gasket
6. Outer Pinion Oil Slinger
7 and 8. Cone and Roller (Outer Pinion Bearing)
9. Shims (Outer Pinion Bearing)
10. Inner Pinion Oil Slinger
11. Shims (Inner Pinion Bearing)
12. Cup (Inner Pinion Bearing)
13. Cone and Roller (Inner Pinion)
14. Ring and Pinion
15. Gasket (Housing Cover)
16. Screw and Washer (Cover)
17. Cover and Plug
18. Lock Pin (Pinion Shaft)
19. Differential Case
20. Shims (Differential Adjusting)
21. Cone and Roller (Differential Bearing)
22. Cup (Differential Bearing)
23. Cap (Differential Bearing)
24. Bolt (Differential Bearing Cap)
25. Bolt (Ring Gear)
26. Pinion Shaft
27. Thrust Washer (Pinion)
28. Pinion
29. Side Gear
30. Thrust Washer (Side Gear)

Fig. 4B4-1--Dana Differential With 9-3/4" Ring Gear - Exploded View

DRIVE PINION

Removal

1. Separate rear universal joint, tape trunnion bearings to joint, position propeller shaft to one side and tie propeller shaft to frame side rail.
2. Using Holding Bar J-8614-11, attach d to pinion shaft flange, remove self- locking nut and washer from pinion shaft.
3. Install Tool J-8614-2, and 3 into holding bar as shown in figure 4B4-4 and remove flange from drive pinion. Remove drive pinion from carrier.
4. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
5. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
6. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 4B4-5, and press pinion from bearing.

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

   The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does not indicate a defective bearing.
2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring, cracking or chipping.

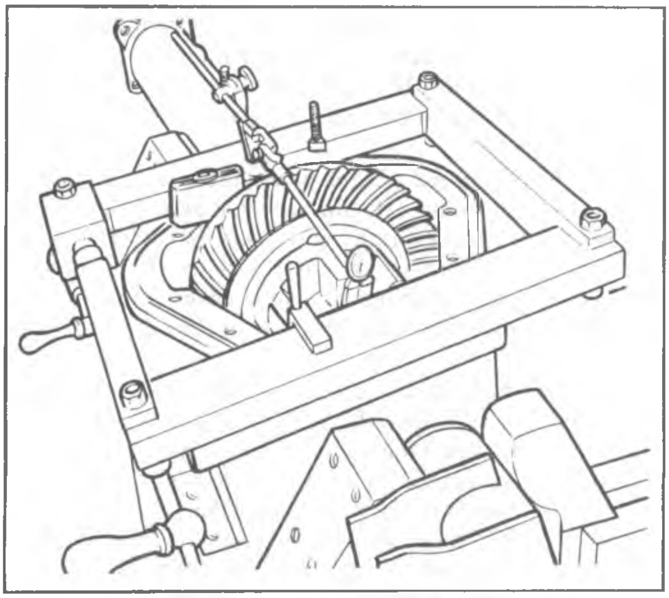


Fig. 4B4-2--Tool J-24385 Mounted on Carrier

4. Inspect differential case for carcks or scores. Inspect side gears, thrust washers, and pinion thrust faces.
5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

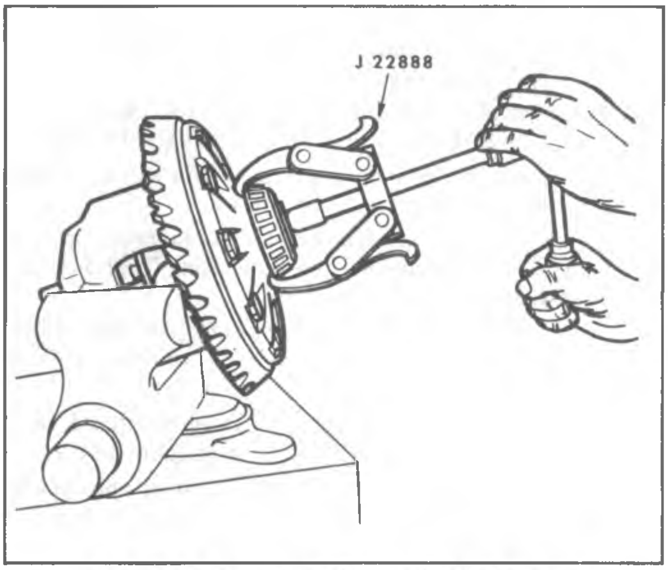


Fig. 4B4-3--Removing Differential Side Bearings

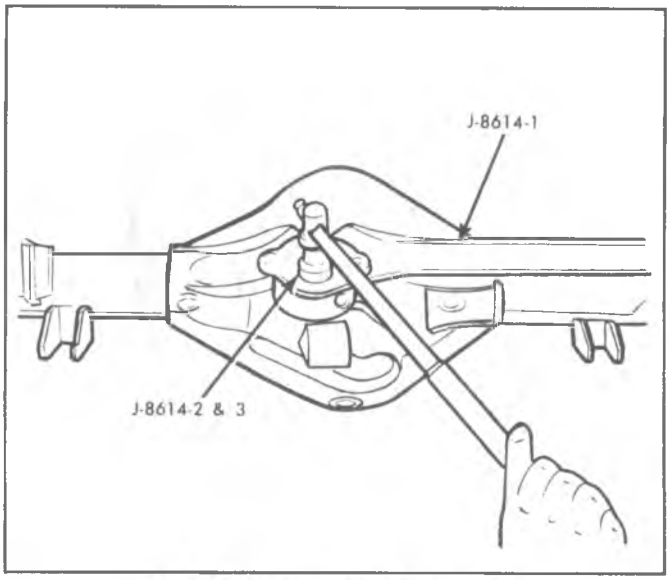


Fig. 4B4-4--Removing Pinion Flange

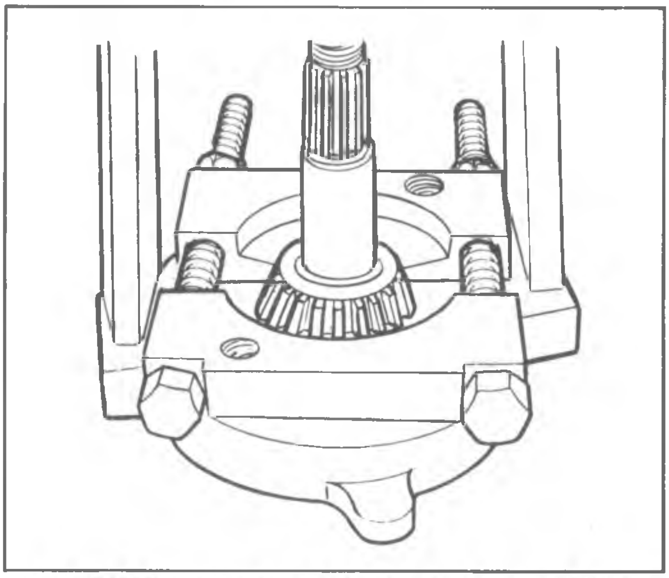


Fig. 4B4-5--Removing Inner Pinion Bearing Cone and Roller

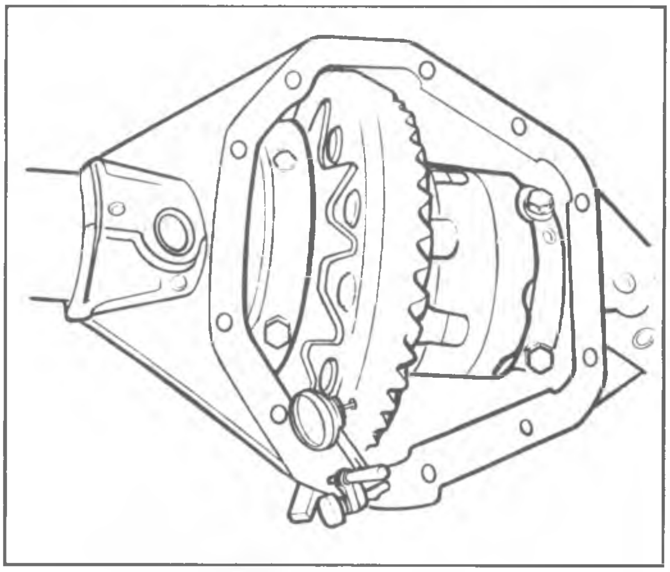


Fig. 4B4-6--Checking Runout

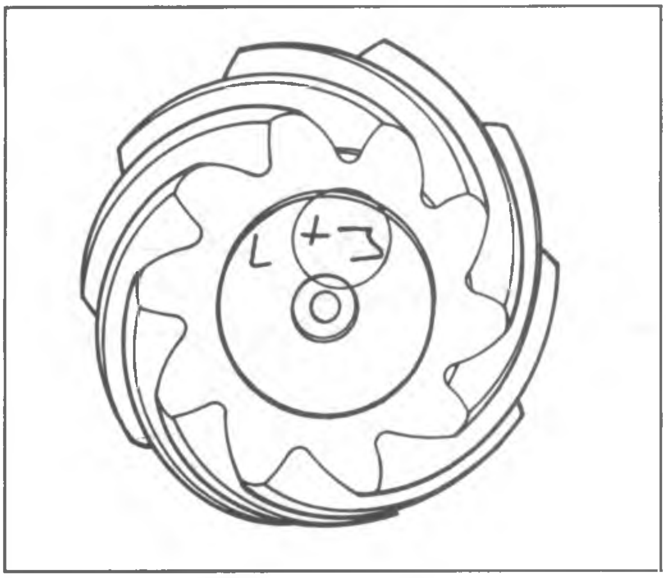


Fig. 4B4-7--Marking From Nominal on Pinion

1. Position differential side gears and new thrust washers in differential case.
2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.
3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.
4. Position ring gear to case, then install cap screws. Tighten cap screws evenly and alternately to specifications.
5. With an arbor press, press differential side bearings onto case using Tool J-21051. Do not install shims at this time.
6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.
7. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 4B4-6. Rotate differential case and check for runout. If runout is greater than .002", the assembly should be removed and the ring gear removed from the case. Again install differential case and check runout at differential case flange.
8. Should runout of case flange be greater than .002" the defect is probably due to bearings or differential case, and should be corrected before proceeding further.
9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "0".
10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.
11. Remove differential from carrier.

DRIVE PINION

Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring gear before proceeding with assembly.

On the button end of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0) number, which indicates the best running position for each particular gear set. This dimension is controlled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched −3, we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a −3 etching indicated. See figure 4B4-7.

If the old ring and pinion set is to be reused, measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads (+2) and the new pinion is (−2), add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart in figure 4B4-8.
2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.
3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.
4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092 as shown in figure 4B4-9.
5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in figure 4B4-10.
6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.
7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion, as in figure 4B4-11.

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 4B4-8--Dana Pinion Code Chart

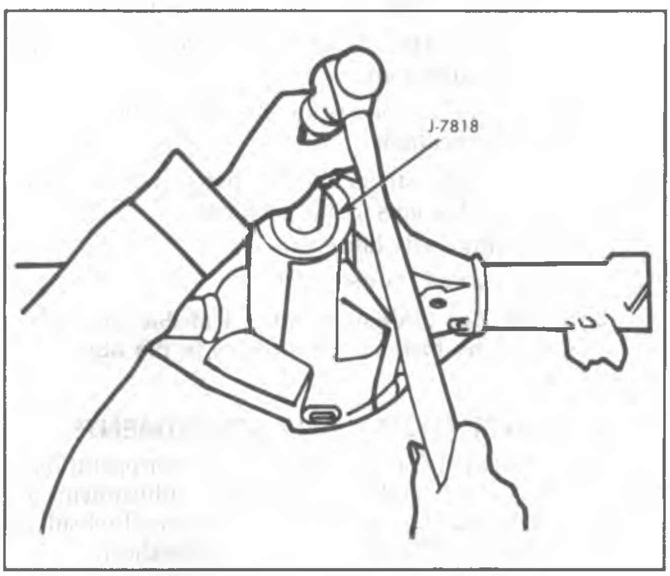


Fig. 4B4-9--Installing Outer Pinion Bearing Cup

8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 355 N·m (255 ft. lbs.).
9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 10 to 20 in. lbs. with original bearings or 20 to 40 in. lb. with new bearings.

   Torque reading to start shaft turning must be disregarded.

10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary.
    - Increase the outer shim pack to reduce rotation torque.
    - Decrease shim pack to increase rotating torque.
11. Remove nut, washer and flange from pinion shaft.
12. Install oil slinger, gasket and using Tool J-22804 install oil seal.
13. Install flange, washer and nut. Torque nut to specifications.

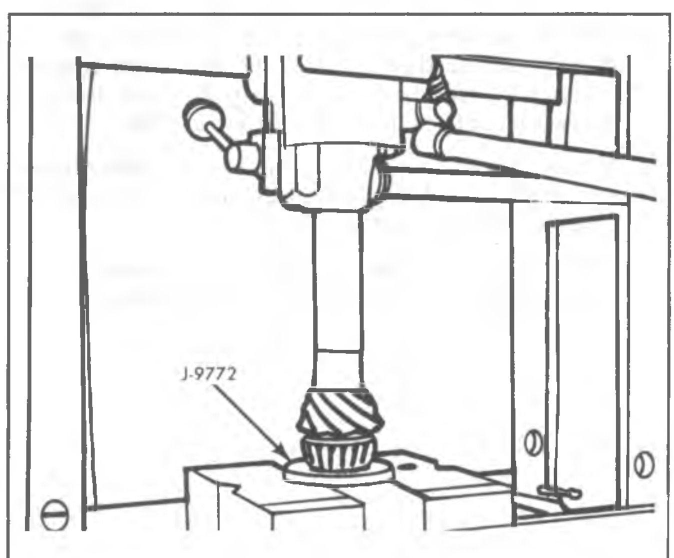


Fig. 4B4-10--Installing Inner Pinion Cone and Roller

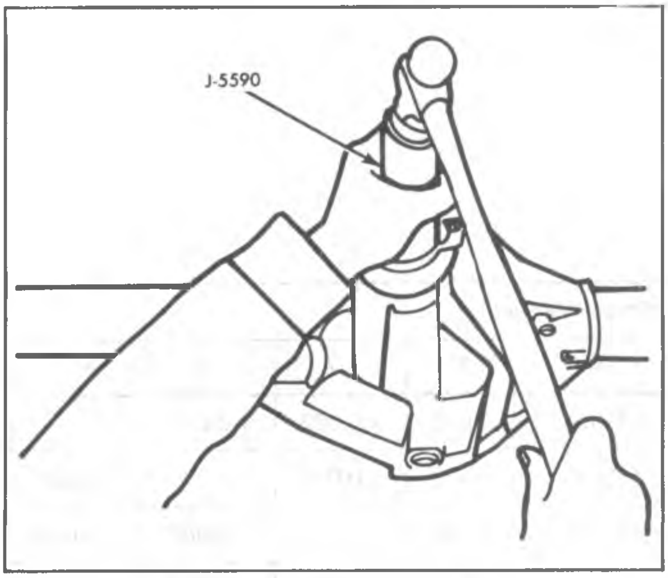


Fig. 4B4-11--Installing Pinion Flange

DIFFERENTIAL CASE

Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing. Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.
2. Install dial indicator on carrier with indicator button contacting back of ring gear, as in figure 4B4-6.
3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "0".
4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take an indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring side gear. Remove differential bearing from the ring side and assemble proper amount of shims. Reassemble bearing.
5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.
   a. Subtract the size of shim pack just installed on ring gear side of case from the reading obtained and recoreded in step 10 of Differential Case-Reassembly.
   b. To this figure, add an additional .015" shims to compensate for preload and backlash.

      Example: If reading in step 10 of Differential Case-Reassembly was .085", and the shims installed on ring gear side of case was .055", the correct amount of shim will be .085" − .055" + .015" = .045".
6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

Installation

1. Spread differential carrier, using spreader as shown in figure 4B4-2.
2. Install differential bearing outer races in their correct location, then install differential case into carrier.
3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft faced hammer to insure proper seating of case in carrier.
4. Remove spreader and torque cap bolts to specifications.
5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
7. Perform Operational Checks and Adjustments.
8. Using a new gasket, install housing cover and torque bolts to specifications.
9. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.
10. Install axles into carrier and axle flange over hub studs. Torque hub stud nuts to specifications.
11. Fill differential with lubricant.
12. Install wheel and tire assembly.

CAUTION: See Caution on page 1 of this section regarding the fasteners referred to in the above steps.

OPERATIONAL CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Refer to Section 4B for description of how to perform these checks and adjustments.

SECTION 4B5

ROCKWELL 12" RING GEAR AXLE

NOTICE: All rear axle attaching fasteners are an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

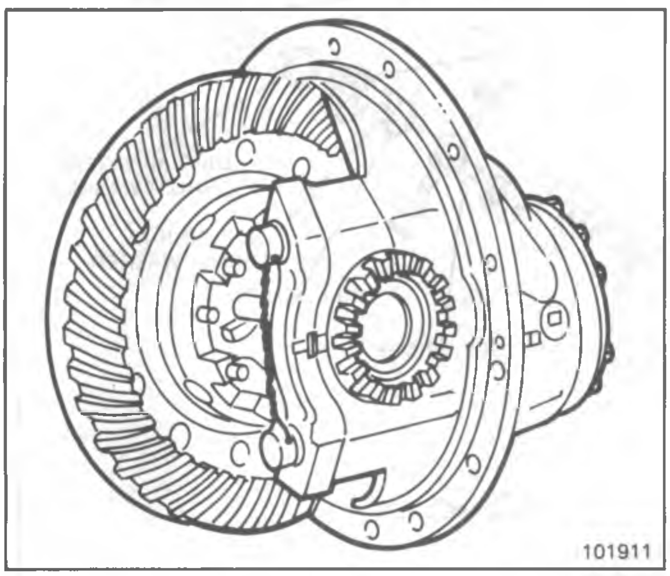


Fig. 4B5-1--Single-Reduction Carrier

The Rockwell Single-Reduction Final Drive (Fig. 4B5-1) employs a heavy duty hypoid drive pinion and ring gear. The differential and gear assembly is mounted on tapered roller bearings. The straddle mounted pinion has two tapered roller bearings in front of the pinion teeth which take the forward and reverse thrust and a third bearing behind the pinion teeth to carry the radial load.

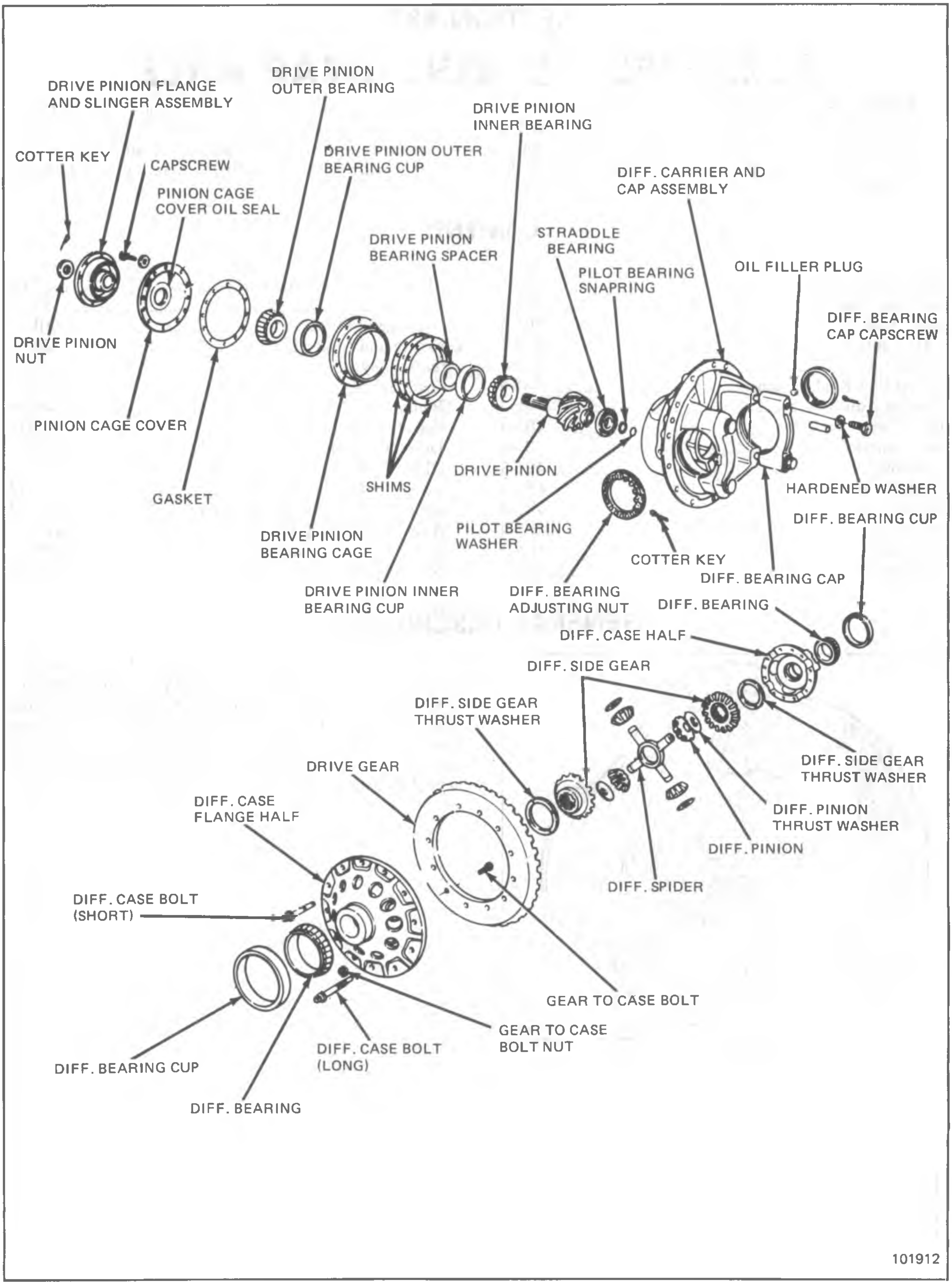


Fig. 4B5-2--Rockwell Assembly

ON-VEHICLE SERVICE

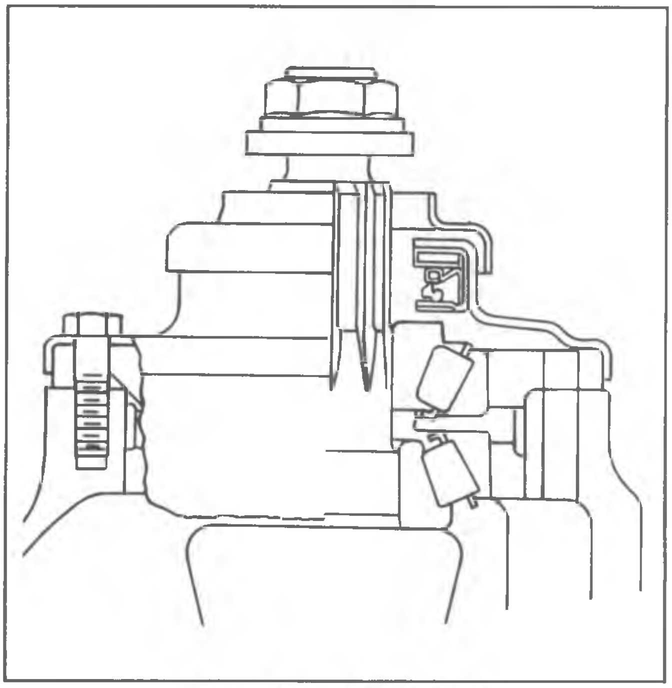


Fig. 4B5-2a -- Pinion Oil Seal

AXLE ASSEMBLY

The axle assembly removal and installation is identical to the procedure for the "Chevrolet 10-1/2" Ring Gear Axle" (Section 4B2).

AXLE VENT

Replacement

If axle vent requires replacement, pry old vent from housing being sure that entire vent is removed. Prick punch around carrier hole to insure fit of replacement vent. Tap new vent into housing using a soft-faced hammer. Vent should be positioned in housing so that flat surface is toward centerline of differential carrier.

AXLE SHAFT

Replacement

1. Remove hub cap, and install Tool J-8117 in tapped hole on shaft flange.
2. Install slide hammer, Tool J-2619, and remove axle shaft.
3. Thoroughly remove old gasket material from hub and hub cap. Clean shaft flange and mating surfaces in the wheel hub.
4. Install axle shaft so that the flange splines index into hub splines. Tap shaft into position, using J-8117 and J-2619.
5. Install new gasket, position flange to hub and install attaching bolts. Torque bolts to specifications.

WHEEL BOLT REPLACEMENT

Refer to procedure listed under "Chevrolet 10-1/2" Ring Gear Axle (Section 4B2).

BEARING ADJUSTMENT

Before checking bearing adjustment, make sure brakes are fully released and do not drag.

Check bearing play by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, movement of brake rotor will be barely noticeable and wheel will turn freely. If movement is excessive, adjust bearing as follows:

1. Remove axle shaft and raise vehicle until wheel is free to rotate.
2. Disengage tang of retainer from locknut and remove both locknut and retainer from axle housing tube with tool J-25510.
3. Use J-25510 to tighten inner adjusting nut at the same time rotating hub to make sure all bearing surfaces are in contact. Then back off inner nut to specified amount of turn-back.
4. Install tanged retainer against the inner adjusting nut. Align inner adjusting nut so short tang of retainer will engage nearest slot on inner adjusting nut.
5. Install outer locknut and tighten to correct specified torque. Then bend long tang of retainer into slot of outer nut. This method of adjustment will result in the proper bearing adjustment.

DRIVE PINION OIL SEAL

Replacement

The pinion oil seal may be replaced with the carrier assembly installed in the vehicle.

1. Disconnect propeller shaft.
2. Scribe a line down the pinion stem, pinion nut and companion flange.
3. Use J-8614-11 to remove the pinion nut and the companion flange.
4. Remove the bolts retaining the oil seal retainer to the carrier, and remove the retainer. See Figure 4B5-2a.
5. Pry the oil seal from the bore, using care not to damage the machined surfaces. Thoroughly clean all foreign material from contact area.
6. Lubricate the cavity between the seal lips with a high melting point bearing lubricant.
7. Install a new pinion oil seal into the bore, using J-22281. Be sure seal bottoms against shoulder in bore.
8. Install the bearing retainer to the carrier.
9. Reinstall the companion flange, pinion nut and propeller shaft.

DIFFERENTIAL CARRIER

Removal (Fig. 4B5-3)

1. Remove plug from bottom of axle housing and drain lubricant.
2. Remove the axle shaft from the drive unit and housing.
3. Disconnect universal at pinion shaft.

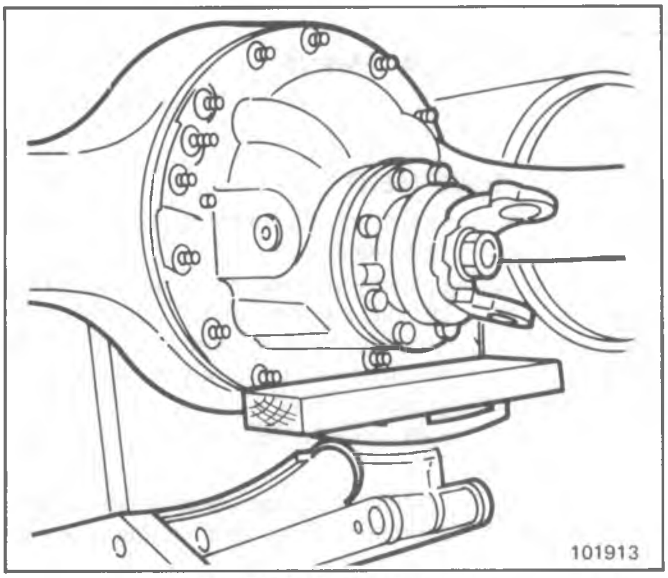


Fig. 4B5-3--Carrier Removal

4. Remove carrier to housing stud nuts and washers. Loosen two top nuts and leave on studs to prevent carrier from falling.
5. Break carrier loose from axle housing with rawhide mallet.
6. Remove top nuts and washers and work carrier free. A small pinch bar may be used to straighten the carrier in the housing bore. However, the end must be rounded to prevent indenting the carrier flange. Use a roller jack to safely remove carrier from housing (Fig. 4B5-3).

Installation

1. Remove any accumulation of dirt, grit or gum from housing bowl and sleeves. Clean housing thoroughly with solvent and blow dry with compressed air.
2. Inspect housing for cracks, loose studs, nicks and burrs at machined surfaces. Remove nicks and burrs with stone or file. Make all necessary repairs or parts replacement before installing drive unit in housing.
3. Install drive unit to housing gasket over housing studs.

   Roll carrier into position on roller jack. Start carrier into housing with four flat washers and nuts equally spaced.

   NOTICE: Do not drive carrier into housing with a hammer at the carrier stud flange. The flange may easily be distorted and cause severe oil leakage.

   Install lock washers and stud nuts on any studs under carrier housing offsets. It is impossible to start these nuts after carrier is drawn into housing.
4. Tighten the four nuts over flat washers alternately to draw carrier squarely into axle housing.
5. Connect universal at pinion shaft.
6. Install axle shafts.

UNIT REPAIR

DIFFERENTIAL CASE AND GEAR ASSEMBLY

Place carrier in suitable holding fixture as illustrated (Fig. 4B5-4).

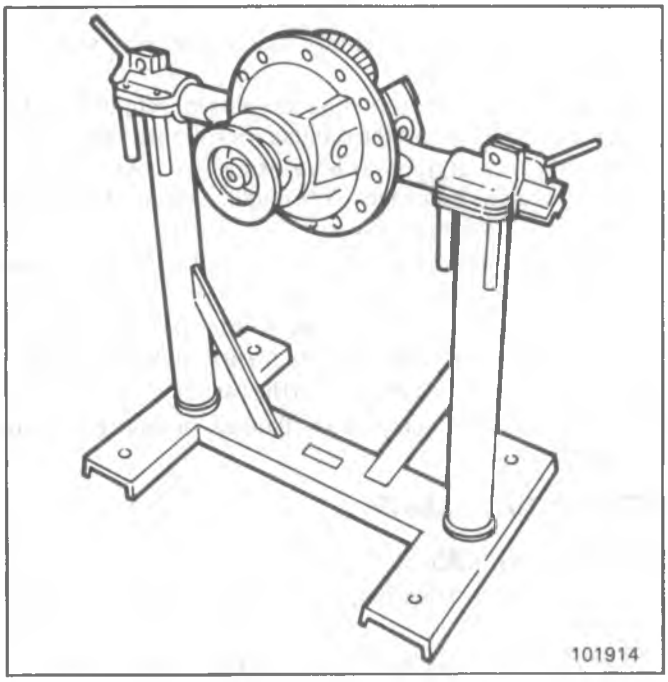


Fig. 4B5-4--Carrier In Repair Stand

If the initial inspection indicates that the drive gear is not going to be replaced, the established backlash should be measured and noted for reference and used at reassembly.

Removal

1. Loosen jam nut and back off thrust adjusting screw (Fig. 4B5-5).
2. Center punch one differential carrier leg and bearing cap to identify for properly reassembling (Fig. 4B5-6).
3. Remove capscrews and adjusting nut locks.

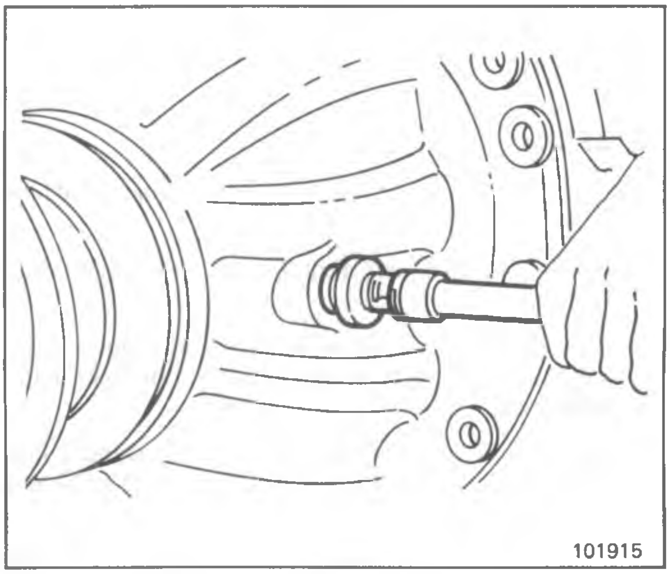


Fig. 4B5-5--Thrust Adjusting Screw

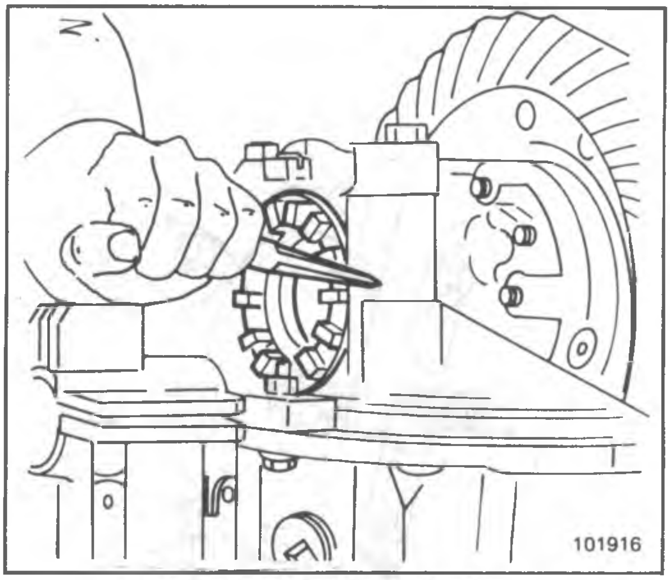


Fig. 4B5-6--Punching Carrier Leg

4. Remove bearing cap, capscrews, bearing caps and adjusting nuts.
5. Lift out differential and gear assembly.

Disassembly

If original identification marks are not clear, mark differential case halves with a punch or chisel for correct alignment when reassembling (Fig. 4B5-8).

1. Remove bolts and separate case halves.
2. Remove spider, pinions, side gears and thrust washers.
3. If necessary, remove rivets and separate gear and case.

Rivet Removal (Fig. 4B5-9)

1. Carefully center punch rivets in center of head.
2. Use drill 1/32" smaller than body of rivet to drill completely through rivet.
3. Press out rivets.

If necessary to replace differential bearings, remove with a suitable puller and/or press (Fig. 4B5-10).

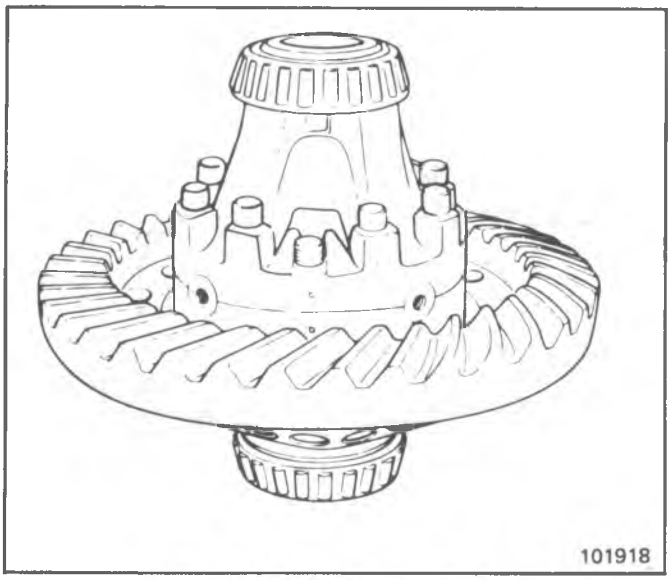


Fig. 4B5-8--Identification Mark

Pinion and Cage Assembly Removal

1. Hold flange with suitable tool and remove pinion shaft nut and washer (Fig. 4B5-11).
2. Remove flange with a suitable puller (Fig. 4B5-12).

NOTICE: Driving the flange off will cause runout.

3. Remove pinion cage capscrews.
4. Remove bearing cover and oil seal assembly.

If necessary to replace oil seat drive seal out and then press in new seal with tool.

5. Remove drive pinion bearing cage (Fig. 4B5-13). Original may have puller holes.

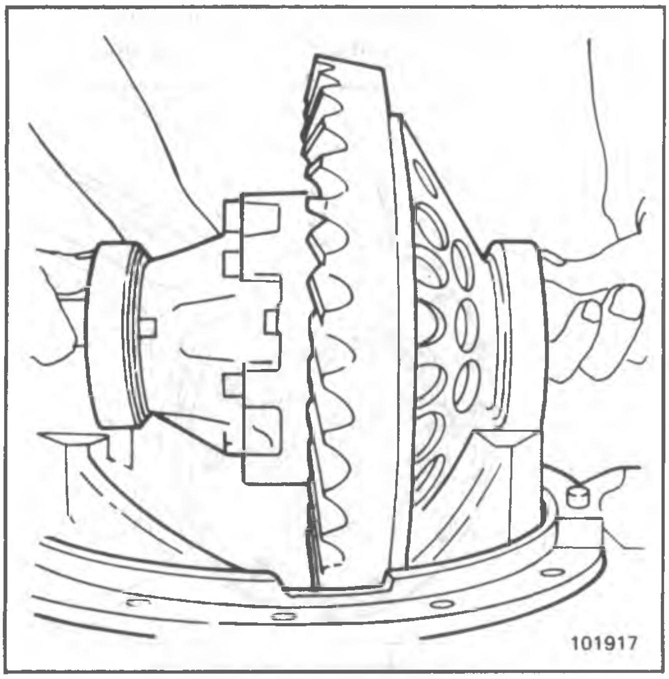


Fig. 4B5-7--Lifting Differential

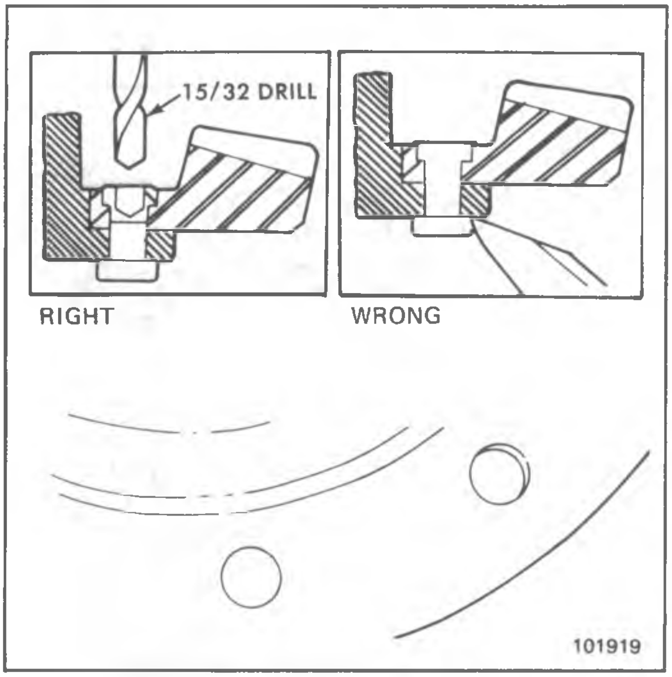


Fig. 4B5-9--Removing Rivets

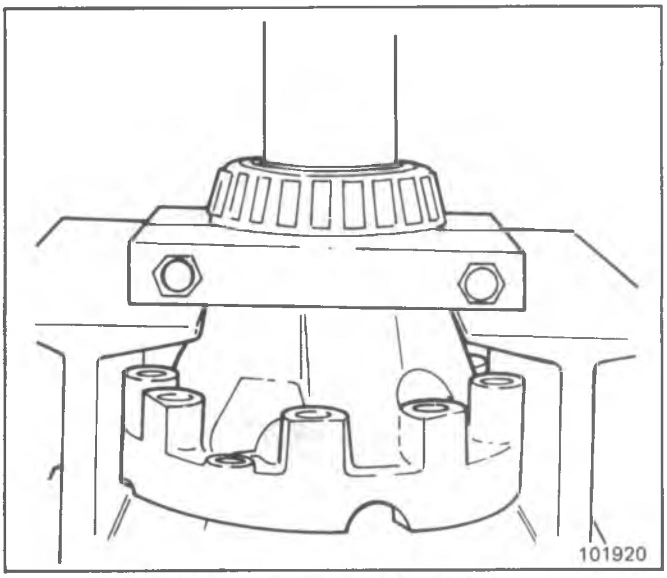


Fig. 4B5-10 -- Removing Differential Bearing

NOTICE: The use of a pinch bar will damage the shims. Driving pinion from inner end with a drift will damage the bearing lock ring groove.

6. Wire shim pack together to facilitate adjustment on reassembling.

Disassemble Pinion and Cage Assembly

1. Tap shaft out of cage with soft mallet or press shaft from cage.
2. Remove outer bearing from cage.
3. Remove spacer or spacer combination from pinion shaft.
4. Remove inner bearing using a press or puller.
5. If necessary to replace rear straddle bearing, remove with suitable puller.
6. Remove oil seal assembly from bearing cover.

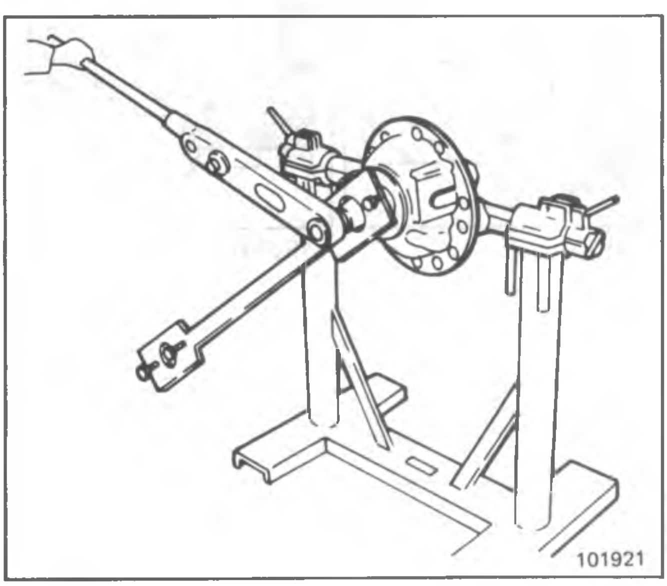


Fig. 4B5-11--Removing Pinion and Cage

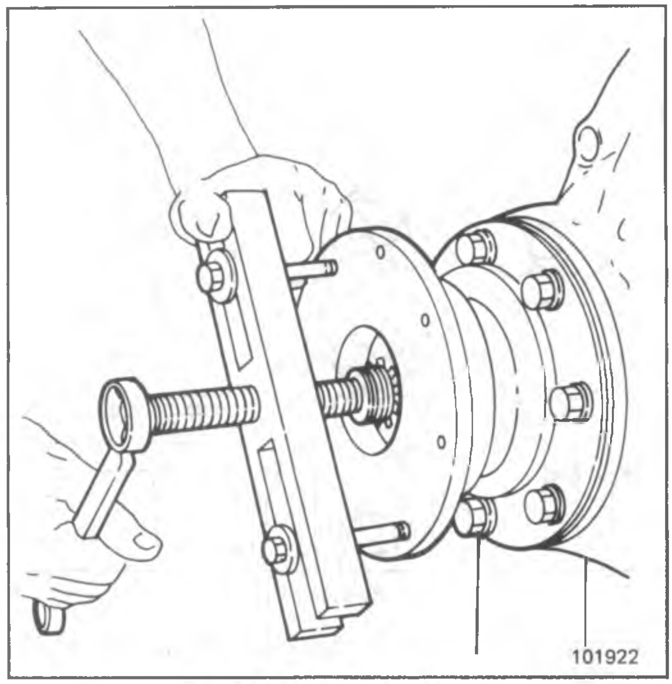


Fig. 4B5-12--Removing Flange

CLEANING AND INSPECTION

Cleaning

Steam cleaning assembled drive units after they have been removed from the housing is not recommended. When this method of cleaning is used, water is trapped in the cored passage of the castings and in the close clearances between parts as well as on the parts. This can lead to corrosion (rust) of critical parts of the assembly and the possiblility of circulating rust particles in the lubricant. Premature failure of bearings, gears and other parts can be caused by this practice. Assembled drive units cannot be properly cleaned by steam cleaning, dipping or slushing. Complete drive unit disassembly is a necessary requisite to thorough cleaning.

Completely assembled axles, torque dividers and transfer cases may be steam cleaned on the outside only, to

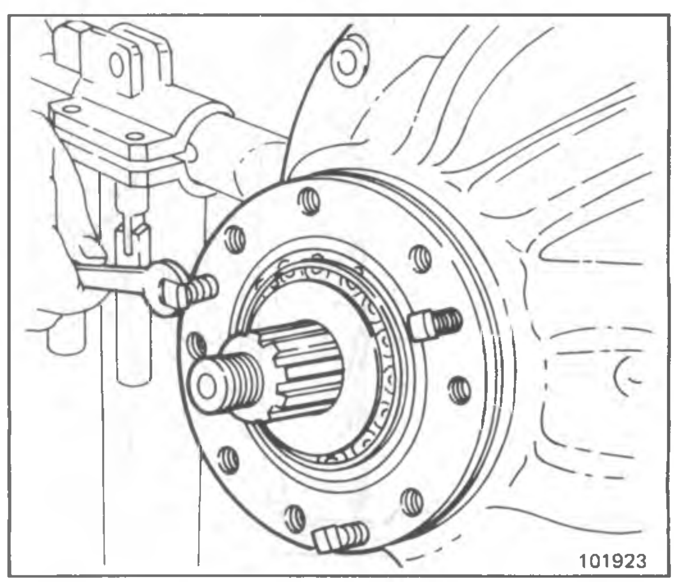


Fig. 4B5-13--Removing Bearing Cage

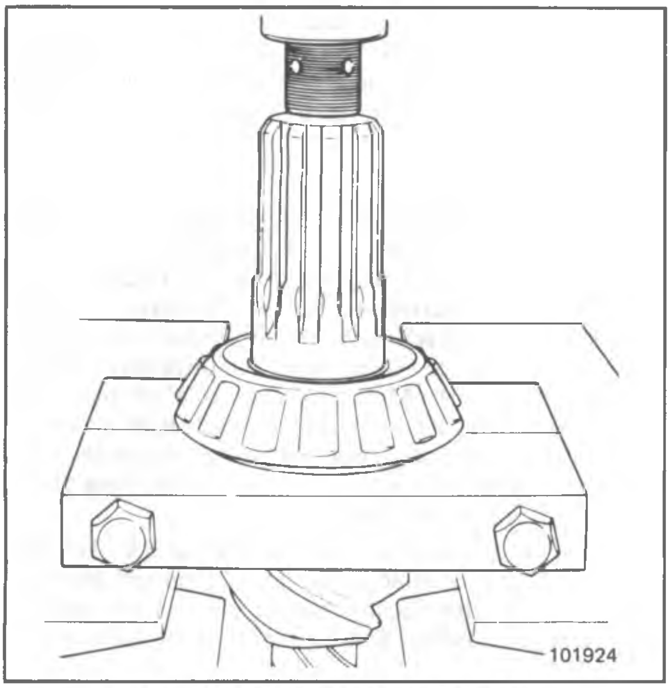


Fig. 4B5-14--Removing Inner Bearing

facilitate initial removal and disassembly, providing all openings are closed. Breathers, vented shift units, and all other openings should be tightly covered or closed to prevent the possibility of water entering the assembly.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless absorbent paper towels or wiping rags free of abrasive material, such as lapping compound, metal filings or contaminated oil. Bearings should never be dried by spinning with compressed air.

Inspection

It is impossible to over stress the importance of careful and thorough inspection of drive unit parts prior to reassembly. Thorough visual inspection for indications of wear or stress, and the replacement of such parts as are necessary will eliminate costly and avoidable drive unit failure.

Inspect all bearings, cups and cones, including those not removed from parts of the drive unit, and replace if rollers or cups are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with sleeves. Avoid the use of drifts and hammers. They may easily multilate or distort component parts.

Refer to Section 4B for bearing diagnosis.

REASSEMBLY

Where silicone RTV gasket material is used, Dow Silastic No. RTV-732 Black and General Electric No. RTV-1473 Black (or equivalent) should be used.

NOTICE: Failure to use appropriate gasket material will cause axle to leak.

Removal of all gaskets including silicone RTV is accomplished by peeling or scraping the used gasket off both mating surfaces. Application of silicone RTV gasket material is as follows:

1. Remove dirt, grease or moisture from both mating surfaces.
2. Dry both surfaces.
3. Apply thin bead, approximately 1/8" diameter completely around one mating surface and all fastener holes to assure complete sealing and prevent leakage.

   CAUTION: Minor concentrations of acetic acid vapor may be produced during application. Adequate ventilation should be provided when silicone RTV is applied in confined areas.

   Further, eye contact with these silicone RTV gasket materials may cause irritation; if eye contact takes place, flush eyes with water for 15 minutes and have eyes examined by a doctor.
4. Assemble the components immediately to permit silicone RTV gasket material to spread evenly.

When rebuilding any assembly, always use torque values on fasteners as specified.

Gear Set Identification

If a new gear set (drive pinion and ring gear) is being installed into the carrier, refer to the following gear set information before starting reassembly. However, if the original gear set is to be installed, start with Pinion and Case Reassembly.

The following information is marked on current drive pinion and gear sets, and will be used for identifying, matching and adjusting procedures. The items listed are keyed to illustration (Fig. 4B5-15).

1. Part Number.
2. Tooth Combination Number.

   The Part Number and Tooth Combination Number are found on the shank or threaded end of all pinions. On the ring gears, the numbers are normally found on the front face of the gear. However, as an option, they may be located at the gear O.D.

   For any given pinion and gear set, the ring gear always has an even part number (i.e. 36786) and the matched pinion has the odd number (i.e. 36787).

   The tooth combination number (i.e. 5-37) indicates the gear set has a 5 tooth pinion and a 37-tooth ring gear, the equivalent of a 7.4 to 1 gear ratio.

   Always refer to the Part Number and Tooth Combination Number before starting the reassembly. Check to be certain the pinion and gear match.

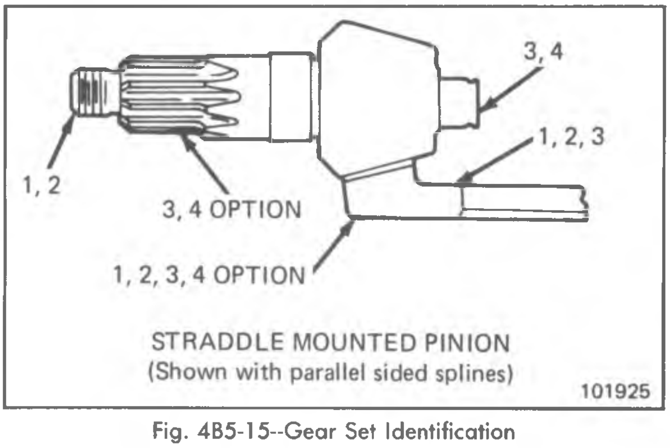


Fig. 4B5-15--Gear Set Identification

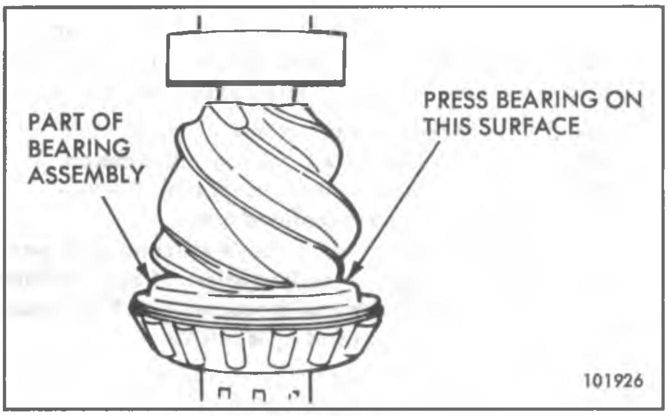


Fig. 4B5-16--Installing Bearings

3. Gear Set Matching Numbers

   All drive pinion and gear sets are manufactured and sold only in matched sets. Both pieces of the set have a matching number such as "M29" or any combination of a letter and number.

   On most pinions, the number is usually marked on the head end. However, on pinions with parallel-sided splines, the number may be marked on the top flat or one of the splines.

   On the ring gear, the number is usually found on the front face of the gear, although sometimes it may be on the gear O.D.

   A gear and pinion which do not have the same matching numbers must not be run together. Therefore, if either a pinion or a ring gear should require replacement, both must be replaced in a matched set.

4. Pinion Cone Variation Number

   Each pinion has a Pinion Cone (P.C.) Variation Number which indicates variations (in thousandths of an inch) from the nominal mounting distance. This Pinion Cone Variation Number is necessary because pinion and gear sets for a specific series of axles cannot be manufactured exactly alike, and there may be slight differences in the Mounting Distance of the individual gear sets. This P.C. Variation Number must be used to modify the Nominal Pinion Gaging Dimension when using a pinion setting gage or when calculating pinion cage shim pack thickness.

   The Pinion Cone Variation Number (i.e. P.C. 3 or P.C. -5) is normally found on the pinion head end; however, it may sometimes be located on a spline of a pinion with the larger parallel-sided-type splines or on the ring gear O.D.

   The nominal pinion mounting distance is 6.125 inch (155.58mm).

   The pinion backlash setting is .005" - .015" (.13 - .39mm).

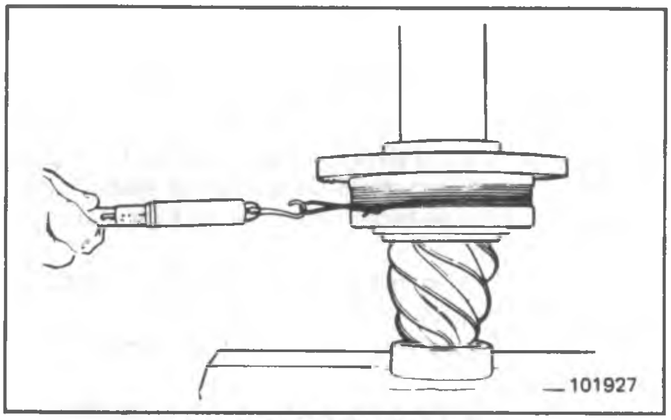


Fig. 4B5-17--Preload Torque

PINION AND CAGE

Reassembly

1. If new cups are to be installed, press firmly against pinion bearing cage shoulders (Fig. 4B5-16).
2. Lubricate bearings and cups with the recommended axle lubricant.
3. Press rear thrust and radial bearings firmly against the pinion shoulders with a suitable sleeve that will bear only on bearing inner race.
4. Install radial bearing lock ring and squeeze ring into pinion shaft groove with pliers.
5. Insert pinion and bearing assembly in pinion cage and position spacer or spacer combination over pinion shaft.
6. Press front bearing firmly against spacer.
7. Rotate cage several revolutions to assure normal bearing contact.

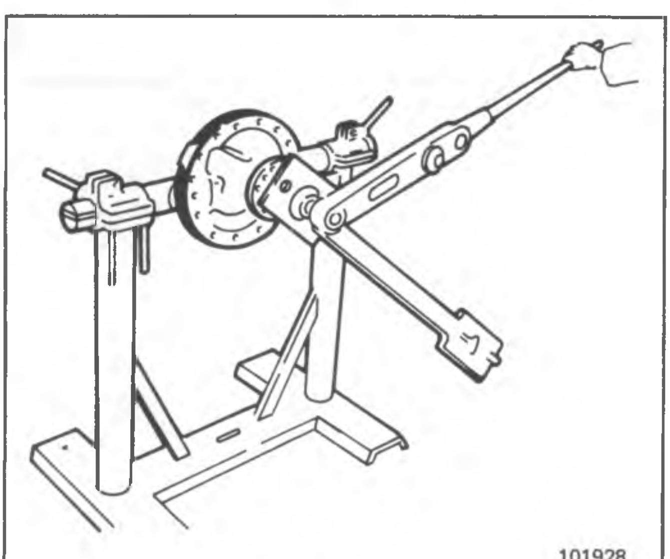


Fig. 4B5-18--Holding and Torquing Pinion Flange

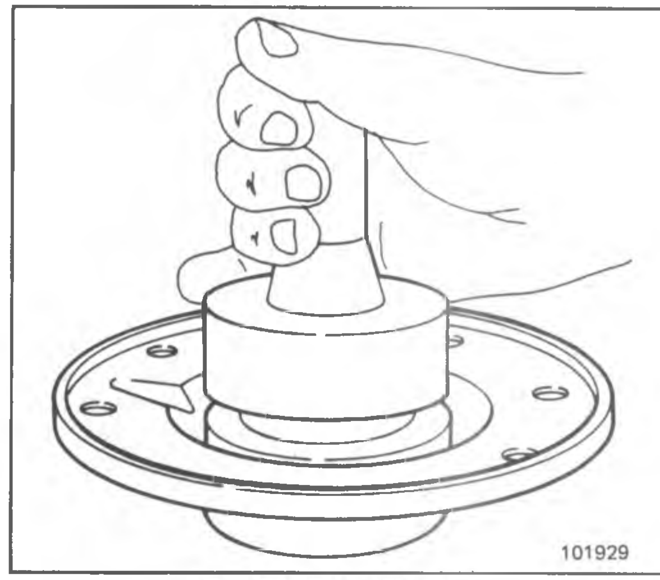


Fig. 4B5-19--Installing Seal

8. While in press under pressure, check bearing preload torque. Wrap soft wire around cage and pull on horizontal line with pound scale (Fig. 4B5-17).

   Use rotating torque, not starting torque.

   If a press is not available, the pinion nut may be tightened to the correct torque and preload checked.

   The correct pressures and torque for checking pinion bearing preload are shown in specifications.

   If rotating torque is not within 5 to 15 pound inches, use thinner spacer to increase or thicker spacer to decrease preload.

Example: Assuming pinion cage diameter to be 6 inches, the radius would be 3 inches and with 5 pounds pull would equal 15 pound inches preload torque.

9. Press flange or yoke against forward bearing and install washer and pinion shaft nut.
10. Place pinion and cage assembly over carrier studs, hold flange and tighten pinion shaft nut to the correct torque. The flange must be held with a suitable tool or fixture to tighten nut (Fig. 4B5-18).
11. Recheck pinion bearing preload torque. If rotating torque is not within 5 to 15 pound inches, repeat the foregoing procedure.
12. Hold flange and remove pinion shaft nut and flange.
13. Lubricate pinion shaft oil seal and cover outer edge of seal body with a non-hardening sealing compound. Press seal against cover shoulder with seal driver (Fig. 4B5-19).
14. Install new gasket and bearing cover.
15. Press flange against forward bearing and install washer and pinion shaft nut (Fig. 4B5-20).
16. Tighten nut to the correct torque value.

Selecting Pinion Cage Shim Pack Thickness

A means of accurately installing a new pinion and cage assembly into the carrier is to mathematically calculate the proper pinion cage shim pack thickness.

The following are the procedures to use:

1. Measure the thickness of the original shim pack used with the gear set being replaced. Use a micrometer or vernier gage. Record this measurement for future use.

2. Observe the "PC" or variation number on the original pinion being replaced. If this number is a plus ( ) value, subtract it from the original shim pack measurement taken in item "1". If the variation number is a minus (-) value, add it to the measurement from item "1". Make a note of this value.

   The value calculated in item "2" will establish a "standard shim pack thickness", without a variation. This value will be used in calculating the shim pack thickness used with a new pinion and gear set.

3. Observe the "PC" or variation number on the new pinion, (locations of the "PC" number are shown above). Add or substract this number as indicated by the variation sign (add or - substract) from the calculated "standard shim pack thickness" determined in item "2".

   The resulting answer indicates the thickness (in thousandths) of the new shim pack to be used. Refer to the following examples which cover all the possible combinations of or - original and new "PC" variations.

After calculating the shim pack thickness, assemble the new pinion and cage assembly with the correct shim pack into the carrier as follows:

Remember all drive pinion and gear sets are manufactured and sold only in matching sets. Therefore, if either a pinion or a ring gear should require replacement, both must be replaced in a matching set.

Pinion and Cage Assembly

Installation

1. Position the correct shim pack between the pinion cage and carrier.

   Use a minimum of three (3) shims per pack. If the pack is made up from various thicknesses of shims, locate thinnest shims on both sides of the pack for maximum sealing ability.
2. Install the pinion and cage assembly with shims into carrier and tap into position with soft mallet.
3. Install pinion cage capscrews. Tighten capscrews to the correct torque.
4. After the differential and gear assembly is installed into carrier, make a gear tooth contact check (Refer to Section 4B).

Differential and Gear

Assembly

NOTICE: The ring gear must be heated before assembling onto the case half, otherwise damage to the case half will result.

Proper service replacement of the differential ring gear onto the differential case half is necessary for correct gear adjustment and longer drive unit service life.

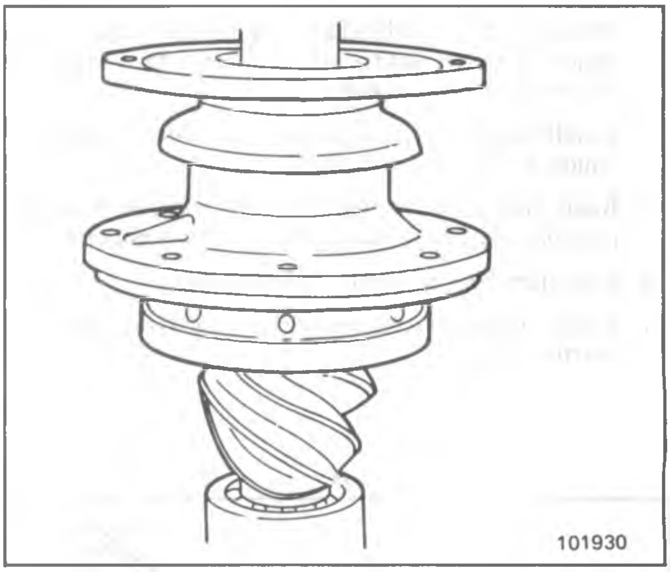


Fig. 4B5-20--Installing Flange

EXAMPLES OF CALCULATION:

EXAMPLE NO. 1		
Original Pack Thickness		.030"
Original Variation (PC +2)	−	.002
Standard Pack Thickness		.028"
New Variation (PC +5)	+	.005
New Pack Thickness		.033"
EXAMPLE NO. 2		
Original Pack Thickness		.030"
Original Variation (PC +2)	+	.002
Standard Pack Thickness		.032"
New Variation (PC +5)	+	.005
New Pack Thickness		.037"
EXAMPLE NO. 3		
Original Pack Thickness		.030"
Original Variation (PC +2)	−	.002
Standard Pack Thickness		.028"
New Variation (PC -5)	−	.005
New Pack Thickness		.023"
EXAMPLE NO. 4		
Original Pack Thickness		.030"
Original Variation (PC -2)	+	.002
Standard Pack Thickness		.032"
New Variation (PC-5)	−	.005
New Pack Thickness		.027"

For correct installation, heat the ring gear in water to approximately 160°-180° for about ten minutes before assembly. This will allow an easier fit of the gear over the differential case pilot, without the use of a press, and without damaging the case and ring gear mating surfaces.

NOTICE: The gear should not be pressed or driven on the case, as this would cause excessive metal particles to lodge between the gear and case, thus resulting in gear runout. Proper installation should, therefore, incorporate preheating the gear as described above to assure correct interference fit and to eliminate metal pick-up.

Differential case and ring gear bolts should be used for service replacement of rivets if required. Replacement bolt kits are available through service. Refer to specifications for service bolt instructions and torque.

Differential Pinion and Side Gear (Fig. 4B5-21)

Assembly

1. Position thrust washer and side gear in ring gear and case half assembly.
2. Place spider with pinions and thrust washers in position.
3. Install component side gear and thrust washer.
4. Align mating marks, position component case half and draw assembly together with four bolts or capscrews equally spaced (Fig. 4B5-22).
5. Check assembly for free rotation of differential gears and correct if necessary.
6. Install remaining bolts and capscrews, tighten to the correct torque.
7. If bearings are to be replaced, press squarely and firmly on differential case halves.

Rolling Resistance Check of Differential Nest

1. Place differntial and ring gear assembly in a vise.

   Use soft metal covers over vise jaw to protect ring gear.

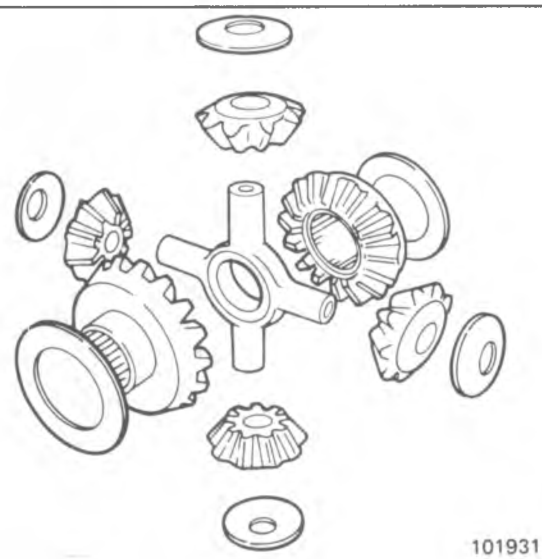


Fig. 4B5-21--Pinion and Side Gears

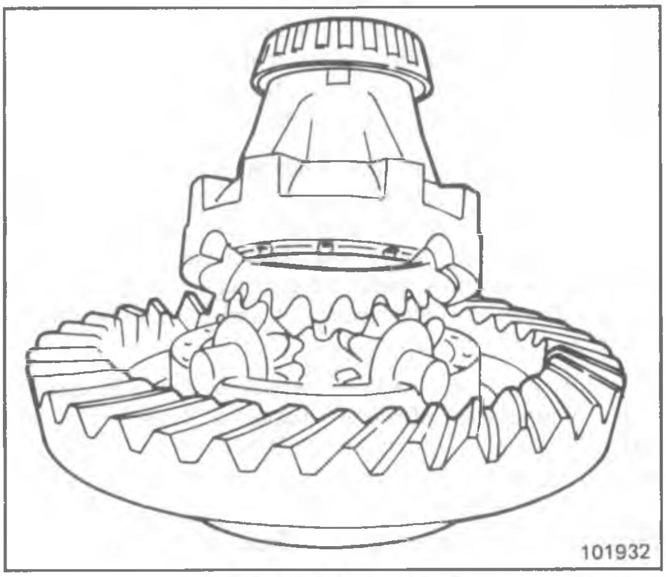


Fig. 4B5-22--Align Marks

2. Insert checking tool (made from splined axle shaft end) into differential nest. Allow splines of tool to engage with spline of one side gear only (Fig. 4B5-23).
3. Using a suitable socket and torque wrench, rotate differential nest while observing scale on torque wrench (Fig. 4B5-24).

   Correct rolling resistance of differential assembly is 50 lb. ft. torque maximum applied to one side gear. This applies to all differential assemblies.

   A suitable checking tool can be made by cutting an axle shaft to an appropriate length and welding a nut on the end to accept a wrench socket (Fig. 4B5-25).

Install Bearing Cups

1. Temporarily install the bearing cups, threaded adjusting rings where employed and bearing caps. Tighten the capscrews to the proper torque.
2. The bearing cups must be of a hand push fit in the bores, otherwise the bores must be reworked with a scraper or some emery cloth until a hand push fit is obtained. Use a blued bearing cup as a gage and check the fits as work progresses. Once the cups fit properly, remove the bearing caps (Fig. 4B5-26).

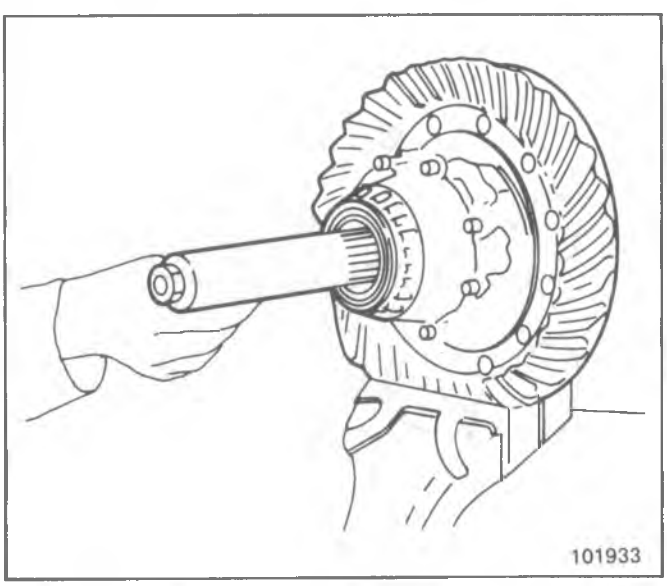


Fig. 4B5-23--Installing Tool

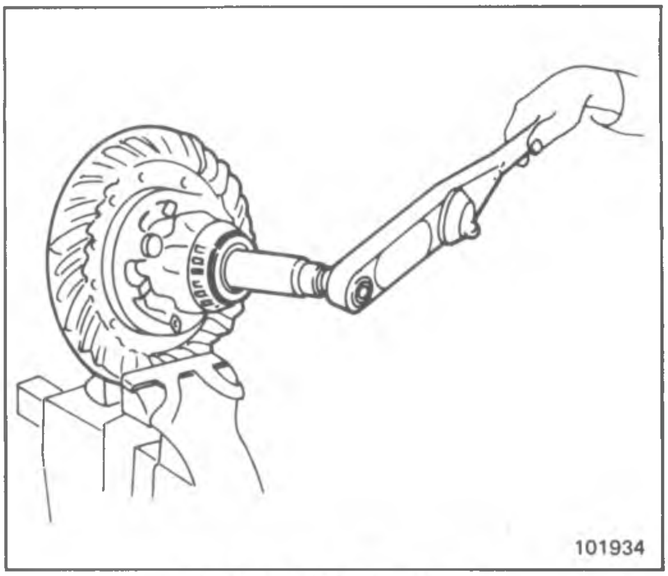


Fig. 4B5-24--Checking Torque

Installing Differential and Gear

1. After checking related parts, coat the differential bearing cones and cups with specified rear axle lubricant.
2. Place the bearing cups over the assembled differential bearing cones, then position the differential assembly in the carrier.
3. Insert bearing adjusting nuts and turn hand-tight against bearing cups.
4. Install bearing caps in the correct location as marked and tap lightly into position.

   If bearing caps do not position properly, adjusting nuts may be cross threaded. Remove caps and reposition the adjusting nuts (Fig. 4B5-27). Forcing caps into position will result in irreparable damage to the carrier housing or bearing caps.

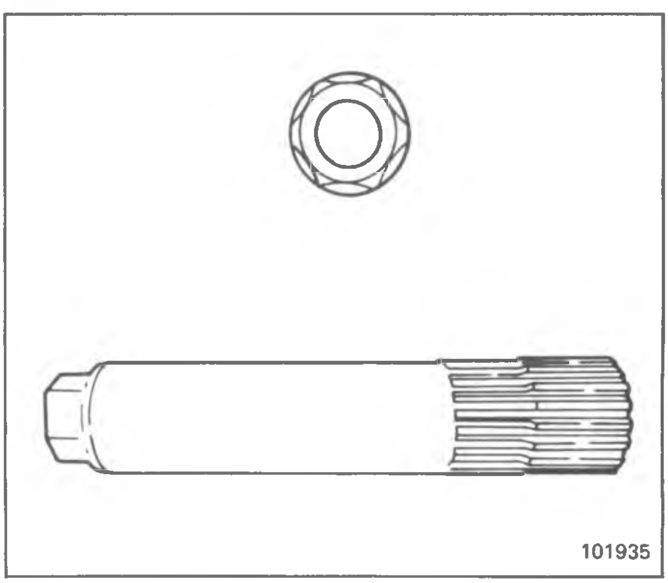


Fig. 4B5-25--Checking Tool

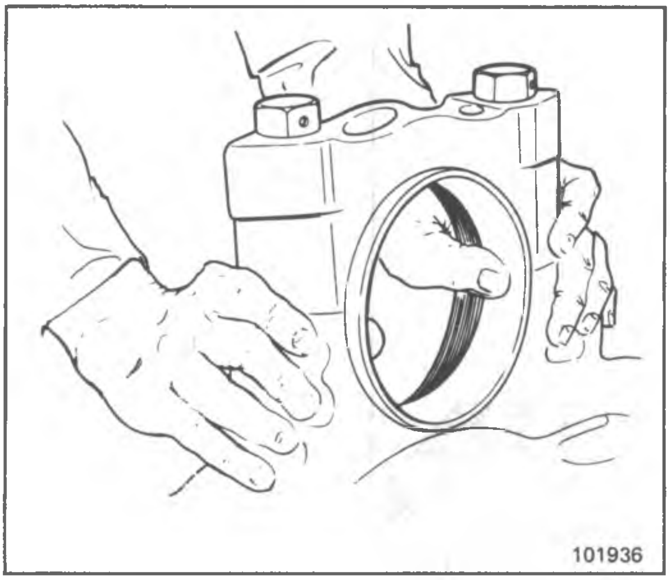


Fig. 4B5-26--Fitting Bearing Cups

5. Install flat washers and capscrews. Tighten stud nuts or capscrews to correct torque.

Adjusting Differential Bearing Preload

1. Using dial indicator at backface of gear, loosen the bearing adjusting nut on the side opposite gear only sufficient to notice end play on the indicator (Fig. 4B5-28).
2. Tighten the same adjusting nut only sufficient to obtain .000 end play.
3. Check gear for runout. If runout exceeds .008", remove differential and check for cause.
4. Tighten adjusting nuts one notch each from .000 end play to preload differential bearings.

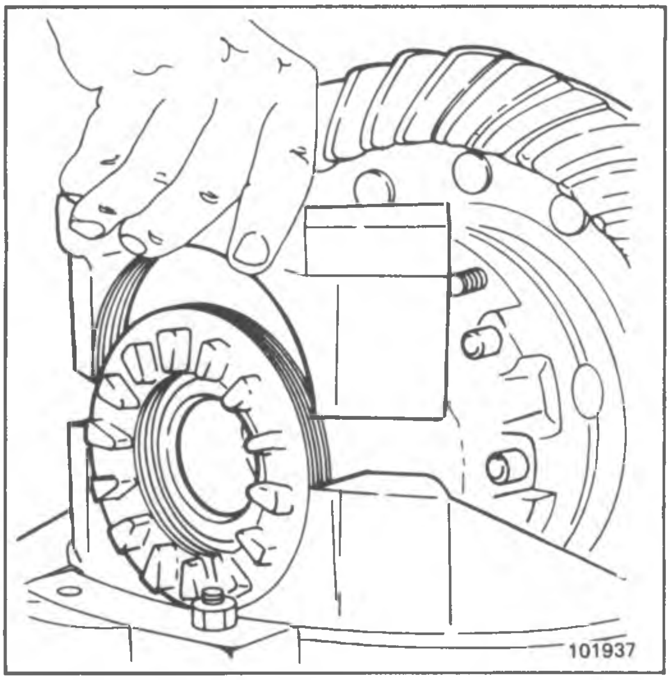


Fig. 4B5-27--Installing Bearing Caps

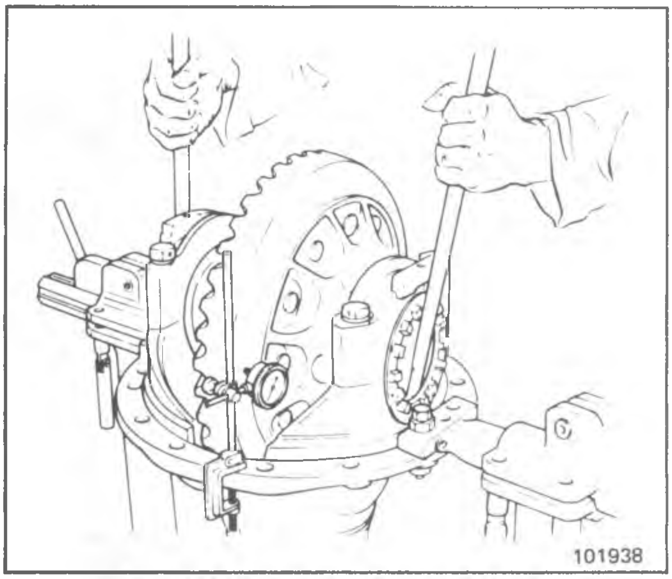


Fig. 4B5-28--Adjusting Bearing Preload

Checking Backlash

If the drive gear is not going to be replaced, use the established backlash recorded before disassembly. For new gears, the new backlash should be initially set at .010". Adjust backlash by moving the gear only. This is done by backing off one adjusting ring and advancing the opposite ring the same amount (Fig. 4B5-29). Install cotter keys.

Installing Thrust Screw

1. Remove carrier from stand and position with back face of hypoid or spiral bevel gear upward.
2. Remove adjusting screw and lock nut.
3. Install thrust screw and lock nut and tighten thrust screw sufficient to locate thrust block firmly against back face of hypoid gear.
4. To secure the correct adjustment of .010" - .015" clearance, loosen adjusting screw (or thrust screw) 1/4 turn and lock securely with nut (Fig. 4B5-30).
5. Recheck to assure minimum clearance of .010" during full rotation of bevel gear.

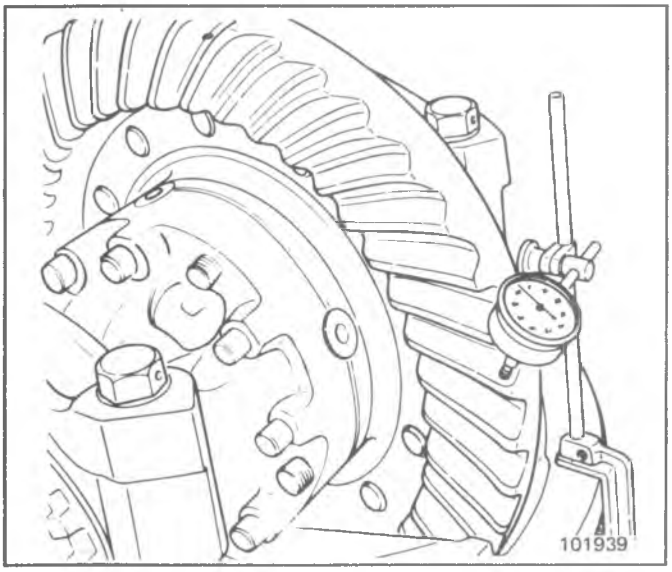


Fig. 4B5-29--Checking Backlash

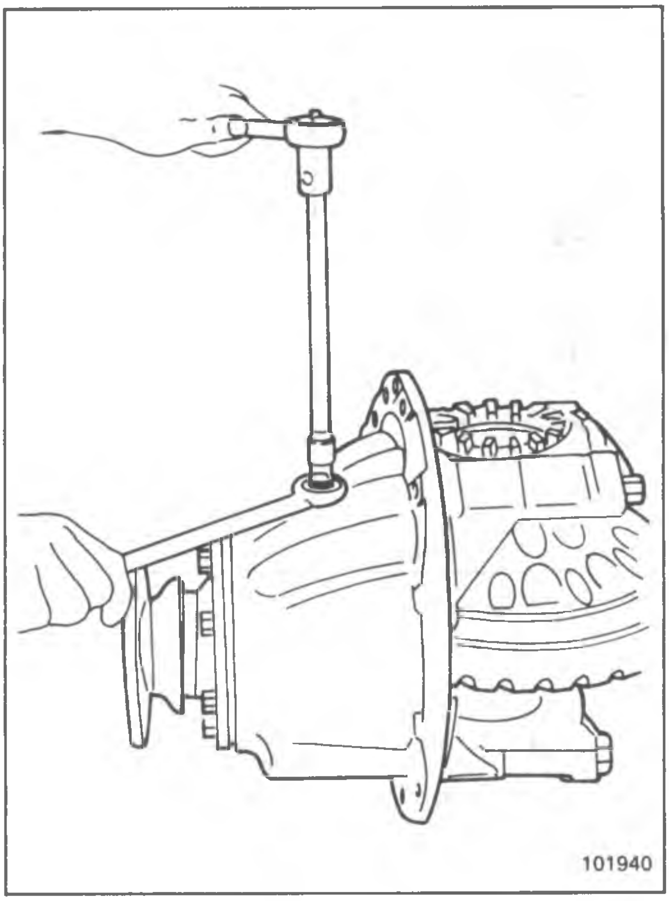
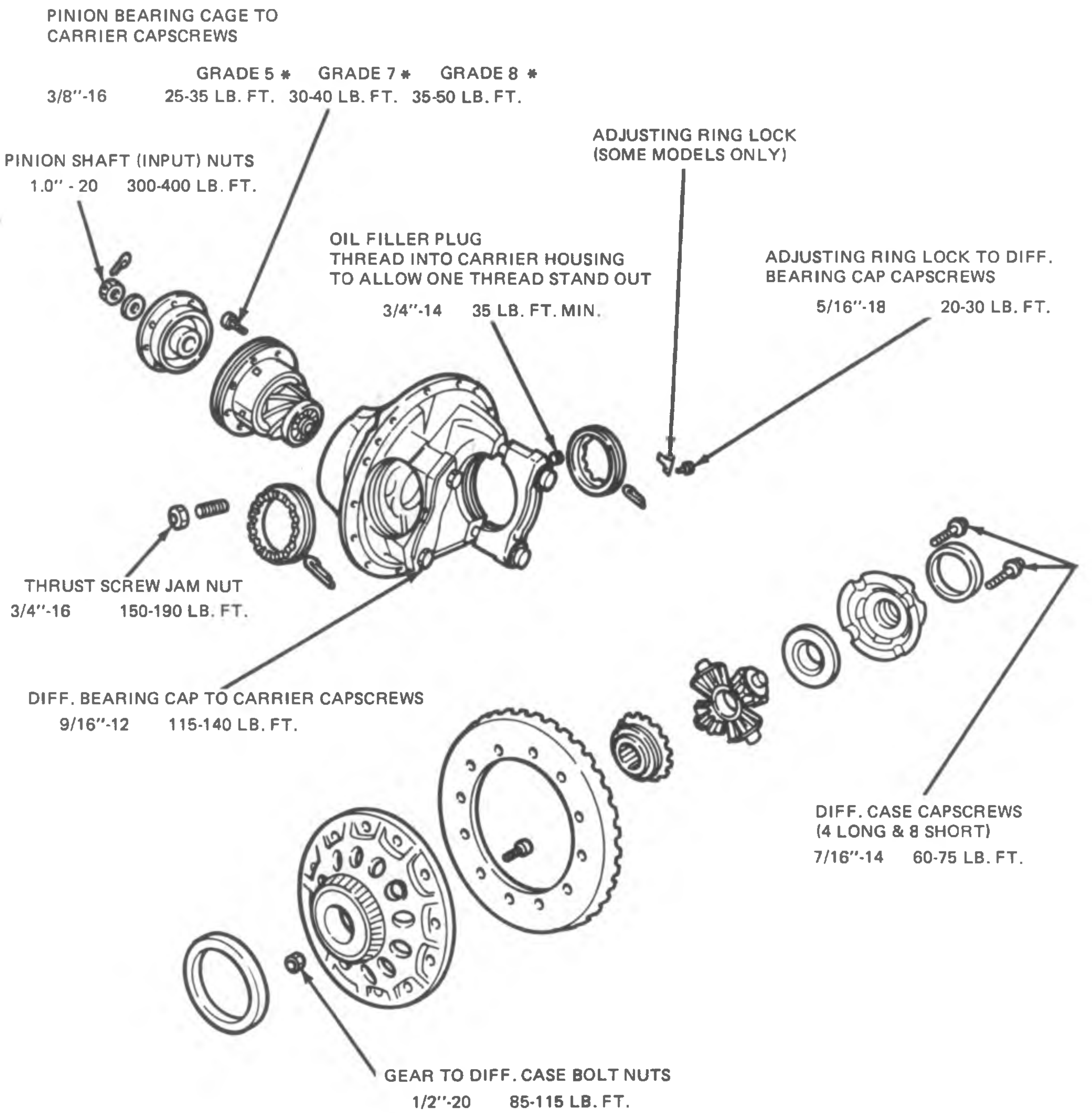


Fig. 4B5-30--Adjusting Thrust Screw



FOR ALL FASTENERS

- ALL TORQUES GIVEN APPLY TO PARTS LIGHTLY COATED WITH RUST PREVENTATIVE TYPE OIL
- FOR DRY PARTS - INCREASE TORQUES 10%
- FOR PARTS HEAVILY COATED WITH OIL - DECREASE TORQUES 10%

* GRADE IDENTIFICATION FOR CAPSCREWS (HEAD MARKINGS)

GRADE 5
GRADE 7
GRADE 8

101942

EATON LOCKING DIFFERENTIAL

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Checking Locking Diff. Operation 1
Diagnosis 2
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GENERAL DESCRIPTION

EATON LOCKING DIFFERENTIAL

The Locking Rear Differential allows for normal differential function, as noted in the Standard Rear Axle Section. Typical construction are shown in Figs. 2 and 3. In addition, the Locking Rear Differential incorporates multi-disc clutch packs and a speed sensitive engagement mechanism, which locks both wheels together if either wheel should spin excessively during slow vehicle operation.

Under light loads, the clutch plates alone tend to lock axle shafts to the differential case, and therefore, each other. This is due primarily to the gear separating load developed on the RH (LH on 10-1/2" model) clutch pack. This induced clutch torque capacity resists motion between the side gear and the rear axle differential case. The axle shaft torques developed when turning a corner will overcome this capacity and allow differentiation. Also, heavier throttle application will cause differentiation, but this initiates the full-lock feature of the unit.

Full locking is accomplished through the use of flyweight governor mechanism, cam system, and multi-disc clutch packs. The flyweights on the governor mechanism move outward to engage a latching bracket whenever the wheel-to-wheel speed varies by approximately 100 rpm or more. This action retards a cam which, in turn, compresses the multi-disc clutch packs locking both side gears to the case. The 100 rpm wheel-to-wheel speed allows for cornering without differential lock-up.

At vehicle speeds above approximately 20 mph (32 km/h), the latching bracket overcomes a spring preload and swings away from the flyweights. At this vehicle speed or greater, the differential will not lock as the added traction is generally not required.

All rear axle parts of vehicles equipped with the Locking Rear Axle are interchangeable with those equipped with the conventional rear axle, except for the case assembly.

CHECKING LOCKING DIFFERENTIAL OPERATION

1. Place the vehicle on a frame-contact hoist, allowing free rotation of the rear wheels.
2. Raise hoist until wheels clear floor. Holding one wheel stationary, slowly rotate other wheel approximately 1/2 revolution per second, in both the forward and reverse directions. Wheel should rotate freely and opposite directions. If both wheels attempt to turn together, the differential is locking prematurely and is defective.
3. Raise hoist to maximum height with one person in vehicle.
4. Start engine making sure that carburetor is set at a slow idle speed.
5. With automatic transmission, apply brakes, then place transmission in drive. With manual transmission, depress clutch and place transmission in first gear.
6. An assistant should then lock one rear wheel by pulling one parking brake cable from under the vehicle.
7. With engine at low idle, slowly release brakes, or slowly engage clutch, as required.
8. Locked rear wheel will remain stationary and free wheel will begin turning. It is important that brakes or clutch be released slowly enough to start the free wheel turning and allow the free wheel to gradually increase in speed. As speed of the free wheel is increased, the differential will lock causing the rotating wheel to stop or both wheels to run at the same speed. The engine may stall if equipped with a manual transmission. It may be necessary to accelerate engine until approximately 10 mph is indicated on vehicle speedometer to cause differential lock.. If indicated speed can be increased beyond 20 mph (32 km/h) without causing differential lock, the unit is not functioning properly.

   NOTICE: Rapid release of brakes or clutch, or rapid acceleration of engine will invalidate test.
9. Lock opposite rear wheel and repeat procedure. The following chart provides guidelines for diagnosis and repair of differential complaints.

DIAGNOSIS

Improper differential operation is generally indicated by non-uniform clutch slippage. Sometimes this produces a chatter or whirring sound. However, these sounds are not always indicative of failure as they could be produced from a lack of proper lubrication. For example, under certain conditions where one wheel is on a very slippery surface and the other on dry payment, wheel spin can occur if over acceleration is attempted. Continued spinning may cause audible noise, such as a whirring sound due to the clutches lacking sufficient lubricant. This does not necessarily indicate failure of the unit.

During regular operation (straight ahead driving) when both wheels rotate at equal speeds, there is an approximately equal driving force delivered to each wheel. When cornering, the inside wheel delivers extra driving force causing slippage in both clutch packs. Consequently, the operational life of the unit is dependent upon equal rotation of both wheels during straight ahead operation. If wheel rotation for both rear wheels is not equal during straight ahead operation, the unit will constantly be functioning as if the vehicle were cornering. This will impose constant slippage on the clutch packs and will eventually lead to abnormal wear on the clutch pack. Therefore, it is important that there be no excessive differences in the rear wheel tire sizes, air pressures, or tire wear patterns.

LOCKING DIFFERENTIAL DIAGNOSIS

Complaint	Possible Cause	Correction
Does not lock.	A. Little or no spring preload on the latching bracket	A. Replace governor assembly and latching bracket.
	B. Flyweights on governor assembly stuck closed.	B. Replace governor assembly and latching bracket.
	C. Broken drive teeth on governor and/or cam gear assembly.	C. Replace cam plate, governor assembly and latching bracket.
	D. Broken clutch plates	D. Replace clutch plates and wave spring.
Locks in turns.	A. Govenor assembly tight in case.	A. Free up governor assembly.
	B. Broken or weak governor flyweight spring.	B. Replace governor assembly and latching bracket.
	C. Flyweight in governor assembly stuck open.	C. Replace governor assembly and latching bracket.
	D. Broken cam plate and/or governor drive teeth.	D. Replace cam plate, governor assembly and latching bracket.
Chatters in turns.	A. Lubricant contaminated.	A. Drain lube hot. Wipe carrier clean. Refill with lube specified in Maintenance and Lubrication Section.
	B. Clutch Plates deteriorated.	B. Replace clutch plates.

Noisy.

NOTE: In addition to normal axle noise (see Rear Axle Diagnosis Section), the locking differential exhibits some clutch noise upon engagement and disengagement.

	A. Broken clutch plates.	A. Replace clutch plates.
	B. Broken thrust block.	B. Replace thrust block.* Check closely for other damage. Replace entire unit if case is damaged.
	C. Broken differential gears.	C. Replace gears.** Check closely for other damage. Replace entire unit if case is damaged.

* Thrust block must be replaced with block of identical thickness.

** If side gears or cam gear is replaced, proper measurement and replacement procedures must be followed. Disregard for such procedure as: May disturb critical clearances, and could result in differential performance complaints.

Fig. 1--Diagnosis Chart

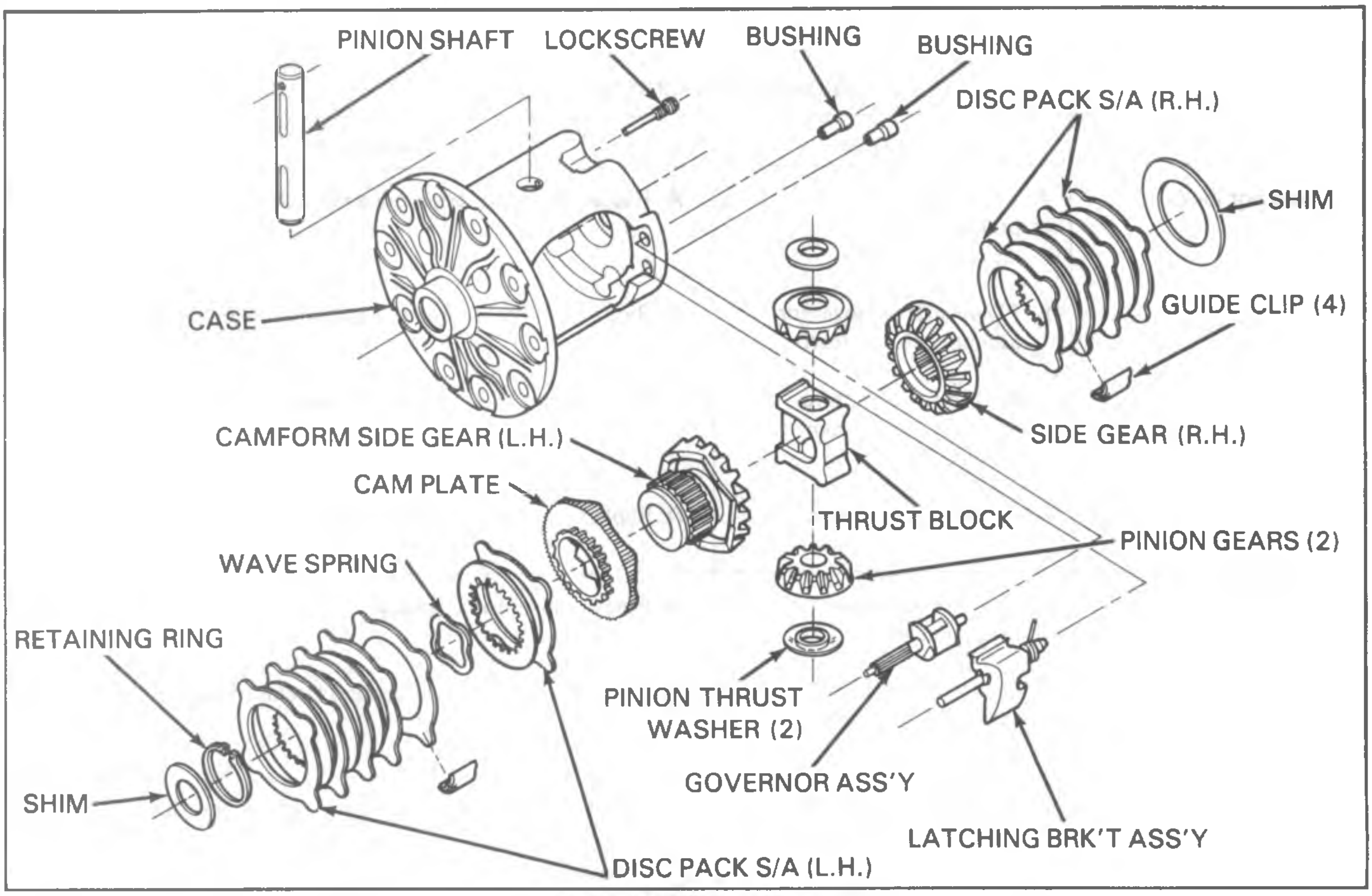


Fig. 2--8-1/2" Ring Gear

UNIT REPAIR

8-1/2" RING GEAR

Due to critical internal clearance dimensions, the differential case cannot be serviced separately. If any case damage is found the entire differntial must be replaced.

Internal clearances are such that shims, thrust block, or gears should not be replaced unnecessarily even if slight wear indications are present. If shim, thrust block, or wers must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.

Internal components can be inspected through the windows of the differential housing.

If the governor assembly and latching bracket are the only items to be replaced, proceed only through step No. 2 of the disassembly procedure. To install new governor and latching bracket, begin at step No. 6 of the reassembly procedure.

CASE - 8.50 R/G

Disassembly

1. Note position of governor and latching bracket assembly, Figure 3. Remove ring gear and side bearings following procedures established for the standard differential.
2. Using bushing puller tool No. J-26252, remove governor assembly and latching bracket by pulling the retaining bushings as shown in Figure 4. Pull the latching bracket spring out of the way while pulling the governor assembly bushing to prevent damage.
3. Remove lock screw and pinion shaft, and roll out differential pinion gears and pinion thrust washers.
4. Remove thrust block.
5. Remove RH disc pack assembly and shim.
6. Remove cam gear, disc pack assembly and shim.

Inspection

1. Clean all parts with solvent. Inspect all bearings for chipping or evidence of excessive wear. Replace parts as needed.
2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. The following are serviceable components for this differential:

- Governor assembly and latching bracket with spring
- Cam plate
- Clutch disc pack with guide clips (Both LH and RH)
- Pinion cross-shaft
- Pinion gears, side gear, cam gear.
- Pinion thrust washers
- Thrust block (8 sizes)
- Retaining ring

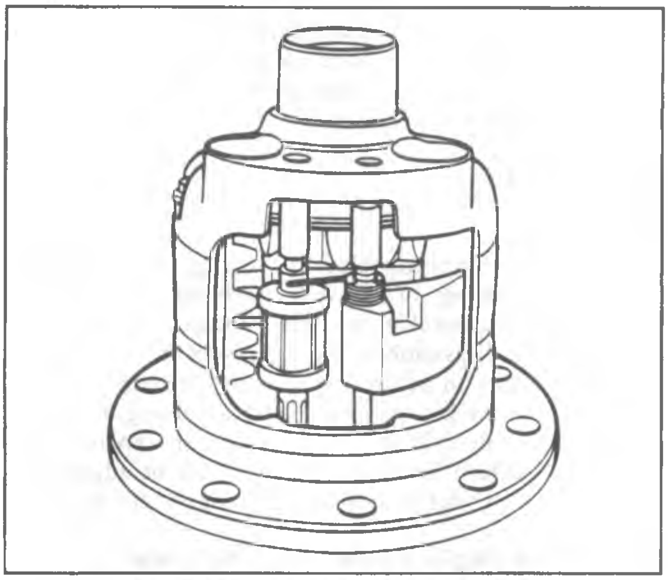


Fig. 3--Governor and Latching Bracket

- Flange end shim (8 sizes), Bell end shim (8 sizes)
- Lock Screw
- Governor Bushing
- Disc Guide Clips (Both LH and RH)

If thrust block or flange end shim only must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the same size.

CAM/CLUTCH SERVICE

Disassembly (Flange End)

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows:

1. Remove retaining ring (use .06 external snap-ring plier) (Fig. 5).
2. Remove discs and camplate. Keep all components in the proper order.

Reassembly - Flange End

Replace cam plate and wave spring or clutch discs as necessary and reassemble as follows: (See Fig.2).

1. Place gear on bench with hub end up.
2. Assemble cam plate with cam form down to mate with cam form on gear.
3. Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown.
4. Assemble on to gear hub (2) splined discs and (3) eared discs alternately as shown. Begin and end with an eared disc.
5. Install retaining Ring.

CLUTCH PACK (R.H.)

Disassembly

1. Remove disc pack and shim from side gear. Keep discs in order.

Reassembly

1. Replace disc and/or clips, as required.
2. Reassemble material on gear hub (two splined discs and three eared discs) alternately as shown in Fig. 2. Maintain original sequence, if new discs are not used. Reinstall original shim, or a new with original thickenss.

NOTICE: If gear hubs are scored, rough or show abnormal wear, check condition of bores in case. If they are damaged or oversize, the entire unit must be replaced.

DIFFERENTIAL THRUST BLOCK AND GEAR

Pinion Gears

Replacement

If it is necessary to replace the pinion gears due to pitting of the teeth, scoring of the pinion shaft bearing surface, or breakage, it will be necessary to disassemble the unit through Step 3 of case dissasembly. Install new pinion gears and pinion thrust washers and reassemble unit as described in Steps 4 through 9 of case reassembly.

NOTICE: If camgear, side gear, or pinion gears are broken, check for other damage and replace parts as needed. If case is damaged, the entire unit must be

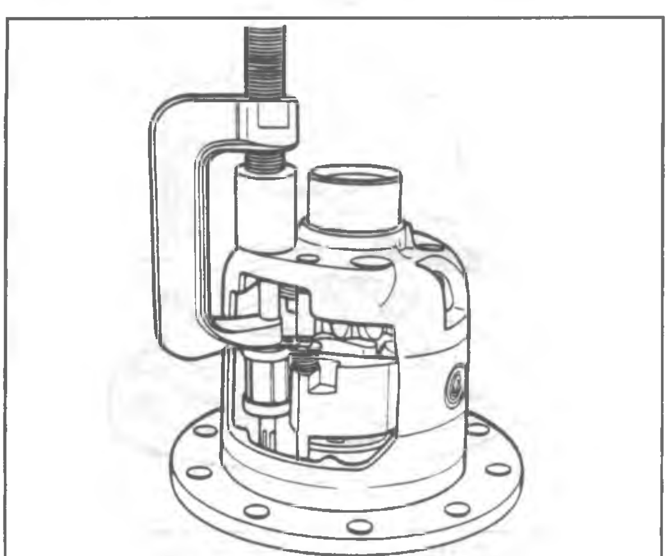


Fig. 4--Bearing Puller J-26252

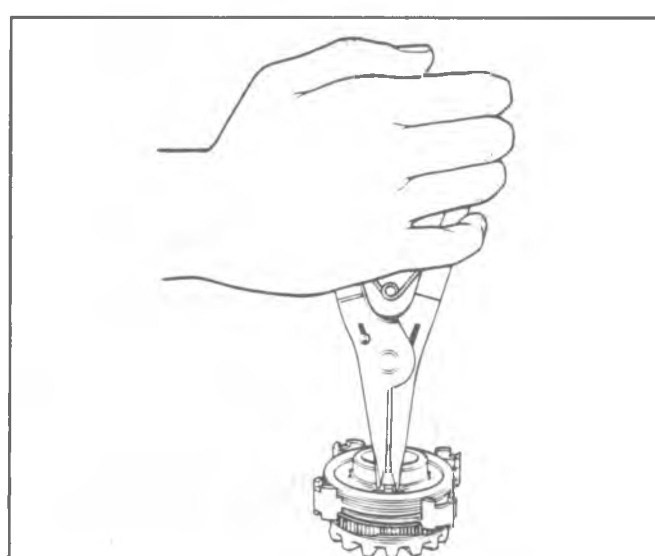


Fig. 5--Retaining Ring

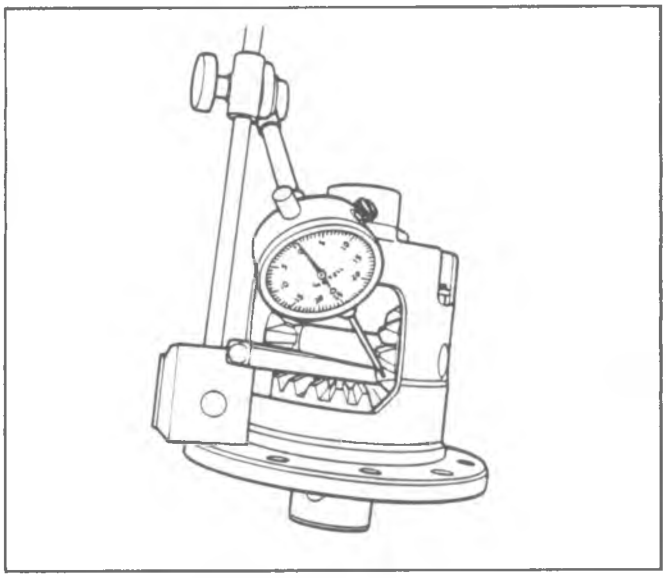


Fig. 6--Camgear to Pinion Gear Backlash

replaced.

Camgear (L.H. Side Gear)

Replacement

If it is necessary to replace the camgear due to pitting of the teeth, scoring of the hub, or breakage, it will be necessary to disassemble the unit completely as described in Steps 1 through 6 of case disassembly and in Steps 1 and 2 of Cam/Clutch Service.

When replacing the camgear, it will be necessary to adjust (by selecting the correct shim) the camgear to pinion gear backlash using the following procedure:

1. Reassemble camgear/disc pack sub-assembly, per reassembly procedure.
2. Install the new camgear and disc pack sub-assembly, using the orignal shim, into the flange end of the case. Place pinion gears and pinion thrust washers into their respective locations in the case, manually depress the camgear into its bore and slide the pinion shaft through the case and both pinion gears.

   If installation of the pinion shaft is prevented by the pinion gears, it will be necessary to replace the original shim with one of less thickness.) Once the pinion shaft is installed, with lockscrew in place, index one tooth of the pinion gear nearest the pinion shaft lockscrew so that it points downward perpendicular to the case flange.
3. Use a large tapered screwdriver or similar shaped tool and firmly wedge it between the camgear and pinion shat.. Using a dial indicator mounted to the case flange(Fig. 6), check pinion to camgear backlash by pulling the pinion gear firmly into its seat and rotate back and forth while reading the gage, note reading. Repeat the above procedure of indexing and checking backlash of the pinion gear opposite the pinion shaft lockscrew, and note reading.

   If backlash is not between .010 and.018, change shim size and repeat backlash procedure until the correct backlash is obtained. The thinner the shim used the greater the backlash reading will be.

NOTICE: When camgear and/or side gear is replaced, thrust block replacement and clearance procedure must be followed during reassembly of the unit. Failure to do so may disturb critical clearances and could result in differential complaints.

Side Gear (R.H.)

Replacement

If it is necessary to replace the side gear due to pitting of the teeth scoring of the hub, or breakage it will be necessary to disassemble the unit as described in Steps 1 through 6 case disassembly. When replacing the side gear it will be necessary to adjust (by selecting the correct shim) the side gear to pinion gear backlash using a similar procedure as described in the camgear replacement. However, backlash for the side gear should be adjusted to within .002-.010, with R.H. side gear wedged against case.

Thurst Block Replacement and Clearance

If it is necessary to replace the thrust block only, replace it with a new one of identical thickness. If the thrust block is broken, check for other damage and replace parts as necessary. If case is damaged, replace the entire unit.

If camgear and/or side gear is replaced, it will be necessary to check the side gear spread dimension and adjust block clearance as follows:

1. Install camgear and disc pack with camgear shim into the flange end of the case. Install side gear and disc pack with shim into the bell end of the case.
2. Install pinion shaft and lockscrew into case. Firmly wedge a large tapered screwdriver or similar shaped tool between the pinion shaft and camgear. Wedge another tapered tool between the pinion shaft and side gear.
3. Using a 1" to 2" telescoping gage, measure the distance between the camgear face and side gear face (side gear spread).

   NOTICE: Makes sure telescoping gage ends rest on the gear face, not on the gear teeth (Fig. 7). Measure the

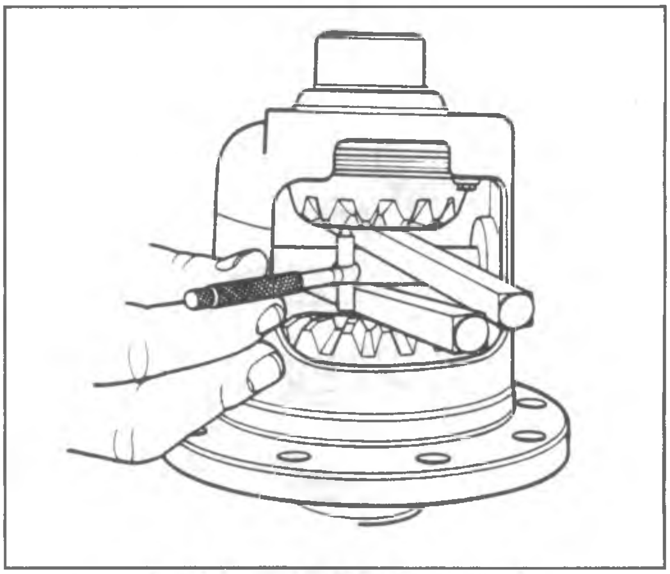


Fig. 7--Measuring Side Gear Spread

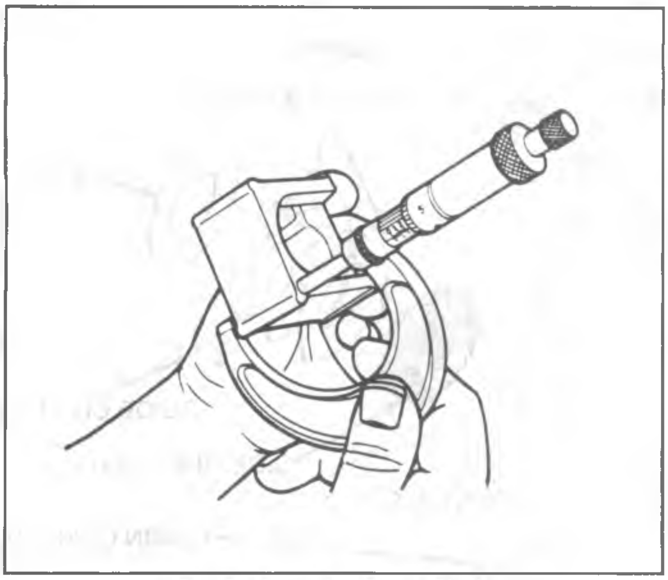


Fig. 8--Measuring Thrust Block

telescoping gage with a 1" to 2" micrometer and not reading. Next, measure the thickness of the original thrust block at outer corner (Fig. 8) and note reading.

If the thrust block thickness is not within a range of .000 to .006 less than the side gear spread, adjust clearance with one of the following procedures:

a. Reshim R.H. Clutch Disc Pack. Note: Backlash of .002 - .010 must still be maintained.

b. Select a new thrust block of the correct size to obtain .000 to .006 clearance.

Once the proper thrust block clearance has been obtained, continue reassembly of case.

CASE

Reassembly (Fig. 2)

1. Install (4) clutch pack guide clips on the ears of the cam gear clutch pack using grease for retention.
2. Install cam gear assembly and original shim in flange end of case. If new camgear is installed, see differential gear replacement.
3. Lock an axle shaft in vise, in a vertical position. Mount the differential case over the end of the axle shaft engaging the spline of the side gear with the shaft. Assemble on to bell end gear hub(3) splined discs and (4) eared discs alternately as shown. Begin and end with an eared disc. Install (4) small clutch pack guide clips on the ears of the bell end clutch pack using grease for retention. Install in case with shim. If new R.H. side gear is installed, refer to differential gear replacement.
4. Install thrust washers onto back surfaces of pinion gears. Use small amount of grease to adhere washers to gears. Insert one pinion gear through the small window opening in the case while at the same time inserting the reaction block and other pinion gear through the large window opening. Rotate the two pinion gears and thrust block 90° so as to position the reaction block with the open side towards the small window opening in the case. Be sure the two pinion gears and thrust washers are in their proper location.

   NOTICE: Thrust block thickness is critical to proper differential function. If new side gears or thrust blocks are installed, refer to instructions in differential gear thrust block replacement.
5. Install pinion shaft and lock screw. A new lock screw must used on assembly.
6. Insert governor assembly and latching bracket into case, Figure 3. Place straight end of latching bracket spring over and to the outside of the engagement shaft to preload the latching bracket against the governor assembly. Press bushing for governor assembly into case to give .004 to .020 shaft end play. A 3/8" diameter plug or socket will aid in pressing the bushing into the housing. Press latching bracket assembly bushing into case to provide .000-.003 shaft end play.
7. Install ring gear and side bearings using the procedure outlined for standards differentials.
8. Place differential unit in carrier and adjust ring gear and pinion backlash and gear tooth pattern as outlined in the standard differential section.
9. Check operation as outlined in Service Test Procedure.

   NOTICE: Use only the rear axle lubricant recommended in Maintenance and Lubrication Section. The usage of any other lubricant or any additive may result in damage to the differential.

UNIT REPAIR

8-7/8" RING GEAR

Due to critical internal clearance dimensions, the differential side gears and case cannot be serviced separately. If any side gear or case damage is found the entire differntial must be replaced.

Internal clearances are such that shims, thrust block and thrust ring should not be replaced unnecessarily even if slight wear indications are present. If shims, thrust block, or thrust ring must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.

Internal components can be inspected through the windows of the differential housing.

If the governor assembly and latching bracket are the only items to be replaced, proceed only through Step No. 2 of the disassembly procedure. To install new governor and latching bracket, gegin at Step No. 6 of the 39 reassembly procedure.

CASE

Disassembly

1. Note position of governor and latching bracket assembly, Fig. 10. Remove ring gear and side bearings following procedures established for the standard

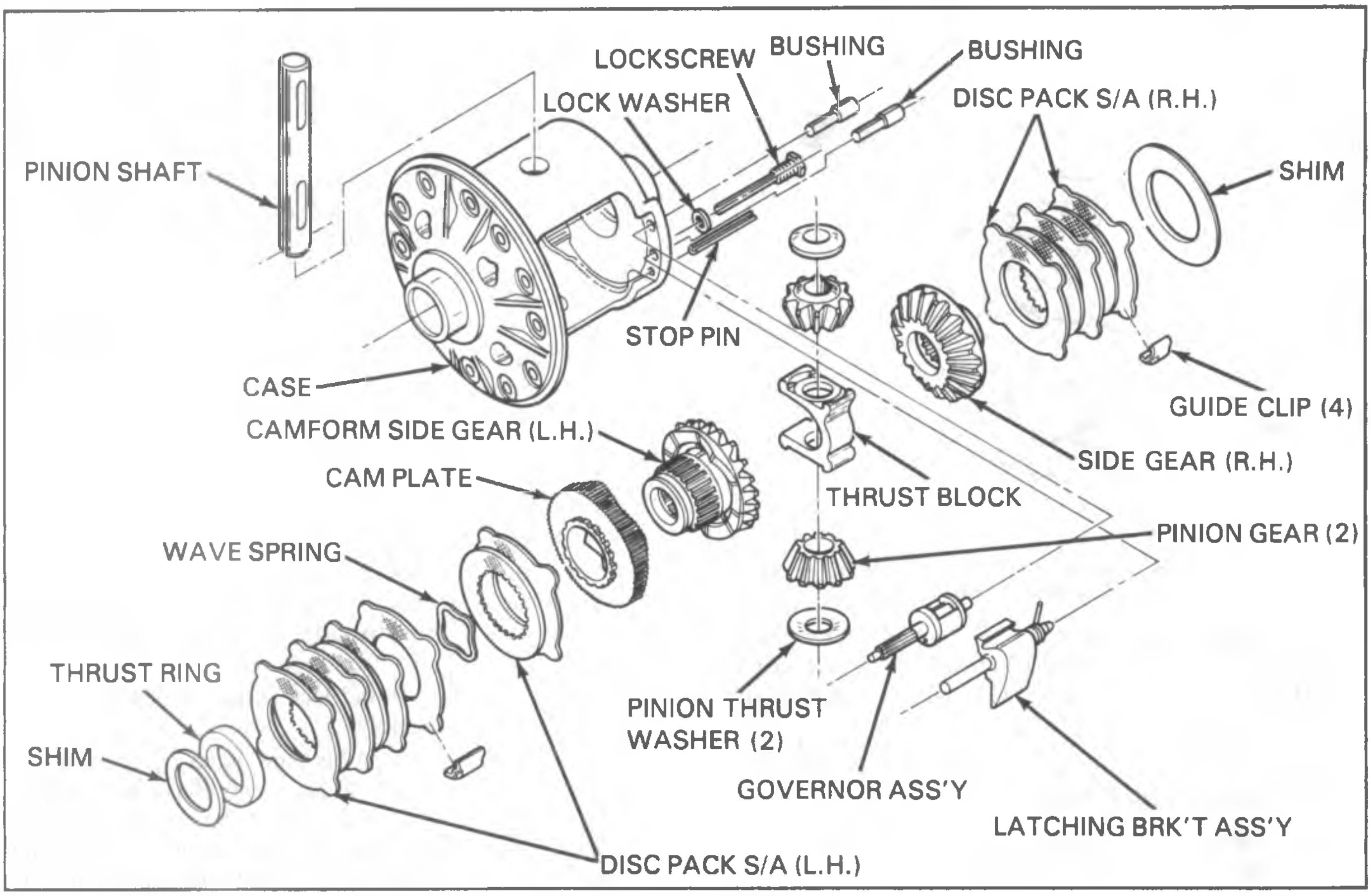


Fig. 9--8-7/8" Ring Gear

differential.

2. Using bushing puller tool J-26252, remove governor assembly and latching bracket by pulling the retaining bushings as shown in Figure 11. Pull the latching bracket spring out of the way while pulling the governor assembly bushing to prevent damage. Remove the stop pin by driving through the case with a drive pin punch.
3. Remove lock screw and pinion shaft, and roll out differential pinion gears.

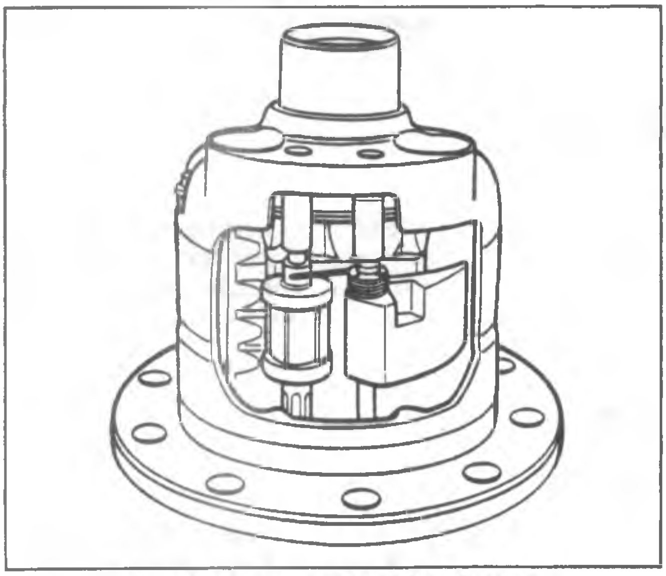


Fig. 10--Governor and Latching Bracket

4. Remove thrust block and pinion thrust washers.
5. Remove R.H. side gear, disc pack and shims.
6. Remove L.H. cam gear, disc pack assembly and disc pack guide clips.

Inspection

1. Clean all parts with solevent. Inspect all bearings for chipping or evidence of excessive wear. Replace parts as needed.
2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. The following are serviceable components for this differential:

- Governor assembly and latching bracket with spring and stop pin.
- Cam plate.
- Clutch disc pack with guid clips (R.H. and L.H.)
- Pinion cross shaft.
- Pinion gears.
- Pinion thrust washers.
- Thrust block (4 sizes).
- Thrust ring.
- Flange end shim (4 sizes).

NOTICE: Attempts to service other components may disturb critical clearances and could result in differential complaints.

NOTICE: If thrust block or flange end shim must be replaced, the original pieces must be carefully measured for thickenss and replaced with a piece of the same size.

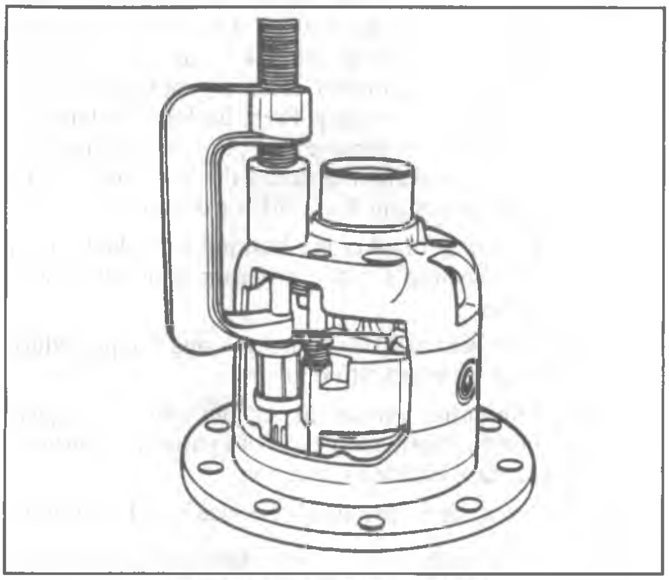


Fig. 11--Bearing Puller J-26252

CAM/CLUTCH SERVICE (L.H.)

Disassembly

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows:

1. Measure and record overall length of gear assembly (from face of gear to back side of thrust ring, include shim). This dimension will be needed to reassembly unit if thrust ring is replaced. DO NOT REPLACE THRUST RING UNLESS NECESSARY. If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.
2. With gear hub end up, compress disc pack and install jaws of split ring bearing remover (J-22912) between the thrust ring and the top disc. Bevel side of bearing remover should face up toward thrust ring.
3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides.
4. Install a 1-1/2" diameter plug similar to (J-8107-4) on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order, Figure 12.

Reassembly

Replace cam plate and wave spring or clutch discs as necessary and reassemble as follows: See Fig. 9.

1. Place gear on bench with hub end up.
2. Assemble cam plate with cam form down to mate with cam form on gear.
3. Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown.
4. Assembly on to gear hub (2) splined discs and (3) eared discs alternately as shown. Begin with a splined disc and end with an eared disc.
5. Locate cam gear assembly in arbor press with hub end up.. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub.

   a. Compress disc pack by pushing down on the discs to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

Clutch Pack (R.H.)

Disassembly

1. Remove disc pack and shim from side gear. Keep discs in order.

Reassembly

1. Replace discs and/or clips, as required.
2. Reassembly material on gear hub (two splined discs and three eared discs) alternately as shown in Fig. 9. Maintain original sequence, if new discs are not used. Reinstall original shim, or a new shim with original thickness.

NOTICE: If gear hubs are scored, rough or show abornal wear, check condition of bores in case. If they are damaged or oversize, the entire unit must be replaced.

Reassembly

1. Install (4) clutch pack guide clips on the ears of the cam gear clutch pack using grease for retention.
2. Install cam gear assembly and original shim in flange end of case. If a new thrust ring has been pressed on the cam gear, reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step 1 of cam gear service section. If the length of the new assembly varies by more than .003"larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

NOTICE: Incorrect shimming will disturb critical clearance dimensions and may result in differential failure.

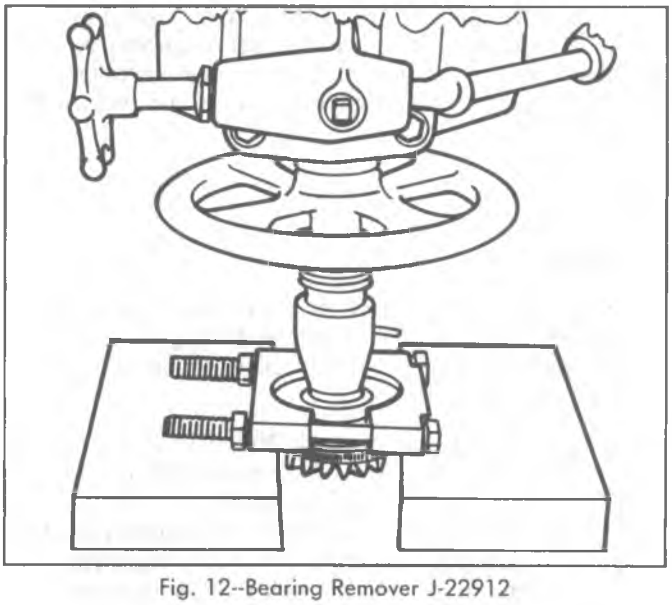


Fig. 12--Bearing Remover J-22912

3. Lock an axle shaft in vise, in a vertical position. Mount the differential case over the end of the axle shaft engaging the spline of the side gear with the shaft. Grease the two pinion gear thrust washers and locate them in their proper position. Install bell end (R.H.) side gear, disc pack,and original shim. Original shim must be used to maintain proper clearance dimensions.
4. Insert one pinion gear through the small window opening in the case while at the same time inserting the thrust block and other pinion gear through the large window opening. Rotate the two pinion gears and thrust block 90° so as to position the reaction block with the open side towards the small window opening in the case. Be sure the two pinion gears and thrust washers are in their proper location.

   NOTICE: Thrust block must be replaced with a block of the identical thickness. Incorrect block thickness will disturb critical clearance dimensions and may result in differential failure.
5. Install shaft and lock screw.
6. Insert governor assembly and latching bracket into case, Figure 10. Place straight end of latching bracket spring over and to the outside of the engagement shaft to preload the latching bracket against the governor assembly. Press bushing and 1/4" stop pin into case. Press bushing for governor assembly into case to give .004 to .020 shaft end play. Press bushing for latching bracket into case to remove end play. A 3/8 diameter plug or socket will aid in pressing the bushings into the housing. Press stop pin flush with top of case.

   For the latching bracket use bushing with the tapered hole. The bushing for the governor assembly has a straight hole.
7. Install ring gear and side bearings using the procedure outlined for standard differentials.
8. Place differential unit in carrier and adjust ring gear and pinion backlash and gear tooth pattern as outlined in the standard differential section.
9. Check operation as outlined in Service Test Procedure.

   NOTICE: Use only the rear axle lubricant recommended in the Maintenance and Lubrication Section. The usage of any other lubricant or any additive may result in damage to the differential.

UNIT REPAIR

9-1/2" RING GEAR

Due to critical internal clearance dimensions, the differential case cannot be serviced separately. If any case damage is found, the entire differential must be replaced.

Internal clearances are such that shims, thrust block, thrust or gears should not be replaced unnessarily even if ring, slight wear indications are present. If shims, thrust block, thrust ring, or gears must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.

Internal components can be inspected through the windows of the differential housing.

If the governor assembly and latching bracket are the only items to be replaced, proceed only through Step No. 2of the disassembly procedure. To install new governor and latching bracket, begin at Step No. 6 of the reassembly procedure.

CASE

Disassembly

1. Note position of governor and latching bracket assembly, Figure 14. Remove ring gear and side bearings following porcedures established for the standard differential.
2. Using bushing puller tool No. J-26252, remove governor assembly and latching bracket by pulling the retaining bushings as shown in Figure 15. Pull the latching bracket spring out of the way while pulling the governor assembly bushing to prevent damage. Remove the stop pin by driving through the case with a 1/4" drive pin punch.
3. Remove lock screw and pinion shaft and roll out differential pinion gears and pinion thrust washers.
5. Remove R.H. side gear, disc pack and shims.
6. Remove cam gear, disc pack assembly and disc pack guide clips.

Inspection

1. Clean all parts with solevent. Inspect all bearing for chipping or evidence of excessive wear. Replace parts as needed.
2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. The following are serviceable components for this differential:

- Governor assembly and latching bracket with spring and stop pin.
- Cam plate.
- Clutch disc pack with guide clips, R.H. and L.H.
- Pinion cross-shaft.
- Lockscrew.
- Pinion gears.
- L. H. Side gear.
- R. H. Side Gear
- Pinion thrust washers.
- Thrust block (9 sizes).
- Thrust ring.
- L.H. side gear.
- L.H. side gear shim (9 sizes)
- R.H. side gear shim (8 sizes)
- Disc guide clips (Both L.H. and R.H.)

NOTICE: If thrust block or flange end shim must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the

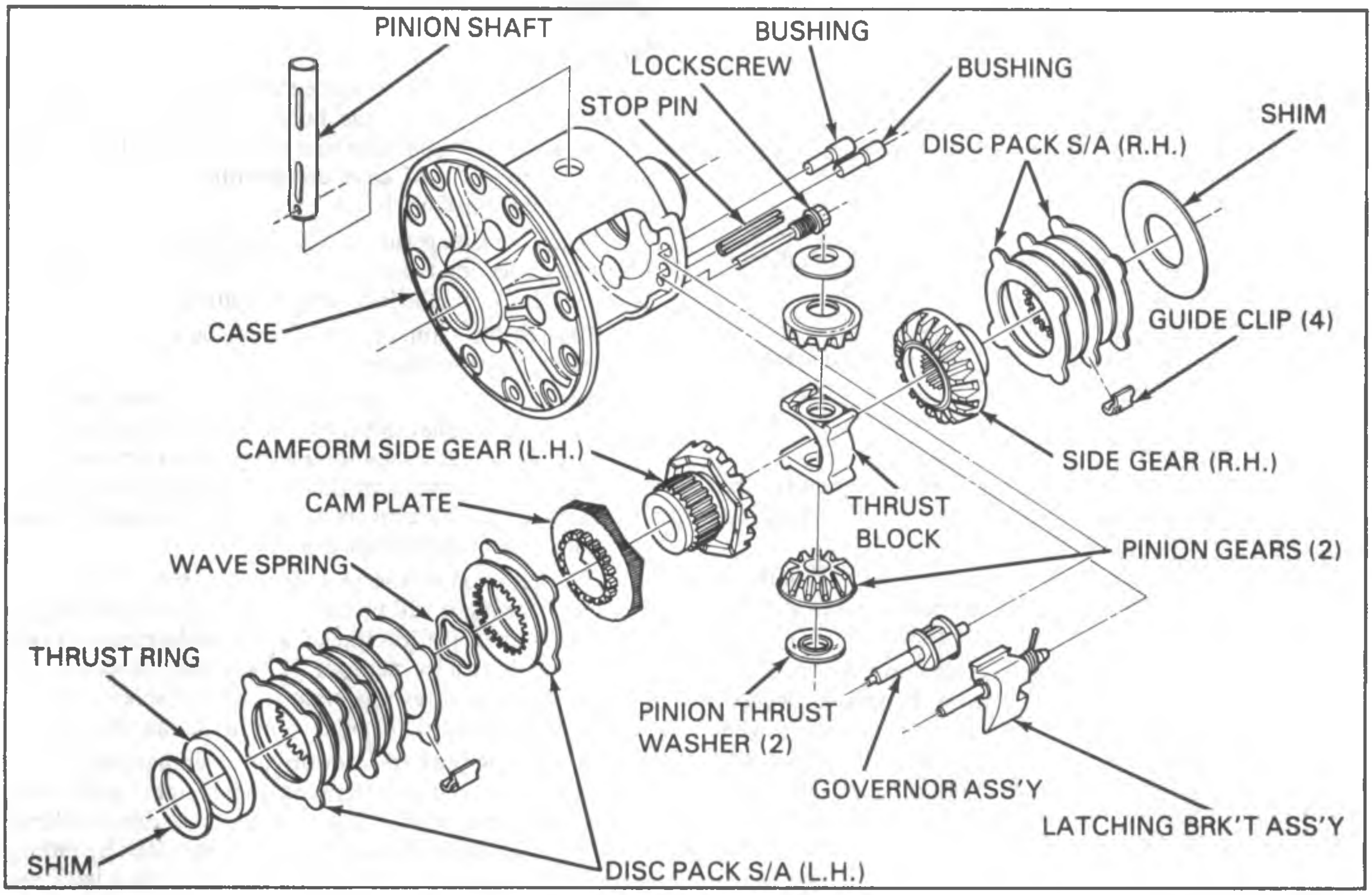


Fig. 13--9-1/2" Ring Gear

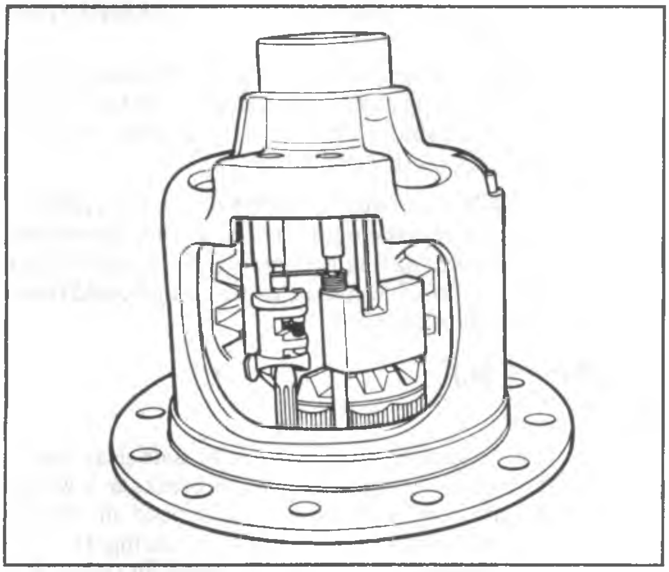


Fig. 14--Governor and Latching Bracket

same size.

CAM/CLUTCH SERVICE

Disassembly

If cam gear (L.H. side gear) and cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows:

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassemble unit if cam gear or thrust ring is replaced. DO NOT REPLACE THRUST RING UNLESS NECESSARY. If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.
2. With gear hub end up, compress disc pack and install jaws of split ring bearing remover (J-22912) between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.

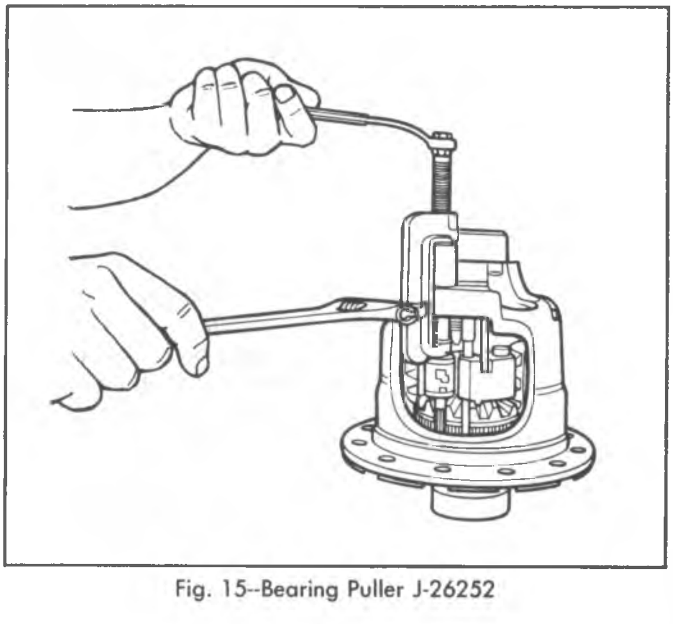


Fig. 15--Bearing Puller J-26252

3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides.
4. Install a 1-3/4" diameter plug or similar tool on hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order, Figure 16.

Reassembly

Replace cam plate and wave spring or clutch discs as necessary and reassembly as follows: See Fig. 13.

1. Place gear on bench with hub end up.
2. Assembly cam plate with cam form down to mate with cam form on gear.
3. Assemble onto cam plate: (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown.
4. Assemble on to gear hub (3) splined discs and (4) eared discs alternately as shown. Begin with a splined disc and end with an eared disc.
5. Locate cam gear assembly in arbor press with hub end up. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub..
   a. Compress disc pack by pushing down on the dics to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

Clutch Pack (R.H.)

Disassembly

1. Remove disc pack and shim from side gear. Keep discs in order.

Reassembly

1. Replace disc and/or clips, as required.
2. Reassemble material on gear hub (two splined discs and three eared discs) alternately as shown in Fig. 13. Maintain original sequence, if new discs are not used. Reinstall original shim, or a new shim with original thickness.

   NOTICE: If gear hubs are scored, rough or show abnormal wear, check condition of bores in case. If they are damaged or oversize, the entire unit must be replaced.

DIFFERENTIAL THRUST BLOCK AND GEAR

Pinion Gears

Replacement

If it is necessary to replace the pinion gears due to to pitting of the teeth, scoring of the pinion shaft bearing surface, or breakage, it will be necessary to disassemble the unit through Step 3 of case disassembly. Install new pinion gears and pinion thrust washers, and reassemble unit as described in Steps 4 through 9 of case reassembly.

NOTICE: If camgear, side gear, or pinion gears are broken, check for other damage and replace parts as needed. If case is damaged the entire unit must be replaced.

Camgear (L.H. Side Gear)

Replacement

If it is necessary to replace the camgear due to pitting of the teeth, scoring of the hub, or breakage, it will be necessary to disassemble the unit completely as described in Steps 1 through 6 of case disassembly and in Steps 1 through 4 of Cam/Clutch Service.

When replacing the camgear, it will be necessary to adjust (by selecting the correct shim) the camgear to pinion gear backlash using the following procedure:

1. Reassemble cam gear/disc pack sub assembly, per reassembly procedure.
2. Install the new camgear and disc pack sub assembly, using the original shim, into the flange end of the case. Place pinion gears and pinion thrust washers into their respective locations in the case, manually depress the camgear into its bore and slide the pinion shaft through the case and both pinion gears.

   If installation of the pinion shaft is prevented by the pinion gears, it will be necessary to replace the original shim with one of less thickenss. Once the pinion shaft is installed, with lockscrew in place, index one tooth of the pinion gear nearest the pinion shaft lockscrew so that it points downward, perpendicular to the case flange.
3. Use a large tapered screwdriver or similar shaped tool and firmly wedge it between the camgear and pinion shaft. Using a dial indicator mounted to the case flange (Fig. 17) check pinion to camgear backlash by pulling the pinion gear firmly into its seat and rotate back and forth while reading the gage, note reading. Repeat the above procedure of indexing and checking backlash of the pinion gear opposite the pinion shaft lockscrew, and note reading.

   If backlash is not between .010 and .018, change shim size and repeat backlash procedure until the correct backlash is obtained. The thinner the shim used, the greater the backlash reading will be.

   NOTICE: When camgear and/or side gear is replaced, thrust block replacement and clearance procedure must be followed during reassembly of the unit. Failure to do so may disturb critical clearances and could result in differential complaints.

Side Gear (R.H.)

Replacement

If it is necessary to replace the R.H. side gear due to pitting of the teeth, scoring of the hub, or breakage it will be necessary to disassemble the unit as described in Steps 1 through 6 of case disassembly. When replacing the side gear, it will be necessary to adjust (by selecting the correct shim) the side gear to pinion gear backlash using a smiliar procedure as described in the camgear replacement. However, backlash for the side gear should be adjusted to within .002-.010, with R.H. side gear wedged against case.

Thrust Block Replacement and Clearance

If it is necessary to replace the thrust block only, replace it with a new one of identical thickness. If the thrust block is broken, check for other damage and replace parts as necessary. If case is damaged, replace the entire

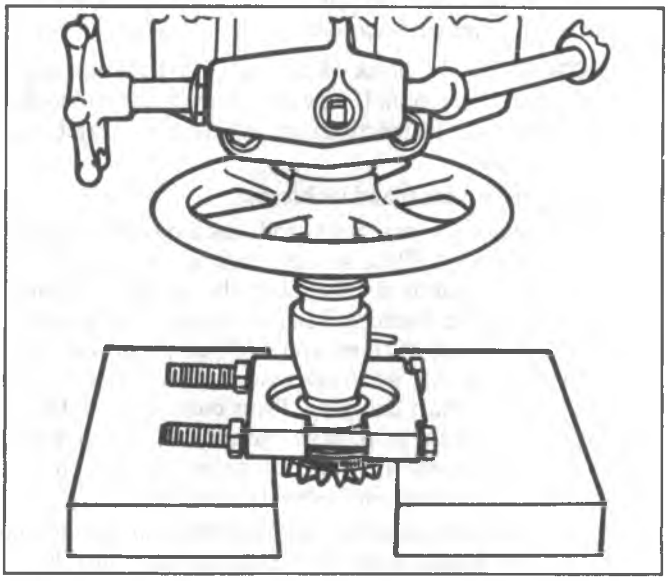


Fig. 16--Bearing Remover J-22912-01

unit.

If camgear and/or side gear is replaced, it will be necessary to check the side gear spread dimension and adjust block clearance as follows:

1. Install camgear and disc pack with camgear shim into the flange end of the case. Install side gear and disc pack with shim into the bell end of the case.
2. Install pinion shaft and lockscrew into case. Firmly wedge a large tapered screwdriver or similar shaped tool between the pinion shaft and camgear. Wedge another tapered tool between the pinion shaft and side gear.
3. Using a 1" to 2" telescoping gage measure the distance between the camgear face and side gear face (side gear spread).

   NOTICE: Make sure telescoping gage ends rest on the gear face, not on the gear teeth (Fig. 18).
4. Measure the telescoping gage with a 1" to 2" micrometer and note reading. Next, measure the

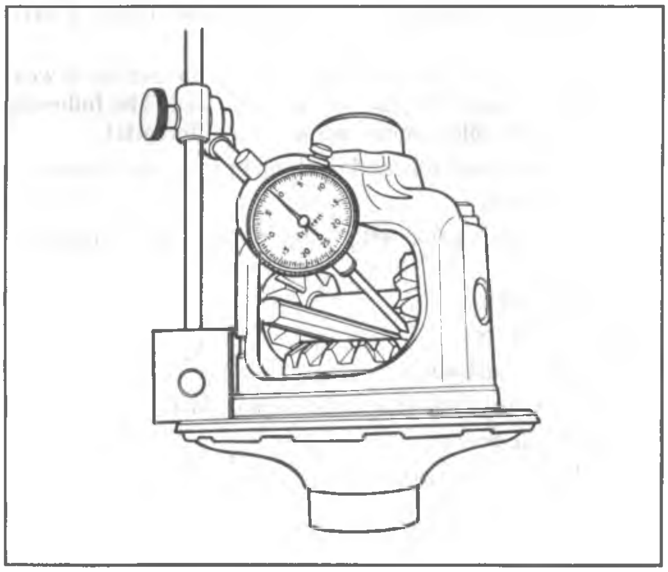


Fig. 17--Measuring Pinion to Camgear Backlash

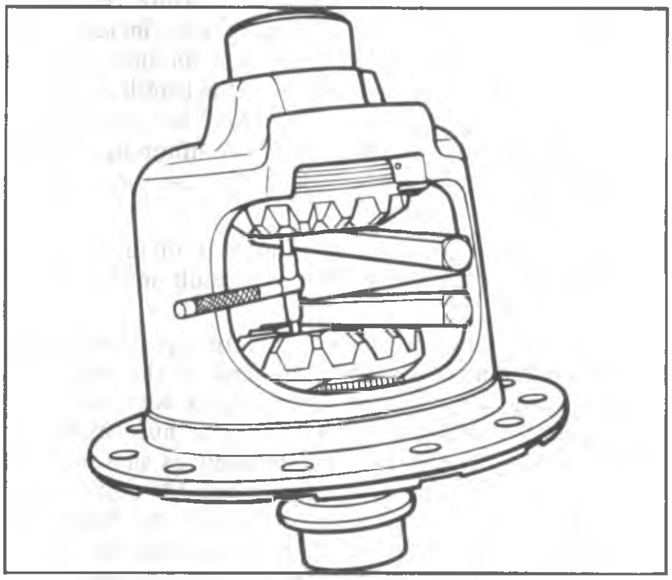


Fig. 18--Measuring Side Gear Spread

thickness of the original thrust block at outer corner (Fig. 19) and note reading.

If the thrust block thickness is not within a range of .000 to.006 less than the side gear spread, adjust clearance with one of the following procedures:

a. Reshim R.H. clutch disc pack. Note: Backlash of .002-.010 must still be maintained.
b. Select a new thrust block of the correct size to obtain .000 to .006 clearance.

Once the proper thrust block clearance has been obtained, continue reassembly of case.

CASE REASSEMBLY

Reassembly

1. Install (4) clutch pack guide clips on the ears of the camgear clutch pack using grease for retention.
2. Install cam gear assembly and original shim in flange end of case. If new cam gear is installed, refer to differential gear replacement procedure. If a new thrust ring has been pressed on the cam gear,

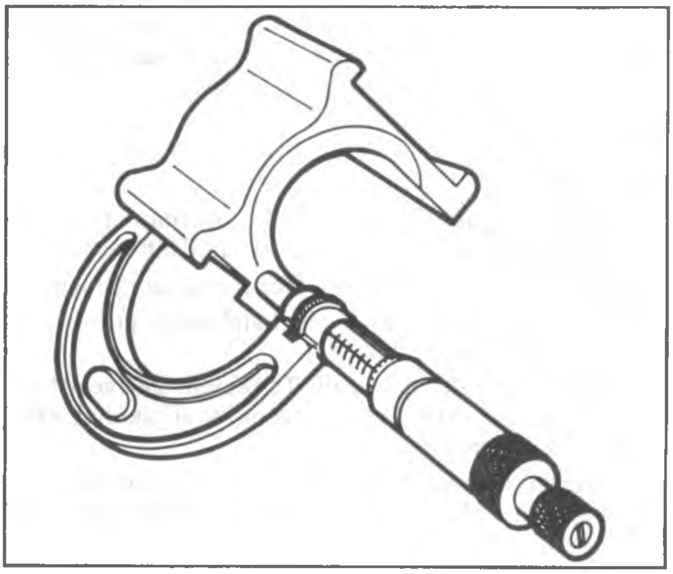


Fig. 19--Measuring Thrust Block

reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step 1 of cam gear service procedure. If the length of the new assembly varies by more than .003" larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

NOTICE: Incorrect shimming will disturb critical clearance dimensions and may result in differential complaints.

3. Lock an axle shaft in vise, in a vertical position. Mount the differential case over the end of the axle shaft engaging the spline of the side gear with the shaft. Assemble on to bell end (R.H.) gear hub (2) splined discs and (3) eared discs alternately as shown. Begin and end with an eared disc. Install (4) small clutch pack guide clips on the ears of the bell end clutch pack using grease for retention. Install in case with shim if new R.H. side gear is installed, refer to differential gear replacement procedure.
4. Install thrust washers onto back surfaces of pinion gears. Use small amount of grease to adhere washers to gears. Insert one pinion gear through the small window opening in the case while at the same time inserting the reaction block and other pinion gear through the large window opening. Rotate the two pinion gears and thrust block 90° so as to position the reaction block with the open side towards the small window opening in the case. Be sure the two pinion gears and thrust washers are in their proper location.

   NOTICE: Thrust block thickness is critical to proper differential function. If new side gears or thrust block is installed, see instructions in differential gear/thrust block section.
5. Install pinion shaft and lockscrew.
6. Insert governor assembly and latching bracket into case, Figure 14. Place straight end of latching bracket spring over and to the outside of the engagement shaft to preload the latching bracket against the governor assembly. Press bushing and 1/4" stop pin into case. Press bushing for governor assembly into case to give .004 to .020 shaft end play. Press bushing for latching bracket into case to remove end play. A 3/8 diameter plug or socket will aid in pressing the bushings into the housing. Press stop pin flush with top of case.

   For the latching bracket, use bushing with the tapered hole. The bushing for the governor assembly has a straight hole.
7. Install ring gear and side bearings using the procedure outlined for standard differentials.
8. Place differential unit in carrier and adjust ring gear and pinion backlash and gear tooth pattern as outlined in the standard differential section.
9. Check operation as outlined in Service Test Procedure.

   NOTICE: Use only the rear axle lubricant recommended in Maintenance and Lubrication Section. The usage of any other lubricant or any additive may result in damage to the differential.

UNIT REPAIR

10-1/2" RING GEAR

Due to critical internal clearance dimensions, the differential case cannot be serviced separately. If any case damage is found, the entire differential must be replaced.

Internal clearances are such that shims, thrust blocks, thrust ring or gears should not be replaced unnecessarily even if slight wear indications are present. If shims, thrust blocks, thrust ring or gears must be replaced due to damage, correct measurement and replacement procedures must be followed. Failure to do so may disturb critical clearances and could result in differential complaints.

CASE

Disassembly

1. Remove ring gear and side bearings following procedures established for the standard differential.
2. Remove (3) screws on front face of ring gear flange.
3. Set unit on right side case half and gently pry apart at yoke hole location (Fig. 21.).
4. Remove left side case half. To prevent side gear from falling out, hold thumb against inside of gear hub while separating case halves.
5. Inspect components for damage. If the governor assembly and latching bracket are the only items to be replaced, remove and proceed to Step 7 of reassembly procedure. Pry under pinion yoke and remove and proceed with detailed inspection if further damage is observed.

Inspection

1. Clean all parts with solvent. Inspect all bearings for chipping or evidence of excessive wear. Replace parts as needed.
2. Inspect all differential components for excessive wear and breakage. Replace parts as needed. **The following are serviceable components for this differential.**

- Governor assembly and latching bracket with spring.
- Cam Plate.
- Clutch disc pack with wave spring and guide clips (R.H.)
- Pinion yoke.
- Pinion gears.
- Pinion thrust washers.
- Clutch disc pack with guide clips (L.H.).
- L.H. side gear.
- R.H. side gear (camgear).
- Thrust blocks (4 sizes).

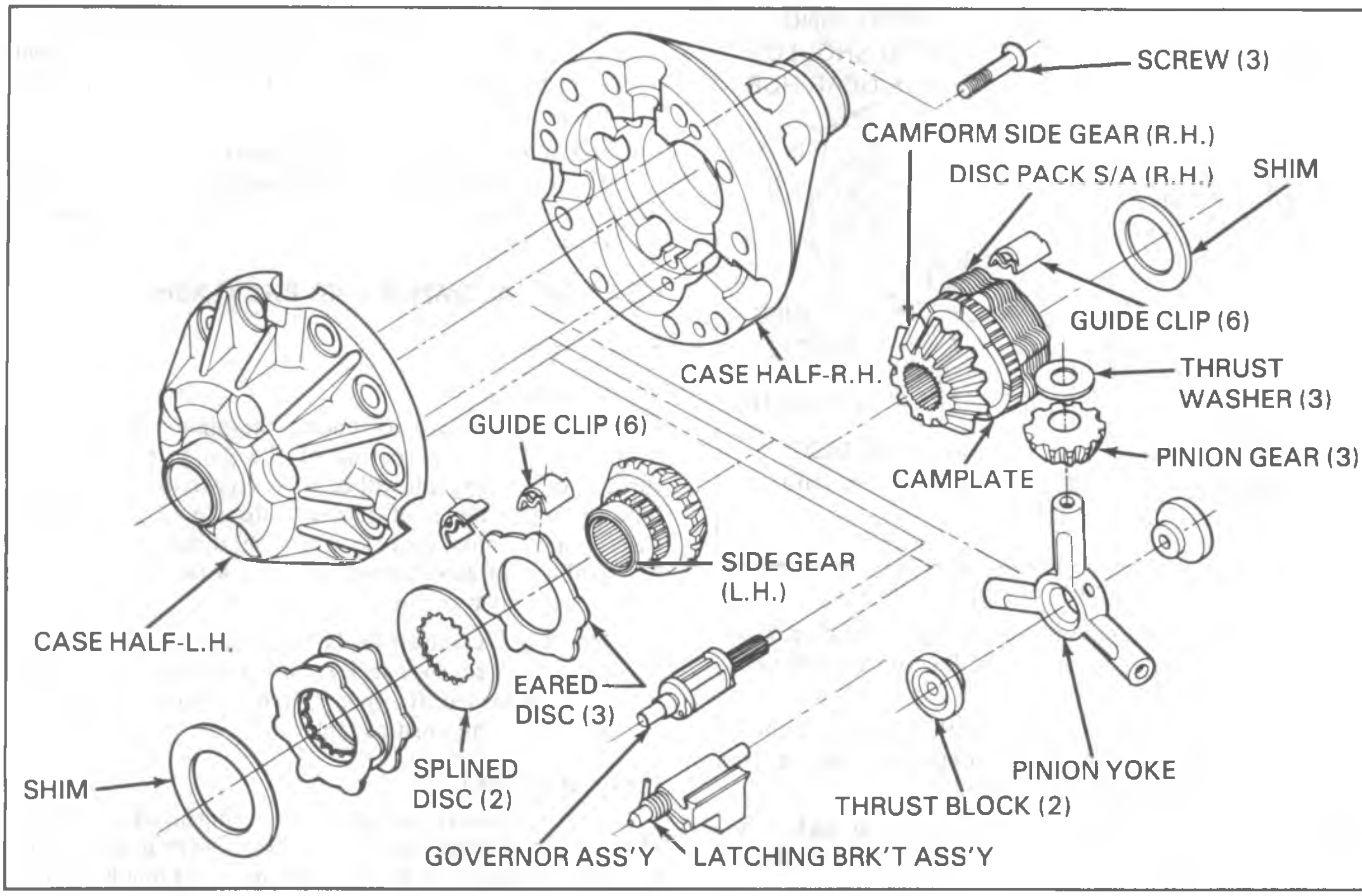


Fig. 20--10-1/2" Ring Gear

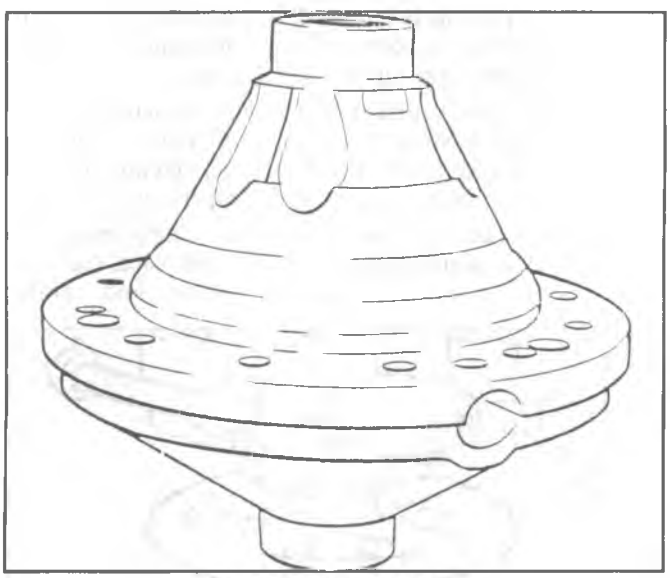


Fig. 21--Differential Case

- Thrust ring.
- Right side shim (4 sizes).
- Guide clips, LH and RH.

CAM/CLUTCH SERVICE

Disassembly

If camgear or cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows: Refer to Figure 23.

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassemble unit if thrust ring is replaced. **Do not replace thrust ring unless necessary**. If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.
2. With gear hub end up, compress disc pack and install jaws of split ring bearing removed (J-22912)

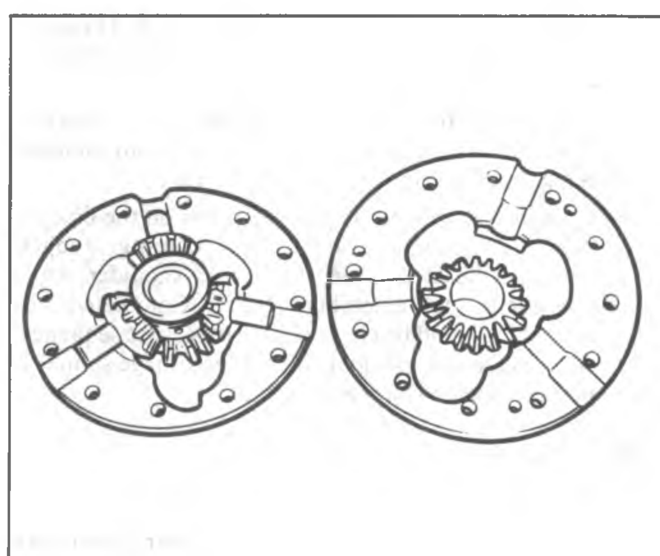


Fig. 22--Differential Halves

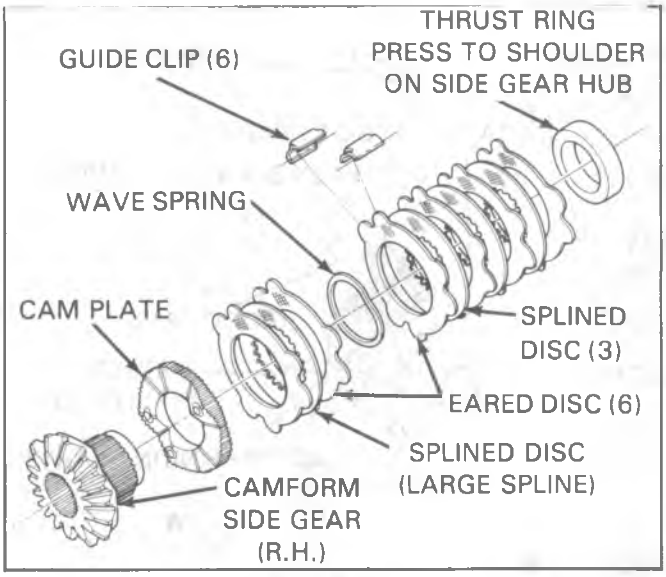


Fig. 23--Cam Plate and Clutch Discs

between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.

3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides (Fig. 24).
4. Install a 1-3/4" diameter plug on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order.

Reassembly

Replace cam plate and/or clutch disc as necessary and reassembly as follows:

1. Place gear on bench with hub end up.
2. Assemble cam plate with cam form down to mate with cam form on gear.
3. Assemble onto cam plate (2) eared discs, (1) splined disc, and (1) wave spring alternately as shown (Fig. 23).
4. Assemble onto gear hub: (4) eared discs and (3) splined discs alternately as shown. Begin and end with an eared disc.
5. Locate cam gear assembly in arbor press with hub end up. Place thrust ring on gear hub and press to shoulder making sure that ring is square with hub.
   a. Compress disc pack by pushing down on the discs to keep the splined discs from becoming wedged between the thrust ring and gear shoulder while pressing the sub-assembly together. Completed sub-assembly should be checked for proper disc sequence. Also, make sure the first splined disc (large spline) is properly located on the cam plate.

Clutch Pack (L.H.)

Disassembly

1. Remove disc pack and shim from side gear. Keep discs in order.

Reassembly

1. Replace discs and /or clips, as required.
2. Reassemble material on gear hub (two splined discs and three eared discs) alternately as shown in Fig. 23. Maintain original sequence, if new discs are not used. Reinstall original shim, or a new shim with original thickness.

   NOTICE: If gear hubs are scored, rough or show abnormal wear, check condition of bores in case. If they are damaged or oversize, the entire unit must be replaced.

GEAR REPLACEMENT AND BACKLASH

Pinion Gears

Replacement

If it is necessary to replace the pinion gears due to pitting of the teeth, scoring of the pinion yoke bearing surface, or breakage, it will be necessary to disassemble the unit through Step 5 of the case disassembly procedure. Install new pinion gears and pinion thrust washers and reassemble unit as described in Steps 4 through 13 of the case reassembly procedure.

NOTICE: If camgear (R.H.), side gear (L.H.), or pinion gears are broken, check for other damage and replace parts as needed. If either R.H. or L.H. case is damaged the entire unit must be replaced.

Camgear (R.H.)

If it is necessary to replace the camgear due to pitting of the teeth of breakage, it will be necessary to diassemble the unit completely as described in Steps 1 through 5 of case disassembly and in Steps 1 through 4 of Cam/Clutch service.

When replacing the camgear, it will be necessary to adjust (by selecting the correct shim) the camgear to pinion gear backlash using the following procedure:

1. Install the new camgear disc pack sub-assembly (as re-assembled in Steps 1 through 5 of the Cam/Clutch service procedure into the R.H. case, making sure that all (6) ear guide clips are in their proper location.
2. Clamp the camgear disc pack sub-assembly firmly into the R.H. case disc pocket by bolting in place, (see Fig. 25) Place all (3) pinion gears and pinion

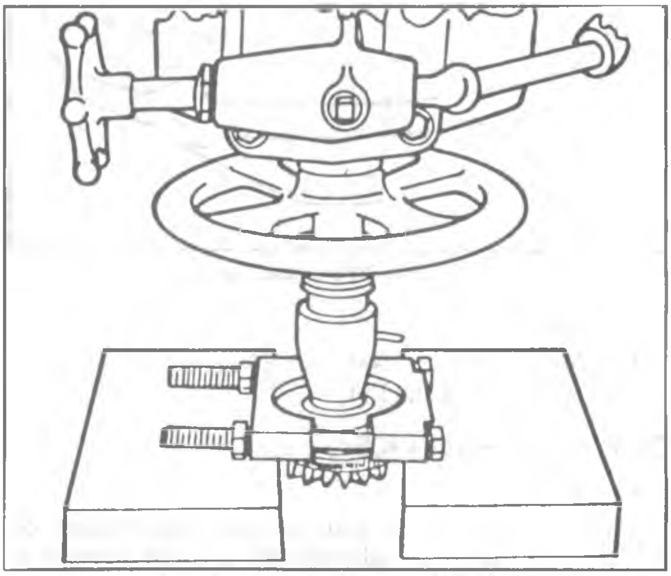


Fig. 24--Bearing Remover J-22919

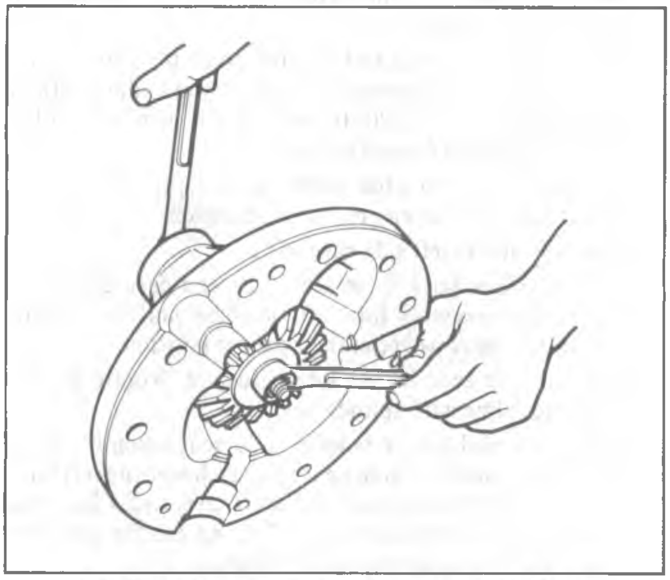


Fig. 25--Retaining Camgear Disc Pack in RH Case

thrust washers on the pinion yoke and firmly seat the yoke into position in the R.H. case (See Figure 26).

Slightly loosen the clamping bolt and index one pinion gear tooth so that it points downward perpendicular to the parting line of the R.H. case half, and retighten the clamping bolt.

4. Using a dial indicator mounted to the case parting surface, measure pinion gear to camgear backlash by holding pinion gear firmly against its seat and gently rotating it back and forth, and note reading (See Fig. 27.).

NOTICE: Take care not to unseat the pinion yoke or backlash reading will be inaccurate.

Repeat the above procedure of indexing and check backlash of the remaining (2) pinion gears, and not readings. If backlash is not between .010 and .018 on all gears, change shim size and repeat backlash procedure until the correct backlash is obtained. The thinner the shim used, the greater the backlash will be.

NOTICE: When camgear and/or side gear is replaced, thrust block replacement and clearance procedures must be followed during reassembly of the unit. Failure to due so may disturb critical clearances and could result in differential complaints.

Side Gear

Replacement

If it is necessary to replace the side gear due to pitting of the gear teeth, scoring of the hub, or breakage, it will be necessary to disassemble the unit as described in Steps 1 through 5 of case disassembly and in Steps 1 and 2 of side gear and clutch disc pack disassembly. When replacing the side gear, it will be necessary to adjust (by selecting the correct shim), the side gear to pinion gear backlash using the same procedure as described in the Camgear replacement procedure. However, backlash should be adjusted to within .002-.010.

Thrust Block Replacement and Clearance

If it is necessary to replace the thrust blocks only, replace them with ones of identical thickness. If the thrust blocks are broken, check for other damage and replace parts as necessary. If either R.H. case or L.H. is damaged, replace the entire unit.

If the camgear (R.H.) and/or side gear (L.H.) is replaced, it will be necessary to check the side gear spread dimension and adjust block clearance as follows:

1. Bolt the camgear (R.H.) disc pack sub-assembly and shim into the R.H. case as described in the Camgear Replacement procedure, and measure distance from the camgear face to the parting surface of the case and note the dimension (See Fig. 28).
2. Bolt the side gear (L.H.) disc pack sub-assembly and shim into the L.H. case half in the same manner and measure the distance from the side gear face to the parting surface of the case and note the dimension. Adding these (2) dimensions together will equal side gear spread.

NOTICE: When adding these dimensions, be certain to subtract out the thickness of the straight-edge from both readings.

Now, measure the thickness of the original thrust blocks together (see Fig. 29). If the thickness of the thrust blocks together is not within a range of .000 to .006 less than the side gear spread,adjust clearance with one of the following procedures:

a. Reshim L.H. clutch disc pack. Note: Backlash of .002-.010 must still be maintained.

b. Select correct size thrust block(s) to obtain .000 to .006 clearance.

Once the proper thrust block clearance has been obtained, continue reassembly of case.

CASE

Reassembly

1. Install (6) clutch pack guide clips on the ears of the camgear clutch pack using grease for retention.
2. Install cam gear assembly and original shim in

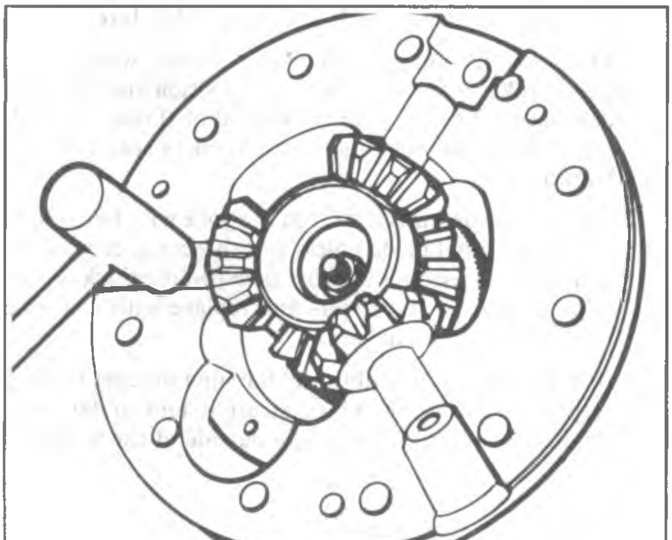


Fig. 26--Pinion Gears and Thrust Washers

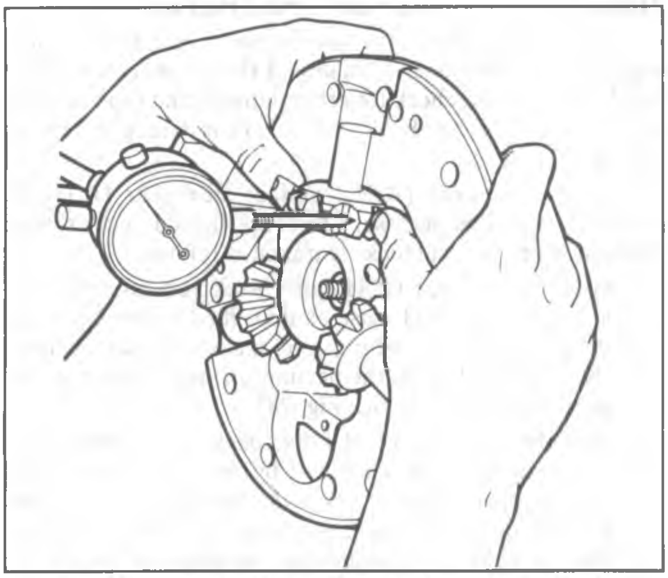


Fig. 27--Measuring Pinion Gear to Camgear Backlash

right side case half. If new camgear is installed, see Differential Gear Replacement Procedure. If a new thrust ring has been pressed on the cam gear, reshimming may be necessary. Measure the overall length of the new cam gear assembly, including the shim and compare to the dimension obtained in Step 1 of Cam/Clutch service procedure. If the length of the new assembly varies by more than .003" larger or smaller than the original dimension, reshimming will be necessary. Select a shim which will result in a reading closest to the original.

NOTICE: Incorrect shimming will disturbe critical clearance dimensions and may result in differential complaints.

3. Install right side thrust block on gear face with button side of block facing up. Use original block unless severely scored or worn. If new block is used, determine face-to-face thickness of original block with calipers and replace with a service block of the same thickness.

   NOTICE: Incorrect block thickness will disturbe critical clearances and may result in differential failure.

4. Preassemble pinions and pinion thrust washers on pinion yoke. Index yoke to proper position and install in housing with center over tutton end of thrust block. A light tap on the yoke may be needed to seat it in the housing.
5. Install left side thrust block on the yoke with flange side up. Use original block unless severly scored or worn. If new block is used, determine face-to-face thickness of original block with calipers and replace with a service block of the same thickness.
6. Install governor assembly and latching bracket in their respective locations. Place straight end of latching bracket spring over and to the outside of the governor shaft to preload the latching bracket against the governor assembly.
7. Install the (3) eared and (2) splined clutch plates on the L.H. side gear alternately, starting and ending with an eared disc. See Fig. 20. If new LH side gear is installed, see Differential Gear Replacement.
8. Install (6) clutch pack guide clips on the left side disc pack assembly using grease for retention.
9. Install shim in left side case half.
10. Remove disc pack from side gear and carefully lower disc pack assembly into left side case half. Make sure clutch guide clips are in their proper position.
11. Install side gear in left side case half. Rotate gear to engage spline with splines on discs.
12. Being careful not to dislodge side gear assembly (hold thumb on inside of side gear spline), lower the left hand case assembly onto the right hand case. Index left hand case so holes in housing will line up for the governor assembly and latching bracket shafts.
13. Turn entire unit over and install three (3) screws.
14. Lock an axle shaft in a vise in a vertical position. Install differential assembly on axle shaft engaging the spline of the axle with a side gear. Rotate unit slowly. A short shaft held in pinion yoke hole will aid in rotating. The unit should turn smoothy without binding or locking up.
15. Install ring gear and side bearings using the procedure outlined for standard differentials.
16. Place differential unit in carrier and adjust ring gear to pinion backlash and gear tooth pattern as outlined in the standard differential section.

NOTICE: Use only the rear axle lubricant recommended in Maintenance and Lubrication Section. The usage of any other lubricant or any additive may result in damage to the differential.

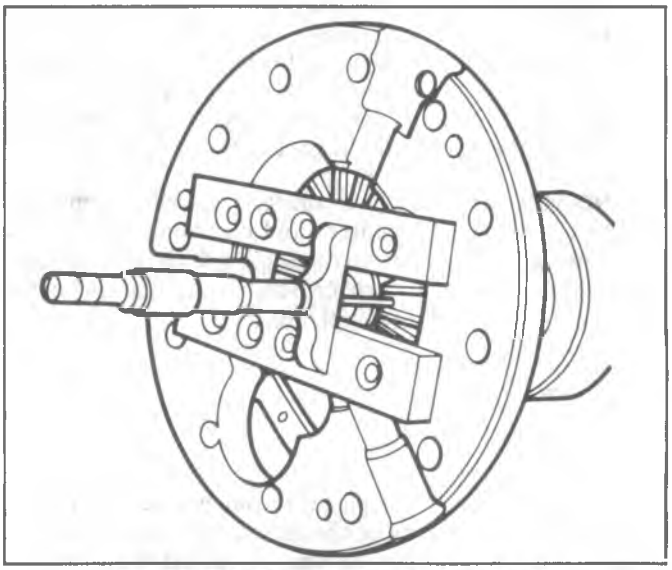


Fig. 28--Side Gear to Case Surface Depth

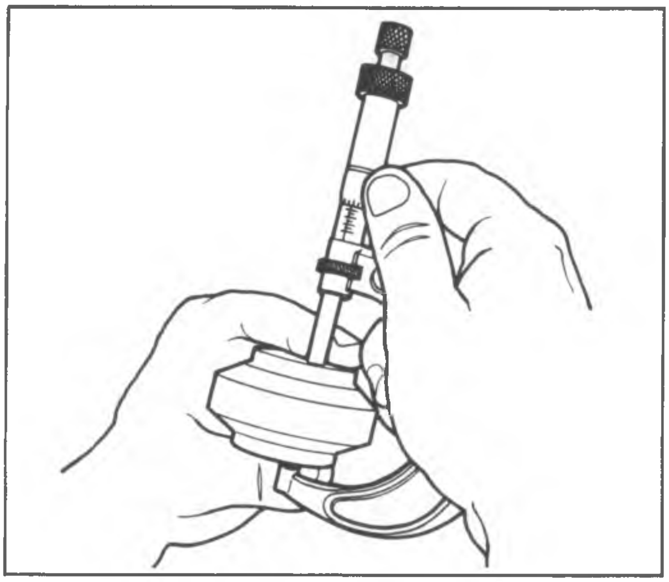


Fig. 29--Measuring Thrust Block

SECTION 4B10

SPECIFICATIONS AND SPECIAL TOOLS

DIFFERENTIAL SPECIFICATIONS

	8½" Chevrolet	9½" Chevrolet	10½" 9¾" Dana	10½" Chevrolet	12" Rockwell
Gear Backlash Preferred	.005"-.008"	.005"-.008"	.004"-.009"	.005"-.008"	.010
Min. and Max.	.003"-.010"	.003"-.010"	.004"-.009"	.003"-.012"	.005 .015
Pinion Bearing Preload (In.-Lbs.) — New	15-30	20-25	20-40	25-35	5-15
— Used	5-10	5-15	10-20	5-15	—

BOLT TORQUES (FT.-LBS.)▲

	8½" Chevrolet	9½" Chevrolet	10½" 9¾" Dana	10½" Chevrolet	12" Rockwell
Carrier Cover	20	20	35	30	—
Ring Gear	80	110	110	120	—
Differential Bearing Caps	55	65	85	135	—

▲Except where noted otherwise

BOLT TORQUES (FT.-LBS.)▲	8½" Chevrolet	9½" Chevrolet	10½" 9¾" Dana	10½" Chevrolet	12# Rockwell
Filler Plugs	25	18	10	18	35
Differential Pinion Lock	20"#	—	—	—	—
Drive Pinion Nut		*	*	*	350
Differential Carrier to Axle Housing		—	—	—	—
Differential Bearing Adjusting Lock		20	—	20	25
Pinion Bearing Cage To Carrier		—	—	65	35
Thrust Pad Lock Nut		—	—	—	—
Brake Backing Plate	35	105	105	105	—
Axle Shaft To Hub Bolts		—	115	115	—

*Torque as necessary to obtain correct preload.

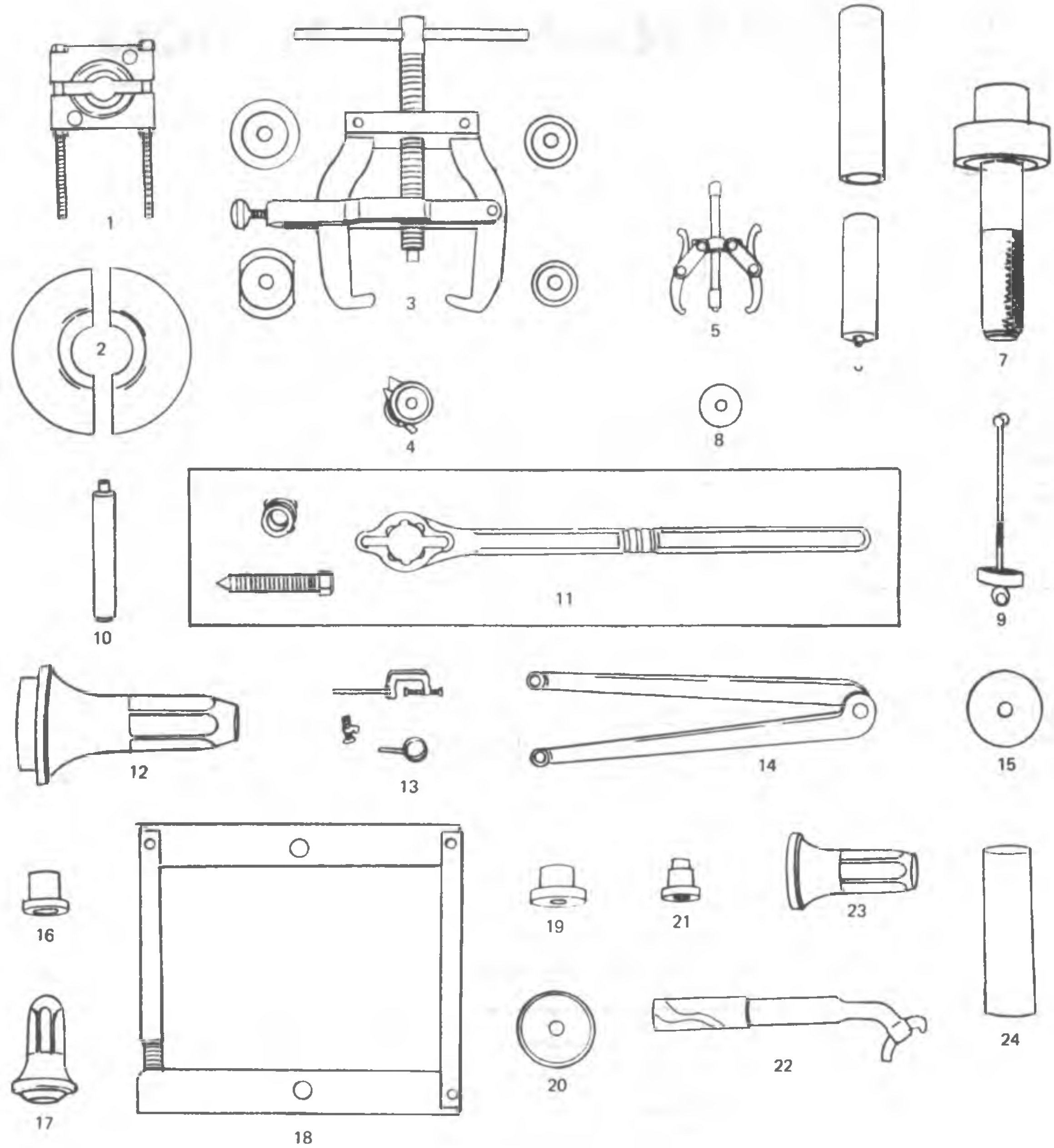
Refer to Section 4B-5

Ring Gear Size	Lubricant Capacity
Chevrolet 8½"	4.2 Pints
Chevrolet 9½"	5.5 Pints
Chevrolet 10½"	5.4 Pints
Dana 10½"	7.2 Pints
Dana 9¾"	6.0 Pints
Rockwell 12"	14.0 Pints

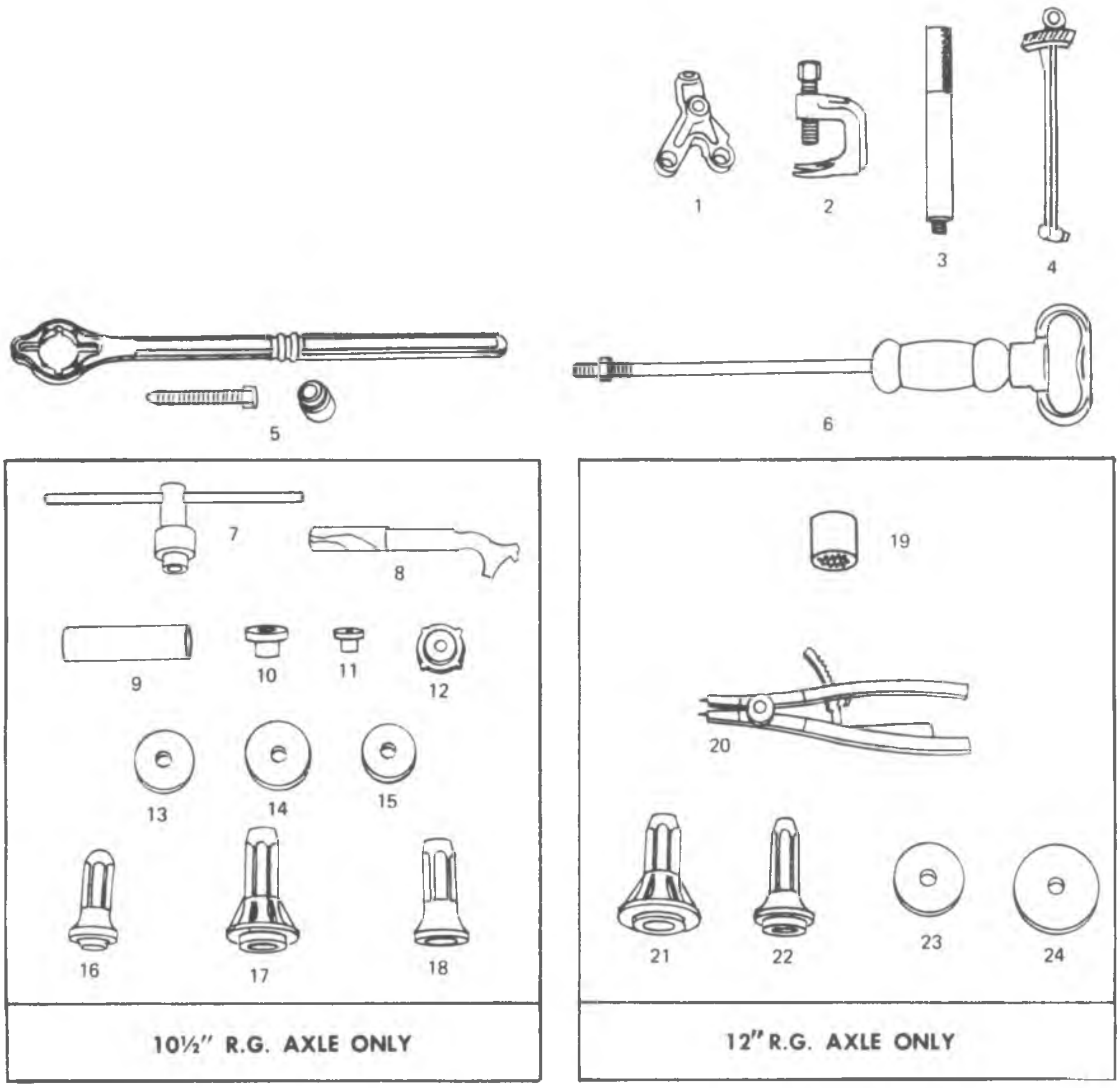
REAR WHEEL BEARING ADJUSTMENT SPECIFICATION

RING GEAR SIZE	BEARING ADJUSTING NUT TORQUE*	ADJUSTING NUT BACK-OFF*	OUTER LOCKNUT TORQUE	RESULTING BEARING ADJUSTMENT	TYPE OF BEARING
10-1/2"	50 FT. LBS.			.001 TO .010 END PLAY	TAPERED ROLLER
9-3/4"	50 FT. LBS.	**	65 FT. LBS.		
12	50 FT. LBS.	1/8 *	250 FT. LBS.	.001 TO .010 END PLAY	TAPERED ROLLER

**Back-off nut and retighten to 35 Ft. Lbs. then, back-off nut 1/4 turn.
*With wheel rotating.



1. J-22912 Press Plate
2. J-1453 Pinion Bearing Press Plate
3. J-8107 Differential Bearing Puller Set
4. J-8107-3 Adapter Plug
5. J-22888 Differential Side Bearing Remover
6. J-1364 Pinion Bearing Ring Drive
7. J-1488 Differential Side Bearing Replacer
8. J-8608 Drive Pinion Rear Bearing Cup Installer (Used with J-8092)
9. J-5853 In.-Lbs. Torque Wrench
10. J-8092 Drive Handle
11. J-8614 Companion Flange Holder and Remover
12. J-22281 Pinion Flange Oil Seal Installer
13. J-8001 Dial Indicator Set
14. J-0972 Differential Nut Wrench
15. J-24381 Pinion Rear Bearing Cup Installer
16. J-24383 Side Bearing Installer
17. J-24384 Pinion Oil Seal Installer
18. J-24385 Case Spreader Tool
19. J-24430 Side Bearing Installer
20. J-24432 Pinion Rear Cup Installer
21. J-23322 Pinion Straddle Bearing Installer
22. J-24429 Adjusting Nut Wrench
23. J-24434 Pinion Oil Seal Installer
24. J-24433 Pinion Rear Bearing Installer



1. J-5748 Positraction Torque Measuring Adapter
2. J-6627 Wheel Bolt Remover
3. J-8092 Driver Handle
4. J-5853 Torque Wrench - Inch/Pound
5. J-8614-II Companion Flange Holder
6. J-2619 Slide Hammer
7. J-2222 Wheel Bearing Nut Wrench
8. J-24429 Adjusting Nut Wrench
9. J-24433 Pinion Rear Bearing Installer
10. J-24430 Differential Side Bearing Installer
11. J-23322 Pinion Straddle Bearing Installer
12. J-24426 Outer Wheel Bearing Cup Tool
13. J-24432 Pinion Rear Bearing Cup Installer
14. J-24427 Inner Wheel Bearing Cup Installer
15. J-8608 Outer Wheel Bearing Cup Installer
16. J-24384 Pinion Oil Seal Installer - Dana
17. J-24428 Wheel Hub Oil Seal Installer
18. J-24434 Pinion Oil Seal Installer - Chevrolet
19. J-25510 Wheel Bearing Adjusting Nut Socket
20. J-22380 Tru-Arc Pliers
21. J-22354 Wheel Oil Seal Installer
22. J-22281 Pinion Oil Seal Installer
23. J-8114 Wheel Bearing Outer Cup Installer
24. J-8093 Wheel Bearing Inner Cup Installer

SECTION 4C

FRONT AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense, it must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

The front axle is a hypoid gear axle unit equipped with steering knuckles. Axle assembly number and production date are stamped on left tube of assembly.

K10-20 Models use a Chevrolet front axle, both incorporate a 8-1/2″ ring gear and have ratings of (K-10) 3600 lb. and (K-20) 3800 lb. The K-30 axle assembly is a Dana (60 Series) which incorporates a 9-3/4″ ring gear and has a 4500 lb. capacity.

Removal

1. Raise vehicle.
2. Remove wheel and tire.
3. Remove and support caliper. (See Notice on Page 1 of this section).
   Care should be taken so as not to stretch or damage the brake hose.
4. Remove hub lock mechanism.
5. Remove gears and snap rings.

DIAGNOSIS

EXCESS NOISE COMPLAINT DIAGNOSTIC PROCEDURE	
Road Test	1. Check tires for irregular wear 2. Check tire pressure 3. Check lubricant level 4. Drive to warm-up front axle 5. Test at various speeds in drive, float, coast and cornering 6. Verify that hubs are locked
Tire Noises	1. Change tire pressure to minimize noises 2. Drive over different road surfaces 3. Smooth black-top minimizes tire noise 4. Cross switch tires, if necessary 5. Snow tire treads and studs cause added noises
Engine or Exhaust Noises	1. Drive slightly above speed where noise occurs, place transmission in neutral 2. Let engine speed drop to idle 3. Stop vehicle 4. Run engine at various speeds
Test for *Wheel Bearing Noise	1. Drive vehicle at low speed on smooth road 2. Turn vehicle to develop left and right motions, traffic permitting 3. Noise should change due to cornering loads 4. Jack-up wheels to verify roughness at wheels
Test for *Differential Bearing Noise	1. Drive vehicle at low speed on a smooth road 2. Constant low pitch bearing noise may be heard 3. Noise should not change in reversing turns 4. Noise pattern should vary with wheel speed
Test for *Pinion Bearing Noise	1. Roughness or whine noise should increase with speed 2. Noise pitch should be higher than differentials 3. Test on smooth road to minimize tire noises 4. Test at various speeds in drive, float, and coast 5. Rear pinion bearing noise may be louder on acceleration 6. Front pinion bearing noise may be louder on deceleration 7. Gear noises tend to peak in a narrow speed range

*NOTE: Bearing tests should be done in 2H (after 4H selection to lock hubs). This removes transfer case whine.

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Fig. 4C-1--Bearing Diagnosis

6. Remove rotor.
7. Remove inner bearing and seal.
8. Remove spindle and backing plate.
9. Remove axle shaft.

Installation

Prior to installation, the following items should be checked.

a. Lube spindle bearing.
b. Clean, inspect and repack inner and outer wheel bearing.
c. Clean hub and spindle and lube spindle.

1. Install seal and thrust washer on axle shaft.
2. Install axle shaft into axle housing.
3. Install spindle.
4. Install splash shield. Torque nuts to specifications.
5. Install rotor and adjust wheel bearings.
6. Install thrust washer and snap ring.
7. Install hub lock mechanism.
8. Install caliper (See Notice on Page 1 of this section). Care should be taken so as not to stretch or damage the brake hose.
9. Install tire and wheel.
10. Lower vehicle.

FRONT AXLE ASSEMBLY (Refer to Fig. 4C-2)

Removal

1. Raise front of vehicle until weight is removed from front springs. Support vehicle with jack stands behind front springs.
2. Disconnect propeller shaft from front axle differential.
3. Disconnect connecting rod from steering arm.
4. Remove and support caliper.
5. Disconnect shock absorbers from axle brackets.

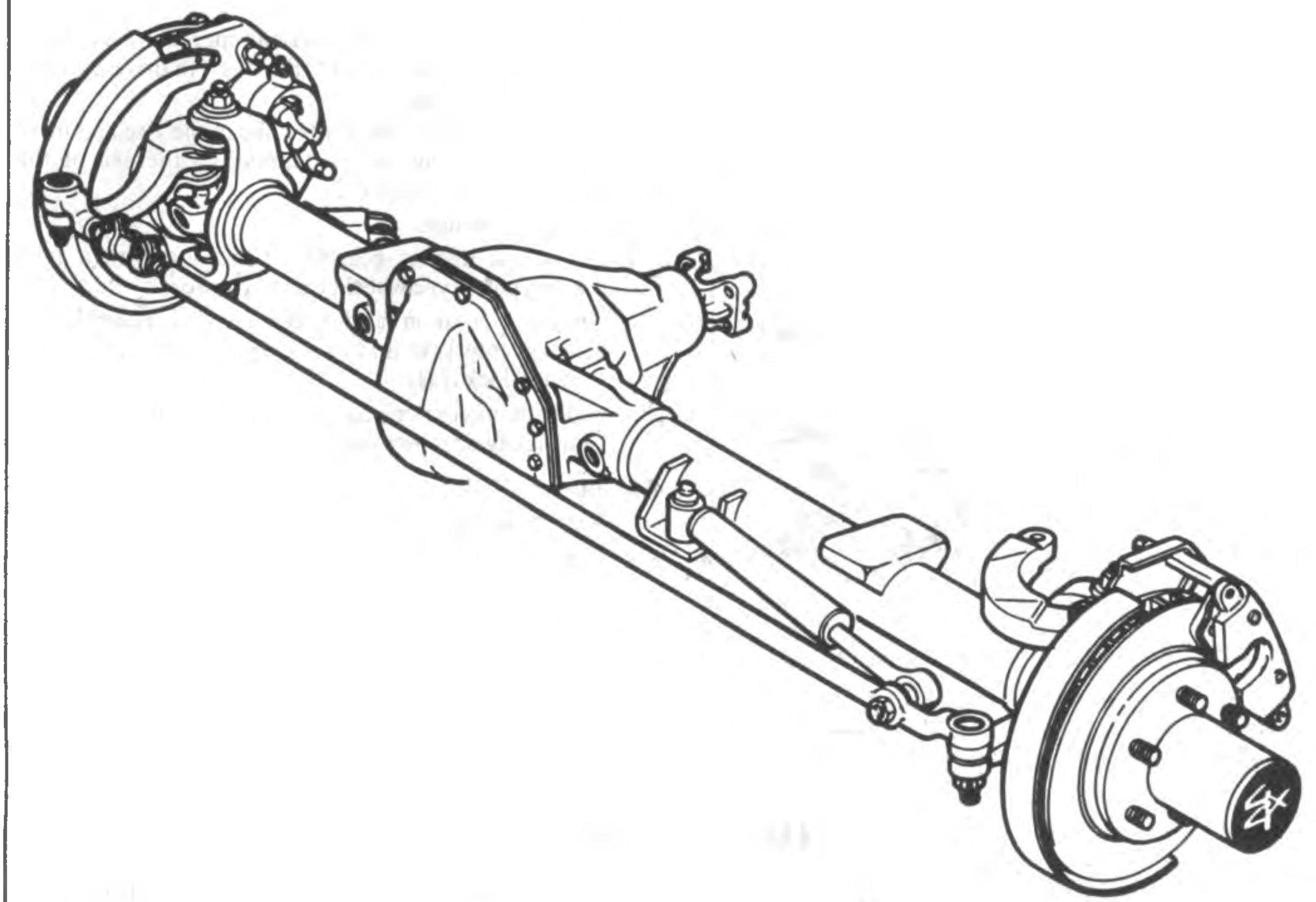


Fig. 4C-2--Front Drive Axle Typical

6. Disconnect axle vent tube clip at the differential housing (see fig. 4C-3).
7. Dismount "U" bolts from axle to separate axle from vehicle springs.
8. Raise vehicle to clear axle assembly and roll front axle out from under the vehicle.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 3, 5, 8 and 9.

1. Vehicle should be on jack stands as in Step 1 of removal instructions.
2. Place axle in position under vehicle.
3. Install "U" bolts attaching axle to front springs.
4. Attach shock absorbers to axle brackets.
5. Install caliper (Refer to Brake Section).
6. Attach connecting rod to steering arm.
7. Remove jack stands and lower front of vehicle.
8. Assemble propeller shaft to front axle differential.
9. Lower vehicle to floor.

Disassembly

Refer to Front Suspension Section for hub, spindle and knuckle removal and installation procedures.

1. Securely mount the axle assembly in a suitable holding fixture.
2. Remove automatic hub lock. (See Front Suspension Section).
3. Remove the wheel bearing outer lock nut, lock ring, and wheel bearing inner adjusting nut as outlined in Front Suspension Section.
4. Remove the disc assembly outer wheel bearing.

   If the disc or other brake components require repairs or replacement, refer to Brake Section.

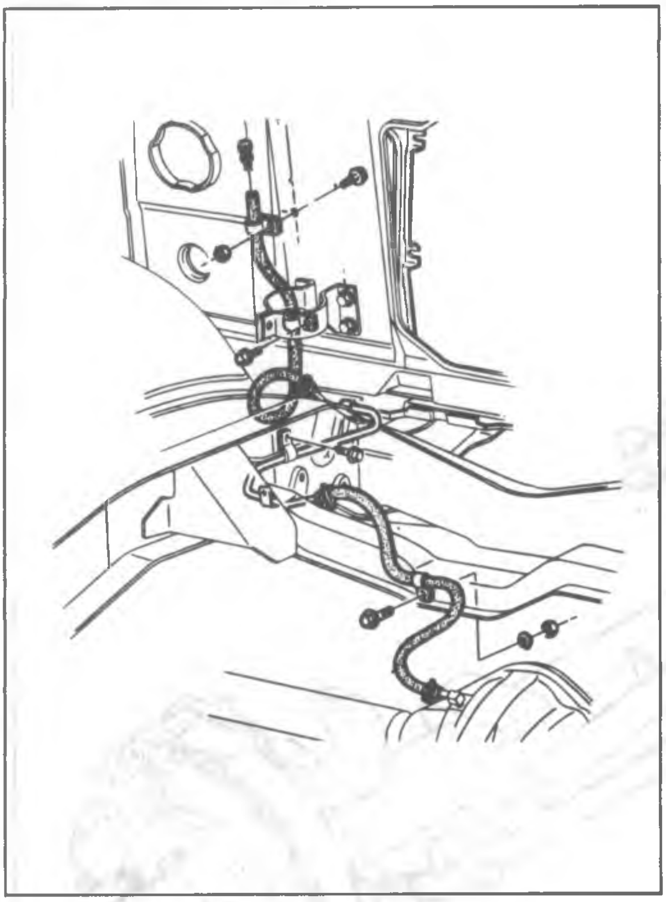


Fig. 4C-3--Axle Vent Hose Routing Typical

Repair Of Axle Joint Components:

1. Remove the lock rings after removing pressure from the trunnion bearings by squeezing the ends of the bearing in a vise.
2. Support the shaft yoke in a bench vise or on a short length of pipe.
3. Using a brass drift and a soft hammer, drive on end of one trunnion bearing just far enough to drive opposite bearing from yoke.
4. Support the other side of the yoke in the vise and drive the other bearing out by tapping on the end of the trunnion using a brass drift.
5. Remove trunnion.
6. Clean and inspect bearings. Lubricate with a high melting point type wheel bearing grease.
7. Replace trunnion and press new or relubricated bearings into yoke and over trunnion hubs far enough to install lock rings.
8. Hold trunnion in one hand and tap yoke lightly to seat bearings against lock rings.

Assembly

Reverse disassembly procedure.

UNIT REPAIR

GENERAL INFORMATION

The differential procedures in this section pertain to Dana model axles only. Procedures for the Chevrolet 8-1/2" model are the same as described in Section 4B.

FRONT AXLE DIFFERENTIAL CASE

Removal (On Vehicle Dana Model) Fig. 4C-4

1. Raise front of vehicle until weight is removed from front springs.
2. Place jack stands under right hand and left hand frame rails.
3. Disconnect the right shock absorber at the axle.
4. Remove the U-bolt nuts.
5. Disconnect the tie rod at the right hand knuckle.
6. Place a jack stand under the right steering knuckle.
7. Lower the axle on stand, remove U-bolts and move spring aside.

   NOTICE: Care should be taken so as not to stretch and damage the brake hose.
8. Turn stabilizer bar to spring plate attaching plate bolt and rotate the spring plate to provide clearance for the spreader tool, J-24385.

   If front axle assembly is removed from vehicle, mount assembly in suitable holding fixture.
9. Remove axle shafts as outlined under Axle Shaft Removal.
10. Remove cover attaching bolts and lock washers and the metal tag secured by one of the attaching bolts Remove cover and gasket.

    The tag shows the number of teeth on pinion and drive gear.
11. Remove differential side bearing caps, making sure they are marked for reassembly in the same position.
12. Position Spreader Tool J-24385 so the two dowels on tool fit into recesses in carrier, install two hold down bolts and install a dial indicator at one end of opening in carrier to indicate width of opening, (Fig. 4C-4 and 4C-5).
13. Expand spreader tool to spread carrier a maximum of .015".

    NOTICE: Do not attempt to remove differential without using the spreader tool. Do not expand carrier more than .015 in. or it may be damaged and take a permanent set.

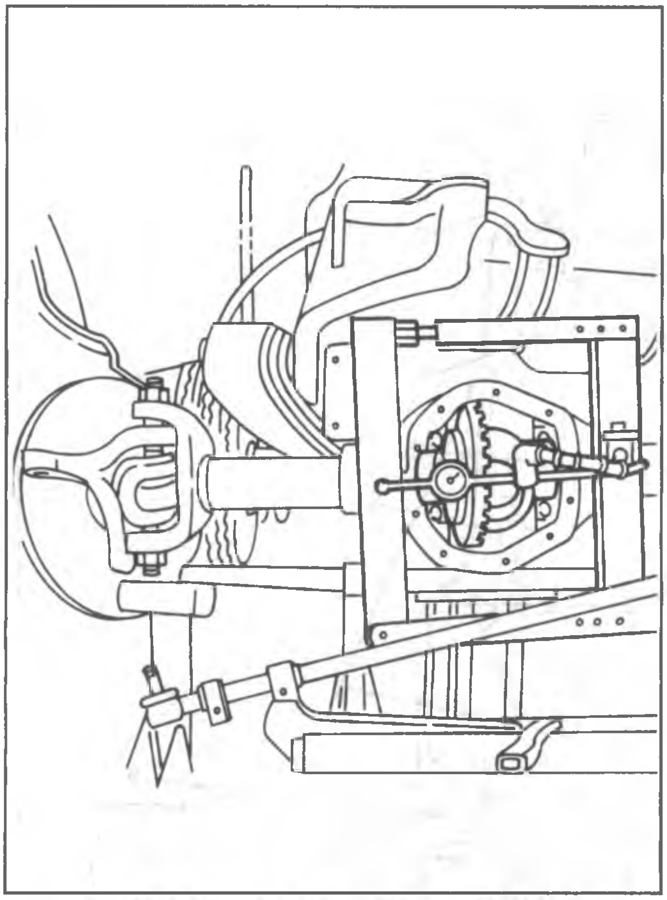


Fig. 4C-4--Removing Differential Case On Vehicle

14. Remove dial indicator and, using a pry bar, lift out differential assembly. Remove and tag bearing cups so they may be reinstalled in their original positions. Relieve pressure on spreader tool and remove tool.

Oil Seal Replacement

The axle shaft inner oil seals are located just outboard of the differential bearings, item 28 Fig. 4C-6. They can be replaced only after the differential is removed from the carrier, using tool J-28648.

Disassembly

1. Remove bearing cups from differential carrier and identify for reassembly.
2. Remove bearing cones from case, using puller J-29721 and correct plug (fig. 4C-8) and remove shims from case. Identify all parts so they may be reassembled in their original location.
3. Drive the pinion shaft lock pin out of case.
4. Remove ring gear bolts from case and separate ring gear from case.
5. Remove pinion shaft, pinions, side gears and thrust washers from case.

DRIVE PINION

Removal

1. Using Holding Bar J-8614-1, attached to pinion shaft flange, remove self-locking nut and washer from pinion shaft.
2. Install Tool J-8614-2, and 3 into holding bar as shown in Figure 4C-9 and remove flange from drive pinion. Remove drive pinion from carrier.
3. With a long drift, tap on inner race of outer pinion bearing to remove pinion oil seal, slinger gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.
4. Should inspection indicate necessity, pinion earing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.
5. Remove inner pinion cone and roller using Tool J-22912, installed as shown in Figure 4C-10, and press pinion from bearing.

Inspection

1. Clean all gears and bearings in cleaning solvent and inspect all bearing cups, races and rollers for scoring chipping or evidence of excessive wear. On pinion bearing rollers, inspect large end of rollers for wear. This is where wear is most evident on tapered roller bearings.

   The pinion bearings are of the tapered type, and the natural wear pattern is a frosted condition with occasional slight scratches on races or rollers. This does not indicate a defective bearing.
2. Inspect pinion splines and flange splines for evidence of excessive wear.
3. Inspect ring gear and pinion teeth for possible scoring cracking or chipping.
4. Inspect differential case for cracks on scores or

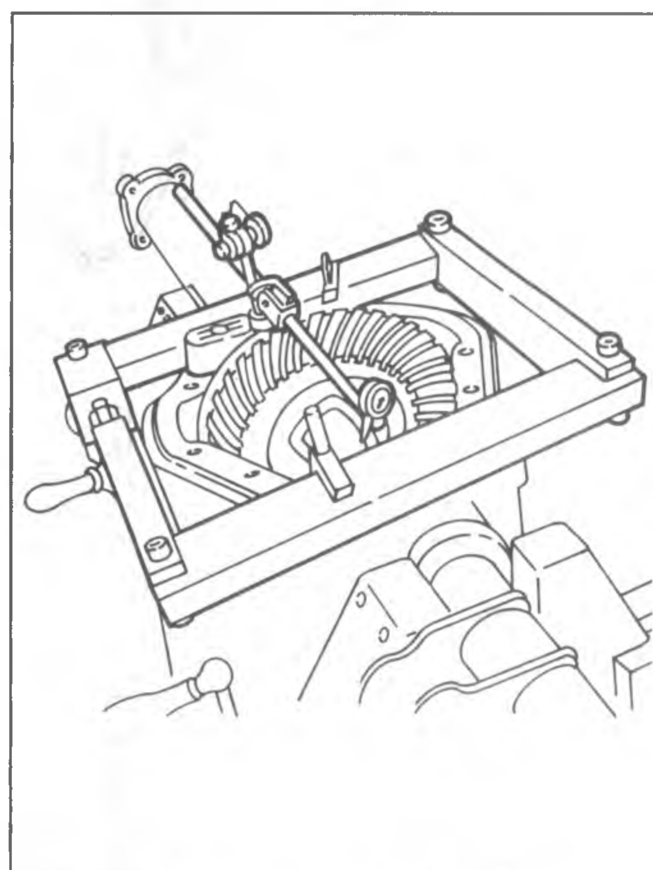
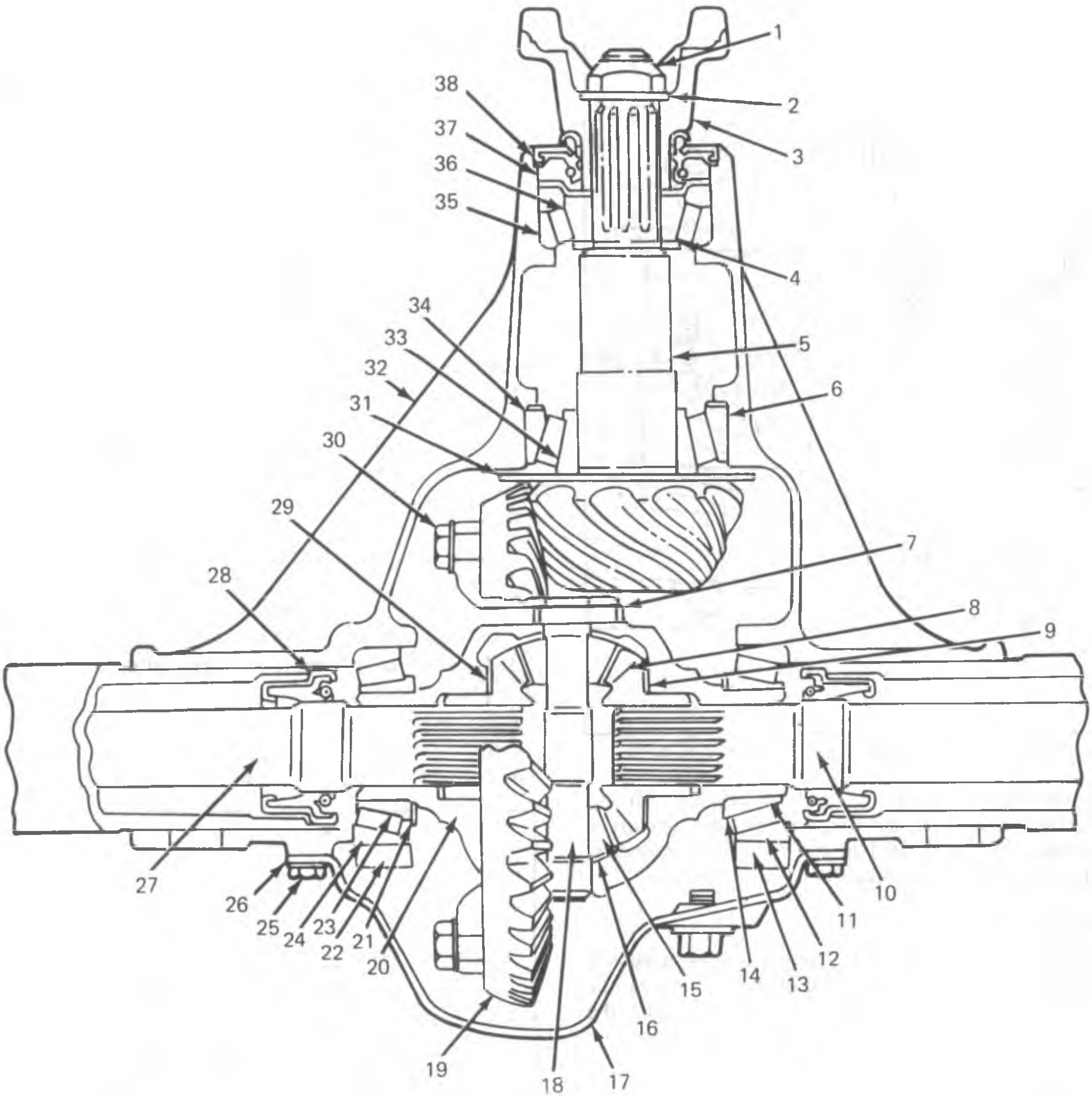
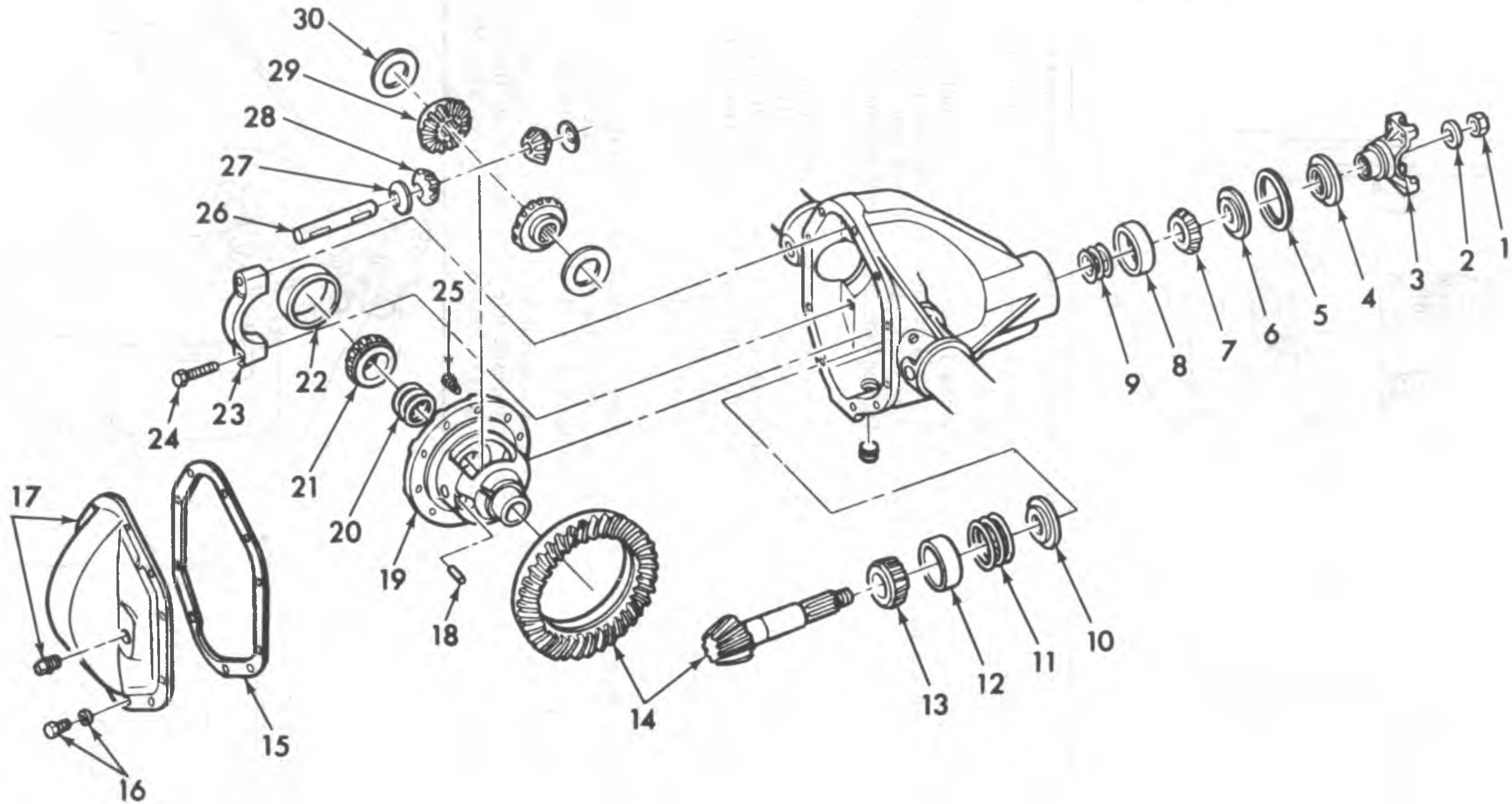


Fig. 4C-5--Spreading Case With J-24385



1. Nut
2. Washer
3. Pinion Flange
4. Outer Bearing Shims
5. Drive Pinion
6. Inner Bearing Shims
7. Lock Pin
8. Differential Side Gear
9. Thrust Washer
10. Axle Shaft
11. Differential Bearing Cone
12. Differential Bearing Cup
13. Bearing Cap
14. Differential Bearing Adjusting Shims
15. Differential Pinion
16. Thrust Washer
17. Cover
18. Pinion Cross Shaft
19. Ring Gear
20. Differential Case
21. Differential Bearing Adjusting Shims
22. Differential Bearing Cap
23. Differential Bearing Cone
24. Differential Bearing Cup
25. Cover Bolt
26. Gasket
27. Axle Shaft
28. Oil Seal
29. Thrust Washer
30. Ring Gear Bolt
31. Oil Slinger
32. Differential Carrier
33. Inner Bearing Cone
34. Inner Bearing Cup
35. Outer Bearing Cup
36. Outer Bearing Cone
37. Oil Slinger
38. Oil Seal

Fig. 4C-6--Front Axle Differential Assembly



1. Nut
2. Washer
3. Companion Flange
4. Pinion Oil Seal
5. Gasket
6. Outer Pinion Oil Slinger

7 and 8. Cone and Roller (Outer Pinion Bearing)

9. Shims (Outer Pinion Bearing)
10. Inner Pinion Oil Slinger
11. Shims (Inner Pinion Bearing)
12. Cup (Inner Pinion Bearing)
13. Cone and Roller (Inner Pinion)
14. Ring and Pinion
15. Gasket (Housing Cover)
16. Screw and Washer (Cover)
17. Cover and Plug
18. Lock Pin (Pinion Shaft)
19. Differential Case
20. Shims (Differential Adjusting)
21. Cone and Roller (Differential Bearing)
22. Cup (Differential Bearing)
23. Cap (Differential Bearing)
24. Bolt (Differential Bearing Cap)
25. Bolt (Ring Gear)
26. Pinion Shaft
27. Thrust Washer (Pinion)
28. Pinion
29. Side Gear
30. Thrust Washer (Side Gear)

Fig. 4C-7--Differential - Exploded View

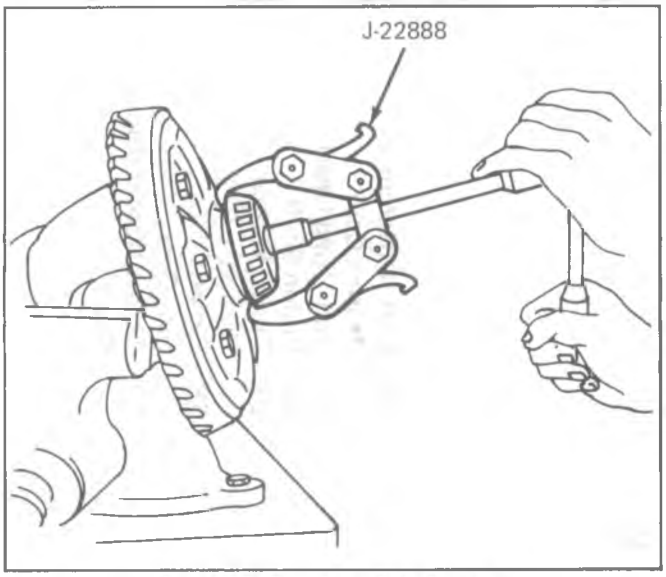


Fig. 4C-8--Removing Side Bearing

side gears, thrust washers, and pinion thrust faces.

5. Check fit of differential side gears in case.
6. Check fit of side gears and axle shaft splines.
7. Inspect differential pinion shaft and spacer for scoring or evidence of excessive wear.

DIFFERENTIAL CASE

Reassembly

1. Position differential side gears and new thrust washers in differential case.
2. Position differential pinions and new thrust washers in differential case. Align pinions with holes in differential case.
3. Install pinion shaft in differential case. Align hole in shaft with hole in case, then install lock pin. Peen hole to prevent pin dropping out of case.
4. Position ring gear to case; then install cap screws. Tighten cap screws evenly and alternately to specifications.
5. With an arbor press, press differential side

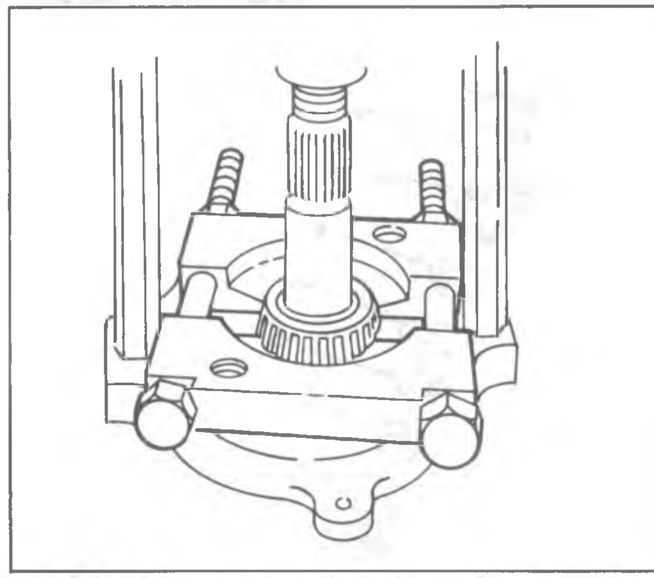


Fig. 4C-10--Removing Inner Pinion Bearing Cone and Roller

bearings onto case using Tool J-22175. Do not install shims at this time.

6. Place differential case in carrier and install bearing caps. Care should be taken to install caps in original position. Use mark placed on caps and carrier at removal. Tighten caps just enough to keep bearing caps in place.
7. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-11). Rotate differential case and check for runout. If runout is greater tha .002", the assembly should be removed and the ring gear removed from case. Again install differential case and check runout at differential case flange.
8. Should runout of case flange be greater than .002", the defect is probably due to bearings or differential case, and should be corrected before proceeding further.
9. Position two screwdrivers between bearing cup and carrier on opposite side of ring gear (away from dial indicator side). Pull on screwdrivers and force

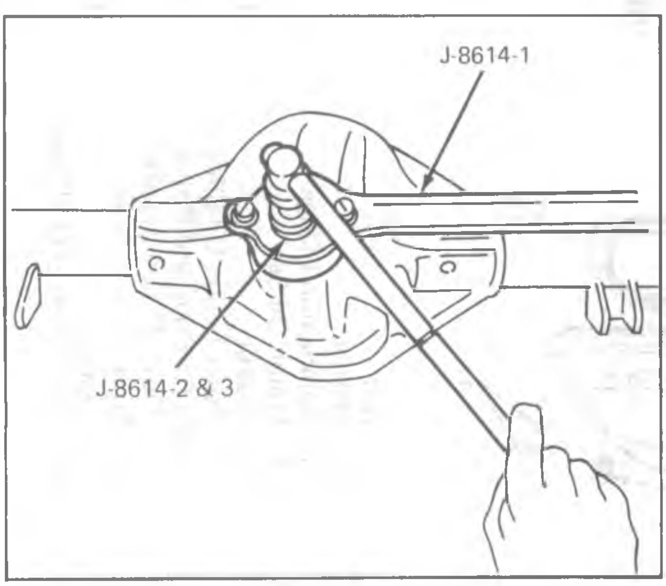


Fig. 4C-9--Removing Pinion Flange

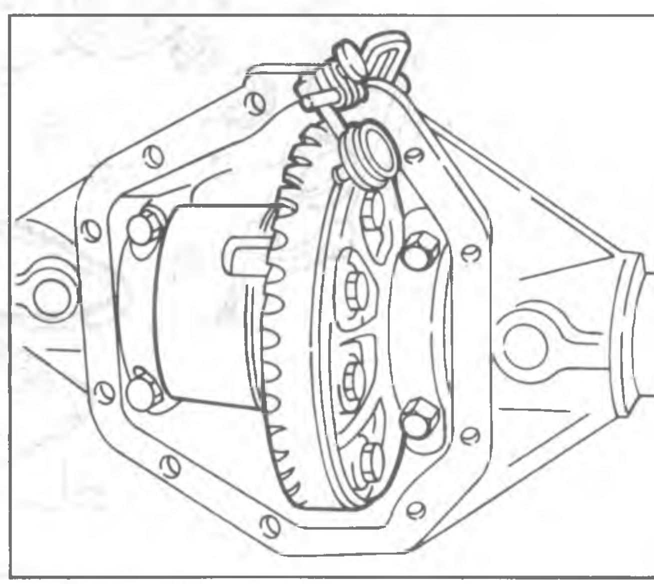


Fig. 4C-11--Checking Runout

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 4C-12--Drive Pinion Shim Chart

differential case as far as possible toward the dial indicator. Rock the ring gear to set the bearings. With force still applied, set indicator at "0".

10. Reposition screwdrivers between bearing cup and carrier on ring gear side. Pull on screwdrivers and force differential case as far as possible toward center of carrier. Repeat several times until the same reading is obtained. Record the indicator reading. This will be the total amount of shims needed (less preload) for setting backlash later during assembly.
11. Remove differential from carrier.

DRIVE PINION

Installation and Adjustment of Depth and Preload

Ring gears and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers of each pinion and ring before proceeding with assembly.

On the button end of each pinion there is etched a plus + number, a minus - number, or a zero(0) number, which indicates the best running position for each particular gear set. This dimension is contolled by the shimming behind the inner bearing cup. Whenever baffles or oil slingers are used, they become a part of the adjusting shim pack.

For example: If a pinion is etched +3, this pinion would require .003" less shims than a pinion etched "0". This means by removing shims, the mounting distance of the pinion is increased by .003" which is just what a +3 etching indicates. Or if a pinion is etched -3, we would want to add .003" more shims than would be required if the pinions were etched "0". By adding .003" shims, the mounting distance of the pinion was decreased .003" which is just what a -3 etching indicated.

If the old ring and pinion set is to be reused measure the old shim pack and build a new shim pack to this same dimension. If baffle is in the axle assembly, it is considered as part of the shim pack.

To change the pinion adjustment, shims are available in thicknesses of .003", .005" and .010".

If baffle or slinger is bent or mutilated, it should be replaced.

Measure each shim separately with a micrometer and add together to get total shim pack thickness from original build up.

If a new gear set is being used, notice the plus or minus etching on both the old and new pinion, and adjust the thickness of the old shim pack to compensate for the difference of these two figures.

For example: If the old pinion reads +2 and the new pinion is -2, add .004" shims to the original shim pack.

1. Determine proper inner shim pack (for setting pinion depth) by using chart (Fig. 4C-12).
2. Install inner shim pack and oil slinger in inner cup bore and drive inner cup into position using Tool J-21059 used with J-8092.
3. To the outer shim pack (for setting preload) add or remove an equal amount as was added or removed from the inner shim pack.
4. Install outer cup in carrier bore, using installer J-7818 with Drive Handle J-8092.
5. Press inner pinion bearing cone and roller onto pinion shaft using Installer J-9772 on arbor press as shown in Figure 4C-13.
6. Install drive pinion and inner bearing cone and roller assembly in differential carrier.
7. Install shims and outer pinion cone and roller on pinion shaft using Tool J-5590 and companion flange to press bearing onto pinion (Fig. 4C-14).
8. Install flange holding bar and install washer and nut on pinion shaft. Torque nut to 355 N·m (255 ft. lbs.).
9. Remove holding bar and with an inch pound torque wrench measure rotating torque. Rotating torque should be 1.2 to 2.2 N·m (10 to 20 in. lbs.) with original bearings or 2.2 to 4.6 N·m (20 to 40 in. lb.) with new bearings.

   Torque reading to start shaft turning must be disregarded.
10. If torque requirements (preload) are not to specifications, adjust shim pack as necessary R

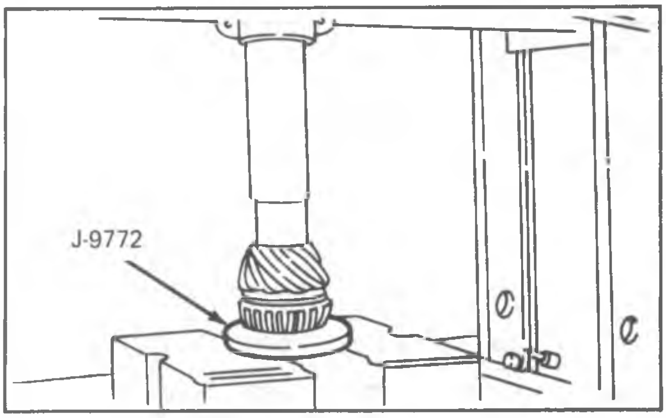


Fig. 4C-13--Installing Inner Pinion Core and Roller

Increase the outer shim pack to reduce rotation torque. Decrease shim pack to increase rotating torque.

11. Remove nut, washer and flange from pinion shaft.
12. Install oil slinger, gasket and using Tool J-22804 install oil seal.
13. Install flange, washer and nut. Torque nut to specifications.

DIFFERENTIAL CASE

Preload and Adjustment

1. Place differential assembly (with pinion assembled) into housing Install bearing caps in their proper position and tighten screws just enough to hold the bearing cups in place.
2. Install dial indicator on carrier with indicator button contacting back of ring gear (Fig. 4C-11).
3. Place two screwdrivers between bearing cup and housing on ring gear side of case, and pry ring gear into mesh with pinion gear as far as it will go. Rock ring gear to allow bearings to seat and gears to mesh. With force still applied, set indicator to "0".
4. Reposition screw drivers on opposite side of ring gear and pry ring gear as far as it will go. Now take and indicator reading. Repeat until the same reading is obtained every time. This reading will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove differential bearing from the ring gear side and assemble proper amount of shims. Reassemble bearing.
5. Remove the differential bearing from the opposite side of ring gear. To determine the amount of shims needed here, use the following method.
   a. Subtract the size of shim pack just installed on ring gear side of case from the reading obtained and recorded in step 10 of Differential Case Reassembly.
   b. To this figure, add an additional .015" shims to compensate for preload and backlash.

   Example: If reading in step 10 of Differential Case--Reassembly was .085" and the shims installed on ring gear side of case was .055", the correct amount of shim will be .085" - .055" + .015" =.045".
6. Install shims as indicated in step 5, (which will give the proper bearing preload and backlash) and install side bearing.

Installation

1. Spread differential carrier, using spreader as shown in Figure 4C-4 and 4C-5.
2. Install differential bearing cups in their correct locations then install differential case into carrier.
3. Install differential bearing caps in the correct location as indicated by marks made at disassembly. Install cap screws finger tight. Rotate differential assembly and rap on case with a soft-faced hammer to ensure proper seating of case in carrier.
4. Remove spreader and torque cap bolts to specifications.
5. Install dial indicator and check ring gear backlash at four equally spaced points around the ring gear. Backlash must be held to .004" to .009" and must not vary more than .002" between positions checked.
6. Whenever backlash is not within limits, differential bearing shim pack should be corrected to bring backlash within limits.
7. Check gear tooth contact as described in "Gear Tooth Contact Pattern Check".
8. After a successful pattern check, install housing cover using a new gasket.
9. Install axle shafts and install axle assembly into vehicle.
10. Fill with recommended lubricant, lower vehicle to floor and road test vehicle.

GEAR TOOTH CONTACT PATTERN CHECK

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life, or both. With a pattern check, the most desirable contact between ring gear and drive pinion for low noise level and long life can be assured.

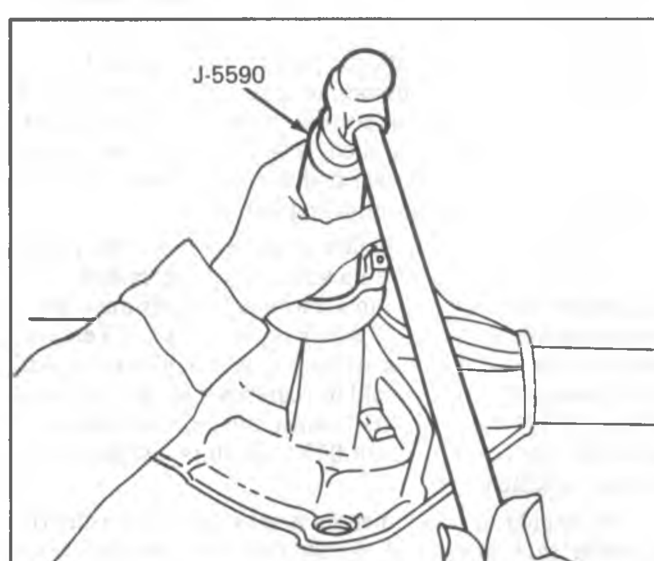


Fig. 4C-14--Installing Pinion Flange

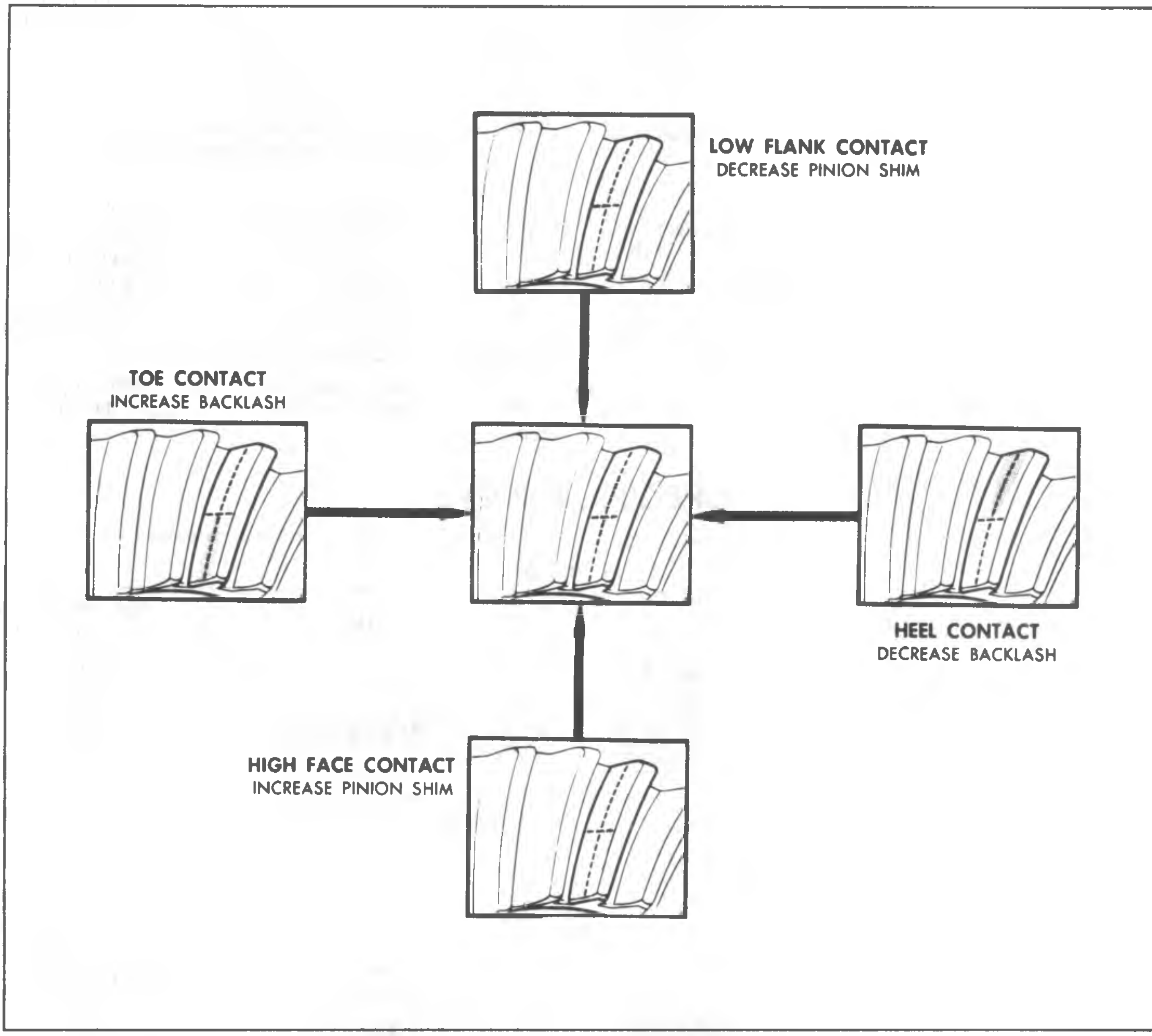


Fig. 4C-16--Gear Tooth Pattern Contact Pattern

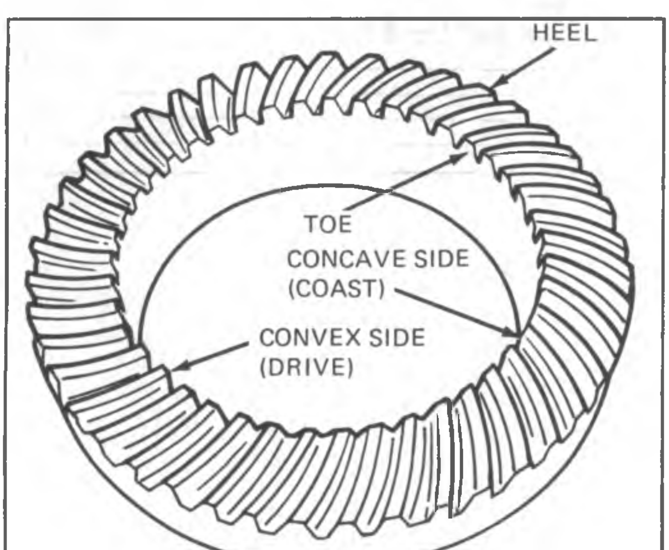


Fig. 4C-15--Gear Tooth Nomenclature

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See Figure 4C-15.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 75 N·m (55 lb. ft.).
4. Apply a load until a torque of 54-70 N·m (40-50 lb. ft.) is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench so that ring gear rotates one full revolution then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear is not recommended.

5. Observe pattern on ring gear teeth and compare with Figure 4C-16.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern. These are backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on hand loaded teeth pattern tests: however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

It may be necessary to adjust both pinion depth and backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerences. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To increase backlash, increase right shim and decrease left shim an equal amount. To decrease backlash decrease right shim and increase left shim an equal amount.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

SPECIFICATIONS

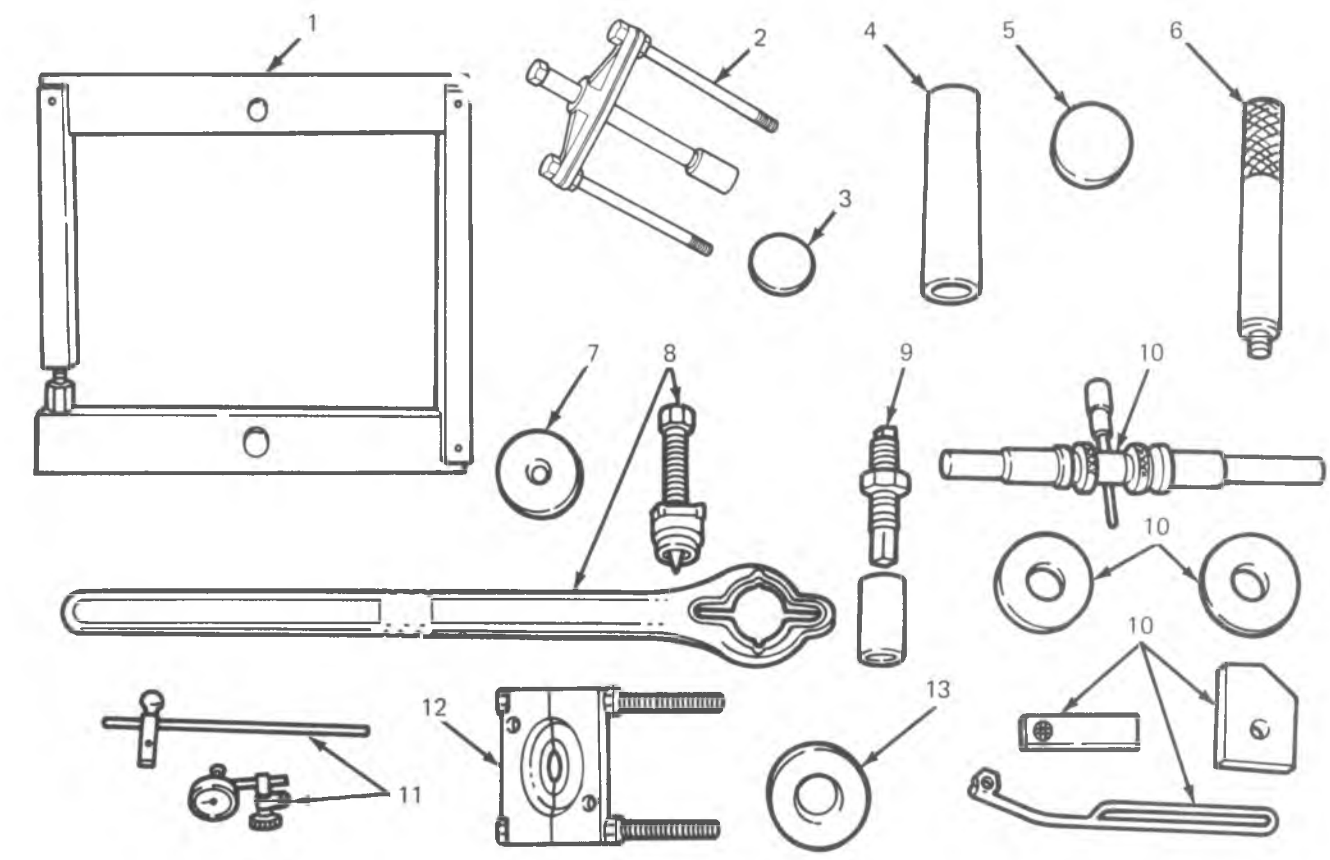
CHEVROLET

Axle	Bolt Torques (Ft.-Lbs.)	Axle	Bolt Torques (Ft.-Lbs.)
Gear and Backlash Preferred	.005-.008	Carrier Cover	20
Min. and Max.	.003-.010	Ring Gear	80
New Pinion Bearing Preload	15-30 in.-lbs.	Differential Bearing Caps	55
Used Pinion Bearing Preload	5-10 in.-lbs.	Filler Plugs	25

DANA

Axle	Bolt Torques (Ft.-Lbs.)	Axle	Bolt Torques (Ft.-Lbs.)
Gear Backlash Preferred	.004"-.009"	Carrier Cover	35
Min. and Max.	.004"-.009"	Ring Gear* — K-30	110
New Pinion Bearing Preload	20-40 in.-lbs.	Differential Bearing Caps	85
Used Pinion Bearing Preload	10-20 in.-lbs.	Filler Plugs	10
		Drive Pinion Nut** — K-30	270

Specification Chart 4C-1



1.	J-24385	Spreader - Axle Carrier
2.	J-29721	Puller - Side Bearing
3.	J-22175	Installer - Side Bearing
4.	J-5590	Installer - Pinion inner and outer bearing cone
5.	J-6368	Installer - Pinion outer bearing cup (use with J;8092)
6.	J-8092	Driver Handle (use with J-6368)
7.	J-9276-2	Installer - Pinion inner bearing
8.	J-8614-01	Holder and Remover - Companion Flange
9.	J-23476	Installer - Companion Flange
10.	J-5341	Gauge - Pinion Depth Consists of Parts: (1) SE 1065-1, (2)-5, (2)-6, (2)-9SS, (1)-10, (1)-58 with 1" micrometer
11.	J-8001	Dial Indicator Set
12.	J-22912	Press Plate Pinion bearing
13.	J-23494	Installer - Pinion oil seal use with J-23476

Fig. 4C-17--Special Tools

SECTION 5

BRAKES

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on Page 1 of this section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and system, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

CAUTION: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. (A water dampened cloth should be used.) Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

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GENERAL INFORMATION

The following service procedures are made for quick and easy access. Refer to the proper brake system for specific service procedures and descriptions.

DIAGNOSIS

INSPECTION AND TESTING BRAKES

Testing Brakes

Brakes should be tested on dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw weight of vehicle toward wheels on one side or if roadway is so rough that wheels tend to bounce.

Test brakes at different vehicle speeds with both light and heavy pedal pressure; however, avoid locking the wheels and sliding the tires on roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked but turning wheels will stop vehicle in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

External Conditions that Affect Brake Performance

1. **Tires**--Tires having unequal contact and grip on road will cause unequal braking. Tires must be

equally inflated and tread pattern of right and left tires must be approximately equal.

2. **Vehicle Loading**--When vehicle has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded vehicle requires more braking effort.
3. **Front Wheel Bearing**--A loose front wheel bearing permits the disc to tilt and have spotty contact with the linings causing erratic action.
4. **Front End Alignment**--Misalignment of the front end, particularly in regard to limits on camber and theoretical king pin inclination, will cause the brakes to pull to one side.

CAUSE \ SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brake Tell-Tale Glows During Stop
Leaking Brake Line or Connection	X	XX							X						XX
Leaking Wheel Cylinder or Piston Seal	X	XX		X				X							X
Leaking Master Cylinder	X	XX													X
Air in Brake System	XX								X						XX
Contaminated or Improper Brake Fluid					X	X	X								X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head			X		XX	X									
Damaged Power Head			X	X	X	X	X								
Improperly Assembled Power Head Valving			X	X	X	X	XX								
Worn Out Brake Lining - Replace			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear - Replace and Correct	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining			XX		X			X	X		X	X			
Incorrect Lining Material - Replace			X	X				X	X			X		X	
Contaminated Brake Lining - Replace				XX				XX	XX	X	X	X		X	
Linings Damaged by Abusive Use - Replace			X	XX				X	X	X	X	X		X	
Excessive Brake Lining Dust			X	XX				XX	XX		X	XX		X	
Heat Spotted or Scored Brake Drums or Rotors				X				X	X		X	X	XX	X	
Out-of-Round or Vibrating Brake Drums												X	XX		
Out-of-Parallel Brake Rotors													XX		
Excessive Rotor Run-Out													X		
Faulty Automatic Adjusters	X						X	X	X						X
Incorrect Wheel Cylinder Sizes			X	X				X	X						
Weak or Incorrect Brake Shoe Retention Springs				X		X	XX	X	X	XX	X	XX			
Brake Assembly Attachments - Missing or Loose	X						X	X	X	X		X	X	X	
Insufficient Brake Shoe Guide Lubricant						X	X	X	X	XX	XX				
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X						
Faulty Metering Valve	X		X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X								
Drums Tapered or Threaded										XX					
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments								X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal	X	X	X				X		X					X	
Improperly Adjusted Master Cylinder Push Rod	X					X	XX								X
Sticking Wheel Cylinder or Caliper Pistons			X			X	X	X	X						
Faulty Proportioning Valve			X		X	X	X								

XX - Indicates more probable cause(s)   X - Indicates causes

GENERAL INFORMATION AND SERVICE

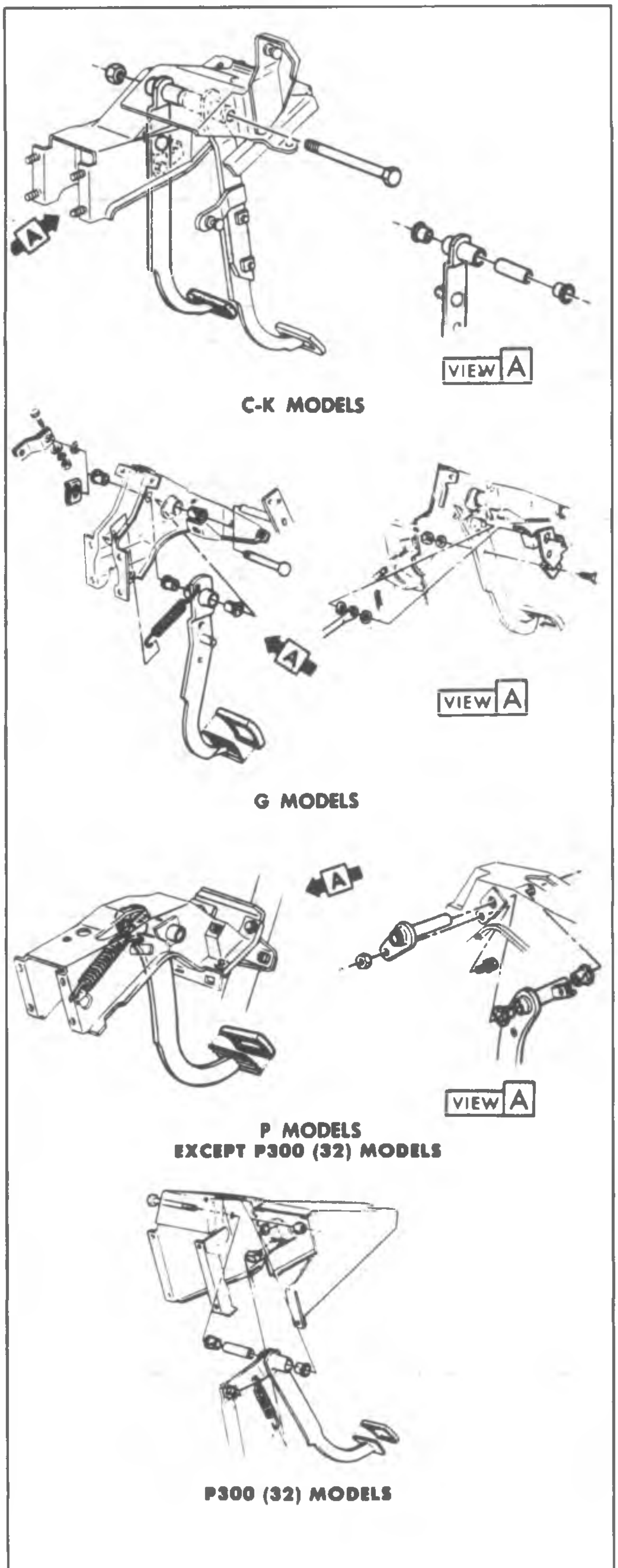


Fig. 5-1--Brake Pedal Installation

PEDAL TRAVEL

At reasonably frequent intervals, the brakes should be inspected for pedal travel, which is the distance the pedal moves toward the floor from a fully-released' position. Inspection should be made with the brake pedal firmly depressed (approximately 90 lbs.) while the brakes are cold.

- C-K-G Manual .... 4.5" (115mm)
- C-K-G Power .... 3.5" (90mm)
- P (Except JF9) .... 3.5" (90mm)
- P (JF9) .... 6.0" (150mm)

On power brake-equipped vehicles, pump the pedal a minimum of 3 times with the engine off before making pedal travel checks. This exhausts all vacuum from the power booster.

BRAKE PEDAL

The brake pedal mounting is an integral design with the clutch pedal (except automatic transmission), necessitating the removal of the clutch pedal before removing the brake pedal.

Removal (Fig. 5-1)

1. Remove the pull back spring from the body or brake pedal support bracket.
2. **Manual Transmission Vehicles**--Remove the clutch pedal as outlined in the Clutch Section.

BRAKE PEDAL ROD

P30(32) Models

Replacement (Fig. 5-2)

1. Remove the cotter pin, nut, special washers and bolt at the brake pedal lever end of rod; discard the cotter pin.
2. Remove the boot to floorpan screws.
3. Raise the vehicle on a hoist.
4. Remove the cotter pin, nut, special washers and bolt at the lower end of the rod and remove the pedal rod assembly. Discard the cotter pin.
5. To install a new rod, adjust the rod length to 31.00" (790 mm) (center of lower attachment).
6. Lubricate the pedal rod bolts and special washers with Delco Brake Lube (or equivalent).
7. Install the rod up through the floor pan opening and install the lower pivot bolt, special washers and nut. Tighten the nut to 22-30 lb. ft. (30-40 N·m) and install a NEW cotter pin.
8. Push the boot up to the floorpan.
9. Lower the vehicle from the hoist.
10. Install the rod upper pivot bolt, special washers and nut. Tighten the nut to 22-30 lb. ft. (30-40 N·m) and install a NEW cotter pin.
11. Fasten the boot to the floorpan and compress the boot to 2.54" (65 mm) installed height; tighten the boot to 2.54" (65 mm) install height; tighten the boot screws to 13-18 lb. in. (1.5-2.0 N·m).

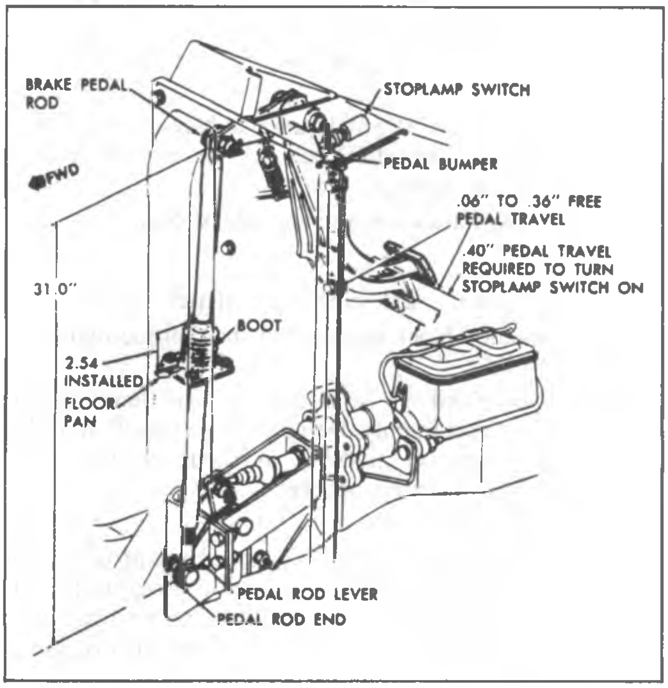


Fig. 5-2--Brake Pedal and Stoplamp Adjustment P30(32) Model

12. Adjust brake pedal and stoplamp switch as outlined previously.

P30(42) and G Models

Replacement

1. **G Models**--Remove the brake pedal striker screw and remove the striker. Remove the cotter pin and washer and disconnect the pedal rod from the brake pedal.
2. **P30(42) Models**--Remove the cotter pin nut and bolt to disconnect the pedal rod from the brake pedal.
3. Remove the pedal rod retainer bolt (at the rod pivot) and remove the retainer.
4. Remove the cotter pin and washer and remove the pedal rod.
5. To install a new rod, reverse Steps 1-4 above. Lubricate pivot points with Delco Brake Lube (or equivalent).

   NOTICE: See "Notice" on Page 1 of this section.
6. Check brake pedal and stoplamp switch adjustments as outlined previously.

STOP LIGHT SWITCH

Adjustment (Fig. 5-3)

The design of the switch and valve mounting provides for automatic adjustment when the brake pedal is manually returned to its mechanical stop as follows:

1. With brake pedal depressed, insert switch and/or valve assembly into tubular clip until switch body and/or valve assembly seats on tube clip. Note that audible "clicks" can be heard as threaded portion of switch and valve are pushed through the clip toward the brake pedal.
2. Pull brake pedal fully rearward against pedal stop, until audible "click" sounds can no longer be heard. Switch and/or valve assembly will be move in tubular clip providing proper adjustment.
3. Release brake pedal, then repeat Step 2 to assure that no audible "click" sounds remain.

Electrical contact should be made when the brake pedal is depressed 1.0-1.24" (25-31 mm) (C-K models), .45-.95" (11-24 mm) (G-P models) from its fully released position.

BRAKE PIPES

Replacement (Fig. 5-5 thru 5-7)

NOTICE: Never use copper tubing because copper is subject to fatigue cracking and corrosion which could result in brake failure.

1. Procure the recommended tubing and steel fitting nuts of the correct size. (Outside diameter of tubing is used to specify size.)
2. Cut tubing to length. Correct length may be determined by measuring old pipe using a cord and adding 1/8" (3mm) for each double flare.
3. Double flare tubing ends using a suitable flaring tool such as J-23530. Follow instructions included in tool set. See Figures 5-4.

   Make sure fittings are installed before starting second flare.

   NOTICE: Double flaring tool must be used as single flaring tools cannot produce a flare strong enough to hold the necessary pressure.
4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of .75" (19 mm) must be maintained to all moving or vibrating parts.

BRAKE HOSES

Inspection

The flexible hydraulic brake hose which transmits hydraulic pressure from the steel brake pipe on the frame to the rear axle and to the calipers should be inspected at the intervals shown in the Maintenance and Lubrication Section. The brake hose assembly should be checked for road hazard damage, for cracks and chafing of the outer cover, and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, it will be necessary to replace it.

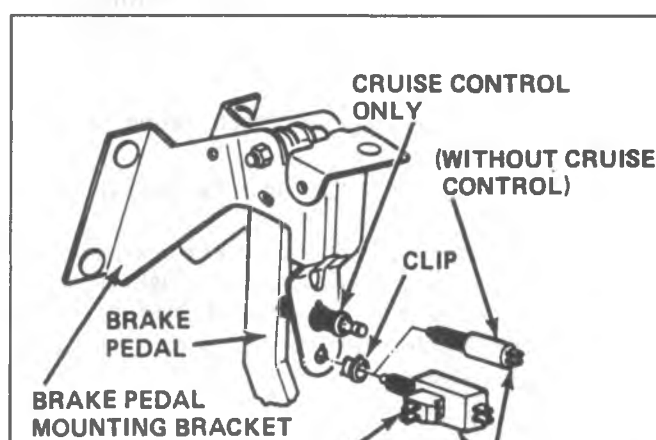


Fig. 5-3--Stoplight Switch

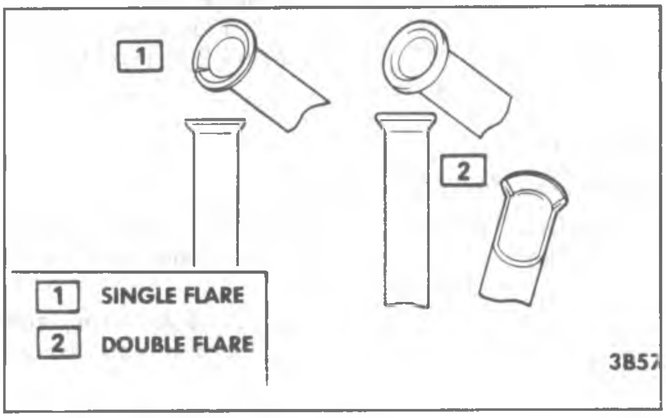


Fig. 5-4-Double Lap Flare

Front Hose

Remove (Figs. 5-5 thru 5-7)

1. Raise vehicle on hoist.
2. Clean dirt and foreign material from both hose end fittings.
3. Disconnect brake pipe from hose fitting using a back-up wrench on fitting. Be careful not to bend frame bracket or brake pipe. It may be necessary to soak the connections with penetrating oil.
4. Remove "U" clip or nut from female fitting at bracket or frame and remove hose from bracket.
5. Remove bolt from caliper end of hose. Remove hose from caliper, and discard the two copper gaskets on eighter side of fitting block.

Installation

1. Use new copper gaskets on both sides of fitting block, wet bolt threads with brake fluid, then with fitting orientation flange engaged with the caliper orientation ledge on JB8 and JF9 (hose located in caliper gate on all except JB8 and JF9), fasten hose to caliper; torque to specifications.
2. With weight of vehicle on suspension, pass female fitting through frame or frame bracket. Fitting fits the frame or frame bracket in only one position With least amount of twist in hose, install fitting in this position. There should be no kinks in hose.
3. Install "U" or nut clip to female fitting at frame bracket or frame.
4. Attach brake pipe to hose fitting using a backup wrench on fitting; torque to specifications.
5. Inspect to see that hose doesn't make contact with any part of suspension. Check in extreme right hand and extreme left hand turn conditions. If hose makes any contact, remove and correct.
6. Bleed brake system.
7. Lower vehicle from hoist.

Rear Hose

Removal (Fig. 5-8)

1. Raise vehicle on hoist.
2. Remove all three brake pipes from hose, two at junction block and, with the use of a back-up wrench, one on the female fitting at bracket. Be careful not to bend bracket or pipes; use penetrating oil if necessary.
3. Remove "U" clip and take female fitting out of bracket.
4. Observe position at which junction block is mounted to the axle. When installing new hose be sure this junction block is in the same position.
5. Remove bolt attaching junction block to axle.

Installation

1. Thread both rear axle pipes into junction block.
2. Bolt junction block to axle and then torque rear pipes into block.
3. Pass female end of hose through bracket; female fitting will fit bracket in only one position (except G models), two positions (G models). Without twisting hose, position female end in bracket.
4. Install "U" clip.
5. Attach pipe to female fitting using a back-up wrench on fitting; torque to specification, again be careful not to bend bracket or pipe. Check to see that hose installation did not loosen frame bracket. Retorque bracket if necessary.
6. Bleed system.
7. Lower vehicle from hoist.

POWER BRAKE VACUUM HOSE FILTER

Removal

1. Use a pair of pliers to move the hose clamp approximately 2" (50mm).
2. Twist the filter in the hose to break the seal and remove the filter.

Installation

1. Install the filter. Be sure the vacuum check valve on the power brake unit is positioned from vertical as shown in Figures 5-9 and 5-10.
2. Position hose clamp to retain filter.

POWER BRAKE UNIT

Vacuum Booster

Replacement (Fig. 5-11)

NOTICE: See "Notice" on Page 1 of this section when installing fasteners referred to in Steps 6, 7 and 9 below.

1. Remove two nuts holding master cylinder to power cylinder and position it away from power cylinder.

   Do not disconnect hydraulic brake lines; be careful not to bend or kink pipes.
2. Disconnect the vacuum hose from the vacuum check valve on the front housing of the power head. Plug vacuum hose to prevent dust and dirt from entering hose.
3. Disconnect the power brake push rod from the brake pedal.
4. Remove the four nuts from the mounting studs which hold the power brake to the cowl.
5. Carry the power brake to a clean work area and clean the exterior of the power brake prior to disassembly.
6. Mount power brake assembly to cowl and torque nuts

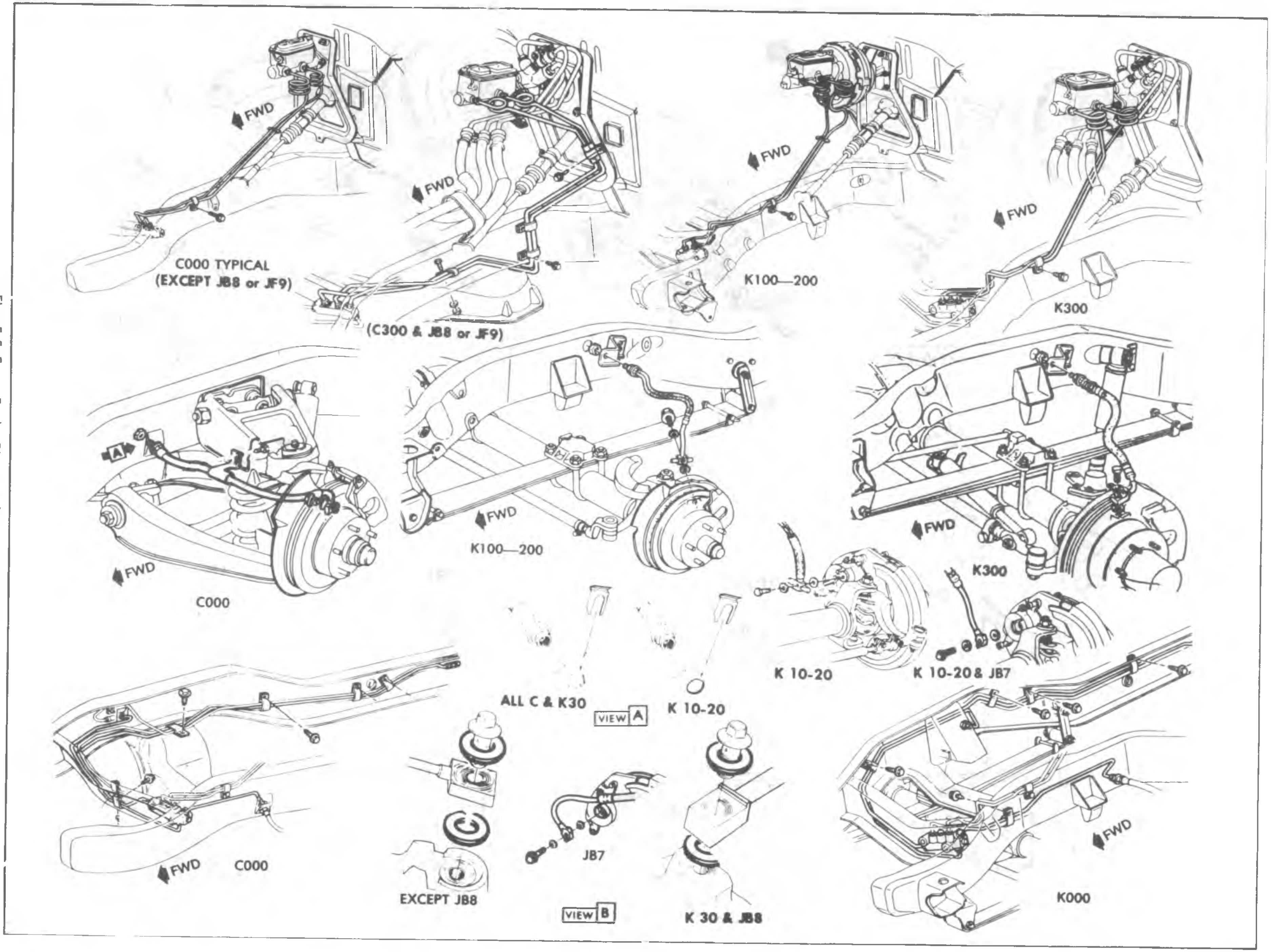


Fig. 5-5--Front Brake Pipes and Hoses-C-K Models

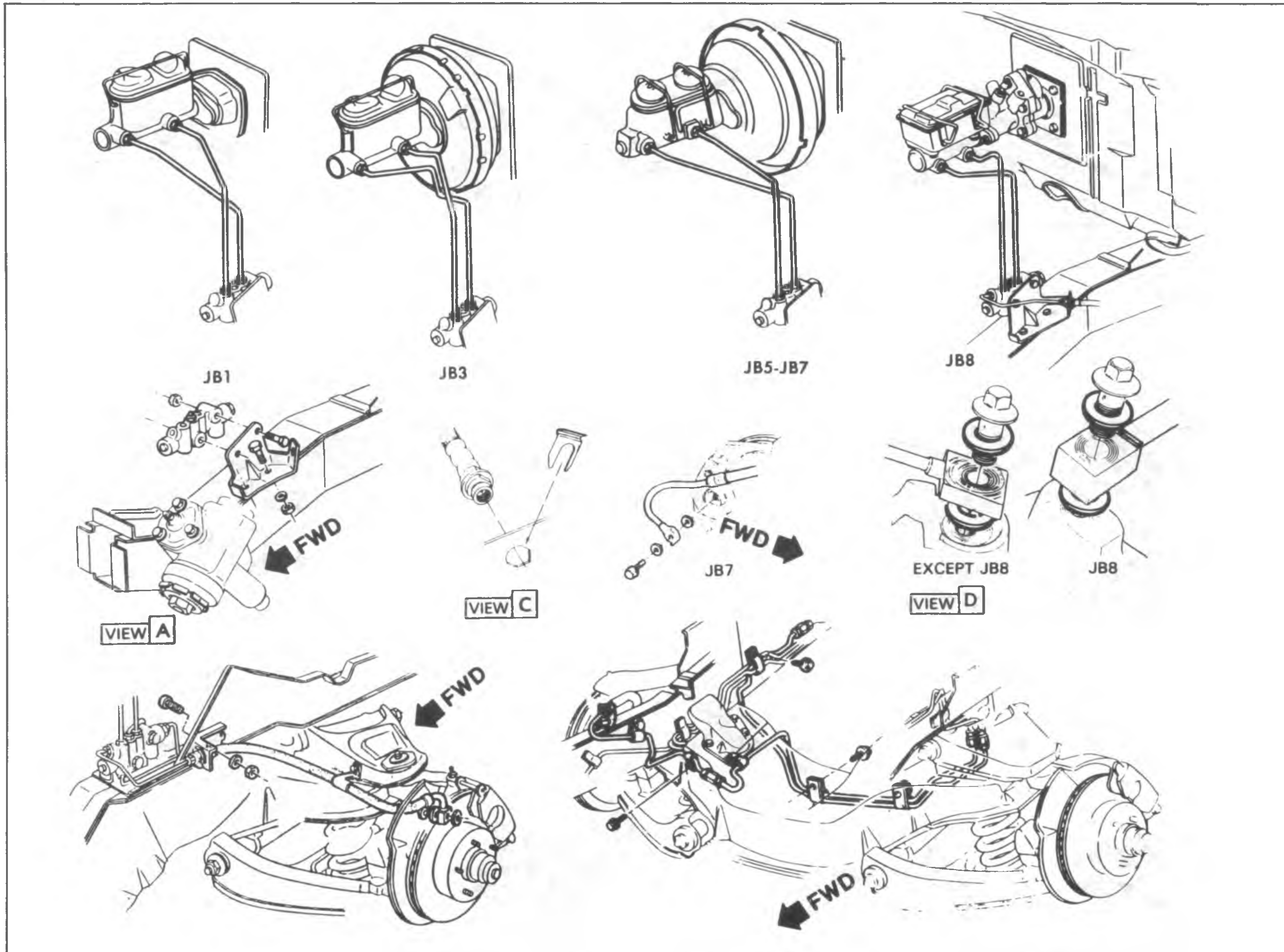


Fig. 5-6--Front Brake Pipes and Hoses-G Models

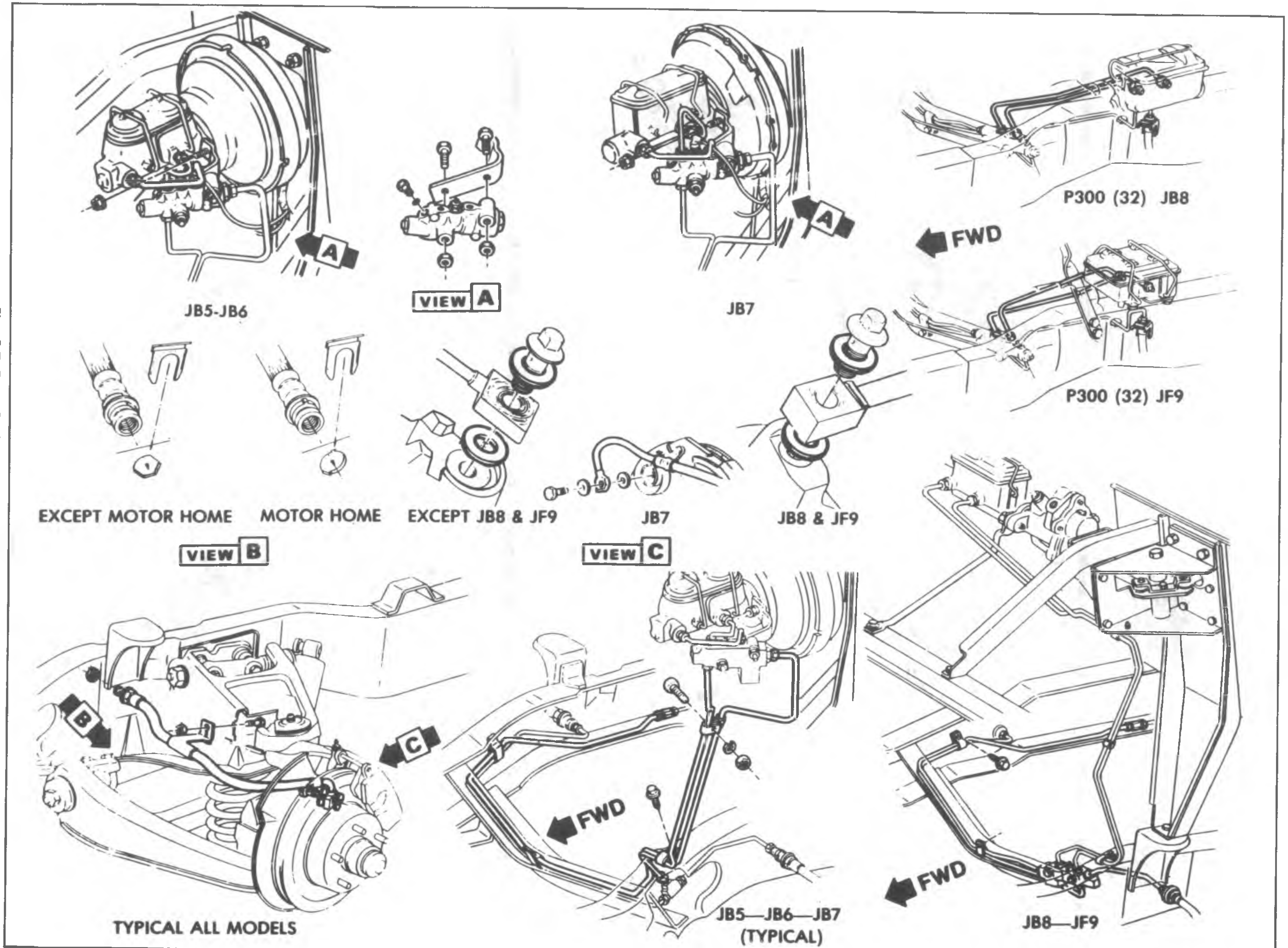


Fig. 5-7--Front Brake Pipes and Hoses-P Models

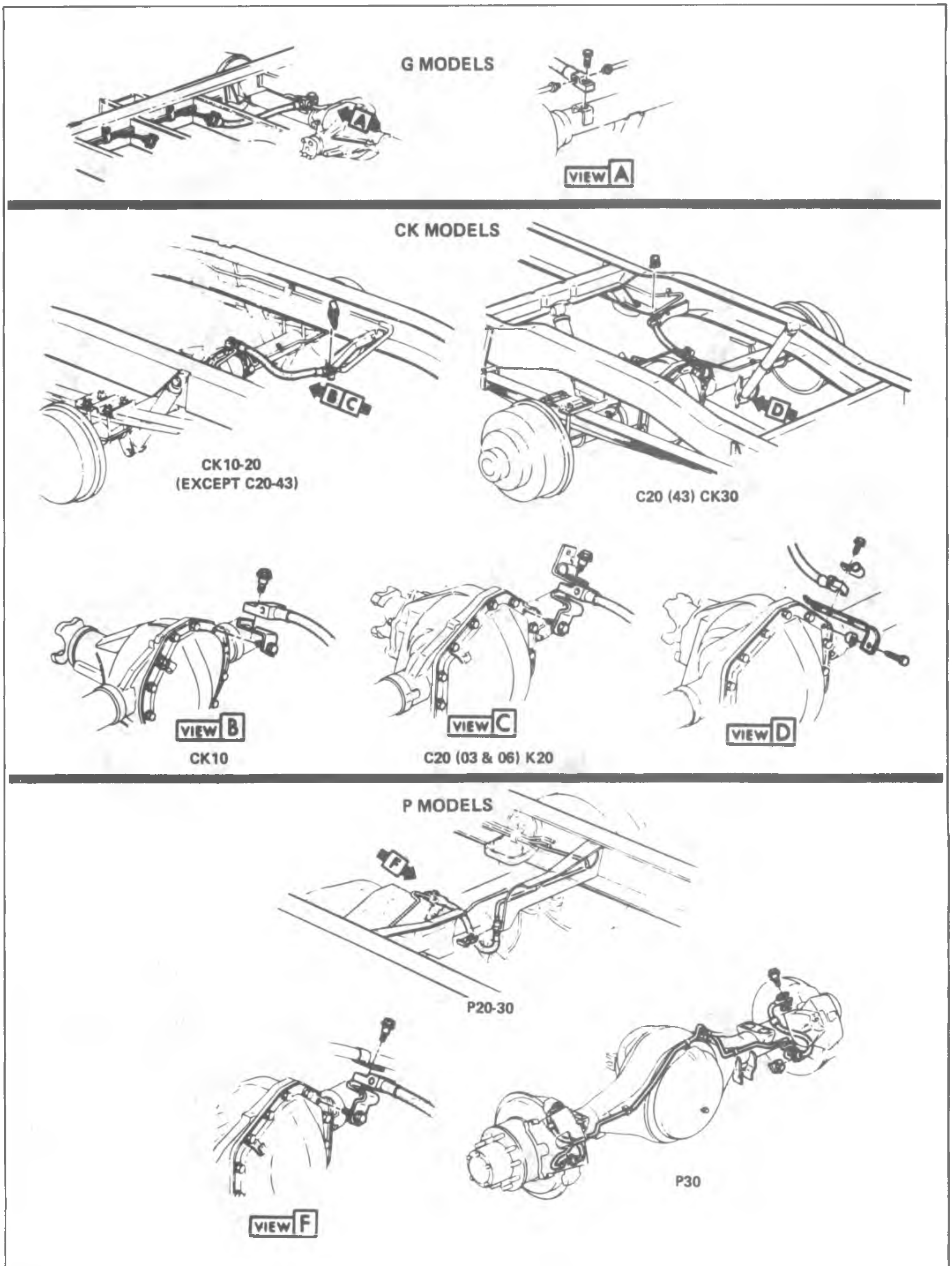


Fig. 5-8 — Rear Brake Hoses.

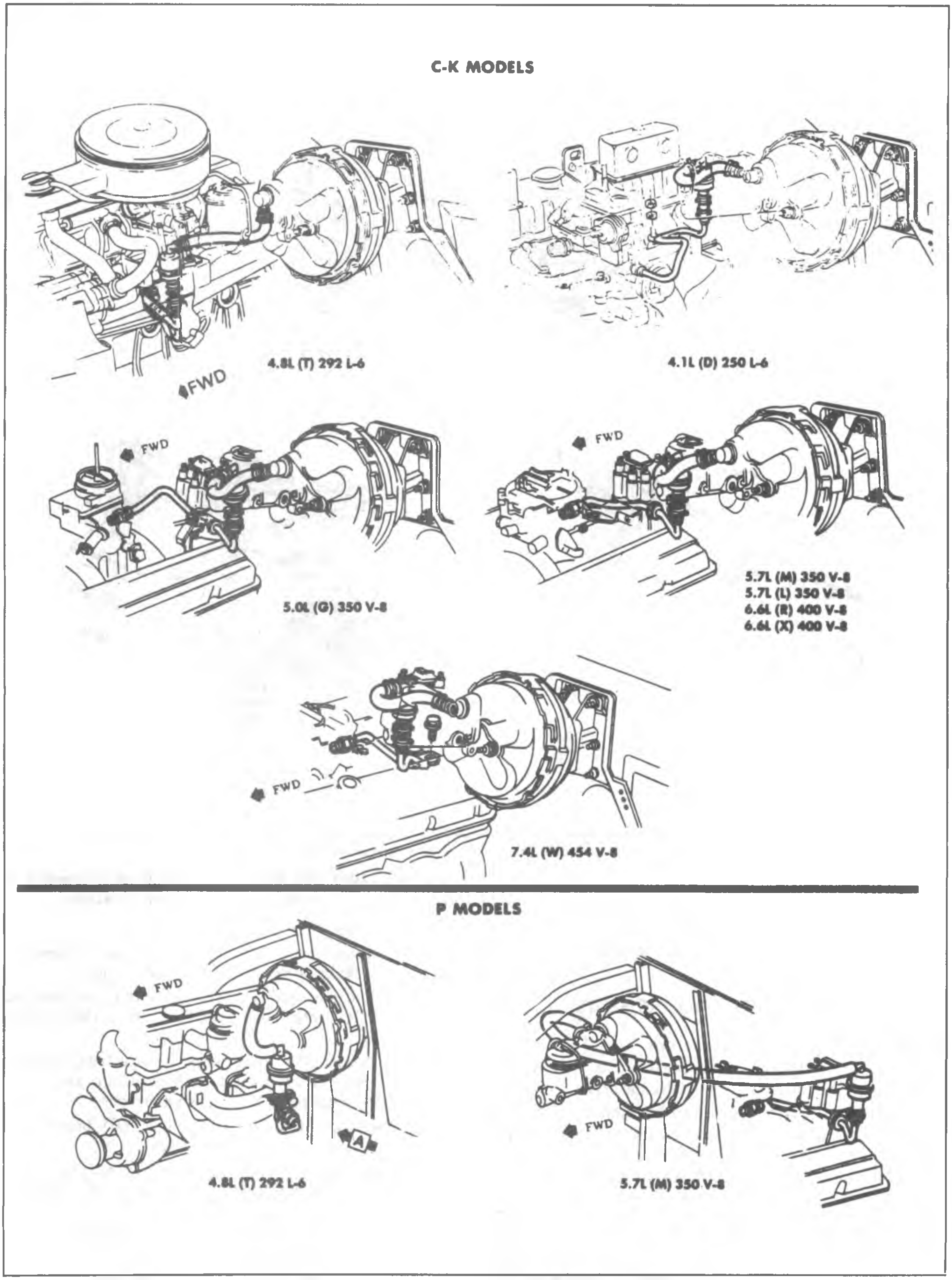


Fig. 5-9--Power Brake Vacuum Hose Filter Installation-C-K-P Trucks

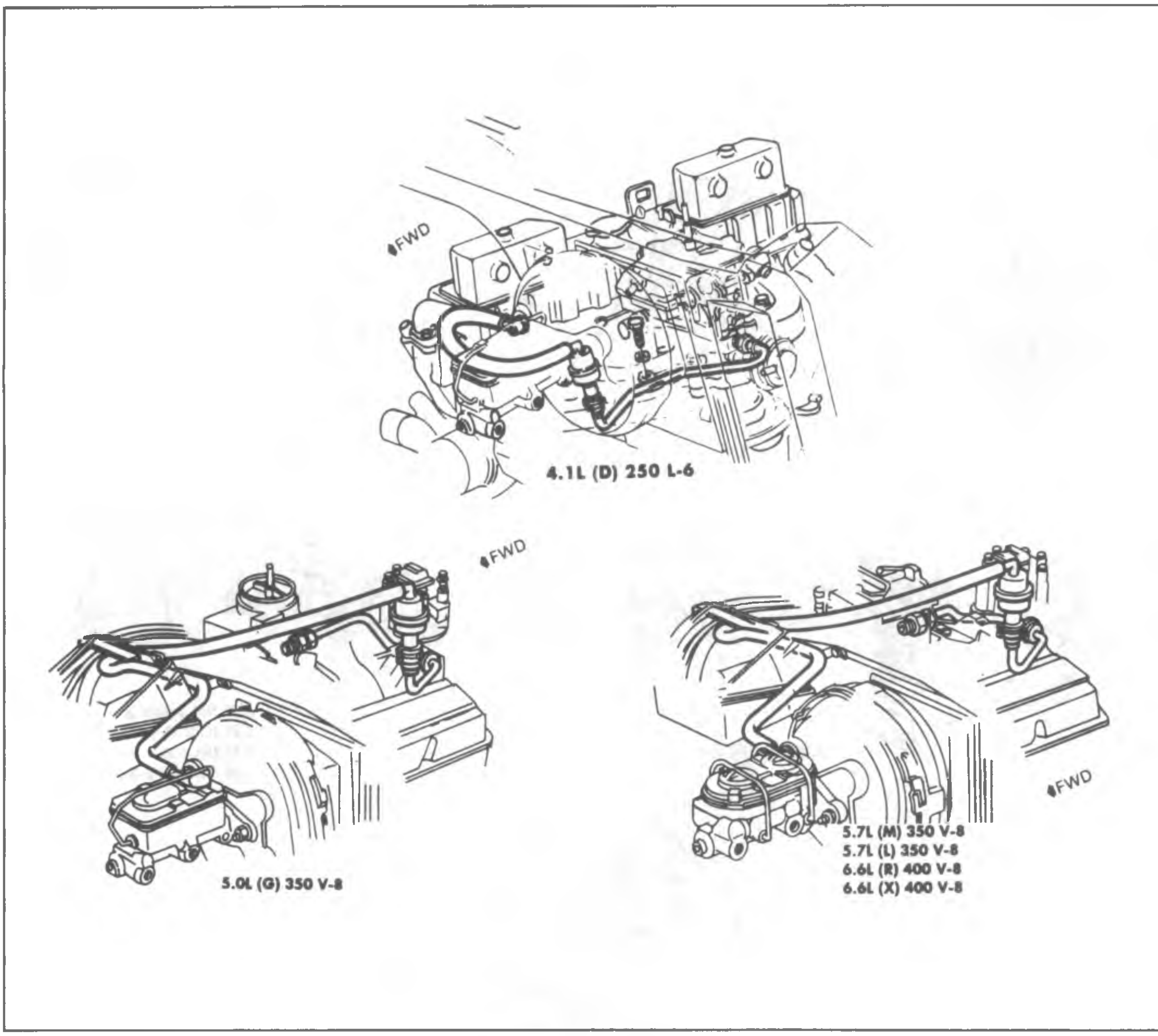


Fig. 5-10--Power Brake Vacuum Hose Filter Installation-G Models

to specified torque.

7. Connect power brake push rod to brake pedal.
8. Connect vacuum hose to vacuum check valve.
9. Connect master cylinder to power cylinder and torque nuts to specifications.

BLEEDING AND FLUSHING BRAKE SYSTEM

Bleeding Brake Hydraulic System

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at all four foundation brakes if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If brake pipe is disconnected at any wheel cylinder, or caliper, then that wheel cylinder or caliper only need be bled. If pipes are disconnected at any fitting located between master cylinder and foundation brakes, then all foundation brakes served by the disconnected pipe must be bled.

Time required to bleed the hydraulic system when the master cylinder is removed can be reduced if the master cylinder is filled with fluid and as much air as possible is expelled before the cylinder is installed on the vehicle..

Manual Bleeding

With power brakes, remove the vacuum reserve by applying the brakes several times with the engine off.

1. Fill the master cylinder reservoirs with brake fluid and keep at least one-half full of fluid during the bleeding operation.
2. If the master cylinder is known or suspected to have air in the bore, then it must be bled before any wheel cylinder or caliper in the following manner:
   a. Disconnect the forward (blind end) brake pipe connection at the master cylinder.
   b. Allow brake fluid to fill the master cylinder bore until it begins to flow from the forward pipe connector port.
   c. Connect the forward brake pipe to the master cylinder and tighten.
   d. Depress the brake pedal slowly one time and

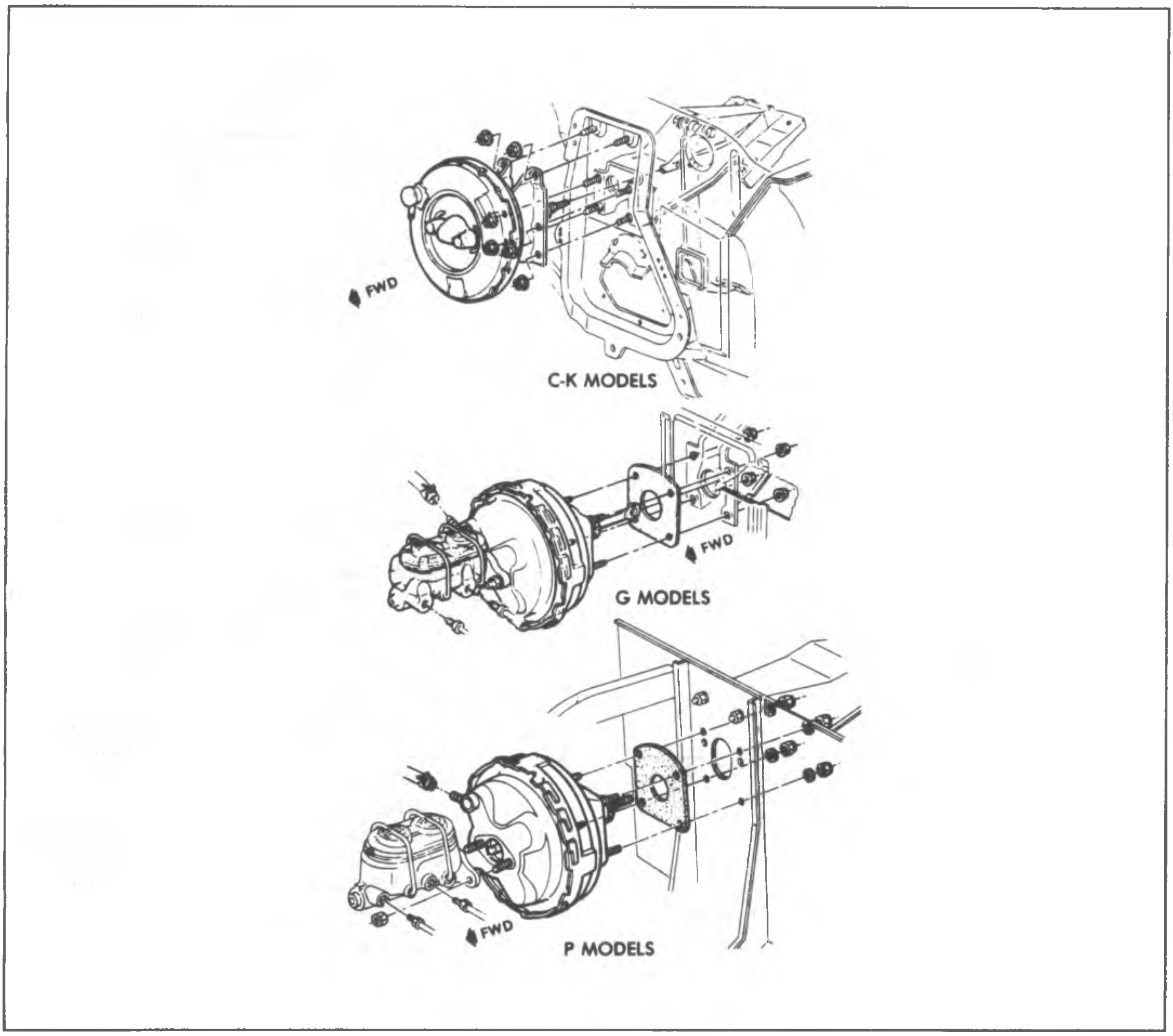


Fig. 5-11--Vacuum Booster Installation

hold. Loosen the forward brake pipe connection at the master cylinder to purge air from the bore. Tighten the connection and then release the brake pedal slowly. Wait 15 seconds. Repeat the sequence, including the 15 second wait, until all air is removed from the bore. Care must be taken to prevent brake fluid from contacting any painted surface.

e. After all air has been removed at the forward connection, bleed the master cylinder at the rear (cowl) connection in the same manner as the front in Step "d" above.

f. If it is known that the calipers and wheel cylinders do not contain any air, then it will not be necessary to bleed them.

3. Individual wheel cylinder or calipers are bled only after all air is removed from master cylinder.

a. Place a proper size box end wrench or Tool J-21472 over the bleeder valve. Attach transparent tube over valve and allow tube to be hand submerged in brake fluid in a transparent container. Depress the brake pedal slowly one time and hold. Loosen the bleeder valve to purge the air from the cylinder. Tighten bleeder screw and slowly release pedal. Wait 15 seconds. Repeat the sequence, including the 15 second wait until all air is removed. It may be necessary to repeat the sequence 10 or more times to remove all the air. **JB1 thru JB6 gas engine vehicle--Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a manner that makes it difficult to bleed the rear side of the system.**

4. It is necessary to bleed all of the wheel cylinders and calipers, the following sequence should be followed: 1)Right rear wheel cylinder; 2)Left rear wheel cylinder; 3)Right front caliper; 4)Left front caliper.

5. Check the brake pedal for "sponginess" and the brake warning light for indication of unbalanced pressure. Repeat entire bleeding procedure to correct either of these two conditions.

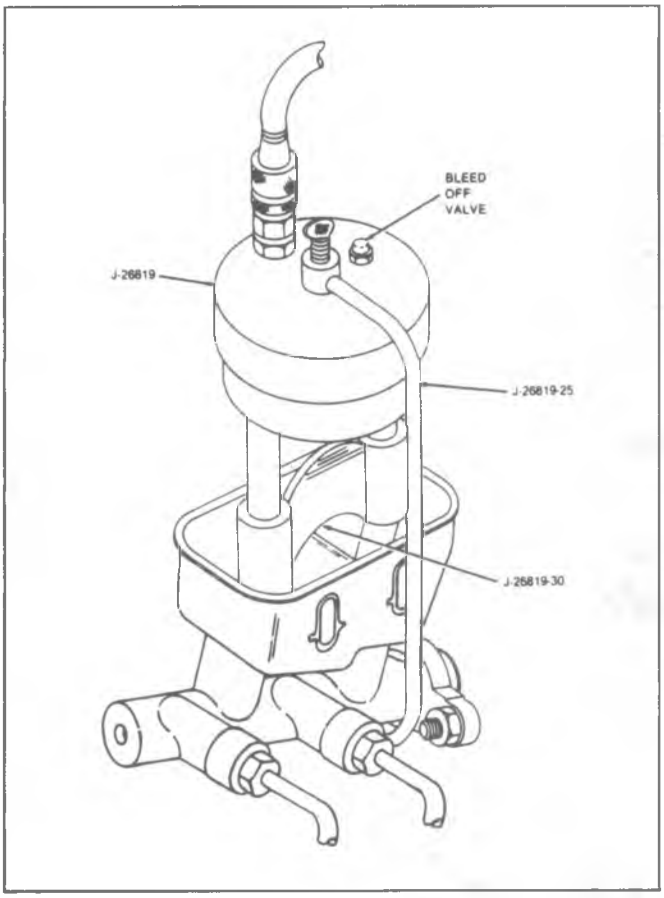


Fig. 5-12--Pressure Bleeding (CK Models JB1 thru JB6)

Pressure Bleeding

Pressure bleeding equipment must be of the diaphragm type. That is, it must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaiminants from entering the hydraulic system.

1. Install the correct pressure bleeding adapter to the master cylinder. Brake Systems JB1 through JB6 gas engine vehicles require adapter J-26819, extension J-26819-30 and clamp J-26819-25. All other systems use J-23518. Refer to Fig. 5-12, special tool illustration and brake system description chart.

   NOTICE: It is very important that the correct master cylinder bleeder adapter be used to avoid possible damage to the master cylinder reservoir (Fig. 5-12).

2. Make sure the pressure tank is at least 1/3 full of Supreme # 11 brake fluid or its equivalent.

   The bleeder must be re-bled each time fluid is added.

3. Charge the bleeder ball to between 140-170 kPa (20 and 25 psi).
4. When ready to begin bleeding, connect hose to master cylinder bleeder adapter and open the tank valve.
5. Disc brakes may require a manual override of the front brake metering or combination valve to permit flow to the front wheels. Therefore, it may be necessary to hold the valve stem open manually during pressure bleeding.

   To hold the metering valve open to bleed the front brakes, the valve stem must be either pushed in or pulled out. Install metering valve actuator J-23709.

6. Bleed the brakes in the following sequence: right rear, left rear, left front and right front.
7. With the proper size wrench over the bleeder valve attach bleeder tube. The discharge end must hang submerged in a clean container partially filled with brake fluid.
8. Open the bleeder valve at least 3/4 turn and allow flow to continue until no air is seen in the fluid.
9. Close the bleed valve. Be sure it seals.
10. Repeat Steps 7-9 for the remaining bleeder valves (see Step 6 for sequence).
11. Check the pedal feel for "sponginess" and repeat the entire procedure if necessaary.
12. Dispose of all removed brake fluid.
13. Remove Tool J-23709 from the combination valve and tighten the mounting bolt.
14. Disconnect bleeder equipment from the brake bleeder adapter.
15. Remove bleeder adapter. Wipe all areas dry if fluid was spilled during adapter removal.
16. Fill master cylinder reservoir(s) to proper level and install master cylinder diaphragm and cover.

Flushing Brake Hydraulic System

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

Flushing is also recommended if there is any doubt as to the grade of fluid in the system. If fluid has been used which contains the slightest trace of of mineral oil, all rubber parts that have been subjected to the contaminated fluid should be replaced.

PARKING BRAKE PEDAL OR HANDLE

Removal (Fig. 5-13)

1. Place parking brake pedal or handle in the released position.
2. Remove nuts from the engine compartment on C, K and G models or bolts from mounting bracket on P models. Take notice of the spacers on P models for reinstallation.
3. Disconnect the release handle rod at the parking brake assembly end (C-K models).
4. Remove the bolts from the underside of the dash and lower the brake assembly (C-K-G Models).
5. **C-K-G Models-** Disconnect the cable ball from the parking brake clevis and remove the assembly.

   P Models- Remove the clevis pin and disconnect the cable from the brake assembly; remove the assembly.

Installation

Reverse the removal procedure. Torque all bolts and nuts. After installing the clevis-pin, use a new cotter pin to secure the clevis pin. Adjust the cable if necessary as outlined below.

NOTICE: SEE "Notice" on Page 1 of this section.

NOTICE: Adjustment of parking brake cable is necessary whenever holding ability is not adequate or

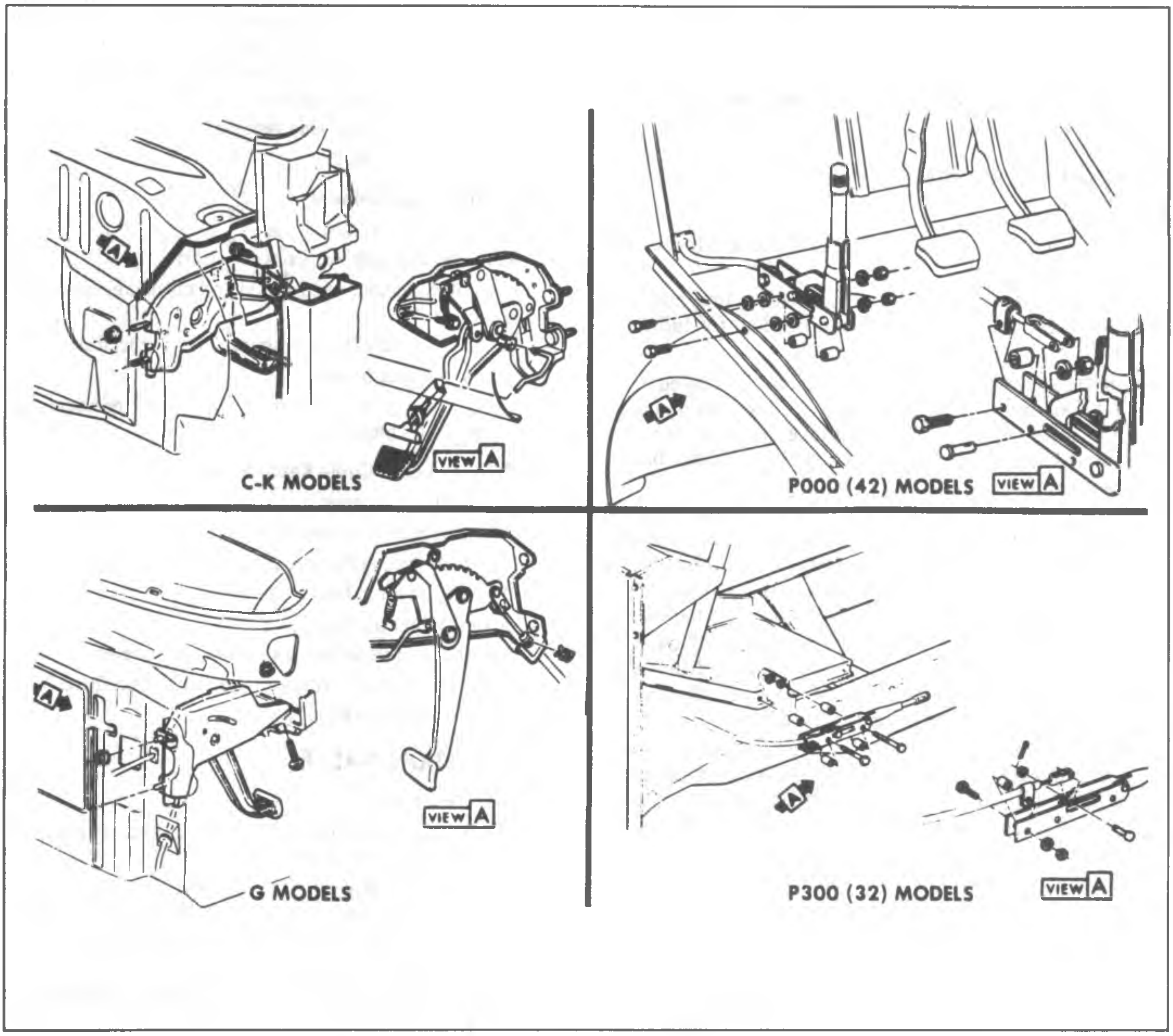


Fig. 5-13--Parking Brake Assembly-Typical

whenever the center brake cables have been disconnected.

NOTICE: The service brake must be properly adjusted as a base for parking brake adjustment; conversely the parking brake must be properly adjusted for the service brake to function as intended.

Inspection

If complete release of the parking brake is not obtained, unless it is forcibly returned to its released position, or if application effort is high, check parking brake assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

1. Clean and lubricate brake cables and equalizer with Delco Brake Lube (or equivalent).
2. Inspect brake assembly for straightness and alignment (replace if necessary).
3. Clean and lubricate parking brake assembly with Delco Brake Lube (or equivalent).
4. Checking routing of cables for kinks or binding.

Adjustment--Foot Pedal Type

Before adjusting parking brake, check service brake condition and adjustment.

1. Raise vehicle on hoist.
2. Loosen the equalizer adjusting nut.
3. Apply parking brake 4 notches from fully released position.
4. Tighten the equalizer nut until a moderate drag is felt when the rear wheels are rotated forward.
5. Fully release parking brake and rotate the rear wheels. No drag should be present.
6. Remove vehicle from hoist.

Adjustment--Orscheln Lever Type

1. Turn adjusting knob on parking brake lever counterclockwise to stop.
2. Apply parking brake.
3. Raise vehicle on a hoist.
4. Loosen nut at intermediate cable equializer and then adjust nut to give light drag at rear wheels.

NOTICE: See "Notice" on Page 1 of this section.

5. Readjust parking brake lever knob to give a definite snap-over-center feel.

PARKING BRAKE (PROPELLER SHAFT) P-30 (Fig. 5-14)

INTERNAL EXPANDING

Adjustment-Drum On

1. Jack up at least one rear wheel. Block wheels and release hand brake.
2. Remove cotter pin and clevis pin connecting pull rod and relay lever. This will assure freedom for full shoe release.

   NOTICE: It may be necessary to knock out lanced area in brake drum with a punch and hammer to gain entry into adjusting screw through brake drum. Be sure all metal has been removed from parking brake compartment.
3. Rotate brake drum to bring one of access holes into line with adjusting screw at bottom of shoes (manual transmission), top of shoes (automatic transmission).
4. Expand shoes by rotating adjusting screws with screwdriver inserted through hole in drum. Move outer end of screwdriver away from drive shaft. Continue adjustment until shoes are tight against drum and drum cannot be rotated by hand. Back off adjustment ten notches and check drum for free rotation.
5. Place parking brake lever in fully released position. Take up slack in brake linkage by pulling back on cable just enough to overcome spring tension. Adjust clevis of pull rod or front cable to line up with hole in relay levers.
   a. Insert clevis pin and cotter pin, then tighten clevis locknut.
   b. Install a new **metal** hole cover in drum to prevent contamination of brake.
   c. Lower rear wheels. Remove jack and wheel blocks.

   NOTICE: See "Notice" on Page 1 of this section.

Adjustment--Drum Off

1. With parking brake drum off, use special Tool J-21177 or J-22364, Drum to Brake Shoe Clearance Gage, to check diameter of drum clearance surface.
2. Turn the tool to the opposite side and fit over brake shoes by turning the star wheel until the gage just slides over the linings.
3. Rotate the gage around the brake shoe lining surface to insure proper clearance.
4. Install propeller shaft flange at mainshaft as outlined in Transmission Section.
5. Lower rear wheels. Remove jack and wheel blocks.

PARKING BRAKE CABLES (Figs. 5-15 and 5-16)

Front Cable Replacement

1. Raise vehicle on hoist.
2. Remove adjusting nut from equalizer.
3. Remove retainer clip from rear portion of front cable at frame and from lever arm.
4. Disconnect front brake cable from parking brake pedal or lever assemblies. Remove front brake cable. On some models, it may assist installation of new cable if a heavy cord is tied to other end of cable in order to guide new cable through proper routing.
5. Install cable by reversing removal procedure.
6. Adjust parking brake.

Center Cable Replacement

1. Raise vehicle on hoist.
2. Remove adjusting nut from equalizer.
3. Unhook connector at each end and disengage hooks and guides.
4. Install new cable by reversing removal procedure.
5. Adjust parking brake.
6. Apply parking brake 3 times with heavy pressure and repeat adjustment.

Rear Parking Brake Cable Replacement

1. Raise vehicle on hoist.
2. Remove rear wheel and brake drum.
3. Loosen adjusting nut at equalizer.
4. Disengage rear cable at connector.
5. Bend retainer fingers.
6. Disengage cable at brake shoe operating lever.
7. Install new cable by reversing removal procedure.
8. Adjust parking brake.

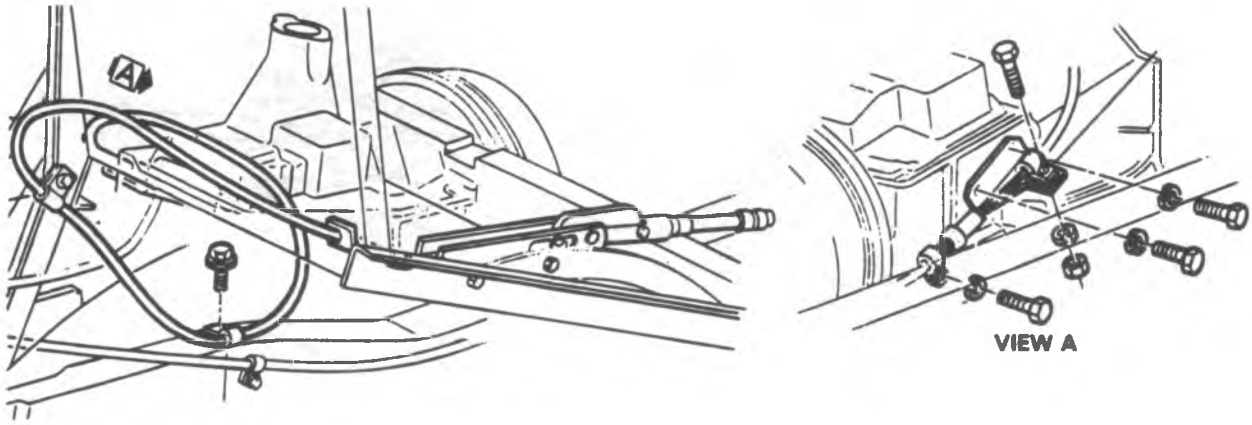
COMBINATION VALVE

Electrical Circuit Test

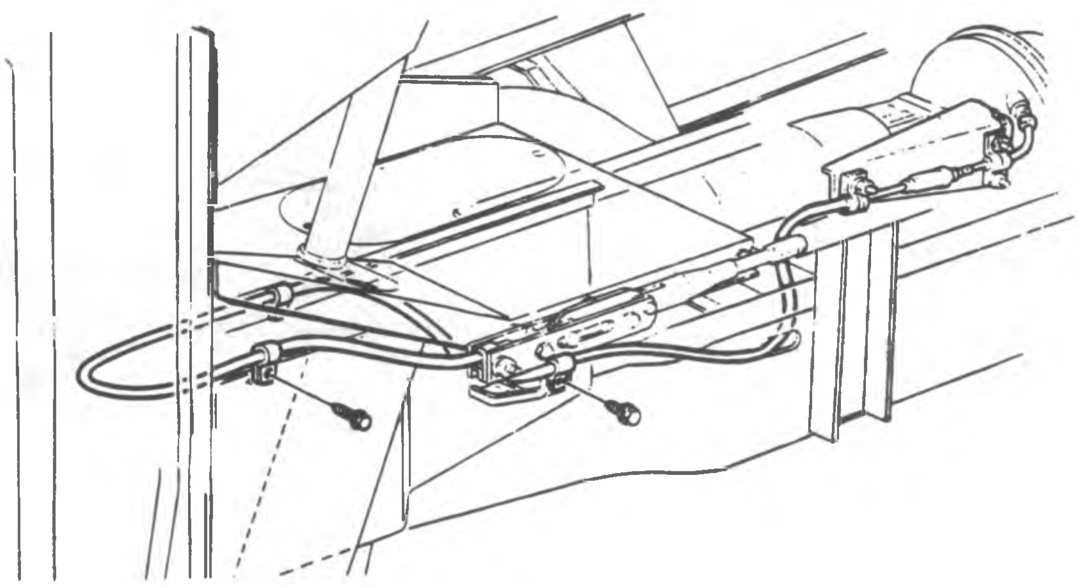
1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key on "ON" - warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is defective. Replace bulb or repair electrical circuit as necessary.
3. When warning lamp lights, turn ignition switch off. Disconnect jumper and reconnect wire to switch terminal.

Brake Warning Light Switch Test

1. Raise vehicle on hoist. Attach a bleeder hose to a rear brake bleed screw and immerse the other end of the hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoir is full.
2. Turn ignition switch to "On"; open bleeder screw while a helper applies moderate pressure to the brake pedal; warning lamp should light. Close bleeder screw before helper releases brake pedal. Reapply brake pedal with moderate-to-heavy pressure; light should go out.
3. Attach the bleeder hose to a front brake bleeder screw and repeat above test. Warning lamp action should be the same as in Step No. 2. Turn ignition switch off.
4. If warning lamp does not light during Steps and 3 but does light when a jumper is connected to ground, the warning light switch portion of the combination valve is defective. Do not attempt to disassemble the combination valve. If any portion of the combination valve is defective, it must be replaced

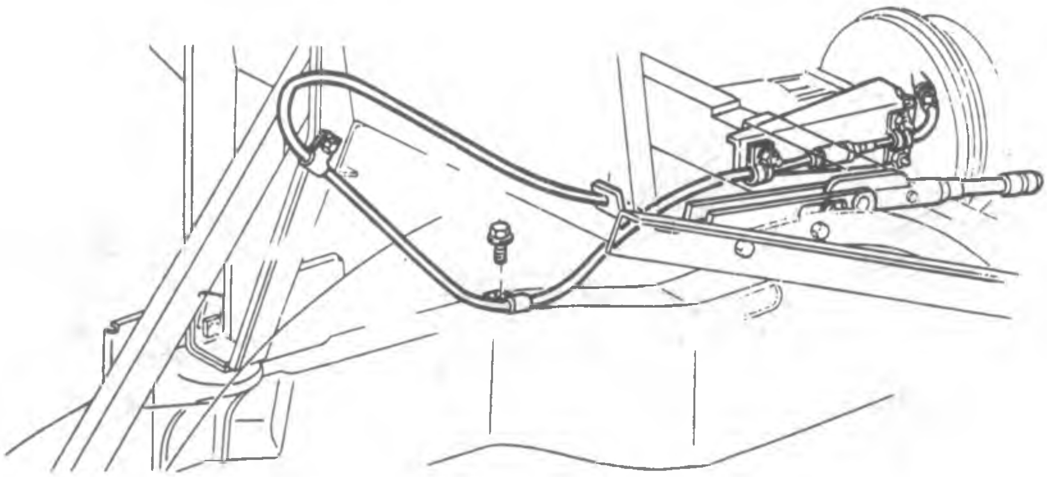


P300(42) & M20 & JF9

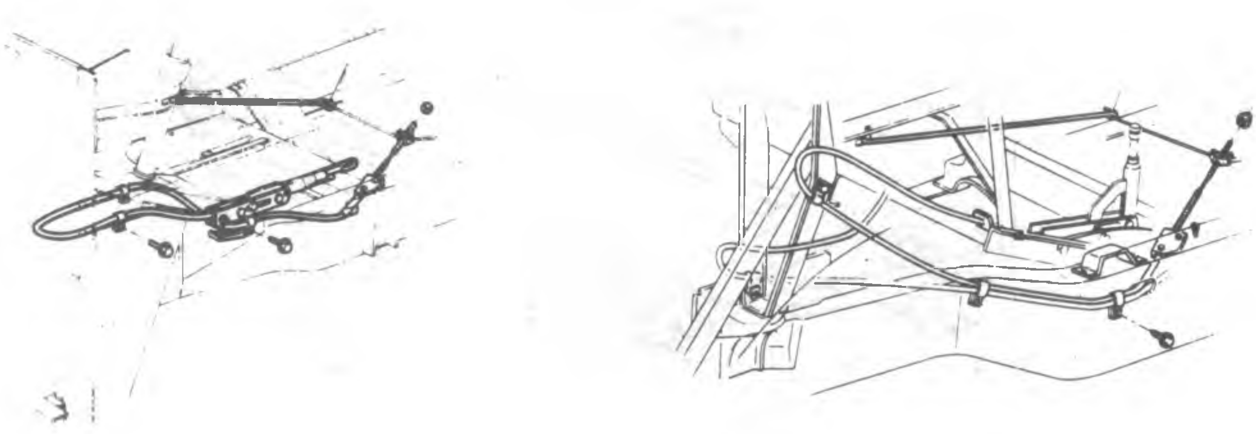


P314 (32) & JF9; P318 (32)

Fig. 5-14 — Parking Brake System P-30 Series



P300 (42) & M40 & JF9



P MODELS

Fig. 5-15 — Parking Brake System P-30 Series

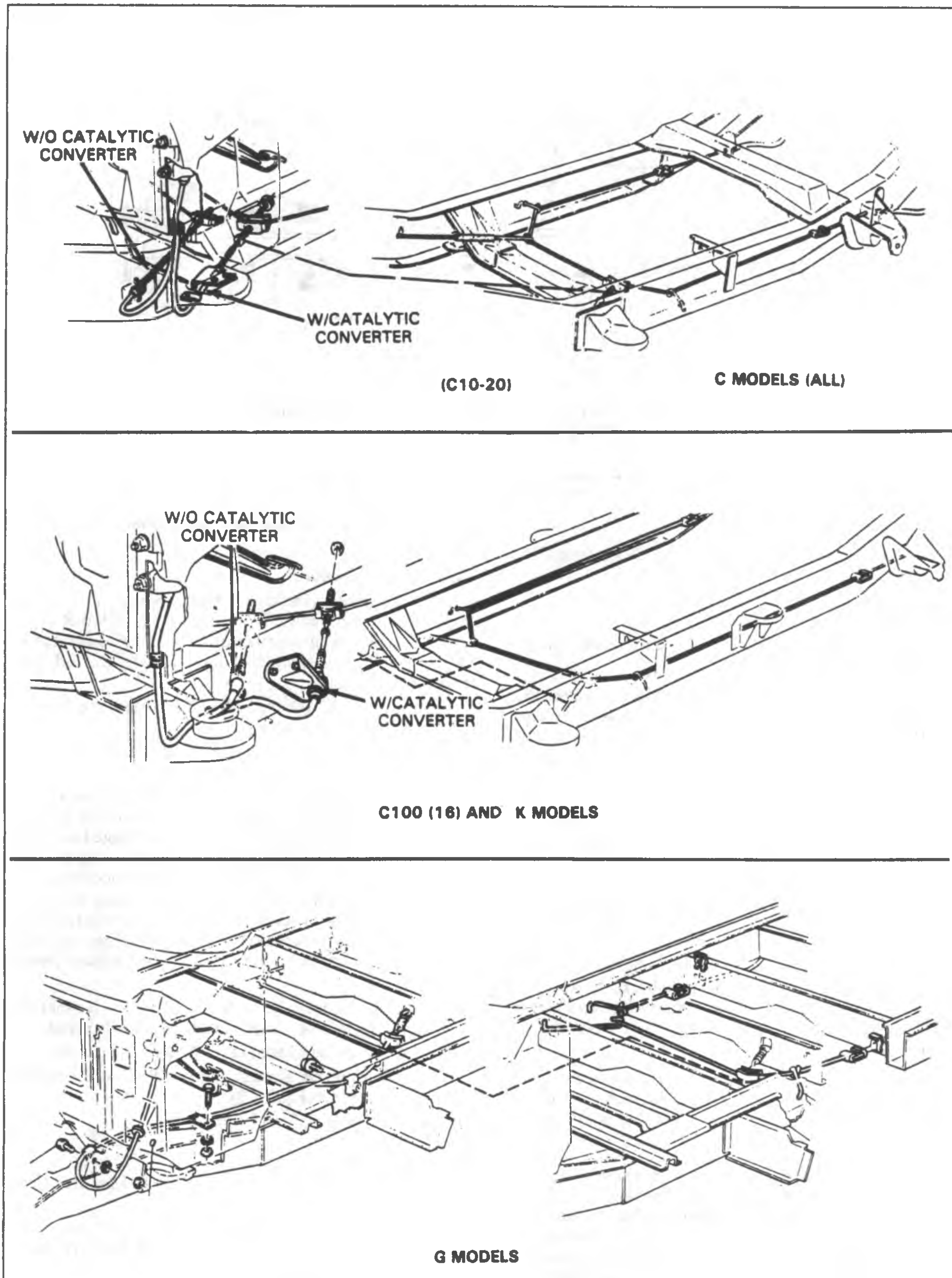


Fig. 5-16 — Parking Brake System, Typical

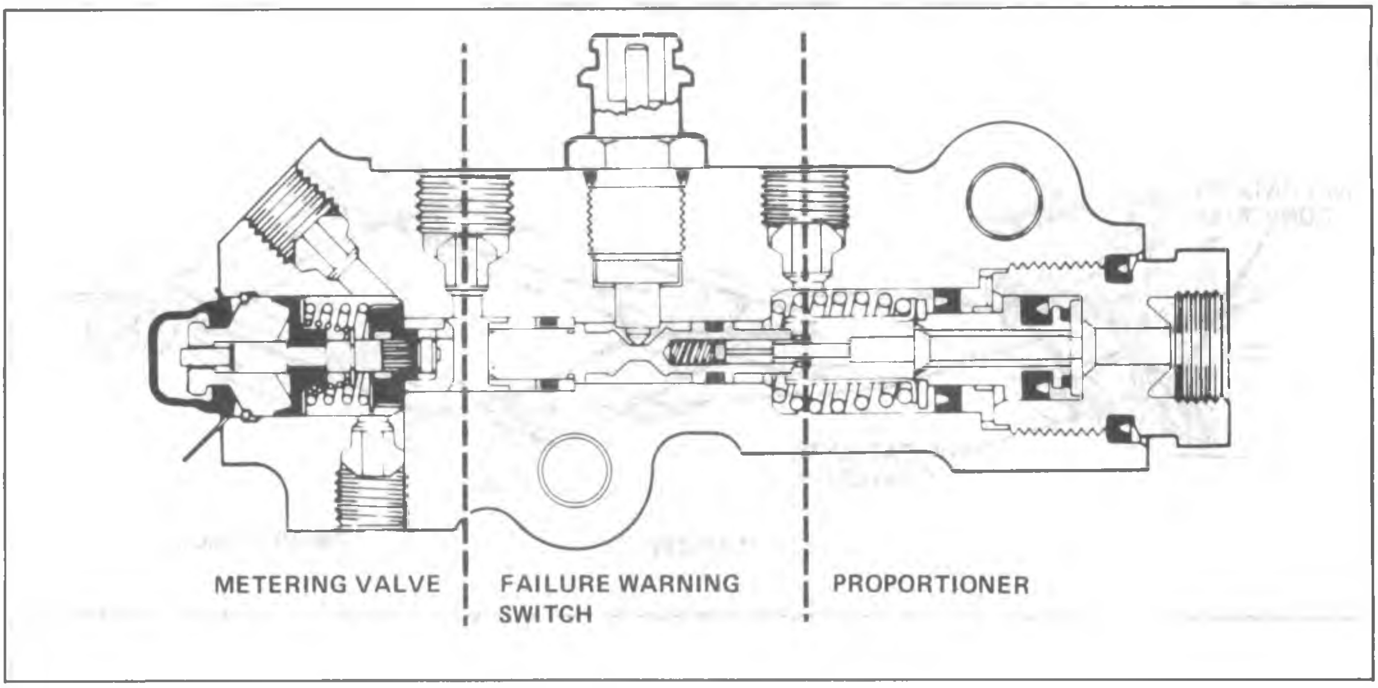


Fig. 5-17--Combination Valve

with a new combination valve.

5. Lower vehicle to floor. Check and refill master cylinder to proper level.

Replacement

The combination valve is not repairable and must be serviced as a complete assembly.

1. Disconnect hydraulic lines at combination valve. Plug lines to prevent loss of fluid and entrance of diret. Disconnect warning switch wiring harness from valve switch terminal.
2. Remove combination valve.
3. Install combination valve by reversing removal steps.
4. Bleed entire brake system. Do not move vehicle until a firm brake pedal is obtained.

HEIGHT SENSING BRAKE PROPORTIONING VALVE

The height sensing brake proportioning valve, used on 30 series models, provides optimum brake balance and efficiency. Vehicle braking force is distributed to the front and rear wheels as defined by light or heavy payload conditions.

Mounted on the frame, the valve responds to changes in vehicle trim height as related to rear axle load. Mechanical linkage connects the valve to a bracket that is attached to the rear axle.

CAUTION: Adding any suspension accessories or other equipment (such as load leveling kits, air shocks, suspension lift kits, additional spring leafs, etc.), or making modification that will change the distance between the axle and the frame without changing the load, will provide a false reading to the brake proportioning valve. This could result in unsatisfactory brake performance which in turn could result in an accident and possibly personal injury.

Adjustment Procedure

If diagnosis indicates front wheel lock-up is experienced when vehicle is operated at near GVWR with a lower than desired brake application rate, the height sensing proportioning valve may be adjusted using the following procedure:

1. Raise vehicle, axle must be allowed to hang free (no load condition), wheels on.
2. Remove nut from valve shaft and remove lever (Fig. 5-18).
3. Rotate valve shaft to permit installation of correct adjustment gage. Center hole of adjustment gage must seat on "D" shape of valve shaft and gage tang must seat in valve mounting hole as shown in Figure 5-19. Adjustment gages are available from service parts.
4. Install lever on valve shaft by pushing plastic bushing and clip assembly over serrations on valve shaft using a "C" clamp or channel lock pliers. When properly installed, serrations on valve shaft fully engage plastic bushing.

   NOTICE: Do not drive lever assembly on valve shaft by using nut, or proper valve setting may be disturbed.
5. Install nut and tighten to 8-11 N·m (70-98) in. lbs.).
6. Sever tang on adjustment gage to allow valve assembly to rotate freely (Fig. 5-19).
7. Lower vehicle and test brakes.

Removal

1. Raise vehicle, axle must be allowed to hang free (load condition) with wheels removed.
2. Clean exterior of valve to prevent dirt from contaminating hydraulic system when brake pipes are disconnected.
3. Disconnect brake lines from valve.
4. Remove nut from shaft and remove lever.

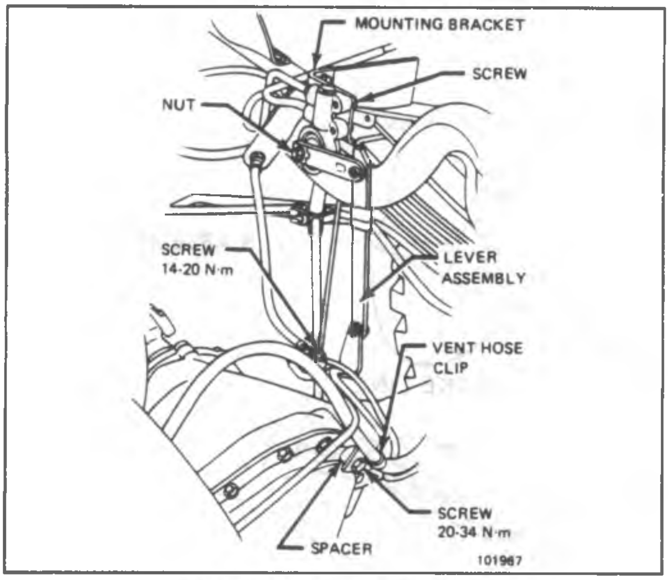


Fig. 5-18--Lever Assembly

5. Remove two screws securing valve to mounting bracket and remove valve.

Install

1. Install valve on mounting bracket and tighten two screws.
2. Before installing lever assembly on valve shaft, be sure all valve brackets, fasteners and links are securely attached.

- New Valve. Install lever assembly on valve shaft by pushing plastic bushing and clip assembly over serration on valve shaft.
- Old Valve. If original valve is being reinstalled, it must be readjusted, refer to valve adjustment procedure, axle having free wheels on.

3. Install nut on shaft and tighten.
4. Connect brake lines to valve.
5. Bleed brake system.
6. Lower vehicle and test brakes.

Lever Assembly

Replacement

1. Raise vehicle, axle must be allowed to hang free (no load condition).
2. Remove nut from height sensing valve shaft.
3. Remove lever from valve.
4. Remove screw holding brake line to lever assembly.
5. Remove screw securing lever assembly to axle housing and remove spacer and vent hose clip (if used).
6. Remove lever assembly.
7. Install spacer (if used), lever assembly, vent hose clip (if used) and secure with screw to axle housing.
8. Perform Steps 3, 4, 5 and 6 of valve adjustment procedure.
9. Install nut on shaft and tighten to 8-11 N·m (70-98 in. lbs.).
10. Install brake line to lever assembly and secure with screw.
11. Lower vehicle and check brakes.

ROTOR SERVICING

Lateral Runout

1. Lateral runout is the movement of the rotor from side to side as it rotates on the steering knuckle spindle. This could be described as "rotor wobble".
2. The movement of the rotor from side to side in the lateral plane causes the brake shoe and lining and pistons to be knocked back into their bores. This results in additional pedal travel required and a vibration during the braking action.
3. To check lateral runout, first tighten the wheel bearings until all of the play is out of the bearings. Fasten a dial indicator to some portion of the suspension so that the point of the stylus contacts the rotor face approximately 1" (25 mm) from the rotor edge (Fig. 5-20). Set the dial at zero Move the rotor one complete rotation, checking the indicator as the rotor moves.
4. Lateral runout should not be over .004" (0.10 mm) total indicator reading.

Parallelism

1. Parallelism is the measurement of the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.
2. A rotor that varies over .0005" (0.013 mm) causes pedal vibration, as well as front end vibration during brake applications. A rotor that does not meet these specifications may be refinished to specifications if precision equipment is available.

Tolerance and Surface Finish

In manufactuirng the brake rotor, tolerances of the rubbing surfaces for flatness, for parallelism and for lateral runout are held very closely. The maintance of these close controls on the shape of the rubbing surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the rubbing surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding .015" (0.38 mm) in depth, which may result from normal use, is not detrimental to brake operation.

Machining

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet the specifications, as shown below, after refinishing. Replace with a new brake rotor.

Wheel Bolt Replacement (Disc Brakes)

NOTICE: See "Notice" on Page 1 of this section.

1. Remove hub and rotor assembly from vehicle.

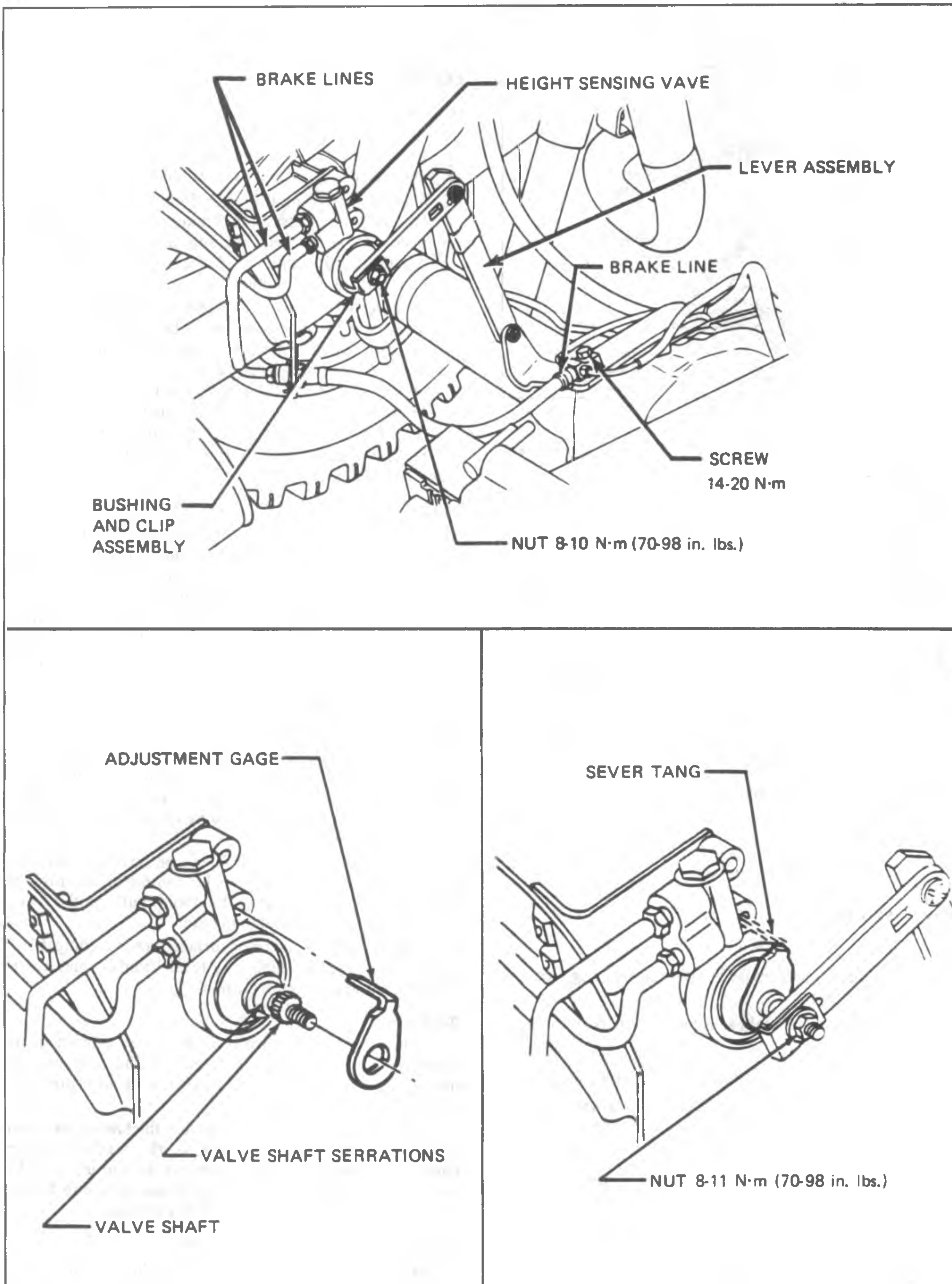


Fig. 5-19--Height Sensing Valve

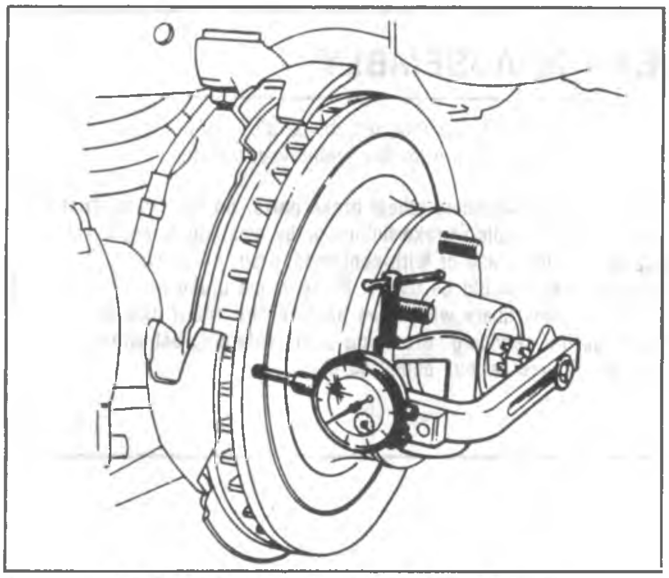


Fig. 5-20--Checking Rotor for Lateral Runout

2. Mark rotor to hub location and remove bolts attaching hub to rotor.
3. The wheel bolts on disc brakes can be pressed out from the outside of the hub and installed from inside the rotor by pressing into place. No drilling or cutting is required.
4. Reinstall assembly and adjust wheel bearings.

BRAKE DRUMS

Inspection and Reconditioning

NOTICE: See "Notice" on Page 1 of this section.

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves and out-of-round.

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it will probably be necessary to rebore in order to true up the braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fine emery cloth but should not be turned. At this stage, eliminating the grooves in drum would necessitate removal of too much metal, while if left alone, the grooves and lining ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be turned for use with new linings. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible to obtain efficient brake performance.

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as pulsating brake pedal. When the braking surface of a brake drum exceeds the factory specification limits in taper (and/or) being out-of round, the drum should be turned to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of machined surface and at right angles to each other.

Turning Brake Drums

If a drum is to be turned, only enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when turned to a miximum diameter as shown in the general specification, it must be replaced. Removal of more metal will affect dissipation of heat and may cause distoriton of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a brake drum that will not meet the specifications, as shown below, after refinishing.

Brake Drum Balance

During manufacture, brake drums are balanced. Any balance weights must not be removed.

Propeller Shaft Brake

Removal (Fig. 5-21)

1. Remove the propeller shaft; See Propeller Shaft Section.
2. Remove the brake drum. It may be necessary to back off the shoe adjustment before removing the drum.

   On automatic transmission models, the exhaust crossover pipe may be in the way. If so, loosen the transmission rear mounting bolts and jack the transmission sufficiently for brake drum to clear the pipe.
3. Remove the two pull back springs.
4. Remove the guide plate from anchor pin.
5. Remove shoe hold down cups, springs, and washers from hold down pins--remove pins.
6. Pull brake shoe and lining assemblies away from anchor pin and remove the strut and spring.
7. Lift the brake shoes and linings with the adjusting nut and bolt and connecting spring off the flange plate.
8. Move the shoes toward each other until the adjusting bolt and connecting spring drop off.
9. Remove the clip holding the brake lever to the primary shoe (shoe with short lining).
10. Compress the spring on the brake cable and remove the cable from the lever.
11. If necessary to remove the anchor pin, straighten the washer from pin hex and reinforcement. Remove reinforcement and washer with anchor pin.
12. If necessary to remove the cable, compress tangs on cable and pull assembly out of the hole in the flange plate.
13. If necessary to remove the flange plate, remove the transmission flange nut and transmission output flange. Remove bolts holding the flange plate to bearing retainer and remove the flange plate.

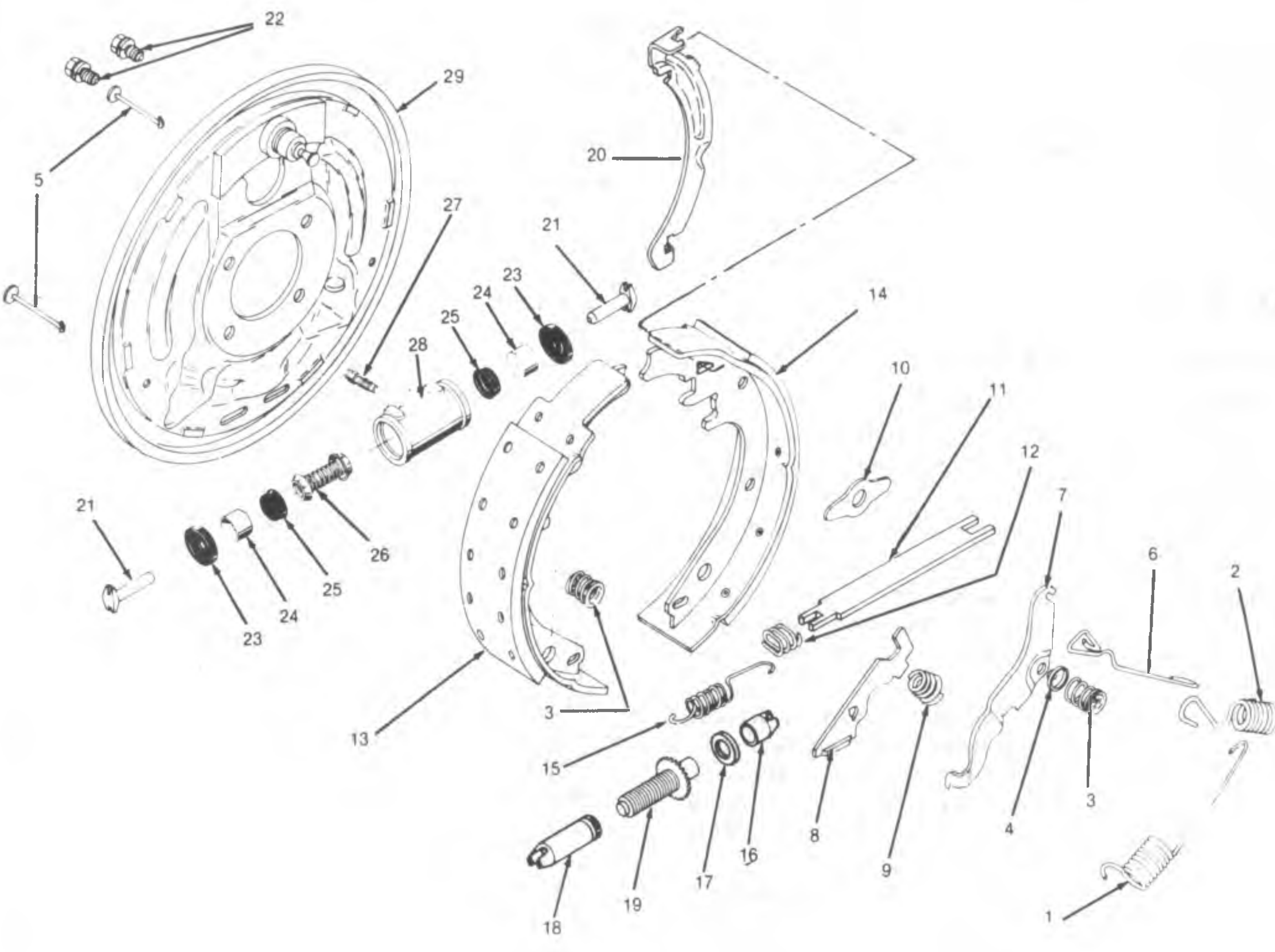
CONVENTIONAL DRUM BRAKE ASSEMBLY

GENERAL DESCRIPTION

This drum brake assembly is a duo-servo design. In the duo-servo brake, the force which the wheel cylinder applies to the primary shoe is multiplied by the primary lining friction to provide a very large force applied to the secondary shoe. Torque from the brake shoes is transferred to anchor pin and through the backing plate, to the axle flange. Adjustment is automatic during reverse brake applications.

NOTICE: Replace all components included in repair kits used to service this drum brake. Lubricate parts as specified. Replace shoe and lining in axle sets only. If any hydraulic component is removed or brake line disconnected, bleed the brake system. The torque values specified are for dry, unlubricated fasteners.

CAUTION: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. (A water dampened cloth should be used.) Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.



1. Return spring
2. Return spring
3. Hold-down spring
4. Lever pivot
5. Hold-down pin
6. Actuator link
7. Actuator lever
8. Pawl
9. Lever return spring
10. Shoe guide
11. Parking brake strut
12. Strut spring
13. Primary shoe
14. Secondary shoe
15. Adjusting screw spring
16. Socket
17. Washer
18. Pivot nut
19. Adjusting screw
20. Parking brake lever
21. Cylinder link
22. Bolt
23. Boot
24. Piston
25. Seal
26. Spring assembly
27. Bleeder valve
28. Cylinder body
29. Backing plate
30. Wheel cylinder assembly
31. Adjusting screw assembly

L H ASSEMBLY

1. REMOVE AND INSTALL BRAKE COMPONENTS.

REMOVE

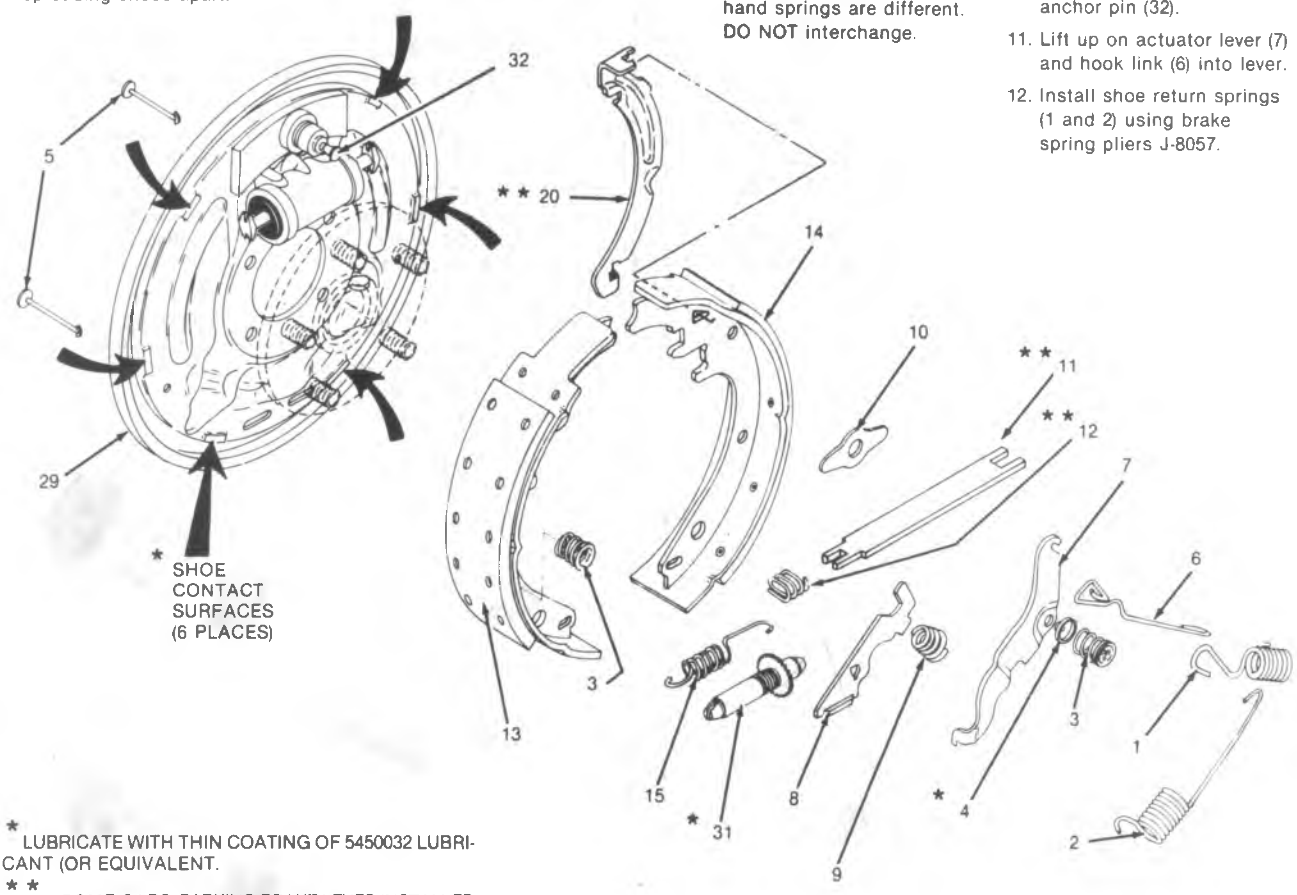
1. Hoist car and mark relationship of wheel to axle. Remove wheel.
2. Mark relationship of drum to axle and remove drum.
3. Remove return springs (1 and 2) using brake spring pliers J-8049.
4. Remove hold-down springs (3) using suitable pliers. Remove lever pivot (4).
5. Remove hold-down pins (5).
6. Lift up on actuator lever (7) and remove actuating link (6).
7. Remove actuator lever (7), pawl (8) and return spring (9).
8. Remove shoe guide (10).
9. Remove parking brake strut (11) and spring (12) by spreading shoes apart.
10. Spread shoe and lining assemblies (13 and 14) to clear axle flange. Disconnect parking brake cable and remove shoes, connected by spring (15), from vehicle.
11. Remove adjusting screw assembly (31) and spring (15) (Note position of Adjusting Spring). Do not interchange adjusting screws from RH and LH brake assemblies.
12. Remove parking brake lever (20) by unhooking lever tab from shoe (14) slot.

NOTICE: If any parts are of doubtful strength or quality due to discoloration from heat, over-stress, or are worn, the part(s) should be replaced.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

1. Install parking brake lever (20) by hooking lever tab into shoe (14) slot as shown.
2. Inspect adjusting screw (19) threads for smooth rotation over full length as shown in A. Clean in fresh brake fluid. Apply brake lube to screw (19) threads, inside diameter of socket (16) and socket face. Adequate lubrication is achieved when a continuous bead of lubricant is produced at open end of pivot nut (18) and socket (16) after parts are assembled and threads fully engaged.
3. Install adjusting screw assembly (31) and spring (15) as shown in A. Coils of spring must not be over star wheel. Left and right hand springs are different. DO NOT interchange.
4. Spread shoe and lining assemblies (13 and 14) to clear axle flange, connect parking brake cable, and install parts on vehicle.
5. Install parking brake strut (11) and spring (12) by spreading shoes (13 and 14) apart.
6. Make sure that strut (11) is properly positioned. The end without the spring (12) engages the parking brake lever (20). The end with the spring engages the opposite shoe (13 or 14).
7. Install shoe guide (10).
8. Install pawl (8), actuator lever (7) and return spring (9).
9. Install hold-down pins (5), lever pivot (4), and hold-down springs (3).
10. Install actuating link (6) on anchor pin (32).
11. Lift up on actuator lever (7) and hook link (6) into lever.
12. Install shoe return springs (1 and 2) using brake spring pliers J-8057.



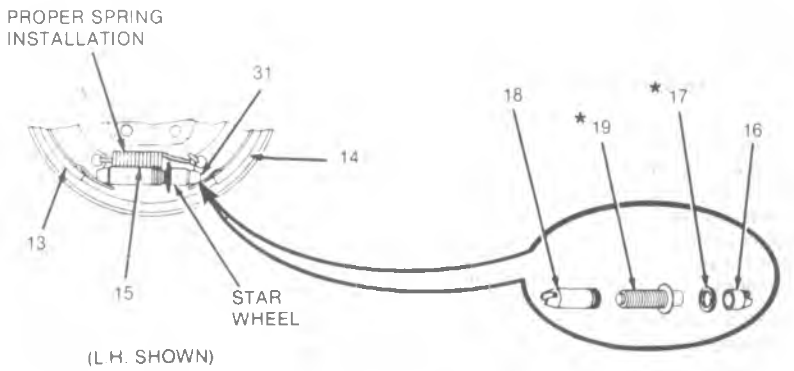
* LUBRICATE WITH THIN COATING OF 5450032 LUBRICANT (OR EQUIVALENT.

** SOME CARS: PARKING BRAKE LEVER INSTALLED ON PRIMARY SHOE FOR RH ASSEMBLIES. TURN PARKING BRAKE STRUT AND SPRING END FOR END FROM POSITION SHOWN.

1. Return spring
2. Return spring
3. Hold-down spring
4. Lever pivot
5. Hold-down pin
6. Actuator link
7. Actuator lever
8. Pawl
9. Lever return spring
10. Shoe guide
11. Parking brake strut
12. Strut spring
13. Primary shoe
14. Secondary shoe
15. Adjusting screw spring
20. Parking brake lever
29. Backing plate
31. Adjusting screw assembly
32. Anchor pin

A

*LUBRICATE WITH THIN COATING OF 5450032 LUBRICANT (OR EQUIVALENT.



13. Primary shoe
14. Secondary shoe
15. Adjusting screw spring
16. Socket
17. Washer
18. Pivot nut
19. Screw
31. Adjusting screw assembly

2. REMOVE AND INSTALL WHEEL CYLINDER.

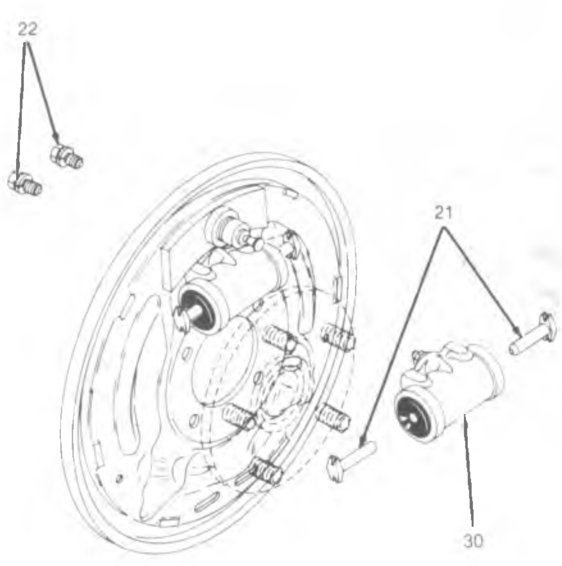
REMOVE

1. Remove dirt and foreign material around wheel cylinder (30) inlet and pilot.
2. Remove links (21) and disconnect inlet tube line.
3. Remove wheel cylinder bolts (22) and lift off wheel cylinder (30).

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

1. Position wheel cylinder (30) and attach with bolts (22).
2. Torque bolts (22) to 11.3-25.4 N·m (100-225 lb-in).
3. Torque inlet tube nut to 13.6-20.3 N·m (120-280 in-lb).



21. Cylinder link
22. Bolt
30. Wheel cylinder

3. DISASSEMBLE AND ASSEMBLE WHEEL CYLINDER.

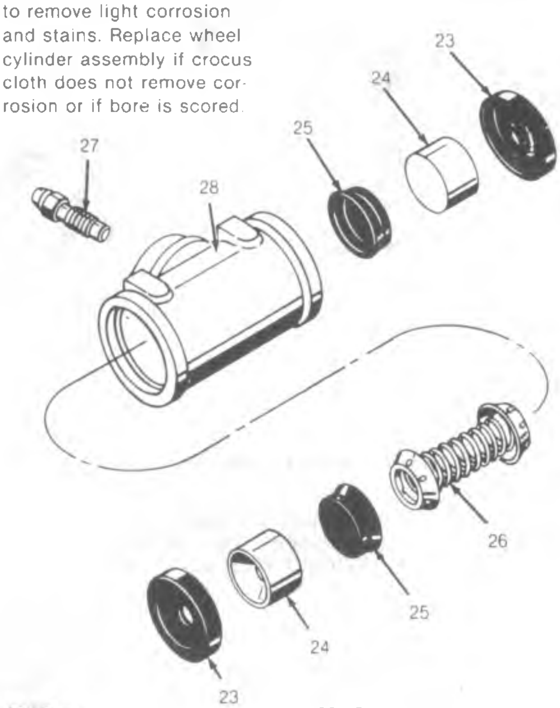
DISASSEMBLE

1. Disassemble parts as shown.
2. Clean wheel cylinder body (28) in fresh brake fluid.
3. Use dry, filtered compressed air to remove excess fluid from wheel cylinder body (28) and to blow out passages.
4. Inspect cylinder bore for scoring and corrosion. Crocus cloth may be used to remove light corrosion and stains. Replace wheel cylinder assembly if crocus cloth does not remove corrosion or if bore is scored.

ASSEMBLE

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

1. Lubricate new seals (25) with clean brake fluid.
2. Assemble as shown, new seals (25), new boots (23) and new spring assembly (26), with wheel cylinder piston (24).
3. Torque bleeder screw (27) to 4.5-10.2 N·m (40-90 in-lb).



23. Boot
24. Piston
25. Seal
26. Spring assembly
27. Bleeder valve
28. Cylinder body

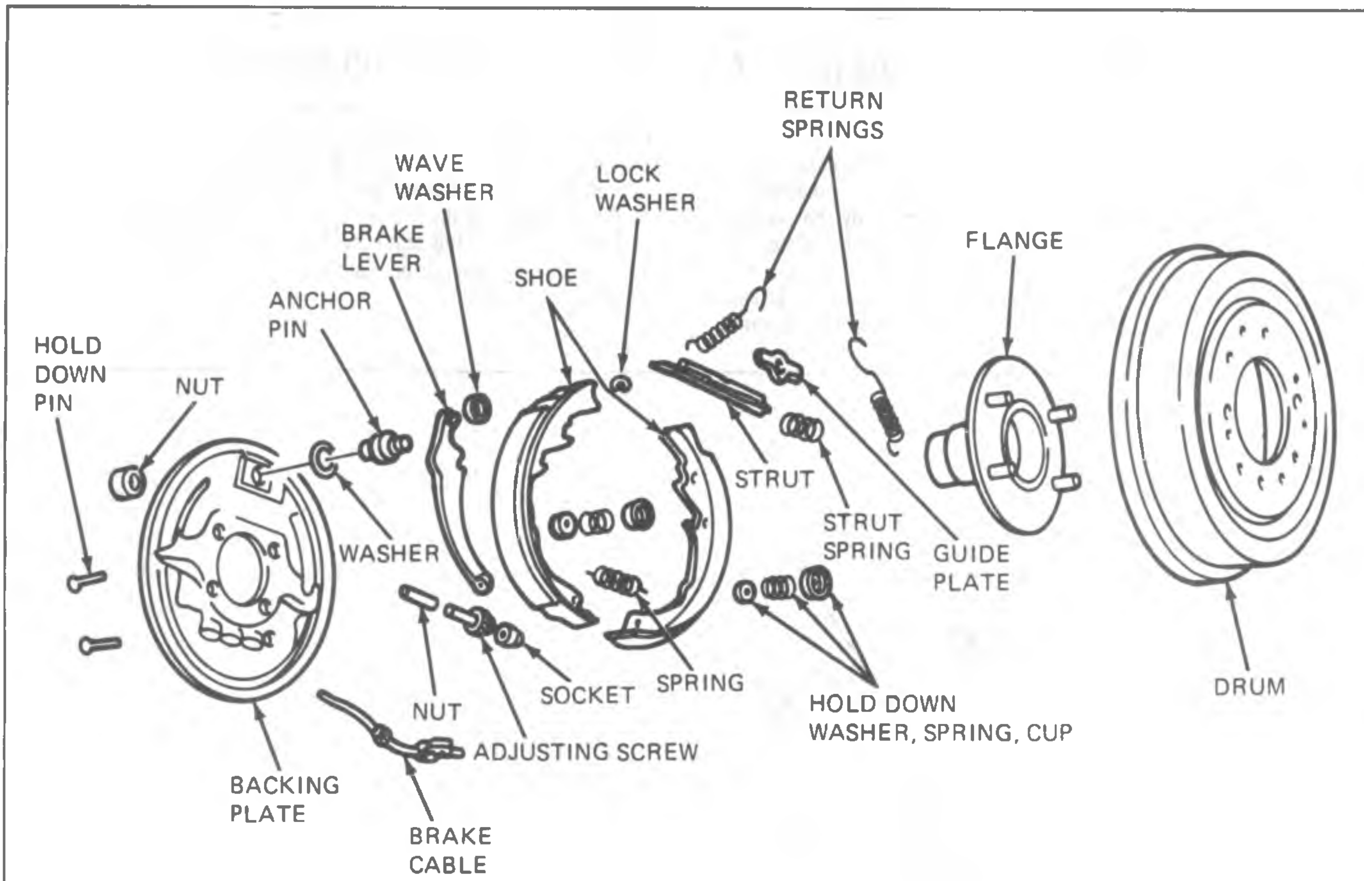


Fig. 5-21--Propshaft Parking Brake Components

Inspection

Replace any worn or broken parts.

Installation

NOTICE: Refer to "Notice" on Page 1 of this section when installing fasteners in Steps 1, 2 and 4 below.

1. Place the flange plate in position on the rear bearing retainer and fasten with four bolts. Torque bolts to 24 lb. ft. (33 N·m).
2. Install transmission output flange on spline of mainshaft and fasten with flange nut. Torque not to 100 lb. ft. (136 N·m).
3. Install cable assembly from back of flange plate. Push retainer through hole in flange plate until tangs securely grip the inner side of the plate.
4. Place washer and reinforcement over the threaded end of anchor pin. Hold anchor pin nut (flat side against flange on flange plate) in position behind flange plate and insert threaded end of anchor pin from front side. Thread the anchor pin into nut and tighten securely (140 lb. ft.--190 N·m). Bend tang of washer over reinforcement and side of washer over hex of anchor pin.
5. Install lever on cable by compressing spring and inserting cable in channel of lever. RFelease spring.
6. Install primary shoe (short lining) to lever as follows: Place pin in lever, place washer on pin and push pin through hole in primary shoe. Fasten parts together by installing the clip in groove of pin.
7. Fasten two brake shoes and linings together by installing connecting spring. Move the shoes toward each other and install adjusting screw.
8. Lubricate the flange plate contact surfaces with a very light coat of Delco Brake Lube (or equivalent).
9. Place shoe and linings in position on flange plate.

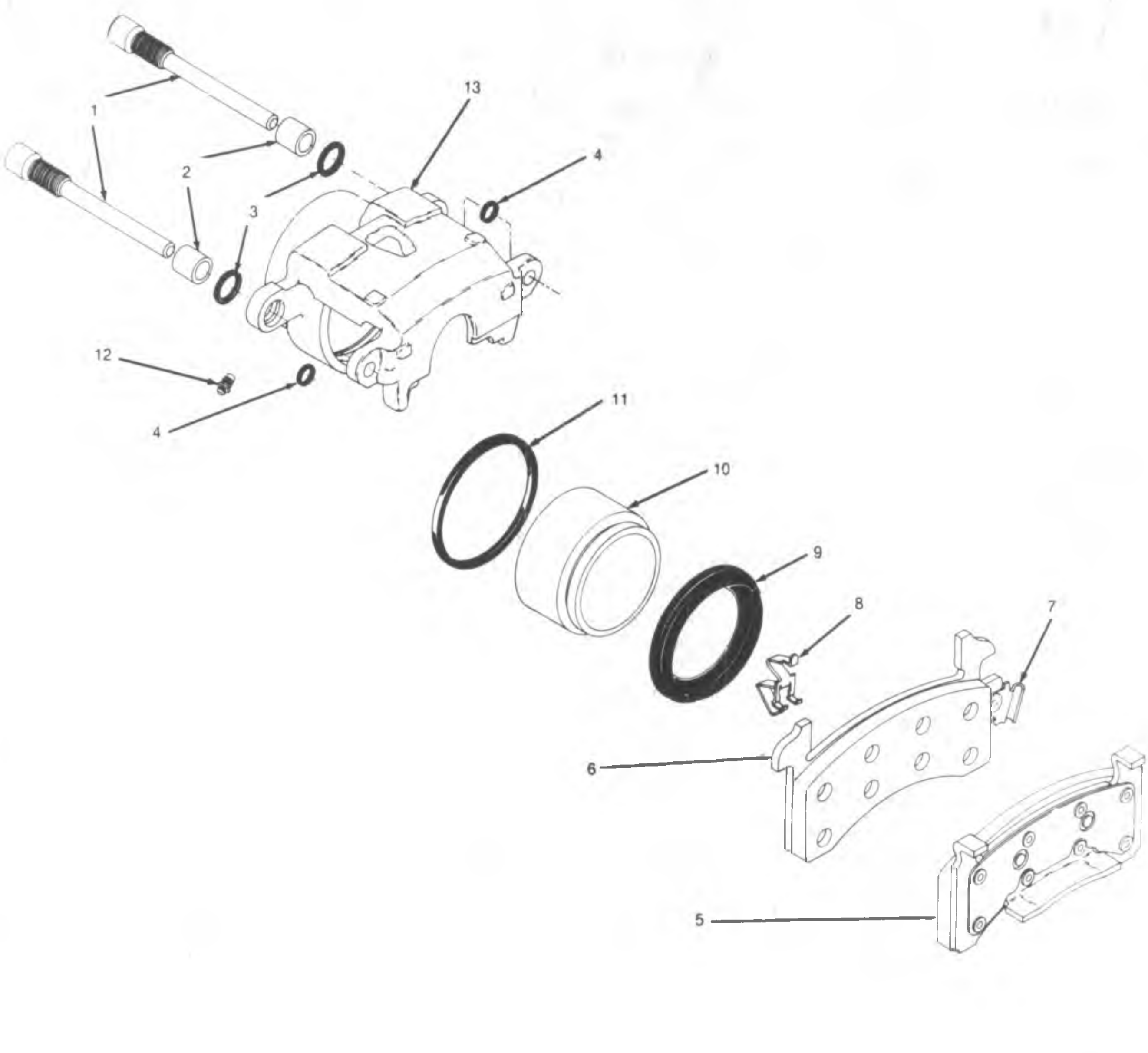
   When facing the brake assembly, the shoe with the short lining should be to the left with the lever assembled to it (automatic transmission), to the right (manual transmission).
10. Pull brake shoes apart and install strut lever and spring between them. The loop on the strut spring should be in the "up" position.
11. Install hold down pins, washers, springs and cups from flange plate to shoes.
12. Place guide plate on anchor pin.
13. Install pull back springs.
14. Remove the "knock out" plug (if necessary) and install a new metal plug in the brake drum adjusting hole.
15. Install the brake drum.
16. Install the propeller shaft.

DISC BRAKE CALIPER ASSEMBLY - 3000/3100 SERIES

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. Hydraulic force, created by applying force to the brake pedal, is converted by the caliper to friction. The hydraulic force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to move (slide) the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor creating friction to stop the vehicle.

NOTICE: Replace all components included in repair kits used to service the caliper. Lubricate parts as specified. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any component is removed or line disconnected, bleed the brake system. Replace shoe and linings in axle sets only. The torque values specified are for dry, unlubricated fasteners.



1. Mounting bolt
2. Sleeve
3. Bushing
4. Bushing
5. Outboard shoe & lining
6. Inboard shoe & lining
7. Wear sensor
8. Shoe retainer spring
9. Boot
10. Piston
11. Piston seal
12. Bleeder screw
13. Caliper housing

1. REMOVE AND INSTALL CALIPER ASSEMBLY.

REMOVE

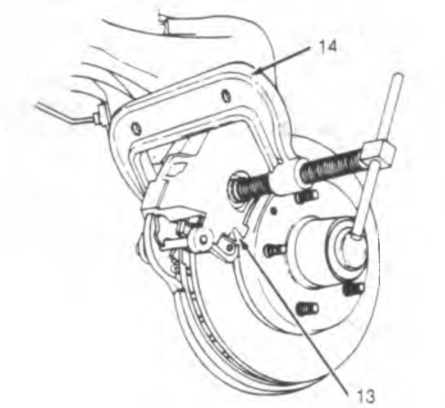
1. Remove ²⁄₃ of brake fluid from master cylinder assembly.
2. Hoist car and mark relationship of wheel to axle. Remove wheel. Reinstall two lug nuts to hold rotor in place.
3. Position C-clamp (14) as shown in A and tighten until piston bottoms in bore.
4. Remove C-clamp (14).
5. Remove bolt holding inlet fitting (15) as shown in B (if only shoe and lining are being replaced, do not remove inlet fitting).
6. Remove allen head mounting bolts (1) shown in B.
7. Inspect mounting bolts for corrosion. If corrosion is found, use new bolts when installing caliper. Do not attempt to polish away corrosion.
8. If only shoe and linings are being replaced, remove caliper (13) from rotor and suspend with a wire hook (17) from front frame or suspension as shown in C.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

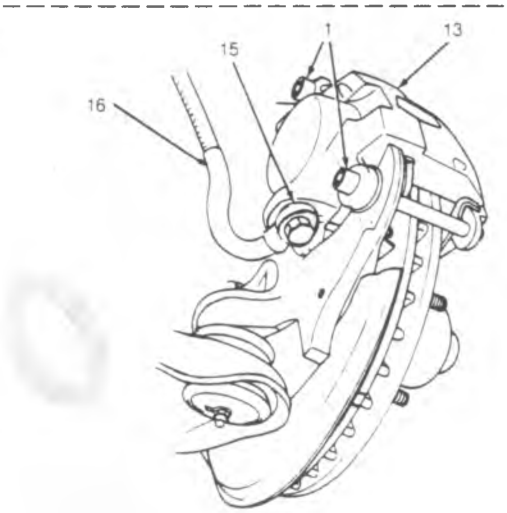
1. Position caliper (13) over rotor in mounting bracket (18).
2. Install mounting bolts (1) and torque to 41-61 N•m (30-45 ft. lb.)
3. Check clearance between caliper (13) and bracket (18) stops as shown in D. If necessary, file ends of bracket stops (18) to provide proper clearance.
4. Install inlet fitting (15) (if removed) and torque to 24-40 N-m (18-30 ft-lb).
5. Install wheels and lower car.
6. Fill master cylinder to proper level. Bleed brakes if inlet fitting was removed.

A



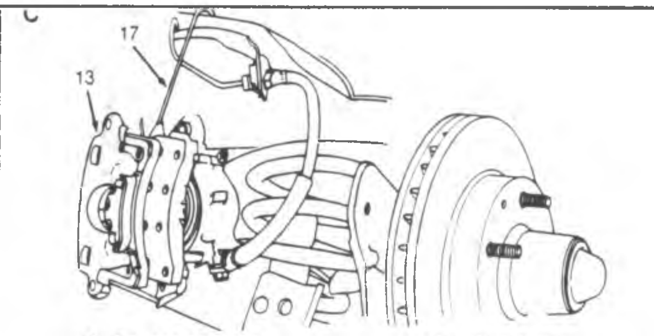
13. Caliper housing
14. C-clamp

B



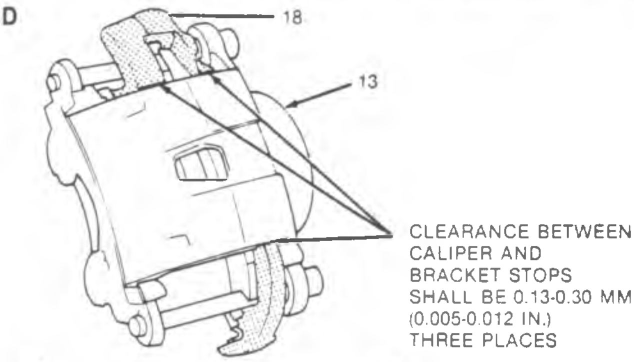
1. Mounting bolt
13. Caliper housing
15. Inlet fitting
16. Brake hose

C



13. Caliper housing
17. Wire hook

D



13. Caliper housing
18. Bracket

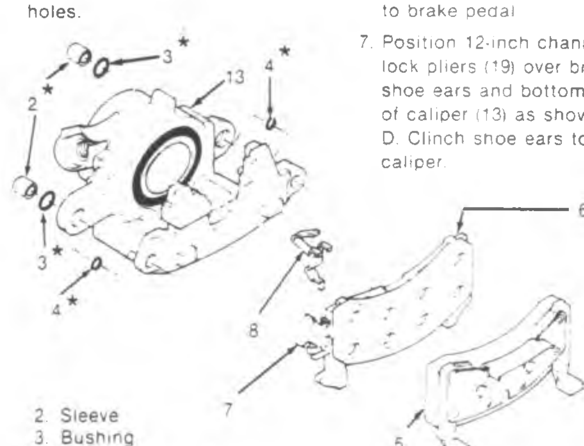
2. REMOVE AND INSTALL SHOE AND LINING ASSEMBLIES.

REMOVE

1. Remove shoe and lining assemblies (5 and 6) from caliper.
2. Remove sleeves (2) from mounting bolt holes.
3. Remove bushings (3 and 4) from grooves is mounting bolt holes.

INSTALL

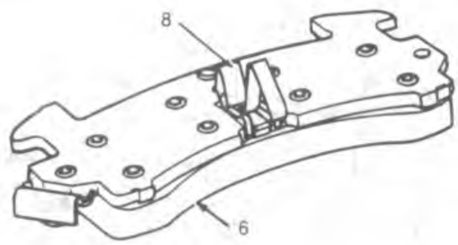
1. lubricate and install new bushings (3 and 4) in grooves in mounting bolt holes.
2. lubricate and install new sleeves (2) in mounting bolt holes.
3. Install retainer spring (8) on inboard shoe (6) as shown in A.
4. Install inboard shoe and lining (6) as shown in B with wear sensor (7) at leading edge of shoe during forward wheel rotation.
5. Install outboard shoe and lining (5) as shown in C.
6. Install caliper as specified in procedure 1. After installation of calipers, apply approximately 778 N (175 lb) of force three times to brake pedal
7. Position 12-inch channel-lock pliers (19) over brake shoe ears and bottom edge of caliper (13) as shown in D. Clinch shoe ears to caliper.



2. Sleeve
3. Bushing
4. Bushing
5. Outboard shoe & lining
6. Inboard shoe & lining
7. Wear sensor
8. Shoe retainer spring
13. Caliper housing

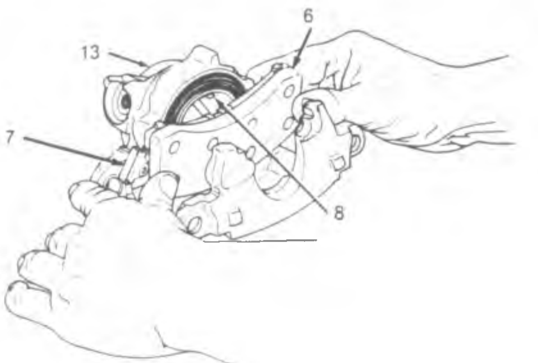
* LUBRICATE WITH SILICONE GREASE (OR EQUIVALENT)

A



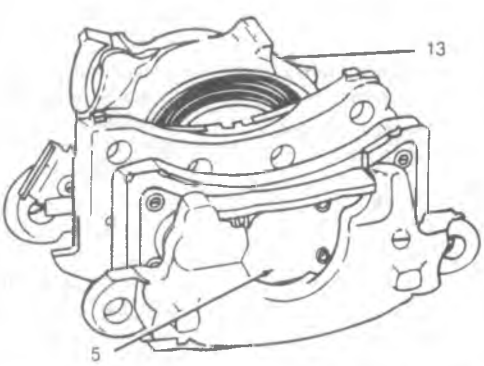
6. Inboard shoe & lining
8. Shoe retainer spring

B



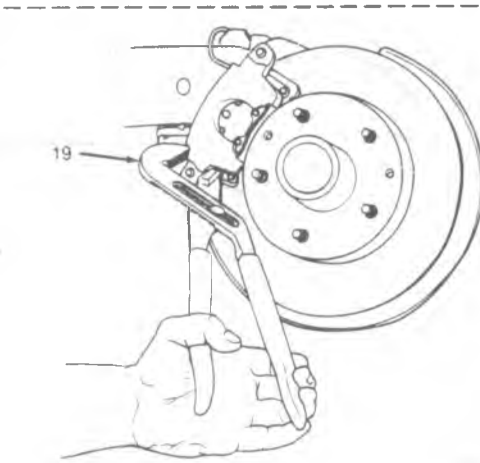
6. Inboard shoe & lining
7. Wear sensor
8. Shoe retainer spring
13. Caliper housing

C



5. Outboard shoe & lining
13. Caliper housing

D



19. Channel lock pliers

3. OVERHAUL CALIPER.

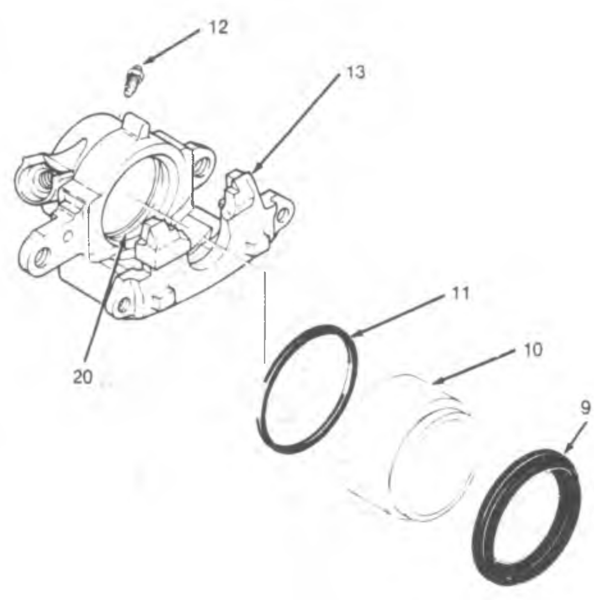
REMOVE

1. Remove piston (10) as shown in A. Use clean shop towels to pad the interior of the caliper (13) and remove the piston by directing compressed air into the caliper inlet hole.
2. Inspect piston (10) for scoring, nicks, corrosion and worn or damaged chrome plating. Replace piston if any of the above defects are found.
3. Remove boot (9) as shown in B, being careful not to scratch the housing bore.
4. Remove piston seal (11) from groove (20) in caliper bore with a piece of wood or plastic. Do not use a metal tool of any type as damage to bore may result.
5. Inspect caliper (13) bore for scoring, nicks, corrosion or wear. Use crocus cloth to polish out any light corrosion. Replace caliper housing if bore will not clean up using crocus cloth.
6. Remove bleeder valve (12).

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Clean all parts, not included in repair kit, in clean, denatured alcohol. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper housing (13) and bleeder valve (12).
2. Install and torque bleeder valve (12) to 9-16 N·m (80-140 in-lb).
3. Lubricate new seal (11) with clean brake fluid.
4. Install piston seal (11) in caliper bore groove (20), making sure seal is not twisted.
5. Install boot (9) on piston (10) as shown in C.
6. Lubricate bore of caliper housing (13) with clean brake fluid.
7. Insert piston (10) into bore of caliper and force down to bottom in bore.
8. Position OD of boot (9) in caliper housing counterbore and seat as shown in D.
9. After installation of caliper assembly, apply approximately 778 N (175 lb) of force three times to the brake pedal.

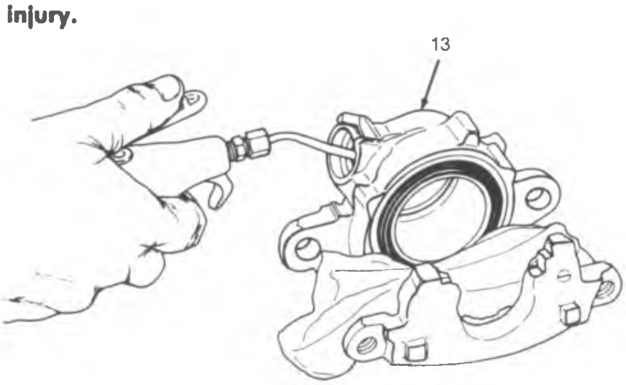


9. Boot
10. Piston
11. Piston seal
12. Bleeder valve
13. Caliper housing
20. Seal groove

A

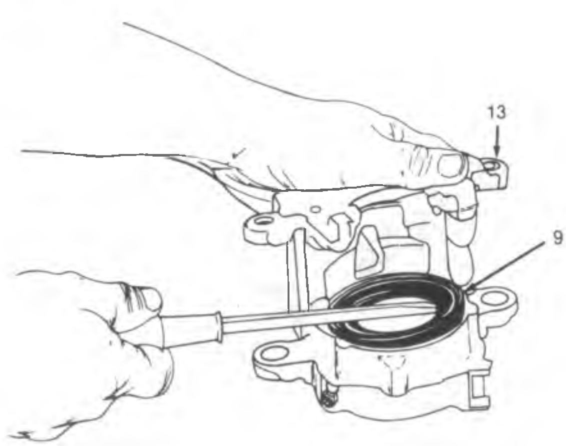
CAUTION: Do not place the fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If piston is blown out—even with padding provided, it may be damaged.



13. Caliper housing

B

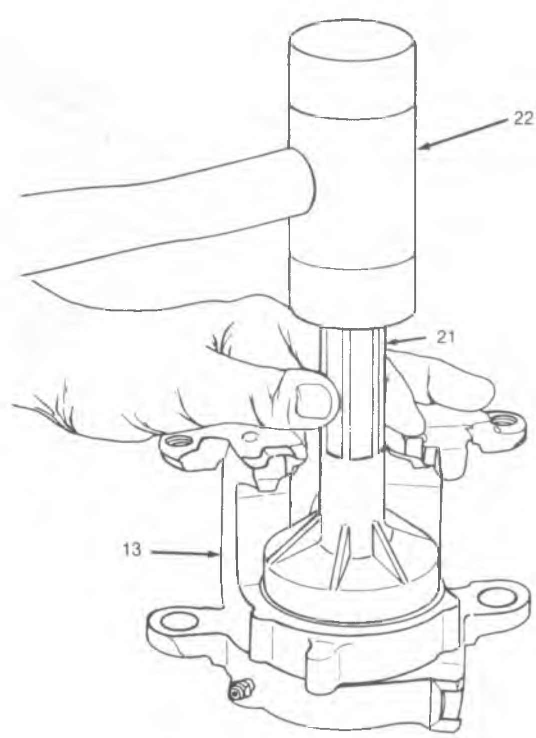


9. Boot
13. Caliper housing

C

9. Boot
10. Piston

D



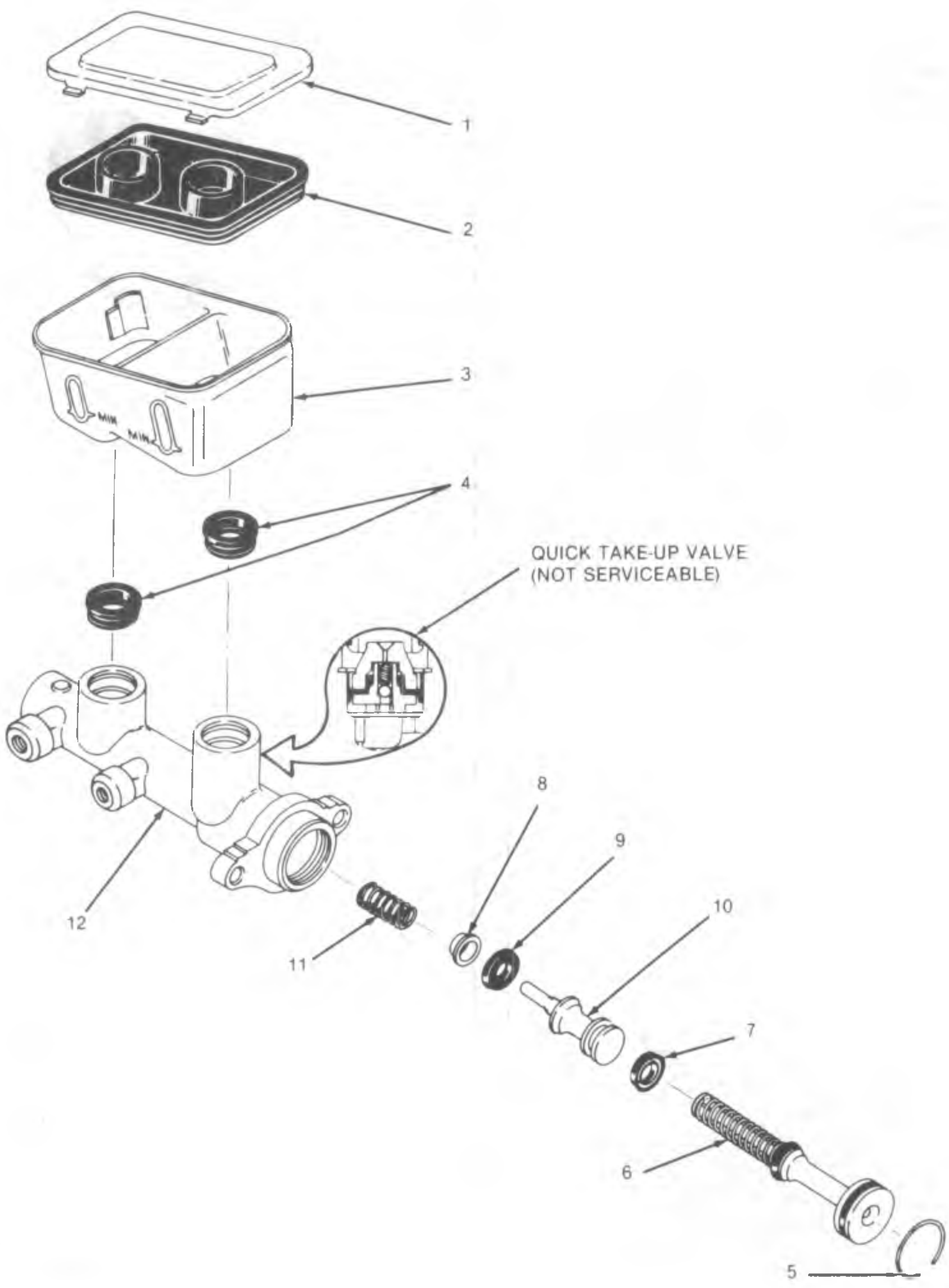
13. Caliper housing
21. Tool J-26267
22. Plastic mallet

COMPOSITE MASTER CYLINDER ASSEMBLY

GENERAL DESCRIPTION

This master cylinder is designed for use with a system incorporating low drag calipers. In addition to the standard master cylinder functions, a quick take-up feature is included. This provides a large volume of fluid to the wheel brakes at low pressure with initial brake application. The low pressure fluid quickly provides the displacement requirements created by the seal retracting pistons into the front calipers and spring retraction of the rear drum brake shoes.

NOTICE: Replace all components included in repair kits used to service this master cylinder. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, bleed the brake system. The torque values specified are for dry, unlubricated fasteners.



1. Reservoir cover
2. Reservoir diaphragm
3. Reservoir
4. Reservoir grommet
5. Lock ring
6. Primary piston assembly
7. Secondary seal
8. Spring retainer
9. Primary seal
10. Secondary piston
11. Spring
12. Cylinder body

1. REMOVE AND INSTALL MASTER CYLINDER.

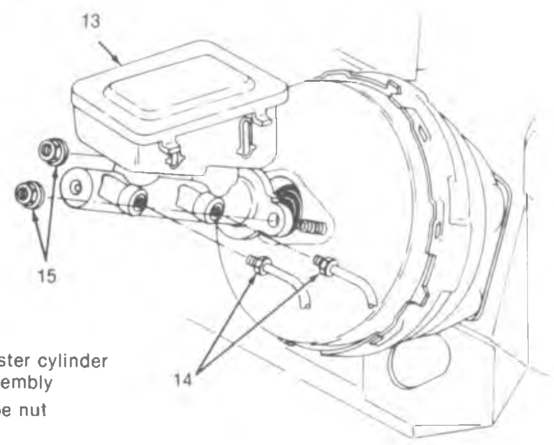
REMOVE

1. Loosen tube nuts (14) and disconnect two hydraulic lines.
2. Remove two attaching nuts (15).
3. Remove master cylinder (13) as shown.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Install master cylinder (13) as shown and torque attaching nuts (15) to 30-45 N·m (22-30 ft-lb).
2. Attach two hydraulic lines. Torque tube nuts (14) to 13.6-20.3 N·m (120-180 in-lb).



13. Master cylinder assembly
14. Tube nut
15. Nut

2. OVERHAUL MASTER CYLINDER

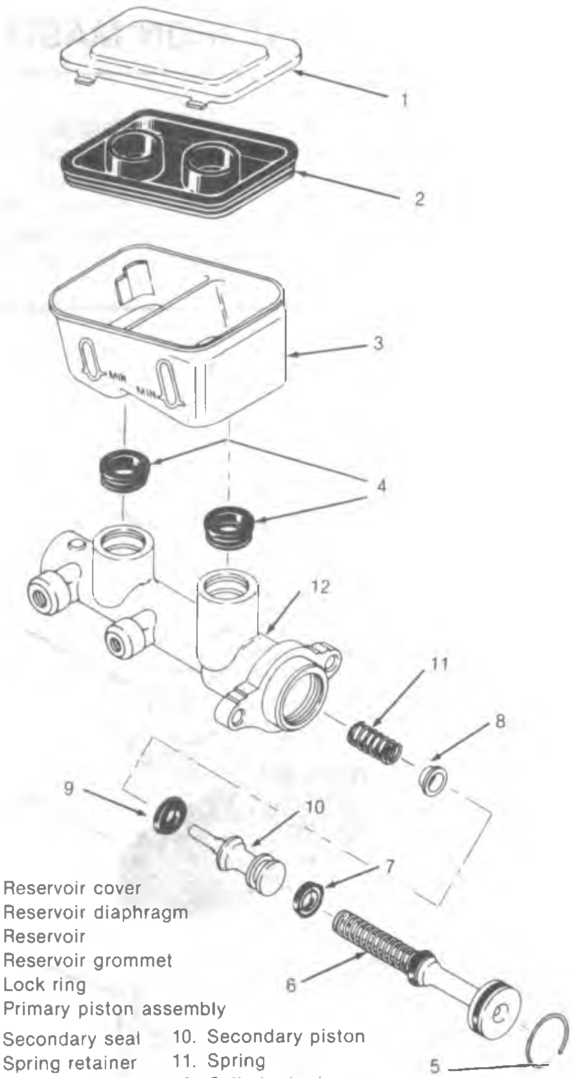
REMOVE

1. Remove reservoir cover (1) and diaphragm (2). Discard any brake fluid in reservoir.
2. Inspect reservoir cover (1) and diaphragm (2) for cuts, cracks or deformation. Replace damaged or defective parts.
3. Depress primary piston (6) and remove lock ring (5).
4. Direct compressed air into the outlet at the blind end of the bore and plug the other outlet to remove primary and secondary pistons (6 and 10).
5. Remove spring retainer (8) and seals (7 and 9) from secondary piston (10).
6. Clamp master cylinder (12) in vise as shown in A—do not clamp on master cylinder body—and use pry bar (16) to remove reservoir (3).
7. Do not attempt to remove quick take-up valve from body (12). Valve is not serviceable separately.
8. Remove reservoir grommets (4).
9. Inspect master cylinder (12) bore for corrosion. If bore is corroded, replace master cylinder. No abrasives shall be used on bore.

INSTALL

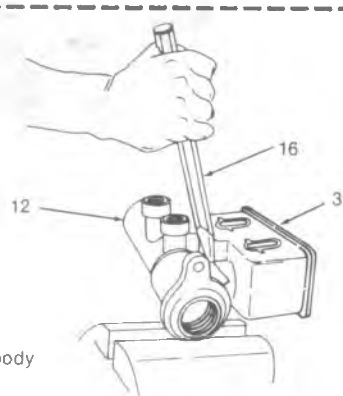
SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Lubricate new reservoir grommets (4) with siliconne brake lube or brake fluid and press into master cylinder body (12). Make sure grommets are properly seated.
2. Lay reservoir (3) on flat, hard surface as shown. Press on master cylinder body (12) using rocking motion as shown in B.
3. Lubricate new seals (7 and 9) with clean brake fluid and install on secondary piston (10), positioning as shown. Install spring retainer (8).
4. Install spring (11) and secondary piston assembly (7 thru 10) in cylinder (12).
5. Lubricate primary piston (6) seals with clean brake fluid. Install primary piston, depress, and install lock ring (5).
6. Fit diaphragm (2) in reservoir cover (1) and install on reservoir (3).



1. Reservoir cover
2. Reservoir diaphragm
3. Reservoir
4. Reservoir grommet
5. Lock ring
6. Primary piston assembly
7. Secondary seal
8. Spring retainer
9. Primary seal
10. Secondary piston
11. Spring
12. Cylinder body

A



3. Reservoir
12. Cylinder body
16. Pry bar

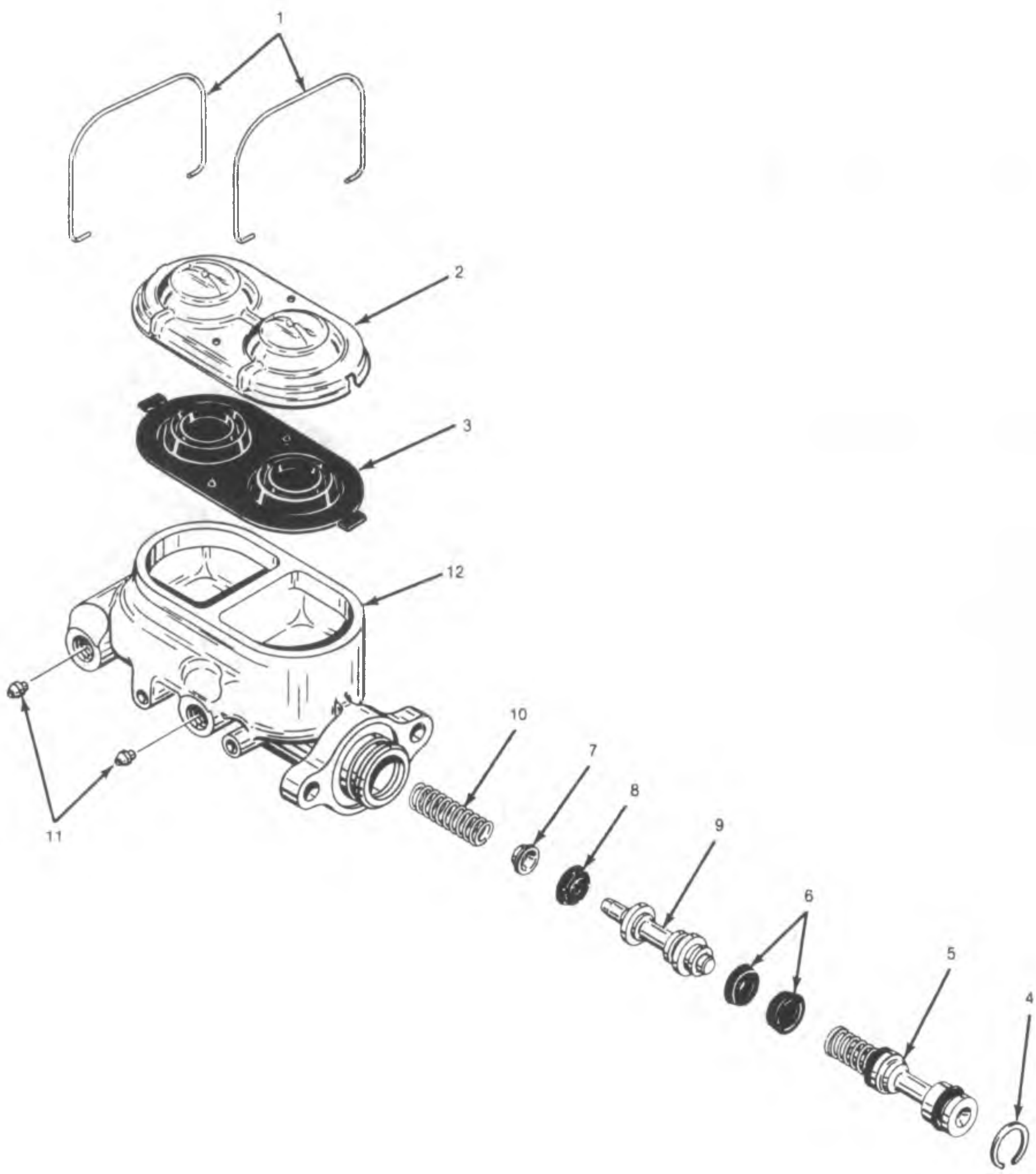
B

CAST IRON MASTER CYLINDER ASSEMBLY

GENERAL DESCRIPTION

This master cylinder is a full cast iron design incorporating a conventional front to rear brake split. The primary piston provides the fluid pressure to the front brakes, while the secondary piston provides the fluid pressure to the rear brakes. If pressure is lost from either system, the remaining system will function to stop the vehicle in accordance with the Federal Motor Safety Standards.

NOTICE: Replace all components included in repair kits to service this master cylinder. Lubricate rubber parts with clean, fresh brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, bleed the brake system. The torque values specified are for dry, unlubricated fasteners.



1. Bail
2. Reservoir cover
3. Reservoir diaphragm
4. Lockring
5. Primary piston assembly
6. Secondary seal
7. Spring retainer
8. Primary seal
9. Secondary piston
10. Spring
11. Tube seat
12. Cylinder body

1. REMOVE AND INSTALL MASTER CYLINDER.

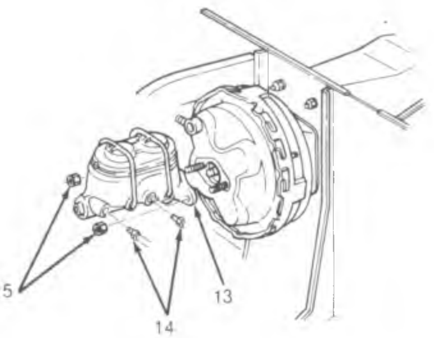
REMOVE

1. Loosen tube nuts (14) and disconnect two hydraulic brake pipes.
2. Remove attaching nuts (15).
3. Remove master cylinder (13).

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Install master cylinder (13) as shown.
2. Torque attaching nuts (15) to 17 N·m (150 in-lb).
3. Attach tube nuts (14) and torque to 11 N·m (100 in-lb).



13. Master cylinder assembly
14. Tube nut
15. Nut

2. REMOVE AND INSTALL RESERVOIR COVER, DIAPHRAGM AND BAILWIRES.

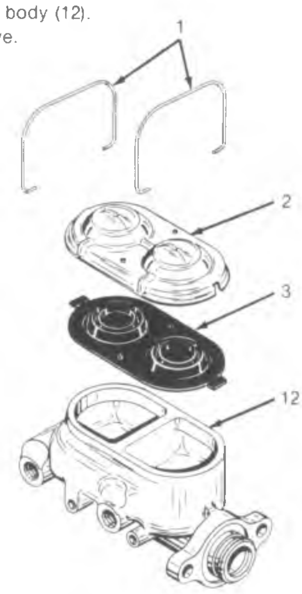
REMOVE

1. Rotate bails (1) away from reservoir cover (2).
2. Remove reservoir cover (2) and diaphragm (3).
3. Inspect reservoir cover (2) and diaphragm (3) for cuts, cracks or deformation. Replace damaged or defective parts.
4. Remove bails (1) only if diaphragm (3) is not sealing to master cylinder body (12). Replace if defective.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Install reservoir diaphragm (3) in reservoir cover (2).
2. Install assembly on reservoir.
3. Secure with bails (1).



1. Bail
2. Reservoir cover
3. Reservoir diaphragm
12. Cylinder body

3. REMOVE AND INSTALL PRIMARY AND SECONDARY PISTONS.

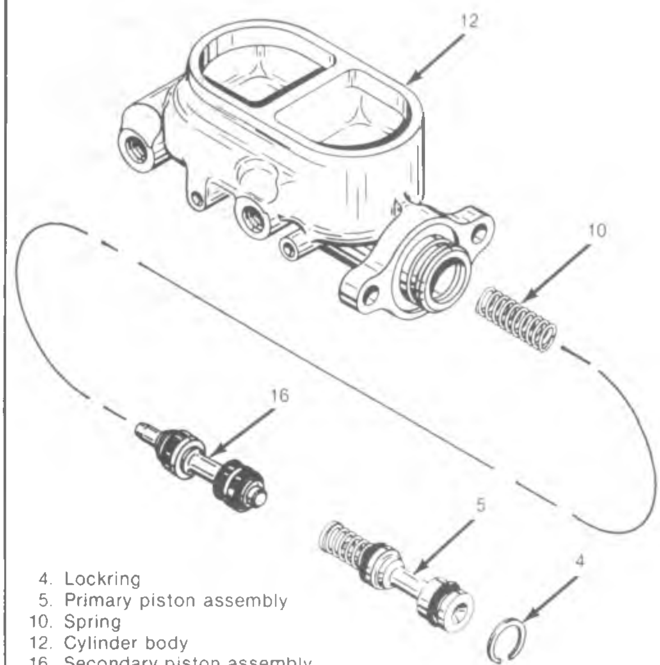
REMOVE

1. Depress primary piston and remove lockring (4).
2. Direct compressed air into the outlet at the blind end of the bore and plug the other outlet to remove primary and secondary pistons (5 and 16).
3. Disassemble secondary piston (16) as shown in A below.
4. Inspect master cylinder bore for scoring, nicks, corrosion or wear. Use crocus cloth to polish out any light corrosion. Replace master cylinder if bore will not clean up using crocus cloth.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Assemble secondary piston as shown in A.
2. Install spring (10), spring retainer (7) and secondary piston (16) assembly in cylinder body (12).
3. Lubricate primary piston (5) seals with clean brake fluid and install primary piston assembly. Depress primary piston and install lockring (4).



4. Lockring
5. Primary piston assembly
10. Spring
12. Cylinder body
16. Secondary piston assembly

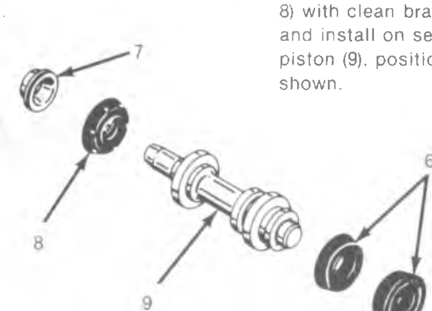
A.

REMOVE

1. Remove seals (6 and 8) as shown.

INSTALL

1. Lubricate new seals (6 and 8) with clean brake fluid and install on secondary piston (9), positioning as shown.



6. Secondary seal
7. Spring retainer
8. Primary seal
9. Secondary piston

4. REMOVE AND INSTALL TUBE SEATS.

REMOVE

1. Remove tube seats (11) as shown in A below.

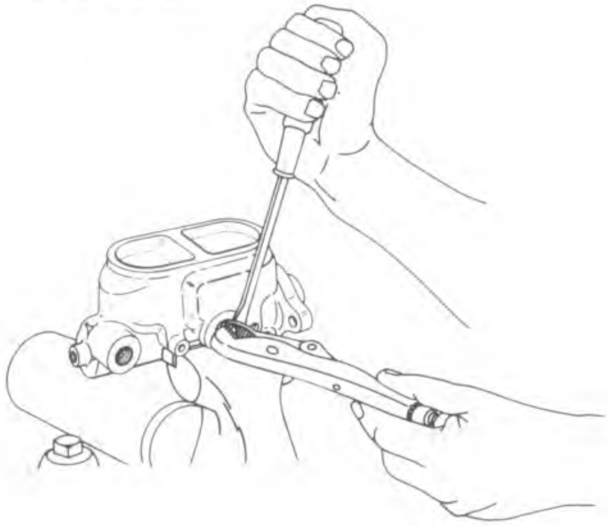
INSTALL

1. Install tube seats (11) as shown in B below.

A.

REMOVE

1. Thread self-tapping screw into tube seat (11) and remove as shown.



B.

INSTALL

1. Position tube seat (11) in body and seat with a spare brake tube nut (14).

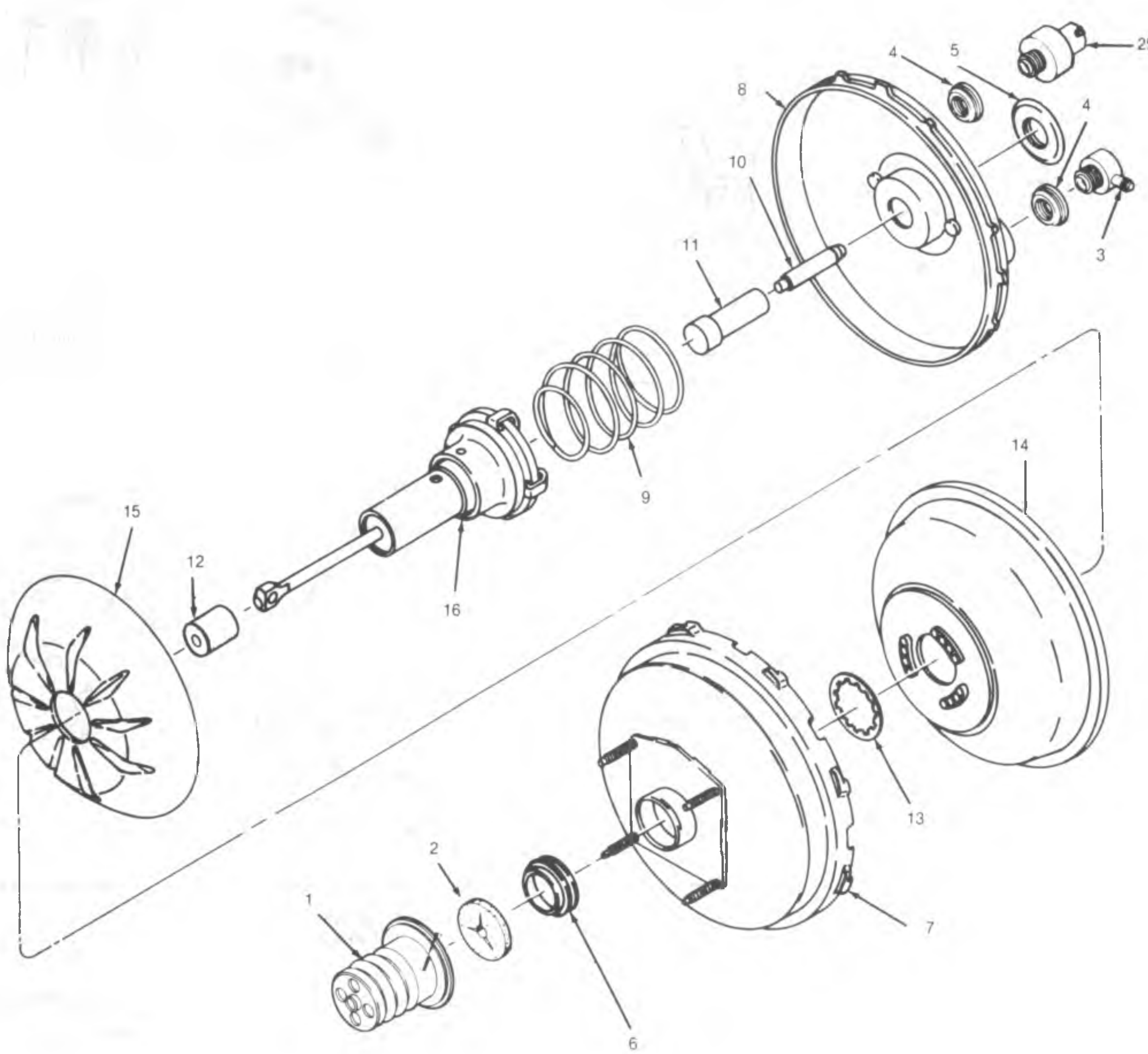
14. Tube nut

POWER HEAD ASSEMBLY - SINGLE DIAPHRAGM

GENERAL DESCRIPTION

This booster is a single diaphragm vacuum suspended unit. It may have a single function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a vacuum suspended booster operates with vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist.

NOTICE: Use all components included in repair kits to service this booster. Lubricate rubber parts, where indicated, with silicone grease provided in kits. The torque values specified are for dry, unlubricated fasteners. If any hydraulic component is removed or brake line disconnected, bleed the brake system.



1. Boot
2. Silencer
3. Vacuum check valve
4. Grommet
5. Front housing seal
6. Power piston bearing
7. Rear housing
8. Front housing
9. Return spring
10. Piston rod (gaged)
11. Reaction retainer
12. Filter
13. Diaphragm retainer
14. Diaphragm
15. Diaphragm support
16. Power piston and pushrod assembly
25. Vacuum switch (some models)

1. REMOVE AND INSTALL BOOSTER.

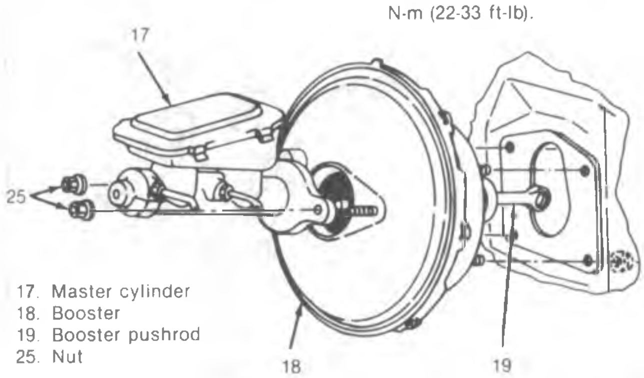
REMOVE

1. Disconnect master cylinder (17) from booster (18) and disconnect booster pushrod (19) from brake pedal.
2. Remove attaching nuts and remove booster as shown.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

1. Install booster to cowl as shown. Torque attaching nuts to 30-45 N·m (22-33 ft-lb).
2. Connect booster pushrod (19).
3. Install master cylinder (17) on booster (18) and torque attaching nuts (25) to 30-45 N·m (22-33 ft-lb).



17. Master cylinder
18. Booster
19. Booster pushrod
25. Nut

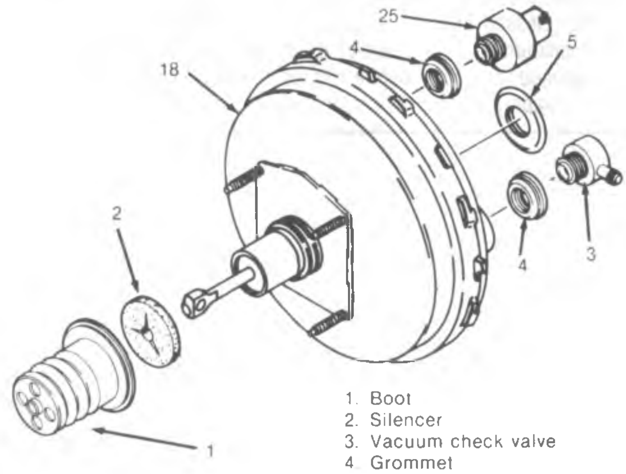
2. REMOVE AND INSTALL EXTERIOR COMPONENTS.

REMOVE

1. Remove parts as shown.

INSTALL

1. Lubricate inside and outside diameters of grommets (4) and front housing seal (5).
2. Install parts as shown.



1. Boot
2. Silencer
3. Vacuum check valve
4. Grommet
5. Front housing seal
18. Booster
25. Vacuum switch (some models)

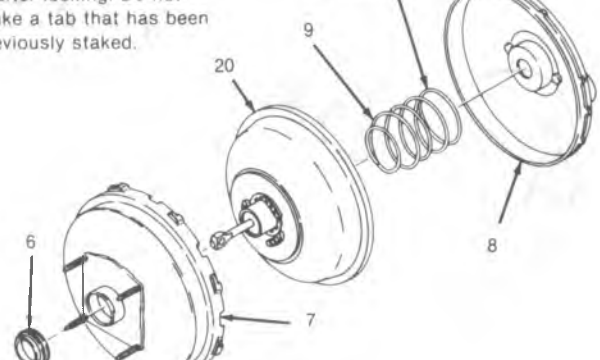
3. UNLOCKING AND LOCKING BOOSTER.

DISASSEMBLY

1. Scribe a mark on front and rear housings (7 and 8) to facilitate assembly.
2. Press down on tool J-9504 (22) and turn counterclockwise to unlock housings as shown in A.
3. Disassemble booster as shown.

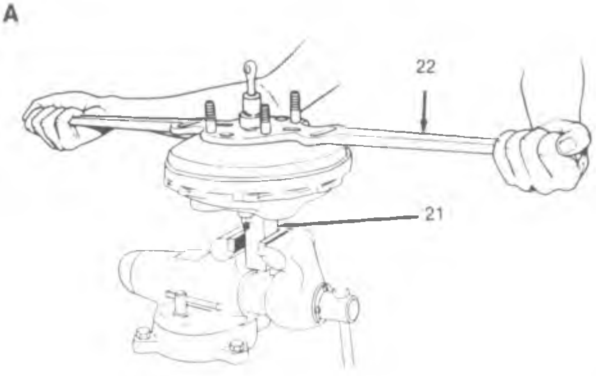
ASSEMBLE

1. Assemble parts as shown. Make sure white coil on return spring (9) is flush against housing.
2. Align scribe marks on housings (7 and 8).
3. Press down on tool J-9504 (22) and turn clockwise to lock front and rear housings (7 and 8) as shown in A. Assembly can be facilitated by connecting a vacuum source to the booster.
4. Stake housing as shown in B after locking. Do not stake a tab that has been previously staked.



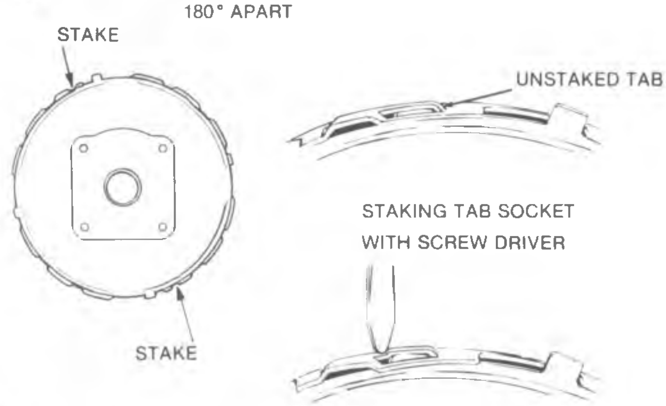
6. Power piston bearing
7. Rear housing
8. Front housing
9. Return spring
20. Power piston group

A



21. Fixture J-22805-01
22. Tool J-9504

B



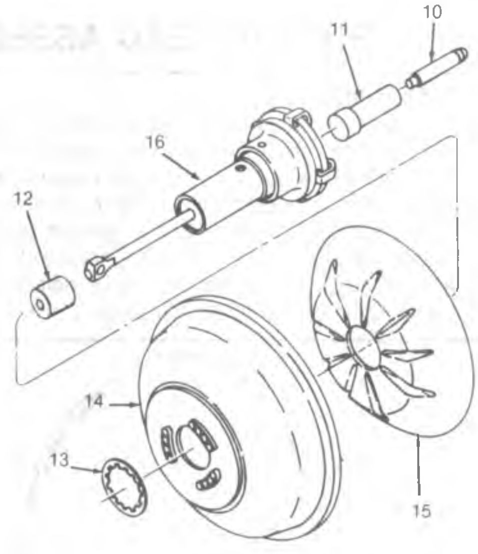
4. DISASSEMBLY AND ASSEMBLY OF POWER PISTON GROUP.

DISASSEMBLE

1. Remove piston rod (10) and reaction retainer (11).
2. Use an awl, ice pick or similar tool to remove filter (12).
3. Grasp assembly at outside edge of diaphragm support (15) and diaphragm (14). Hold with pushrod down against a hard surface. Use a slight force or impact to dislodge diaphragm retainer (13).
4. Remove only parts shown. Do not disassemble power piston and pushrod assembly (16).

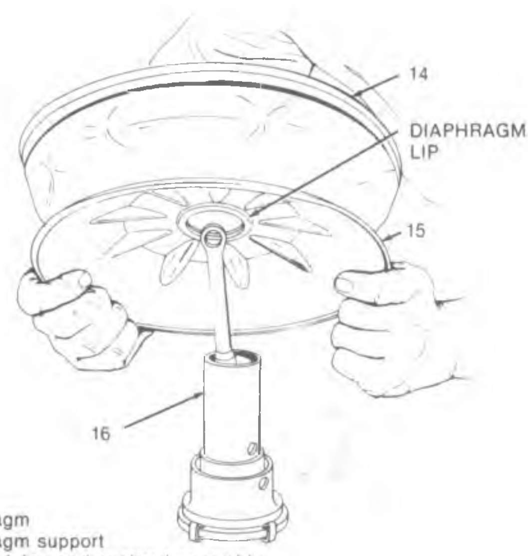
ASSEMBLE

1. Lubricate inside diameter of diaphragm (14) lip and fit in diaphragm support (15).
2. Install diaphragm (14) and support (15) as shown in A.
3. Install new diaphragm retainer (13) and seat as shown in B.
4. Install filter (12), reaction retainer (11) and piston rod (10).



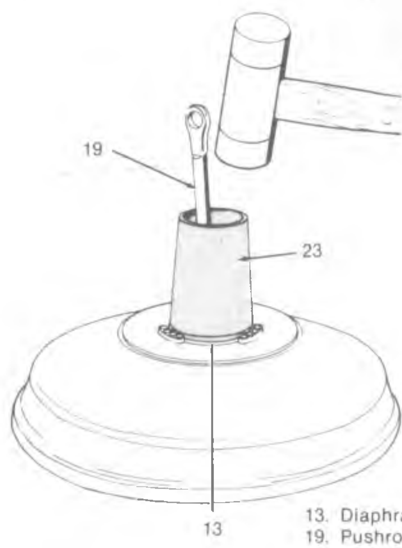
10. Piston rod
11. Reaction retainer
12. Filter
13 Diaphragm retainer
14. Diaphragm
15. Diaphragm support
16. Power piston and pushrod assembly

A



14. Diaphragm
15. Diaphragm support
16. Power piston and pushrod assembly

B

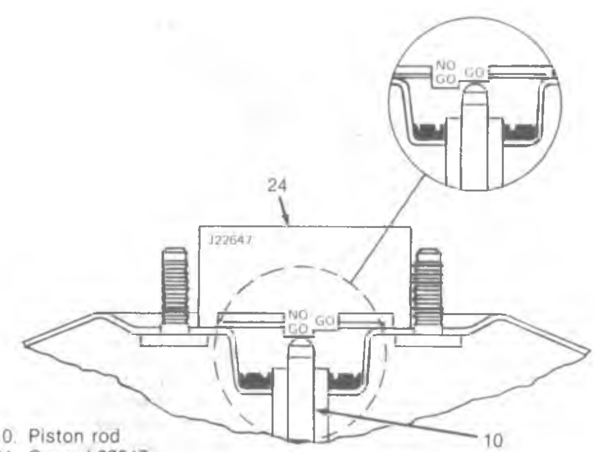


13. Diaphragm retainer
19. Pushrod
23. Tool J-28458

5. GAGING PROCEDURE

GAGING

1. After assembly of booster, position gage (24) over piston rod (10) as shown.
2. If piston rod (10) height is not within GO-NO-GO limits of gage (24), procure and use a service-adjustable piston rod to obtain correct height.



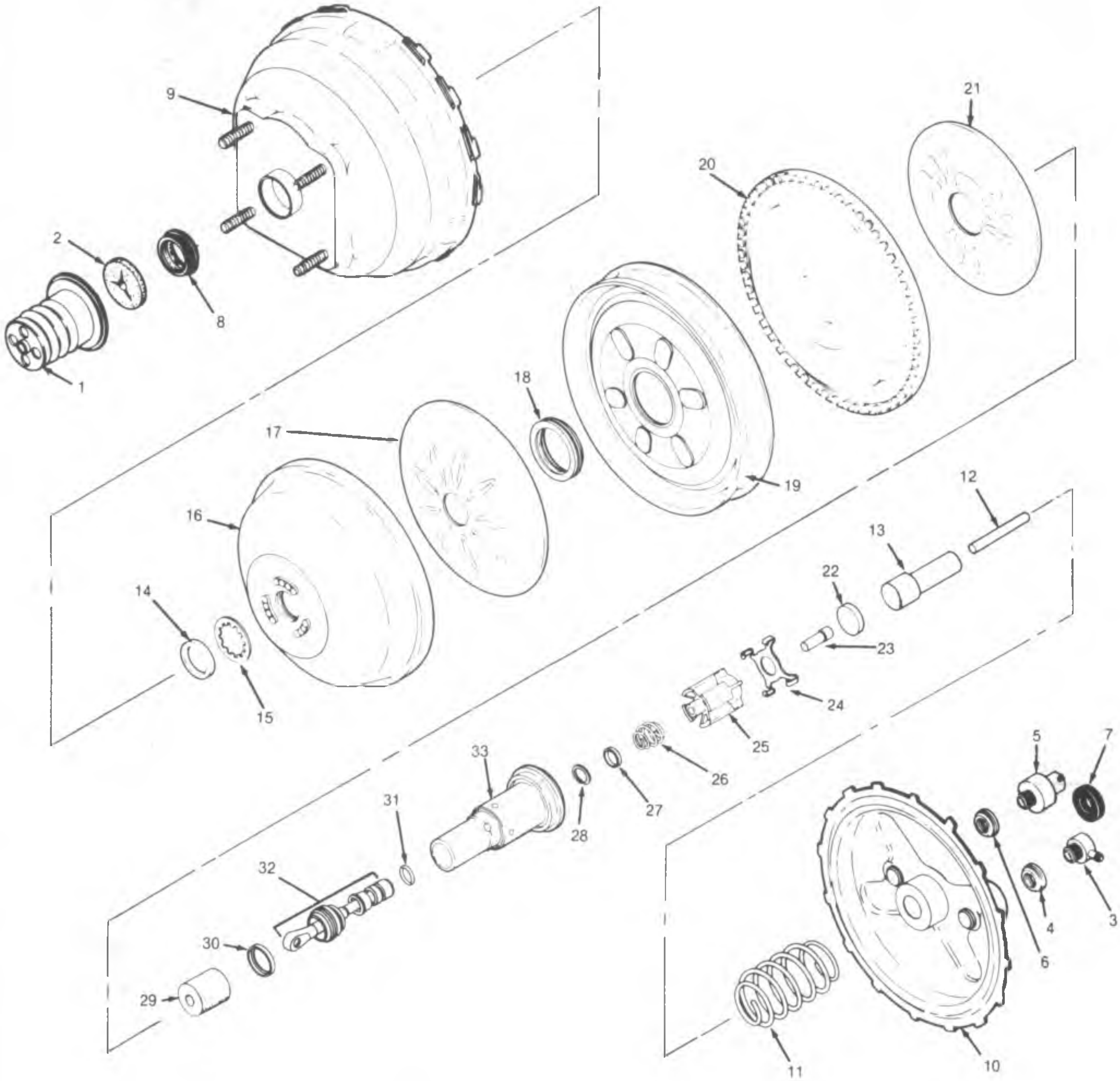
10. Piston rod
24. Gage J-22647

POWER HEAD ASSEMBLY - TANDEM DIAPHRAGM

GENERAL DESCRIPTION

This booster is a tandem vacuum suspended unit. It may have a single or dual function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a tandem vacuum suspended booster operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm to provide the power assist.

NOTICE: Use all components included in repair kits used to service this booster. Lubricate rubber parts, where indicated, with silicone grease provided in kits. The torque values specified are for dry, unlubricated fasteners. If any hydraulic component is removed or brake line disconnected, bleed the brake system.



1. Boot
2. Silencer
3. Vacuum check valve
4. Grommet
5. Vacuum switch (some models)
6. Grommet
7. Front housing seal
8. Primary piston bearing
9. Rear housing
10. Front housing
11. Return spring
12. Piston rod (gaged)
13. Reaction retainer
14. Power head silencer
15. Diaphragm retainer
16. Primary diaphragm
17. Primary support plate
18. Secondary piston bearing
19. Housing divider
20. Secondary diaphragm
21. Secondary support plate
22. Reaction disc
23. Reaction piston
24. Reaction body retainer
25. Reaction body
26. Air valve spring
27. Reaction bumper
28. Retaining ring
29. Filter
30. Retainer
31. O-ring
32. Air valve push rod assembly
33. Power piston

1. REMOVE AND INSTALL BOOSTER.

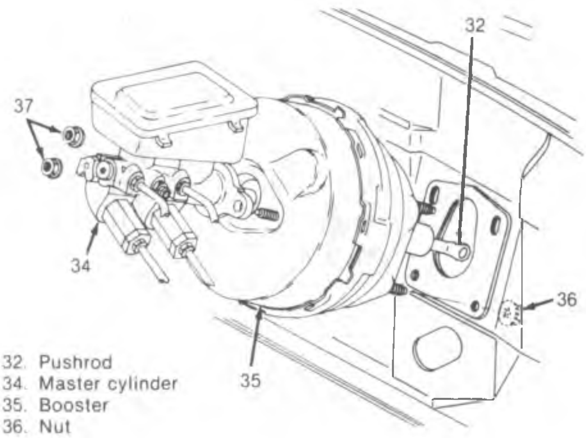
REMOVE

1. Disconnect master cylinder (34) from booster (35) and disconnect booster pushrod (32) from brake pedal.
2. Remove attaching nuts (36) and remove boster as shown.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

1. Install booster (35) to cowl as shown. Torque attaching nuts (36) to 30-45 N·m (22-33 ft-lb).
2. Connect booster pushrod (32).
3. Install master cylinder (34) on booster (35) and torque attaching nuts (37) to 30-45 N·m (22-33 ft-lb).



32. Pushrod
34. Master cylinder
35. Booster
36. Nut
37. Nut

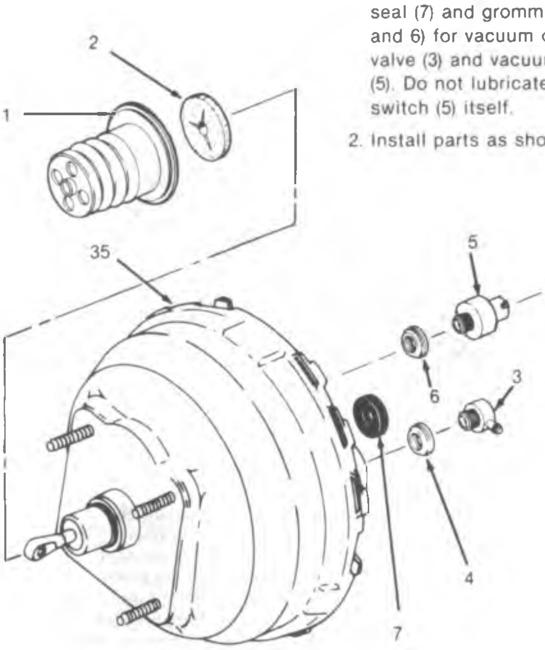
2. REMOVE AND INSTALL EXTERIOR COMPONENTS.

REMOVE

1. Remove parts as shown.

INSTALL

1. Lubricate inside and outside diameters of front housing seal (7) and grommets (4 and 6) for vacuum check valve (3) and vacuum switch (5). Do not lubricate vacuum switch (5) itself.
2. Install parts as shown.



1. Boot
2. Silencer
3. Vacuum check valve
4. Grommet
5. Vacuum switch (some models)
6. Grommet
7. Fronthousing seal
35. Booster

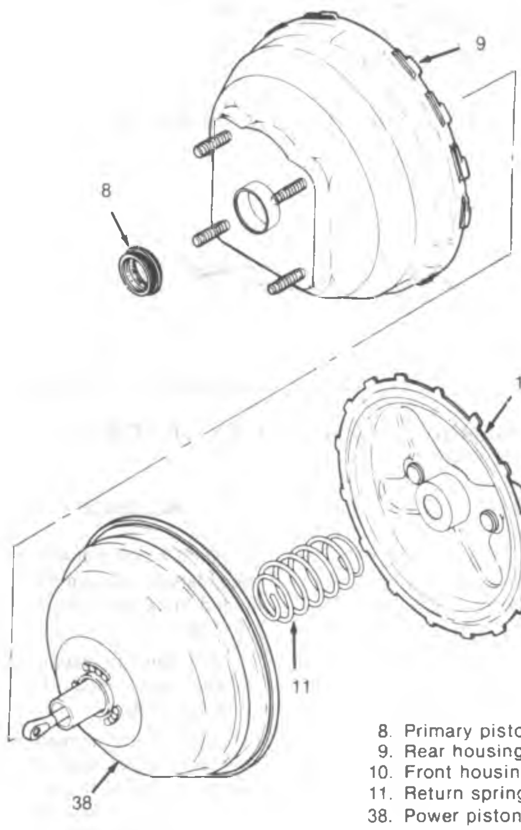
3. UNLOCKING AND LOCKING BOOSTER

DISASSEMBLE

1. Scribe a mark on front and rear housings (9 and 10) to facilitate assembly.
2. Press down on tool J-9504 (40) and turn counterclockwise to unlock housing as shown in A.
3. Disassemble booster as shown.

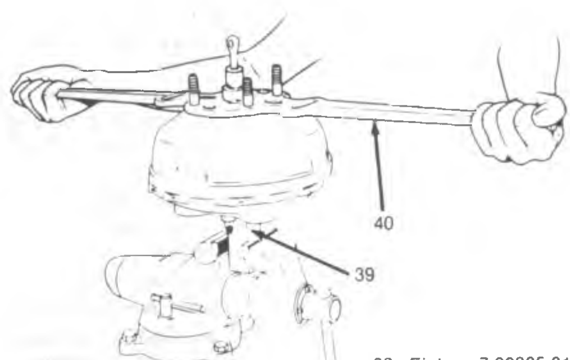
ASSEMBLE

1. Assemble parts as shown.
2. Align scribe marks on housings (9 and 10).
3. Press down on tool J-9504 (40) and turn clockwise to lock front and rear housings (9 and 10) as shown in A. Assembly can be facilitated by connecting a vacuum source to the booster.
4. Stake housing as shown in B after locking. Do not stake a tab that has been previously staked.



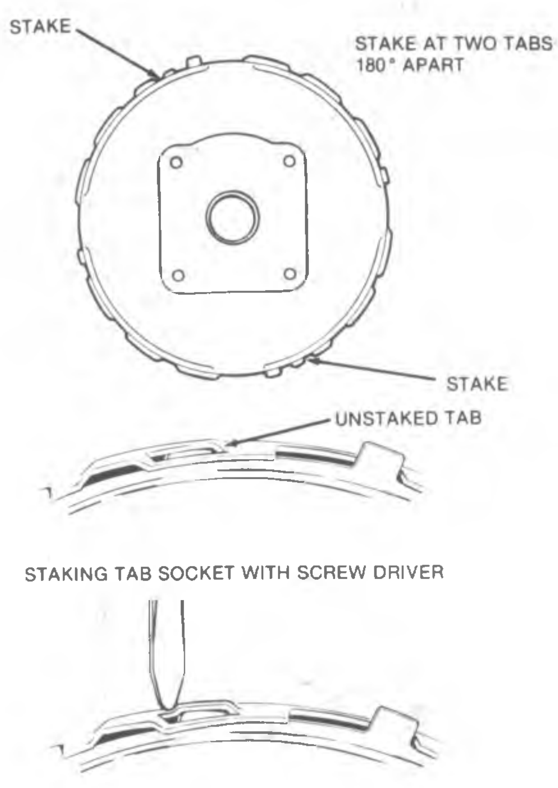
8. Primary piston bearing
9. Rear housing
10. Front housing
11. Return spring
38. Power piston group

A



39. Fixture 7-22805-01
40. Tool J-9504

B



4. DISASSEMBLY AND ASSEMBLY OF POWER PISTON GROUP.

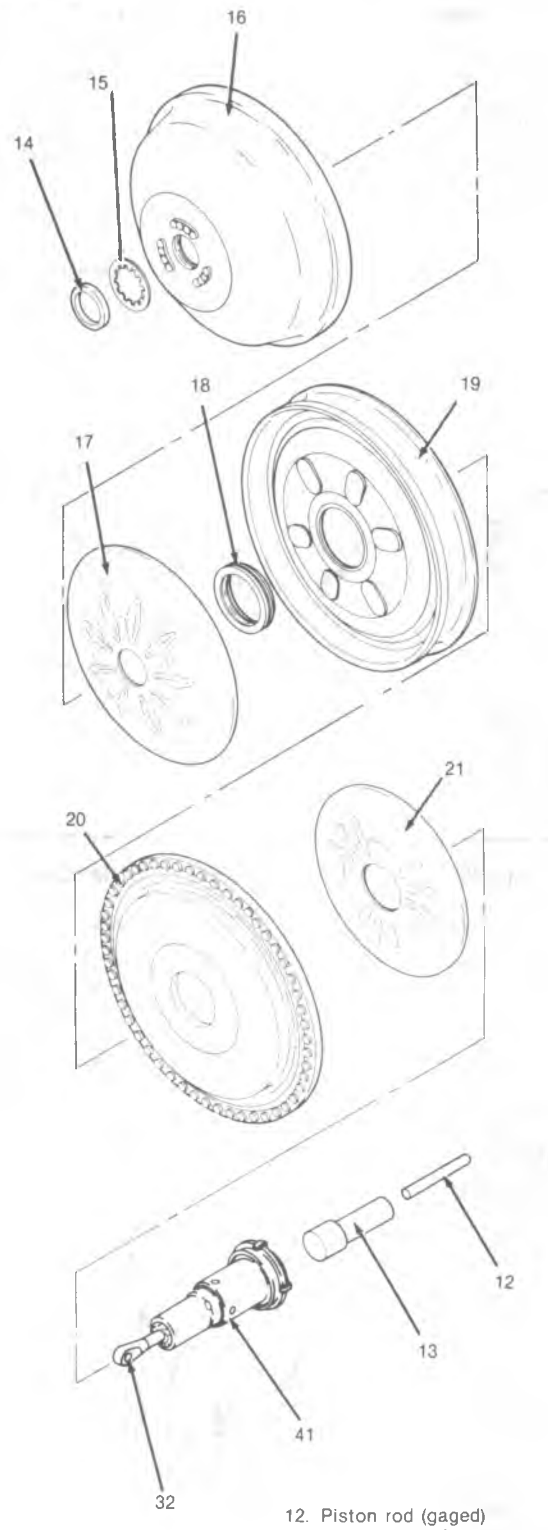
DISASSEMBLE

1. Remove piston rod (12), reaction retainer (13), and power head silencer (14).
2. Grasp assembly at outside edge of divider (19) and diaphragms (16 and 20). Hold with pushrod (32) down against a hard surface. Use a slight force or impact to dislodge diaphragm retainer (15).
3. Remove parts as shown.

ASSEMBLE

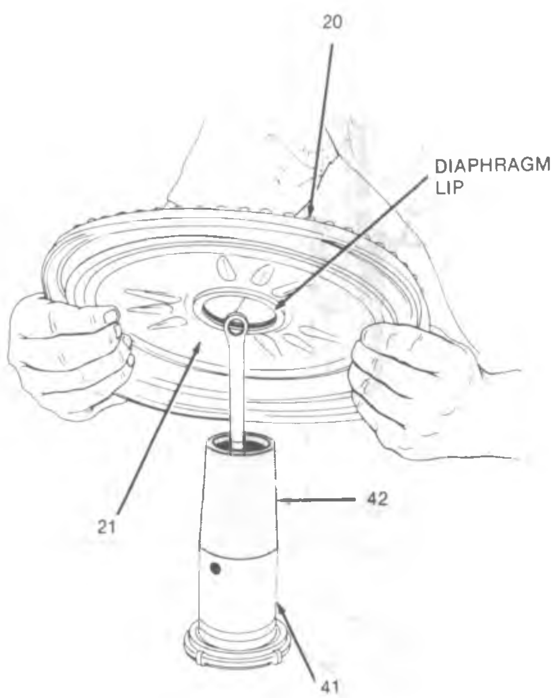
1. Lubricate inside diameter of secondary diaphragm (20) lip and fit in secondary support plate (21).
2. Install secondary diaphragm (20) and support plate (21) as shown in A.
3. Lubricate inside diameter of secondary piston bearing (18) and install in housing divider (19) as shown, flat surface of bearing on same side as 6 raised lugs on divider.
4. Install secondary piston bearing (18) and divider (19) as shown in B.
5. Lubricate inside diameter of primary diaphragm (16) lip and fit in primary support plate (17).
6. Install primary diaphragm (16) and support plate (17) as shown in C.
7. Install diaphragm retainer (15) and seat as shown in D.
8. Install silencer (14), reaction retainer (13) and piston rod (12).

4. (CONT)



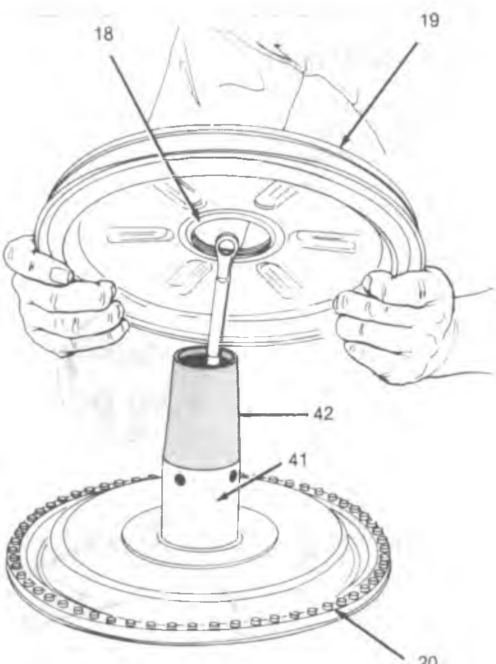
12. Piston rod (gaged)
13. Reaction retainer
14. Power head silencer
15. Diaphragm retainer
16. Primary diaphragm
17. Primary support plate
18. Secondary piston bearing
19. Housing divider
20. Secondary diaphragm
21. Secondary support plate
32. Pushrod
41. Power piston assembly

A



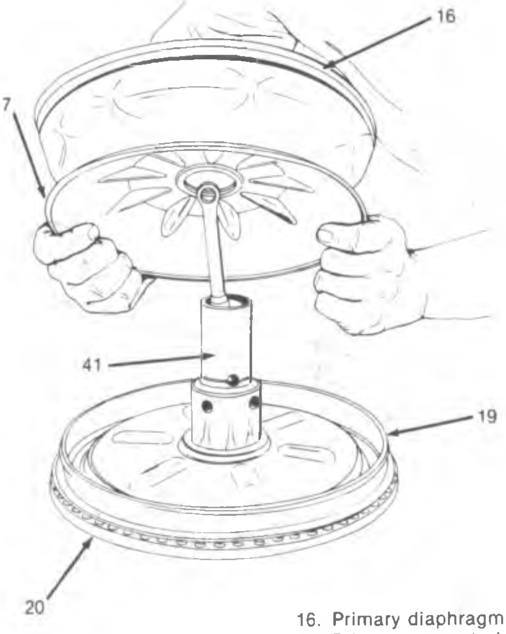
20. Secondary diaphragm
21. Secondary support plate
41. Power piston assembly
42. Tool J-28458

B



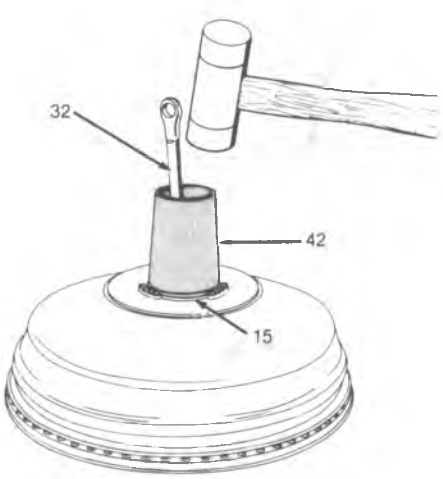
18. Secondary piston bearing
19. Housing divider
20. Secondary diaphragm
41. Power piston assembly
42. Tool J-28458

C



16. Primary diaphragm
17. Primary support plate
19. Housing divider
20. Secondary diaphragm
41. Power piston assembly

D



15. Diaphragm retainer
32. Pushrod
42. Tool J-28458

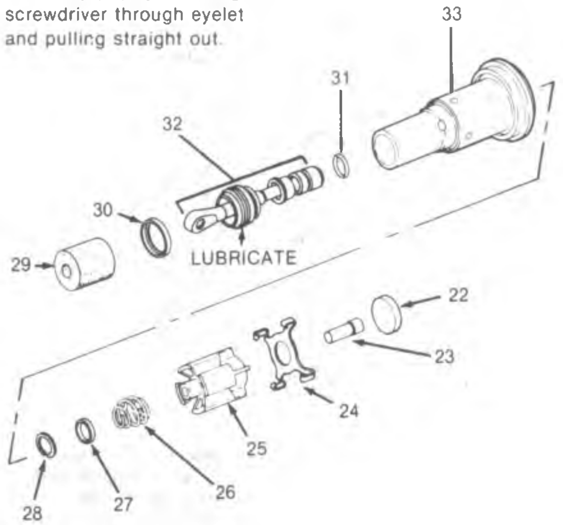
5. DISASSEMBLE AND ASSEMBLE POWER PISTON.

DISASSEMBLE

1. Disassemble as shown.
2. Pry tangs with a screwdriver to remove reaction body retainer (24).
3. Use No. 2 Truarc pliers to remove retaining ring (28) from air valve pushrod assembly (32).
4. Remove air valve pushrod assembly (32) by inserting screwdriver through eyelet and pulling straight out.

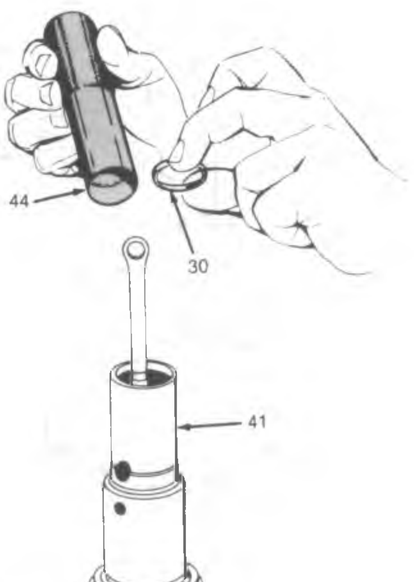
ASSEMBLE

1. Assemble as shown.
2. Install retainer (30) as shown in A and B.



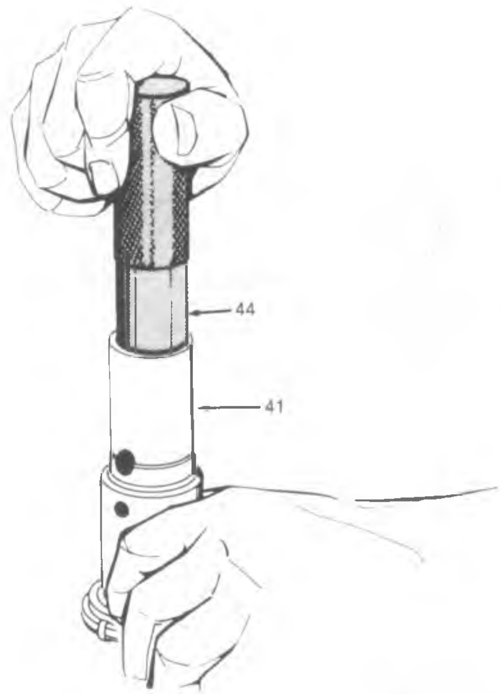
22. Reaction disc
23. Reaction piston
24. Reaction body retainer
25. Reaction body
26. Air valve spring
27. Reaction bumper
28. Retaining ring
29. Filter
30. Retainer
31. O-ring
32. Air valve push rod assembly
33. Power piston

A.



30. Retainer
41. Power piston assembly
44. Tool J-23175-A

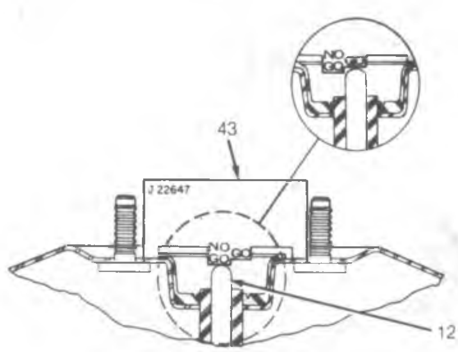
B.



41. Power piston assembly
44. Tool J-23175-A

6. GAGING PROCEDURE

1. After assembly of booster, position gage (43) over piston rod (12) as shown.
2. If piston rod height is not within GO-NO-GO limits of gage, procure and use a service-adjustable piston rod to obtain correct height.



12. Piston rod
43. Gage J-22647

Part	Inspect For	Corrective Action
Power Piston and Support Plate and Reaction Retainer	1. Cracks, distortion, chipping, damaged lever seats, pitted or rough holes.	1. Clean up or replace.
	2. Worn seal surfaces (tubes).	2. Replace
	3. Rough or uneven floating valve seat.	3. Replace
	4. Open passages and flow holes.	4. Clean
Reaction Levers or Plates	1. Cracks, distortion, tears and heavy wear.	1. Replace
Floating Control Valve	1. Deterioration of rubber or warped valve face.	1. Replace
Air Valve - Push Rod Assembly	1. Air valve: scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair - Replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve - push rod assembly.
Front and Rear Housings	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing of diaphragm or other seals.	1. Replace, unless easily repaired
	2. Cracks, damage at ears, damaged threads on studs.	2. Replace, unless easily repaired
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired
	4. Loose studs.	4. Replace or repair.
Air Filters	1. Dirty	1. Replace

Fig. 5-22--Inspection Chart

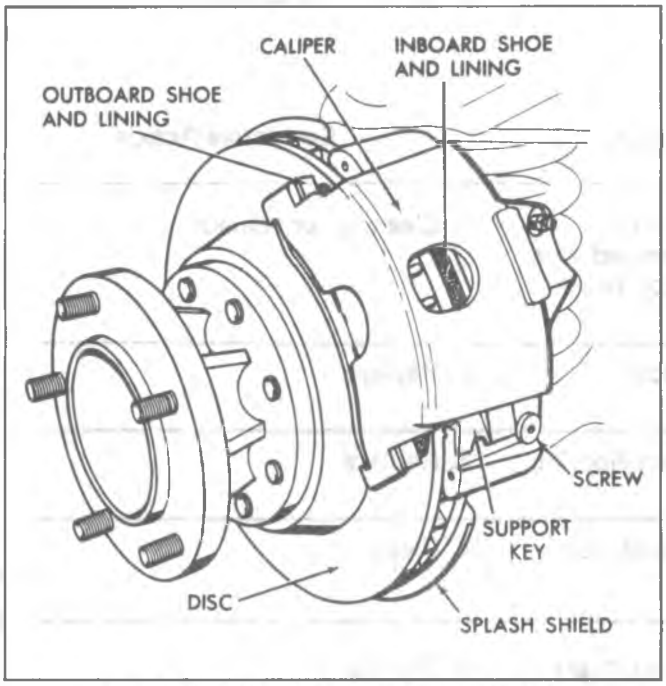


Fig. 5-23--Bendix Front Disc Brake Assembly

BENDIX DISC BRAKE SHOE AND LINING

The brake linings should be inspected any time the wheels are removed. Check both ends of the outboard shoe by looking in at each end of the caliper (Fig. 5-23). This is the point at which the highest rate of wear normally occurs. At the same time, check the lining thickness on the inboard shoe by looking down through the inspection hole in the top of the caliper; see "Brake Inspection" portion of this section. The inboard shoe is installed with the ends of the shoe resting in the steering knuckle. The large tab at the bottom of the outboard shoe is bent over at the right angle and fits in the cutout in the outboard section of the caliper.

Removal (Front or Rear)

NOTICE: See "Notice" on Page 1 of this section.

1. Remove master cylinder cover and observe brake fluid level in front reservoir is more than 1/3 full, siphon the

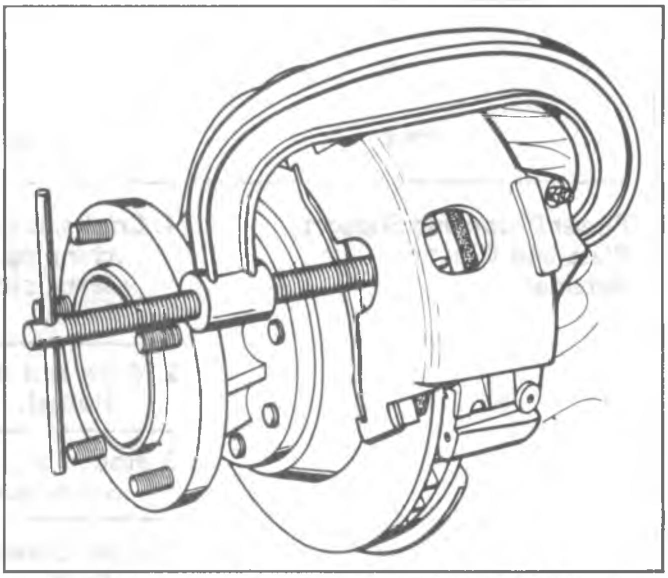


Fig. 5-25--Pushing Piston into Bore Using a "C" Clamp

necessary amount out to bring the level to 1/3 full. This step is taken to avoid reservoir overflow when the caliper piston is pushed back into its bore. Discard the brake fluid removed. Never reuse brake fluid.

2. Raise the vehicle on a hoist and remove wheels.
3. Push the piston back into tis bore. This can be accomplished by using a "C" clamp as shown in Figure 5-25.
4. Remove the bolt at the caliper support key. Using a brass punch, remove the key and spring (Fig. 5-26).
5. Lift the caliper off the disc and support in a raised position with a heavy wire (Fig. 5-27).

NOTICE: Do not support the weight of the caliper on the brake hose as damage to the brake hose could result.

6. Remove the inboard shoe from the steering knuckle or rear caliper support (Fig. 5-24). Remove and discard the inboard shoe clip. Remove the outboard shoe from the caliper. It may be necessary to tap the shoe to loosen it in the caliper housing. Mark disc pad positions if pads are to be reinstalled.

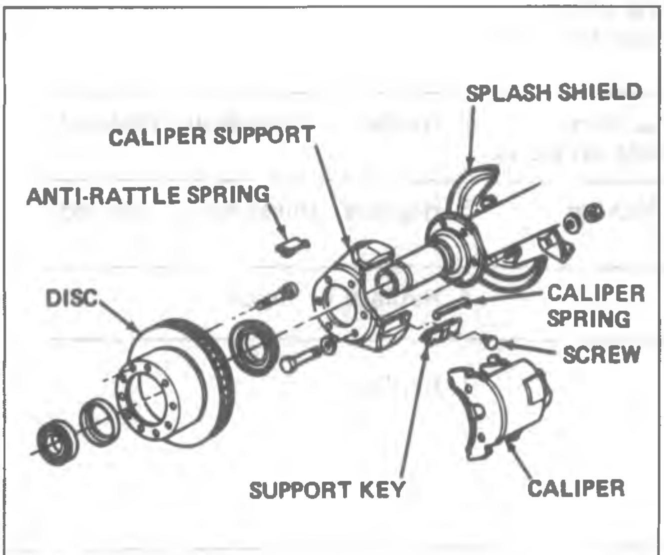


Fig. 5-24--Bendix Rear Disc Brake Assembly

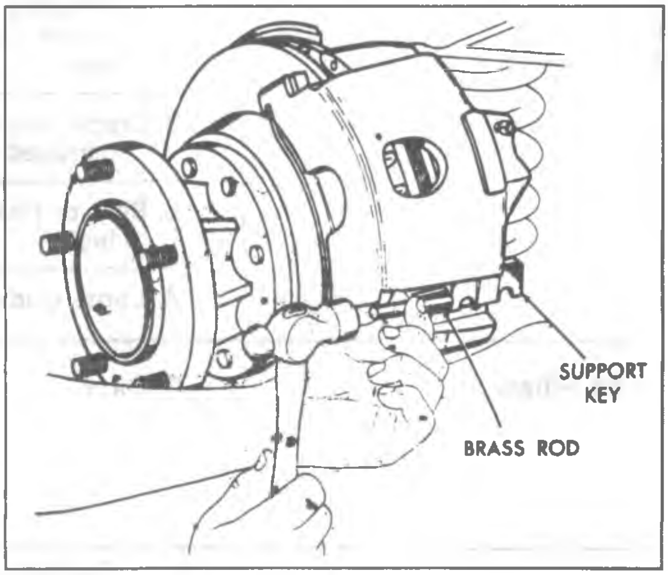


Fig. 5-26--Removing the Caliper Support Key

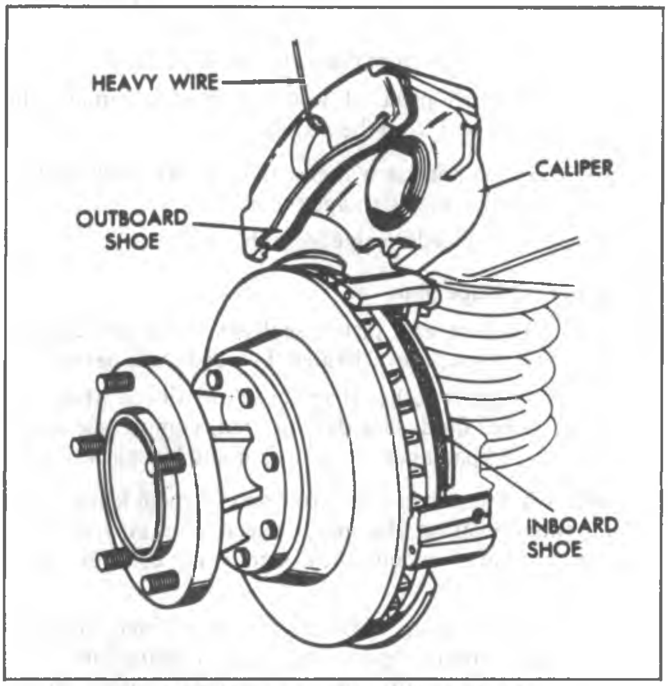


Fig. 5-27--Removing Caliper from the Disc

Cleaning and Inspection

The shoes should be replaced when the lining is worn to approximately 1/32" (0.80 mm) thickness over the rivet heads. Replace shoes in axle sets.

1. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled.
2. Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage.

   NOTICE: Do not use compressed air to clean the inside of the caliper since this may cause the dust boot to become unseated.
3. Use a wire brush to remove any rust or corrosion from the machined surfaces of the steering knuckle (or support) and caliper. It is important to clean those areas of the caliper and support that are in contact during the sliding action of the caliper.

Installation

If original disc pads are being reinstalled, they must be installed in original positions (as marked at removal).

1. Lubricate the caliper and steering knuckle (or support) sliding surfaces and the support spring with Delco Silicone Lube (or equivalent).
2. Install a NEW inboard shoe clip the steering knuckle or rear support. Be sure the tabs are positioned correctly and the loop-type spring positioned away from the rotor. Install the lower end of the inboard shoe into the groove provided in the steering knuckle or support (against the spring clip). Slide the upper end of the shoe into position. Be sure the clip remains in position.
3. Position the outboard shoe in the caliper with the ears at the top of the shoe over the caliper ears and the tab at the bottom of the shoe engaged in the caliper cutout. If assembly is difficult, a "C" clamp may be used. Be careful not to mar the lining.
4. With both shoes installed, lift up the caliper and rest the bottom edge of the outboard lining on the outer edge of the brake disc to make sure there is no clearance between the tab at the bottom of the outboard shoe and the caliper abutment. The outboard shoe should fit tightly in the caliper and should not rattle.
5. Position the caliper over the brake disc, guiding the upper caliper groove onto the mating surface of the steering knuckel or caliper support. Position the caliper to the lower steering knuckle (or support) sliding surface.

   NOTICE: Make sure that he brake hose is not twisted or kinked since damage to the brake hose could result.
6. Place the spring over the caliper support key, install the assembly between the steering knuckle (or rear support) and lower caliper groove. Tap into place (until the key retaining screw can be installed) using a brass punch and a light hammer (Fig. 5-28).
7. Install the screw and torque o 12 to 18 lb. ft. (18-24 N·m). The bolt boss must fit fully into the circular cutout in the key.

   NOTICE: See "Notice" on Page 1 of this section.
8. Reinstall the front wheel and tire assembly.
9. Add brake fluid to the master cylinder reservoir to bring the fluid level up to within 1/4" (6 mm) of the top.

   NOTICE: Before moving the vehicle, pump the brake pedal several times to make sure that it is firm. Do not move vehicle until a firm pedal is obtained. Check master cylinder fluid level again after pumping the brake pedal.

CALIPER OVERHAUL

Bendix

Removal

Clean dirt from hose to caliper connection before proceeding with removal.

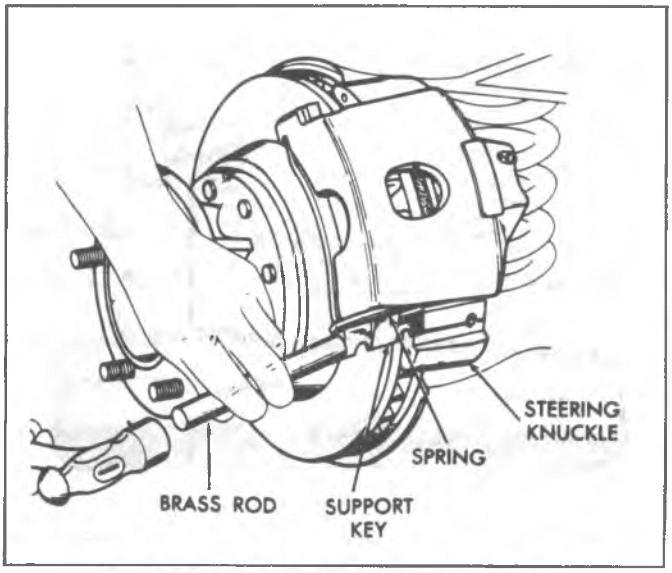


Fig. 5-28--Installing the Caliper Support Key

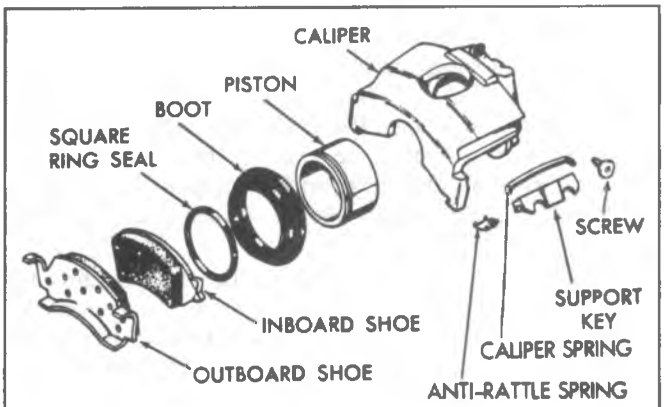


Fig. 5-29--Bendix Brake Caliper Assembly

1. Remove the hose to caliper bolt and cap or tape the open connections to prevent dirt from entering the hose or caliper. Discard the copper gaskets.
2. Remove the caliper assembly as described under "Shoe and Lining-Removal".

Disassembly (Fig. 5-29)

1. Clean the exterior of the caliper using clean brake fluid and place on a clean work surface.
2. Drain the brake fluid from the caliper.

   CAUTION: Do not place the fingers in front of the piston in an attempt to catch or protect it when applying compressed air..
3. Using clean shop cloths, pad the interior of the caliper and remove the piston by directing compressed air into the caliper inlet hole (Fig. 5-30).

   NOTICE: Use just enough air pressure to ease the piston out of the bore. Do not blow piston out of the bore as damage to the piston could result. If the piston is seized or cocked or does not come out readily, release the air pressure and use a soft (brass) hammer to rap sharply on and around the end of the piston. Reapply air pressure to remove the piston.

   NOTICE: An alternate method of removing the piston is to stroke the brake pedal (gently) while the hydraulic lines are still connected. This will push the piston out of the caliper bore.
4. Remove the boot from the piston bore.
5. Using a small piece of wood or plastic, remove the square ring seal from the piston bore.

   NOTICE: Do not use a metal tool of any kind for this operation as it may damage the bore.
6. Remove the bleeder valve from the caliper.

Cleaning and Inspection

The dust boot and piston seal are to be be replaced whenever the caliper is overhauled. Discard these parts.

1. Clean all parts (other than those mentioned above) in clean brake fluid. Use dry, filtered, compressor air to blow out all passages in the caliper and bleeder valve.

   NOTICE: The use of lubricated shop air will leave a film of mineral oil on the metal parts. This may damage rubber parts when they come in contact after reassembly.
2. Check the sliding surfaces of the caliper, steering knuckle (or rear support) and support spring for rust or corrosion. Clean up any surface defects with crocus cloth.
3. Carefully examine the outside surface of the piston for scoring, nicks, corrosion and worn or damaged plating. If any surface defects are detected, replace the piston.

   NOTICE: The piston outside diameter is the primary sealing surface in the caliper assembly. It is manufactured and plated to close tolerances. Refinishing by any means or the use of any abrasive is not acceptable practice.
4. Check the bore in the caliper for the same defects as the piston. The piston bore, however, is not plated and stains or minor corrosion can be polished with croucus cloth.

   Do not use emery cloth or any other form of abrasive. Thoroughly clean the caliper after the use of crocus cloth. If the bore cannot be cleaned up in this manner, replace the caliper.

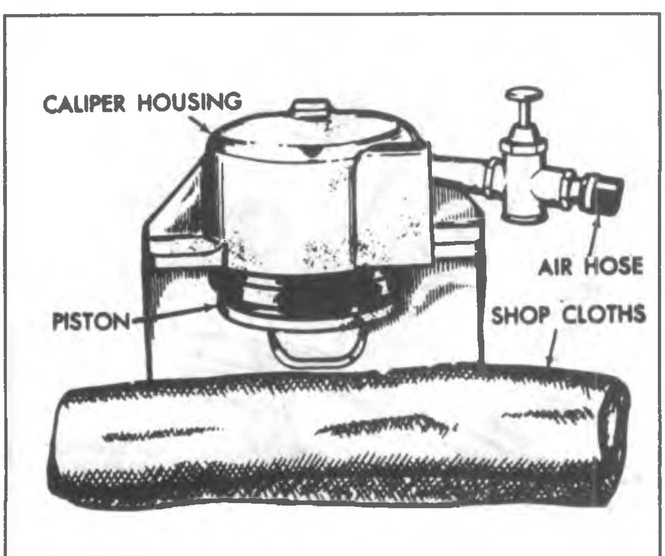


Fig. 5-30--Removing the Caliper Piston

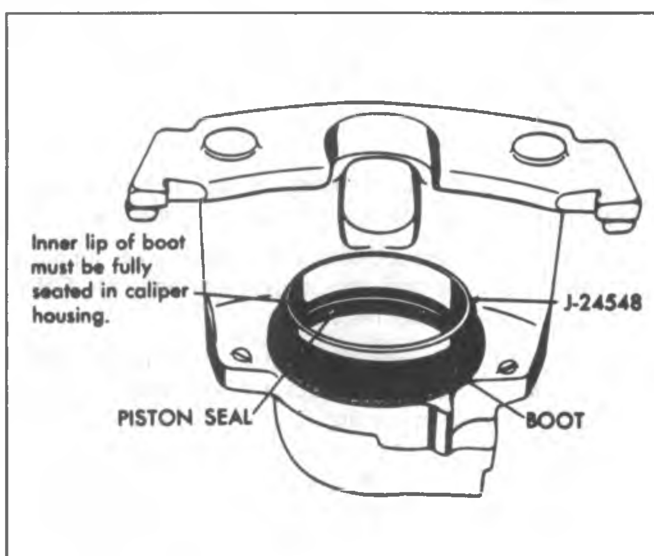


Fig. 5-31--Installing Caliper Piston Boot

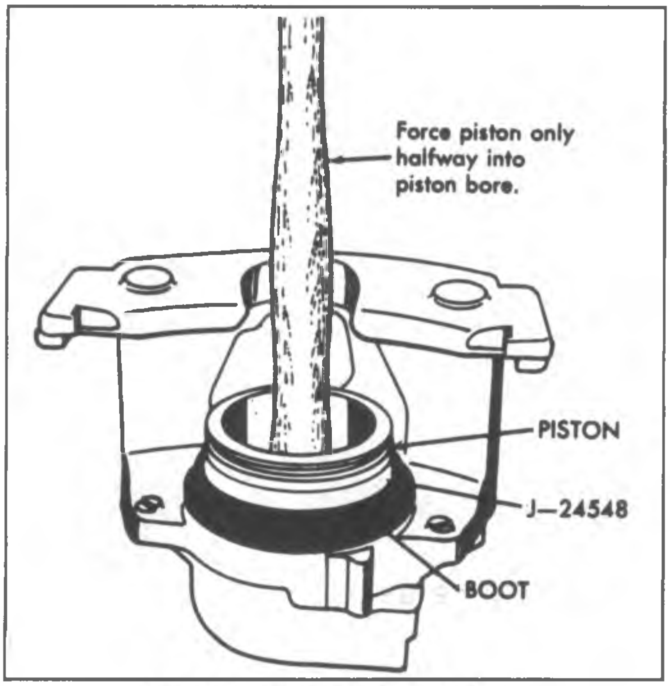


Fig. 5-32--Installing Piston in Caliper

Assembly

1. Lubricate the caliper piston bore and the NEW piston seal with the clean brake fluid. Position the square ring seal in the caliper bore groove.
2. Lubricate both sealing lips of the dust boot and the piston with a light film of clean brake fluid. Place the new boot over Piston Installer Tool J-24548. This is most easily accomplished by placing the boot large diameter over the tool first, then riding the smaller diameter onto the tool. The large diameter lip must then be slid off the tool to make ready for installation into the bore groove. Install the boot (large bead) into the piston bore groove by reaching inside of Tool J-24548 and pressing the boot bead into the groove (Fig. 5-31).

   Be sure boot is fully seated in the groove before proceeding.
3. Place the piston inside of Tool J-24548, force the piston halfway into the piston bore using a wood hammer handle or "C" clamp (Fig. 5-32); remove Tool J-24548. Check to be sure the boot was not unseated at piston installation. Make sure the outer bead of the boot is seated in the piston outer groove.

Installation

Installation of the caliper and mounting parts is the same for: "Shoe and Lining-Disc Brake" except for steps given below:

1. Connect the brake hose to the caliper using NEW copper gaskets.

   NOTICE: Hose must be properly positioned to prevent hose, twist or misalignment or hose damage may result.
2. Bleed the caliper assemblies as outlined earlier in this section.

Bendix Mini-Master Cylinder

Removal

1. Disconnect brake pipes from master cylinder and tape end of pipes to prevent entrance of dirt.
2. Manual brake only -- Disconnect brake pedal from master cylinder push rod.
3. Remove two nuts holding master cylinder to dash or power cylinder and remove master cylinder from vehicle. Be careful not to drip brake fluid on exterior paint.

Disassembly

1. Remove the reservoir cover and diaphragm, and drain the fluid from the reservoir.
2. Remove the four bolts that secure the body to the reservoir using Socket J-25085.
3. Remove the small "O" ring and the two compensating valve seals from the recessed areas on the bottom side of the reservoir.

   Do not remove the two small filters from the insde of the reservoir unless they are damaged and are to be replaced.
4. Depress the primary piston using a tool with a smooth rounded end. Then remove the compensating valve poppets and the compensating valve springs from the compensating valve ports in the master cylinder body.
5. Using a small screwdriver, remove the snap ring at the end of the master cylinder bore. Then release the piston and remove the primary and secondary piston assemblies from the cylinder bore. It may be necessary to plug the front outlet portand to apply low air pressure to the front compensating valve port to remove the secondary piston assembly.

Inspection

Inspect cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder. Corrosion clan be identifed as pits or excessive roughness.

Polish any discolored or stained area with c rocus cloth by revolving cylinder on cloth supported by finger.

Rinse cylinder in clean brake fluid. Shake excess rinsing fluid from cylinder. Do not use a rag to dry cylinder, as lint from rag cannot be kep from cylinder bore surfaces.

Make certain that compensating port in cylinder is clear.

If scratches or corroded spots are too deep to be polished satisfactorily, the cylinder should be replaced.

Assembly

1. Lubricate the secondary piston assembly and the master cylinder bore with clean brake fluid.
2. Assemble the secondary spring (shorter of the two springs) in the open end of the secondary piston actuator, and assemble the piston return spring (longer spring) on the projection at the rear of the secondary piston.
3. Insert the secondary piston assembly, actuator end first, into the master cylinder press assembly to the bottom of the bore.
4. Lubricate the primary piston assembly with clean

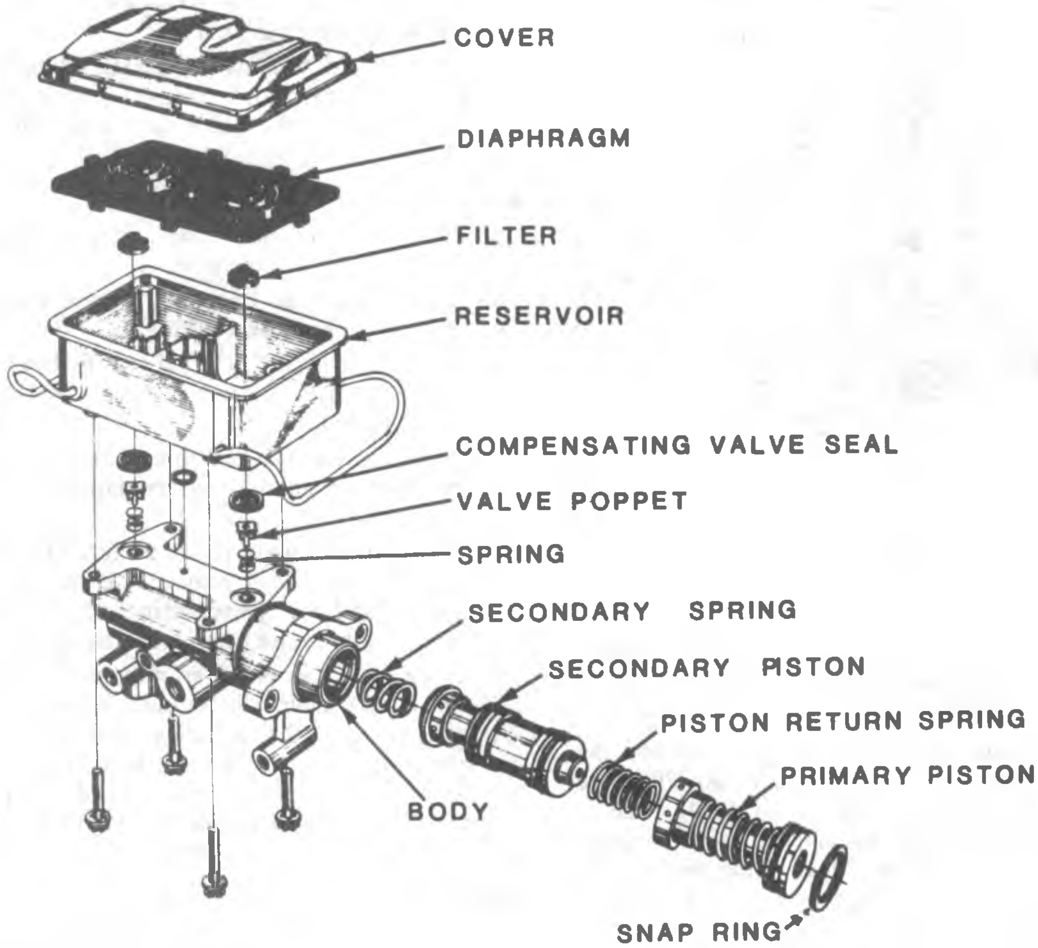


Fig. 5-33--Bendix Mini-Master Cylinder-Exploded View

brake fluid. Insert the primary piston assembly, actuator end first, into the bore.

5. Place the snap ring over a smooth round ended tool and depress the pistons in the bore.
6. Assemble the retaining ring in the groove in the cylinder bore.
7. Assemble the compensating valve seals and the small "O" ring seal in the recesses on the bottom of the reservoir. Be sure that all seals are fully seated.
8. While holding the pistons depressed, assemble the compensating valve springs and the compensating valve poppets in the compensating valve ports.
9. Holding the pistons compressed, position the reservoir on the master cylinder body and secure with the four mounting bolts. Tighten the bolts to 12-15 lb. ft. (16-20 N·m).

Installation

NOTICE: Refer to "Notice" on Page 1 of this section regarding fasteners referred to in Steps 1 and 2 below.

1. Manual brake only -- Connect push rod to brake pedal pin and install retainer while holding master cylinder in place.
2. Install master cylinder on dash or power cylinder; torque nuts to specifications.
3. Connect brake pipes to master cylinder.
4. Bleed hydraulic system.
5. Road test vehicle for proper brake performance.

BENDIX HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST)

CAUTION: The accumulator contains compressed gas. Always use proper tools and follow recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumlator, always replace with a new accumulator. Dispose of an inoperative accumulator by drilling a 1/16" diameter hole through the end of the accumulator

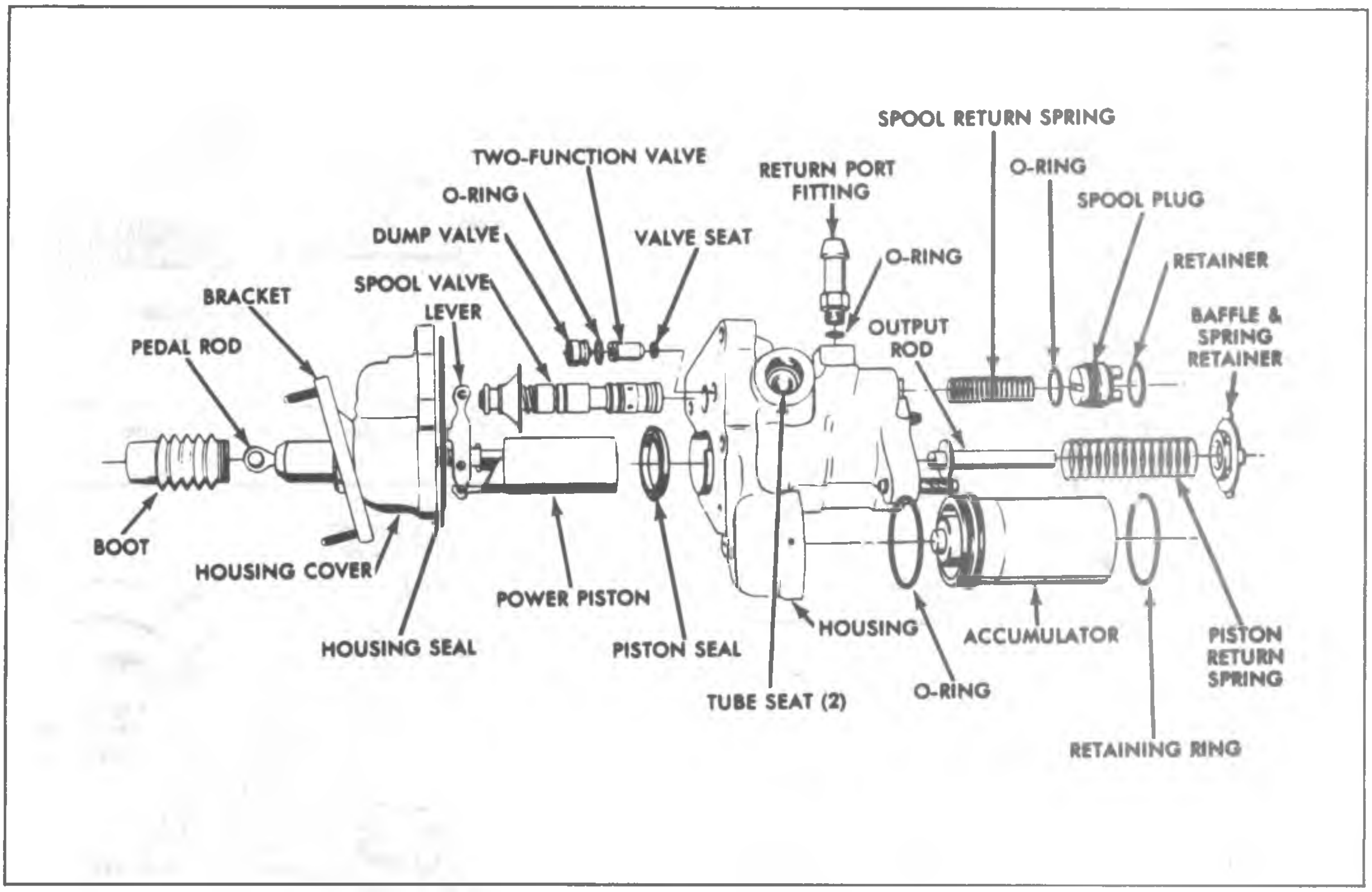


Fig. 5-B1--Bendix Hydro-Boost Explode-Typical

can opposite the "O" ring.

The Bendix Hydraulic Brake Booster utilizes the hydraulic pressure supplied by the poer steering pump to provide power assist for brake applications. The dual master cylinder is mounted to the output push rod end of the booster.

The procedures below include remonal of the mounting bracket even though it is not necessary to remove the bracket for overhaul of the internal assembly.

Disassembly (Fig. 5-B1)

1. Secure the booster in a vise (bracket end up) and use a hammer and chisel to cut the bracket nut that secures the mounting brakcet to the power section (cut the nut at the open slot in the threaded portion of the housing). Be careful to avoid damage to the threads on the booster hub. Spread the nut and remove it from the power section. Then remove the mounting bracket.
2. Remove the pedal rod boot (if equipped) by pulling it off over the pedal rod eyelet.
3. Place Tool J-24569 around the pedal rod and resting on the input rod end as shown as in Figure 5-B2.
4. Place a punch (or similar tool) through the pedal rod from the lower side of Tool J-24569. Push the punch on through to rest on the higher side of the tool. Lift up on the punch to shear the pedal rod retainer; remove the pedal rod.
5. Remove the remnants of the rubber grommet from the groove near the end of the pedal rod and from the groove inside the input rod end.
6. With a small screwdriver, pry the plastic guide out of the output push rod retainer. Disengage the tabs of the spring retainer from the ledge inside the opening near the master cylinder mounting flange of the booster. Remove the retainer, the piston return spring and output rod from the opening (Fig. 5-B3).
7. Place the booster cover in a vise equipped with soft jawed devices. Remove the five screws that secure the booster housing to the cover.
8. Remove the booster assembly from the vise and while holding the unit over a pan, separate the cover from the housing. Remove the "figure eight" seal from the housing cover; discard the seal.
9. Remove the input rod and piston assembly, the spool assembly and spool spring from the booster houising. Compare spool valve condition to Figure 5-B4. If spool valve is defective, the complete unit must be replaced.
10. Inspect power piston. If scratches big enough to be felt with a fingernail are present, the input rod and piston must be replaced.
11. Remove the input rod seals from the input rod end, and the piston seal from the piston bore in the housing; discard the seals.
12. Place the accumulator retaining cap Tool J-26889 over the master cylinder stud and install the nut as shown in Figure 5-B6.
13. Using Tool J-22269-01 or a large "C" clamp (6" minimum), depress the accumulator. Insert a punch into the hole in the housing and remove retaining ring with a small screwdriver, (Fig. 5-B6).

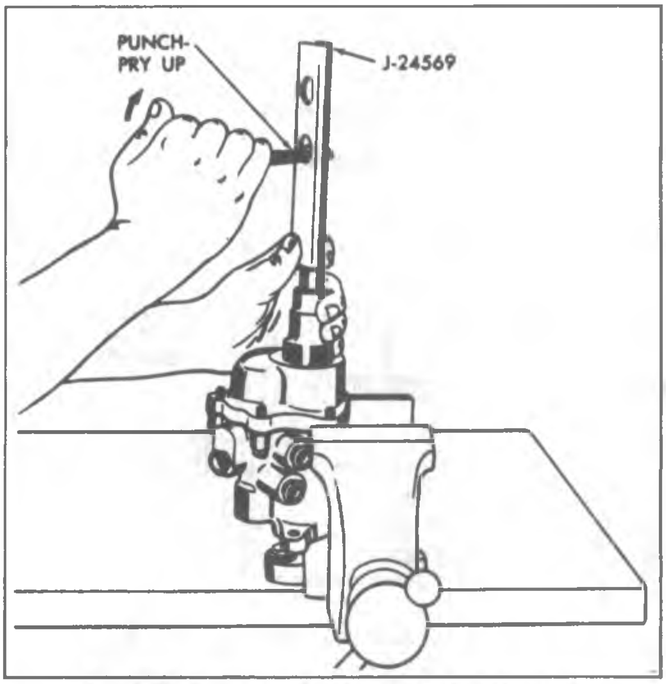


Fig. 5-B2--Removing Booster Pedal Rod (Typical)

14. Slowly back off the clamp until tension on the accumulator is released; remove accumulator and "O" ring.
15. If accumulator valve was determined to be faulty, remove valve using a small diameter wire tool (Fig. 5-B5). Remove the dump valve by catching the tool under the pin guide near the center of the valve, then remove two function valves and seat (Fig. 5-B8).
16. Return hose fitting "O" ring can be removed if leaking.
17. Push spool valve plug in and use a small screwdriver to remove retaining ring (Fig. 5-B9).
18. Remove spool valve plug and "O" ring.
19. Remove the tube seats using No. 4 easy-out as shown in Figure 5-B10.

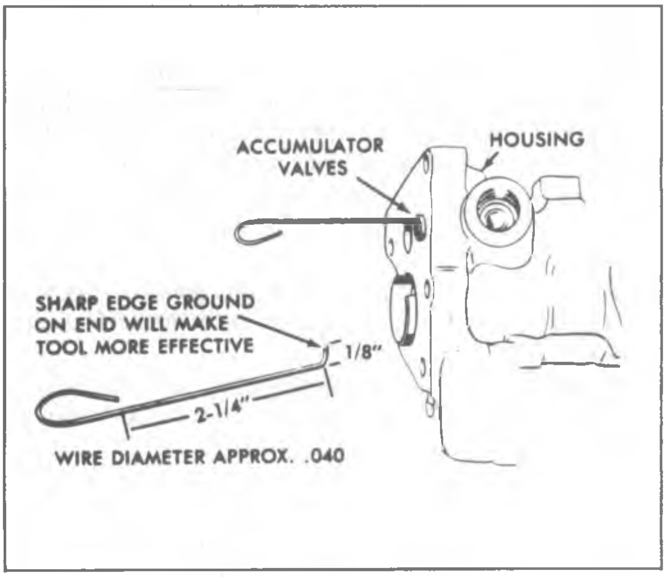


Fig. 5-B5--Removing Accumulator Valves

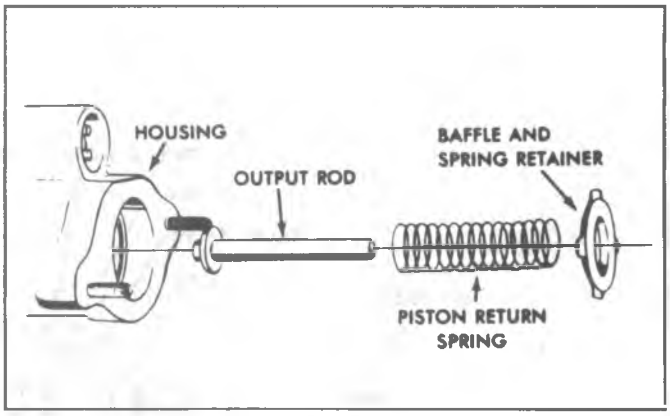


Fig. 5-B3--Output Rod, Spring and Retainer

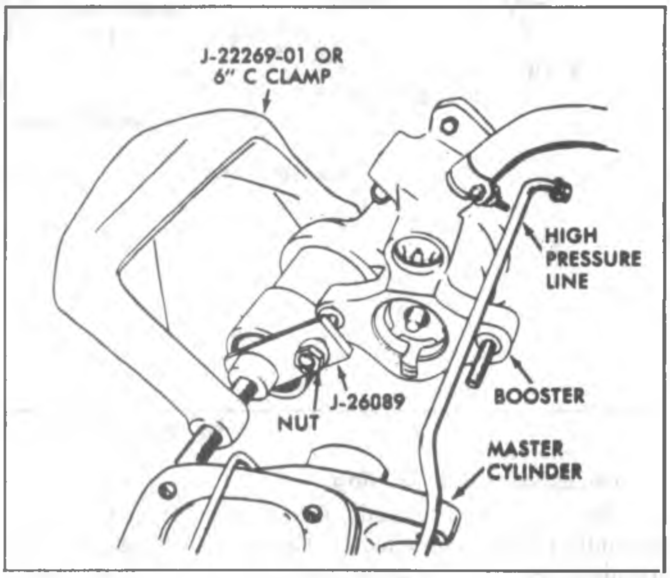


Fig. 5-B6--Compressing Accumulator With J-26889

Cleaning and Inspection

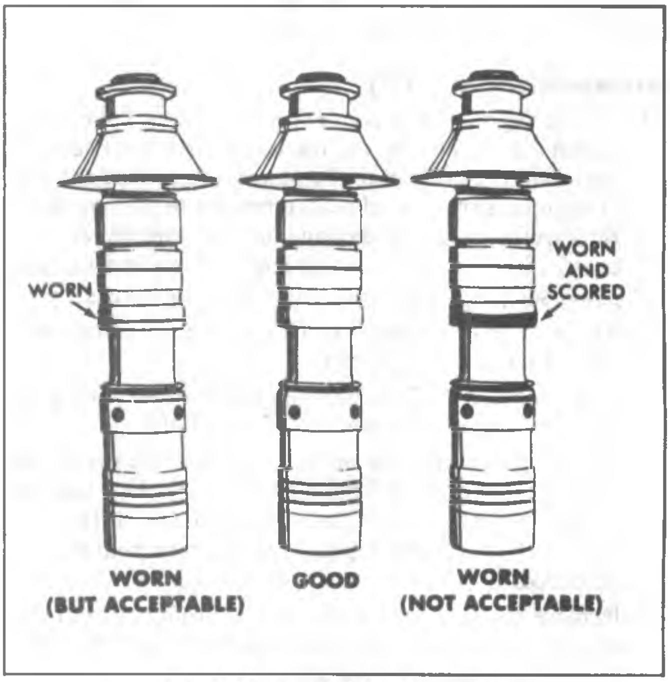


Fig. 5-B4--Spool Valve Inspection

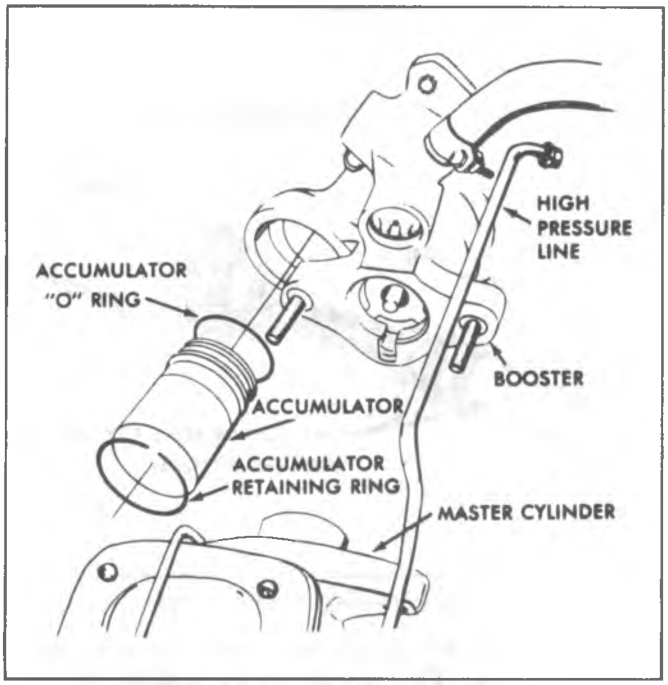


Fig. 5-B7--Accumulator Installation

NOTICE: Be sure to keep parts clean until reassembly. Wash at reassembly if there are any parts dropped or left exposed for eight hours or longer. Lubricate all seals and metal friction points with power steering fluid. Whenever the booster is disassembled and all disturbed seals and damaged tube inserts should be replaced. All of these parts are included in a kit. If any of the accumulator valve components are damaged or lost, replace all the valve components.

1. Clean all metal parts in a suitable solvent. Be careful to avoid losing small parts.
2. Inspect the valve spool and the valve spool bore in the housing for corrosion, nicks, scoring or other damage. Discoloration of the spool or bore, particularly in the grooves, is not harmful and is no cause for replacement.
3. If the valve spool or the valve spool bore has nicks or scoring that can be felt with a fingernail particularly on the lands, the entire booster should be replaced as an assembly.

   The clearance between the spool valve and the spool valve bore of the housing assembly is important. Because of this, the valve spool valve and the housing assembly make up a selective assembly. The spool valve is selected to match the spool valve bore.
4. Inspect the piston for scratches, nicks, etc. If scratches on the outside diameter can be felt with a fingernail, the input rod and piston must be replaced.

Assembly

1. Install "O" ring and spool valve plug (Fig. 5-B9).
2. Install "O" ring and spool valve plug (Fig. 5-B9).
3. Push spool valve plug in and install retaining ring.
4. Coat the piston bore and the piston seal with clean power steering fluid fluid, and assemble the **NEW** seal in the bore. The lip of the seal must be toward the rear (away from the master cylinder mounting flange). Be sure the seal is fully seated in the housing.
5. Lubricate the input rod end, **NEW** input rod seals and Seal Installer with clean power steering fluid. Slide the seals on the tool with the lip of the cups toward the open end of the tool (Fig. 5-B12).
6. Slide the tool over the input rod end and down to the second groove; then slide the forward seal off the tool and into the groove. Assembly the other seal in the first groove. Be sure that both seals are fully seated. Only one seal is used on JD3 and JD5 applications.
7. The piston counterbore on JF9 applications is of a different diameter than on JB8. Remove the pilot portion of Tool J-24551.
8. Lubricate the piston and Piston Installing Tool with clean power steering fluid. Hold the large end of the tool against the piston (Fig. 5-B13), and slide the tool and piston into the piston bore and

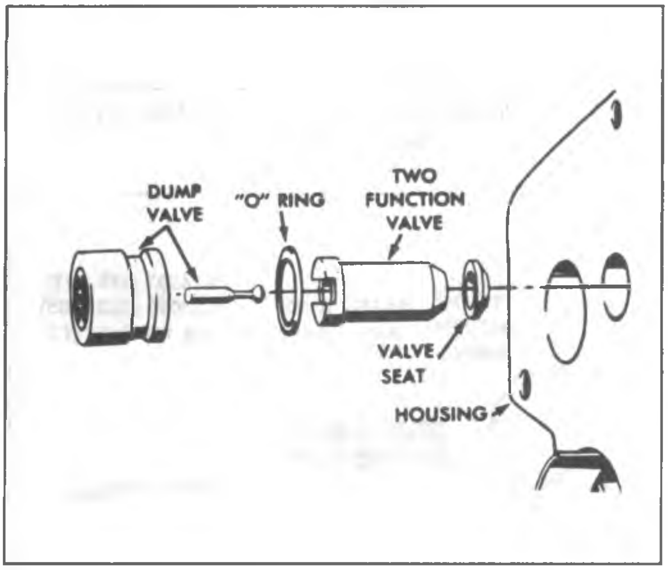


Fig. 5-B8--Accumulator Valves

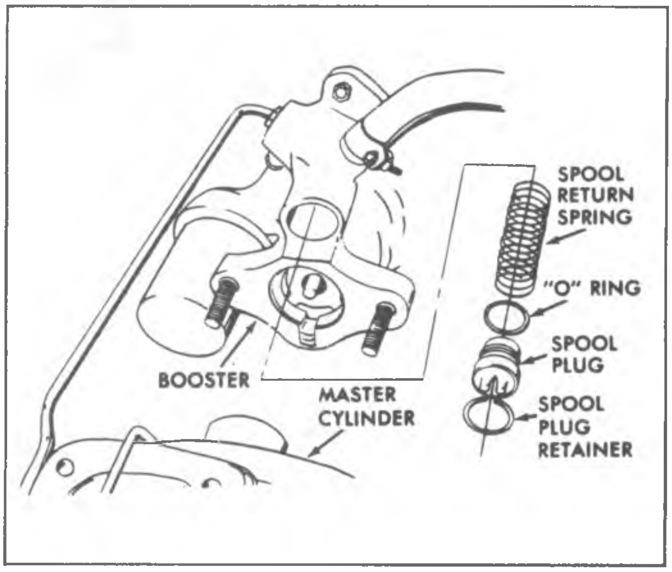


Fig. 5-B9--Spool Valve Plug Removal

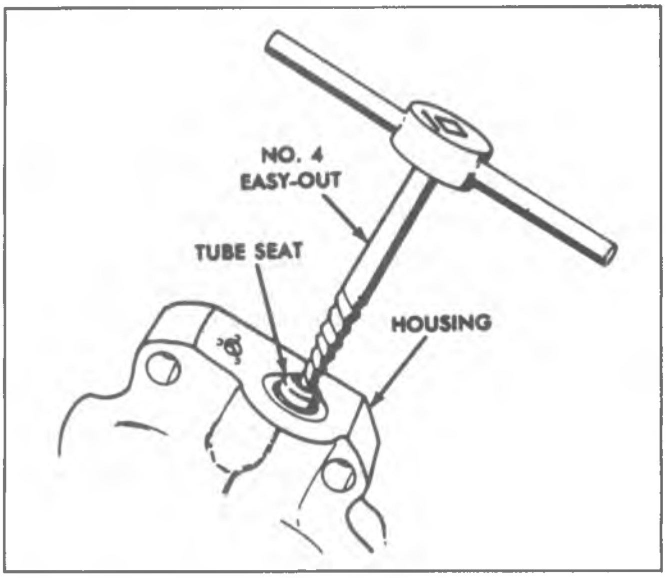


Fig. 5-B10--Removing Tube Seat

through the piston seal. Remove piston installing tool.

9. If removed, install return hose fitting with new "O" ring.
10. If accumulator valve was removed, install new seal into the valve bore. The seat can be forced to the bottom by installing the two function valve (Fig. 5-B8). Make certain the check valve seat is cup side up when in bore.
11. If removed, insert new dump valve over the two function valve making certain that the dump valve plunger is held in place until installation is complete.
12. Insert spoool valve spring and spool valve assembly into bore in housing. Extend power piston lever to accept sleeve on spool valve, then slide lever pins into slot in sleeve.

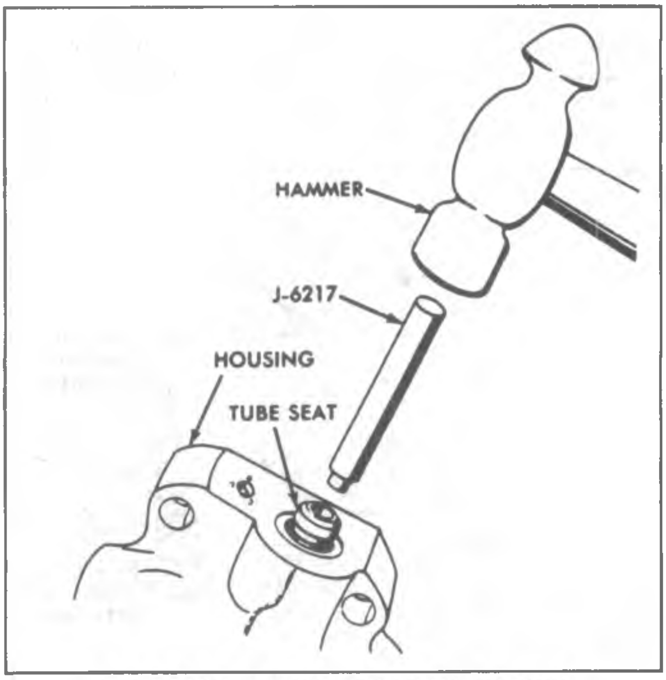


Fig. 5-B11--Installing Tube Seat Using J-6217

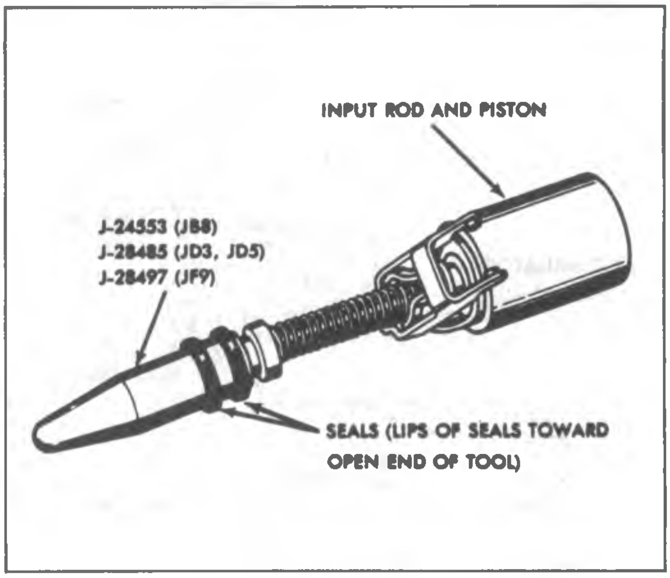


Fig. 5-B12--Installing Input Rod Seals

13. Position a **NEW** "figure eight" seal in the groove in the housing cover. Then join the booster housing and cover and secure with five screws. Tighten the screws to 20 ft. lbs.

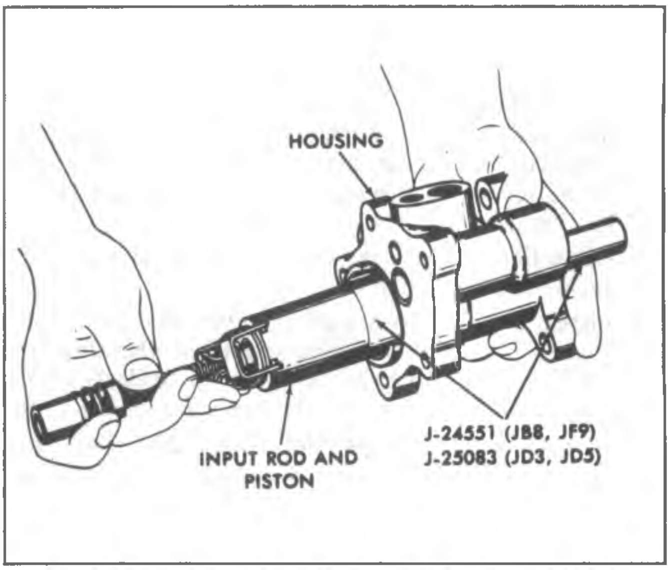


Fig. 5-B13--Installing Input Rod and Piston Assembly Into Booster (Typical)

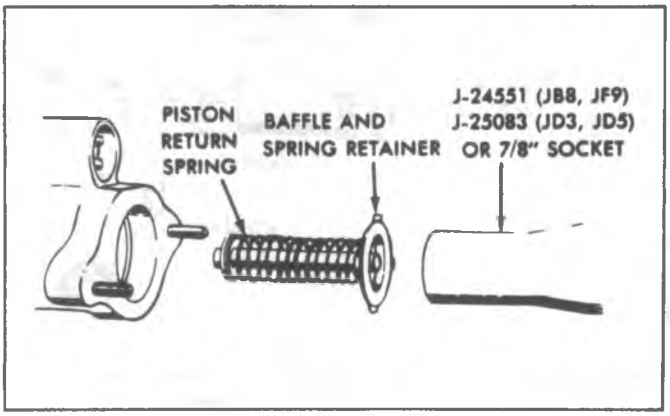


Fig. 5-B14--Installing Baffle and Spring Retainer

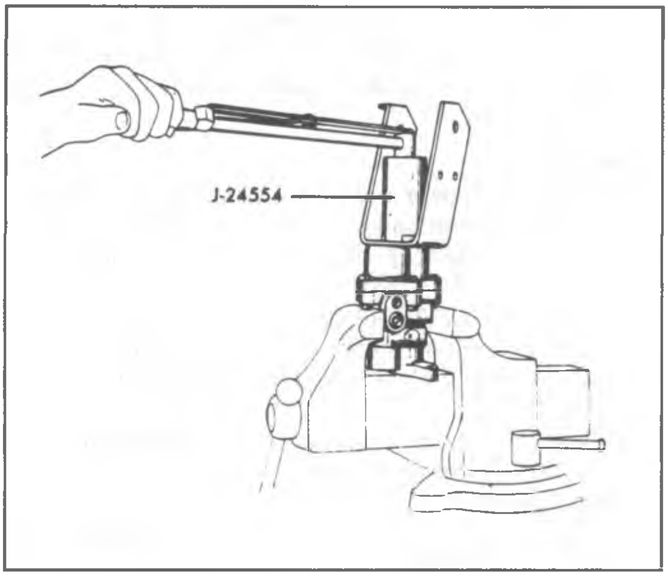


Fig. 5-B15--Installing Mounting Bracket Nut

NOTICE: See "Notice" on Page 1 of this section.

14. Install output rod, spring and new spring retainer.
15. Secure new baffle and spring retainer using Piston Installing Tool or 7/8" socket as shown in Figure 5-B14.
16. Using clean power steering fluid, lubricate accumulator seal. Install seal and accumulator in housing and then place the retaining ring over the accumulator (Fig. 5-B7). Place Tool J-26889 over accumulator.
17. Using Tool J-22269-01 or a large "C" clamp (6" minimum), depress the accumulator making certain that the accumulator is compressed straight (Fig. 5-B6).
18. Snap the retaining ring into the housing groove by pushing it down all the way around with a small screwdriver.
19. Remove Tool J-22269-01 or "C" clamp and retaining cap Tool J-26889.

NOTICE: Carefully check to make sure the retaining ring was completely installed properly.

20. Position the mounting bracket on the booster. The tab on the inside diameter of the large hole in the bracket should fit into a slot in the threaded portion of the booster hub.
21. Install the **NEW** bracket nut with the staking groove outward on the threaded hub of the booster. Using Tool J-24554 and a torque wrench (Fig. 5-B15), tighten the nut to 110 ft. lbs.

NOTICE: See "Notice" on Page 1 of this section.

22. Use a hammer and a small punch inserted into the staking groove of the nut, at the slot in the booster hub (Fig. 5-B16) to stake the nut in place. Be sure that the outer thread of the nut is upset.
23. Assemble a boot (if used) on the pedal rod. Then assemble a **NEW** grommet in the groove near the end of the pedal rod.
24. Moisten the grommet with water (to ease assembly), and insert the grommet end of the pedal rod into the input rod end of the booster housing. Push on the end of the pedal rod to seat the grommet in the groove inside the housing. When the grommet is fully seated, the pedal rod will rotate freely with no binding.
25. Slide the boot on the pedal rod and assemble the large end of the boot onto the hub of the power section.

HYDRO-BOOST BLEEDING PROCEDURE

Whenever the booster is removed and reinstalled, the steering system should be bled as outlined below.

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

1. Fill oil reservoir to proper level and let oil remain undisturbed for at least two minutes.
2. Start engine and run momentarily.
3. Add oil, if necessary.
4. Repeat above procedure until oil level remains constant after running engine.
5. Raise front end of vehicle so that wheels are off the ground.
6. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
7. Add oil if necessary.
8. Lower the vehicle.
9. Start engine and depress the brake pedal several times while rotating the steering wheel from stop to stop.
10. Turn engine off and then pump brake pedal 4-5 times to deplete accumulator pressure.
11. Check oil level and refill as required.
12. If oil is extremely foamy, allow vehicle to stand a few minutes with eninge off and repeat above procedure.

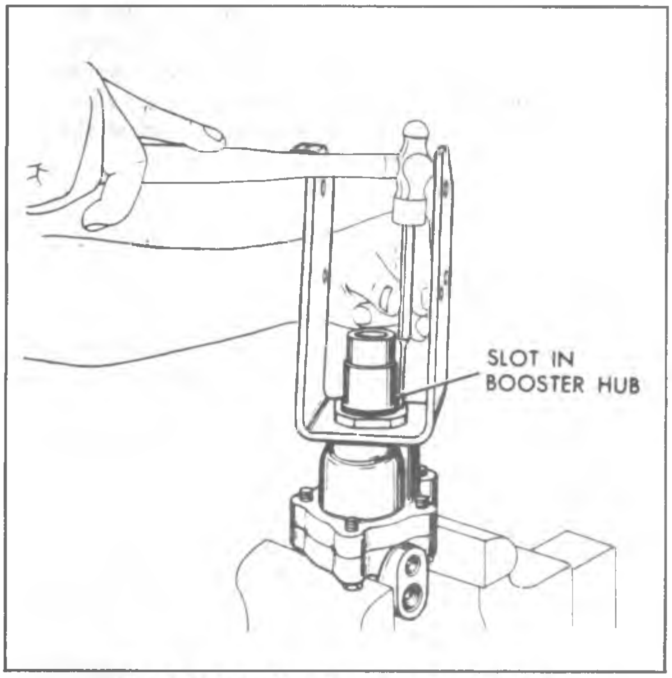


Fig. 5-B16--Staking Mounting Bracket Nut

a. Check belt tightness and check for a bent pulley. (Pulley should not wobble with engine running.)

b. Check to make sure hoses are not touching any other parts of the vehicle, particularly sheet metal.

c. Check oil level, filling to proper levelif necessary, following operations 1 through 10. This step and Step "d" are extremely important as low oil level and/or air in the oil are the most frequent causes of objectionable pump noises.

d. Check the presence of air in the oil. Air will show up as milky appearing oil. If air is present, attempt to bleed system as described in operations 1 through 10. If it becomes obvious that the pump will not bleed after a few trials, proceed as outlined under Power Steering System Test Procedure in the "Steering" Section of this manual.

13. The presence of trapped air in the system will cause the fluid level in the pump to rise when the engine is turned off. Continue to bleed system until this condition no longer occurs.

HYDRO-BOOST BRAKE SYSTEM

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

The following operations can be performed with the booster installed in the vehicle; exceptions to ths statement may exist where Body Manufacturers sheet metal ("P" Models) would require removal of the booster from the vehicle.

Pneumatic Accumulator

CAUTION: The accumulator contains compressed gas. Always use proper tools and follow recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator, always replace with a new accumulator. Dispose of an inoperative accumulator by drilling a 1/16" (1.6mm) diameter hole through the end of the accumulator can opposite the "O" ring.

Removal

1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.
2. Disconnect the high pressure hose.
3. Remove two nuts from master cylinder, then move master cylinder away from booster with brake lines attached.
4. Place the accumulator retaining cap Tool J-26889 over the master cylinder stud and install the nut as shown in Figure 5-34.
5. Using Tool J-22269-01 or a large "C" clamp (6" (150 mm) minimum), depress the accumulator. Insert a punch into the hole in the housing and remove retaining ring with a small screwdriver (Fig. 5-34).

   If the accumulator is not easily compressed approximately 1/8" (3mm) it is still charged. This indicates an internal problem with the accumulator valves and the booster must be disassembled.
6. Slowly back off the clamp until tension on the accumulator is released; remove accumulator and "O" ring.

Installation

1. Using clean power steering fluid, lubricate accumulator seal. Install seal and accumulator in housing and then place the retaining ring over the accumulator (Fig. 5-35). Place Tool J-26889 over accumulator.
2. Using Tool J-22269-01 or a large "C" clamp (6" (150 mm) minimum), depress the accumulator making certain that the accumulator is compressed straight (Fig. 5-34).
3. Snap the retaining ring into the housing groove by pushing it down all the way around with a small screwdriver.
4. Remove Tool J-22269-01 or "C" clamp and retaining cap Tool J-26889.

   Carefully check to make sure the retaining ring was completely installed properly.
5. Connect high pressure hose and check power steering fluid.
6. Install the master cylinder two nuts and accumulator retaining cap Tool J-26889 and close the vehicle hood. Test the unit by starting the engine and turning the steering wheel from stop to stop a few times. Turn off engine and apply brake pedal 4 or 5 times.
7. Remove accumulator retaining cap Tool J-26889 and install master cylinder nut.

   NOTICE: See "Notice" on Page 1 of this section.

Spool Valve Plug

Removal

1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.
2. Remove two nuts from master cylinder, then move master cylinder away from brake lines attached.
3. Push spool valve plug in and use a small screwdriver to remove retaining ring (Fig. 5-36).
4. Remove spool valve plug and "O" ring.

Installation

1. Install "O" ring and spool valve plug (Fig. 5-36).
2. Push spool valve plug in and install retaining ring.
3. Install master cylinder and two nuts to booster.

   NOTICE: See "Notice" on Page 1 of this section.
4. Bleed system. Refer to **"HYDRO-BOOST BLEEDING PROCEDURE"**

Tube Seat

Replacement

1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.
2. Clean dirt around fitting before removing fitting, then disconnect pressure hose at Hydro-Boost and secure hose in a raised position to prevent loss of fluid.

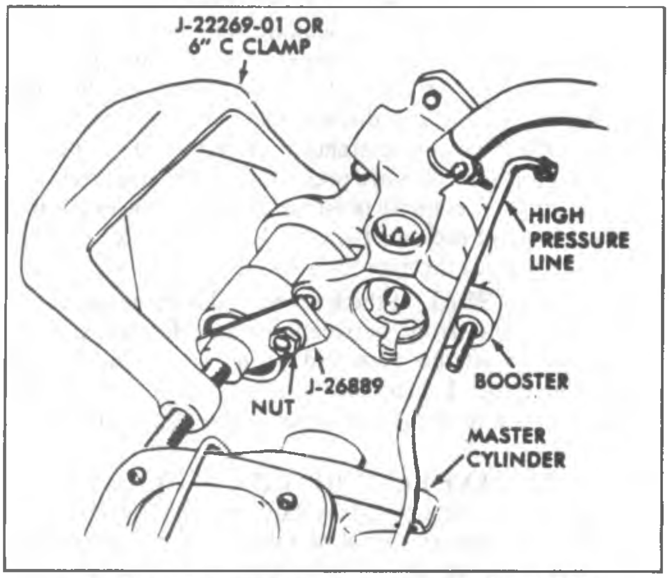


Fig. 5-34--Compressing Accumulator With J-26889

3. To prevent metal chips from entering booster, pack inside of tube seat with petrolatum.
4. Remove tube seat using No. 4 easy-out as shown in Figure 5-37.
5. Wipe petrolatum from housing and clean housing thoroughly to remove any metal chips or dirt.
6. Install tube seat with Tool J-6217 as shown in Figure 5-55.
7. Fill and bleed system. Refer to "**HYDRO-BOOST BLEEDING PROCEDURE**".

Hydro-Boost Unit

Replacement (Figs. 5-39 thru 5-42)

1. Depress and release the brake pedal several times (engine not running) to be sure that all pressure is discharged from the accumulator prior to disconnecting the hoses from the booster.

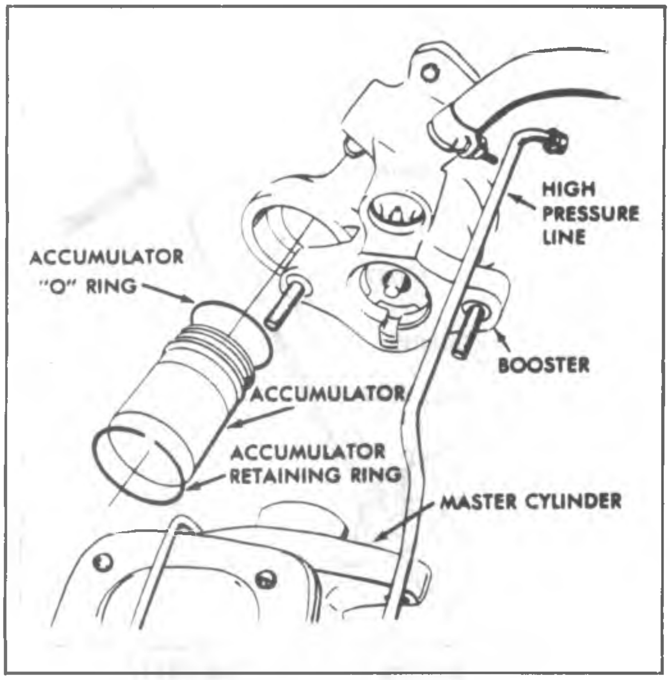


Fig. 5-35--Accumulator Installation

2. **P30(32) Models** - Raise the vehicle on a hoist.
3. Clean all dirt from the booster at the hydraulic line connections and master cylinder.
4. Remove the nuts and lockwashers that secure the master cylinder to the booster and the support bracket. Support the master cylinder, being careful to avoid kinking or bnding the hydraulic lines attached to the master cylinder. Cover the end of the master cylinder with a clean cloth.

   It should not be necessary to disconnect the hydraulic lines from the master cylinder.
5. Disconnect the hydraulic lines from the booster ports. Plug all lines and the booster ports to prevent loss of fluid and to keep out foreign materials.
6. **P30(42) and C-K-G Models-**
   a. Remove booster pedal push rod cotter pin and washer and disconnect the push rod from the brake pedal (C and K models) or booster bracket pivot lever (G and P models).
   b. Remove the lower dash trim, then lower the steering column on C and K models. Remove support brackets on P30 (42) models.
   c. Remove the booster bracket to dash panel or support bracket nuts and remove the booster assembly.
7. **P30(32) Models-**
   a. Remove the cotter pin, nut bolt and washers that secure the operating lever to the vertical brake rod.
   b. RFemove the six nuts, lock washer and bolts that secure the booster linkage bracket to the front and rear support brackets, and remove the booster from the vehicle by sliding the booster off the rear support studs.
   c. Remove the cotter pin, nut, washer and bolt that secures the operating lever to the pedal rod.
   d. Remove the brake pedal rod lever nut and bolt and then remove the lever, sleeve and bushing.

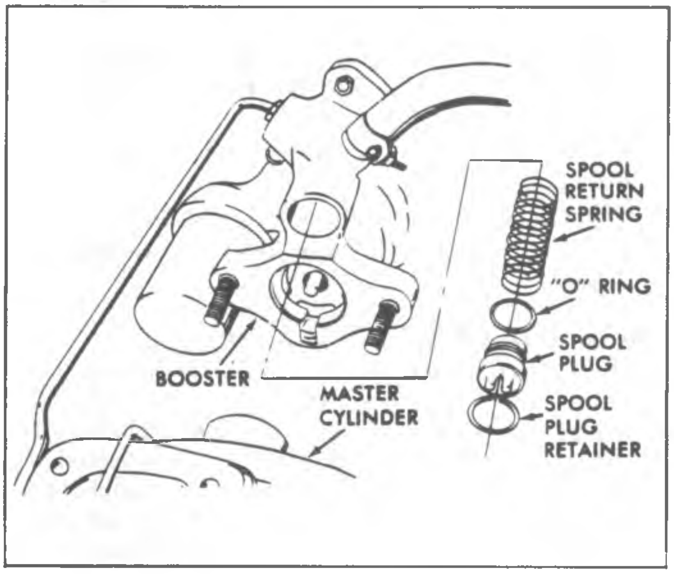


Fig. 5-36--Spool Valve Plug Removal

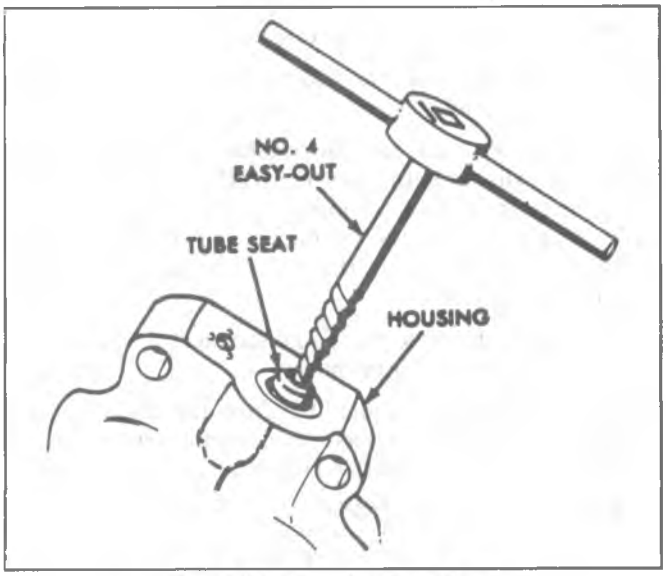


Fig. 5-37--Removing Tube Seat

8. To install, reverse Steps 1-7 above. Torque all hydraulic lines and attaching bolts to specifications. Lubricate pedal rod and linkage pivot bolts, pins, sleeves and bushings with Delco Brake Lube (or equivalent).

   NOTICE: See "Notice" on Page 1 of this section.
9. Fill and bleed system. Refer to "Hydro-Boost Bleeding Procedure."
10. Check brake pedal and stoplamp switch adjustment.

HYDRO-BOOST DIAGNOSIS

Prior to performing the Booster Function Tests, or the Accumulator Leakdown Test, the following preliminary checks must be made:

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

1. Check all power steering and brake lines and connections for leaks and/or restrictions.
2. Check and fill brake master cylinder with **BRAKE FLUID.**
3. Check and fill power steering pump reservoir with **POWER STEERING FLUID.** Be sure fluid is not aerated (air mixed with fluid).
4. Check power steering pump belt for tension and/or damage. Adjust if necessary.
5. Check engine idle speed and adjust if necessary.
6. Check steering pump pressure. Refer to Power Steering Section.

SEAL LEAK DIAGNOSIS (FIG. 5-1H)

1. **INPUT ROD SEAL.** A damaged seal will show up as a fluid leak from the mounting bracket vent hole. The booster must be removed from the vehicle and disassembled. The input rod bore should be checked for any scratches that may cause the leak. If scratches are present, housing cover must be replaced. If no excessive scratches are present, then the booster seal kit can be used to replace the appropriate seals.
2. **POWER PISTON SEAL.** Power piston seal damage will be noticed by fluid leaking out at the common master cylinder-brake booster vent and possible reduction in power assist. The booster must be removed from the vehicle and disassembled. The piston should be checked for any scratches that may be the cause of the leak. If scratches are present, then the input rod and power piston assembly must be replaced. If no excessive scratches are present, then the booster seal kit can be used to replace the appropriate seals.
3. **HOUSING SEAL.** If the housing seal is damaged, fluid will leak out from between the two housings. The booster must be removed from the vehicle and disassembled. The booster seal kit should be used to replace the housing and input rod and power piston seals.
4. **SPOOL VALVE PLUG "O" RING SEAL.** Damage to this seal will be noticed by fluid leaking out past the plug. The booster need not be removed from the vehicle. The master cylinder should be disconnected from the booster.

   Press in on spool plug, insert a small screwdriver between snap ring and housing bore. This unseats one side of the spool plug snap ring from its groove in the bore. Then remove the snap ring from the bore.
5. **ACCUMULATOR "O" RING SEAL.** Damage to this seal will result in fluid leakage past the accumulator cap. The seal can be replaced while the booster is installed on the vehicle. A catch basin should be placed under the booster to catch the fluid when the accumulator or spring cap is removed.

   CAUTION: Before removing the cap, the brake pedal must be pumped 4-5 time to deplete accumulator pressure. Refer to "Pneumatic Accumulator On-Vehicle Service Procedure".
6. **EXTERNAL LEAKAGE AT THE RETURN PORT FITTING.** Tighten fitting to 7lb. ft. (10 N·m). If it

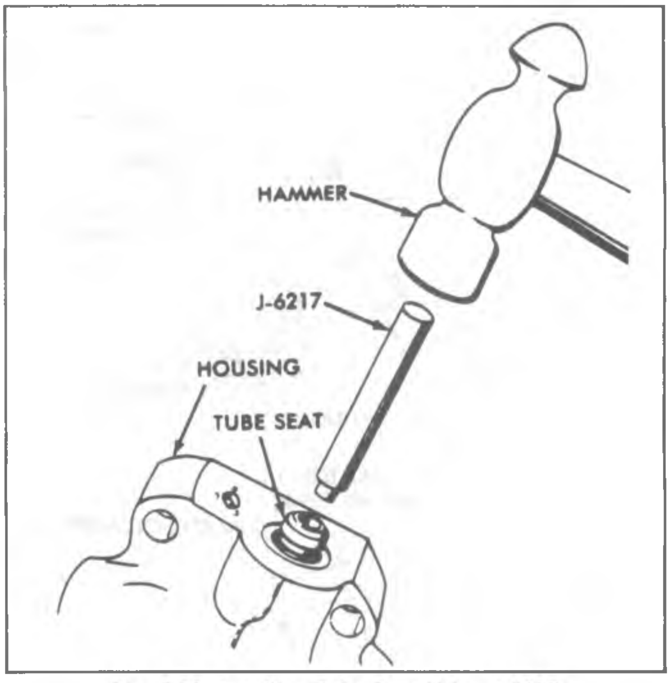


Fig. 5-38--Installing Tube Seat Using J-6217

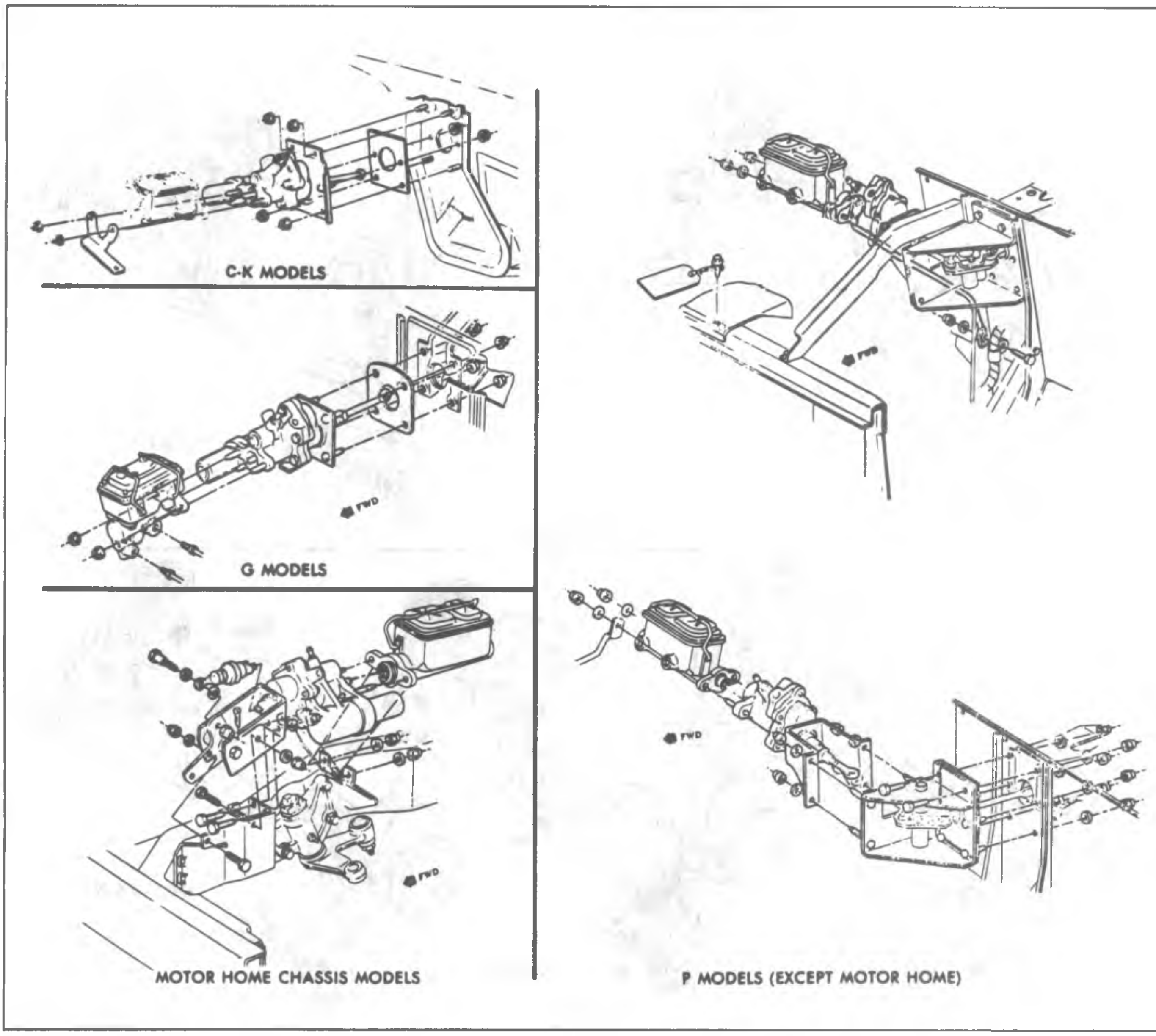


Fig. 5-39--Booster Installation (Hydro-Boost)

continues to leak, replaced "O" ring under fitting.

7. **EXTERNAL LEAKAGE AT THE HIGH PRESSURE GEAR OR PUMP.** Torque tube nut to 30 lb. ft. (40 N·m). If it continues to leak, check for damaged tube flares; if OK, eplace tube seats.

TROUBLE SHOOTING AND TESTING (FIG. 5-HB)

The Hydro-Boost differs from vacuum brake boosters not only in the source of power (hydraulic versus vacuum) but in the fact that it is also a part of another major sub-system of vehicle--the power steering system. Therefore, problems or malfunctions in the steering system may affect the operation of the booster, just as a problem in the booster may affect the steering system. The following noises are associated with the Hydro-boost system and may or may not be cause for customer complaint. Some are normal and for the most part temporary in nature. Others may be a sign of excessive wear or the presence of air in either the booster or the steering syste.

1. Moan or low frequency hum usually accompanied by a vibration in the pedal and/or steering column may be observed during parking maneuvers or other very low speed maneuvers. This may be caused by a low fluid level in the power steering pump or by air in the power steering fluid due to holding the pump at relief pressure (steering wheel held all the way in one direction) for an excessive amount of time (more than 5 seconds). Check the fluid level and fill to makr. System must sit for one hour to remove the air. If the condition persists, this may be a sign of excessiv pump wear and the pump should be checked. Refer to the Power Steering Section.
2. At or near power runout, (Brake pedal near fully depressed position) a high speed fluid noise (faucet type) may be heard. This is a normal condition and will not be heard except in emergency braking conditions, or with vehicle stopped and pedal pushed near fully depressed position.
3. Whenever the accumulator pressure is used, a slight hiss may be noticed. It is the sound of the hydraulic

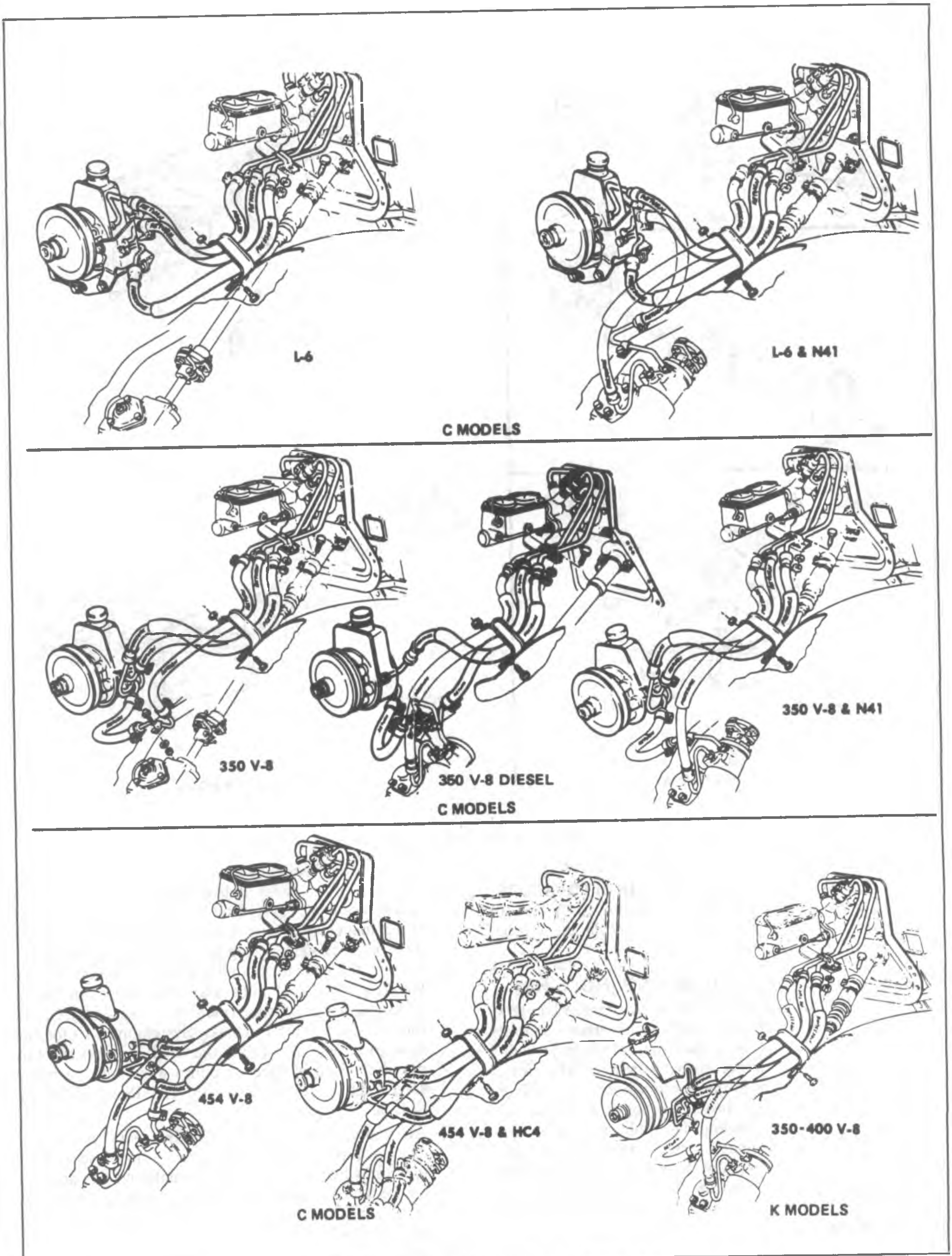


Fig. 5-40--Power Steering Hose Routing-C-K Models

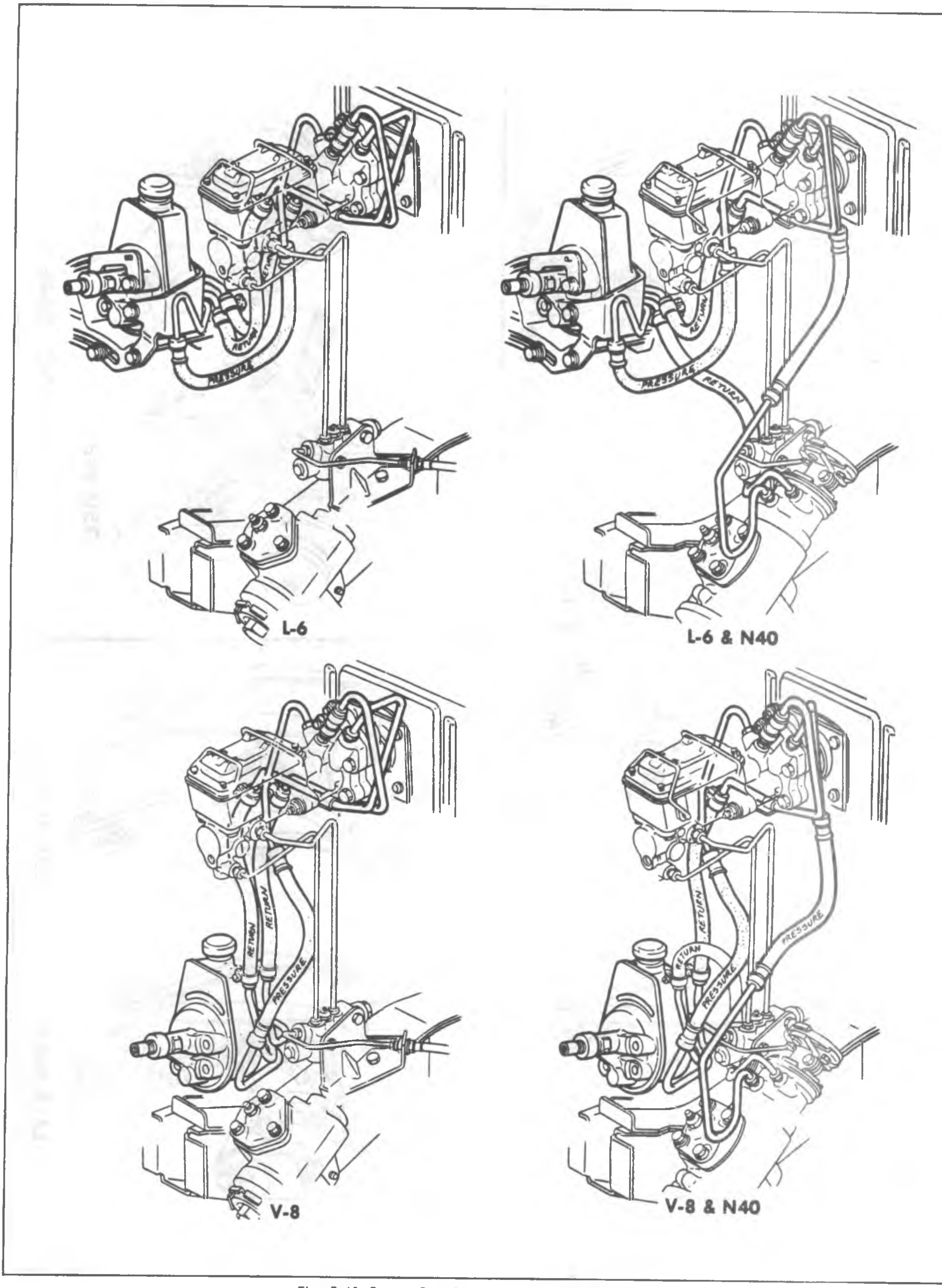


Fig. 5-41--Power Steering Hose Routing-G Models

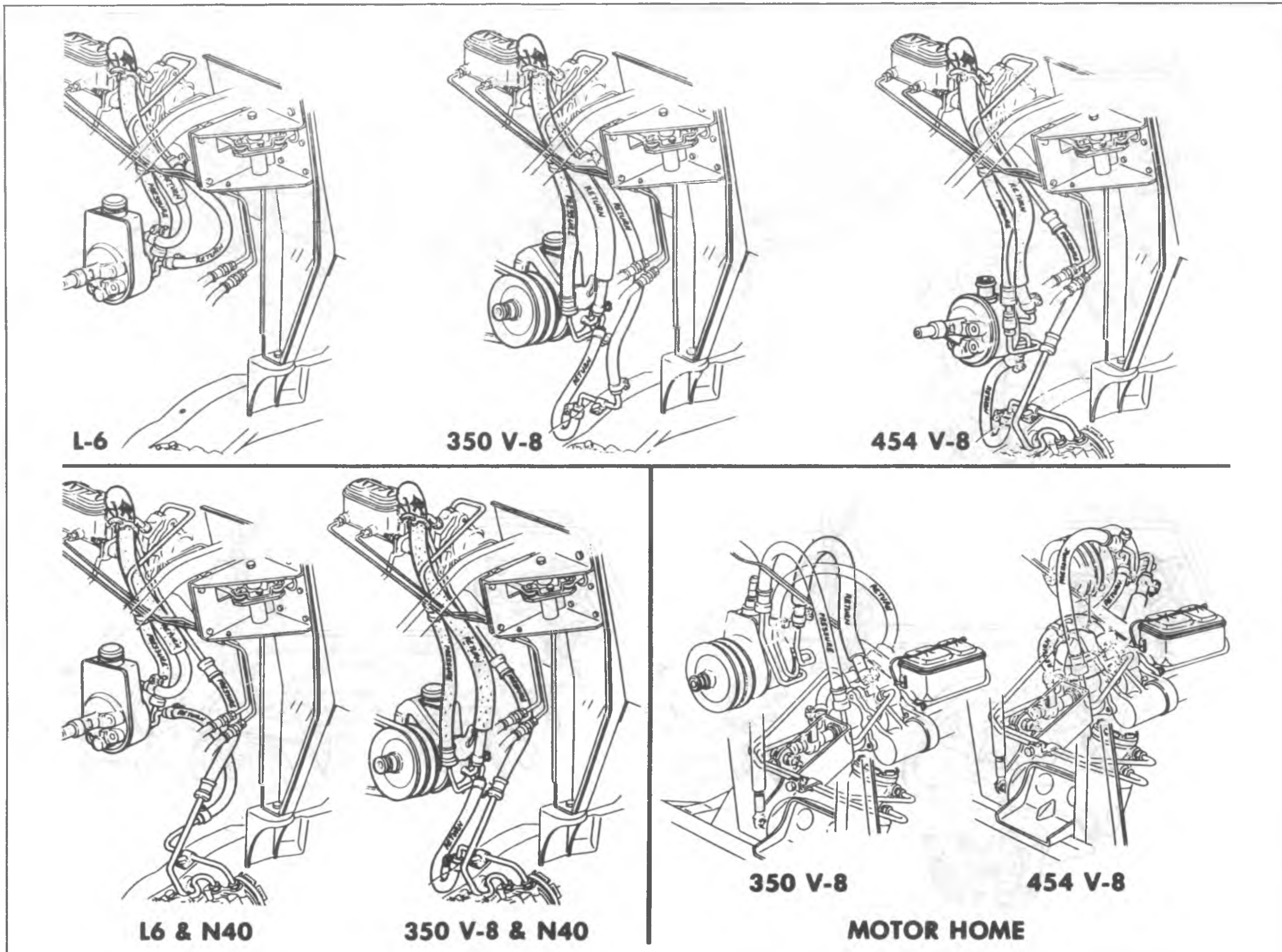
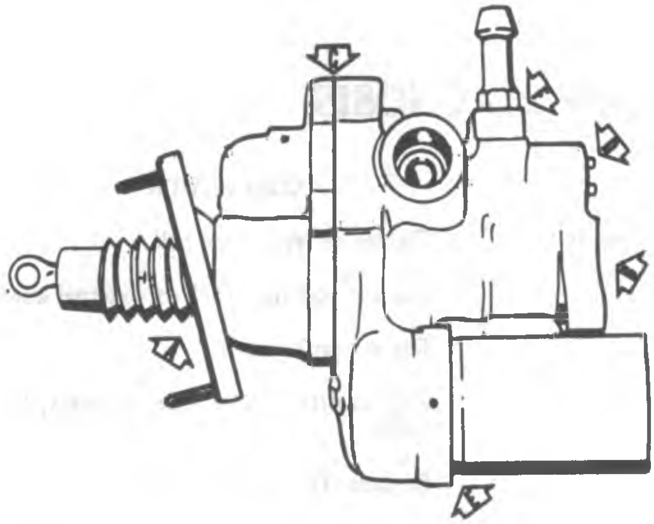


Fig. 5-42--Power Steering Hose Routing-P Models



HYDRO— BOOST SEAL LEAKAGE

A. **INPUT SEAL LEAK** — Fluid leakage from housing cover end of booster near reaction bore. Replace seal(s).

B. **PISTON SEAL LEAK** — Fluid leakage from vent at front of unit near master cylinder. Replace seal.

C. **HOUSING** — Fluid leakage between the housing and housing cover. Replace seal.

D. **SPOOL VALVE SEAL** — Fluid leakage near plug area. Replace seal.

E. **ACCUMULATOR CAP SEAL** — Fluid leakage from accumulator area. Replace seal.

F. **RETURN PORT FITTING SEAL** — Replace seal.

Fig. 5-1H--Seal Leakage Diagnosis

fluid escaping through the accumulator valve, and is completely normal.

4. After the accumulator has been emptied, and the engine is started again, another hissing sound may be heard during the first brake application or the first steering maneuver. This is caused by the fluid rushing through the accumulator charging orifice. It is normal and will only be heard once after the accumulator is emptied. However, if this sound continues, even though no apparent accumulator pressure assist was made, it could be an indication that the accumulator is not holding pressure and should be checked using the procedure for **"ACCUMULATOR LEAKDOWN TEST"**.
5. After bleeding, a "gulping" sound may be present during brake applications as noted in the bleeding instructions.

CHECKING THE RESERVE SYSTEM

1. Start engine and charge accumulator by applying the brake pedal or by turning the steering wheel from stop to stop. Turn off engine and let vehicle sit for one hour. After one hour there should be at least two power assisted applications with the engine off.
2. If the reserve system will not retain a charge for one hour, but functions normally immediately following charging, the accumulator valves are at fault and the booster must be disassembled and the accumulator valves replaced.
3. If the accumulator can be heard charging and discharging, but it does not hold a charge, disassemble the booster and replace the accumulator valves.
4. Deplete the accumulator by pressing the brake pedal 4 or 5 times. If the accumulator can has lost its gas charge, it is possible to rotate or wobble the accumulator can with respect to the housing. Replace the accumulator assembly.

BOOSTER FUNCTIONAL TEST

With the engine off, apply the brake pedal several times until the accumulator is completely depleted. Depress the brake pedal (approximately 40 pounds/180 N pedal force) and start the engine. The pedal should fall and then push back against driver's foot.

ACCUMULATOR LEAKDOWN TEST

Start engine and charge accumulator by either applying the brake pedal (approximately 100 pounds/450 N force) or by turning the steering wheel from stop to stop. Turn off engine and let vehicle sit for one hour. After one hour, there should be two power assisted applies with engine stopped.

HYDRO — BOOST DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Excessive Brake Pedal Effort	Loose or broken power steering pump belt.	Tighten or replace the belt.
	No fluid in power steering reservoir.	Fill reservoir and check for external leaks.
	Leaks in Hydro-Boost	Replace faulty parts.
	Leaks at Hydro-Boost tube fittings.	Tighten fittings or replace tube seats, if faulty.
	External leakage at accumulator	Replace "O" ring and retainer.
	Faulty booster piston seal causing leakage at booster flange vent.	Overhaul with new seal or input rod and piston assembly.
	Faulty booster input rod seal with leakage at input rod end.	Overhaul with new seal kit.
	Faulty booster cover seal with leakage between housing and cover.	Overhaul with new seal kit.
	Faulty booster spool plug seal.	Overhaul with spool plug seal kit.
Slow Brake Pedal Return	Excessive seal friction in booster.	Overhaul with new seal kit.
	Faulty spool action.	Flush steering system while pumping brake pedal.
	Restriction in return line from booster to pump reservoir.	Replace line.
	Damaged input rod end.	Replace input rod and piston assembly.
Grabby Brakes	Faulty spool action caused by contamination in system.	Flush steering system while pumping brake pedal.
Booster Chatters - Pedal Vibrates	Power steering pump belt slips.	Tighten belt.
	Low fluid level in power steering pump reservoir.	Fill reservoir and check for external leaks.
	Faulty spool operation caused by contamination in system.	Flush steering system while pumping brake pedal.
Accumulator Leak Down-System does not hold charge	Contamination in steering hydro-boost system	Flush steering system while pumping brake pedal
	Internal leakage in accumulator system	Overhaul unit using accumulator rebuild kit and seal kit.

Fig. 5-HB--Hydro-Boost Diagnosis

BRAKE SYSTEM DESCRIPTION

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
	GASOLINE ENGINE VEHICLES		
	C-MODELS		
JB1 Low Drag	Disc 11.86 x 1.04	Drum 11.00 x 2.00	None (Manual Brakes)
JB3 Low Drag	Disc 11.86 x 1.04	Drum 11.00 x 2.00	Vacuum — Single Diaphragm
	G-MODELS		
JB1 Low Drag	Disc 11.86 x 1.28	Drum 11.00 x 2.00	None (Manual Brakes)
JB3 Low Drag	Disc 11.86 x 1.28	Drum 11.00 x 2.00	Vacuum — Single Diaphragm
	ALL MODELS		
JB5 Low Drag	Disc 11.86 x 1.28	Drum 11.15 x 2.75	Vacuum — Dual Diaphragm
JB6 Low Drag	Disc 12.50 x 1.28	Drum 11.15 x 2.75	Vacuum — Dual Diaphragm
JB7 Conventional	Disc 12.50 x 1.28	Drum 13.00 x 2.50	Vacuum — Dual Diaphragm
JB8 Conventional	Disc 12.50 x 1.53	Drum 13.00 x 3.50	Hydraulic — Hydroboost
JF9 Conventional	Disc 14.25 x 1.53	Disc 13.75 x 1.53	Hydraulic — Hydroboost
	DIESEL ENGINE VEHICLES		
JD3 Low Drag	Disc 11.86 x 1.28	Drum 11.00 x 2.00	Hydraulic — Hydroboost
JD5 Low Drag	Disc 11.86 x 1.28	Drum 11.15 x 2.75	Hydraulic — Hydroboost

DRUM DIAMETERS

ORIGINAL	MAXIMUM REFINISH	REPLACEMENT (DISCARD)
11.000	11.060	11.090
11.150	11.210	11.240
12.000	12.060	12.090
13.000	13.060	13.090

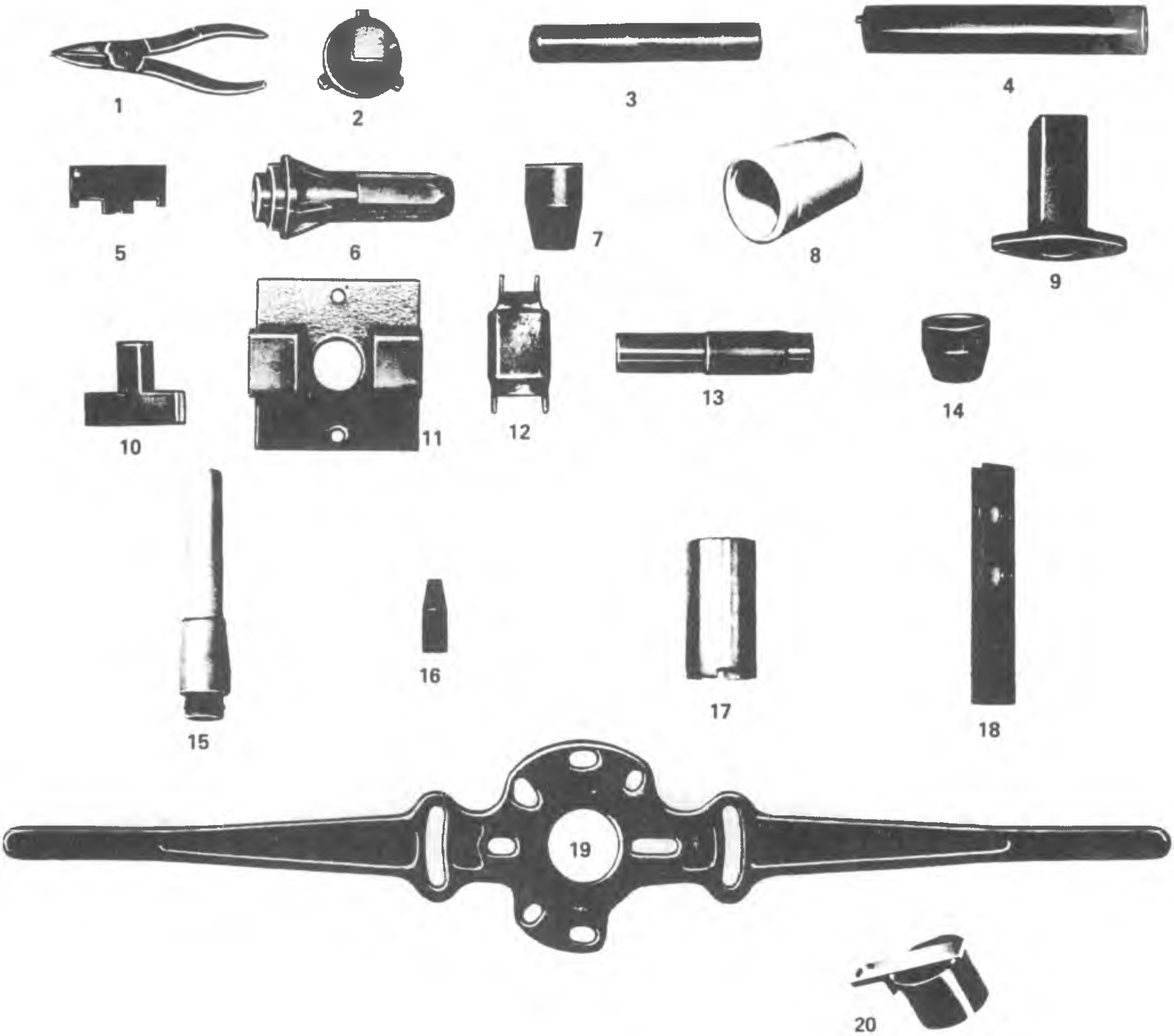
ROTOR THICKNESS

MINIMUM AFTER REFINISHING	REPLACEMENT (DISCARD)
1.480	1.465
1.230	1.215
.980	.965

	C	K	G	P
Master Cylinder — to Dash or Booster	**34 N•m (25 ft. lbs.)	**34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)
Booster to Dash or Frame	**34 N•m (25 ft. lbs.)	**34 N•m (25 ft.lbs.)	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)
Combination Valve — Mounting Bolts	17 N•m (150 in.lbs.)	17 N•m (150 in. lbs.)	23 N•m (17 ft. lbs.)	23 N•m (17 ft. lbs.)
— Bracket	—	—	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)
Caliper — Mounting Bolt	48 N•m (35 ft. lbs.)			
— Support Plate to Knuckle	16 N•m (140 in. lbs.)			
Brake Pedal — Bracket to Dash	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)	17 N•m (150 in. lbs.)	34 N•m (25 ft. lbs.)
— Bracket to I.P.	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)	—	—
— Pivot Bolt Nut	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)	—	
— Sleeve to Bracket	—	—	—	9.5 N•m (85 in. lbs.)
— Stoplamp Switch Bracket	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)	34 N•m (25 ft. lbs.)	—
— Push Rod to Pedal	—	—	—	34 N•m (25 ft. lbs.)
— Push Rod Adjusting Nut	—	—	—	30 N•m (22 ft. lbs.)
Parking Brake — to Dash	12 N•m (100 in. lbs.)	12 N•m (100 in. lbs.)	12 N•m (100 in. lbs.)	—
— to I.P., Kick Panel or Floorpan	17 N•m (100 in. lbs.)	17 N•m (100 in. lbs.)	12 N•m (100 in. lbs.)	24 N•m (18 ft. lbs.)
— Cable Clips — Screws	17 N•m (150 in. lbs.)	—	12 N•m (100 in. lbs.)	17 N•m (150 in. lbs.)
— Bolts	17 N•m (150 in. lbs.)	—	24 N•m (18 ft. lbs.)	6 N•m (55 in. lbs.)
Propshaft Parking Brake — Adjusting Nut	—	—	—	40 N•m (30 ft. lbs.)
— Bracket to Trans.	—	—	—	27 N•m (20 ft. lbs.)
— Cable Clip to Frame	—	—	—	17 N•m (150 in. lbs.)
— Cable Clip to Dash	—	—	—	6 N•m (55 in. lbs.)
— Cable Clip to Trans. Brkt.	—	—	—	27 N•m (20 ft. lbs.)
— Flange Plate	—	—	—	40 N•m (30 ft. lbs.)
— Drum	—	—	—	110 N•m (80 ft. lbs.)
Wheel Cylinder to Flange Plate Bolt	5.5 N•m (50 in. lbs.)/20 N•m (180 in. lbs.) on JB5, JB6, JB7 and JB8			
Rear Brake Anchor Pin	190 N•m (140 ft. lbs.)/312 N•m (230 ft. lbs.) JB7 and JB8)			
Front Brake Hose — to Caliper	44 N•m (32 ft. lbs.)			
— to Frame Nut	7 N•m (58 in. lbs.)			
— Bracket Bolt	17 N•m (150 in. lbs.)	—	17 N•m (150 in. lbs.)	17 N•m (150 in. lbs.)
Rear Brake Hose — to Axle Bracket	*17 N•m (150 in. lbs.)	*17 N•m (150 in. lbs.)	10 N•m (90 in. lbs.)	17 N•m (150 in. lbs.)
— Bracket to Axle	17 N•m (150 in. lbs.)	17 N•m (150 in. lbs.)	—	17 N•m (150 in. lbs.)
Brake Line — Attaching Nuts	17 N•m (150 in. lbs.)			
— Retaining Clips — Screws	17 N•m (150 in. lbs.)	17 N•m (150 in. lbs.)	12 N•m (100 in. lbs.)	17 N•m (150 in. lbs.)
— Bolts	—	—	17 N•m (150 in. lbs.)	24 N•m (18 ft. lbs.)
Brake Bleeder Valves	7 N•m (60 in. lbs.)			
Hydro-Boost — — Pedal Rod — P30 (32) Models	—	—	—	34 N•m (25 ft. lbs.)
— Pedal Rod Boot — P30 (32) Models	—	—	—	20 N•m (15 ft. lbs.)
— Pivot Lever Rod Retainer	—	—	—	34 N•m (25 ft. lbs.)
— Pivot Lever Bolt	—	—	—	60 N•m (45 ft. lbs.)
— Booster Brackets	—	—	—	34 N•m (25 ft. lbs.)
— Booster Brace at Dash or Rad. Supt.	—	—	—	17 N•m (150 in. lbs.)
— Power Steering Pump to Booster Line	34 N•m (25 ft. lbs.)			
— Booster to Gear Line	34 N•m (25 ft. lbs.)			
— Return Line at Booster and Gear	34 N•m (25 ft. lbs.)			
— Return Line Clamp Screw	1.6 N•m (15 in. lbs.)			
— Line Clamp to Bracket Screw	17 N•m (150 in. lbs.)			
— Hose Clamp to Skirt Screw	4.6 N•m (40 in. lbs.)	—	—	—
— Line Clamp to Frame Bolt	17 N•m (150 in lbs.)	—	—	17 N•m (150 in. lbs.)

*27 N•m (20 ft. lbs.)

**44 N•m (32 ft. lbs.) — Master Cylinder to Booster
— Master Cylinder or Booster to Dash Reinforcement



1. J-4880 Snap Ring Pliers
2. J-21524 Power Piston Remover and Installer
3. J-21601 Power Brake Retainer and Installer
4. J-22657 Bushing Retainer Socket
5. J-22647 Height Gauge
6. J-22677 Power Cylinder Seal Installer
7. J-22733 Seal Installer and Protector
8. J-28458 Power Piston Seal Protector
9. J-22805 Power Cylinder Holding Fixture
10. J-22839 Front Plate Holding Fixture
11. J-22893 Booster Separating Adapter
12. J-23101 Power Piston Holding Tool
13. J-23175 Control Valve Installer
14. J-23188 Secondary Bearing Protector
15. J-24551 Piston Installers
    J-25083
16. J-24553 Input Rod Seal Installers
    J-28485
    J-28497
17. J-24554 Socket
18. J-24569 Pedal Push Rod Remover
19. J-9504 Power Cylinder Spanner Wrench
20. J-26889 Accumulator Compressor

SECTION 6

ENGINE

CONTENTS

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Exhaust Systems 6F-1

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

FOR VEHICLES SOLD IN CANADA AND EQUIPPED WITH NON-CLOSED LOOP ENGINES, ALSO REFER TO THE APPROPRIATE CANADIAN SERVICE MANUAL SUPPLEMENT.

GENERAL INFORMATION

STATEMENT ON CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten thousands of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pickup unit.

It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the carburetor, throttle body injector assembly, or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

IN THE MECHANICAL PROCEDURES DESCRIBED IN THIS SECTION, GENERALLY NO REFERENCES WILL BE MADE TO THE REMOVAL OF OPTIONAL EQUIPMENT SUCH AS POWER STEERING PUMP, AIR CONDITIONING COMPRESSOR, ETC.

SHOULD IT BECOME NECESSARY TO REMOVE ANY SUCH ITEM TO PERFORM OTHER SERVICE, REFER TO THE APPROPRIATE SECTION OF THIS SERVICE MANUAL FOR SPECIFIC INFORMATION.

ENGINE MECHANICAL DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Oil Loss	a. External oil leaks.	1. Tighten bolts and/or replace gaskets and seals as necessary.
	b. Improper reading of dipstick.	1. Check oil with car on a level surface and allow adequate drain down time.
	c. Improper oil viscosity.	1. Use recommended S.A.E. viscosity for prevailing temperatures.
	d. Continuous high speed driving and/or severe usage such as trailer hauling.	1. Continuous high speed operation and/or severe usage will normally cause decreased oil mileage.
	e. Crankcase ventilation or P.C.V. system malfunctioning.	1. Service as necessary.
	f. Valve guides and/or valve stem seals worn, or seals omitted.	1. Ream guides and install oversize service valves and/or new valve stem seals.
	g. Piston rings not seated, broken or worn.	1. Allow adequate time for rings to seat. 2. Replace broken or worn rings as necessary.
	h. Piston improperly installed or misfitted.	1. Replace piston or repair as necessary.
Low Oil Pressure	a. Slow idle speed.	1. Set idle speed to specs.
	b. Incorrect or malfunctioning oil pressure switch.	1. Replace with proper switch.
	c. Incorrect or	1. Replace with proper gage.

	malfunctioning oil pressure gage.	
	d. Improper oil viscosity or diluted oil.	1. Install oil of proper viscosity for expected temperature. 2. Install new oil if diluted with moisture or unburned fuel mixtures.
	e. Oil pump worn or dirty.	1. Clean pump and replace worn parts as necessary.
	f. Plugged oil filter.	1. Replace filter and oil.
	g. Oil pickup screen loose or plugged.	1. Clean or replace screen as necessary.
	h. Hole in oil pickup tube.	1. Replace tube.
	i. Excessive bearing clearance.	1. Replace as necessary.
	j. Cracked, porous or plugged oil galleys.	1. Repair or replace block.
	k. Galley plugs missing or mis-installed.	1. Install plugs or repair as necessary.
Valve Train Noise	a. Low oil pressure.	1. Repair as necessary. (See diagnosis for low oil pressure.)
	b. Loose rocker arm attachments.	1. Inspect and repair as necessary.
	c. Worn rocker arm and/or pushrod.	1. Replace as necessary.
	d. Broken valve spring.	1. Replace spring.
	e. Sticking valves.	1. Free valves.
	f. Lifters worn, dirty or defective.	1. Clean, inspect, test and replace as necessary.
	g. Camshaft worn or poor machining.	1. Replace camshaft.
	h. Worn valve guides.	1. Repair as necessary.

ENGINE KNOCK DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine knocks cold and continues for two to three minutes. Knock increases with torque.	a. EFE equipped engines may have valve knock.	1. Replace EFE valve.
	b. Flywheel contacting splash shield.	1. Reposition splash shield.
	c. Loose or broken balancer or drive	1. Tighten or replace as necessary.

	pulleys.	
	d. Excessive piston to bore clearance.[1]	1. Replace piston.
	e. Bent Connecting rod.	1. Replace bent connecting rod.
Engine has heavy knock hot with torque applied.	a. Broken balancer or pulley hub.	1. Replace parts as necessary.
	b. Loose torque converter bolts.	1. Tighten bolts.
	c. Accessory belts too tight or nicked.	1. Replace and/or tension to specs as necessary.
	d. Exhaust system grounded.	1. Reposition as necessary.
	e. Flywheel cracked or loose rivets on flywheel.	1. Replace flywheel.
	f. Excessive main bearing clearance.	1. Replace as necessary.
	g. Excessive rod bearing clearance.	1. Replace as necessary.
Engine has light knock hot in light load conditions.	a. Detonation or spark knock.	1. EST or ESC (See Section 6D or 6E) Check engine timing and fuel quality.
	b. Loose torque converter bolts.	1. Tighten bolts.
	c. Exhaust leak at manifold.	1. Tighten bolts and/or replace gasket.
	d. Excessive rod bearing clearance.	1. Replace bearings as necessary.
Engine knocks on initial start up but only lasts a few seconds.	a. Fuel pump.	1. Replace pump.
	b. Improper oil viscosity.	1. Install proper oil viscosity for expected temperatures.
	c. Hydraulic lifter bleed down.[2]	1. Clean, test and replace as necessary.
	d. Excessive crankshaft end clearance.	1. Replace crankshaft thrust bearing.
	e. Excessive main bearing clearance.	1. Replace worn parts.
Engine knocks at idle hot.	a. Loose or worn drive belts.	1. Tension and/or replace as necessary.
	b. Compressor or generator bearing.	1. Replace as necessary.
	c. Fuel pump.	1. Replace pump.
	d. Valve train.	1. Replace parts as necessary.
	e. Improper oil viscosity.	1. Install proper viscosity oil for expected temperature.
	f. Excessive piston pin clearance.	1. Ream and install oversize pins.
	g. Connecting rod alignment.	1. Check and replace rods as necessary.
	h. Insufficient piston to bore clearance.	1. Hone and fit new piston.
	i. Loose crankshaft balancer.	1. Torque any or replace worn parts.

[1]Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock which disappears in 1.5 minutes should be considered acceptable.

[2]When the engine is stopped, some valves will be open. Spring pressure against lifters will tend to bleed lifter down. Attempts to repair should be made only if the problem is consistent and appears each time engine is started.

DIESEL ENGINE DIAGNOSIS

Diesel Engine Mechanical Diagnosis such as noisy lifters, rod bearings, main bearings, valves, rings and pistons is the same as for a gasoline engine. This diagnosis covers only those conditions that are different for the diesel engine.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Will Not Crank	a. Loose or Corroded Battery Cables	1. Check connections at batteries, engine block and starter solenoid.
	b. Discharged Batteries	1. Check generator output and generator belt adjustment.
	c. Starter Inoperative	1. Check voltage to starter and starter solenoid. If OK, remove starter for repair. (Use diagnostic connector terminals shown on circuit drawing in ELECTRICAL DIAGNOSIS.)
Engine Cranks Slowly- Will Not Start (Minimum Engine Cranking Speed-	a. Battery Cable Connections Loose or Corroded	1. Check connections at batteries, batteries, engine block and starter.
	b. Batteries Undercharged	1. Check charging system.
100 RMP COLD, 240 RPM HOT)	c. Wrong Engine oil	1. Drain and refill with oil of recommended viscosity.
Engine Cranks Normally- Will Not Start	a. Incorrect Starting procedure	1. Use recommended starting procedure.
	b. Glow Plugs Inoperative	1. Refer to ELECTRICAL DIAGNOSIS.
	c. Glow Plug Control System Inoperative.	1. Refer to ELECTRICAL DIAGNOSIS.
	d. No Fuel Into Cylinders	1. Remove any one glow plug. Depress the throttle part way and crank the engine for 5 seconds. If no fuel vapors come out of the glow plug hole, go to step e. If fuel vapors are noticed remove the remainder of the glow plugs and see if fuel vapors come out of each hole when the engine is cranked. If fuel comes out of one glow plug hole only clean and test the injection nozzle in that cylinder. Crank the engine and check to see that fuel vapors are coming out of all glow plug holes. If fuel is coming from each cylinder,

	go to step k.
e. Plugged Fuel Return System	1. Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection, route it to the metal container. Crank the engine. If it starts and runs, correct restriction in fuel return lines. If it does not start, remove the ball check connector from the top of the injection pump and make sure that it is not plugged.
f. No Fuel To Injection Pump — Restricted Fuel Filter	1. Install 1/8 hose on the air bleed port, place hose in container. Open the filter air bleed. Crank the engine, the fuel should come out of hose. If fuel is present go to step j.
g. Fuel Pump Inoperative	1. Remove inlet hose to fuel pump. Connect a hose to the pump from a separate container that contains fuel. Open the filter air bleed. If fuel is not present, replace the pump. Use care to direct the fuel away from source of ignition.
h. Restricted Fuel Tank Filter	1. Remove fuel tank and check filter. (Filter for diesel fuel is white and has a check valve in one end.)
i. No Voltage To Fuel Solenoid	1. Connect a voltmeter to the wire at the injection pump solenoid and ground. The voltage should be a minimum of 9 volts. If there is inadequate voltage, refer to the ELECTRICAL DIAGNOSIS for more information.
j. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
k. Pump Timing Incorrect	Make certain that pump timing mark is aligned with mark on front cover.

	l. Low Compression	1. Check compression to determine cause.
	m. Injection Pump Malfunction	1. Remove injection pump for repair.
Engine Starts But Will Not Continue To Run At Idle	a. Slow Idle Incorrectly Adjusted	1. Adjust idle screw to specification.
	b. Fast Idle Solenoid Inoperative	1. With engine cold, start engine; solenoid should move to hold injection pump lever in "fast idle position." If solenoid does not move, refer to ELECTRICAL DIAGNOSIS.
	c. Restricted Fuel Return System	1. Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection; route it to the metal container. Crank the engine and allow it to idle. If engine idles normally, correct restriction in fuel return lines. If engine does not idle normally, remove the return line check valve fitting from the top of the pump and make sure it is not plugged.
	d. Glow Plugs Turn Off Too Soon	1. Refer to ELECTRICAL DIAGNOSIS.
	e. Pump Timing Incorrect	1. Make certain that timing mark on injection pump is aligned with mark on front cover.
	f. Limited Fuel To Injection Pump	1. Test the engine fuel pump; check fuel lines. Replace or repair as necessary.
	g. Incorrect or Contaminated Fuel	1. Flush fuel system and install correct fuel.
	h. Low Compression	1. Check compression to determine cause.
	i. Fuel Solenoid Closes In Run Position	1. Ignition switch out of adjustment. If OK, refer to ELECTRICAL DIAGNOSIS.
	j. Injection Pump Malfunction.	1. Remove injection pump for repair.
Excessive surge at light throttle, under load. NOTE: If engine has a rough idle,	a. Torque converter clutch engages too soon.	1. See Section 7A, "Torque Converter Clutch Diagnosis."
	b. Timing retarded	1. Be sure timing mark on injection pump is aligned with mark or front cover.

	c. Clogged Fuel Filter	1. Check fuel pump pressure on inlet and outlet sides of filter.
	d. Injection Line Volume Too Low.	1. Replaced affected line(s).
Engine Cold Starts and Idle Rough WITH Excessive Noise and/or Smoke, But Clears Up After Warm-Up	a. Incorrect starting procedure.	1. Advise operator on correct starting procedure.
	b. Injection Pump Timing Incorrect	1. Be sure timing mark on injection pump is aligned with mark on front cover.
	c. Insufficient Engine Break-In Time	1. Break-in engine 2000 or more miles.
	d. Air in System	1. Install a section of clear plastic tubing on the fuel return fitting from the engine. Evidence of bubbles in fuel when cranking or running indicates the presence of an air leak in the suction fuel line. Locate and correct.
	e. Nozzle(s) Malfunctiom	1. Loosen injection line at nozzle. If no R.P.M. drop remove and test. Replace as necessary.
	f. In-Op Glow Plug	1. Replace faulty glow plug.
Engine Misfires Above Idle But Idles Correctly	a. Plugged Fuel Filter	1. Replace filter.
	b. Incorrect Injection Pump Timing	1. Align timing mark on injection pump with mark on front cover.
	c. Incorrect or Contaminated Fuel	1. Flush fuel system and install correct fuel.
Engine Will Not Return To Idle	a. External Linkage Binding Or Misadjusted	1. Free up linkage. Adjust or replace as required.
	b. Fast Idle Malfunction	1. Check fast idle adjustment.
	c. Internal Injection Pump Malfunction	1. Remove injection pump for repair.
Fuel Leaks On Ground-No Engine Malfunction	a. Loose or Broken Fuel Line or Connection	1. Examine complete fuel system, including tank, lines, and injection lines. Determine source and cause of leak and repair.
	b. Injection Pump Internal Seal Leak	1. Remove injection pump for repair.

Noticeable Loss Of Power	a. Restricted Air Intake	1. Check air cleaner element.
	b. EGR Malfunction	1. Refer to Section 6E.
	c. Restricted or Damaged Exhaust System	1. Check system and replace as necessary.
	d. Plugged Fuel Filter	1. Replace filter.
	e. Stuck Advance Piston	1. Increased power loss above 1500 RPM. Remove pump.
	f. Air Leak On Suction Side of Fuel Pump	1. Disconnect at pump, pressurize and check for leaks.
	g. Plugged Fuel Tank Vacuum Vent In Fuel Cap	1. Remove fuel cap. If loud "hissing" noise is heard, vacuum vent in fuel cap is plugged. Replace cap. (Slight hissing sound is normal.)
	h. Restricted Fuel Supply From Fuel Tank To Injection Pump	1. Examine fuel supply system to determine cause of restriction. Repair as required.
	i. Restricted Fuel Tank Filter	1. Remove fuel tank and check filter. (Filter for diesel fuel is white.)
	j. Pinched or Otherwise Restricted Return System	1. Examine system for restriction and correct as required.
	k. Incorrect or Contaminated Fuel	1. Flush fuel system and install correct fuel.
	l. External Compression Leaks	1. Check for compression leaks at all nozzles and glow plugs, using "Leak-Tec" or equivalent. If leak is found, tighten nozzle or glow plug.
	m. Plugged Nozzle(s)	1. Remove nozzles. Have them checked for plugging
	n. Low Compression	1. Check compression to determine cause.
Noise - "Rap" From One or More Cylinders (Sounds Like Rod Bearing Knock)	a. Nozzle(s) Sticking Open or With Very Low Nozzle Opening Pressure	1. Loosen injection line at nozzle. If no R.P.M. drop remove and test. Replace as necessary.
	b. Mechanical Problem	1. Refer to Mechanical Diagnosis.

Excessive Black Smoke And/or Objectionable Combustion and Noise	a. Timing Not To Specification	1. Make certain timing marks are aligned.
	b. EGR Malfunction	1. Refer to Emission Diagnosis (Section 6E)
	c. Blocked Leg In Intake Manifold	1. Probe Each Leg for Blockage.
	d. Injection Pump Internal Problem	1. Remove Injection Pump for Repair.
Engine Noise - Internal Or External	a. Engine Fuel Pump, Generator, Water Pump, Valve Train,Vacuum Pump, Bearings, Etc.	1. Repair or replace as necessary. If noise is internal, see Diagnosis For Noise - Rap From One or More Cylinders and Engine Starts and Idles Rough With Excessive Noise and/or Smoke.
Engine Overheats	a. Coolant System Leak, Oil Cooler System Leak or Coolant Recovery System Not Operating.	1. Check for leaks and correct as required. Check coolant recover jar, hose and radiator cap.
	b. Belt Slipping or Damaged	1. Replace or adjust as required.
	c. Thermostat Stuck Closed	1. Check and replace if required.
	d. Head Gasket Leaking	1. Check and repair as required.
Instrument Panel Oil Warning Lamp "ON" at Idle	a. Oil Cooler or Oil or Cooler Line Restricted	1. Remove restrictions in cooler or cooler line.
	b. Oil Pump Pressure Low	
Engine Will Not Shut Off With Key NOTE: With engine at idle, pinch the fuel return line at the flexible hose to shut off engine.	a. Injection Pump Fuel Solenoid Does Not Return Fuel Valve To "OFF" Position	1. Refer to ELECTRICAL DIAGNOSIS.
Engine Starts, Idles Rough, WITHOUT Abnormal Noise or Smoke	a. Slow Idle Incorrectly Adjusted	1. Adjust slow idle screw to specification.
	b. Injection Leaks	1. Wipe off injection lines and connections. Run engine and check for leaks. Correct leaks.
	c. Restricted Fuel Return System	1. Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection; route it to the metal container. Start the engine and allow it to idle; if engine idles normally, correct restriction in fuel return lines. If engine does not idle normally, remove the return line check valve fitting from the top of the pump and make sure it is not plugged.
	d. Air In System	1. Install a section of clear plastic tubing on the fuel return fitting from the engine. Evidence of bubbles in fuel when cranking or running indicates the presence of an air leak in the suction fuel line. Locate and correct.

e. Incorrect or Contaminated Fuel	1. Flush fuel system and install correct fuel.
f. Nozzle(s) Malfunction	1. Loosen injection line at nozzle. If no RPM drop remove and test. Replace as necessary.
g. Glow Plug Inoperative	1. Replace.

ENGINE COMPRESSION TEST (DIESEL ENGINES)

COMPRESSION TEST

To determine if the valves or rings are the cause of low compression, a test should be made to determine the cylinder compression pressure.

When checking compression, the batteries should be at or near full charge. The lowest reading cylinder should not be less than 80% of the highest and no cylinder reading should be less than 300 p.s.i. (2068 kPa).

1. Remove air cleaner then install air crossover cover J-26996-1 or J-29664-2.
2. Disconnect the wire from the fuel solenoid terminal of the injection pump.
3. Disconnect wires from glow plugs then remove all glow plugs.
4. Screw J-26999-10 and compression gage J-26999 into glow plug hole of the cylinder that is being checked.
5. Crank engine.

This should be done with six "puffs" per cylinder.

- Normal - Compression builds up quickly and evenly to specified compression on each cylinder.
- Piston Rings Leaking - Compression low on first stroke tends to build up on following strokes but does not reach normal.

NOTICE: Do not add oil to any cylinder to compression test as extensive damage may result.

ENGINE COMPRESSION TEST (GASOLINE ENGINES)

ENGINE COMPRESSION TEST

This should be done with four "puffs" per cylinder.

- Normal - Compression builds up quickly and evenly to specified compression on each cylinder.
- Piston Rings Leaking - compression low on first stroke tends to build up on following strokes but does not reach normal. Improves considerably with addition of oil.
- Valves Leaking - Low on first stroke does not tend to build up on following strokes. Does not improve much with addition of oil.

  Use approximately three squirts from a plunger type oiler.

1. Disconnect the "BAT" terminal from the HEI distributor.
2. When checking cylinder compression, the throttle and choke should be open, all spark plugs removed, and the battery at or near full charge. The lowest reading cylinder should not be less than 70% of the highest and no cylinder reading should be less than 100 pounds.

SECTION 6A1

4.1 LITER L-6 VIN CODE D RPO (LE3)

4.8 LITER L-6 VIN CODE T RPO (L25)

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GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 6 cylinders arranged "In-Line". Seven main bearings support the crankshaft which is retained by recessed bearing caps that are machined with the block for proper alignment and clearances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cast iron cylinder head has individual intake and exhaust ports for each cylinder. Valve guides are integral and rocker arms are retained on individual threaded studs pressed into head. The 4.1 L(D) heads have integrated inlet manifolds. The 4.8 L(T) uses separate inlet manifolds.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by seven main bearings. Number seven bearing is the end thrust bearing. Main bearings are lubricated from oil holes which intersect the main oil gallery located on the right side of the block. The cam bearings are also fed oil by intersecting holes with main oil gallery. The lifters are located in the main oil gallery.

A damper assembly, on the forward end of the crankshaft, dampens any engine torsional vibrations. The outer ring of the damper is grooved for the accessory drive belts.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by four bearings and is gear driven. A cast iron crankshaft gear drives the aluminum camshaft gear. Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifters, causes the valve lifters to rotate.

PISTONS AND CONNECTING RODS

The pistons are made of a cast aluminum alloy using two compression rings and one oil control ring.

Piston pins in the 4.1 L (D) engine are offset .060" (1.5mm) toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. This also provides for quieter operation. 4.8 L (T) engine piston pins are on piston centerline for best durability and reduced friction. Pins are chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifters and push rods to the rocker arms. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball is retained by a self locking nut.

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact for quiet operation.

The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point (base circle) of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball traps the oil in the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve. A very small amount of oil will leak out between the plunger and the body.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will be refilled with oil.

INTAKE MANIFOLD

The intake manifold is of cast iron, single level design for efficient fuel distribution. The 4.1 L (D) manifold is an integral unit with the head on all vehicles. 4.8 L (T) engines use separate components. The carburetor pad is centrally located with an early fuel evaporation (EFE) passage running underneath the pad, through which exhaust gases are forced, to promote faster fuel vaporization when the engine is cold. An exhaust gas recirculation port is also cast into the manifold on 4.1 L (D) engines, for the induction of a metered amount of exhaust gases into the air and fuel mixture which has entered through the carburetor.

EXHAUST MANIFOLD

On 4.8 L (T) engines a single four port, underslung, center take down manifold of nodular iron is used to direct exhaust gases from the combustion chambers. On 4.1 L (D) engines a single four port, underslung, dual center take down manifold of nodular iron is used. A heat shield is mounted to the manifold that is used to route heated air to the air cleaner for better fuel vaporization.

Engine Lubrication

Full pressure lubrication, through a full flow oil filter is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump.

Oil drawn by the pick-up screen and pipe is pressurized in the pump and routed to the oil filter. If excessive backpressure is encountered at the filter, a bypass valve allows oil flow to the main oil gallery, located along the right side of the block. This rifle drilled gallery supplies oil to the camshaft bearings, the hydraulic lifters and the crankshaft main bearings.

The connecting rod bearings are supplied oil from the crankshaft main bearings by means of cross drilled passages.

The valve train is supplied its lubrication from the valve lifters. Oil within the lifters is pumped up through the top of the lifters through the hollow push rods to the rocker arms. From the head, oil is drained back to the crankcase through oil drain back holes and the push rod holes. (Fig. 6A1-1).

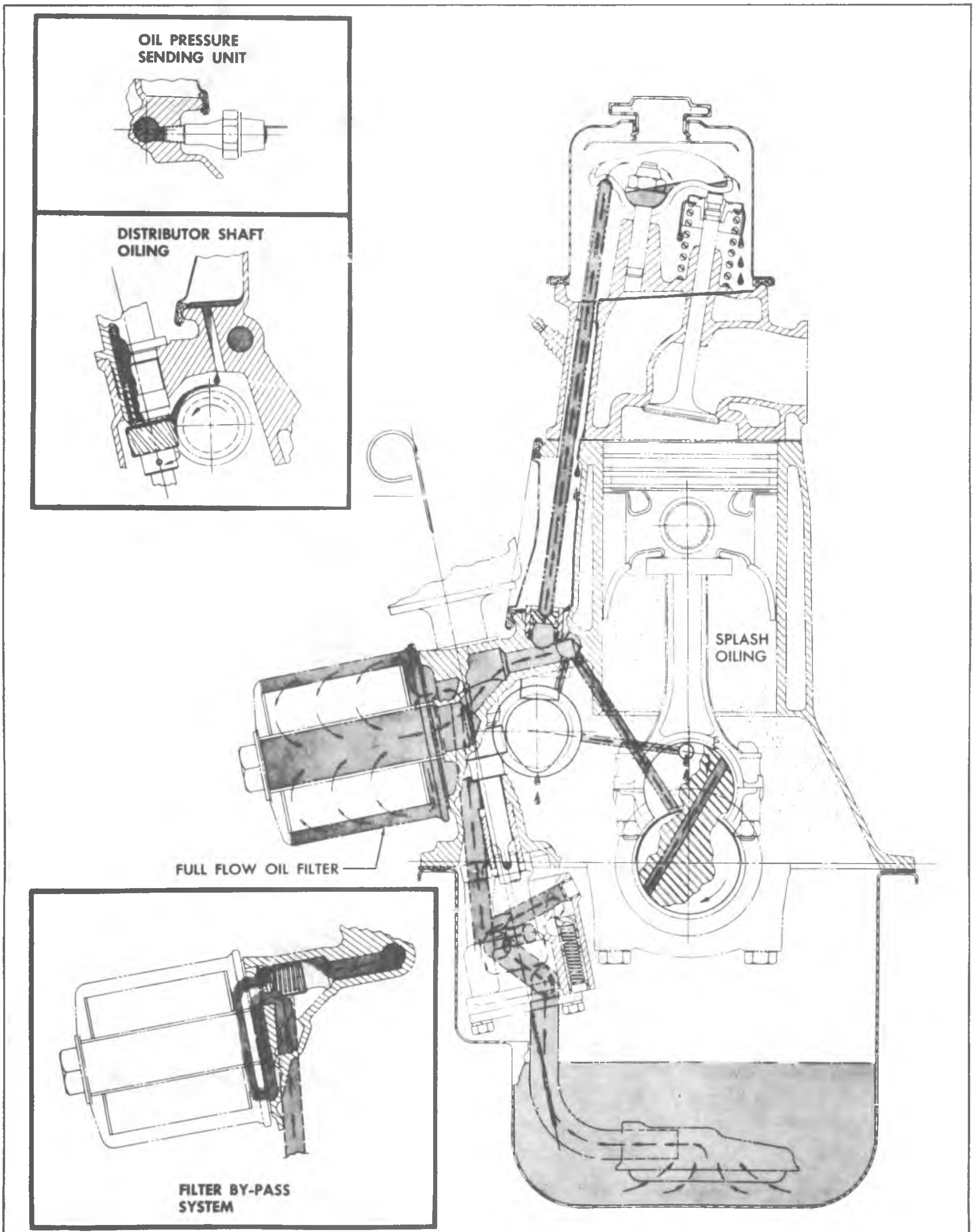

Fig. 6A1-1--In-Line Engine Lubrication

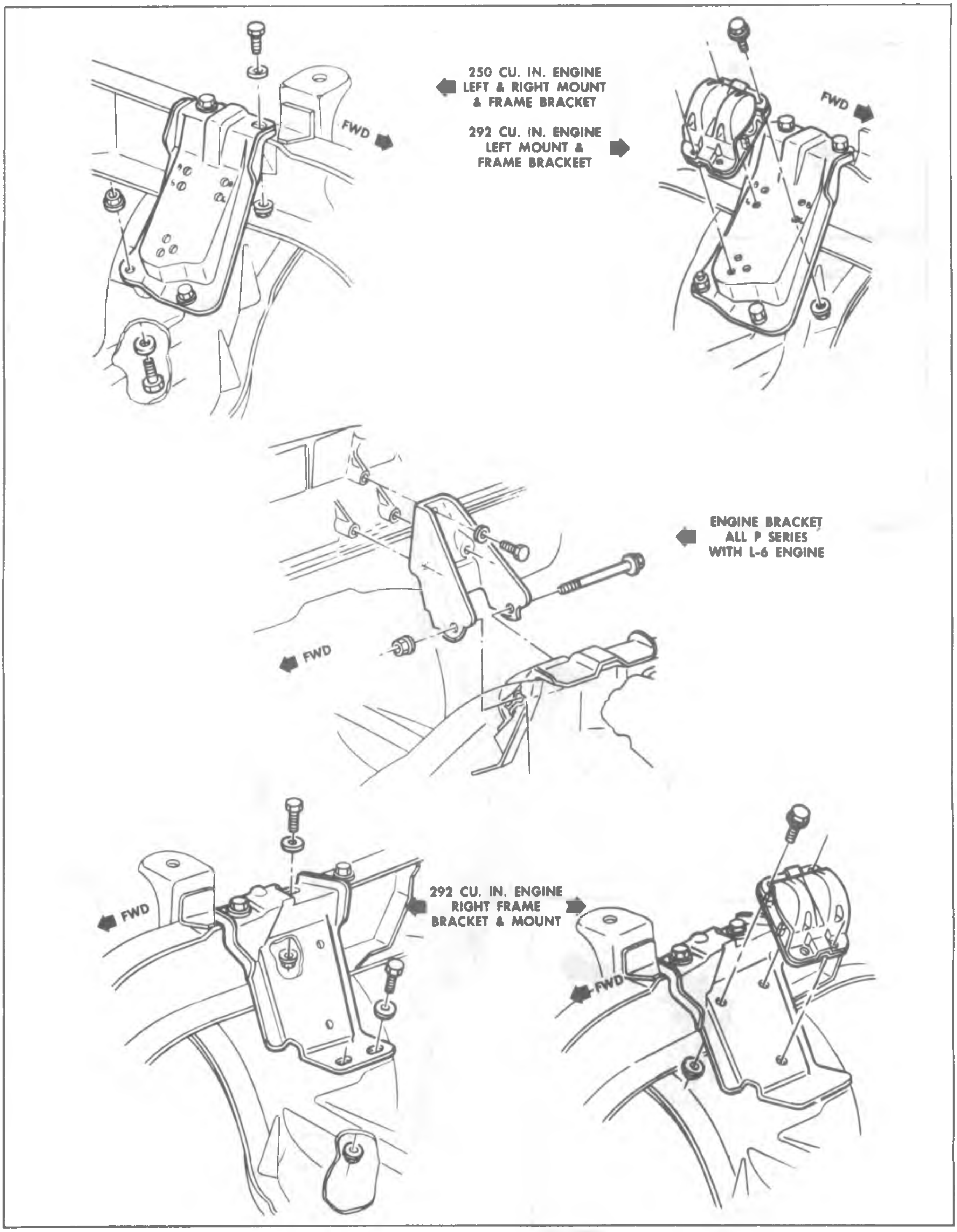

Fig. 6A1-2--"P" Series - Engine Front Mount

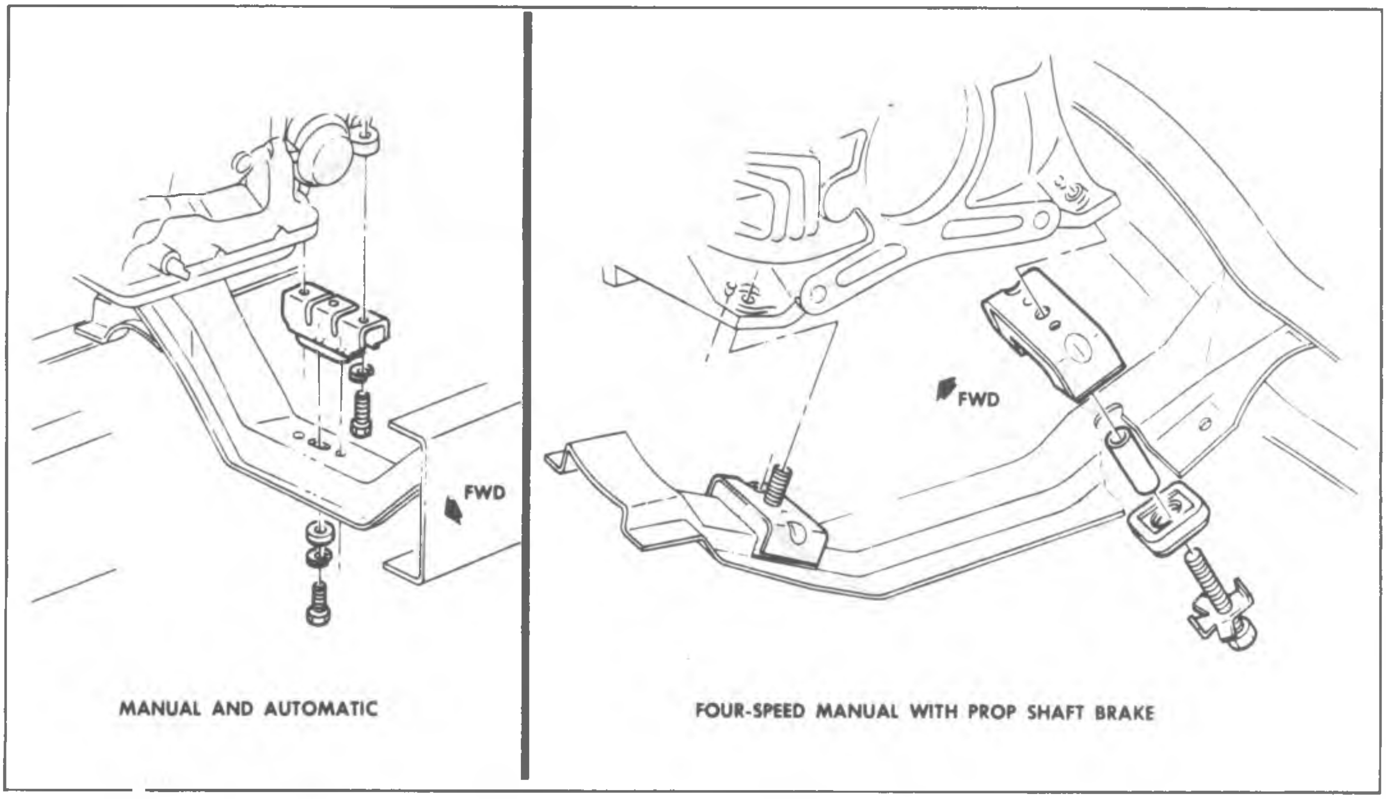

Fig. 6A1-3--"P" Series - Engine Rear Mount

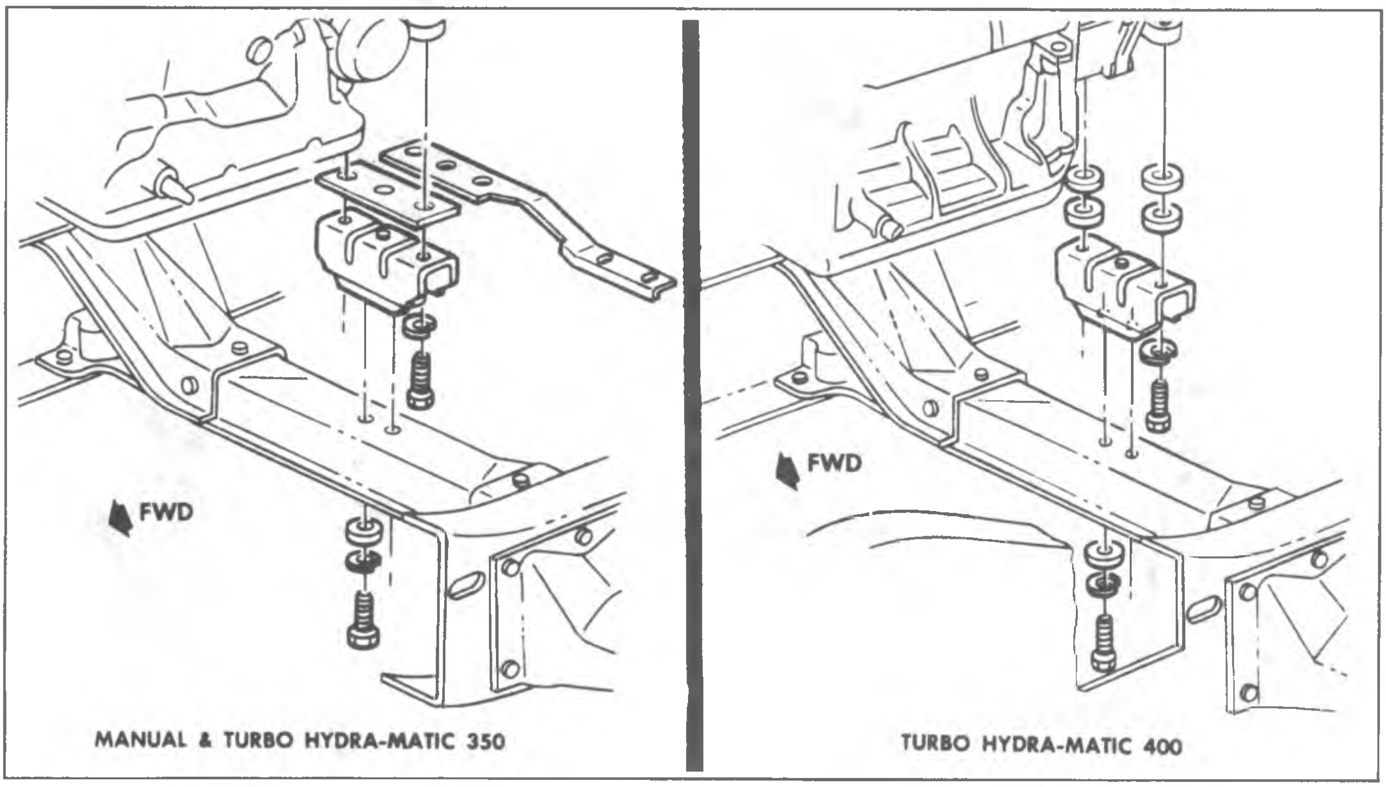

Fig. 6A1-4--"C" Series - Engine Rear Mounts

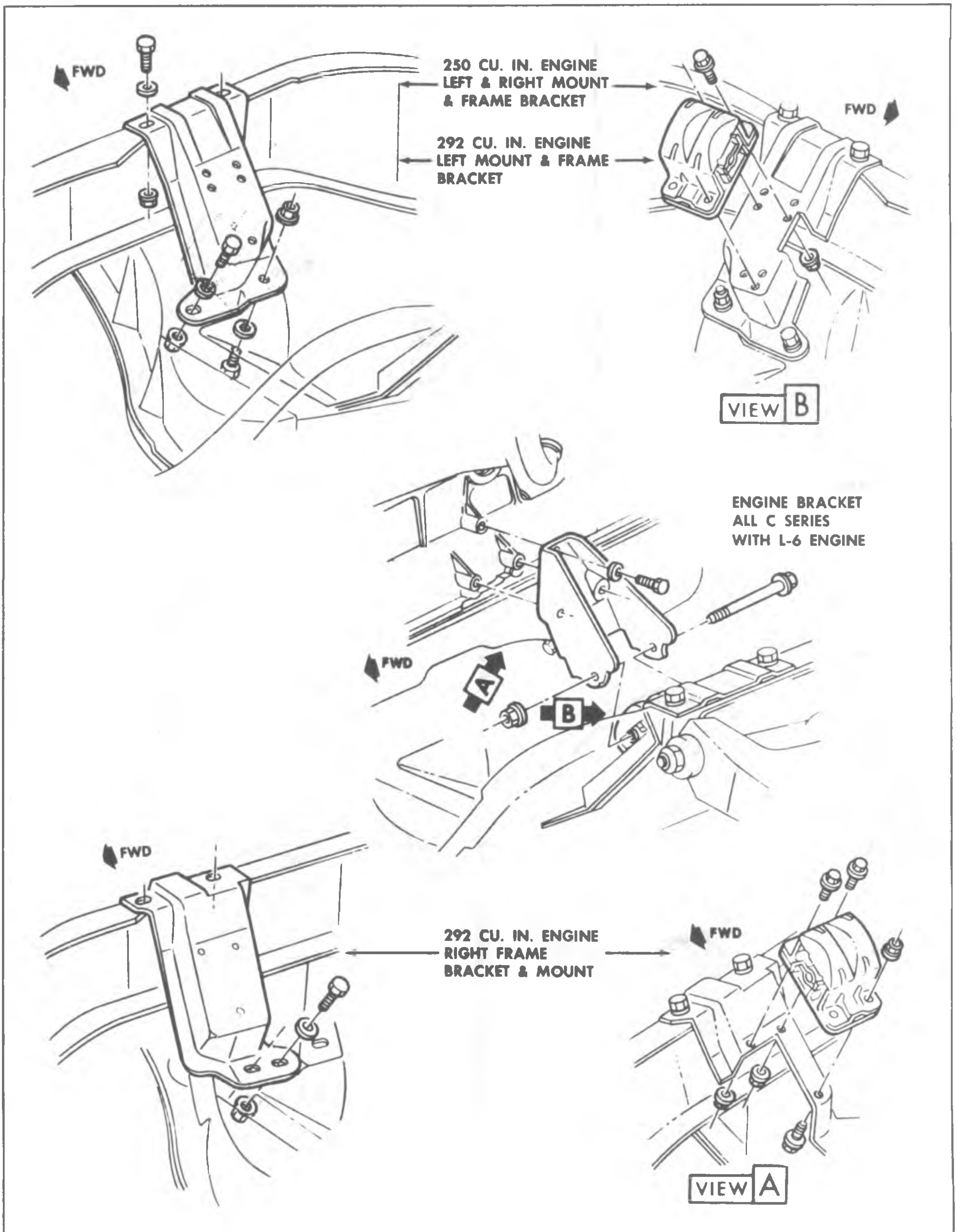

Fig. 6A1-5--"C" Series - Engine Front Mount

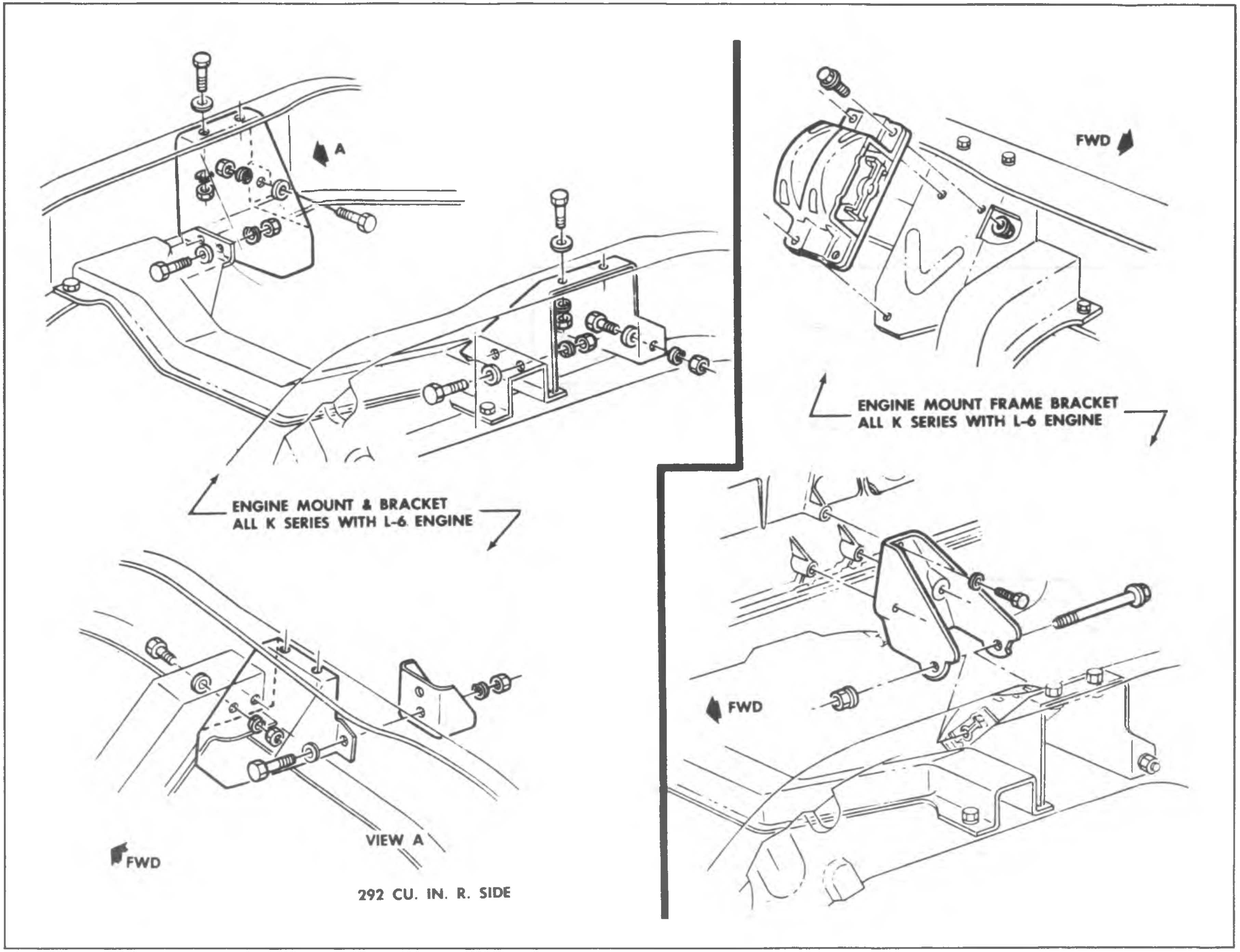

Fig. 6A1-6--"K" Series - Engine Front Mount

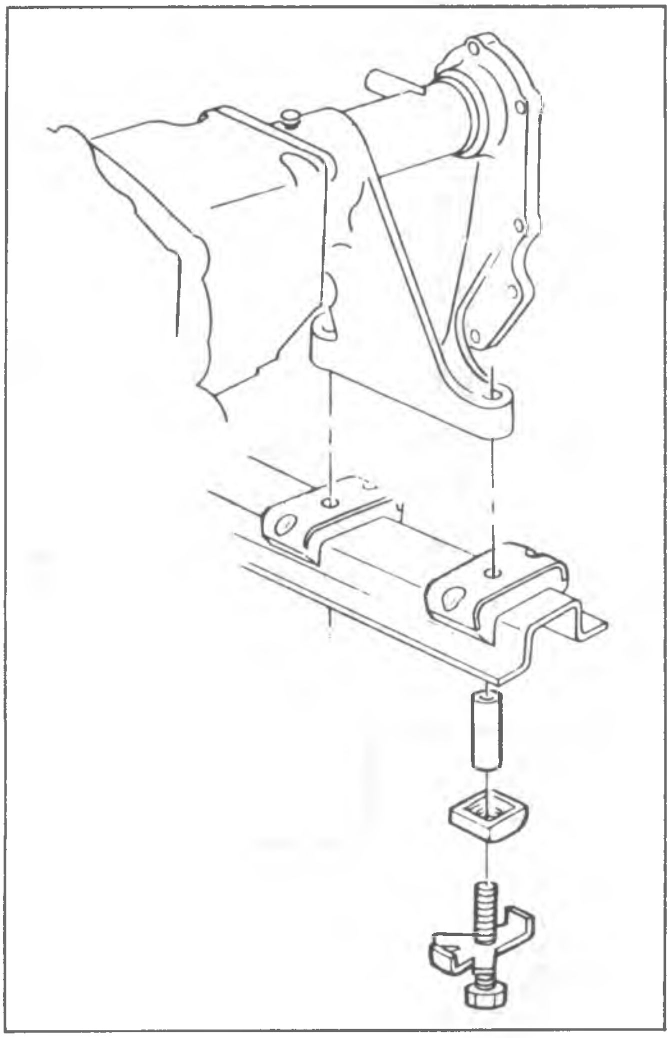

Fig. 6A1-7--"K" Series - Engine Rear Mount

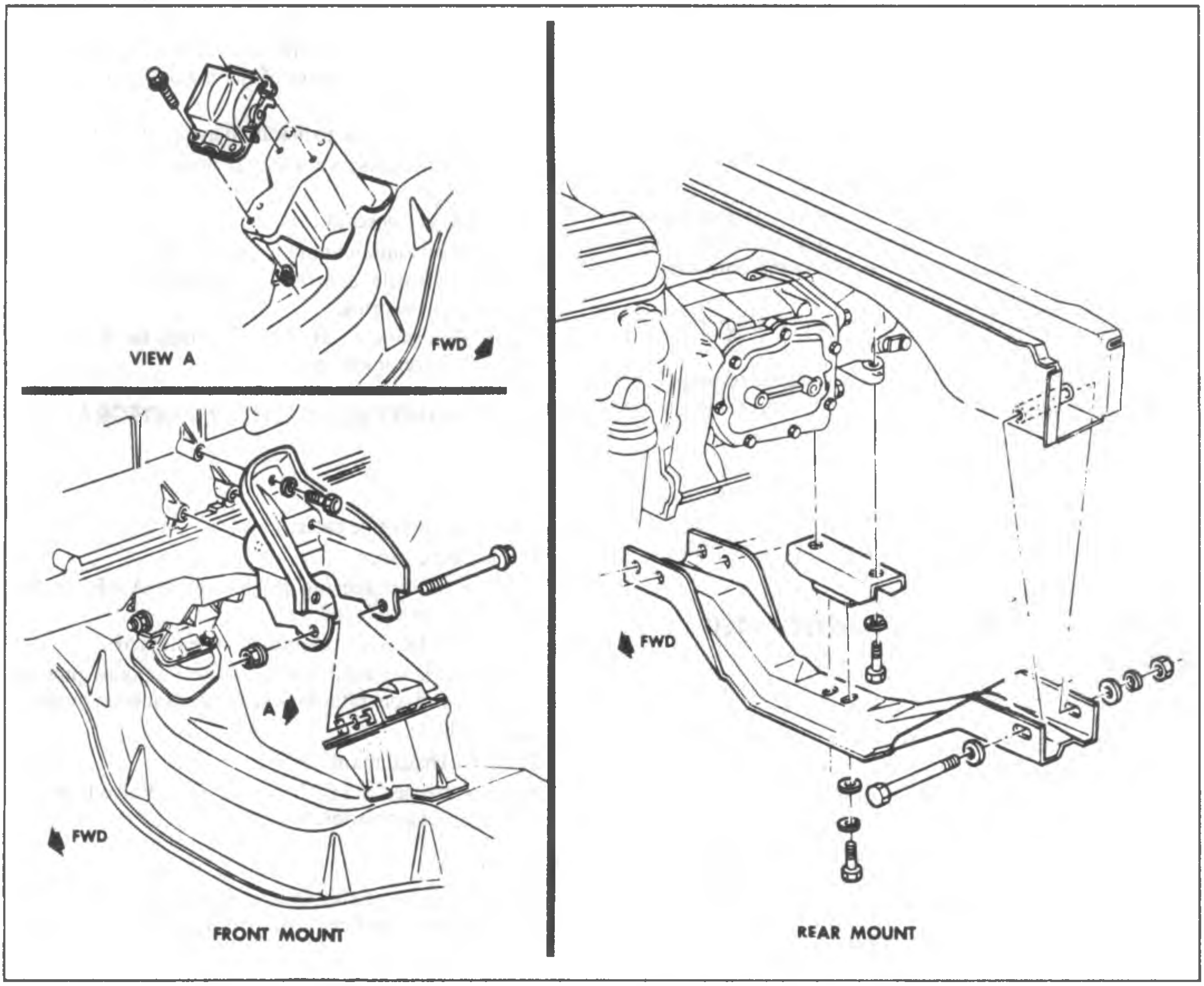

Fig. 6A1-8--"G" Series - Engine Mounts

ON VEHICLE SERVICE

ENGINE MOUNTS

Engine mounts (Fig. 6A1-2 - 6A1-8) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately. because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;

b. Rubber separated from a metal plate of the mount;

c. Rubber split through center,

replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailsahft moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Remove engine mount through bolt.
2. Raise engine and remove mount to frame bracket attaching bolts. Remove mount. Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel.

3. Install new engine mount to frame bracket and torque attaching bolts to specifications.
4. Install engine mount through bolt and torque to 30 lb. ft. (40 N·m) specifications.

Rear Mount Replacement

1. Support engine weight to relieve rear mounts.
2. Remove crossmember-to-mount bolts.
3. On "P" Series with manual transmission and propeller shaft parking brake, remove mount attaching bolts from frame outrigger and clutch housing and remove rear mounting cushions.
4. Remove mount-to-transmission bolts, then remove mount.
5. On "P" Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.
6. Install new mount on transmission.
7. While lowering transmission, align and start cross-member-to-mount bolts.
8. Torque bolts to 45 lb. ft. (60 N·m) then bend lock tabs to bolt head as applicable.

MANIFOLD ASSEMBLY - NON-INTEGRATED HEAD

Removal

1. Disconnect battery negative cable at battery.
2. Remove air cleaner.
3. Disconnect both throttle controls at bellcrank and remove throttle return spring.
4. Disconnect fuel and vacuum lines at carburetor.
5. Disconnect crankcase ventilation hose at rocker arm cover.
6. Disconnect vapor hose at canister.
7. Disconnect exhaust pipe at manifold flange.
8. Remove manifold attaching bolts and clamps then remove manifold assembly.
9. Check for cracks in manifold castings.
10. Separate manifolds by removing one bolt and two nuts at center of assembly.
11. Observe gaskets and packing if necessary to diagnose a leakage problem.

Installation

1. Clean gasket surfaces on cylinder head and manifolds.
2. Lay a straight edge along the full length of the exhaust port faces and measure any gaps between the straight edge and the port faces. If at any point a gap of .030" (.80mm) or more exists, it is likely that the manifold has distorted to a point where it will not seat properly. If a good exhaust seal is to be expected, the exhaust manifold must be replaced.
3. Assemble intake and exhaust manifolds using a new gasket by reinstalling the one bolt and two nuts at the center of the manifold to finger tight.
4. Position a new gasket over manifold end studs on the cylinder head.
5. Install manifold assembly bolts, clamps and washers while holding manifold assembly in place by hand.
6. Clean, oil and torque all manifold assembly to cylinder head bolts and nuts to 40 lbs. ft. (55 N·m).
7. Complete torquing the inlet to exhaust manifold bolt and two nuts at the center of the manifold to 45 lb. ft. (61 N·m).
8. Connect exhaust pipe to manifold using a new packing.
9. Connect crankcase ventilation hose at rocker arm cover.
10. Connect vapor hoses at canister.
11. Connect fuel and vacuum lines a carburetor.
12. Connect throttle controls at bellcrank and install throttle return spring.
13. Install air cleaner, start engine, check for leaks and adjust carburetor idle speed.

EXHAUST MANIFOLD ASSEMBLY - INTEGRATED HEAD

Removal

1. Disconnect negative battery cable.
2. Remove air cleaner.
3. Remove power steering pump and/or A.I.R. pump brackets, if so equipped.
4. Remove PAIR pipes as outlined in Section 6E.
5. Raise vehicle on hoist and disconnect exhaust pipe at manifold and converter bracket at transmission mount.
6. Lower vehicle.
7. Remove exhaust manifold bolts.
8. Remove exhaust manifold, check EFE Valve to see if free and check manifold for cracks.

Installation

If a new exhaust manifold is being installed, the E.F.E. valve and actuator and rod assembly must be transferred from the old component.

1. Clean gasket surface and position new gasket on exhaust manifold.
2. Install manifold bolts, while holding manifold assembly in place.
3. Torque all manifold to cylinder head bolts in sequence to torques shown in figure 6A1-9.
4. Raise vehicle on hoist.
5. Connect exhaust pipe at manifold flange and converter bracket at transmission mount. Attach exhaust pipe and align exhaust system. Torque attaching bolts to specification.

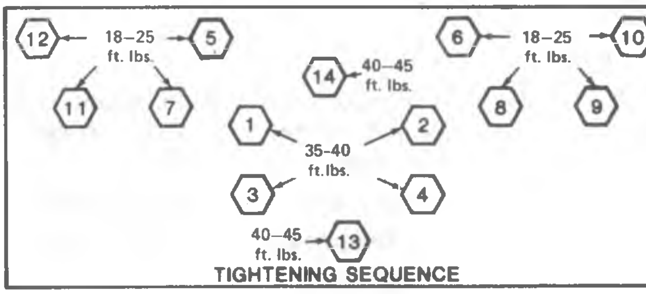

Fig. 6A1-9--Cylinder Head To Exhaust Manifold Tightening Sequence

6. Lower vehicle.
7. Install PAIR pipes as outlined in Section 6E.
8. Install power steering pump and/or A.I.R. pump and brackets, if so equipped. Tighten drive belt using strand tension gage.
9. Install air cleaner.
10. Connect negative battery cable.
11. Start engine and check for leaks.

ROCKER ARM COVER

Removal

1. Disconnect crankcase ventilation hose(s) at rocker arm cover.
2. Remove air cleaner.
3. Disconnect all wires, fuel and vacuum pipes from rocker arm cover clips.
4. On LE3 engines, remove pulse air pipes (as outlined in Section 6E) and disconnect accelerator linkage and springs from bracket.
5. Remove rocker arm cover bolts and remove cover.

   NOTICE: If cover adheres to cylinder head, try bumping end of rocker arm cover with a rubber mallet. If cover still will not come loose, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE.

Installation

1. Clean sealing surfaces on cylinder head and rocker arm cover with degreaser. Remove all loose pieces of RTV or pieces that will cause installation interference.
2. Place a 3/16" (5mm) bead of RTV sealant, #1052366 or equivalent, all around the rocker arm cover sealing surface of the cylinder head. When going around the attaching bolt holes, always flow the RTV on the inboard side of the holes.
3. Place cover on head while RTV is still wet, install retaining bolts and torque to 45 lb. in. (5N·m).
4. Connect wires, fuel and vacuum pipes at rocker arm cover clips.
5. Install pulse air pipes (as outlined in Section 6E), and accelerator linkage and springs where removed.
6. Install air cleaner.
7. Connect crankcase ventilation hoses (where so equipped).

PUSH ROD SIDE COVER

Removal

1. Disconnect battery negative cable.
2. "CK" Models-Remove dipstick tube (rear cover).
3. Remove cover bolts.
4. Remove cover. If cover sticks to block, a heated knife blade, or similar device, used to pry at the sealing surfaces will aid in removal.

Installation (Front Cover)

1. Clean sealing surfaces of both the cover and block with degreaser. Remove loose RTV, or pieces causing installation interference.
2. Place a continuous 1/8" (3mm) bead of RTV sealant, #1052366 or equivalent, all around the cover sealing surface. Place cover on block while sealant is still wet (within 10 minutes). Install retaining bolts and torque to 50 lb. in. (5.6 N·m).
3. "CK" Models - Clean dipstick tube and apply sealant #1052080 or equivalent around tube 1/2" below bead. Install dipstick tube.
4. Connect battery negative cable.

VALVE MECHANISM

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place rocker arms, rocker arm balls and push rods in a rack so that they may be reinstalled in the same location.

Installation and Adjustment

Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:
   a. Mark distributor housing, with chalk, at #1 and #6 positions (plug wire). Remove distrubutor cap and lay aside.
   b. Crank engine until distributor rotor points to #1 cylinder position. The following valves can be adjusted with engine in #1 firing position:
      #1 cylinder-Exhaust and Intake.
      #2 cylinder-Intake
      #3 cylinder-Exhaust
      #4 cylinder-Intake
      #5 cylinder-Exhaust
   c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by rotating the push rod while turning adjusting nut (Fig. 6A1-10). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).
   d. Crank engine until distributor rotor points to #6 position. The following valves can be adjusted with engine in #6 firing position:

      #2 cylinder-Exhaust
      #3 cylinder-Intake
      #4 cylinder-Exhuast
      #5 cylinder -Intake
      #6 cylinder-Intake and Exhuast
4. Install distributor cap.
5. Install rocker arm cover as outlined.
6. Adjust carburetor idle speed (if necessary).

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Replacement

1. Remove rocker arm cover as previously outlined.

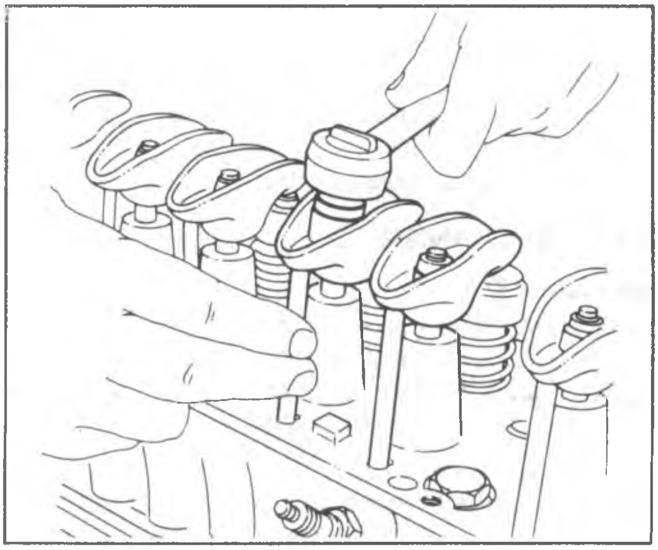

Fig. 6A1-10--Valve Adjustment

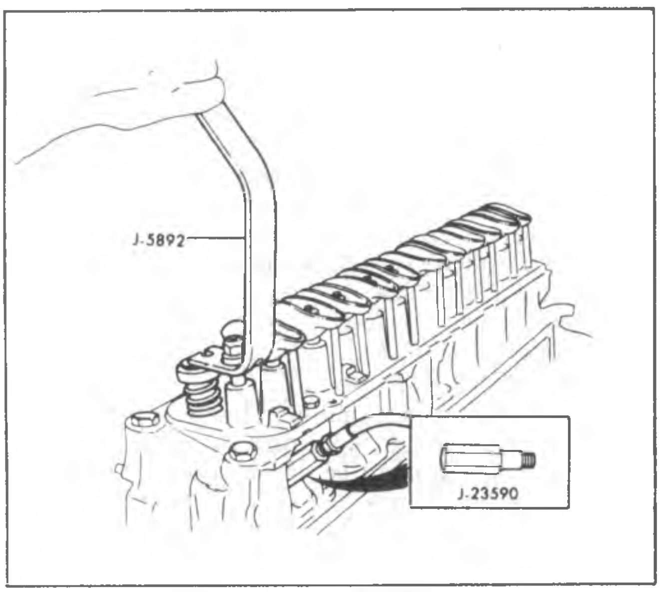

Fig. 6A1-11--Compressing Valve Spring

2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap, valve shield and valve spring and damper (fig. 6A1-11).
5. Remove the valve stem oil seal.
6. To replace, set the valve spring, oil shedder and valve cap in place. Compress the spring with Tool J-5892 and install new oil seal in the lower groove of the stem, making sure the seal is flat and not twisted. A light coat of oil on the seal will help prevent twisting.
7. Install the valve locks and release the compressor tool, making sure the locks seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
8. Using Tool J-23994, apply vacuum to the valve assembly to make sure no air leaks past the seal.
9. Install spark plug, and torque to 15 lb. ft. (20 N·m).
10. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design. Readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Removal

1. Remove rocker arm cover and loosen rocker arms sufficiently to remove the push rods. Place push rods in a rack so that they may be returned to their original location.
2. Mark distributor housing, with chalk, at #1 and #6 positions. Remove distributor cap and lay aside.
3. Remove push rod covers as outlined.
4. Remove valve lifters. Place valve lifters in a rack so that they may be installed in the same location.

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve (fig. 6A1-12).
3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver (fig. 6A1-13).

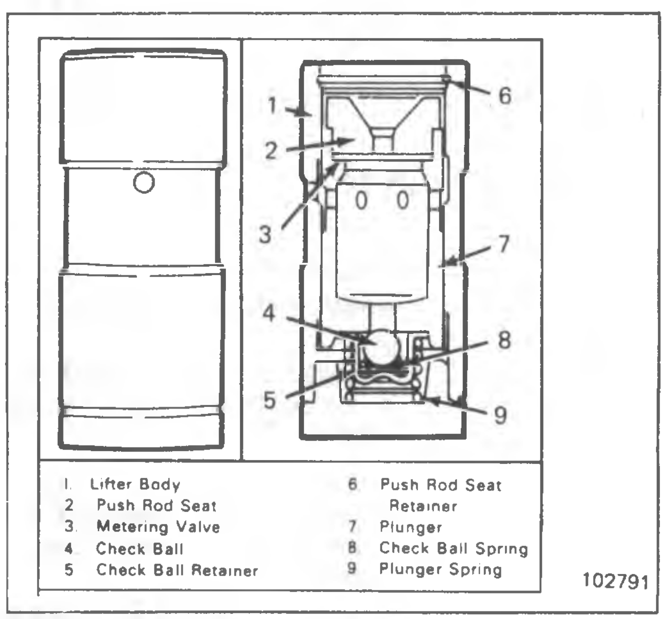

Fig. 6A1-12--Hydraulic Valve Lifter

Fig. 6A1-13--Removing Ball Check Valve

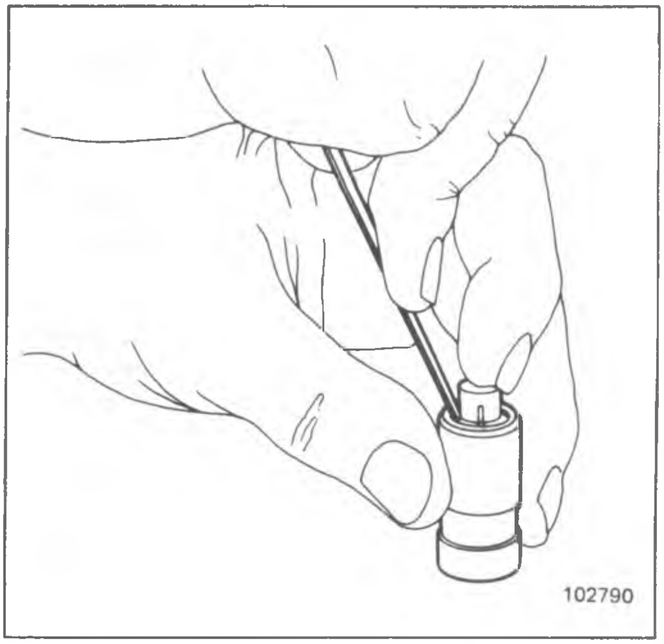

Fig. 6A1-14--Installing Ball Check Valve

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore, if the bottom of the lifter is scuffed or worn inspect the camshaft lobe, if the push rod seat is scuffed or worn inspect the push rod.

An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced.

For proper lifter rotation during engine operation, lifter foot must be convex.

Whenever a new camshaft is installed, replace oil, oil filter and all valve lifters. Install GM E.O.S. or equivalent over the cam and lifter feet after the parts are installed.

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver (fig. 6A1-14).
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" (3mm) drift pin into the plunger and press down solid. (Do not attempt to force or pump the plunger). At this point oil holes in the lifter body and plunger assembly will be aligned (fig. 6A1-15).
5. Insert a 1/16" (1.6mm) drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 6A1-15).

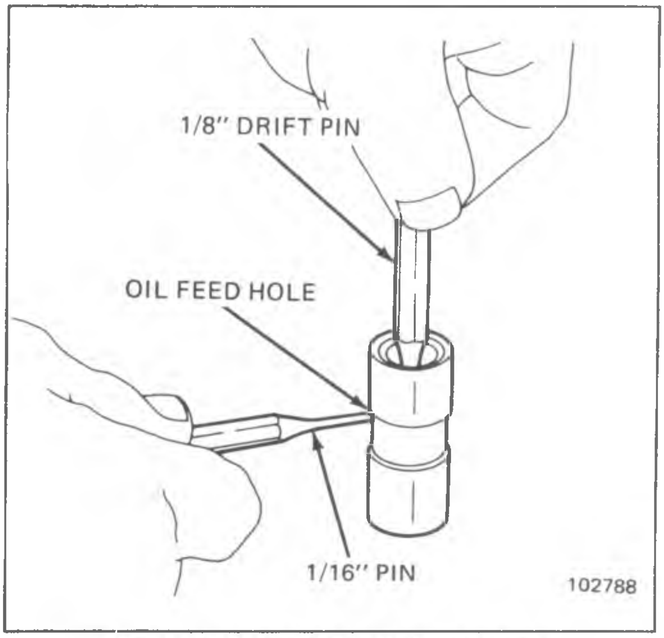

Fig. 6A1-15--Assembling Hydraulic Lifter

6. Remove the 1/8" (3mm) drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (refer to fig. 6A1-12).
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" (1.6mm) drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation.

Installation

1. Coat foot of valve lifters with "Molykote" or its equivalent. Install valve lifters.
2. Using a 1/8" (3mm) bead of RTV, #1052366 or equivalent, on the covers, install push rod side covers and torque bolts to specifications.
3. Install distributor cap.

4. Install push rods and adjust valve mechanism as outlined.
5. Adjust ignition timing and carburetor idle speed.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove manifold assembly as previosuly outlined.
2. Remove rocker arm cover and valve mechanism as previously outlined.
3. Drain cooling system.
4. Remove fuel and vacuum line from retaining clips then disconnect wires from temperature sending units.
5. Disconnect air injection hose at check valve (if so equipped).
6. Disconnect radiator upper hose at coolant outlet housing and battery ground strap.
7. Remove cyl:nder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

1. With the cylinder head removed, use tool J-8062 to compress the valve springs and remove the valve keys. Release the compressor tool and remove rotators or spring caps, oil shields springs and spring damper assemblies, then remove oil seals and valve spring shims.
2. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all deposits from combustion chambers and valve ports using Tool J-8089.
2. Thoroughly clean the valve guides using Tool J-8101.
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.

   NOTICE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.
3. Measure valve stem clearance as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover sealant rail. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem.
   b. Drop the valve head about 1/16" (1.6mm) off the valve seat.

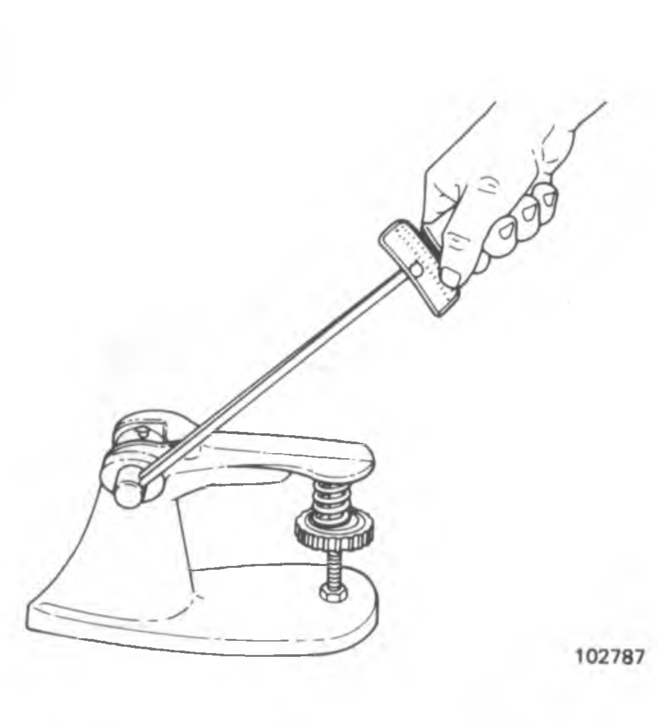

Fig. 6A1-16--Checking Valve Spring Tension

   c. Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications it will be necessary to ream valve guides for oversize valves as outlined.
4. Check valve spring tension with Tool J-8056 spring tester (fig. 6A1-16). Springs should be replaced if not within 10 lbs. (44 N) of the specified load (without dampers).
5. Inspect rocker arm studs for wear or damage.

Assembly

1. Insert valves in the proper ports.
2. Set the valve spring shim, valve spring (with damper), oil shields and valve cap or rotator in place (fig. 6A1-17).
3. Compress the spring with Tool J-8062.

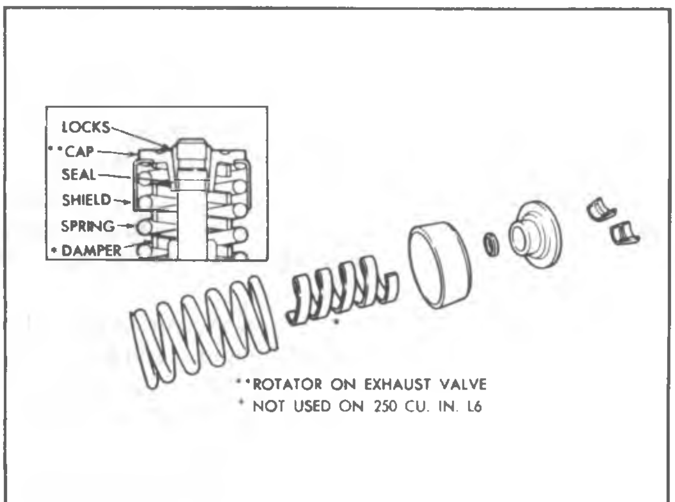

Fig. 6A1-17--Valve Spring Installation

4. Install new oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.
5. Install the valve keys and release the compressor tool, making sure that the keys seat properly in the upper groove of the valve stem.
6. Using Tool J-23994, apply vacuum to the valve assembly to make sure no air leaks past the seal.

Installation

The gasket surfaces on both the head and the block must be clean of any foreign matter and lay aside.

Cylinder bolt threads in the block and threads on the cylinder head bolt must be cleaned. (Dirt will affect bolt torque.) Do not use gasket sealer on composition steel asbestos gasket.

1. Place the gasket in position over the dowel pins.
2. Carefully guide cylinder head into place over dowel pins and gasket.
3. Coat threads of cylinder head bolts with sealing compound, #1052080 or equivalent, and install finger tight.
4. Tighten cylinder head bolts a little at a time until 95 lb. ft. (125N·m) torque is reached. The left-hand front head bolt torque is 85 lb. ft.(115 N·m).
5. Connect radiator upper hose and engine ground strap.
6. Connect temperature sending unit wires and install fuel and vacuum lines in clips.
7. Fill cooling system.
8. Install manifold assembly as previously outlined.
9. Install and adjust valve mechanism as previously outlined.
10. Install and torque rocker arm cover.
11. Connect AIR pipe (if so equipped).

ROCKER ARM STUDS

Replacement

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced with new studs available in .003" and .013" oversize. Studs may be installed after reaming the holes as follows:

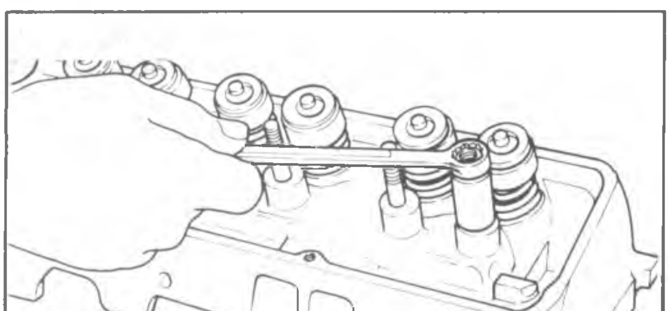

Fig. 6A1-18--Removing Rocker Arm Stud - Typical

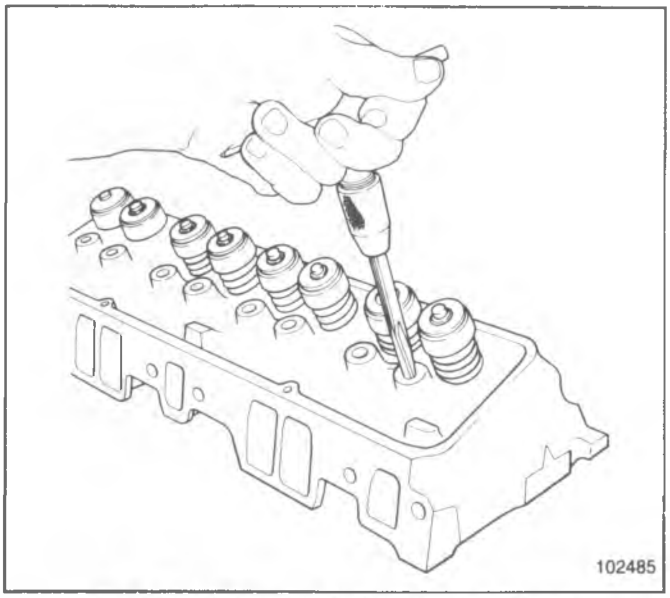

Fig. 6A1-19--Reaming Rocker Arm Stud Bore - Typical

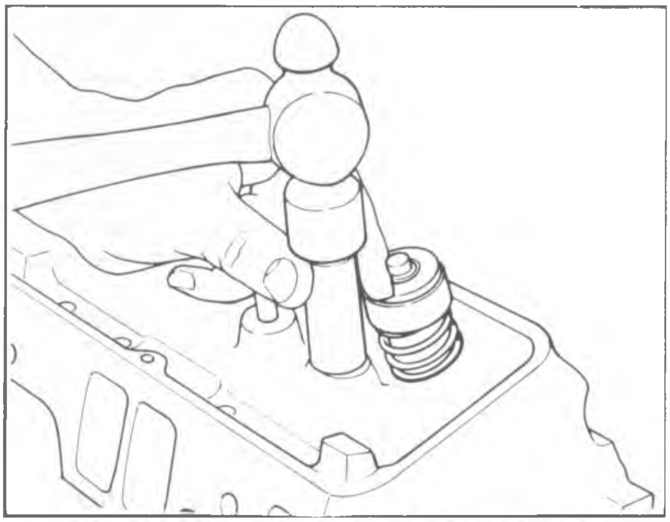

Fig. 6A1-20--Installing Rocker Arm Stud - Typical

1. Remove old stud by placing Tool J-5802-A over the stud, installing nut and flat washer and removing stud by turning nut (fig. 6A1-18).
2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 6A1-19).

   NOTICE: Do not attempt to install an oversize stud without reaming stud hole as this could damage the casting.
3. Coat press-fit area of stud with hypoid axle lubricant. Install new stud, using Tool J-6880 as a guide. Gage should bottom on head (fig. 6A1-20).

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves, use Tool Set J-5830.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valves seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide.

VALVES

Several different types of equipment are available for refacing valves. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Valves that are pitted on the seating face can be ground at the proper angle to retain correct head to valve stem and face relationship.

When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" (.80 mm) thick after grinding, replace the valve.

Valve stems which show excessive wear, or valves that are warped excessively should be replaced.

TORSIONAL DAMPER

Removal

1. Drain radiator and remove.
2. Remove accessory drive belt(s) and pulley (if so equipped).
3. Remove drive pulley from torsional damper.
4. Install Tool J-23523 to damper and turn puller screw to remove damper (fig. 6A1-21).

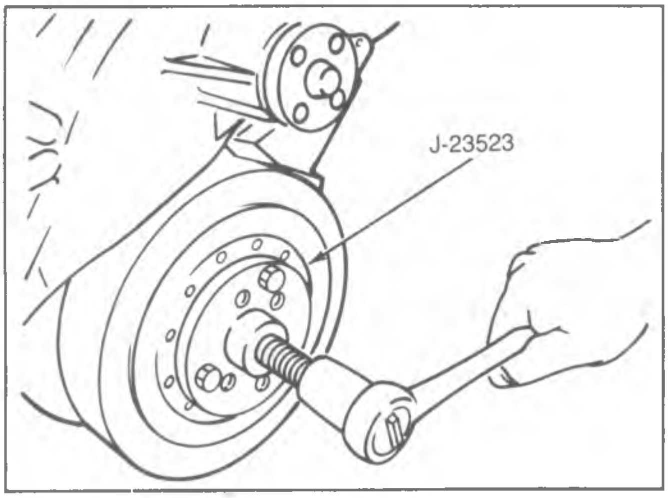

Fig. 6A1-21--Removing Torsional Damper

Installation

1. Coat front cover oil seal contact area of damper with engine oil. Add small amount of sealant to keyway.

   NOTICE: It is necessary to use installer Tool J-22197 to prevent the inertia weight section from walking off the hub during installation of damper.

   The damper on the L25 engine should be pulled on by using special tool J-23523 or equivalent.
2. Attach damper installer Tool J-22197 to damper. Tighten fingers of tool to prevent weight from moving.
3. Position damper on crankshaft and drive into position, using J-5590 until it bottoms against crankshaft gear. Remove installer tool.
4. Install drive pulley on torsional damper (if so equipped).
5. Install accessory drive belt(s) and adjust using strand tension gage.
6. Install radiator.
7. Fill cooling system and check for leaks.

CRANKCASE FRONT COVER (TIMING GEAR COVER)

Removal (without removing oil pan)

1. Remove torsional damper as previously outlined.
2. Remove the oil pan-to-front cover attaching screws.
3. Remove the front cover-to-block attaching screws.
4. On L25 engine only proceed as follows:
   a. Pull the cover slightly forward only enough to permit cutting of oil pan front seal.
   b. Using a sharp knife or other suitable cutting tool, cut oil pan front seal flush with cylinder block at both sides of cover.
   c. Remove front cover and attached portion of oil pan front seal. Remove front cover gasket.
   LE3 engine uses RTV for oil pan sealing. There is no front rubber seal.

Installation

1. Clean gasket surfaces on block and crankcase front cover.
2. Cut tabs from the new oil pan front seal (fig. 6A1-22) use a sharp instrument to ensure a clean cut (L25 engine only).

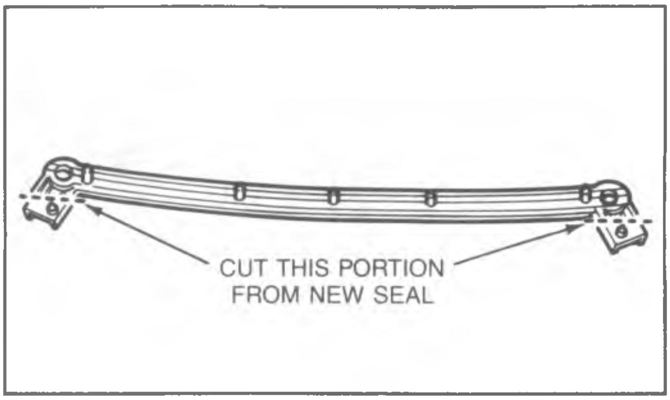

Fig. 6A1-22--Oil Pan Front Seal Modification - L25

3. Install seal to front cover, pressing tips into holes provided in cover.
   On LE3 engine, place a 3/16" (5mm) diameter bead of RTV on cover sealing surface.
4. Coat the gasket with gasket sealer and place in position on cover.
5. Apply a 1/8" (3mm) bead of RTV sealant, #1052366 or equivalent, to the joint formed at the oil pan and cylinder block.
6. Install centering Tool J-23042 in crankcase front cover seal.

   NOTICE: It is important that centering tool be used to align crankcase front cover so that torsional damper installation will not damage seal and so that seal is positioned evenly around damper hub.
7. Install crankcase front cover to block. Install and partially tighten the two, oil pan-to-front cover screws.
8. Install the front cover-to-block attaching screws.
9. Remove centering Tool J-23042 and torque all cover attaching screws to 80 lb. in. (9N·m).
10. Install torsional damper as outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Installed

1. With torsional damper removed, pry old seal out of cover from the front with a large screw driver, being careful not to damage the seal surface on the cover.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-23042.

With Cover Removed

1. With cover removed, pry old seal out of cover from the front with screw driver, being careful not to distort cover.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-23042.

CAMSHAFT

Measuring Lobe Lift

1. Remove valve mechanism as previously outlined.
2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 6A1-23).
3. Rotate the cranksahft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position. Disconnect the coil primary lead before cranking.
5. Compare the total lift recorded from the dial indicator with specifications.
6. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.

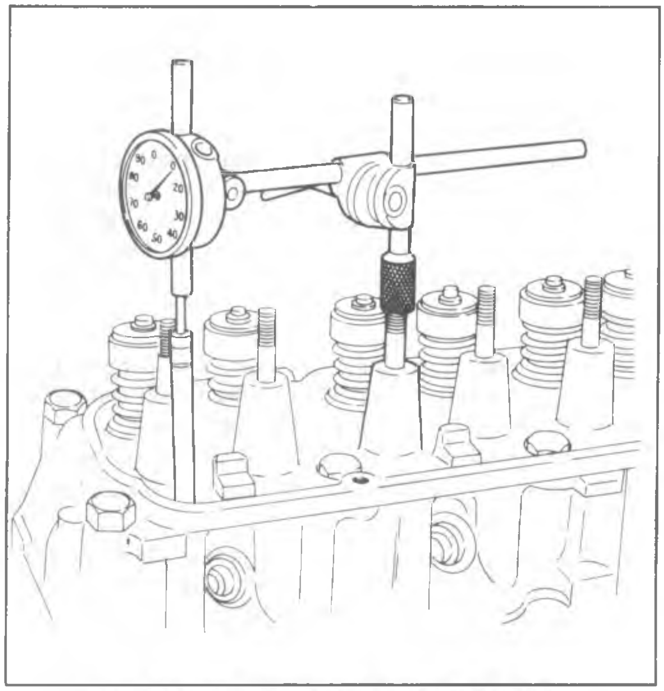

Fig. 6A1-23--Measuring Camshaft Lobe Lift

7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

Removal

1. Remove engine following procedure in this section.
2. Remove lifters as previously outlined.
3. Remove crankcase front cover as previously outlined.
4. Remove fuel pump.
5. Align timing gear marks then remove the two camshaft thrust plate bolts by working through holes in camshaft gear.
6. Remove the camshaft and gear assembly by pulling it out through the front of the block. Support camshaft carefully when removing so as not to damage the camshaft bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

Inspect the camshaft gear and thrust plate for wear or damage. Measure the camshaft end play. This should be .001" to .005".

Gear Replacement

1. If the inspection indicated that the camshaft, gear or thrust plate should be replaced, the gear must be removed from the camshaft. This operation requires the use of camshaft gear remover J-971.
2. Place the camshaft through the gear remover, place end of remover on table of a press and press shaft out of gear.

   NOTICE: Thrust plate must be positioned so that woodruff key in shaft does not damage it when the shaft is pressed out of gear. Also support the hub of the gear or the gear will be seriously damaged.

3. To assemble camshaft gear thrust plate and gear spacer ring to camshaft firmly support camshaft at back of front journal in an arbor press.
4. Place gear spacer ring and thrust plate over end of shaft, and install woodruff key in shaft keyway. Install camshaft gear and press it onto the shaft until it bottoms against the gear spacer ring. The end clearance of the thrust plate should be .001" to .005".

Installation

When a new camshaft is installed, coat camshaft lobes with GM E.O.S. or equivalent, also change oil and oil filter. Replacement of all valve lifters is recommended.

1. Install the camshaft and gear assembly in the engine block, being careful not to damage camshaft bearings or camshaft.
2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up. Push camshaft into position. Install camshaft thrust plate-to-block bolts and torque to 80 lb. in. (9N·m).
3. Check camshaft and crankshaft gear run out with a dial indicator. The camshaft gear run out should not exceed .004" and the crankshaft gear run out should not exceed .003".
4. If gear run out is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear will have to be replaced.
5. Check the backlash between the timing gear teeth with a dial indicator. The backlash should be not less than .004" nor more than .006" for new parts and not more than .008" for worn parts.
6. Install fuel pump.
7. Install crankcase front cover.
8. Install lifters.
9. Install engine in vehicle.

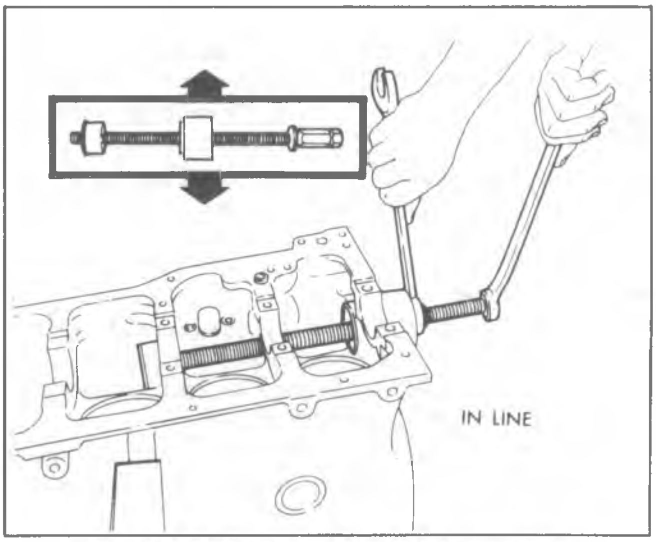

Fig. 6A1-24--Replacing Camshaft Intermediate Bearings

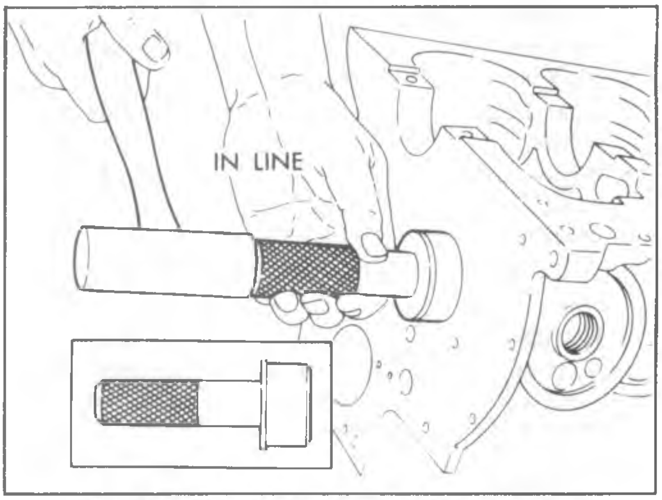

Fig. 6A1-25--Replacing Camshaft Front Bearing

CAMSHAFT BEARINGS

Removal

1. Remove camshaft as previously outlined.
2. Remove oil pan and oil pump as described in this section.
3. Drive camshaft rear plug from cylinder block.
4. Using Tool Set J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
5. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
6. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 6A1-24).
7. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
8. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A1-25).

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A1-25).
2. Using Tool Set J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearings and install puller screw through pilot.
3. Index camshaft bearing in bore, then install remover and installer tool on puller screw with shoulder toward bearing.

NOTICE: All cam bearing oil holes must be aligned with oil holes in cam bore to prevent oil starvation and subsequent failure.

4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.
6. Install a new camshaft rear plug flush to 1/32" (.80mm) deep and parallel with rear surface of cylinder block.

OIL PAN

All except 'G' Van

Removal

1. Disconnect battery negative cable.
2. Raise vehicle and drain engine oil.
3. Remove starter.
4. Remove flywheel splash shield or converter housing underpan, as applicable.
5. Remove "through" bolts from engine front mounts.
6. Raise front of engine, reinstall mount "through" bolts and lower engine.
7. Remove oil pan bolts.
8. Remove oil pan.

Installation

1. Thoroughly clean all gasket sealing surfaces.
2. Using a new gasket, install rear seal in rear main bearing cap.
3. Install front seal on crankcase front cover, pressing tips into holes provided in cover.
4. Install side gaskets to engine block, using a gasket sealant with sufficient body to act as a retainer.
5. Install oil pan, torquing the retaining bolts to 80 lb. in. (9N·m).
6. Raise engine sufficiently to allow removal of "through" bolts - lower engine and install mount "through" bolts. Torque bolts to 75 lb. ft. (100 N·m).
7. Install flywheel splash shield or converter housing underpan, as applicable.
8. Install starter.
9. Lower vehicle and fill crankcase with oil. (See Owner's Manual)
10. Connect battery negative cable, start engine and check for leaks.

"G" Van

Removal

1. Disconnect battery negative cable.
2. Remove engine cover.
3. Remove air cleaner and studs.
4. Remove fan finger guard.
5. Remove radiator upper support brackets.
6. Raise vehicle.

- If vehicle is equipped with a standard transmission, perform the following steps before continuing.
  a. Disconnect clutch cross shaft from left front mount bracket.
  b. Remove transmission to bell housing upper bolt.
  c. Remove transmission rear mount bolts and install two 7/16" x 3" bolts.
  d. Raise transmission using jack and install 2" (51mm) block between mount and crossmember.

7. Remove starter and lay aside. Detach positive battery cable from oil pan studs.
8. Drain crankcase.
9. Remove mount "through" bolts.
10. Raise engine sufficiently to insert wooden blocks between engine mounts and cross member brackets.
11. Remove flywheel splash shield or converter cover, as applicable.
12. Remove oil pan fasteners.
13. Remove oil pan and clean gasket surfaces.

Installation

1. Install new gasket on cleaned gasket surface.
2. Install oil pan and retaining fasteners and torque to specifications. Attach positive battery cable to oil pan studs. Torque nuts.
3. Install flywheel splash shield or converter cover, as applicable.
4. Raise engine sufficiently to remove wooden blocks, lower engine and install mount 'through' bolts. Torque bolts to specification.
5. Install starter.
   - If vehicle is equipped with a standard transmission, perform the following steps.
   a. Raise transmission using jack and remove 2" (51mm) block from between mount and cross member.
   b. Lower transmission on cross member, remove two 7/16" x 3" bolts, install rear mount bolts and torque to specifications.
   c. Install transmission to bell housing upper bolt.
   d. Connect clutch cross shaft to left front mount bracket.
6. Lower vehicle on hoist.
7. Install radiator upper support brackets.
8. Install fan finger guard.
9. Install air cleaner studs and air cleaner.
10. Install engine cover.
11. Fill crankcase with oil. (See Owner's Manual).
12. Connect battery negative cable, start engine and check for leaks.

OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove two flange mounting bolts, pickup pipe bolt, then remove pump and screen as an assembly.

Disassembly

1. Remove the pump cover attaching screws, the pump cover and the pump cover gasket (fig. 6A1-26).
2. Mark gear teeth so they may be reassembled with the same teeth indexing. Remove the idler gear and the drive gear and shaft from the pump body.

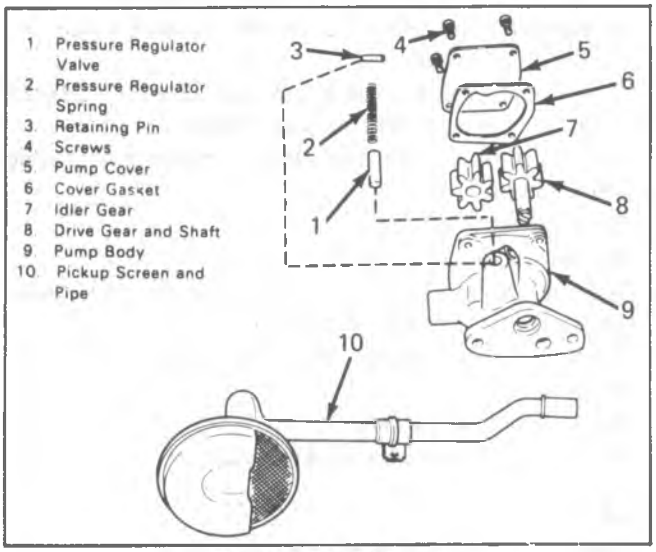

Fig. 6A1-26--Oil Pump

3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump.

   Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

Assembly

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vice, apply sealer to the end of pipe and tap the pipe in place with a plastic hammer using Tool J-8369.

   NOTICE: Be careful of twisting, shearing or collapsing pipe while installing in pump. Pickup screen must be parallel to bottom of oil pan when oil pump is installed.
2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
5. Install the pump cover, with new gasket, and torque attaching screws to 70 lb. in. (8N·m).
6. Turn drive shaft by hand to check for smooth operation.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

On removing a connecting rod cap, it is possible to find a .009" undersize bearing. These are used in manufacturing for selective fitting.

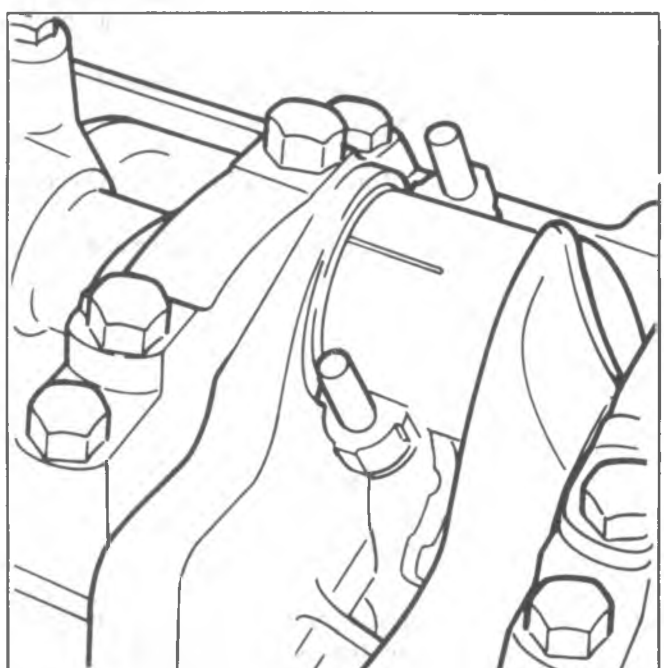

Fig. 6A1-27--Gaging Plastic on Crankpin

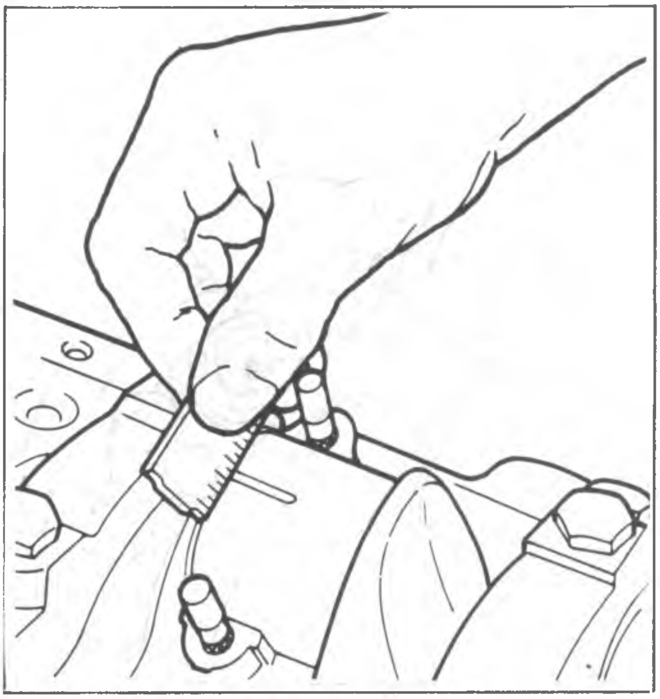

Fig. 6A1-28--Measuring Gaging Plastic

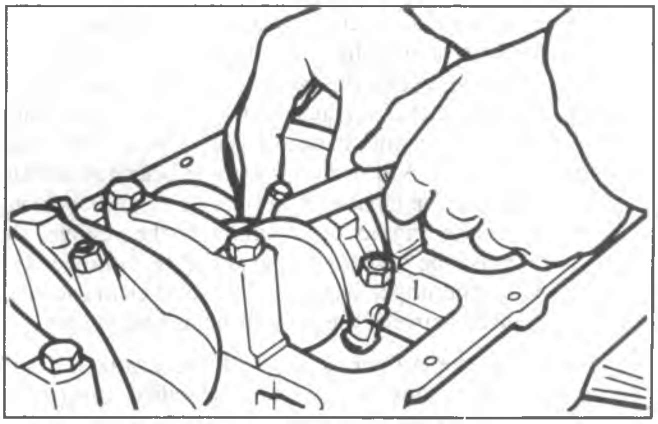

Fig. 6A1-29--Measuring Connecting Rod Side Clearance

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.
   Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearings for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.
   If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.
   a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (fig. 6A1-27). Plastic gage should be positioned in the middle of upper or lower bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).
   b. Install the bearing in the connecting rod and cap.
   c. Install the bearing cap and evenly torque nuts to 35 lb. ft. (47N·m).
      Do not turn the crankshaft with the gaging plastic installed.
   d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (fig. 6A1-28).
6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.
   Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. Undersize is marked on the back of the bearing. If clearance cannot be brought within specification, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to 35 lb. ft. (47N·m).
8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances between the connecting rod cap and side of crankpin (fig. 6A1-29).

CRANKSHAFT MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shim for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

When a production crankshaft cannot be prescision fitted by this method, it is then ground .009" undersize **on only those main journals that cannot be properly fitted. All journals will not necessarily be ground.** A .009" undersize bearing or .010" undersize bearing will then be used for precision fitting in the same manner as previously described.

A reground crankshaft will be identified by the following:

- The crankshaft throw will be stamped on one side of the undersize journal with "9", along with a large spot of light green paint.
- The main bearing cap will be painted light green on each side of the affected.
  If, for any reason, main bearings caps are replaced, shimming may be necessary. Laminated shims for each

cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. **Never replace one half without replacing the other half.**

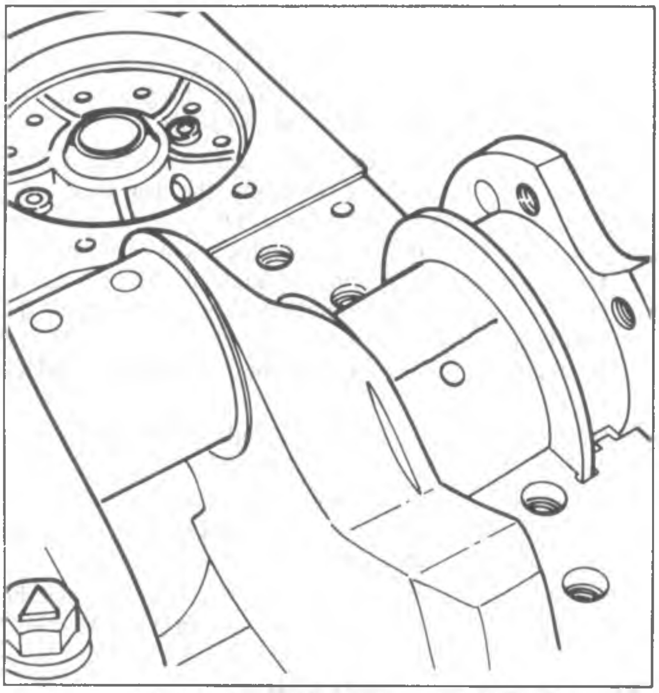

Fig. 6A1-30--Gaging Plastic on Journal - Typical

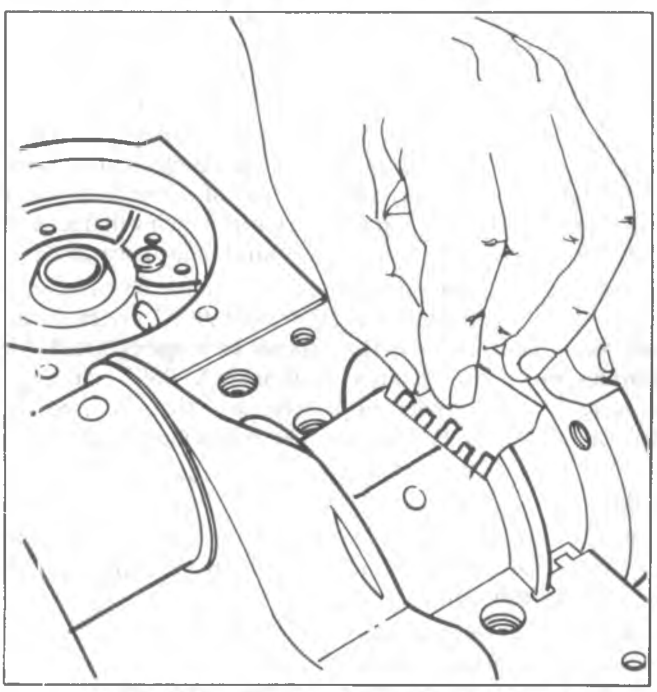

Fig. 6A1-31--Measuring Gaging Plastic - Typcial

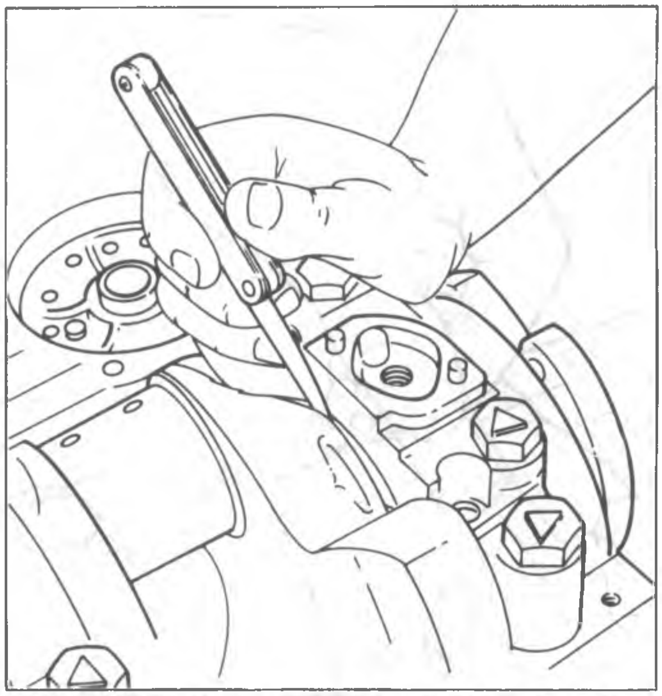

Fig. 6A1-32--Measuring Crankshaft End Play - Typical

Checking Clearance

To obtain the most accurate results with "Plastigage", or its equivalent, a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed. If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft all bearing cap bolts must be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing must be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal, both bearing shells and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 6A1-30).

   Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.
3. Install the bearing cap and evenly torque the retaining bolts to 65 lb. ft. (88N·m). Bearing cap MUST be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width, **at the widest point**, with the

graduations on the gaging plastic envelope (fig. 6A1-31).

Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.
   If a new bearing cap is being installed and clearance is less tha .001", inspect for burrs or nicks; if none are found then install shims as required.
7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.
   After selecting new bearing, recheck clearance.
8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag.
   When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 6A1-32).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removed

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. The rear main journal has no oil hole. Replace the rear main bearing upper half as follows:
   a. Use a small drift punch and hammer to start the upper bearing half rotating out of block.

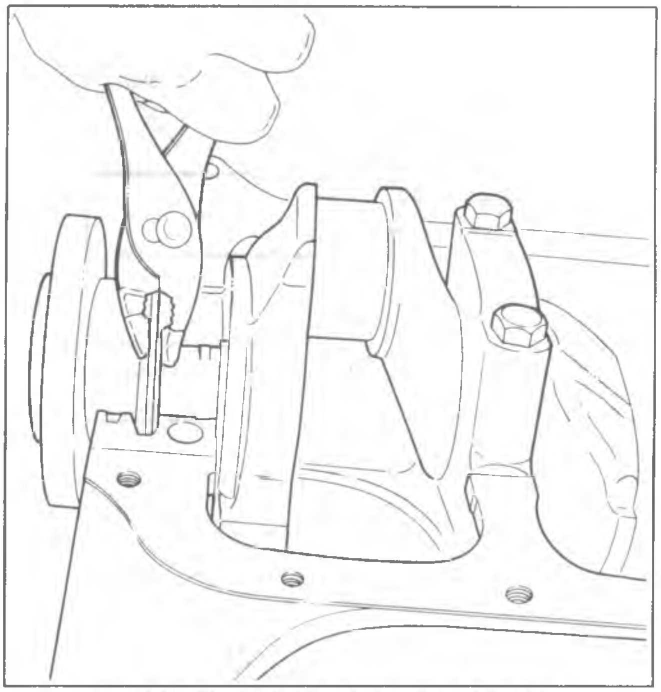

Fig. 6A1-33--Replacing Upper Main Bearing

   b. Use a pair of pliers (with taped jaws) to hold the bearing thrust surface to the oil slinger and rotate the crankshaft to remove bearing (fig. 6A1-33).
   c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block.
   d. Use pliers as in removing to rotate bearing into place. The last 1/4" (6.5mm) movement may be done by holding just the slinger with the pliers or tap in place with a drift punch.
3. All other crankshaft journals have oil holes. Replace the main bearing upper half as follows:
   a. Install a main bearing removing and installing tool, such as Tool J-8080, in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent as required to do the job.
   b. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
   c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
4. Oil new lower bearing and install in bearing cap.
5. Install main bearing caps with arrows pointing toward front of engine.
6. Torque all main bearing caps **except the rear main cap** to 65 lb. ft. (88N·m). Torque rear main bearing cap to 10-12 lb. ft. (14-16N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque **all** main bearing cap bolts to 65 lb. ft. (88N·m).

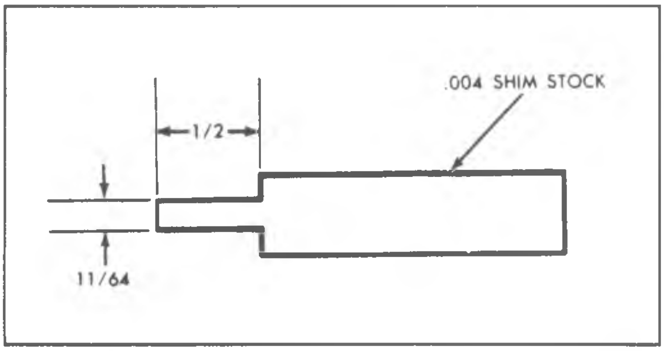

Fig. 6A1-34--Oil Seal Installation Tool

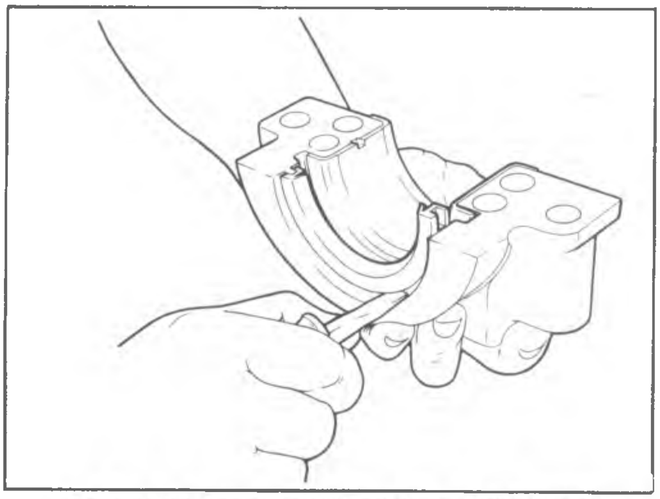

Fig. 6A1-35--Removing Oil Seal Lower Half - Typical

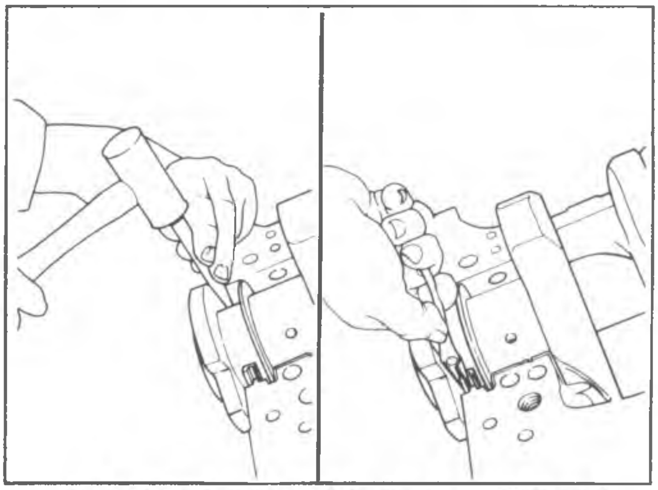

Fig. 6A1-36--Removing Oil Seal Upper Half - Typical

OIL SEAL (REAR MAIN)

Replacement

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Always replace the upper and lower seal as a unit. Install seal with lip facing front of engine. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (fig. 6A1-34) can be used to protect the seal bead when positioning seal as follows:

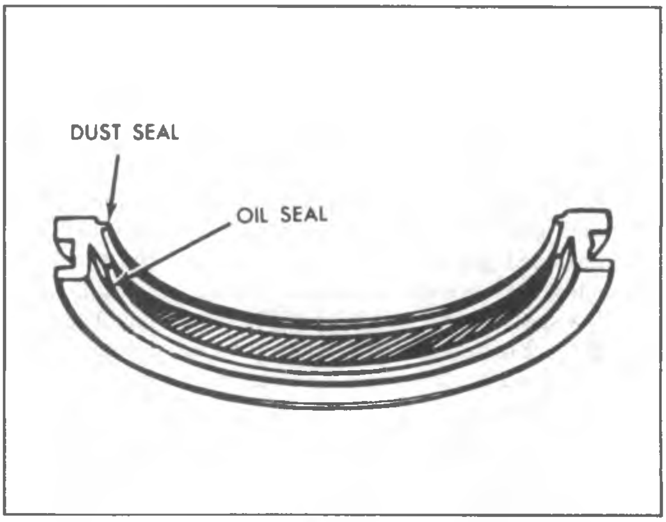

Fig. 6A1-37--Crankshaft Oil Seal - Rear Main

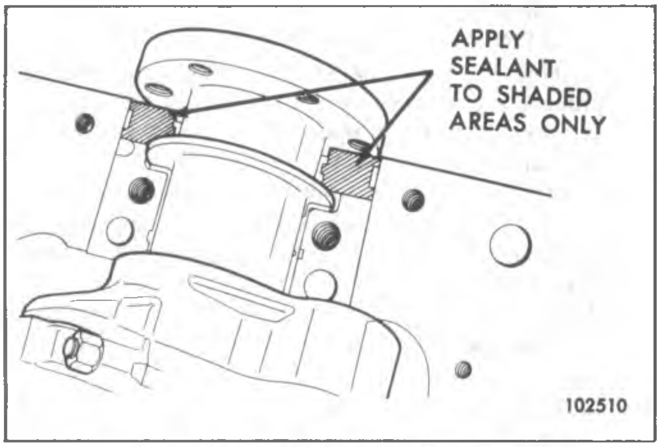

Fig. 6A1-38--Sealing Bearing Cap - Typical

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the bearing cap by prying from the bottom with a small screw driver (fig. 6A1-35).
3. Use a small hammer to tap a brass pin punch on one end of the upper seal until it protrudes far enough to be removed with pliers (fig. 6A1-36).
4. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a nonabrasive cleaner.
5. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.
6. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.
7. Position tip of tool between crankshaft and seal seat in cylinder case.
8. Position seal between crankshaft and tip of tool so that seal bead contacts tip of tool. Make sure that oil-seal lip is positioned toward front of engine (fig. 6A1-37).
9. Roll seal around crankshaft using tool as a "shoe-horn" to protect seal bead from sharp corner of seal seat surface in cylinder case. Installation tool must remain in position until seal is properly positioned with both ends flush with block.

10. Remove tool, being careful not to withdraw seal.
11. Install seal half in bearing cap, again using tool as a "shoe-horn", feeding seal into cap using light pressure with thumb and finger.
12. Install bearing cap to case with sealant applied to the cap-to-case interface being careful to keep sealant off the seal split line (fig. 6A1-38).
13. Install the rear main bearing cap (with new seal) and torque to 10-12 lb. ft. (14-16 N·m). Tap end of crankshaft first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque bearing cap to 65 lb. ft. (88N·m).

PISTON AND CONNECTING ROD ASSEMBLIES

Removal

1. Remove oil pan, oil pump and cylinder head as previously outlined.
2. For the cylinder being serviced, turn crankshaft until piston is at the bottom of the stroke. Place a cloth on top of the piston.
3. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.
4. Turn crankshaft until piston is at top of stroke and remove cloth and cuttings.
5. Remove connecting rod cap and install Tool J-6305 (11/32") on studs. Push connecting rod and piston assembly out of top of cylinder block (fig. 6A1-39). It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

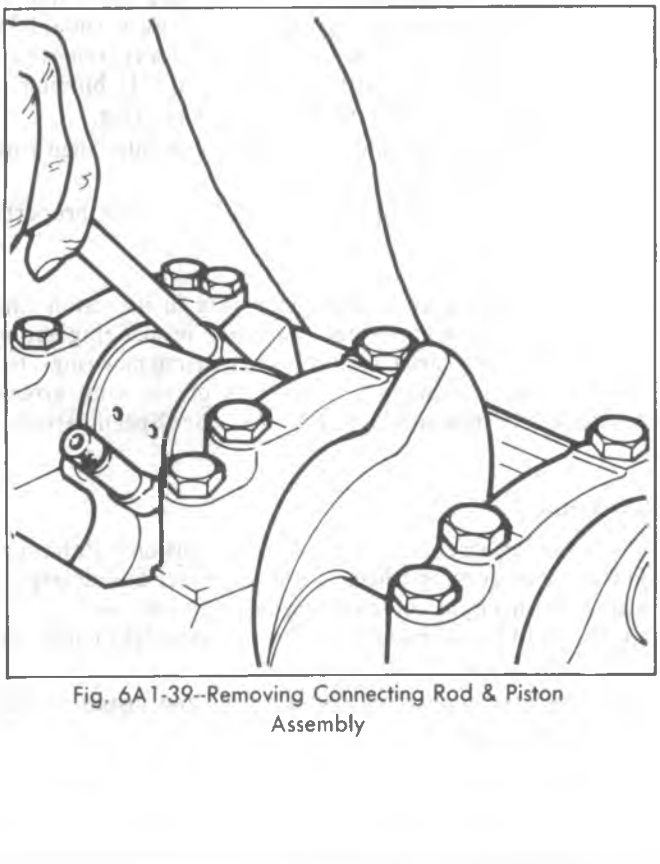

Fig. 6A1-39--Removing Connecting Rod & Piston Assembly

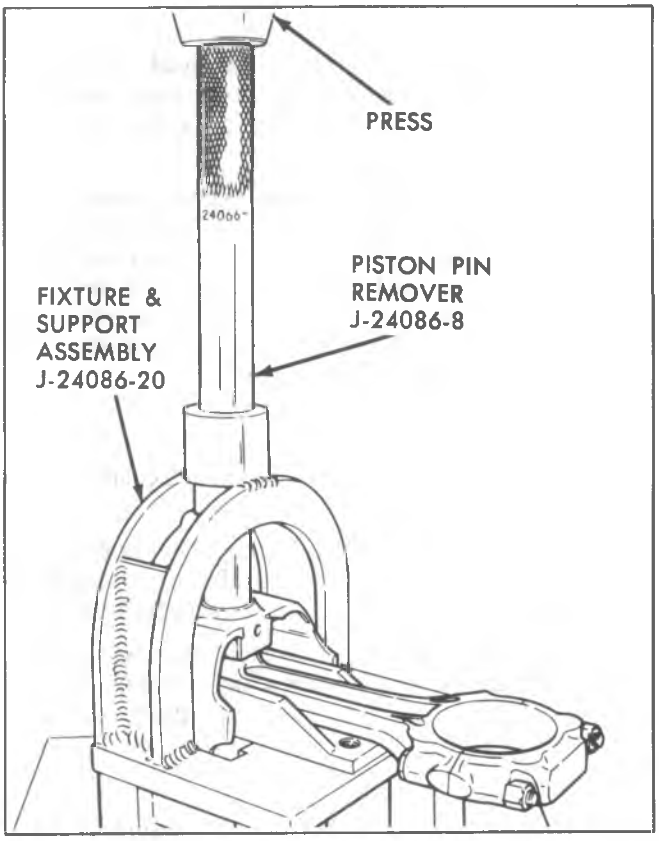

Fig. 6A1-40--Removing Piston Pin

Disassembly

1. Remove connecting rod bearings from connecting rods and caps. If bearings are being reused, place them in a rack so they may be reinstalled in their original positions.
2. Remove piston rings by expanding and sliding them off the pistons. Tools J-8021 (3-7/8") and J-22249 (3-15/16") are available for this purpose.
3. Place connecting rod and piston assembly on tool J-24086-20. Using an arbor press and piston pin remover, J-24086-8, press the piston pin out of connecting rod and piston (fig. 6A1-40).

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air.

Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

ASSEMBLY

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place connecting rod and piston assembly on fixture and support assembly.
3. Using piston pin installer, J-24086-9, press the piston pin into the piston and connecting rod (Fig. 6A1-41). Make sure installer is set properly (see tool instructions).

NOTICE: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

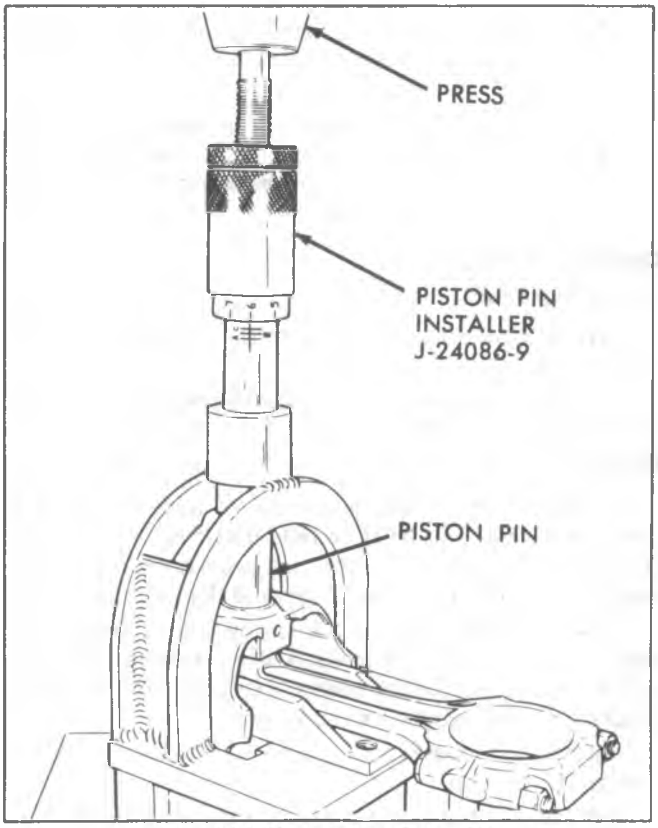

Fig. 6A1-41--Installing Piston Pin

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chrome faced, or treated with molybdenum for maximum life.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage.
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove to make sure that the ring is free. If binding occurs at any point the cause should be determined, and if caused by ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.
8. Install piston rings as follows (fig. 6A1-42):
   a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined, and if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install second compression ring expander then ring with gaps properly located.
   f. Install top compression ring with gap properly located.
9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring groove should be measured (fig. 6A1-43). (See Specifications.)

Installation

Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

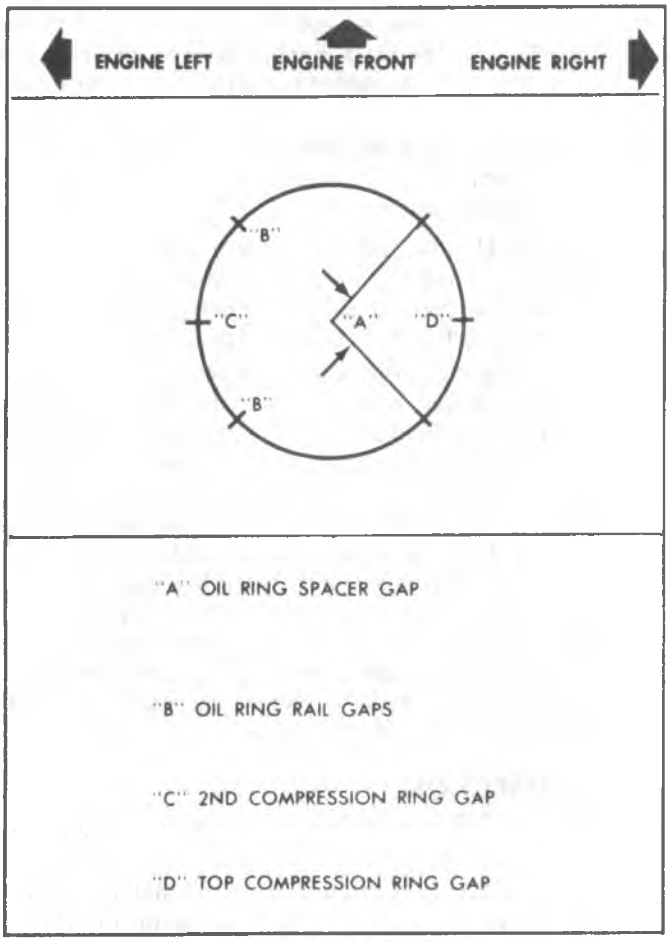

Fig. 6A1-42--Ring Gap Location

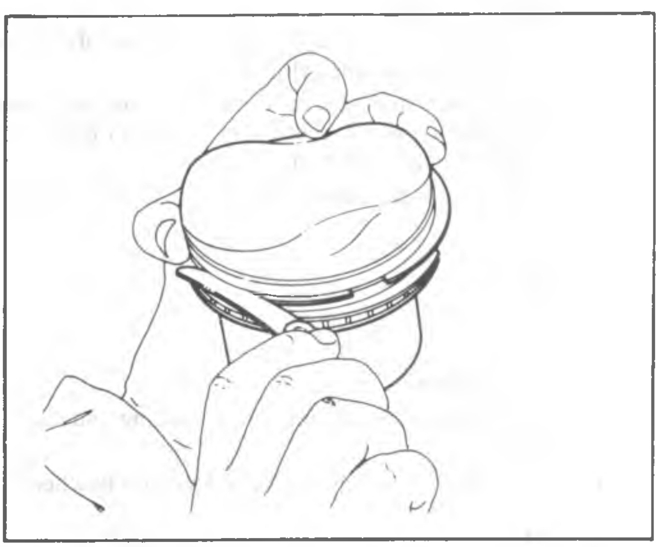

Fig. 6A1-43--Measuring Ring Groove Clearance

2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install Tool J-6305 (11/32") on connecting rod bolts.

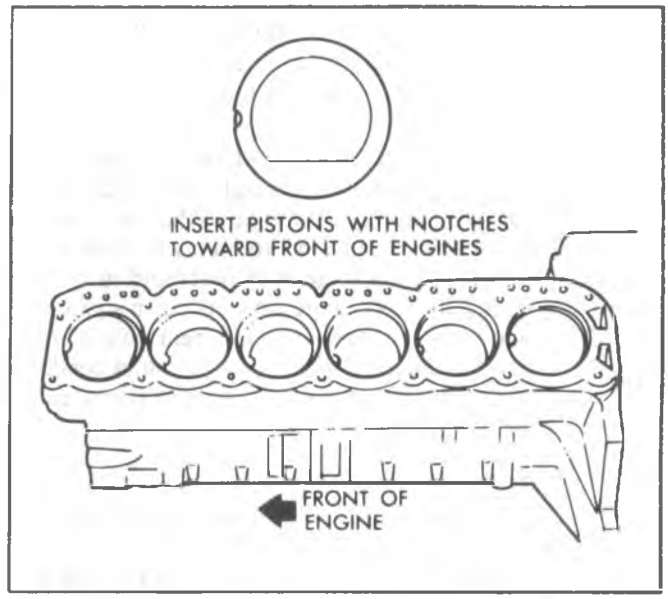

Fig. 6A1-44--Pistons-Installed Position

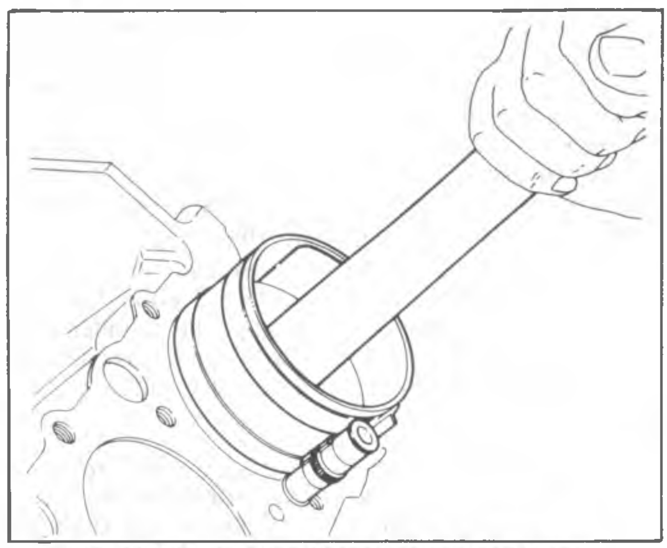

Fig. 6A1-45--Installing Connecting Rod and Piston Assembly

4. Install each connecting rod and piston in its respective bore. Pistons must have notches facing front of engine (fig. 6A1-44).
   Use Tool J-8037 to compress the rings (fig. 6A1-45). Guide the connecting rod into place on the crankshaft journal with Tool J-6305 (11/32"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
5. Remove J-6305.
6. Install the bearing caps and torque nuts to 35 lb. ft. (47N·m).

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all sealing surfaces.

2. Remove oil gallery plugs and clean all oil passages.
3. Clean and inspect water passages in the cylinder block.
4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.
5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "O". Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" taper or wear they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less then .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 45 to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

   NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.
5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil. The bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth. Cylinders should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

PISTON SELECTION

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure the "Cylinder Bore Diameter" with a telescope gage (2-1/2" (64mm) from top of cylinder bore).
   b. Measure the "Piston Diameter" (at skirt across center line of piston pin).
   c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".
   d. Determine if piston to bore clearance is in the acceptable range.
2. If used piston is not acceptable, determine if a new piston can be fitted to the cylinder bore.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance.
4. Mark the piston to identify the cylinder for which it was fitted.

FLYWHEEL

Removal

All Except L25 Engines

1. Remove transmission and/or clutch housing and clutch from engine.
2. Remove flywheel retaining bolts and remove flywheel.

L25 Engines

1. Remove transmission and/or clutch housing and clutch from engine.
2. Mark relationship of flywheel and crankshaft so that dowel holes can be aligned in their original positions on assembly.
3. Remove engine oil pan and rear main bearing cap.

4. Remove flywheel retaining bolts and drive crankshaft dowels out of flywheel and crankshaft. Rotate crankshaft as necessary so dowels clear cylinder block.
5. Remove flywheel and discard used dowel pins.

Repair

Only repair recommended at flywheel used with conventional clutch is replacement of starter gear in event gear is worn or otherwise damaged.

Use torch to heat the gear around entire circumference, then drive the gear off flywheel, using care not to damage the flywheel.

Uniformly heat the flywheel gear to temperature which will expand gear to permit installation. [Temperature must not exceed 400°F (204° C)].

As soon as gear has been heated, install on flywheel.

NOTICE: NEVER HEAT STARTER GEAR TO RED HEAT AS THIS WILL CHANGE METAL STRUCTURE.

Installation

All Except L25 Engines

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.
2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel.
3. Install flywheel retaining bolts and torque to specifications.

L25 Engine

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.
2. Install flywheel on crankshaft and position to align dowel holes of crankshaft flange and flywheel.
3. Install flywheel retaining bolts and torque to specifications.
   - The interference fit dowel pins used on 4.8 L (T) engines must be replaced with an oversize dowel pin when installing the flywheel.
4. When installing the original flywheel, ream the dowel pin holes with Tool J-22808-2. When installing a new flywheel, first ream the dowel pin holes with Tool J-22808-2 and then finish reaming them with Tool J-22808-1.
5. Install oversize dowel pins flush with flywheel retaining bolt surface.
6. Install rear main bearing cap and torque bolts to specifications. Install oil pan with new gaskets and seals. Torque oil pan retaining screws to specifications.

ENGINE ASSEMBLY

Removal ("G" Van/Code D Engine)

1. Disconnect battery negative cable at battery.
2. Drain cooling system.
3. Remove engine cover.
4. Remove air cleaner.
5. If equipped, evacuate A/C system and remove A/C compressor.
6. Disconnect accelerator linkage at carburetor and remove carburetor from manifold.
7. Remove grille and grille cross brace.
8. Remove windshield washer jar and, if equipped, A/C vacuum reservoir.
9. Disconnect radiator hoses from radiator.
10. Remove radiator to radiator support attaching brackets and remove radiator.
    - If equipped with automatic transmission, remove cooler lines from radiator before attempting removal.
    - If equipped with A/C, remove condenser to radiator support attaching bolts and swing condenser to the side, out of the way.
11. Remove heater hoses from engine.
12. Disconnect all necessary wiring from engine:
    - Generator
    - Distributor
    - All sending switches
    - Starter
13. Raise vehicle.
14. Remove fuel line hose from suction side of fuel pump.
15. Drain crankcase.
16. Remove propshaft and plug end of transmission.
17. Remove exhaust pipe from manifold flange.
18. Remove linkage from transmission and disconnect speedometer cable.
19. Remove transmission mount bolts.
    - If equipped with manual transmission, disconnect clutch linkage and remove clutch cross shaft.
20. Remove engine mount "through" bolts.
21. Lower vehicle.
22. Attach lifting devise to engine.
23. Raise engine slightly and remove right hand mount assembly from engine.
24. Remove engine/transmission assembly.

Installation ("G" Van/Code D Engine)

1. Place engine/transmission assembly into vehicle.
2. Install right hand engine mount assembly and lower engine onto mounts.
3. Remove lifting tool.
4. Raise vehicle and install engine mount "through" bolts. Torque to specifications.
5. Install transmission mount bolts. Torque to specifications.
6. Connect transmission shift linkage and speedometer cable.
   - If equipped with manual transmission, connect clutch linkage and install clutch cross shaft.
7. Attach exhaust pipe to manifold flange.
8. Install propshaft.
9. Connect fuel tank line to fuel pump.
10. Lower vehicle.
11. Connect all wiring to engine components:
    - Generator
    - Distributor
    - All sending units
    - Starter

12. Connect heater hoses to engine.
13. Install radiator and hold in place with radiator to support attaching brackets.
    - If equipped with Automatic Transmission, connect cooler lines to radiator.
    - If equipped with A/C, install condenser in front of radiator. Bolt to radiator support.
14. Connect radiator hoses to radiator.
15. Install windshield washer jar and, if equipped, A/C vacuum reservoir.
16. Install grille cross brace and grille.
17. Using a new pad gasket, install carburetor. Connect accelerator linkage.
18. If equipped, mount A/C compressor.
19. Fill crankcase with oil.
20. Fill cooling system.
21. Connect battery negative cable and start engine. Check ignition timing and adjust carburetor if necessary.
22. Install air cleaner and engine cover.

Removal (CK Series/Code D & T Engines)

1. Disconnect battery cables at battery.
2. Remove air cleaner.
3. Drain cooling system.
4. Disconnect accelerator cable from carburetor throttle lever.
    - If equipped with automatic transmission, remove detent cable from carburetor throttle lever.
5. Disconnect all wiring from engine.
6. Remove radiator hoses from radiator.
7. Remove heater hoses from engine.
8. Remove radiator.
9. Remove fan and water pump pulley.
10. Disconnect fuel line from fuel pump.
11. Remove vehicle hood.
12. Raise vehicle.
13. Remove starter.
14. Remove flywheel or torque converter splash shield, as applicable.
15. Disconnect exhaust pipe from exhaust manifold flange. Wire up and out of way.
16. Remove engine mount 'through' bolts.
    - If equipped with automatic transmission, remove converter to flex plate bolts.
    - If 'K' model, remove strut rods at motor mounts.
17. Remove bell housing to engine retaining bolts. Support transmission with chain.
18. Lower vehicle.
19. Attach engine lifting device.
20. Remove engine.

Installation (CK Series/Code D & T Engines)

1. Place engine in vehicle.
2. Raise vehicle.
3. Install bell housing to engine retaining bolts. Torque to specifications.
    - If equipped with automatic transmission, install torque converter to flex plate attaching bolts. Torque to specifications.
4. Install engine mount to frame retaining bolts. Torque to specifications.
5. Connect exhaust pipe to exhaust manifold flange.
6. Install flywheel or torque converter splash shield, as applicable.
7. Install starter. Torque bolts to specifications.
8. Lower vehicle.
9. Attach fuel line to fuel pump.
10. Install water pump pulley and fan. Torque bolts to specifications.
11. Install radiator.
12. Connect heater hoses to engine.
13. Connect radiator hoses to radiator.
14. Connect all wiring to engine.
15. Connect accelerator cable to carburetor throttle lever.
    - If equipped with automatic transmission, connect detent cable to throttle lever.
16. Fill cooling system.
17. Fill crankcase with oil.
18. Install vehicle hood.
19. Connect battery cables, start engine. Check timing and carburetor adjustment. Adjust if necessary.
20. Install air cleaner.

CRANKSHAFT

Removal

1. Remove engine as previously outlined. Remove clutch, if applicable, and flywheel and mount engine on stand.
2. Remove the oil dipstick and oil dipstick tube.
3. Remove the spark plugs.
4. Remove crankshaft pulley and torsional damper.
5. Remove oil pan and oil pump.
6. Remove crankcase front cover.
7. Remove the connecting rod caps and push the pistons to the top of bores.
8. Remove main bearing caps and lift cranksahft out of cylinder block.
9. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out by supporting the front and rear main bearing journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

Installation

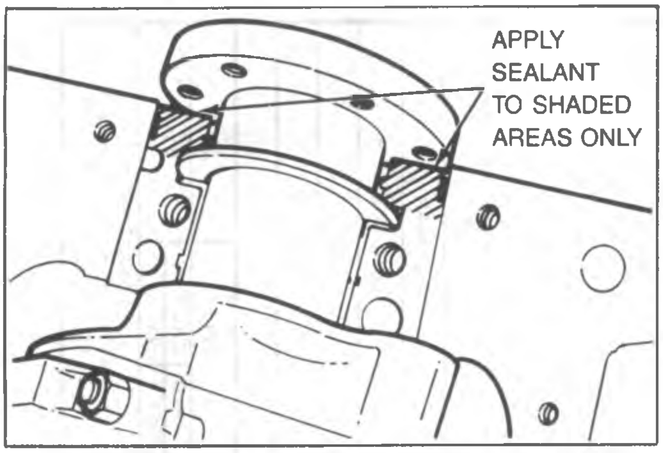

Fig. 6A1-46--Sealing Bearing Cap

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Install lip and helix towards front of engine.
2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (fig. 6A1-46). Do not allow sealer on crankshaft or seal.
6. Install main bearing caps with arrows pointing toward front of engine.
7. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 lbs. ft. (14-16 N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
8. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.
9. Install flywheel and torque to specifications. Align dowel hole in flywheel with dowel hole in crankshaft.
   - On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

Gear Replacement

Remove crankshaft gear using Tool J-8105 and install using Tool J-5590 (fig. 6A1-47).

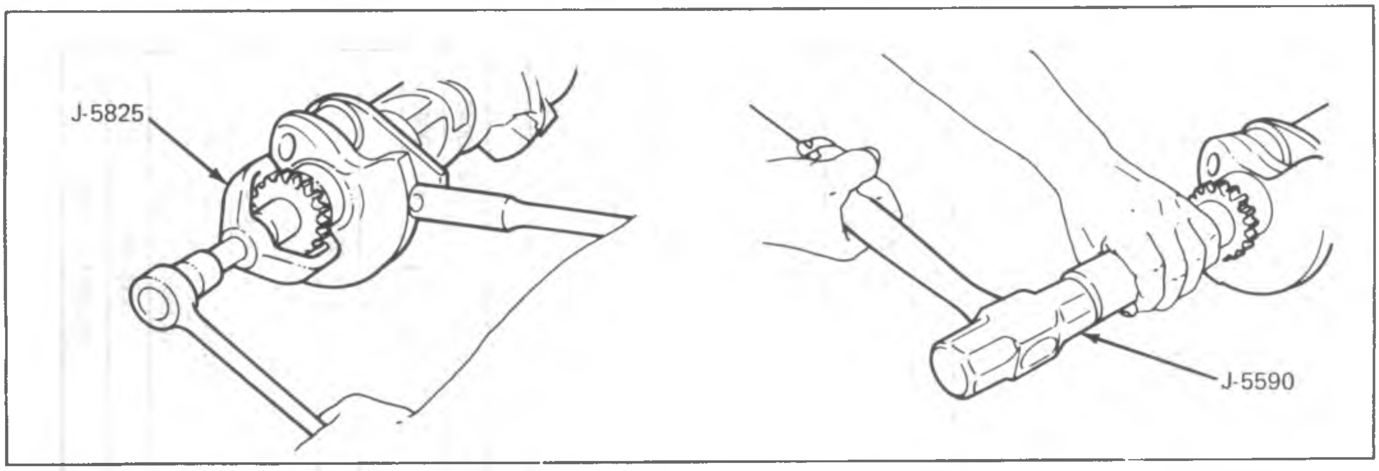

Fig. 6A1-47--Gear Replacement

GENERAL DATA:

TYPE		IN LINE L-6	
DISPLACEMENT	LITRE (*)	4.1 (D)	4.8 (T)
RPO		LE3	L25
BORE		3.876	
STROKE		3.530	4.120
COMPRESSION RATIO		8.25:1	8.0:1
FIRING ORDER		1-5-3-6-2-4	

CYLINDER BORE:

DIAMETER			3.8750-3.8780
OUT OF ROUND	PRODUCTION		.0005 MAX.
OUT OF ROUND	SERVICE		.002 MAX.
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.
TAPER	PRODUCTION	RELIEF SIDE	.0005 MAX.
TAPER	SERVICE		.001 MAX.

PISTON:

CLEARANCE	PRODUCTION	.0010-.0020	.0026-.0036
CLEARANCE	SERVICE	.0030 MAX.	.0045 MAX.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.0012-.0027	.0020-.0040
COMPRESSION	GROOVE CLEARANCE	PRODUCTION	2ND	.0012-.0032	.0020-.0040
COMPRESSION	GROOVE CLEARANCE	SERVICE		HI LIMIT + .001	
COMPRESSION	GAP	PRODUCTION	TOP	.010-.020	
COMPRESSION	GAP	PRODUCTION	2ND	.010-.020	
COMPRESSION	GAP	SERVICE		HI LIMIT + .010	
OIL	GROOVE CLEARANCE	PRODUCTION		.005 MAX.	.005-.0055
OIL	GROOVE CLEARANCE	SERVICE		HI LIMIT + .001	
OIL	GAP	PRODUCTION		.015-.055	
OIL	GAP	SERVICE		HI LIMIT + .010	

* VIN Designation

PISTON PIN

		LE3	L25
DIAMETER		.9270-.9273	
CLEARANCE	PRODUCTION	.00015-.00025	
CLEARANCE	SERVICE	.001 MAX.	
FIT IN ROD		.0008-.0016 INTERFERENCE	

CRANKSHAFT

MAIN JOURNAL	DIAMETER		ALL 2.2979-2.2994	
MAIN JOURNAL	TAPER	PRODUCTION	.0002 MAX.	
MAIN JOURNAL	TAPER	SERVICE	.001 MAX.	
MAIN JOURNAL	OUT OF ROUND	PRODUCTION	.0002 MAX.	
MAIN JOURNAL	OUT OF ROUND	SERVICE	.001 MAX.	
MAIN BEARING CLEARANCE	PRODUCTION		#1-6 .0010-.0024 #7 .0016-.0035	
MAIN BEARING CLEARANCE	SERVICE		#1-6 .0010-.0025	#7 .0015 .0035
CRANKSHAFT END PLAY			.002-.006	
CRANKPIN	DIAMETER		1.999-2.000	2.099-2.100
CRANKPIN	TAPER	PRODUCTION	.0005	
CRANKPIN	TAPER	SERVICE	.001 MAX.	
CRANKPIN	OUT OF ROUND	PRODUCTION	.0005	
CRANKPIN	OUT OF ROUND	SERVICE	.001 MAX.	
ROD BEARING CLEARANCE	PRODUCTION		.0010-.0026	
ROD BEARING CLEARANCE	SERVICE		.0030	
ROD SIDE CLEARANCE			.006-.017	

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2217	.2315
LOBE LIFT ± .002	EXHAUST	FED. .2217 / CALIF. .2315	.2315
JOURNAL DIAMETER		1.8677-1.8697	
CAMSHAFT END PLAY		.003-.008	

VALVE SYSTEM

VALVE SYSTEM			LE3	L25
LIFTER			HYDRAULIC	
ROCKER ARM RATIO			1.75:1	
VALVE LASH	INTAKE		ONE TURN DOWN FROM ZERO LASH	
	EXHAUST			
FACE ANGLE (INT. & EXH.)			45°	46°
SEAT ANGLE (INT. & EXH.)			46°	
SEAT RUNOUT			.002 MAX.	
SEAT WIDTH	INTAKE		.035/.060	
	EXHAUST		.062/.093	
STEM CLEARANCE	PRODUCTION	INT.	.0010-.0027	
		EXH.	.0015-.0032	
	SERVICE		HI LIMIT + .001 INTAKE + .002 EXHAUST	
VALVE SPRING (OUTER)	FREE LENGTH		2.08	
	PRESSURE LBS. @ IN.	CLOSED	78-86 @ 1.66	
		OPEN	170-180 @ 1.26	
	INSTALLED HEIGHT ± 1/32"		1.66	
DAMPER	FREE LENGTH		1.94	
	APPROX. # OF COILS		4	

TORQUE SPECIFICATIONS

Camshaft Thrust Plate ....80 lb. in.
Crankshaft Front Cover ....80 lb. in.
Flywheel Housing Cover ....80 lb. in.
Oil Pan (To Crankcase) (1/4-20) ....80 lb. in.
Oil Pan (To Front Cover) ....50 lb. in.
Oil Pump Cover ....70 lb. in.
Rocker Arm Cover ....45 lb. in.
Connecting Rod Cap ....35 lb. ft.*
Clutch Pressure Plate ....20 lb. ft.*
Oil Pan (To Crankcase) 5/16-18) ....75 lb. in.
Oil Pump ....115 lb. in.
Push Rod Cover ....50 lb. in.
Water Pump ....15 lb. in.
Clutch Pressure Plate ....30 lb. ft.@
Distributor Clamp ....25 lb. ft.
Flywheel Housing ....30 lb. ft.
Manifold (Exhaust) ....30 lb. ft. 2
Manifold (Exhaust To Inlet) .... 45 lb. ft. 2
Manifold To Head .... 40 lb. ft.
Thermostat Housing ....30 lb. ft.
Water Outlet ....30 lb. ft.
Connecting Rod Cap ....40 lb. ft.@
Main Bearing Cap ....65 lb. ft.
Flywheel ....60 lb. ft.*
Torsional Damper ....60 lb. ft.@ 1
Cylinder Head ....95 lb. ft.
Temperature Sending Unit ....20 lb. ft.
Oil Filter ....Hand Tight
Oil Pan Drain Plug ....20 lb. ft.
Flywheel ....110 lb. ft.@
Spark Plug ....17-27 lb. ft.

* 4.1 (D) only
@ 4.8 (T) only
1 Except LH Front Bolt 85 lb. ft.
2 Non-Integral Head

SECTION 6A2
SMALL BLOCK ENGINES

C–K–G TRUCKS

5.0 L (F) V-8 — RPO LF3
5.0 L (H) V-8 — RPO LE9
5.7 L (L) V-8 — RPO LS9
5.7 L (M) V-8 — RPO LT9

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GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 8 cylinders arranged in a "V" shape with 4 cylinders in each bank. Five main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cylinder heads are cast with individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron, and is supported by five main bearings. Number five bearing is the end thrust bearing.

Main bearings are lubricated from oil holes which intersect the camshaft bearings. The camshaft bearings are fed oil by the main oil gallery which is rifle drilled down the center of the block, above the camshaft. Two additional oil galleries are on either side of the main oil gallery to provide an oil supply for the hydraulic lifters.

A torsional damper on the forward end of the crankshaft dampens any engine torsional vibrations.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by five bearings and is chain driven. A steel or sintered iron crankshaft gear drives the timing chain which in turn drives the camshaft through either a nylon/aluminum or cast iron gear depending on application.

Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes the valve lifters to rotate.

Camshaft bearings are lubricated through oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the center of the block, above the camshaft.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring. Piston pins are offset 1/16" (1.6mm) toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are Chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

INTAKE MANIFOLD

The intake manifold is of cast iron double level design for efficient fuel distribution. The carburetor pad is centrally located with a passage running underneath the pad (E.F.E.) through which exhaust gases are forced to promote faster fuel vaporization when the engine is cold. An EGR port is also cast into the manifold for the mixture of exhaust gases with the fuel air mixture.

EXHAUST MANIFOLDS

Two cast iron exhaust manifolds are used to direct exhaust gases from the combustion chambers to the exhaust system. The right hand side manifold receives a heat stove that is used to route heated air to the air cleaner for better fuel vaporization during warmup.

COMBUSTION CHAMBERS

Combustion Chambers are cast to insure uniform shape for all cylinders. Spark plugs are located between the intake and exhaust valves.

The contoured wedge shape of the combustion chamber minimizes the possibility of detonation, facilitates breathing, and provides swirling turbulence for smooth, complete combustion.

ENGINE LUBRICATION

Full pressure lubrication through a full flow oil filter, is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages, to the camshaft and crankshaft to lubricate the bearings. The valve lifter oil gallery feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms (figs. 1 and 2).

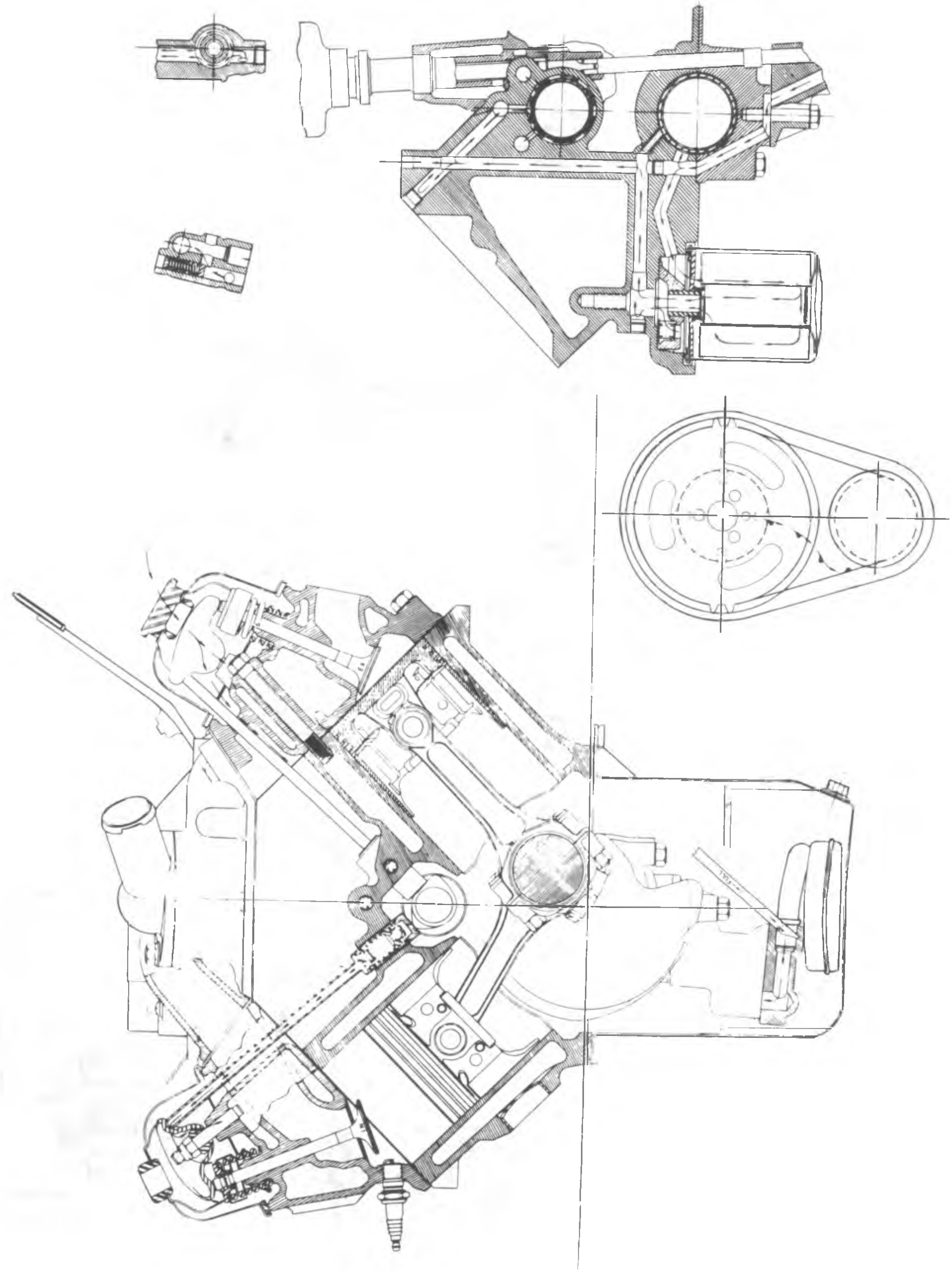


Fig. 1--Engine Lubrication

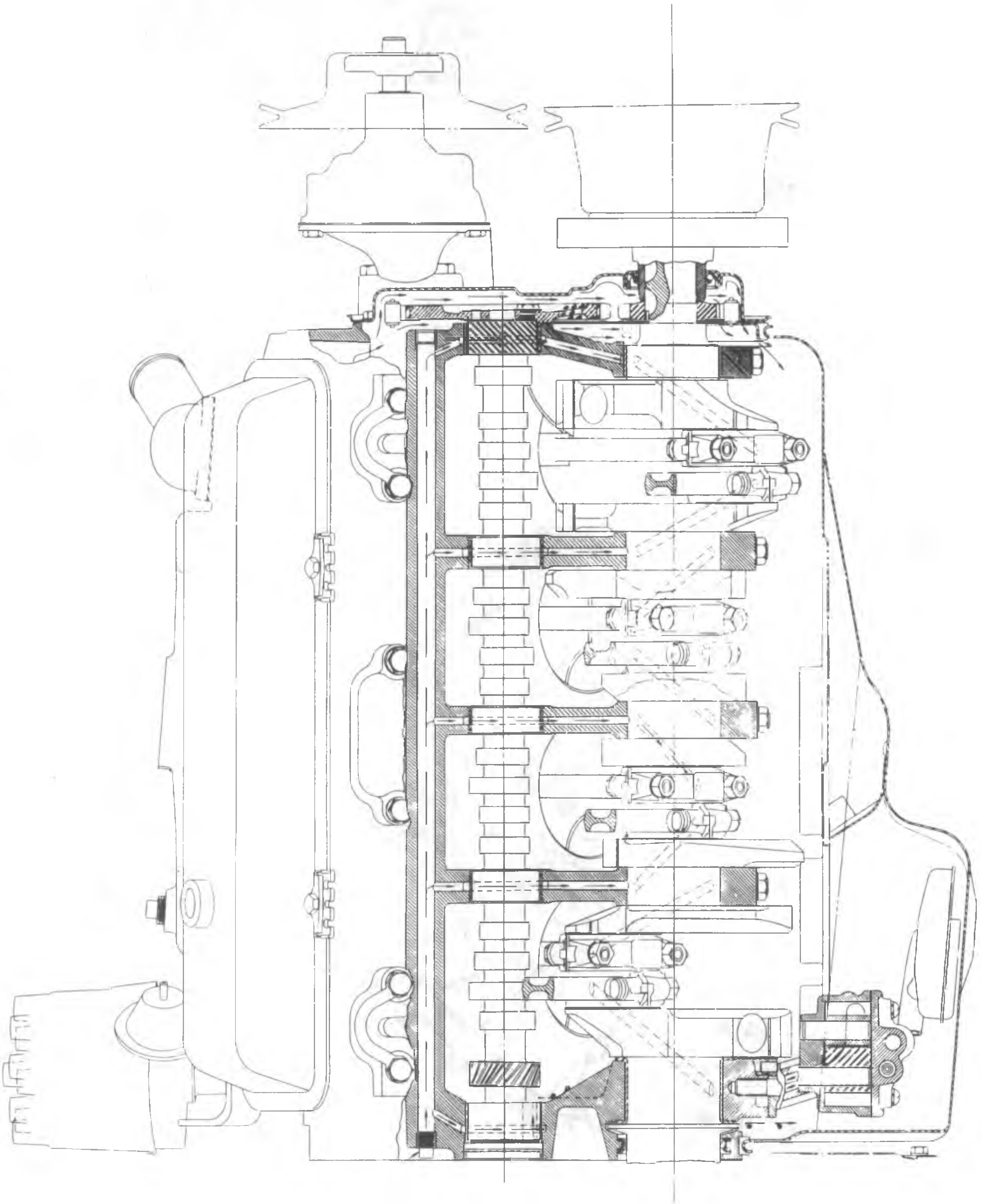


Fig. 2--Engine Lubrication

ON VEHICLE SERVICE

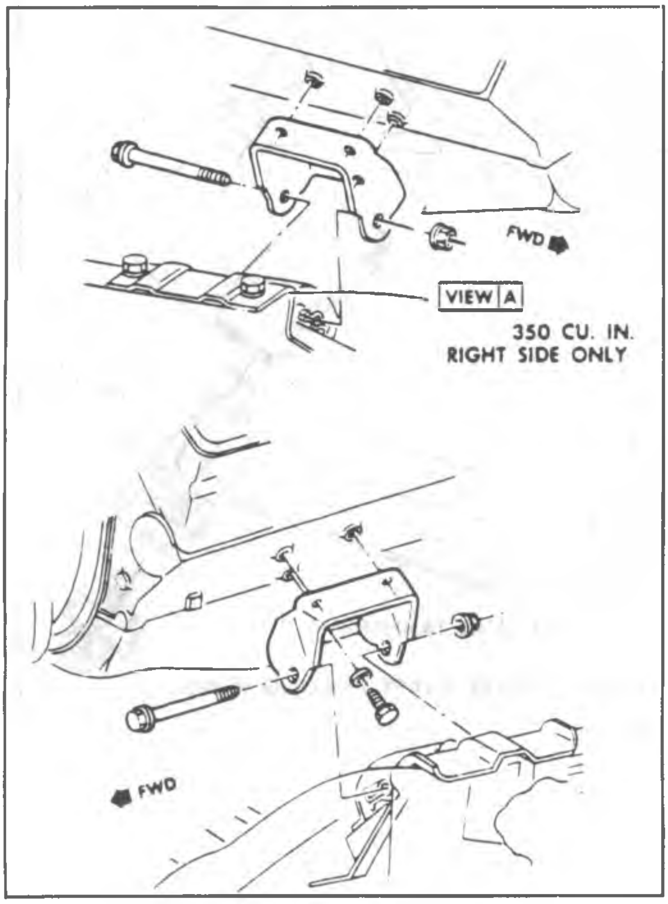


Fig. 3--"P" Series Engine Mount Bracket

ENGINE MOUNTS

Engine mounts (figs. 3 - 8) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;

b. Rubber separated from a metal plate of the mount;

c. Rubber split through center

replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Remove mount retaining bolt from below frame mounting bracket.
2. Raise front of engine and remove mount-to-engine bolts and remove mount.

   NOTICE: Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel which could cause distributor damage.
3. Replace mount to engine and lower engine into place.
4. Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

1. Support engine weight to relieve rear mounts.
2. Remove crossmember-to-mount bolts.
3. On "P" Series with manual transmission and propeller shaft parking brake, remove mount attaching bolts from frame outrigger and clutch housing and remove rear mounting cushions.
4. Remove mount-to-transmission bolts, then remove mount.
5. On "P" Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.
6. Install new mount on transmission.
7. While lowering transmission, align and start crossmember-to-mount bolts.
8. Torque bolts to specifications then bend lock tabs to bolt head as applicable.

INTAKE MANIFOLD

Removal

1. Disconnect battery negative cable.
2. Remove air cleaner.
3. Drain cooling system.
4. On G-Van, remove engine cover.
5. Remove A.I.R. croosover hose.
6. Remove heater and radiator hoses.
7. Remove alternator upper bracket.
8. Disconnect necessary wires and hoses.
9. Disconnect fuel line at carburetor.
10. Disconnect carburetor linkage.
11. Remove spark plug wires (one side).
12. Remove distributor cap, mark position of rotor, then remove distributor.
13. Remove air conditioning compressor and bracket if equipped.
14. Remove brake vacuum pipe.
15. On vehicles equipped with 4 bbl carburetor, remove carburetor.
16. Remove manifold bolts.
17. Remove intake manifold.

1. Clean gasket and seal surfaces on manifold, block,

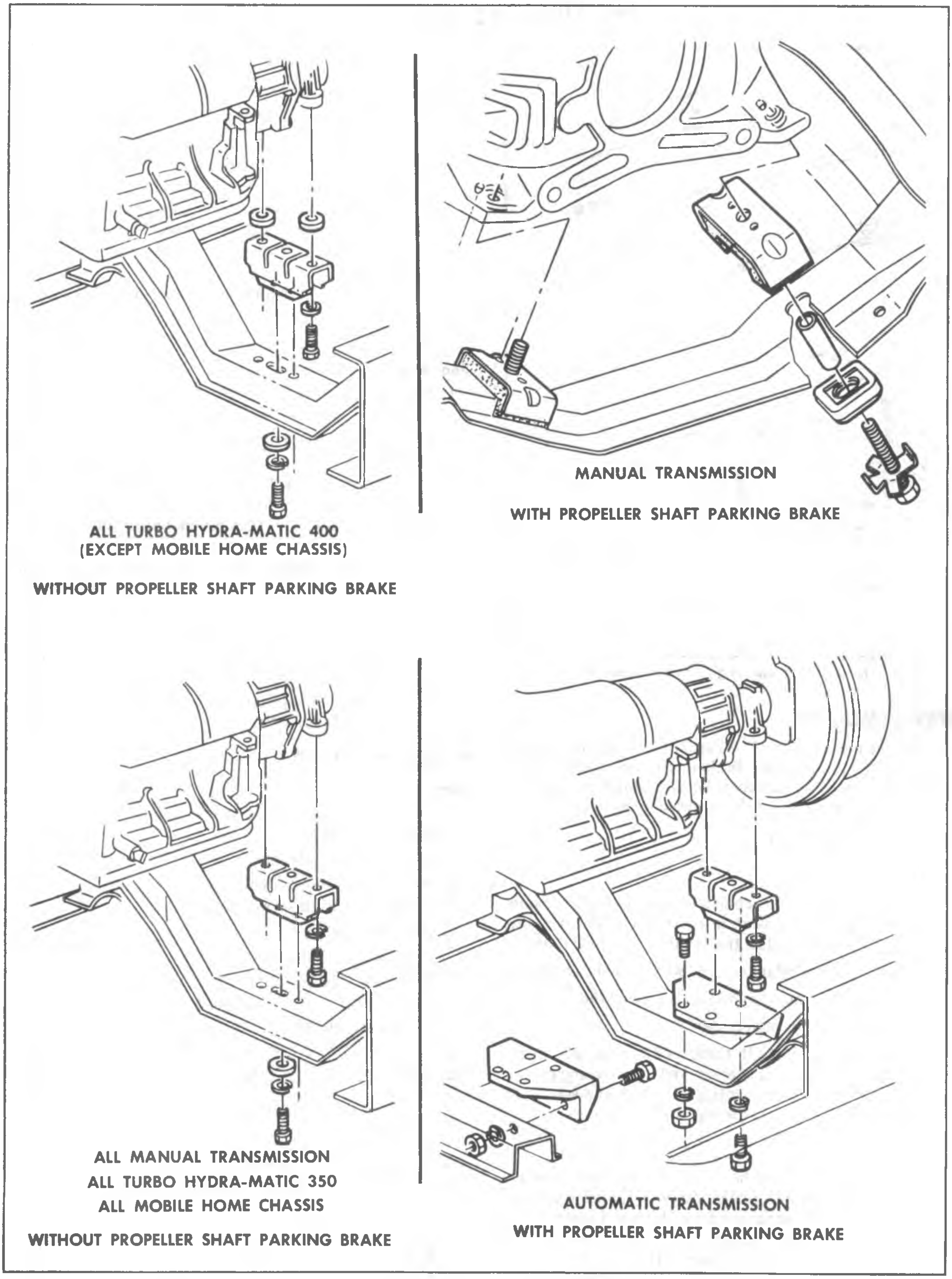


Fig. 4--"P" Series Engine Rear Mount

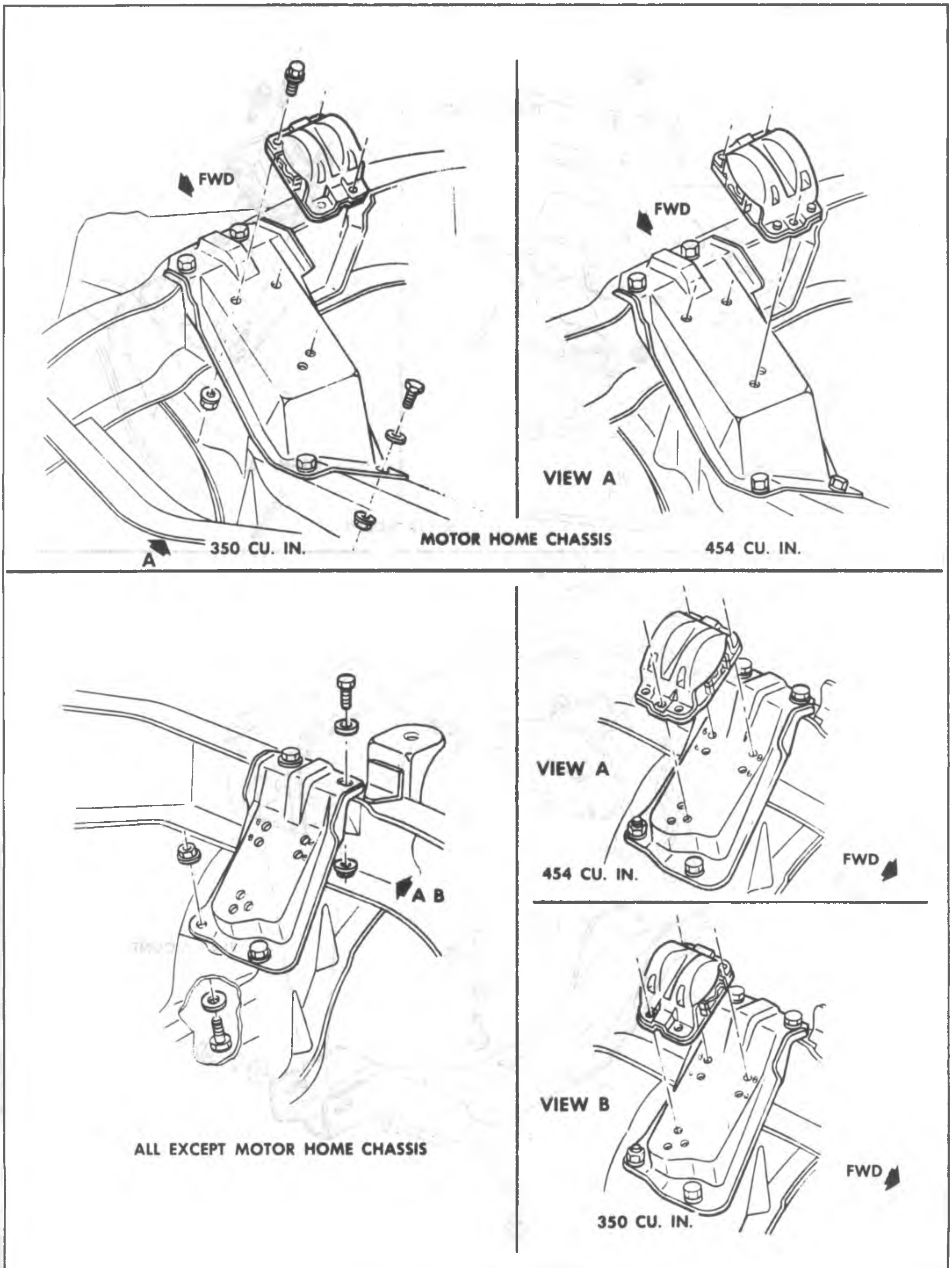


Fig. 5--"P" Series Engine Front Mount

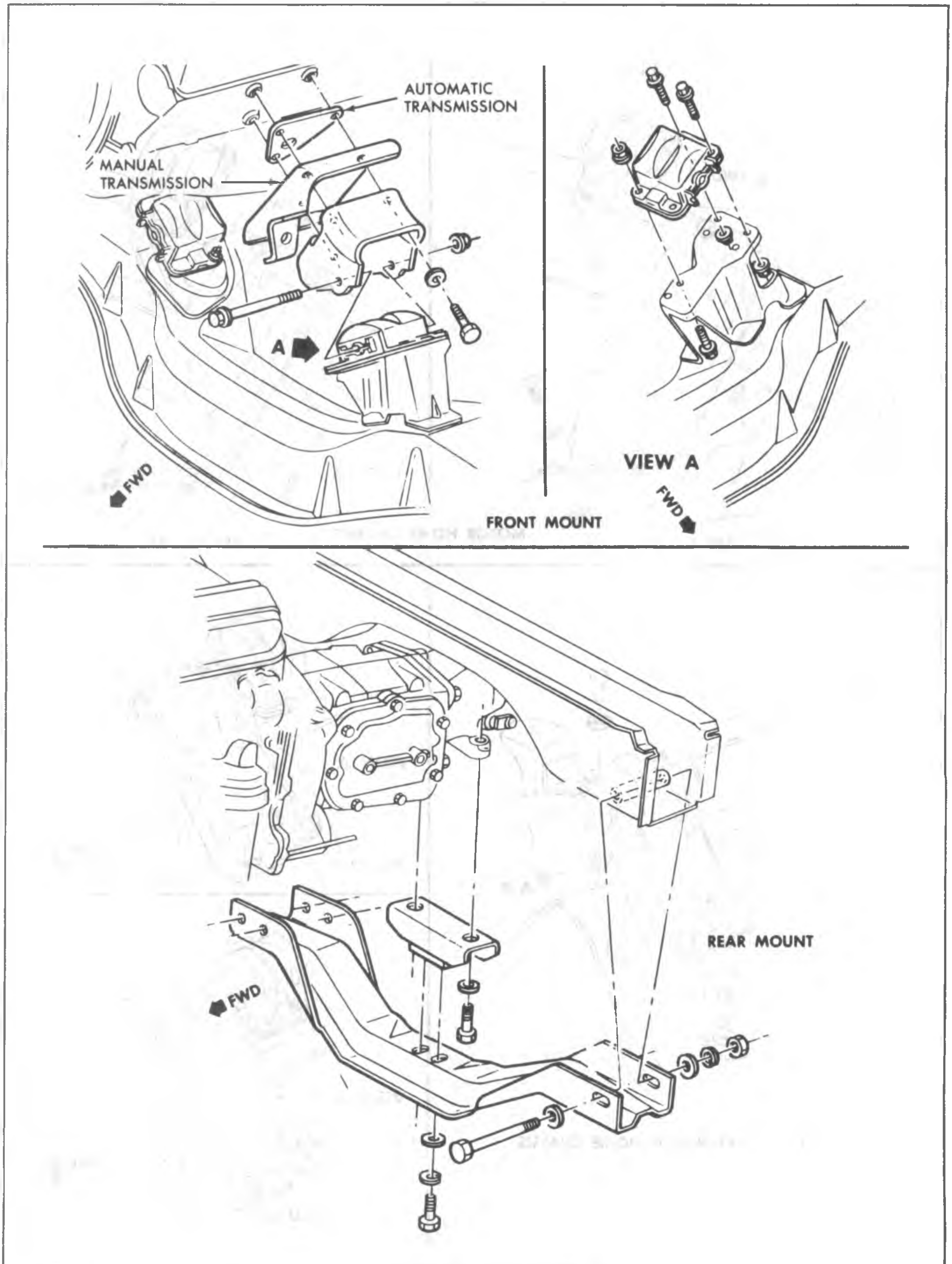


Fig. 6--"G" Series Engine Mounts

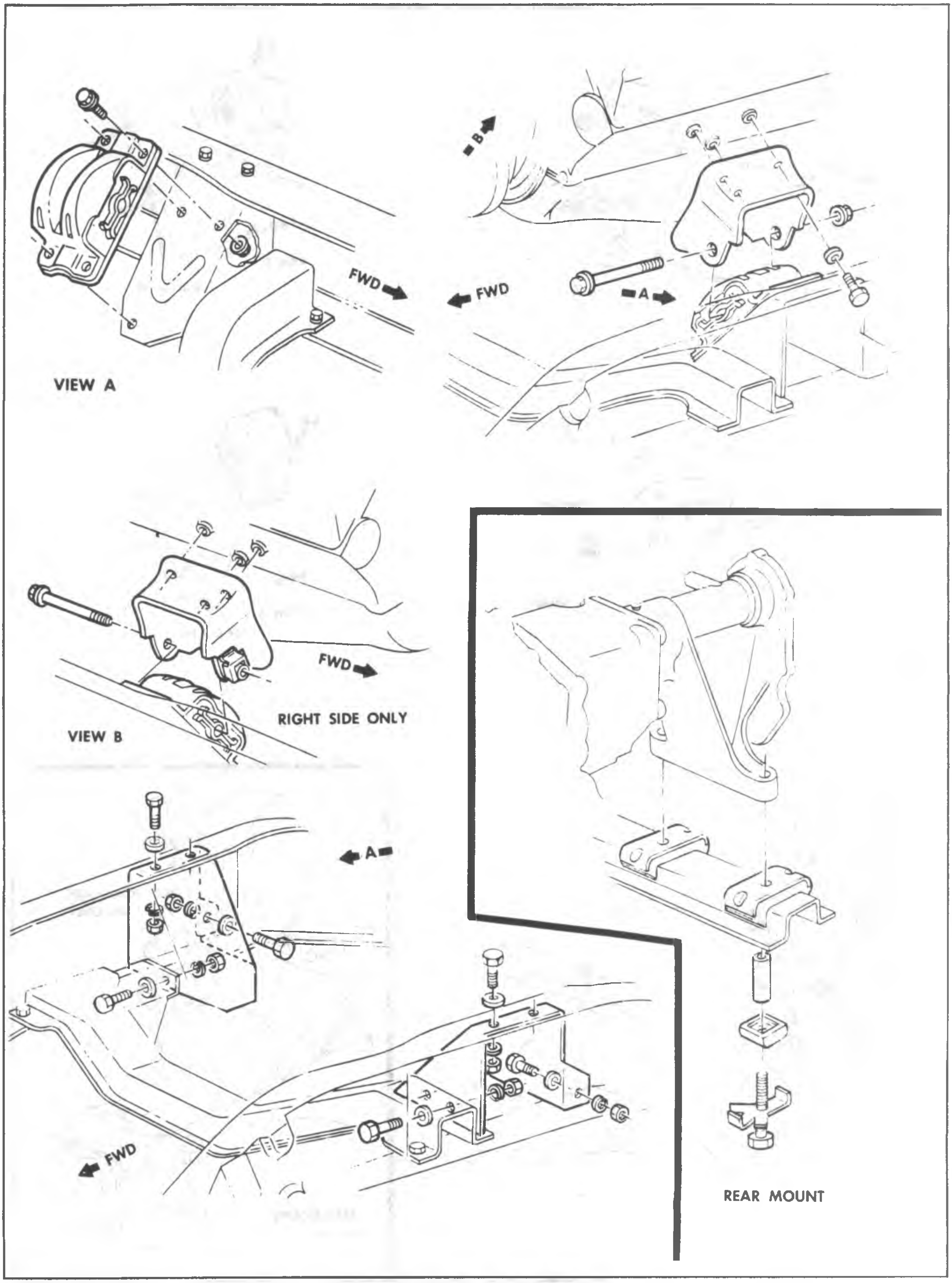


Fig. 7--"K" Series Engine Mounts

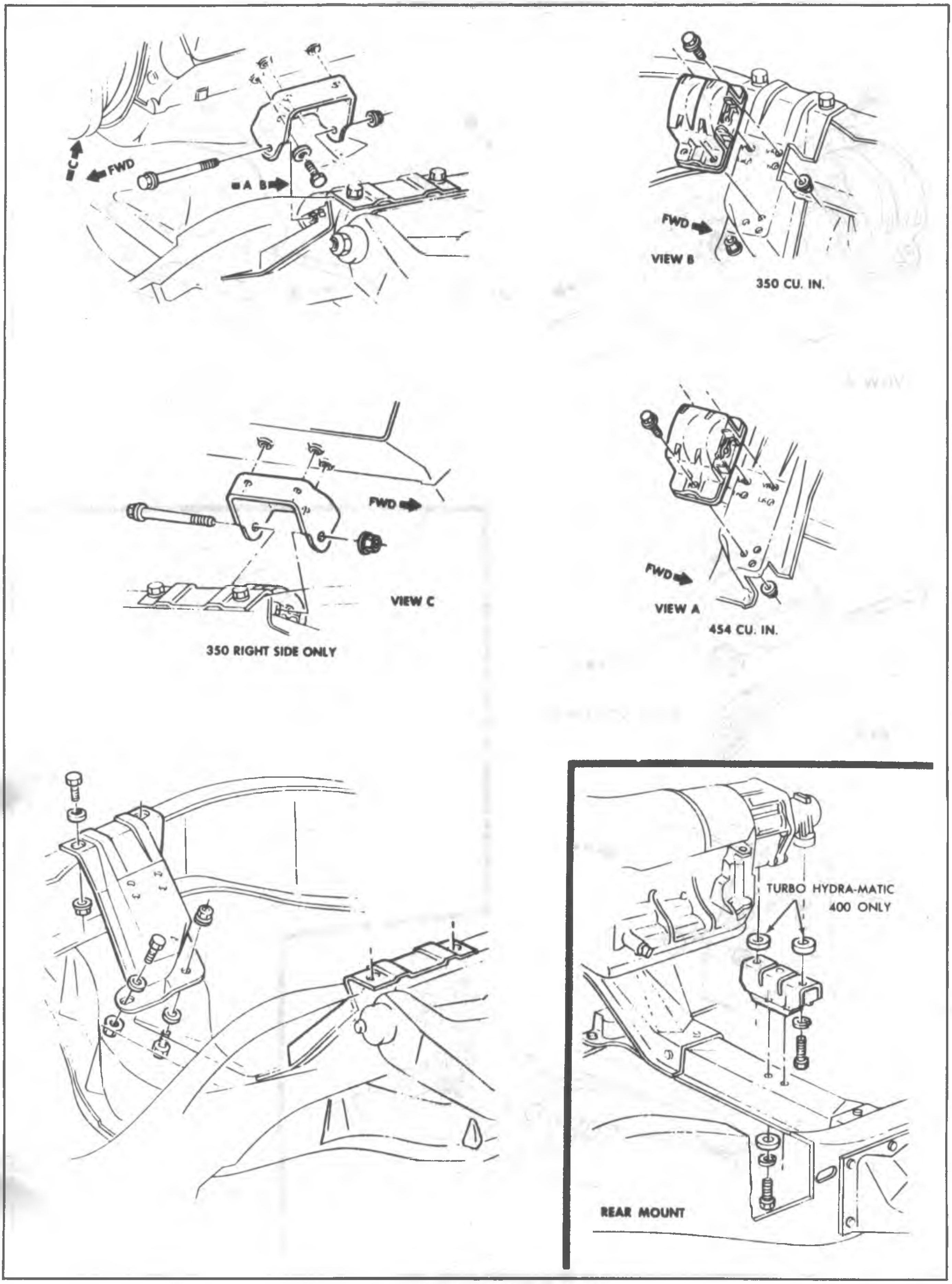


Fig. 8--"C" Series Engine Mounts

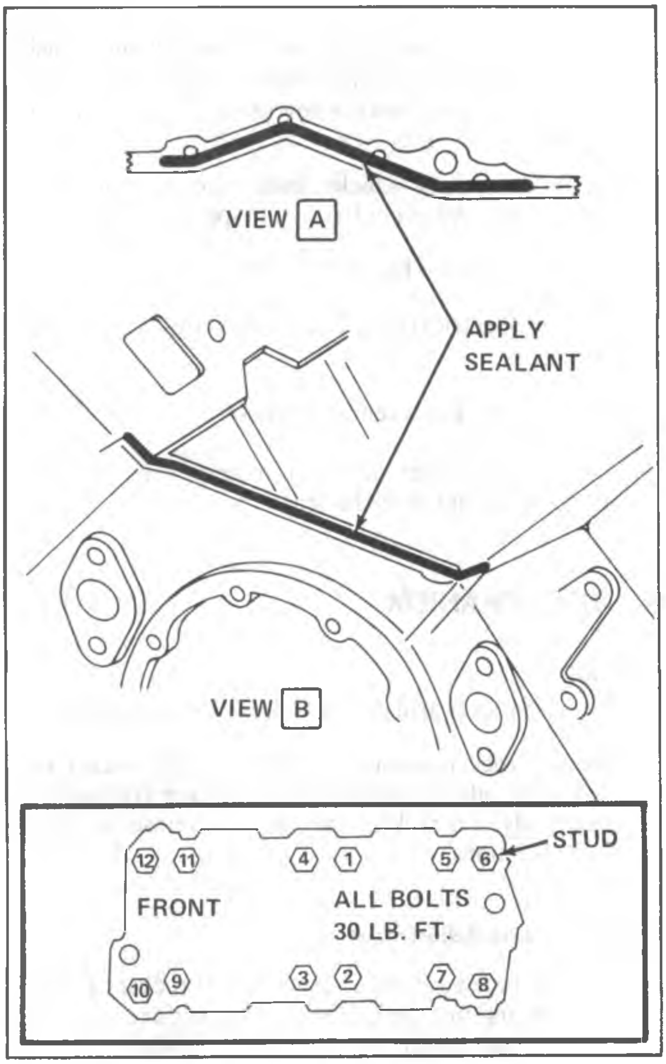


Fig. 9--Intake Manifold Torque Sequence

and cylinder heads with degreaser. Remove all RTV that is loose or will cause installation interference.

2. Install gaskets on cylinder heads and place a 3/16" (5mm) bead of RTV, #1052366 or equivalent, on the front and rear ridges of the cylinder case. Extend the bead 1/2" (13mm) up each cylinder head to seal and retain the manifold side gaskets. Use sealer at water passages.
3. Install manifold and torque bolts to specifications in the sequence outlined in Figure 9.
4. Install carburetor.
5. Install A/C, compressor and bracket if equipped.
6. Install brake vacuum pipe.
7. Install distributor align rotor with mark and install distributor cap.
8. Install spark plug wires.
9. Install carburetor linkage.
10. Connect fuel ine at carburetor.
11. Connect necessary wires and hoses.
12. Install alternator upper bracket.
13. Install heater and radiator hoses.
15. Install A.I.R. crossover hose.
15. On G-Van, install engine cover.
16. Fill cooling system. Follow Owner's Manual for proper procedures and capacities.
17. Install air cleaner.
18. Start engine, adjust timing and carburetor idle speeds (if necessary) and check for leaks.

EXHAUST MANIFOLD

Removal

1. Remove carburetor heat stove pipe.
2. Remove the spark plug wiring heatshields.
3. Disconnect exhaust pipe from manifold and hang exhaust pipe from frame with wire.
4. Remove end bolts then remove center bolts and

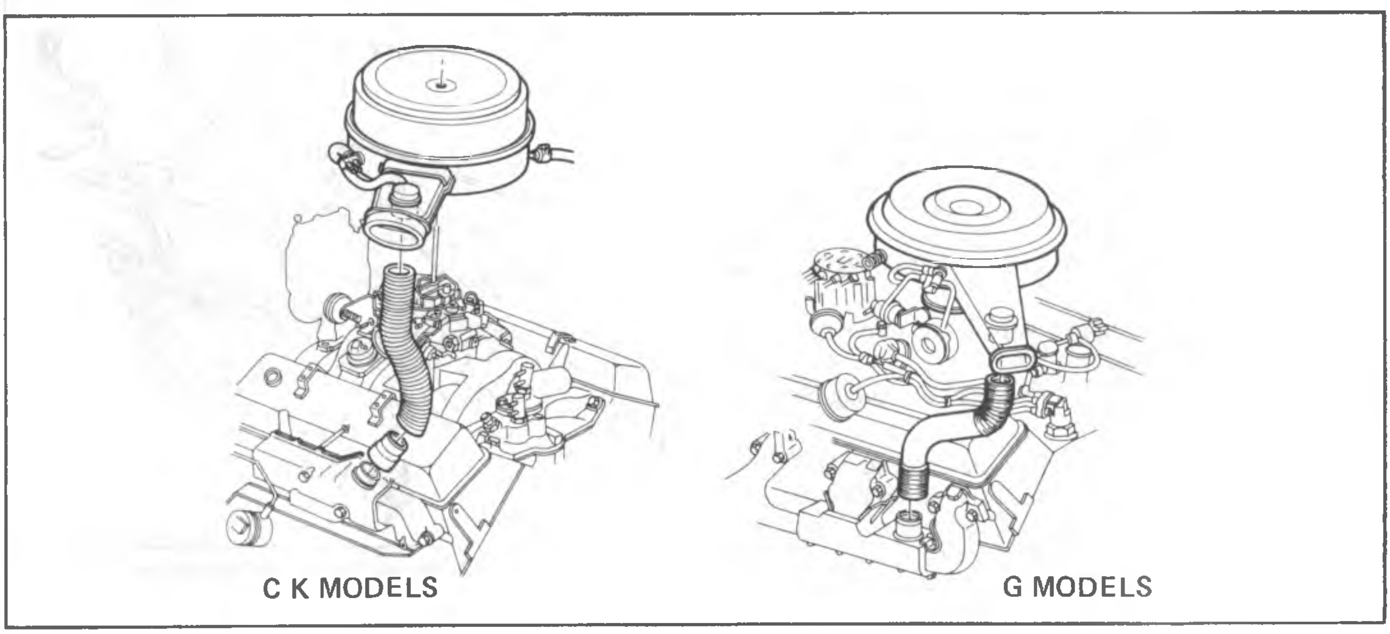


Fig. 10--Carburetor Heat Stove Assembly

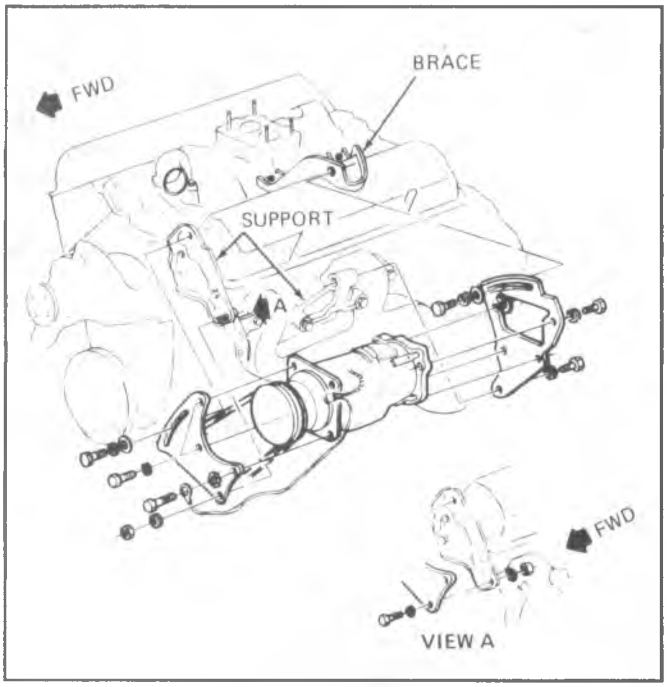


Fig. 11--A/C Compressor Mounting

remove manifold.

Installation

- If installing a new right side manifold, the carburetor heat stove must be transferred from the old unit (fig. 10).

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts (fingertight).
2. Torque manifold bolts to specifications.
3. Connect exhaust pipe to manifold.
4. Install carburetor heat stove pipe.
5. Install spark plug wiring heatshields.
6. Start engine and check for leaks

ROCKER ARM COVER (Fig. 12)

Removal

1. Disconnect battery negative cable.
2. Remove air cleaner.
3. Disconnect crankcase ventilation hoses at rocker arm covers.
4. Disconnect electrical wiring harness from rocker arm clips.
5. Remove carburetor heat stove pipe from right exhaust manifold.
6. If the vehicle is equipped with air cond tioning, remove the A/C compressor rear brace (fig. 11).
7. Remove rocker arm cover to head attaching bolts and remove rocker arm cover.

   NOTICE: If cover adheres to cylinder head, shear off by bumping end of rocker arm cover with a block of wood and a rubber mallet. If cover still will not come loose, **CAREFULLY** pry until loose. DO NOT DISTORT SEALING FLANGE.

Installation

1. When re-installing rocker cover, install a new gasket if so equipped. If sealing surface is RTV remove old RTV and replace with a new gasket and a reinforcement and bolt units.
2. On A/C equipped vehicles, install the A/C compressor upper brace. Adjust pulley belt to specification.
3. Install carburetor heat stove pipe.
4. Connect electrical wiring harness at clips on rocker arm cover.
5. Connect crankcase ventilation hoses.
6. Install air cleaner. Connect battery negative cable, start engine and check for leaks.

VALVE MECHANISM

Removal

1. Remove rocker arm covers as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same locations.

Installation and Adjustment

- Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.

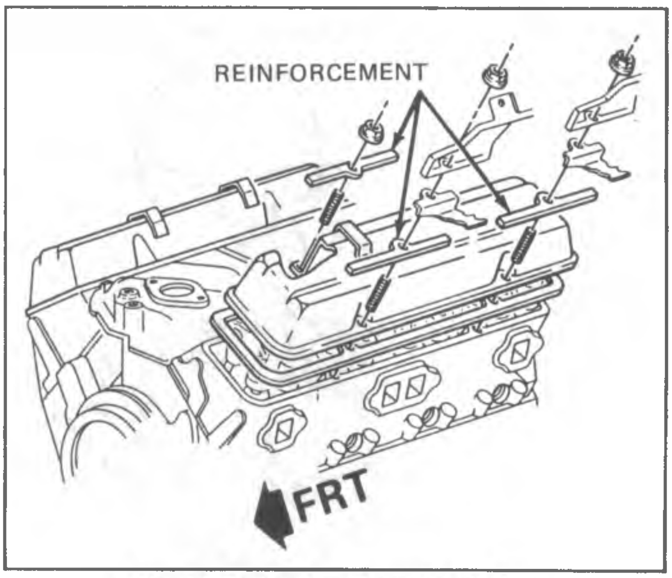


Fig. 12--Rocker Arm Cover Installation

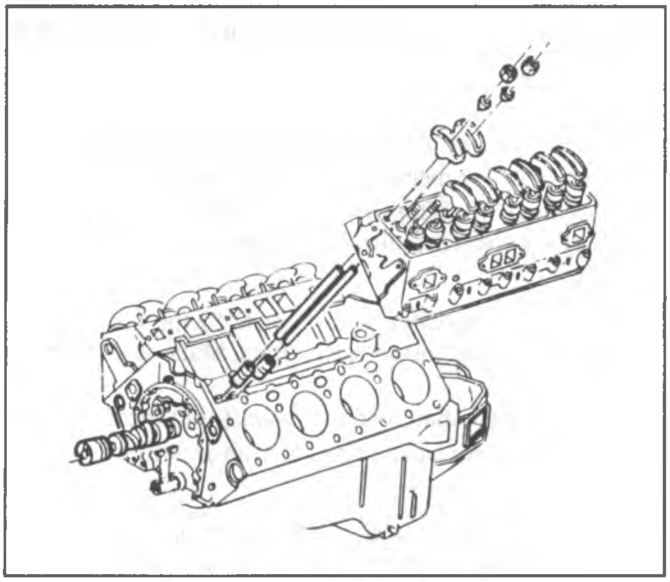


Fig. 13 -- Rocker Arms and Pushrods

3. Adjust valves when lifter is on base circle of camshaft lobe as follows:

   a. Crank engine until mark on torsional damper lines up with center or "O" mark, on the timing tab, fastened to the crankcase front cover, and the engine is in the #1 firing position. This may be determined by placing fingers on the #1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the #1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in #6 firing position and should be rotated one more time to reach the #1 position.

   b. With the engine in the #1 firing position as just determined, the following valves may be adjusted:

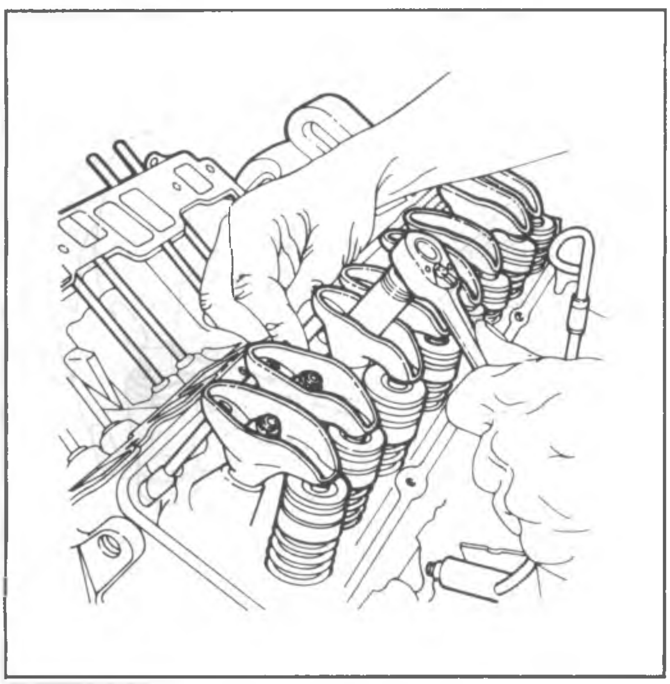


Fig. 14--Valve Adjustment

   - Exhaust--1, 3, 4, 8
   -- Intake--1, 2, 5, 7

   c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by rotating push rod while turning adjusting nut (fig. 14). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).

   d. Rotate the engine one revolution until the pointer "O" mark and torsional damper mark are again in alignment. This is the #6 firing position. With the engine in this position the following valves may be adjusted.

   - Exhaust--2, 5, 6, 7
   -- Intake--3, 4, 6, 8

4. Install rocker arm covers as previously outlined.
5. Start engine and adjust carburetor idle speed, if needed.

VALVE STEM OIL SEAL and/or VALVE SPRING (Fig. 15)

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap, oil shedder and valve spring and damper (fig. 16).
5. Remove the valve stem oil or head oil seal.

Installation

1. Install valve stem seal over valve stem and seat against head.
2. Set the valve spring and damper, oil shedder and valve cap in place. Compress the spring with Tool J-5892 and sure the seal is flat and not twisted. A light coat of oil on the seal will help prevent twisting.

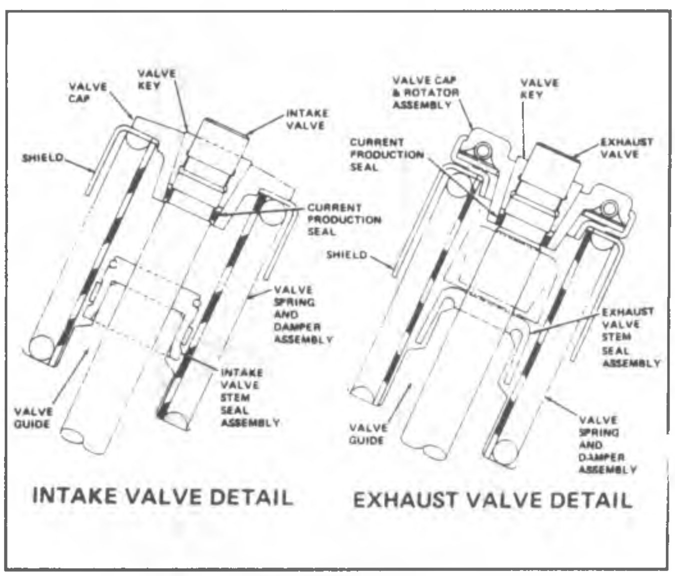


Fig. 15--Valve Seals

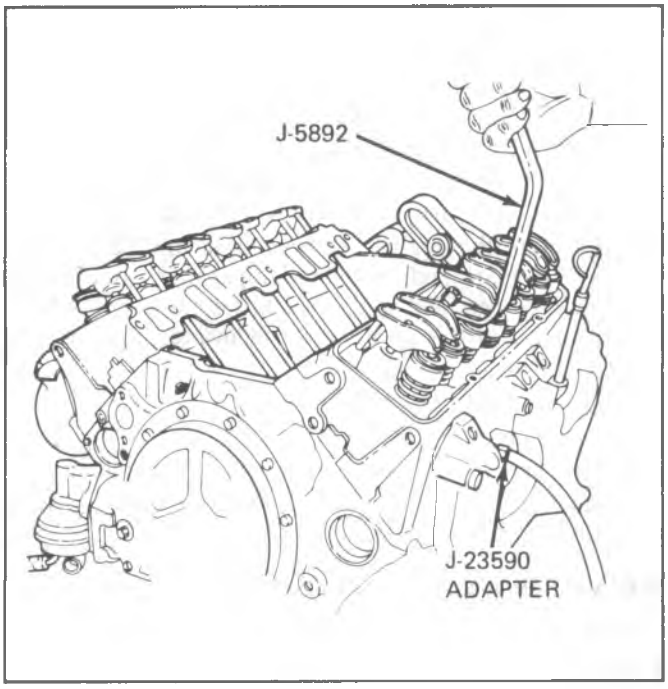


Fig. 16--Compressing Valve Spring

3. Install the valve locks and release the compressor tool making sure the locks seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
4. Using tool J-23994, apply vacuum to the valve cap to make sure no air leaks past the seal.
5. Install spark plug, and torque to 22 lb. ft. (30 N·m).
6. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Removal

1. Remove intake manifold as previously outlined.
2. Remove valve mechanism as previously outlined.
3. Remove valve lifters. Place valve lifters in a rack so that they may be reinstalled in the same location.

Installation

1. Coat foot of valve lifters with "Molykote" or its equivalent and install valve lifters. Make sure lifter foot is convex.
2. Install intake manifold as previously outlined.
3. Install and adjust valve mechanism as outlined.

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve (fig. 17).
3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver (fig. 18).

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore. If the bottom of the lifter is scuffed or worn, inspect the camshaft lobe. If the push rod seat is scuffed or worn, inspect the push rod. An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed.

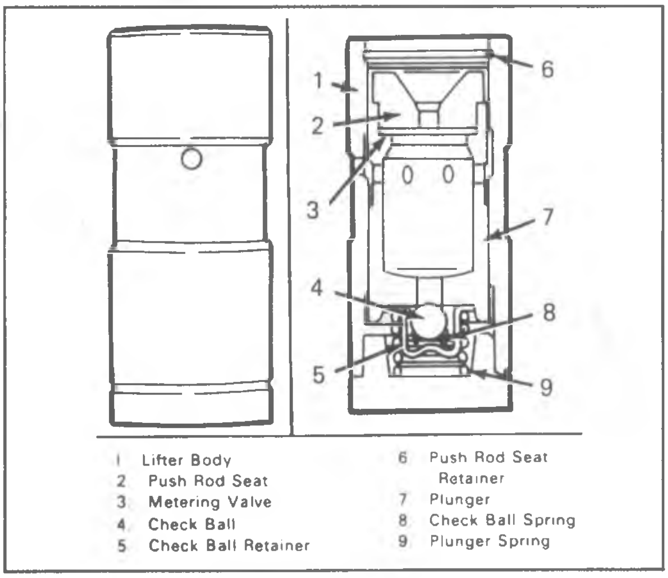


Fig. 17--Hydraulic Valve Lifter

Fig. 18--Removing Ball Check Valve

Fig. 19--Installing Ball Check Valve

All damaged or worn lifters should be replaced.

Whenever a new camshaft is installed, replace oil, oil filter and all valve lifters. Install GM E.O.S. or equivalent over the cam and lifter feet after the parts are installed.

- For proper lifter rotation during engine operation, lifter foot must be convex.

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver (fig. 19).
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid. Do not attempt to force or pump the plunger. At this point, oil holes in the lifter body and plunger assembly will be aligned (fig. 20).
5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 20).
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (fig. 17).
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation. Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove intake manifold as previously outlined.
2. Remove generator lower mounting bolt and lay unit aside.
3. Remove exhaust manifolds as previously outlined.
4. Drain cylinder block of coolant.
5. If vehicle is equipped with A/C, remove A/C compressor and forward mounting bracket. Lay unit aside.
6. Remove valve push rods as previously outlined.
7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

1. With cylinder head removed, remove valve rocker arm nuts, balls and rocker arms (if not previously done).
2. Using Tool J-8062, compress the valve springs (fig. 21) and remove valve keys. Release the compressor tool and remove rotators or spring caps, oil shedders, springs and spring damper, then remove oil seals and valve spring shims.
3. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J-8089 (fig. 22).
2. Thoroughly clean the valve guides using Tool J-8101.
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.

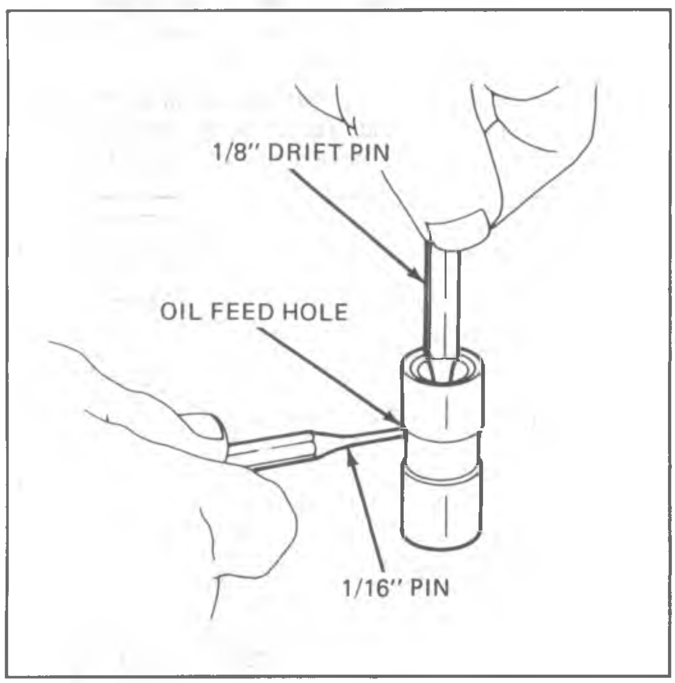


Fig. 20--Assembling Hydraulic Lifter

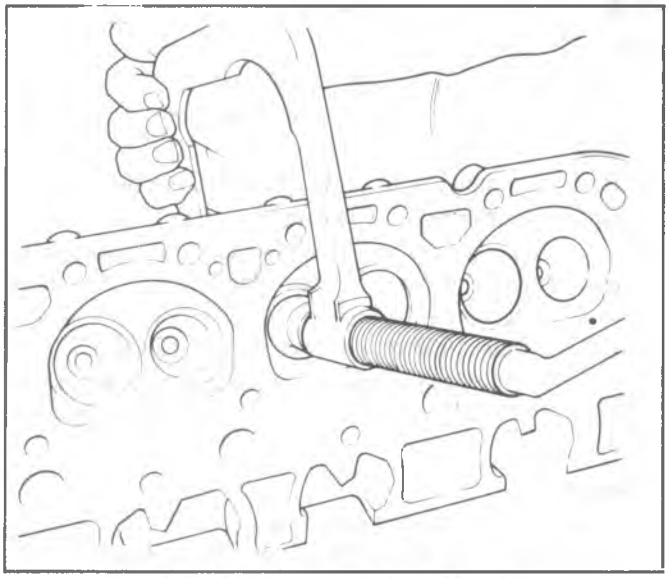


Fig. 21--Compressing Valve Spring

5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the coolant chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.

   NOTICE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.
3. Measure valve stem clearance (fig. 23) as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail.
   b. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide.
   c. Drop the valve head about 1/16" (1.6mm) off the valve seat.
   d. Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves as outlined.
4. Check valve spring tension with Tool J-8056 spring tester (fig. 24). Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. (44 N) of the specified load (without dampers).

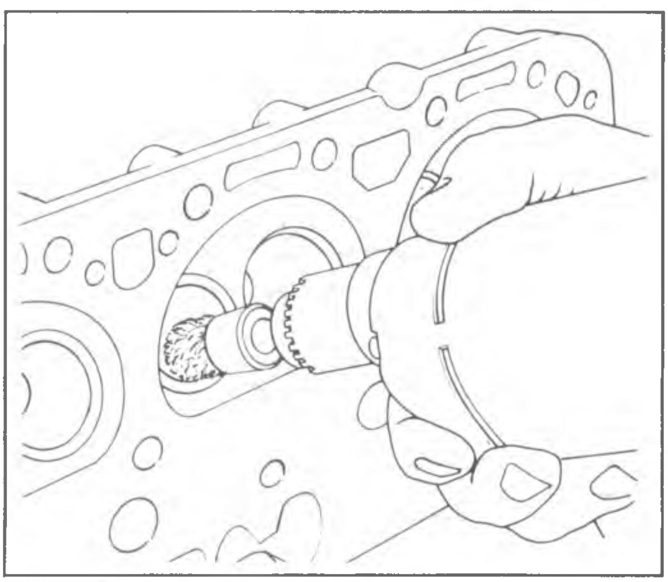


Fig. 22--Cleaning Combustion Chambers

Fig. 23--Measuring Valve Stem Clearances

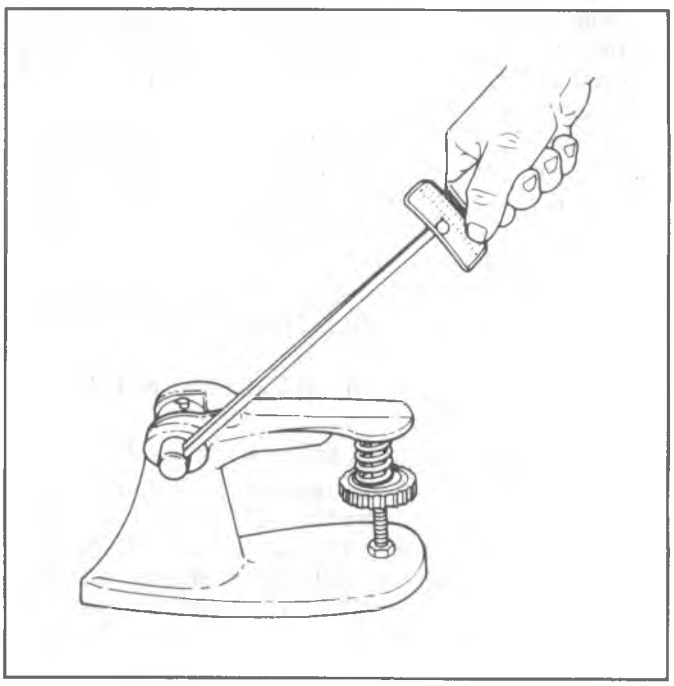


Fig. 24--Checking Valve Spring Tension

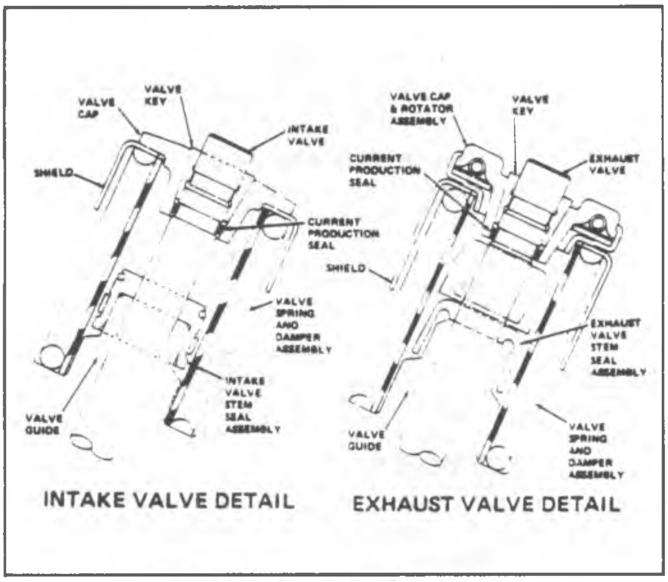


Fig. 25--Valve Spring Installation

5. Inspect rocker arm studs for wear or damage.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:
   a. Set the valve spring shim, valve spring, oil shedder and valve cap or rotator in place (fig. 25).
   b. Compress the spring with Tool J-8062.
   c. Install oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.
   d. Install the valve locks and release the compressor tool, making sure that the locks seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
3. Install the remaining valves.
4. Check each valve stem oil seal by placing Valve Seal Leak Detector (Tool J-23994) over the end of the

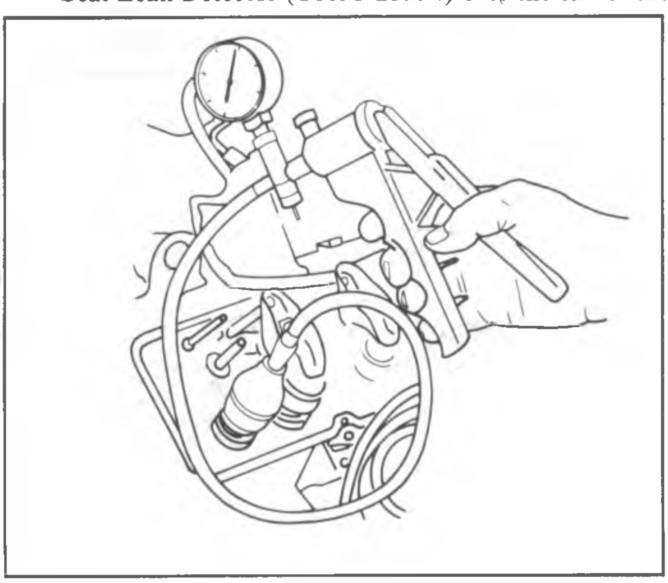


Fig. 26--Checking Valve Stem Oil Seals

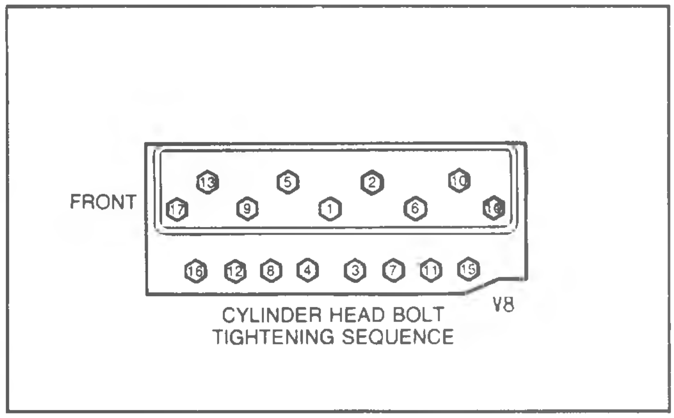


Fig. 27--Cylinder Head Torque Sequence

valve stem and against the cap. Operate the vacuum pump and make sure no air leaks past the seal (fig. 26).

5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 27). Measure from the top of the shim or the spring seat to the top of the oil shedder (fig. 28). If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick. At no time should the spring be shimmed to give an installed height under the minimum specified.

Installation

- The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be clean as dirt will affect bolt torque.

1. If using a STEEL gasket, coat both sides of a new gasket with a good sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.
   - Use no sealer if using a composition STEEL ASBESTOS gasket.

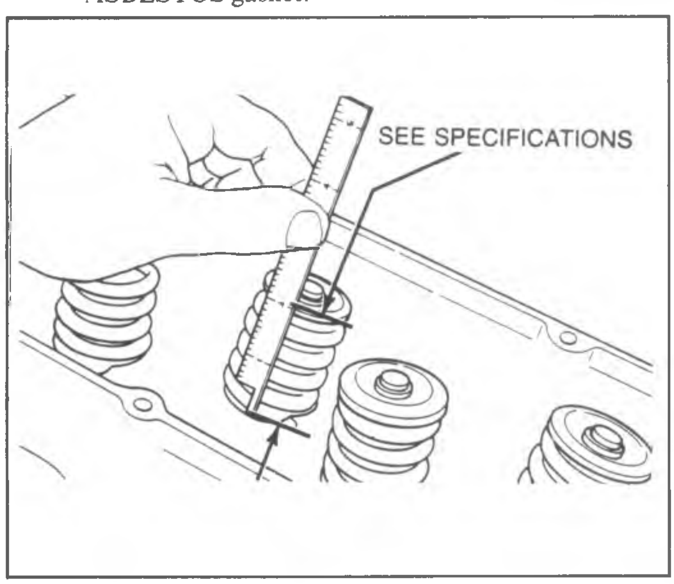


Fig. 28--Measuring Valve Spring Installed Height

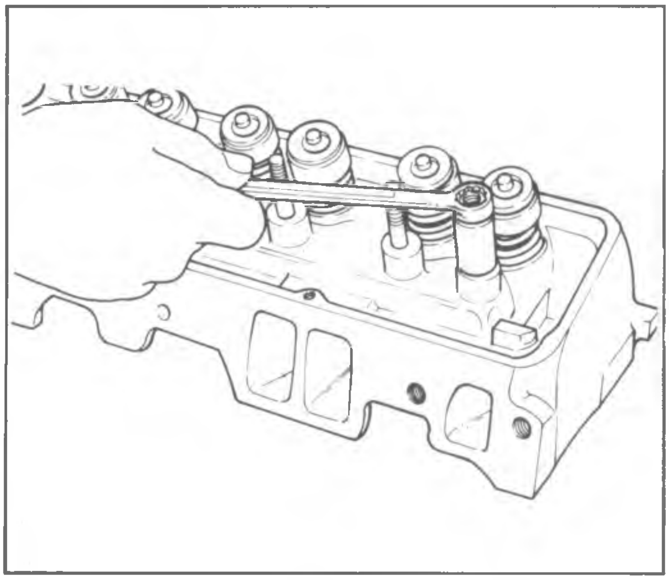


Fig. 29--Removing Rocker Arm Stud

2. Place the gasket in position over the dowel pins with the bead up.
3. Carefully guide the cylinder head into place over the dowel pins and gasket.
4. Coat threads of cylinder head bolts with sealing compound, #1052080 or equivalent, and install bolts finger tight.
5. Tighten each cylinder head bolt a little at a time in the sequence shown in the torque sequence chart until the specified torque is reached.
6. Install exhaust manifolds as previously outlined.
7. Install intake manifold as previously outlined.
8. Install and adjust valve mechanism as previously outlined.

ROCKER ARM STUDS

Replacement

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced with new studs available in .003" and .013" oversize. Studs may be installed after reaming the holes as follows:

1. Remove old stud by placing Tool J-5802-1 over the stud, installing nut and flat washer and removing stud by turning nut (fig. 29).
2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 30).

   NOTICE: Do not attempt to install an oversize stud without reaming stud hole as this could damage the head casting.
3. Coat press-fit area of stud with hypoid axle lubricant. Install new stud, using Tool J-6880 as a guide. Gage should bottom on head (fig. 31).

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J-5830.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valves seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide.

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively

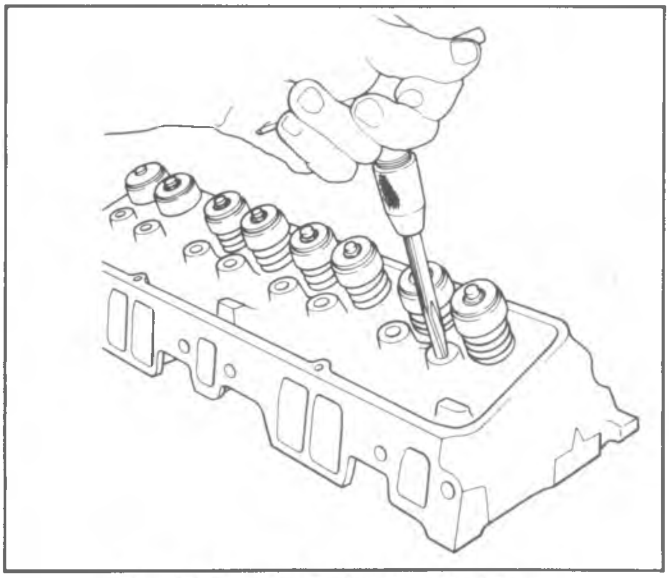


Fig. 30--Reaming Rocker Arm Stud Bore

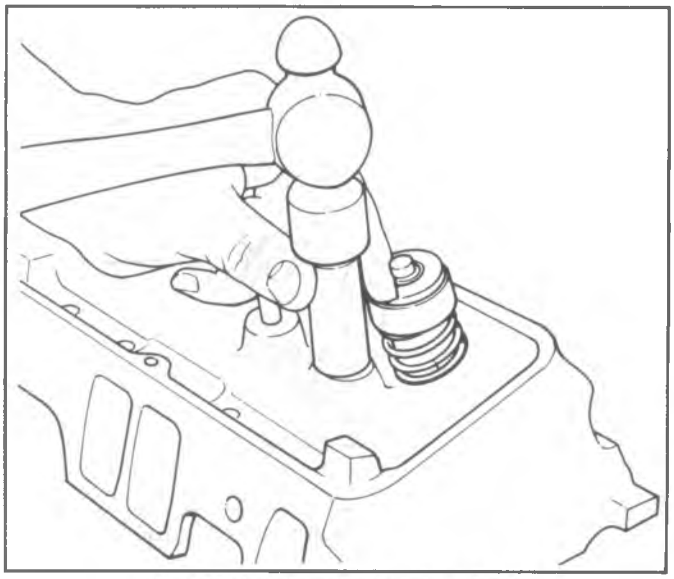


Fig. 31--Installing Rocker Arm Stud

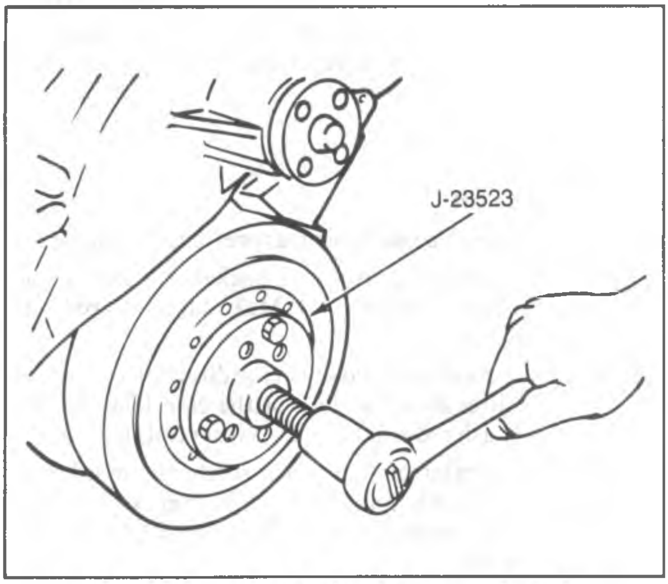


Fig. 32--Removing Torsional Damper - Typical

is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" (.80mm) thick after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

TORSIONAL DAMPER

Removal

1. Remove fan belt, fan and pulley.
2. Remove the fan shroud assembly.
   - If additional operations (such as camshaft removal) are not being performed, radiator removal will not be necessary.
3. Remove accessory drive pulley then remove damper retaining bolt.
4. Install Tool J-23523 on damper then, turning puller screw, remove damper (fig. 32).

Installation

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber type material. The installation procedures (with proper tool) must be followed or movement of the inertia weight section on the hub will destroy the tuning of the torsional damper.

1. Coat front cover seal contact area (on damper) with engine oil.
2. Place damper in position over key on crankshaft.
3. Pull damper onto crankshaft as follows:
   a. Install appropriate threaded end of Tool J-23523 into crankshaft. Install tool in crankshaft so that at least 1/2" (13mm) of thread engagement is obtained.
   b. Install plate, thrust bearing and nut to complete tool installation.
   c. Pull damper into position as shown in Figure 33.
   d. Remove tool from crankshaft then install damper retaining bolt and torque to specifications.
4. Install accessory drive pulley.
5. Install fan shroud.
6. Install fan and pulley to water pump hub and tighten securely.
7. Install fan belt and adjust (see section 6B).
8. Fill cooling system (see section 6B) and check for leaks.

CRANKCASE FRONT COVER

Removal

1. Remove torsional damper as previously outlined.
2. Remove water pump (see section 6B).
3. Remove crankcase front cover attaching screws and remove front cover and gasket, then discard gasket.

Installation

1. Clean gasket surface on block and crankcase front cover.
2. Use a sharp knife or other suitable cutting tool to remove any excess oil pan gasket material that may be protruding at the oil to engine block junction.
3. Apply a 1/8" (3mm) bead of RTV, #1052366 or equivalent, to the joint formed at the oil pan and cylinder block.
4. Coat the cover gasket with gasket sealant and place in position on cover.
5. Install cover-to-oil pan seal, lightly coat bottom of seal with engine oil, and position cover over crankshaft end.
6. Loosely install the cover-to-block upper attaching screws.
7. Tighten screws alternately and evenly while pressing downward on cover so that dowels in block are aligned with corresponding holes in cover. Position cover so that dowels enter holes in cover without binding. Do not force cover over dowels so that cover flange or holes are distorted.
8. Install remaining cover screws and torque to specifications.

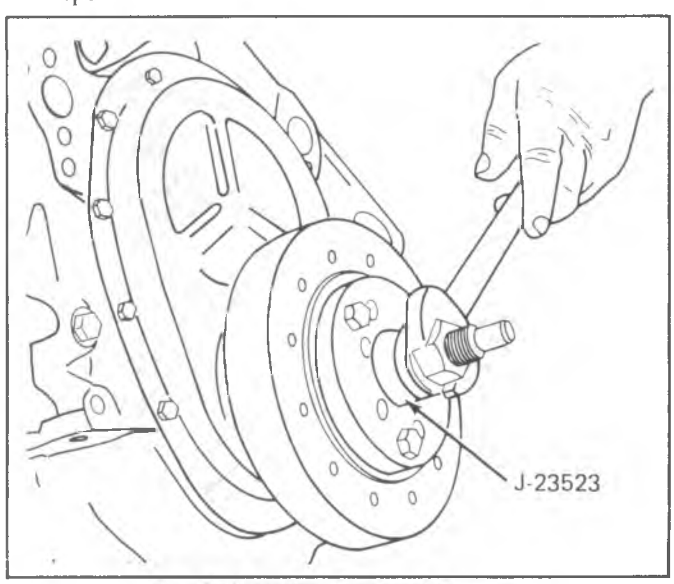


Fig. 33--Installing Torsional Damper

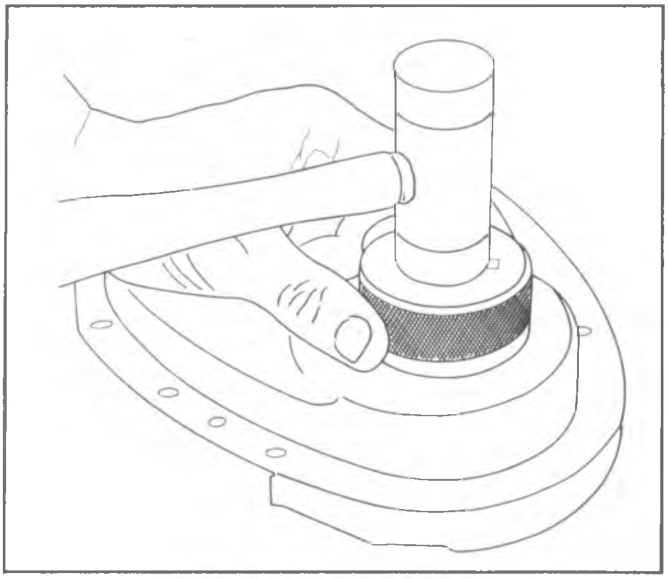


Fig. 34--Installing Oil Seal

9. Install torsional damper and water pump as previously outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removed

1. With cover removed, pry oil seal out of cover from the front with a large screw driver.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-23042. Support rear of cover at seal area.

With Cover Installed

1. With torsional damper removed, pry seal out of cover from the front with a large screw driver. Be careful not to damage the surface on the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-23042 (fig. 34).

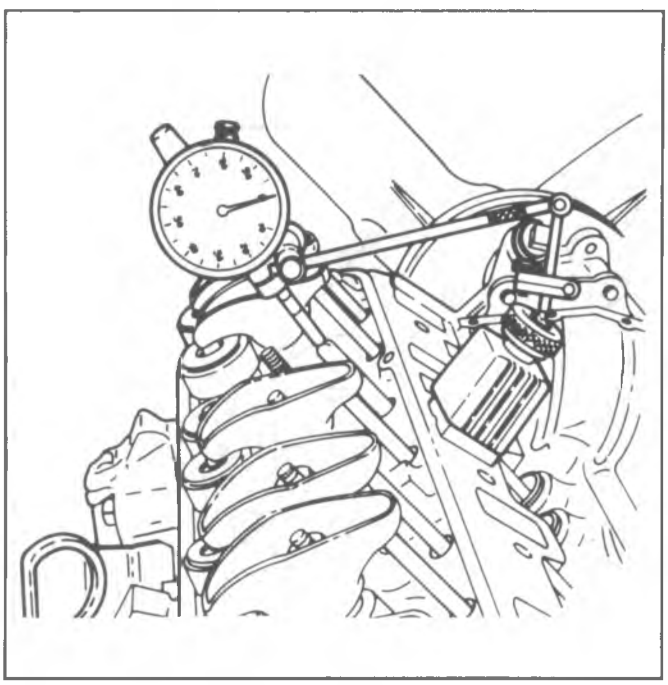


Fig. 35--Measuring Camshaft Lobe Lift

CAMSHAFT

Measuring Lobe Lift

1. Remove the valve mechanism as previously outlined.
2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 35). Make sure push rod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is fully raised position.
   - Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).
5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust valve mechanism as outlined.

Removal

1. On G Van models remove:
   a. grille
   b. radiator
   c. loosen condensor and swing forward.
2. Remove valve lifters as previously outlined.
3. Remove crankcase front cover as previously outlined.
4. Remove grille.
5. Remove fuel pump and push rod (see section 6C).

   Complete camshaft removal as follows:
   - Sprocket is a light fit on camshaft. If sprocket does not come off easily a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.
6. On CK truck remove motor mount through bolts, and raise engine.

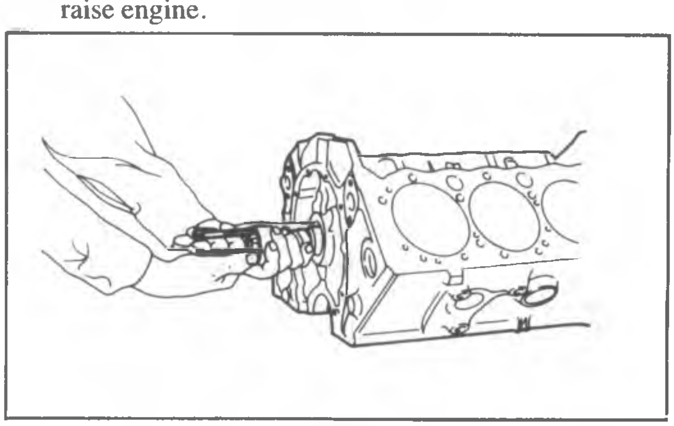


Fig. 36--Removing Camshaft

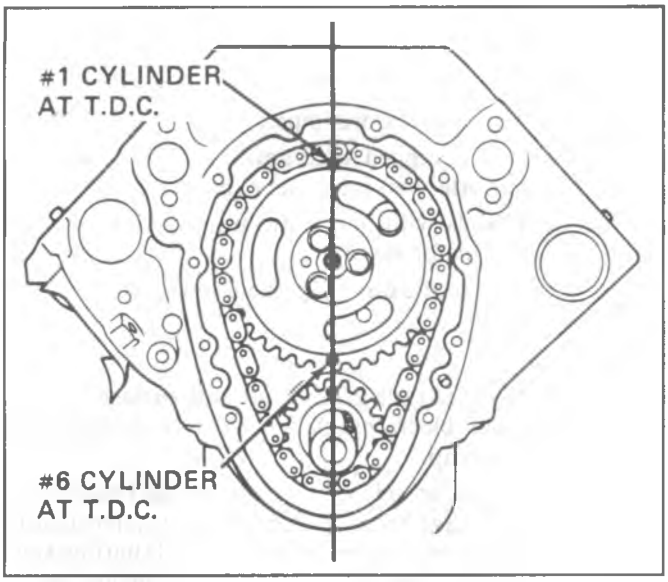


Fig. 37--Camshaft Sprocket Alignment Marks

6. Install two 5/16" - 18 x 4" bolts in camshaft bolt holes then remove camshaft (fig. 36).

NOTICE: All camshaft journals are the same diameter and care must be used in removing camshaft to avoid damage to bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" (.025mm) out-of-round, the camshaft should be replaced.

Installation

Whenever a new camshaft is installed coat camshaft lobes with "Molykote" or its equivalent.

Whenever a new camshaft is installed, replacement of all valve lifters oil filter, and new oil is recommended to insure durability of the camshaft lobes and lifter feet.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Lower engine.
3. Install timing chain on camshaft sprocket (fig. 37). Hold the sprocket vertically with the chain hanging down and align marks on camshaft and crankshaft sprockets.
4. Align dowel in camshaft with dowel hole in camshaft sprocket then install sprocket on camshaft.
5. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
6. Lubricate timing chain with engine oil.
7. Install fuel pump push rod and fuel pump (see section 6C).
8. Install crankcase front cover as previously outlined.
9. Install valve lifters as previously outlined.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced with engine completely or partially disassembled. To replace bearings without complete disassembly, remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.
2. Using Tool J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 38).
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (fig. 39).

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block (fig. 39).
2. Using Tool Set J-6098, with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.
   - Number one cam bearing oil hole must be

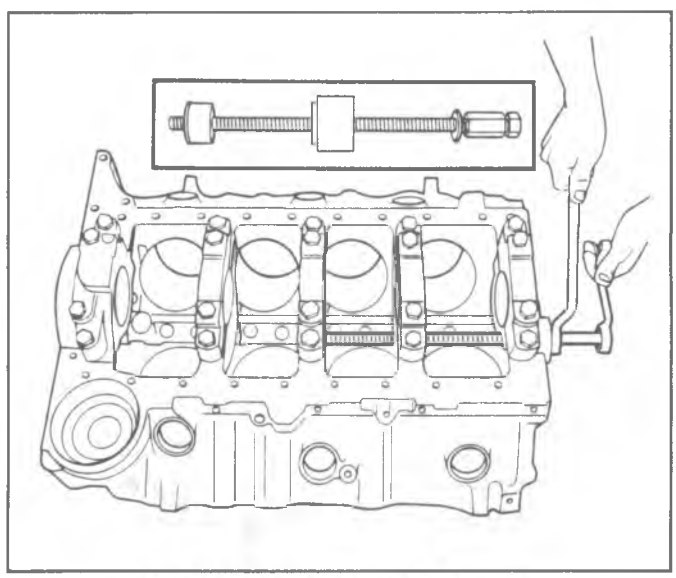


Fig. 38--Removing Camshaft Bearings

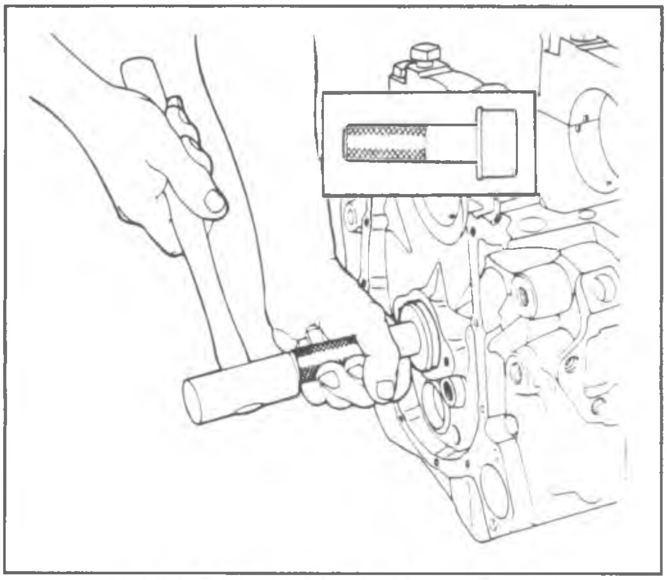


Fig. 39--Replacing Camshaft Front Bearing

positioned so that oil holes are equidistant from 6 o'clock position.

- Number two through number four bearing oil holes must be positioned at 5 o'clock position (toward left side of engine, and at a position even with bottom of cylinder bore).
- Number five bearing oil hole must be in 12 o'clock position.

4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw, and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.
6. Coat new camshaft rear plug O.D. with #1052080 sealant, or equivalent, and install flush to 1/32" (.80mm) deep.

OIL PAN (FIG. 40)

Removal

1. Drain engine oil.
2. Remove exhaust crossover pipe.
3. On vehicles equipped with automatic transmission, remove converter housing under pan.
4. On 'K' models with automatic transmission, remove strut rods at motor mounts.
5. Remove oil pan and discard gaskets and seals.

Installation

1. Thoroughly clean all gasket and seal surfaces on oil pan, cylinder block, crankcase front cover and rear main bearing cap.
2. Install new oil pan side gaskets on cylinder block using gasket sealant as a retainer. Install new oil pan rear seal in rear main bearing cap groove, with ends butting side gaskets. Install new oil pan front seal in groove in crankcase front cover with ends butting side gaskets.
3. Install oil pan and torque bolts to specifications.
4. If 'K' model, replace strut rods.
5. Install converter housing under pan.
6. Install exhaust crossover pipe.
7. Fill with oil, start engine and check for leaks.

OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

Disassembly (Figure 38)

1. Remove the pump cover attaching screws and the pump cover.

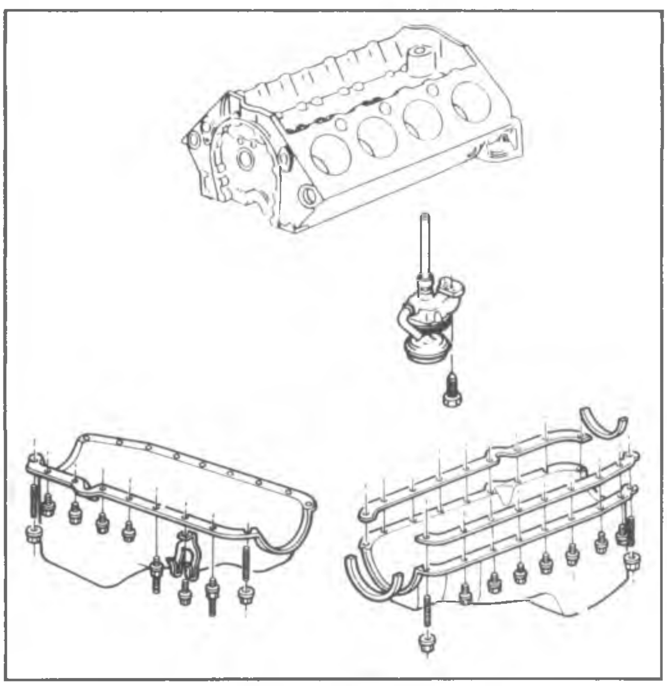
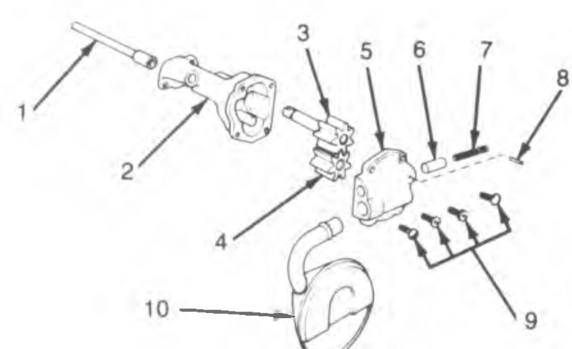


Fig. 40 -- Oil Pan



1. SHAFT EXTENSION
2. PUMP BODY
3. DRIVE GEAR AND SHAFT
4. IDLER GEAR
5. PUMP COVER
6. PRESSURE REGULATOR VALVE
7. PRESSURE REGULATOR SPRING
8. RETAINING PIN
9. SCREWS
10. PICKUP SCREEN AND PIPE

Fig. 41--Oil Pump

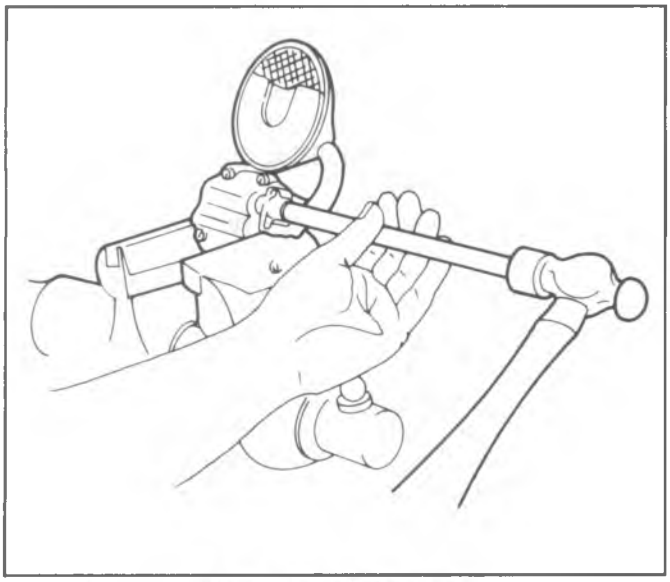


Fig. 42--Installing Screen

2. Mark gear teeth so they may be reassembled with the same teeth indexing. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump. Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
   - The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

Assembly (Figure 41)

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vise, apply sealer to end of pipe, and using Tool J-8369 (fig. 42) tap the pipe in place with a plastic hammer.

   NOTICE: Be careful of twisting, shearing or collapsing pipe while installing in pump.
2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
5. Install the pump cover and torque attaching screws to specifications.
6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.
3. Install oil pan previously outlined.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

On removing a connecting rod cap, it is possible to find a .009" undersize bearing. These are used in manufacturing for selective fitting.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.

   Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.

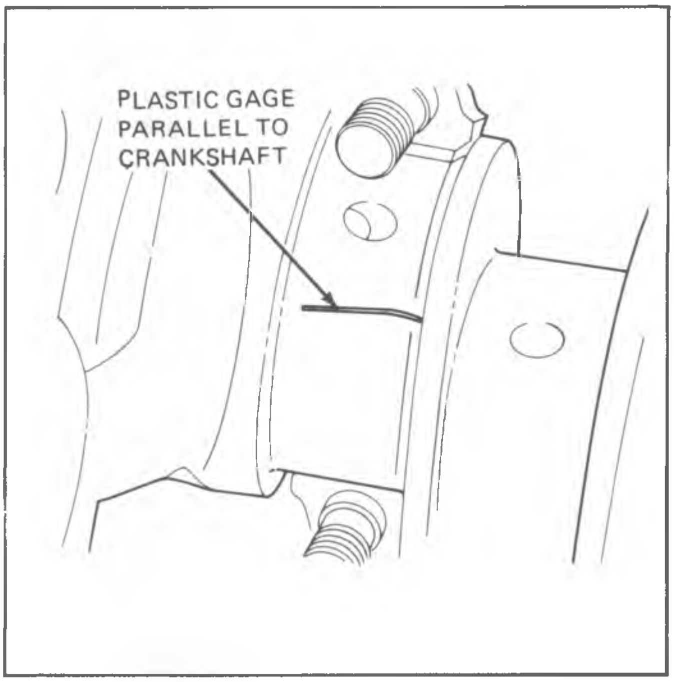


Fig. 43--Gaging Plastic On Crankpin

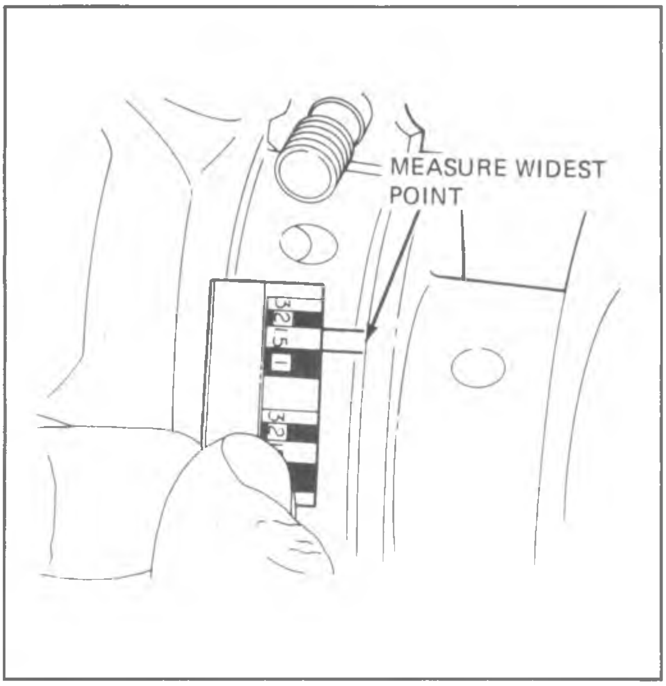


Fig. 44--Measuring Gaging Plastic

4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.

   If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.

   a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (fig. 43). Plastic gage should be positioned in the middle of upper or lower bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).
   b. Install the bearing in the connecting rod and cap.
   c. Install the bearing cap and evenly torque nuts to specifications.

      Do not turn the crankshaft with the gaging plastic installed.
   d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (fig. 44).
6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

   Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps (fig. 45).

MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize **ON ONLY THOSE MAIN JOURNALS THAT CANNOT BE PROPERLY FITTED. ALL JOURNALS WILL NOT NECESSARILY BE GROUND.** A .009" undersize bearing or .010" undersize bearing will then be used for precision fitting in the same manner as previously described.

Identification of a reground crankshaft is by the following:

- The crankshaft throw will be stamped on one side of the undersize journal with "9", along with a large spot of green paint.
- The main bearing cap will be painted light green on each side of the affected journal.

If, for any reason, main bearing caps are replaced,

Fig. 45--Measuring Connecting Rod Side Clearance

Fig. 46--Gaging Plastic on Journal

shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. NEVER REPLACE ONE HALF WITHOUT REPLACING THE OTHER HALF.

Checking Clearance

To obtain the most accurate results with "Plastigage" (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 46).

   Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.
3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap **MUST** be torqued to specifications in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (fig. 47).

   Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round (.001" max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.
6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.

   If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found then install shims as required.
7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

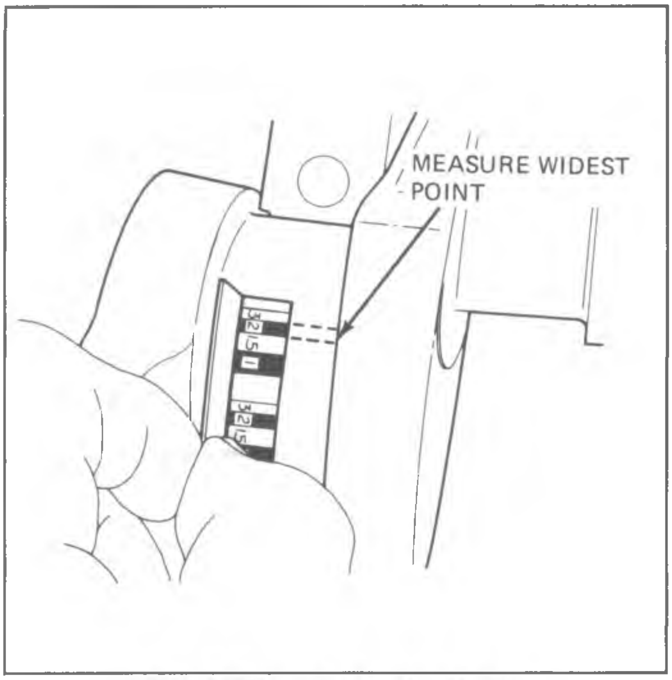


Fig. 47--Measuring Gaging Plastic

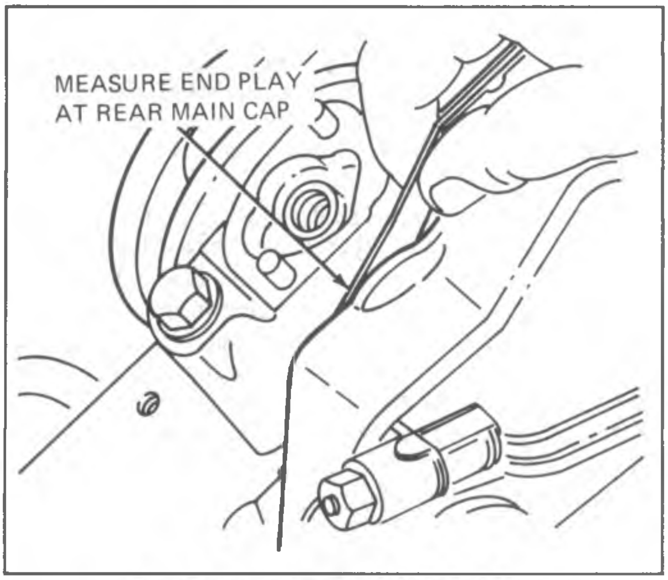


Fig. 48--Measuring Crankshaft End Play

After selecting new bearing, recheck clearance.

8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.

   When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 48).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

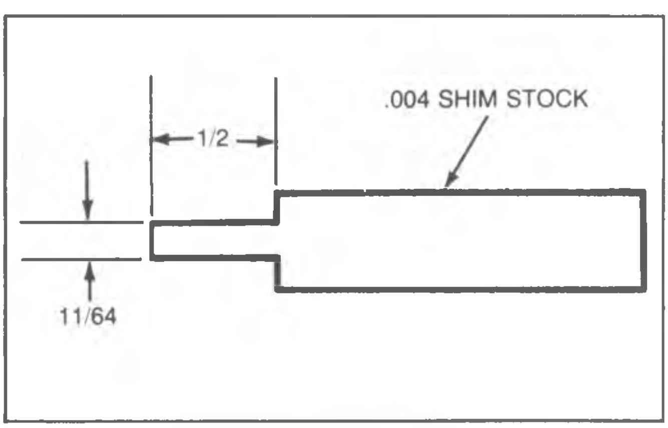


Fig. 49--Oil Seal Installation Tool

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal. If such a tool is not availale, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps EXCEPT THE REAR MAIN CAP to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

OIL SEAL (REAR MAIN)

Replacement

- ALWAYS REPLACE THE UPPER AND LOWER SEAL AS A UNIT.

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (fig. 49) must be used to protect the seal bead when positioning seal as follows:

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the bearing cap by prying from the bottom with a small screw driver (fig. 50).

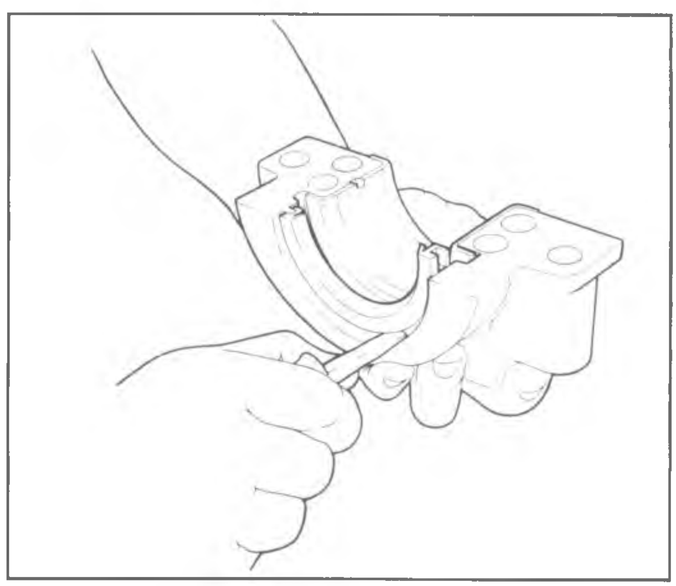


Fig. 50--Removing Oil Seal - Lower Half

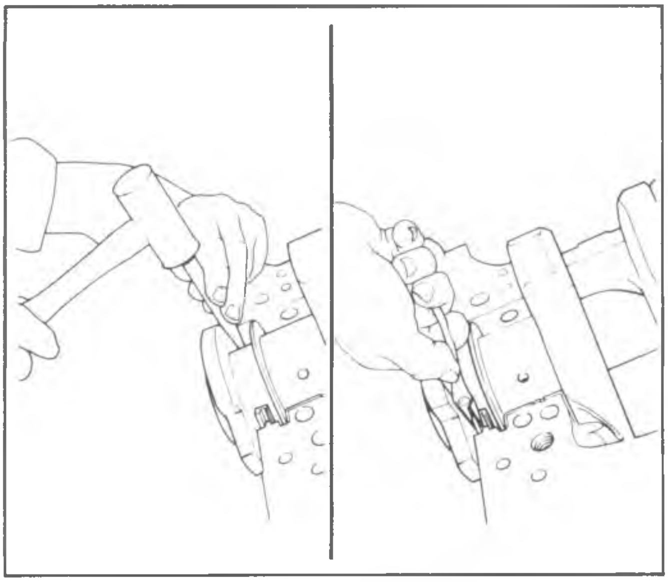


Fig. 51--Removing Oil Seal - Upper Half

3. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 51).
4. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a non-abrasive cleaner.
5. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.
6. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.
7. Position tip of tool between crankshaft and seal seat in cylinder case.
8. Position seal between crankshaft and tip of tool so that seal bead contacts tip of tool. Make sure that oil-seal lip is positioned toward front of engine (fig. 52).
9. Roll seal around crankshaft using tool as a "shoe-horn" to protect seal bead from sharp corner of seal seat surface in cylinder case. Installation tool must remain in position until seal is properly positioned with both ends flush with block.
10. Remove tool, being careful not to withdraw seal.
11. Install seal half in bearing cap, again using tool as a "shoe-horn", feeding seal into cap using light pressure with thumb and finger.
12. Install bearing cap to case with sealant applied to the cap-to-case interface being careful to keep sealant off the seal split line (fig. 53).
13. Install the rear main bearing cap (with new seal) and torque to 10-12 lb. ft. (14-16N·m). Tap end of crankshaft rearward then forward with lead hammer. This will line up thrust surfaces. Retorque bearing cap to specifications.

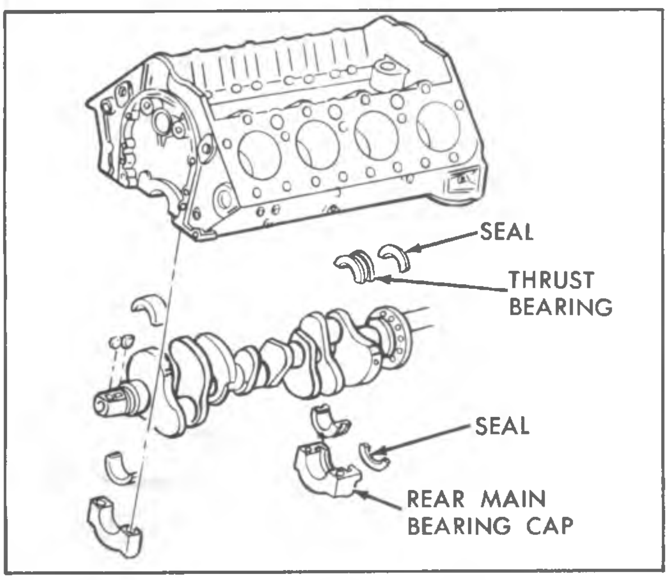


Fig. 52--Crankshaft Oil Seal - Rear Main

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. Remove oil pan, oil pump and cylinder head as previously outlined.
2. For the cylinder being serviced turn crankshaft until piston is at the bottom of the stroke. Place a cloth on top of the piston.
3. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.
4. Turn crankshaft until piston is at top of stroke and remove cloth and cuttings.
5. Remove connecting rod cap and install Tool J-5239 (3/8") on studs. Push connecting rod and piston assembly out of top of cylinder block (fig. 54). It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps. If bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.
2. Remove piston rings by expanding and sliding them off the pistons.

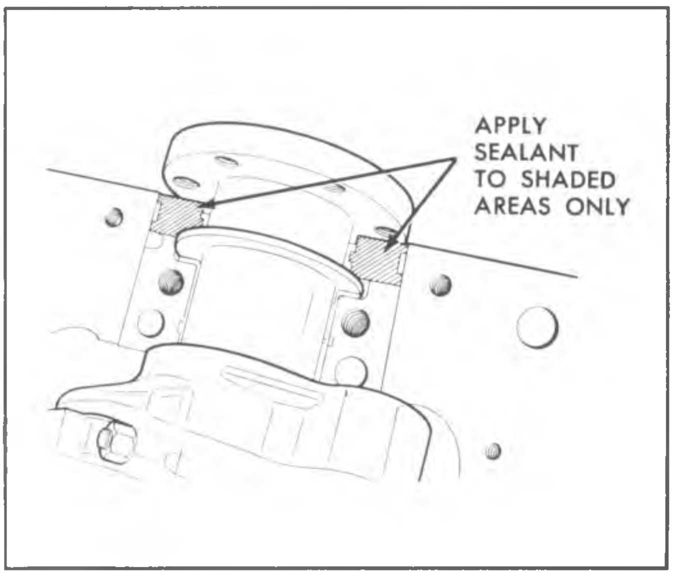


Fig. 53--Sealing Bearing Cap

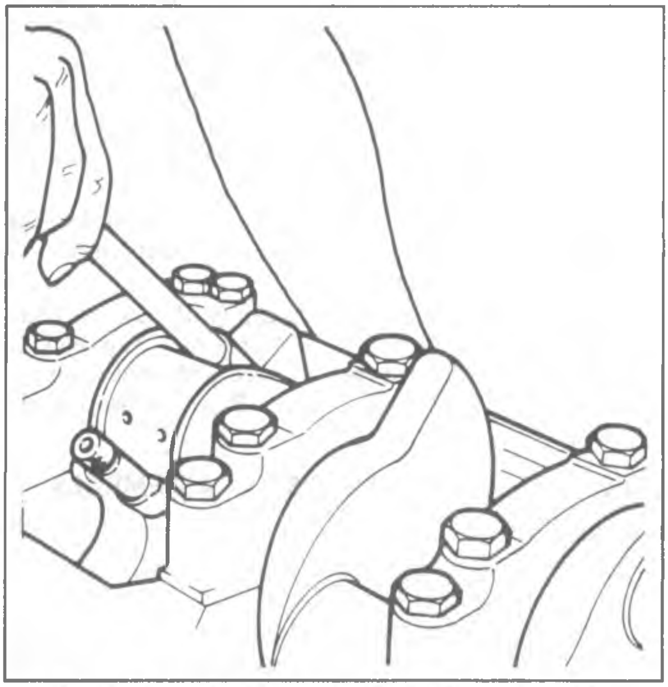


Fig. 54--Removing Connecting Rod & Piston Assembly

3. Place connecting rod and piston assembly on Tool J-24086-20. Using an arbor press and piston pin remover, J-24086-8, press the piston pin out of connecting rod and piston (fig. 55).

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air. Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly.
3. Using piston pin installer, J-24086-9, press the piston pin into the piston and connecting rod (fig. 56).

   NOTICE: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.
4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the MARKED SIDE IS TOWARD THE TOP OF THE PISTON. The top ring is chrome faced, or treated with molybdenum for maximum life. The second compression ring is a tapered face acting as both a compression and oil control ring.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.

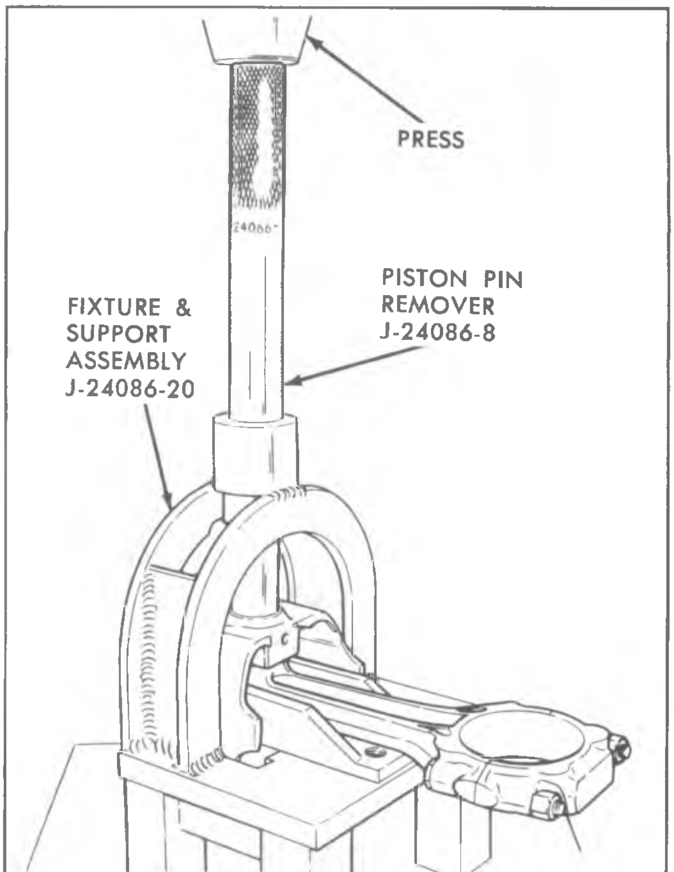


Fig. 55--Removing Piston Pin

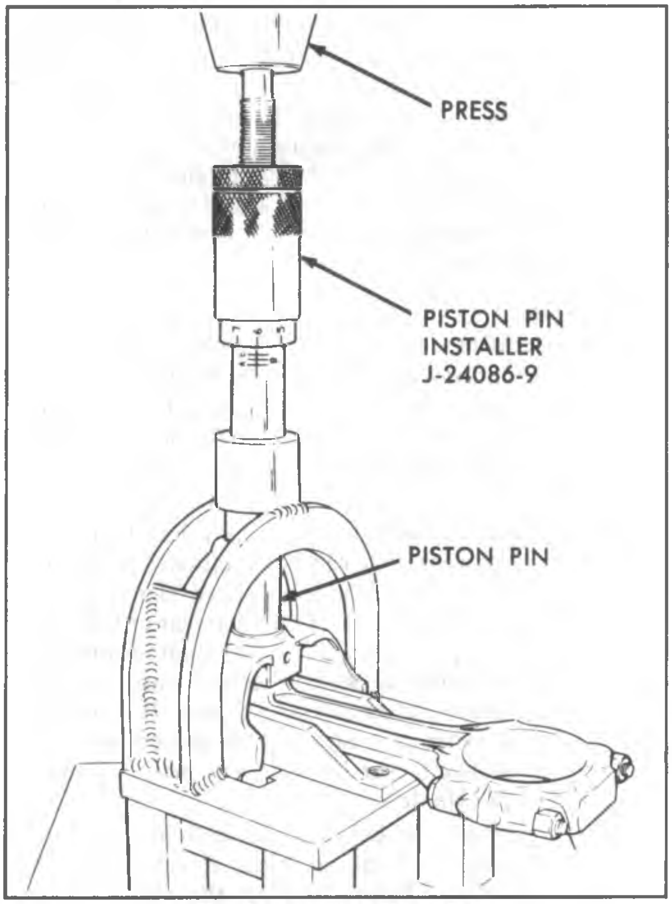


Fig. 56--Installing Piston Pin

3. Measure the space or gap between the ends of the ring with a feeler gage (fig. 57).
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.

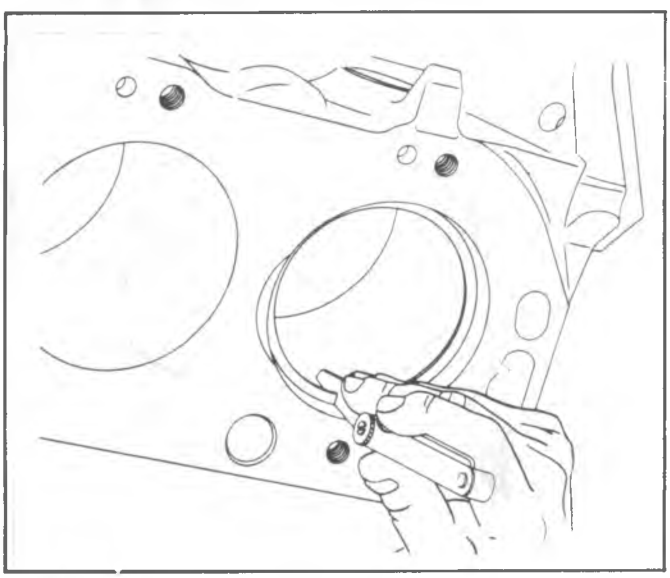


Fig. 57--Measuring Ring Gap

7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (fig. 58) to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by ring groove, correct by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.
8. Install piston rings as follows:
   a. Install oil ring spacer in groove and insert anti-rotation tang (where applicable) in drilled hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point the cause should be determined. If binding is caused by ring groove, correct by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install second compression ring (manufacturer mark up) with gaps properly located.
   f. Install top compression ring (manufacturer mark up) with gap properly located.
9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring and groove should be measured (fig. 59). (See Specifications).

Installation

Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

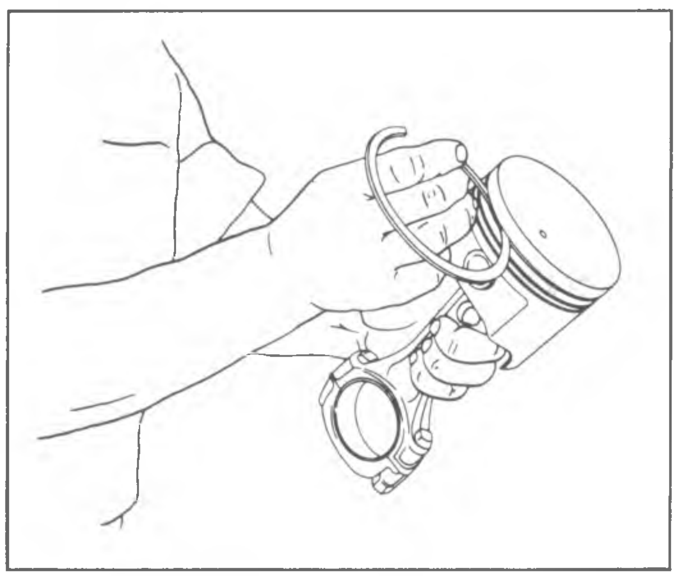


Fig. 58--Checking Ring in Groove

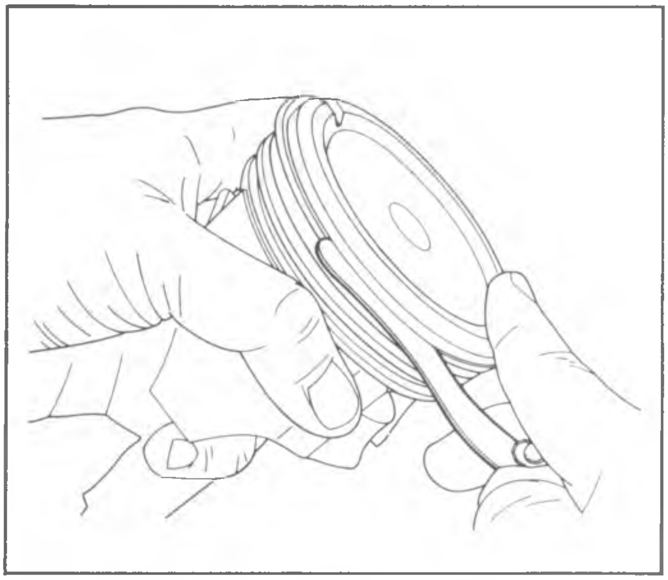


Fig. 59--Measuring Ring Groove Clearance

2. Lightly coat pistons, rings and cylinder walls with light engine oil.

3. With bearing caps removed, install Tool J-5239 (3/8") on connecting rod bolts.

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 to compress the rings (fig. 60). Guide the connecting rod into place on the crankshaft journal with Tool J-5239 (3/8") Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.

5. Remove Tool J-5239.

6. Install the bearing caps and torque nuts to specifications.

Be sure to install new pistons in the cylinders for which they were fitted, and used pistons in the cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1,3,5 and 7 are the left bank and, 2 4, 6 and 8 are the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.

2. Remove oil gallery plugs and clean all oil passages.

3. Clean and inspect coolant passages in the cylinder block.

4. Inspect the cylinder block for cracks in the cylinder walls, coolant jacket, valve lifter bores and main bearing webs.

5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" (.13mm) taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less then .005" (.13mm) wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" (.13mm) taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.

2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston

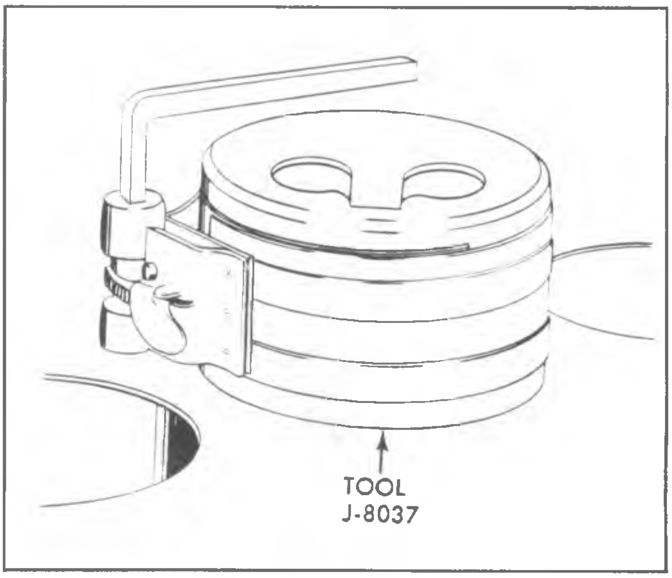


Fig. 60--Installing Connecting Rod Piston Assembly

skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.

3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

   NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.
5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure the "Cylinder Bore Diameter" with a telescope gage 2-1/2" (64mm) from top of cylinder bore.
   b. Measure the "Piston Diameter" (at skirt across center line of piston pin).
   c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".
   d. Locate piston to bore clearance and determine if piston to bore clearance is in the acceptable range.
2. If used piston is not acceptable, determine if a new piston can fit cylinder bore.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance.
4. Mark the piston to identify the cylinder for which it was fitted.

OIL FILTER BYPASS VALVE

Inspection and Replacement

With the oil filter removed, check the spring and fibre valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, the oil filter adapter and bypass valve assembly must be replaced as an assembly. Clean valve chamber in cylinder block thoroughly. Torque retaining screws to specifications.

ENGINE ASSEMBLY

Removal ("G" Van/Code U, L & R Engines)

1. Disconnect battery cables at battery.
2. Drain cooling system.
3. Remove coolant reservoir bottle.
4. Remove grille, upper radiator support and lower grille valance.
5. Disconnect radiator hoses at radiator.
   - If equipped with automatic transmission, remove cooler lines from radiator.
   - If equipped with A/C, evacuate system and remove condenser. Remove A/C vacuum reservoir.
6. Remove washer jar and bracket.
7. Remove radiator to radiator support attaching brackets and remove radiator and shroud.
8. If equipped with P/S, remove pump and lay aside.
9. Remove engine cover.
10. Remove air cleaner air stove pipe.
11. Remove accelerator cable from carburetor and remove carburetor.
12. Disconnect engine wiring harness from connection on firewall.
13. Disconnect heater hoses at engine.
14. Remove thermostat housing.
15. Remove oil fill pipe.
16. If equipped with cruise control, remove servo and bracket and transducer.
17. Raise vehicle.
18. Disconnect exhaust pipe from exhaust manifold flanges.
19. Remove propshaft; plug transmission end.
20. Disconnect transmission shift linkage and speedometer cable.
21. Disconnect fuel hose from fuel pump.
22. Remove transmission mount bolts.
23. Remove engine mount bracket to frame bolts.
24. Drain crankcase.
25. Remove engine mount "through" bolts.
26. Raise engine slightly and remove engine mounts. Block up engine with wood between oil pan and crossmember.
27. Lower vehicle and install lifting tool.
28. Remove engine/transmission assembly.

Installation ("G" Van/Code U, L & R Engines)

1. Place engine/transmission assembly into vehicle. Support engine with blocks of wood between the oil pan and crossmembers.

2. Raise vehicle and install engine mounts. Retain by inserting engine mount "through" bolts.
3. Raise engine slightly, remove wooden blocks and lower engine onto mounts.
4. Install engine mount bracket to frame bolts. Torque to specifications.
5. Install transmission mount bolts. Torque to specifications.
6. Connect fuel tank line and return line to fuel pump.
7. Connect transmission shift linkage and speedometer cable.
8. Install propshaft.
9. Connect exhaust pipe to exhaust manifold flanges.
10. Lower vehicle.
11. Connect heater hoses.
12. Connect engine wiring harness.
13. Using a new gasket, install carburetor. Connect accelerator cable.
14. Install radiator. Install radiator to radiator support attaching brackets.
    - If equipped with automatic transmission, connect cooler lines to radiator.
    - If equipped with A/C, install condenser to radiator support.
15. Connect radiator hoses to radiator.
16. Install grille cross brace and grille.
17. Fill cooling system.
18. Fill crankcase with oil.
    - If equipped with A/C, mount compressor, connect hosing and charge system.
19. Connect battery cables and start engine. Check ignition timing and adjust carburetor if necessary.
20. Install air cleaner and engine cover.

Removal (CK Series/Code U, L & R Engines)

1. Disconnect battery cables at battery.
2. Drain cooling system.
3. Remove air cleaner.
4. Remove all accessory drive belts.
5. Remove fan and water pump pulley.
6. Disconnect upper and lower radiator hoses at engine.
7. Disconnect heater hoses at engine.
    - If equipped with automatic transmission, disconnect cooler lines at radiator.
8. Remove radiator and shroud.
9. Disconnect accelerator linkage and detent linkage, if so equipped, from carburetor.
10. If A/C equipped, remove compressor from engine and lay aside.
11. If power steering equipped, remove pump from engine and lay aside.
12. Remove engine wiring harness from engine.
13. Disconnect fuel line at fuel pump.
14. Disconnect all vacuum lines from intake manifold.
15. Raise vehicle.
16. Drain crankcase.
17. Disconnect exhaust pipe from exhaust manifold flanges.
    - 'K' models with automatic transmission, remove strut rods at motor mounts.
18. Remove flywheel or convertor splash shield, as applicable.
19. Disconnect wiring along right pan rail.
20. Disconnect wiring at starter and remove starter.
21. Disconnect wiring for gas gage.
22. If equipped with automatic transmission, remove convertor to flex plate attaching bolts.
23. Support transmission.
24. Remove bell housing to engine retaining bolts.
25. Remove lower engine mount bracket to frame bolts.
26. Lower vehicle.
27. Remove vehicle hood.
28. Attach engine lifting device.
29. Remove engine.

Installation (CK Series/Code U, L & R Engines)

1. Place engine in vehicle.
2. Raise vehicle.
3. Install engine mount bracket to frame bolts.
4. Install bell housing to engine retaining bolts. Remove transmission support.
5. If equipped with automatic transmission, install convertor to flex plate attaching bolts.
6. Install flywheel or convertor splash shield, as applicable.
7. Connect wiring for gas gage.
8. Install starter. Connect wiring.
9. Install engine wiring harness along right pan rail.
10. Connect exhaust pipe to exhaust manifold flanges.
11. Lower vehicle.
12. Connect all vacuum lines to intake manifold.
13. Connect fuel line at fuel pump.
14. Install engine wiring harness to engine.
15. If power steering equipped, install pump on engine.
16. If A/C equipped, install compressor on engine.
17. Connect accelerator linkage and detent linkage, if so equipped, to carburetor.
18. Install radiator.
    - If equipped with automatic transmission, connect cooler lines to radiator.
19. Connect heater hoses to engine.
20. Connect radiator hoses to engine.
21. Install water pump pulley and fan to water pump.
22. Install accessory drive belts. Adjust to specifications.
23. Fill cooling system.
24. Fill crankcase.
25. Connect battery cables and start engine. Check timing and carburetor adjustment and adjust if necessary.
26. Install air cleaner and vehicle hood.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul, as previously outlined, or without complete disassembly as outlined below.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in stand and clamp securely.
2. Remove the oil dip stick and oil dip stick tube, (if applicable).
3. Remove the starting motor, clutch assembly (if equipped) and flywheel.
4. Remove the spark plugs.
5. Remove crankshaft pulley and torsional damper.
6. Remove oil pan and oil pump.
7. Remove crankcase front cover, and if so equipped, remove timing chain and camshaft sprocket.
8. Check the connecting rod caps for cylinder number identification. If necessary, mark them.
9. Remove the connecting rod caps and push the pistons to top of bores.
10. Remove main bearing caps and lift crankshaft out of cylinder block.
11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

SPROCKET OR GEAR REPLACEMENT (REFER TO FIG. 61)

- Remove crankshaft sprocket using Tool J-5825, install using Tool J-5590.

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips install lip with helix towards front of engine.
2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Recheck bearing clearances using plastigage.
6. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only. Do not allow sealant on crankshaft or seal.
7. Install main bearing caps with arrows pointing toward front of engine.
8. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 lbs. ft. (14-16 N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
9. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.
10. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.
    - Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

GENERAL DATA:

TYPE	90° V-8 GASOLINE			
DISPLACEMENT LITRE (*)	5.0 (F) 5.0 (H)		5.7 (L) 5.7 (M)	
RPO	LF3	LE9	LS9 /LT9	
BORE	3.736		4.000	
STROKE	3.480			
COMPRESSION RATIO	8.6:1	9.2:1	8.2:1	8.3:1
FIRING ORDER	1-8-4-3-6-5-7-2			

CYLINDER BORE:

DIAMETER			3.7350-3.7385	3.9995-4.0025
OUT OF ROUND	PRODUCTION		.001 MAX.	
OUT OF ROUND	SERVICE		.002 MAX.	
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.	
TAPER	PRODUCTION	RELIEF SIDE	.001 MAX.	
TAPER	SERVICE		.001 MAX.	

PISTON:

CLEARANCE	PRODUCTION	.0007-.0017
CLEARANCE	SERVICE	.0027 MAX.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.0012-.0032
COMPRESSION	GROOVE CLEARANCE	PRODUCTION	2ND	.0012-.0032
COMPRESSION	GROOVE CLEARANCE	SERVICE		HI LIMIT PRODUCTION + .001
COMPRESSION	GAP	PRODUCTION	TOP	.010-.020
COMPRESSION	GAP	PRODUCTION	2ND	.010-.025
COMPRESSION	GAP	SERVICE		HI LIMIT PRODUCTION + .010
OIL	GROOVE CLEARANCE	PRODUCTION		.002-.007
OIL	GROOVE CLEARANCE	SERVICE		HI LIMIT PRODUCTION + .001
OIL	GAP	PRODUCTION		.015-.055
OIL	GAP	SERVICE		HI LIMIT PRODUCTION + .010

VIN Designation

PISTON PIN

LF3, LE9 LS9/LT9

DIAMETER		.9270-.9273
CLEARANCE	PRODUCTION	.00025-.00035
CLEARANCE	SERVICE	.001 MAX.
FIT IN ROD		.0008-.0016 INTERFERENCE

CRANKSHAFT

MAIN JOURNAL	DIAMETER		#1 2.4484-2.4493
MAIN JOURNAL	DIAMETER		#2-3-4 2.4481-2.4490
MAIN JOURNAL	DIAMETER		#5 2.4479-2.4488
MAIN JOURNAL	TAPER	PRODUCTION	.0002 MAX.
MAIN JOURNAL	TAPER	SERVICE	.001 MAX.
MAIN JOURNAL	OUT OF ROUND	PRODUCTION	.0002 MAX.
MAIN JOURNAL	OUT OF ROUND	SERVICE	.001 MAX.
MAIN BEARING CLEARANCE	PRODUCTION		#1 .008-.0020
MAIN BEARING CLEARANCE	PRODUCTION		#2-3-4 .0011-.0023
MAIN BEARING CLEARANCE	PRODUCTION		#5 .0017-.0032
MAIN BEARING CLEARANCE	SERVICE		#1 .001-.0015 #2-4 .001-.0025 #5 .0025-.0035
CRANKSHAFT END PLAY			.002-.006
CRANKPIN	DIAMETER		2.0988-2.0998
CRANKPIN	TAPER	PRODUCTION	.0005
CRANKPIN	TAPER	SERVICE	.001 MAX.
CRANKPIN	OUT OF ROUND	PRODUCTION	.0005
CRANKPIN	OUT OF ROUND	SERVICE	.001 MAX.
ROD BEARING CLEARANCE	PRODUCTION		.0013-.0035
ROD BEARING CLEARANCE	SERVICE		.0030
ROD SIDE CLEARANCE			.008-.014

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2484	.2600
LOBE LIFT ± .002	EXHAUST	.2667	.2733
JOURNAL DIAMETER		1.8682-1.8692	
CAMSHAFT END PLAY		.004-.012	

VALVE SYSTEM

LIFTER			HYDRAULIC
ROCKER ARM RATIO			1.50:1
VALVE LASH	INTAKE		ONE TURN DOWN FROM ZERO LASH
	EXHAUST		
FACE ANGLE (INT. & EXH.)			45°
SEAT ANGLE (INT. & EXH.)			46°
SEAT RUNOUT			.002 MAX.
SEAT WIDTH	INTAKE		1/32-1/16
	EXHAUST		1/16-3/32
STEM CLEARANCE	PRODUCTION	INT.	.0010-.0027
		EXH.	.0010-.0027
	SERVICE		HI LIMIT PROD. ± .001 INTAKE + .002 EXH
VALVE SPRING (OUTER)	FREE LENGTH		2.03
	PRESSURE LBS. @ IN.	CLOSED	76-84 @ 1.70
		OPEN	194-206 @ 1.25
	INSTALLED HEIGHT ± 1/32"		1-23/32
DAMPER	FREE LENGTH		1.86
	APPROX. # OF COILS		4

TORQUE SPECIFICATIONS

CAMSHAFT SPROCKET	20 LB. FT.
CLUTCH PRESSURE PLATE	35 LB. FT.
CONN. ROD CAP	45 LB. FT.
CRANKCASE FRONT COVER	80 LB. IN.
CYLINDER HEAD	65 LB. FT.
DISTRIBUTOR CLAMP	20 LB. FT.
EXHAUST MANIFOLD	20 LB. FT.
FLYWHEEL	60 LB. FT.
FLYWHEEL HOUSING	30 LB. FT.
FLYWHEEL HOUSING COVER	80 LB. IN.
INTAKE MANIFOLD	30 LB. FT.
MAIN BEARING CAP	70 LB. FT.
OIL FILTER	25 LB. FT.
OIL FILTER BY-PASS VALVE	80 LB. IN.
OIL PAN TO CRANKCASE (5/16-18)	165 LB. IN.
OIL PAN TO CRANKCASE (1/4-20)	80 LB. IN.
OIL PUMP	65 LB. FT.
OIL PUMP COVER	80 LB. IN.
ROCKER ARM COVER	45 LB. IN.
SPARK PLUG	22 LB. FT.
TEMP. SENDING UNIT	20 LB. FT.
TORSIONAL DAMPER	60 LB. FT.
WATER OUTLET	25 LB. FT.
WATER PUMP	30 LB. FT.

SECTION 6A5

7.4 LITER V-8 VIN CODE W (LE8)

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GENERAL DESCRIPTION (FIG. 6A5-1 & 6A5-2)

CYLINDER BLOCK

The cylinder block is made of cast iron and has 8 cylinders arranged in a "V" shape with 4 cylinders in each bank. Five main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearnances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cast iron cylinder heads have individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual threaded studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron, and is supported by five main bearings. Number five bearing is the end thrust bearing.

All main bearings are lubricated from oil holes that connect to the main oil gallery. This runs along the left side of the cylinder case, just above the oil pan rail. Two additional galleries supply oil to the valve lifters.

A torsional damper on the forward end of the crankshaft dampens any engine torsional vibrations.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by five bearings and is chain driven. An iron crankshaft gear drives the timing chain which in turn drives the camshaft through an aluminum and nylon sprocket.

Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes the valve lifters to rotate and thrusts the cam rearward in the case.

Camshaft bearings are lubricated through oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the left side of the cylinder case.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring. Pins are Chromium steel and have a floating fit in the pistons They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

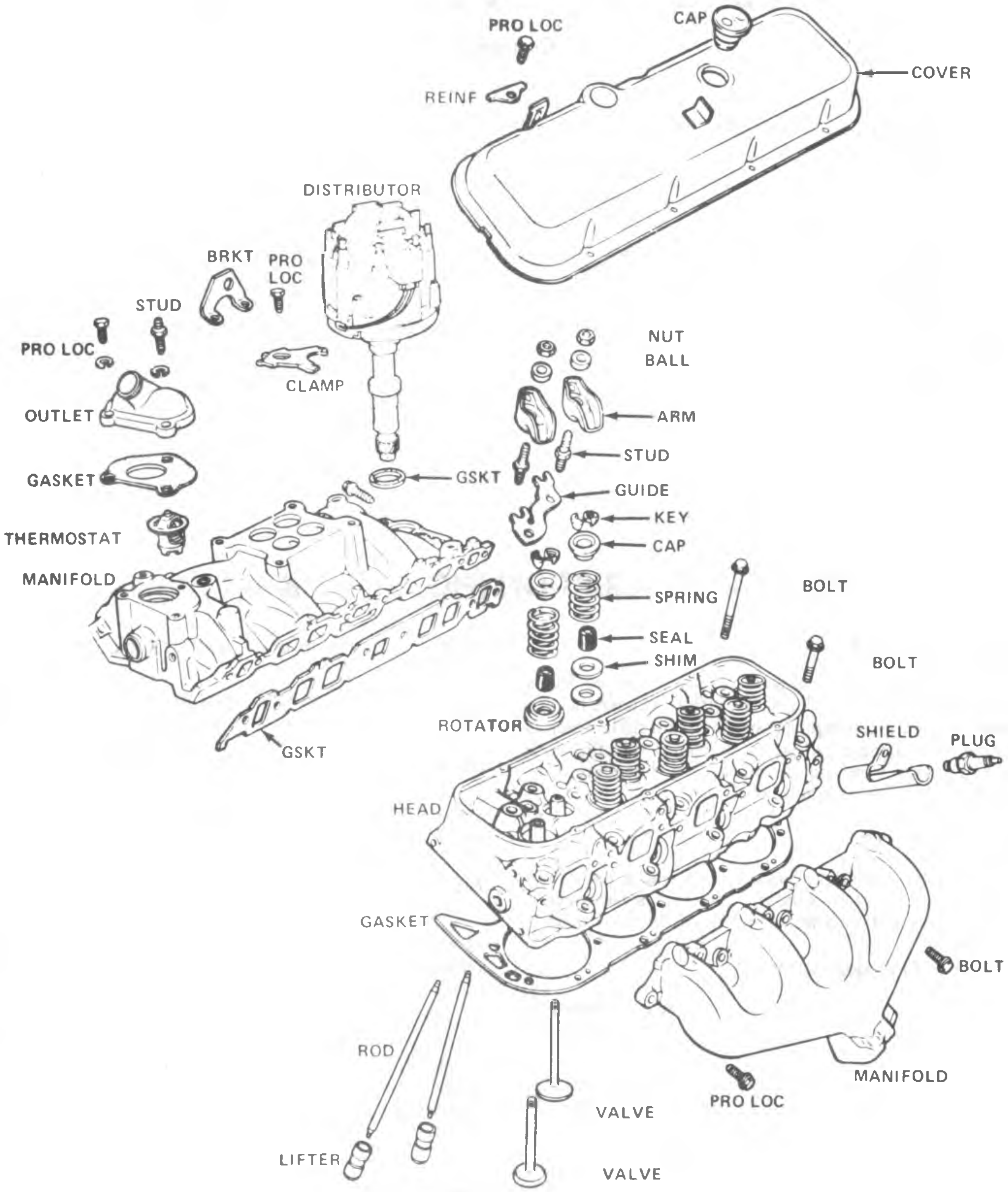


Fig. 6A5-1--**Engine** Upper End

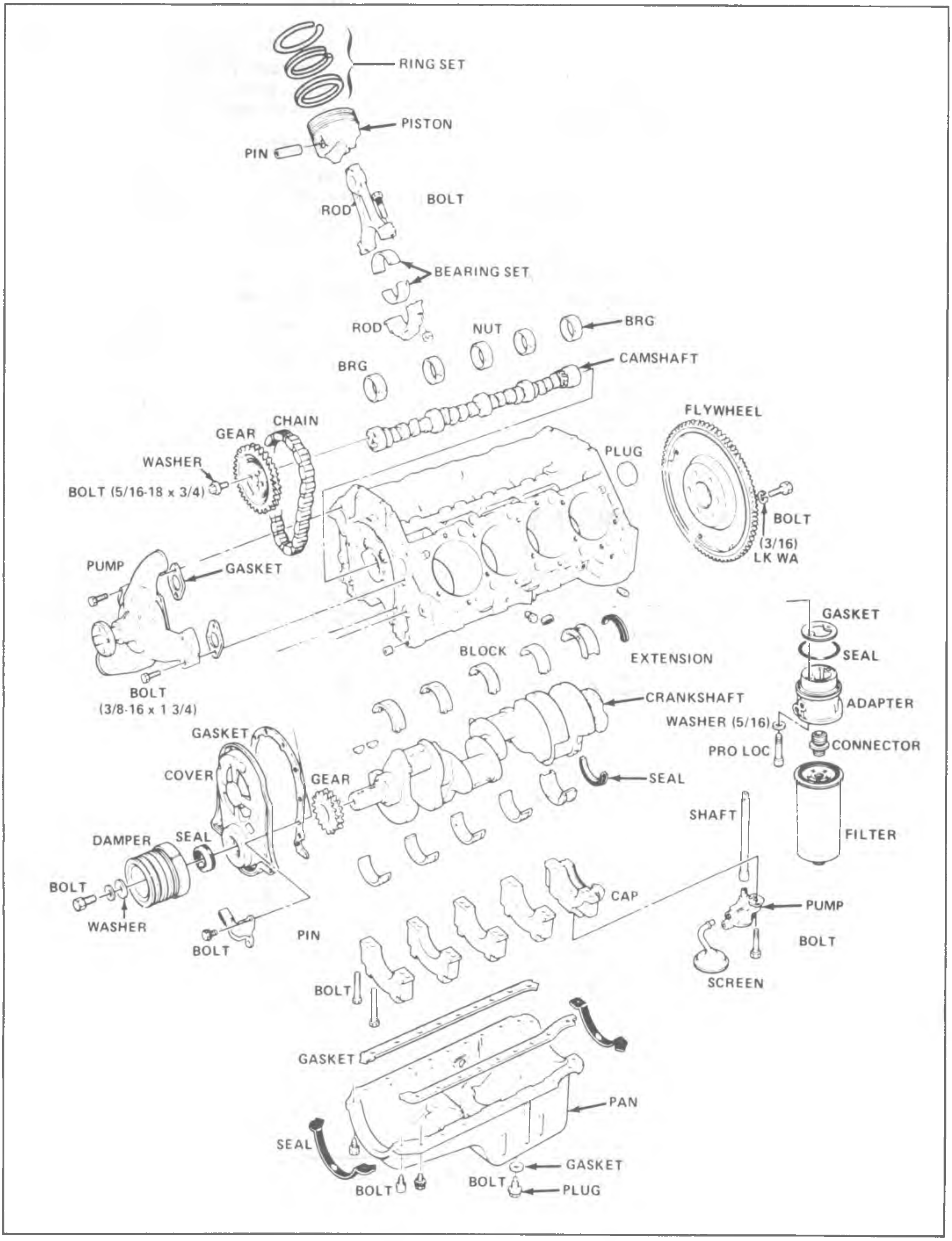


Fig. 6A5-2--Engine Lower End

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

INTAKE MANIFOLD

The intake manifold is of cast iron double level design for efficient fuel distribution. The carburetor pad is centrally located with a passage running underneath the pad (E.F.E.) through which exhaust gases are forced to promote faster fuel vaporization when the engine is cold.

EXHAUST MANIFOLDS

Two cast iron exhaust manifolds are used to direct exhaust gases from the combustion chambers to the exhaust system. The right hand side manifold receives a heat shield that is used to route heated air to the air cleaner for better fuel vaporization.

COMBUSTION CHAMBERS

Combustion Chambers are cast to insure uniform shape for all cylinders. Spark plugs are located between the intake and exhaust valves.

The contoured wedge shape of the combustion chamber minimizes the possibility of detonation, facilitates breathing, and provides swirling turbulence for smooth, complete combustion.

ENGINE LUBRICATION

Full pressure lubrication through a full flow oil filter, is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages, to the camshaft and crankshaft to lubricate the bearings. The valve lifter oil gallery feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms (fig. 6A5-3).

ON VEHICLE SERVICE

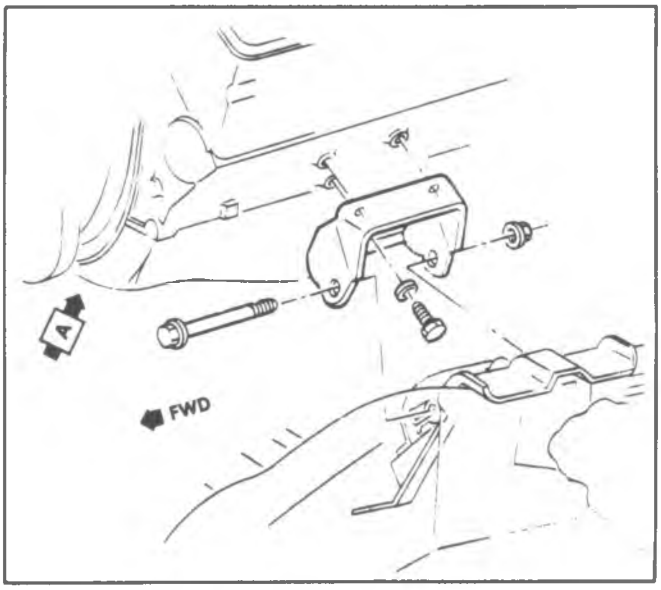


Fig. 6A5-4--"P" Series Engine Mount Bracket

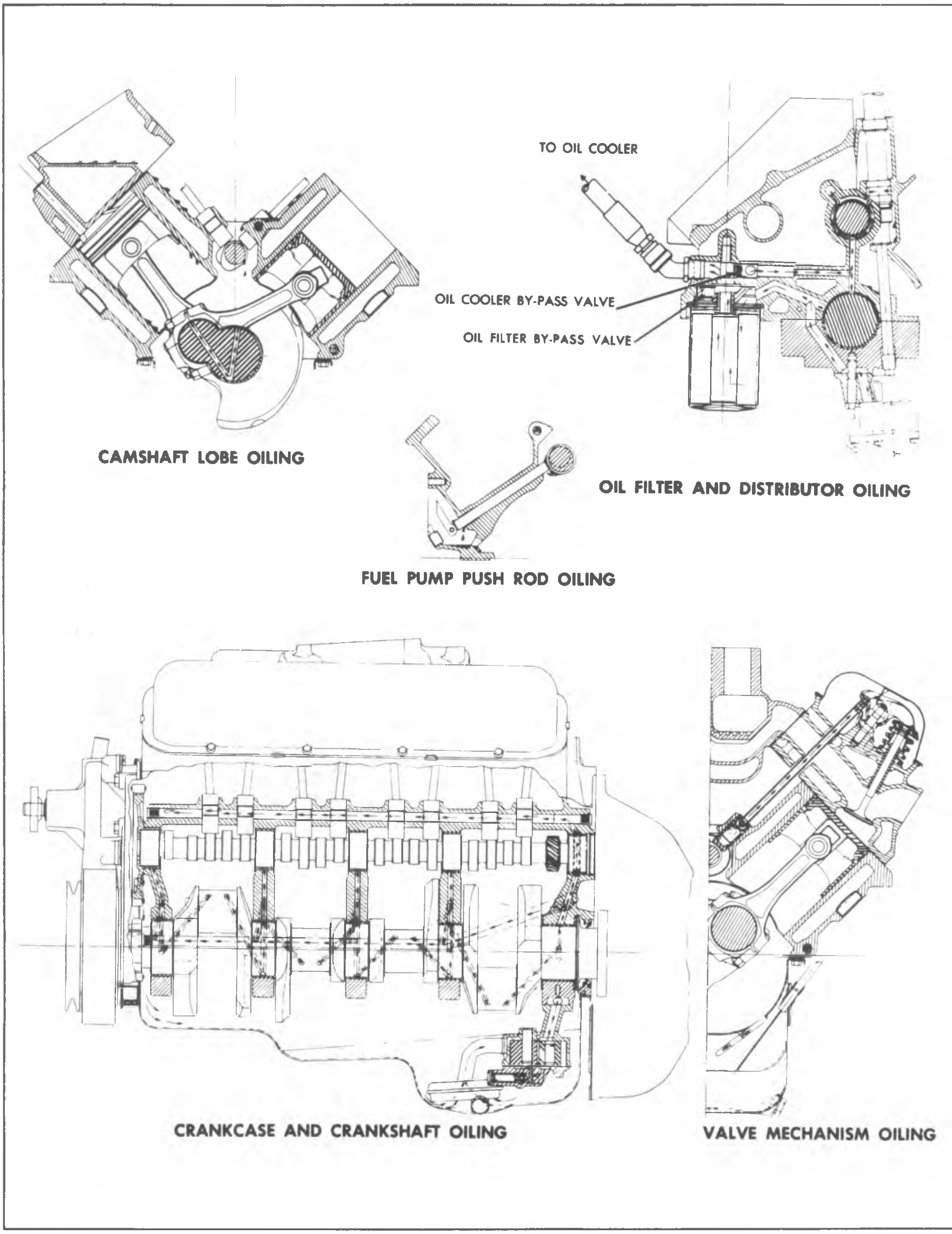


Fig. 6A5-3--"Mark IV" Engine Lubrication

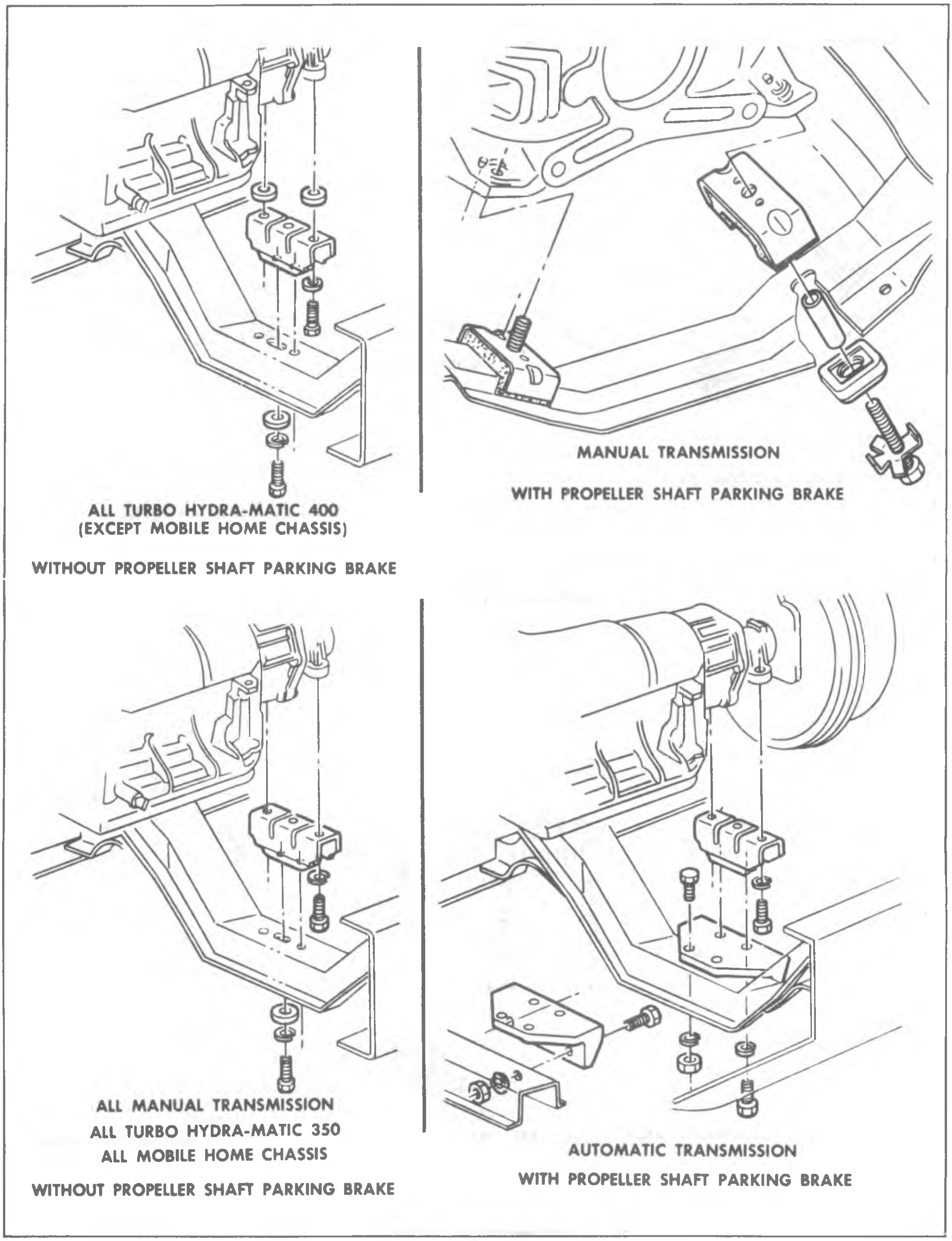


Fig. 6A5-5--"P" Series Engine Rear Mount

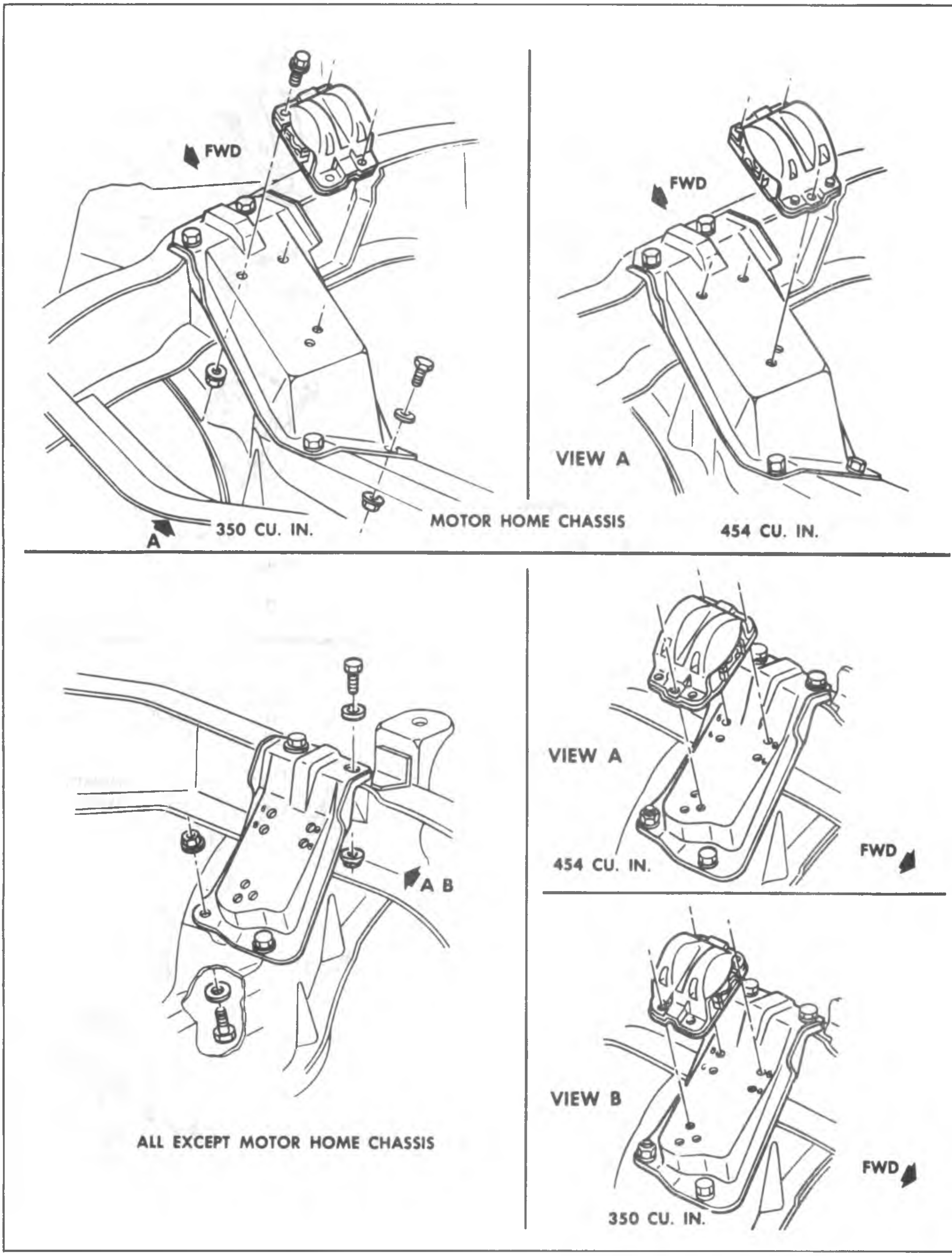


Fig. 6A5-6--"P" Series Engine Front Mount

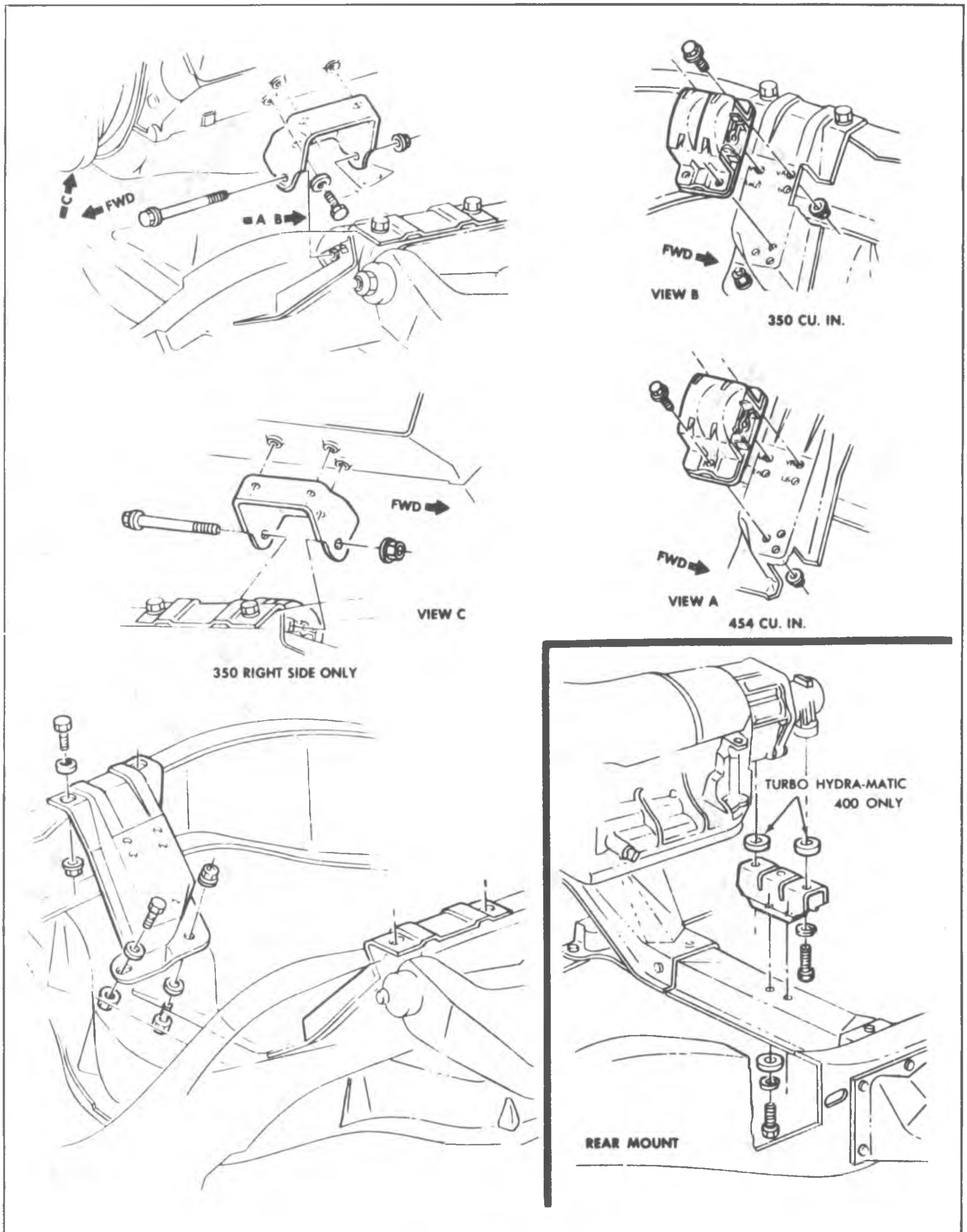


Fig. 6A5-7--"C" Series Engine Mounts

ENGINE MOUNTS

Engine mounts (fig. 6A5-4 - 6A5-7) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;

b. Rubber separated from a metal plate of the mount; or

c. Rubber split through center

Replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Remove mount retaining bolt from below frame mounting bracket.
2. Raise front of engine and remove mount-to-engine bolts and remove mount. Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel which could cause distributor damage.
3. Replace mount to engine and lower engine into place.
4. Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

1. Support engine weight to relieve rear mounts.
2. Remove crossmember-to-mount bolts.
3. On "P" Series with manual transmission and propeller shaft parking brake, remove mount attaching bolts from frame outrigger and clutch housing and remove rear mounting cushions.
4. Remove mount-to-transmission bolts, then remove mount.
5. On "P" Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.
6. Install new mount on transmission.
7. While lowering transmission, align and start cross-member-to-mount bolts.
8. Torque bolts to specifications then bend lock tabs to bolt head as applicable.

INTAKE MANIFOLD

Removal

1. Drain radiator and remove air cleaner.
2. Disconnect:
   - Battery negative cable at battery.
   - Radiator upper hose and heater hose at manifold.
   - Water pump by-pass at water pump.
   - Accelerator linkage at carburetor.
   - Fuel line at carburetor.
   - Crankcase ventilation lines.
   - Spark advance hose at distributor.
3. Remove distributor cap and mark rotor position with chalk, then remove distributor.
4. Remove (as required) air compressor and bracket, accelerator return spring and bracket, and accelerator bellcrank.
5. Remove generator upper mounting bracket.
   - With A/C, remove rear compressor bracket.
6. Remove manifold attaching bolts, then remove manifold and carburetor as an assembly. Discard gaskets and seals.
7. If manifold is to be replaced, transfer:
   - Carburetor and carburetor attaching bolts.
   - Temperature sending unit.
   - Thermostat with housing (use new gasket).
   - Heater hose and water pump by-pass adapters.
   - TVS switch (if applicable).
   - Vacuum fitting(s).

Installation

1. Clean gasket and seal surfaces on manifold, block, and cylinder heads with degreaser.
2. Install gaskets on cylinder heads and new end seals on block.
3. Install manifold and torque bolts to specifications in the sequence outlined in fig. 6A5-8.
4. Install (if removed) air compressor and bracket, accelerator bellcrank.

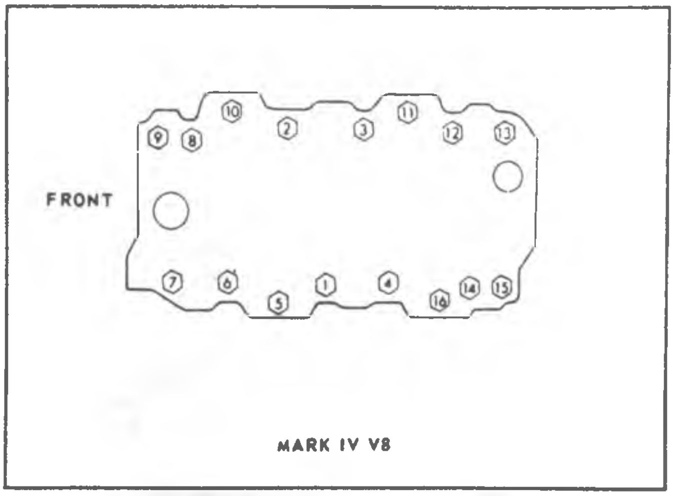


Fig. 6A5-8--Intake Manifold Torque Sequence

5. Install distributor, positioning rotor at chalk mark, then install distributor cap.
6. Connect:
   - Spark advance hose at distributor.
   - Crankcase ventilation lines.
   - Fuel line at carburetor.
   - Accelerator linkage at carburetor.
   - Water pump by-pass at water pump.
   - Battery negative cable at battery.
7. Install air cleaner.
8. Fill with coolant, start engine, adjust ignition timing and carburetor idle speed and check for leaks.

EXHAUST MANIFOLD

Removal

1. Remove carburetor air cleaner and heat stove pipe.
2. Remove spark plugs.
3. Disconnect exhaust pipe from manifold and hang exhaust pipe from frame with wire.
4. Remove end bolts then remove center bolts and remove manifold.

Installation

If installing a new right side manifold, the carburetor heat stove must be transferred from the old unit (fig. 6A5-9).

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts.
2. Torque manifold bolts to specifications.
3. Connect exhaust pipe to manifold.
4. Install spark plugs and torque to 22 lb. ft. (30 N·m).
5. Install carburetor heat stove pipe.
6. Start engine and check for leaks.

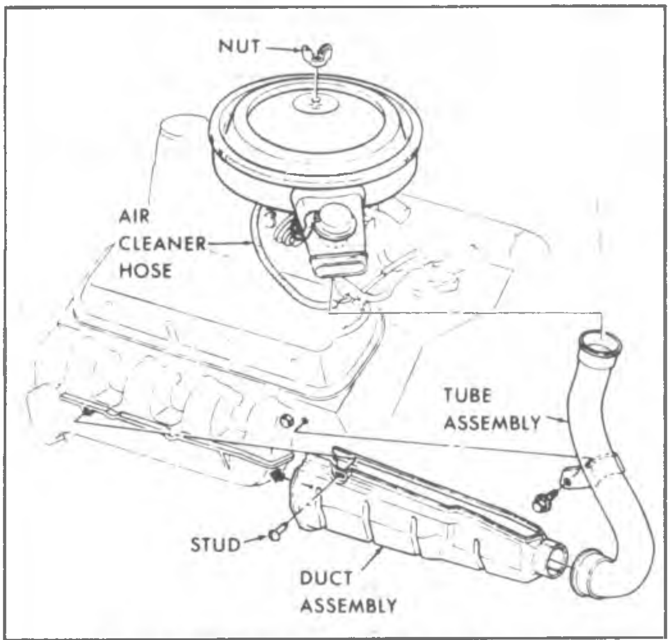


Fig. 6A5-9--Carburetor Heat Stove Assembly

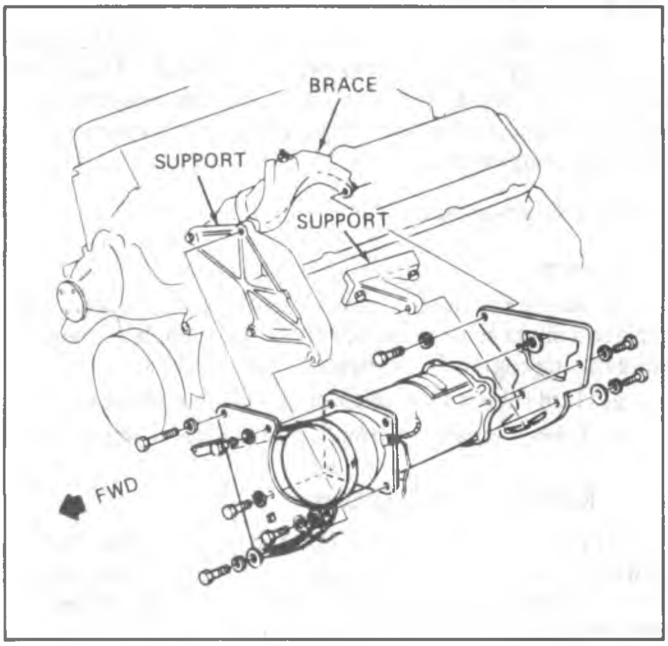


Fig. 6A5-10--A/C Compressor Mounting

ROCKER ARM COVER

Removal

1. Remove air cleaner.
2. Disconnect crankcase ventilation hoses at rocker arm covers.
3. Disconnect electrical wiring harness from rocker arm clips.
4. Remove carburetor heat stove pipe from right exhaust manifold.
5. If the vehicle is equipped with air conditioning, remove the A/C compressor upper brace (fig. 6A5-10).
6. Remove rocker arm cover to head attaching bolts and remove rocker arm cover.

   NOTICE: If cover adheres to cylinder head, shear off by bumping end of rocker arm cover with a rubber mallet. If cover will not come loose, **CAREFULLY** pry until loose. DO NOT DISTORT SEALING FLANGE.

Installation

1. Clean sealing surface on cylinder head and rocker arm cover with degreaser. Using a 3/16" (5mm) bead of RTV, #1052366 or equivalent, place rocker arm cover on the head, install retaining bolts and torque to specification. Loose RTV sealant, or pieces causing installation interference, must be removed from both cylinder head and cover seal surfaces prior to applying new sealant.
   - When going around the attaching bolt holes, always flow the RTV on the inboard side of the holes.
2. On A/C equipped vehicles, install the A/C compressor upper brace. Adjust pulley belt to specification.
3. Install carburetor heat stove pipe.
4. Connect electrical wiring harness at clips on rocker arm cover.
5. Connect crankcase ventilation hoses.
6. Install air cleaner, start engine and check for leaks.

VALVE MECHANISM

Removal

1. Remove rocker arm covers as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same locations.

Installation and Adjustment

Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:
   a. Crank engine until mark on torsional damper lines up with center or "O" mark on the timing tab fastened to the crankcase front cover and the engine is in the #1 firing position. This may be determined by placing fingers on the #1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the #1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in #6 firing position and should be turned over one more time to reach the #1 position.
   b. With the engine in the #1 firing position as determined above, the following valves may be adjusted.
   -- Exhaust--1, 3, 4, 8
   -- Intake--1, 2, 5, 7
   c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by rotating push rod while turning adjusting nut (fig. 6A5-11). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).
   d. Crank the engine one revolution until the pointer "o" mark and torsional damper mark are again in alignment. This is #6 firing position. With the engine in this position the following valves may be adjusted.
   -- Exhaust--2, 5, 6, 7
   -- Intake--3, 4, 6, 8
4. Install rocker arm covers as previously outlined.
5. Start engine and adjust carburetor idle speed.

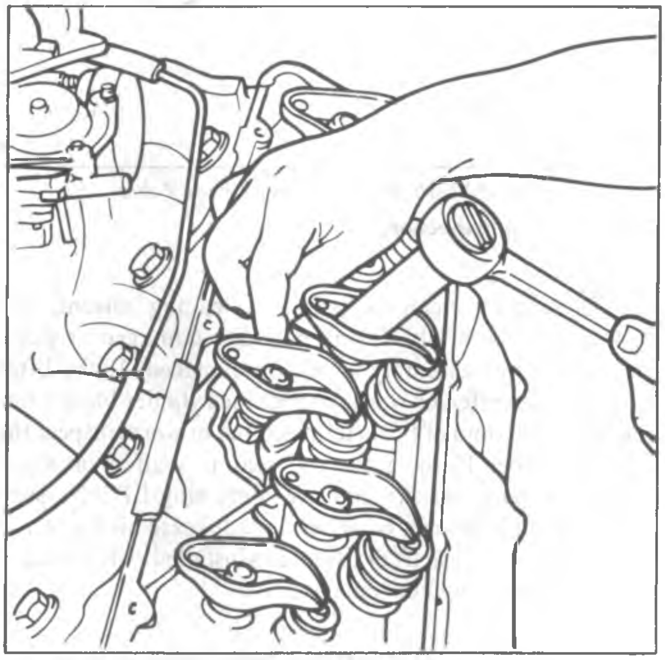


Fig. 6A5-11--Valve Adjustment

VALVE STEM OIL SEAL and/or VALVE SPRING

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap and valve spring and damper (fig. 6A5-12).
5. Remove the valve stem oil seal.

Installation

1. Install new valve stem oil seal (coated with oil) in position over valve guide (fig. 6A5-13). Seal installation instructions are supplied with each service kit. Install seal following procedures outlined on the supplied instruction sheet.

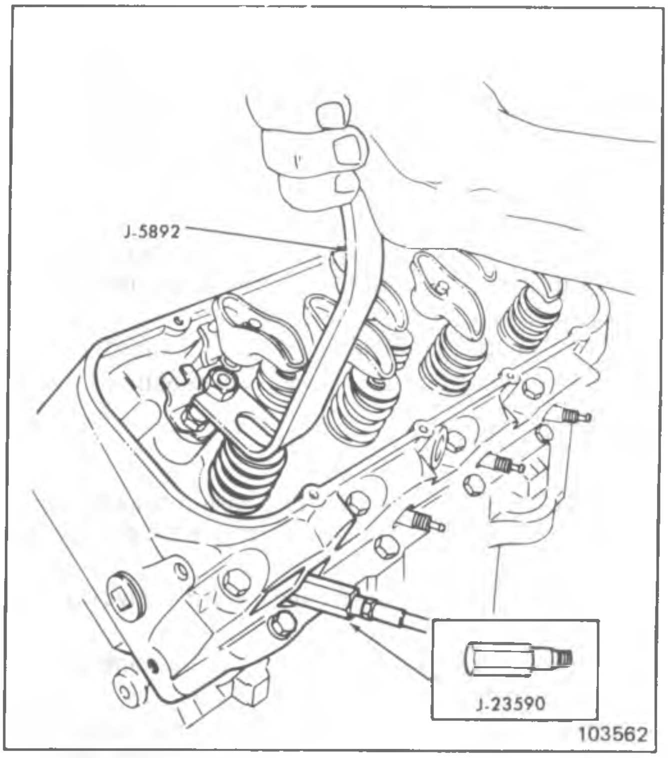


Fig. 6A5-12--Compressing Valve Spring

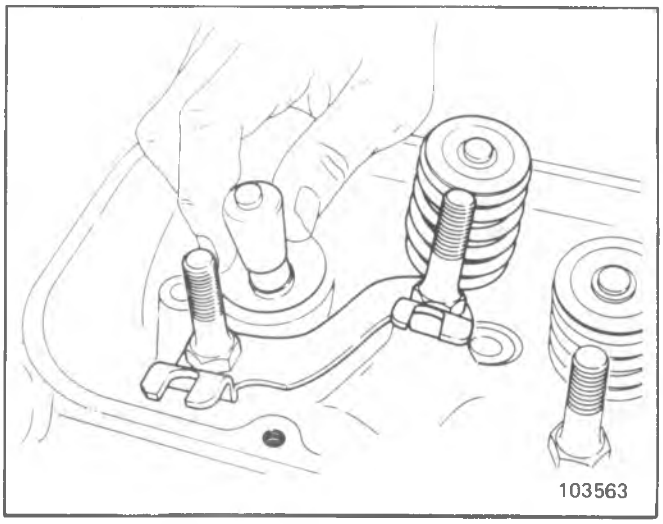


Fig. 6A5-13--Installing Valve Stem Oil Seal

2. Set the valve spring and damper and valve cap in place.
3. Compress the spring with Tool J-5892 and install the valve locks then release the compressor tool, making sure the locks seat properly in the groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
4. Install spark plug, and torque to 22 lb. ft. (30 N·m).
5. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Removal

1. Remove intake manifold as previously outlined.
2. Remove valve mechanism as previously outlined.
3. Remove valve lifters. Place valve lifters in a rack so that they may be reinstalled in the same location.

Installation

1. Coat foot of valve lifters with "Molykote" or its equivalent and install valve lifters. Make sure lifter foot is convex.
2. Install intake manifold as previously outlined.
3. Install and adjust valve mechanism as outlined.

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve (fig. 6A5-14).
3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver (fig. 6A5-15).

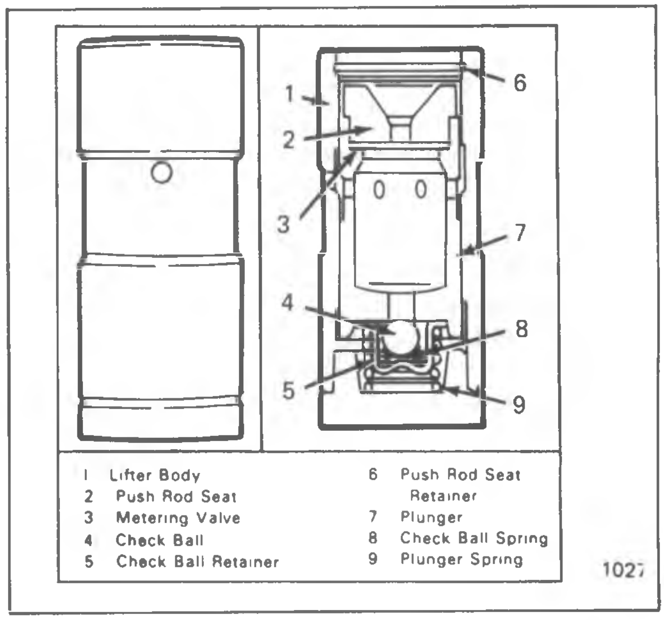


Fig. 6A5-14--Hydraulic Valve Lifter

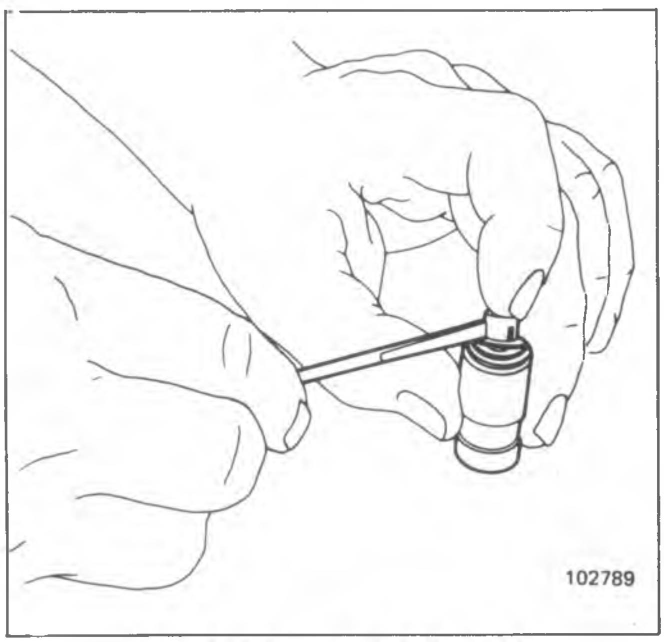


Fig. 6A5-15--Removing Ball Check Valve

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore. If the bottom of the lifter is scuffed or worn, inspect the camshaft lobe. If the push rod seat is scuffed or worn, inspect the push rod. An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced.

- For proper lifter rotation during engine operation, lifter foot must be convex.

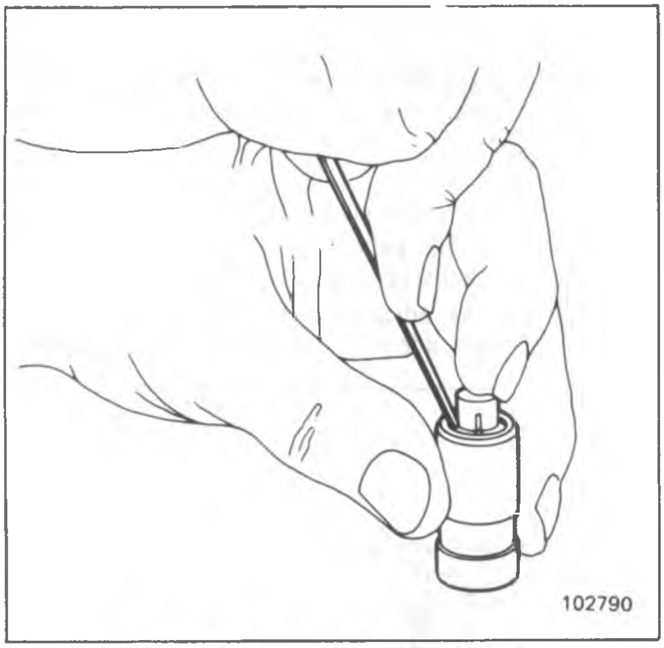


Fig. 6A5-16--Installing Ball Check Valve

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver (fig. 6A5-16).
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid. Do not attempt to force or pump the plunger. At this point, oil holes in the lifter body and plunger assembly will be aligned (fig. 6A5-17).

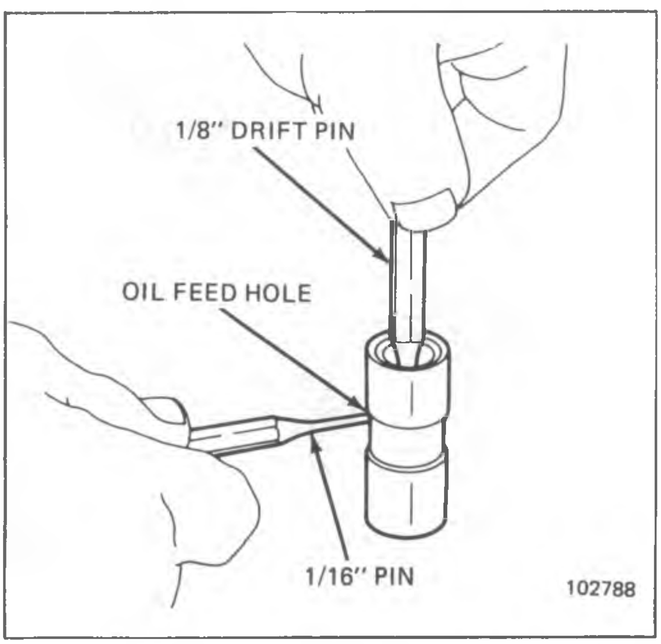


Fig. 6A5-17--Assembling Hydraulic Lifter

5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 6A5-17).
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (fig. 6A5-14).
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation. Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove intake manifold as previously outlined.
2. Remove generator lower mounting bolt and lay unit aside.
3. Remove exhaust manifolds as previously outlined.
4. If vehicle is equipped with A/C, remove A/C compressor and forward mounting bracket. Lay unit aside.
5. Remove valve mechanism as previously outlined.
6. Drain cylinder block of coolant.
7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

1. With cylinder head removed, remove valve rocker arm nuts, balls and rocker arms (if not previously done).
2. Using Tool J-8062, compress the valve springs (fig. 6A5-18) and remove valve keys. Release the compressor tool and remove rotators or spring caps, springs and spring damper, then remove oil seals and valve spring shims.

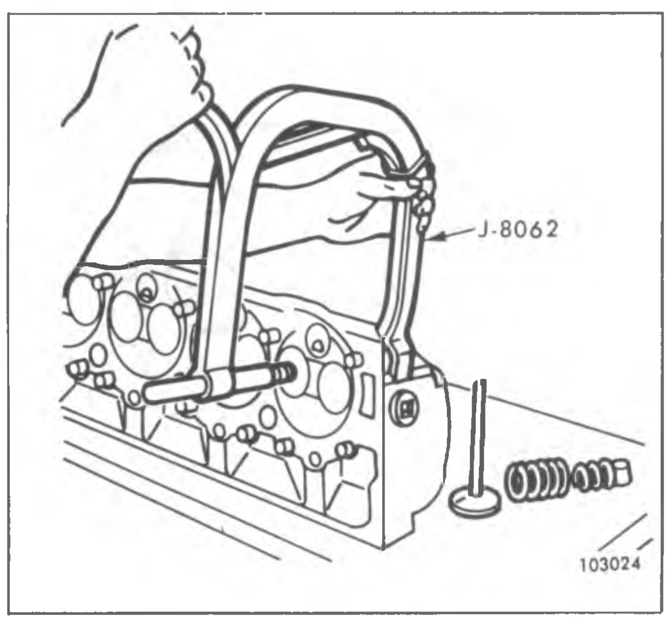


Fig. 6A5-18--Compressing Valve Spring

3. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J-8089 (fig. 6A5-19).
2. Thoroughly clean the valve guides using Tool J-8101 (fig. 6A5-20).
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the coolant chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.

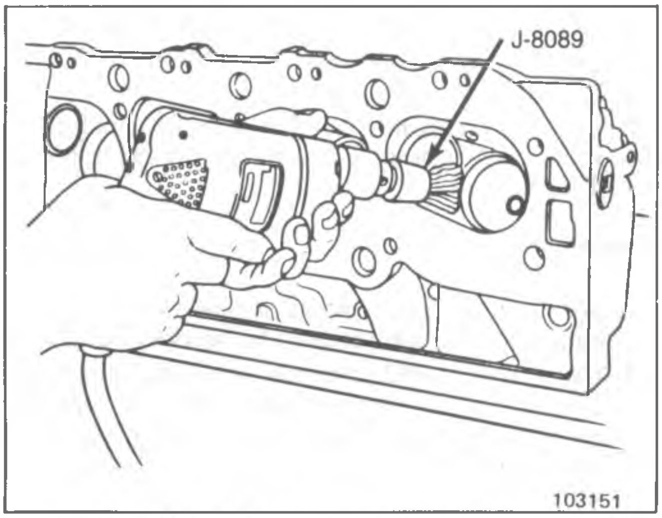


Fig. 6A5-19--Cleaning Combustion Chambers

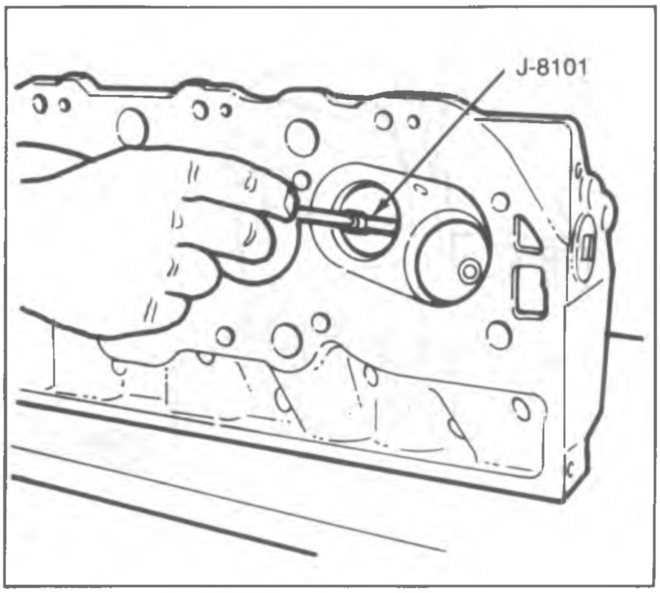


Fig. 6A5-20--Cleaning Valve Guides

NOTICE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.

3. Measure valve stem clearance (fig. 6A5-21) as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail.
   b. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will

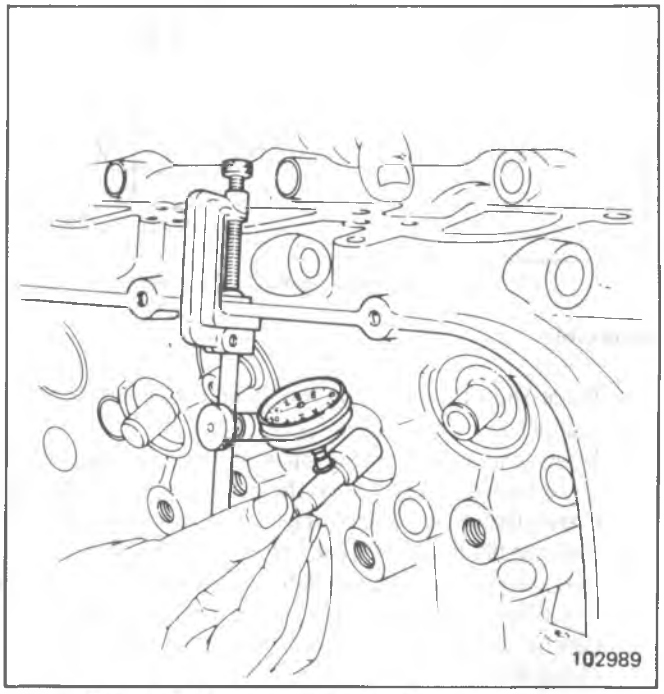


Fig. 6A5-21--Measuring Valve Stem Clearances

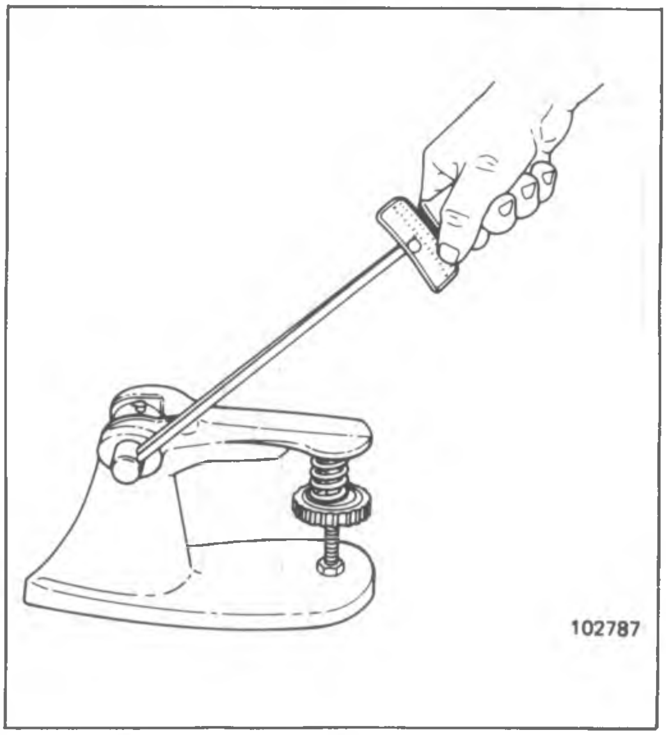


Fig. 6A5-22--Checking Valve Spring Tension cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide.

c. Drop the valve head about 1/16" (1.6mm) off the valve seat.

d. Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves as outlined.

4. Check valve spring tension with Tool J-8056 spring tester (fig. 6A5-22). Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. (44 N) of the specified load (without dampers).
5. Inspect rocker arm studs for wear of damage. Inspect push rod guides for wear or damage.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:

a. Install valve spring shim on valve spring seat then install a new valve stem oil seal over valve and valve guide.

b. Set the valve spring (with damper); and valve cap in place (fig. 6A5-23).

c. Compress the spring with Tool J-8062.

d. Install the valve locks and release the compressor tool, making sure the locks seat properly in the groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.

3. Install the remaining valves.

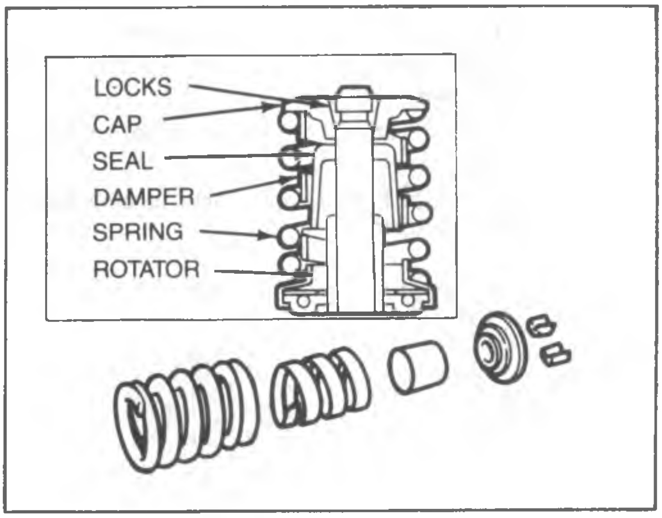


Fig. 6A5-23--Valve Spring Installation

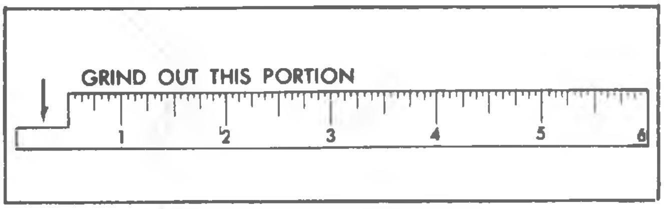


Fig. 6A5-24--Cutaway Scale

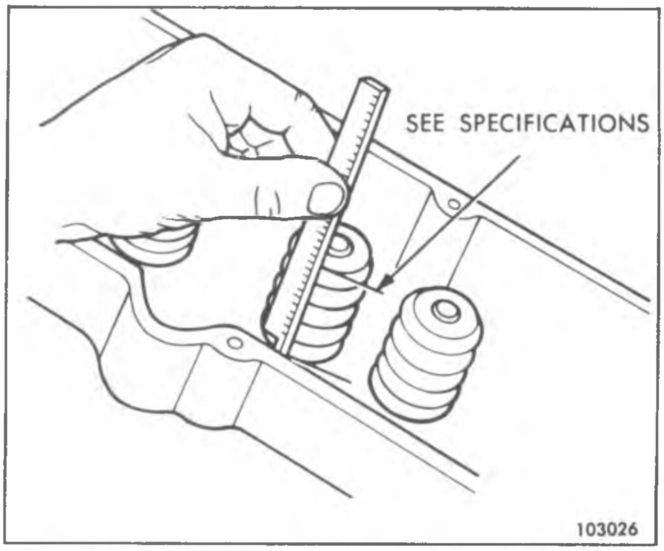


Fig. 6A5-25--Measuring Valve Spring Installed Height

4. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 6A5-24). Measure from the top of the shim or the spring seat to the top of the valve spring or valve spring shield (fig. 6A5-25). If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick. At no time should the spring be shimmed to give an installed height under the minimum specified.

Installation

- The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be clean as dirt will affect bolt torque.

1. On engines using a STEEL gasket, coat both sides of a new gasket with a good sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.

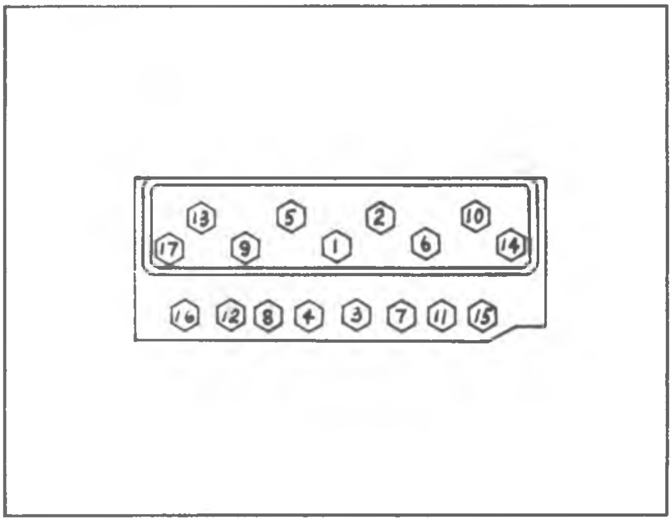


Fig. 6A5-26--Cylinder Head Torque Sequence

- Use no sealer on engines using a composition STEEL ASBESTOS gasket.

2. Place the gasket in position over the dowel pins with the bead up.
3. Carefully guide the cylinder head into place over the dowel pins and gasket.
4. Coat threads of cylinder head bolts with sealing compound, #1052080 or equivalent, and install bolts finger tight.
5. Tighten each cylinder head bolt a little at a time in the sequence shown in figure 6A5-26 until the specified torque is reached.
6. Install exhaust manifolds as previously outlined.
7. Install intake manifold as previously outlined.
8. Install and adjust valve mechanism as previously outlined.

ROCKER ARM STUDS

Replacement

The push rod guides are attached to the cylinder head by the rocker arm studs (fig. 6A5-27). Replace where necessary and torque rocker arm studs to specifications.

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J-7049.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valves seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide.

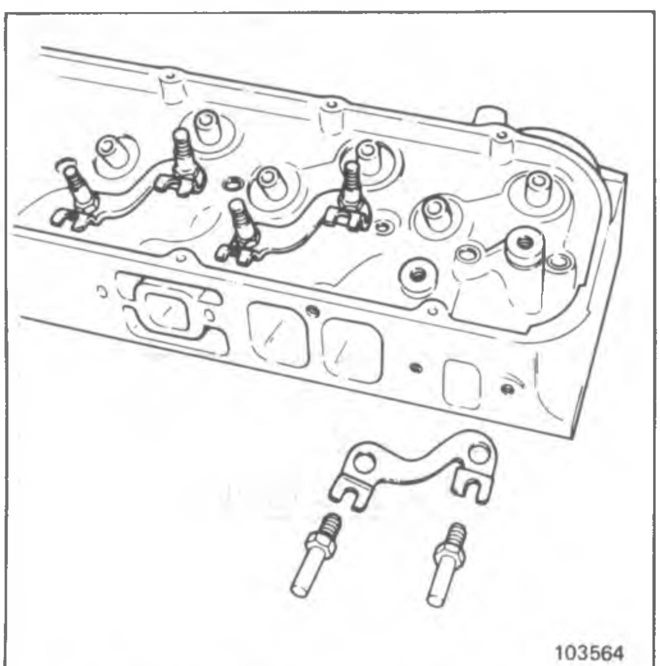


Fig. 6A5-27--Rocker Arm Stud & Push Rod Guide

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" (.80mm) thick after grinding, replace the valve (fig. 6A5-29).

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

TORSIONAL DAMPER

Removal

1. Remove fan belt, fan and pulley.
2. Remove the fan shroud assembly as outlined in Section 6B.
   - If additional operations (such as camshaft removal) are not being performed, the radiator removal will not be necessary.
3. Remove accessory drive pulley then remove damper retaining bolt.
4. Install Tool J-23523 on damper then, turning puller screw, remove damper.

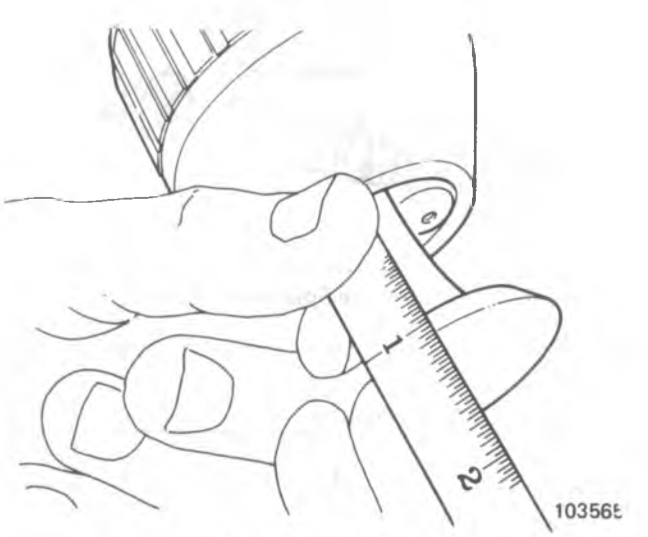


Fig. 6A5-29--Measuring Valve Head

Installation

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber type material. The installation procedures (with proper tool) must be followed or movement of the inertia weight section on the hub will destroy the tuning of the torsional damper.

1. Coat front cover seal contact area (on damper) with engine oil.
2. Place damper in position over key on crankshaft.
3. Pull damper onto crankshaft as follows:
   a. Install appropriate threaded end of Tool J-23523 into crankshaft. Install tool in crankshaft so that at least 1/2" (6.5mm) of thread engagement is obtained.
   b. Install plate, thrust bearing and nut to complete tool installation.
   c. Pull damper into position as shown in Figure 6A5-30.
   d. Remove tool from crankshaft then install damper retaining bolt and torque to specifications.
4. Install accessory drive pulley.
5. Install fan shroud as outlined in Section 6B.
6. Install fan and pulley to water pump hub and tighten securely.
7. Install fan belt and adjust to specifications using strand tension gage.
8. Fill cooling system, start engine and check for leaks.

CRANKCASE FRONT COVER

Removal

1. Remove torsional damper and water pump as outlined.
2. Remove the two, oil pan-to-front cover attaching screws.
3. Remove the front cover-to-block attaching screws.
4. Pull the cover slightly forward only enough to permit cutting of oil pan front seal.

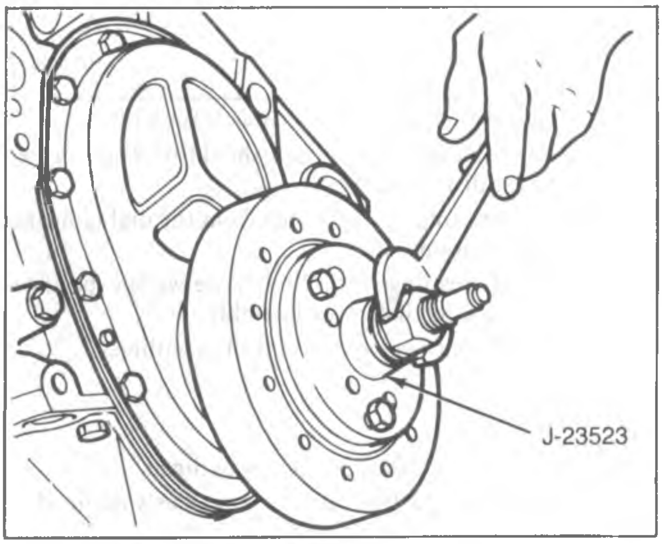


Fig. 6A5-30--Installing Torsional Damper

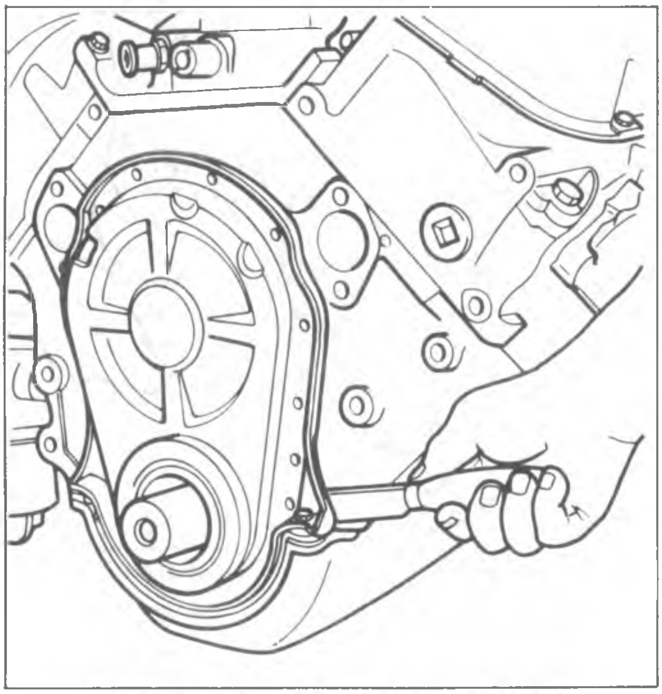


Fig. 6A5-31--Cutting Tabs on Oil Pan Front Seal

5. Using a sharp knife or other suitable cutting tool, cut oil pan front seal flush with cylinder block at both sides of cover (fig. 6A5-31).
6. Remove front cover and attaching portion of oil pan front seal. Remove front cover gasket.

Installation

1. Clean gasket surface on block and crankcase front cover.
2. Cut tabs from the new oil pan front seal (fig. 6A5-32). Use a sharp instrument to ensure a clean cut.
3. Install seal to front cover, pressing tips into holes provided in cover.
4. Coat the gasket with gasket sealer and place in position on cover.
5. Apply a 1/8" (3mm) bead of RTV sealer, #1052366 or equivalent, to the joint formed at the oil pan and cylinder block (fig. 6A5-33).
6. Position crankcase front cover over crankshaft.
7. Press cover downward against oil pan until cover is aligned and installed over dowel pins on block.

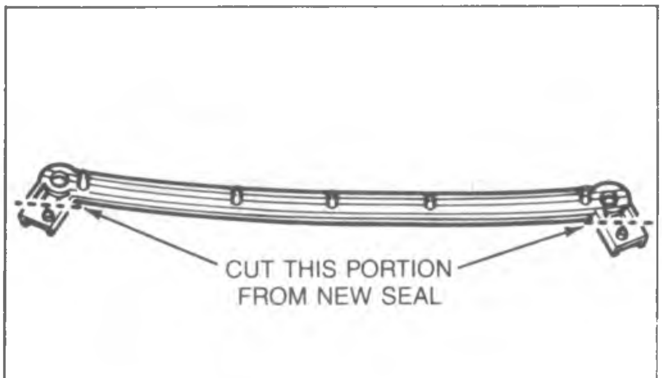


Fig. 6A5-32--Oil Pan Front Seal Modification

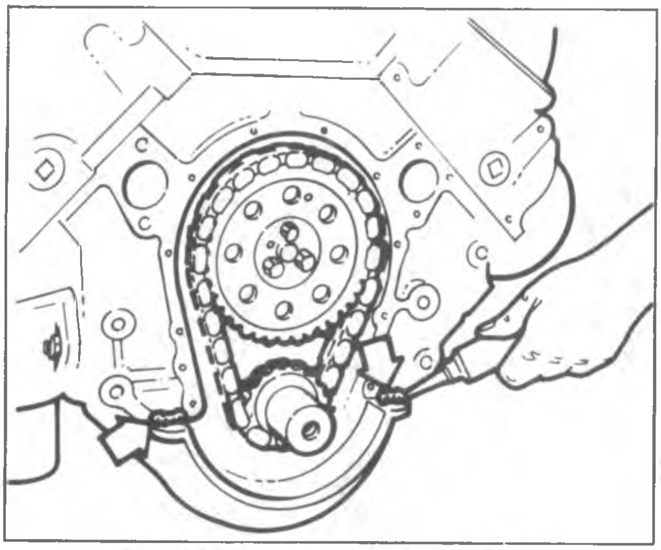


Fig. 6A5-33--Applying Front Cover Sealer

8. Install and partially tighten the two, oil pan-to-front cover attaching screws.
9. Install the front cover-to-block attaching screws.
10. Torque all screws to specifications.
11. Install torsional damper and water pump as previously outlined.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removed

1. With cover removed, pry oil seal out of cover from the front with a large screw driver.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-22102. Support rear of cover at seal area.

With Cover Installed

1. With torsional damper removed, pry seal out of cover from the front with a large screw driver. Be careful not to damage the surface on the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-22102. (fig. 6A5-34).

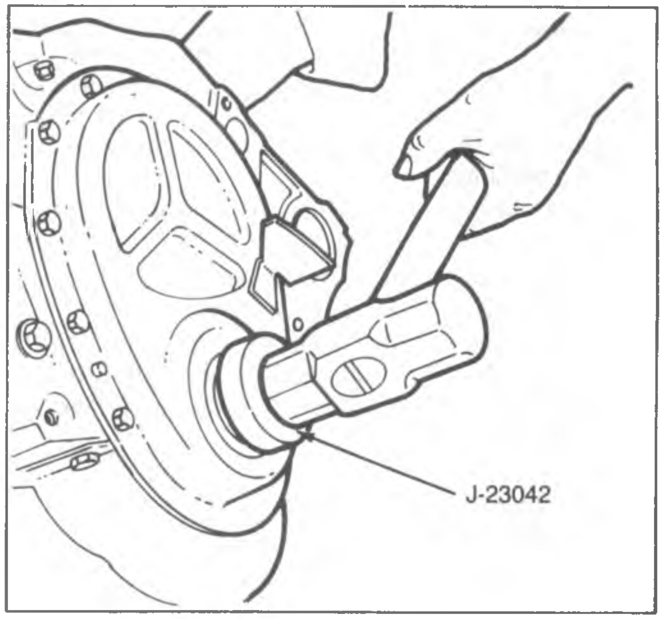


Fig. 6A5-34--Installing Oil Seal

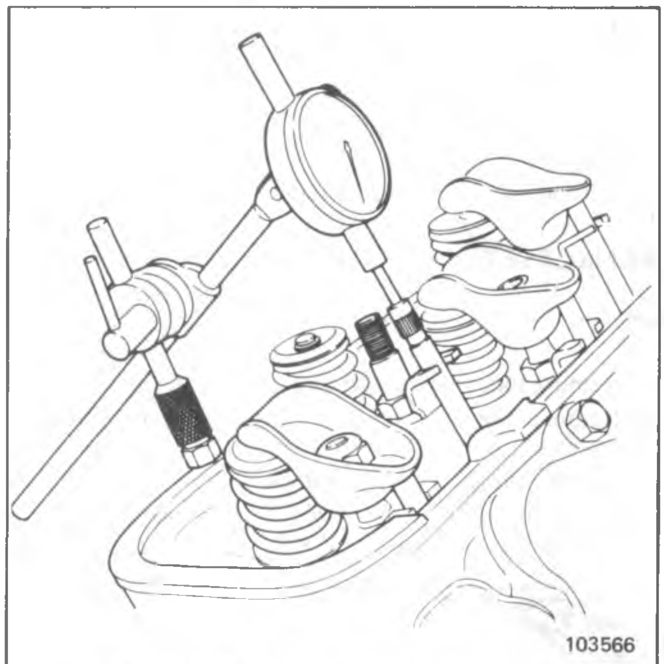


Fig. 6A5-35--Measuring Camshaft Lobe Lift

CAMSHAFT

Measuring Lobe Lift

1. Remove the valve mechanism as previously outlined.
2. Position indicator with ball socket adapter (Tool J-8520) on push rod (fig. 6A5-35). Make sure push rod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is fully raised position.
   - Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).
5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust valve mechanism as outlined.

Removal

1. Remove valve lifters as previously outlined.
2. Remove crankcase front cover as previously outlined.
3. Remove grille.
4. Remove fuel pump push rod as outlined in Section 6C.

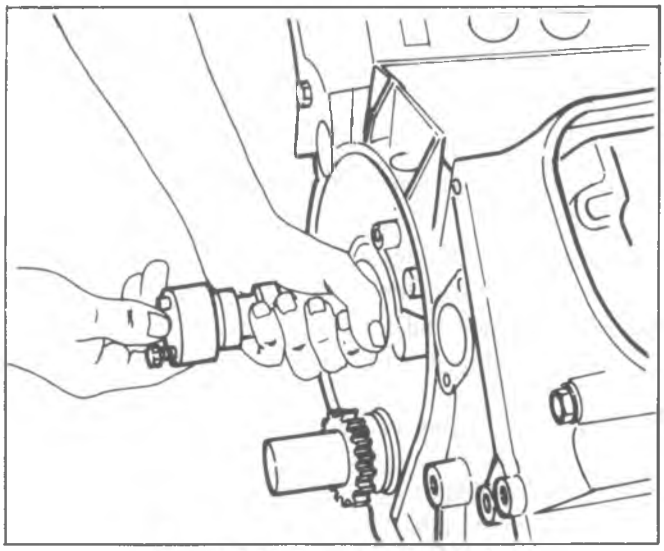


Fig. 6A5-36--Removing Camshaft

5. Complete camshaft removal as follows:
   - Sprocket is a light fit on camshaft. If sprocket does not come off easily a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.
6. Install two 5/16" - 18 x 4" bolts in camshaft bolt holes then remove camshaft (fig. 6A5-36).

   NOTICE: All camshaft journals are the same diameter and care must be used in removing camshaft to avoid damage to bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

Installation

Whenever a new camshaft is installed coat camshaft lobes with "Molykote" or its equivalent.

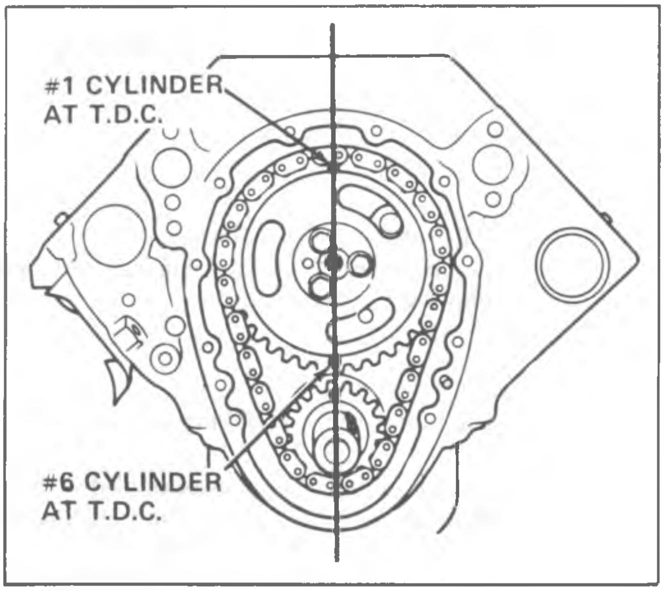


Fig. 6A5-37--Timing Sprocket Alignment Marks

Whenever a new camshaft is installed, replacement of all valve lifters oil filter and engine oil is recommended to insure durability of the camshaft lobes and lifter feet.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install timing chain on camshaft sprocket. Hold the sprocket vertically with the chain hanging down and align marks on camshaft and crankshaft sprockets. (Refer to fig. 6A5-37).
3. Align dowel in camshaft with dowel hole in camshaft sprocket then install sprocket on camshaft.
4. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
5. Lubricate timing chain with engine oil.
6. Install fuel pump push rod as outlined in Section 6C.
7. Install grille.
8. Install crankcase front cover as previously outlined.
9. Install valve lifters as previously outlined.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly of the engine. To replace bearings without complete disassembly remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.
2. Using Tool J-6098 with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.

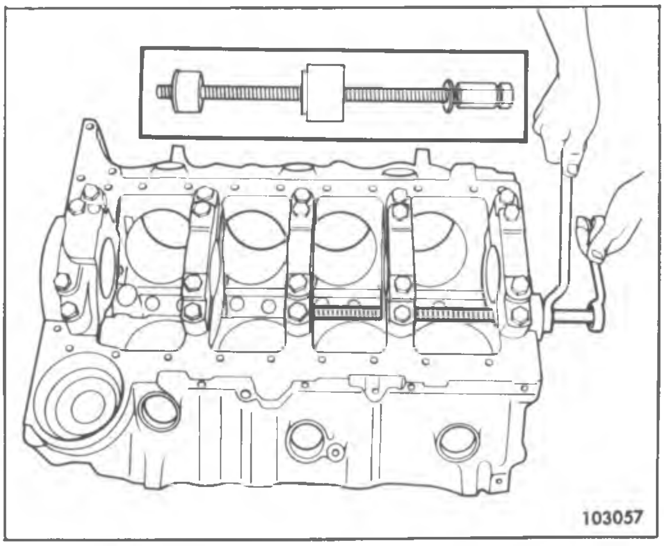


Fig. 6A5-38--Removing Camshaft Bearings

4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 6A5-38).
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A5-39).

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A5-39).
2. Using Tool Set J-6098 with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.
   - Number one through number four cam bearing oil hole must be aligned with oil holes in cam bearing bore.
   - The number five bearing bore is annulus, and cam bearing must be positioned at or near the 6 o'clock position.
4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw, and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.

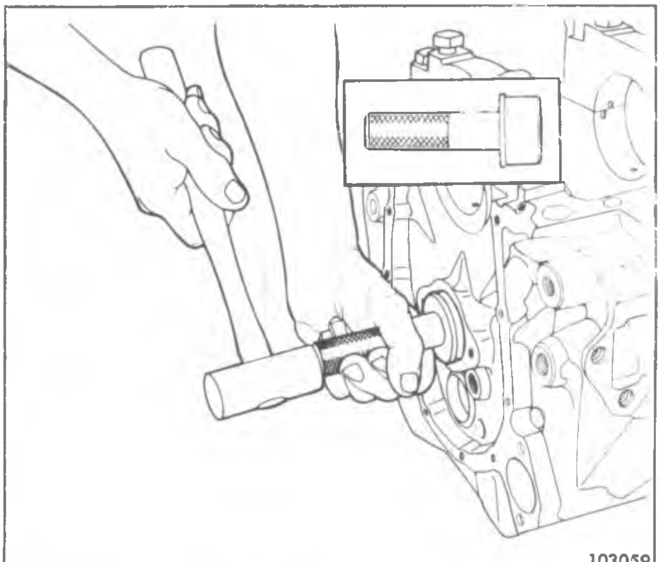


Fig. 6A5-39--Replacing Camshaft Front Bearing

6. Coat new rear plug O.D. with # 1052080 sealant, or equivalent, and install flush to 1/32" (.80mm) deep.

OIL PAN

Removal

1. Disconnect battery negative cable.
2. Loosen fan shroud.
3. Remove air cleaner.
4. Remove distributor cap.
5. Raise vehicle and drain oil pan.
   - If equipped with manual transmission, remove starter.
6. Remove torque converter cover or clutch cover as applicable.
7. Remove oil filter.
8. On gage equipped vehicles, remove oil pressure line from side of block.

   NOTICE: Removal of pressure line is important to prevent crushing of line when raising engine.
9. Remove mount "through" bolts and raise engine.
10. Remove oil pan bolts and drop pan.

Installation

If installing new oil pan, transfer dipstick tube from old unit.

1. With clean sealing surfaces on pan and block, place oil pan on block and install oil pan bolts. Torque to 135 lb. in. (15N·m).
2. Lower engine on mounts and install mount through bolts. Torque to 75 lb. ft. (100 N·m).
3. Install oil pressure line, if applicable, and install oil filter.
4. Install torque converter cover or clutch cover, as applicable.
   - If equipped with manual transmission, install starter.
5. Lower vehicle.
6. Install distributor cap and tighten fan shroud.
7. Fill crankcase with oil; see owners manual.
8. Install air cleaner and connect battery negative cable.
9. Start engine and check for leaks.

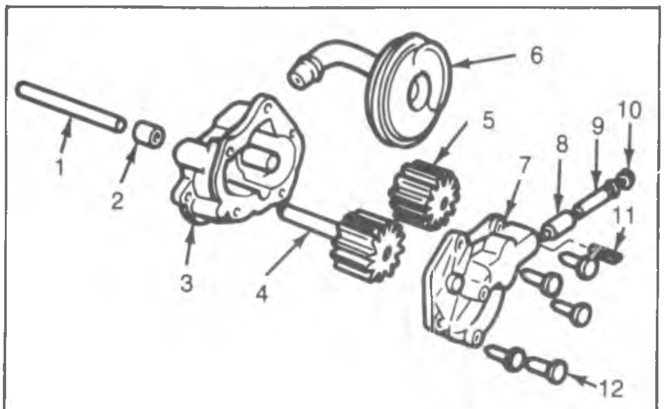
OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

Disassembly (Figure 6A5-40)

1. Remove the pump cover attaching screws and the pump cover.
2. Mark gear teeth so they may be reassembled with the same teeth indexing. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.



1. Shaft Extension
2. Shaft Coupling
3. Pump Body
4. Drive Gear and Shaft
5. Idler Gear
6. Pickup Screen and Pipe
7. Pump Cover
8. Pressure Regulator Valve
9. Pressure Regulator Spring
10. Washer
11. Retaining Pin
12. Screws

Fig. 6A5-40--Oil Pump

4. If the pickup screen and pipe assembly need replacing, the entire pump must be replaced. The screen and pipe assembly is welded to the pump body.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
   - The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen and pipe.
7. Check the pressure regulator valve for fit.

Assembly (Figures 6A5-40)

1. Install the pressure regulator valve and related parts.
2. Install the drive gear and shaft in the pump body.
3. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
4. Install gasket and the pump cover and torque attaching screws to specifications.
5. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.
3. Install oil pan previously outlined.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing. Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.
   If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.

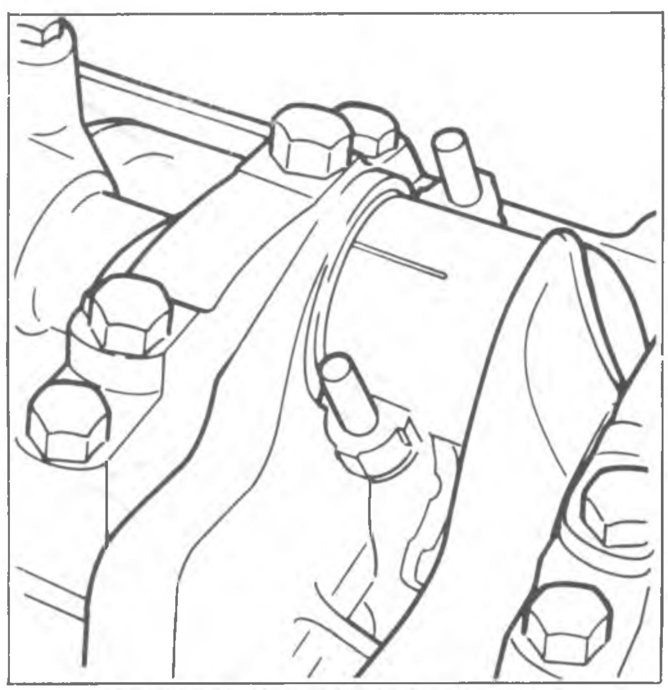


Fig. 6A5-41--Gaging Plastic On Crankpin

a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (fig. 6A5-41). Plastic gage should be positioned in the middle of upper or lower bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).

b. Install the bearing in the connecting rod and cap.

c. Install the bearing cap and evenly torque nuts to specifications. Do not turn the crankshaft with the gaging plastic installed.

d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (fig.6A5-42).

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance. Be sure to check what size bearing is being removed in order to determine proper replacement size bearing.
   If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps (fig. 6A5-43).

MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

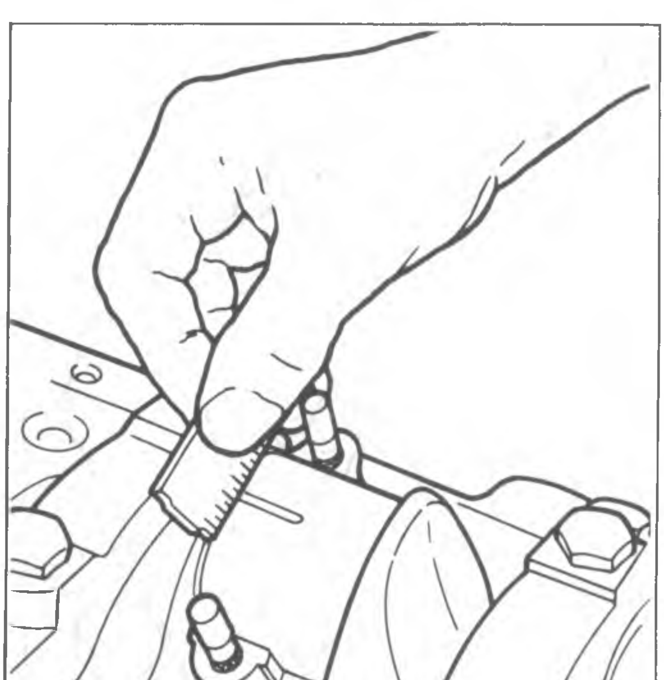


Fig. 6A5-42--Measuring Gaging Plastic

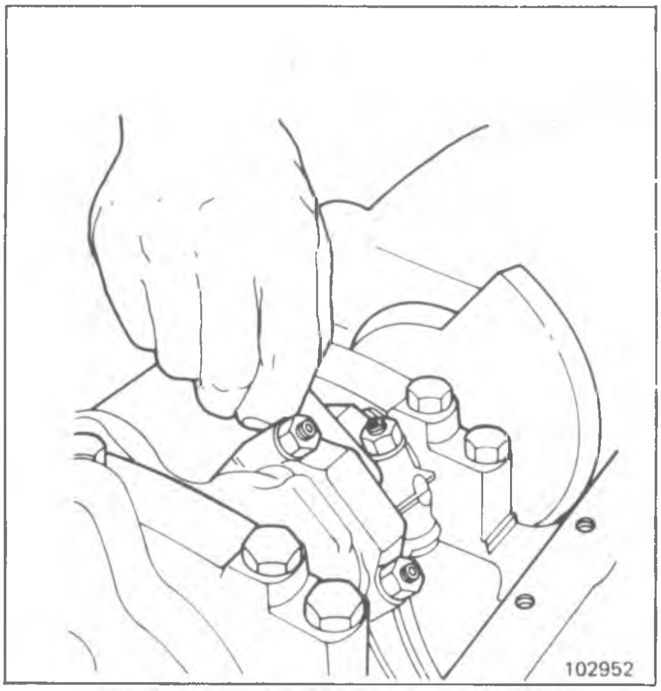


Fig. 6A5-43--Measuring Connecting Rod Side Clearance

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage", (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove the clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.

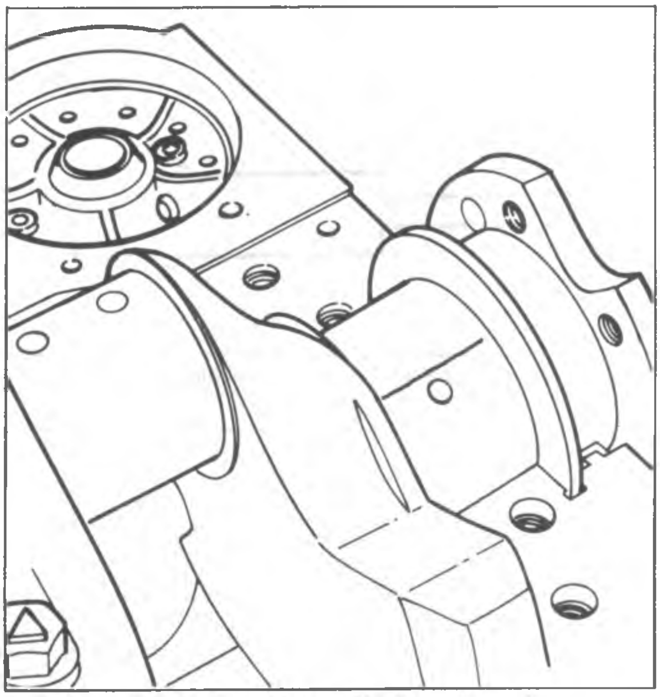


Fig. 6A5-44--Gaging Plastic on Journal

2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 6A5-44). Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap **MUST** be torqued to specifications in order to assure proper reading. Variations in torque affect the compression of the plastic gage.

4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (fig. 6A5-45).

   Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round (.001" max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit. If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found then install shims as required.

7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing. After selecting new bearing, recheck clearance.

8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag. When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.

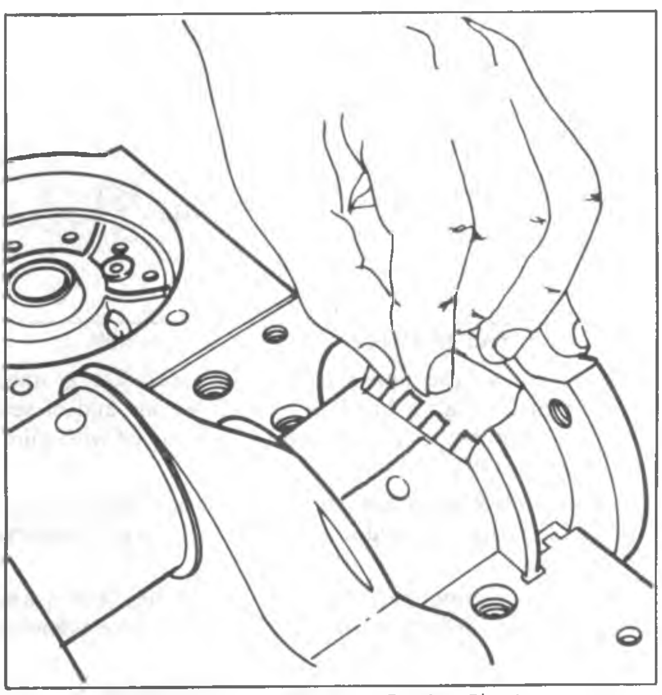


Fig. 6A5-45--Measuring Gaging Plastic

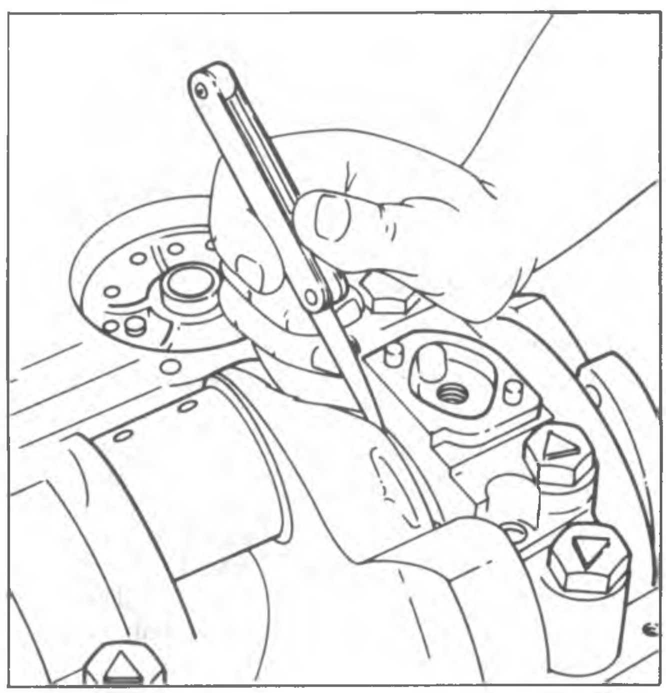


Fig. 6A5-46--Measuring Crankshaft End Play

9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 6A5-46).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal. If such a tool is not availale, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps EXCEPT THE REAR MAIN CAP to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

OIL SEAL (REAR MAIN)

Replacement

- Always replace the upper and lower seal as a unit.

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (fig. 6A5-47) can be used to protect the seal bead when positioning seal as follows:

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the bearing cap by prying from the bottom with a small screw driver (fig. 6A5-48).

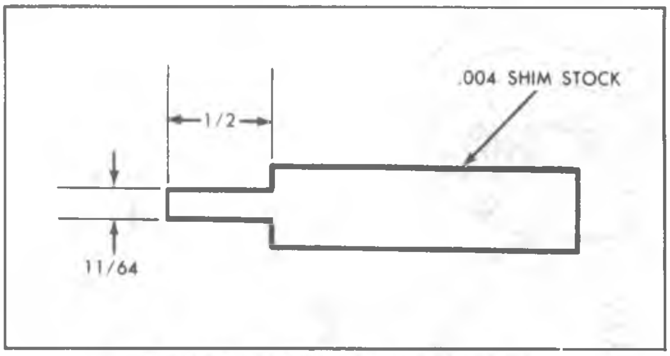


Fig. 6A5-47--Oil Seal Installation Tool

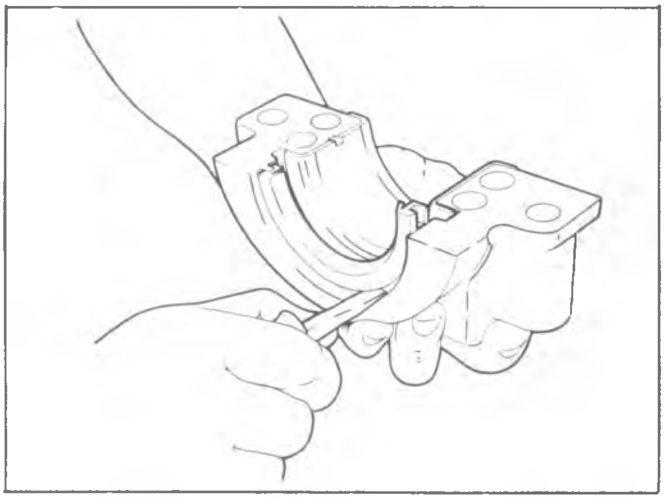


Fig. 6A5-48--Removing Oil Seal - Lower Half

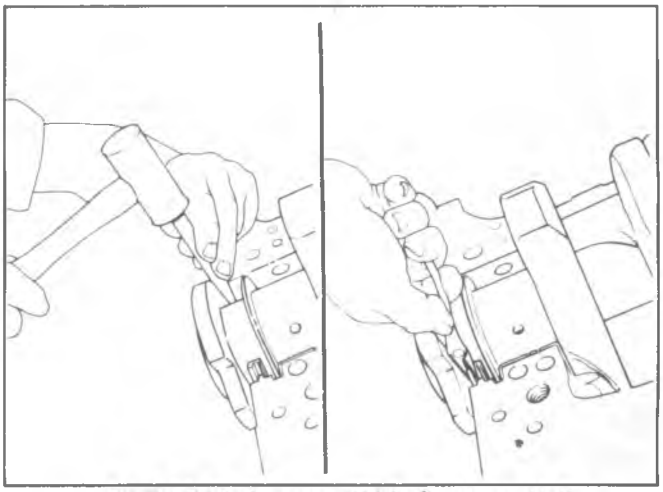


Fig. 6A5-49--Removing Oil Seal - Upper Half

3. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 6A5-49).
4. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a non-abrasive cleaner.
5. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.
6. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.

7. Position tip of tool between crankshaft and seal seat in cylinder case.
8. Position seal between crankshaft and tip of tool so that seal bead contacts tip of tool. Make sure that oil-seal lip is positioned toward front of engine (fig. 6A5-50).
9. Roll seal around crankshaft using tool as a "shoe-horn" to protect seal bead from sharp corner of seal seat surface in cylinder case. Installation tool must remain in position until seal is properly positioned with both ends flush with block.
10. Remove tool, being careful not to withdraw seal.
11. Install seal half in bearing cap, again using tool as a "shoe-horn", feeding seal into cap using light pressure with thumb and finger.
12. Install bearing cap to case with sealant applied to the cap-to-case interface being careful to keep sealant off the seal split line (fig. 6A5-51).
13. Install the rear main bearing cap (with new seal) and torque to 10-12 lb. ft. (14-16N·m). Tap end of crank-shaft first rearward then forward with lead hammer. This will line up thrust surfaces. Retorque bearing cap to specifications.

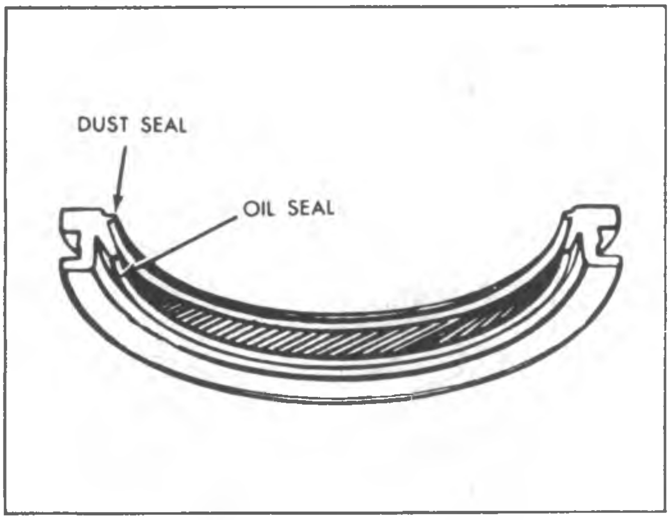


Fig. 6A5-50--Crankshaft Oil Seal - Rear Main

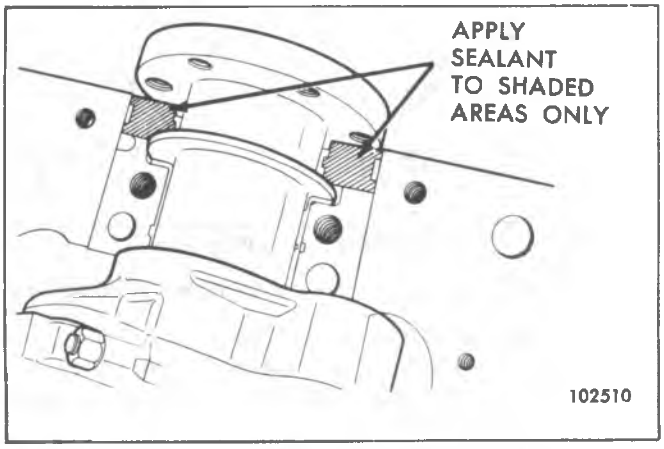


Fig. 6A5-51--Sealing Bearing Cap

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. Remove oil pan, oil pump and cylinder head as previously outlined.
2. For the cylinder being serviced, turn crankshaft until piston is at the bottom of the stroke. Place a cloth on top of the piston.
3. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.
4. Turn crankshaft until piston is at top of stroke and remove cloth and cuttings.
5. Remove connecting rod cap and install Tool J-5329 (3/8") on studs. Push connecting rod and piston assembly out of top of cylinder block. It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps. If bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.
2. Remove piston rings by expanding and sliding them off the pistons.
3. Place connecting rod and piston assembly on Tool J-24086-20. Using an arbor press and piston pin remover, J-24086-8, press the piston pin out of connecting rod and piston (fig. 6A5-52).

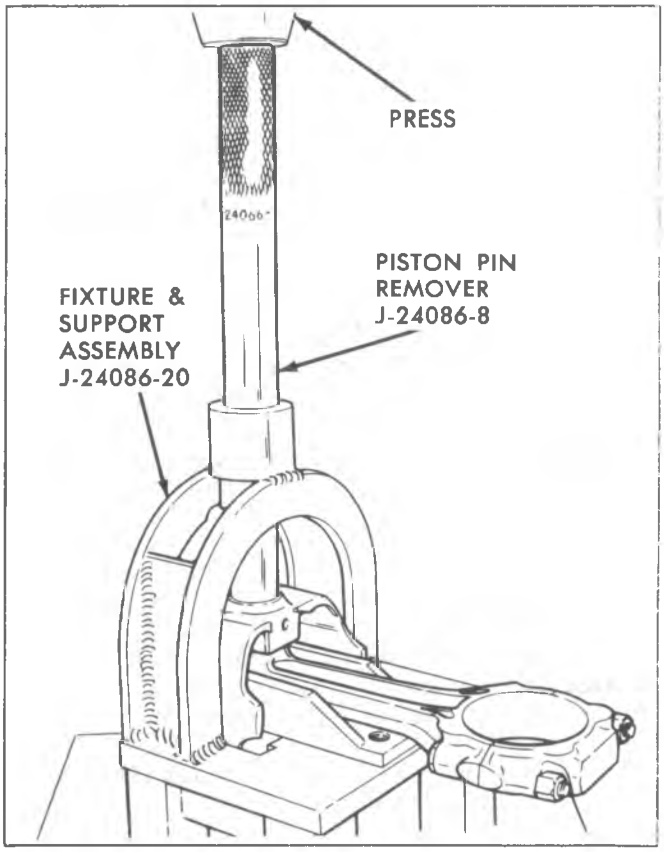


Fig. 6A5-52--Removing Piston Pin

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air. Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly.
3. Using piston pin installer, J-24086-9, press the piston pin into the piston and connecting rod (fig. 6A5-53).

   NOTICE: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.
4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is treated with molybdenum for maximum life.

The 2nd compression ring is a chrome plated, tapered face, reverse twist design.

The oil control rings are of three piece type, consisting of two segments (rails) and an expander.

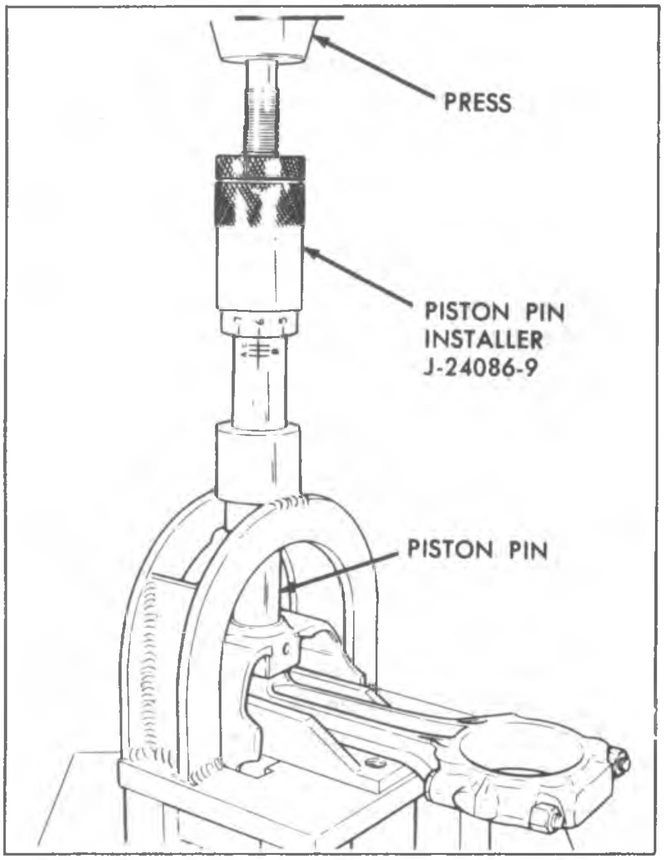


Fig. 6A5-53--Installing Piston Pin

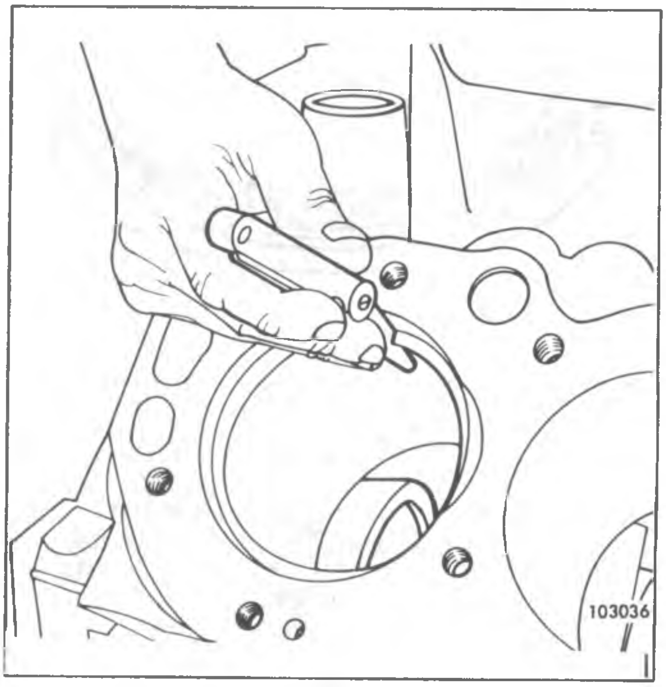


Fig. 6A5-54--Measuring Ring Gap

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage (fig. 6A5-54).

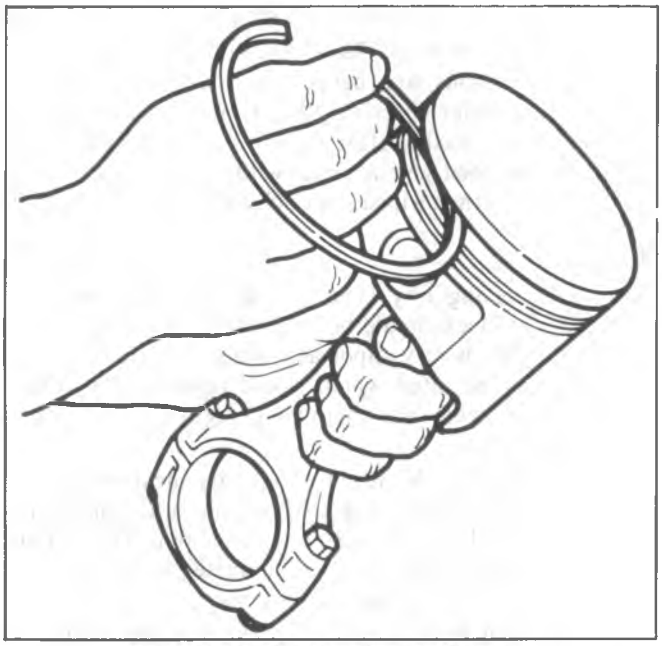


Fig. 6A5-55--Checking Ring in Groove

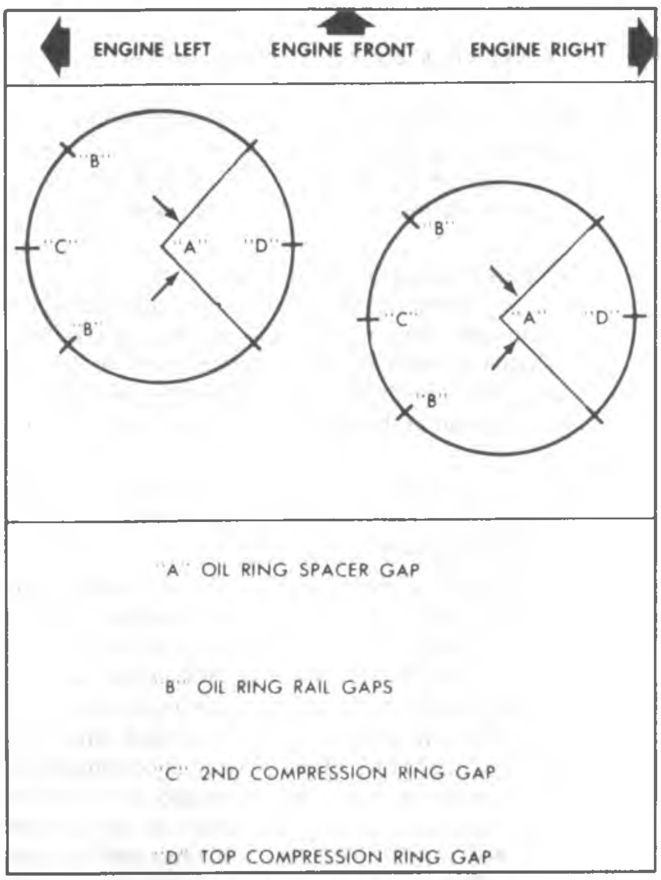


Fig. 6A5-56--Ring Gap Location

4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (fig. 6A5-55) to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by ring groove, correct by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.
8. Install piston rings as follows (fig. 6A5-56):
   a. Install oil ring spacer in groove.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point the cause should be determined. If binding is caused by ring groove, correct by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install second compression ring then properly locate gaps.
   f. Install top compression ring with gap properly located.
9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring and groove should be measured (fig. 6A5-57). (See Specifications).

Installation

Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

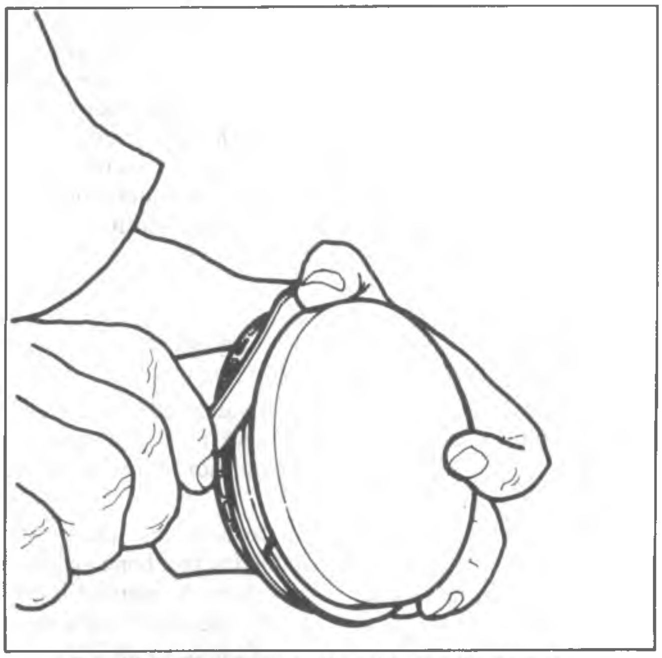


Fig. 6A5-57--Measuring Ring Groove Clearance

2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install Tool J-5329 (3/8") on connecting rod bolts.
4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 to compress the rings. Guide the connecting rod into place on the crankshaft journal with Tool J-6305 (11/32"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
5. Remove Tool J-5329.
6. Install the bearing caps and torque nuts to specifications.

Be sure to install new pistons in the cylinders for which they were fitted, and used pistons in the cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1,3,5 and 7 in the left bank and, 2 4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
2. Remove oil gallery plugs and clean all oil passages.
3. Clean and inspect water passages in the cylinder block.
4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.
5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less then .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks, in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

   NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.
5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:

a. Measure the "Cylinder Bore Diameter" with a telescope gage [[2-1/2" (64mm) from top of cylinder bore]].
b. Measure the "Piston Diameter" (at skirt across center line of piston pin).
c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".
d. Locate piston to bore clearance on Piston Selection Chart and determine if piston to bore clearance is in the acceptable range.

2. If used piston is not acceptable, determine if a new piston can fit cylinder bore.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance.
4. Mark the piston to identify the cylinder for which it was fitted.

OIL FILTER BYPASS VALVE

Inspection and Replacement

With the oil filter removed, check the spring and fibre valve for operation. Inspect for a cracked, broken or stuck valve. If replacement is necessary, the oil filter adapter and bypass valve assembly must be replaced as an assembly. Clean valve chamber in cylinder block thoroughly. Torque retaining screws to specifications.

ENGINE ASSEMBLY

Removal

1. Remove hood.
2. Disconnect battery cables at battery.
3. Remove air cleaner.
4. Drain radiator and block.
5. Disconnect radiator and heater hoses and remove radiator and fan shroud.
6. Disconnect wires at:
   - Starter Solenoid
   - Generator
   - TRC Speed Switch
   - TRC Solenoid
   - Temperature switch
   - Oil Pressure Switch
   - Distributor
7. Disconnect:
   - Accelerator linkage at inlet manifold.
   - Fuel line, from tank, at fuel pump.
   - Hoses at fuel vapor storage canister (if applicable).
   - Vacuum line to power brake unit at manifold, if so equipped.
8. Remove power steering pump and A/C compressor and lay aside, if so equipped.
9. Raise vehicle on hoist.
10. Drain crankcase.
11. Disconnect exhaust pipe at manifold and, if so equipped, converter bracket at transmission rear mount.
12. Remove starter.
13. Remove flywheel splash shield or converter housing cover as applicable.
14. On vehicles with automatic transmission, remove converter to flywheel attaching bolt.
15. Remove mount "through" bolts.
16. Remove bell housing bolts.
17. Lower vehicle on hoist.
18. Raise transmission using floor jack.
19. Attach engine lifting devices, raise engine.
20. Remove motor mount to engine brackets.
21. Remove engine assembly.

Installation

1. Position engine assembly in vehicle.
2. Attach motor mount to engine brackets and lower engine in place.
3. Remove engine lifting device.
4. Remove transmission floor jack.
5. Raise vehicle on hoist.
6. Install mount "through" bolts. Torque to specifications.
7. Install bell housing bolts. Torque to specifications.
8. On vehicles with automatic transmissions, install converter to flywheel attaching bolts. Torque to specifications.
9. Install flywheel splash shield of converter housing cover as applicable. Torque attaching bolts to specifications.
10. Install starter.
11. Connect exhaust pipe at manifold and converter bracket at transmission rear mount.
12. Lower vehicle on hoist.
13. Reinstall power steering pump and A/C compressor, if so equipped.
14. Connect:
    - Accelerator linkage at inlet manifold.
    - Fuel line, from tank, at fuel pump.
    - Hoses at fuel vapor storage canister.
    - Vacuum line to power brake unit at manifold, if equipped.
15. Connect wires at:
    - Starter Solenoid
    - Generator
    - TRC Speed Switch
    - TRC Solenoid
    - Temperature Switch
    - Oil Pressure Switch
    - Distribotor
16. Install radiator and fanshroud and reconnect radiator and heater hoses.
17. Fill cooling system.
18. Fill crankcase with oil. See Section 0B for specifications.
19. Install air cleaner.
20. Install hood.
21. Connect battery cables.

    NOTICE: To avoid possible arcing of battery, connect positive battery cable first.

22. Start engine, check for leaks and check timing.

CRANKSAHFT

The crankshaft can be removed while the engine is disassembled for overhaul, as previously outlined or without complete disassembly as outlined below.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in stand and clamp securely.
2. Remove the oil dip stick and oil dip stick tube, (if applicable).
3. Remove the starting motor, clutch assembly (if equipped) and flywheel.
4. Remove the spark plugs.
5. Remove crankshaft pulley and torsional damper.
6. Remove oil pan and oil pump.
7. Remove crankcase front cover, and if so equipped, remove timing chain and camshaft sprocket.
8. Check the connecting rod caps for cylinder number identification. If necessary, mark them.
9. Remove the connecting rod caps and push the pistons to top of bores.
10. Remove main bearing caps and lift crankshaft out of cylinder block.
11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

SPROCKET OR GEAR REPLACEMENT

Remove crankshaft sprocket using Tool J1619, install using Tool J-21058.

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips install lip with helix towards front of engine.

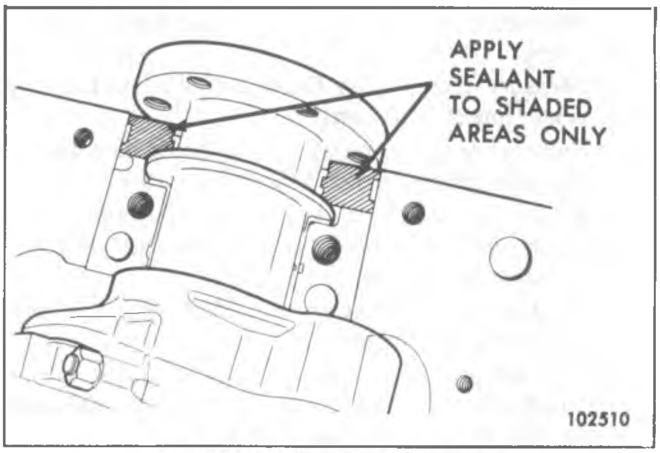


Fig. 6A5-58--Sealing Bearing Cap

2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (fig. 6A5-58). Do not allow sealant on crankshaft or seal.
6. Install main bearing caps with arrows pointing toward front of engine.
7. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 lbs. ft. (14-16 N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
8. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.
9. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.
   - Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

GENERAL DATA:

TYPE		90° V-8 GASOLINE
DISPLACEMENT	LITRE (*)	7.4 (W)
RPO		LE8
BORE		4.250
STROKE		4.000
COMPRESSION RATIO		8.0:1
FIRING ORDER		1-8-4-3-6-5-7-2

CYLINDER BORE:

DIAMETER			4.2495-4.2525
OUT OF ROUND	PRODUCTION		.001 MAX.
	SERVICE		.002 MAX.
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.
		RELIEF SIDE	.001 MAX.
	SERVICE		.001 MAX.

PISTON:

CLEARANCE	PRODUCTION	.0030-.0040
	SERVICE	.0050 MAX.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.0017-.0032
			2ND	.0017-.0032
		SERVICE		HI LIMIT PRODUCTION +.001
	GAP	PRODUCTION	TOP	.010-.020
			2ND	.010-.020
		SERVICE		HI LIMIT PRODUCTION +.010
OIL	GROOVE CLEARANCE	PRODUCTION		.005-.0065
		SERVICE		HI LIMIT PRODUCTION +.001
	GAP	PRODUCTION		.015-.055
		SERVICE		HI LIMIT PRODUCTION +.010

* VIN Designation

PISTON PIN — LE8

DIAMETER		.9895-.9898
CLEARANCE	PRODUCTION	.00025-.00035
	SERVICE	.001 MAX.
FIT IN ROD		.0013-.0021 INTERFERENCE

CRANKSHAFT

MAIN JOURNAL	DIAMETER		
			#1-2-3-4 2.7481-2.7490
			#5 2.7476-2.7486
	TAPER	PRODUCTION	.0002 MAX.
		SERVICE	.001 MAX.
	OUT OF ROUND	PRODUCTION	.0002 MAX.
		SERVICE	.001 MAX.
MAIN BEARING CLEARANCE	PRODUCTION		#1-2-3-4 .0013-.0025
			#5 .0024 .0040
	SERVICE		#1 4 .001-.0025 #5 .0025-.0035
CRANKSHAFT END PLAY			.006-.010
CRANKPIN	DIAMETER		2.2000-2.1990
	TAPER	PRODUCTION	.0005
		SERVICE	.001 MAX.
	OUT OF ROUND	PRODUCTION	.0005
		SERVICE	.001 MAX.
ROD BEARING CLEARANCE	PRODUCTION		.0009-.0025
	SERVICE		.0030 MAX.
ROD SIDE CLEARANCE			.013-.023

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2343
	EXHAUST	.2530
JOURNAL DIAMETER		1.9482-1.9492

VALVE SYSTEM

VALVE SYSTEM			LE8
LIFTER			HYDRAULIC
ROCKER ARM RATIO			1.70:1
VALVE LASH	INTAKE		ONE TURN DOWN FROM ZERO LASH
	EXHAUST		
FACE ANGLE (INT. & EXH.)			45°
SEAT ANGLE (INT. & EXH.)			46°
SEAT RUNOUT			.002 MAX.
SEAT WIDTH	INTAKE		1/32-1/16
	EXHAUST		1/16-3/32
STEM CLEARANCE	PRODUCTION	INT.	.0010-.0027
		EXH.	.0012-.0029
	SERVICE		HI LIMIT + .001 IN. +.002 EX.
VALVE SPRING (OUTER)	FREE LENGTH		2.12
	PRESSURE LBS. @ IN.	CLOSED	84-96 @ 1.80
		OPEN	210-230 @ 1.40
	INSTALLED HEIGHT ± 1/32"		1-51/64
DAMPER	FREE LENGTH		1.86
	APPROX. # OF COILS		4

TORQUE SPECIFICATIONS

CRANKCASE FRONT COVER . . . . 80 LB. IN.
FLYWHEEL HOUSING COVER . . . . 80 LB. IN.
OIL FILTER BYPASS VALVE . . . . 80 LB. IN.
OIL PAN (TO FRONT COVER) . . . . 55 LB. IN.
OIL PUMP COVER . . . . 80 LB. IN.
ROCKER ARM COVER . . . . 50 LB. IN.
CAMSHAFT SPROCKET . . . . 20 LB. FT.
OIL PAN TO CRANKCASE (5/16-18) . . . . . . 135 LB. IN.
CLUTCH PRESSURE PLATE . . . . 30 LB. FT.
DISTRIBUTOR CLAMP . . . . 25 LB. FT.
FLYWHEEL HOUSING . . . . 30 LB. FT.
MANIFOLD (EXHAUST) . . . . 20 LB. FT.
MANIFOLD (INLET). . . . . 30 LB. FT.
WATER OUTLET . . . . 30 LB. FT.
WATER PUMP . . . . 30 LB. FT.
CONNECTING ROD CAP . . . . 50 LB. FT.
CYLINDER HEAD . . . . 80 LB. FT.
OIL PUMP . . . . 65 LB. FT.
ROCKER ARM STUD . . . . 50 LB. FT.
FLYWHEEL . . . . 65 LB. FT.
MAIN BEARING CAP . . . . 110 LB. FT.
TEMPERATURE SENDING UNIT . . . . 20 LB. FT.
TORSIONAL DAMPER . . . . 85 LB. FT.
OIL FILTER . . . . 25 LB. FT.
OIL PAN DRAIN PLUG . . . . 20 LB. FT.
SPARK PLUG . . . . 17-27 LB. FT.

SECTION 6A7

6.2L (C) V-8-RPO LH6
6.2L (J) V-8-RPO LL4

DIESEL

NOTICE: DO NOT USE STARTING FLUIDS. SUCH AIDS CAN CAUSE IMMEDIATE ENGINE DAMAGE.

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GENERAL DESCRIPTION

The engine is a V-8, 6.2L engine. Cylinders #1, 3, 5, 7 are on the left bank and cylinders #2, 4, 6, 8 are on the right bank. The firing order is 1-8-7-2-6-5-4-3. This engine is similar to a V-8 gasoline engine in many ways but major differences occur in the cylinder heads, combustion chamber, fuel distribution system, air intake manifold and the method of ignition. The cylinder case, crankshaft, main bearings, rods, pistons and wrist pins are similar to a gasoline engine but are heavy duty design because of the high compression ratio required in the diesel engine to ignite fuel. Ignition of the fuel in a diesel engine occurs because of heat developed in the combustion chamber during the compression stroke. Thus, no spark plugs or high voltage ignition are necessary for a diesel engine.

Intake and exhaust valves in the cylinder heads operate the same as in a gasoline engine but are of special design and material for diesel operation. The special alloy steel pre-chamber inserts in the cylinder head combustion chambers are serviced separately from the head. With the cylinder head removed, they can be pushed out after removing the glow plugs and injection nozzles. Glow plugs and injector nozzles are threaded for assembly into the head. The injector nozzles are spring loaded and calibrated to open at a specified fuel pressure.

Because the intake manifold is always open to atmospheric pressure, there is no vacuum supply and a vacuum pump is required to operate accessories such as air conditioning, door diaphragms and cruise control.

The engine is designed with a 101mm (3.98 inch) bore and a 97mm (3.8 inch) stroke, which produces 6217 CC (379.4 cubic inches). The compression ratio is 21.5 to 1. The cylinder head incorporates a 17 bolt head design which locates 5 bolts around each cylinder. This helps gasket durability.

The cylinder head includes a high swirl pre-combustion chamber which mixes fuel and air to provide an efficient fuel burn and low emissions. A glow plug is used to assist in starting this system. A special cavity in the piston top further assists in mixing the combustion products for complete buring.

Main bearing caps all use 4 bolts to provide a rigid support for the crankshaft and minimize stress.

The rolled fillet nodular iron crankshaft utilizes a torsional damper, tuned to reduce vibrations.

This engine uses roller hydraulic valve lifters running on a forged steel camshaft.

The fuel system includes a water sensor within the fuel filter.

A block heater is standard equipment to aid starts in severe weather.

LUBRICATION SYSTEM

Seven quarts of oil are required for this engine. The oil pan acts as a reservoir for holding the oil waiting to be circulated through the engine. The oil pan is attached to the bottom side or pan rail of the engine.

The lubricating system of this engine is a pressure feed type which means that a pump forces oil through the galleries to the necessary parts. The pump is mounted to the bottom side of the rear main bearing cap. Extending down from the pump and into the oil is a pick-up tube with a screen cover to filter out foreign material. Oil is picked up by this tube and pumped through the oil pump. The pump is a gear type which uses 2 meshing gears. As these gears rotate in opposite directions, the spaces between the gear teeth and the housing fill with oil from the inlet side of the pump. Then as the teeth mesh, the oil is forced out through the outlet tube. The pump is driven from the engine camshaft by means of an intermediate shaft. The oil is next pumped through a cooler located in the radiator which cools the oil and thus helps to remove engine heat. If the cooler becomes clogged, the engine is equipped with a bypass valve, which allows engine oil to bypass the cooler and continue to feed the engine.

From the cooler the oil passes through a filter. This filter is a cartridge type and all oil going to the engine passes through this filter. The cartridge is made of materials that trap foreign material to prevent it getting to engine components. If this full flow filter becomes clogged, there is also a filter by-pass valve which is spring loaded. This valve protects the engine from oil starvation by opening when increased pump pressure tries to pump oil through a clogged filter. When the pressure causes the by-pass valve to open, the oil by-passes the filter and the engine continues to receive lubrication. Replacement of the filter at proper intervals will prevent damage to the engine due to a clogged filter.

From the filter the oil is pumped through the drilled galleries in the case to the various moving metal parts in the engine. The rear crankshaft bearing is fed by a hole drilled from the rear main bearing bore to main gallery. Oil is pumped further through the main gallery to a drilled oil gallery which has been drilled the full length of the left side of the case. Oil from this gallery feeds the camshaft bearings and a second gallery which runs the full length of the right side of the case. All other engine components are provided lubrication by these 2 oil galleries. Holes are drilled from camshaft bore to crankshaft bore to provide oil for main bearings #1 through #4. Lifters on the right side receive oil from the right side main oil gallery and lifters on the left side receive oil from the left side oil gallery. The lifters contain a disc valve which meters oil to the hollow push rods and to the rocker arm and valve stem in the cylinder head. After a small accumulation of oil is in the head, it begins to drain back to the crankcase. As mentioned before, the first four main bearings receive oil from vertical holes drilled from the cam bores to crank bores. Oil flows onto the crankshaft main bearings and provides lubrication for the crankshaft to rotate freely in its bearings. As the crankshaft rotates, it slings oil off the crankpins to cover cylinder walls, pistons, piston pin and piston rings. Oil drains off these parts and back to the engine.

There is an oil pressure switch which is assembled to the top rear of the cylinder case to sense oil pressure in the main gallery.

COMPRESSION TEST

To determine if the valves or rings are the cause of low compression, a test should be made to determine the cylinder compression pressure.

When checking compression, the batteries should be at or near full charge. The lowest reading cylinder should not be less than 80 percent of the highest and no cylinder reading should be less than 300 p.s.i. (2068 kPa).

1. Remove air cleaner.
2. Disconnect the wire from the fuel solenoid terminal of the injection pump.
3. Disconnect wires from glow plugs then remove all glow plugs.
4. Screw the compression gage J-26999-10 into the glow plug hole of the cylinder that is being checked.
5. Crank engine.

   This should be done with six "puffs" per cylinder.

   Normal-Compression builds up quickly and evenly to specified compression on each cylinder.

   Piston Rings Leaking-Compression low on first stroke tends to build up on following strokes but does not reach normal.

   NOTICE: Do not add oil to any cylinder to compression test as extensive damage may result.

ON VEHICLE SERVICE

Engine mounts (Figures 6A7-1 and 6A7-2) are the nonadjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe mounts while raising engine.

If a powertrain mount exhibits:

a. Hard rubber surface covered with heat check cracks;
b. Rubber separated from a metal plate of the mount; or
c. Rubber split through center.

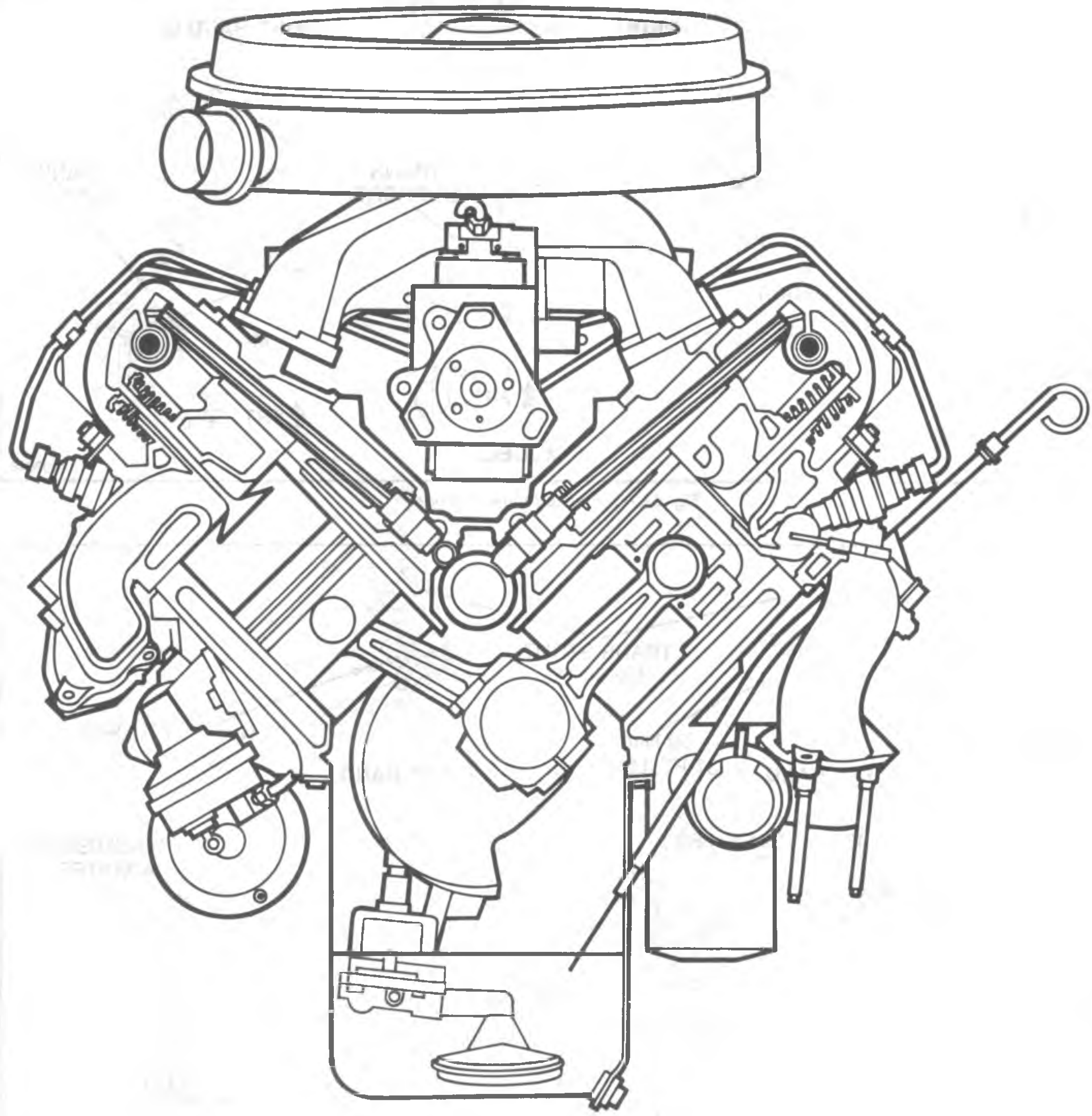
Replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Front Mount Replacement

1. Remove mount retaining bolt from below frame mounting bracket.
2. Raise front of engine and remove mount-to-engine bolts and remove mount. Raise engine only enough for sufficient clearance.
3. Replace mount to engine and lower engine into place.
4. Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

1. Support engine weight to relieve rear mounts.
2. Remove crossmember-to-mount bolts.



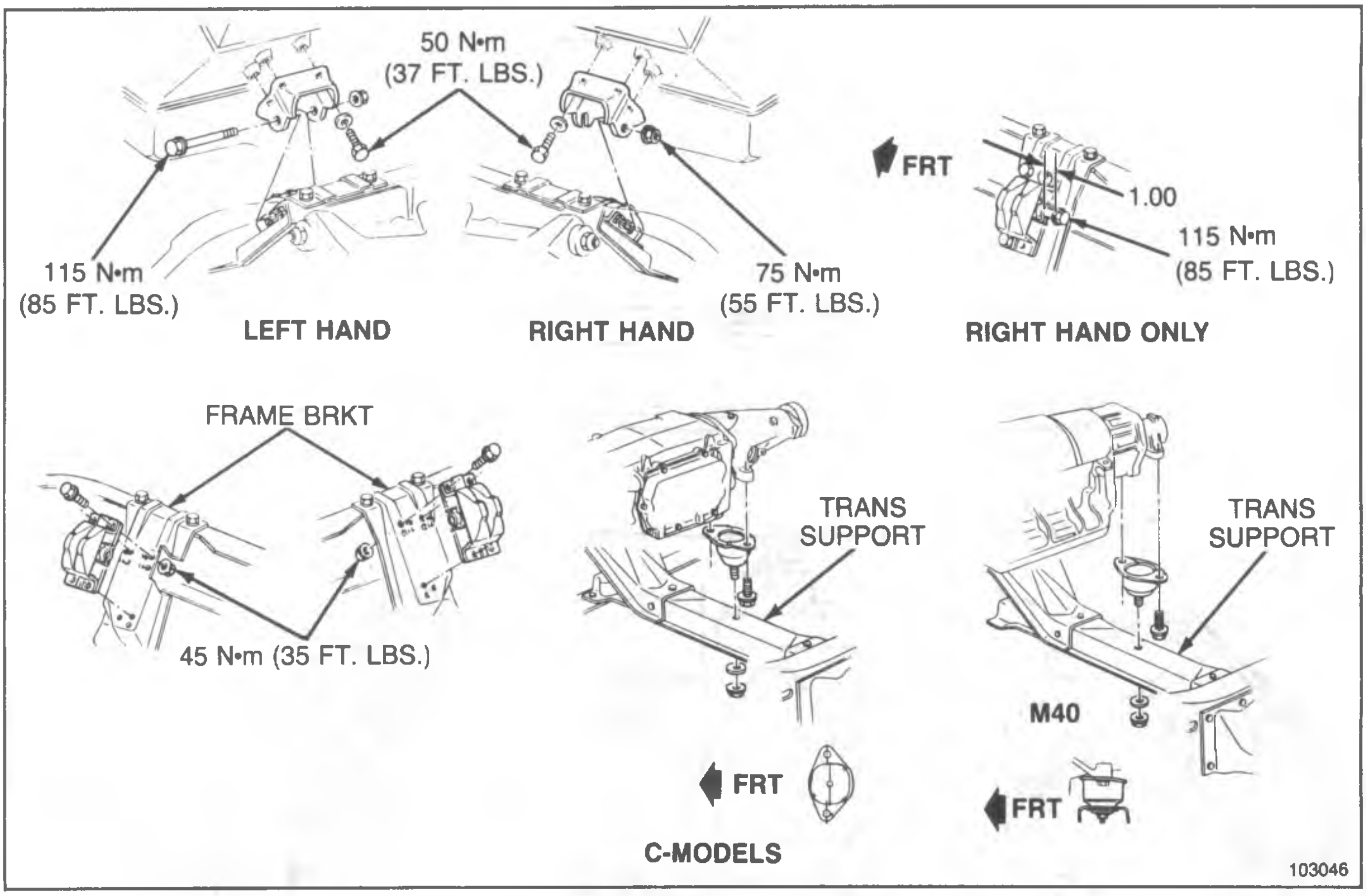


Fig. 6A7-1--Engine Mount C-Model

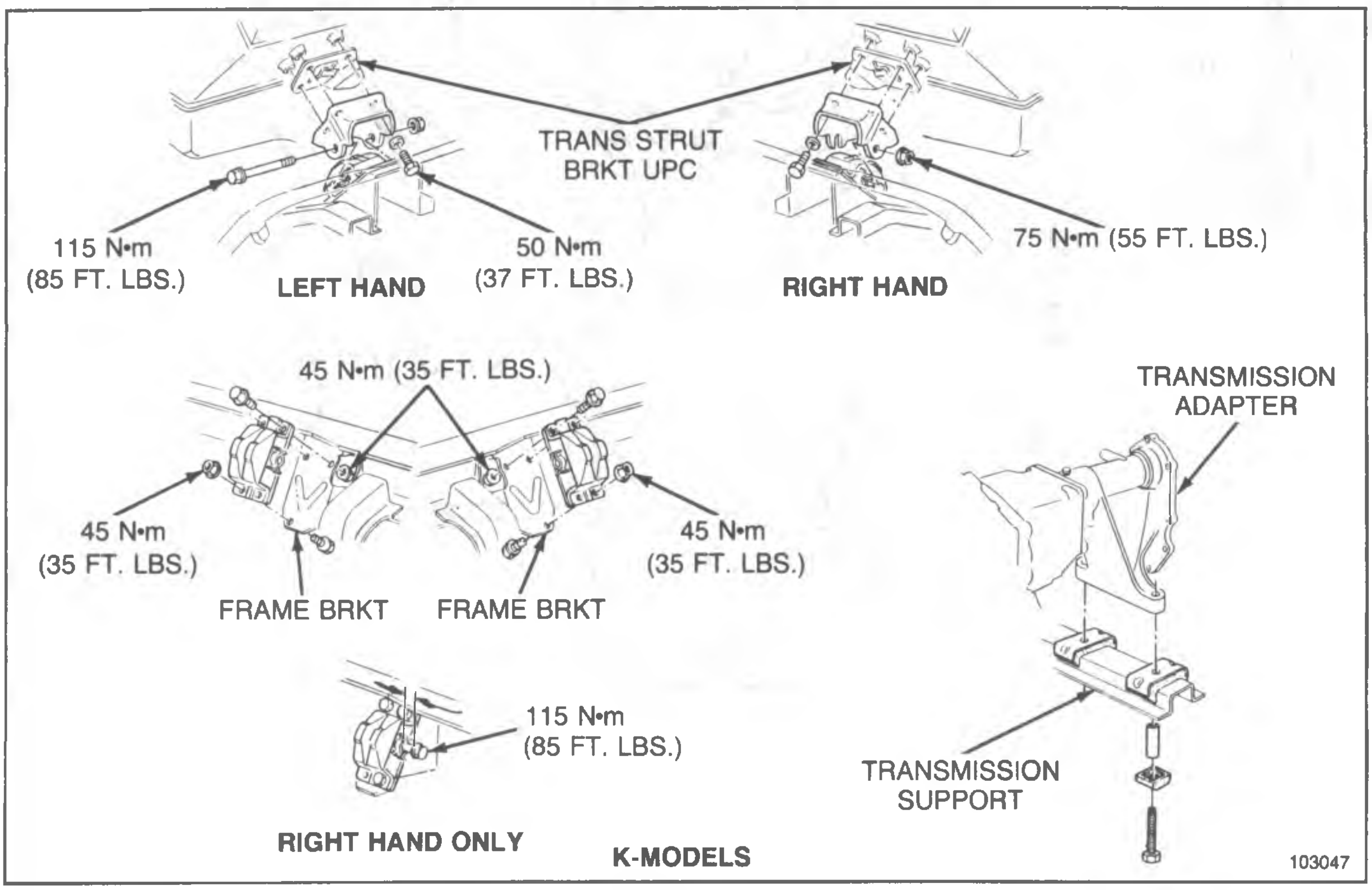


Fig. 6A7-2--Engine Mount K-Model

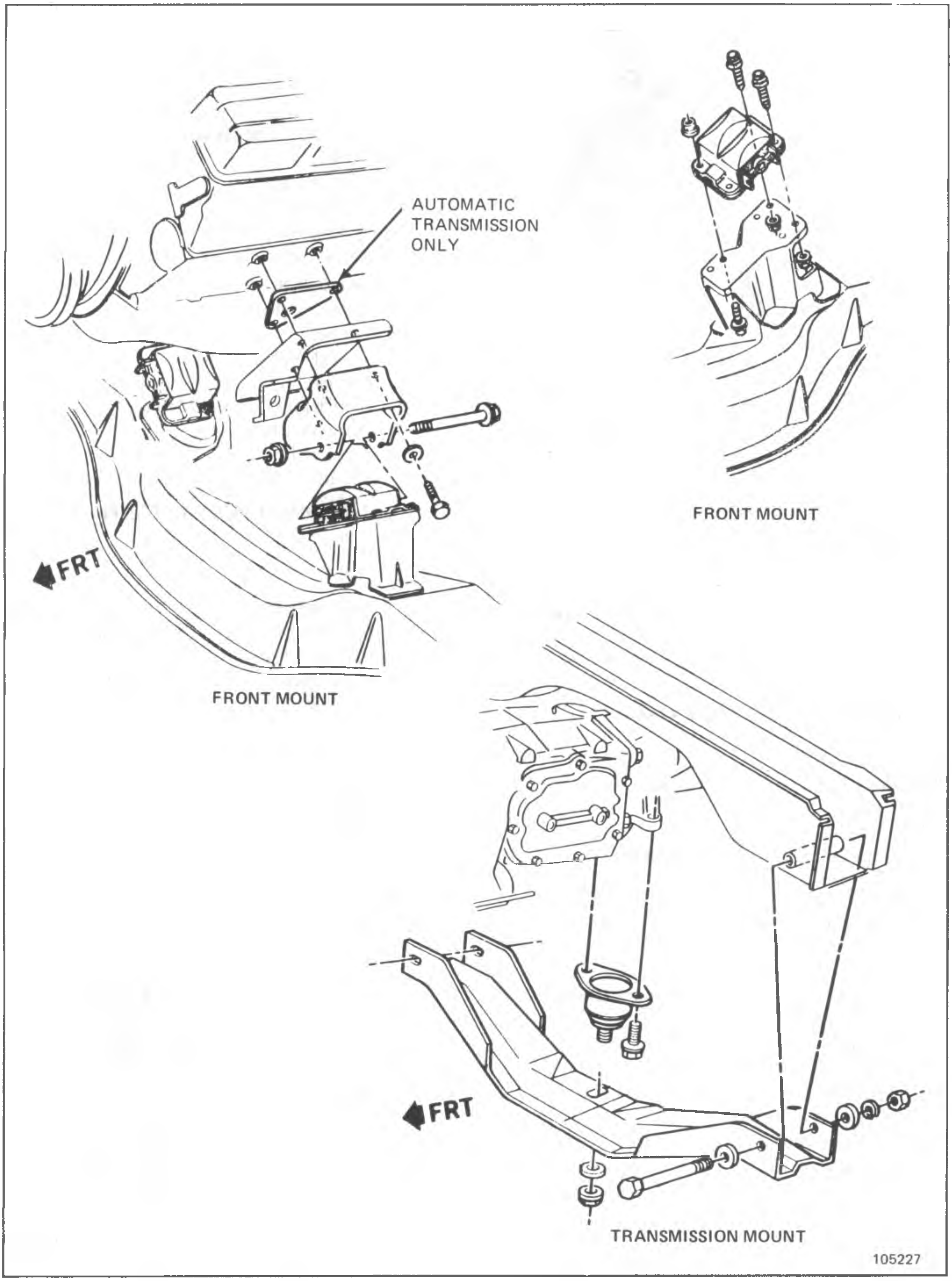


Fig. 6A7-2a--Engine Mount G-Model

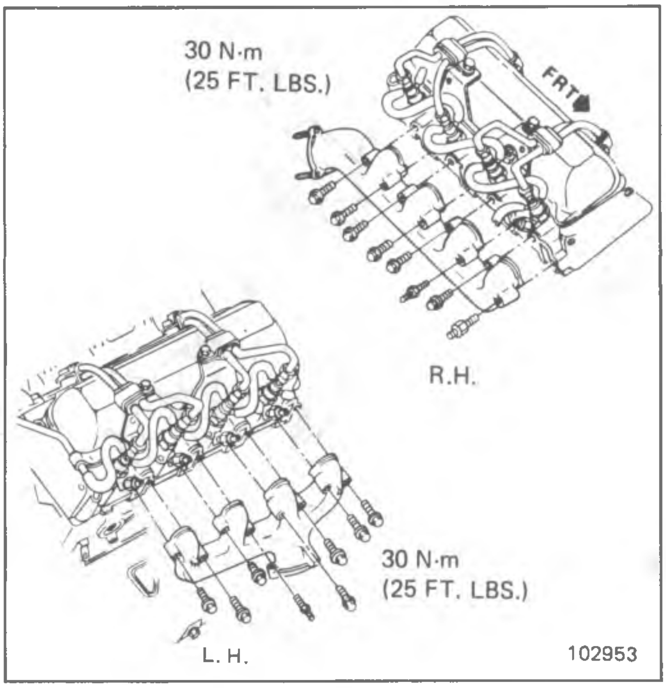


Fig. 6A7-3--Exhaust Manifold

3. Remove mount-to-transmission bolts, then remove mount.
4. Install new mount on transmission.
5. While lowering transmission, align and start crossmember-to-mount bolts.
6. Torque bolts to specifications, then bend lock tabs to bolt head as applicable.

EXHAUST MANIFOLD (Fig. 6A7-3)

CK Truck

Removal and Installation (Right Side)

1. Disconnect batteries.
2. Raise vehicle.
3. Disconnect exhaust pipe from manifold.
4. Lower vehicle.
5. Disconnect glow plug wires.
6. Remove air cleaner duct bracket.
7. Remove glow plugs.
8. Remove manifold bolts.

To install, reverse removal procedures. Refer to figure 6A7-3 for proper bolt torque.

Removal and Installation (Left Side)

1. Disconnect batteries.
2. Remove dipstick tube nut.
3. Remove dipstick tube.
4. Disconnect glow plug wires.
5. Remove glow plugs.
6. Remove manifold bolts.
7. Raise vehicle.
8. Disconnect exhaust at manifold.
9. Remove manifold from bottom. Start manifold bolts while vehicle is raised then reverse removal procedures. Refer to figure 6A7-3 for proper bolt torque.

G Van

Removal and Installation (Right Side)

1. Disconnect batteries.
2. Raise vehicle.
3. Disconnect exhaust pipe at manifold flange.
4. Lower vehicle.
5. Disconnect glow plug wires.
6. Remove manifold bolts.
7. Remove manifold.
8. For installation, reverse removal procedures.

Removal and Installation (Left Side)

1. Disconnect upper battery.
2. Raise vehicle.
3. Disconnect glow plug wires.
4. Lower vehicle.
5. Disconnect exhaust at manifold flange.
6. Remove manifold bolts.
7. Remove manifold.
8. For installation, reverse removal procedures.

VACUUM PUMP/OIL PUMP DRIVE (Fig. 6A7-4)

CKG Truck

Removal

1. Disconnect batteries.
2. Remove air cleaner. Cover intake manifold.
3. Remove hold down clamp.
4. Disconnect vacuum line on CK models
5. Remove pump.

Installation

1. Install new gasket
2. Install vacuum pump as shown, making sure pump hex shaft is fully seated in oil pump.
3. For remainder of installation reverse removal procedures.

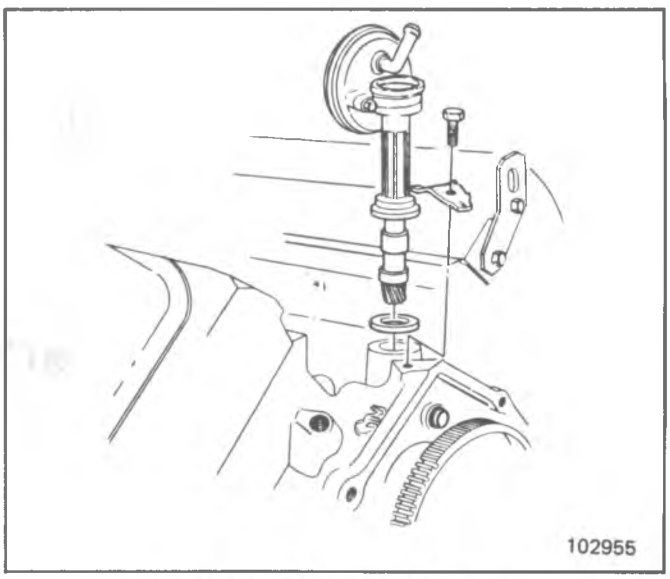


Fig. 6A7-4--Vacuum Pump

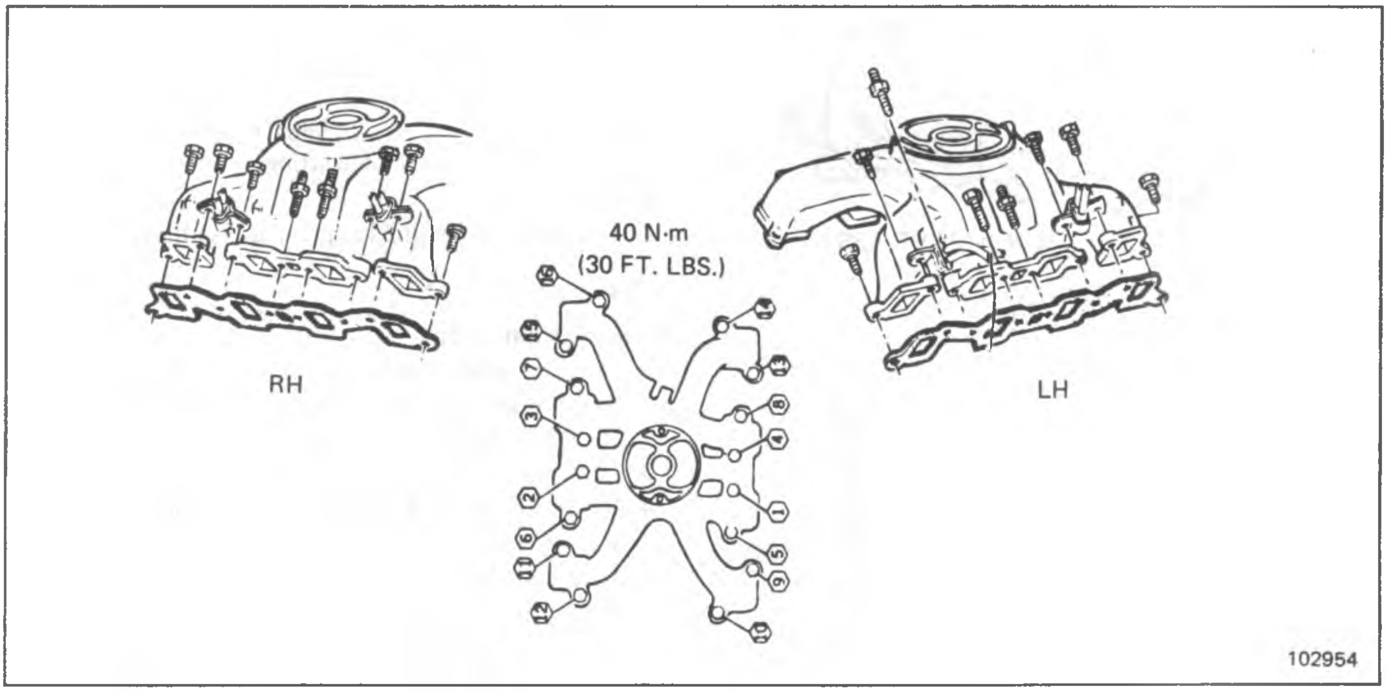


Fig. 6A7-5--Intake Manifold

G Van

Removal

1. Disconnect batteries.
2. Remove engine cover.
3. Disconnect vacuum lines.
4. Remove hold down clamp.
5. Remove vacuum pump. Place a rag or cover over hole to prevent foreign material from entering the engine.

Installation

1. Install new gasket.
2. Install vacuum pump as shown.
3. For remainder of installation, reverse removal procedures.

INTAKE MANIFOLD (Fig. 6A7-5)

CK Truck

Removal

1. Disconnect batteries.
2. Remove air cleaner.
3. Remove crankcase ventilator tubes.
4. Loosen vacuum pump hold down clamp and rotate pump in order to gain access to manifold bolt.
5. Remove EPR/EGR valve bracket, if equipped.
6. Remove rear A/C bracket, if equipped.
7. Remove intake manifold bolts. Injection line clips are retained by the same bolts.
8. Remove intake manifold.
9. If any further operations are to be performed install protective covers J-29664-1.

Installation

1. Remove protective covers atter use.
2. Gasket surfaces must be clean prior to installation.
3. Install new gasket.
   Gasket has opening for EGR on light duty applications, and gasket has insert covering opening for heavy duty applications.
4. Install intake manifold.
5. Install intake manifold bolts in sequence as shown.
6. Refer to 6.2 Diesel Fuel Injection Section for fuel line installation.
7. For the remainder of the installation procedures reverse removal.

G Van

Removal

1. Disconnect batteries.
2. Remove engine cover.
3. Remove air cleaner.
4. Disconnect necessary wires and hoses and remove EGR/EPR switches.
5. Remove crankcase depression regulator valve and disconnect hoses to valve.
6. Remove crankcase depression regulator valve hoses from intake manifold.
7. If equipped with air conditioning, remove rear compressor bracket.
8. Remove fuel filter to intake manifold bracket.
9. Remove oil pump, place a rag or cover over hole to prevent foreign material from entering the engine.
10. Remove intake bolts and fuel line clips.
11. Remove intake.

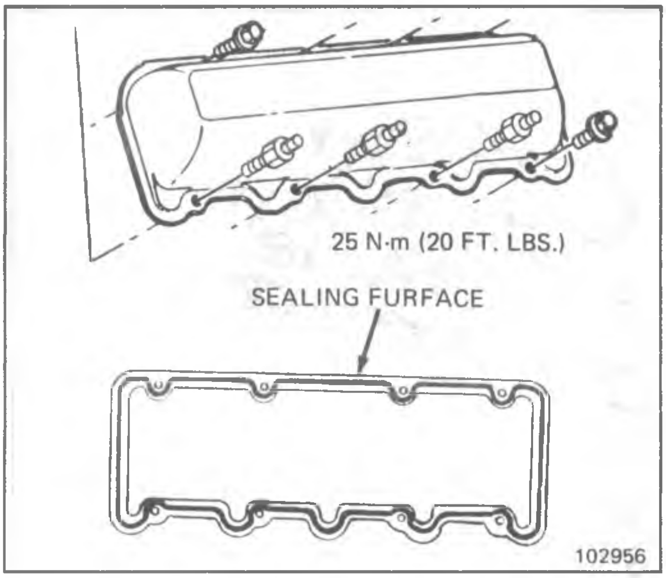


Fig. 6A7-6--Rocker Arm Cover

12. If any further operations are to be performed, install protective covers J-29664-1.

Installation

1. Remove protective covers after use.
2. Gasket surfaces must be clean prior to installation.
3. Install new gasket.

   Gasket has opening for EGR on light duty applications, and gasket has insert covering opening for heavy duty applications.
4. Install intake manifold.
5. Install intake manifold bolts in sequence shown.
6. Refer to 6.2 Diesel Fuel Injection Section for fuel line installation.
7. For remainder of the installation procedures, reverse removal.

ROCKER ARM COVER (Fig. 6A7-6)

CK Truck

Removal

1. Remove intake manifold as previously outlined.
2. Remove injection lines as outlined in 6.2 Diesel Fuel Injection Section (#5 and #7 injection lines do not have to be removed for right side only).
3. Remove wire loom from clip.
4. Remove wire loom bracket (2 nuts).
5. Remove rocker cover bolts and cover.

Installation

1. Clean sealing surface on head and intake manifold.
2. Place a 5mm diameter (3/16") bead of RTV sealant #1052915 or equivalent all around the rocker cove. sealing surface. (When going around the attaching bolts holes always flow the sealant on the inboard side of the holes). Sealer must be wet to touch when bolts are torqued.

   NOTICE: When applying sealant, keep sealant out of bolt holes as this could cause a "hydraulic" condition which could damage the head casting.
3. Install the rocker cover bolts and studs.
4. Install loom wire bracket.
5. Install injection lines as outlined in 6.2 Diesel Fuel Injection Section.
6. With protective covers J-29664-1 installed start engine and check for leaks at line fittings.
7. Stop engine.
8. Install intake manifold as previously outlined.

G Van

Removal (Right Side)

1. Remove intake manifold as previously outlined.
2. Remove injection lines as outlined in 6.2 Diesel Fuel Injection Section.
3. Disconnect glow plug wires.
4. Remove loom bracket nuts and remove bracket.
5. Remove rocker cover bolts.
6. Remove rocker cover.

Installation (Right Side)

1. Clean sealing surface on head and intake manifold.
2. Place a 5mm diameter (3/16") bead of RTV sealant #1052915 or equivalent all around rocker cover sealing surface. (When going around the attaching bolt holes, always flow the sealant on the inboard side of holes.) Sealer must be wet to touch when bolts are torqued.

   NOTICE: When aplying sealant, keep sealant out of bolt holes as this could cause a "hydraulic" condition which could damage the head casting.
3. Install rocker cover bolts and studs.
4. Reverse removal procedures for the remainder of installation procedures.

Removal (Left Side)

1. Remove intake manifold as previously outlined.
2. Remove injection lines as outlined in 6.2 Diesel Fuel Injection Section. Before lowering vehicle, it may be necessary to remove other components mentioned below after injection line removal.
3. If equipped with A/C:
   - Remove upper fan shroud.
   - Remove A/C belt.
   - Raise vehicle.
   - Disconnect exhaust at manifold flange.
   - Remove rear A/C brace from exhaust manifold and remove manifold.
   - Lower vehicle.
   - Discharge A/C system.
   - Disconnect A/C lines at compressor.
   - Remove A/C compressor from brackets and remove compressor.
4. Loosen dipstick tube front bracket and remove from stud.
5. Remove loom bracket nuts and remove brackets.
6. Remove rocker cover bolts and disconnect fuel return bracket.
7. Remove rocker cover.

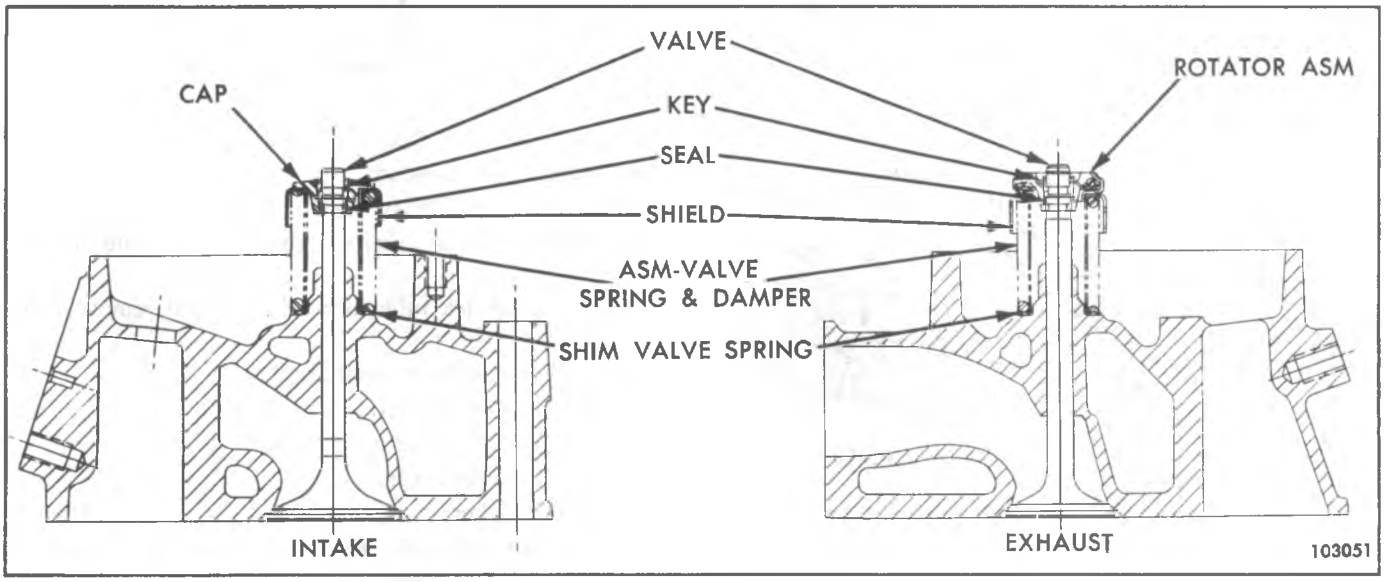


Fig. 6A7-8--Valve Assembly

Installation (Left Side)

Follow sealing procedures as outlined for right side installation.

Reverse removal procedures for remainig installation steps.

ROCKER ARM AND SHAFT/PUSHRODS (Fig. 6A7-7)

CK Truck, G Van

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove rocker arm and shaft.
3. If rocker arm is to be removed, remove cotter pin and remove rocker arm from shaft.
4. At this time push rods can be removed. Push rod upper end must be identified for reinstallation.

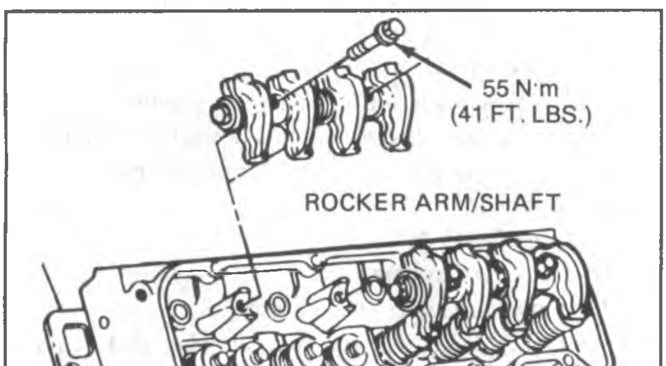


Fig. 6A7-7--Rocker Arm Shaft/Pushrods

Installation

1. If push rods were removed, install push rods.

   NOTICE: Push rods must be installed with painted or marked end up, failure to do so could cause premature wear or damage.
2. If rocker arms were removed from shaft, install rocker arms and spring in proper order.
3. Install rocker arm shaft assembly and torque bolt to 45 N·m (41 ft. lbs.). Tighten slow enough to permit lifter bleed down, and avoid piston-to-valve interference.

VALVE STEM OIL SEAL/OR VALVE SPRING

CK Truck, G Van

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

Removal

1. Remove rocker arm assemblies.
2. Rotate engine so piston is at top dead center for each cylinder, or install air line adapter J-29666 to glow plug port and apply compressed air to hold valves in place.
3. Install Tool J-5892-1 or J-26513 and compress the valve spring until valve keys are accessible; then remove keys, valve cap or rotator, springs and seals. If valve spring does not compress, tap tool with a mallet to break bind at rotator and keys.

Installation

1. Install seal, valve spring and cap rotator. Using Tool J-5892-1 or J-26513, compress the valve spring until the valve keys can be installed.
2. Install rocker arm assemblies.

CYLINDER HEAD AND GASKET (Fig. 6A7-9)

CK Truck

Removal

1. Remove injection lines and intake manifold as previously outlined.
2. Remove rocker arm covers as previously outlined.

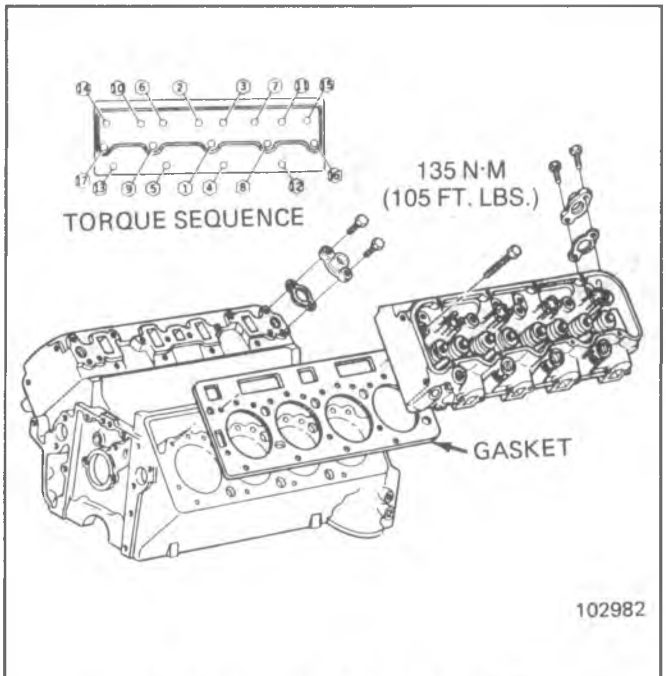


Fig. 6A7-9--Cylinder Head and Gasket

3. Drain coolant.
4. Remove dipstick tube (left side).
5. Disconnect ground wire at cowl (right side).
6. Raise vehicle
7. Disconnect exhaust pipe from manifold.
8. Lower vehicle.
9. If equipped with A/C remove compressor and lay aside (left side).
10. Remove generator and lay aside (right side).
11. Disconnect glow plug wires.
12. Remove rocker arm assemblies.
13. Remove push rods. Mark push rods for reinstallation. Place rocker arm shafts and push rods in a rack so they may be reinstalled in the same location.
14. Disconnect radiator, bypass, and heater hoses.
15. Disconnect ground strap.
16. Remove thermostat housing/crossover at cylinder head.
17. Remove cylinder head bolts (17 each side). Rear left cylinder head bolt may have to remain in head upon removal.
18. Remove cylinder head.

G Van

Removal (Right Side)

1. Remove intake manifold as previously outlined.
2. Remove injection lines as outlined in 6.2 Diesel Fuel Injection Section.
3. If equipped with cruise control, remove transducer.
4. If equipped with A/C, remove upper fan shroud.
5. If equipped with A/C, remove A/C belt.
6. Raise vehicle.
7. Disconnect exhaust at manifold flange.
8. If equipped with A/C, remove rear A/C brace from exhaust manifold.
9. Disconnect glow plug wires.
10. Lower vehicle.
11. If equipped with AC:
    - Discharge A/C system.
    - Disconnect A/C lines at compressor.
    - Remove A/C compressor from brackets and remove compressor.
12. Loosen dipstick tube front bracket and remove from stud.
13. Remove oil fill tube upper bracket.
14. Remove loom bracket.
15. Remove rocker cover bolts.
16. Remove rocker cover.
17. Remove rocker arm assemblies.
18. Remove push rods. Push rod upper end must be identified for reinstallation.
19. Drain cooling system.
20. Remove air cleaner resonator and bracket.
21. Remove transmission fill tube nut and position aside.
22. Disconnect heater, radiator and by-pass hoses at crossover.
23. Remove generator upper bracket.
24. Remove coolant crossover.
25. Remove cylinder head bolts.
26. Disconnect transmission dipstick at rear of head and remove tube.
27. Remove cylinder head.

Removal (Left Side)

1. Remove intake manifold as previously outlined.
2. Remove injection lines at pump.
3. If equipped with cruise control, remove transducer.
4. If equipped with A/C, remove upper fan shroud.
5. If equipped with A/C, remove A/C belt.
6. Raise vehicle.
7. Disconnect exhaust at exhaust manifold flange.
8. Remove rear A/C brace from exhaust manifold and remove manifold.
9. Remove power steering lower adjusting bolts.
10. Disconnect glow plug wires and temperature switch.
11. Remove injection lines at nozzles, cap nozzles.
12. Lower vehicle.
13. If equipped with A/C:
    - Discharge A/C system.
    - Disconnect A/C lines at compressor.
    - Remove A/C compressor from bracket and remove compressor.
14. Remove upper power steering attachment and lay aside.
15. Loosen dipstick tube front bracket and remove stud.
16. Remove oil fill tube upper bracket.
17. Disconnect T.V. cable.
18. Remove glow plug controller and bracket.
19. Remove glow plug relay.

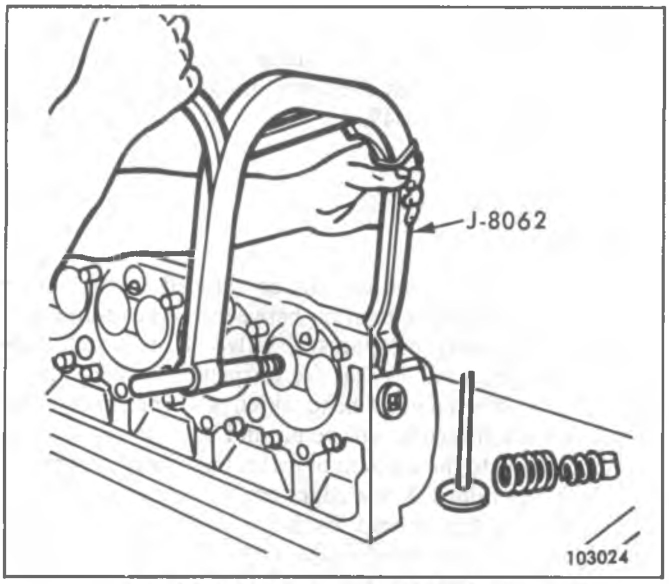


Fig. 6A7-10--Compressing Valve Spring

20. Disconnect oil pressure switch and loom.
21. Remove loom bracket.
22. Remove vacuum line clip bolt at head.
23. Remove rocker cover bolts and disconnect fuel return line bracket.
24. Remove rocker cover.
25. Remove rocker arm assembly.
26. Remove push rods. Push rod upper end must be identified for reinstallation.
27. Drain cooling system.
28. Remove air cleaner resonator and bracket.
29. Remove transmission fill tube nut and lay tube aside.
30. Disconnect heater, radiator and bypass hoses at crossover.
31. Remove generator upper bracket.
32. Remove coolant crossover.
33. Remove head bolts.
34. Remove cylinder head.

Disassembly

1. With cylinder head removed using tool J-8062, compress the valve springs (figure 6A7-10) and remove valve keys. Release the compressing tool and remove rotators or spring caps, springs and spring damper, then remove oil seal and valve spring shims.
2. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.
3. If necessary to remove pre-chamber, remove the glow plug and injection nozzle then tap out with a small blunt nylon drift. Pre-chambers with facial crack greater than .200" should be replaced.

Cleaning

1. Clean all carbon from combustion chambers and valve parts using tool J-8089 (figure 6A7-11).
2. Thoroughly clean valve guides using tool J-8101 (figure 6A7-).
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from the head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the coolant chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems. Inspect deck face for scratches or dents across gasket fire-ring area. Marks across coolant seal surfaces can be no deeper than .003".

   NOTICE: Excessive valve stem to bore clearance will cause excessive oil combustion and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.
3. Measure valve stem clearance (fig. 6A7-12) as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail.

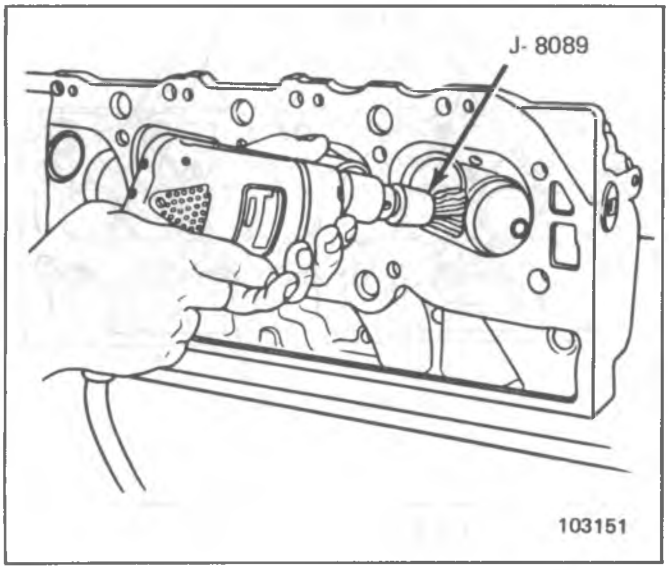


Fig. 6A7-11--Cleaning Combustion Chamber

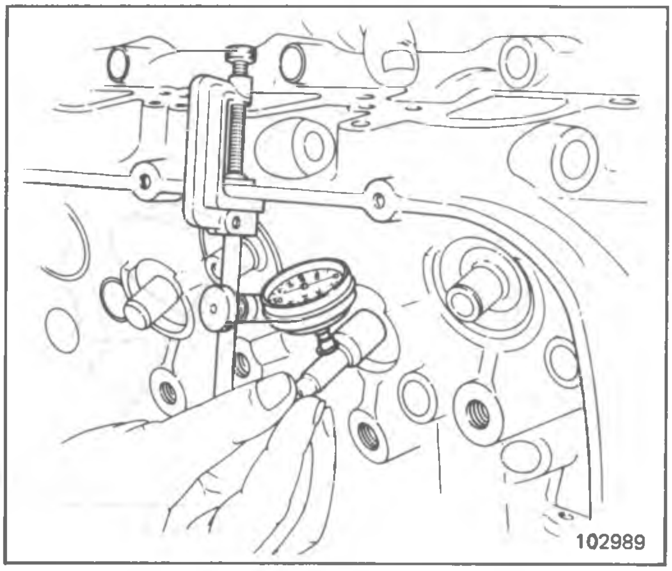


Fig. 6A7-12--Measuring Valve Stem Clearance

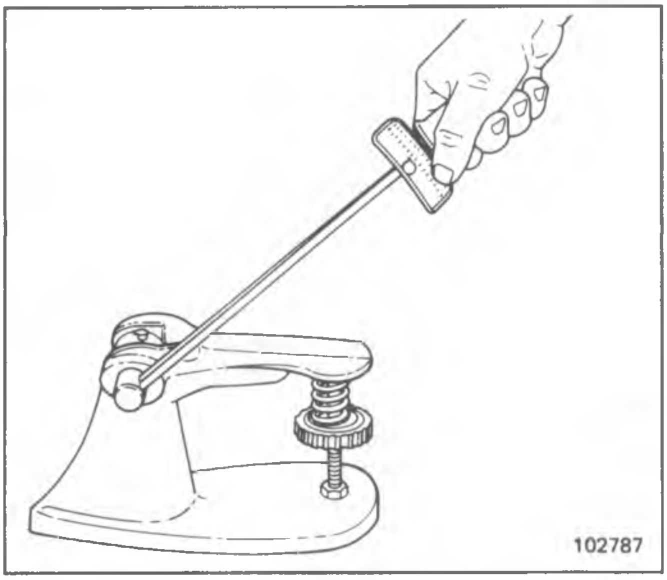


Fig. 6A7-13--Checking Valve Spring Tension

b. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide.

c. Drop the valve head about 1/16" (1.6mm) off the valve seat.

d. Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves as outlined.

4. Check valve spring tension with Tool J-8056 spring tester (Fig. 6A7-13). Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not with 44 N (10 lbs.) of the specified load (without dampers).

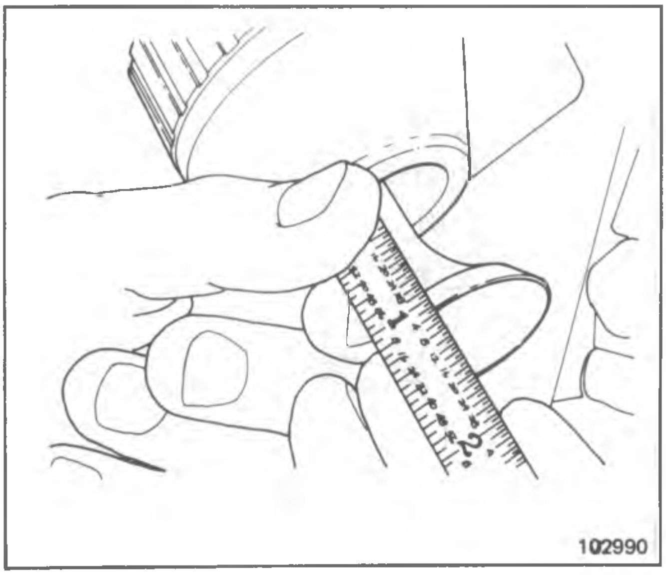


Fig. 6A7-14--Measuring Valve Head

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J-7049.

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" (.80mm) thick after grinding, replace the valve (fig. 6A7-14). Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:
   a. Install valve spring shim on valve spring seat then install a new valve stem oil seal.
   b. Set the valve spring (with damper); and valve cap in place.
   c. Compress the spring with Tool J-8062.
   d. Install the valve locks and release the compressor tool, making sure the locks seat properly in the groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.

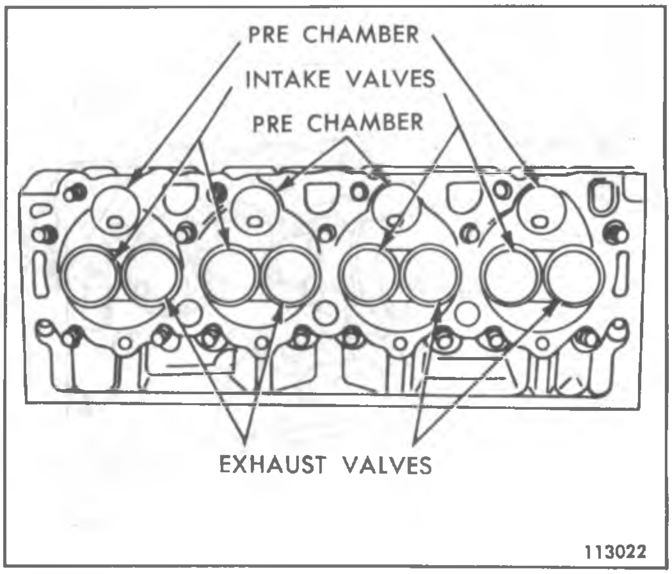


Fig. 6A7-15--Valve Location

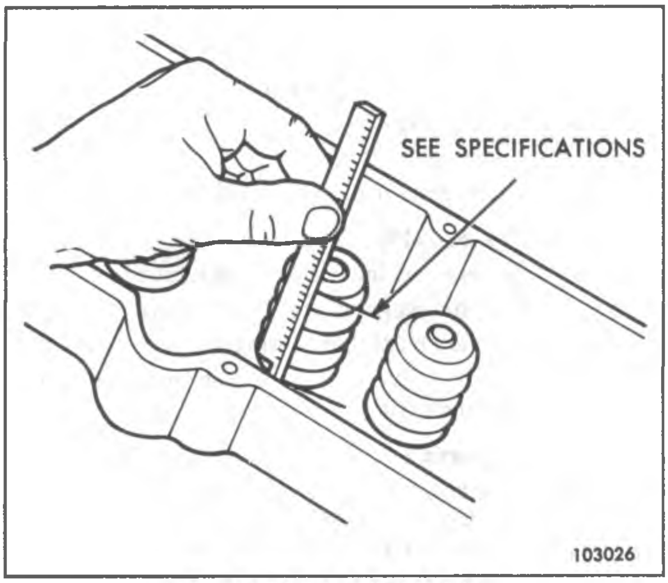


Fig. 6A7-16--Installed Height

3. Install the remaining valves.
4. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 6A7-16). Measure from the top of the shim or the spring seat to the top of the valve spring or valve spring shield. If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick. At no time should the spring be shimmed to give an installed height under the minimum specified.
5. Install pre-chamber, if removed. The pre-chamber can only be installed in one position. Use a 1-1/4" socket to reinstall pre-chamber and install in cylinder head. The pre-chamber should be flush .002" above the face of the head.

Installation (All Models)

All gasket surfaces (especially cylinder head gasket surfaces) to be entirely free of dirt, sand, and foreign matter directly before and during assembly.

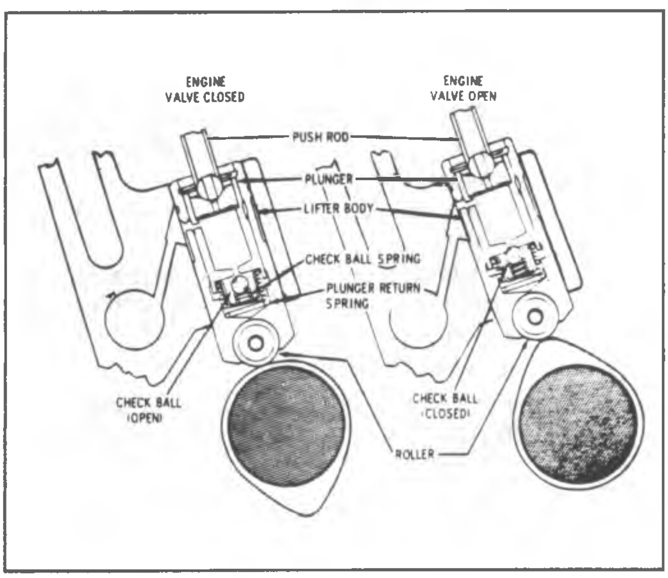


Fig. 6A7-17--Valve Lifter-Cutaway View

Head gaskets are a special composition gasket that must be used WITHOUT a sealer.

No additional sealer can be used when installing the head gaskets as the passage surfaces are sealed when the gaskets are made, using a newly developed method and material. This sealer is accurately printed on the surface of the gasket in the exact quantity required and provides the desired bond between the head and the block. Applying additional sealer would only result in the possibility of leakage.

1. Place the gasket over the dowel pins. Left rear cylinder head bolt must be installed into head prior to installation.
2. Carefully guide the cylinder head into place.
3. Coat threads and underside of cylinder head bolts with sealing compound 1052080 or equivalent, and install bolts finger tight.
4. Tighten each cylinder bolt as follows:
   (a). In sequence, torque all bolts to 25 N.M. (20 ft. lb.)
   (b). In sequence, re-torque all bolts to 65 N.M. (50 ft. lb.)
   (c). In sequence, turn each bolt an additional 90 degrees (1/4 turn).
5. Following steps a, b & c should achieve minimum of 135 N.M. (105 ft. lb.), in the same sequence using a torque wrench check each bolt to insure a minimum of 135 N.M. is reached at all bolt positions. If any bolt is under 135 N.M. tighten to 135 N.M. (105 ft. lbs.).
6. For remainder of installation reverse removal procedure.

VALVE LIFTERS (Fig. 6A7-17)

Roller hydraulic lifters are used to reduce the amount of friction between the valve lifter and the camshaft lobe. Guides keep the lifters from rotating on the camshaft lobes.

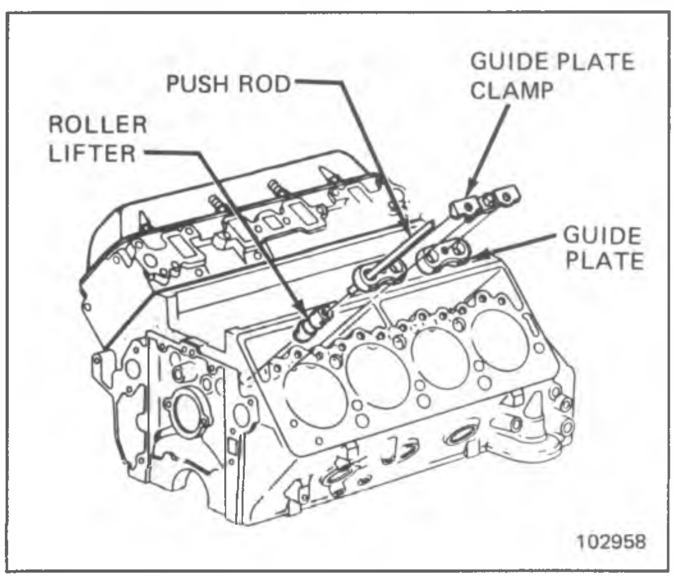


Fig. 6A7-18--Valve Lifter Removal

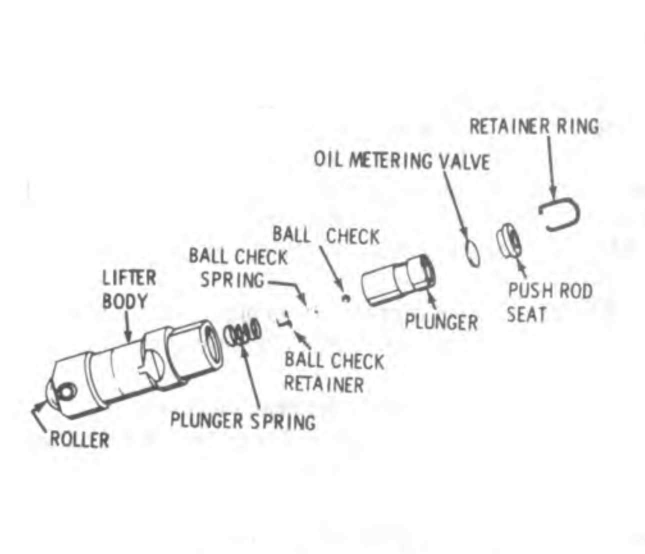


Fig. 6A7-19--Valve Lifter-Exploded View

Operation

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push-rods to the rocker arms.

When the lifter begins to roll up the cam lobe, the check valve disc is held against its seat in the plunger by the check valve disc spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push-rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the check valve disc to open against the check valve disc spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

Valve lifters and push rods should be kept in order so they can be re-installed in their original position. The push rods must be installed with painted end up. This is necessary as the premium ball is located on the upper end only.

CK Truck

Removal (6A7-18)

1. Remove rocker arm covers as previously outlined.
2. Remove rocker arms as previously outlined.
3. Remove guide clamps and guide plates. It may be necessary to use mechanical fingers to remove the guide plates.
4. Remove lifters using Tool J-29834 and a magnet through access

G Van

Removal

1. Remove cylinder head as previously outlined.
2. Remove guide clamp.
3. Remove guide plate.
4. Remove lifters. holes in cylinder head.

Dissassembly (Fig. 6A7-19)

1. Remove the retainer ring with a small screwdriver.
2. Remove push-rod seat and oil metering valve.
3. Remove plunger and plunger spring.
4. Remove check valve retainer from plunger, then remove valve and spring.

Cleaning and Inspection

After lifters are disassembled, all parts should be cleaned in clean solvent. A small particle of foreign material under the check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the roller body or plunger is defective, replace with a new lifter assembly.

Whenever lifters are removed, check as follows:

1. Roller should rotate freely, but without excessive play.
2. Check for missing or broken needle bearing.
3. Roller should be free of pits or roughness. If present, check camshaft for similar condition. If pits or roughness are evident, replace lifter and camshaft.

Assembly

1. Coat all lifter parts with a light coating of clean engine oil.
2. Assemble valve disc spring and retainer into plunger. Make sure retainer flange is pressed tight against bottom of recess in plunger.
3. Install plunger spring over check retainer.
4. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
5. Install oil metering valve and push rod seat into lifter and install retaining ring.

CK Truck, G Van

Installation

Prime new lifters by working lifter plunger while submerged in new kerosene or diesel fuel. Lifter could be damaged if dry when starting engine.

Coat the roller and bearings of lifter with 1052365 lubricant or equivalent.

1. Install lifters into original position in cylinder block. On CK Truck, use a rigid mechanic's wire or welding rod. Fabricate a lifter installing tool.
2. Install valve lifter guide plate.
3. Install guide plate clamp. Crankshaft must be manually rotated 720° after assembly of lifter guide plate clamp to insure free movement of lifters in guide plates.
4. On G Van, install cylinder head as previously outlined.

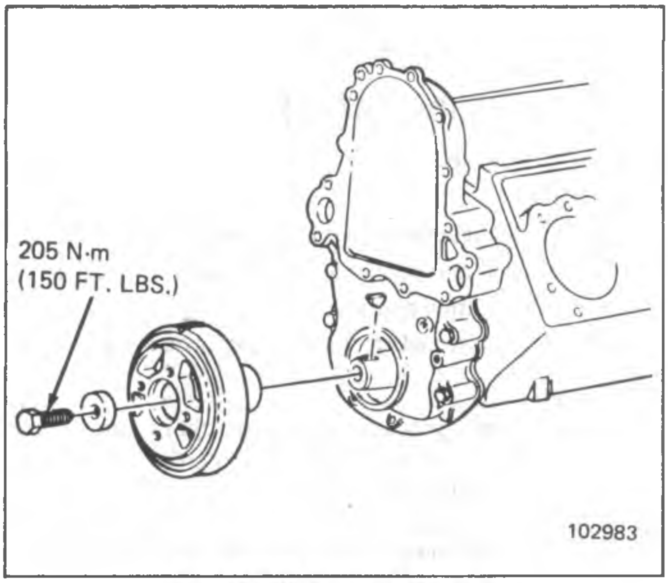


Fig. 6A7-20--Torsional Damper

CRANKSHAFT PULLEY

CK Truck

Removal

1. Disconnect batteries.
2. Remove generator belt.
3. Remove power steering belt.
4. Remove A/C belt if equipped.
5. Remove pulley.

Installation

1. Install pulley.
2. Install belt(s). Adjust belts. See Cooling Section.

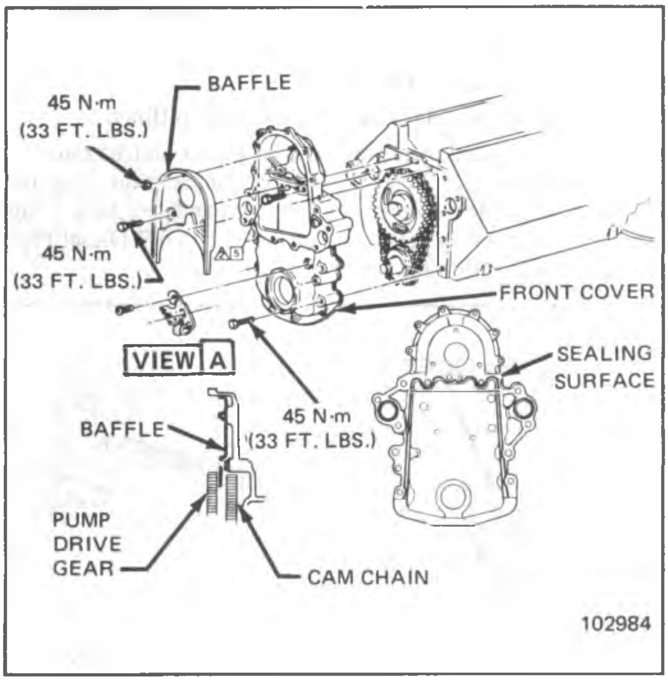


Fig. 6A7-21--Front Cover

G-Van

Removal

1. Disconnect batteries.
2. Remove upper fan shroud.
3. Remove generator belt.
4. Remove power steering belt.
5. If equipped with A/C, remove A/C belt.
6. Raise vehicle.
7. Remove crankshaft pulley.

Installation

1. Install pulley.
2. Install belts. Adjust belts. See Cooling Section.
3. Install upper fan shroud.

TORSIONAL DAMPER (FIG. 6A7-20)

CK Truck, G Van

Removal

1. Disconnect batteries.
2. Remove crank pulley as previously outlined.
3. Remove torsional damper using tool J-23523 and suitable pilot or pilot J-29788.

Installation

1. Install damper using a mallet. Assemble key parallel to crankcase. Tap damper far enough on crankshaft so attaching bolt can be installed. Torque bolt to specification.
2. Install crank pulley as outlined.
3. Install belt(s). Adjust belts. See Cooling Section.

FRONT COVER (Fig. 6A7-21)

CK Truck, G Van

Removal

1. Drain engine block.
2. Remove water pump as outlined in Cooling Section.

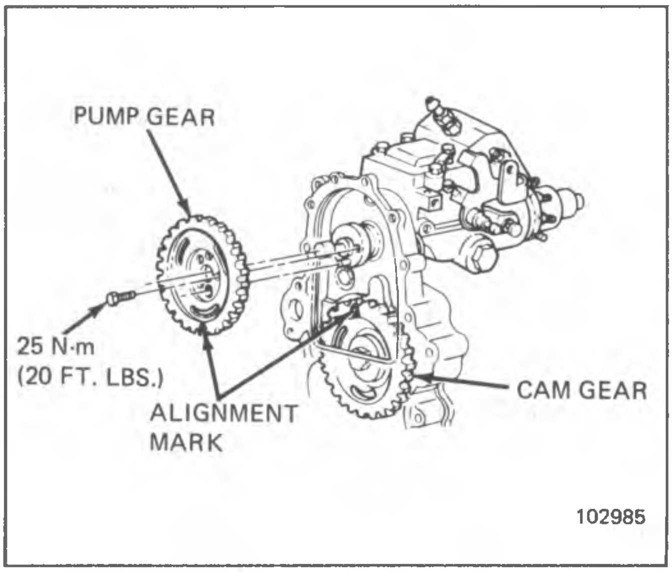


Fig. 6A7-22--Gear Alignment

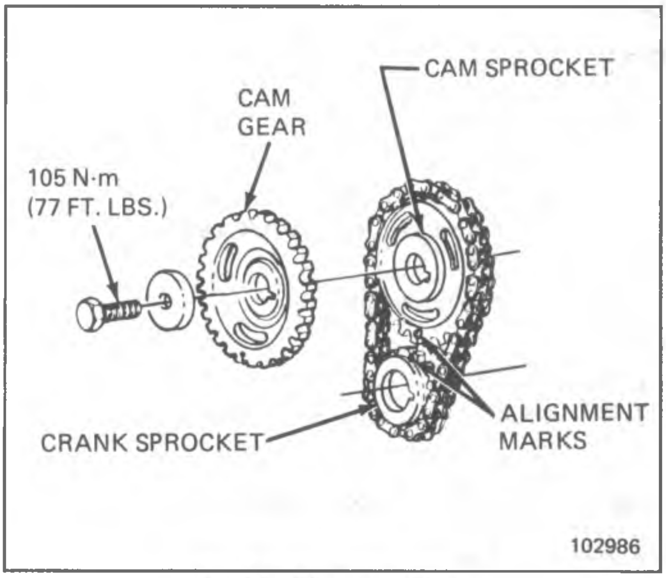


Fig. 6A7-23--Timing Chain

3. Rotate engine and align marks on pump gear and camshaft gear (Fig. 6A7-22).
4. Scribe a mark aligning injection pump flange and front cover.
5. Remove crank pulley as previously outlined.
6. Remove torsional damper as previously outlined.
7. Remove front cover to oil pan bolts (4).
8. Remove fuel return line clips (2).
9. Remove injection pump driven gear.
10. Remove injection pump retaining nuts from front cover.
11. Remove baffle.
12. Remove remaining cover bolts.
13. Remove front cover.

Installation

1. With sealing surfaces cleaned place a 2mm (3/32") bead of sealant #1052357 or equivalent as shown in figure 6A7-21. Apply R.T.V. sealer #1052915 to bottom portion of front cover which attaches to oil pan.
2. Install front cover.
3. Install baffle.
4. Install injection pump making sure scribe marks on injection pump and front cover are aligned.
5. Install injection pump driven gear making sure marks on camgear and pump gear are aligned. Be sure dowel pin and 3 holes on pump flange are aligned.
6. For remainder of installation reverse removal procedures.

Oil Seal (Front Cover)

Replacement (Cover Removed)

1. With cover removed, pry oil seal out of cover.
2. Install new seal using tool J-22102.

Replacement (Cover Installed)

1. With torsional damper removed, pry seal out of cover from the front with a large screwdriver. Be careful not to damage the surface on the crankshaft.
2. Install new seal using tool J-22102.
3. Install torsional damper as outlined.

TIMING CHAIN (Fig. 6A7-23)

CK Truck, G Van

Removal

1. Remove front cover as previously outlined.
2. Remove bolt and washer attaching camshaft gear.
3. Remove injection pump gear.
4. Remove cam sprocket, chain, and crank sprocket.

Installation

1. Install cam sprocket, lubricate chain and crank sprocket together and align timing marks on sprockets as shown in figure 6A7-23.
2. Rotate crankshaft 360° so that camshaft gear and injection pump gear aligned as shown in Figure 6A7-22.
3. Install front cover as previously outlined. Any time the timing chain, gears or sprockets are replaced it will be necessary to retime the engine. Refer to 6.2 Diesel Fuel Injection Section for injection pump timing procedure.

CAMSHAFT (FIG. 6A7-24)

CK Truck

Removal

1. Disconnect batteries.
2. Raise vehicle.
3. Drain radiator and block.
4. Disconnect exhaust pipe at exhaust manifolds.
5. Remove fan shroud attaching bolts.
6. Lower vehicle.
7. Remove fan shroud attaching bolts.
8. Remove radiator as described in the Cooling Section.
9. Remove fan.
10. Remove vacuum pump.
11. Remove intake manifold as previously outlined.
12. Remove injection pump lines at pump and nozzles as outlined in 6.2 Diesel Fuel Injection Section. Cap injection nozzles. to prevent dirt from entering fuel. (Tag injection lines for reinstallation). Refer to 6.2 Diesel Fuel Injection section for removal sequence.

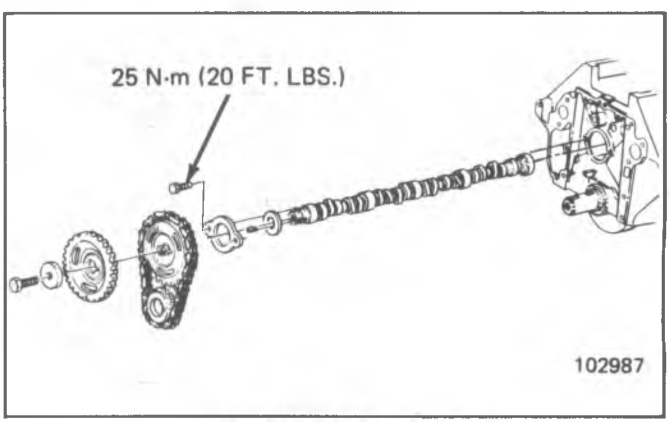


Fig. 6A7-24--Camshaft

13. Remove water pump as outlined in Cooling Section.
14. Remove injection pump gear.
15. Scribe a mark on front cover aligning the line on injection pump flange to the front cover.
16. Remove injection pump from cover.
17. Remove power steering pump and generator and lay aside.
18. If equipped with A/C remove compressor and lay aside.
19. Remove rocker arm covers as previously outlined.
20. Remove rocker arm shaft assembly and push rods. Place parts in a rack so they may be reinstalled in the same location.
21. Remove thermostat housing/crossover from cylinder heads.
22. Remove cylinder head as previously outlined with exhaust manifolds attached.
23. Remove valve lifter clamps, guide plates and valve lifters. Place parts in a rack so they may be reinstalled in the same location.
24. Remove front cover as previously outlined.
25. Remove timing chain as previously outlined.
26. Remove fuel pump.
27. Remove cam retainer plate.
28. If equipped with A/C remove A/C condensor mounting bolts, and with the aid of an assistant, lift condensor.
29. Remove camshaft.

G Van

Removal

1. Disconnect batteries.
2. Remove headlight bezels.
3. Remove grille.
4. Remove bumper.
5. Remove lower valence panel.
6. Remove hood latch.
7. Remove coolant recovery bottle.
8. Remove upper tie bar.
9. If equipped with A/C, disconnect lines.
10. Remove condenser.
11. Disconnect low coolant wire.
12. Disconnect engine oil cooler lines at radiator.
13. With automatic transission, disconnect transmission cooler lines at radiator.
14. Disconnect lower radiator hoses at radiator.
15. Disconnect upper radiator hoses at radiator.
16. Remove radiator.
17. Remove fan assembly.
18. Remove oil pump drive unit.
19. Remove cylinder heads as previously outlined.
20. Remove generator lower bracket.
21. Remove water pump and crank pulleys.
22. Remove torsional damper as previously outlined.
23. Remove timing cover plate and water pump.
24. Rotate crankshaft and align timing marks.
25. Remove injection pump driven gear.
26. Remove inner baffle.
27. Align injection pump and front cover by scribing a line across pump flange and front cover.
28. Remove front cover.
29. Remove fuel pump.
30. Remove lifters.
31. Remove injection pump drive gear, timing chain and crankshaft gear.
32. Remove cam retainer plate.
33. Remove camshaft.

CK Truck, G Van

Installation

Whenever a new camshaft is installed, replacement of all valve lifters, oil filter, and new oil is recommended to insure durability of the camshaft lobes and lifters. Whenever a new camshaft is installed coat camshaft lobes with "Molycote" or its equivalent.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install retainer plate 25 N·m (20 ft. lbs.).
3. Install fuel pump.
4. Install timing chain as previously outlined.
5. Install front cover as previously outlined.
6. Install valve lifters, guide plates and clamps, rotate crankshaft as outlined in valve lifter installation to insure valve lifters are free to travel.
7. Install cylinder head as previously outlined.
8. Install rocker arm shaft assembly and push rods as outlined. Care must be taken to insure push rods are installed properly.
9. Install rocker arm covers.
10. Install injection pump to front cover, making sure lines on pump and scribe line on front cover are aligned.
11. Install injection pump driven gear, making sure gears are aligned. Any time the timing chain, gears, or sprockets are replaced, it will be necessary to retime the engine (refer to 6.2 Diesel Fuel Injection Section for injection pump timing procedure).
12. Install water pump as outlined in Cooling Section.
13. Install injection lines as outlined in 6.2 Diesel Fuel Injection Section.
14. Install generator, power steering and A/C.
15. Install crank pulley.
16. Install fan.
17. Install drive belts and adjust as necessary. Refer to Cooling Section.
18. Install A/C condenser.
19. Install fan shroud (CK Truck).
20. Install radiator, and fill with coolant. On G Van, install coolant recovery bottle.
21. Connect necessary wires and hoses.
22. Raise vehicle.
23. Connect exhaust pipes to exhaust manifold.
24. Lower vehicle.
25. Install vacuum pump (CK Truck). Oil Pump drive unit (G Van)

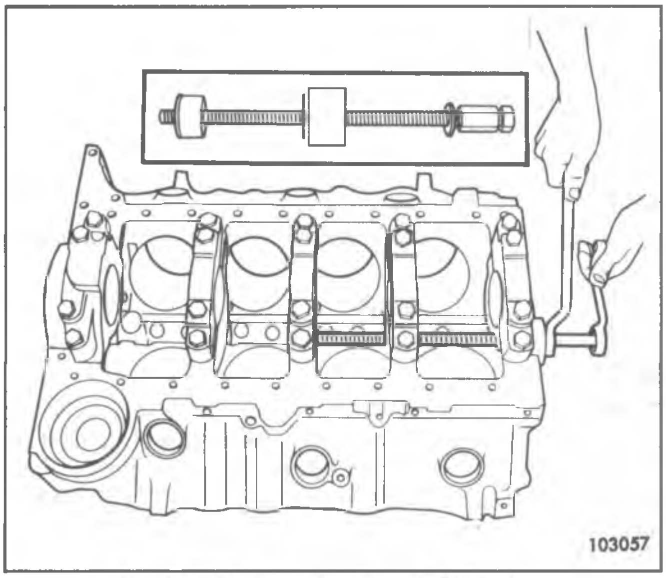


Fig. 6A7-25--Removing Camshaft Bearings

26. Connect secondary fuel filter lines (with adapter).
27. Install cylinder head covers J-29664-1.
28. Connect battery.
29. Start engine and check for leaks.
30. Stop engine.
31. Remove protective covers.
32. Loosen vacuum pump hold down and connect filter (with adapter) to fuel lines (G Van).
33. Install intake manifold as previously outlined.
34. On G Van:
    - Install upper tie bar.
    - Install fan shroud.
    - Install hood latch.
    - Install lower valence panel.
    - Install bumper.
    - Install grille.
    - Install headlight bezels.

CAMSHAFT BEARINGS

CK Truck, G Van

Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.
2. Using Tool J-6098 with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool J-6098-11 for #2, 3, 4 bearing with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (fig. 6A7-25).
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool J-6098-11 for #1 and J-6098-12 for #5 bearing on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (fig. 6A7-26).

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block.
2. Using Tool Set J-6098 with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.

   Number one through number four cam bearing oil hole must be aligned with oil holes in cam bearing bore.

   The number five bearing bore is annulus, and cam bearing must be positioned at or near the 6 o'clock position.
4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw, and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.
6. Coat new rear plug O.D. with #1052080 sealant, or equivalent, and install flush to 1/32" (.80mm) deep.

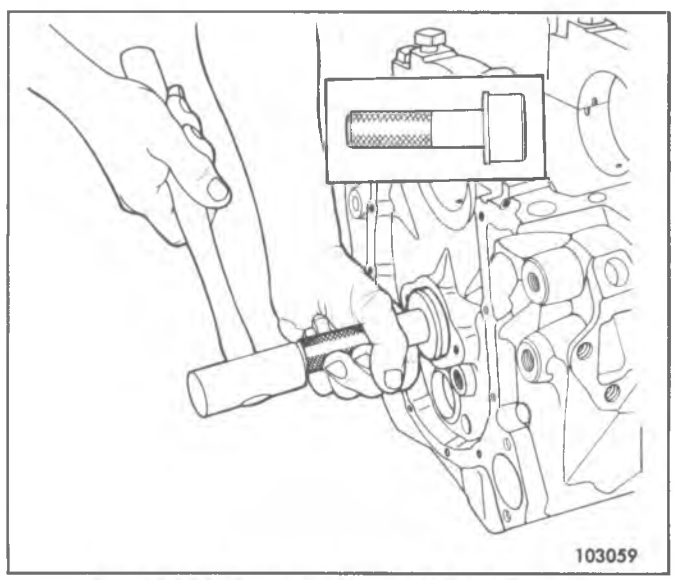


Fig. 6A7-26--Replacing Camshaft Front Bearing

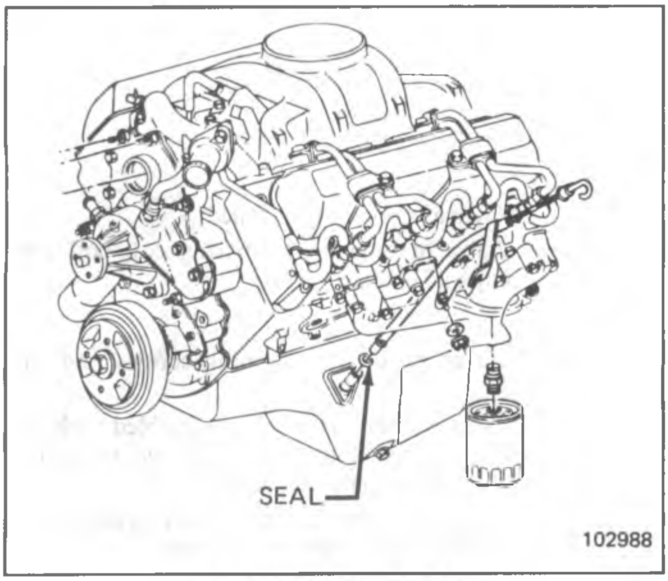


Fig. 6A7-27--Dipstick Tube

DIPSTICK TUBE (Fig. 6A7-27)

CK Truck

Removal and Installation

1. Disconnect batteries.
2. Remove attaching bolt at exhaust manifold.
3. Remove dipstick tube.
4. Remove O-ring seal. To install reverse removal procedures.

G Van

Removal and Installation

1. Disconnect batteries.
2. Remove engine cover.
3. Remove air cleaner.
4. Disconnect tube forward bracket at thermostat.
5. Disconnect tube at left rocker cover bracket.
6. Raise vehicle.
7. Disconnect exhaust at manifold.
8. Remove exhaust manifold bolts.
9. Remove exhaust manifold.
10. Pull dipstick tube from pan.
11. Lower vehicle.
12. Remove dipstick tube.
13. Remove and replace O-ring seal. To install, reverse removal procedures.

OIL PAN (Fig. 6A7-28)

CK Truck

Removal

1. Disconnect batteries.
2. Raise vehicle.
3. Drain oil.
4. Remove transmission dust cover.
5. Remove oil pan bolts.
6. Remove engine mount through bolt (left side).
7. Raise engine.
8. Remove oil pan.

Installation

At time of installation, flanges must be free of oil. A 5.0mm bead of 1052915 or equivalent. sealer must be applied and sealer must be wet to the touch when bolts are torqued.

1. Check rear seal for cracks.
2. Install oil pan and torque bolts to specifications.
3. Lower engine.
4. Install engine mount through bolt.
5. Install transmission dust cover.
6. Lower vehicle.
7. Refill oil.
8. Connect battery.

G Van

Removal

1. Disconnect battery.
2. Remove engine cover.
3. Remove oil dipstick.
4. Remove transmission oil dipstick.
5. Disconnect engine oil dipstick tube at left rocker cover.
6. Disconnect transmission dipstick at bell housing and pull from transmission.
7. Disconnect T.V. cable at injection pump rod and at transmission dipstick tube.
8. Remove upper bellhousing bolt.
9. Remove vacuum pump.
10. Raise vehicle.
11. Remove propshaft.
12. Disconnect speedometer cable at transmission.
13. Disconnect torque converter clutch connector at

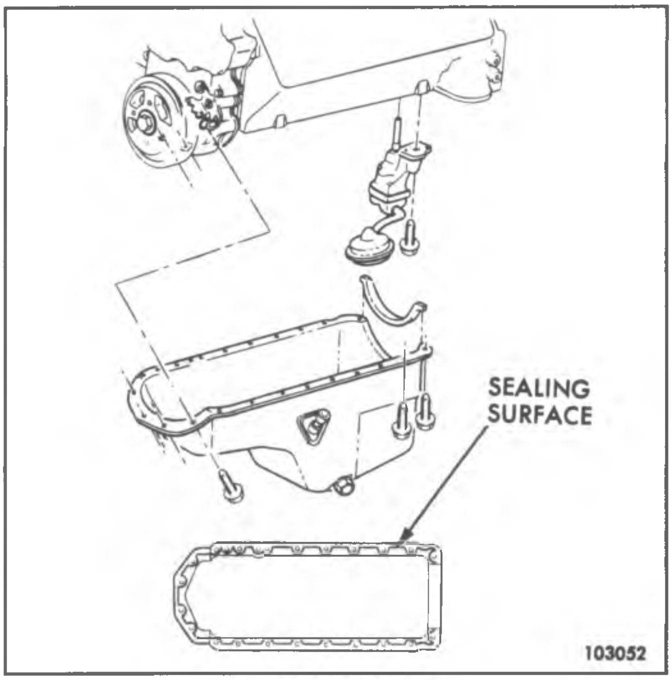


Fig. 6A7-28--Oil Pan

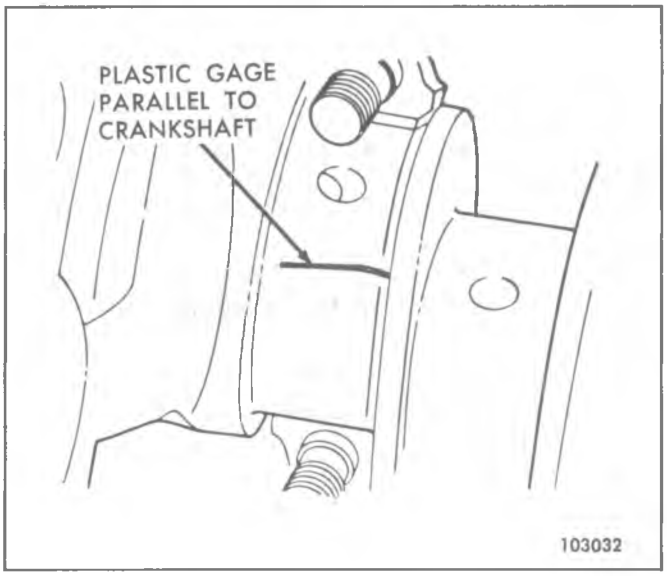


Fig. 6A7-29--Gaging Plastic on Crankpin

transmission.

14. Disconnect shift linkage at transmission.
15. Disconnect transmission cooler lines at transmission.
16. Remove flexplate inspection cover.
17. Remove flexplate to torque converter bolts.
18. Support transmission.
19. Remove transmission mount to crossmember nut.
20. Remove crossmember.
21. Remove bellhousing to cylinder case bolts.
22. Remove transmission assembly.
23. Remove flexplate.
24. Remove dipstick tube from enigne oil pan.
25. Drain crankcase.
26. Disconnect engine oil cooler lines at cylinder case.
27. Remove starter.
28. Remove oil pan bolts -- includes disconnecting battery and cooler line clips.
29. Lower pan from cylinder case.
30. It may be necessary to rotate crankshaft so forward throw and Number 1 and 2 journals are up, giving front of pan clearance.
31. Remove oil pump to main cap bolt, disconnect drive shaft and let assembly fall into pan.
32. Remove oil pan.

Installation

At time of installation, flanges must be free of oil. A 5.0mm bead of sealer 1052915 or equivalent must be applied and sealer must be wet to the touch when bolts are torqued.

1. Check rear seal for cracks.
2. Install dipstick tube in pan before fully seating oil pan.
3. Inspect oil pump drive shaft bushing, check for cracks, replace if necessary.
4. Lay oil pump assembly into oil pan.
5. Install oil pump to main cap.
6. Install oil pan.
7. Reverse removal procedures for the remainder of installation steps.

OIL PUMP

CK Truck, G Van

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

Disassembly

1. Remove the pump cover attaching screws and the pump cover.
2. Mark gear teeth so they may be reassembled with the same teeth indexing. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.

   The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

Assembly

1. Install the pressure regulator valve and related parts.
2. Install the drive gear and shaft in the pump body.
3. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
4. Install the pump cover and torque attaching screws to specifications.
5. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning hex on top end of extension shaft with drive hex on lower end of vacuum pump drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.
3. Install oil pan previously outlined.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustemnt. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Service bearings are

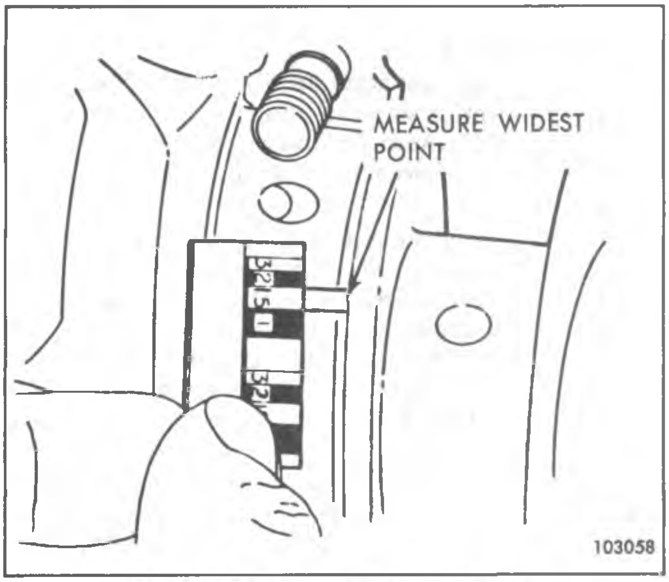


Fig. 6A7-30--Measuring Gaging Plastic

available in standard size and .001". For use with new and used standard size crankshafts.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing. Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent. If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.
   a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (fig. 6A7-29). Plastic gage should be positioned in the middle of upper or lower bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).
   b. Install the bearing in the connecting rod and cap.
   c. Install the bearing cap and evenly torque nuts to specifications. Do not turn the crankshaft with the gaging plastic installed.
   d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (Fig. 6A7-30).
6. If the clearance exceeds specification (.0018" - .0039"), select a new, correct size, bearing and remeasure the clearance. Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps (Fig. 6A7-31).

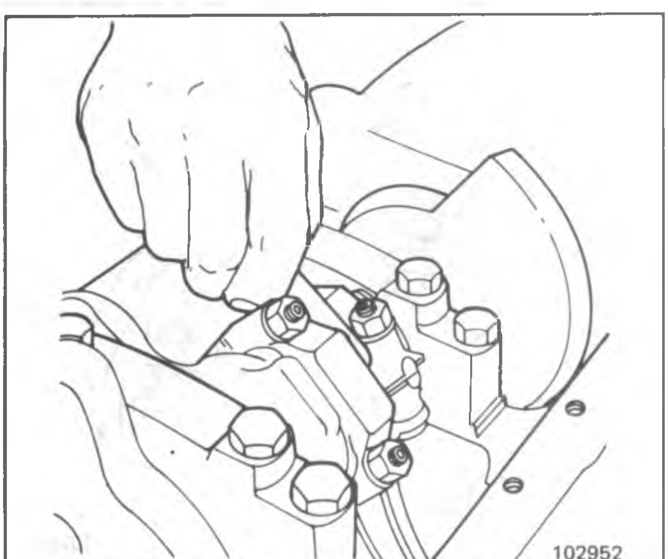


Fig. 6A7-31--Connecting Rod Side Clearance

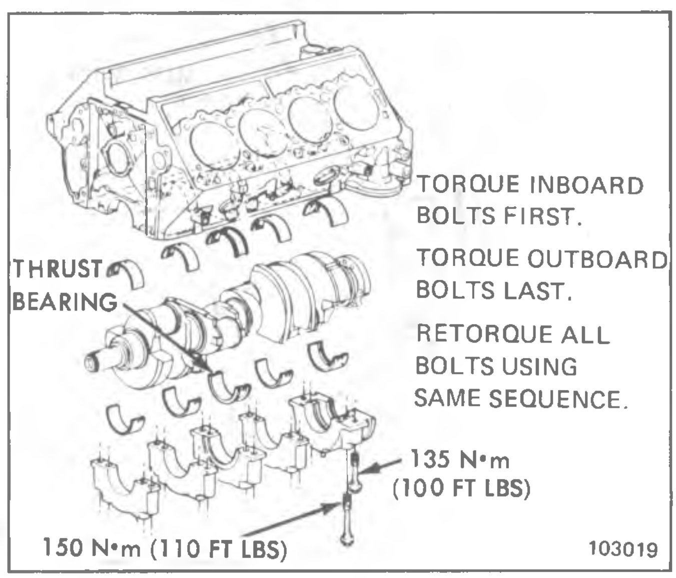


Fig. 6A7-32--Main Bearings

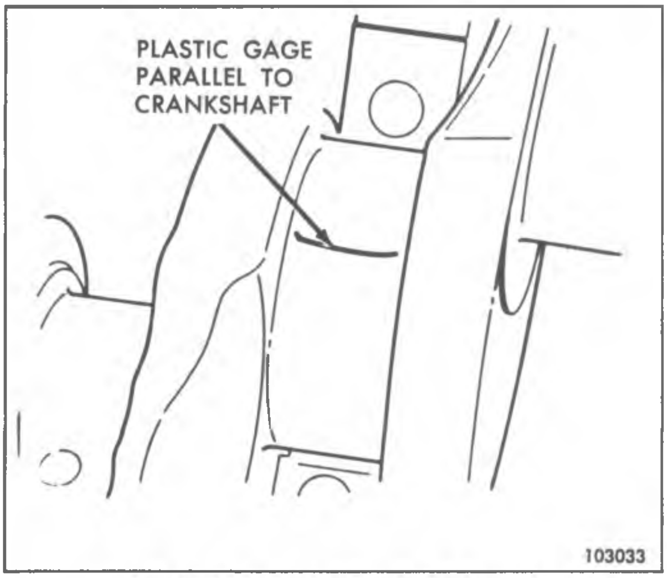


Fig. 6A7-33--Gaging Plastic On Journal

MAIN BEARINGS (Fig. 6A7-32)

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001 " undersize insert which will decrease the clearance .0005" from using a full standard bearing.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage" (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove the clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 6A7-33). Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.
3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap MUST be torqued to specifications in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (fig. 6A7-34). Normally main bearing journals wear

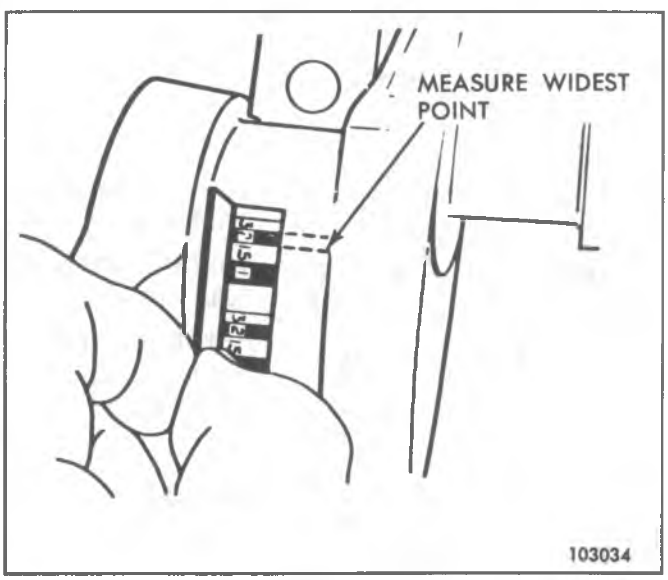


Fig. 6A7-34--Measuring Gaging Plastic

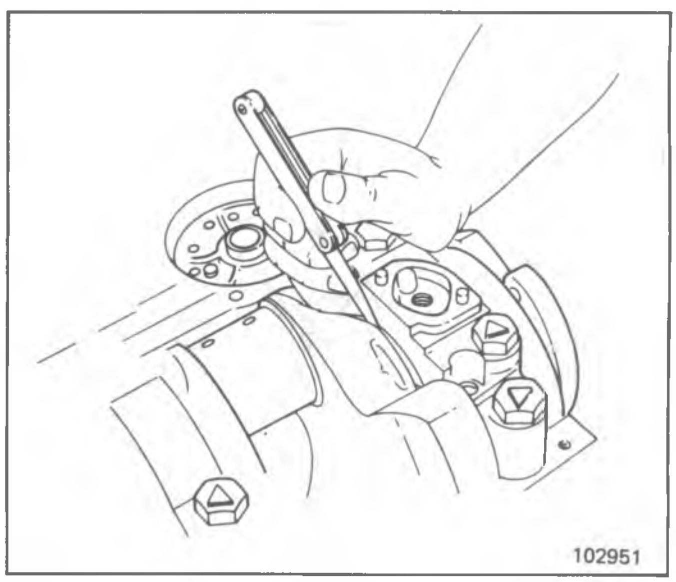


Fig. 6A7-35--Crankshaft End Play

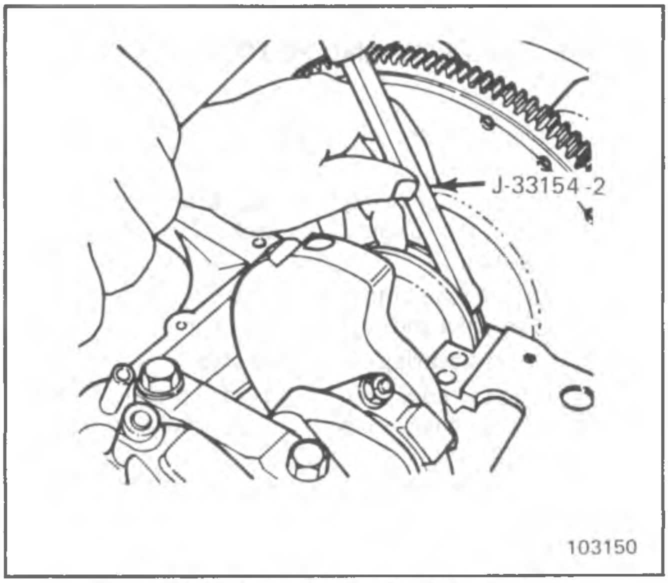


Fig. 6A7-36--Using Packing Tool Upper Half

evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round (.001" max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications #1, 2, 3, 4 (.0018"-.0033") and #5 (.0022" - .0037"), the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit. If a new bearing cap is being installed and clearances are less than .001", inspect for burrs or nicks; if none required, then install shims as required.
7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing. After selecting new bearing, recheck clearance.
8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag. When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 6A7-35).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, mainbearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and glow plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap.
7. Torque all main bearing caps EXCEPT THE REAR MAIN CAP to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16 N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

OIL SEAL-REAR MAIN

Repair

1. Remove oil pan and oil pump as previously outlined.
2. Remove rear main bearing cap.
3. Use packing tool J-33154-2 and gently drive upper

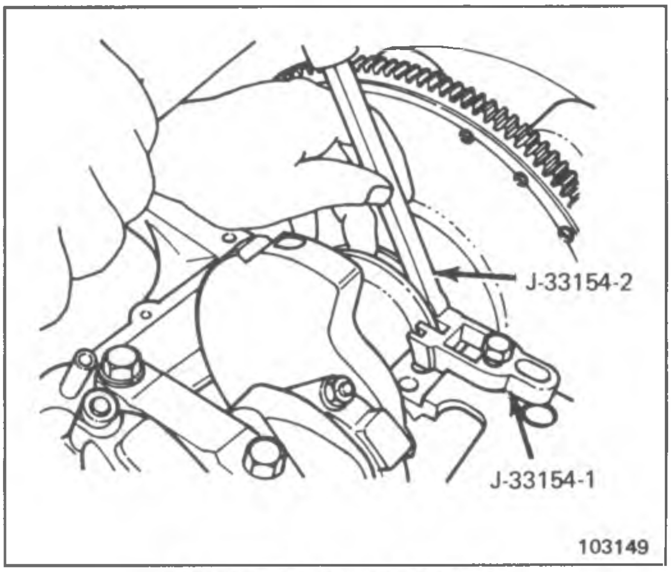


Fig. 6A7-37--Using Guide Tool

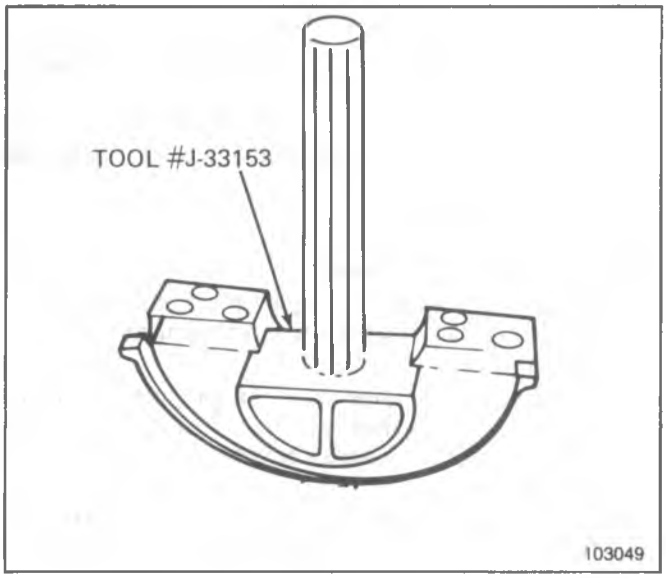


Fig. 6A7-38--Installing New Seal Lower Half

seal into groove approximately 1/4". Do this on both sides (Figure 6A7-36).

4. Measure the amount the seal was driven up on one side and add 1/16", using a sharp tool cut that length from the old seal removed from the rear main bearing cap. Repeat the procedure for the other side. Use the rear main bearing cap as a holding fixture when cutting the seal.
5. Install guide tool (J-33154-1) onto cylinder block (Figure 6A7-37).
6. Using packing tool, work the short pieces cut in Step 4 onto the guide tool and then pack into cylinder block. The guide tool and packing tool have been machined to provide a built-in stop. Use this procedure for both sides.
7. It may help to use oil on the short pieces of the rope seal when packing into the cylinder block.
8. Apply Loctite 496 or equivalent and install a new rope seal in the rear main bearing cap.
9. Using tool J-33153 as shown in Figure 6A7-38 and cut ends of seal flush with cup.
10. Place a piece of plastic gaging material on the rear main journal.
11. Install the rear main bearing cap and torque to 95 N·m (70 ft. lbs.).
12. Remove the rear cap and check the plastic gage for bearing clearance. If out of specification, recheck the ends of the seal for fraying that may be preventing the cap from fully seating. Correct as necessary.
13. Clean plastic gage from journal and bearing.
14. Apply a thin film of anaerobic sealant, #1052357 or equivalent to the cap. Keep sealant off the seal and bearing.
15. Just prior to assembly, apply a light coat of engine oil on crankshaft surface that will contact seal.
16. Install rear main bearing cap. Torque bolts torque bolts to specifications.
17. Install oil pump and oil pan as previously outlined.

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. Remove oil pan, oil pump and cylinder head as previously outlined.
2. For the cylinder being serviced, turn crankshaft until piston is at the bottom of the stroke. Place a cloth on top of the piston.
3. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.
4. Remove rod bearing cap and bearing.
5. Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads.
6. Remove rod and piston assembly through the top of the cylinder bore.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps. If bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.
2. Remove piston rings by expanding and sliding them off the pistons.
3. Remove piston pin retaining ring and remove piston pin.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
2. Remove oil gallery plugs and clean all oil passages.
3. Clean and inspect water passages in the cylinder block.
4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.
5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of- round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less than .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is

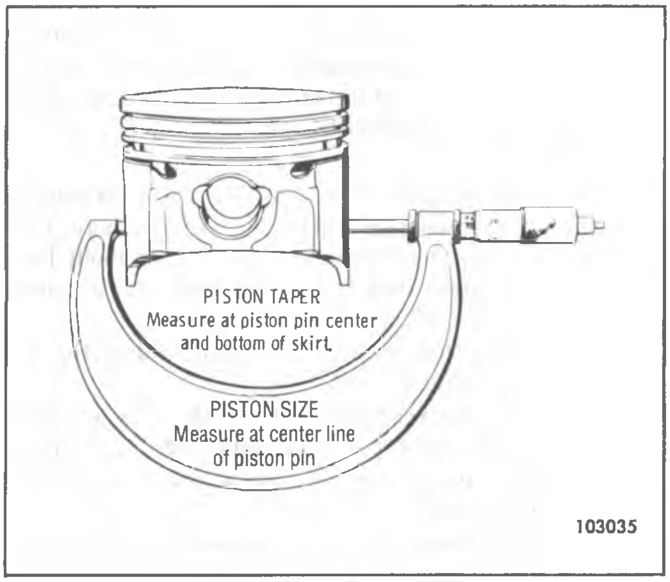


Fig. 6A7-39--Measuring Piston

desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diamter as the piston and honed to give the specified clearance.
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
3. When finished honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks, in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

   NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.
5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. Cylinder should not be cleaned with a kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure the "Cylinder Bore Diamter" with a telescope gage 2-1/2" (64mm) from the top of cylinder bore.
   b. Measure the "Piston Diameter" (at skirt across center line of piston pin).
   c. Subtract piston diameter from cylinder bore diamter to determine "Piston to Bore Clearance".
2. If used piston is not acceptable, determine if a new piston can fit cylinder bore.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance.
4. Mark the piston to identify the cylinder for which it was fitted.

ROD ASSEMBLY

If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

PISTONS

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BURSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

PISTON PINS

The piston pin is a free floating piston pin. It is important that the piston and rod pin hole be clean and free

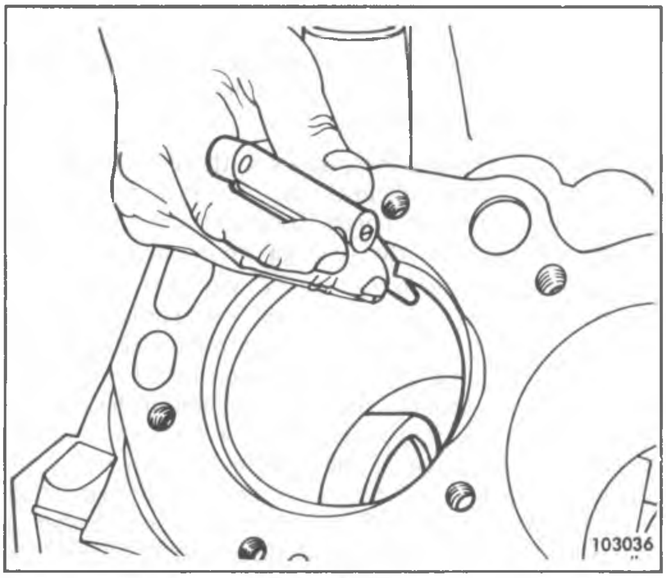


Fig. 6A7-40--Measuring Piston Ring Gap

of oil when checking pin fit. The rod may be installed in the piston with either side facing up.

Whenever the replacementof a piston pin is necessary, remove the ring retaining the pin. Whenever the retaining ring is removed, it must be replaced wiht a new ring. Using tool J-29134, install piston pin retaining ring.

It is very important that after installing the piston pin retaining rings that the rings be rotated to make sure they are fully seated in their grooves.

RINGS

The pistons have three rings (two compression rings and one oil ring). The oil ring consists of two rails and an expander. Pistons do not have oil drain holes behind the rings.

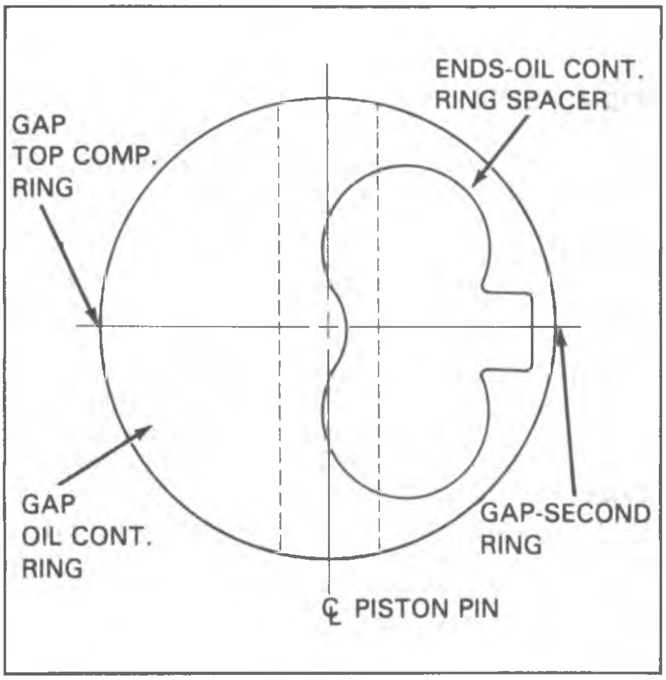


Fig. 6A7-41--Ring Gap Location

Ring Gap

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chrome faced, or treated with molybdenum for maximum life.

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage (fig. 6A7-40).
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by ring groove, correct by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

RING INSTALLATION

For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

ROD AND PISTON (Fig. 6A7-44)

Installation

1. Install connecting rod bolt guide hose over rod bolt threads. (Fig. 6A7-43).
2. Lightly coat pistons, rings and cylinder walls with light engine oil. Depression on top of piston to be

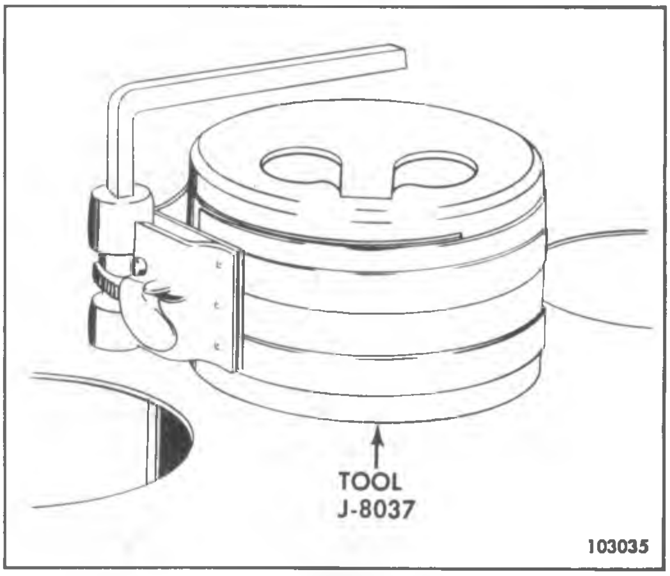


Fig. 6A7-42--Piston Ring Compressor

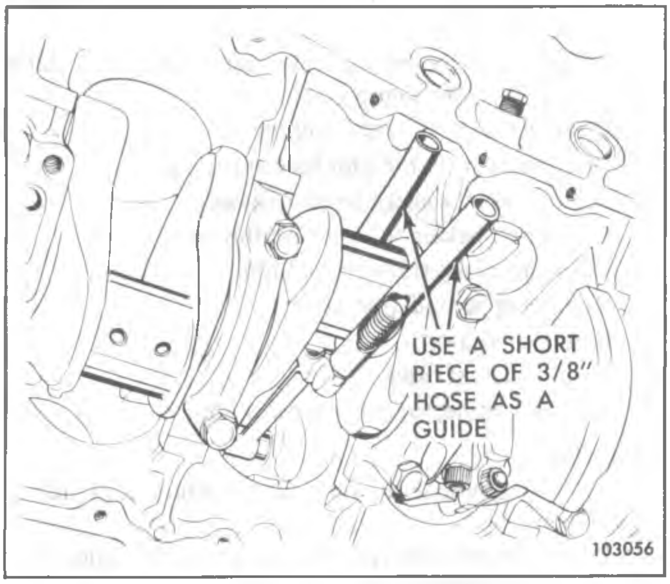


Fig. 6A7-43--Connecting Rod Bolt Guide

assembled toward outside of engine.

3. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 to compress the rings. Guide the connecting rod into place on the crankshaft journal. Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
4. Install the bearing caps and torque nuts to specifications 65 N·m (45 ft. lbs.). Be sure to install new pistons in the cylinders for which they were fitted, and used pistons in the cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 in the left bank and, 2, 4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

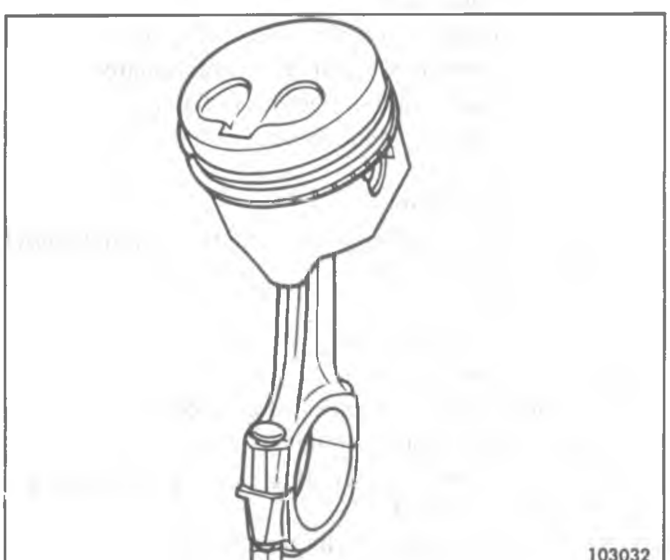


Fig. 6A7-44--Piston Identification

CRANKSHAFT (Fig. 6A7-45)

Removal

1. Remove engine.
2. Remove flywheel
3. Mount engine in stand and clamp securely.
4. Remove oil dipstick and tube.
5. Remove glow plugs.
6. Remove front cover as previously outlined.
7. Remove oil pan.
8. Remove oil pump.
9. Remove connecting rod caps. Install protective hose on connecting rod studs. Place bearings in a rack so they may be re-installed in their original location.
10. Remove main bearing caps. Place bearing caps in a rack so they may be re-installed in their original position.
11. Remove rear main bearing oil seal.
12. Remove rear main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

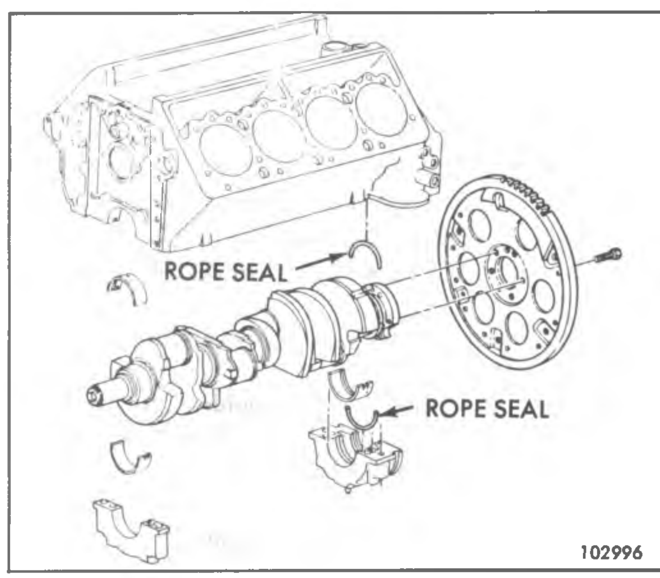


Fig. 6A7-45--Crankshaft

Installation

1. Apply a drop of sealer to bearing cap and cylinder and case groove prior to installing rope seal.
2. Install rear main oil seal in cylinder block and rear main cap. Seal must be firmly installed in place, in cylinder and case and bearing cap completely filling groove. End of seal must be cut clean and flush with cylinder case and bearing cap mounting surface.
3. Install main bearings in cylinder block and main bearing caps.
4. Torque all except rear main bearing cap bolts to specifications. Torque rear main cap to 14-16 N·m (10-12 in. lbs.) then tap end of crankshaft, first rearward then forward with lead hammer. This will line up rear main bearing and crankshaft thrust surface.
5. Install connecting rod bearings.
6. Reverse removal procedures.

ENGINE ASSEMBLY

CK Truck

Removal

1. Disconnect batteries.
2. Raise vehicle.
3. Remove transmission dust cover.
4. Disconnect torque converter.
5. Disconnect exhaust.
6. Remove starter bolts.
7. Disconnect wires and remove starter.
8. Remove transmission bell housing bolts.
9. Remove left motor mount bolts.
10. Remove right motor mount bolts.
11. Disconnect block heaters.
12. Remove wire harness, trans cooler lines and front battery cable clamp at oil pan.
13. Disconnect fuel return lines at engine.
14. Disconnect oil cooler lines at engine.
15. Remove lower fan shroud bolts.
16. Lower vehicle.
17. Remove hood.
18. Drain cooling system.
19. Remove air cleaner with resonator.
20. Remove primary filter from cowl.
21. Disconnect ground cable at alternator bracket.
22. Disconnect alternator wires and clips.
23. Disconnect TPS, EGR-EPR, Fuel cut off at injection pump.
24. Remove harness from clips at rocker covers includes disconnecting glow plugs.
25. Disconnect EGR-EPR solenoids, glow plugs, controller, temperature sender and move harness aside.
26. Disconnect ground strap, left side.
27. Remove fan.
28. Remove upper radiator hoses at engine.
29. Remove fan shroud.
30. Remove power steering pump and belt.
31. Remove power steering reservoir - lay pump and reservoir aside.
32. Disconnect vacuum at cruise servo and accelerator cable at injection pump.
33. Disconnect heater hose at engine.
34. Disconnect lower radiator hose at engine.
35. Disconnect oil cooler lines at radiator.
36. Disconnect heater hose and overflow at radiator.
37. Disconnect auto trans cooler lines.
38. Remove upper radiator cover.
39. Remove radiator.
40. Remove detent cable.
41. Remove engine, support transmission.

Installation

To install, reverse the removal procedures and include the following:

If fuel filters were removed, they must be filled with clean diesel fuel to avoid long cranking.

G Van

Removal

1. Disconnect batteries.
2. Remove headlight bezels.
3. Remove grille.
4. Remove bumper.
5. Remove lower valence panel.
6. Remove hood latch.
7. Remove coolant recovery bottle.
8. Remove upper fan shroud.
9. Remove upper tie bar.
10. Remove engine cover.
11. If equipped with A/C:
    - Discharge A/C system.
    - Disconnect A/C condenser lines.
    - Remove condenser.
12. Disconnect low coolant wire.
13. Drain cooling system.
14. Disconnect engine oil cooler lines at radiator.
15. Disconnect transmission cooler lines at radiator.
16. Disconnect lower radiator hose at radiator.
17. Disconnect upper radiator hose at radiator.
18. Remove radiator.
19. Remove fan assembly.
20. Remove fuel injection pump as outlined in 6.2 Diesel Fuel Injection Section.
21. Raise vehicle.
22. Disconnect exhaust pipe at manifold.
23. Remove inspection cover.
24. Remove flex plate to torque converter bolts.
25. Remove motor mount through bolt nuts.
26. Disconnect block heater at element and disconnect ground wire to block.
27. Remove bellhousing to cylinder case bolts.
28. Remove starter.
29. Lower vehicle.

SPECIAL TOOLS

J-6098-10	Camshaft Brg Rem & Inst	J-33043-5 (.751 - .773)	T.P.S Gage Block LL4 (700R4 Transmission)
J-26999-10	Compression Gage Adapter	J-7049	Valve Guide Reamer Set
J-29134	Piston Pin Retaining Ring	J-5830	Valve Guide Reamer Set
J-29664	Manifold Cover	J-8037	Piston Ring Compressor
J-29666	Airline Adapter	J-22102	Front Cover Seal Installer
J-29873	Nozzle Socket	J-23523-D	Harmonic Balancer Remover
J-33042	Static Timing Gage	J-8089	Wire Brush, Combustion Chamber
J-33153	Rear Main Seal Installer	J-8101	Valve Guide Cleaner
J-33154	Rear Main Seal Packer	J-8056	Spring Tester
J-26513	Valve Spring Compressor	J-8062	Valve Spring Compressor
J-6098.01	Camshaft Brg Rem & Inst (Used With J-6098-10)	J-29834	Valve Lifter Remover
J-33043-2 (.646-.668)	T.P.S And Vacuum Regulator Valve Gage Block	J-6098-11,-12	Camshaft Brg Rem & Inst (No's. 2,3,4,No. 5, No.1)
J-33043-4 (.602-.624)	T.P.S Gage Block		

103456

Special Tools

30. If equipped with cruise control, remove cruise control transducer.
31. If equipped with A/C:
    - Remove rear A/C brace.
    - Disconnect A/C lines at compressor.
    - Remove A/C brackets and remove compressor.
32. Remove power steering pump and lay aside.
33. Remove oil fill tube upper bracket.
34. Remove glow plug relay.
35. Disconnect oil pressure sender and loom.
36. Remove air cleaner resonator and bracket.
37. Remove transmission fill tube nut and lay aside.
38. Disconnect heater and radiator and bypass hoses at crossover.
39. Remove generator upper bracket.
40. Remove coolant crossover.
41. Disconnect fuel lines at fuel pump.
42. Install J-33888 engine lifting device adapter.
43. Install lifting device.
44. Remove engine.

Installation

To install, reverse remove procedures.

GENERAL DATA:

Type	90° V8 Diesel
Displacement	6.2 Liter
RPO	LH6, LL4
Bore	101 mm
Stroke	97 mm
Compression Ratio	21.5:1
Firing Order	1-8-7-2-6-5-4-3

CYLINDER BORE:

Diameter	100.987-101 .065
Out of Round	.02 Max.
Taper-Thrust Side	.02 Max.

PISTON:

(Bores 1-6)	Clearance	* B	.089-.115
		* Z	.112-.138

Bores 7&8 to be fit .013 Looser

PISTON RING:

Compression	Groove Clearance	Top	.076-.178
		2nd	.039-.080
	Gap	Top	.3-.55
		2nd	.75-1.0
Oil	Groove Clearance		.040-.096
	Gap		0.25-0.51

PISTON PIN:

Diameter	30.9961-31.0039
Clearance	.0101-.0153
Fit in Rod	.0081-.0309

CAMSHAFT:

Lift ± .05	In	7.133
	Ex	7.133
Journal Diameter	#1, 2, 3, 4	55.025-54.975
	#5	51.025-50.975
Journal Clearance		.026-.101

CRANKSHAFT:

Main Journal	Diameter	#1 2 3 4	74.917-74.941
		#5	74.912-74.936
	Taper		.005 Max.
	Out Of Round		.005 Max.
Main Bearing Clearance		#1, 2, 3, 4	.045-.083
		#5	.055-.093
Crankshaft End Play			0.10-0.25
Crankpin	Diameter		60.913-60.939
	Taper		.005 Max.
	Out Of Round		.005 Max.
	Rod Bearing Clearance		.045-.100
	Rod Side Clearance		.63/.17

VALVE SYSTEM:

Lifter		Hydraulic Roller
Rocker Arm Ratio		1.5 to 1
Face Angle (All)		45°
Seat Angle (All)		46°
Seat Runout		.05
Seat Width	In	.89-1.53
	Ex	1.57-2.36
Stem Clearance	In	.026/.069
	Ex	.026/.069
Valve Spring		
	Pressure N @ mm Closed	356 @ 46.0
	Open	1025 @ 35.3
	Installed Height	46

NOTICE: All dimensions are in millimetres (mm) unless otherwise specified.

* BOHN PISTONS
* ZOLLNER PISTONS

101085

ENGINE	Ft. Lbs.	(N·m)
Injection Pump to Gear Bolts	13-20	18-27
Injection Pump Attaching Nuts	25-37	34-50
Injection Line Nut to Pump	15-24	20-32
Injection Line Nut to Nozzle	15-24	20-32
Injection Pump Fuel Filter Inlet Line	15-20	20-27
Injection Pump Fuel Filter Outlet Line	15-20	20-27
Injection Pump Fuel Inlet Line	15-20	20-27
Injection Nozzle to Cylinder Head	44-60	60-80
Glow Plug	8-12	11-16
Controller	13-20	18-27
Main Bearing Cap Bolts	105-117	143-158
Inner		
Outer	94-105	128-143
Oil Pump to Bearing Cap Bolts	59-74	80-100
Rocker Arm Shaft Bolt to Head	41	55
Valve Cover Bolts and Studs	13-20	18-27
Oil Pan Bolts	4-10	6-14
Oil Pan Rear Bolts	13-20	18-27
Crankshaft Balancer to Crankshaft Bolt	140-162	190-220
Front Cover to Cylinder Block	25-37	34-50
Fan Driven Pulley to Hub Bolts	15-20	20-27
Fan Clutch to Fan	15-20	20-27
Water Pump to Front Cover Bolts	25-37	34-50
Water Pump to Cover Bolts M8—1.25 x 35	15-20	20-27
Water Pump Plate to Front Cover	13-20	18-27
Water Pump Plate to Water Pump	13-20	18-27
Thermostat Housing Crossover to Head	25-37	34-50
Intake Manifold to Cylinder Head Bolts	25-37	34-50
Exhaust Manifold to Cylinder Head Bolts	18-33	25-45
Engine Mount to Cylinder Block Bolts	30-40	40-54
Engine Mount to Frame Mount	25-35	34-48
Vacuum Pump Clamp to Cylinder Block Bolt	25-37	34-50
Cylinder Head Bolts	103	135
Connecting Rod Nuts	44-52	60-70
Camshaft Sprocket Bolt	66-81	90-110
Lifter Guide Plate Retainer	13-25	18-35
Camshaft Thrust Plate	13-20	18-27
Fuel Pump To Block	20-30	27-40
Fuel Pump Adapter Plate to Block	4-7	6-10
Fuel Filter To Inlet Manifold (G-Van)	25-37	34-50

SECTION 6B

ENGINE COOLING

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GENERAL DESCRIPTION

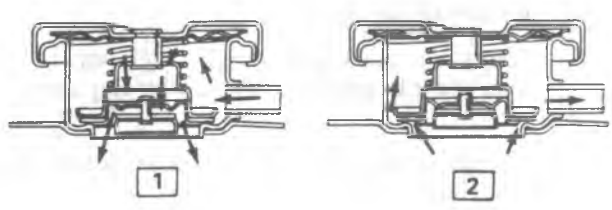

Fig. 6B-1--Radiator Pressure Cap

All Chevrolet Light Duty Trucks have pressure type engine cooling systems with thermostatic control of coolant circulation. The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of the coolant which increases the cooling efficiency of the radiator. The 15 pound (103 kPa) pressure cap used raises the boiling point of coolant to approximately 258° F (125°C) at sea level.

The radiator cap should be washed with clean water and pressure checked every 12 months.

All models have a closed cooling system using a round pressure cap (Fig. 6B-1) and a coolant reservoir. Coolant can be added without removing the radiator cap.

A pressure-vacuum valve radiator cap is used which allows the coolant to expand through the pressure valve in the center of the cap without building unnecessary pressure. The expanding coolant flows into the coolant reservoir. The vent valve closes due to expansion and coolant flow. The nominal 15 pound (103 kPa) pressure will not be reached until the system is working at maximum capacity.

Any air or vapor in the cooling system will be forced to the coolant reservoir under the liquid level and leave through the vent tube at the top of the reservoir. As the system cools, the extra coolant in the reservoir will be drawn back to the radiator through the vent valve. In this manner, the radiator will keep itself full at all times.

COOLANT LEVEL

The need for additional coolant can be detected by observing the level of coolant in the "see through" reservoir while the engine is at normal operating temperature. The radiator cap need not normally be removed.

The coolant level should be at the "Full Cold" mark when the system is cool or at ambient temperature. After the vehicle has been driven sufficiently to obtain normal operating temperatures, the level should be above the "Full Cold" mark.

Periodically, the radiator cap should be removed to observe coolant level in the radiator.

CAUTION: The radiator coolant level should only be checked when the engine is cool. If the radiator cap is removed from a hot cooling system, serious personal injury may result.

Coolant levels in crossflow radiators with coolant recovery bottles should be maintained to the top of the filler neck.

The recovery bottle should be at its appropriate mark when checked.

Regardless of whether freezing temperatures are expected or not, cooling system protection should be maintained at least to -20°F (-29°C), to provide adequate corrosion protection and loss of coolant from boiling. With glycol content less than requirement for -20°F (-29°C) protection, coolant boiling point is less than the temperature indicating light setting. When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20°F (-29°C) may occur, a sufficient amount of an ethylene glycol base anti-freeze that meets a GM Specification 1825-M should be used.

NOTICE: Alcohol or methanol base anti-freeze, or plain water, are not recommended for your engine at anytime. They will not provide proper protection against corrosion.

Flushing Cooling System

Various methods and equipment may be used to perform this service. If special equipment such as a back flusher is used, equipment manufacturer's instructions should be followed. However, it is advisable to remove the thermostat

ALL L6 ENGINES AND ALL V8 ENGINES EXCEPT DIESEL		
GENERATOR A.I.R. PUMP P/S PUMP	NEW USED	578 N (130 lb.) 222-356 N (50-80 lb.)
A/C COMPRESSOR	NEW USED	645 N (145 lb.) 289-445 N (65-100 lb.)
6.2L – V8 DIESEL		
GENERATOR P/S PUMP A/C COMPRESSOR	NEW USED	778 N (175 lb.) 245-445 N (55-100 lb.)

Fig. 6B-2--Drive Belt Tension Specifications

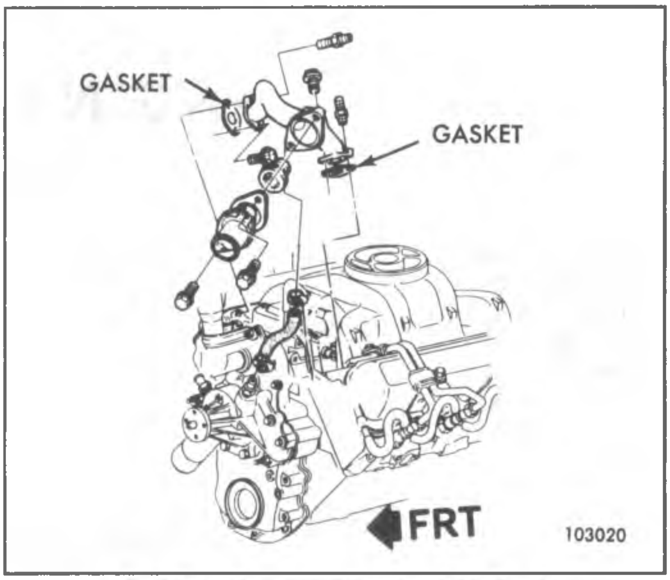

Fig. 6B-3--Thermostat Housing 6.2L Diesel

before flushing the system.

THERMOSTAT

The thermostat consists of a restriction valve actuated by a thermostatic element. This is mounted in the housing at the cylinder head coolant outlet above the water pump on L-6, and in the forward part of the intake manifold, under the coolant outlet on "small block" and "Mark". Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested.

The thermostat for the 6.2L diesel is mounted in the coolant crossover pipe located at the front of the engine. Refer to Fig. 6B-3.

DRIVE BELTS

Frayed or cracked belts should be replaced and tensioned to specifications using a strand tension gage, such as tool J-23600-B or equivalent.

Loose belts may place an extremely high impact load on driven component bearings due to the whipping action of the belt.

An over tightened belt places unnecessary loads on the component bearings.

In figure 6B-2, the minimum reading is the lowest allowable setting before the belt must be reset. When readjusting, the adjustment specification should be met. When adjusting a drive belt, it is important that the proper adjustment specification be used. Refer to figures 6B-4 thru 6B-7 for adjustment.

- A 'Used' belt is one that has been rotated at least one complete revolution on engine pulleys. This begins the 'seating' of the belt and it should never be reset to 'New' belt specifications.

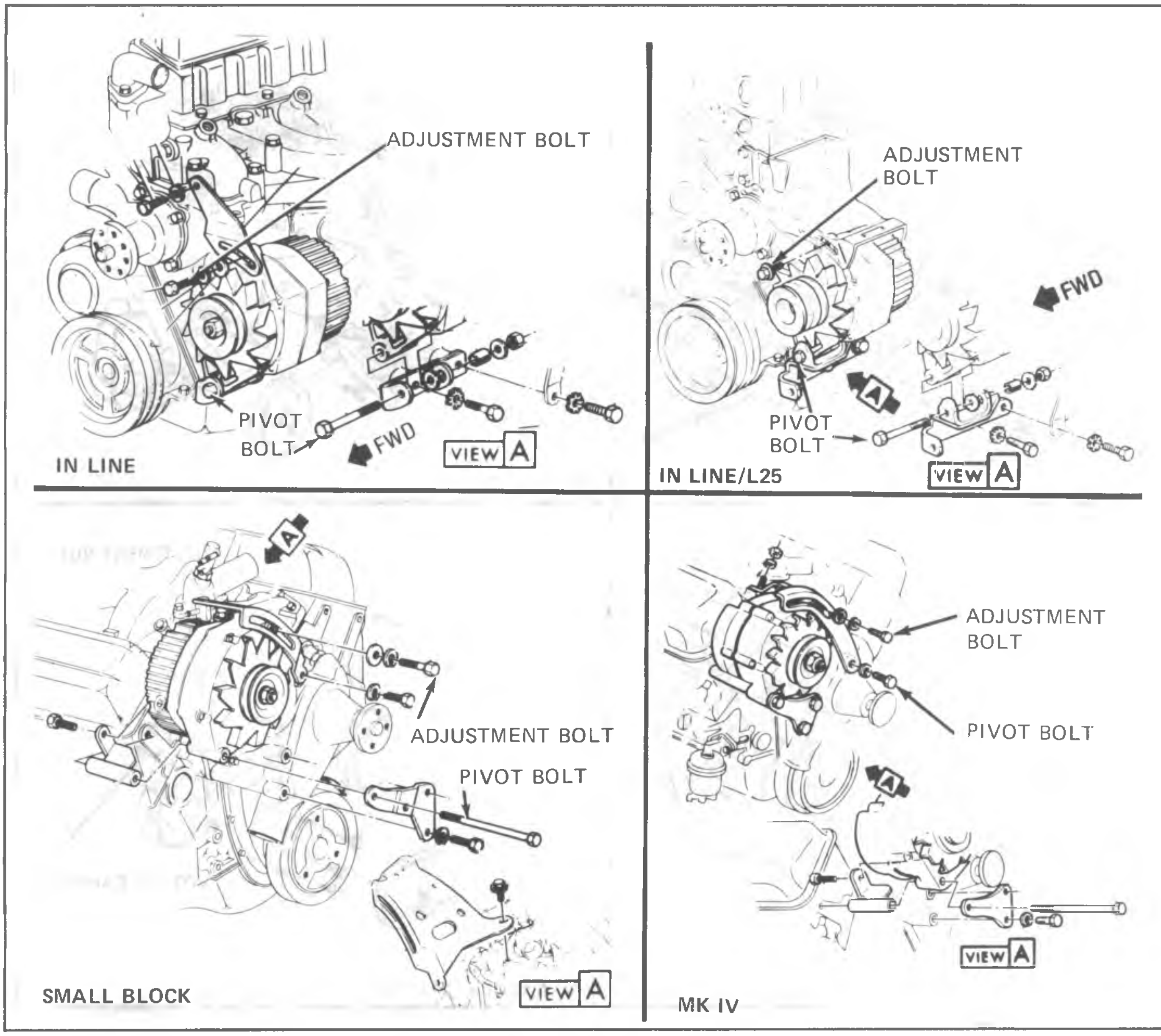

Fig. 6B-4--Generator Adjustment

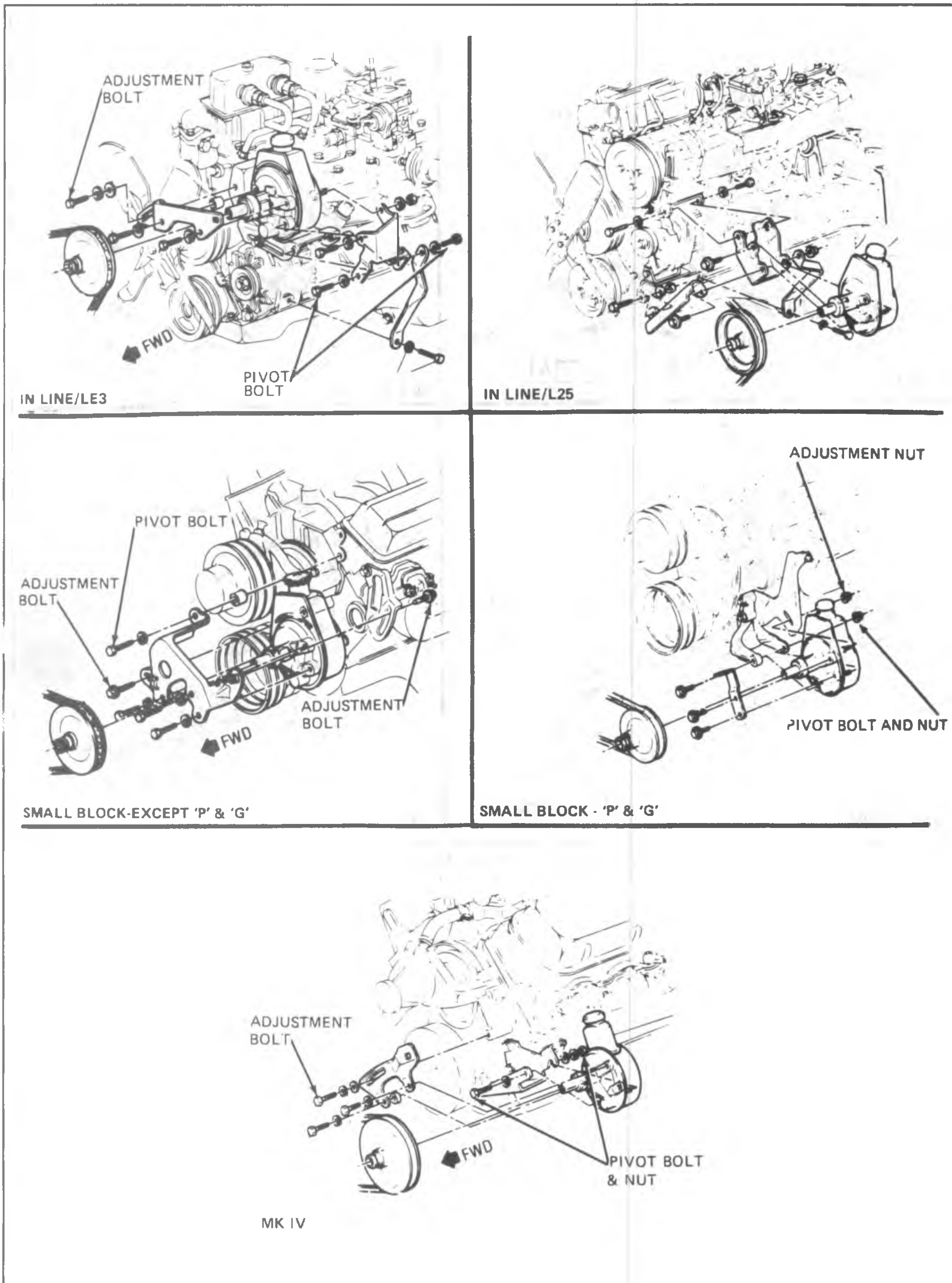

Fig. 6B-5--P/S Pump Adjustment

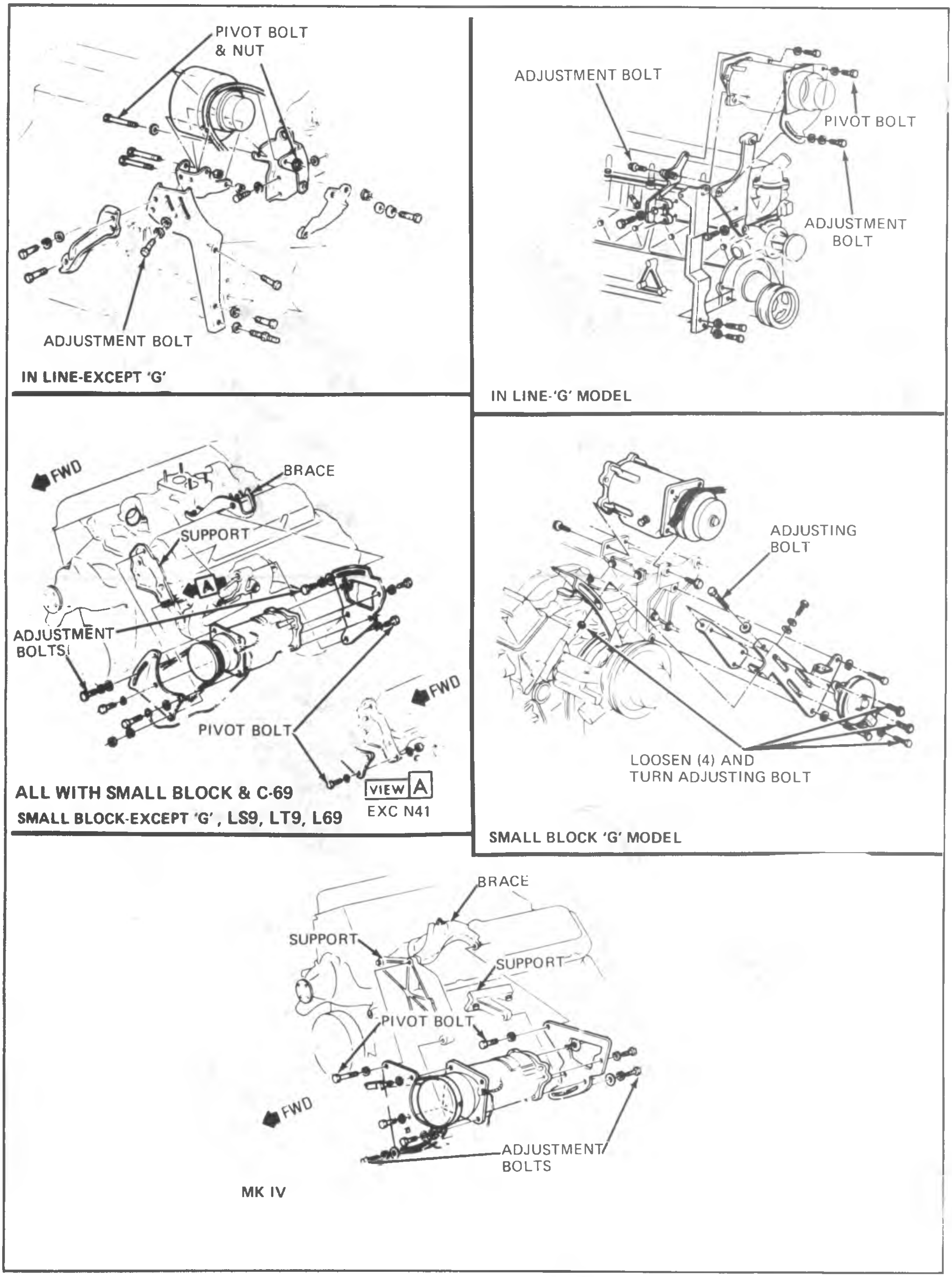

Fig. 6B-6--A/C Compressor Adjustment

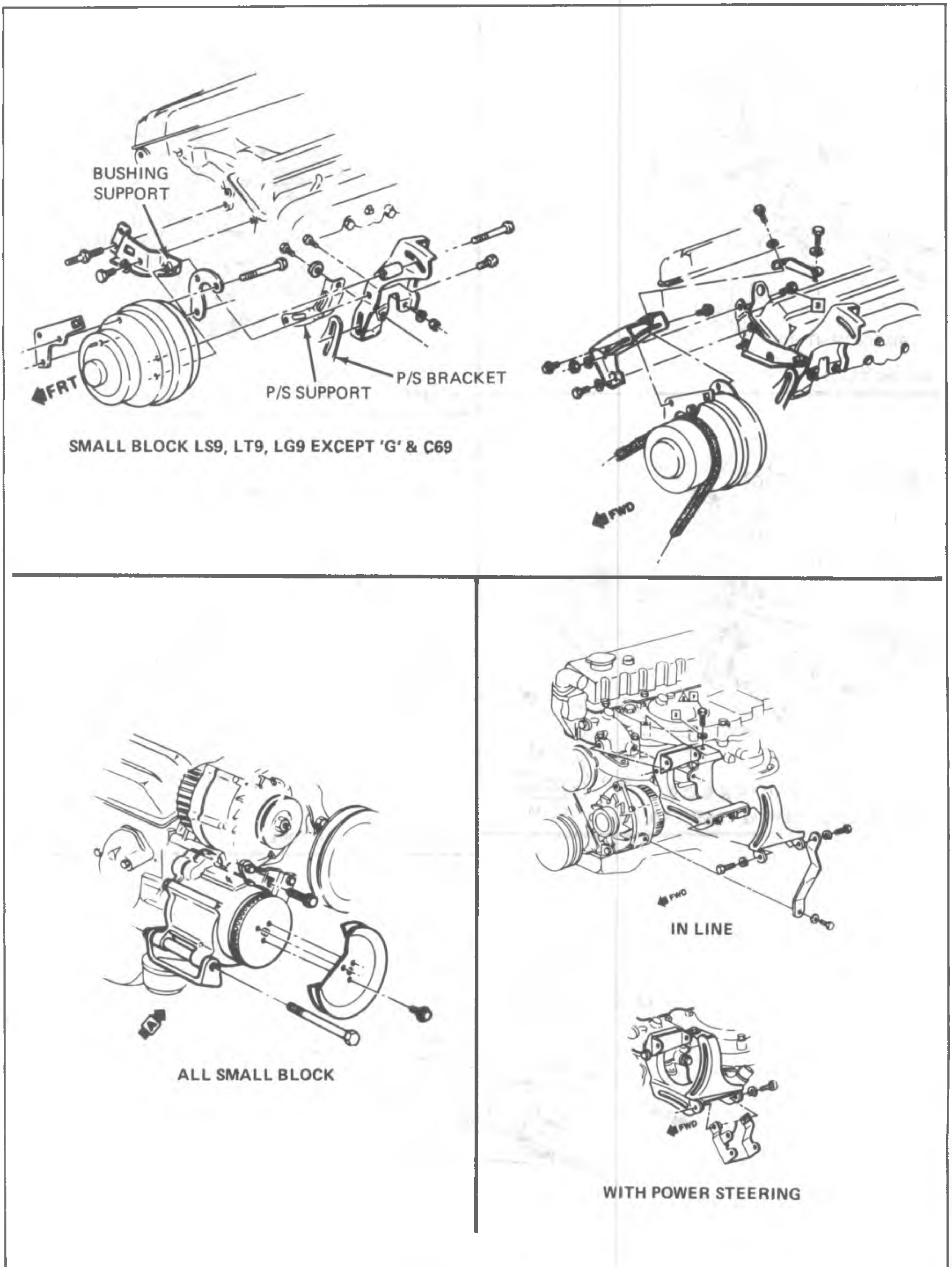

Fig. 6B-7--A/C and A.I.R. Adjustment

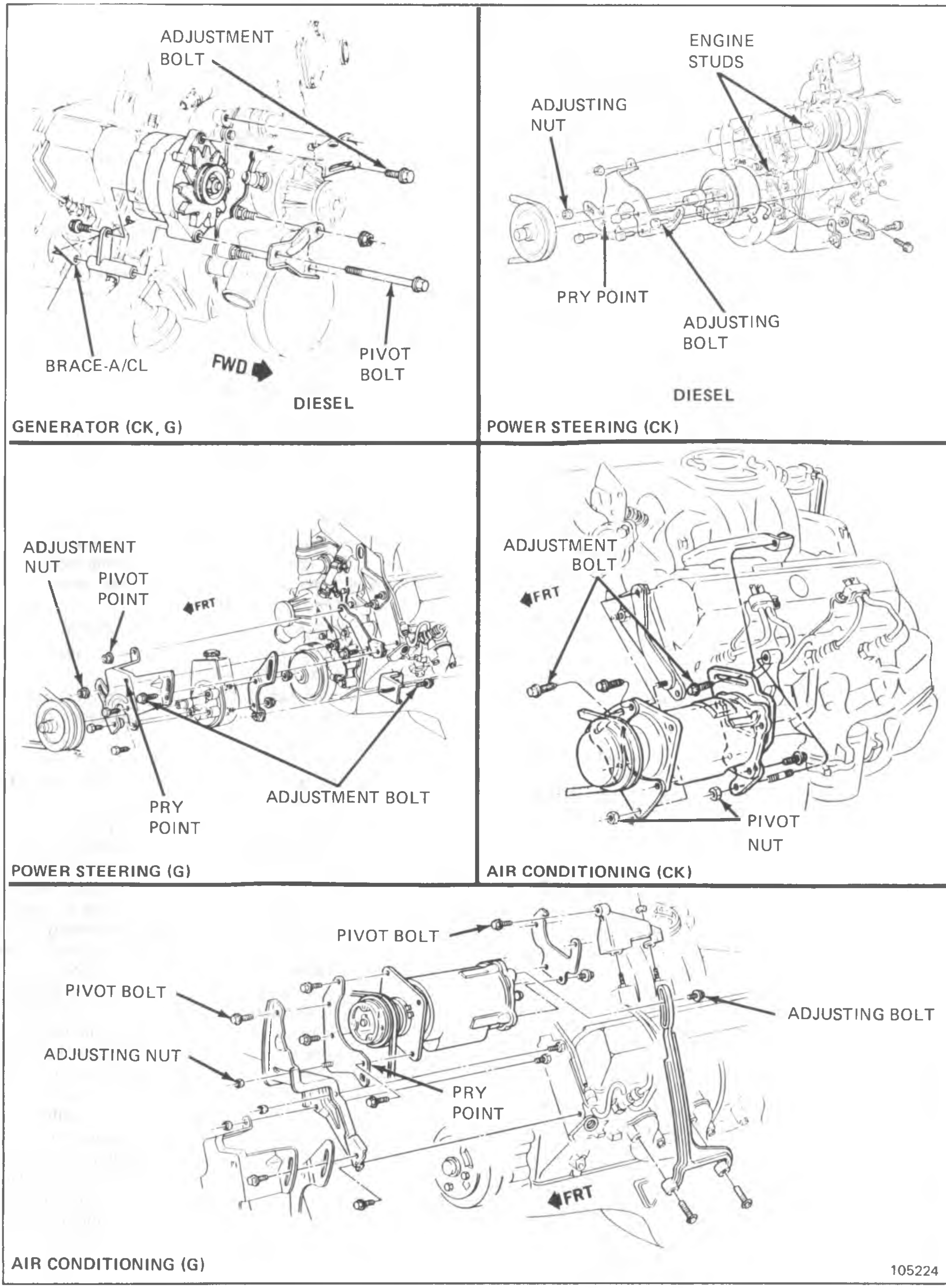

Fig. 6B-8--Diesel Drive Belt Adjustments

DIAGNOSIS

If the cooling system requires frequent addition of coolant in order to maintain the proper level, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no damage.

Air may be drawn into the cooling system through leakage at the water pump seal or through leaks in the coolant recovery system. Gas may be forced into the cooling system through leakage at the cylinder head gasket(s) even though the leakage is not sufficient to allow coolant to enter the combustion chamber.

SYSTEM CHECKS

Exhaust Leaks

To check for exhaust leaks into the cooling system, drain the system until the coolant level stands just above the top of the cylinder head(s), then disconnect the radiator upper hose and remove the thermostat and fan belt(s). Start the engine and quickly accelerate several times. At the same time note any appreciable coolant rise or the appearance of bubbles which are indicative of exhaust gases leaking into the cooling system.

NOTICE: A defective head gasket may allow exhaust gases to leak into the cooling system. This is particularly damaging to the cooling system as the gases combine with the water to form acids which are harmful to the radiator and engine.

Water Pump

Water pump operation may be checked by running the engine while squeezing the radiator upper hose (engine warm A pressure surge should be felt. Check for a plugged venthole in pump.

Radiator

Test for restriction in the radiator, by warming the engine up and then turning the engine off and feeling the radiator. The radiator should be hot along the left side and warm along the right side, with an even temperature rise from right to left. Cold spots in the radiator indicate clogged sections.

Thermostat

An operational check of the thermostat can be made by hanging the thermostat on a hook in a 33% glycol solution 25°F (4°C) above the temperature stamped on the thermostat valve. Submerge the valve completely and agitate the solution thoroughly. Under this condition the valve should open. Remove the thermostat and place in a 33% glycol solution 10°F (-12°C) below temperature indicated on the valve. With valve completely submerged and coolant agitated thoroughly, the valve should close completely.

Overheat and/or Noise

Engine overheat and/or cooling system noise may be caused by restrictions in the cooling system.

Components which may be prone to this condition are cylinder head, water pump, block, thermostat housing and inlet manifold. Symptoms of this condition are as follows:

- Engine may make snapping/cracking noises.
- Heater core may gurgle or surge.
- Radiator hoses may collapse and expand.
- Heater hoses may vibrate and thump.
- Overheat light may or may not come on.

Symptoms are the result of coolant boiling at some localized area and may be noticed after extending idling and/or while being driven. Determine which side of the engine is involved and whether it is more at the front or rear of engine.

Diagnosis/Inspection

1. Isolate area of engine the localized boiling is originating from. This can be done by probing engine with a sounding bar (large screw driver).
2. With radiator cap removed, observe water being circulated in radiator. Feel the front area of radiator for cold spots which indicate blockage. Blocked radiators generally occur on units that have accrued miles and not on new vehicles.

   CAUTION: The radiator cap should be removed from a cool engine only. If the radiator cap is removed from a hot cooling system, serious personal injury may result.
3. Inspect thermostat to see if it opens completely.
4. Inspect thermostat housing to make sure it is completely free of obstructions.
5. Remove water pump from vehicle and remove the back cover on the pump. All internal passages can be inspected using a flash light.
6. Inspect cross over at the front of the inlet manifold. This entire passage can be seen with only the thermostat removed.
7. Remove heads, but lay them aside for now and check the block first because the heads are the most complex pieces as far as coolant passages are concerned.
8. With water pump and heads removed, ALL coolant passages CAN be inspected by using a pen light flash light. All water jacket areas can be seen directly and a block should never be replaced as being suspect unless the restricted area can be DIRECTLY SEEN.
9. If none of the above inspections reveal the problem area, the heads must be considered prime suspect. Heads with blocked coolant passages generally have more than one area that is blocked. Inspect the heads for signs of overheat discoloration (a dark blue or black area). If none are found look in the coolant passages for blockage and probe all passages that are accessible.

   The head is very intricate and all passages cannot be reached. Use a probe that is fairly substantial as a tag wire may go through or around a partially blocked area. If nothing is found by visual inspection and probing, inspect the passages for a rough ragged appearance. The roughest internal passages are probably the ones that are blocked.

   Replace a blocked or suspect head and inspect the replacement head in the same manner before installing it.

FAN CLUTCH

1.- Noise

Fan noise is sometimes evident under the following normal conditions:

- When clutch is engaged for maximum cooling.
- During first few minutes after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition after overnight settling.

Fan noise or an excessive roar will generally occur continuously, however, under all high engine speed conditions (2500 r.p.m. and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, the clutch should be replaced.

2. - Looseness

Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 1/4" (6.5mm) maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

3. - Silicone Fluid Leak

The operation of the unit is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. If the degree of leakage appears excessive, however, proceed to item 4.

4. - Engine Overheating

If the fan and clutch assembly free-wheels with no drag (revolves over 5 times when spun by hand), the clutch should be replaced.

ENGINE COOLING SYSTEM COMPLAINT

TO AVOID NEEDLESS TIME AND COST IN DIAGNOSING COOLING SYSTEM COMPLAINTS, THE CUSTOMER SHOULD BE QUESTIONED ABOUT DRIVING CONDITIONS THAT PLACE ABNORMAL LOADS ON THE COOLING SYSTEM.

1. DOES OVERHEATING OCCUR WHILE PULLING A TRAILER?

   IF ANSWER IS "YES" – HOW HEAVY IS TRAILER? IF TRAILER WEIGHT IS GREATER THAN 2,000 LBS. & VEHICLE IS EQUIPPED WITH NORMAL DUTY COOLING SYSTEM, A HEAVY DUTY COOLING PACKAGE IS REQUIRED [PER MFR'S TRAILER HAULING SPECS.]. FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

2. IS VEHICLE EQUIPPED WITH ADD–ON OR AFTER MARKET AIR CONDITIONING SYSTEM?

   IF ANSWER IS "YES" – WAS HEAVY DUTY RADIATOR INSTALLED WITH THE SYSTEM? IF NOT, INSTALL HEAVY DUTY AIR CONDITIONING RADIATOR FOR THE CAR MODEL INVOLVED [PER MANUFACTURER'S SPECS.]. FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

3. IS OVERHEATING OCCURRING AFTER PROLONGED IDLE, IN GEAR, A/C SYSTEM OPERATING?

   IF ANSWER IS "YES" – INSTRUCT OWNER ON DRIVING TECHNIQUES THAT WOULD AVOID OVERHEATING SUCH AS:
   a. IDLE IN NEUTRAL AS MUCH AS POSSIBLE – INCREASE ENGINE R.P.M. TO GET HIGHER AIR FLOW & WATER FLOW THROUGH RADIATOR.
   b. TURN A/C SYSTEM OFF DURING EXTENDED IDLES IF OVERHEATING IS INDICATED BY HOT LIGHT OR TEMP. GAGE.

   FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

4. IS OVERHEATING OCCURRING AFTER PROLONGED DRIVING IN SLOW CITY TRAFFIC, TRAFFIC JAMS, PARADES, ETC.?

   IF ANSWER IS "YES" – INSTRUCT OWNER ON DRIVING TECHNIQUES THAT WOULD AVOID OVERHEATING – SAME AS FOR PROLONGED IDLES – NO. 3. FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

IF NONE OF THE ABOVE APPLY, GO TO DIAGNOSTIC CHART

TO EFFECTIVELY USE THIS CHART, QUESTION THE OWNER TO DETERMINE WHICH OF THE FOLLOWING [3] CATEGORIES APPLIES TO THE COMPLAINT:

1. HOT LIGHT OR HOT INDICATION ON TEMPERATURE GAGE
2. BOILING
3. COOLANT LOSS

1. IF COMPLAINT IS HOT LIGHT OR HOT INDICATION ON TEMPERATURE GAGE –

   WAS HOT LIGHT ACCOMPANIED BY BOILING? IF ANSWER IS "YES", GO TO BOILING ON CHART
   IF ANSWER IS "NO", GO TO HOT LIGHT ON CHART

2. IF COMPLAINT IS BOILING – GO TO BOILING ON CHART

3. IF COMPLAINT IS COOLANT LOSS –

   DETERMINE IF CUSTOMER IS OVERFILLING THE SYSTEM, THIS WOULD NORMALLY RESULT IN SMALL AMOUNTS OF COOLANT LOSS THROUGH THE OVERFLOW TUBE. IF THIS IS THE CASE, INSTRUCT THE CUSTOMER ON PROPER FILL LEVEL & NO FURTHER DIAGNOSTIC CHECKS SHOULD BE REQUIRED.

   IF OVERFILLING IS NOT THE PROBLEM, GO TO COOLANT LOSS ON CHART.

NOTICE: ANYTIME COOLING SYSTEM IS OBVIOUSLY CONTAMINATED, THE SYSTEM SHOULD BE DRAINED AND FLUSHED.

CAUTION – THE COOLING SYSTEM IS DESIGNED TO OPERATE AT 15 P.S.I. PRESSURE & TEMPERATURES EXCEEDING 200° F. CAUTION SHOULD BE EXERCISED WHEN REMOVING PRESSURE CAP OR SERVICING THE SYSTEM.

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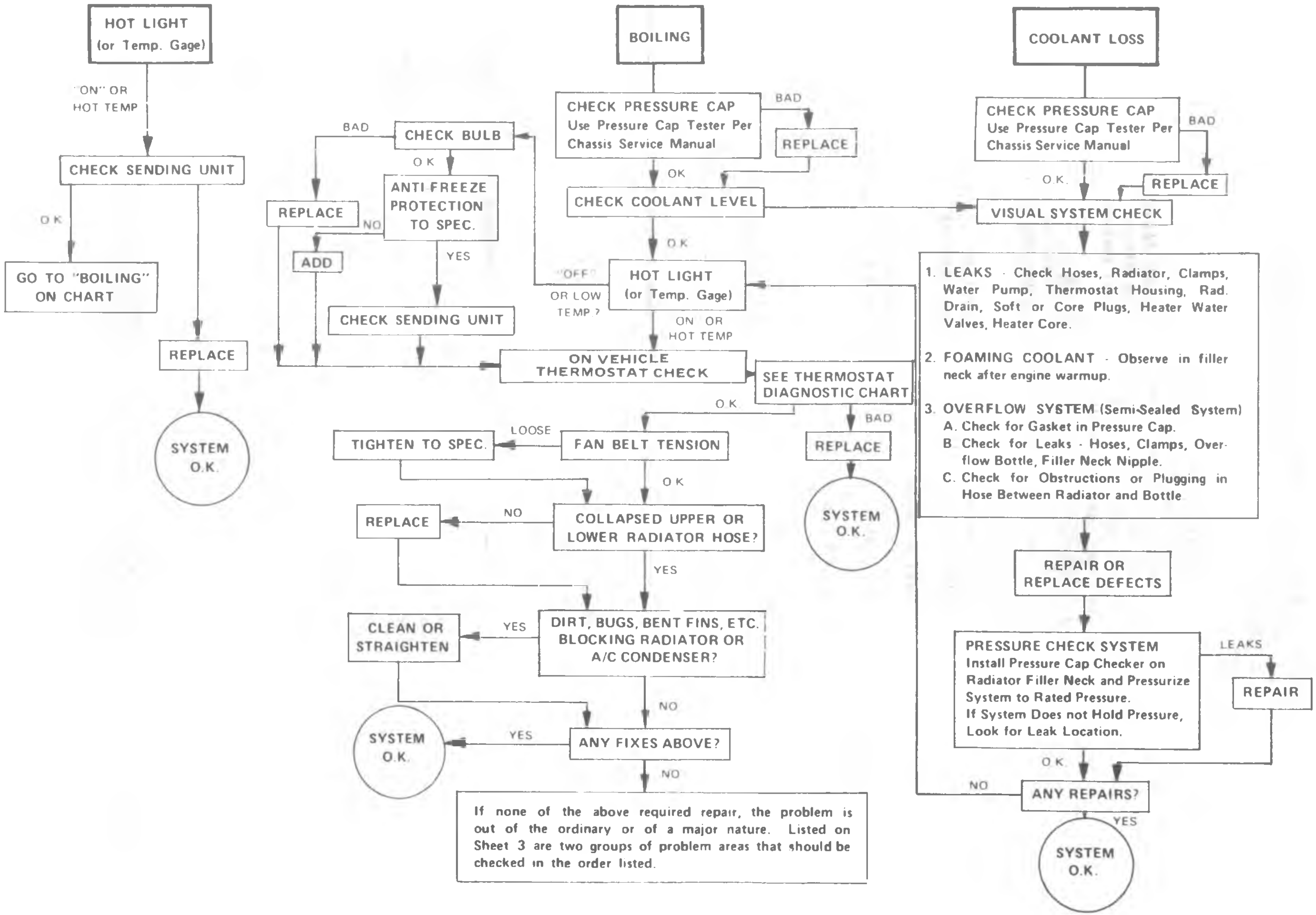
DIAGNOSIS CHART

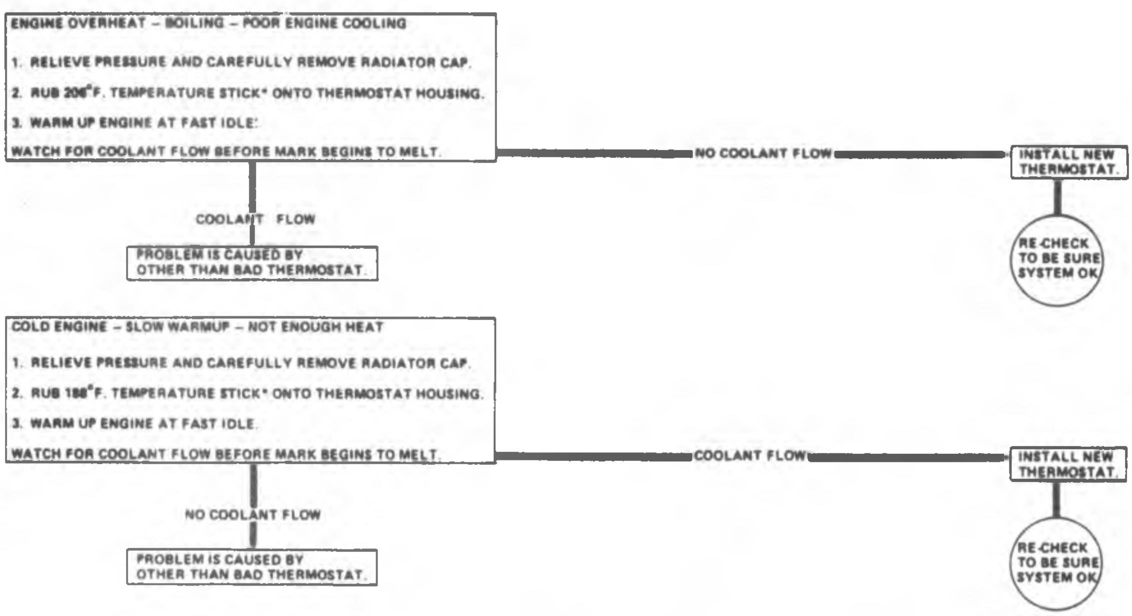


A. <u>PROBLEMS NOT REQUIRING DISASSEMBLY OF COOLING SYSTEM –</u>

1. LARGE OBSTRUCTIONS BLOCKING RADIATOR OR CONDENSER
   - a. AUXILIARY OIL COOLERS — RELOCATE
   - b. LICENSE PLATES — RELOCATE
   - c. SPARE TIRES — RELOCATE
   - d. ICE, MUD OR SNOW OBSTRUCTING GRILLE – REMOVE
2. ENGINE OIL OVERFILL – CHECK ENGINE OIL DIPSTICK
3. WRONG RADIATOR FOR APPLICATION – CHECK PART NO. AGAINST PARTS LIST
4. LOOSE, DAMAGED OR MISSING AIR SEALS – SEE BODY SERVICE MANUAL
5. MISSING OR DAMAGED LOWER AIR BAFFLE – SEE BODY SERVICE MANUAL
6. WRONG IGNITION TIMING – SEE CHASSIS SERVICE MANUAL

B. <u>PROBLEMS REQUIRING DISASSEMBLY OF COOLING SYSTEM –</u>

1. INCORRECT OR DAMAGED FAN – CHECK PART NO. AGAINST PARTS LIST
2. FAULTY EMISSION SYSTEM COMPONENTS (COULD CAUSE OVERHEATING AT IDLE)
   - a. PCV VALVE — SEE CHASSIS SERVICE MANUAL
   - b. TVS OR TCS — SEE CHASSIS SERVICE MANUAL
3. PRESSURE CHECK COOLING SYSTEM WITH PRESSURE CAP INSTALLED – WILL SHOW IF PRESSURE CAP LEAKS BECAUSE OF RADIATOR FILLER NECK DAMAGE
4. DEFECTIVE WATER PUMP
   - a. ERODED OR BROKEN IMPELLER VANES
   - b. FAILED BEARING OR SEAL – CHECK FOR SHAFT OR BEARING PLAY
5. PLUGGED RADIATOR TUBES – SEND TO RADIATOR REPAIR SHOP FOR FLOW CHECK
6. INTERNAL SYSTEM LEAKS
   - a. HEAD GASKET – SEE CHASSIS SERVICE MANUAL
   - b. CRACKED BLOCK
   - c. TIMING CHAIN COVER
   - d. INTAKE MANIFOLD GASKET
7. PLUGGED COOLANT PASSAGES IN CYLINDER HEADS – REMOVE HEADS AND CHECK VISUALLY



*NOTE: THE TEMPERATURE STICK IS A PENCIL LIKE DEVICE WHICH HAS A WAX MATERIAL CONTAINING CERTAIN CHEMICALS WHICH MELT AT A GIVEN TEMPERATURE. THEMPERATURE STICKS CAN BE USED TO DETERMINE A THERMOSTAT'S OPERATING TEMPERATURE BY RUBBING 188°F. AND 206°F. STICKS ON THE THERMOSTAT HOUSING. THE MARKS MADE BY THE STICKS SHOULD MELT WHEN COOLANT TEMPERATURES OF 188°F. AND 206°F. ARE REACHED, RESPECTIVELY. THESE TEMPERATURES ARE THE NORMAL OPERATING RANGE OF THE THERMOSTAT, THEREFORE, IF THE COOLANT FLOWS AS INDICATED ON THE DIAGNOSIS CHART, THE THERMOSTAT MAY BE DEFECTIVE.

ON VEHICLE SERVICE

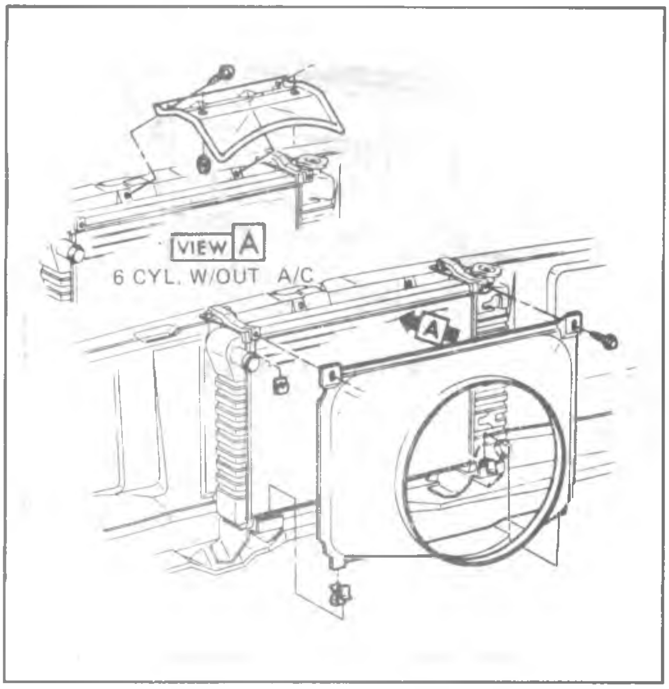


Fig. 6B-9--"G" Van Fan Shroud

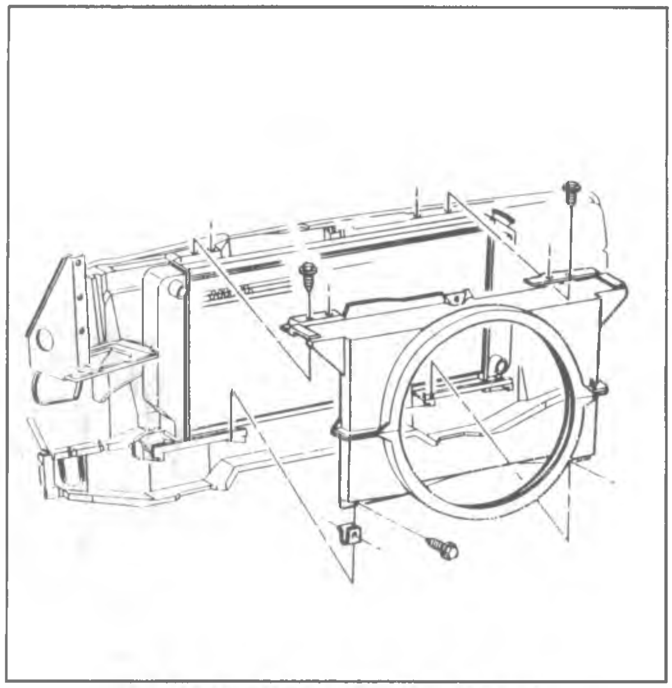


Fig. 6B-10 "G" Van Fan Shroud Diesel

FAN SHROUD (FIGS. 6B-9 THRU 6B-13)

Removal (CK Series)

1. Disconnect battery negative cable.
2. Remove fan shroud to radiator retainer attaching screws.
3. Remove fan clutch to water pump hub attachments.
4. Remove shroud by pulling up and out of lower retaining clips. Fan shroud and fan clutch assembly must be removed together.

Installation (CK Series)

1. Lower fan shroud and fan clutch along back of radiator. Make sure lower edge fits into lower retaining clips.
2. Install fan clutch to water pump attachments and torque to 27 N·m.
3. Install shroud to radiator retainer attaching screws. Torque to 6 N·m.
4. Connect battery negative cable.

Removal ("G" Series-V8 Engines)

1. Disconnect battery negative cable.
2. If A/C equipped, remove vacuum reservoir.
3. Remove windshield washer jar and bracket.
4. Remove shroud retaining screws.
5. Remove radiator support bracket.
6. Remove dip stick from engine (transmission also if equipped with automatic).

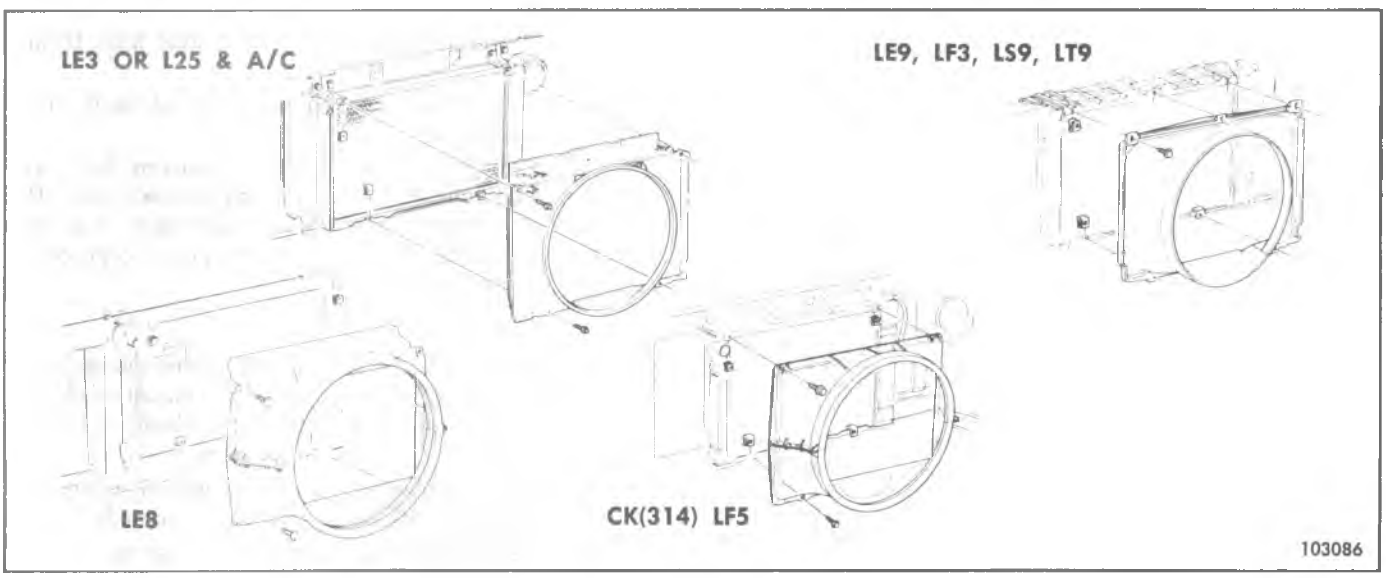


Fig. 6B-11--"CK" Series Fan Shroud

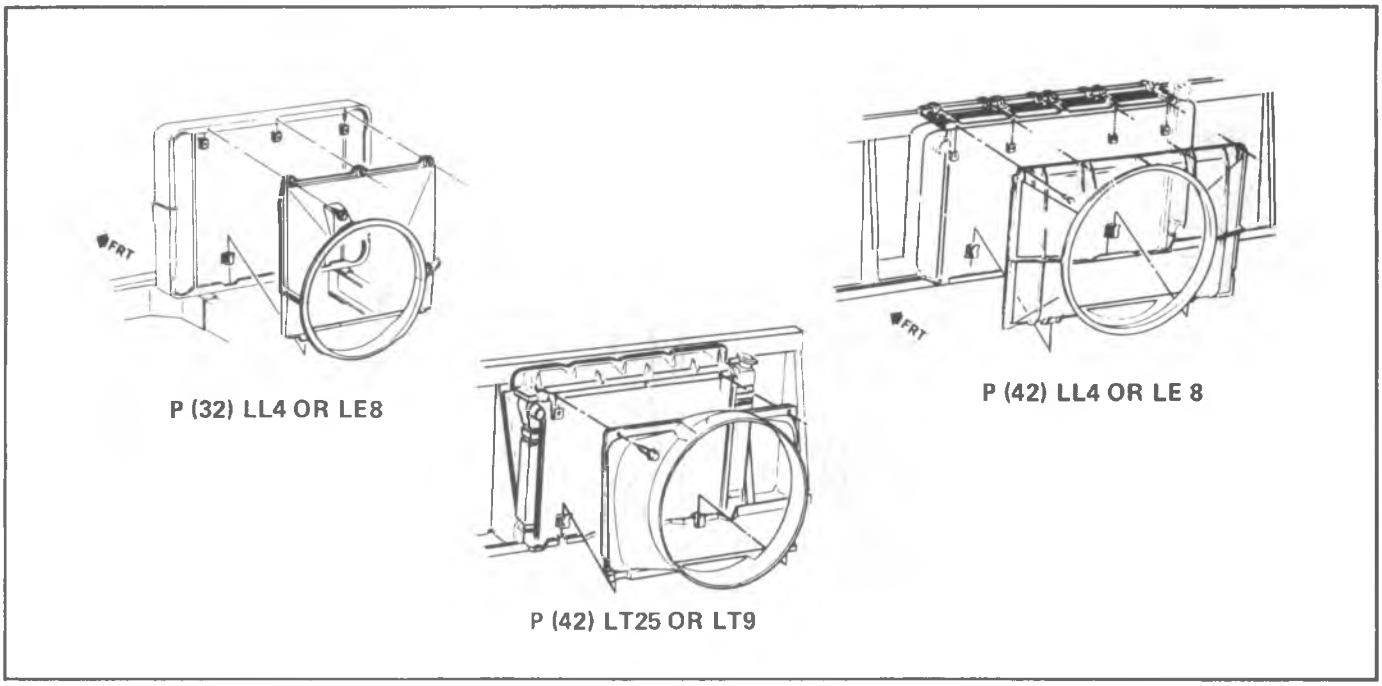


Fig. 6B-12--"P" Series Fan Shroud

7. Remove radiator hose strap from shroud.
8. Remove fan shroud from water pump (leave pulley), then remove fan and shroud together.

Installation ("G" Series-V8 Engines)

1. Install fan and shroud together then, attach fan to water pump.
2. Attach radiator hose strap to shroud.
3. Install dipstick in engine and, where applicable, in transmission.
4. Install radiator support bracket.
5. Install shroud retaining screws.
6. Install windshield washer jar and bracket.
7. If equipped with A/C, install vacuum reservoir.
8. Connect battery cable.

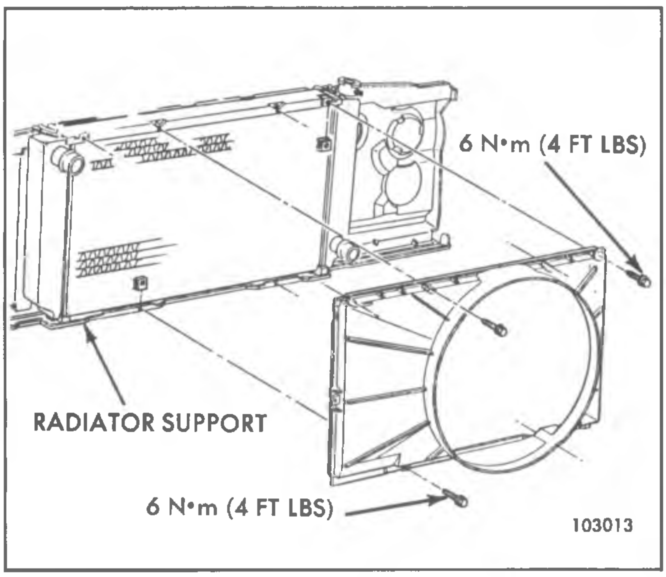


Fig. 6B-13--Fan Shroud 6.2L Diesel-CK Models

Removal (G Model Diesel)

1. Disconnect batteries.
2. Remove air cleaner intake (rotate snorkel up).
3. Remove fan shroud bolts.
4. Disconnect hood latch cable.
5. Remove windshield washer bottle.
6. Remove upper shroud.
7. For installation, reverse removal procedures.

WATER PUMP

Removal - L6

1. Disconnect battery negative cable at battery.
2. Drain cooling system.
3. Remove accessory drive belts.
4. Remove fan to water pump hub (or fan clutch to water pump hub) attaching bolts (or nuts) and remove fan and pulley.
5. Remove lower radiator hose and heater hose from water pump.
6. Remove water pump to block attaching bolts and remove water pump.
   - On some vehicles, the generator adjusting brace is retained by one of the water pump to block bolts. If necessary, loosen generator adjusting bolt to allow this brace to be moved away from pump to prevent removal interference.

Installation - L6

1. With clean sealing surfaces on both water pump and block, place new gasket on water pump, mount on block and retain with attaching bolts. Torque bolts to 15 lb. ft. (20 N·m).
   - If generator adjusting brace was moved, move to original position before torquing water pump bolts.
2. Install lower radiator hose and heater hose to pump.

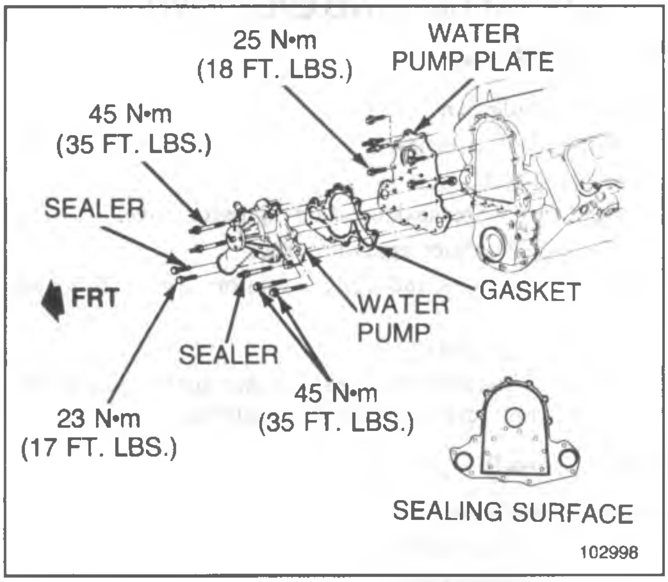


Fig. 6B-14--Water Pump 6.2L Diesel

3. Install water pump pulley and fan (or fan clutch assembly) on water pump hub. Torque retaining fasteners to 30 N·m (25 N·m if engine has fan clutch assembly).
4. Install accessory drive belts and adjust to specifications.
5. Connect battery negative cable.
6. Fill cooling system, as outlined in Owners Manual.
7. Start engine and run, with radiator cap removed, until radiator upper hose becomes hot (thermostat open).
8. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
9. Install cap, making sure arrows line up with overflow tube.

Removal - V8

1. Disconnect battery negative cable at battery.
2. Drain cooling system.
3. Remove accessory drive belts.
4. Remove fan to water pump hub (or fan clutch to water pump hub) attaching bolts (or nuts) and remove fan and pulley.
5. Remove generator lower brace to water pump attaching bolts and swing brace down and out of way.
6. Remove generator upper brace to water pump attaching bolts.
7. Remove lower radiator hose and heater hose from water pump. On 7.4 liter engine, remove by-pass hose.
8. Remove water pump to block attaching bolts and remove pump.

Installation - V8

If installing new water pump, transfer heater hose fitting from old unit. On 7.4 liter engine, also transfer by-pass fitting.

1. With clean sealing surfaces on both water pump and block, place a 1/8" (3mm) bead of RTV, #1052366 or equivalent, along the sealing edge of each water pump leg. Place pump against block and retain with attaching bolts. Torque bolts to 20 N·m.
2. Attach lower radiator hose and heater hose to water pump. On 7.4 liter engine, install by-pass hose.
3. Attach generator upper and lower braces to water pump. Torque bolts to 35 N·m.
4. Install water pump pulley and fan (or fan clutch) to water pump hub. Torque fasteners to 30 N·m.
5. Install accessory drive belts. Adjust to specifications.
6. Connect battery negative cable.
7. Fill cooling system, as outlined in Owners Manual.
8. Start engine and run, with radiator cap removed, until radiator upper hose becomes hot (thermostat open).
9. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
10. Install cap, making sure arrows line up with overflow tube.

Removal - Diesel (Fig. 6B-14)

1. Disconnect battery.
2. Remove fan.
3. Remove fan shroud.
4. Drain radiator.
5. If equipped with A/C, remove A/C hose bracket nuts.
6. Remove oil fill tube.
7. Remove generator pivot bolt and remove belt.
8. Remove generator lower bracket.
9. Remove power steering belt.
10. Remove power steering pump and lay aside.
11. Remove A/C belt if equipped.
12. Disconnect by-pass hose and lower radiator hose.
13. Remove water pump bolts.
14. Remove water pump plate and water pump.
15. If water pump gasket is to be repaired, remove plate attaching bolts to water pump and replace gasket.

Installation

At the time of installation, flanges must be free of oil. Apply anarobic sealer 1052357 or equivalent as shown in Figure 6B-14. Sealer must be wet to the touch when bolts are torqued.

1. Attach water pump and plate assembly.
2. Connect by-pass hose and lower radiator hose.
3. Install power steering pump.
4. Install generator.
5. Install drive belts and adjust.
6. Install oil fill tube.
7. Install fan shroud.
8. Install fan.
9. Fill coolant to proper level.
10. Connect battery.
11. Seat engine and check for leaks.

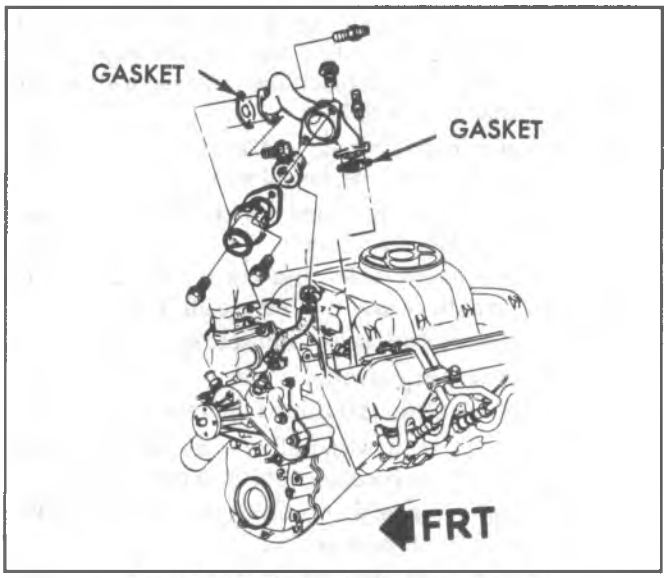


Fig. 6C6-15--Thermostat Housing (Diesel)

THERMOSTAT

Removal (Except 6.2L Diesel)

1. Disconnect battery negative cable at battery.
2. Drain cooling system until radiator coolant level is below thermostat.
3. Remove water outlet attaching bolts and remove outlet. Remove thermostat.

Installation (Except 6.2L Diesel)

Prior to installing thermostat, make sure thermostat housing and coolant outlet sealing surfaces are clean.

1. Place a 1/8" (3mm) bead of RTV sealer, #1052366 or equivalent, all around the coolant outlet sealing surface on the thermostat housing.
2. Place thermostat in housing.
3. Install coolant outlet while RTV is still wet. Torque retaining bolts to 20 lb. ft. (27 N·m).
4. Connect battery negative cable.
5. Fill cooling system, as outlined in Owners Manual.
6. Start engine and run, with radiator cap removed, until radiator upper hose becomes hot (thermostat open).
7. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
8. Install cap, making sure arrows line up with overflow tube.

Removal/Installation (Diesel)

1. Disconnect batteries.
2. On G Van, remove upper fan shroud.
3. Drain coolant.
4. On G Van, remove engine oil dipstick tube brace and oil fill brace.
5. Remove housing bolts.
6. Remove upper hose.
7. For installation, reverse removal steps.

THERMOSTAT HOUSING CROSSOVER

CK Truck (Diesel)

Removal/Installation

1. Disconnect batteries.
2. Drain coolant.
3. Remove crankcase depression regulator valve.
4. Remove generator upper bracket.
5. Remove by-pass and upper radiator hoses and heater hose.
6. Remove crossover.
7. Prior to installation, clean gasket surfaces, replace gaskets and reverse removal procedures.

G Van (Diesel)

Removal/Installation

1. Disconnect batteries.
2. Remove engine cover.
3. Remove air cleaner.
4. Remove air cleaner resonator and bracket.
5. Remove upper fan shroud.
6. Remove generator upper bracket.
7. Disconnect heater, radiator and bypass hoses at crossover.
8. Remove coolant crossover.
9. Prior to installation, clean gasket surfaces, replace gaskets and reverse removal procedures.

RADIATOR (FIGS. 6B-16 THRU 6B-20)

Removal (G & CK Series) Except 6.2L

1. Disconnect battery negative cable at battery.
2. Drain cooling system.
3. Remove radiator hoses from radiator.
4. Remove overflow hose from radiator.

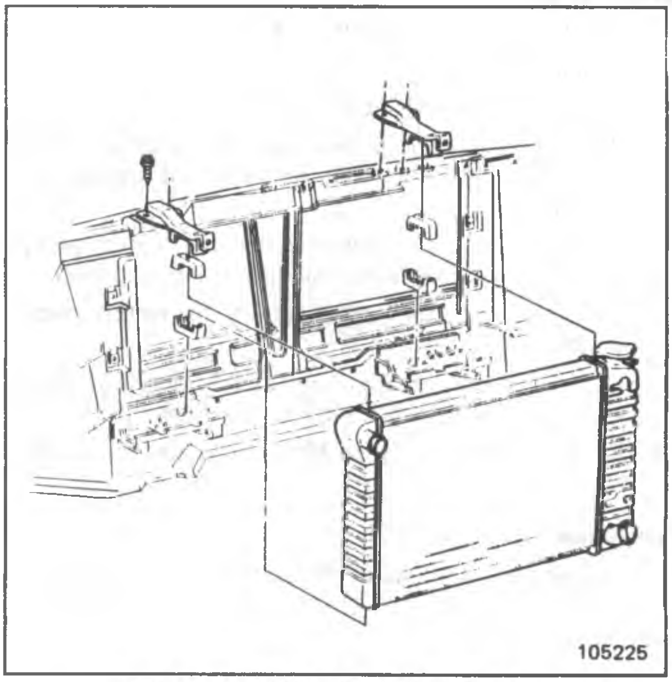


Fig. 6B-16--'G' Van Radiator Mounting

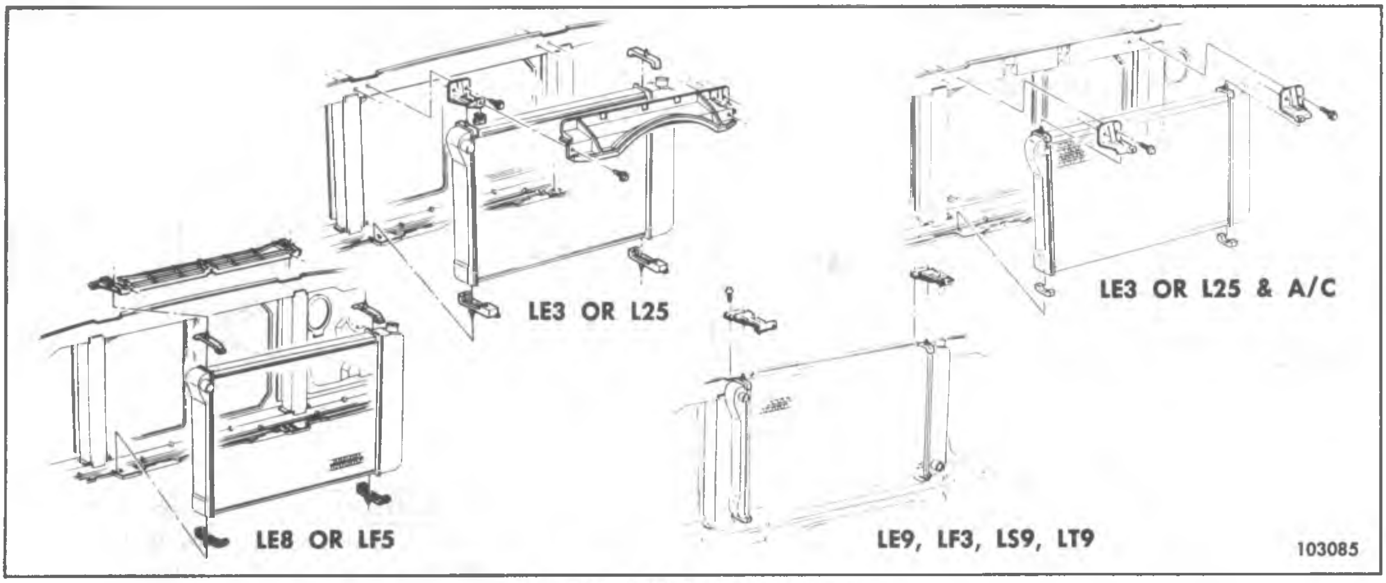


Fig. 6B-17--'CK' Radiator Mounting

5. Remove fan shroud, and disconnect transmission cooler lines.
6. Remove radiator to radiator support retainers (upper mounting panel on "CK") and remove radiator.

Installation

1. Place radiator in vehicle and install radiator to radiator support retainers.
2. Install fan shroud.
3. Connect overflow hose to radiator.
4. Connect radiator hoses to radiator.
5. Connect battery negative cable.
6. Fill cooling system, as outlined in Owners Manual.
7. Start engine and run, with radiator cap removed, until radiator upper hose beocmes hot (thermostat open).
8. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
9. Install cap, making sure arrows line up with overflow tube.

RADIATOR 6.2L DIESEL

CK Truck

Removal/Installation

1. Disconnect battery.
2. Drain coolant.
3. Remove fan shroud attaching screws.
4. Disconnect oil cooler lines.
5. Disconnect transmission cooler lines.
6. Disconnect radiator hoses.
7. Disconnect overflow hose.
8. Remove upper radiator supports.
9. Remove radiator.
10. For installation procedures, reverse removal procedures.

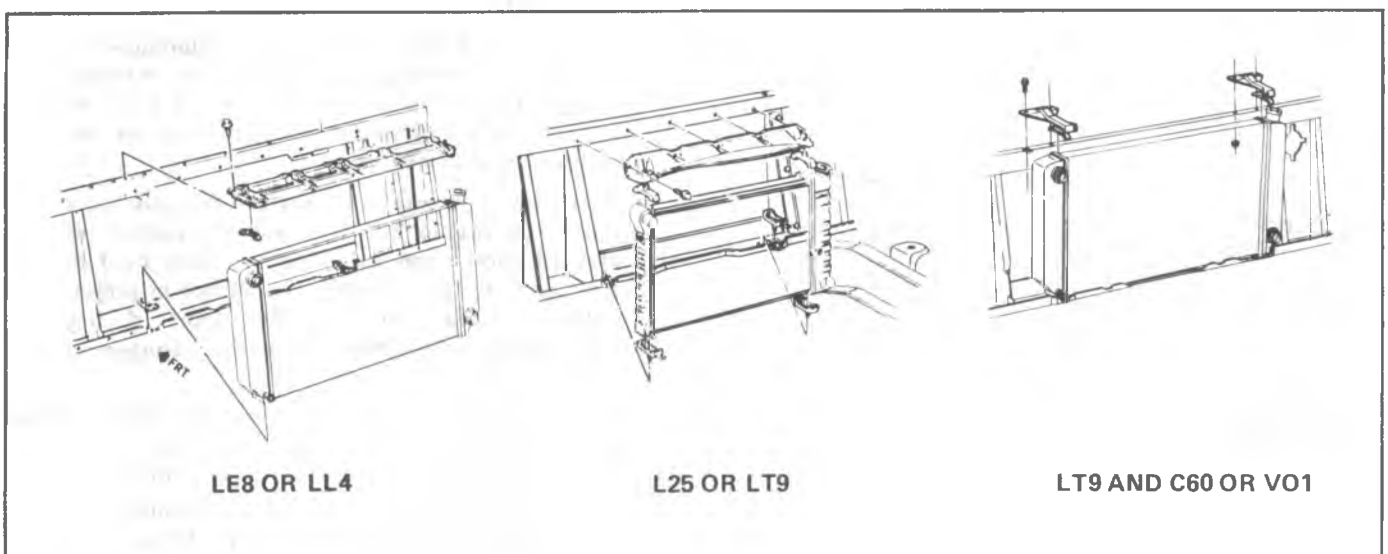


Fig. 6B-18--'P' (42) Radiator Mounting

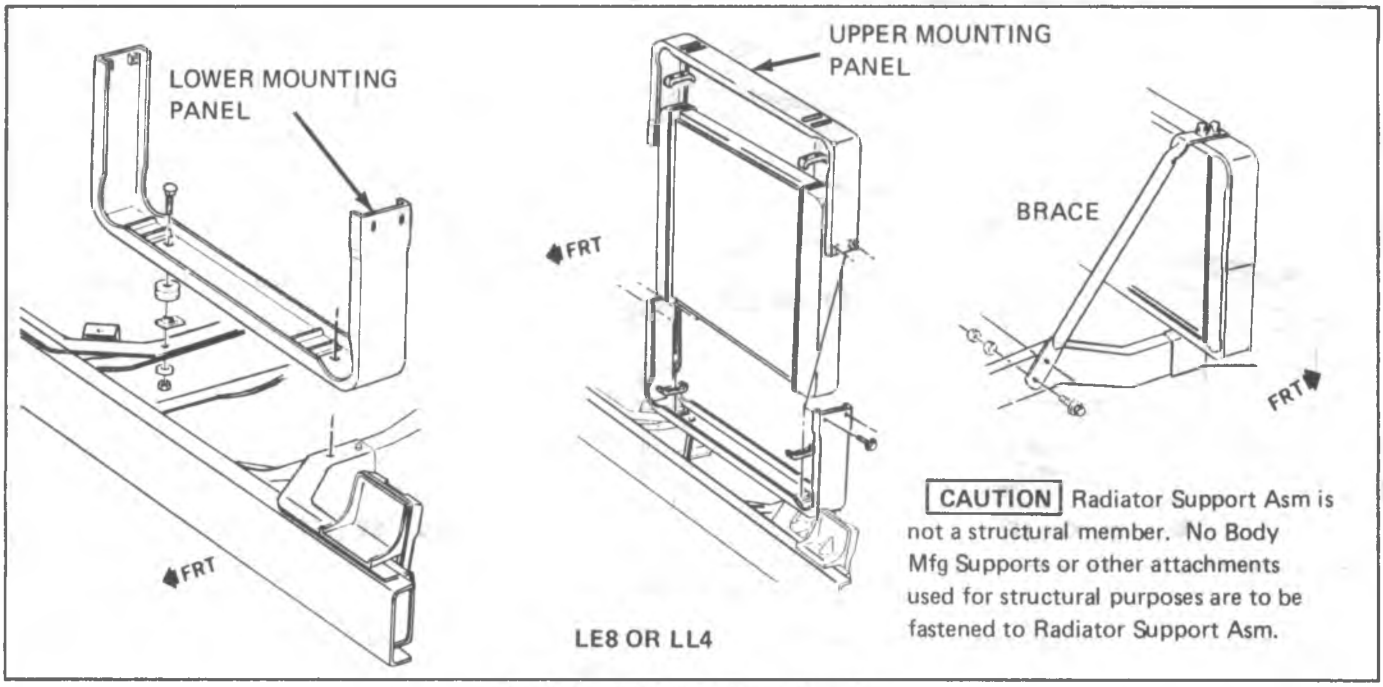


Fig. 6B-19--'P' (32) Radiator Mounting

G Van

Removal/Installation

1. Disconnect batteries.
2. Drain coolant.
3. Remove air intake snorkel.
4. Remove windshield washer bottle.
5. Disconnect hood release cable.
6. Remove upper fan shroud.
7. Disconnect upper radiator hose at radiator.
8. Disconnect transmission cooler lines.
9. Disconnect low coolant sensor.
10. Disconnect overflow hose.
11. Disconnect engine oil cooler lines.
12. Raise vehicle.

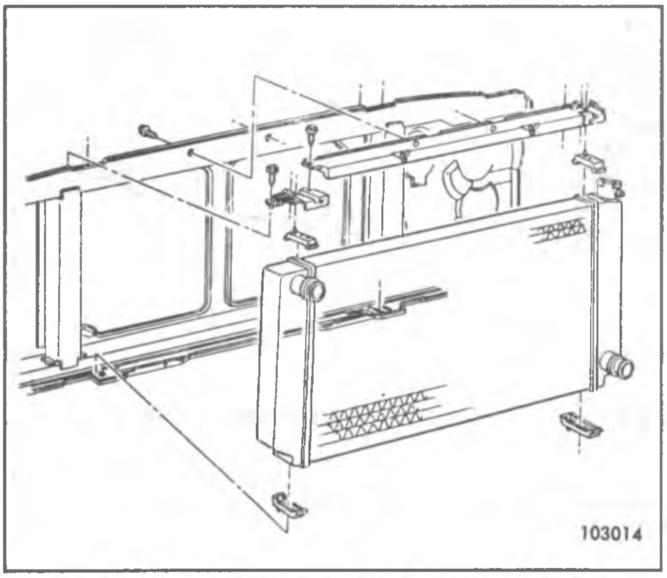


Fig. 6B-20--Radiator Mounting 6.2L Diesel CK Models

13. Disconnect lower radiator hose.
14. Lower vehicle.
15. Disconnect master cylinder from booster.
16. Remove radiator.
17. For installation, reverse removal procedures.

FAN/FAN CLUTCH

Removal (All)

1. Remove battery negative cable at battery.
2. Remove radiator fan shroud as required.
3. Remove fan clutch hub-to-water pump hub attaching bolts or nuts, as applicable, and remove fan clutch assembly.
4. Remove fan from fan clutch hub.

Installation (All)

CAUTION: If a fan blade is bent or damaged in any way, no attempt should be made to repair and/or reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new fan assembly.

CAUTION: It is essential that the fan assembly remain in proper balance. Balance cannot be assured once a fan assembly has been bent or damaged. A fan assembly that is not in proper balance could fail and fly apart during subsequent use, creating an extremely dangerous condition.

All mating surfaces (water pump hub and fan clutch hub) should be inspected for smoothness and reworked as necessary to eliminate burrs or other imperfections.

1. With fan on fan clutch hub, install fan clutch assembly to water pump hub. Torque attaching bolts, or nuts, to 20 lb. ft. (27 N·m). Be sure to align reference marks on both hubs.
2. Install radiator shroud as required.
3. Connect battery negative cable.

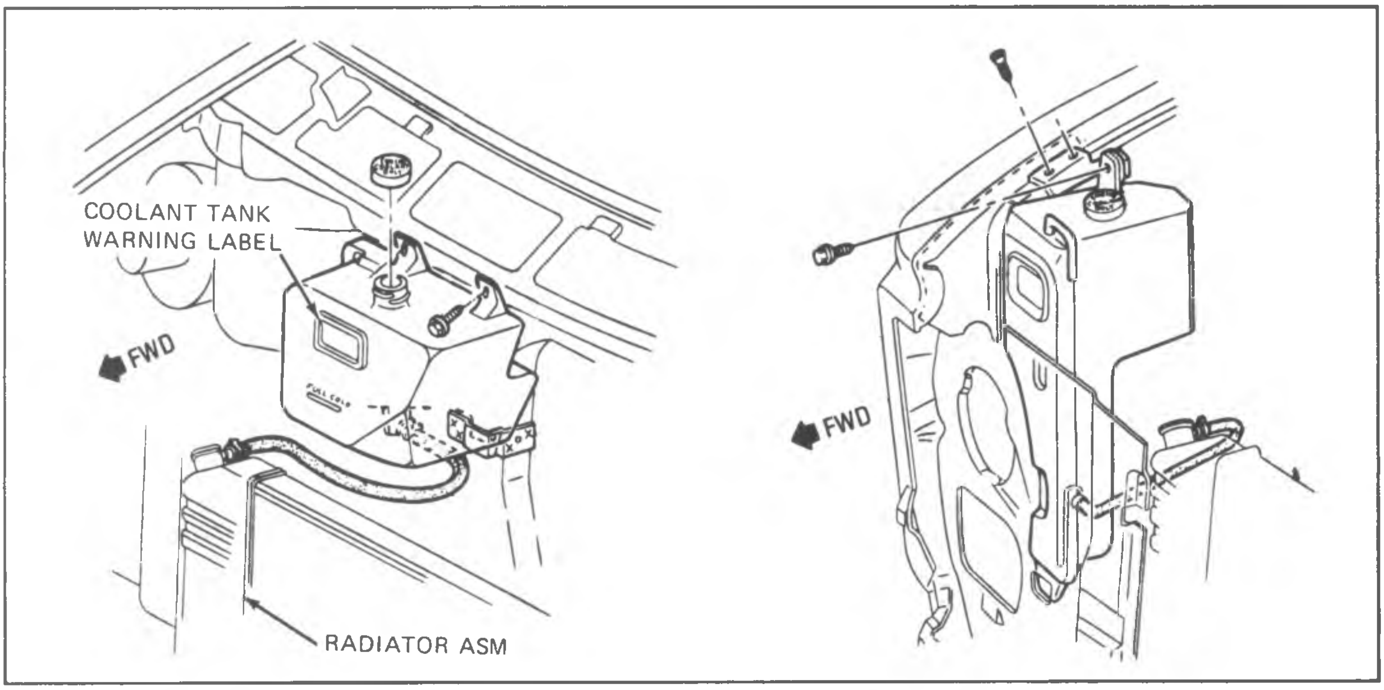


Fig. 6B-21--'G' Van Coolant Recovery Bottle

COOLANT RECOVERY BOTTLE (FIGS. 6B-21 & 6B-22)

Removal

1. Disconnect battery negative cable.
2. Remove coolant overflow hose from recovery bottle.
3. Remove recovery bottle retaining fasteners and remove bottle from vehicle.

Installation

When installing coolant recovery bottle, make sure unit is clean and free from contamination. If needed, wash bottle with soap and water. Rinse thoroughly.

1. Install bottle in vehicle and retain with appropriate fasteners.
2. Connect coolant overflow hose to recovery bottle.

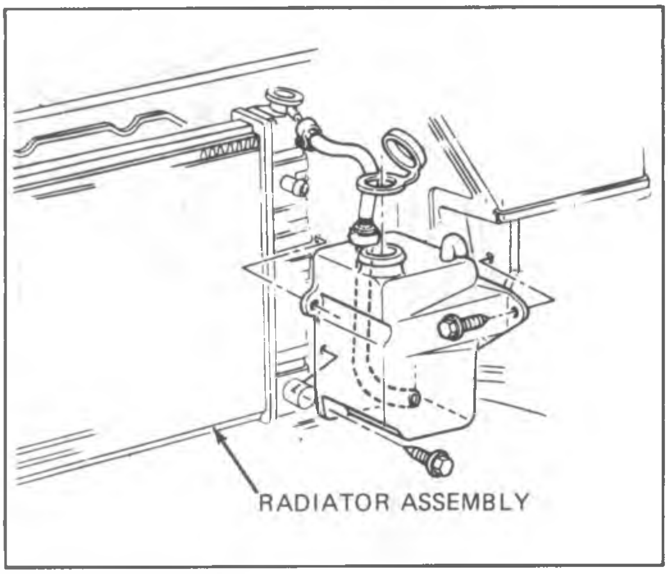


Fig. 6B-22--'CK' Series Coolant Recovery Bottle

3. Fill recovery bottle to appropriate mark, as outlined in Owners Manual.
4. Connect battery cable.

ENGINE OIL COOLER

All truck vehicle lines have available, as either standard or optional equipment, oil coolers for the engine oil. For the location of these units, refer to figures 6B-23 & 6B-24.

COOLANT LEVEL INDICATOR

Indicator Lamp Will Not Illuminate

1. Turn ignition switch to **CRANK** position. If lamp illuminates, lamp is ok and connector is properly installed on module, go to Step 2. If lamp does not illuminate, check bulb, socket, wiring between socket and module connector, and connector on module. Replace or repair as required.
2. Turn ignition switch to ON position and disconnect electrical lead at coolant level sensor on radiator. If lamp fails to illuminate, check wiring between coolant level sensor connector and module for short circuit to ground. If ok, replace module.

Indicator Lamp Remains Illuminated

1. Turn ignition switch to ON position and check coolant level. Add coolant if necessary. If indicator lamp remains illuminated, go to Step 2.
2. Disconnect electrical lead at coolant level sensor on radiator. Use a jumper wire and "G" electrical connector. If lamp does not illuminate, replace sensor. If lamp remains illuminated, connect electrical lead and go to Step 3.
3. Check for an open circuit between sensor and module. If an open circuit is found, repair. If no open circuit is found, replace module.

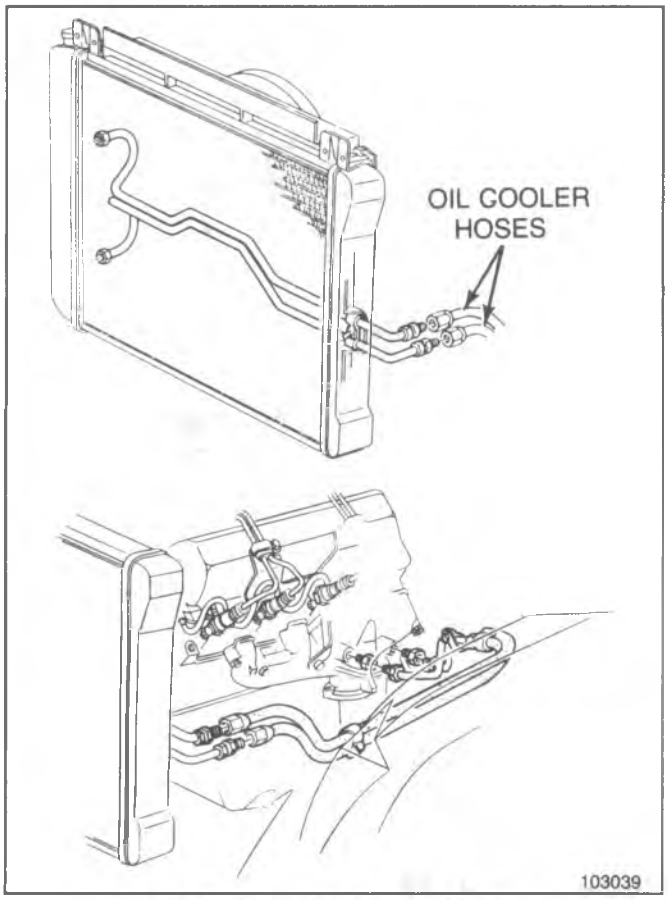


Fig. 6B-23--Engine Oil Cooler - 6.2L Diesel

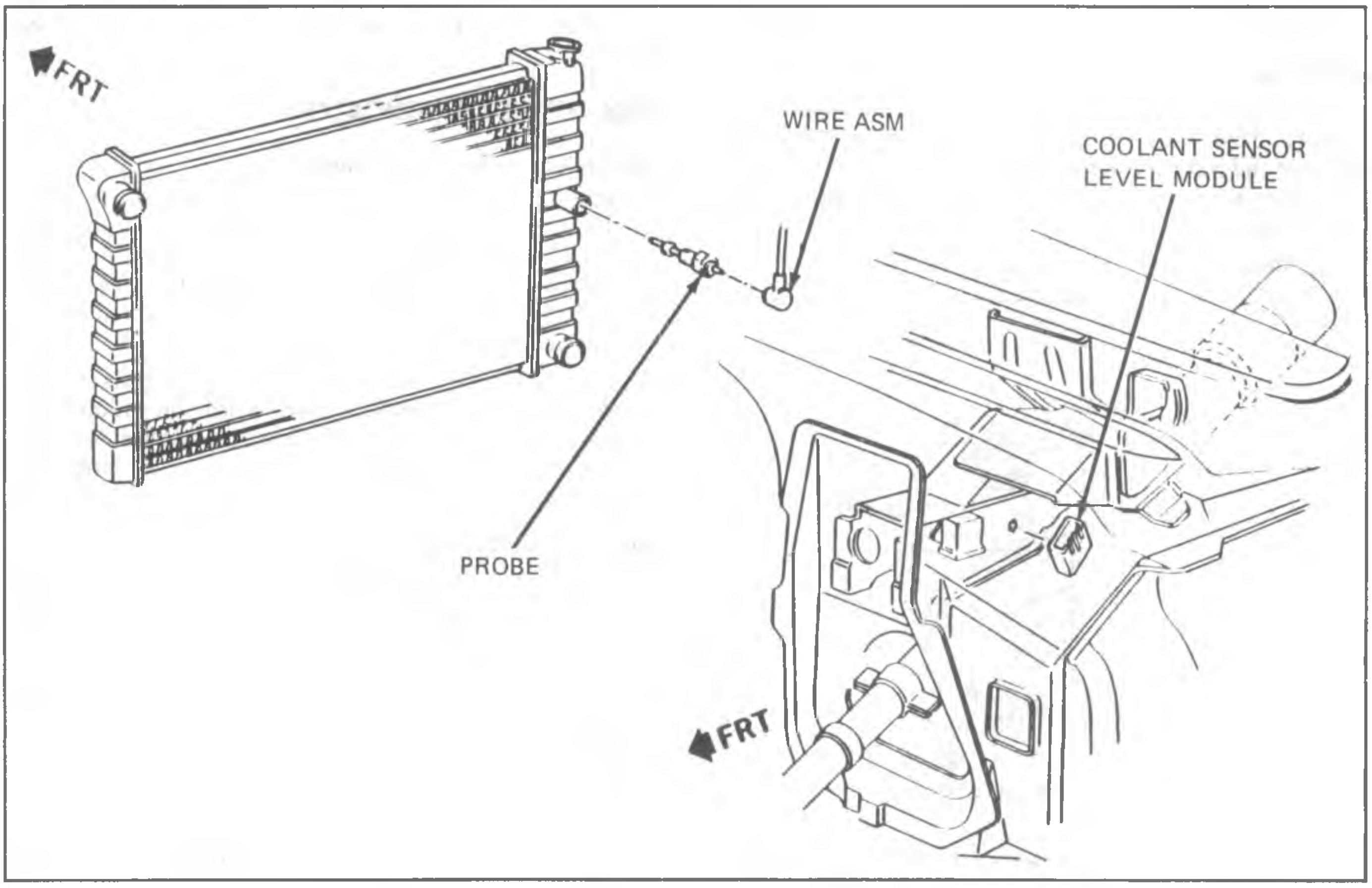


Fig. 6B-24 — Coolant Level Indicator

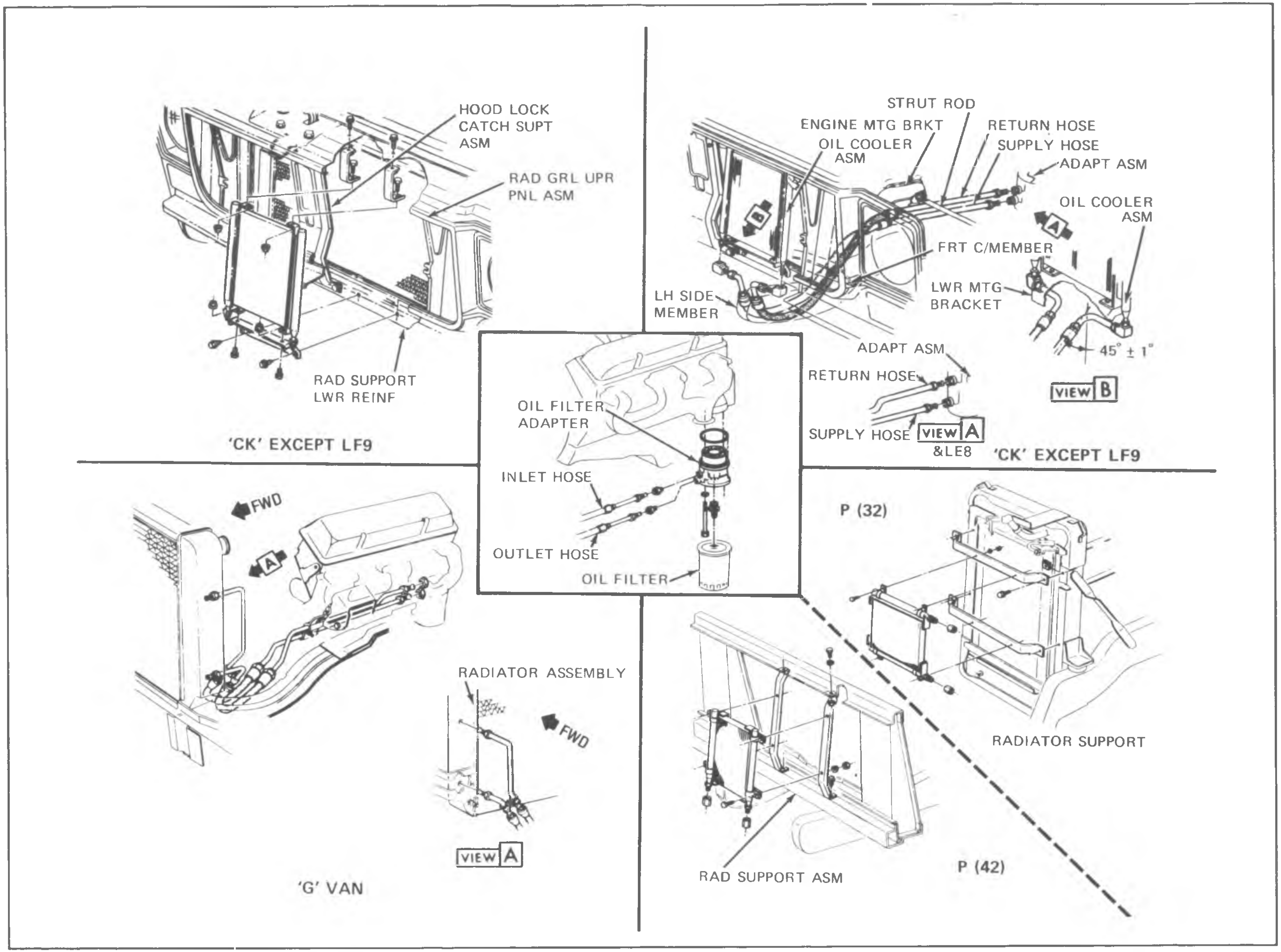


Fig. 6B-25 — Engine Oil Coolers Except Diesel

SECTION 6C

ENGINE FUEL - GASOLINE

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GENERAL INFORMATION

ALL NEW GM VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAP, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

Typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation.

NOTICE: All gasoline engines require the use of unleaded fuel only. Use of leaded and/or low lead fuel can result in engine damage and reduce the effectiveness of the Emission Control Systems.

DIAGNOSIS

Refer to Figures 6C-1 through 6C-10 for diagnosis of:

- Gasoline Fuel System (Fig. 6C-1 through 6C-8).
- Evaporative Emission Control System (Fig. 6C-9).
- Fuel Tank (Fig. 6C-10).

FUEL SYSTEM DIAGNOSIS

The following diagnostic procedures are for fuel system problems and their effects on vehicle performance. Other systems of the vehicle can also cause similar problems and should be checked when listed on the chart. The problem areas described are:

1. Engine cranks normally. Will not start.
2. Engine starts and stalls.
3. Engine starts hard.
4. Engine idles abnormally and/or stalls.
5. Inconsistent engine idle speeds.
6. Engine diesels (after-run) upon shut off.
7. Engine hesitates on acceleration.
8. Engine has less than normal power at low speeds.
9. Engine has less than normal power on heavy acceleration or at high speed.
10. Engine surges.
11. Poor gas mileage.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start	Improper starting procedure used.	Check with the customer to determine if proper starting procedure is used, as outlined in the Owner's Manual.
	Choke valve not operating properly.	Check the choke valve and/or linkage as necessary. Replace parts if defective. If caused by foreign material and gum, clean with suitable non-oil base solvent.
	No fuel in carburetor.	• Perform fuel pump flow test. • Inspect fuel inlet filter. If plugged, replace. • If fuel filter is okay, remove air horn and check for a bind in the float mechanism or a sticking inlet needle. If okay, adjust float as specified.
	Engine flooded. To check for flooding, remove the air cleaner with the engine immediately shut off and look into the carburetor bores. Fuel will be dripping off nozzles.	Remove the air horn. Check fuel inlet needle and seat for proper seal. If a needle and seat tester is not available, apply vacuum to the needle seat with needle installed. If the needle is leaking, replace. Check float for free movement, bent float hanger or binds in the float arm. If foreign material is in fuel system, clean the system and replace fuel filters as necessary. If excessive foreign material is found, completely disassemble and clean.

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Fig. 6C-1--Fuel System Diagnosis - 1 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts — Will Not Keep Running	Fuel pump.	Check fuel pump pressure and volume, replace if necessary.
	Idle speed.	Check per Emission Label.
	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses — correct as necessary.
	Engine does not have enough fast idle speed when cold.	Check for free movement of fast idle cam. Clean and/or realign as necessary.
	Choke vacuum break units are not adjusted to specification or are defective.	Adjust both vacuum break assemblies to specification. If adjusted okay, check the vacuum break units for proper operation as follows: To check the vacuum break units, apply a constant vacuum source of at least 10" Hg., plungers should slowly move inward and hold vacuum. If not, replace the unit. Always check the fast idle cam adjustment when replacing or adjusting vacuum break units.
	Choke valve sticking and/or binding.	Clean and align linkage or replace if necessary.
	Insufficient fuel in carburetor.	Check fuel pump pressure and volume. Check for partially plugged fuel inlet filter. Replace if contaminated. Check the float level adjustment for binding condition. Adjust as specified.
Engine Starts Hard (Cranks Normally)	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses — correct as necessary. See Emission Label.
	Incorrect starting proceaure.	Check to be sure customer is using the starting procedure outlined in Owner's Manual.

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Fig. 6C-2--Fuel System Diagnosis - 2 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts Hard (Cranks Normally) (Continued)	Malfunction in accelerator pump system.	Check accelerator pump adjustment and operation. Check pump discharge ball for sticking or leakage.
	Choke valve not closing.	Check choke valve and linkage for binds and alignment. Clean and repair or replace as necessary.
	Vacuum breaks misadjusted or malfunctioning.	Check both vacuum break assemblies to specifications.
	Insufficient fuel in bowl.	Check fuel pump pressure and volume. Check for partially plugged fuel inlet filter. Replace if dirty. Check float mechanism. Adjust as specified.
	Flooding.	Check float and needle and seat for proper operation.
	Slow engine cranking speed.	Refer to starting circuit diagnosis. Section 6D.
	Closed Loop Emission Control or Computer Command Control.	See Engine Emission Section.
Engine starts but will not continue to run or will run but surges and backfires	Faulty fuel pump.	Perform fuel pump test. Remove and replace fuel pump as required.
Engine will not start	Faulty fuel pump.	Remove and replace fuel pump as required.
Engine Idles Abnormally (Too fast or too slow)	Idle speed.	Check per Emission Label.
	Air leaks into carburetor bores beneath throttle valves, manifold leaks, or vacuum hoses disconnected or installed improperly.	Check all vacuum hoses and restrictors leading into the manifold or carburetor base for leaks or being disconnected. Install or replace as necessary. Torque carburetor to manifold bolts. Using a pressure oil can, spray light oil or kerosene around manifold to head surfaces and carburetor throttle body. NOTE: Do not spray at throttle shaft ends. If engine RPM changes, tighten or replace the carburetor or manifold gaskets as necessary.
	Clogged or malfunctioning PCV system.	Check PCV system. Clean and/or replace as necessary.
	Carburetor flooding.	Remove air horn and check float adjustment.
	Check by using procedure outlined under "Engine Flooded."	Check float needle and seat for proper seal. If a needle and seat tester is not available, apply vacuum to the needle seat with needle installed. If the needle is leaking or damaged, replace.

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Fig. 6C-3--Fuel System Diagnosis - 3 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Idles Abnormally (Too fast or too slow) (Continued)		Check float for free movement. Check for bent float hanger or binds in the float arm.
		If foreign material is found in the carburetor, clean the fuel system and carburetor. Replace fuel filter as necessary.
	Restricted air cleaner element.	Replace as necessary.
	Idle system plugged or restricted.	Clean carburetor, see Unit Repair.
	Incorrect idle mixture adjustment.	Readjust per specified procedure.
	Throttle blades or linkage sticking and/or binding.	Check throttle linkage and throttle blades (primary and secondary) for smooth and free operation. Correct problem areas.
Engine Diesels (After Run) upon Shut Off	Loose, broken or improperly routed vacuum hoses.	Check condition and routing of all vacuum hoses. Correct as necessary. (Refer to Emission Label)
	Idle speed.	Check per instructions on Emission Label.
	Fast idle cam not fully off.	Check fast idle cam for freedom of operation. Clean, repair, or adjust as required.
		Check choke linkage for binding. Clean and correct as necessary.
	Excessively lean carburetor.	Refer to Mixture Control Adjustments.
	Ignition Timing retarded.	Set to specifications.
Engine Hesitates On Acceleration	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses — correct or replace.
	Accelerator pump not adjusted to specification or inoperative.	Adjust accelerator pump, replace.
	Inoperative accelerator pump system.	Remove air horn and check pump cup. If cracked, scored or distorted, replace the pump plunger.

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Fig. 6C-4--Fuel System Diagnosis - 4 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Hesitates On Acceleration (Continued)	NOTE: a quick check of the pump system can be made as follows: With the engine off, look into the carburetor bores and observe pump nozzles while quickly opening throttle lever. A full stream of fuel should emit from each pump nozzle.	Check the pump discharge ball for proper seating and location.
	Foreign matter in pump passages.	Clean and blow out with compressed air.
	Float level too low	Check and reset float level to specification.
	Front vacuum break diaphragm not functioning properly.	Check operation of vacuum break diaphragm.
	Air valve malfunction.	Check operation of secondary air valve. Check spring tension adjustment.
	Inoperative air cleaner heated air control.	Check operation of thermostatic air cleaner system.
	Fuel filter dirty or plugged.	Replace filter and clean fuel system as necessary.
	Distributor malfunctioning.	Check for proper operation.
	Timing not to specifications.	Adjust to specifications.
	Choke coil.	Check operation.
	EGR valve stuck open.	Inspect and clean EGR valve.
	Closed Loop Emission Control or Computer Command Control.	See Engine Emission Section.
Engine Has Less Than Normal Power At Normal Accelerations	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses.
	Clogged or defective PCV system.	Clean or replace as necessary.
	Choke sticking.	Check complete choke system for sticking or binding. Clean and realign as necessary. Check adjustment of choke thermostatic coil.
		Check jets and channels for plugging; clean and blow out passages.

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Fig. 6C-5--Fuel System Diagnosis - 5 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Has Less Than Normal Power At Normal Accelerations (Continued)	Air cleaner temperature regulation improper.	Check regulation and operation of air cleaner system.
	Transmission malfunction.	Refer to transmission diagnosis.
	Ignition system malfunction.	Check ignition system. See Section 6D. Refer to E.S.T. diagnosis.
	Exhaust system.	Check for restrictions. Correct as required.
	Closed Loop Emission Control or Computer Command Control.	See Engine Emission Section.
Less Than Normal Power On Heavy Acceleration Or At High Speed	Carburetor throttle valves not going wide open. Turn off engine and check by pushing accelerator pedal to floor.	Correct throttle linkage to obtain wide open throttle in carburetor.
	Secondary throttle lockout not allowing secondaries to open.	Check for binding or sticking lockout lever.
		Check for free movement of fast idle cam.
	Spark plugs fouled, incorrect gap.	Clean, regap, or replace plugs.
	Plugged air cleaner element.	Replace element.
	Air valve malfunction. (Where applicable)	Check for free operation of air valve.
		Check spring tension adjustment. Make necessary adjustments and corrections.
	Plugged fuel inlet filter.	Replace with a new filter element.
	Insufficient fuel to carburetor.	Check fuel pump and system, run pressure and volume test.
	Choke closed or partially closed.	Free choke valve or linkage.
	Float level too low.	Check and reset float level to specification.

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Fig. 6C-6--Fuel System Diagnosis - 6 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Less Than Normal Power On Heavy Acceleration Or At High Speed (Continued)	Transmission malfunction.	Refer to transmission diagnosis.
	Ignition system malfunction.	Check ignition system. See Section 6D.
	Fuel metering jets restricted.	If the fuel metering jets are restricted and an excessive amount of foreign material is found in the fuel bowl, the carburetor should be completely disassembled and cleaned.
	Fuel pump.	Check fuel pump pressure and volume, inspect lines for leaks and restrictions.
	Exhaust system.	Check for restrictions. Correct as required.
	Closed Loop Emission Control or Computer Command Control.	See Engine Emission Section.
Engine Surges	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses. Correct as necessary.
	PCV system clogged or malfunctioning.	Check PCV system. Clean or replace as necessary.
	Loose carburetor,EGR or intake manifold bolts and/or leaking gaskets.	Torque carburetor to manifold bolts.
		Using a pressure oil can, spray light oil or kerosene around manifold to head mounting surface and carburetor base. If engine RPM changes, tighten or replace the carburetor or manifold gaskets as necessary. Check EGR mounting bolt torque.
	Low or erratic fuel pump pressure.	Check fuel delivery and pressure.
	Contaminated fuel.	heck for contaminants in fuel. Clean system if necessary.
	Fuel filter plugged.	Check and replace as necessary.
	Float level too low.	Check and reset float level to specification.
	Malfunctioning float and/or needle and seat.	Check operation of system. Repair or replace as necessary.
	Fuel jets or passages plugged or restricted.	Clean and blow out with compressed air.
	Ignition system malfunction.	Check ignition system. See Section 6D.
	Exhaust system.	Check for restrictions. Correct as necessary.
	Closed Loop Emission Control or Computer Command Control.	See Engine Emission Section.
Poor Gas Mileage	Customer driving habits.	Run mileage test with customer driving if possible. Make sure car has 2000-3000 miles for the "break-in" period.

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Fig. 6C-7--Fuel System Diagnosis - 7 of 8

FUEL SYSTEM DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Poor Gas Mileage (Continued)	Loose, broken or improperly routed vacuum hoses.	Check condition of all vacuum hose routings. Correct as necessary.
	Engine in need of service.	Check engine compression, examine spark plugs; if fouled or improperly gapped, clean and regap or replace. Check ignition wire condition and check and reset ignition timing. Replace air cleaner element if dirty. Check for restricted exhaust system and intake manifold for leakage. Check carburetor mounting bolt torque. Check vacuum and mechanical advance.
	Fuel leaks.	Check fuel tank, fuel lines and fuel pump for any fuel leakage.
	Closed Loop Emission Control or Computer Command Control.	See Engine Emission Section.
Poor Gas Mileage and/or Black Smoke from Tail Pipe	High fuel level in carburetor.	Check fuel inlet needle and seat for proper seal. Test, using suction from a vacuum source. If needle is leaking, replace. Check for loaded float. Reset float level to specification. If excessive foreign material is present in the carburetor bowl, the carburetor should be cleaned.
	Choke system.	Check choke linkage for binding. Clean or repair as required. Check thermostatic coil. Check electric choke wiring.
	Plugged air cleaner element.	Replace element.
	Exhaust system.	Check for restrictions. Correct as required.
	Low tire pressure or incorrect tire size.	Inflate tires to specifications and use correct size tires.
	Evaporative emission canister.	See evaporative section (Diagnosis).
	Transmission malfunction or in wrong gear.	Refer to transmission diagnosis.
Car feels like it is running out of gas — surging occurs in mid-speed range	Plugged fuel filters.	Remove and replace filters.
	Faulty fuel pump.	Perform fuel pump test. Remove and replace fuel pump as required.
	Foreign material in fuel system or kinked fuel pipes or hoses.	Inspect pipes and hoses for kinks and bends, blow out to check for plugging. Remove and replace as required.

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Fig. 6C-8--Fuel System Diagnosis - 8 of 8

DIAGNOSIS
EVAPORATIVE CONTROL SYSTEM

CONDITION	POSSIBLE CAUSE	CORRECTION
Evidence of fuel loss or fuel vapor odor A) From area of fuel tank or fuel cap — Perform pressure check to determine possible causes	1. Leaking or plugged fuel or EVAP hoses.	1. Repair or replace hoses as necessary.
	2. Leaking fuel cap.	2. Repair or replace cap as necessary.
	3. Leaking fuel filler neck.	3. Repair or replace as necessary.
	4. Fuel filler neck gasket surface nicked, burred, or dented.	4. Repair or replace as necessary.
	5. Leaking sending unit or gasket.	5. Repair or replace as necessary.
	6. Plugged or inoperative tank pressure control valve.	6. Repair or replace as necessary.
B) From under hood — Perform pressure check to determine possible causes	1. Liquid fuel leaking from fuel lines, fuel pump or carburetor.	1. Tighten fuel lines, repair or replace fuel pump or carburetor as necessary.
	2. Cracked or damaged canister.	2. Repair or replace canister as necessary.
	3. Inoperative bowl vent valve. (See Bowl Vent Check Procedures).	3. Repair or replace hoses. Replace canister.
	4. Inoperative purge valve. (See Purge Valve Check Procedures).	4. Repair or replace hoses. Replace canister.
	5. Disconnected, misrouted, kinked, deteriorated or damage vapor hoses or control hoses.	5. Check for proper connections, and check routing as well as condition. Correct as necessary.
	6. Bowl vent hose misrouted.	6. Reroute hose without low spots.
	7. Air cleaner or air cleaner gasket improperly seated.	7. Reinstall air cleaner and/or replace gasket.
	8. Leaking or inoperative tank pressure control valve.	8. Repair or replace as necessary.
Poor idle or driveability or driveability slugging	1. Inoperative purge valve. (See Purge Valve Check Procedures).	1. Replace or repair hoses. Replace canister.
	2. Inoperative bowl vent valve. (See Bowl Vent Check Procedures).	2. Repair or replace hoses. Replace canister.
	3. Vacuum leak at tank pressure control valve.	3. Repair or replace hoses and/or valve.
Collapsed fuel tank (Loss of tank capacity)	1. Plugged or pinched vapor pipe or hoses and defective cap.	1. Check all lines from tank to canister and replace cap.
	2. Canister filter plugged and defective cap.	2. Replace filter in canister and cap.
	3. Plugged or ruptured diaphragm in tank pressure control valve and defective cap.	3. Replace tank pressure control valve and cap.

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Fig. 6C-9--Evaporative Control System

DIAGNOSIS
FUEL TANK

CONDITION	POSSIBLE CAUSE	CORRECTION
Gasoline Odor	1. Tank overfilled.	Do not "pack" tank. Fill to automatic shut-off.
	2. Fuel feed line leaking.	Correct as required.
	3. Leak in fuel tank.	Purge tank and repair or replace tank as required.
	4. Disconnected fuel vapor pipe or hoses.	Connect pipe or hoses as required.
	6. Faulty fill cap or tank neck.	Install new cap or tank neck as required.
Collapsed Fuel Tank	1. Plugged or pinched vapor pipe or hoses, & defective cap.	Check all lines from tank to canister and replace cap.
	2. Canister filter plugged & defective cap.	Replace filter in canister & cap.
Fuel Tank Rattles	1. Mounting straps loose.	Tighten straps to specifications.
	2. Baffle loose.	Replace fuel tank.
	3. Foreign material in tank.	Remove tank and clean.
Fuel Starvation	1. Tank gage unit filter plugged.	Replace filter.
	2. Fuel line pinched, plugged or mis-routed.	Check open or re-route as required.

Fig. 6C-10--Fuel Tank Diagnosis

6.2L WATER IN FUEL DETECTOR DIAGNOSIS

OPERATION

The Diesel "Water in Fuel" system uses an electronic water detector mounted inside the fuel tank on the fuel gage sender. The detector will warn the driver when 1 - 2½ gallons of water are present in the fuel tank by lighting a "Water in Fuel" light on the instrument panel. The light will also come on for 2-5 seconds each time the ignition is turned on. This bulb check assures the driver the light is working. If there is water in the fuel, the light will come back on after a 3-6 second off delay, and then remain on.

WATER IN FUEL LIGHT ON AT ALL TIMES

With ignition on disconnect 2 wire connector at rear of fuel tank and check water in fuel light.

- LIGHT ON → Locate and repair short to ground in yel/blk wire from 2 wire connector to IP water in fuel lamp.
- LIGHT OFF → Drain fuel tank per draining instructions. Connect 2 wire connector and check water in fuel light.
  - LIGHT ON → Remove tank unit Check wires for short circuits. If OK, replace detector.
  - LIGHT OFF → Normal - fuel had water in it.

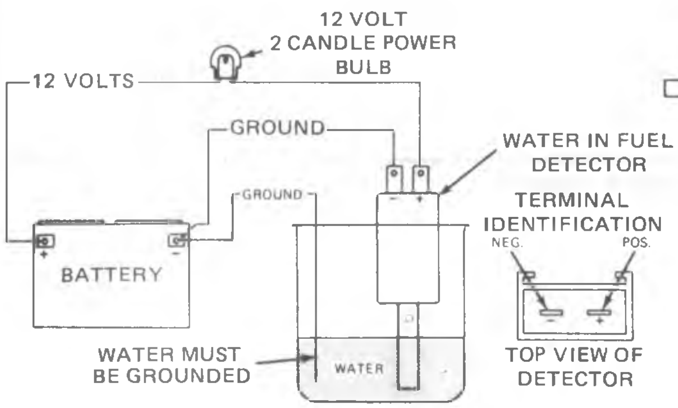
WATER IN FUEL LIGHT DOES NOT COME ON DURING BULB CHECK

With ignition on disconnect 2 wire connector at rear of fuel tank and ground the yel/blk wire in the body harness. Check water in fuel light.

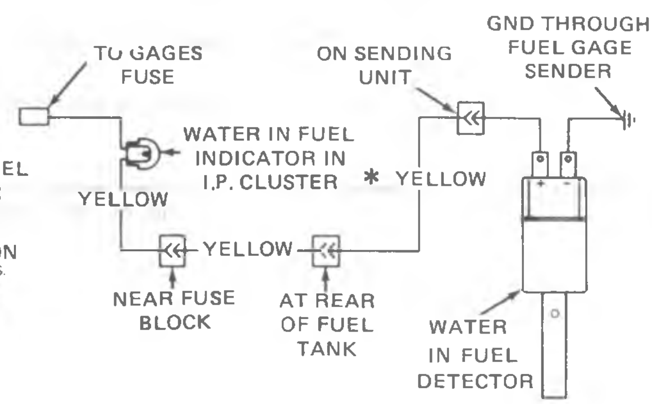
- LIGHT ON → Remove fuel gage tank unit and check yellow wire for opens. Check connections to water in fuel detector and mounting screw-must be tight. If OK, replace water in fuel detector.
- LIGHT OFF → Check water in fuel bulb. If OK, check for open circuit in yellow wire from 2 wire connector at rear of tank to IP water in fuel lamp socket.

TESTING WATER IN FUEL DETECTOR

Connect water in fuel detector as shown using a 12V 2-C.P. bulb. There must be a ground circuit to the water for the detector to work. The light will turn on for 2-5 seconds then dim out. It will then turn back on (after 3-6 second delay) when about 3/8" of the detector probe is in the water. Refer to illustration for test set-up.



TEST SET-UP



WATER IN FUEL DETECTOR CIRCUIT

Fig. 6C-10a--Water In Fuel Detector

FUEL FILTER

GENERAL DESCRIPTION

All gasoline engine fuel filters are located in the carburetor fuel inlet. These fuel filter elements are of pleated paper. Elements are placed in the inlet hole with the gasket surface outward. A spring holds the element outward, sealing it by compressing a gasket surface against the inlet fitting.

ON-VEHICLE SERVICE

The carburetor inlet fuel filter should be replaced at intervals shown in Section 0B. A plugged filter and/or check valve will restrict fuel flow.

After assembling any filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

Other Filters or Strainers

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally required no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water; the tank should therefore be removed and thoroughly cleaned.

Fuel Filter Replacement

1. Disconnect fuel line connection at fuel inlet filter nut.
2. Remove fuel inlet filter nut from carburetor.
3. Remove filter and spring.
4. If removed, install check valve in fuel inlet filter.

   The fuel inlet check valve must be installed in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter must include the check valve.
5. Install fuel inlet filter spring, filter, and check valve assembly in carburetor. Check valve end of filter faces toward fuel line. Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.
6. Install new gasket on fuel inlet filter nut and install nut in carburetor. Tighten nut to 24 N·m (18 ft. lbs.). Tightening beyond specified torque can damage gasket.
7. Install fuel line and tighten connection.
8. Start engine and check for leaks.

FUEL PUMP

GENERAL DESCRIPTION

The fuel pump (Figs. 6C-11 through 6C15) is a diaphragm type pump and is actuated by the rocker arm through a link and a push rod.

Some vehicles have a fuel pump with an outlet for a vapor return system. Any vapor which forms is returned to the fuel tank along with hot fuel through a separate line. This greatly reduces any possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump.

DIAGNOSIS

Complete diagnosis of all possible causes of the trouble prior to replacement of the fuel pump will save time, expense and possible causes of the trouble prior to replacement of the fuel pump will save time, expense and possibly prevent a repeat complaint.

Low Pressure Complaint

The only way to check fuel pump pressure is by connecting an accurate pressure gage to the fuel line at carburetor level. Never replace a fuel pump without first making that simple check.

Not Enough Fuel Flow Complaint

When an engine has a "starving-out" condition, many mechanics jump to the conclusion that the fuel pump is not pumping enough fuel. Many times the "starving-out" condition is actually due to a weakness in the ignition system, since these two troubles are very hard to separate. Even when an engine is starving for fuel, the cause is more likely to be a plugged fuel filter or a restricted fuel line than a malfunctioning fuel pump.

ON-VEHICLE SERVICE

Inspection and Test

If the fuel system is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested in the vehicle, as follows:

Inspection of Fuel System

1. Make certain that there is fuel in the tank.
2. With the engine running, inspect for leaks at all fuel feed hose connections from fuel tank to carburetor. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air leaks or restrictions on suction side of mechanical fuel pump will seriously affect pump output.
3. Inspect for leaks at fuel pump diaphragm flange.
4. Disconnect feed pipe near carburetor.
5. Disconnect distributor connectors so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If no fuel, or only a little flows from pipe, the feed line is clogged or fuel pump is inoperative. Before condemning the fuel pump, disconnect feed line at both ends and blow through it with air hose to make certain that fuel pump is operating within specifications.

Fuel Pump Pressure Test

1. Disconnect fuel line at pump and connect a suitable pressure gage.
2. Start engine and check pressure with engine running

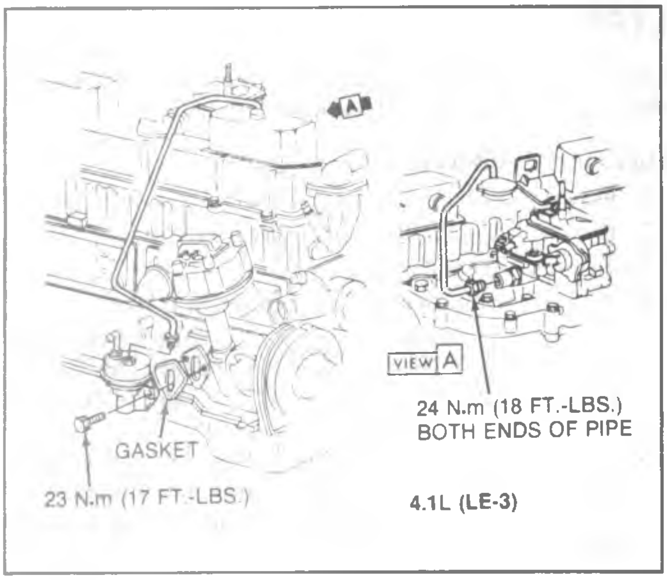


Fig. 6C-11--Fuel Pump--4.1 L

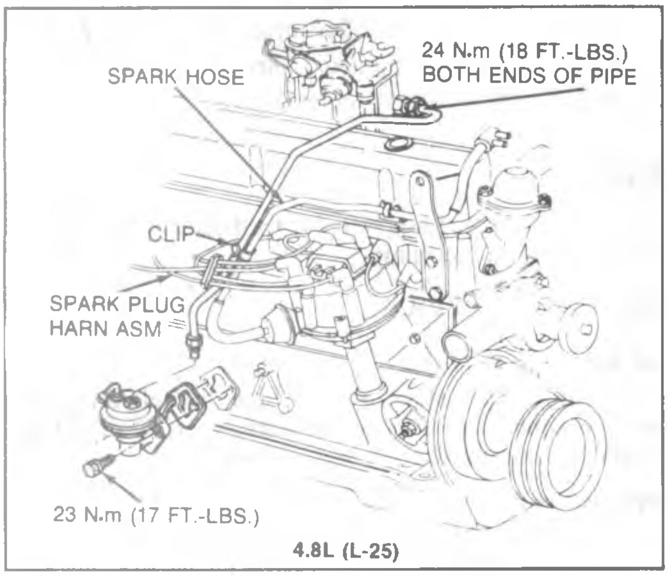


Fig. 6C-12--Fuel Pump--4.8 L

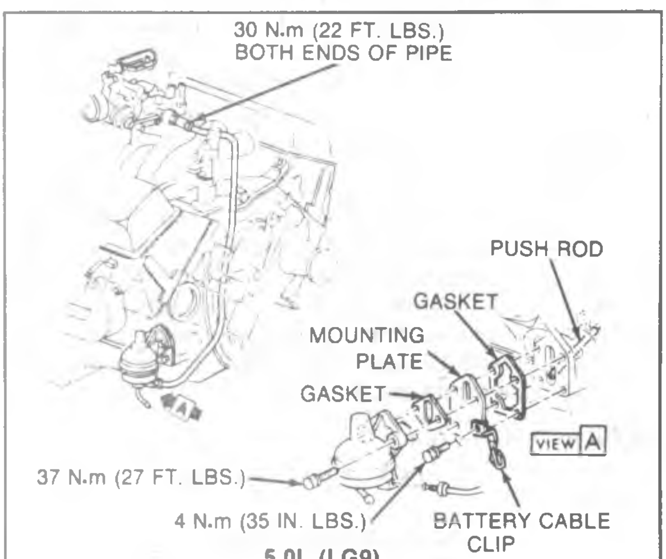


Fig. 6C-13--Fuel Pump--5.0 L

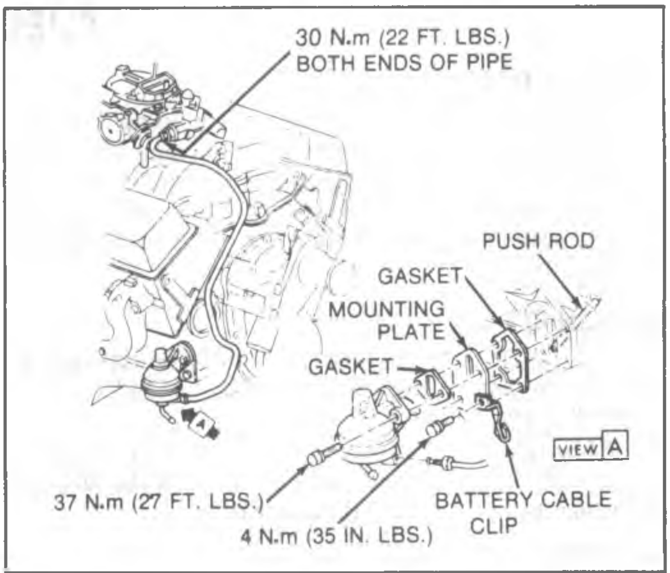


Fig. 6C-14--Fuel Pump--5.7 L

at slow idle speed. Fuel pump pressure should be as specified at the end of this section On vehicles equipped with a vapor return system, squeeze off the return hose so that an accurate reading can be obtained.

3. If fuel pump pressure is below minimum, pump must be replaced.

Fuel Pump Flow Test

1. Disconnect fuel line from carburetor. Run fuel line into a suitable measuring container.
2. While observing the sweep second hand of a clock or watch, run the engine at idle until there is one pint of fuel in the container. One pint should be pumped in 30 seconds or less.
3. If flow is below minimum, check for restriction in the line.

Removal

1. Disconnect fuel inlet hose from pump. Disconnect vapor return hose, if so equipped.

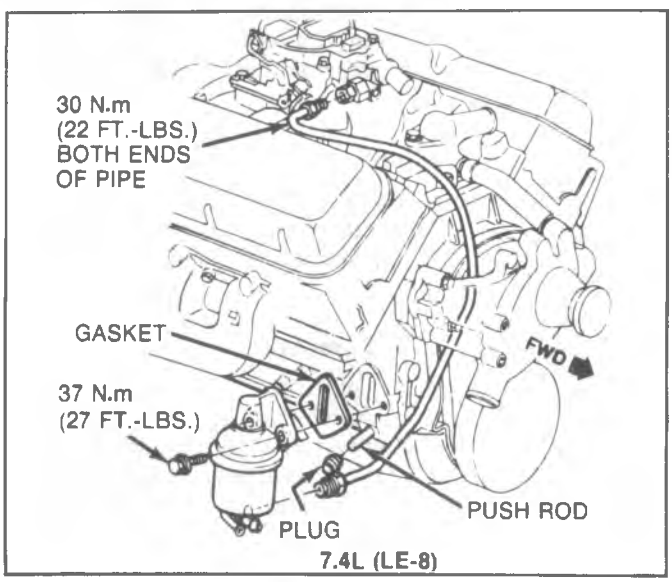


Fig. 6C-15--Fuel Pump--7.4 L

2. Disconnect fuel outlet pipe.
3. Remove two bolts holding fuel pump.
4. Remove fuel pump, push rod, gasket and mounting plate (if used).

Installation

1. Install push rod, gasket, mounting plate (if used) and fuel pump.
2. Install two hex head bolts, turning them alternately and evenly.
3. Install fuel outlet pipe. If it is difficult to start fitting, time can be saved by disconnecting upper end of pipe from carburetor. Tighten fitting securely, meanwhile holding fuel pump nut with a wrench. Install and tighten fitting at carburetor, if removed.
4. Install fuel inlet hose and clamp. Install vapor return hose and clamp, if so equipped.
5. Start engine and check for leaks.

FUEL TANK

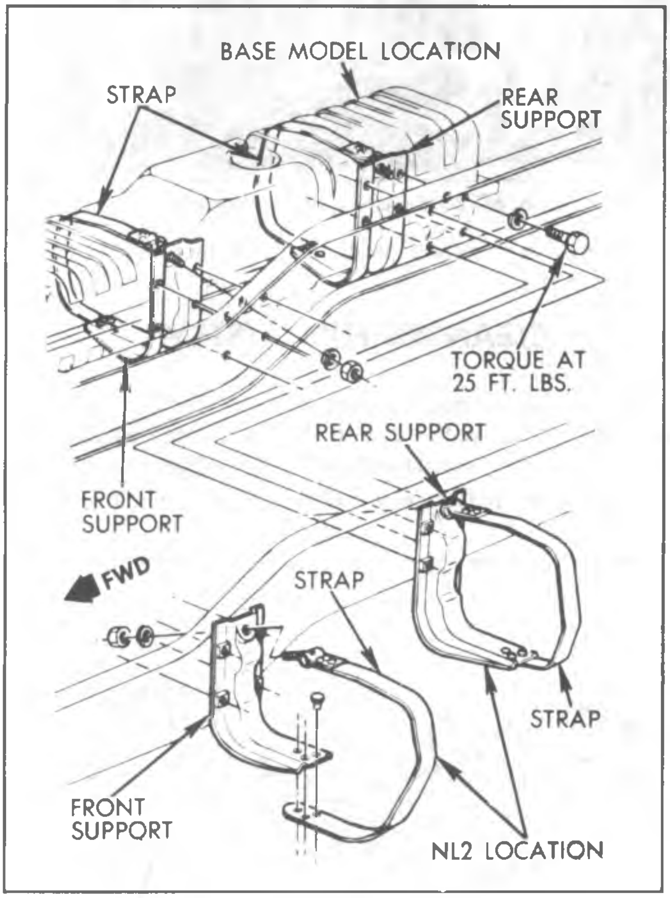


Fig. 6C-16--Fuel Tank Mounting-Cab and Crewcab

ON-VEHICLE SERVICE

Outside Frame Rail Fuel Tank-

Cab and Crewcab (Figs. 6C-16 and 18)

1. Drain tank.
2. Disconnect fuel lines, meter wire and ground lead.
3. Remove strap supports (lines, vent) and clip.
4. Loosen clamps from filler neck and vent line.
5. Remove strap bolts and lock washers from tank front and rear locations on inside frame rail.
6. Remove tank from frame simultaneously disengaging filler neck hose from filler neck (Fig. 6C-18 and 6C-19).
7. Remove meter assembly from fuel tank using Tool J-24187 (Fig. 6C-20).
8. Reverse removal procedure to install fuel tank.

Center and Auxiliary Fuel Tank

CK 10 and 20 (06, 16) (Figs. 6C-21, 22) G Van (Fig. 6C-23).

1. Drain tank.
2. Raise vehicle on hoist.
3. Unclamp upper filler neck and vent tube hose (Fig. 6C-18 and 19).
4. Unclamp gage unit hoses at frame end.
5. Support tank and remove support straps.
6. Lower tank and disconnect meter wire.
7. Remove tank.
8. Install in the reverse order, using new antisqueak material.
9. Lower vehicle and remove from hoist.

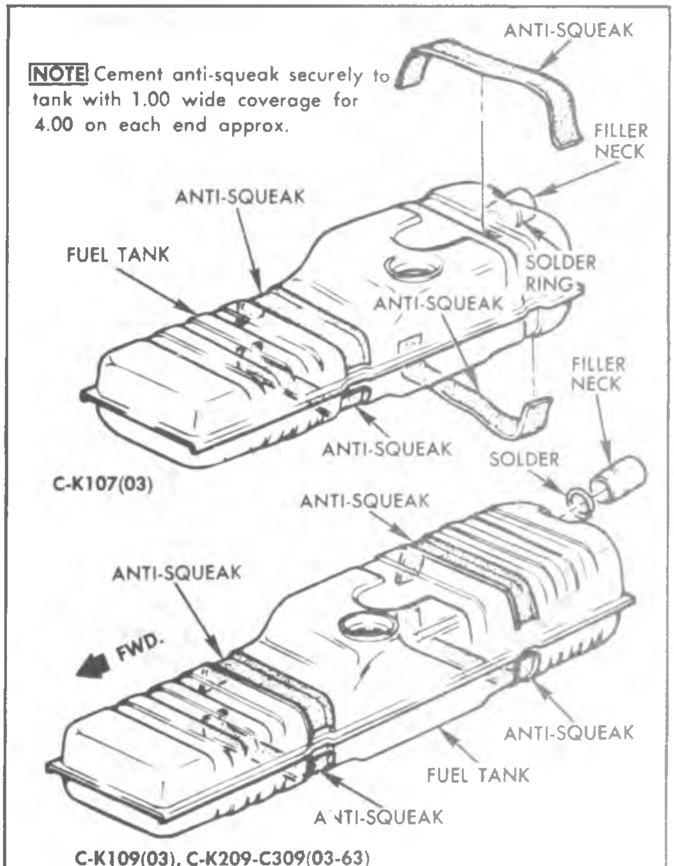


Fig. 6C-17--Fuel Tank-Cab and Crewcab

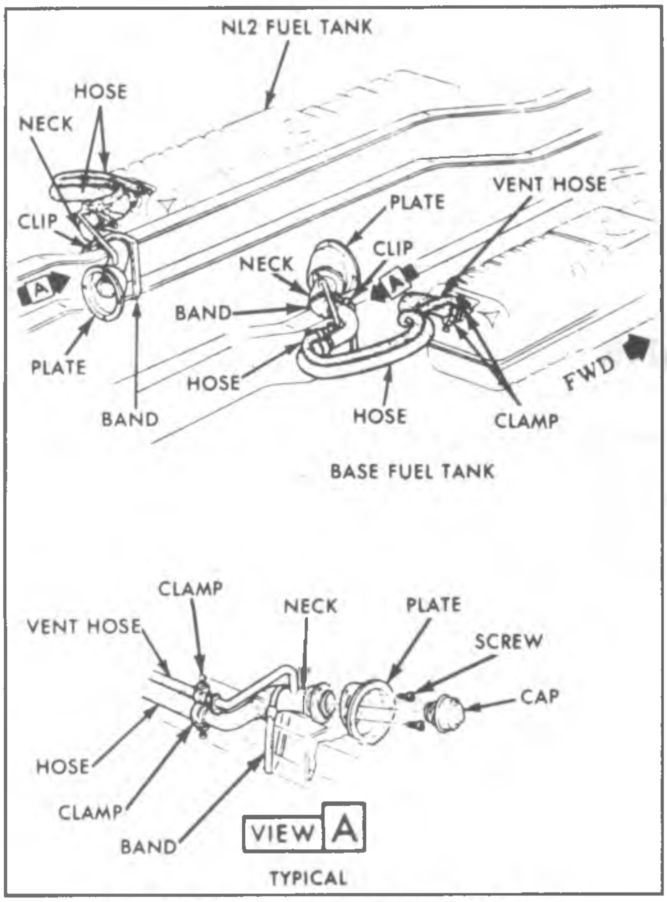


Fig. 6C-18--Fuel Tank Filler Neck (03 & 43)

Frame Mounted Fuel Tank - P Model (Figs. 6C-25 and 26)

1. Drain tank.
2. Remove filler neck.
3. Disconnect meter unit fuel line and wiring.
4. Remove bolts attaching tank supports to frame.
5. Remove tank complete with mounting bracket and support straps.
6. Remove tank from brackets and support straps, if necessary.

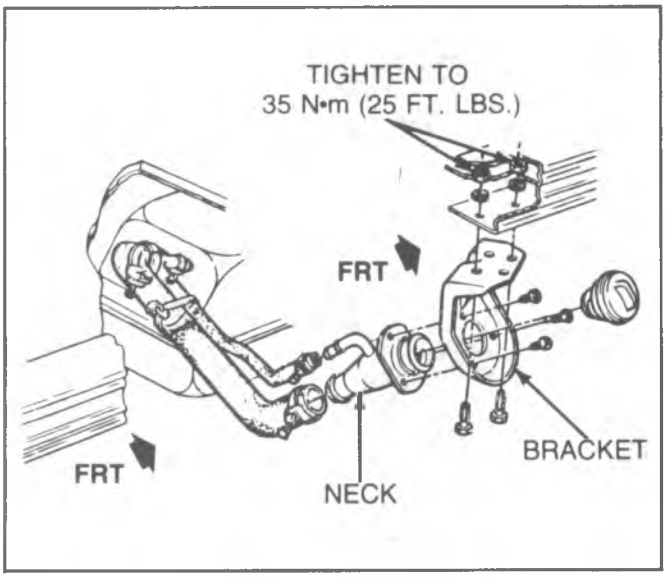


Fig. 6C-19--Filler Neck-Cab Stake Body

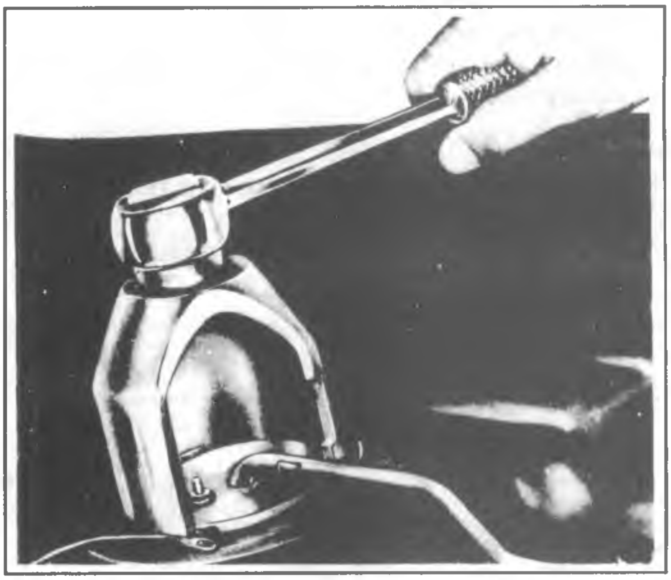


Fig. 6C-20--Removing Meter Assembly

7. Install in reverse order and replace antisqueak material.

CLEANING FUEL SYSTEM

Cleaning

If trouble is due to contaminated fuel or foreign material that has been put into the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect battery negative cable and distributor feed wire.

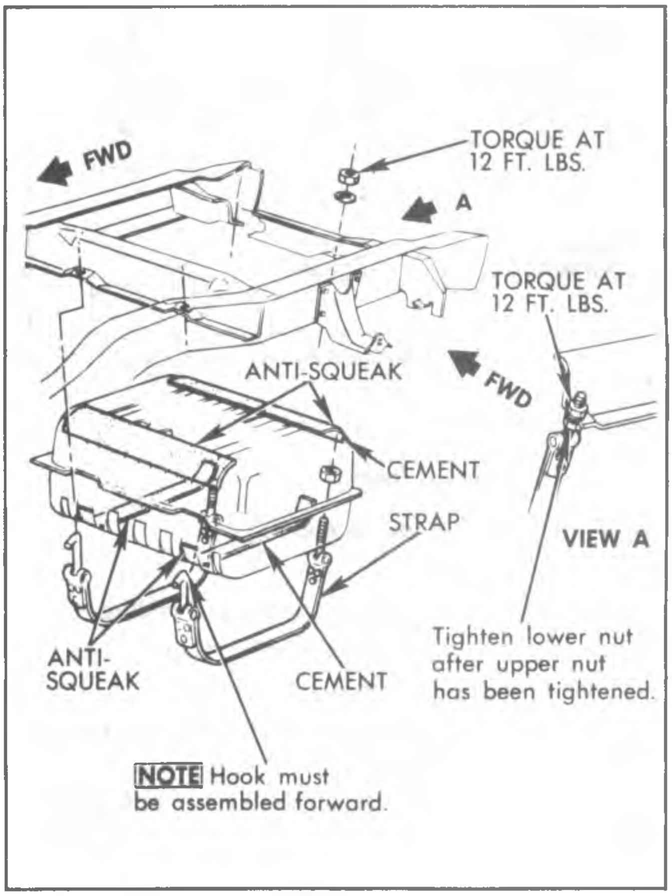


Fig. 6C-21--Fuel Tank, CK 10-20 (06, 16)

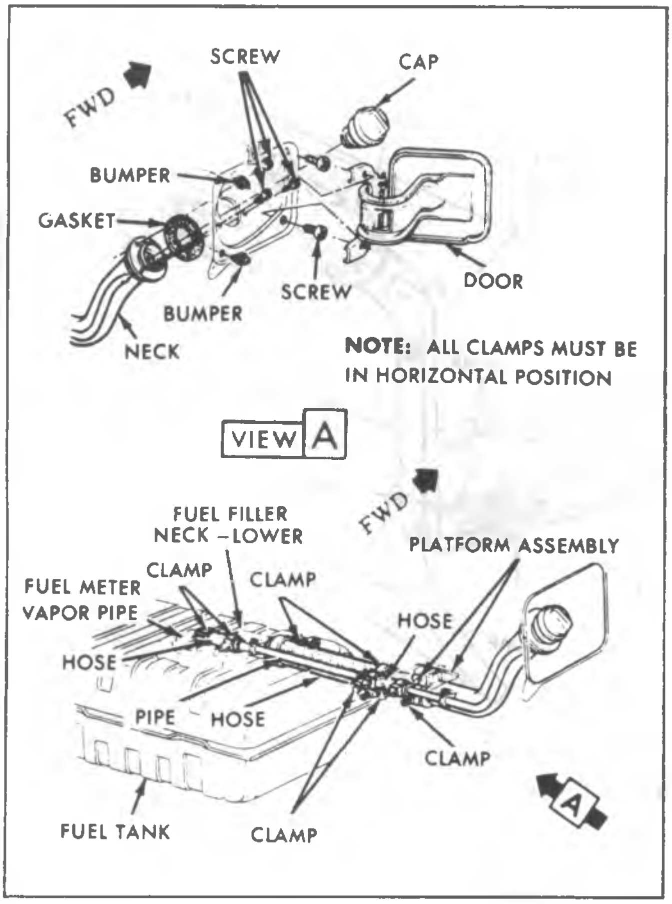


Fig. 6C-22--Fuel Tank, CK 10-20 (06, 16)

2. Drain fuel tank.
3. Remove fuel tank.
4. Remove fuel inlet filter at carburetor and inspect for contamination. If filter is plugged replace (leave fuel line disconnected).
5. Locate tank away from heat, flame, or other source of ignition. Remove fuel gage tank unit and inspect condition of filter. If filter is contaminated a new filter should be installed upon reassembly.
6. Complete draining of tank by rocking it and allowing fuel to run out of tank unit hole.
7. Purge fuel tank with steam or running hot water for at least five minutes. Pour water out of tank unit hole (rock tank to assure complete removal of water).

   This procedure will not remove fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required.
8. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and fuel return line (if equipped). Apply air pressure in the direction fuel normally flows through line.
9. Use low air pressure to clean pipes on tank unit.
10. Clean filter on fuel tank unit, if required. Install fuel tank gage unit, (with new gasket) into tank and install tank. Connect tank unit wires and all fuel lines, except pump to carburetor line (see "Removal of Tank" for proper procedure).
11. Connect a hose to fuel line at carburetor; insert other end of hose into a one gallon fuel can.
12. Connect battery cable. Make sure distributor feed wire is disconnected.
13. Put six gallons of clean fuel in tank and operate starter to pump two quarts of fuel into fuel can. This will purge fuel pump.
14. Remove hose and connect fuel line to carburetor.
15. Connect distributor feed wire.
16. Check all connections for leaks.

AUXILIARY FUEL TANK CONTROL

The auxiliary fuel tank switch (Fig. 6C-26a) is located on the instrument panel, just left of the ashtray. The switch controls fuel tank switching and fuel gage indication in a single operation.

To operate:

Depress the rocker switch at the TOP for the Right Hand (R.H.) tank; at the BOTTOM for the Left Hand (L.H.) tank. When pressing the switch, a detent will be felt. Continue pressing beyond the detent and hold momentarily (1 second or more) to fully activate the tank switching unit. Release the switch and it will return to the detent position.

FUEL TANK SELECTOR VALVE CHECK

Before attempting any electrical diagnosis, insure that all electrical and ground connections are clean and tight (Fig. 6C-26b).

A simple check can be made to determine if the Fuel Tank Selector Valve is operating by listening for audible operation of the motor inside the selector valve, when the switch is pressed.

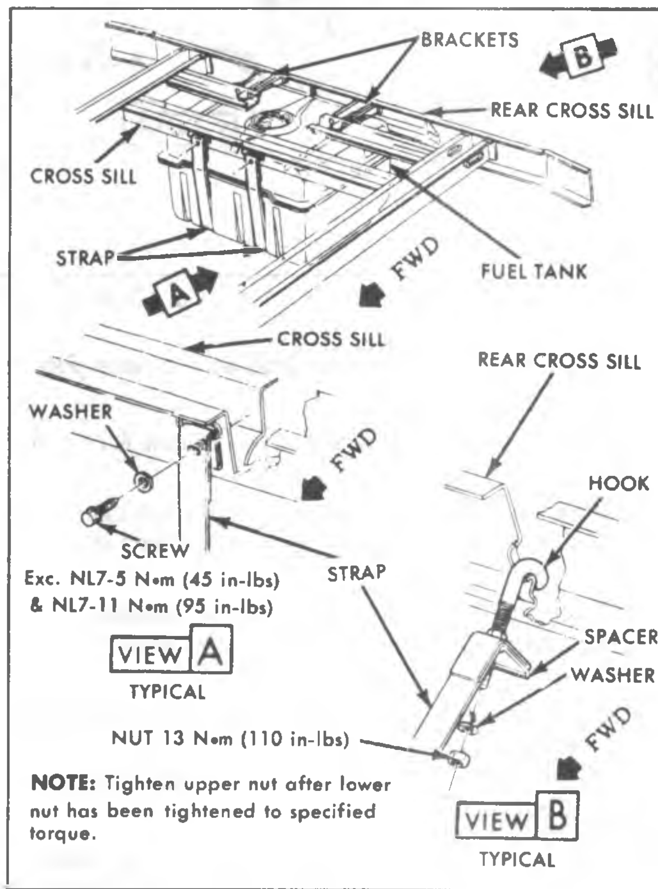


Fig. 6C-23--Fuel Tank Installation G Van

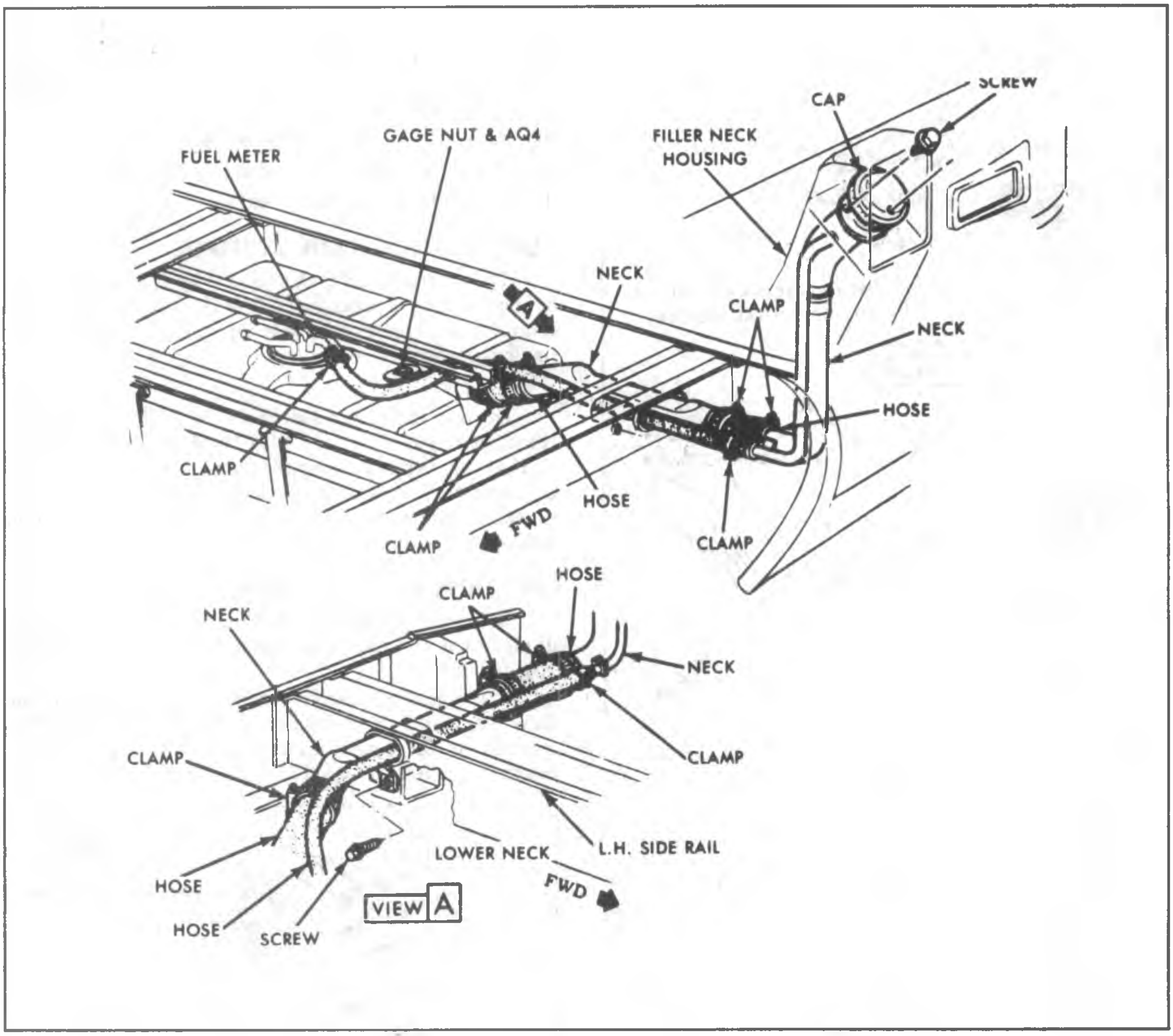


Fig. 6C-24--Fuel Tank and Filler Neck G Van

Checking Instrument Panel Side of Harness (Fig. 6C-26c)

1. Disconnect selector valve harness at Point A (Fig. 6C-26c).
2. With ignition on, connect one lead of a test light to one terminal of the female harness connector. Probe remaining terminal.

   Test light should light in both switch positions. If OK, go to Step 7. If light does not light, continue with Step 3.
3. Check for proper ground connection (Black or Black with Pink Wire) at Buss Bar (Fig. 6C-26c).
4. Check for proper connection to ignition receptical in Fuse Panel (Fig. 6C-26c).
5. If ground and ignition connections are OK, check for proper connection at selector valve switch. Check for bent terminals on back of switch and in switch connector and for B at pink wire and Ground at black wire in switch connector.
6. Repeat Step 2. If OK, continue with Step 7.
7. With ignition on, connect one lead of a test light to ground and probe light Green wire of female connector at Point A (Fig. 6C-26c). Test light should light to one switch position only. If OK, proceed with selector valve harness check.

   If light does not light in either position, continue with Step 8.
8. Replace selector valve switch (Fig. 6C-26a).
9. Repeat Step 2. If not OK, there is an open in harness between switch and connection Point A. Repair or replace as necessary.

   If the conditions in Steps 2 and 7 are corrected, but a problem still exists, perform check of selector valve side of harness.

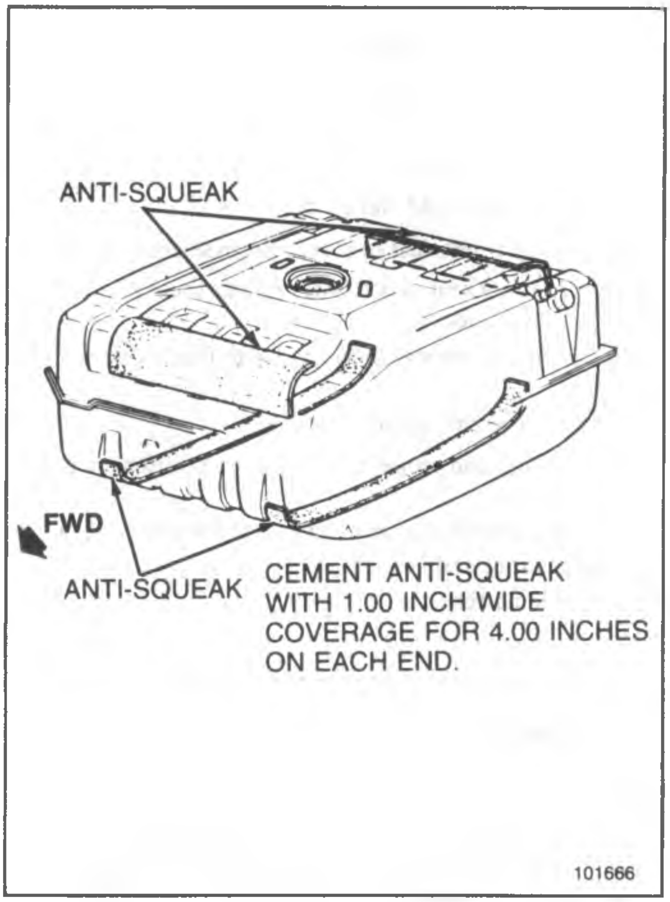


Fig. 6C-25--Fuel Tank - P Model

Checking Selector Valve Side of Harness (Includes Fuel Tank Selector Valve)

Before performing this portion of the procedure, be sure there is sufficient fuel (approximately 10 gallons in one tank and 5 gallons in the other) in both tanks.

1. Remove harness connector from fuel tank selector valve (Fig. 6C-26d).
2. Connect a known good selector valve and with ignition switch, ON activate instrument panel switch and note gage reading of both right and left hand tank.

   If a change is indicated between tanks, system is operating properly. If not, repair open in harness between selector valve and Point A (Fig. 6C-26c). If a change is indicated between tanks when switch is activated, original selector valve was defective, replace with new valve.

If fuel gage operates, but not accurately, refer to Section 8C for fuel gage diagnosis.

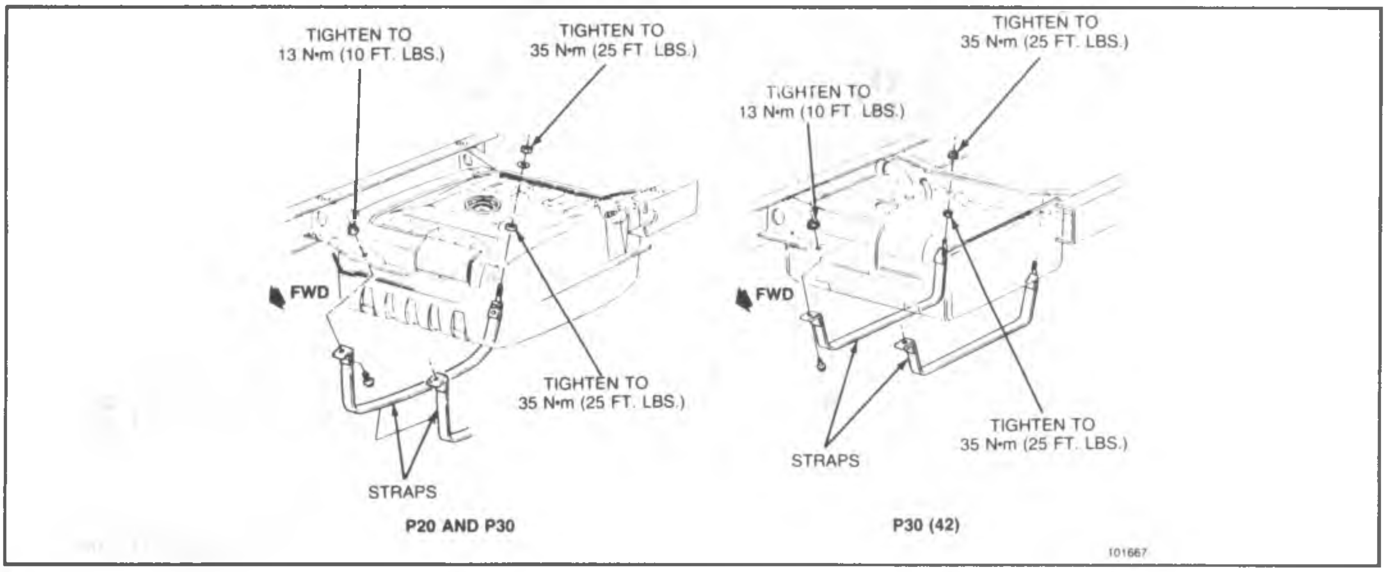


Fig. 6C-26--Fuel Tank Mounting - P Model

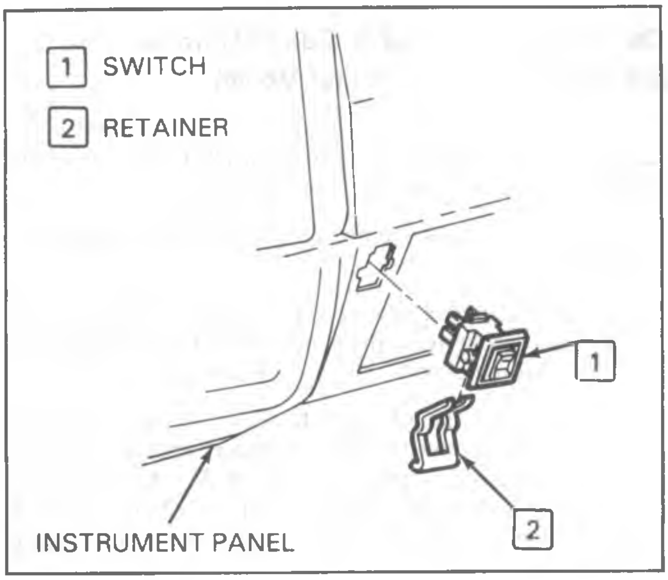


Fig. 6C-26a--Auxiliary Tank Switch

Fuel Tank Selector Valve

Replacement (Fig. 6C-27)

1. Disconnect battery.
2. Remove hose shield and brace.
3. Disconnect electrical connector from selector valve.
4. Remove fuel and vapor hoses noting their position for later installation.
5. Remove two screws holding valve to frame and remove valve.
6. Install valve and tighten screws.
7. Install fuel and vapor hoses in same positions noted at removal.
8. Connect electrical connector to selector valve.
9. Install brace and hose shield.
10. Connect battery.

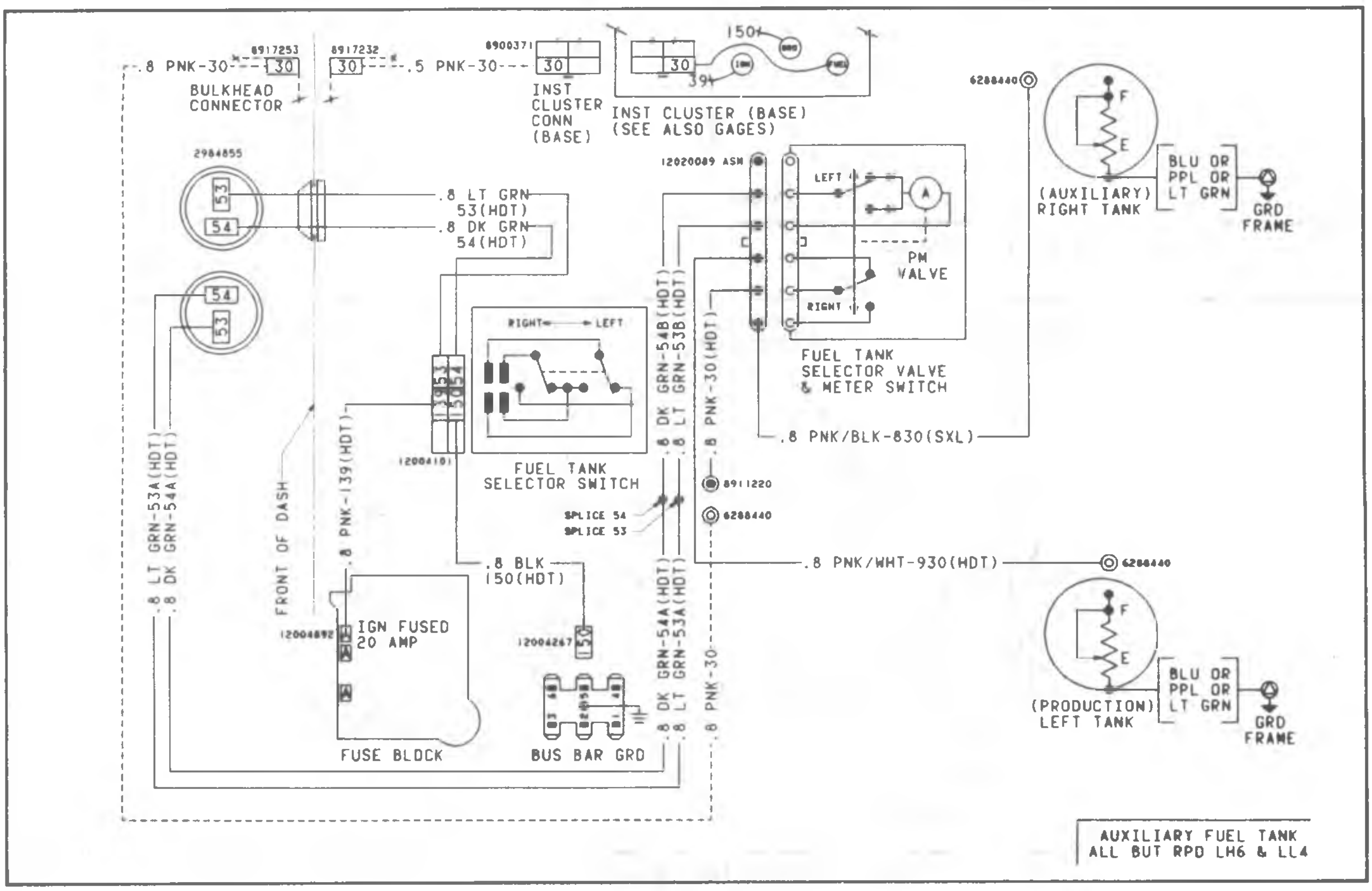


Fig. 6C-26b--Auxiliary Tank Wiring

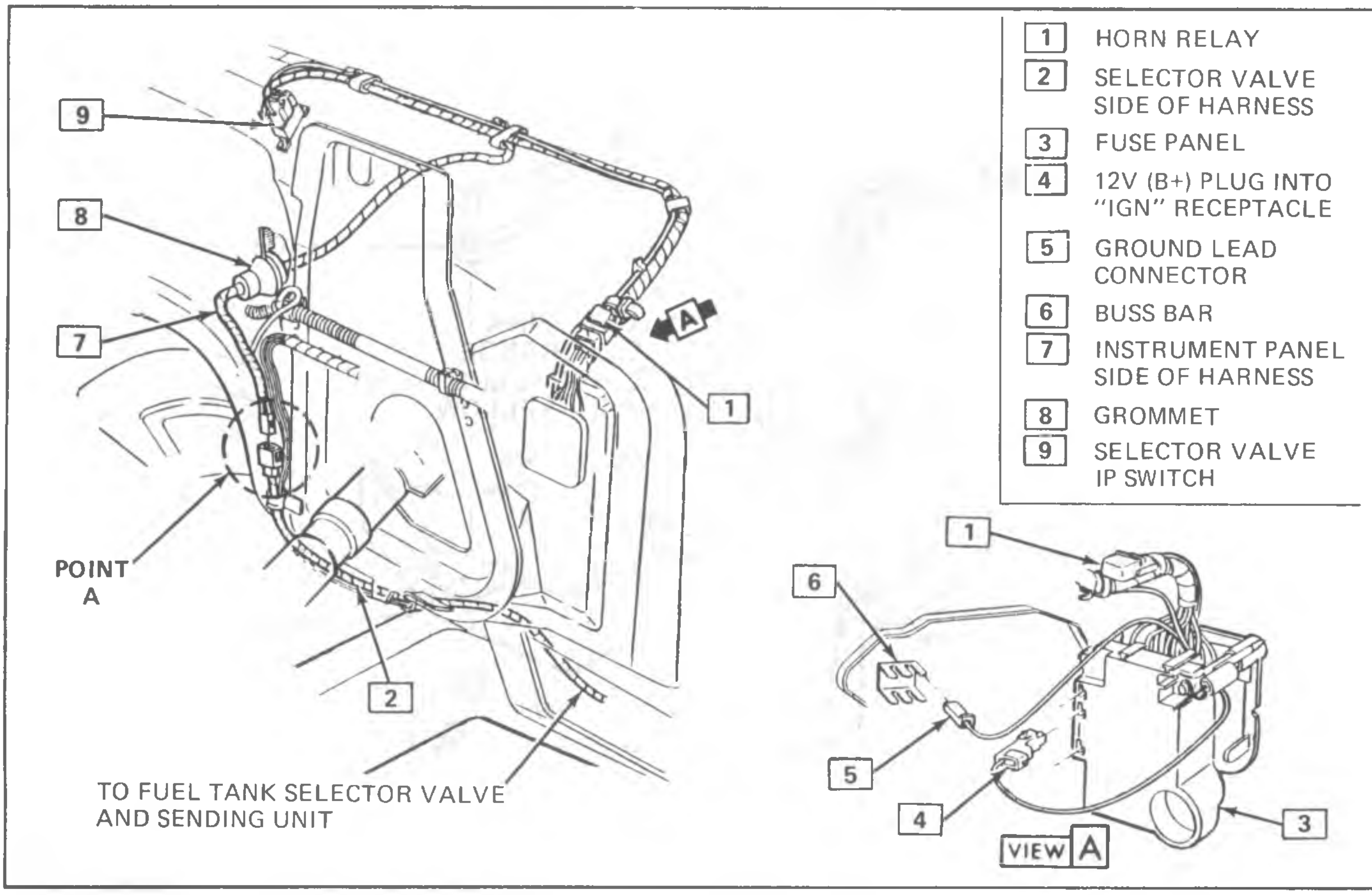


Fig. 6C-26c--Auxiliary Tank IP Wiring

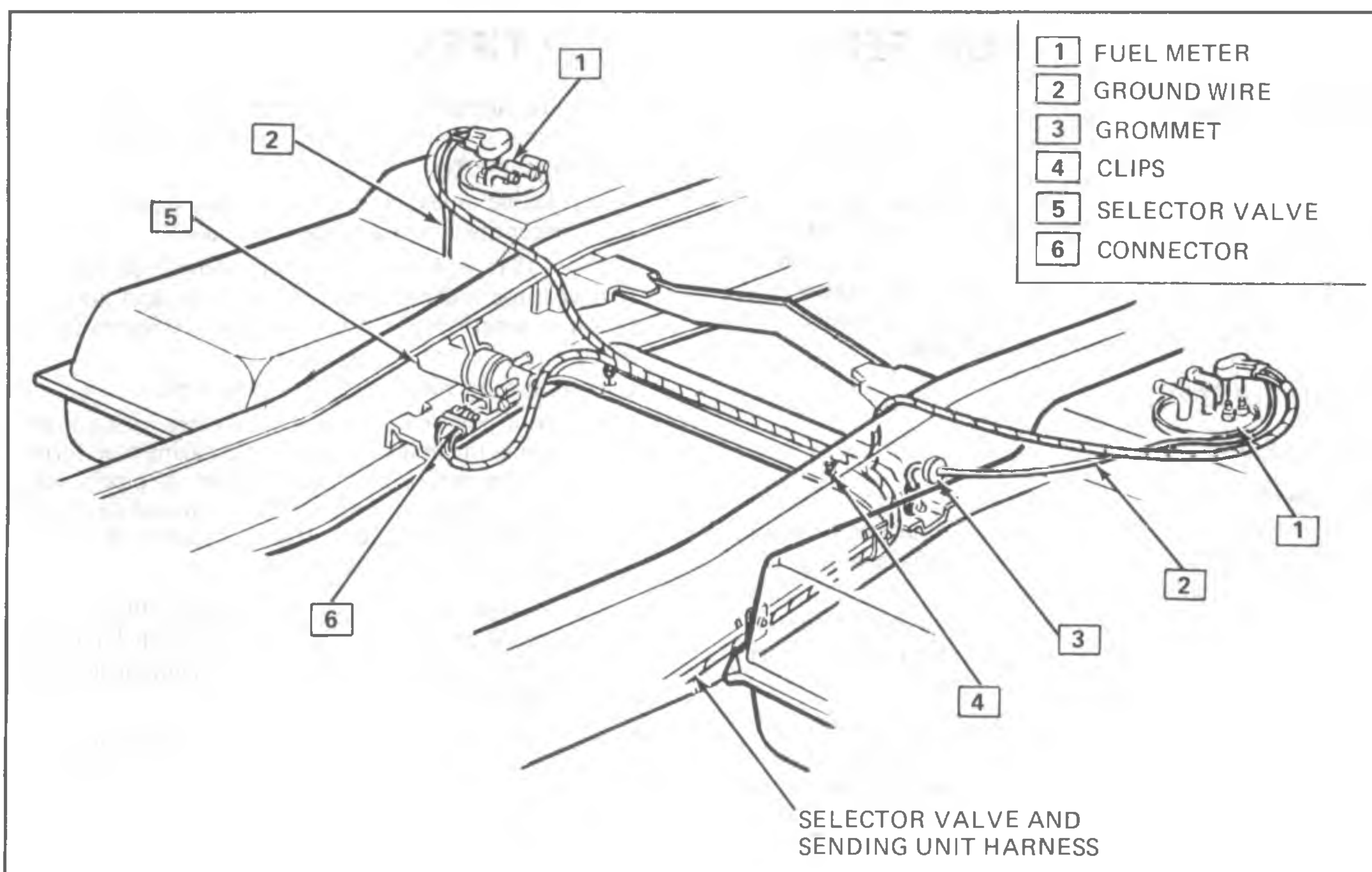


Fig. 6C-26d--Auxiliary Tank Selector Valve Wiring

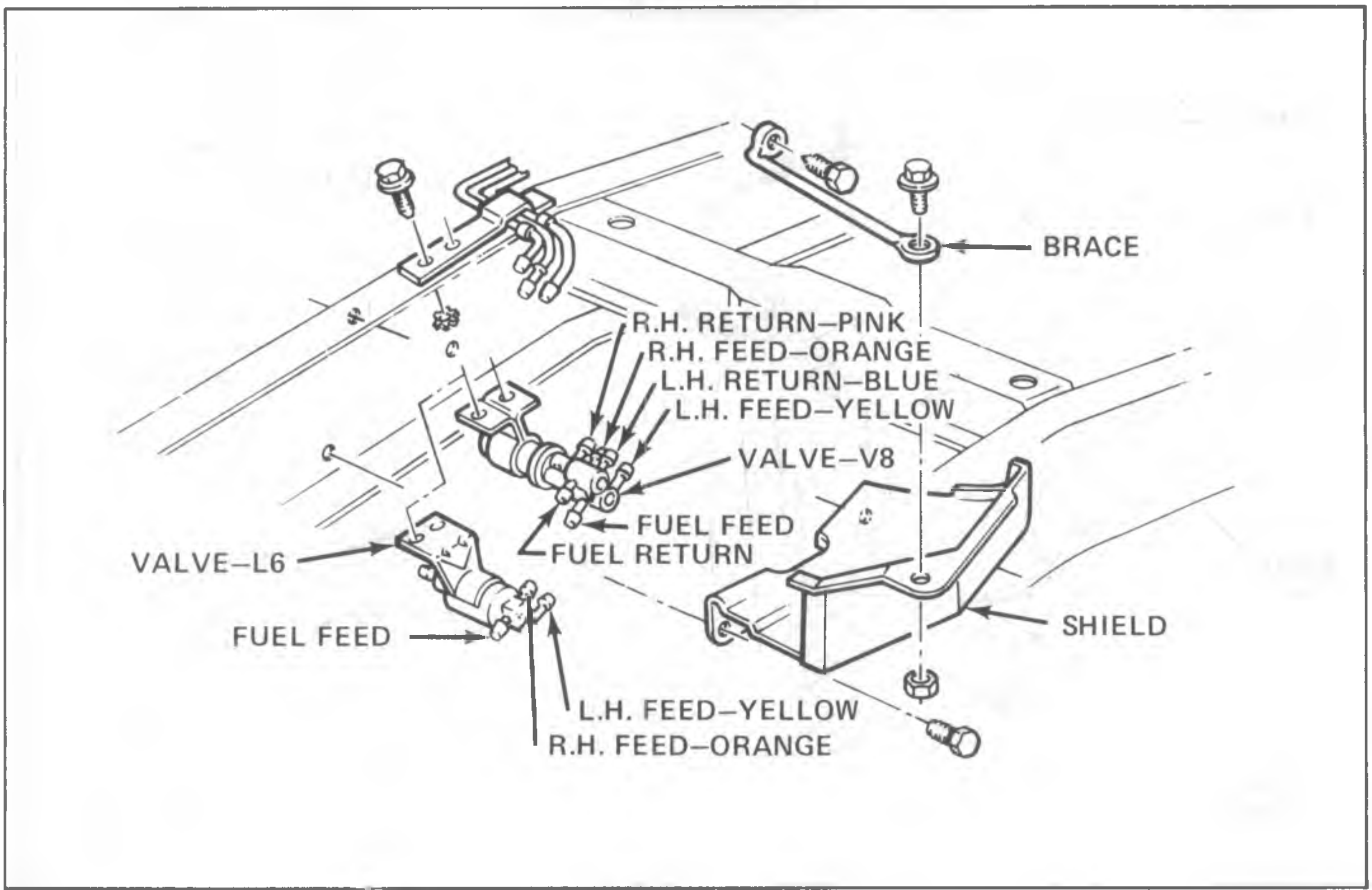


Fig. 6C-27--Selector Valve

FUEL FEED AND VAPOR PIPES

GENERAL DESCRIPTION

Fuel feed pipes are secured to the underbody with clamp and screw assemblies. Flexible hoses are located at fuel tank fuel, vapor and return lines and fuel pump. The pipes should be inspected occasionally for leaks, kinks or dents. If evidence of dirt or foreign material is found in carburetor, fuel pump or pipes, pipe should be disconnected and blown out. Dirt or foreign material may be caused by a damaged or omitted fuel strainer in fuel tank.

ON-VEHICLE SERVICE

Fuel Line Repair

Replacement

1. If replacement of a fuel feed, fuel return or emission pipe is required use welded steel tubing meeting GM Specification 124-M or its equivalent.
2. Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibrations.
3. When rubber hose is used to replace pipe, use only reinforced fuel resistant hose which meets GM Specification 6165-M. Hose inside diameter must match pipe outside diameter.
4. Do not use rubber hose within 4" (100 mm) of any part of the exhaust system or within 10" (254 mm) of the catalytic converter.
5. In repairable areas, cut a piece of fuel hose 4" (100 mm) longer than portion of the line removed.

   If more than a 6 inch (152 mm) length of pipe is removed, use a combination of steel pipe and hose so that hose lengths will not be more than 10 inches (254 mm).

   Follow the same routing as the original pipe.
6. Cut ends of pipe remaining on car square with a tube cutter. Using the first step of a double flaring tool, form a bead on the end of both pipe sections. If pipe is too corroded to withstand bead operation without damage, the pipe should be replaced. If a new section of pipe is used, form a bead on both ends of it also.
7. Use screw type hose clamp, Part Number 2494772, or equivalent. Slide clamps onto pipe and push hose 2" (51 mm) onto each portion of fuel pipe. Tighten clamps on each side of repair.
8. Pipes must be properly secured to the frame to prevent chafing.

EVAPORATIVE CONTROL SYSTEM (ECS)

GENERAL DESCRIPTION

All light duty emissions and some heavy duty emission vehicles are equipped with a system designed to prevent escape of fuel vapor to the atmosphere. Vapor generated by evaporation of fuel in the tank, previously exhausted to atmosphere, is transferred by an emission line to the engine compartment. During periods of operation, vapors are fed directly to the engine for consumption. During periods of inoperation, an activated charcoal canister located in the emission line stores any vapor generated for consumption during the next period of operation.

The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

With this closed system it is extremely important that only vapors be transferred to the engine. To avoid the possibility of liquid fuel being drawn into the system, these following features are included as part of the total system:

1. A fuel tank overfill protector is provided on all series to assure adequate room for expansion of liquid fuel volume with temperature changes.
2. A one point fuel tank venting system is provided on all series to assure that the tank will be vented under any conceivable vehicle attitude.
3. To protect the tank from mechanical damage in the event of excessive internal or external pressures resulting from the operation of this closed system, a pressure-vacuum relief valve, located in the gas cap, will control the tank internal pressure.

ON-VEHICLE SERVICE

Maintenance requirement is that the oiled fiberglass filter assembled in the bottom of the canister, be replaced at intervals shown in Section 0B. Under extremely dusty conditions, more frequent attention may be required.

Check operation of bowl vent and purge valve.

Canister and Filter

Removal

1. Note installed position of hoses on canister.
2. Disconnect hoses from top of canister.
3. Loosen clamps and remove canister.
4. If replacing filter, pull out filter from bottom of canister with your fingers.

Inspection

1. Check hose connection openings. Assure that they are open.
2. Check operation of purge valve by applying vacuum to the valve. A good valve will hold vacuum.

Installation

1. Install new filter.
2. Install canister and tighten clamp.
3. Connect hoses in same order.

Canister Purge Valve

Disassembly

1. Disconnect lines at valve.
2. Snap off valve cap (slowly remove cap as diaphragm is under spring tension). Remove diaphragm, spring retainer and spring.
3. Replace parts as necessary. Check orifice openings.

Assembly

1. Install spring, spring retainer, diaphragm and cap.
2. Connect lines to valve.

Checking Purge Valve

1. Remove purge valve control vacuum line. Check for a vacuum signal with engine operating above idle (1500 RPM). If no vacuum signal, perform EGR System Function Check.
2. Apply an external vacuum source to the purge valve control diaphragm. A good valve will hold vacuum.
3. If the valve will not hold vacuum, replace canister.
4. If valve holds vacuum, remove purge line and check for vacuum. If no vacuum, check PCV hoses and system. Repair ir replace as necessary.

Checking Bowl Vent Valve

1. Remove the bowl vent vapor hose from the carburetor.
2. Check the open condition of the valve by connecting to a manual vacuum pump. It should not be possible to obtain .5 inch Hg if the valve is open.
3. If a high resistance or plugged system is found, check for a plugged or restricted hose. Hose may be cleared with compressed air. If the hose is clear, remove the canister filler. If the restriction persists, replace the canister.
4. A simple check of the valve closed condition can be obtained with the same procedure as in Step 2, but with the engine operating at operating temperature. Manifold vacuum will be applied to the valve through the control line. The bowl vent line should exhibit a plugged condition.
5. If the valve is not closed, remove the control vacuum line and check for vacuum. If no vacuum is present, check hose for restriction or vacuum leak. Repair or replace as required. If vacuum is present, replace canister.

Pressure Checking Evaporative Control System

1. Stabilize vehicle by operating until warmed up.
2. Remove tank line at canister and observe for liquid in the line. Hook-up pressure device.
3. Apply 15" H_2O pressure to the fuel vapor line.
   A. Observe for excessive loss of pressure.
   B. If negligible pressure loss occurs observe for fuel vapor smell or fuel loss at points listed in Diagnostics under Possible Cause.
   C. Remove fuel filler cap(s) and observe for pressure in tank(s).
4. Remove fuel cap (LH on duel tank units) and blow on vent line to check for obstructions. (Install LH cap on dual tank units and remove RH cap. Repeat above.)

ACCELERATOR CONTROLS

The accelerator control system is cable type. There are no linkage adjustments. A reference between the bottom of accelerator pedal and floor pan should be used only as a check for bent bracket assembly. Check torque references.

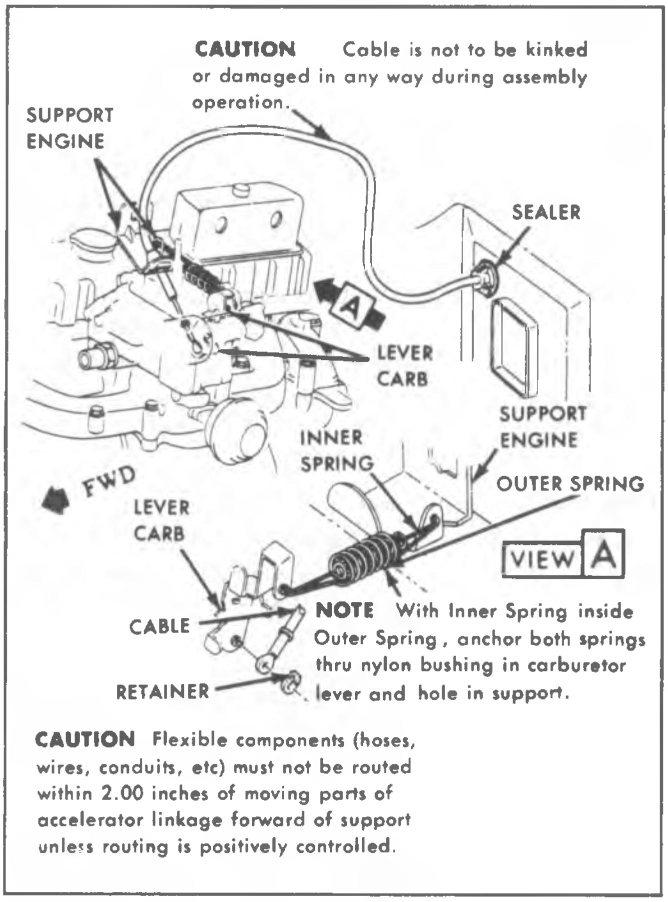


Fig. 6C-28--Accelerator Controls L6-Light Duty Emissions

Check for correct opening and closing positions by operating accelerator pedal and if any binding is present, check routing of cable.

ACCELERATOR CONTROL CABLE

Refer to figures 6C-28 through 6C-31 for removal and installation of accelerator control cable.

ACCELERATOR PEDAL

Refer to figures 6C-32 through 35 for removal and installation of accelerator pedal.

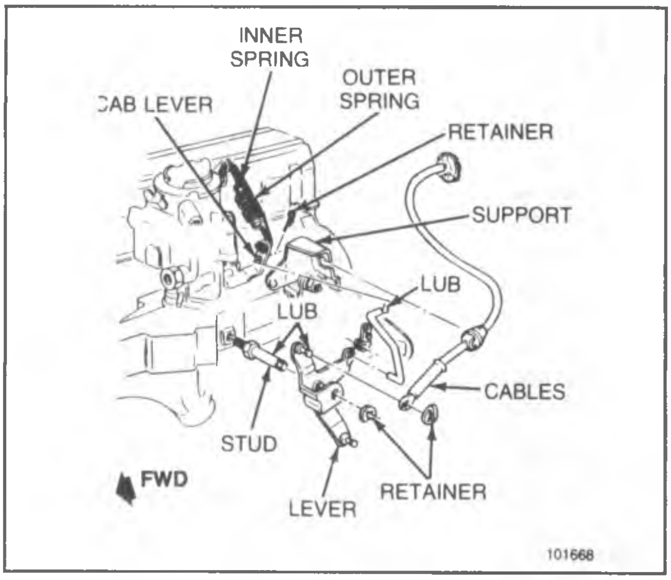


Fig. 6C-29--Accelerator Controls L6-Heavy Duty Emissions.

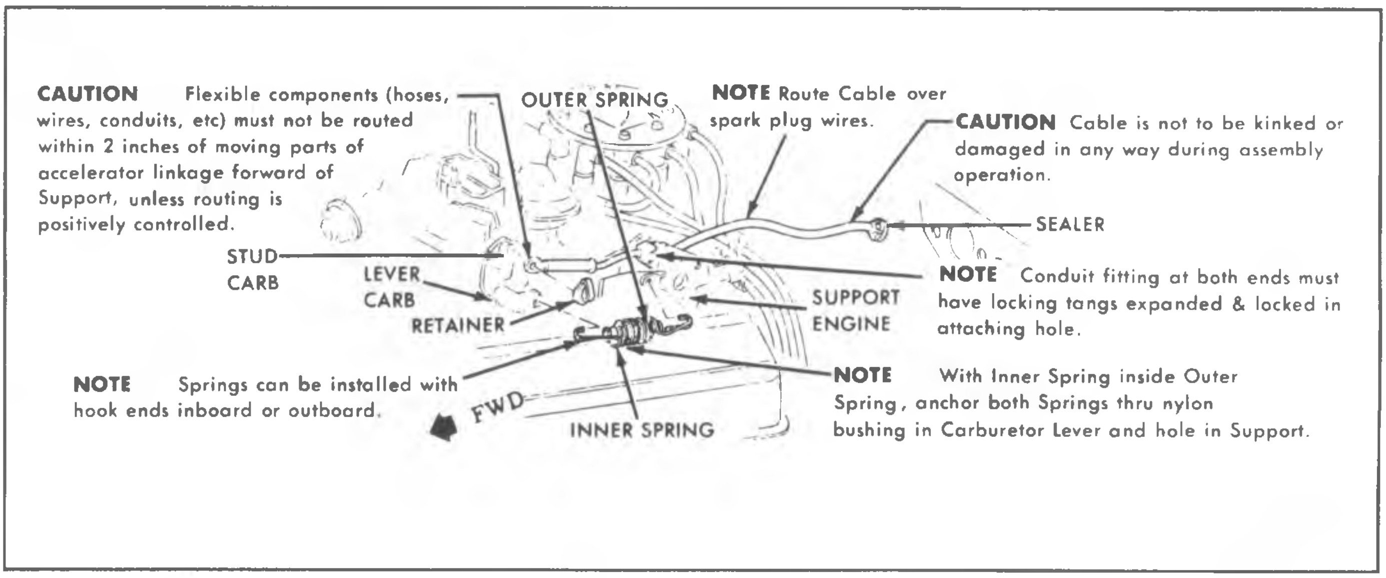


Fig. 6C-30--Accelerator Controls V8-2Bbl.

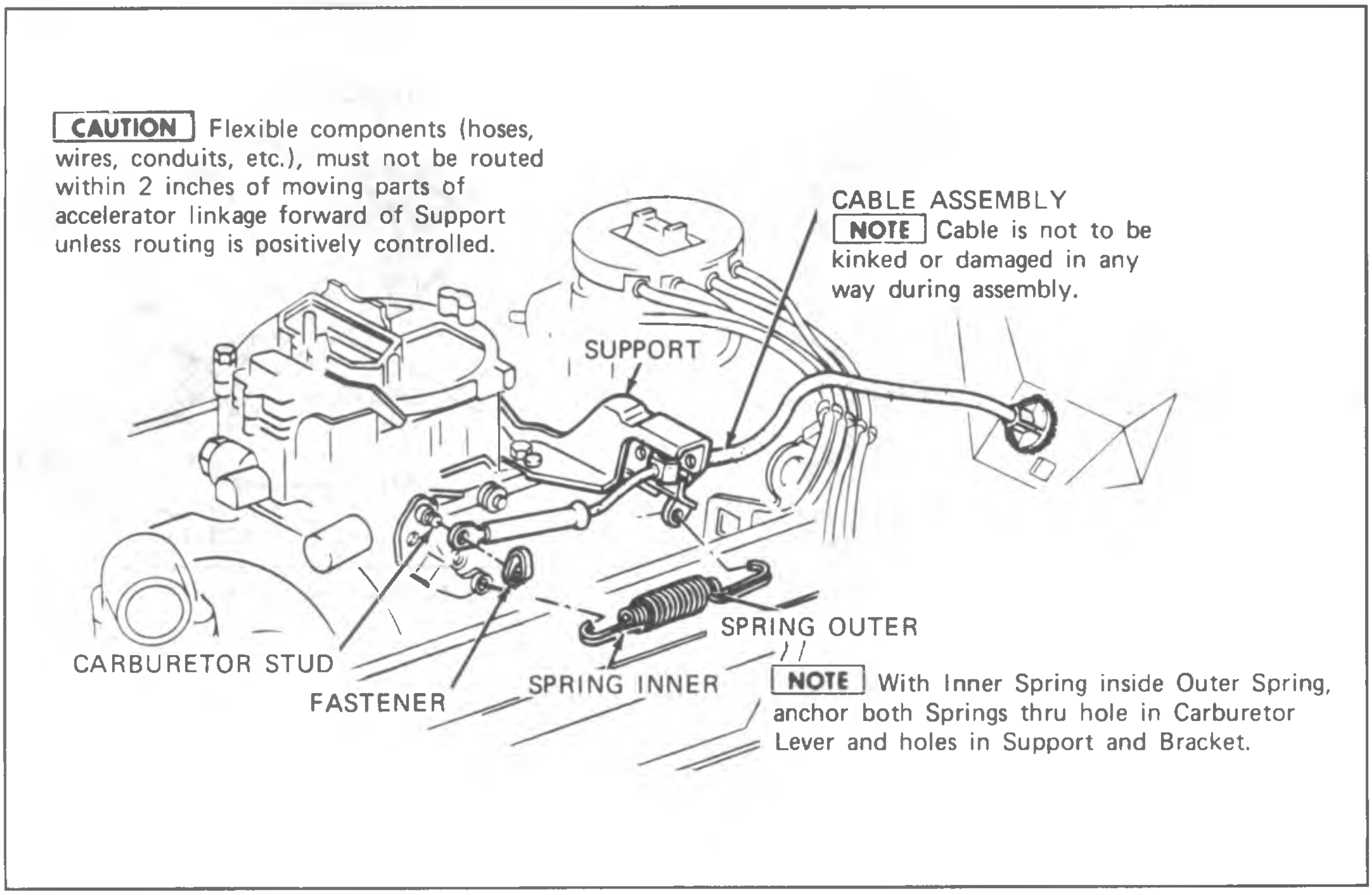


Fig. 6C-31--Accelerator Controls V8-4Bbl.

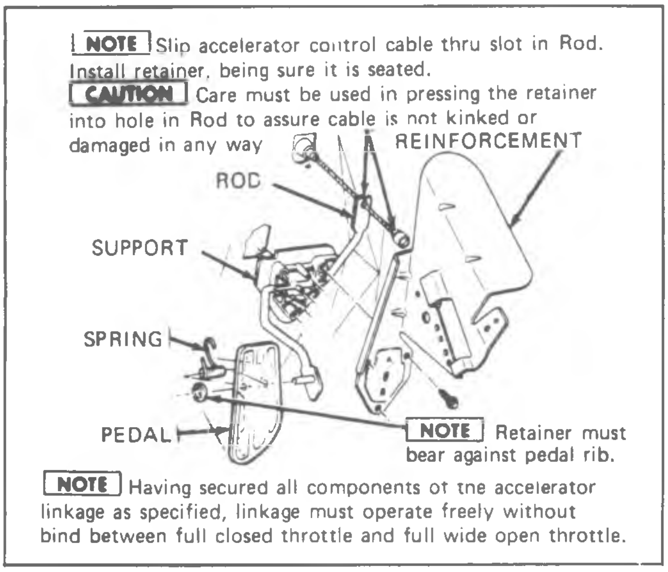


Fig. 6C-32--Accelerator Pedal-CK

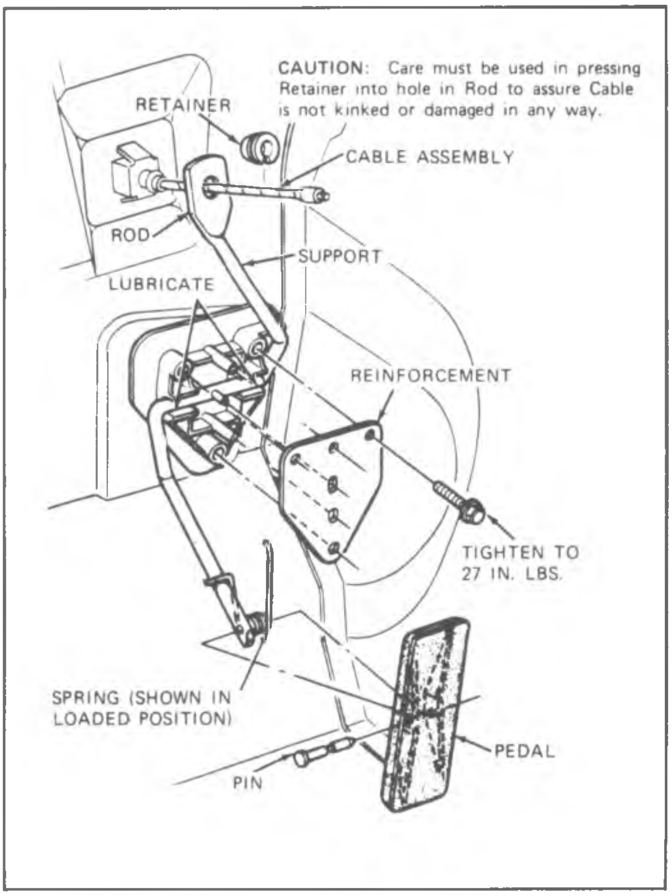


Fig. 6C-33--Accelerator Pedal-G

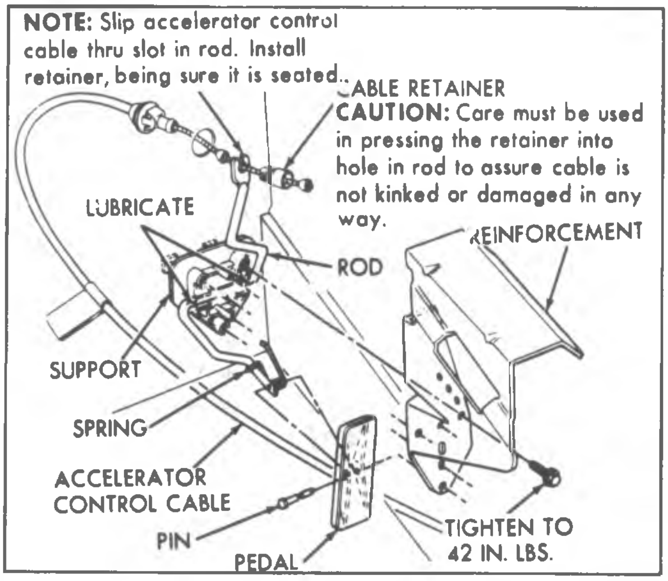


Fig. 6C-34--Accelerator Pedal-P42

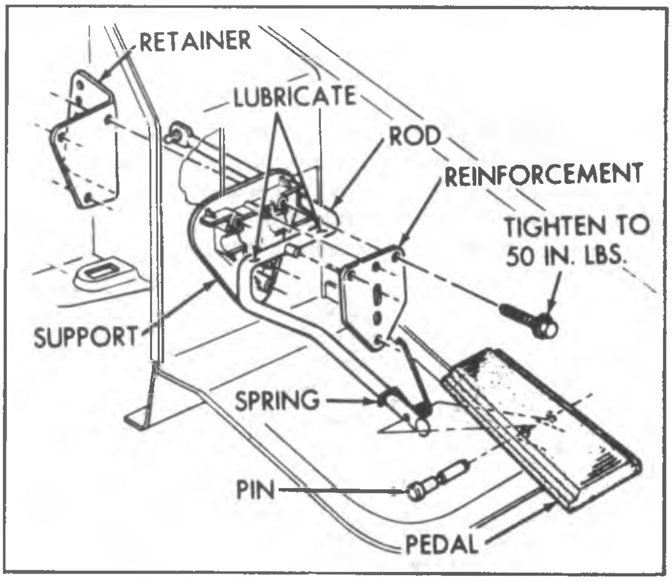


Fig. 6C-35--Accelerator Pedal-P32

SPECIFICATIONS

FUEL PUMP PRESSURE

ENGINE	P.S.I.
L6 (ALL)	4½-6
V8 (ALL) WITHOUT VAPOR RETURN LINE	7½-9
V8 (EXC LF8) WITH VAPOR RETURN LINE	5½-7
V8 (LF8) WITH VAPOR RETURN LINE	7½-9

TORQUE SPECIFICATIONS

IME CARBURETOR

SCREW	TORQUE (IN. LBS.)	SCREW	TORQUE (IN. LBS.)
AIR HORN TO BOWL	45	FUEL INLET NUT	400
AIR CLEANER BRIDGE	70	FAST IDLE CAM	50
THROTTLE BODY TO BOWL	180	CHOKE LEVER	25
NEEDLE SEAT	45	PUMP LEVER	30*
METERING JET	40		

*Loctite AVV or equivalent

M2M- M4M CARBURETOR

SCREW	TORQUE (IN. LBS.)
THROTTLE BODY	
THROTTLE BODY TO BOWL	46
CHOKE HOUSING	
CHOKE LEVER	14
CHOKE HOUSING ATTACHING	46
CHOKE HOUSING COVER	26
AIR HORN	
AIR HORN TO BOWL 10-32	46
AIR HORN TO BOWL 8-32	26
AIR HORN TO THROTTLE BODY	46
CHOKE LEVER	14
VACUUM BREAK UNIT	26
FUEL INLET NUT	400
NEEDLE SEAT	45
METERING JET	40
SOLENOID BRACKET	71

Fig. 6C-36--Specifications

ANGLE DEGREE TO DECIMAL CONVERSION
MODEL M2MC, M2ME AND M4MC CARBURETOR

THE RELATION BETWEEN DECIMAL AND ANGLE READINGS IS NOT EXACT DUE TO MANUFACTURING TOLERANCES OF THE COMPONENT PARTS. THIS CHART IS SUPPLIED FOR USE BY THE MECHANIC WHO HAS ACCESS TO PLUG GAUGES ONLY. THE RECOMMENDED TOOL IS AN ANGLE GAUGE FOR ACCURACY AND BEST OVERALL PERFORMANCE AND EMISSIONS.

ANGLE DEGREES	DECIMAL EQUIV. TOP OF VALVE	ANGLE DEGREES	DECIMAL EQUIV. TOP OF VALVE
5	.023	33	.203
6	.028	34	.211
7	.033	35	.220
8	.038	36	.227
9	.043	37	.234
10	.049	38	.243
11	.054	39	.251
12	.060	40	.260
13	.066	41	.269
14	.071	42	.277
15	.077	43	.287
16	.083	44	.295
17	.090	45	.304
18	.096	46	.314
19	.103	47	.322
20	.110	48	.332
21	.117	49	.341
22	.123	50	.350
23	.129	51	.360
24	.136	52	.370
25	.142	53	.379
26	.149	54	.388
27	.157	55	.400
28	.164	56	.408
29	.171	57	.418
30	.179	58	.428
31	.187	59	.439
32	.195	60	.449

Fig. 6C-37--Angle to Decimal Conversion

SPECIAL TOOLS

Idle Mixture Socket J-29030-B
Adjustable Float Gage J-9789-90
Bending Tool J-9789-111
Needle Valve Seat Remover J-22769
Carburetor Stand J-9789-118
Float Level Gage J-9789-130
Float Level Gage J-9789-135
Carburetor Choke Angle Gage J-26701-4

SECTION 6C1

E4ME & E4MC CARBURETOR

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GENERAL DESCRIPTION

The Models E4ME and E4MC Quadrajet Carburetors are of the four barrel, two stage design, used with the Computer Command Control System of fuel control, which is further described in Section 6E of this manual. The carburetor comprises three major assemblies: the air horn, the float bowl and the throttle body. It has six basic operating systems (Float, Idle, Main Metering, Power, Pump and Choke). The E4ME uses an electric choke and the E4MC uses a hot air choke.

See Figures 6C1-2 through 6C1-8A

A single float chamber supplies fuel to the four carburetor bores. A closed-cell rubber float, brass needle seat, and a rubber tipped float valve with pull clip, are used to control fuel level in the float chamber.

An electrically operated mixture control solenoid, mounted in the float bowl, is used to control the air and fuel mixture in the primary bores of the carburetor. The plunger in the solenoid is controlled (or "pulsed") by electrical signals received from the Electronic Control Module (ECM).

The air valves and metering rods control the air/fuel metering in the secondary bores. A pair of tapered metering rods are attached to a hanger, which operates by cam action resulting from the air valve angle, and provides the additional fuel flow necessary during increased engine air flow at wide open throttle. Model E4ME employs an electrically heated thermostatic coil to provide the choke valve closing force for cold start-up and for correct opening timing during warmup, while Model E4MC uses a hot air heated thermostatic coil for these purposes Vacuum break units control initial choke valve opening at start and during warmup. An unloader tang on the fast idle lever forces the choke valve open, to purge a flooded engine, when the accelerator is pressed to the floor. A fast idle cam, following the choke valve movement, acts as a graduated throttle stop, providing increased idle speed during warmup.

An Idle Speed Control (ISC) assembly, monitored by the ECM, controls engine idle speed. The curb (or base) idle speed is programmed into the ECM and IS NOT ADJUSTABLE. When the throttle lever is resting against the ISC plunger, the ISC acts as a "dashpot" on throttle closing. An Idle Speed Solenoid or Idle Load Compensator is used on some models to position the primary throttle valve, providing engine idle speed requirements.

On E4MC models, an Idle Load Compensator (ILC) mounted on the float bowl is used to control curb idle speeds. The ILC uses manifold vacuum to sense changes in engine load (for example, A/C compressor clutch engaged) and compensates by adjusting throttle angle for curb idle speed. The ILC uses a spring-loaded vacuum-sensitive diaphragm whose plunger either extends (vacuum decrease) or retracts (vacuum increase) to adjust throttle angle for curb idle speeds. The ILC Solenoid is ECM controlled - See Section 6E1.

The Idle Speed Control (ISC) and Idle Load Compensator (ILC) are adjusted at the factory. A special plunger head requires use of a special tool to turn it, this is to discourage readjustment. NO ATTEMPT should be made to adjust the ISC or ILC unless, in diagnosis, curb idle speed is not to specification. (If adjustment is necessary, refer to "On-Car" service.)

On vehicles that do not include an ISC or ILC but are equipped with air conditioning, an Idle Speed Solenoid (ISS) is used to maintain curb idle speed whenever the air conditioning compressor clutch is engaged (ISS solenoid energized by A/C switch).

The carburetor model identification number is stamped vertically on the float bowl, near the secondary throttle lever. See Figure 6C1-1

Refer to the part number on the bowl when servicing the carburetor. When replacing the float bowl assembly, follow the instructions contained in the service package. Stamp or engrave the model number on the new float bowl.

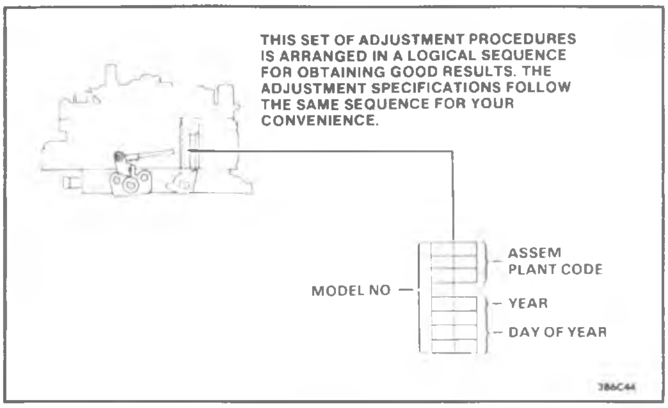


Figure 6C1-1 Carburetor Identification

ON CAR SERVICE

FLOAT MECHANICAL LEVEL CHECK

See Figure 6C1-8AA on Page 6C1-7

CHOKE CHECK PROCEDURE-ALL

Check unloader and idle setting adjustments.

Choke linkage and fast idle cam must operate freely. Bent, dirty, or otherwise damaged linkage must be cleaned, repaired, or replaced as necessary. Do not lubricate linkage since lubricant will collect dust and cause sticking.

CHECKING ELECTRIC CHOKE

This check should be performed at an ambient temperature of 15° to 27°C (60° to 80°F).

1. Allow choke to cool so that when throttle is opened slightly, choke blade fully closes.
2. Start engine and determine time for choke blade to reach full open position. (Start timing when engine starts.)
3. If the choke blade fails to open fully within 3.5 minutes, proceed with Steps 4 and 5 below.
4. Check voltage at the choke heater connection (engine must be running):
   a. If the voltage is approximately 12-15 volts, replace the electric choke unit.
   b. If the voltage is low or zero, check all wires and connections. If any connections in the oil pressure switch circuitry are faulty, or if pressure switch is failed open, the oil warning light will be on with the engine running. Repair wires or connectors as required.
5. If Steps 4a and 4b do not correct the problem, replace oil pressure switch. No gasket is used between the choke cover and the choke housing due to grounding requirements.

See Figures 6C1-7 and 6C1-8

CHECKING HOT AIR CHOKE

1. With parking brake applied, drive wheels blocked, transmission in Park or Neutral, start engine and allow engine to warm up, visually checking to be certain choke valve opens fully.
2. If choke valve fails to open fully, momentarily touch choke housing and hot air inlet pipe or hose to determine if sufficient heat is reaching the choke coil.

   CAUTION: The choke housing and hot air inlet pipe or hose are "hot" to the touch. Use care to prevent burning of hands.

   If choke housing and/or heat inlet are cool to the touch, check for loss of vacuum to the housing, restricted heat inlet in the choke housing or choke heat pipe, collapsed or deteriorated heat inlet hose, or restricted passages in the manifold choke heat stove. Replace or correct as necessary.

See Figure 6C1-8A

ON-CAR SPEED ADJUSTMENTS

Idle Speed Control (ISC) Adjustment

Prior to adjustment, check for an identification letter appearing on the ISC adjustment plunger, Figure 6C1-8C. If NO LETTER appears, using Tool J-29607, BT-8022 or equivalent, remove plunger from ISC unit. Then, measure length of plunger from back side of plunger head to end of plunger screw - Dimension "A" (Figure 6C1-8C). Record this measurement for use at Step 17. Reinstall plunger screw in ISC unit, turning plunger in to a preset position so that the distance measured from the back side of the plunger head to the ISC nosepiece is LESS THAN Dimension "B".

See Figure 6C1-8C

All Models

Before starting engine, place transmission selector lever in PARK (AUTO trans.) or NEUTRAL (MAN. trans.), set parking brake, and block drive wheels.

NOTICE: DO NOT disconnect or connect ISC connector with ignition "ON" as damage to the ECM may occur.

1. Prepare vehicle for adjustments - see Vehicle Emission Control Information Label.
2. Connect tachometer (distributor side of tach filter, if used).
3. Connect dwell meter to mixture control (M/C) solenoid dwell lead. Remember to set dwell meter on the six cylinder scale, regardless of the engine being tested.
4. Turn A/C "OFF".
5. Start engine and run until system enters "closed" loop (dwell meter needle starts to vary).
6. Turn ignition "OFF".
7. Unplug connector from ISC motor.
8. Fully retract ISC plunger by applying 12 volts to terminal "C" of the ISC motor connection and ground lead to terminal "D" of the ISC motor connection. To

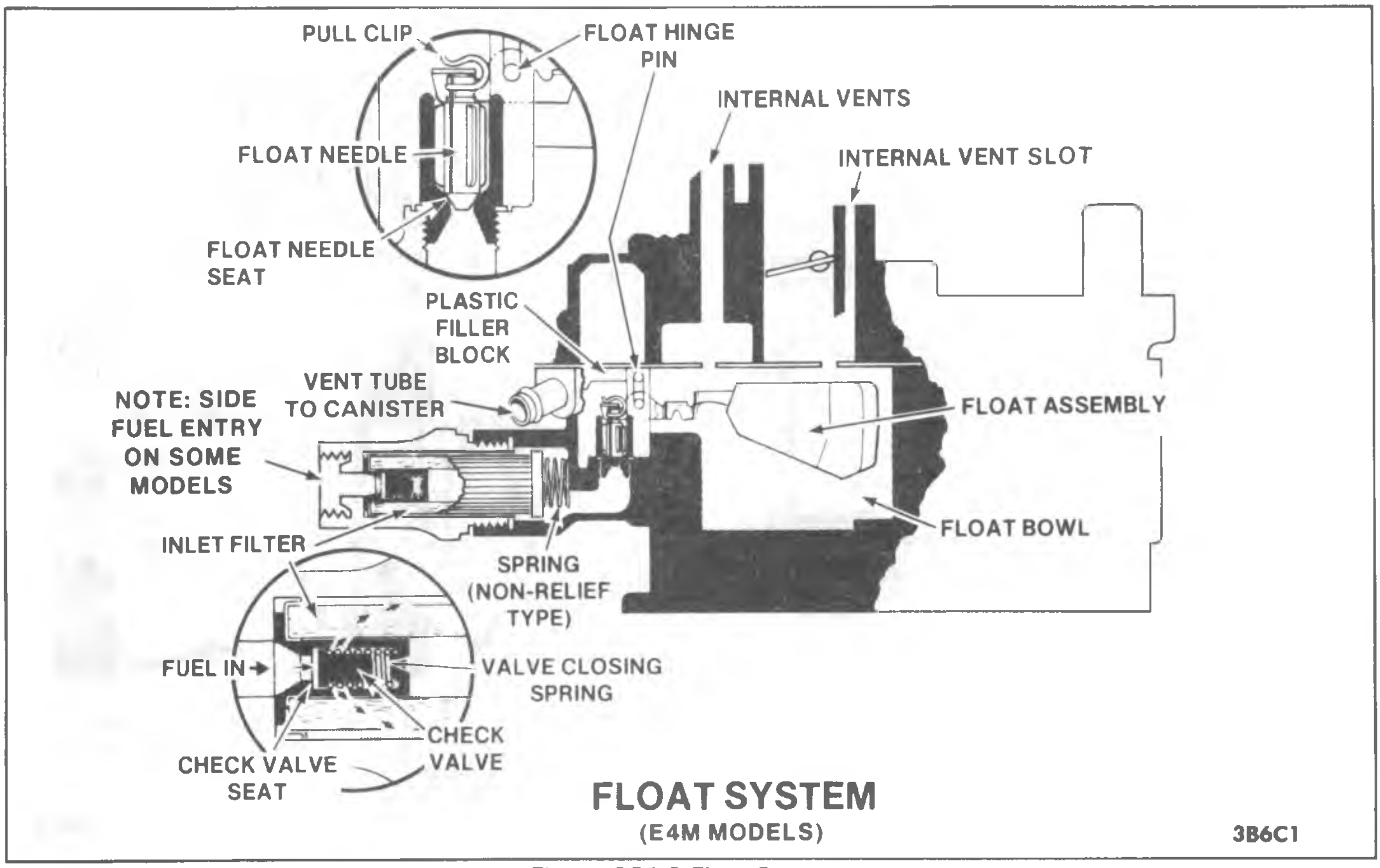


Figure 6C1-2 Float System

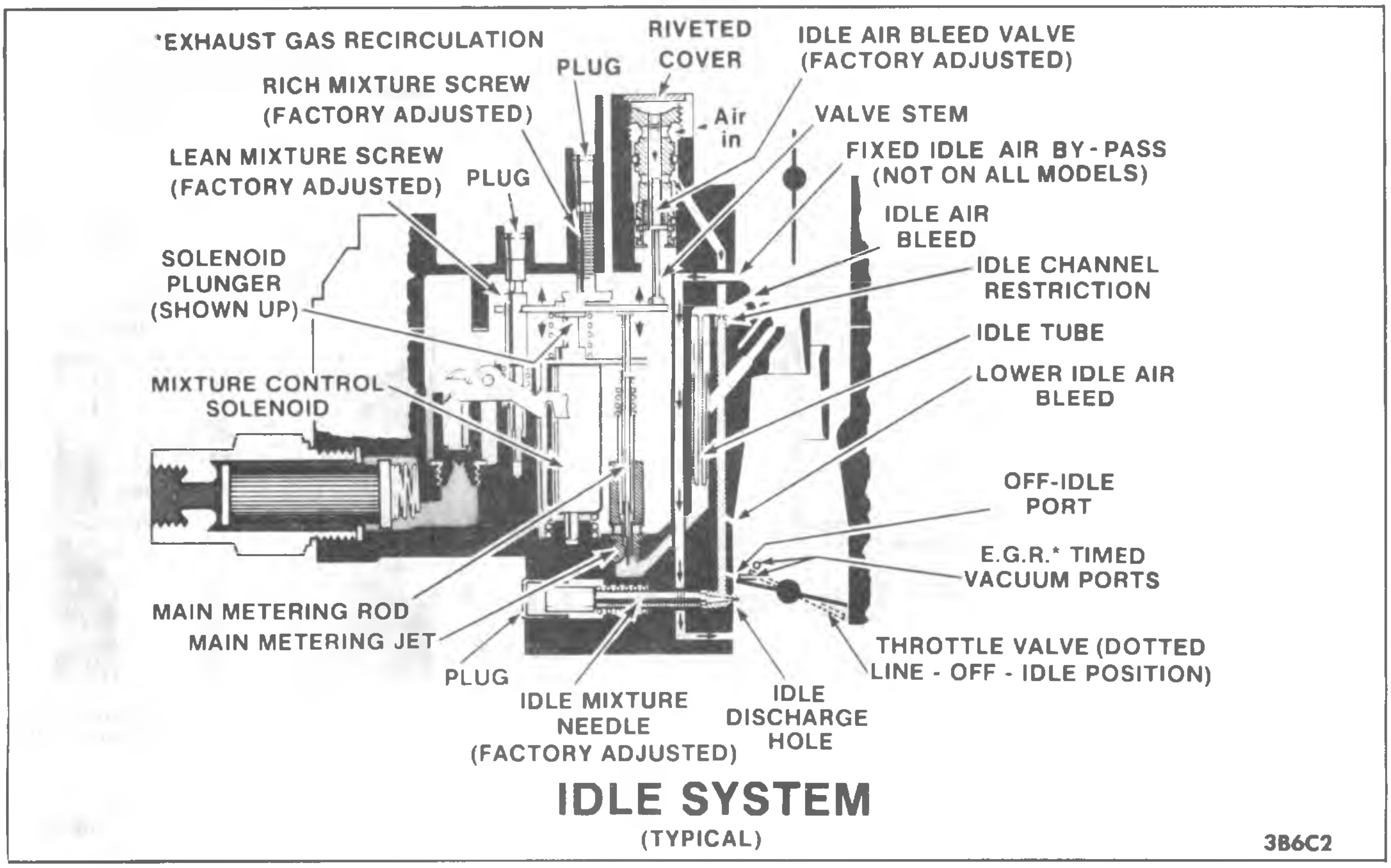


Figure 6C1-3 Idle System

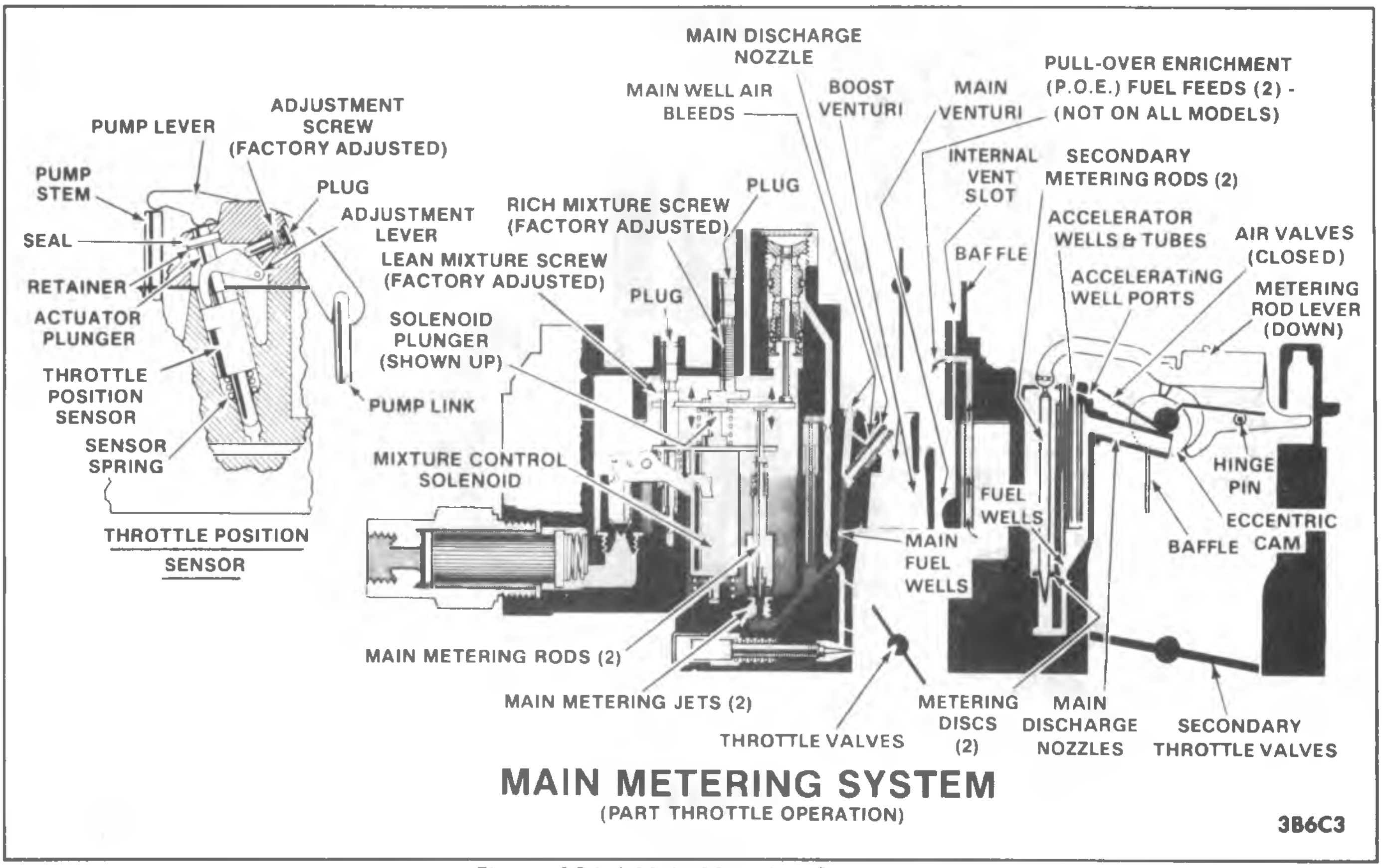


Figure 6C1-4 Main Metering System

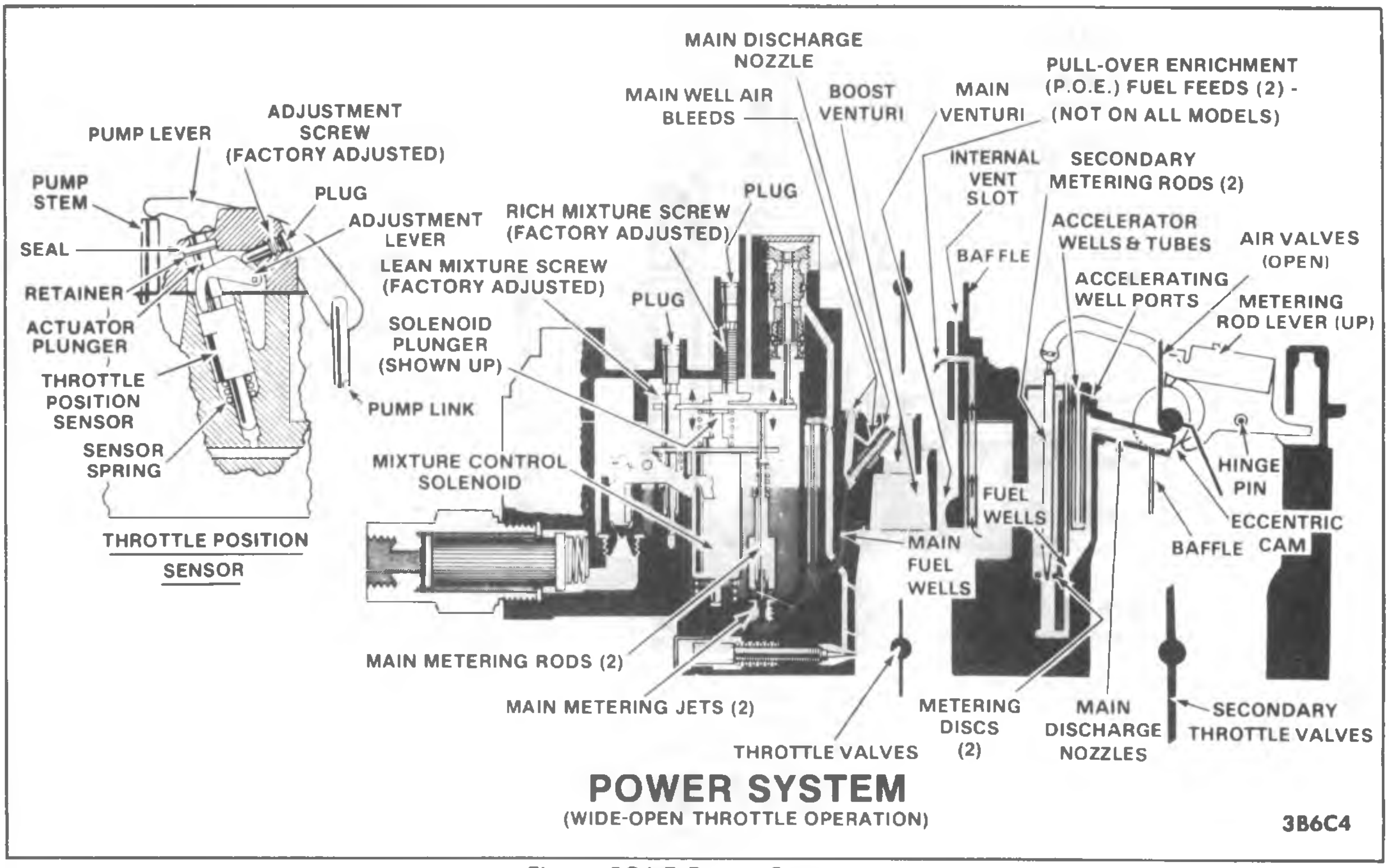
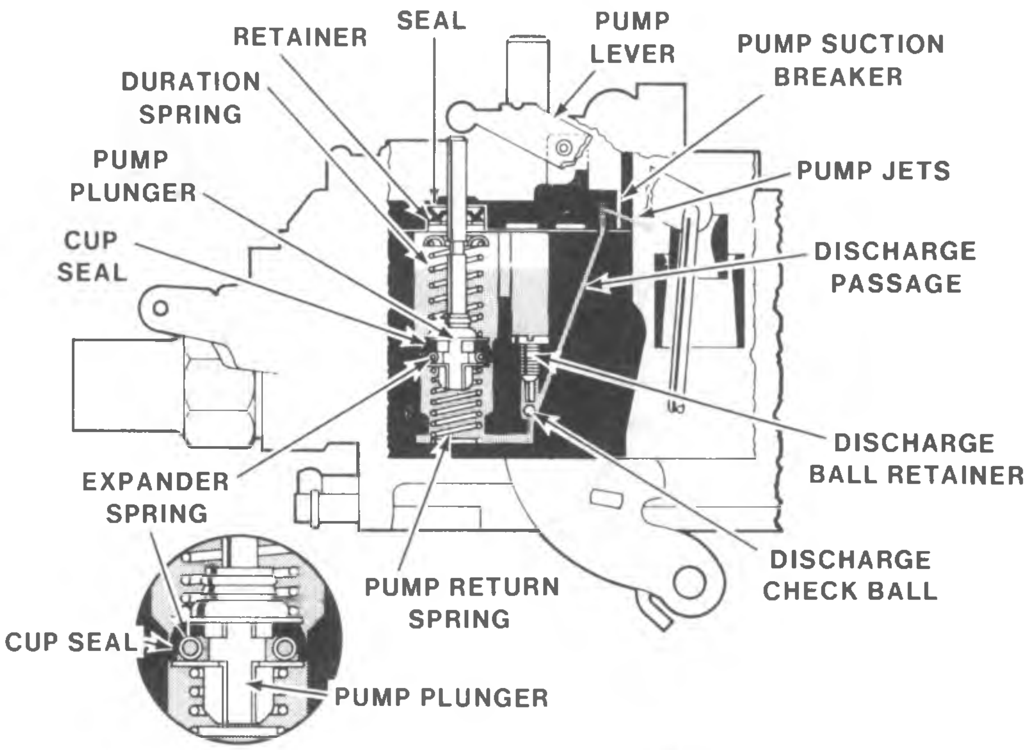


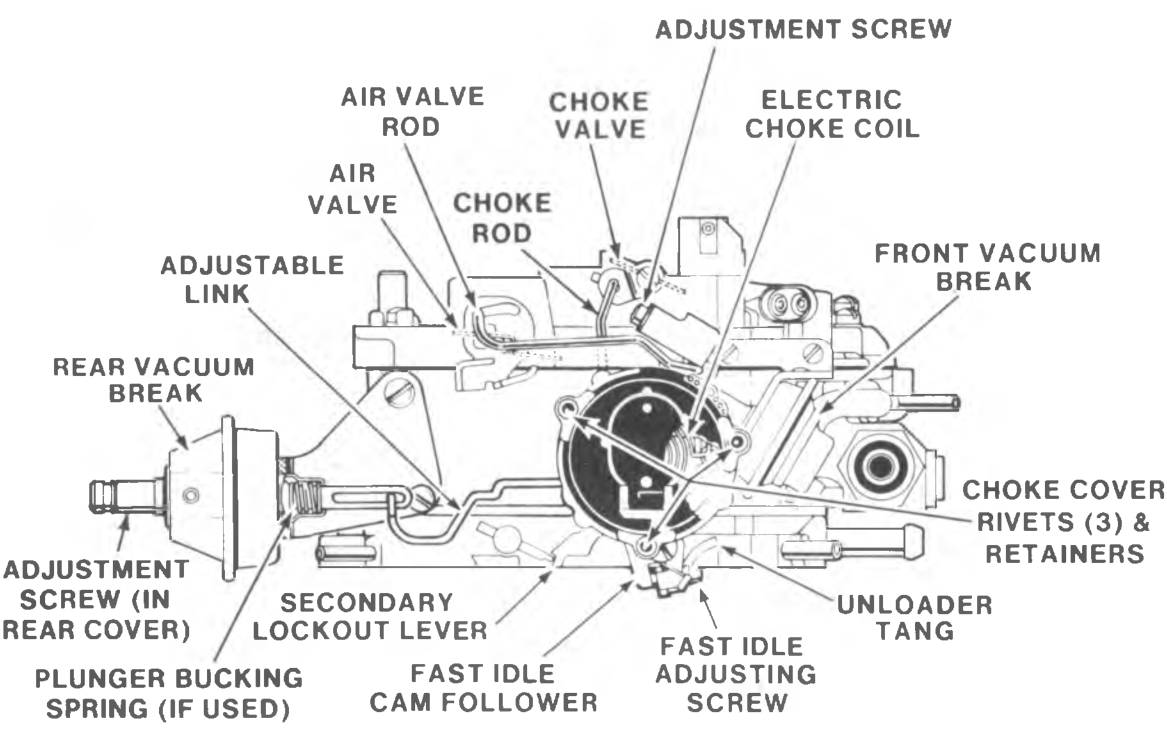
Figure 6C1-5 Power System



PUMP SYSTEM - TYPICAL

4B6C100

Figure 6C1-6 Pump System



CHOKE SYSTEM - TYPICAL
(ELECTRIC CHOKE TYPE)

4B6C101

Figure 6C1-7 Choke System-E4ME (with Rear Vacuum Break)

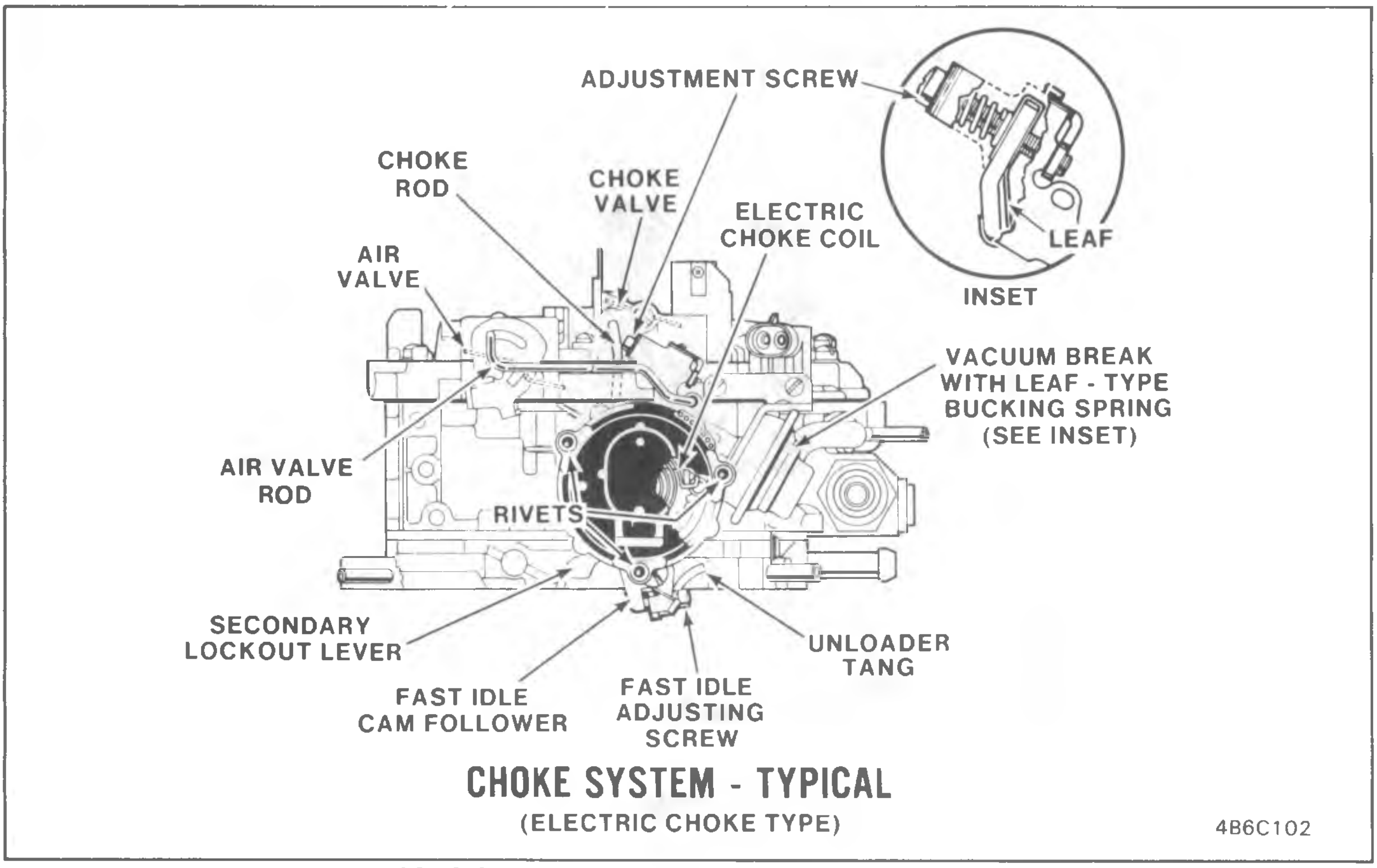


Figure 6C1-8 Choke System-E4ME (without Rear Vacuum Break)

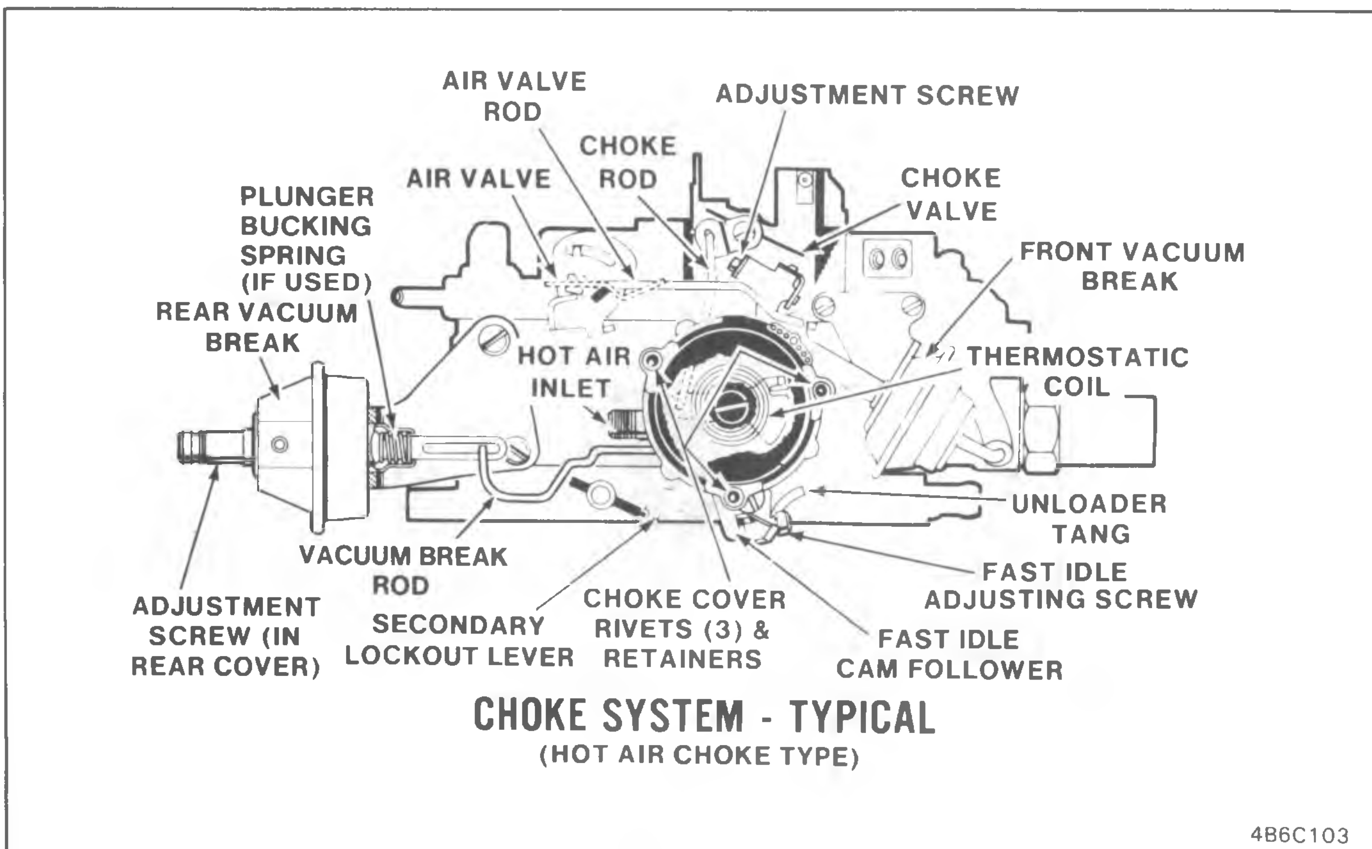


Figure 6C1-8A Choke System-E4MC

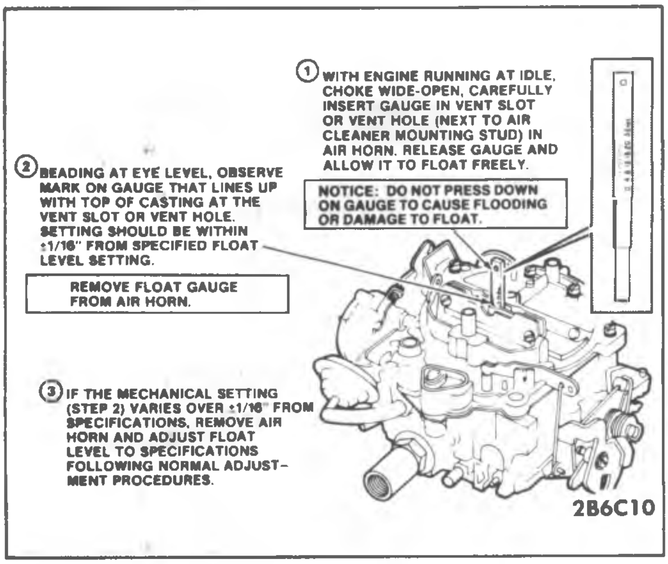


Figure 6C1-1A External Float Gage Check Procedure

prevent internal damage to ISC, apply finger pressure to ISC plunger while retracting.

See Figure 6C1-8B

NOTICE: DO NOT leave battery voltage applied to motor longer than necessary to retract ISC plunger. Prolonged contact will damage motor. Also, NEVER connect voltage source across terminals "A" and "B" as damaged to the internal throttle contact switch will result.

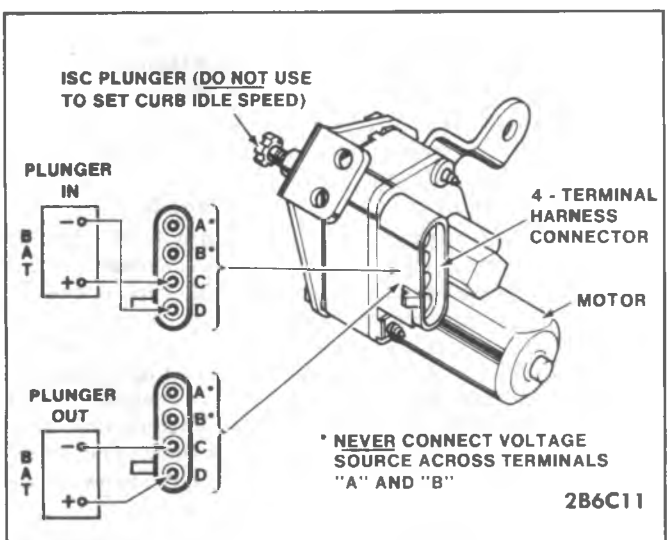


Figure 6C1-8B Idle Speed Control Assembly-Typical

9. Start engine and wait until dwell meter needle starts to vary, indicating "closed loop" operation.
10. With parking brake applied and drive wheels blocked, place transmission in drive (neutral-manual transmission models).
11. With ISC plunger fully retracted, adjust carburetor base (slow) idle stop screw (minimum authority) to the RPM shown in Figure 6C1-60.
12. PLACE TRANSMISSION IN PARK (AUTO TRANS.) OR NEUTRAL (MAN. TRANS.)
13. Fully extend ISC Plunger by applying 12 volts to Terminal "D" of the ISC Motor Connection and ground lead to Terminal "C" of the ISC Motor Connection. Leave power applied only long enough to extend the plunger.

    NOTICE: Never connect voltage source across terminals "A" and "B" as damage to the internal throttle contact switch will result.

14. Manual transmission: Using Tool J-29607 or BT-8022 or equivalent, turn ISC Plunger to obtain ISC adjustment RPM (Maximum Authority) shown in Figure 6C1-60.
15. Automatic Transmission
    a. With Transmission in Park, using Tool J-29607 or BT-8022 or equivalent, preset ISC plunger to obtain 1500 RPM.
    b. With parking brake set and drive wheels blocked, place transmission in drive. Using Tool J-29607 or BT-8022 or equivalent, turn ISC Plunger to obtain ISC adjustment RPM (Maximum Authority) shown in Figure 6C1-60.
16. Recheck ISC Maximum Authority Adjustment RPM with voltage applied to Motor (Step 13). Motor will ratchet at full extension with power applied.
17. After adjustment of ISC plunger, measure distance from back side of plunger head to ISC nosepiece, Dimension "B", Figure 6C1-8C. Dimension must NOT exceed that shown by plunger type as either identified by plunger length or letter identification.

See Figure 6C1-8D

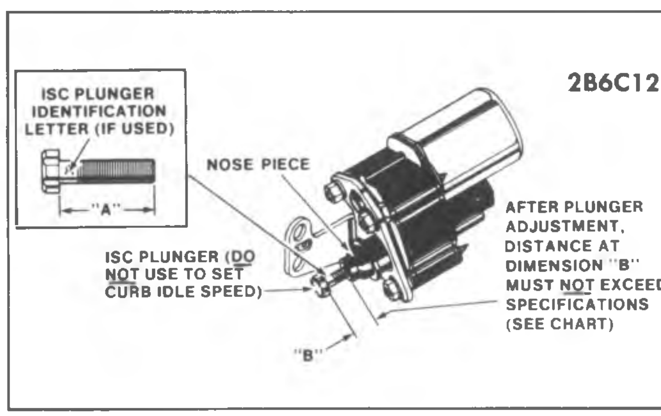


Figure 6C1-8C Plunger Maximum Adjustment

18. Fully retract ISC Plunger (Step 8). Place Transmission in Park (AUTO Trans.) or Neutral (MAN. Trans.) and turn ignition "Off". Disconnect 12 Volt Power source, Ground lead, Tachometer and Dwell Meter. With ignition "Off", reconnect four (4) Terminal Harness connector to ISC Motor. To prevent internal damage to ISC, apply finger pressure to ISC plunger while retracting.
19. Remove block from drive wheels.

Idle Load Compensator (ILC) Adjustment - E4MC

1. Prepare vehicle for adjustments - see Vehicle Emission Control Information Label.
2. Connect tachometer (distributor side of TACH filter, if used.).
3. Remove air cleaner and plug vacuum hose to Thermal Vacuum Valve (TVV).
4. Disconnect and plug vacuum hose to EGR.
5. Disconnect and plug vacuum hose to canister purge port.

IDLE SPEED CONTROL PLUNGER		
IDENTIFICATION LETTER	PLUNGER LENGTH DIMENSION A	AFTER ADJUSTMENT (STEPS 14, 15, or 16), DISTANCE AT DIMENSION "B" MUST NOT EXCEED
NONE	14.1 mm (9/16")	5.6 mm (7/32")
NONE	16.3 mm (41/64")	8.0 mm (5/16")
X	18.5 mm (47/64")	10.0 mm (25/64")
A	19.3 mm (49/64")	10.8 mm (27/64")
Y	20.5 mm (51/64")	12.0 mm (15/32")
S	21.2 mm (27/32")	12.7 mm (1/2")
Z	22.5 mm (7/8")	14.0 mm (35/64")
G	23.2 mm (29/32")	14.7 mm (37/64")
E	25.6 mm (1")	17.1 mm (43/64")
L	27.5 mm (1 3/32")	19.0 mm (3/4")
J	30.0 mm (1 3/16")	21.5 mm (27/32")
N	32.0 mm (1 17/64")	23.5 mm (59/64")
T	34.0 mm (1 11/32")	25.5 mm (1") 2B6C13

Figure 6C1-8D Plunger Maximum Adjustment Chart

6. Disconnect and plug vacuum hose to ILC.
7. Back out idle stop screw on carburetor 3 turns.
8. Turn A/C "OFF".
   BEFORE STARTING ENGINE, PLACE TRANSMISSION IN PARK, SET PARKING BRAKE, AND BLOCK DRIVE WHEELS.
9. With engine running (engine warm, choke off), transmission in drive, and ILC plunger fully extended (no vacuum applied). Using Tool J-29607, BT-8022 or equivalent, adjust plunger to obtain 725 RPM E4MC models - Figure 6C1-8E. Jam nut on plunger must be held with wrench to prevent damage to guide tabs.

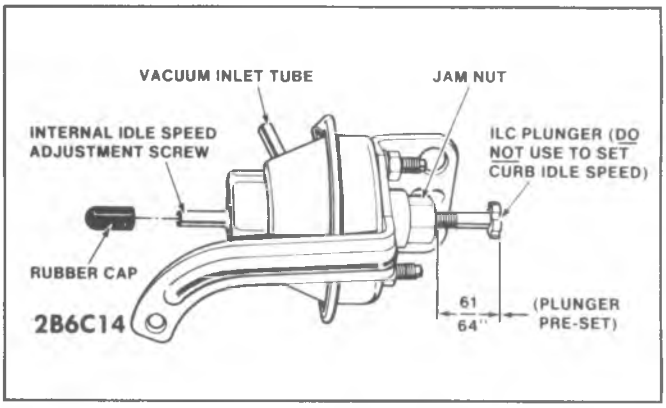


Figure 6C1-8E Idle Load Compensator (ILC)-Typical

10. Remove from vacuum hose, reconnect hose to ILC and observe idle speed. Idle speed should be 500 RPM in drive. IF SPEED IS CORRECT (STEP 10) NO FURTHER ADJUSTMENT OF ILC IS NECESSARY. PROCEED TO STEP 12.
11. IF SPEED IS NOT CORRECT (STEP 10)
    a. Stop engine and remove the ILC. Plug vacuum hose to ILC.
    b. With the ILC removed, remove the rubber cap from the center outlet tube and then remove the metal plug (IF USED) from this same tube.
    c. Install ILC on carburetor and reattach throttle return spring and any other related parts removed during disassembly. Remove plug from vacuum hose and reconnect hose to ILC.
    d. Using a spare rubber cap with hole punched to accept a .090" (3/32") hex key wrench, install cap on center wrench through cap to engage adjusting screw inside tube. Start engine and turn adjusting screw with wrench to obtain 500 RPM in drive. Turning the adjusting screw will change the idle speed approximately 75-100 RPM for each complete turn. Turning the screw counterclockwise will increase the engine speed.
    e. Remove wrench and cap (with hole) from center outlet tube and install new rubber cap.
    f. Engine running, transmission in drive, observe idle speed. If a final adjustment is required, it will be necessary to repeat Steps 12a through 12e.
12. Engine running, transmission in drive, measure distance from the jam nut to tip of the plunger, Dimension "A", Figure 6C1-13. Dimension must NOT exceed 25mm (1 inch).
13. Disconnect and plug vacuum hose to ILC. Apply vacuum source such as hand vacuum pump J-23768, BT-7517 or equivalent to ILC vacuum inlet tube to fully retract the plunger.
14. Adjust the idle stop screw on the carburetor float bowl to obtain 500 RPM in drive.
15. Place transmission in PARK and stop engine.
16. Remove plug from vacuum hose and install hose on ILC vacuum inlet tube.
17. Remove plug and reconnect all vacuum hoses.

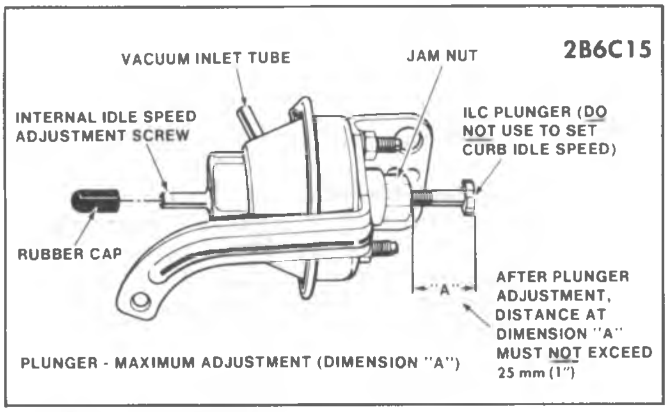


Figure 6C1-8F ILC Plunger - Maximum Adjustment

18. Install air cleaner and gasket.
19. Remove block from drive wheels.

Differential Vacuum Delay Valve (DVDV)

The DVDV is located in the vacuum line between the Idle Load Compensator (ILC) and the vacuum source. It is used on all 5.0L engines (engine code Y).

See Figure 6C1-8G

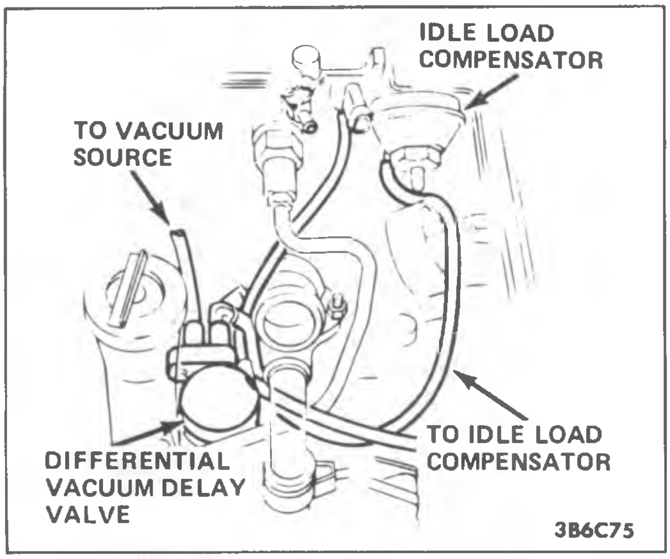


Figure 6C1-8G DVDV Hose Routing

The DVDV acts as cushioning device by slightly delaying the operation of the ILC until a constant vacuum change has occurred. Without the DVDV the ILC would react too quickly to changes in engine vacuum, causing a surging condition or if too restrictive to vacuum flow, it would cause a stalling or run-on condition.

To check the operation of the DVDV, install a vacuum gage with a "T" into the hose from the DVDV to the ILC. Install a vacuum pump to port 1 (Figure 6C1-8H) and apply 60 kPa (17.8") of vacuum while watching the other vacuum gage, it should take six (6) to nine (9) seconds for the vacuum to rise to 57.0 kPa (16.9"). Remove the vacuum gage with "T", install the vacuum pump to port 2 and leave port 1 open. Air should flow through the valve after 1.7 kPa (.5") is applied.

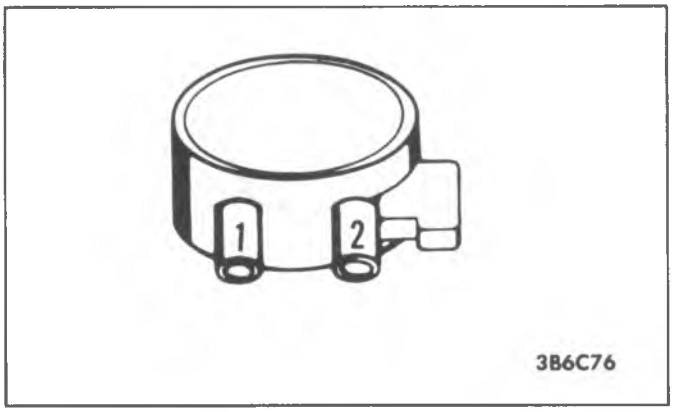


Figure 6C1-8H Differential Vacuum Delay Valve

A/C Idle Speed Solenoid (ISS) Adjustment

See Figure 6C1-8I for Idle Speed Solenoid (ISS Adjustment)

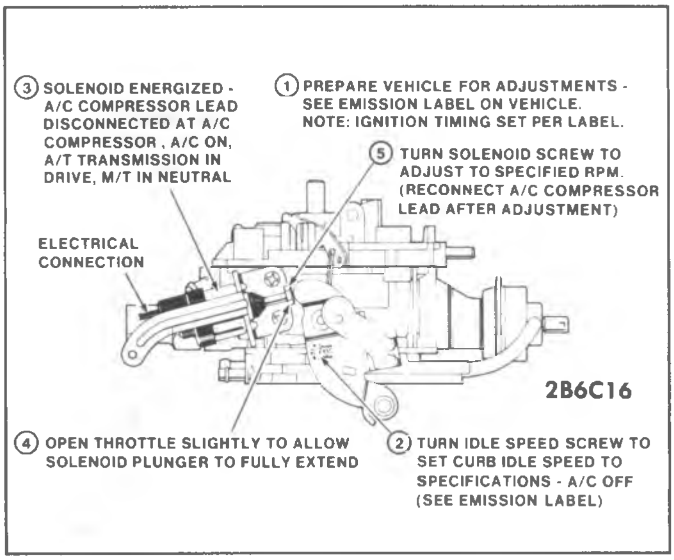


Figure 6C1-8I Idle Speed Solenoid Adjustment

Throttle Position Sensor (TPS) Adjustment

The plug convering the TPS adjustment screw (Figure 6C1-8H) is used to provide a tamper-resistant design and retain the factory setting during vehicle operation. DO NOT REMOVE the plug unless, in diagnosis, the "System Performance Check" (Section 6E) indicates the TPS Sensor is not adjusted correctly or it is necessary to replace the air horn assembly, float bowl, TPS sensor, or TPS adjustment screw. This is a critical adjustment that must be performed accurately to ensure proper vehicle performance and control of exhaust emissions.

If necessary to adjust the TPS sensor:

1. Using a 2mm (5/64") drill, drill a 1/16" to 1/8" deep hole in aluminum plug covering TPS adjustment screw. Use care in drilling to prevent damage to adjustment screw head.

See Figure 6C1-8H

2. Start a No. 8 1/2" long self-tapping screw in drilled hole turning screw in only enough to ensure good thread engagement in hole.
3. Placing a wide-blade screwdriver, between screw head and air horn casting, pry against screw head to remove plug. DISCARD PLUG.

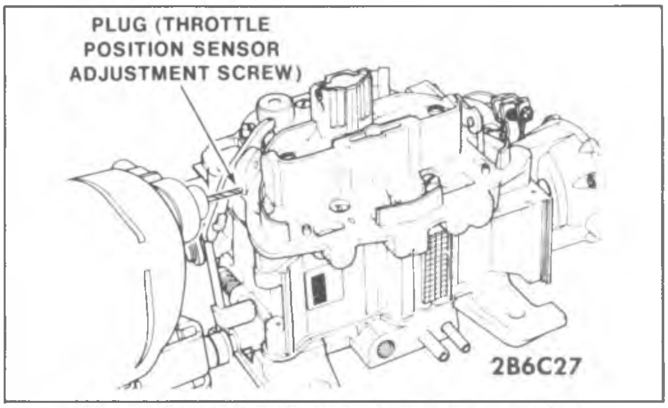


Figure 6C1-8J TPS Adjustment Screw Plug

4. Using Tool J-28696 or equivalent, remove TPS adjustment screw.

See Figure 6C1-8I

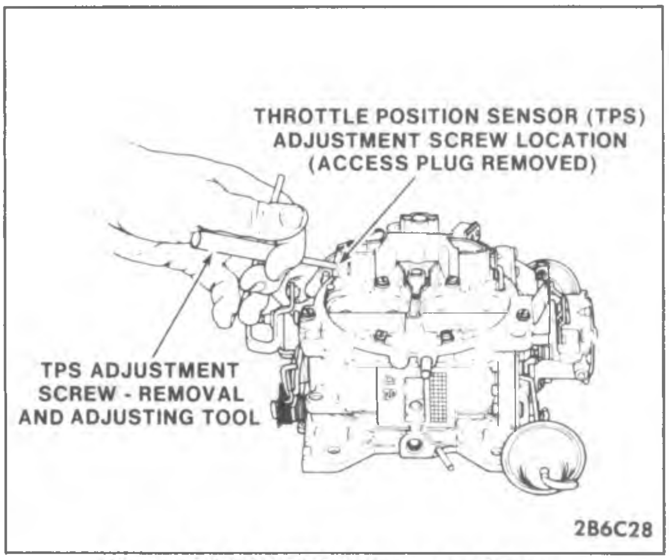


Figure 6C1-8K TPS Adjustment Screw

5. Connect digital voltmeter (such as J-29125) from TPS connector center terminal (B) to bottom terminal (C). (Jumpers for access can be made using terminals 12014836 and 12014837.)

6. With ignition on, engine stopped, reinstall TPS adjustment screw and with Tool J-28696, BT-7967A or equivalent quickly adjusting screw to obtain specified TPS voltage with A/C off.

See Specifications Figure 6C1-60

7. After adjustment, install new plug (supplied in service kits) in air horn, driving plug in place until flush with raised pump lever boss on casting.

NOTICE: Plug must be installed to retain the TPS adjustment screw setting. Replacement adjusting screw is coated with threadlocking compound and can be used without a plug. If a plug or replacement screw is not available, remove old screw and apply GM threadlocking compound 1052624 to screw threads, then repeat Step 6.

Mixture Control Solenoid Plunger Travel

Checking

Mixture control solenoid plunger travel should be checked before proceeding with any carburetor adjustments or disassembly.

Using Float Gage J-9789-130, BT-7720, or equivalent, (used to check float level setting externally), insert gage in the vertical "D" shaped vent hole in the air horn casting, next to the Idle Air Bleed Cover, Figure 6C1-9. It may be necessary to file or grind material off the gage to allow it to enter the vent hole freely. Gage will be used to check total mixture control solenoid plunger travel.

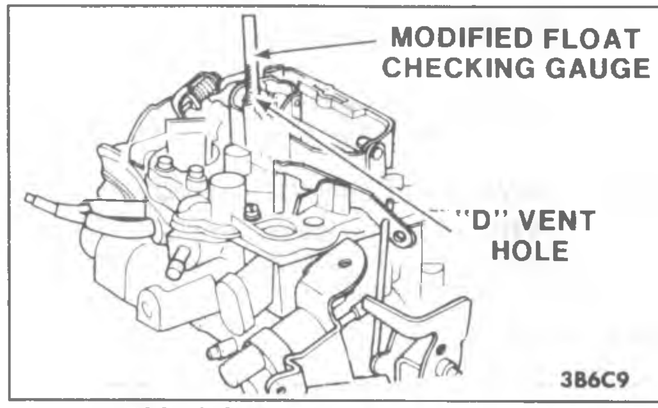


Figure 6C1-9 Checking Solenoid Plunger Travel

With engine off, air cleaner and gasket removed, measure mixture control solenoid plunger travel as follows:

1. Insert float gage down "D" shaped vent hole. Press down on gage and release, observing that the gage moves freely and does not bind. With gage released, (plunger UP position), read at eye level and record the reading of the gage mark (in inches) that lines up with the top of air horn casting, (upper edge).
2. Lightly press down on gage until bottomed, (plunger DOWN position). Read and record (inches) the reading of the gage mark that lines up with top if air horn casting.
3. Subract gage UP position (Step l) from gage DOWN position (Step 2), and record difference. This difference is total plunger travel.
4. If total plunger travel (Step 3) is between 2/32" and 6/32", proceed to Idle Air Bleed Valve Adjustment. If it is less than 2/32" or greater than 6/32", make mixture control solenoid plunger adjustments indicated below.

Adjustments

1. Remove air horn, mixture control solenoid plunger, air horn gasket and plastic filler block, using normal service procedures.
2. Remove throttle side metering rod. Install mixture control solenoid gaging Tool J-33815-1, BT-8253-A, or equivalent, over the throttle side metering jet rod guide, and temporarily reinstall the solenoid plunger into the solenoid body.

See Figure 6C1-10

3. Holding the solenoid plunger in the DOWN position, use Tool J-28696-10, BT-7928, or equivalent, to turn lean mixture (solenoid)screw counterclockwise until the plunger breaks contact with the gaging tool. The

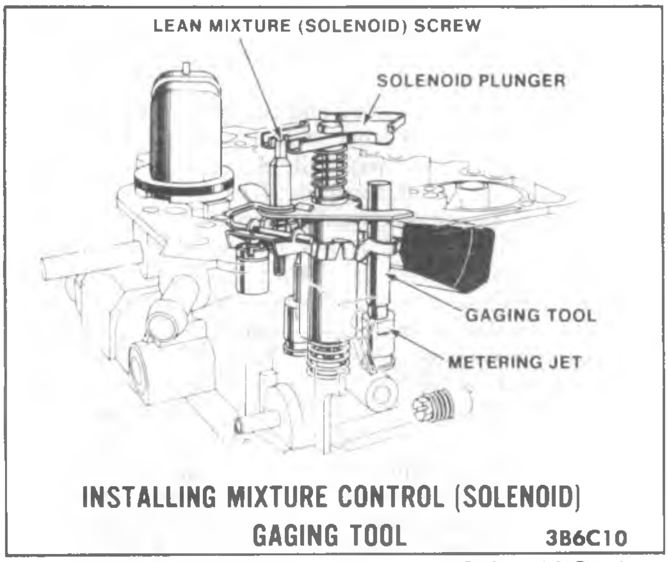


Fig. 6C1-10 Installing Mixture Control Solenoid Gaging Tool

adjustment is correct when the solenoid plunger is contacting BOTH the SOLENOID STOP and the GAGING TOOL.

See Figure 6C1-11

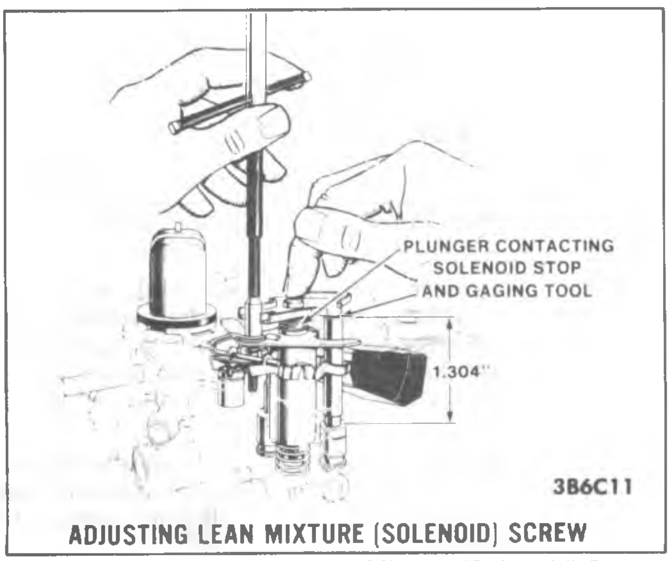


Figure 6C1-11 Adjusting Lean Mixture (Solenoid) Screw

If the total difference in adjustment required less than 3/4 turn of the lean mixture (solenoid) screw, the original setting was within the manufacturer's specifications.

4. Remove solenoid plunger and gaging tool, and reinstall metering rod and plastic filler block.
5. Invert air horn and remove rich mixture stop screw and rich authority adjusting spring from bottom side of air horn, using Tool J-28696-4, BT-7967A or equivalent.

See Figure 6C1-12

6. Remove lean mixture screw plug and the rich mixture stop screw plug from air horn, using a suitably sized punch.

See Figure 6C1-13

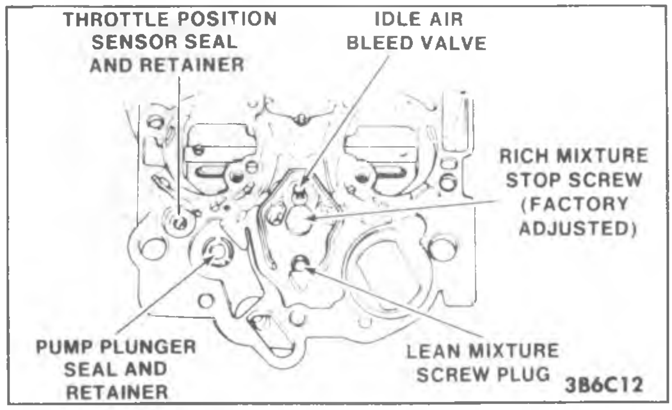


Figure 6C1-12 Removing Rich Mixture Stop Screw

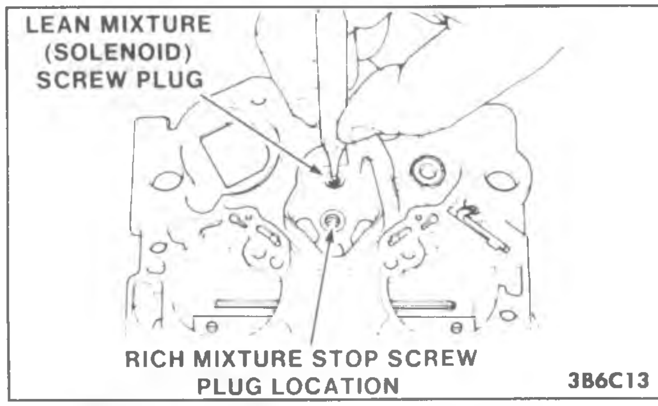


Figure 6C1-13 Removing Lean Mix. Screw & Rich Mix. Stop Screw Plugs

7. Reinstall rich mixture stop screw and rich authority adjusting spring in air horn and bottom lightly, then back screw out 1/4 turn.
8. Reinstall air horn gasket, mixture control solenoid plunger and air horn to carburetor.
9. Insert external float gage in vent hole and, with Tool J-9789-130, BT-7220, or equivalent, adjust rich mixture stop screw to obtain 4/32" total plunger travel.

See Figure 6C1-14

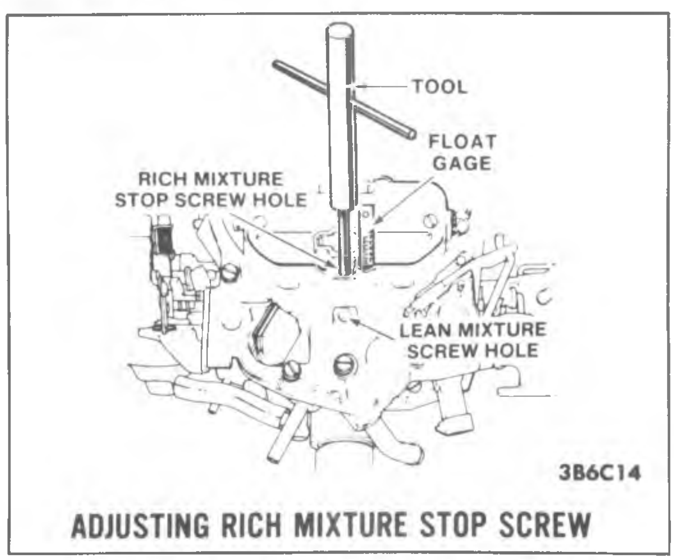


Figure 6C1-14 Adjusting Rich Mixture Stop Screw

10. With solenoid plunger travel correctly set, install plugs (supplied in service kits) in the air horn, as follows:
    a. Install plug, hollow end down, into the access hole to lean mixture (solenoid) screw, and use suitably sized punch to drive plug into the air horn until the top of the plug is even with the lower edge of the hole chamfer. Plug must be installed to retain the screw setting and to prevent fuel vapor loss.

See Figure 6C1-15

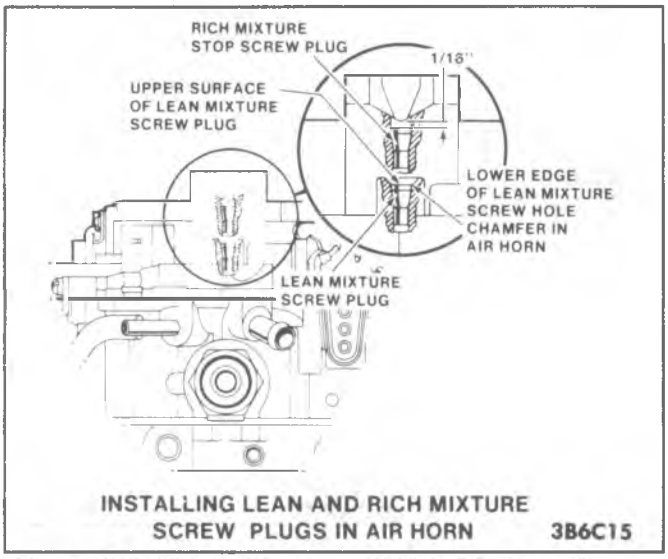


Figure 6C1-15 Installing Lean & Rich Mix. Stop Screw Plugs

    b. Install plug, with hollow end down, over the rich mixture stop screw access hole, and drive plug into place so that the top of the plug is 1/16" below the surface of the air horn casting. Plug must be installed to retain screw setting.

See Figure 6C1-15

Idle Mixture and Speed Adjustment

A cover is riveted in place over the idle air bleed valve, and the access holes to the idle mixture needles are sealed with hardened plugs, to seal the factory settings, during original equipment production. These items are NOT to be removed unless required for cleaning, part replacement, improper dwell readings (Step 4, below), or if the System Performance Check (Section 6E) indicates the carburetor is the cause of the trouble.

Idle Mixture

Adjustment

1. Before proceeding:
    a. Set Parking brake and block drive wheels.
    b. Disconnect and plug hoses, as directed on Emission Control Information Label under the hood.
    c. Check ignition timing as shown on the Emission Control Information label.
    d. Connect dwell meter and tachometer as noted in "System Performance Check" chart in Section 6E.
2. Start engine, and with transmission in Park or Neutral, run engine at idle until fully warm and a varying dwell is noted on the dwell meter. It is essential that the engine is operated for a sufficient length of time to ensure that the engine coolant and the oxygen sensor in the exhaust, are at full operational temperature.
3. Check engine idle speed and compare to specifications on the underhood label. If necessary, adjust curb idle speed. On models with Idle Speed Control (ISC) or Idle Load Compensator (ILC), no curb idle adjustment is possible as curb idle speed is controlled by ECM. If speed is out of specification, refer to appropriate section for correct setting procedure.
4. With engine idling in Drive (Neutral for manual transmission), observe dwell reading on the 6 cylinder scale. If varying within the 10-50° range, adjustment is correct. If NOT, perform the following:
5. IDLE AIR BLEED VALVE COVER REMOVAL
   To gain access to the idle air bleed valve for identification, adjustment or servicing, it is necessary to remove the idle air bleed valve cover. If cover is riveted, remove as follows starting with Step "a". If cover is staked in place, see Figure 6C1-15A.

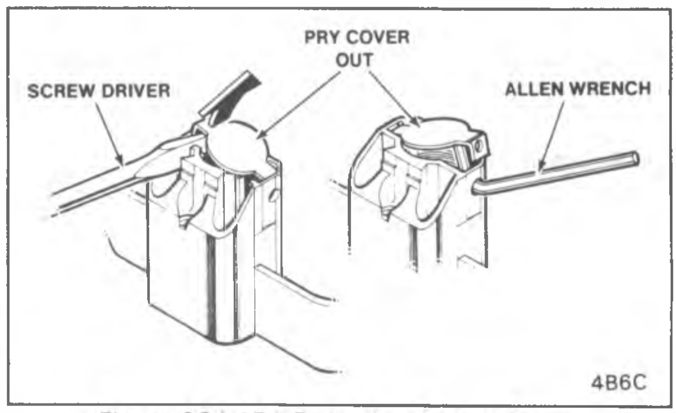


Figure 6C1-15A Removing Staked Cover

    a. To remove rivited cover start with engine off, cover internal bowl vents and air inlets to the bleed valve with masking tape or equivalent. Cover carburetor air intakes with masking tape to prevent metal chips from entering carburetor and engine.
    b. Carefully align a No. 35 (.110") drill bit on one of the steel rivet heads holding the idle air bleed valve cover in place. Drill only enough to remove rivet head.

See Figure 6C1-16

Drill the remaining rivet head located on the other side of the tower. Use a drift and small hammer to drive the remainder of the rivets out of the idle air bleed valve tower in the air horn casting. Use care in drilling to prevent damage to the air horn casting.

    c. Lift out cover over the idle air bleed valve and remove the rivet pieces from inside the idle air bleed valve tower.

CAUTION: For the next operation, safety glasses must be worn to protect the eyes from possible metal shaving damage.

Using shop air, carefully blow out any remaining chips from inside the tower. **DISCARD COVER AFTER REMOVAL.** A missing cover indicates that the idle air bleed valve setting has been changed from its original factory setting.

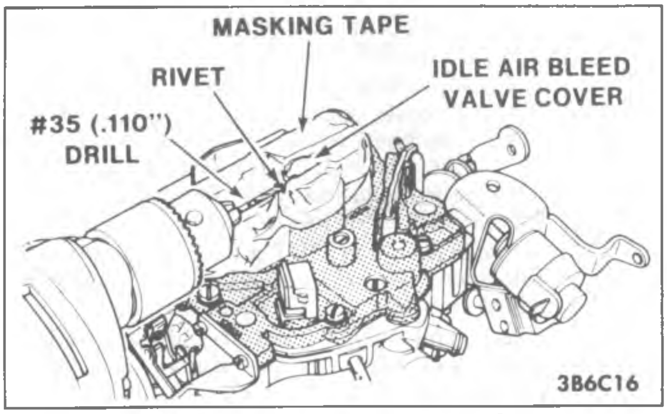


Figure 6C1-16 Removing Idle Air Bleed Cover Rivets

d. With cover removed, look for presence (or absence) of a letter identification on top of idle air bleed valve.

See Figure 6C1-17

If NO identifying letter appears on top of the valve, begin PROCEDURE A, below. If the valve IS identified with a letter, begin PROCEDURE B.

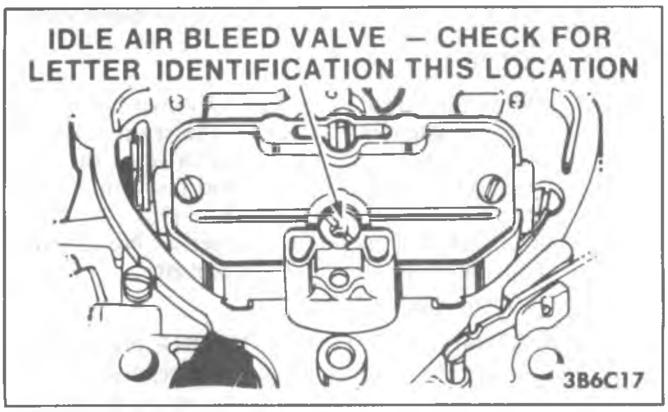


Figure 6C1-17 Idle Air Bleed Valve-Letter ID Location

Procedure A (No Letter on Idle Air Bleed Valve)

1. **PRESETTING THE IDLE AIR BLEED VALVE** to a gage dimension if the idle air bleed valve was serviced prior to on-vehicle adjustment.
   (Only necessary if idle air bleed valve was serviced prior to on-vehicle adjustment):
   a. Install idle air bleed valve gaging Tool J-33815-2, BT-8253-B, or equivalent, in throttle side "D" shaped vent hole in the air horn casting. The upper end of the tool should be positioned over the open cavity next to the idle air bleed valve.

See Figure 6C1-18

   b. While holding the gaging tool down lightly, so that the solenoid plunger is against the solenoid stop, adjust the idle air bleed valve so that the gaging tool will pivot over and just contact the top of the valve. The valve is now preset for on-vehicle adjustment.

See Figure 6C1-19

   c. Remove gaging tool.
2. **ADJUSTING THE IDLE AIR BLEED VALVE** on the vehicle to obtain correct dwell reading.

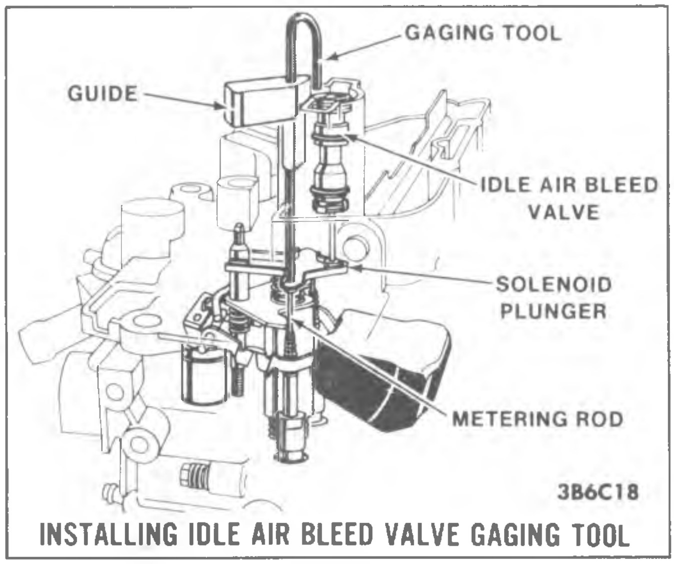


Figure 6C1-18 Installing Idle Air Bleed Valve Gaging Tool

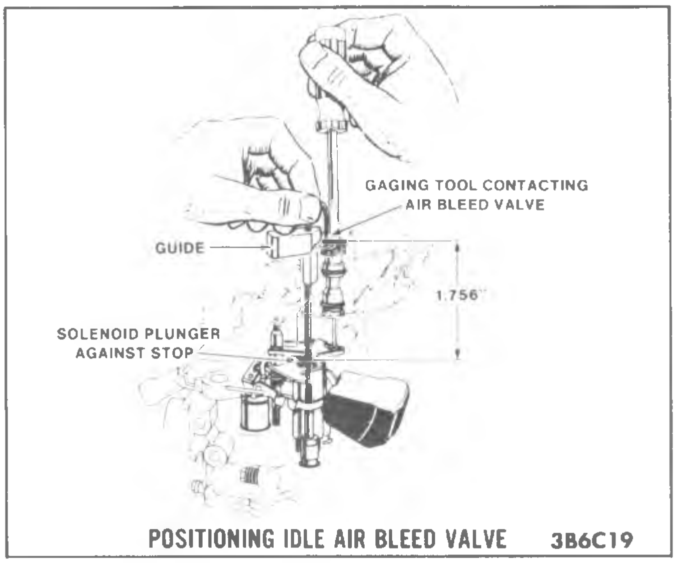


Figure 6C1-19 Positioning Idle Air Bleed Valve

a. Start engine and allow it to reach normal operating temperature.
b. While idling in Drive (Neutral for manual transmission), use a screwdriver to slowly turn valve counterclockwise or clockwise, until the dwell reading varies within the 25-35° range, attempting to be as close to 30° as possible. Perform this step carefully. The air bleed valve is very sensitive and should be turned in 1/8 turn increments only.
c. If, after performing Steps a and b above, the dwell reading does not vary and is not within the 25-35° range, it will be necessary to remove the plugs and to adjust the idle mixture needles.

IDLE MIXTURE NEEDLE PLUG REMOVE -- only if necessary:

1. Remove the carburetor from the engine, following normal service procedures, to gain access to the plugs covering the idle mixture needles.
2. Invert carburetor and drain fuel into a suitable container.
3. Place carburetor on a suitable holding fixture, with manifold side up. Use care to

avoid damaging linkage, tubes, and parts protruding from air horn.

4. Make two parallel cuts in the throttle body, one on each side of the locator points beneath the idle mixture needle plug (manifold side), with a hacksaw.

See Figure 6C1-20

The cuts should reach down to the steel plug, but should not extend more than 1/8" beyond the locator points. The distance between the saw cuts depends on the size of the punch to be used.

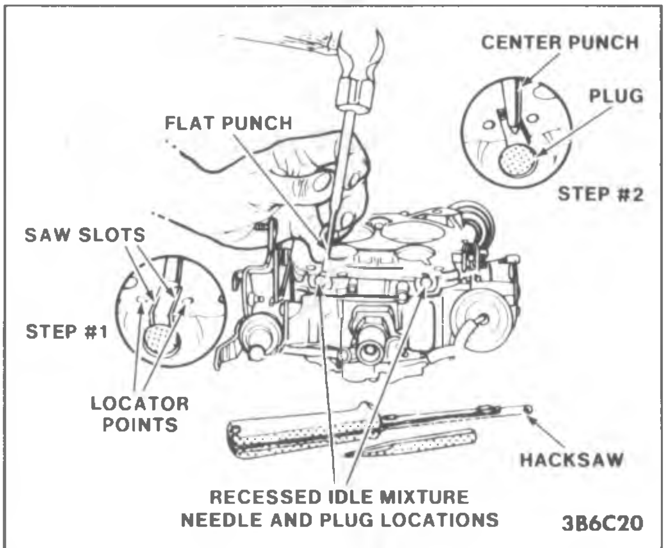


Figure 6C1-20 Removing Idle Needle Plugs

5. Place a flat punch near the ends of the saw marks in the throttle body. Hold the punch at a 45° angle and drive it into the throttle body until the casting breaks away, exposing the steel plug.
   The hardened plug will break, rather than remaining intact. It is not necessary to remove the plug in one piece, but remove the loose pieces.
6. Repeat this procedure with the other mixture needle.

3. **SETTING THE IDLE MIXTURE NEEDLES (IF NECESSARY)** where correct dwell reading could not be obtained with idle air bleed valve adjustment.
   a. Using Tool J-29030-B, BT-7610B, or equivalent, turn both idle mixture needles clockwise until they are lightly seated, then turn each mixture needle counterclockwise the number of turns specified.
   b. Reinstall carburetor on engine using a new flange mounting gasket, but do not install air cleaner and gasket at this time.
4. **READJUSTING IDLE AIR BLEED VALVE** to finalize correct dwell reading.
   (Only necessary if idle mixture needles required setting in Step (3), above).
   a. Start engine and run until fully warm, and repeat "ADJUSTING THE AIR BLEED VALVE!, Step (2), above.
   b. If unable to set dwell to 25-35°, and the dwell is below 25°, turn both mixture needles counterclockwise an additional turn. If dwell is above 35°, turn both mixture needles clockwise an additional turn. Readjust idle air bleed valve to obtain dwell limits.
   After adjustments are complete, seal the idle mixture needle openings in the throttle body, using silicone sealant, RTV rubber, or equivalent. The sealer is required to discourage unnecessary adjustment of the setting, and to prevent fuel vapor loss in that area.
   On vehicles WITHOUT a carburetor-mounted Idle Speed Control or Idle Load Compensator, adjust curb idle speed if necessary.
   Check, and only if necessary adjust, fast idle speed as described on Emission Control Information label.

Procedure B (Letter Appears on Idle Air Bleed Valve)

Carburetors WITH letter identification on the idle air bleed valve are adjusted by:

1. **SETTING THE IDLE AIR BLEED VALVE** to a gage dimension.
   a. Install air bleed valve gaging tool J-33815-2, BT-8253-B, or equivalent, in throttle side "D" shaped vent hole in the air horn casting. The upper end of the tool should be positioned over the open cavity next to the idle air bleed valve.

See Figure 6C1-18

   b. While holding the gaging tool down lightly, so that the solenoid plunger is against the solenoid stop, adjust the idle air bleed valve so that the gaging tool will pivot over and just contact the top of the valve. See Figure 6C1-19.
   The valve is now set properly. No further adjustment of the valve is necessary.
   c. Remove gaging tool.
2. **ADJUSTING THE IDLE MIXTURE NEEDLES** on the vehicle to obtain correct dwell readings.
   a. Remove idle mixture needle plugs, following instructions in PROCEDURE A, Number (2), Part d, Steps 1-6 only.
   b. Using Tool J-29030-B, BT-7610-B, or equivalent, turn each idle mixture needle clockwise until lightly seated, then turn each mixture needle counterclockwise 3 turns.
   c. Reinstall carburetor on engine, using a new flange mounting gasket, but do not install air cleaner or gasket at this time.
   d. Start engine and allow it to reach normal operating temperature (drive wheels blocked).
   e. While idling in Drive (Neutral for manual transmission), adjust both mixture needles equally, in 1/8 turn increments, until dwell reading varies within the 25-30° range, attempting to be as close to 30° as possible. If reading is too low, turn mixture needles counterclockwise. If reading is too high, turn mixture needles clockwise. Allow time for dwell reading to stabilize after each adjustment.
   After adjustments are complete, seal the idle mixture needle openings in the throttle body, using silicone sealant, RTV rubber, or equivalent. The sealer is required to discourage unnecessary readjustment of the setting, and to prevent fuel vapor loss in that area.
   On vehicles WITHOUT a carburetor-mounted Idle Speed Control or Idle Load Compensator, adjust curb idle speed if necessary.

Check, and if necessary, adjust fast idle speed, as described on the Emission Control Information Label.

UNIT REPAIR

In many cases, necessary service can be carried out and completed without removing the carburetor from the engine. Adjustments of individual systems as found in the preceding "On Car Service" section served as examples.

The information that follows pertains to a complete overhaul. The carburetor first must be removed from the engine. A complete overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets, diaphragms, seals, worn or damaged parts, and adjustment of individual systems.

Refer to exploded view for parts identification. Always replace internal gaskets that are removed. Base gasket should be inspected and replaced, only if damaged.

See Figure 6C1-21

NOTICE: Before performing any service on the carburetor, it is essential that it be placed on a suitable holding fixture, such as Tool J-9789-118, BT-30-15, or equivalent. Without the use of the holding fixture, it is possible to damage throttle valves or other parts of the carburetor.

Carburetor Replacement

Removal

1. Raise hood and cover fenders.
2. Disconnect battery and remove air cleaner.
3. Disconnect accelerator linkage.
4. Disconnect transmission detent cable.
5. Disconnect cruise control, if equipped.
6. Disconnect all necessary vacuum lines.
8. Disconnect fuel line at carburetor inlet.
9. Remove 4 attaching bolts and remove carburetor.

Installation

1. Reverse removal procedures.
2. Torque remaining bolts to:
   Long Bolts - 9 N·m (7 ft. lbs.)
   Short Bolts - 15 N·m (11 ft. lbs.)

Idle Control Devices

Removal

1. Remove the attaching screws, then remove the Idle Speed Solenoid, Idle Load Compensator or Idle Speed Control from the float bowl.

   NOTICE: The Idle Speed Solenoid, Idle Load Compensator, or Idle Speed Control, should not be immersed in any carburetor cleaner, and should always be removed before complete carburetor overhaul. as carburetor cleaner will damage the internal components.

2. The Idle Air Bleed Valve is set at the factory and capped with a tamper-resistant riveted cover. The valve assembly should be REMOVED ONLY if servicing is required, OR when the air horn assembly must be soaked in carburetor cleaner. The valve should be ADJUSTED only after servicing, or if the lean mixture screw or the rich mixture stop screw has been adjusted.

   NOTICE: If the idle air bleed valve is not removed, the air horn assembly should be cleaned with a low volatility cleaning solvent only.

   If cover is riveted, remove as follows starting with Step "a". If cover is staked in place, see Figure 6C1-22A.

   a. If rivited cover removal is necessary, cover internal bowl vents and air inlets to the bleed valve with masking tape.

See Figure 6C1-23

   b. Carefully align a No. 35 (.110") drill bit on rivet head. Drill only enough to remove head of rivet holding the idle air bleed valve cover.

   c. Use a suitably sized punch to drive out the remainder of the rivet from the castings. Repeat procedure with other rivet.

   CAUTION: For the next operation, safety glasses must be worn to protect eyes from possible metal shaving damage.

   d. Lift out cover and remove any pieces of rivet still inside tower. Use shop air to blow out any remaining chips.

   e. Remove idle air bleed valve, and check for presence (or absence) of an identifying letter on top of the idle air bleed valve. This will determine the adjustment procedure necessary after reassembly.

See Figure 6C1-24

   f. Remove and discard "O" ring seals from valve. New "O" ring seals are required for reassembly. The idle air bleed valve is serviced as a complete assembly only.

3. Remove upper choke lever from the end of choke shaft by removing retaining screw. Rotate upper choke lever to remove choke rod from slot in lever.
4. Remove choke rod from lower lever inside the float bowl casting. Remove rod by holding lower lever outward with small screwdriver and twisting rod counterclockwise.
5. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on the metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger.
6. With a small drift punch of the correct size, drive roll pin (pump lever pivot pin) inward until end of pin is against air cleaner locating boss on air horn casting. Remove pump lever and lever from pump rod.

See Figure 6C1-25

   NOTICE: Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.

7. Remove front vacuum break hose from tube on float bowl.
8. Remove eleven air horn-to-bowl screws; then remove the two countersunk attaching screws located next to the venturi. If used, remove secondary air baffle deflector from beneath the two center air horn screws.

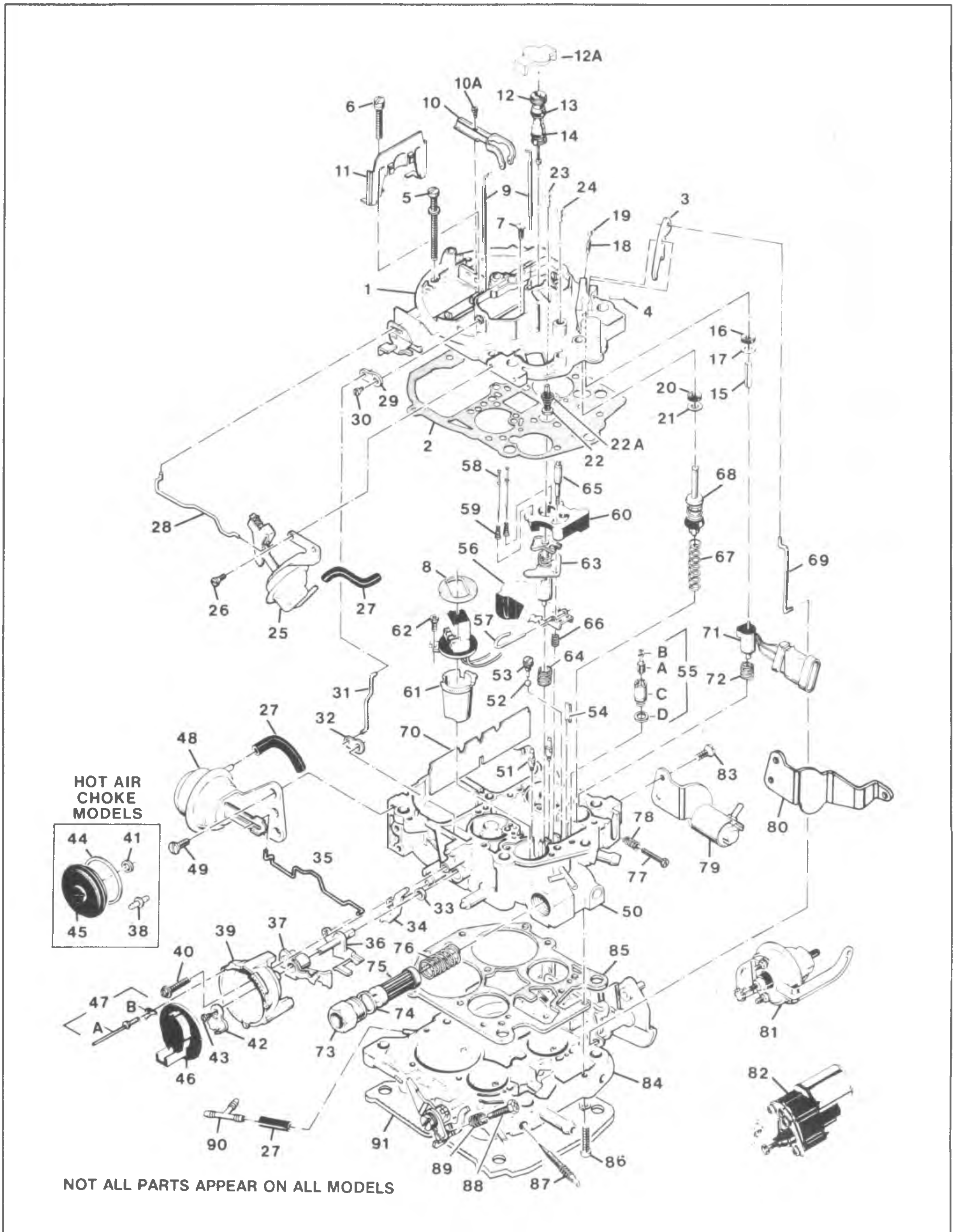


Figure 6C1-21 Carburetor Assembly - Exploded View

AIR HORN PARTS

No. Part Name (Not all parts appear on all models.)

1. Air Horn Assembly
2. Gasket - Air Horn
3. Lever - Pump Actuating
4. Roll Pin - Pump Lever Hinge
5. Screw - Air Horn, Long (2)
6. Screw - Air Horn, Short
7. Screw - Air Horn, Countersunk (2)
8. Gasket - Solenoid Connector to Air Horn
9. Metering Rod - Secondary (2)
10. Holder - Secondary Metering Rod
10a. Screw - Secondary Metering Rod Holder
11. Baffle - Secondary Air
12. Valve - Idle Air Bleed
12a. Cover - Idle Air Bleed Valve
13. "O" Ring (Thick) - Idle Air Bleed Valve
14. "O" Ring (Thin) - Idle Air Bleed Valve
15. Plunger - Throttle Position Sensor (TPS) Actuator
16. Seal - TPS Plunger
17. Retainer - TPS Seal
18. Screw - TPS Adjusting
19. Plug - TPS Adjusting Screw
20. Seal - Pump Plunger
21. Retainer - Pump Seal
22. Screw - Solenoid Plunger Stop (Rich Stop)
22a. Spring - Rich Authority Adjusting
23. Solenoid Plunger Stop Screw (Rich Stop)
24. Plug - Solenoid Adjusting Screw (Lean Mixture)

CHOKE PARTS

No. Part Name (Not all parts appear on all models.)

25. Vacuum Break & Bracket Assembly - Primary (Front)
26. Screw - Vacuum Break Attaching (2)
27. Hose - Vacuum Break
28. Rod - Air Valve
29. Lever - Choke (Upper)
30. Screw - Choke Lever
31. Rod - Choke
32. Lever - Intermediate Choke (Lower)
33. Seal - Intermediate Choke Shaft
34. Lever - Secondary Throttle Lockout
35. Link - Secondary Vacuum Break (Rear)
36. Intermediate Choke Shaft & Lever Assembly
37. Cam - Fast Idle
38. Seal - Choke Housing to Bowl (Hot Air Choke)
39. Choke Housing
40. Screw - Choke Housing to Bowl
41. Seal - Intermediate Choke Shaft (Hot Air Choke)
42. Lever - Choke Coil
43. Screw - Choke Coil Lever
44. Gasket - Stat Cover (Hot Air Choke)
45. Stat Cover & Coil Assembly (Hot Air Choke)
46. Stat Cover & Coil Assembly - Electric Choke
47. Kit - Choke Cover Retainer (A - Rivet, B - Retainer)
48. Vacuum Break & Bracket Assembly - Secondary (Rear)
49. Screw - Vacuum Break Attaching (2)

FLOAT BOWL PARTS

No. Part Name (Not all parts appear on all models.)

50. Float Bowl Assembly
51. Primary Metering Jet Assembly
52. Ball - Pump Discharge
53. Retainer - Pump Discharge Ball
54. Baffle - Pump Well
55. Needle & Seat Assembly (A - Float Needle, B - Pull Chip, C - Needle Seat, D - Seat Gasket)
56. Float & Lever Assembly
57. Hinge Pin - Float Assembly
58. Rod - Primary Metering
59. Spring - Primary Meting Rod (2)
60. Insert - Float Bowl
61. Insert - Aneroid Cavity
62. Screw - Solenoid Connector Attaching
63. Mixture Control (M/C) Solenoid & Plunger Assembly
64. Spring - SOlenoid Tension
65. Screw - Solenoid Adjusting (Lean Mixture)
66. Spring - Solenoid Adjusting Screw
67. Spring - Pump Return
68. Pump Assembly
69. Link - Pump
70. Baffle - Secondary Bores
71. Throttle Position Sensor (TPS)
72. Spring - TPS Tension
73. Filter Nut - Fuel Inlet
74. Gasket - Filter Nut
75. Filter - Fuel Inlet
76. Spring, Fuel Filter
77. Screw - Idle Stop
78. Spring - Idle Stop Screw
79. Idle Stop Solenoid & Bracket Assembly
80. Bracket - Throttle Return Spring
81. Idle Load Compensator & Bracket Assembly
82. Idle Speed Control & Bracket Assembly
83. Screw - Bracket Attaching

THROTTLE BODY PARTS

No. Part Name (Not all parts appear on all models.)

84. Throttle Body Assembly
85. Gasket - Throttle Body
86. Screw - Throttle Body
87. Idle Mixture Needle & Spring Assembly
88. Screw - Fast Idle Adjusting
89. Spring - Fast Idle Screw
90. Tee - Vacuum Hose
91. Gasket - Flange

4B6C105

Figure 6C1-22 Exploded View Parts Description-E4ME & E4MC

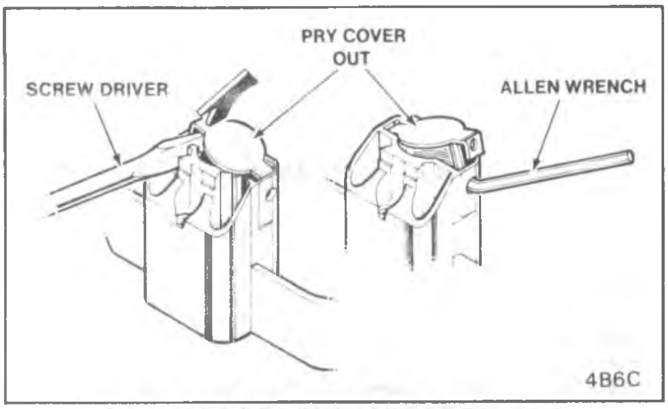


Figure 6C1-22A Staked Cover Removal

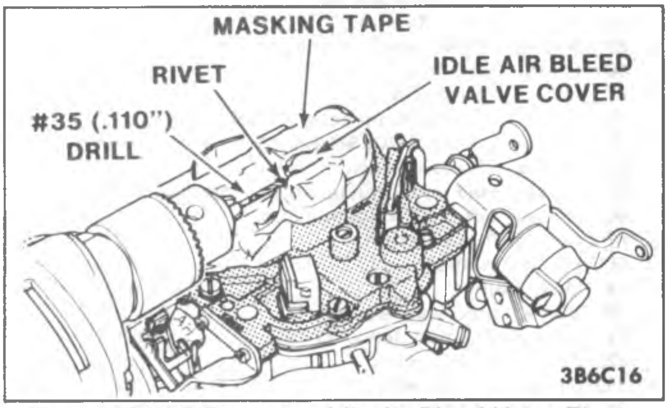


Figure 6C1-23 Removing Idle Air Bleed Valve Rivets

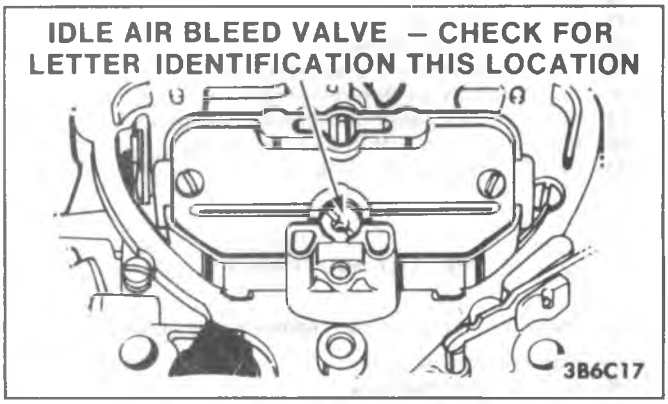


Figure 6C1-24 Idle Air Bleed Valve-ID Letter Location

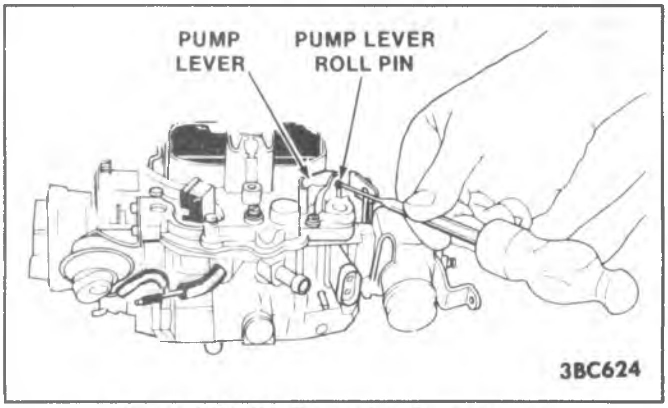


Figure 6C1-25 Removing Pump Lever

See Figure 6C1-26

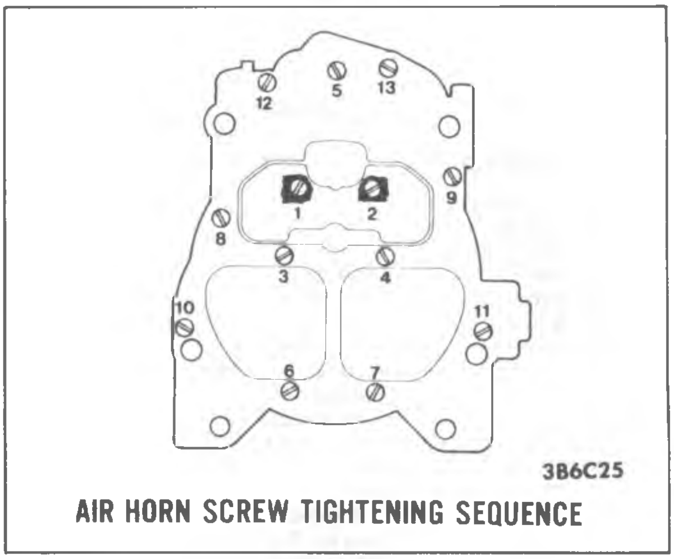


Figure 6C1-26 Air Horn Screw Location

9. Remove air horn from float bowl by lifting it straight up. The air horn gasket should remain on the float bowl for removal later.

NOTICE: When removing air horn from float bowl, use care to prevent damaging the mixture control solenoid connector, Throttle Position Sensor (TPS) adjustment lever, and the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT remove them.

Air Horn

Disassembly

1. Remove front vacuum break bracket attaching screws. The vacuum break assembly may now be removed from the air valve dashpot rod, and the dashpot rod from the air valve lever.

   NOTICE: Do not place vacuum break assembly in carburetor cleaner, as damage to vacuum break will occur.

2. Remove Throttle Position Sensor (TPS) plunger by pushing plunger up through seal in air horn.

   NOTICE: To prevent damage to the sealing surface, use fingers only to remove the plunger.

3. Remove TPS seal and pump plunger stem seal by inverting air horn and using a small screwdriver to remove staking holding seal retainers in place. Remove and discard retainers and seals.

See Figure 6C1-27

NOTICE: Use care in removing the TPS plunger seal retainer and pump plunger stem seal retainer to prevent damage to air horn casting. New seals and retainers are required for reassembly.

4. Invert air horn, and use Tool J-28696-4, BT-7967A, or equivalent, to remove rich mixture stop screw.

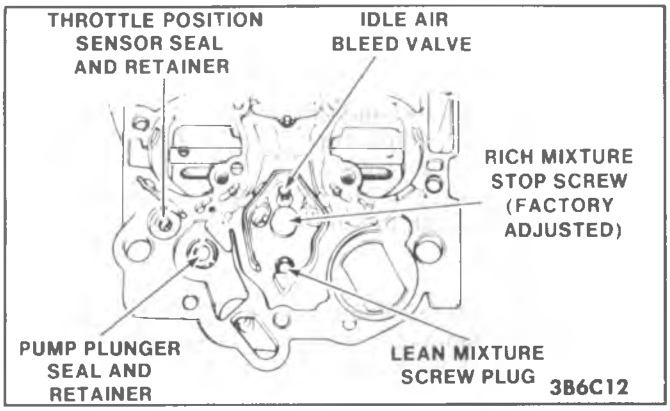


Figure 6C1-27 Pump Plunger and TPS Seal Removal

See Figure 6C1-27

5. Use a suitable punch to drive Lean Mixture Screw Plug and Rich Mixture Stop Screw Plug out of the air horn. Discard plugs.

See Figure 6C1-28

Further disassembly of the air horn is not required for cleaning purposes.

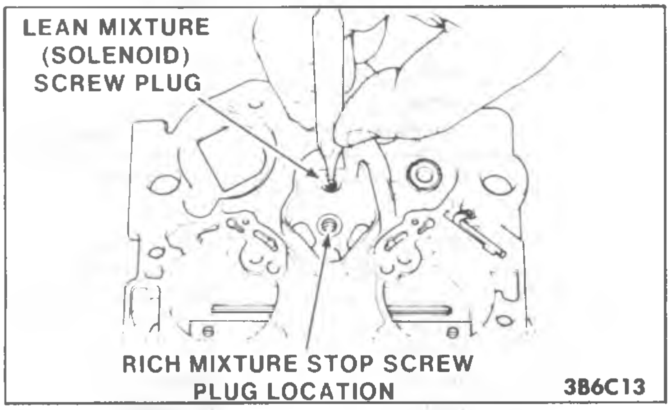


Fig. 6C1-28 Removing Lean Mix. Screw & Rich Mix. Stop Screw Plugs

The choke valve and choke valve screws, the air valves and air valve shaft should not be removed. However, if it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. Instructions for assembly are included in the repair kit.

Float Bowl

Disassembly

1. Remove solenoid-metering rod plunger by lifting straight up.

See Figure 6C1-29

2. Remove air horn gasket by lifting it from the dowel locating pins on float bowl. Discard gasket.
3. Remove pump plunger from pump well.
4. Invert air horn, and use Tool J-28696-4 or BT-7967A to remove rich mixture stop screw and rich authority adjusting spring.
5. Remove staking holding Throttle Position Sensor (TPS) in bowl as follows:
   a. Lay a flat tool or metal piece across bowl casting to protect gasket sealing surface.
   b. Use a small screwdriver to depress TPS sensor lightly and hold against spring tension.

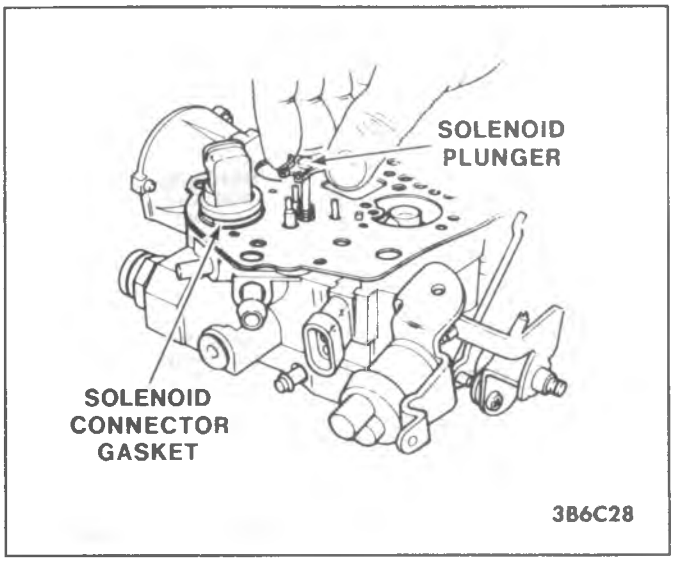


Figure 6C1-29 Solenoid Plunger Removal

   c. Observing safety precautions, pry upward with a small chisel or equivalent to remove bowl staking, making sure prying force is exerted against the metal piece and not against the bowl casting.

NOTICE: Use care not to damage the TPS sensor.

   d. Push up from bottom on electrical connector and remove TPS and connector assembly from bowl.

NOTICE: Use care in removing sensor and connector assembly to prevent damage to this critical electrical part.

   Remove spring from bottom of TPS well in float bowl.

6. Remove plastic filler block over float bowl.
7. Carefully lift each metering rod out of the guided metering jet, checking to be sure the return spring is removed with each metering rod. Remove return spring by sliding off end of rod.

See Figure 6C1-30

NOTICE: Use extreme care when handling these critical parts to avoid damage to metering rod and spring.

8. Remove the mixture control solenoid from the float bowl as follows:
   a. Remove screw attaching solenoid connector to float bowl. Do not remove solenoid connector from float bowl until called for in text.
   b. Use Tool J-28696-10, BT-7928, or equivalent, to remove lean mixture (solenoid) screw. Do not remove plunger return spring or connector and wires from the solenoid body. The mixture control solenoid with plunger, and connector are only serviced as a complete assembly.
   c. If used, remove plastic aneroid cavity insert from cavity in float bowl beneath solenoid connector.
   d. Remove solenoid screw tension spring (next to float hanger pin).

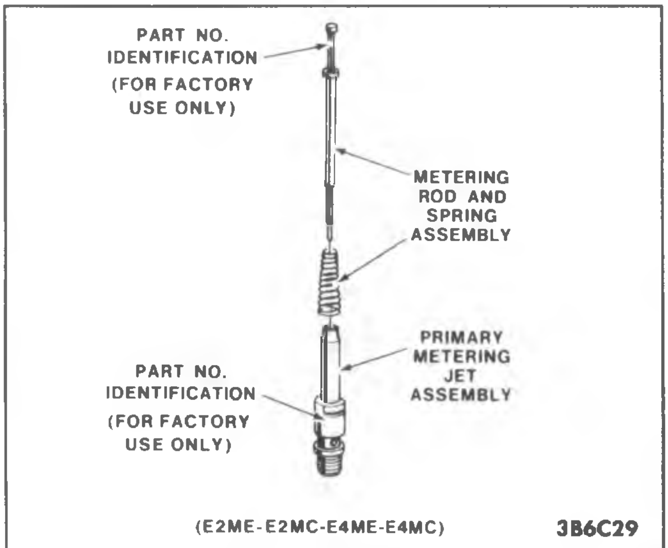


Figure 6C1-30 Metering Rod and Jet Identification

9. Remove float assembly and float needle by pulling up on retaining pin. Remove needle and seat and gasket using set remover Tool J-22769, BT-3006M, or equivalent.
10. Remove large mixture control solenoid tension spring from boss on bottom of float bowl located between guided metering jets.
11. If necessary, remove the primary main metering jets using special Tool J-28696-4, BT-7928, or equivalent.

NOTICE: Use care installing tool on jet, to prevent damage to the metering rod guide (upper area), and locating tool over vertical flat sections on lower area of jet. Also, no attempt should be made to remove the secondary metering jets (metering orifice plates). These jets are fixed and, if damaged, entire bowl replacement is required.

12. Remove pump discharge check ball retainer and turn bowl upside down, catching discharge ball in palm of hand.
13. Remove secondary air baffle, if replacement is required.
14. Remove pump well fill slot baffle only if necessary.
15. If rear vacuum break assembly is used, remove hose from assembly, and remove rear vacuum break control and bracket assembly. Also, remove two screws from bracket and rotate the assembly to remove vacuum break rod from slot in plunger head. The non-adjustable vacuum break rod, riveted to the intermediate choke lever, is not removed at this time, but is removed after the removal of the choke assembly from the float bowl.

NOTICE: Do not place vacuum break assembly in carburetor cleaner, as damage to unit will occur.

Choke

Disassembly

The tamper-resistant choke cover is used to discourage unnecessary readjustment of the choke thermostatic cover an coil assembly. However, if it is necessary to remove the cover and coil assembly during normal carburetor disassembly for cleaning and overhaul, the procedures below should be followed.

Choke Cover

Removal

1. Support float bowl and throttle body, as an assembly, on a suitable holding fixture such as Tool J-9789-118, BT-30-15, or equivalent.
2. Carefully align a #21 drill (.159") on rivet head and drill only enough to remove rivet head.

See Figure 6C1-31

Drill the two remaining rivet heads, then use a drift and small hammer to drive the remainder of the rivets out of the choke housing.

NOTICE: Use care in drilling to prevent damage to the choke cover or housing.

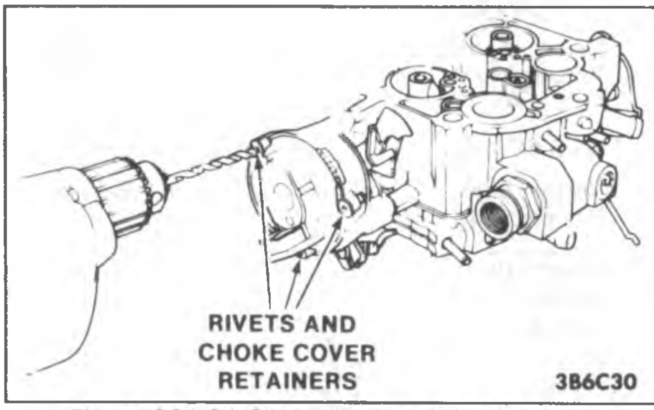


Figure 6C1-31 Choke Housing Rivet Removal

3. Remove the two conventional retainers, retainer with tab, choke cover gasket (where used), and choke cover assembly from choke housing. Do not remove baffle plate from beneath the thermostatic coil on the choke cover (hot air choke models).
4. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing. The complete choke assembly can be removed from the float bowl by sliding outward.

See Figure 6C1-32

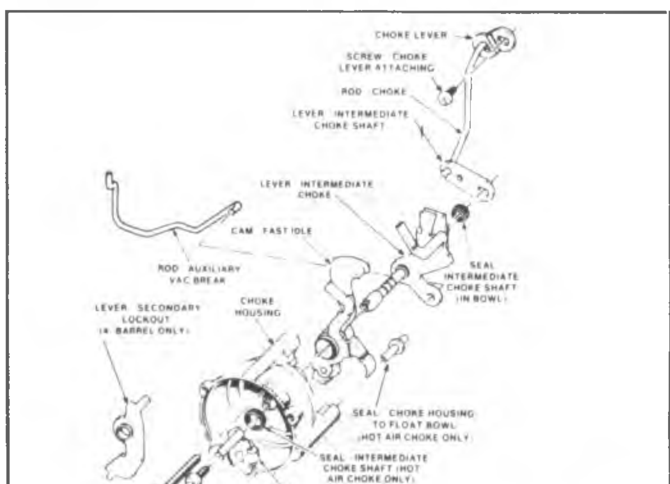


Figure 6C1-32 Choke Assembly Removal

5. Remove plastic tube seal (hot air models only) from vacuum inlet boss on choke housing.

NOTICE: Do not immerse the plastic tube seal in carburetor cleaner, as damage to seal will occur.

6. Remove secondary throttle valve lock-out lever from float bowl.

See Figure 6C1-32

7. Remove lower choke lever from inside float bowl cavity by inverting bowl.
8. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing. Remove thermostatic coil lever from flats on intermediate choke shaft. Remove intermediate choke shaft from the choke housing by sliding it outward. The fast idle cam can now be removed from the intermediate choke shaft.

NOTICE: On hot air choke models, remove the cup seal from inside the choke housing shaft hole. Discard the seal. Also, remove the cup seal from the float bowl insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE THE INSERT.

Remaining Float Bowl Parts

Disassembly

1. Remove fuel inlet nut, gasket, check valve, filter assembly and spring. Discard check valve filter assembly and gasket.
2. Remove three throttle body-to-bowl attaching screws and lockwashers and remove throttle body assembly.
3. Remove throttle body-to-bowl insulator gasket.

Throttle Body

Disassembly

NOTICE: Place throttle body assembly on carburetor holding fixture to avoid damage to throttle valves.

1. Remove pump rod from throttle lever by rotating rod until tang on rod aligns with slot in lever.

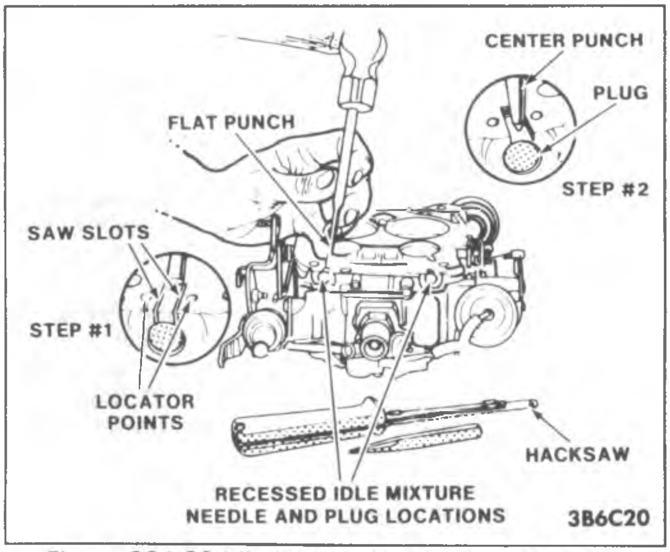


Figure 6C1-33 Idle Mixture Needle Plug Removal

2. Remove Idle Mixture Needle Plugs:
   a. With manifold side up, use hacksaw to make two parallel cuts in the throttle body, one on each side of the locator points beneath the idle mixture needle plug.

See Figure 6C1-33

   The cuts should reach down to the steel plug, but should not extend more than 1/8" beyond the locator points. The distance between the saw cuts will depend on the si of the punch to be e used.
   b. Place a flat punch at a point near the ends of the saw marks in the throttle body. Hold the punch at a 45° angle, and drive it into the throttle body until the casting breaks away, exposing the steel plug.
   The hardened steel plug will break rather than remaining intact. It is not necessary to remove the plug in one piece, just remove the loose pieces.
   c. Repeat the procedure for the other idle mixture needle plug.
3. Use Tool J-29030-B, BT-7610B, or equivalent, to remove idle mixture needles, for thorough throttle body cleaning.
   Further disassembly of the throttle body is not required for cleaning purposes. The throttle valve screws are permanently staked in place and should not be removed. The throttle body is serviced as a complete assembly.

Cleaning and Inspection

Except for the air horn assembly with idle air bleed valve installed, the carburetor parts should be cleaned in a cold immersion type cleaner such as Carbon X (X-55) or its equivalent. The air horn assembly, with idle air bleed in place, should be cleaned using only a low volatility cleaning solvent.

NOTICE: The air horn (with bleed valve), idle speed solenoid, idle load compensator, idle speed control, throttle position sensor, thermostatic choke cover and coil, rubber parts, plastic parts, diaphragms, pump plunger, etc., should not be immersed in carburetor cleaner as they will swell, harden, or distort. Also, provide special protection for the metering rods and jets, and idle air bleed valve (if removed) when cleaning to prevent damage to these critical parts.

The plastic cam on the air valve shaft and bushing in bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt. Do not pass drills or wire through jets.
2. Inspect upper and lower surfaces of carburetor castings for damage.
   IMPORTANT: If float bowl needs replacement, inspect for letters "MW" on the casting. These letters indicate a machined pump well, and determine the type of pump needed. If the letters are present, a replacement bowl also must have "MW" letters.
3. Inspect holes in levers for excessive wear or out-of-round conditions. If worn, levers should be replaced.

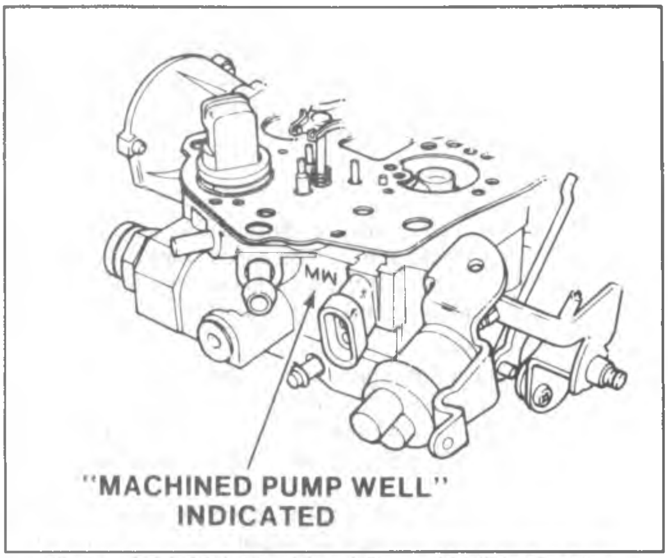


Figure 6C1-33A Machined Pump Well Indication

4. Inspect plastic parts for cracks, damage, etc. Replace if necessary.
5. Check, repair or replace parts if the following problems are encoutered:
   a. FLOODING
      1. Inspect float needle and seat for dirt, deep wear grooves, scores and proper seating.
      2. Inspect float needle pull clip for proper installation. Be careful not to bend needle pull clip.

See Figure 6C1-34

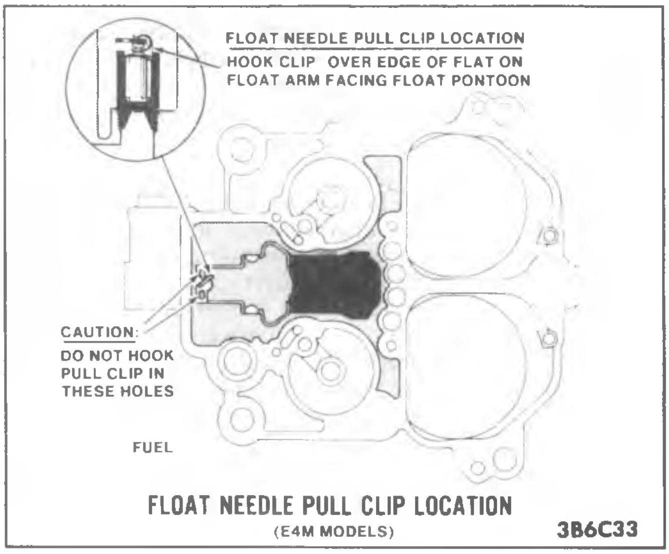


Figure 6C1-34 Float Needle Pull Clip Location

      3. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check weight of the float in comparison with a new float.
      4. Replace fuel inlet filter and check valve.
   b. HESITATION
      1. Inspect pump plunger for cracks, scores or excessive cup wear, and replace plunger if necessary.
      2. Inspect pump duration and return springs for distortion.
      3. Check all pump passages and jets for dirt, improper seating of discharge check ball and scores in pump well. Check condition of pump discharge check ball.
      4. Check pump linkage for excessive wear. Repair or replace if necessary.
   c. HARD STARTING-POOR COLD OPERATION
      1. Check choke valve and linkage for excessive wear, binds or distortion.
      2. Inspect choke vacuum break diaphragms for leaks.
      3. Replace carburetor fuel filter.
      4. Inspect float needle for sticking, dirt, etc.
      5. Examine fast idle cam for wear or damage.
      6. Also check items under "Flooding".
   d. POOR PERFORMANCE - POOR GAS MILEAGE
      1. Clean all fuel and vacuum passages in castings.
      2. Check choke valve for freedom of movement.
      3. Check metering rods for dirt, sticking, binding, missing springs, damage parts or excessive wear.
      4. Check mixture control solenoid plunger for sticking, binding, damaged parts or excessive wear
      5. Inspect metering jets for being dirty, loose, worn or damaged. Numbers stamped on primary metering rods and jets are for internal factory identification only, and DO NOT indicate the rod or jet size. Service replacement rods and jets are included in a Metering Jet and Rod service package, and must be installed in matched sets.
      6. Check idle air bleed valve for sticking, binding, dirt, damage or missing "O" rings.
      7. Check air valve for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in the kit.
      8. Check TPS plunger for sticking, binding, or improper adjustment. Plunger must move freely in seal in air horn.
   e. ROUGH IDLE
      1. Inspect gasket and gasket mating surfaces on castings for damage to sealing beads, nicks, burrs and other damage.
      2. Clean all idle fuel passages.
      3. If removed, inspect idle mixture needles for ridges, burrs, or being bent.
      4. Check idle air bleed valve for sticking, binding, dirt or missing "O" rings.
      5. Check throttle lever and valves for binds, nicks, and other damage.
      6. Check all diaphragms for possible ruptures or leaks.
      7. Clean plastic parts only in cleaning solvent - never in gasoline.

NOTICE: Choke linkage and fast idle cam must operate freely. Bent, dirty or otherwise damaged linkage must be cleaned, repaired, or replaced as necessary. Do not lubricate linkage, as this will collect dust and cause sticking.

Check Fuel Lines and Service Fuel Filter

1. Inspect fuel lines for kinks, bends, or leaks and correct any problems found.
2. Replace filter in carburetor inlet, making sure the type used includes the check valve in the filter inlet.

If a complaint of poor high speed performance exists on the car, fuel pump filter and lines should be checked.

Throttle Body

Assembly

1. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outward toward throttle lever.
2. Install idle mixture needles and springs using Tool J-29030-B, BT-7610B, or equivalent. Lightly seat each needle and then turn counterclockwise the number of turns shown in the Specifications chart at the end of this Carburetor section.

   Final idle mixture adjustment is made on the vehicle. (See Mixture Control Adjustments under "On Car Service").

Float Bowl

Assembly

If a new float bowl assembly is used, stamp or engrave the model number on the new float bowl at location shown in Figure 6C1-1.

1. Install new throttle body-to-bowl insulator gasket over two locating dowels on bowl.
2. Install throttle body making certain throttle body is properly located over dowels on float bowl. Install three throttle body-to-bowl screws and lockwashers and tighten evenly and securely.
3. Place carburetor on proper holding fixture such as J-9789-118, BT-30-15, or equivalent.
4. Install fuel inlet filter spring, a new check valve filter assembly, new gasket and inlet nut. Tighten nut to 24 N·m (18 ft. lbs.).

NOTICE: When installing a service replacement filter, make sure the filter is the type that includes the check valve to meet government safety standards. New service replacement filters with check valve meet this requirement. When properly istalled, hole in filter faces toward inlet nut. Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced. Tightening beyond specified torque can damage nylon gasket.

Choke Housing to Float Bowl

Assembly

1. Install new cup seal into insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.
2. Install secondary throttle valve lock-out lever on boss of float bowl, with recess in hole in lever facing inward.

See Figure 6C1-32

3. Install new cup seal in inside choke housing shaft hole. Lip on seal faces inward, toward inside of housing.
4. Install fast idle cam on the intermediate choke shaft (steps on cam face downward).
5. Carefully install fast idle cam and intermediate choke shaft assembly in choke housing. Install thermostatic coil lever on flats on intermediate choke shaft. Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face toward fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.
6. If used, install rear vacuum break unit in hole of the intermediate choke shaft lever. The end of the link faces toward the choke housing when installed correctly.
7. On hot air choke models, insert plastic tube seal (to float bowl) in vacuum inlet hole on choke housing.
8. Install lower choke rod (inner) lever into cavity in float bowl.

See Figure 6C1-34

Install choke housing to bowl, sliding intermediate choke shaft into lower (inner) lever, (Figure 6C1-32). Tool J-23417, BT-6911, or equivalent, can be used to hold the lower choke lever in correct position while installing the choke housing.

The intermediate choke shaft lever and fast idle cam are in correct position when the tang on lever is beneath the fast idle cam.

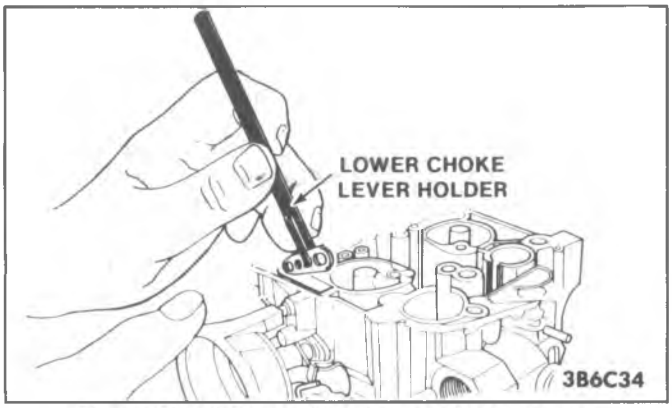


Figure 6C1-35 Installing Lower Choke Lever

9. Install choke housing retaining screws and washers, and tighten securely.

See Figure 6C1-32

Check linkage for freedom of movement. Do not install choke cover and coil assembly until inside coil lever is adjusted, (see Adjustment Procedures and Specifications at end of this section).

Completion of Float Bowl Assembly

1. If used, install end of vacuum break rod in slot in rear vacuum break plunger. Install rear vacuum break and bracket assembly on float bowl, using two large countersunk attaching screws. Tighten securely.
2. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.
3. If removed, install baffle inside of pump well with slot toward bottom.
4. Install pump discharge check ball, and retainer screw, in passage next to pump well. Tighten retainer screw securely.

5. If removed, carefully install primary main metering jets in bottom of float bowl using Tool J-28696-4, BT-7928, or equivalent.

NOTICE: Use care in installing jets to prevent damage to metering rod guide.

6. Install large mixture control solenoid tension spring over boss on bottom of float bowl.
7. Install needle seat assembly, with gasket, using seat installer J-22769, BT-3006M, or equivalent.
8. To make adjustment easier, carefully bend float arm upward at notch in arm before assembly.
9. Install float needle onto float arm by sliding float lever under needle pull clip. Proper installation of the needle pull clip is to hook the clip over the edge of the float on the float arm facing the float pontoon.

See Figure 6C1-34

10. Install float hinge pin into float arm with end of loop of pin facing pump well. Install float assembly by aligning needle in the seat, and float hinge pin into locating channels in float bowl. DO NOT install float needle pull clip into holes in float arm.
11. Make Float Level Adjustment. Procedure will be found in Carburetor Adjustment Procedures section.

See Figure 6C1-33

12. If used, install plastic aneroid cavity insert beneath the mixture control solenoid connector in float bowl, aligning insert with the recess of bowl cavity. Tang on upper lip of insert goes in deep slot in bowl closest to the fuel inlet nut. Make sure insert is seated in cavity and flush with float bowl casting surface.
13. Install mixture control solenoid screw tension spring between raised bosses next to float hanger pin.
14. Install mixture control solenoid and connector assembly as follows:
    a. Install solenoid carefully in the float chamber, aligning pin on end of solenoid with hole in raised boss at bottom of bowl. Align solenoid connector wires to fit in slot in bowl, or plastic insert if used.
    b. Install lean mixture (solenoid) screw through hole in solenoid bracket and tension spring in bowl, engaging first six screw threads to assure proper thread engagement.
    c. Install mixture control solenoid gaging Tool J-33815-1, BT-8253-A, or equivalent, over the throttle side metering jet rod guide, and temporarily install solenoid plunger.

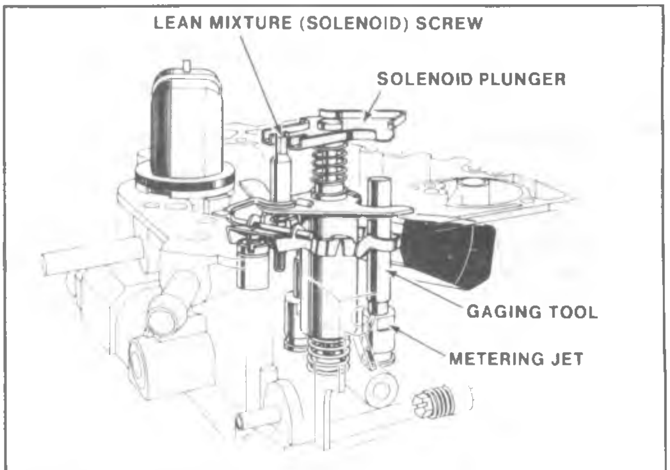
See Figure 6C1-36

    d. Holding the solenoid plunger against the Solenoid Stop, use Tool J-28696-10, BT-7928, or equivalent, to turn the lean mixture (solenoid) screw slowly clockwise, until the solenoid plunger just contacts the gaging tool. The adjustment is correct when the solenoid plunger is contacting BOTH the Solenoid Stop and the Gaging Tool.

See Figure 6C1-37

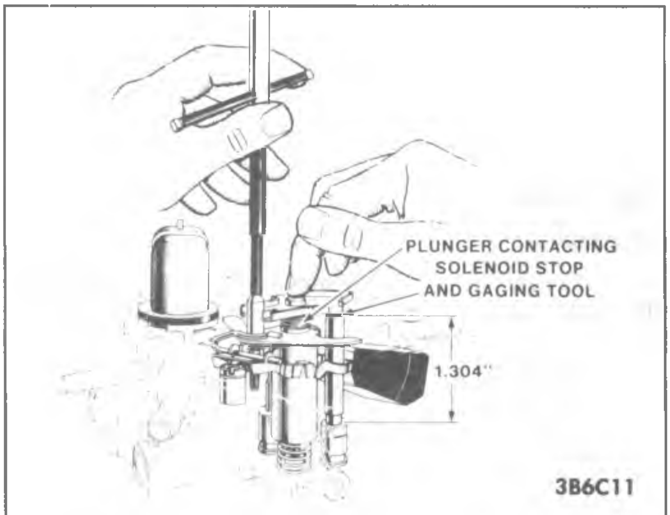
    e. Remove solenoid plunger and gaging tool.

15. Align solenoid wires with notch in plastic insert (if used) and connector lugs with recesses in bowl. Install connector attaching screw. Tighten screw securely.



INSTALLING MIXTURE CONTROL (SOLENOID) GAGING TOOL 3B6C10

Figure 6C1-36 Installing Mix. Control Solenoid Gaging Tool



ADJUSTING LEAN MIXTURE (SOLENOID) SCREW

Figure 6C1-37 Adjusting Lean Mixture (Solenoid) Screw

NOTICE: DO NOT overtighten screw, which could cause damage to the connector.

16. Install Throttle Position Sensor return spring in bottom of well in float bowl.
17. Install Throttle Position Sensor and connector assembly in float bowl by aligning groove in electrical connector with slot in float bowl casting. Push down on connector and sensor assembly so that connector and wires are located below bowl casting surface.
18. Install plastic filler block over float valve, pressing downward until properly seated (flush with bowl casting surface).
19. Slide metering rod return spring over metering rod tip until small end of spring stops against shoulder on rod. Carefully install metering rod and spring assembly through hole in plastic filler block and gently lower the metering rod into the guided metering jet, until large end of spring seats on the recess on end of jet guide.

NOTICE: DO NOT FORCE METERING ROD down in jet. USE EXTREME CARE when handling these critical parts to avoid damage to rod and spring. If service replacement metering rods, springs and jets are installed, they must be installed in matched sets.

20. Install pump return spring in pump well.
21. Install pump plunger assembly in pump well.
22. Holding down on pump plunger assembly against return spring tension, install air horn gasket by aligning pump plunger stem with hole in gasket, and aligning holes in gasket over TPS plunger, solenoid plunger return spring, metering rods, solenoid attaching screw and electrical connector. Position gasket over the two dowel locating pins on the float bowl.
23. Holding down on air horn gasket and pump plunger assembly, install the solenoid-metering rod plunger in the solenoid, aligning slot in end of plunger with solenoid attaching screw. Be sure plunger arms engage top of each metering rod.

See Figure 6C1-29

If a service replacement Mixture Control Solenoid package is installed, the solenoid and plunger MUST be installed as a matched set.

Air Horn

Assembly

1. If removed, install TPS adjustment screw in air horn using Tool J-28696-10, BT-7967A, or equivalent. Final adjustment of the Throttle Position Sensor is made on vehicle (see "On Car Service").
2. Inspect the air valve shaft pin for lubrication. Apply a liberal quantity of lithium base grease to the air valve shaft pin, especially in the area contacted by the air valve spring.
3. Install new pump plunger and TPS plunger seals and retainers in air horn casting.

See Figure 6C1-27

The lip on the seal faces outward, away from the air horn mounting surface. Lightly stake seal retainer in three places, choosing locations different from the original stakings.

4. Install rich mixture stop screw and rich authority adjusting spring from bottom side of the air horn. Use Tool J-28696-4, BT-7967A, or equivalent, to bottom the stop screw lightly, then back out 1/4 turn. Final adjustment procedure will be covered later in this section.
5. Install TPS actuator plunger in seal.

Air Horn to Bowl

Installation

1. Carefully lower air horn assembly onto float bowl while positioning the TPS Adjustment Lever over the TPS sensor, and guiding pump plunger stem through seal in air horn casting. To ease installation, insert a thin screwdriver between air horn gasket and float bowl to raise the TPS Adjustment Lever positioning it over the TPS sensor.

See Figure 6C1-38

Make sure that the bleed tubes and accelerating well tubes are positioned properly through the holes in the air horn gasket. Do not force the air horn assembly onto the bowl, but lower it lightly into place.

2. Install two long air horn screws and lockwashers, nine short screws and lockwashers, and two countersunk screws (located next to the carburetor venturi area). Install secondary air baffle beneath screws No. 3 and 4.

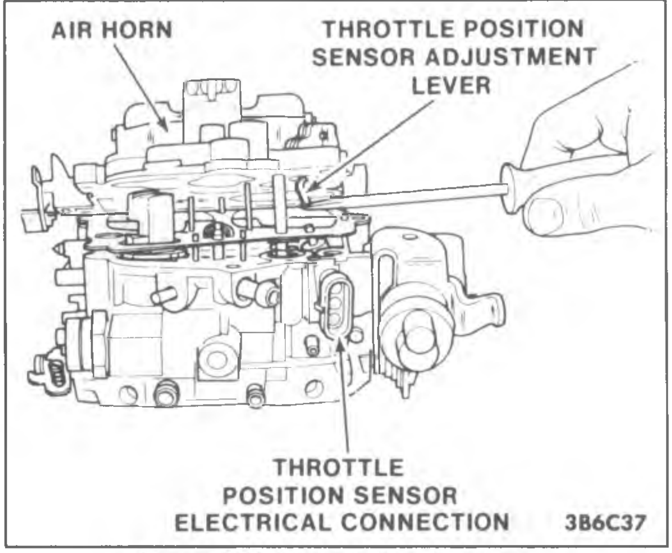


Figure 6C1-38 Installing Air Horn

See Figure 6C1-24

Tighten all screws evenly and securely, following air horn screw tightening sequence.

See Figure 6C1-26

3. Install air valve rod into slot in the lever on the end of the air valve shaft. Install the other end of the rod in hole in front vacuum break plunger. Install front vacuum break and bracket assembly on the air horn, using two attaching screws. Tighten screws securely. If vacuum break adjustment is necessary, see Adjustment Procedures and Specifications.
4. Connect upper end of pump rod to pump lever. Place lever between raised bosses on air horn casting, making sure lever engages TPS actuator plunger and the pump plunger stem. Align hole in pump lever with holes in air horn casting boxes. Using a small drift or rod the diameter of the pump lever roll pin will aid alignment. Using diagonal (sidecutter) pliers on the end of the roll pin, pry the roll pin only enough to insert a thin blades screwdriver between the end of the pump lever roll pin and the air cleaner locating boss on air horn casting. Use screwdriver to push pump lever roll pin back through the casting until end of pin is flush with casting bosses on the air horn.

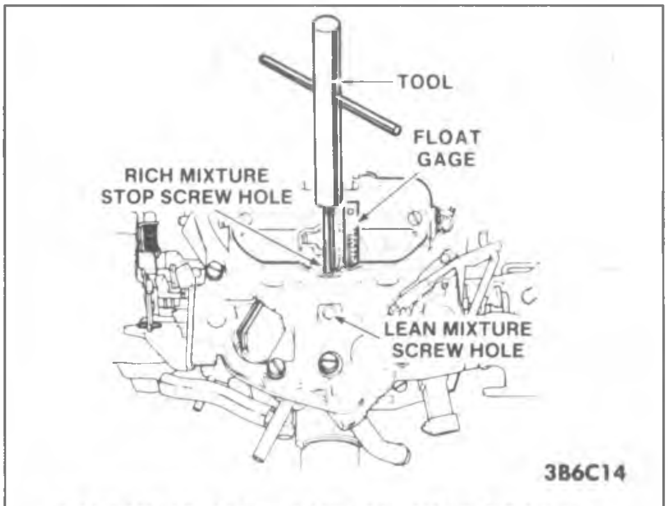
NOTICE: Use care installing the roll pin to prevent damage to the pump lever bearing surface and casting bosses.

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw and tighten securely. Work air valves up and down several times to make sure they move freely in both directions.
6. Connect choke rod into lower choke lever inside bowl cavity. Install choke rod in slot in upper choke lever, and position lever on end of choke shaft, making sure flats on end of shaft align with flats in lever. Install attaching screw and tighten securely. When properly installed, the lever will point to the rear of the carburetor, and the number on the lever will face outward.
7. Adjust the Rich Mixture Stop Screw:

a. Insert external float gaging Tool J-9789-130, BT-7720, or equivalent, in the vertical "D" shaped vent hole in the air horn casting, (next to the Idle Air Bleed Valve), and allow it to float freely.

See Figure 6C1-39

It may be necessary to modify the gage, by filing it, to permit it to enter the hole freely.



ADJUSTING RICH MIXTURE STOP SCREW

Figure 6C1-39 Adjusting Rich Mixture Stop Screw

b. Read at eye level the mark on the gage, in inches, that lines up with the top of the air horn casting. Record reading.
c. Lightly press down on gage, and again read and record the mark on the gage that lines up with the top of the air horn casting.
d. Subtract gage UP dimension, found in Step b, from gage DOWN dimension, fcund in Step c, and record the difference in inches. This difference in dimensions is total solenoid plunger travel.
e. Insert Tool J-28696-10, BT-7928, or equivalent, in the access hole in the air horn, and adjust the rich mixture stop screw to obtain 4/32" total solenoid plunger travel.

8. With solenoid plunger travel correctly set, install plugs, supplied in service kit, in the air horn:
   a. Install plug, hollow end down, into the access hole to the lean mixture (solenoid) screw, and use a suitably sized punch to drive plug into the air horn until top of plug is even with the lower edge of the hole chamfer.

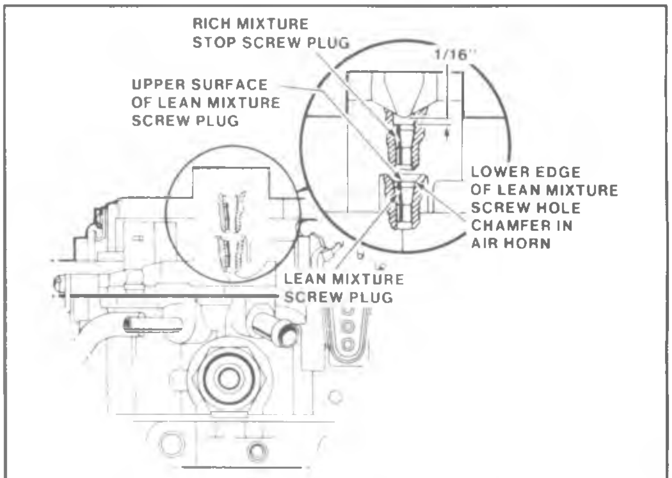
See Figure 6C1-40

Plug must be installed to retain the setting of the screw, and to prevent fuel vapor loss.

   b. In a similar manner, install plug over the rich mixture stop screw access hole, and drive plug into place so that the top of the plug is 1/16" below the surface of the air horn casting. Plug must be installed to retain the setting of the screw.

See Figure 6C1-40

9. Install the Idle Air Bleed Valve:
   a. Lightly coat two new "O" ring seals with silicone oil, or automatic transmission fluid, to



INSTALLING LEAN AND RICH MIXTURE SCREW PLUGS IN AIR HORN

Fig. 6C1-40 Installing Plugs (Lean & Rich Mix. Stop Screws)

aid in their installation on the idle air bleed valve body. The thick seal goes in the upper groove, and the thin seal goes in the lower groove.

See Figure 6C1-41

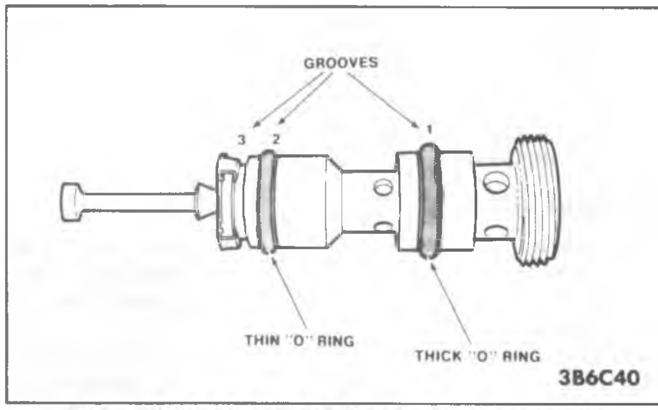


Figure 6C1-41 Idle Air Bleed Valve Assembly

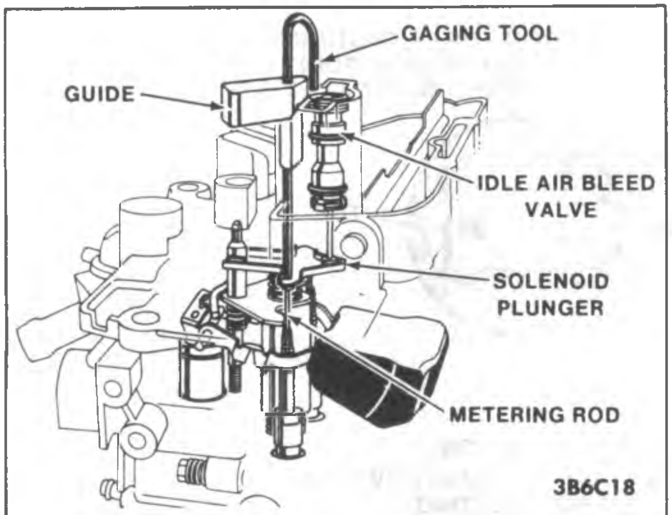
   b. Install idle air bleed valve in the air horn, making sure that there is proper thread engagement.
   c. Insert idle air bleed valve gaging Tool J-33815-2, BT-8353-B, or equivalent, in throttle side "D" shaped vent hole of the air horn casting. The upper end of the tool should be positioned over the open cavity next to the idle air bleed valve.

See Figure 6C1-42

   d. Holding the gaging tool down lightly so that the solenoid plunger is against the solenoid stop, adjust the idle air bleed valve so that the gaging tool will pivot over and just contact the top of the valve.

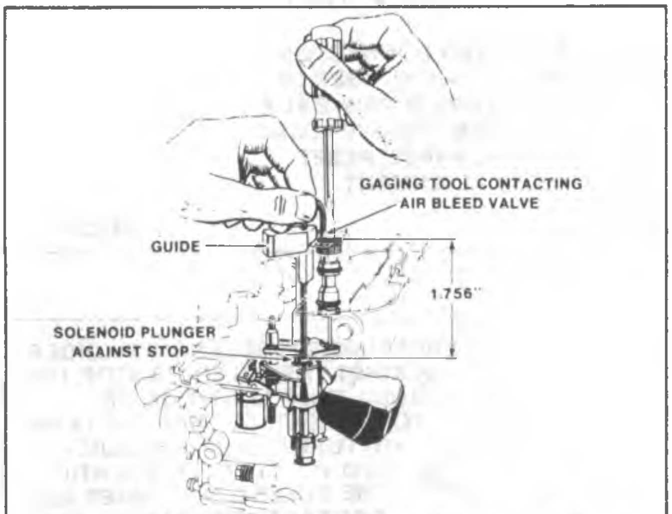
See Figure 6C1-43

   e. Remove gaging tool.
   f. If NO LETTER appears on the Idle Air Bleed Valve, the final adjustment of this type of idle air bleed valve is made on the vehicle.



INSTALLING IDLE AIR BLEED VALVE GAGING TOOL

Figure 6C1-42 Installing Idle Air Bleed Valve Gaging Tool



POSITIONING IDLE AIR BLEED VALVE 3B6C19

Figure 6C1-43 Positioning Idle Air Bleed Valve

See Figure 6C1-24

Refer to "Procedure A" under Idle Mixture Adjustment in the "On Car Service" section, page 6C1- .

If a LETTER appears on the Idle Air Bleed Valve, NO FURTHER ADJUSTMENT OF THE IDLE AIR BLEED VALVE IS NECESSARY.

See Figure 6C1-24

The idle mixture is adjusted by the idle mixture needles. Refer to "Procedure B" under Idle Mixture Adjustment in the "On Car Service" section, page 6C1- .

10. Perform adjustments indicated below, which will be found in the Carburetor Adjustment Procedures section:

    Air Valve Spring Adjustment, Figure 6C1-37, and

    Choke Coil Lever Adjustment, Figure 6C1-38.

11. Install the cover and coil assembly in the choke housing, as follows:

    a. Place cam follower on highest step of fast idle cam.
    b. Install the thermostatic cover and coil assembly, and gasket (if used), in the choke housing, making sure coil tang engages the inside coil pick-up lever.

NOTICE: On E4ME models, ground contact for the electric choke is provided by a metal plate located at the rear of the choke cover assembly. DO NOT install a choke cover gasket between the electric choke assembly and the choke housing.

    c. A choke cover retainer kit is required to attach the choke cover to the choke housing. Follow instructions found in the kit, and install proper retainer and rivets, using suitable blind rivet tool.

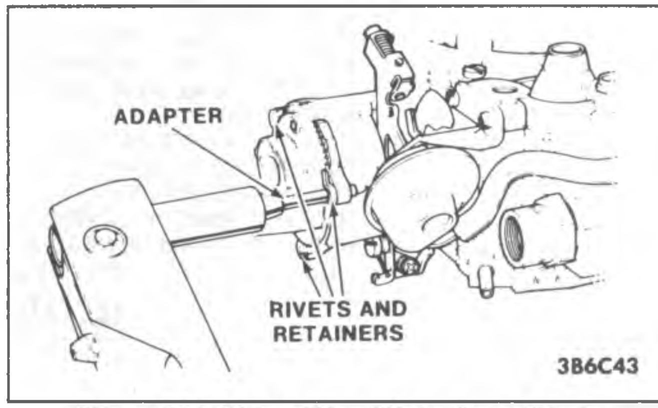


Figure 6C1-44 Installing Choke Cover Rivets

    d. It may be necessary to use an adapter (tube) if the installing tool interferes with the electrica' connector tower on the choke cover.

See Figure 6C1-44

    e. On hot air choke models, torque the choke hea pipe nut to 95 in./lbs.

12. Install hose on front vacuum break and on tube o float bowl.
13. Position idle speed solenoid, idle load compensator, idle speed control, and bracket assembly on float bov retaining with two large countersunk screws. Tight screws securely.
14. Perform the remaining adjustments indicated belc which will be found in the Carburetor Adjustm Procedures section.

See Figures 6C1-45 through 6C1-59

    Choke Rod - Fast Idle Cam Adjustment, Fig 6C1-40

    Primary (Front) Vacuum Break Adjustment, 6C

    Secondary (Rear) Vacuum Break Adjustment, 6C

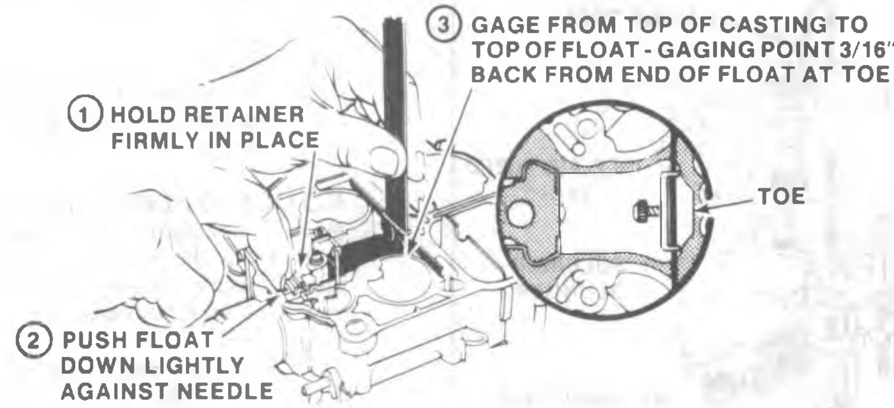
    Air Valve Rod Adjustment - Front, 6C1-44

    Air Valve Rod Adjustment - Rear, 6C1-45

    Unloader Adjustment, Figure 6C1-46

    Secondary Lockout Adjustment, Figure 6C1-47

15. Reinstall carburetor on vehicle with new flange ga following vehicle manufacturer's directions.



4 IF FLOAT LEVEL VARIES OVER ±1/16" FROM SPECIFICATIONS,
FOR LEVEL TOO HIGH, HOLD RETAINER IN PLACE AND PUSH DOWN ON CENTER OF FLOAT PONTOON TO OBTAIN CORRECT SETTING.
FOR LEVEL TOO LOW,

A IF M4M OR M2M CARBURETOR, REMOVE POWER PISTON, METERING RODS, PLASTIC FILLER BLOCK. REMOVE FLOAT, BEND FLOAT ARM UPWARD TO ADJUST. REINSTALL PARTS. VISUALLY CHECK FLOAT ALIGNMENT.

B IF E4M OR E2M REMOVE METERING RODS, SOLENOID CONNECTOR SCREW. COUNT. AND RECORD FOR REASSEMBLY, THE NUMBER OF TURNS NEEDED TO LIGHTLY BOTTOM LEAN MIXTURE SCREW. BACK OUT AND REMOVE SCREW, SOLENOID, CONNECTOR. REMOVE FLOAT AND FLOAT ARM UPWARD TO ADJUST. REINSTALL PARTS, RESET LEAN MIXTURE SCREW. VISUALLY CHECK FLOAT ALIGNMENT.

FLOAT ADJUSTMENT 3B6C45

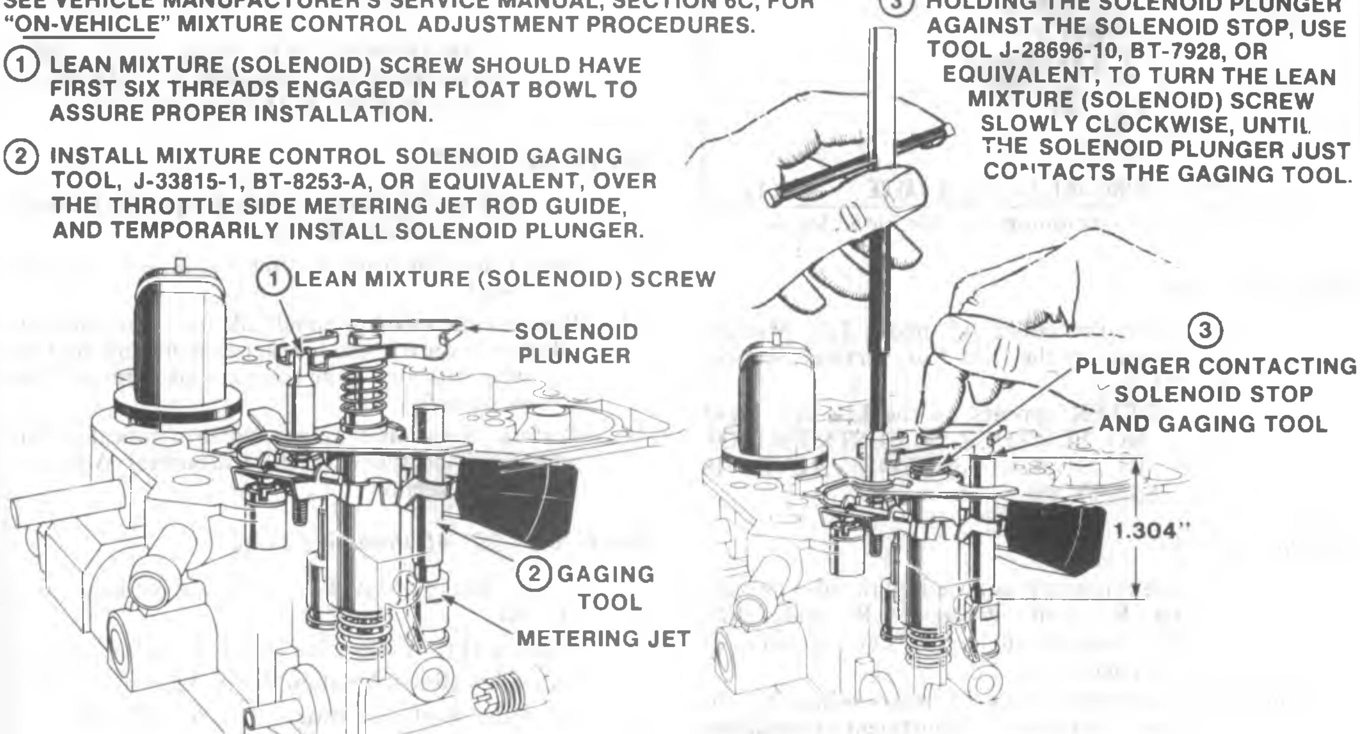
Figure 6C1-45 Float Adjustment

SEE VEHICLE MANUFACTURER'S SERVICE MANUAL, SECTION 6C, FOR "ON-VEHICLE" MIXTURE CONTROL ADJUSTMENT PROCEDURES.

1 LEAN MIXTURE (SOLENOID) SCREW SHOULD HAVE FIRST SIX THREADS ENGAGED IN FLOAT BOWL TO ASSURE PROPER INSTALLATION.

2 INSTALL MIXTURE CONTROL SOLENOID GAGING TOOL, J-33815-1, BT-8253-A, OR EQUIVALENT, OVER THE THROTTLE SIDE METERING JET ROD GUIDE, AND TEMPORARILY INSTALL SOLENOID PLUNGER.

3 HOLDING THE SOLENOID PLUNGER AGAINST THE SOLENOID STOP, USE TOOL J-28696-10, BT-7928, OR EQUIVALENT, TO TURN THE LEAN MIXTURE (SOLENOID) SCREW SLOWLY CLOCKWISE, UNTIL THE SOLENOID PLUNGER JUST CONTACTS THE GAGING TOOL.



LEAN MIXTURE SCREW (BENCH) ADJUSTMENT
E2M & E4M MODELS ONLY 3B6C46

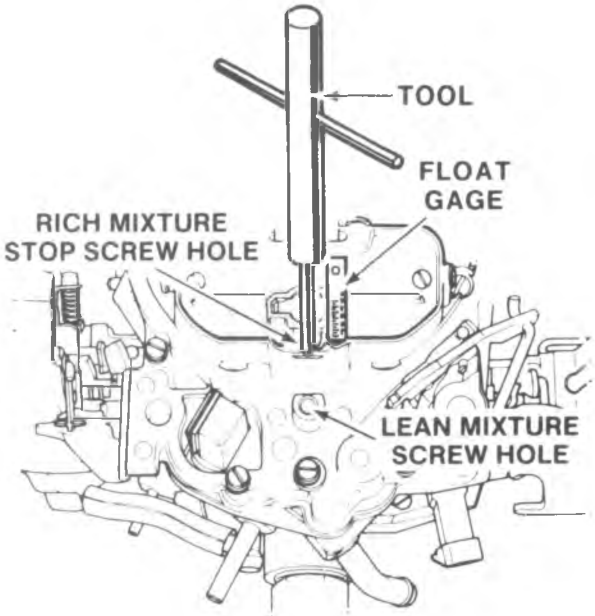
Figure 6C1-46 Lean Mixture (Solenoid) Screw Bench Adjustment

SEE VEHICLE MANUFACTURER'S SERVICE MANUAL, SECTION 6C, FOR ON-VEHICLE MIXTURE CONTROL ADJUSTMENT PROCEDURES.

(1) WITH LEAN MIXTURE SCREW SET PROPERLY AND AIR HORN REINSTALLED FOLLOWING RECOMMENDED SERVICE PROCEDURES, INSERT TOOL J-9789-130, BT-7720 OR EQUIVALENT IN VERTICAL "D" SHAPED VENT HOLE IN AIR HORN CASTING.

(2) USE TOOL J-28696-10, BT-7928, OR EQUIVALENT, TO TURN RICH MIXTURE STOP SCREW CLOCKWISE UNTIL TOTAL SOLENOID PLUNGER TRAVEL IS 4/32" (3.175 mm.)

(3) INSTALL NEW PLUGS PROVIDED IN SERVICE KITS, TO RETAIN RICH MIXTURE STOP SCREW AND LEAN MIXTURE (SOLENOID) SCREW SETTINGS, AND TO PREVENT FUEL VAPOR LOSS.



RICH MIXTURE STOP SCREW (BENCH) ADJUSTMENT

E2M & E4M MODELS ONLY

3B6C47

Figure 6C1-47 Rich Mixture Stop Screw Bench Adjustment

REFER TO VEHICLE MANUFACTURER'S SERVICE MANUAL SECTION 6C, FOR ON-VEHICLE IDLE MIXTURE ADJUSTMENT PROCEDURES

(1) IDLE MIXTURE NEEDLES

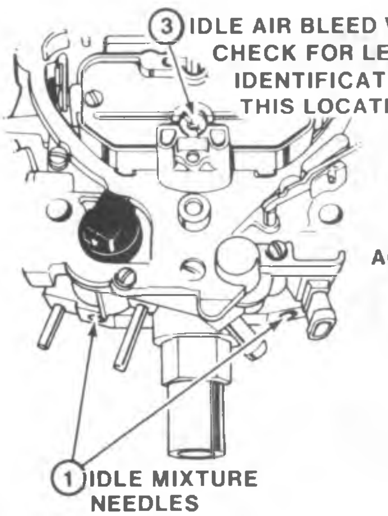
USE TOOL J-29030-B, BT-7610-B, OR EQUIVALENT TO LIGHTLY SEAT BOTH NEEDLES AND THEN BACK OUT NUMBER OF TURNS SHOWN IN SPECIFICATIONS SECTION.

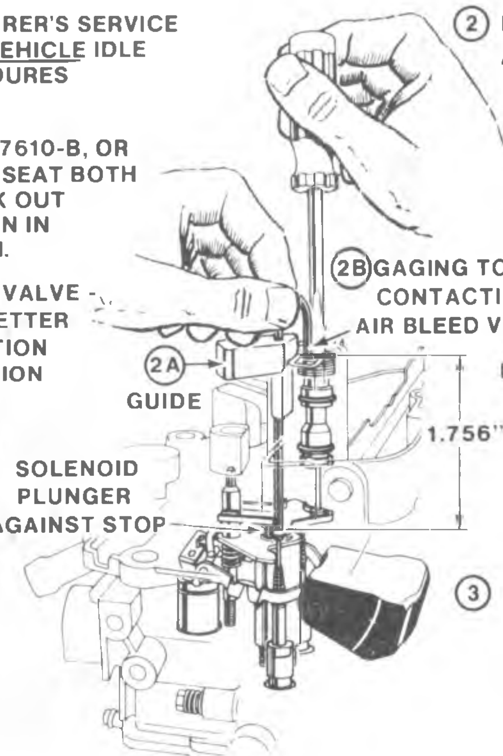
(2) IDLE AIR BLEED VALVE

A. INSERT AIR BLEED VALVE GAGING TOOL J-33815-2, BT 8253-B, OR EQUIVALENT, IN THROTTLE SIDE "D" SHAPED VENT HOLE OF AIR HORN CASTING. UPPER END OF TOOL SHOULD BE POSITIONED OVER OPEN CAVITY NEXT TO VALUE.

B. HOLDING THE GAGING TOOL DOWN LIGHTLY SO THAT THE SOLENOID PLUNGER IS AGAINST THE SOLENOID STOP, ADJUST AIR BLEED VALVE SO THAT GAGING TOOL WILL PIVOT OVER AND JUST CONTACT TOP OF VALVE.

(3) CHECK FOR LETTER IDENTIFICATION (OR NO LETTER) ON TOP OF AIR BLEED VALVE. THIS WILL DETERMINE THE CORRECT PROCEDURE FOR FINAL ON-VEHICLE IDLE MIXTURE ADJUSTMENT.





IDLE MIXTURE (BENCH) ADJUSTMENT

E2M & E4M MODELS ONLY

3B6C48

Figure 6C1-48 Idle Mixture Bench Adjustments

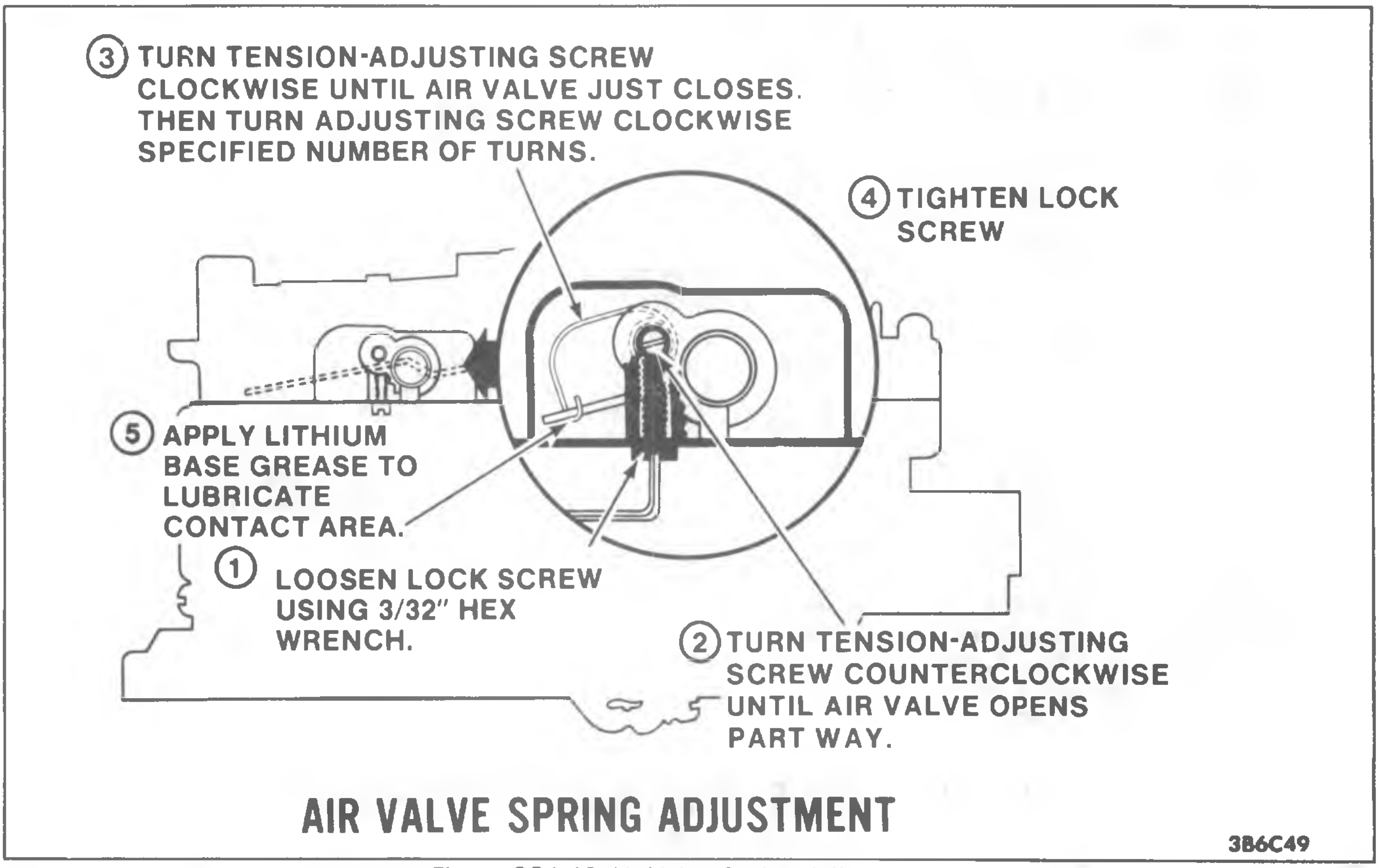


Figure 6C1-49 Air Valve Spring Adjustment

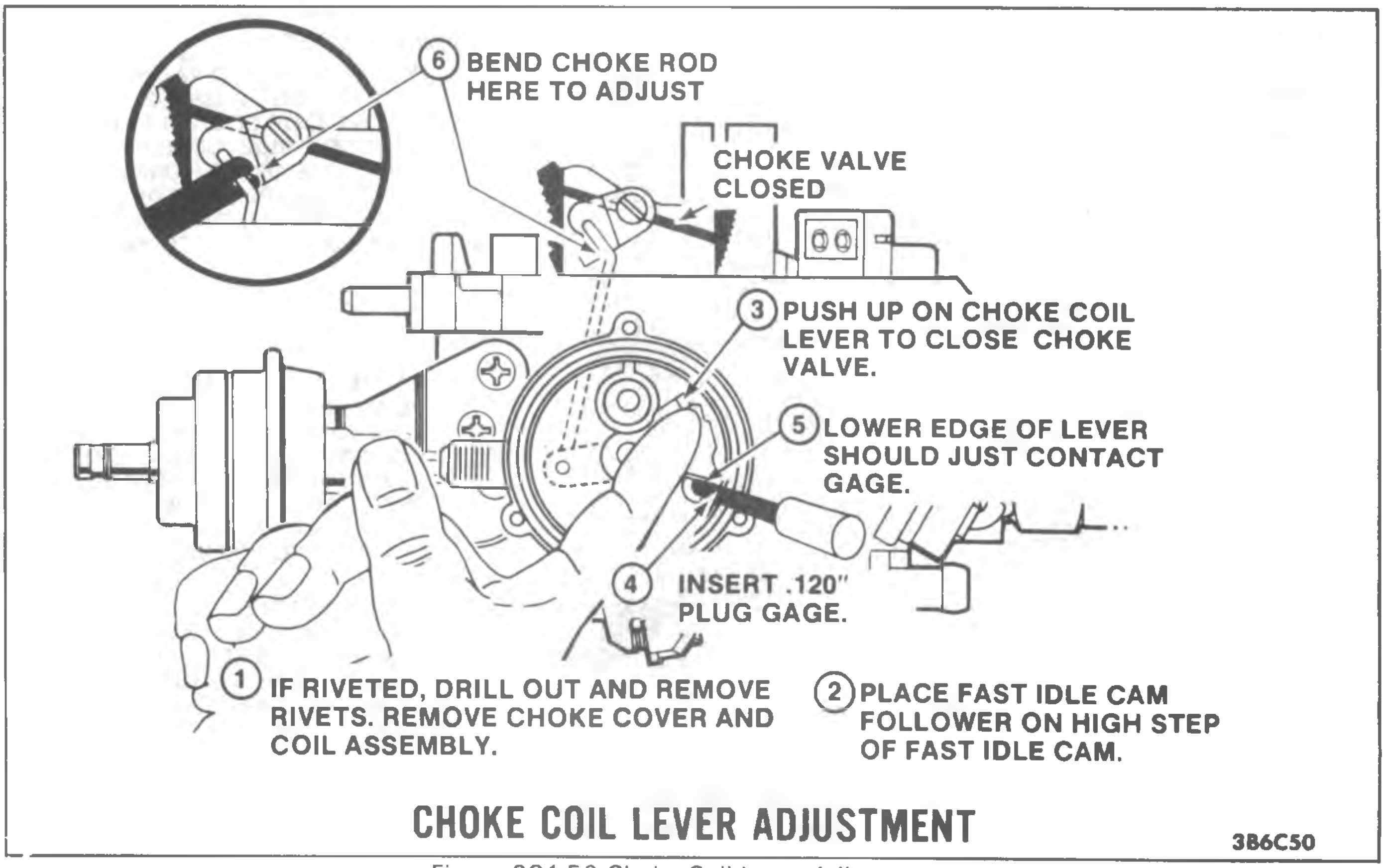


Figure 6C1-50 Choke Coil Lever Adjustment

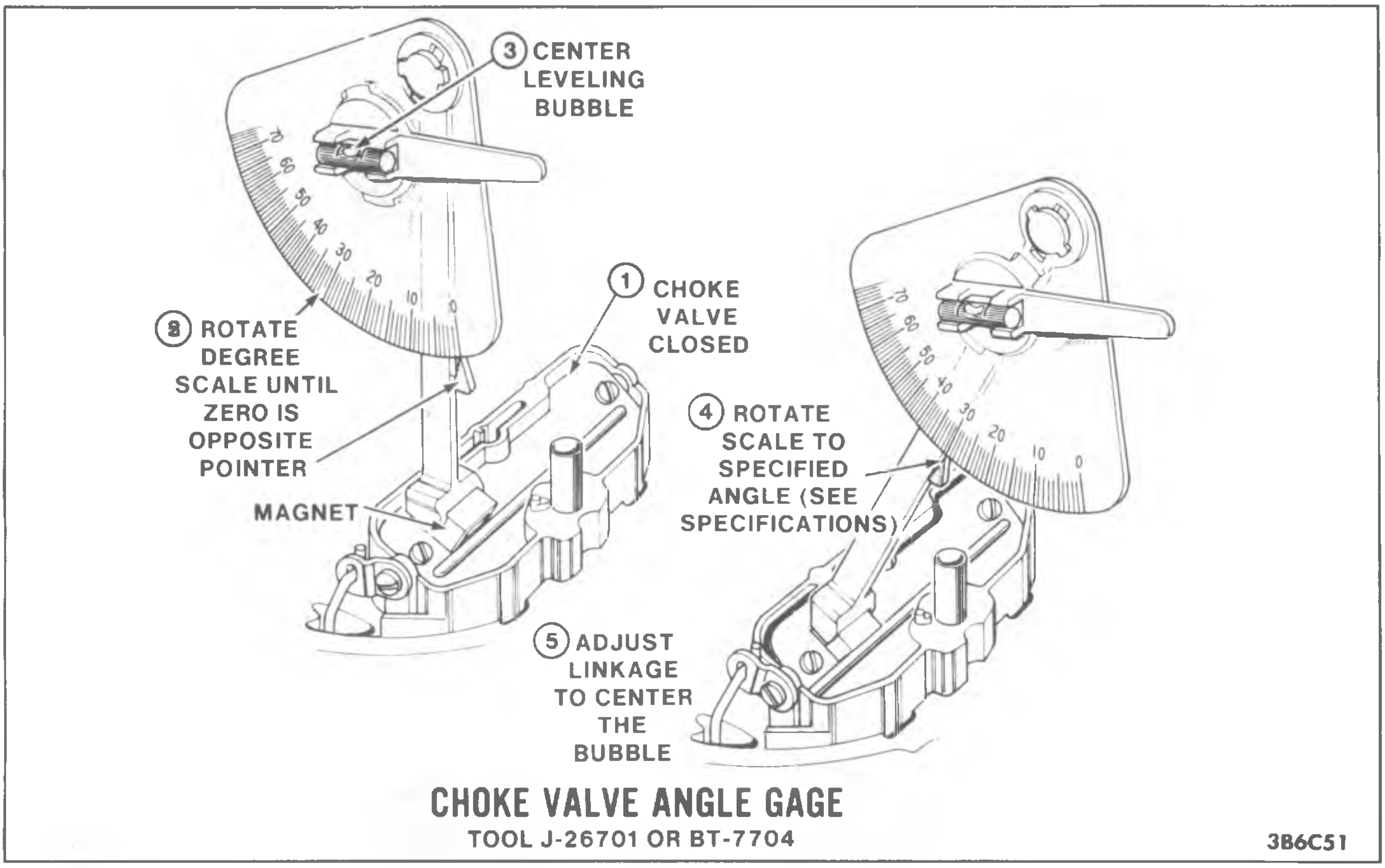


Figure 6C1-51 Choke Valve Angle Gage

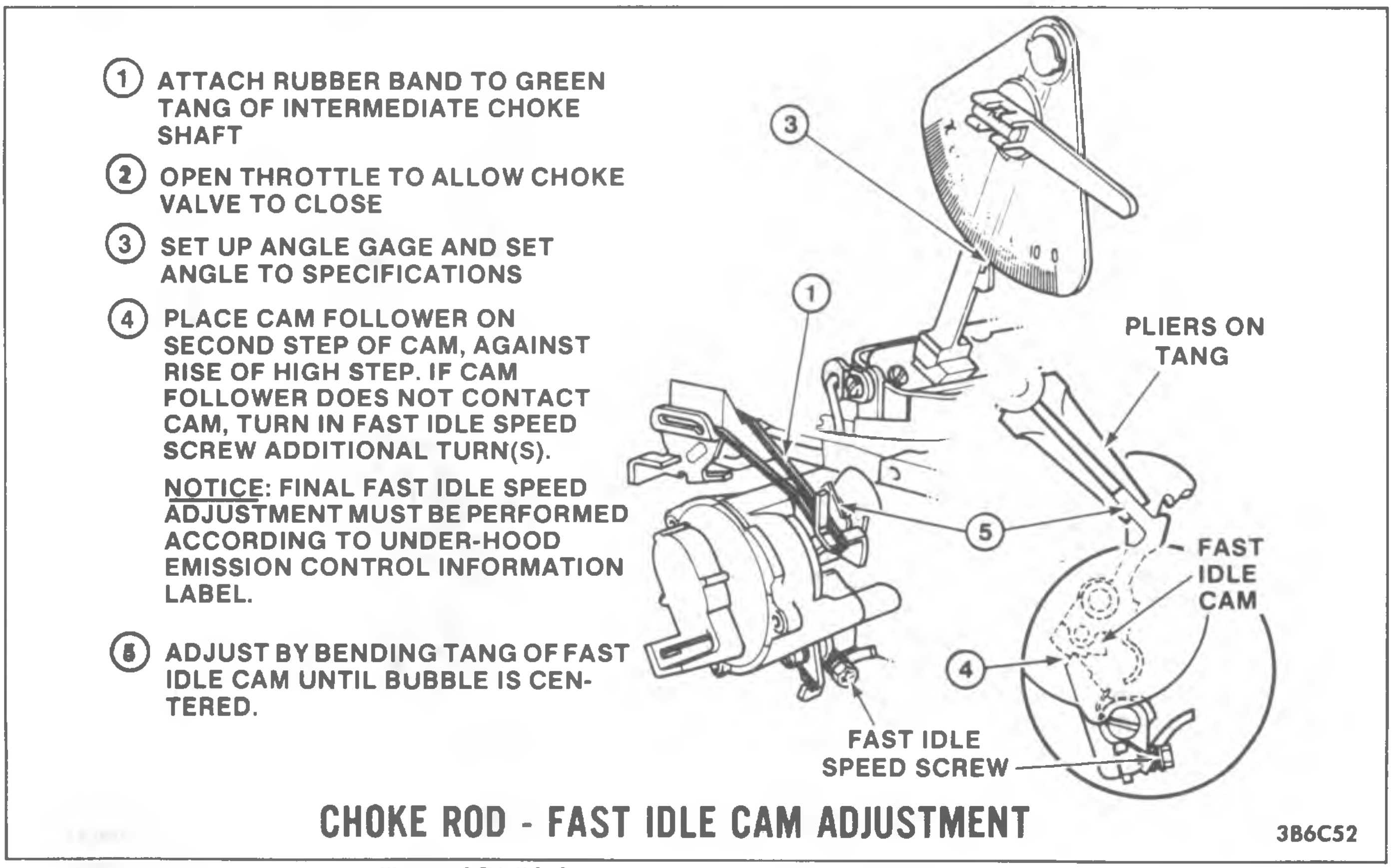


Figure 6C1-52 Choke Rod - Fast Idle Cam Adjustment

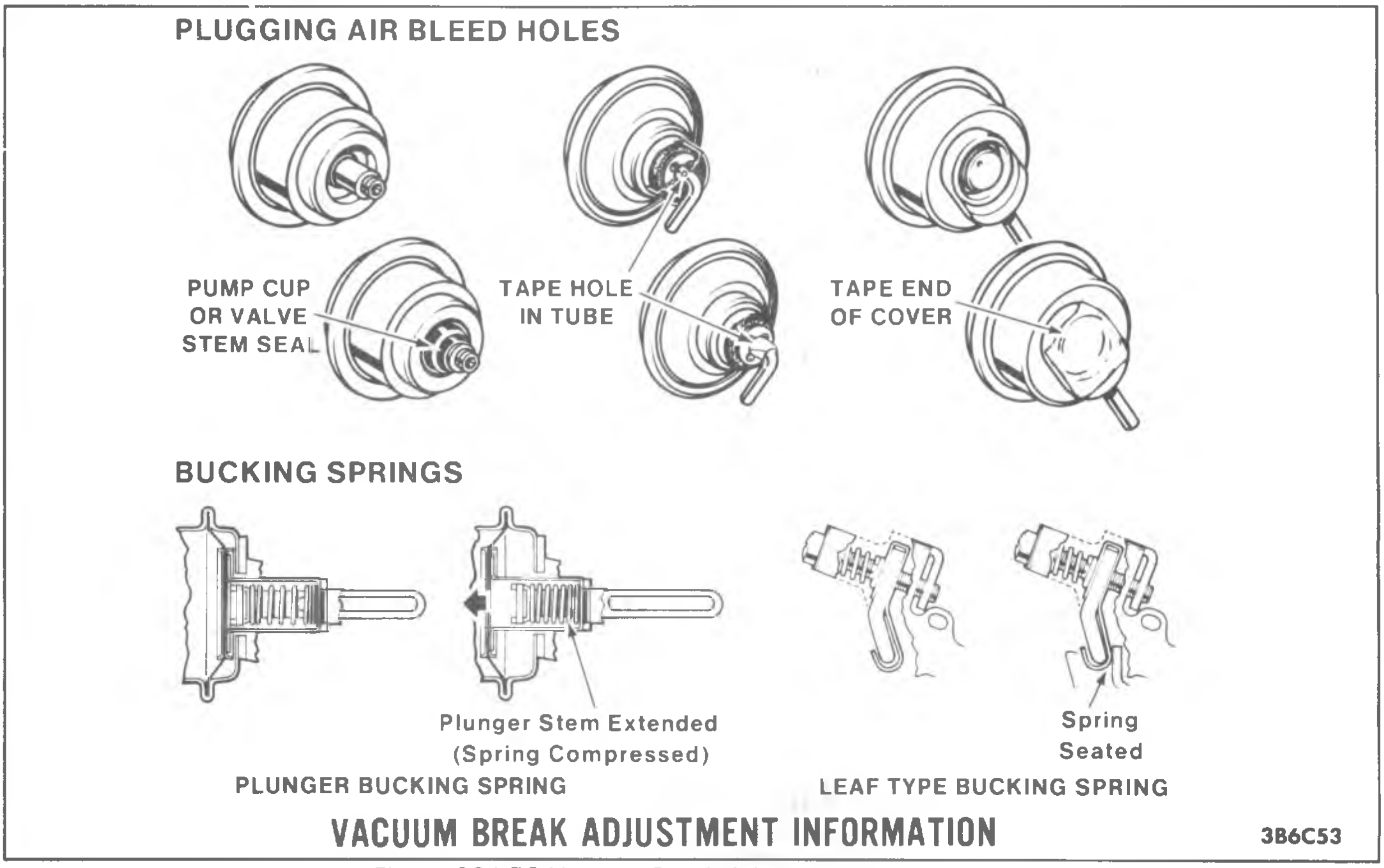
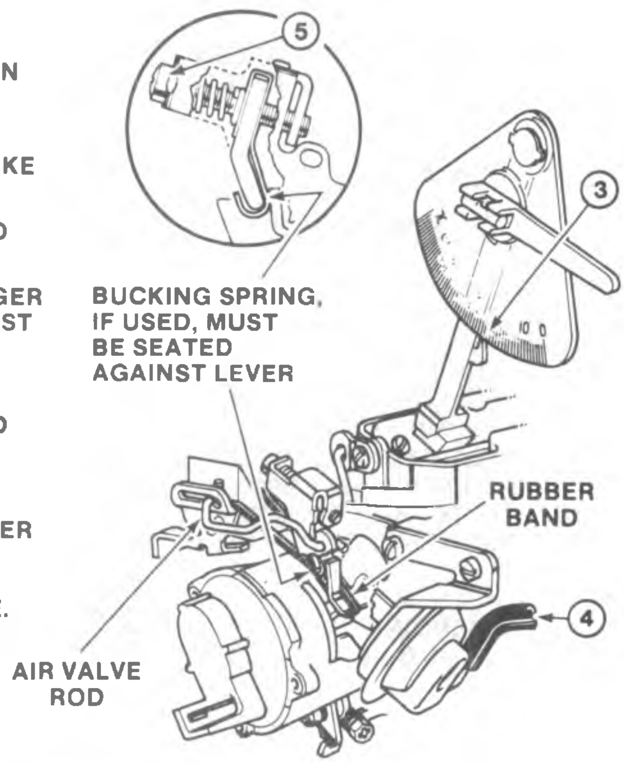


Figure 6C1-53 Vacuum Break Adjustment Information

1. ATTACH RUBBER BAND TO GREEN TANG OF INTERMEDIATE CHOKE SHAFT
2. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE
3. SET UP ANGLE GAGE AND SET TO SPECIFICATION
4. RETRACT VACUUM BREAK PLUNGER USING VACUUM SOURCE, AT LEAST 18" HG. PLUG AIR BLEED HOLES WHERE APPLICABLE

   ON QUADRAJETS, AIR VALVE ROD MUST NOT RESTRICT PLUNGER FROM RETRACTING FULLY. IF NECESSARY, BEND ROD (SEE ARROW) TO PERMIT FULL PLUNGER TRAVEL. FINAL ROD CLEARANCE MUST BE SET AFTER VACUUM BREAK SETTING HAS BEEN MADE.
5. WITH AT LEAST 18" HG STILL APPLIED, ADJUST SCREW TO CENTER BUBBLE



FRONT VACUUM BREAK ADJUSTMENT

3B6C54

Figure 6C1-54 Front (Primary) Vacuum Break Adjustment

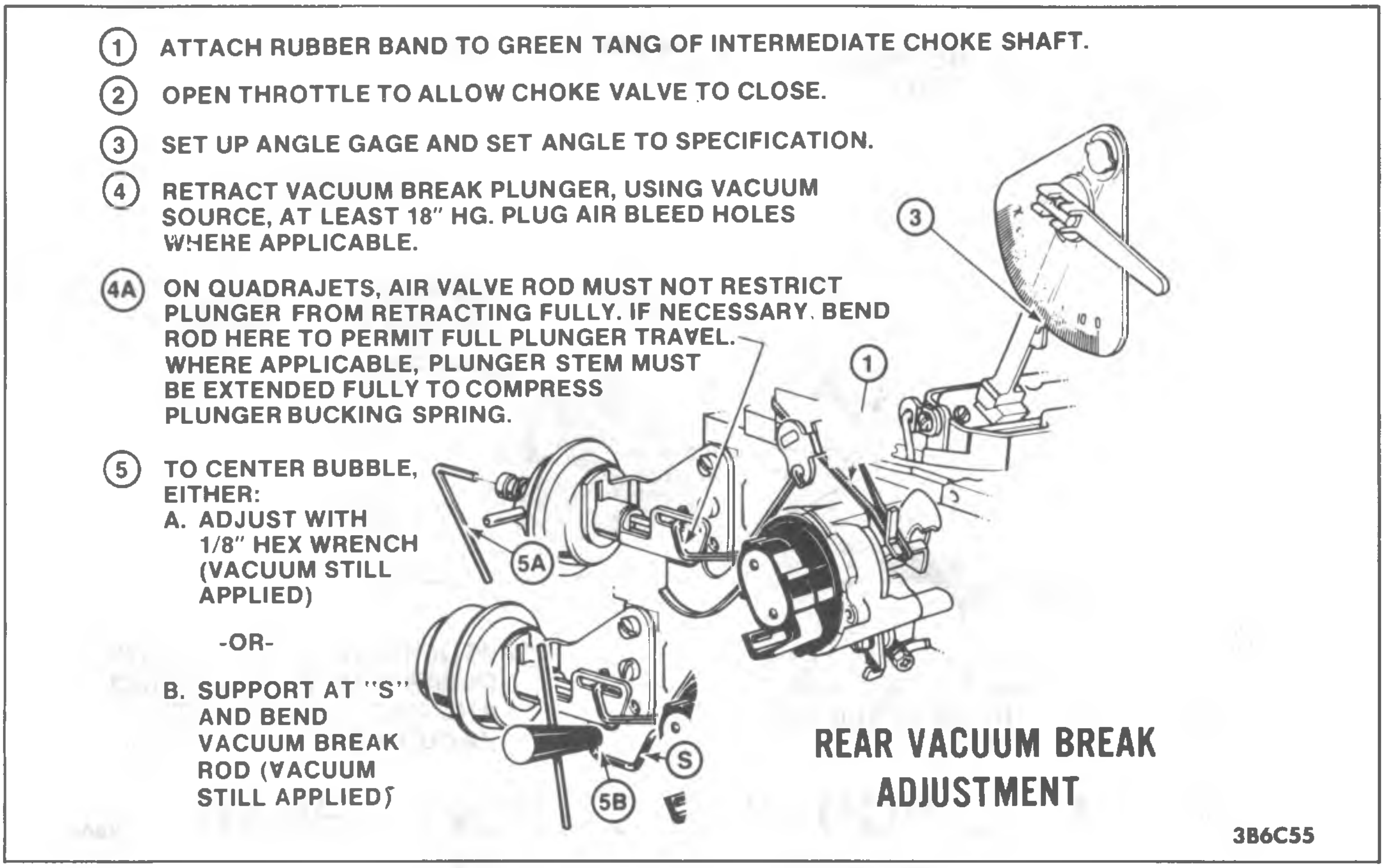


Figure 6C1-55 Rear (Auxiliary) Vacuum Break Adjustment

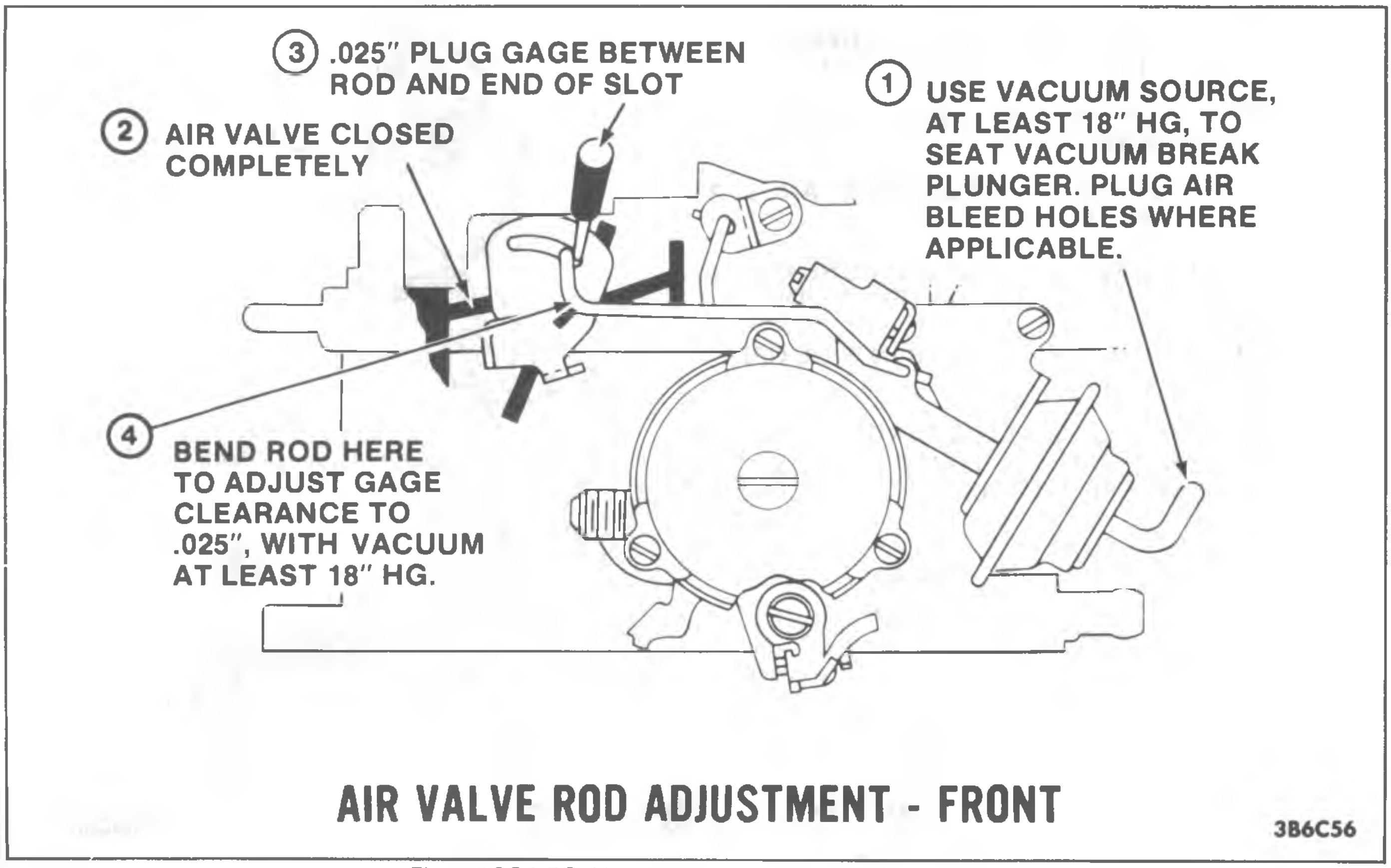


Figure 6C1-56 Air Valve Rod Adjustment - Front

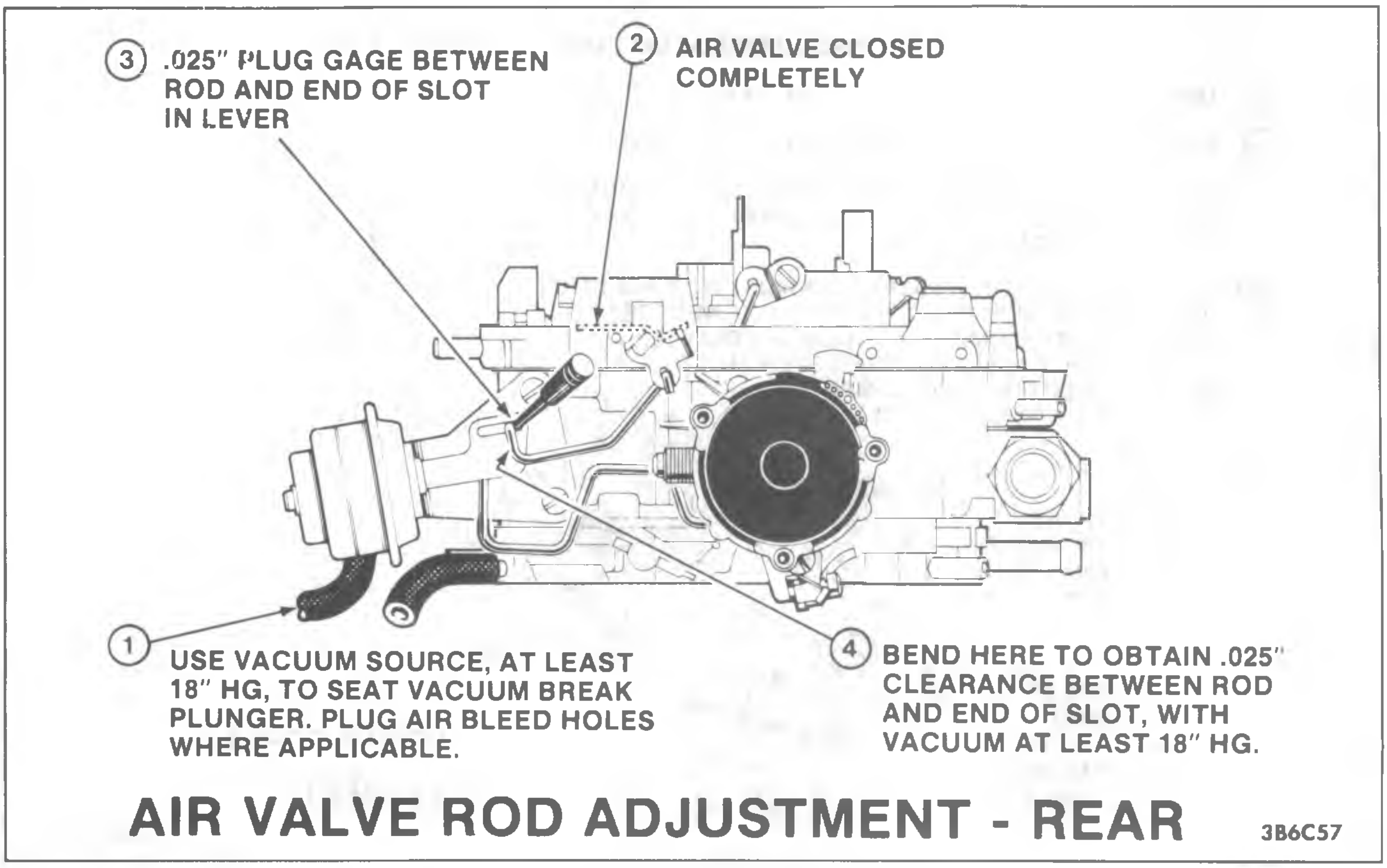


Figure 6C1-57 Air Valve Rod Adjustment - Rear

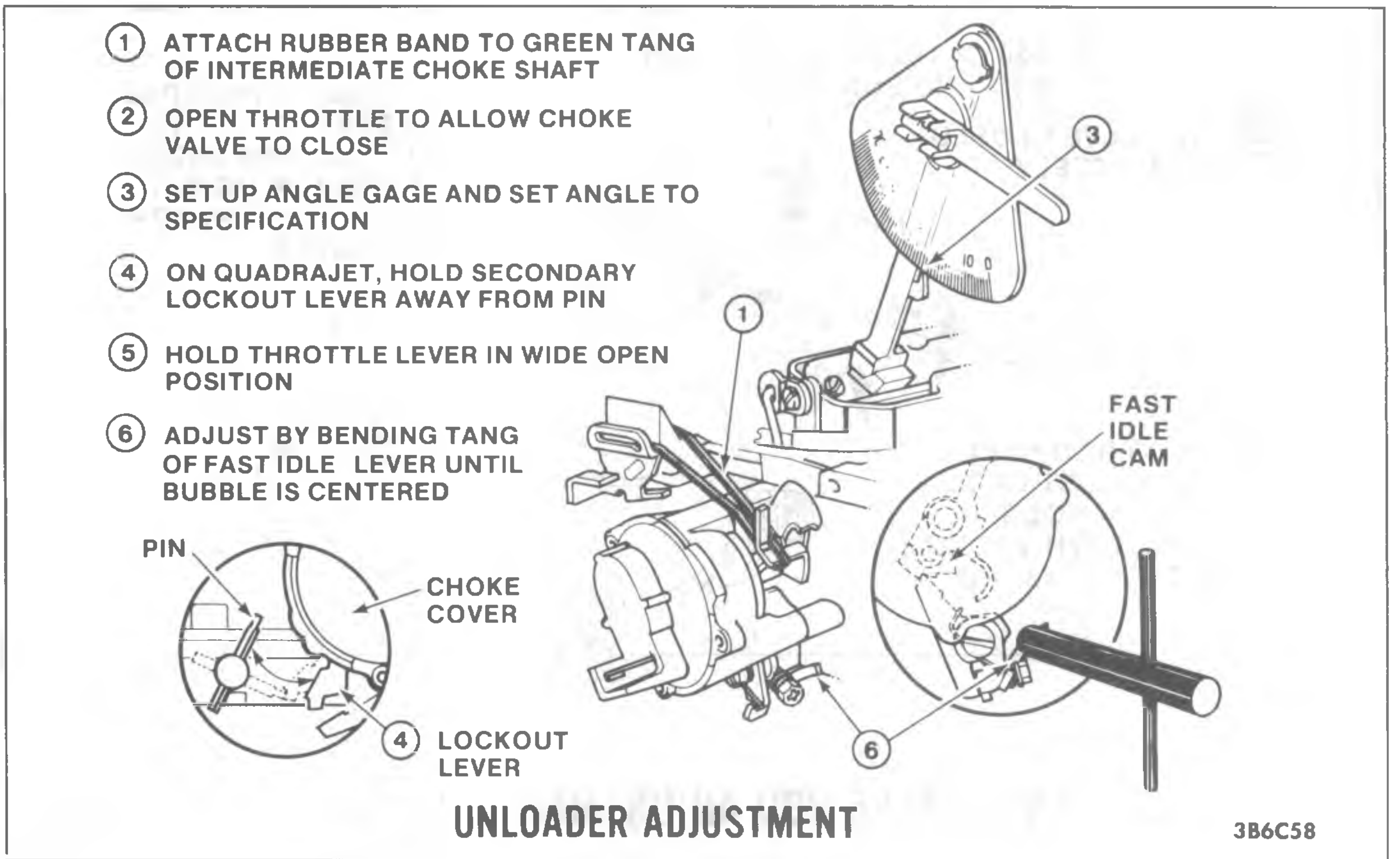


Figure 6C1-58 Unloader Adjustment

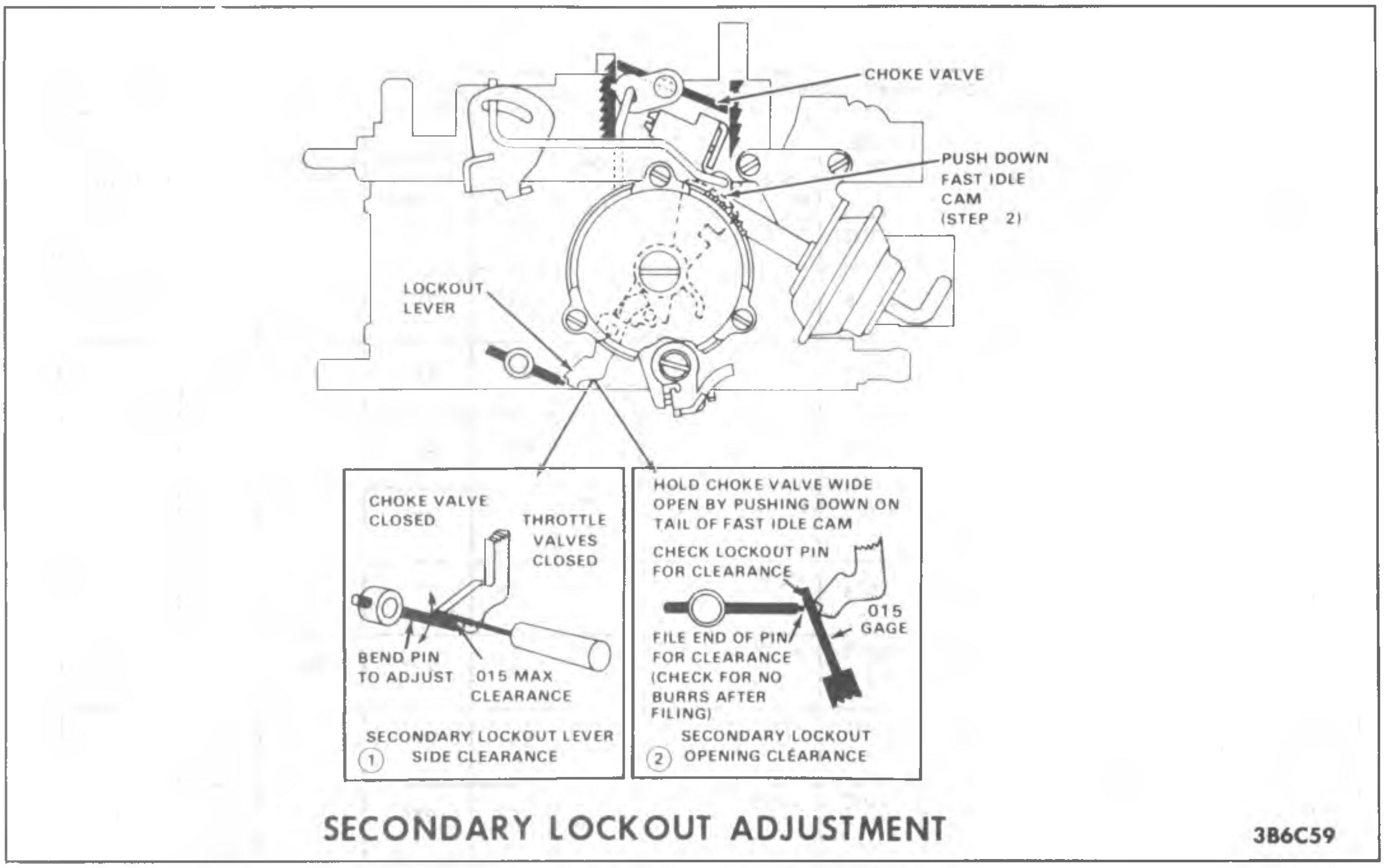


Figure 6C1-59 Secondary Lockout Adjustment

MODEL E4ME CARBURETOR ADJUSTMENT SPECIFICATIONS												
CARBU-RETOR NUMBER	FLOAT LEVEL ±2/32"	LEAN MIXTURE SCREW	RICH MIXTURE SCREW ±2/32"	IDLE MIXTURE NEEDLE (NO. OF TURNS)	IDLE AIR BLEED VALVE	AIR VALVE SPRING (NO. OF TURNS)	CHOKE STAT LEVER	CHOKE ROD CAM ±2.5°	VACUUM BREAK FRONT ±2.5°	VACUUM BREAK REAR ±3.5°	AIR VALVE ROD	UNLOADER ±4°
17084201	11/32 (8.7 mm)	1.304 Gage	4/32	3-3/8	NOTE 1	7/8	.120 Gage	20°	27°	—	.025	38°
17084205	11/32 (8.7 mm)	1.304 Gage	4/32	3-3/8	NOTE 1	7/8	.120 Gage	38°	27°	—	.025	38°
17084208	11/32 (8.7 mm)	1.304 Gage	4/32	3-3/8	NOTE 1	7/8	.120 Gage	20°	27°	—	.025	38°
17084209	11/32 (8.7 mm)	1.304 Gage	4/32	3-3/8	NOTE 1	7/8	.120 Gage	38°	27°	—	.025	38°
17084210	11/32 (8.7 mm)	1.304 Gage	4/32	3-3/8	NOTE 1	7/8	.120 Gage	20°	27°	—	.025	38°
17084507	14/32 11.0 mm	1.304 Gage	4/32	NOTE 2	NOTE 1	1	.120 Gage	20°	27°	36°	.025	36°
17084509	14/32 11.0 mm	1.304 Gage	4/32	NOTE 2	NOTE 1	1	.120 Gage	20°	27°	36°	.025	36°
17084525	14/32 11.0 mm	1.304 Gage	4/32	NOTE 2	NOTE 1	1	.120 Gage	20°	25°	36°	.025	36°
17084527	14/32 11.0 mm	1.304 Gage	4/32	NOTE 2	NOTE 1	1	.120 Gage	20°	25°	36°	.025	36°

120183

1 PRESET WITH 1.756 GAGE, FINAL ADJUSTMENT ON VEHICLE

2 PRESET 3 TURNS, FINAL ADJUSTMENT ON VEHICLE

THROTTLE POSITION SENSOR (TPS)		
ENGINE CODE	TPS VOLTAGE ±0.1 Volt	THROTTLE POSITION
G (L69)	.48 Volts	Curb Idle
H (LG4)	.48 Volts	Curb Idle
6 (LM1)	.48 Volts	Curb Idle
F (LF3)	.41 Volts	Curb Idle
L (LS9)	.41 Volts	Curb Idle

IDLE SPEED CONTROL USAGE
ENGINE CODE A (LD5)
ENGINE CODE 9 (LC3)

Figure 6C1-60 Carburetor Specifications

SECTION 6C3

CARBURETOR MODEL E2SE

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Adjustment Specifications 6C3-30

ALL NEW GM VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAP, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

For vehicles sold in Canada and equipped with non-closed loop engines, also refer to the appropriate Canadian Service Manual Supplement.

GENERAL DESCRIPTION

The Model E2SE Varajet is a two barrel, two stage down-draft carburetor used with the Computer Command Control system of fuel control. It has three major assemblies; air horn, float bowl and throttle body; and has the following six basic operating systems:

- FLOAT (Figure 6C3-1)
- IDLE (Figure 6C3-2)
- MAIN METERING (Figure 6C3-3)
- POWER (Figure 6C3-4)
- PUMP (Figure 6C3-5)
- CHOKE (Figure 6C3-6)

An exploded view of this carburetor with part names, is shown in Figure 6C3-7.

A single float chamber supplies fuel to both bores. A float, a float needle seat, a float needle with pull clip, and float bowl insert(s) (43 and 47), help control the level of fuel in the float chamber. On some models, a float stabilizing spring adds further control of fuel level for vehicles used in rugged terrain.

An electrically operated mixture control solenoid, mounted in the air horn and extending into the float bowl, controls the air/fuel mixture in the primary bore. A plunger, at the end of the solenoid, is submerged in the fuel chamber of the float bowl, and is controlled (or pulsed) by signals from the Electronic Control Module (ECM).

In the secondary bore, an air valve, and a tapered metering rod operating in a fixed jet, control the air/fuel mixture during increased engine air flow at wide open throttle.

To provide extra fuel during quick throttle openings, the pump system uses a plunger type pump. On some models, a thermostatically controlled bypass valve is used. Where used, this valve contains a temperature-sensitive snap disc and is pressed into the air horn casting. During cold engine start-up, the pump delivers its full capacity to the primary bore. At operating temperatures over 43° C. (110° F.), the bypass valve opens, allowing some fuel to be pumped back into the float bowl.

An electrically heated choke stat provides the choke valve closing force for cold start-up, and for choke opening during warmup. Two vacuum break assemblies control initial choke valve opening at start and during warmup. To purge the engine if flooded, a throttle lever unloader tang forces the choke valve open, when the accelerator is pressed to the floor. A fast idle cam, following choke valve movement, acts as a variable throttle stop, to provide increased idle speed during warmup.

A throttle position sensor (TPS), mounted in the float bowl, which signals the ECM when the throttle position changes. As changes occur, a tang on the pump lever moves the TPS plunger, changing the signal to the ECM, to control various engine operating modes.

An idle speed device, either an Idle Stop Solenoid or a Throttle Lever Actuator, is used to position the primary throttle valve to provide engine idle speed requirements.

DIAGNOSIS

During disassembly inspection and reassembly, give special attention to the parts mentioned below, and repair or replace if necessary, if the problems named have been encountered:

Procedures in this section refer to Figure 6C3-7.

Also refer to Engine Performance Diagnosis (Section 6) for additional diagnosis.

A. FLOODING

Inspect

1. Fuel inlet filter (55) for damage or clogged condition.
2. Float needle pull clip (48B), and the float stabilizing spring (46) if used, for improper installation.
3. Float and lever assembly (45) and hinge pin (44) for distortion, bind, and burrs.
4. Float needle and needle seat (48A and 48C) for dirt, grooves or scoring.
5. For engine flooding.

B. HESITATION

Inspect

1. Pump link (68) for wear.
2. Pump (39) for cracks, scores, and cup wear.
   - A used pump cup shrinks when dry, and should be soaked in fuel for eight hours before testing.
   - Pump well for scoring.
3. Pump return spring (40) and duration spring for distortion.
4. Pump passages and jet for dirt.
   - Discharge ball (52) for improper seating.
   - Discharge spring (51) for distortion.
5. If thermostatically controlled bypass valve allows fuel to bypass below 45° C. (110° F.), replace air horn assembly.

C. HARD STARTING - POOR COLD OPERATION

Inspect

1. Choke valve and linkage for wear, binds or distortion.
   - Do not lubricate linkage, as this will collect dust, causing sticking.
2. Vacuum break assemblies (4 and 12) for leaks.
3. Fuel filter (55) for damage or clogged condition.
4. Float needle (48A) for sticking, dirt, etc.
5. Also items under "A. Flooding", above.

D. POOR PERFORMANCE - OR - POOR GAS MILEAGE

Inspect

1. Choke valve for binding.
2. Air valve and secondary metering rod for binding
   - If either is damaged, or if you know that the metering rod adjustment has been changed from its original setting, replace air horn assembly.
3. Air valve spring, for improper installation, or incorrect windup (if applicable).
4. Fuel filter (55) for damage or clogged condition.
5. Metering jet and lean mixture needle assembly (49) for dirt, loose lean mixture needle, and damage.
6. All fuel and air passages for clogs and dirtiness.

Important

Do not readjust lean mixture needle inside the metering jet, UNLESS the Computer Command Control system performance check indicated readjustment is required. See "ON-Vehicle Service".

E. ROUGH IDLE

Inspect

1. Throttle lever and valves for binds, nicks and other damage.
2. All gaskets and mating casting surfaces for nicks, burrs and damage to sealing beads.
3. Idle mixture needle for ridges, burrs, and bends.
4. Idle fuel passages for dirt, etc.

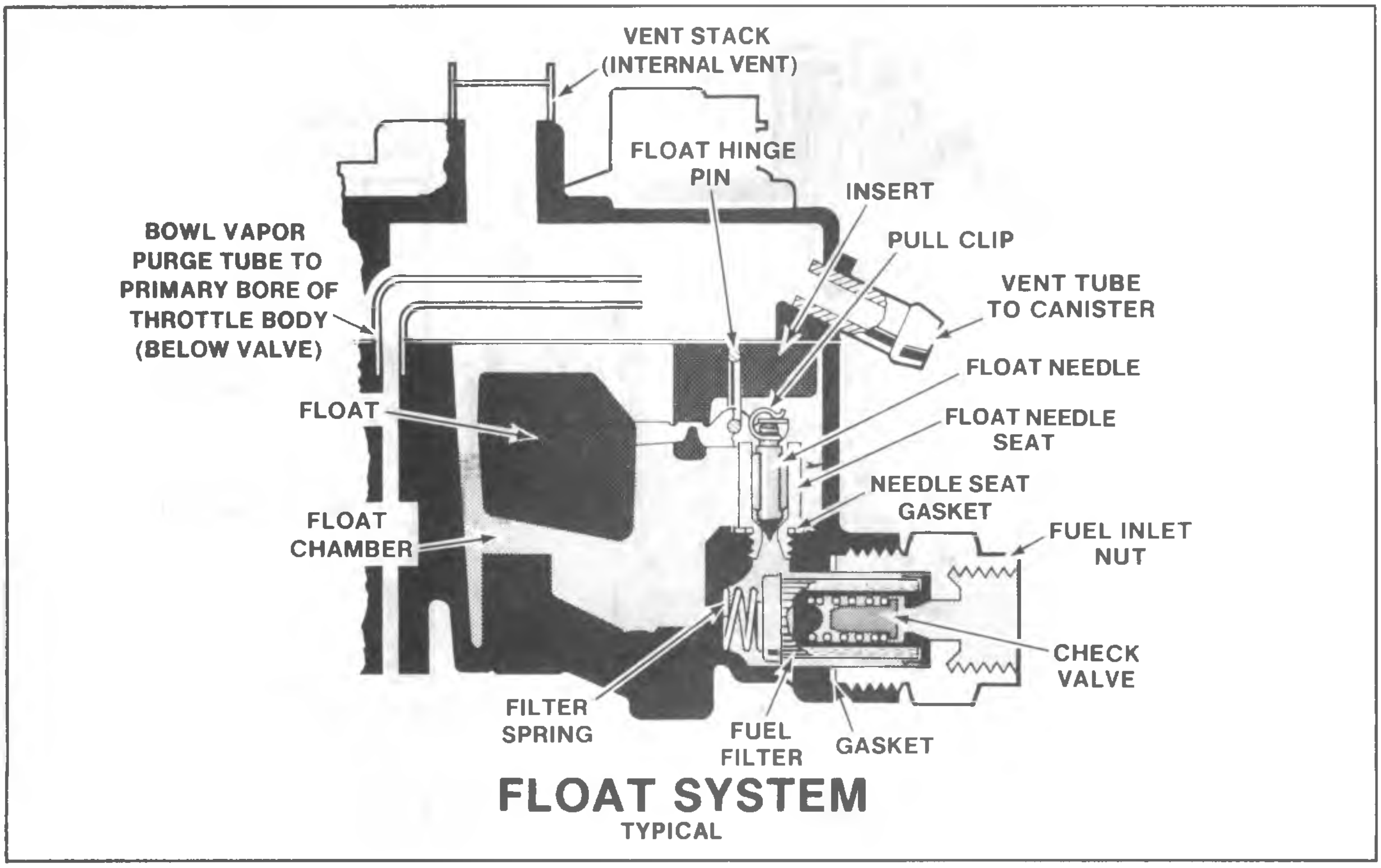


Figure 6C3-1 Float System

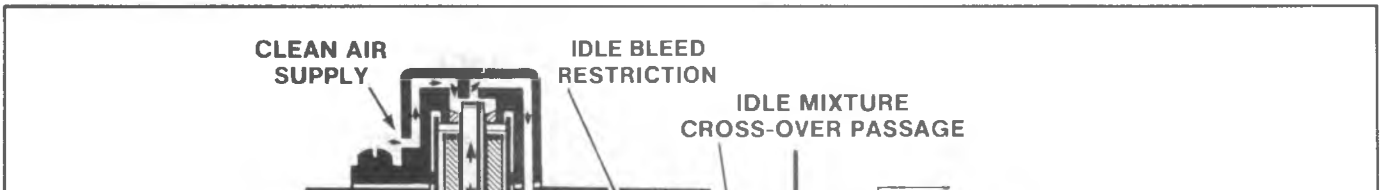


Figure 6C3-2 Idle System

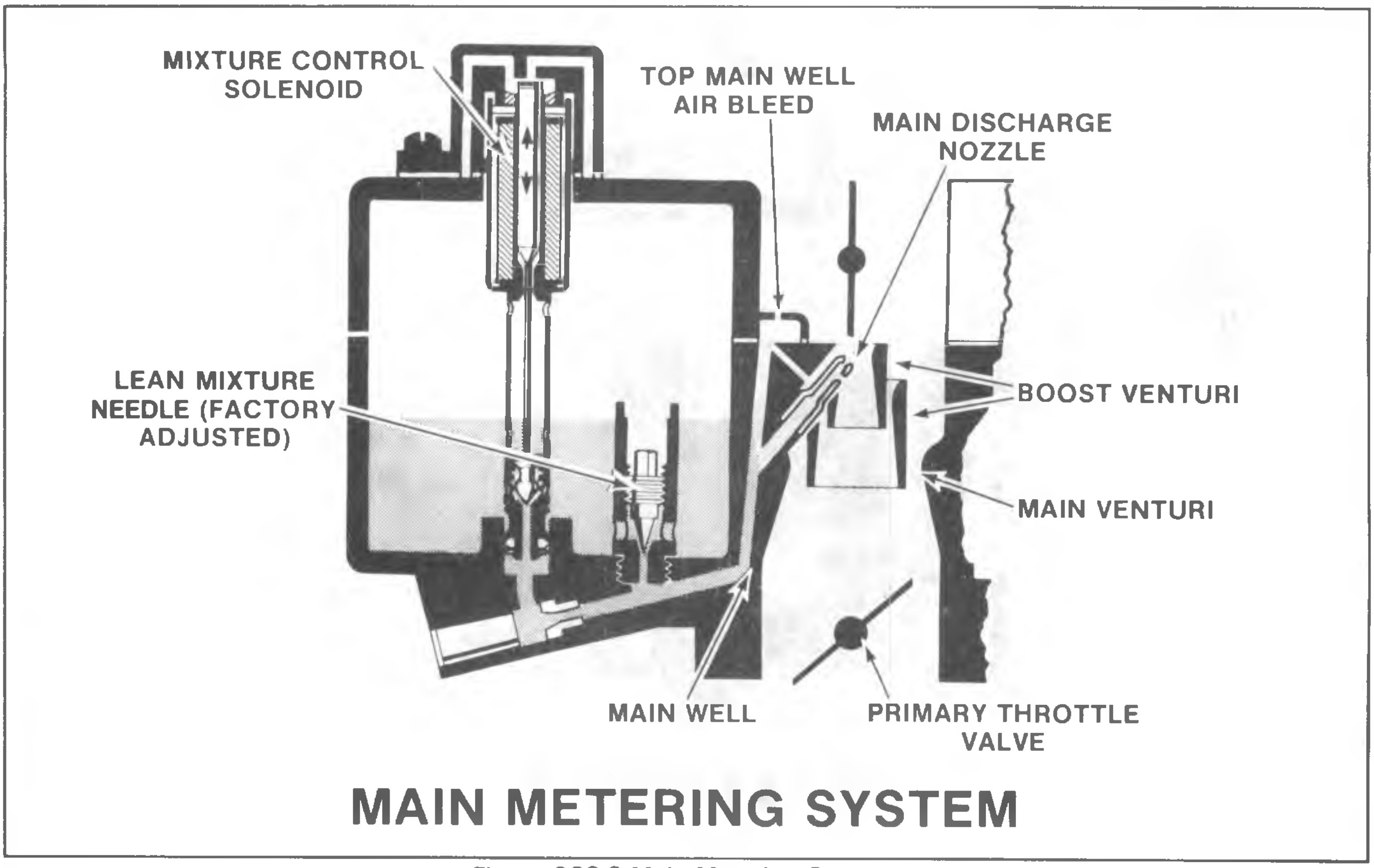


Figure 6C3-3 Main Metering System

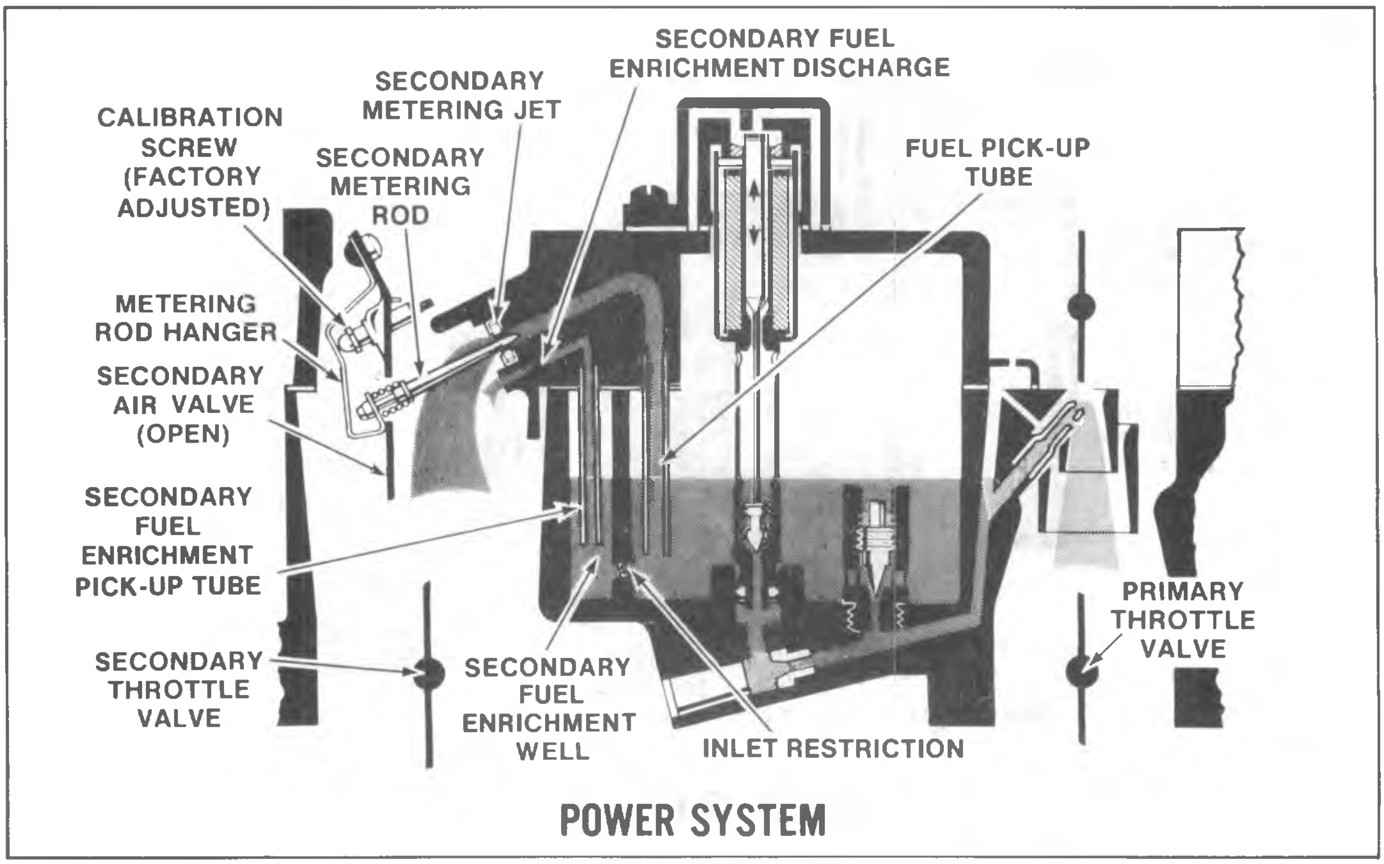


Figure 6C3-4 Power System

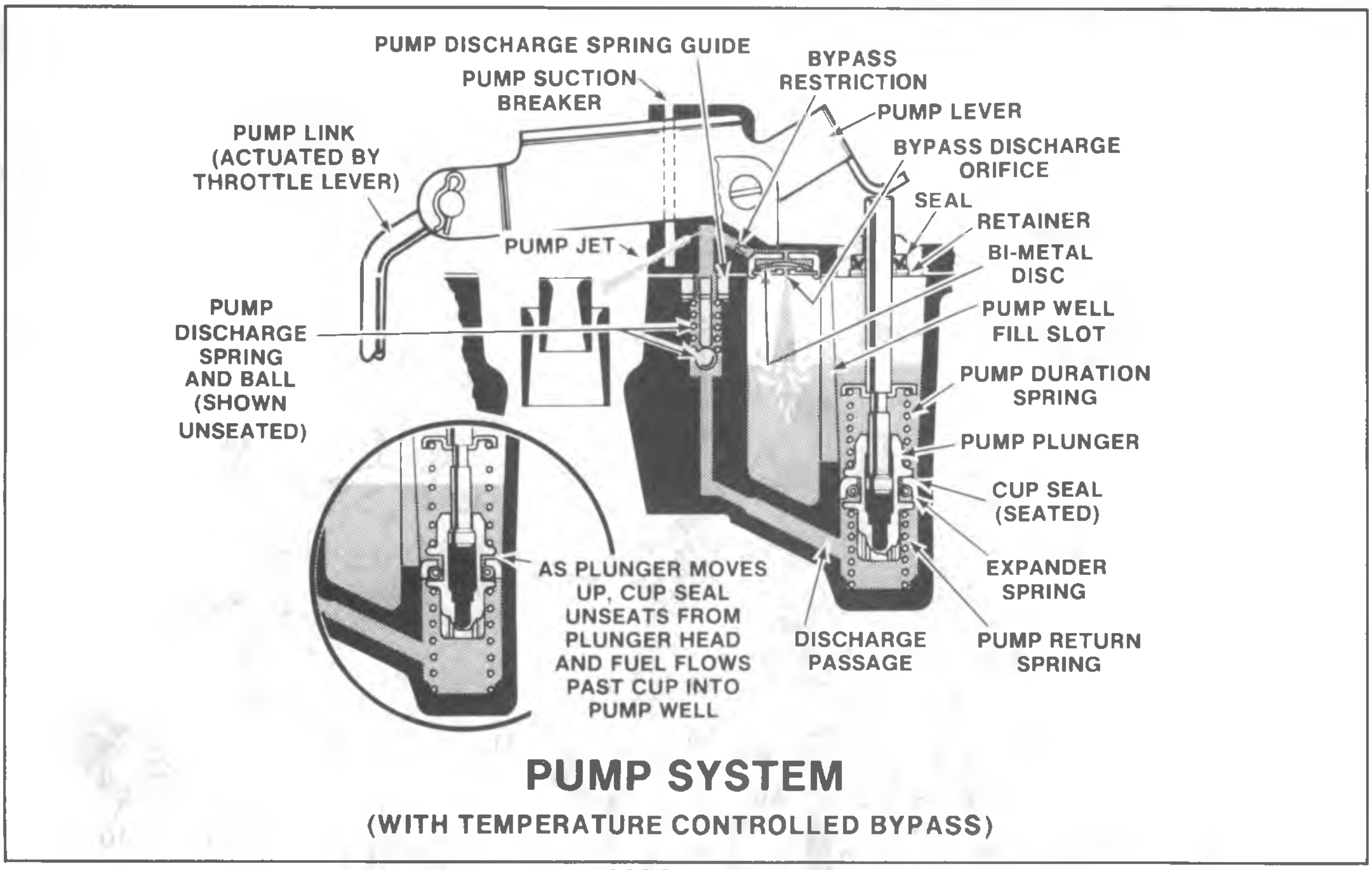


Figure 6C3-5 Pump System

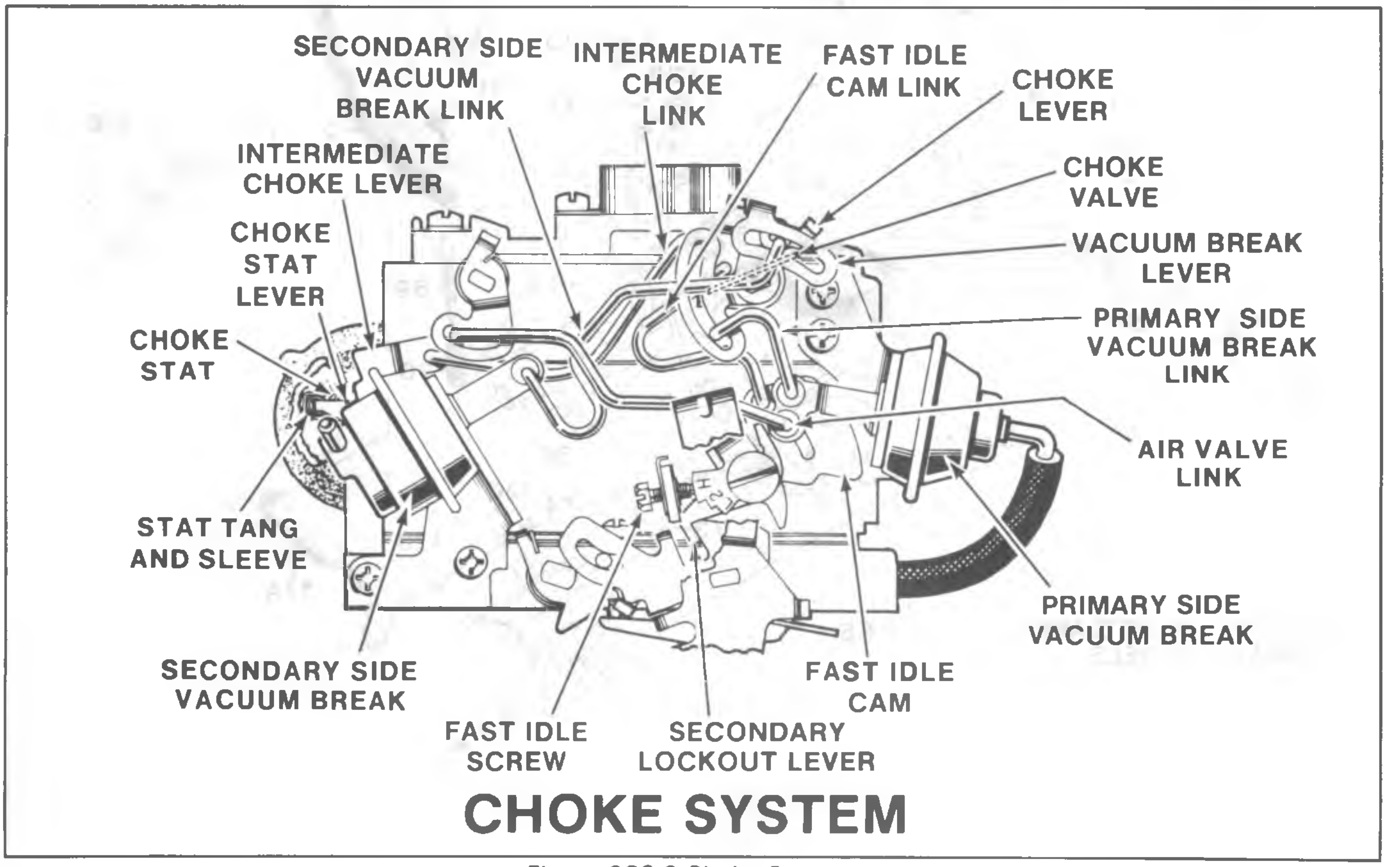


Figure 6C3-6 Choke System

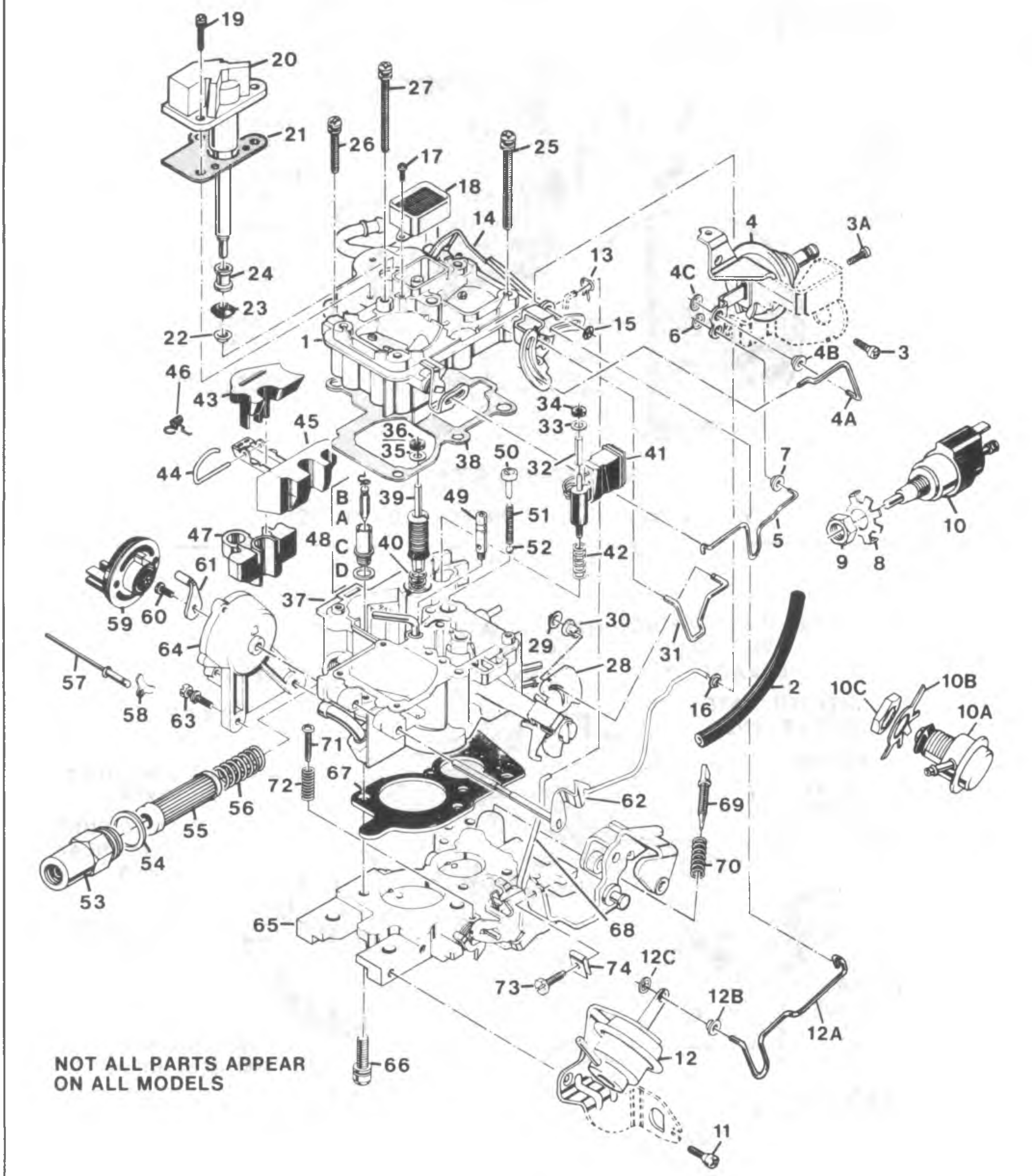


Figure 6C3-7 E2SE Carburetor (1 of 2)

AIR HORN PARTS

1. AIR HORN ASSEMBLY
17. SCREW-VENT STACK ATTACHING
18. VENT STACK
19. SCREW ASSEMBLY-M/C SOLENOID ATTACHING
20. MIXTURE CONTROL (M/C) SOLENOID
21. GASKET-SOLENOID TO AIR HORN
22. RETAINER-M/C SOLENOID SEAL
23. SEAL-SOLENOID TO FLOAT BOWL
24. SPACER-M/C SOLENOID
25. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (LARGE)
26. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (SHORT)
27. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (LONG)
32. PLUNGER-TPS ACTUATOR
33. RETAINER-TPS PLUNGER SEAL
34. SEAL-THROTTLE POSITION SENSOR (TPS) PLUNGER
35. RETAINER-PUMP STEM SEAL
36. SEAL-PUMP STEM
38. GASKET-AIR HORN TO FLOAT BOWL

CHOKE PARTS

2. HOSE-PRIMARY SIDE VACUUM BREAK
3. SCREW-PRIMARY SIDE VACUUM BREAK ATTACHING

3A SCREW ASSEMBLY-PRIMARY SIDE VACUUM BREAK ATTACHING

4. VACUUM BREAK ASSEMBLY-PRIMARY SIDE

4A LINK-PRIMARY SIDE VACUUM BREAK

4B BUSHING-PRIMARY SIDE VACUUM BREAK LINK

4C RETAINER-PRIMARY SIDE VACUUM BREAK LINK

5. LINK-AIR VALVE
6. RETAINER-AIR VALVE LINK
7. BUSHING-AIR VALVE LINK
11. SCREW-SECONDARY SIDE VACUUM BREAK ATTACHING
12. VACUUM BREAK ASSEMBLY-SECONDARY SIDE

12A LINK-SECONDARY SIDE VACUUM BREAK

12B BUSHING-SECONDARY SIDE VACUUM BREAK LINK

12C RETAINER-SECONDARY SIDE VACUUM BREAK LINK

15. RETAINER-INTERMEDIATE CHOKE SHAFT LINK
16. BUSHING-INTERMEDIATE CHOKE SHAFT LINK
29. RETAINER-FAST IDLE CAM LINK
30. BUSHING-FAST IDLE CAM LINK
31. LINK-FAST IDLE CAM
57. RIVET-CHOKE COVER ATTACHING
58. RETAINER-CHOKE COVER
59. ELECTRIC CHOKE COVER & STAT ASSEMBLY
60. SCREW-CHOKE STAT LEVER ATTACHING
61. LEVER-CHOKE STAT
62. INTERMEDIATE CHOKE SHAFT, LEVER, AND LINK ASSEMBLY
63. SCREW ASSEMBLY-CHOKE HOUSING ATTACHING
64. CHOKE HOUSING

FLOAT BOWL PARTS

14. LEVER-PUMP
28. CAM-FAST IDLE
37. FLOAT BOWL ASSEMBLY
39. PUMP ASSEMBLY
40. SPRING-PUMP RETURN
41. SENSOR-THROTTLE POSITION (TPS)
42. SPRING-TPS ADJUSTING
43. INSERT-FLOAT BOWL-UPPER
44. HINGE PIN-FLOAT
45. FLOAT & LEVER ASSEMBLY
46. SPRING-FLOAT STABILIZING
47. INSERT-FLOAT BOWL-LOWER
48. NEEDLE & SEAT ASSEMBLY (A-FLOAT NEEDLE, B-FLOAT NEEDLE PULL CLIP, C-FLOAT NEEDLE SEAT, D-FLOAT NEEDLE SEAT GASKET)
49. JET & LEAN MIXTURE NEEDLE ASSEMBLY
50. GUIDE-PUMP DISCHARGE SPRING
51. SPRING-PUMP DISCHARGE
52. BALL-PUMP DISCHARGE
53. NUT-FUEL INLET
54. GASKET-FUEL INLET NUT
55. FILTER-FUEL INLET
56. SPRING-FUEL FILTER
67. GASKET-THROTTLE BODY TO FLOAT BOWL

THROTTLE BODY PARTS

13. RETAINER-PUMP LINK
65. THROTTLE BODY ASSEMBLY
66. SCREW ASSEMBLY-THROTTLE BODY TO FLOAT BOWL
68. LINK-PUMP
69. IDLE MIXTURE NEEDLE
70. SPRING-IDLE MIXTURE NEEDLE
71. SCREW-THROTTLE STOP
72. SPRING-THROTTLE STOP SCREW
73. SCREW-FAST IDLE
74. RETAINER-FAST IDLE SCREW

IDLE SPEED CONTROL DEVICES

8. RETAINER-IDLE SOLENOID NUT
9. NUT-IDLE STOP SOLENOID
10. SOLENOID-IDLE STOP

10A ACTUATOR-THROTTLE LEVER

10B RETAINER-THROTTLE LEVER ACTUATOR NUT

10C NUT-THROTTLE LEVER ACTUATOR

Figure 6C3-7a E2SE Carburetor (2 of 2)

ON-VEHICLE SERVICE

CARBURETOR IDENTIFICATION

The carburetor part number is stamped vertically on the float bowl in a float area as shown in Figure 6C3-8. Refer to this part number when servicing the carburetor.

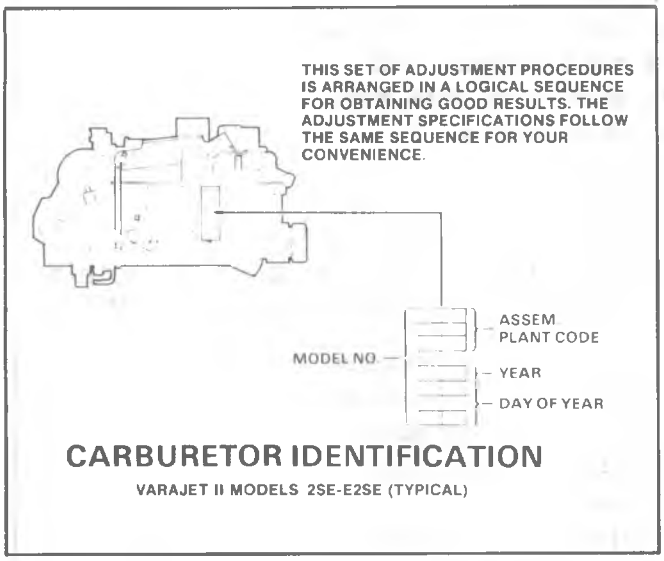


Figure 6C3-8 Carburetor Identification

CARBURETOR REPLACEMENT (FIGURE 6C3-9)

Always replace all internal gaskets that are removed. Base gasket should be inspected and replaced only if damaged.

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosis, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check fuel filter.

1. Remove air cleaner and gasket.
2. Disconnect fuel pipe and vacuum lines.
3. Disconnect electrical connectors.
4. Disconnect accelerator linkage.
5. If equipped with automatic transmission, disconnect downshift cable.
6. If equipped with cruise control, disconnect linkage.
7. Remove carburetor attaching bolts.
8. Remove carburetor and EFE heater/insulator (if used).

Installation

Fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of no-lead fuel will enable carburetor to be filled and the operation of the float and inlet needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

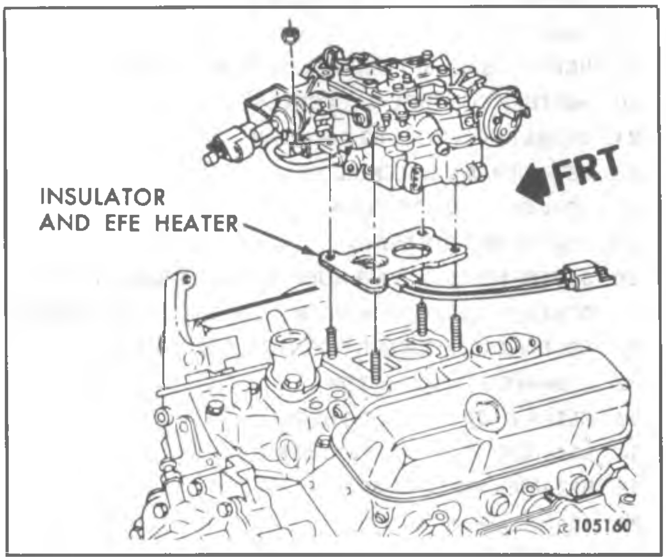


Figure 6C3-9 Carburetor Replacement

1. Inspect EFE heater/insulator for damage.
   Be certain throttle body and EFE heater/insulator surfaces are clean.
2. Install EFE heater/insulator.
3. Install carburetor and tighten nuts alternately to correct torque (See Carburetor Mounting Torque).
4. Connect downshift cable as required.
5. Connect cruise control cable as required.
6. Connect accelerator linkage.
7. Connect electrical connections.
8. Connect fuel pipe and vacuum hoses.
9. Check base (slow) and fast idle.
10. Install air cleaner.

CARBURETOR MOUNTING TORQUE

When torquing carburetor after removal, overhaul, replacement or when installing a new EFE heater/insulator, torque mounting bolts, in a clockwise direction, to 18 N·m (13 ft. lbs.).

When retorquing carburetor at recommended maintenance intervals, check in a clockwise direction. If less than 9 N·m (7 ft. lbs.), retorque to 13 N·m (9 ft. lbs.); if greater than 9 N·m (7 ft. lbs.) do not retorque.

FUEL FILTER REPLACEMENT

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

1. Remove air cleaner.
2. Disconnect fuel line connection at inlet fuel filter nut.
3. Remove inlet fuel filter nut from carburetor.
4. Remove filter and spring (Figure 6C3-10).
5. Install spring and filter element in carburetor with hole in filter toward nut.

6. Install new gasket on inlet fitting nut and install nut in carburetor and tighten to 24 N·m (18 ft. lbs.).
7. Install fuel line and tighten connector to 24 N·m (18 ft.lbs.) while holding fuel inlet fitting with wrench.
8. Run engine and observe for leaks.

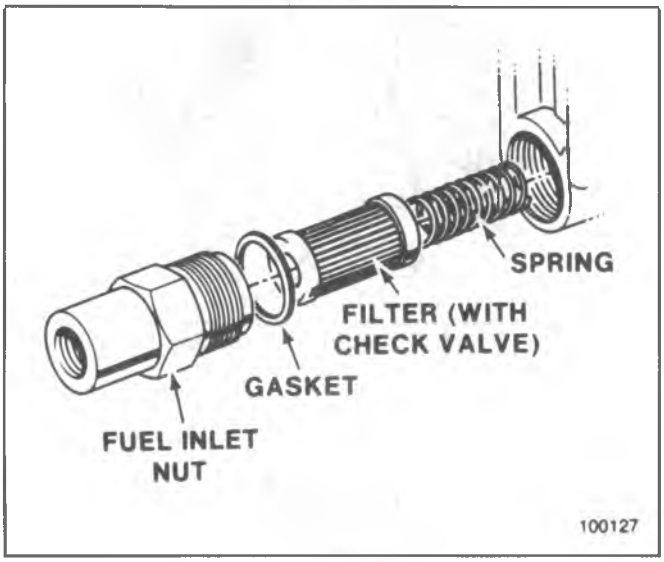


Figure 6C3-10 Fuel Filter

CHOKE AND HOSES

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

Choke Check Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links ar connected and there are no signs of damage.
2. If choke or linkage binds, sticks or works sluggishly, clean with Delco Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. If cleaning does not correct, replace binding parts.
3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or signs of deterioration. Replace or correct as necessary.
4. Make sure vacuum break diaphragm plunger are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine, primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.

Checking Electric Choke

If the electric choke fails, the following checks should be made:

1. Check voltage at the choke heater connection with the engine running. If voltage is between 12 and 15 volts, replace the electric choke unit.
2. If the voltage is low or zero, check all wires and connections.
3. If steps 1 and 2 are OK, check the following:
   - Gage equipped vehicles - See Section 8 for Choke Heater Circuit Diagnosis.
   - Non-gage equipped vehicles - if the connection at the oil pressure switch is faulty, the temperature/pressure warning light will be off with the ignition key "on" and the engine not running. Repair wires as required. If choke is still inoperative, replace oil pressure switch.

Choke Coil Replacement

1. Remove air cleaner and disconnect choke electrical connector.
2. Align a 4mm (5/32") drill on rivet head and drill only enough to remove rivet head (Figure 6C3-11). After removing rivet heads and retainers, use a drift and small hammer to drive the remainder of the rivet from the choke housing. Use care in drilling to prevent damage to the choke cover or housing. Remove the three retainers and choke cover assembly from choke housing.
3. Remove choke coil from housing.
4. Install the choke cover and coil assembly in choke housing as follows:

   Install the choke cover and coil assembly in the choke housing, aligning notch in cover with raised casting projection on housing cover flange. Make sure coil pickup tank engages the inside choke coil lever.

   A choke cover retainer kit is required to attach the choke cover to the choke housing. Install proper retainers and rivets contained in kit using a suitable blind rivet installing tool.
5. Connect choke electrical connector.
6. Start engine, check operation of choke and then install air cleaner.

SECONDARY VACUUM BREAK THERMAL VACUUM SWITCH (TVS)

The secondary vacuum break TVS, located in the air cleaner, improves cold starting and cold driveability by sensing carburetor air inlet temperature to control the carburetor secondary vacuum break.

Replacement

1. Remove air cleaner cover and element.
2. Disconnect vacuum hoses.
3. Remove clip from TVS and remove TVS.
4. Install new TVS and replace clip.
5. Reconnect vacuum hoses (refer to Vehicle Emission Control Information Label).
6. Install air cleaner cover and element.

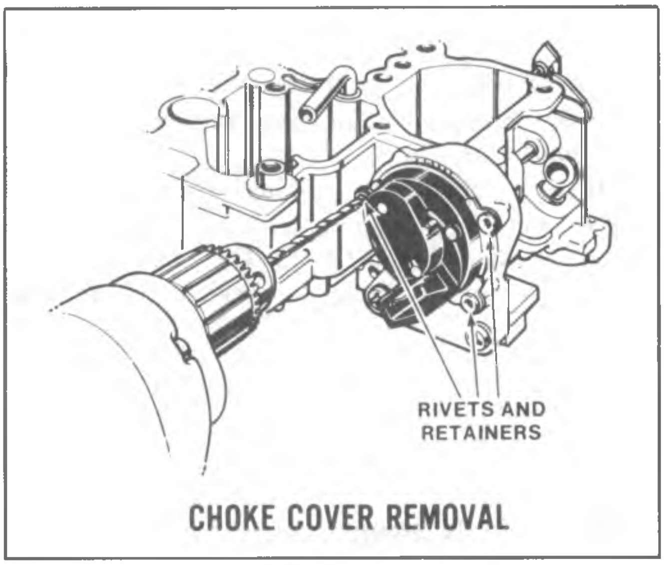


Figure 6C3-11 Choke Cover Removal

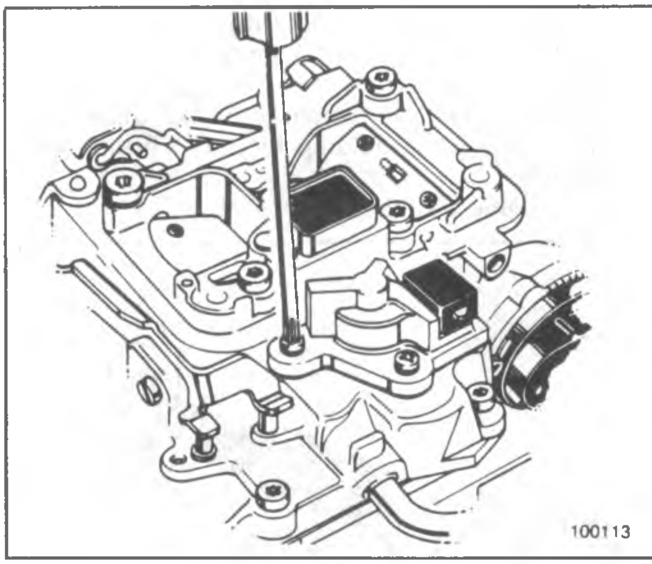


Figure 6C3-12 M/C Solenoid Removal and Installation

Secondary Vacuum Break TVS Check

1. With engine at normal operating temperature, the Thermal Vacuum Switch (TVS) must be open (air cleaner cover on).
2. Apply either engine or auxiliary vacuum to the TVS inlet port and check for vacuum at the outlet port (outlet port connects to secondary vacuum break).
3. If there is no vacuum, check air cleaner assembly for leaks, thermostatic air cleaner vacuum hoses and/or replace the TVS.

MIXTURE CONTROL SOLENOID REPLACEMENT

Refer to Emission Section for diagnosis of mixture control (M/C) solenoid.

1. Remove three (3) mixture control solenoid screws in air horn (Figure 6C3-12), then using a slight twisting motion, carefully lift solenoid out of air horn. Remove and discard solenoid gasket.
2. Remove seal retainer and rubber seal from end of solenoid stem being careful not to damage or nick end of solenoid stem (Figure 6C3-13). Discard seal and retainer.
3. Install spacer and new rubber seal on new mixture control solenoid stem making sure seal is up against the spacer. Then, using a 3/16" socket and hammer, carefully drive retainer on stem. Drive retainer on stem only far enough to retain rubber seal on stem leaving a slight clearance between the retainer and seal to allow for seal expansion.
4. Prior to installing a replacement mixture control solenoid, lightly coat the rubber seal on the end of the solenoid stem with a automatic transmission fluid or light engine oil.
5. Using a new mounting gasket, install mixture control solenoid on air horn, carefully aligning solenoid stem with recess in bottom of bowl.
6. Use a slight twisting motion of the solenoid during installation to ensure rubber seal on stem is guided into recess in the bottom of the bowl to prevent distortion or damage to the rubber seal. Install three (3) solenoid attaching screws and tighten securely.

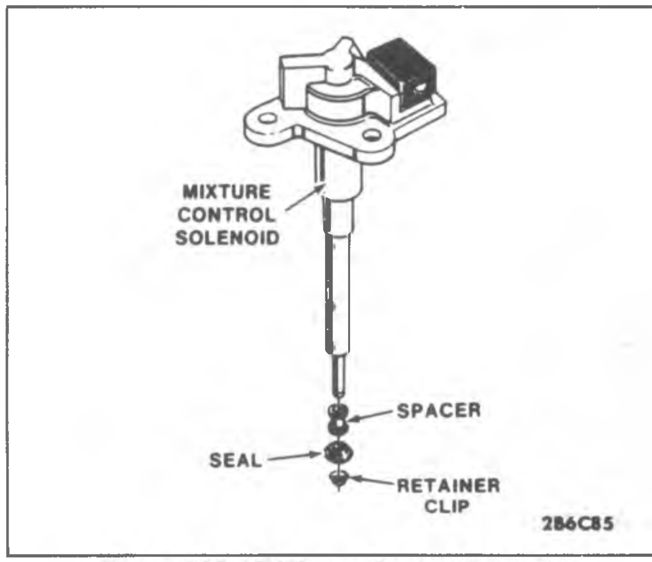


Figure 6C3-13 Mixture Control Solenoid

7. Install Mixture Control Solenoid Connector, and check for proper latching. Latch may require filing, as shown in Figure 6C3-14.

   Check colors of wires in connector for proper position (Figure 6C3-14). Pink wire must be on right hand terminal of connector, as viewed from harness end. If incorrect, use Tool J-28742, BT 8234-A or equivalent to remove wires from connector and replace.

   The System Performance Check should be performed after any repairs to the Computer Command Control system have been made.

IDLE STOP SOLENOID

The solenoid should be checked to assure that the solenoid plunger extends when the solenoid is energized. An inoperative solenoid could cause stalling

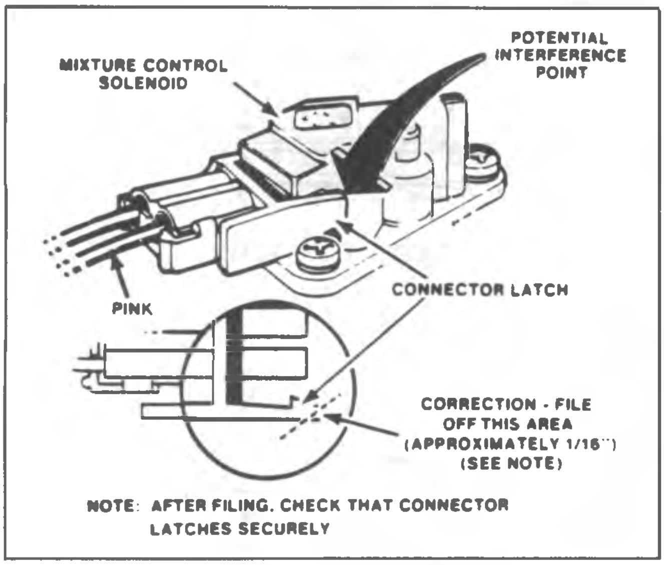


Figure 6C3-14 Mixture Control Solenoid Connector

or a rough idle when hot, and should be replaced as necessary.

Checking Procedure

1. Turn on ignition, but do not start engine. Position transmission lever in Drive (A/T) or Neutral (M/T). On vehicles equipped with air conditioning, A/C switch must be on.
2. Open and close throttle to allow solenoid plunger to extend.
3. Disconnect wire at solenoid. Solenoid plunger should retract from throttle lever.
4. Connect solenoid wire. Plunger should move out and contact the throttle lever. Solenoid may not be strong enough to open the throttle, but the plunger should move.
5. If plunger does not move in and out as wire is disconnected and connected, check voltage feed wire:
   a. If voltage is 12-15 volts, replace solenoid.
   b. If voltage is low or zero, locate cause of open circuit in solenoid feed wire and repair.

Remove

1. Remove carburetor air cleaner.
2. Disconnect electrical connector at solenoid.
3. Remove large retaining nut, tabbed lock washer, and remove solenoid.

Install

1. Install solenoid and retaining nut, bending lock tabs against nut flats.
2. Connect electrical connector.
3. Install air cleaner.
4. Refer to Vehicle Emission Control Information Label and adjust idle speed.

CARBURETOR ADJUSTMENTS

Before checking or resetting the carburetor as the cause of poor engine performance or rough idle; check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission control (EEC) system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts.

Make all adjustments with engine at normal operating temperature, choke full open, air cleaner installed, and air conditioning off (if equipped), except where noted set idle speeds only when Emission Control System is in closed loop mode.

IDLE MIXTURE ADJUSTMENT

The E2SE carburetor has been calibrated at the factory and should not normally need adjustment in the field. For this reason, the mixture adjustment should never be changed from the original factory setting. However, if during diagnosis, the "System Performance Check" (See Section 6E1) indicates the carburetor to be the cause of a Driver Performance Complaint or emissions failure or critical parts such as air horn, float bowl or throttle body are replaced, the carburetor can be adjusted using the following procedure. After adjustment, cover plugged areas with RTV rubber or equivalent.

CARBURETOR PRE-SET PROCEDURE

1. Remove carburetor from engine following normal service procedures to gain access to plug covering the idle mixture needle. Remove plug (Figure 6C3-15) following procedure under Unit Repair (Throttle Body Disassembly). Turn mixture needle in until lightly seated and back out 4 turns.
2. If the plug in air horn covering idle air bleed has been removed (Figure 6C3-7), replace air horn. If plug is still in place, do not remove plug.
3. Remove vent stack screen assembly (Figure 6C3-7) to gain access to lean mixture screw. (Be sure to reinstall vent stack screen assembly after adjustment).
4. Using tool J-28696-10 or BT 7928 or equivalent, turn lean mixture screw (Figure 6C3-16) in until lightly bottomed and back out 2-1/2 turns.
5. Reinstall carburetor on engine:
   a. Do not install air cleaner and gasket.
   b. Disconnect the bowl vent line at carburetor.
   c. Disconnect the EGR valve hose and canister purge hose at the carburetor and cap the carburetor ports.
   d. Refer to Vehicle Emission Control Information Label and observe hose from port "D" on carburetor to temperature sensor and secondary vacuum break TVS. Disconnect hose at temperature sensor on air cleaner and plug open hose.
   e. Connect the positive lead of a dwell meter to the mixture control solenoid test lead (green connector). Connect the other meter lead to ground. Set dwell meter to 6-cylinder position. Connect a tachometer to distributor lead (brown connector).

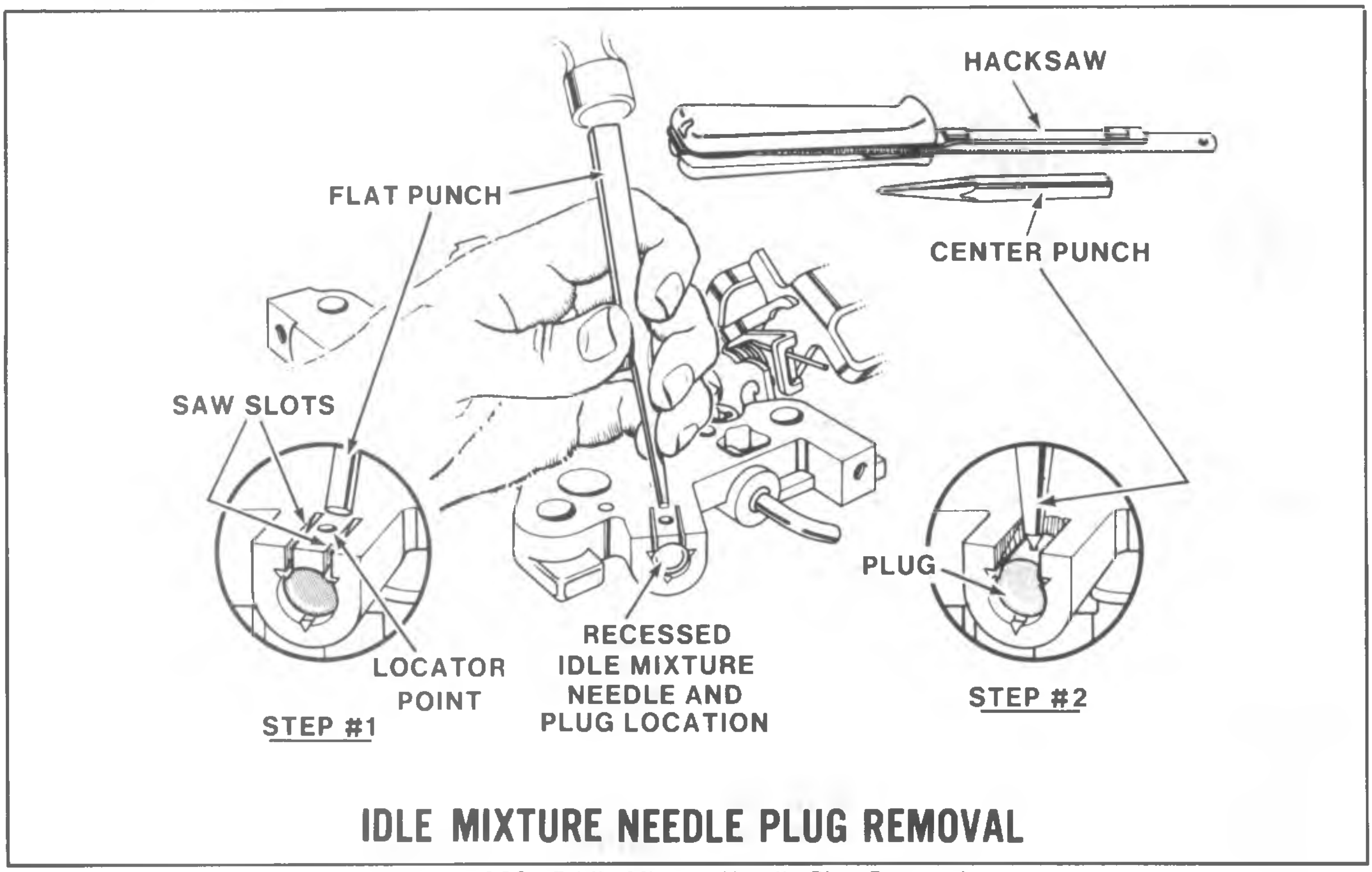


Figure 6C3-15 Idle Mixture Needle Plug Removal

(Tachometer should be connected to the distributor side of the tach filter if vehicle is equipped with a tachometer).

f. BLOCK DRIVE WHEELS.

g. Place transmission PARK (automatic transmission) or NEUTRAL (manual transmission) and set the parking brake.

6. Proceed to Mixture Adjustment Procedure.

Mixture Adjustment Procedure

1. Perform carburetor pre-set procedure.
2. Run engine on high step of fast idle cam until engine cooling fan starts to cycle. (At least three minutes and until in closed loop.)
3. Run engine at 3,000 RPM and adjust the lean mixture screw (Figure 6C3-16) slowly in small increments allowing time for dwell to stabilize after turning the screw to obtain an average dwell of 35°. If dwell is too low, back screw out; if too high, turn it in. If unable to adjust to specifications, inspect main metering circuit for leaks. restrictions, etc. (See Unit Repair).

   The dwell reading of the M/C solenoid is used to determine calibration and is sensitive to changes in fuel mixture caused by heat, air leaks, etc. While idling, it is normal for the dwell to increase and decrease fairly constantly over a relatively narrow range, such as 5°. However, it may occasionally vary by as much as 10-15° momentarily due to temporary mixture changes. The dwell reading specified is the average of the most consistent variation. The engine must be allowed a few moments to stabilize at idle or 3, 000 RPM as applicable before taking a dwell reading.
4. Return to idle.
5. Adjust idle mixture screw (Figure 6C3-16) to obtain an average dwell of 25° with cooling fan in off cycle. If reading is too low, back screw out. If too high, turn it in. Allow time for reading to stabilize after each adjustment. Adjustment is very sensitive. Make final check with adjusting tool removed.

   If unable to adjust to specifications, inspect idle system for leaks, restrictions, etc. (See Unit Repair).
6. Disconnect mixture control solenoid when cooling fan is in off cycle and check for an RPM change of at least 50 RPM. If RPM does not change enough, inspect idle air bleed circuit for restrictions, leaks, etc. (See Unit Repair).
7. Run engine at 3,000 RPM for a few moments and note dwell reading. Dwell should be varying with an average reading of 35°.

   If not at 35° average dwell: Reset lean mixture screw per Step 3. Then reset idle mixture screw to obtain 25° dwell per Step 5.

   If at 35° average dwell: Reconnect systems disconnected earlier (purge and vent hoses, EGR valve, etc.), reinstall vent screen and set idle speed(s) per instructons on Vehicle Emission Control Information Label. It is not necessary to repeat "Systems Performance Check" after proper adjustment of carburetor.

THESE ADJUSTMENTS SHOULD BE PERFORMED ONLY IF INDICATED BY SYSTEM PERFORMANCE CHECK.

LEAN MIXTURE SCREW:

1. WITH VENT SCREEN (OR ENTIRE AIR HORN) OFF, USE TOOL J-28696-10 OR BT-7928 OR EQUIVALENT, TO LIGHTLY BOTTOM LEAN MIXTURE SCREW.
2. BACK OUT NUMBER OF TURNS INDICATED IN SPECIFICATIONS.
3. REFER TO VEHICLE MANUFACTURER'S SERVICE MANUAL SECTION 6C FOR "LEAN MIXTURE ADJUSTMENT".

IDLE MIXTURE SCREW:

4. WITH IDLE MIXTURE SCREW PLUG REMOVED, USE TOOL J-29030 OR BT-7610B OR EQUIVALENT TO LIGHTLY BOTTOM SCREW.
5. BACK OUT NUMBER OF TURNS INDICATED IN SPECIFICATIONS.
6. REFER TO SERVICE MANUAL SECTION 6C FOR "IDLE MIXTURE ADJUSTMENT".

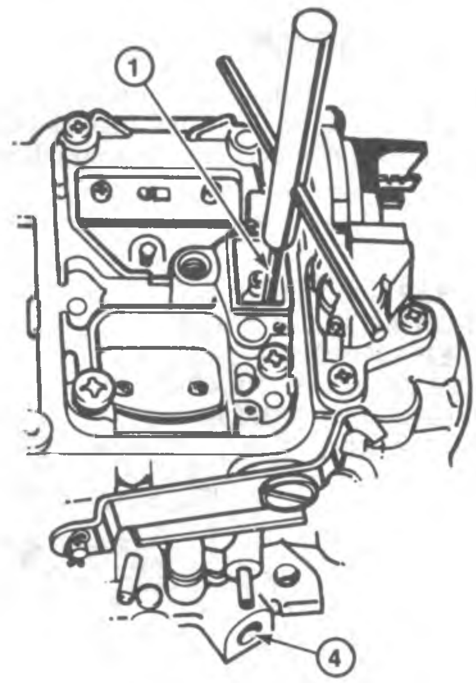


Figure 6C3-16 Lean Mixture and Idle Mixture Screw Adjustment

THROTTLE POSITION SENSOR (TPS) ADJUSTMENT

The cup plug covering the TPS adjustment screw (Figure 6C3-17) is used to provide a tamper-resistant design. DO NOT REMOVE the the plug unless, in diagnosis, the "System Performance Check" (Refer to Emission Section) indicates the TPS Sensor is not adjusted correctly or it is necessary to replace the air horn assembly, float bowl, TPS sensor, or TPS adjustment screw. This is a critical adjustment that must be performed accurately and carefully to ensure proper vehicle performance and control of emissions.

If necessary to adjust the TPS sensor, proceed as follows:

1. Using a 2mm (5/64") drill, drill a hole in the steel cup plug covering the TPS adjustment screw. Use care in drilling to prevent damage to adjustment screw head.
2. Using a small slide hammer or equivalent, remove steel plug from air horn.
3. Disconnect the TPS connector and jumper all three terminals. (Jumpers can be made up using terminals 12014836 and 12014837). Make jumpers up with #16, #18 or #20 wire approximately 6" long.
4. Connect digital voltmeter (J-34029 or equivalent) from TPS connector center terminal (B) to bottom terminal (C).
5. With ignition on, engine stopped, turn the TPS screw with flat bladed screwdriver or equivalent to obtain voltage shown in Specifications at end of this section.
6. After adjustment, a new cup plug (supplied in service kits) or silicone sealant or equivalent must be inserted in air horn. If cup plug is used, the cup should face outward and be flush with air horn casting.

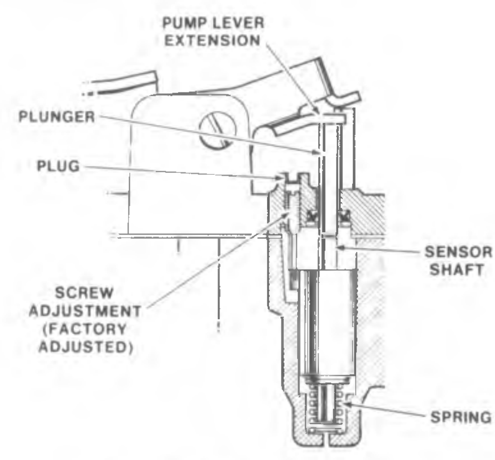


Figure 6C3-17 Throttle Position Sensor

FAST IDLE ADJUSTMENT

Refer to the Vehicle Emission Control Information Label and Figure 6C3-18 for Fast Idle Adjustment.

IDLE SPEED ADJUSTMENT

Refer to the Vehicle Emission Control Information Label on the vehicle and Figures 6C3-19 and 20 for adjustment procedures and specification information.

FLOAT LEVEL CHECK

The float level may be checked externally using tool J-9789-135 or BT-8104 and referring to Figure 6C3-21.

The remaining carburetor adjustments are part of Unit Repair. These adjustments, in most cases, may be performed on the vehicle. Refer to Figures 6C3-48, through 6C3-55 for adjustment procedures.

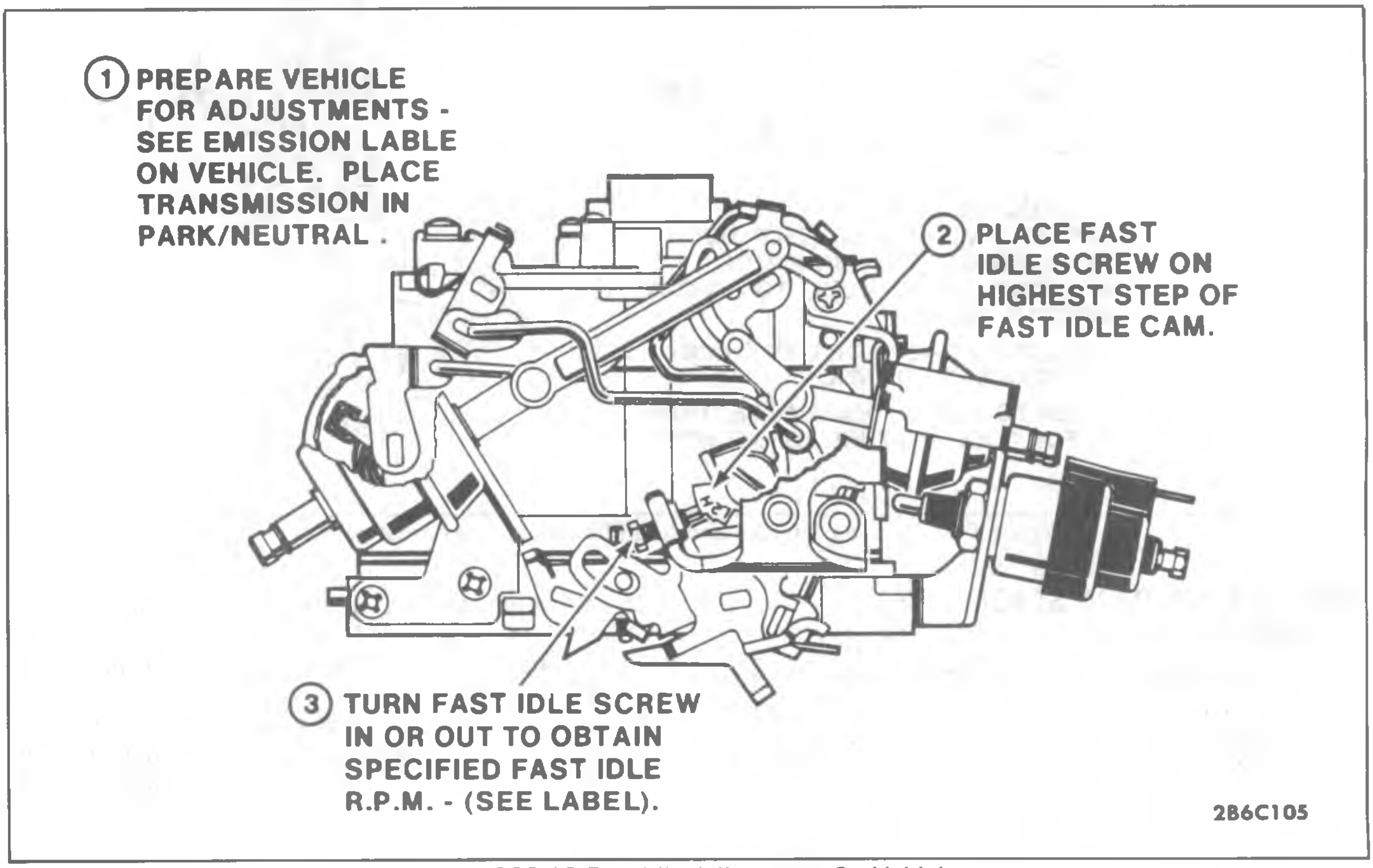


Figure 6C3-18 Fast Idle Adjustment On Vehicle

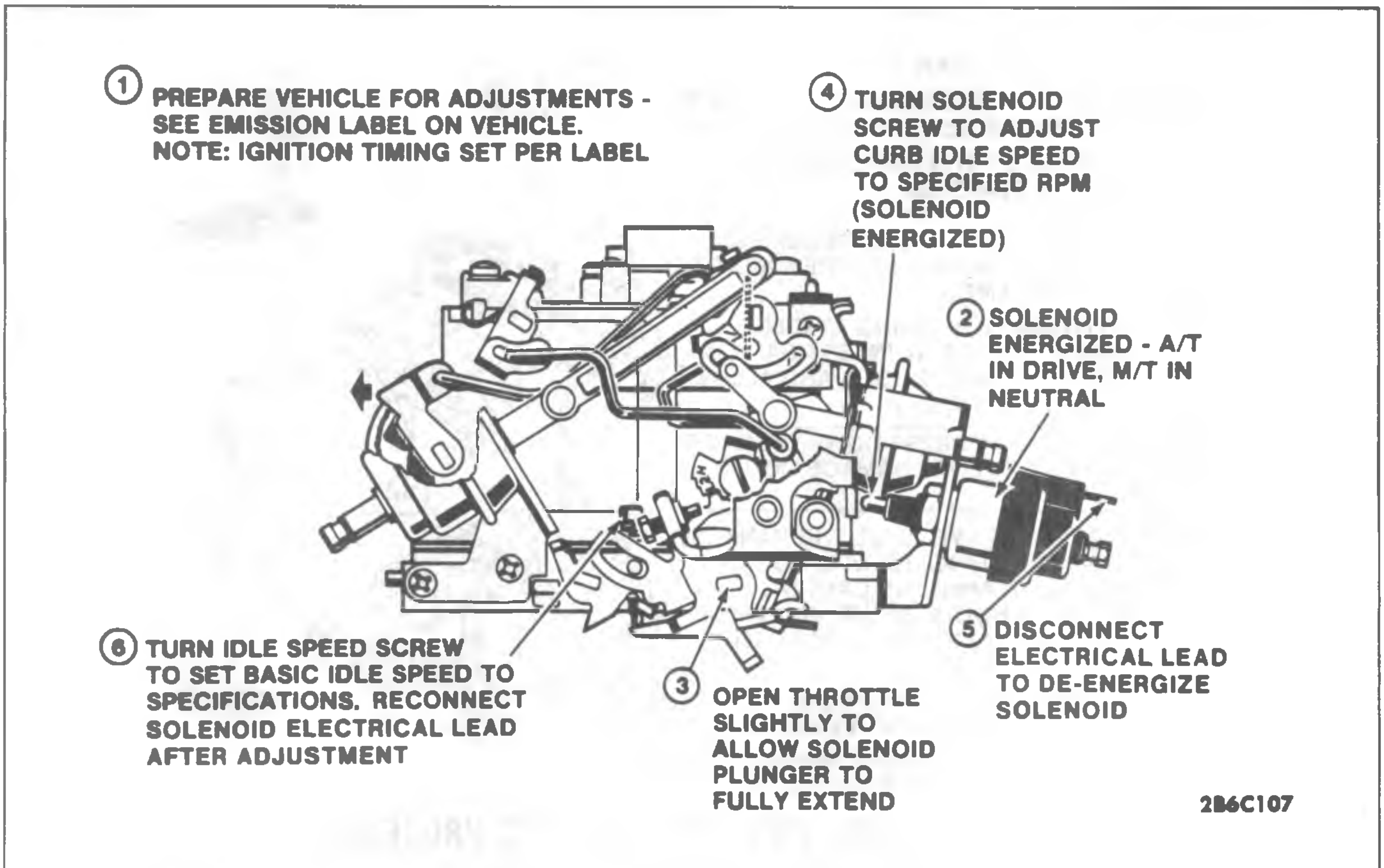


Figure 6C3-19 Idle Speed Adjustment - Without A/C

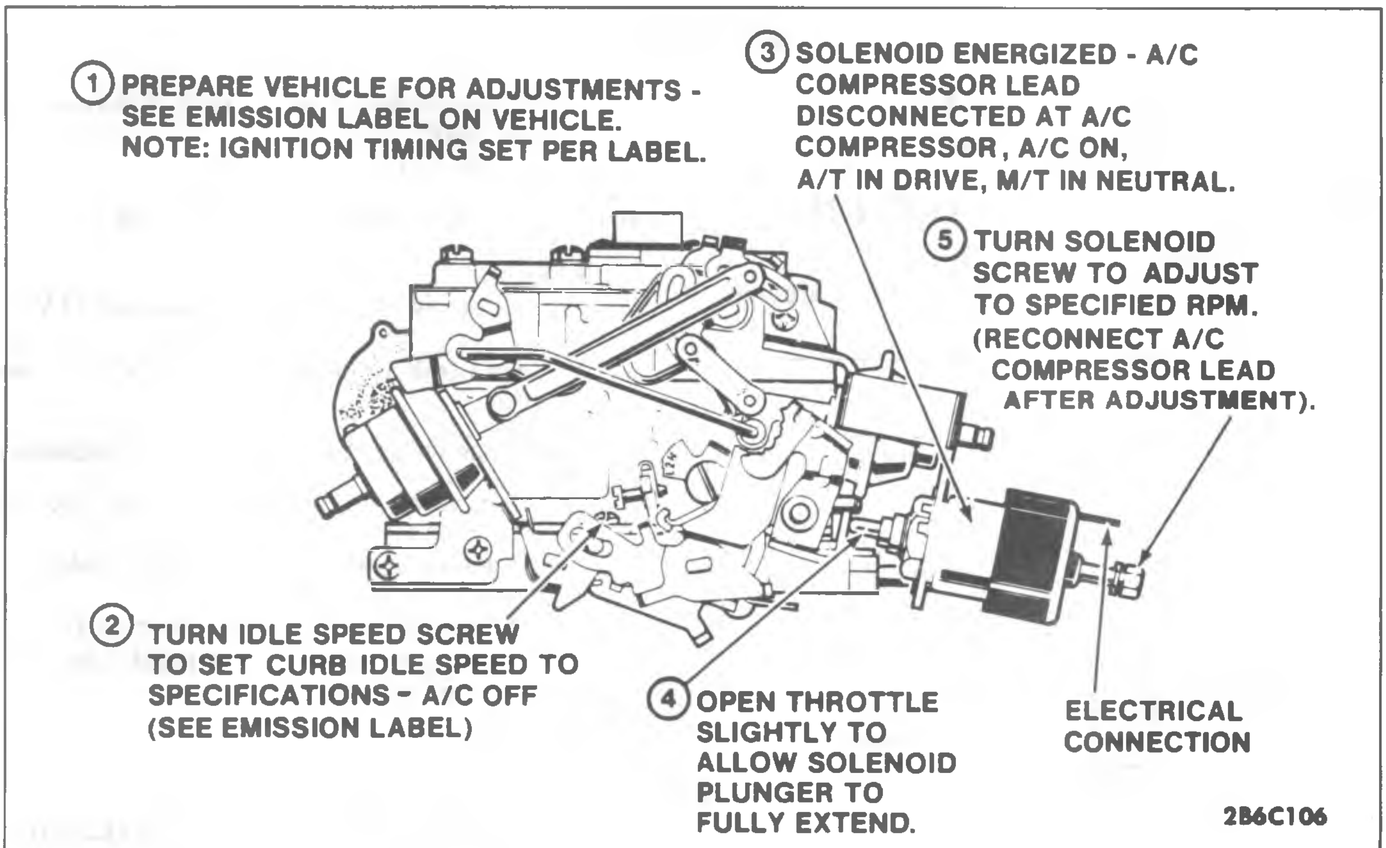


Figure 6C3-20 Idle Speed Adjustment - With A/C

(1) REMOVE AIR HORN VENT STACK.

(2) SELECT CORRECT GAGE FROM BT-8104 OR J-9789-135 SERIES FOR CARBURETOR.

(3) a USING BT-8104 GAGE SERIES, INSERT BRIDGE

-OR-

b USING J-9789-135 GAGE SERIES, REMOVE AIR HORN SCREW NEXT TO OPEN VENT.

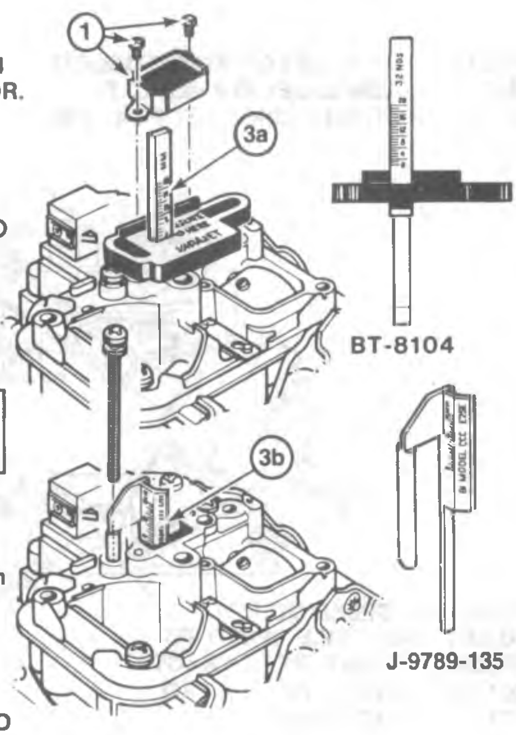
(4) WITH ENGINE RUNNING AT IDLE, CHOKE WIDE-OPEN, INSERT GAGE IN BRIDGE OR GUIDE HOLE, AND ALLOW IT TO FLOAT FREELY.

NOTICE: DO NOT PRESS DOWN ON GAGE. FLOODING OR FLOAT DAMAGE COULD RESULT.

(5) OBSERVE AT EYE LEVEL THE MARK ON GAGE THAT LINES UP WITH TOP OF BRIDGE OR AIR HORN CASTING. SETTING SHOULD BE WITHIN ±1.588mm (1/16") OF SPECIFIED FLOAT LEVEL SETTING.

INCORRECT FUEL PRESSURE WILL ADVERSELY AFFECT FUEL LEVEL.

(6) IF NECESSARY, REMOVE AIR HORN AND ADJUST FLOAT LEVEL TO SPECIFICATION.



FLOAT GAGE - EXTERNAL CHCKING PROCEDURE

Figure 6C3-21 External Float Check Procedure

UNIT REPAIR

DISASSEMBLY

(Figure 6C3-7 is a general reference)

Remove or Disconnect (Figures 6C3-15, 22).

Tools Required:
J-9789-118 or BT-30-15, Carburetor Holding Stand

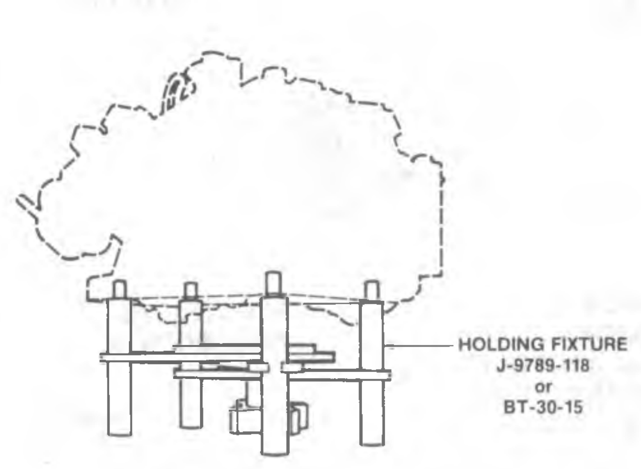


Figure 6C3-22 Holding Stand

1. Invert carburetor, remove plug covering idle mixture needle (69).
2. Install carburetor holding stand.

Remove or Disconnect (Figure 6C3-7, 23)

1. Hose (2).
2. Bracket screw (3), and screw assembly (3A), if used.
3. Vacuum break assembly (4) and links from slots in levers.

Disassemble (If part replacement is necessary)

- Air valve link retainer (6), link (5), and bushing (7).
- Vacuum break link retainer (4C), link (4A), and bushing (4B).
- Idle speed device retainer (8 or 10B).
- Attaching nut (9 or 10C) and idle speed device (10 or 10A).

Remove or Disconnect

4. Bracket screws (11).
5. Vacuum break assembly (12) and link (12A) from slot in choke lever.

Disassemble (If part replacement is necessary)

- Retainer (12C), secondary side vacuum break link (12A), and bushing (12B).

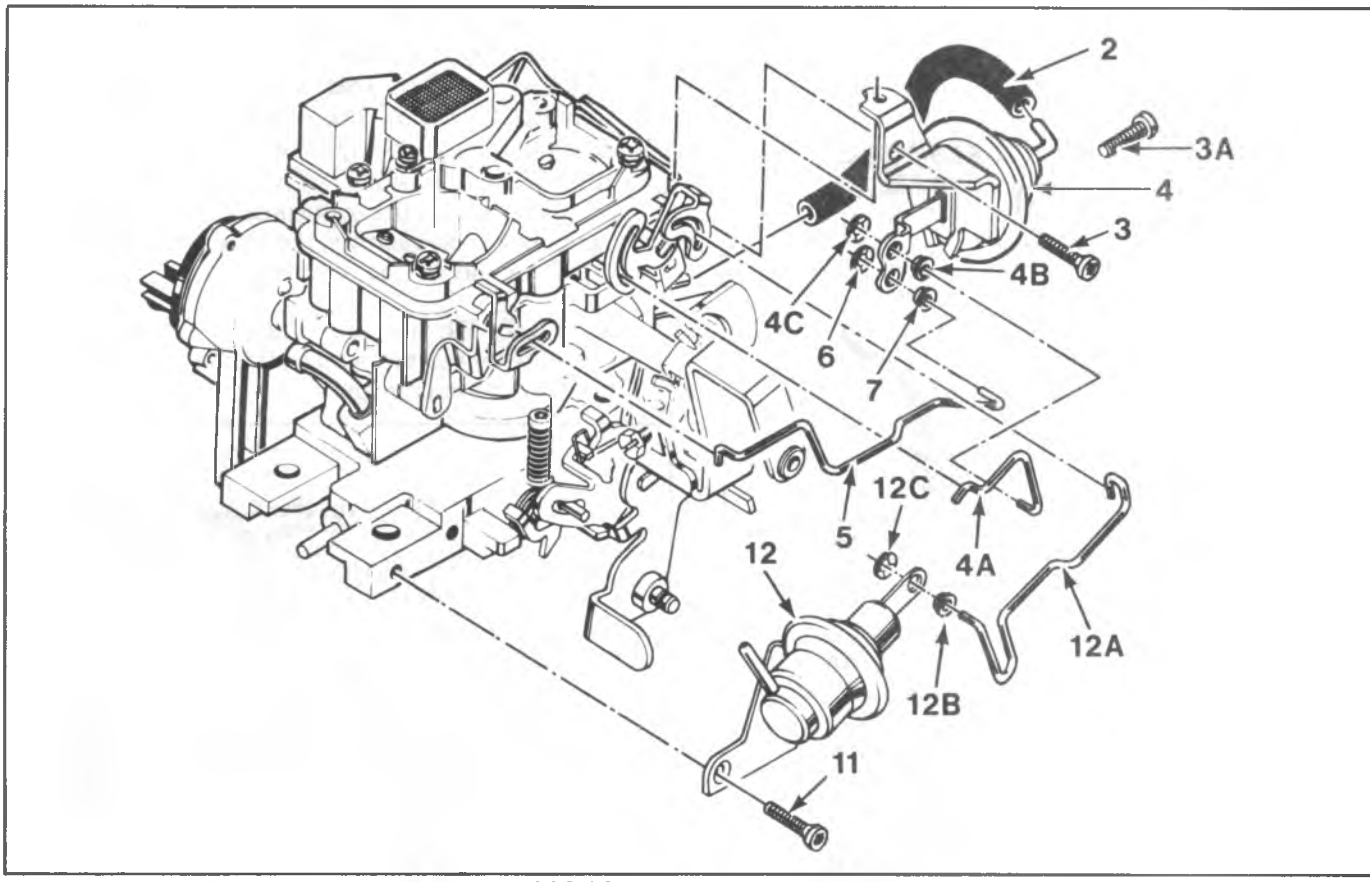


Figure 6C3-23 Vacuum Breaks and Links

- Idle stop solenoid retainer (8)
- Attaching nut (9) and solenoid (10).

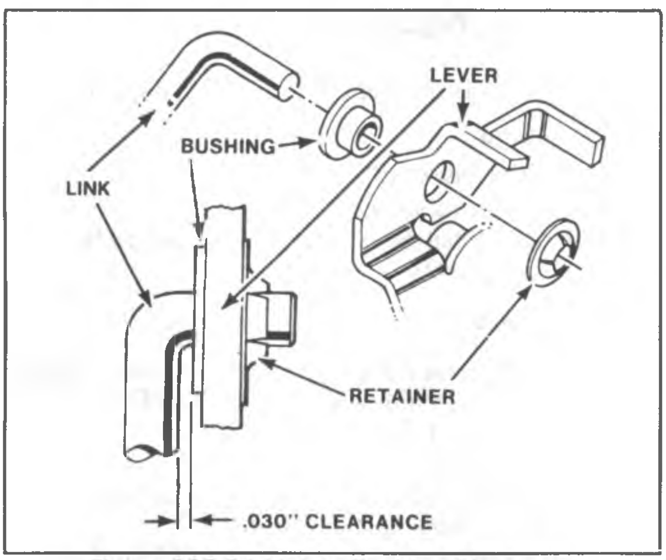


Figure 6C3-24 Link to Bushing Clearance

AIR HORN REMOVAL

Remove or Disconnect (Figures 6C3-7, 24, 25, 26, 27).

1. Three screw assemblies (19).
2. Solenoid (20).
3. Gasket (21) and discard.

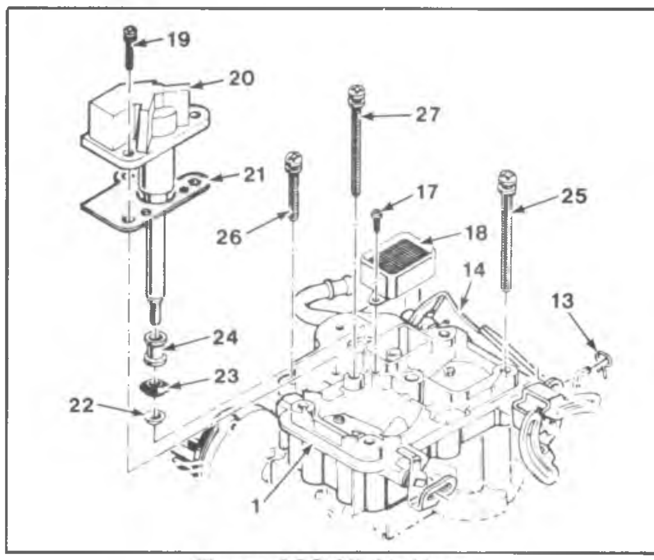


Figure 6C3-25 Air Horn

Disassemble (Figure 6C3-25).

- Retainer (22) and discard.
- Seal (23) and discard.
- Spacer (24) and save for reassembly.

4. Two screws (17), and vent stack (18).
5. Intermediate choke shaft link retainer (15), at choke lever and discard.
6. Choke link and bushing (16) from choke lever (save bushing).
7. Retainer (29) and bushing (30) from fast idle cam link (31) (discard retainer).

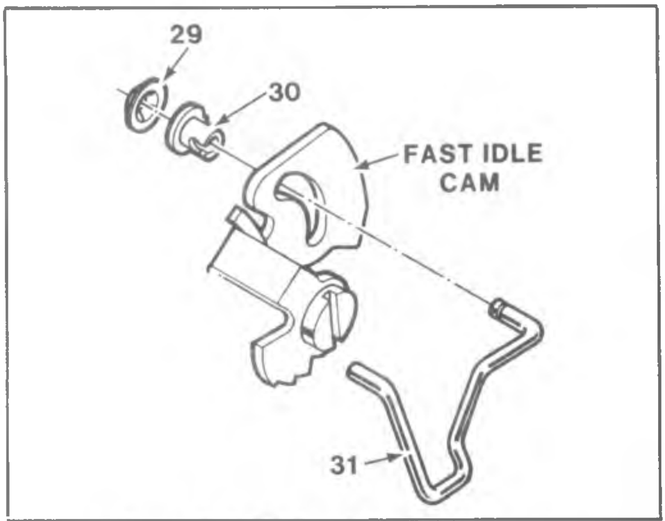


Figure 6C3-26 Fast Idle Cam Linkage

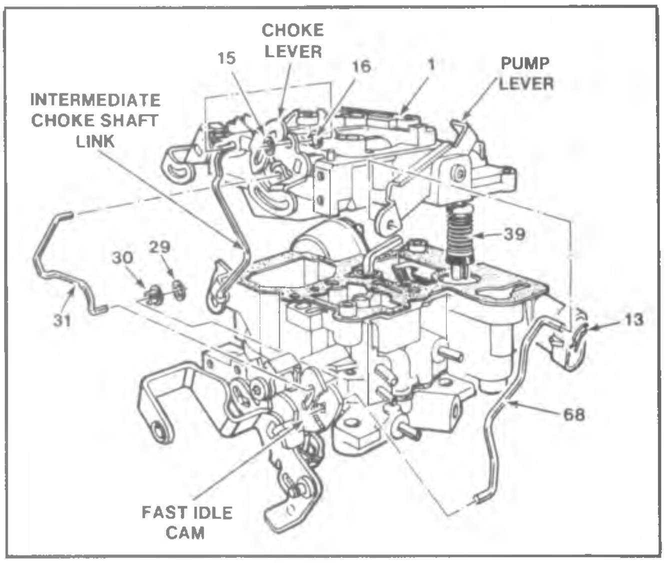


Figure 6C3-27 Air Horn and Float Bowl

NOTICE: Do not remove fast idle cam screw and cam (28) from float bowl. If removed, cam might not operate properly when reassembled. If needed, a replacement float bowl will include a secondary lockout lever, fast idle cam, and cam screw.

8. Retainer (13) from pump link (68).

NOTICE: Do not remove the screw attaching the pump lever (14) to air horn assembly (1). When reassembled, screw might not hold properly.

9. Seven screw assemblies of various lengths (25, 26, and 27).
10. Air horn assembly (1).
    - Tilt to disconnect fast idle cam link (31) from slot in fast idle cam (28); and pump link (68) from hole in pump lever (14).
11. Cam link (31) from choke lever.
    - Line up "squirt" on link with slot in lever.

Remove or Disconnect (Figure 6C3-7, 28)

1. Invert air horn. Remove TPS actuator plunger (32).
    - The TPS adjusting screw and plug should not be removed.
2. Remove stakings that hold TPS plunger seal retainer (33), and pump stem seal retainer (35).
3. Retainers and seals (33, 34, 35, 36 and discard).
4. Further disassembly of the air horn is not required for cleaning purposes. The choke valve and choke valve screws, the air valve and air valve shaft should not be removed.

NOTICE: Do not turn the secondary metering rod adjusting screw. Rod could come out of jet and possibly cause damage.

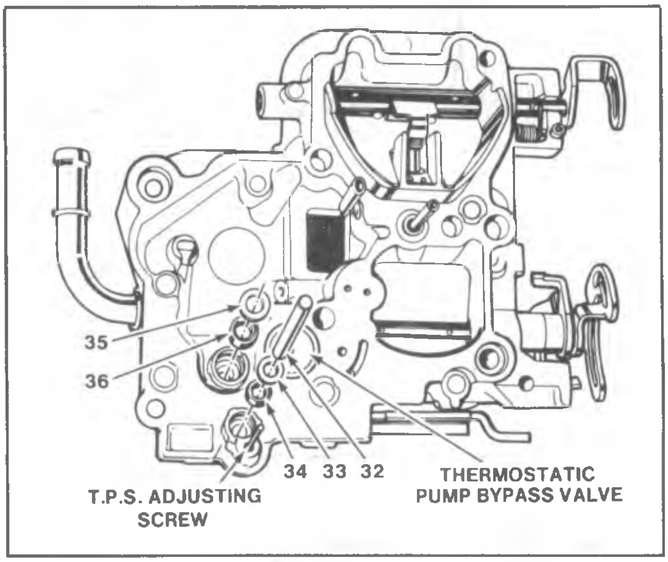


Figure 6C3-28 Air Horn Bottom View

FLOAT BOWL DISASSEMBLY

Remove or Disconnect (Figure 6C3-7, 29, 30)

1. Pump (39).
2. Air horn gasket (38).
3. Return spring (40).
4. Throttle Position Sensor (TPS) assembly (41), and spring (42).

Inspect

- TPS connector wires for broken insulation, which could cause grounding of the TPS.

5. Upper insert (43).
6. Hinge pin (44).
    - Float and lever assembly (45), with float stabilizing spring (46) if used.
    - Float needle and pull clip (48A and 48B).
7. Lower insert (47), if used.
8. Float needle seat (48C) and seat gasket (48D).
9. Jet and lean mixture needle assembly (49).

Important

Do not remove or change the preset adjustment of calibration needle in the metering jet unless Computer Command Control system performance check requires it. (See "On-Vehicle Service").

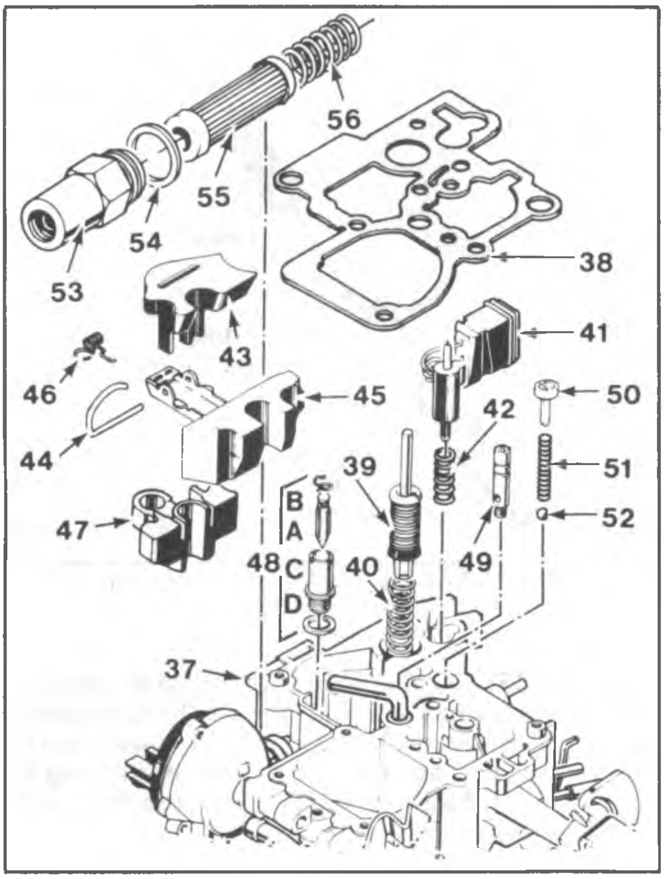


Figure 6C3-29 Float Bowl

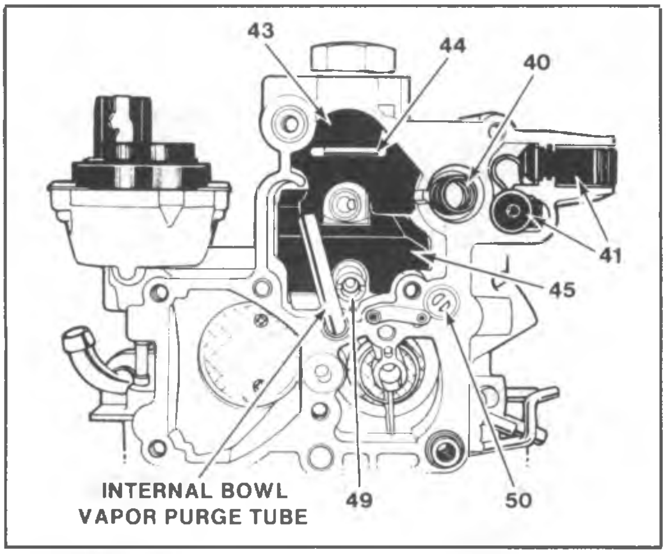


Figure 6C3-30 Float Bowl Parts Location

Remove or Disconnect (Figure 6C3-31)

- Pump discharge spring guide (50), using slide hammer puller only.

NOTICE: Do not pry guide. Damage could occur to the sealing surfaces, and could require replacement of the float bowl.

10. Spring (51) and ball (52).
    - Invert bowl, catch as they fall.
11. Fuel inlet nut (53).
12. Filter spring (56).
13. Filter assembly (55) and discard.
14. Gasket (54) and discard.

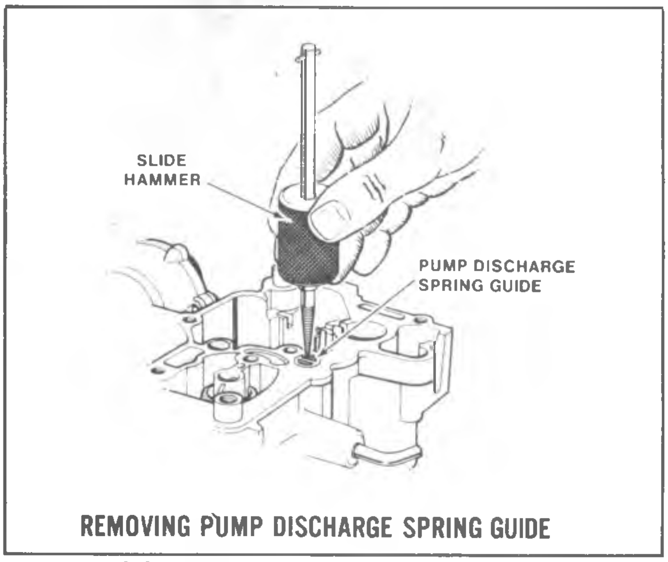


Figure 6C3-31 Removing Pump Discharge Spring Guide

CHOKE ASSEMBLY AND THROTTLE BODY REMOVAL

Remove or Disconnect (Figures 6C3-7, 32, 33)

1. Choke cover:
   - Use 4mm (5/32") drill bit to remove heads (only) from rivets (57).
   - Remove retainers (58).
   - Remaining pieces of rivets, using drift and small hammer.
   - Electric choke cover and stat assembly (59).
2. Stat lever screw (60).
3. Stat lever (61).
4. Intermediate choke shaft, lever and link assembly (62).
5. Two screw assemblies (63).
6. Housing (64).

Remove or Disconnect (Figure 6C3-34, 35)

Tools Required:

J-29030-B or BT-7610-B, Idle Mixture Socket (Double -D)

1. Four screw assemblies (66), and throttle body assembly (65) from inverted float bowl.
2. Gasket (67).
3. Pump link (68).
   - Line up "squirt" on link with slot in lever.
4. Count and make a record of the number of turns needed to lightly bottom the idle mixture needle (69), then back out and remove needle and spring assembly.
5. Do not disassemble throttle body further.

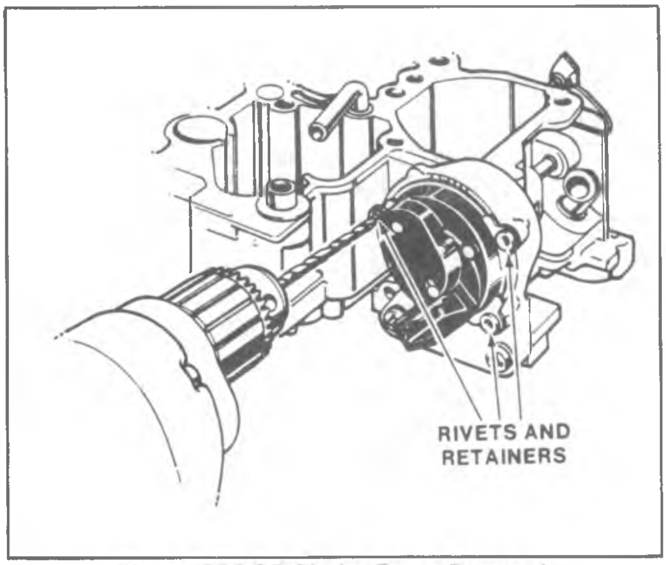


Figure 6C3-32 Choke Cover Removal

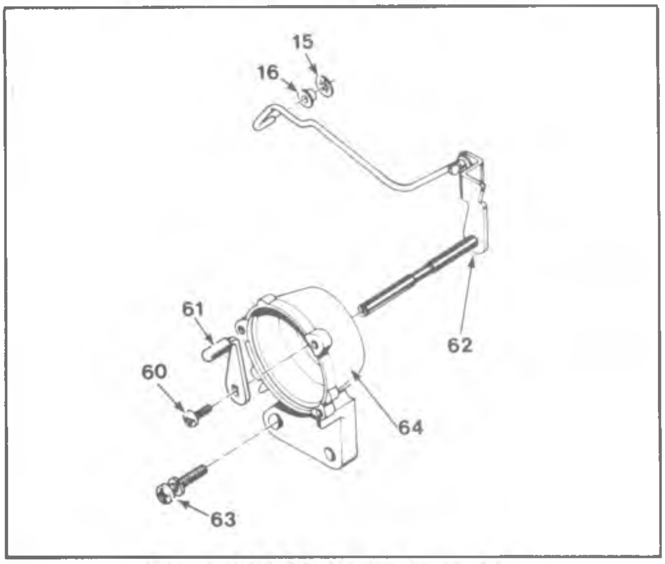


Figure 6C3-33 Choke Assembly

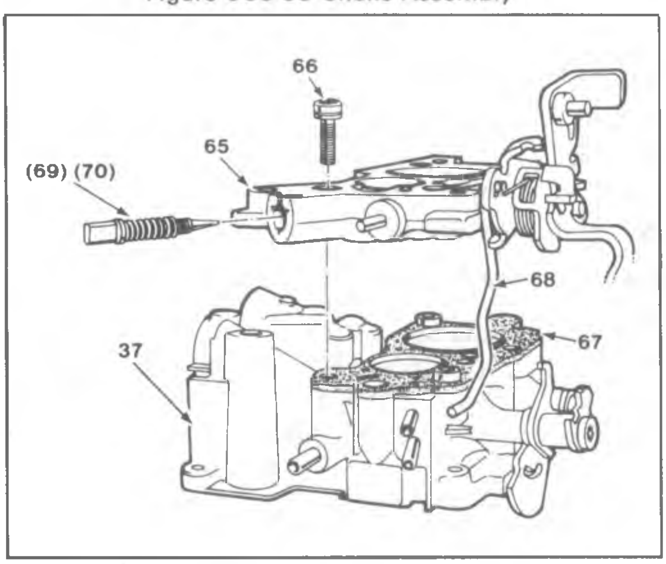


Figure 6C3-34 Throttle Body to Float Bowl

Clean

1. Metal parts in cold immersion cleaner, Carbon X (X-55) or equivalent.

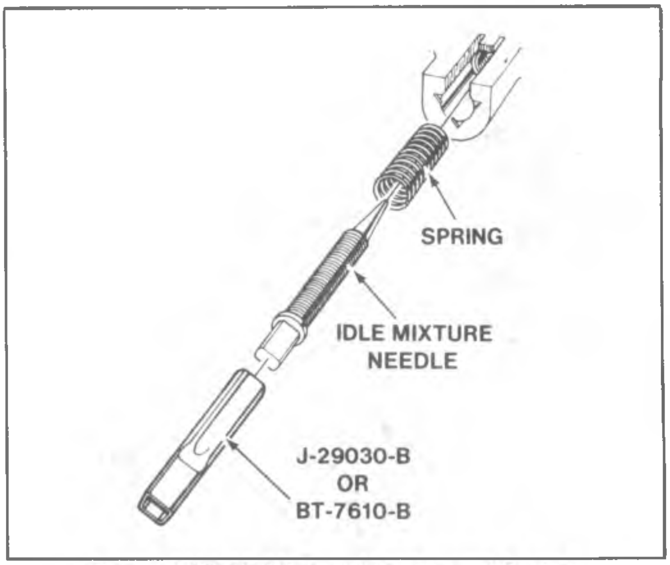


Figure 6C3-35 Mixture Needle and Spring

NOTICE: Do not immerse idle stop solenoid, mixture control solenoid, throttle lever actuator, TPS, electric choke, rubber and plastic parts, diaphragms, and pump, in cleaner, as they may be damaged. Plastic bushing in throttle lever will withstand normal cleaning.

2. Blow dry with shop air.
   - Be sure all fuel and air passages are free of burrs and dirt.
   - Do not pass drill bits or wires through jets and passages.

Inspect

- Mating surfaces of casting for damage. Replace if necessary.
- Holes in levers for wear or out-of-round conditions.
- Bushings for damage and excessive wear. Replace if necessry.

REASSEMBLY

THROTTLE BODY ON FLOAT BOWL ASSEMBLY

Install or Connect (Figures 6C3-7, 34, 35, 36)

Tools Required:
J-29030-B or BT-7610-B, Idle Mixture Socket (Double - D)

1. Needle and spring assembly (69 and 70).

Adjust

- Lightly bottom needle.
  - Back it out the number of turns recorded during removal, as a preliminary adjustment.
  - See "On Vehicle Service" for final idle mixture adjustment.

2. Pump link (68).
3. New gasket (67) on inverted float bowl (37).
4. Throttle body (65) to bowl.
   - Finger tighten four screw assemblies (66).
   - If secondary actuating lever engages lockout lever, and linkage moves without binding, tighten screw assemblies.
5. If float bowl assembly was replaced, stamp or engrave model number on new bowl in same location as on old bowl.

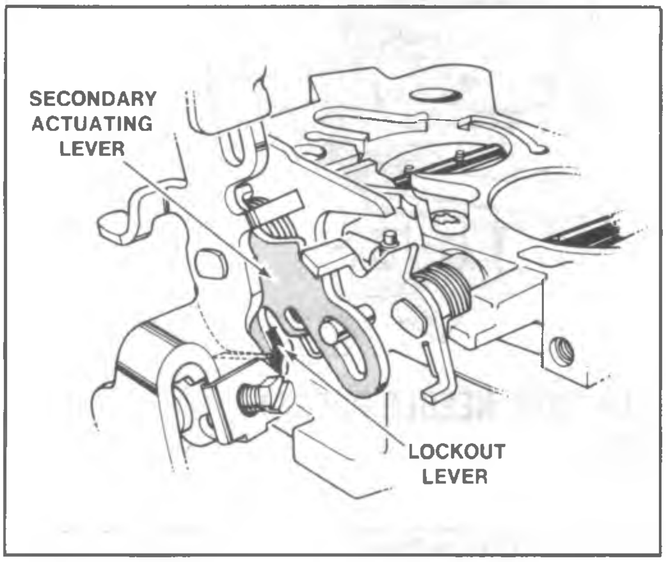


Figure 6C3-36 Lockout Lever

Install or Connect (Figures 6C3-22, 33)

Tools Required:
J-9789-118 or BT-30-15, Carburetor holding stand

1. Throttle body and float bowl together on holding stand.
2. Choke housing (64) on throttle body, with screw assemblies (63).
3. Intermediate choke shaft, lever and link assembly (62).
4. Choke stat lever (61) on intermediate choke shaft.
   - Intermediate choke lever must be upright.
5. Lever attaching screw (60) in shaft.

FLOAT BOWL REASSEMBLY

Install or Connect (Figures 6C3-7, 29, 30)

1. Gasket (54) on inlet nut (53).
2. New filter assembly (55) in nut.
3. Filter spring (56).
4. Inlet nut (53).

Tighten

- Fuel inlet nut to 24 N·m (18 ft. lbs.).

CAUTION: Tightening beyond this limit may damage gasket and could cause a fuel leak, which might result in personal injury.

5. Pump discharge ball (52) and spring (51).
6. New spring guide (50). Tap until top is flush with bowl casting.
7. Needle seat (48C) with gasket (48D).
8. If used, lower insert (47).
9. Jet and lean mixture needle assembly (49).

Important

Only if a Computer Command Control system performance check, made before disassembly, indicated an incorrect lean mixture needle setting:

Adjust (Figure 6C3-37)

Tools Required:
J-28696-10 or BT-7928 Lean Mixture Adjusting Tool

- Lightly bottom the lean mixture needle. Back it out 2-1/2 turns, as a preliminary adjustment. See "On-Vehicle Service" for final lean mixture needle adjustment.

Assemble (Figures 6C3-7, 29, 38, 39)

1. Bend float lever (45) upward slightly at notch.
2. If used, float stabilizing spring (46) on float.
3. Hinge pin (44) in float lever, with ends toward the pump well.
4. Needle (48A) with pull clip assembly (48B) on edge of float lever.

Install or Connect (Figures 6C3-29, 30, 38, 39)

1. Float and lever assembly (45) in float bowl.

Adjust (Figure 6C3-7, 40)

Tools Required:
J-9789-90 or BT-8037, Float Level T-Scale

- Float level. Refer to adjustment specifications at end of section for model number identified on float bowl.

2. Upper insert (43) over hinge pin, with top flush with bowl.
3. TPS spring (42).
4. TPS assembly (41). Parts must be below surface of bowl.
5. Gasket (38) over dowels.
6. Spring (40).
7. Pump assembly (39).

AIR HORN REASSEMBLY

Install or Connect (Figure 6C-28)

1. New pump stem seal (36) with lip facing outside of carburetor and retainer (35).
   - Stake at new locations.
2. New TPS actuator plunger seal (34) with lip facing outside of carburetor and retainer (33). Stake at new locations.

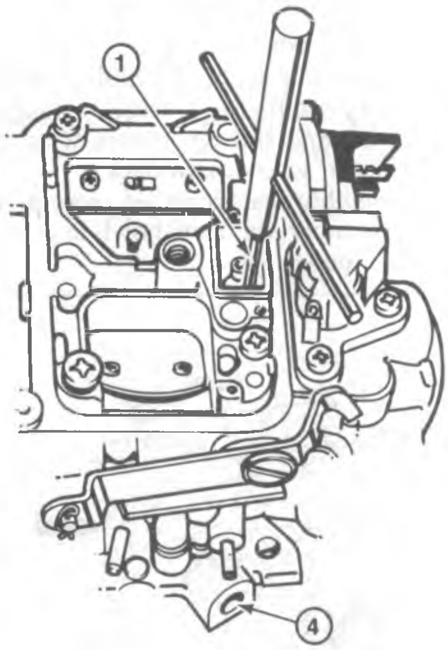
THESE ADJUSTMENTS SHOULD BE PERFORMED ONLY IF INDICATED BY SYSTEM PERFORMANCE CHECK.

LEAN MIXTURE NEEDLE:

1. WITH VENT STACK (OR ENTIRE AIR HORN) OFF, USE TOOL J-28696-10 OR BT-7928 OR EQUIVALENT, TO LIGHTLY BOTTOM LEAN MIXTURE NEEDLE.
2. BACK OUT NUMBER OF TURNS INDICATED IN SPECIFICATIONS.
3. REFER TO VEHICLE MANUFACTURER'S SERVICE MANUAL SECTION 6C FOR "LEAN MIXTURE ADJUSTMENT".

IDLE MIXTURE NEEDLE:

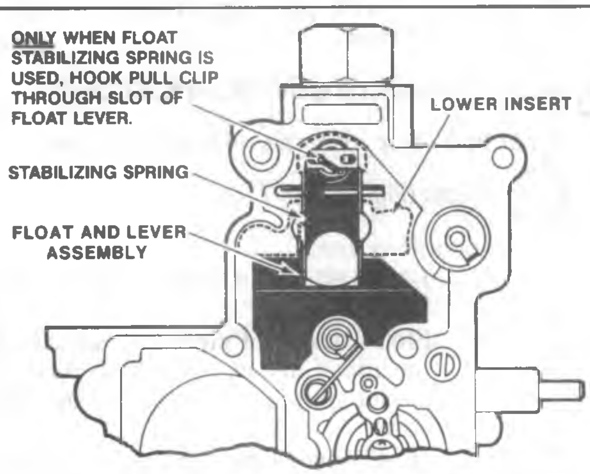
4. WITH IDLE MIXTURE NEEDLE PLUG REMOVED, USE TOOL J-29030 OR BT-7610B OR EQUIVALENT TO LIGHTLY BOTTOM NEEDLE.
5. BACK OUT NUMBER OF TURNS INDICATED IN SPECIFICATIONS.
6. REFER TO SERVICE MANUAL SECTION 6C FOR "IDLE MIXTURE ADJUSTMENT".



LEAN MIXTURE NEEDLE & IDLE MIXTURE NEEDLE PRESET ADJUSTMENTS

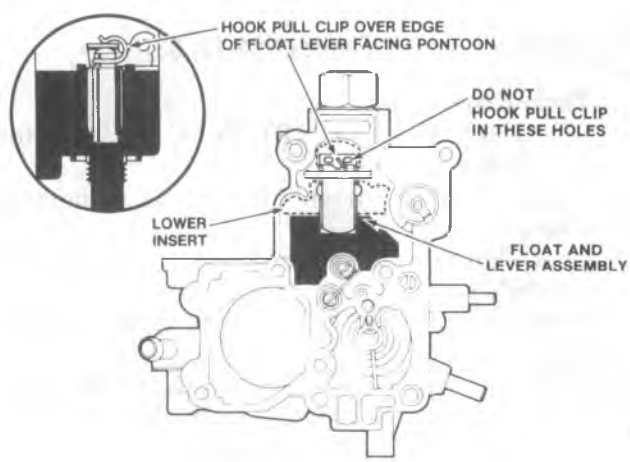
E2SE MODELS ONLY

Figur 6C3-37 Lean Mixture Needle and Idle Mixture Preset



FLOAT WITH STABILIZING SPRING

Figure 6C3-38 Float with Stabilizing Spring



FLOAT WITHOUT STABILIZING SPRING

Figure 6C3-39 Float without Stabilizing Spring

3. TPS plunger (32) through seal in air horn.

→← Install or Connect (Figure 6C3-41)

- Lithium base grease, liberally to pin, if used, where contacted by spring.

INSTALLATION OF AIR HORN TO FLOAT BOWL

→← Install or Connect (Figures 6C3-25, 26, 27)

1. Fast idle cam link (31) in choke lever.

   Line up "squirt" on link with slot in lever.
2. Rotate cam to highest position. Lower end of fast idle cam link goes in cam slot, and the pump link (68) end into hole in lever.
3. Hold pump (39) down, and lower the air horn assembly onto float bowl. Guide pump stem through seal (36).
4. One air horn screw assembly, 25, 26, or 27). Finger tighten to hold in place.
5. Cam link (31) in slot of cam.
6. New bushing (30) and retainter (29) to link, with large end of bushing facing retainer.

   Check for freedom of movement.

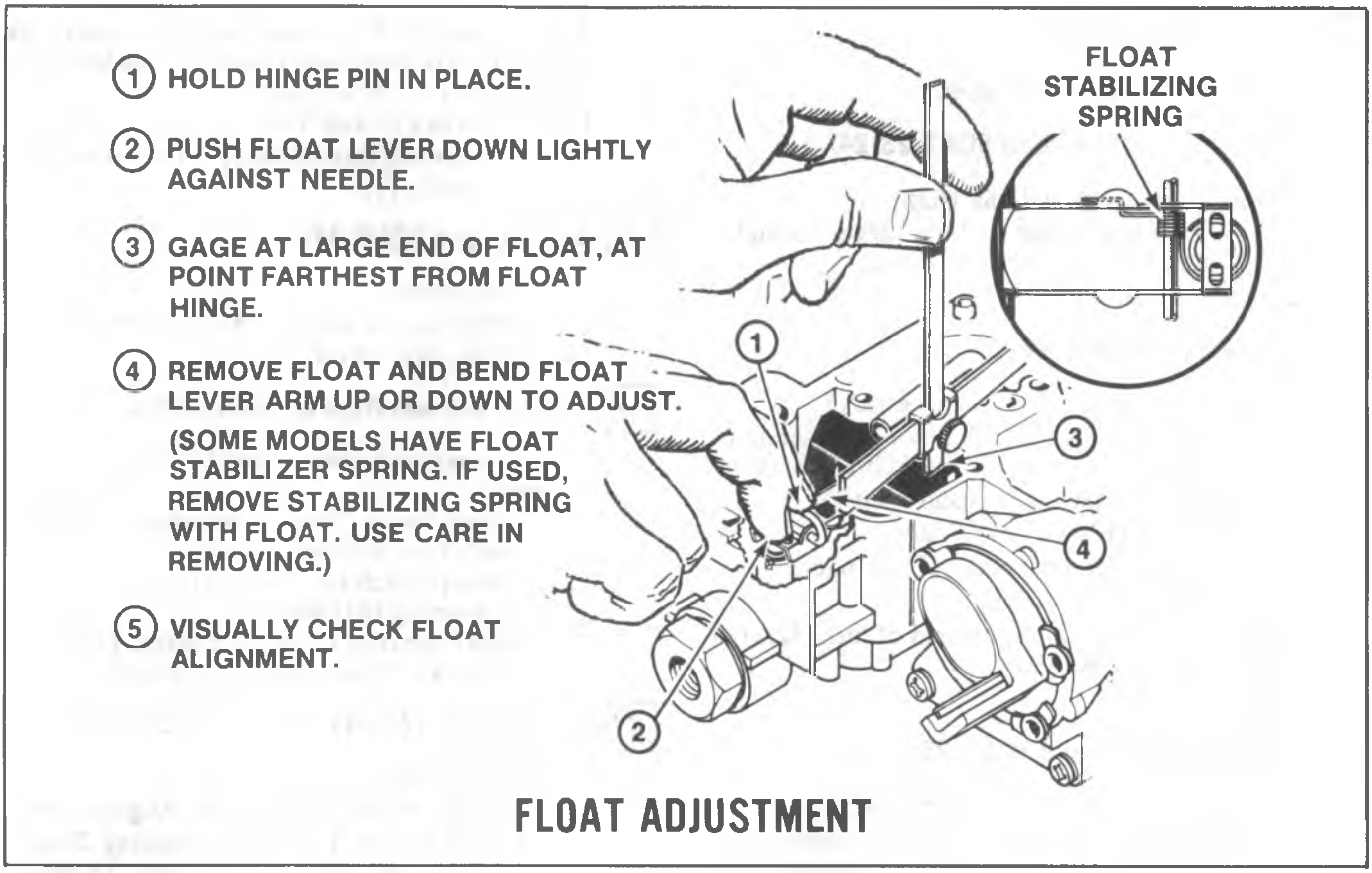


Figure 6C3-40 Float Adjustment

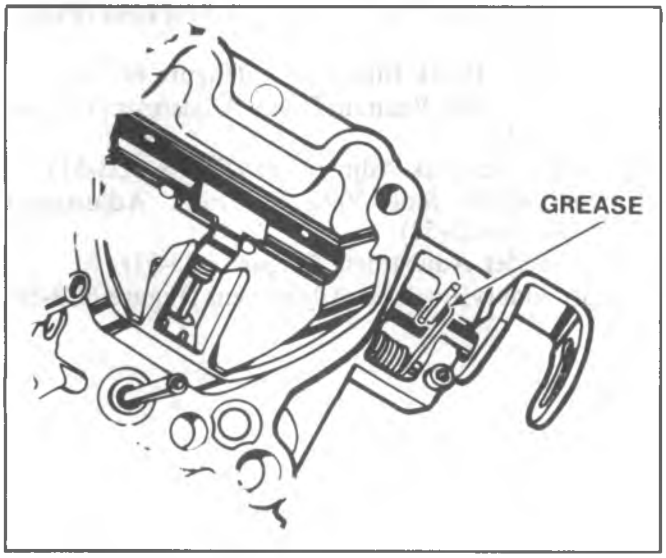


Figure 6C3-41 Air Valve Spring Lubrication

Install or Connect (Figure 6C3-25, 42)

1. Attaching screw assemblies of various lengths (25, 26, and 27).

   ##### Assemble

   1. Spacer (24).
   2. New seal (23).

      Lightly coat seal with automatic transmission fluid.

      Assemble on solenoid stem, touching spacer.
   3. New retainer (22).
2. New gasket (21) on air horn
3. Mixtue control solenoid (20) lining up stem with recess in bowl.
4. Solenoid screw assemblies (19).
5. Vent stack (18), with two attaching screws (17), (unless lean mixture needle requires on-vehicle adjustment).
6. New retainer (13) on pump link.

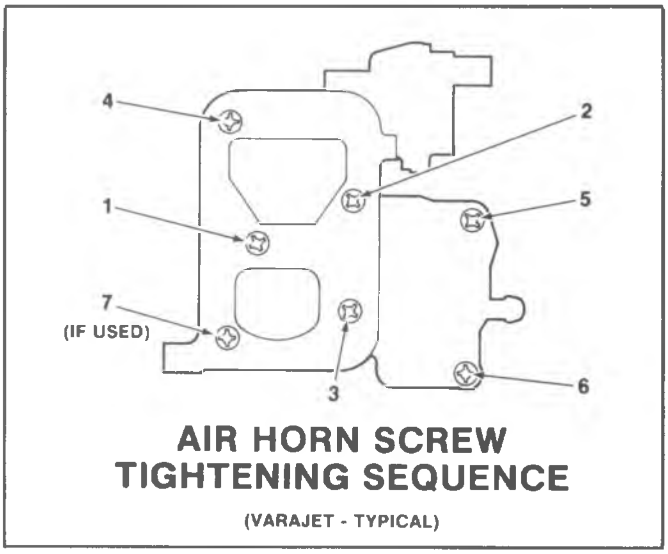


Figure 6C3-42 Air Horn Tightening

Adjust (Figure 6C3-43)

- Air valve spring, if adjustable.

Install or Connect (Figures 6C3-7, 23, 24)

1. Bushing (16) on choke link (62).
   With intermediate choke lever upright, install link in choke lever hole.
2. New link retainer (15).

Assemble (Figure 6C3-7, 23)

(If part replacement is necessary)

- Idle stop solenoid (10), retainer (8), and nut (9) to secondary side vacuum break bracket.
- Bend retainer tab to secure nut.
- Bushing (12B) to link (12A).
- Link to vacuum break (12) plunger.
- Retainer (12C) to link.

3. Rotate assembly (12), insert end of link (12A) in upper slot of choke lever.
4. Bracket screws (11).

Assemble (Figure 6C3-7, 23)

(If part replacement is necessary)

- Idle speed device (10 or 10A), retainer (8 or 10B), and nut (9 or 10C) to primary side vacuum break bracket.
- Bend retainer tab to secure nut.
- Bushing (48) to vacuum break link (4A).
- Link to vacuum break (4) plunger.
- Retainer (4C) to link.
- Bushing (7) to air valve link (5).
- Link to plunger.
- Retainer (6) to link.

5. Rotate assembly (4), insert end of air valve link (5) in air valve lever, and vacuum break link (4A) in lower slot of choke lever.
6. Bracket screws (3 and 3A).
7. Hose (2) between throttle body tube and vacuum break assembly (4).

Adjust (Figure 6C3-7, 44)

Tools Required:
J-9789-111 or BT-3006M, Bending Tool

8. Choke Stat Lever (61)

Install or Connect (Figures 6C3-45, 46)

Choke cover and stat assembly (59) in choke housing:

1. If stat has a "trap" (box-shaped pick-up tang), trap surrounds lever.
2. Line up notch in cover (59) with projection on housing (64) flange.
   Install retainers (58) and rivets (57) with rivet tool. If necessary, use adapter.

Adjust (Figures 6C3-47, 48, 50, 51, 52, 53, 54

Tools Required:
J-26701 or BT-7704, Choke Angle Gage
J-9789-111 or BT-3006M, Bending Tool
J-23738 or BT-7517, Hand Operated Vacuum Device

Choke Link - Fast Idle Cam Adjustment (Figure 6C3-48)
Vacuum Break Information (Figure 6C3-49)
Primary Side Vacuum Break Adjustment (Figure 6C3-50)
Air Valve Link Adjustment (Figure 6C3-51)
(Secondary Side Vacuum Break Adjustment (Figure 6C3-52)
Unloader Adjustment (Figure 6C3-53)
Secondary Lockout Adjustment (Figure 6C3-54)

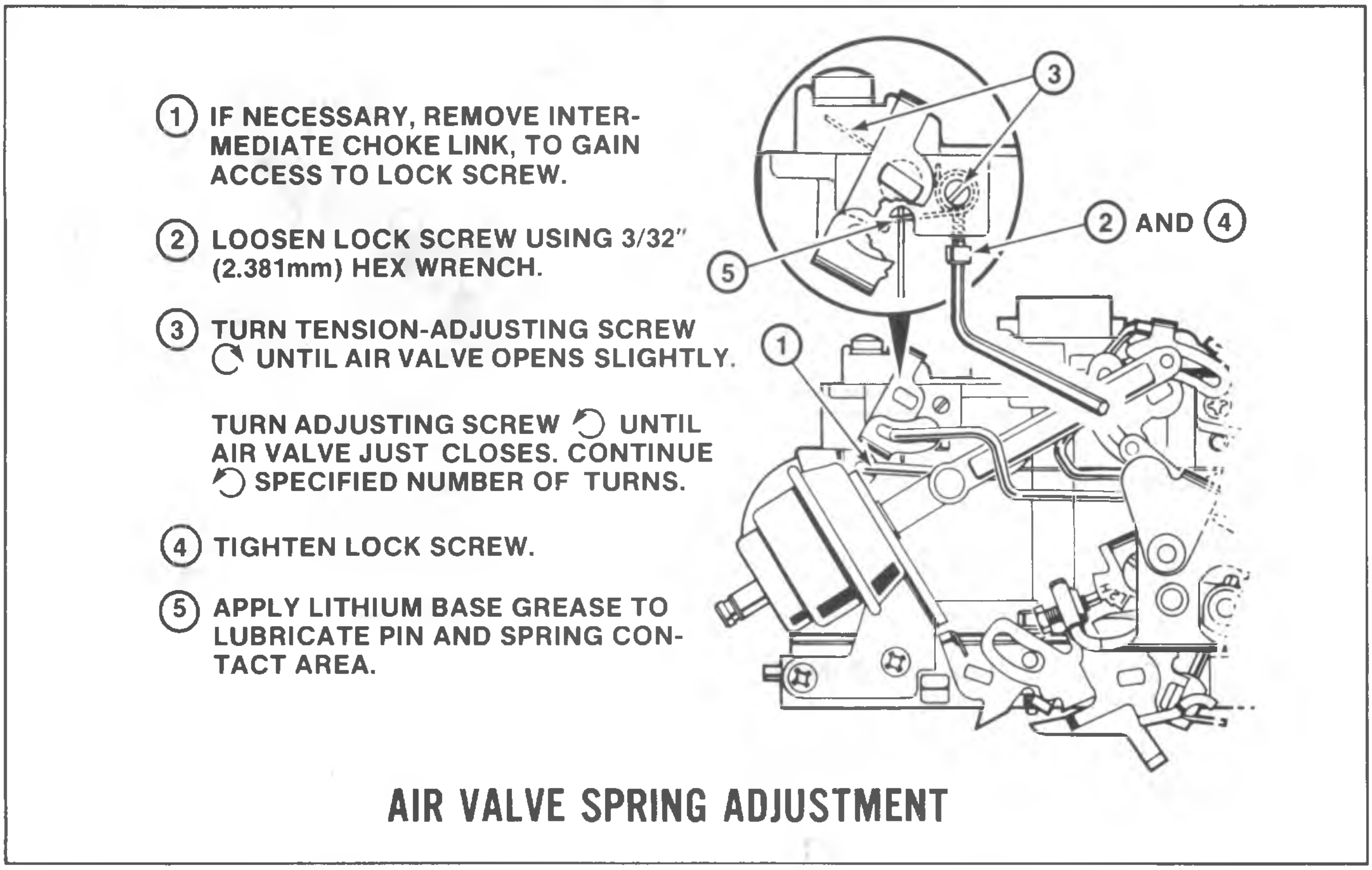


Figure 6C3-43 Air Valve Spring Adjustment

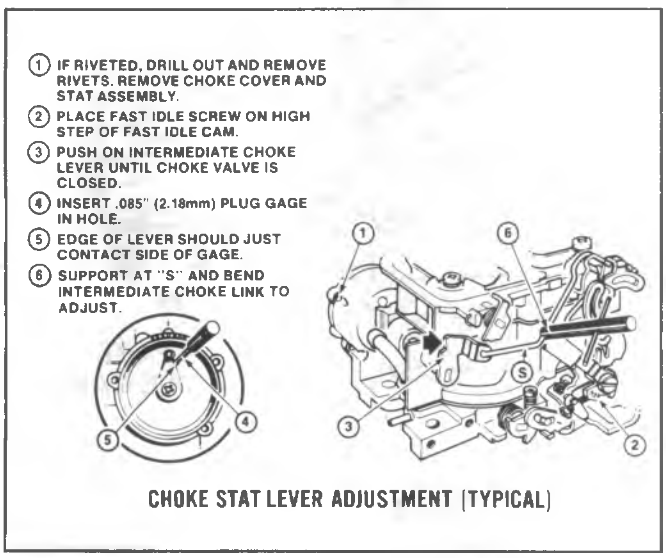


Figure 6C3-44 Choke Stat Lever Adjustment

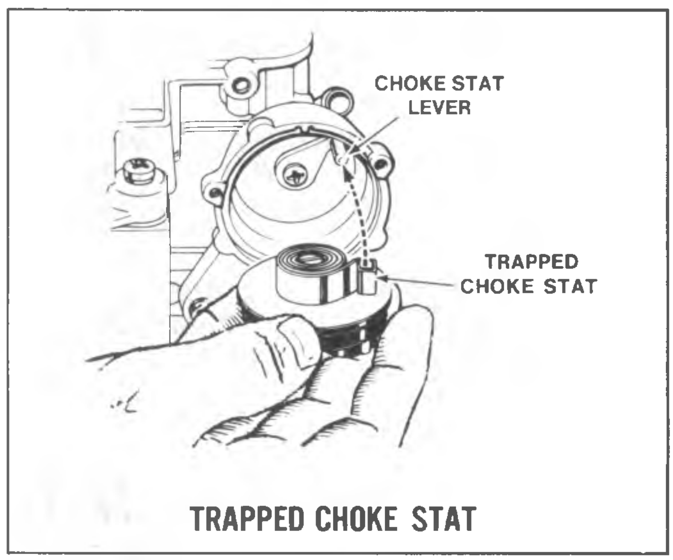


Figure 6C3-45 Trapped Choke Stat

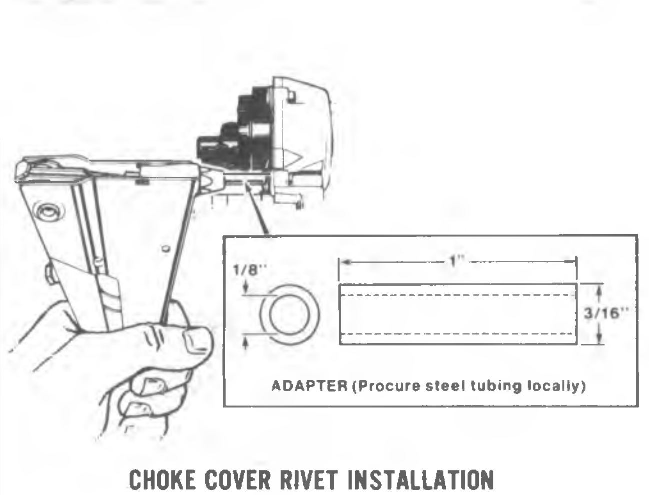


Figure 6C3-46 Choke Cover Installation

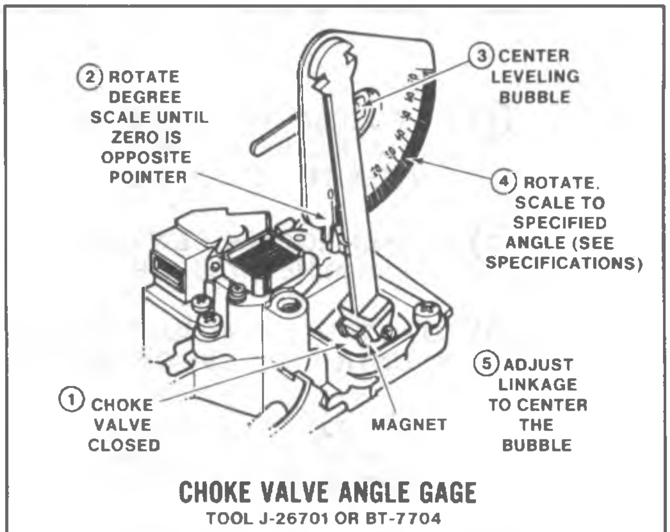


Figure 6C3-47 Choke Valve Angle Gage

(1) ATTACH RUBBER BAND TO INTERMEDIATE CHOKE LEVER.

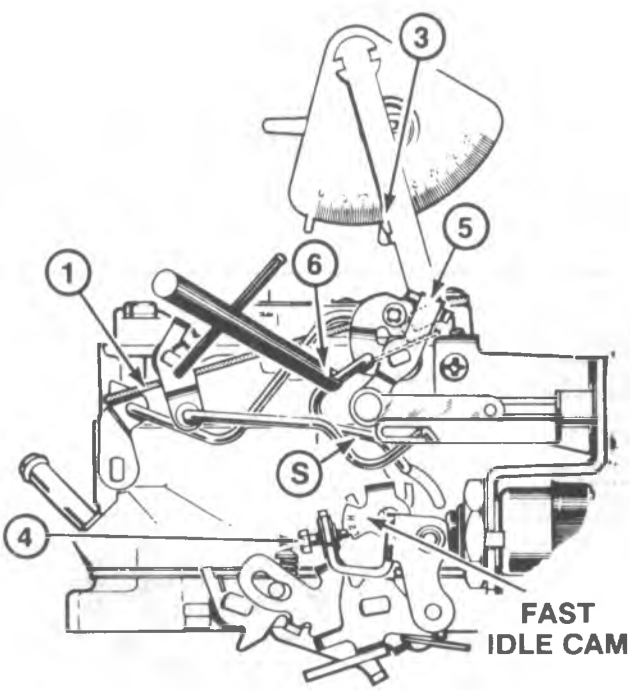
(2) OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE.

(3) SET UP ANGLE GAGE AND SET ANGLE TO SPECIFICATIONS.

(4) PLACE FAST IDLE SCREW ON SECOND STEP OF CAM AGAINST RISE OF HIGH STEP.

(5) PUSH ON CHOKE SHAFT LEVER TO OPEN CHOKE VALVE AND TO MAKE CONTACT WITH BLACK CLOSING TANG.

(6) SUPPORT AT "S" AND ADJUST BY BENDING FAST IDLE CAM LINK UNTIL BUBBLE IS CENTERED.



CHOKE LINK - FAST IDLE CAM ADJUSTMENT

Figure 6C3-48 Choke Link-Fast Idle Cam Adjustment

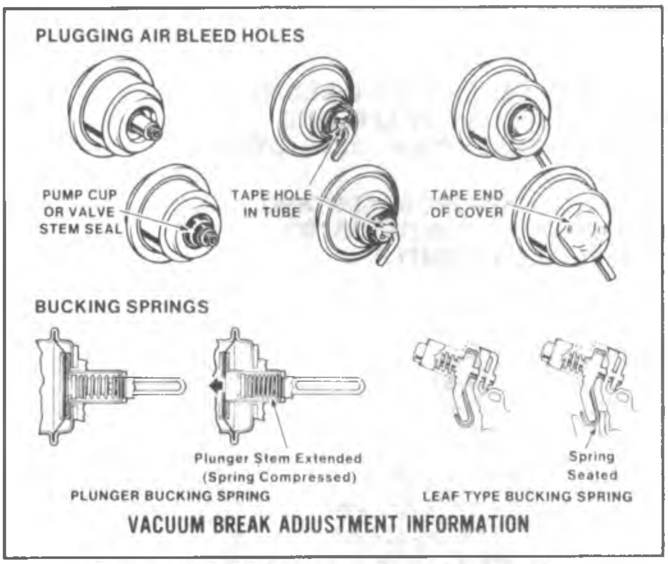


Figure 6C3-49 Vacuum Break Information

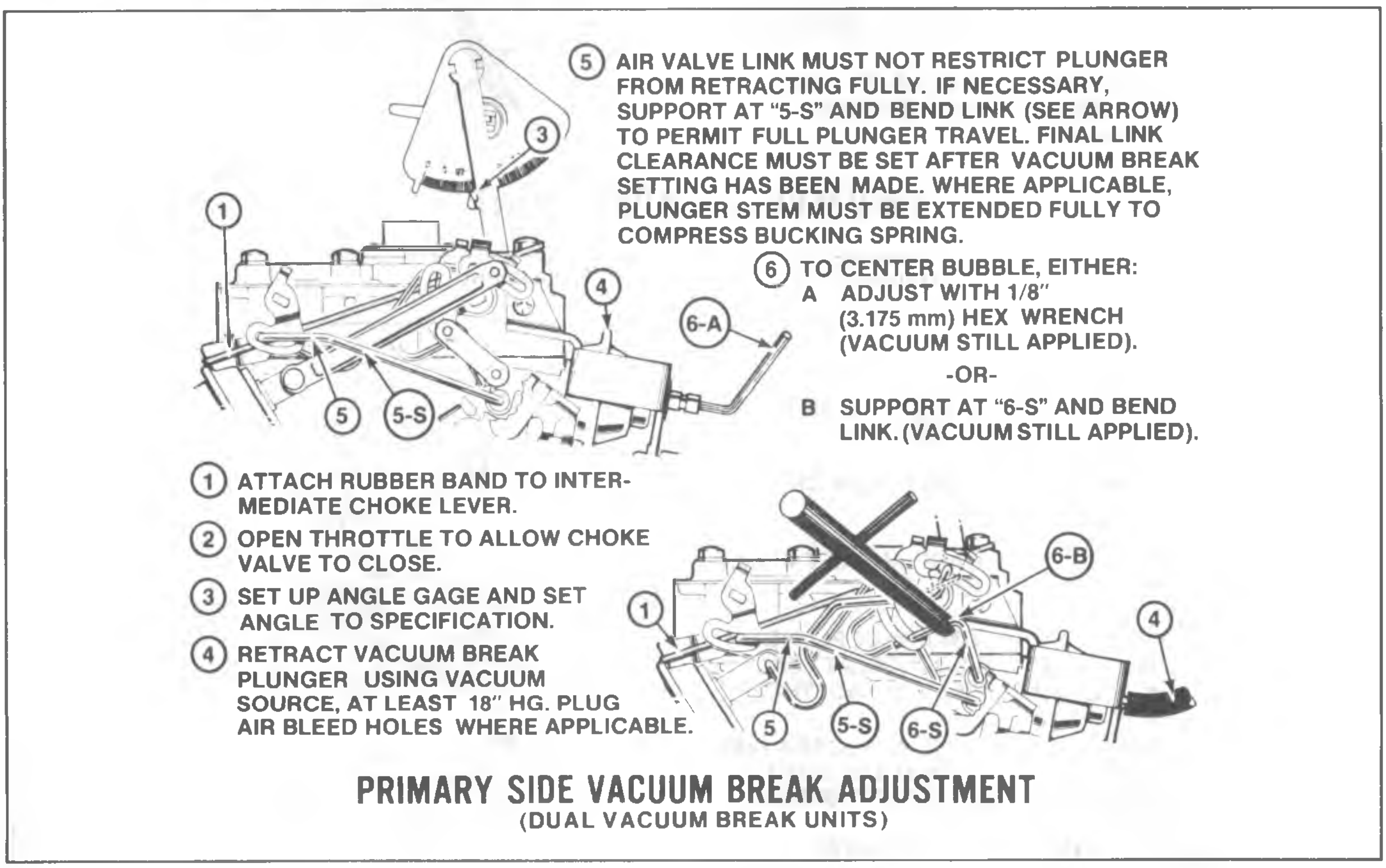
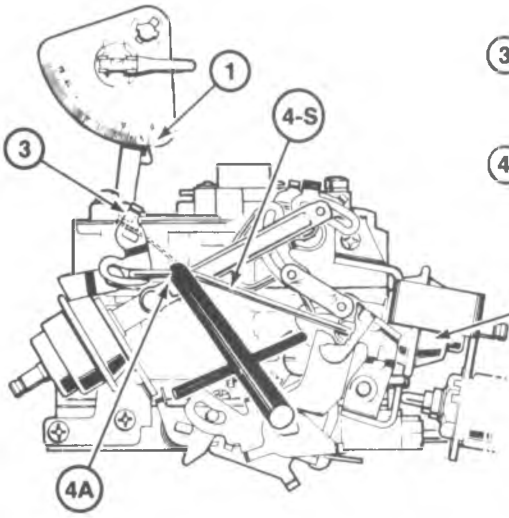
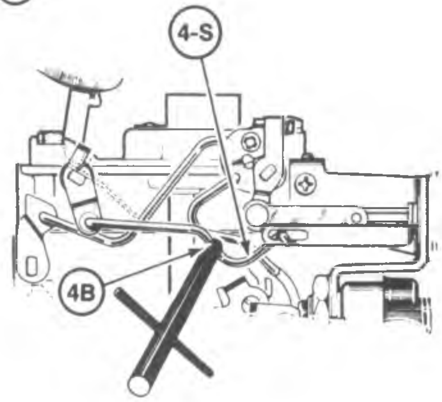


Figure 6C3-50 Primary Vacuum Break Adjustment



3. ROTATE AIR VALVE IN THE DIRECTION OF OPEN AIR VALVE BY APPLYING LIGHT PRESSURE TO AIR VALVE LEVER.

4. TO ADJUST, SUPPORT AT "4-S" AND BEND AIR VALVE LINK ("A" OR "B") UNTIL BUBBLE IS CENTERED.



1. SET UP ANGLE GAGE ON AIR VALVE AND SET ANGLE TO SPECIFICATIONS.

2. USE VACUUM SOURCE, AT LEAST 18" HG., TO SEAT VACUUM BREAK PLUNGER.

AIR VALVE LINK ADJUSTMENT

Figure 6C3-51 Air Valve Link Adjustment

1. ATTACH RUBBER BAND TO INTERMEDIATE CHOKE LEVER.

2. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE.

3. SET UP ANGLE GAGE AND SET ANGLE TO SPECIFICATION.

4. RETRACT VACUUM BREAK PLUNGER USING VACUUM SOURCE, AT LEAST 18" HG. PLUG AIR BLEED HOLES WHERE APPLICABLE.

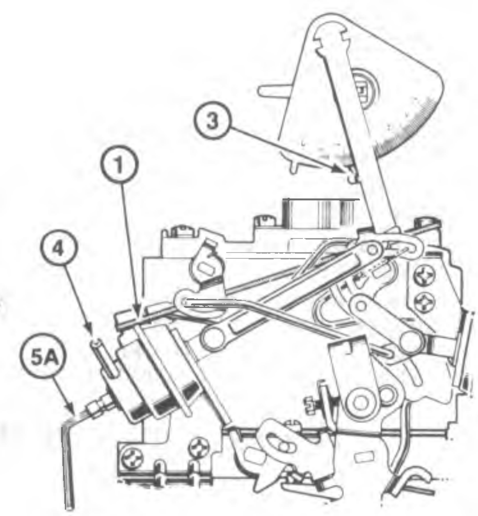
   WHERE APPLICABLE, PLUNGER STEM MUST BE EXTENDED FULLY TO COMPRESS PLUNGER BUCKING SPRING.

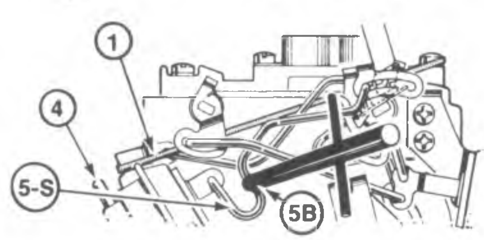
5. TO CENTER BUBBLE, EITHER:

   A. ADJUST WITH 1/8" (3.175 mm) HEX WRENCH (VACUUM STILL APPLIED)

   -OR

   B. SUPPORT AT "5-S", BEND LINK (VACUUM STILL APPLIED)

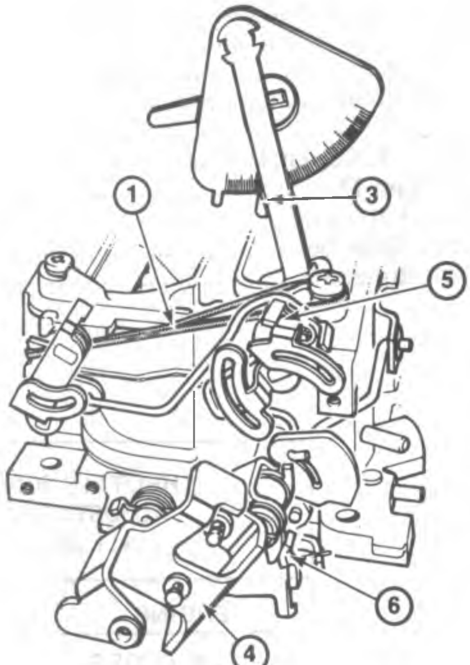




SECONDARY SIDE VACUUM BREAK ADJUSTMENT

Figure 6C3-52 Secondary Vacuum Break Adjustment

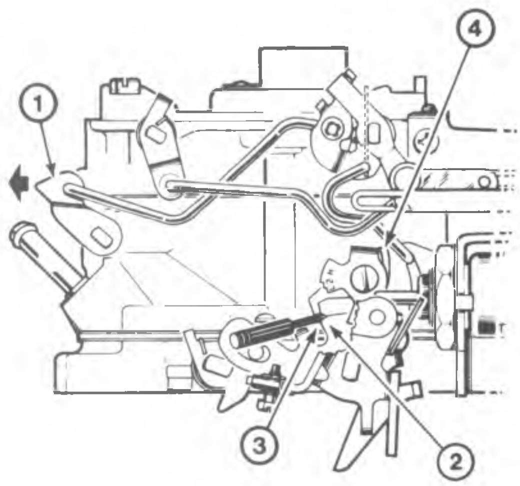
1. ATTACH RUBBER BAND TO INTERMEDIATE CHOKE LEVER.
2. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE.
3. SET UP ANGLE GAGE AND SET ANGLE TO SPECIFICATIONS.
4. HOLD THROTTLE LEVER IN WIDE OPEN POSITION.
5. PUSH ON CHOKE SHAFT LEVER TO OPEN CHOKE VALVE AND TO MAKE CONTACT WITH BLACK CLOSING TANG.
6. ADJUST BY BENDING TANG UNTIL BUBBLE IS CENTERED.



UNLOADER ADJUSTMENT

Figure 6C3-53 Unloader Adjustment

1. HOLD CHOKE VALVE WIDE OPEN BY PUSHING DOWN ON INTERMEDIATE CHOKE LEVER.
2. OPEN THROTTLE LEVER UNTIL END OF SECONDARY ACTUATING LEVER IS OPPOSITE TOE OF LOCKOUT LEVER.
3. GAGE CLEARANCE - DIMENSION SHOULD BE .025".
4. IF NECESSARY TO ADJUST, BEND LOCKOUT LEVER TANG CONTACTING FAST IDLE CAM.



SECONDARY LOCKOUT ADJUSTMENT (TYPICAL)

Figure 6C3-54 Secondary Lockout Adjustment

SPECIAL TOOLS

Idle Mixture Socket J-29030-B/BT-7610-B
Float Level Scale J-9789-90/BT-8037
Bending Tool J-9789-111/BT-3007
Carburetor Stand J-9789-118A/BT-30-15
Float Level Gage J-9789-135/BT-8104
Carburetor Choke Angle Gage J-26701-A/BT-7704
Hand Vacuum Device J-23738/BT-7517
Metering Jet Remover J-28696-B/BT-7928
Carburetor Gage Set J-9789-C/BT-3005-A
Digital Multimeter J-34029/BT-3450

THROTTLE POSITION SENSOR (TPS) ADJUSTMENT SPECIFICATIONS (ALL SETTINGS + 0.1 VOLT)	
ENGINE	VOLTAGE
2.8L VIN CODE B	.255 AT CURB IDLE
2.8L VIN CODE X	.31 AT CURB IDLE
2.8L VIN CODE Z	.255 AT CURB IDLE

CARBURETOR MODEL E2SE ADJUSTMENT SPECIFICATIONS											
CARB. NUMBER	FLOAT LEVEL ±2/32″		LEAN MIXTURE SCREW (TURNS)	IDLE MIXTURE SCREW (TURNS)	AIR VALVE SPRING (TURNS)	CHOKE COIL LEVER	FAST IDLE CAM (CHOKE ROD) ±3.5°	VAC. BREAK PRI. ±2.5°	AIR VALVE ROD	VAC. BREAK SEC. ±3.5°	UN-LOADER ±6°
	Inch	mm									
17084356	9/32	7.0	2-1/2	4	3/4	.085	22°	25°	1°	30°	30°
17084357	9/32	7.0	2-1/2	4	3/4	.085	22°	25°	1°	30°	30°
17084358	9/32	7.0	2-1/2	4	3/4	.085	22°	25°	1°	30°	30°
17084359	9/32	7.0	2-1/2	4	3/4	.085	22°	25°	1°	30°	30°
17084368	4/32″	3.3	2-1/2	4	3/4	.085	22°	25°	1°	30°	30°
17084370	4/32″	3.3	2-1/2	4	3/4	.085	22°	25°	1°	30°	30°
17084430	11/32	8.65	2-1/2	4	1	.085	15°	26°	1°	38°	42°
17084431	11/32	8.65	2-1/2	4	1	.085	15°	26°	1°	38°	42°
17084434	11/32	8.65	2-1/2	4	1	.085	15°	26°	1°	38°	42°
17084435	11/32	8.65	2-1/2	4	1	.085	15°	26°	1°	38°	42°
17084534	5/32	3.6	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084535	5/32	3.6	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084537	5/32	3.6	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084538	5/32	3.6	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084540	5/32	3.6	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084542	4/32″	3.0	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084632	9/32	7.0	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084633	9/32	7.0	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084635	9/32	7.0	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°
17084636	9/32	7.0	2-1/2	4	1/2	.085	28°	25°	1°	35°	45°

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Figure 6C3-55 Adjustment Specifications

SECTION 6C6

DIESEL FUEL INJECTION

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GENERAL DESCRIPTION

FUEL SYSTEM

The 6.2 liter diesel engine fuel system is composed of:

- Fuel tank.
- Mechanical fuel pump.
- Fuel filter with heater and water sensor.
- Injection distributor pump.
- High pressure lines.
- Fuel injection nozzles.
- Filer restriction switch.

Fuel is pulled from the fuel tank by the Mechanical pump which is located on the right side of the engine. It is driven by an eccentric lobe on the camshaft through a push rod. Fuel is then pumped through the filter mounted on front of dash on CK models and under the rear of air cleaner on GP models. The filter removes foreign material which could damage the injection pump or clog the injector nozzle. From the filter, the fuel is pumped to the injection pump.

The 6.2 liter injection pump is mounted on top of the engine under the intake manifold. It is gear driven by 2 gears -- one attached to the front end of the camshaft which drives the second gear that is attached to the end of the injection pump shaft. These 2 gears are the same size and have the same number of teeth; thus, the injection pump shaft turns at the same rate as the camshaft and one-half the speed of the crankshaft. The pump will turn in the opposite direction to that of the camshaft and crankshaft.

The injection pump is a high pressure rotary type pump that directs a metered pressurized fuel through the high pressure tubes to the eight injector nozzles. The eight high pressure lines are all the same length although their shape may be different. This prevents any difference in timing, cylinder to cylinder.

WATER IN FUEL

The diesel engine has a water in fuel warning system allowing the user to guard against water in fuel, which is very critical in diesel engines.

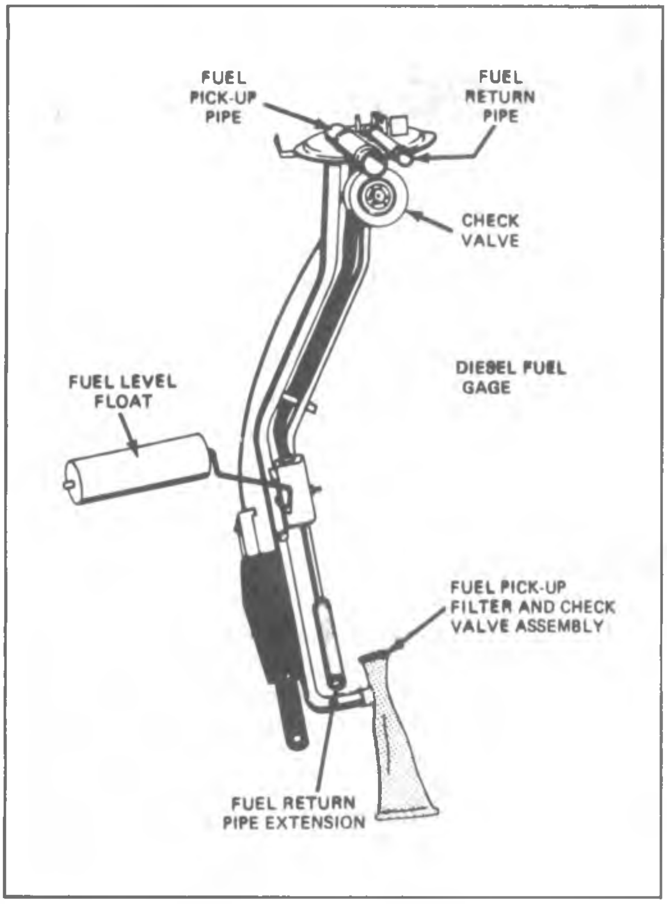


Fig. 6C6-2--Sending Unit

REPLACEMENT FUEL FILTER

The fuel filter on CK models is located on the front of dash.

The fuel filter on G-Van models is mounted on the rear of the inlet manifold under the air cleaner and is accessible by removing the engine cover.

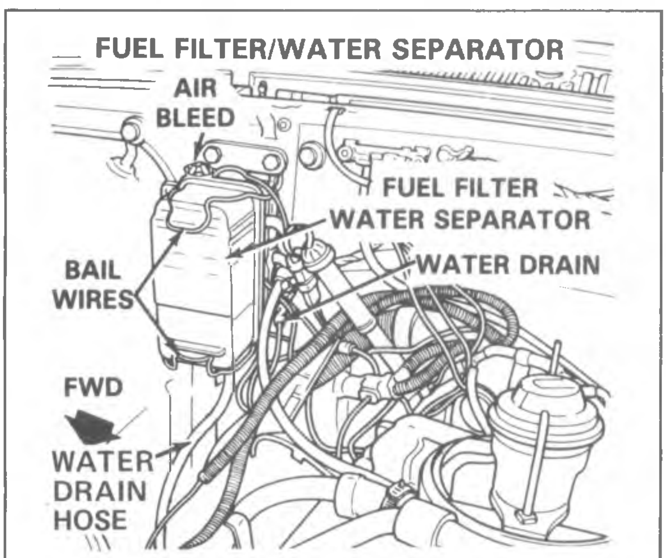


Fig. 6C6-3--Fuel Filter-CK Truck

The fuel filter is easily removed and installed with the use of a screwdriver. To prevent fuel spillage -- drain fuel from the filter by opening both the air bleed and water drain valve allowing fuel to drain out into an appropriate container.

Removal

1. Remove fuel tank cap. This releases any pressure or vacuum in the tank.
2. Disengage both bail wires with a screwdriver.
3. Remove the filter.
4. Clean any dirt off the fuel port sealing surface of the filter adapter and the new filter.
5. Install the new filter -- snap into position with bail wires.
6. Close the water drain valve -- and open the air bleed. Connect a 1/8" I.D. hose to the air bleed port and place the other end into a suitable container.
7. Disconnect fuel injection pump shut off solenoid wire.
8. Crank engine for 10-15 seconds and then wait one minute for the starter motor to cool. Repeat until clear fuel is observed coming from the air bleed.

   NOTICE: If engine is to be cranked, or starting attempted with the air cleaner removed, care must be taken to prevent material from being pulled into the air inlet manifold which could result in engine damage.
9. Close the air bleed, reconnect the injection pump solenoid wire and replace fuel tank cap.
10. Start engine and allow it to idle for 5 minutes.
11. Check fuel filter for leaks.

IDLE SPEED SETTING PROCEDURE (FIGS. 6C6-5 and 6C6-6)

1. All idle speeds are to be set within 25 RPM of specified value.
2. Set parking brake and block drive wheels.
3. Engine must be at normal operating temperature.

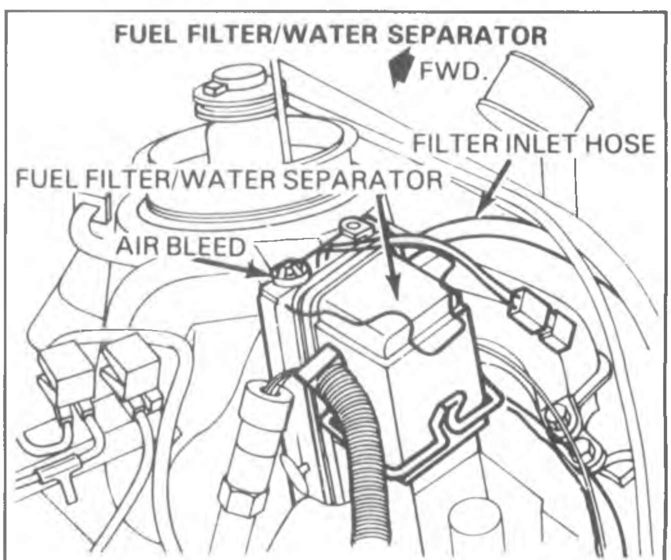


Fig. 6C6-4--Fuel Filter G Van

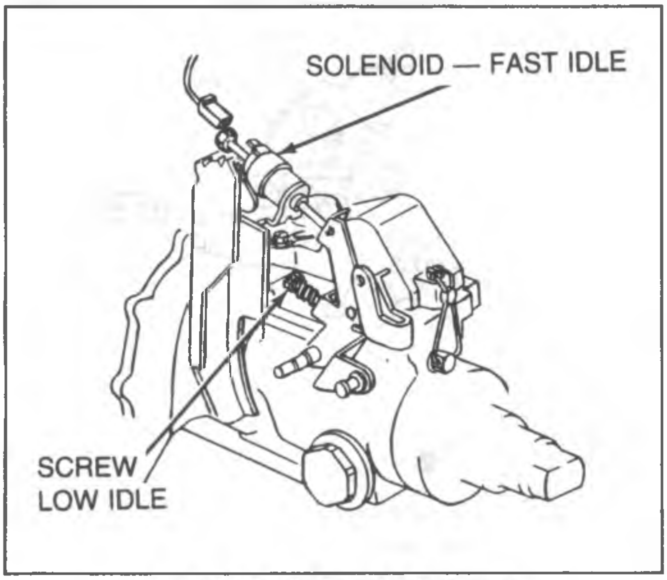


Fig. 6C6-5--Idle Speed Adjustments

Air cleaner should be on and all accessories should be turned off.

4. Install, tool J-26925, diesel tachometer or equivalent per manufacturers instructions.
5. Adjust low idle speed screw on fuel injection pump to an engine speed of 650 RPM in neutral or park for automatic transmission and for manual transmissions.
6. Adjust fast idle speed as follows:
   a. Remove connector from fast idle solenoid. Use an insulated jumper wire from battery positive terminal to solenoid terminal to energize solenoid.
   b. Open throttle momentarily to ensure that the fast idle solenoid plunger is energized and fully extended.
   c. Adjust the extended plunger by turning the hex head to an engine fast idle speed of 800 RPM in neutral.
   d. Remove jumper wire and reinstall connector to fast idle solenoid.
7. Remove tachometer.

THROTTLE POSITION SWITCH AND VACUUM REGULATOR VALVE ADJUSTMENT (FIGS. 6C6-7,8,9)

HOUSING PRESSURE COLD ADVANCE

The HPCA feature is designed to advance the injection timing about 4° during cold operation. This circuit is actuated by a temperature switch on the right rear head bolt. The switch is calibrated to open the circuit at 95°F. Below the switching point, housing pressure is decreased from 10 psi to zero which advances the timing 4°. Above 95°F, the switch opens de-energizing the solenoid and the housing pressure is return to 10 psi. The fast idle solenoid is energized by the same switch. The switch again closes when the temperature falls below 85°F.

Purpose:

1. Emission Control device.
2. Better cold starts.
3. Improves idle when cold.

When changing the fuel filter or when the vehicle has run out of fuel, disconnect the connector from the temperature switch and jumper connector terminals. This will aid in purging air from the pump. (This procedure is necessary only on a hot engine, as the circuit will always be closed when the engine is cold).

INJECTION PUMP FUEL LINES (FIGS. 6C6-10 and 6C6-11)

When lines are to be removed, clean all line fittings thoroughly before loosening. Immediately cap the lines, nozzles and pump fittings to maintain cleanliness.

CK Truck

Removal

1. Disconnect batteries.
2. Disconnect air cleaner bracket at valve cover.
3. Remove crankcase ventilator bracket and move aside.
4. It may be necessary to loosen vacuum pump hold-down clamp and rotate pump in order to gain access to intake manifold bolt.
5. Remove intake manifold bolts. Injection line clips are retained by the same bolts.
6. Remove intake manifold.
7. Install protective covers J-29664-1.
8. Remove injection line clips at loom brackets.
9. Remove injection lines at nozzles and cover nozzles with protective caps.
10. Remove injection lines at pump and tag lines for reinstallation.
11. Remove fuel line from injection pump.

Installation

1. Install injection lines as shown in Figures 6C6-10 and 6C6-11.
2. Remove protective covers.
3. Install intake manifold.
4. Tighten vacuum pump holddown clamp.
5. Install crankcase ventilator.
6. Connect air cleaner.
7. Connect batteries.

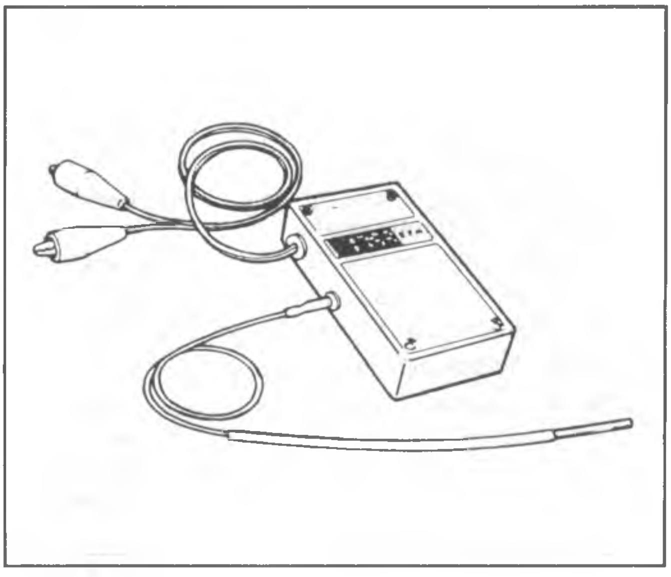
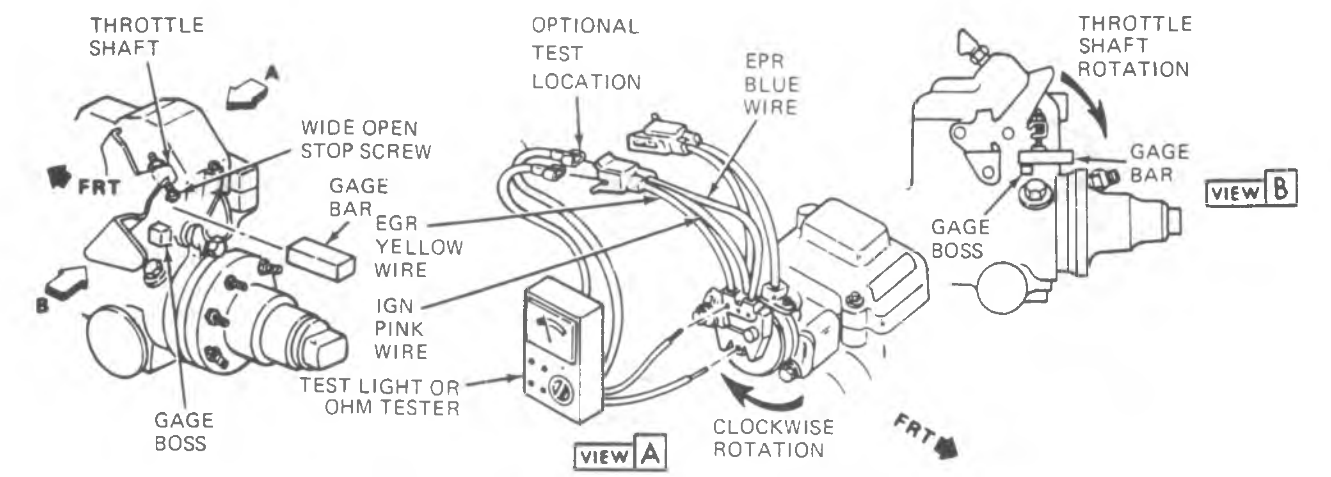


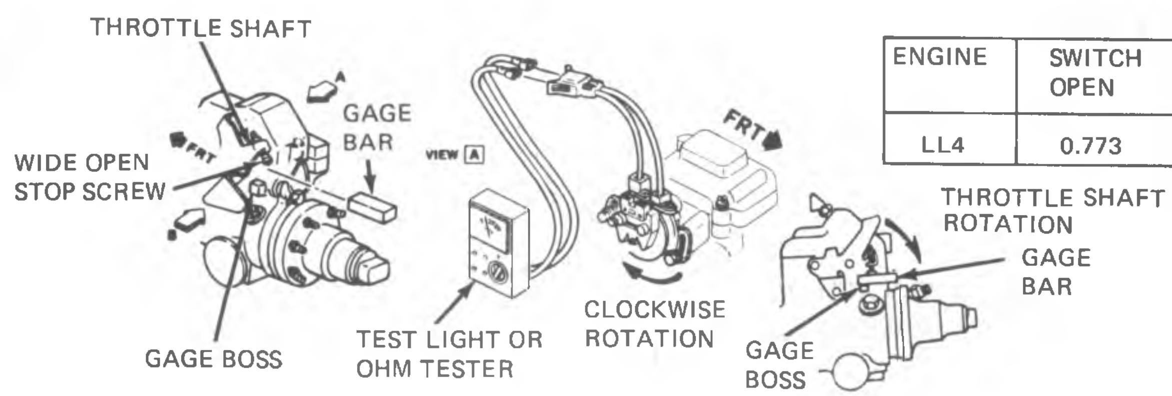
Fig. 6C6-6--Using Tool J-26925



1. Loose assemble throttle position switch to fuel injection pump with throttle lever in closed position.
2. Attach a continuity meter across the IGN (pink) and EGR (yellow) terminals or wires.
3. Insert the proper "switch-closed" gage block as shown on Emission Control Label between the gage boss on the injection pump and the wide open stop screw on the throttle shaft.
4. Rotate and hold the throttle lever against the gage block.
5. Rotate the throttle switch clockwise (facing throttle switch) until continuity pivot occurs (high meter reading) across the IGN and EGR terminals or wires. Hold switch body at this position and tighten mounting screws to 5-7 N•m (4-5 ft. lbs.)

   NOTE: Switch point must be set only while rotating switch body in clockwise direction.
6. Release throttle lever and allow it to return to idle position. Remove the "switch-closed" gage bar and insert the "switch-open" gage bar. Rotate throttle lever against "switch-open" gage bar. There should be no continuity (meter reads ∞) across the IGN and EGR terminals or wires. If no continuity exists, switch is set properly. However, if there is continuity, then the switch must be reset by returning to step 1 and repeating the entire procedure.

Fig. 6C6-7--T.P.S. Adjustment LH6 Engine

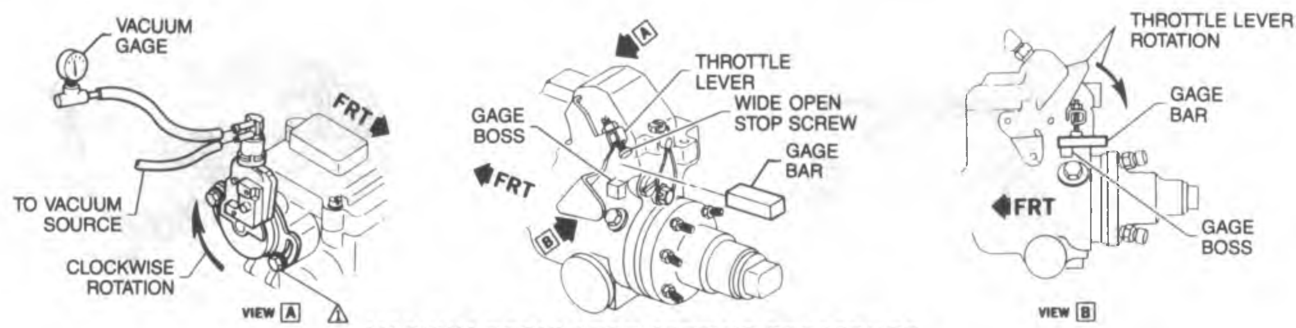


ENGINE	SWITCH OPEN	SWITCH CLOSED
LL4	0.773	0.751

1. Loose assemble throttle position switch to fuel injection pump with throttle lever is closed position.
2. Attach a continuity meter across terminals.
3. Insert the "switch-closed" gauge block between the gauge boss on the injection pump and the wide open stop screw on the throttle shaft.
4. Rotate and hold the throttle lever against the gauge block.
5. Rotate the throttle switch clockwise (facing throttle switch) until continuity just occurs (high meter reading) across the terminals. Hold switch body at this position and tighten mounting screws to 5.7 N•m (4-5 ft. lbs.)

   NOTE: Switch point must be set only while rotating switch body in clockwise direction.
6. Release throttle lever and allow it to return to idle position. Remove the "switch-closed" gauge bar and insert the "switch-open" gauge bar. Rotate throttle lever against "switch-open" gauge bar. There should be no continuity (meter reads ∞) across the terminals. If no continuity exists, switch is set properly. However, if there is continuity, then the switch must be reset by returning to step 1 and repeating the entire procedure.

Fig. 6C6-8--T.P.S. Adjustment LL4 and 700R4 Transmission



VACUUM REGULATOR SETTING PROCEDURE

1. ATTACH THE VACUUM REGULATOR VALVE SNUGLY, BUT LOOSELY TO THE FUEL INJECTION PUMP. THE VALVE BODY MUST BE FREE TO ROTATE ON THE PUMP.
2. ATTACH VACUUM SOURCE OF 67 ± 5 kpa TO BOTTOM VACUUM NIPPLE. ATTACH VACUUM GAGE TO TOP VACUUM NIPPLE.
3. INSERT VACUUM REGULATOR VALVE GAGE BAR (0.646) BETWEEN THE GAGE BOSS ON THE INJECTION PUMP AND THE WIDE OPEN STOP SCREW ON THE THROTTLE LEVER.
4. ROTATE [illegible] THE THROTTLE SHAFT AGAINST THE GAGE BAR.
5. SLOWLY ROTATE THE VACUUM REGULATOR VALVE BODY CLOCKWISE (FACING VALVE) UNTIL VACUUM GAGE READS 27 ± 2 kpa. HOLD VALVE BODY AT THIS POSITION AND TIGHTEN MOUNTING SCREWS TO 5-7 N·m (4-5 ft. lbs.)

   NOTE: VALVE HAS BUILT IN HYSTERESIS AND MUST BE SET WHILE ROTATING VALVE BODY IN CLOCKWISE DIRECTION ONLY.
6. CHECK BY RELEASING THE THROTTLE SHAFT ALLOWING IT TO RETURN TO THE IDLE STOP POSITION. THEN ROTATE THROTTLE SHAFT BACK AGAINST THE GAGE BAR TO DETERMINE IF VACUUM GAGE READS WITHIN 27 ± 2 kpa. IF VACUUM IS OUTSIDE LIMITS, RESET VALVE.

Fig. 6C6-9--V.R.V. Adjustment LL4 Engine

G Van

Removal

1. Disconnect batteries.
2. Remove engine cover.
3. Remove intake manifold as outlined in 6.2 Liter Diesel Section (Section 6A7).
4. Install protective covers J-29664-1.
5. Remove injection line clips at loom brackets.
6. Raise vehicle (left bank only).
7. Remove injection lines at nozzles and cover nozzles with protective caps.
8. Lower vehicle (left bank only).
9. Remove injection lines at pump and tag lines for reinstallation.

Installation

1. Install injection lines as shown in Figures 6C6-10 and 6C6-11.
2. Raise and lower vehicle as necessary (left bank only).

INJECTION PUMP

CK Truck

Removal

1. Disconnect batteries.
2. Remove fan.
3. Remove fan shroud.
4. Remove intake manifold as described in 6.2 Liter Diesel Section (Section 6A7).
5. Remove fuel lines as previously outlined.
6. Disconnect accelerator cable at injection pump, and detent cable where applicable (Fig. 6C6-13).
7. Disconnect necessary wires and hoses at injection pump.
8. Disconnect fuel return line at top of injection pump.
9. Disconnect fuel feed line at injection pump.
10. Remove A/C hose retainer bracket if equipped with A/C.
11. Remove oil fill tube, includes C.D.R.V. vent hose assembly.
12. Remove grommet.
13. Scribe or paint a mark on front cover and injection pump flange.
14. It will be necessary to rotate engine in order to gain access to driven gear to injection pump retaining bolts through the oil filler neck hole (Figure 6C6-12).
15. Remove injection pump to front cover attaching nuts.
16. Remove pump and cap all open lines and nozzles.

Installation

1. Replace gasket.
2. **Align locating pin on pump hub with slot in injection pump driven gear (Figures 6C6-13 and 6C6-15).** At the same time, aligning marks.

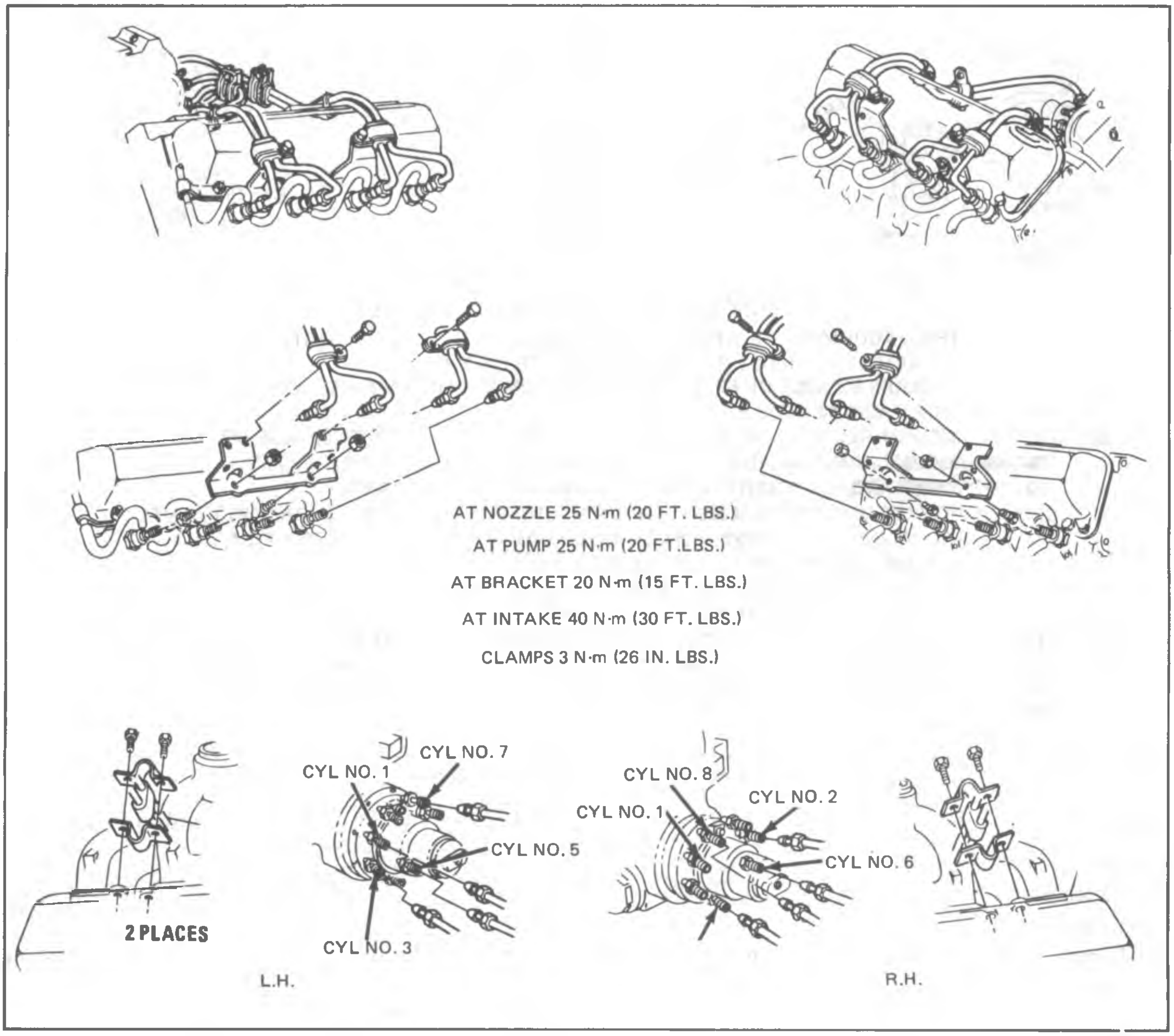


Fig. 6C6-10--Fuel Injection Lines

3. Attach injection pump to front cover, torque nuts to 40 N·m (30 ft. lbs.). Align timing marks before fully torquing nuts.
4. Install drive gear to injection pump bolts, torque bolts to 25 N·m (20 ft. lbs.).
5. Install oil fill tube, includes C.D.R.V. vent hose assembly.
6. Install grommet.
7. Install A/C hose retainer bracket if equipped.
8. Install fuel feed line at injection pump, torque to 25 N·m (20 ft. lbs.).
9. Install fuel return line at top of injection pump.
10. Connect necessary wires and hoses.
11. Connect accelerator cable.
12. Connect injection lines.
13. Install intake manifold.
14. Install fan shroud.
15. Install fan.
16. Connect batteries.
17. Start engine and check for leaks.

G Van

Removal

1. Remove intake manifold as previously outlined.
2. Remove air cleaner inlet hose (rotate snorkel up).
3. Remove hood latch, disconnect cable and move aside.
4. Remove windshield washer bottle.
5. Remove fan shroud bolts.
6. Remove upper shroud.
7. Disconnect rubber hose from oil fill tube.
8. Disconnect oil fill tube attaching nuts and remove oil fill tube.
9. Remove oil fill tube grommet.
10. Rotate engine as necessary and remove drive gear to pump bolts.
11. Remove fuel filter and bracket -- includes line to injection pump.

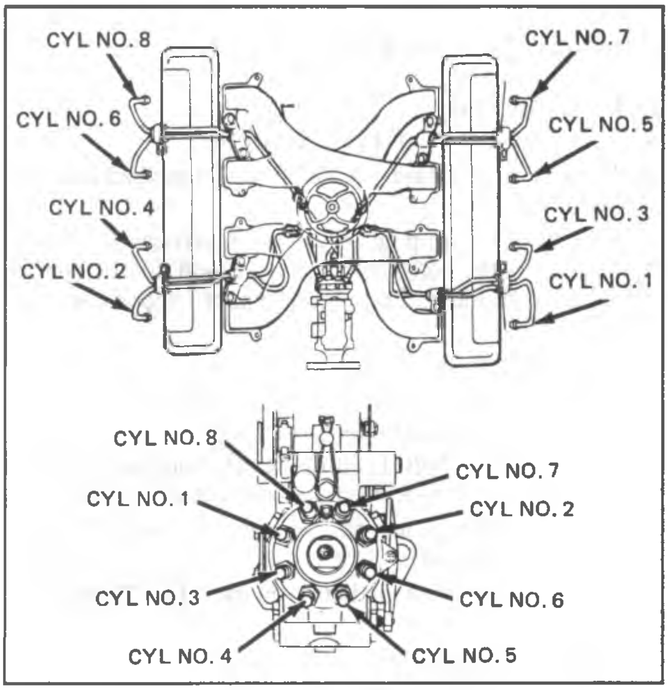


Fig. 6C6-11--Fuel Line Routing

12. Disconnect wire looms from injection lines.
13. Disconnect injection lines at brackets. Also disconnect oil pan dipstick tube at left cylinder head.
14. Disconnect electrical connections at injection pump.
15. If equipped with automatic transmission, disconnect T.V. cable.
16. Disconnect accelerator cable.
17. Disconnect injection lines at nozzles Numbers 2, 4, 5, 6, 7, 8.
18. Raise vehicle.
19. Disconnect Number 1 and 3 injection lines at nozzles.
20. Cover nozzles Numbers 1, 3, 5, 7.
21. Lower vehicle.

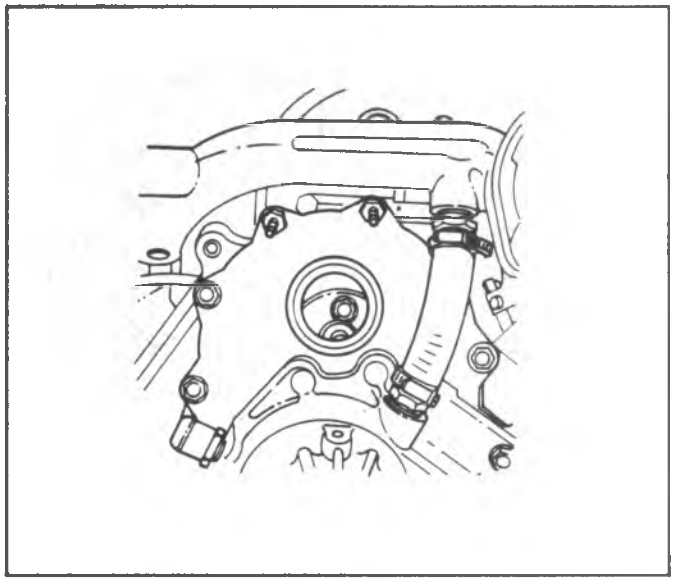


Fig. 6C6-12--Pump Drive Gear Bolts

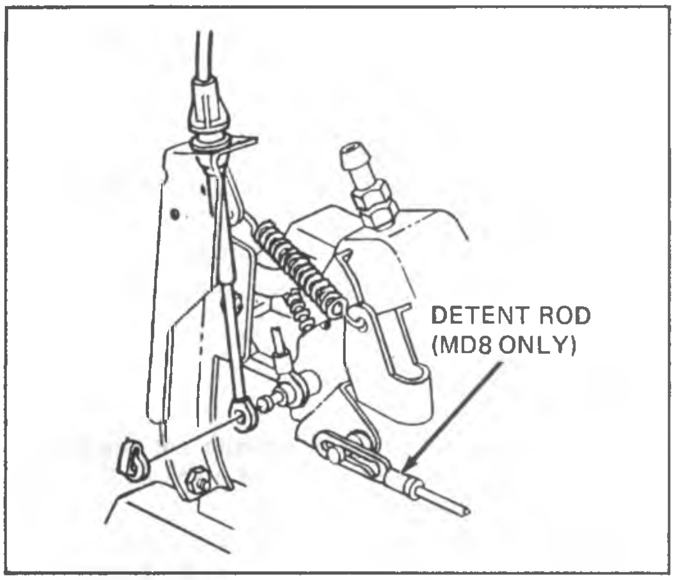


Fig. 6C6-14--Accelerator Linkage

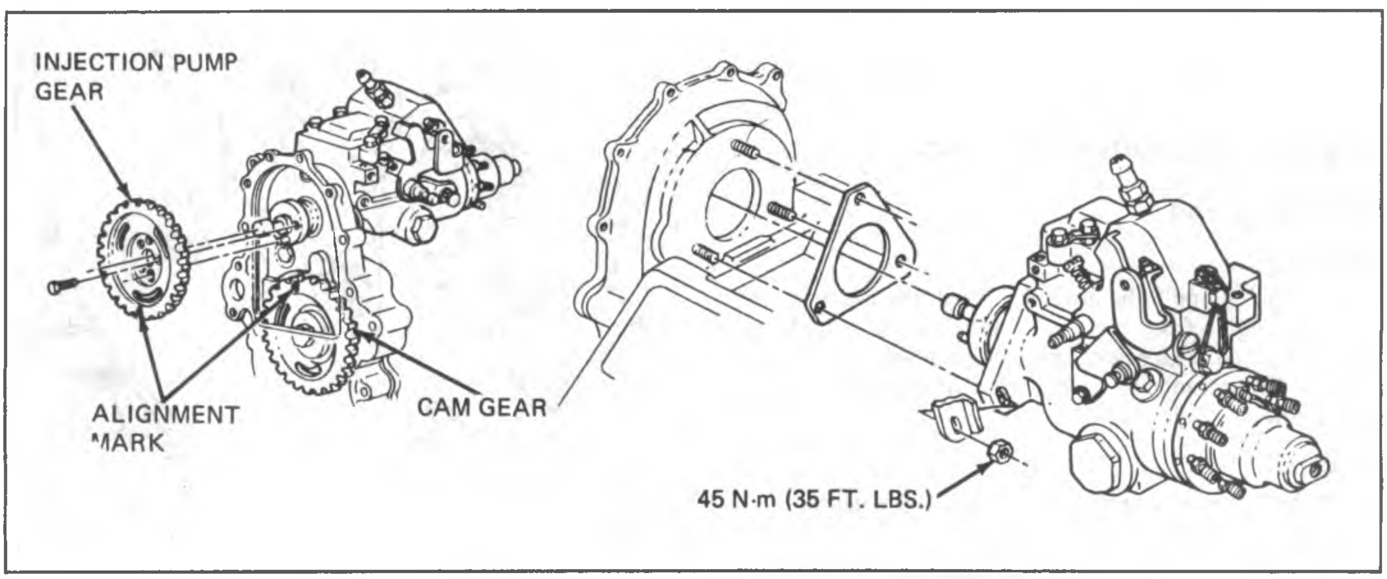


Fig. 6C6-13--Injection Pump Installation

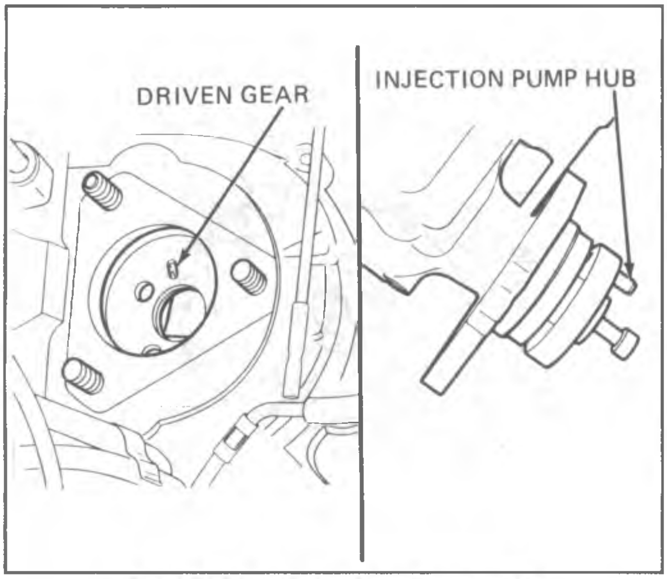


Fig. 6C6-15--Injection Pump Locating Pin

22. Cover nozzles Number 2, 4, 6, 8.
23. Disconnect injection lines at pump and remove lines. Tag lines for reinstallation.
24. Cap all lines.
25. Disconnect fuel return line.
26. Scribe a mark on front cover and pump flange for reinstallation
27. Remove pump to front cover attaching nuts.
28. Remove injection pump and cap all open discharge fittings.

Installation

1. Replace gasket.
2. **Align locating pin on pump hub with slot in injection pump gear (Figures 6C6-13 and 6C6-15).** At the same time, align timing marks.
3. Attach injection pump to front cover, torque nuts to 40 N·m (30 ft. lbs.). Align timing marks before fully torquing nuts.
4. Attach pump to drive gear, torque bolts to 25 N·m (20 ft. lbs.).
5. For the remainder of installation procedures, reverse removal steps.

CHECKING OR ADJUSTING TIMING

CK Truck, G Van

Checking

For the engine to be properly timed, the marks on the top of the engine front cover and the injection pump flange must be aligned. The engine must be off when the timing is reset. On Federal models, align scribe marks. On California models, align half circles.

Adjusting

If the marks are not aligned, adjustment is necessary.

1. Loosen the three pump retaining nuts.
2. Align mark on injection pump with mark on front cover and tighten nuts to 40 N·m (30 ft. lbs.).
3. Adjust throttle rod.

MARKING TDC ON FRONT HOUSING

CK Truck, G Van

1. Set engine to TDC #1 cylinder (firing).
2. Install timing fixture J-33042 in F.I. pump location. Do not use gasket.
3. Slot of F.I. pump gear to be in vertical 6 o'clock position - (If not, remove fixture and rotate engine crankshaft 360°). The timing marks on gears will be aligned.
4. Fasten gear to fixture, and tighten.
5. Install on 10mm nut to housing upper stud to hold fixture flange nut to be "finger" tight.
6. Torque large bolt (18mm head) counterclockwise (toward left bank) to 50 ft. lbs. Tighten 10mm nut.
7. Insure crankshaft has not rotated (and fixture did not bind on 10mm nut).
8. Strike scriber with mallet to mark "TDC" on front housing.
9. Remove timing fixture.
10. Install fuel injection pump with gasket.
11. Install one 8mm bolt to attach gear to pump hub and tighten to specification.
12. Align timing mark on F.I. pump to front housing mark. Tighten to specification (3) 10mm attachment nuts.
13. Rotate engine and install remaining (2) pump gear attaching bolts and tighten to specification.

INJECTION NOZZLE (Fig. 6C6-17)

Nozzles used in CK models and G models are different and are not interchangeable.

Removal

1. Disconnect batteries.
2. Disconnect fuel line clip.
3. Remove fuel return hose.
4. Remove fuel injection line as previously outlined.
5. Remove injection nozzle using tool J-29873 whenever possible.

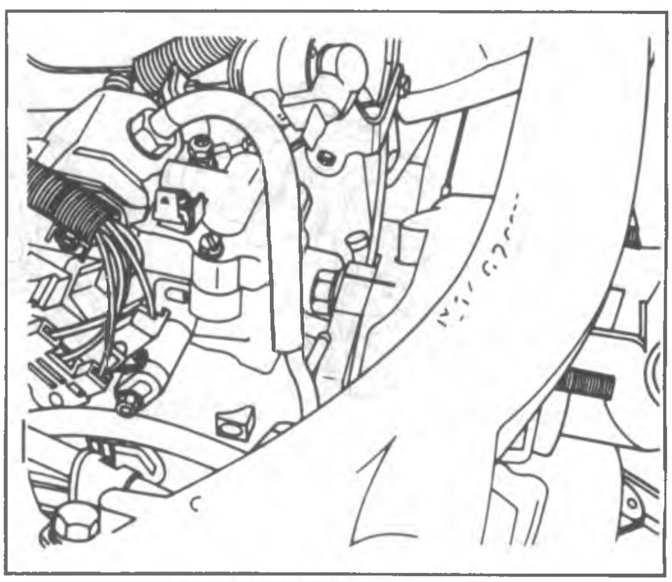


Fig. 6C6-16--Alignment Marks

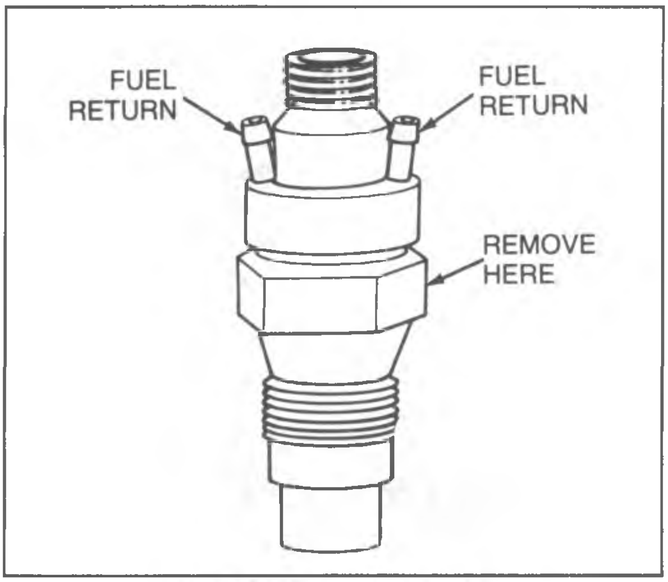


Fig. 6C6-17--Injection Nozzle

NOTICE: When removing an injection nozzle, use tool J-29873. Be sure to remove the nozzle using the 30mm hex (Fig. 6C6-17). Failure to do so will result in damage to the injection nozzle. Always cap the nozzle and lines to prevent damage and contamination.

Testing

Test is comprised of the following checks:

Nozzle Opening Pressure

Chatter

Leakage

Spray Pattern

Each test should be considered a unique test, i.e, when checking opening pressure, do not check for leakage.

If all of the above tests are satisfied, the nozzle holder assembly can be again installed in the engine without any changes. If any one of the tests is not satisfied, the complete nozzle holder assembly must be replaced. The nozzle holder will then be further checked and repaired at a centralized location.

Test Lines - 6x2x400mm (1.5mm bore).

Test Fluid per ISO 4113 (Example Shell V1399, Viscor 1487c or equivalent).

Kinetic Viscosity at 40° per ISO 3104: 2.45...2.75mm² /second.

Test Oil Temperature during Test: 20-25°C (room temperature).

Refer to the equipment manufacturers instructions for exact test procedures.

CAUTION: When testing nozzles, do not place your hands or arms near the tip of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle, preferably transparent, to contain the spray.

Test Sequence

Preparation

1. Connect the nozzle holder assembly to the test line.
2. Place clear plastic tubes on overflow connections to prevent leakoff from being confused with actual leak..
3. Close the shutoff valve to the pressure gage.
4. **Fill and flush the nozzle holder assembly with test oil by activating the lever repeatedly and briskly. This will apply test oil to all functionally important areas of the nozzle and purge it of air.**

Obtaining Pressure Check

1. Open shutoff valve at pressure gage 1/4 turn.
2. Depress lever of tester slowly. Note at what pressure the needle of the pressure gage stopped. Some nozzles may pop, other may drip down at this time (this is not leakage). The maximum observed pressure is the opening pressure.
3. The opening pressure should not fall below the lower limit of 105 bar (1500 psi on used nozzles).
4. Replace nozzles which fall below the lower limit.

Leakage Test

1. Further open shutoff valve at pressure gage (1/2 to 1-1/2 turns).
2. Blow-dry nozzle tip.
3. Depress lever of manual test stand slowly until gage reads a pressure of 95 bar (1400 psi). Observe tip of nozzle. A drop may form but not drop off within a period of 10 seconds.
4. Replace the nozzle holder assembly if a droplet drops off the nozzle bottom within the 10 seconds.

Chatter Test

When testing for chatter, it should be noted that the sound (chatter) for new and used nozzles may vary.

On used nozzles, carbonized fuel oil deposited on the pintle and on the nozzle tip produces different sound (chatter) between new and used nozzles on the test stand.

With some used nozzles, the chatter is difficult to detect during slow actuation of the hand test stand lever. Some nozzles may chatter more (louder) than others. As long as there is chatter, the nozzle is acceptable.

1. Close shutoff lever at pressure gage.
2. Depress lever of manual test stand slowly noting whether chatter noises can be heard.
3. If no chatter is heard, **increase the speed of lever movement until it reaches a point where the nozzle chatters.** At fast lever movement, the nozzle may emit a "hissing" or "squealing" sound rather than the normal "chatter", this is acceptable.
4. These sounds indicate that the nozzle needle moves freely and that the nozzle seat, guide, as well as the pintle, have no mechanical defects.
5. Replace nozzles which do not chatter.

Spray Pattern

This nozzle features a longer nozzle overlap, greater pintle to body clearance, and greater needle to body clearance. This assembly also features an internal wave

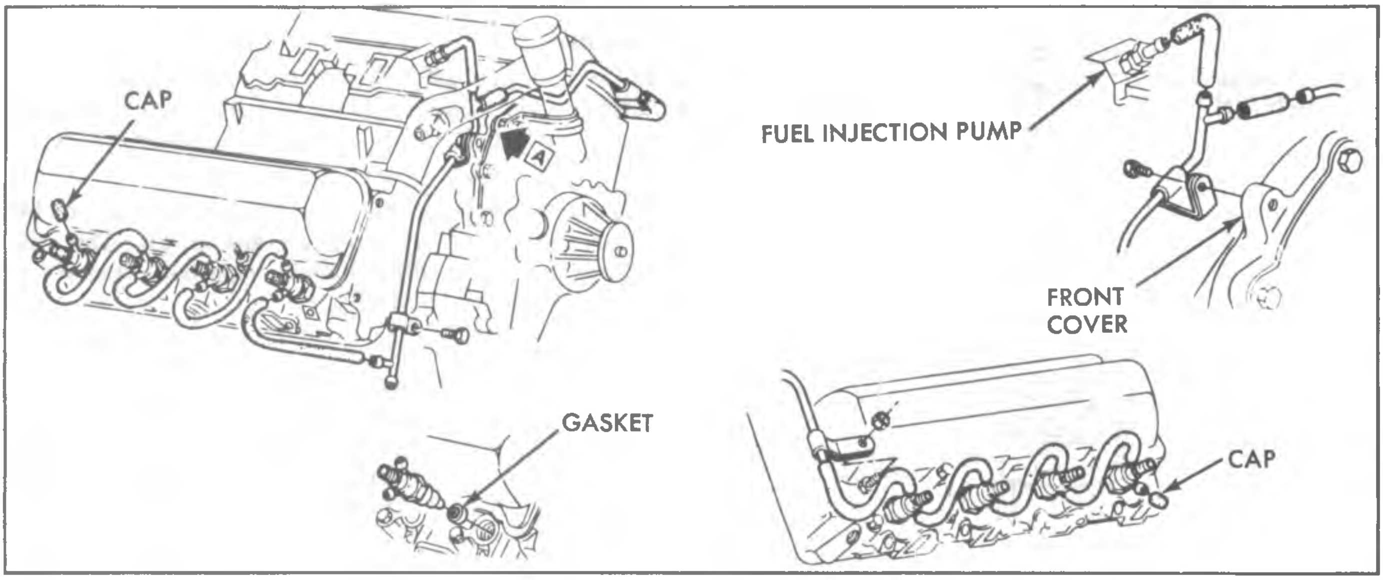


Fig. 6C6-18--Nozzle Installation

washer between the nozzle nut and nozzle. Because of these features, objective testing is difficult. A **pop tester will not deliver fuel with the velocity necessary to obtain proper spray pattern analysis. Based on the above, this type nozzle should not be rejected for spray pattern.**

Installation (Fig. 6C6-18)

1. Remove protective caps from nozzle.
2. Install nozzle and torque to 70 N·m (50 ft. lbs.).
3. Connect fuel injection line, torque nut to 25 N·m (20 ft. lbs.).
4. Install fuel return hose.
5. Install fuel line clip.
6. Connect battery.

INJECTION PUMP ON VEHICLE SERVICE

There are areas on the injection pump where leaks can be corrected without removing the pump from the engine.

PUMP COVER SEAL AND/OR GUIDE STUD SEAL REPLACEMENT

1. Disconnect the negative cables from both batteries.
2. Remove the air cleaner and intake. Install screens J-29664 in the cylinder head.
3. Disconnect the injection pump fuel solenoid and housing pressure cold advance wires and the fuel return pipe.
4. Remove top attaching bolt and loosen lower attaching bolts on fast idle solenoid and move solenoid aside.
5. Clean the injection pump cover, upper portion of the pump and the guide stud area. Place several rags in engine valley to catch fuel.
6. Remove injection pump cover and remove screws from the cover.

   NOTICE: Extreme care must be exercised to keep foreign material out of the pump when the cover is off. If any objects are dropped into the pump, they must be removed before the engine is started or injection pump damage or engine damage could occur. STEPS 7, 8 and 9 ARE FOR GUIDE STUD SEAL REPLACEMENT ONLY.
7. Observe position of metering valve spring over the top of the guide stud. This position must be exactly duplicated during reassembly (Fig. 6C6-20).
8. Remove the guide stud and washer. Note location of parts prior to removal.
9. Reinstall the guide stud with a new washer making certain that the upper extension of the metering valve spring rides on top of the guide stud. Torque the guide stud to 9.5 N·m (85 in. lbs.). Overtorquing the guide stud may strip the aluminum threads in the housing
10. Hold the throttle in the idle position.
11. Install new pump cover seal. Make sure the screws are not in the cover and position the cover about 1/4 inch forward (toward shaft end) and about 1/8 inch above the pump (Fig. 6C6-21).
12. Move the cover rearward and downward into position, being careful not to cut the seal and reinstall the cover screws. Be careful not to drop or lose flat washer and internal lock washer with each screw. Flat washer must be against pump cover. Torque to 3.7 N·m (33 in. lbs.).
13. Reconnect the negative cables to both batteries.
14. Turn the ignition switch to the run position and touch the pink solenoid wire to the solenoid. A clicking noise should be heard as the wire is connected and disconnected. If this clicking is not observed, the linkage may be jammed in a wide open throttle position and the engine MUST NOT be started, go to Step 15. If clicking is observed, connect the pump solenoid and housing pressure cold advance wires (Fig. 6C6-22) then proceed to Step 17.
15. Remove the cover. Ground the solenoid lead (opposite the hot lead) and connect the pink wire. With the ignition switch in the run position, the solenoid in the cover should move the linkage. If not, the solenoid must be replaced. Minimum voltage across solenoid terminals must be 12.0.

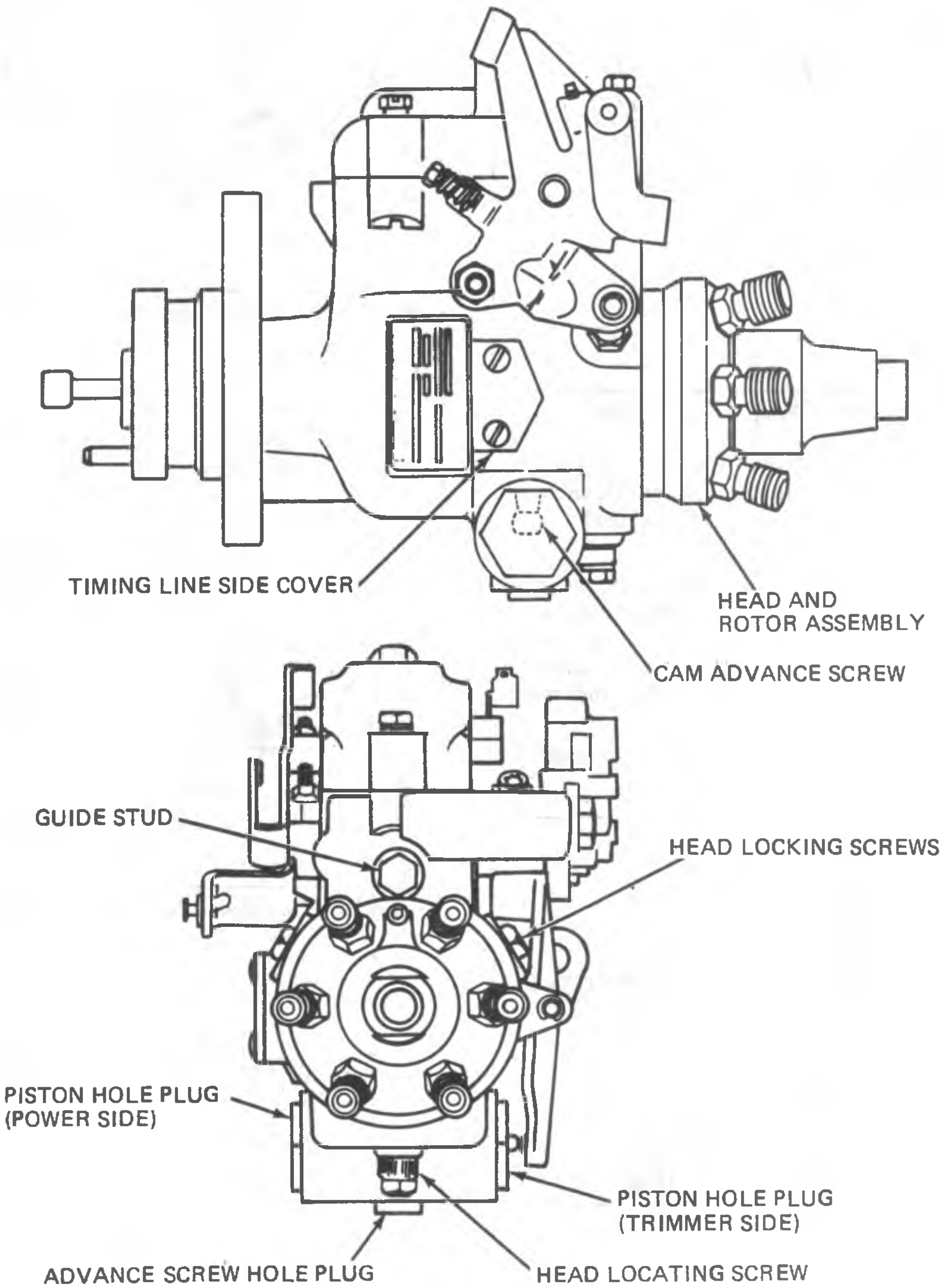


Fig. 6C6-19--Injection Pump Components Location

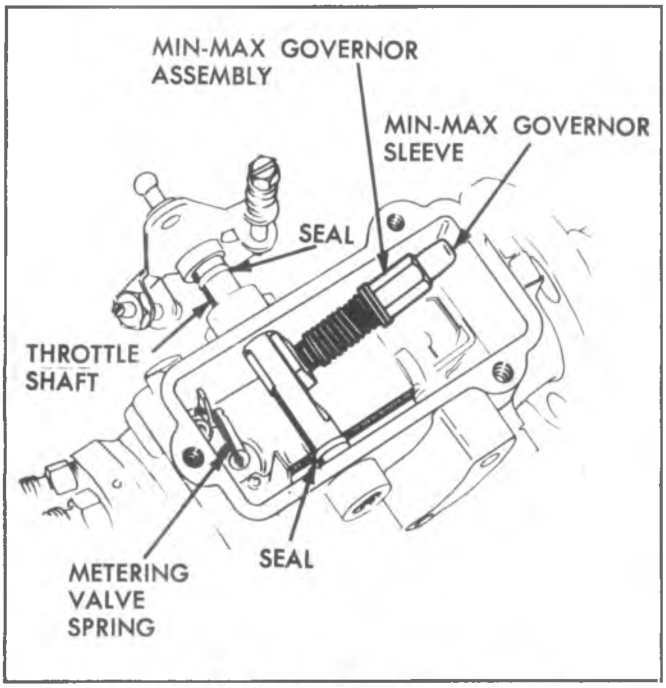


Fig. 6C6-20--Injection Pump Cover Removed

16. Reinstall the cover and repeat Step 11, 12, 13, and 14.
17. Reinstall the fuel return pipe and the throttle cable and return springs, and reposition fast idle solenoid.
18. Start the engine and check for leaks.
19. Idle roughness may be observed due to the air in the pump, give it plenty of time to purge which it will do by allowing the engine to idle. It may be necessary to shut the engine down for several minutes to allow air bubbles to rise to the top of the pump where they will be purged.
20. Remove the intake manifold screens, then reinstall the intake and air cleaner.

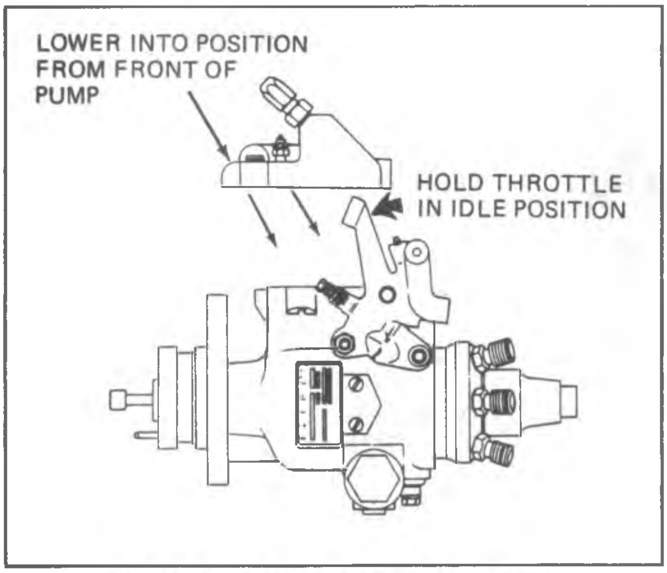


Fig. 6C6-21--Installing Injection Pump Cover

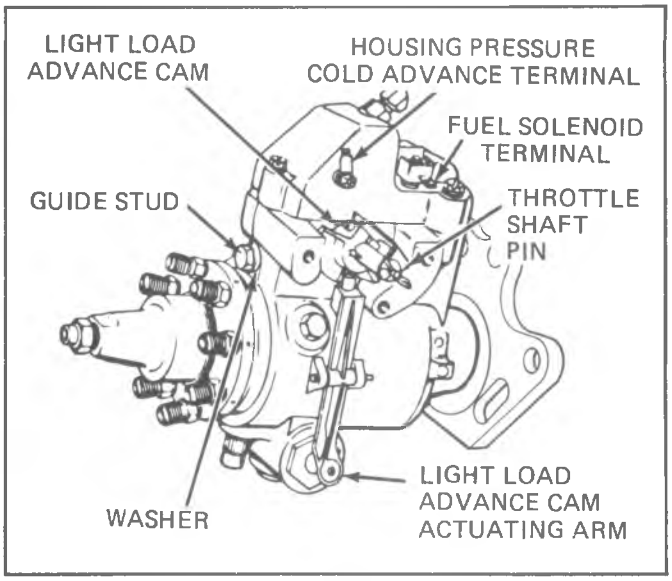


Fig. 6C6-22--Injection Pump Housing Right Side View Typical

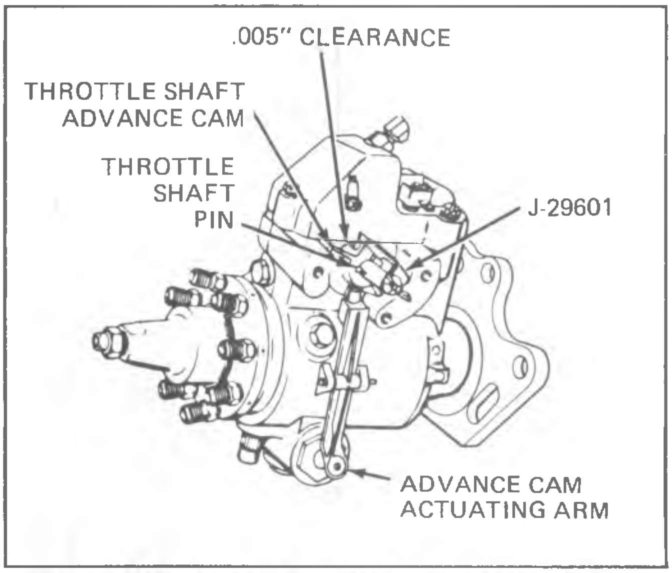


Fig. 6C6-23--Injection Pump With Tool J29601 Installed

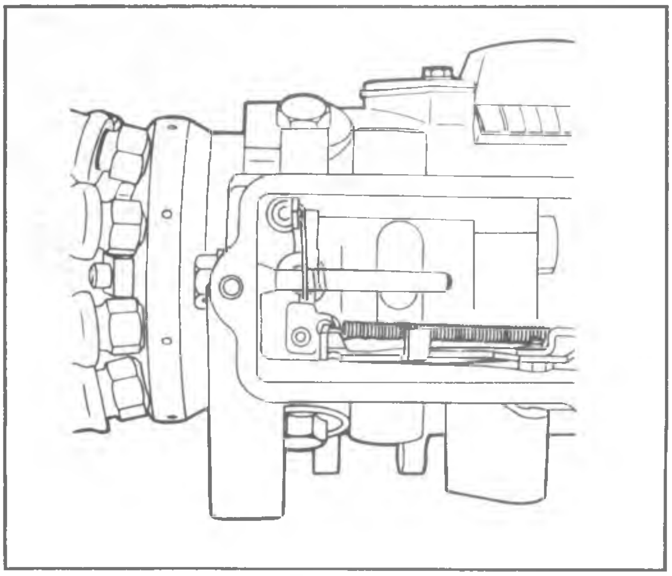


Fig. 6C6-24--Metering Valve Spring Position

2. Remove the air cleaner and intake. Install screens in the cylinder head J-29664.
3. Disconnect the injection pump fuel solenoid and housing pressure cold advance wires and the fuel return pipe.
4. Mark the position of the T.P.S. switch or vacuum regulator valve for reinstallation, remove the throttle rod and return springs. Loosen and move aside the fast idle solenoid.
5. Remove the throttle cable bracket.
6. Install tool J-29601 over the throttle shaft with slots of tool engaging pin. Put the spring clip over the throttle shaft advance cam and tighten the wing nut. Without loosening the wingnut, pull the tool off the shaft. (This provides the proper alignment on reassembly) (Fig. 6C6-23). Loosen face cam screw.
7. Drive the pin from the throttle shaft and remove the throttle shaft advance cam and fiber washer. Remove any burrs from the shaft that may have resulted from pin removal.
8. Clean the injection pump cover, upper portion the pump, the throttle shaft and the guide stud area. Place several rags in the engine valley to catch fuel.
9. Remove injection pump cover and remove screws from the cover.

NOTICE: Extreme care must be exercised to keep foreign material out of the pump when the cover is off. If any objects are dropped into the pump, they must be removed before the engine is started or injection pump damage or engine damage could occur.

10. Observe position at metering valve spring over the top of the guide stud. This position must be exactly duplicated during reassembly (Fig. 6C6-24).
11. Remove the guide stud and washer. Note location of parts prior to removal.
12. Rotate the min-max governor assembly up to provide clearance and remove from the throttle shaft (Fig. 6C6-20). If idle governor spring becomes disengaged from throttle block, it must be reinstalled with tightly wound coils toward throttle block.
13. Remove the throttle shaft assembly and examine the shaft for unusual wear or damage, replace if required.
14. Examine the throttle shaft bushings in the pump housing for any evidence of damage or unusual wear and leaks. Remove the pump and send to the local Stanadyne dealer if bushing replacement is necessary.
15. Remove the throttle shaft seals. Do not attempt to cut the seals to remove, as nicks in the seal seat will cause leakage.
16. Install new shaft seals using care not to cut the seals on the sharp edges of the shaft. Apply J-33198 Synkut oil or a light coating of clean chassis grease on the seals.
17. Carefully slide the throttle shaft back into the pump to the point where the min-max governor assembly will slide back onto the throttle shaft (Fig. 6C6-20).
18. Rotate the min-max governor assembly downward, hold in position and slide the throttle shaft and governor into position.
19. Install a new mylar washer, the throttle shaft advance cam, (do not tighten cam screw at this time), and a new throttle shaft drive pin (Fig. 6C6-22).
20. Align the throttle shaft advance cam so tool J-29601 can be reinstalled over the throttle shaft, pin in the slots and the spring clip over the advance cam.
21. Insert a .005" feeler gage beteeen the white washer on the throttle shaft and the pump housing. Squeeze the throttle shaft and tighten the cam screw. Torque to 3.1 N·m (30 in. lbs.) and secure with Loctite 290 or equivalent. Remove tool J-29601 (Fig. 6C6-25).
22. Reinstall the guide stud with a new washer, making certain that the upper extension of the metering valve spring rides on top of the guide stud. Torque the guide stud to 9.5 N·m (85 in. lbs.). Overtorquing the guide stud may strip the aluminum threads in the housing (Fig. 6C6-22).
23. Hold the throttle in the idle position.
24. Install new pump cover seal. Make sure the screws are not in the cover and position the cover about 1/4 inch forward (toward shaft end) and about 1/8 inch above the pump (Fig. 6C6-21).
25. Move the cover rearward and downward into position, being careful not to cut the seal and reinstall the cover screws. Be careful not to drop and lose flat washer and internal lock washer with each screw. Flat washer must be against pump cover. Torque to 3.7 N·m (33 in. lbs.). Install vacuum regulator valve or T.P.S. switch as outlined.
26. Reconnect the negative cables to both batteries.
27. Turn the ignition switch to the run position and touch the pink solenoid wire to the solenoid. A clicking noise should be heard as the wire is connected and disconnected. If this clicking is not observed, the linkage may be jammed in a wide open throttle position and the engine MUST NOT be started. If clicking is observed, connect the pump solenoid and housing pressure cold advance wires (Fig. 6C6-22), then proceed to Step 30.
28. Remove the cover. Ground the solenoid lead (opposite the hot lead) and connect the pink wire. With the ignition switch in the run position, the solenoid in the cover should move the linkage. If not, the solenoid must be replaced. Minimum voltage across solenoid terminals must be 12.0.
29. Reinstall the cover and repeat Step 27.
30. Reinstall throttle cable bracket, detent cable and fast idle solenoid.
31. Reinstall the throttle cable and return springs. Make sure the timing mark on the pump and housing are aligned and make sure the nuts attaching pump to the housing are tight. Install fuel return pipe.
32. Start the engine and check for leaks.
33. Idle roughness may be observed due to the air in the pump, give it plenty of time to purge which it will do by allowing the engine to idle. It may be necessary to shut the engine down for several minutes to allow air bubbles to rise to the top of the pump where they will be purged.
34. Remove the head screens, then reinstall the intake and air cleaner.

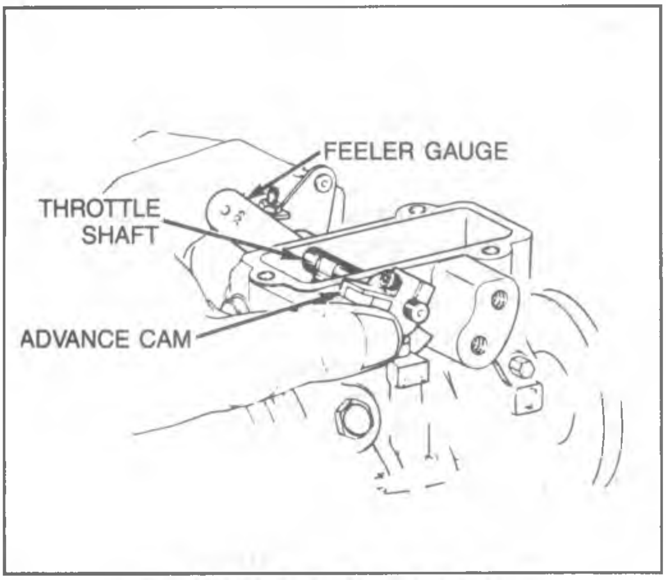


Fig. 6C6-25--Feeler Gage Installation

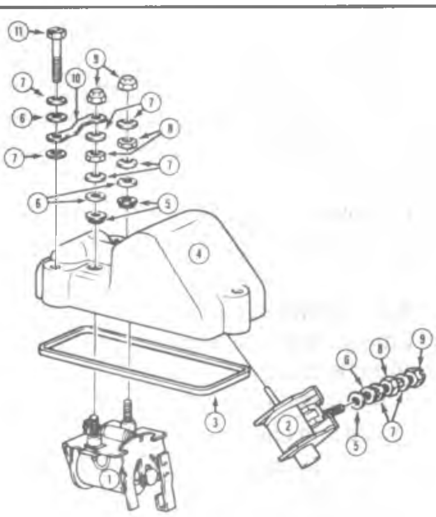
SOLENOIDS (Fig. 6C6-26)

Removal

1. Remove the pump cover, see "Pump Cover Seal".
2. Remove the terminal contact nut(s) and remove the solenoid from the cover noting the position of any insulating washers.

Installation

1. Place the solenoid in the cover making certain on the shut off solenoid that the linkage is free and on the housing pressure cold advance solenoid that the plunger is centered so that it will contact the fitting check ball.
2. Place the insulating washers on the terminal studs (where used) and install the terminal nuts. Torque the nuts to 1.00-1.5 N·m (10-15 in. lbs.).
3. Check the operation of the solenoid prior to installing the pump cover with the use of a 12V (min) DC power source. Make certain that the shut off linkage is free if that solenoid was replaced.
4. Install the pump cover, see "Pump Cover Seal", Steps 9 through 19.



1. Shutdown Solenoid Assembly
2. Cold Advance Solenoid
3. Governor Control Cover Gasket
4. Governor Control Cover
5. Terminal Insulating Washer
6. Plain Washers
7. Lockwashers
8. Nut
9. Nut, Terminal Contact
10. Terminal Grounding Strap
11. Governor Control Cover Screw

Fig. 6C6-26--Solenoids

1. Return Line Connector
2. Cover, Governor Control
3. Screw
4. Lockwasher or Plain Washer
5. Governor Cover Gasket
6. Vent Screw Assembly
7. Head Locking Screw
8. Pressure Tap Screw
9. Seal
10. Housing
11. Screw
12. Timing Line Cover
13. Timing Line Cover Gasket

Fig. 6C6-27--Side Housing and Drive Group

SIDE COVER GASKET (Fig. 6C6-27)

Removal

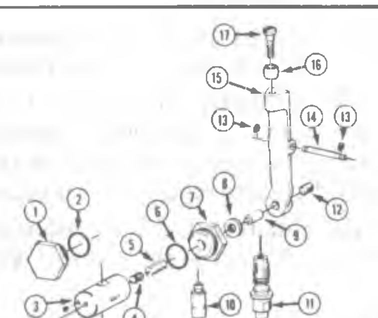
1. Remove the 2 screws, cover and gasket.

Installation

1. Install the gasket, cover and two screws, torque the screws to 1.5-2.5 N·m (15-20 in. lbs.).

INJECTION PUMP OFF-VEHICLE SERVICE

Refer to Injection Pump removal. Off-vehicle service operations require a leak test after repair. See Pressure Testing.



1. Power Side Plug
2. "O" Ring Seal
3. Piston Assembly
4. Servo Advance Valve
5. Mechanical Light Load
6. "O" Ring Seal
7. Spring Side Plug
8. Washer
9. Servo Advance Plunger
10. Cam Advance Pin
11. Head Locating Screw
12. Servo Advance Adjusting Screw (DO NOT ADJUST)
13. Retaining Ring
14. Rocker Lever Pin
15. Rocker Lever
16. Roller
17. Screw
18. "O" Ring
19. Cam Advance Pin Hole Plug

Fig. 6C6-28--Automatic Advance Group

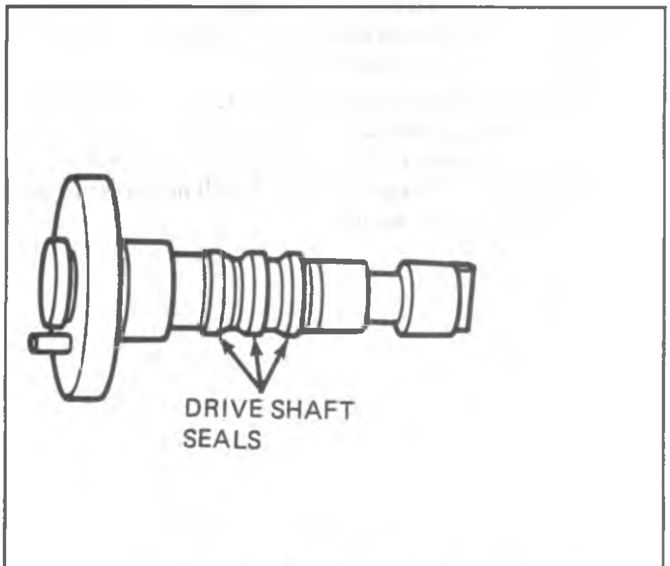


Fig. 6C6-29--Drive Shaft Seal Removal

ADVANCE PIN HOLE PLUG SEAL (Fig. 6C6-28)

Removal

1. Tap the advance pin hold plug lightly with a hammer to loosen.
2. Loosen and remove the plug, remove the seal and do not reuse it.

Installation

1. Lube a new seal and install it on the plug.
2. Install the plug and torque it to 8.5-11.0 N·m (75-100 in. lbs.).

AUTO ADVANCE SEALS (Fig. 6C6-28)

Removal

1. Remove the advance pin hole plug as stated in "ADVANCE PIN HOLE PLUG".
2. Remove the spring side advance piston hold plug.
3. Remove the plug, piston, spring and slide washer.
4. Remove the power side advance piston hole plug.
5. Remove the plug, piston and slide washer.
6. Disassemble both plugs and pistons.

Installation

1. Lube the new seals and reassemble as shwon in Fig. 6C6-28.
2. Torque the plugs to 27 N·m (20 ft. lbs.).
3. Install the advance screw hole plug using a new seal. Torque to 8.5-11.0 N·m (75-100 in. lbs.).

HYDRAULIC HEAD SEAL - O-RING

Removal

1. Remove the throttle shaft and seals, see "THROTTLE SHAFT SEAL REPLACEMENT".
2. Remove the metering valve (Fig. 6C6-20).
3. Remove the housing vent screw assembly (Fig. 6C6-27).
4. Remove the advance pin hole plug , see "ADVANCE PIN HOLE PLUG".
5. Remove the Advance Pin (Fig. 6C6-28).
6. Locate the pump assembly and holding fixture so that the rear of pump is slopeing down and remove the head locating screws and seal.
7. Using a twisting motion, remove the hydraulic head assembly. Remove the "O" ring seal.

Installation

1. Install a new hydraulic head seal and lube it.
2. Install the head assembly into the pump housing, lube and install the two head locking screws finger tight. Turn the pump upside down.
3. Lube and install a new seal on the head locating screw and install the screw torquing it to 20-25 N·m (15-18 ft. lbs.) (Fig. 6C6-28).
4. Torque the head locking screws to 20-25 N·m (15-18 ft. lbs.) (Fig. 6C6-27).
5. Install the advance pin (Fig. 6C6-18).
6. Install the advance pin hole plug and seal. See "ADVANCE PIN HOLE PLUG".
7. Move the pump so the cover opening is up, and install the metering valve.
8. Install the throttle shaft, seals and pump cover, see "THROTTLE SHAFT AND SEALS".

DRIVE SHAFT SEAL REPLACEMENT

Removal

1. Disconnect necessary wires, hoses and cables from the injection pump.
2. Remove the injection pump as outlined previously.
3. Mount the pump in holding fixture J-29692-B, and tilt the pump slightly towards you.
4. Remove the fast idle solenoid bracket.
5. Remove drive shaft from pump with a rotating motion while pulling on shaft. Shaft is retained by "O" ring clip.
6. Remove the drive shaft (alignment pin at top).
7. Remove and discard the drive shaft seals.

Installation

1. Install new seals using tool J-29745-A.
2. Lubricate the seal installer with Synkut oil J-33198 or the equivalent.
3. Install one black seal.
4. Relubricate the seal installer and install the red seal.
5. Relubricate the seal installer and install the last black seal.
6. Install a new "O" ring retaining clip on the drive shaft.
7. Carefully install the drive shaft, making sure that the drill points on the drive shaft end and the rotor are matched.
8. Install the fast idle solenoid bracket.
9. Install the pump as previously outlined.

PRESSURE TESTING

1. Drain all fuel from the pump.
2. Connect an air line to the pump inlet connection. Be certain that the air supply is clean and dry.
3. Seal off the return line fitting and completely immerse the pump in a bath of clean test oil.
4. Raise the air pressure in the pump to 137.9 kpa (20 psi). Leave the pump immersed in the oil for 10 minutes to allow any trapped air to escape.
5. Watch for leaks after the 10 minute period. If the pump is not leaking, reduce the air pressure to 13.8 kpa (2 psi) for 30 seconds. If there is still no leak, increase the pressure to 137.9 kpa (20 psi). If still no leaks are seen, the pump is ready for use.

SECTION 6C7

CARBURETOR MODEL 1ME

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GENERAL DESCRIPTION

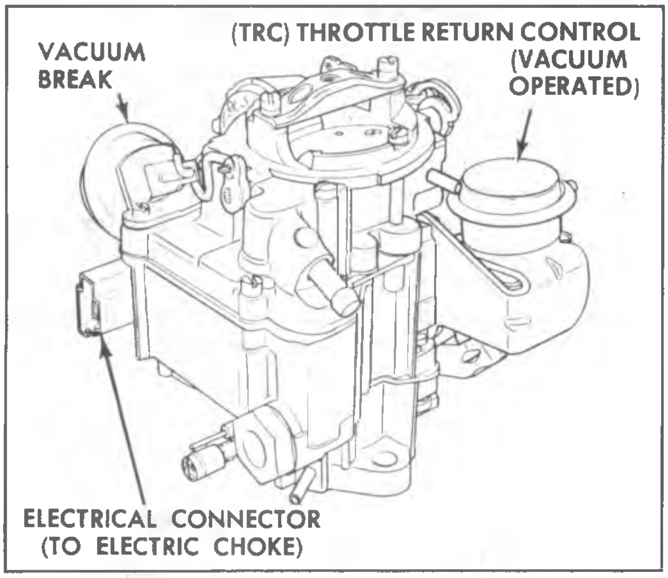


Fig. 6C7-1--Model 1ME Carburetor

The Model 1ME, carburetor (Fig. 6C7-1) is a single bore downdraft carburetor using a triple venturi in conjunction with a plain tube nozzle.

Fuel flow through the main metering system is controlled by a main well air bleed and a variable orifice jet. A power enrichment system is used to provide good performance during moderate to heavy acceleration and at higher engine speeds.

The model 1ME incorporates an integral automatic choke system which uses an electrically heated choke coil. The vacuum diaphragm unit is mounted externally on the air horn and connects to the thermostatic coil lever through a connecting link.

The electric choke coil is contained in a choke housing mounted on a bracket attached to the float bowl. Special rivets are installed to retain the factory setting of the choke coil and provide a non-adjustable design.

An integral, pleated-paper fuel inlet filter is mounted in the fuel bowl behind the fuel inlet nut to give maximum filtraton of incoming fuel. A check valve is used in the filter inlet to prevent fuel draining from the fuel system after roll-over.

To improve hot engine starting and meet evaporative emission requirements, fuel vapors from the carburetor bowl are vented to the vapor canister on some models. A tube (location F) is added to the air horn to connect air horn and canister.

Other features of the Model 1ME carburetor include an aluminum throttle body for decreased weight and improved heat distribution and a thick throttle body to bowl insulator gasket to keep excessive engine heat from the float bowl.

On California models, seals have been added in the float bowl to seal the power piston drive rod and the pump lever to prevent escape of fuel vapors to atmosphere. During unit repair, the seals and retainer, where used, must be removed prior to immersion of the float bowl in carburetor cleaner.

The carburetor model identification is stamped on a vertical portion of the float bowl, adjacent to the fuel inlet nut (Fig. 6C7-2).

If replacing the float bowl, follow the manufacturer's instructions contained in the service package so that the identification number can be transferred to the new float bowl.

An electrically operated idle stop solenoid is used on all models.

Dual throttle return springs are used on all carburetors.

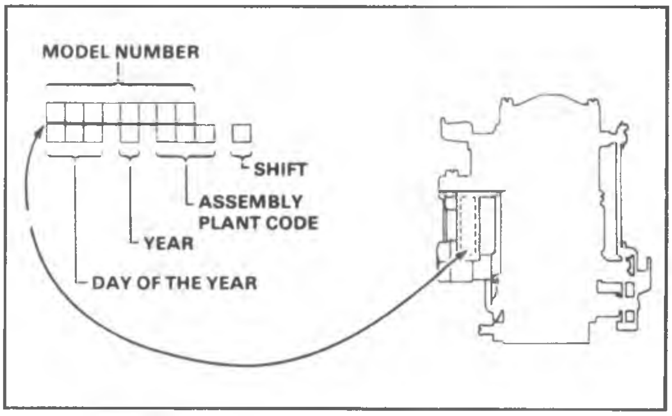


Fig. 6C7-2--Model 1ME Carburetor Identification

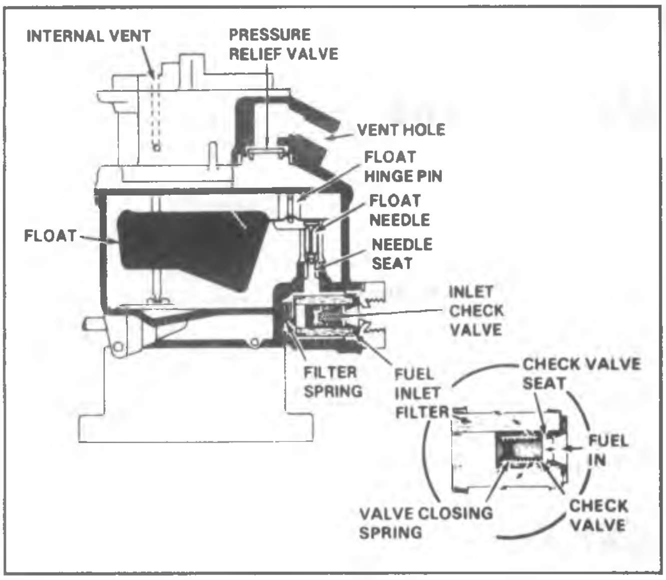


Fig. 6C7-3--Float System

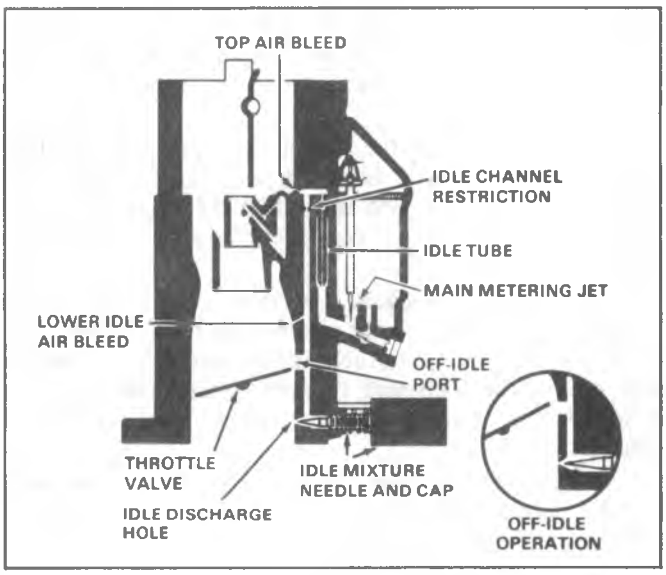


Fig. 6C7-4--Idle System

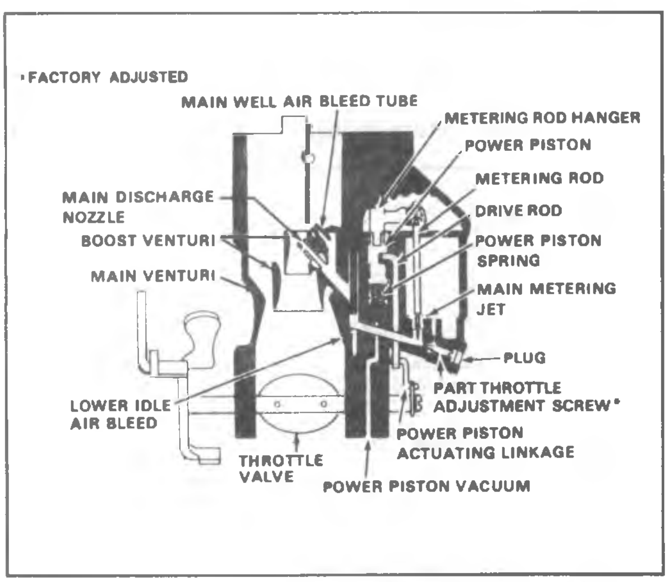


Fig. 6C7-5--Main Metering System Typical

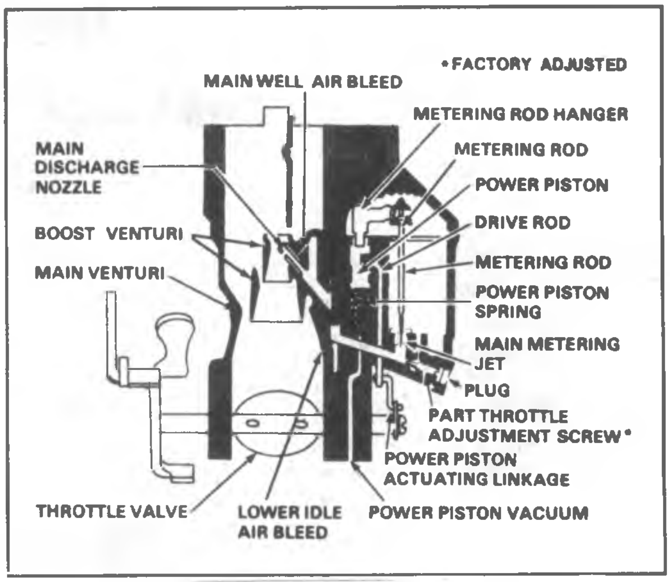


Fig. 6C7-6--Power Enrichment System

The throttle lever has a spun-in plastic bushing, this is used as the bearing surface for the dual throttle return springs.

The spun-in plastic return spring bushing will withstand normal cleaning time in an approved cold immersion type carburetor cleaner. The bushing is not serviced separately and should not be removed from the carburetor throttle lever.

Six basic systems of operation are used: float, idle, main metering, power enrichment, pump and choke (6C7-3 through 8).

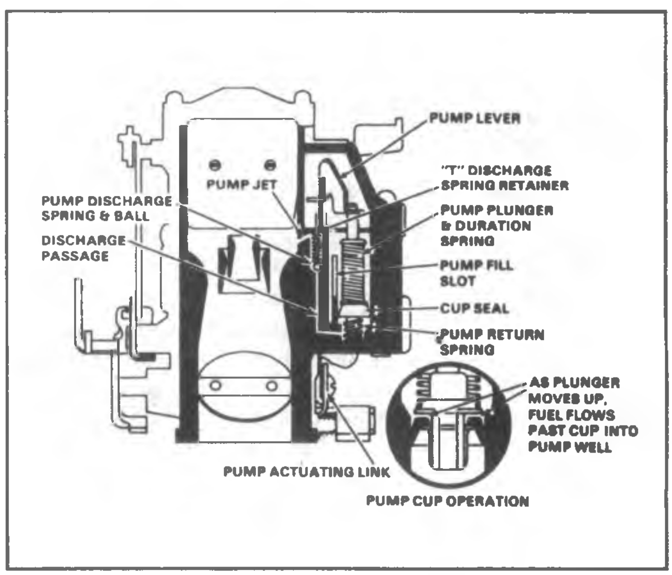


Fig. 6C7-7--Pump System

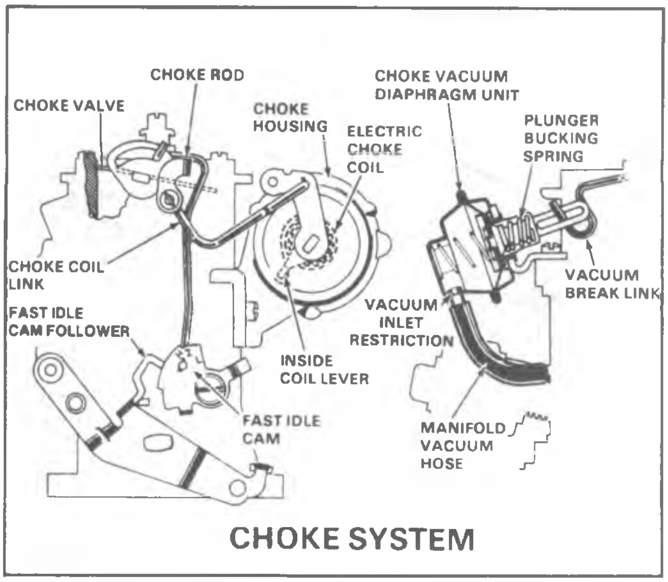


Fig. 6C7-8--Choke System

ON-VEHICLE SERVICE

CHOKE CHECKING PROCEDURE

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.
2. If choke or linkage binds, sticks, or works sluggishly, clean with Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. Refer to disassembly instructions for additional direction if cleaning does not correct.
3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspects hoses for cracks, abrasions, hardness or other signs of deterioration. Replace or correct as necessary.
4. Make sure vacuum break diaphragm shaft is fully extended when engine is off. If shaft is not fully extended, replace vacuum break assembly. Start engine – vacuum break diaphragm shaft should fully retract within 10 seconds. If unit fails to retract, replace vacuum break assembly.
5. Allow choke to cool so that when throttle is opened slightly choke blade fully closes. This check must be performed at an ambient temperature of 16°C to 27°C (60°F to 80°F).
6. Start engine and determine time for choke blade to reach full open position. (Start timer when engine starts).
7. If the choke blade fails to open fully within 3-1/2 minutes, proceed with steps 8-9-10 below.
8. Check voltage at the choke heater connection. (Engine must be running). If the voltage is approximately 12-15 volts, replace the electric choke unit.
9. If the voltage is low or zero, check all wires and connections. If the connections at the oil pressure switch are faulty, the oil warning light will be off with the key "on" and engine off. If the fuse is blown, the radio or turn signal indicator will be inoperative. Repair wires or replace fuses as required.
10. If step 9 is good, replace oil pressure switch.

No gasket is used between the choke cover and the choke housing due to grounding requirements.

CHECKING SOLENOID

1. Turn on ignition, but do not start engine.
2. Open throttle to allow solenoid plunger to extend.
3. Hold throttle lever wide open, feel end of plunger and disconnect wire at solenoid.
4. Plunger should move. Some spring tension should be felt.
5. If plunger did not move, back out 1/8 hex screw (counterclockwise) one full turn and repeat steps 3 and 4.
6. If plunger moves in step 5, connect wire to solenoid and adjust idle speed.
7. If plunger did not move in step 5 insert test lamp (1893 bulb or smaller) between solenoid feed wire and ground.
8. If lamp lights, replace solenoid.
9. If lamp does not light, locate cause of open circuit in solenoid feed wire.

CARBURETOR ADJUSTMENTS

A carburetor is designed to meet the particular requirements of the engine, transmission and vehicle and although they may look alike, they are not usually interchangeable. Refer to carburetor part number and/or specifications when making adjustments.

Before checking or resetting the carburetor as the cause of poor engine performance or rough idle; check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts.

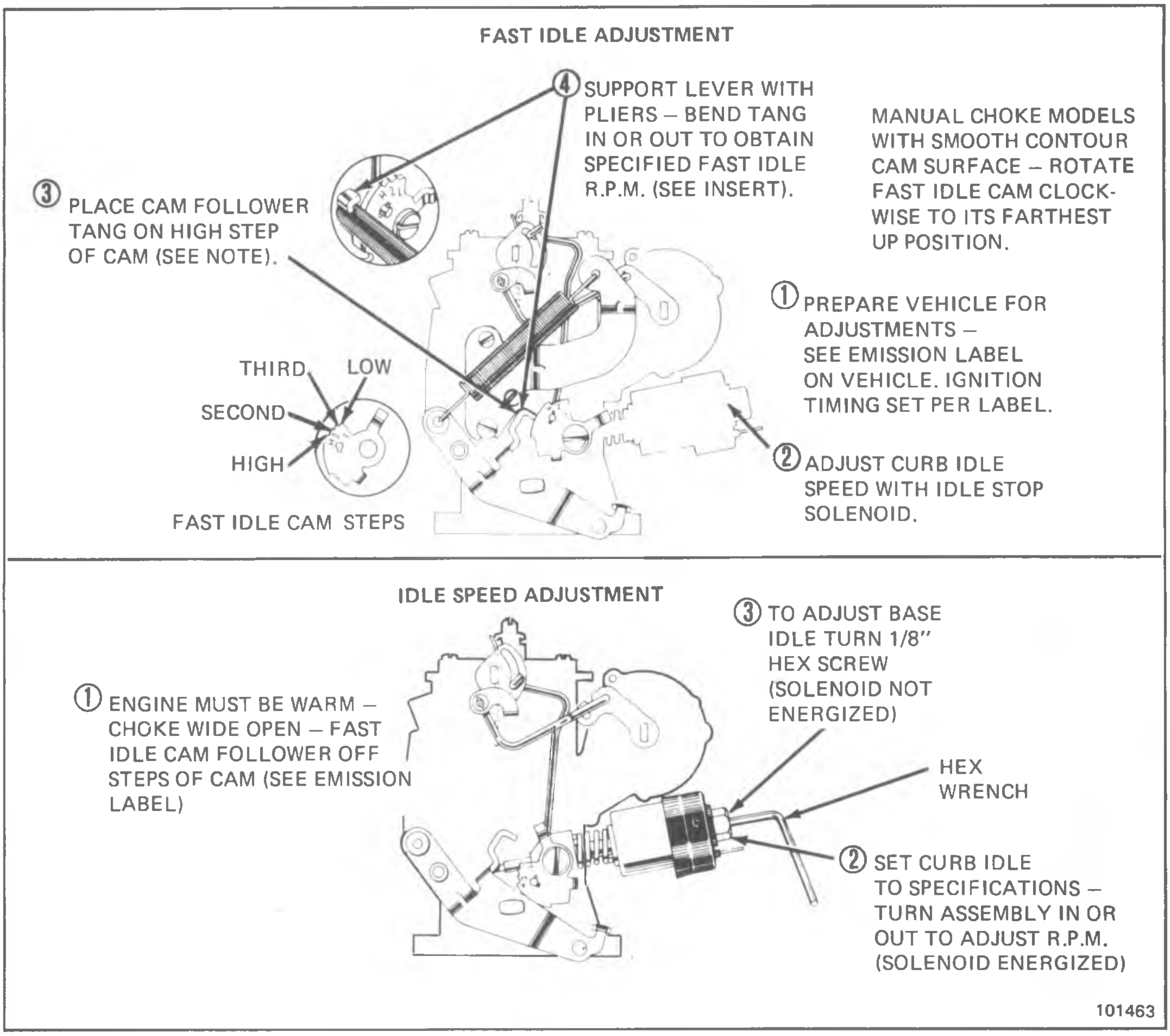


Fig. 6C7-9--Speed Adjustments

Make all adjustments with engine at normal operating temperature, choke full open, air cleaner installed. Except as noted, air conditioning should be "off" and all vacuum lines and all electrical leads connected. Set parking brake and block drive wheels. Air cleaner can be removed for set-up accessibility but must be completely installed during actual setting.

Refer to Figure 6C7-9 for fast idle and idle speed adjustments.

IDLE MIXTURE ADJUSTMENT (LEAN DROP)

1. Set parking brake and block drive wheels.
2. Remove air cleaner for access to carburetor, but keep vacuum hoses connected.
3. Disconnect and plug other hoses, as directed on Vehicle Emission Control information label under the hood.
4. Place transmission in Neutral or Park.
5. Start engine and bring to normal operating temperature, choke open, air conditioning off.
6. Connect an ACCURATE tachometer to engine.
7. Disconnect vacuum advance and plug hose. Check ignition timing. If necessary, adjust to specification shown on Vehicle Emission Control Information label. Reconnect vacuum advance.
8. Carefully remove cap from idle mixture screw. Be careful not to bend screw. Lightly seat screw, then back out just enough so engine will run.
9. Back screw out (richen) 1/8 turn at a time until maximum idle speed is obtained. Then set idle speed to higher value shown on Vehicle Emission Control Information label. Repeat step 9 to be certain you have maximum idle speed.
10. Turn screw in (lean) with 1/8 turn increments until idle speed reaches a lower value shown on Vehicle Emission Control Information label.
11. Reset idle speed to specification shown on Vehicle Emission Control Information label.
12. Check and adjust fast idle as described on the vehicle Emission Control Information label.

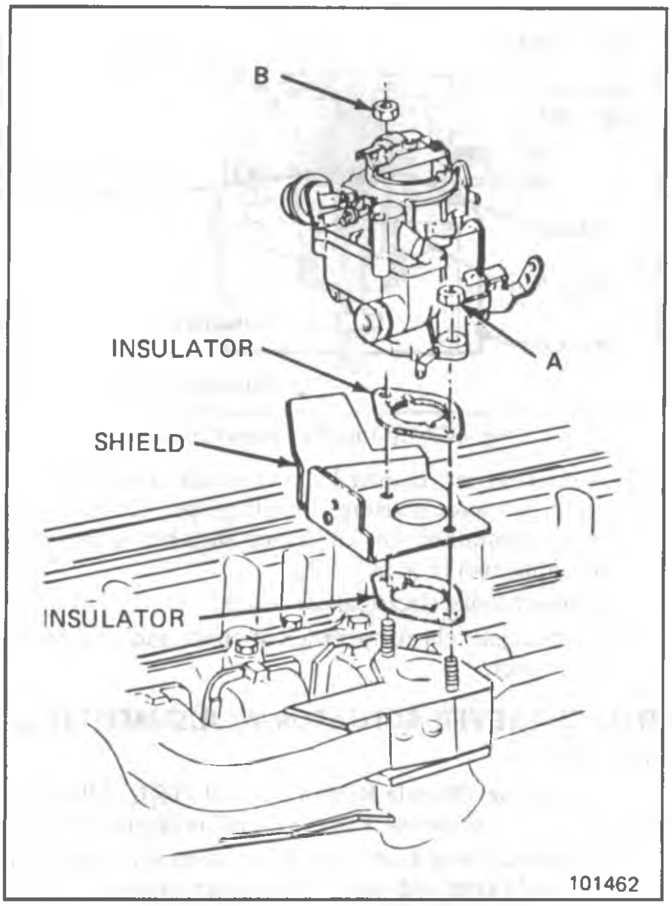


Fig. 6C7-10--1ME Carburetor Replacement

13. Reconnect vacuum hoses. Install air cleaner.
14. Recheck idle speed. If necessary, reset to specification.

CARBURETOR MOUNTING TORQUE

When torquing carburetor after removal, overhaul, replacement or when installing a new heat insulators, torque mounting nuts A and B to 4 N·m (37 in. lbs.) and then retorque to 22 N·m (16 ft. lbs.).

CARBURETOR REPLACEMENT (FIG. 6C7-10)

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosing cause, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect electrical connector at choke.
4. Disconnect accelerator linkage.
5. Disconnect solenoid electrical connector.
6. Remove carburetor attaching nuts and remove carburetor and solenoid assembly attachment.
7. Remove insulator gaskets and shield.

Installation

It is good shop practice to fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of fuel will enable carburetor to be filled and the operation of float and intake needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

1. Be certain throttle body and intake manifold sealing surface are clean.
2. Install carburetor insulators and shield.
3. Install carburetor over manifold studs.
4. Install vacuum and fuel lines at carburetor
5. Install attaching nuts and tighten alternately to 4 N·m (37 in. lbs.) and the retorque to 22 N·m (16 ft. lbs.).
6. Tighten fuel line.
7. Connect accelerator linkage.
8. Connect choke and solenoid electrical connectors.
9. Install air cleaner.
10. Check and adjust idle speed.

SOLENOID REPLACEMENT

An inoperative solenoid should be replaced.

Removal

1. Remove carburetor air cleaner.
2. Disconnect electrical connector at solenoid.
3. Unscrew and remove solenoid from float bowl assembly.

Installation

1. Hold choke valve wide open so that fast idle cam follower clears fast idle cam.
2. Install solenoid and turn in until it contacts lever tang.
3. Connect electrical connector.
4. Install air cleaner.
5. Check and adjust idle speed.

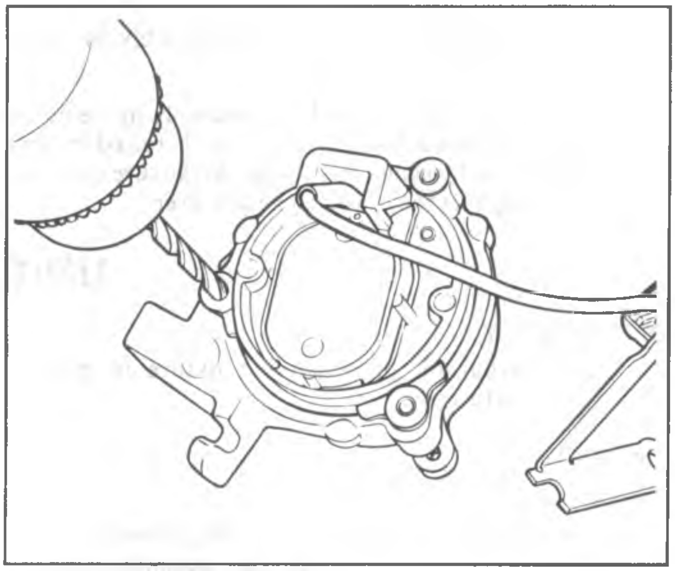


Fig. 6C7-11--Choke Coil

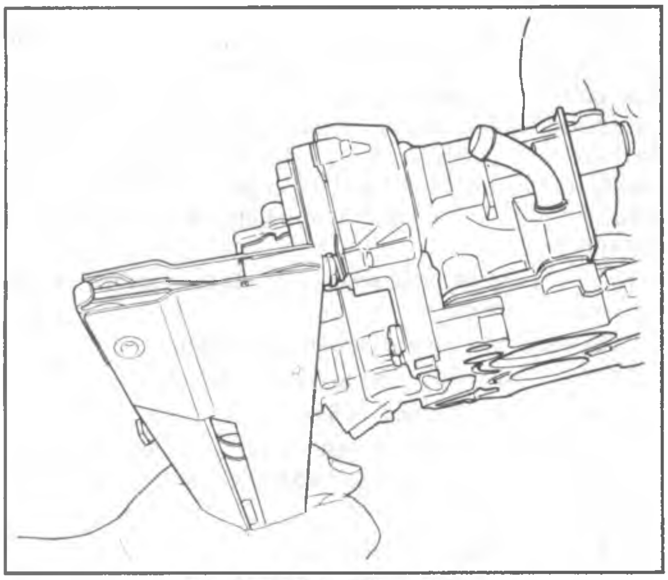


Fig. 6C7-12--Installing Choke

CHOKE COIL REPLACEMENT (Fig. 6C7-11a)

Choke mechanism should be checked for free operation. A binding condition may have developed from petroleum gum formation on the choke shaft or from damage. Choke shafts can usually be cleaned without disassembly by using Carbon X(X55) or equivalent.

1. Remove air cleaner and disconnect choke electrical connector.
2. Align a #21 drill (.159") on rivet head and drill only enough to remove rivet head. After removing rivet heads and retainers, use a drift and small hammer to drive the remainder of the rivets out of the choke housing. Use care in drilling to prevent damage to choke cover or housing. Remove the three retainers and choke cover assembly from choke housing.
3. Remove choke coil from housing.
4. Install the choke cover and coil assembly in choke housing as follows:

   Install the choke cover and coil assembly in the choke housing, aligning notch in cover with raised casting projection on housing cover flange. Make sure coil pick-up tang engages the inside choke coil lever.

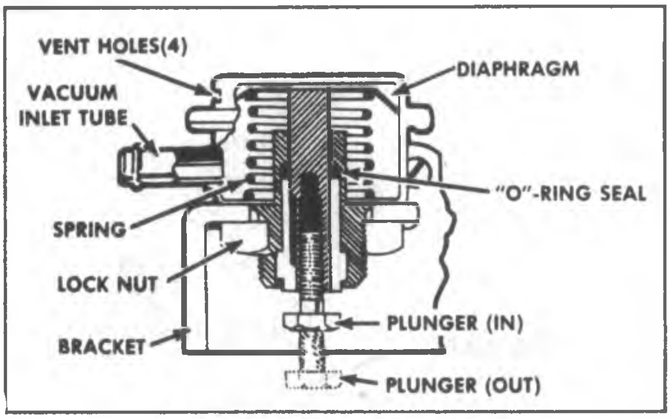


Fig. 6C7-13--Throttle Return Control

   A choke cover retainer kit is required to attach choke cover to choke housing. Install proper retainers and rivets contained in kit using suitable blind rivet installing tool (Fig. 6C7-12).

5. Connect choke electrical connector.
6. Start engine, check operation of choke and then install air cleaner.

THROTTLE LEVER ACTUATOR ADJUSTMENT (Fig. 6C7-13)

Adjust the Throttle Return Control (TRC) idle speed to specification, shown on Vehicle Emission label, as follows:

1. Disconnect hose from solenoid valve to actuator at the solenoid valve, and connect hose to an external vacuum source equipped with a vacuum gage.
2. Check the throttle lever, shaft, and linkage to be sure that they operate freely without binding or sticking.
3. Start engine, run until warmed up and idle is stable (transmission in Park or Neutral).
4. Apply 68 kPa (20 in. Hg.) vacuum to the actuator. Manually open the throttle slightly and allow to close against the extended actuator plunger. Note the engine rpm.
5. If the rpm is not within the specified TRC speed range, then turn the screw on the actuator plunger in the appropriate direction and repeat step 3 until the specified TRC speed range is obtained.

CARBURETOR ADJUSTMENTS

Refer to Figures 6C7-29 and 6C7-30 for carburetor adjustments.

UNIT REPAIR

DISASSEMBLY

Place carburetor on a holding fixture to prevent damage to throttle valve.

Air Horn

Removal

1. Remove choke vacuum break diaphragm hose.
2. Remove vacuum break diaphragm assembly from air horn by removing two attaching screws. These screws have a tapered head and do not use lockwashers. Remove diaphragm plunger stem from diaphragm to choke lever link. (Fig. 6C7-14).

   NOTICE: Screw that retains vacuum break lever to choke shaft is installed with thread torque retaining compound. It is not necessary to remove this screw and lever unless choke shaft replacement is required

3. Remove fast idle cam attaching screw; then remove fast idle cam (Fig. 6C7-16).

   Remove choke rod from choke coil lever on end of choke shaft.

4. Remove choke coil assembly as follows: Align a #21 drill (.159") on rivet head and drill only enough to remove rivet head. Drill the two remaining

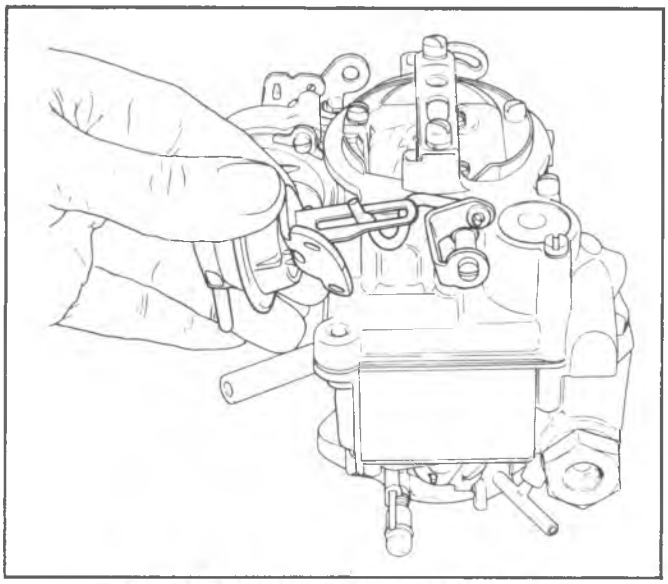


Fig. 6C7-14--Vacuum Break Diaphragm

rivet heads and then use a drift and small hammer to drive the remainder of the rivets out of the choke housing. Remove the three retainers and choke cover assembly from choke housing.

5. Choke coil housing need not be removed from float bowl unless replacement is necessary. To remove choke housing, remove three attaching screws from float bowl. Two screws have lockwashers and the one facing the choke housing has a tapered head for locating choke housing.
6. Remove four remaining air horn to bowl attaching screws and lockwashers (three long and one short screw).
7. Remove air horn by lifting and twisting back towards choke housing so that the choke coil lever link will disengage from the choke coil lever at the choke housing, invert and place on clean bench. Air horn to float bowl gasket can remain on bowl for removal later (Fig. 6C7-16).

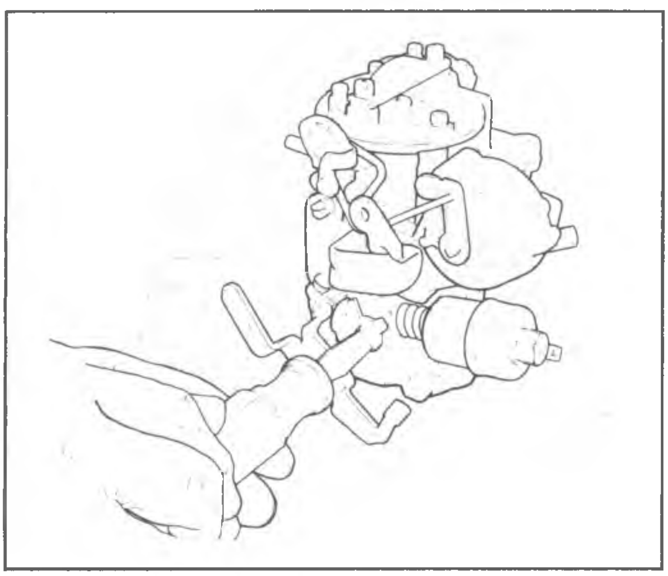


Fig. 6C7-15--Fast Idle Cam

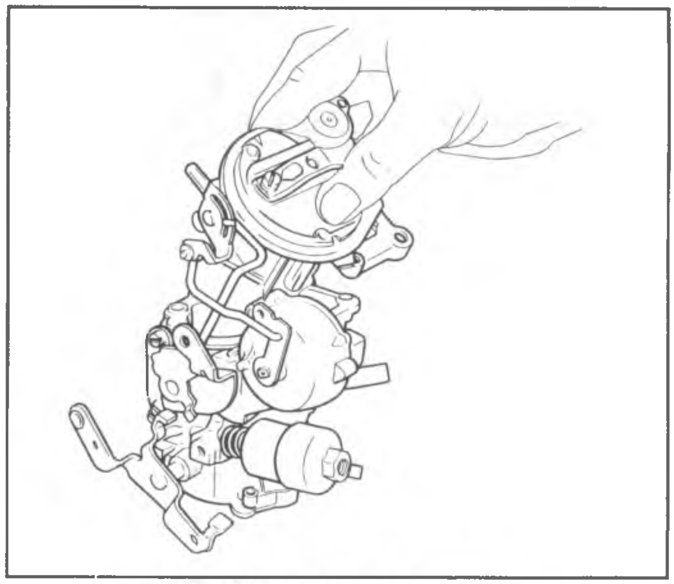


Fig. 6C7-16--Air Horn Removal

Disassembly

1. If required, the choke valve and choke shaft can be removed from air horn by removing the screw that retains the vacuum break lever to the choke shaft. Care should be exercised when removing this screw because it is retained in place by thread torque retaining compound. Remove the two attaching screws from the choke valve, then, remove the choke valve and choke shaft from air horn.

   The choke valve screws are staked in place so it will be necessary to file off staking and re-stake during assembly. Do not bend choke shaft when restaking.
2. No further disassembly of the air horn is necessary.

Float Bowl Disassembly

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod lever so that it can be slid over lever for ease in removal. (Fig. 6C7-17).
2. Remove float assembly from float bowl by lifting

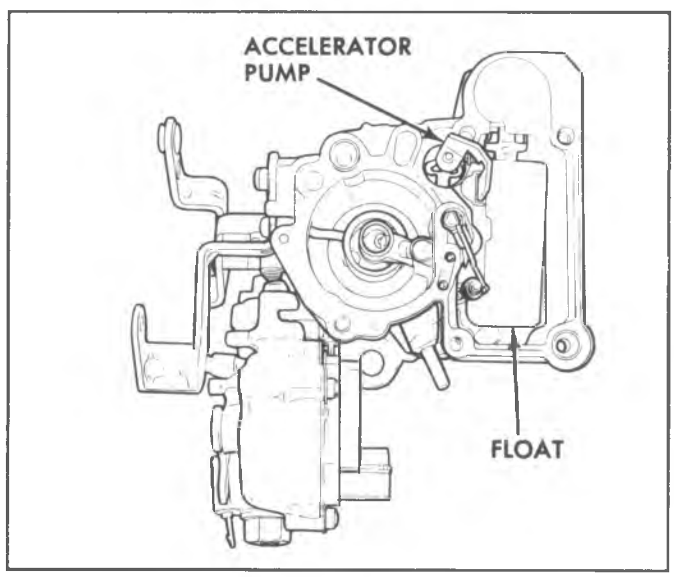


Fig. 6C7-17--Float Bowl Disassembly

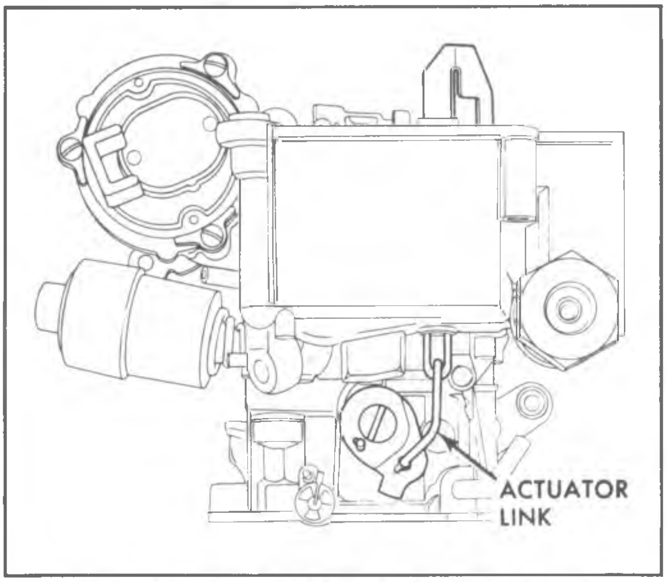


Fig. 6C7-18--Pump and Power Piston Actuator Lever

upward on float hinge pin. Remove hinge pin from float arm.

3. Remove float needle from seat.
4. Disconnect accelerator pump and power piston actuator lever from end of throttle shaft by removing lever attaching screw (Fig. 6C7-18).
5. Hold down on power piston while removing lever. Power piston spring and metering rod assembly may now be removed from float bowl (Fig. 6C7-19).
6. Remove lower end of power piston link from actuator lever by rotating until tang on rod slides out of notch in lever.
7. Remove actuator lever from lower end of accelerator pump link in same manner.
8. Push down on accelerator pump and remove actuator link by rotating until tang on rod aligned with slot on pump plunger lever. Remove the link.
9. Remove pump assembly from float bowl (Fig. 6C7-20).
10. Remove pump return spring and power piston spring from float bowl (Fig. 6C7-20).

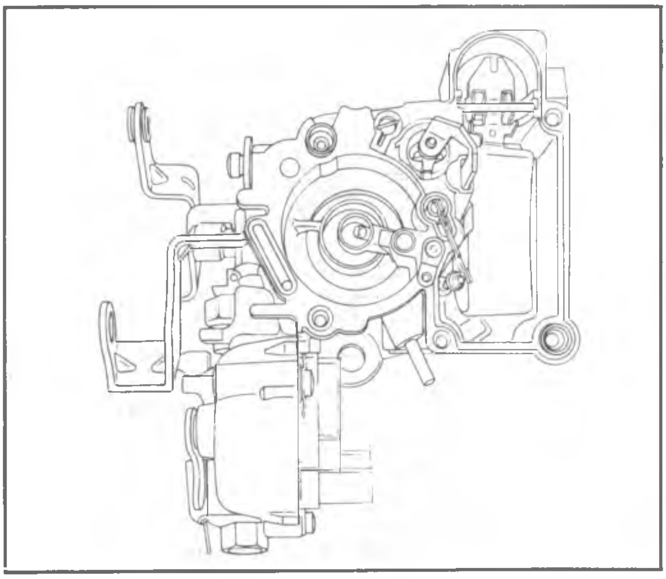


Fig. 6C7-19--Float Bowl Assembly

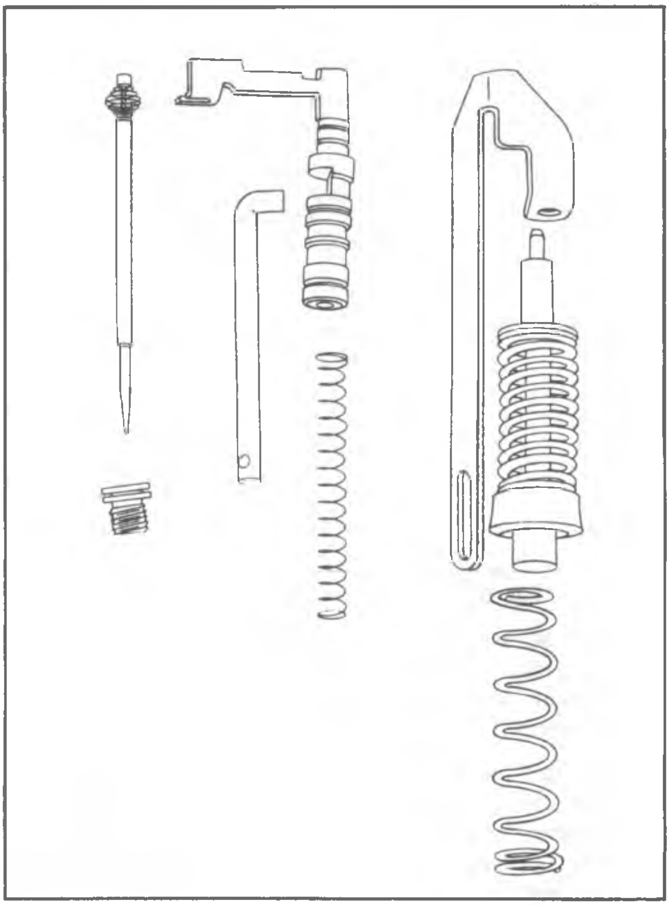


Fig. 6C7-20--Metering Rod and Accelerator Pump

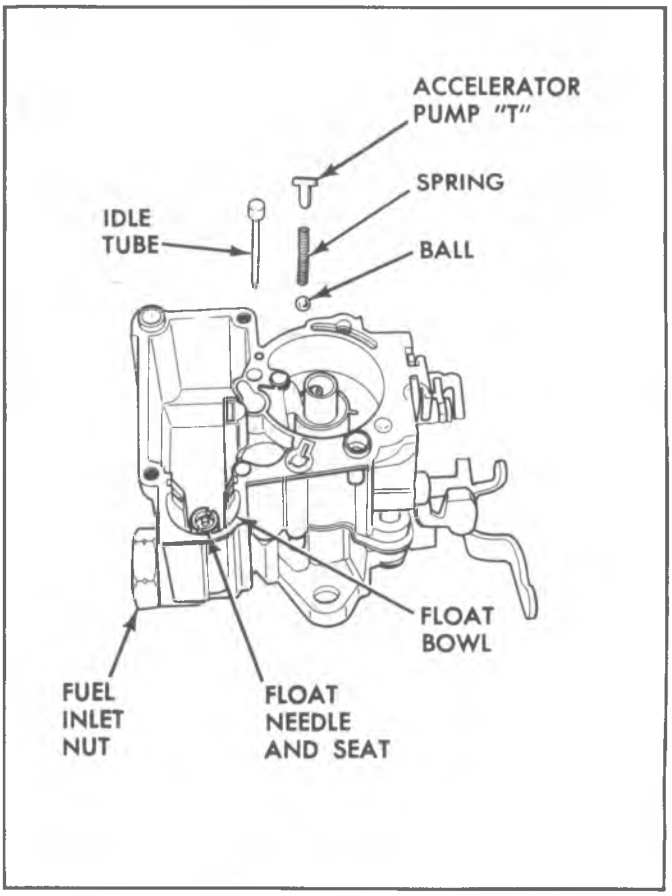


Fig. 6C7-21--Pump Discharge "T" Retainer

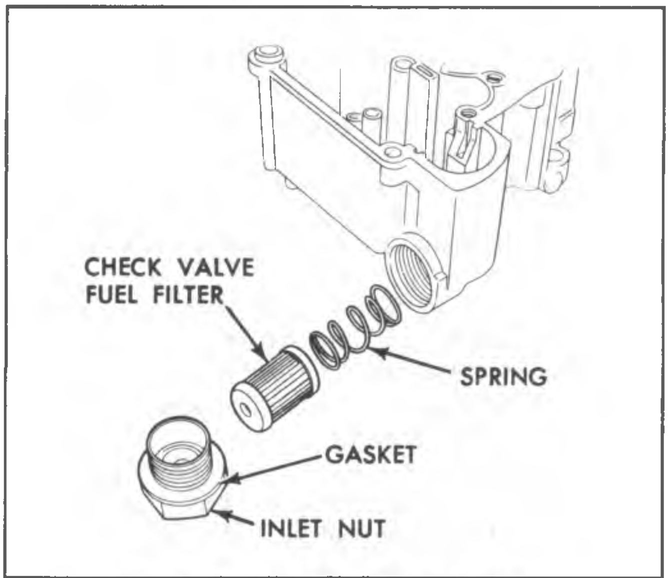


Fig. 6C7-22--Fuel Filter and Check Valve

11. Remove "T" guide and pump discharge spring using needle nose pliers (Fig. 6C7-21).
12. Pump discharge ball and idle tube can be removed at the same time by inverting the bowl.
13. Remove main metering jets from bottom of fuel bowl.
14. Remove float needle seat and gasket using Tool J-22769.
15. The idle stop solenoid can be removed at this time if desired.
16. Remove the fuel inlet nut, filter and spring (Fig. 6C7-22).

    No further disassembly of the float bowl is required.

Throttle Body (Fig. 6C7-23)

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Thorttle body and insulator gasket may now be removed.
2. No further disassembly of the throttle body is necessary unless the idle mixture needle is damaged or the idle channels need cleaning. If necessary to remove the idle mixture needle, cut the tang from the plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been readjusted.

   Due to the close tolerance fit of the throttle valve in the bore of the throttle body, do not remove the throttle valve or shaft.

CLEANING AND INSPECTION

The carburetor should be cleaned in a cold immersion type cleaner. Rubber and plastic parts should not be immersed in carburetor cleaner. However, the air horn which has the plastic relief valve will withstand normal cleaning in carburetor cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon X (X-55) or equivalent.
2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
4. Inspect upper and lower casting sealing surfaces for damage.
5. Inspect holes in levers for excessive wear or out of round condition. If levers are worn they should be replaced.
6. Examine fast idle cam for excessive wear or damage.
7. Check throttle and choke levers and valve for binds and other damage.
8. Check all springs for distortion or loss in tension; replace as necessary.

CARBURETOR ASSEMBLY

After carburetor has been disassembled, new gaskets and filter must be used.

Throttle Body (Fig. 6C7-23)

1. If removed, install idle mixture needle and spring into throttle body until lightly seated. Back out two turns as a preliminary adjustment. Final idle mixture adjustment will be made on vehicle.
2. Invert float bowl and install new throttle body to bowl insulator gasket.
3. Install throttle body on bowl gasket so all holes in throttle body are aligned with holes in gasket.
4. Install two throttle body to bowl attaching screws and lockwashers. Tighten even and securely to 20 N·m (15 ft. lbs.).

Float Bowl

1. Install fuel filter spring, filter, and check valve assembly, (if used), inlet nut and gasket rubber seal on check valve faces fuel inlet nut.

   The fuel inlet check valve must be installed (where required) in the filter to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over. New service replacement filter include the check valve, where required.
2. Install idle stop solenoid and spring, if removed. Adjust later for correct idle speed.
3. Install main metering jet into bottom of fuel bowl. Tighten securely.
4. Using wide blade screwdriver install needle seat and gasket.
5. Install idle tube flush with bowl casting.
6. Install pump ball, spring and "T" into pump discharge hole (Fig. 6C7-21).

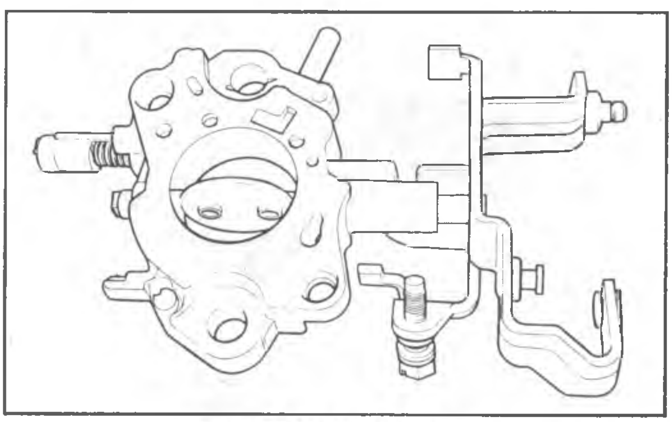


Fig. 6C7-23--Throttle Body

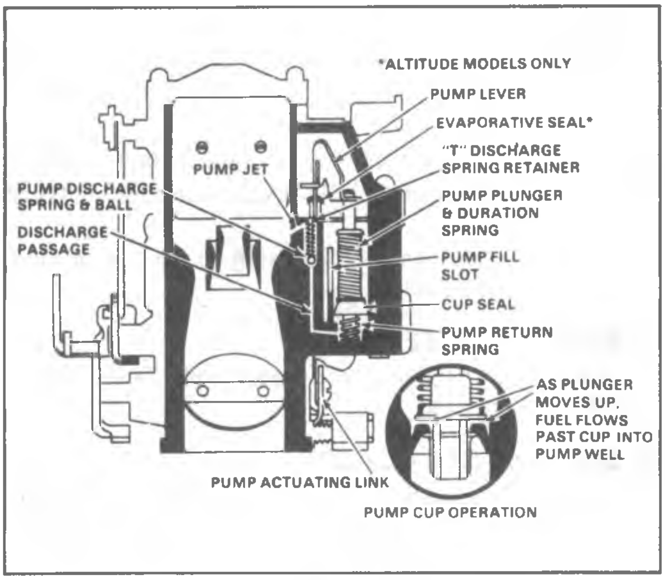


Fig. 6C7-24--Pump Drive Link

7. Drive pump discharge "T" in until flush with bowl casting.
8. Install accelerator pump return spring.
9. Install power piston return spring into piston cavity in the bowl.
10. Install lower end of pump link into actuator lever which fits on throttle shaft. Ends of link point toward carburetor. Bend in link faces fuel inlet nut.
11. Install curved power piston actuator link into throttle actuator lever. End protrudes outward away from throttle bore and has tang which retains link to lever.
12. Install pump plunger assembly into pump well with actuating lever protruding through bottom of bowl casting. Push downward on pump lever and install pump assembly drive link into slot in lower end of shaft. Tang on upper end of link retains link to pump shaft (Fig. 6C7-24).
13. Assembly metering rod to holder on power piston. Spring must be on top of arm when assembled correctly. Then install power piston actuating rod (right angle end) into slot in the power piston.
14. Install power piston, metering rod and drive rod assembly into the float bowl. End of drive rod must enter hole in bowl and end of metering rod into jet.
15. Before fastening power piston and pump actuator lever to end of throttle shaft, hold power piston assembly down and slide upper end of curved power piston actuator link into lower end of power piston actuating rod.
16. Install actuating lever on end of throttle shaft by aligning flats or lever with flats on shaft. Install lever retaining screw and tighten securely.
17. Install float needle valve on to float arm hooking pull clip over edge of float arm.
18. Install float hinge pin into float arm. Install float needle into seat and float with hinge pin into float bowl. Hinge pin should in locating channels in float bowl.

Float Level Adjustment (Fig. 6C7-25)

1. Hold float retaining pin firmly in place push down on float arm at outer end against top of float needle, as shown.
2. Use adjustable "T" scale and measure distance from top of float at index point on toe to float bowl gasket surface (gasket removed).
3. To adjust, bend float pontoon up or down at float arm junction.

Metering Rod Adjustment (Fig. 6C7-26)

1. Open throttle valve, slide metering rod out of holder and remove from main metering jet.
2. To check adjustment, back out 1/8" hex screw on idle stop solenoid and rotate fast idle cam so that cam follower is not contacting steps on cam.
3. With throttle valve completely closed, apply pressure to top of power piston and hold piston down against stop.
4. Holding downward pressure on power piston, swing metering rod holder over flat surface of bowl casting next to carburetor bore.

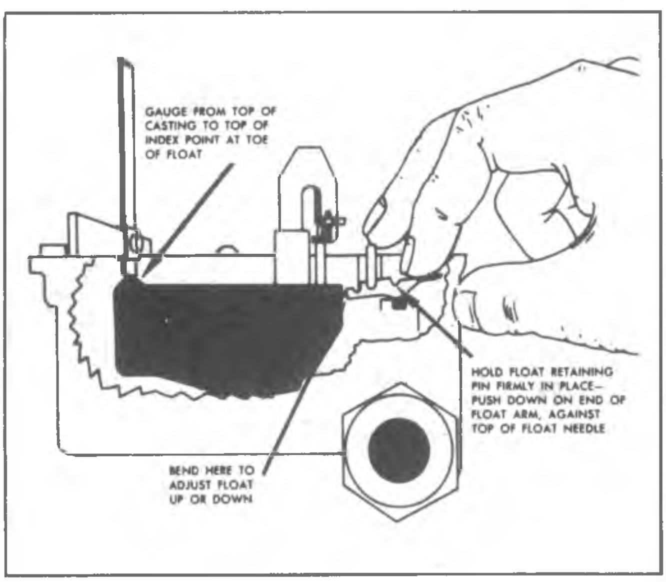


Fig. 6C7-25--Float Level Adjustment

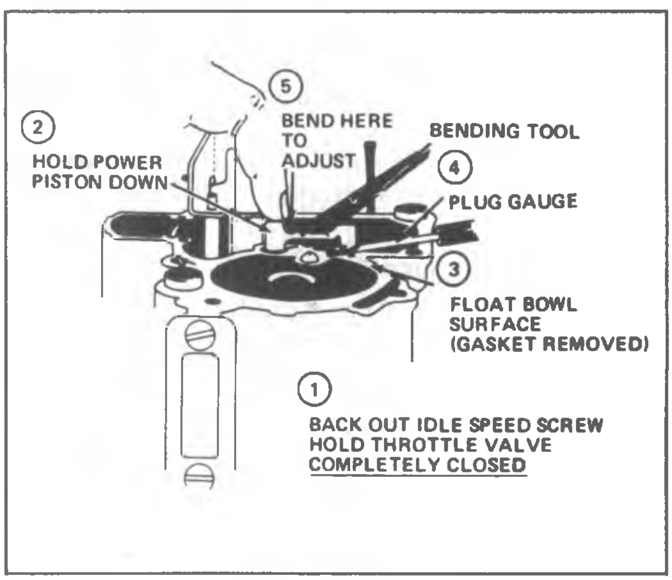


Fig. 6C7-26--Metering Rod Adjustment

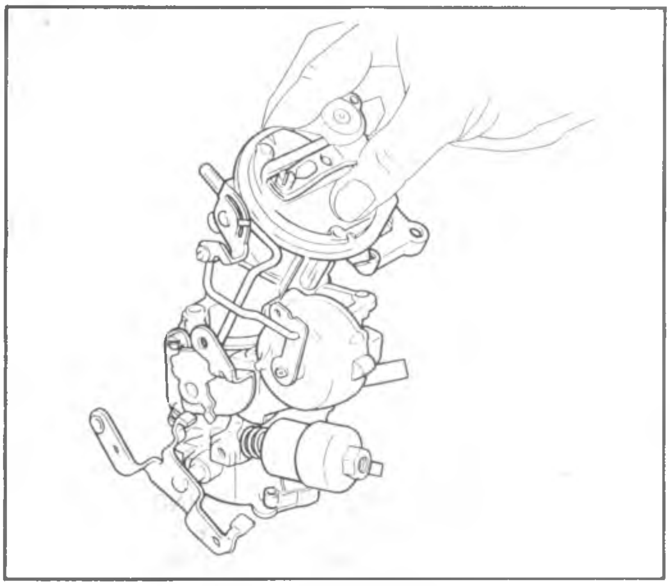


Fig. 6C7-27--Installing Air Horn

5. Insert gage between bowl casting and lower surface of metering rod holder. Gage should have a slide fit between both surfaces, as shown.
6. To adjust, carefully bend metering rod holder up or down.
7. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and press gasket firmly in place

Air Horn

1. Install choke shaft assembly and choke valve into air horn, if removed. Align choke valve, tighten two retaining screws and stake securely in place.

   NOTICE: Apply a torque retaining compound to the vacuum break lever retaining screw and install lever to choke shaft.

2. Install air horn to float bowl by engaging choke coil lever link into notched hole in choke coil lever on choke housing. Then carefully twist and lower air horn onto float bowl. Install three long and one short air horn to float bowl attaching screws and lockwashers (Fig. 6C7-27).
3. Install the choke vacuum break diaphragm assembly using two short air horn screws opposite the choke housing, connecting the choke vacuum break diaphragm link to slotted diaphragm plunger stem. The two attaching screws for the choke vacuum break assembly have tapered heads for locating choke diaphragm bracket. Make sure to use these in this location Tighten all air horn screws evenly and securely using proper tightening sequence (Fig. 6C7-28).
4. If removed, install choke housing to float bowl using three attaching screws. Two screws have lockwashers and the other one which face the choke housing has a tapered head for locating choke housing.
5. Install fast idle cam, and fast idle cam link to upper choke lever assembly. Numbers on fast idle cam face outward.
6. Install the choke cover and coil assembly in choke housing as follows:
   a. Install the choke cover and coil assembly in the choke housing, aligning notch in cover with raised casting projection on housing cover flange. Make sure coil pick-up tang engages the inside choke coil lever.

   A choke cover retainer kit is required to attach choke cover to choke housing. Install proper retainers and rivets contained in kit using suitable blind rivet installing tool. It may be necessary to use an adapter (tube) if installing tool interferes with electrical connector tower on choke cover.

   Do not use a gasket between electric coil and housing, as the coil is electrically grounded through housing.
7. Install choke vacuum diaphragm hose to tube on diaphragm and connect to vacuum tube on bowl.

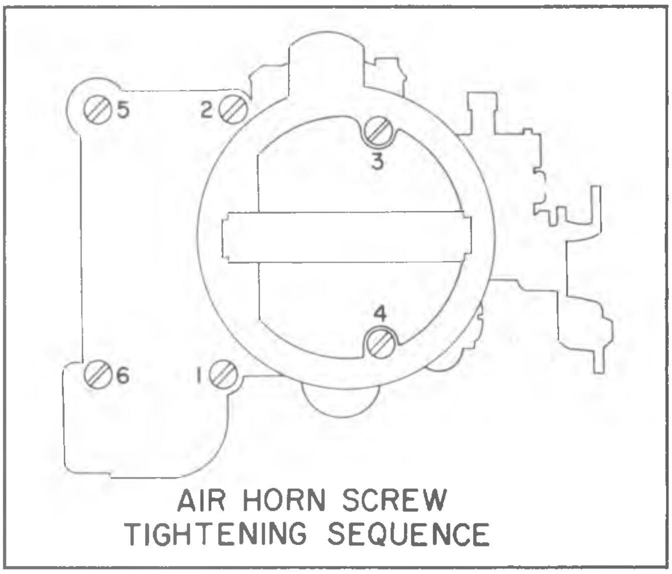


Fig. 6C7-28--Tightening Sequence

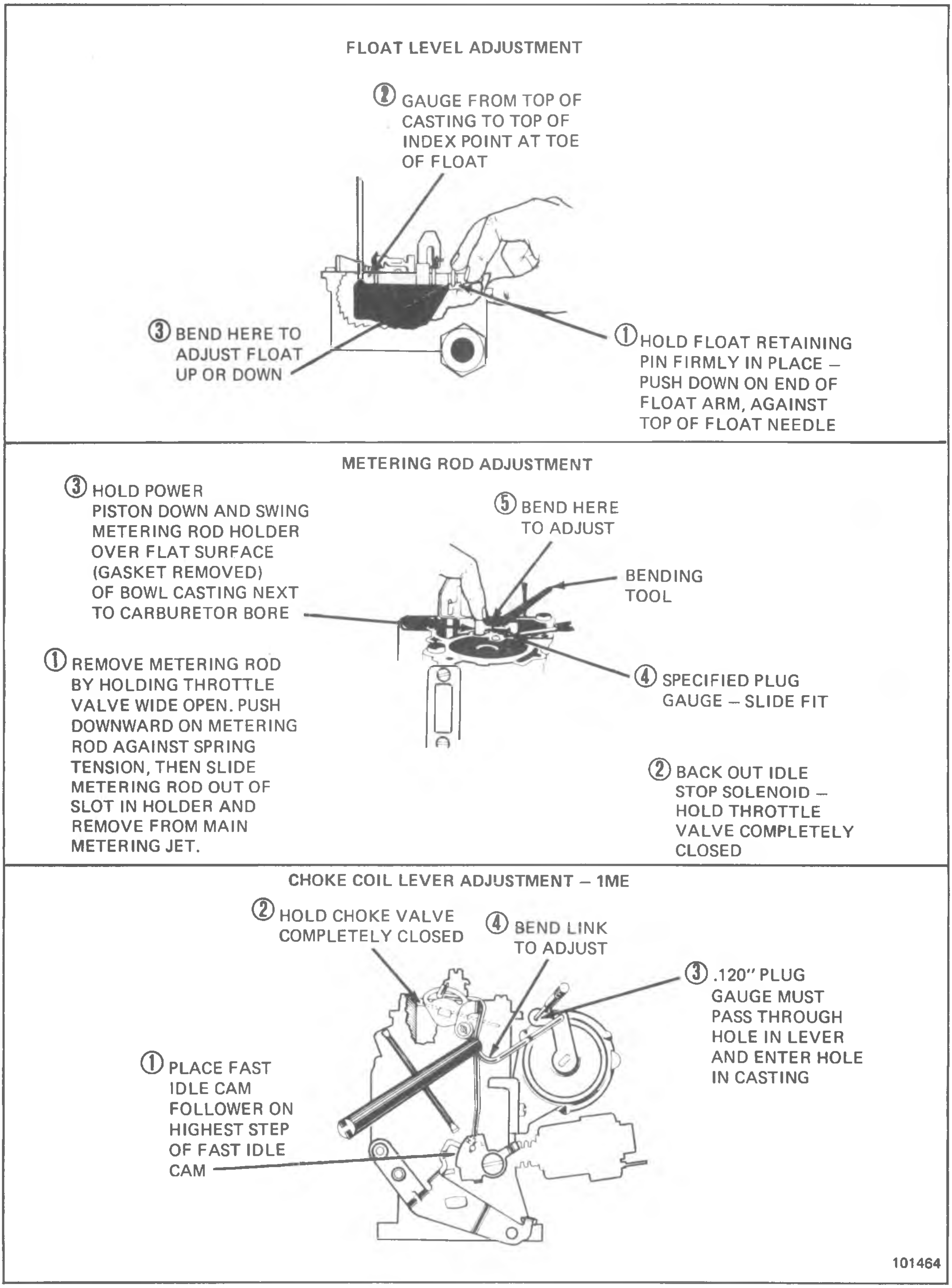
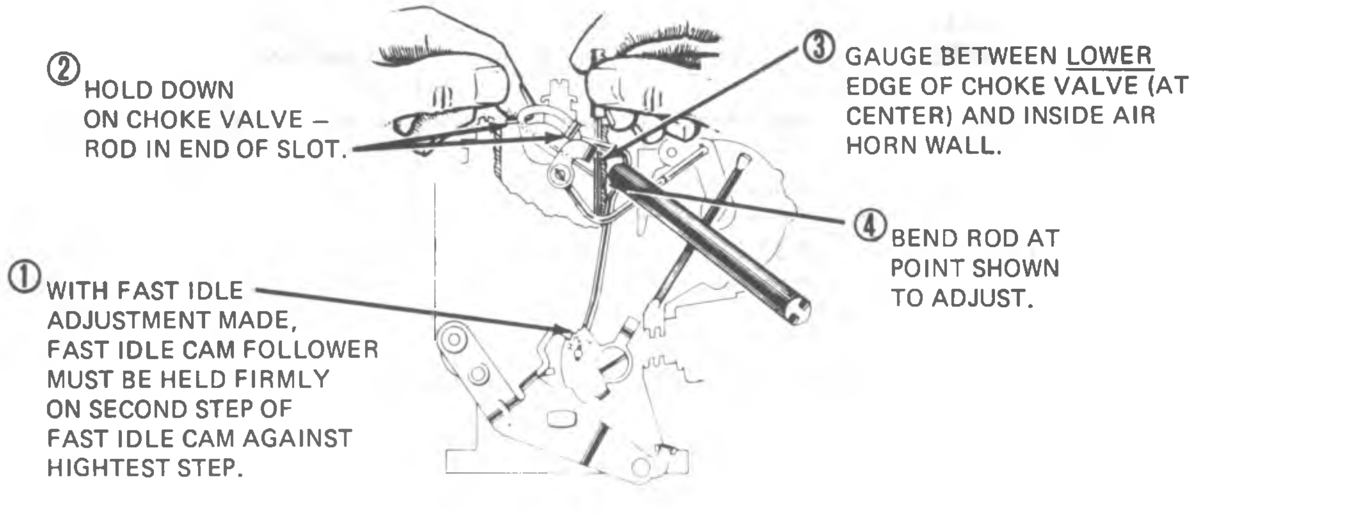
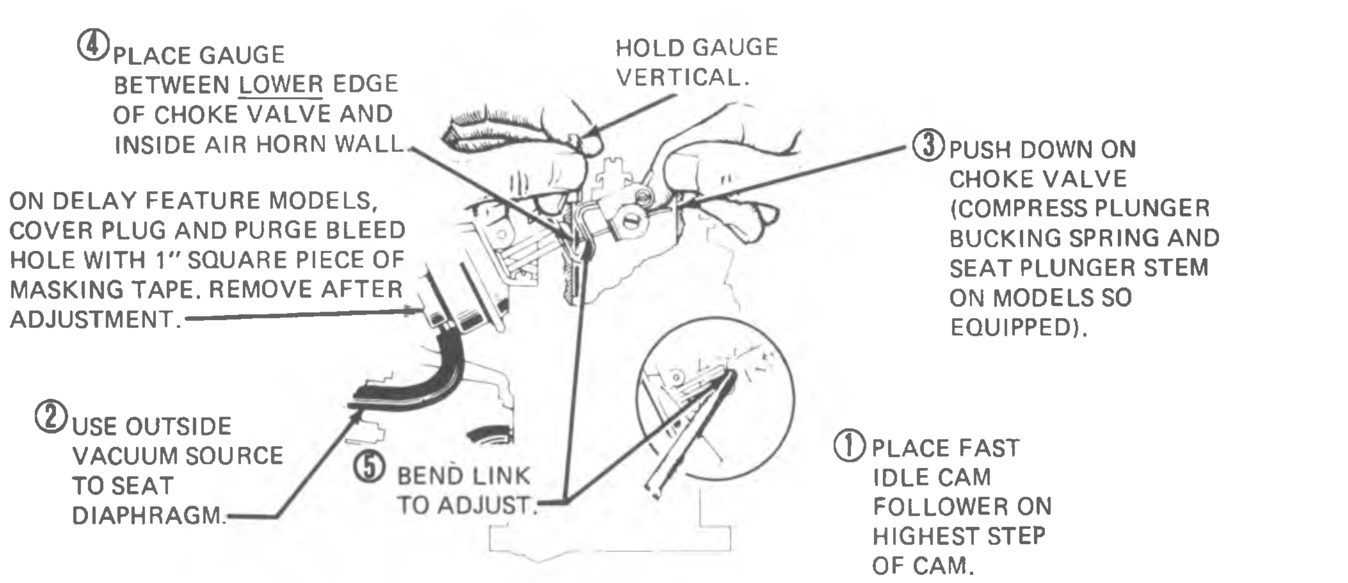


Fig. 6C7-29--1ME Adjustments (1 of 2)

CHOKE ROD (FAST IDLE CAM) ADJUSTMENT (2ND STEP)



VACUUM BREAK ADJUSTMENT – 1ME (BOWL SIDE)



UNLOADER ADJUSTMENT – 1ME (WIDE OPEN KICK)

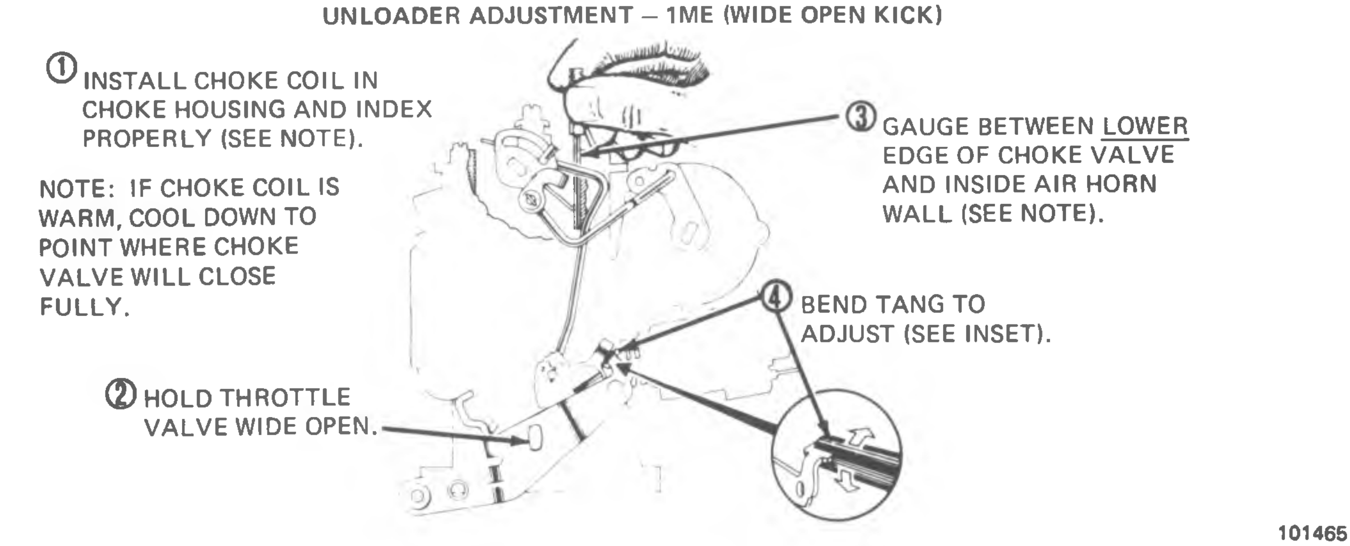


Fig. 6C1-30--1ME Adjustments (2 of 2)

CARBURETOR MODEL 1ME ADJUSTMENT SPECIFICATIONS					
CARBURETOR PART NUMBER	FLOAT LEVEL	METERING ROD	CHOKE ROD CAM ADJ	VACUUM BREAK	UNLOADER
	mm/(Inches)	mm/(Inches)	mm/(Inches)	mm/(Inches)	mm/(Inches)
17081009 FED.	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)
17084329 CAL.	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)

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Figure 6C7-31 — 1ME Adjustment Specifications

SECTION 6C9

CARBURETOR MODEL 2SE

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ALL NEW GM VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAP, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

For vehicles sold in Canada and equipped with non-closed loop engines, also refer to the appropriate Canadian Service Manual Supplement.

GENERAL DESCRIPTION

The model 2SE Varajet is a two barrel, two stage, down-draft carburetor. It has three major assemblies: air horn, float bowl and throttle body; and has the following six basic operating systems:

- FLOAT (Figure 6C9-1)
- IDLE (Figure 6C9-2)
- MAIN METERING (Figure 6C9-3)
- POWER (Figure 6C9-4)
- PUMP (Figure 6C9-5)
- CHOKE (Figure 6C9-6)

An exploded view of this carburetor with part names, is shown in Figure 6C9-7.

A single float chamber supplies fuel to both bores. A float (71), a float needle seat (72C), a float needle (72A) with pull clip (72B), and float bowl insert(s) (69 and 74), help control the level of fuel in the float chamber. On some models, a float stabilizing spring (73) adds further fuel level control for vehicles used in rugged terrain.

A vacuum-operated power piston (75A or 75B), and a tapered metering rod (76) moving in a metering jet (78), control the air/fuel mixture in the primary bore, in response to varying engine demands.

In the secondary bore, the air valve, and a tapered metering rod operating in a fixed jet, control the air/fuel mixture during increased engine air flow at wide open throttle.

To provide extra fuel during quick throttle openings, the pump system uses a plunger type pump (67). On some models, a thermostatically controlled bypass valve is used. Where used, this valve contains a temperature-sensitive snap disc and is pressed into the air horn (1) casting. During cold engine start-up, the pump delivers its full capacity to the primary bore. At operating temperatures over 43° C. (110° F.), the bypass valve opens, allowing some fuel to be pumped back to the float bowl.

An electrically heated choke stat (50) provides the choke valve closing force for cold start-ups, and for choke opening during warmup. Two vacuum break assemblies (30 and 38) control initial choke valve opening at start and during warmup. To purge the engine if flooded, a throttle lever unloader tang forces the choke valve open, when the accelerator is pressed to the floor. A fast idle cam, following choke valve movement, acts as a variable throttle stop, to provide increased idle speed during warmup.

An idle speed device -- Idle Stop Solenoid (127), Idle Load Compensator (130), or Throttle Lever Actuator (133) -- may be used to position the primary throttle valve to meet engine idle speed requirements.

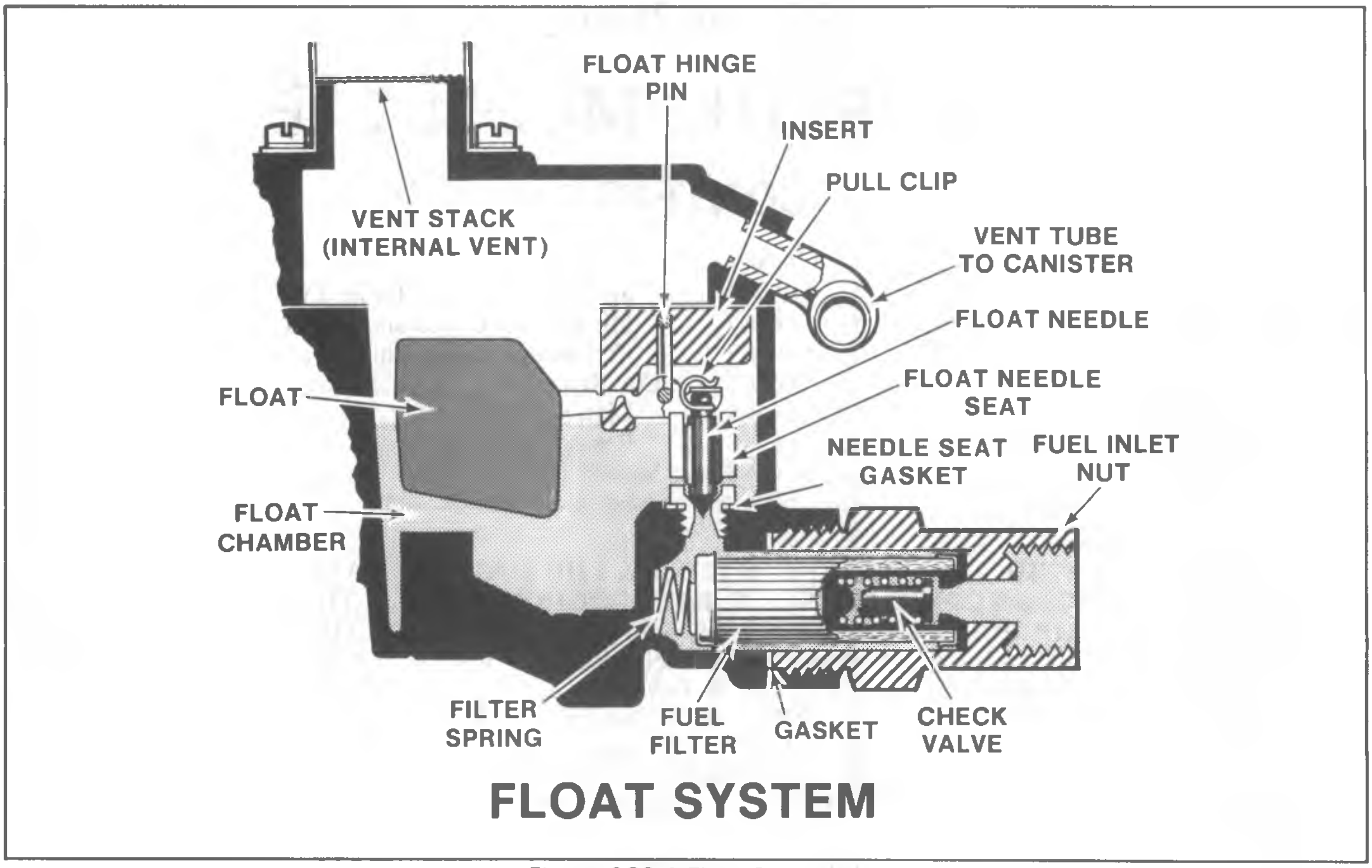


Figure 6C9-1 Float System

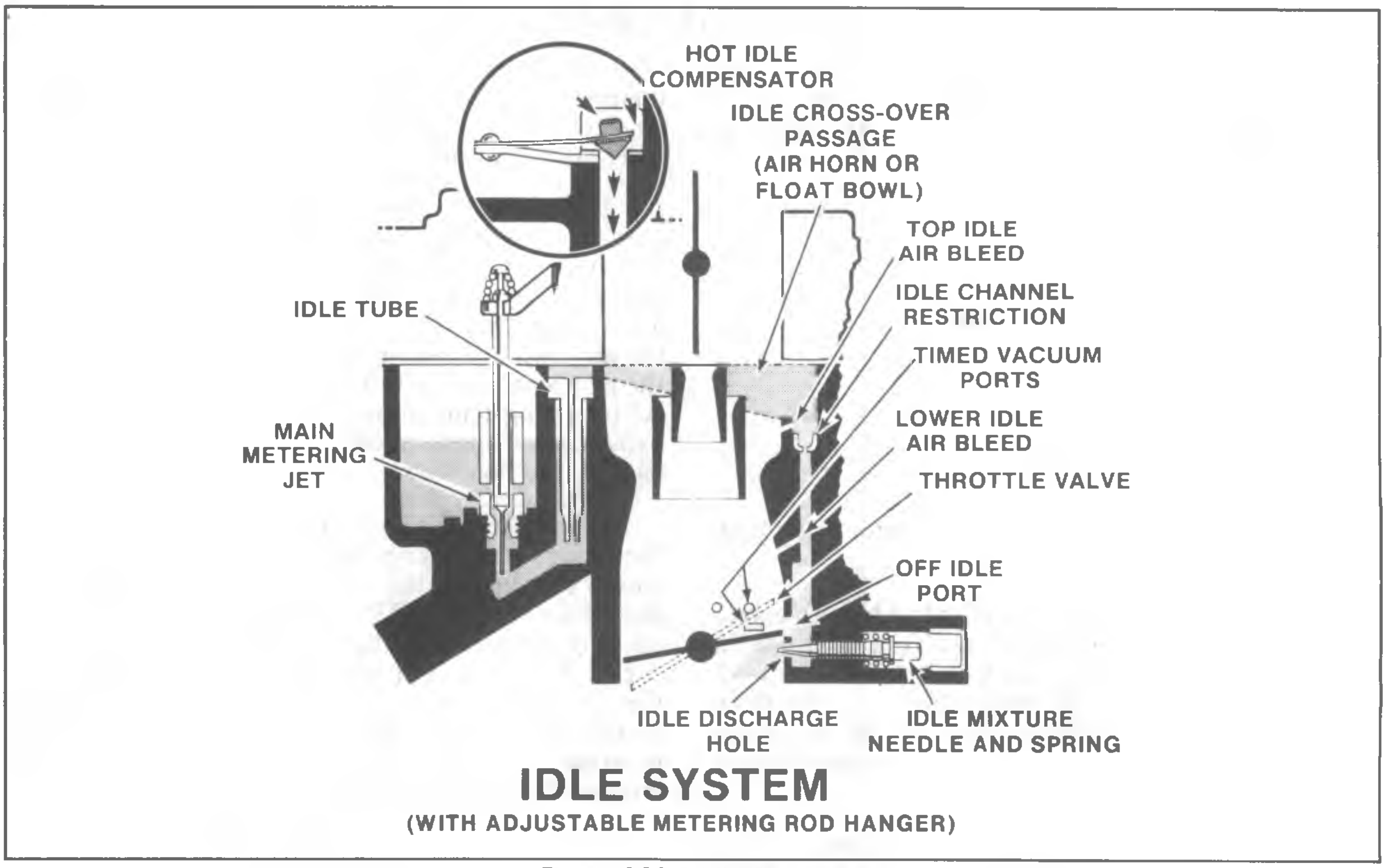
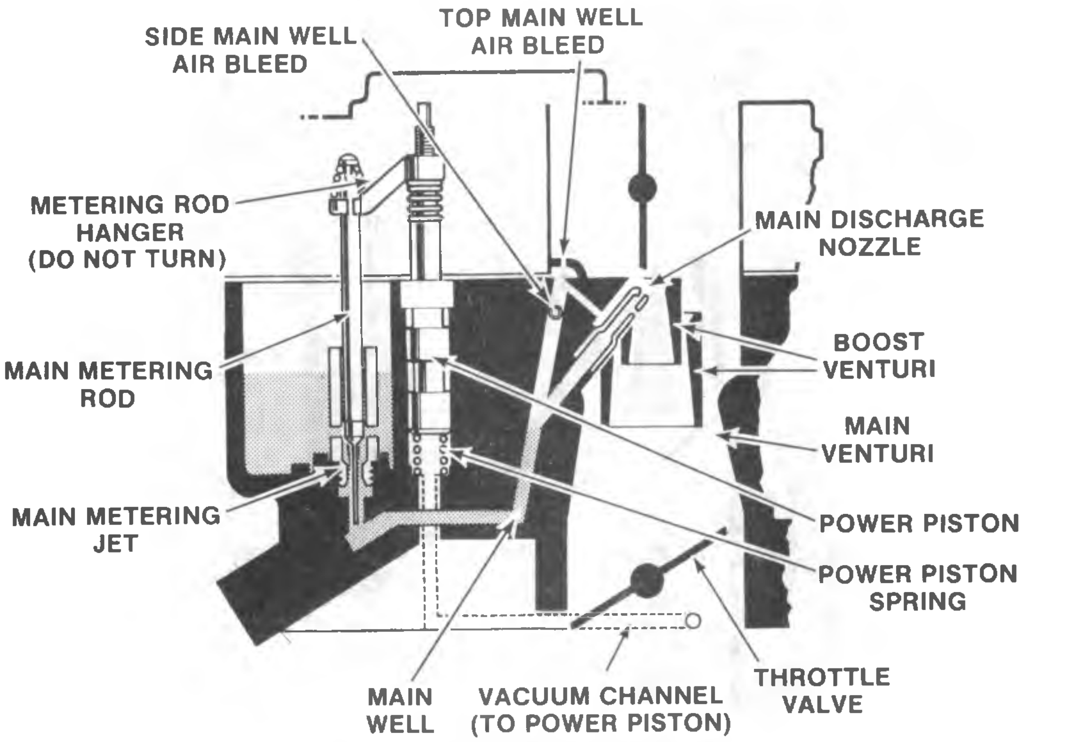


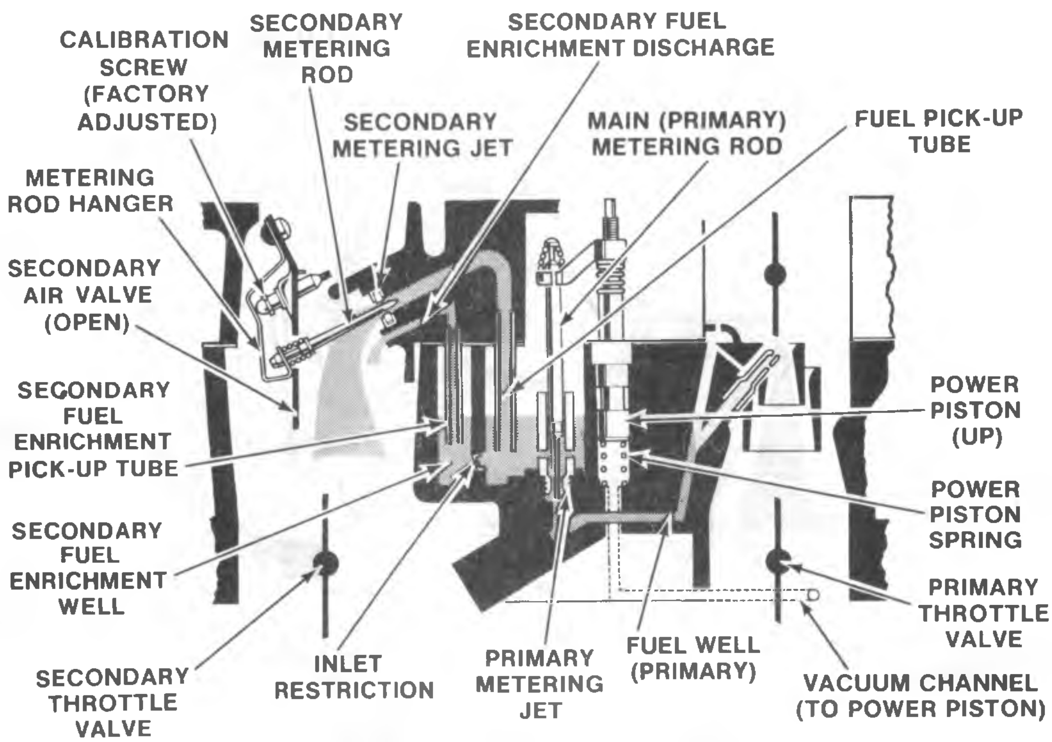
Figure 6C9-2 Idle System



MAIN METERING SYSTEM

(WITH ADJUSTABLE METERING ROD HANGER)

Figure 6C9-3 Main Metering System



POWER SYSTEM (INCLUDING SECONDARY STAGE)

(WITH ADJUSTABLE METERING ROD HANGER)

Figure 6C9-4 Power System

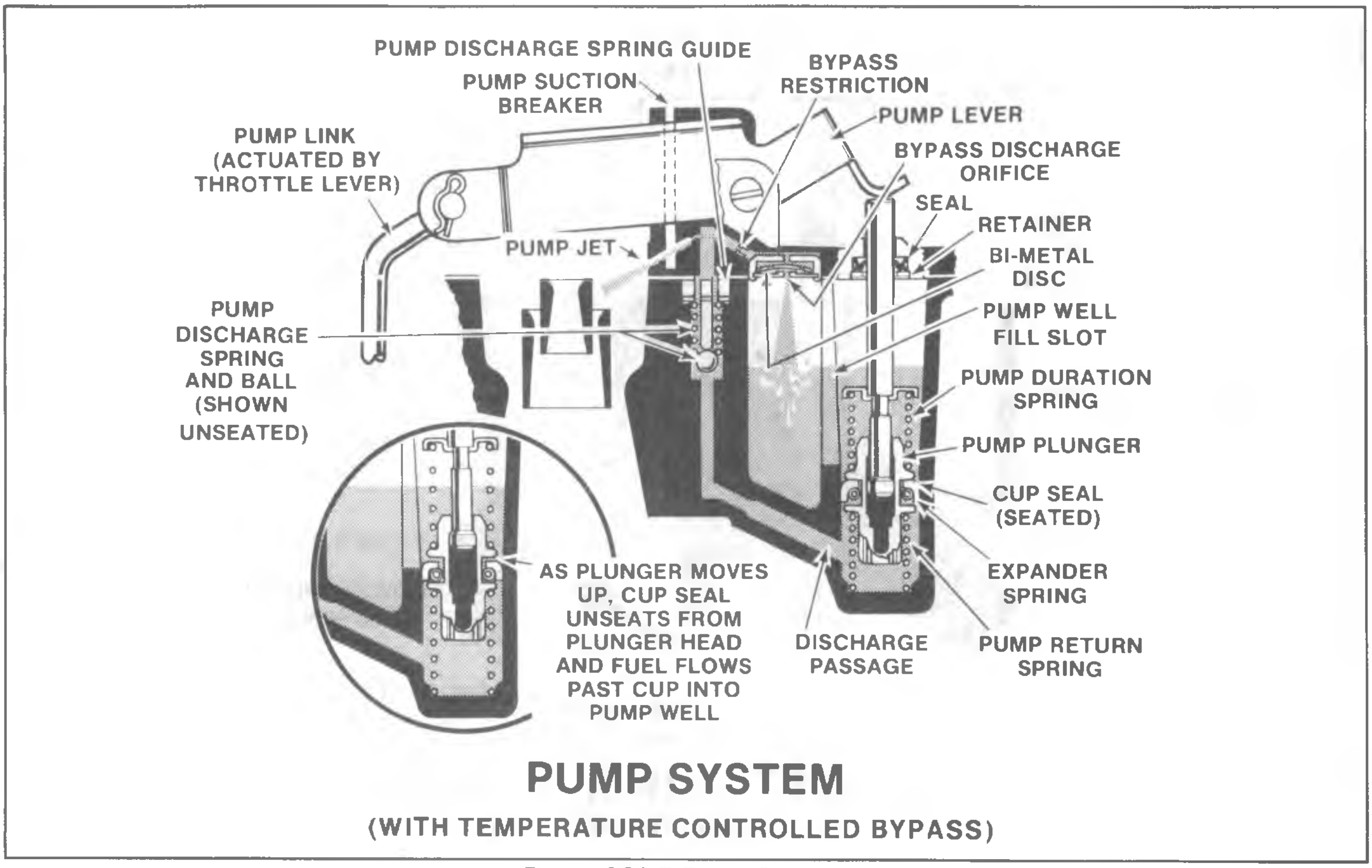


Figure 6C9-5 Pump System

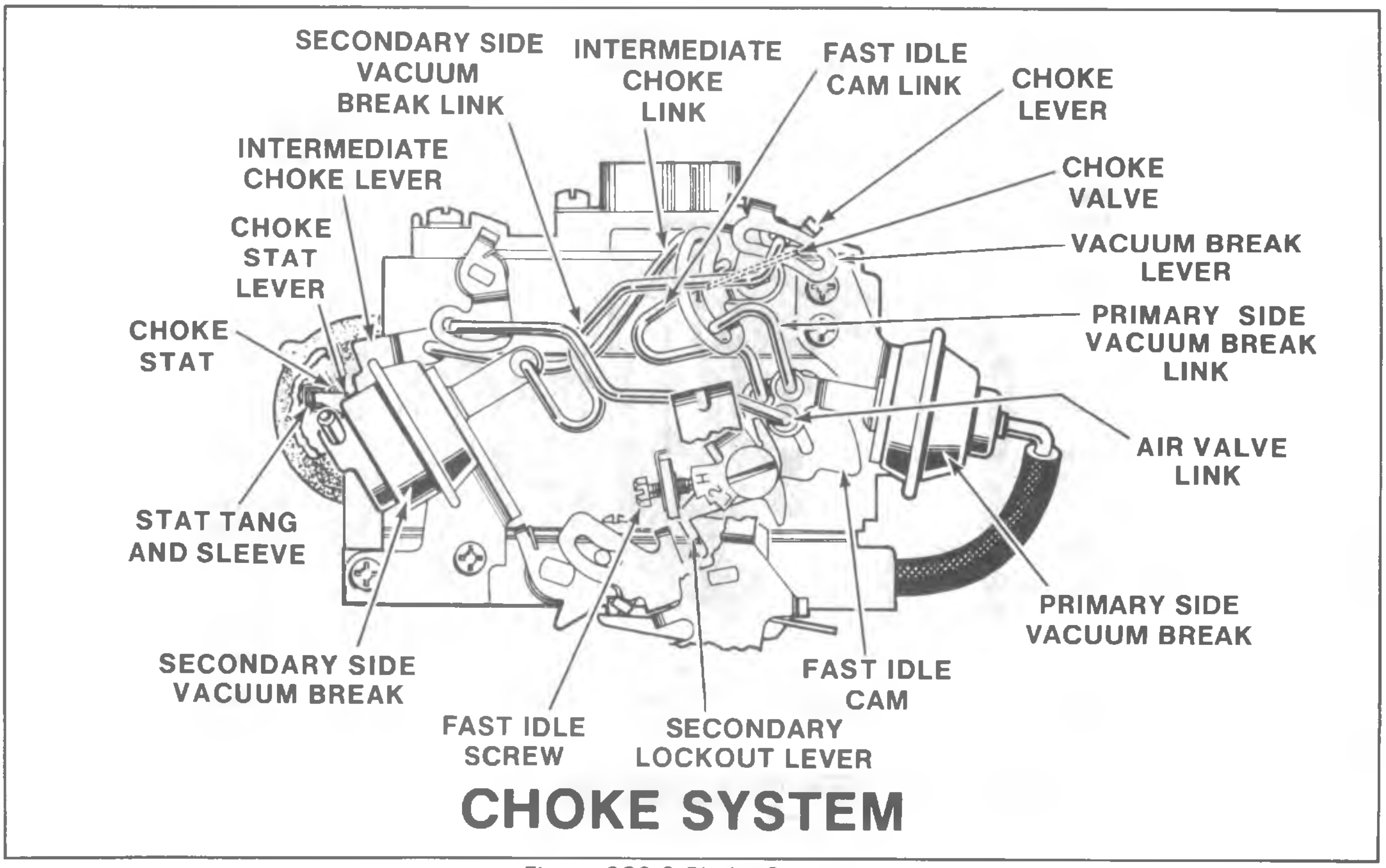


Figure 6C9-6 Choke System

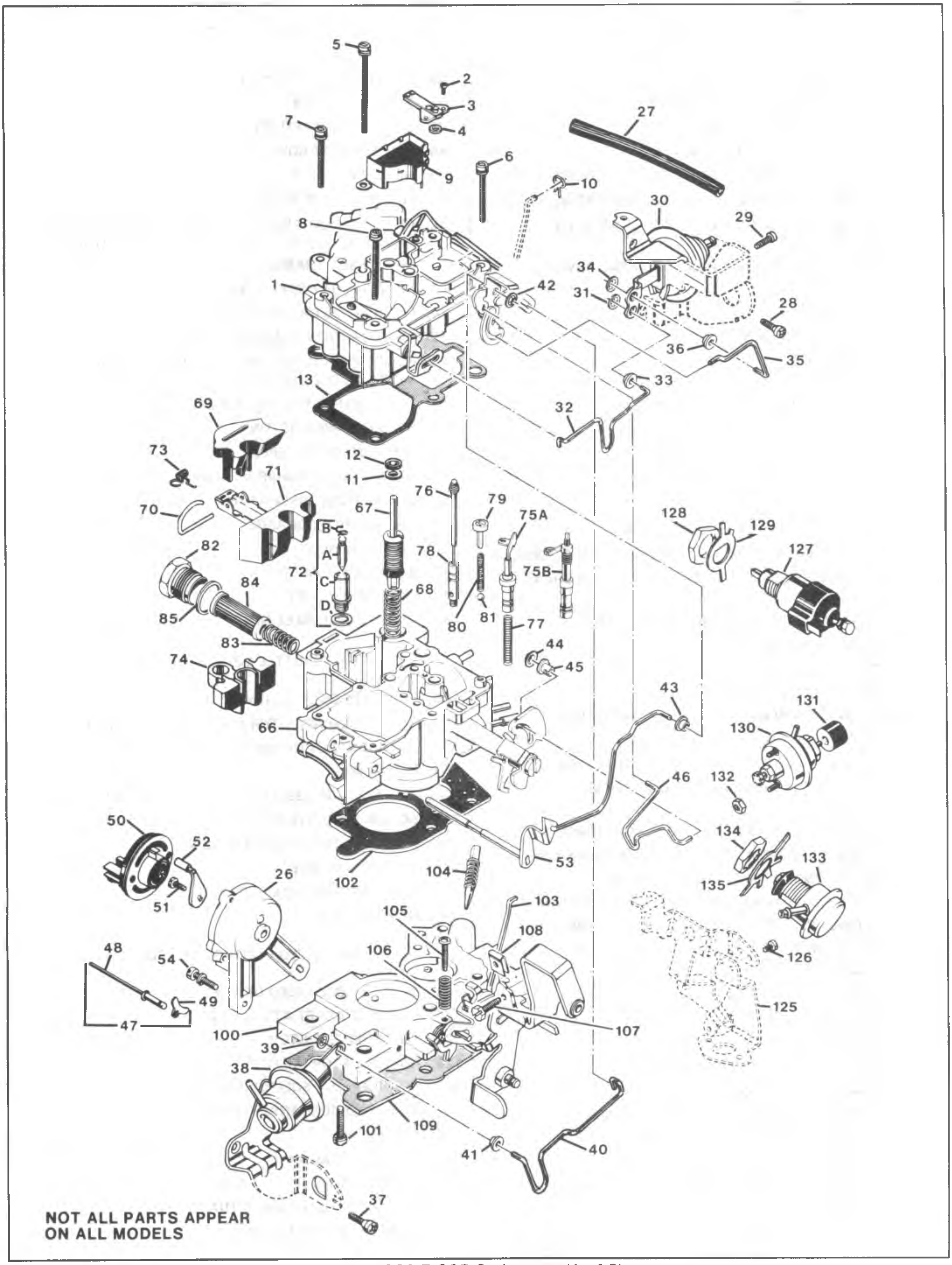


Figure 6C9-7 2SE Carburetor (1 of 2)

AIR HORN PARTS

1. AIR HORN ASSEMBLY
2. SCREW-HOT IDLE COMPENSATOR
3. HOT IDLE COMPENSATOR
4. GASKET-HOT IDLE COMPENSATOR
5. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (LONG)
6. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (LARGE)
7. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (SHORT)
8. SCREW ASSEMBLY-AIR HORN TO FLOAT BOWL (MEDIUM)
9. VENT STACK
10. RETAINER-PUMP LINK
11. RETAINER-PUMP STEM SEAL
12. SEAL-PUMP STEM
13. GASKET-AIR HORN TO FLOAT BOWL

CHOKE PARTS

26. HOUSING-CHOKE
27. HOSE-VACUUM BREAK-PRIMARY SIDE
28. SCREW-PRIMARY SIDE VACUUM BREAK ATTACHING
29. SCREW ASSEMBLY-PRIMARY SIDE VACUUM BREAK ATTACHING
30. VACUUM BREAK ASSEMBLY-PRIMARY SIDE
31. RETAINER-AIR VALVE LINK
32. LINK-AIR VALVE
33. BUSHING-AIR VALVE LINK
34. RETAINER-PRIMARY SIDE VACUUM BREAK LINK
35. LINK-PRIMARY SIDE VACUUM BREAK
36. BUSHING-PRIMARY SIDE VACUUM BREAK LINK
37. SCREW-SECONDARY SIDE VACUUM BREAK ATTACHING
38. VACUUM BREAK ASSEMBLY-SECONDARY SIDE
39. RETAINER-SECONDARY SIDE VACUUM BREAK LINK
40. LINK-SECONDARY SIDE VACUUM BREAK
41. BUSHING-SECONDARY SIDE VACUUM BREAK LINK
42. RETAINER-INTERMEDIATE CHOKE SHAFT LINK
43. BUSHING-INTERMEDIATE CHOKE SHAFT LINK
44. RETAINER-FAST IDLE CAM LINK
45. BUSHING-FAST IDLE CAM LINK
46. LINK-FAST IDLE CAM
47. KIT-CHOKE COVER RETAINER
48. RIVET-CHOKE COVER ATTACHING
49. RETAINER-CHOKE COVER
50. ELECTRIC CHOKE COVER & STAT ASSEMBLY
51. SCREW-CHOKE STAT LEVER ATTACHING
52. LEVER-CHOKE STAT
53. INTERMEDIATE CHOKE SHAFT, LEVER & LINK ASSEMBLY
54. SCREW ASSEMBLY-CHOKE HOUSING ATTACHING

FLOAT BOWL PARTS

66. FLOAT BOWL ASSEMBLY
67. PUMP ASSEMBLY
68. SPRING-PUMP RETURN
69. INSERT-FLOAT BOWL-UPPER
70. HINGE PIN-FLOAT
71. FLOAT & LEVER ASSEMBLY
72. NEEDLE & SEAT ASSEMBLY (A-FLOAT NEEDLE, B-FLOAT NEEDLE PULL CLIP, C-FLOAT NEEDLE SEAT, D-FLOAT NEEDLE SEAT GASKET)
73. SPRING-FLOAT STABILIZING
74. INSERT-FLOAT BOWL-LOWER

75A POWER PISTON ASSEMBLY

75B POWER PISTON ASSEMBLY-WITH ADJUSTABLE METERING ROD HANGER

76. ROD ASSEMBLY-PRIMARY METERING
77. SPRING-POWER PISTON
78. JET-PRIMARY METERING
79. GUIDE-PUMP DISCHARGE SPRING
80. SPRING-PUMP DISCHARGE
81. BALL-PUMP DISCHARGE
82. NUT-FUEL INLET
83. SPRING-FUEL FILTER
84. FILTER-FUEL INLET
85. GASKET-FUEL INLET NUT

THROTTLE BODY PARTS

100. THROTTLE BODY ASSEMBLY
101. SCREW ASSEMBLY-THROTTLE BODY TO FLOAT BOWL
102. GASKET-THROTTLE BODY TO FLOAT BOWL
103. LINK-PUMP
104. IDLE MIXTURE NEEDLE & SPRING ASSEMBLY
105. SCREW-THROTTLE STOP
106. SPRING-THROTTLE STOP SCREW
107. SCREW-FAST IDLE
108. RETAINER-FAST IDLE SCREW
109. GASKET-FLANGE

IDLE SPEED CONTROL DEVICES

125. BRACKET-IDLE SPEED DEVICE
126. SCREW-BRACKET ATTACHING
127. SOLENOID-IDLE STOP
128. NUT-IDLE STOP SOLENOID
129. RETAINER-IDLE SOLENOID NUT
130. IDLE LOAD COMPENSATOR (ILC) ASSEMBLY
131. CAP-ILC
132. NUT-ILC ATTACHING
133. ACTUATOR-THROTTLE LEVER
134. NUT-THROTTLE LEVER ACTUATOR
135. RETAINER-ACTUATOR NUT

Figure 6C9-7a 2SE Carburetor (2 of 2)

DIAGNOSIS

During disassembly and reassembly, give special attention to the parts mentioned below, and repair or replace if necessary, if these problems have been encountered:

Also refer to Engine Performance Diagnosis (Section 6) for additional diagnosis.

A. FLOODING

Inspect

1. Fuel inlet filter (84) for damage or clogged condition.
2. Float needle and needle seat (72A and 72C) for dirt, grooves or scoring.
3. Float needle pull clip (72B), and the float stabilizing spring (73) if used, for improper installation.
4. Float and lever assembly (71) and hinge pin (70) for distortion, binds, and burrs.

B. HESITATION

Inspect

1. Pump link (103) for wear.
2. Pump (67) for cracks, scores, and cup wear.
   - A used pump cup shrinks when dry, and should be soaked in fuel for eight hours before testing.
   - Pump well for scoring.
3. Pump return spring (68) and duration spring for distortion.
4. Pump passages and jet for dirt.
   - Discharge ball (81) for improper seating.
   - Discharge spring (80) for distortion.
5. If thermostatically controlled bypass valve allows fuel to bypass below 43° C. (110° F.), replace air horn assembly.

C. HARD STARTING - POOR COLD OPERATION

Inspect

1. Choke valve and linkage for wear, binds or distortion.
   - Do not lubricate linkage, as dust will collect, causing sticking.
2. Vacuum break assemblies (30) and (38) for leaks.
3. Fuel filter (84) for damage or clogged condition.
4. Float needle (72A) for sticking, dirt, etc.
5. Also items under "A. Flooding", above.

D. POOR PERFORMANCE - OR - POOR GAS MILEAGE

Inspect

1. Choke valve for binding.
2. Air valve and secondary metering rod for binding.
   - If either is damaged, or if you know that the metering rod adjustment has been changed from its original setting, replace the air horn assembly.
3. Air valve spring for improper installation, and for incorrect windup (if applicable).
4. Fuel filter (84) for damage or clogged condition.
5. Power piston (75A or 75B), metering rod (76), and jet (78); for dirt, sticking, binding, damaged parts and wear.
6. All fuel and air passages for clogs and dirtiness.

E. ROUGH IDLE

Inspect

1. Throttle lever and valves for binds, nicks and other damage.
2. All gaskets and mating casting surfaces for nicks, burrs and damage to sealing beads.
3. Idle mixture needle (104) for ridges, burrs, and bends.
4. Idle fuel passages for dirt, etc.

ON-VEHICLE SERVICE

CARBURETOR IDENTIFICATION

The carburetor part number is stamped vertically on the float bowl in a flat area as shown in Figure 6C9-8. Refer to this part number when servicing the carburetor.

CARBURETOR REPLACEMENT (FIGURE 6C9-9)

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosis, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check fuel filter.

1. Remove air cleaner and gasket.
2. Disconnect fuel pipe and vacuum lines.
3. Disconnect electrical connectors.
4. Disconnect accelerator linkage.
5. If equipped with automatic transmission, disconnect downshift cable.
6. If equipped with cruise control, disconnect linkage.
7. Remove carburetor attaching bolts.
8. Remove carburetor and EFE heater/insulator.

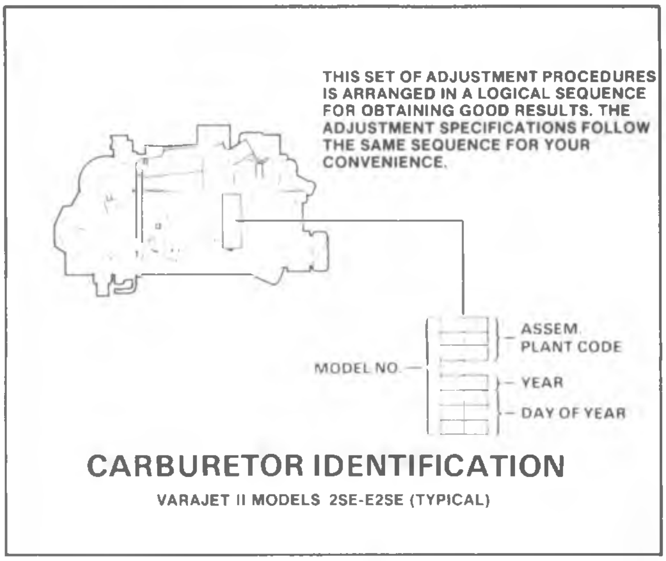


Figure 6C9-8 Carburetor Identification

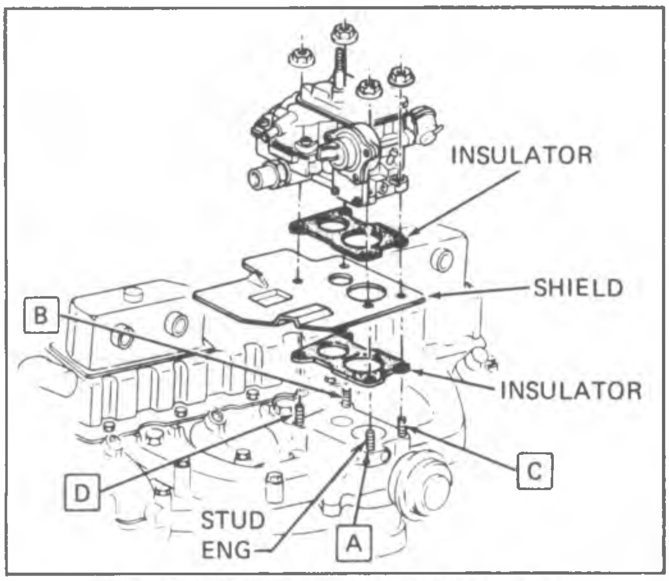


Figure 6C9-9 Carburetor Replacement

Installation

Fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of no-lead fuel will enable carburetor to be filled and the operation of the float and inlet needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

1. Inspect EFE heater/insulator for damage.
   Be certain throttle body and EFE isolator surfaces are clean.
2. Install EFE heater/insulator.
3. Install carburetor and tighten nuts alternately to correct torque (See Carburetor Mounting Torque).
4. Connect downshift cable as required.
5. Connect cruise control cable as required.
6. Connect accelerator linkage.
7. Connect electrical connections.
8. Connect fuel pipe and vacuum hoses.
9. Check base (slow) and fast idle.
10. Install air cleaner.

CARBURETOR MOUNTING TORQUE

When torquing carburetor after removal, overhaul, replacement or when installing a new EFE heater/insulator, torque mounting bolts, in a clockwise direction, to 18 N·m 5 N·m (160 in.lbs. 45 in.lbs.).

When retorquing carburetor at recommended maintenance intervals, check in a clockwise direction. If less than 9 N·m (80 in.lbs.), retorque to 13 N·m (110 in.lbs.); if greater than 9 N·m (80 in.lbs.), do not retorque.

FUEL FILTER REPLACEMENT

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

1. Remove air cleaner.
2. Disconnect fuel line connection at inlet fuel filter nut.
3. Remove inlet fuel filter nut from carburetor.
4. Remove filter and spring (Figure 6C9-10).
5. Install spring and filter element in carburetor with hole in filter toward nut.
6. Install new gasket on inlet fitting nut and install nut in carburetor and tighten to 34 N·m (300 in. lbs.).
7. Install fuel line and tighten connector to 24 N·m (18 ft. lbs.) while holding fuel inlet fitting with wrench.
8. Run engine and observe for leaks.

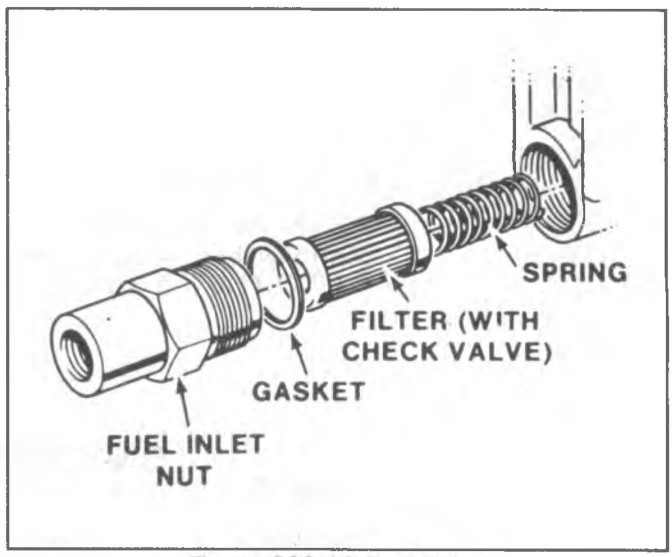


Figure 6C9-10 Fuel Filter

CHOKE AND HOSES

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

Choke Check Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.
2. If choke or linkage binds, sticks or works sluggishly, clean with Delco Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. If cleaning does not correct, replace binding parts.
3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or signs of deterioration. Replace or correct as necessary.
4. Make sure vacuum break diaphragm shafts are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine, primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.

Checking Electric Choke

If the electric choke fails, the following checks should be made:

1. Check voltage at the choke heater connection with the engine running. If voltage is between 12 and 15 volts, replace the electric choke unit.
2. If the voltage is low or zero, check all wires and connections.
3. If steps 1 and 2 are OK, check the following:
   - Gage equipped vehicles - See Section 8 for Choke Heater Circuit Diagnosis.
   - Non-gage equipped vehicles - if the connection at the oil pressure switch is faulty, the temperature/pressure warning light will be off with the ignition key "on" and the engine not running. Repair wires as required. If choke is still inoperative, replace oil pressure switch.

CHOKE COIL REPLACEMENT

Choke mechanism should be checked for free operation. A binding condition may have developed from petroleum gum formation on the choke shaft or from damage. Choke shafts can usually be cleaned without disassembly.

1. Remove air cleaner and disconnect choke electrical connector.
2. Align a #21 drill (.159") on rivet head and drill only enough to remove rivet head (Figure 6C9-11). After removing rivet heads and retainers, use a drift and small hammer to drive the remainder of the rivet from the choke housing. Use care in drilling to prevent damage to the choke cover or housing. Remove the three retainers and choke cover assembly from choke housing.
3. Remove choke coil from housing.
4. Install the choke cover and coil assembly in choke housing as follows:

   Install the choke cover and coil assembly in the choke housing, aligning notch in cover with raised casting projection on housing cover flange. Make sure coil pickup tang engages the inside choke coil lever.

   A choke cover retainer kit is required to attach the choke cover to the choke housing. Install proper retainers and rivets contained in kit using a suitable blind rivet installing tool.
5. Connect choke electrical connector.
6. Start engine, check operation of choke and then install air cleaner.

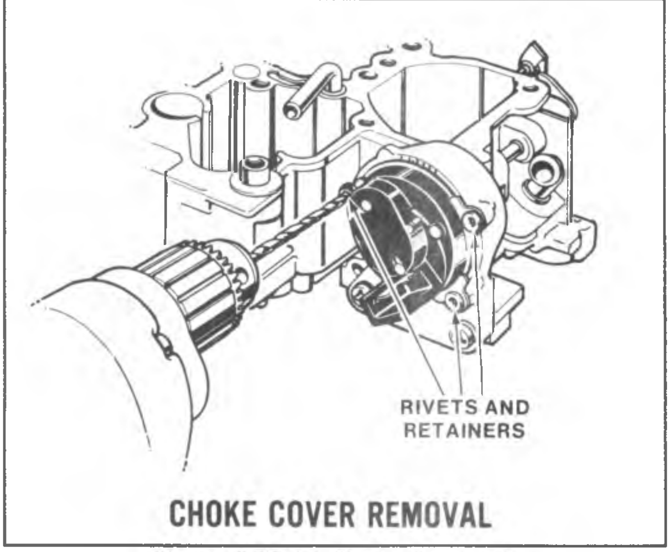


Figure 6C9-11 Choke Removal

SECONDARY VACUUM BREAK THERMAL VACUUM SWITCH (TVS)

The secondary vacuum break TVS, located in the air cleaner, improves cold starting and cold driveability by sensing carburetor air inlet temperature to control the carburetor secondary vacuum break.

Replacement

1. Remove air cleaner cover and element.
2. Disconnect vacuum hoses.
3. Pry clip from TVS and remove TVS.
4. Install new TVS and replace clip.
5. Reconnect vacuum hoses (refer to Vehicle Emission Control Information label).
6. Install air cleaner cover and element.

Secondary Vacuum Break TVS Check

1. With engine at normal operating temperature, the Thermal Vacuum Switch (TVS) must be open (air cleaner cover on).
2. Apply either engine or auxiliary vacuum to the inlet port and check for vacuum at the outlet port (outlet port connects to secondary vacuum break).
3. If there is no vacuum, check thermostatic air cleaner vacuum hoses and/or replace the TVS.

IDLE MIXTURE CHECK AND ADJUSTMENT

Propane Enrichment

Idle mixture screw has been preset at the factory and sealed. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacement or high emissions as determined by official inspections. Adjusting mixture by other than the following method may violate Federal and/or California or other state or provincial laws.

Because of the sealed idle mixture screw, the idle mixture checking procedure requires artificial enrichment by adding propane.

1. Set parking brake and block drive wheels. Engine must be at normal operating temperature and air conditioning off.
2. Disconnect and plug hoses as directed on the Vehicle Emission Control Information label under the hood.
3. Connect an accurate tachometer to engine.
4. Disconnect vacuum advance and set timing to specification shown on the Vehicle Emission Control Information label. Re-connect vacuum advance.
5. Set carburetor idle speed (RPM) to specification as shown on Vehicle Emission Control Information label.
6. Disconnect crankcase ventilation tube from air cleaner.
7. Using tool J-26911, insert hose with rubber stopper, from propane valve into crankcase ventilation tube opening in air cleaner. Propane cartridge mut be vertical (Figure 6C9-12).
8. With engine idling in Drive (automatic) or Neutral (Manual), slowly open propane control valve while pressing button. Continue to add propane until maximum enriched idle RPM drops due to over richness. Note maximum enriched idle RPM.

   If rich RPM drop cannot be obtained, check for empty cartridge or propane system leaks.

   - Propane enrichment RPM is the differential between idle speed RPM and maximum idle RPM.

   The maximum idle RPM is the idle RPM plus propane enrichment RPM.
9. If maximum enriched idle RPM is within specifications, the idle mixture is correct, go to Step 17.
10. If maximum enriched idle RPM is not within specifications, remove carburetor from engine to gain access to plug covering the idle mixture needle. Remove plug following procedure under Unit Repair (Throttle Body Disassembly).
11. Tightly seat mixture needle and then back out 3 turns.
12. Place transmission in Drive (automatic) or Neutral (manual).
13. Back needle out (richen 1/8 turn at a time until maximum idle speed is obtained). Then set idle speed to maximum enriched idle RPM.
14. Turn mixture needle in (clockwise) 1/8 turn at a time until idle speed reaches value given Vehicle Emission Control Information label.
15. Recheck maximum enriched RPM with propane. If not within specification, repeat adjustment beginning with Step 12.
16. Check and adjust fast idle as described on Vehicle Emission Control Information label.
17. Turn off engine. Remove propane tool, connect crankcase ventilation tube. Reconnect vacuum hoses.

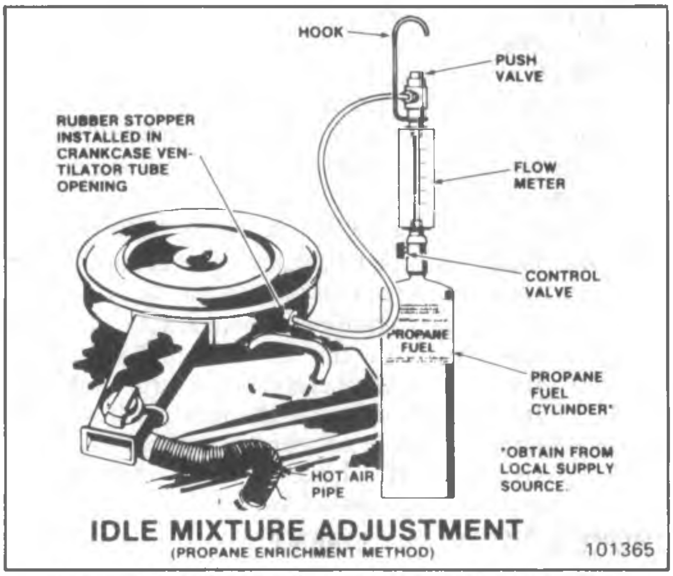


Figure 6C9-12 Idle Mxture-Propane Enrichment

CARBURETOR ADJUSTMENTS

Before checking or resetting the carburetor as the cause of poor engine performance or rough idle; check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission control (EEC) system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts.

FAST IDLE ADJUSTMENT

Refer to the Vehicle Emission Control Information label and Figure 6C9-13 and 14 for fast idle adjustment.

IDLE SPEED ADJUSTMENT

Refer to the Vehicle Emission Control Information label on the vehicle and Figure 6C9-13 and 14 for adjustment procedures and specification information.

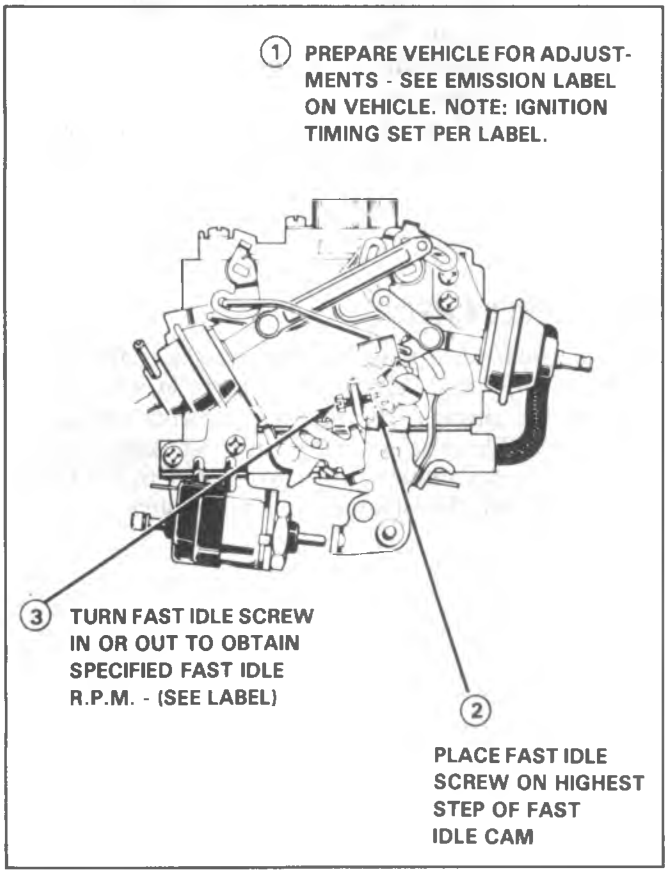


Figure 6C9-13 Fast Idle Adjustment

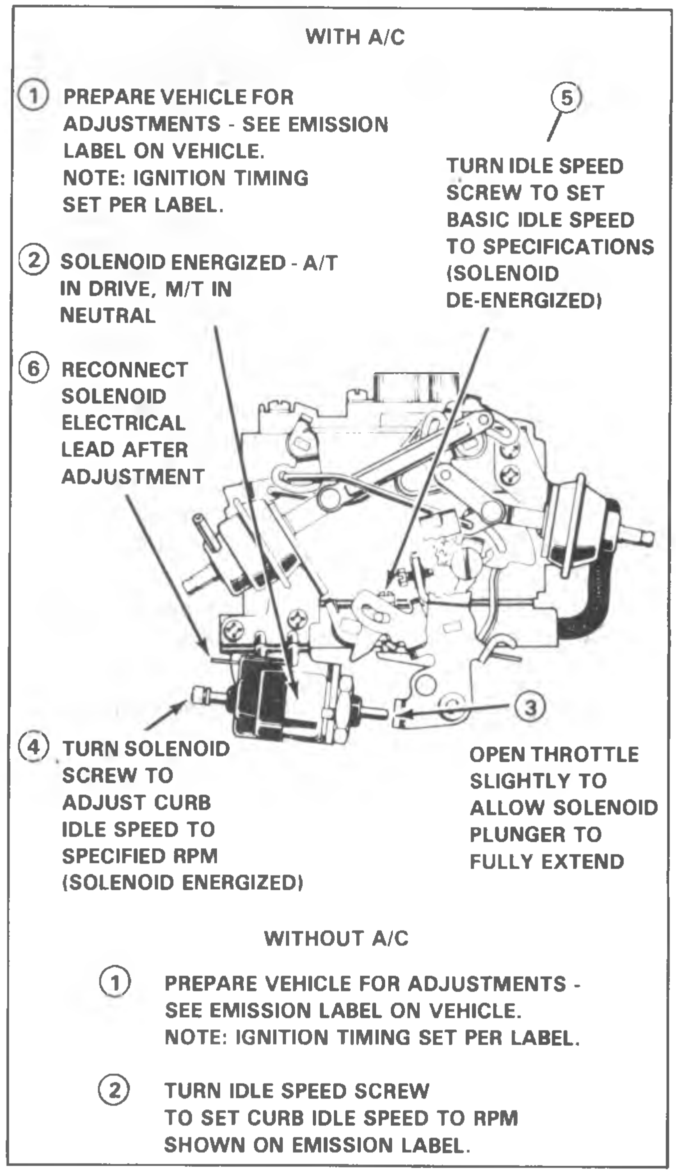


Figure 6C9-14 Idle Speed w/and w/o A/C

IDLE SOLENOID

The solenoid should be checked to assure that the solenoid plunger extends when the solenoid is energized. An inoperative solenoid could cause stalling or a rough idle when hot, and should be replaced as necessary.

Check

1. Turn on ignition, but do not start engine. Position transmission lever in Drive (A/T) or Neutral (M/T). On vehicles equipped with air conditionig, A/C switch must be ON.
2. Open and close throttle to allow solenoid plunger to extend.
3. Disconnect wire at solenoid. Solenoid plunger should drop away from throttle lever.
4. Connect solenoid wire. Plunger should move out and contact the throttle lever. Solenoid may not be strong enough to open the throttle, but the plunger should move.
5. If plunger does not move in and out as wire is disconnected and connected, check for voltage feed wire:
   a. If voltage is 12-15 volts, replace solenoid.
   b. If voltage is low or zero, locate cause of open circuit in solenoid feed wire and repair.

Removal

1. Remove carburetor air cleaner.
2. Disconnect electrical connector at solenoid.
3. Remove large retaining nut, tabbed lock washer, and remove solenoid.

Installation

1. Install solenoid and retaining nut, bending lock tabs against nut flats.
2. Connect electrical connector.
3. Install air cleaner.
4. Refer to Vehicle Emission Control Information label, and adjust idle speed.

FLOAT LEVEL CHECK

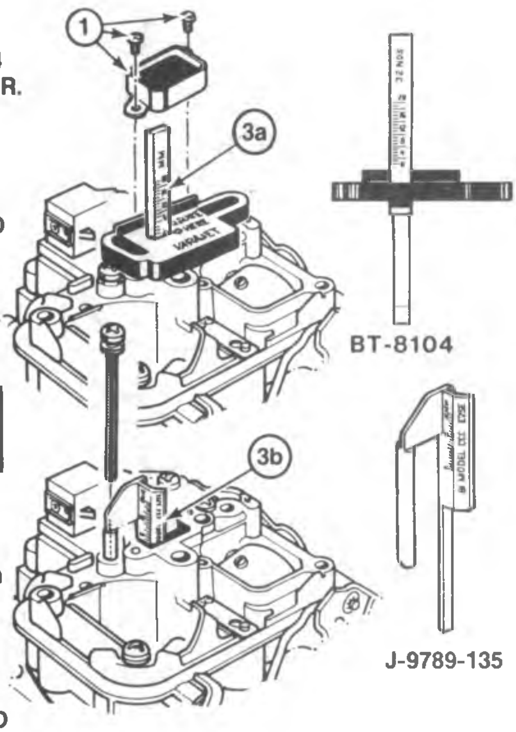
The float level may be checked externally using tool J-9789-130 and referring to Figure 6C9-15.

The remaining carburetor adjustments are part of Unit Repair. These adjustments, in most cases, may be performed on the vehicle. Refer to Figures 6C9-44, 45, 46, 47, 48, 49 and 50 for adjustment procedures.

(1) REMOVE AIR HORN VENT STACK.
(2) SELECT CORRECT GAGE FROM BT-8104 OR J-9789-135 SERIES FOR CARBURETOR.
(3) a USING BT-8104 GAGE SERIES, INSERT BRIDGE
-OR-
b USING J-9789-135 GAGE SERIES, REMOVE AIR HORN SCREW NEXT TO OPEN VENT.
(4) WITH ENGINE RUNNING AT IDLE, CHOKE WIDE-OPEN, INSERT GAGE IN BRIDGE OR GUIDE HOLE, AND ALLOW IT TO FLOAT FREELY.

NOTICE: DO NOT PRESS DOWN ON GAGE. FLOODING OR FLOAT DAMAGE COULD RESULT.

(5) OBSERVE AT EYE LEVEL THE MARK ON GAGE THAT LINES UP WITH TOP OF BRIDGE OR AIR HORN CASTING. SETTING SHOULD BE WITHIN ±1.588mm (1/16") OF SPECIFIED FLOAT LEVEL SETTING.
INCORRECT FUEL PRESSURE WILL ADVERSELY AFFECT FUEL LEVEL.
(6) IF NECESSARY, REMOVE AIR HORN AND ADJUST FLOAT LEVEL TO SPECIFICATION.



FLOAT GAGE - EXTERNAL CHCKING PROCEDURE

Figure 6C9-15 External Float Check Procedure

UNIT REPAIR

DISASSEMBLY

(Figure 6C9-7 Is a General Reference)

Remove or Disconnect (Figures 6C9-16, 17, 18)

Tools Required:
J-9789-118 or BT-30-15, Carburetor Holding Stand

1. Invert carburetor; remove plug covering idle mixture needle (104).
2. Install Holding Stand.
3. Hose (27)
4. Bracket screws (28) and (29).
5. Vacuum break assembly (30) and links from slots in levers.

Disassemble

- Air valve link retainer (31), link (32), and bushing (33).
- Vacuum break link retainer (34), link (35), and bushing (36).
- Idle speed device retainer (129 or 135).
- Nut (128, 132, or 134) and idle speed device (127, 130, or 133).

Remove or Disconnect (Figure 6C9-18)

6. Bracket screws (37).
7. Vacuum break assembly (38) and link from slot in choke lever.

Disassemble

(If part replacement is necessary).

- Retainer (39), secondary side vacuum break link 40), and bushing (41).
- Idle stop solenoid retainer (129).
- Attaching nut (128) and solenoid (127).

Remove or Disconnect (Figures 6C9-19, 20, 21, 22)

1. Intermediate choke link retainer (42), at choke lever.
   - Discard retainer.
2. Choke link and bushing (43) from choke lever.
   - Save bushing for reassembly.
3. If used, remove retainer (44) and bushing (45) from fast idle cam link (46).
   - Use new retainer on reassembly.

NOTICE: Do not remove fast idle cam screw and cam from float bowl. When reassembled, screw might not hold properly. If needed, a replacement float bowl includes a secondary lockout lever, fast idle cam and fast idle cam screw.

4. Retainer (10) from pump link (103).

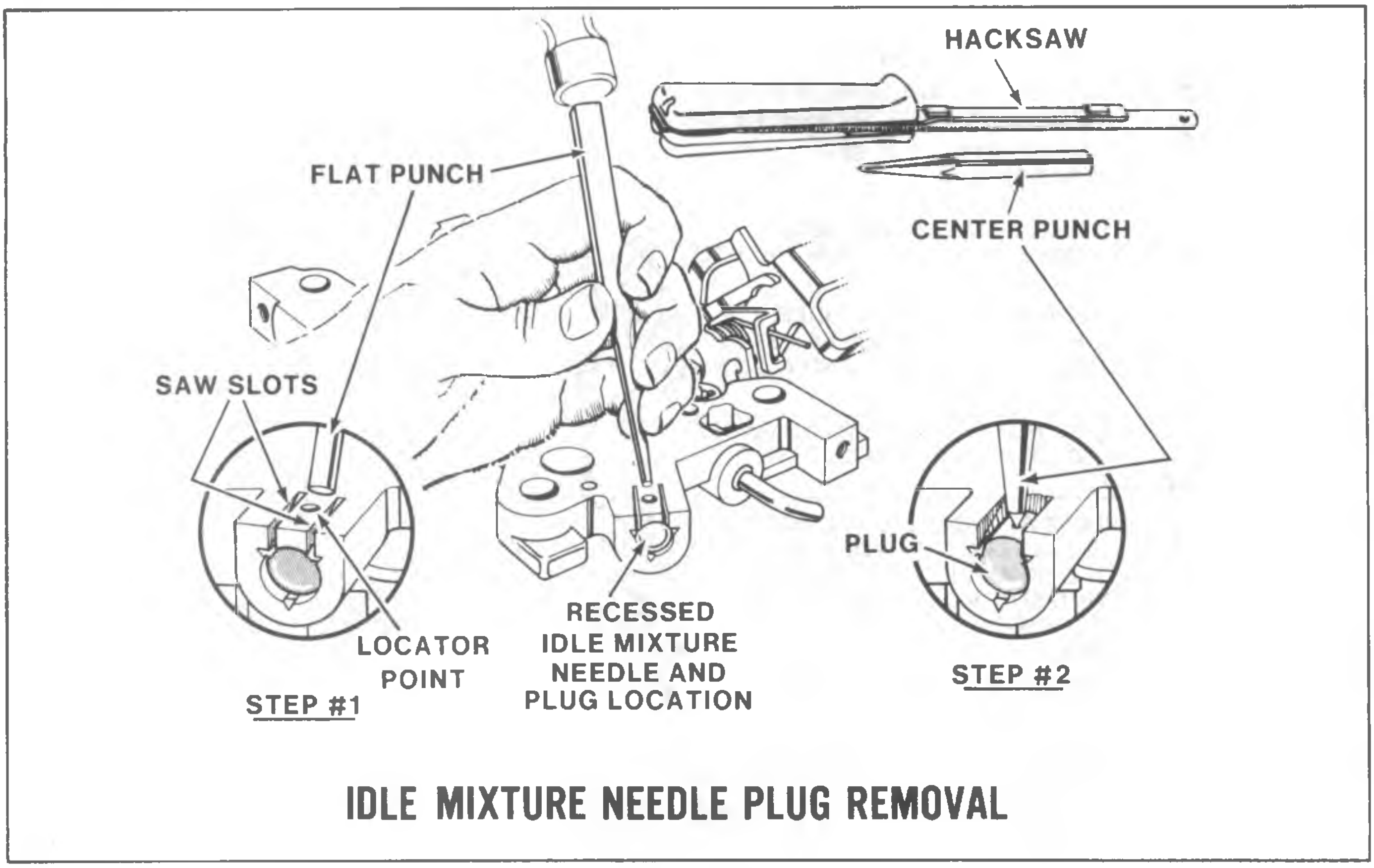


Figure 6C9-16 Idle Needle Plug

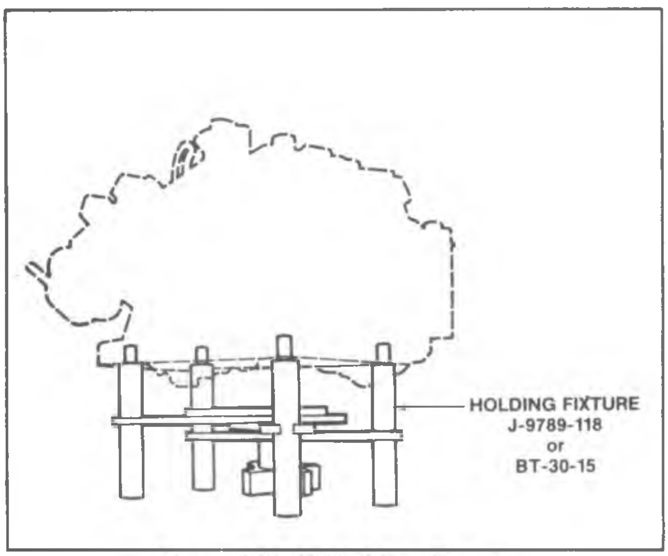


Figure 6C9-17 Holding Fixture

NOTICE: Do not remove screw attaching the pump lever to air horn assembly. When reassembled, screw might not hold properly.

5. If hot idle compensator (3) is used:
   - Two attaching screws (2).
   - Compensator.
   - Gasket (4).
6. Seven screw assemblies of various lengths (5, 6, 7, 8), and vent stack (9).
7. Air horn assembly (1).
   - Tilt to disconnect fast idle cam link (46) from slot in fast idle cam; and pump link (103) from hole in pump lever.
8. Fast idle cam link (46) from choke lever.
   - Line up "squirt" on link with slot in lever.

←→ Remove or Disconnect (Figure 6C9-23)

1. Invert air horn. Remove staking that holds pump stem seal retainer (11), using a small screwdriver.
2. Retainer (11) and pump stem seal (12).
   - Discard both.
3. Do not disassemble air horn any further.

NOTICE: Do not turn the secondary metering rod adjusting screw. Rod could come out of jet and cause damage.

←→ Remove or Disconnect (Figures 6C9-24, 25, 26)

1. Pump (67).
2. Air horn gasket (13).
3. Return spring (68).
4. Upper insert (69)
   - Hinge pin (70),
   - Float and lever assembly (71), with stabilizing spring (73) if used,
   - Needle and pull clip (72A and 72B).

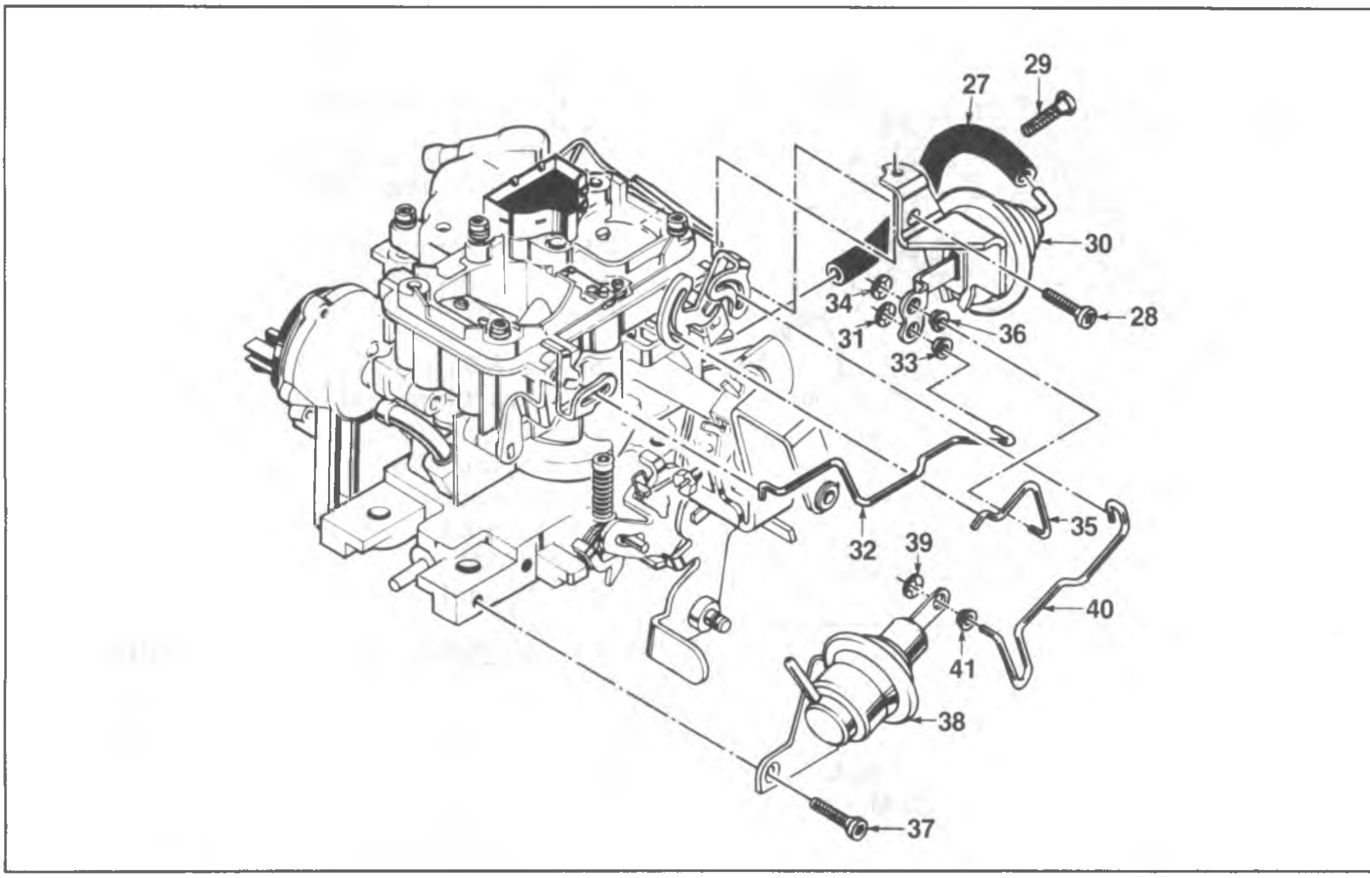


Figure 6C9-18 Vacuum Breaks and Links

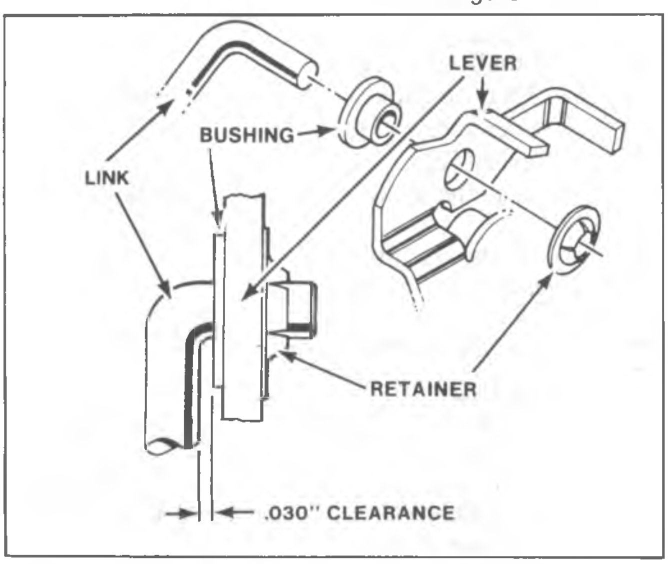


Figure 6C9-19 Choke Linkage

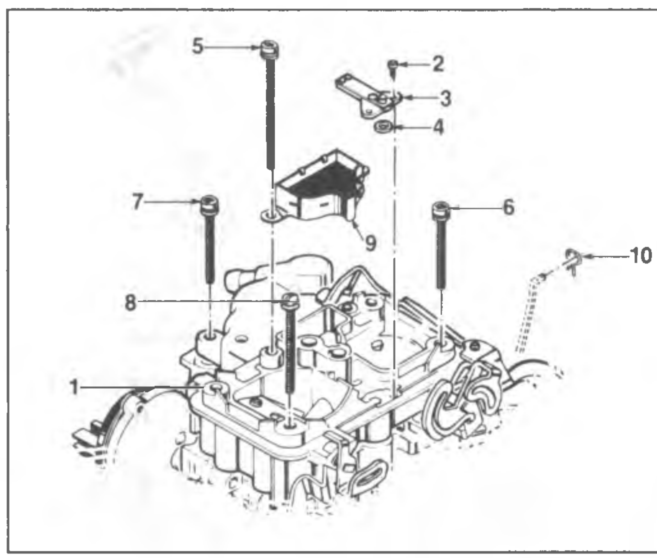


Figure 6C9-20 Air Horn

5 Lower insert (74), if used.

6. Needle seat (72C), and gasket (72D).

- Power piston (75A or 75B) and metering rod assembly (76).
  - Do not use pliers.
  - Repeatedly press piston down and allow it to snap free.

Disassemble (Figure 6C9-27)

If necessary to remove metering rod (76) from power piston hanger (75A or 75B), compress spring on top of metering rod, and line up groove of rod with slot in hanger. Avoid damage to tip.

Important

Power piston (75B) includes an adjustable metering rod hanger to calibrate part throttle (APT) metering. Do not remove nor change position of the hanger. Fuel metering may be seriously affected.

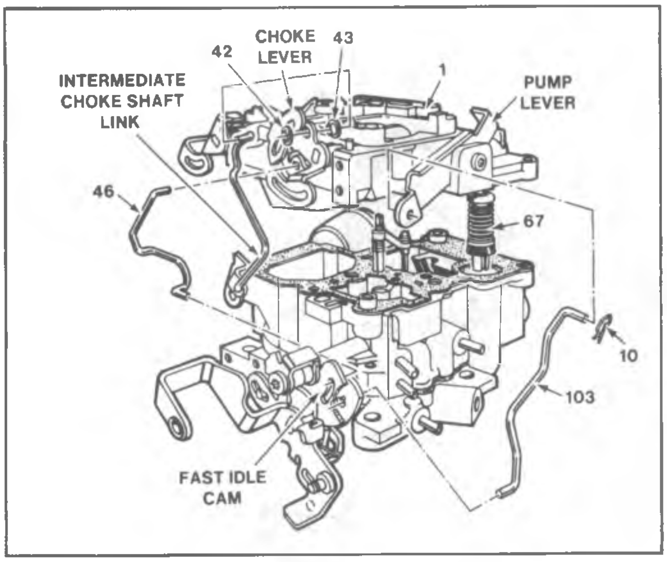


Figure 6C9-21 Air Horn and Float Bowl

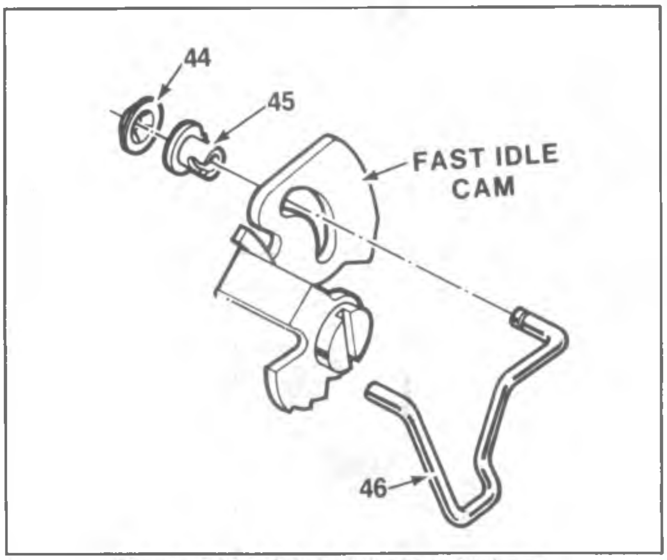


Figure 6C9-22 Fast Idle Cam Linkage

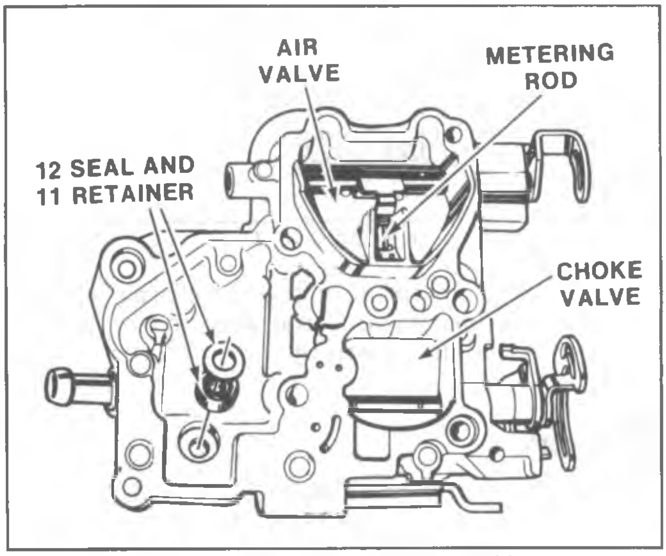


Figure 6C9-23 Air Horn - Bottom View

7. Power piston spring (77).
8. Primary metering jet (78).

Remove or Disconnect (Figure 6C9-28)

- Pump discharge spring guide (79), using slide hammer puller only.

NOTICE: Do not pry on guide. Damage could occur to the sealing surfaces, and require replacement of the float bowl.

9. Spring (80) and ball (81).
   - Invert bowl and catch as they fall.
10. Fuel inlet nut (82).
11. Filter spring (83).
12. Filter assembly (84).
    - Discard.
13. Gasket (85).
    - Discard.

CHOKE ASSEMBLY AND THROTTLE BODY REMOVAL

Remove or Disconnect (Figures 6C9-29, 30)

1. Choke cover:
   - Use 4mm (.159") bit to remove heads (only) from rivets (48).
   - Retainers (49).
   - Remaining pieces of rivets, with drift and small hammer.
   - Electric choke cover and stat assembly (50).
2. Stat lever screw (51).
3. Stat lever (52).
4. Intermediate choke shaft, lever and link assembly (53).
5. Two screw assemblies (54).
6. Housing (26).

Remove or Disconnect (Figures 6C9-31, 32)

Tools Required:
J-29030-B or BT-7610-B, Idle Mixture Socket (Double - D).

1. Four screws (101), and throttle body assembly (100) from inverted float bowl.
2. Gasket (102).
3. Pump link (103). Line up "squirt" on link with slot in lever.
4. Count and make a record of number of turns needed to lightly bottom the idle mixture needle (104), then back out and remove needle and spring assembly.
5. Do not disassemble throttle body any further.

Clean

1. Metal parts in cold immersion-type cleaner, Carbon X (X-55) or equivalent.

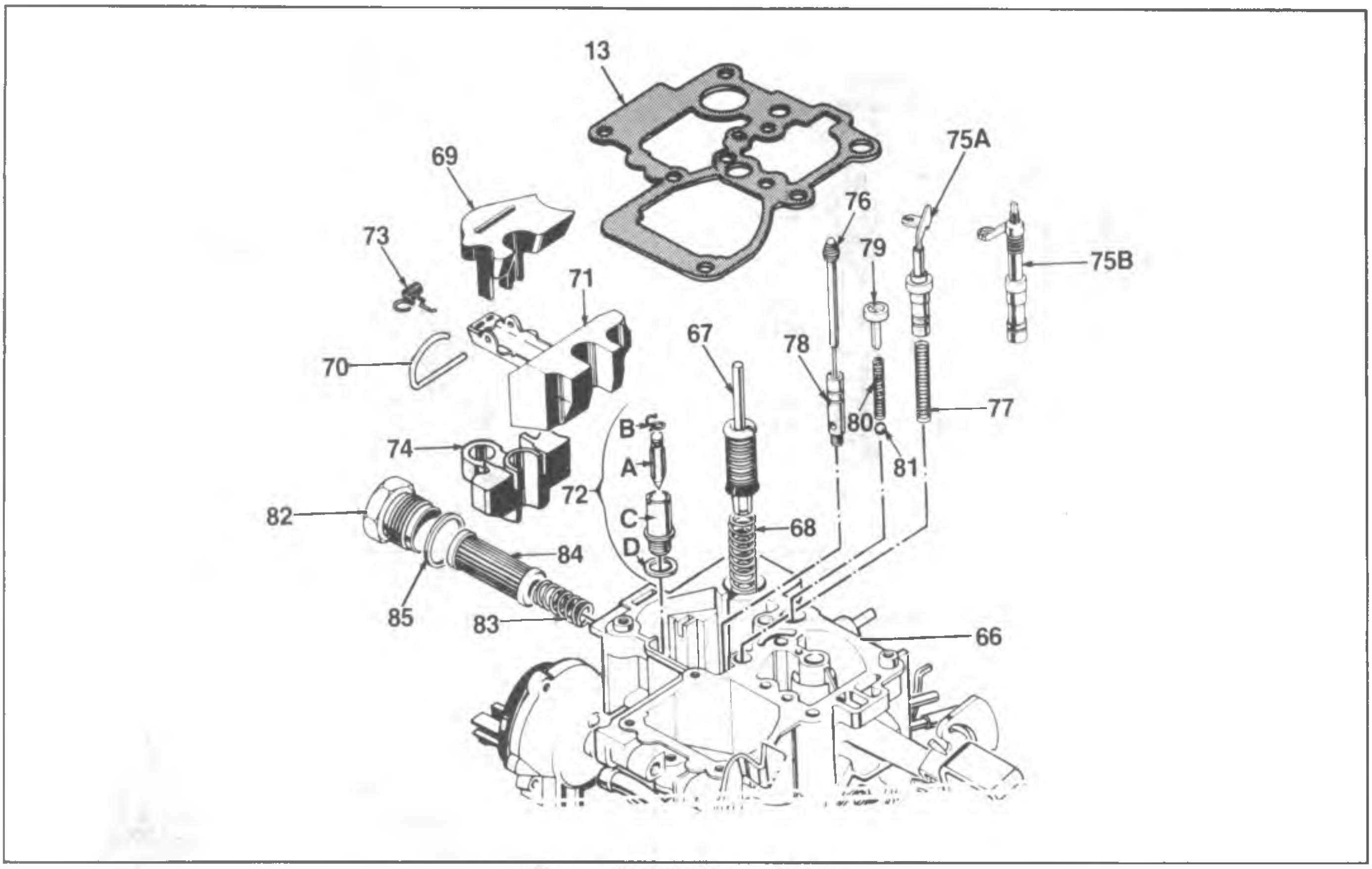


Figure 6C9-24 Float Bowl

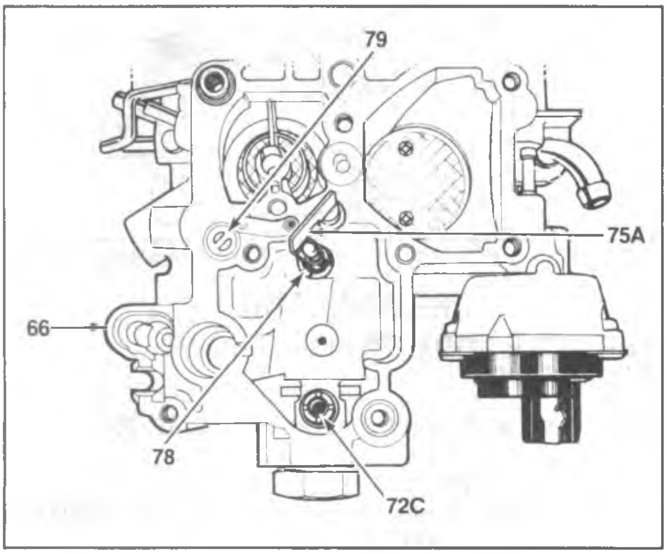


Figure 6C9-25 Float Bowl - Parts Location

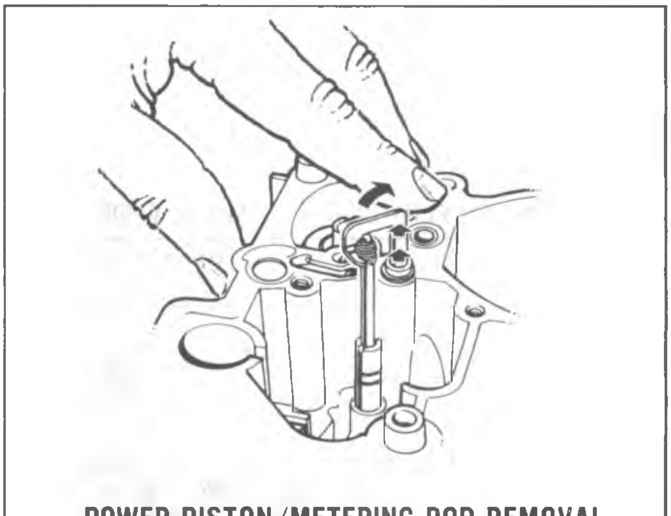


Figure 6C9-26 Power Piston /Metering Rod

NOTICE: DO NOT IMMERSE idle stop solenoid, idle load compensator, throttle lever actuator, electric choke, rubber and plastic parts, diaphragms, and pump, in cleaner, as they may be damaged. Plastic bushing in throttle lever will withstand normal cleaning.

2. Blow dry with shop air.

   Be sure all fuel and air passages are free of burrs and dirt.

   Do not pass drill bits or wires through jets or other passages.

Inspect

- Mating surfaces of castings for damage. Replace if necessary.
- Holes in levers for wear and out-of-round conditions.
- Bushings for damage and excessive wear. Replace if necessary.

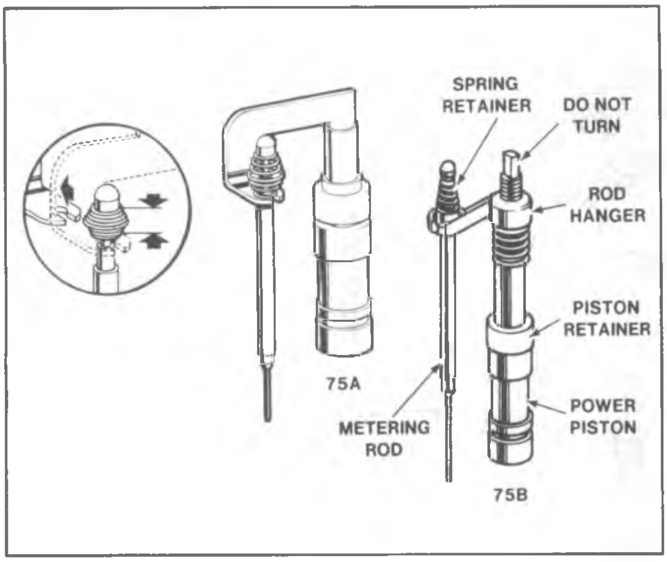


Figure 6C9-27 Power Piston/Metering Rod

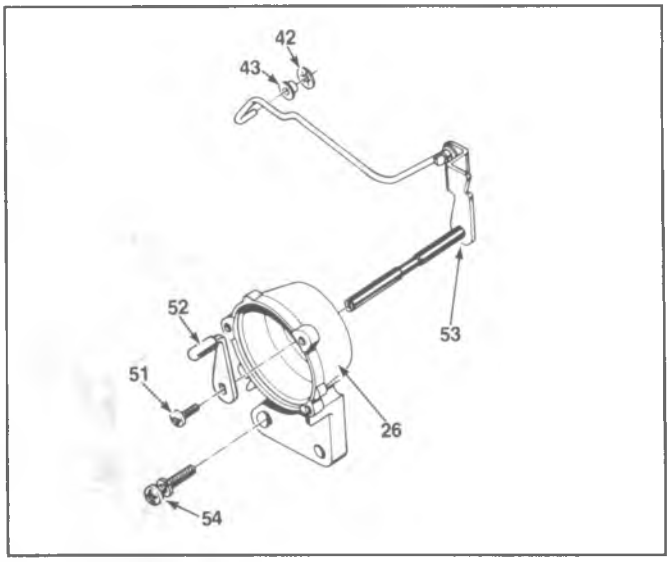


Figure 6C9-30 Choke Linkage

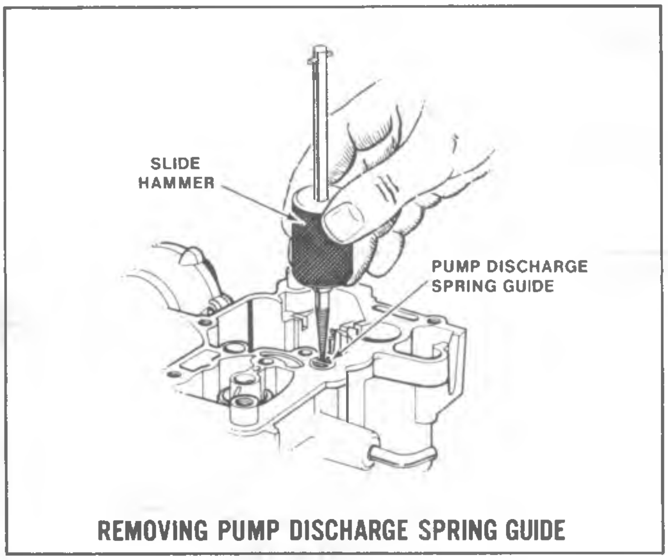


Figure 6C9-28 Pump Discharge Spring Guide

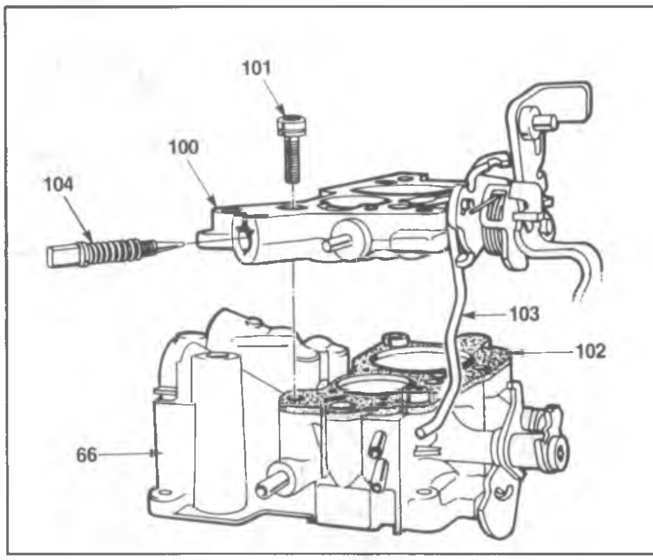


Figure 6C9-31 Throttle Body to Float Bowl

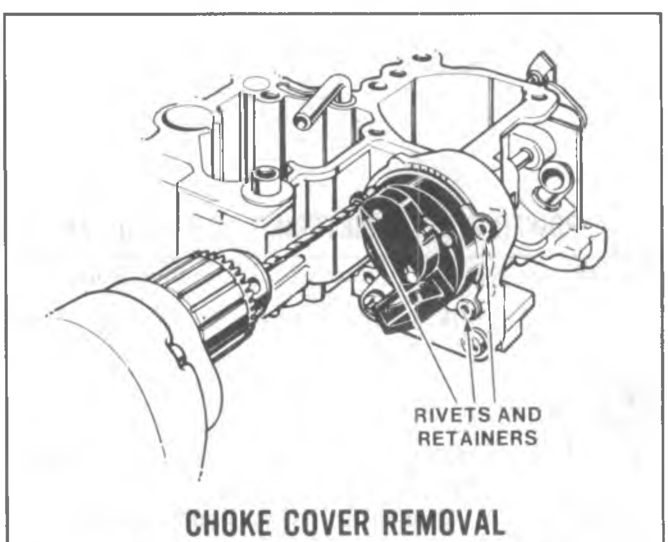


Figure 6C9-29 Choke Cover Removal

RE-ASSEMBLY

THROTTLE BODY ON FLOAT BOWL ASSEMBLY

Install or Connect (Figures 6C9-31, 32, 33)

Tools Required:

J-29030-B or BT-7610-B, Idle Mixture Socket (Double - D).

1. Needle and spring assembly (104).

Adjust (Figure 6C9-32)

- Lightly bottom needle.
  - Back it out the number of turns recorded during removal, as a preliminary adjustment.
  - See "On Vehicle Service" for final idle mixture adjustment.

2. Pump link (103).
3. New gasket (102) on inverted float bowl (66).
4. Throttle body (100) to bowl.

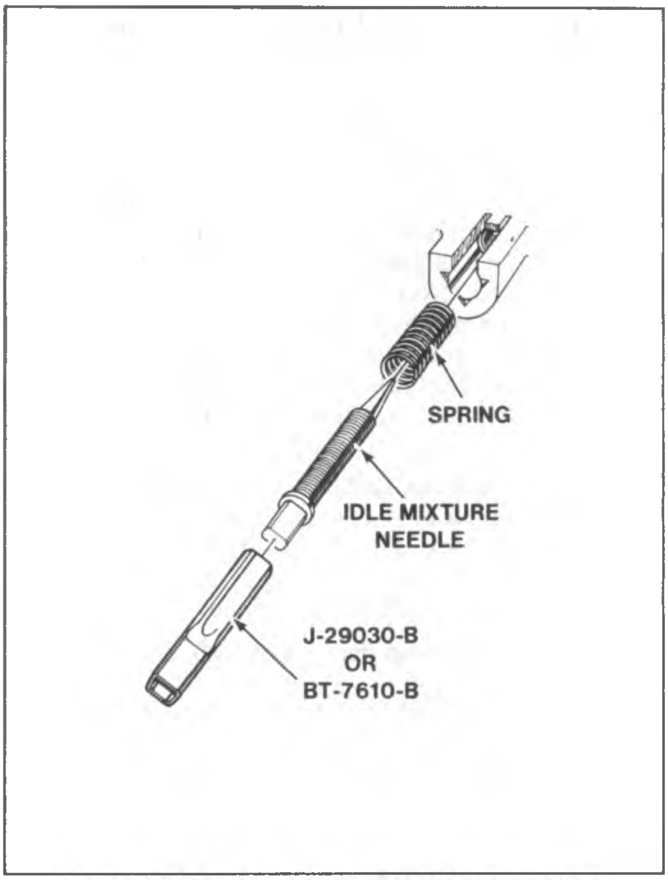


Figure 6C9-32 Idle Mixture Needle and Spring

- Finger tighten four screw assemblies (101).
- If used, secondary actuating lever must engage lockout lever.
- If linkage moves without binding, tighten screw assemblies.

5. If float bowl assembly was replaced, stamp or engrave model number on new bowl in same location as on old bowl.

Install or Connect (Figure 6C9-30)

Tools Required:

J-9789-118 or BT-30-15, Carburetor Holding Stand.

1. Throttle body and float bowl together on Holding Stand.
2. Choke housing (26) on throttle body, with screw assemblies (54).
3. Intermediate choke shaft, lever and link assembly (53).
4. Choke stat lever (52) on intermediate choke shaft.
   - Intermediate choke lever must be upright.
5. Lever attaching screw (51) in shaft (53).

FLOAT BOWL REASSEMBLY

Install or Connect (Figures 6C9-24, 25)

1. New gasket (85) on inlet nut (82).
2. New filter assembly (84) in nut.
3. Filter spring (83).
4. Inlet nut (82).

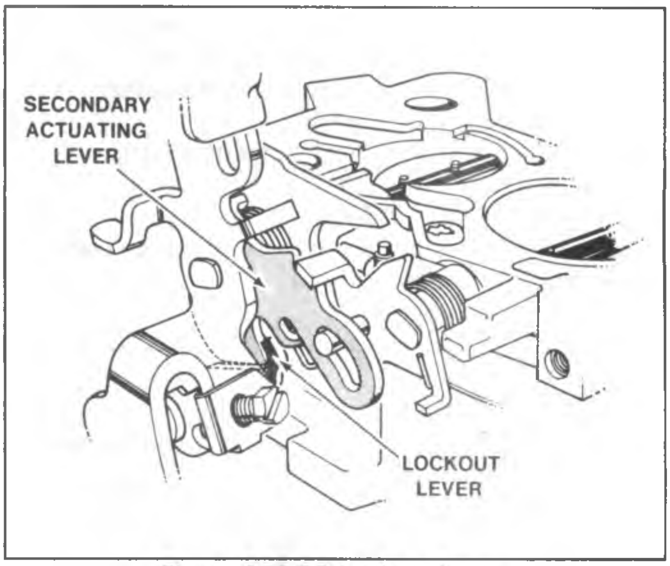


Figure 6C9-33 Lockout Lever

Tighten

- Inlet nut to 24 N·m (18 ft. lbs.).

CAUTION: Tightening beyond this limit may damage gasket and cause a fuel leak, which might result in personal injury or product damage.

Install or Connect (Figures 6C9-24, 25)

1. Pump discharge ball (81) and spring (80).
2. New spring guide (79).
   - Tap guide until top is flush with bowl casting.
3. Needle seat (72C) with gasket (72D).
4. If used, lower insert (74).
5. Metering jet (78).

Assemble (Figures 6C9-24, 34, 35)

1. Bend float lever (71) upward slightly at notch.
2. If used, float stabilizing spring (73) on float.
3. Hinge pin (70) in float lever, with ends to face the pump well.
4. Needle (72A) with pull clip assembly (72B) on edge of float lever.

Install or Connect (Figures 6C9-24, 25, 34, 35)

1. Float and lever assembly in float bowl.

Adjust (Figure 6C9-36)

Tools Required:

J-9789-90 or BT-8037, Float Level T-Scale.

- Float level. Refer to adjustment specifications at end of this section.

2. Power piston spring (77) in piston bore.

Assemble (Figure 6C9-27)

- If removed, reassemble metering rod (76) to hanger on power piston (75A or 75B).

3. Power piston and metering rod assembly.
   - Use small hammer and drift to press retainer into bore, flush with casting. Avoid damage to rod tip.
4. Upper insert (69) over hinge pin (70), with top flush with bowl.
5. Gasket (13) over dowels.
   - The slit portion goes over power piston.
6. Pump return spring (68).
7. Pump assembly (67).

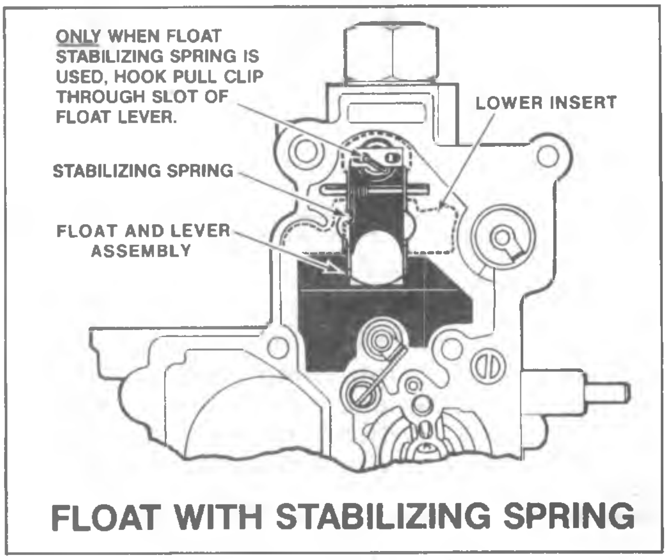


Figure 6C9-34 Float with Spring

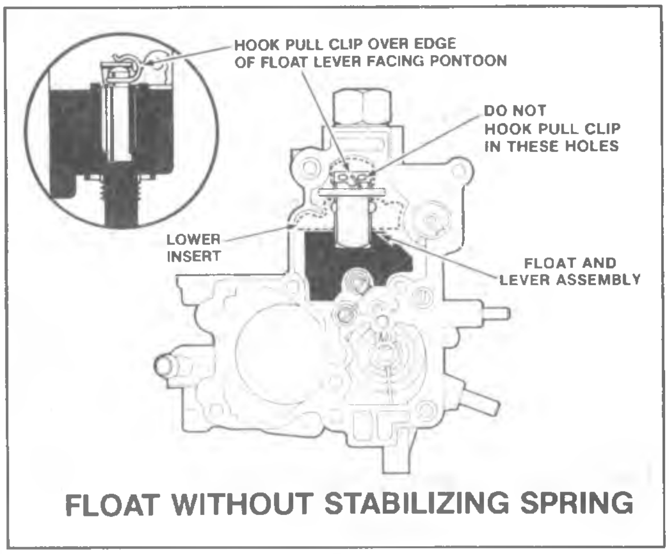


Figure 6C9-35 Float w/o Spring

AIR HORN REASSEMBLY

Install or Connect (Figures 6C9-23, 37)

1. New pump stem seal (12) (Lip faces outside of carburetor), and retainer (11).
   - Stake at new locations.
2. Lithium base grease, liberally to pin, if used, where contacted by spring.

INSTALLATION OF AIR HORN TO FLOAT BOWL

Install or Connect (Figures 6C9-21, 22, 20)

1. Fast idle cam link (46) in choke lever.
   - Line up "squirt" on link with slot in lever.
2. Rotate cam to highest position. Lower end of fast idle cam link goes in cam slot, and the pump link (103) end into hole in lever.
3. Hold pump (67) down, and lower air horn assembly onto float bowl, guide the pump stem through seal (12).
4. One air horn attaching screw, (5, 6, 7 or 8).
   - Finger tighten to hold in place.
5. If cam link is attached to cam with bushing (45) and retainer (44), install link in cam slot with new bushing and retainer. (Large end of bushing toward retainer.)
   - Check for freedom of movement.

Install or Connect (Figures 6C9-20, 38)

1. Screw assemblies of various lengths (5, 6, 7, 8), and vent stack (9).
2. If hot idle compensator (3) is used, new gasket (4), compensator, and two screws (2).
3. New retainer (10) on pump link (103).

Adjust (Figure 6C9-39)

- Air valve spring, if adjustable.

Install or Connect (Figures 6C9-19, 18)

1. Bushing (43) on choke link (53).
   - With intermediate choke lever upright, install link in choke lever hole.
2. New link retainer (42).

   Assemble

   (If Necessary)
   - Idle stop solenoid (127), retainer (129), and nut (128) to secondary side vacuum break (38) bracket.
   - Bend retainer tab to secure nut.
   - Bushing (41) to link (40).
   - Link to vacuum break (38) plunger.
   - Retainer (39) to link.
3. Rotate assembly (38), insert end of link (40) in upper slot of choke lever.
4. Bracket screws (37).

   Assemble

   (If Necessary)
   - Idle speed device (127, 130 or 133), retainer (129 or 135), and nut (128, 132 or 134) to primary side vacuum break (30) bracket.
   - If used, bend retainer tab to secure nut.
   - Bushing (36) to vacuum break link (35).
   - Link to vacuum break (30) plunger.
   - Retainer (34) to link.

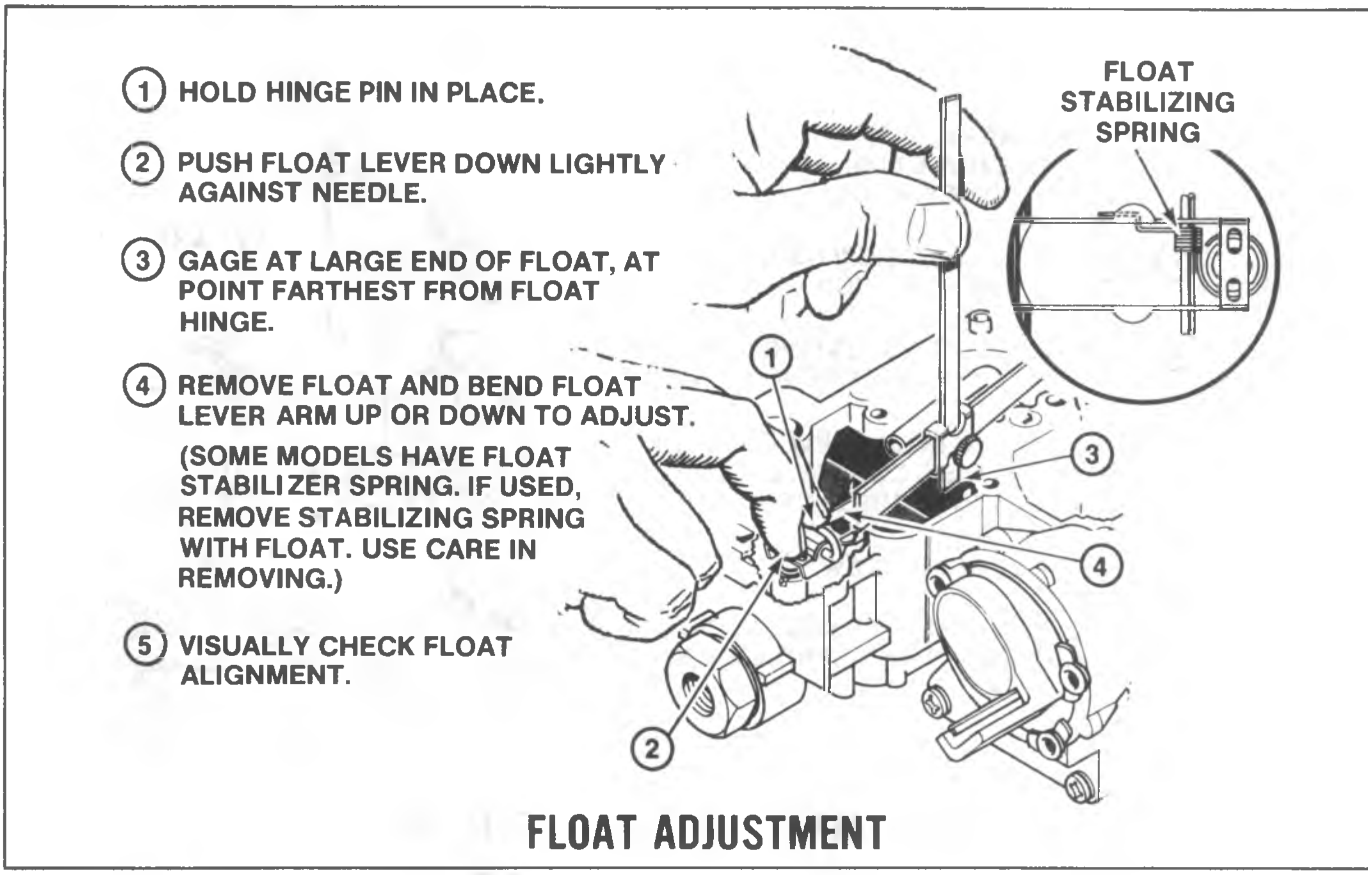


Figure 6C9-36 Float Adjustment

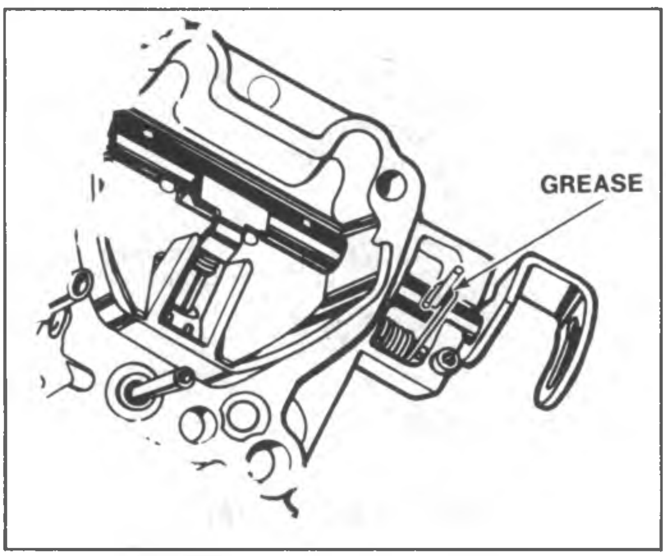


Figure 6C9-37 Air Valve Spring Lub.

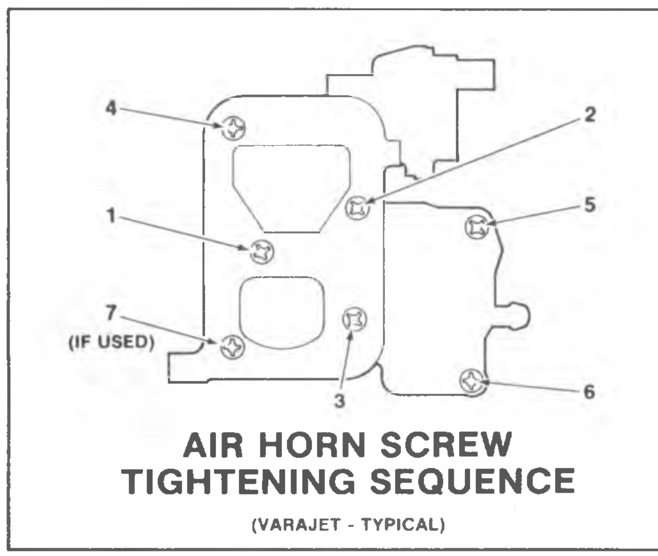


Figure 6C9-38 Air Horn Tightening

- Bushing (33) to air valve link (32).
- Link to vacuum break (30) plunger.
- Retainer (31) to link.

5. Rotate assembly (30), insert end of air valve link (32) in air valve lever, and vacuum break link (35) in lower slot of choke lever.
6. Bracket screws (28 and 29).
7. Hose (27) between throttle body tube and vacuum break assembly.

Adjust (Figure 6C9-40)

Tools Required:
J-9789-111 or BT-3006M, Bending tool.

- Choke stat lever (52).

Install or Connect (Figures 6C9-41, 42)

Choke cover and stat assembly in choke housing:

1. If stat (50) has a "trap" (box-shaped pick-up tang), trap surrounds lever.
2. Line up notch in cover (50) with projection on housing (26) flange.
3. Install retainers (49) and rivets (48) with rivet tool. If necessary, use adapter.

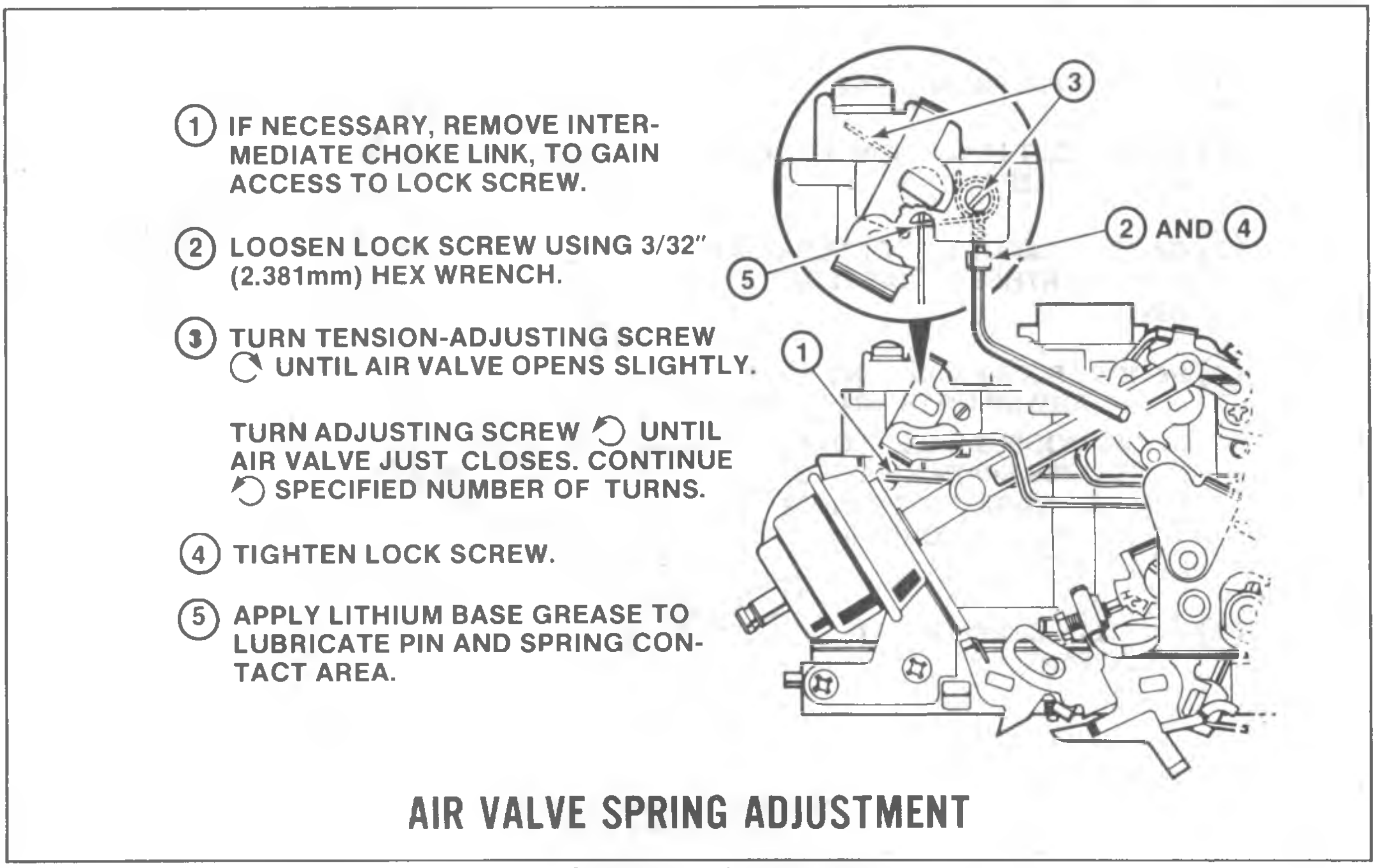


Figure 6C9-39 Air Valve Spring Adjustment

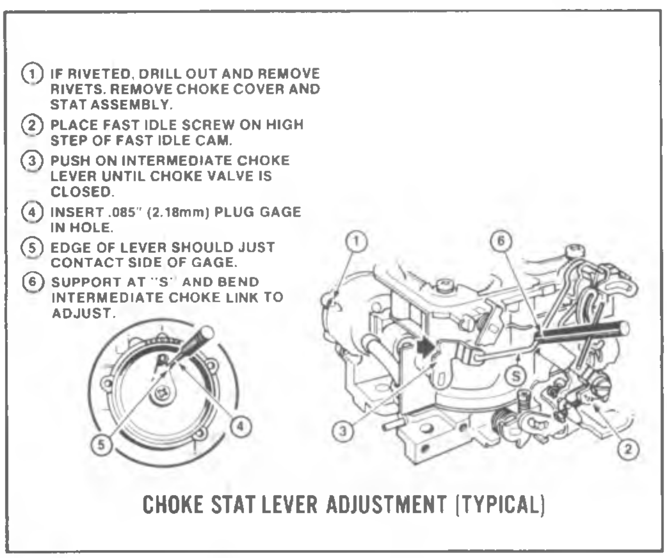


Figure 6C9-40 Choke Lever Adjustment

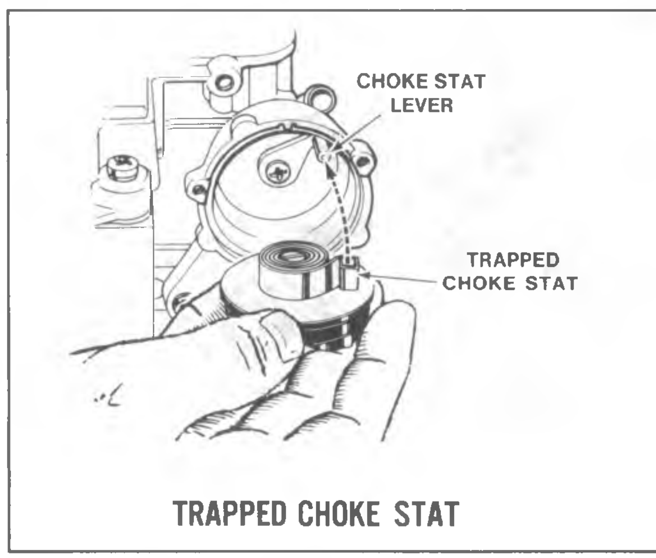


Figure 6C9-41 Trapped Choke Stat

Adjust (Figures 6C9-43, 44, 45, 46, 47, 48, 49, 50)

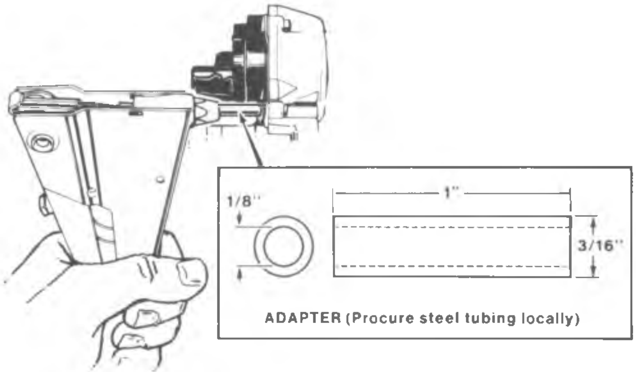
Tools Required:

J-26701 or BT-7704, Choke Angle Gage

J-9789-111 or BT-3006M, Bending Tool

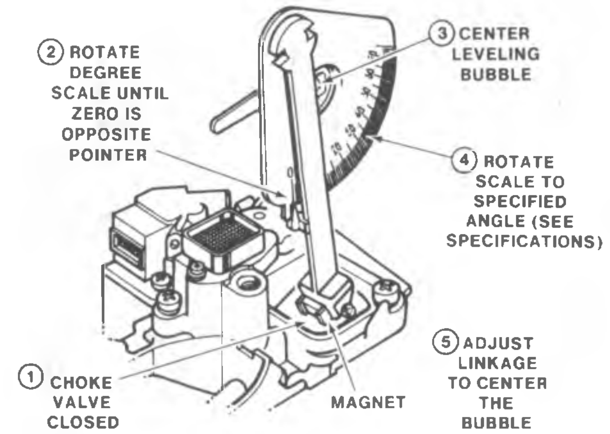
J-23738 or BT-7517, Hand operated Vacuum Device

- Choke Link - Fast Idle Cam Adjustment (Figure 6C9-44)
- Primary Side Vacuum Break Adjustment (Figure 6C9-46)
- Air Valve Link Adjustment (Figure 6C9-47)
- Secondary Side Vacuum Break Adjustment (Figure 6C9-48)
- Unloader Adjustment (Figure 6C9-49)
- Secondary Lockout Adjustment, if used (Figure 6C9-50)



CHOKE COVER RIVET INSTALLATION

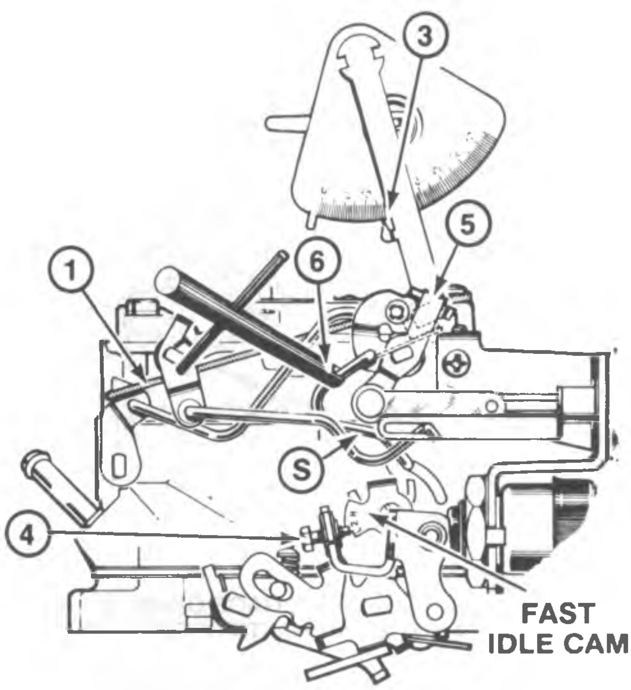
Figure 6C9-42 Installing Choke Cover



CHOKE VALVE ANGLE GAGE
TOOL J-26701 OR BT-7704

Figure 6C9-43 Choke Valve Angle Gage

1. ATTACH RUBBER BAND TO INTERMEDIATE CHOKE LEVER.
2. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE.
3. SET UP ANGLE GAGE AND SET ANGLE TO SPECIFICATIONS.
4. PLACE FAST IDLE SCREW ON SECOND STEP OF CAM AGAINST RISE OF HIGH STEP.
5. PUSH ON CHOKE SHAFT LEVER TO OPEN CHOKE VALVE AND TO MAKE CONTACT WITH BLACK CLOSING TANG.
6. SUPPORT AT "S" AND ADJUST BY BENDING FAST IDLE CAM LINK UNTIL BUBBLE IS CENTERED.



CHOKE LINK - FAST IDLE CAM ADJUSTMENT

Figure 6C9-44 Fast Idle Cam Adjustment

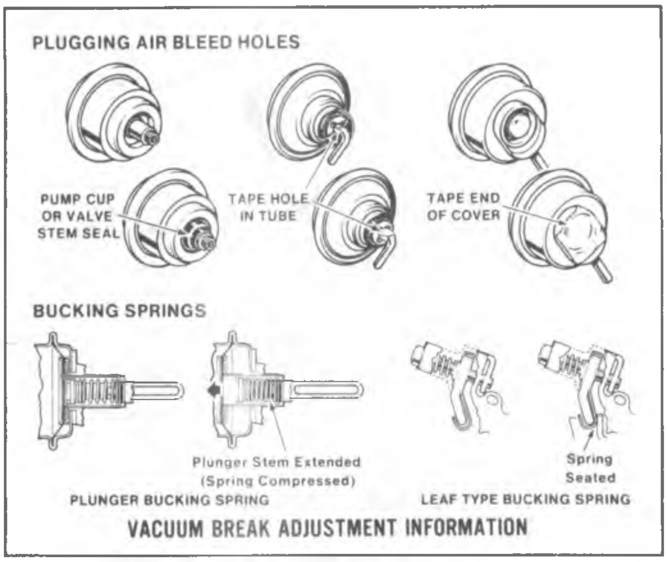


Figure 6C9-45 Vacuum Break Adjustment

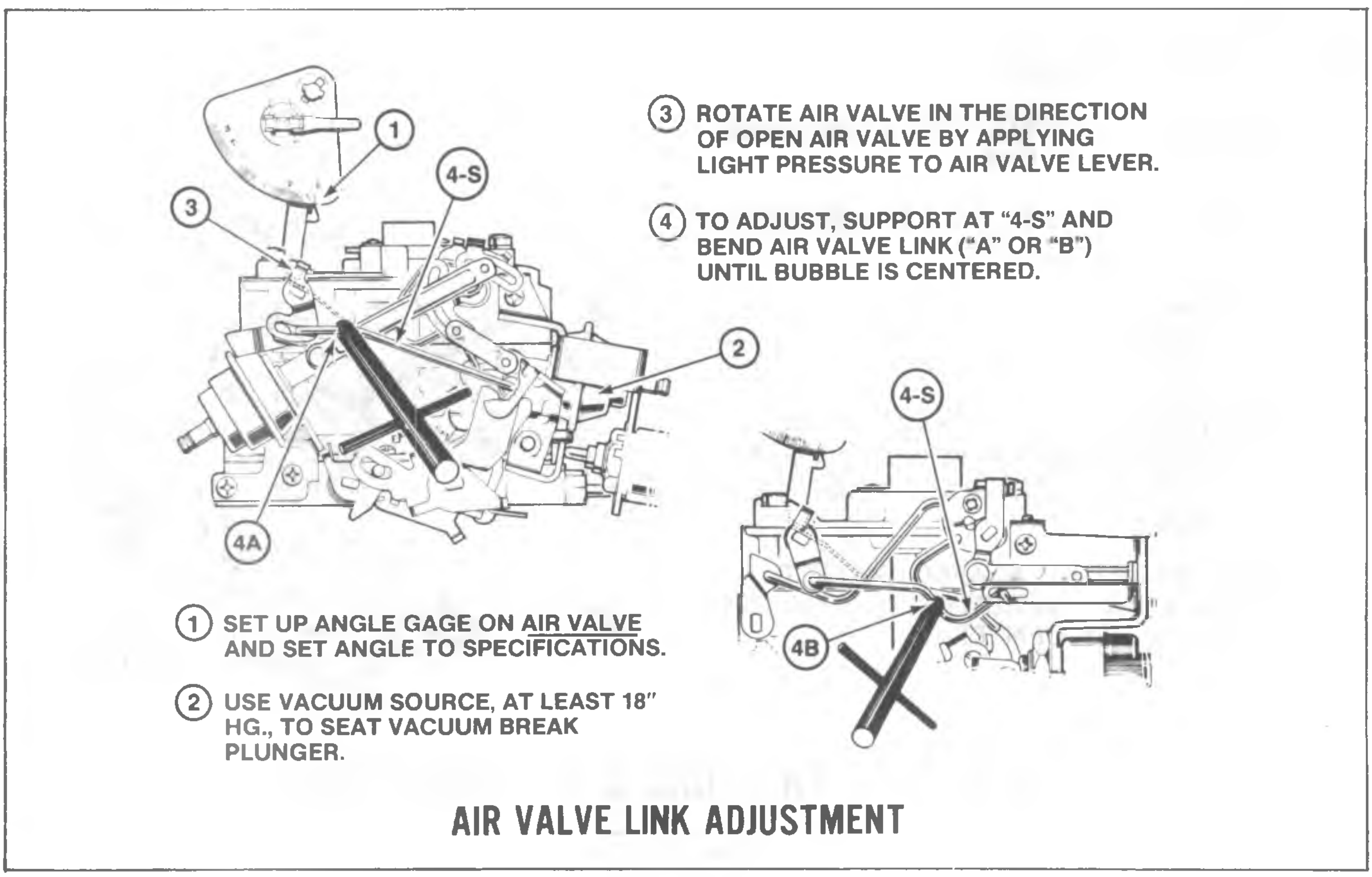


Figure 6C9-46 Air Valve Link Adjustment

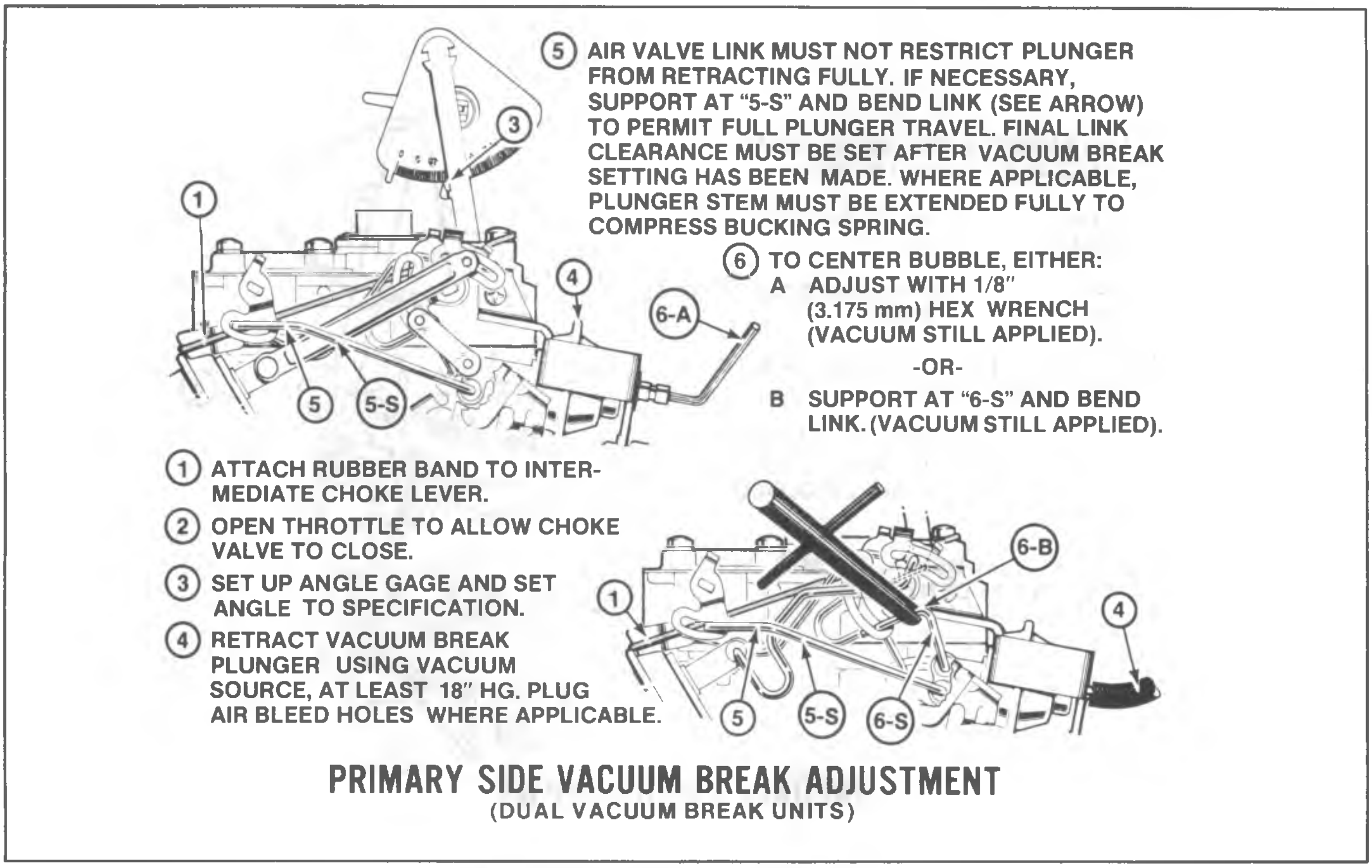


Figure 6C9-47 Air Valve Link Adjustment

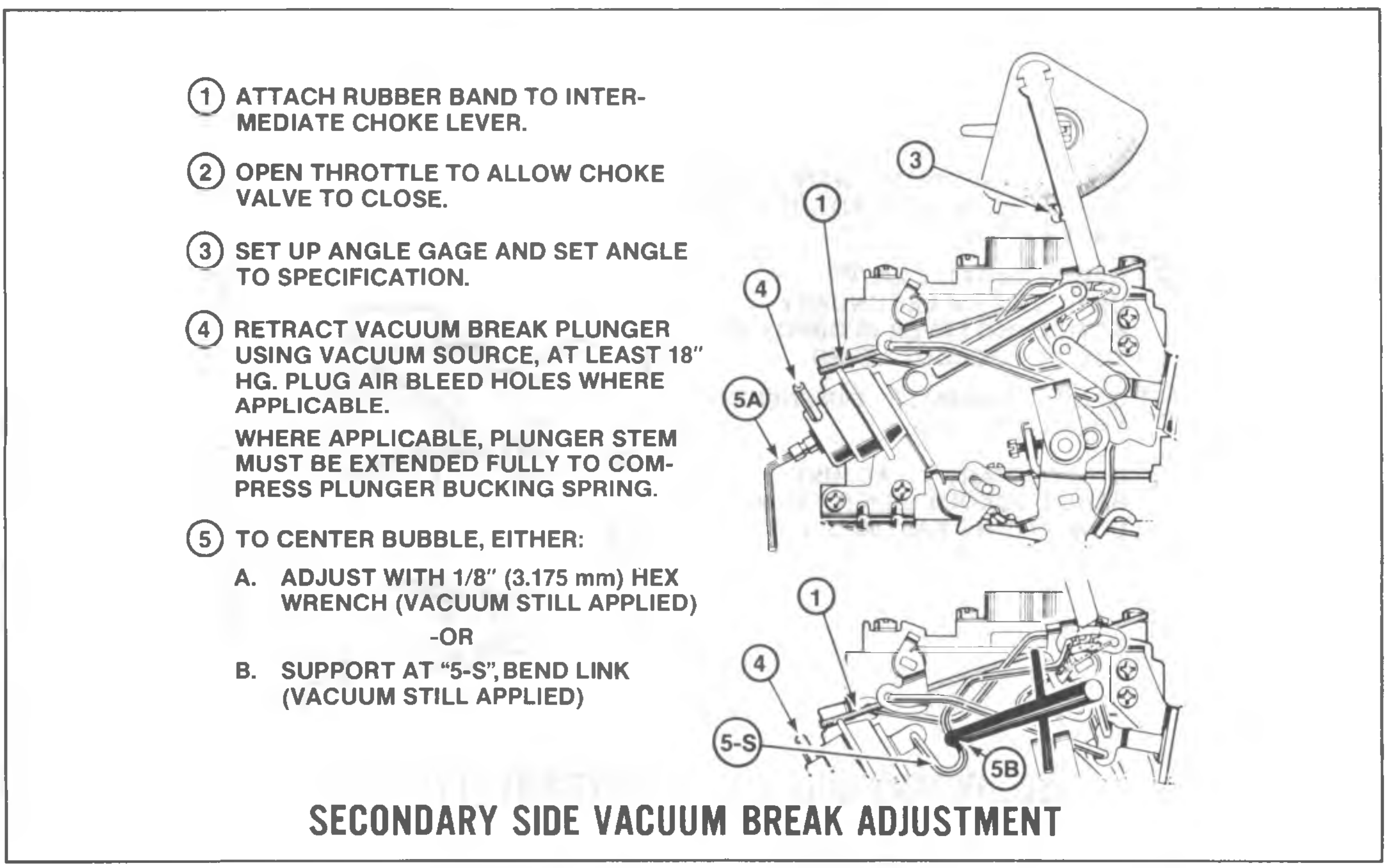
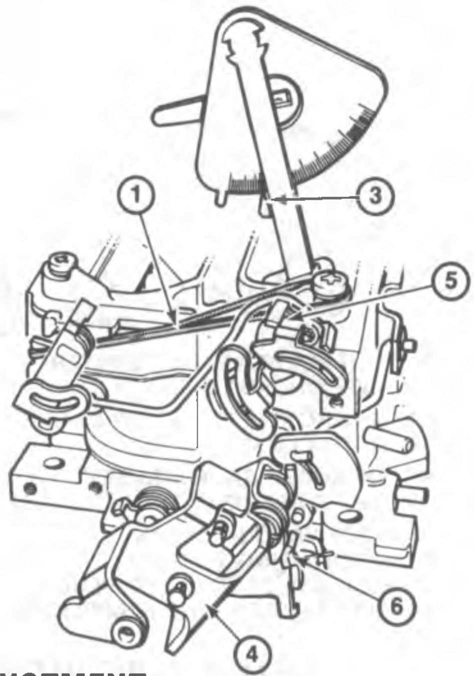


Figure 6C9-48 Secondary Vacuum Break Adjustment

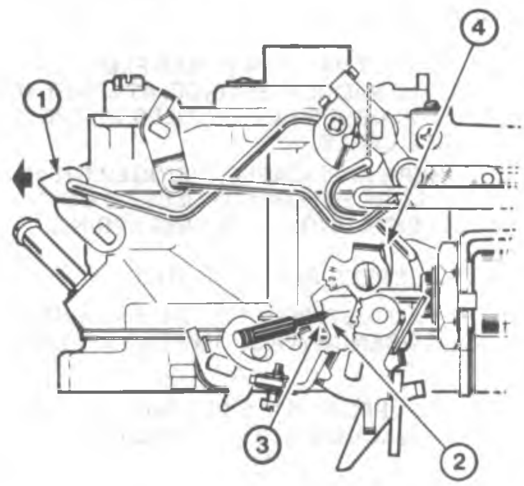
1. ATTACH RUBBER BAND TO INTERMEDIATE CHOKE LEVER.
2. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE.
3. SET UP ANGLE GAGE AND SET ANGLE TO SPECIFICATIONS.
4. HOLD THROTTLE LEVER IN WIDE OPEN POSITION.
5. PUSH ON CHOKE SHAFT LEVER TO OPEN CHOKE VALVE AND TO MAKE CONTACT WITH BLACK CLOSING TANG.
6. ADJUST BY BENDING TANG UNTIL BUBBLE IS CENTERED.



UNLOADER ADJUSTMENT

Figure 6C9-49 Unloader Adjustment

1. HOLD CHOKE VALVE WIDE OPEN BY PUSHING DOWN ON INTERMEDIATE CHOKE LEVER.
2. OPEN THROTTLE LEVER UNTIL END OF SECONDARY ACTUATING LEVER IS OPPOSITE TOE OF LOCKOUT LEVER.
3. GAGE CLEARANCE - DIMENSION SHOULD BE .025".
4. IF NECESSARY TO ADJUST, BEND LOCKOUT LEVER TANG CONTACTING FAST IDLE CAM.



SECONDARY LOCKOUT ADJUSTMENT (TYPICAL)

Figure 6C9-50 Secondary Lockout Adjustment

SPECIAL TOOLS

Idle Mixture Socket	J-29030-B/BT-7610-B
Float Level Scale	J-9789-90/BT-8037
Bending Tool	J-9789-111/BT-3007
Carburetor Stand	J-9789-118A/BT-30-15
Float Level Gage	J-9789-135/BT-8104
Carburetor Choke Angle Gage	J-26701-A/BT-7704
Hand Vacuum Device	J-23738/BT-7517
Metering Jet Remover	J-28696-B/BT-7928
Carburetor Gage Set	J-9789-C/BT-3005-A
Digital Multimeter	J-34029/BT-3450

CARBURETOR MODEL 2SE ADJUSTMENT SPECIFICATIONS

CARBU-RETOR NUMBER	FLOAT LEVEL ±1/16"		AIR VALVE SPRING (TURNS)	CHOKE COIL LEVER	FAST IDLE CAM (CHOKE ROD) ±3.5°	VAC. BREAK PRI. ±2.5°	AIR VALVE ROD	VAC. BREAK SEC. ±3.5°	UN-LOADER ±6°	PROPANE ENRICH-MENT (RPM)
	mm	Inch								
17084348	8.4	11/32	1	.085	22°	30°	1°	32°	40°	50*
17084349	8.4	11/32	1	.085	22°	30°	1°	32°	40°	50*
17084350	8.4	11/32	1	.085	22°	30°	1°	32°	40°	50*
17084351	8.4	11/32	1	.085	22°	30°	1°	32°	40°	50*
17084352	8.4	11/32	1	.085	22°	30°	1°	35°	40°	50* 60**
17084353	8.4	11/32	1	.085	22°	30°	1°	35°	40°	50*
17084354	8.4	11/32	1	.085	22°	30°	1°	35°	40°	50* 60**
17084355	8.4	11/32	1	.085	22°	30°	1°	35°	40°	50*
17084360	4.2	5/32	1	.085	22°	30°	1°	32°	40°	50*
17084362	4.2	5/32	1	.085	22°	30°	1°	32°	40°	50*
17084364	4.2	5/32	1	.085	22°	30°	1°	35°	40°	50*
17084366	4.2	5/32	1	.085	22°	30°	1°	35°	40°	50*
17084390	11.5	7/16	1-1/2	.085	28°	30°	1°	38°	38°	50*
17084391	11.5	7/16	1-1/2	.085	28°	30°	1°	38°	38°	
17084392	11.5	7/16	1-1/2	.085	28°	30°	1°	38°	38°	
17084393	11.5	7/16	1-1/2	.085	28°	30°	1°	38°	38°	
17084410	8.7	11/32	N/A	.085	15°	23°	1°	38°	42°	
17084412	8.7	11/32	N/A	.085	15°	23°	1°	38°	42°	
17084425	8.7	11/32	N/A	.085	15°	26°	1°	36°	40°	
17084427	8.7	11/32	N/A	.085	15°	26°	1°	36°	40°	
17084560	8.7	11/32	N/A	.085	15°	24°	1°	34°	38°	
17084562	8.7	11/32	N/A	.085	15°	24°	1°	34°	38°	
17084569	8.7	11/32	N/A	.085	15°	24°	1°	34°	38°	

* = WITH BOWL VENT DISCONNECTED AT CARBURETOR EXC. CHASSIS CAB
** = WITH BOWL VENT DISCONNECTED AT CARBURETOR W/CHASSIS CAB
N.A. = NOT ADJUSTABLE

080983

SECTION 6C10

CARBURETOR MODEL M4ME/M4MC

ALL NEW GM VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAP, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

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GENERAL DESCRIPTION

The Models M4ME and M4MC are four barrel, two stage carburetors with proven carryover design features. The carburetor comprises three major assemblies: the air horn, the float bowl and the throttle body. It has six basic operating systems (Figures 6C10-1 through 6C10-8):

- FLOAT
- IDLE
- MAIN METERING
- POWER
- PUMP
- CHOKE

A single float chamber supplies fuel to all carburetor bores. A closed-cell rubber float, brass needle seat, and plastic tipped float needle with pull clip, are used to control fuel level in the float chamber. A vacuum-operated power piston and metering rods control the air/fuel metering in the primary bores of the carburetor. The tapered metering rods are attached to the power piston and move in fixed metering jets to provide the fuel flow for varying engine demands.

The air valves and metering rods control the air/fuel metering in the secondary bores of the carburetor. A pair of tapered metering rods are attached to a hanger, which operates by cam action resulting from the air valve angle, and provides the additional fuel flow necessary during increased engine air flow at wide open throttle. The pump system uses a pump plunger to provide extra fuel during quick throttle openings.

The Model M4ME employs an electrically heated choke coil, and Model M4MC uses a hot air heated choke coil, to provide the choke valve closing force for cold startup and for correct opening timing during warmup. Vacuum break units control initial choke valve opening at start and during warmup. An unloader tang on the throttle lever forces the choke valve open, to purge a flooded engine, when the accelerator is pressed to the floor. A fast idle cam, following choke valve movement, acts as a graduated throttle stop, to provide increased idle speed during warmup. On some models, an Idle Speed Solenoid is used to position the primary throttle valve to provide engine idle speed requirements.

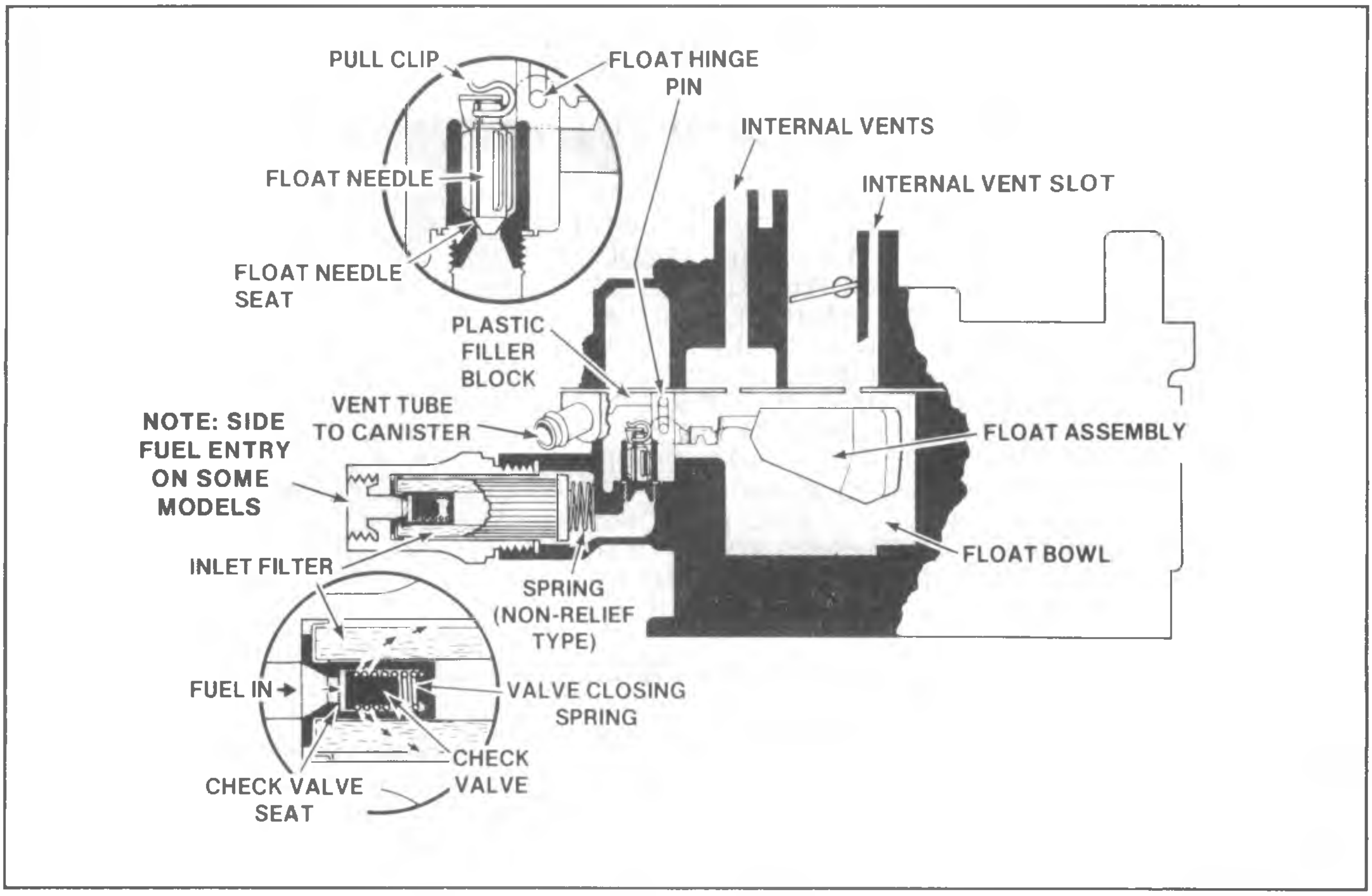

Fig. 6C10-1--Float System

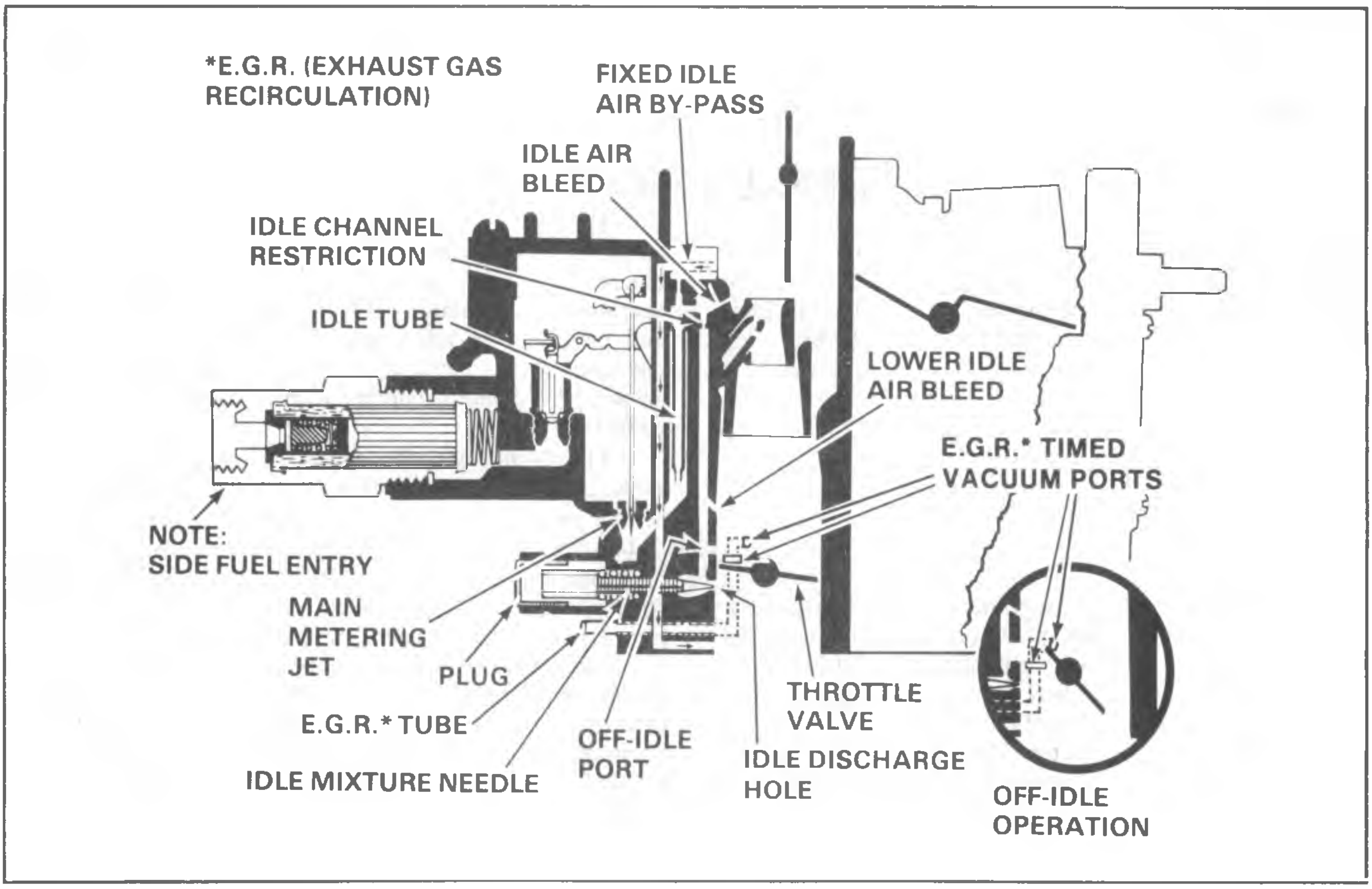

Fig. 6C10-2--Idle System

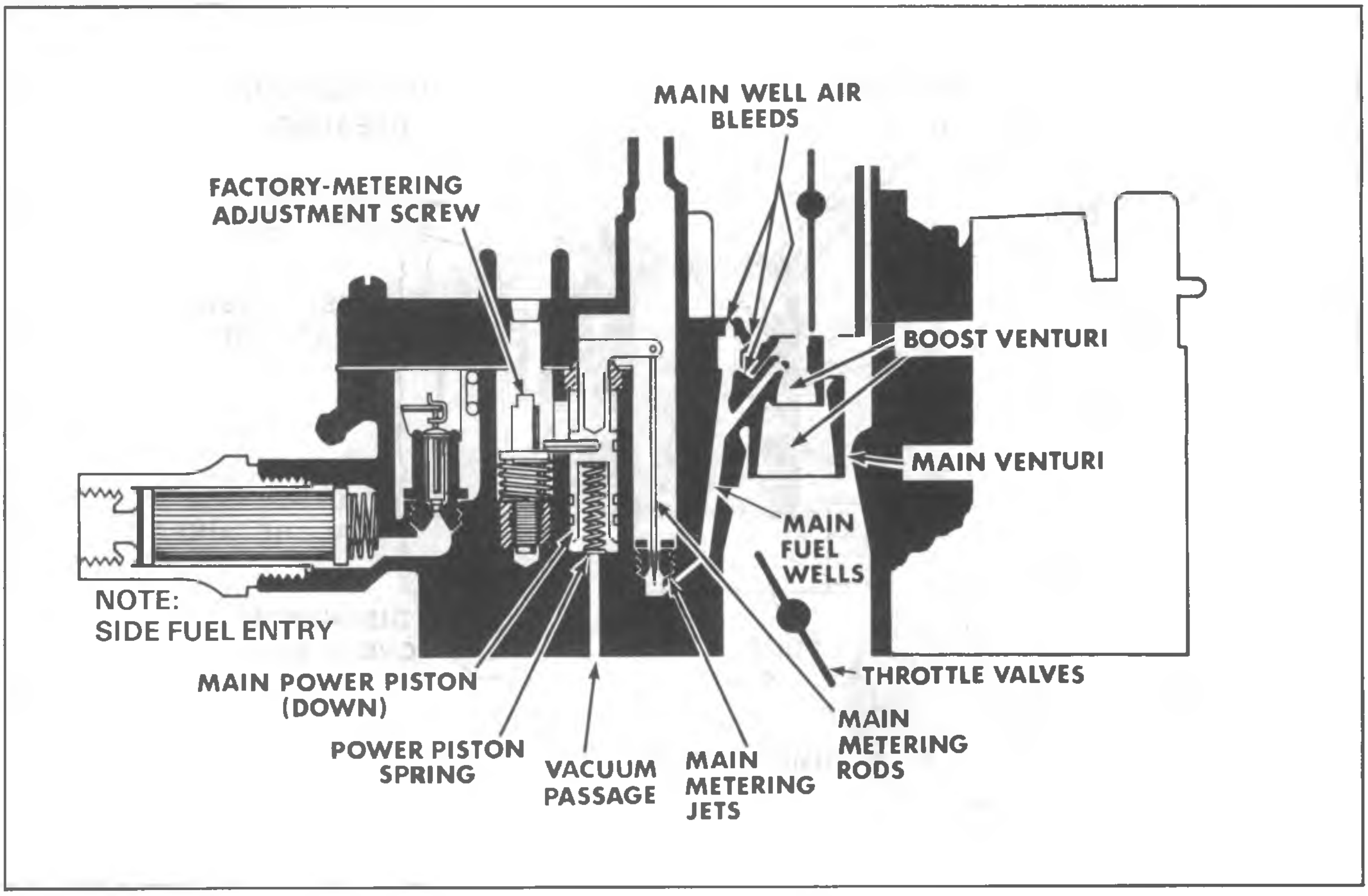

Fig. 6C10-3--Main Metering System

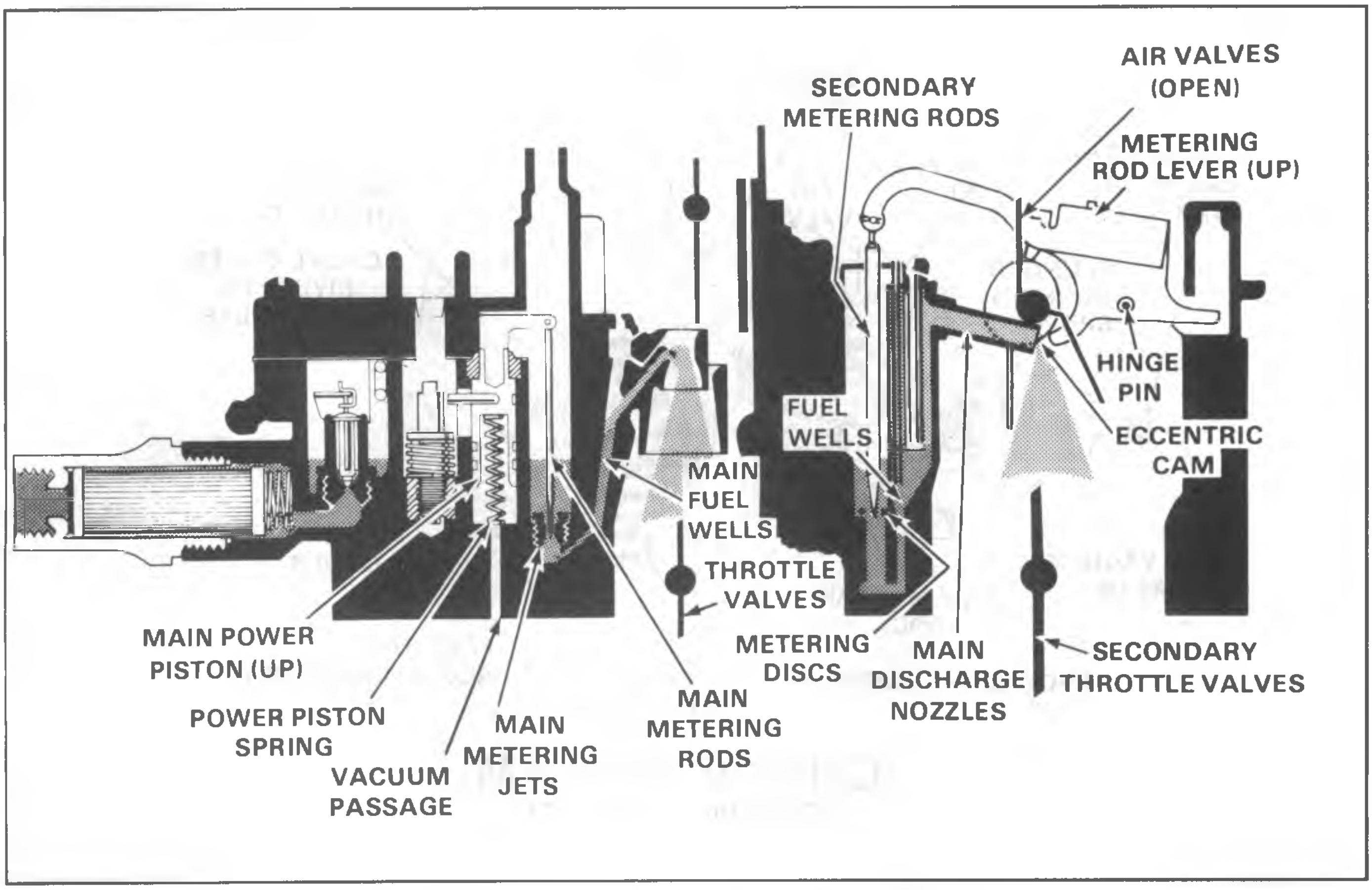

Fig. 6C10-4--Power System

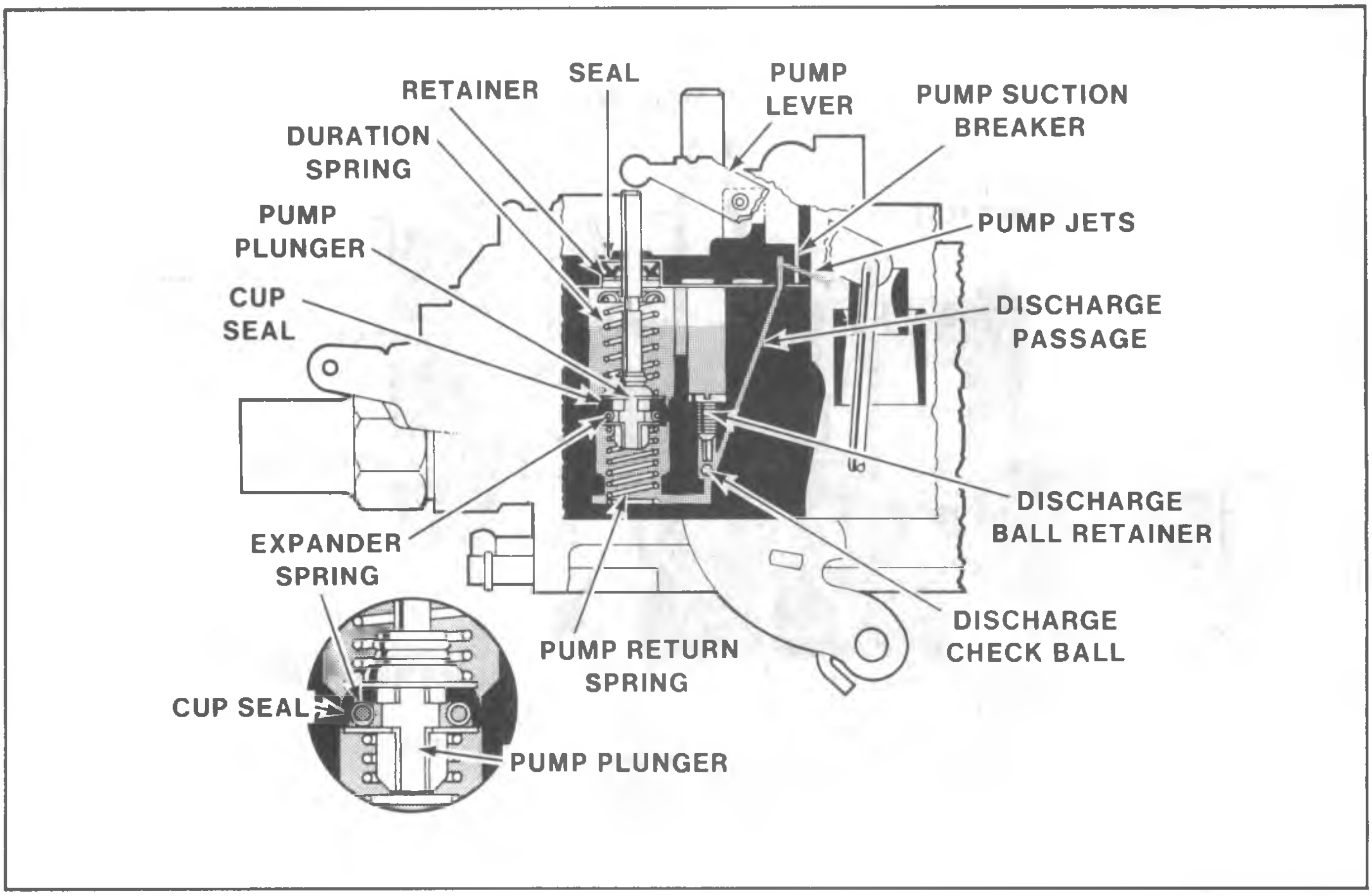

Fig. 6C10-5--Pump System

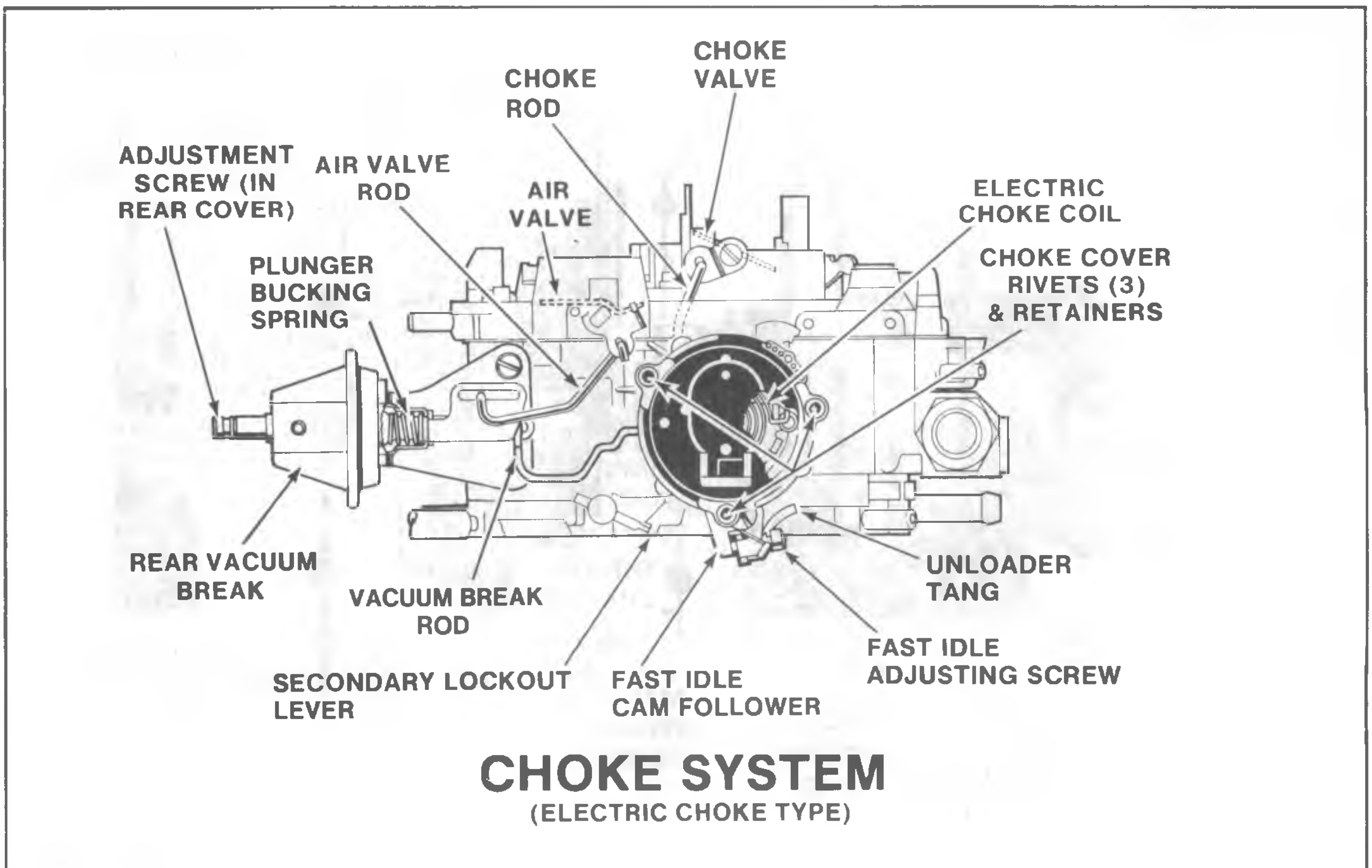

Fig. 6C10-6--Choke System - M4ME (with Rear Vacuum Break)

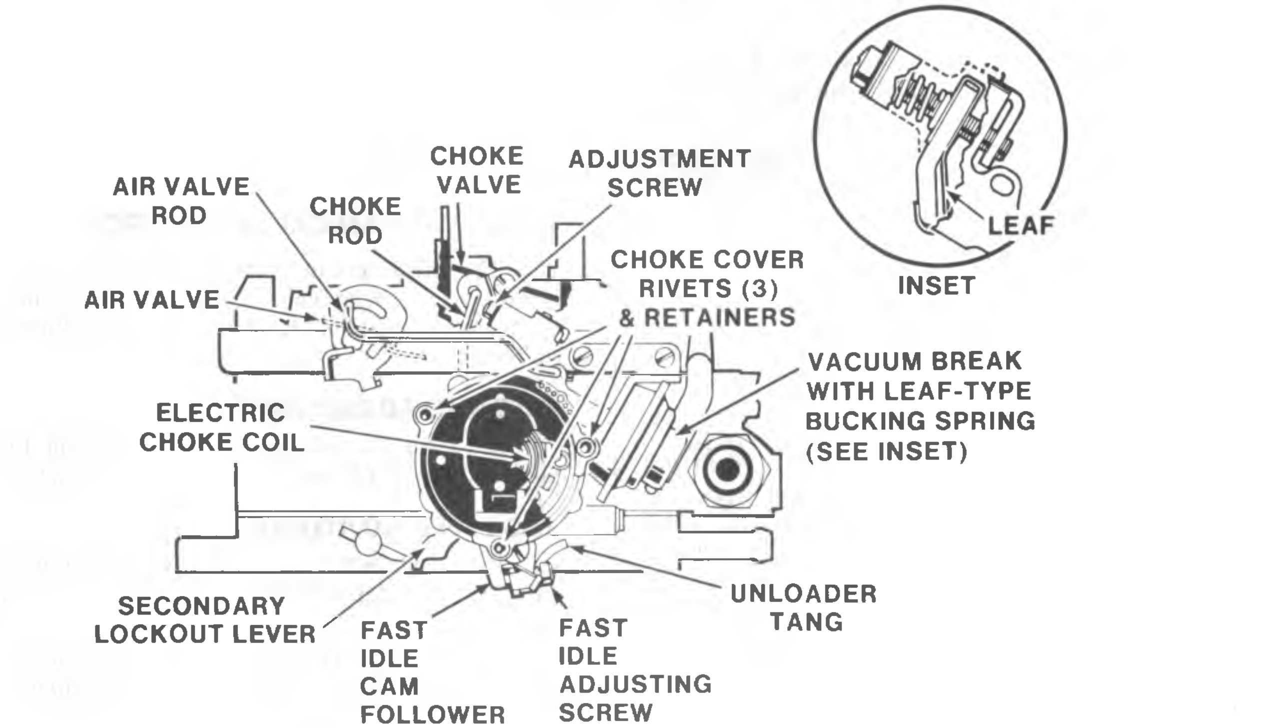

Fig. 6C10-7--Choke System - M4ME (without Rear Vacuum Break)

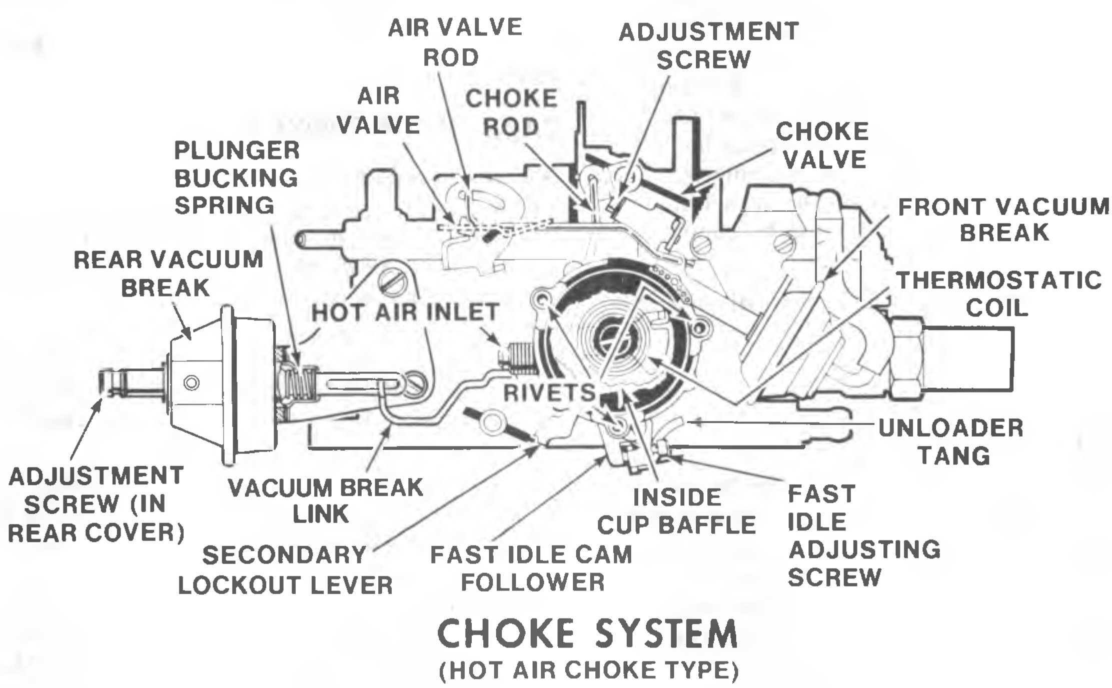

Fig. 6C10-8--Choke System - M4MC

DIAGNOSIS

Refer to Engine Performance Diagnosis (Section 6) and/or Cleaning and Inspection under Unit Repair in this section.

ON-VEHICLE SERVICE

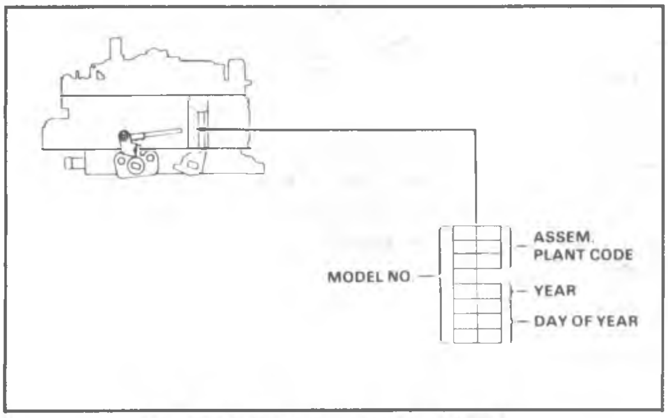

Fig. 6C10-9--Carburetor Identification

GENERAL INFORMATION

A carburetor is designed to meet the particular requirements of the engine, transmission and vehicle and although they may look alike, they are not usually interchangeable. Refer to carburetor part number and/or specifications when making adjustments.

Before checking or resetting the carburetor as the cause of poor engine performance or rough idle; check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torque of carburetor mounting bolts/nuts. Make all adjustments with engine at normal operating temperature, choke full open, air cleaner installed. Except as noted air conditioning should be "off" and all vacuum lines and all electrical leads connected. Set parking brake and block drive wheels. Air cleaner can be removed for set-up accessibility but must be completely installed during actual setting.

Refer to the end of this section for special tools and adjustment specifications.

CARBURETOR IDENTIFICATION

For ease of service, alphabetical code letters are included on the air horn, float bowl, and throttle body casting at external tube locations to identify hose connections. The carburetor model identification number is stamped vertically on the float bowl, near the secondary throttle lever (Fig. 6C10-9). Refer to the part number on the bowl when servicing the carburetor. When replacing the float bowl assembly, follow the instructions contained in the service package. Stamp or engrave the model number on the new float bowl.

FLOAT MECHANICAL LEVEL CHECK

The float level can be checked without removing the air horn by using float gage J-9789-130/ or equivalent and following external float level checking procedures in Figures 6C10-10.

FAST IDLE ADJUSTMENT

Refer to the Vehicle Emission Control Information label and Figure 6C10-11 for fast idle adjustment.

IDLE SPEED ADJUSTMENT

Refer to Figure 6C10-12 and Vehicle Emission Control Information label for idle speed adjustment without air conditioning.

Refer to Figure 6C10-13 and Vehicle Emission Control Information label for idle speed adjustment with air conditioning.

Refer to Figure 6C10-14 and Vehicle Emission Control Information label for throttle lever actuator assembly.

CHOKE AND HOSES

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

Use vacuum device J-23738/BT-7517 or equivalent to check vacuum break.

CARBURETOR CHOKE CHECK

General Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.
2. If choke or linkage binds, sticks or works sluggishly, clean with choke cleaner X-20-A or equivalent. Use cleaner as directed on can. Refer to Unit Repair instructions for additional direction if cleaning does not correct.
3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasions, hardness or other signs of deterioration. Replace or correct as necessary.
4. Make sure vacuum break diaphragm shaft is fully extended when engine is off. If shaft is not fully extended, replace vacuum break assembly. Shaft should fully retract within 10 seconds after starting engine. If unit fails to retract, replace vacuum break assembly.

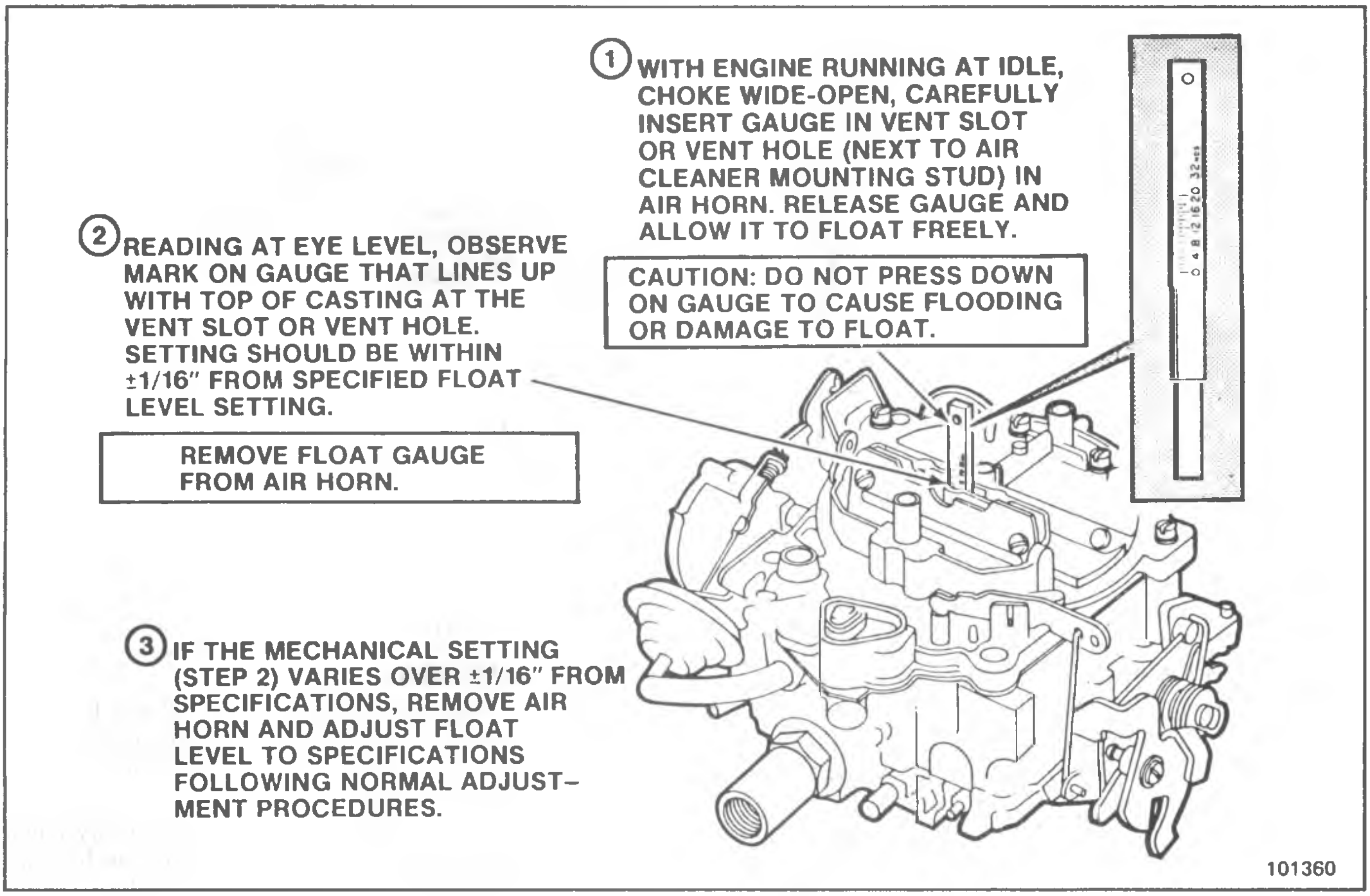

Fig. 6C10-10--External Float Level Check

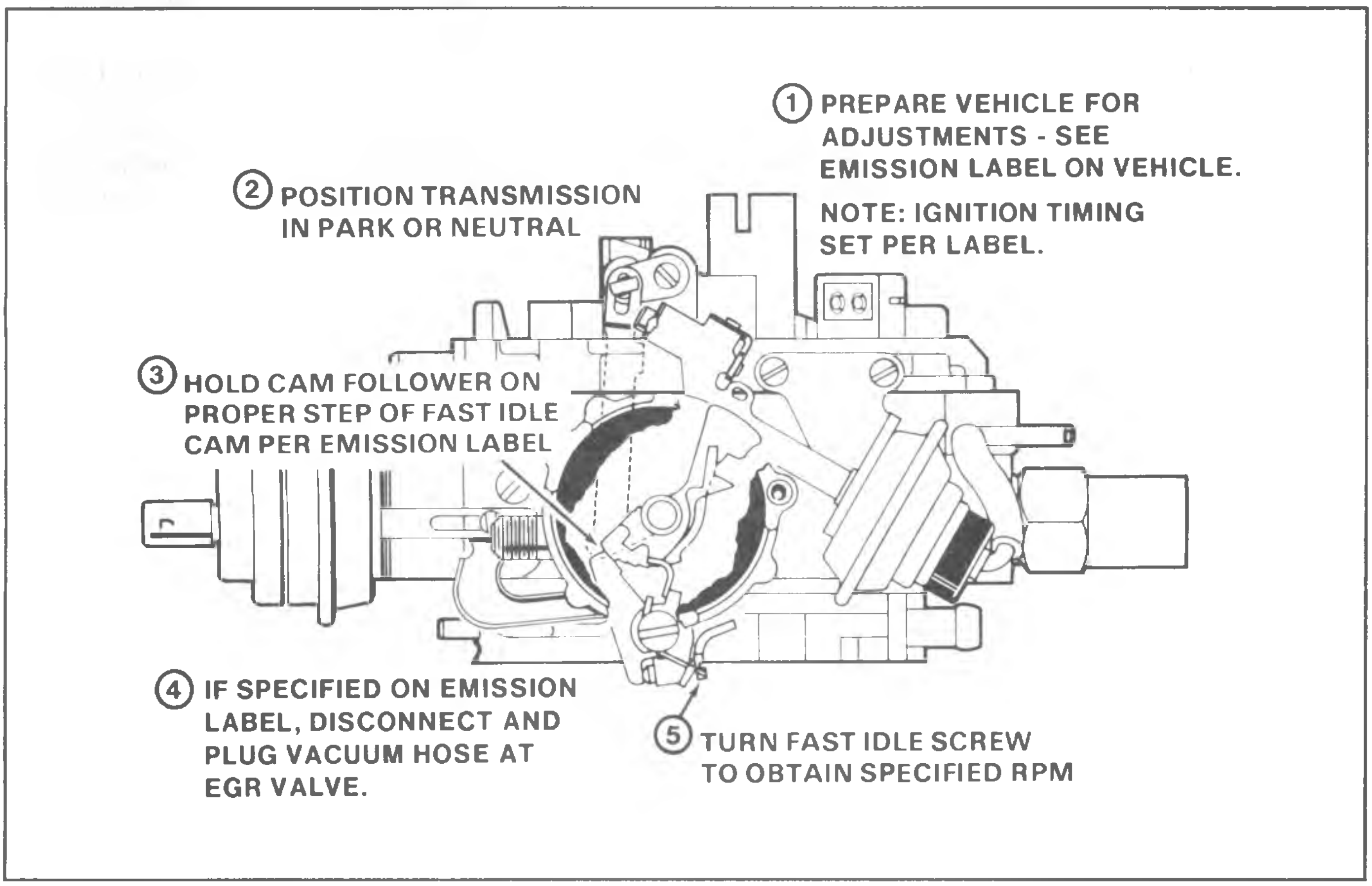

Fig. 6C10-11--Fast Idle Adjustment

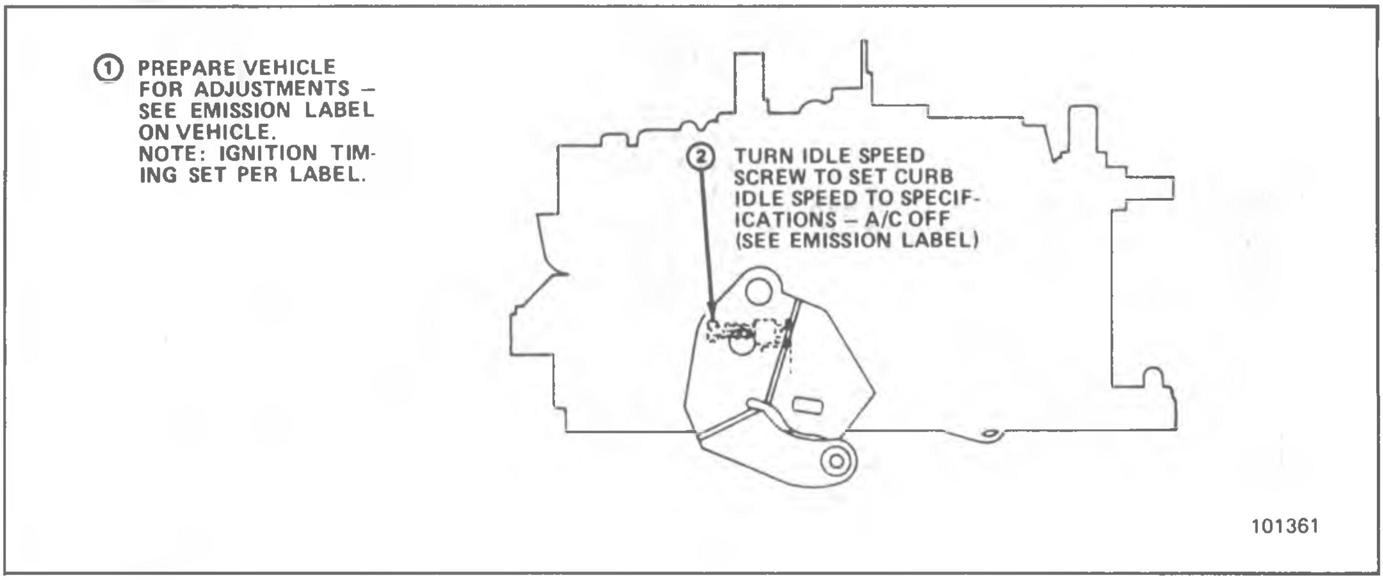

Fig. 6C10-12--Idle Speed Adjustment-Without A/C

Checking Electric Choke

This check should be performed at an ambient temperature of 60 to 80°F (15 to 27°C).

1. Allow choke to cool so that when throttle is opened slightly choke blade fully closes.
2. Start engine and determine time for choke blade to reach full open position. (Start timer when engine starts).
3. If the choke blade fails to open fully within 3.2 minutes, proceed with steps 4 and 5 below.
4. Check voltage at the choke heater connection: (Engine must be running).
   a. If the voltage is approximately 12-15 volts, replace the electric choke unit.
   b. If the voltage is low or zero, check all wires and connections. Repair wires or replace fuses as required.

Checking Hot Air Choke

1. With parking brake applied, drive wheels blocked, transmission in Park or Neutral, start engine and allow engine to warm up, visually checking to be certain choke valve opens fully.
2. If choke valve fails to open fully, momentarily touch choke housing and hot air inlet pipe or hose to determine if sufficient heat is reaching the choke coil.

CAUTION: The choke housing and hot air inlet pipe or hose are "Hot" to the touch. Use care to prevent burning of hands.

3. If choke housing and/or heat inlet are cool to the touch, check for loss of vacuum to the housing, restricted heat inlet in the choke housing or choke heat pipe, collapsed or deteriorated heat inlet hose, or restricted passages in the manifold choke heat stove. Replace or correct as necessary.

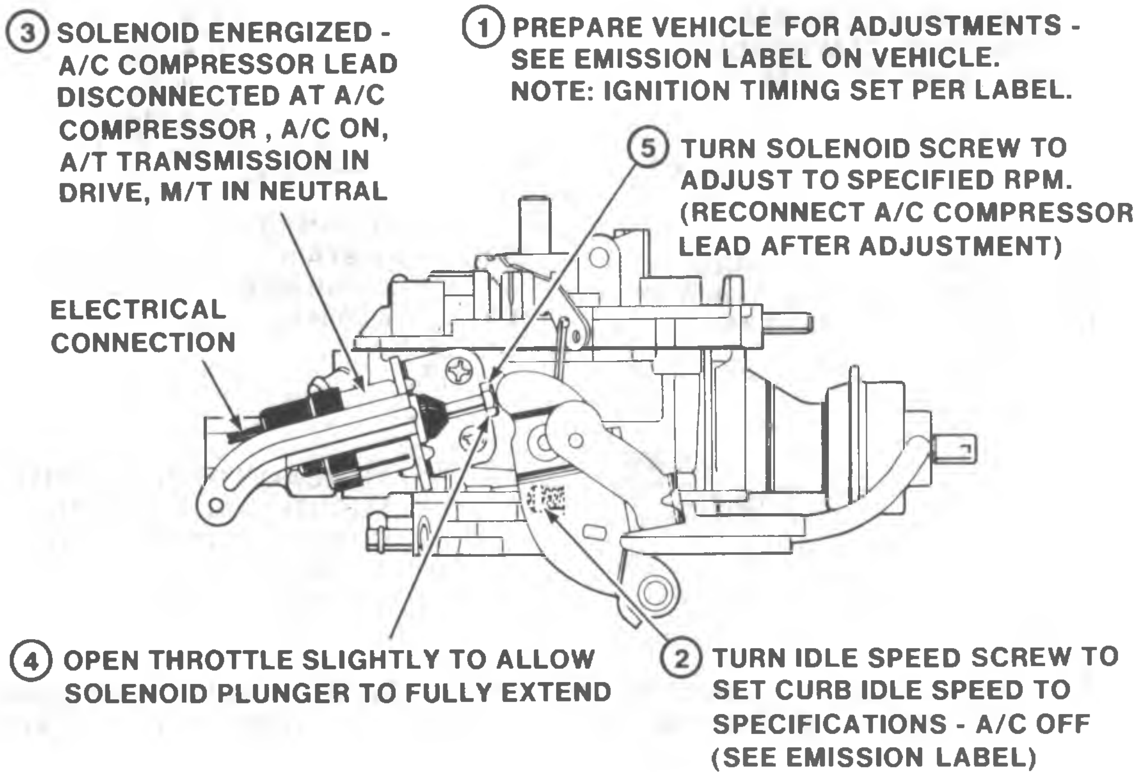

Fig. 6C10-13--Idle Speed Adjustment-With A/C

IDLE SPEED SOLENOID CHECK

1. Turn on ignition, but do not start engine.
2. Turn A/C to "on" position.
3. Open throttle to allow solenoid to extend, close throttle.
4. Disconnect lead at solenoid. Solenoid plunger should drop away from throttle lever.
5. Connect solenoid lead. Plunger should move out and contact the throttle lever. Solenoid may not be strong enough to open the throttle, but the plunger should move.
6. If plunger does not move in and out as lead is disconnected and connected, insert test light (1893 bulb or smaller) between the solenoid feed wire and ground.
7. If light lights, replace solenoid.
8. If light does not light, locate cause of open circuit in solenoid feed wire.

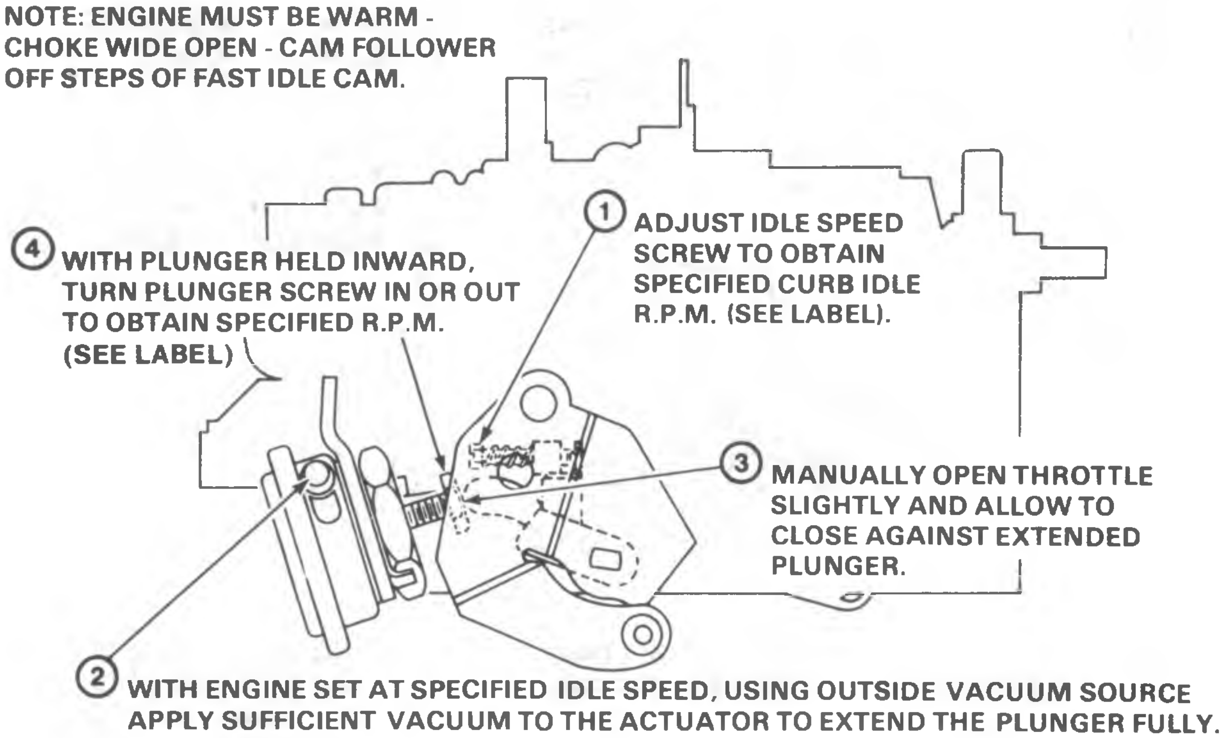

Fig. 6C10-14--Throttle Lever Actuator Adjustment

IDLE MIXTURE CHECK AND ADJUSTMENT (PROPANE ENRICHMENT)

Light Duty Emission Vehicles Only

Idle mixture needles have been preset at the factory and sealed. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacement or high emissions as determined by offical inspections. Adjusting mixture by other than the following method may violate Federal and/or California or other state or Provincial laws. Because of the sealed idle mixture needles, the idle mixture checking procedure requires artificial enrichment by adding propane.

1. Set parking brake and block drive wheels.
   Engine must be at normal operating temperature and air conditioning off.
2. Disconnect and plug hoses as directed on the Emission Control Information label under the hood.
3. Connect an accurate tachometer to engine.
4. Disconnect vacuum advance and set timing to specification shown on the Vehicle Emission Control Information label. Re-connect vacuum advance.
5. Set carburetor idle speed to specification as shown on Vehicle Emission Control Information label.
6. Disconnect crankcase ventilation tube from air cleaner.
7. Using tool J-26911/BT-7816, insert hose with rubber stopper, from propane valve into crankcase ventilation tube opening in air cleaner. Propane cartridge must be vertical (Fig. 6C10-15).
8. With engine idling in drive (neutral for manual shifts) slowly open propane control valve while pressing button. Continue to add propane until speed drops due to over richness. Note maximum engine speed (enriched speed).
   If rich speed drop cannot be obtained check for empty cartridge or propane system leaks.
9. If the enriched idle speed is within the enriched idle specification the mixture is correct. Go to step 17.
10. If the enriched idle speed is not within specifications, remove mixture screw plugs as follows:
    a. Remove carburetor from engine, following normal service procedures, to gain access to the plugs covering the idle mixture needles.
    b. Invert carburetor and drain fuel in container.
    c. Place carburetor on a suitable holding fixture-manifold side up.
    Use care to avoid damaging linkage, tubes, and parts protruding from air horn.
    d. Make two parallel cuts in the throttle body on either side of the locator points beneath the idle mixture needle plug (manifold side) with a hack saw (Fig. 6C10-16). The cuts should reach down to the steel plug but should not extend more than 1/8" beyond the locator points. The distance between the saw marks depends on the size of the punch to be used.
    e. Place a flat punch at a point near the ends of the saw marks in the throttle body. Holding the punch at a 45° angle, drive it into the throttle body until the casting breaks away, exposing the steel plug.

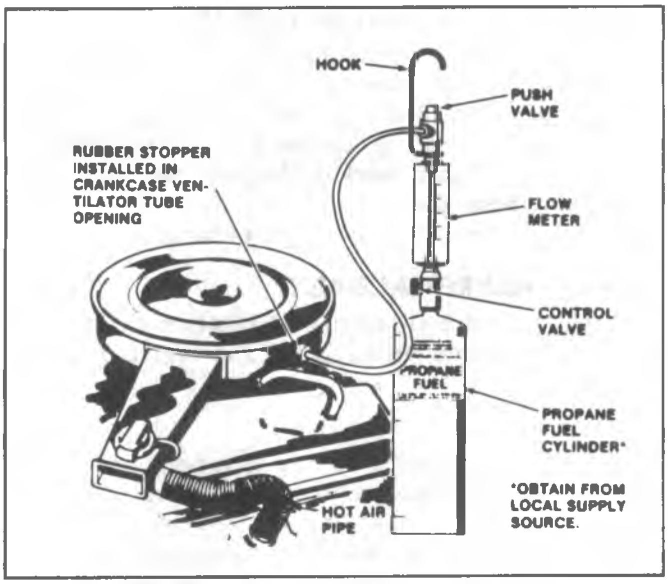

Fig. 6C10-15--Idle Mixture Choke-Propane Enrichment

f. Holding a center punch vertical, drive it into the steel plug. Then holding the punch 45° angle , drive the plug out of the casting.

   Hardened plug will break rather than remaining intact. It is not necessary to remove the plug completely; instead, remove loose pieces.

g. Repeat procedure for the remaining mixture needle.

11. Using tool J 29030/BT-76108 or equivalent, lightly seat mixture needles, then back out equally, just enough so engine will run.
12. Place transmission in Drive (automatic) or Neutral (manual).
13. Back each screw out (richen 1/8 turn at a time until maximum idle speed is obtained). Then set idle speed to the enriched idle specification.
14. Turn each mixture screw in (clockwise) 1/8 turn at a time until idle speed reaches value given on Emission Control Information label.
15. Re-check enriched speed with propane. If not within specification, repeat adjustment beginning with Step 12.
16. After adjustments are complete, seal the idle mixture needle setting using silicone sealant RTV rubber or equivalent. The sealer is required to prevent tampering with the setting and to prevent the possibility of loss of fuel vapors.
17. Check and, if necessary, adjust fast idle as described on Emission Control Information label.
18. Turn off engine. Remove propane tool, connect crankcase ventilation tube. Unplug and reconnect vacuum hoses. Install air cleaner.
19. Remove blocks from drive wheels.

IDLE MIXTURE ADJUSTMENT - BEST IDLE METHOD

Heavy Duty Emission Vehicles Only

Idle mixture needles have been preset at the factory and sealed. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacetment, or high emissions as determined by official inspections.

If necessary, remove idle needle plugs (See Idle Mixture Needle Plug Removal procedure listed under Light Duty Emission Vehicles).

Perform this adjustment with engine at operating temperature, parking brake applied, drive wheels blocked and transmission in park or neutral.

1. Remove air cleaner.
2. Connect tachometer and vacuum gage to engine.
3. As a preliminary adjustment, turn idle mixture needles in lightly to seat and back out 2 turns.

   NOTICE: Do not turn idle mixture needle tightly against seat or damage may result.
4. With engine running (choke wide open and transmission in neutral) adjust idle speed screw to idle speed specified on Vehicle Emission Control Information label.
5. Adjust each idle mixture needle to obtain highest RPM.

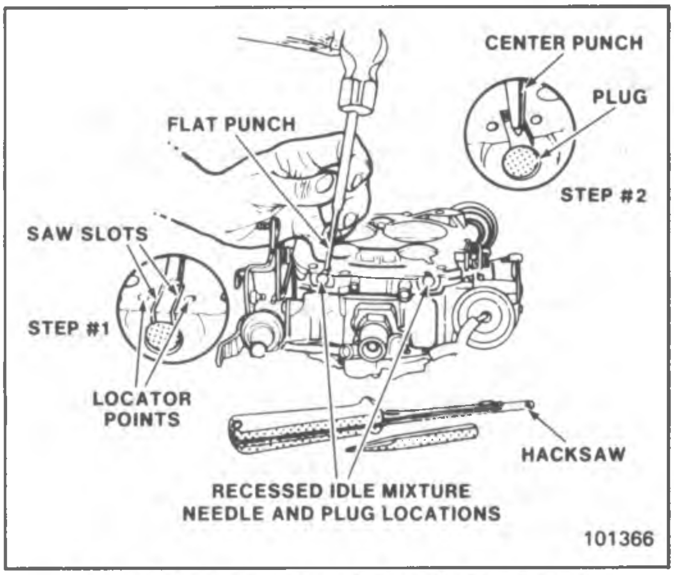

Fig. 6C10-16--Removing Idle Needle Plug-Typical

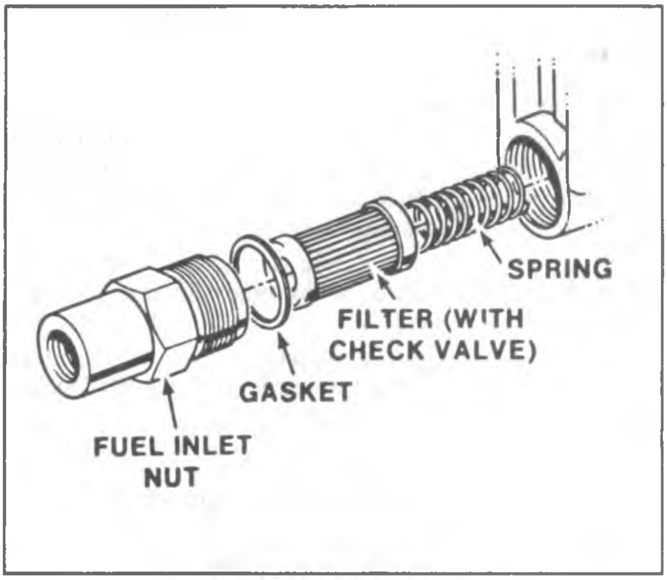

Fig. 6C10-17--Fuel Filter

6. Repeat steps 4 and 5 until "best" idle is obtained.
7. If necessary, reset curb idle speed to specifications on underhood label.
8. After adjustments are complete, seal the idle mixture needle setting using silicone sealant RTV rubber or equivalent. The sealer is required to prevent tampering with the setting and to prevent the possibility of loss of fuel vapors.
9. Check and, if necessary, adjust throttle lever actuator.
10. Check and, if necessary, adjust fast idle speed as described on Emission Control Information label.
11. Turn off engine, remove gages, unplug and reconnect vacuum hoses. Install air cleaner.
12. Remove block from drive wheels.

FUEL FILTER REPLACEMENT

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

1. Remove air cleaner.
2. Disconnect fuel line connection at inlet fuel filter nut.
3. Remove inlet fuel filter nut from carburetor.
4. Remove filter and spring (Figure 6C10-17).
5. Install spring and filter element in carburetor with hole in filter toward nut.
6. Install new gasket on inlet fitting nut and install nut in carburetor and tighten to 34 N·m (300 in. lbs.).
7. Install fuel line and tighten connector to 24 N·m (18 ft. lbs.) while holding fuel inlet fitting with wrench.
8. Run engine and observe for leaks.

CARBURETOR MOUNTING TORQUE

When torquing carburetor after removal overhaul, replacement or when installing a new heat insulator, torque mounting bolts, in a clockwise direction, to 16 N·m (144 in. lbs.). When retorquing carburetor at recommended maintenance intervals, check in clockwise direction. If less than 7 N·m (60 in. lbs.), retorque to 11 N·m (96 in. lbs.); if greater than 7 N·m (60 in. lbs.), do not retorque.

CARBURETOR REPLACEMENT

Always replace all internal gaskets that are removed. Base gasket should be inspected and replaced only if damaged.

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by presence of dirt, water, or other foreign matter in carburetor. To aid in diagnosis, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.
2. Disconnect wire at solenoid, if equipped.
3. Disconnect fuel pipe and vacuum lines.
4. Disconnect choke system (Fig. 6C10-18).
5. Disconnect accelerator linkage.
6. If equipped with automatic transmission, disconnect downshift cable.
7. If equipped with cruise control, disconnect linkage.
8. Remove carburetor attaching bolt, carburetor and insulator.

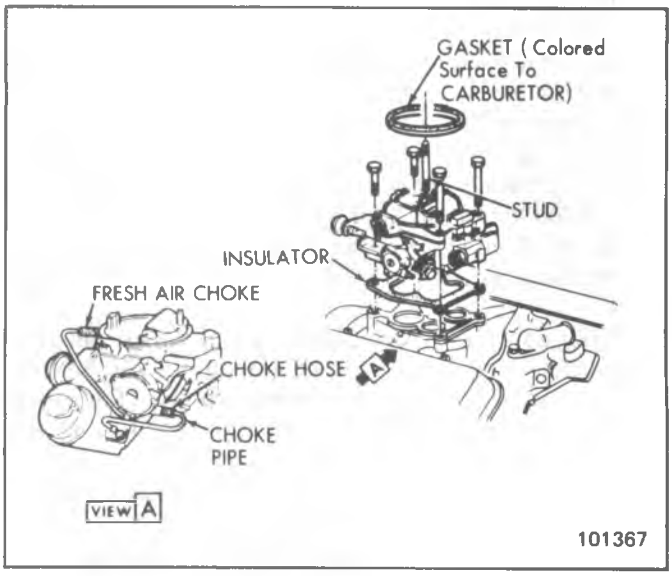

Fig. 6C10-18--Carburetor and Choke Pipes-M4MC

Installation

1. Clean sealing surfaces on intake manifold and carburetor.
2. Fill carburetor bowl before installing carburetor.
3. Install carburetor with new insulator and tighten bolts to correct torque (See Carburetor Mounting Torque).
4. Connect downshift cable as required.
5. Connect cruise control cable as required.
6. Connect accelerator linkage.
7. Connect choke system.
8. Connect fuel pipe and vacuum hoses.
9. Connect solenoid as required.
10. Install air cleaner.
11. Check and adjust idle speed.

UNIT REPAIR

The procedures that follow apply to a complete carburetor overhaul with the carburetor removed from the engine. Refer to Figures 6C10-19 and 6C10-20 for part identification during disassembly and assembly of carburetor components. In many cases, service adjustmentss of individual systems may be completed without removing the carburetor from the engine (refer to "On-Vehicle Service").

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets, diaphragms, seals, worn or damaged parts and service adjustment of individual system, plus restoring tamper-resistant features where applicable.

DISASSEMBLY

Place carburetor on a holding fixture J 9789-118, BT-30-15, or equivalent to prevent damage to throttle valves.

Idle Speed Solenoid (ISS) (If Equipped)

Remove attaching screws and remove idle speed solenoid (or similar throttle actuating device) from float bowl.

The solenoid should not be immersed in carburetor cleaner and should always be removed before complete carburetor overhaul. Carburetor cleaner will damage the internal parts.

Air Horn

Removal

1. Remove upper choke lever from the end of choke shaft by removing retaining screw. Then rotate lever to remove choke rod from slot in lever.
2. Remove choke rod from lower (inner) choke lever inside the float bowl casting. Remove rod by holding lower lever outward with small screwdriver and twisting rod counterclockwise.
3. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger, then lifting up on the metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger.
4. Using tool J-25322, drive small roll pin (pump lever pivot pin) inward just until pump lever can be removed from air horn. Remove pump lever from pump rod (Fig. 6C10-21). Note location of pump rod for reassembly. Use care when driving small roll pin to prevent damage to pump lever casting bosses on air horn.
5. Remove front (primary) vacuum break hose from tube on float bowl noting tube location for reassembly later.
6. Remove eleven (or seven) air horn-to-bowl screws; then remove the two countersunk attaching screws (Number 1 and 2) located next to the venturi (Fig. 6C10-22). If used, remove secondary air baffle deflector from beneath the two center air horn screws (Numbers 3 and 4).
7. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later.

   When removing air horn from float bowl, use care to prevent damage to the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE THEM.

Air Horn

Disassembly

1. Remove front vacuum break bracket attaching screws. The vacuum break assembly may now be removed from the air valve rod and the rod from the air valve lever.

   NOTICE: Do not place vacuum break assembly in carburetor cleaner. Carburetor cleaner will damage internal parts.
2. If used, remove pump plunger stem seal by inverting air horn and, using a small screwdriver, remove staking holding the seal retainer in place (Fig. 6C10-23). Remove and discard retainer and seal. Use care in removing the pump plunger stem seal retainer to prevent damage to air horn casting. A new seal and retainer are required for reassembly.
3. Further disassembly of the air horn is not required for cleaning purposes. The choke valve and choke valve screws and air valve and air valve shaft should not be removed. However, if it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. Instructions for assembly are included in the repair kit.

Float Bowl

Disassembly

1. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath

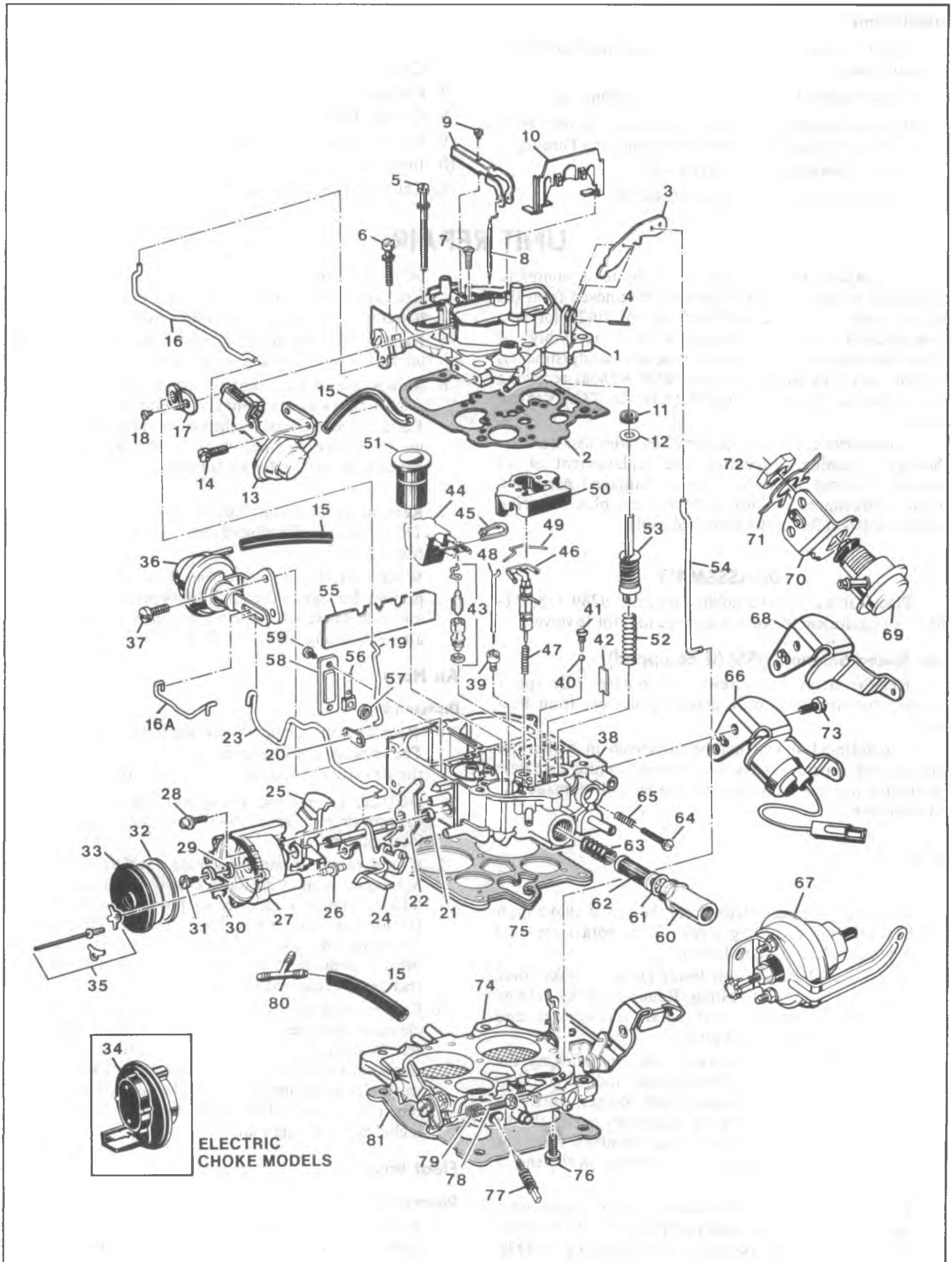

Fig. 6C10-19--M4MC/M4ME Carburetor Exploded View

AIR HORN PARTS
1 — Air Horn Assy.
2 — Gasket — Air Horn
3 — Lever — Pump Actuating
4 — Roll Pin — Pump Lever Hinge
5 — Screw — Air Horn Long (2)
6 — Screw — Air Horn Short ( )
7 — Screw — Air Horn Countersunk (2)
8 — Metering Rod — Secondary (2)
9 — Holder and Screw — Secondary Metering Rod
10 — Baffle — Secondary Air
11 — Seal — Pump Plunger
12 — Retainer — Pump Seal

CHOKE PARTS
13 — Vac. Break Control & Bracket — Front
14 — Screw — Control Attaching (2)
15 — Hose — Vacuum
16 — Rod — Air Valve
16A— Rod — Air Valve (Truck)
17 — Lever — Choke Rod (Upper)
18 — Screw — Choke Lever
19 — Rod — Choke
20 — Lever — Choke Rod (Lower)
21 — Seal — Intermediate Choke Shaft
22 — Lever — Secondary Lockout
23 — Link — Rear Vacuum Break
24 — Int. Choke Shaft & Lever
25 — Cam — Fast Idle
26 — Seal — Choke Housing to Bowl (Hot Air Choke)
27 — Kit — Choke Housing
28 — Screw — Choke Housing to Bowl
29 — Seal — Intermediate Choke Shaft (Hot Air Choke)
30 — Lever — Choke Coil
31 — Screw — Choke Coil Lever
32 — Gasket — Stat Cover (Hot Air Choke)
33 — Stat Cover & Coil Assy. (Hot Air Choke)
34 — Stat Cover & Coil Assy. (Electric Choke)
35 — Kit — Stat Cover Attaching
36 — Rear Vacuum Break Assembly
37 — Screw — Vacuum Break Attaching (2)

FLOAT BOWL PARTS
38 — Float Bowl Assembly
39 — Jet — Primary Metering (2)

FLOAT BOWL PARTS (Continued)
40 — Ball — Pump Discharge
41 — Retainer — Pump Discharge Ball
42 — Baffle — Pump Well
43 — Needle & Seat Assembly
44 — Float Assembly
45 — Hinge Pin — Float Assembly
46 — Power Piston Assembly
47 — Spring — Power Piston
48 — Rod — Primary Metering (2)
49 — Spring — Metering Rod Retainer
50 — Insert — Float Bowl
51 — Insert — Bowl Cavity
52 — Spring — Pump Return
53 — Pump Assembly
54 — Rod — Pump
55 — Baffle — Secondary Bores
56 — Idle Compensator Assembly
57 — Seal — Idle Compensator
58 — Cover — Idle Compensator
59 — Screw — Idle Compensator Cover (2)
60 — Filter Nut — Fuel Inlet
61 — Gasket — Filter Nut
62 — Filter — Fuel Inlet
63 — Spring — Fuel Filter
64 — Screw — Idle Stop
65 — Spring — Idle Stop Screw
66 — Idle Speed Solenoid & Bracket Assembly
67 — Idle Load Compensator & Bracket Assembly
68 — Bracket — Throttle Return Spring
69 — Actuator — Throttle Lever (Truck Only)
70 — Bracket — Throttle Lever Actuator (Truck Only)
71 — Washer — Actuator Nut (Truck Only)
72 — Nut — Actuator Attaching (Truck Only)
73 — Screw — Bracket Attaching (2)

THROTTLE BODY PARTS
74 — Throttle Body Assembly
75 — Gasket — Throttle Body
76 — Screw — Throttle Body (3)
77 — Idle Mixture Needle & Spring Assy. (2)
78 — Screw — Fast Idle Adjusting
79 — Spring — Fast Idle Screw
80 — Tee — Vacuum Hose
81 — Gasket — Flange

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Fig. 6C10-20--Carburetor Parts Description

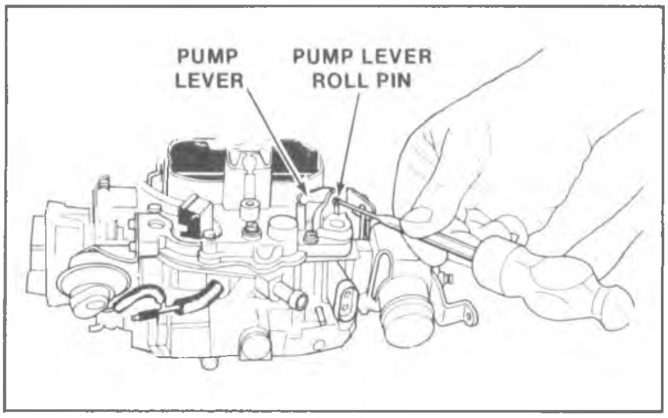


Fig. 6C10-21--Removing Pump Lever

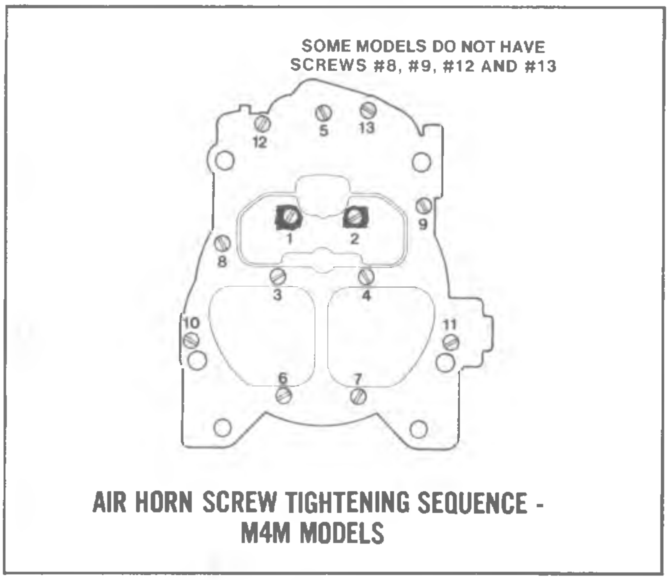


Fig. 6C10-22--Air Horn Screw Location

the power piston hanger, being careful not to distort springs holding the main metering rods. Discard gasket.

2. Remove pump plunger from pump well.
3. Remove pump return spring from pump well.
4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free.

   The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston to snap the piston up against

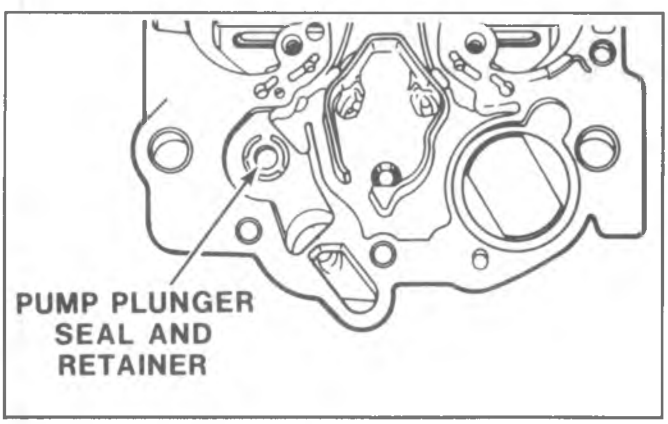


Fig. 6C10-23--Pump Plunger Stem Seal

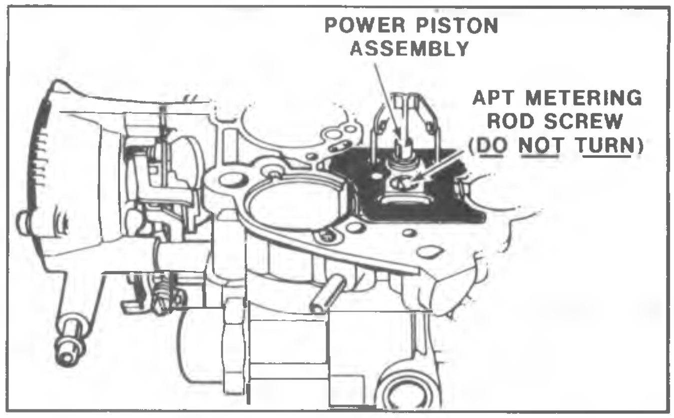


Fig. 6C10-24--APT Metering Rod Screw

the retainer. This procedure may have to be repeated several times.

Do not remove power piston by using pliers on metering rod hanger or pressed in hanger may come loose from piston.

5. Remove the power piston spring from the well.

The A.P.T. metering rod adjustment screw, located in a well next to the power piston well (Fig. 6C10-24) is set at the factory and **no attempt** should be made to change the adjustment in the field. If float bowl replacement is required during service, the new float bowl will be supplied with an A.P.T. metering rod screw pre-set as required.

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C10-25).

   Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly.

7. Remove plastic filler block over float chamber.
8. Remove float assembly and float needle by pulling up on retaining pin. Remove float needle seat and gasket using seat remover J 22769, BT-3006M, or equivalent.
9. If used, remove plastic insert cavity in float bowl.

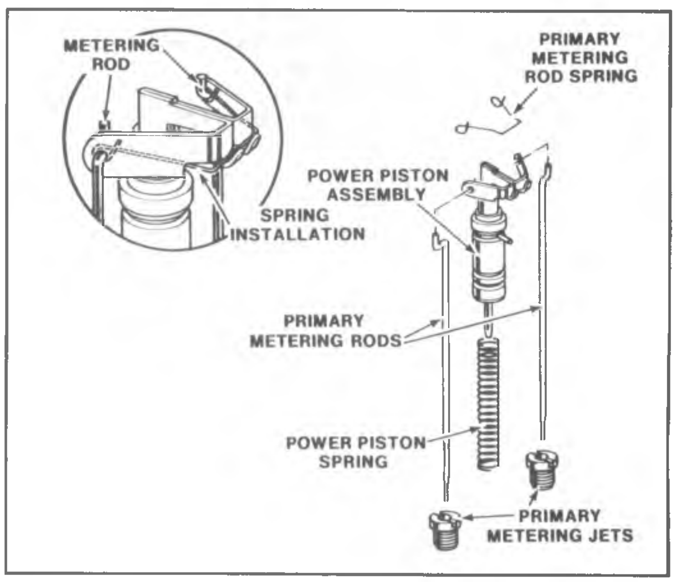


Fig. 6C10-25--Power Piston and Metering Rods

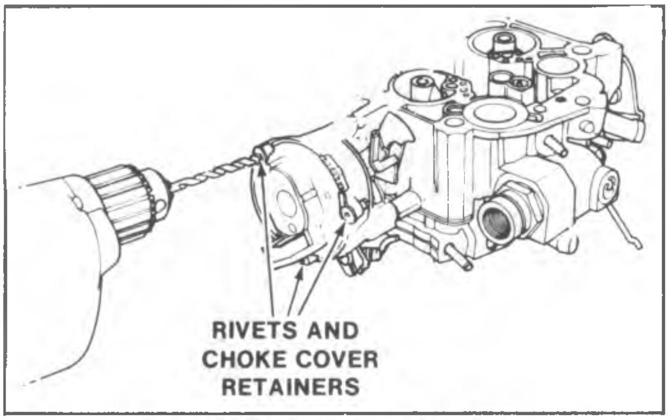


Fig. 6C10-26--Removing Choke Cover

10. If necessary, remove primary main metering jets.

    NOTICE: No attempt should be made to remove the secondary metering jet (metering orifice plates). These jets are fixed and, if damaged, replacement of the entire float bowl is required.

11. Remove pump discharge check ball retainer. Invert bowl and catch discharge ball as it falls from the bowl.
12. Remove secondary air baffle, if replacement is required.
13. Remove pump well fill slot baffle only if necessary.
14. Remove hoses from rear vacuum break assembly, where used. Remove (2) screws and rotate the assembly to remove vacuum break link from slot in plunger head and, if used, air valve rod.

    NOTICE: Do not place vacuum break assembly in carburetor cleaner because it will damage internal parts.

Choke

Disassembly

The tamper-resistant choke cover is used to discourage unnecessary readjustment of the choke thermostatic cover and coil assembly in the field. However, it is necessary to remove the cover and coil assembly during normal carburetor disassembly for cleaning and overhaul the procedures should be followed.

Choke Cover

Removal

1. Support float bowl and throttle body as an assembly, on a suitable holding fixture such as Tool J 9789-118, BT-30-15, or equivalent.
2. Carefully align a #21 drill (.159") on rivet head and drill only enough to remove rivet head (Fig. 6C10-26). Drill the two (2) remaining rivet heads and then use a drift and small hammer to drive the remainder of the rivets out of the choke housing. Use care in drilling to prevent damage to choke cover or housing.
3. Remove the three retainers, choke cover gasket (if used), and choke cover assembly from choke housing.

   Do not remove baffle plate from beneath the thermostatic coil on the choke cover (hot air choke model).

4. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (Fig. 6C10-27). The complete choke assembly can be removed from the float bowl by sliding outward.
5. Remove plastic tube seal (hot air models only) from vacuum inlet boss on choke housing.

   Do not immerse the plastic tube seal in carburetor cleaner.

6. If used, remove rear (auxiliary) vacuum break link from intermediate choke lever.
7. Remove secondary throttle valve lockout lever from float bowl (6C10-27).
8. Remove lower (inside) choke lever from inside float bowl cavity by inverting bowl.
9. To disassemble intermediate choke shaft from choke housing, remove choke coil lever retaining screw at end of intermediate shaft and remove lever (Fig. 6C10-27). Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft. On hot air models, remove the cup seal from inside choke housing shaft hole. Discard seal.
10. Remove the cup seal (from the intermediate choke shaft) from the float bowl insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT.

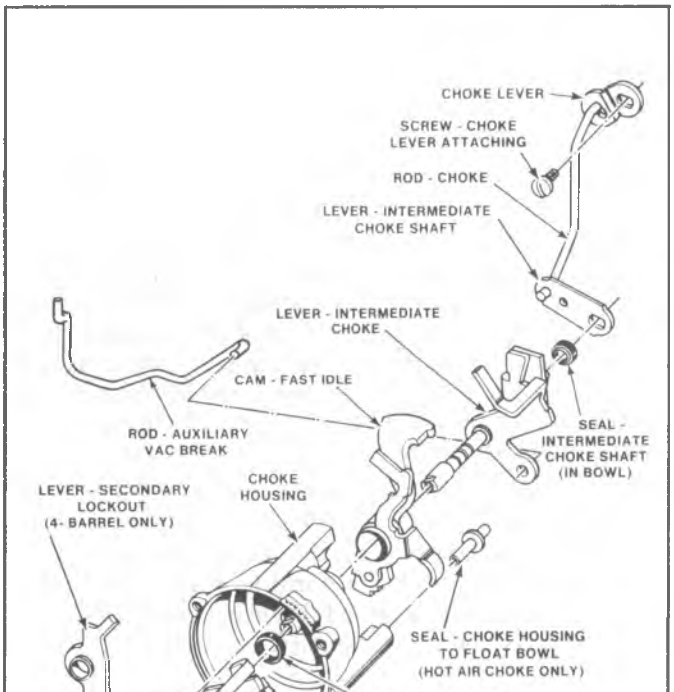


Fig. 6C10-27--Choke Assembly - Removal

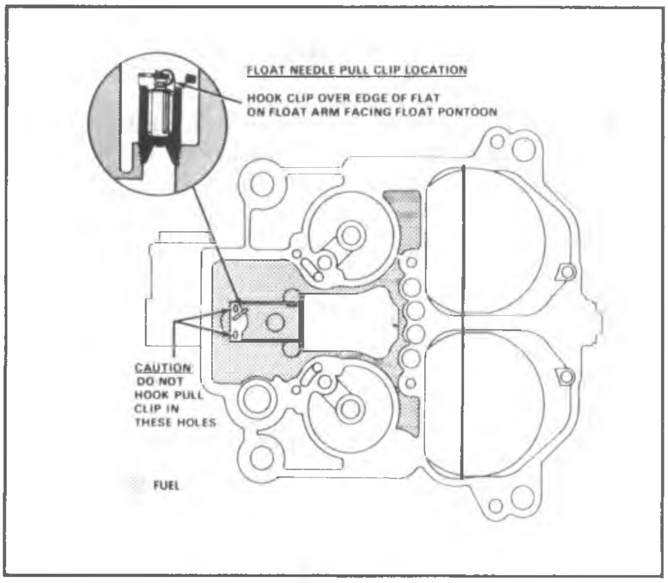


Fig. 6C10-28--Flood Needle Pull Clip Location

Float Bowl

Disassembly

1. Remove fuel inlet nut, gasket and check valve filter assembly and spring.
2. Remove three throttle body to bowl attaching screws and lockwashers and remove throttle body assembly.
3. Remove throttle body to bowl insulator gasket.

Throttle Body

Disassembly

Place throttle body assembly on carburetor holding fixture to avoid damage to throttle valves.

1. Remove pump rod from throttle lever by rotating rod until tang on rod aligns with slot in lever.
2. **Do not remove** plugs covering idle mixture needles during normal carburetor cleaning and servicing. Remove plugs only if diagnosis indicates the carburetor is the cause of a driver complaint or emission failure, or the idle mixture needles or throttle body must be replaced, in which case, the plugs may be removed and the idle mixture adjusted on the vehicle, carefully following "On-Vehicle Service" procedures.

If necessary to remove the idle mixture needles, see Idle Mixture Needle Plug Removal (Fig. 6C10-16).

Further disassembly of the throttle body is not required for cleaning purposes. The throttle valve screws are permanently staked in place and should not be removed. The throttle body is serviced as a complete assembly.

CLEANING AND INSPECTION

Metal carburetor parts should be cleaned in cold immersion type cleaner. such as Carbon X (X-55) or its equivalent.

NOTICE: The electric solenoid, rubber parts, plastic parts, diaphragms, pump plunger, pump stem seal, etc. should not be put in immersion type cleaner as they will swell, harden or distort.

The plastic cam on the air valve shaft and bushing insert in bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt. Do not pass drills or wire through jets.
2. Inspect upper and lower surfaces of carburetor casting for damage.

   Important: If float bowl needs replacement, inspect for letters "MW" on the casting. These letters indicate a machined pump well, and determine the type of heavy duty (H.D.) replacement pump when needed. If the letters are present, a replacement bowl also must have "MW" letters.
3. Inspect holes in levers for excessive wear or out of round conditions. If worn, lever should be replaced.
4. Inspect plastic parts for cracks, damage, etc. Replace if necessary.
5. Check, repair or replace the following parts if the following problems were encountered.

   a. **Flooding**

      1. Inspect float needle seat for dirt, deep wear grooves, scores and in proper seating.
      2. Inspect float needle pull clip for proper installation (Fig. 6C10-28). Be careful not to bend needle pull clip.
      3. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check density of material in the float, if heavier than normal, replace float.
      4. Replace fuel inlet filter.

   b. **Hesitation**

      1. Inspect pump plunger for cracks, scores or excessive cup wear and replace plunger if necessary.
      2. Inspect pump duration and return springs for being weak or distorted.
      3. Check all pump passages and jets for dirt, improper seating of discharge ball and scores in

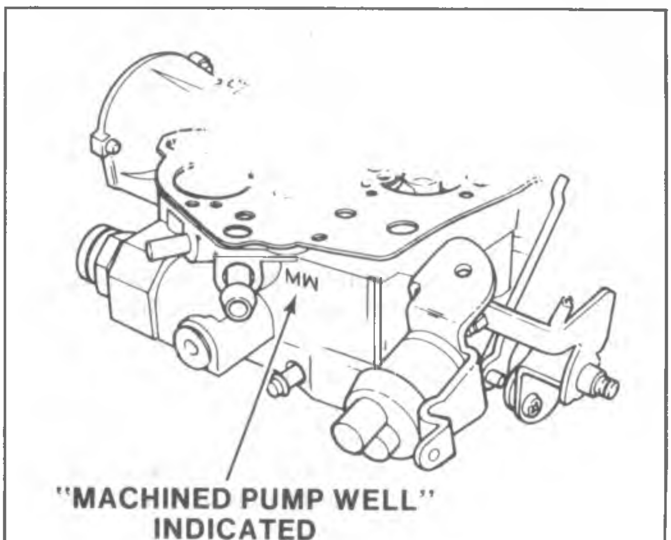


Fig. 6C10-28a--Mechanical Pump Well

pump well. Check condition of pump discharge check ball.

4. Check pump linkage for excessive wear. Repair or replace if necessary.

c. **Hard Starting - Poor Cold Operation**

1. Check choke valve and linkage for excessive wear, binds or distortion.
2. Inspect choke vacuum diaphragm for leaks.
3. Replace carburetor fuel filter.
4. Inspect float needle for sticking, dirt etc.
5. Examine fast idle cam for wear or damage.
6. Also check items under "Flooding".

d. **Poor Performance - Poor Gas Mileage**

1. Clean all fuel and vacuum passages in castings.
2. Check choke valve for freedom of movement.
3. Check power piston metering rods for dirt, sticking, binding, damaged parts or excessive wear.
4. Inspect primary metering jets for being dirty, loose, worn or damaged.
5. Check air valves for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in the kit.

e. **Rough Idle**

1. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks, burrs and other damage.
2. Clean all idle fuel passages.
3. If removed, inspect idle mixture needles for ridges, burrs, or being bent.
4. Check throttle lever and valves for binds, nicks, and other damage.

5. Check all diaphragms for possible ruptures or leaks.
6. Clean plastic parts only in cleaning solvent - never in gasoline.

CHECK CARBURETOR CHOKE AND UNLOADER OPERATION AND ADJUSTMENT

NOTICE: Choke linkage and fast idle cam must operate freely. Bent, dirty or otherwise damaged linkage must be cleaned, repaired, or replaced as necessary. Do not lubricate linkage, as this will collect dust and cause sticking.

CHECK FUEL LINES AND SERVICE FUEL FILTER

1. Inspect fuel lines for kinks, bends, or leaks and correct any defects found.
2. Replace filter in carburetor inlet, making sure type used includes the check valve in the filter inlet.

If a complaint of poor high speed performance exists on the vehicle, fuel pump tests should be performed.

ASSEMBLY

Throttle Body

Assembly

1. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outward toward throttle lever.
2. If removed, install idle and springs mixture needle and springs using Tool J-29030-B, BT-7610B, or equivalent. Lightly seat each needle and then back out 3 turns as a preliminary idle mixture adjustment. Final idle mixture adjustment must be on the engine using the procedures described under "On-Vehicle Service"

Float Bowl

Assembly

If a new float bowl assembly is used, stamp or engrave the model number on the new float bowl (Fig. 6C10-9).

1. Install new throttle body to bowl gasket over two locating dowels on bowl.
2. Install throttle body making certain throttle body is properly located over dowels on float bowl. Install throttle body to bowl screws and tighten evenly and securely.
3. Place carburetor on proper holding fixture such as J9789-118, BT-30-15 or equivalent.
4. Install fuel inlet filter spring, filter, a new check valve filter assembly, new gasket and inlet nut and tighten nut to 24 N·m (18 ft. lbs.).

When installing a service replacement filter, be sure the filter is the type that includes the check valve to meet government safety standards. New service replacement filters with check valve meet this requirement. When properly installed, hole in filter faces toward inlet nut. Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced. Tightening beyond specified torque can damage inlet nut gasket to cause fuel leak.

Choke Housing to Float Bowl

1. Install new cup seal into insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward (Fig. 6C10-27).
2. Install secondary throttle valve lockout lever on boss on float bowl with recess in hole in lever facing inward (Fig. 6C10-27).
3. On hot air choke model, install new cup seal into choke shaft hole. Lips on seal face inward toward float bowl.
4. Place fast idle cam on the intermediate choke shaft (with steps on fast idle cam facing downward). Install intermediate choke shaft in choke housing pushing shaft through seal in housing.
5. Install choke coil lever on flats on intermediate chokeshaft, install retaining screw, and tighten securely (Fig. 6C10-27). Lever is properly aligned when both inside and outside levers face toward fuel inlet.
6. If rear vacuum break link is used, install rear vacuum break link in hole in immediate choke shaft lever. The end of link faces toward choke housing

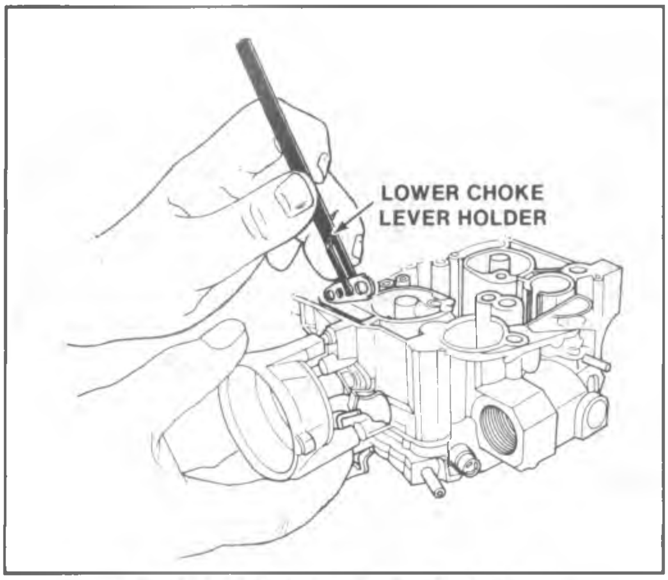


Fig. 6C10-29--Installing Lower Choke Lever

when installed correctly.

7. On hot air choke models, insert plastic tube seal (to float bowl) in vacuum inlet hole on choke housing (Fig. 6C10-25).
8. Install lower (inner) choke lever in cavity in float bowl using Tool J-23417, BT-6911 or equivalent (Fig. 6C10-29). Install choke housing to bowl sliding intermediate choke shaft through bowl seal and into lower (inner) choke lever.

   The intermediate choke shaft lever and fast idle cam are in correct position when the tang on lever is beneath the fast idle cam.

8. Install choke housing retaining screw and washer (Fig. 6C10-27) and tighten securely. Check linkage for freedom of movement.

   Do not install the choke cover and coil assembly until completion of adjustments (starting at Figure 6C10-34).

Float Bowl

Completion of Assembly

1. On all models, except those using an air valve rod to the rear vacuum break, install end of vacuum break link in slot in rear vacuum break plunger. Install vacuum break and bracket assembly on float bowl using two large countersunk attaching screws. Tighten securely.
2. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.
3. If removed, install baffle in side of pump well with slot at bottom.
4. Install pump discharge check ball and retainer screw in passage next to pump well. Tighten retainer screw securely.
5. If removed, carefully install primary metering jets in bottom of float bowl. Jets should be seated securely in bowl-do not overtighten.
6. Install plastic insert, if used, into cavity in float bowl.
7. Install needle seat assembly, with gasket, using seat installer J-22769, BT-3006M or equivalent.
8. To make adjustment easier, carefully bend float arm upward at notch in arm before assembly.
9. Install float needle onto float arm by sliding float lever under needle pull clip. Proper installation of the needle pull clip is to hook the clip over the edge of the float on the float arm facing the float pontoon (Fig. 6C10-28).
10. Install float hinge pin into float arm with end of loop of pin facing pump well. Install float assembly by aligning needle in the seat and float hinge pin into locating channels in the float bowl. **Do not** install float needle pull clip into holes in float arm or flooding may result. See Figure 6C10-28 for correct needle pull clip location.
11. Perform **Float Level Adjustment** referring to Figure 6C10-31.
12. Install plastic filler block over float needle, pressing downward until properly seated.
13. Install power piston spring in power piston well.
14. If metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod (Fig. 6C10-25). Install power piston assembly in well (aligning pin on piston with slot in well) and with metering rods properly position in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer in place lightly.
15. Install pump return spring in pump well.
16. Install air horn gasket by sliding tab of gasket carefully around main metering rods and beneath the power piston hanger. Position gasket over the two dowel pins on the float bowl.
17. Carefully lift one corner of the air horn gasket and install pump plunger in the pump well by pushing the plunger to the bottom of the well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket and press gasket in place.

Air Horn

Assembly

1. Apply a liberal quantity of a lithium base grease to the air valve shaft pin (Figure 6C10-23), making sure to lubricate pin surface contacted by the closing spring.
2. If used, install new pump plunger stem seal and retainer in air horn casting (Fig. 6C10-17). The lip on the seal faces toward outside of carburetor. Lightly stake seal retainer in three places, choosing locations diferent from the original stakings.

Air Horn to Bowl

Installation

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl. Be sure that the bleed tubes, pull-over enrichment tubes (if used) and pump plunger stem are positioned properly through the holes in the air horn gasket.

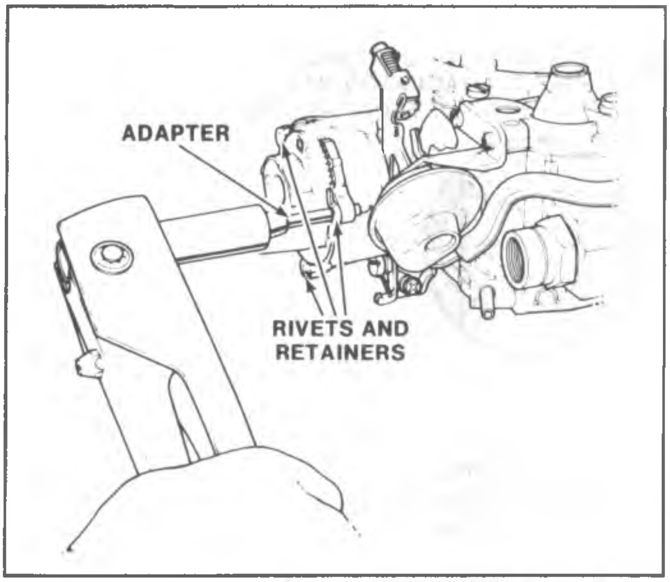


Fig. 6C10-30--Installing Choke Cover Rivets

Do not force the air horn assembly onto the bowl but rather lightly lower in place.

2. Install eleven (or seven) air horn attaching screws and lockwashers; and two countersunk screws (Nos. 1 2) located next to the carburetor venturi area. If used, install secondary air baffle deflector under air horn screws **3 and 4. Tighten all screws evenly and securely following air horn screw tightening sequence (Fig. 6C10-22).**
3. On models using a single rear vacuum break, install air valve rod in air valve lever. Install end of air valve rod and vacuum break link in slots in vacuum break plunger. Install vacuum break and bracket assembly on float bowl using too large countersunk attaching screws. Tighten screws securely. If vacuum break adjustment is necessary, see adjustment.procedure (Fig. 6C10-39).
4. On models using a front vacuum break, install air valve rod into slot in air valve lever. Install the other end of rod in hole in front vacuum break diaphragm plunger. Install vacuum break on air horn using two attaching screws. Tighten screws securely. If vacuum break adjustment is necessary, see adjustment. procedure (Fig. 6C10-38).
5. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever, noted at disassembly. Align hole in pump lever with hole in air horn casting using J-25322 or equivalent. Using screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn.

   Use care installing the roll pin to prevent damage to pump lever bearing surface and casting bosses.
6. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod hanger, with rods, onto air valve cam follower. Install retaining screw and tighten securely. Work air valves up and down several times to make sure they move free in all positions.
7. Connect choke rod into lower choke lever inside bowl cavity. Install choke rod into slot in upper choke lever and position lever on end of choke shaft. Install retaining screw and tighten securely. When properly installed, the lever will point to the rear of the carburetor and the number on the lever will face outward.
8. Perform adjustments indicated below, which will be found in the carburetor adjustment section:

   Air Valve Spring Adjustment, Figure 6C10-33.

   Choke Coil Lever Adjustment, Figure 6C10-34.
9. Install the cover and coil assembly in the choke housing:

   a. Place cam follower on hightest step of fast idle cam.

   b. Install the thermostatic cover and coil assembly, and gasket (if used), in the choke housing, making sure coil tang engages the inside coil pick-up lever.

   NOTICE: On M4ME models, ground contact for the electric choke is provided by a metal plate located at the rear of the choke cover assembly. Do not install a choke cover gasket between the electric choke assembly and the choke housing.

   c. A choke cover retainer kit is required to attach the choke cover to the choke housing. Follow instructions contained in kit and install proper retainers and rivets using suitable blind rivet installing tool (Fig. 6C10-30).

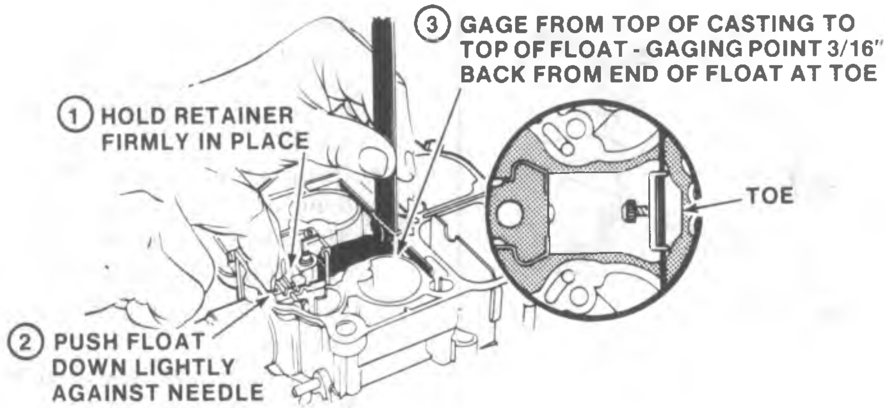
   d. It may be necessary to use an adapter (tube) if the installing tool interferes with the electrical connector tower on the choke cover, (Figure 6C10-30).

   e. On hot air choke models, torque the choke heat pipe nut to 10 N·m (95 in. lbs.).
10. Install hose on front vacuum break and on tube on float bowl.
11. If used, position ISS or similar throttle actuating device and/or bracket assembly on float bowl, retaining with two large countersunk screws. Tighten screws securely.
12. Perform the remaining unit repair adjustments (Figs. 6C10-31 through 6C10-42).
13. Reinstall carburetor on vehicle with new insulator referring to On-Vehicle Service for installation and idle speed adjustment.

UNIT REPAIR ADJUSTMENTS

The carburetor adjustments that are part of Unit Repair, in most cases, may be performed on the vehicle.

- Float Adjustment (Fig. 6C10-31)
- Pump Adjustment (Fig. 6C10-32)
- Air Valve Spring Adjustment (Fig. 6C10-33)
- Choke Coil Lever Adjustment (Fig. 6C10-34)
- Choke Valve Angle Gage (Fig. 6C10-35)
- Choke Rod-Fast Idle Cam Adjustment (Fig. 6C10-36)
- Vacuum Break Adjustment Information (Fig. 6C10-37)
- Front (Primary) Vacuum Break Adjustment (Fig. 6C10-38)
- Rear (Auxiliary) Vacuum Break Adjustment (Fig. 6C10-39)
- Air Valve Rod Adjustment - Front (Fig. 6C10-40)



4 IF FLOAT LEVEL VARIES OVER ±1/16" FROM SPECIFICATIONS,
FOR LEVEL TOO HIGH, HOLD RETAINER IN PLACE AND PUSH DOWN ON CENTER OF FLOAT PONTOON TO OBTAIN CORRECT SETTING.
FOR LEVEL TOO LOW.

A IF M4M OR M2M CARBURETOR, REMOVE POWER PISTON, METERING RODS, PLASTIC FILLER BLOCK. REMOVE FLOAT, BEND FLOAT ARM UPWARD TO ADJUST. REINSTALL PARTS. VISUALLY CHECK FLOAT ALIGNMENT.

B IF E4M OR E2M REMOVE METERING RODS, SOLENOID CONNECTOR SCREW. COUNT, AND RECORD FOR REASSEMBLY, THE NUMBER OF TURNS NEEDED TO LIGHTLY BOTTOM LEAN MIXTURE SCREW. BACK OUT AND REMOVE SCREW, SOLENOID, CONNECTOR. REMOVE FLOAT AND FLOAT ARM UPWARD TO ADJUST. REINSTALL PARTS, RESET LEAN MIXTURE SCREW. VISUALLY CHECK FLOAT ALIGNMENT.

Fig. 6C10-31--Float Adjustment

- Air Valve Rod Adjustment - Rear (Fig. 6C10-41)
- Unloader Adjustment (Fig. 6C10-42)
- Secondary Lockout Adjustment (Fig. 6C10-43)

Refer to On-Vehicle Service for additional carburetor adjustment procedures performed on the vehicle.

SPECIAL TOOLS

Special tools are listed at the end of this section.

SPECIFICATIONS

Refer to the end of this section for carburetor specifications.

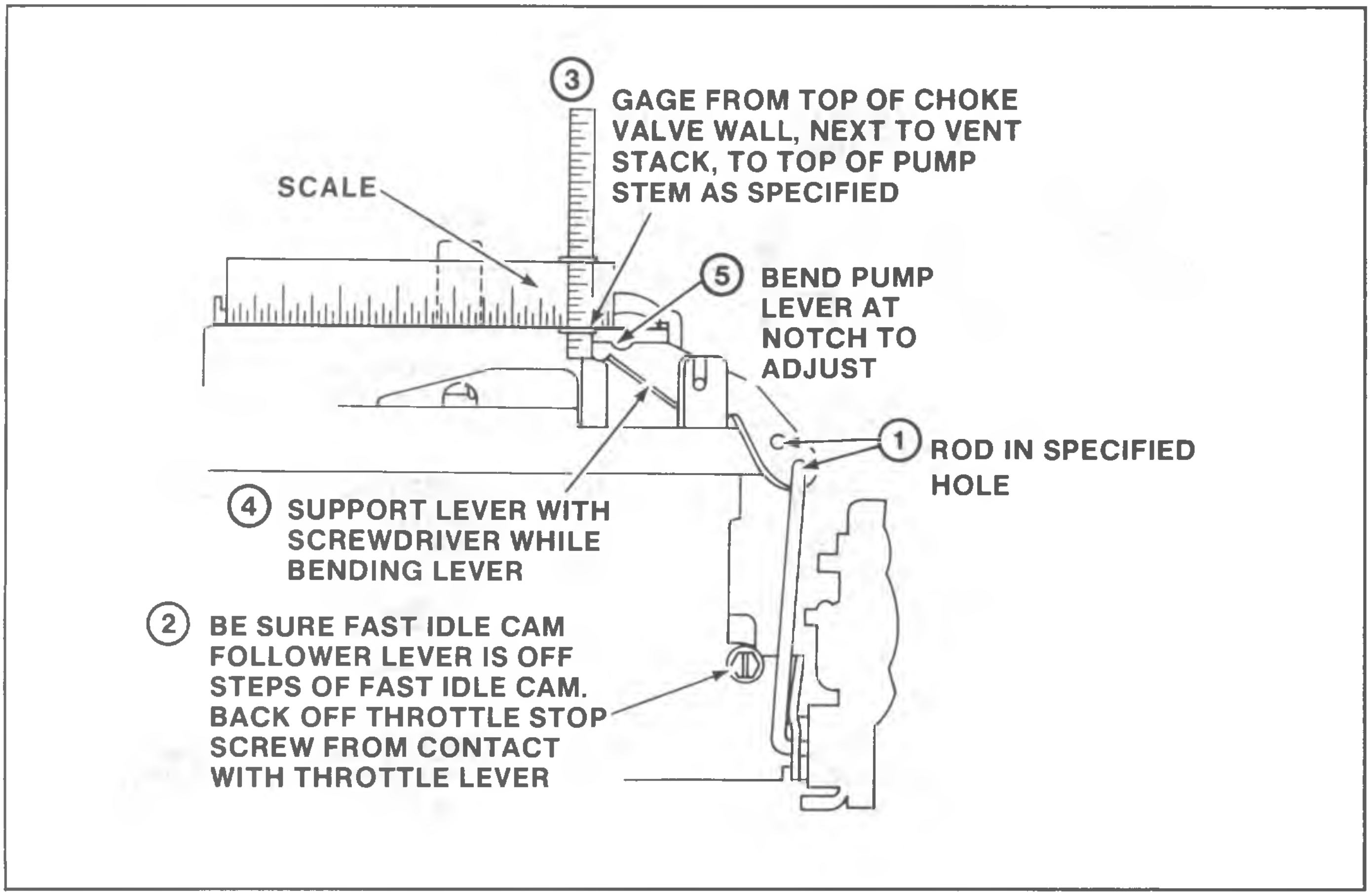


Fig. 6C10-32--Pump Adjustment

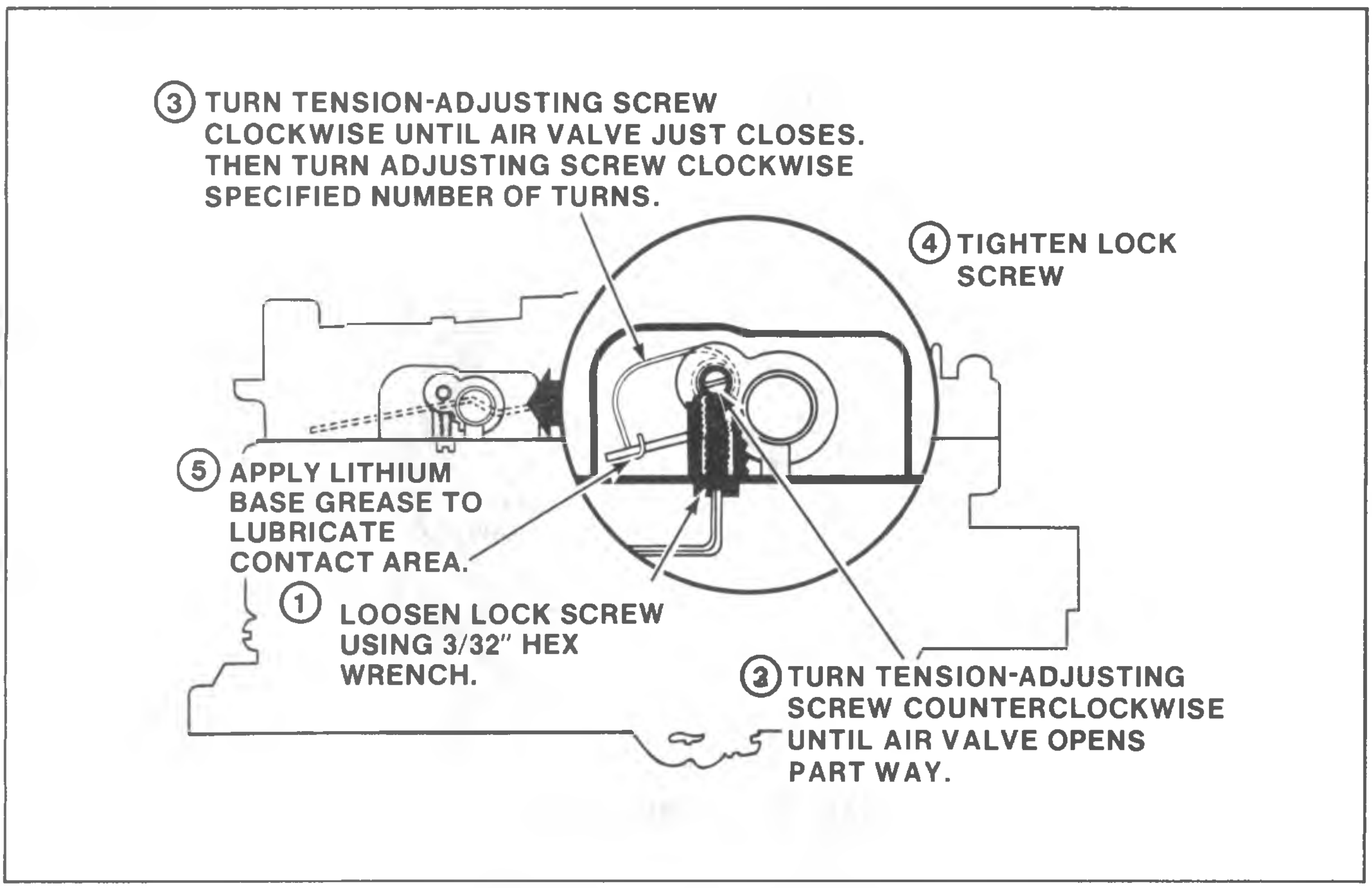


Fig. 6C10-33--Air Valve Spring Adjustment

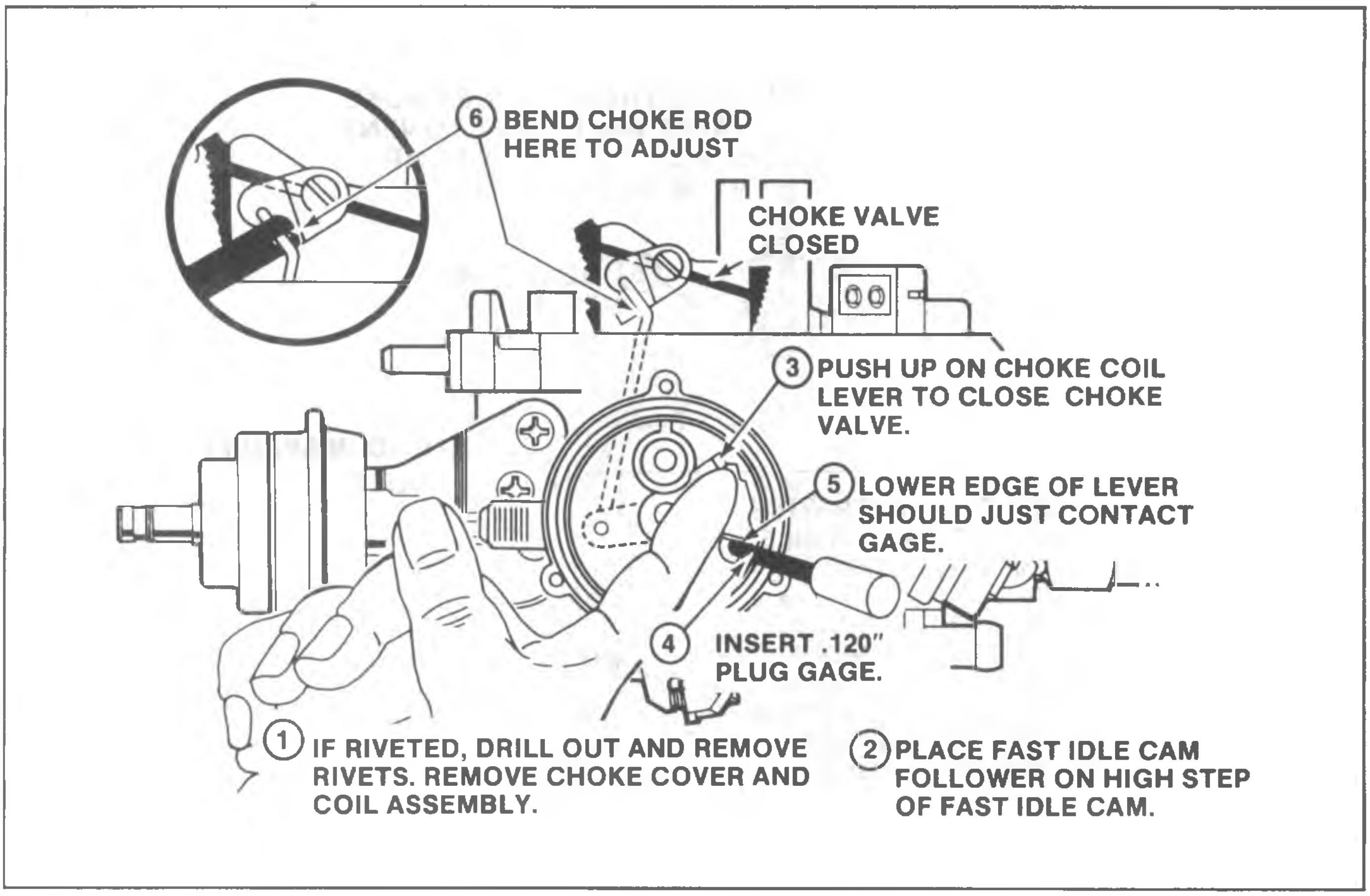


Fig. 6C10-34--Choke Coil Lever Adjustment

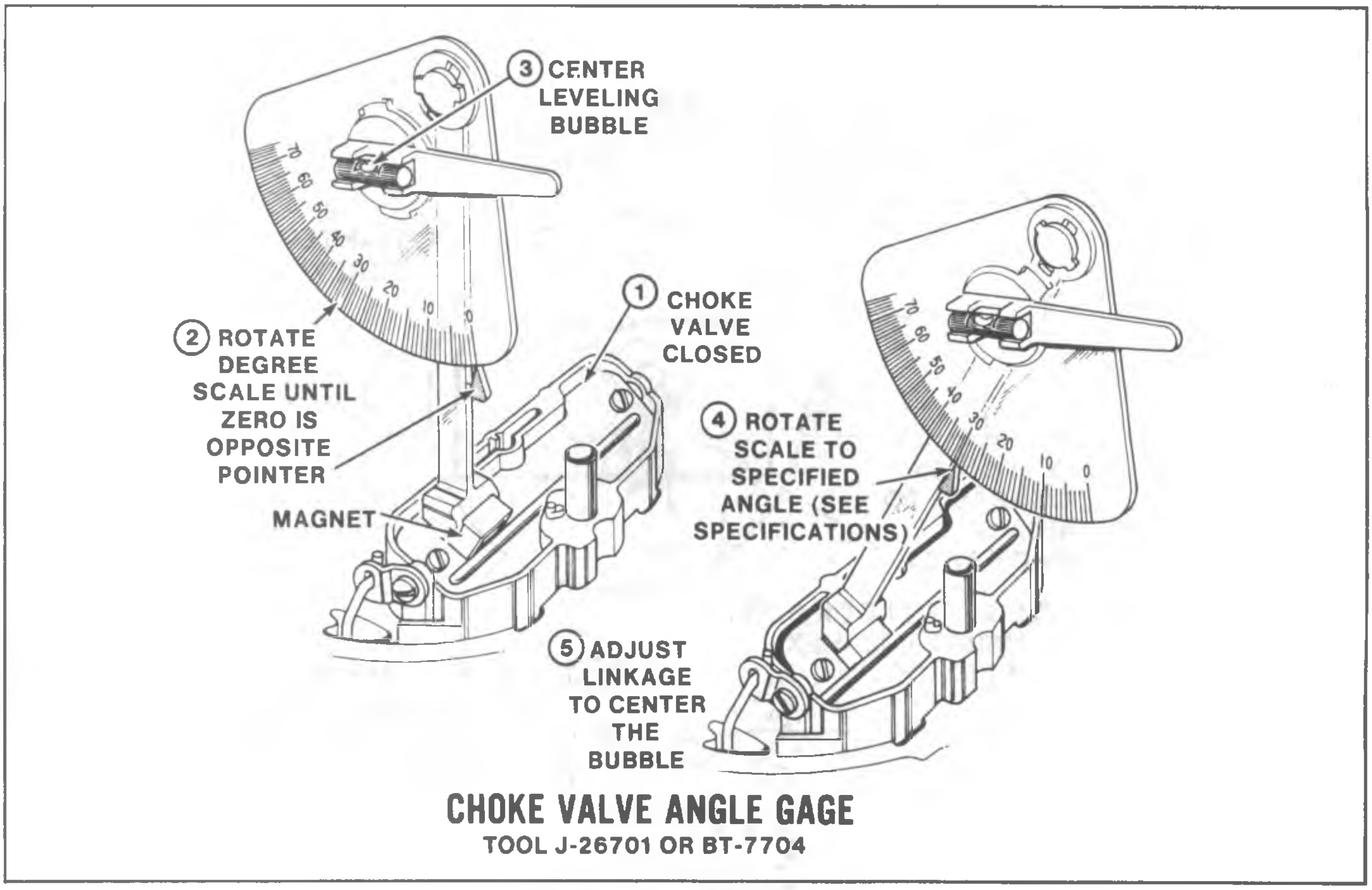


Fig. 6C10-35--Choke Valve Angle Gage

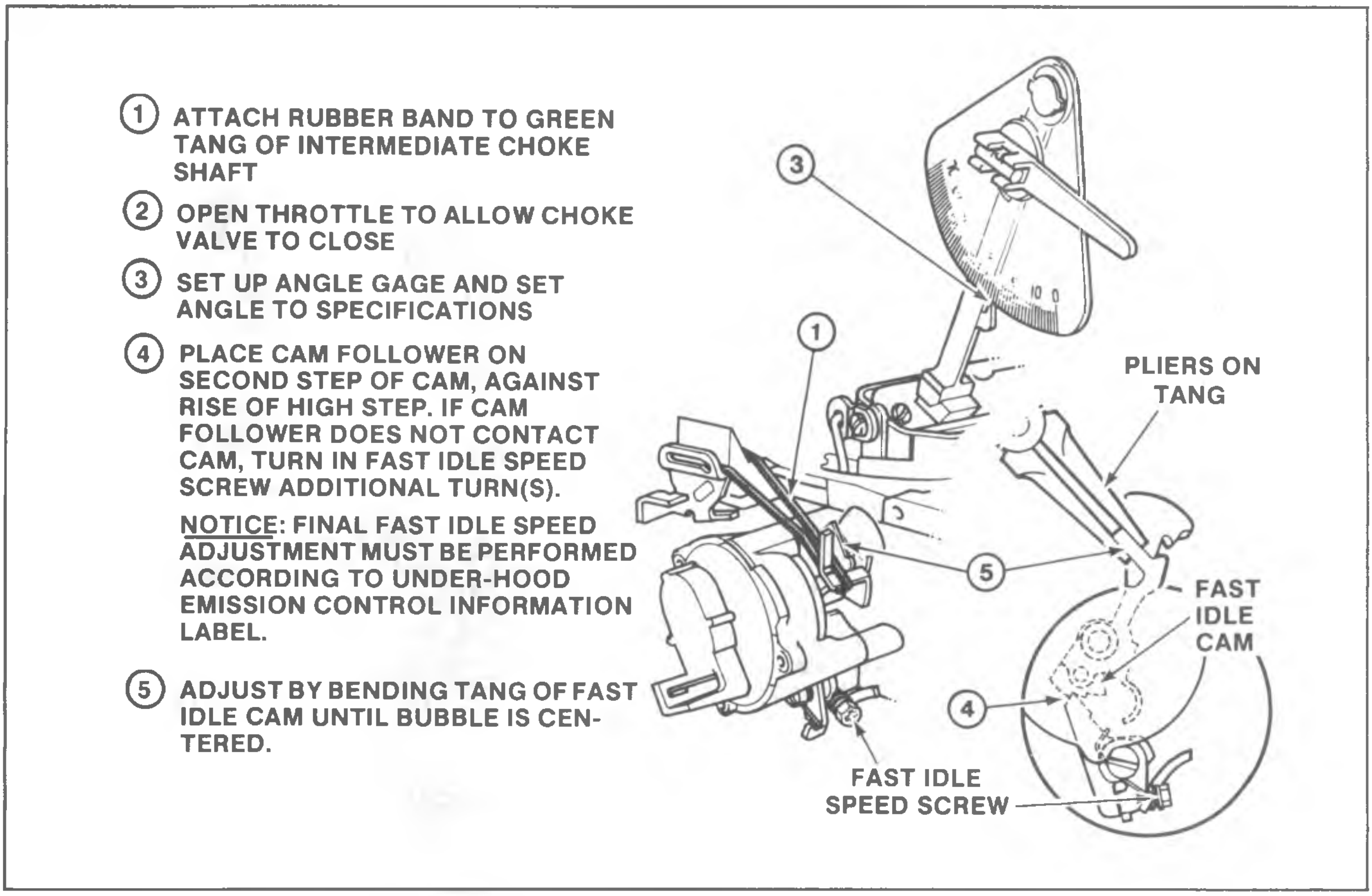


Fig. 6C10-36--Choke Rod-Fast Idle Cam Adjustment

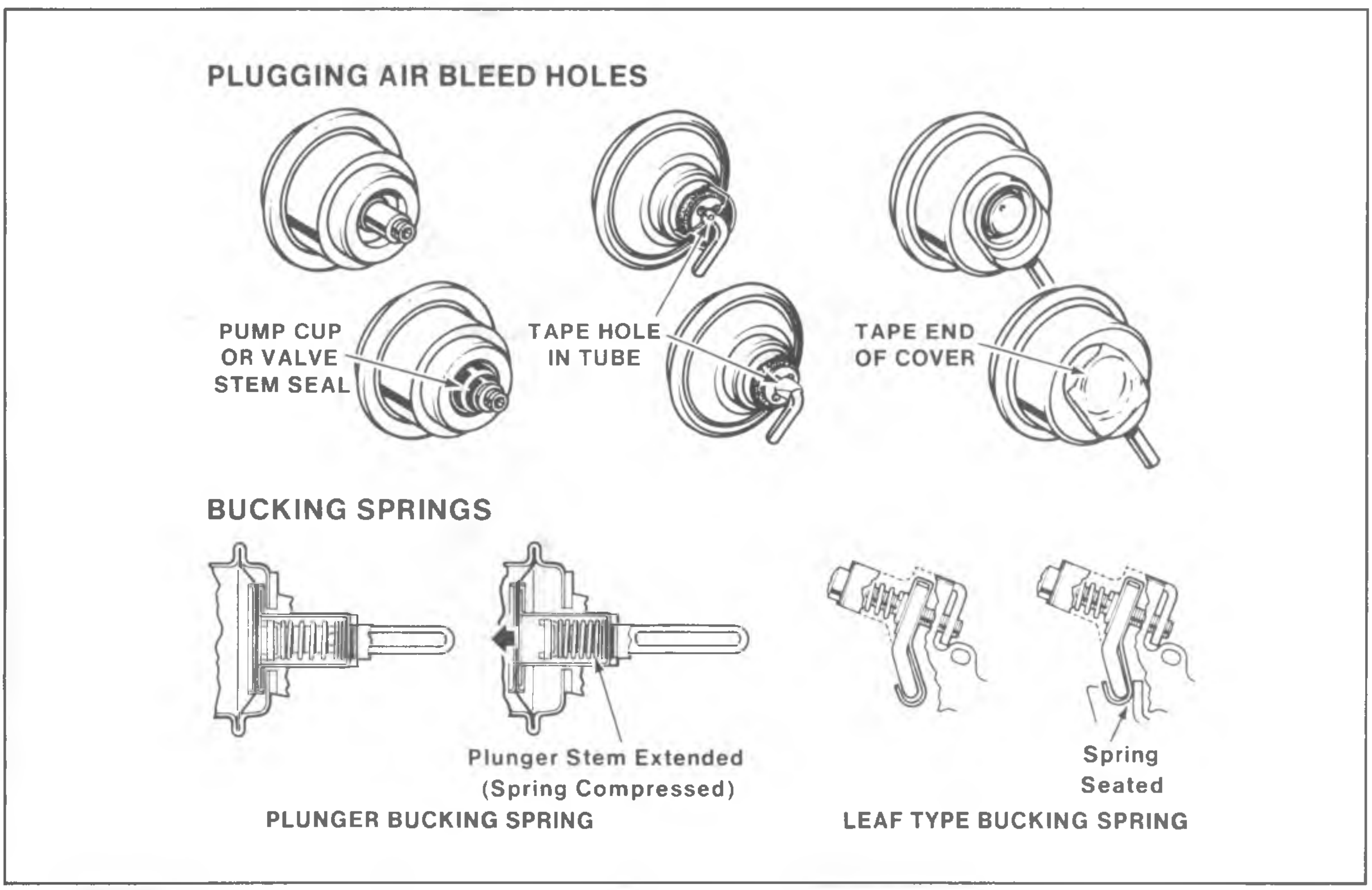


Fig. 6C10-37--Vacuum Break Adjustment Information

1. ATTACH RUBBER BAND TO GREEN TANG OF INTERMEDIATE CHOKE SHAFT
3. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE
3. SET UP ANGLE GAGE AND SET TO SPECIFICATION
4. RETRACT VACUUM BREAK PLUNGER USING VACUUM SOURCE, AT LEAST 18" HG. PLUG AIR BLEED HOLES WHERE APPLICABLE

   ON QUADRAJETS, AIR VALVE ROD MUST NOT RESTRICT PLUNGER FROM RETRACTING FULLY. IF NECESSARY, BEND ROD (SEE ARROW) TO PERMIT FULL PLUNGER TRAVEL. FINAL ROD CLEARANCE MUST BE SET AFTER VACUUM BREAK SETTING HAS BEEN MADE.
5. WITH AT LEAST 18" HG STILL APPLIED, ADJUST SCREW TO CENTER BUBBLE

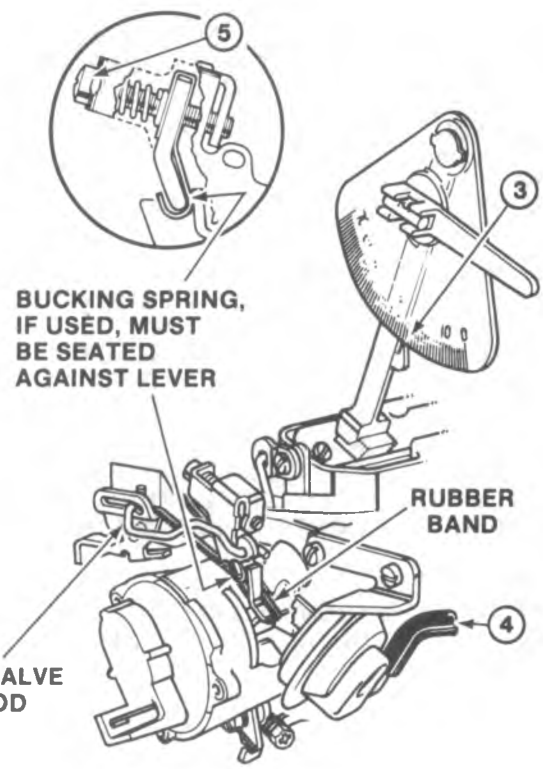


Fig. 6C10-38--Front Vacuum Break Adjustment

1. ATTACH RUBBER BAND TO GREEN TANG OF INTERMEDIATE CHOKE SHAFT.
2. OPEN THROTTLE TO ALLOW CHOKE VALVE TO CLOSE.
3. SET UP ANGLE GAGE AND SET ANGLE TO SPECIFICATION.
4. RETRACT VACUUM BREAK PLUNGER, USING VACUUM SOURCE, AT LEAST 18" HG. PLUG AIR BLEED HOLES WHERE APPLICABLE.

4A. ON QUADRAJETS, AIR VALVE ROD MUST NOT RESTRICT PLUNGER FROM RETRACTING FULLY. IF NECESSARY, BEND ROD HERE TO PERMIT FULL PLUNGER TRAVEL. WHERE APPLICABLE, PLUNGER STEM MUST BE EXTENDED FULLY TO COMPRESS PLUNGER BUCKING SPRING.

5. TO CENTER BUBBLE, EITHER:
   A. ADJUST WITH 1/8" HEX WRENCH (VACUUM STILL APPLIED)

   -OR-

   B. SUPPORT AT "S" AND BEND VACUUM BREAK ROD (VACUUM STILL APPLIED)

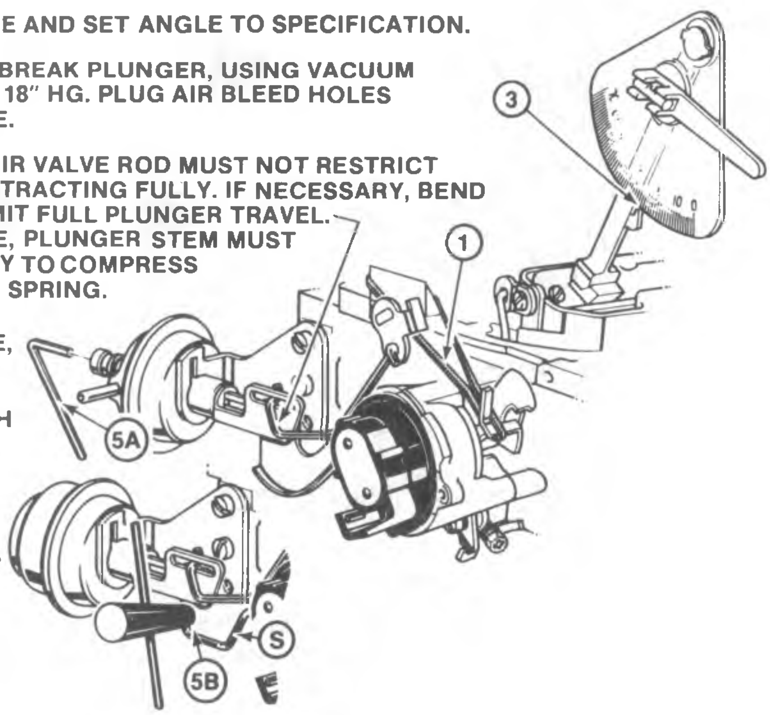


Fig. 6C10-39--Rear Vacuum Break Adjustment

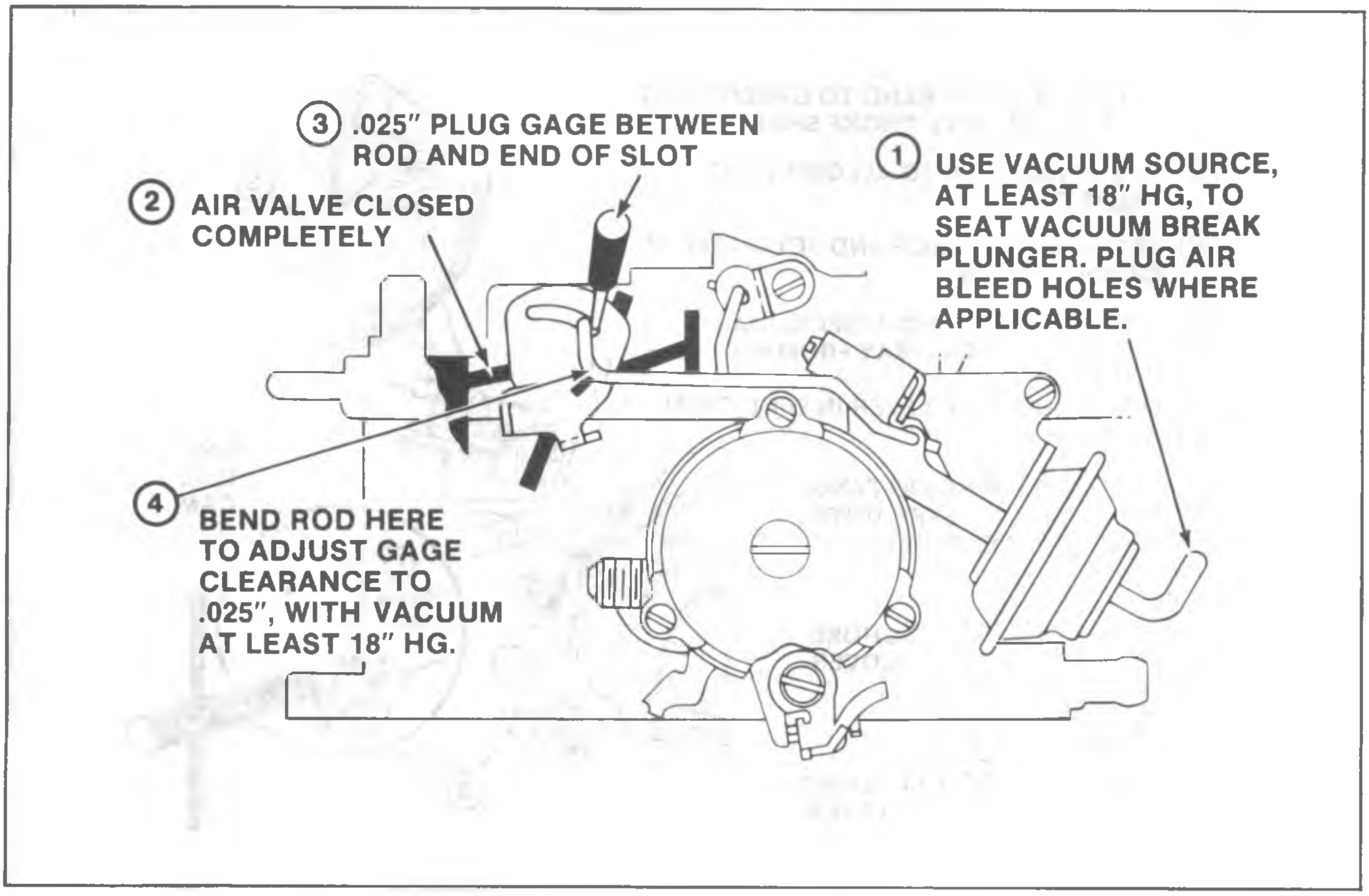


Fig. 6C10-40--Air Valve Rod Adjustment - Front

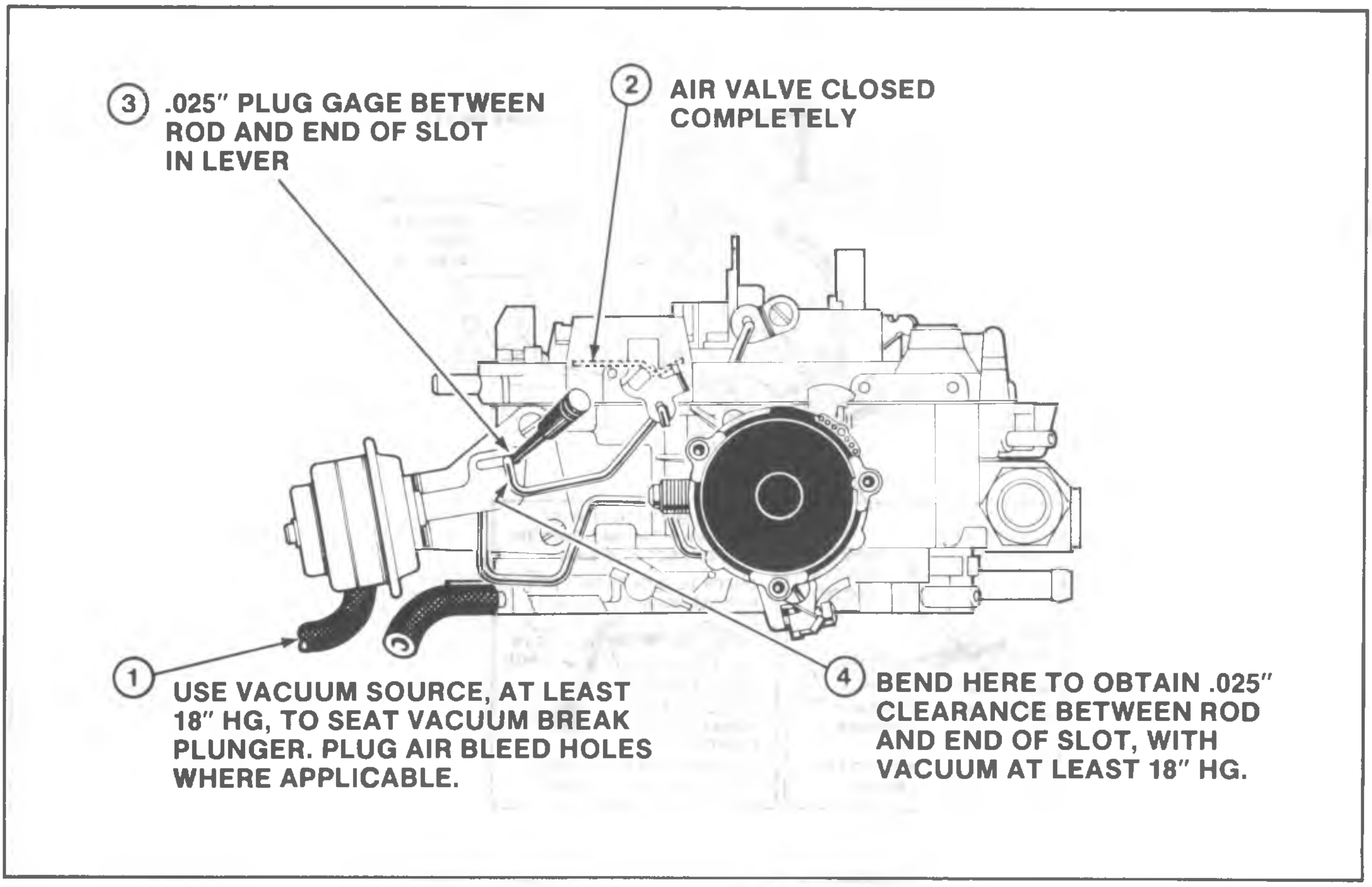


Fig. 6C10-41--Air Valve Rod Adjustment - Rear

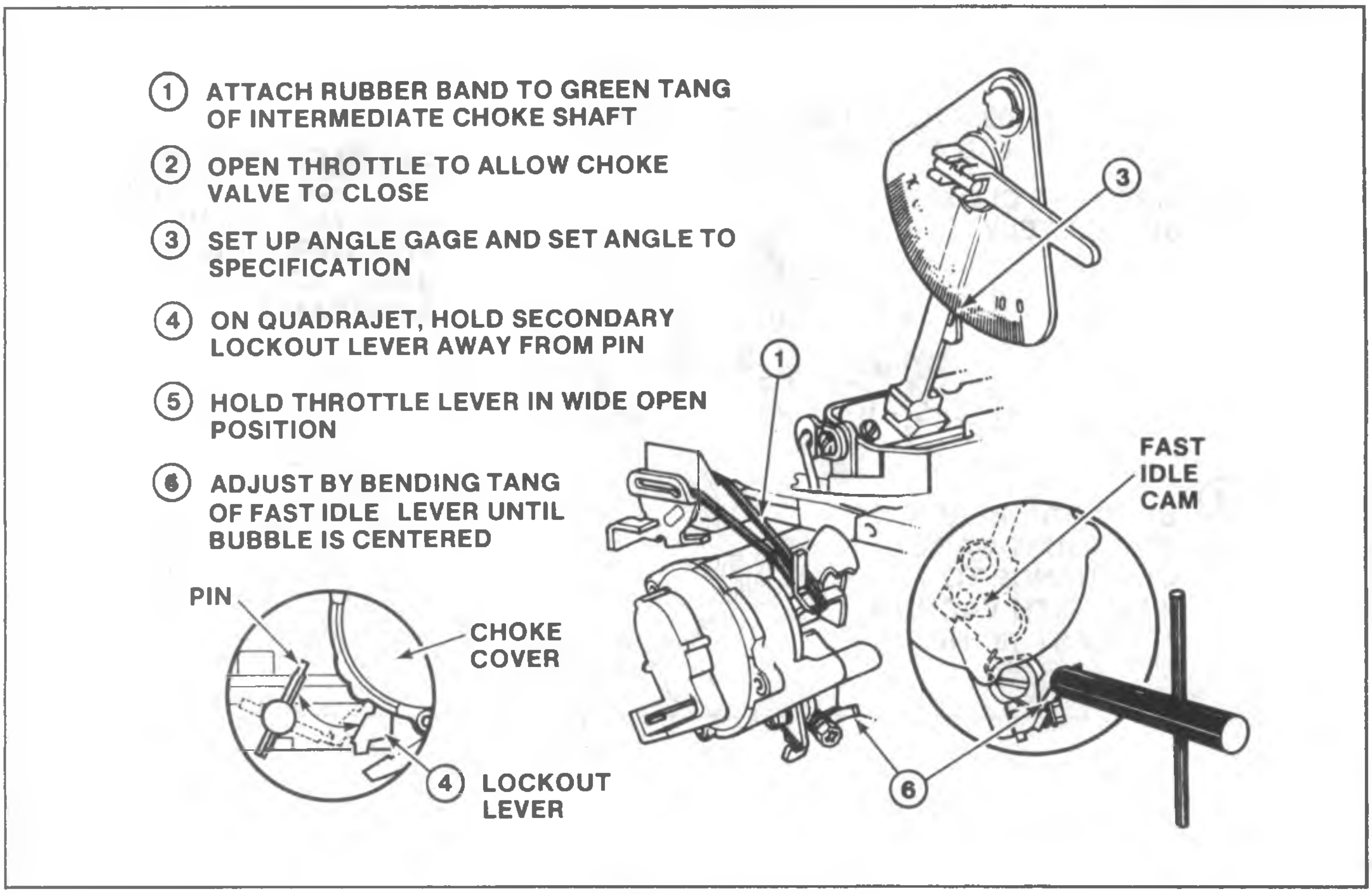


Fig. 6C10-42--Unloader Adjustment

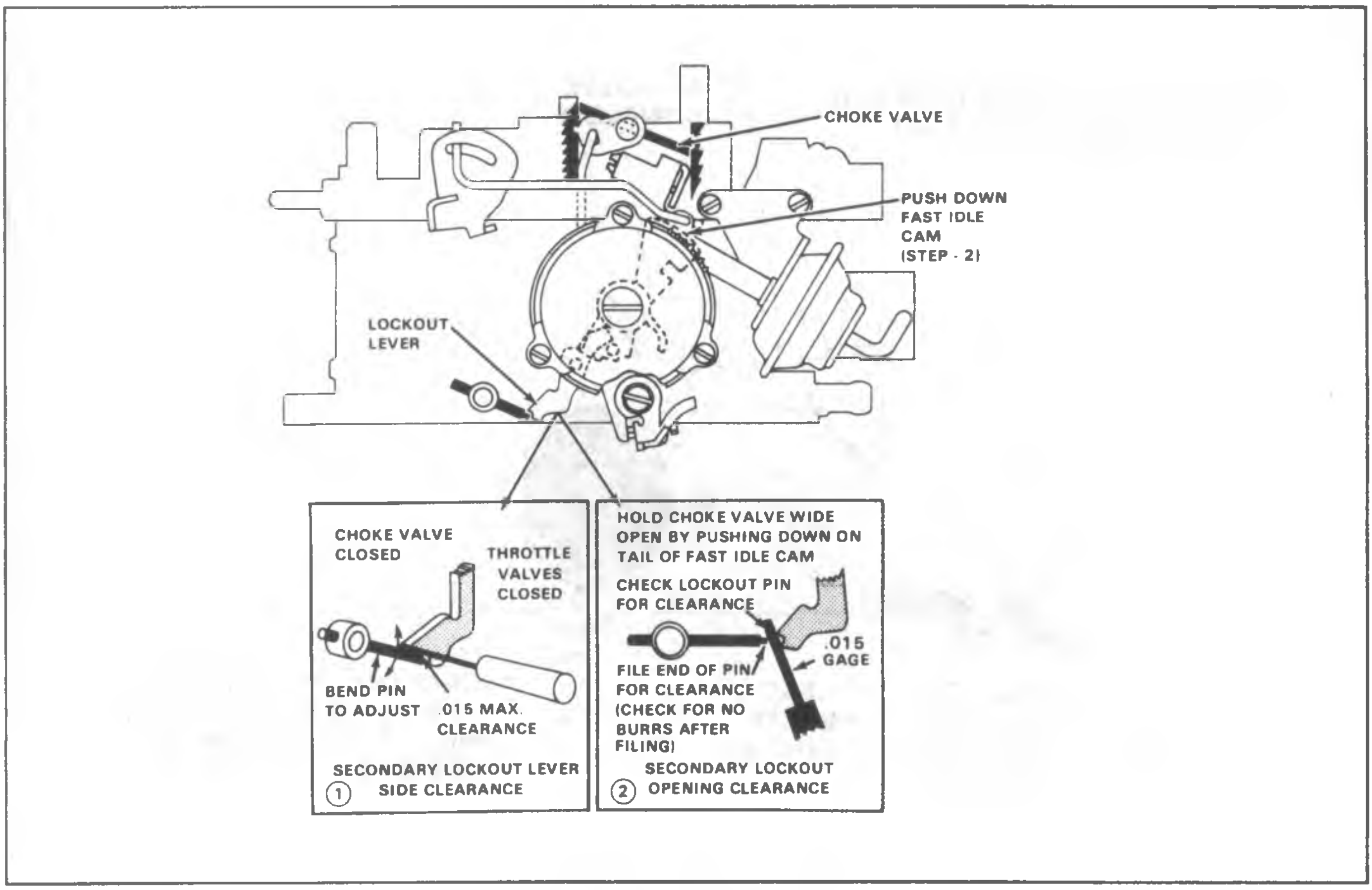


Fig. 6C10-43--Secondary Lockout Adjustment

SPECIAL TOOLS

Digital Multimeter	J-34029/BT-345
Carburetor Gage Set	J-9789-C/BT-3005-A
Float Level T - Scale	J-9789-90/BT-8037
Bending Tool	J-9789-111/BT-3007
Carburetor Stand	J-9789-118/BT-30-15
Carburetor Float Level Gage	J-9789-130/BT-7720
Carburetor Choke Angle Gage	J-26701-A/BT-7704
Choke Lever Installing Tool	J-23417/BT-6911
Idle Mixture Socket	J-29030-B/BT-7610B
Hand Vacuum Device	J-23738/BT-7517
Mixture Control Adjustment Set	J-28696-B/BT-7928
Rich/Lean Mixture Screw Adjust	J-28696-10/BT-2967 and BT-7928
Pump Lever Pin Punch	J-25322/BT-7523
Needle Valve Seat Remover Installer	J-22769/BT-3006M
Rich Mixture Screw Remover Installer	J-28696-4/BT-7967 and BT-7928
Propane Enrichment Device	J-26911/BT-7816
Fuel Inlet Nut Wrench	J-23443
Remote Control Carburetor Adjustment Wrench	J-22646-02/BT-3555

MODEL M4MC/M4ME CARBURETOR ADJUSTMENT SPECIFICATIONS												
CARBU-RETOR PART NO.	FLOAT LEVEL mm (Inches) ± 1/16"	PUMP ROD SETTING mm (Inches)	PUMP ROD LOCA-TION	AIR VALVE SPRING (Turns)	CHOKE COIL LEVER	FAST IDLE CAM (CHOKE ROD) ± 2.5°	VACUUM BREAK FRONT ± 2.5°	VACUUM BREAK REAR ± 3.5°	AIR VALVE ROD mm (Inches)	UN-LOAD-ER ± 4°	PROPANE ENRICH-MENT SPEED
17080212	9.5 (3/8)	7.0 (9/32)	INNER	3/4	.120	46°	24°	30°	0.6 (.025)	40°	—
17080213	9.5 (3/8)	7.0 (9/32)	INNER	1	.120	37°	23°	30°	0.6 (.025)	40°	—
17080298	9.5 (3/8)	7.0 (9/32)	INNER	1	.120	37°	23°	30°	0.6 (.025)	40°	—
17082213	9.5 (3/8)	7.0 (9/32)	INNER	1	.120	37°	23°	30°	0.6 (.025)	40°	—
17083298	9.5 (3/8)	7.0 (9/32)	INNER	1	.120	37°	23°	30°	0.6 (.025)	40°	—
17084200	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	
17084206	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	20
17084211	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	
17084220	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	80
17084221	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	80
17084226	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17084227	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17084228	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	80
17084229	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	80
17084230	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	20
17084231	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	40
17084234	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	20
17084235	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	80
17084290	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17084291	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	100
17084292	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17084293	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	100
17084294	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	30
17084298	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	30
17084500	9.5 (3/8)	7.0 (9/32)	INNER	1	.120	37°	23°	30°	0.6 (.025)	40°	—
17084501	9.5 (3/8)	7.0 (9/32)	INNER	1	.120	37°	23°	30°	0.6 (.025)	40°	—
17084502	9.5 (3/8)	7.0 (9/32)	INNER	7/8	.120	46°	24°	30°	0.6 (.025)	40°	—

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SECTION 6D

ENGINE ELECTRICAL

CONTENTS

ELECTRICAL SYSTEM GENERAL DIAGNOSIS. 6D-1
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For vehicles sold in Canada and equipped with non-closed loop engines, also refer to the appropriate Canadian Service Manual Supplement.

ELECTRIC CHOKE HEATER-OIL PRESSURE SWITCH

All carbureted gasoline engines without gage instrumentation have a two terminal oil pressure switch to control current to the electric choke heater. This switch also provides for the illumination of the "Oil" or "Check Engine" indicator lamp. On vehicles with gages, a choke heater relay is used to control current to the choke heater and provide for the illumination of the "Choke" warning indicator. Refer to the Body and Chassis Electrical Wiring Diagram for choke heater and associated indicator lamp circuitry.

ELECTRIC CHOKE HEATER CHECKING PROCEDURE

1. Allow choke to cool so that when throttle is opened slightly, choke blade fully closes.

   This check must be performed with engine not running and at an ambient temperature of 60°C to 27°C, (140°F to 80°F).
2. Start engine and determine time for choke blade to reach full open position. (Start timer when engine starts).
3. If the choke blade fails to open fully within 3.5 minutes, proceed with steps 4-5-6 below.
4. Check voltage at the choke heater connection. (Engine must be running). If the voltage is approximately 12-15 volts, replace the electrical choke unit.
5. If the voltage is low or zero, check all wires and connections. No gasket is used between the choke cover and the choke housing because of grounding requirements. If any connections in the oil pressure switch circuitry are faulty or if the oil pressure switch is failed open, the oil warning light will be on with the engine running. Repair wires or connections as required.
6. If all wiring and connections are good, replace oil pressure switch.

CHECK ENGINE LIGHT

The instrument panel "Check Engine" light is an integral part of the Computer Command Control System. Refer to the Emissions Section for a detailed description of its operation and use, as a diagnostic indicator.

GENERAL ELECTRICAL SYSTEM DIAGNOSIS

Engine electrical system diagnosis includes the battery, ignition (primary and secondary) starter (and related wiring) and the generator (and related wiring). The following diagnosis charts will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that components section of the service manual.

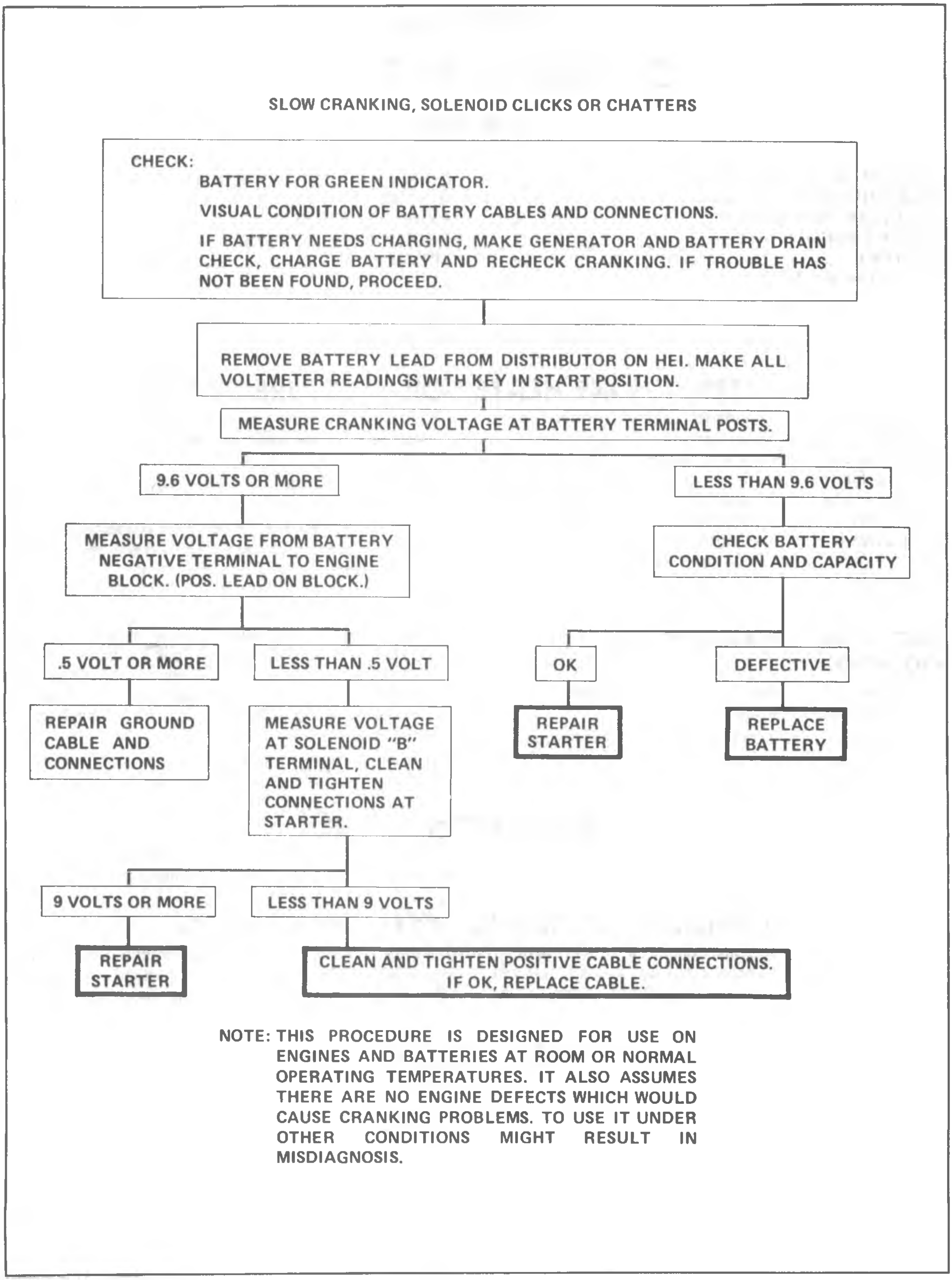

Fig. 6D-1--General Electrical System Diagnosis 1 of 2

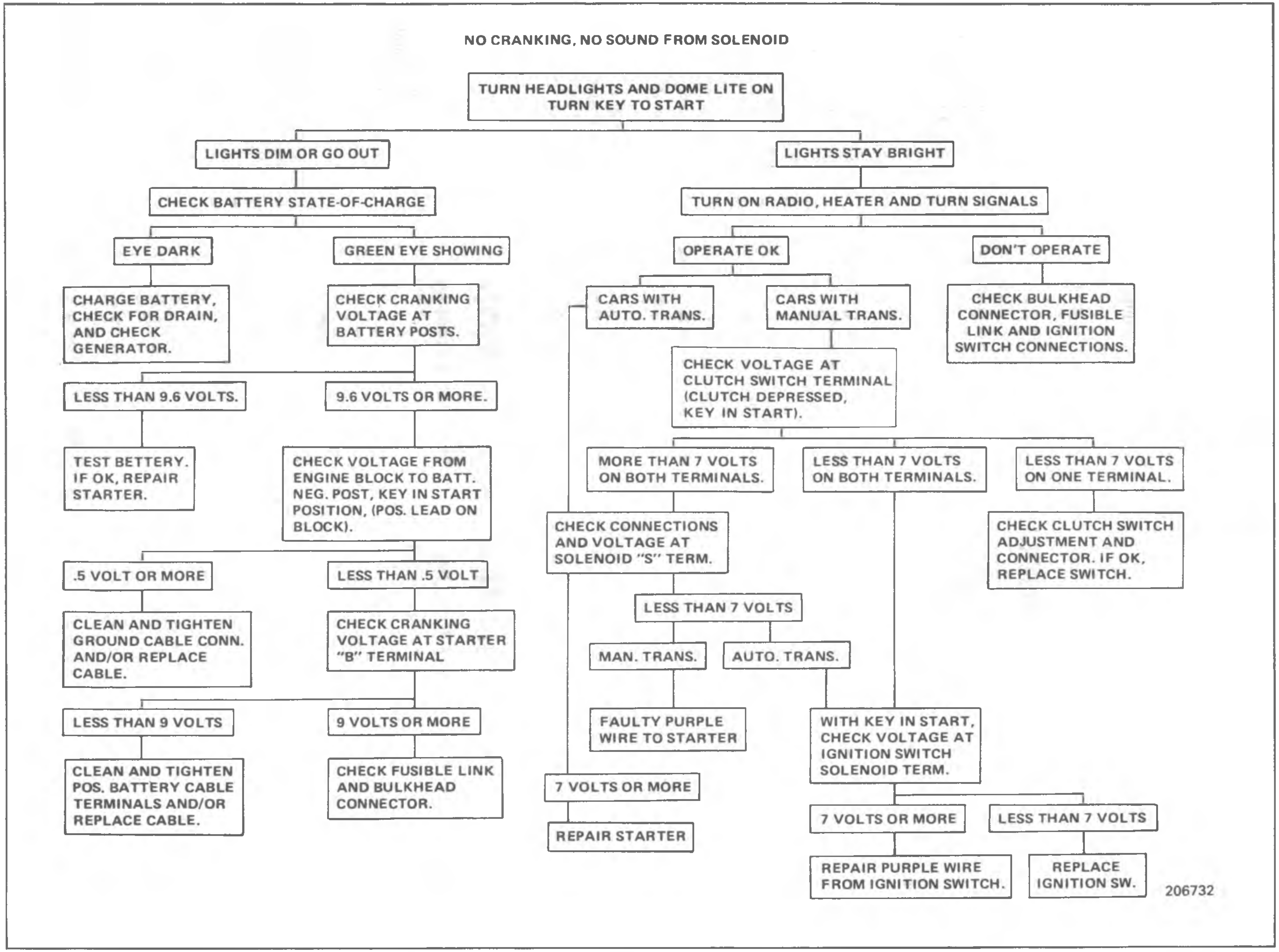

Fig. 6D-2--General Electrical System Diagnosis 2 of 2

BATTERY

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GENERAL DESCRIPTION

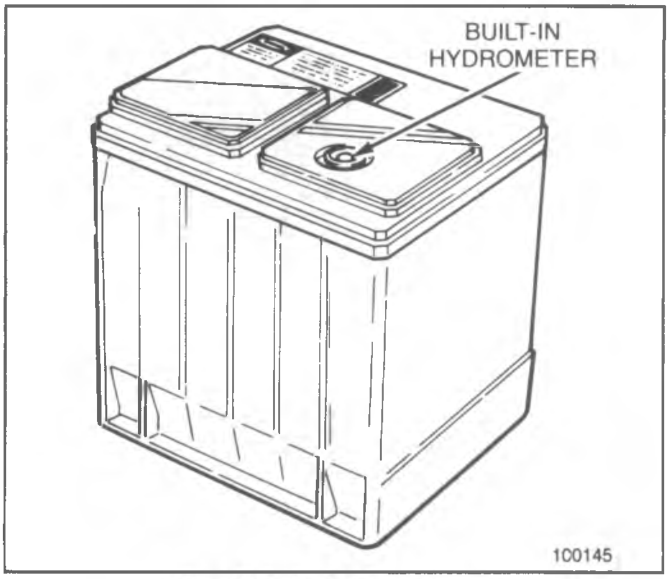


Fig. 6D-3--Sealed Top Battery

The sealed battery (see Fig. 6D-3) is standard on all vehicles (see Specifications). There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the side. These vent holes allow the small amount of gas produced in the battery to escape. The battery has the following advantages over conventional batteries:

1. No water addition for the life of the battery.
2. Overcharge protection. If too high a level voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery leading to gassing, which causes liquid loss.
3. Not as liable to self-discharge as compared to a conventional battery. This is particularly important when a battery is left standing for long periods of time.
4. More power available in a lighter and smaller case.

The battery has three major functions in the electrical system.

First, it is a source of electrical energy for cranking the engine. Second it acts as a voltage stabilizer for the electrical system. And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

GENERAL INFORMATION

COMMON CAUSES OF FAILURE

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service. If the battery tests good but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Accessories left on overnight .
2. Slow average driving speeds for short periods.
3. The vehicle electrical load is more than the generator output particularly with the addition of after market equipment.
4. Defects in the charging system such as electrical shorts, slipping fan belt, faulty generator or voltage regulator.
5. Battery abuse, including failure to keep the battery cable terminals clean and tight or loose battery hold down. See On-Vehicle Service for torque specifications.
6. Mechanical problems in the electrical system such as shorted or pinched wires.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in charged condition.

Carrier and Hold-Down

The battery carrier and hold-down clamp should be clean and free from corrosion before installing the battery. The carrier should be in a sound condition so that it will support the battery securely and keep it level.

Make certain there are no parts in carrier before installing the battery.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight but not over tightened.

Visual Inspection

The external condition of the battery should be checked periodically for damage such as cracked cover or case.

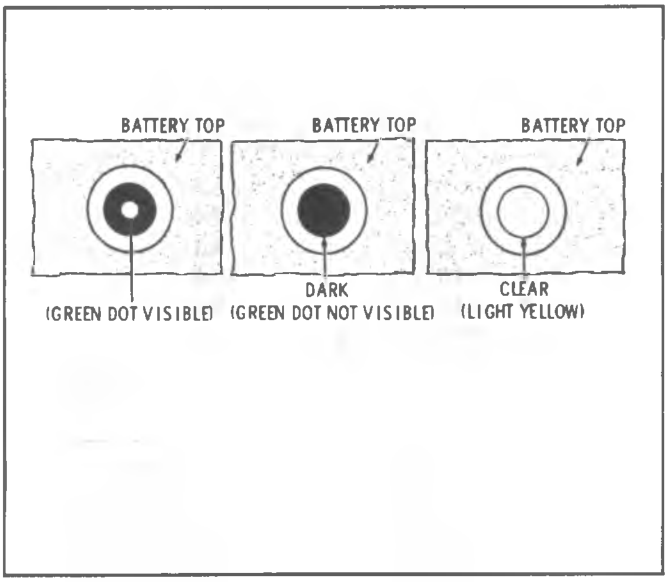


Fig. 6D-4--Built-In Hydrometer

RATINGS

A battery has two ratings: (1) a reserve capacity rating at 27°C (80°F) which is the time a fully charged battery will operate the car with no generator operation, (2) a cold crank rating at -18°C (0°F) which indicates the cranking load capacity. (See Specifications for specific battery ratings).

Built-In Hydrometer

The sealed battery has a built-in temperature compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure. When observing the hydrometer, make sure that the battery has a clean top. A light may be needed in some poorly-lit areas.

Under normal operation, two indications can be seen (see Figure 6D-4):

1. GREEN DOT VISIBLE

Any green appearance is interpreted as a "green dot" and the battery is ready for testing.

2. DARK; GREEN DOT NOT VISIBLE

If there is a cranking complaint, the battery should be tested as described in the Diagnosis section. The charging and electrical systems should also be checked at this time.

Occasionally, a third condition may appear:

3. CLEAR OR LIGHT YELLOW

This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping or normal battery wearout. When finding a battery in this condition, it may indicate high charging voltage caused by a faulty charging system and therefore, the charging and electrical system may need to be checked. If a cranking complaint exists and is caused by the battery, it should be replaced.

DIAGNOSIS

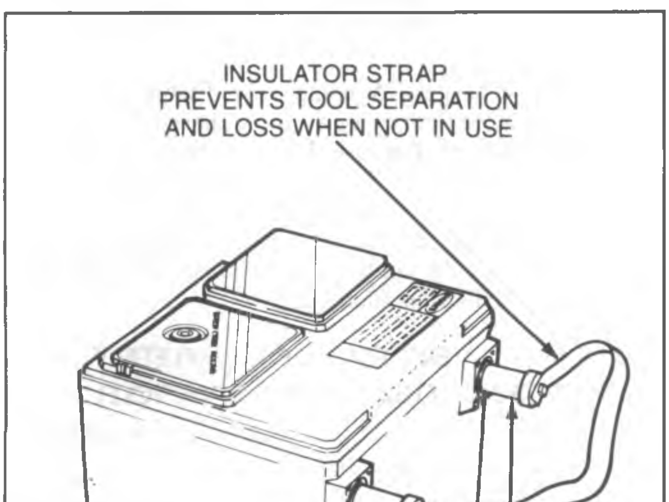


Fig. 6D-5--Side Terminal Battery Adapters

The following procedure should be used for testing batteries:

1. VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace the battery. Determine cause of damage and correct as needed. If not, proceed to step 2.

2. HYDROMETER CHECK (Fig. 6D-4)

a. GREEN DOT VISIBLE
   - go to step 3.

b. DARK; GREEN DOT NOT VISIBLE.

Charge the battery as outlined under Charging Procedure section and proceed to Step 3.

3. LOAD TEST

Load testing may require use of battery side terminal adapters to insure good connections (see Fig. 6D-5). On diesel engine vehicles, disconnect and test each battery separately.

a. Connect a voltmeter and a battery load tester across the battery terminals.

b. Apply 300 ampere load for 15 seconds to remove surface charge from the battery. Remove load.

c. Wait 15 seconds to let battery recover and apply specified load from load test chart (See Specific Vehicle subsection). Read voltage after 15 seconds, then remove load.

d. If voltage does not drop below the minimum listed

Battery	Test Load (Amps)
1099	150
1103	200
1105	250
1106	270
1110	190

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
70° F. (21° C.)	9.6
50° F. (10° C.)	9.4
30° F. (0° C.)	9.1
15° F. (−10° C.)	8.8
0° F. (−18° C.)	8.5
0° F. (BELOW: −18° C.)	8.0

6733

Fig. 6D-6--Temperature vs. Voltage Drop

in Fig. 6D-7, the battery is good and should be returned to service. Temperature of the battery will change the minimum voltage to pass the load test. See Figure 6D-6 and estimate the temperature the battery has been exposed to for the last several hours.

ON-CAR SERVICE

BATTERY CHARGING

When it is necessary to charge the battery, the following safety precautions must be followed:

1. DO NOT CHARGE battery if hydrometer is clear or light yellow. Replace battery.
2. If the battery feels hot 52°C (125°F) or if violent gassing or spewing of electrolyte through the vent hole occurs, discontinue charging or reduce charging rate.

CHARGING PROCEDURE

1. Batteries with green dot showing do not require charging unless they have just been discharged (such as in cranking vehicle).
2. When charging sealed-terminal batteries out of vehicle, install adapter kit ST-1201 or 1846855 or equivalent). (Refer to Figure 6D-5). Post-type batteries need no adapters.
3. Make sure all charger connections are clean and tight.
4. For best results, batteries should be charged while electrolyte and plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting charger.
5. Charge battery until green dot appears (See Charging Time Required). Battery should be checked every half-hour while charging. Tipping or shaking battery may be necessary to make green dot appear.
6. After charging, battery should be tested as outlined in BATTERY TESTING.

Charging Time Required:

The time required to charge a battery will vary dependent upon the following factors:

- Size of Battery - A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- Temperature - A longer time will be needed to charge any battery at 0°F than at 80°F. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, then in time the battery will accept a higher rate as the battery warms.
- Charger Capacity - A charger which can supply only five amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.
- State-Of-Charge - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

CHARGING A VERY FLAT OR COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

The following procedure should be used to recharge a very flat or completely discharged battery:

Unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at battery terminals with an accurate voltmeter. If below 10 volts, then the charge current will be very low and it could take some time before it accepts a current in excess of a few milliamperes. Such low current may not be detectable on ammeters available in the field.
2. Set battery charger on high setting.
3. Some chargers feature polarity protection circuitry which prevents charging unless the charger leads are connected to the battery terminals correctly. A

completely discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction telling how to bypass or override the circuitry so that the charger will turn on and charge a low-voltage battery.

4. Battery chargers vary in the amount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows:

- VOLTAGE

A. 16.0 or more -- Up to 4 hours
B. 14.0 - 15.9 -- Up to 8 hours
C. 13.9 or less -- Up to 16 hours

If the charge current is still not measurable at the end of the above charging times, the battery should be replaced.

If the charge current is measurable during the charging time, the battery is considered to be good and charging should be completed in the normal manner.

5. It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a useable state. As a general rule of thumb, using the reserve capacity rating (RC) (refer to specifications) of the battery as the number of ampere hours of charge which will usually bring the green dot into view. For example, if battery is rated at 75 RC minutes, it would be completely recharged as follows:

- 10 ampere charge x 7-1/2 hours ....75 AH or
- 25 ampere charge x 3 hours ....75 AH, etc.

6. It is recommended that any battery recharged by this procedure be LOAD TESTED to establish serviceability.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

NOTICE: Do not push or tow the vehicle to start. Damage to the emission system and/or to other parts of the vehicle may result.

NOTICE: Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

CAUTION: Departure from these conditions or the procedure below could result in: (1) Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or (2) damage to electronic components of either vehicle.

CAUTION: Never expose battery to open flame or electric spark-batteries generate a gas which is flammable and explosive.

CAUTION: Remove rings, watches, and other jewelry. Wear approved eye protection.

CAUTION: Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) and any other metal on the car, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place automatic transmission in "PARK" (NEUTRAL for manual transmission.) Turn off the ignition, turn off lights and all other electrical loads.
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery.

   NOTICE: When jump starting a diesel engine vehicle with charging equipment, be sure equipment used is 12-volt and negative ground. Do not use 24-volt charging equipment. Using such equipment can cause serious damage to the electrical system or electronic parts.
3. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure. (Use 12-volt battery only to jump start the engine).
4. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compressor bracket or generator mounting bracket) at least 18 inches from the battery of the vehicle being started (DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY).
5. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the car with the discharged battery.
6. Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first.

Remove and Install

1. Disconnect negative cable.
2. Disconnect positive cable.
3. Remove retainer screw and retainer.
4. Remove battery.
5. To install, reverse removal procedure.
6. Torque battery cables to 12 N·m (19 lb. ft.).

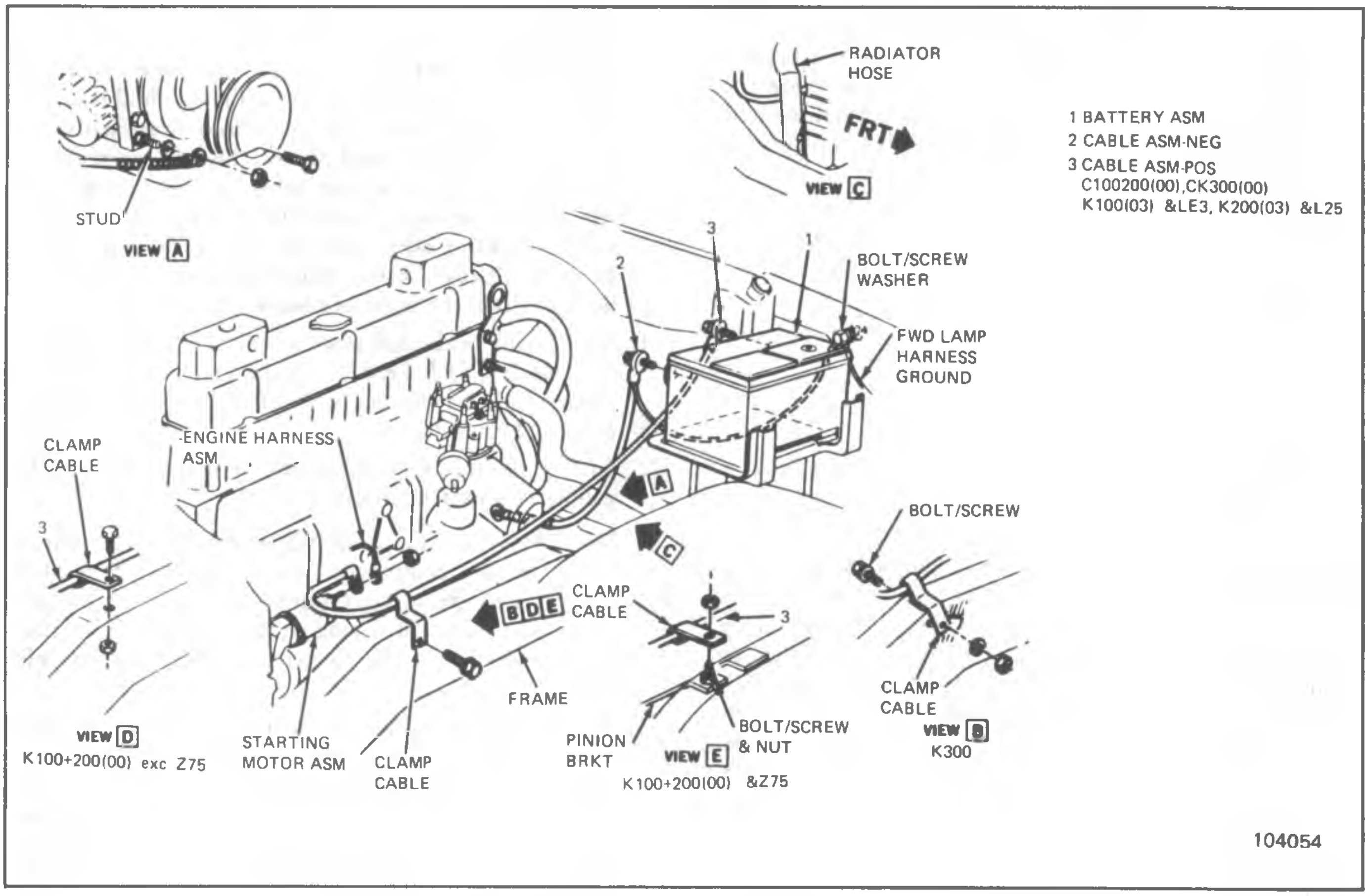


Fig. 6D-8--Battery Cables CK LE2/I25

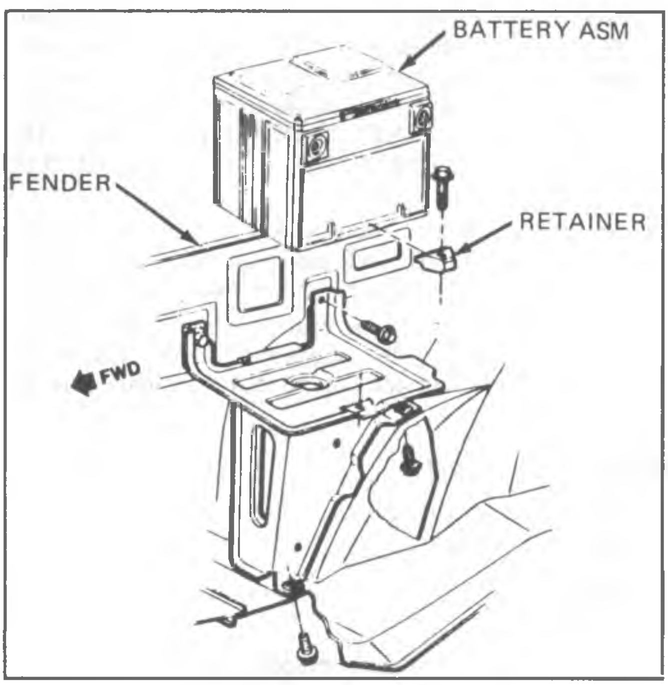


Fig. 6D-7--Battery Mounting-CK Truck

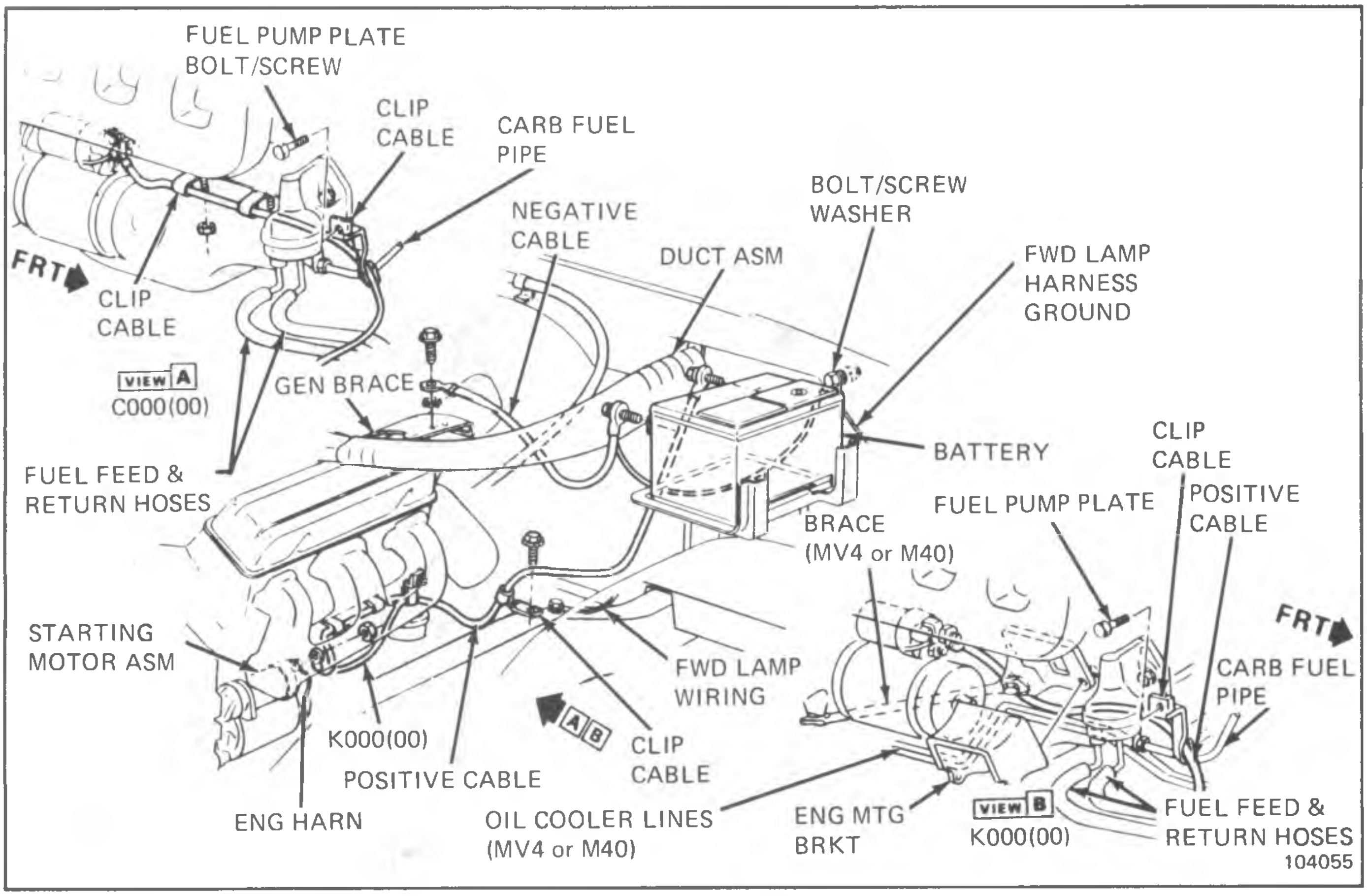


Fig. 6D-9--Battery Cables CK LE9/LF3/LF5/LS9/LT9

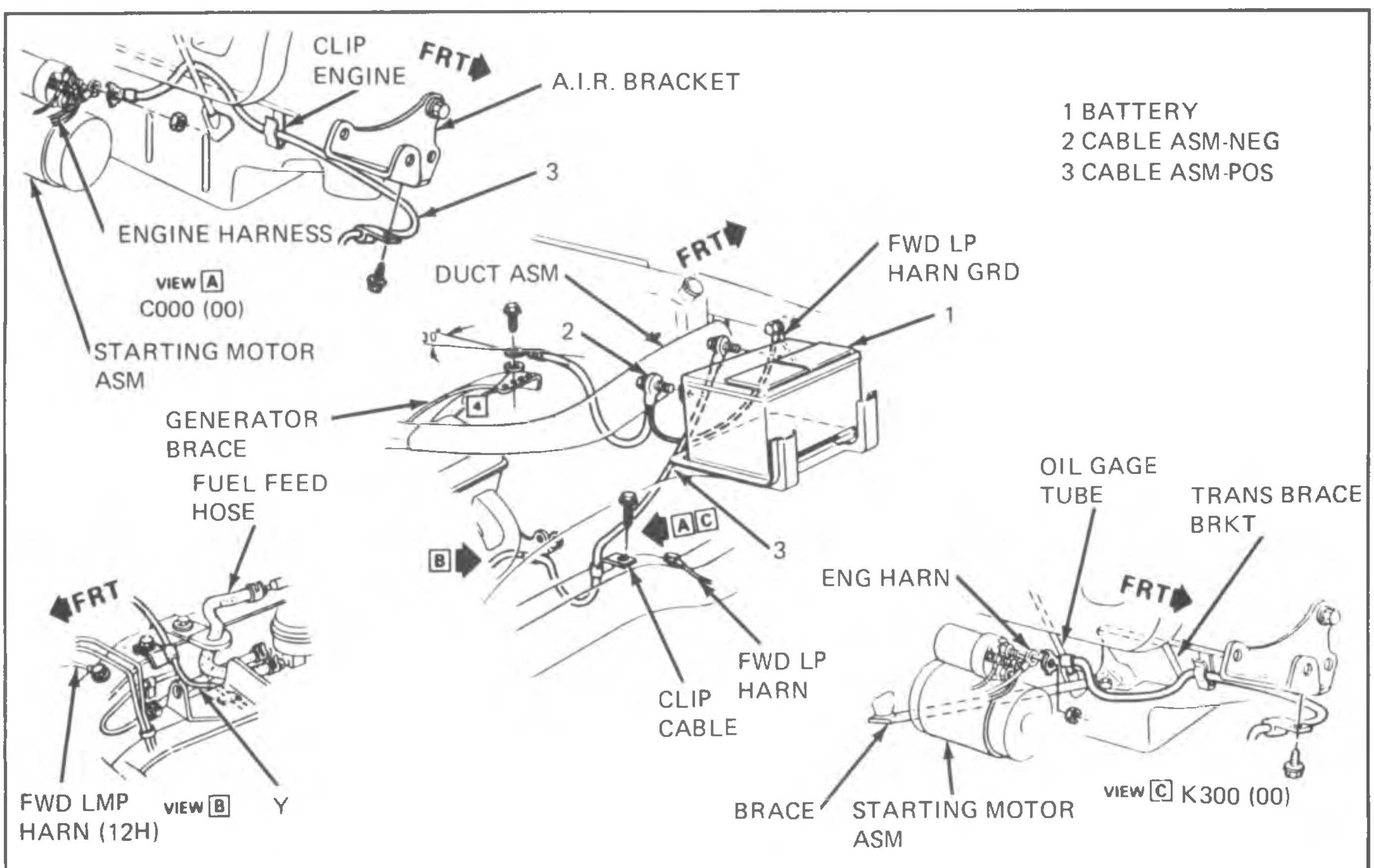


Fig. 6D-10--Battery Cables CK LE8

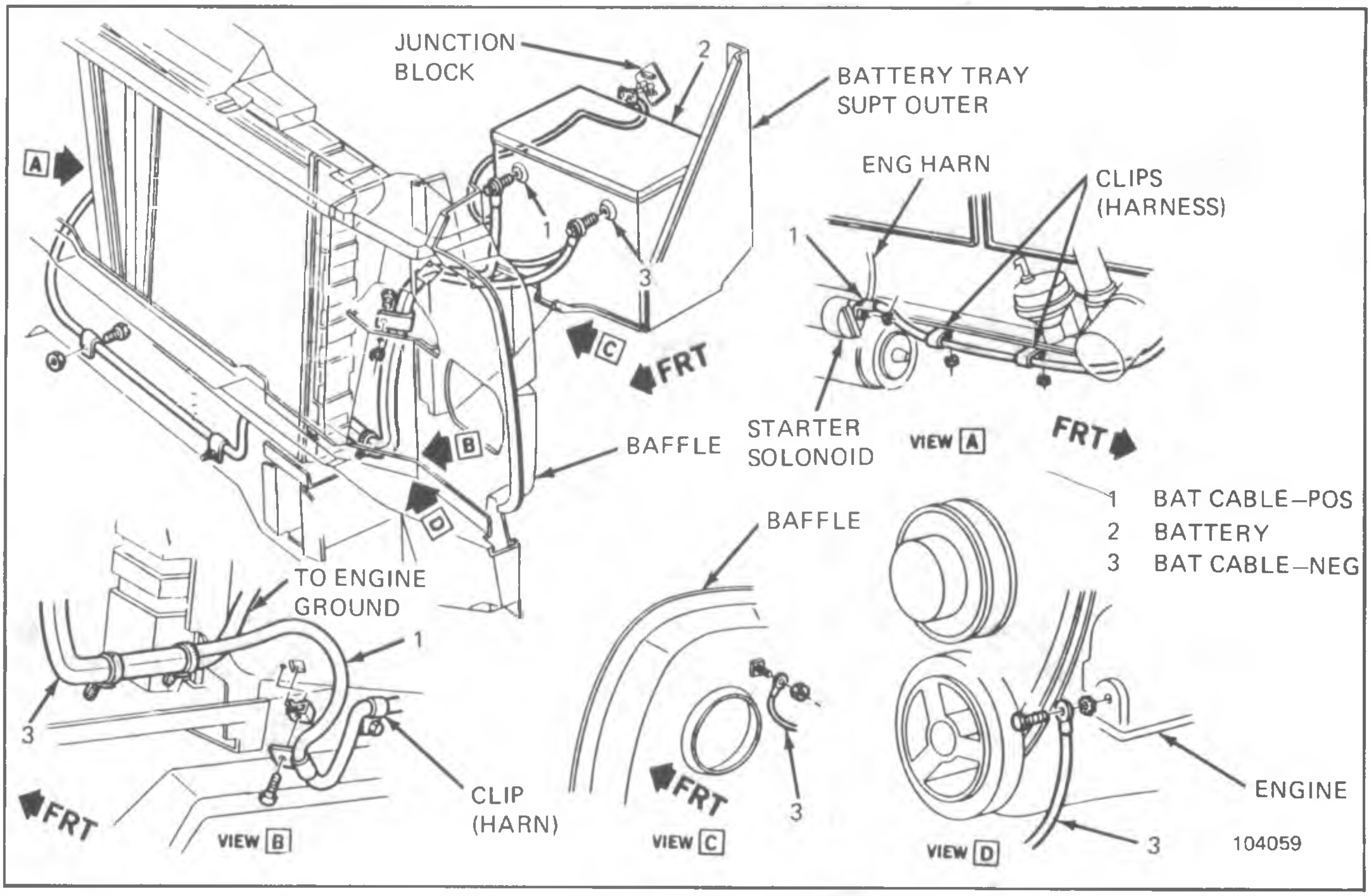


Fig. 6D-11--Battery Cables G-LE3

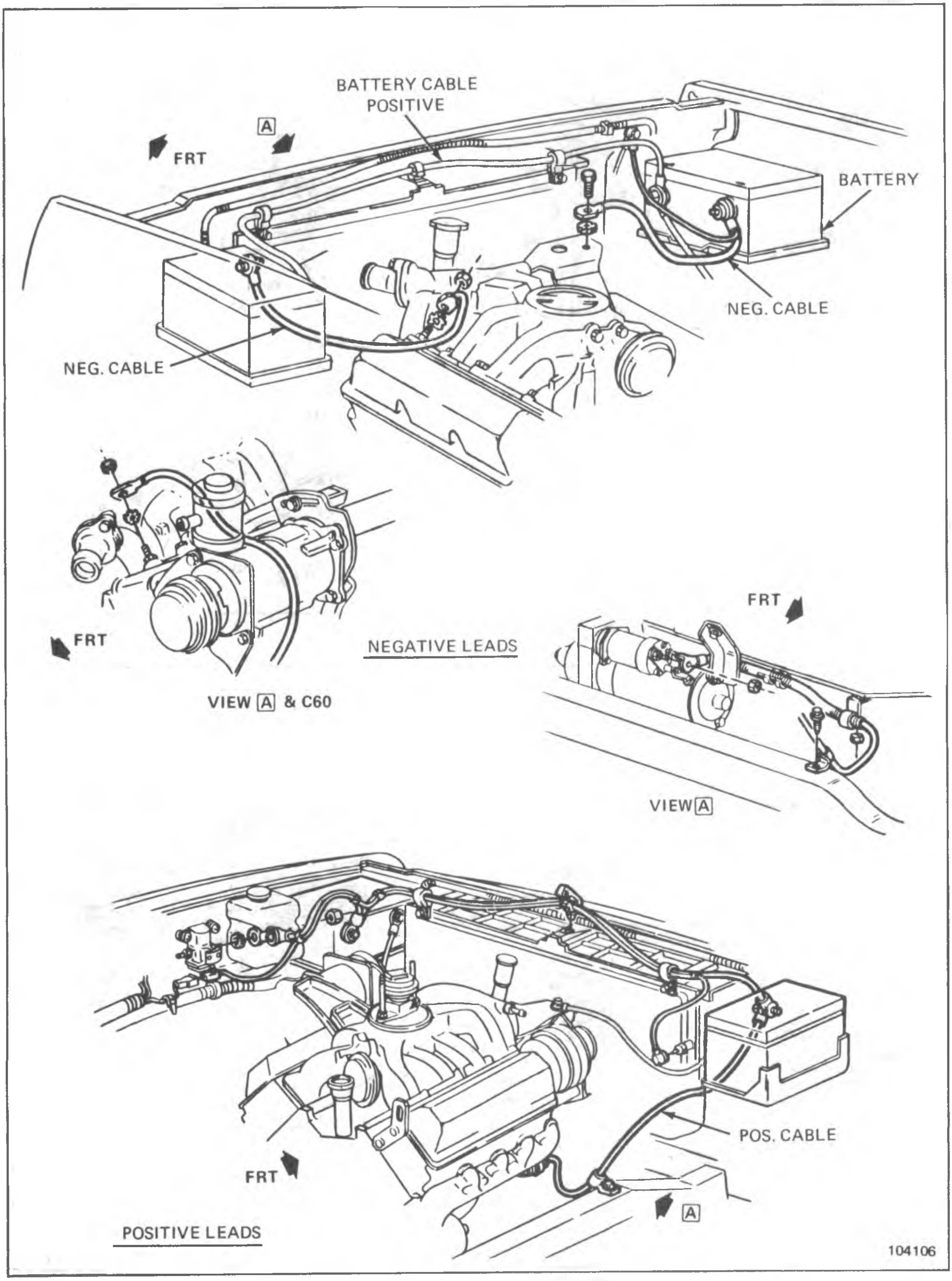


Fig. 6D-12--Battery Cables CK-Diesel Engine

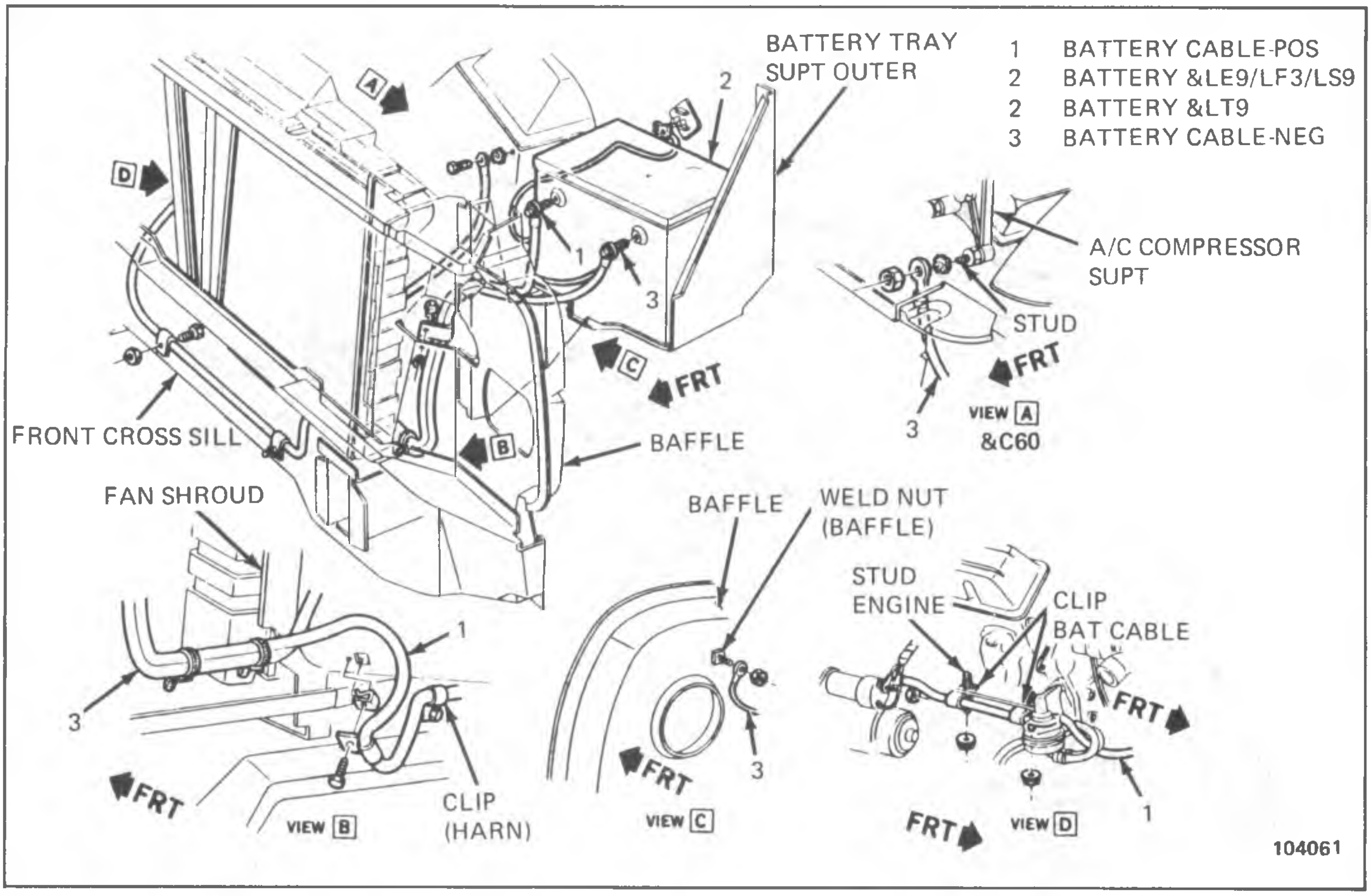


Fig. 6D-13--Battery Cables G-LE9/LF3/LS9/LT9

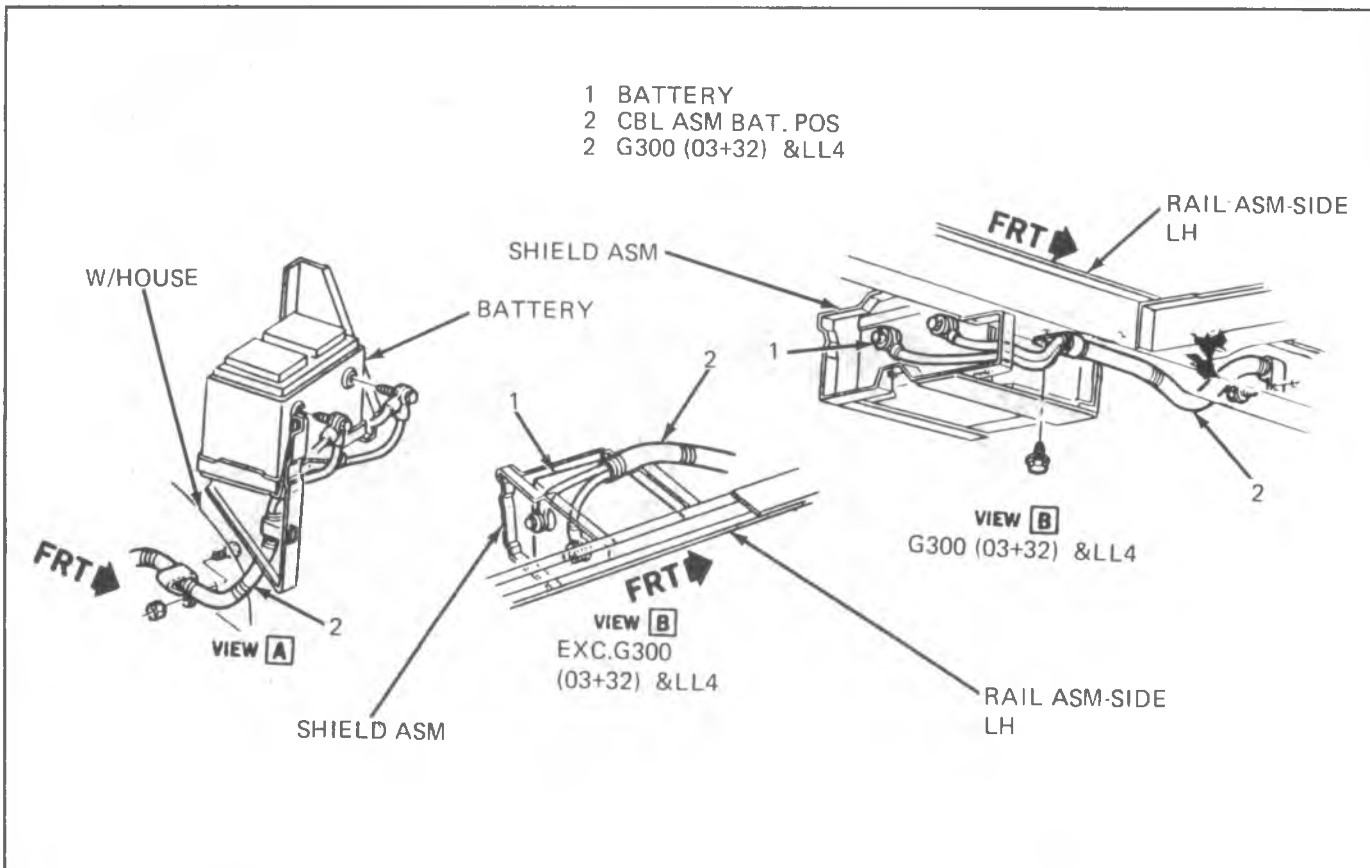


Fig. 6D-14--Battery Cables-G Diesel

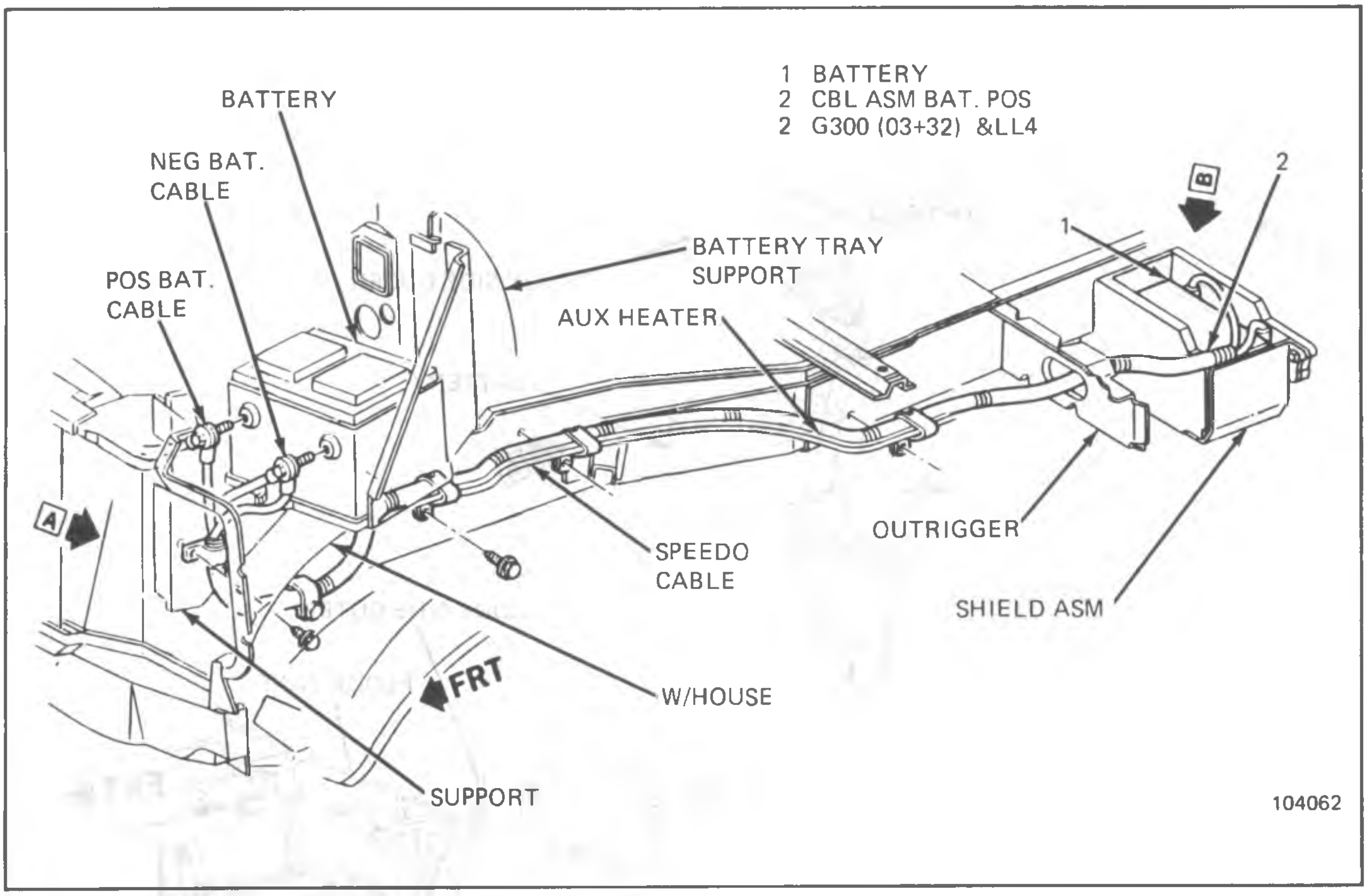


Fig. 6D-15--Battery Cables-G Diesel

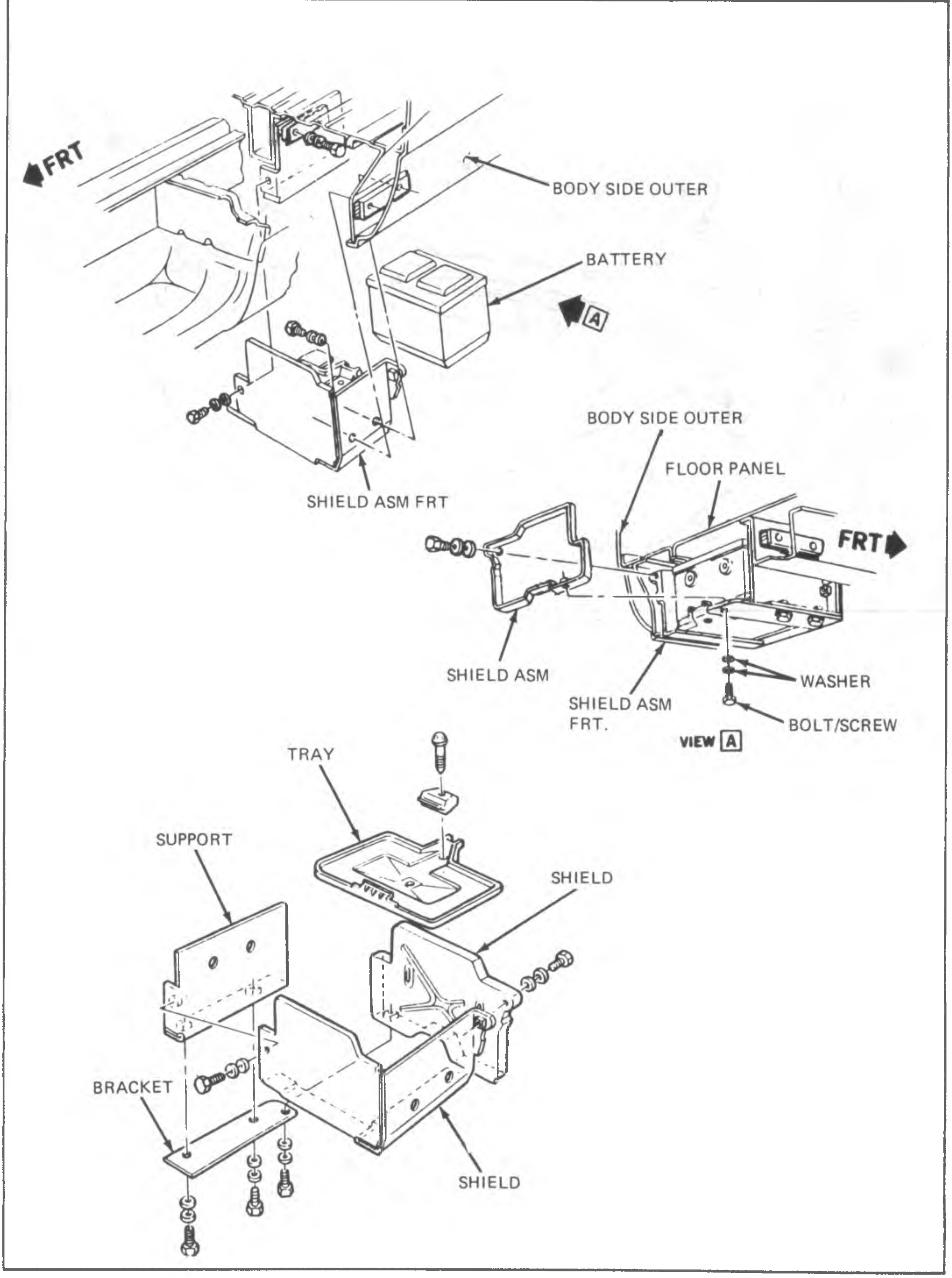


Fig. 6D-16--Buttery Mounting G

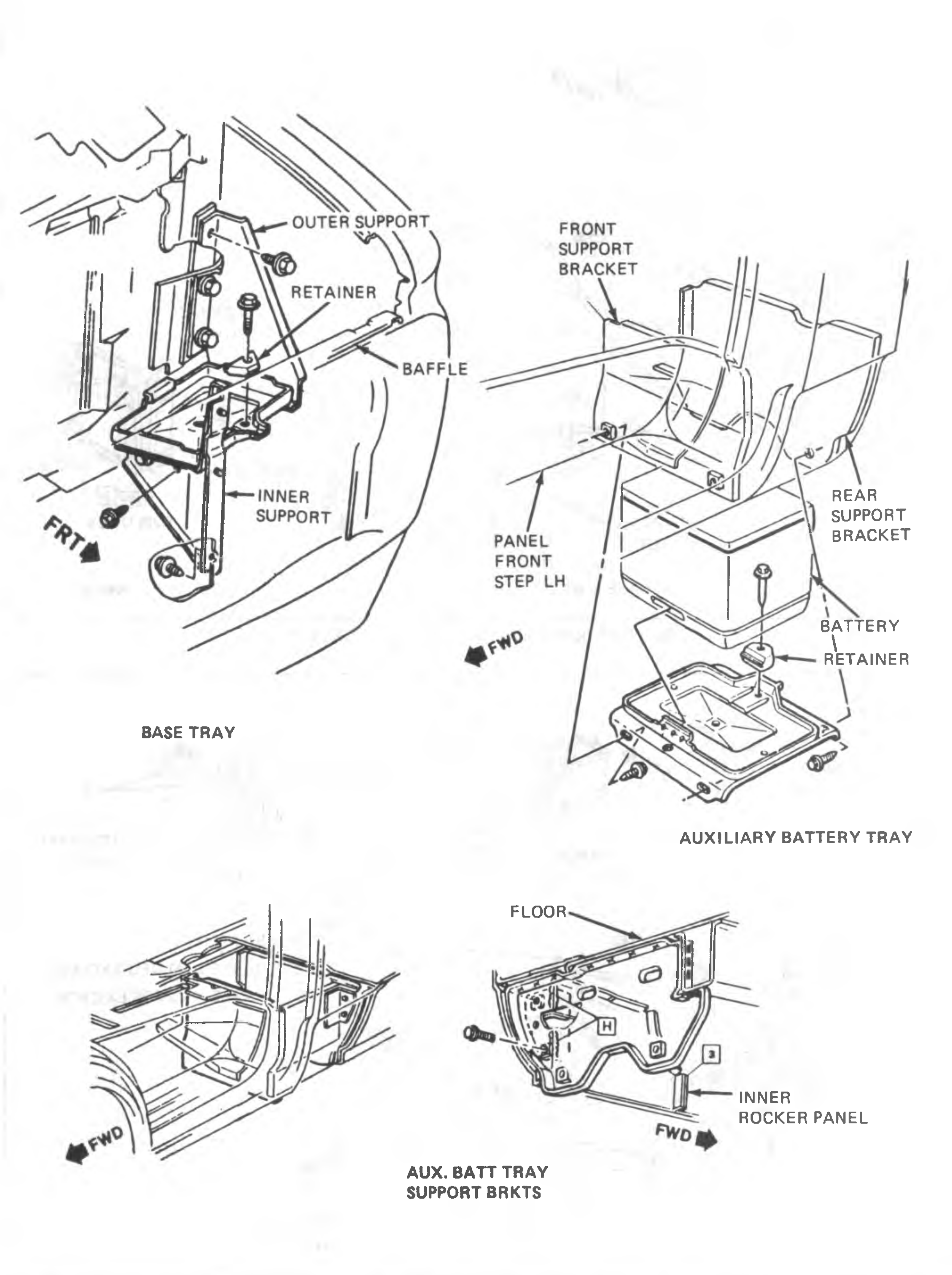


Fig. 6D-17–Battery Tray Mounting G

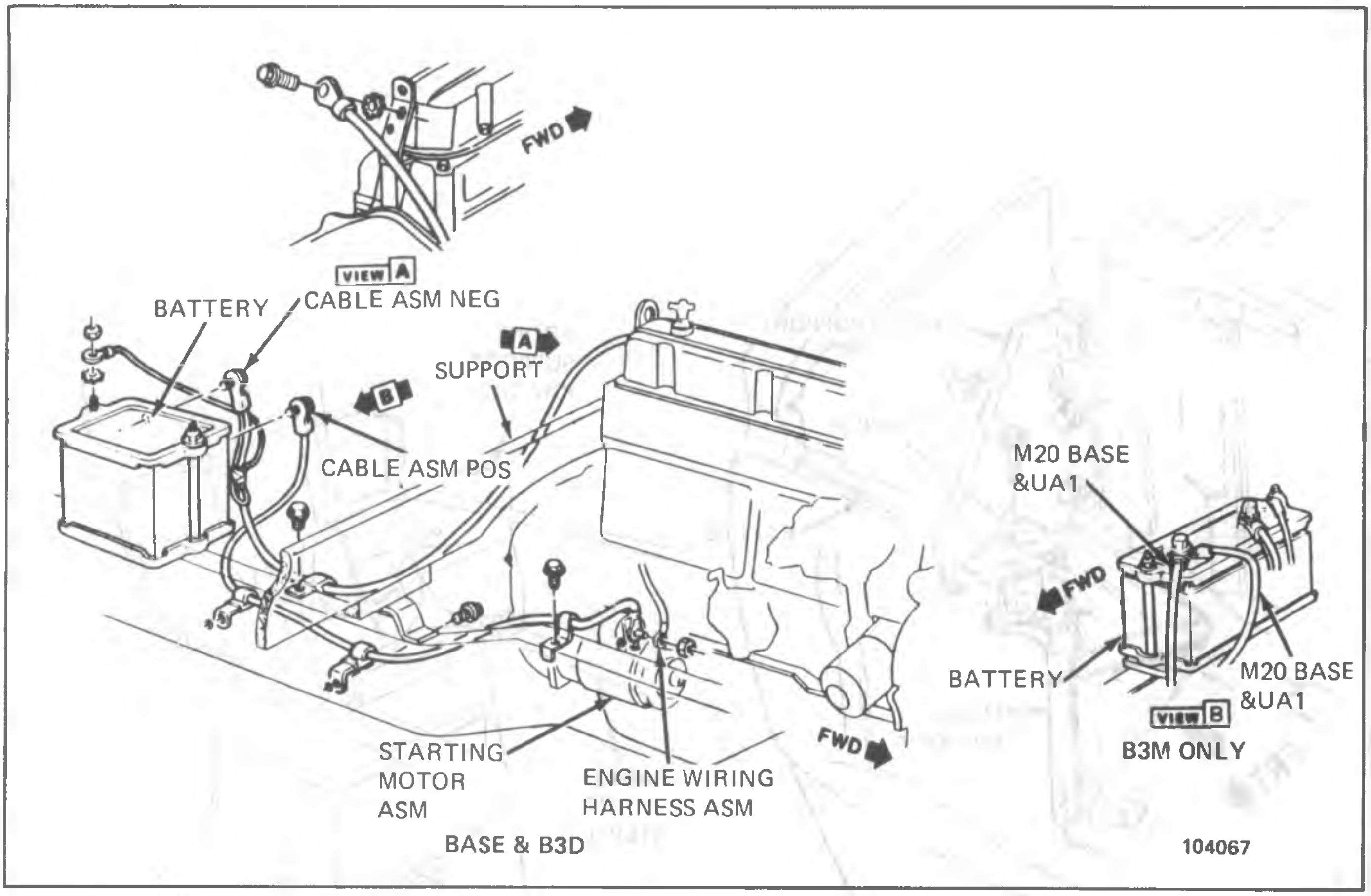


Fig. 6D-18--Battery Cables-P Series-L25, Exc E32, E33

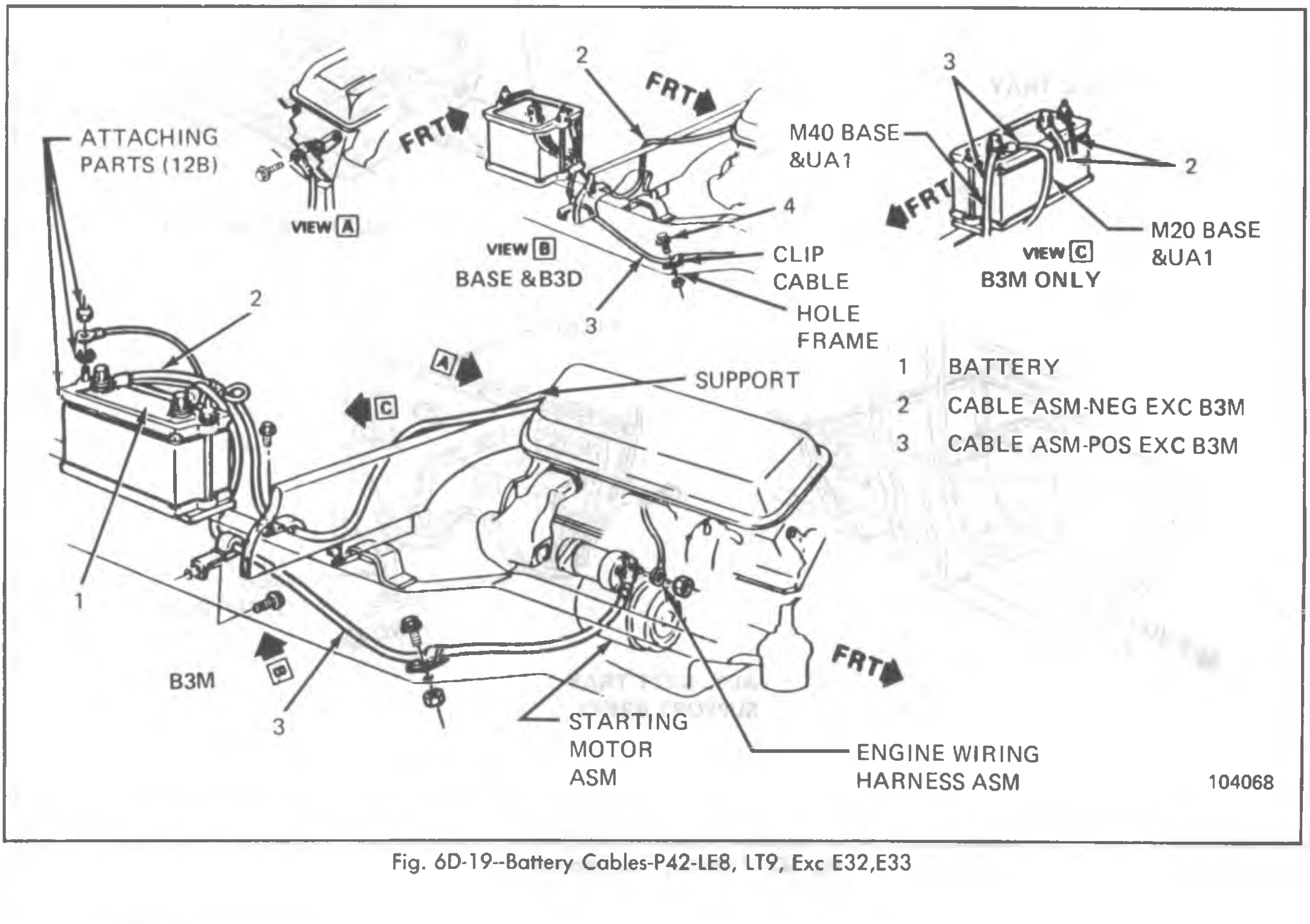


Fig. 6D-19--Battery Cables-P42-LE8, LT9, Exc E32,E33

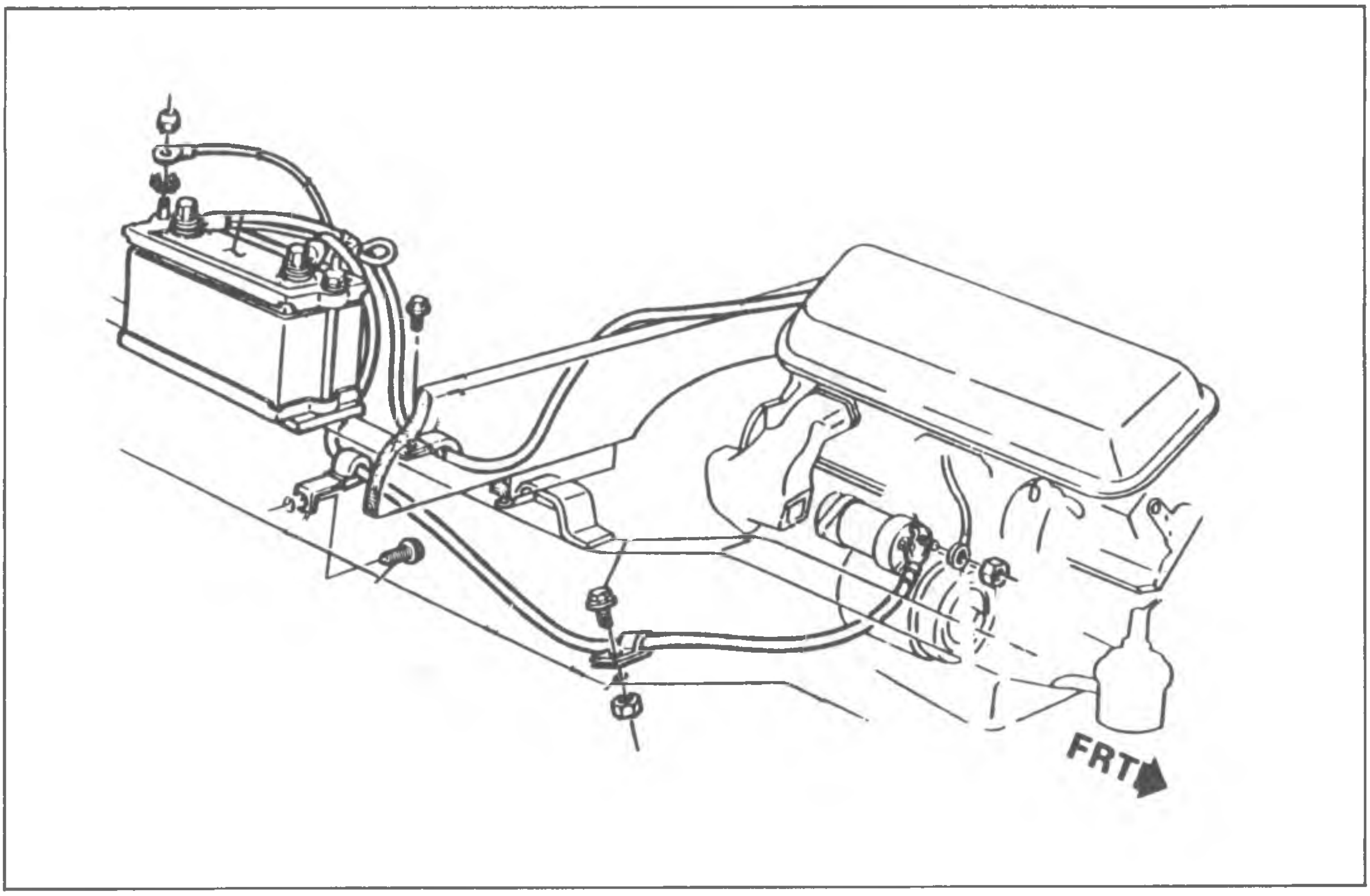
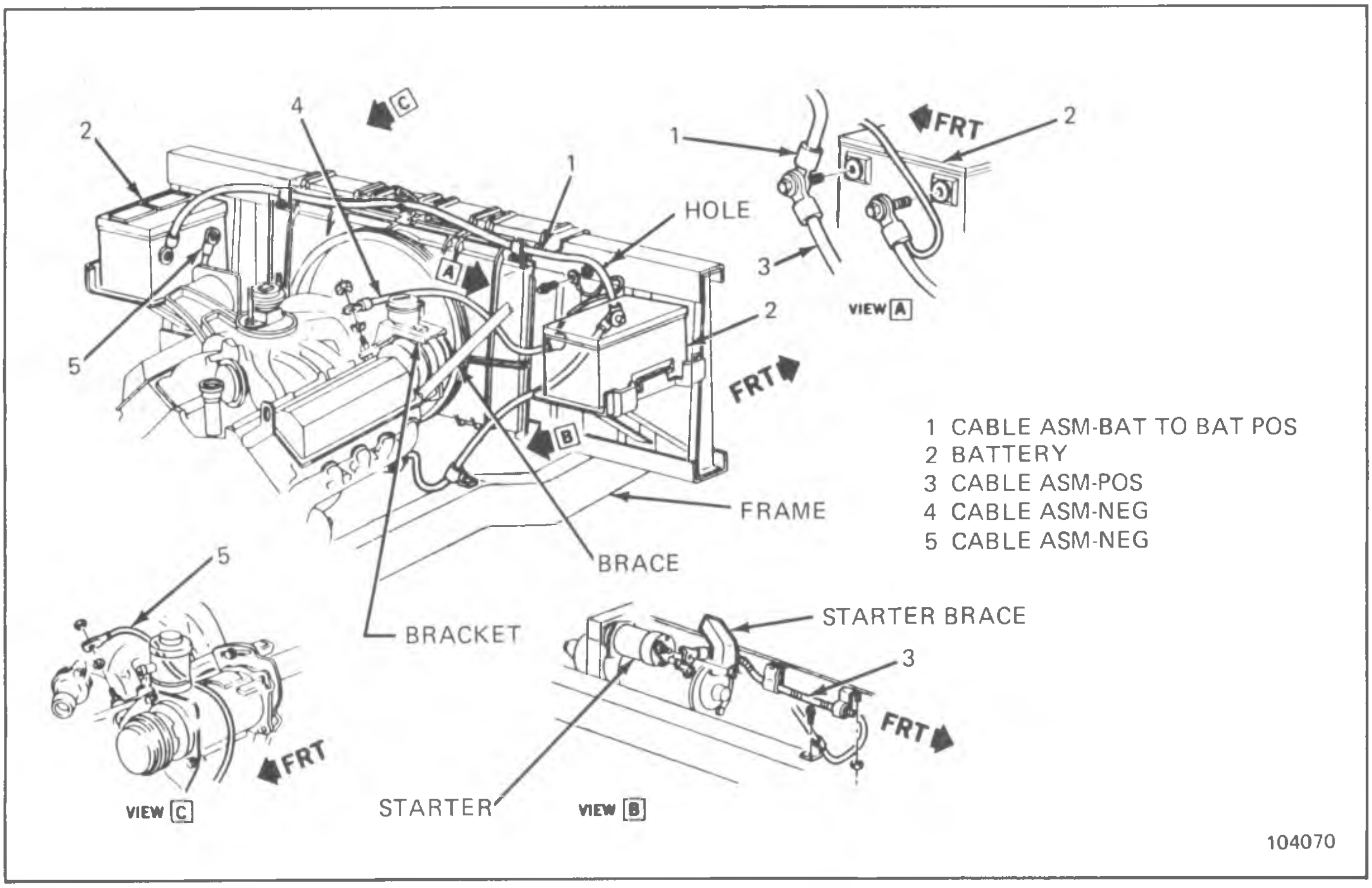


Fig. 6D-20--Battery Cables-P42-LE8, LT9 Exc E32, E33



1 CABLE ASM-BAT TO BAT POS
2 BATTERY
3 CABLE ASM-POS
4 CABLE ASM-NEG
5 CABLE ASM-NEG

Fig. 6D-21--Battery Cables-P42-LL4 and E32/E33

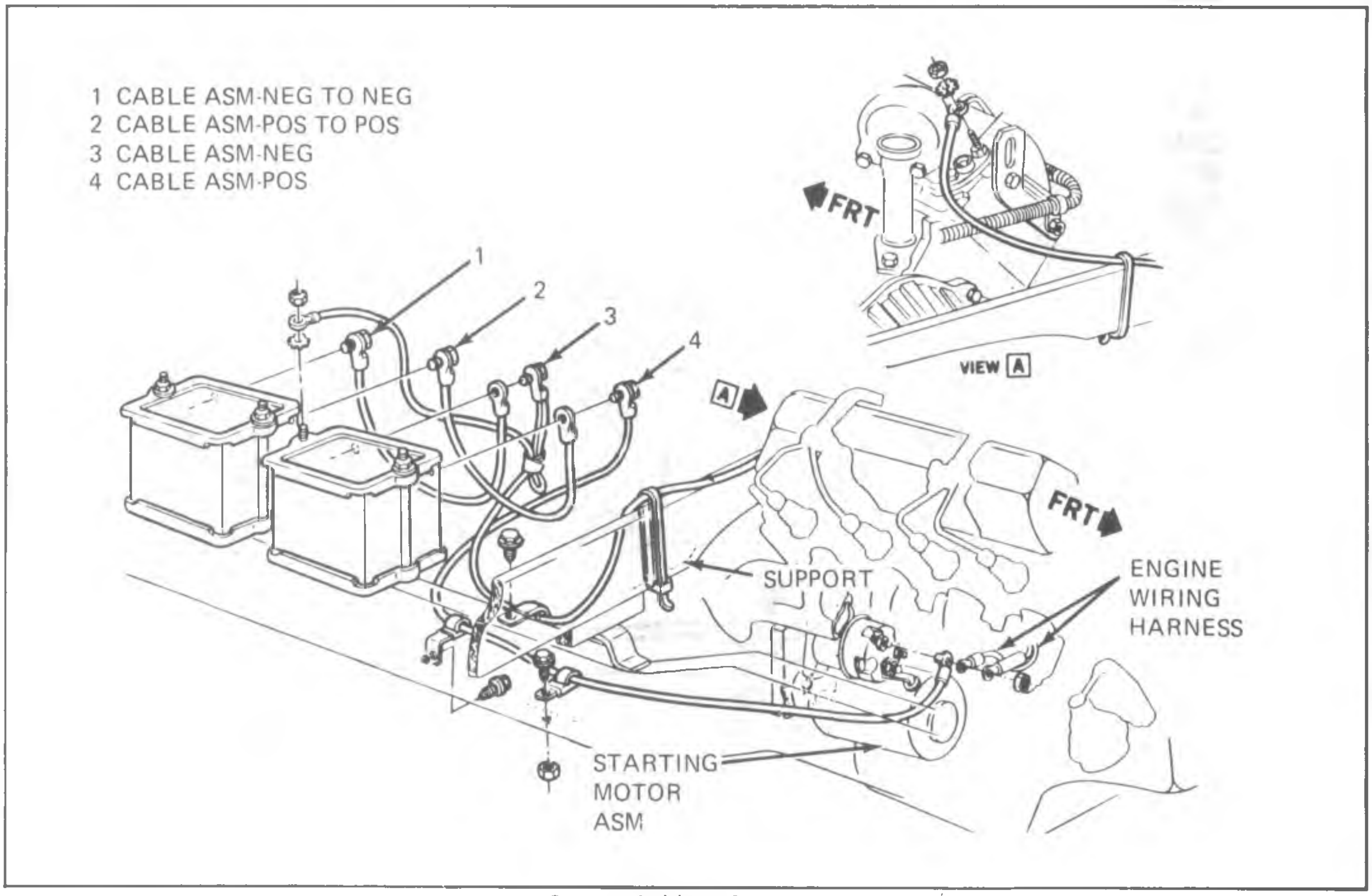


Fig. 6D-22--Battery Cables-P300-42 LL4 Exc. E32/E33

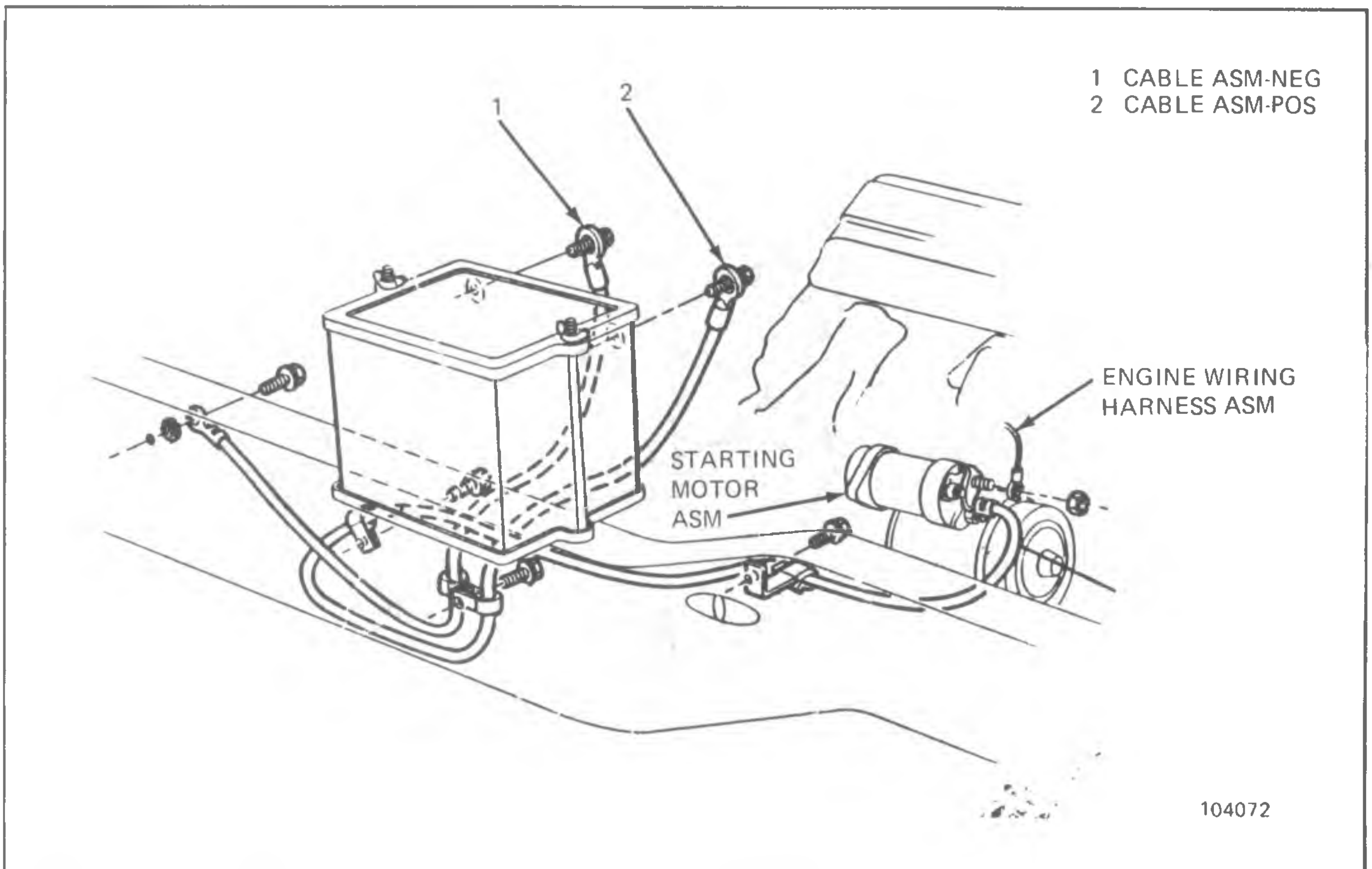


Fig. 6D-23--Battery Cables-P-LT9/LE8 and E32/E33

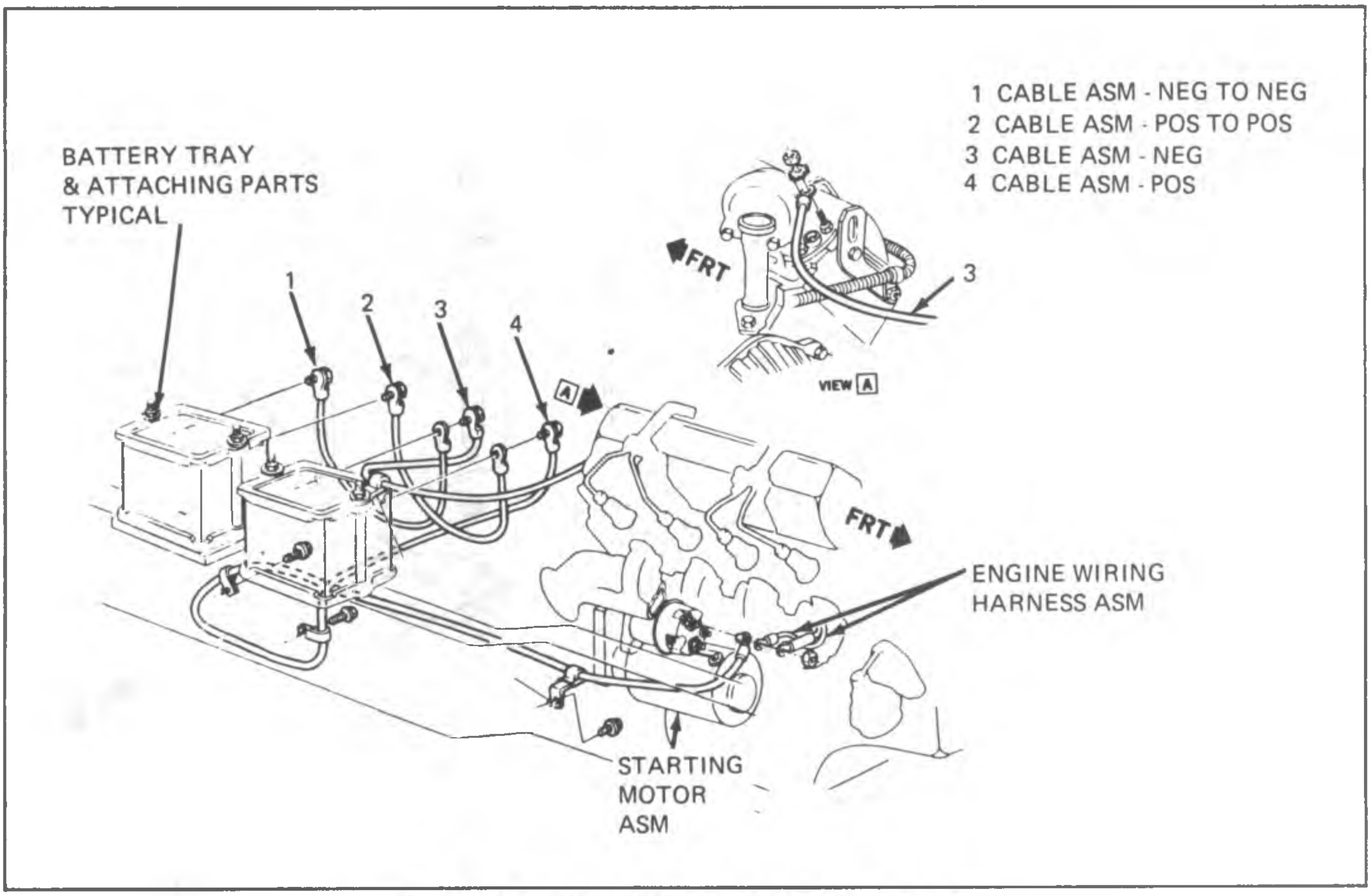


Fig. 6D-24--Battery Cables-P32, LT9/LE8 Exc. E32, E33

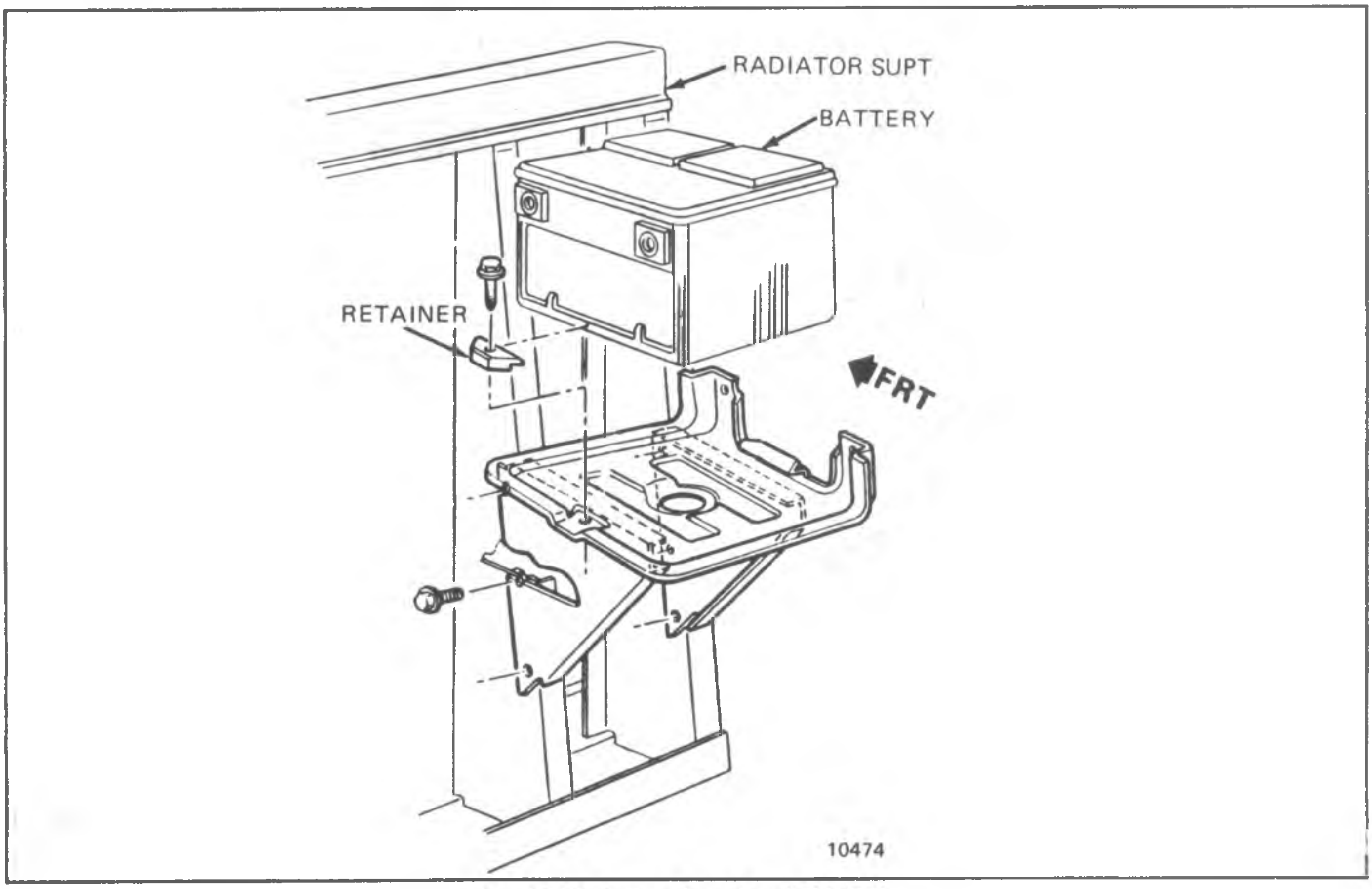


Fig. 6D-25--Battery Tray-P and E32/E33

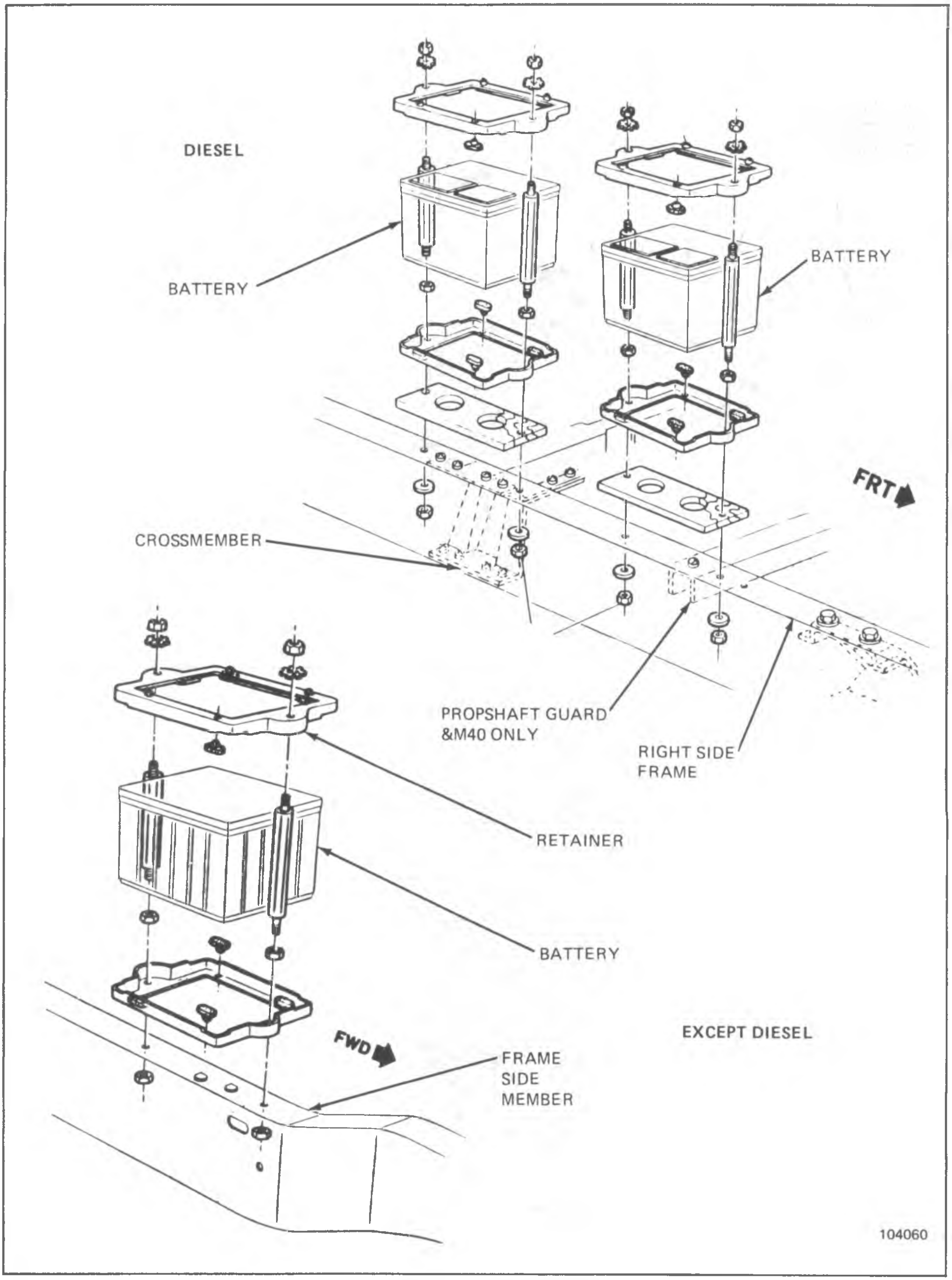


Fig. 6D-26--Battery Tray-P and LL4

CHARGING SYSTEM

General Description 6D-21
Diagnosis 6D-22
Faulty Indicator Lamp Operation 6D-22
Undercharged tBattery 6D-24
Overcharged Battery 6D-24
On-Vehicle Service 6D-26
Unit Repair 6D-27

GENERAL DESCRIPTION

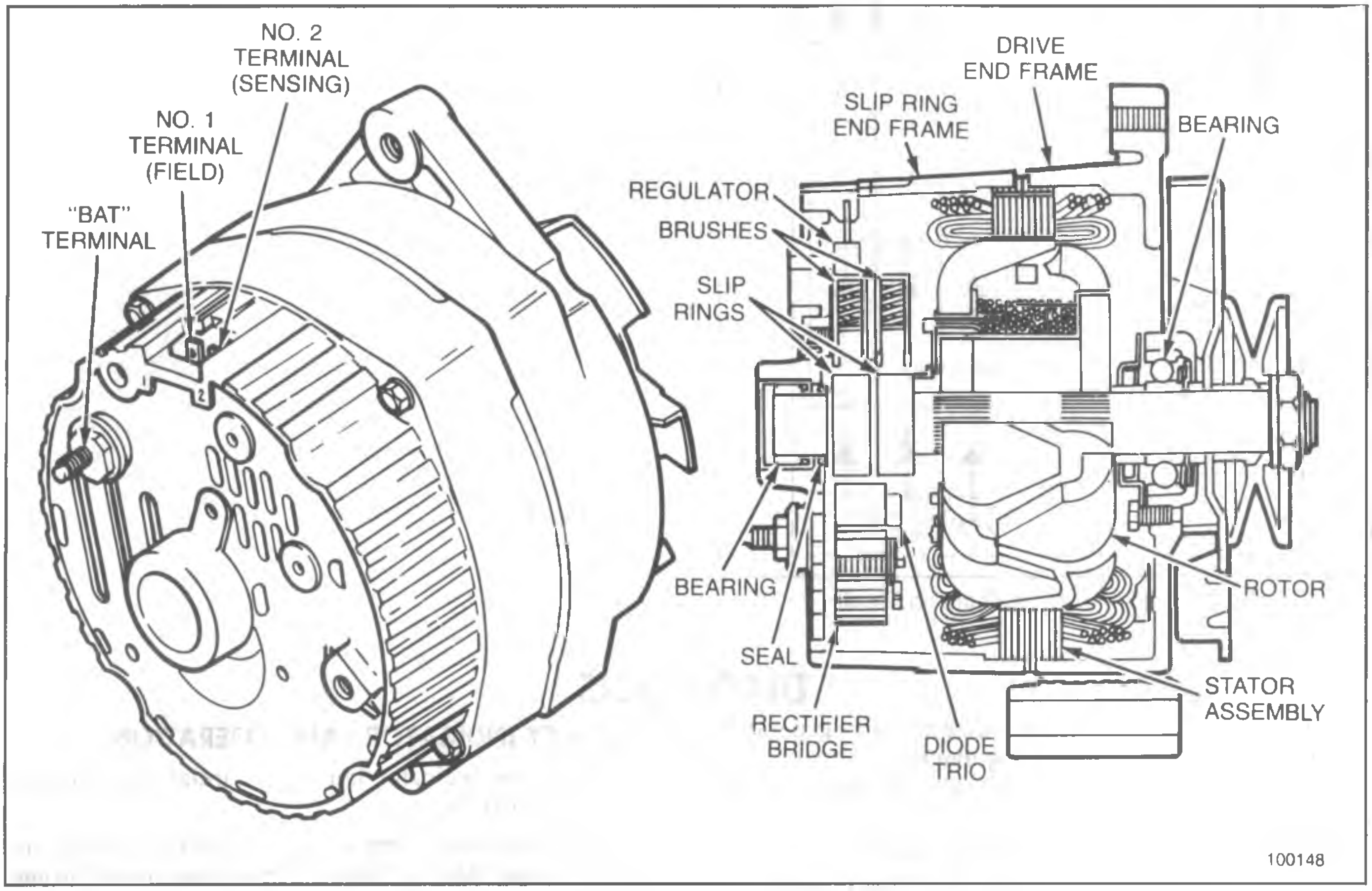


Fig. 6D-27--SI Generator-Typical

The basic charging system is the SI integral regulator charging system (Figure 6D-27). The internal components are connected electrically as shown in Fig. 6D-28. The generator is connected to the car electrically as shown in Section 8A under charging circuit.

The generator used on individual vehicles will be one of the following types: 10-SI, 12 SI, 15 SI, or 27 SI. The 15 SI and 27 SI generators have delta stator windings and cannot be checked for opens. The other differences among the four (4) types are output current ratings, and drive end and slip ring end bearing stack up. Specifications are given at the end of each subsection.

The brown field wire to the generator is used to turn on the generator. The 10 ohm resistance, provided by either the generator warning lamp, choke heater relay or the resistance wire is needed to protect the diode trio.

Several models of generators are available with different output ratings. Their basic operating principles are the same.

The generator features a solid state regulator that is mounted inside the generator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting cannot be adjusted.

The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A recitifier bridge connected to the stator windings contains six diodes, and electrically changes the stator a.c. voltages to a d.c. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio which also is connected to the stator windings. A capacitor or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

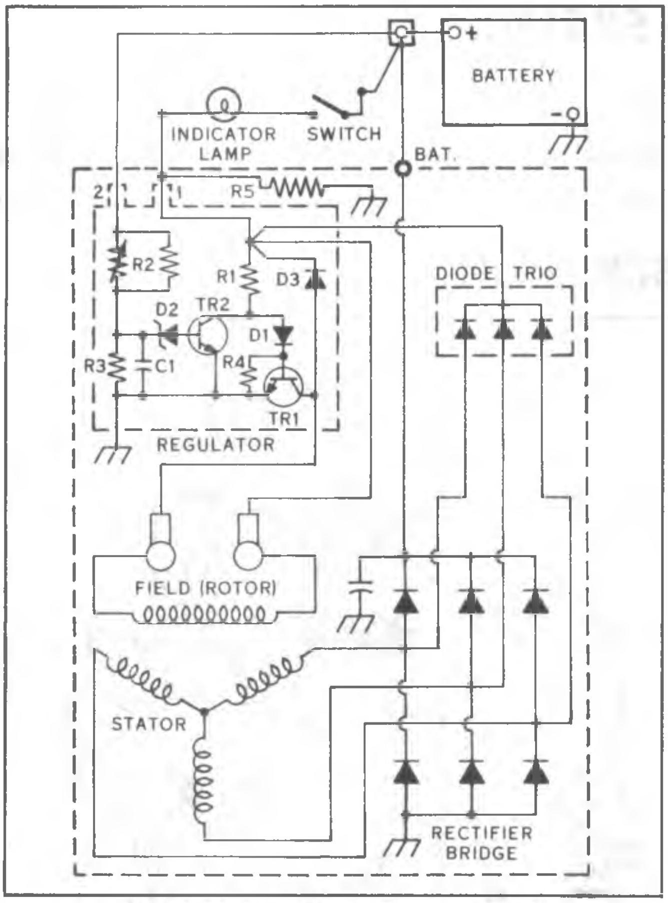


Fig. 6D-28--Regulator in Charging Circuit

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.

DIAGNOSIS

A charging circuit wiring diagram for generator connections is shown in the wiring diagrams.

To avoid damage. always follow these precautions:

- Do not reverse connections to the generator.
- Do not short across or ground any of the terminals in the charging circuit except as directed by the instructions.
- NEVER operate the generator with the output terminal disconnected.
- When connecting a charger or a booster battery to the vehicle battery, see Battery Charging Section.

In some cars, a voltmeter may be used instead of an indicator lamp. In this case, Section "A" pertaining to faulty indicator lamp operation should be omitted from the troubleshooting procedure.

Trouble in the charging system will show up as one or more of the following conditions:

A. Faulty indicator lamp operation.

B. An undercharged battery as evidenced by slow cranking or hydrometer dark.

C. An overcharged battery as evidenced by excessive spewing of electrolyte from the vents.

A. FAULTY INDICATOR LAMP OPERATION

Check the indicator lamp for normal operation as shown in Fig. 6D-29.

If the indicator lamp operates normally, proceed to "Undercharged Battery" section. Otherwise, proceed to **one** of the following three **abnormal** conditions.

1. **Switch Off, Lamp On** - Unplug the connector from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as covered in the "GENERATOR REPAIR" Section. This condition will cause an undercharged battery.
2. **Switch On, Lamp Off, Engine Stopped** - This condition can be caused by the defects listed in part 1 above, or by an open in the circuit. To determine where an open exists, proceed as follows:
   a. Check for a blown fuse, or fusible link, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.
   b. If no defects have been found, proceed to Undercharged Battery section.
3. **Switch On, Lamp On, Engine Running** - Check for a

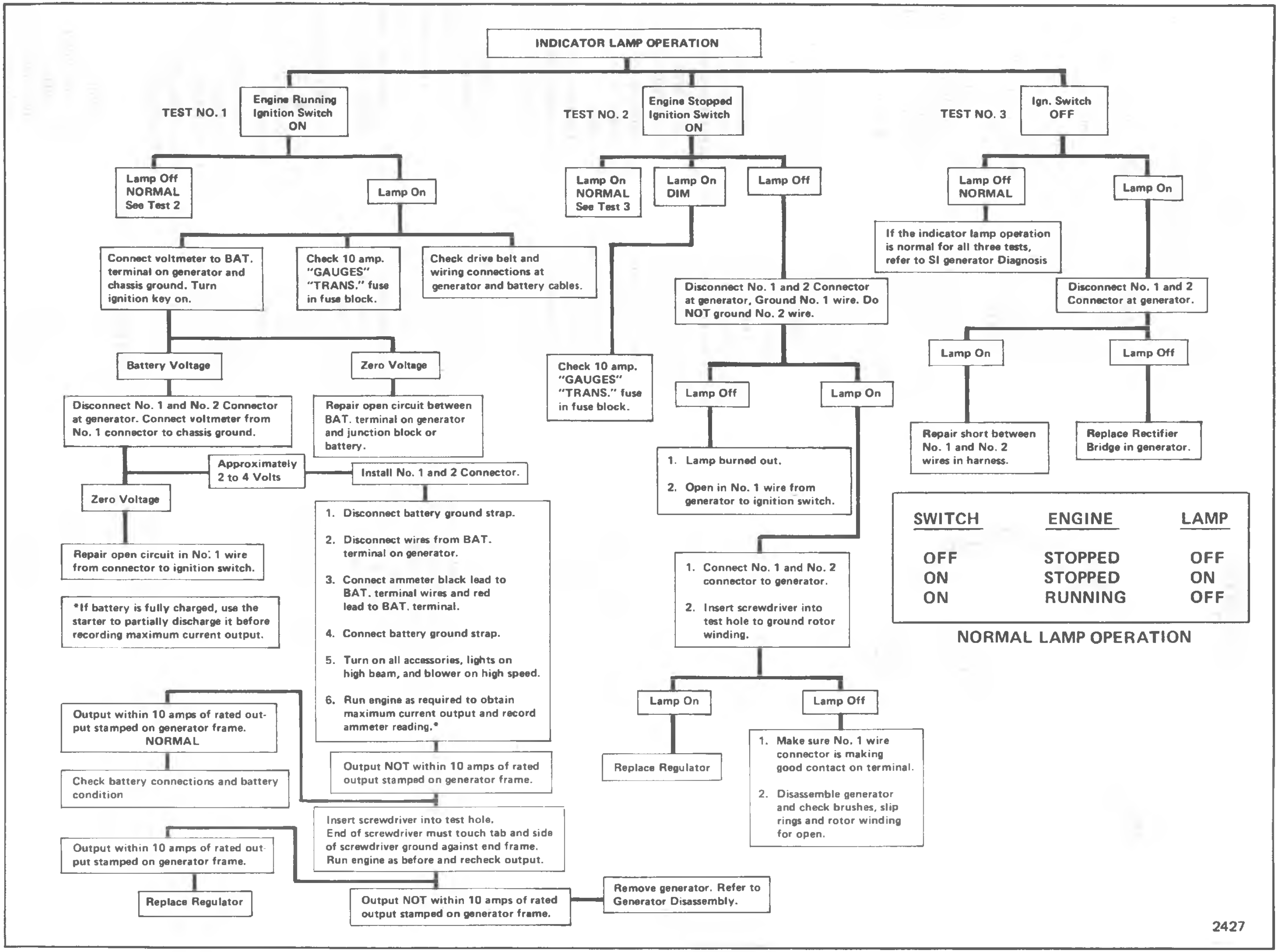


Fig. 6D-29--Charging System Diagnosis

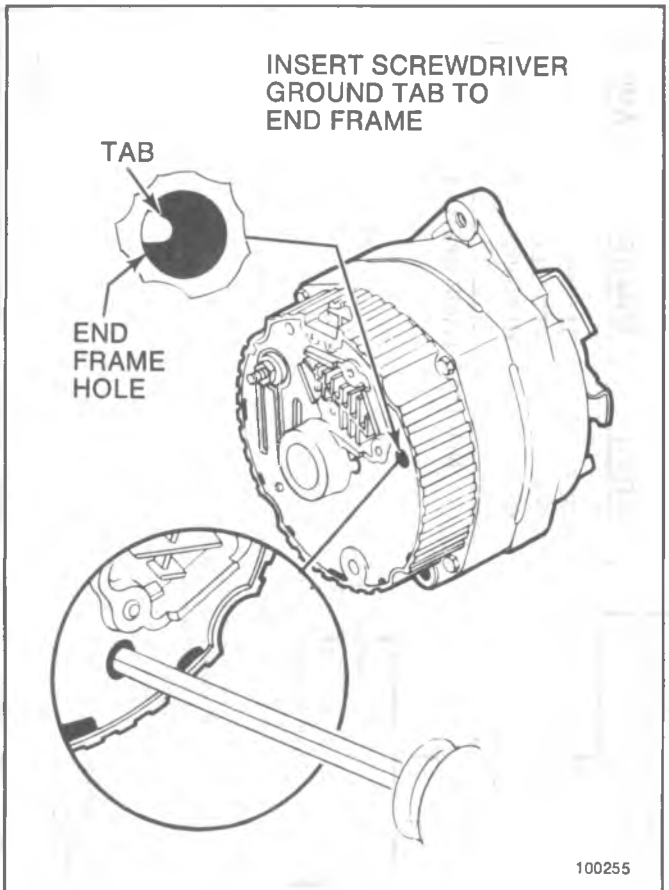


Fig. 6D-30--Generator Test Hole

blown fuse, (where used), between indicator lamp and switch, and also in A/C circuit. Other possible causes of this condition are covered in the "UNDERCHARGED BATTERY" section. If a defect has been found and corrected at this point, no further checks need be made.

B. Choke Light on After Start

If the generator fails to produce from 12 to 14.5 volts after the engine is running at a speed above idle, the choke heater relay will be grounded through the brown white wire to the generator at terminal 1. This will cause the relay points to remain open, thus stopping current flow back through the choke heater relay. This will cause the choke indicator to light.

1. Check generator terminal 1 for voltage during fast idle. If voltage is incorrect, see On-Vehicle Serive and Unit Repair.

B. UNDERCHARGED BATTERY

This condition, as shown by slow cranking or hydrometer dark can be caused by one or more of the following conditions even though the indicator lamp may be operating normally. The following procedures also applies to cars with a voltmeter.

1. Insure that the undercharged condition has not been caused by accessories left on for extended periods.
2. Check the drive belt for proper tension (see Engine Cooling Section).
3. If a battery defect is suspected, refer to Battery Section.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and bulkhead, and the battery cable connections at the battery, the starter and the ignition ground.
5. With ignition switch "on" and all wiring harness leads connected, connect a voltmeter from
   a. Generator "BAT" terminal to ground.
   b. Generator No. 1 terminal to ground.
   c. Generator No. 2 terminal to ground.

A zero reading indicates an open between voltmeter connection and battery.

Generators have a built-in feature which avoids overcharge and accessory damage by preventing the generator from turning on if there is an **open** in the wiring harness connected to the No. 2 (sensing) generator terminal.

6. If Steps 1 through 5 check satisfactorily, check generator as follows:
   a. Disconnect negative battery cable.
   b. Connect an ammeter or generator tester in the circuit at the "BAT" terminal of the generator.
   c. Reconnect negative battery cable.
   d. Turn on radio, windshield wipers, lights high beam and blower motor on high speed. Connect a carbon pile across the battery (or use generator tester).
   e. Operate engine about 2000 RPM, and adjust carbon pile as required, to obtain maximum current output.
   f. If ampere output is within 10 amperes of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 5.
   g. If ampere output is not within 10 percent of rated output, determine if test hole is accessible (Fig. 6D-32). If accessible go to step h. If not accessible go to step l.
   h. Ground the field winding by inserting a screwdriver into the test hole (Fig. 6D-30). Tab is within 19mm (3/4 inch) of casting surface. Do not force screwdriver deeper than one inch (25mm) into end frame to avoid damaging generator.
   i. Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.
   j. If output is within 10 amperes of rated output, check field winding, diode trio, and rectifier bridge as covered in UNIT REPAIR section, and test regulator with an approved regulator tester.
   k. If output is not within 10 amperes of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in the UNIT REPAIR Section.
   l. If test hole is not accessible, disassemble generator and make tests listed in UNIT REPAIR section.

C. OVERCHARGED BATTERY

1. To determine battery condition refer to Battery section.
2. If an obvious overcharge condition exists as evidenced by excessive spewing of electrolyte, proceed to disassembly section of "Unit Repair" and check field windings for grounds and shorts. If

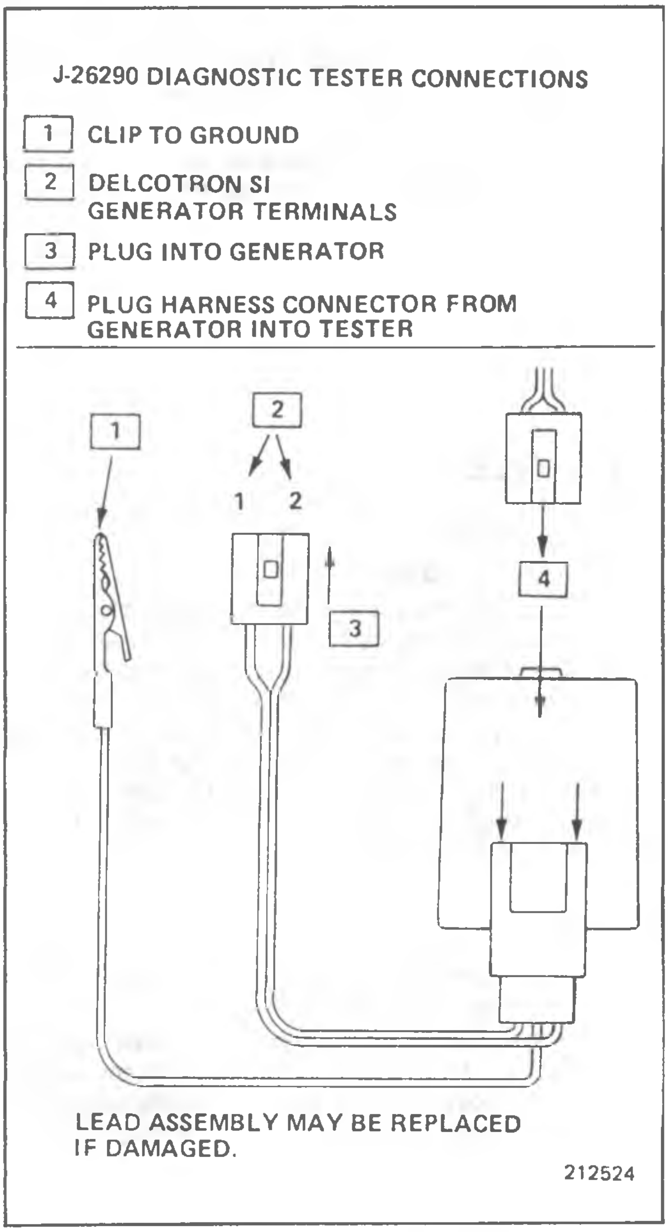


Fig. 6D-31--J-26290 Diagnostic Tester Connections

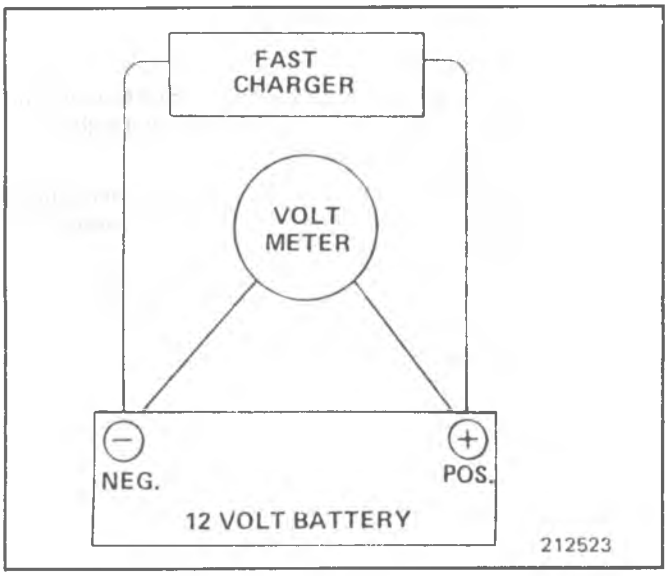


Fig. 6D-32--On Car Voltage Regulator Test

defective, replace rotor, and test regulator with an approved regulator tester.

Generator Tester - many testers are available to check the generator. They provide a quick on-car test, and can save time over conventional diagnostic methods. Consult manufacturer's instructions for usage.

GENERATOR DIAGNOSTIC TESTER INDICATIONS (TOOL J-26290)

This tester is designed as a quick check to determine if the generator should be removed from the vehicle. It will indicate about 98% of charging system faults.

Be certain engine is at fast idle when using tester in Part 2.

Connect tester as shown in Fig. 6D-31.

1. Engine Off: (Lights and Accessories Off)
   a. Light flashes--Skip Steps b and c and go to Part 2.
   b. Light on--Indicates fault in tester which should be replaced.
   c. Light off-Pull plug from generator:
      (1) Flashing light--indicates that the generator should be removed and the rectifier bridge replaced.
      (2) Light off-indicates faulty tester or no voltage to tester. Check for 12-volts at #2 terminal of harness connector. Repair wiring or terminals if 12-volts is not available. Replace tester if 12-volts is available.
2. Engine at Fast Idle: (Lights and Accessories Off)

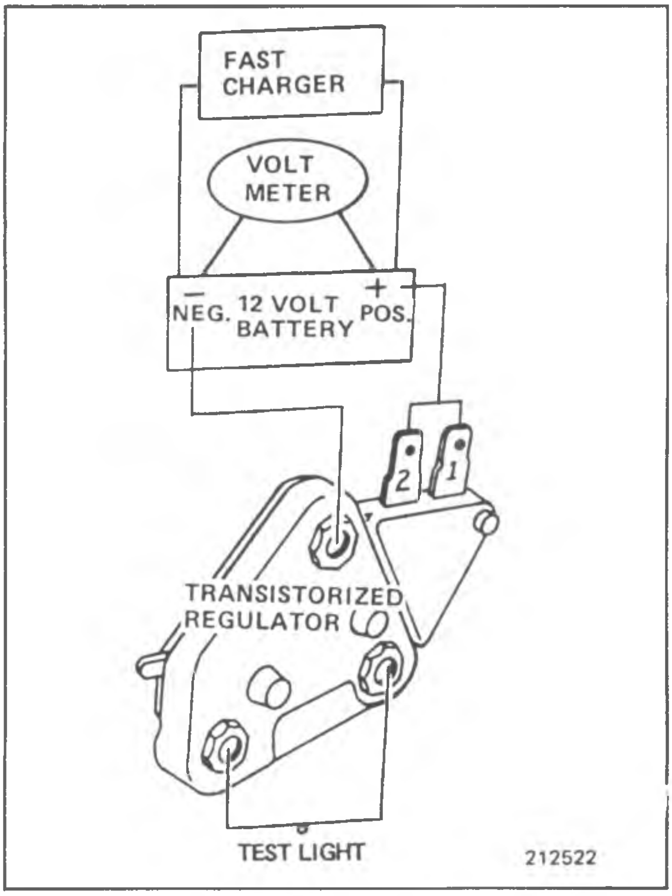


Fig. 6D-33--Off Car Voltage Regulator Test

d. Light off--Charging system good, DO NOT remove generator.

e. Light on--Indicates a component failure within the generator. Remove generator and check diode trio, rectifier bridge and stator.

f. Light flashing--Indicates a problem within the generator. Remove generator and check regulator, rotor field coil, brushes and slip rings.

TRANSISTORIZED VOLTAGE REGULATOR TEST

Procedure

1. Connect a fast charger and a voltmeter to the battery as shown in Fig. 6D-32.
2. Turn on the ignition and slowly increase the charge rate. The generator light in the vehicle will dim at the voltage regulator setting. Voltage regulator setting should be a minimum of 13.5 volts and a maximum of 16.0 volts.

NOTICE: This test works if the rotor circuit is good, even if the stator rectifier bridge or diode trio is bad.

ON-VEHICLE SERVICE

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end, and each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension (see Sec. 6B).

- When adjusting belt tension, apply pressure at center of generator, never against either end frame.

TESTING VOLTAGE REGULATOR - OFF CAR

1. Connect voltmeter and fast charger to 12-volt battery as shown in Fig. 6D-33.
2. Connect regulator and test light as shown, observe battery polarity.
3. Test light should be on.
4. Turn on fast charger and slowly increase charge rate. Observe voltmeter, light should go out at the voltage regulator setting. Voltage regulator setting should be a minimum of 13.5 volts and a maximum of 16.0 volts.

The test light is connected into the circuit, exactly as the rotor is when the regulator is inside the generator. The regulator shuts off the current to the test light when the regulator setting is reached. This voltage will vary with temperature differences.

UNIT REPAIR

SLIP RING SERVICING

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

NOTICE: The rotor must be rotated in order to clean the slip rings evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

The illustrations which follow should be used when unit repair to the generator becomes necessary.

Remove

1. Disconnect negative battery terminal at battery.

   CAUTION: Failure to observe this step may result in an injury from hot battery lead at generator.

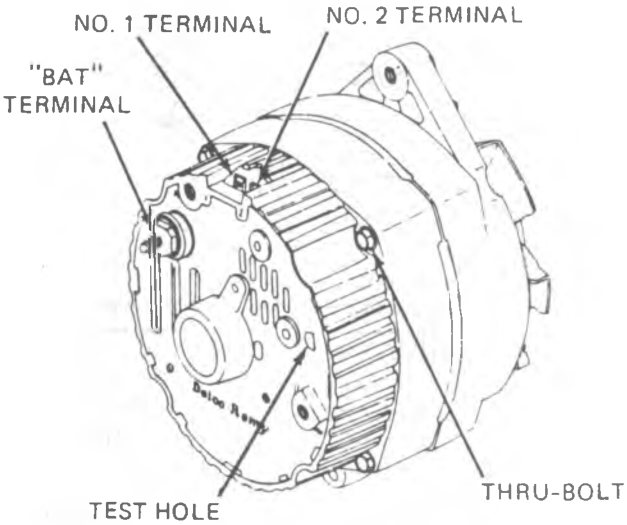
2. Remove two terminal plug and battery leads on back of generator.
3. Loosen adjusting bolts (see Fig. 6D-37, to 6D-41 for generator mounting).
4. Remove generator drive belt.
5. Remove thru bolt which retains generator.
6. Remove generator from vehicle.

Install

1. If removed from vehicle, install generator to mounting bracket with bolts, washers and nuts. Do not tighten.
2. Install generator drive belt.
3. Tighten belt to the specified belt tension. See Engine Cooling Section for proper belt tensioning procedures.
4. Tighten bolts.
5. Install generator terminal plug and battery leads to generator.
6. Connect negative battery terminal.

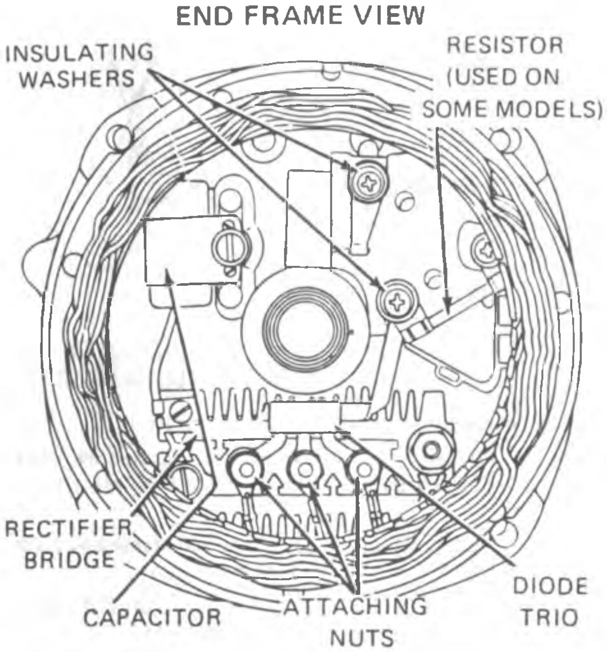
DISASSEMBLY, TEST AND REASSEMBLY (GENERATOR REMOVED FROM ENGINE)

THRU-BOLT LOCATION



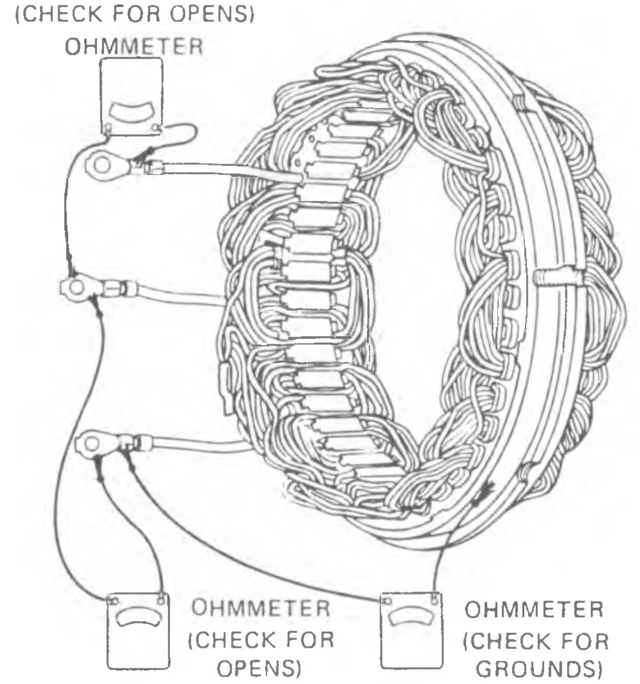
1. Make scribe marks on end frames to facilitate reassembly.
2. Remove four thru-bolts and separate drive end frame assembly from rectifier end frame assembly.

END FRAME VIEW



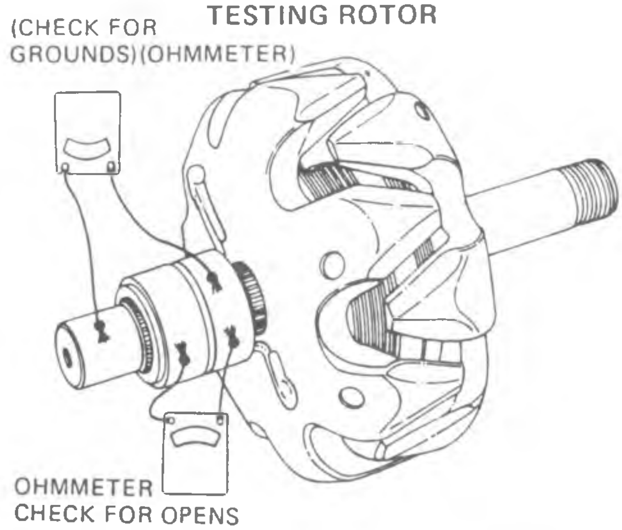
3. Remove three attaching nuts and regulator attaching screws.
4. Separate stator, diode trio and regulator from end frame. NOTE: The regulator cannot be tested on the work bench except with a regulator tester.

TESTING STATOR



5. On 10SI only, check stator for opens with ohmmeter (two checks). If either reading is high (infinite), replace stator.
6. On all series, check stator for grounds. If reading is low, replace stator.

TESTING ROTOR



7. Check rotor for grounds with ohmmeter. Reading should be very high (infinite). If not, replace rotor.
8. Check rotor for opens. Should read 2.4-3.5 ohms. If not, replace rotor.

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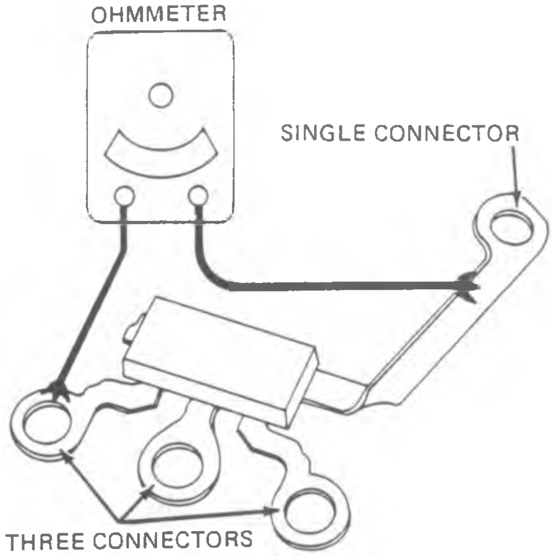
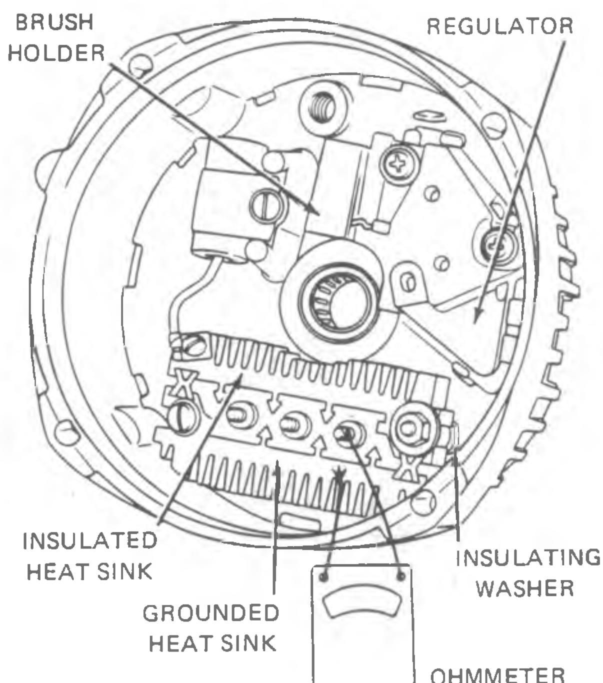
Fig. 6D-34--Generator Unit Repair - 1 of 3

TESTING TRIO



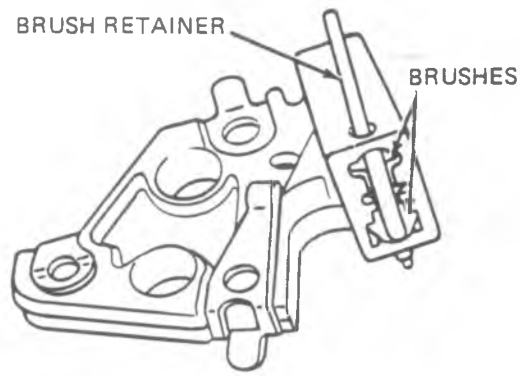
9. To check diode trio, connect ohmmeter as shown, then reverse lead connections. Should read high and low. If not, replace diode trio.
10. Repeat same test between single connector and each of other connectors.

TESTING RECTIFIER BRIDGE



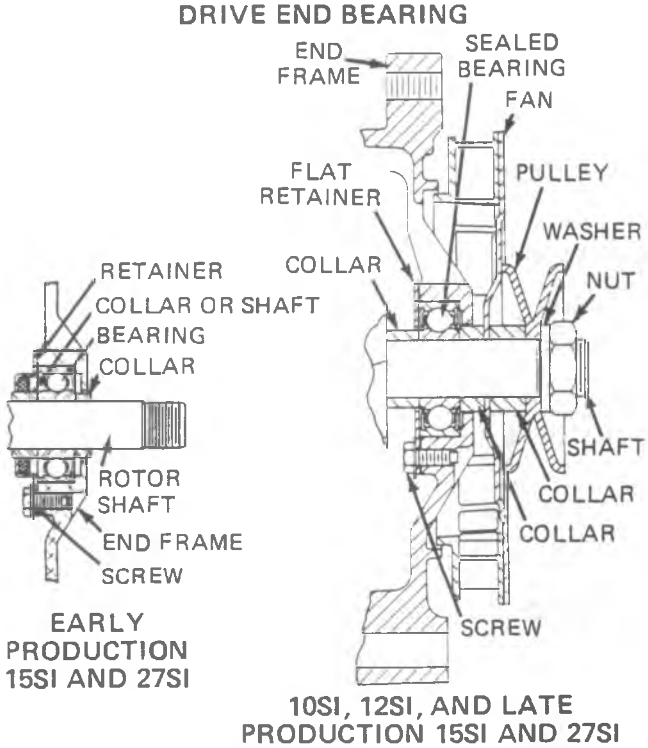
11. Check rectifier bridge with ohmmeter connected from grounded heat sink to flat metal on terminal. Reverse leads. If both readings are the same, replace rectifier bridge.
12. Repeat test between grounded heat sink and other two flat metal clips.
13. Repeat test between insulated heat sink and three flat metal clips.
    To replace bridge, remove attaching screws.

BRUSHES RETAINED IN HOLDER



14. Clean brushes with soft, dry cloth.
15. Put brushes in holder and hold with brush retainer wire.

DRIVE END BEARING



16. Observe stack-up of parts in both illustrations.
    To remove rotor and drive end bearing, remove shaft nut, washer and pulley, fan and collar. Push rotor from housing.
17. Remove retainer plate inside drive end frame and push bearing out. Clean all parts with soft cloth.
18. Press against outer race to push bearing in. Fill cavity between retainer plate and bearing with lubricant on early production 15SI and 27SI. Series 10SI, 12SI and late production 15SI and 27SI use sealed bearing – no lubricant is required. Assemble retainer plate.
19. Press rotor into end frame. Assemble collar, fan, pulley, washer and nut. Torque shaft nut to **40-60** lb.-ft., (54-82 N-M).

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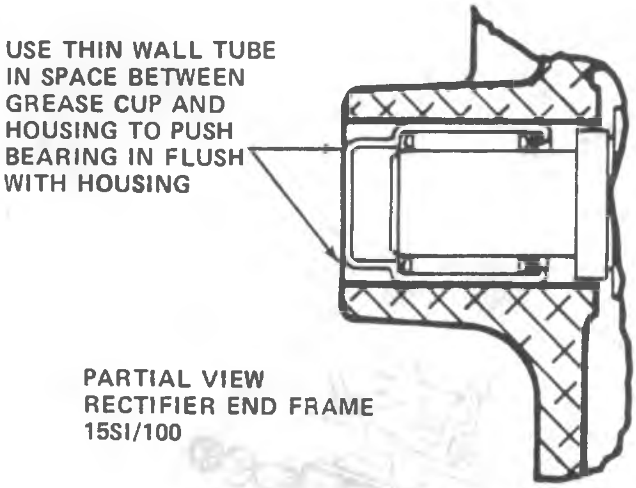
Fig. 6D-35--Generator Unit Repair - 2 of 3

RECTIFIER END BEARING 15SI SERIES



20. PUSH SLIP RING END BEARING OUT FROM OUTSIDE TOWARD INSIDE OF END FRAME.
21. ON 10SI AND 12SI, PLACE FLAT PLATE OVER NEW BEARING, PRESS FROM OUTSIDE TOWARD INSIDE UNTIL BEARING IS FLUSH WITH END FRAME.
22. ON 15SI, SEE ILLUSTRATION.
23. ASSEMBLE BRUSH HOLDER, REGULATOR, RESISTOR, DIODE TRIO, RECTIFIER BRIDGE AND STATOR TO SLIP RING END FRAME.
24. ASSEMBLE END FRAMES TOGETHER WITH THRU-BOLTS. REMOVE BRUSH RETAINER WIRE.

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Fig. 6D-36--Generator Unit Repair - 3 of 3

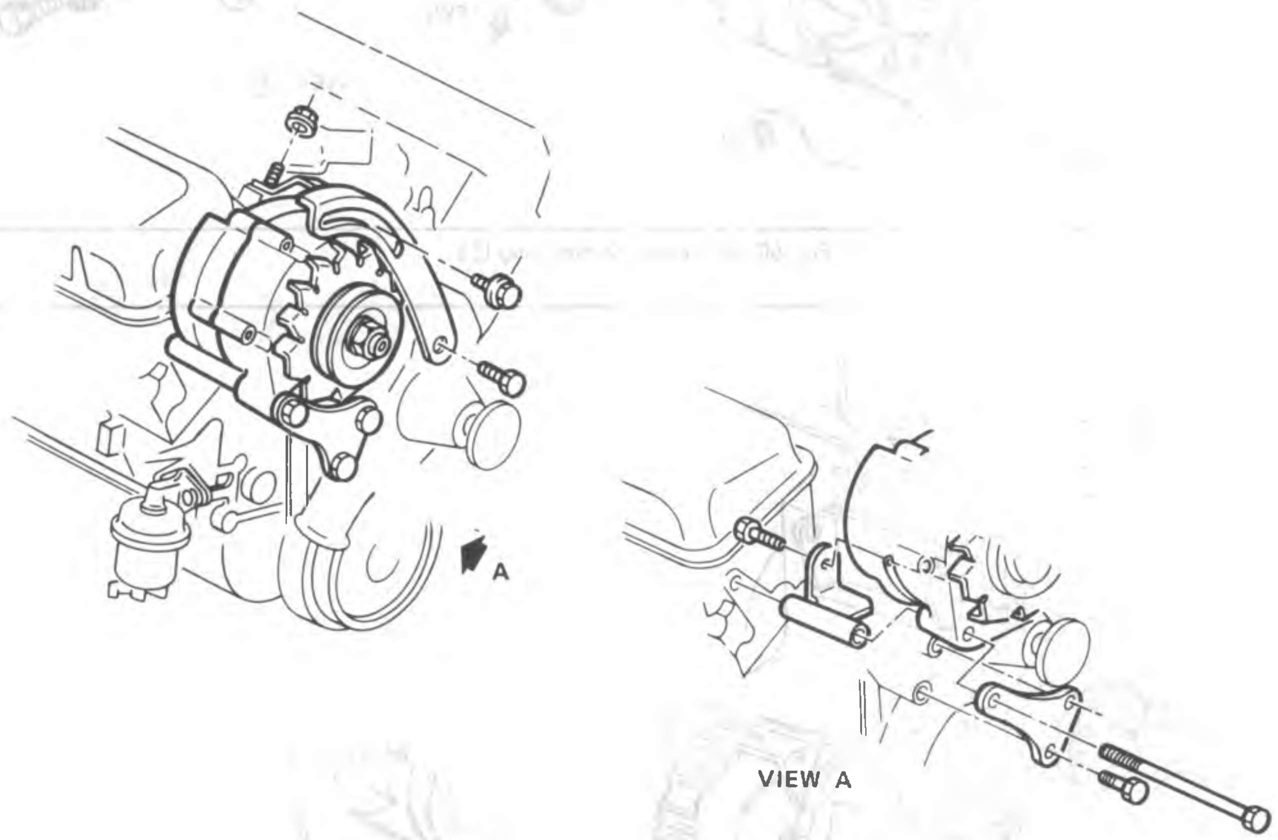


Fig. 6D-37--Generator Mounting-LE8/LT9

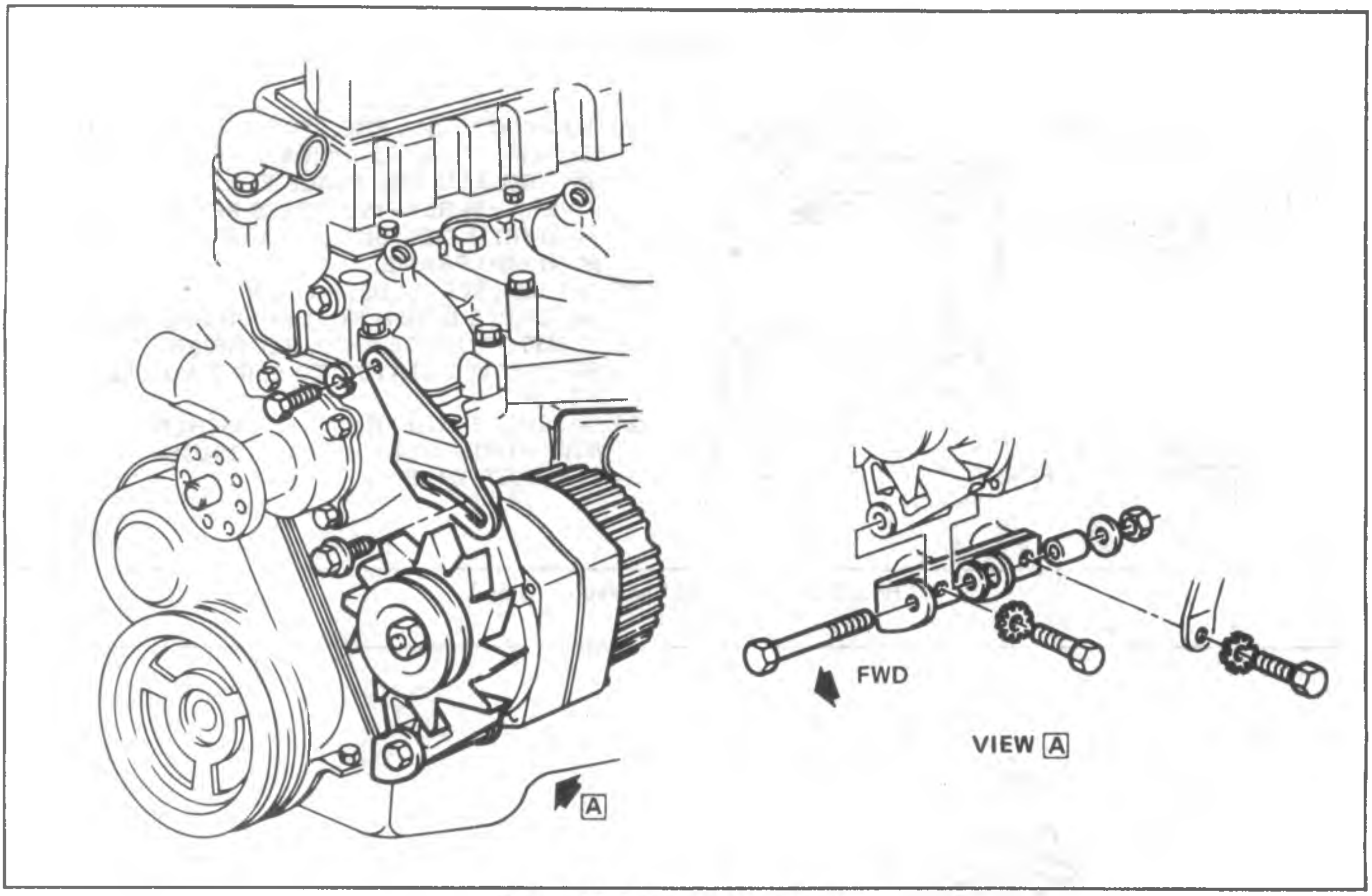


Fig. 6D-38--Generator Mounting-LE3

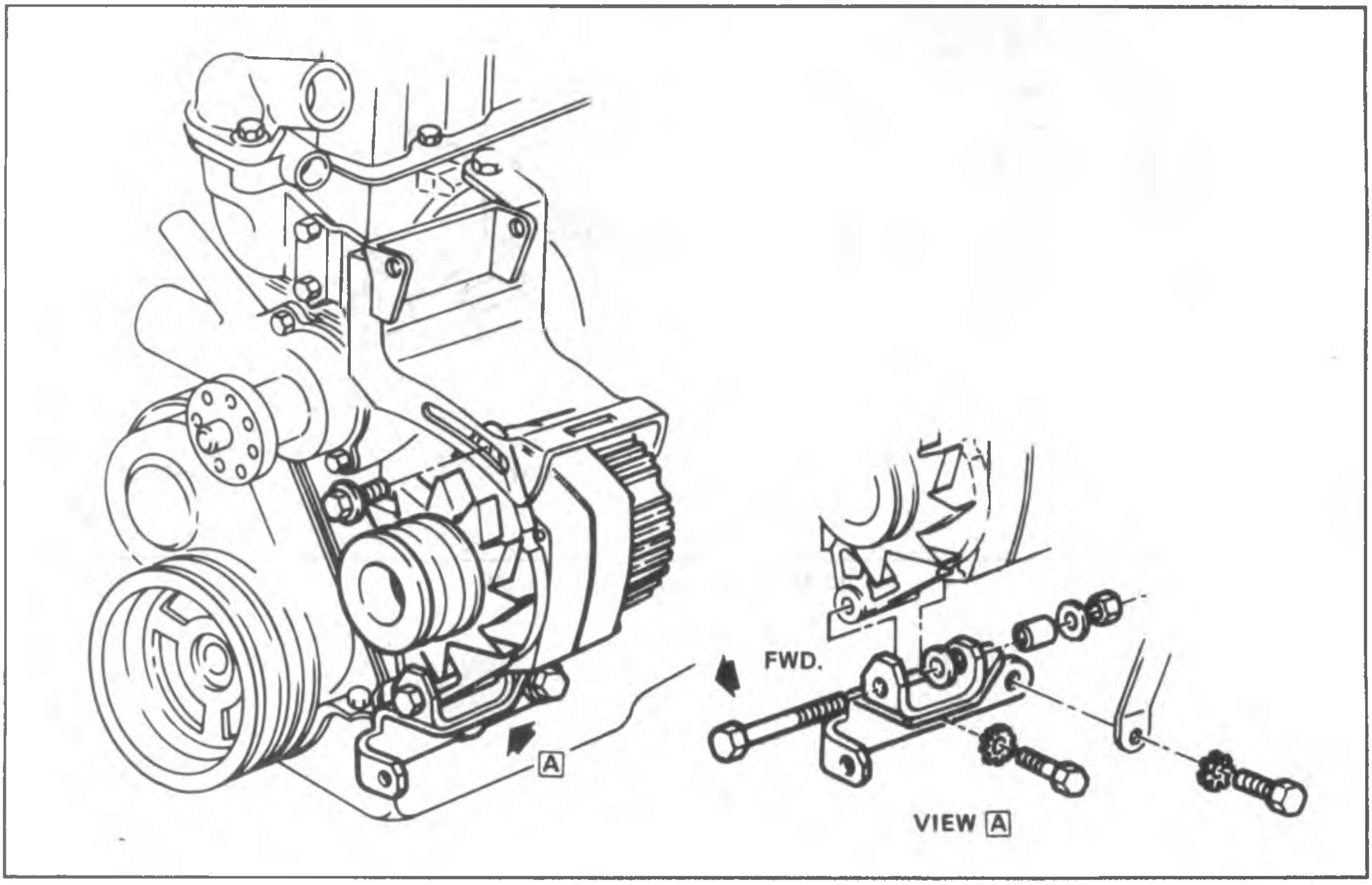


Fig. 6D-39--Generator Mounting-L25

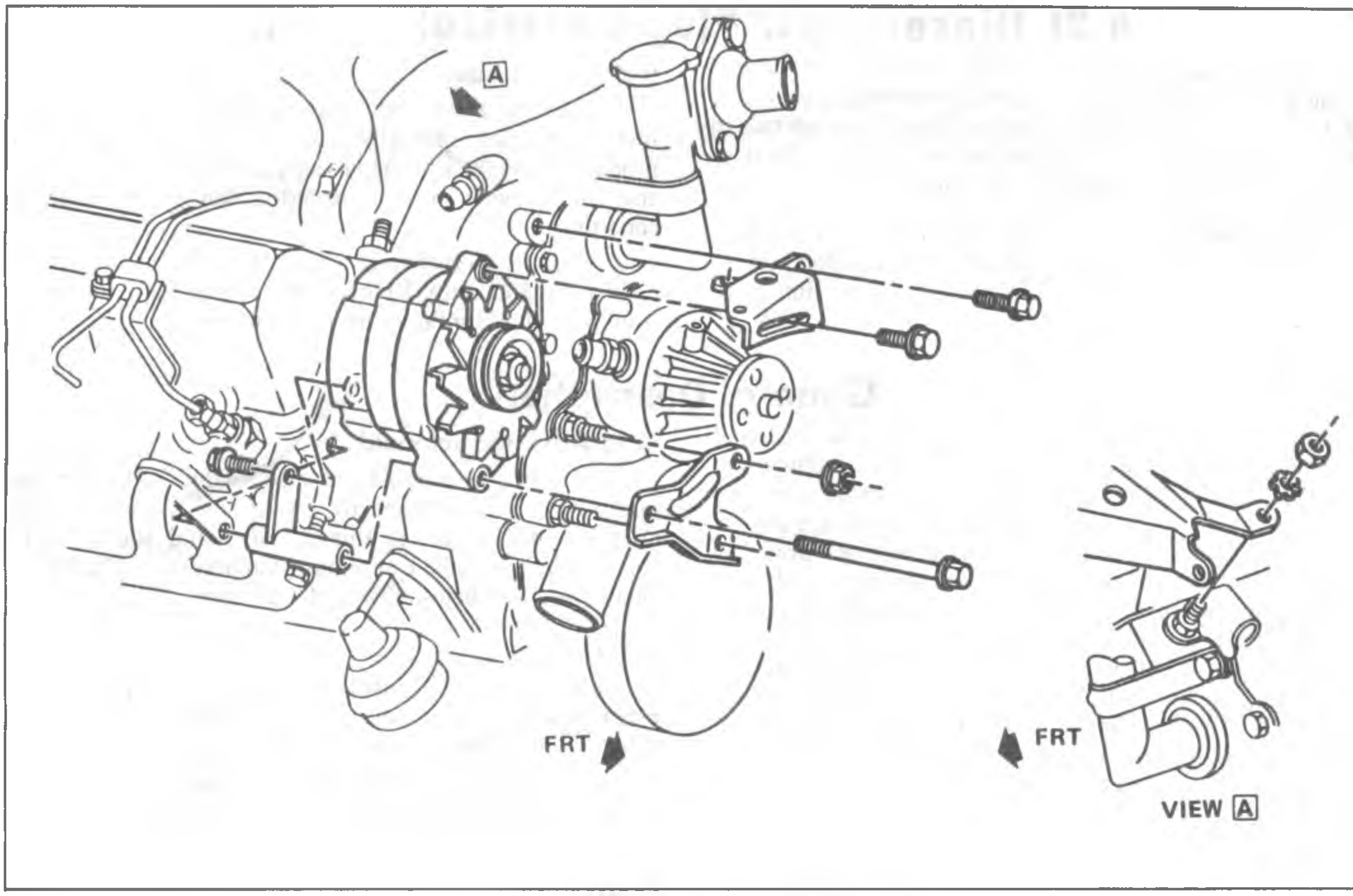


Fig. 6D-40--Generator Mounting-Diesel

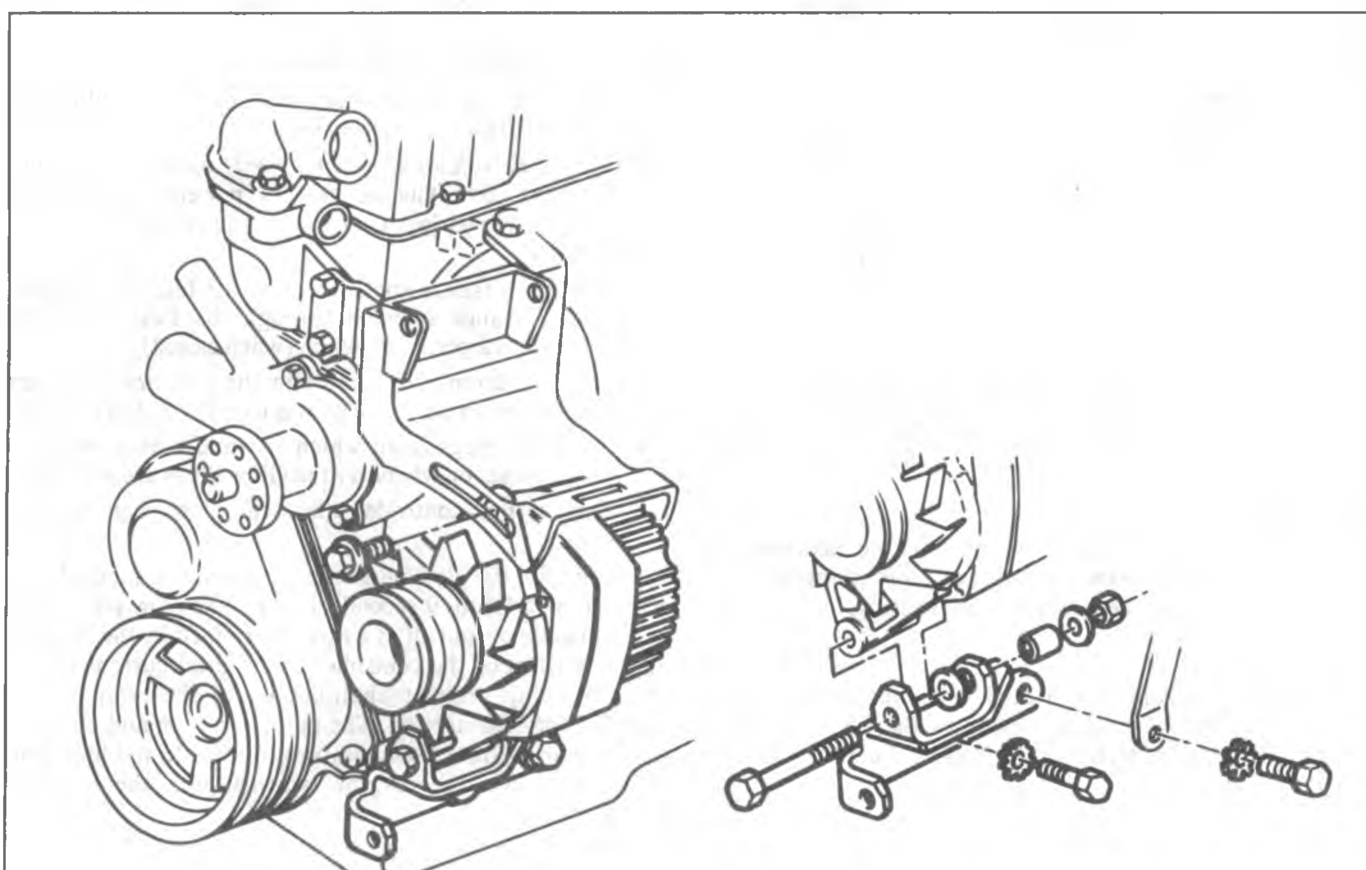


Fig. 6D-41--Generator Mounting-P300 (42) L25

6.2L Diesel Glow Plug Electrical System

In the diesel engine, air alone is compressed in the cylinder; then after the air has been compressed a charge of fuel is sprayed into the cylinder and ignition occurs due to the heat of compression. Eight glow plugs are used to preheat the chamber as an aid to starting.

They are 6 volt heaters (operated at 12 volts) that turn on when the ignition key is turned to the run position prior to starting the engine. They remain pulsing a short time after starting, then automatically turn off.

Instrumentation

Vehicles with the diesel engine have special instrumentation indicators to permit the operator to properly apply the starting procedure. A Glow Plugs light on the I.P. provides this information on engine starting conditions.

Also, these vehicles have a water in fuel lamp and low engine coolant lamp. Refer to the engine fuel and engine cooling sections for information on these systems.

General Description

The 6.2 liter diesel glow plug control system consists of a thermal controller, glow plug relay, 6 volt glow plugs, and a "Glow Plugs" lamp. Other components which have no function in controlling glow plug operation but are part of the electrical system start and run operations are: fuel solenoid, fast idle and cold advance solenoids, cold advance temperature switch, and the TCC, EGR and EPR solenoids. The electrical operation and diagnosis of the fuel solenoid, fast idle and cold advance solenoid and the cold advance temperature switch will be covered briefly here. Refer to Section 7, Transmissions for information on the TCC system and to Section 6E, Emissions for information on the EGR and EPR systems.

Controller

The thermal controller is mounted in the water passage at the rear of the engine. Thermostatic elements within the controller are designed to open or close the ground circuit to the glow plug relay as necessary to control the pre-heat and afterglow cycles of glow plug operation.

Glow Plug Relay

The glow plug relay located on the left inner fender panel provides current to the glow plugs. The relay is pulsed on and off by the thermal controller.

NOTICE: This relay is automatically controlled. Any attempt to bypass relay with jumper wire or rewire for manual control may result in glow plug failure.

Glow Plugs

The glow plugs used in this system are 6 volt plugs which are operated at electrical system voltage (12 volts). They are not designed to burn continuously, and are pulsed on and off as needed, by the thermal controller.

Glow Plugs Lamp

The glow plugs lamp is mounted in the instrument cluster. The lamp is wired across the glow plugs and is illuminated whenever the glow plugs are heating.

Fuel solenoid

The fuel solenoid is activated whenever the ignition switch is on. The solenoid is located in the fuel injection pump housing cover. Refer to the Engine Fuel Section of this manual for service.

Cold Advance Solenoid

the cold advance solenoid, also located in the injection pump cover, is controlled by a cold advance temperature switch which activates this solenoid and the fast idle solenoid at a specified minimum temperature. The switch should be closed below 90°F and open above 122°F.

BATTERY

the diesel engine uses dual batteries to provide the extra power required to operate the glow plugs and the larger starter used on this engine.

A Standard generator supplies charging current to both batteries at the same time. There are no switches or relays in the charging circuit.

Starter

The starter is larger and designed to crank the engine at least the 100 RPM required for starting.

Circuit Operation - Cold Start

WiTh the ignition switch in "Run" the following events take place simulTaneously.

1. The fuel solenoid is energized opening the fuel metering valve. The fuel heater is powered provided the temperature is low enough to require heating of the fuel.
2. Battery voltage is applied to the Fast Idle solenoid and Cold Advance solenoid through the Fast Idle/Cold Advance temperature switch (when closed).
3. Battery current flows through the thermal controller circuits and through the glow plug relay coil to ground.
4. the Glow Plugs lamp which is wired across the glow plugs, comes on whenever the Glow Plugs are powered.
5. The thermal controller starts the glow plugs heating cycle.

Initially, the glow plugs are activated continuously for a period of 7 1/2 to 9 seconds at 0°F. The glow plugs then begin to pulse on and off at a rate determined by the thermal characteristics of the controller. The initial current brings the glow plug preheat chamber up to the temperature required for cold starting. The pulse cycle (on and off) acts to maintain chamber temperature to provide stable engine warm up. As the engine warms up, the thermal controller turns off all current to the relay de-energizing the glow plugs completely. The controller is capable of varying glow plug operation as required (up to one minute) when the engine is started warm, and little or no heating is necessary.

Controller failure as in the case of prolonged preheat (more than 9 seconds) would cause a circuit breaker in the controller to open, cutting off glow plug operation completely.

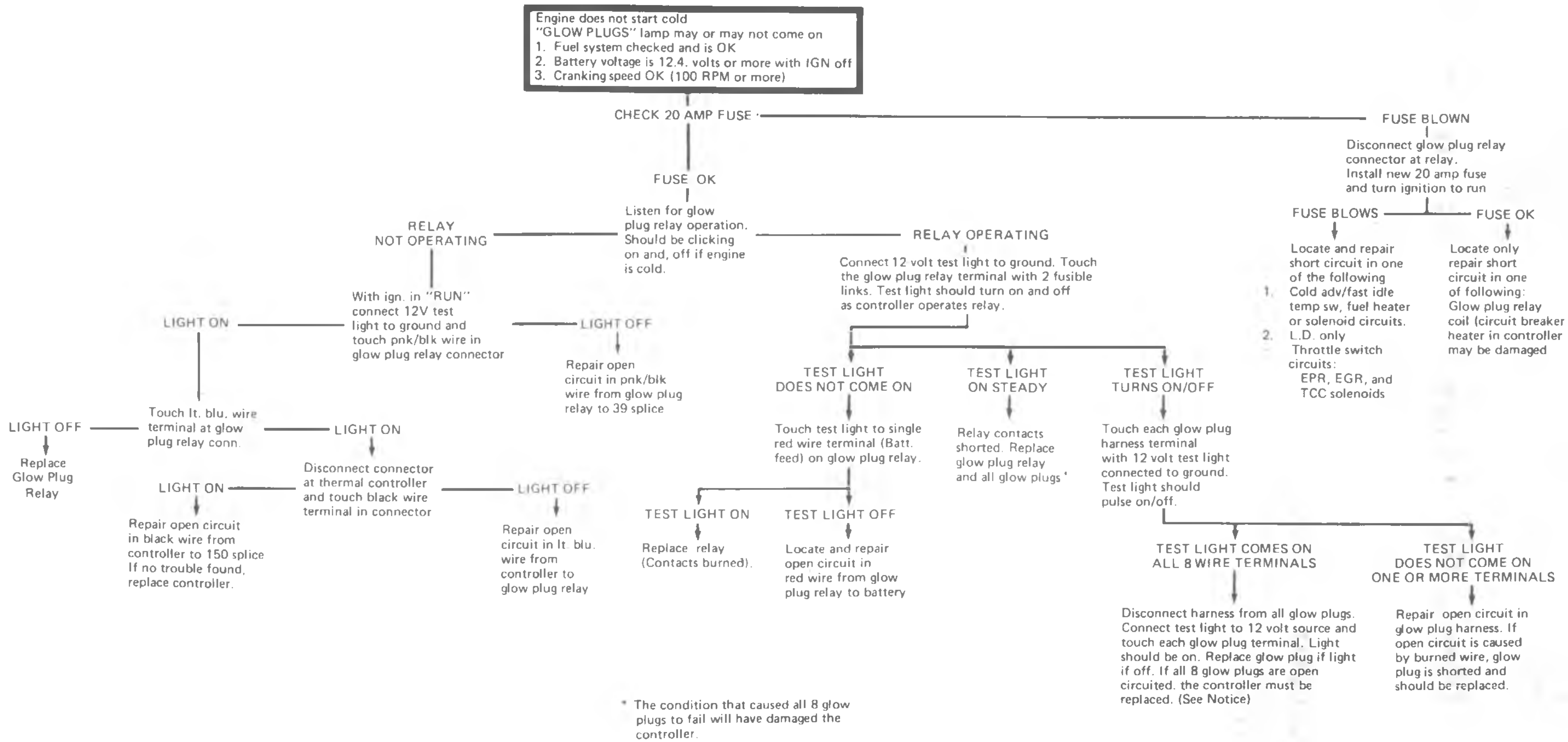
Diesel Glow Plug Electrical System Diagnosis

Before attempting any diagnosis of problems in the glow plug electrical system, insure that connectors are installed properly and that all connections are clean and tight.

STARTER/GENERATOR MOUNTING

Starter and Generator mounting is illustrated in Figures 6D-43 through 6D-45.

6.2L. DIESEL ELECTRICAL SYSTEM DIAGNOSIS



THERMAL CONTROLLER CHECK

With connector removed from controller the controller heater circuits may be checked using a high impedance ohmeter. However, this check will not determine shorted switches within the controller.

Pin 3 – Pin 2 .40 to .75 Ω

Pin 4 – Pin 5 27 Ω ± 3 Ω

Pin 5 – Pin 1 130 Ω ± 10%

Pin 2 – Pin 6 Continuity ("O" ohms)

GLOW PLUGS LAMP CYCLES ON AND OFF WARM ENGINE

↓

This condition can be caused by an open circuit in 25 circuit from gen telltale output to pin 1 of the controller, or by generator output failure – To check generator operation, see Section 6D of this manual.

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6.2 LITER DIESEL ELECTRICAL SYSTEM DIAGNOSIS

ENGINE CONTINUES TO RUN IGNITION KEY OFF

↓

ENGINE CONTINUES TO RUN

↓

Disconnect pink wire at injection pump solenoid.

- ENGINE CONTINUES TO RUN
  ↓
  Remove injection pump for repair.
- ENGINE STOPS
  ↓
  Check ignition switch adjustment. If OK, replace ignition switch. Check ign. sw. assoc. wiring.

ENGINE STAYS ON FAST IDLE AT ALL TIMES

↓

Turn A/C off, ignition on and disconnect fast idle solenoid — dark green wire.

- SOLENOID DOES NOT RETRACT
  ↓
  Check throttle linkage or solenoid plunger for binding. If linkage is OK, replace solenoid.
- SOLENOID RETRACTS
  ↓
  Connect solenoid wire. Open throttle slightly. Disconnect 2-wire connector at fast idle temperature sw.
  ↓
  SOLENOID RETRACTS
  ↓
  Check continuity of temperature switch with self powered test light (KD-125 or equiv): continuity below 90°F, no continuity above 122°F. Replace switch if bad.

ENGINE RUNS ROUGH ON COLD START GLOW PLUGS NOT CYCLING ON AND OFF AFTER ENGINE STARTS — 20 AMP FUSE OK

(All open circuit in the orn wire from controller to glow plug relay or an open heater element between pin 4 and 5 of the controller will cause this condition)

↓

WITH IGN OFF
Using self powered test lite check continuity of orn wire from pin 4 of controller, to the glow plug relay.

- NO CONTINUITY
  Repair open circuit in orn wire from controller to relay.
- CONTINUITY
  ↓
  Disconnect controller connector and using a high impedance millimeters check pin 4 to pin 5 resistance (should be 27 $\pm$ Ω 3)
  → INCORRECT READING OR OPEN CIRCUIT — Controller is defective.

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6.2 LITER DIESEL ELECTRICAL DIAGNOSIS

NO GLOW PLUGS LAMP –

1. Check 20 Amp Fuse
FUSE OK

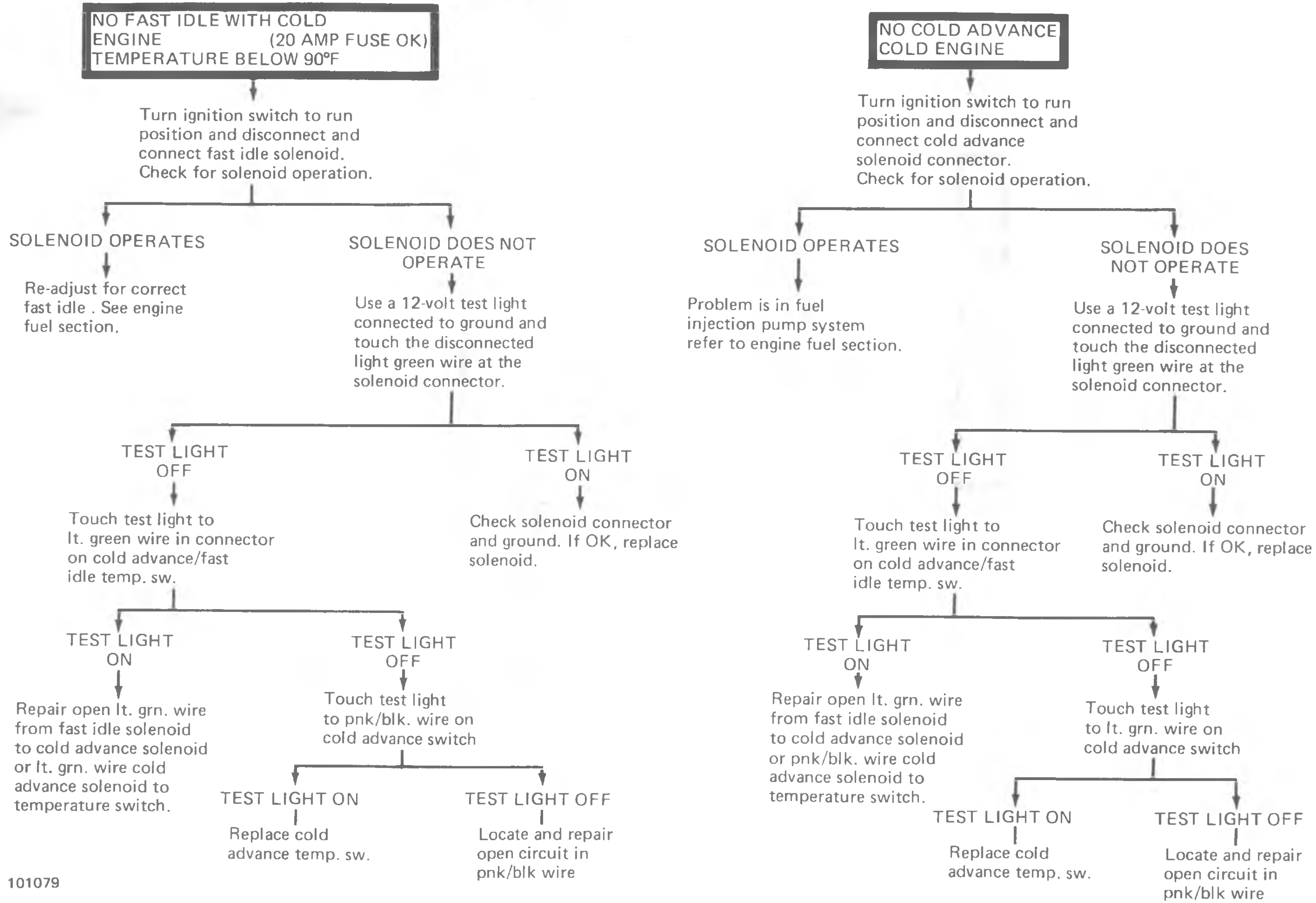
↓

With ignition in "Run"
Check for glow plug relay operation
by listening for click at relay.

- **Relay clicking**
  ↓
  With ignition switch OFF
  Check continuity of BLK wire circuit 150A,
  from bulb socket to fuse block bus bar grd.
  - **Continuity**
    Check continuity of ORN/BLK wire
    circuit 503 from bulb socket to
    splice 503
  - **No Continuity**
    Repair as necessary
- **Not clicking**
  go to
  "Engine does not
  start cold" chart
  (relay not operating).

6.2 LITER DIESEL ELECTRICAL SYSTEM DIAGNOSIS

IF NEITHER FAST IDLE OR COLD ADVANCE SOLENOIDS OPERATE, CHECK FOR VOLTAGE AT COLD ADV/FAST IDLE TEMP. SW.



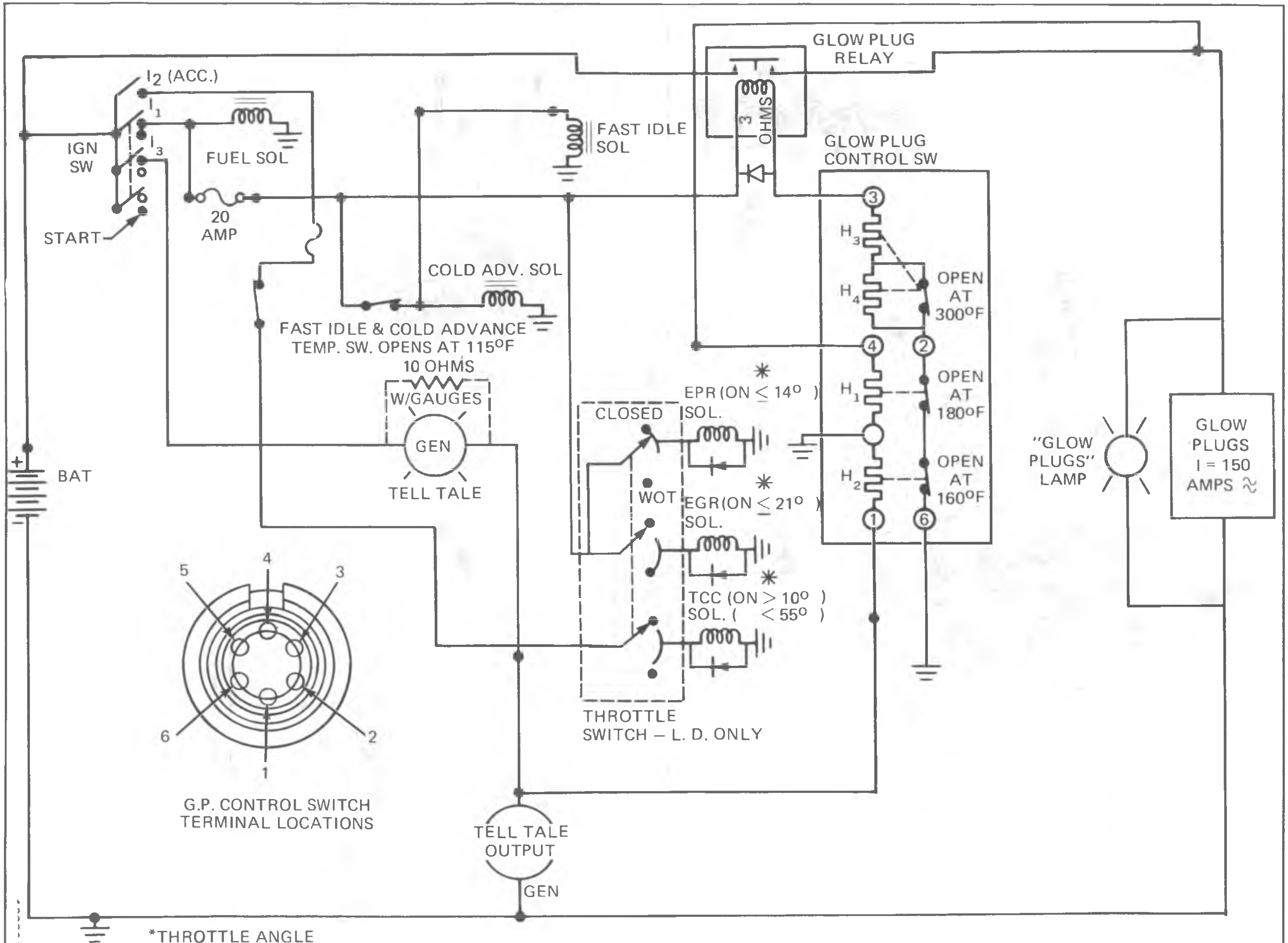


Fig. 6D-42--Diesel Glow Plug Simplified Wiring Diagram

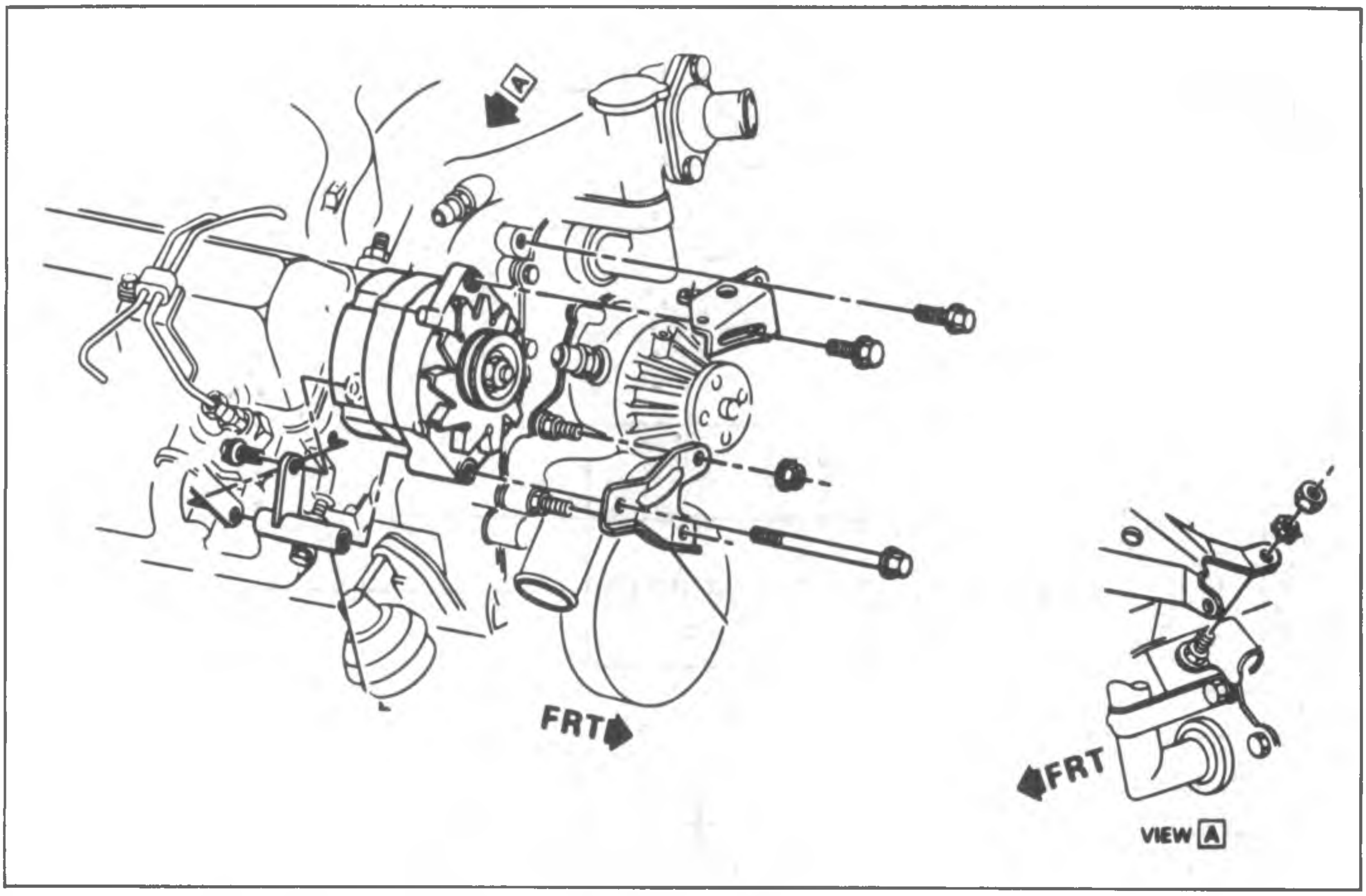


Fig. 6D-45--Generator Mounting - with A/C

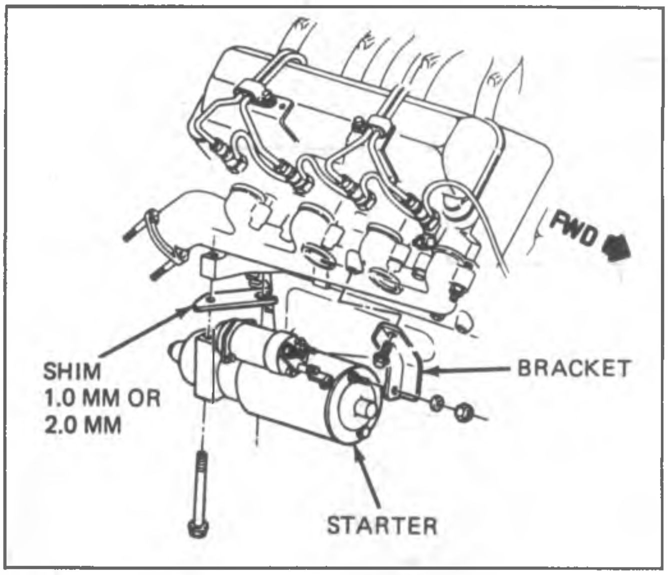


Fig. 6D-43--Diesel Starter Mounting

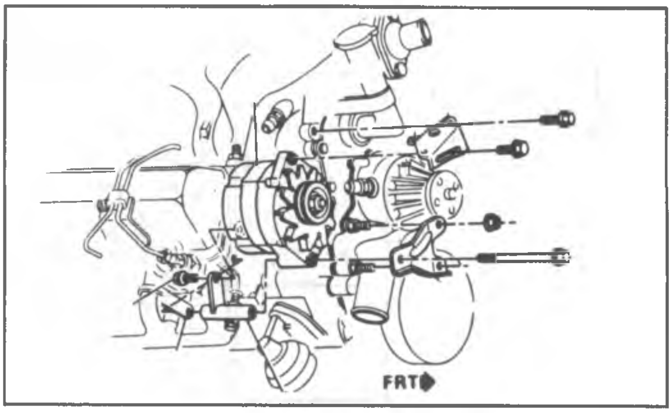


Fig. 6D-44--Generator Mounting

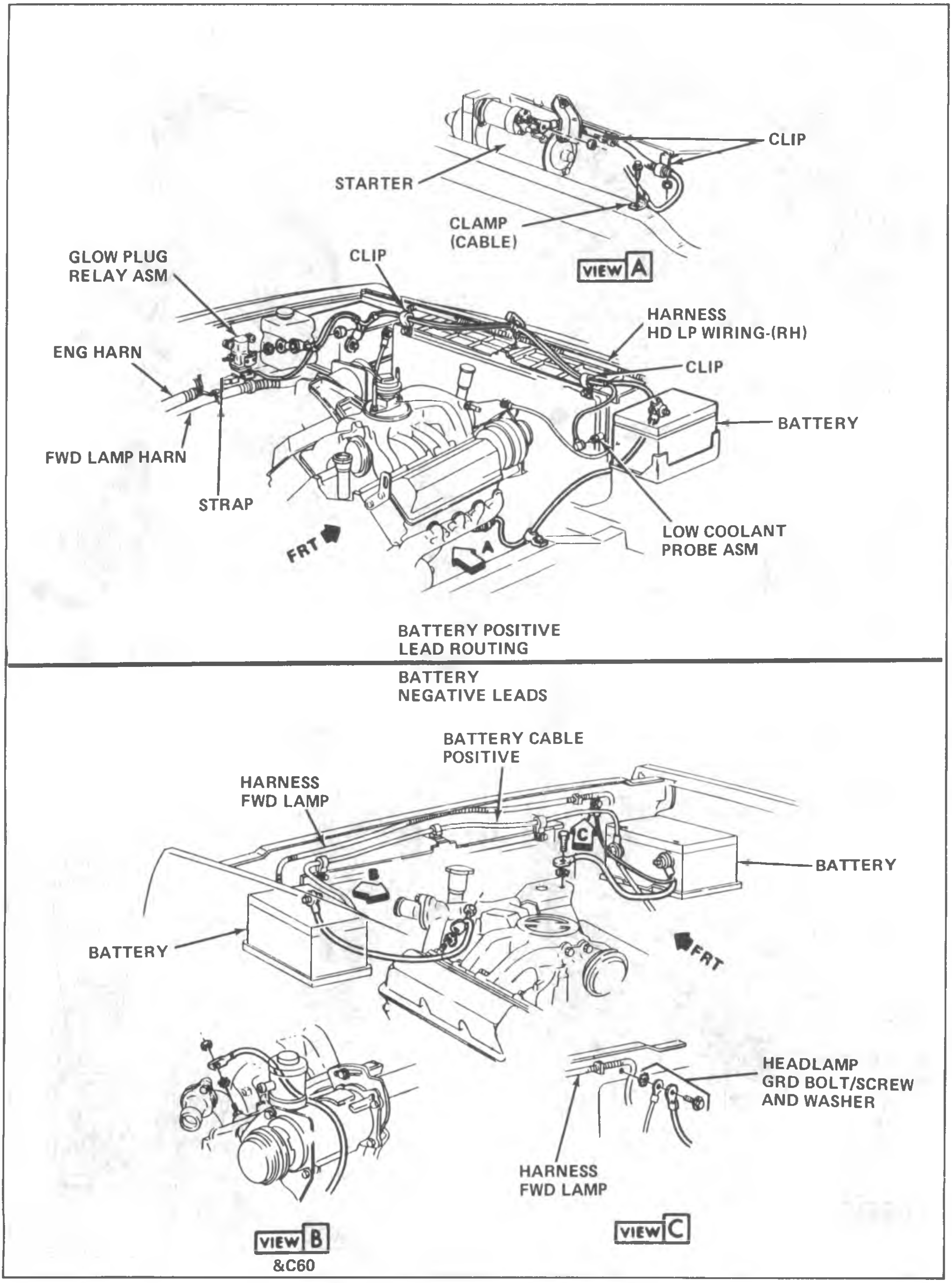


Fig. 6D-46--Battery and Leads

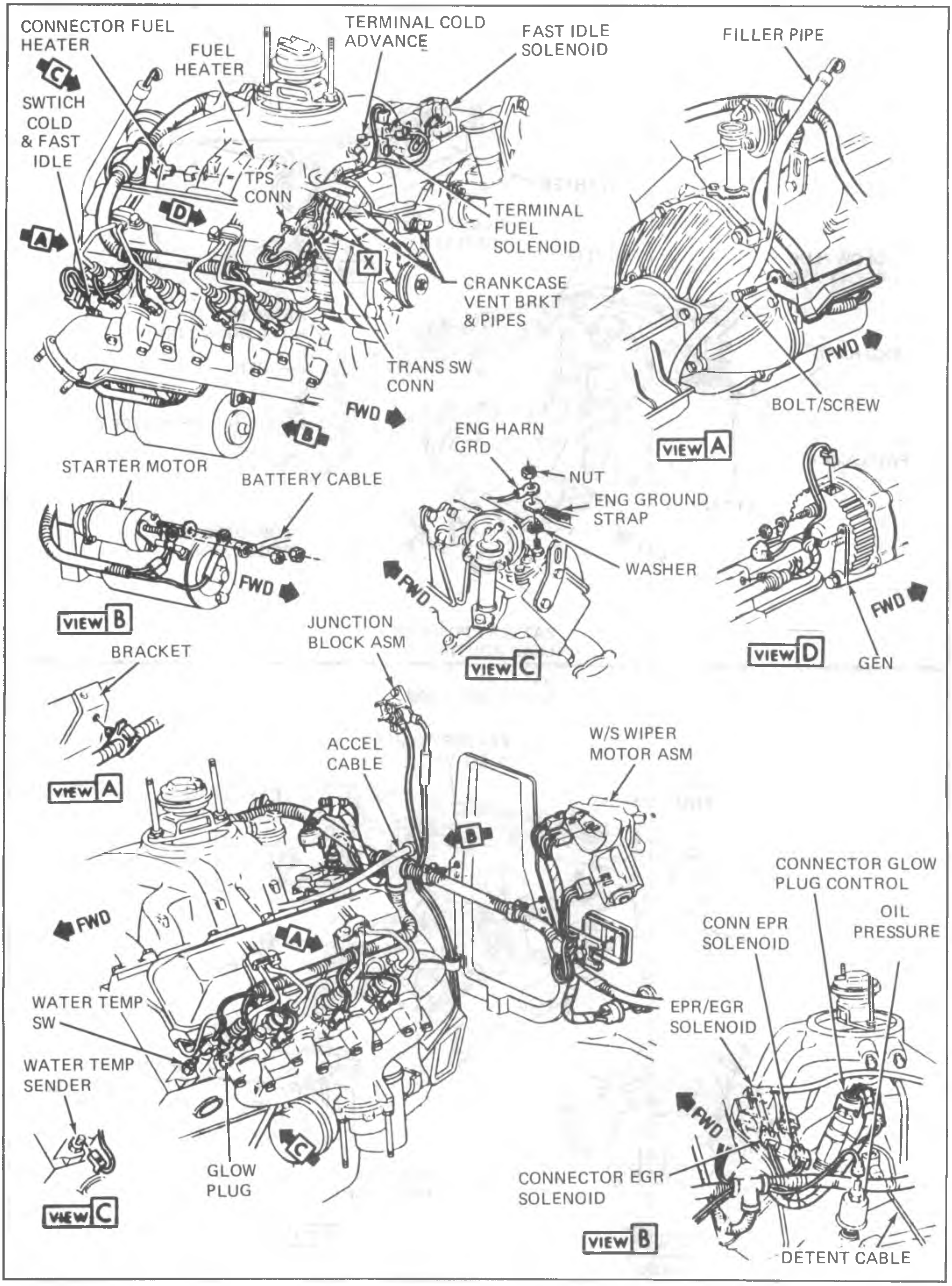


Fig. 6D-47--Engine Compartment Wiring-LH6

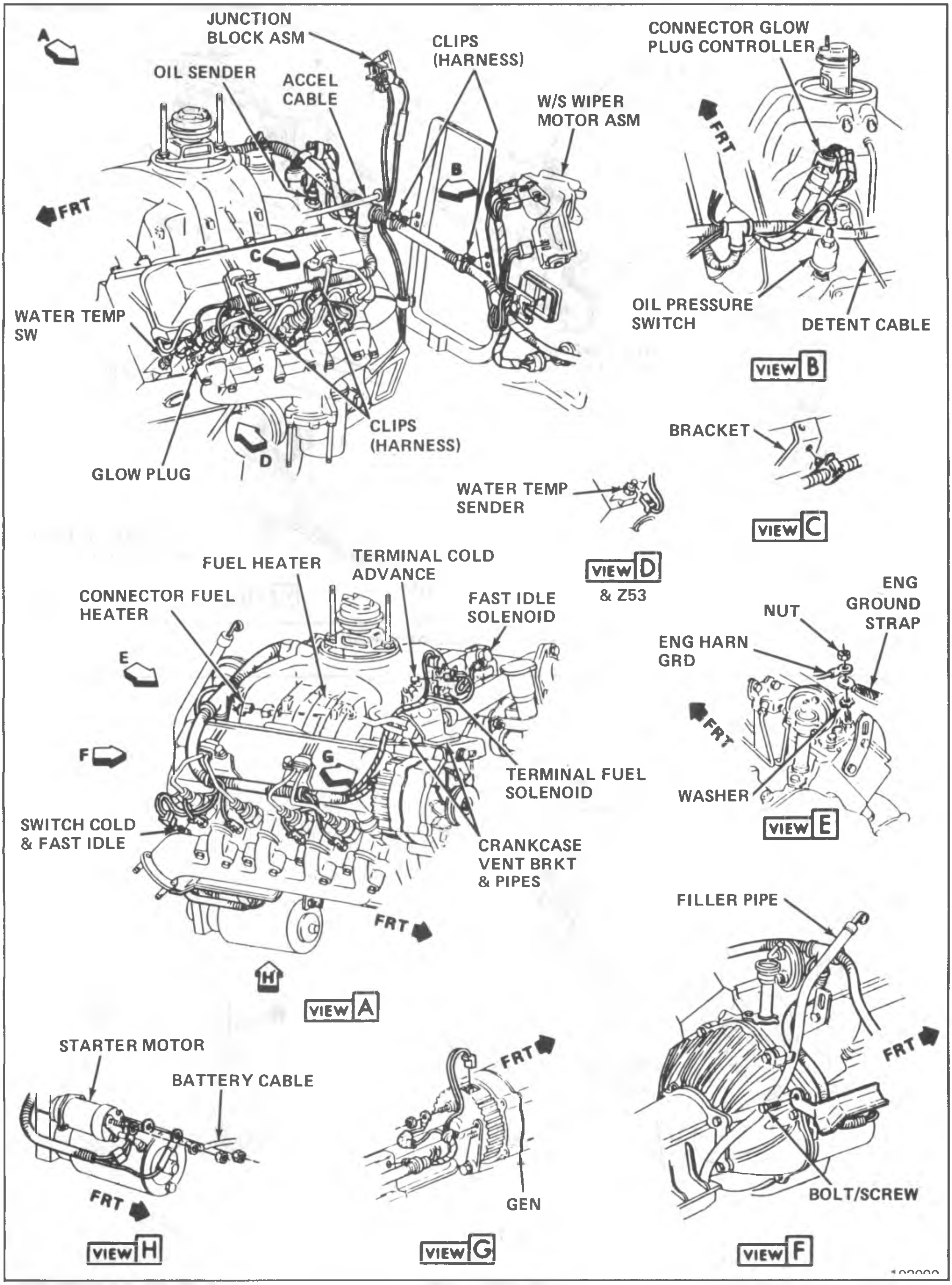


Fig. 6D-48--Engine Compartment Wiring-LL4

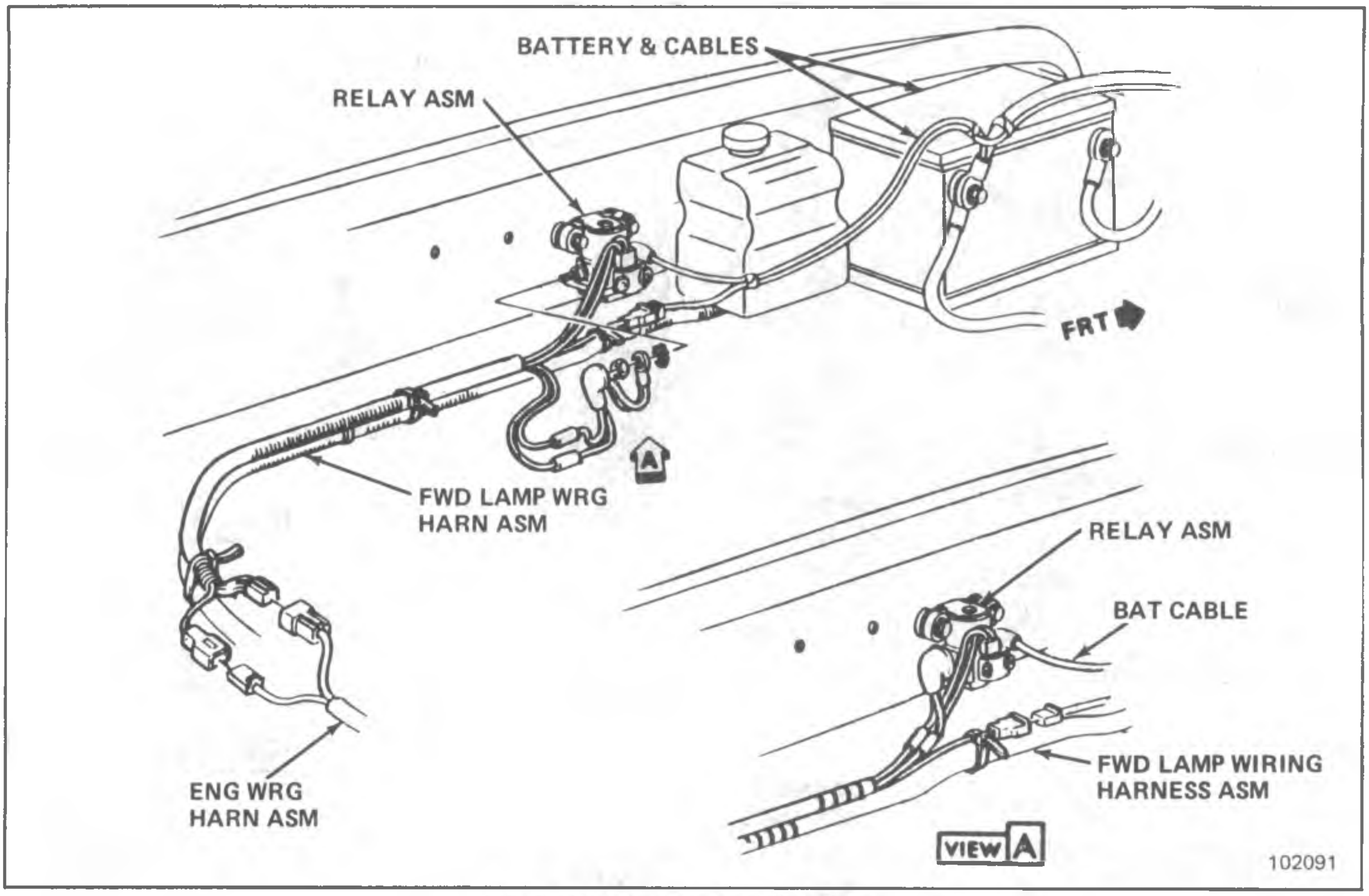


Fig. 6D-49--Diesel Engine Wiring-Relay

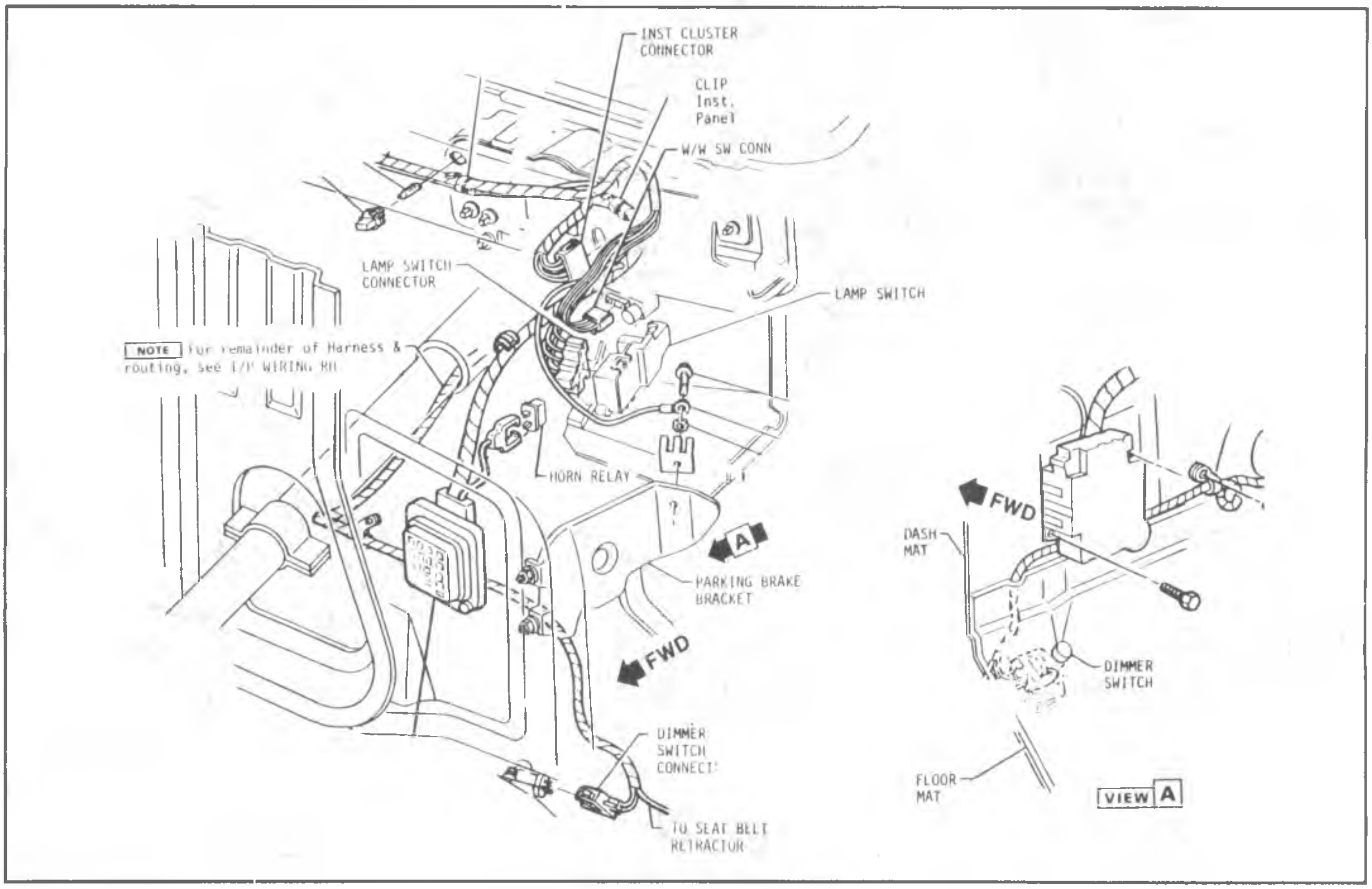


Fig. 6D-50--I.P. Wiring-Left Side and Bus Bar Grd

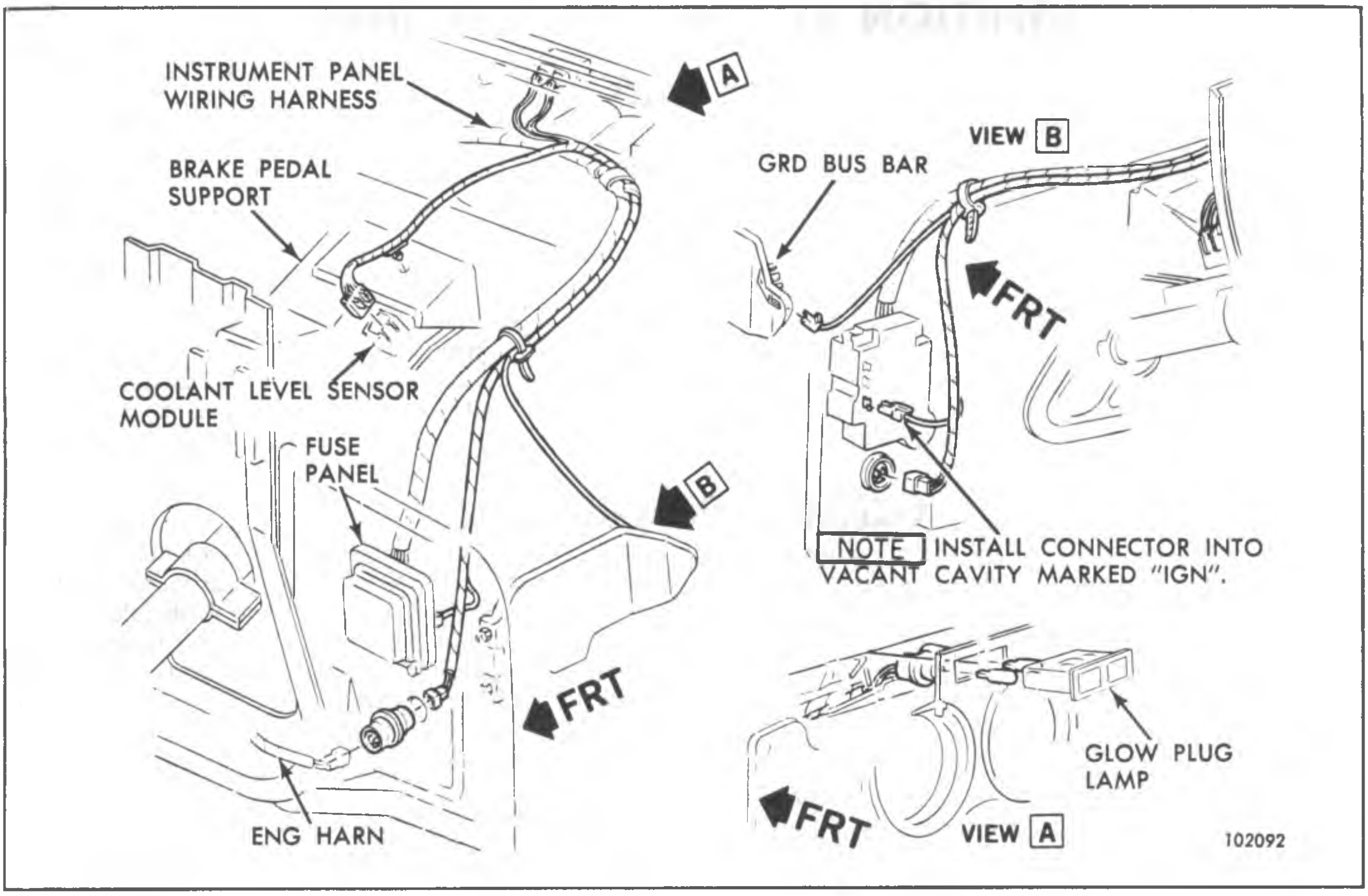


Fig. 6D-51--Glow Plug Lamp Wiring

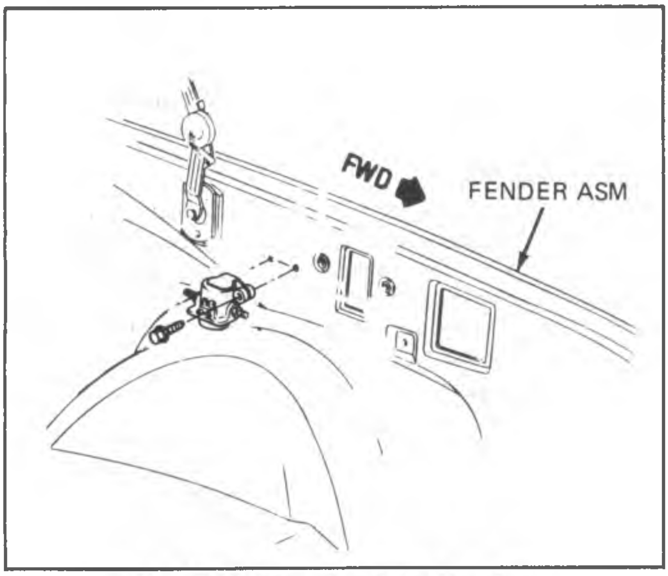


Fig. 6D-52--Glow Plug Relay Mounting

IGNITION SYSTEM - GAS ENGINES

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GENERAL DESCRIPTION

The ignition circuit consists of the battery, the distributor, the ignition switch, the spark plugs, and the primary and secondary wiring. Refer to the Battery portion of this section for battery information.

H.E.I. DISTRIBUTOR

The High Energy Ignition distributor used on all engines combines all ignition components in one unit (Fig. 6D-53 and 6D-54). The external electrical connections are the ignition switch feed wire, the tachometer pickup, and the six or eight spark plug leads. The ignition switch feed connector to the distributor has full battery voltage when the ignition switch is in the "RUN" and "START" positions. There is NO RESISTOR WIRE FROM THE IGNITION SWITCH TO THE DISTRIBUTOR. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor. The High Energy Ignition System is basically identical in operation to conventional ignition except the module and pick-up coil replace the contact points.

The High Energy Ignition is a magnetic pulse triggered, transistor controlled, inductive discharge ignition system. The magnetic pick-up assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth, and a pick-up coil. When the teeth of the timer core rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage in the pick-up coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding which is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise supression.

The magnetic pick-up assembly is mounted over the main bearing on the distributor housing, and is made to rotate by the vacuum control unit, thus providing vacuum advance. The timer core is made to rotate about the shaft by conventional advance weights, thus providing centrifugal advance.

The module automatically controls the dwell period, stretching it with increasing engine speed. The HEI system also features a longer spark duration, made possible by the higher amount of energy stored in the coil primary. This is desirable for firing lean mixtures.

Some engines use an HEI/EST distributor. All spark timing changes in the H.E.I. (EST) distributor are done electronically by the Electronic Control Module (ECM) which monitors information from various engine sensors, computes the desired spark timing and signals the distributor to change the timing accordingly. No vacuum or mechanical advance are used. Further EST information is found in Section 6E, Emissions.

Electronic Spark Control

An additional electronic control (ESC) is used on vehicles equipped with an LE9 engine. The Electronic Spark Control (ESC) system is a closed loop system that controls engine detonation by modifying the spark advance when detonation occurs, after which the spark control will revert to EST. The amount of retard is a function of the degree of detonation.

There are two basic components in this system as outlined below.

Controller. (Fig. 6D-55)

The (ESC) controller processes the sensor signal and applies it to the distributor to adjust spark timing. The process is continuous so that the presence of detonation is monitored and controlled. The controller is a hard wired signal processor/amplifier which operates from 6 to 16 volts. The controller has no memory storage.

Sensor (Fig. 6D-55)

The (ESC) sensor is a piezoelectric device, mounted in the engine block that detects the presence (or abscence) and intensity of detonation by the vibration characteristics of the engine. The output is an electrical signal that goes to the controller. A sensor failure would allow no retard.

ESC Vacuum Switch See (Fig. 6D-56)

On LE9 engine equipped vehicles with automatic transmission a "tip in" vacuum switch is used. Its function is to provide a momentary contact closure (signal) to the ESC controller during a throttle "tip in" condition which then briefly retards spark timing to minimize knock.

The switch contacts are normally open under steady engine vacuum conditions including no vacuum, and all brief increasing vacuum conditions. Basically the switch closes only during rapidly decreasing vacuum conditions such as that encountered on rapid throttle operation.

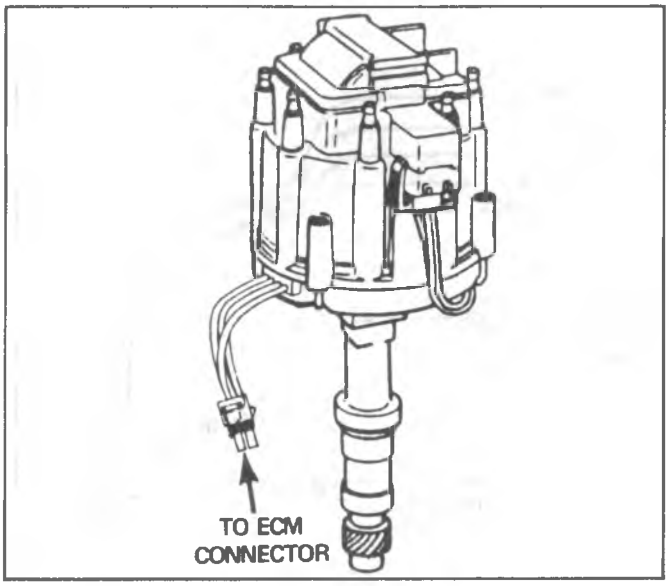


Fig. 6D-53--HEI Distributor Assembly

When making compression checks, disconnect ignition switch connector (pink wire) from HEI system.

No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

IGNITION TIMING

Timing specifications for each engine are listed in Section 6E and on the Vehicle Emissions Control Information label on the radiator support. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. Do not pierce the plug lead. Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly. The timing procedure remains the same as the conventional ignition system. Always follow Vehicle Emissions Control Information label procedures when adjusting timing.

Some engines will incorporate a magnetic timing probe hole for use with special electronic timing equipment. Consult manufacturer's instructions for use of this equipment.

SECONDARY WIRING

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 8mm diameter silicone rubber jacket. The silicone wiring will withstand very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. The silicone spark plug boots form a tight seal on the plug and the boot should be twisted 1/2 turn before removing. Care should also be exercised when connecting a timing light or other pick-up equipment. Do not force contacts between the boot and wiring or through the silicone jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot, or use a tool designed for this purpose.

SPARK PLUGS (FIG. 6D-57)

Resistor type, tapered seat spark plugs are used on all gasoline engines. No gasket is used on these tapered seat plugs. See Fig. 6D-58 for an explanation of letter coding on spark plugs.

See Engine Exhaust Emissions Section (6E) for spark plug application and gap sizes. Always replace plugs with the correct plug listed on the Vehicle Emissions Control Information label.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high-speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling or continual stop-and-go or slow-speed driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over with resultant missing of

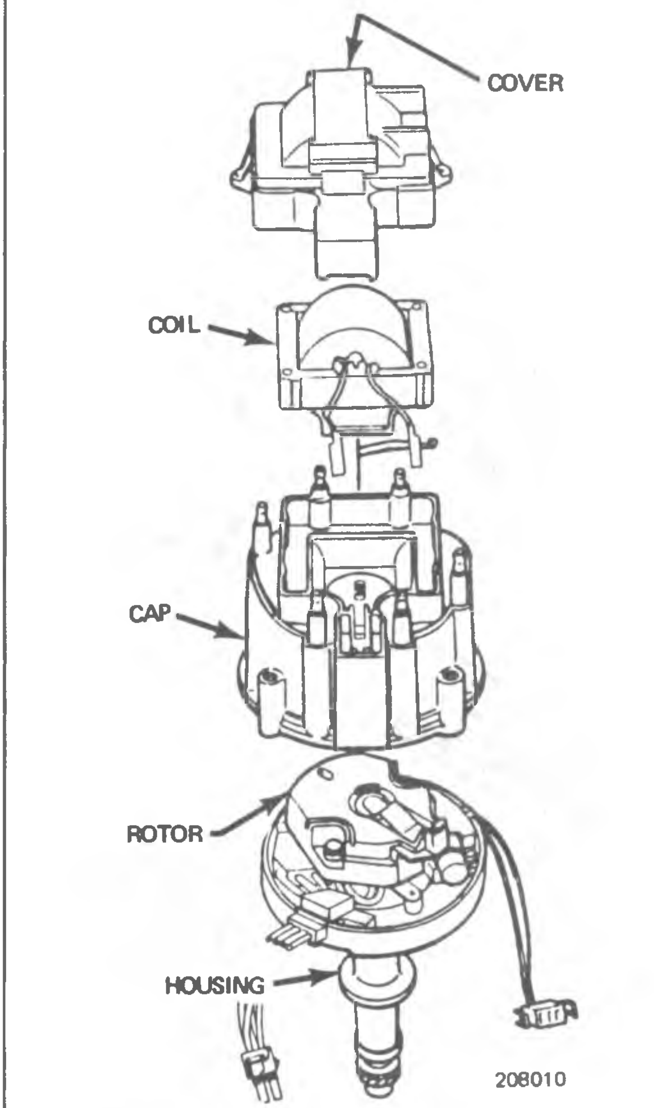


Fig. 6D-54--HEI Distributor - Exploded View

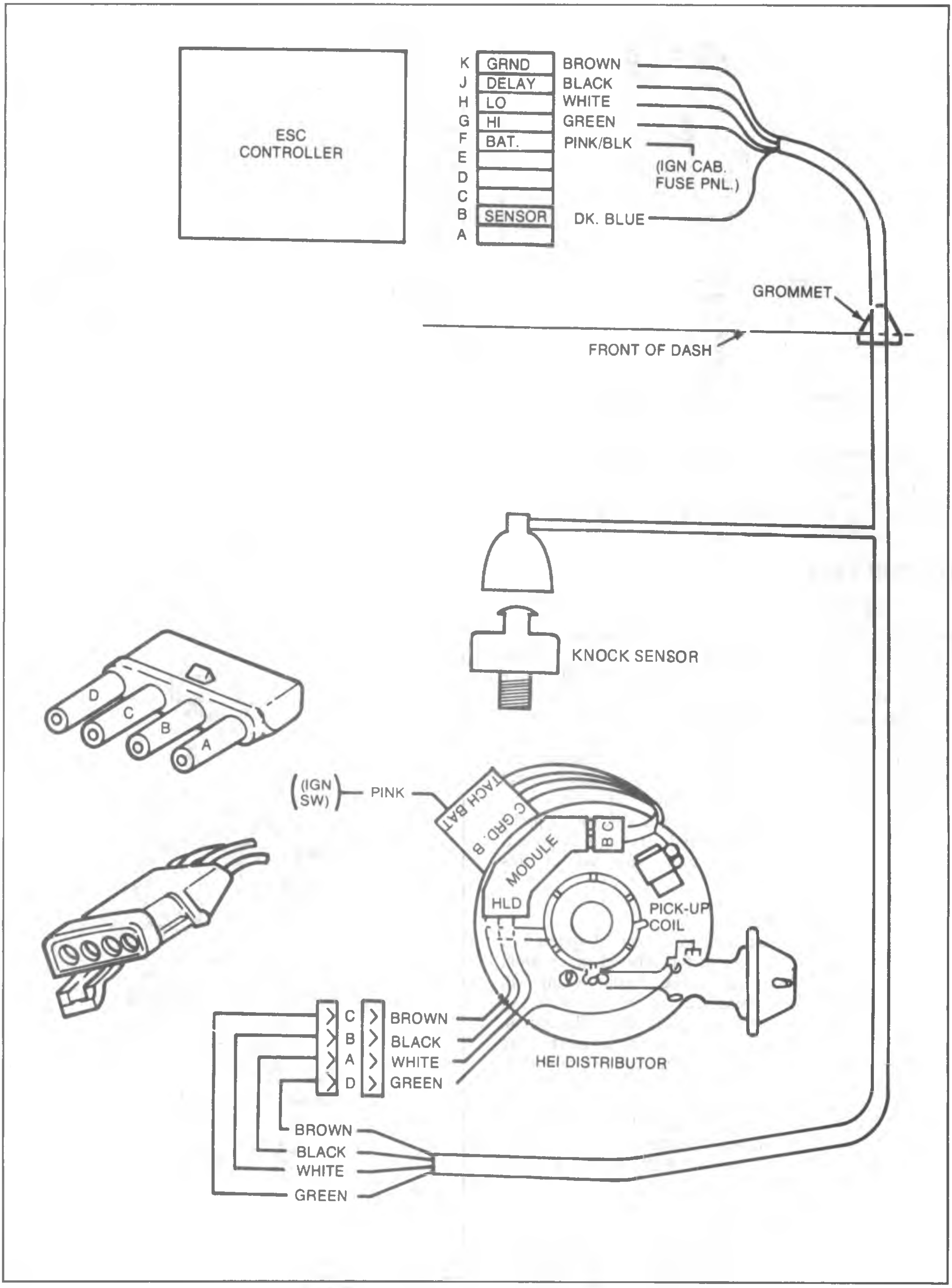


Fig. 6D-55--ESC Controller, Sensor and Wiring

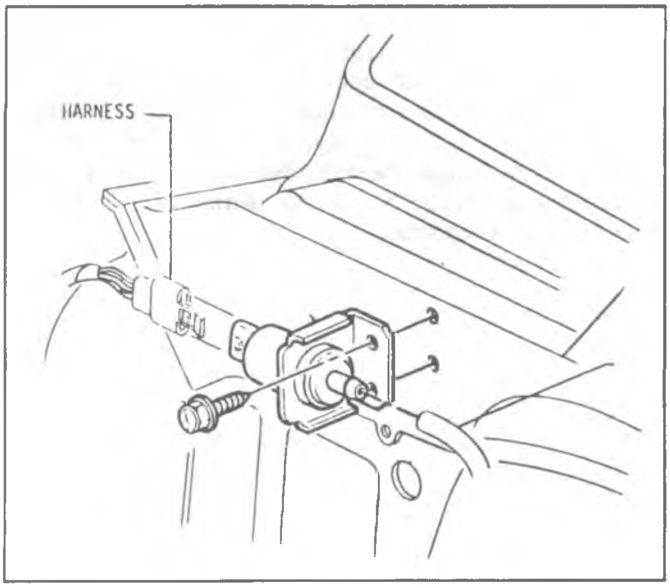


Fig. 6D-56--ESC Vacuum Switch Mounting

engine, even though a film is allowed to accumulate on exposed portion of plug porcelains.

Do not mistake corona discharge for flash-over or a shorted insulator. Corona is a steady blue light appearing around insulator, just above the shell crimp. It is the visible evidence of high-tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring

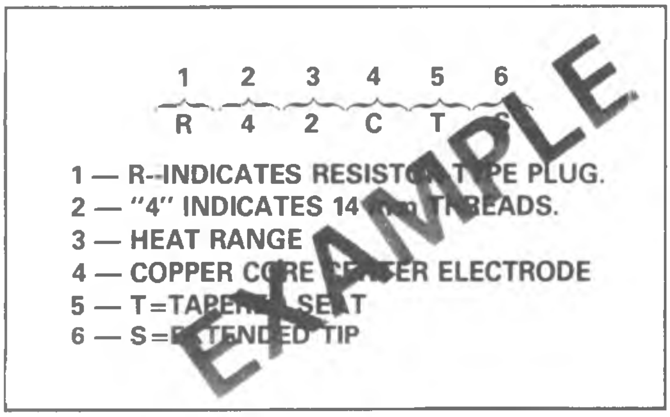


Fig. 6D-58--Spark Plug Coding

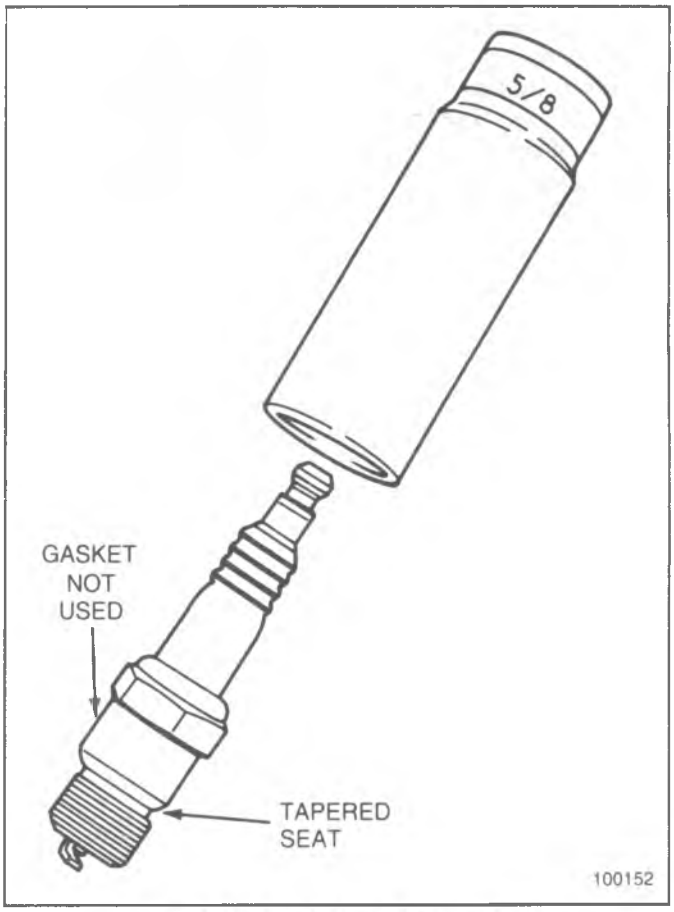


Fig. 6D-57--Spark Plug - Tapered Seat

is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

IGNITION SWITCH

The mechanical switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B. See Section 8 for the detailed explanation of the electrical switching.

DIAGNOSIS

H.E.I. DISTRIBUTOR

Use Figure 6D-59 and 60 for H.E.I. Diagnosis.

SPARK PLUGS

Worn or dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to carbon fouled plugs, excessive gap or broken insulator.

Fouled plugs may be indicated by checking for black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that are consistently greater than normal or that a plug which is too hot is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads, due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of shell and may not be visible.

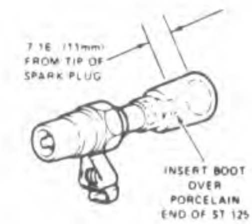
Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of break may result from the plug operating too "hot", encountered in sustained periods of high-speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

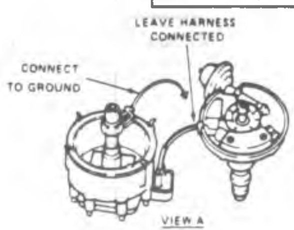
ENGINE CRANKS, BUT WILL NOT RUN (WITH INTEGRAL IGNITION COIL)

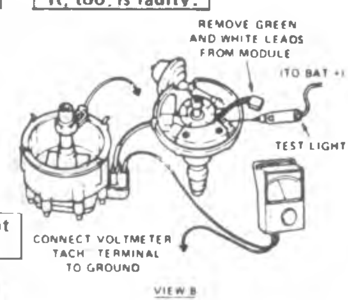
NOTE: Perform Diagnostic Circuit Check before using this procedure.
If a tachometer is connected to the tachometer terminal, disconnect it before proceeding with the test.
Intermittent no start may be caused by wrong pick-up or ignition coil.

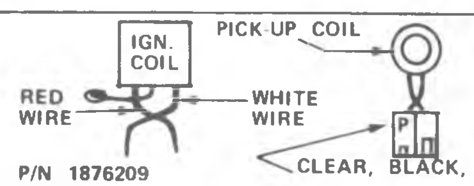
1. Check spark at plug with ST-125 while cranking (if no spark on one wire, check a second wire). *

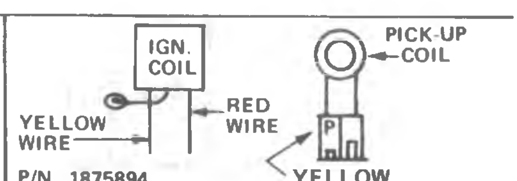
- Spark
  - Check fuel, spark plugs, etc.
- No Spark
  - Disconnect 4 term. EST connector and see if engine will run.
    - Runs
      - See Code 42 chart.
    - Doesn't run
      - 2. Check voltage at distributor "bat" terminal while cranking
        - Under 7 volts
          - Repair primary circuit to ignition switch.
        - 7 volts or more
          - 3. With ignition "on," check "tach" terminal voltage.
            - Under 1 Volt
              - It is faulty ign. coil connection or coil
            - 1 to 10 Volts
              - Replace module and check for spark from coil as in Step 6.
                - Spark
                  - System OK
                - No Spark
                  - Replace ign. coil. It, too, is faulty.
            - 10 Volts or More
              - 4. Check for spark at coil output terminal with ST-125 while cranking. (View A)
                - Spark
                  - Check color match of pick-up coil connector and ign. coil lead. ** Inspect cap for water, cracks, etc. If OK replace rotor.
                - No Spark
                  - 5. Remove pick-up coil leads from module Check tach. term. voltage with "ign" "on." Watch voltmeter as test light is momentarily connected from bat. + to module terminal "P". (View B) Not more than 5 seconds
                    - No Drop In Voltage
                      - Check module grnd and for open in wires from cap to distributor. If OK, replace mod.
                    - Voltage Drops
                      - 6. Check for spark from coil with ST-125 as test light is removed from module terminal.
                        - Spark
                          - It is pick-up coil or connections. Coil resistance should be 500-1500 ohms and not grounded.
                        - No Spark
                          - If module tester is available, test module
                            - Bad
                              - Replace module
                            - OK
                              - Check ign. coil ground. If OK, replace ign. coil.
                          - If no module tester is available
                            - 7. Check ign. coil ground circuit. If OK, replace ign. coil and repeat Step 6.
                              - Spark
                                - System OK
                              - No Spark
                                - Coil removed is OK, reinstall original coil and replace module.











* A few sparks and then nothing, is considered no spark.

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Fig. 6D-59--HEI Diagnosis

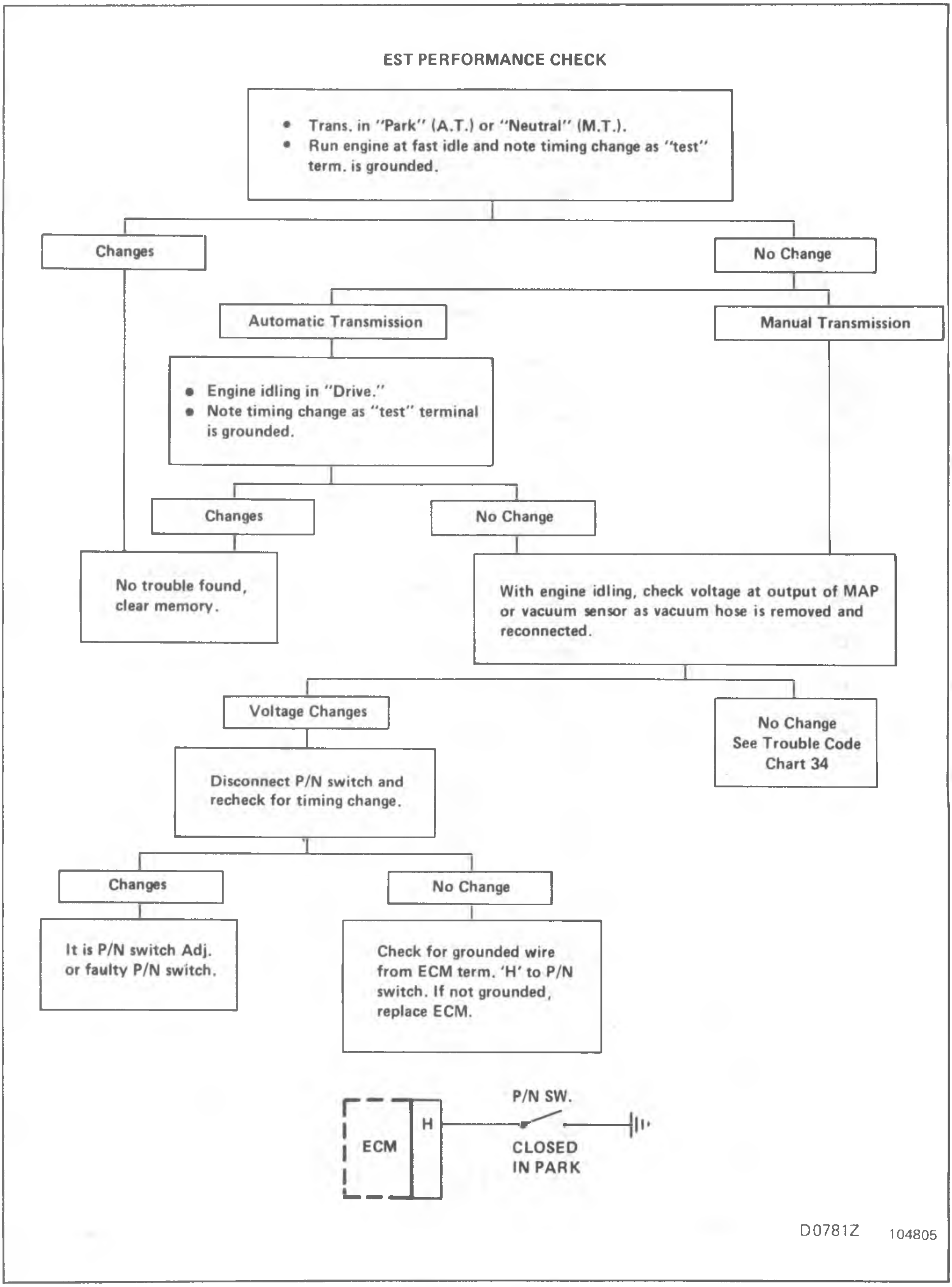


Fig. 6D-60--HEI Diagnosis

CHEVROLET LIGHT TRUCK
ESC SYSTEM DIAGNOSIS

BEFORE ATTEMPTING ANY DIAGNOSIS, CHECK CONNECTION AT SENSOR AND INSURE THAT ALL CONNECTIONS ARE CLEAN AND TIGHT

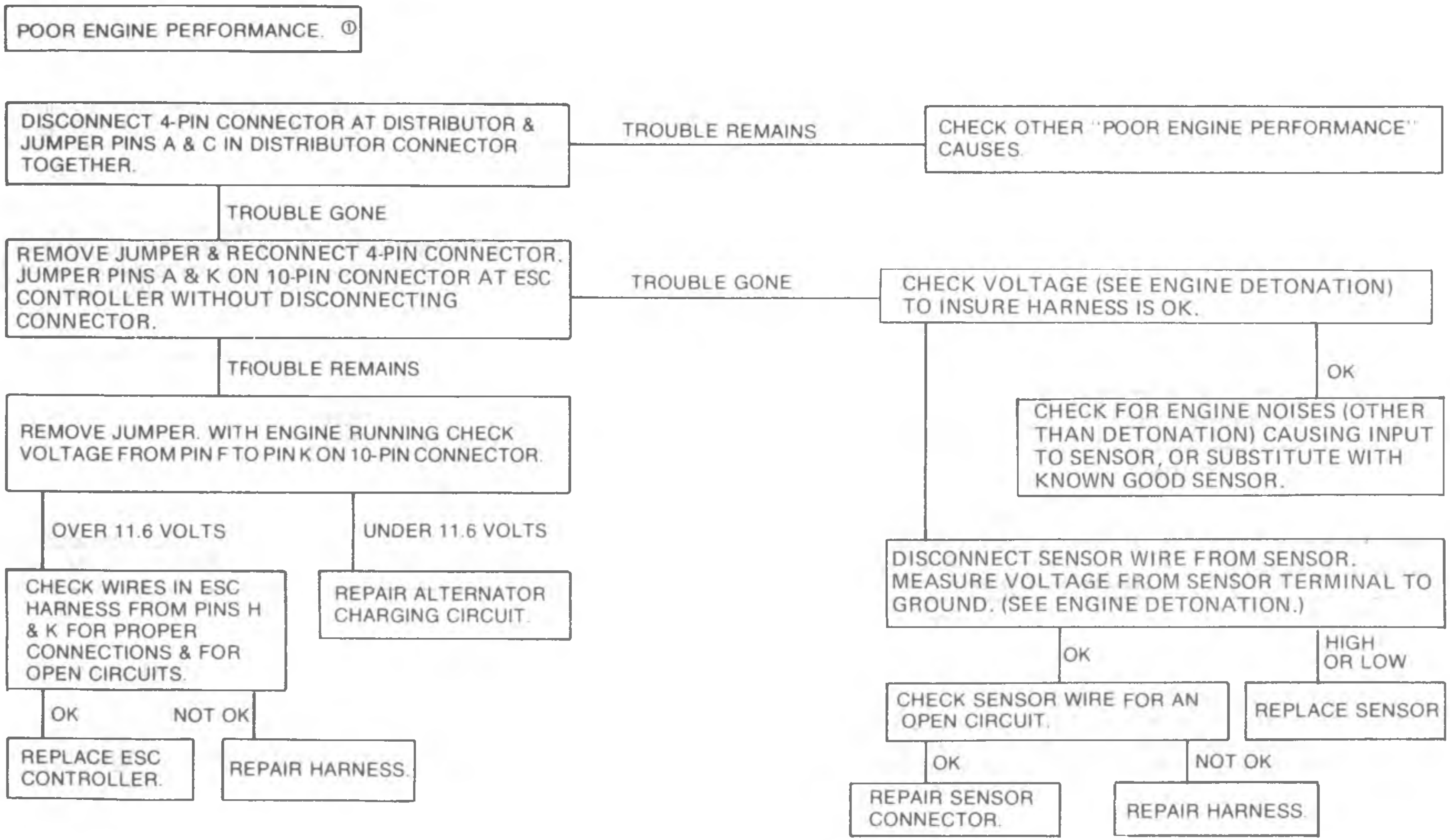
ENGINE DETONATION ①

WITH ENGINE RUNNING AT FAST IDLE SPEED & TRANS. IN N OR P (ENGINE SPEED ABOVE 1000 RPM), TAP EXHAUST MANIFOLD LIGHTLY & REPEATEDLY & CHECK FOR SPARK TIMING RETARD (WITH TIMING LIGHT).

- RETARD → CHECK OTHER "ENGINE DETONATION" CAUSES
- NO RETARD → DISCONNECT 10-PIN CONNECTOR FROM ESC CONTROLLER. MEASURE VOLTAGE FROM PIN B TO PIN K IN CONNECTOR WITH ENGINE OPERATING AT APPROX. 2000 RPM. VOLTAGE SHOULD BE GREATER THAN 80 MILLIVOLTS, (.08 VOLTS)
  - LOW → DISCONNECT SENSOR WIRE FROM SENSOR. MEASURE VOLTAGE FROM SENSOR TERMINAL TO GROUND. SHOULD BE GREATER THAN 80 MILLIVOLTS (.08 VOLTS) WITH ENGINE OPERATING AT APPROX 2000 RPM.
    - HIGH OR LOW → REPLACE SENSOR.
    - OK → CHECK WIRES FROM PINS A, B, & K (IN 10-PIN CONNECTOR) FOR OPEN & SHORT CIRCUITS.
      - OK → REPAIR SENSOR CONNECTOR.
      - NOT OK → REPAIR HARNESS.
  - OK → TRY TO START ENGINE (WITH 10-PIN CONNECTOR DISCONNECTED).
    - START → REPLACE DISTRIBUTOR MODULE.
    - NO START → RECONNECT 10-PIN CONNECTOR TO CONTROLLER. DISCONNECT SENSOR WIRE FROM SENSOR & INSERT A JUMPER WIRE INTO SENSOR WIRE CONNECTOR. WITH ENGINE RUNNING AT FAST IDLE SPEED, LAY WIRE ON TOP OF DISTRIBUTOR OVER IGNITION COIL & CHECK FOR SPARK TIMING RETARD.
      - RETARD → REPLACE SENSOR.
      - NO RETARD → MEASURE VOLTAGE FROM PIN H TO PIN K WITH IGNITION SWITCH ON. SHOULD BE MORE THAN 0.2 VOLT.
        - OK → REPLACE ESC CONTROLLER.
        - NOT OK → REPAIR OPEN CIRCUIT IN WIRE FROM PIN H IN ESC HARNESS.

① SOME OCCASIONAL TRACE-TO-LIGHT DETONATION IS ACCEPTABLE

CHEVROLET LIGHT TRUCK
ESC SYSTEM DIAGNOSIS



CHEVROLET LIGHT TRUCK
ESC SYSTEM DIAGNOSIS

ENGINE CRANKS BUT DOES NOT START. ①

CHECK ESC HARNESS FOR PROPER CONNECTIONS.
1. 10-PIN CONNECTOR TO ESC CONTROLLER.
2. 4-PIN CONNECTOR TO DISTRIBUTOR.
3. 2-BLADE MALE CONNECTOR TO DISTRIBUTOR.
4. 2-BLADE FEMALE CONNECTOR TO IGNITION SWITCH LEAD (PINK WIRE).

- NOT OK → REPAIR CONNECTIONS.
- OK ↓

DISCONNECT 4-PIN CONNECTOR AT DISTRIBUTOR & JUMPER PINS A & C IN DISTRIBUTOR CONNECTOR TOGETHER.

- NO START → CHECK OTHER "ENGINE CRANKS BUT DOES NOT START" CAUSES.
- START ↓

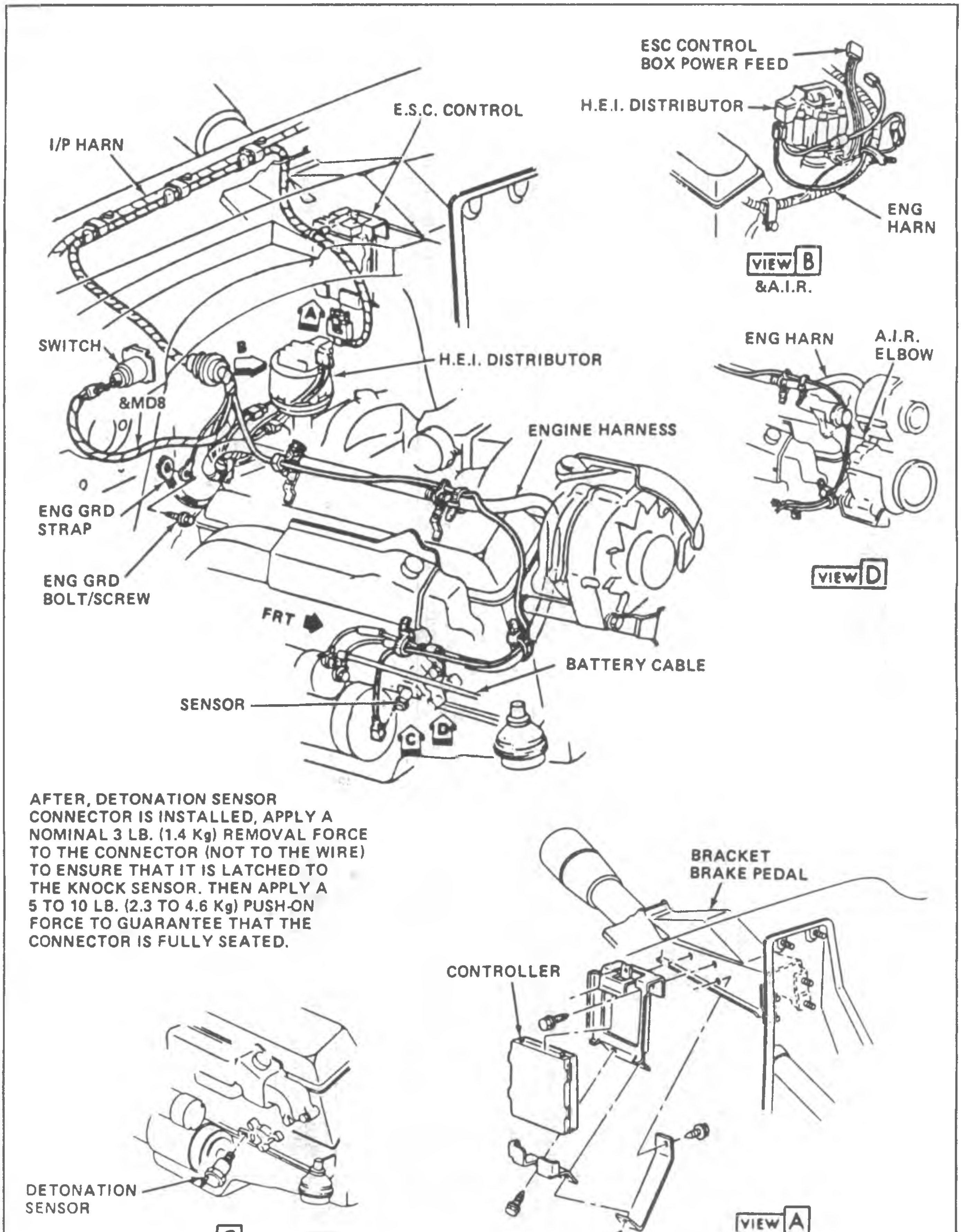
REMOVE JUMPER & RECONNECT 4-PIN CONNECTOR TO DISTRIBUTOR. WITH IGNITION ON, CHECK VOLTAGE FROM PIN F TO PIN K ON 10-PIN CONNECTOR AT ESC CONTROLLER.

- UNDER 7.0 VOLTS → REPAIR CIRCUIT BETWEEN IGNITION SWITCH & PIN F.
- OVER 7.0 VOLTS ↓

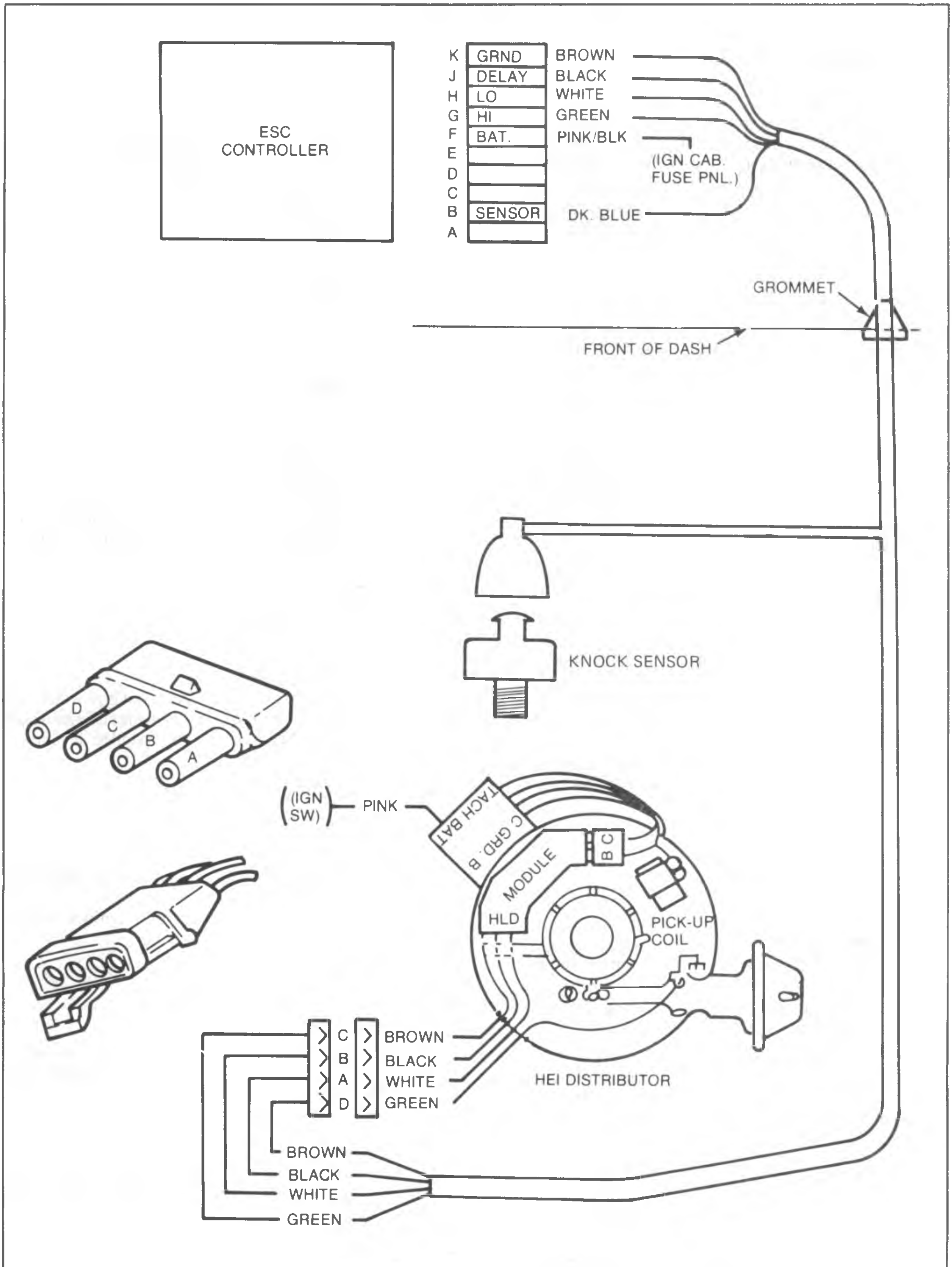
CHECK WIRES IN ESC HARNESS FROM PINS G, H, J, & K (IN 10-PIN CONNECTOR) FOR OPEN & SHORT CIRCUITS.

- NOT OK → REPAIR HARNESS.
- OK ↓

REPLACE ESC CONTROLLER.



ESC Controller, Sensor and Wiring



-Chart--ESC Wiring Schematic

ON-VEHICLE SERVICE

H.E.I. DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire at the distributor. When disconnecting this connector do not use a screwdriver or tool to release the locking tab as it may break.
2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.
3. The tachometer (TACH) terminal is next to the ignition switch (BAT) connector on the distributor cap.

   NOTICE: The tachometer terminal must NEVER be allowed to touch ground, as damage to the module and/or ignition coil can result.

   NOTICE: Some service tachometers and electronic diagnostic equipment currently in use may NOT be compatible with the High Energy Ignition System. It is recommended that you consult your representative of such equipment as to the necessary updating of your equipment for compatibility with the HEI System.
4. There is no dwell adjustment as this is controlled by the module.
5. The centrifugal advance and vacuum advance are similar to the conventional ignition.
6. The material used to construct the spark plug cables is very pliable and soft. This cable will withstand more heat and carry a higher voltage. Due to the more pliable cable, scuffing and cutting become easier. It is therefore extremely important that the spark plug cables be routed correctly to prevent chaffing or cutting. See Spark Plug Section of On-Vehicle Service. Also when removing a spark plug wire from a spark plug, twist the boot on the spark plug and pull on the boot to remove the wire.

Remove and Replace

Distributor

1. Disconnect ignition switch battery feed wire and tachometer lead (if equipped) from distributor cap. Also release the coil connectors from the cap. (DO NOT use a screwdriver or tool to release the locking tabs.)
2. Remove distributor cap by turning four latches counterclockwise. Move cap out of the way.

   If necessary to remove secondary wires from cap, release wiring harness latches and remove wiring harness retainer. The spark plug wire numbers are indicated on the retainer.
3. Remove vacuum hose from vacuum advance unit.
4. Remove distributor clamp screw and hold-down clamp.
5. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.

   To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted in Step 5.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing:

a. Remove No. 1 spark plug.
b. Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.
c. Align timing mark on pulley to "O" on engine timing indicator.
d. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap.
e. Install distributor and connect ignition feed wire.
f. Install distributor cap and spark plug wires.
g. Check engine timing (see Set Ignition Timing below).

Vacuum Advance Unit

REMOVAL

1. Remove distributor cap and rotor.
2. Remove module.
3. Remove two vacuum advance attaching screws.
4. Turn the pick-up coil clockwise and push the rod end of the vacuum advance down so that it will disengage and clear the pick-up coil plate.

INSTALLATION

To install, reverse removal procedure.

Rotor

1. Remove distributor cap.
2. The rotor is retained by two screws and is provided with a slot which fits over a square lug on the advance weight base, so that the rotor can be installed in only on position.

Integral Ignition Coil

Removal

1. Remove distributor cap.
2. Remove three coil cover attaching screws, and lift off cover.
3. Remove coil attaching screws and lift ignition coil and lead from cap.

Installation

To install, reverse removal procedure.

Capacitor

The capacitor is part of the coil wire harness assembly. Since the capacitor is used only for radio noise suppression, it will seldom need replacement.

Removal

1. Remove distributor cap and rotor.
2. Remove capacitor attaching screw, and unplug connector from module. It may help to loosen the module.

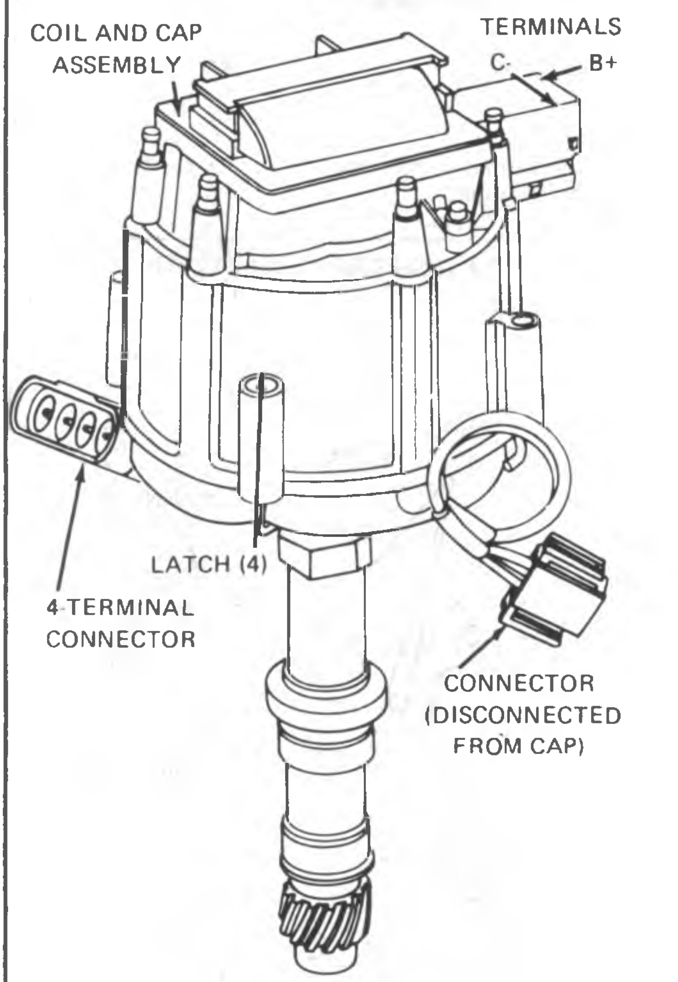
Installation

1. To install, reverse above procedure.
2. Install hold down screw making sure ground lead is under screw.

Unit Repair

DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (COIL IN CAP)

"COIL IN CAP" DISTRIBUTOR



1. A 6-cyl. EST distributor with coil-in-cap is illustrated.
2. Detach wiring connector from cap, as shown.
3. Turn four latches and remove cap and coil assembly from lower housing.

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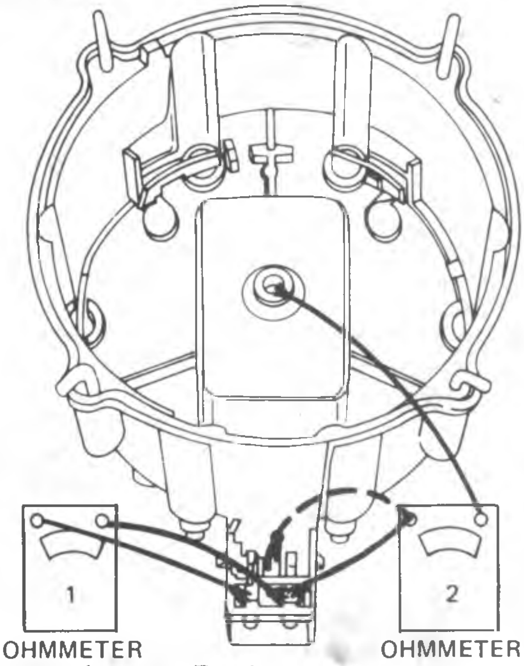
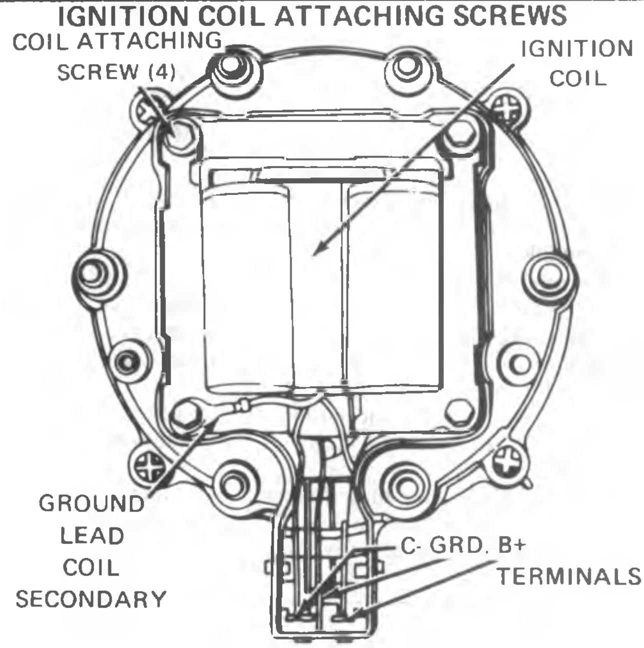
TESTING IGNITION COIL



4. Connect ohmmeter, Test 1.
5. Reading should be zero, or nearly zero. If not, replace coil, Step 8.
6. Connect ohmmeter both ways, Test 2. Use high scale. Replace coil only if both readings are infinite, Step 8.
7. If coil is good, go to Step 13.

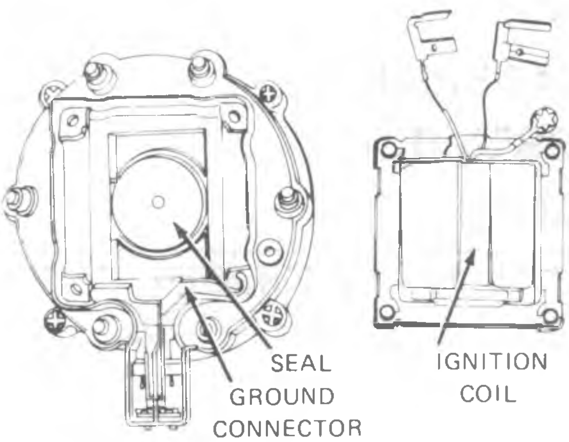
IGNITION COIL ATTACHING SCREWS



8. Remove coil-cover attaching screws and lift off cover.

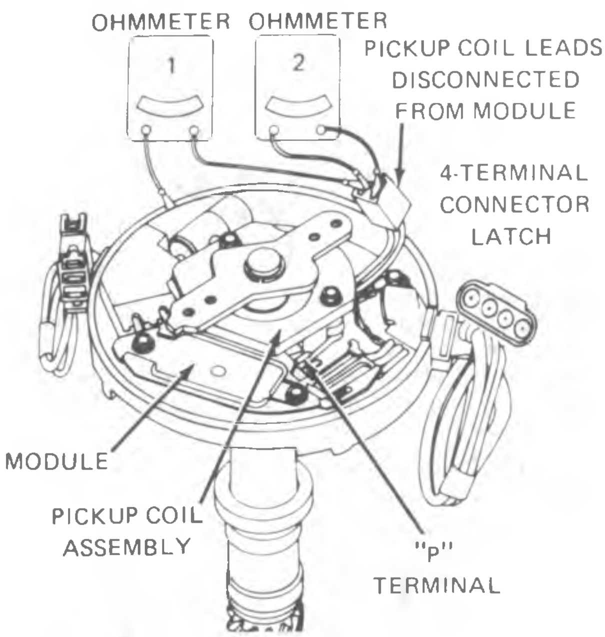
Fig. 6D-61--Distributor Unit Repair

IGNITION COIL REMOVED FROM CAP



9. Remove ignition coil attaching screws and lift coil with leads from cap.
10. Remove ignition coil arc seal.
11. Clean with soft cloth and inspect cap for defects. Replace, if needed.
12. Assemble new coil and cover to cap.

TESTING PICKUP COIL



13. On all distributors, including distributors with Hall Effect Switch identified in Step 27, remove rotor and pickup coil leads from module.
14. Connect ohmmeter Test 1 and then Test 2.
15. If vacuum unit is used, connect vacuum source to vacuum unit. Replace unit if inoperative. Observe ohmmeter throughout vacuum range; flex leads by hand without vacuum to check for intermittent opens.
16. Test 1 — should read infinite at all times.
    Test 2 — should read steady at one value within 500-1500 ohm range.
    NOTE: Ohmmeter may deflect if operating vacuum unit causes teeth to align. This is not a defect.
17. If pickup coil is defective, go to Step 18. If okay, go to Step 23.

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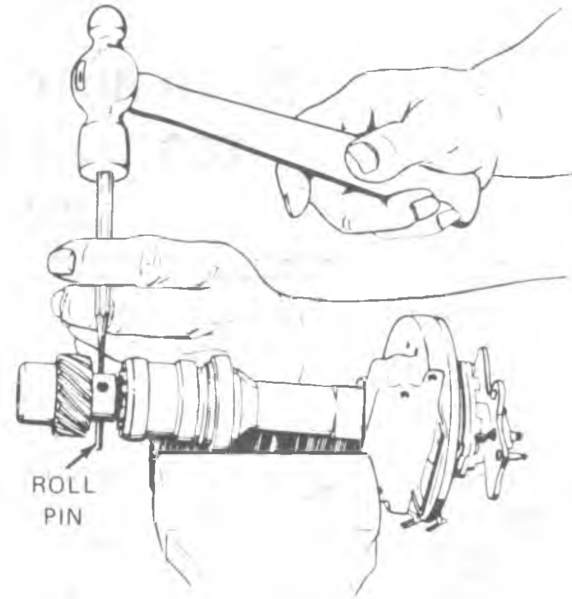
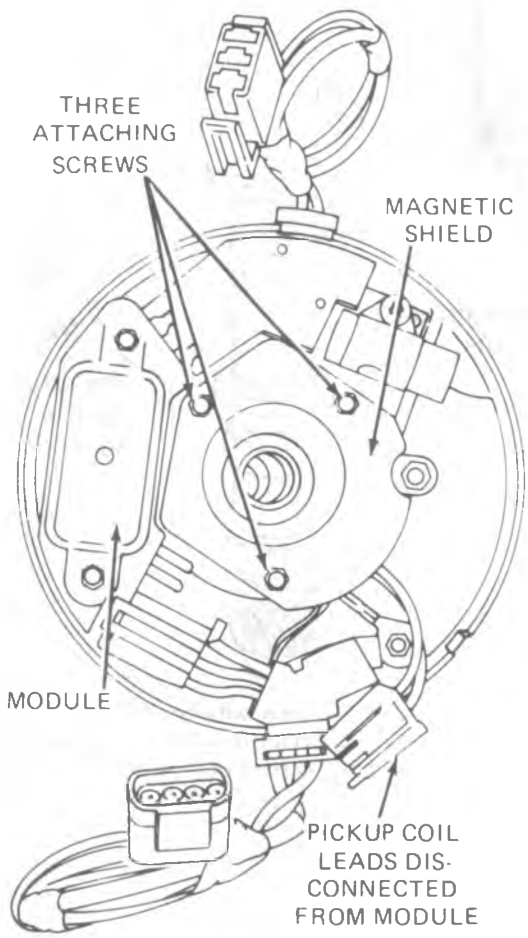
DRIVING PIN FROM SHAFT



18. Mark distributor shaft and gear so they can be reassembled in same position.
19. Drive out roll pin.

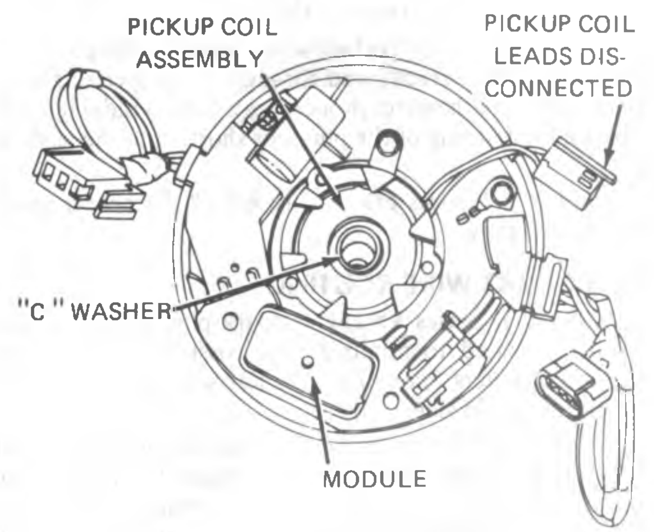
SHAFT ASSEMBLY REMOVED



20. Remove gear and pull shaft assembly from distributor.

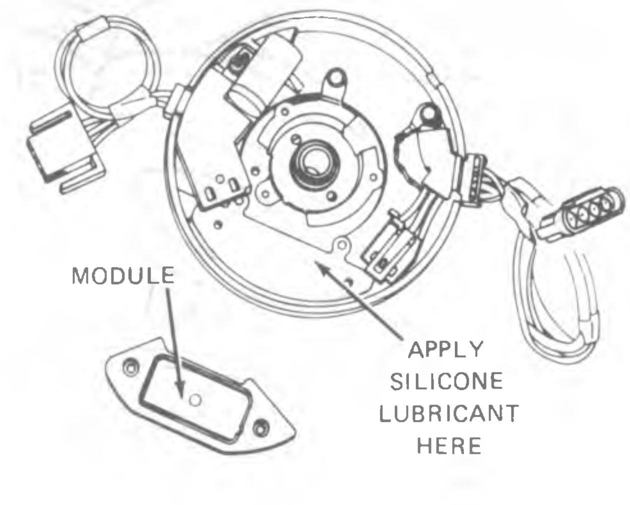
Fig. 6D-62--Distributor Unit Repair

ALUMINUM NON-MAGNETIC SHIELD REMOVED



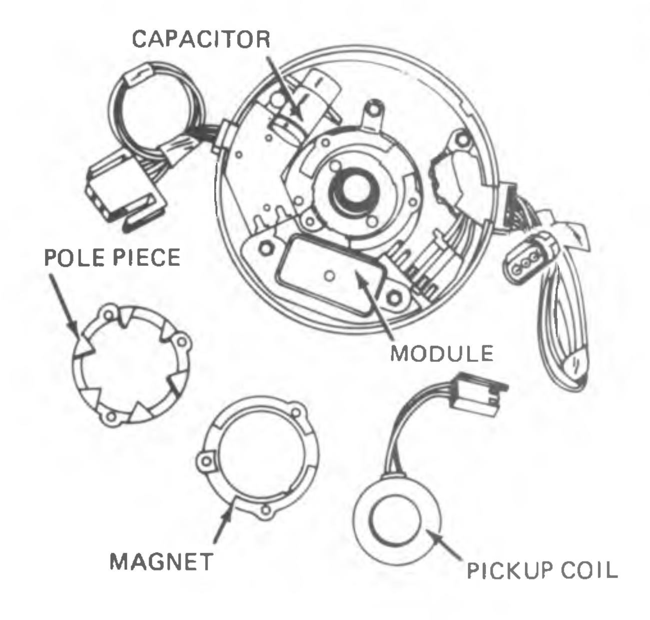
21. Remove three attaching screws and remove magnetic shield.

MODULE REMOVED



23. Remove two module attaching screws, and capacitor attaching screw. Lift module, capacitor and harness assembly from base.
24. Disconnect wiring harness from module.
25. Check module with an approved module tester.
26. Install module, wiring harness, and capacitor assembly. Use silicone lubricant on housing under module.

PICKUP COIL REMOVED AND DISASSEMBLED



22. Remove retaining ring and remove pickup coil, magnet and pole piece.

DISTRIBUTOR WITH HALL EFFECT SWITCH

27. The procedures previously covered, Steps 1 - 26, apply also to distributors with Hall Effect Switches.

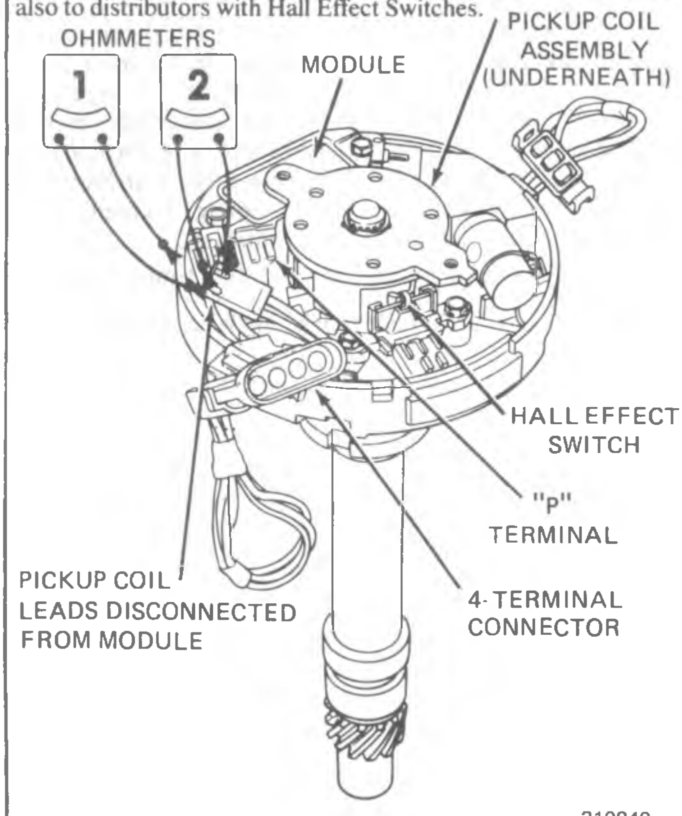


Fig. 6D-63--Distributor Unit Repair

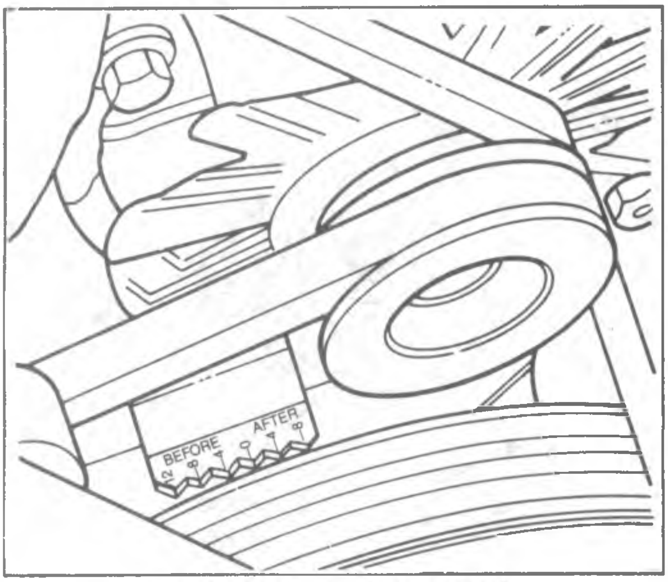


Fig. 6D-64--Timing Mark - Typical

SET IGNITION TIMING

1. Refer to the Vehicle Emissions Control Information label located on the radiator support panel. Follow all instructions on the label.
2. With ignition off, connect the pick-up lead of timing light to the number one spark plug. Use a jumper lead between the wire and plug or an inductive type pick-up. DO NOT pierce the wire or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to manufacturer's instructions.
3. Start the engine, and aim the timing light at the timing mark (see Fig. 6D-64). The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark with the timing light, slightly rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt, and re-check the timing.
4. Turn off the engine and remove the timing light.

   Reconnect the number one spark plug wire, if removed.

SPARK PLUG WIRES

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing, and pull on the boot only to remove the wire.

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

Refer to Figures 6D-65 thru 6D-68 for proper spark plug wire routing.

SPARK PLUG WIRE ROUTING

1983 C-K Series V8 engine spark plug wiring routing has been revised to minimize the possibility of crossfire between cylinders 5 and 7 on the left side and cylinders 4 and 8 on the right side.

It is important that the new routings be kept intact during service, and followed exactly when wires have been disconnected for any reason, or when replacement of the wires or wire becomes necessary. The correct wiring routing for the engines affected is shown in Figures 6D-66 and 67.

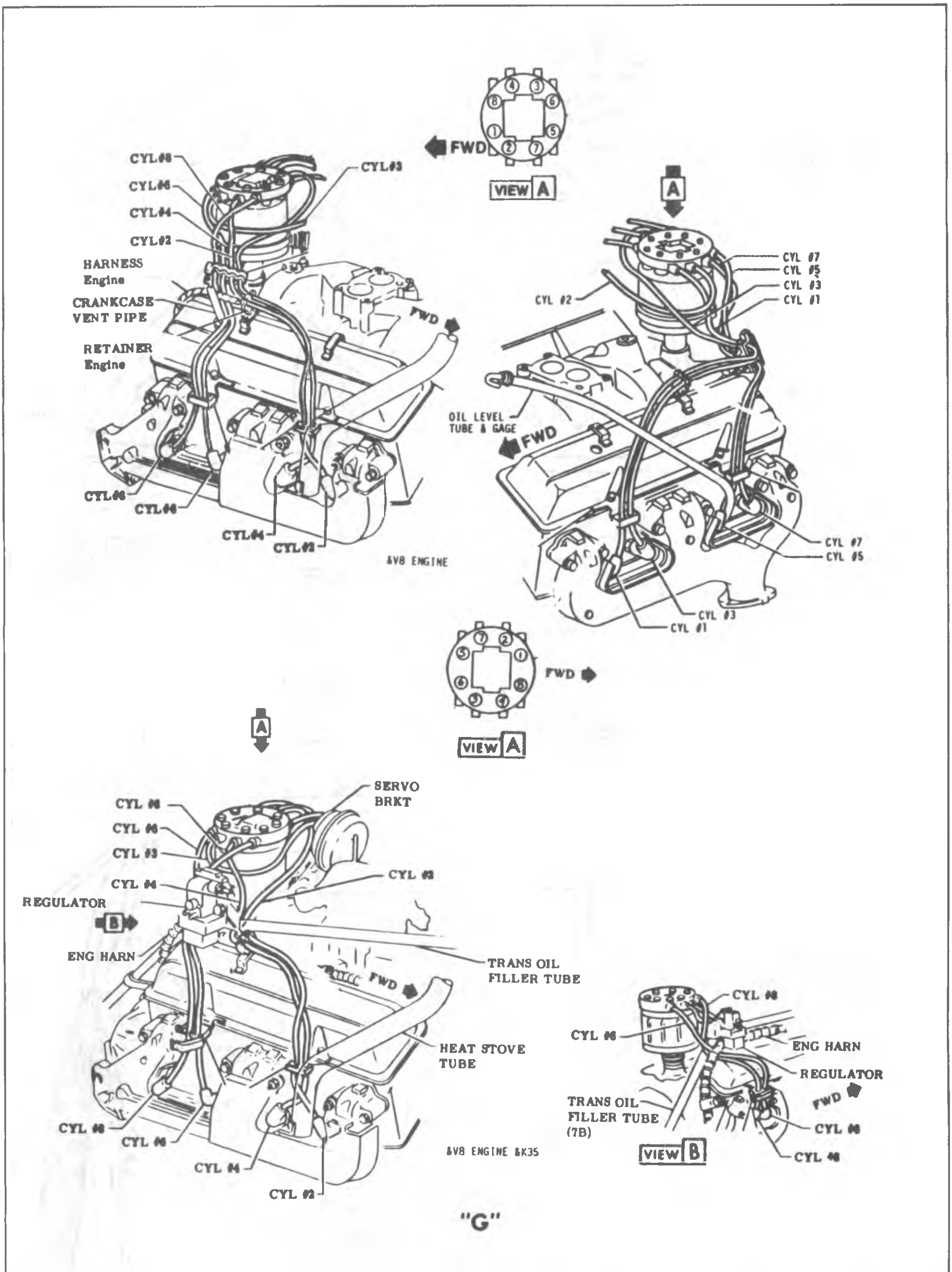


Fig. 6D-65--Spark Plug Wire Routing

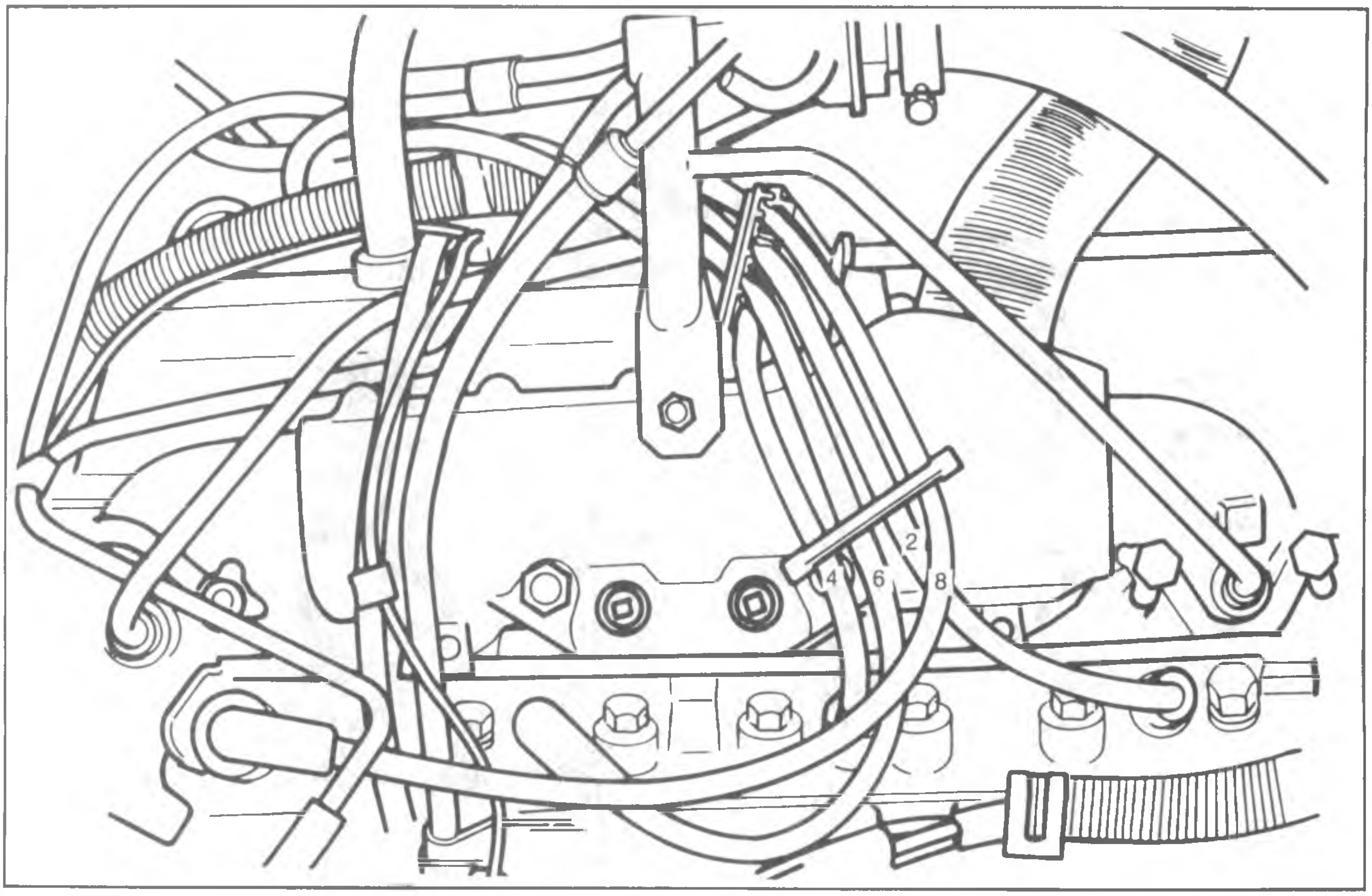


Fig. 6D-66--CK Series V8 Engines Spark Plug Wiring Routing-Right Side

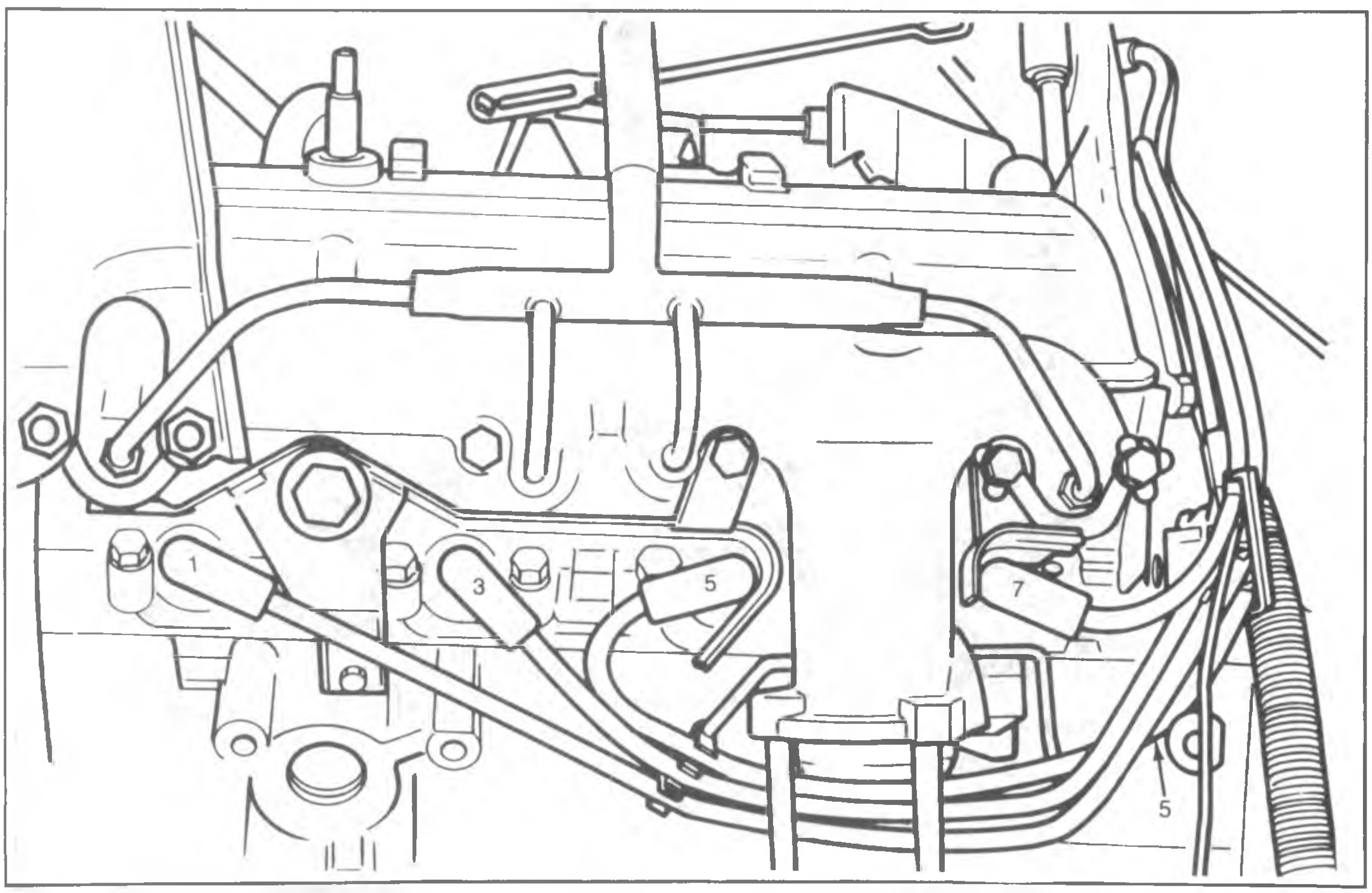


Fig. 6D-67--CK Series V8 Engines Spark Plug Wiring Routing-Left Side

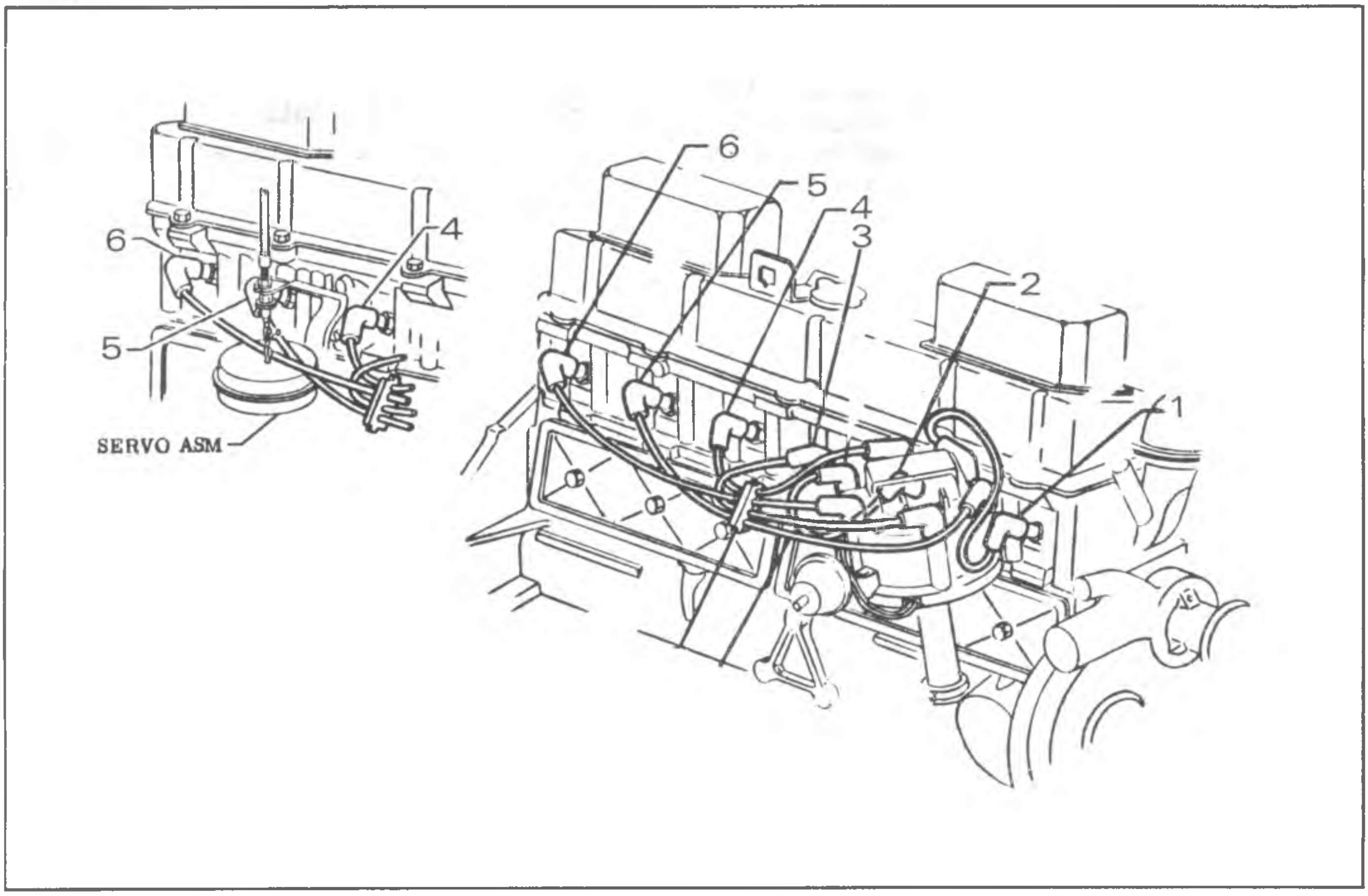


Fig. 6D-68--Spark Plug Wiring Routing-G Series

IGNITION SWITCH

GENERAL DESCRIPTION

The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly. For a complete explanation of the key and lock cylinder, and the actuator rod assembly, refer to the Steering section of this manual.

The ignition switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking. The ignition switch used on all vehicles have five positions: OFF, LOCK, ACCESSORY, RUN and START. OFF is the center position of the key-lock cylinder, and LOCK is the next position to the left. ACCESSORY is located one more detent to the left of LOCK. Turning the key to the right of the OFF position until spring pressure is felt will put the ignition switch in the RUN position, and when turned fully to the right against spring pressure, the switch will be in the START position.

All ignition switches have five terminals which are connected in different combinations for each of the three operating positions. A brass plate, inside the switch, has three contacts which connect these terminals. Figure 6D-31D shows the positions of the contacts in all positions as viewed from the key side of the switch. There is also a ground pin in the switch which contacts the "ground" terminal when the ignition switch is in the START position. This pin contacts the IGN. terminal when in the OFF position.

Ignition Start and Run Circuit

The ignition switch is fed from the battery to the BAT. terminal of the switch. When the ignition switch is in the OFF position, no current flows through the switch. When the ignition switch is turned to the ACC. position, the BAT. terminal is connected to the ACC. terminal. This permits operation of accessories when the engine is not running.

When the ignition switch is turned to the START position, the BAT. terminal is connected to the SOL. and IGN. terminals. When the clutch or automatic transmission neutral start switches are closed, current flows to the starter solenoid. This energizes the solenoid windings. The solenoid has two sets of windings: a "pull-in" winding and a "hold-in" winding. Both windings are used to create the magnetic field to actuate the the solenoid plunger and move the starter pinion into engagement with the flywheel. As the solenoid plunger reaches the end of its travel, it closes a switch which connects battery voltage to the starter motor. With battery voltage applied to both terminals of the "pull-in" windings, the "pull-in" winding is no longer energized, so that only the "hold-in" winding keeps the starter solenoid engaged.

The instrument panel warning lights are fed from the ignition terminal of the ignition switch and have battery voltage applied to them when the ignition switch is in the START and RUN position. These circuits are explained in the Chassis Electrical Section.

When the ignition switch is released from the START to the RUN position, the IGN. terminal is still connected to the BAT. terminal With the ignition switch in the RUN position, the BAT. terminal is connected to the IGN. terminal and the ACC. terminal. This permits operation of all accessories and the ignition system.

ENGINE WIRING HARNESSES

Engine Wiring Harnesses are shown in Figures 6D-70 through 6D-75

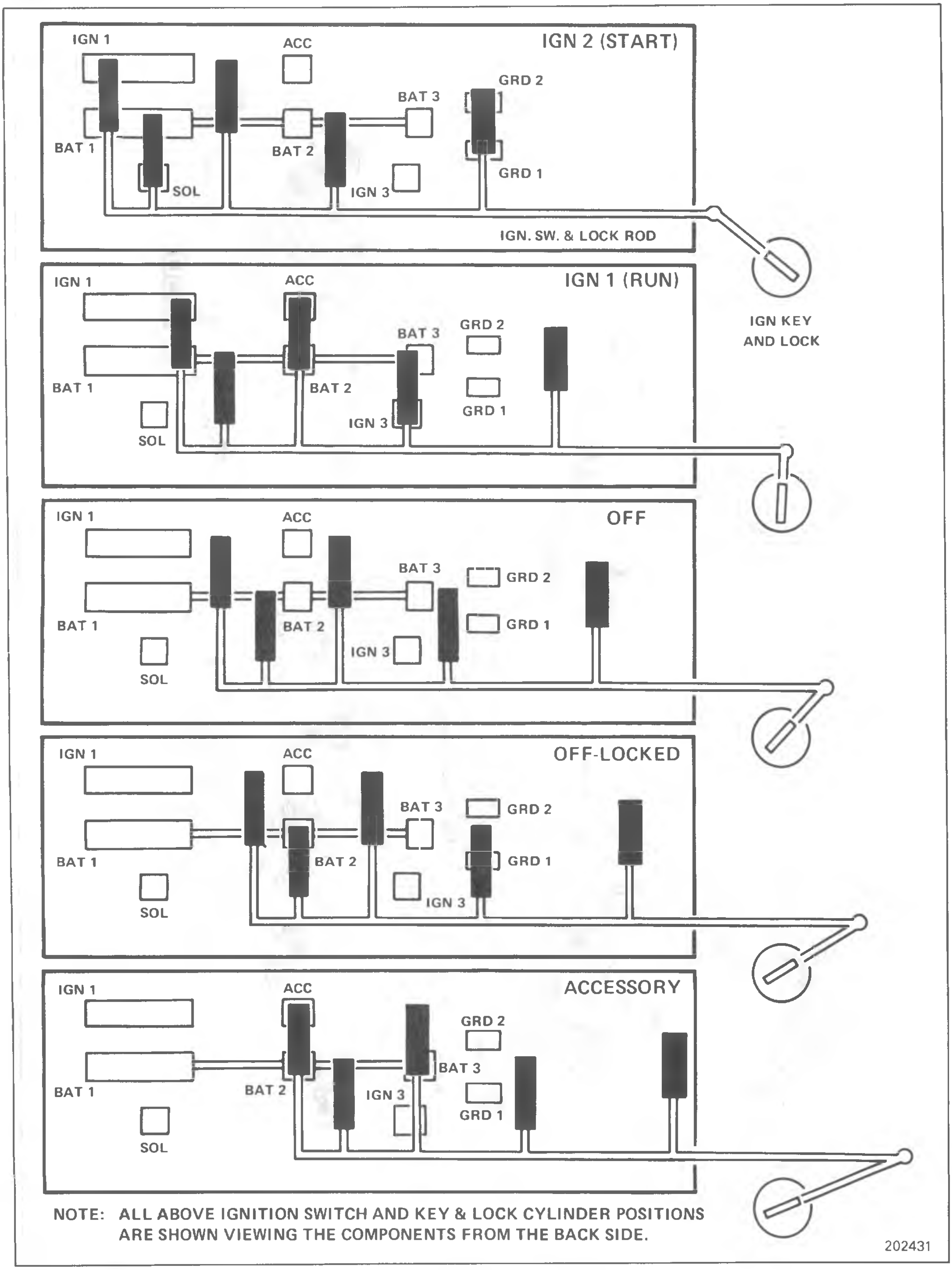


Fig. 6D-69--Ignition Switch Circuit

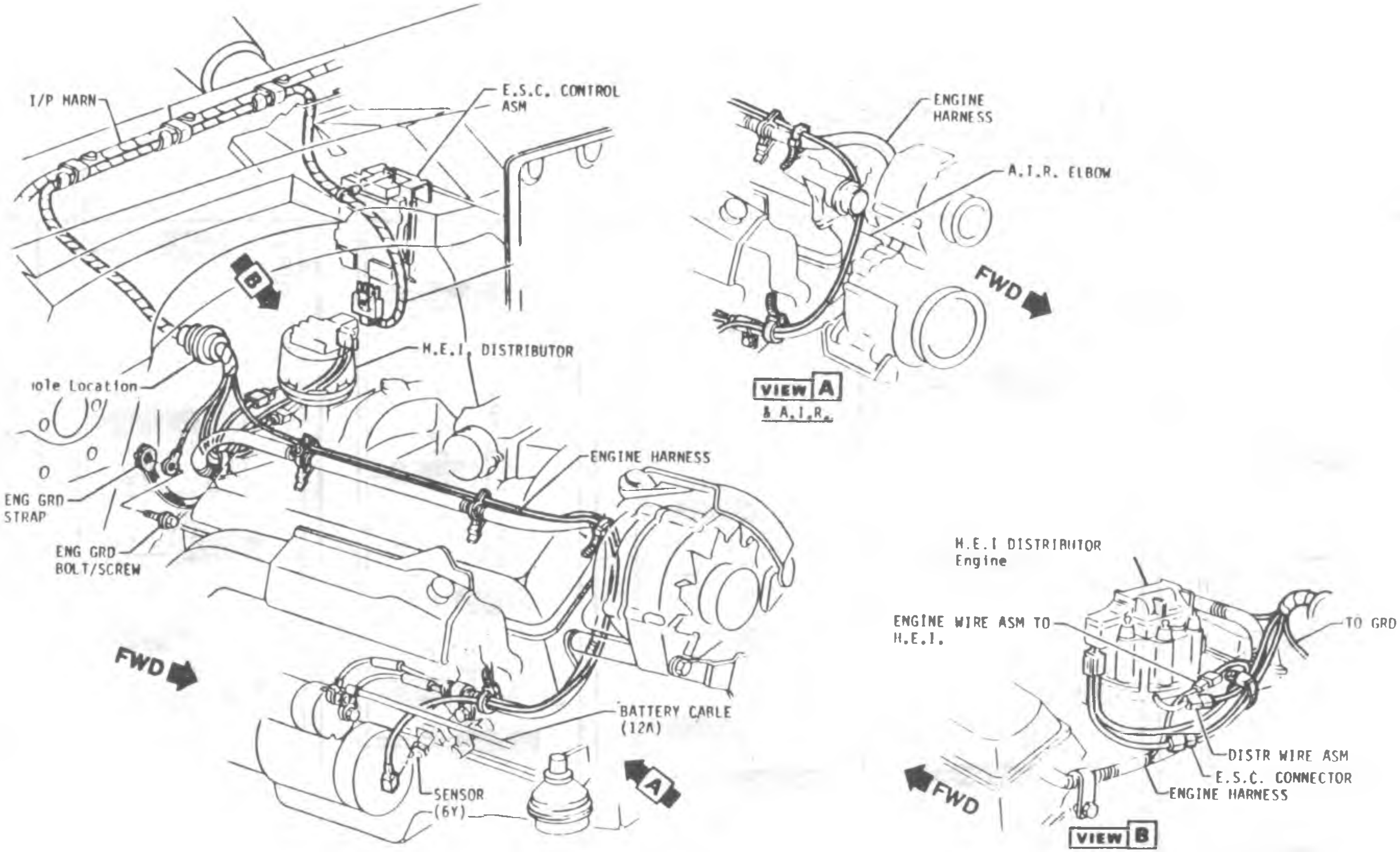


Fig. 6D-70--Engine Wiring LE9, LF3, LG9, LS9

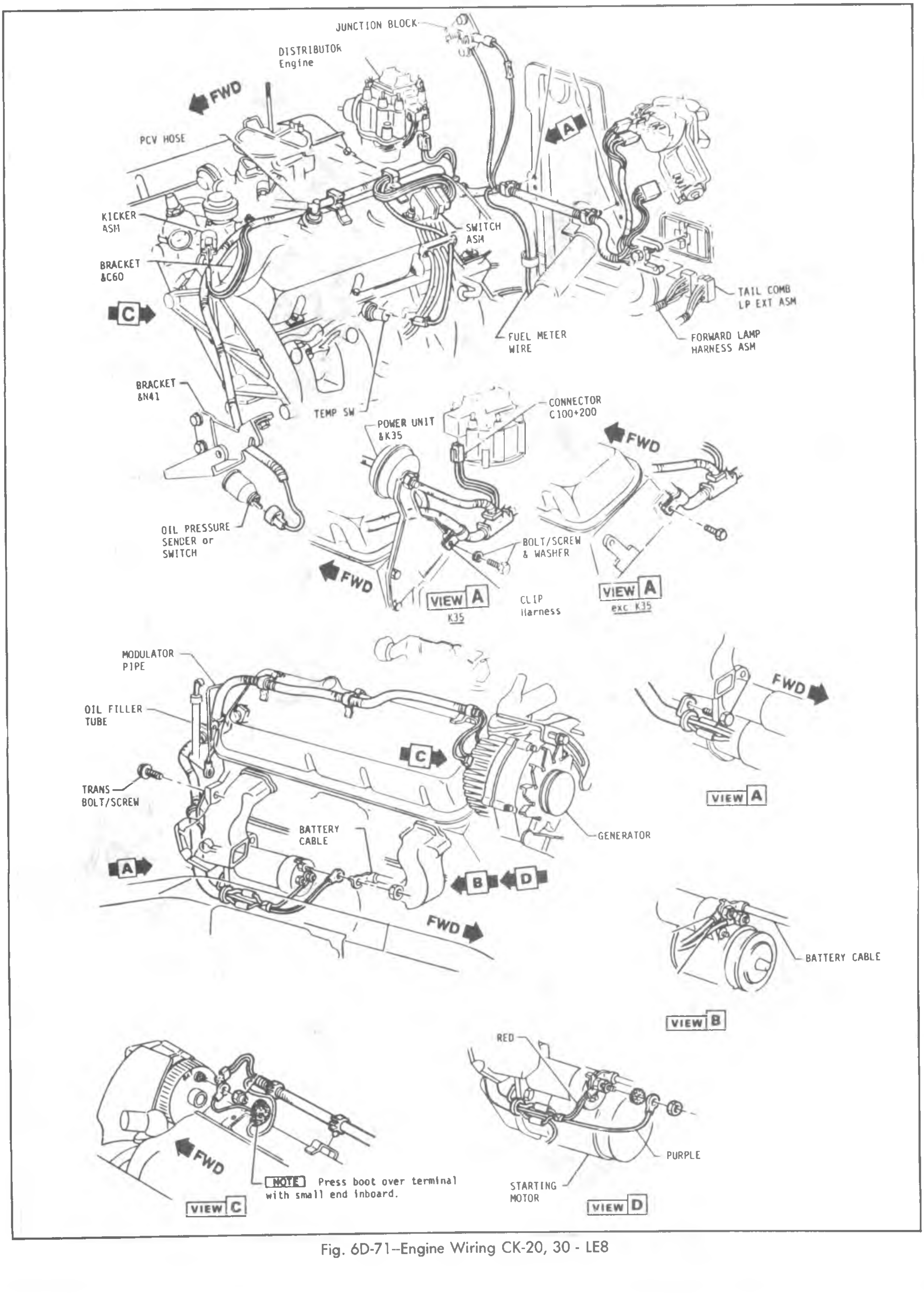


Fig. 6D-71--Engine Wiring CK-20, 30 - LE8

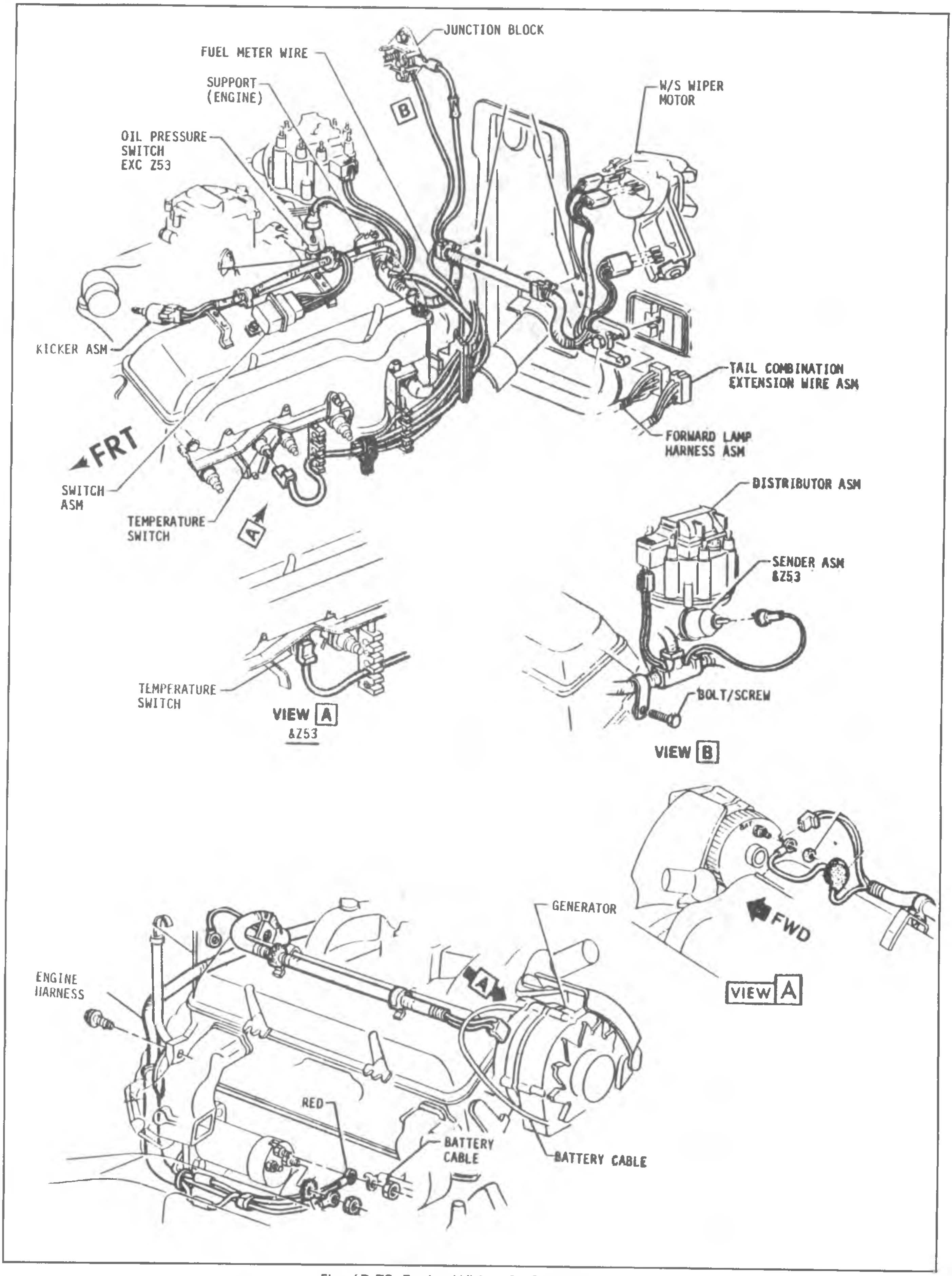


Fig. 6D-72--Engine Wiring CK-20, 30 - LT9

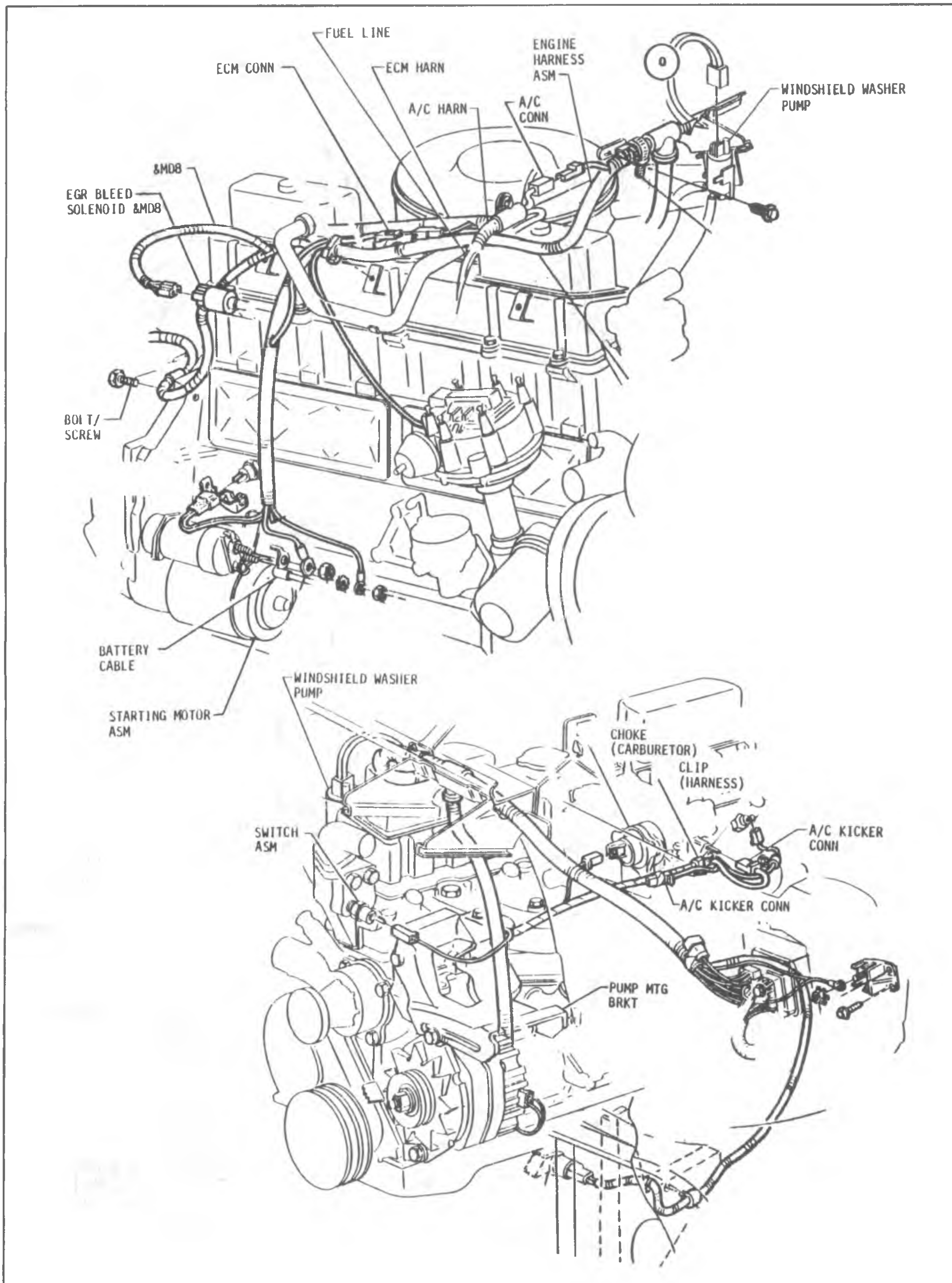


Fig. 6D-73--Engine Wiring G Series LE3

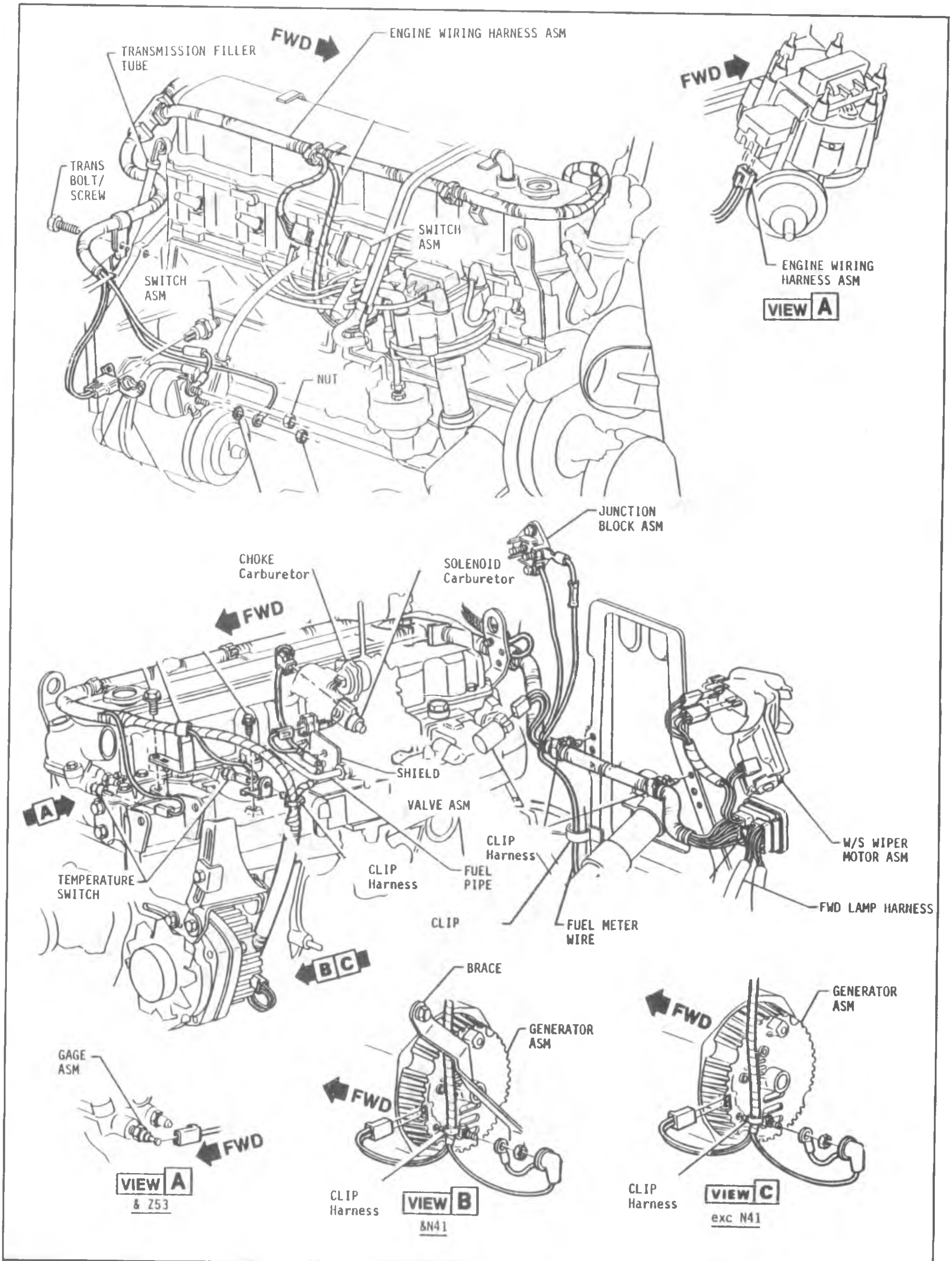


Fig. 6D-74--Engine Wiring CK Series- L25

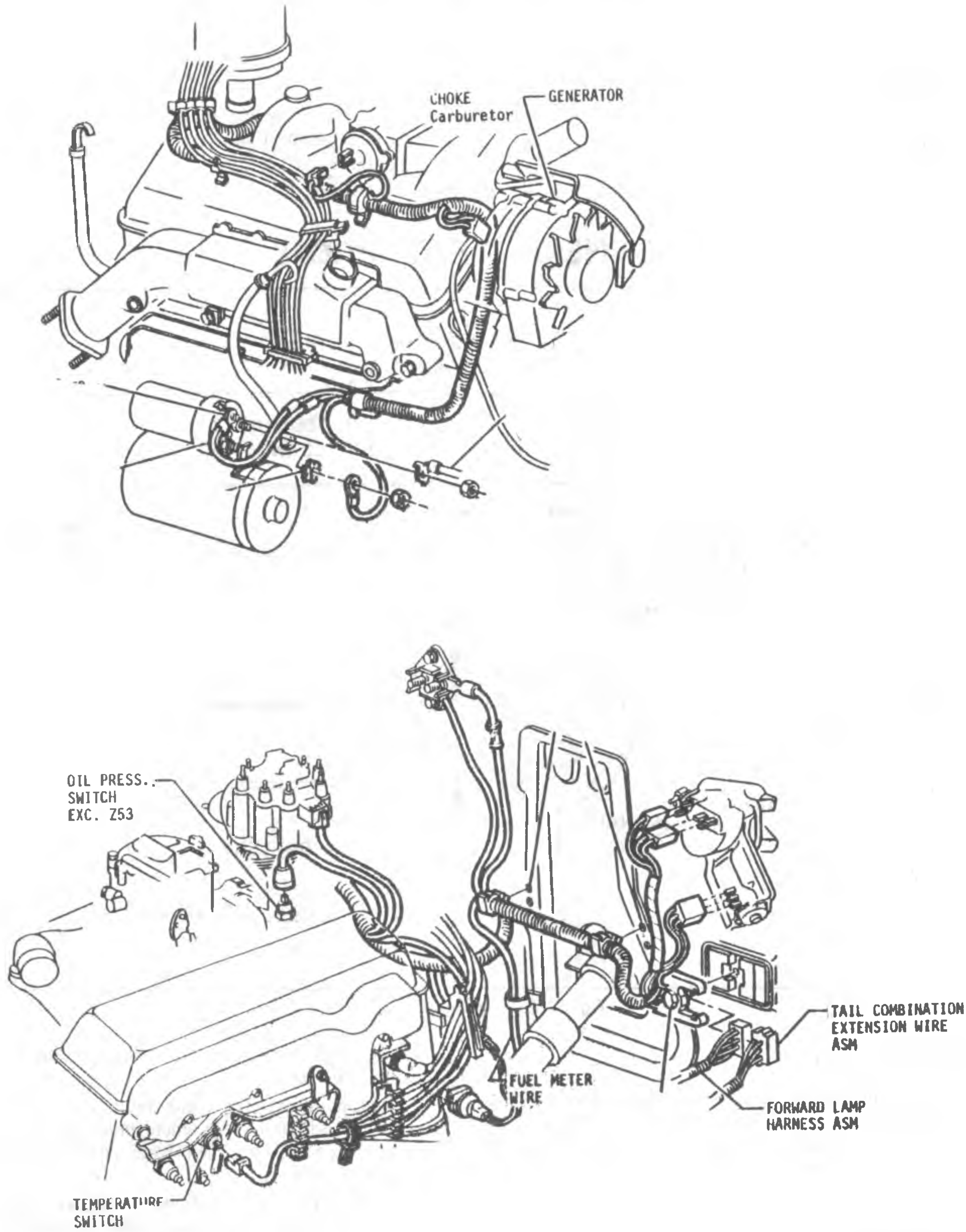


Fig. 6D-75--Engine Wiring CK Series - LE9

CRANKING SYSTEM

General Description 6D-74
Cranking Circuit 6D-74
Starter Motor 6D-74
Diagnosis 6D-78
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Starter 6D-81
Solenoid 6D-82
Overhaul 6D-82
Disassembly 6D-82
Component Inspection 6D-83
Reassembly 6D-86
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GENERAL DESCRIPTION

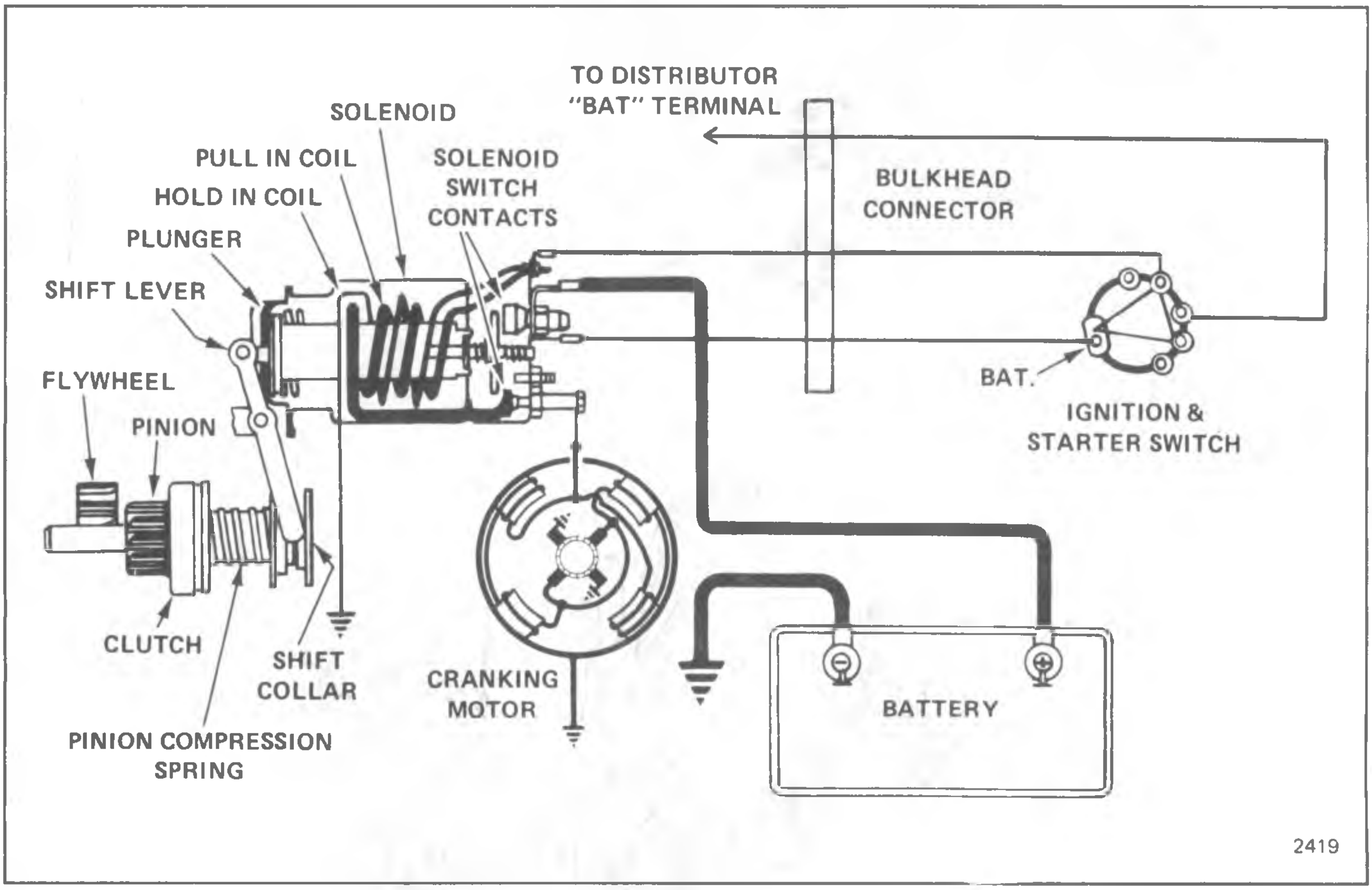


Fig. 6D-76--Cranking Circuit - All

CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Figure 6D-76. Only the starting motor will be covered in this portion.

STARTING MOTOR

Three types of starter motors are used. The first referred to as the 5MT Phase III is shown in Figs. 6D-77 and 6D-78. The second, referred to as the 10MT series, is shown in Fig. 6D-79. The third type, referred to as the 27MT series used on diesel equipped engines, is shown in Fig. 6D-80. The main difference is that the 27MT has a center bearing. Differences in service procedures will be pointed out as they occur.

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing protecting them from exposure to dirt, icing conditions and splash.

In the basic circuit shown in Figure 6D-1E, the solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be opened immediately when the engine starts.

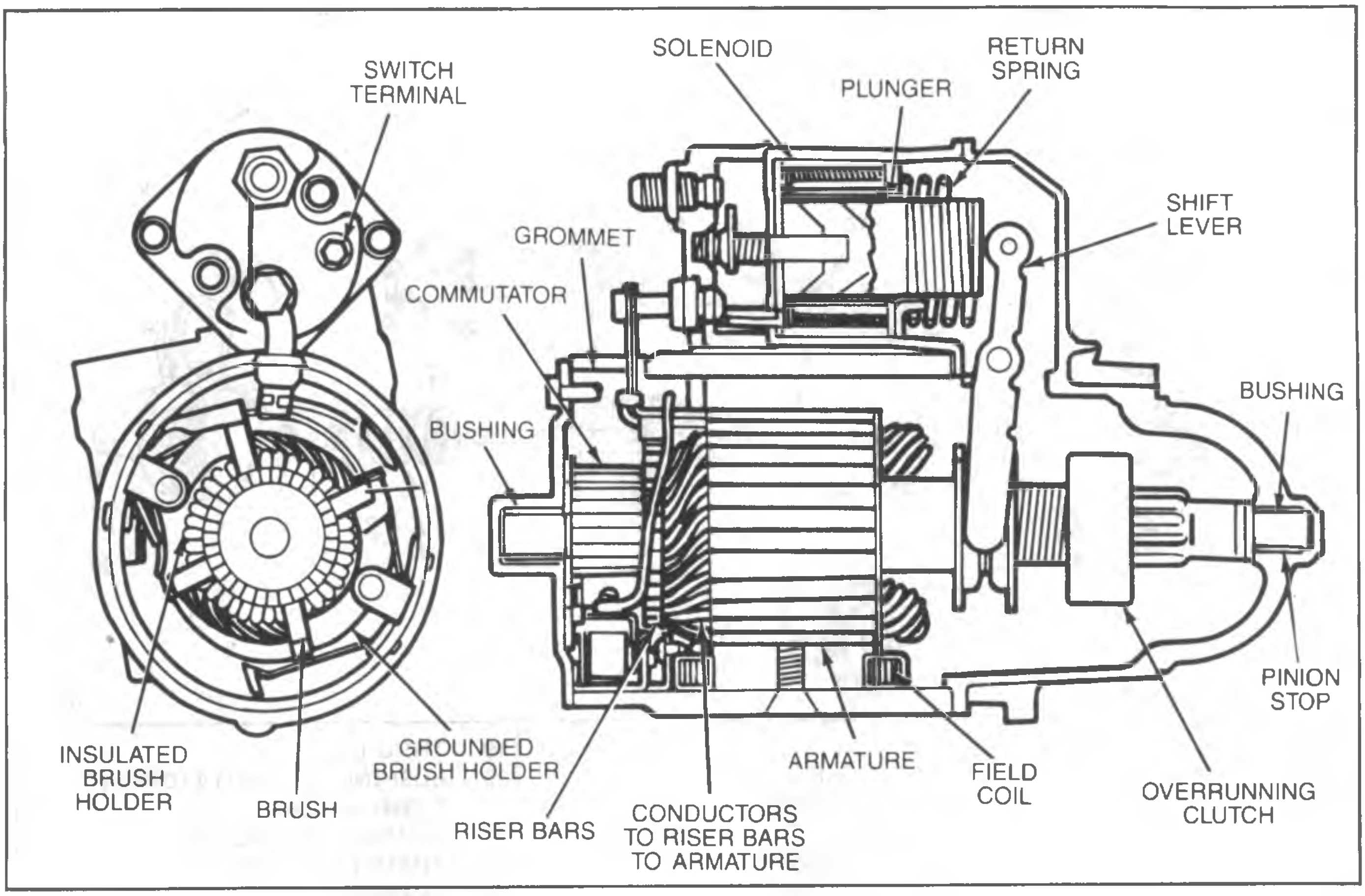
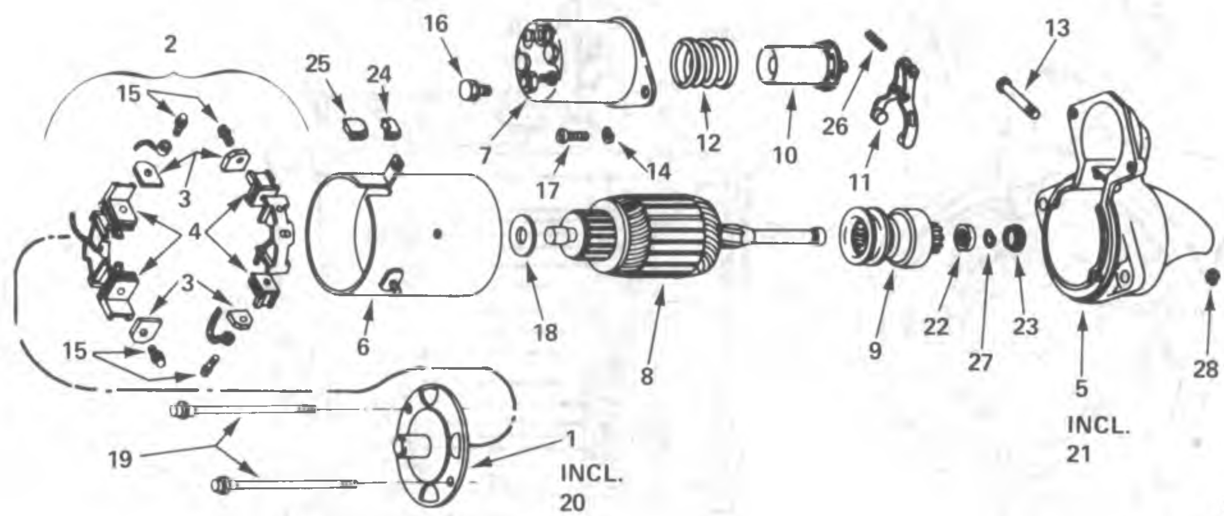


Fig. 6D-77--Cross Section of 5MT Starting Motor



		19. THRU BOLT
1. FRAME–COMMUTATOR END	10. PLUNGER	20. BUSHING–COMMUTATOR END
2. BRUSH AND HOLDER PKG.	11. SHIFT LEVER	21. BUSHING–DRIVE END
3. BRUSH	12. PLUNGER RETURN SPRINGER	22. PINION STOP COLLAR
4. BRUSH HOLDER	13. SHIFT LEVER SHAFT	23. THRUST COLLAR
5. HOUSING–DRIVE END	14. LOCK WASHER	24. GROMMET
6. FRAME AND FIELD ASM.	15. SCREW–BRUSH ATTACHING	25. GROMMET
7. SOLENOID SWITCH	16. SCREW–FIELD LEAD TO SWITCH	26. PLUNGER PIN
8. ARMATURE	17. SCREW–SWITCH ATTACHING	27. PINION STOP RETAINER RING
9. DRIVE ASM.	18. LEATHER WASHER—BRAKE	28. LEVER SHAFT RETAINING RING

Fig. 6D-78--Exploded View, 5MT Motor

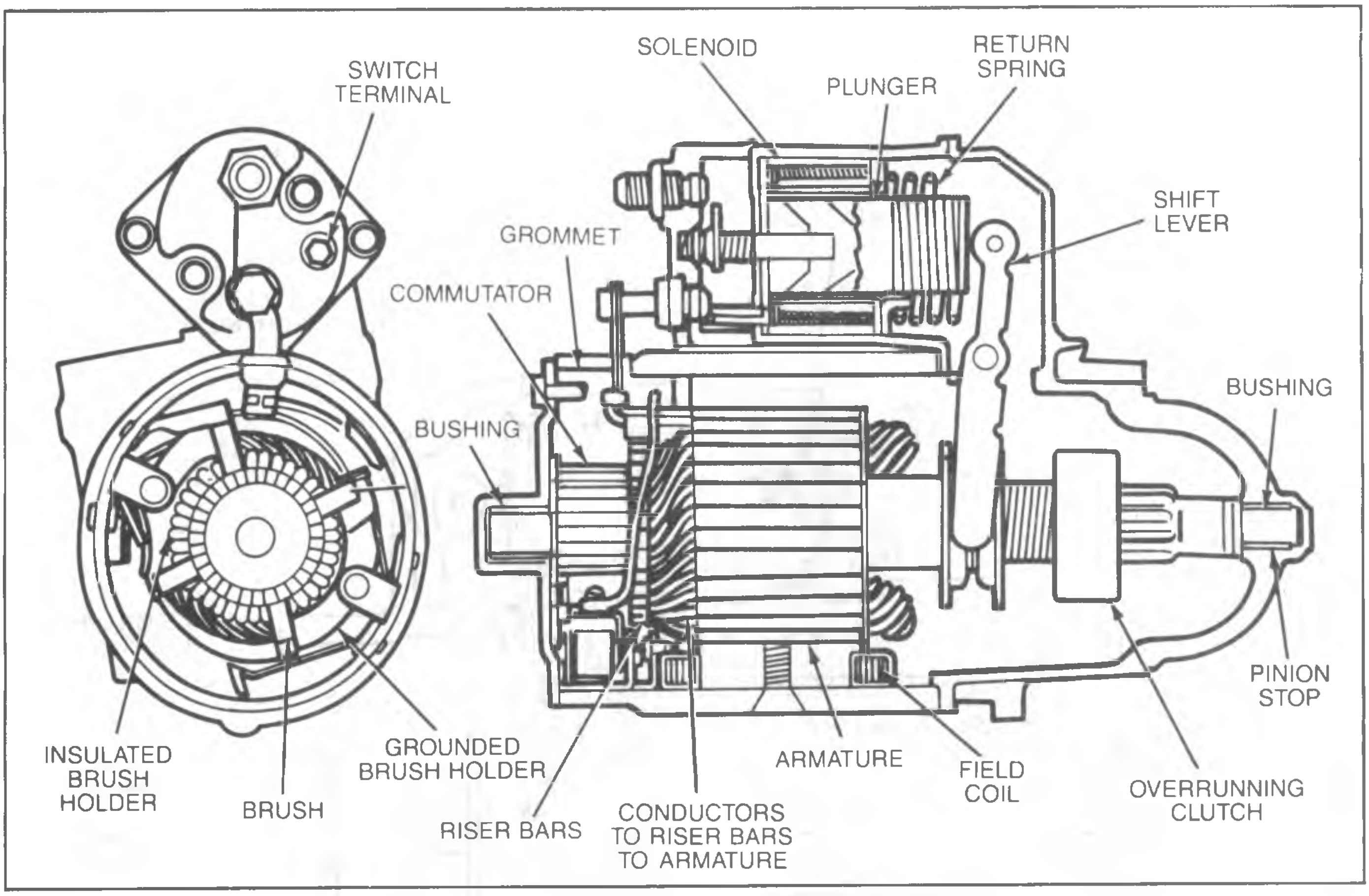


Fig. 6D-79--Cross Section of 10MT Starting Motor

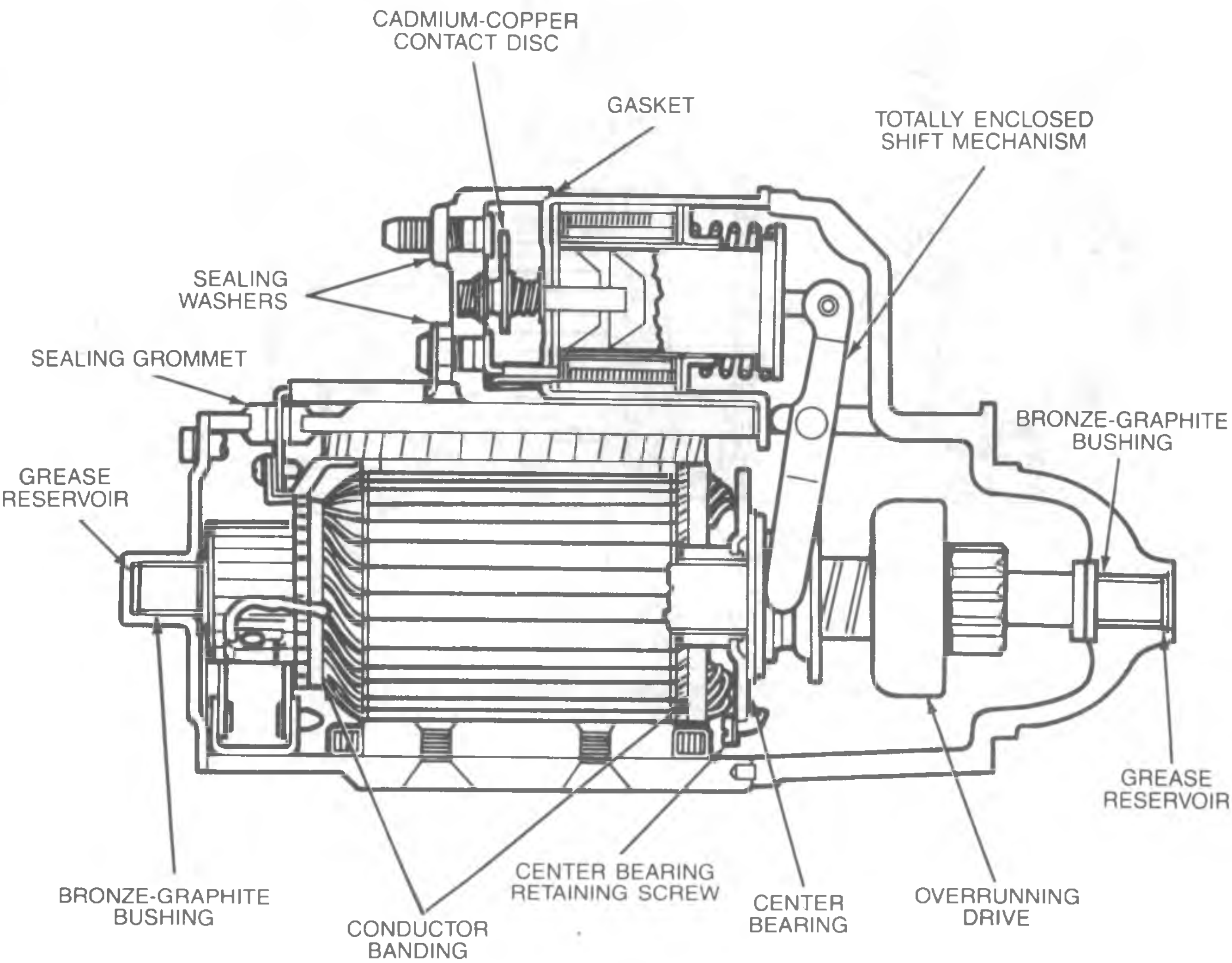


Fig. 6D-80--Cross Section of 27MT Starting Motor

DIAGNOSIS

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Battery:

To determine the condition of the battery, follow the testing procedure outlined in the Battery Section.

Wiring:

Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch, and battery, including all ground connections. Clean and tighten all connections as required.

Solenoid and Ignition Switch:

Inspect all switches to determine their condition.

Starter Motor Noise:

To correct starter motor noise during starting, use the following procedure:

1. Refer to Fig. 6D-81 to determine the problem.
2. If the complaint is smiliar to problem categories 1 or 2 above, correction can be achieved by proper "shimming".
   a. Remove lower flywheel housing cover and examine for visual problems - bent flywheel, unusual wear, etc.

	PROBLEM	CAUSE
1.	HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.	DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL.
2.	HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OKAY. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.
3.	A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER IS STILL HELD ENGAGED. SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER IS ENGAGED.	MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.
4.	A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

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Fig. 6D-81--Starter Motor Noise Diagnosis

b. Start engine and carefully touch outside diameter of rotating flywheel ring gear with chalk or crayon to show high point of tooth runout after engine is turned off. Turn engine off and rotate flywheel so that the marked teeth are in the area of the starter pinion gear.

c. Disconnect negative battery cable to prevent inadvertent cranking of engine.

e. If the clearance is grossly over .5mm (.020") (in the vicinity of 1.5mm (.060") or more), shimming the starter towards the flywheel is required. (This is generally the problem causing broken flywheel teeth or starter housings.)

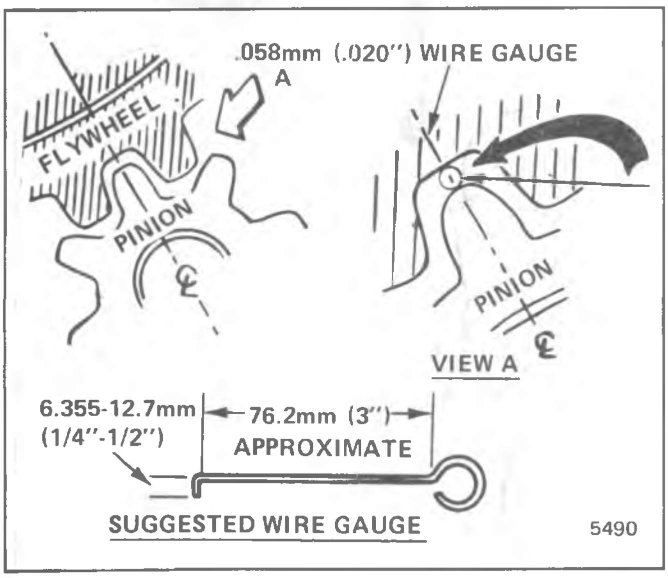


Fig. 6D-82--Flywheel to Pinion Clearance

Shimming the starter towards the flywheel can be accomplished by shimming only the outboard starter mounting pad. A shim of .4mm (.015") thickness at this location will decrease the clearance by approximately .3mm (.010").

If normal starter shims are not available, substitute shims can be improvised from plain washers or other suitable material.

Motor:

If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

Regardless of the construction, never operate the cranking motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the cranking motor.

A general diagnosis is covered in Figure 6D-1 and 6D-2. Once a problem has been traced to the starter, proceed to the test procedure below.

Test Procedure

With the cranking motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. Tight bearings, a bent armature shaft, or a loose pole shoe screw will cause the armature to not turn freely. If the armature does not turn freely the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

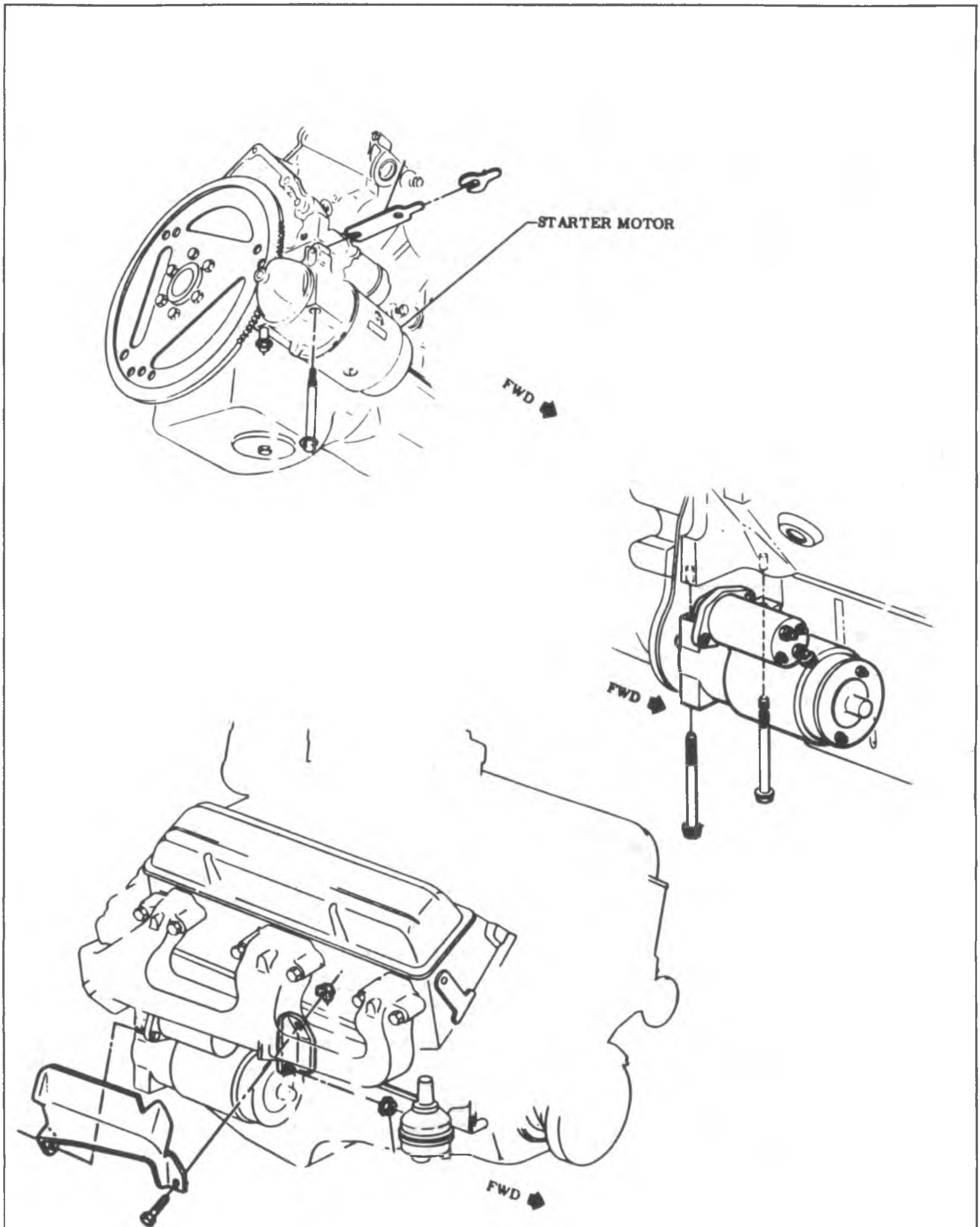


Fig. 6D-83--Starter Motor Mounting

ON-VEHICLE SERVICE

Starting motors do not require lubrication except during overhaul.

When the motor is disassembled for any reason, lubricate as follows:

1. The armature shaft and drive end and commutator end bushings should be coated with no. 1960954 lubricant or equivalent.
2. The roll type overrunning clutch requires no lubrication. However, the drive assembly should be wiped clean. Do not clean in any degreasing tank or with grease dissolving solvents; this will dissolve the lubricant in the clutch mechanism. Use silicon grease General Electric CG321, Dow Corning 33 Medium or equivalent, on the shaft underneath the overrunning clutch assembly.

REMOVE AND REPLACE

Starter (Fig. 6D-83)

Use the following procedure to remove the starter:

1. Disconnect negative battery lead at battery.
2. Raise vehicle.
3. Remove starter braces, shields, etc., that may be in the way.
4. Remove two starter motor to engine bolts, and allow starter to drop down.
5. Remove solenoid wires and battery cable and remove starter.
6. To replace, reverse the above procedure. Insure that any shims removed are replaced.

Solenoid

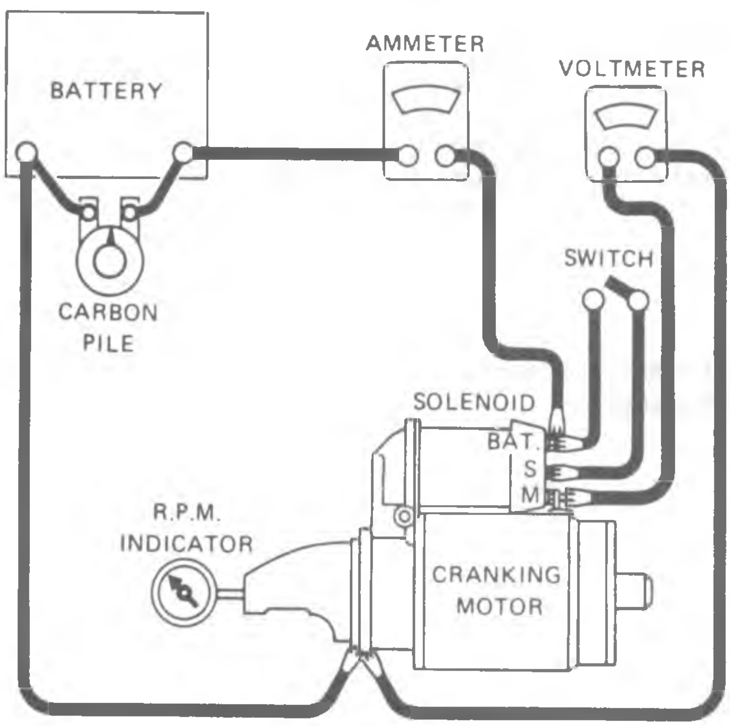
Use the following procedure to remove the solenoid from the starter:

1. Disconnect field strap.
2. Remove solenoid to drive housing attaching screws, motor terminal bolt, and remove solenoid by twisting.
3. Replace by reversing above procedures.

UNIT REPAIR

5MT, 10MT, 25MT AND 27MT STARTER MOTORS DISASSEMBLY, TEST AND REASSEMBLY (STARTER REMOVED FROM ENGINE)

NO-LOAD TEST



With the starter motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. If the armature does not turn freely, the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

Make connections as shown. Close the switch and compare the RPM, current, and voltage readings with the specifications . If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with the switch open. Use the test results as follows:

1. Rated current draw and no-load speed indicates normal condition of the starter motor.

2. Low free speed and high current draw indicates:

- Too much friction — tight, dirty, or worn bearings, bent armature shaft allowing armature to drag.
- Shorted armature. This can be further checked on a growler after disassembly.
- Grounded armature or fields. Check further after disassembly.

3. Failure to operate with high current draw indicates:

- A direct ground in the terminal or fields.
- "Frozen" bearings (this should have been determined by turning the armature by hand).

4. Failure to operate with no current draw indicates:

- Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.
- Open armature coils. Inspect the commutator for badly burned bars after disassembly.
- Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

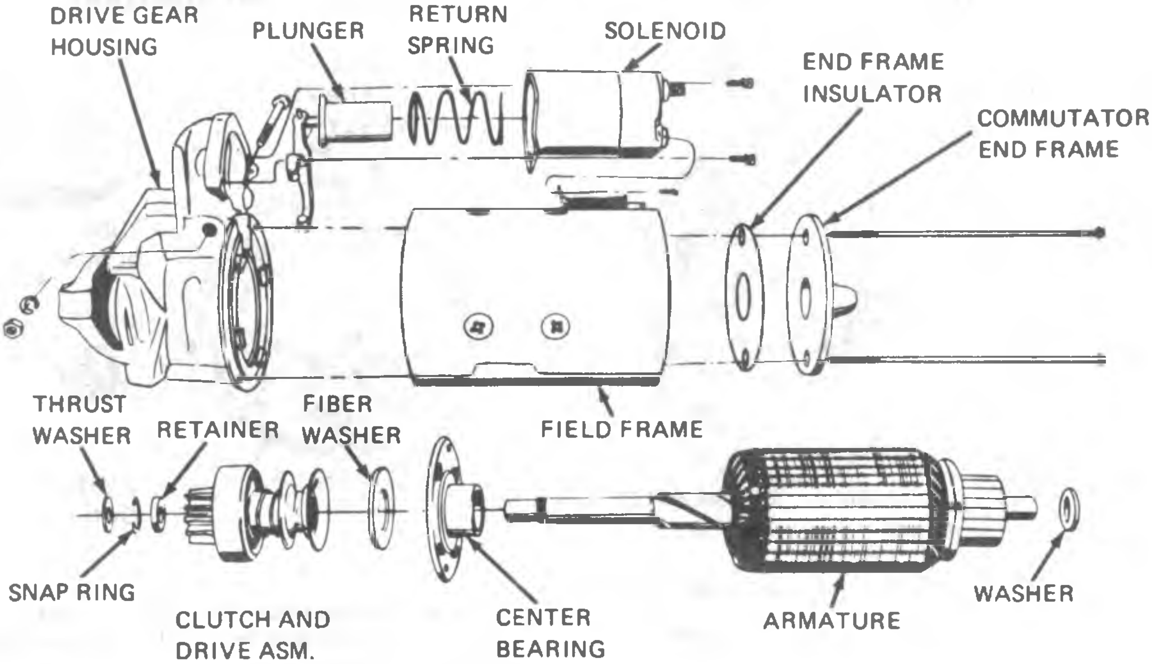
5. Low no-load speed and low current draw indicates:

- High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.

6. High free speed and high current draw usually indicate shorted fields. If shorted fields are suspected, replace the field coil assembly. Also check for shorted armature, using a growler.

Fig. 6D-84--Starter Unit Repair 1 of 6

STARTER DISASSEMBLY

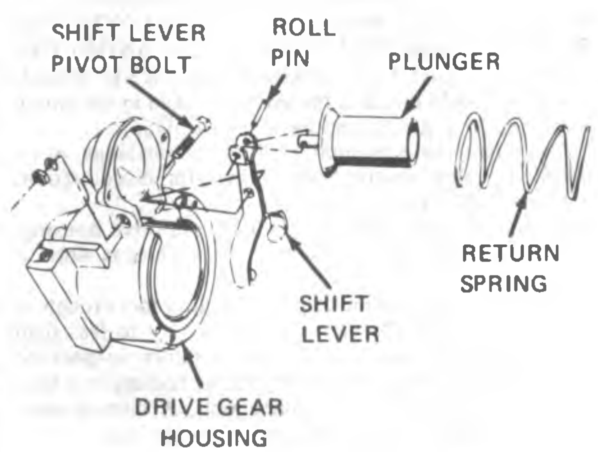


7. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring. Solenoid may now be serviced without further starter disassembly at this time.

8. Remove 2 through bolt , then remove commutator end frame (diesel only, remove insulator) and washer.

9. Remove field frame assembly from drive gear housing. (On diesel starter, armature remains in drive end frame.)

SHIFT LEVER AND PLUNGER REMOVAL

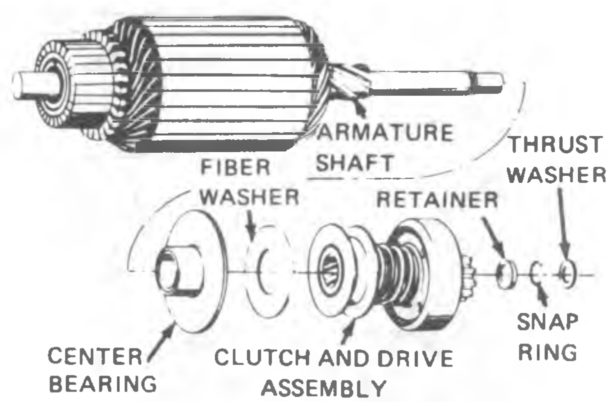


Steps 10 and 11 are required only on diesel starters.

10. Remove shift lever pivot bolt.

11. Remove center bearing screws (25 MT only) and remove drive gear housing from armature shaft. Shift lever and plunger assembly will now fall away from starter clutch.

REMOVE DRIVE ASSEMBLY FROM SHAFT



12. If necessary to remove overrunning clutch from armature shaft, proceed as follows:

a. Remove thrust washer or collar from armature shaft.

b. Slide a 5/8" deep socket or piece of pipe of suitable size over shaft against retainer as a driving tool. Tap tool to move retainer off snap ring.

c. Remove snap ring from groove in shaft. If snap ring is distorted, it will be necessary to use a new one on reassembly.

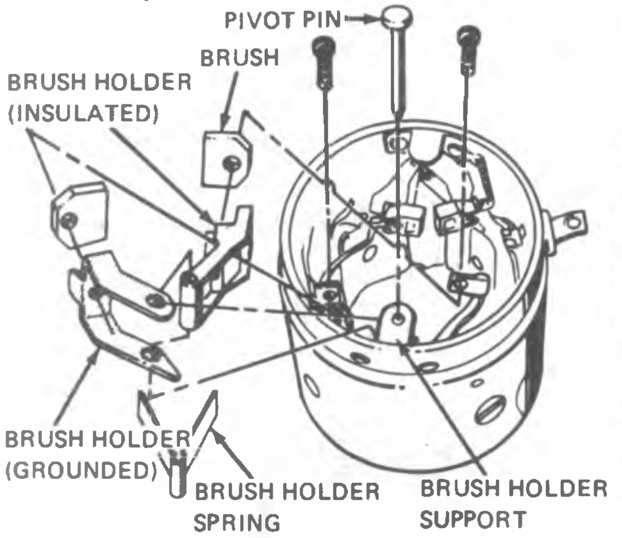
d. Remove retainer, clutch assembly (also fiber washer and center bearing on diesel) from armature shaft.

13. The shift lever and plunger may be disassembled at this time by removing the roll pin.

Fig. 6D-85--Starter Unit Repair 2 of 6

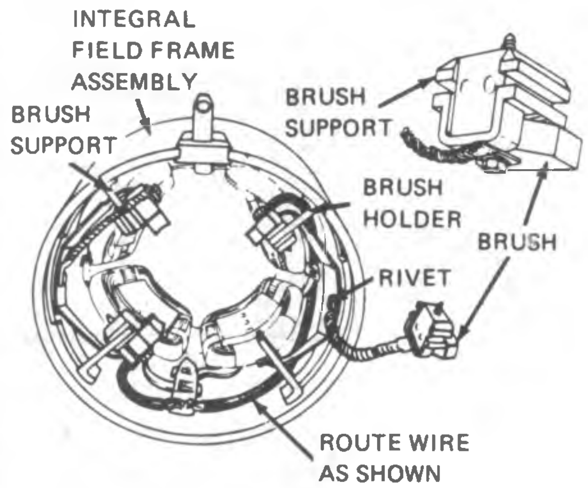
REPLACE BRUSH HOLDER

(STANDARD STARTER)



14. If necessary to replace brush holder parts, proceed as follows:
 a. Remove brush holder pivot pin which positions one insulated and one grounded brush.
 b. Remove brush spring.
 c. Replace brushes as necessary.

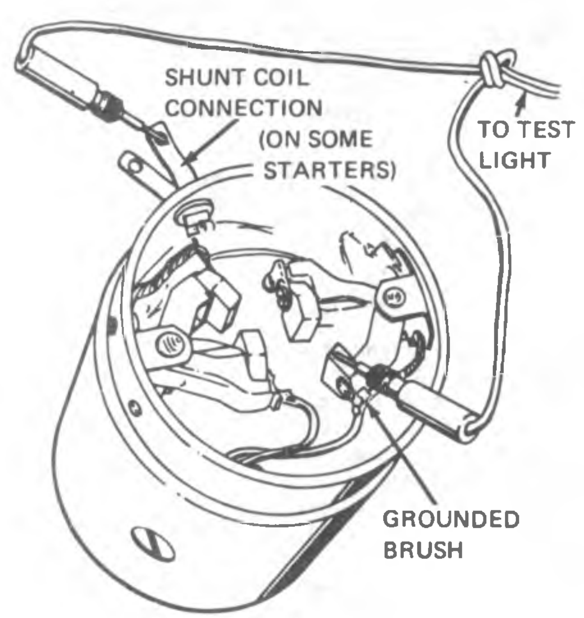
(SMALL 5MT STARTER)



 a. Remove brush holder from brush support.
 b. Remove screw from brush holder and separate brush and holder.
 c. Inspect brush holder for wear or damage.
 d. Replace brushes and/or holders as necessary.

CLEANING INSPECTION AND TESTS

TESTING SHUNT COIL FOR OPEN



15. Clean all starting motor parts, but DO NOT USE GREASE DISSOLVING SOLVENTS FOR CLEANING THE OVERRUNNING CLUTCH, ARMATURE, AND FIELD COILS, solvent would dissolve the grease packed in the clutch and would damage armature and field coil insulation.

16. Inspect armature commutator, shaft and bushings, overrunning clutch pinion, brushes and springs for discoloration, damage or wear. Replace as required.

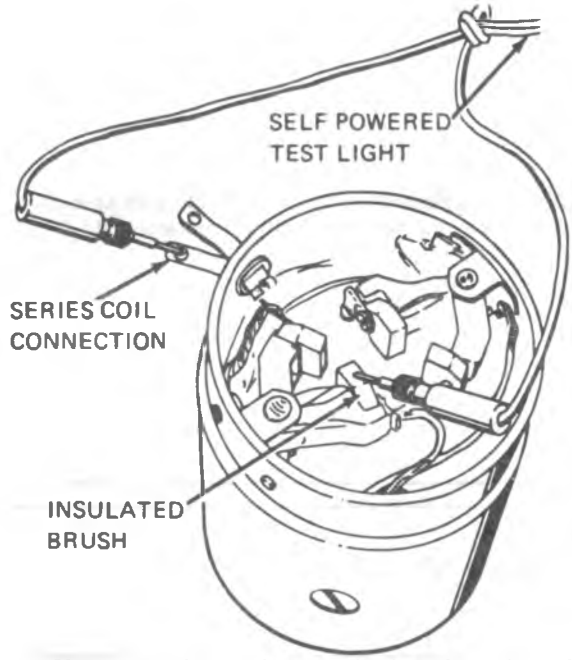
17. Check fit of armature shaft in bushing in drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.

18. Inspect armature commutator. If commutator is rough, it should be turned down. Do not undercut or turn to less than 1.650" O.D. Do not turn out-of-round commutators. Inspect the points where the armature conductors join the commutator bars to make sure they have a good connection. A burned commutator bar is usually evidence of a poor connection.

19. If test equipment is available:
 a. Check the armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.
 b. Using a test lamp, place one lead on the shunt coil terminal and connect the other lead to a ground brush. This test should be made from both ground brushes to insure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require replacement.

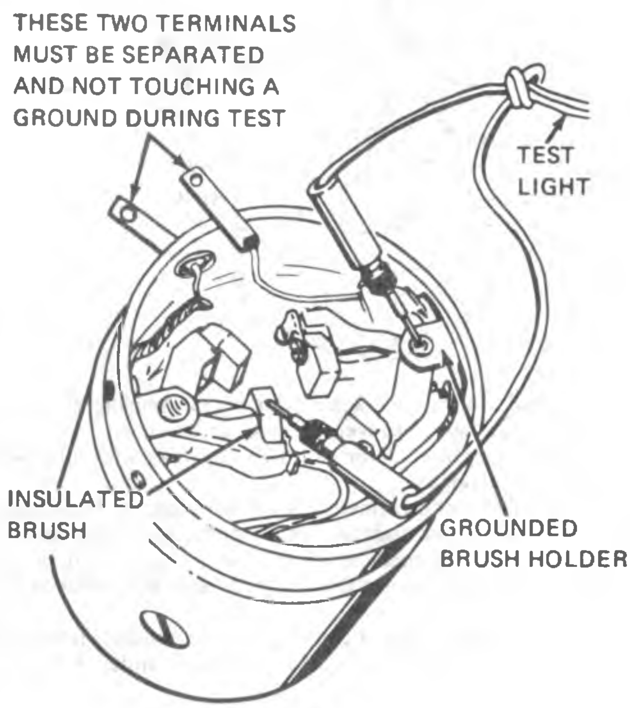
Fig. 6D-86--Starter Unit Repair 3 of 6

TESTING SERIES COIL FOR OPEN



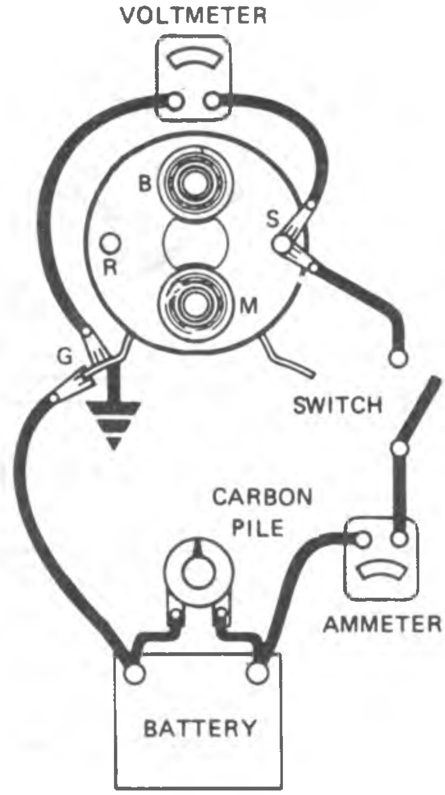
c. Using a test lamp, place one lead on the series coil terminal and the other lead on the insulated brush. If the lamp fails to light, the series coil is open and will require repair or replacement. This test should be made from each insulated brush to check brush and lead continuity.

TESTING SERIES COIL FOR GROUND



d. On starters with shunt coil, separtate series and shunt coil strap terminals during this test. Do not let strap terminals touch case or other ground. Using a test lamp place one lead on the grounded brush holder and the other lead on either insulated brush. If the lamp lights, a grounded series coil is indicated and must be repaired or replaced.

TESTING SOLENOID WINDINGS



e. Check the current draw of the solenoid winding as follows:

If solenoid is not removed from starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests. Complete tests in a minimum of time to prevent overheating of the solenoid.

To check hold-in winding, connect an ammeter in series with 12-volt battery and the "switch" terminal on the solenoid. Connect a voltmeter to the "switch" terminal and to ground. Connect carbon pile across battery. Adjust the voltage to 10 volts and note the ammeter reading. It should be 14.5 to 16.5 amperes for all starting motors.

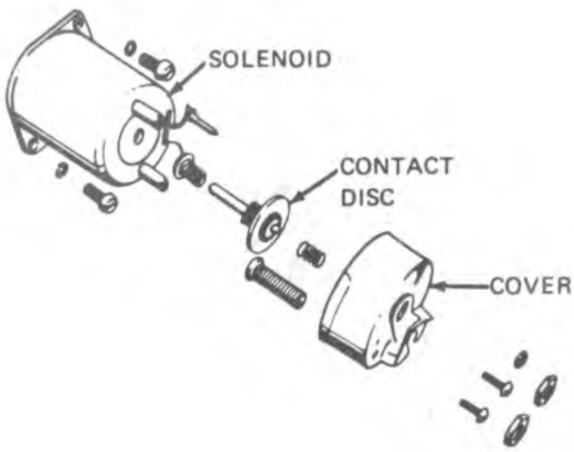
To check both windings, connect as for previous test. Ground the solenoid motor terminal. Adjust the voltage to 10 volts and note the ammeter reading. It should be 41 to 47 amperes for all starting motors.

NOTE: Current will decrease as windings heat up.

Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid and the solenoid should be replaced. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit. Check connections then replace solenoid if necessary.

Fig. 6D-87--Starter Unit Repair 4 of 6

SOLENOID SWITCH DISASSEMBLY



f. The starter solenoid switch is serviced as an assembly. The cover can be removed to inspect the contacts and contact disc if necessary.

STARTER ASSEMBLY

20. Assemble the armature and clutch as follows:

a. Lubricate drive end of armature shaft with lubricant 1960954 or equivalent.

b. Install center bearing (diesel starters) with bearing toward the armature winding. Then install the fiber washer on the armature shaft.

c. Slide clutch assembly onto armature shaft with pinion away from armature.

d. Slide retainer onto shaft with cupped side facing the end of shaft.

e. Install snap ring into groove on armature shaft.

f. Install thrust washer on shaft.

g. Position retainer and thrust washer with snap ring in between. Using two pliers, grip retainer and thrust washer or collar and squeeze until snap ring is forced into retainer and is held securely in groove in armature shaft.

21. Lubricate drive gear housing bushing with lubricant 1960954 or equivalent.

22. Engage shift lever yoke with clutch and slide complete assembly into drive gear housing.

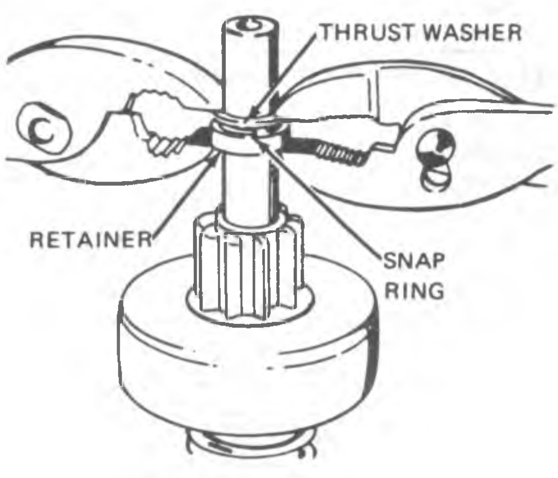
On non-diesel starters the shift lever may be installed in drive gear housing first.

23. Install the center bearing screws (25 MT diesel only) and the shift lever pivot bolt. Tighten securely.

24. Install solenoid assembly.

25. Apply sealer, No. 1050026 or equivalent to solenoid flange where field frame contacts it.

INSTALLING RETAINER, WASHER AND RING



26. Position field frame against drive gear housing on alignment pin using care to prevent damage to brushes.

27. Lubricate commutator end-frame bushing with lubricant 1960954 or equivalent.

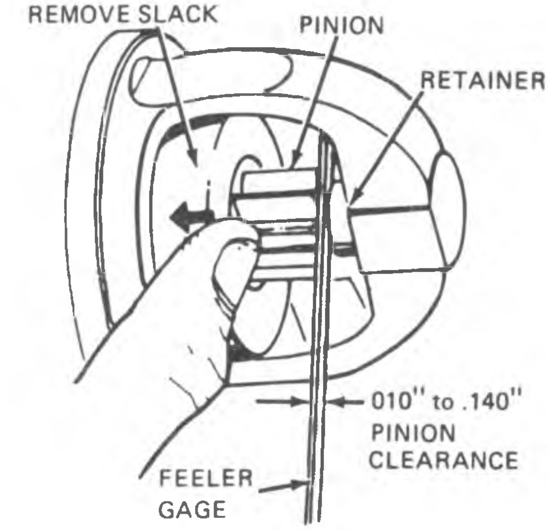
28. Install washer on armature shaft and slide end frame onto shaft, then install and tighten through-bolts. On diesel starter, install insulator and then end frame onto shaft. Then install through bolts, making sure they pass through bolt holes in insulator.

29. Connect the field coil connector to the solenoid terminal.

30. Check pinion clearance as outlined under PINION CLEARANCE.

Fig. 6D-88--Starter Unit Repair 5 of 6

CHECKING PINION CLEARANCE



When the starter motor has been disassembled or the solenoid has been replaced, it is necessary to check the pinion clearance. Pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

31. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.
32. Connect one 12 volt battery lead to the solenoid switch terminal and the other to the starter frame.
33. Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.
34. Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gage. The clearance should be .010" to .140".

Means for adjusting pinion clearance is not provided on the starter motor. If the clearance does not fall within limits, check for improper installation and replace all worn parts.

Fig. 6D-89--Starter Unit Repair 6 of 6

BATTERY SPECIFICATIONS				
MODEL	APPLICATION	COLD CRANK RATE @ 0 °F (-18 °C)	AMPS FOR LOAD TEST	25 AMP RESERVE CAPACITY (MINUTES)
70-405 1981103	CK BASE ALL GAS G BASE LE3	405	200	75
71-390 1981110	G-V8-GAS BASE P-ALL GAS BASE EXC. B 3M	390	190	90
1200	P-BASE-B3M GAS	475	230	130

STARTER SPECIFICATIONS							
			NO LOAD TEST @ 10 VOLTS				
ENGINE/ APPLICATION	STARTER		AMPS		RPM		
	PART NO.	SERIES	MIN.	MAX.	MIN.	MAX.	SPEC. NO.
C LE9, LF3 K LE9 MAN TRANS	1998427	5MTPH3	50	75	6000	11,900	C3591
C LE3, L25 K LE3, L25 MAN P L25 G LE3	1998437	10MT	60	90	6500	10,500	C3592
K LE9, LS9, LE3, L25, LT9 AUTO TRANS	1998438	10MT	70	110	6500	10,700	C3589
C LS9, LT9 K LS9, LT9 MAN G LF3, LE9, L89, LT9	1998439	10MT	70	110	6500	10,700	C3589
C LE8 K LE8 MAN P LE8	1998441	10MT	70	110	6500	10,700	C3563
K LE8-AUTO	1998443	10MT	70	110	6500	10,700	C3589
P LT9 (P30042 & JF9 & M20)	1998444	10MT	—	—	—	—	C3589

SPECIFICATIONS

GENERATOR

CK PICK-UP & BLAZER				
Engine	Generator	P/N	Model	Rating
LE3	K85	1100203	10SI	37A
LE3	K81	1100209	12SI	66A
L25 (-N41)	K85	1100225	10SI	37A
L25 (&N41)	K85	1100203	10SI	37A
L25 (-N41)	K81	1100242	12SI	66A
L25 (&N41)	K81	1100207	12SI	66A
V-8 Gas	K85	1100204	10SI	37A
V-8 Gas	K81	1100208	12SI	66A
Diesel	K81	1100241	12SI	66A

CK SUBURBAN				
Engine	Generator	P/N	Model	Rating
Gas V8	K85	1100204	10SI	37A
	K81	1100208	12SI	66A
	K64	1100217	12SI	78A
Diesel	K81	1100241	12SI	66A
	K64	1100259	12SI	78A

G-VAN				
Engine	Generator	P/N	Model	Rating
LE3	K85	1100203	10SI	37A
LE3	K81	1100207	12SI	66A
V8 Gas	K85	1100204	10SI	37A
V8 Gas	K81	1100208	12SI	66A
Diesel	K81	1100241	12SI	66A

P-TRUCK				
Engine	Generator	P/N	Model	Rating
L25	K79	1100229	10SI	42A
L25	K81	1100209	12SI	66A
L25	K97	1101064	27SI	80A
LT9/LE8	K79	1100231	10SI	42A
LT9/LE8	K81	1100208	12SI	66A
LT9/LE8	K97	1101063	27SI	80A
LL4	K81	1100241	12SI	66A
LL4	K64	1100293	15SI	85A

104015

SECTION 6E8

DRIVEABILITY AND EMISSIONS

CARBURETED VEHICLE - CKGP TRUCK

4.1L VIN CODE D (RPO LE3)

4.8L VIN CODE T (RPO L25)

5.0L VIN CODE F (RPO LF3)

5.0L VIN CODE H (RPO LE9)

5.7L VIN CODE L (RPO LS9)

5.7L VIN CODE M (LT9)

7.4L VIN CODE A (RPO LE8)

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ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

The engine has controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

The following emission controls are on all engines:

- Positive Crankcase Ventilation (PCV)
- Exhaust Gas Recirculation (EGR)
- Thermostatic Air Cleaner (THERMAC)
- Air Management
- Early Fuel Evaporation (EFE) (except 4.8L)

The 4.1L engine in California has a Computer Command Control System which controls:

- Fuel Control System
- Air Management
- Electronic Spark Timing (EST)
- Transmission Converter Clutch (TCC)

The 5.0L (RPO LF3) and 5.7L (RPO LS9) engines in California have a Computer Command Control system which controls:

- Fuel Control System
- Air Management
- Exhaust Gas Recirculation (EGR)
- Evaporative Emission Control System (EECS)
- Electronic Spark Timing (EST)
- Transmission Converter Clutch (TCC)

All engines in California have an Evaporative Emission Control System. The 4.1L, 5.0L and 5.7L (LS9) engines outside of California have an Evaporative Emission Control System.

A Throttle Return Control (TRC) system is used on heavy duty emissions - 4.8L, 5.0L (LE9) and 5.7L (LT9) vehicles.

COMPUTER COMMAND CONTROL

California Only

An Electronic Control Module (ECM) is the heart of the Computer Command Control system. Figure 1 has a list of sensors the ECM uses to get information about engine operation and the various systems it controls. Details of basic operation, diagnosis, and service are covered in Section C - Component Systems.

The ECM has the ability to do some diagnosis of itself. When it recognizes a problem, it lights a "CHECK ENGINE" lamp on the instrument panel. This does not mean that the engine should be stopped right away, but that the cause of the light coming on should be checked as soon as reasonably possible.

Under the instrument panel on a CK truck or under the driver's seat on a G-Truck, is an Assembly Line Communication Link (ALCL) connector that is used by the assembly plant for a computerized check-out of the system. This connector is used in service to help diagnose the system (see "Diagnostic Procedure Terms").

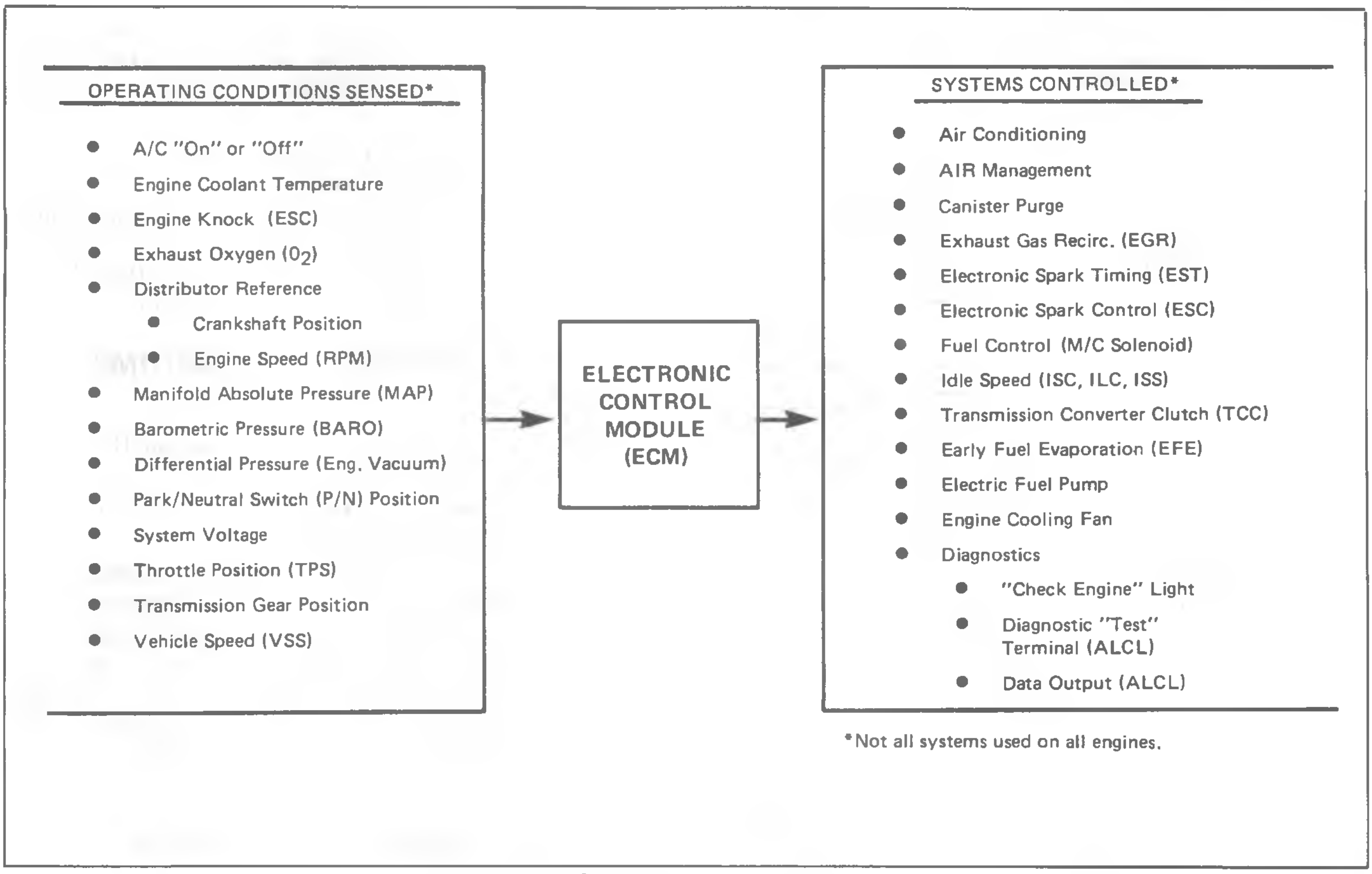


Figure 1 ECM Operating Conditions Sensed and Systems Controlled

HOW TO USE THIS SECTION

DIAGNOSTIC PROCEDURE USE

The diagnostic procedures used in this section are designed to find and repair engine performance or emission related problems.

Federal

Refer to Section B for a list of various driveability symptoms. Refer to Section C for emission control system components which describe a system, diagnosis and give on-vehicle service procedures.

California

The way to approach a problem is to follow three basic steps (shown in Figure 2):

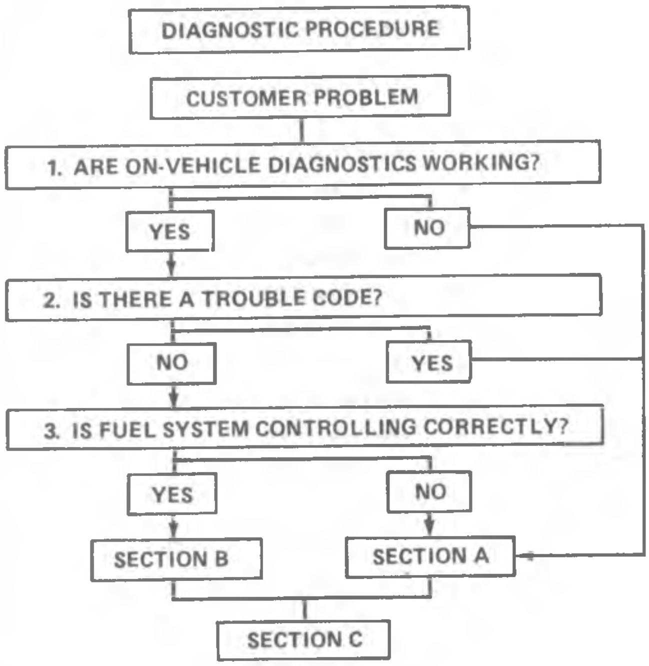
1. **Are the On-Vehicle Diagnostics working?** We find this out by performing the "Diagnostic Circuit Check" (Figure 22). Since this is the starting point for the diagnostic procedure, **always** begin here. If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart in Section A to correct the On-Vehicle Diagnostics. If the vehicle will not start, see "Engine Cranks But Won't Run" in Section B (Symptoms). If the On-Vehicle Diagnostics are OK, the next step is:
2. **Is there a Trouble Code stored?** If a trouble code is stored, go directly to the numbered code chart in Section A. If no trouble code is stored, the third step is:
3. **Is the Fuel System controlling correctly?** We find this out in the "System Performance Check" (Figure 24). If the fuel system is **not** controlling correctly, a chart in Section A will be used to correct the problem. If the "System Performance Check" shows that the system is in closed loop and operating normally, go to the Driveability Symptoms in Section B.

   Section B lists various driveability symptoms which may be found, and suggests checks of related components, many of which are found in Section C.

This procedure, which takes only a short time, will help lead you repair the problem in the least amount of time.

VISUAL UNDERHOOD INSPECTION

One of the most important checks that must be done before **any** diagnostic procedure is a careful visual underhood inspection.This can often lead to fixing a problem without further steps. Inspect **all** vacuum hoses for correct routing, pinches, cuts, or disconnects. Be sure to inspect hoses that are difficult to see beneath the air cleaner, compressor, generator, etc. Inspect **all** the wires in the engine compartment for correct and good connections, burned or chaffed spots, pinched wires, or contact with sharp edges or hot exhaust manifolds. **This visual inspection is very important.** It must be done carefully and thoroughly.



SECTION A: **DIAGNOSTIC CHARTS**
Based on results of diagnostic circuit check, system performance check, and/or codes

SECTION B: **SYMPTOMS**
Based on driveability symptoms, when no codes, or intermittent codes, are stored

SECTION C: **COMPONENT SYSTEMS**
Provides diagnostic and on-vehicle service for component systems

Figure 2 Diagnostic Procedure Use

SECTION A - DIAGNOSTIC CHARTS

California Only

This section is used for 4.1L, 5.0L (LF3) and 5.7L (LS9) engines in California with Computer Command Control.

The Diagnostic Charts in Section A are used to find and repair problems which the On-Vehicle Diagnostics or System Performance Check have found. These can be:

1. Charts which fix a problem when the on-vehicle diagnostics don't work;
2. Charts where a stored trouble code leads you to a particular problem; and
3. Charts which are used because the System Performance Check found a problem.

SECTION B - DRIVEABILITY SYMPTOMS

Federal/California

The Symptom diagnostics in Section B are used **only** after checking that:

1. The On-Vehicle Diagnostics are working;
2. No trouble codes are stored;
3. The System Performance Check is normal; and
4. A careful visual check found no problems.

These driveability symptoms include such items as "Detonation" and "Sluggish, Spongy". Each of these procedures will normally lead to checking a component system of the vehicle, such as EGR, EST, TCC, etc. Each of these are covered under "Component Systems" in Section C.

SECTION C - COMPONENT SYSTEMS

Federal/California

Each component system of the vehicle's engine and emission control system, and several other systems which are controlled by the Electronic Control Module (ECM), is covered individually. Each system will have:

- General Description to explain:
  - How the system and each of its parts work.
  - Where the parts are located.
  - What the vacuum and electrical circuits are.
  - How the vehicle will operate if one of the parts malfunctions.
- Diagnostic procedures for that system will be covered. This may be a diagnostic chart (listed in the contents as Chart C-2A, C-5, etc.), or may be a simple functional check of a part.
- On-Vehicle Service procedures will be given along with information on locating parts in the Parts Catalog.

BASIC KNOWLEDGE REQUIRED

Before using this section of the Service Manual, there are some areas that you should be familiar with. Without this basic knowledge, you will have trouble using the diagnostic procedures in this section.

BASIC ELECTRICAL CIRCUITS

You should understand the basic theory of electricity, and know the meaning of voltage, amps, and ohms. You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram.

USE OF CIRCUIT TESTING TOOLS

You should know how to use a test light, how to connect and use a tachometer, and how to use jumper wires to by-pass components to test circuits.

USE OF DIGITAL VOLT-OHM METER (DVM)

You should be familiar with the Digital Volt-Ohm Meter, particularly essential tool J-29125-A. You should be able to measure voltage, resistance, and current. You should be familiar with the controls of the meter and how to use it correctly.

SOURCES OF ADDITIONAL INFORMATION

If you need basic knowledge of electrical troubleshooting, Section 8A of this Service Manual contains helpful information in the Introduction. Basic use of circuit testing tools is also covered in Section 8A. The Digital Volt-Ohm Meter is covered in the "Special Information" portion of this section.

DIAGNOSTIC PROCEDURE TERMS

"CHECK ENGINE" LIGHT

California Only

The "CHECK ENGINE" light on the instrument panel has two functions:

- It is used as a indicator lamp to tell the driver that a problem has occured, and that the vehicle should be taken for service as soon as reasonably possible.
- It is used by the technician to read out "Trouble Codes" to help diagnosis system problems.

As a bulb and system check, the "CHECK ENGINE" light will come "On" with the ignition switch "On" and the engine not running. When the engine is started, the "CHECK ENGINE" light will turn off. If the "CHECK ENGINE" light remains on, the self-diagnostic system has detected a problem. If the problem goes away, the light will go out after 10 seconds, but a Trouble Code will remain stored in the ECM. This indicates that the self-diagnostic system has deleted a problem but for some reason the problem was corrected. This is often caused by a loose connection.

INTERMITTENT "CHECK ENGINE" LIGHT

The Diagnostic Charts in Section A are set up to check whether or not a stored trouble code is "intermittent" or "hard". An "intermittent" code is one which does not reset itself, and is not present while you are working on the car. This is often caused by a loose connection. If a chart leads you to an intermittent condition, go to "INTERMITTENT CHECK ENGINE LIGHT" in Section B. A "hard" code is one which repeats itself in the chart procedures, and is present when you are working on the vehicle. The chart with the stored trouble code number will lead you to the cause of the problem.

TROUBLE CODES

The Electronic Control Module, or ECM, is really a small computer. It uses sensors to look at many engine operating conditions. It has a memory, and it knows what certain sensor readings should be under certain conditions. These conditions are described on the facing page of each Trouble Code Chart. If a sensor reading is not what the ECM thinks it should be, the ECM will turn on the "CHECK ENGINE" light on the instrument panel, and will store a Trouble Code in the memory. The Trouble Code indicates which CIRCUIT the trouble is in. A circuit consists of a sensor (such as coolant temperature), the wiring and connectors to it, and the ECM.

To get a Trouble Code out of the ECM, we use the Assembly Line Communication Link, or ALCL.

ALCL CONNECTOR

The Assembly Line Communication Link (ALCL) is a diagnostic connector located in the passenger compartment (see Figure 3). It has terminals which are used in the assembly plant to check if the Computer Command Control is operating properly. Terminal "B" is the Diagnostic "Test" terminal , and it can be connected to terminal "A", or ground, to enter the Diagnostic mode.

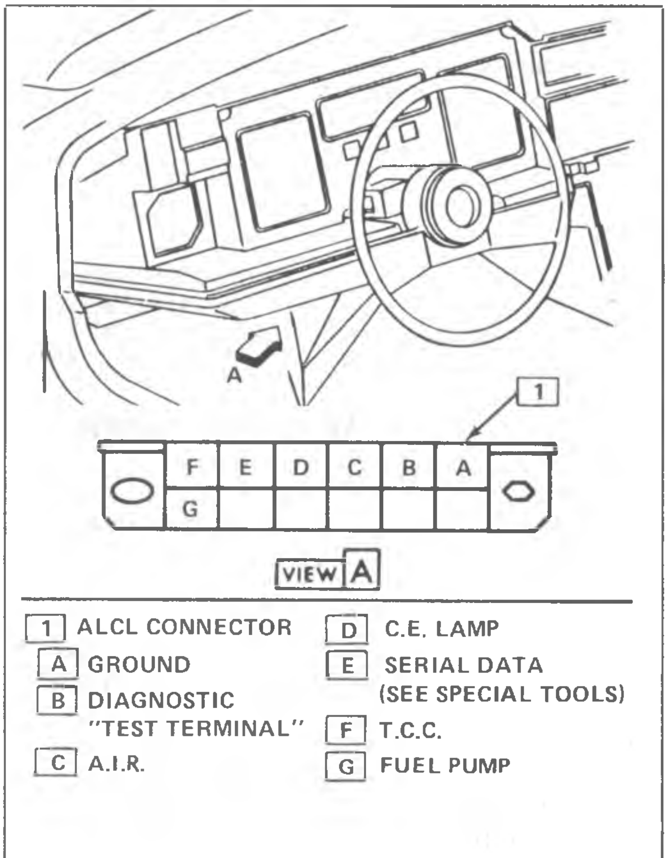


Figure 3 ALCL Connector

Diagnostic Mode

If the "Test" terminal is grounded with the ignition "ON" and the engine stopped, the system will enter the **Diagnostic Mode.** In the this mode the ECM will:

1. Display a code "12" by flashing the "CHECK ENGINE" light (indicating the system is operating). A code "12" consists of one flash, followed by a short pause, then two flashes in quick succession. This code will be flashed three times. If no other codes are stored, code 12 will continue to flash until the "Test" terminal is ungrounded. The Engine should not be started with the"Test" terminal grounded, because it

may continue to flash a Code 12 with the engine running. When the "Test"terminal is grounded after the engine is running, the system will enter the "Diagnostic Mode" and any stored code will flash if there is a problem or fault, but Code 12 will flash only if there is a problem with the distributor reference signal.

2. Display any stored trouble codes by flashing the "CHECK ENGINE" light. Each code will be flashed three times, then code "12" will be flashed again. If a trouble code is displayed, the memory is cleared, then the engine is run to see if the code is a "hard" or"intermittent" failure. If it is a "hard" failure, a Diagnostic chart is used to find the problem. If it is an intermittent failure, the charts are not used. A physical inspection of the applicable system should be.
3. Energize all ECM controlled relays and solenoids (with some exceptions, as noted in "Component Systems"). The ISC motor (if equipped) also moves back and forth, and the EGR solenoid (if equipped) is turned on and off.
4. Additional trouble codes will not be set.

ALCL Mode

Equipment is available from various suppliers for reading information from the serial data terminal in the ALCL. With the equipment connected, the ECM will be in the ALCL mode. The information which can be obtained, and how it can be used in diagnosis, is found in the Special Information Section.

CLEARING TROUBLE CODES

California Only

When the ECM finds a problem, the "CHECK ENGINE" light will come "ON" and a trouble code will be recorded in the ECM memory. If the problem is intermittent, the "CHECK ENGINE" light will go out after 10 seconds when the fault goes away. However, the trouble code will be retained in the ECM memory until the battery voltage to the ECM terminal "R" is removed. Removing battery voltage for 10 seconds will clear all stored trouble codes. Do this by disconnecting the ECM harness from the positive battery pigtail, ECM fuse, or ECM connector, for 10 seconds with the ignition "off".

Trouble Codes should be cleared after repairs have been completed on a problem. Also, some Diagnostic Charts will tell you to clear the codes before using the chart. This allows the ECM to reset the code while going through the chart, which will help to find the cause of the problem more quickly.

NOTICE: To prevent internal ECM damage, the ignition must be "OFF" when disconnecting or reconnecting power to ECM (for example battery positive cable, ECM pigtail, ECM fuse, jumper cables, etc.).

ABBREVIATIONS AND GLOSSARY OF TERMS

A/F – Air/Fuel (A/F Ratio)

AIR – AIR INJECTOR REACTION SYSTEM – Air flow from pump is directed into engine to reduce exhaust emissions.

ALCL – ASSEMBLY LINE COMMUNICATION LINK – Used at assembly to evaluate Computer Command Control and for service to flash "CHECK ENGINE" light if there are trouble codes.

BARO – BAROMETRIC ABSOLUTE PRESSURE SENSOR – Reads atmospheric pressure. May be called BARO, or barometric absolute pressure sensor.

BAT+ – Battery Positive Terminal

VEHICLE INERTIA WEIGHT CLASS – Weight of car; used in exhaust emission tests to determine inertia weight settings for the chassis dynamometer. This information is used to calibrate the engine calibration unit (PROM).

CCC – COMPUTER COMMAND CONTROL – has a electronic control module to control air/fuel and emission systems.

CCP – CONTROLLED CANISTER PURGE – ECM controlled solenoid valve that permits manifold vacuum to purge the evaporative emissions from the charcoal canister.

CDRV – CRANKCASE DEPRESSION REGULATOR VALVE – Used to regulate (meter) the flow of crankcase gases back into a diesel engine.

CE – CHECK ENGINE – Lights when a malfunction occurs in Computer Command Control.

CID – Cubic Inch Displacement

CLOOP – Closed Loop

CLCC - CLOSED LOOP CARBURETOR CONTROL – Used to describe oxygen sensor to ECM to M/C solenoid circuit operation.

COOLANT TEMPERATURE SENSOR – Device that senses the engine coolant temperature, and passes that information to the electronic control module through a coaxial connector.

Conv. – CATALYTIC CONVERTER, THREE-WAY – Exhaust converter containing platinum and palladium to speed up conversions of HC and CO, and rhodium to accelerate conversion of NOx.

CO – CARBON MONOXIDE – One of the pollutants found in engine exhaust.

DIAGNOSTIC CODE – Pair of numbers obtained from flashing "CHECK ENGINE" light. This code can be used to deternine area in the system where a malfunction may be located.

DIAGNOSTIC "TEST"TERM. – Lead of ALCL Connector which is grounded to get a Trouble Code

DVM (10 Meg.) – Digital Voltmeter with 10 Million ohms resistance – used for measurement in electronic systems.

DWELL – The amount of time (recorded on a dwellmeter in degrees of crankshaft rotation) that voltage passes through a closed switch; for example, ignition contact points or internal switch in an electronic control module.

EAC – ELECTRIC AIR CONTROL – Used on AIR System to direct air flow to Air Switching valve or air cleaner.

EAS – ELECTRIC AIR SWITCHING to direct air flow to catalystic converter or exhaust parts of the engine.

ECM — ELECTRONIC CONTROL MODULE — A metal cased box (located in passenger compartment) containing electronic circuitry which electrically controls and monitors air/fuel and emission systems on Computer Command Control, and turns on the "CHECK ENGINE" light when a malfunction occurs in the system.

ECU – ENGINE CALIBRATION UNIT – An electronic component which can be specifically programmed to the design of each vehicle model to control the M/C solenoid. The ECUM plugs into the electronic control module (ECM). The ECU is usually called a PROM.

EFI – ELECTRONIC FUEL INJECTION is Computer Command Control using throttle body injection.

EGR – EXHAUST GAS RECIRCULATION (EGR) – Method of reducing NOx emission levels.

EECS – EVAPORATIVE EMISSIONS CONTROL SYSTEM – Used to prevent gasoline vapors in the fuel tank and carburetor or TBI from entering the atmosphere.

EFE – EARLY FUEL EVAPORATION (EFE) – Method of warming the intake manifold during cold engine operation. Provides efficient air/fuel mixing.

EMR – Electronic Module Retard. Controls spark retard.

ENERGIZE/DE-ENERGIZE – When voltage is passed through the M/C solenoid, the metering control armature is pulled into the solenoid (energized). When the voltage to the solenoid is turned off, a spring raises the metering control armature (de-energized).

ESC – ELECTRONIC SPARK CONTROL – Used to modify spark advance when detonation occurs.

EST – ELECTRONIC SPARK TIMING – ECM controlled timing of ignition spark.

FED – FEDERAL – Vehicle/engine available in all states except California.

HC – HYDROCABRONS (HC) – One of the pollutants found in engine exhaust.

HIGH IMPEDANCE VOLTMETER – Has high opposition to the flow of electrical current. Good for reading circuits with low current flow, such as found in electronic systems.

HEI – HIGH ENERGY IGNITION – is a distributor that uses an electronic module and pick-up coil in place of contact points.

Hg – MERCURY, A calibration material used as a standard for vacuum measurement.

IAC – IDLE AIR CONTROL – installed in TBI and controlled by the ECM to regulate idle air.

IDEAL MIXTURE – The air/fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions, typically 14.7/1.

IDLE AIR BLEED VALVE – Controls the amount of air let into the idle fuel mixture prior to the mixture entering the idle system, when the M/C solenoid is energized.

IGN – Ignition.

INPUTS – Information from sources (coolant temperature sensors, exhaust oxygen sensor, etc.) that tells the ECM how the engine is performing.

INTERMITTENT – Occurs now and then; not continuously. In electrical cicruits, refers to occasional open, short, or ground.

I.P. – Instrument Panel.

ISC – IDLE SPEED CONTROL MOTOR – Regulates throttle valve position, is controlled by the ECM.

km/hr – Kilometer Per Hour

L – Liter

L-4 – Four Cylinder In-Line Engine

MALFUNCTION – A problem that causes the system to operate incorrectly. Typical malfunctions are; wiring harness opens or shorts, failed sensors, or M/C solenoid or PROM failure.

MANIFOLD VACUUM SENSOR – Reads pressure changes in intake manifold in relation to barometric pressure. May be called manifold/barometric pressure sensor, or differential sensor.

MAP – MANIFOLD PRESSURE SENSOR – Reads pressure changes in intake manifold. May be called MAP, or manifold absolute pressure sensor.

M/C – Mixture Control

MIXTURE CONTROL (M/C) SOLENOID – Device, installed in carburetor, which regulates the air/fuel ratio.

MODE – A particular state of operation.

MPH – Miles Per Hour

N.C. – Normally Closed. State of relay contacts or solenoid plunger when no voltage is applied.

N·m – Newton Meters (Torque)

N.O. – Normally Open. State of relay contacts or solenoid plunger when no voltage is applied.

NOx – NITROGEN, OXIDES OF (NOx)–One of the pollutants found in engine exhaust.

0_2 – Oxygen (Sensor) – Monitors the oxygen content of the exhaust system and generates a voltage signal to the ECM.

OPEN LOOP – Describes ECM control of the M/C solenoid without use of oxygen sensor information.

OUTPUT – Functions, typically solenoids, that are controlled by the ECM.

OXYGEN SENSOR, EXHAUST – Device that detects that amount of oxygen (0_2) in the exhaust stream, and sends that information to the ECM.

PAIR – PULSE AIR INJECTION REACTOR SYSTEM – pulsed air directed into engine to reduce exhaust emissions.

PCV – POSITIVE CRANKCASE VENTILATION – Prevent fumes in crankcase from passing into atmosphere.

P/N – Park/Neutral

Port – Exhaust Port

PROM – Programmable Read Only Memory; an electronic term used to describe the engine calibration unit (ECU).

RPM – REVOLUTIONS PER MINUTE – A measure of rotational speed.

RVB – REAR VACUUM BRAKE – Is used to control choke operation during cold engine condition.

SELF-DIAGNOSTIC CODE – The ECM can detect malfunctions in the system. If a malfunction occurs, the ECM turns on the "CHECK ENGINE" light. A diagnostic code can be obtained from the ECM through the "CHECK ENGINE" light. This code will indicate the area of the malfunction.

TACH – Tachometer

TBI – Throttle Body Injection (Unit) – is controlled by the ECM to supply precise air/full mixture into the intake manifold.

TCC – TORQUE CONVERTER CLUTCH – ECM controlled solenoid in transmission which positively couples the transmission to the engine.

THERMAC – THERMOSTATIC AIR CLEANER – provides preheated air to outer intake manifold to provide better driveability when engine is cold.

TPS – THROTTLE POSITION SENSOR – Device that tells the ECM when the throttle position changes.

TVS – THERMAL VACUUM SWITCH. Used to control vacuum in relationship to engine temperature.

V – Volt

V-6 – SIX CYLINDER ENGINE – Arranged in a "V"

V-8 – EIGHT CYLINDER ENGINE – Arranged in a "V"

VACUUM – Negative pressure; less than atmospheric pressure

VACUUM, MANIFOLD – Vacuum source in manifold below throttle plate.

VACUUM, PORTED – Vacuum source in carburetor above closed throttle plate.

VAC SENSOR – Abbreviation Car Divverential Pressure Sensor which is a vacuum sensor.

VIN – Vehicle Identification Number

VSS – VEHICLE SPEED SENSOR (VSS) – Sensor in speedometer cluster which sends vehicle speed information to the electronic control module.

WOT – Wide Open Throttle

ENGINE COMPONENTS

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Figure 4) is located in the engine compartment (fan shroud, radiator support, shocktower, hood underside, etc.) of every vehicle produced by General Motors Corporation. The label contains important emission specifications and setting procedures, as well as a vacuum hose schematic with emission components identified.

When servicing the engine or emission systems, the Vehicle Emission Control Information label should be checked for up-to-date information.

ENGINE EMISSION COMPONENTS

California Only

A top view location of emission components for each engine are shown in the following illustrations.

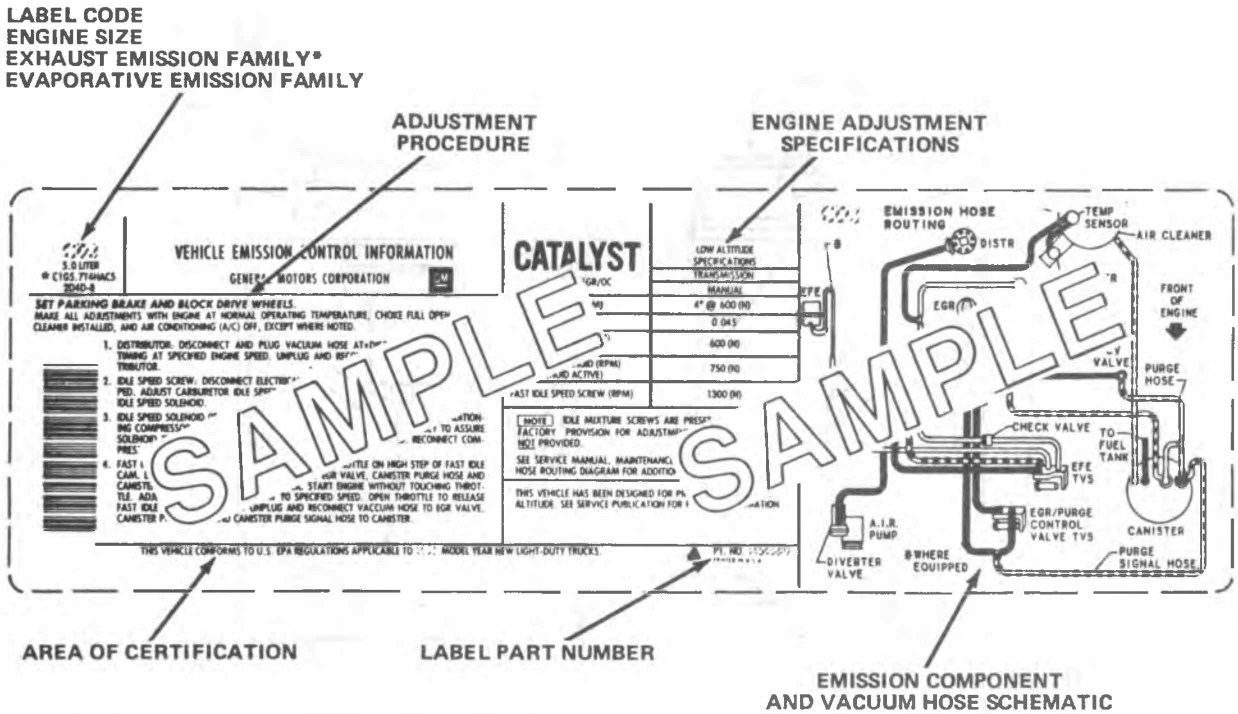
- Component Locations - 4.1L (CK Series) - Figure 5
- Component Locations - 4.1L (G Series) - Figure 8
- Component Locations - 5.0L/5.7L (CK Series) - Figure 13
- Component Locations - 5.0L/5.7L (G Series) - Figure 16

The wiring harness routings and component locations for the Computer Command Control are shown in the following illustrations.

- Wiring Harness - 4.1L (CK Series) - Figures 6 and 7
- Wiring Harness - 4.1L (G Series) - Figures 9 and 10
- Wiring Harness - 5.0L/5.7L (CK Series) - Figures 14 and 15
- Wiring Harness - 5.0L/5.7L (G Series) - Figures 17 and 18

Refer to Figures 11 and 19 for Computer Command Control wiring schematic diagrams.

Refer to Figures 12 and 20 for Computer Command Control (ECM) connector terminal end wires. Voltage values that are taken at the ECM should be very close to the chart. There may be a slight variation due to low battery.



"ALWAYS REFER TO THE VEHICLE EMISSION CONTROL INFORMATION LABEL FOR THE CORRECT AND MOST CURRENT SPECIFICATIONS".

***EXHAUST EMISSION FAMILY**

E1 G 5.7 T 4 HA C5

CERT YEAR
E = 1984

DIVISION
- 1G = Chevrolet
- 2G = Pontiac
- 3G = Oldsmobile
- 4G = Buick
- 6G = Cadillac

DISPLACEMENT
Liters - Largest if more than one

VEHICLE CLASS AND STANDARDS
- V = Gasoline Vehicle
- W = Calif. Std. Gasoline Vehicle
- T = Gasoline Truck
- D = Diesel Vehicle
- E = 100K Calif. Std. Diesel Vehicle
- K = Diesel Truck

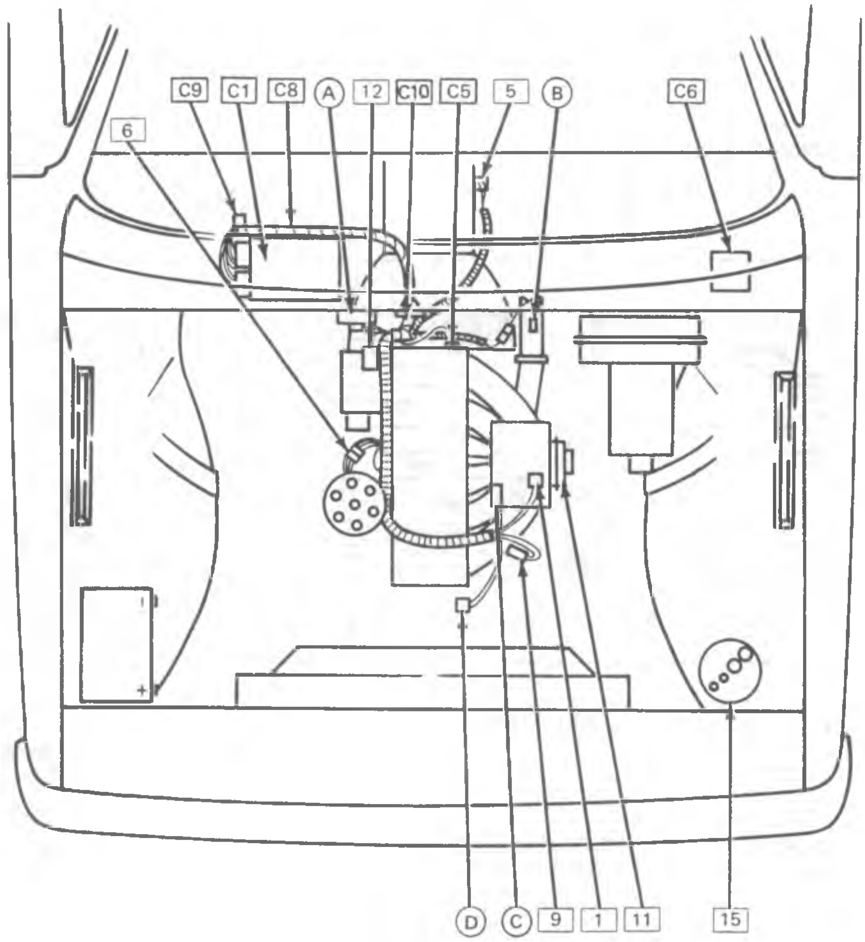
FUEL METERING
- 1 = 1bbl
- 2 = 2bbl
- 4 = 4bbl
- 5 = TBI
- 7 = MFI
- 8 = PFI
- 9 = PFI Turbo

CATALYST DESCRIPTION

Engine Family Suffix Code (Describes Emission System)

CHECK SUM DIGIT

Figure 4 Vehicle Emission Control Information Label



"C/K" SERIES
4.1 (250 CID) L6 RPO: LE 3 V.I.N. CODE: D
CALIFORNIA ONLY

COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C5 System Ground
- C6 Fuse Panel
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

AIR/FUEL SYSTEM

- 1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

- 5 Trans. Conv. Clutch Connector

IGNITION SYSTEM

- 6 Electronic Spark Timing Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 11 Exhaust Gas Recirculation Valve
- 12 Exhaust Gas Recirculation Solenoid Valve (A/T)

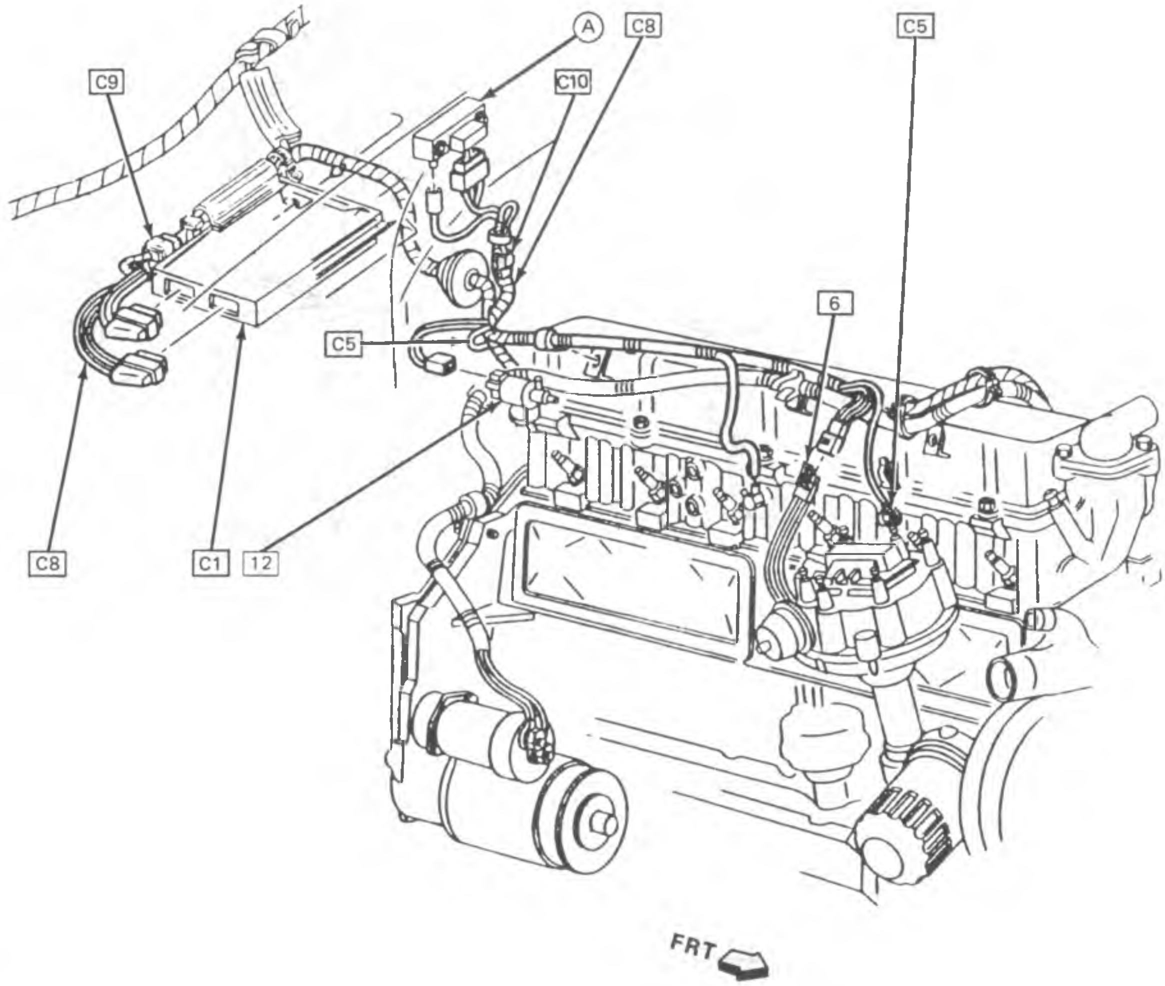
FUEL VAPOR CONTROL SYSTEM

- 15 Vapor Canister

SENSORS/SWITCHES

- A Vacuum Sensor
- B Exhaust Oxygen Sensor
- C Throttle Position Sensor
- D Coolant Sensor

Figure 5 Component Locations - 4.1L (CK Series)



COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C5 System Ground
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

IGNITION SYSTEM

- 6 Electronic Spark Time Connector

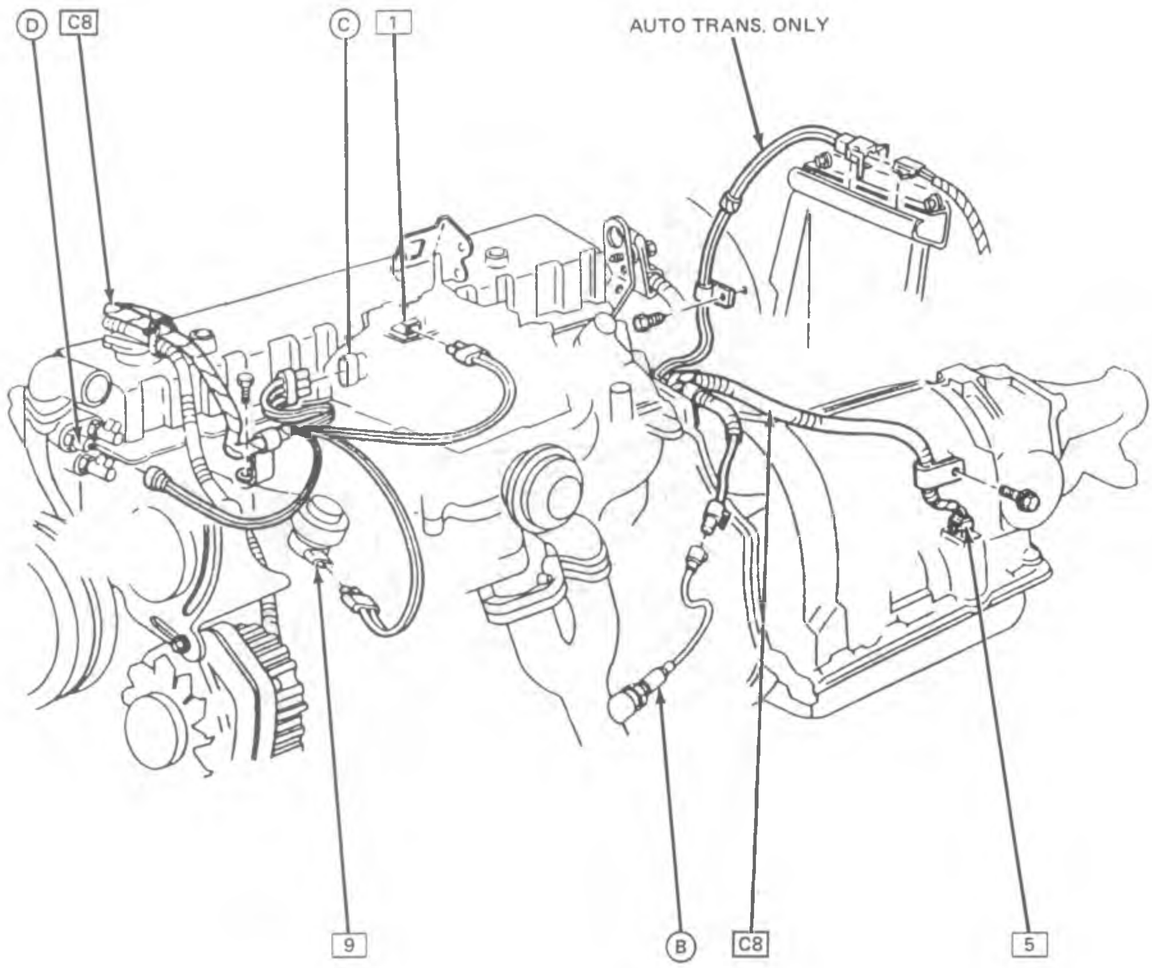
EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 12 Exhaust Gas Recirculation Solenoid Valve (A/T)

SENSORS/SWITCHES

- A Vacuum Sensor

Figure 6 ECM Wire Harness - 4.1L (CK Series) (1 of 2)



COMPUTER SYSTEM

C8 Computer Control Harness

AIR/FUEL SYSTEM

1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

5 Trans. Conv. Clutch Connector

AIR INJECTION SYSTEM

9 Air Divert Solenoid Valve

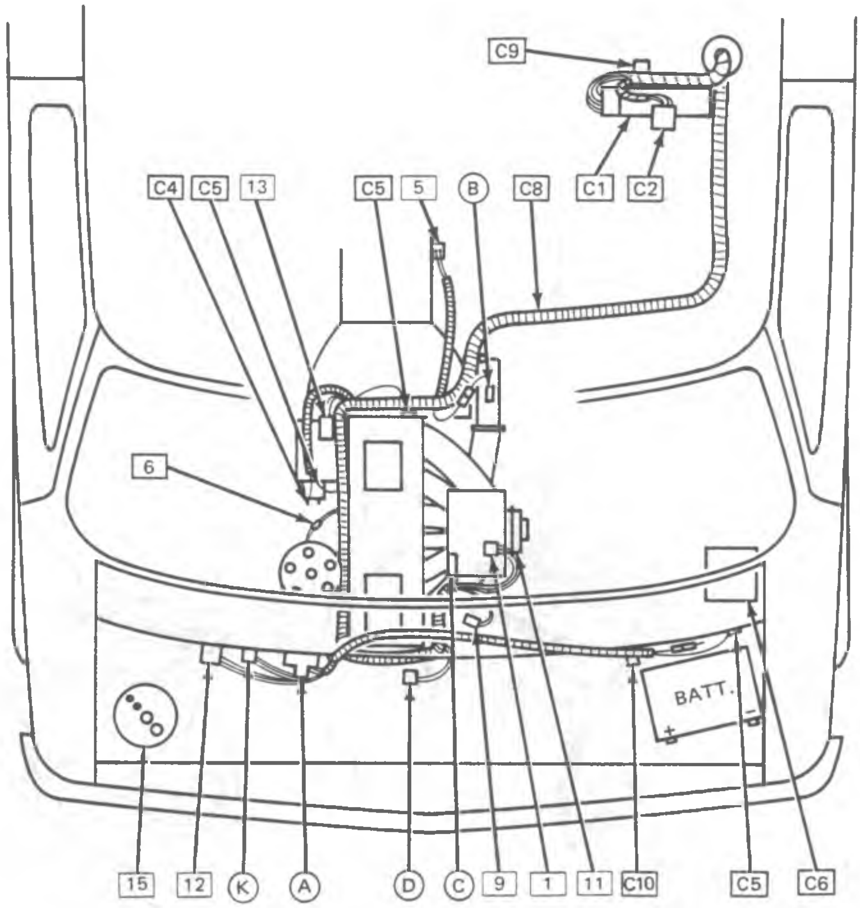
SENSORS/SWITCHES

B Exhaust Oxygen Sensor

C Throttle Position Sensor

B Coolant Sensor

Figure 7 ECM Wire Harness - 4.1L (CK Series) (2 of 2)



"G" TRUCK SERIES
4.1L (250 CID) L6 RPO: LE3 V.I.N. CODE: D
CALIFORNIA ONLY

COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C2 ALCL Connector
- C4 System Power
- C5 System Ground
- C6 Fuse Panel
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

AIR/FUEL SYSTEM

- 1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

- 5 Trans. Conv. Clutch Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 11 Exhaust Gas Recirculation Valve
- 12 Exhaust Gas Recirculation Valve Solenoid

FUEL VAPOR CONTROL SYSTEM

- 13 Canister Purge Solenoid Valve
- 15 Vapor Canister

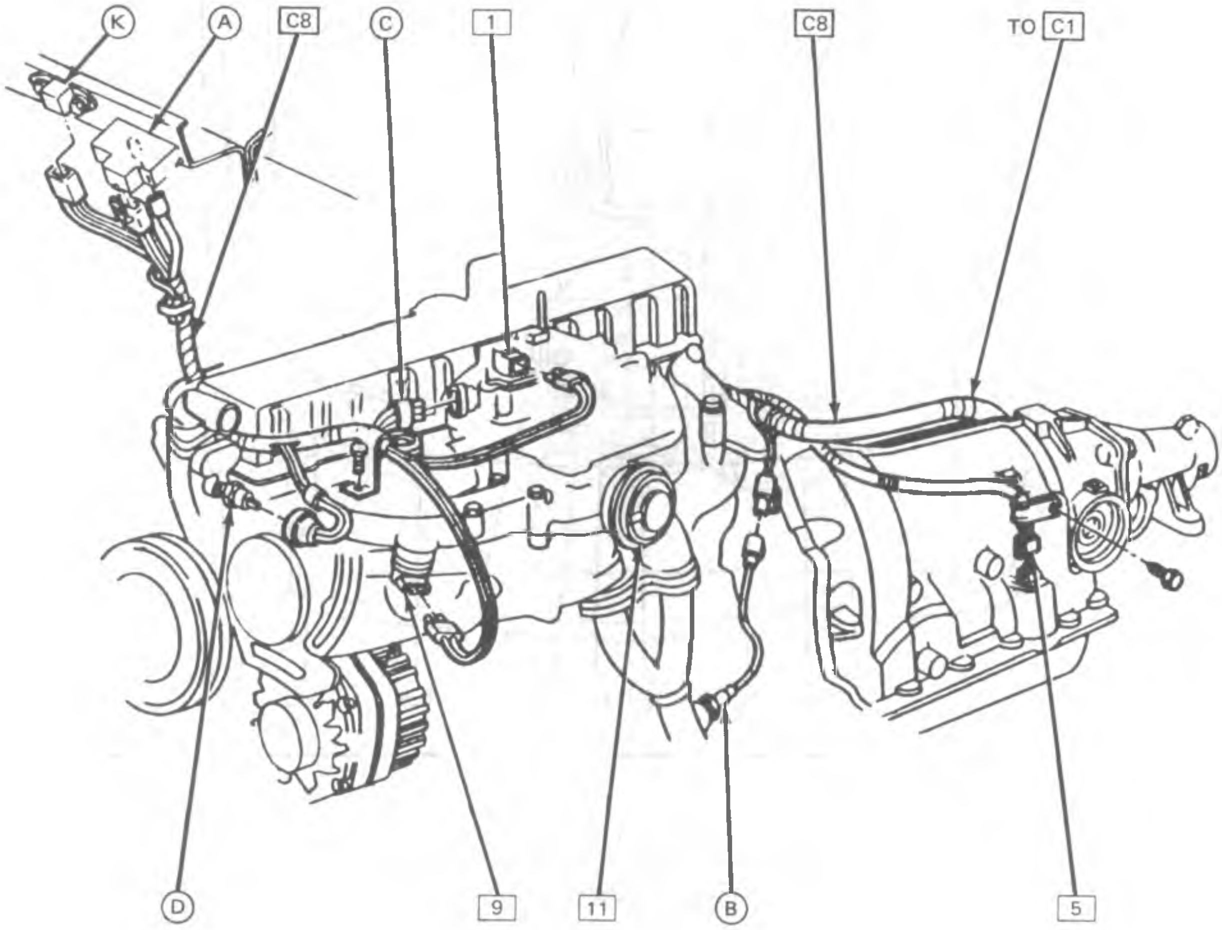
IGNITION SYSTEM

- 6 Electronic Spark Timing Connector

SENSORS/SWITCHES

- A Vacuum Sensor
- B Exhaust Oxygen Sensor
- C Throttle Position Sensor
- B Coolant Sensor
- K W.O.T. Relay (M/T)

Figure 8 Component Locations - 4.1L (G Series)



COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C4 System Power
- C5 System Ground
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

AIR/FUEL SYSTEM

- 1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

- 5 Trans. Conv. Clutch Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 11 Exhaust Gas Recirculation Valve
- 12 Exhaust Gas Recirculation Valve Solenoid

FUEL VAPOR CONTROL SYSTEM

- 13 Canister Purge Solenoid Valve

SENSORS/SWITCHES

- A Vacuum Sensor
- B Exhaust Oxygen Sensor
- C Throttle Position Sensor
- D Coolant Sensor
- K W.O.T. Relay (M/T)

Figure 9 Wire Harness - 4.1L (G Series) (1 of 2)

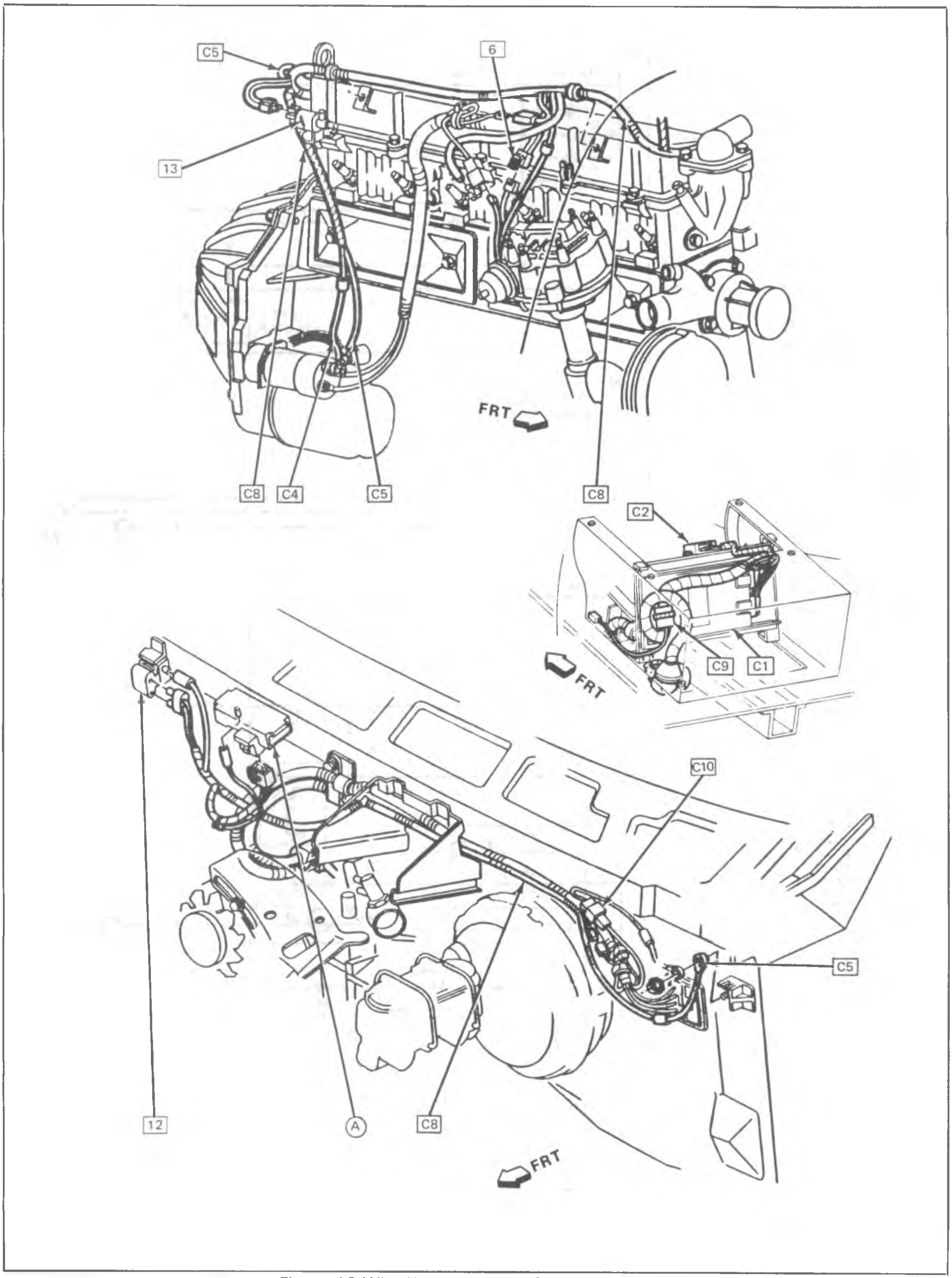


Figure 10 Wire Harness - 4.1L (G Series) (2 of 2)

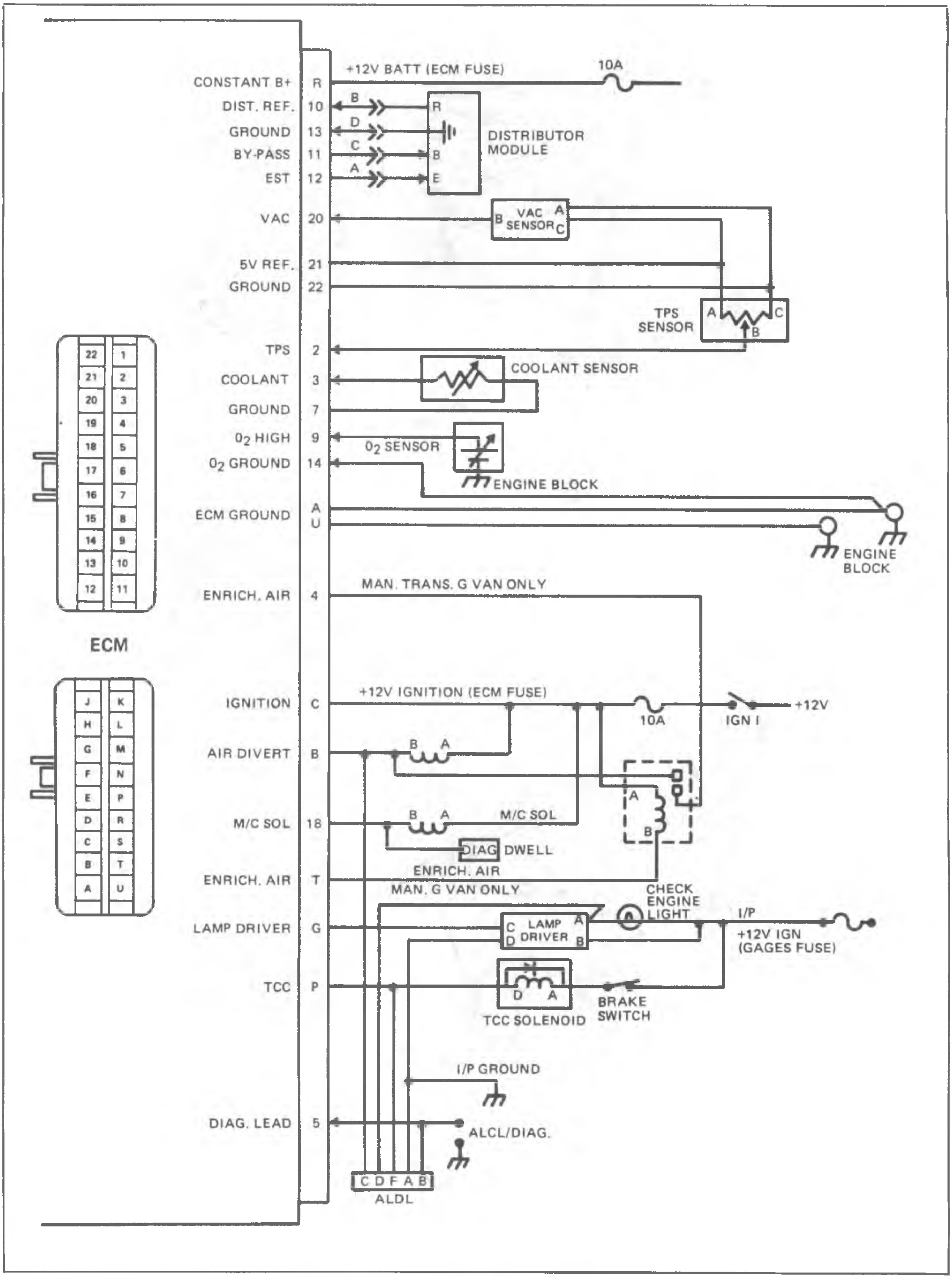


Figure 11 ECM Wiring Diagram - 4.1L

ECM TERMINAL VOLTAGE

4.1L CALIF. CKG TRUCK

THIS ECM VOLTAGE CHART IS FOR USE WITH A DIGITAL VOLTMETER TO FURTHER AID IN DIAGNOSIS. THESE VOLTAGES WERE DERIVED FROM A KNOWN GOOD CAR. THE VOLTAGES YOU GET MAY VARY DUE TO LOW BATTERY CHARGE OR OTHER REASONS, BUT THEY SHOULD BE VERY CLOSE.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

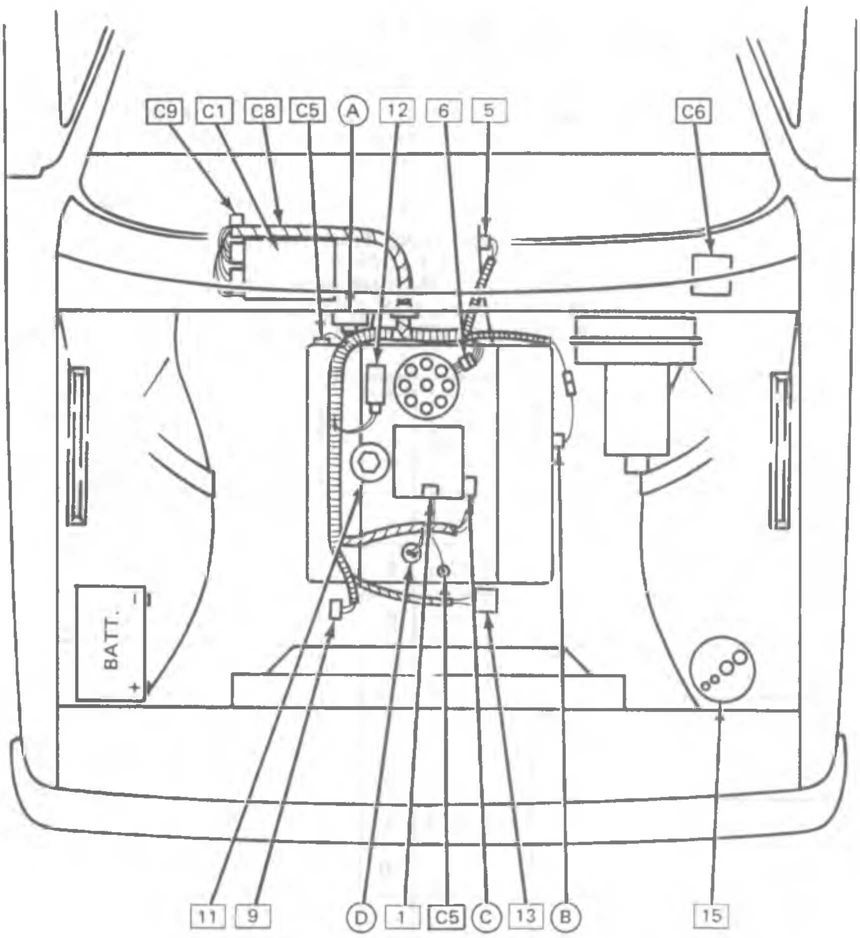
- ENGINE AT OPERATING TEMPERATURE
- CLOSED LOOP
- ENGINE IDLING (FOR "ENGINE RUN" COLUMN)
- TEST TERMINAL NOT GROUNDED
- SCANNER NOT INSTALLED

Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open	Circuit	Terminal	Terminal	Circuit	Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open
0	0	0	SENSOR RETURN	22	1	NOT USED			
5	5	5	5V REFERENCE	21	2	TPS SENSOR SIGNAL	*1.0 †5.0	*1.0	5.0
.5-.65	2-3	* .5	VACUUM SENSOR OUTPUT	20	3	COOLANT TEMP. SENSOR SIGNAL	*2.5	*2.5	5.0
			NOT USED	19	4	ENRICHMENT AIR	* .5	* .5	* .5
12	5–10 (var.)	* .5	M/C SOLENOID	18	5	DIAGNOSTIC TEST TERM	5	5	5
			NOT USED	17	6	NOT USED			
			NOT USED	16	7	COOLANT TEMP. SENSOR RETURN	0	0	0
			NOT USED	15	8	NOT USED			
* .5	* .5	1.7	OXYGEN SENSOR – LO	14	9	OXYGEN SENSOR – HI	.3–.45	.1–.9 (var.)	.3–.45
* .5	* .5	*1.0	DIST. REF. PULSE – LO	13	10	DIST. REF. PULSE – HI	* .5	1–2 (var.)	* .5
* .5	1–2 (var.)	* .5	EST	12	11	IGN. MODULE BY-PASS	* .5	3.7	* .5

Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open	Circuit	Terminal	Terminal	Circuit	Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open
			NOT USED	J	K	NOT USED			
			NOT USED	H	L	NOT USED			
10	* .5	* .5	"CHECK ENGINE" LAMP	G	M	NOT USED			
			NOT USED	F	N	NOT USED			
			NOT USED	E	P	TRANS CONVERTER CLUTCH SOLENOID	12	14	* .5
			NOT USED	D	R	TROUBLE CODE MEMORY POWER	12	14	* .5
12	14	* .5	IGN. 1 POWER	C	S	NOT USED			
12	14	* .5	AIR DIVERT SOLENOID	B	T	ENRICHMENT AIR	12	12	* .5
0	0	0	GROUND (TO ENGINE)	A	U	GROUND (TO ENGINE)	0	0	0

* = Value Shown or Less Than that Value
† = Wide Open Throttle
(var.) = variable
P/N = Park or Neutral
D/R = Drive or Reverse

Figure 12 Connector Terminal End View - 4.1L



"C/K" SERIES
5.0/5.7 (305/350 CID) V8 RPO: LF3/LS9 V.I.N. CODE: F/L
CALIFORNIA ONLY

COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C5 System Ground
- C6 Fuse Panel
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

AIR/FUEL SYSTEM

- 1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

- 5 Trans. Conv. Clutch Connector

IGNITION SYSTEM

- 6 Electronic Spark Timing Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 11 Exhaust Gas Recirculation Valve
- 12 Exhaust Gas Recirculation Solenoid Valve

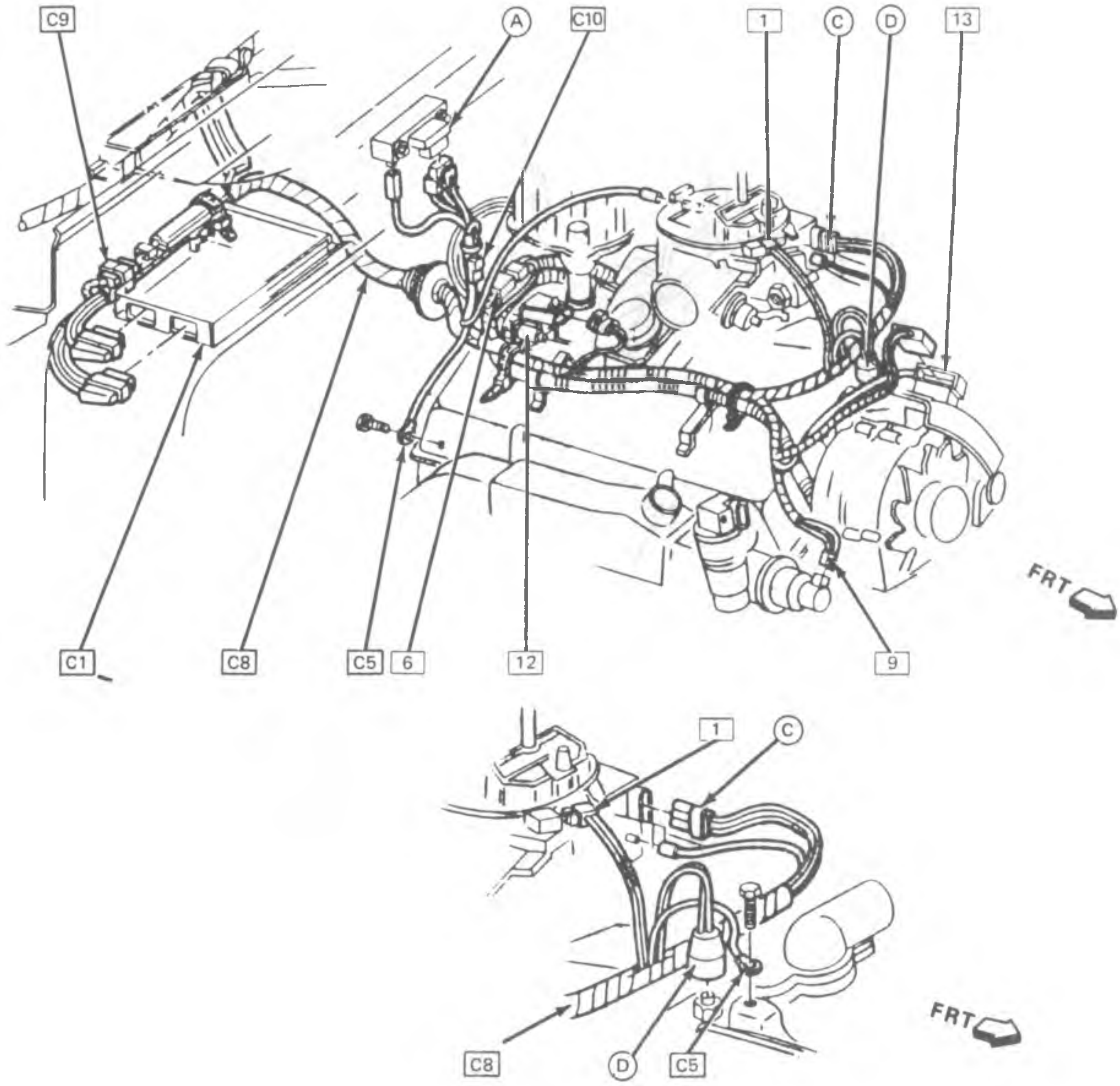
FUEL VAPOR CONTROL SYSTEM

- 13 Canister Purge Solenoid Valve
- 15 Vapor Canister

SENSORS/SWITCHES

- A Vacuum Sensor
- B Exhaust Oxygen Sensor
- C Throttle Position Sensor
- D Coolant Sensor

Figure 13 Component Locations - 5.0L/5.7L (CK Series)



COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C2 ALCL Connector
- C5 System Ground
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

AIR/FUEL SYSTEM

- 1 Mixture Control

IGNITION SYSTEM

- 6 Electronic Spark Timing Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 12 Exhaust Gas Recirculation Solenoid Valve (A/T)

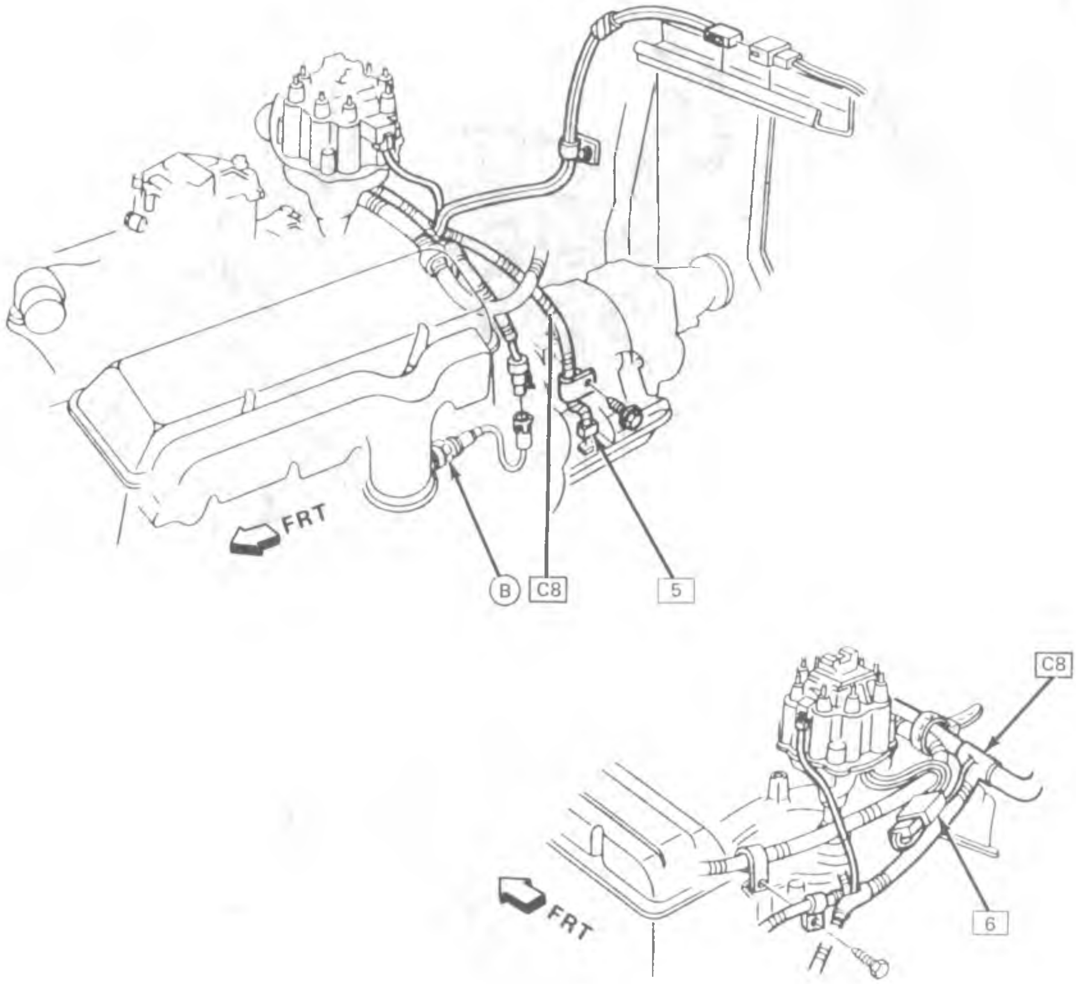
FUEL VAPOR CONTROL SYSTEM

- 13 Canister Purge Solenoid Valve

SENSORS/SWITCHES

- A Vacuum Sensor
- D Throttle Position Sensor
- D Coolant Sensor

Figure 14 Wire Harness - 5.0L/5.7L (CK Series (1 of 2)



COMPUTER SYSTEM

C8 Computer Control Harness

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

5 Trans. Conv. Clutch Connector

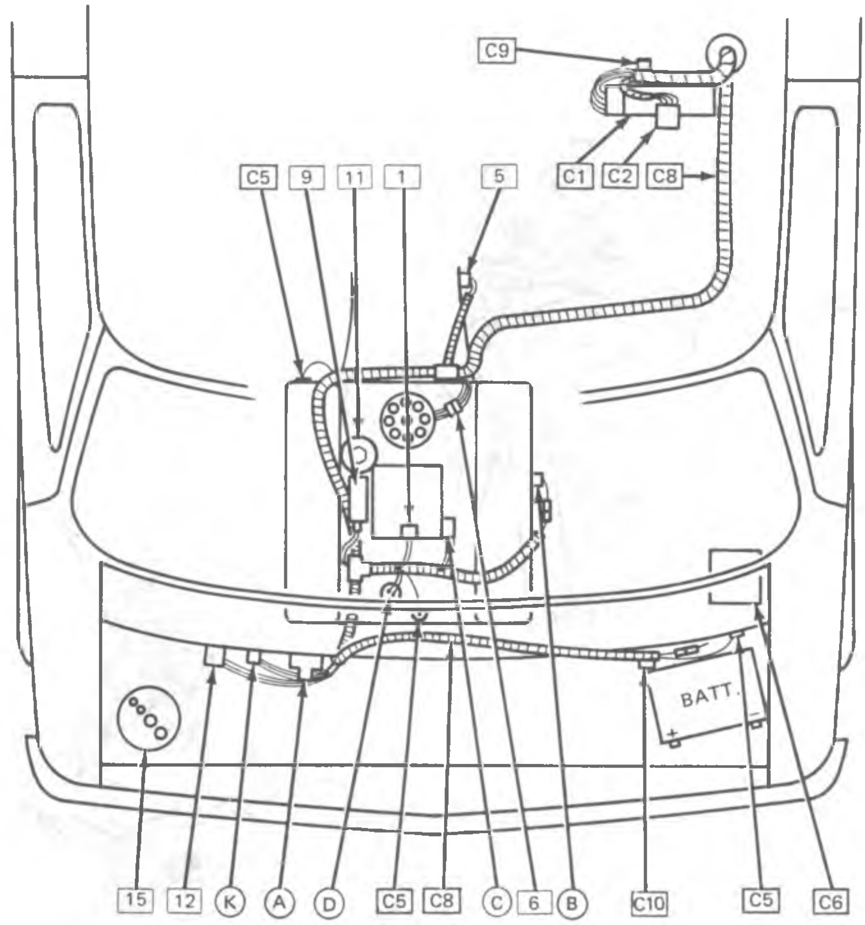
IGNITION SYSTEM

6 Electronic Spark Timing Connector

SENSORS/SWITCHES

B Exhaust Oxygen Sensor

Figure 15 Wire Harness - 5.0L/5.7L (CK Series) (2 of 2)



"G" TRUCK SERIES
5.0/5.7L (305/350 CID) V8 RPO: LF3/L59 V.I.N. CODE: F/L
CALIFORNIA ONLY

COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C2 ALCL Connector
- C5 System Ground
- C6 Fuse Panel
- C8 Computer Control Harness
- C9 Remote Lamp Driver
- C10 Dwell Connector

AIR/FUEL SYSTEM

- 1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

- 5 Trans. Conv. Clutch Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 11 Exhaust Gas Recirculation Valve
- 12 Exhaust Gas Recirculation Valve Solenoid

FUEL VAPOR CONTROL SYSTEM

- 15 Vapor Canister

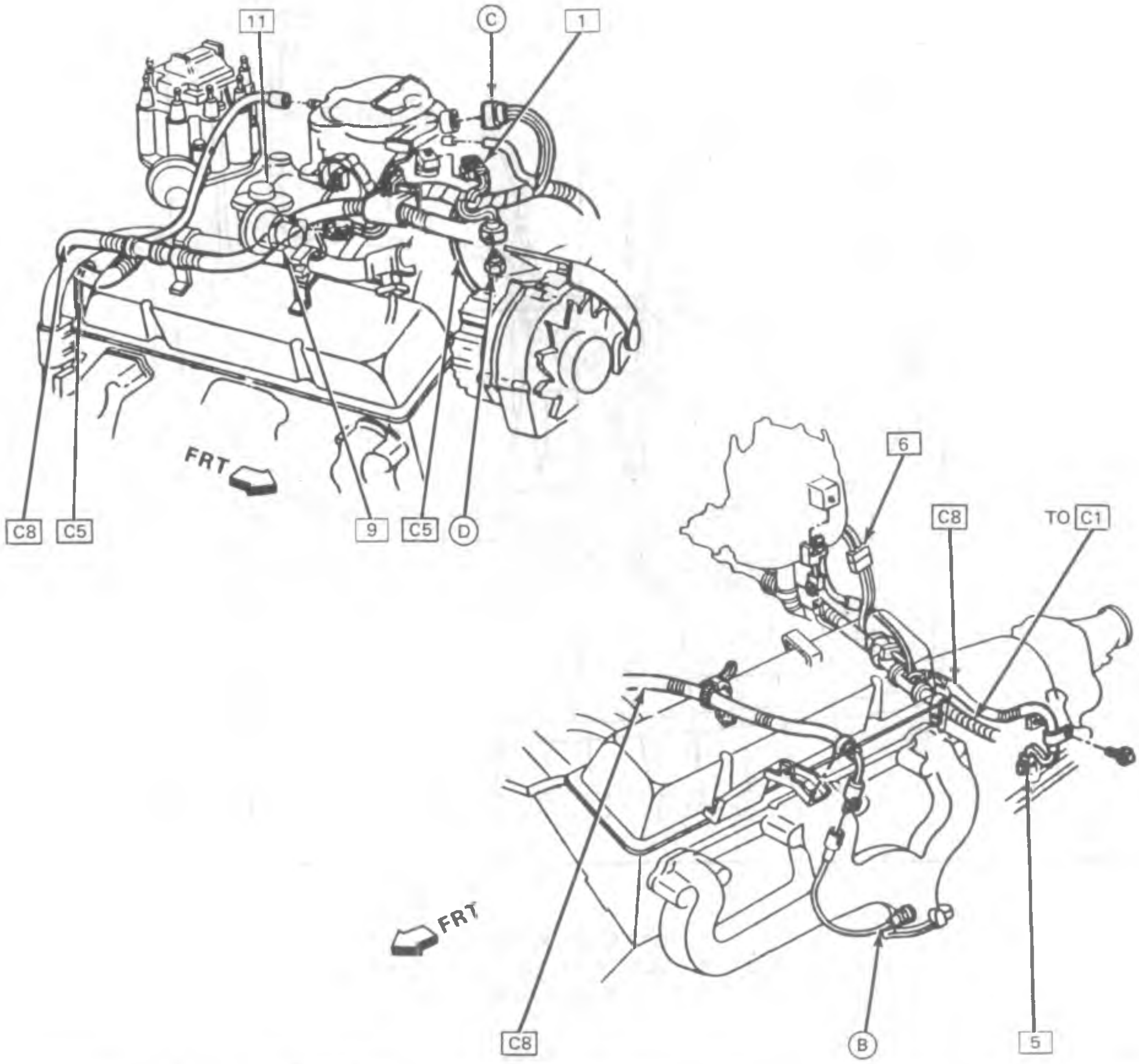
IGNITION SYSTEM

- C6 Electronic Spark Timing Connector

SENSORS/SWITCHES

- A Vacuum Sensor
- B Exhaust Oxygen Sensor
- B Throttle Position Sensor
- D Coolant Sensor
- K W.O.T. Relay

Figure 16 Component Locations - 5.0L/5.7L (G Series)



COMPUTER SYSTEM

- C1 Electronic Control Module (ECM)
- C5 System Ground
- C8 Computer Control Harness

AIR/FUEL SYSTEM

- 1 Mixture Control

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

- 5 Trans. Conv. Clutch Connector

AIR INJECTION SYSTEM

- 9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

- 11 Exhaust Gas Recirculation Valve
- 12 Exhaust Gas Recirculation Solenoid Valve

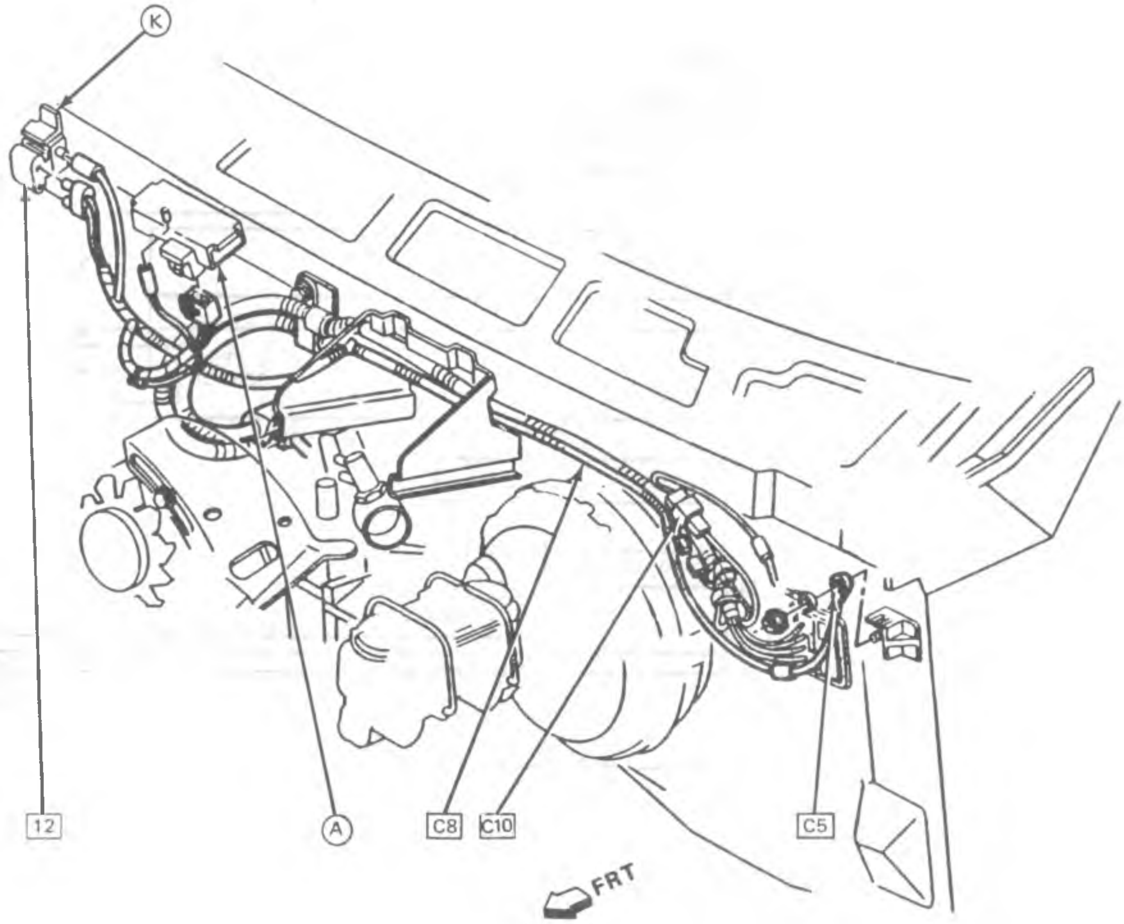
IGNITION SYSTEM

- 6 Electronic Spark Timing Connector

SENSORS/SWITCHES

- A Manifold Pressure Sensor
- B Exhaust Oxygen Sensor
- C Throttle Position Sensor
- D Coolant Sensor

Figure 17 Wire Harness - 5.0L/5.7L (G Series) (1 of 2)



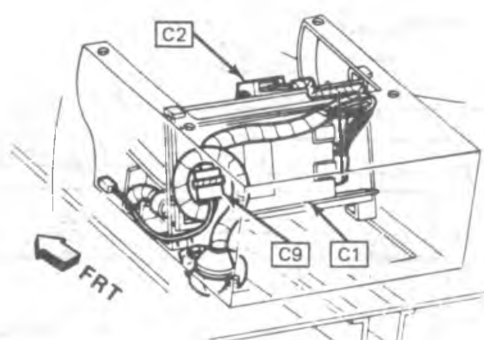


Figure 18 Wire Harness - 5.0L/5.7L (G Series) (2 of 2)

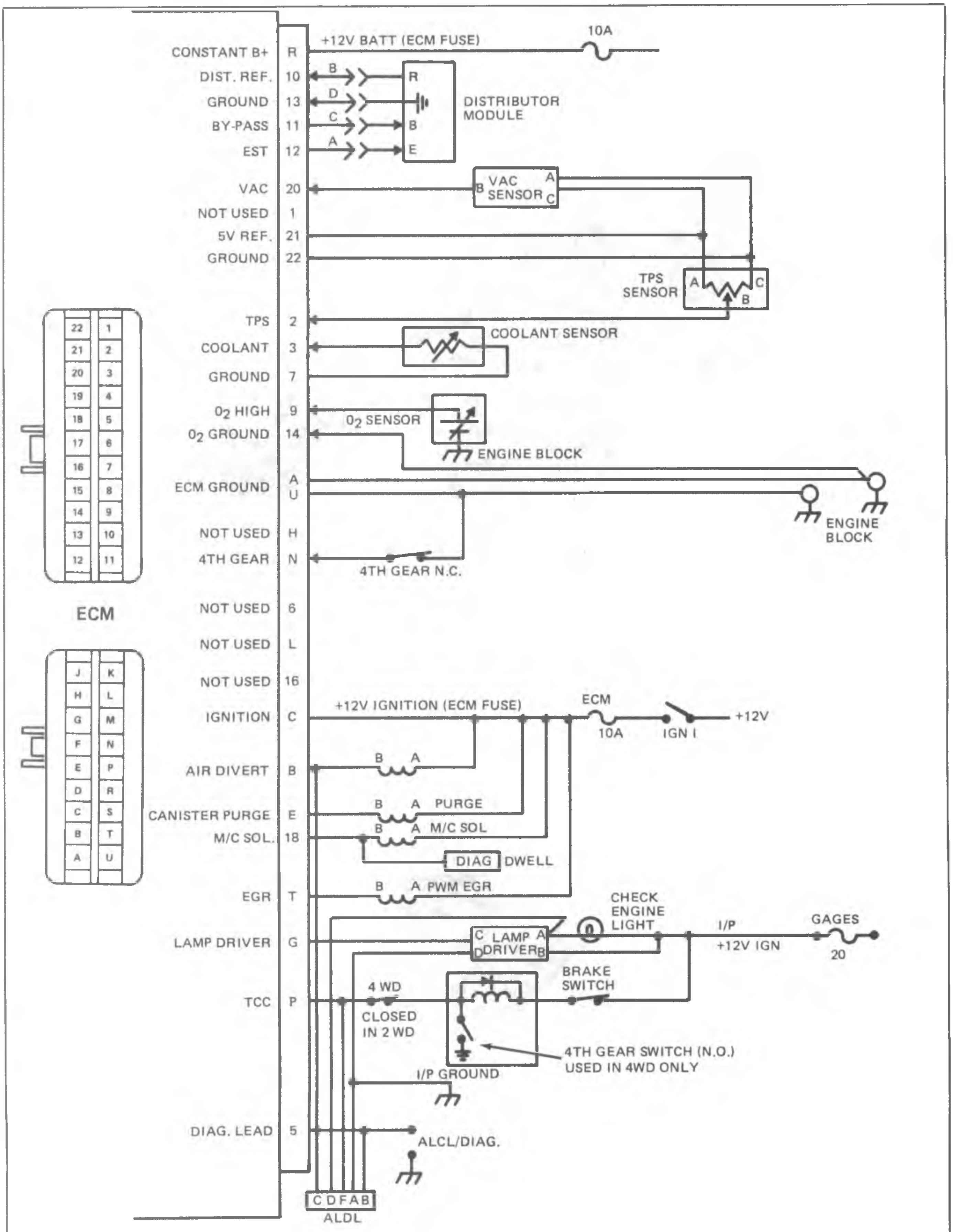


Figure 19 ECM Wiring Diagram - 5.0L and 5.7L

ECM TERMINAL VOLTAGE

5.0 - 5.7L CKG CALIF. TRUCK

THIS ECM VOLTAGE CHART IS FOR USE WITH A DIGITAL VOLTMETER TO FURTHER AID IN DIAGNOSIS. THESE VOLTAGES WERE DERIVED FROM A KNOWN GOOD CAR. THE VOLTAGES YOU GET MAY VARY DUE TO LOW BATTERY CHARGE OR OTHER REASONS, BUT THEY SHOULD BE VERY CLOSE.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- ENGINE AT OPERATING TEMPERATURE
- CLOSED LOOP
- ENGINE IDLING (FOR "ENGINE RUN" COLUMN)
- TEST TERMINAL NOT GROUNDED
- SCANNER NOT INSTALLED
- 2 WD

Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open	Circuit	Terminal	Terminal	Circuit	Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open
0	0	0	SENSOR RETURN	22	1	NOT USED			
5	5	5	5V REFERENCE	21	2	TPS SENSOR SIGNAL	*1.0 †5.0	*1.0	5.0
.5-.65	2-3	* .5	VACUUM SENSOR OUTPUT	20	3	COOLANT TEMP. SENSOR SIGNAL	*2.5	*2.5	5.0
			NOT USED	19	4	NOT USED			
12	5-10 (var.)	* .5	M/C SOLENOID	18	5	DIAGNOSTIC TEST TERM	5	5	5
			NOT USED	17	6	NOT USED			
			NOT USED	16	7	COOLANT TEMP. SENSOR RETURN	0	0	0
			NOT USED	15	8	NOT USED			
* .5	* .5	1.7	OXYGEN SENSOR – LO	14	9	OXYGEN SENSOR – HI	.3–.45	.1–.9 (var.)	.3–.45
* .5	* .5	*1.0	DIST. REF. PULSE – LO	13	10	DIST. REF. PULSE – HI	* .5	1–2 (var.)	* .5
* .5	1-2 (var.)	* .5	EST	12	11	IGN. MODULE BY-PASS	* .5	3.7	* .5

Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open	Circuit	Terminal	Terminal	Circuit	Voltage Key "ON"	Voltage Engine Run	Voltage Circuit Open
			NOT USED	J	K	NOT USED			
			NOT USED	H	L	NOT USED			
10	* .5	* .5	"CHECK ENGINE" LAMP	G	M	NOT USED			
			NOT USED	F	N	NOT USED			
12		* .5	PURGE	E	P	TRANS CONVERTER CLUTCH SOLENOID	12	14	* .5
			NOT USED	D	R	TROUBLE CODE MEMORY POWER	12	14	* .5
12	14	* .5	IGN. 1 POWER	C	S	NOT USED			
12	14	* .5	AIR SWITCHING SOLENOID	B	T	EGR	12	* 1	* .5
0	0	0	GROUND (TO ENGINE)	A	U	GROUND (TO ENGINE)	0	0	0

* = Value Shown or Less Than that Value
† = Wide Open Throttle
(var.) = variable
P/N = Park or Neutral
D/R = Drive or Reverse

Figure 20 ECM Connector Terminal End View - 5.0L and 5.7L

SECTION A

DIAGNOSTIC CHARTS

CALIFORNIA ONLY

Diagnosis information will be found in Sections A, B and C. Which section to use is determined as follows:

Section A

Contains charts that are to be used when problems are found in the "Diagnostic Circuit Check" or the "System Performance Check".

Section B

Contains driveability symptoms which are referred to when no problem is found in Section A.

Section C

Contains charts for diagnosing systems indicated in the Section B driveability symptoms.

STARTING POINT

The "Diagnostic Circuit Check" (Figure 22) is the starting point for driveability or emission diagnosis. It verifies the system is functioning correctly. Some special considerations to keep in mind while making the "Diagnostic Circuit Check" are:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked while checking the system.

Cold Oxygen Sensor

On some engines, the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop." To restore "Closed Loop" operation, run the engine at part throttle and accelerate from idle to part throttle a few times until the system goes "Closed Loop."

BASIC PROCEDURE

If you have not reviewed the Basic Information on how to use the Diagnostic Procedures, go to the Introduction of this section.

DIAGNOSTIC CHARTS

Figure 22 - Diagnostic Circuit Check
Figure 24 - System Performance Check
Figure 26 - Chart A-1, Dwell Fixed Under 10°
Figure 28 - Chart A-2, Dwell Fixed Between 10° and 50°
Figure 30 - Chart A-3, Dwell Fixed Over 50°
Figure 32 - Chart A-5, "CHECK ENGINE" Light Inoperative
Figure 34 - Chart A-6, Won't Flash Code 12
Figure 36 - Code 12, No Reference Pulse
Figure 38 - Code 13, Oxygen Sensor Circuit
Figure 40 - Code 14, Coolant Sensor Shorted
Figure 42 - Code 15, Coolant Sensor Open
Figure 44 - Code 21, Throttle Position Sensor
Figure 46 - Code 23, M/C Solenoid Circuit Low
Figure 48 - Code 34, Differential Pressure (Vacuum) Sensor
Figure 50 - Code 41, No Distributor Reference Signal
Figure 52 - Code 42, Electronic Spark Timing
Figure 54 - Code 44, Lean Exhaust Indication
Figure 56 - Code 45, Rich Exhaust Indication
Figure 58 - Code 51, PROM
Figure 60 - Code 54, M/C Solenoid High
Figure 62 - Code 55, ECM (4.1L only)

TROUBLE CODE IDENTIFICATION

The "CHECK ENGINE" light will only be "ON" if the malfunction exists under the conditions listed below. It takes up to five seconds minimum for the light to come on when a problem occurs. If the malfunction clears, the light will go out and a trouble code will be set in the ECM. Code 12 does not store in memory. If the light comes "on" intermittently, but no code is stored, go to the "Driver Comments" section. Any codes stored will be erased if no problem reoccurs within 50 engine starts. A specific engine may not use all available codes.

The trouble codes indicate problems as follows:

TROUBLE CODE 12	No distributor reference pulses to the ECM. This code is not stored in memory and will only flash while the fault is present. Normal code with ignition "on," engine not running.
TROUBLE CODE 13	Oxygen Sensor Circuit — The engine must run up to four minutes at part throttle, under road load, before this code will set.
TROUBLE CODE 14	Shorted coolant sensor circuit — The engine must run two minutes before this code will set.
TROUBLE CODE 15	Open coolant sensor circuit — The engine must run five minutes before this code will set.
TROUBLE CODE 21	Throttle Position Sensor (TPS) circuit voltage high (open circuit or misadjusted TPS). The engine must run 10 seconds, at specified curb idle speed, before this code will set.
TROUBLE CODE 23	M/C solenoid circuit open or grounded.
TROUBLE CODE 34	Differential pressure (vacuum) sensor circuit – The engine must run up to two minutes, at specified curb idle, before this code will set.
TROUBLE CODE 41	No distributor reference pulses to the ECM at specified engine vacuum. This code will store in memory.
TROUBLE CODE 42	Electronic spark timing (EST) bypass circuit or EST circuit grounded or open.
TROUBLE CODE 44	Lean exhaust indication — The engine must run two to minutes, in closed loop and at part throttle, before this code will set.
TROUBLE CODE 45	Rich exhaust indication — The engine must run two minutes, in closed loop and at part throttle, before this code will set.
TROUBLE CODE 51	Faulty or improperly installed calibration unit (PROM). It takes up to 30 seconds before this code will set.
TROUBLE CODE 54	Shorted M/C solenoid circuit and/or faulty ECM.
TROUBLE CODE 55	Grounded Vref (terminal "21"), high voltage on oxygen sensor circuit or ECM.

Figure 21 Trouble Code Identification

DIAGNOSTIC CIRCUIT CHECK

The purpose of the Diagnostic Circuit Check is to 1) make sure the "CHECK ENGINE" light works, 2) the ECM is operating and can recognize a fault, and 3) to determine if any codes are stored. If codes are stored, it also checks to see if they indicate an intermittent problem. This is the starting point for any diagnosis. If there are not codes indicated, go to the System Performance Check. If no additional checks are called out from the System Performance Check, go to the Driveability Symptoms, Section "B."

1. Check for proper operation of the "CHECK ENGINE" light with the key "ON," engine not running. The light should be on steady.
2. Grounding the test terminal will flash a Code 12 and any stored trouble codes. The light must go "ON" and "OFF" for a proper code. If the light goes from "Bright" to "Dim" this is not considered a code. See Chart A-6 in that case.
3. This step is to determine if any codes, other than Code 12 that was recorded before, are still present, or were intermittent and are no longer there. Memory is cleared and vehicle run for two minutes to see if trouble code(s) will reset.
4. If the light is "ON," fault is still present; therefore, go to the applicable trouble code chart.
5. If the light is "OFF," the fault is either intermittent, or it is a code that cannot be set in the stall in two minutes. For codes that cannot be set in the stall during the Diagnositc Circuit Check, the applicable trouble code chart will determine if those codes are intermittent.

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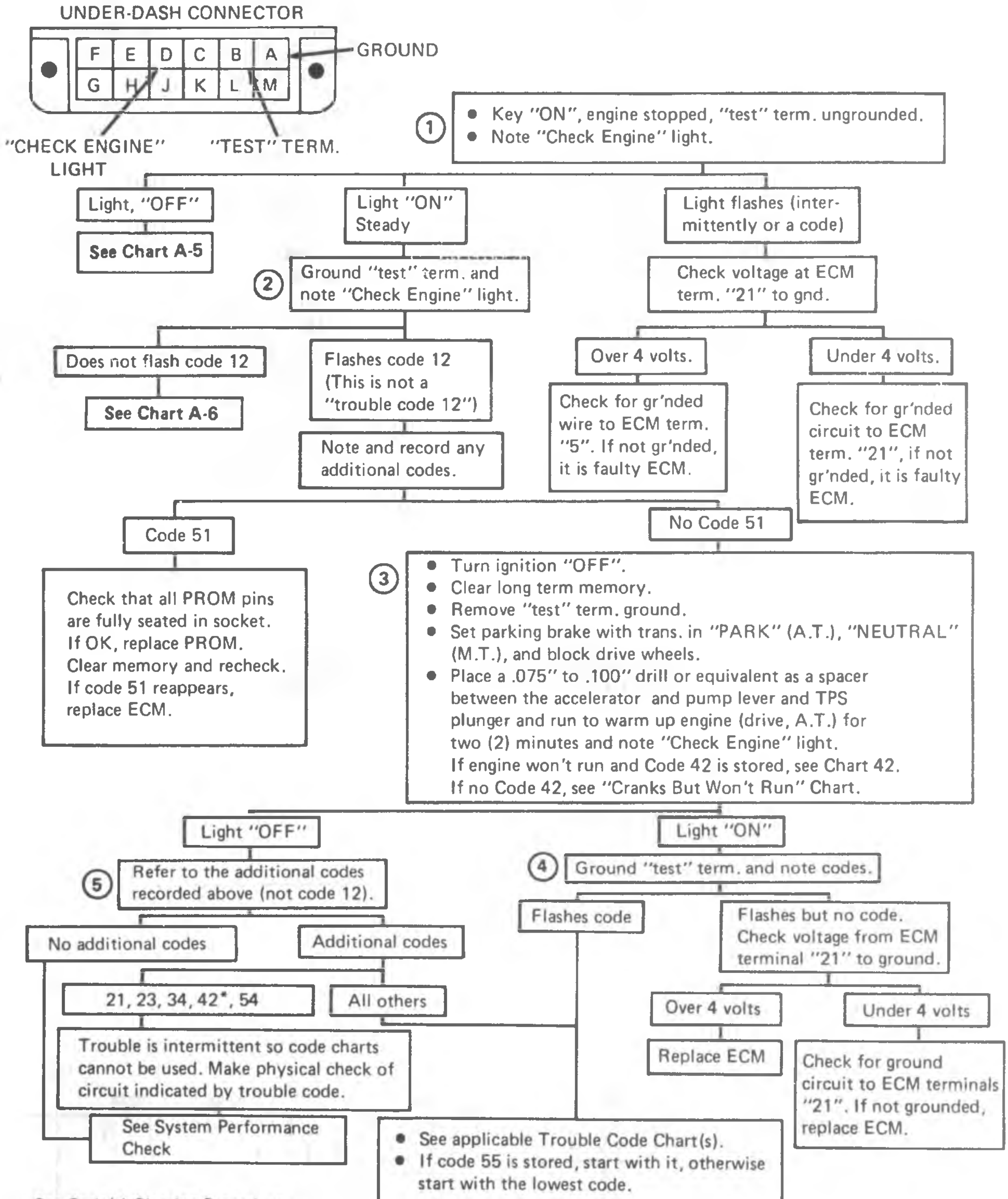
DIAGNOSTIC CIRCUIT CHECK

- Always check "PROM" for the correct application and installation before replacing an "ECM".
- Remove terminal(s) from ECM connector for problem circuit involved, clean terminal contact and expand slightly to increase contact pressure and recheck to see if problem is corrected.
- In case of repeat ECM failure, check for a shorted solenoid or replay controlled by the ECM.



See Code(s) Clearing Procedure.

The System Performance Check should be performed after any repairs to the "System" have been made.

*It is possible to set a false Code 42 on starting, but the "Check Engine" light will not be "ON." No corrective action is necessary.

Figure 22 Diagnostic Circuit Check

SYSTEM PERFORMANCE CHECK

1. Checks for ability of carburetor main metering system to change the Air/Fuel mixture. Disconnecting M/C solenoid makes carburetor operate full-rich and reconnecting it with the dwell lead grounded makes it operate full-lean.

   Normal response - RPM drops as M/C solenoid is reconnected. Usually 400-1000 RPM, but should be at least 300 RPM.

1A. Some M/C solenoids are polarity sensitive and will not pull solenoid plunger down if polarity is reversed.

   If plugging the PCV, Purge, or Bowl Vent vacuum hose causes RPM to drop over 300 RPM, that hose leads to the souce of the problem.

   If RPM increases as M/C solenoid is connected, it indicates the system is running extremely rich. This can sometimes be caused by incorrect valve timing.

2. Checks for proper control of idle circuit.

2A. This is a full-rich command to the carburetor and can be caused by:
   1. Lean engine condition.
   2. Grounded oxygen sensor wire or bad sensor.
   3. Open in wire from ECM term. "14" to ground.
   4. Open wire to ECM term. "22".
   5. Open in coolant sensor circuit.

2B. There is an open loop condition. It can be caused by:
   1. An open oxygen sensor circuit or bad sensor.
   2. An open in coolant sensor circuit.
   3. An open in wire from ECM term. "14" to ground.

2C. This is a full lean command. It can be caused by:
   1. Rich engine condition caused by:
      a. M/C Solenoid wire connections reversed.
      b. Leaking Bowl Vent valve, excessive fuel in vapor canister, fuel in crankcase, faulty carburetor calibration or carburetor.

2D. Normal reading - operates in closed loop - dwell is between 10°-50°, but varying. Running for 1 minute at fast idle is to make sure the oxygen sensor is warm.

3. Checks for proper control of main metering system. RPM must be at least 3000 to get into the main metering system operation. Removing and plugging the hose may set a Code 34 so memory will have to be cleared.

3A. A missing "O" ring between the switching valve solenoid and the valve, or a faulty valve, may cause air to leak to the exhaust ports at higher RPM only.

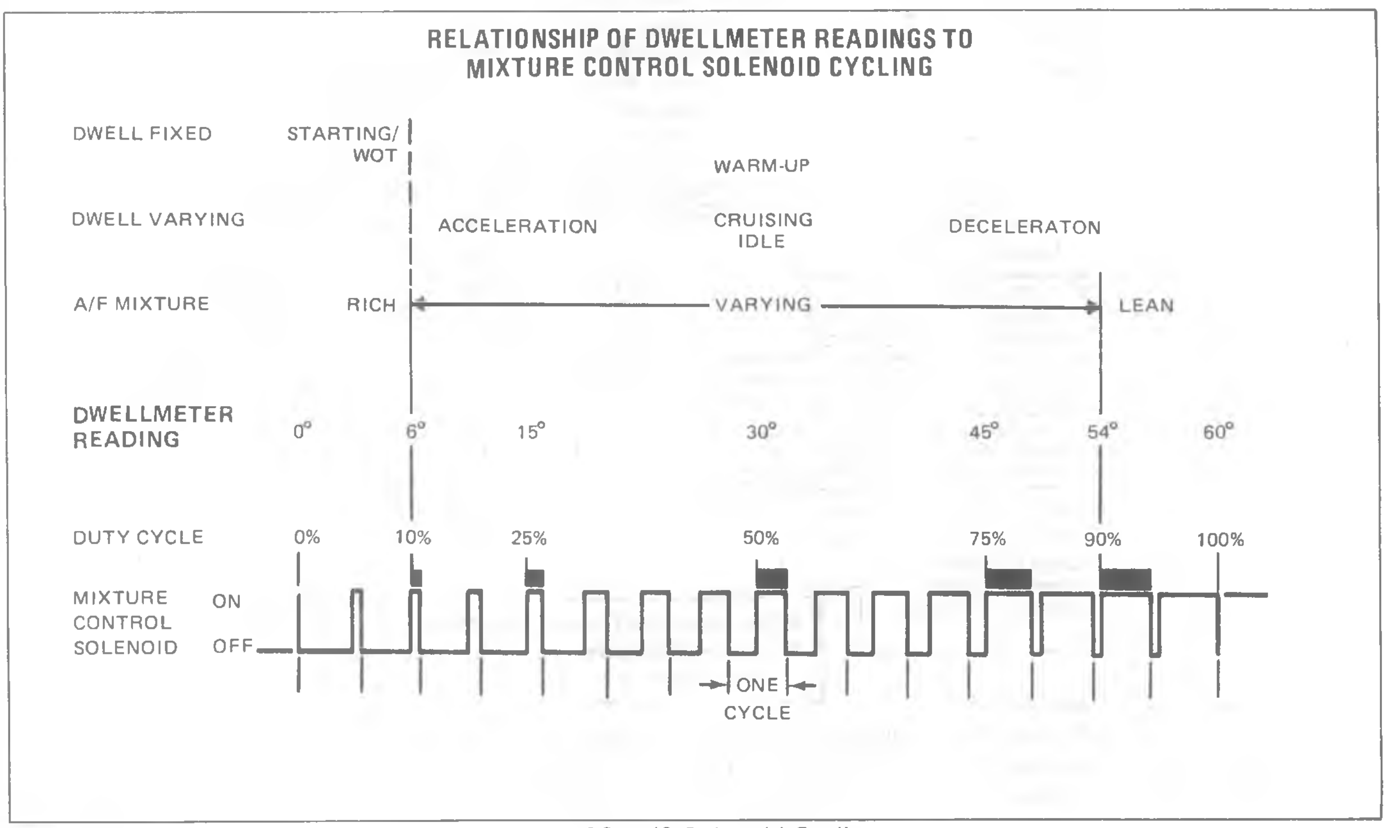


Figure 23 M/C Solenoid Cycling

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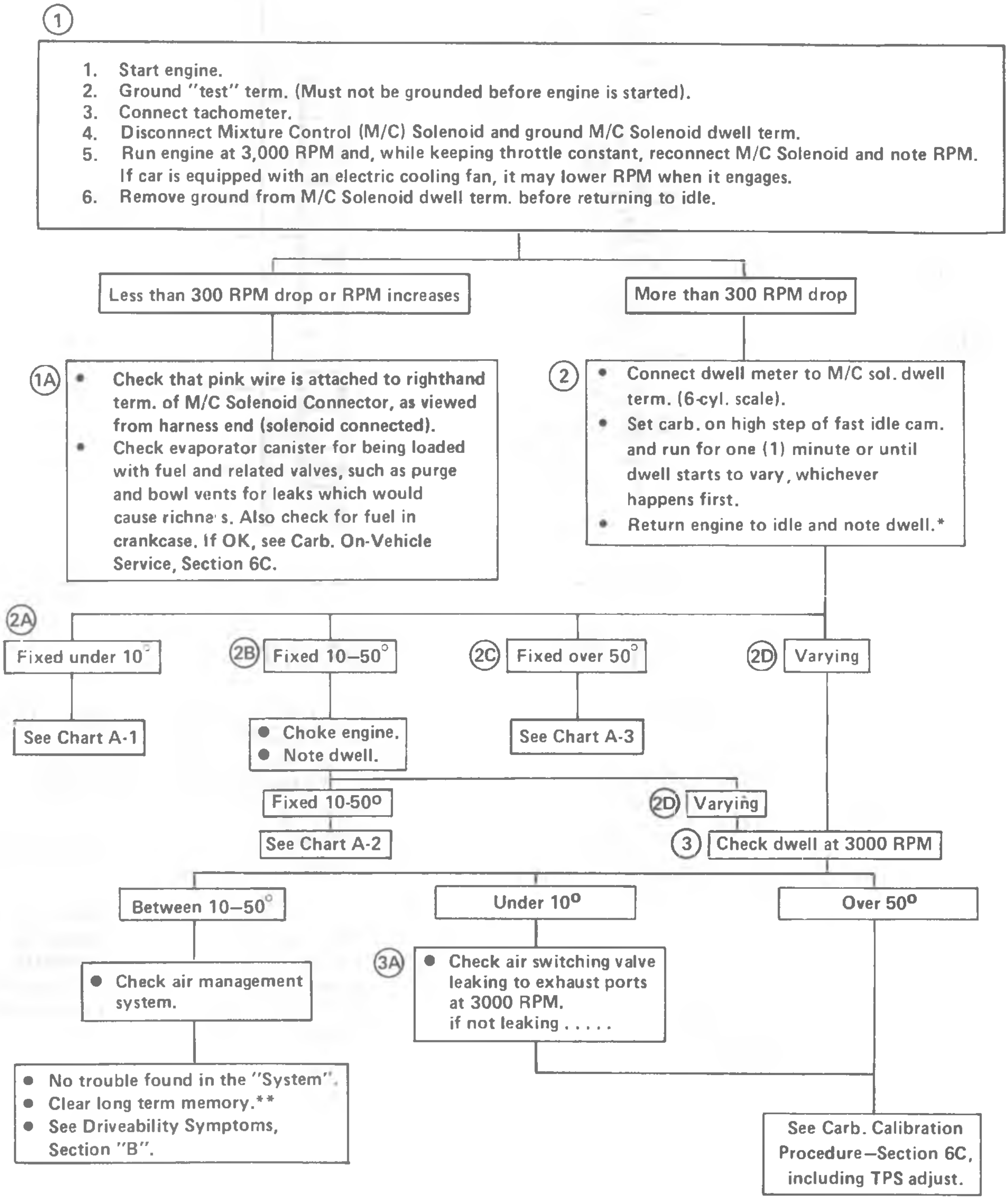
SYSTEM PERFORMANCE CHECK



* Oxygen sensors may cool off at idle and the dwell change from varying to fixed. If this happens, running the engine at fast idle will warm it up again.

** See Code(s) Clearing Procedure.

Figure 24 System Performance Check

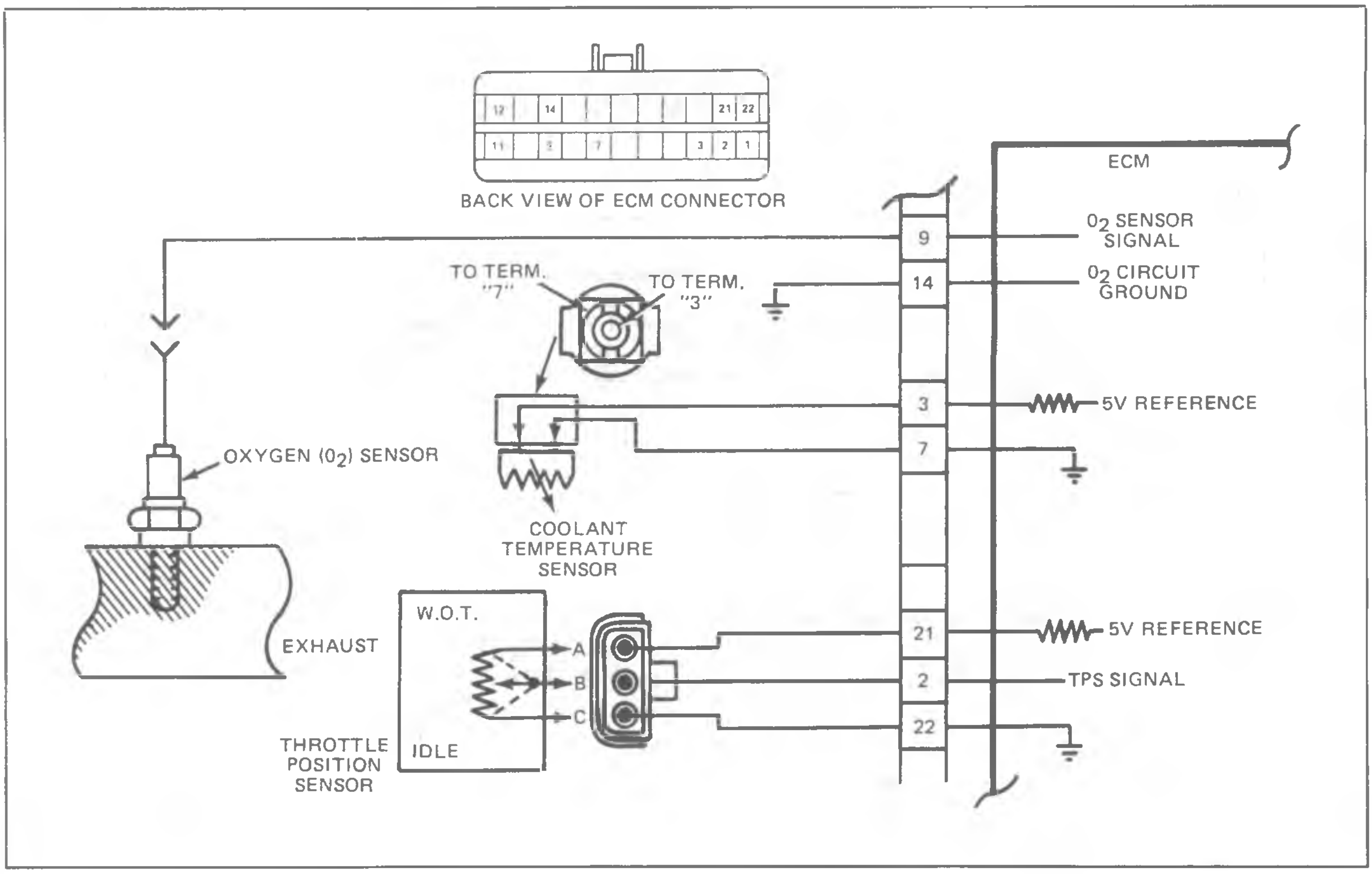


Figure 25 Wiring Diagram - CHART A-1

CHART A-1, DWELL FIXED UNDER 10°

1. Determines if the problem is CCC related or engine related.

   Dwell should start increasing as soon as engine is choked, and go higher as it is choked more, until it goes over 50°. With severe choking, the dwell could move up scale momentarily even if it is not engine related, but it will move right back to a low dwell. If dwell responds, the problem is a lean engine.

1A. Checks for cause of lean condition that resulted in full rich command.

2. Checks for ECM response to input to 0_2 sensor circuit. The voltmeter is used to put a voltage on the oxygen sensor circuit to simulate a rich condition. Dwell should increase (a lean command) if ECM and harness are good.

3. Checks for normal coolant sensor circuit condition. Voltage on a normalized hot engine should be under 2.5V.

4. This step checks for an open in the ground circuit to ECM Term. "14" and grounded 0_2 sensor circuit.

   Terminal "2" voltage should be under 1.0 volt at idle. A high voltage could be caused by an open in the circuit at Term. "22". Normally, this would cause Codes 21 and 34 (and 35 if equipped with idle speed control) but won't set them on some engines.

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CHART NO. A-1
DWELL FIXED UNDER 10°
(LEAN EXHAUST INDICATION)

1
- Ground "Test" terminal.
- With engine at 2000 rpm, choke engine and note dwell (ignore any variation as throttle position is changed).

Dwell increases to over 50°

1A
- Check for air or vacuum leak (including air management system and deceleration valve, if used).
- Check for an exhaust leak.
- Vacuum hose routing.
- Check EGR operation.

No leak
- See Carb. Calibration Procedure—Section 6C

Leak

Repair

Dwell did not reach 50°

2
- Disconnect Oxygen Sensor.
- Connect digital multimeter J29125-A or equivalent and set on the 20 volt scale, from bat. + to purple wire to ECM (not Oxygen Sensor).*
- Note dwell, at part throttle.

Increases
- Check for open from ECM Term. 14 to ground (including ECM connections).
- If not open, replace oxygen sensor.

Under 10°

3
- Ignition "On", engine stopped.
- Check voltage from ECM terminals "3" to "7".

Over 3 Volts
- Check for open in coolant sensor circuit.

Under 3 Volts

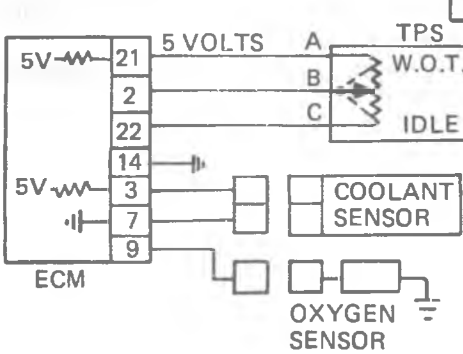
4
- Check for an open from ECM Term. 14 to ground and grounded purple wire to ECM Term. "9".
- If circuits are OK, check ECM terminal "2" to ground.

Over 1 volt
- Check for open from ECM term. "22" to TPS term "C".

open
- Repair Open

not open
- Fault is bad ECM conn. at term. "22" or ECM.

Under 1 V
- It is a faulty ECM conn. at term. "14" or ECM



*Do Not use an ordinary voltmeter or jumper in place of digital voltmeter, because they have too little resistance. A voltage source of 1.0V to 1.7V (such as a flashlight battery) can be connected with the Positive terminal to the purple wire and the negative terminal to ground as a jumper. If the polarity is reversed, it won't work.

Figure 26 Dwell Fixed Under 10° - CHART A-1

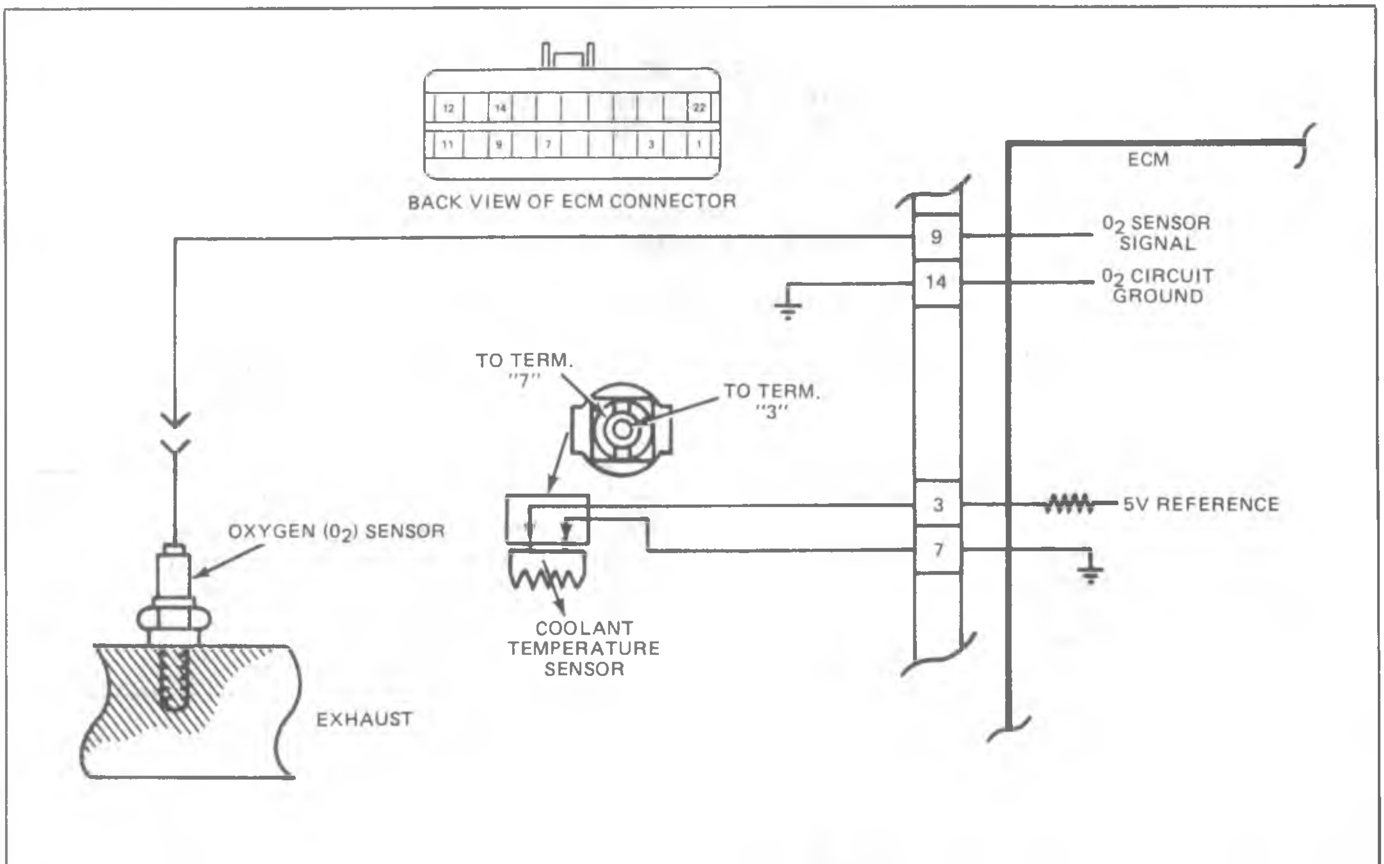


Figure 27 Wiring Diagram - CHART A-2

CHART A-2, DWELL FIXED BETWEEN 10° AND 50°

1. Running engine at part throttle for one minute warms up the oxygen sensor.

   Grounding O_2 sensor input checks ECM response to a "lean" signal.

   Normal response-dwell decreases to full rich command.

1A. On some ECM's, an open in circuit to Term. "14" can cause open loop.

1B. Checks output of O_2 sensor with full rich command from ECM caused by grounded O_2 sensor input.

   Normal response, voltage at O_2 sensor over .8 volt.

2. This step grounds O_2 sensor circuit at ECM to check for opens in wiring, to ECM Terminals "9" and "14".

   Normal response to "lean" signal, dwell decreases; that is a rich command.

3. This step checks for voltage to the coolant sensor. Normal reading on a warm engine is less than 2.5 volts.

   An open circuit would cause a reading of approximately 5 volts.

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CHART NO. A-2
DWELL FIXED BETWEEN 10°-50°
OPEN COOLANT OR OXYGEN SENSOR CIRCUIT

Certain engines have a very stable dwell at idle. Choke engine to verify fixed or varying dwell.
Check for sticking TPS plunger and adjustment and low coolant.

(1)
- Start engine.
- Ground "test" terminal.
- Run engine at 2000 rpm for one minute.
- Return engine to idle.
- Disconnect oxygen sensor and ground connector term. on lead to ECM (not sensor). Leave grounded for rest of checks.

Dwell decreases.

(1A)
- Check for open from ECM term. "14" to ground.

Open
- Repair

Not Open

(1B)
- Leave purple wire grounded.
- Check voltage from oxygen sensor to ground with digital voltmeter on 2 volt. scale. It should read over .8 volt.

OK
- It is faulty oxygen sensor connection.

Not OK.
- Replace oxygen sensor.

No dwell change.

(2)
- Connect jumper between terminals "9" and "14" at ECM.

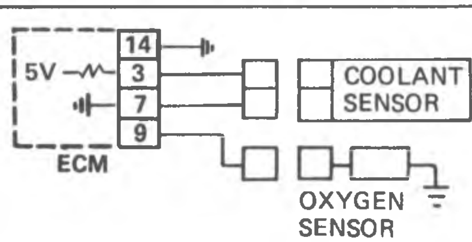
Dwell decreases.
- Repair open in wire to oxygen sensor.

No dwell change.

(3)
- Ignition "ON", engine stopped.
- Check voltage from ECM terminal "3" to ground.

Over 4 volts.
- Repair open in coolant sensor circuit. Reconnect oxygen sensor. (See Code 15 chart for coolant sensor resistance values.)*

Under 4 volts.
- It is faulty connection to ECM terms. "3", "7", "9", "14" or faulty ECM. Reconnect oxygen sensor.



*Checking coolant sensor resistance may require use of connector and wire assembly No. 12026621 for accessibility.

Figure 28 Dwell Fixed Between 10° and 50° - CHART A-2

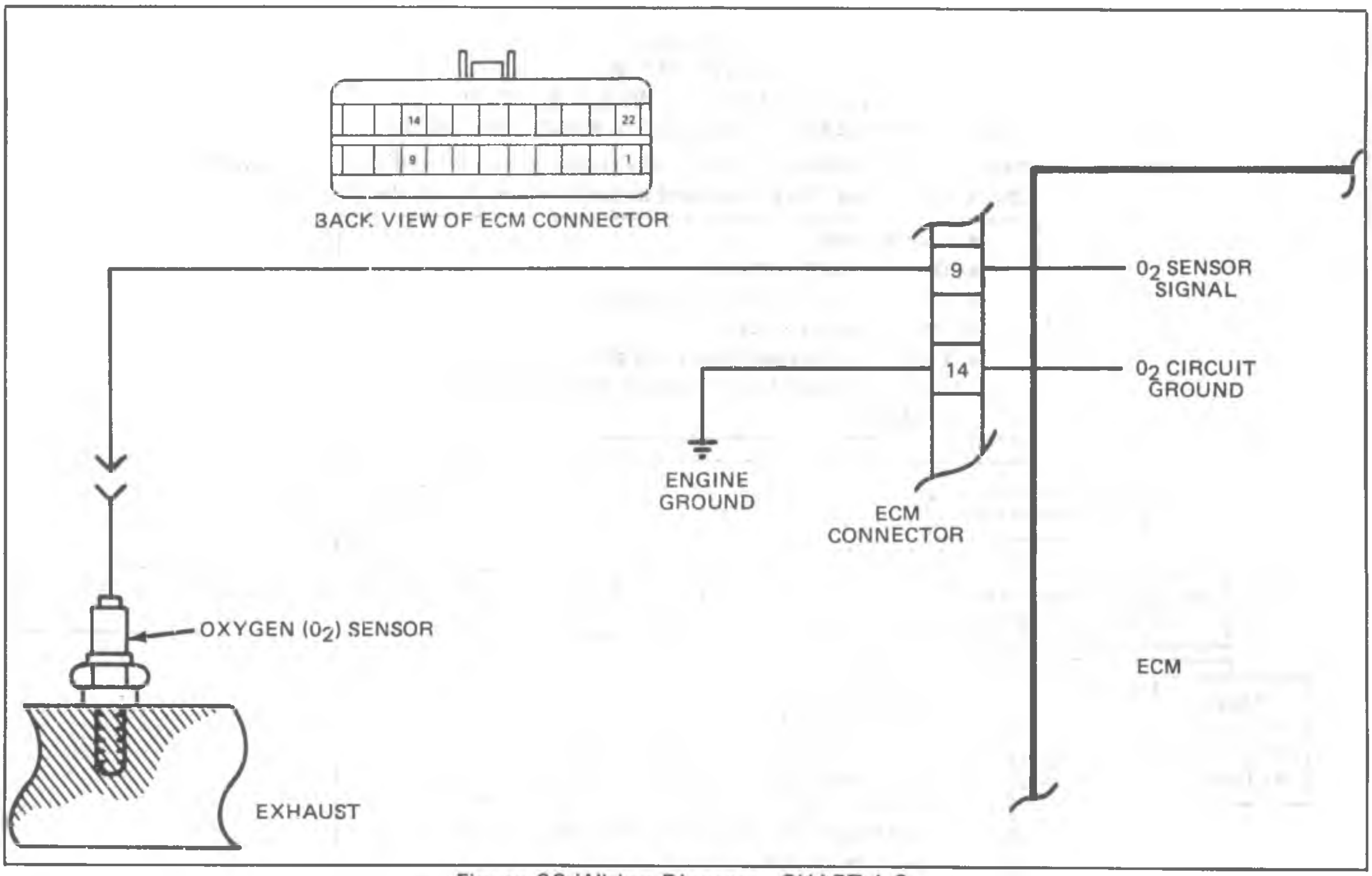


Figure 29 Wiring Diagram - CHART A-3

CHART A-3, DWELL FIXED OVER 50°

1. Determines whether problem is related to engine or electronics.

   Normal response - dwell decreases (rich command) - says electronics (O_2 sensor, harness and ECM) are OK; problem is a rich engine condition.

   This may require a large air leak if engine is very rich. When it is lean enough, the engine will start to run rough.

1A. If plugging the PCV or bowl vent vacuum hose causes the dwell to decrease, that hose leads to the source of the problem.

2. Checks ECM response to a "lean" O_2 signal. Normal response - low dwell (rich command) - No dwell change says it is bad ECM. It couldn't be an open wire because that would cause open loop operation and may set Code 13.

3. Checks for excessive voltage in O_2 line. This would usually set a Code 55 (4.1L only).

   If under .55V, wire and ECM are OK; fault is in O_2 sensor. If over .55V, wire is shorted to B+ or a faulty ECM.

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CHART NO. A-3
DWELL FIXED OVER 50°
RICH EXHAUST INDICATION

(1)
- Start engine, ground "test" term.
- Run engine at fast idle for 2 minutes.
- Return to idle.
- Remove large vacuum hose such as PCV but not enough to stall the engine.
- Note dwell, should drop at least 20°.

Dwell drops 20°.

(1A)
- Check evap. canister for being loaded with fuel and related valves, such as purge and bowl vent, for leaks which would cause richness, also fuel in crankcase.
- If OK, see Carb. On-Vehicle Service-Section 6C1, 6C2 or 6C3.

(2) **Does not drop 20°.**
- Disconnect oxygen sensor.
- Ground harness connector terminal on lead to ECM (not oxygen sensor).

Dwell drops to under 10°

(3)
- Ign. "ON," engine stopped.
- Remove ground from harness connector and check voltage from that term. to ground with digital voltmeter.

Under .55 Volts
- It is faulty oxygen sensor.

Over .55 Volts
- Check wire from ECM term. "9" for short to Bat. +. If not shorted, it is faulty ECM.

No Dwell Change
- Replace ECM

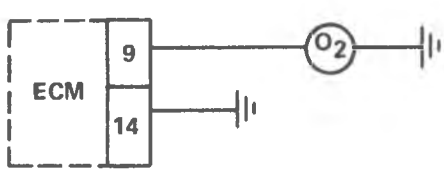


Figure 30 Dwell Fixed Over 50 °

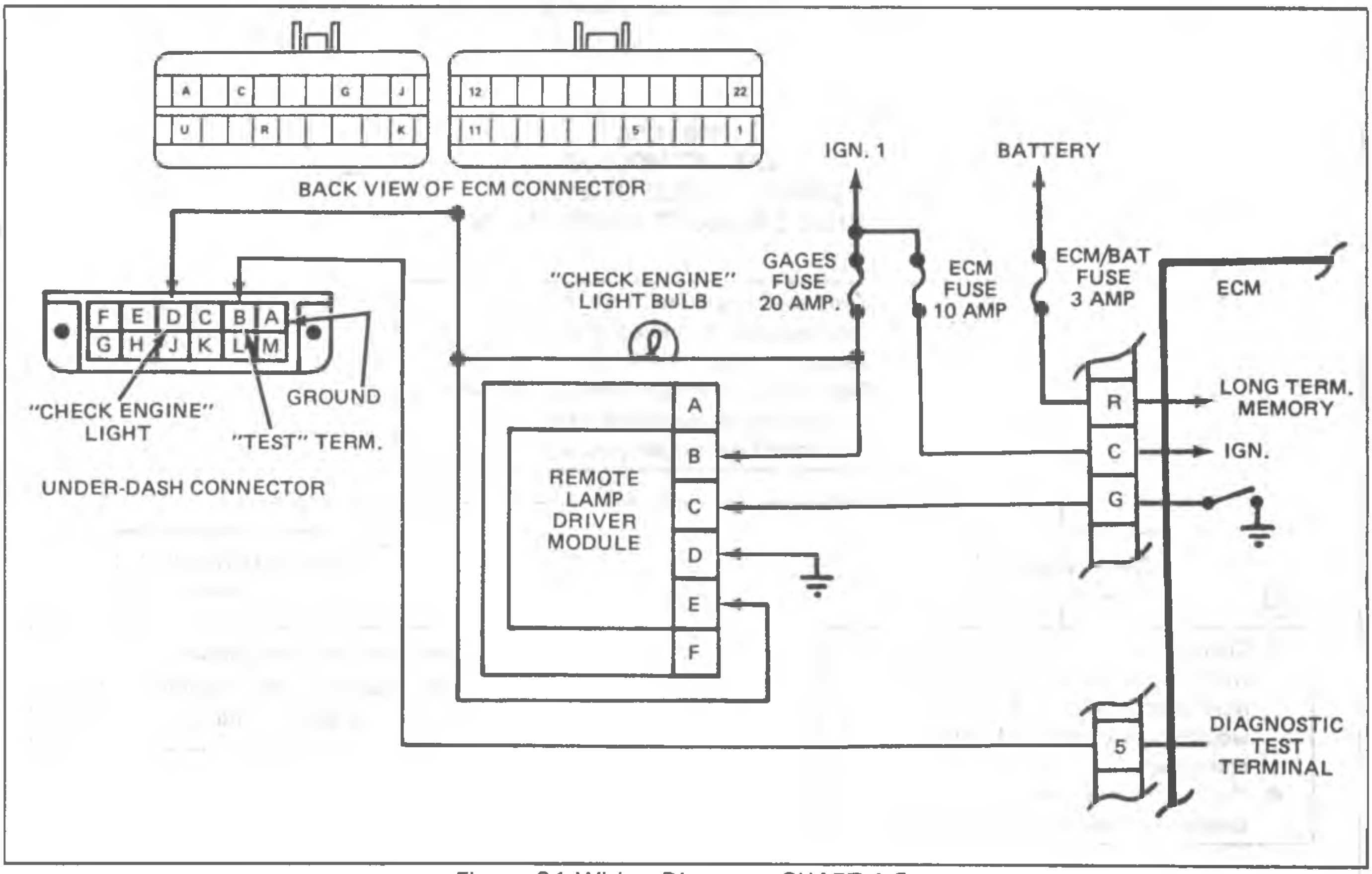


Figure 31 Wiring Diagram - CHART A-5

CHART A-5, "CHECK ENGINE" LIGHT INOPERATIVE

1. This checks for blown gauge fuse or open in "CHECK ENGINE " light circuit, including IP connector, printed circuit and "CHECK ENGINE" lamp.

   Normal response is lamp "ON".

2. This checks for a shorted ECM.

   Grounded ECM terminal "G" will turn the "CHECK ENGINE" light "OFF". If disconnecting ECM turns light "ON", ECM is shorted. Normal response is lamp "ON".

3. This checks for grounded wire from terminal "C" of lamp driver to terminal "G" of ECM, an open circuit to terminal "B" of lamp driver, a bad ground or faulty lamp driver.

   A normal reading is about 9 to 11 volts because of the drop through the upper resistor in the lamp driver. Over 11 volts indicates there is no drop in the lamp driver. This indicates a bad ground or faulty lamp driver.

4. This step checks for an open in the wire to terminal "B".

   Normal voltage is approximately battery voltage.

4A. This checks for an open wire to terminal "E" from the "CHECK ENGINE" lamp.

   With terminal "E" grounded, the lamp should normally light. Lamp "OFF" indicates an open, and lamp "ON" indicates faulty lamp driver connection or lamp driver.

5. This checks for a grounded wire from driver terminal "C" to ECM terminal "G". Normal response is light "ON".

1984 CCC
CHART NO. A-5
"CHECK ENGINE" LIGHT INOPERATIVE

(1)
- Ignition "on", engine stopped.
- Momentarily ground "Check Engine" light terminal in ALCL connector (terminal "D") and note "Check Engine" light.

Light "Off"
- Check for a blown gage fuse and open in wire from ALCL to Instrument Panel (I.P.) "Check Engine" light terminal, if not open it is faulty bulb or connection to it.

Light "On"

(2)
- Turn "OFF" ignition and disconnect ECM.
- Turn "ON" ignition and note light.

Light "ON"
- See ECM Replacement Check, Chart C-1

Light "OFF"

(3)
- Check voltage from remote lamp driver terminal "C" to ground.

Under 6 volts

(4)
- Check voltage from driver terminal "B" to ground.

Under 10 volts
- Repair open in circuit to gage fuse from terminal "B"

Over 10 volts

(5)
- Remove wire from driver connector cavity "C".
- Reconnect lamp driver and note "Check Engine" light.

Light "On"
- Repair ground wire from driver terminal "C" to ECM terminal "G".

Light "Off"
- It is faulty driver connections or driver.

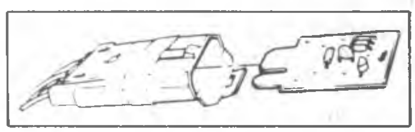
6 to 11 volts

(4A)
- Ground lamp driver terminal "E" and note "Check Engine" light.

Light "On"
- It is faulty lamp driver connection or driver.

Light "Off"
- Repair open in wire to lamp driver terminal "E"

Over 11 volts
- Check for open from lamp driver terminal "D" to ground.
- If not open, replace lamp driver.



REMOTE LAMP DRIVER

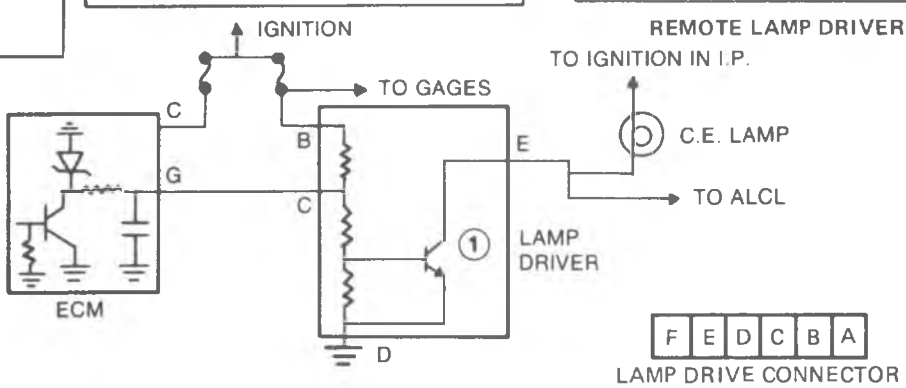


Figure 32 "CHECK ENGINE" Light Inoperative - CHART A-5

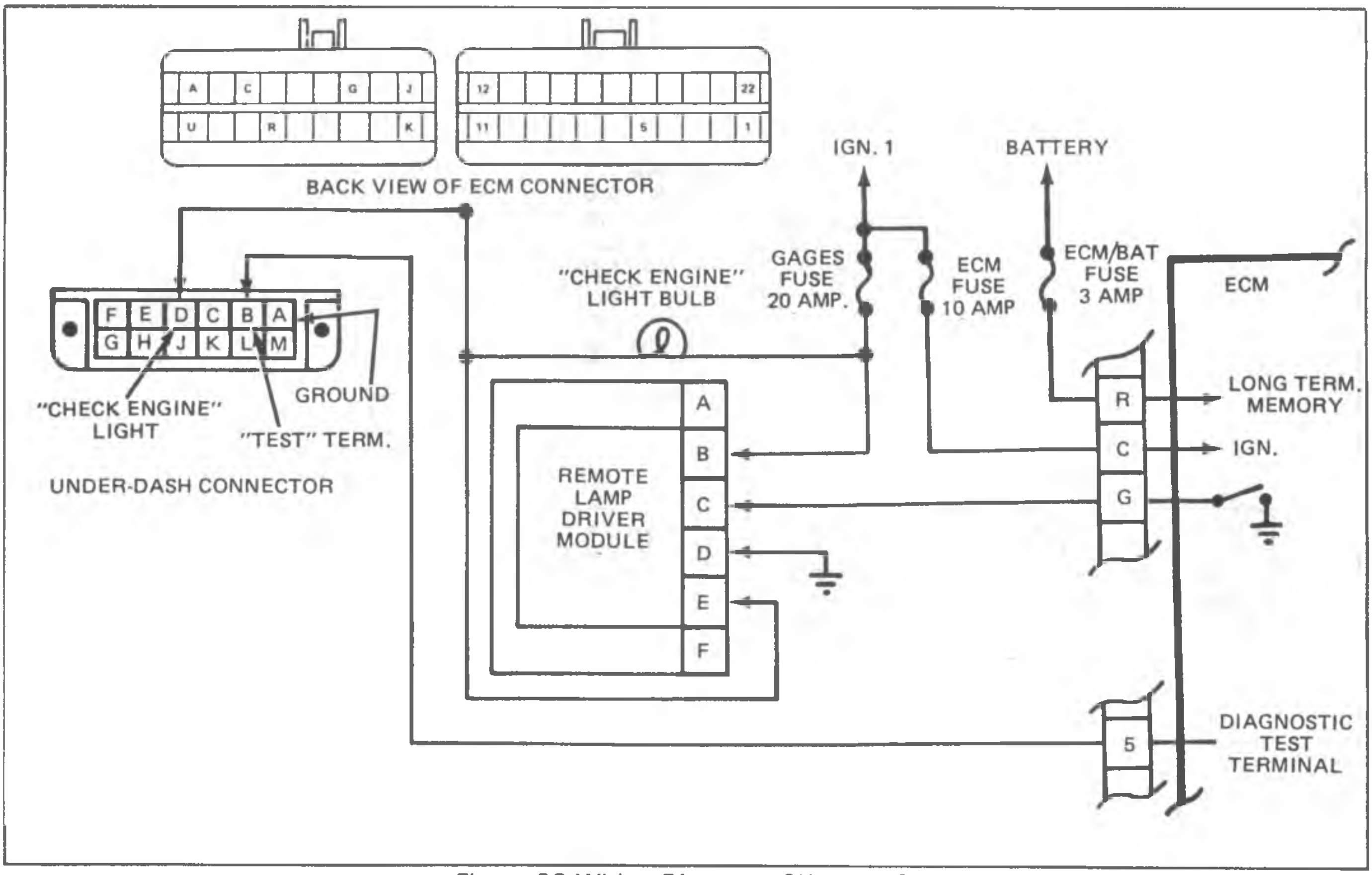


Figure 33 Wiring Diagram - CHART A-6

CHART A-6, WON'T FLASH CODE 12

1. This step checks for short to battery voltage in wire to Terminal 'C' or faulty lamp driver.

   Normal voltage reading is 9-11 volts.
2. This step checks to see if problem is related to the ECM or the lamp driver.

   Normally, grounding Terminal 'C' should turn lamp "OFF". If it does, the problem is related to the ECM and its wiring. If not, it is related to the lamp driver and its wiring.
3. Grounding Terminal 'G' at ECM and finding light "ON" indicates an open in the wire to Terminal 'C' of lamp driver.

   Normally, grounding Terminal 'G' should turn lamp "OFF".
4. This step checks for open in wire from ECM to test terminal in ALCL connector. The lamp should flash Code 12 when Terminal "5" is grounded.
5. Checks for proper voltage supply to ECM. Both should read over 9 volts. Terminal 'C' is ignition and Terminal 'R' is constant battery for long term memory.
6. Checks for a bad ground to ECM - Terminals 'A' and 'U' are connected together in the ECM.
7. This step distinguishes between a faulty ECM and PROM. Normal response is for Code 51 to flash even though the PROM is not installed in the ECM. If it doesn't, it means that the ECM is faulty.

1984 CCC

CHART NO. A-6

"CHECK ENGINE LIGHT" ON AT ALL TIMES OR WON'T FLASH CODE 12

Check fuses that supply power to ECM.
Repeat Diagnostic Circuit Check after any repair.

(1)
- Disconnect ground from "test" terminal.
- Key "on", engine stopped.
- Check voltage from lamp driver terminal "C" to ground.

Over 11 volts
- Check for short from terminal "C" wire to B+.
- If not shorted, replace lamp driver.

Under 11.5 volts

(2)
- Ground lamp driver terminal "C" and note "Check Engine" light.

Light "On"
- Disconnect driver and note "Check Engine" light.

Light "Off"
- It is faulty connection to driver terminal "C" or faulty driver.

Light "On"
- Repair ground in wire from driver terminal "E" to "Check Engine" light.

Light "Off'

(3)
- Ground terminal "G" at ECM and note "Check Engine" light.

Light "On"
- Repair open in wire from ECM terminal "G" to driver terminal "C".

Light "Off"

(4)
- Ground term. 5 at ECM and note "Check Engine" light.

Flashes
- Repair open in wire from ECM terminal "5" to "test" terminal

"On" steady

(5)
- Disconnect ground from terminal "5".
- Check voltage from ECM terminals "C" and "R"to ground.

Either under 9 volts
- Repair poor connection or open in circuit to terminal that reads low.

Both over 9 volts

(6)
- Check voltage from ECM terminal "U" to ground.

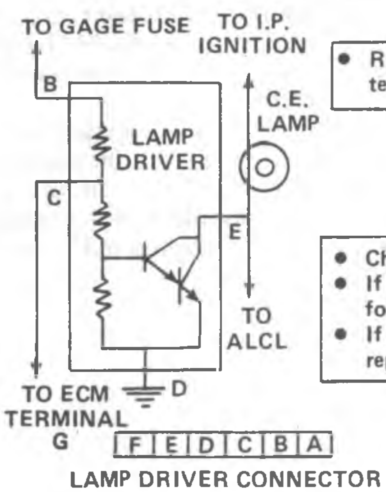
Over 1 volt
- Repair open or poor connection from terminals "A" and "U" to ground.

Under 1 volt

(7)
- Turn ign. "OFF". Remove PROM.
- Turn ign. "ON".
- After 30 secs., check for Code 51.

Code 51
- Check for proper PROM installation.
- If OK, install new PROM and recheck for Code 12.
- If Code 12 does not flash, See ECM replacement Check, Chart C-1

No Code 51.
- See ECM Replacement Check, Chart C-1



Repeat Diagnostic Circuit check after any repair.

Figure 34 Won't Flash Code 12 - CHART A-6

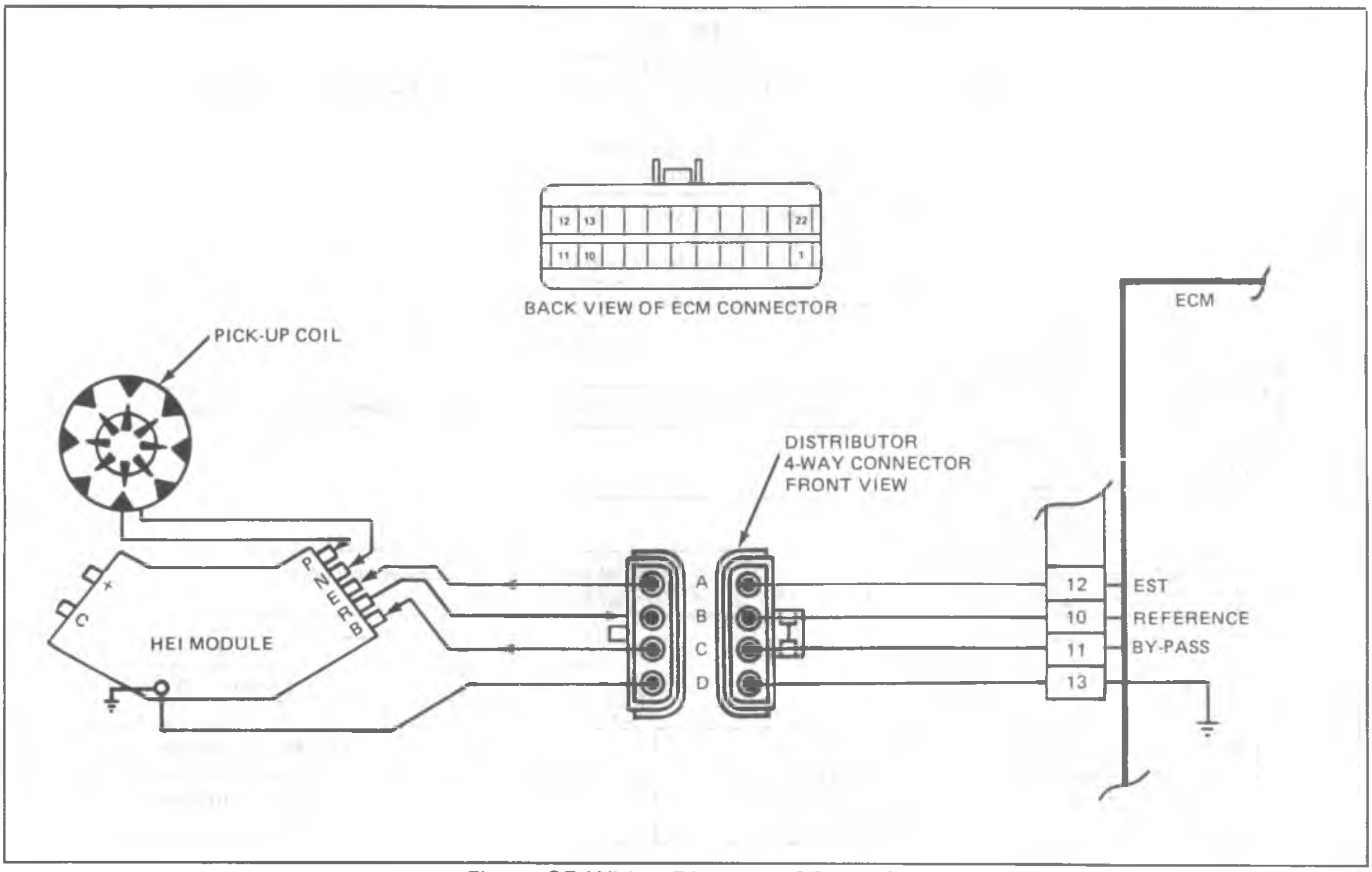


Figure 35 Wiring Diagram - CODE 12

CODE 12 NO DISTRIBUTOR REFERENCE PULSE

Code 12 means the ECM is "ON" and sees no reference pulse from the distributor. This is a normal code with the ignition "ON" and engine not running. Code 12 is not stored and will only flash when the fault is present. With the engine running, Code 12 could mean an open or ground in the distributor reference circuit. Code 41 will appear with Code 12 if the engine is running with no dist. reference signal. If the problem clears, Code 41 will store.

1. This step checks for a poor connection at the EST 4 wire connector as being the source of no distributor reference pulse. Check for corrosion, connector terminals not fully seated, or terminal not properly attached to the wire. The terminal must be removed from the connector and carefully inspected.

2. This step determines if a reference pulse is being sent to the ECM. Voltage should normally increase as you go from idle to part throttle. A voltage increase indicates the signal is being generated by the module and fault is a bad connection at the ECM, or faulty ECM. To check the connection at the ECM, the terminal must be removed from the connector.
3. With an open circuit, there is still a small amount of voltage at the ECM. It will not increase when the throttle is opened. If the circuit from Terminal "10" to the module is not opened or grounded, the source of no signal is the module itself.

1984 CCC

CODE 12
NO REFERENCE PULSES TO THE ECM
(EXCEPT 3.8L V-6 VIN CODE 9)

(1)
- Check connections at four (4) terminal EST distributor connector.

Not OK
- Repair

OK

(2)
- With engine idling, connect digital voltmeter from ECM terminal "10" to ground. Check voltage at idle and at part throttle.

- Voltage increases at part throttle.
  - Faulty conn. at ECM term. "10" or ECM.

- Voltage doesn't increase.

(3)
- Check for open or grounded reference lead from HEI module to ECM.
- If OK, replace HEI module

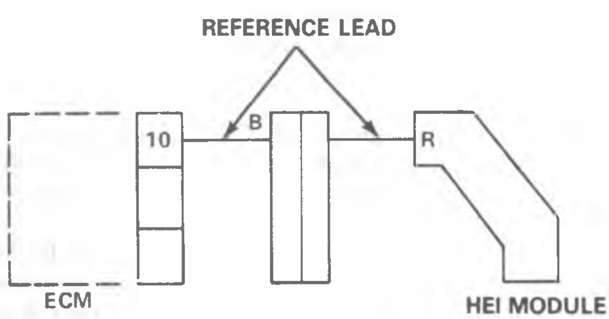


Figure 36 No Distributor Reference Pulse - CODE 12

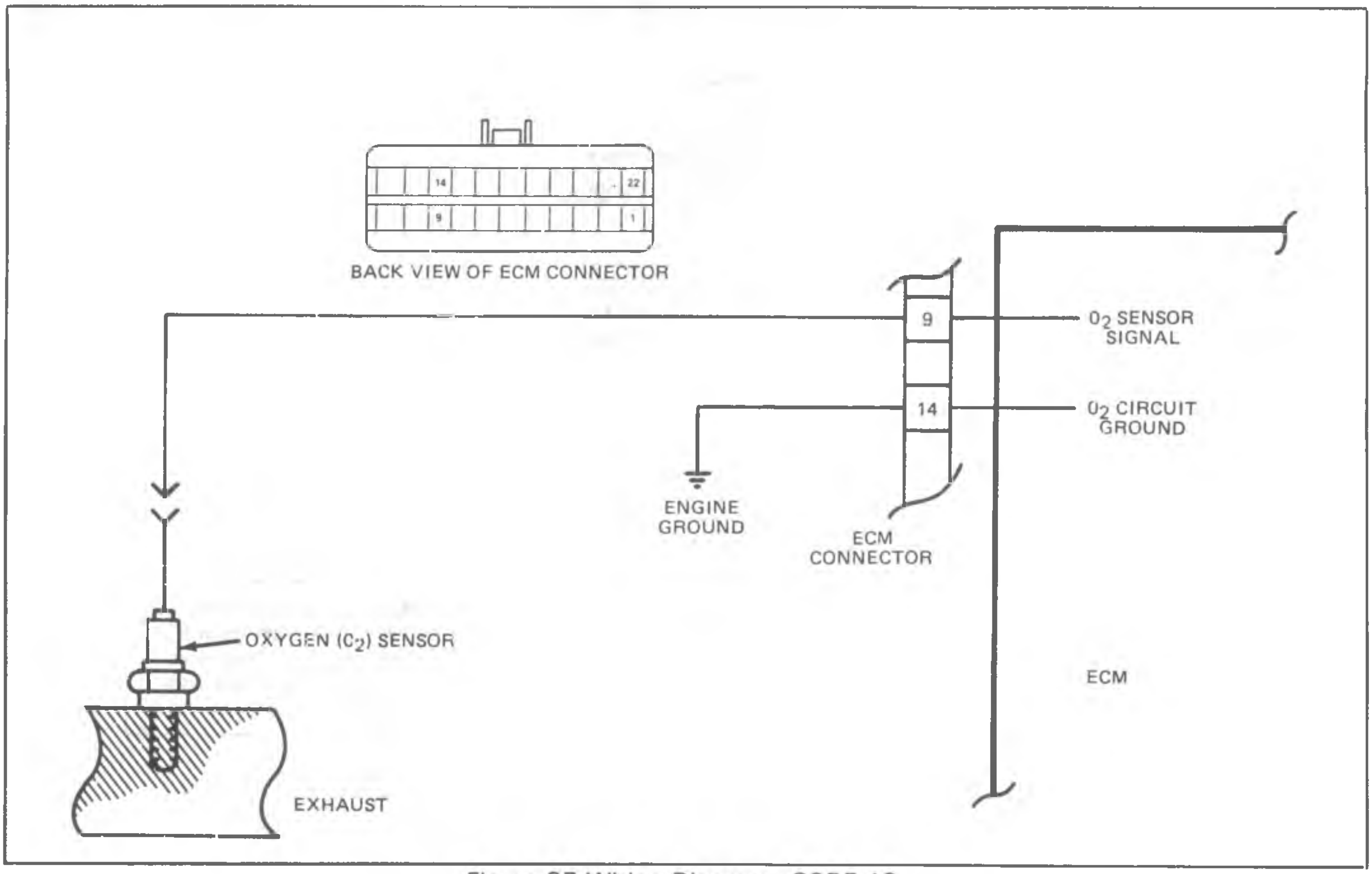


Figure 37 Wiring Diagram - CODE 13

CODE 13, OXYGEN SENSOR CIRCUIT

Code 13 means an open in the oxygen sensor circuit with the following conditions:

- Oxygen sensor voltage is within a specified range.
- Above a specified TPS value.
- More than a specified time after the engine has warmed up.

The ECM supplies a voltage of about .45V between Terminals "9 and 14". (Voltage may read as low as .32V when measured with a 10 megohm DVM.) The 0_2 sensor varies the voltage within a range from about 1 volt if the exhaust is rich down through about .1V if exhaust is lean.

1. This step is to determine if the problem is still present.

   A normal dwell will vary indicating the fault is not present, while a fixed dwell indicates the fault is still present.
2. By grounding the 0_2 sensor circuit to the ECM, a "low voltage (lean) signal" is sent to the ECM.

   If the ECM is not faulty and the circuit is complete a "low voltage signal" should result in a full rich command (low dwell) from the ECM.
3. This step determines if the 0_2 sensor is functioning. With the rich command, the 0_2 sensor should read a high voltage, over .8V if it is functional, since the exhaust is rich. If the 0_2 sensor functions, fault is in the connections to the sensor.
4. This step checks for an open in the ECM 0_2 sensor ground circuit. Normal voltage is below 1 volt if the circuit is complete. The worse the connection is, the higher the voltage will read.
5. This step grounds the 0_2 signal wire at the ECM. If the ECM is functional, dwell should go to below 10°, since this is a "low voltage signal" indicating lean exhaust. No change indicates a problem at the ECM connections, or the ECM.

1984 CCC
CODE 13
(OPEN OXYGEN SENSOR CIRCUIT)

Check for sticking or misadjusted throttle position sensor.

If 13 and 21 are displayed, go to 21 first.

(1)
- Connect dwell meter to M/C Sol., use 6-cyl. scale.
- Ground "test" terminal and note dwell at 2000 rpm's

Varying within 10°-50°
- Trouble is intermittent. Oxygen sensor circuit is OK at present.
- Check oxygen sensor circuit for intermittent connection. Clear memory.

Fixed under 10°
- See Chart #A-1

Fixed About 30°

(2)
- With engine idling, disconnect oxygen sensor and ground purple wire leading to ECM (not oxygen sensor).

Under 10° dwell.

(3)
- Leave purple wire grounded.
- Check voltage from oxygen sensor to ground with digital voltmeter on 2 volt scale. It should read over .8 volts.

OK
- Faulty oxygen sensor connections or sensor.

Not OK
- Replace oxygen sensor.

Over 10° dwell.

(4)
- Check voltage from ECM terminal "14" to ground.

Under 1 volt

(5)
- Connect jumper between ECM terminals "9" and "14".

Over 10° dwell.
- Faulty conn. at ECM terms. "9 or 14" or ECM.

Under 10° dwell.
- Repair open in oxygen sensor harness lead from connector to ECM.

Over 1 volt
- Repair open between ECM terminal "14" and ground.

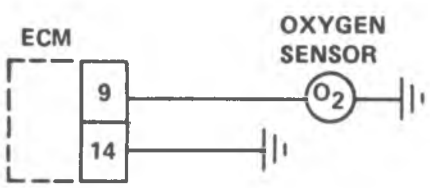


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Figure 38 Oxygen Sensor Circuit - CODE 13

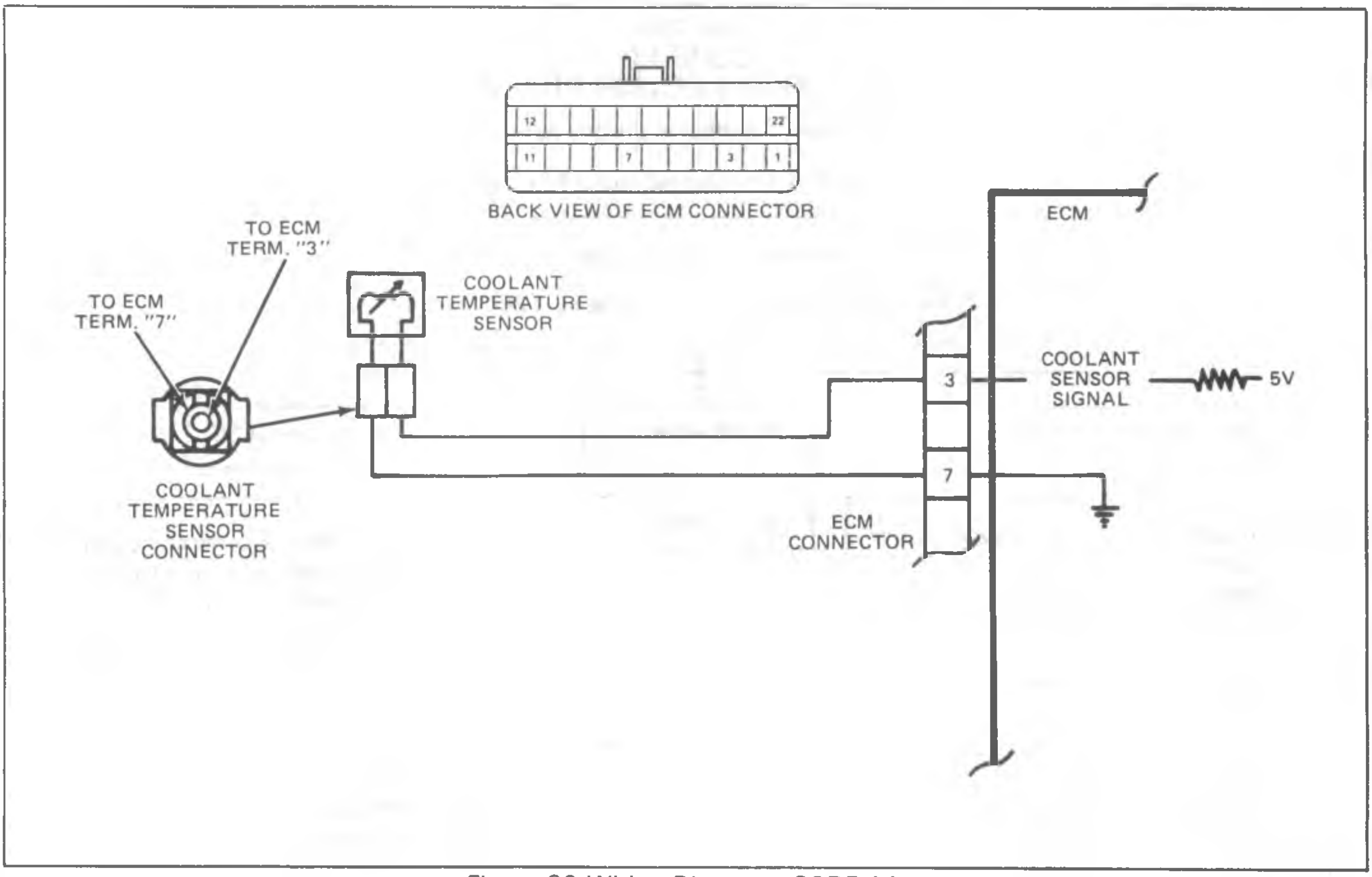


Figure 39 Wiring Diagram - CODE 14

CODE 14, COOLANT SENSOR CIRCUIT SHORTED

Code 14 means the ECM has seen low resistance of the coolant sensor circuit as follows:

- Low resistance (high engine temperature)
- Or low voltage (at ECM Terminal "3")
- For a time longer than specified

1. This step determines whether the fault is at the coolant sensor or elsewhere in the circuit. Normal voltage should be about 5 volts in the circuit.

2. This step checks for a grounded circuit between the ECM and the coolant sensor. Test light to B+ should be "OFF" in an ungrounded circuit. The coolant sensor is not connected during the test.

1984 CCC

CODE 14

SHORTED COOLANT SENSOR CIRCUIT

If the engine hot light is "on", check for overheating condition first.

1

- Engine at normal operating temp.
- Disconnect coolant sensor.
- Ignition "on", engine stopped.
- Check voltage between harness conn. term's. It should be about 5 volts.

Under 4 volts

2

- Remove numbered term. ECM connector and connect test light from Bat. + to term. 3 of connector (not ECM).

Light "Off"

- Check for short between coolant sensor wires.
- If not shorted, replace ECM.

Light "On"

- Repair grounded wire to ECM term. "3".

Over 4 volts

- Replace coolant sensor.

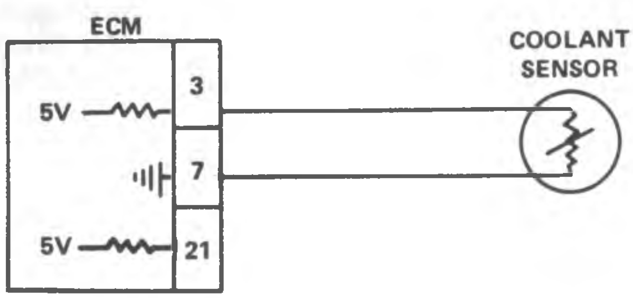


Figure 40 Coolant Sensor Circuit Shorted - CODE 14

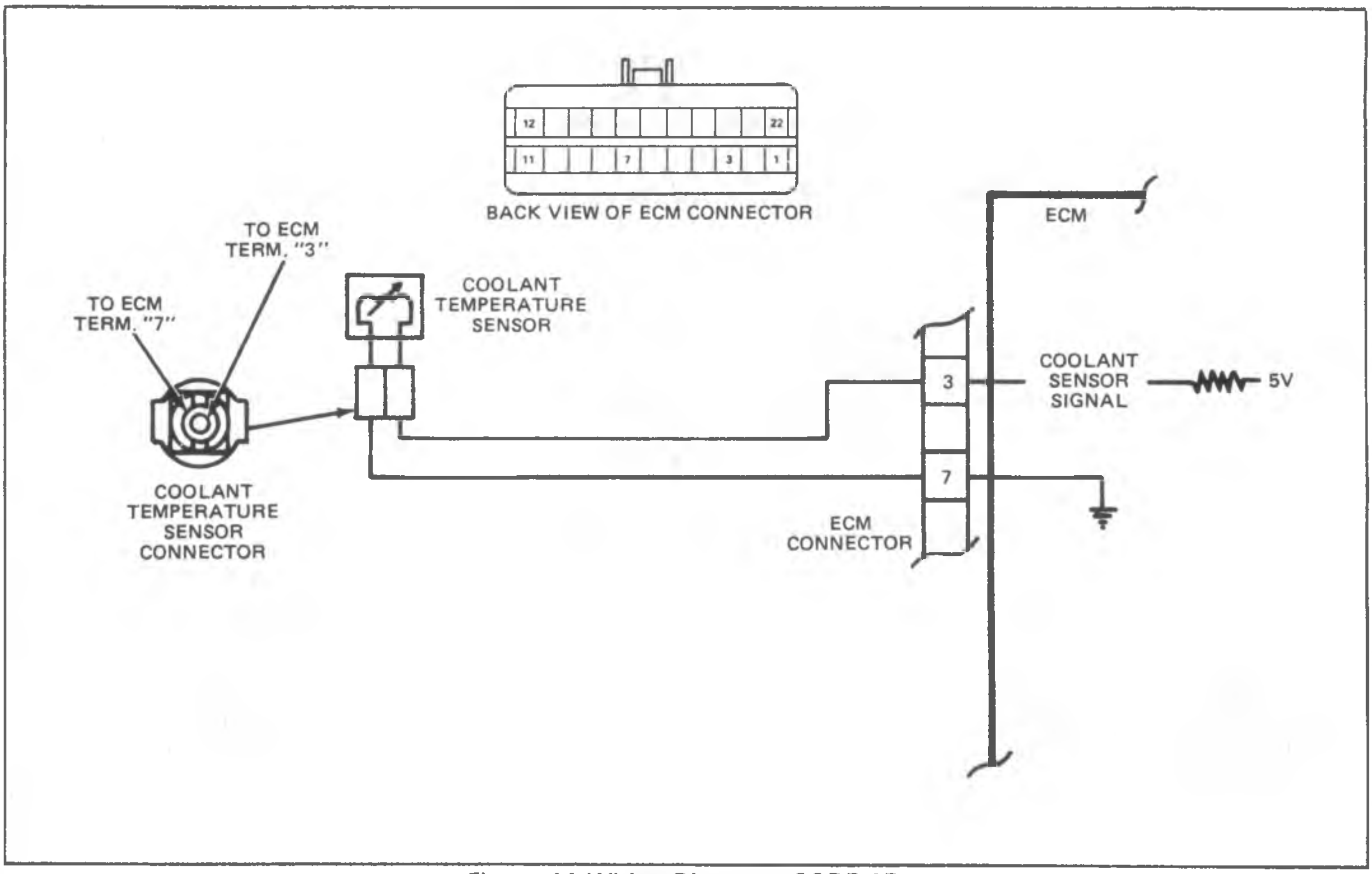


Figure 41 Wiring Diagram - CODE 15

CODE 15, COOLANT SENSOR CIRCUIT OPEN

Code 15 means the ECM has seen the resistance of the Coolant Sensor Circuit too high as follows:

- High resistance (Cold Engine Temperature)
- Or high voltage (at ECM Terminal "3")
- For a time longer than specified

This could cause detonation on a warm engine due to too much spark advance or poor driveability due to wrong fuel control.

1. Checks to see if problem is still present. If it is, the "CHECK ENGINE" light will come "ON" and Code 15 will be set.
2. Checks to see if the fault is the coolant sensor or lack of voltage to the coolant sensor. Normally you should have 5 volts across the coolant sensor connector terminals.
3. Determines whether the low voltage at the sensor connector is due to opens in the coolant sensor wires, or in another part of the 5V ref. circuit. Normal voltage should be about 5V from ECM Terminals "3" to "7".
4. Checks resistance of the coolant sensor. If the resistance is within the chart specifications, coolant sensor is not faulty; therefore, check for corrosion at the connector, or low coolant level.

1984 CCC
CODE 15
OPEN COOLANT SENSOR CIRCUIT

(1)
- Run engine for 5 minutes in closed loop, or until "check engine" light comes "on".

Light

(2)
- Disconnect coolant sensor.
- Ignition "on", engine stopped.
- Check voltage between sensor connector term's. It should be about 5 volts.

Under 4 volts

(3)
- Check voltage from ECM term's. "3" to "7" (sensor disconnected).

Under 4 volts
- It is faulty ECM connection at terminal "3" or "7" or ECM.

Over 4 volts
- Check for open in wires to ECM term's. "3" and "7".

Over 4 volts

(4)
- Check resistance of coolant sensor. It should be under 1000 ohms on a warm engine.*

OK
- It is poor sensor connection or low coolant level.

Not OK
- Replace sensor.

No Light
- Trouble is intermittent. Make physical inspection of circuit for intermittent connections. Clear memory.

*

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,600
70	20	3,400
40	-4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

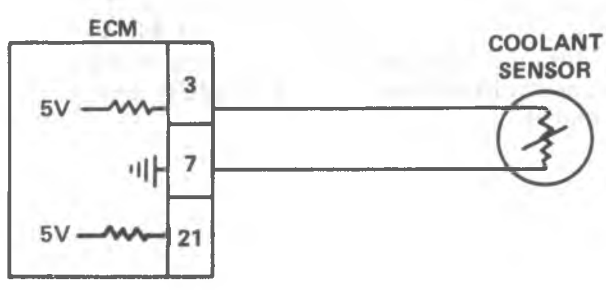


Figure 42 Coolant Sensor Circuit Open - CODE 15

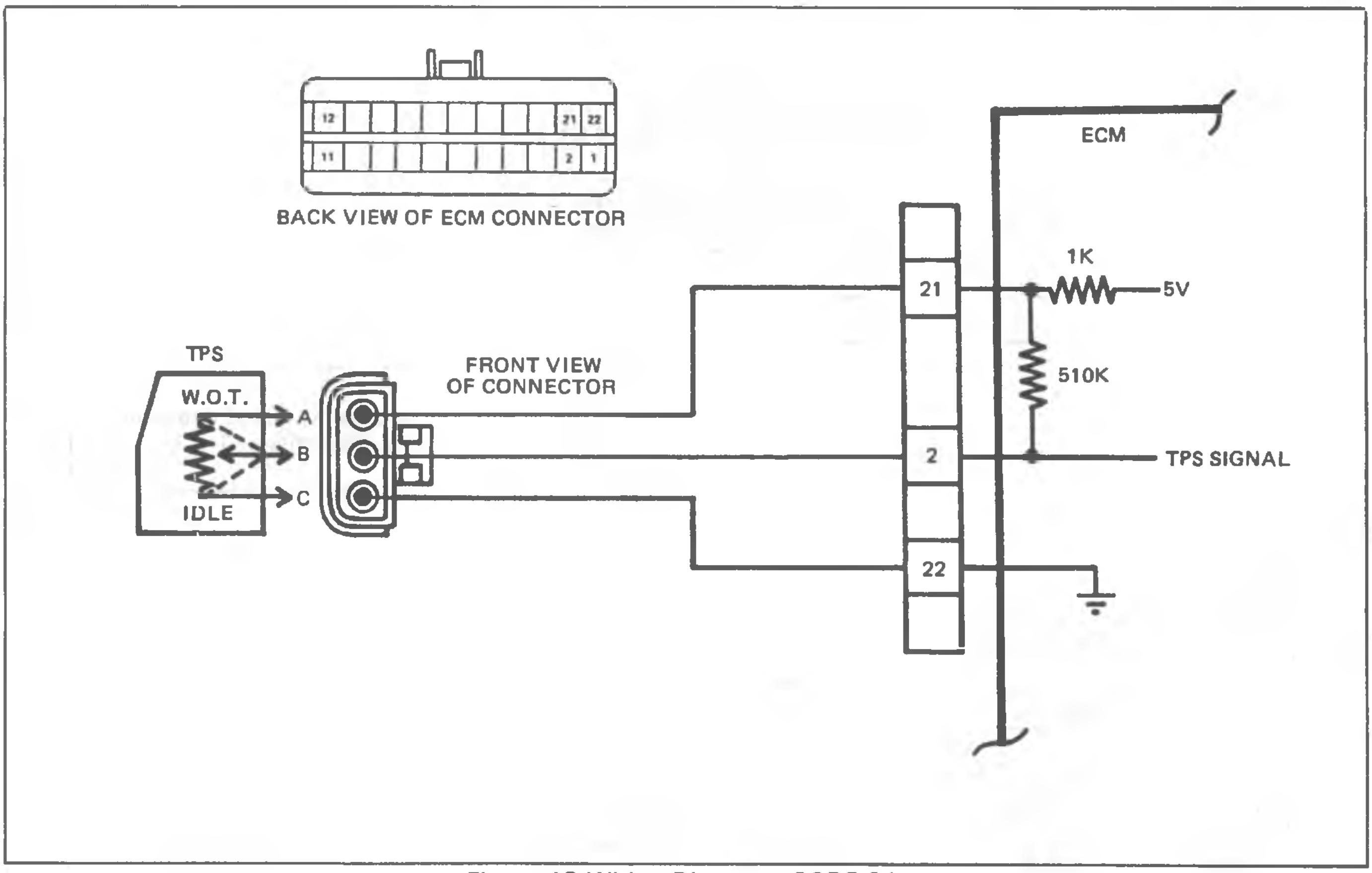


Figure 43 Wiring Diagram - CODE 21

CODE 21, TPS CIRCUIT HIGH

Code 21 means that the ECM has seen a high TPS voltage for:

- Over about 10 seconds
- Below a specified RPM
- Below a specified engine load.

Due to the pull-up resistor between Terms. "21" and "2" within the ECM, an open in the TPS circuit will place about 5 volts (high TPS signal) at Term. "2" of the ECM.

1. Checks the circuits from the TPS connector back to the ECM. Both wires should read about 5V because of the pull-up resistor in the ECM. A 10 Meg. ohm resistence meter must be used. A lower resistence voltmeter would read virtually zero at terminal B.
2. Checks to see if the low voltage at the TPS connector is an open in open in the circuit or a faulty ECM. A normal reading at the ECM is about 5V.
3. This step simulates closed throttle, so dwell should increase if the ECM is good.
4. This step tests the resistance of the TPS switch itself. A normal reading is under 20,000 ohms.

1984 CCC
CODE 21
OPEN TPS CIRCUIT OR MISADJUSTED

Check for stuck or misadjusted TPS Plunger.
Repair as necessary. If OK, proceed:

(1)
- Connect dwell meter to M/C solenoid – use 6-cyl. scale.
- Disconnect TPS harness connector from sensor.
- Check voltage from harness connector terminal "B" to "C"with a digigal voltmeter.
- Ignition on, Engine stopped.

Under 2 volts.

(2)
- Check voltage from ECM TERM. "2" to "22".

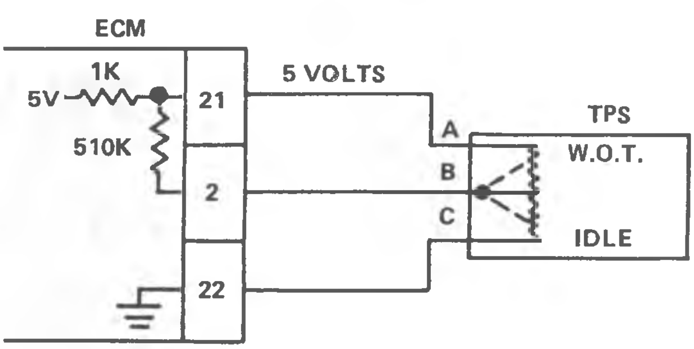
  - **Under 2 volts.**
    - Faulty ECM Connections or ECM.
  - **Over 2 volts.**
    - Repair open in harness to TPS.

Over 2 volts.

(3)
- Start engine and let it idle.
- Jumper harness connector term. "B" to "C" and note dwell.

  - **Under 10°**
    - Replace ECM
  - **Over 10°**
    - Check TPS connector terminal connections.
      - **Not OK**
        - Repair
      - **OK**

        (4)
        - Check TPS resistance from "A" to "B" then "A" to "C".
          - Any over 20,000 ohms
            - Replace TPS Sensor.
          - Both under 20,000 ohms
            - Adjust TPS, see Section 6C.
            - If unable to adjust, replace TPS.



- After any repair, clear long term memory.

Figure 44 Throttle Position Sensor Circuit - CODE 21

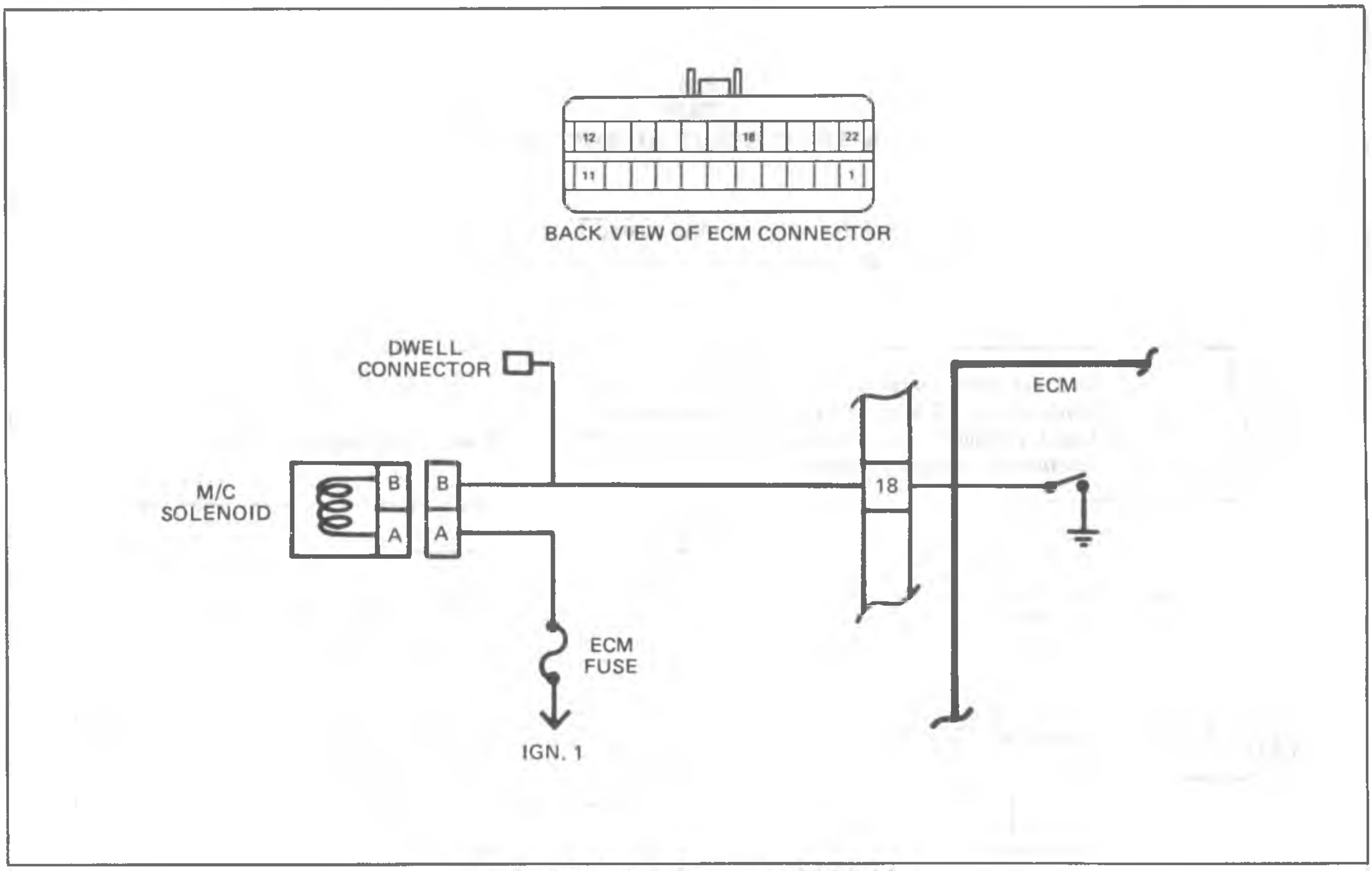


Figure 45 Wiring Diagram - CODE 23

CODE 23, M/C SOLENOID CIRCUIT LOW

Code 23 says the ECM has seen the voltage at ECM Term. "18" stay low instead of rising and falling as the M/C solenoid is turned "ON" and "OFF". This could be caused by an open in the M/C solenoid circuit or a ground on the ECM side of the M/C solenoid.

An open would cause a full rich condition and cause poor economy, odor, smoky exhaust or poor driveability. A ground would cause a full lean condition and cause poor driveability.

1. Checks for a complete circuit from the battery to the M/C solenoid dwell lead. It should be battery voltage. Battery voltage means there might be an open circuit between the dwell connector and ground. No voltage could be either an open between the connector and battery or a ground on the ECM side of the M/C solenoid.

2. Checks for B+ on the pink ignition source wire. Test light should light between the ignition source and ground.

2A. Checks for an open in the solenoid to ECM circuit. A normal circuit would read about battery voltage at the ECM Terminal "18".

3. This step determines whether the fault is in the M/C solenoid, a ground in the circuit to the ECM, or the ECM. A light would indicate a ground in circuit to Terminal "18" or a faulty ECM. A voltmeter can't be used because it is normal to have enough current flow through the ECM even with the circuit open to make a voltmeter read, but not enough to light a test light.

4. This checks for ground in the wire to ECM Term. "18". If it is grounded, the light will stay "ON".

1984 CCC

CODE 23

OPEN OR GROUNDED M/C SOLENOID CIRCUIT

Check connections at M/C solenoid. If O.K.: Clear memory and recheck for code(s). If no code 23, circuit is OK.

(1)
- Ignition "on", engine stopped.
- Do not ground "Test" terminal.
- Check voltage at M/C solenoid dwell lead after M/C solenoid stops cycling (after 25 sec., if applicable)

Under 10 Volts

(2)
- Disconnect M/C solenoid
- Connect test light from the sol. connector battery terminal pink lead to ground.

Light Off
- Check for open B+ circuit to solenoid.

Light On

(3)
- Connect test light between sol. harness connector terminals. Do not use voltmeter.

Light Off
- Check for an open in wire from M/C sol. to dwell connector.
- If not open, it is a faulty M/C solenoid connection or solenoid.

Light On

(4)
- Remove numbered term. ECM connector.

Light On
- Repair ground in wire from solenoid to ECM terminal "18".

Light Off
- See ECM Replacement Check, Chart C-1

Over 10 Volts

(2A)
- Check voltage at ECM term "18".

Over 10 Volts
- Check carburetor M/C sol. resistance.

Over 10 ohms
- See ECM Replacement Check, Chart C-1

Under 10 ohms
- Replace solenoid and ECM.

Under 10 Volts
- Repair open in SOL/ECM wire.

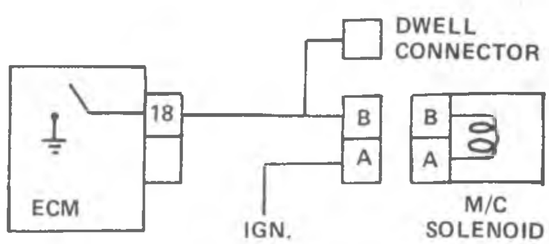


Figure 46 M/C Solenoid Circuit Low - CODE 23

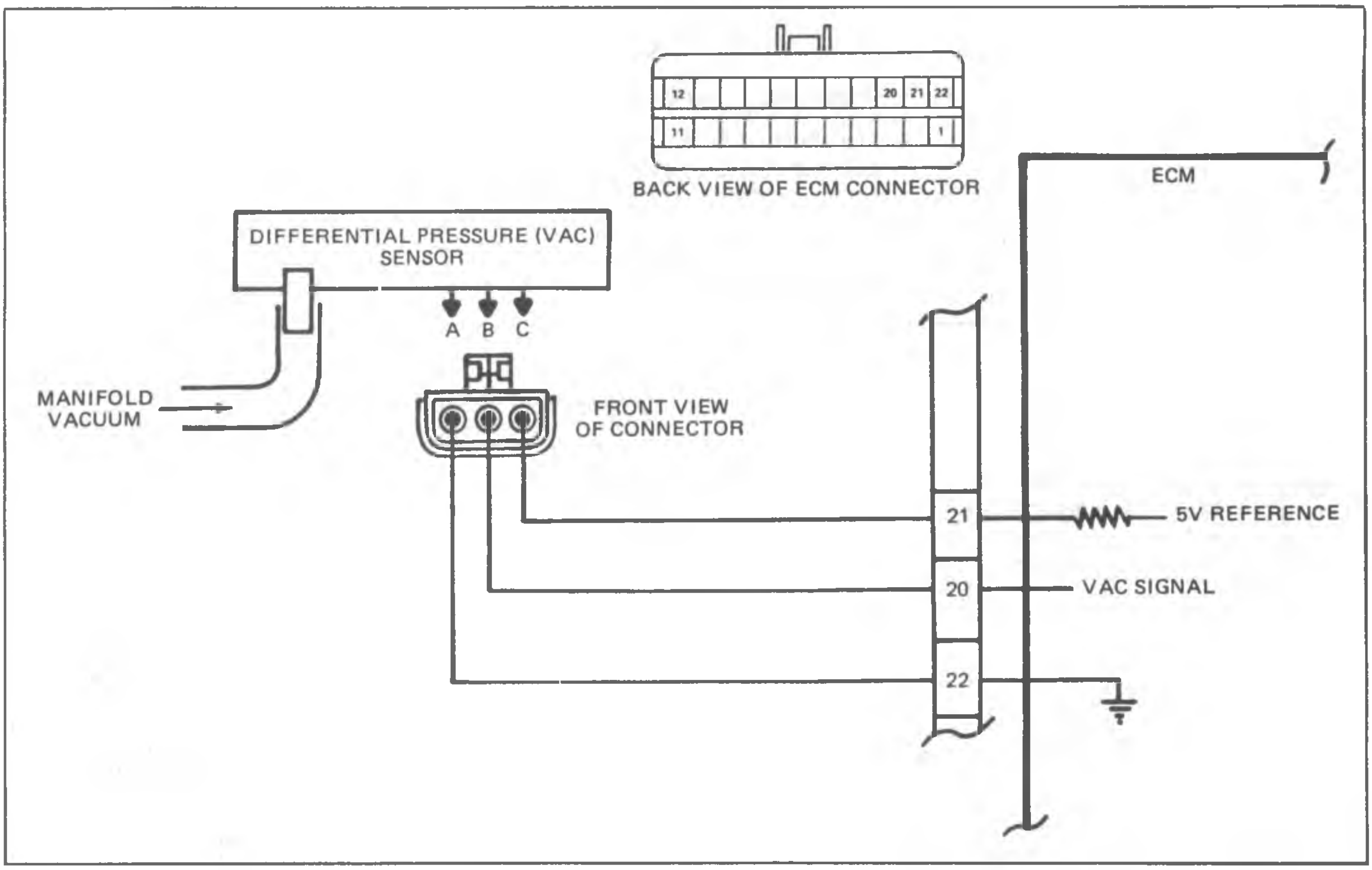


Figure 47 Wiring Diagram - CODE 34 (Vacuum Sensor)

CODE 34, DIFFERENTIAL PRESSURE (VACUUM) SENSOR CIRCUIT

Code 34 says that the ECM has seen the following:

- Pressure outside a specified voltage range (seen by ECM as voltage at Term. "20").
- Engine RPM less than a given value.
- Engine at operating temperature.
- All the above for a time greater than specified.

The vacuum sensor is a differential pressure sensor that measures the difference in pressure between atmosphere and manifold. The voltage output is opposite a MAP sensor. The vacuum sensor supplies high voltage at high vacuum. High voltage increases spark advance while low voltage reduces advance.

1. Checks output of sensor at idle to determine if sensor is within specification. Normal sensor will read less than 1 volt with key "ON", engine "OFF" and over 3 volts with engine idling with a minimum of 50 kPa (15″) vacuum.

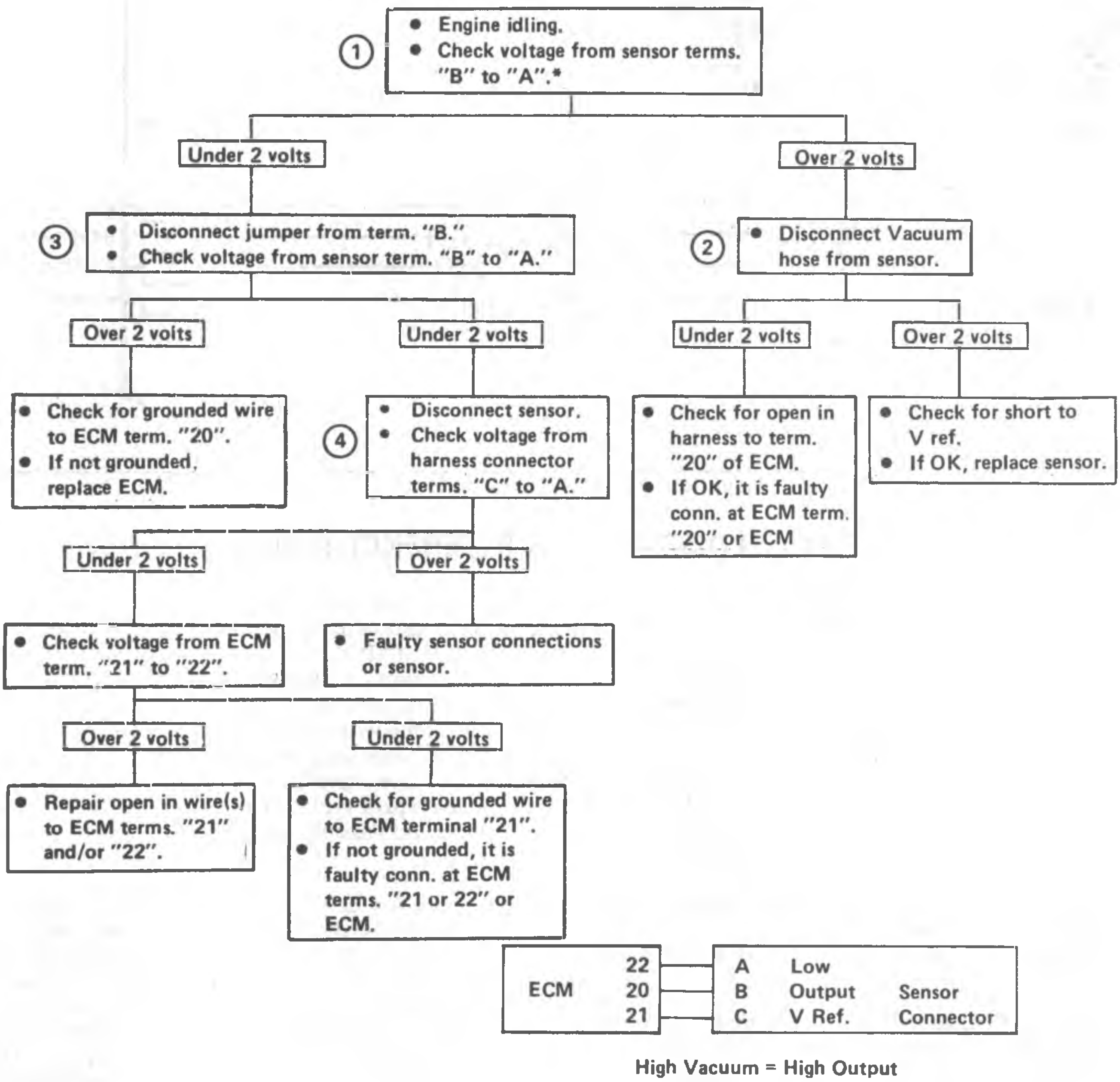
2. A normal sensor should drop below 1 volt when vacuum is removed. This step tests for that drop at the sensor.

3. Checks for a ground in wire from Term. 'B' of vacuum sensor to ECM. This would be the case if the voltage went up over 2 volts when the line was opened.

4. Checks to see if the fault is in the sensor, or in the ECM wiring, or in the ECM. If the voltage goes up over 2 volts with the sensor disconnected, the sensor or sensor connections are faulty.

1984 CCC
CODE 34
PRESSURE DIFFERENTIAL SENSOR (VAC) VOLTAGE TOO HIGH OR LOW

Check for over 34 kPa (10 inches) of vacuum at sensor with engine idling. If not OK, repair.



*This requires use of three jumpers between the sensor and the connector. They can be made using terminals 12014836 and 12014837.

Figure 48 Vacuum Sensor Circuit - CODE 34

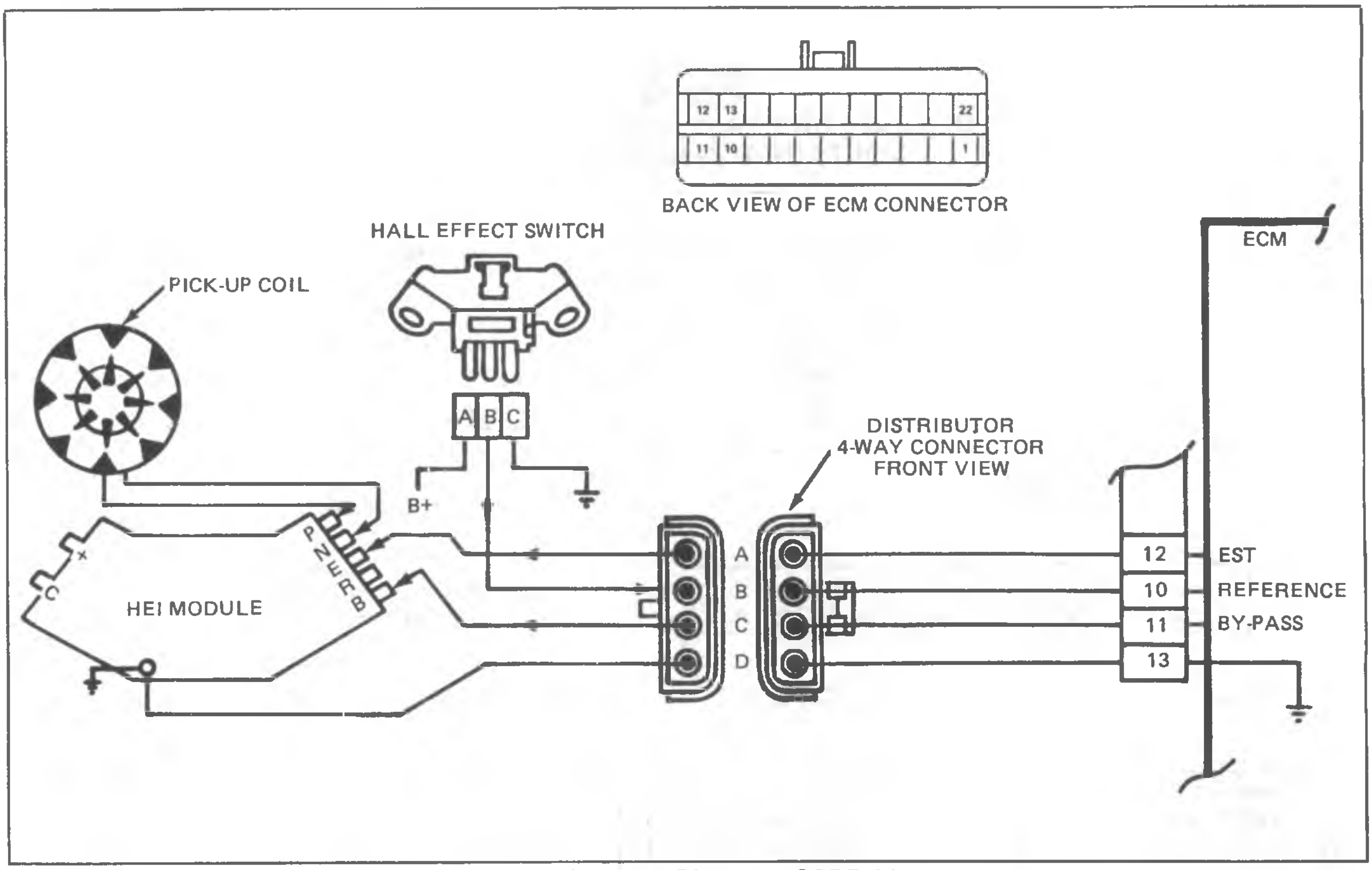


Figure 49 Wiring Diagram - CODE 41

CODE 41, NO DISTRIBUTOR REFERENCE SIGNAL

Code 41 says that there are no distributor references pulses to the ECM at a specified engine vacuum. This code could set with the key "ON", engine "Not Running" if the MAP or vacuum sensor was defective by indicating "Engine Running" voltage with just the key "ON". With a constant open or ground in the reference signal circuit, Code 12 would be set along with a 41. Use Chart 12 if 12 and 41 are set. Code 41 alone indicates the problem is intermittent. When the distributor reference line signal is lost, the engine runs full rich and with retarded (base) spark timing. The result is poor performance, poor fuel economy, and possibly rotten egg odor from exhaust.

1. Checks to see if Vacuum sensor voltage changes with loss of vacuum supply. A good sensor will change voltage at Terms. 'A' to 'B' by 1 volt or more.

1A. Since the voltage change was less than 1 volt, the problem is in the vacuum system. The ECM has "SEEN" engine running vacuum equivalent with no distributor reference signal, with the key "on" and engine not running.

2. Checks for cause of an intermittent open or ground in the distributor circuit. Fault could also be an intermittent stuck Vacuum sensor that has the same voltage output as an engine "running" with only the key "ON", thus, no reference signal. Terminals must be removed from connectors to properly check them. The distributor pick-up coil should also be checked.

1984 CCC

CODE 41

NO DISTRIBUTOR REFERENCE SIGNAL

If vacuum has been applied to MAP or VAC sensors with the key "ON" engine not running, a false Code 41 could be set.

1. With engine idling, check voltage change of VAC or MAP sensor terminals "B" to "A" as vacuum hose is removed.

1A. Less than 1.0 volt change

- Fault is in the MAP or VAC sensor circuit. See chart 34.

More than 1.0 volt change

- Trouble is intermittant.

2. Make physical check of wires and connections for grounds and bad connections. Also check distributor pick-up coil resistance and connections. Fault could be an intermittant MAP or VAC Sensor.

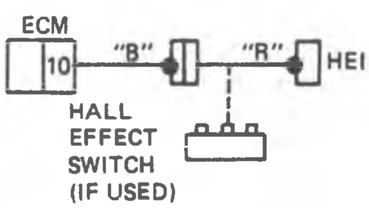


Figure 50 No Distributor Reference Signal - CODE 41

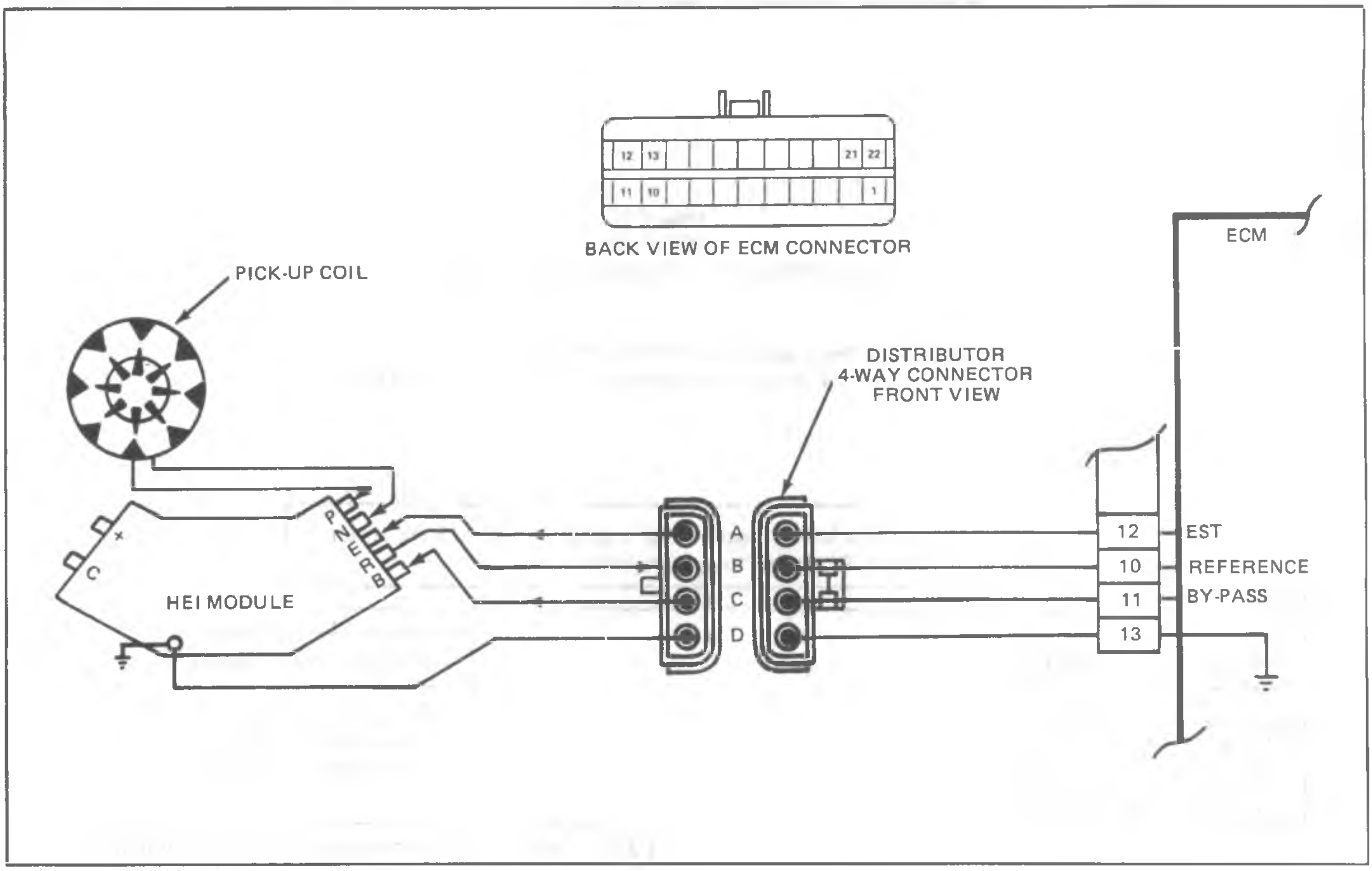


Figure 51 Wiring Diagram - CODE 42

CODE 42, ELECTRONIC SPARK TIMING (EST)

Code 42 says that the ECM has seen:

- Open or grounded By-pass Circuit (Term. "11")
- Open or grounded EST Circuit (Term. "12")

With a grounded EST Circuit, the engine may not run. A grounded EST may sometimes not set a code unless cranked 10 seconds or longer with circuit grounded.

1. This checks operation of EST. Grounding the "test" terminal causes timing to go to a fixed value which is normally different from that obtained with EST operating. Therefore, the timing should change. Usually the change can be heard in engine RPM. If so, the timing change does not have to be checked.

2. This step eliminates the ECM and ECM connections from the module input. By jumpering Terminals "A" and "B", the distributor ref. signal is fed directly into the EST line of the module. By putting voltage through the test light on Terminal "C" of the harness, the module is switched to the EST mode and the vehicle should run. If the engine stops, there is no EST signal reaching the module due to open or poor connections, or the module is faulty.
3. By removing the jumper, you are opening the EST signal, and the engine should stop.
4. Since the engine ran when the module was jumpered, it says the problem is not in the distributor (if the correct HEI module is installed). The wrong HEI module can set a Code 42.

1984 CCC

CODE 42
BYPASS OR EST PROBLEM

If vehicle will not start and run, check for grounded EST wire to ECM terminal "12."

A 1981 HEI module can cause a Code 42.

1
- **With engine at fast idle, note timing.**
- **Ground "test" terminal.**
- **Note timing; it should change.**

No change

2
- Disconnect 4 terminal EST connector from distributor.
- With engine stopped, connect jumper from "A" to "B" in distributor side of EST connector.
- Start engine, ground "test" terminal and connect test light from Battery + to term. "C" of same conn.

OK

No trouble found

Engine stops

- Check for open EST wire to terminal "E" of HEI module.
- If wire is OK, it is faulty HEI module connection or module.

Engine runs

3
- **With test light still connected, remove jumper between terminals "A" and "B".**

Engine runs

Check distributor wires for:
- **Open or ground to module terminal "B".**
- **Short between module terminals "R" and "E".**
- **If wires are OK, it is faulty HEI module connection or module.**

Engine stops

4
- Check for correct HEI module.
- Check for open wire from EST Connector terminal "A" to ECM terminal "12".
- Check for open or ground wire from EST Connector terminal "C" to ECM terminal "11".

- **If not grounded or open,**
- **Check for good contact between ECM and terms. "11" and "12". If good terminal contact, release ECM.**

- **If grounded or open**

Repair

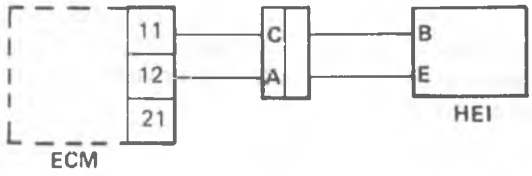


Figure 52 Electronic Spark Timing - CODE 42

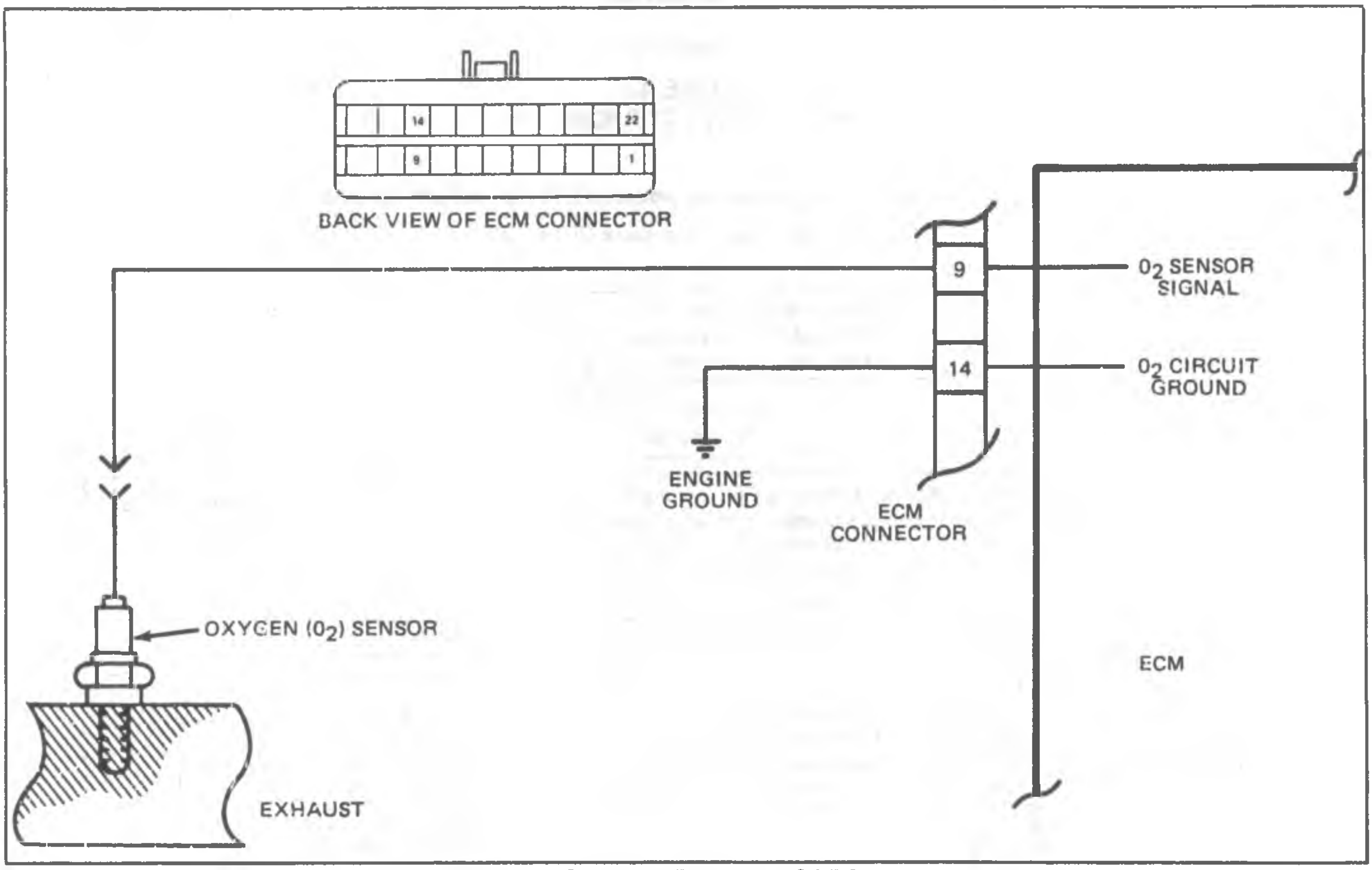


Figure 53 Wiring Diagram - CODE 44

CODE 44, LEAN EXHAUST INDICATION

Code 44 says that the ECM has seen 0_2 sensor voltage under the following conditions:

- Voltage lower than specified
- Closed loop
- Above a specified TPS value
- For a time longer than specified

1. Check to see if the condition is still present. A fixed dwell of under 10° indicates the problem is still present. A fixed dwell under 10° at idle, with dwell varying at 3000 RPM, usually indicates an intake leak. Check these areas prior to replacing the 0_2 sensor.

2. Checks to see if the ECM is able to respond to a rich condition caused by choking the engine. If it does, the problem is a lean engine condition, **not** electrical.

3. If dwell increases to over 50° with heavy choking, the fault is an air leak, since the ECM was able to respond. If air is going to exhaust ports, disconnect the solenoid(s) for the air control valve. If air still goes to the ports, it is a faulty valve.

4. This step puts a rich 0_2 signal (about 1 volt) into Terminal "9" of the ECM. Dwell should increase (lean command).

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CODE 44
LEAN EXHAUST INDICATION

- If M/C solenoid does not click with ignition "ON" and "TEST" term. grounded, and there is no code 23 or 54, check for sticking M/C solenoid.

(1)
- Ground test terminal.
- Connect dwell meter to M/C solenoid – use 6-cylinder scale.
- Run engine at 3000 RPM in closed loop and note dwell.

Between 10-50°

- Check for cause of intermittent lean condition such as faulty carb base gasket leaking vacuum hoses, or leaky intake gasket.
- If no leaks are found, replace oxygen sensor.

Under 10°

(2)
- With engine at part throttle, choke engine

Dwell increases to Over 50°

(3)
- Check for air leak (including air management system to exhaust ports at 3000 RPM and decel valve if used).
- Check for exhaust leak.

No leak

- See Carburetor Calibration Procedure Section 6C.

Leak

- Repair

Dwell did not reach 50°

(4)
- Disconnect oxygen sensor.
- Connect digital multimeter J291125-A or equivalent and set on the 20 volt scale, from bat. + to purple wire to ECM (not oxygen sensor).*
- Note dwell, at part throttle.

Increases

- Check for an open from ECM term. "14" to ground.
- If not open, replace oxygen sensor.

Under 10°

- Check for open from ECM term. "14" to ground and grounded purple wire to ECM term. "9".
- If circuits are OK, it is faulty connection at ECM terms. "9 or 14" or ECM.

* Do Not use an ordinary voltmeter or jumper in place of the digital voltmeter because they have too little resistance. A voltage source of 1.0V to 1.7V (such as a flashlight battery) can be connected with the Positive terminal to the purple wire and the negative terminal to ground as a jumper. If the polarity is reversed, it won't work.

If chart does not resolve problem, see Driveability Symptoms, Section "B".

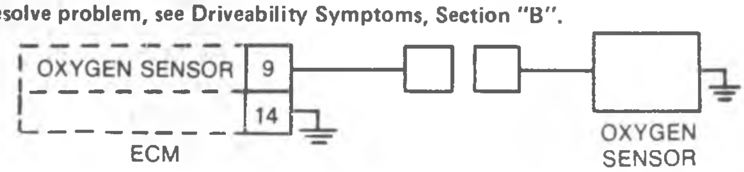

Figure 54 Lean Exhaust Indication - CODE 44

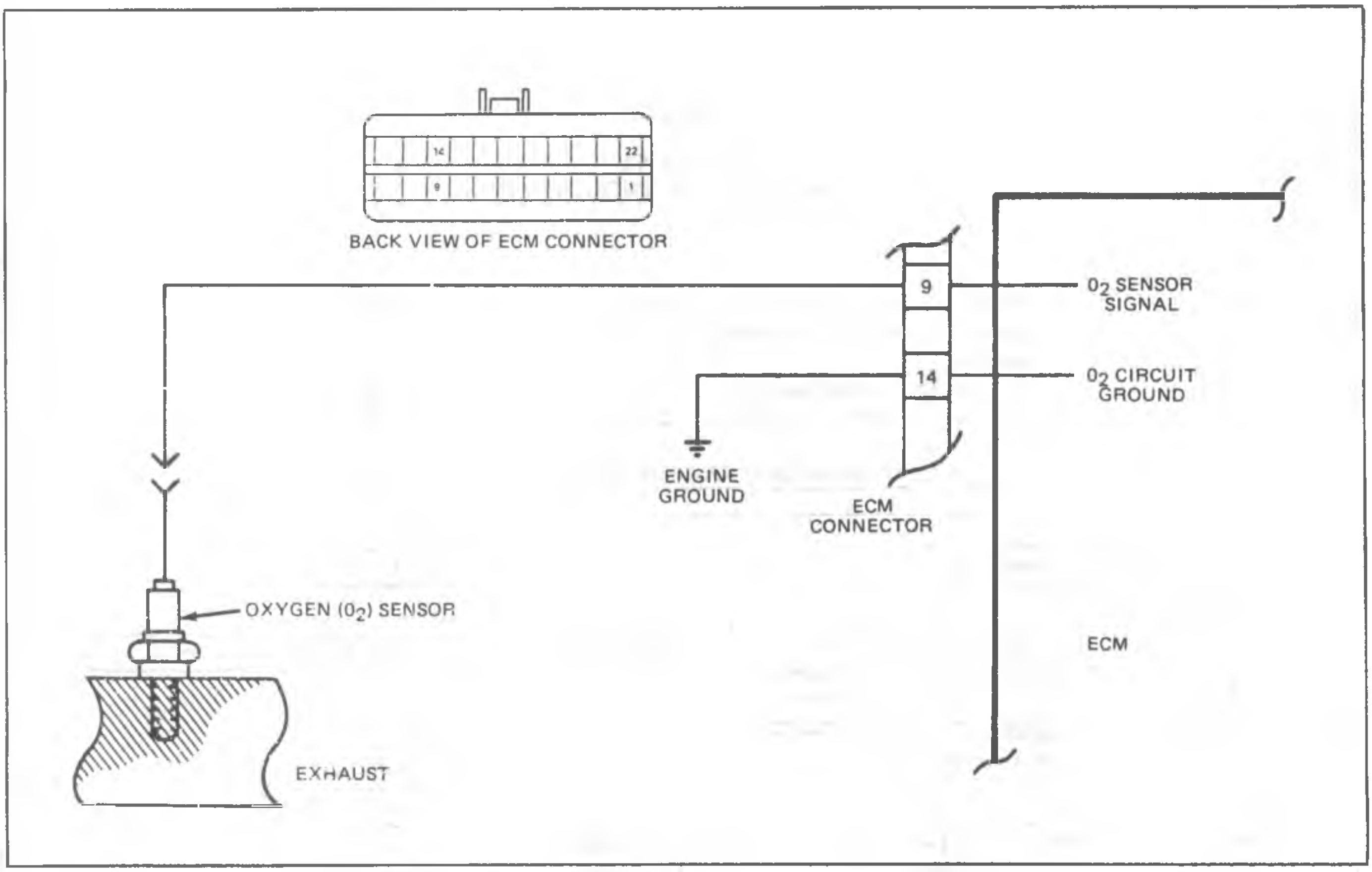

Figure 55 Wiring Diagram - CODE 45

CODE 45, RICH EXHAUST INDICATION

Code 45 says that the ECM has seen:

- High oxygen sensor voltage
- More than specified time (about 2 minutes)
- Above a specified TPS value
- Closed loop

A high voltage can be caused by a rich exhaust or 0_2 sensor contaminated with silicone.

1. Checks to see if fault is still present. A dwell of under 50° indicates engine should be checked for cause of intermittent rich condition: i.e.,
   - Purge or bowl vent valves leaking.
   - Fuel in crankcase.
   - Fuel in evaporative canister.
   - Sticking mixture control solenoid or metering rods.
2. This step causes a lean condition by putting an air leak into the engine to see if ECM can respond. A drop in the dwell indicates ECM and 0_2 sensor are not faulty. Look for source of constant rich condition. See step one examples.
3. This step tests to see if ECM is able to respond to a lean exhaust 0_2 signal (low voltage). If no dwell change with a grounded lead to 0_2 sensor Term. "9", fault is in ECM. It couldn't be an open 0_2 wire because that would set Code 13.
4. This step checks the voltage from the ECM at the 0_2 sensor harness. Normal voltage at this point is the ECM bias voltage for no 0_2 signal which is approximately .45V. If voltage is high, the wire to the ECM could be shorted to B+, or it is a faulty ECM.

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CODE 45
RICH EXHAUST INDICATION

- If M/C solenoid does not click with ign. "ON" and "TEST" term. grounded, and there is no Code 23 or 54, check for sticking M/C solenoid.
- If Code 54 is present, go to Chart 54 first.

(1)
- Start engine ground "Test" terminal.
- Connect dwell meter to M/C Sol.—use 6 cyl. scale.
- Run at 3000 RPM in Park or Neutral and note dwell.

Under 50°
- Trouble is intemittent. System is OK at present. Clear memory.

Over 50°

(2)
- With engine idling, note dwell.
- Remove large vacuum hose (such as PCV source) to cause an air leak (but not enough to stall engine).
- Note dwell, should drop at 20°.

OK
- Check that pink wire is attached to right-hand term. of M/C solenoid connector, as viewed from harness end.
- Check evaporator canister for being loaded with fuel and related valves, such as purge and bowl vent, for leaks which would cause richness, also fuel in crankcase. If OK, see Carburetor On-Vehicle Service-Section 6C.

Not OK

(3)
- Disconnect oxygen sensor.
- Ground harness connector terminal on lead to ECM (not oxygen sensor).

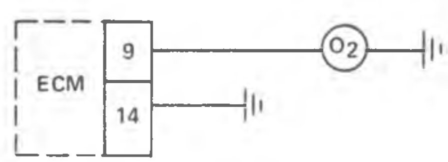
Dwell Drops to Under 10°

(4)
- Ignition "ON," engine stopped.
- Remove ground from oxygen sensor harness connector and check voltage from that term. to ground with digital voltmeter.

Under .55V
- It is faulty oxygen sensor.

Over .55V
- Check wire from ECM term. 9 for short to Bat. +.
- If not shorted, it is faulty ECM.

No Dwell Change
- Replace ECM



If chart does not resolve problem, see Driveability Symptoms, Section "B".

Figure 56 Rich Exhaust Indication - CODE 45

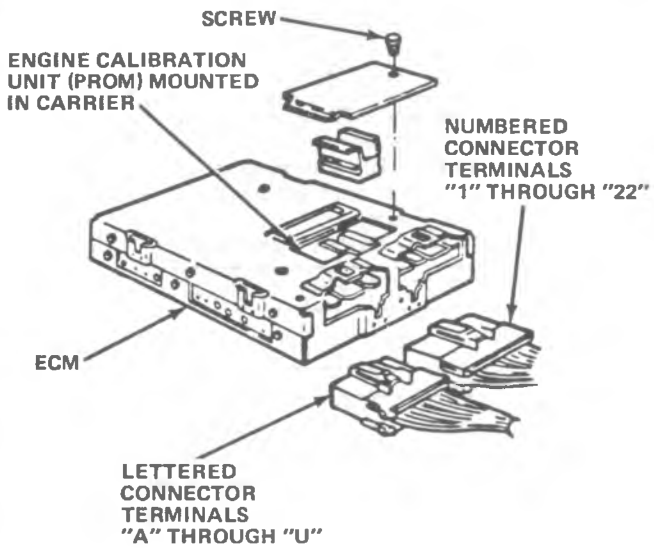
CODE 51, PROM

Code 51 sets if any one of the following occur:

- Faulty PROM unit
- PROM unit improperly installed (may not set a code if installed backwards)
- Some PROM pins not making contact (i.e., bent)

Always check to see that the PROM pins are not bent and are inserted properly into the ECM.

Make certain the PROM is installed in the proper direction as shown in the chart.



- ELECTRONIC CONTROL MODULE (ECM) MOUNTING HARDWARE NOT ILLUSTRATED. HARDWARE CONFIGURATION WILL VARY WITH VEHICLE.

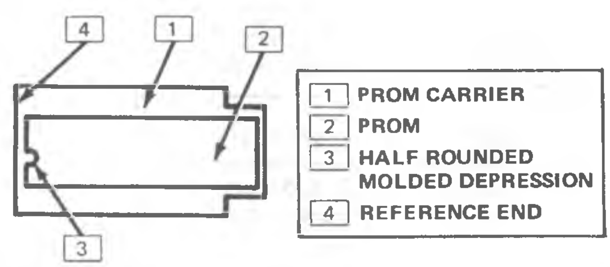
A. 1. Disconnect the two connectors from the ECM. One is numbered and the other is lettered.

2. Remove the ECM mounting hardware.
3. Remove the ECM from the passenger compartment.
4. Remove the one sheet metal screw holding the access cover closed.
5. Remove the access cover.

- REPLACEMENT ELECTRONIC CONTROL MODULE (ECM) IS SUPPLIED WITHOUT AN ENGINE CALIBRATION UNIT (PROM) SO CARE SHOULD BE TAKEN WHEN REMOVING THE PROM FROM A DEFECTIVE ECM AS IT WILL BE REUSED IN THE NEW ECM.

B. 1. Grasp the engine calibration unit (PROM) carrier and gently rock the carrier from side to side while applying a firm upward force and remove the defective PROM.

2. Note the reference end of PROM carrier (squared off symmetrical end) and carefully set aside.



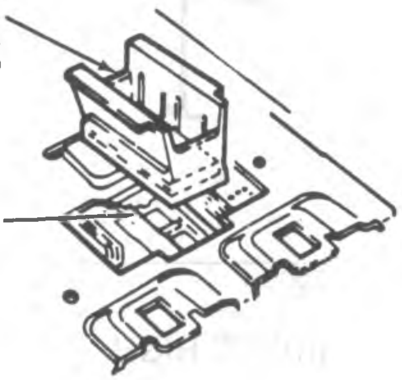
C. 1. Take the new electronic control module (if required) out of its packaging and check the service number to make sure it is the same as the defective ECM.

Figure 57 PROM Replacement Procedure - Code 51

1984 CCC
CODE 51
PROM PROBLEM

Check that all pins are fully inserted in the socket. If OK, replace PROM and recheck, if problem not corrected, replace ECM.

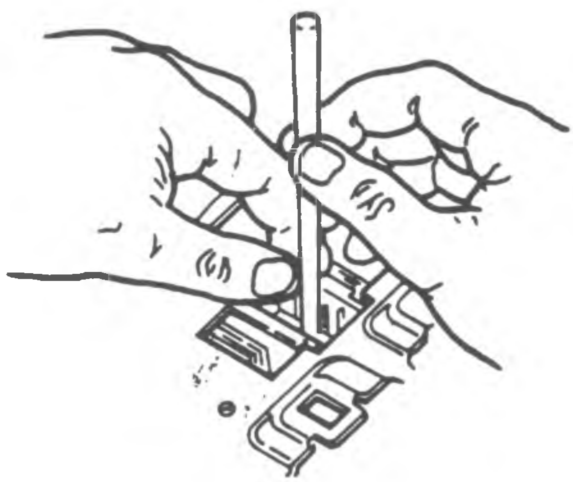
D. 1. Take the PROM mounted in the PROM carrier (which you had previously set aside) and check that the molded half round depression on the PROM is at the squared off symmetrical end of the carrier. Also make sure there is equal space between the ends of the PROM and the carrier.



E. 1. Position the carrier squarely over the PROM socket with the squared off symmetrical end of the carrier aligned with the small notch in the socket at the pin 1 end.

2. Press down firmly on the top of the carrier.

3. While firmly pressing down on the carrier, take a narrow blunt tool and press down on the body of the PROM. Try to seat the PROM in the socket squarely by alternately pressing on either end of it.



F. 1. Replace access cover on new ECM.

2. Reinstall access cover fastening screw.

3. Reinstall new ECM in passenger compartment.

4. Connect the two connectors to the new ECM.

5. Turn ignition on and start engine.

6. Ground diagnostic "test" terminal.

- If trouble code 51 does not occur, the PROM is installed properly.
- If trouble code 51 occurs, the PROM is not fully seated, installed backwards, has bent pin, or is defective.
  - If it is necessary to remove the PROM, follow instructions in step, "A" & "B".
  - If not fully seated, press firmly on PROM.
  - If pins bend, remove PROM, straighten pins and reinstall. If bent pins break or crack during straightening, discard PROM and replace it.
  - If found defective, replace PROM.
  - If installed backwards, REPLACE THE PROM.

ANYTIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH IS TURNED ON, THE PROM IS DESTROYED.

Figure 58 PROM - CODE 51

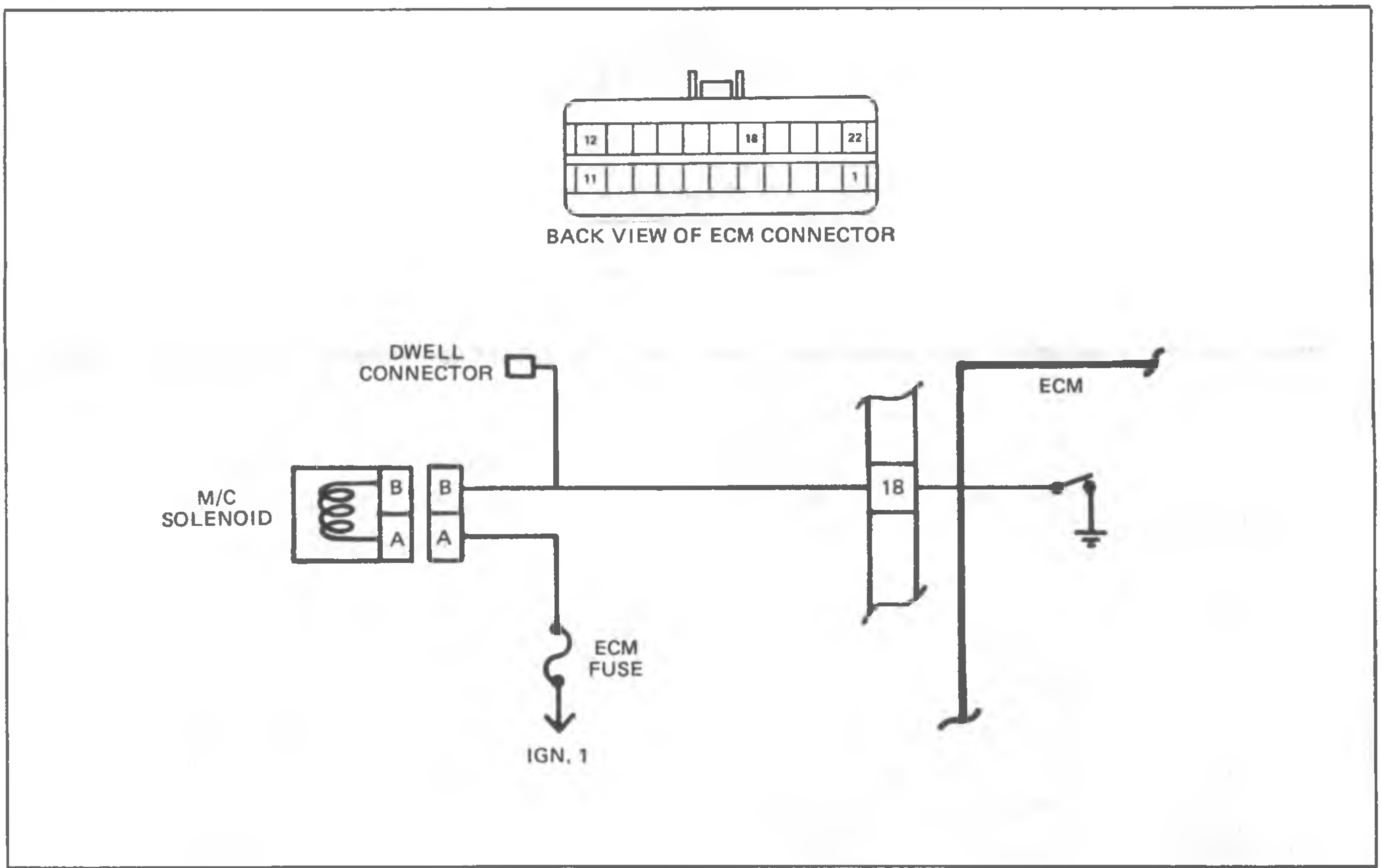


Figure 59 Wiring Diagram - CODE 54

CODE 54, M/C SOLENOID CIRCUIT HIGH

Code 54 will be set if there is constant high voltage at ECM Term. "18".

A shorted solenoid or a wiring short to 12V would cause the solenoid to remain in the full rich position. This would cause excessive fuel consumption, and excessive exhaust odor.

1. Checks the M/C solenoid resistance to determine if the fault is in the solenoid or ECM harness/ECM. A normal solenoid has about 18 to 32 ohms of resistence.
2. Checks to see if reason for high voltage to Term. "18" is a faulty ECM or a short to 12V on that wire. If the test light to ground lights at the M/C solenoid test lead with both ends of harness disconnected, there is a short to 12V in the wire.

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CODE 54

CONSTANT HIGH VOLTAGE FROM M/C SOLENOID-TO-ECM

1 Check M/C Solenoid Resistance

Under 10 OHMS

- Replace solenoid and ECM.

Over 10 OHMS

2
- Ignition "ON", engine stopped.
- Connect test light from ground to dwell lead at M/C solenoid with sol. disconnected.
- Disconnect numbered terminal connector at ECM.

Light Off

- See ECM Replacement Check, Chart C-1

Light On

- Repair short to bat. + in blue wire to ECM term. "18".
- Replace ECM

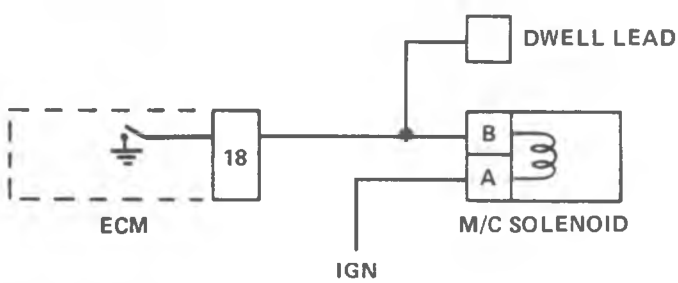

Figure 60 M/C Solenoid Circuit High - CODE 54

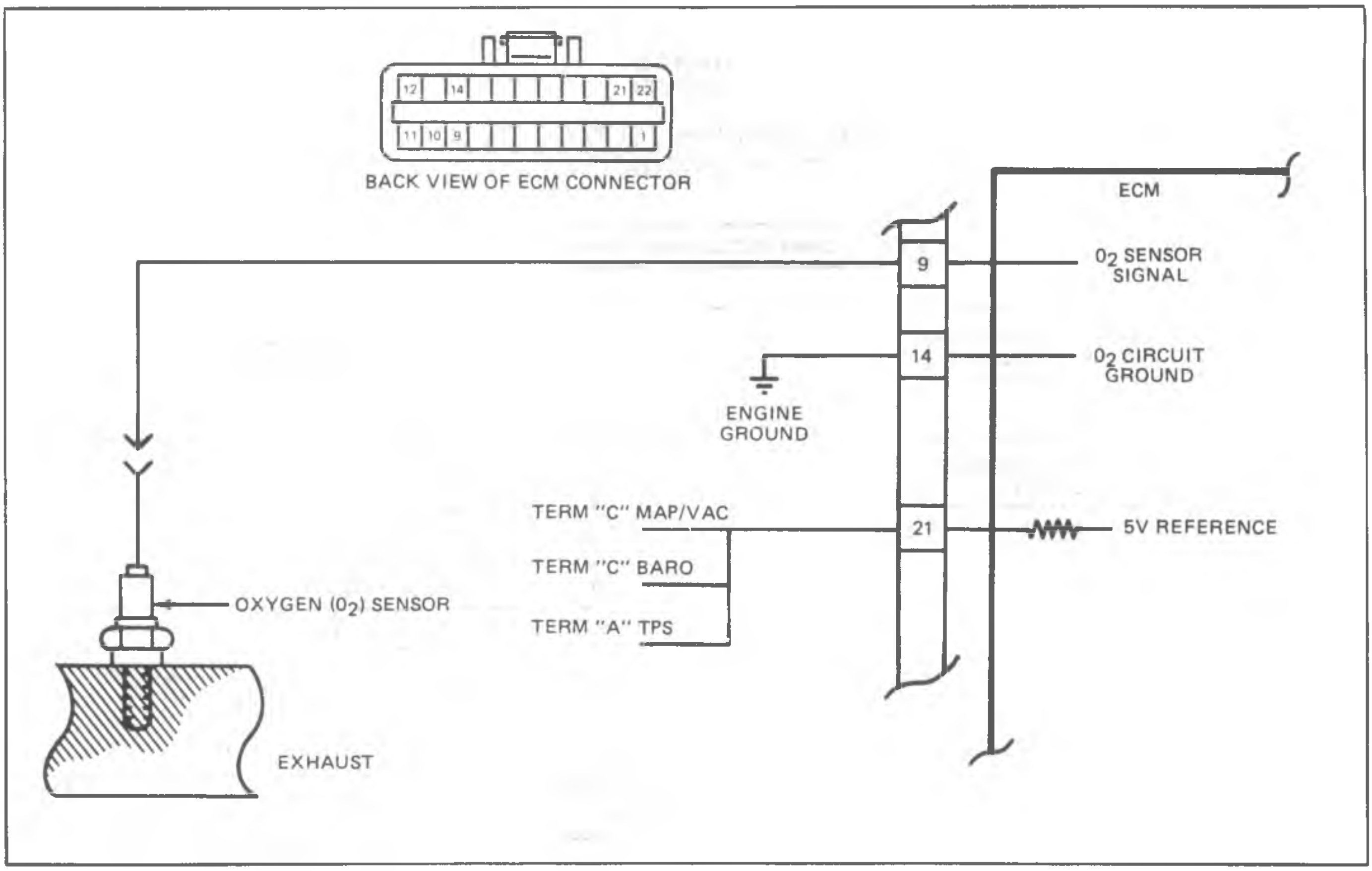

Figure 61 Wiring Diagram - CODE 55 (4.1L Only)

CODE 55 (4.1L ONLY)

Code 55 says that the ECM has seen one of the following:

- Grounded 5V reference (Terminal "21")
- High voltage on the 0_2 sensor circuit
- High voltage in ECM

1. Checks to see if fault is in the 0_2 sensor circuits if the light remains "OFF" or in the 5V ref. circuits if the light came back "ON".
2. This step checks for proper 5V reference.

2A. Determines if the source of high voltage is the ECM, or the wire harness shorted to 12V, by disconnecting the harness from the ECM.

2B. Determines if the source of low voltage is a ground in circuit to Term. "21" of the ECM or the ECM itself.

2C. Determines whether source of fault is in 0_2 sensor circuits or ground in 5V reference circuit. A normal circuit should read under 1 volt (.3-.45 volts).

3. Checks for source of high voltage on 0_2 circuit by separating harness from ECM. If voltage remains high, fault is not in ECM.
4. Voltage under 1 volt is normal. This step checks for intermittent ground in 5V reference circuits.

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TROUBLE CODE 55

High voltage on oxygen sensor circuit or wrong voltage on ECM terminal 21.

Check for corrosion at ECM edgeboard connectors and terms. If present, check for coolant sensor, windshield or heater core leaks. Repair leak, clean connector terms. and replace ECM. Also, check for 4 term. EST harness being too close to electrical signals, such as spark plug wires, distributor housing, generator, etc.

(1)
- Disconnect test terminal.
- Disconnect oxygen sensor and note "check engine" light with engine idling for less than one minute.

Light On

(2)
- Ignition "ON," engine stopped.
- Check voltage from ECM Terminal "21" to "22."

Over 6 Volts

(2A)
- Turn Ign. "OFF."
- Disconnect numbered connector from ECM.
- Ign. "ON," check voltage from connector Term. "21" to "22."

Voltage

Check for short in B+ wire to Term. "21."

No Voltage

Replace ECM

Under 4 Volts

(2B)

Check for ground in circuit to ECM Terminal "21" (includes shorted or grounded TPS or Vacuum Sensors). If not grounded or shorted, replace ECM.

4 to 6 Volts / **Light Off**

(2C)
- Disconnect oxygen sensor.
- Ign. "ON," engine idling.
- Check voltage from connector of purple wire disconnected from oxygen sensor.

Over 1 Volt

(3)
- Turn "OFF" ign., disconnect numbered ECM connector and then with engine idling,
- Check voltage from ECM, harness connector Term. "9" to ground.

Over 1 Volt

Check for short from wire to ECM Term. "9" to Bat.

Under 1 Volt
- Check for open circuit from Term. "14" to ground.
- If not open, replace ECM.

Under 1 Volt

(4)
- Check for intermittent ground in circuits to ECM Terminal "21" (includes TPS and Vacuum Sensors).
- Clear codes and check for reoccurence of Code 55.
- If it reappears, it could be a faulty oxygen sensor.

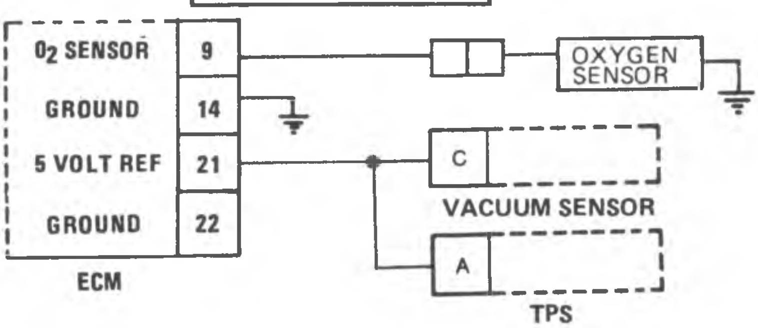


Figure 62 CODE 55 (4.1L Only)

BLANK

SECTION B

DRIVEABILITY SYMPTOMS

BEFORE STARTING

California Only

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The ECM and "CHECK ENGINE" light are operating.
2. There are no trouble codes stored, or only intermittent codes.
3. The fuel control system is operating OK (by performing System Performance Check, Figure 24).

Federal and California

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the engine cranks but does not run, see "No Start - Engine Cranks OK" below.

VISUAL CHECK

Several of the symptom procedures below call for a careful visual check. This check should include:

- Vacuum hoses for splits, kinks, and proper connections, as shown on Vehicle Emission Control Information label.
- Ignition wires for cracking, hardness, proper routing, proper firing order, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.

INTERMITTENT "CHECK ENGINE" LIGHT

CALIFORNIA ONLY

Definition: "CHECK ENGINE" light comes on at times, but does not stay on. There may or may not be a stored code.

DO NOT use the Trouble Code Charts in Section A for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of Trouble Code Charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful visual check as described at start of Section B. Check for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed to increase contact tension.
  - Bad terminal to wire connection. This requires removing the terminal from the connector body to check. See Wiring Harness for details.
- If a visual check does not find the cause of the problem, the vehicle can be driven with a voltmeter connected to the suspected circuit and ground. If the voltage reading changes as the problem occurs, the problem is in that circuit.
- Check for intermittent connection in circuit from:
  - Open Ignition coil ground and arcing at spark plug wires or plugs.
  - "CHECK ENGINE" light wire to ECM for short to ground.
  - Diagnostic "Test" Terminal wire to ECM, for short to ground.
  - ECM terminals A and U to engine ground.
- Loss of trouble code memory. To check, ground the dwell lead for 10 seconds with "Test" terminal left ungrounded. Code 23 should be stored after engine is stopped, and ignition turned to "run" position. If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM terminal 13 to distributor, should be a good ground.
- Check for open diode or resister across A/C compressor clutch, and for other open diodes (see wiring diagrams).

NO START - ENGINE CRANKS OK

Definition: Engine cranks OK, but does not start. May fire a few times.

- Perform "Diagnostic Circuit Check".
- Make sure proper starting procedure is being used. See Owner's Manual.
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness and proper connections at both distributor cap and spark plugs.
- Remove air cleaner:
  - Check carburetor choke valve, vacuum break(s), linkage and unloader operation. See Section 6C. Set to specifications. Choke valve should move smoothly and be closed when cold, and open when hot.
- Check for presence of fuel by noting carburetor accelerator pump operation. Look for gas squirt in carburetor bore while quickly opening throttle lever.
  - If no pump squirt,
    - Check for fuel in tank.
    - Check carburetor fuel inlet filter. Replace if dirty or plugged.
    - Check fuel pump capacity.
    - If fuel pump checks OK, check float needle for sticking in seat, or binding float.

  If there is a pump squirt,
    - Crank engine and check for flooding.
    - If not flooding, see "Ignition System Check", Chart C-4A, page 6E8-123.
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- Visually check distributor cap inside and out for moisture, dust, cracks, burns, and arcing to coil mounting screws.
- Try to turn distributor shaft by hand. Drive pin may be broken.
- After starting engine, perform the "System Performance Check."
- Very cold temperatures:
  - Check that the proper viscosity oil is being used, and crank case oil is not contaminated with gasoline.

HARD START - COLD

Definition: Engine cranks OK, but does not start for a long time. Does eventually run. If the engine starts but immediately dies (as soon as key is released from start position), See "No Start, Engine Cranks OK" symptom.

- Perform "Diagnostic Circuit Check"
- Perform the "System Performance Check"
- Make sure driver is using correct starting procedure. See Owner's Manual.
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Air leaks at carburetor mounting and intake manifold.
  - Ignition wires for cracking, hardness, and proper connections, at both the distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Check the choke valve, throttle and fast idle cam for sticking. Replace any malfunctioning parts. If caused by foreign material and gum, clean with suitable non-oil base solvent. See Section 6C.
- Check choke and vacuum break operation and adjustment. Choke should be closed cold. See Section 6C.
- Check EGR system for sticky operation that could cause valve to stick open.
- Check float level using external float gage. Adjust float to specification if required. See Section 6C.
- Check carburetor fuel inlet filter. Replace if dirty or plugged.
- Check ignition system - see Chart C-4A, page 6E8-123. Check distributor for:
  - Worn shaft
  - Bare and shorted wires
  - Pick-up coil resistance and connections
  - Loose ignition coil ground
  - Moisture in distributor cap.
- Remove spark plugs; check for wet plugs, wear, improper gap, burned electrodes or heavy deposits. Repair or replace as necessary.
- Check ignition timing per Vehicle Emission Control Information label.

HARD START - HOT

Definition: Engine cranks OK, but does not start for a long time. Does eventually run. If the engine starts but immediately dies (as soon as key is released from start position), see "Ignition System Check", chart C-4A, page 6E8-123.

- Perform "Diagnostic Circuit Check."
- Perform the "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks, and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness, and proper connections, at the distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Make sure driver is using correct starting procedure. See Owner's Manual.
- Check choke valve, throttle linkage and fast idle cam for sticking.
- Check choke and vacuum break operation and adjustment. Choke should be open hot. See Section 6C.
- Check for carburetor flooding. See Section 6C.
- Check fuel inlet filter. If plugged replace.
- Check float level using external float gage. Adjust float to proper specification if required. See Section 6C.
- Check EFE valve, if applicable. EFE valve should be open.
- Check EGR System for sticky operation that could cause valve to stick open.
- Check for obvious overheating problems.
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Inoperative electric cooling fan circuit.
- Check ignition system, Section 6D. Check distributor for:
  - Worn shaft.
  - Bare and shorted wires.
  - Intermittent pickup coil or connections, module, ignition coil ground and condenser. Repair or replace as necessary.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
- Check ignition timing. See Vehicle Emission Control Information label.

STALL AFTER START - COLD

Definition: Engine at room or outside temperature, within three minutes after start. (1) Stalls after brief idle; (2) dies as soon as any load is placed on engine (such as A/C turned "ON" or transmission engaged); or (3) Dies on initial driveaway.

If symptom is present cold and hot, go to symptom "Stall After Start - Hot".

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC. See page 6E8-159.
- Check carburetor choke valve, throttle linkage and fast idle cam for sticking.
- With engine running, visually check vacuum break linkage for movement while removing and re-installing vacuum hoses to vacuum breaks. If the linkage does not move and vacuum is at hose, check for binding linkage. If linkage OK, replace vacuum break unit.
- With engine "OFF", check all choke adjustments, including vacuum breaks and TVS if used. See Section 6C.
- Check fast idle speed setting, if applicable, and curb idle speed.
- Check carburetor accelerator pump operation.
- Check EFE valve for proper operation. EFE valve should be closed cold. See Chart C-9A, page 6E8-155, for EFE Valve.
- Check EGR valve for proper operation. See Chart C-7A, page 6E8-143 or Chart C-7C, page 6E8-144.
- Check engine timing. See Vehicle Emission Control Information label.
- Poor or contaminated gasoline. Suggest owner try different brand.

STALL AFTER START - HOT

Definition: The engine starts OK, but (1) dies after brief idle; (2) dies as soon as any load is placed on engine (such as A/C turned "ON" or transmission engaged); (3) dies on initial driveaway.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC.
- Check carburetor choke and vacuum breaks for proper operation. See Section 6C for check procedure.
- Check float level using external float gage. See Section 6C.
- Check carburetor accelerator pump operation.
- Check EGR valve for proper operation - Chart C-7A, page 6E8-143.
- Check for overcharged A/C System.
- Check for high A/C Head pressure - could be caused by inoperative cooling fan.
- Check for obvious overheating problems:
  - Low coolant
  - Loose water pump belt
  - Restricted air flow to radiator or restricted water flow thru radiator.

HESITATION, SAG, STUMBLE

Defnition: Momentary lack of response as the accelerator is pushed down. Can occur at all vehicle speeds. Usually most severe when first trying to make vehicle move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness, and proper connections, at both distributor and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC. See page 6E8-xx.
- Note: Cold engine only - check the following for sticking or faulty operation:
  - Carburetor choke, including vacuum break, throttle linkage and fast idle cam.
  - Check choke TVS if used.
  - Check all choke adjustments, including vacuum breaks.
- Check float level using external float gage. See Section 6C.
- Check carburetor accelerator pump operation:
- Check vacuum hose to vacuum sensor for leaks, restrictions, and proper connections (should be manifold vacuum).
- Check EGR valve operation, Chart C-7A, page 6E8-143.
- Check TPS adjustment, page 6E8-109. Use ALCL tool if available.
- Check canister purge system for proper operation, Chart C-3, page 6E8-119.
- Check for open ignition coil ground and for intermittent ECM ground.
- Check engine timing. See Vehicle Emission Conrol Information label.
- Poor or contaminated gasoline, suggest owner try different brand.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.

- Ignition wires for cracking, hardness, and proper connections, at both distributor cap and spark plugs.
- Wiring for proper connections, pinches and cuts.
- 4-Terminal EST connector and wires near spark plug wires.

- Have driver read explanation of transmission converter clutch and A/C compressor operation in Owner's Manual.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC - See page 6E8-159.
- Check for intermittent open, or short to ground in TCC circuit, term. "N" at ECM, to terminal "B" at transmission.
- Check for proper operation of EGR. See Chart C-7A, page 6E8-143.
- Check carburetor fuel inlet filter, replace if dirty or plugged.
- Check carburetor float level using external float gage.
- Test fuel pump capacity.
- Remove spark plugs, check for cracks, wear, improper gap, burned electrodes or heavy deposits.
- Check condition of distributor cap, rotor and spark plug wires.
- Check for arcing to coil attaching screws in distributor cap.
- Check for intermittent ground connection on integral ignition coil.
- Poor or contaminated gasoline. Suggest owner try different brand.

LACK OF POWER, SLUGGISH OR SPONGY

Definition: Engine delivers less than expected power, little or no increase in speed when accelerator pedal is pushed down part way.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, harness, and proper connections, at both the distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Compare customer's vehicle to similar unit. Make sure the customer's vehicle has an actual problem. Was the customer's old vehicle much more powerful?
- Make sure hot air tube is connected to air cleaner.
- Remove air cleaner and check air filters for dirt, or for being plugged. Replace as necessary.
- Check for proper operation of THERMAC. See page 6E8-159.
- Check for full throttle valve opening in carburetor by depressing accelerator pedal to floor.
- Check for proper operation of carburetor air valve (if equipped). See Section 6C.
- Check carburetor float level using external float gage.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check transmission for proper downshift and TCC operation.
- Check EGR operation. See Chart C-7A, page 6E8-143.
- Check EST operation. If ALCL tool is available, check for excessive retard. Excessive retard may be caused by carbon build-up in cylinders which can be removed with "Top Engine Cleaner."
- Check vacuum sensor output as applicable. see C-1E, page 6E8-91.
- Check EFE Valve.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
- Check for an exhaust system restriction:
  1. With engine at normal operating temperature, connect a vacuum gage to any convenient vacuum port on intake manifold.
  2. Run engine at 1000 RPM and record vacuum reading.
  3. Increase RPM slowly to 2500 RPM. Note vacuum reading at steady 2500 RPM.
  4. If vacuum at steady 2500 RPM is more than 3" lower than at 1000 RPM, exhaust system should be inspected for restrictions, see CHART B-1, page 6E8-83.
- Check engine valve timing and compression.
- Check engine for proper or worn camshaft, see Section 6A.
- Poor or contaminated fuel. Suggest owner try different brand.

BACKFIRE

Definition: Fuel ignites in intake manifold, or exhaust system, making a loud popping noise.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking or hardness proper connection, at both the distributor cap and spark plugs.
  - Chaffed wiring harness by pulleys or metal edges.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC. See page 6E8-159.
- Note: Cold engine only - check the following for sticking or faulty operation:
  - Carburetor choke, including vacuum break and throttle linkage. Check choke TVS if used.
  - Check EFE Valve.
- Check carburetor accelerator pump operation.
- Check vacuum sensor hose for restriction, or for fuel or water in hose.
- Check for proper operation of EGR valve.
- Perform a compression check - look for sticking or leaking valves.
- Check for restricted exhaust system, see CHART B-1, page 6E8-83.
- Check output voltage of ignition coil. See Chart C-4A, page 6E8-123.
- Check operation of decel (gulp) valve if so equipped.
- Check for crossfire between spark plugs, distributor cap, spark plug wires and proper routing of plug wires. Wires for cylinders which fire in sequence on the same side of the engine should not be routed next to each other; i.e., 8 and 4, and 5 and 7. See Section 6D.
- Check for intermittent condition in ignition system.
  - Pick-up coil
  - EST wire (to ECM Terminal 12)
  - Ignition coil ground on integral coil
  - Ignition coil primary connections
- Check for proper valve timing.

MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. Not normally felt above 1500 RPM or 30 MPH (48 km/h). The exhaust has a steady splitting sound at idle or low speed.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks, and proper connections as shown on Vehicle Emission Control Information label.
  - Ignition wires for proper firing order, cracking, hardness and proper connections at both distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Check spark plug wire routing for correct firing order.
- Check ignition system for misfiring spark plug:
  1. Disconnect and plug air cleaner and EGR vacuum hoses.
  2. Remove one spark plug wire at a time using insulated pliers.
  3. If there is no RPM drop on one or more cylinders, or excessive variation in drop, check for spark on the suspected cylinder(s) with ST125 spark cap tool or equivalent.
  4. If no spark when checking with ST125, check spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 OHMS, replace wire(s).
  - If spark with ST125, check spark plug and compression for that/those cylinder(s).
- Visually check distributor cap inside and out for moisture, dust, cracks, burns and check for arcing to coil mounting screws. With engine running, spray cap and plug wires with fine water mist to check for shorts.
- Check for lose of ground, or intermittent ground, in integral ignition coil.
- Check EGR valve for sticking partially open.
- Remove spark plugs and check for cracks, wear, improper gap, burned electrodes, or heavy deposits.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes, repair as necessary. Section 6A.

CUTS OUT

Definition: Pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust may have a steady spitting sound at idle or low speed. May only happen with TCC applied, but this does not indicate a TCC problem.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness and proper connections at both distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
  - Check that 4-Terminal EST connector wires are not near spark plug wires. Four terminal wiring harness should be as far from distributor as possible.
- Check for misfiring at spark plugs:
  1. Disconnect and plug air cleaner and EGR vacuum hoses.
  2. Check spark at all plug wires with ST125.
     - If there is no spark on any cylinder, see "Ignition System Check", Chart C-4A, page 6E8-123
     - No spark at one or more cylinders:
       - Check spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 OHMS, replace wire(s). If wires check OK, or
     - Spark at all cylinders
       - Visually check distributor cap inside and out for moisture, dust, cracks, burns and check for arcing to coil mounting screws. With engine running, spray cap and plug wires with fine water mist to check for shorts.
- Check for poor ground on integral ignition coil.
- Remove spark plugs and check for cracks, wear, improper cap, burned electrodes and heavy deposits.
- Check pickup coil in distributor with ohmmeter, and check for proper connections at module. Pickup coil should be 500-1500 OHMS and not grounded. See Sec. 6D.
  - If pickup coil checks OK,
    - Check for ignition dwell increase from low to high RPM by connecting dwell meter to distributor "TACH" terminal. If dwell doesn't increase, replace ECM.
- Remove rocker covers, check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section 6A.
- Check for exhaust system restriction, see CHART B-1, page 6E8-83.

ROUGH, UNSTABLE OR INCORRECT IDLE; STALLING

Definition: The engine runs unevenly at idle. If bad enough, the vehicle may shake. Also, the idle may vary in RPM (called "hunting"). Either condition may be bad enough to cause stalling. Engine idles at incorrect speed.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness, or proper connections, at both distributor cap and spark plugs.
- Check throttle linkage for sticking or binding.
- Check carburetor for flooding.
- Check float level using external float gage. See Section 6C.
- Check engine idle speed. See Vehicle Emission Control Information label.
- Check EGR System. See Chart C-7A, page 6E8-143. There should be no EGR at idle. Pulse Width Modulated Systems do not work in Park or Neutral.
- If rough idle occurs hot, perform these additional checks:
  - Check PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Check canister purge and bowl vent control system. See CHART C-3.
  - Remove carbon with top engine cleaner. Follow instructions on can.
  - Check for proper spark plug gap.

- Run a cylinder compression check. See Section 6A.

- Check ignition timing. See Vehicle Emission Control Information label.
- Check for exhaust system restriction, see CHART B-1, page 6E8-83.

WON'T IDLE

Definition: Engine starts OK, but dies at idle. Will run if accelerator pedal is held at part throttle.

- Perform "Diagnostic Circuit Check."
- Perform "Systems Performance Check." if possible.
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Air leaks at carburetor mounting and intake manifold.
- Check carburetor float level using external float gage. See Section 6C.
- Check for carburetor flooding.
- Check EGR system, See Chart C-7A, page 6E8-143. Check for a loose valve or sticking EGR plunger. If sticking operation is found, replace valve. There should be no EGR at idle. It may be necessary to remove the valve to check for leaking.
- Check engine idle speed. See Vehicle Emission Control Information label.
- Check carburetor idle adjustment. If unable to adjust, check carburetor idle system. See Section 6C.
- Check spark plug condition and gap.
- Check for exhaust system restrictions, see CHART B-1, page 6E8-83.

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

- Check owner's driving habits.
  - Is A/C on full time (Defroster mode on)?
  - Are tires at correct pressure?
  - Are excessively heavy loads being carried?
  - Is acceleration too much, too often?
  - Suggest driver read "Important Facts on Fuel Economy" in Owner's Manual.
- Perform "Diagnostic Circuit Check."
- Perform the "System Performance Check."
- Check air cleaner damper door operation. See page 6E8-158.
- Check air cleaner element (filter) for dirt or being plugged.
- Check for proper calibration of speedometer.
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness and proper connections.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check EST operation, Chart C-4C, page 6E8-125.
- Check ESC operation, Section 6D.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes or heavy deposits. Repair or replace as necessary.
- Check compression. See Section 6A.
- Check TCC for proper operation. See Chart C-8B, page 6E8-149. Use ALCL tool if available.
- Check for dragging brakes.
- Suggest owner fill fuel tank and recheck fuel economy.
- Check for exhaust system restriction, see CHART B-1, page 6E8-83.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Carburetor choke, throttle linkage and fast idle cam for sticking.
- Check carburetor choke, vacuum break linkage, throttle linkage and fast idle cam for proper adjustment. See Section 6C.
- Check cruise control for proper adjustment. See Section 9.
- Check engine idle speed.
- Check ignition timing. See Vehicle Emission Control Information label.
- Remove carbon with top engine cleaner. Follow instructions on can.
- Check for engine overheating. Use ALCL tool (Calif.) if available. Normal coolant temperature is 85°C-100°C (185°F-215°F).
  - Low coolant:
  - Loose fan belt
  - Restricted air flow
  - Inoperative electric cooling fan, or fan clutch.

DETONATION/SPARK KNOCK

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like popcorn popping.

- Check EGR System for proper operation. See Chart C-7A, page 6E8-143.
- Check vacuum sensor hose for fuel in hose or restrictions, and vacuum sensor for low output and proper connections or vacuum sensor for high output.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check for obvious overheating problems. Use ALCL tool if available. 85°C-100°C (185°F-215°F) is normal.
  - Low coolant:
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Inoperative electric cooling fan circuit.
- Check for air leaks at carburetor mounting and intake manifold.
- Check for poor fuel quality, proper octane rating.
- Check TPS enrichment operation. See Chart C-2F, page 6E8-109.
- Remove carbon with top engine cleaner. Follow instructions on can.
- If excessive carbon in cylinders, check for leaking valve seals.
- Check for incorrect PROM.
- Check for improper operation of transmission (i. e., linkage adjustment) and TCC.
- Check for incorrect basic engine parts, such as cam, heads, pistons, etc.

EXCESSIVE EXHAUST EMISSIONS (ODORS)

Definition: Vehicle fails an emission test. May also have excessive "rotten egg" smell (hydrogen sulfide).

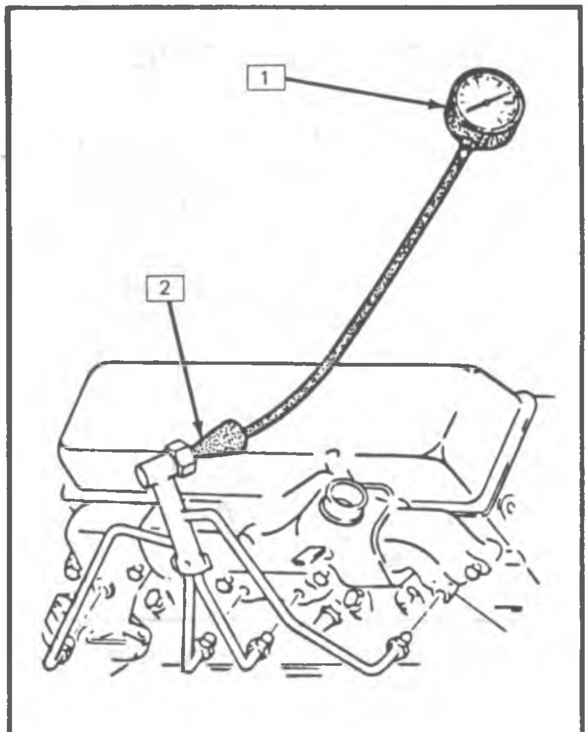
- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check."
- If test shows excessive CO and HC, (also has excessive odors):
  - Check items which cause vehicle to run rich.
    - Make sure engine is at normal operating temperature.
    - Visually check hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
    - Remove air cleaner and check air filter for dirt or being plugged. Replace as necessary.
    - Check for misadjusted idle mixture if plugs are removed.
    - Check choke valve and linkage for sticking of faulty operation.
    - Check choke, vacuum breaks and fast idle adjustments.
    - Check for stuck PCV valve or obstructed hose.
    - Check for lead contamination of catalytic converter. Check for absence of filler neck restrictor.
    - Check operation of air management system. See Chart C-6C, page 6E8-135 or Chart C-6D, page 6E8-133.
    - Check carburetor for flooding.
    - Check float level using external float gage. See Section 6C.
    - Check canister for loading and check purge system for proper operation. See Chart C-3, page 6E8-119.
    - Check for incorrect idle speed.
    - Check for incorrect timing. See Vehicle Emission Control Information label.

    - Check condition of spark plugs, plug wires and distributor cap.
- If test shows excessive NOx:
  - Check items which cause vehicle to run lean, or to run too hot.
    - Check EGR valve for not opening. See Chart C-7A, page 6E8-143.
    - Check for vacuum leaks.
    - Check for inoperative THERMAC. See page 6E8-159.
    - Check coolant system and coolant fan for proper operation.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See Vehicle Emission Control Information label.

CHART B-1
RESTRICTED EXHAUST SYSTEM CHECK
ALL VEHICLES WITH A.I.R. OR PULSAIR

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. The following diagnostic procedure is recommended:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.
4. With the engine at normal operating temperature and running at 2500 rpm, observe the exhaust system backpressure reading on the gauge.
5. If the backpressure exceeds 2¾ psi, a restricted exhaust system is indicated.
6. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
7. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected, and replaced using current recommended procedures.



1 FUEL PUMP PRESSURE GAUGE

2 HOSE AND NIPPLE FROM PROPANE ENRICHMENT DEVICE (J-26911)

ALL VEHICLES WITHOUT AIR OR PULSAIR

1. With engine at normal operating temperature, connect a vacuum gage to any convenient vacuum port on intake manifold.
2. Disconnect EGR solenoid electrical connector or connect EGR valve directly to vacuum source bypassing any switches or solenoids.
3. Run engine at 1000 RPM and record vacuum reading.
4. Increase RPM slowly to 2500 RPM. Note vacuum reading at steady 2500 RPM.
5. If vacuum at 2500 RPM decreases more than 3" from the reading at 1000 RPM, the exhaust system should be inspected for restrictions.
6. Disconnect exhaust pipe from engine and repeat steps 3 & 4. If vacuum still drops more than 3" with exhaust disconnected, check valve timing.

Figure 63 Restricted Exhaust System Check - CHART B-1

SECTION C

COMPONENT SYSTEMS

COMPUTER COMMAND CONTROL

CALIFORNIA ONLY

GENERAL DESCRIPTION

Electronic Control Module (ECM)

The Electronic Control Module (ECM) (Figure 64) is the control center of the Computer Command Control system. It constantly looks at the information from various sensors, and controls the various systems that affect vehicle performance. For service, the ECM has two parts: a Controller (the ECM without the PROM), and a separate calibrator (PROM).

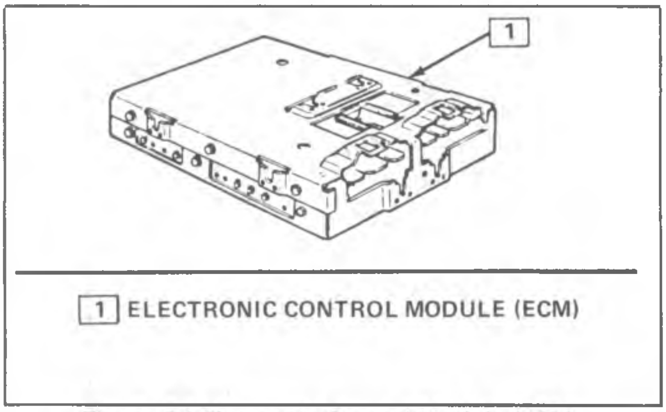


Figure 64 Electronic Control Module (ECM)

To allow one model of ECM to be used for many different vehicles, a device called a Calibrator or PROM (Programmable Read Only Memory) is used (Figure 65). The PROM is located inside the ECM, and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one ECM part number can be used by many vehicle lines, a PROM is very specific and must be used for the right vehicle. For this reason, it is very important to check the latest parts book and Service Bulletin information for the correct part number when replacing a PROM.

An ECM used for service (called a Controller) comes without a PROM. The PROM from the old ECM must be carefully removed and installed in the new ECM (Figures 57 and 58).

The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "CHECK ENGINE" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM.

Remote Lamp Driver

The Remote Lamp Driver (Figure 66) controls the "CHECK ENGINE" Light. It is a small circuit board located in a plastic holder taped to the harness near the ECM. It turns the "CHECK ENGINE" Light

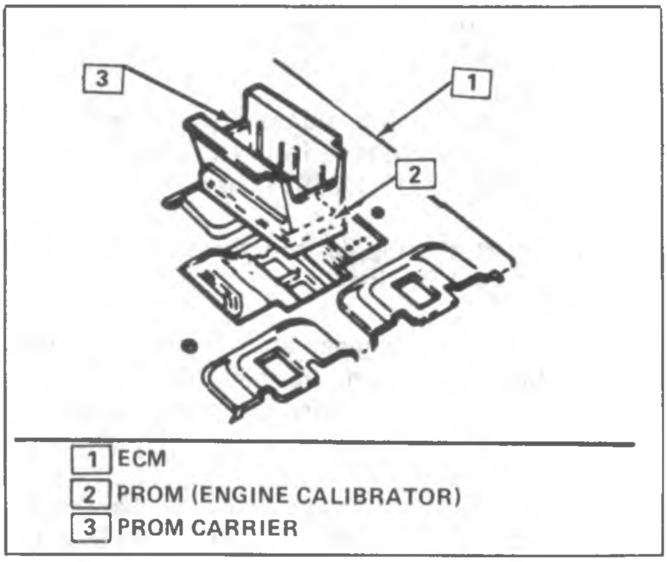


Figure 65 PROM (Engine Calibrator)

"ON" any time the ignition is "ON" and the ECM is not pulling Terminal "C" of the Lamp Driver to ground. This normally occurs with the ignition "ON", engine not running. The main advantage of the Remote Lamp Driver is if the ECM looses power, the "CHECK ENGINE" Light will come "ON" to indicate a fault. For diagnosis, see Charts A-5 or A-6, page 6E8-41 or page 6E8-43.

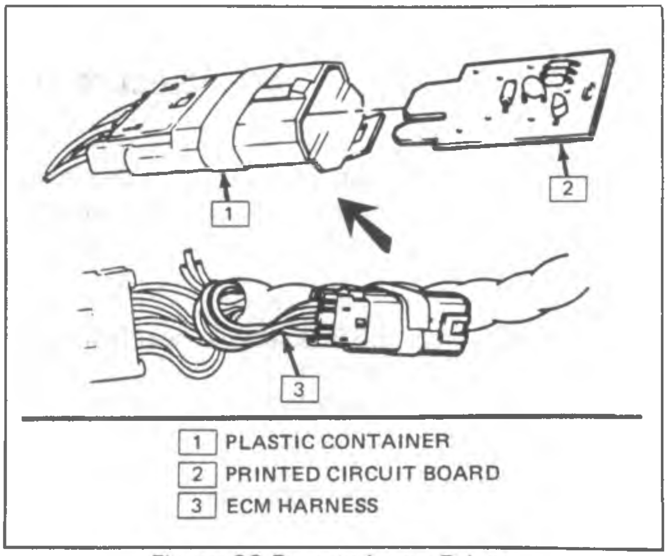


Figure 66 Remote Lamp Driver

INFORMATION SENSORS

Engine Coolant Temperature Sensor

The coolant sensor (Figure 67) is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the coolant sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

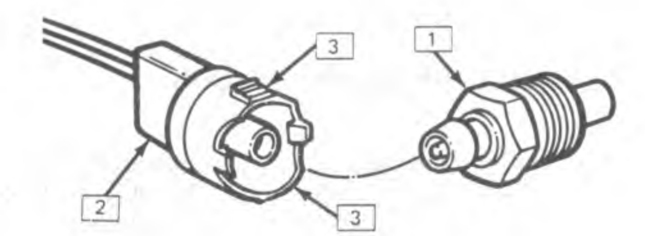


Figure 67 Engine Coolant Temperature Sensor

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

Differential Pressure (Vacuum) Sensor

The Differential Pressure (Vacuum on VAC) sensor located under the hood. It measures engine vacuum directly. It has a high voltage output (near 5 volts) at high vacuum, and a low output at low vacuum. It is called a Differential Pressure sensor since it measures the difference between outside air pressure and manifold vacuum, rather than an absolute pressure.

A failure in the VAC Sensor Circuit should set a Code 34.

Exhaust Oxygen (O_2) Sensor

The exhaust oxygen sensor (Figure 68) is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output. This voltage ranges from approximately .1 volt (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture).

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the carburetor injector (lean mixture-low O_2 voltage-rich command, rich mixture-high O_2 voltage-lean command).

The O_2 sensor, if open, should set a Code 13. A shorted sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45.

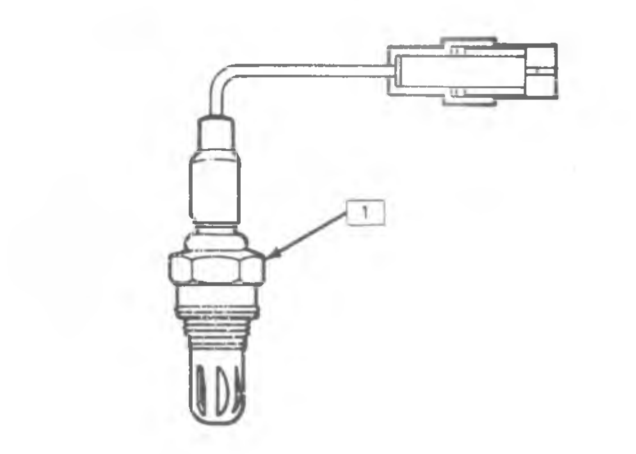


Figure 68 Exhaust Oxygen (O_2) Sensor

Throttle Position Sensor (TPS)

Refer to Fuel Control System for service information on throttle position sensor.

Distributor

The distributor not only controls engine timing, but acts as a sensor to tell the ECM the crankshaft position and engine RPM. See "Electronic Spark Timing." for service information.

Transmission Gear Position

See "Transmission Converter Clutch" for service information that includes transmission gear position.

DIAGNOSIS

Since the ECM can have a failure which may effect only one circuit, following the Diagnostic Procedures in Section "A" can reliably tell when a failure has occurred in the ECM, or released circuits in Computer Command Control.

The PROM will generally set a Code 51 if it fails.

The Engine Coolant Temperature Sensor diagnosis is part of **Code 14 or Code 15** charts.

The Differential Pressure (VAC) Sensor diagnosis is covered in **CODE 34** if a code is set. To check the Differential Pressure (VAC) sensor, use **CHART C-1E.**

The O_2 sensor diagnosis is covered in **CODE 13 and CODE 44 and 45** Charts.

The remote lamp driver diagnosis is covered in **CHART A-5 and A-6.**

The throttle position sensor diagnosis is covered in **CODE 21 and CODE 22** if a code is set. To check TPS enrichment, refer to **CHART C-2F** in the Fuel Control System section.

ON-VEHICLE SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Refer to Figures 6, 10, 14 or 10, for location of electronic control module.

Service of the ECM should normally consist of either replacement of the ECM or a PROM change (Figure 57 and 58).

If the diagnostic procedures call for the ECM to be replaced, the engine calibrator (PROM) and ECM should be checked first to see if they are the correct parts. If they are, remove the PROM from the faulty ECM and install it in the new service ECM. THE SERVICE ECM WILL NOT CONTAIN A PROM. Trouble Code "51" indicates the PROM is installed improperly or has malfunctioned. When Code "51" is obtained, check the PROM installation for bent pins or pins not fully seated in the socket. If the PROM is installed correctly and Code "51" still shows, replace the PROM.

Important

When replacing the production ECM with a new ECM, it is important to transfer the Production Broadcast Code and Production ECM number to the new ECM Label. Please do not record on ECM Cover. This will enable positive identification of ECM Components throughout the service life of the vehicle.

NOTICE: To prevent internal ECM damage, the ignition must be "OFF" when disconnecting or reconnecting power to ECM (for example, battery positive cable, ECM pigtail, ECM fuse, jumper cables, etc.).

See Section 8C for ECM removal and installation procedures. The ECM is located behind the instrument panel on CK series, and under the driver's seat on a G series.

PROM

Figures 57 and 58

Code 51 indicates a faulty PROM, bent pins, or incorrect installation.

NOTICE: It is possible to install a PROM backwards. If the PROM is installed backwards and the ignition key turned to "ON," the PROM circuitry will be destroyed, requiring PROM replacement.

Before replacing a PROM, check it for proper installation and correct alignment of the locator marks. The PROM's pins should be fully inserted in their sockets when the PROM is plugged into the ECM. The CODE 51 chart has PROM replacement instructions, and replacement package also has instructions included.

COOLANT TEMPERATURE SENSOR

NOTICE: Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Control system. See Wire Harness views in Introduction for location of coolant sensor.

Remove or Disconnect

1. Negative battery cable.
2. Drain cooling system below level of sensor.
3. Electrical connector.
4. Carefully back out coolant sensor.

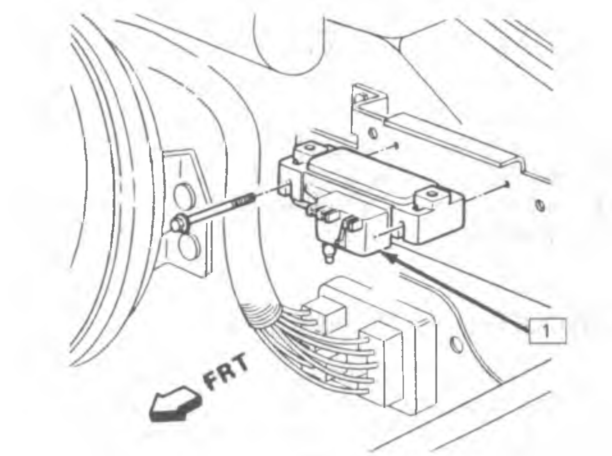
Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Refill coolant system if necessary.
4. Negative battery cable.

DIFFERENTIAL PRESSURE SENSOR

Figure 69

Other than checking for loose hoses and correct vacuum and electrical connections the only service possible is unit replacement if diagnosis shows sensor to be faulty.



1 DIFFRENTIAL PRESSURE SENSOR

Figure 69 Diff. Press. Sensor - Typical

OXYGEN SENSOR

Figure 70

NOTICE: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor.

Take care when handling the oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

Remove or Disconnect

The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F). Excessive force may damage threads in exhaust manifold or exhaust pipe.

1. Negative battery cable.
2. Raise vehicle if necessary for access.
3. Electrical connector.
4. Carefully back out Oxygen Sensor.

Install or Connect

Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will tend to burn away, but the glass beads will remain, making the sensor easier to remove.

New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine, and, if for any reason it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat threads of oxygen sensor with anti-seize compound P/N 5613695 or equivalent if necessary.
2. Sensor, and torque to 41 N·m (30 ft. lbs.).
3. Electrical connector.
4. Lower vehicle if necessary.
5. Negative battery cable.

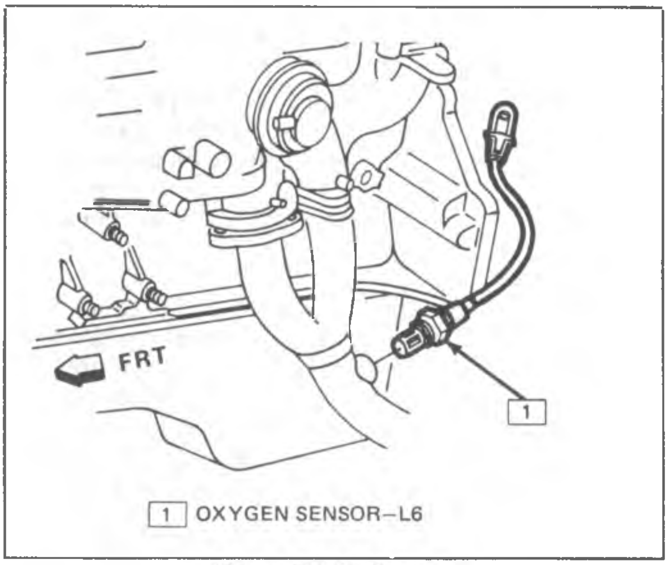


Figure 70 O_2 Sensor

REMOTE LAMP DRIVER

Figure 66

Replace remote lamp driver only if diagnosis has determined that it has failed. The driver is inside a container, taped to the harness near the ECM. Open container and replace remote lamp driver as required.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sealer, Exhaust Oxygen Sender (Anti-Seize Compound)	3.671
Sensor, Coolant Temp.	3.760
Sensor, Exhaust Oxygen	3.670
Sensor, Manif. Diff. Press.	3.670

CHART C-1, ECM REPLACEMENT CHECK

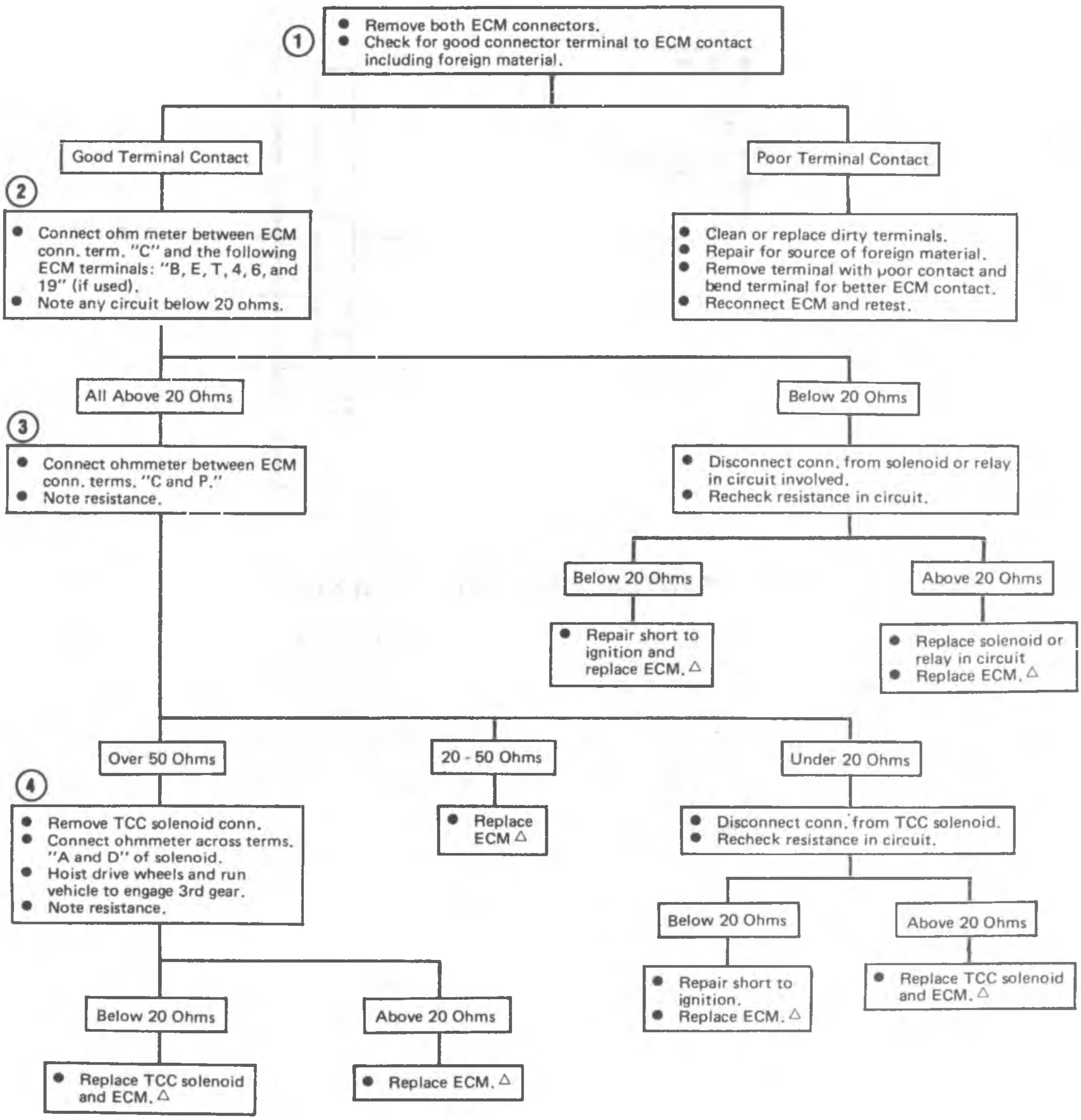
Prior to replacing an ECM, the circuit involved must be tested for: 1) poor connector terminal to ECM contact; 2) direct battery voltage on an ECM ground circuit from a short to B+; or 3) shorted solenoid or relay. If a short is found, the circuit must be repaired prior to replacing the ECM to prevent repeat ECM failures.

1. Checks for good terminal contact due to weak or dirty terminals. Remove terminal to inspect. Replace if broken or dirty. If coolant is present, replace coolant sensor and connector. Also, replace ECM connector terminal and blow coolant out of harness. Clean connector with alcohol or spray contact cleaner and replace ECM.
2. Checks for a short to ignition or shorted solenoid or relay. All terminals must be tested since several are connected internally in the ECM. A short in one circuit may cause another circuit in the ECM to be inoperative that does not have an external fault, but was the cause of "driver's complaint." Any circuit testing below 20 ohms is shorted to ignition, or shorted across the relay or solenoid.
3. Checks for shorted TCC solenoid. Some transmissions have a normally open 3rd gear switch in series with the solenoid. The ohmmeter will read infinite resistance (open circuit) in these cases. If the reading is less than 20 ohms, a short to ignition or faulty solenoid exists. A normal solenoid will read between 20 - 50 ohms.
4. Checks for shorted TCC circuit in units with a 3rd gear switch. The vehicle must be in 3rd gear to close the switch to obtain a resistance reading. A normal solenoid will read between 20 - 50 ohms.

1984 CCC
CHART C-1

ECM REPLACEMENT CHECK

- Always check "PROM" for the correct application and installation before replacing an "ECM".



△If replacing an original equipment ECM, transfer the original broadcast code to the label on the replacement ECM.

Figure 71 ECM Replacement Check, CHART C-1

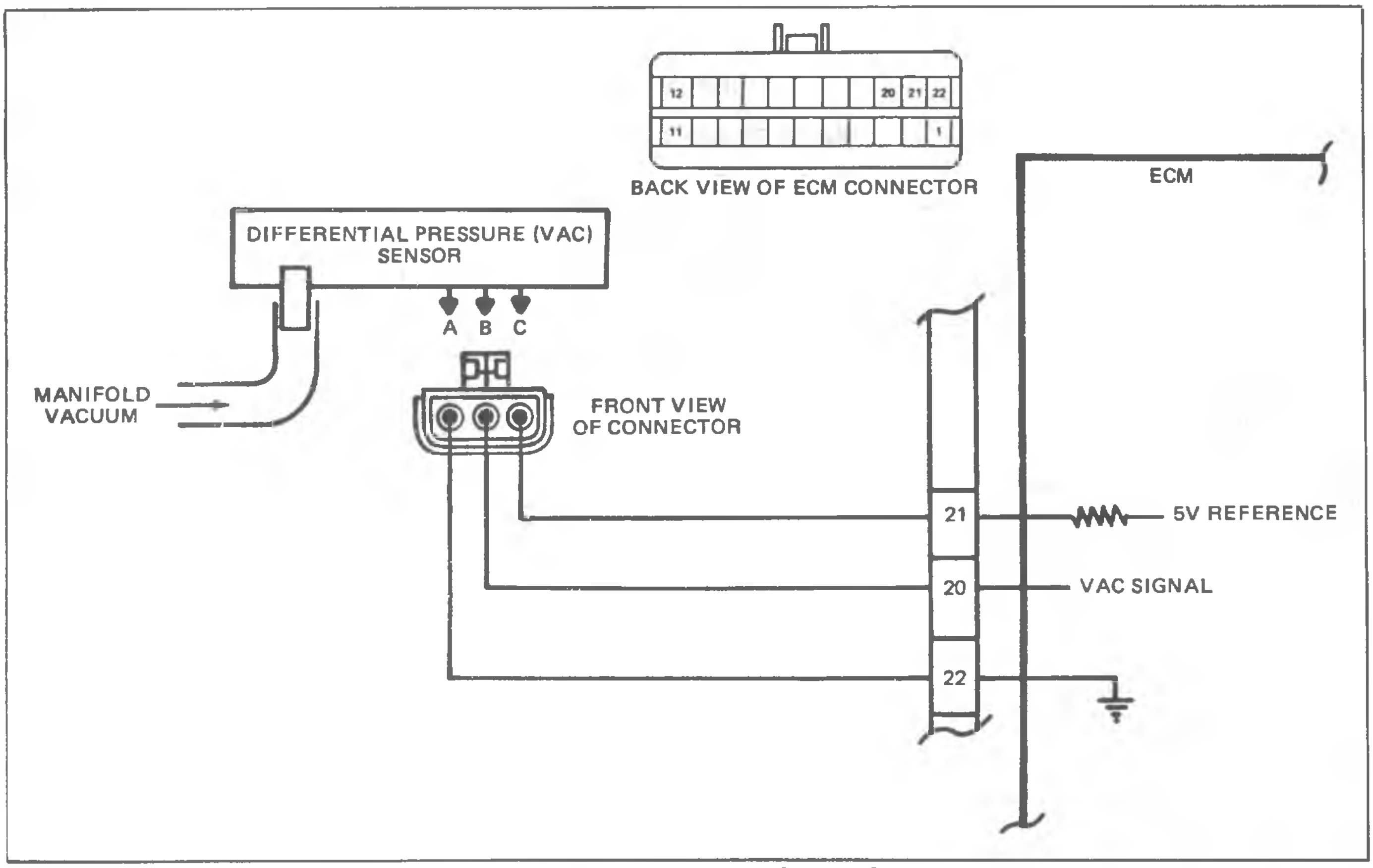


Figure 72 Wiring Diagram - CHART C-1E

CHART C-1E, DIFFERENTIAL PRESSURE (VAC) SENSOR CHECK

1. This checks the output of the sensor. The VAC sensor is a differential pressure sensor that measures the difference in pressure between atmosphere and manifold. The voltage output is opposite the MAP sensor. It supplies high voltage at high vacuum. Normal reading with engine stopped, key "ON" is less than 1 volt, while at idle should be above 3 volts. High voltage increases spark advance, while low voltage reduces spark advance.

2. This checks the rate of change of the output with vacuum. Again, the normal reading would be about in the middle of the range indicated. Also, the voltage should change as soon as the vacuum changes. If it doesn't, it could result in detonation or a sag on acceleration. It could also be caused by poor fuel or a restriction in the hose to the sensor.

1984 CCC

CHART NO. C-1E
DIFFERENTIAL PRESSURE SENSOR (VAC) CHECK

If vacuum is applied to VAC sensor with key "ON" engine not running, a false Code 41 could be set.

(1)
- Ignition "ON", engine stopped.
- Check voltage from sensor terminal "B" to "A".*
- It should be .50-.64 volts.

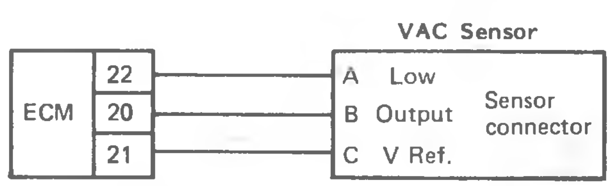
Not OK
- Replace sensor.

OK

(2)
- Apply 10" of vacuum and note voltage.
- It should be 2.25 to 2.95 volts.**

Not OK
- Replace sensor.
- Clear long term memory.

OK
- No trouble found.
- Clear long term memory.



High Vacuum = High Output

* This requires use of three jumpers between the sensor and the connector. They can be made using terminals 12014836 and 12014837.

** If voltage does not immediately follow vacuum change, sensor is faulty.

Figure 73 Differential Pressure (VAC) Sensor Check - CHART C-1E

FUEL CONTROL SYSTEM

GENERAL DESCRIPTION

The basic function of the fuel control system is to control fuel delivery to the engine.

The Electronic Control Module (ECM) controls the fuel delivery from information received regarding:

- Coolant temperature
- Crankshaft RPM
- Amount of oxygen in the exhaust stream
- Throttle position
- Intake Manifold Pressure

The ECM controls fuel delivery to the carburetor through an electrically operated Mixture Control (M/C) solenoid (Figures 74 and 75) mounted in the float bowl. A plunger in the solenoid is pulsed by the ECM to allow more or less fuel to mix with the air entering the carburetor. When the solenoid is energized, there is less fuel flow providing a leaner fuel mixture. When the solenoid is de-energized, there is more fuel flow providing a richer fuel mixture. The solenoid is turned on and off at a rate of 10 times per second.

The M/C solenoid "on" time verse "off" time is varied to change the mixture. This is called ECM command.

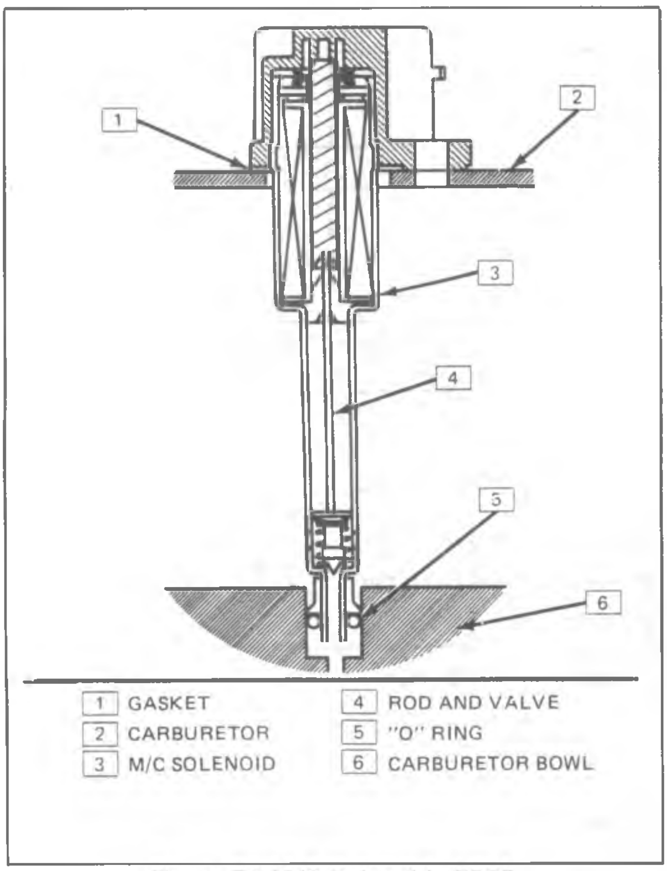


Figure 74 M/C Solenoid - E2SE

OXYGEN SENSOR

An exhaust oxygen (0_2) sensor, mounted in the exhaust system, monitors the oxygen content of the exhaust gas stream.

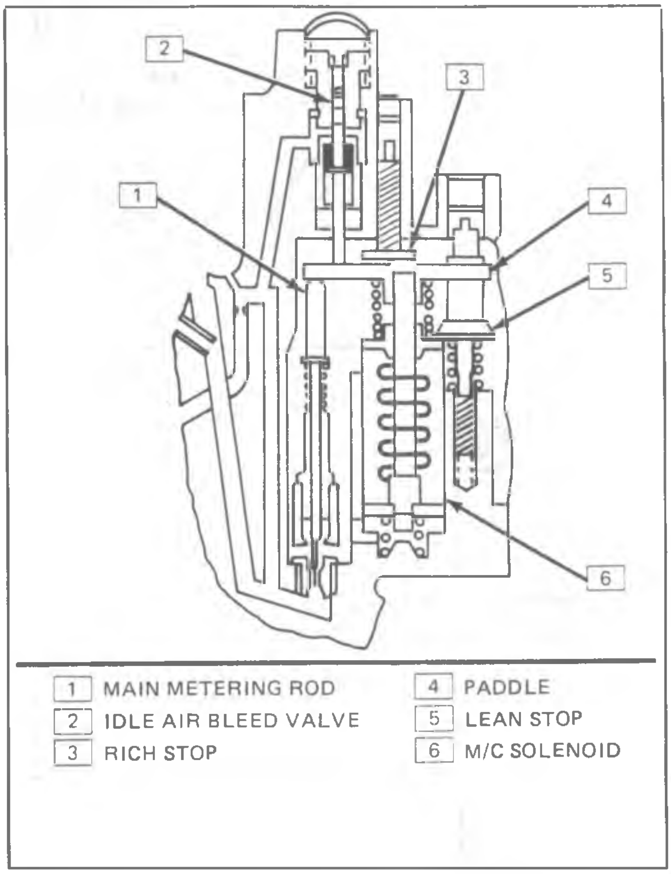


Figure 75 M/C Solenoid - E4ME

The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output. This voltage ranges from approximately. 0.100 volts (high 0_2 - lean mixture) to 0.900 volts (low 0_2 - rich mixture).

By monitoring the voltage output of the 0_2 sensor, the ECM will know what fuel mixture command to give to the solenoid (lean mixture-low voltage-rich command, rich mixture-high voltage-lean command).

ECM COMMAND

The ECM command determines the fuel control delivery and can be monitored with a dwell meter set on the 6-cylinder scale. It is connected to the M/C Solenoid dwell connector (green) located in the harness near the solenoid (Figure 76).

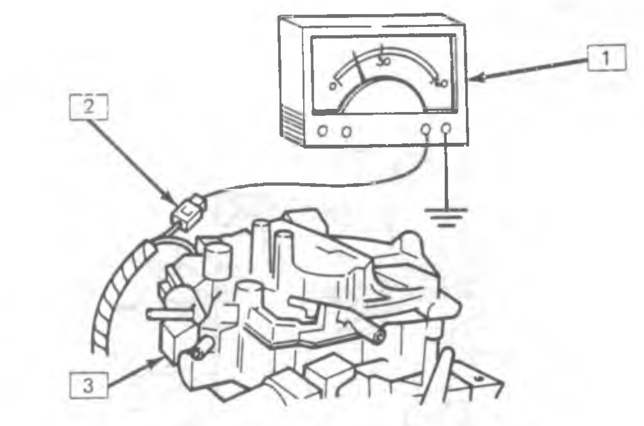
CLOSED LOOP

(Figure 77)

On a normal operating engine the dwell meter needle, at both idle and part throttle, will be between 10° and 50° dwell and varying. This is called "CLOSED LOOP" operation. This means that the oxygen sensor affects control of the fuel delivery.

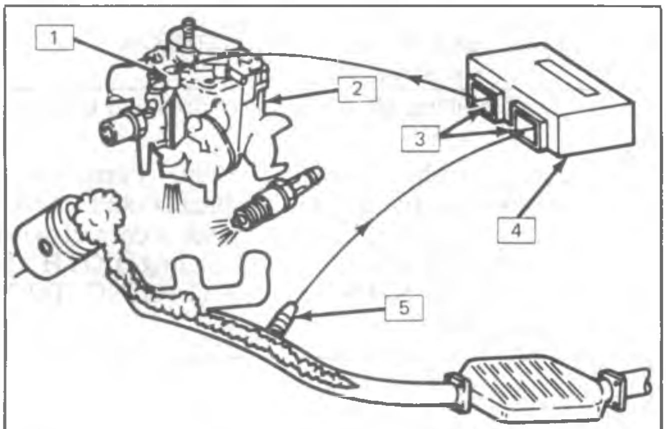
OPEN LOOP

The oxygen sensor does not affect fuel control in "OPEN LOOP" operation and the dwell reading will



1 DWELL METER (SET ON 6-CYL SCALE)
2 M/C SOLENOID DWELL CONNECTOR
3 CARBURETOR

Figure 76 Dwell Meter



1	M/C SOLENOID	4	ECM
2	CARBURETOR	5	OXYGEN SENSOR
3	VARIOUS INPUTS		

Figure 77 Closed Loop Cycle

not vary. This condition is when the engine is cold, the oxygen sensor is below 360°C (600°F) or at wide-open throttle (WOT).

The fuel control system includes the following:

- An Electronic Control Module (ECM) - the control center.
- Mixture Control (M/C) solenoid - pulses to meter more or less fuel.
- Oxygen (0_2) sensor - sends voltage signal to ECM depending on the amount of oxygen in exhaust stream.
- Throttle Position Sensor - sends voltage signal to ECM affecting fuel delivery.
- ECM Command - visual view of fuel delivery using dwell meter.

THROTTLE POSITION SENSOR

The throttle position sensor (TPS) changes position as the throttle valve angle changes. The TPS is a potentimeter, mounted in the caburetor, with one end connected to 5 volts from the ECM and the other end to ground. A third wire is connected to the ECM to measure voltage from the TPS. At a closed throttle position, the output of the TPS is approximately .5 volts. As the throttle plate opens, the output voltage increases so that at wide-open throttle the output is approximately 5 volts.

By monitoring the output voltage from the TPS, the ECM can affect fuel delivery based on throttle valve angle.

If the TPS is out of adjustment, idle quality may be affected and performance may be poor. If the TPS circuit is open, the ECM will think the vehicle is at wide-open throttle, and cause the ECM command to go full rich, and set a Trouble Code 21.

CARBURETOR CALIBRATION

The Computer Command Control provides correct air/fuel mixture of the carburetor during all ranges of engine operation.

The System Performance Check is used to check the operation of the mixture control solenoid, the main metering circuit in the carburetor, and the operation of the Computer Command Control by use of a dwell meter.

The dwell reading is used to determine carburetor calibration and is sensitive to changes in fuel mixture such as heat, air leaks, lean and rich condition. When idling, a normal dwell will increase and decrease over a narrow 5° dwell range. However, it may occasionally vary as much as a 10° to 15° dwell range momentarily because of a temperary mixture change. A dwell reading is the average of the most consistant variation within the 10° to 50° scale of the meter.

The carburetor has been calibrated at the factory and should not normally need adjustment in the field. If during diagnosis, the System Performance Check or trouble code diagnosis indicates that carburetor calibration is needed, the carburetor can be calibrated using the procedures in On-Vehicle Service.

DIAGNOSIS

Refer to **SECTION A** for diagnosis of fuel control system with Computer Command Control. Also refer to **SECTION B** for driveability symptoms related fuel control system.

E4ME CARBURETOR

CALIFORNIA ONLY

ON-VEHICLE SERVICE

E4ME CAREBURETOR CALIBRATION

The System Performance Check must be performed before using the following calibration procedure.

Check and adjust float level if necessary (Figure 78) if not to specifications. Refer to E4ME Carburetor Sections for float level specifications.

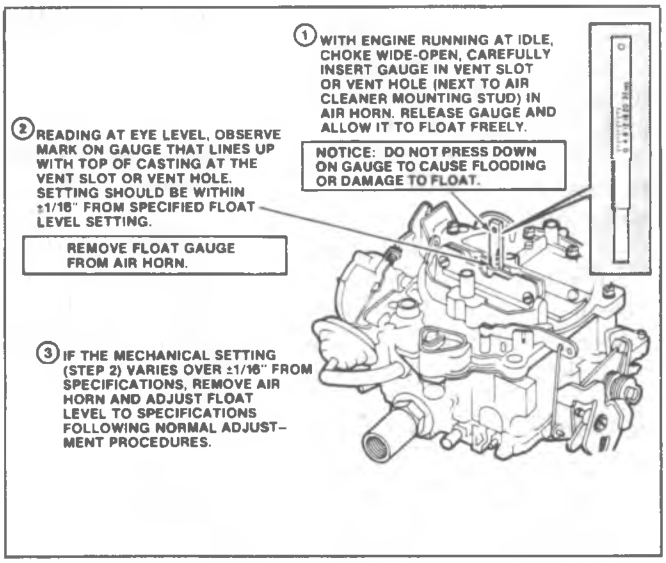


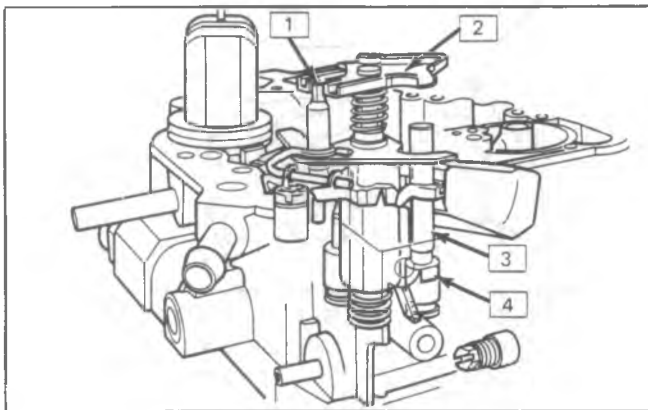
Figure 78 External Float Gage Check

If referred to this section because idle dwell is bad, go to "Idle Mixture and Speed Adjustment".

If dwell is off at 3000 RPM, go to "Mixture Control (M/C) Solenoid Plunge Adjustments".

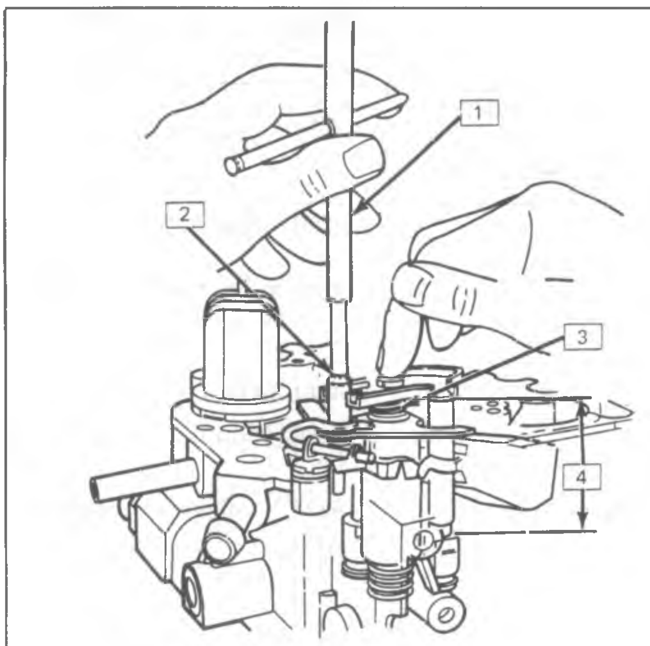
Mixture Control Solenoid Plunger Adjustments

1. Remove air horn, mixture control solenoid plunger, air horn gasket and plastic filler block, using normal service procedures.
2. Check carburetor for cause of incorrect mixture:
   a. M/C solenoid bore or plunger worn or sticking.
   b. Metering rods for:
      - Incorrect part number
      - Sticking
      - Rods or springs not installed properly
   c. Foreign material in jets.
3. Remove throttle side metering rod. Install mixture control solenoid gaging tool, J-33815-1, BT-8253-A, or equivalent, over the throttle side metering jet rod guide, and temporarily reinstall the solenoid plunger into the solenoid body. (Figure 79)
4. Holding the solenoid plunger in the DOWN position, use Tool J-28696-10, BT-7928, or equivalent, to turn lean mixture (solenoid) screw counterclockwise until the plunger breaks contact with the gaging tool. Turn slowly clockwise until the plunger breaks contact with the gaging tool. The adjustment is correct when the solenoid plunger is contacting BOTH the SOLENOID STOP and the GAGING TOOL (Figure 80).



1 LEAN MIXTURE (SOLENOID)SCREW
2 SOLENOID PLUNGER
3 GAGING TOOL J33815-1/BT8253-A
4 METERING JET

Figure 79 Installing Mixture Control Solenoid Gaging Tool



1 TOOL J28696-10/BT7928
2 LEAN MIXTURE SCREW
3 PLUNGER CONTACTING SOLENOID STOP AND GAGING TOOL
4 GAGING TOOL J33815-1/BT8253-A (1.304" HIGH)

Figure 80 Adjusting Lean Mixture (Solenoid) Screw

If the total difference in adjustment required less than 3/4 turn of the lean mixture (solenoid) screw, the original setting was within the manufacturer's specifications.

5. Remove solenoid plunger and gaging tool, and reinstall metering rod and plastic filler block.
6. Invert air horn, and remove rich mixture stop screw from bottom side of air horn, using Tool J-28696-4, BT7967A or equivalent (Figure 81).

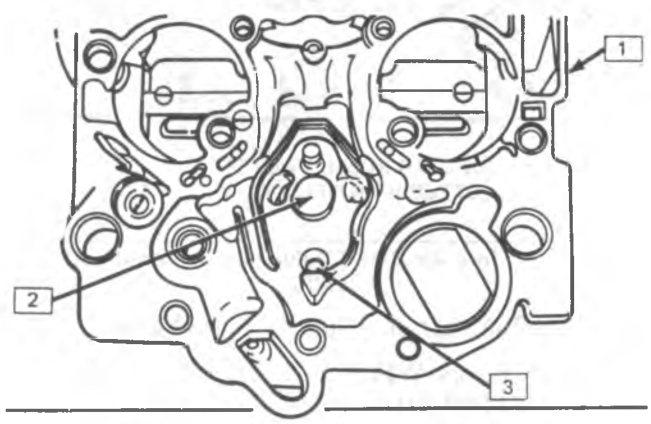


Figure 81 Removing Rich Mixture Stop Screw

7. Remove lean mixture screw plug and the rich mixture stop screw plug from air horn, using a suitable sized punch. (Figure 82)

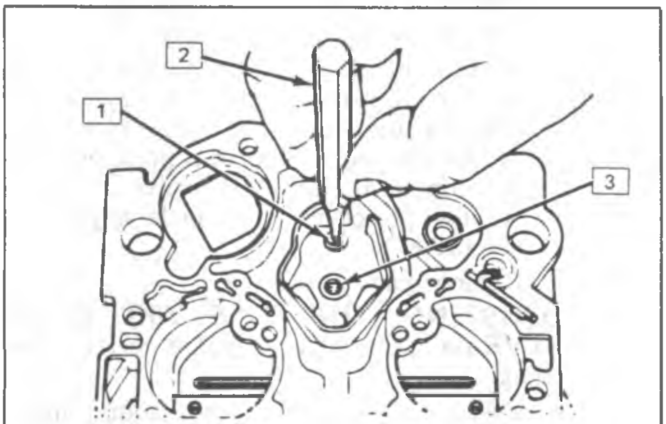


Figure 82 Removing Lean and Rich Mixture Stop Screw Plugs

8. Reinstall rich mixture stop screw in air horn and bottom lightly, then back screw out 1/4 turn.
9. Reinstall air horn gasket, mixture control solenoid plunger and air horn to carburetor.
10. Adjust M/C Solenoid Plunger travel.
    a. Insert float gage down "D" shaped vent hole. Press down on gage and release, observing that the gage moves freely and does not bind. With gage released, (plunger UP position), read at eye level and record the reading of the gage mark (in inches) that lines up with the top of air horn casting, (upper edge).
    b. Lightly press down on gage until bottomed, (plunger DOWN position). Read and record (in inches) the reading of the gage mark that lines up with top of air horn casting.
    c. Subtract gage UP position (Step 1) from gage DOWN position (Step 2), and record difference. This difference is total plunger travel.

    Insert external float gage in vent hole and, with Tool J-28696-10, BT-7928, or equivalent, adjust rich mixture stop screw to obtain 4/32" total plunger travel. (Figure 83)

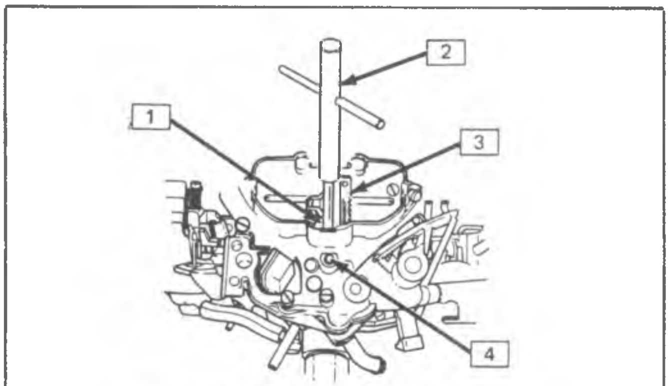


Figure 83 Adjusting Rich Mixture Stop Screw

11. With solenoid plunger travel correctly set, install plugs (supplied in service kits) in the air horn, as follows:
    a. Install plug, hollow end down, into the access hole to lean mixture (solenoid) screw, and use suitably sized punch to drive plug into the air horn until the top of plug is even with the lower. Plug must be installed to retain the screw setting and to prevent fuel vapor loss.
    b. Install plug, with hollow end down, over the rich mixture stop screw access hole, and drive plug into place so that the top of the plug is 1/16" below the surface of the air horn casting . (Figure 84)

    Plug must be installed to retain screw setting.
12. Check M/C solenoid dwell at 3000 RPM.
    a. Disconnect vacuum line to canister purge valve and plug it.
    b. Ground diagnostic "test" terminal.
    c. Run engine until it is at normal operating temperature (upper radiator hose hot) and in closed loop.

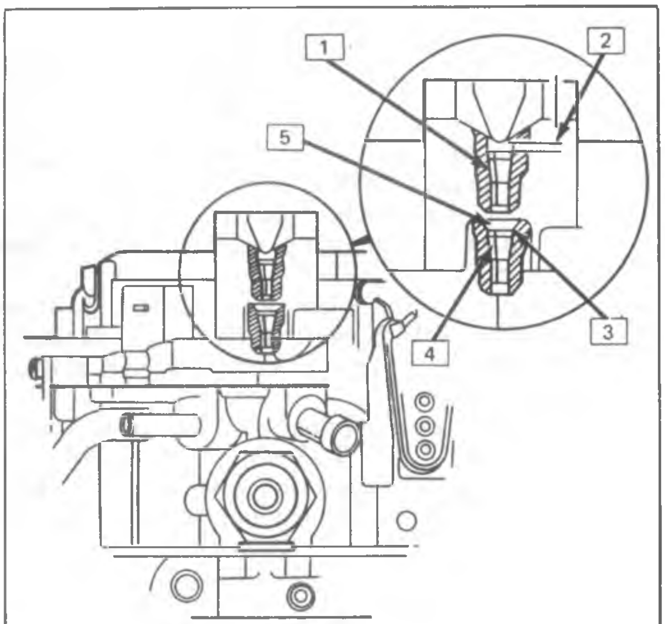


Figure 84 Installing Lean and Rich Mixture Stop Screw Plugs

d. Check M/C dwell at 3000 RPM.
   1) If within 10°-50°, calibration is complete.
   2) If higher than 50°, check carburetor for cause of rich condition.
   3) If below 10°, look for cause of lean engine condition such as vacuum leaks. If none found, check for cause of lean carburetor.

Idle Mixture and Speed Adjustment

A cover is in place over the idle air bleed valve, and the access holes to the idle mixture needles are sealed with hardened plugs, to seal the factory settings, during original equipment production. These items are NOT to be removed unless required for cleaning, part replacement, improper dwell readings, or if the System Performance Check indicates the carburetor is the cause of the trouble.

1. Idle air bleed cover.
   a. Pry off and discard idle air bleed cover.
   A missing cover indicates that the idle air bleed valve setting has been changed from its original factory setting.
   b. With cover removed, look for presence (or absence) of a letter identification on top of idle air bleed valve (Figure 85).
   c. If NO identifying letter appears on top of the valve, begin **PROCEDURE A** , below. If the valve IS identified with a letter, begin **PROCEDURE B** .

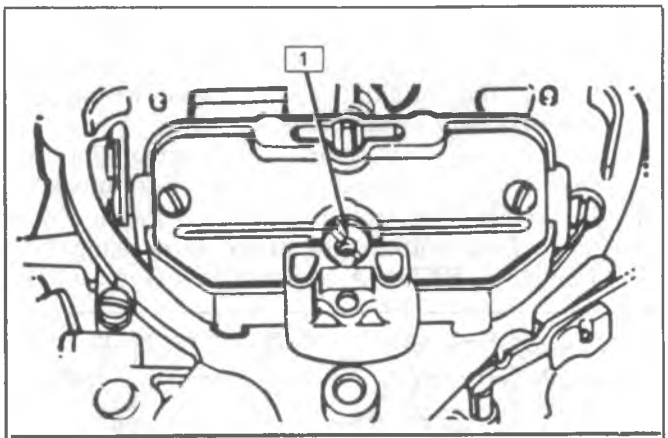
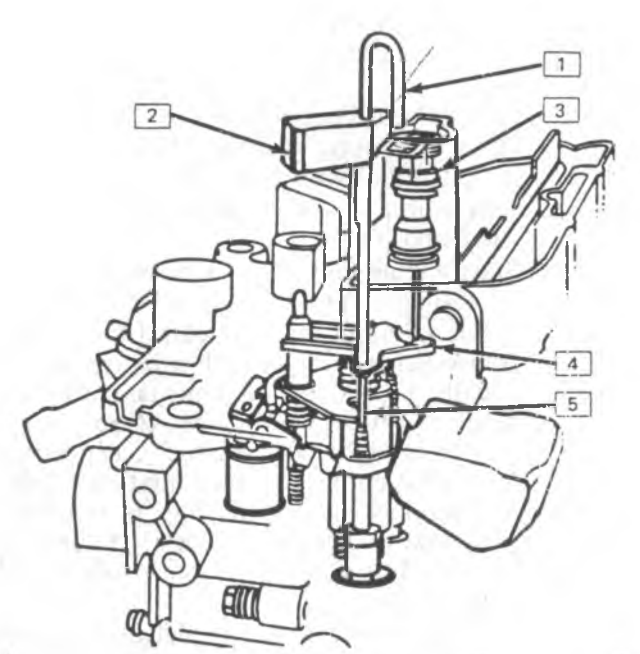


Figure 85 Idle Air Bleed Valve-Letter Identification Location

Procedure A (No Letter on Idle Air Bleed Valve)

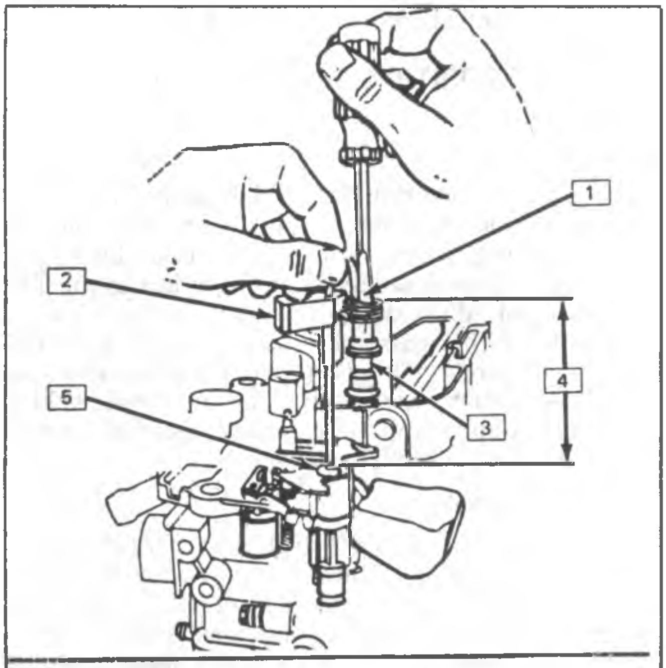
Carburetors WITHOUT letter identification on the idle air bleed valve are adjusted by:

1. **PRESETTING THE IDLE AIR BLEED VALVE** to a gage dimension if the idle air bleed valve was serviced prior to on-vehicle adjustment.
   (Only necessary if idle air bleed valve was serviced prior to on-vehicle adjustment.)
   a. Install idle air bleed valve gaging Tool J-33815-2, BT-8253-B, or equivalent, in throttle side "D" shaped vent hole in the air horn casting. The upper end of the tool should be positioned over the open cavity next to the idle air bleed valve. (Figure 86)
   b. While holding the gaging tool down lightly, so that the solenoid plunger is against the solenoid stop, adjust the idle air bleed valve so that the gaging tool will pivot over and just contact the top of the valve. The valve is now preset for on-vehicle adjustment (Figure 87).
   c. Remove gaging tool.
2. **ADJUSTING THE IDLE AIR BLEED VALVE** on the vehicle to obtain correct dwell reading.
   a. Disconnect vacuum hose from canister purge valve and plug it.
   b. Start engine and allow it to reach normal operating temperature.
   c. While idling in Drive (Neutral for manual transmission), use a screwdriver to slowly turn valve counterclockwise or clockwise, until the dwell reading varies within the 25-35° range, attempting to be as close to 30° as possible.
   Perform this step carefully. The air bleed valve is very sensitive and should be turned in 1/8 turn increments only.
   d. If, after performing Steps b and c above, the dwell reading does not vary and is not within the 25-35° range, it will be necessary



1 GAGING TOOL – J-33815-2/BT8253-8
2 GUIDE
3 IDLE AIR BLEED VALVE
4 SOLENOID PLUNGER
5 METERING ROD

Figure 86 Installing Idle Air Bleed Valve Gaging Tool



1 TOOL CONTACTING VALVE
2 GUIDE
3 IDLE AIR BLEED VALVE
4 GAGING TOOL – J-33815-2/BT8253B (1.756" HIGH)
5 PLUNGER AGAINST STOP

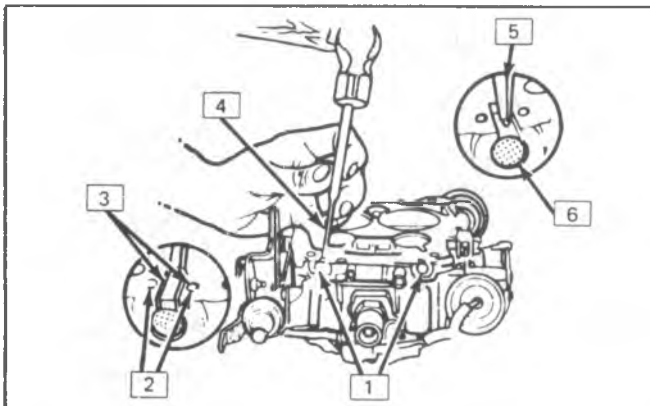
Figure 87 Positioning Idle Air Bleed Valve

to remove the plugs and to adjust the idle mixture needles.

IDLE MIXTURE NEEDLE PLUG REMOVAL – only if necessary:

1. Remove the carburetor from the engine, following normal service procedures, to gain access to the plugs covering the idle mixture needles.
2. Invert carburetor and drain fuel into a suitable container.
3. Place carburetor on a suitable holding fixture, with manifold side up. Use care to avoid damaging linkage, tubes, and parts protruding from air horn.
4. Make two parallel cuts in the throttle body, one on each side of the locator points beneath the idle mixture needle plug (manifold side), with a hacksaw (Figure 88).

   The cuts should reach down to the steel plug, but should not extend more than 1/8" beyond the locator points. The distance between the saw cuts depends on the size of the punch to be used.



1 RECESSED IDLE MIXTURE NEEDLE AND PLUG LOCATIONS
2 LOCATOR POINTS
3 HACKSAW SLOTS
4 FLAT PUNCH
5 CENTER PUNCH
6 PLUG

Figure 88 Removing Idle Needle Plugs

5. Place a flat punch near the ends of the saw marks in the throttle body. Hold the punch at a 45° angle and drive it into the throttle body until the casting breaks away, exposing the steel plug.

   The hardened plug will break, rather than remaining intact. It is not necessary to remove the plug in one piece, but remove the loose pieces.
6. Repeat this procedure with the other mixture needle.

3. **SETTING THE IDLE MIXTURE NEEDLES (IF NECESSARY)** where correct dwell reading could not be obtained with idle air bleed valve adjustment.

   a. Using Tool J-29030, BT-7610B, or equivalent, turn both idle mixture needles clockwise until they are lightly seated, then turn each mixture needle counterclockwise the number of turns specified in applicable Sec. 6C.

b. Reinstall carburetor on engine using a new flange mounting gasket, but do not install air cleaner and gasket at this time.

4. **READJUSTING IDLE AIR BLEED VALVE** to finalize correct dwell reading. (Only necessary if idle mixture needles required setting in Step 3, above.)

   a. Start engine and run until fully warm, and repeat "ADJUSTING THE AIR BLEED VALVE", Step 2, above.

   b. If unable to set dwell to 25-35°, and the dwell is below 25°, turn both mixture needles counterclockwise an additional turn. If dwell is above 35°, turn both mixture needles clockwise an additional turn. Readjust idle air bleed valve to obtain dwell limits.

      After adjustments are complete, seal the idle mixture needle openings in the throttle body, using silicone sealant, RTV rubber, or equivalent. The sealer is required to discourage unnecessary adjustment of the setting, and to prevent fuel vapor loss in that area.

      On vehicles WITHOUT a carburetor-mounted Idle Speed Control or Idle Load Compensator, adjust curb idle speed if necessary.

      Check, and only if necessary adjust, fast idle speed as described on Vehicle Emission Control Information label.

Procedure B (Letter Appears on Idle Air Bleed Valve)

Carburetor WITH letter identification on the idle air bleed valve are adjusted by:

1. **SETTING THE IDLE AIR BLEED VALVE** to a gage dimension, and

   a. Install air bleed valve gaging Tool J-33815-2, BT-8253-B, or equivalent, in throttle side "D" shaped vent hole in the air horn casting. The upper end of the tool should be positioned over the open cavity next to the idle air bleed valve. (Figure 86)

   b. While holding the gaging tool down lightly, so that the solenoid plunger is against the solenoid stop, adjust the idle air bleed valve so that the gaging tool will pivot over and just contact the top of the valve. (Figure 87)

      The valve is now set properly. No further adjustment of the valve is necessary.

   c. Remove gaging tool.

2. **ADJUSTING THE IDLE MIXTURE NEEDLES** on the vehicle to obtain correct dwell readings.

   a. Remove idle mixture needle plugs, following instructions in PROCEDURE A, Number 2, part d, Steps 1-6 only.

   b. Using Tool J-29030-B, BT-7610-B, or equivalent, turn each idle mixture needle clockwise until lightly seated, then turn each mixture needle counterclockwise 3 turns.

   c. Reinstall carburetor on engine, using a new flange mounting gasket, but do not install air cleaner or gasket at this time.

   d. Disconnect vacuum hose to canister purge valve and plug it.

   e. Start engine and allow it to reach normal operating temperature.

   f. While idling in Drive (Neutral for manual transmission), adjust both mixture needles equally, in 1/8 turn increments, until dwell reading varies within the 25-35° range, attempting to be as close to 30° as possible. If reading is too low, turn mixture needles counterclockwise. If reading is too high, turn mixture needles clockwise. Allow time for dwell reading to stabilize after each adjustment.

      After adjustments are complete, seal the idle mixture needle openings in the throttle body, using silicone sealant, RTV rubber, or equivalent. The sealer is required to discourage unnecessary readjustment of the setting, and to prevent fuel vapor loss in that area.

      Adjust curb idle speed if necessary.

      Check, and if necessary, adjust fast idle speed, as described on the Vehicle Emission Control Information label.

THROTTLE POSITION SENSOR (TPS)

Adjust

The plug covering the TPS adjustment screw is used to provide a tamper-resistant design and retain the factory setting during vehicle operation. DO NOT REMOVE the plug unless diagnosis indicates the TPS Sensor is not adjusted correctly, or it is necessary to replace the air horn assembly, float bowl, TPS, or TPS adjustment screw. This is a critical adjustment that must be performed accurately to ensure proper vehicle performance and control of exhaust emissions. Remove TPS plug if not already removed.

TPS Plug Removal

1. Using a 2mm (5/64") drill, drill a 1/16" to 1/8" deep hole in aluminum plug covering TPS adjustment screw. (Figure 89) Use care in drilling to prevent damage to adjustment screw head.
2. Start a No. 8, 1/2" long self-tapping screw in drilled hole turning screw in only enough to ensure good thread engagement in hole.
3. Placing a wide-blade screwdriver between screw head and air horn casting, pry against screw head to remove plug. DISCARD PLUG.

TPS Adjustment

Adjustment is required if voltage is different than specifications by more than $\pm$.05 volts.

1. Using Tool J-28696 or equivalent, remove TPS adjustment screw (Figure 90).

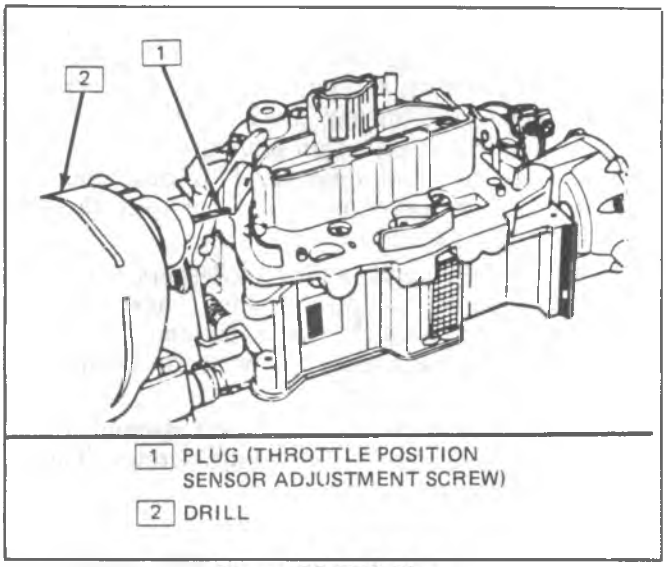


Figure 89 TPS Plug

2. Connect digital voltmeter J29125-A from TPS connector center "C" to bottom terminal "C". (Jumpers for access can be made using terminals 12014836 and 12014837).
3. With ignition ON, engine stopped, reinstall TPS adjustment screw and with Tool J-28696, BT-7967A or equivalent quickly adjust screw to obtain specified TPS voltage with A/C off, throttle position specified in Figure 90.

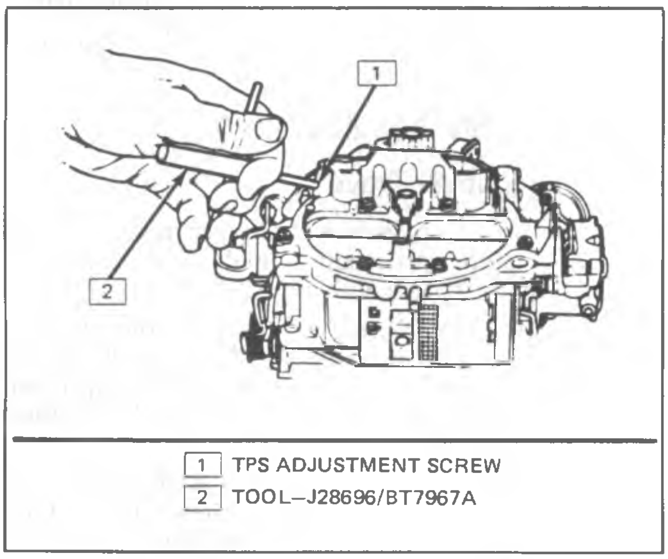


Figure 90 TPS Adjustment Screw

4. After adjustment, install new plug (supplied in service kits) in air horn, driving plug in place until flush with raised pump lever boss on casting.

NOTICE: Plug must be installed to retain the TPS adjustment screw setting. If plug is not available, remove screw and apply Delco Threadlock Adhesive X-10 or equivalent to screw threads, then repeat adjustment.

5. Clear trouble code memory after adjustment.

↔ Remove or Disconnect

1. M/C Solenoid and TPS electrical connector.
2. Idle speed control or idle speed solenoid electrical connector.
3. Air horn:
   a. Attaching screws and remove idle speed control or, idle speed solenoid or idle load compensator.
   b. Upper choke lever from the end of choke shaft by removing retaining screw. Rotate upper choke lever to remove choke rod from slot in lever.
   c. Choke rod from lower lever inside the float bowl casting. Remove rod by holding lower lever outward with small screwdriver and twisting rod counterclockwise.
   d. Pump lever from pump link (Figure 91).
   e. Front vacuum break hose from tube on float bowl.
   f. Air horn-to-bowl screws; then remove the two countersunk attaching screws located next to the venturi.
   g. Air horn from float bowl by lifting it straight up.

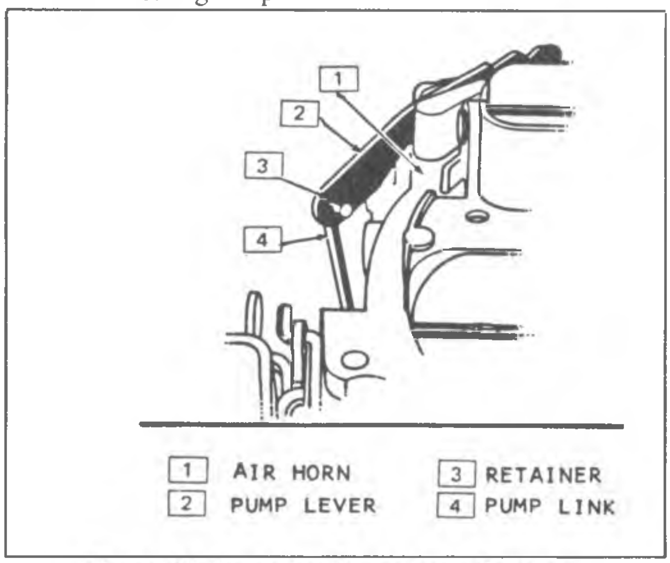


Figure 91 Removing Pump Lever Retainer

4. Solenoid-metering rod plunger by lifting straight up (Figure 92).
5. Air horn gasket by lifting it from the dowel locating pins on float bowl. DISCARD GASKET.
6. Staking holding TPS in bowl as follows:
   a. Lay a flat tool or metal piece across bowl casting to protect gasket sealing surface.
   b. Use a small screwdriver to depress TPS sensor lightly and hold against spring tension.
   c. Observing safety precautions, pry upward with a small chisel or equivalent to remove bowl staking, making sure prying force is exerted against the metal piece and not against the bowl casting.
   d. Push up from bottom on electrical connector and remove TPS and connector assembly from bowl.

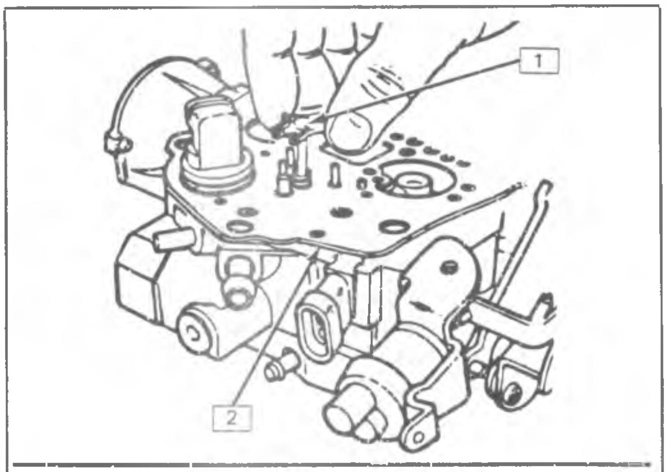


Figure 92 Solenoid-Metering Plunger

Install or Connect

1. TPS and connector assembly in float bowl by aligning groove in electrical connector with slot in float bowl casting. Push down on connector and sensor assembly so that connector and wires are located below bowl casting surface.

   Be sure green TPS actuator plunger is in place in air horn.

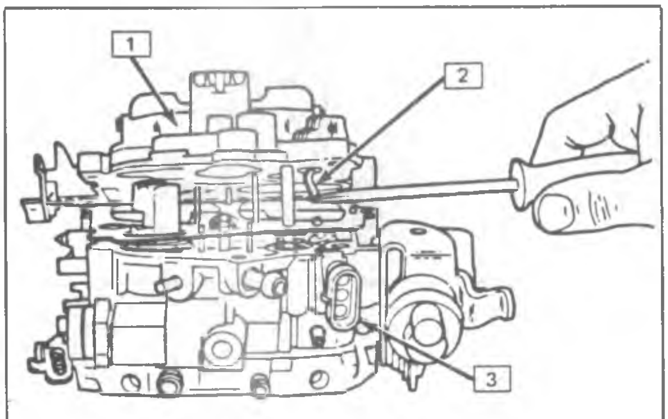


Figure 93 Installing Air Horn

2. Air horn, holding down on pump plunger assembly against return spring tension, and aligning pump plunger stem with hole in gasket, and aligning holes in gasket over TPS plunger, solenoid plunger return spring, metering rods, solenoid attaching screw and electrical connector. Position gasket over the two dowel locating pins on the float bowl.
3. Solenoid-metering rod plunger, holding down on air horn gasket and pump plunger assembly, and aligning slot in end of plunger with solenoid attaching screw.
4. Carefully lower air horn assembly onto float bowl while positioning the TPS Adjustment Lever over the TPS sensor, and guiding pump plunger stem through seal in air horn casting. To ease installation, insert a thin screwdriver between air horn gasket and float bowl to raise the TPS Adjustment Lever positioning it over the TPS sensor. (Figure 93)
5. Air horn screws and lockwashers, and two countersunk screws (located next to the carburetor venturi area). Tighten all screws evenly and securely, following air horn screw tightening sequence.
6. Front vacuum break and bracket assembly on the air horn, using two attaching screws. Tighten screws securely.
7. Pump link to pump lever.
8. Choke rod into lower choke lever inside bowl cavity. Install choke rod in slot in upper choke lever, and position lever on end of choke shaft, making sure flats on end of shaft align with flats in lever. Install attaching screw and tighten securely. When properly installed, the lever will point to the rear of the carburetor, and the number on the lever will face outward.
9. Idle speed control motor.
10. M/C solenoid, TPS and idle speed control or idle speed solenoid electrical connectors.
11. Clear trouble code memory after replacement.
12. Check TPS voltage and refer to TPS adjustment procedure if required.

MIXTURE CONTROL SOLENOID

Checking Plunger Travel

Mixture control solenoid plunger travel should be checked before proceeding with any carburetor adjustments or disassembly.

Using Float Gage J-9789-130, BT-7720, or equivalent, (used to check float level setting externally), insert gage in the vertical "D" shaped vent hole in the air horn casting, next to the Idle Air Bleed Cover. (Figure 94)

It may be necessary to file or grind material off the gage to allow it to enter the vent hole freely. Gage will be used to check total mixture control solenoid plunger travel.

With engine off, air cleaner and gasket removed, measure mixture control solenoid plunger travel as follows:

1. Insert float gage down "D" shaped vent hole. Press down on gage and release, observing that the gage moves freely and does not bind. With gage released, (plunger UP position), read at eye level and record the reading of the gage mark (in inches) that lines up with the top of air horn casting, (upper edge).
2. Lightly press down on gage until bottomed, (plunger DOWN position). Read and record mm (inches) the reading of the gage mark that lines up with top of air horn casting.

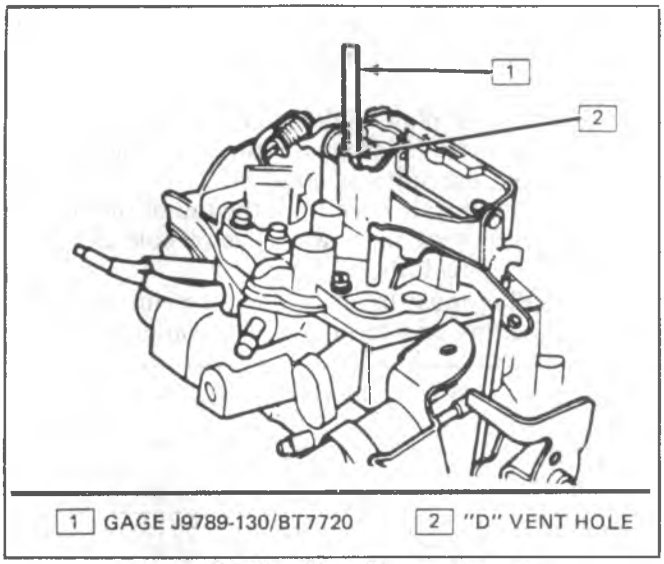


Figure 94 Checking Plunger Travel

3. Substract gage UP position (Step 1) from gage DOWN position Step 2), and record difference. This difference is total plunger travel.
4. If total plunger travel (Step 3) is between 2.4 mm and 4.8mm (2/32" and 6/32"), proceed to Idle Air Bleed Valve Adjustment. If it is less than 2.4 mm (2/32") or greater than 4.8 mm (6/32"), adjust mixture control solenoid plunger travel indicated below.

Adjusting Plunger Travel

1. Remove air horn, mixture control solenoid plunger, air horn gasket and plastic filler block, using normal service procedures.
2. Remove throttle side metering rod. Install mixture control solenoid gaging tool, J-33815-1, BT-8253-A, or equivalent, over the throttle side metering jet rod guide, and temporarily reinstall the solenoid plunger into the solenoid body. (Figure 95)

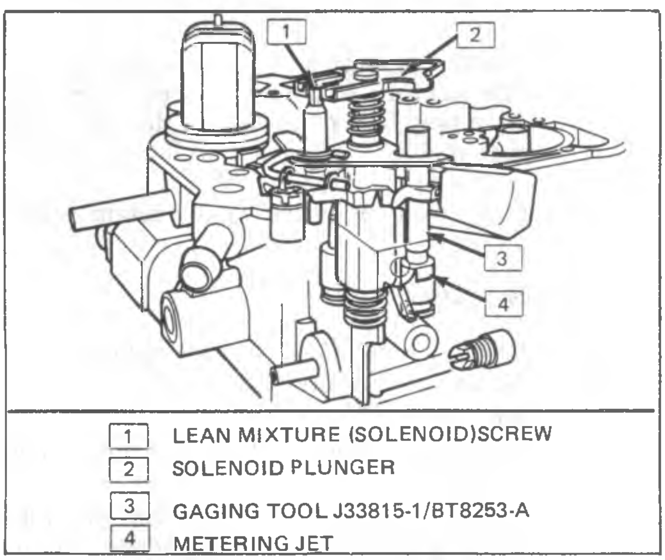


Figure 95 M/C Solenoid Gaging Tool

3. Holding the solenoid plunger in the DOWN position, use Tool J-28696-10, BT-7928, or equivalent, to turn lean mixture (solenoid) screw counterclockwise until the plunger breaks contact with the gaging tool. Turn slowly clockwise until the plunger just contacts the gaging tool. The adjustment is correct when the solenoid plunger is contacting BOTH the SOLENOID STOP and the GAGING TOOL. (Figure 96)

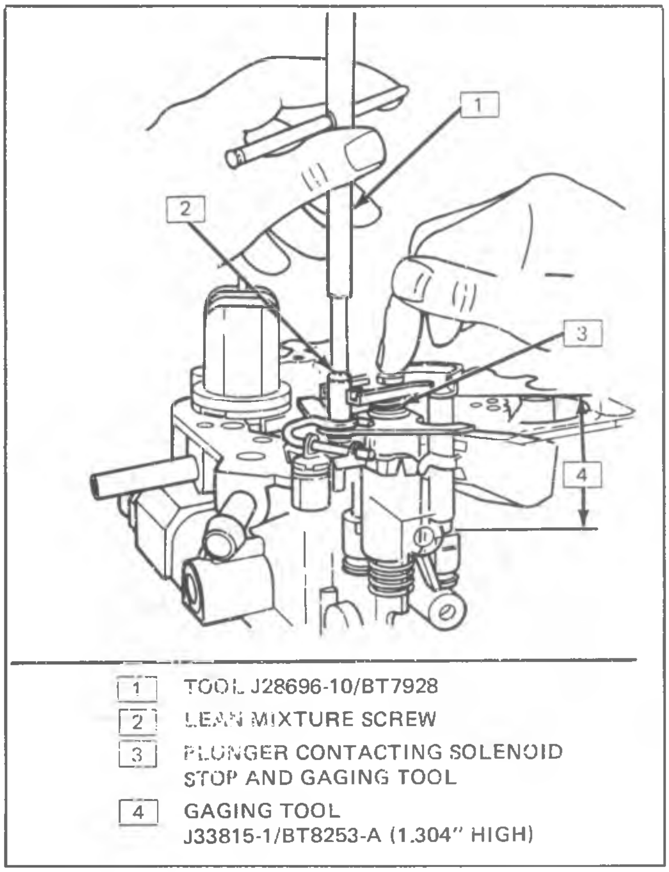
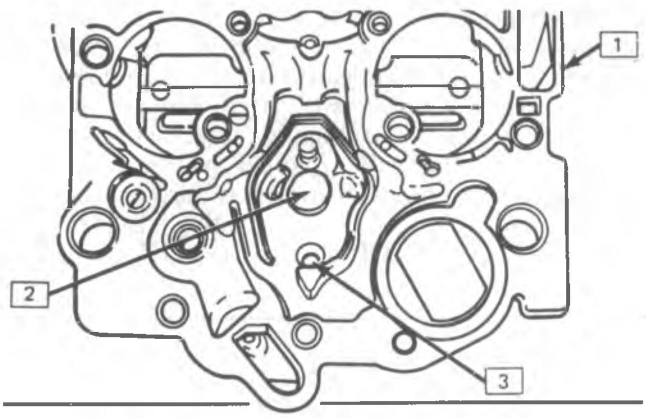


Figure 96 Adjusting Lean Mixture Screw

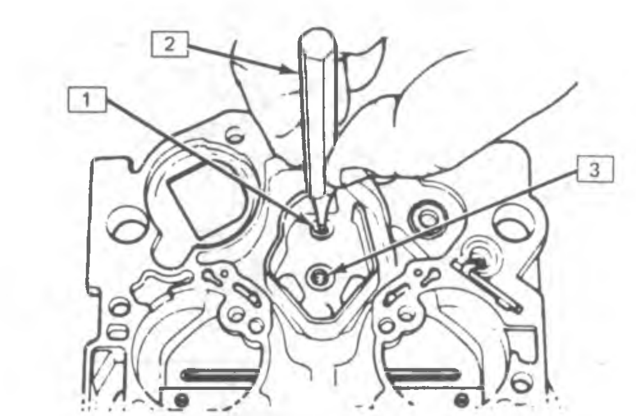
If the total difference in adjustment required less than 3/4 turn of the lean mixture (solenoid) screw, the original setting was within the manufacturer's specifications.

4. Remove solenoid plunger and gaging tool, and reinstall metering rod and plastic filler block.
5. Invert air horn, and remove rich mixture stop screw from bottom side of air horn, using Tool J-28696-4, BT7967A or equivalent. (Figure 97).
6. Remove lean mixture screw plug and the rich mixture stop screw plug from air horn, using a suitable sized punch. (Figure 98)
7. Reinstall rich mixture stop screw in air horn and bottom lightly, then back screw out 1/4 turn.
8. Reinstall air horn gasket, mixture control solenoid plunger and air horn to carburetor.
9. Insert external float gage in vent hole and, with Tool J-28696-10, BT-7928, or equivalent, adjust rich mixture stop screw to obtain 4/32" total plunger travel. (Figure 99)



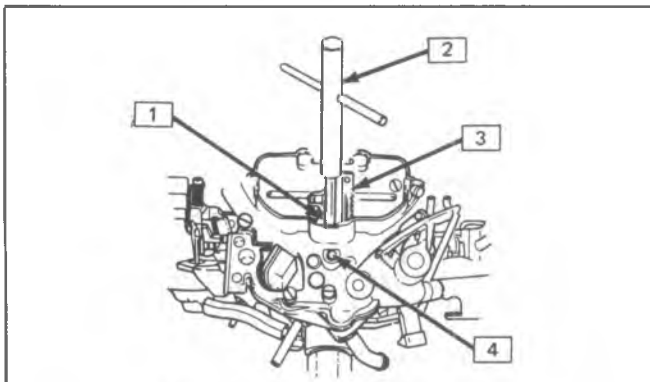
1 AIR HORN (INVERTED)
2 RICH MIXTURE STOP SCREW
3 LEAN MIXTURE SCREW PLUG

Figure 97 Rich Mixture Stop Screw



1 LEAN MIXTURE SCREW PLUG
2 PUNCH
3 RICH MIXTURE STOP SCREW PLUG

Figure 98 Mixture Screw Plugs

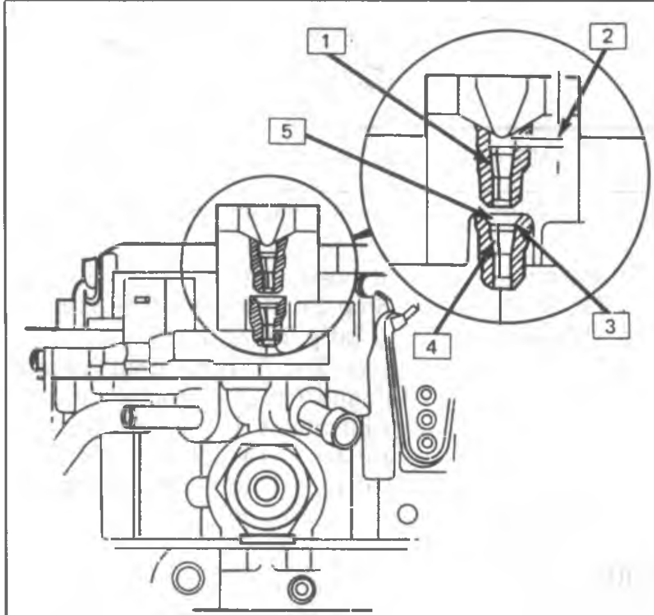


1 RICH MIXTURE STOP SCREW
2 TOOL–J28696-10/BT7928
3 GAGE–J9789-13/BT7720
4 LEAN MIXTURE SCREW HOLE

Figure 99 Adjusting Rich Mixture Stop Screw

10. With solenoid plunger travel correctly set, install plugs (supplied in service kits) in the air horn, as follows:
    a. Install plug, hollow end down, into the access hole to lean mixture (solenoid) screw, and use suitably sized punch to drive plug into the air horn until the top of the plug is even with the lower edge of hole chamfer. (Figure 100)

       Plug must be installed to retain the screw setting and to prevent fuel vapor loss.



1 RICH MIXTURE STOP SCREW PLUG
2 DIMENSION–1.6 mm (1/16"0 BELOW SURFACE
3 LOWER EDGE OF HOLE
4 LEAN MIXTURE SCREW PLUG
5 UPPER SURFACE OF PLUG

Figure 100 Installed Screw Plugs

    b. Install plug, with hollow end down, over the rich mixture stop screw access hole, and drive plug into place so that the top of the plug is 1/16" below the surface of the air horn casting. (Figure 100)

       Plug must be installed to retain screw setting.

↔ Remove or Disconnect

1. M/C solenoid and TPS electrical connector.
2. Idle speed control electrical connector.
3. Air horn:
    a. Attaching screws and remove idle speed control.
    b. Upper choke lever from the end of choke shaft by removing retaining screw. Rotate upper choke lever to remove choke rod from slot in lever.
    c. Choke rod from lower lever inside the float bowl casting. Remove rod by holding lower

lever outward with small screwdriver and twisting rod counterclockwise.

d. Pump lever from pump link. (Figure 101)

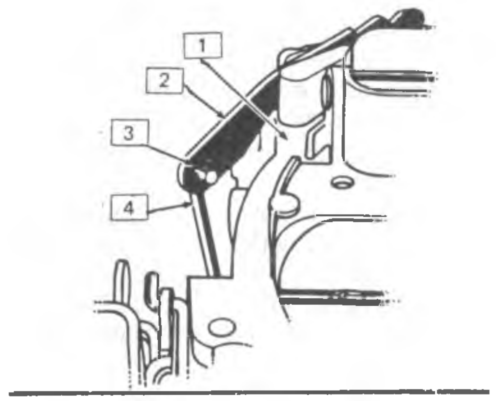


Figure 101 Removing Pump Lever Retainer

e. Front vacuum break hose from tube on float bowl.

f. Air horn-to-bowl screws; then remove the two countersunk attaching screws located next to the venturi.

9. Air horn from float bowl by lifting it straight up.

4. Solenoid-metering rod plunger (Figure 102) by lifting straight up.
5. Air horn gasket by lifting it from the dowel locating pins on float bowl. DISCARD GASKET.

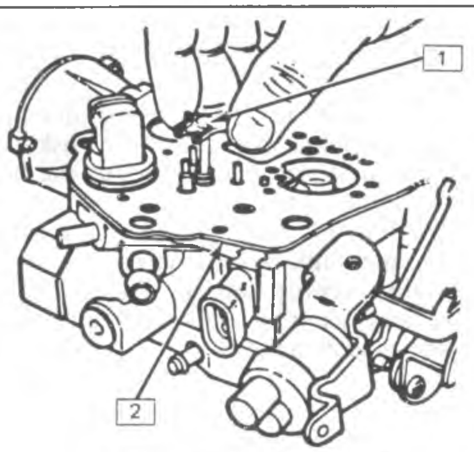


Figure 102 Metering Plunger

6. Plastic filler block over float bowl.
7. Carefully lift each metering rod out of the guided metering jet, checking to be sure the return spring is removed with each metering rod.
8. Lean mixture screw using tool J28696-10, BT-7928 or equivalent.
9. Screw attaching solenoid connector to float bowl and lift the mixture control solenoid and connector assembly from the float bowl.

Install or Connect

If a service replacement Mixture Control Solenoid package is installed, the solenoid and plunger MUST be installed as a matched set.

1. Mixture control solenoid and connector assembly as follows:
   a. Solenoid carefully in the float chamber, aligning pin on end of solenoid with hole in raised boss at bottom of bowl. Align solenoid connector wires to fit in slot in bowl, or plastic insert if used.
   b. Lean mixture (solenoid) screw through hole in solenoid bracket and tension spring in bowl, engaging first six screw threads to assure proper thread engagement.
   c. Mixture control solenoid gaging Tool, J-33815-1, BT-8253-A, or equivalent, over the throttle side metering jet rod guide, and temporarily install solenoid plunger. (Figure 103)

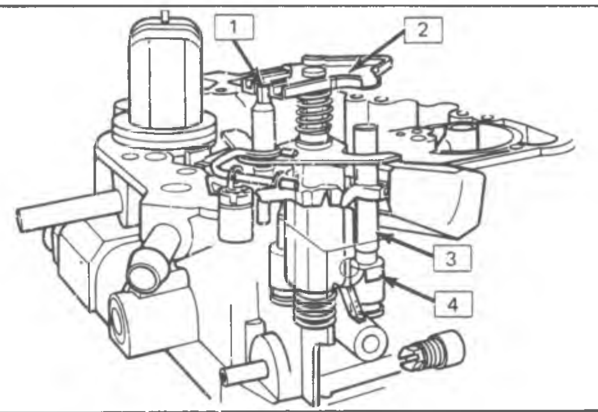
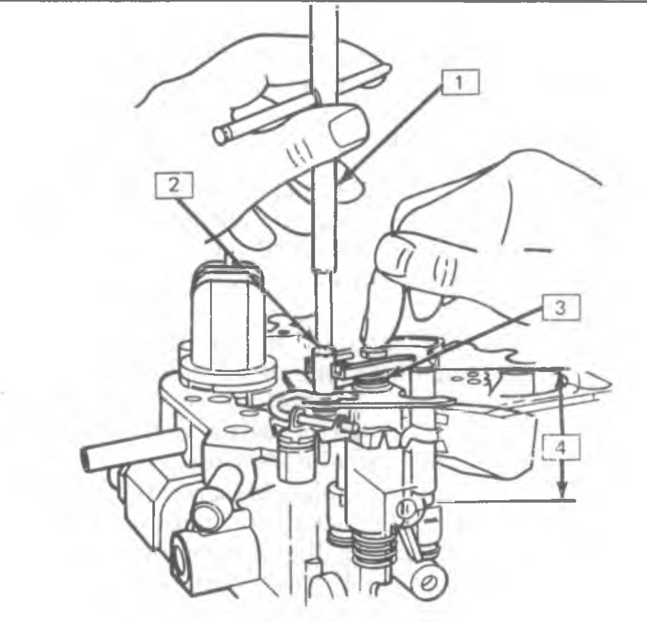


Figure 103 Installing Mixture Control Solenoid Gaging Tool

   d. Holding the solenoid plunger against the Solenoid Stop, useTool J-28696-10, BT-7938, or equivalent, to turn the lean mixture (solenoid) screw slowly clockwise, until the solenoid plunger just contacts the gaging tool. The adjustment is correct when the solenoid plunger is contacting BOTH the Solenoid Stop and the Gaging Tool (Figure 104).
   e. Remove solenoid plunger and gaging tool.
2. Align solenoid wires with notch in plastic insert (if used) and connector lugs with recesses in bowl. Install connector attaching screw. Tighten screw securely.

NOTICE: DO NOT overtighten screw, which could cause damage to the connector.



1 TOOL J28696-10/BT7928
2 LEAN MIXTURE SCREW
3 PLUNGER CONTACTING SOLENOID STOP AND GAGING TOOL
4 GAGING TOOL J33815-1/BT8253-A (1.304" HIGH)

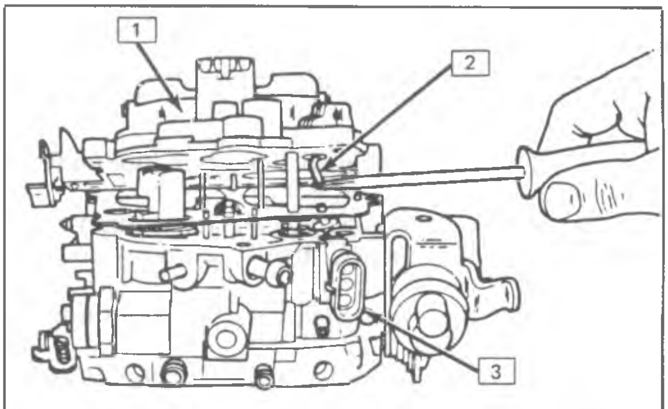
Figure 104 Adjusting Lean Mixture (Solenoid) Screw

3. Plastic filler block over float valve, pressing downward until properly seated (flush with bowl casting surface).
4. Install metering rod and spring assembly through hole in plastic filler block and gently lower the metering rod into the guided metering jet, until large end of spring seats on the recess on end of jet guide.

NOTICE: DO NOT FORCE METERING ROD down in jet. USE EXTREME CARE when handling these critical parts to avoid damage to rod and spring. If service replacement metering rods, springs and jets are installed, they must be installed in matched sets.

5. Air horn, holding down on pump plunger assembly against return spring tension and aligning pump plunger stem with hole in gasket, and aligning holes in gasket over TPS plunger, solenoid plunger return spring, metering rods, solenoid attaching screw and electrical connector. Position gasket over the two dowel locating pins on the float bowl.
6. Solenoid-metering rod plunger, holding down on air horn gasket and pump plunger assembly, and aligning slot in end of plunger with solenoid attaching screw. (Figure 102)

   Be sure plunger arms engage top of each metering rod.
7. Carefully lower air horn assembly onto float bowl while positioning the TPS Adjustment Lever over the TPS sensor, and guiding pump plunger stem through seal in air horn casting. To ease installation, insert a thin screwdriver between air horn gasket and float bowl to raise the TPS Adjustment Lever positioning it over the TPS sensor. (Figure 105)



1 AIR HORN
2 TPS ADJUSTMENT LEVER
3 TPS ELECTRICAL CONNECTOR

Figure 105 Installing Air Horn

Make sure that the tubes are positioned properly through the holes in the air horn gasket. Do not force the air horn assembly onto the bowl, but lower it lightly into place.

Install attaching screws and lockwashers, and two countersunk screws (located next to the carburetor venturi area). Tighten all screws evenly and securely, following air horn screw tightening sequence.

E2SE CARBURETOR

CALIFORNIA ONLY

ON-VEHICLE SERVICE

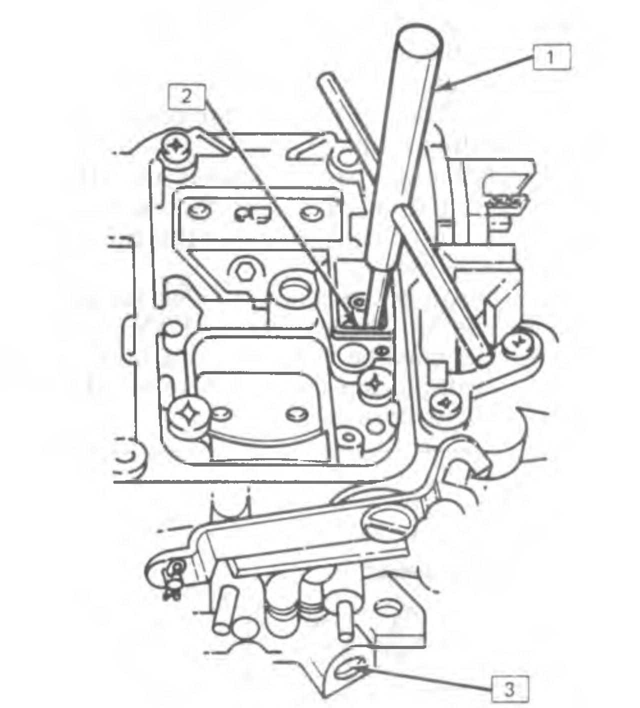
E2SE CARBURETOR CALIBRATION

1. Remove vent stack screw assembly.
2. Connect dwell meter to mixture control solenoid dwell connector.
3. Connect tachometer.
4. Block DRIVE WHEELS and set parking brake.
5. Run engine on high step of the fast idle cam until system is in "closed loop" (dwell meter varying).
6. Run engine at 3000 RPM and adjust lean mixture screw (Figure 106) to obtain an average dwell of 35° using tool J28696-10 or BT-7928.

   Adjust in small increment allowing time for dwell to stabilize.

If unable to adjust, inspect idle system for leak or restrictions (See E2SE Carburetor Unit Repair).

7. Return to idle and observe dwell reading. Dwell should be varing within 25° to 35° and calibration is completed.
   Reinstall vent stack.

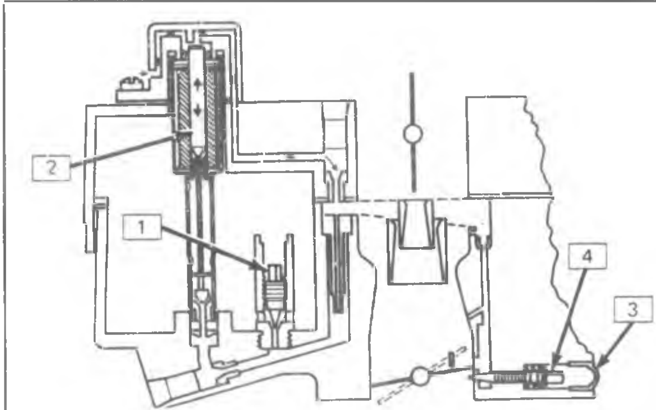


1 TOOL J-28696-10-B/BT-7928
2 LEAN MIXTURE SCREW
3 IDLE MIXTURE NEEDLE

Figure 106 E2SE Carburetor Calibration

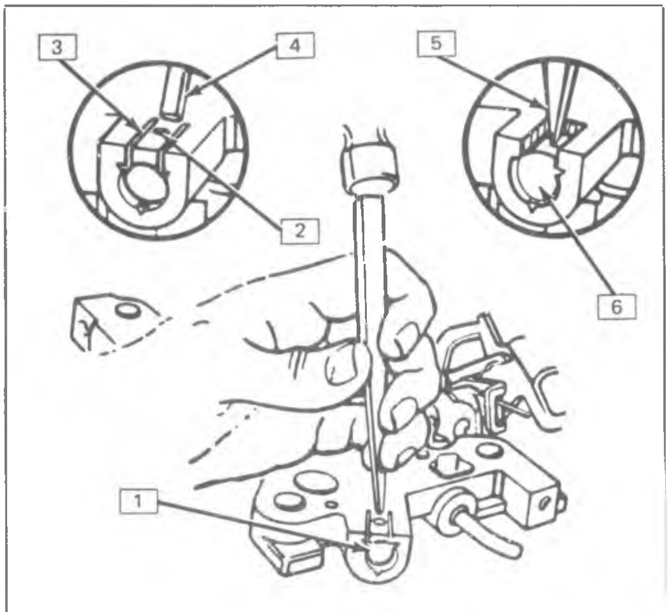
If calibration is not correct at idle, turn off engine and remove carburetor from engine to remove idle mixture needle plug.

8. Remove carburetor from engine:
   a. Remove air cleaner and gasket.
   b. Disconnect electrical connectors.
   c. Disconnect accelerator linkage.
   d. Disconnect automatic transmission downshift cable, if equipped.
   e. Disconnect cruise control linkage if equipped.
   f. Disconnect fuel and vacuum lines from carburetor.
   g. Remove carburetor attaching bolts and carburetor.
9. Remove idle mixture needle plug. (Figure 107)
   a. Invert carburetor and place on suitable holding fixture, (manifold side up).
   b. Make two parallel cuts in the throttle body, one on each side of the locator point, with a hacksaw. Cuts should reach down to the steel plug, but should not extend more than 1/8″ (3.2mm) beyond the locator point. Distance between saw cuts depends on size of the punch to be used. (Figure 108)



1 LEAN MIXTURE SCREW
2 MIXTURE CONTROL SOLENOID
3 PLUG
4 IDLE MIXTURE NEEDLE

Figure 107 Idle Mixture Needle



1 RECESSED IDLE MIXTURE NEEDLE AND PLUG LOCATION
2 LOCATOR POINT
3 HACKSAW SLOTS
4 FLAT PUNCH
5 CENTER PUNCH
6 PLUG

Figure 108 Removing Plug

   c. Place a flat punch at a point near the ends of the saw marks in the throttle body. Hold the punch at a 45° angle, and drive it into the throttle body until the casting breaks away, exposing the steel plug. (Figure 108)
   d. Hold center punch in vertical position, and drive it into the plug. Now hold punch at a 45° angle, and drive plug out of the casting.

NOTICE: Hardened plug will break, rather than remaining intact. It is not necessary to remove the plug completely, but remove loose pieces to allow use of idle mixture adjusting tool (J-29030, BT-7610B or equivalent).

10. Reinstall carburetor on engine tightening nuts to 18 N·m (160 in.lbs.)
    a. Do not install air cleaner and gasket.
    b. Disconnect the bowl vent line at carburetor.
    c. Disconnect hose at temperature sensor on air cleaner and plug hose.
    e. Disconnect EGR and canister purge hoses at carburetor and carburetor ports.
11. Run engine on high step of the fast idle cam until system is in "closed loop" (dwell meter needle varying).
12. Return engine to idle and adjust idle mixture screw (Figure 106) to obtain an average dwell at 25° using tool J29030-B or BT-7610-B.

    Adjust in small increments allowing time for dwell to stabilize.

    If unable to adjust, inspect idle system for leak or restrictions (See E2SE Carburetor Unit Repair).
13. Disconnect mixture control solenoid (fan off) and check for a 50 RPM change.

    If there is not at least a 50 RPM change, inspect idle air bleed circuit for restrictions or leaks (see E2SE Carburetor Unit Repair).
14. Run engine at 3000 RPM and observe dwell reading. Dwell should be varying with an average reading of 35°.
    - If not at 35° average dwell, repeat lean mixture screw and idle mixture needle adjustments.
15. Connect linkage and hoses which were disconnected. Install vent screen. Check and set idle speed as required per Vehicle Emission Control Information label.

THROTTLE POSITION SENSOR

Checking

Refer to diagnosis Chart A-4 for TPS Enrichment Check.

Trouble Code 21 may set if TPS is misadjusted. Refer to Trouble Code 21 for complete diagnosis if code sets.

Adjustment

Adjustment is required if voltage is different than specifications by more than ± 0.05 volts.

The cup plug covering the TPS adjustment screw (Figure 109) is used to provide a tamper-resistant design and retain the factory setting during vehicle operation. DO NOT REMOVE the plug unless diagnosis indicates the TPS is not adjusted correctly or it is necessary to replace the air horn assembly, float bowl, TPS, or TPS adjustment screw. This is a critical adjustment that must be performed accurately and carefully to ensure proper vehicle performance and control of emissions.

If necessary to adjust the TPS, proceed as follows:

1. Using a .078" (5/64") drill, drill a hole in the steel cup plug covering the TPS adjustment screw.

   Use care in drilling to prevent damage to adjustment screw head.
2. Using a small slide hammer or equivalent, remove steel plug from air horn.
3. Disconnect the TPS connector and jumper all three terminals. (Jumpers can be made up using terminals 12014836 and 12014837). Make jumpers up with #16, #18 or #20 wire approximately 6" long.
4. Connect digital voltmeter (J-29125-A) or equivalent from TPS connector center terminal (B) to bottom terminal (C).
5. With ignition on, engine stopped, turn the TPS screw with flat bladed screwdriver or equivalent to obtain .26 volts at curb idle throttle position with A/C OFF.
6. After adjustment, a new cup plug (supplied in service kits) or silicone sealant, RTV rubber, or equivalent, must be inserted in air horn. If cup plug is used, the cup should face outward and be flush with air horn casting.

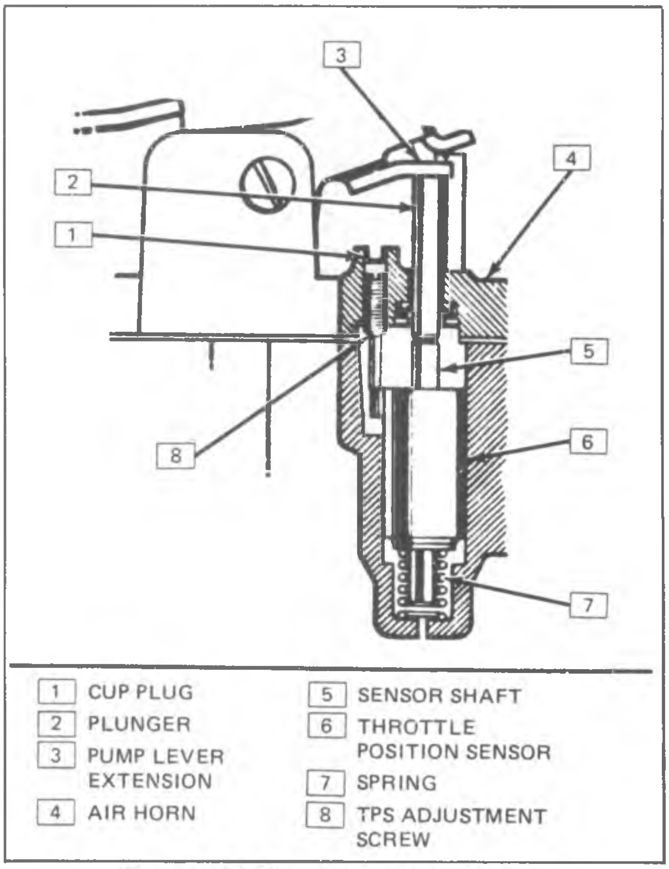
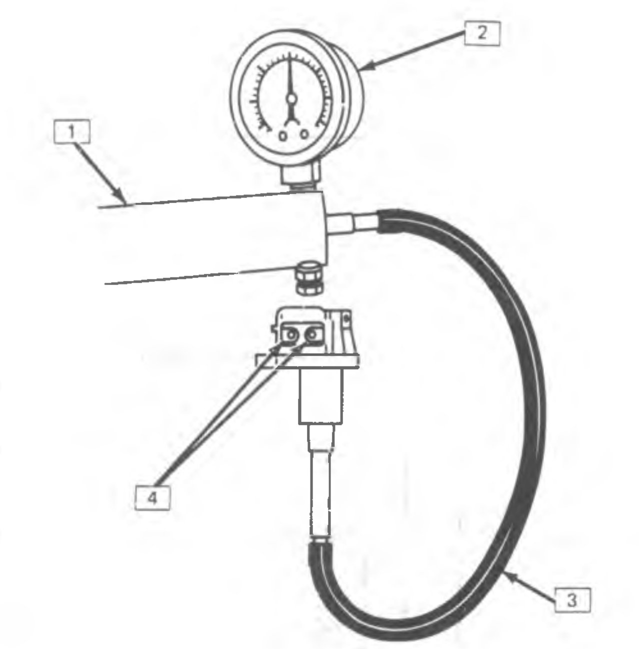


Figure 109 Throttle Position Sensor

MIXTURE CONTROL (M/C) SOLENOID

Checking

1. Remove M/C solenoid.
2. Connect electrical connector with solenoid removed from the carburetor.
3. Ground dwell terminal.
4. Connect vacuum pump to the end of the solenoid. (Figure 110)



1 VACUUM PUMP
2 VACUUM GAGE
3 VACUUM HOSE
4 SOLENOID TERMINALS

Figure 110 Checking M/C Solenoid

5. Ignition "ON" and engine stopped. This energizes solenoid in lean postion.
6. Apply approximately 16 kPa (5" Hg) and hold. If vacuum will not hold for approximately 5 seconds, replace solenoid.
7. Disconnect ground from dwell lead and vacuum gage reading should go to zero. Replace solenoid if stuck in down position.

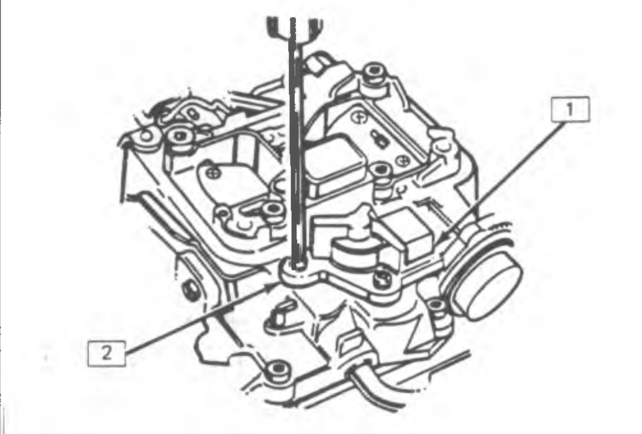
Remove or Disconnect

1. Air cleaner.
2. Electrical connector at M/C solenoid.
3. Three (3) mixture control solenoid screws in air horn (Figure 111) then using a slight twisting motion, carefully lift solenoid out of air horn. Remove and discard solenoid gasket.
4. Seal retainer and rubber seal from end of solenoid stem being careful not to damage or nick end of solenoid stem (Figure 112). Discard seal and retainer.

   Check solenoid for leak with vacuum pump. Replace as required.

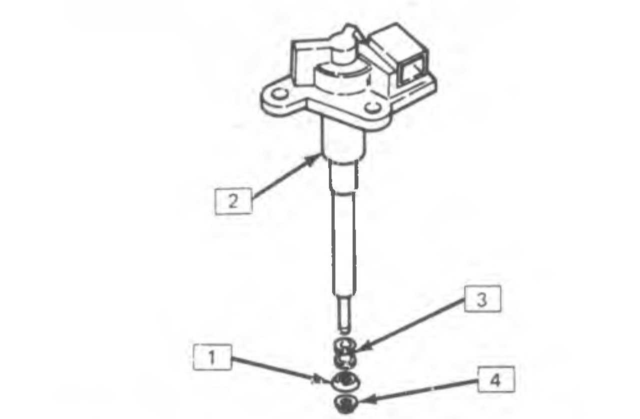
Install or Connect

1. Spacer and new rubber seal on mixture control solenoid stem making sure seal is up against the spacer. Then, using a 3/16" socket and light hammer, carefully drive retainer on stem. Drive retainer on stem only far enough to retainer rubber seal on stem leaving a slight clearance between the retainer and seal to allow for seal expansion.



1 ELECTRICAL CONNECTOR
2 MIXTURE CONTROL SOLENOID

Figure 111 M/C Solenoid Removal and Installation



1 SEAL
2 MIXTURE CONTROL SOLENOID
3 SPACER
4 RETAINER CLIP

Figure 112 M/C Solenoid

   Prior to installing a replacement mixture control solenoid, lightly coat the rubber seal on the end of the solenoid stem with a silicone grease or light engine oil.

2. Mixture control solenoid with new gasket. Align solenoid stem with recess in bottom of bowl.

   Use a slight twisting motion of the solenoid during installation to ensure rubber seal on stem is guided into recess in the bottom of the bowl to prevent distortion or damage to the rubber seal. Install three(3) solenoid attaching screws and tighten securely.

3. Mixture control solenoid electrical connector.
4. Perform System Performance Check.

PARTS INFORMATION

PART NAME	GROUP
Carburetor	3.725
Sensor Kit, Throttle Position	3.764
Solenoid Kit, Mixture Control	3.440

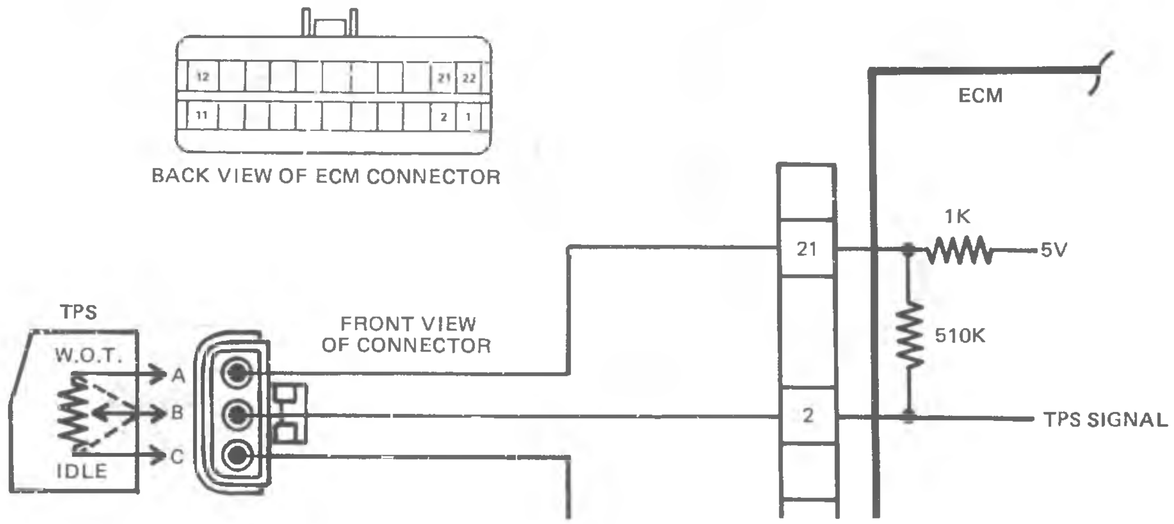


Figure 113 Wiring Diagram - CHART C-2F

CHART C-2F, TPS ENRICHMENT CHECK

1. This step checks that the TPS will cause an ECM "Rich" command when fully depressed manually. On some vehicles, this will cause a low dwell (full rich). On others it will not.

   Code 21 should normally be set.

2. This step distinguishes between a faulty TPS or ECM harness/ECM.

   Code 21 should normally be set, if engine RPM is not set above specifications.

3. This step checks for 5V. ref. at TPS. It should be about 5 volts. If loss of V. Ref. were in the ECM, it should set Codes 21 and 34 since this is the same 5V to Vacuum Sensor. Therefore, it must be an open in the wire.

4. This step checks for a grounded circuit. Normal circuit should read about 5 volts. Checking for grounded TPS output to Terminal "2" of ECM, or short in wiring to Terminals "2" and "22" from TPS, indicates whether fault is in wiring or ECM. A voltmeter with a 10 megohms resistance must be used for an accurate reading.

1984 CCC

CHART NO. C-2F
TPS ENRICHMENT CHECK

(1)
- Engine at specified idle speed in "D" (A.T.) or "N" (M.T.) and A/C off.
- "Test" terminal not grounded.
- Fully depress TPS plunger for 15 seconds. This should set code 21.
- With engine idling, ground test terminal and check for code 21.

Code 21
- Enrichment circuit OK.
- Clear long term memory.

No code 21

(2)
- Disconnect ground from "test" term.
- Disconnect TPS and check for code 21 after 15 sec. (with engine idling).

Code 21

(3)
- Check voltage from harness connector term. "A" to "C" with digital voltmeter J-29125 or equivalent.
- It should be about 5 volts.

Under 4 volts
- Check for open in wire to ECM term. 21.

Over 4 volts
- It is faulty connection to TPS term. "A", TPS adj. or faulty TPS.

No code 21

(4)
- Check voltage from harness conn. terminal "B" to "C" with digital voltmeter J-29125 or equivalent.
- It should read about 5 volts.

Over 2 volts
- Check for idle set too high. If OK,
- It is faulty ECM.

Under 2 volts
- Check for ground in wire to ECM term. "2" and short between wires to ECM term's. "2" and "22".
- If not grounded or shorted, it is faulty ECM.

- After any repair clear long term memory.

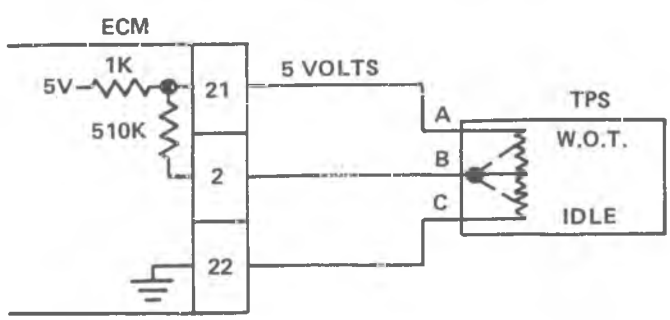


Figure 114 TPS Enrichment Check - CHART C-2F

THROTTLE RETURN CONTROL (TRC) SYSTEM

GENERAL DESCRIPTION

The TRC system (Figure 115) used on heavy duty emission vehicles, consists of three major components:

- Throttle Lever Actuator - Mounted as part of the carburetor assembly, this device opens the primary throttle plates a preset amount in excess of curb idle when engine vacuum is applied to it. This actuating vacuum is controlled by a separate solenoid vacuum control valve.
- Solenoid Vacuum Control Valve - Mounted separately from the carburetor, this off-on valve is held open above a present nominal engine speed by a signal from an engine speed sensor. The valve when open allows a vacuum signal to be applied to the throttle lever actuator as long as the present engine speed is exceeded.
- Engine Speed Switch - Mounted separately from the solenoid vacuum control valve, this switching device monitors engine speed at the distributor and supplies a continuous electrical signal to the solenoid vacuum control valve as long as the preset engine speed is exceeded.

DIAGNOSIS

Check hoses for cracking, abrasion, or deterioration and replace as necessary. Check for shorted or broken wires and ensure that electrical connectors are fully engaged at the distributor, speed switch and control valve. Check system function for proper operation and adjust as necessary.

1. Connect precision tachometer (capable of resolving 10 RPM) to the distributor "TACH" terminal.
2. Start engine and advance throttle to indicated 1890 RPM. Throttle lever actuator should be extended at this speed.
3. Reduce throttle opening to indicated 1700 RPM. Throttle lever actuator should be retracted at this speed.
4. If the throttle lever actuator operates outside of the 1700 to 1890 RPM limits, the speed switch is out of calibration and should be replaced.
5. If the actuator does not operate at any speed, proceed with the following steps.
   a. With a voltmeter, check for voltage at the control valve and speed switch. This is accomplished by connecting the negative probe of the voltmeter to the engine "ground" and inserting the positive probe in the connector cavity of the voltage source wire. A voltage of 12-14 volts should be measured at this terminal on both the valve and speed switch. When making this measurement, it is not necessary to unplug the connector from its component. The voltmeter probe can be inserted in the connector body on the wire side of the connector to contact the metal terminal.
   b. If voltage is present at one device and not the other, repair the engine wiring harness as required.
   c. If voltage is not present at either device, check the engine harness connections at the distributor and/or bulkhead connector. Repair as required.
   d. If the proper voltage exists at each device, to check for proper solenoid valve operation "ground" the valve-to-switch connecting wire terminal at the solenoid connector using a jumper wire. The throttle lever actuator should extend (engine running).
   e. If it does not extend, remove the hose from the solenoid side port that connects to the actuator hose. Visually check the orifice in this port for plugging. Clear the orifice as required. If not plugged, replace the solenoid vacuum control valve.
   f. If the actuator extends in Step D, ground the valve-to-switch wire terminal at the speed switch. If it does not extend, repair the wire connecting the speed switch and valve. If it does extend, check the speed switch ground wire for "ground" - it should read 0 volts when checked with a voltmeter with the engine running, check the speed switch-to-distributor wire for proper connection. With both the ground and distributor wires properly connected and if the actuator does not extend when operating above 1890 RPM, replace the speed switch.
6. If the actuator remains extended at all speeds, proceed as with the following steps.
   a. Remove connector from solenoid vacuum control valve.
   b. If actuator remains extended, check the orifice in the valve side port for plugging. If plugged, clear and reconnect system and recheck. If the actuator again remains extended, remove the valve connector. If the actuator does not retract, replace the solenoid vacuum control valve.
   c. If the actuator retracts with the valve connector off, reconnect and then remove the speed switch connector. If the actuator retracts. replace the speed switch. If the actuator does not retract, the valve-to-switch wire is shorted to ground in the wiring harness. Repair as required.

Throttle Lever Actuator - Checking Procedure

1. Disconnect valve to actuator hose at valve and connect to an external vacuum source equipped with a vacuum gage.
2. Apply 68 kPa (20") vacuum to the actuator and seal off the vacuum source. If the vacuum gage reading drops, then the actuator is leaking and must be replaced.
3. To check the actuator for proper operation:
   a. Check the throttle lever, shaft, and linkage to be sure that they operate freely without binding or sticking.

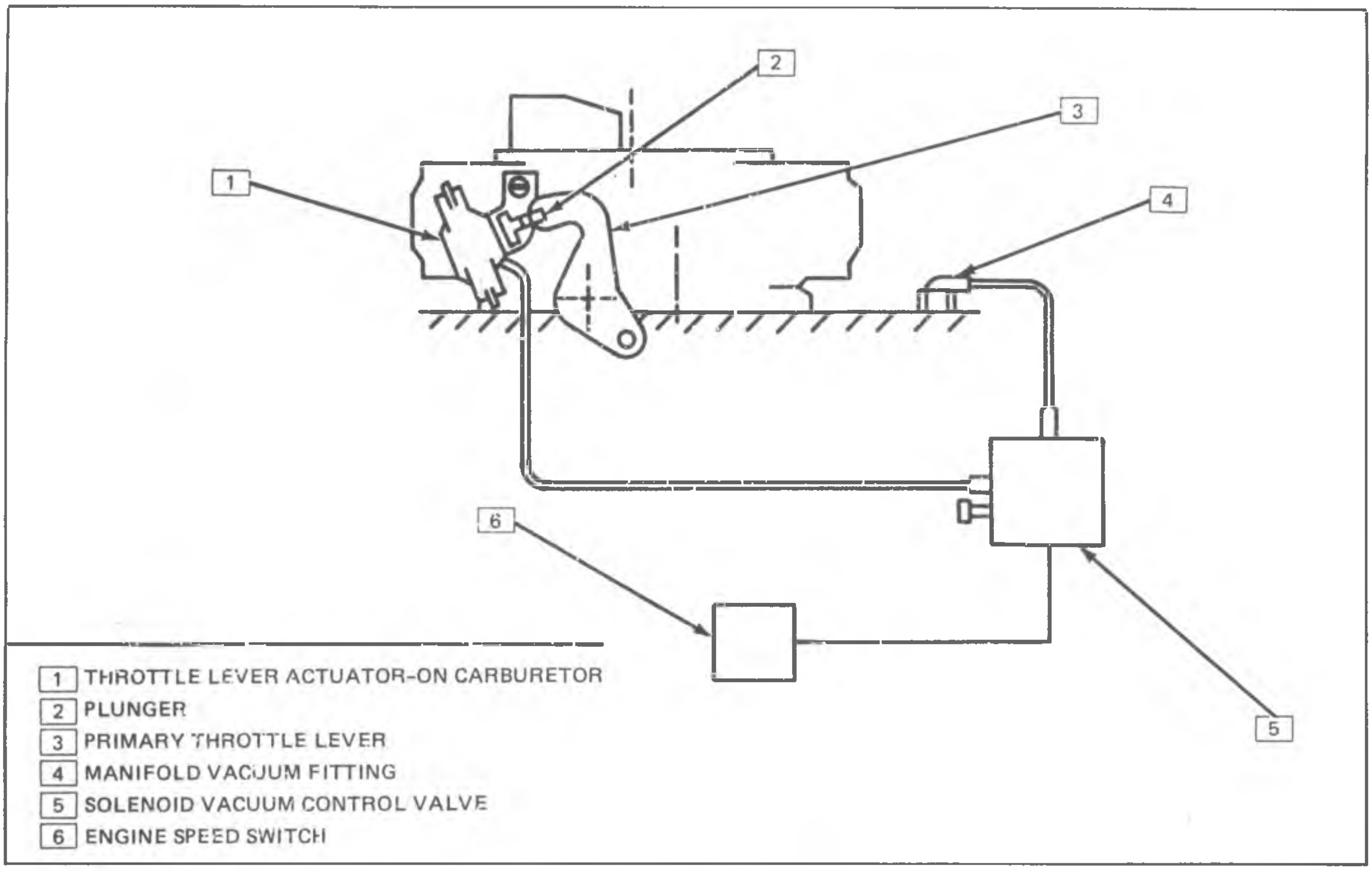


Figure 115 Throttle Return Control System

b. Start engine and run until warmed up and idle is stable. Note idle rpm.

c. Apply 68 kPa (20″) vacuum to the actuator. Manually open the throttle slightly and allow to close against the extended actuator plunger. Note the engine rpm.

d. Release and reapply 68 kPa (20″) vacuum to the actuator and note the rpm to which the engine speed increased (do not assist the actuator).

e. If the rpm obtained in Step "D" is not within 150 rpm of that obtained in Step"C", then the actuator plunger may be binding due to dirt, corrosion, varnish, etc., or the actuator diaphragm may be too weak. If binding is not indicated or cannot be corrected, then the actuator must be replaced.

f. Release the vacuum from the actuator and the engine speed should return to within 50 rpm of the idle speed noted in STep 2. If it does not, the plunger may be binding due to dirt, corrosion, varnish, etc. If the problem cannot be corrected, the actuator must be replaced.

g. If the engine rpm noted in Step 3 is not within the specified TRC speed range, the TRC actuator must be adjusted. See Throttle Lever Actuator Adjusting Procedure (Figure 116).

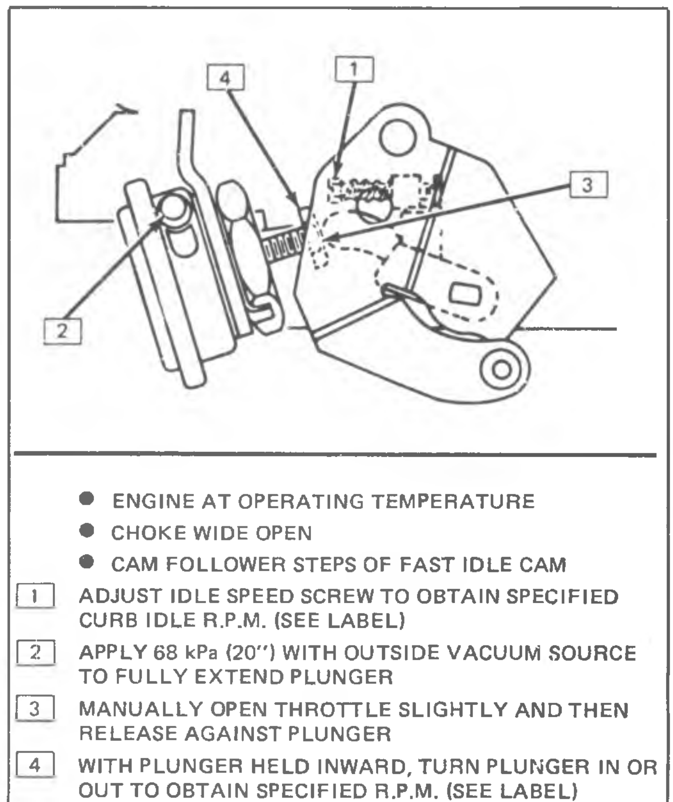


Figure 116 Throttle Lever Actuator Adjustment

ON-VEHICLE SERVICE

ENGINE SPEED SWITCH

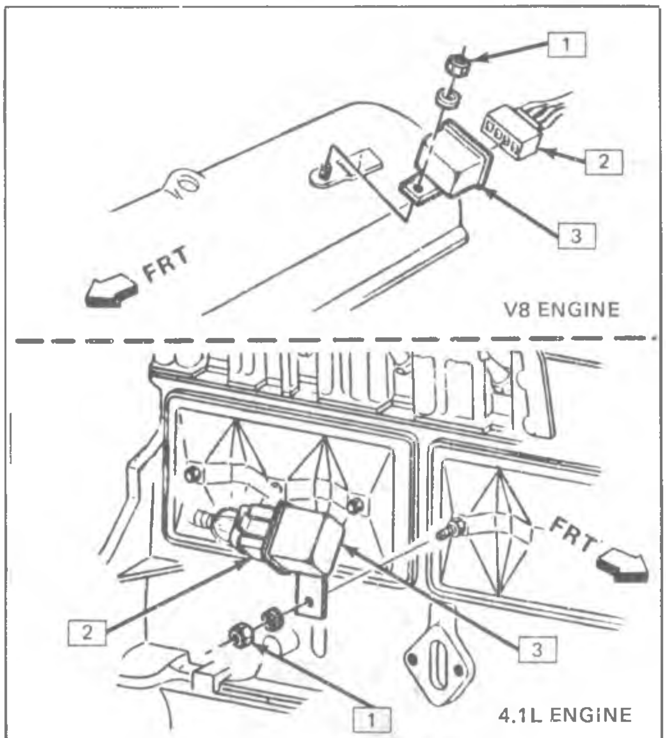
Figure 117

Remove or Disconnect

1. Electrical connector.
2. Engine speed switch.

Install or Connect

1. Engine speed switch.
2. Electrical connector.



1	NUT—TIGHTEN TO 28 N·m (20 FT. LBS.)
2	ELECTRICAL CONNECTOR
3	ENGINE SPEED SWITCH

Figure 117 Engine Speed Switch

SOLENOID VACUUM CONTROL VALVE

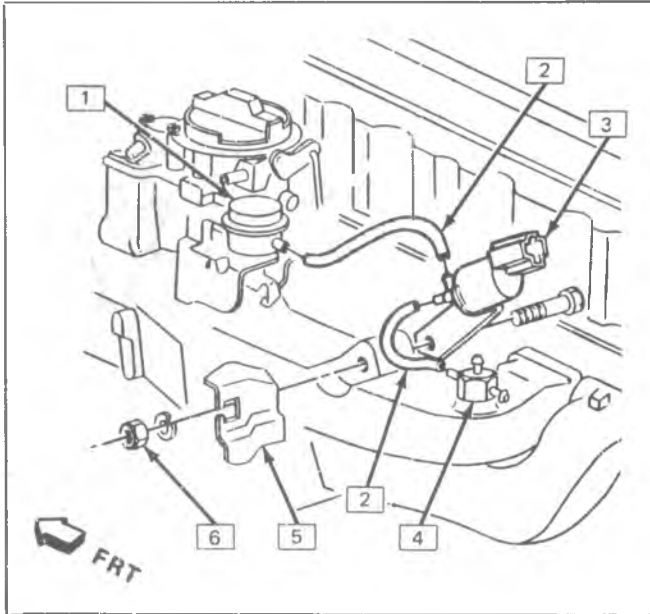
Figures 118 and 119

Remove or Disconnect

1. Electrical connector
2. Vacuum hoses
3. Solenoid vacuum control valve

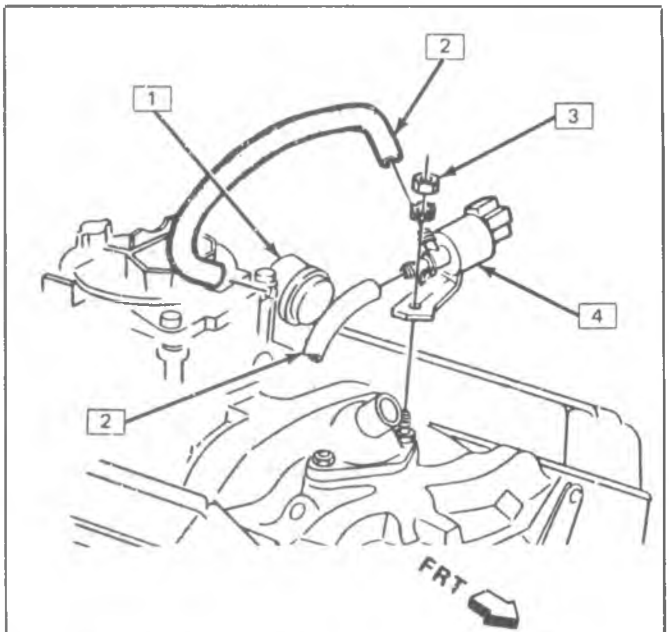
Install or Connect

1. Solenoid vacuum control valve
2. Vacuum hoses
3. Electrical connector.



1	THROTTLE LEVER ACTUATOR
2	VACUUM HOSE
3	SOLENOID VACUUM CONTROL VALVE
4	MANIFOLD VACUUM FITTING
5	ACCELERATOR SUPPORT
6	NUT—TIGHTEN TO 34 N·m (25 FT. LBS.)

Figure 118 Solenoid Vacuum Control Valve-4.1L



1	THROTTLE LEVER ACTUATOR
2	VACUUM HOSE
3	NUT TIGHTEN TO 28 N·m (20 FT. LBS.)
4	SOLENOID VACUUM CONTROL VALVE

Figure 119 Solenoid Vacuum Control Valve - V8

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

GENERAL DESCRIPTION

PURPOSE

The basic Evaporative Emission Control System (EECS) used on all vehicles is the charcoal fuel vapor canister storage method (see Figure 120). This method transfers fuel vapor from the fuel tank and carburetor float bowl to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

VAPOR CANISTER, PRIMARY

Figure 120

The basic large size, two chamber closed bottom Canister operates as follows:

Gasoline vapors from the fuel tank flow into the tube labeled "Fuel Tank", and vapors from the carburetor float bowl flow into the tube labeled "CARB BOWL", and are absorbed by the carbon. The canister is purged when the engine is running above idle speed. The closed bottom design keeps water from entering the bottom of the canister, freezing, and restricting purge air flow. During purge, air is drawn from the clean side of the air cleaner, to the tube on the canister labeled "AIR CLNR", through the carbon and into the intake manifold to be burned. Some closed bottom canisters draw purge air directly from the atmosphere.

VAPOR CANISTER, AUXILIARY

Figure 121

An Auxiliary Fuel Vapor Canister is added to a primary closed bottom canister to increase capacity when dual fuel tanks are used. On the bottom is a hose which connects to the primary canister's purge air inlet. On top is a purge air inlet. Vapor overflowing

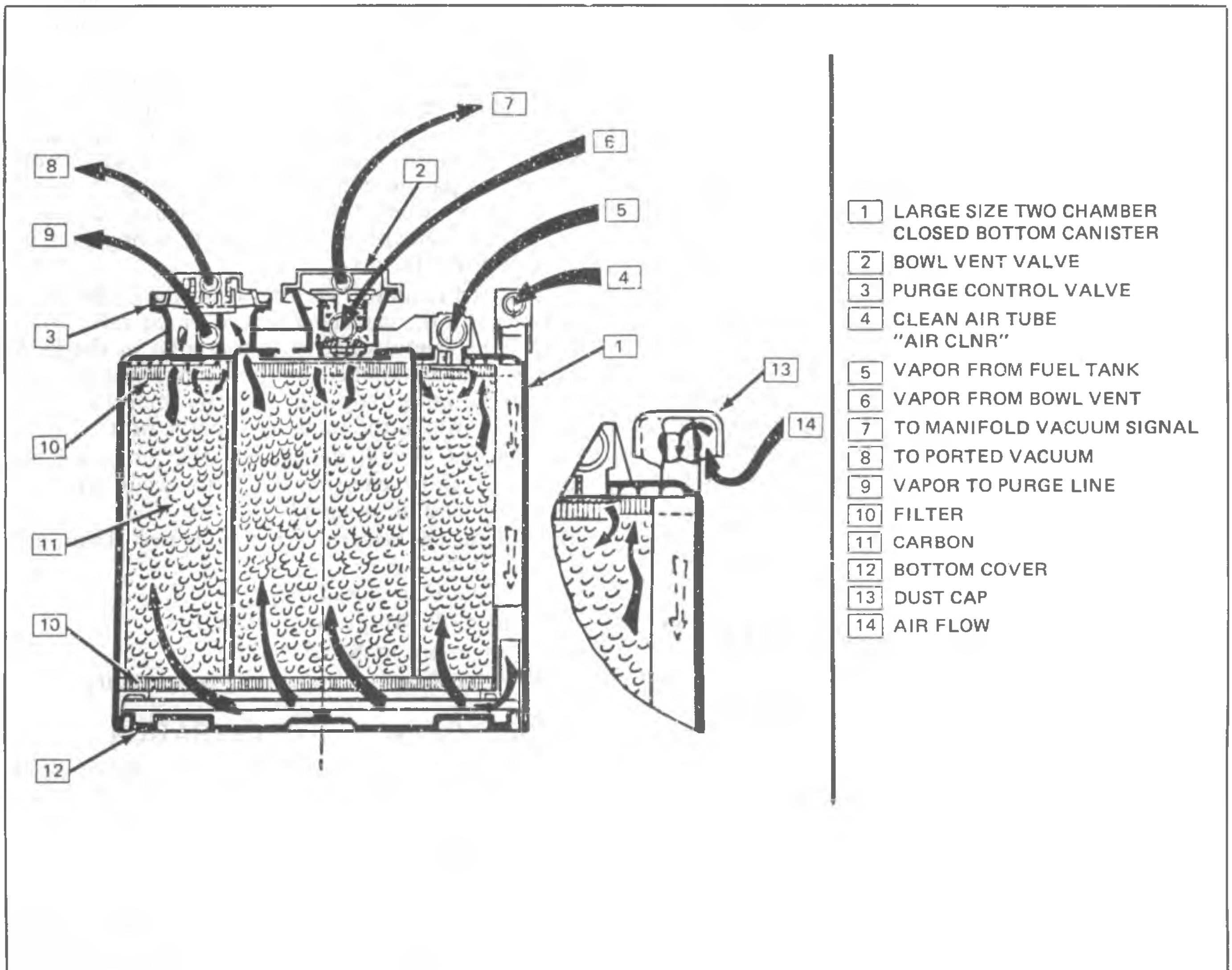
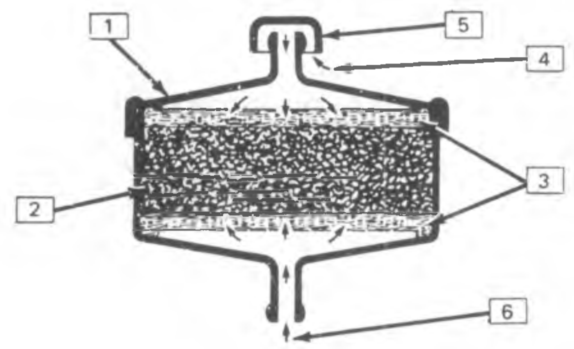


Figure 120 Vapor Canister - Two Chamber Closed Bottom



1 AUXILIARY CANISTER
2 CARBON
3 FILTERS
4 AIR FLOW DURING PURGE
5 DUST CAP
6 VAPOR FROM PRIMARY CANISTER

Figure 121 Auxiliary Vapor Canister

from the primary canister is stored in the auxiliary canister. During purge, vapor flows through the auxiliary canister, the primary canister and into the intake manifold for burning during combustion.

CANISTER PURGE CONTROL VALVE

The Purge Valve is a spring-biased diaphragm valve, normally closed, which allows or prevents purging of the canister. When the engine is off or idling, the spring holds the valve closed, preventing canister purge. When the engine is off-idle, however, timed manifold vacuum pulls the diaphragm upward, opening the valve and allowing the canister to be purged.

VAPOR VENT CONTROL VALVE

The vapor vent control valve prevents venting of the carburetor float bowl during engine operation. A spring-biased diaphragm valve, normally open, allows (or prevents) fuel vapors from the float bowl to enter the canister. When the engine is off, spring tension holds the valve open, allowing normal venting. When the engine is turned on, however, manifold vacuum pulls the diaphragm up to close the valve.

EVAPORATIVE EMISSION SYSTEM-NON-ECM CONTROLLED

4.1L-LE3, 4.8L-L25 Cal, 5.0L-LE9 Fed, 5.7L-LS9 Fed, 5.7L-LT9 Cal Engines

Figures 122 or 123

These systems use the following control valves:

- Purge control valve mounted on the canister
- Vapor vent valve mounted on the canister.
- A thermal bowl vent valve (some applications)
- A thermostatic vacuum switch (TVS) installed in the intake manifold to sense engine coolant temperature.

When the engine is shut off, manifold vacuum is lost at the vapor vent valve. The springloaded valve in the vapor vent valve now connects the carburetor bowl vent to the canister. Carburetor float chamber vapors now pass into the canister for storage. When the engine is restarted, manifold vacuum draws the vapor vent controlling valve against spring pressure, closing off the bowl vent. Ported vacuum from the carburetor is connected to the TVS. When the TVS opens ported vacuum opens the purge control valve. When the valve opens, manifold vacuum draws vapors from the canister into the intake manifold.

The thermal bowl vent valve (TBVV) is located in the section of hose that connects the carburetor bowl vent fitting to the canister control valve.

The TBVV will close and prevent vapor movement at 32°C (90°F) and below. The TBVV will open at 49°C (120°F) to permit vapor flow to the canister control valve.

EVAPORATIVE EMISSION SYSTEM-ECM CONTROLLED

Figure 123

The controlling valves in this system are:

- Purge control valve mounted on the canister.
- Vapor vent valve mounted on the canister.
- Canister purge solenoid valve controlled by the ECM.

When the engine is shut off, full manifold vacuum is lost at the vapor vent valve. The springloaded valve in the vapor vent valve now connects the carburetor bowl vent to the canister. Carbureter float chamber vapors now pass into the canister for storage. When the engine is restarted, full manifold vacuum draws the vapor vent controlling valve against spring pressure, closing off the bowl vent.

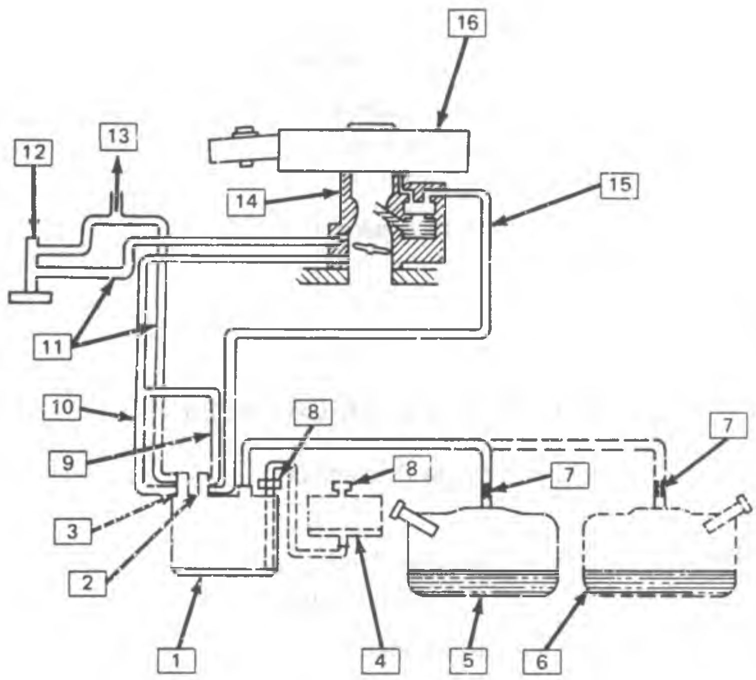
Ported manifold vacuum from the carburetor is connected to the canister purge solenoid valve. When the purge solenoid valve is de-energized by the ECM, vacuum will be applied to the canister purge valve, causing the valve to open and vapors from the canister to purge through the carburetor purge port.

The ECM will de-energize the purge solenoid valve and allow canister purge to occur when the following conditions have been met:

- Engine has been running for a period of time after starting.
- System is in closed loop.
- Engine RPM above idle speed.
- System not in ALCL mode.
- Engine at normal operating-temperature.

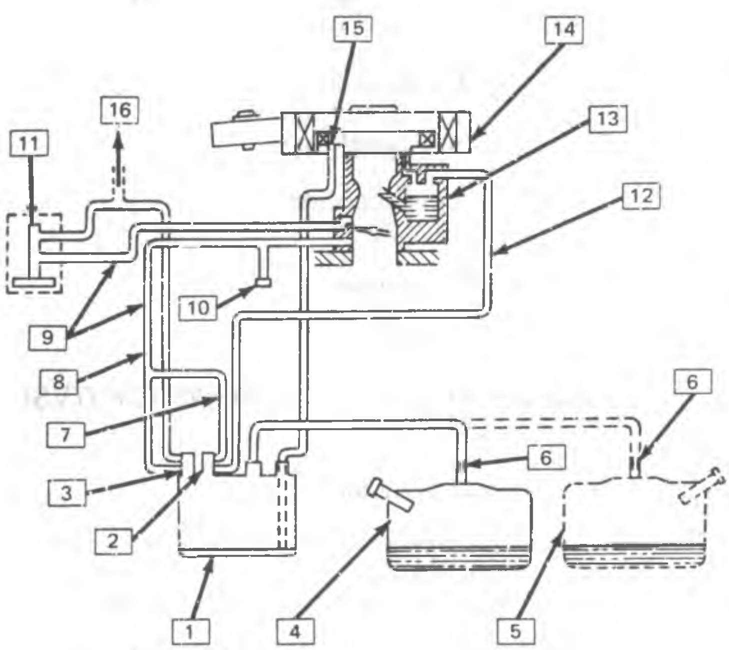
RESULTS OF INCORRECT OPERATION

- Poor idle, stalling and poor driveability can be caused by:
  - Inoperative bowl vent valve
  - Inoperative purge valve
  - Damaged canister
  - Hoses split, cracked and, or, not connected to the proper tubes.
- Evidence of fuel loss or fuel vapor odor can be caused by:
  - Liquid fuel leaking from fuel lines, fuel pump or carburetor
  - Cracked or damaged canister



1 CANISTER
2 BOWL VENT VALVE
3 CANISTER PURGE VALVE
4 AUX FUEL VAPOR CANISTER
PICK UPS WITH AUX. FUEL TANK
VANS WITH 33 GALLON FUEL TANK
5 FUEL TANK
6 AUX FUEL TANK
7 FUEL TANK VENT LINE RESTRICTION
8 VENT
9 VACUUM SIGNAL FOR BOWL VENT
10 VAPOR PURGE LINE
(FULL MANIFOLD VACUUM)
11 PORTED MANIFOLD VACUUM
12 TVS
13 TO EGR VALVE
14 CARBURETOR
15 CARBURETOR BOWL VENT LINE
16 AIR CLEANER

Figure 122 Evaporative Emission System-L6



1 CANISTER
2 BOWL VENT VALVE
3 CANISTER PURGE VALVE
4 FUEL TANK
5 AUX. FUEL TANK
6 FUEL TANK VENT LINE RESTRICTION
7 VACUUM SIGNAL FOR BOWL VENT VALVE
8 VAPOR PURGE LINE (FULL
MANIFOLD VACUUM)
9 PORTED MANIFOLD VACUUM
10 PCV VALVE
11 TVS–FEDERAL APPLICATIONS ELECTRIC
PURGE SOLENOID–CALIFORNIA
12 CARBURETOR BOWL VENT LINE
13 CARBURETOR
14 AIR CLEANER
15 FUEL VAPOR CANISTER VENT
16 TO EGR VALVE AND TCC

Figure 123 Evaporative Emission System-V8

- Inoperative bowl vent valve
- Inoperative purge valve
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses
- Bowl vent hose misrouted
- Air cleaner or air cleaner gasket improperly seated

DIAGNOSIS

The canister purge solenoid valve operation is covered in **CHART C-3** at the end of this section.

FUEL VAPOR CANISTER

- Visual check of fuel vapor canister.
  - Cracked or damaged, replace canister.
  - Fuel leaking from bottom of canister. Replace canister and check operation of total system.
- Refer to CHART C-3, Canister Purge Check for California canister purge controlled by a solenoid.

Functional Test - Canister Vapor Vent Valve

Apply a short length of hose to the carburetor bowl vapor tube of the canister (lower tube), and blow into it, to determine that air will pass the vapor vent valve into the canister. If not possible to blow into the canister, it must be replaced.

With a hand vacuum pump, apply vacuum 51kPa (15″ Hg) to the vacuum signal tube on the diaphragm assembly cover. The diaphragm should hold vacuum for at least 20 seconds. If it does not, diaphragm is leaking, and the canister must be replaced.

With vacuum still applied to the vacuum signal tube, again attempt to blow into the carburetor bowl vapor tube of the canister. Now air should not pass the vapor vent valve into the canister, indicating that the valve is sealing properly. If air does enter the canister past the vapor vent valve, the valve is not functioning properly, and the canister must be replaced.

Functional Test - Canister Purge Control Valve

Apply a short length of hose to the PCV tube of purge valve assembly (lower tube), and attempt to blow through it. Little or no air should pass into the canister. (A small amount of air will pass if the canister has a constant purge hole.)

With a hand vacuum pump, apply vacuum 51kPa (15″ Hg) through the control vacuum signal tube to the purge valve diaphragm. If the diaphragm does not hold vacuum for at least 20 seconds, the diaphragm is leaking, and the canister must be replaced.

If the diaphragm holds vacuum, again try to blow through the hose connected to the PCV tube while vacuum is still being applied. An increased flow of air should be observed. If not, the canister must be replaced.

ON-VEHICLE SERVICE

CANISTER

←→ Remove or Disconnect

1. Hoses from canister
2. Screw from bracket
3. Canister

→← Install or Connect

1. Canister
2. Screw
3. Hoses to canister

AUXILIARY VAPOR CANISTER

←→ Remove or Disconnect

1. Hose
2. Screws from fender skirt
3. Auxiliary vapor canister

→← Install or Connect

1. Auxiliary vapor canister
2. Screws
3. Hose

CANISTER HOSES

Refer to Vehicle Emission Control Information label for routing of canister hoses.

When replacing hoses, use hose meeting GM Specification 6148M or its equivalent.

SOLENOID VALVE

←→ Remove or Disconnect

1. Electrical connector
2. Solenoid Valve

→← Install or Connect

1. Solenoid valve.
2. Electrical connector.

THERMOSTATIC VACUUM SWITCH (TVS) REPLACEMENT

←→ Remove or Disconnect

1. Drain coolant below level of TVS.
2. Vacuum hoses.
3. Thermostatic vacuum switch (TVS).

OFF-VEHICLE CHECK OF THERMAL VACUUM SWITCHES

Thermal vacuum switches open, close, or switch vacuum sources when the calibration temperature is reached. The following general checking procedures can be used for all thermal vacuum switches. Refer to number stamped on base of valve or switch for calibration temperature.

1. Allow TVS to cool below calibration temperature.
2. Inspect switch to make sure it is in good condition.
3. Connect vacuum gage(s) to output port(s) of the TVS. (See vacuum hose schematic on Vehicle Control Emission Information label.)
4. Compare vacuum gage reading(s) with the procedures and in the TVS descriptions given under each valve name.
5. Heat TVS to a temperature above the calibration temperature. Never apply a torch or open flame directly to the TVS.
6. Compare vacuum gage reading to the correct reading indicated on switch or valve base.

NOTICE: Leakage of up to 7 kPa (2" HG) vacuum in 2 minutes is allowable and does not mean a defective part.

7. If operation is satisfactory, reinstall valve or switch. If valve or switch is defective, replace with a new part.

Install or Connect

1. Thermostatic vacuum switch with soft setting sealant applied to male threads. Sealant should not be on end of TVS.
2. Tighten to 14 N·m (120 in. lbs.) then turn clockwise as required to align with hoses.
3. Vacuum hoses.
4. Add coolant as required.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Solenoid, Fuel Vapor Canister	3.140

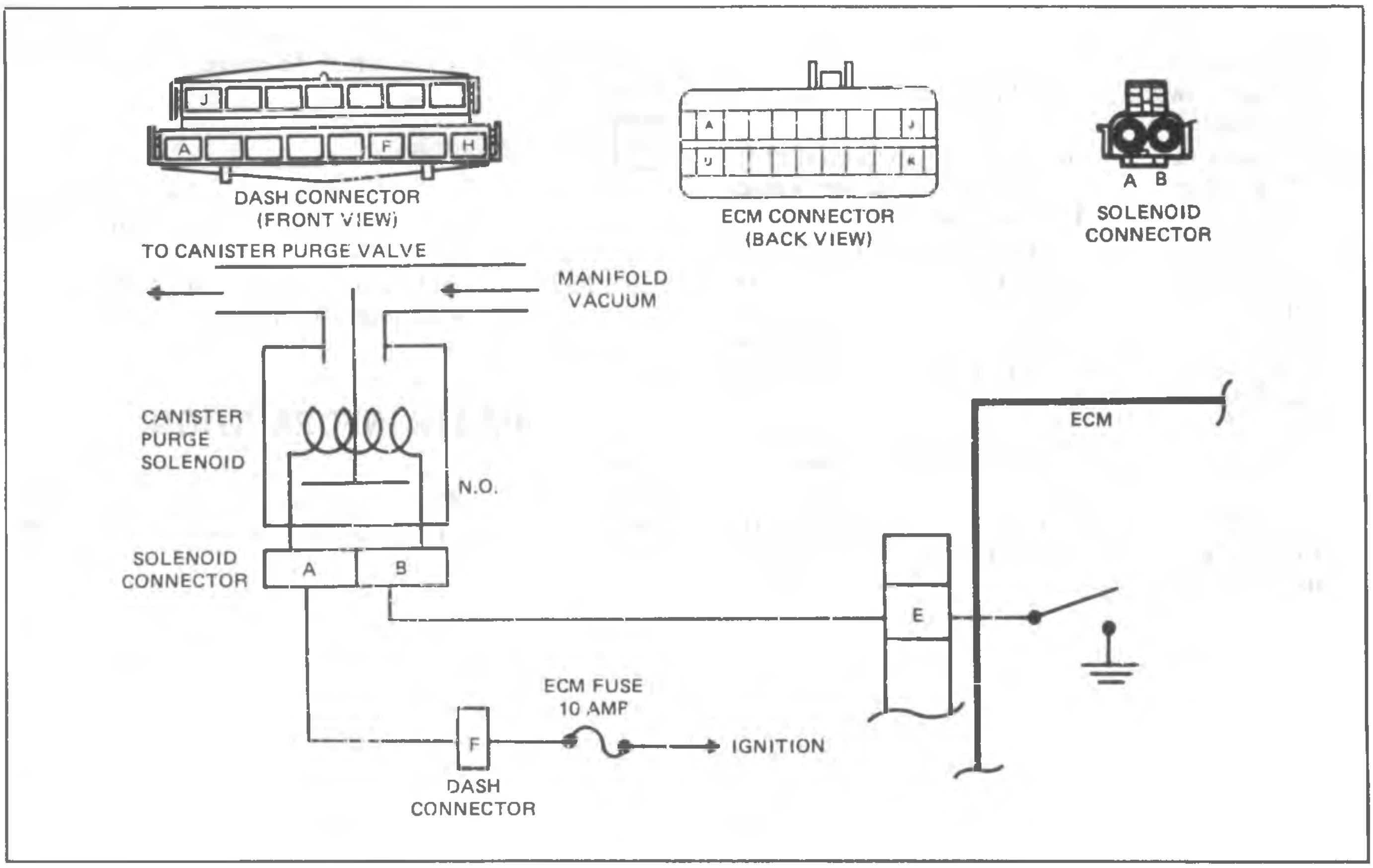


Figure 124 Wiring Diagram - CHART C-3

CHART C-3, CANISTER PURGE CHECK

5.0L (LF3) Calif and 5.7L (LS9) Calif

Canister purge is controlled by a solenoid that allows manifold vacuum to purge the canister when de-energized. The ECM supplies a ground to energize the solenoid (purge off). The solenoid is energized (no purge) by grounding the test terminal with the ingition "ON" and engine stopped, or with the engine running if the following are met:

- Engine run time less than specified.
- Coolant temperature below a given value.
- Vehicle speed below a given value.
- TPS below a given value.

If the above are not met, the purge solenoid should be de-energized, that is purge "ON".

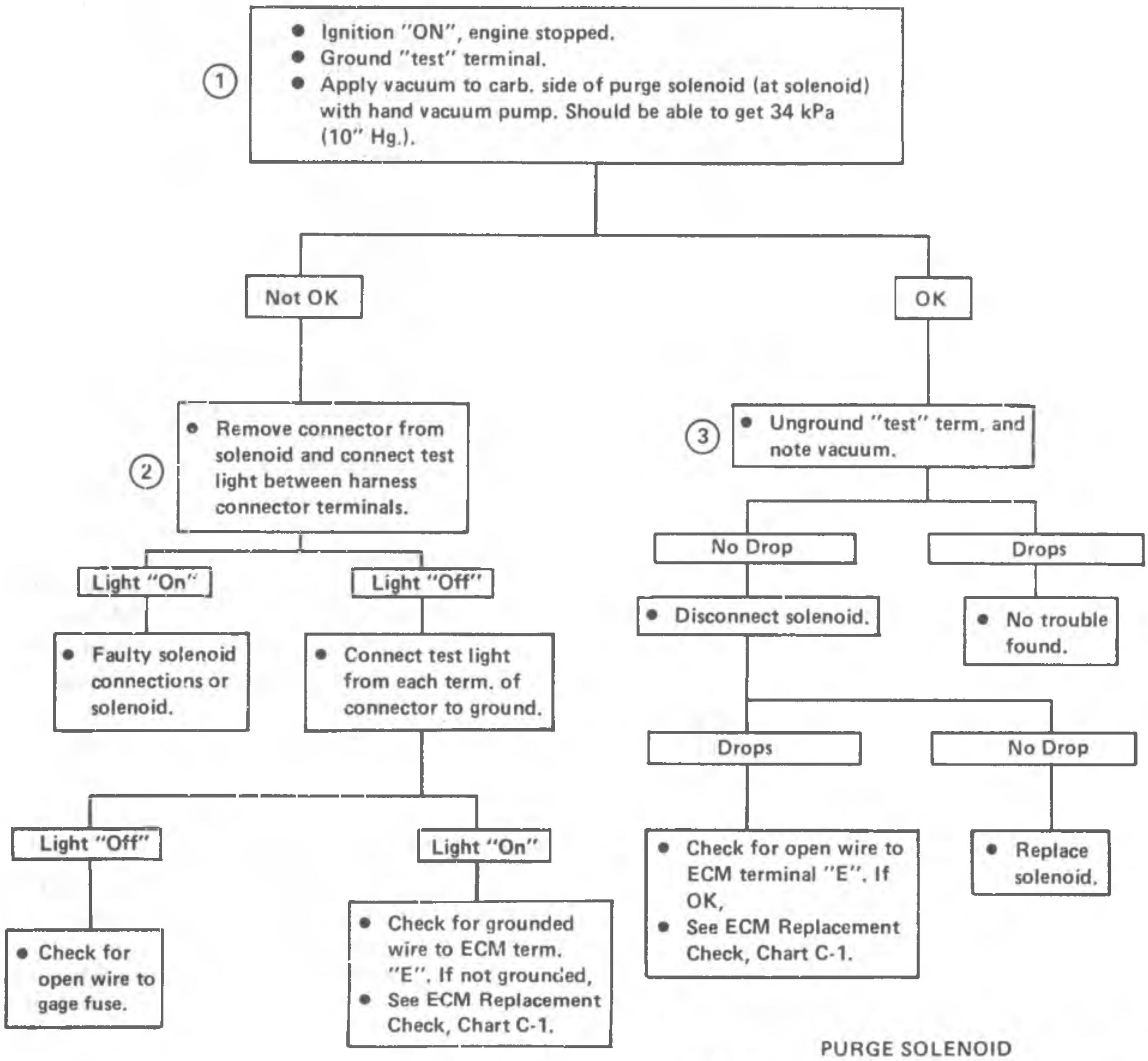
1. Checks to see if solenoid is energized and will not allow vacuum to pass.

2. Checks to see if signal to energize solenoid (Light "ON") is present at the solenoid. Light "ON" is normal and would indicate no fault in ECM or circuit to solenoid.

3. Checks to see if solenoid passes vacuum when test terminal is un-grounded (solenoid de-energized). It should open and keep the pump from building up a vacuum.

1984 CCC
CHART C-3
CANISTER PURGE VALVE CHECK

Check purge hose condition and connections. Repair as necessary:



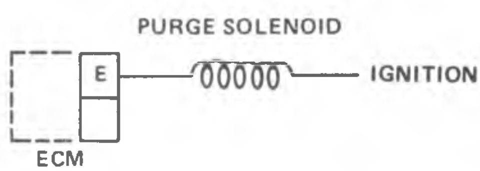


Figure 125 Canister Purge Valve Diagnosis - CHART C-3

ELECTRONIC SPARK TIMING (EST) SYSTEM

GENERAL DESCRIPTION

PURPOSE

The High Energy Ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the ECM controls distributor spark advance (timing) with the Electronic Spark Timing (EST) system.

Only the Electronic Spark Timing (EST) system (Figure 127) will be described here. Additional information on the HEI system is found in Section 6D.

GENERAL DESCRIPTION

The high energy ignition (HEI) system (described in Section 6D) with EST has a seven terminal module. Two different module terminal arrangements are used depending on the distributor (Figure 126).

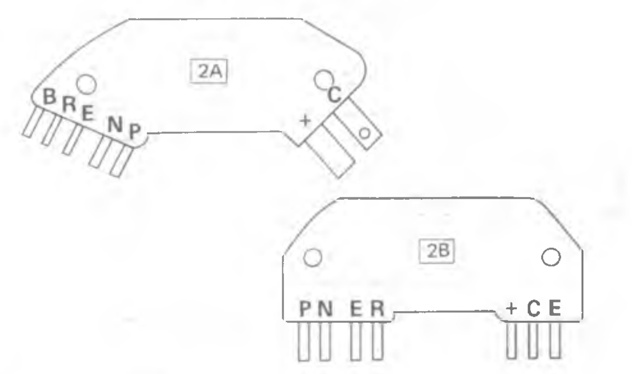


Figure 126 EST Distributor Modules

To properly control ignition/combustion timing the ECM needs to know

- crankshaft position
- engine speed (rpm)
- engine load (manifold pressure or vacuum)
- atmospheric (barometric) pressure
- engine temperature

The EST system consists of the distributor module, ECM, and connecting wires. The distributor has four wires from the HEI module connected to a four terminal connector which mates with a four wire connector from the ECM. The connector terminals are lettered as shown in Figure 0396.

These circuits perform the following functions:

- Distributor reference - terminal B

  This provides the ECM with RPM and crankshaft positon information.
- Reference ground - terminal D

  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.
- By-Pass - terminal C

  At about 400 RPM, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.
- EST - terminal A

  This circuit triggers the HEI module. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the entire spark curve will be incorrect.

  An open in the EST circuit will set a Code 42 and cause the engine to run on the HEI module timing. This will cause poor performance and poor fuel economy. A ground may set a Code 42, but the engine will not run.

The ECM uses information from the MAP or vacuum and coolant sensors in addition to RPM to calculate spark advance as follows.

Low MAP output voltage (high vacuum sensor output voltage) = more spark advance

Cold Engine = more spark advance

High Vacuum Sensor Output Voltage = more spark advance

Low Vacuum Sensor Output Voltage = less spark advance

Hot Engine = less spark advance

Results of Incorrect EST Operation

Detonation could be caused by low MAP output, (high vac. sensor output), or high resistance in the coolant sensor circuit.

Poor performance could be caused by low VAC sensor output) or low resistance in the coolant sensor circuit.

How Code 42 is Determined

When the system is running on the HEI module, that is, no voltage on the by-pass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the RPM for EST is reached (about 400 RPM) the ECM applies 5 volts to the by-pass line and the EST should no longer be grounded in the HEI module so the EST voltage should be varying.

If the by-pass line is open, the HEI module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the HEI module will switch to EST but because the line is grounded there will be no EST signal and the engine will not run. A Code 42 may or may not be set.

DIAGNOSIS

The description, operation and further diagnosis of the HEI system can be found in Section 6D.

IGNITION SYSTEM CHECK

Refer to Integral coil, **Chart C-4A** .

EST PERFORMANCE CHECK

Refer to EST Performance Check, **Chart C-4C.**

ON-VEHICLE SERVICE

SETTING TIMING

Set timing according to instructions on Vehicle Emission Control Information label.

PARTS INFORMATION

PART NAME	GROUP
Sensor, Coolant Temp (6)	1.150
Sensor, M.A.P. (1 ATMS) (7)	3.670
Controller, ECM (Remanufactured) (1)	3.670
Distributor (12)	2.361
Module, Distr (2)	2.383
Coil, Distr (4)	2.170

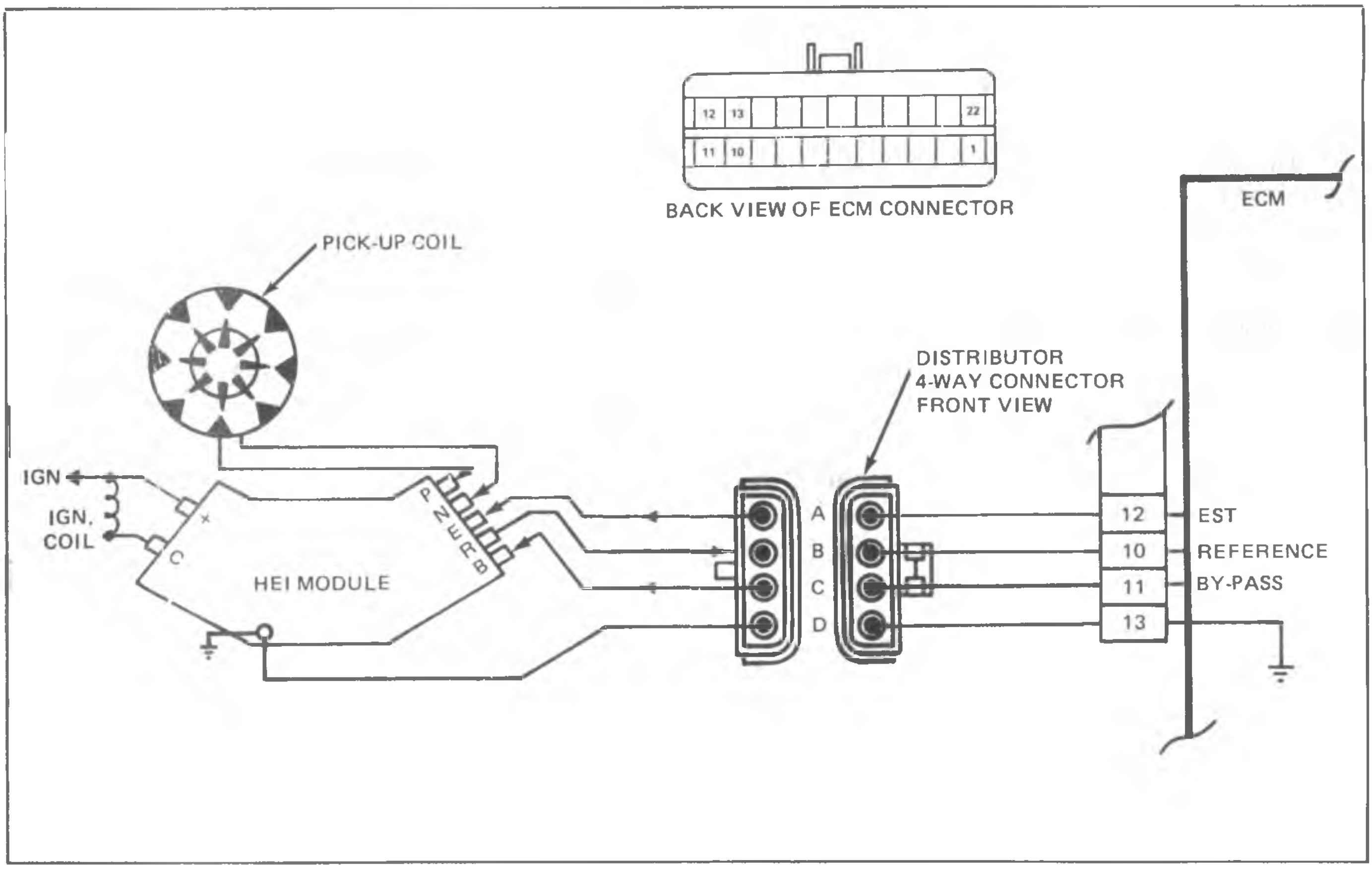


Figure 127 Wiring Diagram - CHART C-4A

CHART C-4A, IGNITION SYSTEM CHECK (INTEGRAL COIL)

1. Checks for proper output from the ignition system. The ST-125 requires a minimum of 25, 000 volts to fire. This check can be used in case of an ignition miss because the system may provide enough voltage to run the engine but not enough to fire a spark plug under heavy load.

1A. If the engine will start with the connector disconnected, it indicates the problem is related to the EST circuit. The problem would usually be a grounded EST line or no ground to the ECM.

2. Normal reading during cranking is about 9-10 volts.

3. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned off so normal voltage should be about 12 volts. If the module is turned "ON", the voltage would be low but above 1 volt. This could cause the ignition coil to fail from excessive heat.

   With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach terminal.

4. Checks the voltage output with the pick-up coil triggering the module. A spark says the ignition system has enough output, but intermittent no-starts or poor performance can result if the polarity of the ignition coil and pick-up coil is not correct.

   The color of the pick-up coil connector has to be yellow if one of the ignition coil leads is yellow. If the ignition coil has a white lead, any pick-up coil connector color **except** yellow is OK.

5. Checks for an open module or circuit to it. 12 volts applied to the module "P" terminal should turn the module "ON" and the voltage should drop to about 7-9 volts.

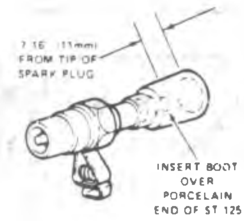
6. This should turn off the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

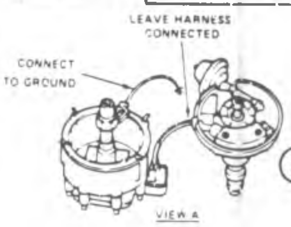
1984 CCC
CHART C-4A
IGNITION SYSTEM CHECK
(WITH INTEGRAL IGNITION COIL)

NOTE: Perform Diagnostic Circuit Check before using this procedure.
If a tachometer is connected to the tachometer terminal, disconnect it before proceeding with the test.
Intermittent no start may be caused by wrong pick-up or ignition coil.

1. Check spark at plug with ST-125 while cranking (if no spark on one wire, check a second wire). *
   - Spark → Check fuel, spark plugs, etc.
   - No Spark → 1A

1A. Disconnect 4 term. EST connector and see if engine will run.
   - Doesn't run → 2
   - Runs → See Code 42 chart.



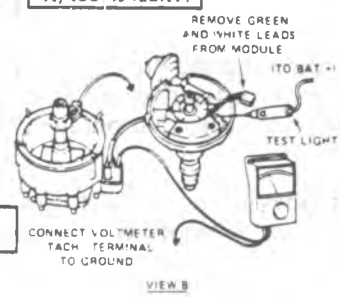


2. Check voltage at distributor "bat" terminal while cranking
   - 7 volts or more → 3
   - Under 7 volts → Repair primary circuit to ignition switch.

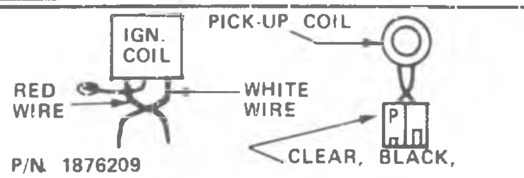
3. With ignition "on," check "tach" terminal voltage.
   - Under 1 Volt → It is faulty ign. coil connection or coil
   - 10 Volts or More → 4
   - 1 to 10 Volts → Replace module and check for spark from coil as in Step 6.
     - Spark → System OK
     - No Spark → Replace ign. coil. It, too, is faulty.

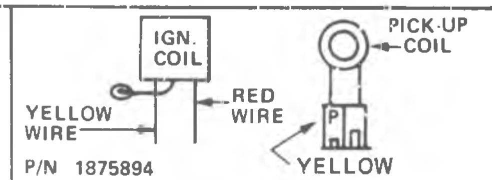
4. Check for spark at coil output terminal with ST-125 while cranking. (View A)
   - Spark → Check color match of pick-up coil connector and ign. coil lead. ** Inspect cap for water, cracks, etc. If OK replace rotor.
   - No Spark → 5

5. Remove pick-up coil leads from module Check tach. term. voltage with "ign" "on." Watch voltmeter as test light is momentarily connected from bat. + to module terminal "P". (View B) Not more than 5 seconds
   - No Drop In Voltage → Check module grnd. and for open in wires from cap to distributor. If OK, replace mod.
   - Voltage Drops → 6



6. Check for spark from coil with ST-125 as test light is removed from module terminal.
   - No Spark
     - If module tester is available, test module
       - OK → Check ign. coil ground. If OK, replace ign. coil.
       - Bad → Replace module
     - If no module tester is available → Check ign. coil ground circuit. If OK, replace ign. coil and repeat Step 6.
       - Spark → System OK
       - No Spark → Coil removed is OK, reinstall original coil and replace module.
   - Spark → It is pick-up coil or connections. Coil resistance should be 500-1500 ohms and not grounded.





* A few sparks and then nothing, is considered no spark.

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Figure 128 Ignition System Check (Integral Coil) - CHART C-4A

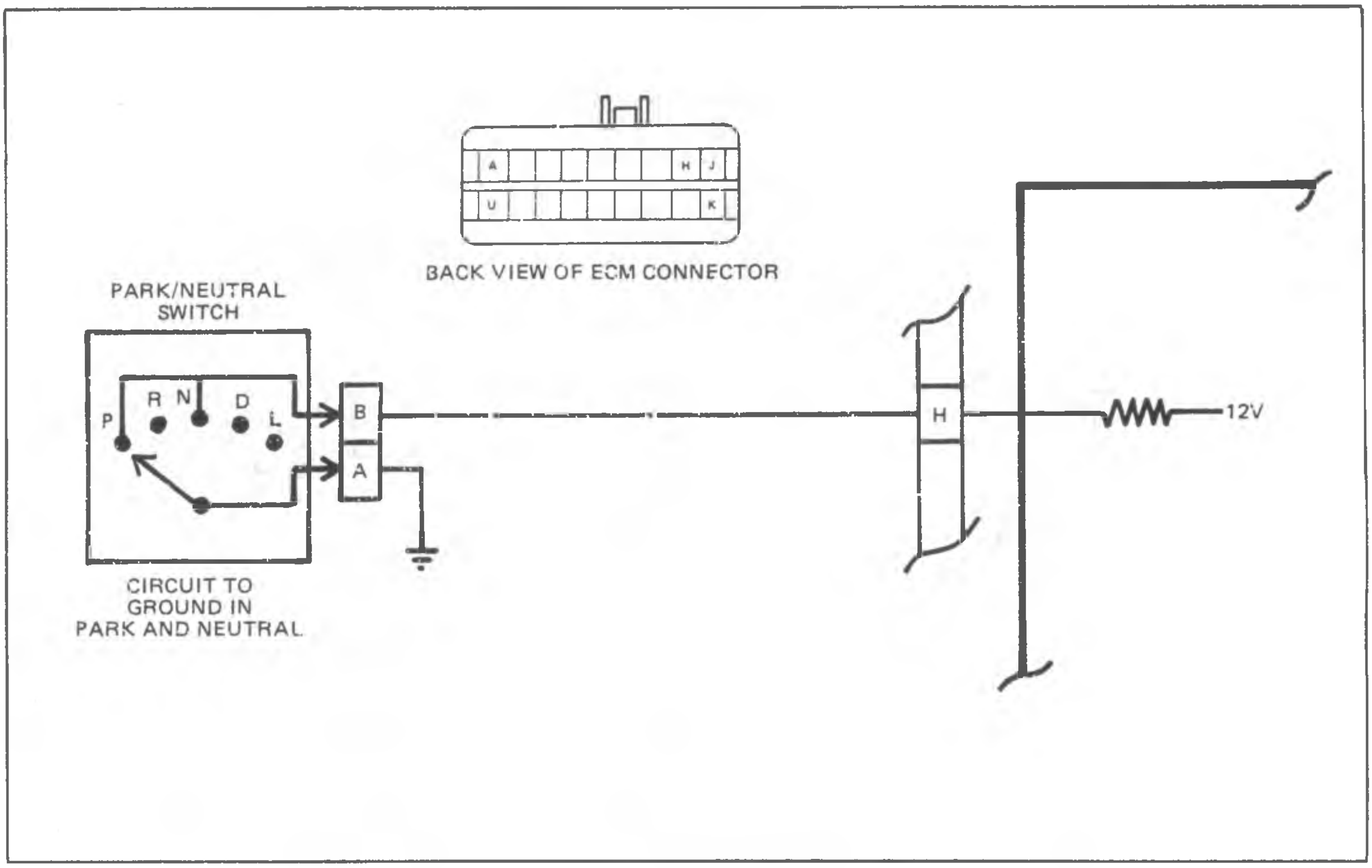


Figure 129 Wiring Diagram - CHART C-4C

CHART C-4C, EST PERFORMANCE CHECK

1. Grounding the "test" terminal causes the system to go to a fixed spark advance which should be different from that obtained with EST operating.

   Engine is run at fast idle to get more spark advance. Usually the change is enough so it can be heard in RPM change. If so, it is not necessary to check timing.
2. The check in drive is made because some engines will not have EST operating in P/N.
3. Checks to see if fault is in MAP/VAC system.

1984 CCC
CHART C-4C
EST PERFORMANCE CHECK

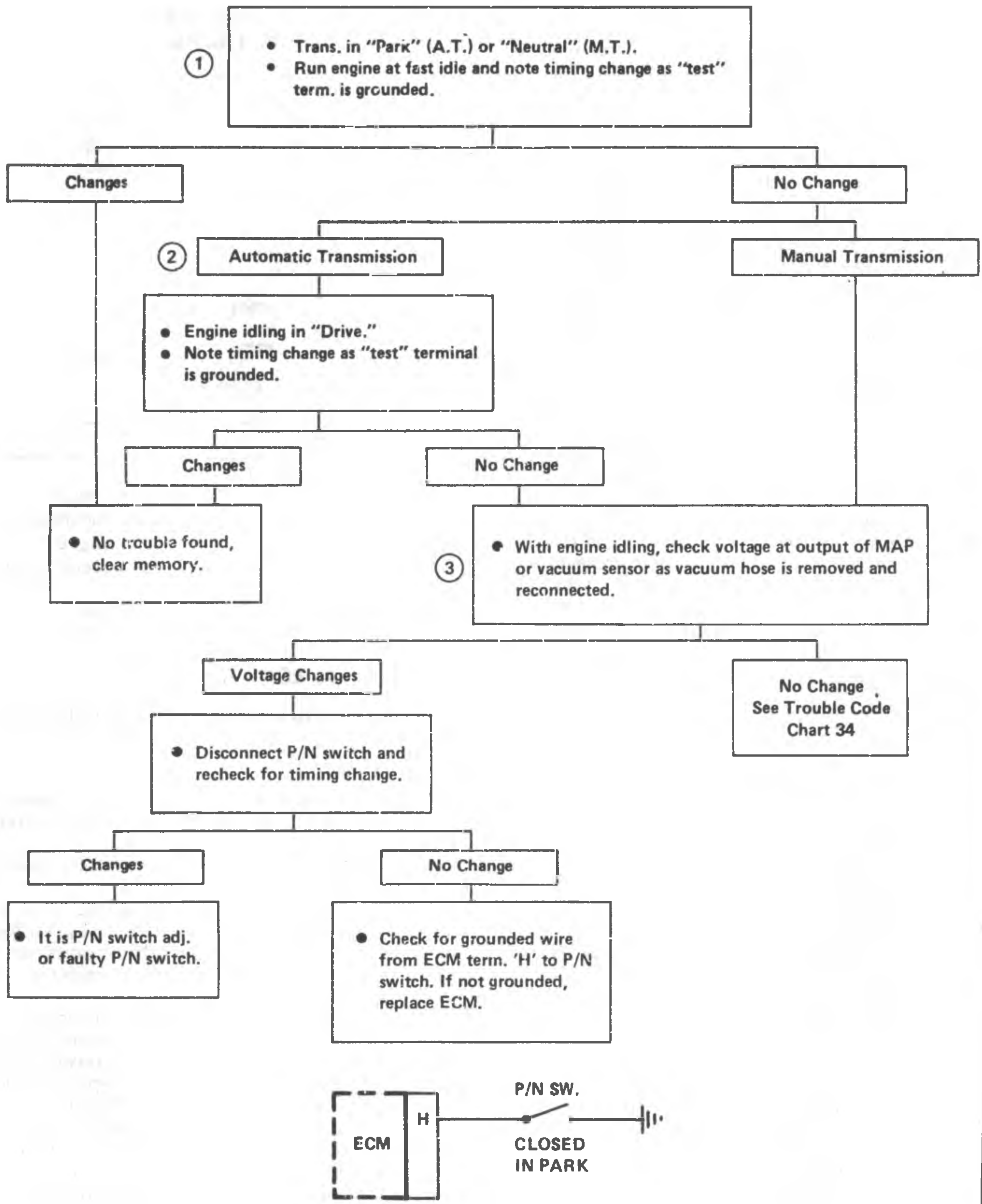


Figure 129A EST Performance Check - CHART C-4C

AIR INJECTION REACTION (A.I.R.) SYSTEM

GENERAL DESCRIPTION

PURPOSE

This system is used to reduce carbon monoxide (CO), and hydrocarbon (HC) emissions. The air injection reaction (AIR) system provides additional oxygen to continue the combustion process after the exhaust gases leave the combustion chamber. A belt driven air pump provides pressurized air which is injected into the exhaust port of the cylinder head or exhaust pipe and then into the exhaust system. The AIR system operates at all times and will bypass air only for a short duration of time during deceleration and at high speeds. A diverter valve performs a bypass function, and the check valve protects the air pump from damage by preventing a back flow of exhaust gas.

The system includes an air pump, a control valve, check valves, and necessary plumbing.

A.I.R. PUMP OPERATION

- The air pump is driven by a belt on the front of the engine and supplies the air to the system.
- Intake air passes through a centrifugal filter fan at the front of the pump, where foreign materials are separated from the air by centrifugal force.
- Air flows from the pump through a control valve to a check valve. The check valve prevents back flow of exhaust into the pump in the event of an exhaust backfire or pump drive belt failure.

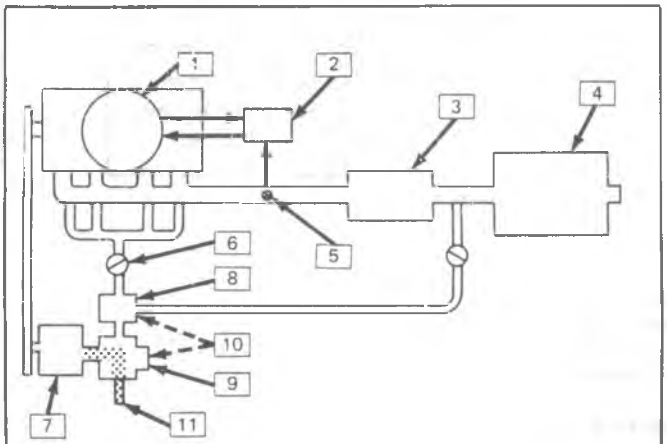


Figure 130 A.I.R. System - California with ECM

AIR CONTROL, NON ECM CONTROLLED

Diverter Valve, 4.1L Federal, 4.8L All, 5.0L Federal, 5.7L Federal, 7.4L All

Figure 131

The diverter valve directs the air from the AIR pump to the exhaust manifolds during normal operation and diverts the air during an engine decel. A pressure relief assembly protects against excessive system operating pressures.

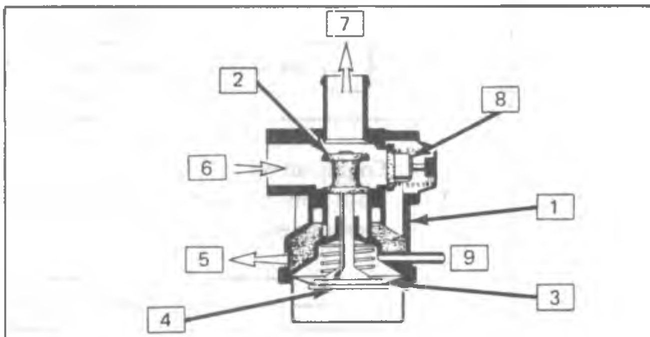


Figure 131 Standard Diverter Valve

AIR CONTROL, ECM CONTROLLED

Electric Air Control Valve, 4.1L Cal., 5.0L Cal., 5.7L Cal.

Figures 130 and 132

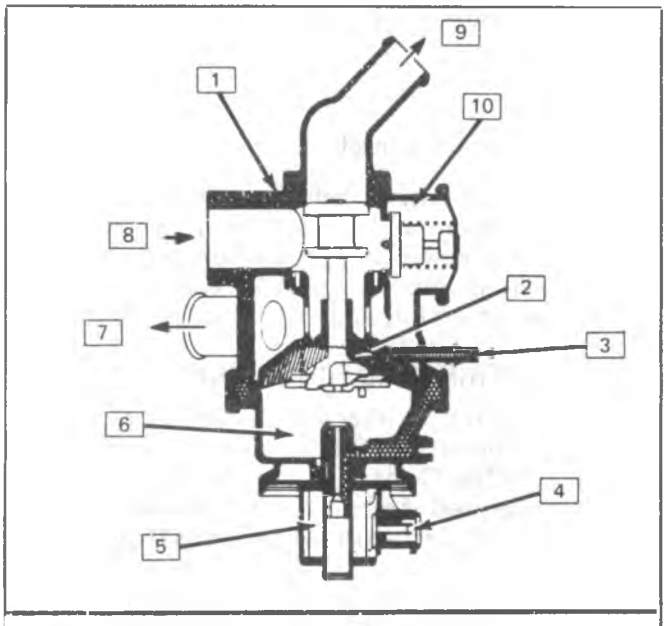
The Electric Air Control valve combines electronic control with the normal diverter valve function.

This valve is electronically controlled to provide divert air under any driving mode.

When the solenoid is energized, the valve will perform like a Standardized Diverter Valve. Air from the air pump is directed to the exhaust ports, unless there is a great sudden rise in manifold vacuum due to throttle deceleration.

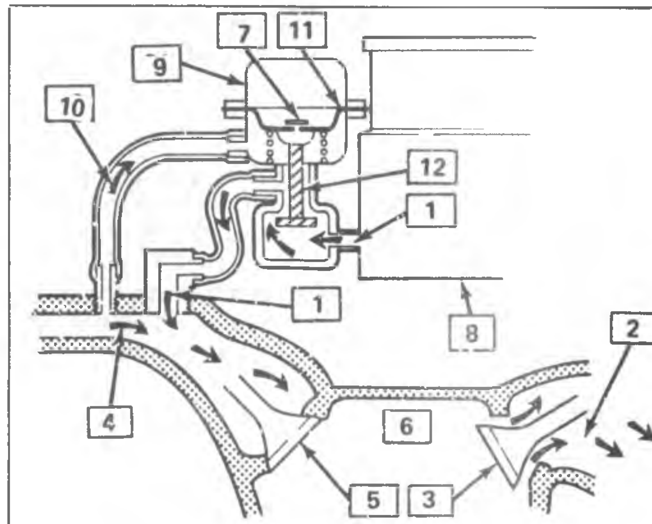
When the solenoid is de-energized, pressurized air from the air pump is allowed to enter the decel timing chamber. This places sufficient pressure on the metering valve diaphragm to overcome spring tension, closing the valve, causing air from the air pump to divert to the air cleaner or to atmosphere.

- Divert occurs under the following conditions:
  - Rich operating condition.
  - When the ECM recognizes a problem and sets the "CHECK ENGINE" light.
  - During deceleration, very high vacuum.
  - High RPM when air pressure exceeds the setting for relief valve in the air control valve.



1 ELECTRIC AIR CONTROL VALVE	6 DECEL TIMING CHAMBER
2 DECEL TIMING ASSEMBLY	7 DIVERT AIR TO AIR CLEANER
3 VERY HIGH VACUUM SIGNAL PORT	8 AIR FROM PUMP
4 ELECTRICAL TERMINAL	9 AIR TO EXHAUST PORTS
5 SOLENOID	10 PRESSURE RELIEF ASSEMBLY

Figure 132 Electric Air Control Valve (EAC)



1 AIR FLOW	8 AIR CLEANER
2 EXHAUST GAS	9 DECELERATION VALVE
3 EXHAUST VALVE	10 MANIFOLD VACUUM
4 INTAKE FLOW	11 DIAPHRAGM
5 INTAKE VALVE	12 VALVE
6 COMBUSTION CHAMBER	
7 VACUUM BLEED VALVE	

Figure 133 Deceleration Control

Results of Incorrect A.I.R. System Operation

- If no air (oxygen) flow enters the exhaust stream at the exhaust ports, HC and CO emission levels will be too high.
- Air flowing to the exhaust ports at all times could cause a rich ECM command and increased temperature of the converter.

DECELERATION CONTROL

Figure 133

To help prevent backfiring during high vacuum conditions a deceleration (gulp) valve is used to allow air to flow into the intake manifold. This air enters the air/fuel mixture to lean the rich condition created by high vacuum when the throttle valve closes on deceleration.

The vacuum draws the deceleration valve diaphragm down and opens the valve allowing air from the air cleaner to flow into the intake manifold.

DIAGNOSIS

The diagnosis of the ECM controlled AIR system is covered in CHART C-6C (EDV) and CHART C-6D (EDV) at the end of this section.

FUNCTIONAL CHECKS

Deceleration Valve

1. Remove air cleaner, plug air cleaner vacuum source and connect tachometer.
2. With the engine running at specified idle speed, remove the small deceleration valve signal hose from the manifold vacuum source.
3. Reconnect the signal hose and listen for air flow through the ventilation pipe and into the deceleration valve. There should also be a noticeable speed drop when the signal hose is reconnected.
4. If the air flow does not continue for at least one second or the engine speed does not drop noticeably, check the deceleration valve hoses for restrictions or leaks.
5. If no restrictions or leaks are found, replace the deceleration valve.

Air Pump

The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 RPM and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTICE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump.

NOTICE: The AIR System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the Air Injection Reactor System, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed proceed as follows:

Inspect

3. For a seized Air Injection Pump.
4. Hoses, tubes and all connections for leaks and proper routing.

CAUTION: Do not oil AIR pump.

5. For air flow from control/switching valve.
6. AIR injection pump for proper mounting and bolt torque.
7. If no irregularities exist and the AIR injection pump noise is still excessive, remove and replace pump.

Hose and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected from a check valve or whenever check valve failure is suspected (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through the check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not operate properly.

ON-VEHICLE SERVICE

DRIVE BELT

Remove or Disconnect

1. Inspect drive belt for wear, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of A/C compressor, AIR pump, generator, and crankshaft pulleys.

PUMP CENTRIFUGAL FILTER FAN

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

CAUTION: Centrifugal fan should not be removed from pump unless it is damaged, as removal will destroy the fan.

Before starting replacement note the following:

- Do not allow any filter fragments to enter the air pump intake hole.
- Do not remove filter fan by inserting a screwdriver between pump and filter fan. Air damage to sealing lip pump will result.
- Do not remove metal drive hub from filter fan.
- It is seldom possible to remove the filter fan without destroying it.
- See Figure 134 to remove fan.

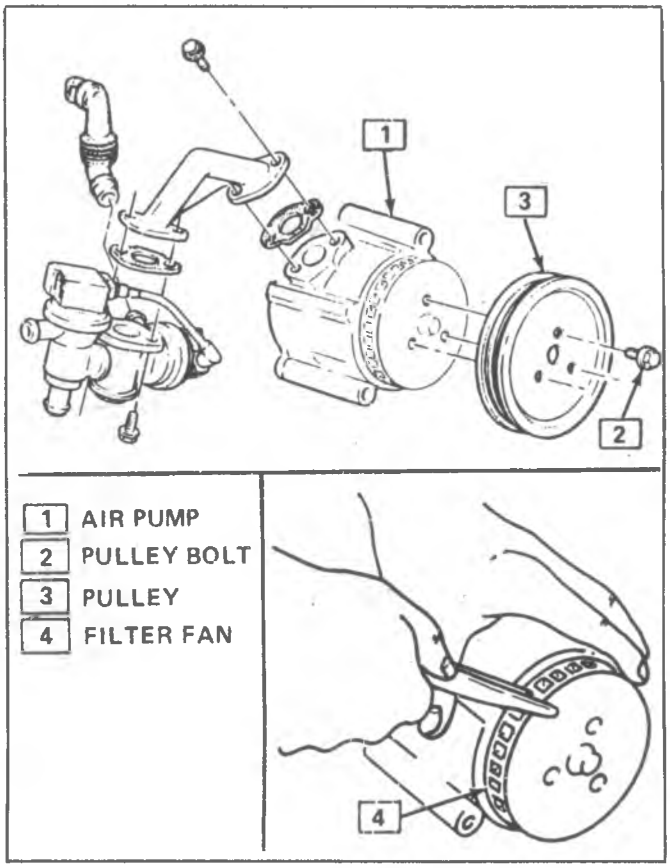


Figure 134 Pump Filter Fan Service

AIR INJECTION PUMP

Figures 135, 136, 137 or 138

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Loosen bolt, holding pump to mounting brackets, release tension on drive belts.
3. Move belts out of the way, then remove pump hoses, vacuum and electrical connections, and control valve.
4. Pulley, then pump.
5. If required, insert needle nose pliers and pull filter fan from hub (see Figure 134).

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Hoses, vacuum and electrical connections, and control valve.
3. New filter fan on pump hub.
4. Spacer and pump pulley against centrifugal filter fan.
5. Pump pulley bolts and tighten equally to 13 N·m (10 lb.-ft.). This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
6. Pump drive belt and adjust.
7. Check air injection system for proper operation (see Chart C-6C or C-6D).

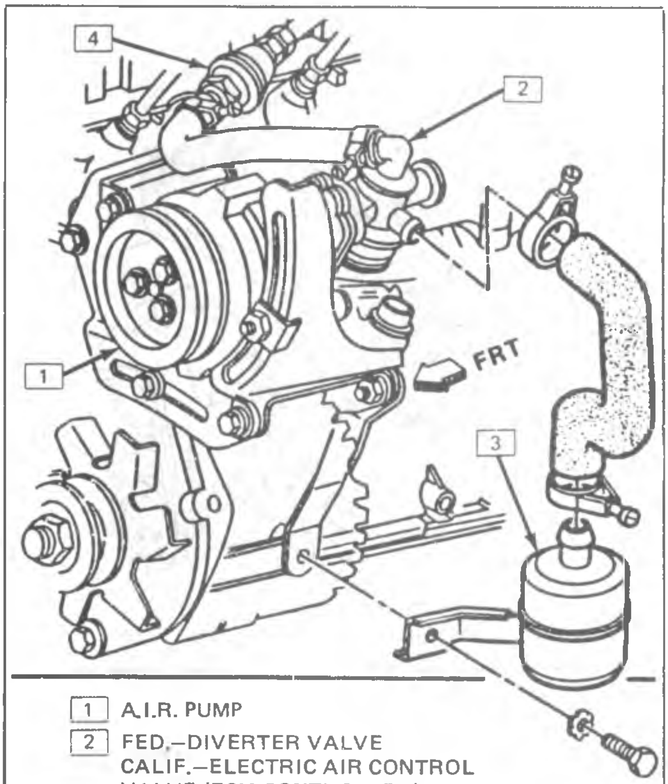
AIR INJECTION CONTROL VALVE

Remove or Disconnect

1. Battery ground cable.
2. Air cleaner.
3. Adapter bolts (See Figure 134).
4. Air outlet hoses from valve.
5. Adapter.
6. Electrical connectors and vacuum hoses from valve.
7. Control valve.

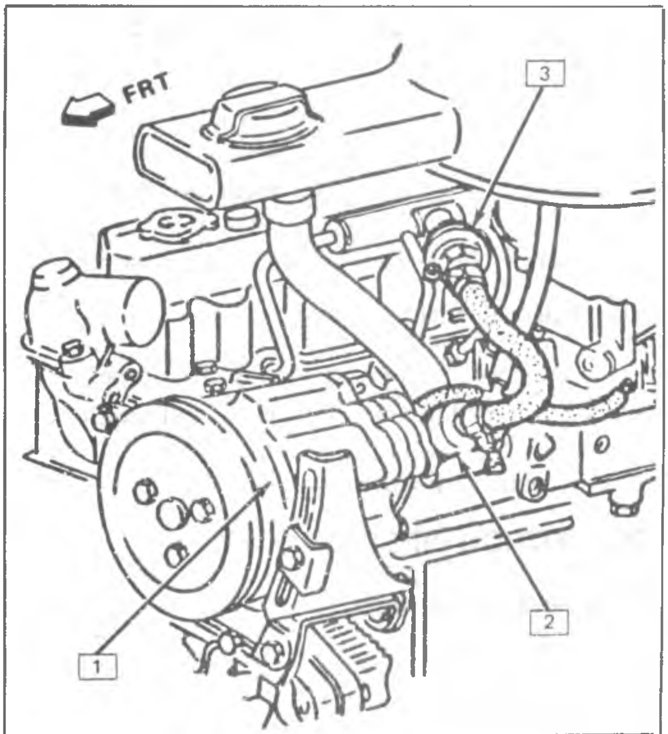
Install or Connect

1. Control valve.
2. Electrical connectors and vacuum hoses.
3. Adapter.
4. Air hoses to valve.
5. Adapter bolts to pump.
6. Air cleaner.
7. Battery ground cable.
8. Check system operation (see Chart C-6C or C-6D).



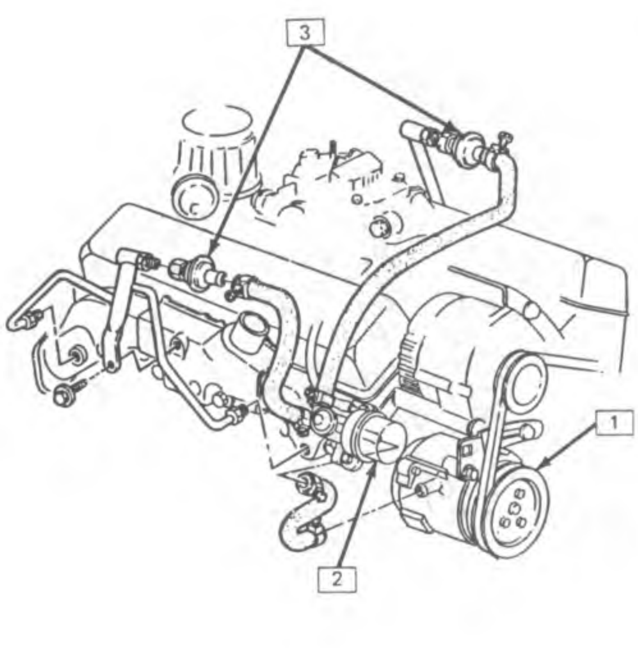
1 A.I.R. PUMP
2 FED.–DIVERTER VALVE
CALIF.–ELECTRIC AIR CONTROL VALVE (ECM CONTROLLED)
3 SILENCER
4 CHECK VALVE

Figure 135 A.I.R. Control Valve Silencer - 4.1L



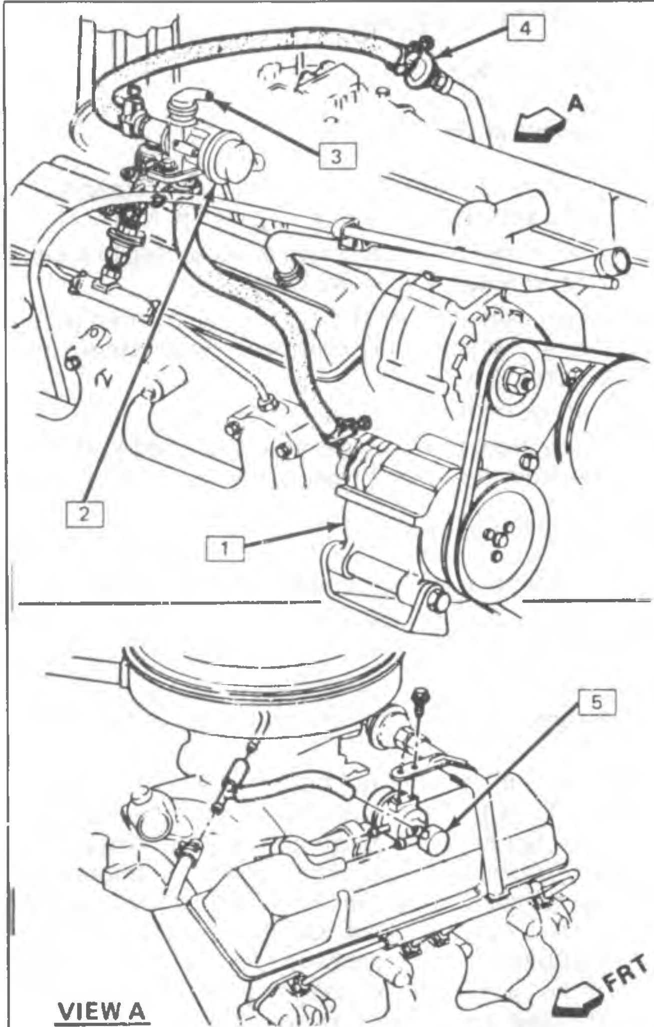
1 A.I.R. PUMP
2 AIR CONTROL VALVE
3 CHECK VALVE

Figure 136 Air Diverter Valve and Hoses - 4.3L



1 A.I.R. PUMP
2 FED.–DIVERTER VALVE CALIF. ELECTRIC AIR CONTROL VALVE (ECM CONTROLLED)
3 CHECK VALVE

Figure 137 A.I.R. Hoses and Pipes - V8 (CK Series



1 A.I.R. PUMP
2 DIVERTER VALVE
3 TUBE TO AIR CLEANER
4 CHECK VALVE
5 DECELERATION VALVE

Figure 138 A.I.R. Hoses and Deceleration Valve - V8 (G Series)

AIR INJECTION ENGINE CHECK VALVE

Remove or Disconnect

1. Any parts required for access.
2. Release clamp and disconnect air hoses from check valve.
3. Unscrew check valve from air injection pipe.

Install or Connect

1. Screw check valve onto air injection pipe.
2. Position air hose on check valve and secure with clamp.
3. Any parts removed for access.

AIR INJECTION PIPE ASSEMBLY

Remove or Disconnect

1. Hose
2. Check Valve
3. Nuts attaching pipes-to-manifold
4. Pipe Assembly

Install or Connect

1. Nuts attaching pipes-to-manifold
2. Check Valve
3. Hose

DECELERATION VALVE

Remove or Disconnect

1. Vacuum hoses from valve.
2. Screws securing valve to engine bracket.
3. Deceleration valve.

Install or Connect

1. Deceleration valve.
2. Screws securing valve to engine bracket.
3. Vacuum hoses to valve.

PARTS INFORMATION

PART NAME	GROUP
Adapter, AIR Inj Cont Vlv	3.671
Bracket, AIR Inj Pump Supt	3.655
Bracket, AIR Inj Pump	3.655
Fan, AIR Pump	3.665
Gasket, AIR Inj Dvtr Vlv El	3.671
Harness, AIR Inj Cont Vlv Vac	3.675
Hose, AIR Inj Cont Vlv	3.675

Hose, AIR Inj Cont Vlv Dvtr 3.675
Pulley, AIR Inj Pump 3.650
Pump, AIR Inj 3.660
Valve, AIR Inj Cont 3.670
Valve, AIR Inj Eng Chk 3.670
Valve, AIR Inj Control (Divert) 3.620
Valve, AIR Inj Switching 3.670

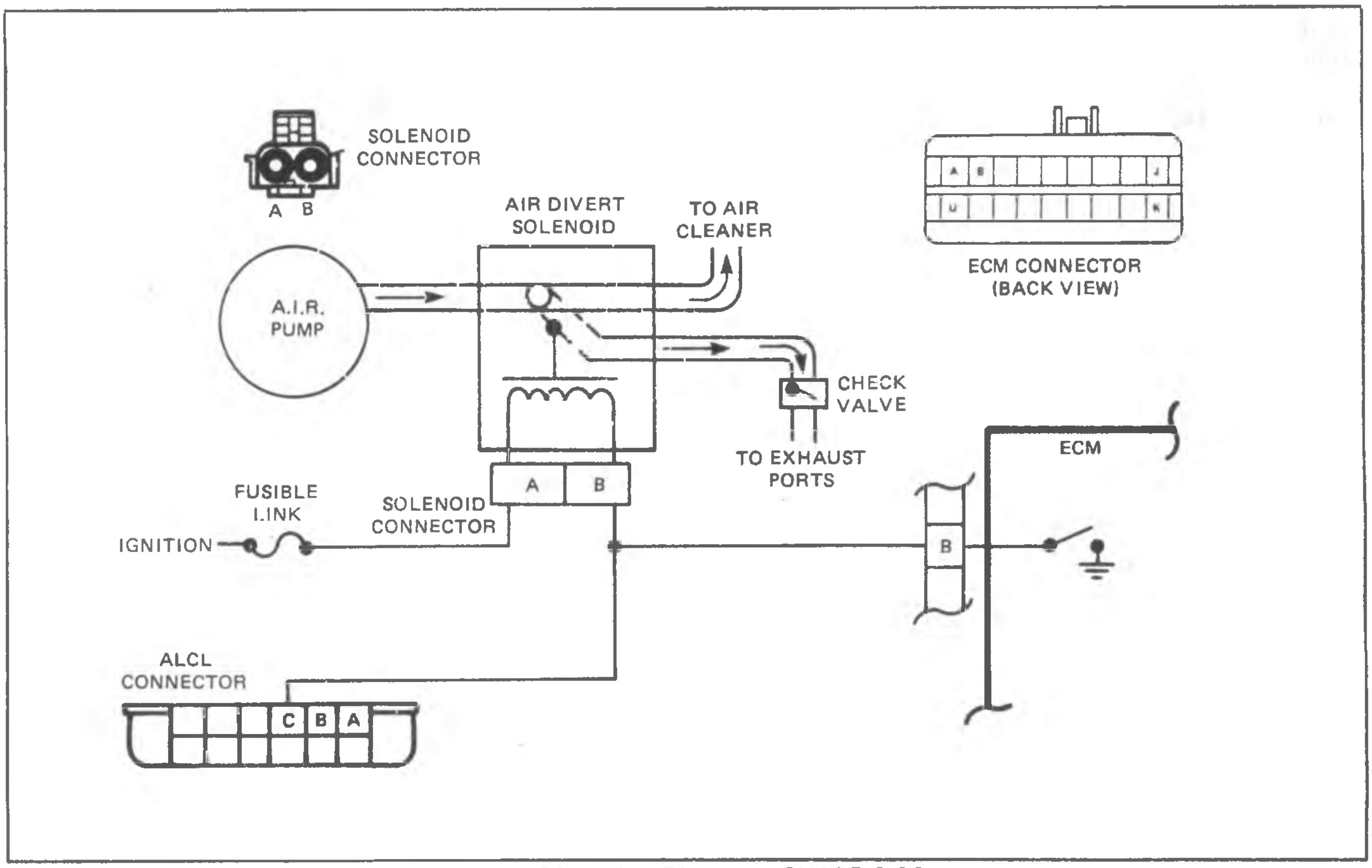


Figure 139 Wiring Diagram - CHART C-6C

CHART C-6C, ELECTRIC DIVERT

This system uses a singlebed converter and Air Managerment is controlled by an air control valve.

When grounded by the ECM, the solenoid applies vacuum to the valve to direct air to the exhaust ports. When de-energized air diverts to air cleaner, air will go to the ports provided a good valve has a ground to the ECM and good manifold vacuum.

1. This is a system performance test. When vehicle goes to closed loop, air will switch from the ports to divert.
2. Tests for a grounded electric divert circuit. Normal system light will be "OFF".
3. Checks for an open control circuit. Grounding test terminal will energize the solenoid if ECM and circuits are normal. In this step, if test light is "ON", circuits are normal and fault is in valve connections or valve.

1984 CCC

CHART C-6C
ELECTRIC DIVERTER VALVE CHECK (EDV)
(EXCEPT 4.1L "G" VAN WITH M.T.)

Check for at least 34 kPa (10") of vacuum at valve with engine idling.

(1)
- "Test" terminal ungrounded.
- Run engine at part throttle (under 2000 RPM).
- Air should go to exhaust ports until system goes closed loop, then divert to air cleaner.

OK
- No trouble found

Not OK

(2)
- Test term. ungrounded.
- Ignition "ON," engine stopped.
- Remove connector from divert valve and connect a test light between connector terminals.

Light On
- Check for grounded wire from sol. to ECM.
- If not grounded, replace ECM.

Light Off

(3)
- Ground "Test" Terminal
- Note Check Engine Light.

Light On

It is faulty divert valve connections or valve.

Light Off
- Connect test light across connector terms.
- Note test light.

Light Off
- Check for blown fuse or open in pink wire to ignition.

Light On
- Check for an open in wire from sol. to ECM.
- If OK, check resistance of solenoid winding.
- If under 20 ohms, replace solenoid and ECM.
- If over 20 ohms, replace ECM only.

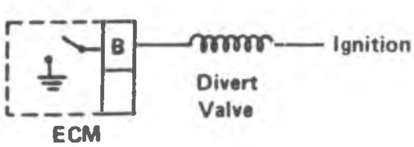


Figure 140 Electric Divert - CHART C-6C

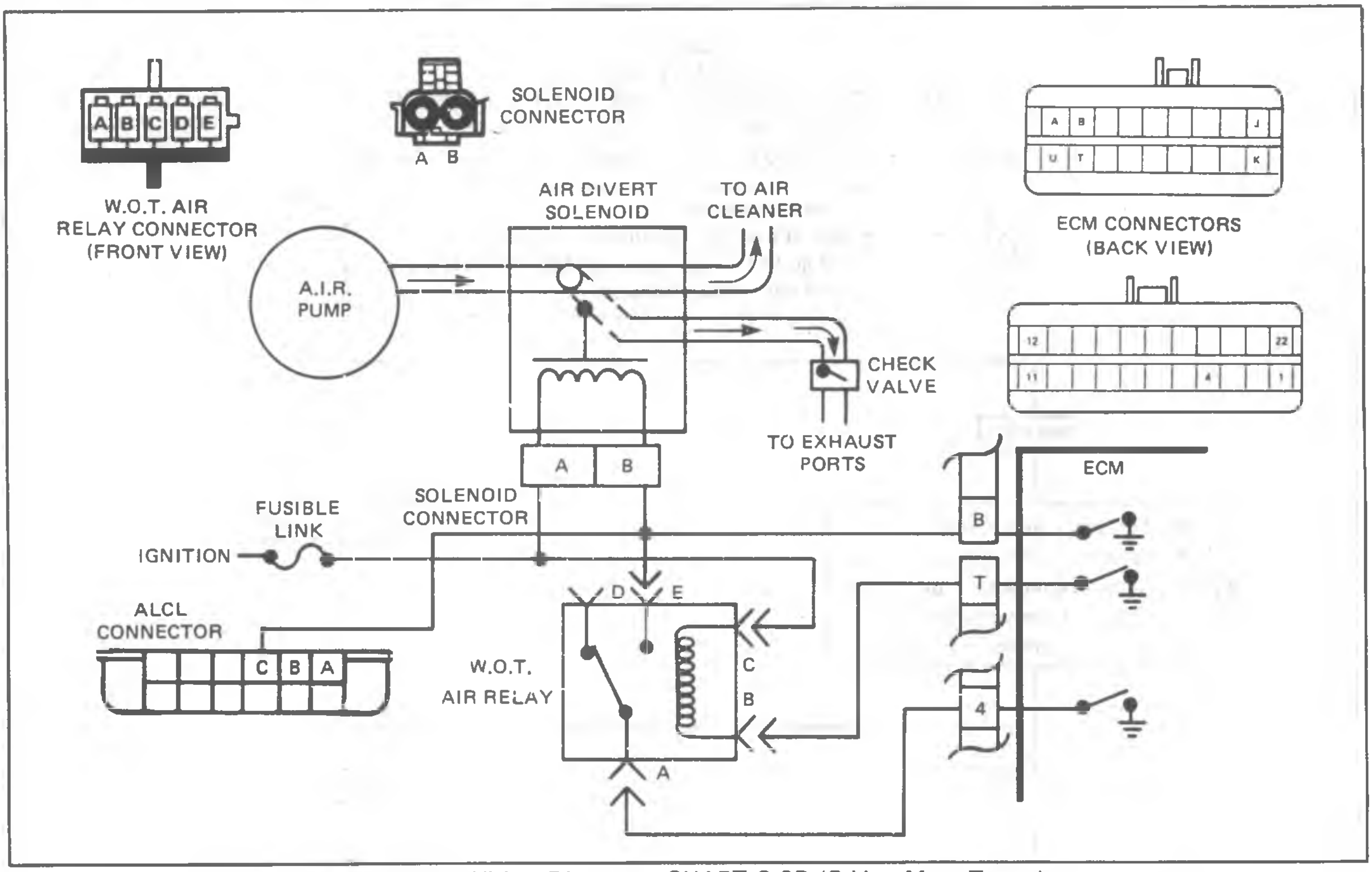


Figure 141 Wiring Diagram - CHART C-6D (G Van Man. Trans.)

CHART C-6D, ELECTRIC DIVERTER VALVE CHECK

1. Checks for normal air to ports during open loop operation. This is a short period of time. Prepare to check for AIR distribution prior to start up.
2. Checks for normal switch back to ports when default is added (TPS high in this case).
3. Checks to see if constant port air is from a faulty WOT air relay circuit. If when relay is disconnected and air is diverted back to air cleaner, fault is in WOT circuit. If air remains to ports, fault is in diverter valve circuit or ECM.
4. Checks to see if switch to port air can be made with the WOT function. If air switches, fault is in ECM connection at terminal "B" or ECM. If no switching occurs, it is faulty valve or faulty circuit to ignition.

Figure 142 Electric Diverter Valve Check - CHART C-6D (G Van Man. Trans.)

1984CCC

CHART C-6D
ELECTRIC DIVERTER VALVE CHECK

4.1L "G" Van with M.T. only.

Check for at least 34 kPa (10") of vacuum at valve with engine idling.

1. • Check for air to exhaust ports while system is in open loop after start-up, then divert to air cleaner when it goes closed loop.

OK

2. • With system in closed loop, depress TPS plunger (not the throttle) completely for 15 seconds. Air should switch from divert to ports for 10 seconds.

- **OK** → No trouble found.
- **Not OK** → • Ignition "ON", engine stopped. check voltage from W.O.T. air relay conn. terms. E and C to ground with relay disconnected.
  - **One term. low.** → Check for open circuit to that term.
  - **Both Bat. Voltage** → • Ground diag. "test" term. • Connect test light from Bat. + to relay conn. term. "A" and "B".
    - **Both light.** → Replace W.O.T. air relay.
    - **One light.** → Check for open in wire to ECM for terminal that doesn't light. If not open, it is faulty ECM connection or ECM.

Constant port air

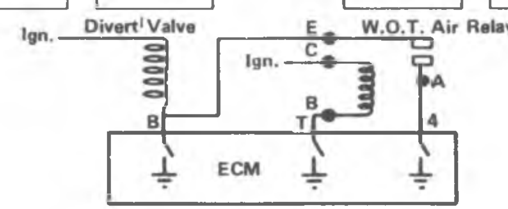
3. • Engine idling in closed loop. • Disconnect W.O.T. air relay and note air.

- **To Ports** → • Disconnect divert valve and connect test light between harness conn. terms. • Ignition "ON", note light.
  - **Light Off** → Replace divert valve.
  - **Light On** → Check for grounded wire to ECM term. "B" or W.O.T. air relay term. "E". If not grounded, replace ECM.
- **To air Cleaner** → • Ign. "ON", engine stopped. • Connect test light from Bat. + to ter. "T" of W.O.T. air relay and note light.
  - **Light Off** → Replace W.O.T. air relay.
  - **Light On** → Check for grounded wire to ECM term. "T". If not grounded, replace ECM.

Constant divert

4. • Engine idling in closed loop. • Fully depress TPS plunger (not the throttle) for 15 seconds. Air should switch to ports for 10 seconds.

- **Not OK** → • Disconnect divert sol. and connect test light from each term. to ground and note light.
  - **Light Off** → Check for open circuit from sol. to ignition switch.
  - **Light on both terminals.** → Check for short from Bat. + to wire to ECM term. "B" and recheck system.
  - **Light on one terminal.** → It is faulty divert valve connection or valve.
- **OK** → • Check for open wire from divert valve to ECM term. "B". If not open, it is faulty ECM connection or ECM



EXHAUST GAS RECIRCULATION (EGR) SYSTEM

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperatures. It does this by decreasing combustion temperature.

The main element of the system is an EGR valve operated by vacuum, and mounted on the intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure 143.

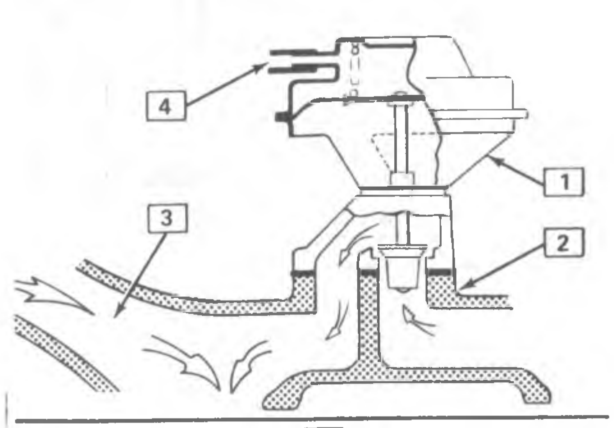


Figure 143 Exhaust Gas Recirculation

OPERATION

The EGR valve is opened by ported manifold vacuum to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle. The EGR valve is usually open under the following conditions:

- Warm engine operation
- Above idle speed

On some transmission converter clutch (TCC) equipped vehicles the EGR system is turned off, or reduced when TCC is on.

The amount of exhaust gas recirculated is controlled by variations in vacuum and in some cases, exhaust back pressure.

Two sources of vacuum are used:

- Vacuum port above the carburetor throttle valve. (ported manifold vacuum)
- Intake manifold vacuum port. (full manifold vacuum)

Types of EGR Valves

Two types of EGR valves are used:

- Ported
- Negative backpressure

- Ported EGR valve, Figure 144.

This valve is controlled by a flexible diaphragm which is spring loaded to hold the valve closed. Ported manifold vacuum applied to the top side of the diaphragm overcomes the spring pressure and opens the valve in the exhaust gas port. This allows exhaust gas to be pulled into the intake manifold and enter the engine cylinders.

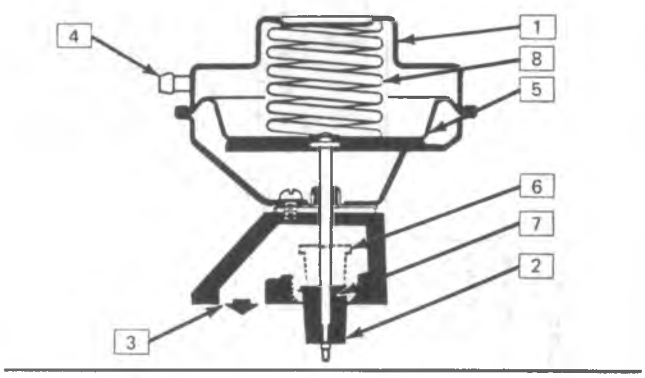


Figure 144 Ported EGR Valve

- Negative Backpressure EGR Valve

The negative backpressure EGR valve is similar to the positive backpressure EGR valve except that the bleed valve spring is moved from above the diaphragm to below, and the valve is normally closed. The negative backpressure valve varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust back pressure.

The diaphragm on this valve (shown in Figure 145) has an internal air bleed hole which is held closed by a small spring when there is no exhaust backpressure.

Engine vacuum opens the EGR valve against the pressure of a large spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes.

This valve will open if vacuum is applied with the engine not running.

EGR Valve Identification Figure 146

- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve after the part number.
- Negative backpressure EGR valves will have a "N" stamped on the top side of the valve after the part number.
- Port EGR valves have no identification stamped after the part number.

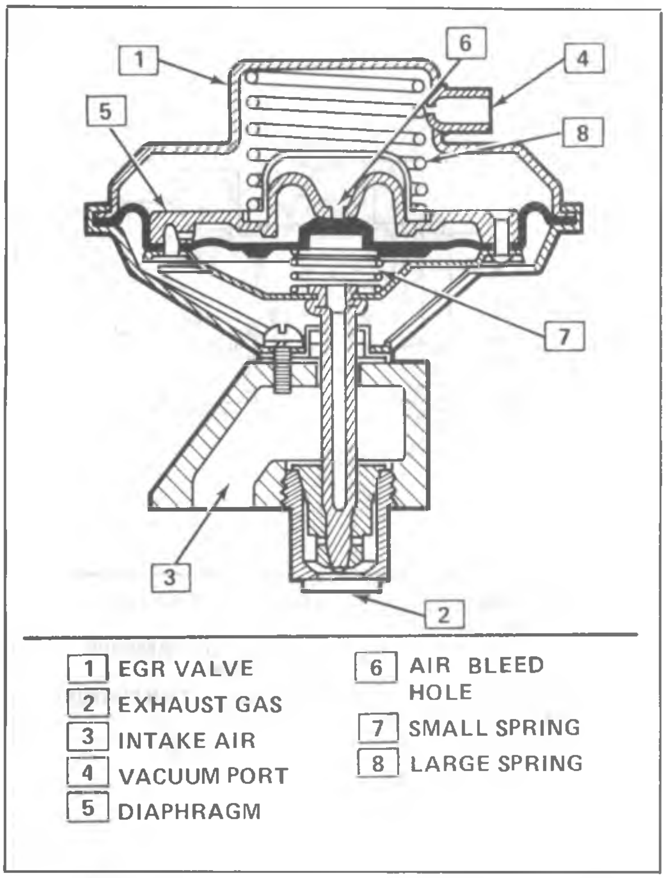


Figure 145 Negative Backpressure EGR Valve

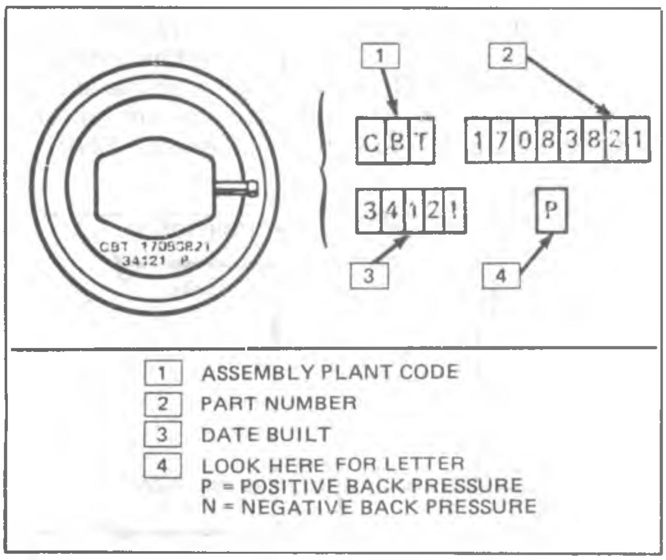


Figure 146 EGR Valve Identification

EGR CONTROL

A variety of methods are used to control EGR valves.

- Ported manifold vacuum directly to EGR valve.
- Ported manifold vacuum controlled by a thermostatic vacuum switch (TVS).
- Ported or full manifold vacuum controlled by a solenoid.

Ported Manifold Vacuum Figure 146A

This system uses ported manifold vacuum connected directly to the EGR valve. The amount of EGR is controlled by the amount of manifold vacuum and throttle opening.

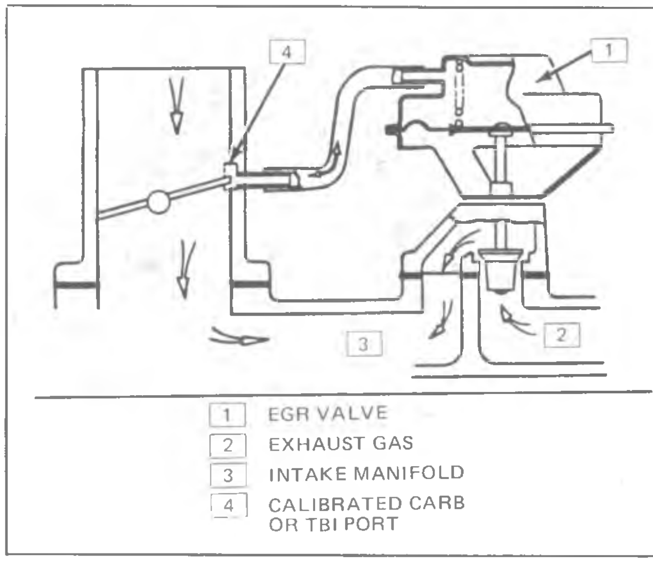


Figure 146A Ported Vacuum EGR control

Thermostatic Vacuum Switch (TVS) Figure 147

The thermostatic vacuum switch (TVS) closes off vacuum during cold engine operation to cut off EGR. The TVS may control more than EGR, so it may have more than two terminals. 4.1L (LE3) Federal vehicles use a TVS mounted in the air cleaner.

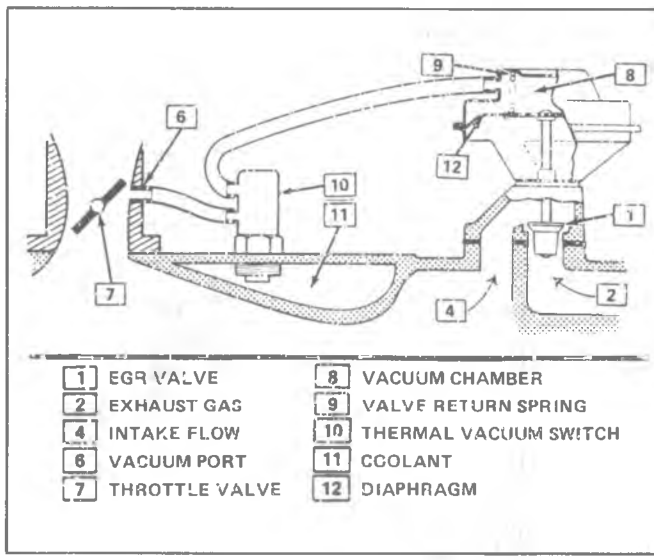


Figure 147 TVS Control of EGR System

EGR Bleed Solenoid, 4.1L - LE3, Cal.

The EGR bleed solenoid (Figure 148) decreases ported vacuum to the EGR valve when the transmission converter clutch is applied. This solenoid is not ECM controlled. Control of this solenoid is through the TCC solenoid.

Vacuum/Solenoid Control and EGR Vacuum Control

To regulate EGR flow on 5.0L/5.7L engines (Calif), an ECM controlled solenoid is used in the vacuum line (Figure 149). The ECM uses information from the following sensors to regulated the solenoid:

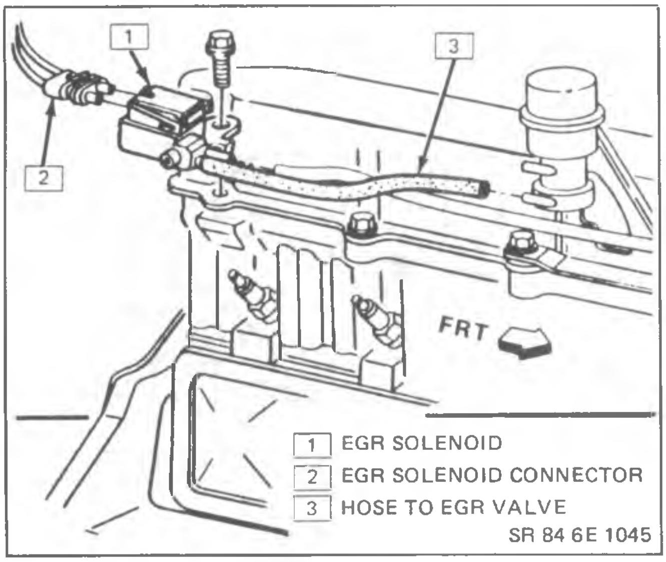


Figure 148 EGR Bleed Solenoid, 4.1L - LE3, Cal.

- Coolant Temperature
- Throttle Position (TPS)
- Vacuum

- On some vehicles during cold engine operation, a signal from the ECM energizes the EGR solenoid blocking vacuum to the EGR valve. The solenoid is also energized during cranking and at wide open throttle. When the engine warms up, the EGR solenoid is turned off and the EGR valve operates on normal port vacuum and exhaust backpressure signals.
- California 5.0L - LF3 and 5.7L - LS9 engines use what is called "pulse width modulation". This means the ECM turns the solenoid on and off many times a second and varies the amount of "on" time (!L"!xpulse width") to vary the amount of EGR.

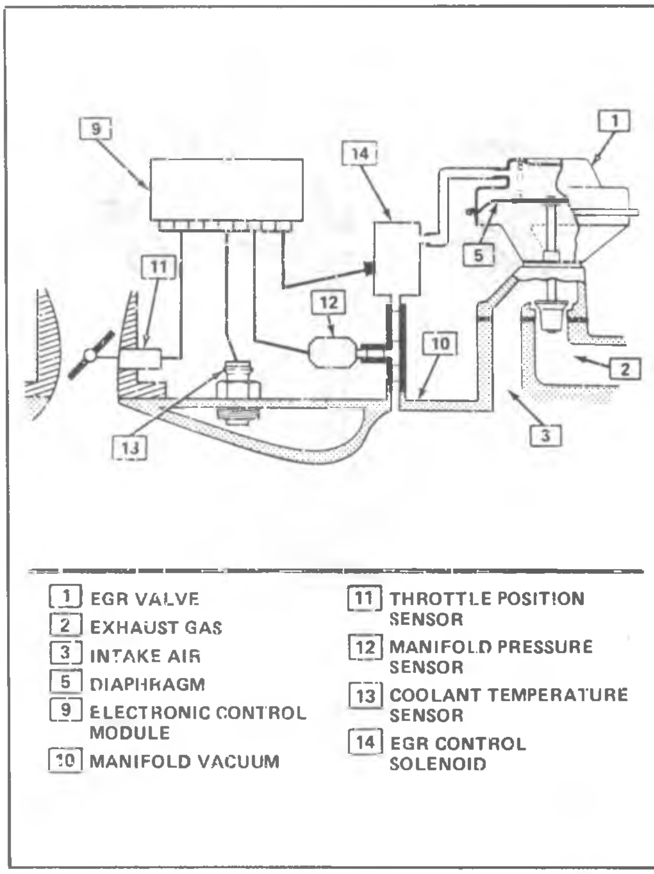


Figure 149 Vacuum Solenoid Controlled EGR

The EGR vacuum control (Figure 150) has a vacuum solenoid that uses "pulse width modulation". This means the ECM turns the solenoid on and off many times a second and varies the amount of "on" time ("pulse width") to vary the amount of EGR.

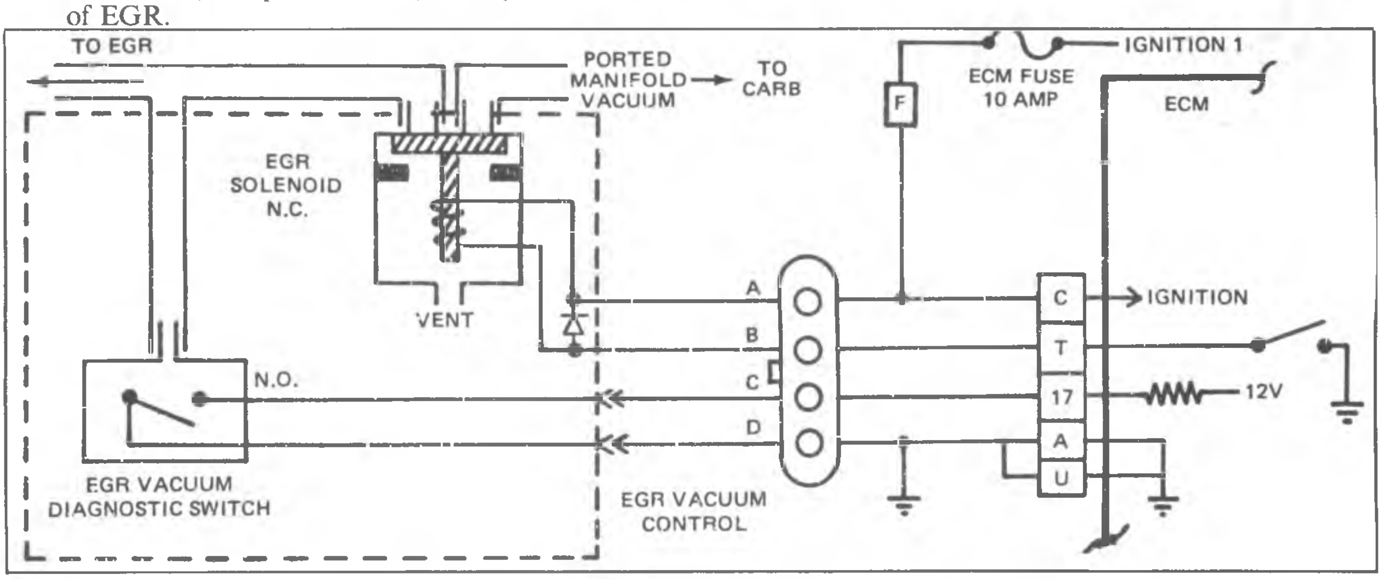


Figure 150 EGR Vacuum Control

RESULTS OF INCORRECT EGR SYSTEM OPERATION

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or stop. With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may happen:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Vehicle surges during cruise.
- Rough idle.

If the EGR valve should stay open all of the time, the engine may not idle.

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could causes:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

DIAGNOSIS

Diagnosis of the EGR system is covered in charts at the end of this section.

- CHART C-7A for Pulse Width Modulated EGR.
- CHART C-7C for EGR Valve Check - Non-ECM Controlled

ON-VEHICLE SERVICE

EGR VALVE

Remove or Disconnect

1. Air cleaner.
2. EGR valve vacuum hose at valve. (Figure 151)
3. Bolts.
4. EGR valve from manifold.

Install or Connect

1. EGR valve to manifold (use new gasket.)
2. Bolts.
3. Vacuum hose to EGR valve.
4. Air cleaner.

CLEANING EGR VALVES

Non-Serviceable (Non-Take-Apart) EGR Valves

NOTICE: Do not wash valve assembly in solvents or degreaser - permanent damaged to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

Clean

1. Hold the valve assembly in hand (Figure 152). Then, using a light snapping action with a plastic hammer, tap on the end of the round pintle to remove the exhaust deposits from the valve seat. Empty loose particles.
2. Clean the mounting surface of the EGR valve with a wire wheel or wire brush, and the pintle with a wire brush.
3. Depress the valve diaphragm and check the seating area for cleanliness by looking thru the valve outlet. If pintle or seat are not completely clean, repeat step 1.
4. Inspect the valve outlet for deposits. Remove any deposit build-up with a screw driver or other suitable sharp tool.
5. Clean mounting surface with a wire wheel or wire brush, then using a new gasket install the valve assembly to the intake manifold or adapter. Torque the bolts to 34 N·m (15 ft. lbs.).
6. Connect vacuum hoses.

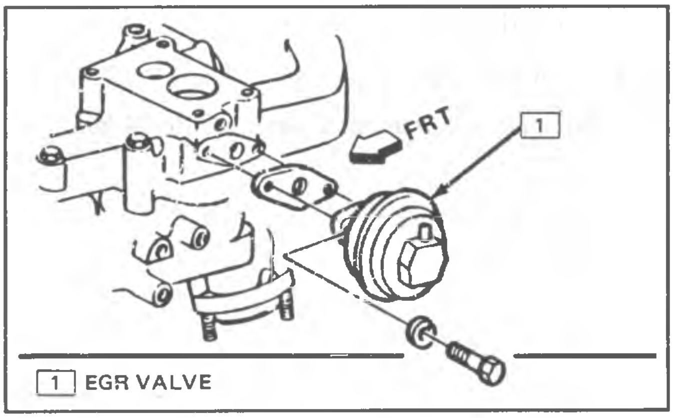


Figure 151 EGR Valve

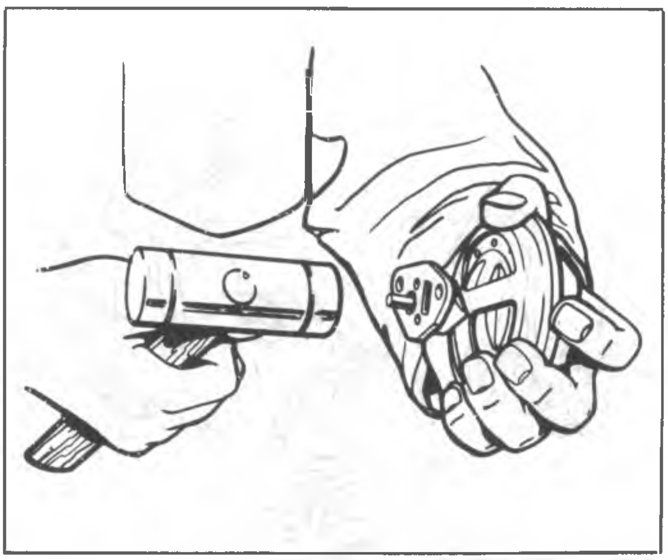


Figure 152 EGR Valve Cleaning

EGR Manifold Passage

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Do not wash EGR valve in solvents or degreaser - permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve. See "Clean" procedure for EGR valve if cleaning of valve is necessary.

EGR VACUUM SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. Electrical connector at solenoid (Figure 153).
4. Vacuum hoses.
5. Nut and solenoid.

Install or Connect

1. Solenoid and bracket. Tighten nut to 24 N·m (17 ft.lbs.).
2. Vacuum hoses.
3. Electrical connector.
4. Air cleaner.
5. Negative battery cable.

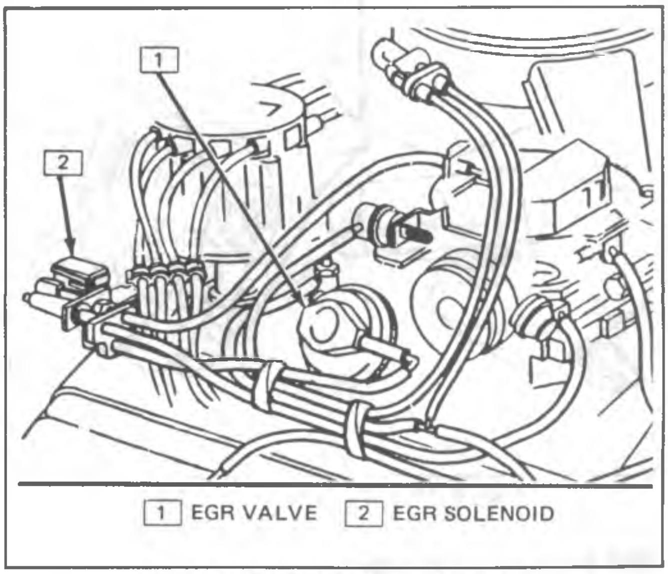


Figure 153 EGR Vacuum Solenoid

THERMOSTATIC VACUUM SWITCH (TVS) REPLACEMENT

Remove or Disconnect

Figures 154, 155, 156 or 157

1. Drain coolant below level of TVS.
2. Vacuum hoses.
3. Thermostatic vacuum switch (TVS).

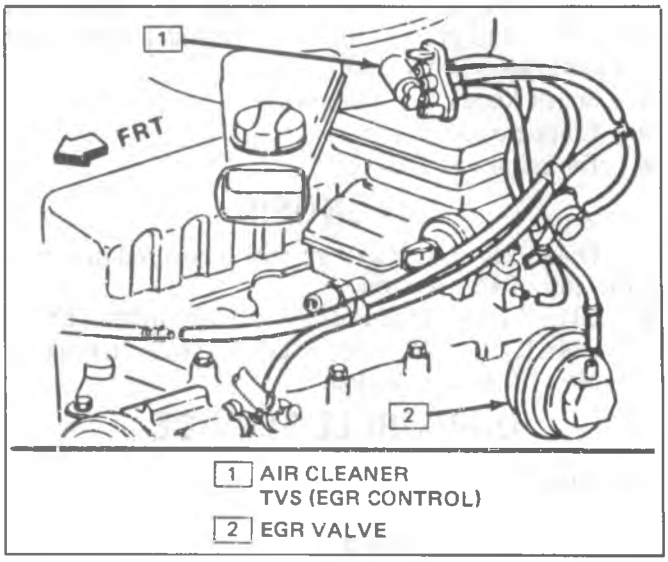


Figure 154 TVS Location, 4.1L-LE3, Federal

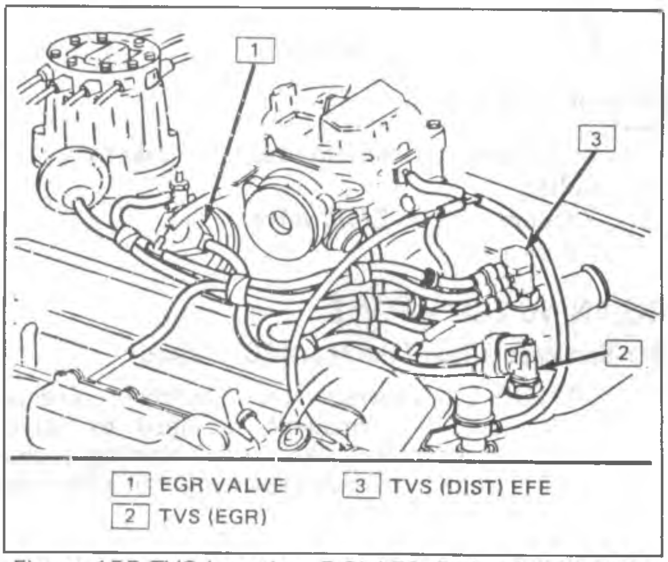


Figure 155 TVS Location, 5.0L-LE9, Federal, 5.7L-LS9, Federal, 5.7L-LT9, California

OFF-VEHICLE CHECK OF THERMAL VACUUM SWITCHES

Thermal vacuum switches open, close, or switch vacuum sources when the calibration temperature is reached. The following general checking procedures can be used for all thermal vacuum switches. Refer to number stamped on base of valve or switch for calibration temperature.

1. Allow TVS to cool below calibration temperature.
2. Inspect switch to make sure it is in good condition.
3. Connect vacuum gage(s) to output port(s) of the TVS. (See vacuum hose schematic on Vehicle Control Emission Information label.)

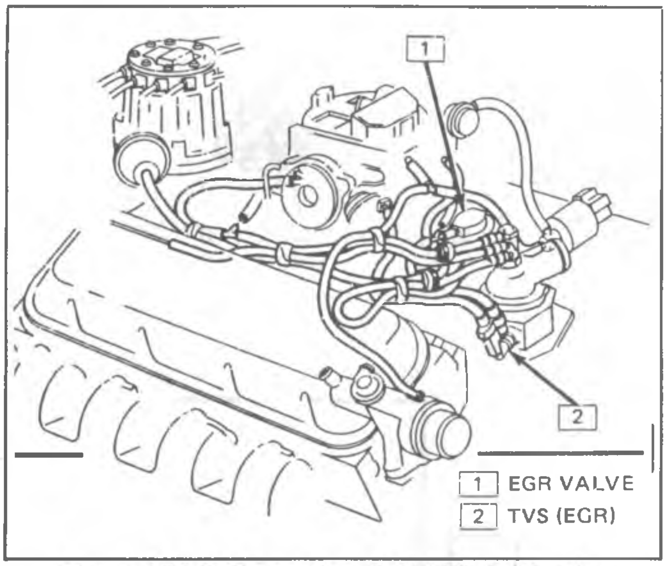


Figure 156 TVS Location, 7.4L-LE8, California

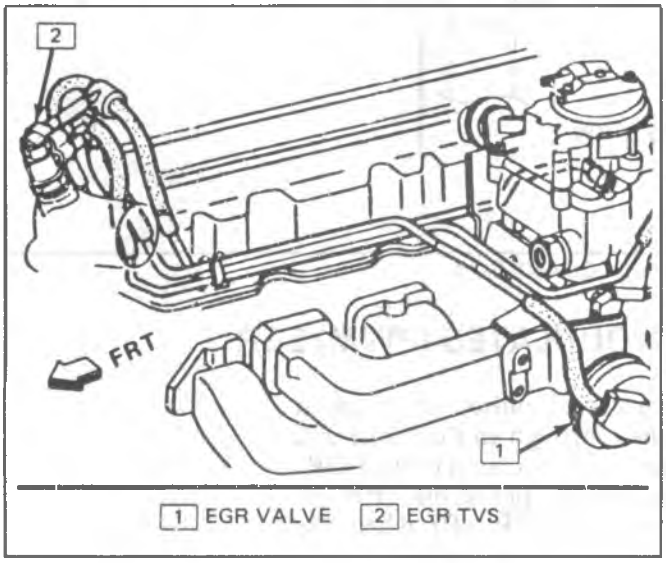


Figure 157 TVS Location, 4.8L-L25, California

4. Compare vacuum gage reading(s) with the procedures and in the TVS descriptions given under each valve name.
5. Heat TVS to a temperature above the calibration temperature. Never apply a torch or open flame directly to the TVS.
6. Compare vacuum gage reading to the correct reading indicated on switch or valve base.

NOTICE: Leakage of up to 7 kPa (2″ HG) vacuum in 2 minutes is allowable and does not mean a defective part.

7. If operation is satisfactory, reinstall valve or switch. If valve or switch is defective, replace with a new part.

Install or Connect

1. Thermostatic vacuum switch with soft setting sealant applied to male threads. Sealant should not be on end of TVS.
2. Tighten to 14 N·m (120 in. lbs.) then turn clockwise as required to align with hoses.
3. Vacuum hoses.
4. Add coolant as required.

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR (1)	3.670
Solenoid, EGR cont VLV RLY (14)	3.670
Gasket, EGR Valve (15)	3.680

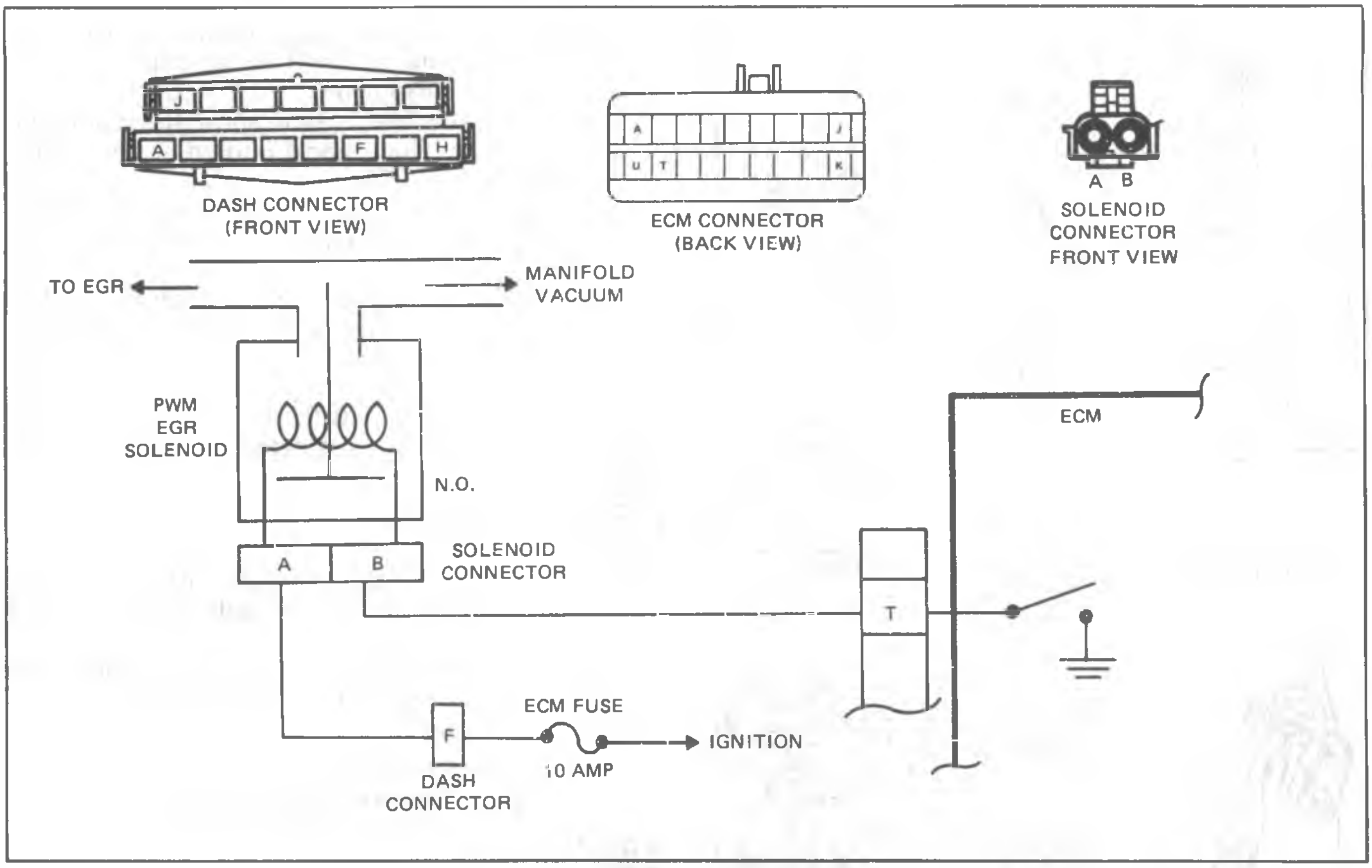


Figure 158 Wiring Diagram - CHART C-7A

CHART C-7A, PULSE WIDTH MODULATED (PWM) EGR

PWM EGR is an ECM control that pulses the vacuum signal to the EGR. This is accomplished through an EGR solenoid that when energized by the ECM shuts off the vacuum to the EGR. This system can pulse the solenoid many times per second (PWM). The EGR solenoid is always energized (EGR off) when the transmission is in park or neutral.

1. Checks to see if the EGR passages are restricted or if the valve is stuck open.

2. With the 4 wire EST connector disconnected, the ECM thinks the engine is not running. Grounding the test terminal, under this condition, causes the ECM to pulse the EGR solenoid "ON" and "OFF" for testing.

3. Checks EGR solenoid electrical control circuit. The test light should flash "ON" and "OFF" repeatedly if the ECM, harness and connections are OK.

1984 CCC

CHART C-7A
EXHAUST GAS RECIRCULATION (EGR) VALVE CHECK
PULSE WIDTH MODULATED (PWM) EGR
EXCEPT 3.0L (V.I.N. E) 3.8L (V.I.N. A) AND 4.1L (V.I.N. 4)

Check vacuum hoses for leaks and proper connections and electrical connectors for proper connections.

1
- Place transmission in P/N.
- Run warm engine at idle.
- Push up on underside of EGR valve diaphragm. RPM should drop.

No RPM change.
- Clean EGR valve or passages or replace valve as needed.

RPM drops.
- Check for movement of EGR valve diaphragm as RPM is changed from approx. 2000 to idle. It should not move.

Moves
- Check P/N switch circuit for open circuit or P/N switch adjustment.

Not OK
- Adjust or replace P/N switch.
- See Chart 24B.

OK

3
- Stop engine.
- Disconnect electrical connector from EGR solenoid.
- Connect test light between EGR solenoid connector terminals.
- Ign. "ON", "test" term. grounded, light should flash repeatedly.

Light Flickers
- Check vac. to EGR sol. at 2000 - 3000 RPM. If not at least 10", repair.
- If vac. at sol. is OK, it is faulty EGR sol. connection or solenoid.

Light Off
- Connect test light from each EGR conn. term. to gn'd. and note light.

Light "OFF"
- Repair open in wire from solenoid to Ign. (including blown fuse).

Light "ON"
- Check for open in wire to ECM terminal "T".
- If not open, see ECM Replacement Check, Chart C-1

Steady Light
- Check for ground in wire to ECM term. "T".
- If not gn'd., see ECM Replacement Check, Chart C-1

Doesn't Move.

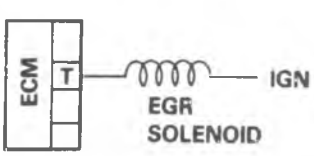
2
- Repeat above check with distributor 4 term. EST connector disconnected and "test" term. grounded. It should move.

Doesn't Move

Moves
- Remove EGR soln. conn.
- Install test light across harness conn. terminals
- Run engine at idle in "D" and observe light.

Light Flickers
- No trouble found*

Steady Light
- Short in P/N switch circuit-See Chart 24B.



Reconnect 4 term. EST connector and EGR solenoid after completing checks. Disconnect ground from "test" term.

*If no trouble found and rough idle still exists, make physical check for leaking or loose EGR valve.

Figure 159 Pulse Width Modulated (PWM) EGR System Diagnosis - CHART C-7A

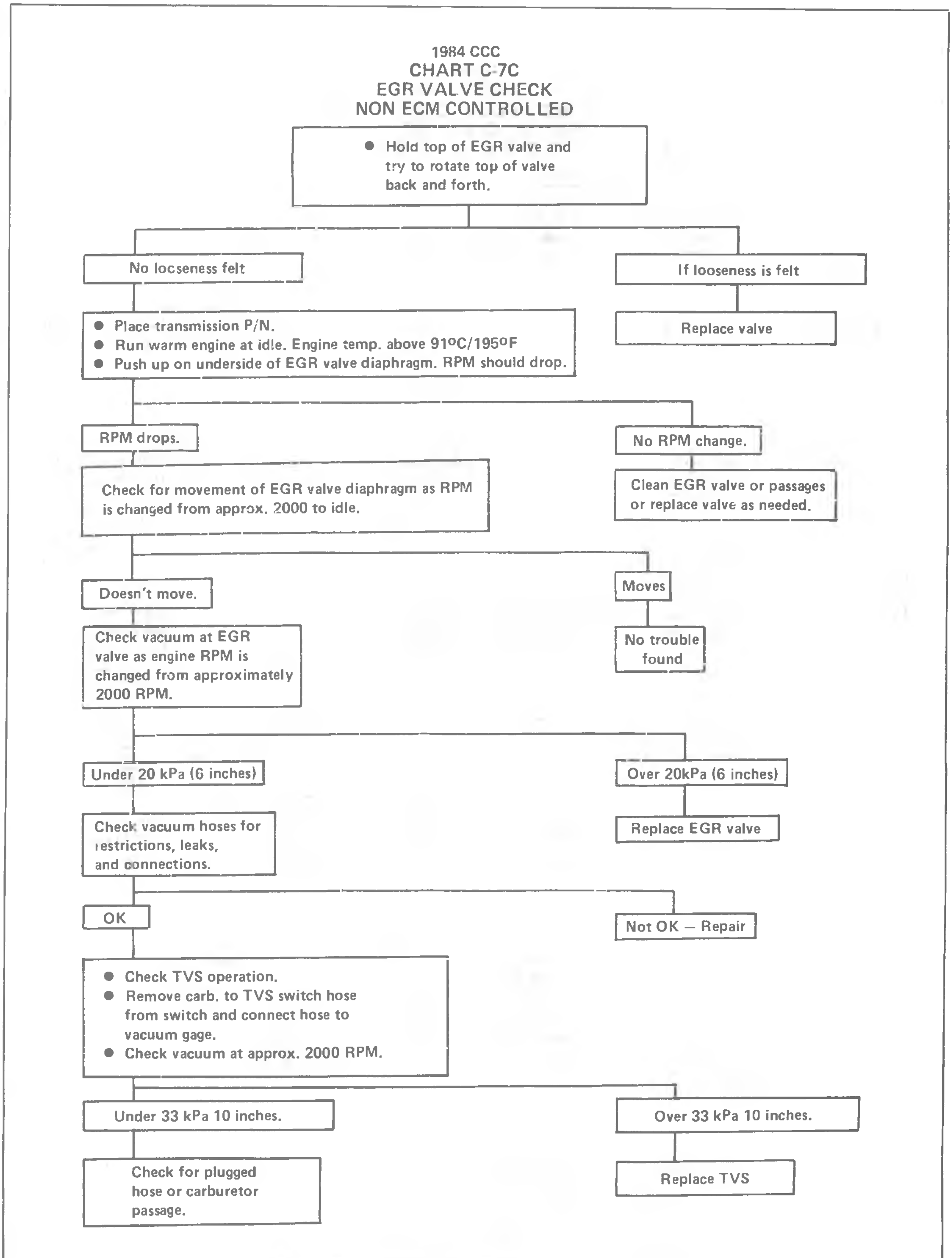


Figure 160 EGR Valve Check - Non-ECM Controlled - CHART C-7C

BLANK

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM

GENERAL DESCRIPTION

PURPOSE

The Transmission Converter Clutch (TCC) System uses a solenoid operated valve in the automatic transmission to couple the engine flywheel to the output shaft of the transmission thru the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

OPERATION

For the converter clutch to apply, two conditions must be met:

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section 7A. This section will cover only the electrical operation of the TCC system.
- The ECM grounds the TCC solenoid in the transmission which moves a check ball in a fluid line (Figure 161). This will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

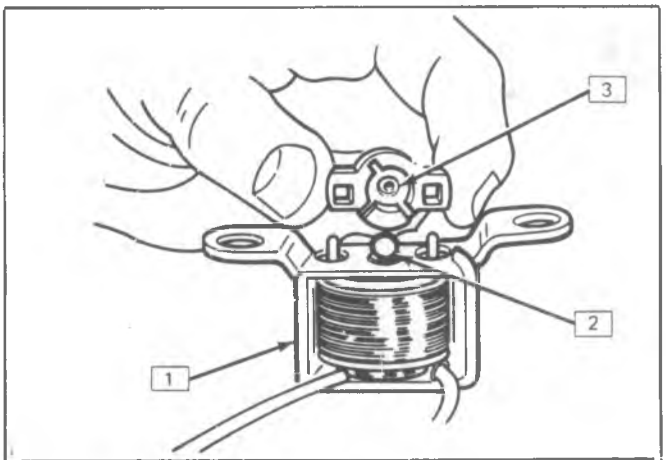


Figure 161 TCC Solenoid

The ECM controls the TCC apply solenoid by looking at several sensors:

- Coolant Temperature Sensor. Engine must be warmed up before clutch can apply.
- Throttle Position Sensor (TPS). After the converter clutch applies, the ECM uses the information from the TPS to release the clutch when the vehicle is accelerating or decelerating at a certain rate.
- Gear Select Switch. Some transmissions use a 3rd or 4th gear switch to send a signal to the ECM telling it what gear the transmission is in. The ECM uses this information to vary the conditions under which the clutch applies or releases. However, the transmission does not have to be in high gear in order for the ECM to turn the clutch on. Transmissions using gear select switches can be identified by 3 or 4 wires coming out of TCC connector.

On some transmissions, a third gear switch (normally open) is placed in series on the battery side of the TCC solenoid. This switch prevents TCC application until the transmission is in third gear and then the switch closes, completing the circuit to the ECM.

Another switch used in the TCC circuit is a brake switch which opens the 12 volt supply to the TCC solenoid when the brake is depressed.

Also some transmissions use a 4-3 pulse switch (or 3-2 on some 3-speed transmissions), to open the TCC solenoid circuit momentarily during a downshift.

The diagnostic charts will cover the switches used with each engine/transmission combination.

Results of Incorrect TCC Operation

If the converter clutch is applied at all times, the engine will stall immediately, just as in a manual transmission with the clutch applied.

If the converter clutch does not apply, fuel ecomony may be lower than expected. If the Vehicle Speed Sensor fails, the TCC will not apply. If the 3rd or 4th gear switch does not operate, the TCC will not apply at the right time.

The Transmission Converter Clutch (TCC) system has different operating characteristics than an automatic transmission without TCC. If the driver complains of a "chuggle" or "surge" condition, the vehicle should be road tested and compared to a similar vehicle to see if a real problem exists. The Owner's Manual section on TCC operation should be reviewed with the driver. Another TCC complaint may be a downshift felt when going up a grade, especially with cruise control. This may not be a downshift, but a clutch disengagement due to the change in TPS to maintain cruising speed.

DIAGNOSIS

The diagnosis of the TCC system is covered in **CHART C-8B** .

ON-VEHICLE SERVICE

- See Section 7A for TCC Solenoid replacement.
- See Section 8C for brake switch replacement.

PARTS INFORMATION

PART NAME	GROUP
Sensor, VSS (1)	9.761
Valve, Clutch and Cruise Vac. Sw	3.885
Solenoid, TCC	4.122

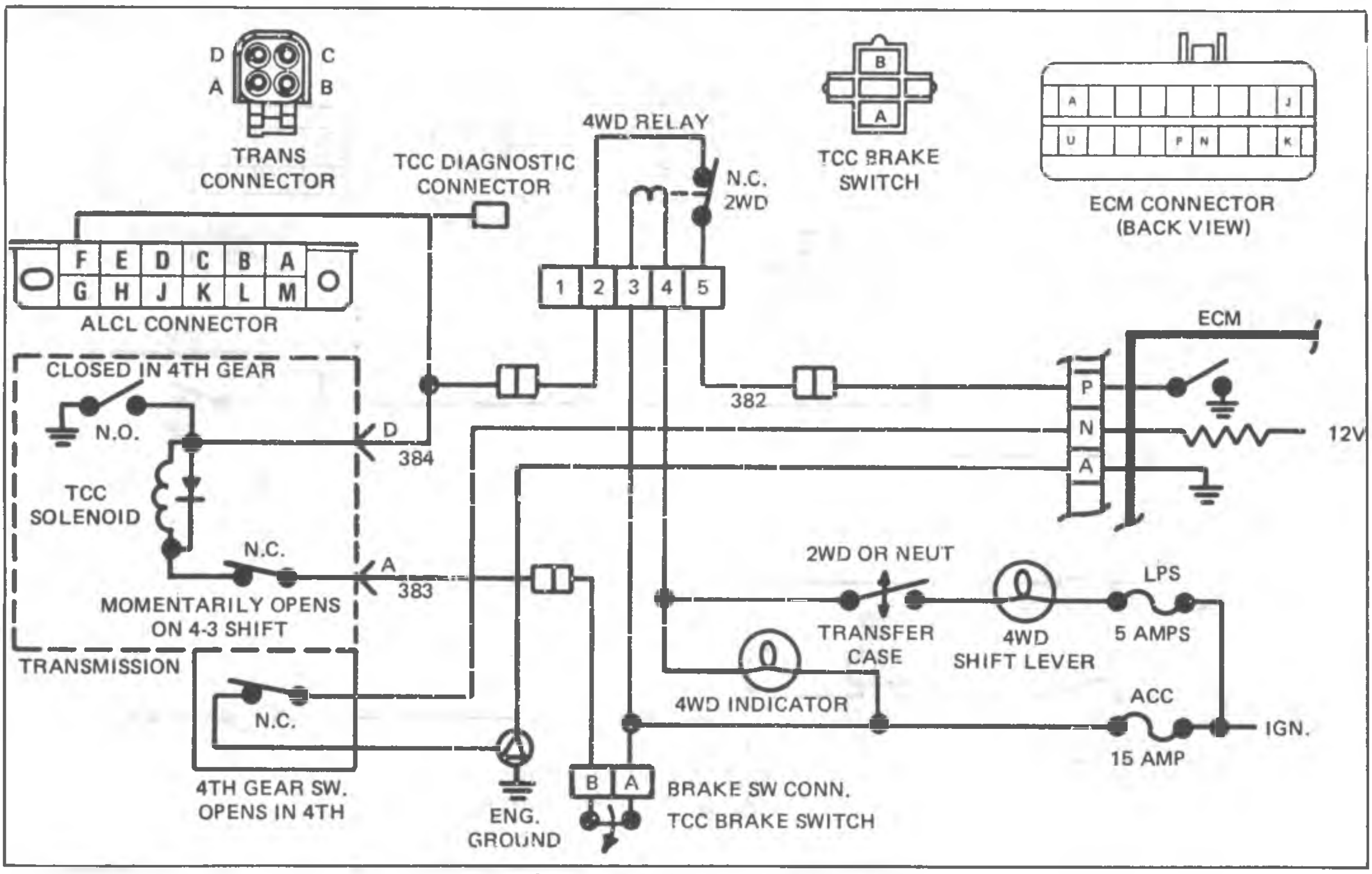


Figure 162 Wiring Diagram - TCC 4WD V8

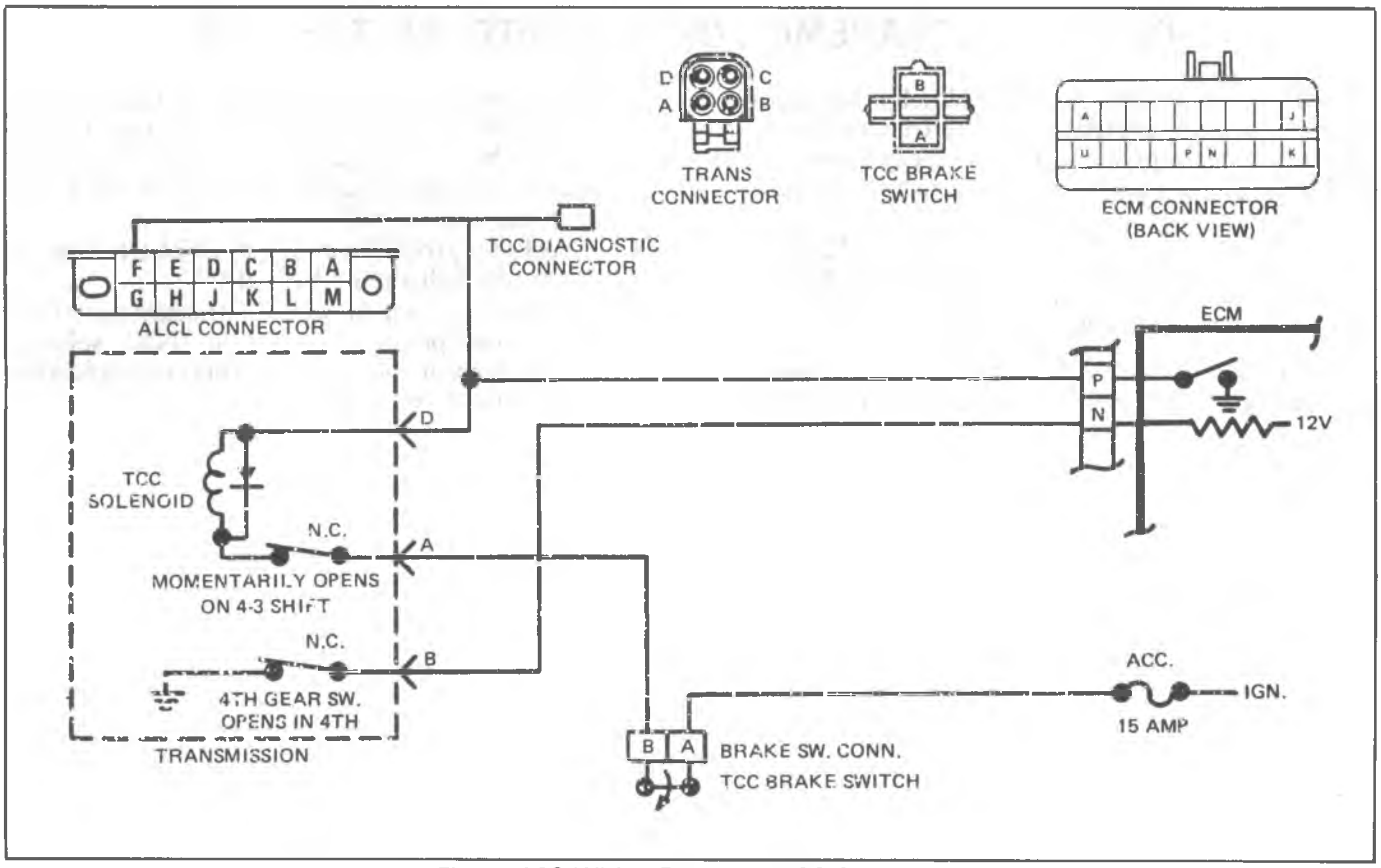


Figure 163 Wiring Diagram - TCC 2WD V8

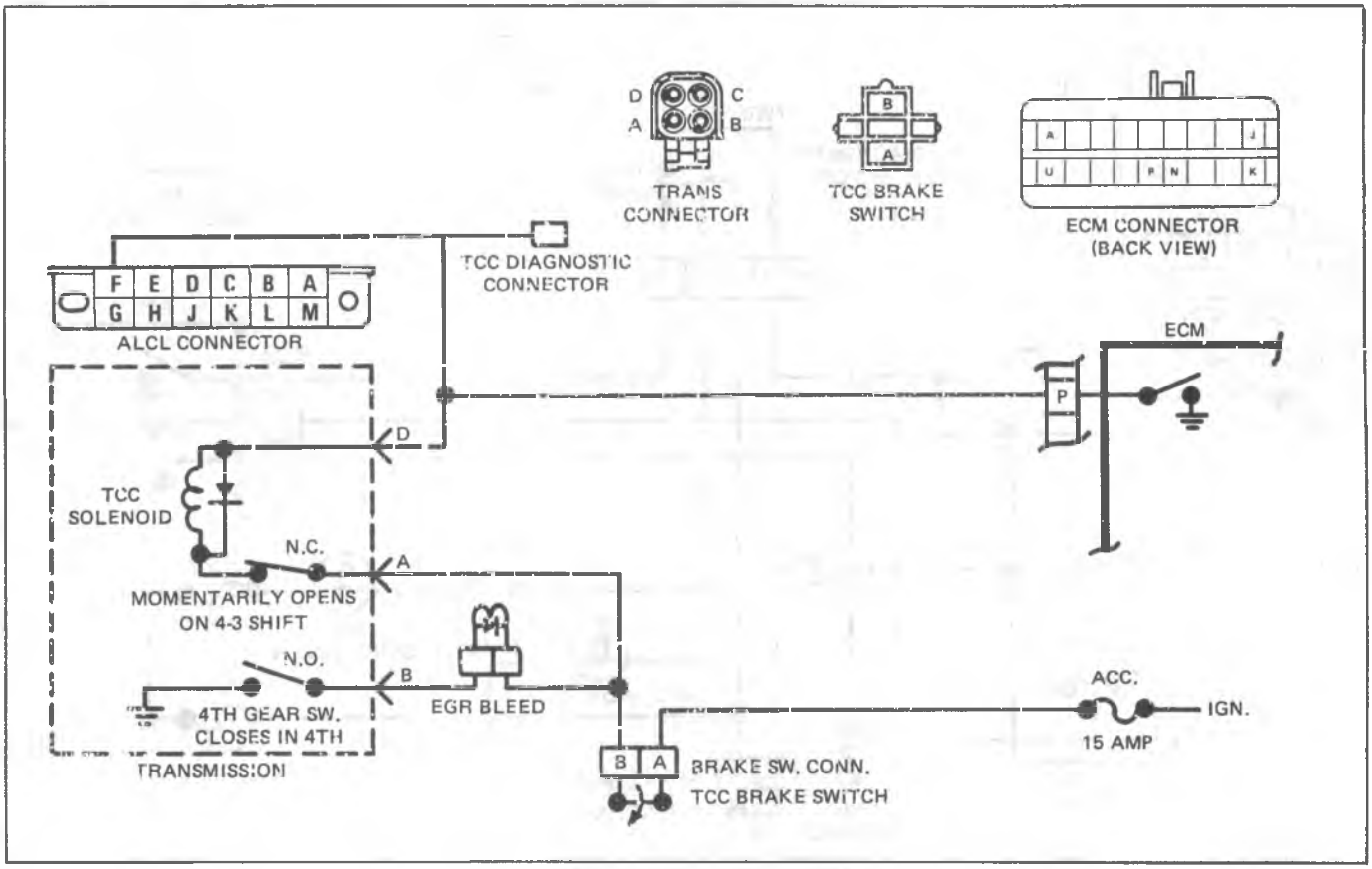


Figure 164 Wiring Diagram - TCC - L6

CHART C-8B, TRANSMISSION CONVERTER CLUTCH (TCC)

The transmission converter clutch is activated by a TCC solenoid located inside the transmission pan. The solenoid is supplied voltage by the ignition and the ECM completes the ground to energize the solenoid.

.1. Checks for complete circuit from ignition through TCC solenoid to ALCL TCC test terminal. Normally the light should be "ON" if circuit is not grounded or open.

2. Checks to see if ECM completes ground to energize TCC solenoid. Light should go "OUT".

3. This increases throttle opening to increase TPS output. If TPS output is too low, the clutch won't apply. On some applications, running free doesn't requie enough throttle opening to allow the transmission to shift.

4. Checks for ground in circuit to ECM terminal 'P'. Normally ligh should be "OFF".

5. Checks for open in wire to transmission from TCC test point or open in TCC solenoid connections or solenoid. If wiring is complete test light should be "ON".

1984 CCC
TRANSMISSION CONVERTER CLUTCH (TCC) CHECK
CHART C-8B
ELECTRICAL DIAGNOSIS

Mechanical checks, such as linkage, oil level, etc., should be performed prior to using this chart.

1
- Connect test light from T.C.C. test point in Term. "F" in ALCL connector to ground.
- Four wheel drive vehicle should be in Two-wheel drive.
- With drive wheels off floor, key "ON", engine not running.
- Note light.

Light on

- Test light should go out as brake pedal is momentarily depressed.

OK

2
- Increase speed to 50-55 mph and note light.

Light "on"

- Lightly depress parking brake and open throttle to maintain 50-55 mph for 5 seconds and note light.

Light "on"

3
- Check volt. from ECM term. "2" to ground with digital V.M. with ign. on, eng. stopped, throttle wide open.

Over 1 volt

- Check TPS adj. Check for low coolant level and higher than normal resistance in coolant sensor circuit.
- If OK, see ECM Replacement Check, Chart C-1.

Under 1 volt

- Check for gn'd. in wire to ECM term. "2".
- If not grounded, replace ECM.

Light off

- Check TPS adjustment.
- If OK, no trouble found.

Light "off"

TCC Electrical System OK

Not OK

- It is faulty brake switch or adj.

Light off

4
- Check for blown fuse. If OK, disconnect connector at trans. and connect test light from harness connector "A" to "D" terminal.
- With ignition on, engine stopped, note test light.

Light off

- Connect test light from term. "A" to ground.
- Note light.

Light on

5
- Connect test light between harness connector term's. again. Ground trans. test point & note light.

Light off

- Repair open in wire from trans. to test point or faulty 4WD relay.

Light on

- It is faulty conn. at trans. or trans. sol. circuit.

Light off

- Repair open in TCC brake switch circuit or adj. switch.

Light on

- Check for ground in wire to ECM term. "P".
- If not grounded, see ECM. Replacement check, Chart C-1.

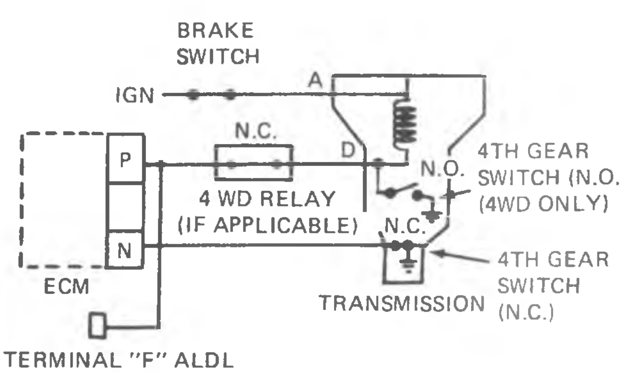


Figure 165 TCC System Diagnosis - CHART C-8B

BLANK

EARLY FUEL EVAPORATION SYSTEM (EFE)

GENERAL DESCRIPTION

PURPOSE

The EFE system used on all engines except 4.8L, provides a source of rapid heat to the engine induction system during cold driveaway. Rapid heating is desireable because it provides quick fuel evaportion and more uniform fuel distribution to aid cold driveability. It also reduces the length of time carburetor choking is required, so it reduces exhaust emissions.

OPERATION

The EFE system is a Vacuum Servo type that uses a valve and vacuum actuator which increases the exhaust gas flow under the intake manifold during cold engine operation. The valve is located in the exhaust and the vacuum actuator is vacuum operated (Figure 166) by a Thermal Vacuum Switch (TVS) (Figure 167). When vacuum is applied to the actuator, the valve closes, causing the intake to heat up.

Wnen coolamt temperature increases the TVS stops vacuum to the actuator.

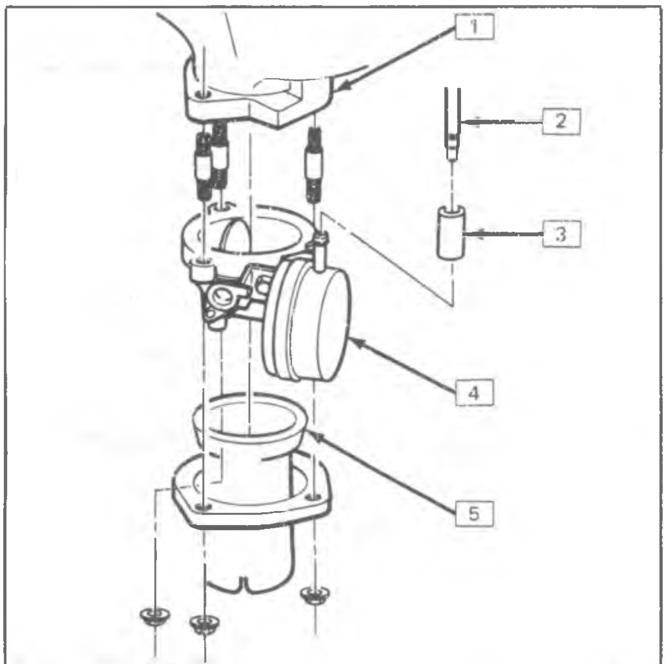


Figure 166 EFE System - Vacuum Servo Type

Results of Incorrect EFE Operation

No EFE when cold:

- Engine may stumble and stall during warm-up.
- Engine takes longer time to warm up.
- Choke may heat up and be off before engine is warm.

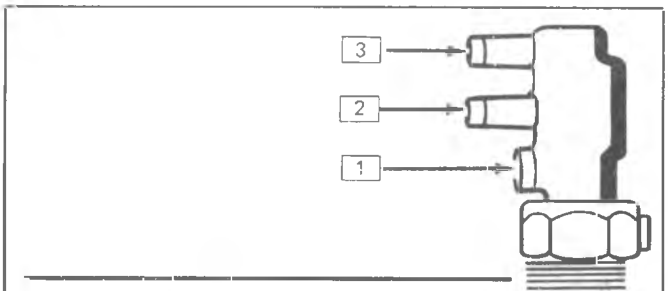


Figure 167 Thermal Vacuum Switch - V8

EFE stays on:

- Poor performance.
- Lack of power when warm due to superheated gases.
- Engine may overheat.

DIAGNOSIS

GENERAL

The operation of the EFE system is to be checked at regular maintenance intervals. Refer to Section 0B for maintenance interval information.

VACUUM SERVO EFE DIAGNOSIS

- TVS controlled - See **CHART C-9C**

ON-VEHICLE SERVICE

VALVE AND ACTUATOR - V8

Figures 168 and 169

Remove or Disconnect

1. Vacuum hose at EFE valve.
2. Exhaust pipe to manifold nuts, and tension springs.
3. Lower right hand exhaust (crossover) pipe and seal - complete removal of pipe is not always necessary.
4. EFE valve and actuator

Install or Connect

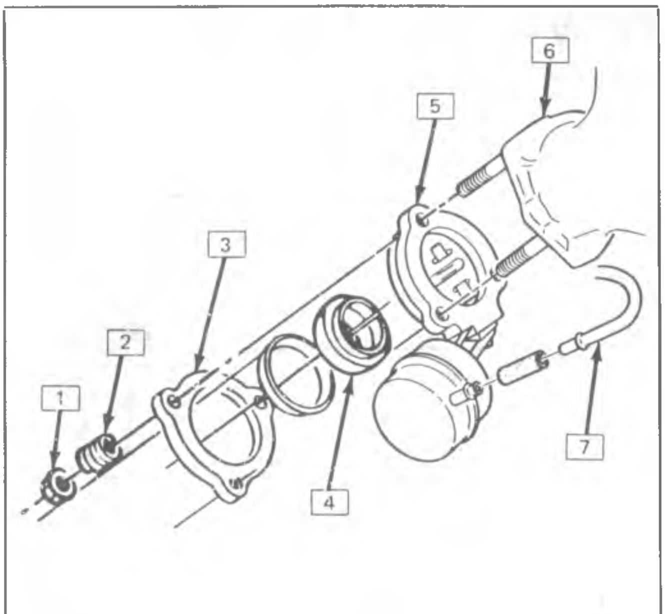
1. EFE valve (replace seals and gaskets if used).
2. Exhaust (crossover) pipe and seal.
3. Exhaust pipe to manifold nuts and tension springs. Tighten nuts to 20 N·m (15 ft.lbs.).
4. Vacuum hose at EFE valve.

ACTUATOR ASSEMBLY

Figure 170

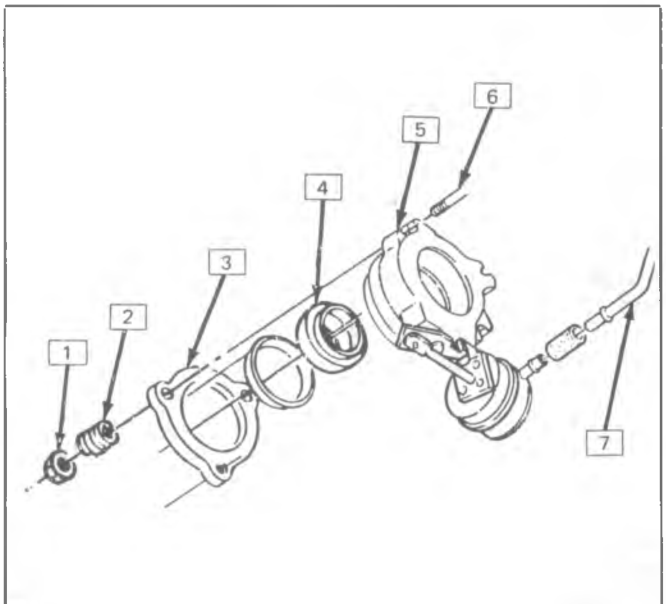
Remove or Disconnect

1. Vacuum hose at actuator.
2. Nuts attaching actuator.



[1] NUT–TIGHTEN TO 20 N·m (15 FT. LBS.)
[2] TENSION SPRING
[3] RIGHT HAND EXHAUST PIPE
[4] SEAL
[5] VALVE AND ACTUATOR
[6] EXHAUST MANIFOLD
[7] MANIFOLD VACUUM PIPE

Figure 168 Valve and Actuator - 7.4L



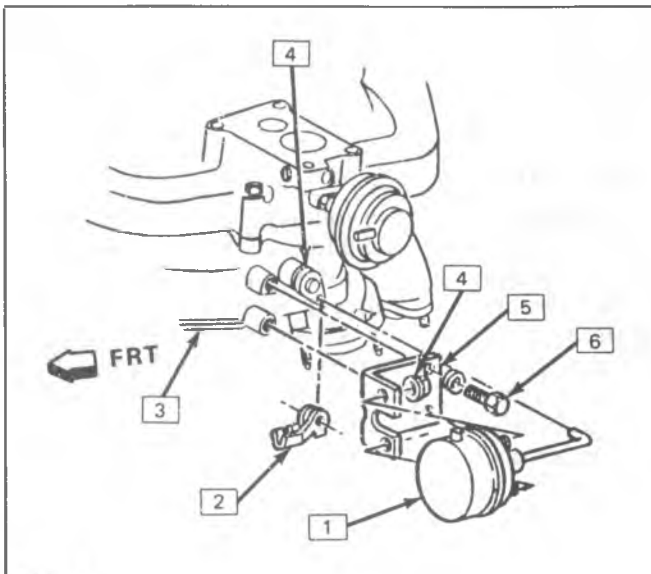
[1] NUT–TIGHTEN TO N·m (15 FT. LBS.)
[2] TENSION SPRING
[3] RIGHT HAND EXHAUST PIPE
[4] SEAL
[5] VALVE AND ACTUATOR
[6] STUD–EXHAUST MANIFOLD
[7] MANIFOLD VACUUM PIPE

Figure 169 Valve and Actuator - V8 (Except 7.4L)

3. Retainer.
4. Bracket (if required).

Install or Connect

1. Bracket (if removed)
2. Retainer
3. Nuts attaching actuator
4. Vacuum hose at actuator



[1] ACTUATOR ASSEMBLY
[2] RETAINER
[3] EXHAUST MANIFOLD
[4] LEVER–HEAT VALVE
[5] NUT–TIGHTEN TO 3 N·m (25 IN. LBS.)
[6] BRACKET
[7] BOLT–TIGHTEN TO 28 N·m (20 FT. LBS.)

Figure 170 - EFE Actuator - 4.1L

COOLANT THERMAL VACUUM SWITCH (TVS)

Figure 171

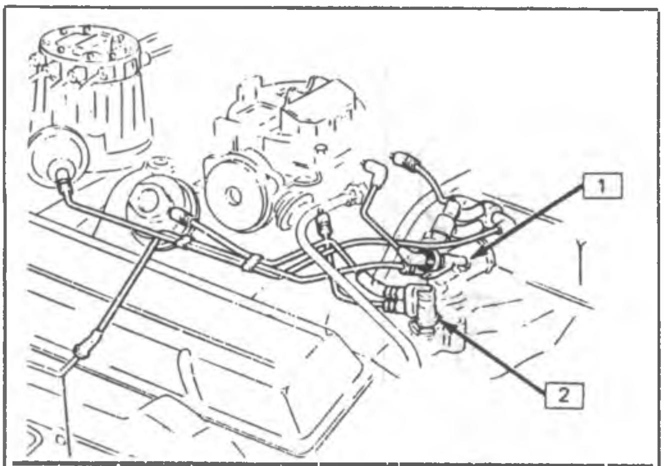
The TVS is located on the engine coolant outlet housing.

Remove or Disconnect

1. Drain coolant below level of engine coolant outlet housing.
2. Hoses at TVS ports.
3. TVS. Refer to number stamped on base of TVS for calibration temperature.

Install or Connect

1. Apply a soft setting sealant uniformly on replacement TVS male threads. No sealant should be applied to sensor end of TVS.
2. TVS. Tighten to 14 N·m (120 lbs. in.) and then hand torque clockwise as required to align TVS to accommodate hoses.
3. Hoses to TVS ports.
4. Coolant as required.



1 EFE–TVS SWITCH
2 EGR–TVS SWITCH

Figure 171 EFE Coolant TVS

OIL THERMAL VACUUM SWITCH (TVS)

Figure 172

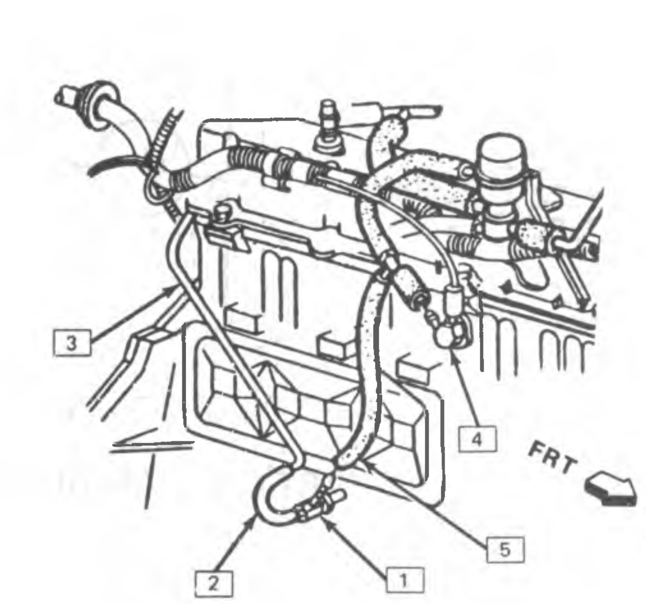
The TVS is located on the lower right side of the engine block.

Remove or Disconnect

1. Vacuum hoses at the TVS ports.
2. Thermal vacuum switch.

Install or Connect

1. Thermal vacuum switch. Tighten to 12 N·m (110 in. lbs.) and then hand torque clockwise as required to align TVS vacuum hoses.
2. Vacuum hoses at the TVS ports.



1 THERMAL VACUUM SWITCH
2 VACUUM HOSE–TO EFE ACTUATOR
3 PIPE–TO EFE ACTUATOR
4 MANIFOLD VACUUM FITTING
5 VACUUM HOSE–FROM MANIFOLD VACUUM

Figure 172 EFE Oil TVS - 4.1L

PARTS INFORMATION

PART NAME	GROUP
Valve, w/Actuator, EFE	3.140
Switch, EFE Vlv Thermo Vac	3.140

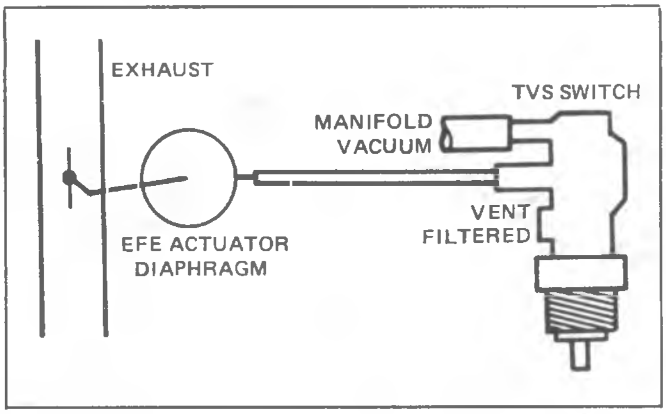


Figure 173 EFE Vacuum Servo - CHART C-9C

CHART C-9C, VACUUM SERVO CHECK WITH TVS

1. Engine temperature should be below 40°C (105°F).
2. Valve should open above 40°C (105°F).
3. There should be at least 34 kPa (10" Hg.) vacuum available to valve.
4. Valve may be seized up. It may free up using heat valve lubricant (part #1050422). If valve does not free up, it must be replaced.

1984
CHART C-9C
EFE CHECK
VACUUM SERVO WITH TVS

- Inspect vacuum hoses for being pinched, plugged or cracked.

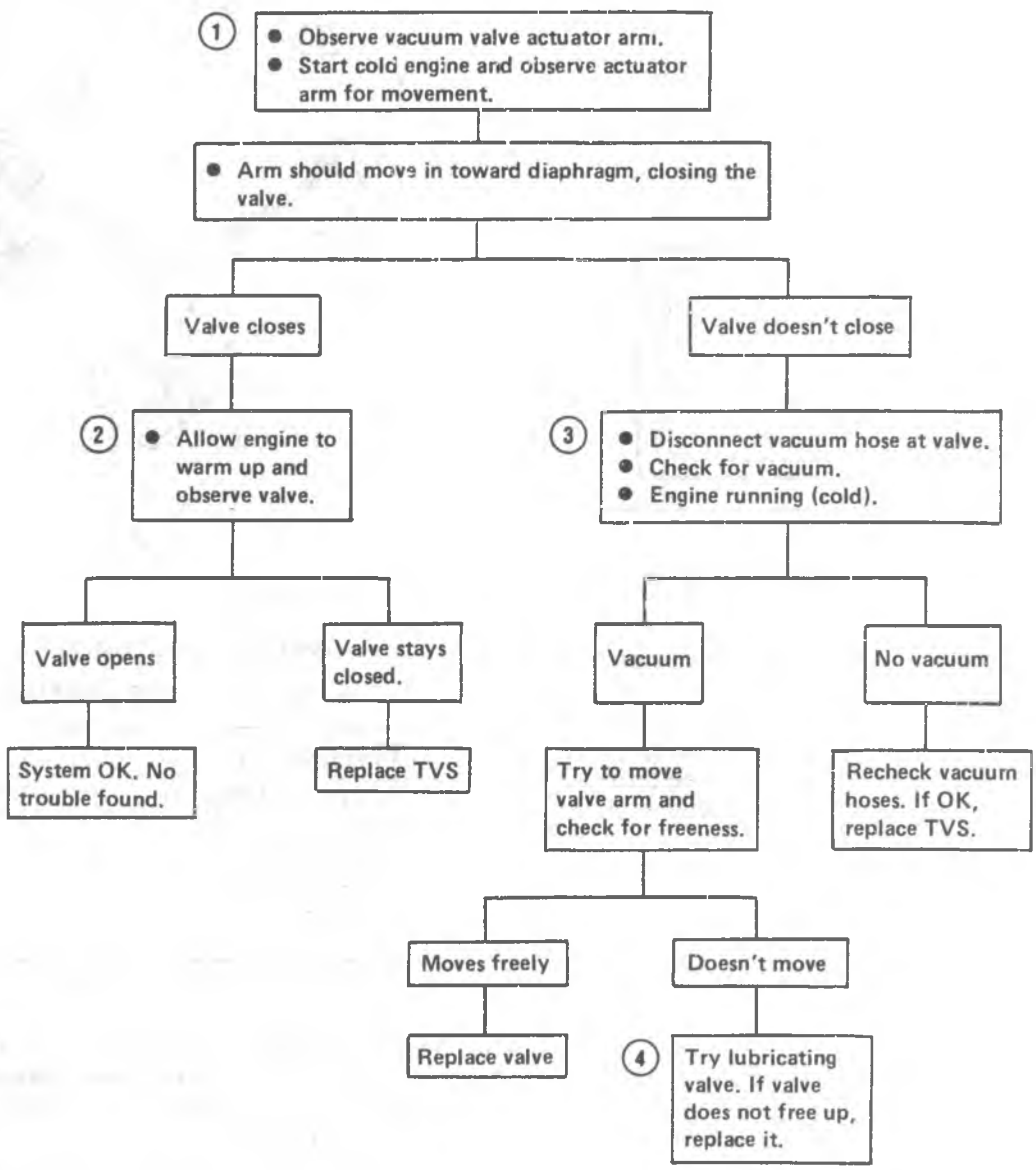


Figure 174 EFE Vacuum Servo Check - CHART C-9C

POSITIVE CRANKCASE VENTILATION (PCV)

GENERAL DESCRIPTION

A Positive Crankcase Ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the intake manifold Figure 176).

The primary control is through the PCV valve (Figure 175) which meters the flow at a rate depending on manifold vacuum.

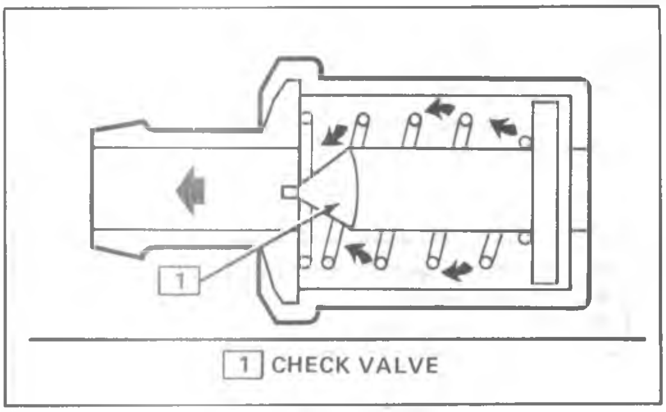


Figure 175 PCV Valve Cross Section

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the air cleaner to be consumed by normal combustion.

Results of Incorrect PCV Operation

- A plugged valve or hose may cause:
  - Rough idle.
  - Stalling or slow idle speed.
  - Oil leaks.
  - Oil in air cleaner.
  - Sludge in engine.
- A leaking valve or hose would cause:
  - Rough idle.
  - Stalling.
  - High idle speed.

DIAGNOSIS

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn off the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

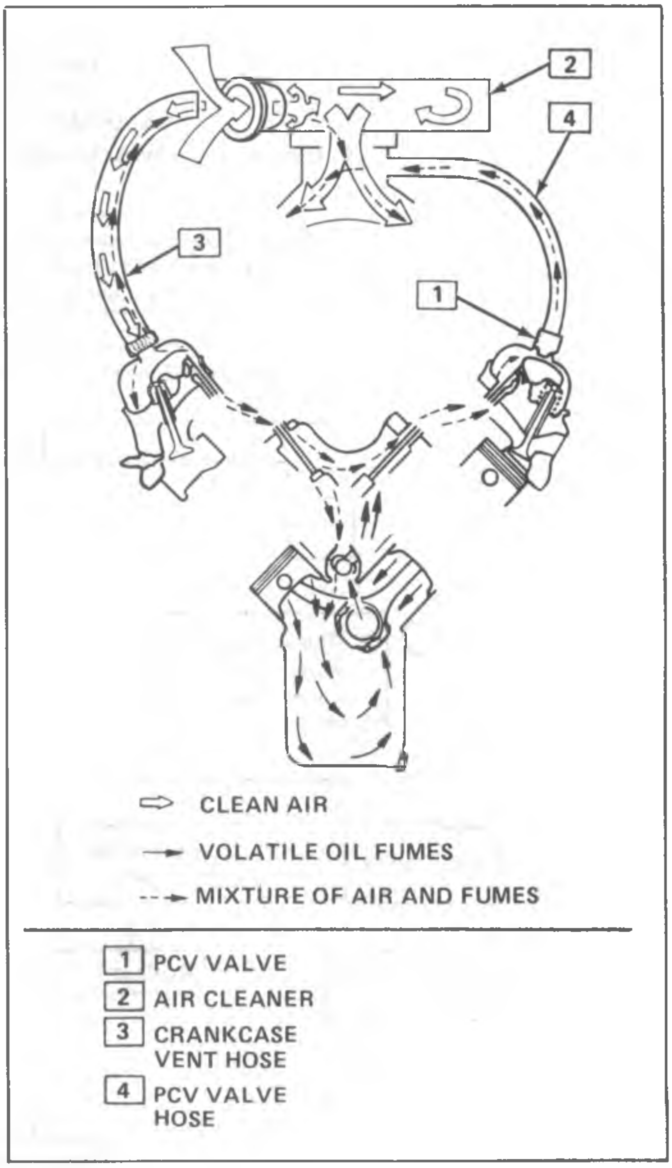


Figure 176 PCV Flow

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

Proper operation of the PCV System (Figure 177) is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

ON-VEHICLE SERVICE

See Figure 177 for replacement of PCV system components.

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve and air cleaner breather at intervals shown in Section 0B.

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

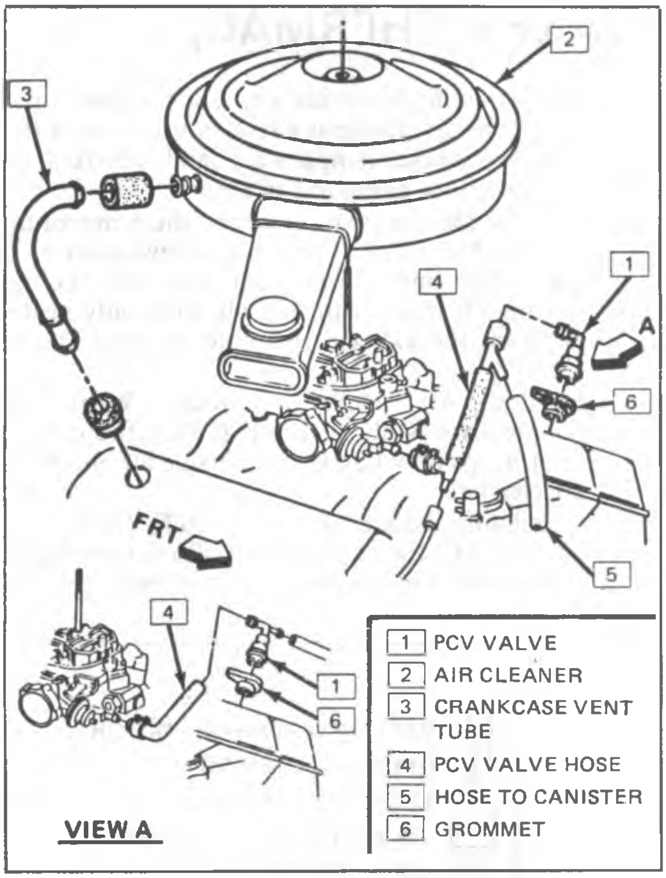


Figure 177 Positive Crankcase Ventilation System

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Valve Asm, C/Case Vent	1.745
Tube, C/Case Vent	1.762
Hose, C/Case Vent Vlv	1.762

THERMOSTATIC AIR CLEANER (THERMAC)

GENERAL DESCRIPTION

PURPOSE

A heated intake air system is used to give good driveability under varying climatic conditions. By having a uniform inlet air temperature, the fuel system can be calibrated to reduce exhaust emissions and to eliminate throttle blade icing.

OPERATION

The THERMAC air cleaner operates by heated air and manifold vacuum (Figure 178). Air can enter the air cleaner from outside the engine compartment or from a heat stove built around the exhaust manifold. A vacuum diaphram motor, built into the air cleaner snorkel, moves a damper door, to admit hot air from the exhaust manifold, outside air, or a combination of both. Inside the air cleaner is a temperature sensor that reacts to air intake temperature and controls the amount of vacuum going to the motor.

- Hot Air Delivery Mode. When the temperature is below 86°F (30°C), the sensor allows vacuum to the motor and the damper door will be up, shuting off outside air and allowing only heated air from the exhaust manifold to enter the air cleaner.
- Outside Air Delivery Mode. When the temperature is above 131°F (55°C), the damper door drops down and only outside air enters the air cleaner.
- Regulating Mode. Between 86°F (30°C) and 131°F (55°C) the damper door allows both heated and outside air to enter the air cleaner.

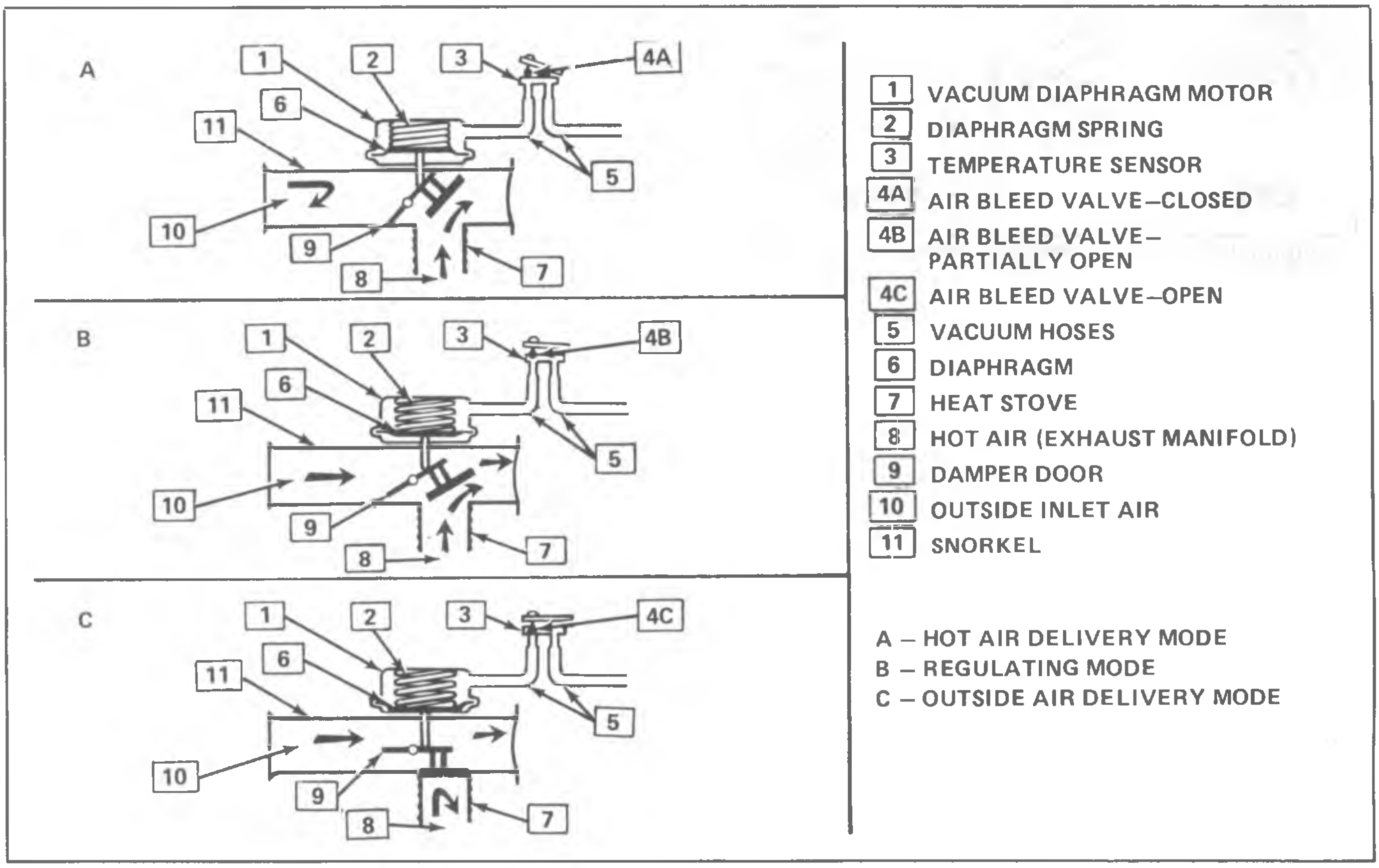


Figure 178 THERMAC Operation

THERMAC Delay Valve

Some applications use a delay valve on the hose connecting the vacuum motor to the temperature sensor (Figure 179). When vacuum in this hose drops for any reason, the check valve will bleed off the vacuum to the vacuum motor slowly.

Results of Incorrect THERMAC Operation

- Hesitation during warm-up can be caused by:
  - Heat stove tube disconnected.
  - Vacuum diaphram motor inoperative (open to Snorkel).
  - No manifold vacuum.
  - Damper door does not move.
  - Missing air cleaner to carburetor seal.
  - Missing air cleaner cover seal or loose cover.
  - Loose air cleaner.
- Lack of power, sluggish, or spongy, on a hot engine can be caused by:
  - Damper door does not open to outside air.

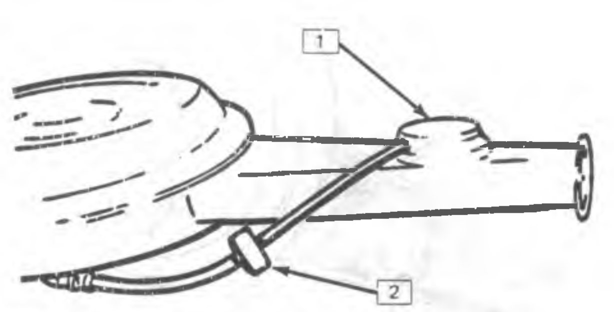


Figure 179 THERMAC Delay Valve

- Temperature sensor doesn't bleed off vacuum.

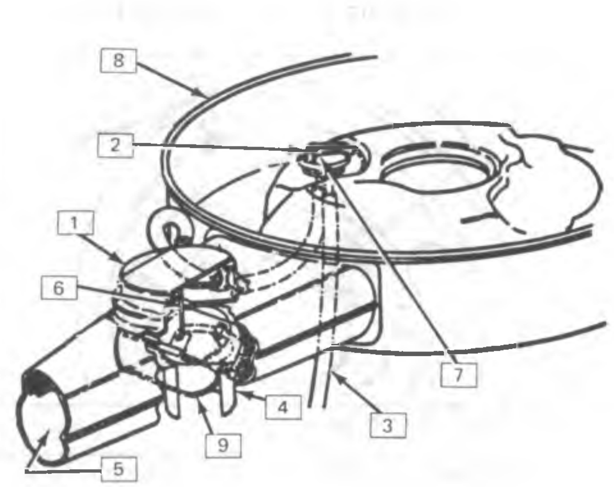


Figure 180 THERMAC Air Cleaner

DIAGNOSIS

THERMAC AIR CLEANER CHECK

1. Inspect system to be sure all hoses and heat stove tube are connected. Check for kinked, plugged or deteriorated hoses.
2. Check for presence and condition of air cleaner to carburetor gasket seal.
3. With air cleaner assembly installed, damper door should be open to outside air.
4. Start engine. Watch damper door in air cleaner snorkel. When engine is first started, damper door should move and close off outside air. As air cleaner warms up, damper door should open slowly to outside air.
5. If the air cleaner fails to operate as described above, perform vacuum motor check. If it operates, the door may not be moving at the right temperature. If the driveability problem is during warm-up, make the temperature sensor check below.

VACUUM MOTOR CHECK

1. With engine off, disconnect vacuum hose at vacuum diaphragm motor.
2. Apply at least 23 kPa (7 in. Hg.) of vacuum to the vacuum diaphragm motor. Damper door should completely block off to outside air when vacuum is applied. If not, check to see if linkage is hooked up correctly.
3. With vacuum still applied, trap vacuum in vacuum diaphragm motor by bending hose. Damper door should remain closed. If not, replace vacuum diaphragm motor assembly. (Failure of the vacuum diaphragm motor assembly is more likely to be caused from binding linkage or a corroded snorkel than from a failed diaphragm. This should be checked first, before replacing the diaphragm.)
4. If vacuum motor checks OK, check vacuum hoses and connections. If OK, replace the temperature sensor.

TEMPERATURE SENSOR CHECK

1. Start test with air cleaner temperature below 30°C (86°F). If engine has been run recently, remove air cleaner cover and place thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 30°C (86°F) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to Step 2.
2. Start and idle engine. Damper door should move to close off outside air immediately if engine is cool enough. When damper door starts to open the snorkel passage (in a few minutes), remove air cleaner cover and read thermometer. It must read about 55°C (131°F).
3. If the damper door is not open to outside air at temperature indicated, temperature sensor is malfunctioning and must be replaced.

ON-VEHICLE SERVICE

AIR CLEANER ELEMENT

Remove or Disconnect

1. Air cleaner cover.
2. Old element.

Install or Connect

1. New element.
2. Air cleaner cover. Do not over-torque nuts (install finger-tight).

VACUUM DIAPHRAGM MOTOR

Figure 181

Remove or Disconnect

1. Air cleaner.
2. Vacuum hose from motor.
3. Drill out the two spot welds initially with a 1. 6mm (1/16") drill, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.
4. Motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Install or Connect

1. Drill a 2.8mm (7/64") hole in snorkel tube at center of vacuum motor retaining strap.
2. Vacuum motor linkage into control damper assembly.
3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure motor to the snorkel tube. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
4. Vacuum hose to motor and install air cleaner.

SENSOR

Figure 182

Remove or Disconnect

1. Air cleaner.
2. Hoses at sensor.
3. Pry up tabs on sensor retaining clip. Remove clip and sensor from air cleaner. Note position of sensor for installation.

Install or Connect

1. Sensor and gasket assembly in original position.
2. Retainer clip on hose connectors.
3. Vacuum hoses and air cleaner on engine.

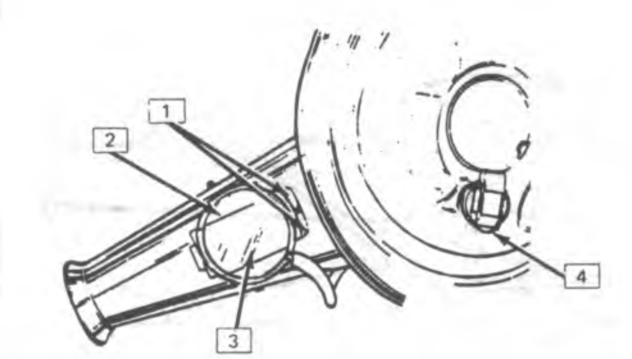


Figure 181 Replacing Vacuum Diaphragm Motor

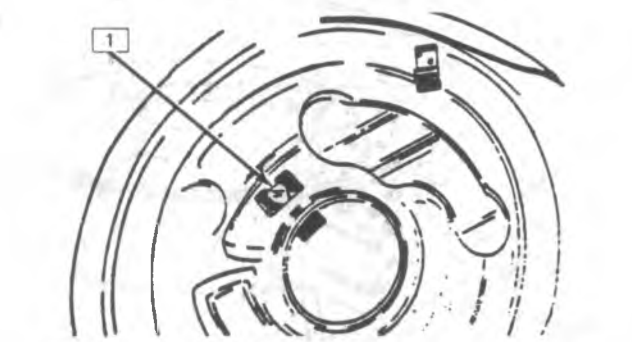


Figure 182 Replacing THERMAC Sensor Retaining Clip

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Element (Paper)	3.410
Nut, A/Cl	3.403
Seal, Air Cleaner	3.403
Sensor, A/Cl	3.415
Motor, A/Cl Vac Diaph	3.415
Tube, Eng Air Heat Stove	3.417
Stove, Eng Air Heat	3.417

ECM WIRE HARNESS AND CONNECTORS

GENERAL DESCRIPTION

The ECM wire harness electrically connects the ECM to the various solenoids, switches, and sensors in the engine compartment. The ECM is located inside the vehicle in the instrument panel.

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. As shown in Figure 183, the connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

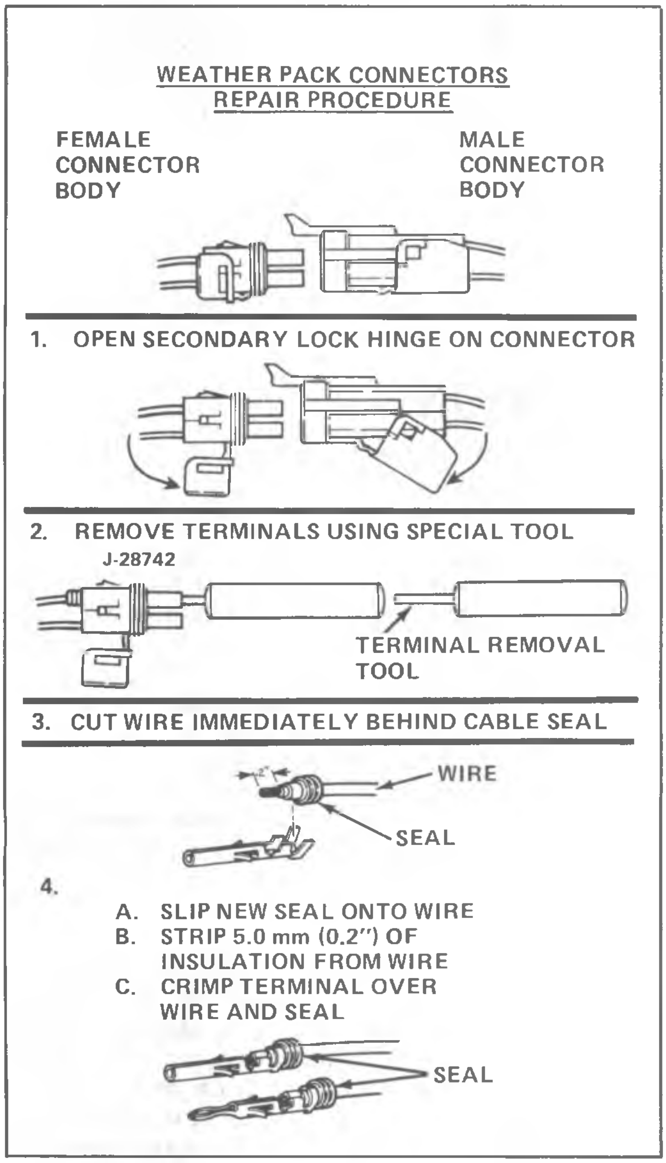


Figure 183 Weather-Pack Terminal Repair

ON-VEHICLE SERVICE

Connectors on the Computer Command Control are known as Weather-Pack connectors. Figure 183 shows a Weather-Pack terminal and the tool (J-28742) required to service it. This tool is used to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed. And, unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the terminals. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Molded-on connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. Figure 184 has instructions on splicing wires.

Use care when probing the connections or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. **Never** probe through the Weather-Pack seals.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

WIRE HARNESS

ECM wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced into a harness, use wire with high temperature insulation only.

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in Figure 184.

It is seldom necessary to replace a complete harness. If replacement is necessary, refer to ECM Wire Harness figures in the Introduction for proper harness routing.

CONNECTORS AND TERMINALS

Weather-Pack connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

Replacement connectors and terminals are listed in Group 8.965 of the Parts Catalog.

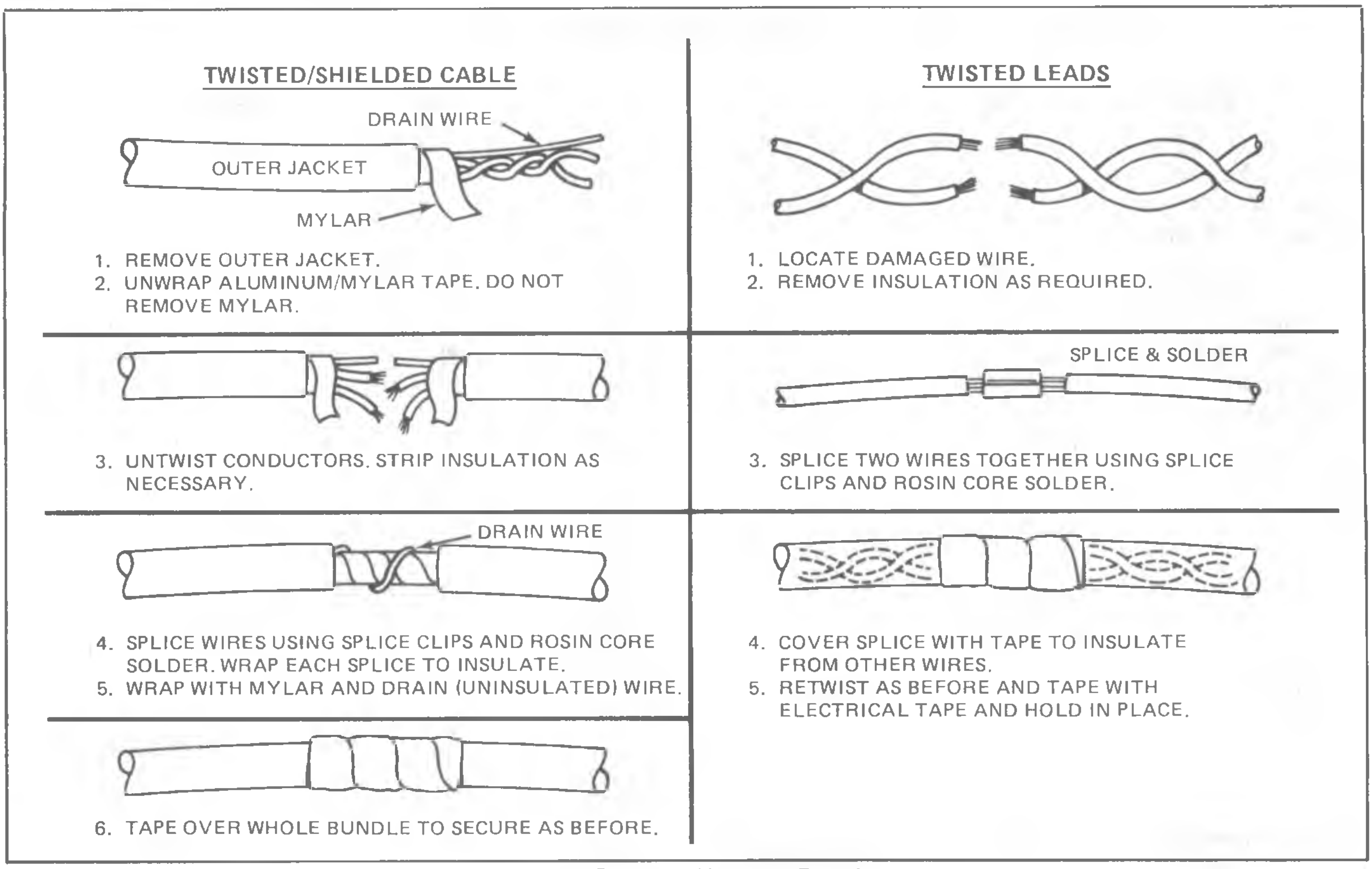


Figure 184 Wire Harness Repair

SPECIAL INFORMATION

TOOLS NEEDED TO DIAGNOSE THE SYSTEM

The Computer Command Control system does not require special testers for diagnosis. A tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A), vacuum pump, vacuum gage and jumper wires are required for diagnosis. A test light or voltmeter must be used when specified in the procedures. They must **not** be interchanged. See Figures 185 and 186 for tools needed to test and diagnosis system.

ALCL TOOLS

The ALCL connector under the dash has a variety of information available on terminal "E" (called Serial Data). There are several tools available for reading this information.

ALCL tools do not make the use of diagnostic charts unnecessary. They do not tell exactly where a problem is in a given circuit. However, with an understanding of what each position on the equipment measures, and knowledge of the circuit involved, the tools can be very useful in getting information which would be more time consuming to get with other equipment. In some cases, it will provide information that is either extremely difficult or impossible to get with other equipment.

When a chart calls for a sensor reading, the ALCL tool can be used to read the following directly:

- Park/Neutral
- Throttle Position Sensor
- Differential Pressure Sensor
- Coolant Temperature Sensor
- Oxygen Sensor

When the ALCL tool is plugged in, the "CHECK ENGINE" light will flash rapidly. This indicates that information is being transmitted to the tool. When the tool is plugged in, it takes out the timer that keeps the system in open loop for a certain period of time. Therefore, it will go closed loop as soon as the vehicle is started, if all other closed loop conditions are met. This means that if, for example, the air management operation were checked with the ALCL tool plugged in, the air management system would not function normally because the air would go to the converter as soon as the vehicle was started and would not go to ports for a period of time.

Intermittent Conditions

The ALCL tool is helpful in cases of intermittent operation. The tool can be plugged in and observed while driving the vehicle under the condition where the light comes "ON" momentarily, or the engine driveability is poor momentarily. If the problem seems to be related to certain areas that can be checked on the ALCL tool, then those are the positions that should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the ALCL tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

For more complete information on the operation of these tools, see the manufacturer's instructions.

SPECIFICATIONS

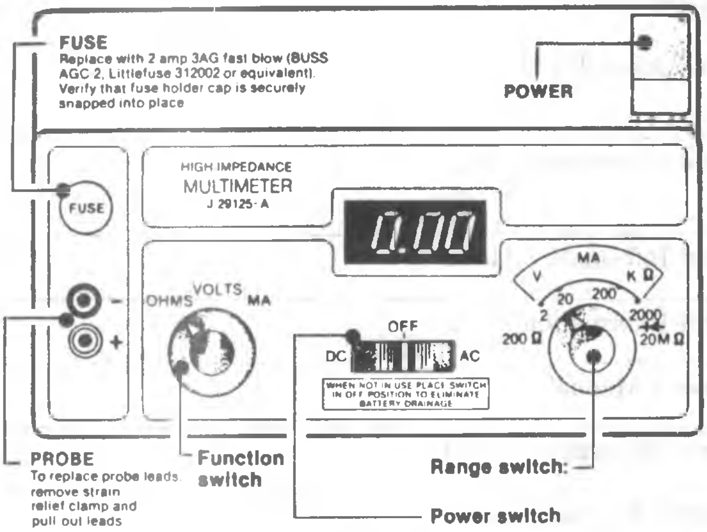
Specification	Location of Information
Engine Timing	Vehicle Emission Control Information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Idle Speed, Non-ECM Controlled	Vehicle Emission Control Information label.
Idle Speed, Minimum	Vehicle Emission Control Information label.
Fast Idle Speed	Vehicle Emission Control Information label.
Spark Plug Type	See Section 0A, or Owner's Manual
Spark Plug Gap	Vehicle Emission Control Information Label.
Engine V.I.N. Code	8th digit of V.I.N. number. See Section 0A.
Engine Family	Vehicle Emission Control Information label.
Filter Part Numbers	See Section 0A or Owner's Manual.
Part Numbers of Major Components	WDD-GM Parts Book.
Replacement Vehicle Emission Control Information Label	WDD-GM Label Catalog.

TPS ADJUSTMENT SPECIFICATION

(ALL SETTINGS $\pm$ 0.1 VOLT)

ENGINE	VOLTAGE
4.1L Automatic Trans.	0.255 At Curb Idle
4.1L Manual Trans.	0.86 High Step of Fast Idle Cam
5.0L	0.41 At Curb Idle
5.7L	0.41 At Curb Idle

SPECIAL TOOLS



HIGH IMPEDANCE MULTIMETER
J29125-A

VOLTMETER—Voltage Position Measures amount of voltage. Connected parallel to exiting circuit. A digital high impedance voltmeter is used because some circuits require accurate low voltage readings, and some circuits have a very high resistance in the ECM. This meter also accurately measures extremely low current flow. Refer to meter for more information.

- Both function and range switch must be set properly, and the DC or AC position selected. DC is used for most measurements.

OHMMETER—Resistance Position Measures resistance of circuit directly in ohms. Refer to meter for more information.

- 1. display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- Intermittent connection in circuit may be indicated by digital reading that will not stabilize on circuit.
- Range Switch.

J23738/BT7517

VACUUM PUMP (20 IN. HG. MINIMUM)
Use gage to monitor manifold engine vacuum. Check vacuum sensors, solenoids and valves with hand pump.

J28742/BT8234-A

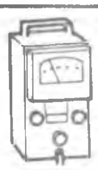
WEATHER PACK TERMINAL REMOVER
Used to remove terminals from Weather Pack connectors. Refer to wiring harness service for removal procedure.

J33095/BT8234-A

ECM CONNECTOR TERMINAL REMOVER
Use to extract a terminal from connectors at the ECM.

UNPOWERED TEST LIGHT
Used to check wiring for complete circuit. Connect lead wire to good ground. Probe with test prod to connector or component terminal. Bulb will light if voltage is present.

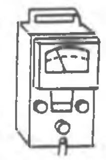
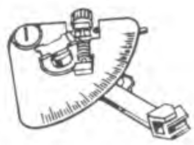
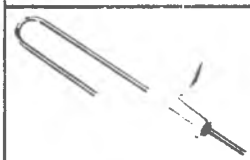
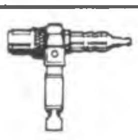
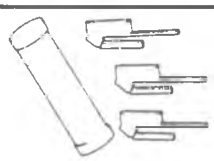
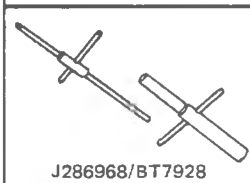
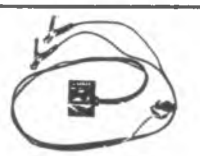
JUMPER WIRES (#16, 18 OR 20 GAGE WIRE)
- Clip jumper wire used to complete a circuit by bypassing an open.
- Set of jumper wires used to insert between Weather Pack connectors to permit access to the connector terminals for circuit checking. Six wires approximately 6" long. Use terminals 12014836 and 12014837. One set - female terminals both ends, one set - male at both ends and four sets - male terminals at one end and female terminals at the opposite end.



TACHOMETER
Use either a crankshaft harmonic balance pickup type or electronic coil trigger signal pickup type

Figure 185 Special Tools

SPECIAL TOOLS
CARBURETOR

	**DWELLMETER** USED TO MONITOR THE FUEL CONTROL DELIVERY DETERMINED BY THE ECM COMMAND. (SET ON 6 CYL. SCALE)	 J9789-C/BT3005	**CARBURETOR GAGE SET** USED TO PERFORM CARBURETOR GAGE AND ANGLE SETTING
 J29533A/BT8127	**OXYGEN SENSOR WRENCH** USED TO REMOVE OR INSTALL THE OXYGEN SENSOR	 J9789-111/BT8231C	**BENDING TOOL (PART OF J9789-C)** USED TO BEND CARBURETOR LINKAGE.
 J33815-1/BT8253-A	**M/C SOLENOID GAGING TOOL** USED TO ADJUST THE MIXTURE CONTROL SOLENOID PLUNGER ON E2ME OR E4ME CARBURETOR	 J26701-A/BT7704	**CHOKE ANGLE GAGE (PART OF J9789-C)** USED TO SET CHOKE ANGLE TO ADJUSTMENT SPECIFICATION
 J33815-2/BT8253-A	**AIR BLEED VALVE GAGING TOOL** USED TO ADJUST IDLE AIR BLEED VALVE ON E2ME OR E4ME CARBURETOR	 J9789-130/BT7720	**CARBURETOR FLOAT LEVEL GAGE (PART OF J9789-C)** USED TO CHECK FLOAT LEVEL ON M/C SOLENOID PLUNGER TRAVEL ON E2ME OR E4ME CARBURETOR
 J26795/BT7220-1	**HEI SPARK TESTER** USE TO CHECK HEI SPARK VOLTAGE.	 J9789-135/BT8104	**FLOAT LEVEL GAGE SET** USED TO CHECK FLOAT LEVEL ON 2SE OR E2SE CARBURETOR
 J286968/BT7928	**MIXTURE ADJUSTMENT TOOL** USED TO ADJUST LEAN MIXTURE AND RICH MIXTURE STOP SCREWS ON E2SE, E2ME OR E4ME CARBURETOR	 J29030-B/BT7610B	**IDLE MIXTURE SOCKET** USED TO ADJUST IDLE MIXTURE NEEDLE ON A E2SE CARBURETOR
 J25322/BT7523	**PUMP LEVER PIN PUNCH** USED TO DRIVE PUMP LEVER PIN INWARD TO ALLOW REMOVAL OF THE PUMP LEVER.	 J29607/BT8022	**ISC ADJUSTING WRENCH** USED TO ADJUST ISC PLUNGER TO OBTAIN MAXIMUM SPECIFICATION RPM SPEED.
 J22646-02	**CARBURETOR ADJUSTMENT WRENCH** USED TO REMOTE ADJUST IDLE MIXTURE NEEDLE ON THE VEHICLE.	 J34025/BT8256A	**ISC MOTOR TESTER** USED TO TEST OPERATION OF ISC MOTOR IN EITHER DIRECTION AND CONDITION OF THE INTERNAL SWITCH

84SM1 SR846E0589

Figure 186 Special Tools

SECTION 6E9

DIESEL EMISSIONS

6.2L DIESEL ENGINE

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD, FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR THE PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHENEVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

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GENERAL DESCRIPTION

The 6.2L diesel engine has controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

The 6.2L (RPO LH6) diesel engine (Figs. 6E9-1 and 3) with Federal light duty emission regulations has the following controls:

- Crankcase Ventilation
- Exhaust Gas Recirculation

The 6.2L (RPO LH6) diesel engine (Figs. 6E9-2 and 4) with California light duty emission regulations has the following controls:

- Crankcase Ventilation
- Diesel Electronic Control - which controls:
  - Exhaust Gas Recirculation
  - Transmission Converter Clutch
  - Cold Advance Control

The 6.2L (RPO LL4) diesel engine (Fig. 6E9-5) with heavy duty emission regulations has the following controls:

- Crankcase Ventilation
- Vacuum Regulator Valve

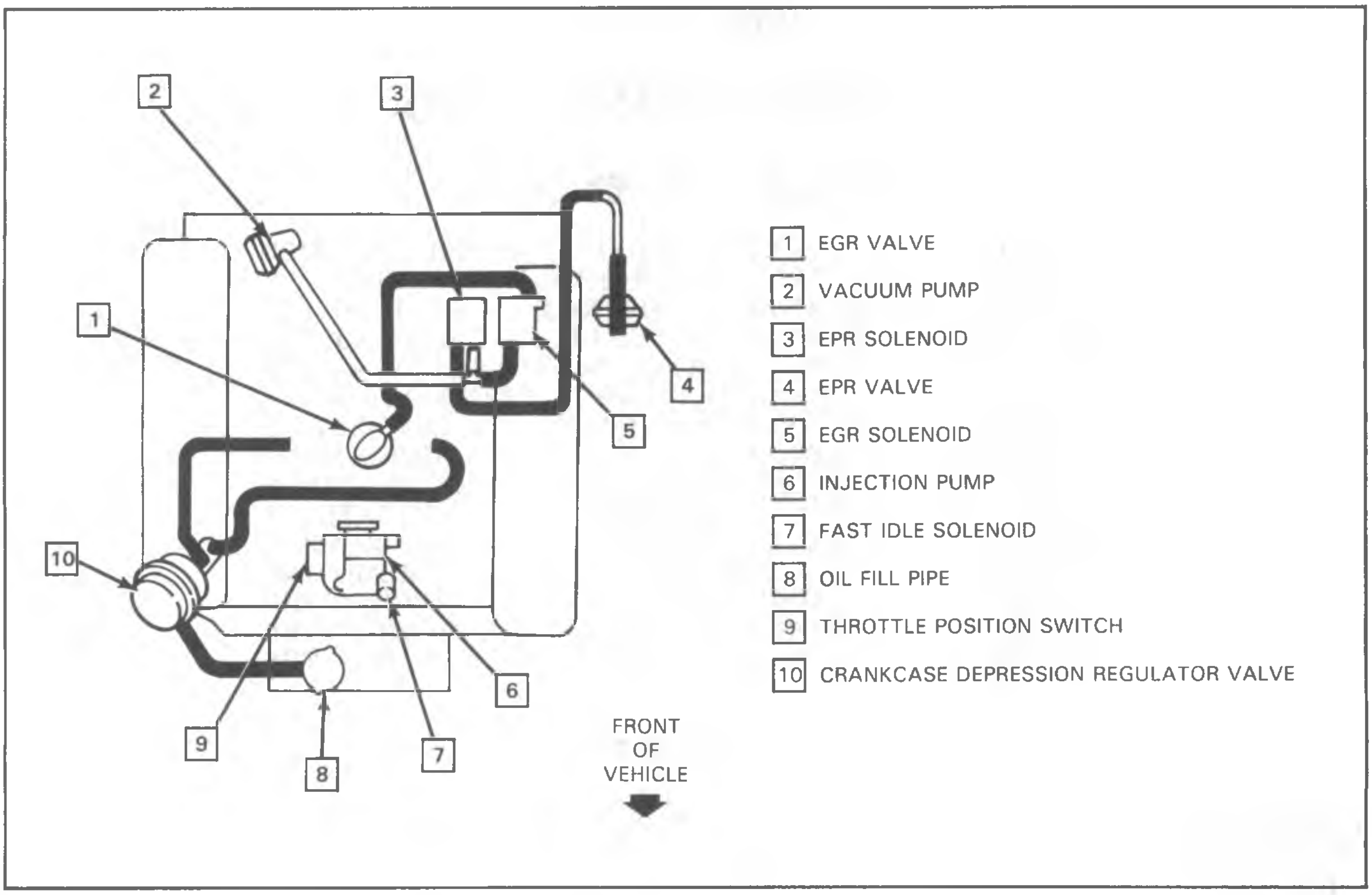


Fig. 6E9-1--Emission Systems-Federal CK (LH6 Engine)

VACUUM PUMP

General

Since the air crossover and intake manifold on a diesel engine are unrestricted, no vacuum source is available as there is with a gasoline engine. A vacuum pump, driven by the engine, provides a vacuum source to operate the EGR system (LH6), the vacuum regulator valve (LL4), air conditioning servos (if used) and cruise control servo (if used).

CK Series

Fig. 6E9-6

The vacuum pump is located at the top rear of the engine. It is a diaphragm pump which requires no periodic maintenance. A drive gear on the lower end of the drive housing assembly powers the engine oil lubricating pump.

GP Series

Fig. 6E9-7

The vacuum pump is located on the front right side of the engine. It is a diaphragm pump which requires no periodic maintenance.

On-Vehicle Service

CK Series (Fig. 6E9-6)

Remove or Disconnect

1. Batteries
2. Air Cleaner. Cover intake manifold
3. Electrical connector to engine speed sensor (California)
4. Vacuum hose
5. Clamp
6. Vacuum pump and gasket

Connector or Install

1. New gasket on pump
2. Vacuum pump
3. Clamp
4. Vacuum hose
5. Engine speed sensor electrical connector (California)
6. Air cleaner
7. Batteries

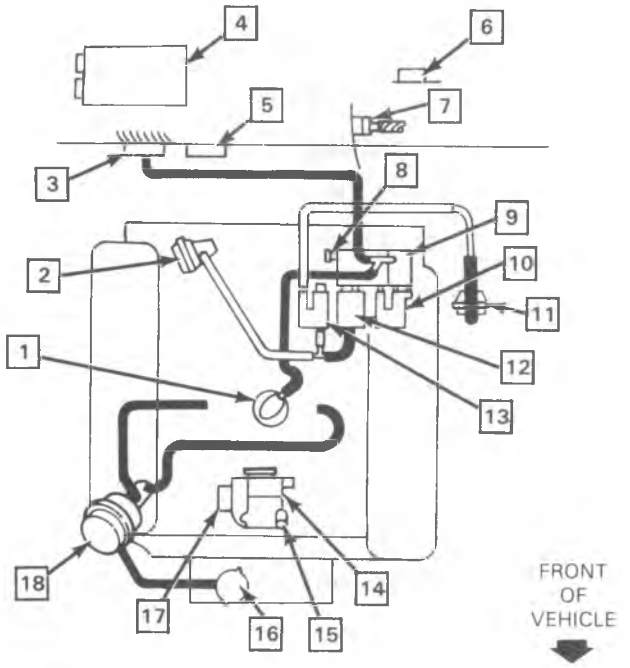
GP Series (Fig. 6E9-8)

Remove or Disconnect

1. Belt
2. Vacuum hose
3. Vacuum pump
4. Pulley assembly

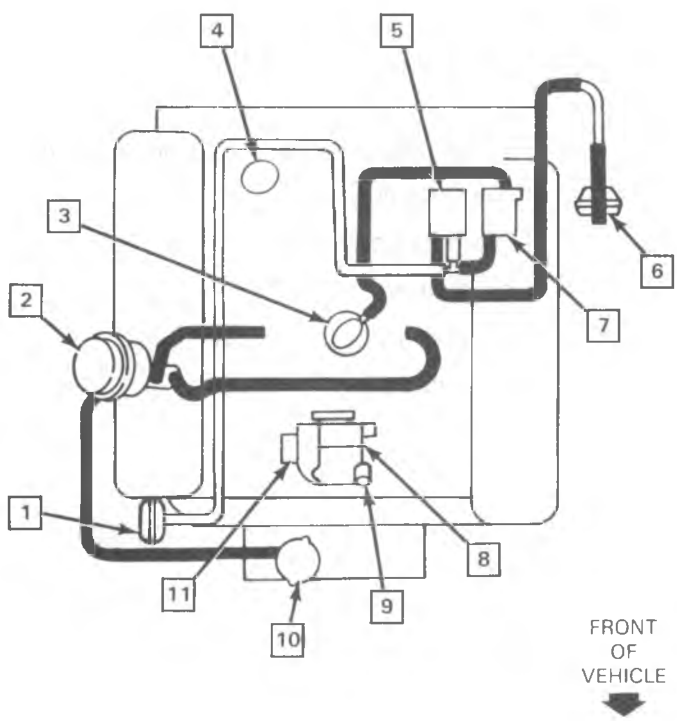
Connect or Install

1. Pulley on pump
2. Vacuum pump
3. Vacuum hose
4. Belt-tighten to specs.



1 EGR VALVE
2 VACUUM PUMP AND ENGINE SPEED SENSOR
3 MAP SENSOR
4 ECM (UNDER DASH)
5 COLD ADVANCE CONTROL RELAY
6 ALDL CONNECTOR
7 TCC SOLENOID
8 VENT FILTER
9 MANIFOLD
10 EGR VENT SOLENOID
11 EPR VALVE
12 EGR SOLENOID
13 EPR SOLENOID
14 INJECTION PUMP
15 FAST IDLE SOLENOID
16 OIL FILL PIPE
17 THROTTLE POSITION SENSOR
18 CRANKCASE DEPRESSION REGULATOR VALVE

Fig. 6E9-2--Emission Systems-California CK (LH6 Engine)



1 VACUUM PUMP
2 CRANKCASE DEPRESSION REGULATOR VALVE
3 EGR VALVE
4 ENGINE SPEED SENSOR
5 EPR SOLENOID
6 EPR VALVE
7 EGR SOLENOID
8 INJECTION PUMP
9 FAST IDLE SOLENOID
10 OIL FILL PIPE
11 THROTTLE POSITION SWITCH

Fig. 6E9-3--Emission Systems-Federal G (LH6 Engine)

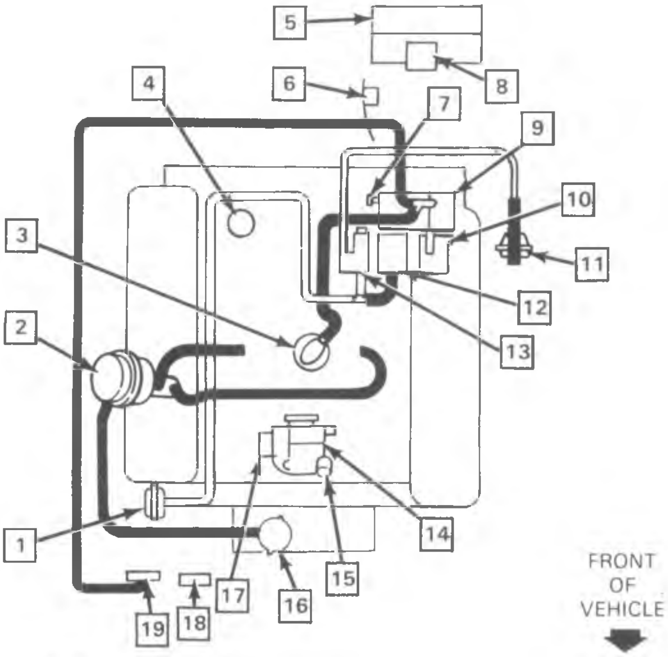


Fig. 6E9-4--Emission Systems-California G (LH6 Engine)

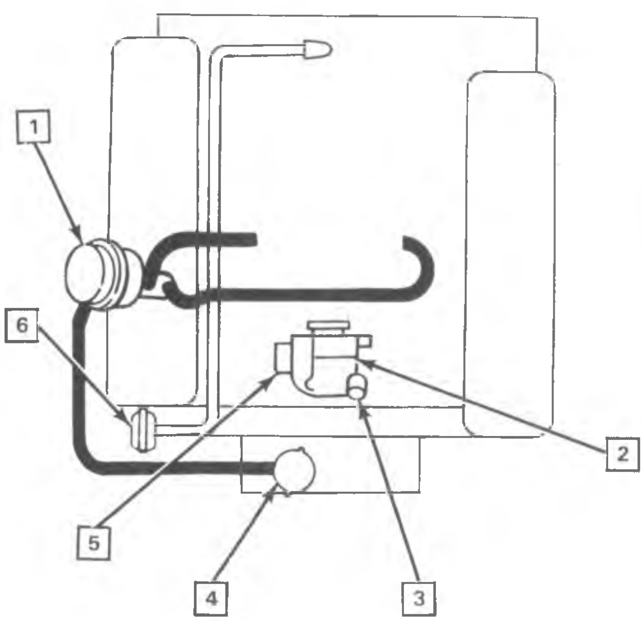
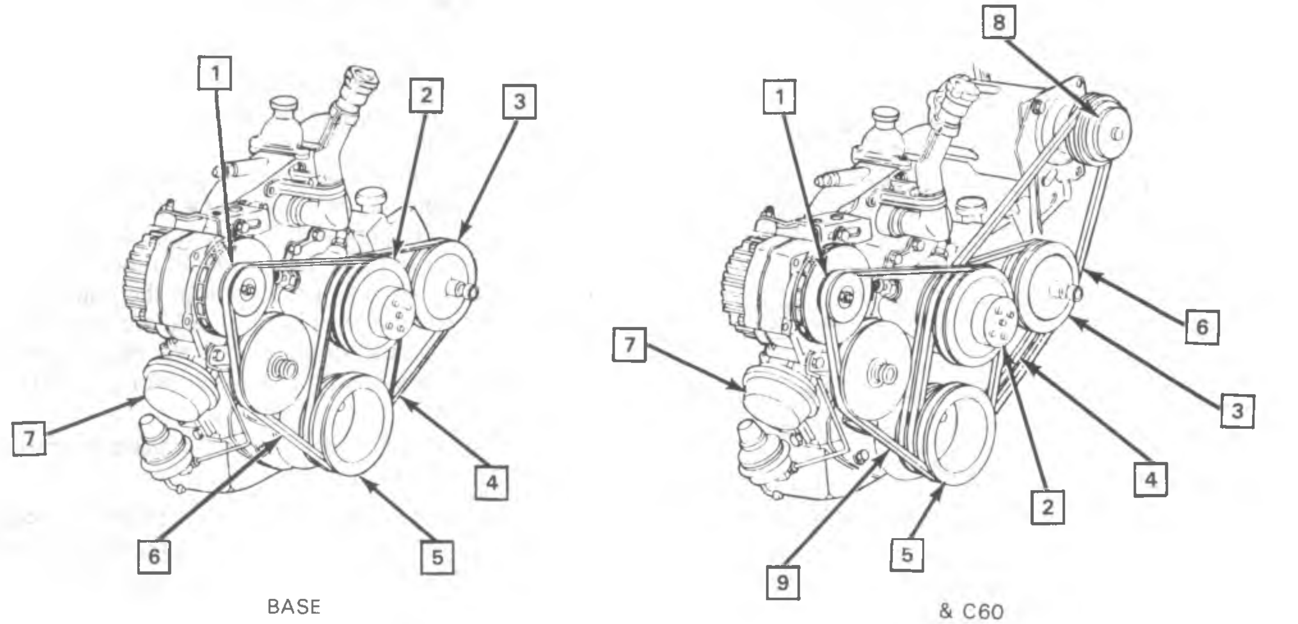


Fig. 6E9-5--Emission System-LL4 Engine

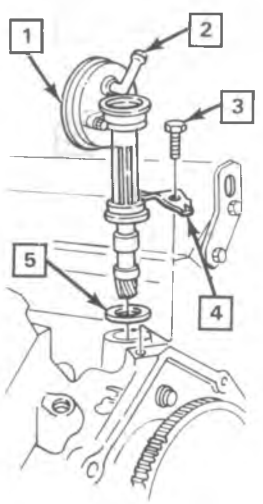


1 GENERATOR PULLEY
2 WATER PUMP PULLEY
3 POWER STEERING PULLEY
4 FIRST TRACK
5 CRANKSHAFT PULLEY
6 SECOND TRACK
7 VACUUM PUMP
8 AC COMPRESSOR PULLEY
9 THIRD TRACK

Fig. 6E9-7--Vacuum Pump-GP

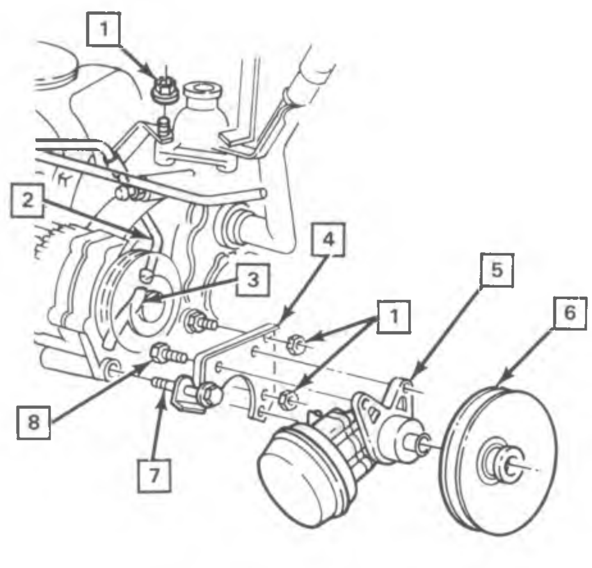
PART INFORMATION

PART NAME	GROUP
Valve, Drive and Vac	3.280



1 VACUUM PUMP
2 VACUUM SOURCE TO VACUUM LINE
3 BOLT (TIGHTEN to 42 N·m (30 ft. lbs.)
4 CLAMP
5 GASKET

Fig. 6E9-6--Vacuum Pump-CK



1 NUT - TIGHTEN TO 42 N·m (30 ft. lbs.)
2 PIPE
3 VACUUM HOSE
4 SUPPORT BRACKET
5 VACUUM PUMP
6 PUMP PULLEY
7 BOLT - TIGHTEN TO 42 N·m (30 ft. lbs.)
8 BOLT - TIGHTEN to 27 N·m (20 ft. lbs.)

Fig. 6E9-8--Vacuum Pump-GP Series

CRANKCASE VENTILATION SYSTEM

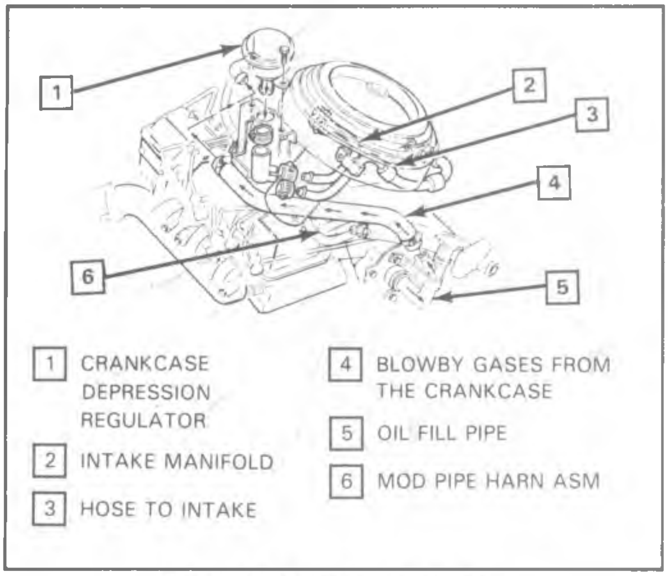


Fig. 6E9-9--Crankcase Ventilation

The crankcase ventilation system (Figs. 6E9-9 and 10) is used on all 6.2L (LH6 and LL4) diesel engine and is designed to reduce the the crankcase pressure at idle. This reduced pressure reduces engine oil leaks. The system consists of a crankcase depression regulator valve located at the front right cylinder head.

The crankcase depression regulator (CDR) valve is used to regulate (meter) the flow of crankcase gases back into the engine. The valve is designed to limit vacuum in the crankcase as the gases are drawn from the oil fill pipe through the valve and into the intake manifold (air cross-over) on two sides.

The intake manifold vacuum acts against a spring loaded diaphragm to control the flow of crankcase gases (Fig. 6E9-11). Higher intake vacuum levels pull the diaphragm closer to the top of the outlet tube. This reduces the amount of gases being drawn from the crankcase and decreases the vacuum level in the crankcase. As the intake vacuum decreases, the spring pushes the diaphragm away from the top of the outlet tube allowing more gases to flow to the intake manifold.

Refer to Section OB for diesel crankcase ventilation system maintenance requirements.

NOTICE: Do not allow any solvent to come in contact with the diaphragm of the Crankcase Depression Regulator Valve because the diaphragm will fail.

DIAGNOSIS

CDR Valve Test

The purpose of the CDR valve is to maintain 3-4 inches of water on a manometer (vacuum in the crankcase). Too little vacuum will tend to force oil leaks. Too much vacuum will pull oil into the air crossover.

-The CDR valve is checked with a water manometer. The U-tube manometer (Fig. 6E9-12) indicates pressure or vacuum by the difference in the height of two columns of fluid.

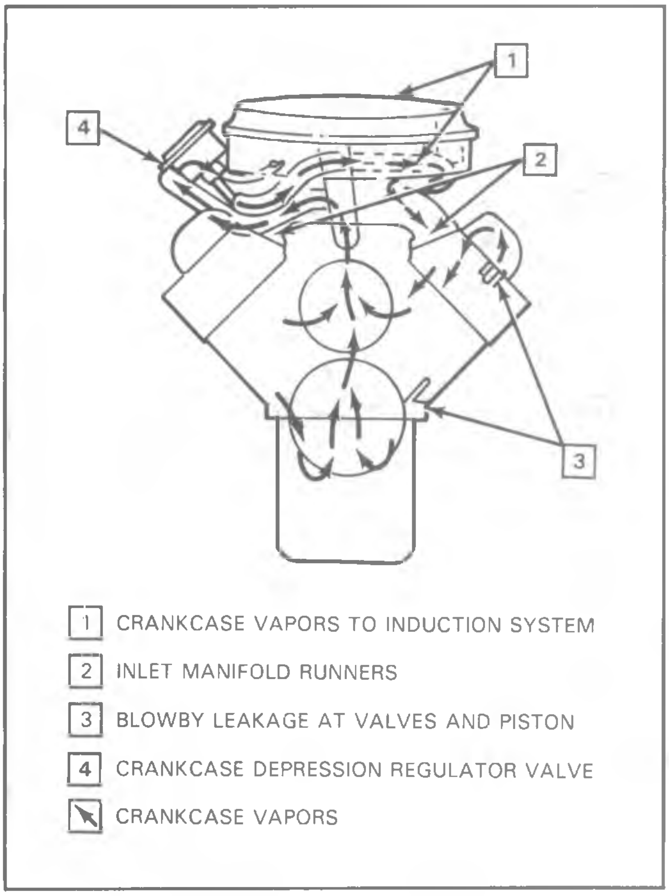


Fig. 6E9-10--Crankcase Vapor Flow

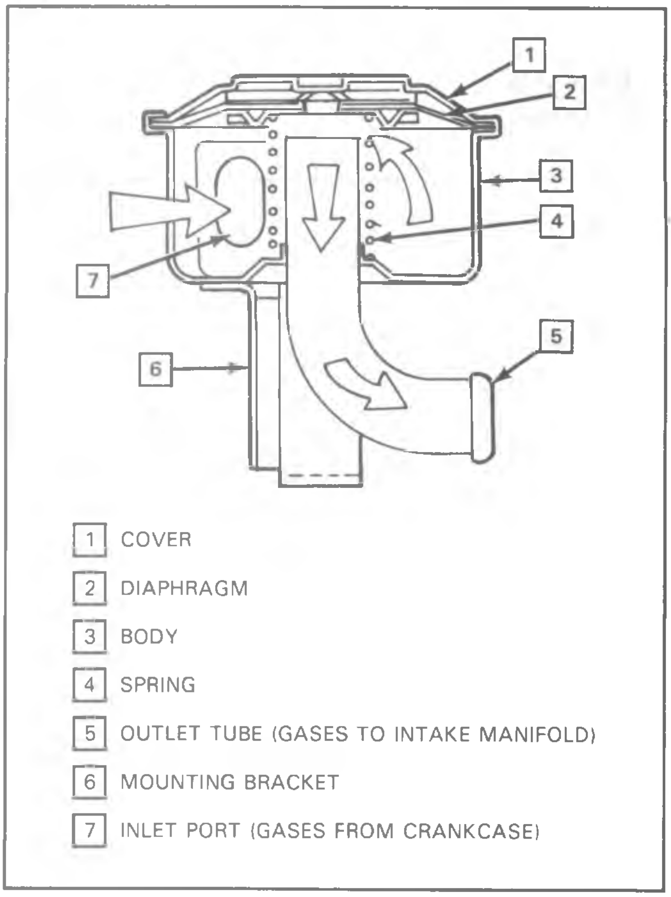


Fig. 6E9-11-CDR Valve Operation

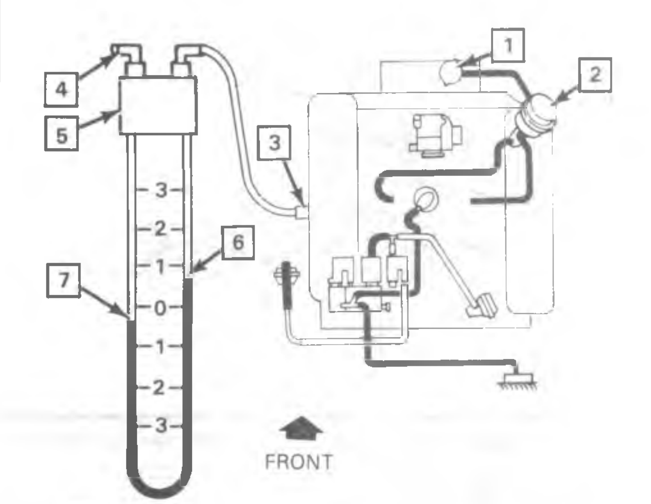


Fig. 6E9-12--CDR Valve Test

Connect one end of the manometer to the engine oil dip stick hole. The other end of the manometer is vented to atmosphere.

Install air cleaner and run engine at idle.

CDR Valve Specification

One inch (1") water pressure @ idle to approximately 3-4 inches water vacuum at full load. Add the amount that the manometer column travels up, to amount column travels down to obtain total PSI/Vacuum. An example (Fig. 6E9-12) of a manometer reading is as follows: One-half inch above zero plus one-half inch below zero equals one inch vacuum reading (1/2" + 1/2" = 1").

ON-VEHICLE SERVICE

Fig. 6E9-9

The crankcase depression regulator valve is replaced as an assembly. Replace hoses as required if inspection indicates cracks or decay.

PART INFORMATION

PART NAME	GROUP
Bracket, C/Case Depr Reg Vlv	1.745
Hose, C/Case Depr Reg Vlv	1.762
Tube, C/Case Depr Reg Vlv	1.745
Valve, C/Case Depr Reg Vlv	1.745

VACUUM REGULATOR VALVE

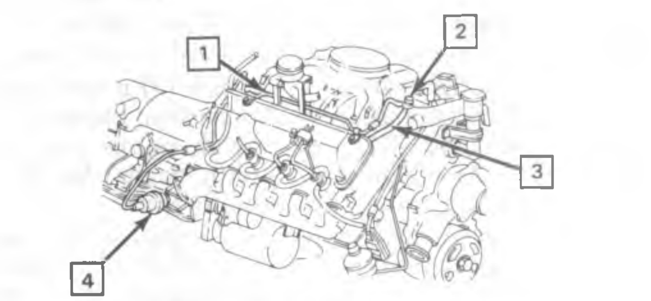


Fig. 6E9-13--Vacuum Regulator Valve

A vacuum regulator valve (Fig. 6E9-13) used on engines with heavy duty emission regulations (LL4 engine) regulates the vacuum signal to the vacuum modulator of a 400 automatic transmission. It is mounted to the injection pump and vacuum is supplied from the vacuum pump.

DIAGNOSIS

Refer to the 400 Automatic Transmission for the diagnosis of the vacuum modulator and the vacuum signal to the modulator.

ON-VEHICLE SERVICE

Adjustment (Figs. 6E9-14 and 15)

1. Attach the vacuum regulator valve snugly to the fuel injection pump. The switch body must be free to rotate on the pump.
2. Attach vacuum source of 67 ±5 kPa (20" Hg. ±1.5" Hg.) to the bottom vacuum nipple. Attach vacuum gage to the top vacuum nipple.
3. Insert vacuum regulator valve gage block between the gage boss on the injection pump and the wide open stop screw on the throttle lever (Switch on position).
4. Rotate and hold the throttle shaft against the gage block.
5. Slowly rotate the vacuum regulator valve body clockwise (facing valve) until vacuum gage reads 27 ±2 kPa (8 ±.6" Hg.). Hold valve body at this position and tighten mounting screws to 5-7 N·m (4-5 ft. lbs.).

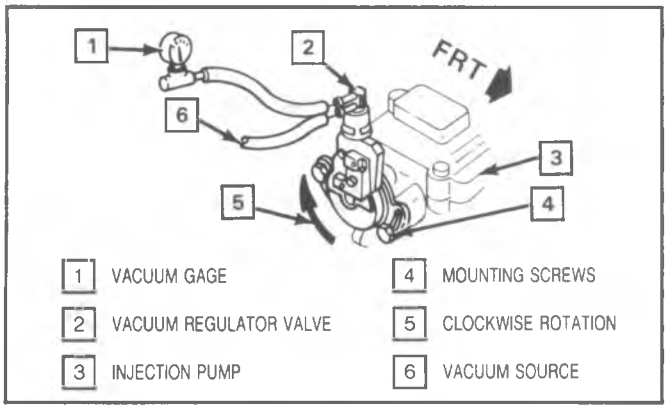


Fig. 6E9-14--Vacuum Regulator Valve Adjustment

NOTICE: Valve must be set while rotating valve body in clockwise direction only.

6. Check by releasing the throttle shaft allowing it to return to the idle stop position. Then rotate throttle shaft back aganist the gage block to determine if vacuum gage reads within 27 ±2 kPa (8 ± .6" Hg.). If vacuum is outside limits, reset valve.

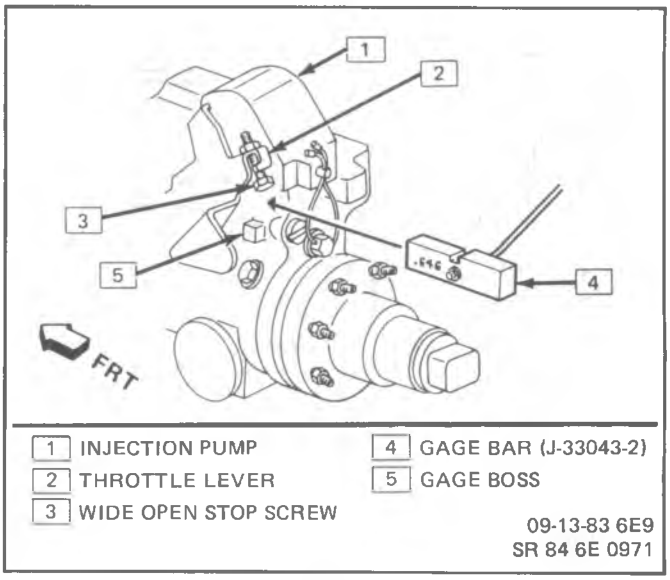


Fig. 6E9-15--Gage Block

PARTS INFORMATION

PART NAME	GROUP
Valve, Trans Vac Reg	4.205

EXHAUST GAS RECIRCULATION SYSTEM

LH6-FEDERAL

The exhaust gas recirculation (EGR) system (Fig. 6E9-16) consists of:

- EGR valve
- Exhaust Pressure Regulator (EPR)
- EGR Solenoid
- EPR Solenoid
- Throttle Position Switch (TPS)
- Vacuum Pump

The EGR system is not used on the LL4 with heavy duty emission requirements.

To lower the formation of nitrogen oxides (NOx), it is necessary to reduce combustion temperatures. This is done by introducing exhaust gases into the cylinders.

The exhaust gases take the place of fresh air that contains nitrogen and oxygen. With a lesser quantity of nitrogen and oxygen, less NOx is formed during combustion.

The EGR valve (Fig. 6E9-17) installed on the intake manifold, introduces the exhaust gases to the incoming fresh air at the engine air crossover.

The EPR valve (Fig. 6E9-18) installed between the exhaust manifold and exhaust pipe, is used to increase exhaust backpressure during idle which increases the exhaust flow through the EGR system. The EPR valve is normally open.

The Throttle Position Switch (TPS) is mounted on the throttle shaft of the injection pump. As the throttle is opened, one switch contact opens a circuit and another switch contact closes a circuit at a calibrated throttle angle.

At idle, the EPR solenoid (Fig. 6E9-19) is energized through the TPS and this allows vacuum from the vacuum pump to close the EPR valve which causes exhaust backpressure. At a calibrated throttle angle, the EPR solenoid is de-energized and the EPR valve opens.

At idle, vacuum from the vacuum pump passes through the EGR solenoid (Fig. 6E9-19) to the EGR valve which open the valve. At a calibrated throttle angle, the EGR solenoid is energized, vacuum is cut off to the EGR valve, and the EGR valve closes.

There are three different cams used to change the calibrated angle switch point to delay the time when the EPR valve opens and the EGR valve closes.

- Blue Cam - 0° Difference
- Black Cam - 5° Difference
- Red Cam - 10° Difference

Refer to Figure 6E9-20 for a summary of EGR and EPR solenoid and EGR and EPR valve operations.

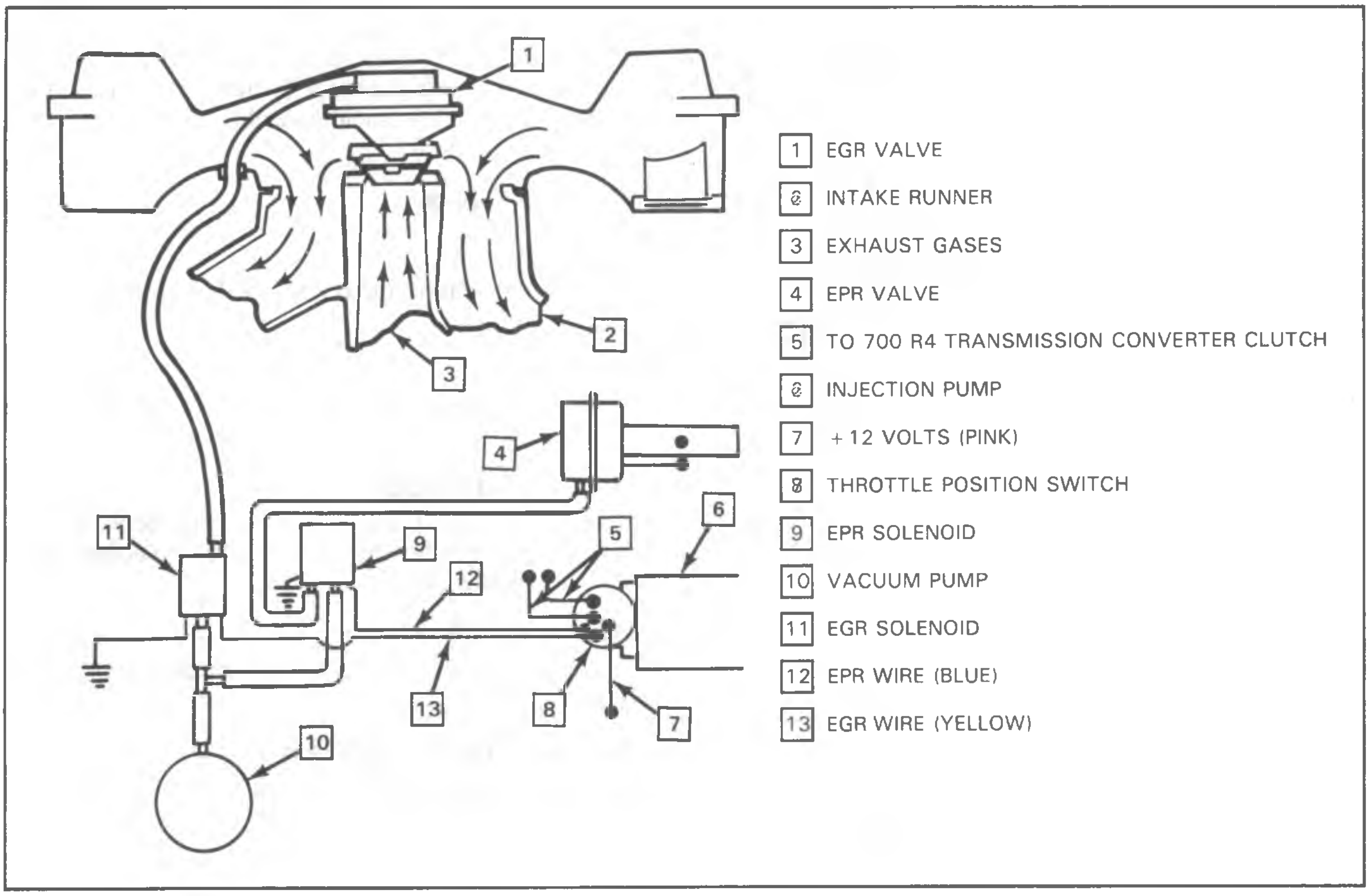


Fig. 6E9-16--EGR System-Federal (LH6)

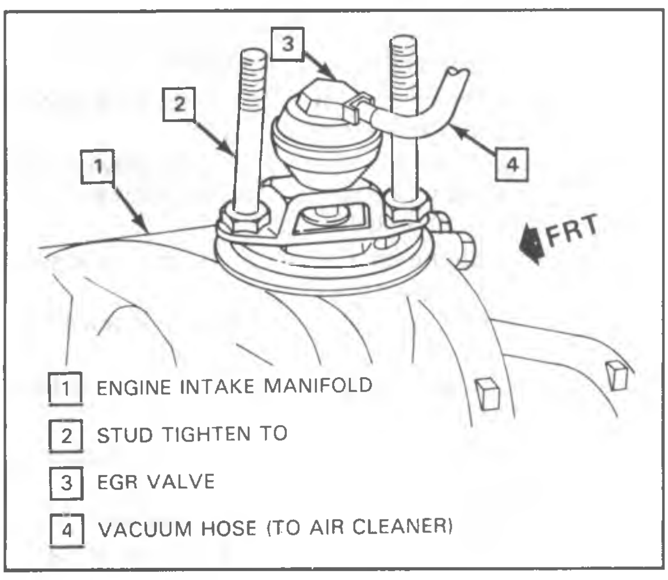


Fig. 6E9-17--EGR Valve

Diagnosis

Heavy black exhaust smoke upon acceleration generally indicates a malfunction in the EGR system.

Functional Operation

1. Start engine and operate to open thermostat temperature.
2. Remove air cleaner cover to observe operation of EGR valve.
3. With engine at idle, the EGR valve should be open. (Observe valve head in up position and noticeable exhaust noise intake.) If not, check and correct any electrical and hose connection which may be loose and/or disconnected.
4. Remove vacuum hose from EGR valve. The valve head should drop with a noticeable reduction in noise. Reconnect hose.
5. At idle, the hose to the EGR valve should have approximately 6.75 kPa (20 inches of vacuum). If

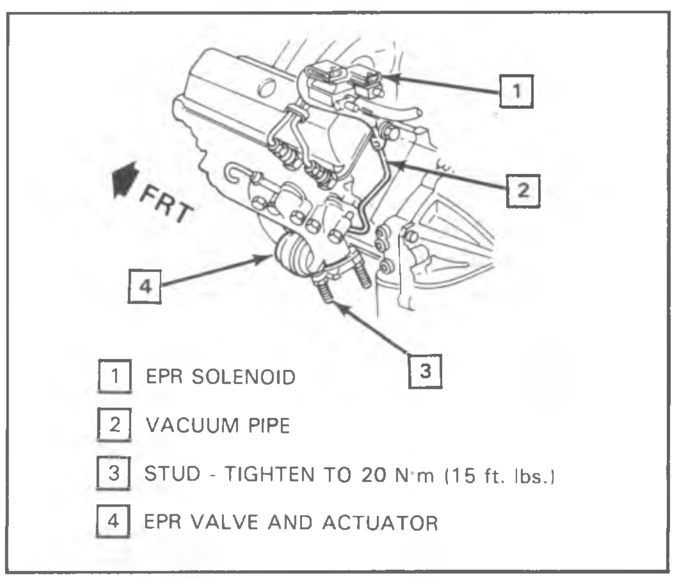


Fig. 6E9-18--EPR Valve and Solenoid

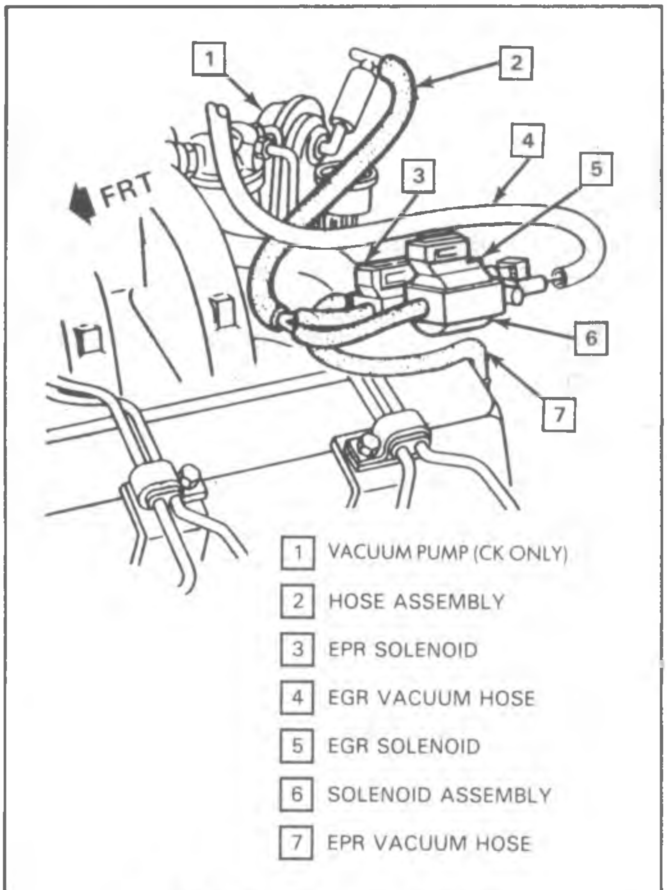


Fig. 6E9-19--EGR/EPR Solenoids

vacuum is not present, check output of the vacuum pump at the pump. The pump should produce a minimum of 67.5 kPa (20 inches of vacuum.)

6. If vacuum is present at the EGR valve but the valve does not open and close as the hose is put on and taken off, the EGR valve is stuck and should be checked and replaced if necessary.
7. Manually operate the throttle lever at the injection pump through approximately 15° to 20° of travel. The EGR valve should close when the TPS reaches the calibrated point.
8. Check the pink wire to the TPS for 12 volts (key on). If 12 volts is not present, check for any loose connections, open wire, and a blown 20 amp gage fuse (View D).
9. Correct any lose wire connections and change fuse. With key on, the blue wire from the TPS switch should also have 12 volts. The blue wire feeds the EPR solenoid. At idle if the pink wire has 12 volts but the blue one does not, the TPS is inoperative and should be changed.
10. With engine off, but key on, operate the throttle through 20° travel. At approximately 15°, the TPS will cut out the 12 volts to the blue wire (EPR). At approximately 20°, the TPS will cut in 12 volts to the yellow wire (EGR). If not, the TPS is inoperative.
11. Check to see that the electrical connections are made at the EGR-EPR solenoid assembly and that the hoses are routed correctly and connected to the solenoids.
12. If vacuum is present at the solenoid assembly and the solenoids are receiving an electrical signal as previously mentioned and operation of the TPS through the calibrated points does not operate the EGR and/or EPR valves, the solenoid assembly is inoperative and should be replaced.

On-Vehicle Service

EGR VALVE

Refer to diagnosis and replace EGR Valve (Fig. 6E9-17) if required.

EPR VALVE

Refer to diagnosis and replace EPR Valve (Fig. 6E9-18) if required.

EGR/EPR SOLENODIS

The EGR AND EPR solenoid (Fig. 6E9-19) are replaced as an assembly. Refer to diagnosis to determine if replacement is required.

VACUUM PUMP

Refer to Figures 6E9-6 or 6E9-8 for replacement of the vacuum pump.

THROTTLE POSITION SWITCH

Refer to diagnosis and adjust or replace. The throttle position switch if required.

TPS Adjustment

LH6 Engine

Figs. 6E9-15 and 21

1. Disconnect connectr to throttle position switch (TPS).
2. Loosen the mounting screws retaining the TPS.
3. Connect an ohmmeter or test light to the IGN (pink) and EGR (yellow) terminals at the TPS.
4. Insert proper "switch closed" gage block between the gage boss on the injection pump and the wide open stop screw on the throttle shaft.
5. Rotate the throttle lever and hold the wide open stop screw against the gage block.
6. Rotate the TPS until there is continuity or test lamp lights.
7. Hold TPS at this position and tighten the mounting screws to 6 N·m (53 in. lbs.).

ENGINE SPEED	EGR VALVE	EGR SOLENOID	EPR VALVE	EPR SOLENOID
Idle to 15° Throttle	Open	Not Energized (Vacuum to Valve)	Closed	Energized Vacuum To Valve)
15° to 20° Throttle	Open	Not Energized (Vacuum to Valve)	Open	Not Energized (No Vacuum to Valve)
20° to Full Throttle	Closed	Energized (No Vacuum to Valve)	Open	Not Energized (No Vacuum to Valve)

Fig. 6E9-20--EGR System Operation

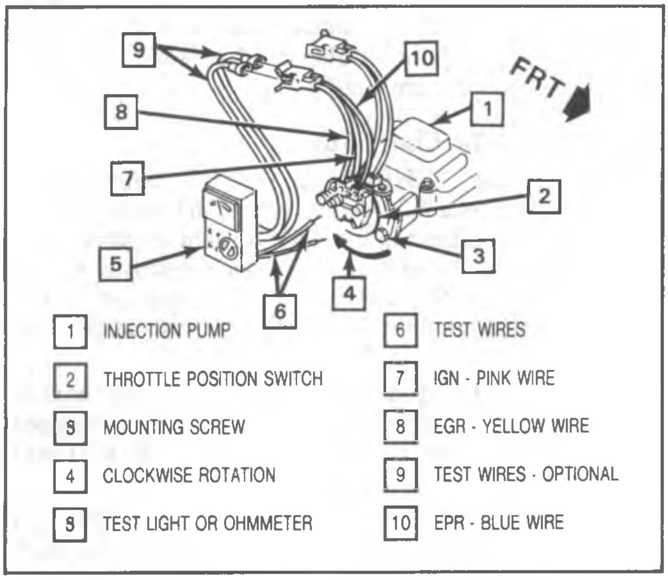


Fig. 6E9-21--TPS Adjustment (LH6 Engine)

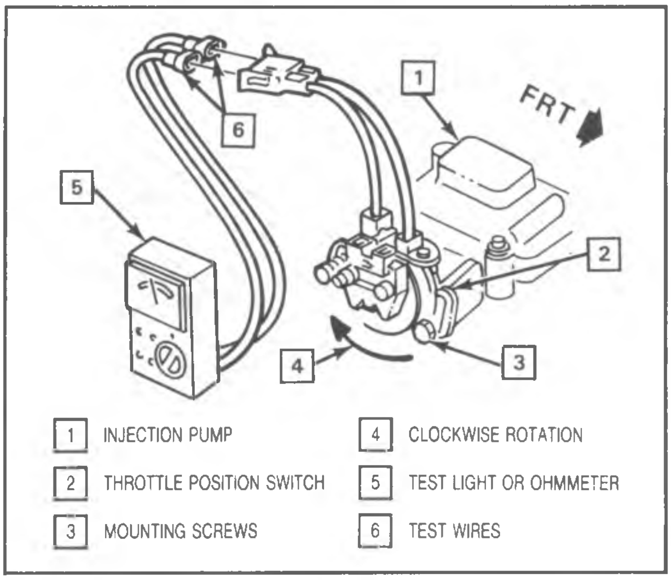


Fig. 6E9-22--TPS Adjustment (LL4 Engine w/700 R4)

8. Return throttle lever to idle position and remove gage block.
9. Insert "switch open" gage block and rotate throttle lever against block. There should be no continuity or test light which means the switch is adjusted correctly.

   If there is continuity, repeat Steps 1 through 9.
10. Remove gage block and ohmmeter.
11. Connect TPS connector.

TPS Adjustment

LL4 Engine w/700 R4 AT

Figs. 6E9-15 and 22

1. Disconnect connector to throttle position switch (TPS).
2. Loose the mounting screw retaining the TPS.
3. Connect an ohmmeter or test light to the TPS terminals.
4. Insert the "switch closed" gage block (0.751) between the gage boss on the injection pump and the wide open stop screw on the throttle shaft.
5. Rotate the throtte lever and hold the wide open stop screw against the gage block.
6. Rotate the TPS until there is continuity or test lamp lights.
7. Hold the TPS at this position and tighten the mounting screws to 6 N·m (53 in. lbs.).
8. Return throttle lever to idle position and remove gage block.
9. Insert "switch open" gage block (0.773) and rotate throttle lever against block. There should be no continuity or test light which means the switch is adjusted correctly.

   If there is continuity, repeat Steps 1 through 9.
10. Remove gage block and ohmmeter.
11. Connect TPS connector.

PARTS INFORMATION

PART NAME	GROUP
Solenoid, EGR Valve and Exh Press Reg	3.670
Switch, Throttle Position	3.440
Valve, EGR	3.670
Valve, w/Actuator Exh Press Reg	3.640

DIESEL ELECTRONIC CONTROL SYSTEM

RPO LH6-CALIFORNIA

The Diesel Electronic Control (DEC) System is used on a 6.2L diesel engine in California to electronically control the exhaust gas recirculation system and the transmission converter clutch.

The DEC system has the following components:

- Diesel Electronic Control Module (ECM)
- Absolute Pressure (MAP) Sensor
- EGR Solenoid
- EGR Vent Solenoid
- EGR Valve
- EPR Solenoid
- EPR Valve
- Throttle Position Sensor
- Engine Speed Sensor
- ALDL Connector
- TCC Solenoid

The Diesel Electronic Control Module (ECM) (Figs. 6E9-23 and 24) is a computer that controls:

- Exhaust Gas Recirculation (EGR) System
- Exhaust Pressure Regulation (EPR) - Part of EGR system.
- EGR System Diagnosis

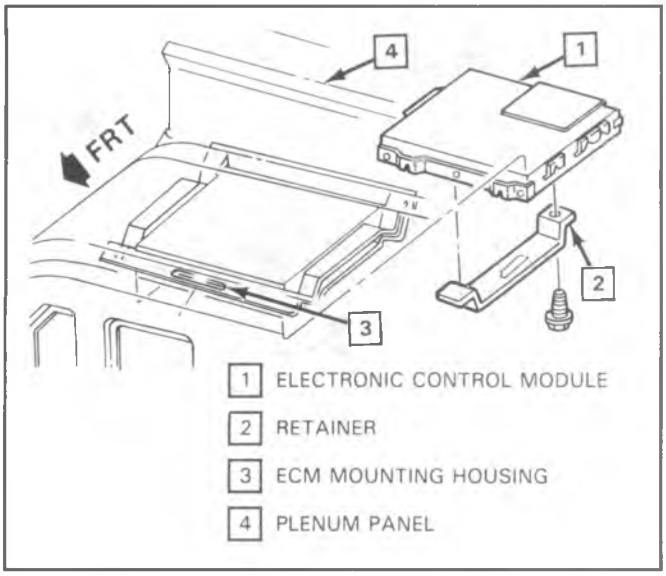


Fig. 6E9-23--Electronic Control Module (CK Series)

- Transmision Converter CLutch (TCC)

The ECM monitors the following inputs to control EGR and TCC:

- Engine RPM - Engine Speed Sensor
- EGR Vacuum - MAP Sensor
- Throttle Position-TPS

ALDL Connector

Under the instrument panel on a series CK (Fig. 6E9-25) or under the driver's seat on a series GP (Fig. 6E9-24) is an Assembly Line Diagnostic Link (ALDL) that is used by the assembly plant for a computerized check-out of the system. This connector is also used in service to help diagnose the EGR system and TCC.

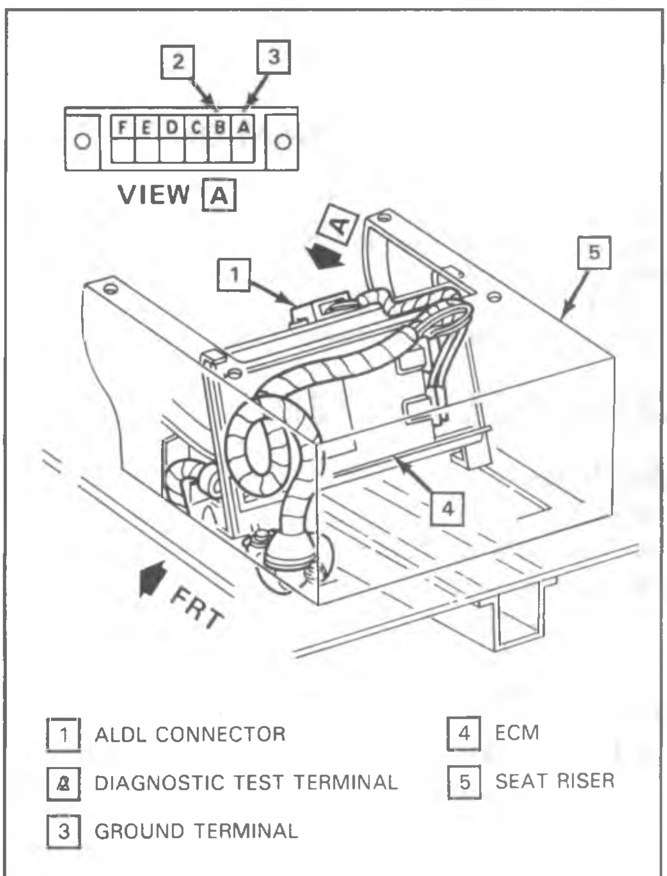


Fig. 6E9-24--ECM and ALDL Connector (GP Series)

Diesel Diagnostic Check Tool

There is no "CHECK ENGINE" lamp on the instrument panel of a 6.2L engine vehicle in California. The ECM can detect a fault in the EGR System but there is no Trouble Code in the circuit. A Diesel Diagnostic Check (DDC) Tool (Fig. 6E9-26) is connected into the ALDL connector and cigar lighter or BAT terminal on the fuse panel.

When the ECM detects a fault with the engine running, the Check Engine Light (CEL) will be illuminated on the DDL tool. If the condition is corrected, the CEL will go off.

The DDC tool is also used to determine whether or not a driveability problem is the result of a fault in the EGR system. All diagnosis using this tool should start with the Diesel Diagnostic Circuit Check.

Electronic Control Module

The Electronic Control Module (ECM) (Fig. 6E9-27) is serviced in two parts. Inside the ECM is a replaceable component called a calibrator (Fig. 6E9-28). The calibrator is referred to as a PROM (Programmable Read Only Memory) because information can be programmed into the unit for specific calibrations required for a specific vehicle/ engine combination.

The ECM is supplied without a calibrator for service and is called a Controller. This allows one controller to be used with several different calibrators.

Diagnosis

Refer to diagnosis in the exhaust gas recirculation system or transmission converter clutch to determine if the ECM needs to be replaced.

On-Vehicle Service (Fig. 6E9-28.1)

The ECM is located under the instrument panel on a CK Series (Fig. 6E9-23) and under the driver's seat on a G or P Series (Fig. 6E9-24).

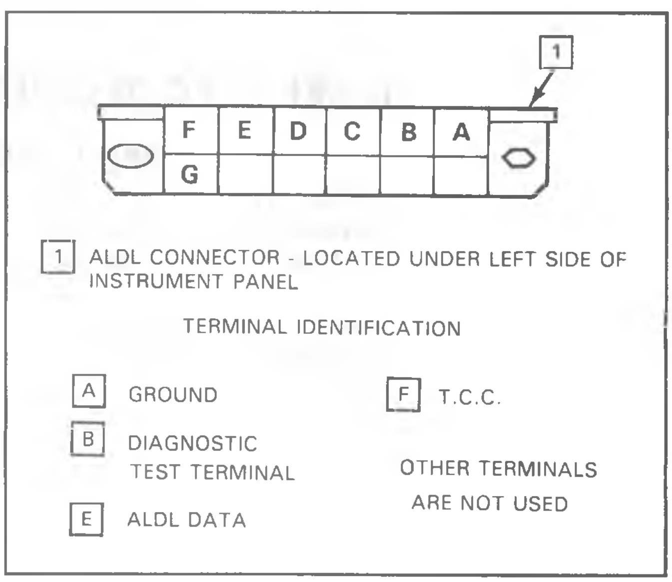
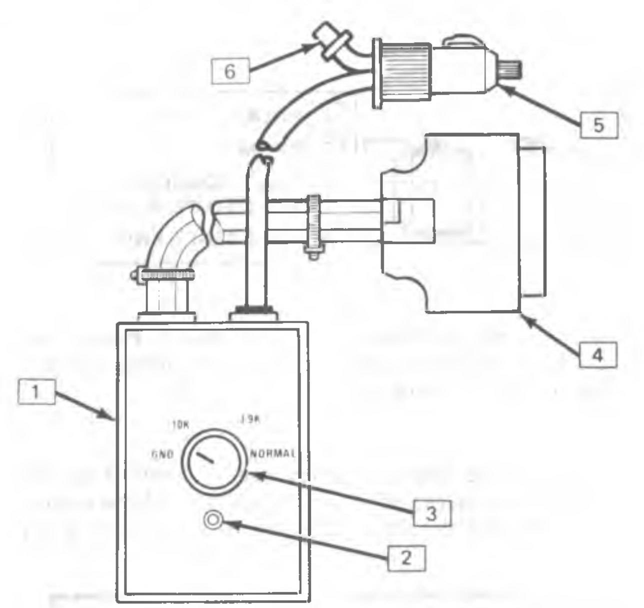


Fig. 6E9-25--ALDL Connector (CK Series)



1 DIESEL DIAGNOSTIC CHECK TOOL DDC TOOL J-34750 OR EQUIVALENT
2 CHECK ENGINE LIGHT (CEL)
3 ALDL DIAGNOSTIC MODE SELECTOR SWITCH
4 ALDL CONNECTOR
5 CIGAR LIGHTER PLUG-IN
6 BAT CONNECTOR

SR 84 6E 1095

Fig. 6E9-26--DDC Tool

Important

When replacing a production ECM with a service controller, transfer the Production Broadcast Code and Production ECM Number to the service controller label. Do not record on the removable cover. This provides identification of the ECM throughout the service life of the vehicle.

Remove or Disconnect

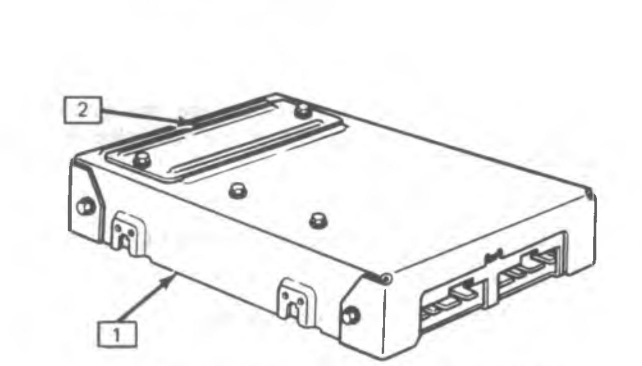
NOTICE: To prevent internal ECM damage, the ignition must be off when disconnecting or reconnecting the ECM connector.

1. ECM mounting hardware.
2. Connector from ECM.
3. ECM
4. Calibrator access cover.
5. Calibrator. Grasp the calibrator carrier and gently rock from side to side and upward.

Install or Connect

Record Production Broadcast Code and Production ECM Number from removed ECM to service controller. Any time a calibrator is installed backwards and the ignition is turned on, the calibrator will be destroyed.

1. Calibrator removed from previous ECM. Position carrier squarely over the socket and press down firmly on the top of the carrier. While pressing down on carrier, use a narrow blunt tool and alternately pressing down on either end of the calibrator body to seat into socket.



1 ELECTRONIC CONTROL MODULE (ECM)
2 PROM ACCESS COVER

4S 1601-6E

Fig. 6E9-27--Electronic Control Module

2. Access cover.
3. Connector to ECM.
4. ECM with mounting hardware.

PART INFORMATION

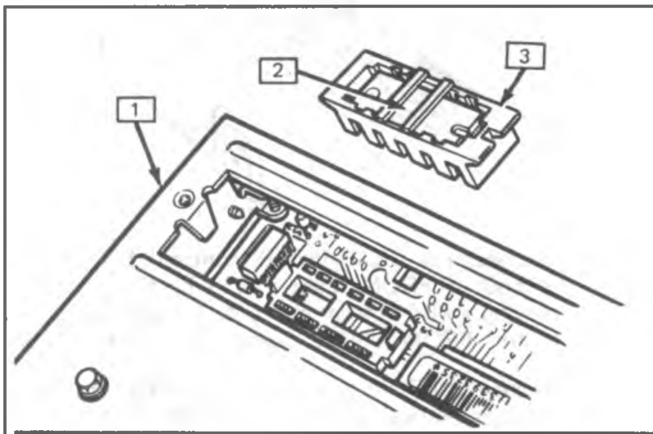
PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670

Wiring Schematic

Refer to Figure 6E9-29 for the wiring schematic of the Diesel Electronic Control System.

ECM Terminal Voltage

Refer to Figure 6E9-30 for the voltages at the ECM connector or terminal and wires. Voltage values that are taken at the ECM terminals should be very close to the chart. There may be a slight variation due to low battery.



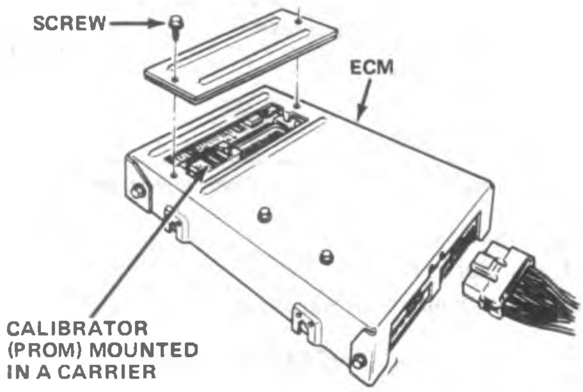
1 ECM
2 PROM (ENGINE CALIBRATOR)
3 PROM CARRIER

4S 1184-6EA

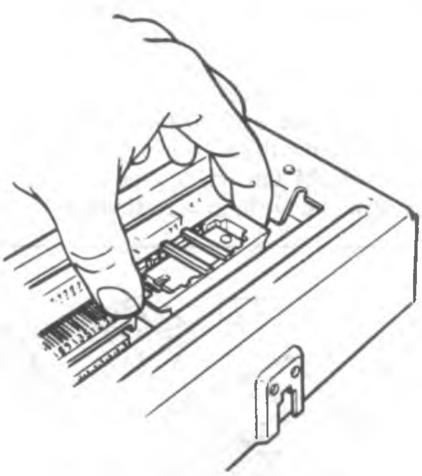
Fig. 6E9-28--Calibrator

NOTICE: To prevent internal damage, the ignition must be off when disconnecting or reconnecting the ECM connector.

1. Remove ECM mounting hardware.
2. Disconnect the connector from the ECM.
3. Remove ECM.
4. Remove calibrator access cover.

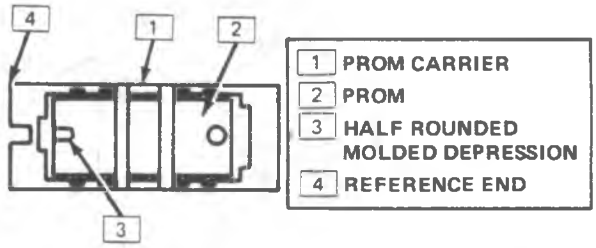


5. Remove calibrator. Grasp the calibrator carrier and gently rock from side to side and upward.



- Replacement ECM (called controller) is supplied without a PROM. Care should be taken when removing a PROM from an ECM that is being replaced as this PROM will be used in a service controller.

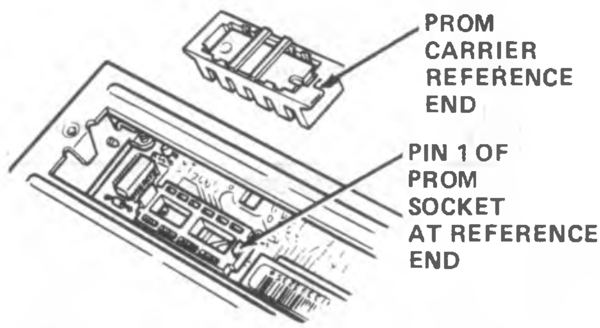
6. A correct PROM in a carrier is where the squared off symmetrical end of the carrier is at the same end as the half-rounded molded depression on the PROM. If a new PROM is to be installed, check to see that the installation of the PROM to-carrier is correct. Check for correct PROM part number.



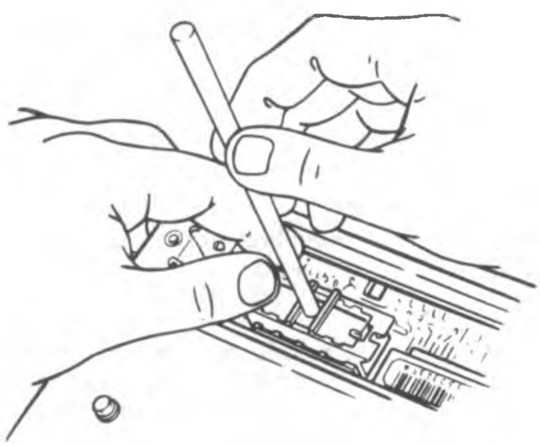
7. If a service controller is to be installed, check the service part number to make sure that it is the correct controller for the replaced ECM.

8. Position the carrier squarely over the PROM socket with the squared off symmetrical end of the carrier aligned with the small notch in the socket at the pin 1 end.

ANYTIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH IS TURNED ON, THE PROM IS DESTROYED.



9. Press down firmly on the top of the carrier.
10. While firmly pressing down on the carrier, take a narrow blunt tool and press down on the body of the PROM. Try to seat the PROM in the socket squarely by alternately pressing on either end of it.



11. Install access cover.
12. Install mounting hardware.
13. Install ECM and connect the connector.

5S 1345-6E

Fig. 6E6-28.1--ECM or Calibrator Replacement

ABBREVIATIONS

ALDL	Assembly Line Diagnostic Link
CEL	"CHECK ENGINE" Light
CKT	Circuit
DDC	Diesel Diagnostic Check Tool
DEC	Diesel Engine Control System
DVM	Digital Volt-Ohm Meter with 10 meg-ohm impedence
ECM	Electronic Control Module-Diesel
EGR	Exhaust Gas Recirculation
EPR	Exhaust Pressure Regulator
IP	Instrument Panel
MAP	Absolute Pressure Sensor
PWM	Pulse Width Modulated
RPM	Revolutions Per Minute
TCC	Transmission Converter Clutch
TPS	Throttle Position Sensor
V-Ref	ECM Reference Voltage (Approximately 5.3v)
WOT	Wide Open Throttle

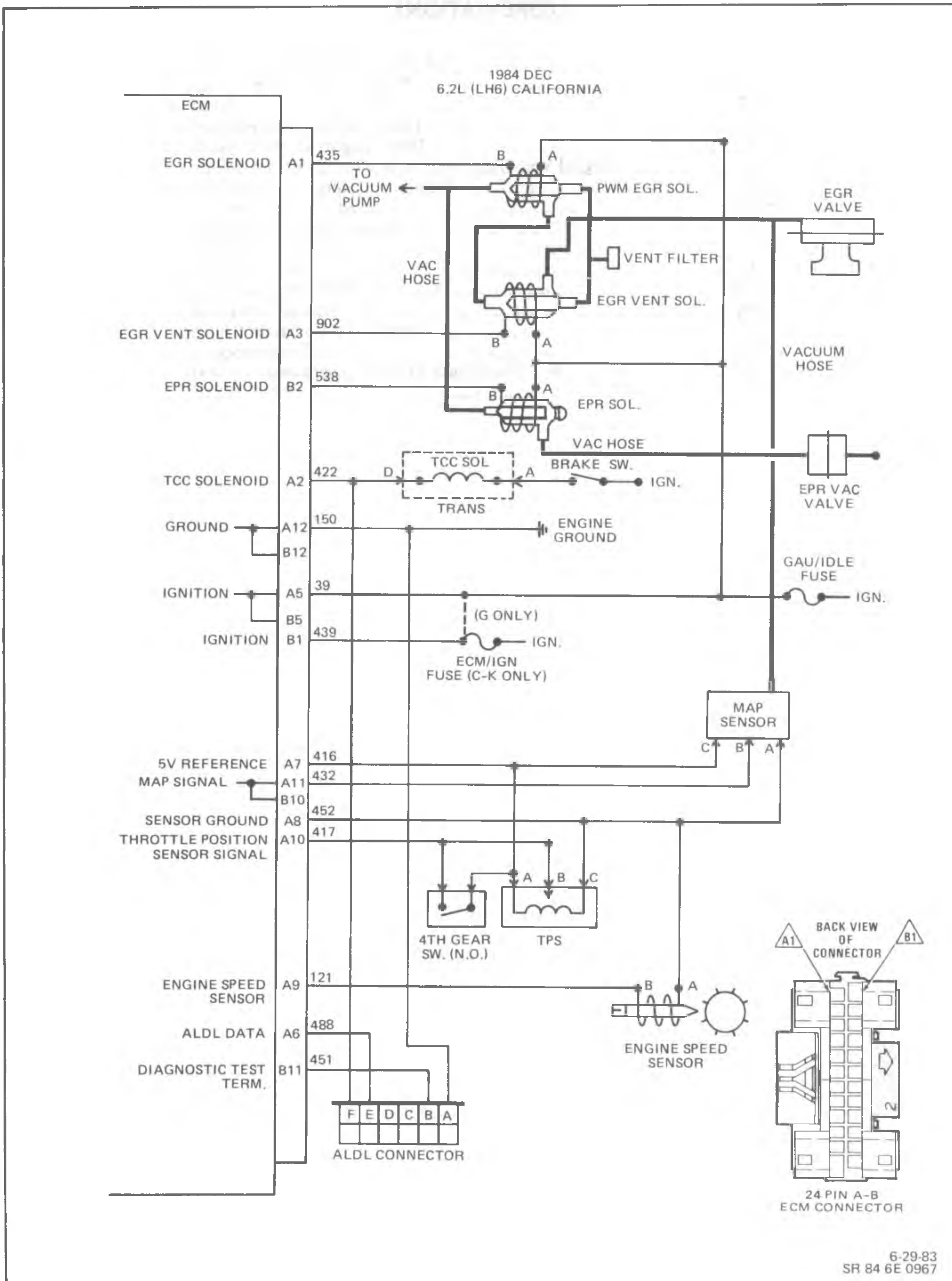


Fig. 6E9-29--Diesel Electronic Control System Wiring Schematic

ECM TERMINAL VOLTAGE

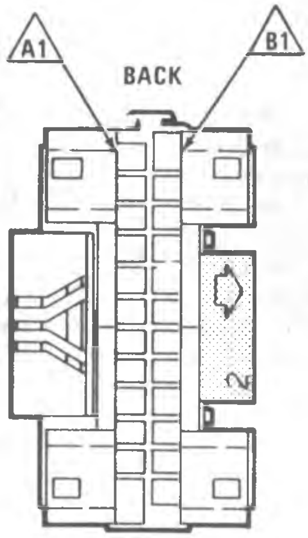
6.2L DIESEL (RPO LH6) CALIFORNIA

THIS ECM VOLTAGE CHART IS FOR USE WITH A DIGITAL VOLTMETER TO FURTHER AID IN DIAGNOSIS. THE VOLTAGES YOU GET MAY VARY DUE TO LOW BATTERY CHARGE OR OTHER REASONS, BUT THEY SHOULD BE VERY CLOSE.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- ENGINE AT OPERATING TEMPERATURE
- BATTERIES FULLY CHARGED AND GLOW PLUGS NOT CYCLING
- TEST TERMINAL NOT GROUNDED
- DDC. TOOL NOT INSTALLED

VOLTAGE				
KEY "ON"	ENG. RUN	OPEN CRT.	CIRCUIT	PIN
*1.0	14	*.5	EGR SOLENOID	A1
12	14	*.5	TCC SOLENOID	A2
*1.0	14	*.5	EGR VENT SOLENOID	A3
–	–	–	NOT USED	A4
12	14	*.5	IGNITION	A5
12	*.5	*.5	ALDL DATA	A6
5.01	5.01	5.01	5V REFERENCE	A7
*.5	*.5	*.5	SENSOR GROUND	A8
*.5	.22 var.	*.5	† ENGINE SPEED SENSOR	A9
.57 var.	.57 var.	*.5	TPS SIGNAL	A10
4.83 var.	.45	3.0	MAP SIGNAL	A11
*.5	*.5	–	GROUND	A12



24 PIN A-B CONNECTOR

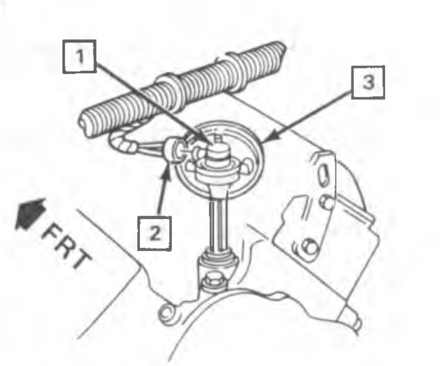
		VOLTAGE		
PIN	CIRCUIT	KEY "ON"	ENG. RUN	OPEN CRT.
B1	IGNITION	12	14	*.5
B2	EPR SOLENOID	12	*1.0	*.5
B3	NOT USED	–	–	–
B4	NOT USED	–	–	–
B5	NOT USED	–	–	–
B6	NOT USED	–	–	–
B7	NOT USED	–	–	–
B8	NOT USED	–	–	–
B9	NOT USED	–	–	–
B10	NOT USED	–	–	–
B11	DIAGNOSTIC TEST TERMINAL	5.01	5.01	5.01
B12	NOT USED	–	–	–

† – AC VOLT SCALE READING
* – VOLTAGE LESS THAN THAT VALUE
var. – VARIES WITH ENGINE SPEED, THROTTLE POSITION, OR ALTITUDE

4S 1258-6E9

Fig. 6E9-30--ECM Terminal Voltage

EXHAUST GAS RECIRCULATION (EGR) SYSTEM



1 ENGINE SPEED SENSOR
2 SENSOR CONNECTOR
3 VACUUM PUMP (CK ONLY)

Fig. 6E9-31--Engine Speed Sensor

GENERAL

The EGR system lowers the formation of nitrogen oxides by reducing combustion temperature. This is done by introducting exhaust gases into the cylinders through an EGR valve. The ECM controls the amount of EGR to meet emission control requirements and maintain good driveability through an EGR solenoid which regulate the vacuum to the EGR valve. Two main sensor inputs to the ECM are used to calculate the amount of EGR.

The EGR Valve (Fig. 6E9-17), installed on the intake manifold, introduces the exhaust gases to the incoming fresh air at the engine air crossover. The EPR valve (Fig. 6E9-18), installed between the exhaust manifold and the exhaust pipe, is used to increase exhaust backpressure during idle which increases the exhaust flow through the EGR system. The EPR valve is normally open.

A vacuum pump is required to provide a vacuum source to operate the EGR system. Refer to the beginning of Section 6E9 for additional information.

Engine Speed Sensor (Fig. 6E9-31) - mounted at the center rear of the engine it is used as an input to the ECM to measure the RPM of the engine. Refer to Figure 6E9-40 for additional information.

Throttle Position Sensor (Fig. 6E9-32) - mounted to the injection pump throttle valve is used as an input to the ECM to measure the degree of throttle angle. Refer to Figure 6E9-46 for additional information.

MAP Sensor (Fig. 6E9-33) - mounted on the right side of the cowl is used to measure the amount of absolute pressure in the ECM vacuum line. Refer to Figure 6E9-44 for additional information.

EGR/EPR Solenoid Assy.

The EGR/EPR Solenoid Assembly (Fig. 6E9-34) mounted on top rear of the engine is controlled by the EGR. The ECM controls the EGR solenoid to regulate the vacuum to the EGR valve. By controlling the time the EGR solenoid is "ON" or "OFF" regulates the amount of EGR. The ECM calculates the amount of EGR based on inputs from the engine speed sensor and the throttle position sensor. The ECM is programmed to vary the "ON" and "OFF" time of the EGR solenoid based on these two sensor inputs. To monitor the ECM control of EGR, a MAP sensor is used to measure the amount of absolute pressure in the EGR vacuum line. If a minor variation is calculated EGR and actual EGR as monitored by the MAP sensor exists, the ECM makes a correction. If the variation exceeds an amount in excess of what the ECM can correct for, an error is detected by the ECM and the system will go into default.

When the ECM recognizes the operating range for no EGR, the EGR vent solenoid operates to allow rapid venting of vacuum to the EGR valve. Refer to Figure 6E9-42 for additional information. The ECM signal energizes the EPR solenoid at idle which allows vacuum to close the EPR valve. Refer to Figure 6E9-48 for additional information.

DIAGNOSIS

The diagnosis of the DEC system should always start with the Diesel Diagnostic Circuit Check (Fig. 6E9-35). This will determine if the system is operating correctly.

If the DEC system is not working properly, the Diesel Diagnostic Circuit Check will direct diagnosis to another DEC system circuit.

The circled numbers on the chart refer to facing page step information. These steps explain why the circuit is being checked at this point.

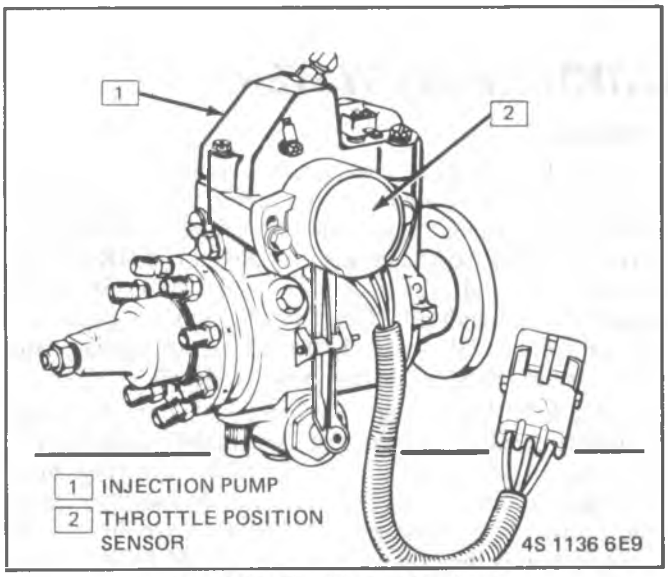


Fig. 6E9-32--Throttle Position Sensor

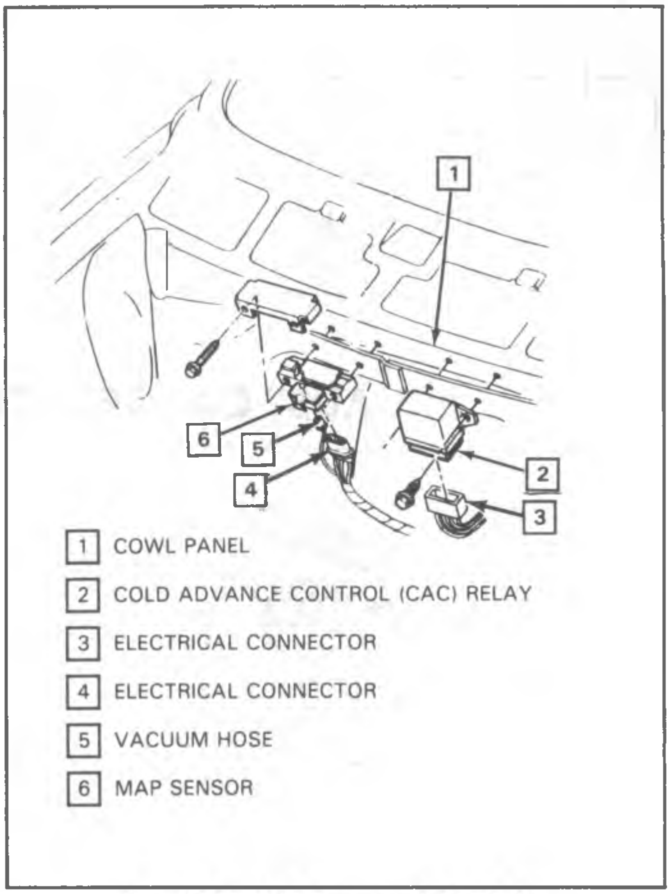


Fig. 6E9-33--MAP Sensor and CAC Relay

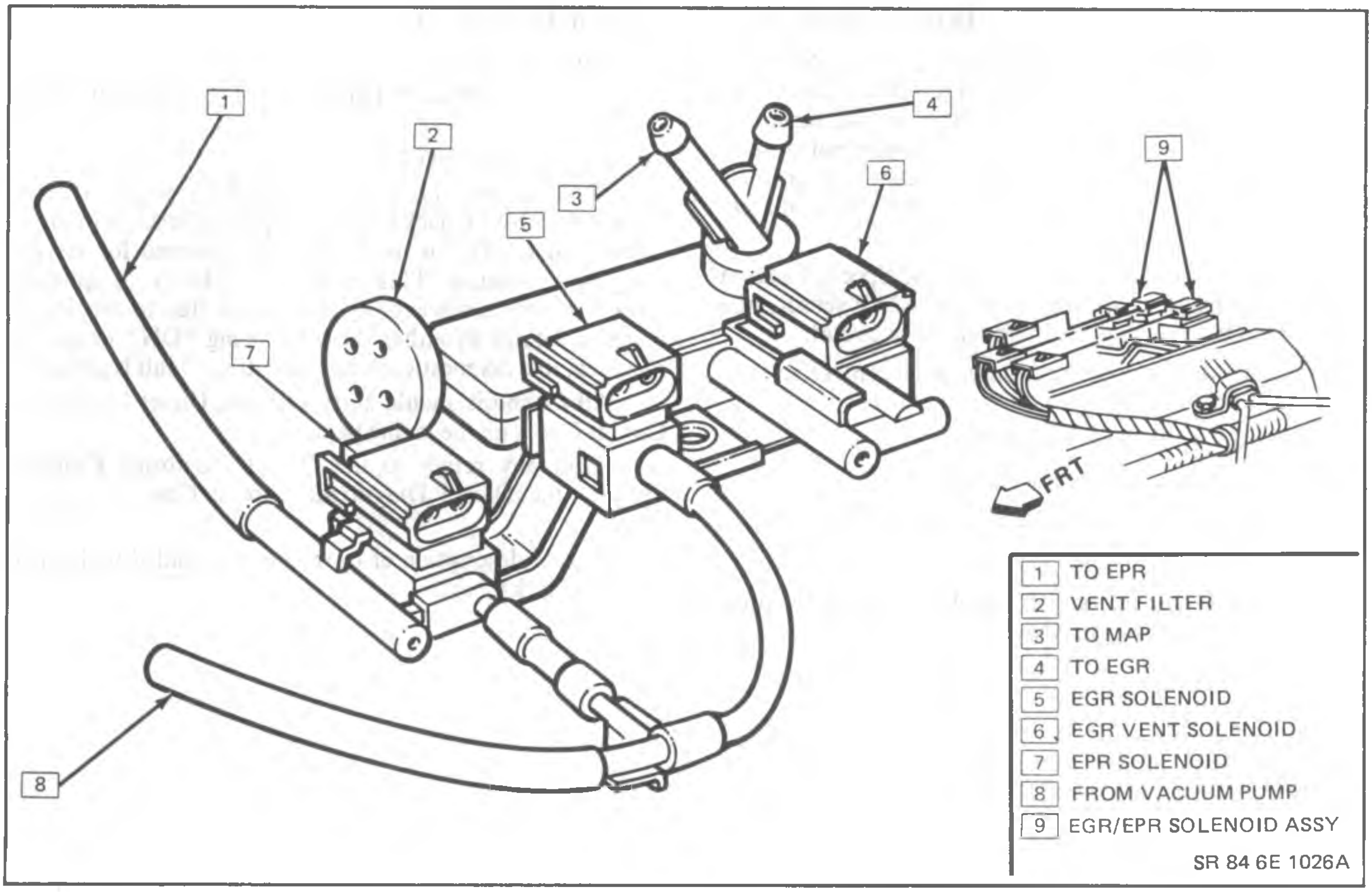


Fig. 6E9-34--EGR/EPR Solenoid Assembly

CIRCUIT CHECKS

Diesel Diagnostic Circuit Check .... Figure 6E9-35
DDC Tool Check .... Figure 6E9-37
ECM Check .... Figure 6E9-39
Engine Speed Sensor Check .... Figure 6E9-41
EGR/EGR Vent Check .... Figure 6E9-43
MAP Sensor Check .... Figure 6E9-45
TPS Check .... Figure 6E9-47
EPR Solenoid Electrical Check .... Figure 6E9-49
EPR Vacuum Check .... Figure 6E9-51

DIESEL DIAGNOSTIC CIRCUIT CHECK

The ECM provides the diagnostic logic to detect faults in the systems the ECM monitors or controls. The ECM, when it recognizes a fault, has he capability of turning a "Check Engine" Light (CEL) "ON" but does not store or flash a trouble code. Furthermore, if the condition corrects itself, the CEL signal will be turned "OFF" immediately following the correction.

The ECM recognizes errors in Engine Speed, Vacuum errors in the EGR vacuum loop via the MAP sensor, and electrical faults involving the 5 volt reference circuit.

The ECM is a multifuction engine controller that controls the following:

1. Exhaust Gas Recirculation (EGR)
2. Exhaust Pressure Regulation (EPR)
3. Transmission Converter Cluth Control (TCC)
4. System Diagnosis

The ECM monitors the following inputs to allow proper engine control of the above.

1. Engine RPM
2. Absolute Pressure (MAP) used to monitor EGR vacuum
3. Throttle Position (TPS)

Since the vehicles which use the 6.2L engine are not equipped with a "Check Engine" Light, a Diesel Diagnostic Check (DDC) Tool is used whenever the need for service diagnostics occurs. This allows the ability to quickly recognize that a driveability problem is due to the ECM being in default by either the CEL being "ON" or one of the selectable diagnostic modes indicating a fault is present.

All diagnosis should start with the Diesel Diagnostic Circuit Check on the facing page.

After any repair to the Diesel Electronic Control System, the Diesel Diagnostic Circuit Check must be repeated.

A brief description of operation is included with each System Check Chart.

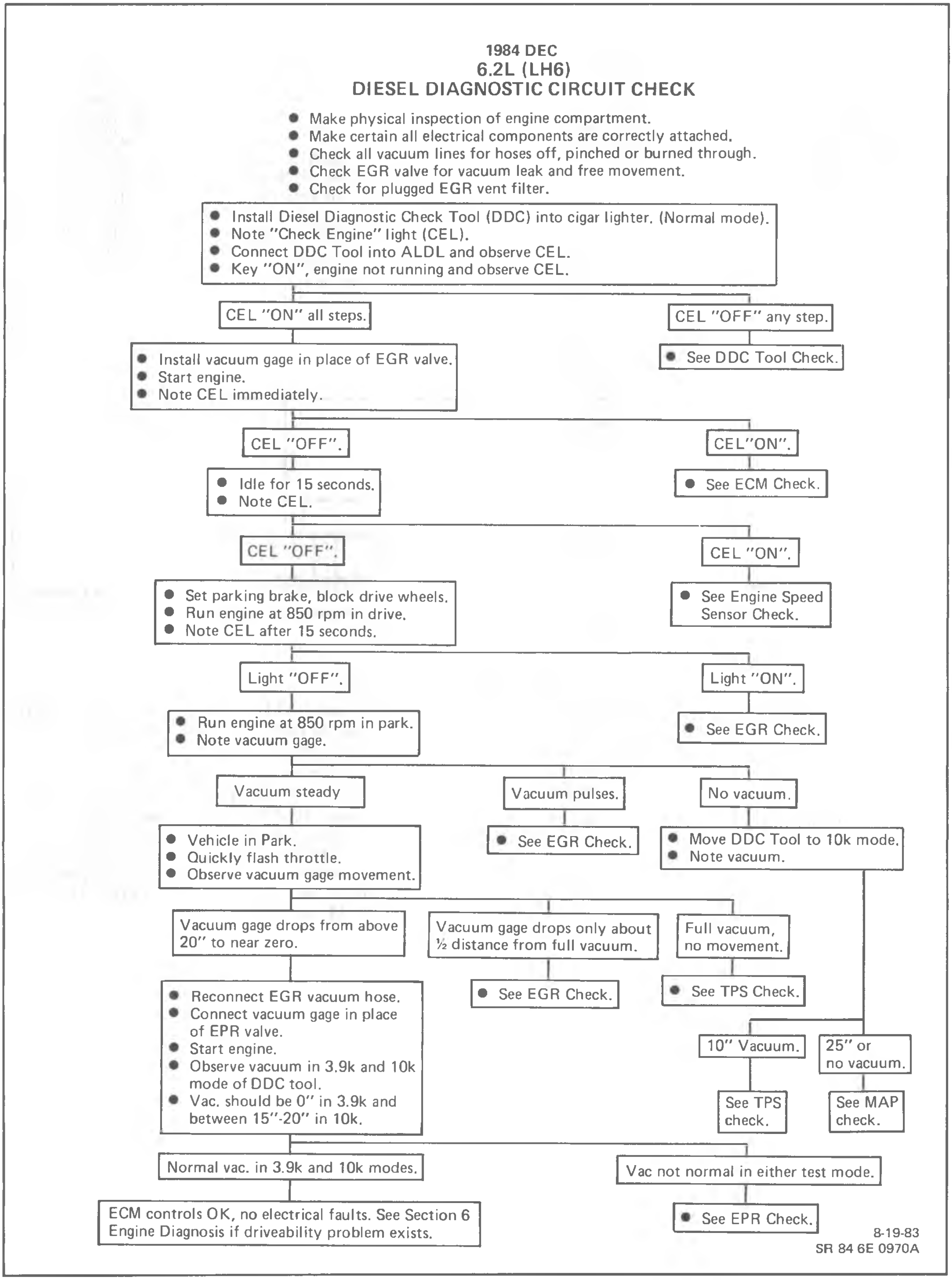


Fig. 6E9-35--Diesel Diagnostic Circuit Check

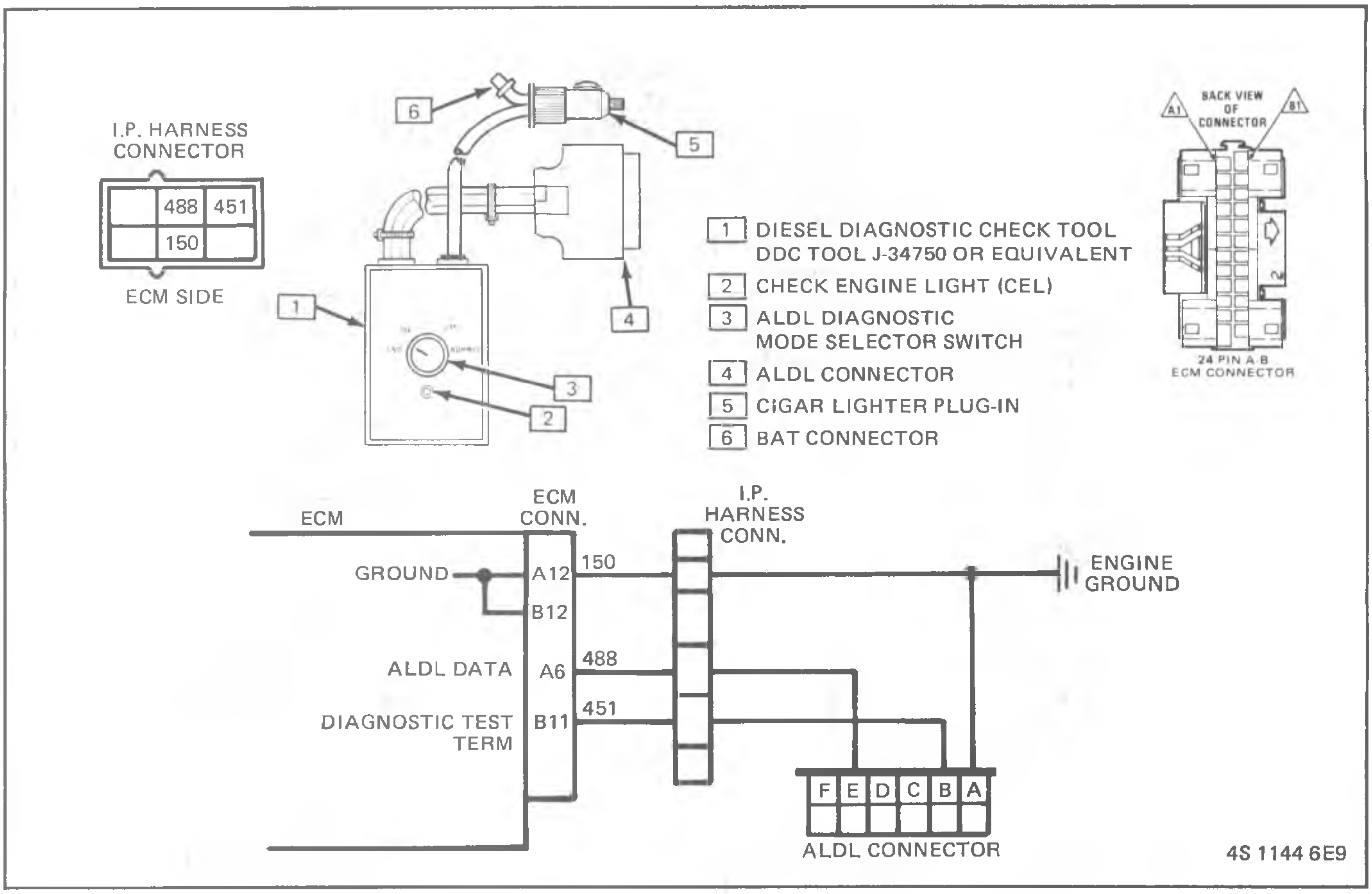


Fig. 6E9-36--DDC Tool Check (1 of 2)

DDC TOOL CHECK (6.2L LH6)

The Diesel Diagnostic Check (DDC) Tool is a combination "Check Engine" Light (CEL) and diagnostic mode selector. The tool allows a check on the ECM's ability to detect a fault and set a CEL. The mode selector assists diagnostics if a fault is present, even if there was no CEL.

Prior to any diagnostics, it must be verified that the DDC tool is functioning.

1. Checks to see if the DDC tool is supplied with 12 volts. Light should be "ON" with only the power cord installed.
2. Checks to see if ALDL circuit is grounded or faulty. Normally when connection is made to ALDL, the CEL should remain "ON".
3. When ignition is turned "ON", the CEL should remain "ON". If CEL goes "OFF", ECM may be shorted internally. Note: When using the DDC tool in any of the diagnostic modes (3.9K or 10K), the CEL will flicker. This is normal. Also, when going from any diagnostic mode to either Normal or Ground, the CEL will come on solid for 10 seconds, then go off. This is the normal ECM reset time.

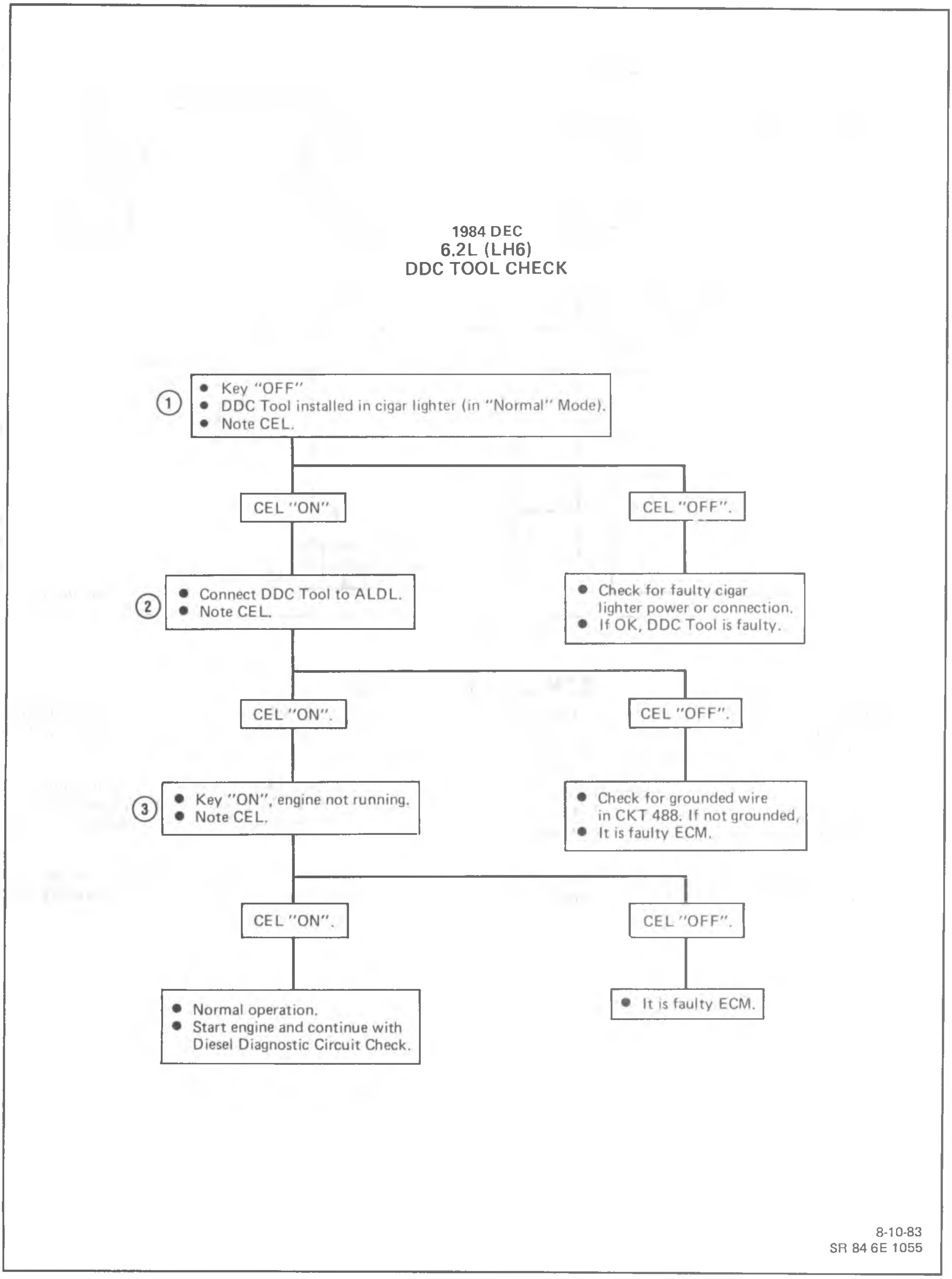


Fig. 6E9-37--DDC Tool Check (2 of 2)

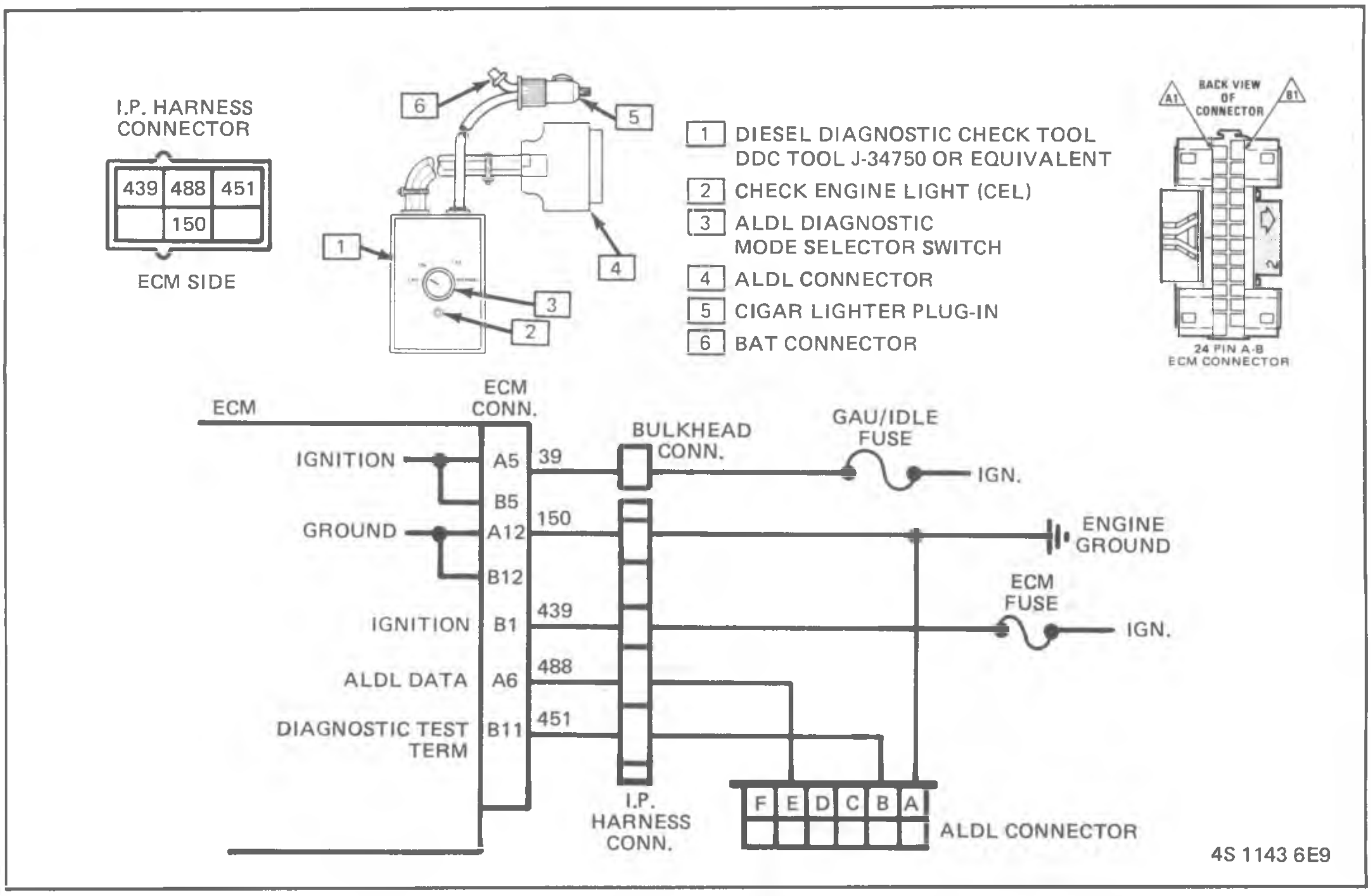


Fig. 6E9-38--ECM Check (1 of 2)

ECM CHECK (6.2L LH6)

The ECM check is made to determine why the "Check Engine" Light remains "ON" after the engine is started. Normally, the ECM will not recognize a fault for at least 10 seconds after start-up. If the CEL remains "ON", the ECM has lost power, ground or the signal that turns the CEL "OFF" has been lost. Since the the CEL is remote from the ECM, it can recognize faulty ECM power or ECM.

1. Checks for proper CEL signal at ALDL. It should normally be about battery voltage until the vehicle is started.
2. Checks for 12 volts at ECM ignition feed terminals. Battery voltage should normally be present at both terminals.
3. Checks for good ECM ground. Light should normally be "ON". If ECM power and ground terminals are OK, check for good ECM to connector terminal contact.
4. When the vehicle is started, the ECM turns the CEL "OFF" and voltage at ALDL should normally drop under 6 volts.

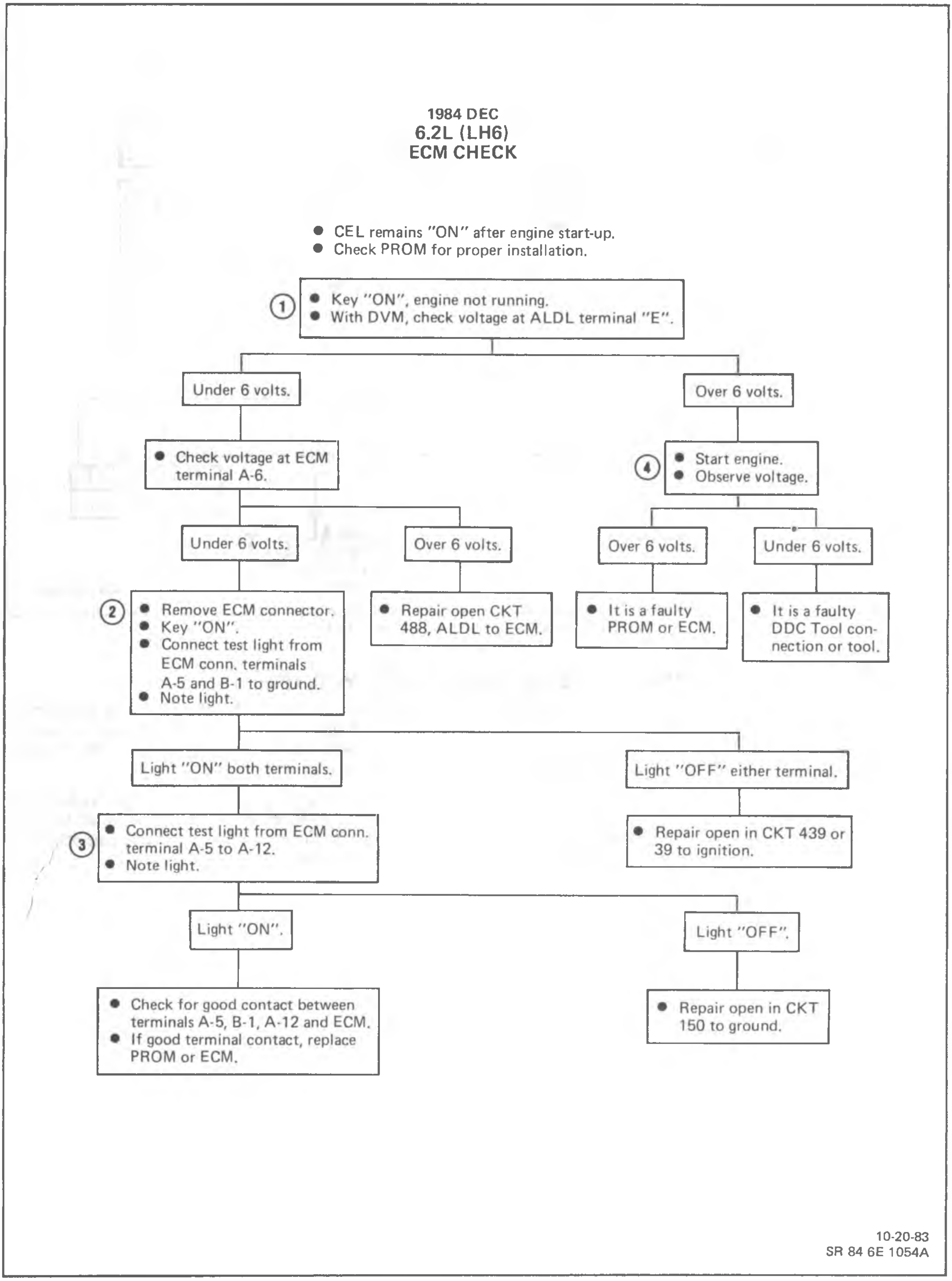


Fig. 6E9-39--ECM Check (2 of 2)

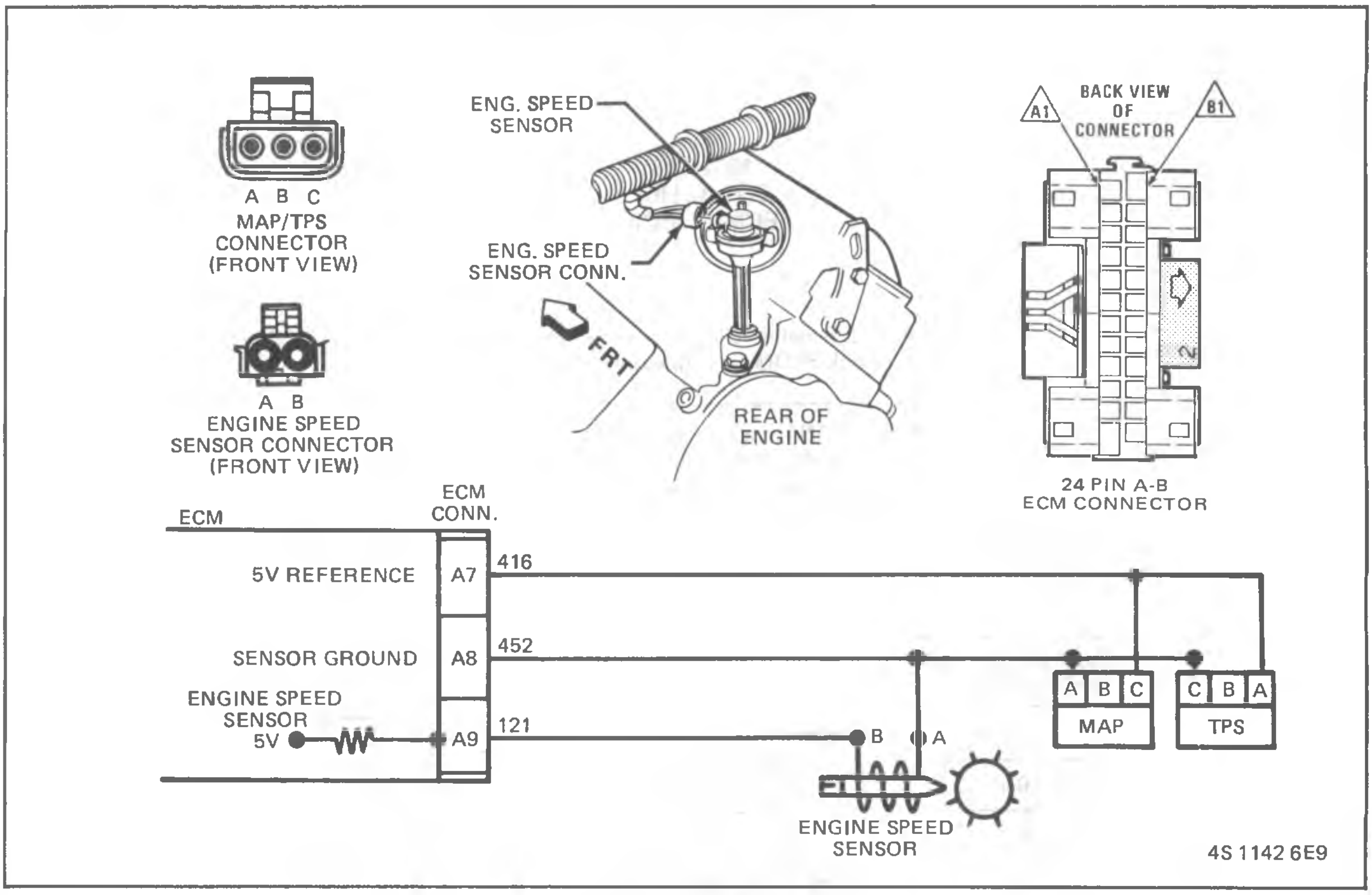


Fig. 6E9-40--Engine Speed Sensor Check (1 of 2)

ENGINE SPEED SENSOR CHECK (6.2L LH6)

The Engine Speed Sensor is a camshaft driven pick-up mounted at the center rear of the engine.

It is sourced by 5 V-reference and allows the ECM to measure engine RPM by the number of times the voltage is pulsed. The Engine Speed Sensor pulses 4 times per revolution.

1. Checks for a good 5 V-reference. Normally, the ECM should be at about 5 volts for fully charged batteries.
2. Checks for proper ECM voltage to the Engine Speed Sensor. If the circuit to the ECM is complete, normal voltage will be about 5 volts with the harness disconnected from the sensor.
3. Checks for a good sensor ground circuit (CKT 452) from sensor to ECM. Since Step 2 indicated an open, the results of this step indicates whether the open is in the wire or at the ECM.

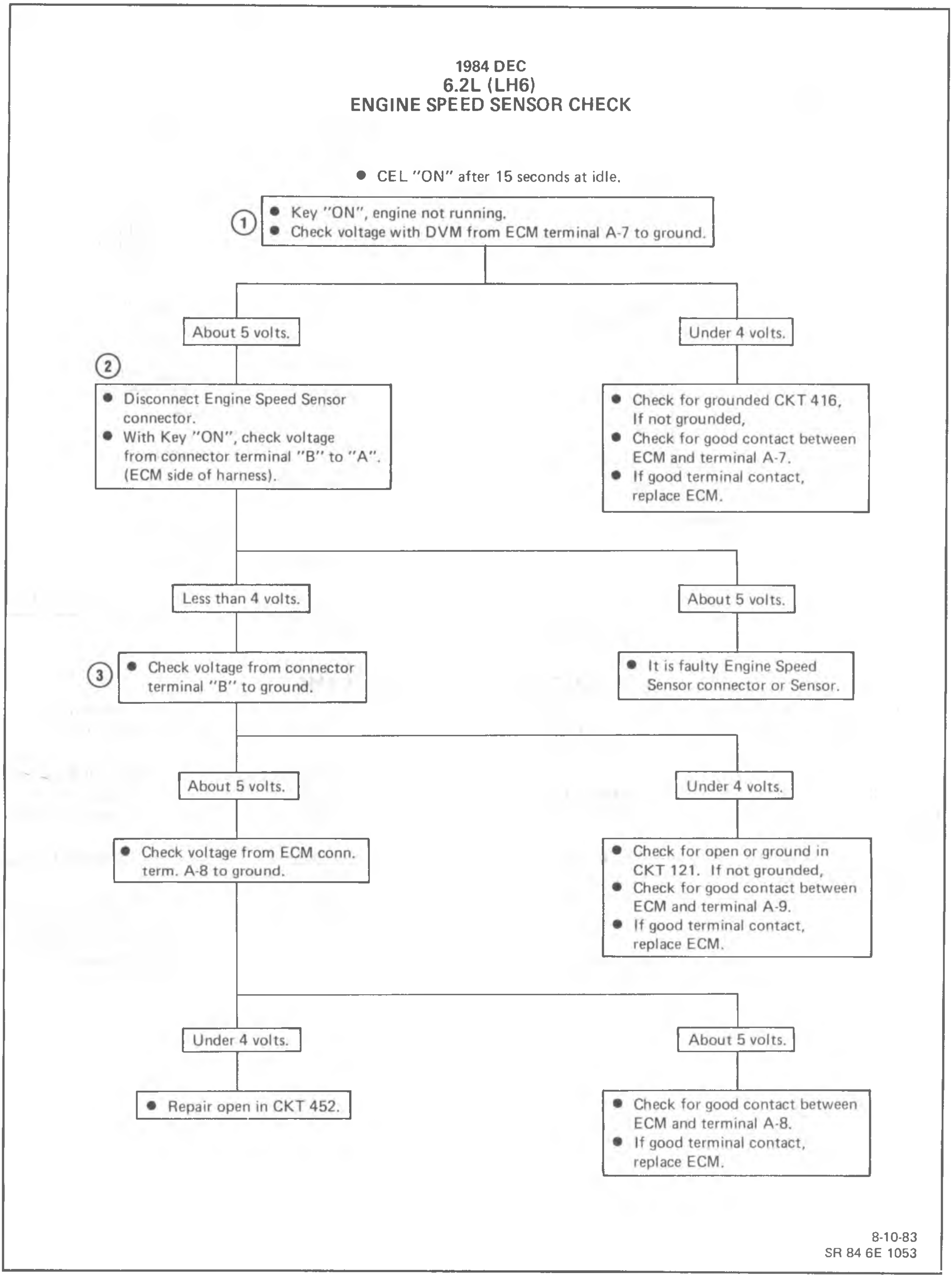


Fig. 6E9-41--Engine Speed Sensor Check (2 of 2)

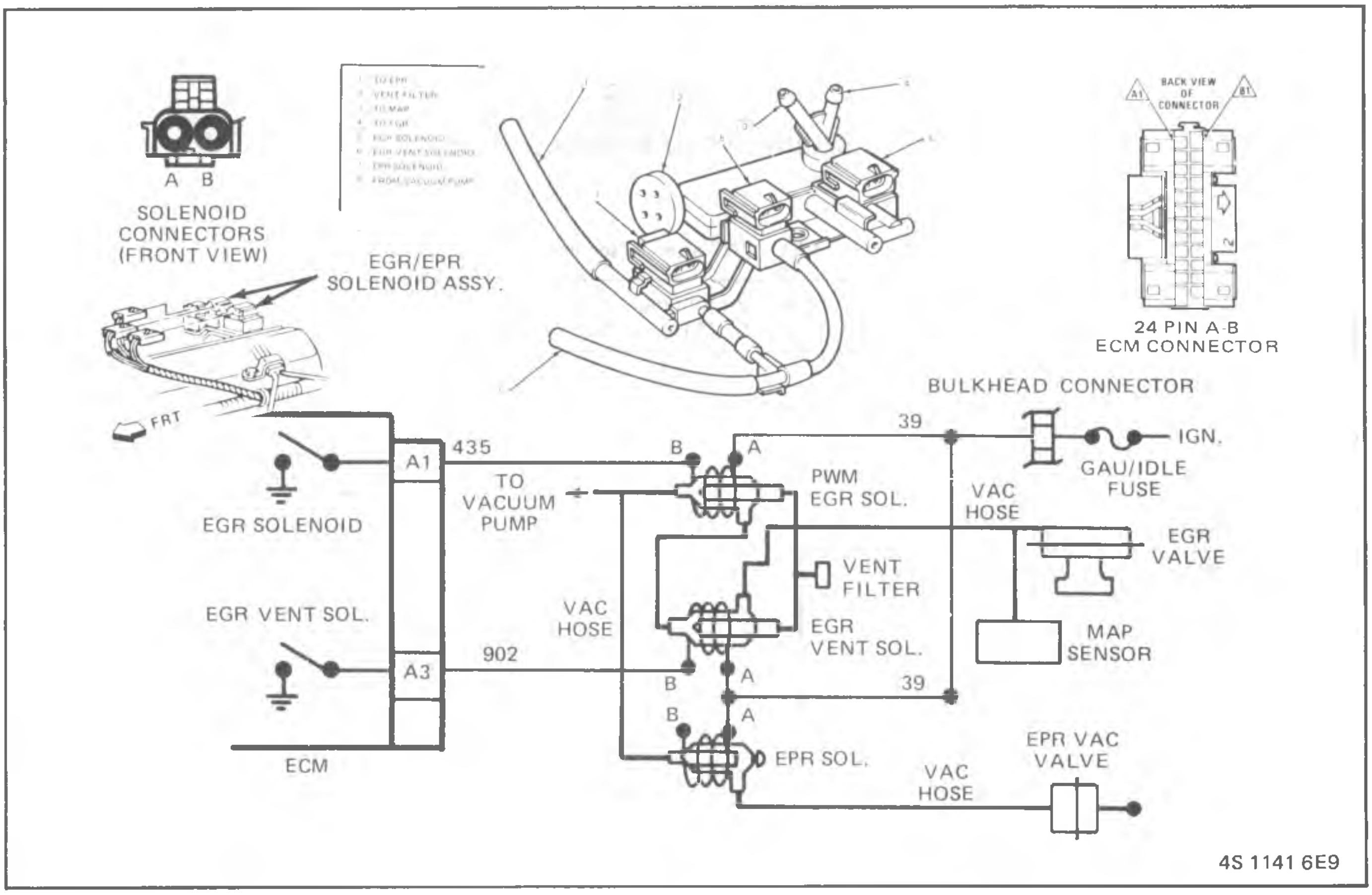


Fig. 6E9-42--EGR/EGR Vent Check (1 of 2)

EGR/EGR VENT CHECK (6.2L LH6)

The EGR solenoid controls the amount of vacuum to the EGR valve. The signal from the ECM is Pulse Width Modulated (PWM) which varies the cycle ("ON" time) from 0% to 100%.

As the EGR solenoid cycles, vacuum to the EGR valve is controlled. When the EGR solenoid is "'ON", there is no EGR vacuum.

The EGR Vent Solenoid operates to allow rapid venting of EGR vacuum to improve driveability and performance when the ECM recognizes the operating range for no EGR. When the solenoid is "ON", EGR vacuum is vented.

Both solenoids operate on 12 volts supplied by ignition. The ECM supplies the ground to turn the solenoids "ON".

1. Checks for EGR vacuum at idle. Normally, there should be full EGR vacuum at idle (above 68 kPa/20" vacuum).
2. Checks for a ground in the circuit that would energize either solenoid. At idle, neither solenoid should be "ON". A test light "ON" indicates a faulty ground in the circuit.
3. Checks for complete circuits to both solenoids. The test light should be "ON" normally.
4. Using the DDC tool in the 3.9k mode should turn the vacuum "OFF" to the EGR valve by ECM activation of the EGR vent solenoid. If vacuum is present, the ECM was not able to energize the EGR vent solenoid.

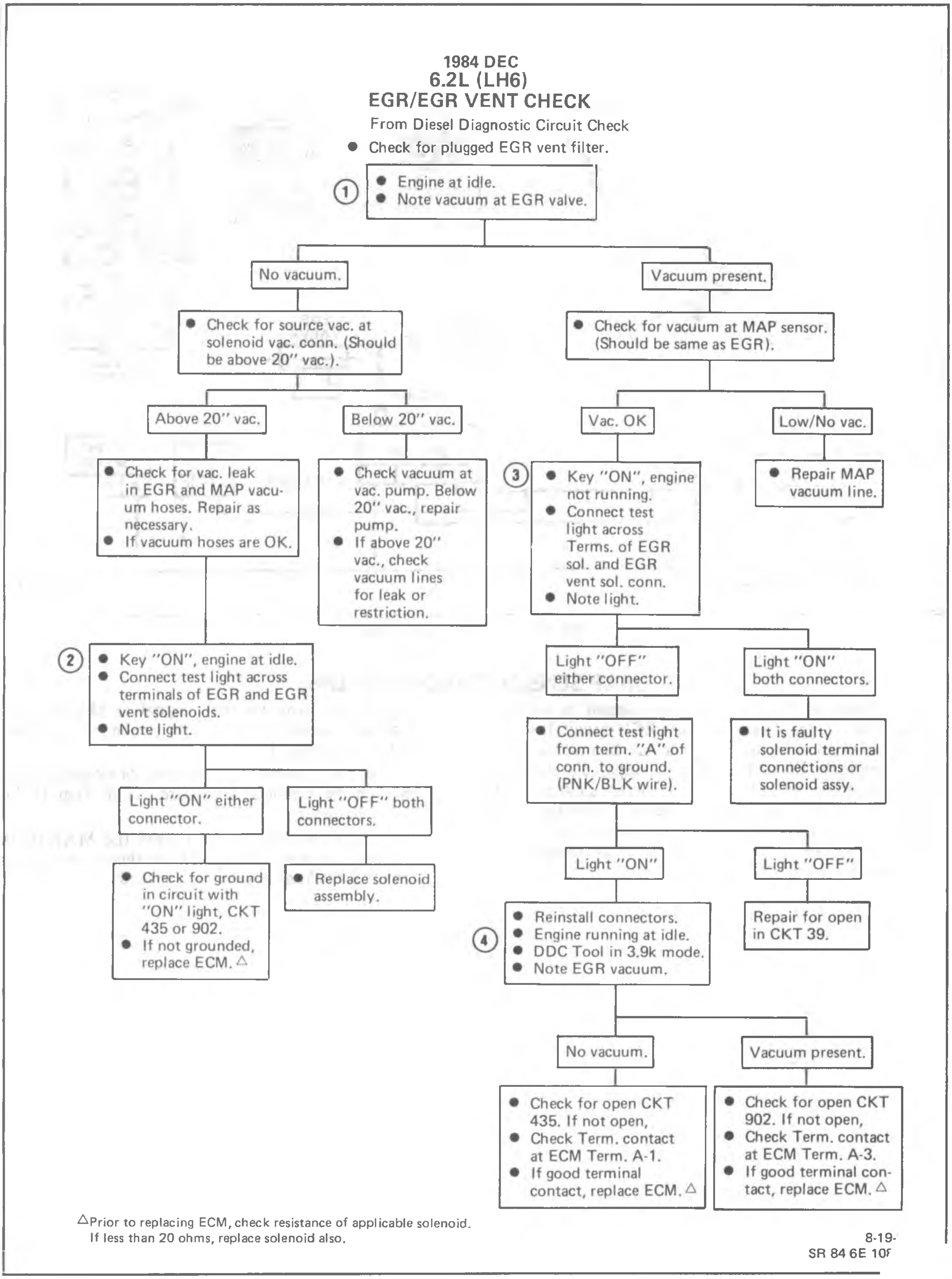


Fig. 6E9-43--EGR/EGR Vent Check (2 of 2)

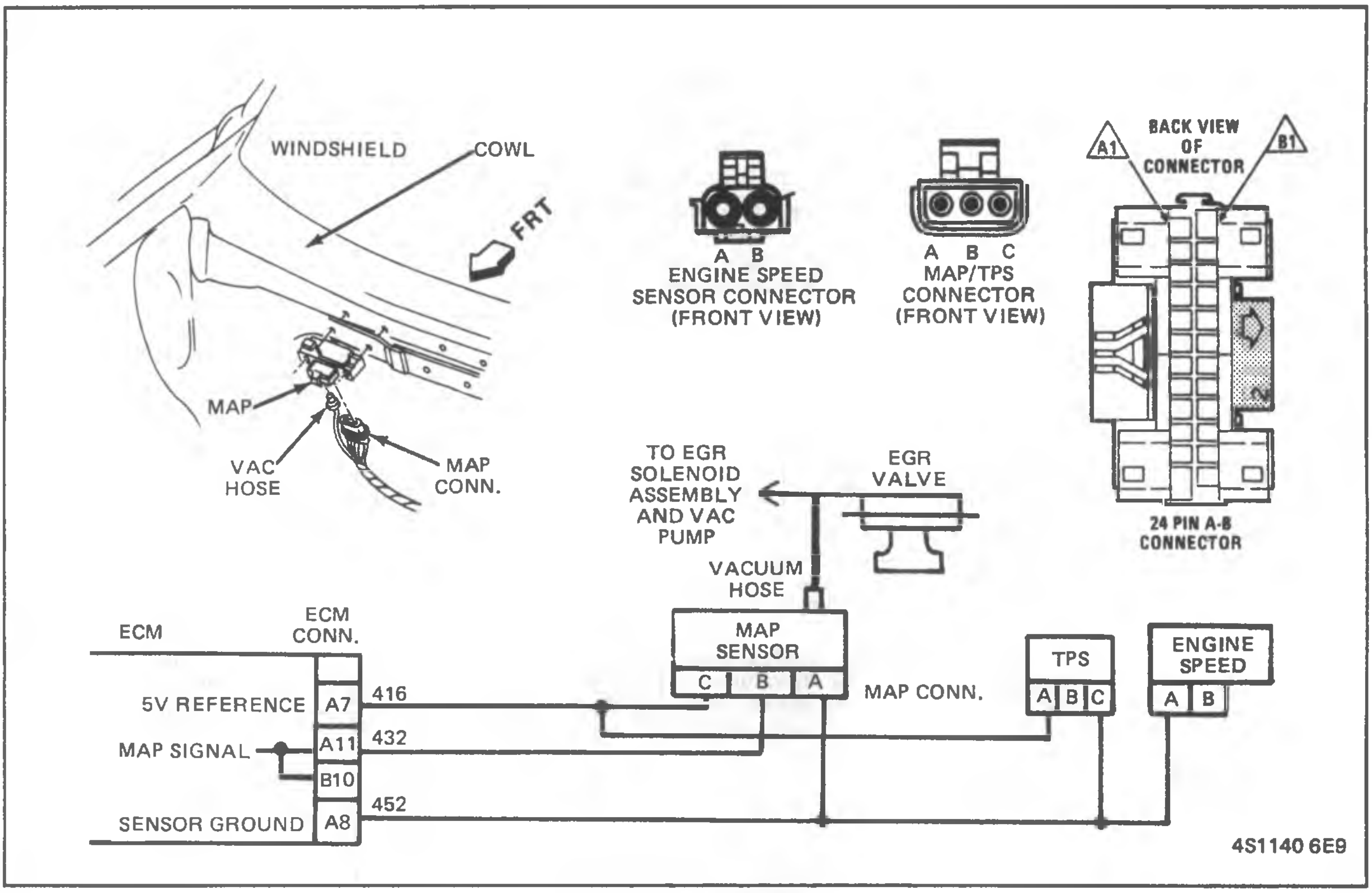


Fig. 6E9-44--MAP Sensor Check

MAP SENSOR CHECK (6.2L LH6)

A Manifold Absolute Pressure Sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the ECM. The signal is compared to the EGR duty cycle calculated by the ECM. If there is a difference in the ECM command and what is at the EGR valve sensed by the MAP, the ECM makes minor adjustments to connect. When a major difference is sensed, the ECM recognizes a fault and sends a full EGR signal.

1. Checks for 5-volt reference signal to MAP Sensor. Normally, about 5 volts should present with the key "ON" at Terminal "C".
2. Checks for a complete circuit from MAP sensor back through the sensor ground wire. As in Step 1, this should be about 5 volts.
3. Checks for normal response from the MAP to an external vacuum signal. There should be be an immediate voltage as vacuum is applied.

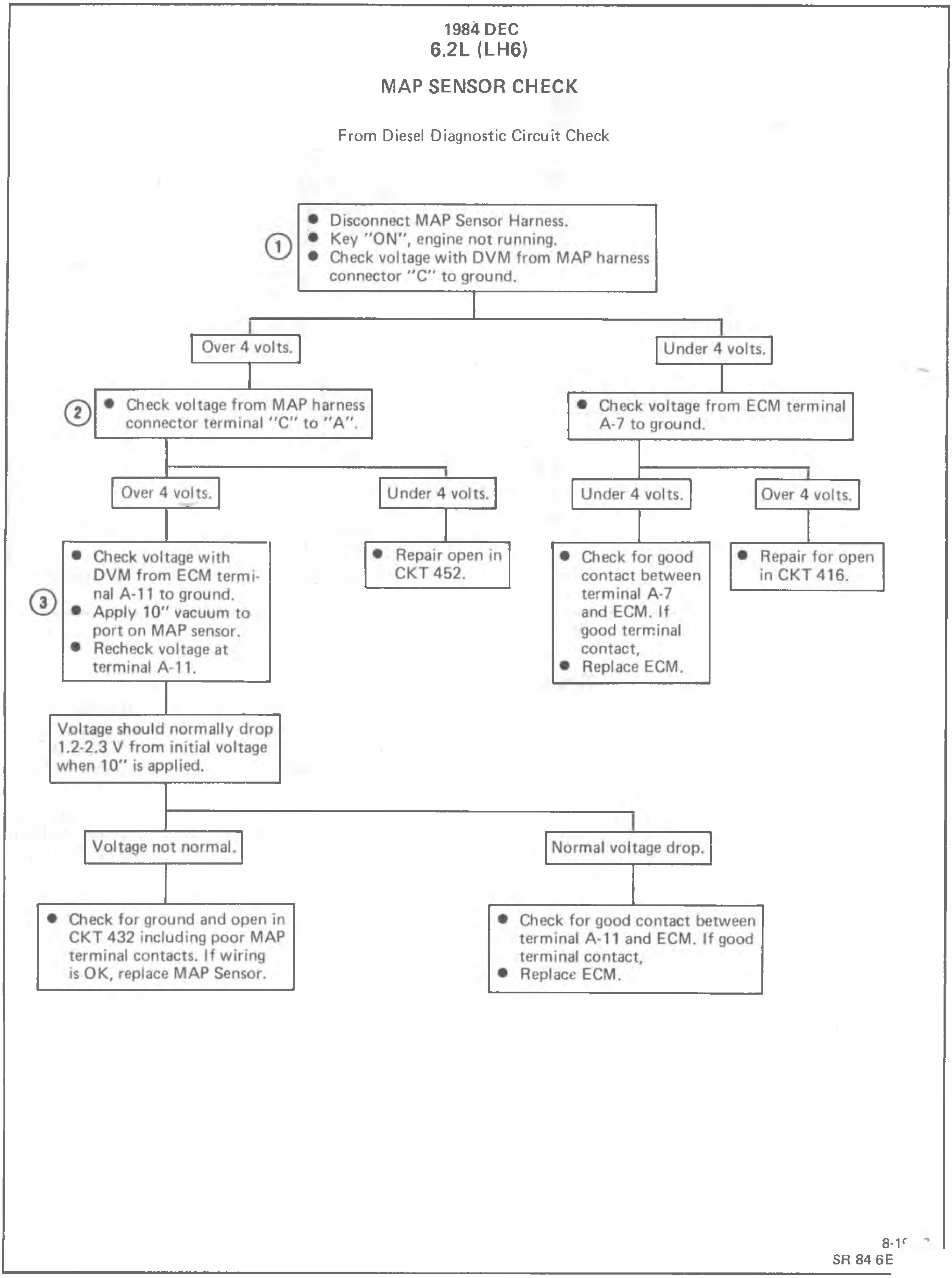


Fig. 6E9-45--MAP Sensor Check (2 of 2)

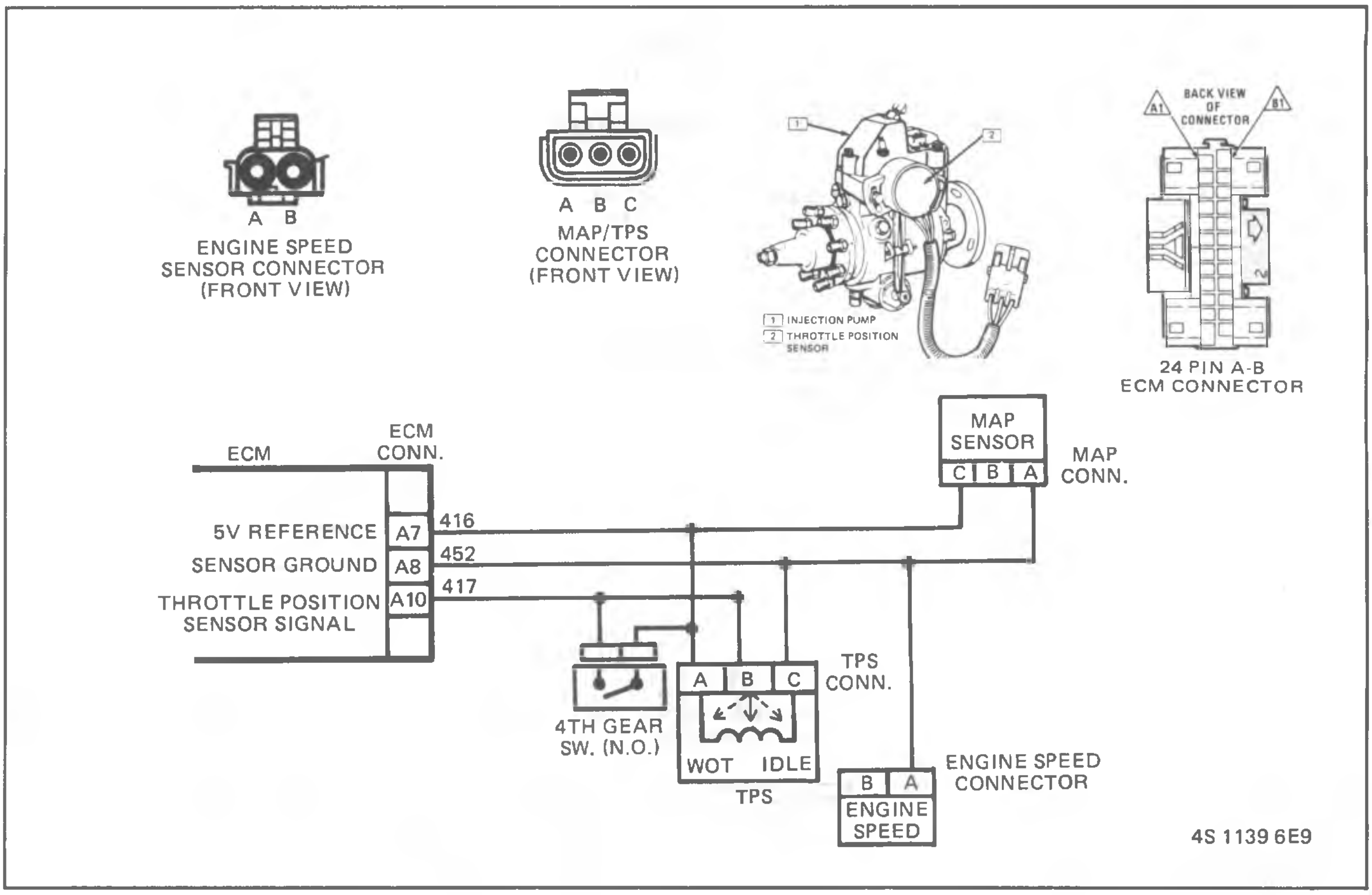


Fig. 6E9-46--TPS Check (1 of 2)

TPS CHECK (6.2L LH6)

The Throttle Position Sensor (TPS) is a variable resistor that signals the ECM the degree of throttle opening. The sensor is connected to 5-volt reference and has the highest resistance at closed throttle. At wide open throttle, the resistance is lowest and output to the ECM will be near 5 volts.

1. Checks for complete 5-volt reference circuit. If the circuit is complete from V-ref and back to sensor ground in ECM, DVM will read about 5 volts.
2. Checks for a shorted or stuck 4th gear switch. When the transmission shifts to 4th gear, this switch will close and signal the ECM to turn "OFF" EGR. If the 4th gear switch is not faulty, there could be a short to V-ref or a faulty TPS adjustment or switch.
3. Checks for normal response at ECM from TPS. Voltage should be normally less than 1 volt at closed throttle and go to about 5 volts at WOT. If voltage change is OK, circuit is complete.

1984 DEC
6.2L (LH6)
TPS CHECK

From Diesel Diagnostic Circuit Check

1
- Key "ON", engine not running.
- Disconnect TPS harness connector.
- Check voltage from TPS harness connector terminal "A" to "C".

Over 4 volts.

2
- Reconnect TPS harness.
- Check voltage from ECM terminal A-10 to ground.

Under 4 volts.

- Check voltage from TPS connector terminal "A" to ground.

Under 4 volts.

- Repair open in CKT 416.

Over 4 volts.

- Repair open in CKT 452.

Under 4 volts.

3
- Depress throttle to WOT (key "ON", engine not running).
- Note voltage change. Voltage should go from less than 1V to about 5V at WOT.

Over 4 volts.

- Check for shorted (closed) 4th gear switch. If not shorted,
- Check for short to V-ref. in CKT 417. If not shorted,
- It is a misadjusted or faulty TPS.

No voltage change.

- Check for ground or open in CKT 417. If not grounded or open,
- Check TPS adjustment. If proper adjustment cannot be made, it is faulty TPS terminal contact or TPS.
- If adjusted properly, replace ECM.

Voltage changes.

- Check TPS adjustment. If proper adjustment cannot be made, it is faulty TPS terminal contact or TPS.
- If adjusted properly, check for good contact between terminal A-10 and ECM. If good terminal contact, replace ECM.

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Fig. 6E9-47--TPS Check (2 of 2)

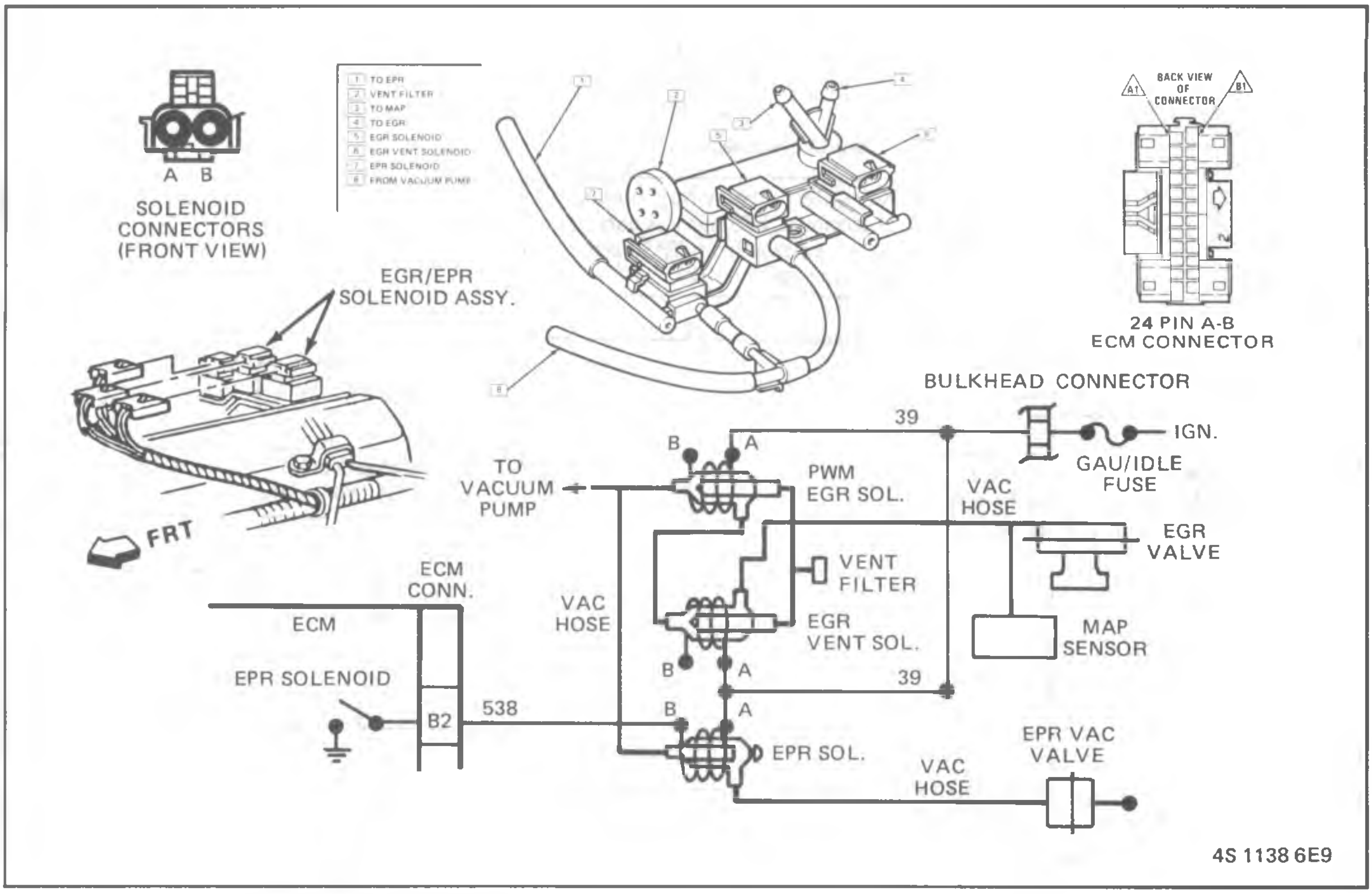

Fig. 6E9-48--EPR Solenoid Electrical Check (1 of 2)

EPR SOLENOID ELECTRICAL CHECK (6.2L LH6)

The EPR solenoid controls vacuum to the EPR valve. The EPR solenoid, when energized, allows vacuum pump vacuum to close the EPR valve and increase exhaust back pressure for proper EGR operation. The solenoid is supplied 12 volts by the ignition and the ECM completes the ground to energize the solenoid and turn EPR "ON".

1. Checks for a short to ground or a faulty ECM signal to EPR solenoid. Test light should normally be "OFF".
2. Checks for signal to energize EPR solenoid with engine at idle. If the test light is "ON", electrical circuits to the solenoid are OK.

1984 DEC

6.2L (LH6) EPR SOLENOID ELECTRICAL CHECK

- Perform Diesel Diagnostic Check First.
- Check for plugged EGR vent filter.

1
- Key "ON", engine not running.
- Remove EPR solenoid connector.
- Connect test light across conn. terms.
- Note test light.

Light "OFF".

2
- Start engine.
- Note light at idle.

Light "ON"

- Check for ground in CKT 538. If not grounded,
- Replace ECM. △

Light "OFF".

- Connect test light from conn. Term. "A" to ground. (PNK/BLK wire)

Light "ON".

- Electrical circuit OK.
- See EPR Vacuum Check.

Light "ON".

- Check for open in CKT 538. If not open,
- Check for poor contact at ECM Term. B-2. If good contact replace ECM.△

Light "OFF".

- Repair for open in CKT 39.

△ Prior to replacing ECM, check resistance of applicable solenoid. If under 20 ohms, replace solenoid also.

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Fig. 6E9-49--EPR Solenoid Electrical Check (2 of 2)

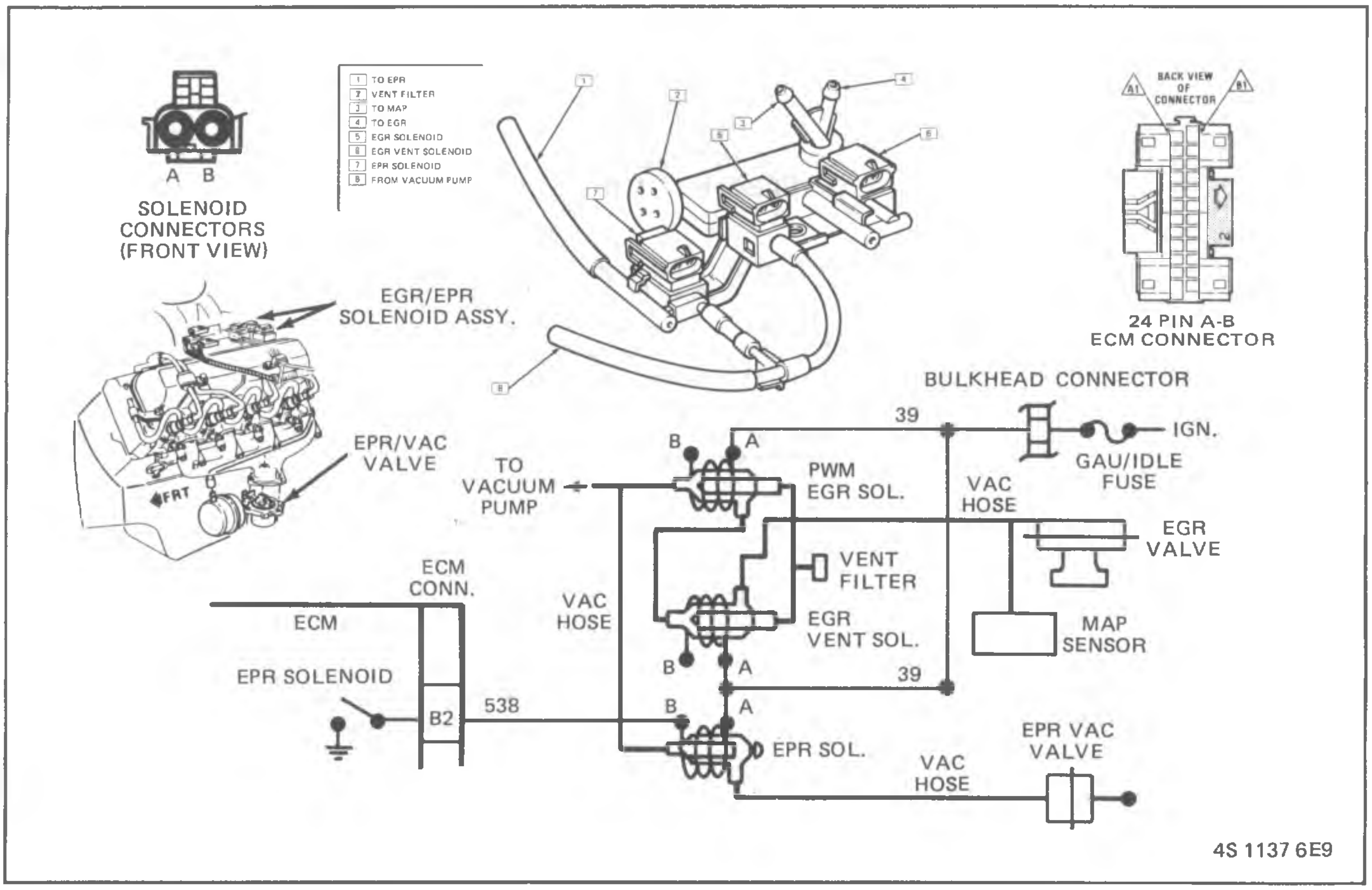

Fig. 6E9-50--EPR Vacuum Check (1 of 2)

EPR VACUUM CHECK (6.2L LH6)

The EPR Solenoid controls vacuum to the EPR valve. The EPR solenoid, when energized, allows vacuum pump vacuum to close the EPR valve and increase exhaust back pressure for proper EGR operation. The EPR valve is a combination vacuum, actuator and exhaust restrictor plate. When vacuum is applied to the actuator, the restrictor plate closes to increase exhaust system back pressure to allow the EGR valve to function more efficiently.

1. Checks for normal EPR vacuum at idle. Since electrical circuit was verified as OK on prior chart, if no vacuum is present, it is due to no source vacuum (vacuum pump) or a restriction or leak in vacuum lines to valve including the solenoid.
2. Checks to see if solenoid will respond to ECM command. In 3.9K mode, EPR solenoid is de-energized, so no vacuum should be present if the solenoid did close.
3. Checks for normal operation of EPR valve. When vacuum is applied to vacuum, valve actuator should move and hold.

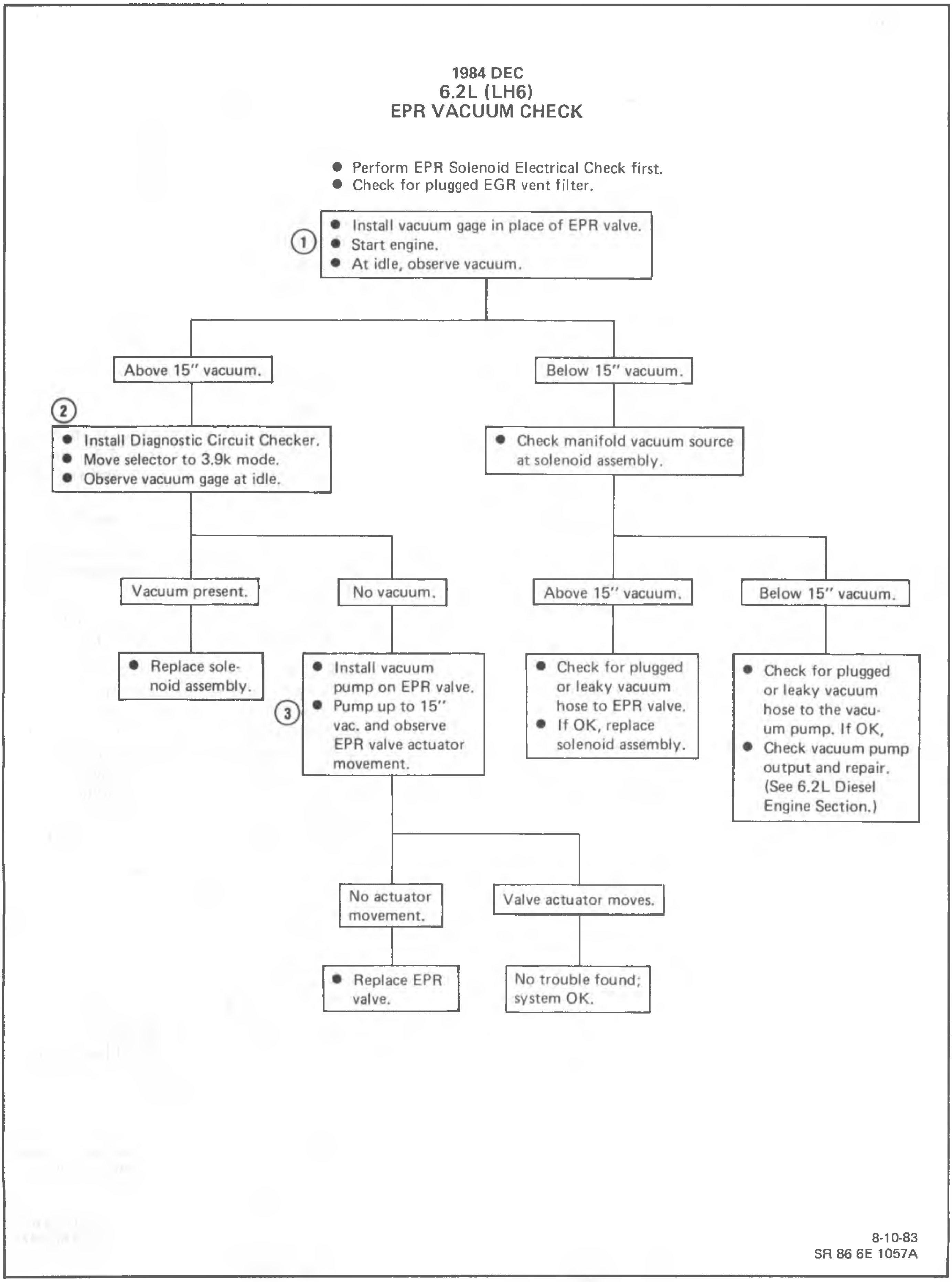

Fig. 6E9-51--EPR Vacuum Check (2 of 2)

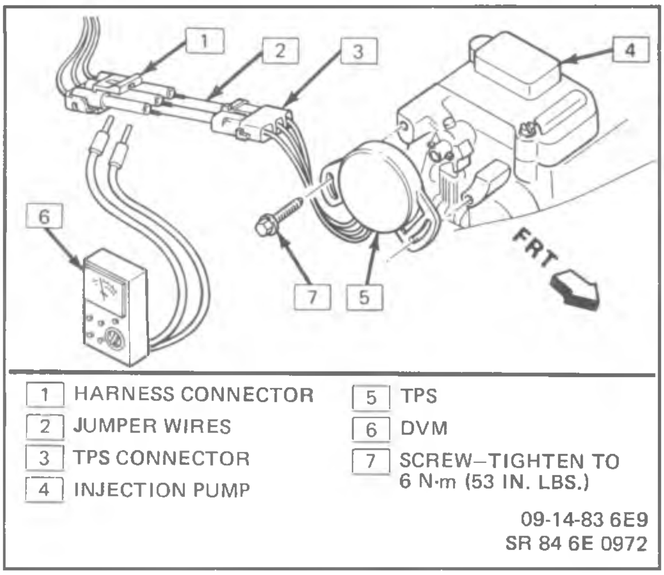

Fig. 6E9-52--TPS Adjustment

ON-VEHICLE SERVICE

EGR Valve

Refer to diagnosis that checks EGR system and replace EGR Valve (Fig. 6E9-17) as required.

EPR Valve

Refer to diagnosis that checks EPR system and replace EPR valve (Fig. 6E9-18) as required.

Vacuum Pump

Refer to Figures 6E9-6 or 6E9-8 for replacement of the vacuum pump.

Engine Speed Sensor (Fig. 6E9-31)

Remove or Disconnect

1. Batteries
2. Air cleaner. Cover intake manifold.
3. Engine speed sensor electrical connector.
4. Vacuum hose (CK only)
5. Clamp
6. Engine speed sensor with vacuum pump (CK only)

Connect or Install

1. Engine speed sensor assembly and gasket.
2. Clamp
3. Vacuum hose (CK only)
4. Electrical connector
5. Air cleaner
6. Batteries

Throttle Position Sensor

Adjustment

1. Remove Air Cleaner Assembly and related hoses.
2. Disconnect TPS connector. Install jumper wires between TPS and harness. Jumpers can be made using terminals P/N 12014836 and 12014837. Three jumpers or their equivalent will be necessary (Fig. 6E9-52).
3. Key "ON", engine not running.
4. Install TPS/VRV gage block to J-33043-2 or equivalent using the .646 side of the block. Position tool between gage boss on injection pump and the wide open stop screw on throttle shaft (Fig. 6E9-53).
5. Rotate the throttle lever and hold the wide open stop screw against the gage block.
6. Using a DVM J-29124 or equivalent, measure voltage from TPS connector terminals "A" to "C". This is V-ref. Record the voltage reading (Fig. 6E9-54).
7. Now measure and record voltage between terminals "B" to "C". This is the TPS voltage (Fig. 6E9-54).
8. Compare the voltage recorded in Step 7 under the corresponding V-ref. recorded in Step 6 against the data in TPS table (Fig. 6E9-54).

   The TPS voltage should be within $\pm 1\%$ of voltage shown. Example: A V-reference of 4.6 - the TPS voltage may be 2.87 to 2.93 volts and be within tolerance.
9. If no adjustment is necessary, proceed to Step 12.
10. To adjust TPS, loosen the two attaching screws and rotate TPS until the correct TPS voltage is obtained as per TPS Table (Fig. 6E9-54).
11. When the correct TPS value is obtained, tighten the TPS attaching screws to 6 N·m (53 in. lbs.).
12. Check TPS voltage by releasing the throttle lever alllowing it to return to the idle stop position measuring voltage from terminals "B" to "C". Return lever against gage block. Voltage should be less than 1 volt at closed throttle and return to TPS voltage within $\pm 1\%$ of the adjusted voltage when throttle is again opened against gage block. If voltage does not return to TPS voltage, repeat Steps 10, 11 and 12. If at closed throttle, voltage is not less than 1 volt or adjustment cannot be made, replace TPS.

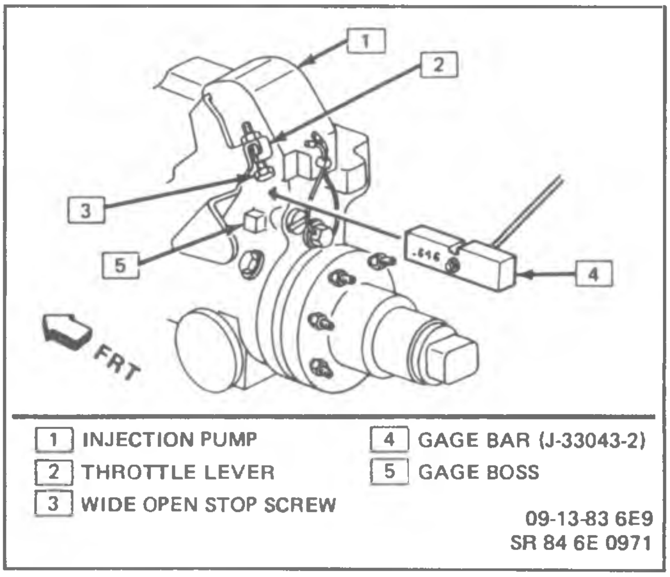

Fig. 6E9-53--Gage Block

V-REFERENCE →	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5
TPS VOLTAGE → (with gage tool installed)	2.84	2.90	2.96	3.02	3.09	3.15	3.21	3.28	3.34	3.40	3.47

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Fig. 6E9-54--TPS Voltage Table

13. Remove gage block tool.
14. Turn ignition "OFF".
15. Remove jumper wires and reconnect TPS harness connector.
16. Reinstall Air Cleaner Assembly and related hoses.

Remove or Disconnect

1. Air cleaner and related hoses.
2. TPS connector.
3. TPS attaching screws.
4. TPS

Connect or Install

1. TPS and attaching screws.
2. Adjust TPS voltage following procedure above.
3. TPS connector.
4. Air cleaner and related hoses.

MAP Sensor

Refer diagnosis that checks MAP sensor circuit and replace sensor (Fig. 6E9-33) as required.

EGR/EGR Solenoid Assy.

The EGR solenoid, EGR vent solenoid and EPR solenoid are replaced as an assembly. The vent filter can be replaced as required. If diagnosis has determined that any solenoid does not operate, replace with complete assembly (Fig. 6E9-34).

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, MAP	3.682
Sensor, Throttle Position	3.440
Sensor, Veh. Spd	3.682

TRANSMISSION CONVERTER CLUTCH (TCC)

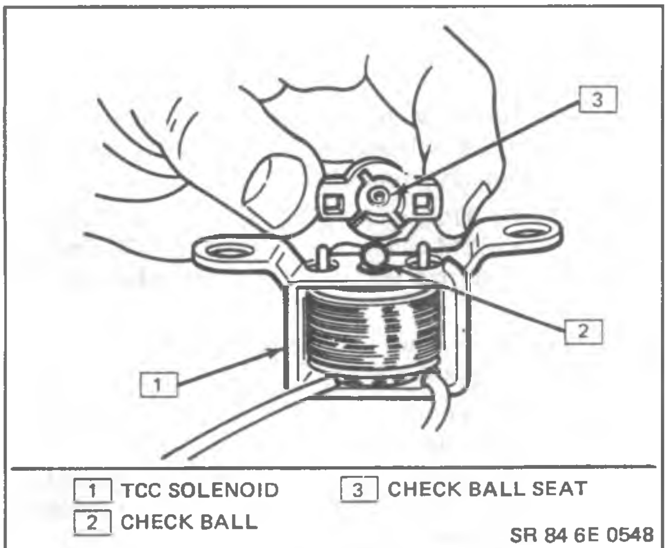


Fig. 6E9-55--TCC Solenoid

The Transmission Convert Clutch (TCC) System uses a solenoid operated valve (Fig. 6E9-55) in the automatic transmission to couple the engine flywheel to the output shaft of the transmission through the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

Refer to TCC check for additional information.

Results of Incorrect TCC Operation

If the converter clutch is applied at all times, the engine will stall immediately, just as in a manual transmission with the clutch applied.

If the converter clutch does not apply, fuel economy may be lower than expected.

The Transmission Converter Clutch (TCC) system has different operating characteristics than an automatic transmission without TCC. If the driver complains of a "chuggle" or "surge" condition, the vehicle should be road tested and compared to a similar vehicle to see if a real problem exists. The Owner's Manual section on TCC operation should be reviewed with the driver. Another TCC complaint may be a downshift felt when going up a grade, especially with cruise control. This may not be a downshift, but a clutch disengagement due to the change in TPS to maintain cruising speed.

DIAGNOSIS

Refer to Figures 6E9-56 and 57 for a check of the transmission converter clutch circuit controlled by the ECM.

ON-VEHICLE SERVICE

- See Section 7A for TCC Solenoid replacement.
- See Section 8C for brake switch replacement.
- Refer to Diesel Electronic Control System for replacement of the ECM.

PARTS INFORMATION

PART NAME	GROUP
Solenoid kit, with seal	4.122

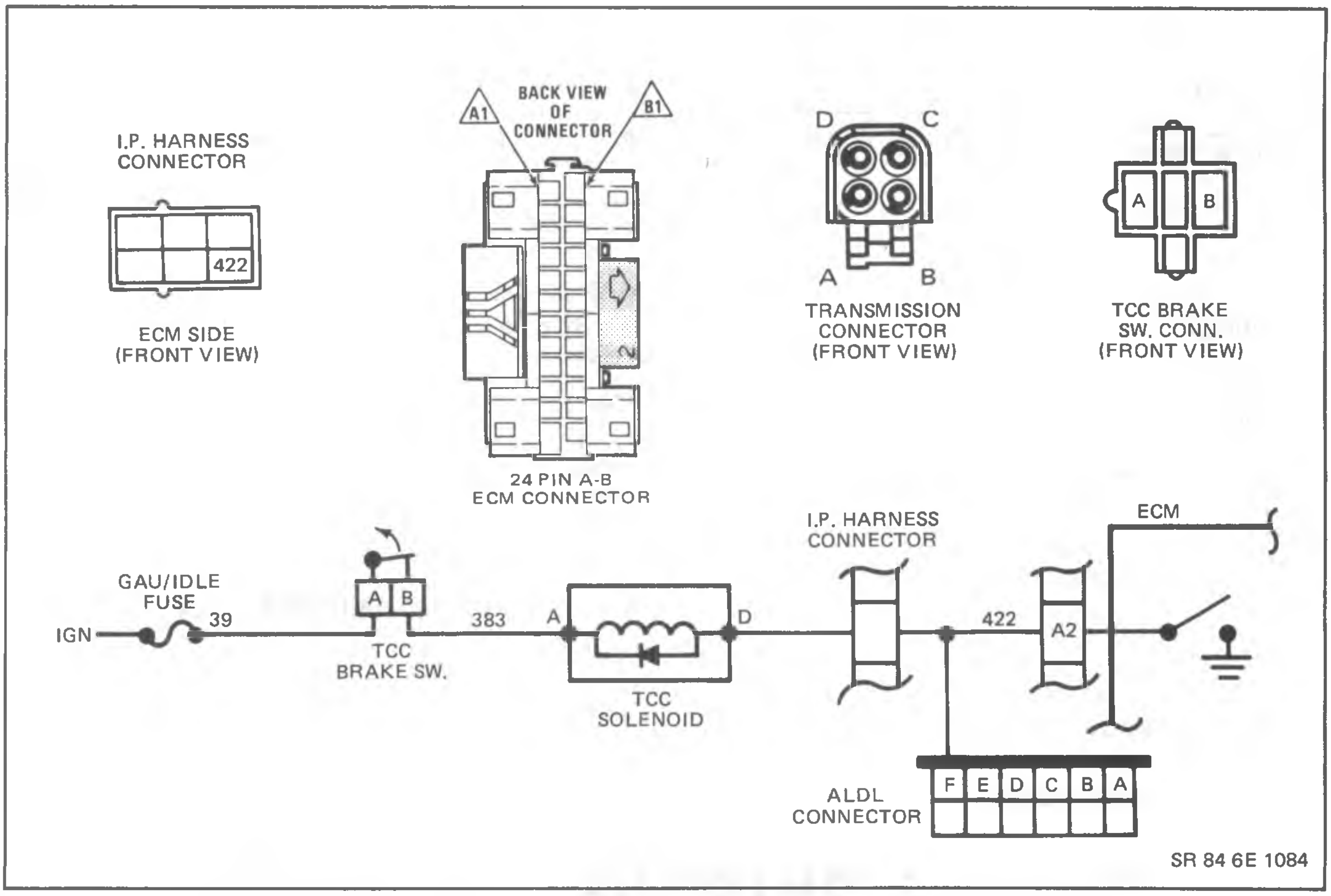


Fig. 6E9-56--TCC Check (1 of 2)

TCC CHECK

The purpose of the TCC is to eliminate power loss during highway cruise driving conditions. When the Torque Converter Clutch is applied, the conventional fluid coupling between engine and transmission is replaced by a straight through mechanical coupling. The heart of the system is a solenoid located inside the transmission and is controlled by the ECM. Ignition to the solenoid passes through a brake switch which opens when the brake is applied. The ECM completes the ground to activate the TCC solenoid for clutch engagement.

The ECM completes the circuit whenever the TPS exceeds a calibrated valve for throttle opening.

1. Checks for complete circuit from ignition through solenoid up to test point. Test light should be "ON" normally since ECM has not completed circuit yet.
2. Checks for ECM to complete circuit to ground to energize TCC solenoid and engage TCC. Test light should normally go out when ECM completes circuit.
3. Checks for TPS signal. If signal to ECM is correct, fault is in ECM connection or ECM. If TPS signal to ECM is incorrect (voltage) proper operation will not occur.
4. Checks for ground in circuit to ECM Terminal A-2. Normally, light should be "OFF".
5. Checks for ignition voltage to Terminal "A" of TCC conn. Light should normally be "ON".
6. Checks for complete circuit from ignition to ground via TCC test terminal in ALDL. Normally, light should go "ON" if harness is good.

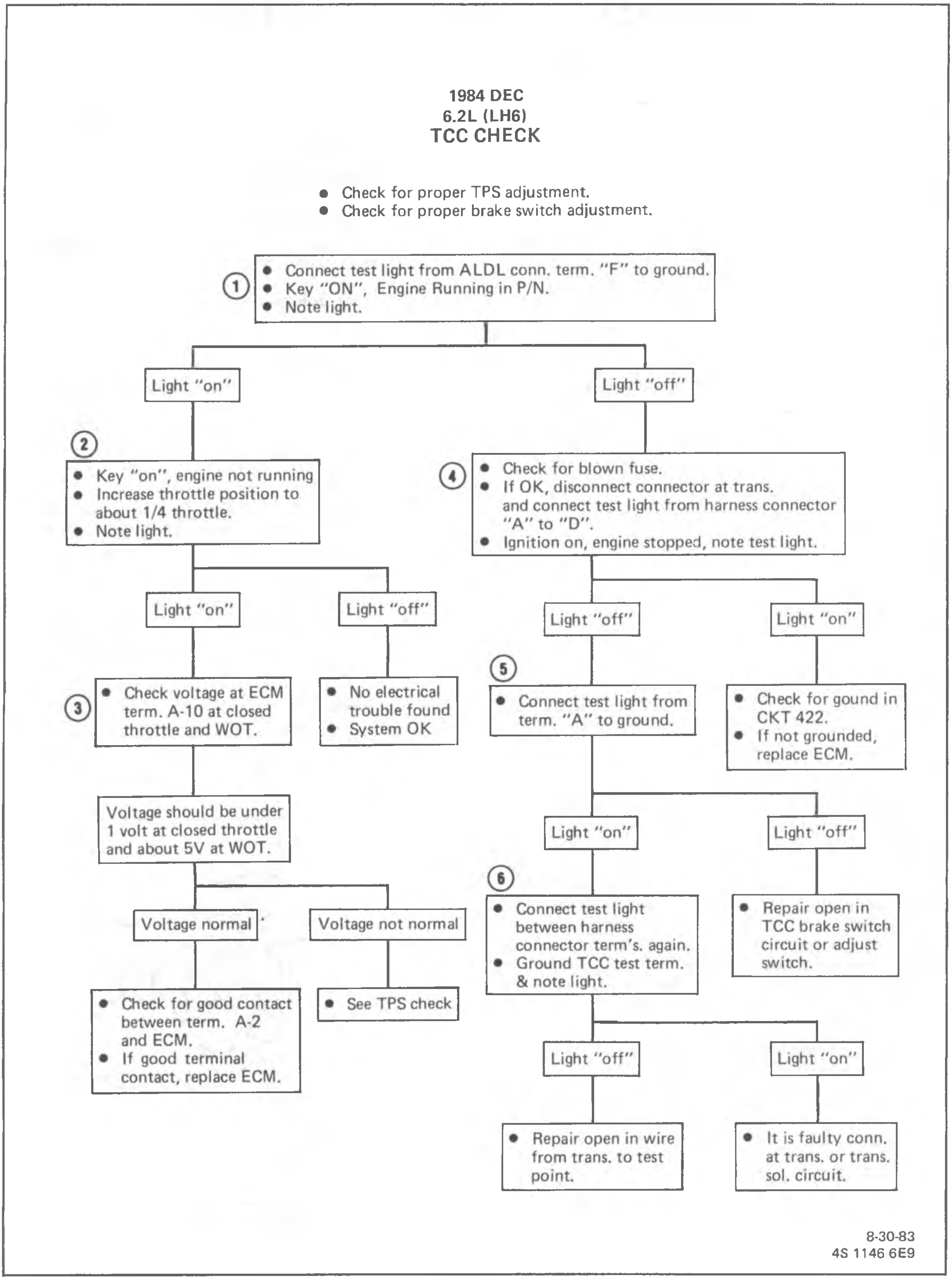


Fig. 6E9-57--TCC Check (2 of 2)

COLD ADVANCE CONTROL CIRCUIT

LH6-CALIFORNIA

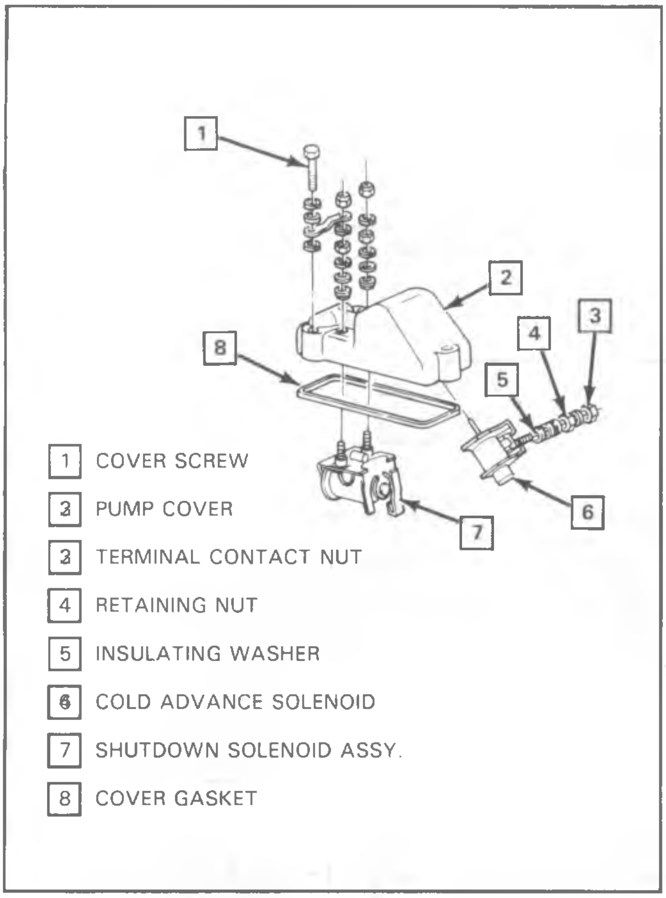


Fig. 6E9-58--Cold Advance Solenoid

GENERAL

The cold advance control circuit is designed to advance the injection timing about 4° during cold operation. This circuit is activated by a temperature switch through a cold advance control relay and to a cold advance solenoid (Fig. 6E9-58). The switch is calibrated to open the circuit above coolant temperature of 95°F (35°C). Below the switching point and with ignition switch "ON", the cold advance solenoid is continuously energized without the engine running. Below the switching point and engine running, a timer in the relay starts to operate and closes the circuit to the cold advance solenoid for 35 seconds (4 seconds). When the cold advance solenoid is energized and the engine is running, the housing pressure is decreased from 69 kPa (10 psi) to zero which advances the timing 4°.

After 35 seconds, the cold advance solenoid is de-energized and the housing pressure is returned to 69 kPa (10 psi).

The temperature switch also energizes the fast idle solenoid (Fig. 6E9-59) below 95°F (35°C). When the coolant temperature is above 95°F (35°C) is the fast idle solenoid is de-energized.

DIAGNOSIS

Refer to Figure 6E9-60 for checking procedures to diagnosis the cold advance control circuit.

ON-VEHICLE SERVICE

Cold Advance Control Relay

Refer to Figure 6E9-33 for location and replacement of the cold advance control relay.

Cold Advance Solenoid

Figure 6E9-58

Remove or Disconnect

1. Pump cover - refer to Section 6C6, Diesel Fuel Injection for removal procedure.
2. Terminal contact nut and retaining nut.
3. Cold advance solenoid.

Install or Connect

1. Cold advance solenoid making certain that the plunger is centered so that it will contact the fitting check ball.
2. Insulating washer, plain washer and lockwasher.
3. Retaining nut - tighten to 1.2 N·m (11 in. lbs.).
4. Terminal contact nut and lockwasher.
5. Check operation of solenoid using 12 volt source.
6. Pump cover, follow procedure in Diesel Fuel Injection Section 6C6.

Fast Idle Solenoid

Refer to the Vehicle Emission Control Information label on the vehicle for specifications and adjustment procedure to set the fast idle speed by adjusting the fast idle solenoid (Fig. 6E9-59).

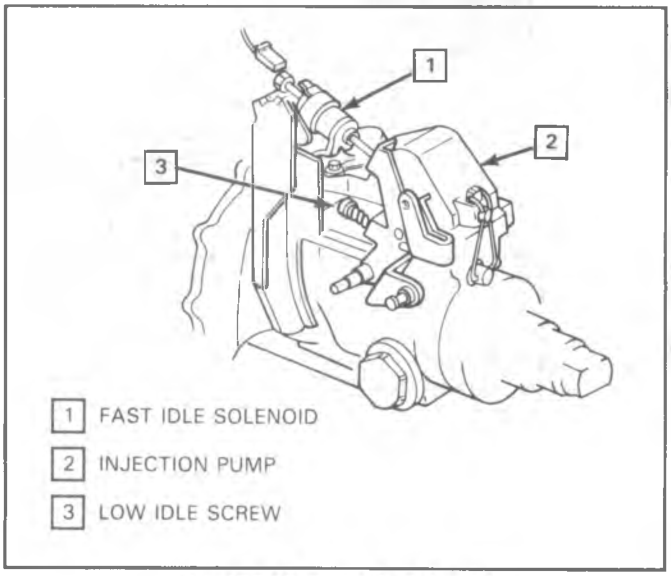


Fig. 6E9-59--Fast Idle Solenoid

1984 DEC

6.2L (LH6) CALIFORNIA ONLY
COLD ADVANCE CONTROL (CAC) CHECK

Check for blown fuse, repair for short if blown.
Engine coolant temperature below 95°F.

- Key "ON", engine not running.
- Connect test light from Cold Advance Solenoid conn. to ground. (leave harness connected to solenoid).
- Note light.

Light "ON"

- Start engine.
- Light should remain "ON" for approx. 35 sec. then go "OFF" with a drop in engine RPM.

Not OK

Light remains "ON" or not "ON" for 35 sec.

- Remove CAC relay conn.
- Connect test light across Terms. "A and G".
- Start engine and note light.

Light "OFF"

- Check for open to ground in CKT 150 or open to generator in CKT 25. (CKT 25 will have system voltage only while generator is operating).

Light "ON"

- It is faulty relay connections or relay.

Light goes "OFF". No drop in RPM.

- It is faulty CAC solenoid.

OK

No trouble found.

Light "OFF"

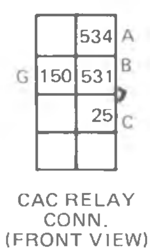
- Remove and jumper Cold Advance Coolant temperature switch connector.
- Note test light at relay Terminal "A".

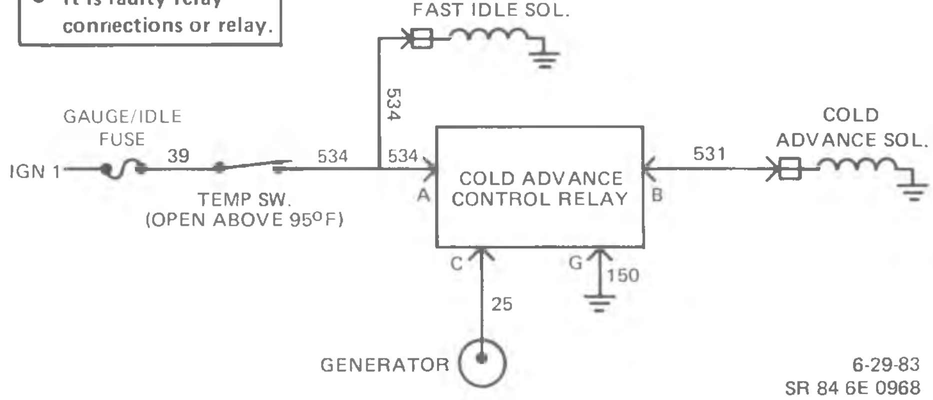
Light "OFF"

- Repair open in CKT 39 to ign. or CKT 534 to CAC relay.

Light "ON"

- It is a faulty temperature switch connection or temperature switch. (Switch should be closed below 95°F).





6-29-83
SR 84 6E 0968

Fig. 6E9-60--Cold Advance Control Check

SECTION 6F

ENGINE EXHAUST SYSTEM

GENERAL DESCRIPTION

The Exhaust System is suspended by hangers attached to the frame members.

Annoying rattles and noise vibrations in the Exhaust System are usually caused by misalignment of parts. When aligning the system, leave all bolts or nuts loose until all parts are properly aligned, then tighten, working from front to rear.

When replacing a muffler, the tailpipe(s) should also be replaced.

Sealer such as **1051249, or equivalent, should be used at all clamped joint connections.**

NOTICE: When jacking or lifting vehicle from frame side rails, be certain lift pads do not contact catalytic converter as damage to converter will result.

CATALYTIC CONVERTER

The catalytic converter is an emission control device added to a gasoline engine light duty emission exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream (Figs. 6F-1 6F-2). The catalyst in the converter is not serviceable.

THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

Periodic maintenance of the exhaust system is not required; however, if the vehicle is raised for other service, it is advisable to check the general condition of the catalytic converter, pipes and muffler(s).

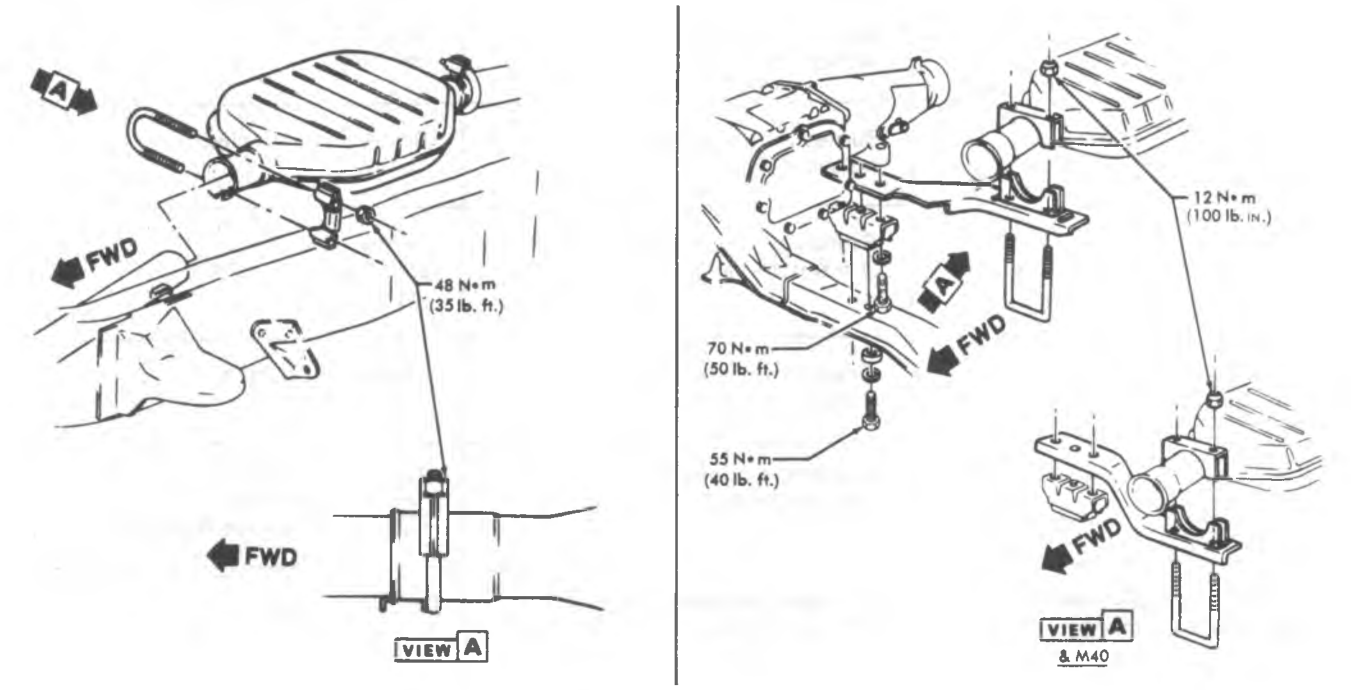


Fig. 6F-1--Catalytic Converter-CK Series

CONDITION	POSSIBLE CAUSE	CORRECTION
Leaking Exhaust Gases	Leaks at pipe joints.	Tighten U-bolt nuts at leaking joints to 30 lb. ft. (40 N·m).
	Damaged or improperly installed seals or packing.	Replace seals or packing as necessary.
	Loose exhaust pipe heat tube extension connections.	Replace seals or packing as required. Tighten stud nuts or bolts to specifications.
	Burned or rusted out exhaust pipe heat tube extensions.	Replace heat tube extensions as required.
Exhaust Noises	Leaks at manifold or pipe connections.	Tighten clamps at leaking connections to specified torque. Replace gasket or packing as required.
	Burned or blown out muffler.	Replace muffler assembly.
	Burned or rusted out exhaust pipe.	Replace exhaust pipe.
	Exhaust pipe leaking at manifold flange.	Tighten attaching bolts nuts to 17 lb. ft. (23 N·m)
	Exhaust manifold cracked or broken.	Replace manifold.
	Leak between manifold and cylinder head.	Tighten manifold to cylinder head stud nuts or bolts to specifications.
Loss of engine power and/or internal rattles in muffler.	Dislodged turning tubes and or baffles in muffler.	Replace muffler.
Loss of engine power.	Imploding (inner wall collapse) of exhaust pipe (except "P" Truck)	Replace exhaust pipe.

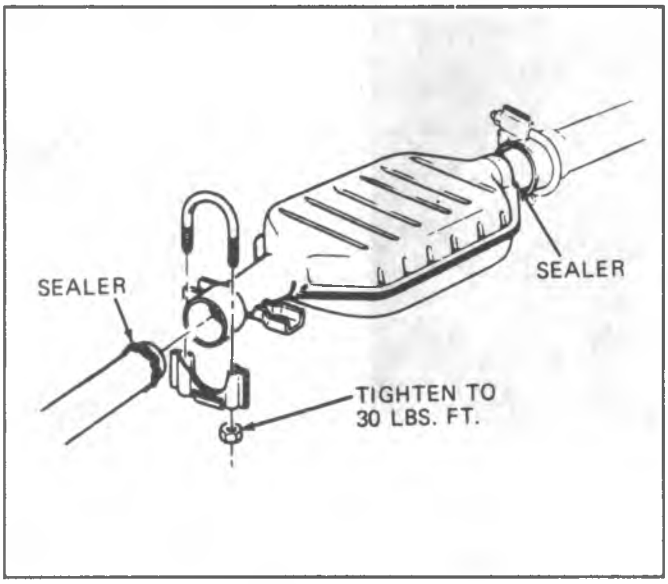


Fig. 6F-2--Catalytic Converter-G Series

ON-VEHICLE SERVICE

BOTTOM COVER

If, for any reason, the bottom cover of a single bed converter is torn or damaged, it can be replaced with a repair kit.

BOTTOM COVER REPLACEMENT

1. Remove bottom cover by cutting close to the bottom outside edge, Fig. 6F-3. Do not remove the fill plug. The depth of the cut must be very shallow to prevent damage to the inner shell of the converter.
2. Remove insulation.
3. Inspect inner shell of the converter for damage. If there is damage in the inner shell, the converter assembly must be replaced.
4. Place new insulation in the replacement cover (Fig. 6F-4). Apply sealing compound, **8998245 or equivalent, all around the cover after the insulation is in position. Apply extra sealer at the front and rear opening for the pipes (Fig. 6F-5).**
5. Install replacement cover on converter (Fig. 6F-6).
6. Install cover retaining channels on both sides of the converter (Fig. 6F-7).
7. Attach 2 clamps over retaining channels at each end of the converter (Fig. 6F-8).

Fig. 6F-3--Removing Bottom Cover

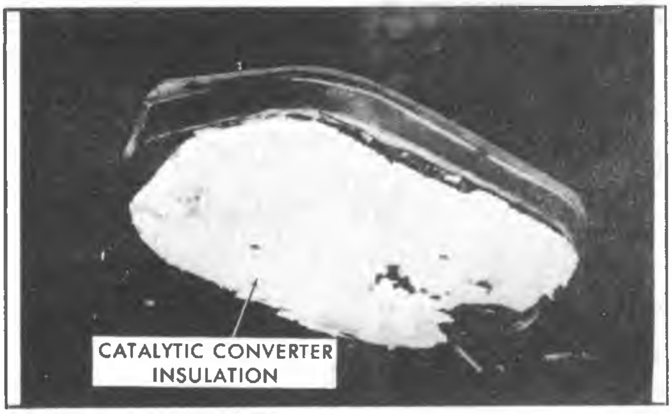


Fig. 6F-4--Catalytic Converter Insulation

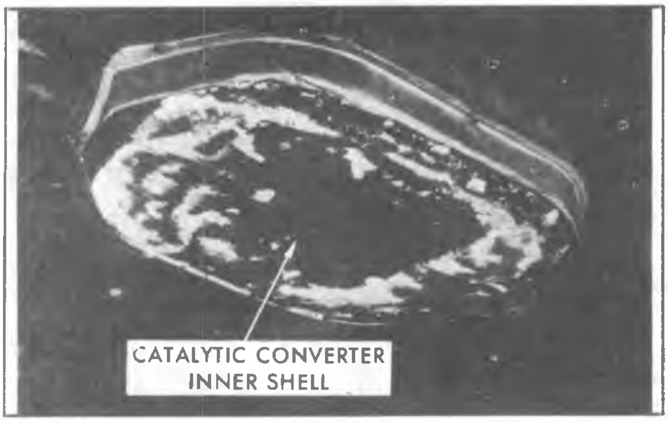


Fig. 6F-5--Catalytic Converter Inner Shell

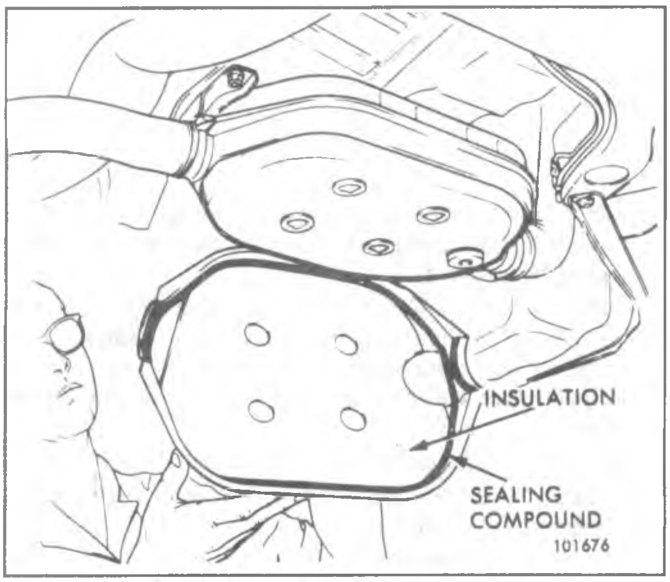


Fig. 6F-6--Installing Bottom Cover Replacement

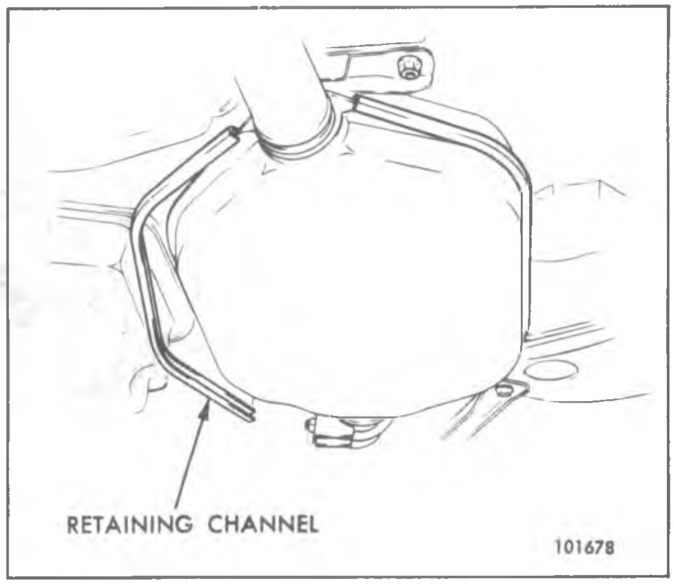


Fig. 6F-7--Installing Bottom Cover Retaining Channels

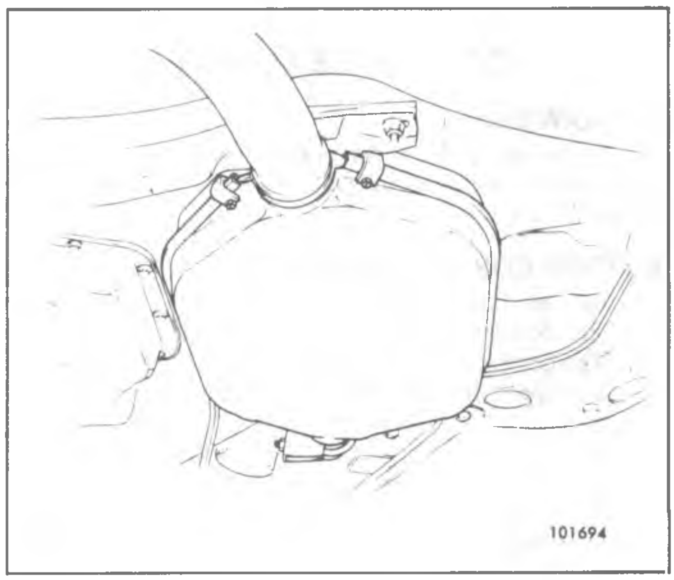


Fig. 6F-8--Installing Bottom Cover Clamps

SECTION 6H
VACUUM PUMPS

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Belt Driven 6H-4

GENERAL DESCRIPTION

The vacuum pump is designed to aid the engine in maintaining a proper vacuum level for accessories. This is accomplished by using either an electric or a mechanical vacuum pump.

GEAR DRIVE VACUUM PUMP

The gear driven vacuum pump is a diaphragm pump which requires no periodic maintenance. It is driven by a cam inside the drive assembly to which it mounts. The drive housing assembly has a drive gear on the lower end which meshes with the camshaft gear in the engine. This drive gear causes the cam in the drive ousing to rotate. The drive gear also powers the engine oil lubricating pump.

BELT DRIVEN VACUUM PUMP (Figure 6H-2)

The belt driven vacuum pump is a diaphram pump which requires a belt adjustment at regular intervals. It is driven by the alternator belt.

UNIT REPAIR

GEAR DRIVEN VACUUM PUMP (Figure 6H-1)

Removal

1. Remove vacuum hose from vacuum pump inlet.
2. Remove bolt and clamp holding drive assembly to engine block.
3. Carefully lift the pump and drive assembly out of engine block.
4. Cover hole in engine block with a cloth to prevent foreign material falling into the engine block.

Installation

1. Remove protective cloth from engine.
2. Insert pump and drive assembly in engine, making sure that the gears on the drive assembly mesh with the gears on the engine camshaft.
3. Rotate the pump into position so the bracket and bolt can be installed.
4. Install clamp and bolt.
5. Install vacuum hose to pump.

BELT DRIVEN VACUUM PUMP (Figure 6H-2)

Removal

1. Disconnect battery.
2. Drain engine coolant.
3. Remove windshield washer reservoir.
4. Remove coolant reservoir and hose.
5. Loosen alternator belt.
6. Remove attaching bolts.
7. Raise vehicle.
8. Remove lower radiator hose.
9. Disconnect vacuum hose.
10. Remove lower pump bolt and vacuum pump.

For installation, reverse removal procedure.

VACUUM PUMP DIAGNOSIS

EXCESSIVE BRAKE PEDAL EFFORT, BRAKE WARNING LIGHT ON (BRAKES WITH VACUUM ASSIST).

BLOCK WHEELS, APPLY PARKING BRAKE AND PLACE TRANSMISSION SELECTOR LEVER IN "PARK" OR "NEUTRAL" BEFORE STARTING ENGINE.

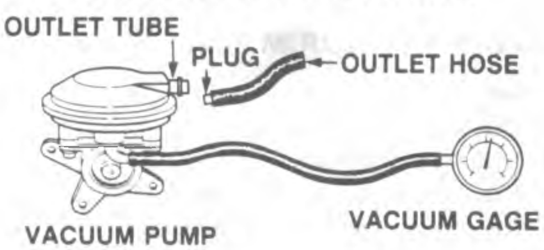
STEP 1

SEE "VACUUM PUMP DIAGNOSIS" ILLUSTRATION BELOW.

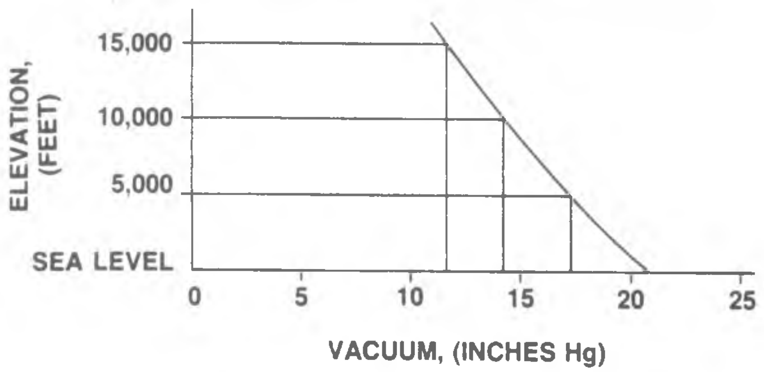
CONNECT VACUUM GAGE TO VACUUM PUMP INLET. WHERE APPLICABLE, DISCONNECT OUTLET HOSE FROM OUTLET TUBE ON PUMP AND PLUG END OF HOSE. DO NOT PLUG VACUUM PUMP OUTLET TUBE. WITH ENGINE IDLING, VACUUM SHOULD REACH 70 kPa (21" Hg) MINIMUM AT SEA LEVEL WITHIN 30 SECONDS (SEE GRAPH FOR VACUUM AT OTHER ELEVATIONS).

- CHECKS OKAY. LEAK IN SYSTEM OTHER THAN VACUUM PUMP
  - GO TO STEP 2
- LOW VACUUM OR FLUCTUATING GAGE READING
  - 1. CHECK GAGE AND CONNECTIONS FOR LEAKS.
    2. IF BELT DRIVEN, CHECK BELT TENSION AND PULLEY FIT TO SHAFT.
    3. CHECK IDLE RPM.
  - RECHECK VACUUM GAGE
    - VACUUM O.K.
      - GO TO STEP 2
    - LOW VACUUM REPLACE PUMP
      - GO TO STEP 1

VACUUM PUMP DIAGNOSIS



VACUUM PUMP, NO-LEAK VACUUM MINIMUM ACCEPTABLE vs. ALTITUDE



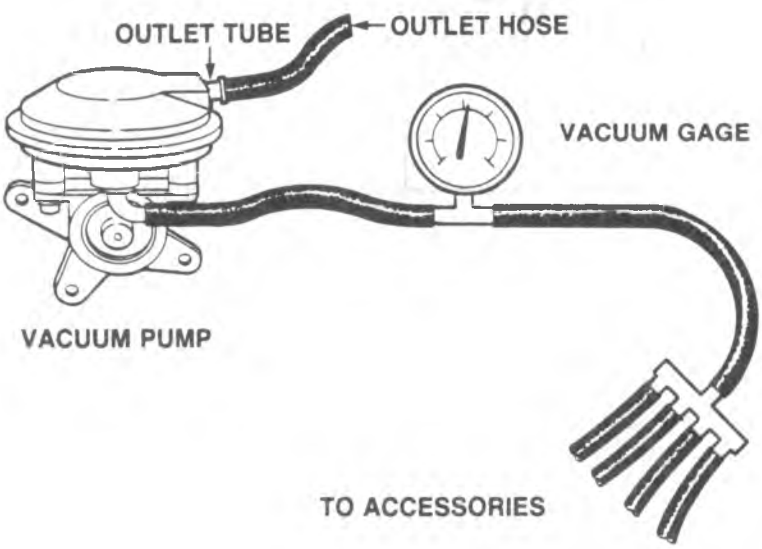
STEP 2

SEE "VEHICLE VACUUM SYSTEM DIAGNOSIS" ILLUSTRATION BELOW.

WHERE APPLICABLE, REMOVE PLUG FROM OUTLET HOSE AND RECONNECT HOSE TO PUMP OUTLET TUBE. RECONNECT VACUUM HOSE WITH A "TEE" AND VACUUM GAGE LOCATED NEAR PUMP INLET. WITH ENGINE IDLING, VACUUM MAY BE 10 kPa (3" Hg) LESS THAN MEASURED IN STEP 1 AFTER ONE MINUTE.

- CHECKS OKAY. ANY REMAINING PROBLEMS ARE NOT WITH VACUUM SYSTEM.
- LOW VACUUM – UNACCEPTABLE.
  - CHECK ALL ATTACHING HOSES FOR LEAKS – REPAIR AS REQUIRED.
  - IF STILL LOW VACUUM, CHECK ALL VACUUM ACCESSORIES FOR OUT OF SPECIFICATION LEAKS. REPAIR OR REPLACE AS REQUIRED.

VEHICLE VACUUM SYSTEM DIAGNOSIS



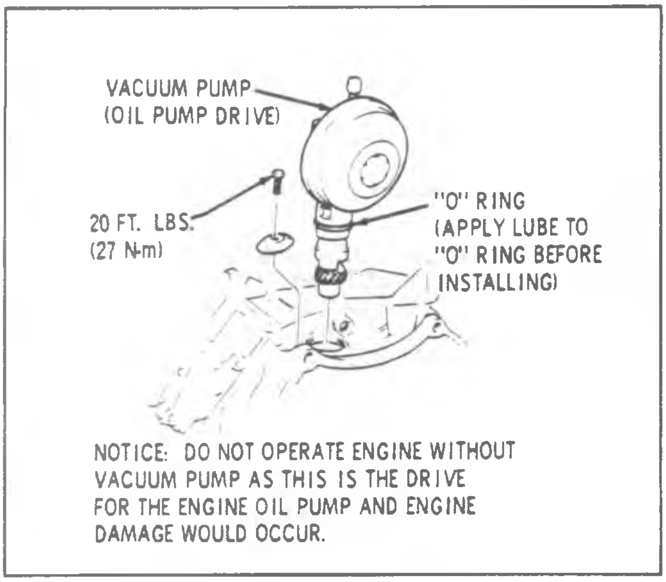


Fig. 6H-1--Gear Driven Vacuum Pump

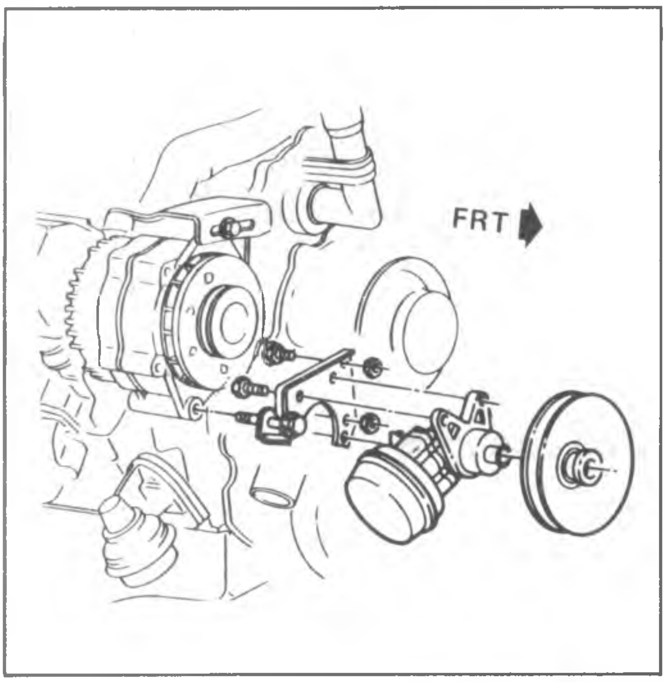


Fig. 6H-2--Belt Driven Vacuum Pump

SECTION 7A

AUTOMATIC TRANSMISSION

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GENERAL DESCRIPTION

The service procedures contained in this section are common to the automatic transmission sections contained in this manual. Refer to the proper automatic transmission section for specific service procedures.

DIAGNOSIS

Before diagnosis of any transmission complaint is attempted, there must be understanding of oil checking procedure and what appearance the oil should have. Many times a transmission malfunction can be traced to low oil level or improper reading of dipstick. Due to the transmission fluid that is now being used it may appear to be darker and have a stronger odor. This is normal, and not a positive sign of required maintenance or transmission failure.

Also when the dipstick is removed, it should be noted whether the oil is devoid of air bubbles or not. Oil with air bubbles gives an indication of an air leak in the suction lines, which can cause erratic operation and slippage. Water in the oil imparts a milky, pink cast to the oil and can cause spewing. Water in the oil can also cause swelling of nylon parts.

Preliminary Checking Procedure

1. Check and correct oil level (see fluid level and capacity).
2. Road test vehicle to verify transmission problem using all selective ranges, noting discrepancies in operation.
3. If engine performance indicates an engine tune-up is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in transmission problems.
4. Check T.V./detent cable adjustment.
5. Check and correct vacuum lines and fittings.
6. Check and correct manual linkage.
7. Install oil pressure gage and compare with pressure readings in the appropriate transmission section.
8. Isolate the unit or circuit involved in the malfunction.

	MODEL			
Application	125 125C	200 200C	200-4R	400
Oil Pan Side Cover	X X	X	X	X

Fig. 7A-1 -- R.T.V. Usage Chart

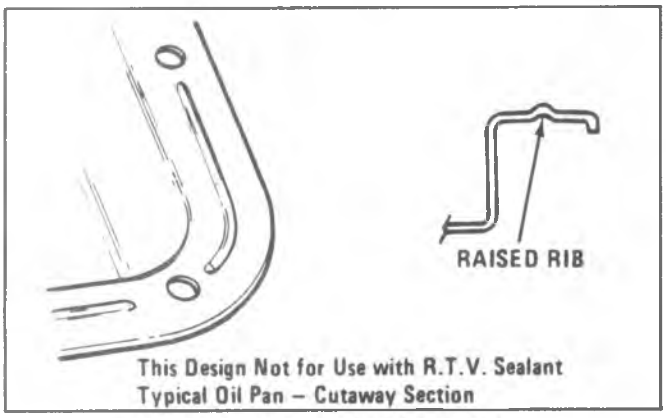


Fig. 7A-2 -- Raised Rib Oil Pan Design

R.T.V. Silicone Sealant

Various transmission models may be built with R.T.V. (room temperature vulcanizing) Silicone Sealant in place of some gaskets - i.e., oil pan and side cover. Refer to specific transmission model section for removal procedure if R.T.V. Sealant has been used as a gasket on any part.

Sealant Application

1. R.T.V. Sealant is an effective gasket substitute for the following applications, depending on pan design. Refer to Fig. 7A-1.

   If R.T.V. is used on an oil pan or side cover, the flange surface must be either flat or have depressed stiffening ribs. Do not use R.T.V. on pans which have raised stiffening ribs. Refer to Fig. 7A-2.
2. Before applying R.T.V. Sealant, the mating surfaces of both parts must be cleaned with solvent and air dried.
3. Apply a (1/16 in.) bead of R.T.V. Sealant to the part flange and assemble wet. The bead of R.T.V. should be applied around the inside of the bolt holes. If the part has depressed stiffening ribs, the bead of R.T.V. must be installed on the high portion of the surface, not in the groove. Refer to Fig. 7A-3.

MAINTENANCE SCHEDULE

The fluid level should be checked at each oil change (see below). When adding or changing fluid, use DEXRON®-II or equivalent automatic transmission fluid. Under normal driving conditions, change transmission fluid every 100,000 miles (160 000 km).

Fluid Drain Intervals

The transmission operating temperature resulting from the type of driving conditions under which the vehicle is used, is the main consideration in establishing the proper frequency of transmission fluid changes.

Change the transmission fluid and filter every 15,000 miles (24 000 km) if the vehicle is usually driven under one or more of the following conditions which are considered severe transmission service.

1. In heavy city traffic. Where the outside temperature regularly reaches 90°F (32°C).
2. In very hilly or mountainous areas.
3. Frequent trailer pulling.

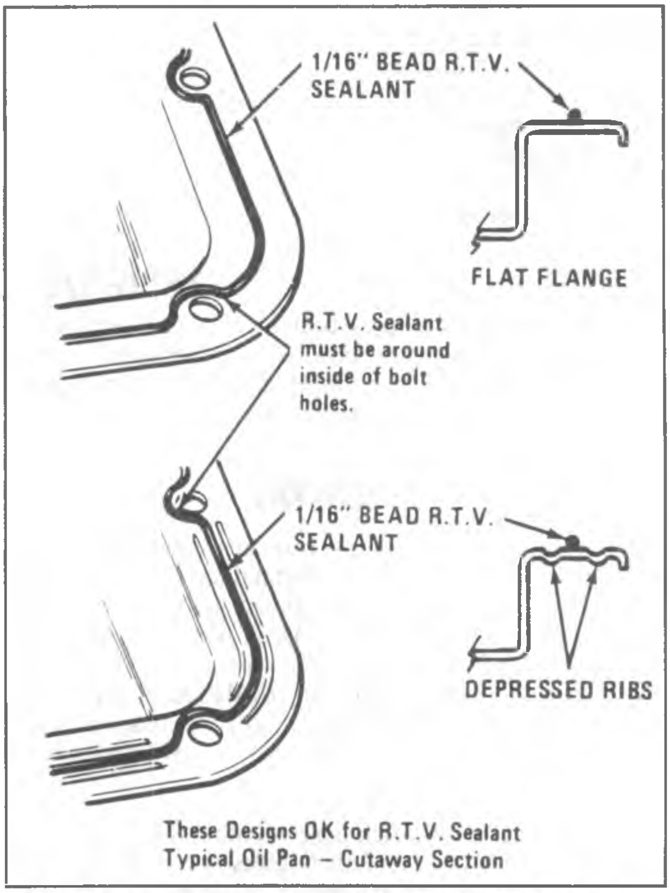


Fig. 7A-3 -- Depressed Ribs and Flat Flange Oil Pan Design

AUTOMATIC 350C TRANSMISSION	
Pan Removal	6.3 pts. (3.3 liters)
Overhaul	20.0 pts. (9.5 liters)
AUTOMATIC 400 TRANSMISSION	
Pan Removal	9.0 pts. (4.0 liters)
Overhaul	22.0 pts. (10.0 liters)
AUTOMATIC 700-4R TRANSMISSION	
Pan Removal	10.0 pts. (4.7 liters)
Overhaul	23.0 pts. (10.9 liters)

Fig. 7A-4--Transmission Fluid Capacity

4. Commercial use, such as taxi, police car, or delivery service.

   If the vehicle is not used under any of these conditions, change the fluid and filter every 100,000 miles (160 000 km).

Fluid Level and Capacity

To bring fluid level from ADD mark to FULL mark requires one pint (.5 liters) of fluid. Fluid level should be checked at every engine oil change.

Fluid level should be to FULL Mark with transmission fluid at normal operating temperature 200°F (93°C). With fluid at room temperature, 70°F (21°C) level will be between the two dimples on the dipstick. The normal operating temperature is obtained only after at least 15 miles (24 km) of highway type driving.

Checking and Adding Fluid (Transmission at Operating Temperature)

The automatic transmission is designed to operate at the "FULL HOT" mark on the dipstick at normal operating temperatures of 190° - 200°F (88°C - 93°C) and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway type driving.

To determine proper level, proceed as follows:

1. Park vehicle on level surface and apply parking brake and block vehicle wheels.
2. With the selector lever in the PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
3. Immediately check fluid with the selector lever in PARK, engine running at SLOW IDLE and the car on a LEVEL surface. The fluid level on the dipstick should be at the "FULL HOT" mark. Recheck fluid 1 to 3 minutes after adding fluid, engine running.
4. If additional fluid is required, add sufficient fluid to bring to the "FULL HOT" mark on the dipstick.

Checking and Adding Fluid (Transmission at Room Temperature 65° to 85°F, 18° to 29°C)

Automatic transmission are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases. A level change of over 19.05mm (3/4") will occur as fluid temperature rises from 60° to 180°F (16° to 82°C) (Figure 7A-5).

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the vehicle is on a hill.

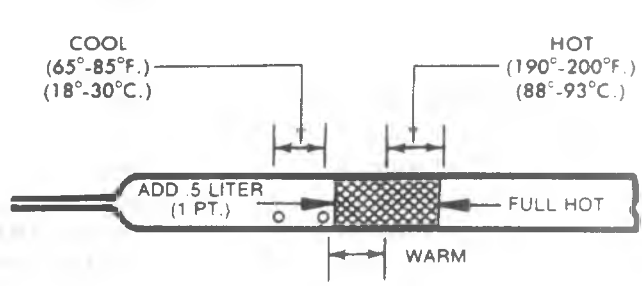
Check the transmission fluid level with the engine running, the shift lever in park, and the vehicle level.

If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down, usually about 30 minutes after the vehicle has been parked.

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.

Wipe it clean and re-insert until cap seats. Remove dipstick and note reading.

1. If the fluid feels cool, about room temperature, (65° to 85°F or 18° to 29°C), the level should be between the two dimples below the "add" mark.
2. If it feels warm, the level should be close to the "ADD" mark (either above or below).
3. If it feels hot (cannot be held comfortably), the level should be between the "ADD" and "FULL" marks.



NOTE: DO NOT OVERFILL. IT TAKES ONLY ONE PINT TO RAISE LEVEL FROM "ADD" TO "FULL" WITH A HOT TRANSMISSION.

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Fig. 7A-5 -- Transmission Dipstick

Changing Fluid

1. Raise vehicle.
2. With drain pan placed under transmission oil pan, remove oil pan attaching bolts from front and side of pan.
3. Loosen rear pan attaching bolts approximately four (4) turns.
4. Carefully pry transmission oil pan loose with screwdriver, allowing fluid to drain.
5. Remove remaining bolts and remove oil pan and gasket.
6. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.
7. If required, remove screen/filter-to-valve body bolts. Remove screen/filter and gasket.
8. Thoroughy clean screen assembly in solvent and dry thoroughly with clean compressed air. Paper or felt type filters should be replaced.
9. Install as required, a new gasket or "O" ring onto the screen/filter assembly. Lubricate "O" rings with petrolatum. If required, install screen/filter attaching bolts and torque bolts as specified in each transmission section.
10. Install new gasket on oil pan and install oil pan. Torque attaching bolts as specified in each transmission section.
11. Lower vehicle and add the proper amount of DEXRON®-II automatic transmission fluid or its equivalent through filler tube (Figure 7A-4).
12. With selector lever in PARK position, apply parking brake, start engine and let idle (carburetor off fast idle step.) DO NOT RACE ENGINE.
13. Move selector lever through each range and, with selector lever in PARK range, check fluid level.
14. Add additional fluid to bring level between the dimples on the dipstick (cool level).

Adding Fluid To Fill Dry Transmission and Converter

In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add the proper amount of transmission fluid through filler tube. See Figure 7A-4 for proper amount.
2. With manual control lever in park (P) position, depress accelerator to place carburetor on fast idle cam. DO NOT RACE ENGINE. Move manual control lever through each range.
3. Check fluid level with selector lever in park (P), engine running at idle (1-3 minutes) and vehicle on LEVEL surface and add additional fluid to bring level to a point between the two dimples on the dipstick. Do not overfill.

Manual Linkage

Manual linkage should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage within the rear/reaction internal gear lugs or output ring gear lugs. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

If the linkage is not adjusted properly, an internal leak could occur at the manual valve which could cause a clutch and/or band failure.

CAUTION: With the selector lever in the "Park" position, the parking pawl should freely engage within the rear/reaction internal gear lugs or output ring gear lugs and prevent the vehicle from rolling, which could cause personal injury.

Checking Transmission Mount

Raise vehicle. Push up and pull down on transmission tailshaft while observing transmission mount. If rubber separates from metal plate of mount or if tailshaft moves up but not down (mount bottomed out) replace mount. If there is relative movement between a metal plate of mount and its attaching point, tighten screws or nuts attaching mount to transmission or crossmember.

T.V. Cable System

The T.V. Cable used with the Automatic 700-4R transmission should not be thought of as an automatic downshift cable. The T.V. cable used on the Automatic 700-R4 controls line pressure, shift points, shift feel, part throttle downshifts and detent downshifts. The function of the cable is similar to the combined functions of the vacuum modulator and the downshift (detent) cable used on 350C transmission.

The T.V. cable operates the throttle lever and bracket assembly (Figures 7A-6 and 7A-7).

The Throttle Lever and Bracket Assembly serves two (2) basic functions:

1. Th primary function of this assembly is to transfer the carburetor throttle plate movement to the T.V. plunge in the control valve assembly as related by the T.V. cable and linkage (Figure 7A-6). This causes T.V. pressure and line pressure to increase according to engine throttle opening and also controls part throttle and detent downshifts. The proper adjustment of the T.V. cable is based on the T.V. plunger being fully depressed to flush with the T.V. bushing at engine wide open throttle.
2. The second function of the assembly involves the T.V. exhaust valve lifter rod, spring and the T.V. exhaust ball. The function of this system is to prevent the transmission from operating at low (idle position) pressures, if the T.V. cable should become broken or disconnected. If the cable is not connected or broken, the T.V. lifter rod will not move from its normal, spring loaded, up position which holds the T.V. exhaust check ball off its seat. The T.V. lifter rod will drop down to allow the T.V. exhaust ball to seat only if the cable is broken, disconnected or extremely out of adjustment. With the transmission pan removed, it should be possible to pull down on the T.V. exhaust valve lifter rod and the springs should return the rod to its normal up position. If the throttle lever and bracket assembly or lifter rod binds or sticks so that the T.V. lifter rod cannot lift the exhaust ball off its seat, high line pressures and delayed upshifts will result. The normal shape of the T.V. lifter rod is shown in Figure 7A-9. The right angle leg must not be bent to any other angle or it will not function properly.

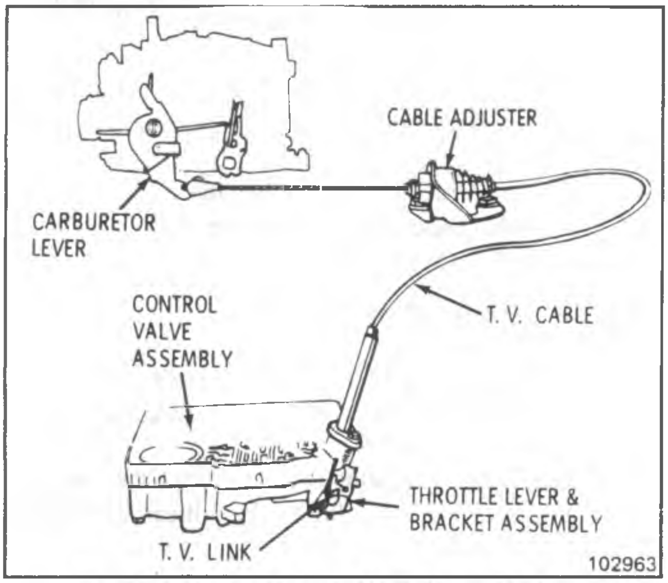


Fig. 7A-6--Throttle Valve (T.V.) Cable and Linkage

Diagnosis Procedure

If the T.V. cable is broken, sticky, misadjusted or incorrect part for the model, the vehicle may exhibit various malfunctions.

Sticking or binding T.V. linkage can result in delayed or full throttle shifts. The T.V. cable must be free to travel to the full throttle position and return to the closed throttle position without binding or sticking.

Some binding or sticking of the T.V. cable and associated parts may only occur with the engine running and will not be noted or obtained with the engine off.

Inspection of the T.V. linkage for sticking or binding should be made with engine running at idle speed, with the transmission selector in Neutral and the parking brakes set. Pull the T.V. cable full travel through the cable terminal and then release the cable; it should return to the closed throttle position against the cable terminal (Figure 7A-10). If the T.V. cable sticks, and remains ahead of the cable terminal (Figure 7A-11), it may be caused by one or more of the following:

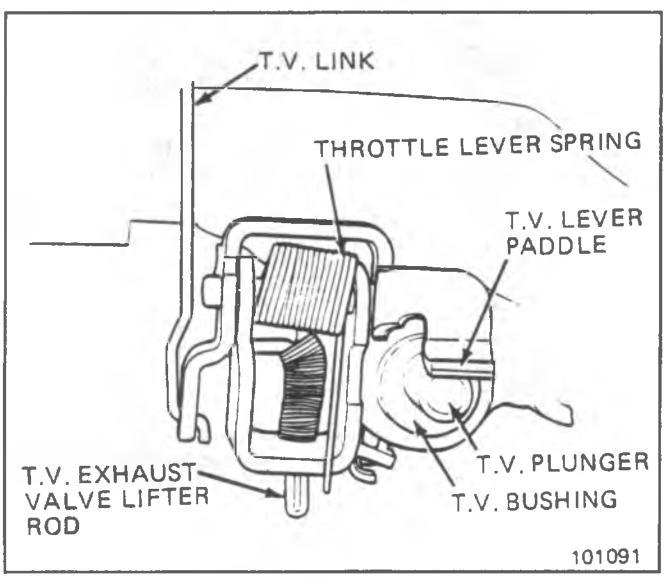


Fig. 7A-7--Throttle Lever and Bracket Assembly

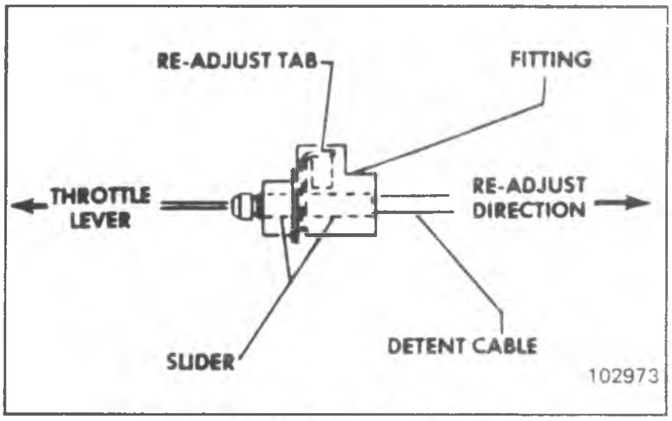


Fig. 7A-8--T.V. Cable (Self Adjusting)

1. Sharp bends or a damaged T.V. cable housing. Correct by rerouting the cable or replace it if required.
2. Sharp end or burr on the T.V. link, dragging in the T.V. cable housing. Correct by making end smooth, using a file or stone. DO NOT SHORTEN LINK.
3. Bent T.V. link. Correct by straightening or replace as required.
4. Misalignment of the throttle lever and bracket assembly on the coiled pin in the control valve assembly (Figure 7A-12).
5. Damaged or binding throttle lever and bracket assembly. Correct by straightening or replace as required.
6. Throttle lever spring unhooked or damaged. Correct by assembling the spring properly or replace the throttle lever and bracket assembly as required.

If the T.V. cable is adjusted too long, it may result in one of the two following conditions:

a. Early and slipping shifts and/or no detent downshifts.

b. Delayed or full throttle shifts by causing the transmission to operate in the high pressure mode. The transmission senses a malfunction of the T.V. cable and associated parts; and to prevent burning the clutches and band due to low line pressures, it will go into the high pressure mode. Line pressures checked under the minimum T.V. conditions in Neutral and Drive will be in the range of the "full" T.V. pressures if the transmission is in high pressure mode. The complaint could be

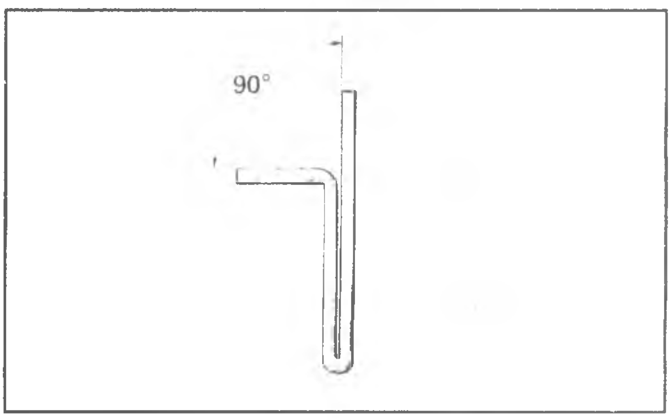


Fig. 7A-9--Throttle Valve Lifter Rod

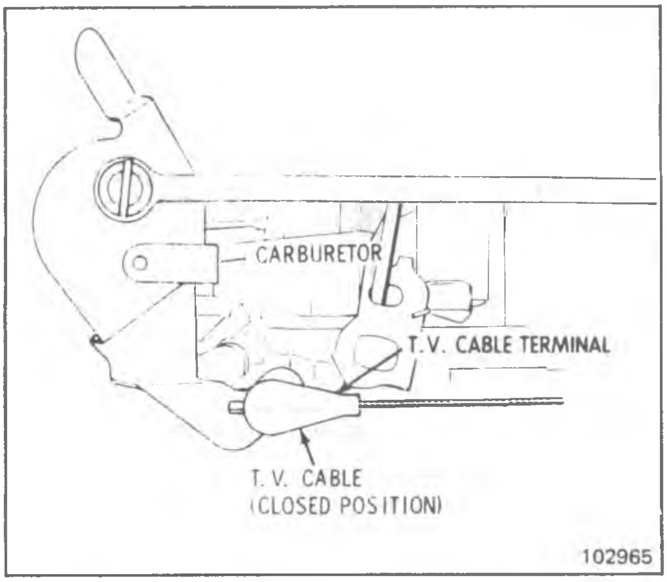


Fig. 7A-10--T.V. Cable at Carburetor Lever (Typical)

described as no upshifts, delayed or sharp upshifts.

Downshift (Detent) Cable System for 350C Transmissions

The detent valve is activated by the downshift (detent) cable which is connected to the carburetor linkage. When the throttle is half open, the detent valve is actuated, causing a part throttle downshift at speeds below 50 mph (80 km/h). When the throttle is fully opened, the detent valve is actuated causing the transmission to downshift. The 3-1 detent downshift may be obtained when vehicle speed is approximately 6 to 12 mph (9 to 19 km/h) below the maximum throttle 1-2 upshift point. The 3-2 detent downshift may be obtained when vehicle speed is approximately 4 to 8 mph (6 to 13 km/h) below the maximum throttle 2-3 upshift point.

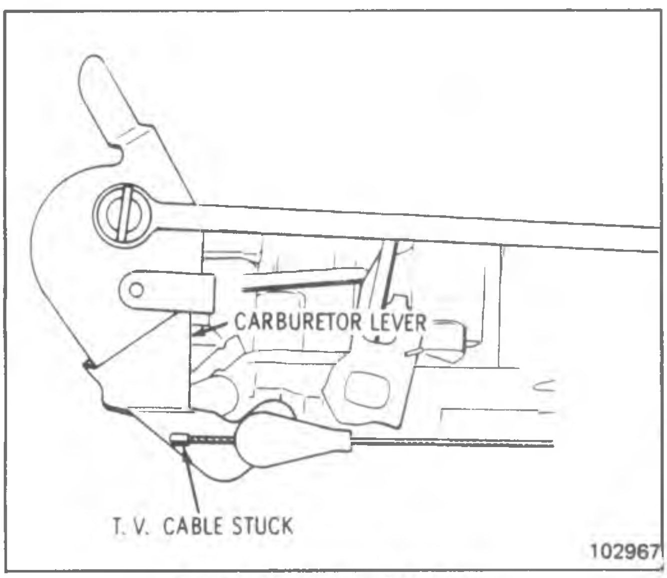


Fig. 7A-11--Sticking T.V. Cable

Adjustment Procedure fot T.V. and Detent Cable

Preliminary Checks

1. Check transmission oil level and correct as required.
2. Be sure engine is operating properly and brakes are not dragging.
3. Check for correct cable, according to the parts catalog.
4. Check tghat the cable is connected at both ends.
5. Adjust the cable as follows:

Adjusting Cable (Diesel Engine Only)

1. Stop Engine.
2. Remove cruise control rod (if so equipped).
3. Disconnect transmission T.V. or detent cable terminal from throttle assembly.
4. Loosen lock nut on pump rod and shorten several turns.
5. Rotate the lever assembly to the full throttle position and hold.
6. Lengthen pump rod until the injection pump lever contacts the full throttle stop.
7. Release tghe lever assembly and tighten pump rod lock nut.
8. Remove the pump rod from the lever assembly.
9. Reconnect the transmission T.V. or detent cable terminal to throttle assembly.
10. Depress and hold the metal re-adjust tab on the cable upper end. Move the slider through the fitting in the direction away from the lever assembly until the slider stops against the fitting.
11. Release the tab, rotate ghe lever assembly to the full throttle stop and release the lever assembly.
12. Reconnect the pump rod (and cruise control throttle rod if so equipped).
13. If equipped with cruise control, adjust the servo throttle rod to minimum slack (engine off) then put clip in first free hole closet to the bellcrank, but

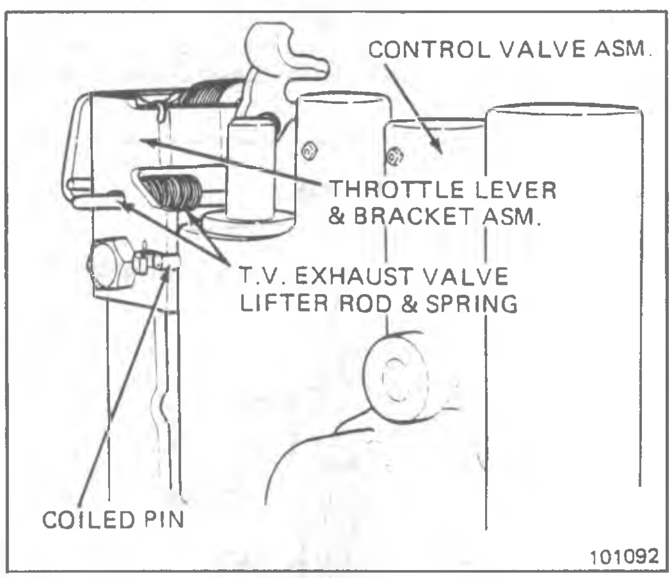


Fig. 7A-12--Alignment of Throttle Lever and Bracket Assembly

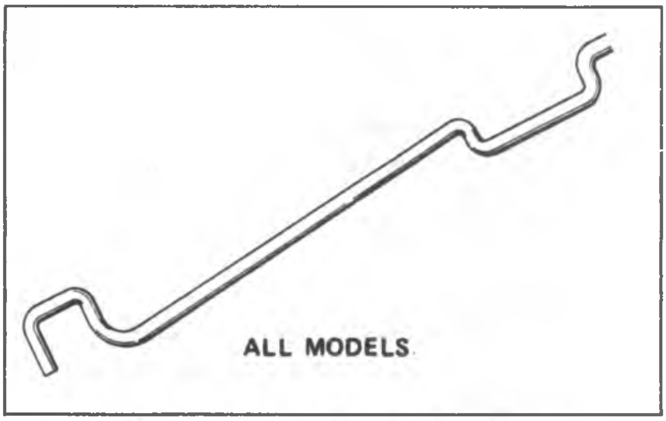


Fig. 7A-13--Throttle Lever to Cable Link

within the servo bail.

Adjusting Self-Adjusting Type Cable (Gas Engine)

1. Stop engine.
2. Depress re-adjust tab. Move slider back through fitting in direction away from throttle body until slider stops against fitting.
3. Release re-adjust tab.
4. Open carburetor lever to "full throttle stop" position to automatically adjust cable. Release carburetor lever.
5. Check cable for sticking and binding.

   Road test vehicle - if OK, return to owner. If delayed or only full throttle shifts still occur, proceed with the following:

   Remove the oil pan and inspect the throttle lever and bracket assembly (See Figure 7A-12). Check that the T.V. exhaust valve lifter rod is not distorted and not binding in the control valve assembly or spacer plate. The T.V. exhaust check ball must move up and down as the lifter does. Also, be sure lifter spring holds the lifter rod up against the bottom of the control valve assembly. Make sure T.V. plunger is not stuck. Inspect transmission for correct throttle lever to cable link (See Figure 7A-13).

   If the T.V. cable is adjusted too short or not adjusted at all, it will result in raising the line pressure and shift points. It may also limit the carburetor opening to prevent full throttle operation.

DETENT DOWNSHIFT SWITCH (Fig. 7A-14)

Adjustment (400)

1. Preset switch by pressing the plunger as far forward as possible.
2. Press accelerator pedal down to a wide open throttle position and the switch will self adjust.

Vacuum Modulator System

A vacuum modulator is used to automatically sense any change in torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

Vacuum Modulator Diagnosis

A failed vacuum modulator can cause one or more of the following complaints.

1. Harsh upshifts and downshifts.
2. Delayed upshifts.
3. Soft upshifts and downshifts.
4. Slips in low, drive and reverse.
5. Transmission overheating.
6. Engine burning transmission oil.

   If any one of the above complaints are encountered, the modulator must be checked.

Vacuum Diaphragm Check

Turn modulator so vacuum line stem points downward. If transmission oil comes out, the vacuum diaphragm is bad.

Gasoline and/or water vapor may settle in the vacuum side of the modulator. If this is found in a vehicle which may be exposed to 10°F (-12°C) temperatures or below, the modulator must be changed.

Check solution that comes out of the modulator for evidence of lubricity. If the solution does not have the feel of oiliness, it can be assumed the solution is a mixture of gas and/or water. The only way transmission oil can be on the vacuum side of the modulator is by a leak in the vacuum diaphragm.

If oil is found, the modulator must be replaced. If oil is not found in the vacuum side of the modulator, but the transmission oil level is continually low, and no external leaks are found, there is a possibility that a pin hole leak exists in the diaphragm and the modulator should be replaced.

Atmospheric Leak Check

1. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam.
2. Using a short piece of rubber hose, apply air

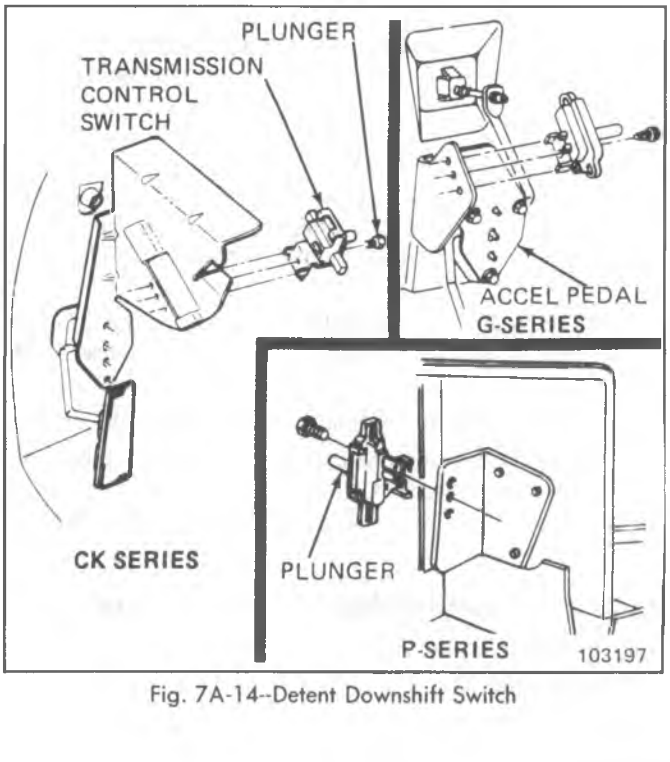


Fig. 7A-14--Detent Downshift Switch

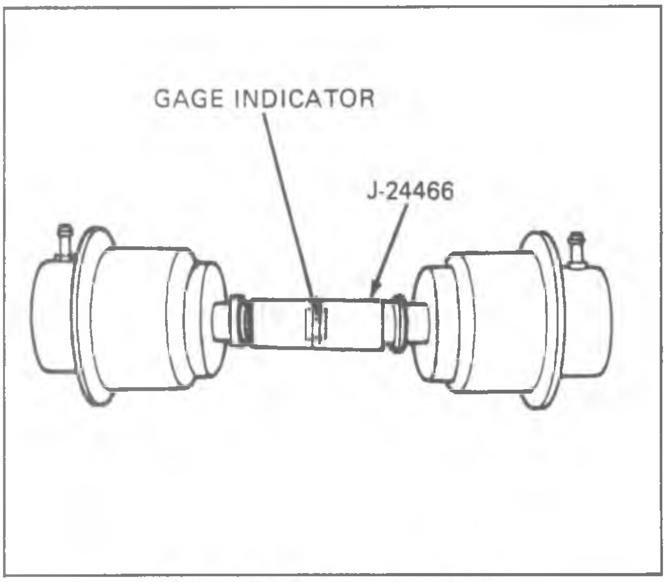


Fig. 7A-15--Checking Modulator

pressure to the vacuum pipe by blowing into the tube and looking for bubbles. If bubbles appear, replace the modulator. Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

Load Check

This check is made using an available tool, J-24466. The gage compares the load of a known good modulator with a modulator being checked.

1. Install the modulator that is known to be acceptable on either end of the gage.
2. Install the modulator in question on the opposite end of the gage (Figure 7A-15).
3. Holding the modulators in a horizontal position, bring them slowly together under pressure. If the modulator in question is bad, the gage line will remain blue. If the modulator is good, the gage line will be white. When making the comparison, make sure that both modulators are of the same type. The part numbers are stamped on the dome of the modulator.

Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

If the modulator passes the above checks, the following items should also be checked as a possible cause of the problem.

1. Check freeness of modulator valve in transmission case.
2. Check the vacuum line from the manifold to modulator for holes, cracks or dents. Check the rubber hose connection at the modulator and at the intake manifold for leaks.

Causes of Improper Vacuum At Modulator

1. Engine.
   a. Tune up.
   b. Loose vacuum fittings or improperly routed hoses/ lines.
   c. Vacuum operated accessory leak (hoses, vacuum valve, etc.).
   d. Engine exhaust system restricted.
   e. Diesel - Vacuum Regulator Valve adjustment (See Section 6C6).
2. Vacuum line to modulator.
   a. Leak.
   b. Loose fitting.
   c. Restricted orifice or incorrect orifice size.
   d. Carbon build up at modulator vacuum fitting.
   e. Pinched line.
   f. Grease in pipe (delayed or no upshift-cold).

GENERAL DESCRIPTION

Torque Converter

The torque converter is filled with oil and is attached to the engine crankshaft by a flex plate and always rotates at engine speed.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required.

The 3-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly.

Torque Converter Clutch

The Torque Converter Clutch Assembly consists of a 3-element torque converter with the addition of a converter clutch. The converter clutch is splined to the turbine assembly, and when operated, applies against the converter cover providing a mechanical direct drive coupling of the engine to the planetary gears.

Converter clutch operation determined by a series of controls and by drive range selection. The transmission must be in drive range, and the vehicle must have obtained a preset speed depending on engine and transmission combination.

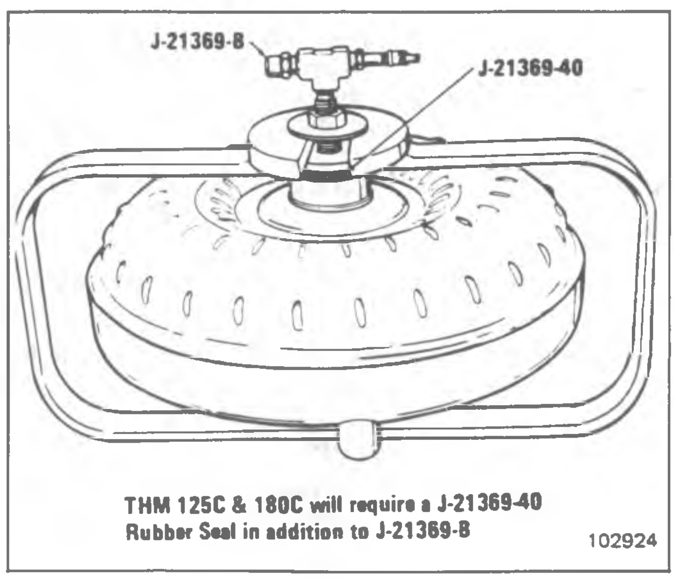


Fig. 7A-16--Installing Tool J-21369

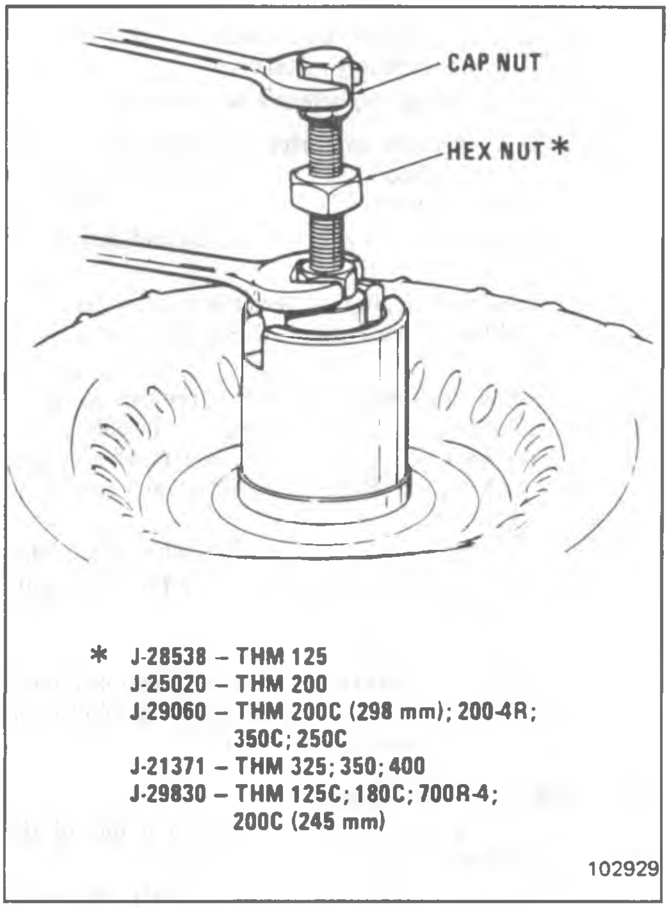


Fig. 7A-17--Installing Tools

DIAGNOSIS

Leak Checking Converter

1. Check converter for leaks as follows:
   a. Install J-21369-2 and J-21369-6 and tighten hex nut on J-21369-2 (Figure 7A-16).
   b. Fill converter with air; 551 kilopascals (80 psi).
   c. Submerge in water and check for leaks.

   CAUTION: After leak testing, bleed pressurized air from J-21369-2 before removing tools from converter. Escaping high pressure may cause personal injury.
2. Check converter hub surfaces for signs of scoring or wear.

Check Converter End Clearance as Follows:

1. Fully release collet end of required end play tool. See Fig. 7A-17.
2. Install collet end of tool into converter hub until it bottoms; then tighten cap nut to 6.7 N·m (5 ft. lbs.). (Figure 7A-17).

   For THM 400 converter

   a. Install tool J-21371-3 and tighten hex nut to 4.0 N·m (3 ft. lbs.) Figure 7A-18).
   b. Install dial indicator and set it at zero while its plunger rests on the cap nut of tool (Figure 7A-18).
   c. Loosen hex nut while holding cap nut stationary. With hex nut loose and holding tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than 0-1.27 mm (0-.050"). If the end clearance is greater, the converter must be replaced (Figure 7A-18).

   For all other converters

   a. Install dial indicator J-8001, (Fig. 7A-19) and set it at zero while its plungers rests on the converter.
   b. Lift up the arm on the tool handle. Converter end clearance should be 0-1.2mm (0-.050". If the end clearance is greater, the converter must be replaced (Fig. 7A-19).
3. With the transmission in cradle or portable jack, install the converter assembly into the pump assembly, making sure that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

   The converter will be properly installed if the distance is 25.4 mm (1.00") minimum between the engine mounting face of the case and the front face of the converter cover drive straps.
4. Retain converter with J-21366.

Converter Stator Operation

Stator Assembly Freewheels

If the stator roller clutch becomes ineffective, the stator assembly freewheels at all times in both directions. With this condition, the vehicle tends to have poor acceleration from a standstill. At speeds above 48 to 56 km/h (30-35 mph), the vehicle may act normal. If poor acceleration problems are noted, it should first be determined that the exhaust system is not blocked, the engine is running properly and the transmission is in first (1st) gear when starting out.

If the engine will freely accelerate to high rpm in Neutral (N), it can be assumed that the engine and exhaust

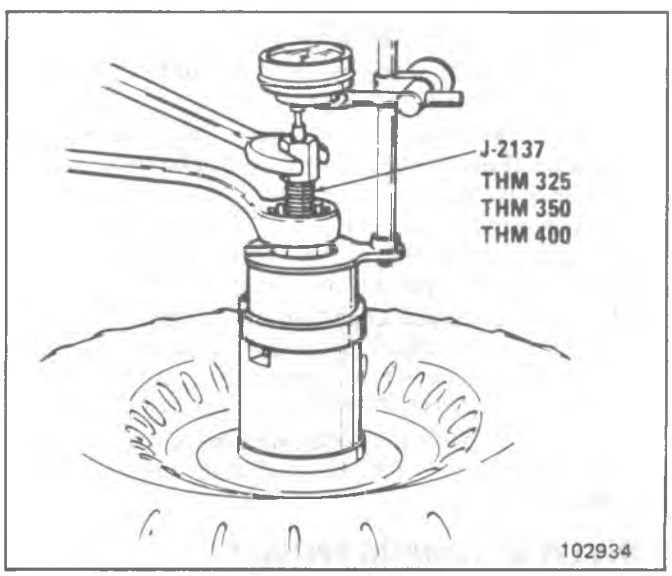


Fig. 7A-18--Checking End Clearance

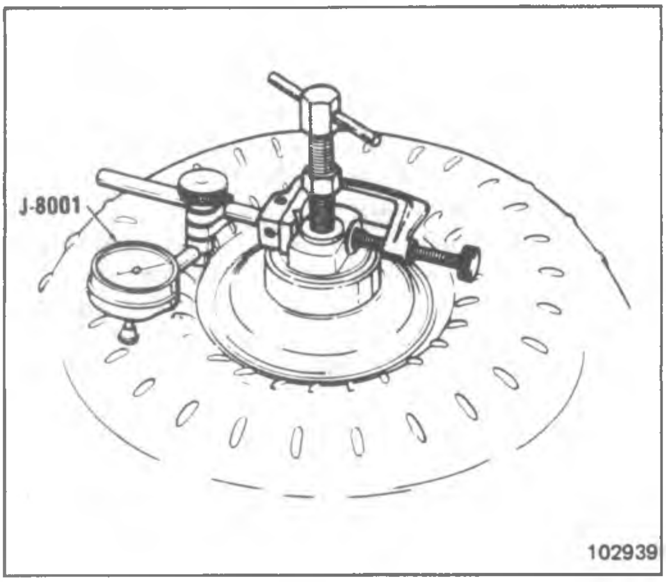


Fig. 7A-19--Checking End Clearance

system are normal.

Stator Assembly Remains Locked Up

If the stator assembly remains locked up at all times, the engine rpm and vehicle speed will tend to be limited or restricted at high speeds. The vehicle performance when accelerating from a standstill will be normal. Engine overheating may be noted. Visual examination of the converter may reveal a blue color from the overheating that will result.

Under conditions above, if the converter has been removed from the transmission, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely in the clockwise direction, but not turn or be very difficult to turn in the counterclockwise direction.

Do not use such items as the pump cover or stator shaft to turn the race as the results may be misleading.

Checking For Converter Vibration

1. Inspect for missing or loose converter-to-flywheel bolts. Tighten or replace as necessary.
2. Inspect converter for damage or missing balance weights. If the converter is damaged or balance weights are missing, replace the converter.
3. Change position of converter-to-flywheel 120 degrees at a time to cancel out engine and converter unbalance. Recheck in each position for vibration improvements.
4. If the unbalanced condition still exists, leave the converter-to-flywheel in the best balanced position. Install longer flywheel-to-converter bolts adding and removing washers until the best balance is achieved.

   Be sure the bolts are not bottoming in the holes. Always rotate the converter by hand after adding washers to check for clearance.

CONVERTER FLUSHING PROCEDURE (Fig. 20 thru 22)

1. Drill an 11/32" hole in the converter between the two vane extrusions and adjacent to the converter weld seam edge. See Figure 20.
   a. Drill the hole to apprixmate completion.
   b. Remove the drill bit from the started hole and coat it with grease to hold any metal chips.
   c. Complete drilling the hole at low drill speed.

   NOTICE: To prevent converter damage, drill at right angles to the surface and sleeve the drill bit so it can enter no deeper than 1/4".
2. Apply grease to a 1/8 x 27 NPSF tap and thread the hole.
3. Drain fluid by propping converter in a drain pan with the drilled hole at the bottom. Drain approximately 15 minutes.
4. Charge converter hub with air to remove as much contaminated transmission fluid as possible. Set converter on pilot, pour in two quarts of cleaning solvent and agitate. Redrain converter and use air to blow dry.
5. Coat a 1/8 x 27 NPTF pipe plug with teflon pipe sealant or equivalent and install. Use pipe plug part number 9427882 or equivalent.
6. Torque to 8 ft. lbs.
7. Pressure test the converter for leaks at 80 psi using tool J-21369. Put liquid soap or leak-detecting solution on the pipe plug and watch for bubbles.

Torque Converter Evaluation

The converter should only be replaced if one of the following conditions exist:

1. Either the front oil pump cover or body are badly scored, which results in cast iron grindings entering the converter and thus, the oil circuit. This could be a result of the drive gear wearing into the crescent, or down into the pocket, or the outer gear wearing in the pocket or some other condition such as a cracked flexplate, causing the drive lugs on the drive gear to become badly damaged.
2. Internal converter failure, such as the stator overrun clutch not locking, thrust bearing failure, etc. Such failures are also normally associated with

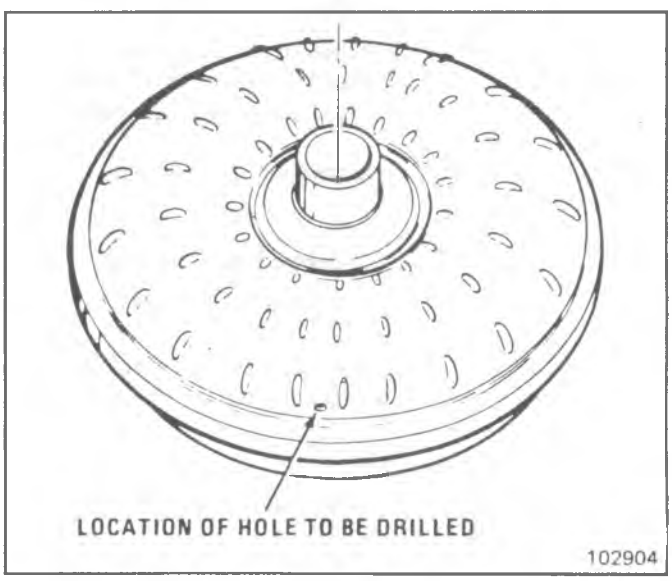


Figure 20--Converter Drilling

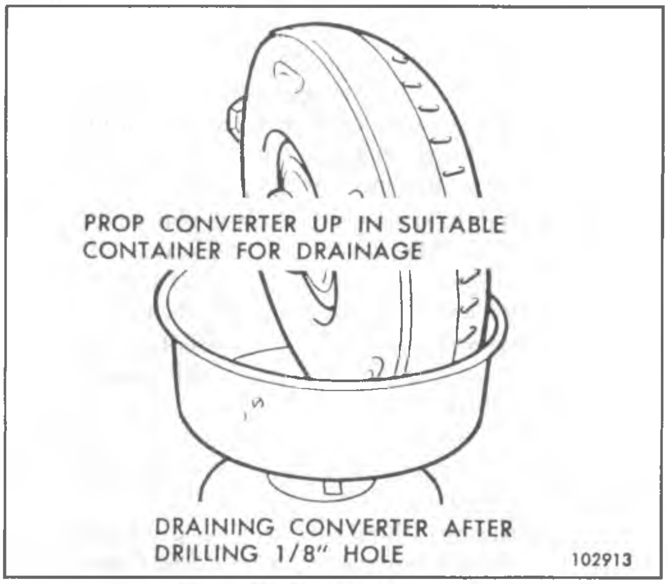


Figure 21--Draining Converter

"aluminized" oil in the converter.

3. End play in the converter exceeds 1.27 mm (.050"). This measurement cannot be estimated, but must be made with tool J-21371.
4. Leaking externally, such as at the hub weld area. A converter that has been in service and which did not leak, very likely never will.
5. A scored, or otherwise damaged hub, which could cause a front seal failure or front pump bushing failure.
6. A broken, damaged, or even possibly a bad fitting converter pilot, which could cause the converter to either not fit into the crankshaft bore properly or not be correctly aligned with the crankshaft.
7. The converter has an unbalance which results in a vibration that cannot be corrected. Most such problems are minimal and most times can be corrected by following Converter Vibration Procedure. A secondary balance procedure is to balance flywheel. If the original balance weights have broken loose and the procedure discussed does not correct the condition, then the converter should be replaced.

The converter should not be replaced for one of the following conditions:

1. The oil has an odor, is discolored, and there is no evidence of metal particles. There is no indication that there is internal damage, nor any front pump damage. Dump out as much oil as possible from the converter and replace only the oil filter in the pan.
2. The oil cooler was defective which allowed engine coolant to enter the transmission. Drill, drain and repair the converter as described in converter flushing procedure. (Including T.C.C. Converters).
3. A small amount of wear (sometimes referred to as fretting wear) appears on the hub where the oil pump drive gear locates. A certain amount of such wear is normal for both the hub and oil pump gear. Neither the converter nor the front pump assembly should be replaced.
4. The threads in one or more of the three converter bolts holes are damaged. Correct such conditions with the use of a Heli-Coil or its equivalent.

GENERAL SERVICE PROCEDURES

Engine Coolant In Transmission

If the transmission oil cooler, located in the radiator assembly, has developed a leak allowing engine coolant to enter the transmission, use the following procedure:

1. Remove transmission from vehicle.
2. Disassemble transmission and replace all rubber type seals. (The coolant will attack the seal material causing leakage.)
3. Replace the composition-faced clutch plate assemblies. (The facing material may become separated from the steel center portion).
4. Replace the nylon washers, speedometers gears and governor gear. (The nylon can swell and become damaged.)
5. Flush the converter, including T.C.C. types.
6. Thoroughly clean and rebuild transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

Clutch Plate Diagnosis

1. Compositioned Plates.
   a. Dry plates and inspect for pitting, flaking, wear, glazing, cracking, charring and chips or metal particles imbedded in lining.
   b. If a compositioned plate shows any of the above conditions, replacement is required.
2. Steel Plates.
   a. Wipe plates dry and check for discoloration. If the surface is smooth and even color smear is indicated, the plate should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plate must be replaced.
3. Clutch Release Spring.
   a. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would require replacement of the

Figure 22--Pressure Testing Converter

springs.

Causes of Burned Clutch Plates

1. Forward Clutch
   a. Check ball in clutch housing damaged, stuck or missing.
   b. Clutch piston cracked, seals damaged or missing.
   c. Low line pressure.
   d. Pump cover oil seal rings missing, broken or undersize, ring groove oversize.
   e. Case valve body face not flat or porosity between channels.
2. Intermediate Clutch
   a. Intermediate clutch piston seals damaged or missing.
   b. Low line pressure.
   c. Case valve body face not flat or porosity between channels.
3. Direct Clutch
   a. Clutch piston seals damaged or missing.
   b. Case valve body face not flat or porosity between channels.

Burned clutch plates can be caused by incorrect usuage of clutch plates. Also, engine coolant in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

Case Porosity Repair

External leaks caused by case porosity have successfully been repaired with the transmission in the vehicle by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 93°C (200°F).
2. Raise vehicle on a hoist or jack stand, engine running and locate source of oil leak. Check for leak in all operating positions. A mirror may be helpful in finding leaks.
3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and air dry.
4. Using instructions of the manufacturer, mix a sufficient amount of epoxy, No. 1052533, or equivalent to make repair. Observe cautions of manufacturer in handling.
5. While the transmission case is still HOT, apply the epoxy to the area to be repaired. A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement. Make certain the area to be repaired is fully covered.
6. Allow cement to cure for three hours before starting engine.
7. Road test and check for leaks.

Service Methods

When servicing the transmission, it is recommended that upon disassembly of a unit, all parts should be cleaned and inspected as outlined under CLEANING AND INSPECTION. The unit should be reassembled before disassembly of other units to avoid confusion and interchanging of parts.

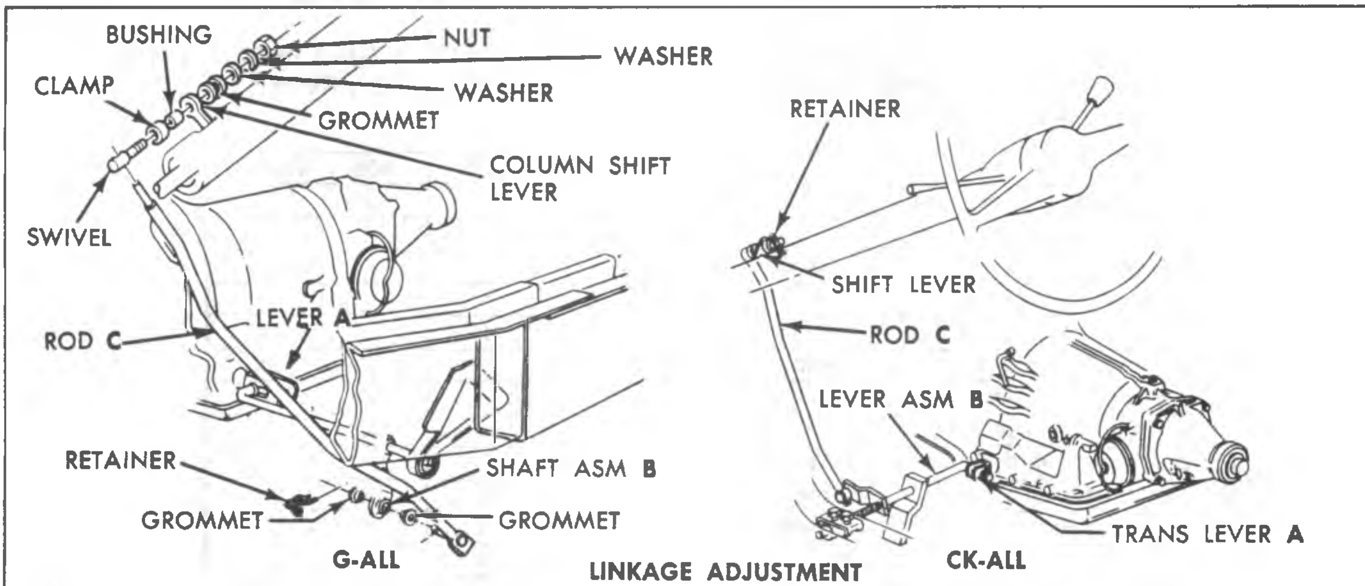
1. Before disassembly of the unit, thoroughly clean the exterior.
2. Disassembly and reassembly of the unit and the subassemblies must be made on a clean bench. As in repairing any hydraulically operated unit, cleanliness is of the utmost importance; therefore, the bench, tools, and parts must be kept clean at all times.
3. Before installing cap screws into aluminum parts, ALWAYS DIP SCREWS INTO TRANSMISSION OIL to prevent cap screws from galling the aluminum threads and also to prevent the screws from seizing.
4. Always use a torque wrench when installing cap screws into aluminum parts to prevent the possibility of stripping the threads.
5. If tapped, threads in aluminum parts are stripped or damaged, the part can be made serviceable by the use of Heli-Coils or equivalent.
6. Seal protecting tools must be used when assembling the units to prevent damage to the seals. The slightest flaw in the sealing surface of the seal can cause an oil leak.
7. The aluminum castings and the valve parts are very susceptible to nicks, burrs, etc., and care should be exercised when handling them.
8. The internal snap rings should be expanded and the external snap rings compressed if they are to be reused. This will insure proper seating when installed.
9. Replace all "O" rings, gaskets and oil seals that are removed. Oil seal rings should not be removed unless damaged.
10. During assembly of each unit, all internal parts must be lubricated with oil.

Parts Cleaning and Inspection

Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the transmission should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During inspection and reassembly, all parts should be thoroughly cleaned with cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts. Do not use solvents on neoprene seals, composition-faced clutch plates or thrust washers. All oil passages should be blown out and checked to make sure that they are not obstructed. Small passages should be checked with tag wire. All parts should be inspected to determine which parts are to be replaced.

The various inspections of parts are as follows:

1. Inspect linkage and pivot points for excessive wear.
2. Bearing and thrust surfaces of all parts should be checked for excessive wear and scoring.
3. Check for broken seal rings, damaged ring lands and damaged threads.
4. Inspect seals and "O" rings.
5. Mating surfaces of castings and end plate should be checked for burrs and irregularities may be removed by lapping the surface with crocus cloth. The crocus cloth should be laid on a flat surface, such as a piece of plate glass.
6. Castings should be checked for cracks and sand holes.



LINKAGE ADJUSTMENT

1. SET TRANS LEVER (A) IN "NEUTRAL" POSITION BY MOVING TRANS LEVER (A) CLOCKWISE TO THE "PARK" DETENT THEN COUNTERCLOCKWISE TWO DETENTS TO "NEUTRAL".
2. SET THE COLUMN SHIFT LEVER IN "NEUTRAL" GATE NOTCH. THIS IS OBTAINED BY ROTATING UNTIL SHIFT LEVER DROPS INTO "NEUTRAL" GATE NOTCH. NOTE DO NOT USE INDICATOR POINTER AS A REFERENCE TO POSITION THE SHIFT LEVER.
3. ATTACH ROD (C) TO TRANS SHAFT ASM (B) AS SHOWN.
4. SLIDE SWIVEL AND CLAMP ONTO ROD (C) ALIGN WITH COLUMN SHIFT LEVER AND COMPLETE ATTACHMENT.
5. HOLD COLUMN LEVER AGAINST NEUTRAL STOP "PARK POSITION SIDE".
6. TIGHTEN NUT USING RECOMMENDED TORQUE.

102923

Fig. 7A-23--Column Shift Linkage Adj.

Oil Cooler Pipes

If replacement of transmission steel tubing cooler lines is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations. Steel tubing should be flared using the double flare method.

Cooler Line Flushing

In a major transmission failure, where particles of metal have been carried with the oil throughout the units of the transmission, it will be necessary to flush out the oil cooler and connecting lines. To flush the oil cooler and lines, use the following procedure:

1. Disconnect both cooler lines from the transmission.
2. Place a hose over the end of the cooler inlet line (from the bottom of the cooler) and insert the hose into an empty container.
3. Flush clean oleum solvent or equivalent through the return line (from the top of the cooler) using an oil suction gun until clean solvent comes out of the hose. This will "back flush" the cooler.
4. Remove the hose from the inlet cooler line and place it on the return line.
5. Flush clean oleum solvent or equivalent through the inlet line until clean solvent comes out the return line. Remove remaining solvent from cooler with compressed air applied to the return line and flush with transmission fluid.
6. Reconnect oil cooler lines and torque nuts to 17 N·m (12 ft. lbs.).

SERVO ASSEMBLY

Removal and Installation 700-R-4

1. Disconnect battery cable.
2. Raise the vehicle.
3. Using tool J-29714, remove 2-4 servo cover and retaining ring.
4. Remove 4th gear apply piston and "O" ring.
5. Remove 2nd gear servo piston assembly.
6. Remove the inner servo piston assembly, oil seal and spring.
7. Check the apply pin using Tool J-33037.
8. To install, just reverse Steps 1 through 6.
9. Lower the vehicle, check and fill transmission fluid.

SPEEDOMETER DRIVEN GEAR (350C, 400, 700-R4)

Removal and Installation

1. Disconnect speedometer cable.
2. Remove retainer bolt, retainer, speedometer driven gear and "O" ring seal.
3. To install, reverse removal procedure, using new "O" ring seal (if required) and adjust fluid level.

THE FOLLOWING PARTS CAN BE SERVICED WITH THE TRANSMISSION IN THE VEHICLE. FOR REMOVAL AND INSTALLATION PROCEDURES NOT LISTED IN THIS SECTION REFER TO THE APPROPRIATE UNIT REPAIR SECTION.

	350 C	400	700-R4
1. Governor Cover and Seals	X	X	X
2. Governor Assembly	X	X	X
3. Governor Pressure Switch (Diesel only)			X
4. Governor Pipes		X	
5. Intermediate Servo Cover and Seal	X		X
6. Intermediate Servo Piston Assembly		X	X
7. Rear Servo Assembly		X	
8. Front Servo Assembly		X	
9. 3rd Accumulator Check Valve Assembly			X
10. Oil Pan and Oil Screen (Intake Pipe) Assembly	X	X	X
11. Control Valve Assembly (Valve Body)	X	X	X
12. Auxillary Valve Body Assembly	X		
13. Check Balls and Valve Body Space Plates and Gaskets	X	X	X
14. Pressure Regulator Parts	X	X	X
15. Inside Detent/Range Lever	X		X
16. Manual Detent Roller and Spring Assembly	X	X	X
17. Throttle Lever and Bracket Assembly			X
18. TV/Detent Cable and 'O' Ring	X		X
19. TV Boost Valve and Bushing			
20. Parking Pawl Actuator Rod	X	X	X
21. Parking Pawl Bracket	X	X	X
22. Parking Pawl	X	X	X
23. Manual Shaft and Seal	X	X	X
24. Manual Valve	X	X	X
25. Manual Valve Link	X	X	X
26. Extension Housing and Gasket	X	X	X
27. Rear Seal	X	X	X
28. 1-2 Accumulator Assembly	X	X	X
29. 3-4 Accumulator Assembly			X
30. Low and Reverse Clutch Cup Plug			
31. Reverse Boost Valve and Bushing			
32. Stop Valve			
33. Intermediate Band Anchor Pin			X
34. 4-3 Pressure Switch			
35. 4th Clutch Pressure Switch			
36. Vacuum Modulator	X	X	
37. Cooler Fittings	X	X	X
38. Oil Filter Pipe and 'O' Ring		X	X
39. Speedometer Driven Gear Assembly	X	X	X
40. Speedometer Drive Gear	X		X
41. Down Shift Solenoid		X	
42. Converter Clutch Valve and Springs	X		
43. Converter Clutch Solenoid	X		X
44. Solenoid Wire Clips	X		X
45. Electical Connectors	X	X	X
46. Governor Feed Screen	X	X	
47. Pump Pressure Screen	X	X	
48. Modulator Valve	X	X	
49. Intermediate Band Adjustment	2B7A11A		

Fig. 7A-24--On-Vehicle Service Items

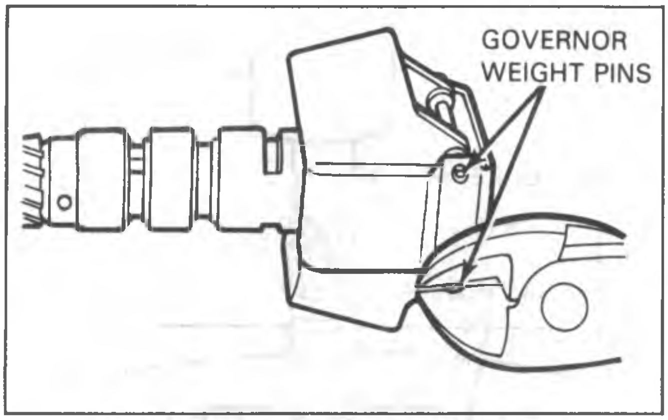


Fig. 7A-25--Removing Governor Weight Pins

REAR OIL SEAL (350C, 400, 700-R4)

Removal and Installation

1. Remove propeller shaft as outlined in Section 4A.
2. Pry out lip oil seal with suitable tool.
3. Coat outer casing of new lip oil seal with a nonhardening sealer and drive it into place with Installer J-21426 (700-R4) J-21359 or J-24057 (400).
4. Install propeller shaft as outlined in Section 4A and adjust fluid level.

GOVERNOR

Removal and Installation

350C

1. Remove governor cover and "O" ring seal from case. Aid removal of cover with screwdriver. Use extreme care not to damage cover. If cover is damaged, it must be replaced.
2. Withdraw governor assembly from case. Check governor bore and governor sleeve for scoring.

   The governor should be replaced only if the O.D. surface of the sleeve is scored, the carriçer is loose on the sleeve, or the valve is sticking in the sleeve, after a thorough cleaning has been attempted.
3. When installing governor cover, uniformly apply Locite Cup Plug Sealer #2 or equivalent to governor cover.

400

1. Raise vehicle.
2. Remove governor cover attaching screws, cover and gasket. Discard gasket.
3. Remove governor assembly from case.
4. Refer to the Overhaul Section for inspection procedures.
5. Install governor.
6. Using a new gasket, install cover and retaining bolts. Torque bolts to specifications.
7. Lower vehicle and adjust fluid level.

700-4R

1. Raise vehicle.
2. Remove governor cover from case using a screwdriver. Use extreme care not to damage cover. If cover is damaged, it must be replaced.
3. Remove governor.
4. Refer to the Overhaul Section for inspection procedure.
5. Install governor.
6. Apply anaerobic sealant, such as Loctite Cup Plug Sealant II, or equivalent, to cover, then install governor cover using a brass drift around the outside flange of the cover. Do not distort cover on installation.
7. Lower vehicle and check transmission fluid level.

350C, 700-R4 and 400 Governor Repair

All parts of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble the governor assembly in order to replace the driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified. (Fig. 7A-25).
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform the following inspections and replace governor driven gear, if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve opening at entry 5.1mm (.020") minimum with a feeler gage, holding governor as shown with governor weights extended completely outward (Fig. 7A-26).
11. Check valve opening at exhaust 5.1 mm (.020") minimum with a feeler gage, holding governor as shown

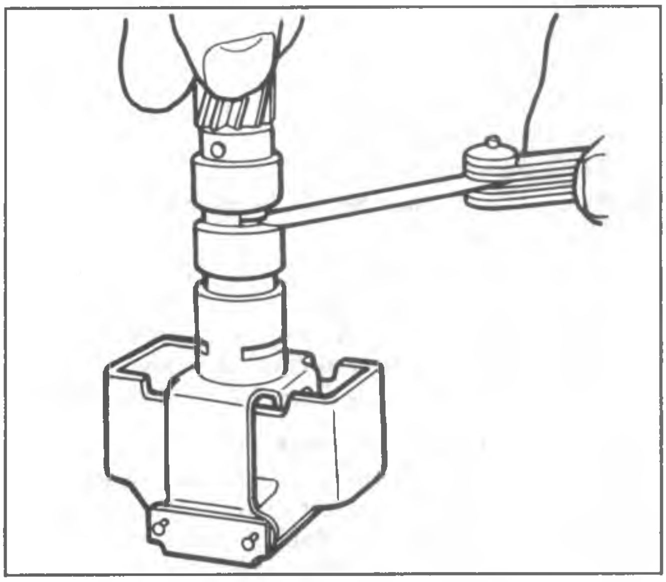


Fig. 7A-26--Check Valve Opening (Entry)

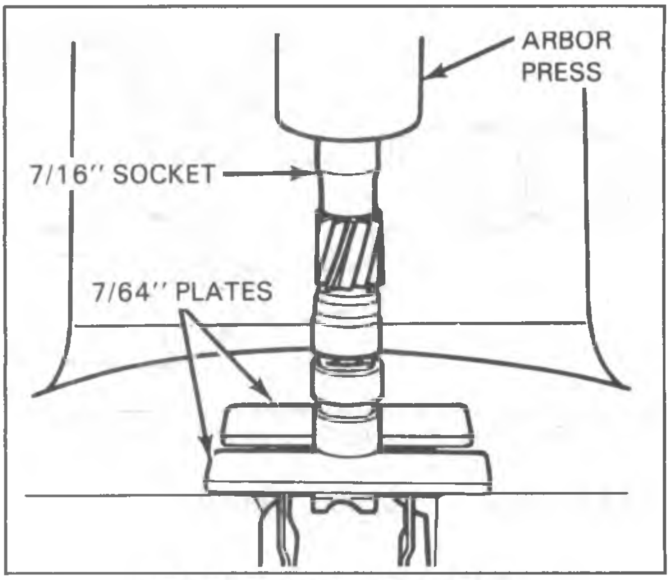


Fig. 7A-28--Installing Driven Gear

with governor weights completely inward (Fig. 7A-27). Sleeve must be tight in carrier.

Governor Driven Gear Replacement

To facilitate governor repair in the field, governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch or 1/8" drill rod.
2. Support governor on 7/64" plates installed in exhaust slots of governor sleeve, place in press, and with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 7/64" plates, installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder (Fig. 7A-28).
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch, and then while supporting governor in press, drill new hole through sleeve and gear using a standard 1/8" drill (Fig. 7A-29).
6. Install retaining pin, making sure each end is slightly below top of hole.
7. Stake both ends of pin hole, two places.
8. Wash governor assembly thoroughly to remove any chips that may have collected.

Assembly

1. Install governor valve in bore of governor sleeve.
2. Install governor weights and springs, and thrust cap on governor sleeve.
3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.

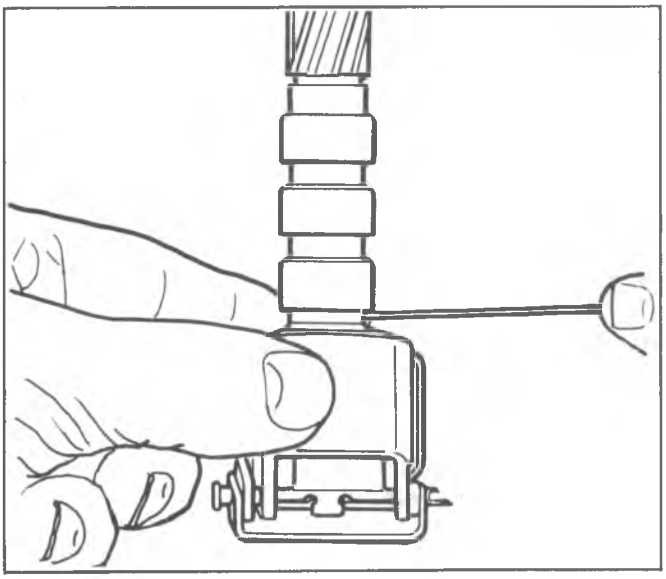


Fig. 7A-27--Check Valve Opening (Exhaust)

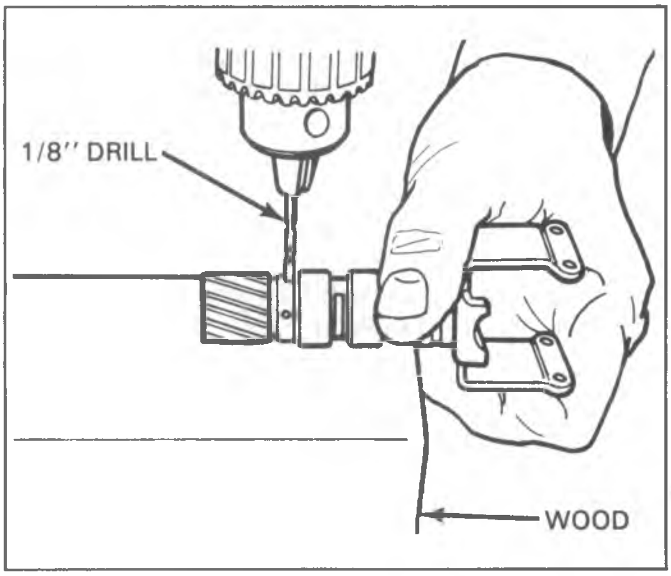


Fig. 7A-29--Drilling Hole in Driven Gear

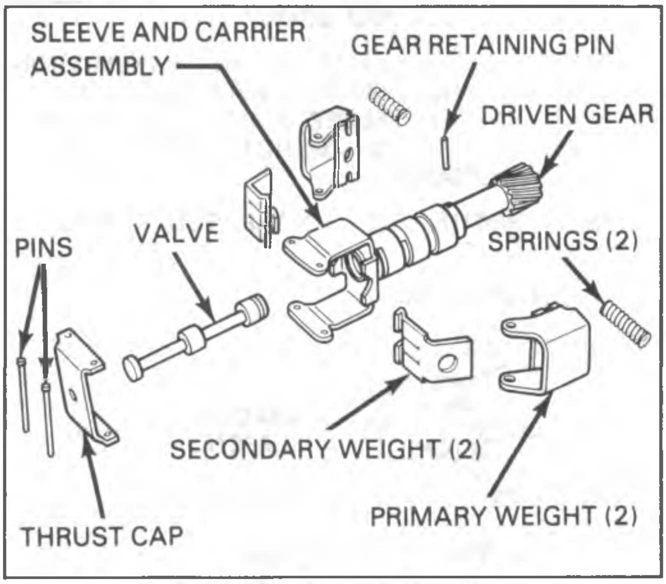


Fig. 7A-30--Governor Assembly

4. Check governor weight assemblies for free operation on pins, and governor valve for free operation in governor sleeve.

PRESSURE REGULATOR VALVE (400)

Removal and Installation

1. Raise vehicle.
2. Referring to draining procedures, drain transmission fluid from oil pan.
3. Remove oil pan, gasket and screen.
4. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using J-5403.
5. Remove regulator boost valve bushing and valve.
6. Remove pressure regulator spring.
7. Remove spring retainer, washer spacer(s), if present, and regulator valve.
8. Installation of pressure regulator valve is the reverse of the removal. Install new gasket on oil pan and adjust fluid level.
9. Lower vehicle.

CONTROL VALVE ASSEMBLY

Control Valve Assembly

350C

1. Refer to draining procedures, drain transmission fluid from oil pan.
2. Remove oil pan, gakset and filter. Disconnect electrical connectors at valve body.
3. Remove detent spring and roller assembly from valve body and remove valve body-to-case bolts.
4. Remove valve body assembly while disconnecting manual control valve link from range selector inner lever and removing detent control valve link from the detent actuating lever.
5. Remove manual valve and link assembly from valve body assembly.
6. Refer to the Overhaul Section for inspection procedures.
7. Installation of control valve assembly is the reverse of removal. Torque valve body bolts to 17 N·m (12 ft. lbs.).

Refer to Refilling of Transmission portion of this section for correct fluid level.

400

1. Refer to draining procedures, drain transmission fluid from oil pan.
2. Remove oil pan, gasket and filter.
3. Disconnect lead wire from pressure switch assembly.
4. Remove control valve body attaching bolts and detent roller spring assembly.
5. Remove control valve body assembly and governor pipes.
6. Remove the governor screen from end of governor feed pipe or from the feed pipe hole in the case. Clean governor screen in clean solvent and air dry.
7. Refer to the Overhaul Section for inspection procedures.
8. Installation of control valve assembly is the reverse of removal. Torque valve body bolts to 10 N·m (8 ft. lbs.).

Refer to Refilling of Transmission portion of this section for correct fluid level.

700-R4

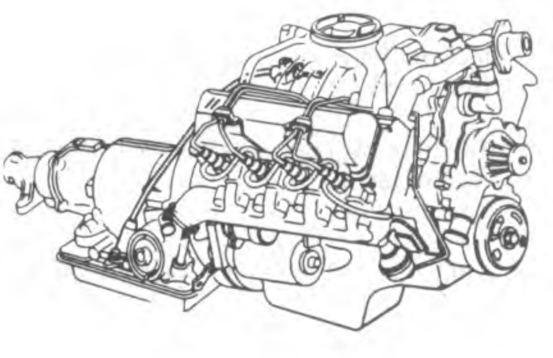
1. Refer to draining procedures, drain transmission fluid from oil pan.
2. Remove oil pan, gasket and filter.
3. Disconnect electrical connectors at valve body.
4. Remove detent spring and roller assembly from valve body and remove valve body-to-case bolts.
5. Remove valve body assembly while disconnecting manual control valve link from range selector inner lever and removing the throttle lever bracket from T.V. link.
6. Refer to the Overhaul Section for inspection procedures.
7. Installation of control valve assembly is the reverse of removal. Torque valve body bolts to 11 N·m (8 ft. lbs.).

Refer to Refilling of Transmission portion of this section for correct fluid level.

VACUUM MODULATOR (350C, 400)

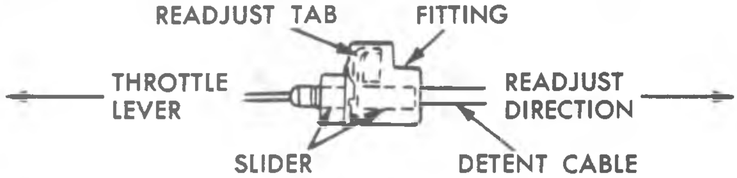
Removal and Installation

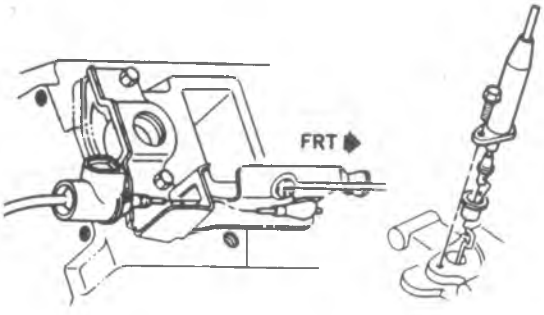
1. Disconnect vacuum hose from vacuum modulator stem and remove vacuum modulator attaching screw and retainer.
2. Remove modulator assembly and its "O" ring seal from case.
3. Remove modulator valve from case.
4. Installation of the modulator and modulator valve is the reverse of REMOVAL. Install a new "O" ring seal and adjust the fluid level.



ADJUSTMENT PROCEDURE

1. AFTER INSTALLATION OF CABLE TO THE TRANSMISSION, ENGINE BRACKET, AND THROTTLE LEVER, CHECK TO ASSURE THAT THE CABLE SLIDER IS IN THE ZERO OR FULLY READJUSTED POSITION (IF NOT, REFER TO READJUSTMENT PROCEDURE).
2. ROTATE THE THROTTLE LEVER TO THE "FULL TRAVEL STOP" POSITION.
3. RELEASE THROTTLE LEVER.





READJUSTMENT PROCEDURE

IN CASE READJUSTMENT IS NECESSARY BECAUSE OF INADVERTANT ADJUSTMENT BEFORE OR DURING ASSEMBLY, OR FOR REPROCESSING, PERFORM THE FOLLOWING:

1. DEPRESS AND HOLD METAL READJUST TAB.
2. MOVE SLIDER BACK THROUGH FITTING IN DIRECTION AWAY FROM THROTTLE LEVER UNTIL SLIDER STOPS AGAINST FITTING.
3. RELEASE METAL READJUST TAB.
4. REPEAT STEP 2 OF ADJUSTMENT PROCEDURE.

102932

Fig. 7A-31--T.V./Detent Cable Adj. Diesel Engine

T.V./DETENT CABLE

Removal and Installation

1. Remove air cleaner, if necessary.
2. Push in on re-adjust tab and move slider back through fitting in direction away from throttle lever.
3. Disconnect cable terminal from throttle lever, see Figs. 7A-31, 32 and 33.
4. Compress locking tabs and disconnect cable assembly from bracket.
5. Remove routing clips or straps (if used), remove screw and washer securing cable to transmission and disconnect cable from link.
6. Install new seal into transmission case hole .
7. Connect transmission end of cable and secure to transmission case with bolt and washer tightened to 10 N·m (8 lb. ft.).
8. Route cable as removed and connect clips or straps.
9. Pass cable through bracket and engage locking tabs of cable on bracket.
10. Connect cable terminal to throttle lever.
11. Adjust cable - see "Adjustment Procedure".
12. Install air cleaner, if removed.

TRANSMISSION

Generally, pressure testing should be performed before transmission removal.

Removal (Except K Model)

1. Open hood and place protectors on both fenders.
2. Remove air cleaner assembly.
3. Disconnect T.V./detent cable at its upper end - see "T.V./Detent Cables".
4. Remove transmission oil dipstick (and bolt holding dipstick tube if accessable.)
5. Raise vehicle.
6. Remove propeller shaft as outlined in Section 4A.
7. Disconnect speedometer cable at the transmission.
8. Disconnect shift linkage at transmission.
9. Disconnect all electrical leads at the transmission and any clips that retain the leads to the transmission case.
10. Remove transmission support braces and flywheel cover. Mark flywheel and torque converter to maintain original balance.
11. Remove torque converter to flywheel bolts and/or nuts.
12. Disconnect the catalytic converter support bracket if equipped.
13. Remove transmission mount attaching bolts.
14. Position a transmission jack under the transmission oil pan and raise the transmission slightly.
15. Remove transmission support to frame bolts (and insulators if used).
16. Slide the transmission support rearward and remove from vehicle.

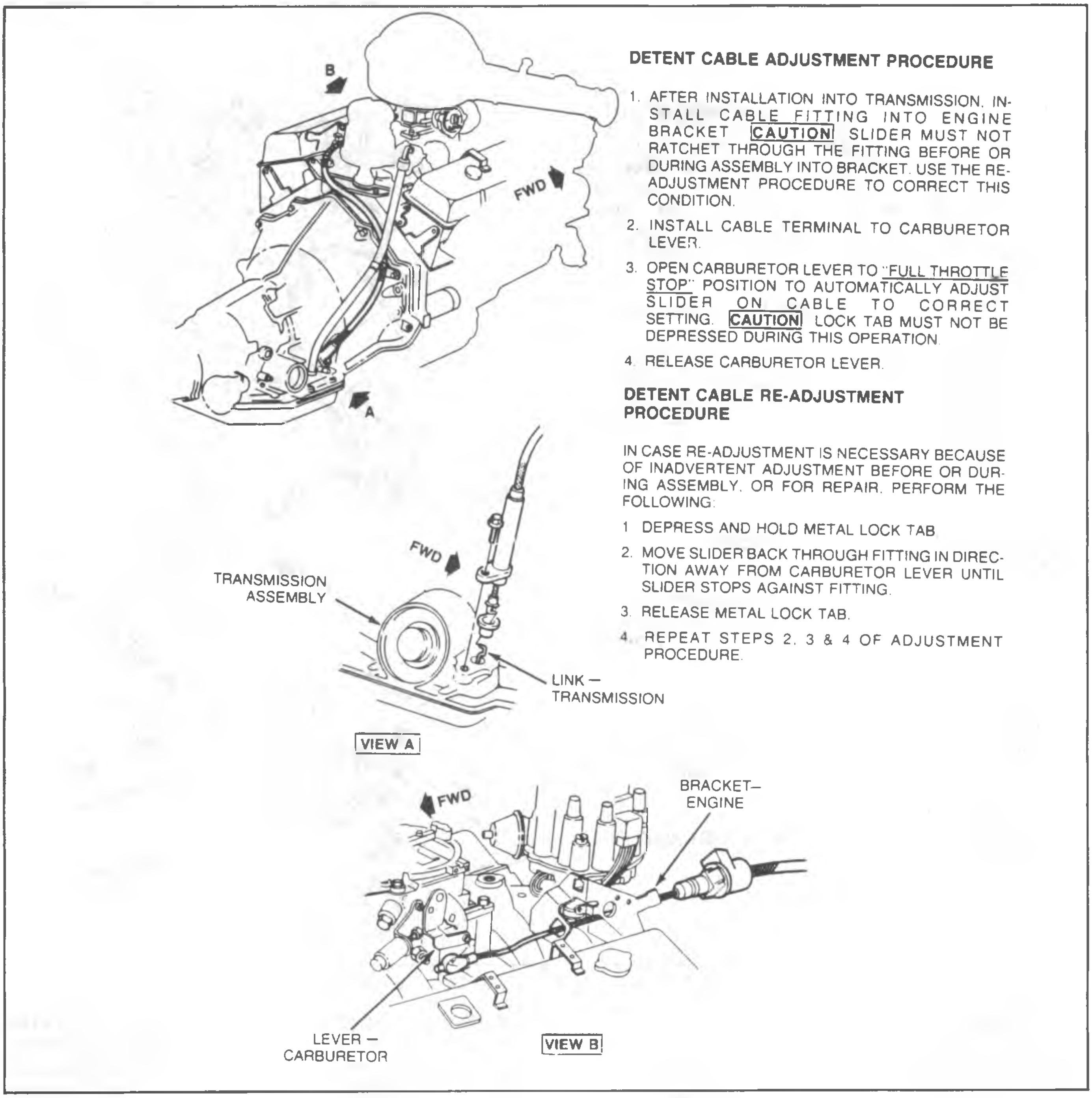


Fig. 7A-32--T.V./Detent Cable Adj. Gasoline Engine

17. Lower the transmission to gain access to the oil cooler lines and T.V./detent cable attachments.
18. Disconnect the oil cooler lines and T.V./detent cable. Cap all openings.
19. Support engine with a suitable tool and remove the transmission to engine bolts.
20. Disconnect the transmission assembly, being careful not to damage any cables, lines or linkage.
21. Install torque converter holding tool J-21366 and remove the transmission assembly from the vehicle.

Removal (K Model)

1. Open hood and place protectors on both fenders.
2. Remove air cleaner.
3. Disconnect T.V./detent cable at its upper end.
4. Remove transfer case shift lever knob and boot.
5. Raise vehicle
6. Remove propeller shafts as outlined in Section 4A.
7. Disconnect speedometer cable at transmission.
8. Disconnect shift linkage at transmission.
9. Disconnect all electrical leads at the transmission, transfer case and any clips that retain the leads.
10. Disconnect transfer case shift linkage.
11. Remove transmission support strut rods and flywheel cover. Mark flywheel and torque converter to maintain original balance.
12. Remove torque converter to flywheel bolts and/or nuts.

DETENT CABLE ADJUSTMENT PROCEDURE

1. AFTER INSTALLATION INTO TRANSMISSION, INSTALL CABLE FITTING INTO ENGINE BRACKET. **CAUTION** SLIDER MUST NOT RATCHET THROUGH THE FITTING BEFORE OR DURING ASSEMBLY INTO BRACKET. USE THE READJUSTMENT PROCEDURE TO CORRECT THIS CONDITION.
2. INSTALL CABLE TERMINAL TO CARBURETOR LEVER.
3. OPEN CARBURETOR LEVER TO "FULL THROTTLE STOP" POSITION TO AUTOMATICALLY ADJUST SLIDER ON CABLE TO CORRECT SETTING. **CAUTION** LOCK TAB MUST NOT BE DEPRESSED DURING THIS OPERATION.
4. RELEASE CARBURETOR LEVER.

DETENT CABLE RE-ADJUSTMENT PROCEDURE

IN CASE RE-ADJUSTMENT IS NECESSARY BECAUSE OF INADVERTENT ADJUSTMENT BEFORE OR DURING ASSEMBLY, OR FOR REPAIR, PERFORM THE FOLLOWING:

1. DEPRESS AND HOLD METAL LOCK TAB.
2. MOVE SLIDER BACK THROUGH FITTING IN DIRECTION AWAY FROM CARBURETOR LEVER UNTIL SLIDER STOPS AGAINST FITTING.
3. RELEASE METAL LOCK TAB.
4. REPEAT STEPS 2, 3 & 4 OF ADJUSTMENT PROCEDURE.

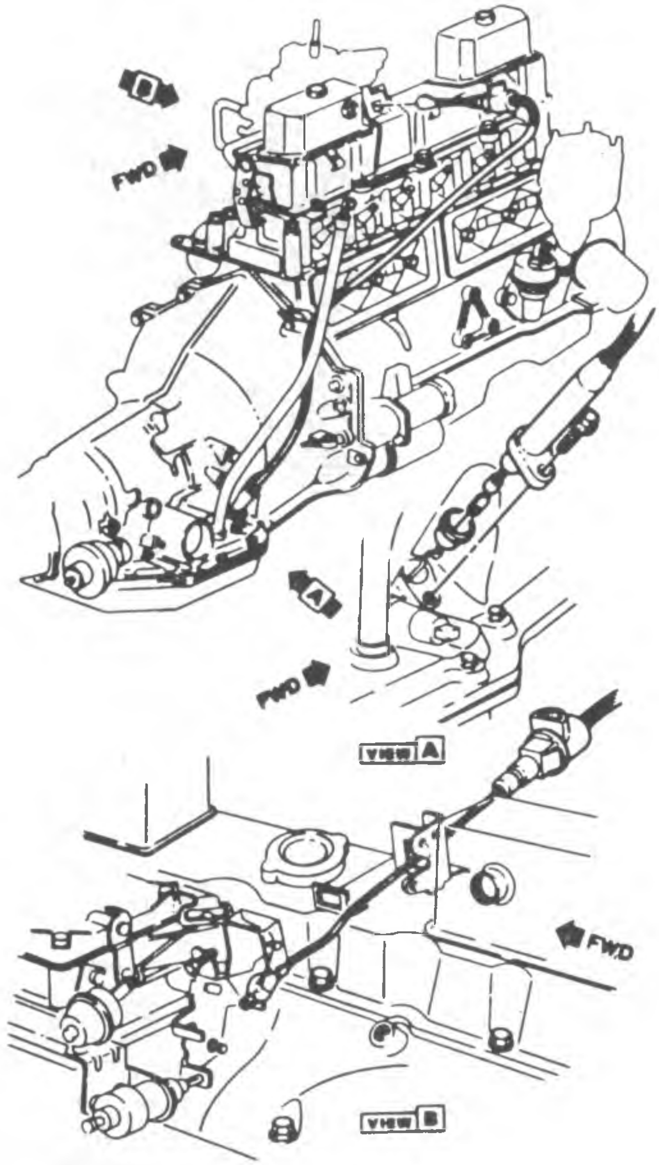


Fig. 7A-33--T.V./Detent Cable Adj. Gasoline Engine

13. Disconnect transmission oil cooler lines at the transmission.
14. Support transmission and transfer case with a jack.
15. Remove transfer case to frame bracket bolts. Remove mount bolts and crossmember.
16. Disconnect transmission to engine bolts, remove transmission and transfer case, being careful not to damage any cables, lines or linkage.

To install, reverse the removal procedure and include the following:

Before installing the flex plate to converter bolts, make certain that the weld nuts on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Hand start the three bolts and tighten finger tight, then torque to specifications. This will insure proper converter alignment. Install new oil seal on oil filler tube before installing tube.

Torque all fasteners to specifications - See "Specifications". Adjust shift linkage - see "Shift Linkage Adjustments*.

Adjust T.V./Detent Cable - See "T.V./Detent Cable Adjustment". Refill transmission with fluid - See "Checking and Adding Fluid".

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS

MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., SHOULD BE PERFORMED PRIOR TO USING THIS CHART.

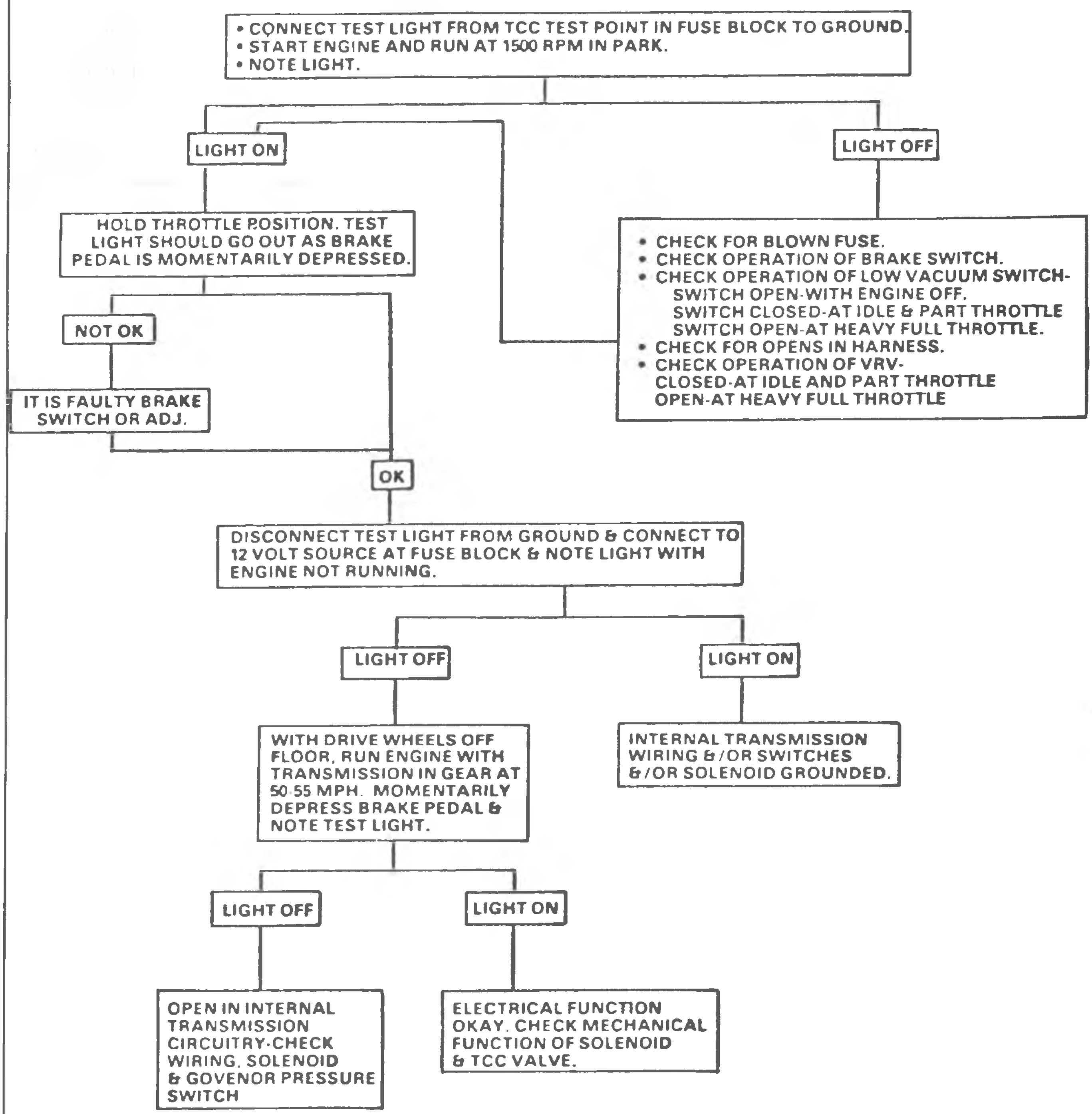


Fig. 7A-34--T.C.C. Diagnosis

Transmission to Engine Attachment	50 N·m	(35 ft. lbs.)
Transmission Support Brace Attachments	90 N·m	(65 ft. lbs.)
Control Rod Linkage Adjustment Bolt	30 N·m	(20 ft. lbs.)
TV/Detent Cable to Case	10 N.m	(7 ft. lbs.)
Converter Housing Cover (Except K-Series)	10 N·m	(7 ft. lbs.)
Converter Housing Cover (K-Series)	35 N·m	(25 ft. lbs.)
Oil Cooler Lines to Transmission	15 N·m	(10 ft. lbs.)
Oil Cooler Lines to Radiator	30 N·m	(20 ft. lbs.)
Transfer Case Adapter to Transmission	35 N·m	(25 ft. lbs.)
Transfer Case Adapter to Transfer Case	35 N·m	(25 ft. lbs.)
Transfer Case Support Strut to Transfer Case	175 N·m	(130 ft. lbs.)
Transfer Case Support Strut to Engine	50 N·m	(35 ft. lbs.)

102927

Fig. 7A-SP Specifications

SECTION 350C

AUTOMATIC 350C TRANSMISSION

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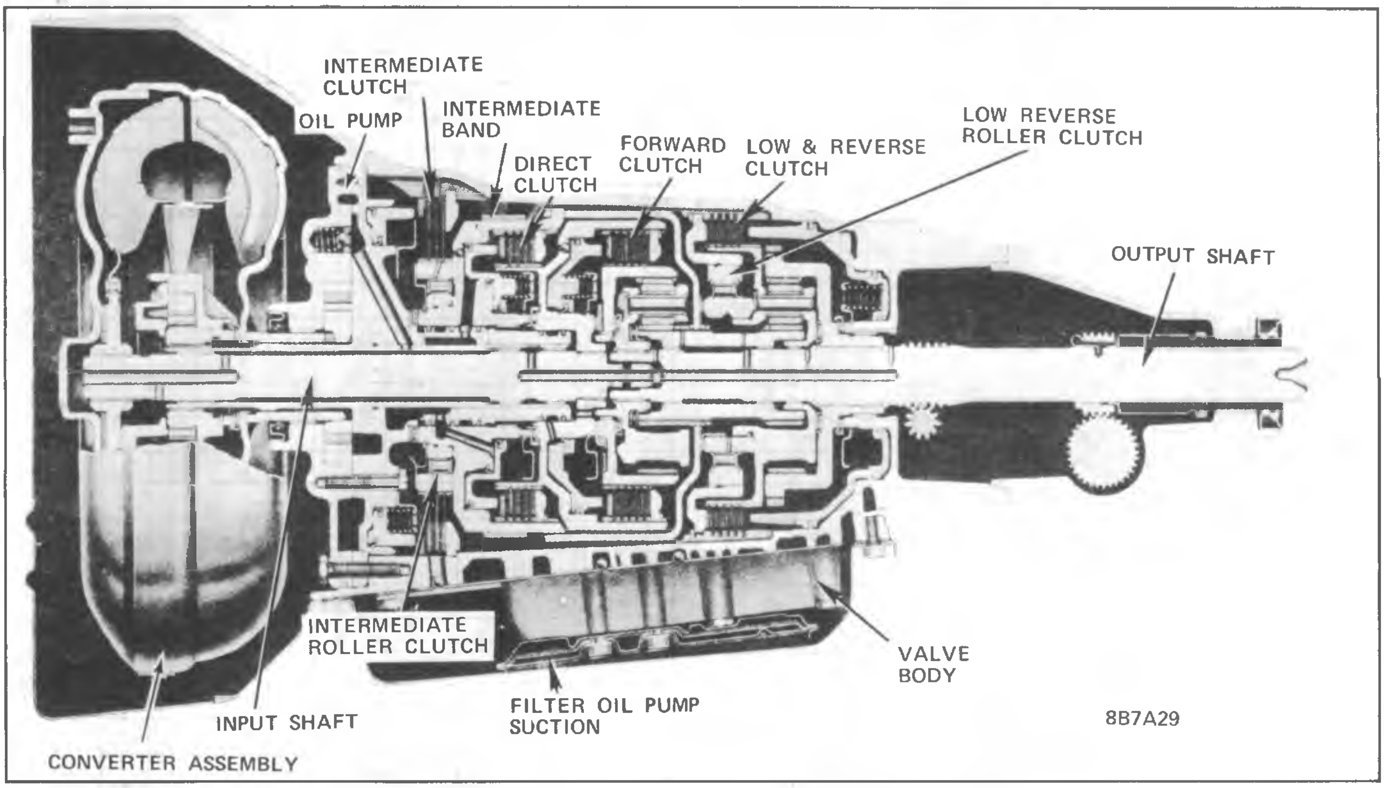

Figure 350C-1 Typical 350 Automatic Transmission

GENERAL DESCRIPTION

The 350C automatic transmission, is a fully automatic unit consisting primarily of a 4-element hydraulic torque converter and two planetary gear sets. Four multiple-disc clutches, two roller clutches, and an intermediate overrun band provide the friction elements required to obtain the desired function of the two planetary gear sets.

A hydraulic system pressurized by a gear type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

1. Manual Linkage - To select the desired operating range.
2. Engine Vacuum - To operate the vacuum modulator.
3. Detent Cable - To operate the detent valve.

TROUBLE DIAGNOSIS

The key to correcting any complaint is to make use of all the available symptoms and logically letting them direct you to the cause. Symptoms or conditions that will help are determined by subjective road test, oil pressure checks or noise evaluation.

When dealing with automatic transmission complaints, it is best to gather as many symptoms as possible before making the decision to remove the transmission from the vehicle. Remember, **THE VEHICLE IS THE BEST TEST STAND AND DIAGNOSTIC TOOL AVAILABLE TO YOU,** if the transmission is operable. Once the transmission is on the bench, it cannot tell you "what hurts" and quite frequently the correction of the cause of the complaint does not require removal of the transmission from the vehicle.

350 AUTOMATIC TRANSMISSION
DIAGNOSIS CHART

PROBLEM

CAR ROAD TEST →

LEGEND
X—PROBLEM AREA V.S. CAUSE
*—@ "O" VACUUM ONLY
O—BALLS #2/3/4 ONLY
L—LOCKED
S—STUCK

POSSIBLE CAUSE	ALL RANGES—SLIPS	DRIVE—SLIPS—NO 1ST GEAR	LINE PRESSURE—ALL LOW	LINE PRESSURE—ALL HIGH	1-2 INTERM. CL. PRES. HIGH	1-2 INTERM. CL. PRES. LOW	2-3 DIRECT CL. PRES. HIGH	2-3 DIRECT CL. PRES. LOW	NO 1-2 UPSHIFT	1-2 U.S. EARLY/LATE	1-2 UPSHIFT @ W.O.T. ONLY	SLIPS—1-2 UPSHIFT	ROUGH—1-2 UPSHIFT	NO 2-3 UPSHIFT	2-3 U.S.—EARLY/LATE	SLIPS—2-3 UPSHIFT	ROUGH—2-3 UPSHIFT	NO WOT. 1-2 UPSHIFT	NO—PART TH. DOWN SHIFT	NO—FULL TH. DOWN SHIFT	2-3 UPSHIFT—W.O.T. ONLY	HARSH—DOWN SHIFT	L1 RANGE—NO ENG. BRAKING	L2 RANGE—NO ENG. BRAKING	NEUTRAL—DRIVES IN NEUTRAL	REVERSE—NO REVERSE	SLIPS IN REVERSE	PARK—NO PARK—RATCHETS	NOISY—ALL RANGES	1-2 2-3 SHIFT NOISY	REV. & D, L1 & L2 NOISY	LOW COOLER—FLOW	SPEWS OIL OUT BREATHER
LOW OIL LEVEL/WATER IN OIL	X	X	X			X		X				X				X											X		X	X		X	X
VACUUM LEAK				X	X		X		X	X	X		X		X		X				X												
MODULATOR & / OR VALVE	X	X	*	X	X							X	X		X	X	X										X						
STRAINER & / OR GASKET	X	X	X			X		X																			X		X			X	X
GOVERNOR—VALVE/SCREEN			X	X					X	X					X																		
VALVE BODY—GASKET/PLATE	X	X	X			X		X	X	X		X		X	X	X											X		X				
PRES. REG. & / OR BOOST VALVE	X	X	X	X	X	X	X	X	X			X	X			X	X						X	X		X	X						
BALL (#1) SHY	X	X	*			X				X		X			X	X						O				X	X						
1-2 SHIFT VALVE						X			X	X	X	X											X				X						
2-3 SHIFT VALVE								X						X	X	X	X		X														
MANUAL LOW CONT'L VALVE																							X										
DETENT VALVE & LINKAGE				X							X				X				X	X	X												
DETENT REG. VALVE																		X															
2-3 ACCUMULATOR						X						X					X																
MANUAL VALVE/LINKAGE	X	X	X																				X	X		X	X						
POROSITY/CROSS LEAK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X		X	X						
PUMP—GEARS	X	X	X			X		X				X				X													X				
PRIMING VALVE SHY	X	X	X																														S
COOLER VALVE LEAK																																X	X
CLUTCH SEAL RINGS	X	X	X			X		X	X			X		X		X							X	X		X	X						
POROUS/CROSS LEAK	X	X	X			X		X	X			X	X	X		X		X								X	X					X	X
GASKET SCREEN—PRESSURE	X	X	X																							X	X		X			X	
BAND—INTERM, O.R.																								X									
CASE—POROUS/X LEAK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X			X	X					X	
1-2 ACCUMULATOR	X	X	X			X			X			X	X																				
INTERMED. SERVO		X	X			X						X												X									
FORWARD CLUTCH ASS'Y		X																					X	X	X	L							
DIRECT CLUTCH ASS'Y								X						X		X										X	X			X			
INTERMED. CL. ASS'Y						X			X			X																		X			
L & REV. CL. ASS'Y																							X			X	X						
INT. ROLLER CL. ASS'Y									X			X												X									
L. & R. ROLLER CL. ASS'Y		X																															
PARK PAWL/LINKAGE																												X					
CONVERTER ASS'Y																													X		X		
GEAR SET & BEARINGS																													X	X			

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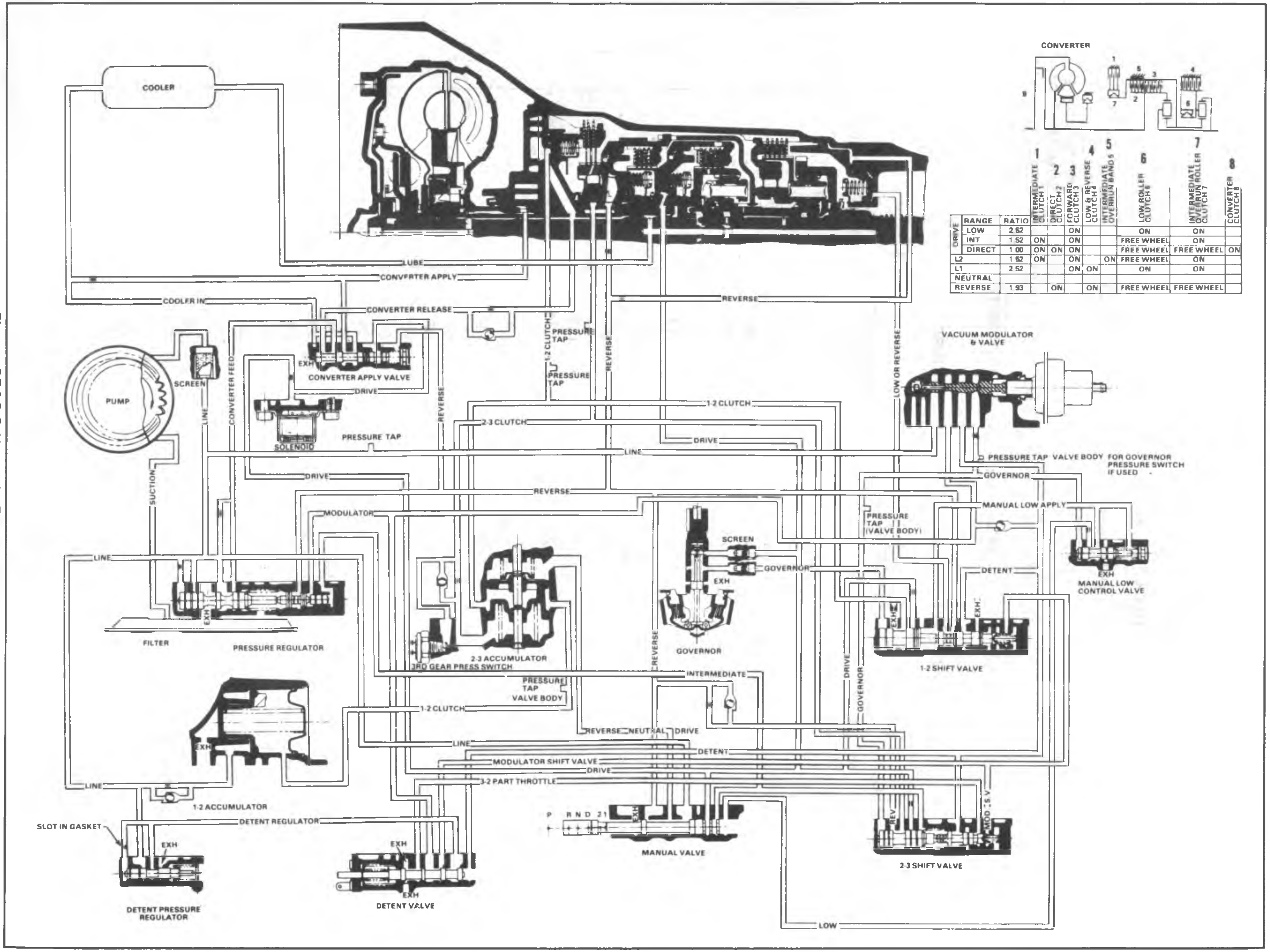
Figure 2 Diagnosis Chart



	RANGE	RATIO	1 INTERMEDIATE CLUTCH 1	2 DIRECT CLUTCH 2	3 FORWARD CLUTCH 3	4 LOW & REVERSE CLUTCH 4	5 INTERMEDIATE OVERRUN BAND 5	6 LOW ROLLER CLUTCH 6	7 INTERMEDIATE OVERRUN ROLLER CLUTCH 7	8 CONVERTER CLUTCH 8
DRIVE	LOW	2 52			ON			ON	ON	
	INT	1 52	ON		ON			FREE WHEEL	ON	
	DIRECT	1 00	ON	ON	ON			FREE WHEEL	FREE WHEEL	ON
L2		1 52	ON		ON		ON	FREE WHEEL	ON	
L1		2 52			ON	ON		ON	ON	
NEUTRAL										
REVERSE		1 93		ON		ON		FREE WHEEL	FREE WHEEL	

Figure 350C-3 Neutral - Engine Running

1984 THM 350C

PRELIMINARY CHECKING PROCEDURE

CHECK TRANSMISSION OIL LEVEL

CHECK OUTSIDE MANUAL LINKAGE AND CORRECT

CHECK ENGINE TUNE

INSTALL OIL PRESSURE GAGE

CONNECT VACUUM GAGE TO MODULATOR LINE & TACHOMETER TO ENGINE

TOTAL RUNNING TIME FOR THIS COMBINATION NOT TO EXCEED 2 MINUTES.

CHECK OIL PRESSURES IN FOLLOWING MANNER

RANGE	MODELS	– PSI – Modulator* Line Connected	Modulator** Line Disconnected
DRIVE – BRAKES APPLIED	WC, XC, XN	55 - 64	119 - 139
	XA	68 - 88	148 - 171
	XS, XX	55 - 64	148 - 173
	WA, WS	55 - 66	119 - 139
	WW	55 - 64	119 - 139
L2 or L1 – BRAKES APPLIED	WC, XC, XN	82 - 95	119 - 139
	XA	89 - 111	148 - 172
	XS, XX	80 - 93	148 - 173
	WA, WS	82 - 96	119 - 139
	WW	82 - 95	119 - 139
REVERSE – BRAKES APPLIED	WC, XC, XN	88 - 103	217 - 103
	XA	102 - 134	226 - 259
	XS, XX	83 - 97	237 - 270
	WA, WS	88 - 105	237 - 286
	WW	88 - 103	228 - 260
NEUTRAL – BRAKES APPLIED	WC, XC, XN	55 - 62	119 - 139
	XA	68 - 86	148 - 170
	XS, XX	55 - 62	148 - 173
	WA, WS	55 - 66	119 - 139
	WW	55 - 64	119 - 139
DRIVE IDLE – SET ENGINE IDLE TO SPECIFICATIONS BRAKES APPLIED	WC, XC, XN	55 - 64	
	XA	68 - 88	
	XS, XX	55 - 64	
	WA, WS	55 - 66	
	WW	55 - 64	
DRIVE – 30 MPH CLOSED THROTTLE OR ON HOIST*	WC, XC, XN	55 - 64	
	XA	68 - 88	
	XS, XX	55 - 64	
	WA, WS	55 - 66	
	WW	55 - 64	

*MODULATOR LINE CONNECTED: Run engine to 1,000 RPM, close throttle and check PSI

**MODULATOR LINE DISCONNECTED: Check PSI at 1,000 RPM, throttle open

350C-15B

Figure 350C-4 Oil Pressure Chart

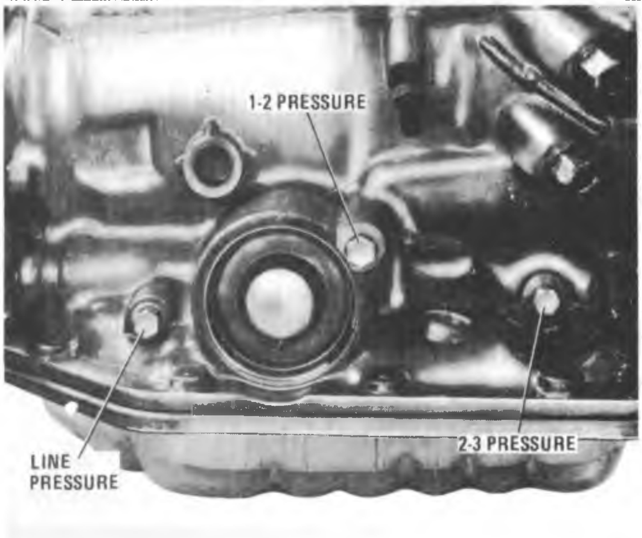
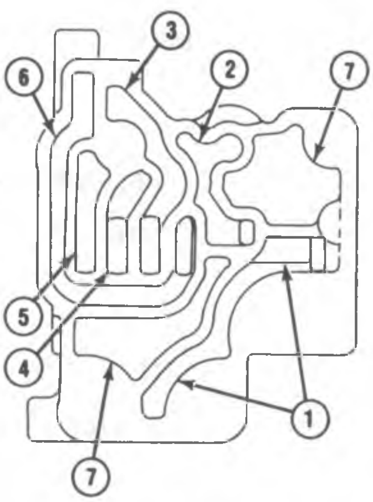
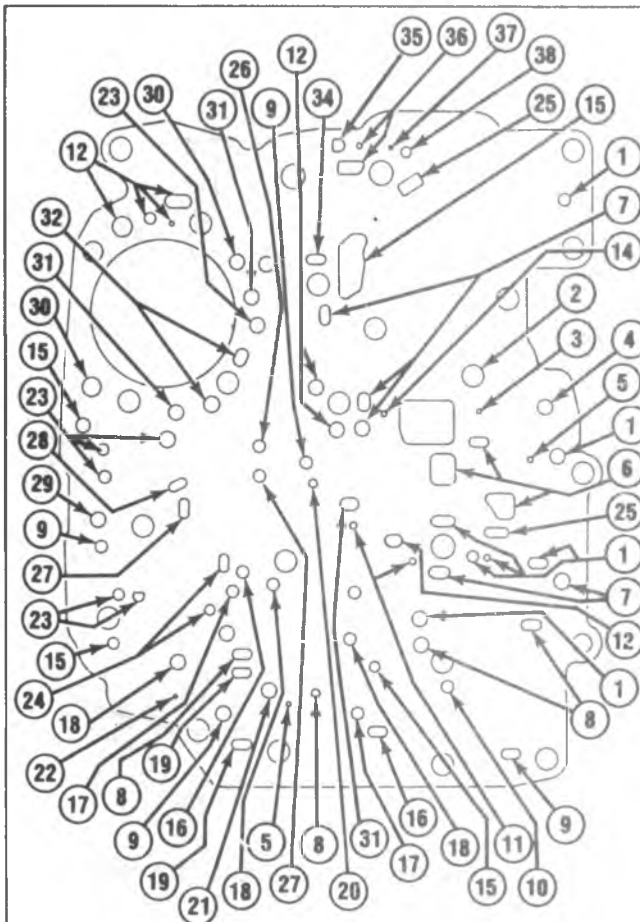


Figure 350C-5 Line Pressure Plug Location



1. REVERSE
2. 2-3 CLUTCH
3. CONVERTER APPLY
4. CONVERTER FEED
5. CONVERTER RELEASE
6. COOLER IN
7. VOID

Figure 350C-6 Auxiliary Valve Body Oil Passages



1. REVERSE
2. BOLT HOLE
3. PUMP PRESSURE ORIFICE
4. EXHAUST
5. REVERSE ORIFICE
6. PUMP PRESSURE
7. DRIVE
8. LOW
9. GOVERNOR
10. MODULATOR
11. DRIVE ORIFICE
12. DIRECT CLUTCH 2-3
13. SUCTION
14. CONVERTER FEED ORIFICE
15. DRAIN
16. MODULATOR THRU DETENT VALVE
17. DETENT MODULATOR (3-2)
18. DETENT
19. MANUAL LOW CONTROL
20. EXHAUST 1-2 CLUTCH
21. LOW REVERSE CLUTCH
22. GOVERNOR ORIFICE
23. LINE
24. MODULATOR
25. CONVERTER FEED
26. MODULATOR OR DETENT REGULATOR
27. DETENT REGULATOR
28. EXHAUST INT. CLUTCH
29. INTERMEDIATE SERVO (R.N.D.)
30. INTERMEDIATE CLUTCH 1-2
31. INT. SERVO REL. (RND)

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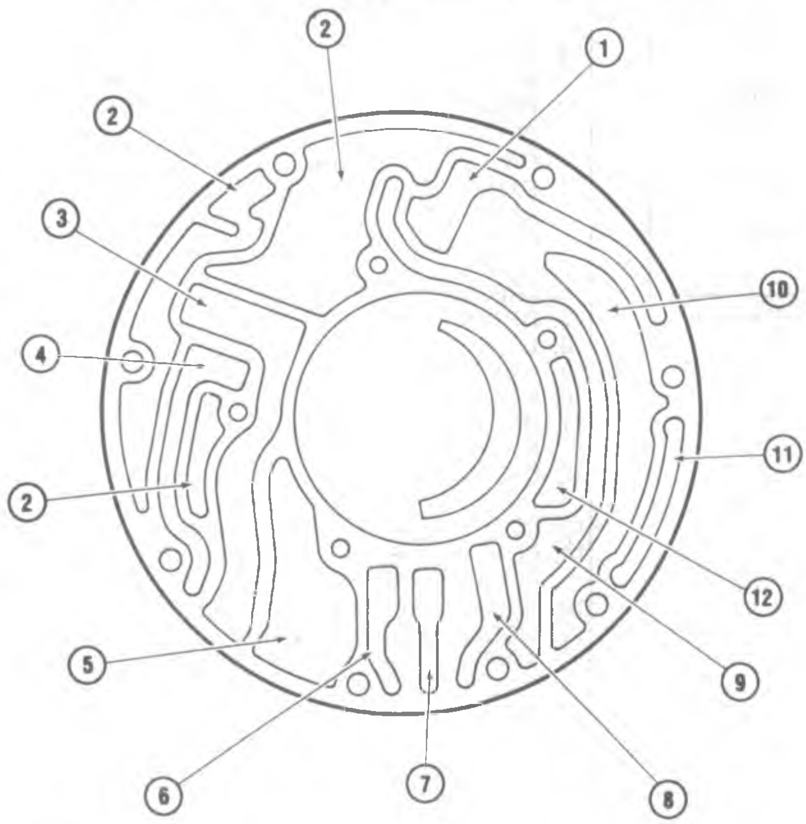
Figure 350C-7 Valve Body Spacer Plate

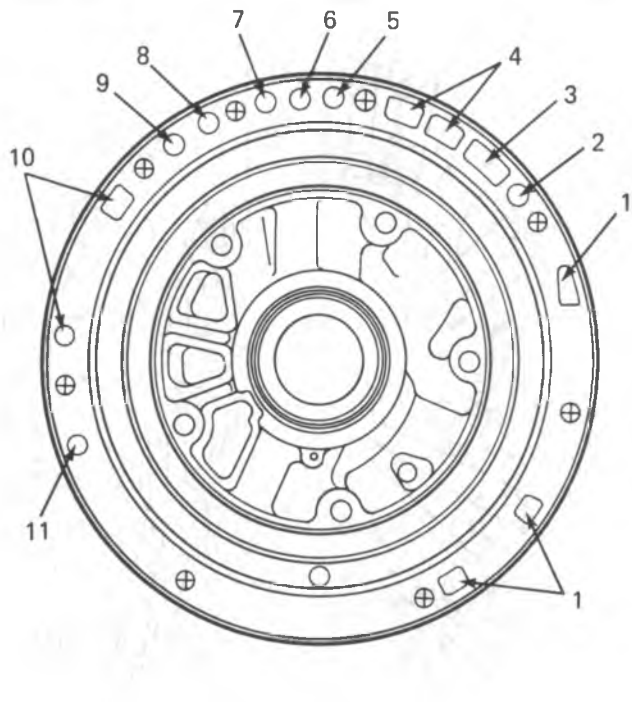
IDENTIFICATION OF OIL CHANNELS IN PUMP COVER



IDENTIFICATION OF OIL CHANNELS IN PUMP BODY FRONT FACE

1. COOLER OUT
2. EXHAUST
3. PUMP PRESSURE
4. REVERSE (DIRECT CLUTCH OUTER)
5. SUCTION
6. CONVERTER RELEASE
7. FORWARD CLUTCH (DRIVE)
8. DIRECT CLUTCH
9. INTERMEDIATE CLUTCH
10. CONVERTER CLUTCH APPLY
11. COOLER IN
12. LIP SEAL DRAIN

Figure 350C-8 Identification of Oil Pump Passages

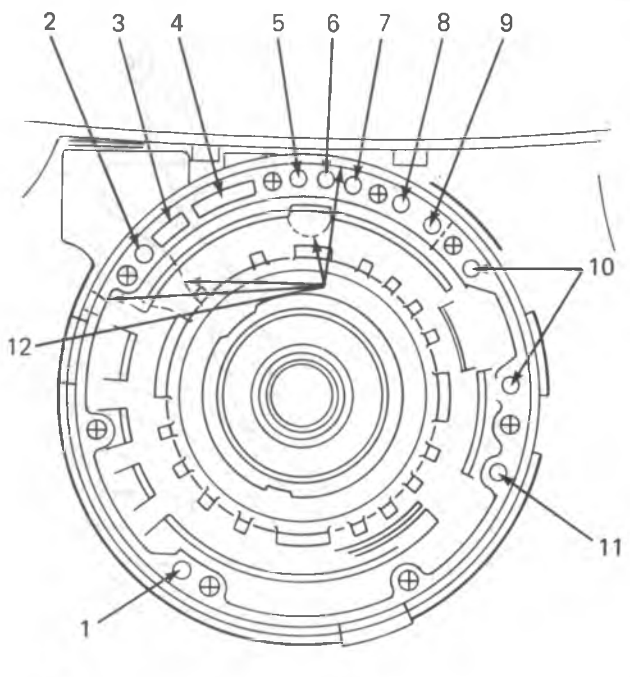


ILL. NO. | DESCRIPTION

1 BREATHER
2 REVERSE (DIRECT CLUTCH — OUTER)
3 PUMP PRESSURE
4 SUCTION
5 CONVERTER RELEASE
6 FORWARD CLUTCH
7 DIRECT CLUTCH
8 INTERMEDIATE CLUTCH APPLY
9 CONVERTER APPLY
10 COOLER IN
11 COOLER OUT

350C-14B

Figure 350C-9 Identification of Pump Rear Face Oil Passages

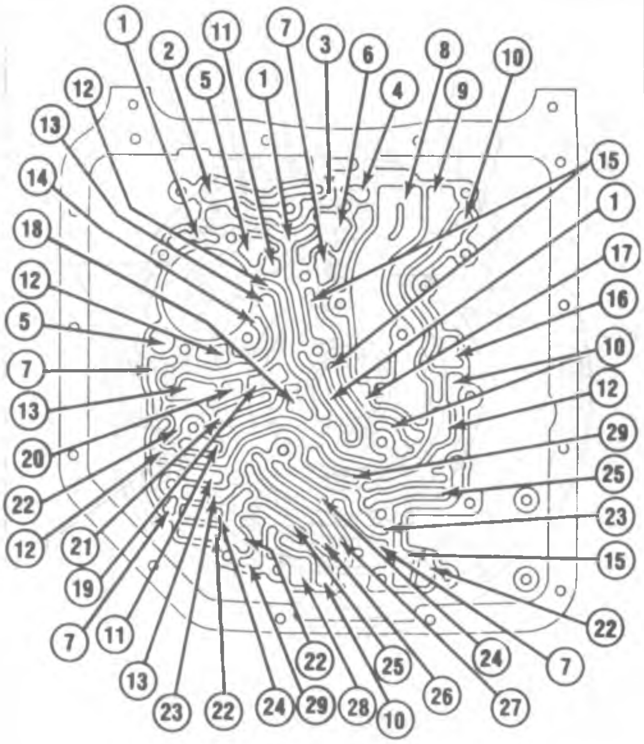


ILL. NO. | DESCRIPTION

X BOLT HOLES
1 BREATHER
2 REVERSE (DIRECT CLUTCH — OUTER)
3 PUMP PRESSURE
4 SUCTION
5 C.C. RELEASE
6 FORWARD CLUTCH
7 DIRECT CLUTCH
8 INTERMEDIATE CLUTCH APPLY
9 CONVERTER APPLY
10 COOLER IN (TO RADIATOR)
11 COOLER OUT (FROM RADIATOR)
12 DRAIN (4) CAST OPEN PORTS

7C-56B

Figure 350C-10 Identification of Case to Pump Oil Passages



1. DIRECT CLUTCH (2-3)
2. COOLER IN
3. CONVERTER APPLY
4. CONVERTER RELEASE
5. INTERMEDIATE CLUTCH (1-2)
6. DRIVE FORWARD CLUTCH
7. DRAIN
8. SUCTION
9. PUMP PRESSURE
10. REVERSE
11. VOID
12. INTERMEDIATE SERVO RELEASE (R, N, D)
13. LINE
14. 2-3 CLUTCH
15. DRIVE
16. EXHAUST
17. CONVERTER FEED
18. EXHAUST (1-2) CLUTCH
19. MODULATOR OR DETENT REGULATOR
20. EXHAUST INTERMEDIATE CLUTCH
21. DETENT REGULATOR
22. GOVERNOR
23. MODULATOR
24. DETENT 2
25. LOW
26. DETENT MODULATOR (3-2)
27. MODULATOR THRU DETENT VALVE
28. LOW REVERSE CLUTCH
29. MANUAL LOW CONTROL

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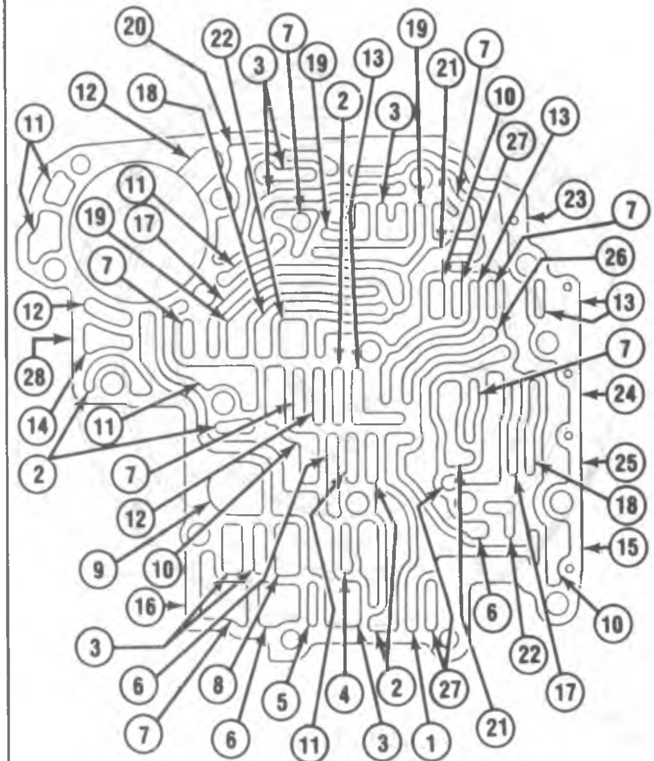
Figure 350C-11 Identification of Case Face Oil Passages



1. INTERMEDIATE (L_2)
2. DRIVE
3. LINE
4. CONVERTER FEED
5. SPEED RELEASE
6. REVERSE
7. EXHAUST
8. EXHAUST OPEN TO SUMP
9. SUCTION
10. GOVERNOR
11. 2-3 CLUTCH
12. 1-2 CLUTCH
13. MANUAL LOW CONTROL
14. VOID
15. PRESSURE REGULATOR
16. MANUAL
17. DETENT 1
18. MODULATOR OR DETENT REGULATOR
19. DETENT REGULATOR
20. INTERMEDIATE SERVO RELEASE
21. DETENT 2
22. MODULATOR
23. DETENT PRESSURE REGULATOR
24. 1-2 SHIFT
25. 2-3 SHIFT
26. LOW OR REVERSE
27. LOW
28. DETENT

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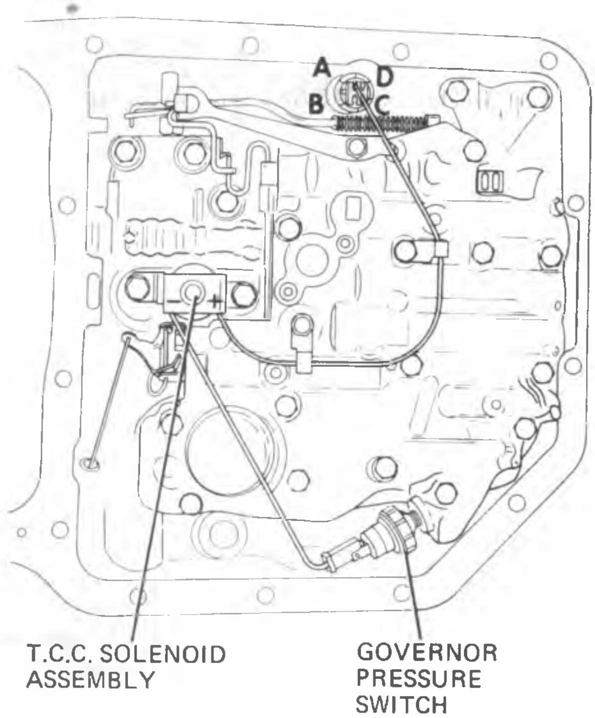
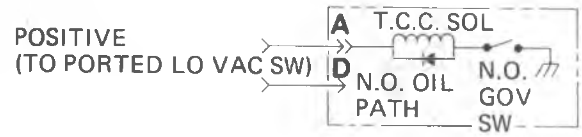
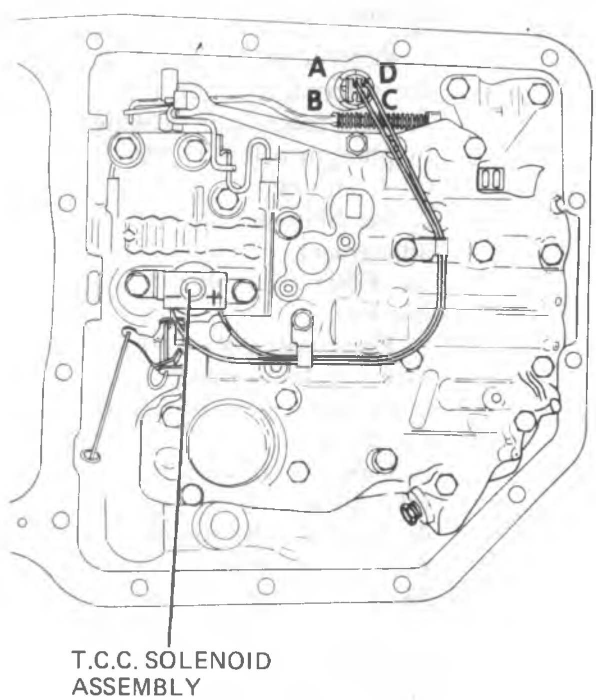
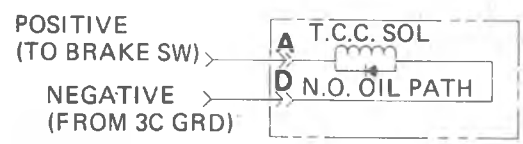
Figure 350C-12 Identification of Valve Body Oil Passages





4.1 L C- TRUCK
5.7 L B- POLICE–CANADA
5.0 L B-SEDAN– CANADA
4.1 L G- VAN–SHORT
4.1 L G- VAN– LONG





5.0 L H.P. MONTE CARLO

Figure 350C-13 350-C Wiring Diagrams

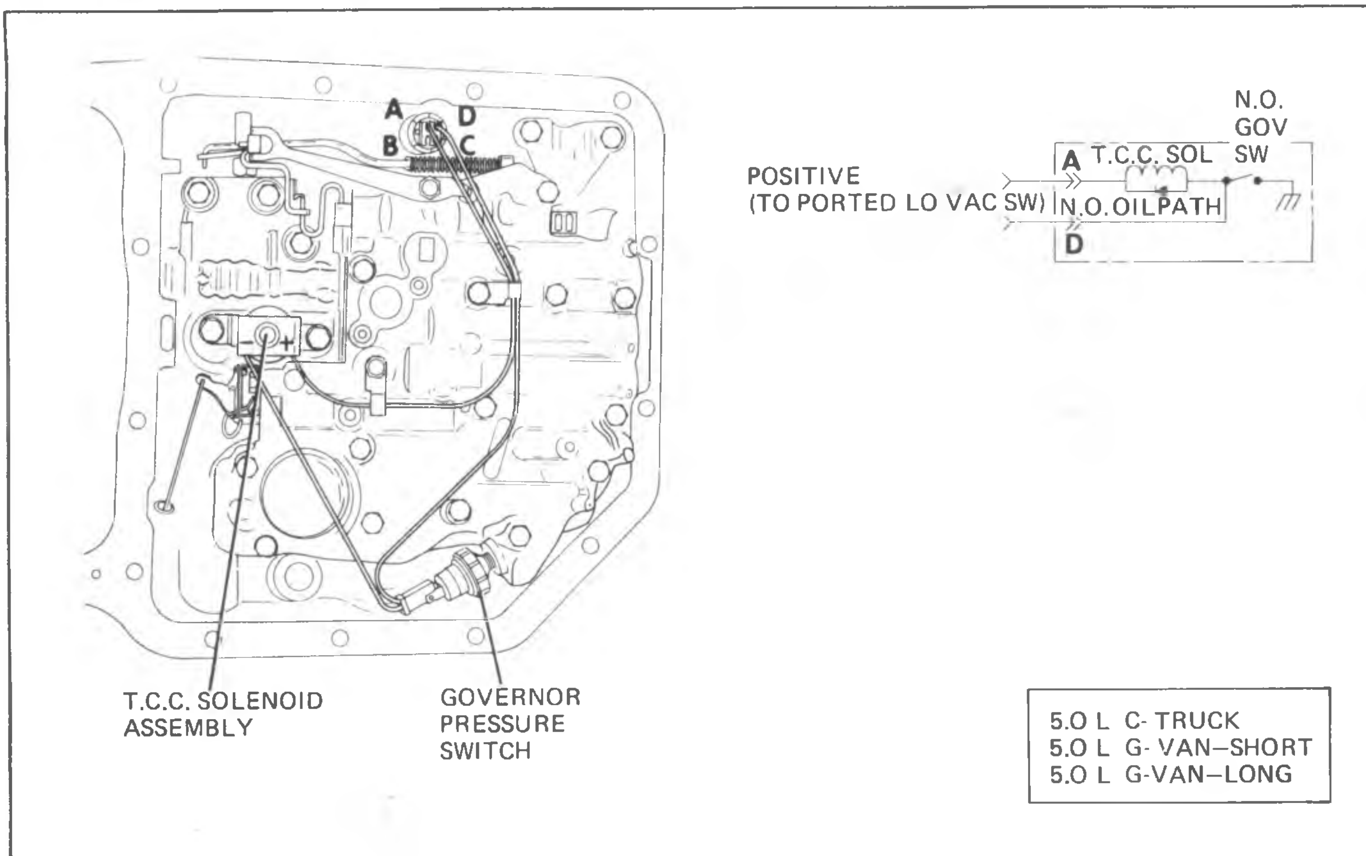


Figure 350C-13A 350-C Wiring Diagram

350C TROUBLE DIAGNOSIS CHART

Condition	Possible Cause	Correction
No drive range - (install pressure gage).	1. Low oil level.	1. Correct level - check for external leaks or vacuum modulator (leaking diaphragm will evacuate oil from unit).
	2. Manual Linkage adjustment.	2. See Manual linkage adjustment.
	3. Low oil pressure.	3a. Filter assembly blocked. b. Pump assembly - pressure regulator, pump drive gear - tangs damaged by converter. c. Case - porosity in intake bore.
	4. Control valve assembly.	4. Manual valve disconnected from inner lever.
	5. Forward clutch.	5a. Forward clutch does not apply - piston cracked; seals missing, damaged; clutch plates burned. b. Pump feed circuit to forward clutch oil seal rings missing or broken on pump cover; leak in feed circuits; pump to

		case gasket mispositioned or damaged. Clutch drum ball check stuck or missing.
	6. Roller clutch assembly.	6. Broken spring or damaged cage.
Oil pressure high low	1. High oil pressure.	1a. Vacuum line or fittings leaking. b. Vacuum modulator. c. Modulator valve. d. Pressure regulator. e. Oil pump.
	2. Low oil pressure.	2a. Vacuum line or fittings obstructed. b. Vacuum modulator. c. Modulator valve. d. Pressure regulator. e. Governor. f. Oil pump.
1-2 shift - full throttle only.	1. Detent valve misadjusted.	1. Sticking or linkage
	2. Vacuum leak.	2. Vacuum line or fittings leaking.
	3. Control valve assembly.	3a. Valve body gaskets - leaking, damaged, incorrectly installed. b. Detent valve train stuck. c. 1-2 valve stuck.
	4. Case assembly.	4. Porosity.
First speed only - no 1-2 shift.	1. Governor assembly.	1a. Governor valve sticking. b. Driven gear loose, damaged or worn (check for pin in case and length of pin showing); also, check output shaft drive gear for nicks or rough finish, if driven gear shows damage..
	2. Control valve assembly.	2a. 1-2 shift valve train stuck closed. b. Governor feed channels blocked. c. Valve body gaskets - leaking, damaged, incorrectly installed.
	3. Case	3a. Porosity between channels. b. Governor feed channel blocked, governor bore scored or worn, allowing cross pressure leak.
	4. Intermediate clutch.	4a. Clutch piston seals - missing, improperly assembled, cut. b. Intermediate roller clutch.

		Broken spring or damaged cage.
First and second speeds only, no 2-3 shift.	1. Control valve assembly. 2. Direct clutch.	1a. 2-3 shift train stuck. b. Valve body gaskets - leaking, damaged, incorrectly installed. 2a. Pump hub - direct clutch oil seal rings - broken, missing. b. Clutch piston seals - missing, improperly assembled, cut, piston ball check stuck or missing.
Drive in "Neutral".	1. Manual linkage. 2. Forward clutch.	1. Misadjusted 2. Clutch does not release - (this condition will also cause "No Reverse").
No motion in "Reverse", or slips in "Reverse" - (install pressure gage).	1. Low oil level. 2. Manual linkage. 3. Oil pressure. 4. Control valve assembly. 5. Intermediate servo. 6. Low and reverse clutch. 7. Direct clutch. 8. Forward clutch.	1. Add oil. 2. Misadjusted. 3a. Modulator valve stuck. b. Modulator and reverse boost valve stuck. c. Pump hub - direct clutch oil seal rings broken. d. Direct clutch piston seal cut or missing. e. Low and reverse clutch piston seal cut or missing. f. No. 1 check ball missing. 4a. Valve body gaskets - leaking, damaged, incorrectly installed (other malfunctions may also be indicated). b. 2-3 valve train stuck in upshifted position. This will also cause 1-3 upshift in drive range. c. 1-2 valve train stuck in upshifted position. 5a. Piston or pin stuck so intermediate overrun band is applied. 6. Piston out or seal damaged or missing. 7a. Outer seal damaged or missing. b. Clutch plates burned - may be caused by stuck ball check in piston. 8. Clutch does not release (will also cause "Drive" in "Neutral".

Slips in all ranges, slips on take-off - (install pressure gage).	1. Oil level low.	1. Add oil.
	2. Oil pressure.	2a. Vacuum modulator inoperative. b. Vacuum modulator valve sticking. c. Filter assembly - plugged or leaks.
	3. Case	3a. Pressure regulator valve stuck. b. Pump to case gasket damaged or incorrectly installed.
	4. Forward clutch slipping.	4. Cross leaks, porosity.
Slips 1-2 shift - (install pressure gage).	1. Oil level low.	1. Add oil.
	2. Oil pressure.	2a. Vacuum modulator assembly inoperative. b. Modulator valve sticking. c. Pump pressure regulator valve.
	3. 2-3 accumulator.	3. Oil ring damaged or missing.
	4. 1-2 accumulator.	4. Oil ring missing or damaged, case bore damaged.
	5. Pump to case gasket.	5. Mispositioned
	6. Case	6. Porosity between channels.
	7. Intermediate clutch.	7. Piston seals missing or damaged; clutch plates burned.
Rough 1-2 shift - (instrall pressure gage).	1. Oil pressure. for loose fittings, restrictions in line.	1a. Vacuum modulator - check b. Modulator valve stuck. c. Valve body - regulator or boost valve stuck. d. Pump to case gasket - off location or damaged.
	2. Case	2. Porosity between channels.
	3. 1-2 accumulator assembly.	3a. Oil rings damaged. b. Piston stuck. c. Broken or missing spring. d. Bore damaged. e. Check accumulator feed hole in valve body plate.

Slips 2-3 shift - (install pressure gage).	1. Oil level low. 2. Oil pressure low. 3. Case 4. Direct clutch.	1. Add oil. 2a. Modulator assembly. b. Modulator valve. c. Pump pressure regulator valve or boost valve; pump to case gasket off location. 3. Porosity 4. Piston seals leaking, or ball check leak.
Rough 2-3 shift - (install pressure gage).	1. Oil pressure high 2. 2-3 accumulator assembly.	1a. Vacuum leak. b. Modulator valve sticking. c. Valve body - pressure regulator or boost valve inoperative. 2a. 2-3 accumulator spring missing, broken. b. Accumulator piston stuck.
No engine braking - L2 - 2nd gear.	1. Intermediate servo and 2-3 accumulator. 2. Intermediate overrun band. 3. Oil pressure low.	1a. Servo or accumulator oil rings or bores leaking. b. Servo piston stuck. 2. Intermediate overrun band broken, burned (check for cause). 3. Pressure regulator and/or boost valve stuck.
No engine braking - L-1 - 1st gear.	1. Manual low control valve assembly. 2. Oil pressure low. 3. Low and reverse clutch.	1. Stuck 2. Pressure regulator and/or boost valve stuck. 3. Piston inner seal damaged or missing.
No part throttle downshift - (install pressure gage).	1. Oil pressure. 2. Detent valve and linkage. 3. 2-3 shift valve.	1. Vacuum modulator assembly, modulator valve, pressure regulator valve train (other malfunctions may also be noticed). 2. Sticks or disconnected or broken. 3. Stuck
No detent downshifts.	1. Control valve assembly. 2. Detent valve and linkage.	1. 2-3 valve stuck. 2. Sticks or disconnected or broken.
Low or high shift points - (install pressure gage).	1. Oil pressure.	1a. Engine vacuum - check at transmission end of the modulator pipe. b. Vacuum modulator assembly vacuum line connections at engine and transmission, modulator valve, pressure

		regulator valve train.
	2. Governor	2a. Valve sticking. b. Feed holes restricted or leaking, pipes damaged or mispositioned. c. Feed line plugged.
	3. Detent valve and linkage.	3. Stuck open. (Will cause late shifts).
	4. Control valve assembly.	4a. 2-3 valve train sticking. b. 1-2 shift valve train sticking.
	5. Case	5. Porosity
Won't hold in "Park".	1. Manual linkage.	1. Misadjusted
	2. Internal linkage.	2a. Parking brake lever and actuator assembly. Check for chamfer on actuator rod sleeve. b. Parking pawl broken or inoperative.
Locks up in manual low (usually hot only).	1. Converter pressure leaking into direct clutch thru stator shaft.	1. Check stator shaft position.
	2. Direct clutch.	2a. Direct clutch bore undersize or piston oversize. b. Direct clutch feed hole shy small chamber.
	3. Lo and Reverse Clutch.	3. Lo and Reverse Clutch piston center seal missing or cut.
Second gear start or slips second gear only.	1. Intermediate clutch.	1. Wrong number of clutch plates or wrong piston.
Locks up in reverse (usually hot only).	1. Forward clutch.	1. Bore undersize or piston oversize.
	2. Direct clutch.	2. Direct clutch feeding forward clutch thru stator shaft. (check stator shaft position.)
Locks in reverse from park to reverse only.	1. Parking pawl.	1. Parking pawl staying in due to a burr on leading edge.
Cold morning reverse no drive till engine warms up.	1. Pressure regulator bore or sleeve tight.	1. Remove and repair.
Shifts cold but not warm.	1. Governor assembly.	1. Nylon gear roll pin shy.
No drive-but has manual low.	1. Low & reverse roller clutch.	1. Low & reverse roller clutch installed backwards.

No 1-2 shift-makes 1-3 shift and 3-1 shift, but has all shifts manually.	1. Intermediate roller clutch.	1. Intermediate roller clutch not locking.
Governor nylon gear stripped 360°.	1. Case pin. missing. 2. Output shaft.	1. Governor case pin 2. Output shaft rough or worn.
Governor gear stripped one sied.	1. Governor sizing in bore.	1. Repair or replace as necessary.
Slow reverse (cold only).	1. Low oil level.	1. Adjust oil level.
Harsh 1-2 shift.	1. 1-2 accumulator.	1a. Piston or spring. b. Accumulator feed hole in valve body plate.
Slow reverse (hot only).	1. Valve body. 2. Shift selector lever.	1a. Leaking valve body support plate. 2a. Bent or S-hook hole off location. b. S-hook bent. c. Detent roller spring hole off location. d. Manual valve S-hook hole off location.
No Converter Clutch	1. Refer to section 6E and 8A. Sections for Converter Clutch Diagnosis.	

UNIT REPAIR

EXTERNAL PARTS (FIGURE 350C-15)

Removal and Inspection

1. Place transmission in Fixture J-8763-02. Do not overtighten. See Figure 350C-14.
2. With transmission in Holding Fixture J-8763-02, remove torque converter assembly. It may be necessary to pry the converter with a screwdriver due to a suction condition caused by the input shaft "O" ring.
3. Refer to Section 7A for converter diagnosis and "on car" service information.

For Transmission Serial Number Information Refer to 0A Section.

4. Remove modulator assembly attaching bolt and retainer.
5. Remove vacuum modulator assembly "O" ring seal and modulator valve from case. See Figure 350C-16.
6. Inspect modulator "O" ring seal for nicks, cuts or damage. Replace if necessary.
7. Refer to Section 7A for vacuum modulator diagnosis and service information.

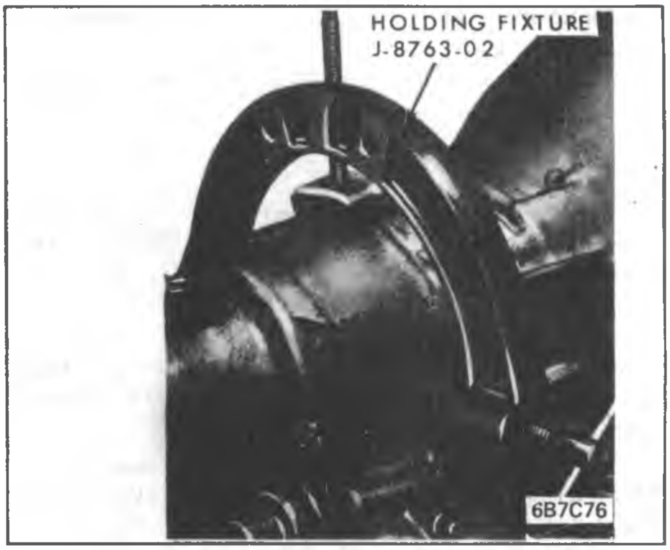


Figure 350C-14 Transmission Holding Fixture

Extension Housing

8. Remove bolt retainer and speedometer driven gear from side of extension housing and remove

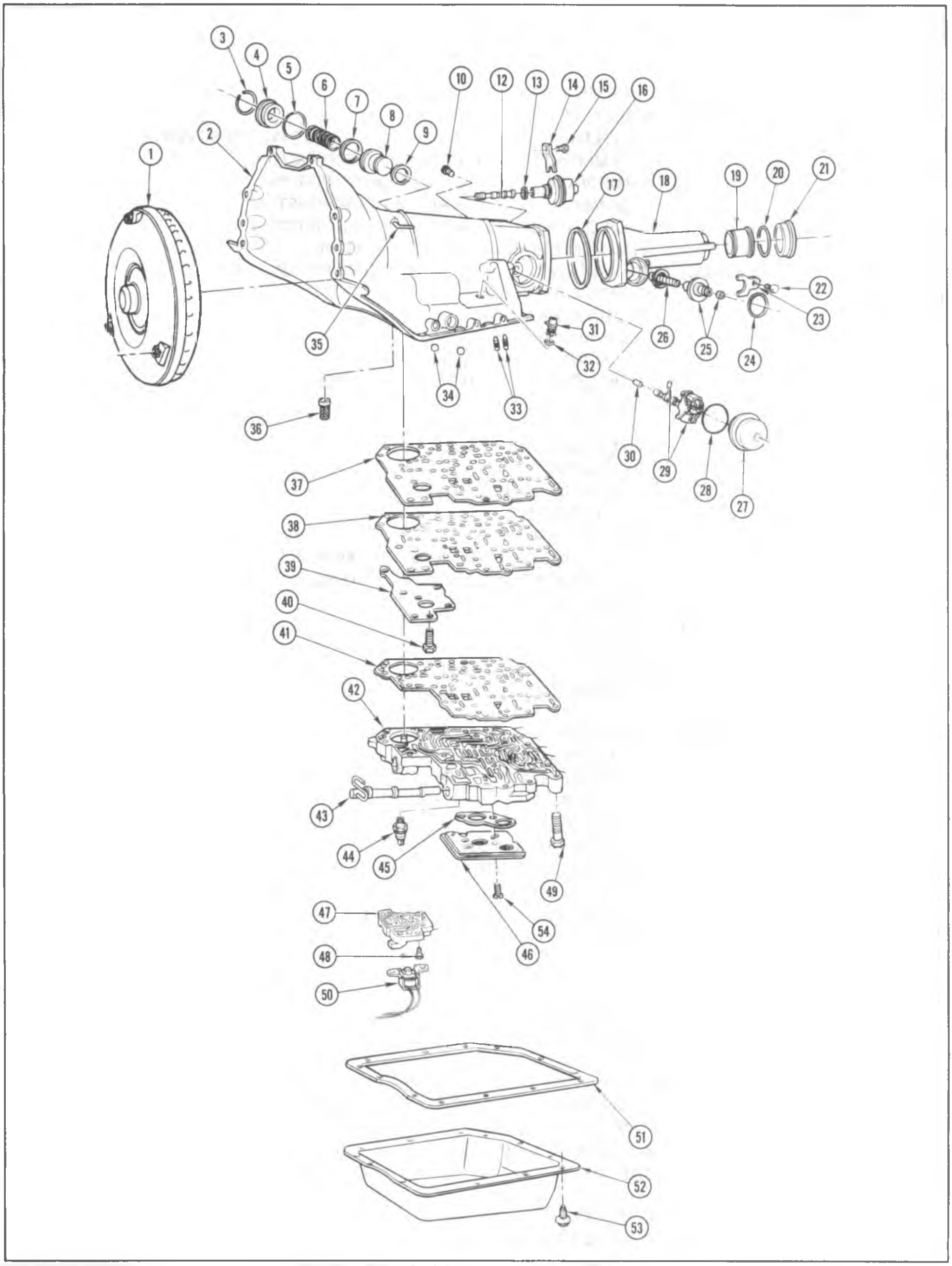


Figure 350C-15 External Parts

ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY, TRANSMISSION
2	CASE ASSEMBLY, TRANSMISSION
3	RETAINER, INTERMEDIATE CLUTCH ACCUMULATOR PISTON COVER
4	COVER, INTERMEDIATE CLUTCH ACCUMULATOR PISTON
5	SEAL, INTERMEDIATE CLUTCH ACCUMULATOR PISTON COVER
6	SPRING, INTERMEDIATE CLUTCH ACCUMULATOR PISTON
7	RING, INTERMEDIATE CLUTCH ACCUMULATOR PISTON SEAL
8	PISTON, INTERMEDIATE CLUTCH ACCUMULATOR
9	RING, INTERMEDIATE CLUTCH ACCUMULATOR PISTON SEAL
10	PLUG, LINE PRESSURE CHECK
12	VALVE, VACUUM MODULATOR
13	SEAL, VACUUM MODULATOR TO CASE
14	RETAINER, VACUUM MODULATOR
15	BOLT, VACUUM MODULATOR RETAINER TO CASE
16	MODULATOR, VACUUM
17	SEAL, CASE EXTENSION TO CASE
18	EXTENSION, TRANSMISSION CASE
19	BUSHING, EXTENSION
20	SEAL, TRANSMISSION OUTPUT YOKE SLEEVE
21	SEAL, CASE EXTENSION OIL
22	BOLT, SLEEVE RETAINER
23	RETAINER, SPEEDOMETER DRIVEN GEAR SLEEVE
24	SEAL, SPEEDO DRIVEN GEAR SLEEVE TO EXTENSION
25	SLEEVE, SPEEDO DRIVEN GEAR
26	GEAR, SPEEDO DRIVEN
27	COVER, GOVERNOR
28	SEAL, GOVERNOR COVER TO CASE
29	GOVERNOR ASSEMBLY, TRANSMISSION
30	PIN, DOWEL
31	CONNECTOR, CASE ELECTRICAL
32	SEAL, CASE ELECTRICAL CONNECTOR
33	SCREEN, GOVERNOR PRESSURE HOLE
34	BALL, CHECK VALVE
35	PIPE, TRANSMISSION VENT
36	SCREEN, OIL PUMP PRESSURE HOLE
37	GASKET, VALVE BODY – UPPER
38	PLATE, VALVE BODY – SPACER
39	SUPPORT, VALVE BODY – SPACER PLATE
40	BOLT, SUPPORT TO CASE
41	GASKET, VALVE BODY – LOWER
42	BODY, VALVE
43	VALVE ASSEMBLY, MANUAL
44	SWITCH, OIL PRESSURE
45	GASKET, OIL PUMP FILTER
46	SCREEN, OIL FILTER
47	BODY, AUXILIARY VALVE
48	BOLT, AUXILIARY VALVE BODY TO VALVE BODY
49	BOLT, VALVE BODY TO CASE
50	SOLENOID, TORQUE CONVERTER CLUTCH
51	GASKET, OIL PAN
52	PAN, OIL
53	BOLT, OIL PAN TO CASE
54	BOLT, OIL SCREEN TO VALVE BODY

Figure 350C-15A External Parts

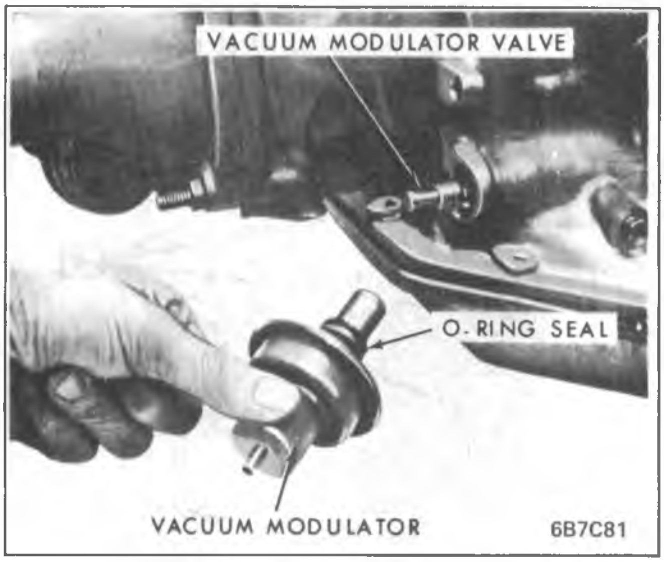


Figure 350C-16 Vacuum Modulator

four (4) extension housing to case attaching bolts. See Figure 350C-17.

9. Remove speedometer drive gear and retaining clip.
10. Inspect gear teeth for nicks, burrs or damage.

Figure 350C-17 Extension Housing

11. Remove extension housing to case oil seal.
12. Remove the extension housing lip seal using a screwdriver. See Figure 350C-18.
13. Remove oil pan and pan gasket.
14. Remove filter assembly and filter gasket.

Valve Body

15. Remove detent roller and spring assembly from valve body. See Figure 350C-19.
16. Remove actuator pin from detent valve actuator lever assembly. Remove detent control link.
17. Disconnect solenoid wires. Remove pressure switch only if replacement is necessary.
18. Remove solenoid attaching bolts and solenoid. Inspect solenoid wires for loose connections and cut or worn insulator.

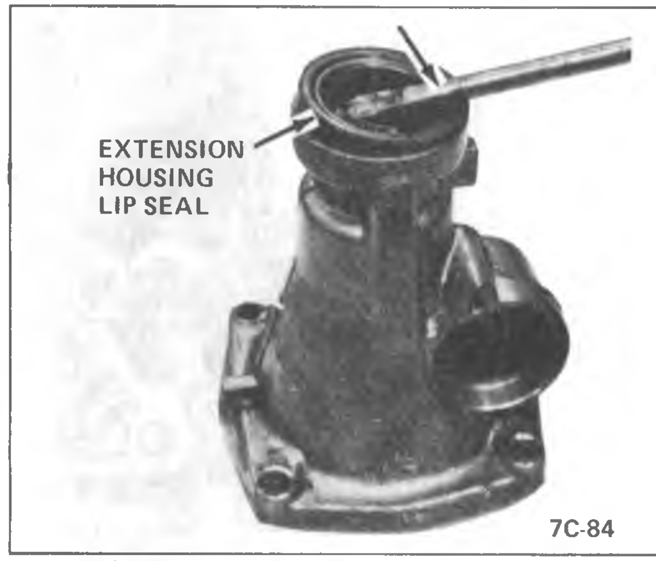


Figure 350C-18 Extension Housing Lip Seal Removal

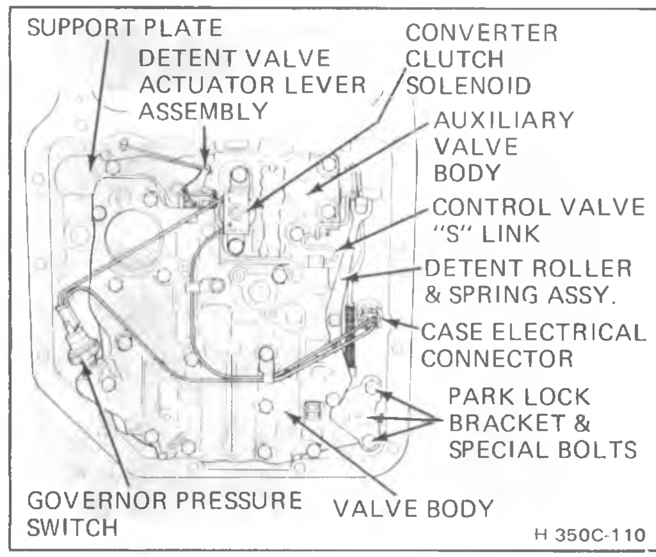


Figure 350C-19 Valve Body and Related Component.

19. Remove manual shaft retaining clip with screwdriver and slide manual shaft outward. This will allow the control valve "S" link to be removed. (Figure 350C-20)
20. Remove valve body attaching bolts and valve body.
21. Remove auxiliary valve body attaching bolts and auxiliary valve body. (Figure 350C-21)
22. Remove support plate attaching bolts and support plate.
23. Remove spacer plate and gaskets. (Figure 350C-22).

    The spacer plate to valve body gasket has a yellow ink stripe. The yellow ink stripe is necessary for identification purposes. This gasket is almost identical to the spacer plate to case gasket.
24. Remove 5 check balls. Note the locations of check balls. (Figure 350C-23).
25. Remove park lock bracket and special bolts. Figure 350C-19.

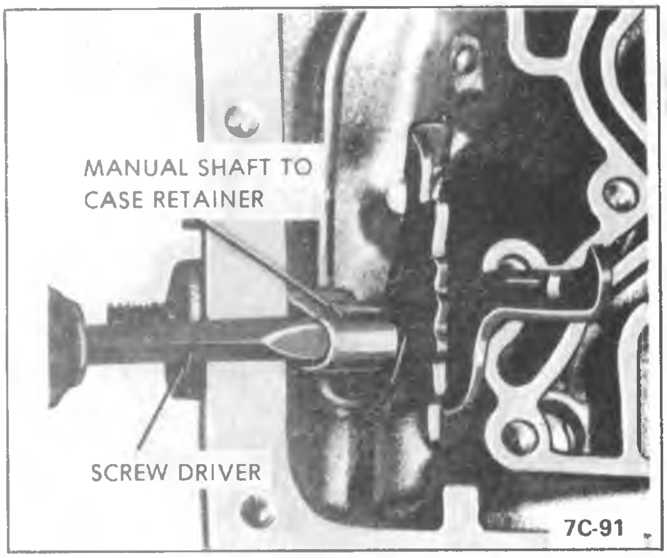


Figure 350C 20 Manual Shaft Retainer Removal

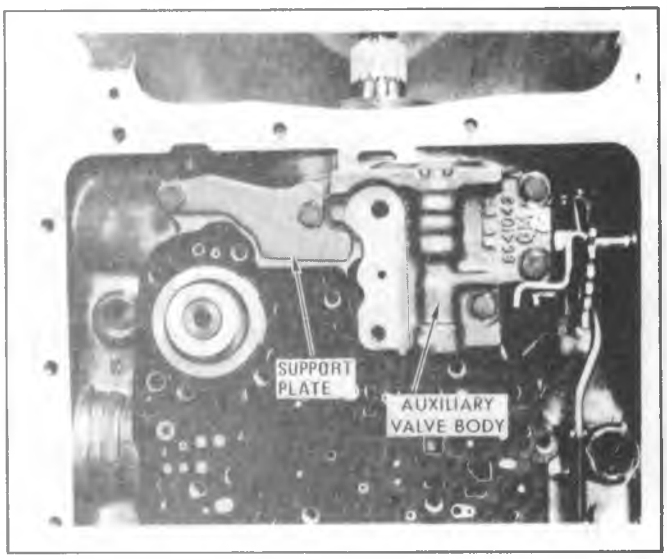


Figure 350C-21 Auxiliary Valve Body and Support Plate

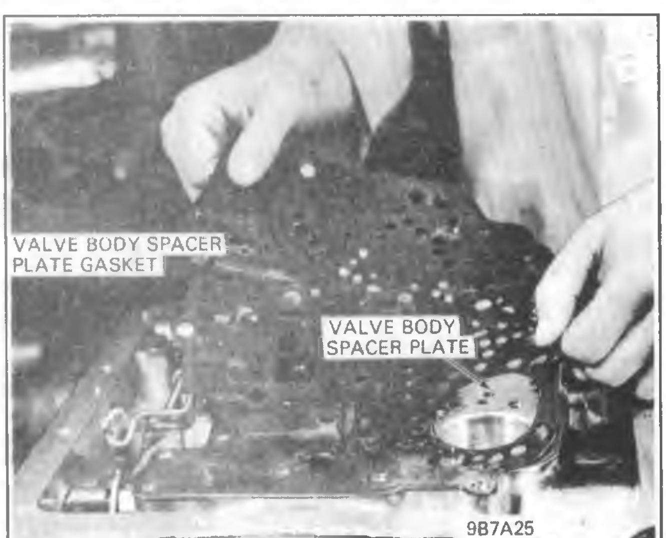


Figure 350C-22 Valve Body and Spacer Plate Gasket

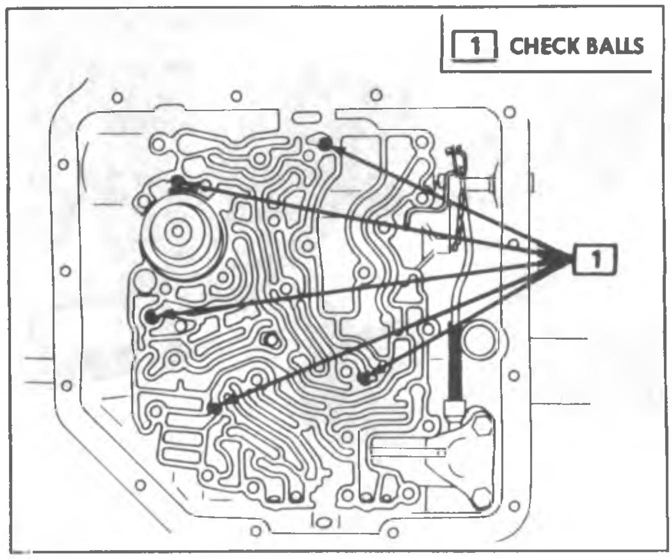


Figure 350C-23 Check Ball Locations

26. Remove oil pump pressure screen from the case. Inspect for damage. Clean or replace as necessary. (Figure 350C-24).

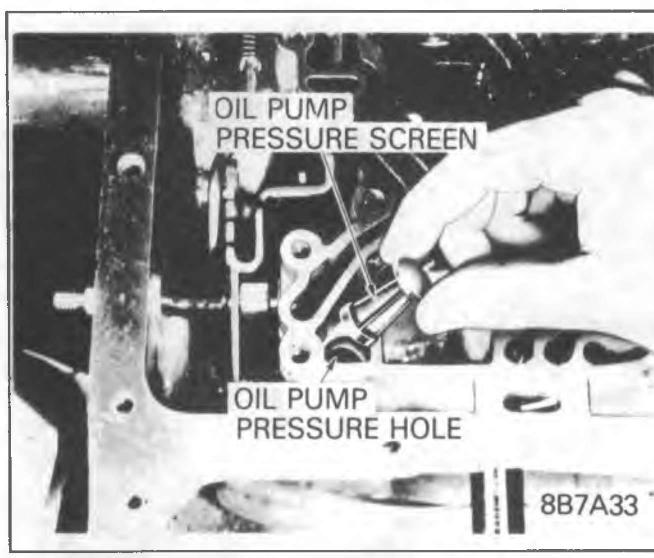


Figure 350C-24 Pump Screen Removal

27. Remove governor screen from case. Inspect for damage. Clean or replace as necessary. (Figure 350C-25.)
28. Remove case electrical connector and "O" ring by depressing tabs.
29. If removal of internal manual linkage is required procede as follows:
    a. Remove jam nut holding range selector inner lever to manual shaft.
    b. Remove manual shaft from case. Remove range selector inner lever and parking pawl actuating rod.
    c. Remove manual shaft to case lip seal, if necessary. See Figure 350C-26.
    d. Remove parking pawl shaft retaining plug stake marks.

    Remove retaining plug, parking pawl shaft, parking pawl, disengaging spring. See Figure 350C-27.

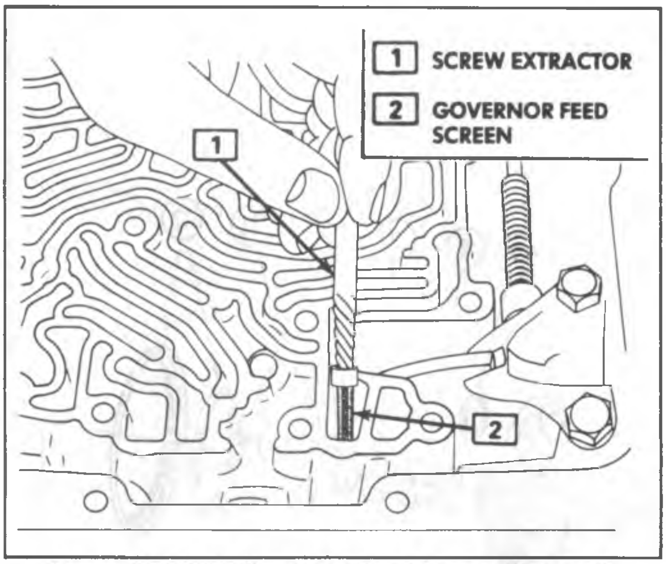


Figure 350C-25 Governor Feed Screen Removal

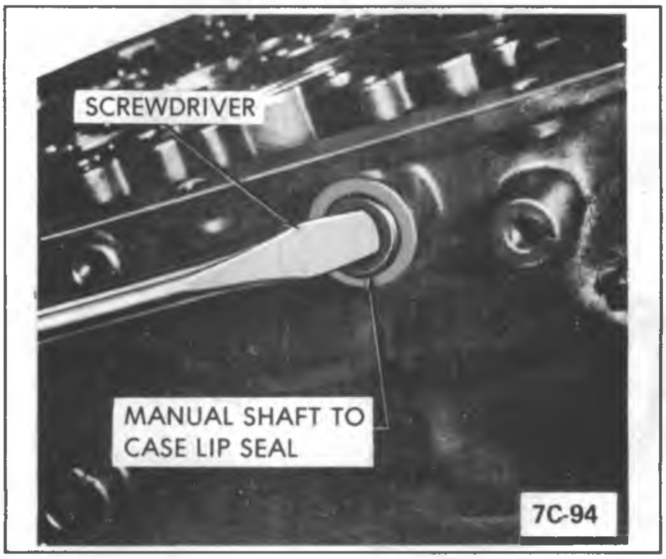


Figure 350C-26 Manual Shaft Lip Seal Removal

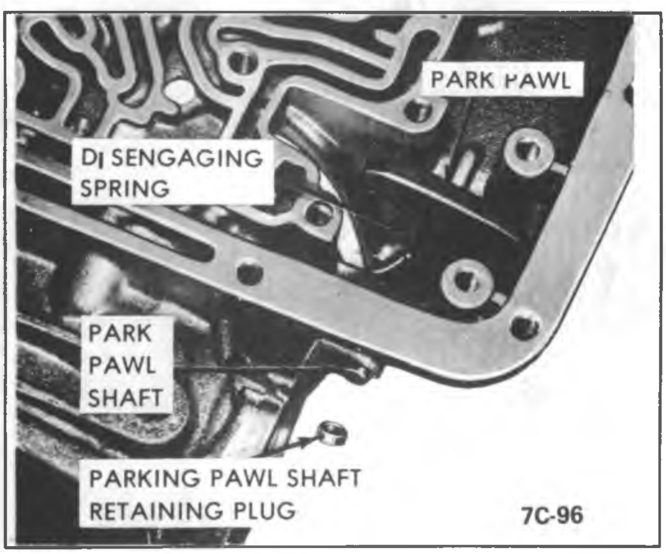


Figure 350C-27 Park Pawl

30. Remove intermediate servo piston, washer, spring seat, and apply pin. See Figure 350C-28.

31. If the piston or seal requires replacement, the piston assembly will have to be replaced. (Piston and Seal are one assembly).

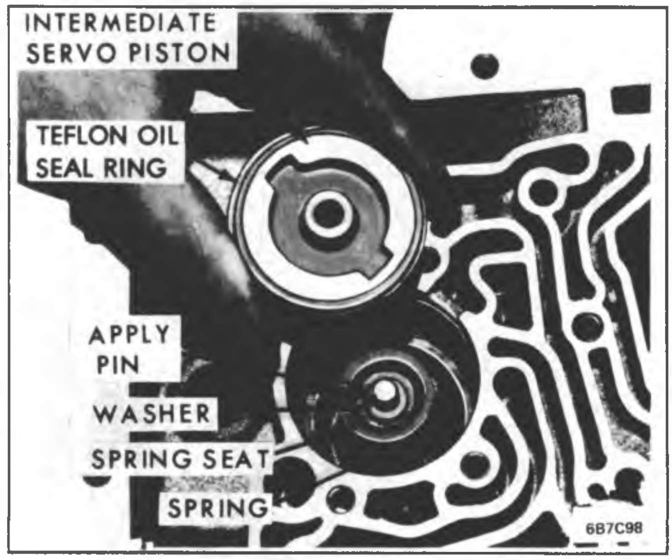


Figure 350C-28 Intermediate Servo Assembly

INTERNAL PARTS (FIGURE 350C-29)

Removal and Inspection

Oil Pump Assembly

1. Remove eight (8) pump attaching bolts with washer type seals.
2. Install two (2) threaded slide hammers J-7004 into threaded holes in pump body. Tighten jam nuts and remove pump assembly from case. See Figure 350C-30.
3. Remove pump assembly to case gasket.

Intermediate Clutch Cushion Spring, Intermediate Clutch Plates and Intermediate Overrun Brake Band

1. Remove intermediate clutch cushion spring.
2. Remove the intermediate clutch faced plates, the steel separator plates, and one wave spring.
3. Inspect condition of the composition and steel plates. Do not diagnose a lined drive plate by color.
   A. Dry composition plates with compressed air and inspect the surfaces for:
      1. Pitting and flaking
      2. Wear
      3. Glazing
      4. Cracking
      5. Charring
      6. Chips or metal particles imbedded in lining

      If the drive plate exhibits any of the above conditions, replacement is required.
   B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot

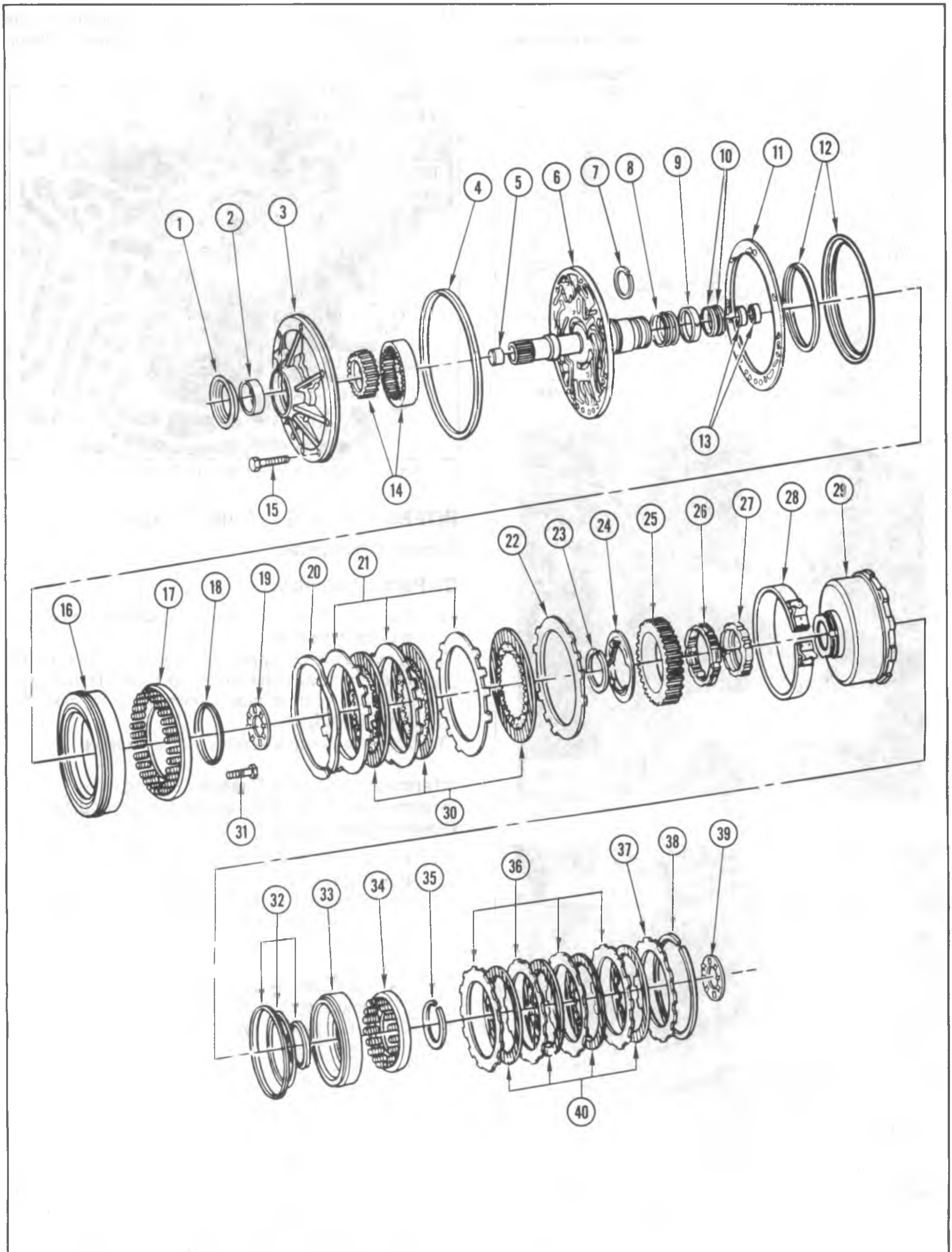


Figure 350C-29 Internal Parts

ILL. NO.	DESCRIPTION
1	SEAL, OIL PUMP TO CONVERTER HUB
2	BUSHING, OIL PUMP BODY
3	BODY ASSEMBLY, OIL PUMP
4	SEAL, OIL PUMP TO CASE
5	BUSHING, OIL PUMP STATOR SHAFT – FRONT
6	COVER ASSEMBLY, OIL PUMP
7	RING, STEADY REST
8	RING, DIRECT CLUTCH DRUM OIL
9	BUSHING, DIRECT CLUTCH DRUM
10	RING, FORWARD CLUTCH HOUSING OIL SEAL
11	GASKET, OIL PUMP TO CASE
12	SEAL, INTERMEDIATE CLUTCH PISTON
13	BUSHING, OIL PUMP STATOR SHAFT – REAR
14	GEAR, OIL PUMP DRIVE AND DRIVEN
15	BOLT, OIL PUMP TO CASE
16	PISTON, INTERMEDIATE CLUTCH
17	SEAT ASSEMBLY, INTERMEDIATE CLUTCH PISTON RETURN – WITH SPRINGS
18	SPACER, OIL PUMP THRUST BEARING
19	BEARING, DIRECT CLUTCH DRUM TO PUMP COVER – THRUST
20	SPRING, INTERMEDIATE CLUTCH CUSHION
21	PLATE, INTERMEDIATE CLUTCH REACTION (STEEL)
22	PLATE, INTERMEDIATE CLUTCH PRESSURE
23	RING, INTERMEDIATE OVERRUN CLUTCH RETAINER – FRONT
24	RETAINER, INTERMEDIATE OVERRUN CLUTCH
25	RACE, INTERMEDIATE OVERRUN CLUTCH – OUTER
26	CLUTCH, INTERMEDIATE OVERRUN
27	CAM, INTERMEDIATE OVERRUN CLUTCH
28	BAND, INTERMEDIATE OVERRUN CLUTCH BRAKE
29	DRUM, DIRECT CLUTCH
30	PLATE, INTERMEDIATE CLUTCH DRIVE (FACED)
31	BOLT, PUMP COVER TO BODY
32	SEAL, DIRECT CLUTCH PISTON
33	PISTON, DIRECT CLUTCH
34	SEAT ASSEMBLY, DIRECT CLUTCH PISTON RETURN – WITH SPRINGS
35	RING, DIRECT CLUTCH RETURN SPRING RETAINER
36	PLATE, DIRECT CLUTCH DRIVEN (STEEL)
37	PLATE, DIRECT CLUTCH PRESSURE (STEEL)
38	RING, DIRECT CLUTCH PRESSURE PLATE
39	BEARING, DIRECT CLUTCH DRUM THRUST – REAR
40	PLATE, DIRECT CLUTCH DRIVE (FACED)

Figure 350C-29A Internal Parts - Callouts

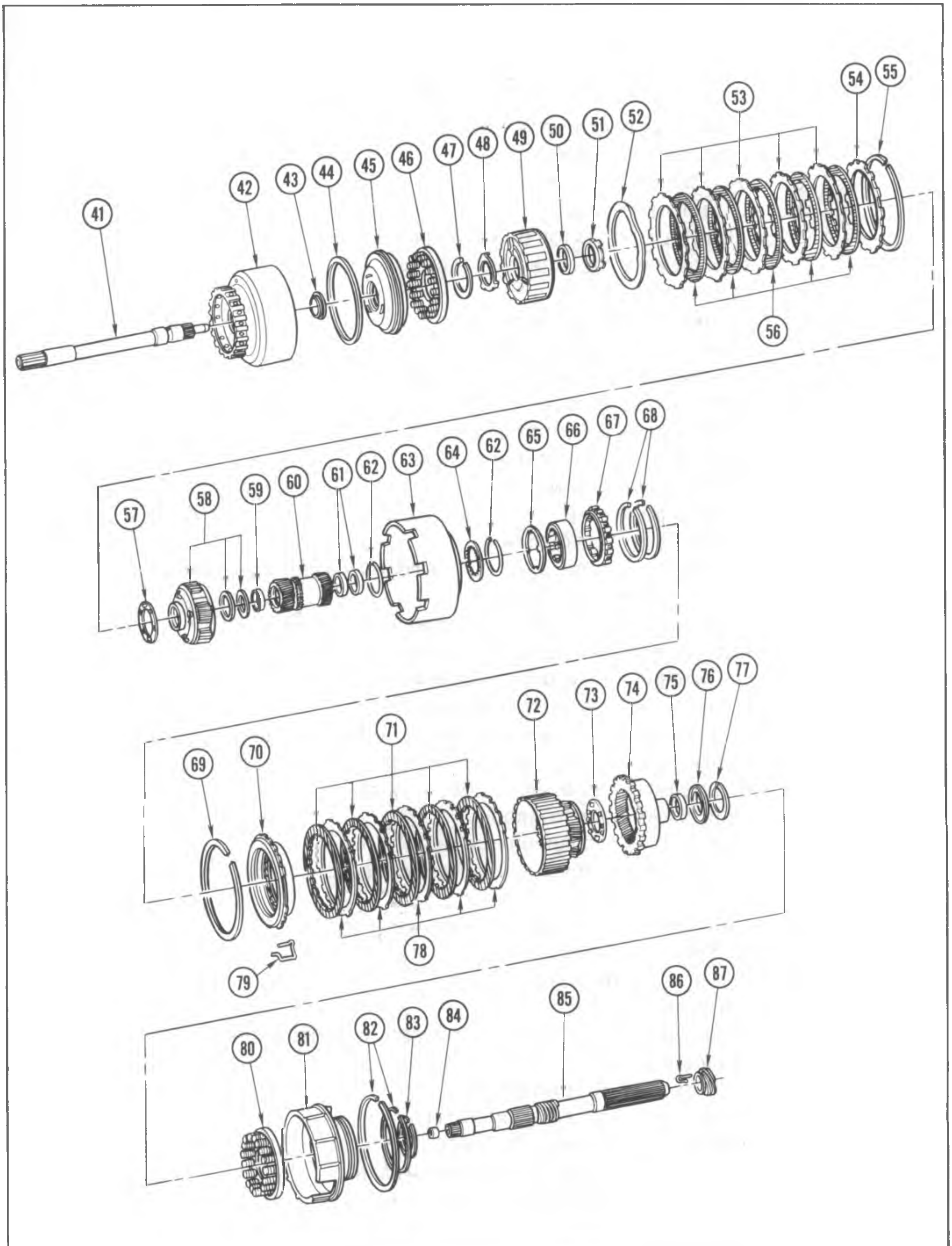


Figure 350C-29B Internal Parts - (Con't)

ILL. NO.	DESCRIPTION
41	SHAFT, TRANSMISSION INPUT
42	HOUSING, FORWARD CLUTCH
43	SEAL, FORWARD CLUTCH PISTON – INNER
44	SEAL, FORWARD CLUTCH PISTON – OUTER
45	PISTON, FORWARD CLUTCH
46	SEAT ASSEMBLY, FORWARD CLUTCH PISTON – WITH SPRINGS
47	RING, FORWARD CLUTCH PISTON RETURN SPRING SEAT RETAINER
48	WASHER, INPUT RING GEAR THRUST – FRONT
49	GEAR, INPUT RING
50	BUSHING, INPUT RING GEAR
51	RETAINER
52	SPRING, FORWARD CLUTCH PISTON CUSHION
53	PLATE, FORWARD CLUTCH DRIVE (STEEL)
54	PLATE, FORWARD CLUTCH PRESSURE (STEEL)
55	RING, FORWARD CLUTCH PRESSURE PLATE RETAINER
56	PLATE, FORWARD CLUTCH DRIVEN (FACED)
57	BEARING, OUTPUT CARRIER
58	CARRIER ASSEMBLY, OUTPUT
59	BUSHING, REACTION CARRIER PLANET
60	GEAR, SUN
61	BUSHING, SUN GEAR TO OUTPUT SHAFT
62	RING, SUN GEAR DRIVE SHELL RETAINER
63	SHELL, SUN GEAR DRIVE
64	WASHER, SUN GEAR THRUST
65	WASHER, SUN GEAR SHELL REAR THRUST
66	RACE, LO AND REVERSE OVERRUN CLUTCH
67	CLUTCH, LO AND REVERSE OVERRUN
68	RING, LO AND REVERSE CLUTCH TO CAM RETAINER
69	RING, LO AND REVERSE CLUTCH SUPPORT TO CASE
70	SUPPORT ASSEMBLY, LO AND REVERSE CLUTCH
71	PLATE, LO AND REVERSE CLUTCH DRIVE (FACED)
72	CARRIER, REACTION PLANET
73	BEARING, OUTPUT RING GEAR THRUST – FRONT
74	GEAR, OUTPUT RING
75	BUSHING, CASE TO OUTPUT SHAFT
76	BEARING, OUTPUT RING GEAR SUPPORT TO CASE
77	RING, LO AND REVERSE CLUTCH PISTON RETURN SPRING SEAT RETAINER
78	PLATE, LO AND REVERSE CLUTCH REACTION (STEEL)
79	SPRING, LO AND REVERSE CLUTCH SUPPORT RETAINER
80	SEAT ASSEMBLY, LO AND REVERSE CLUTCH PISTON RETURN – WITH SPRINGS
81	PISTON, LO AND REVERSE
82	SEAL, LO AND REVERSE CLUTCH PISTON
83	RING, OUTPUT CARRIER RETAINER TO OUTPUT SHAFT
84	BUSHING, OUTPUT SHAFT
85	SHAFT ASSEMBLY, OUTPUT
86	CLIP, SPEEDOMETER DRIVE GEAR TO OUTPUT SHAFT
87	GEAR, SPEEDOMETER DRIVE

Figure 350C-29C Internal Parts - Callouts

Figure 350C-30 Pump Removal

discoloration or surface scuffing is indicated, the plates must be replaced.

4. Remove intermediate clutch pressure plate.
5. Remove intermediate overrun brake band. See Figure 350C-31.

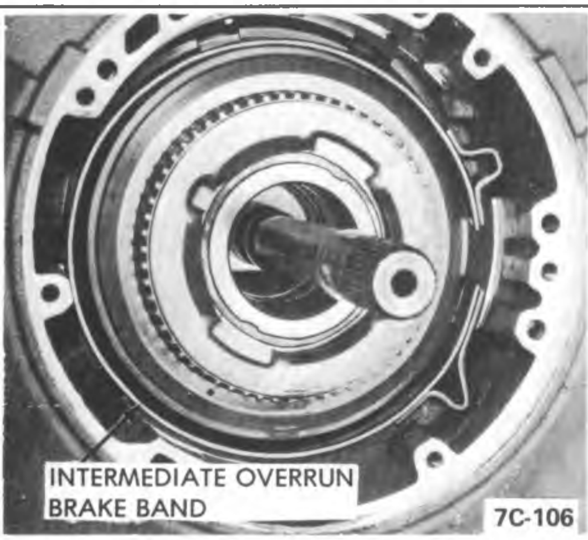


Figure 350C-31 Intermediate Overrun Brake Band

Direct and Forward Clutch Assemblies

1. Remove direct and forward clutch assemblies from case. See Figure 350C-32.

Input Ring Gear

1. Remove forward clutch housing to input ring gear front thrust washer. Inspect for excessive wear or scoring.
2. Remove input ring gear. See Figure 350C-33.

Output Carrier Assembly

1. Remove input ring gear to output carrier needle thrust bearing.
2. Remove output carrier to output shaft snap ring. See Figure 350C-34.

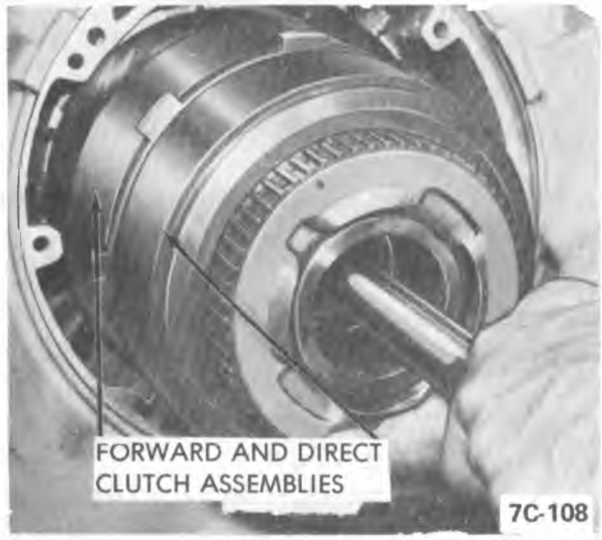


Figure 350C-32 Forward and Direct Clutch Assembly Removal

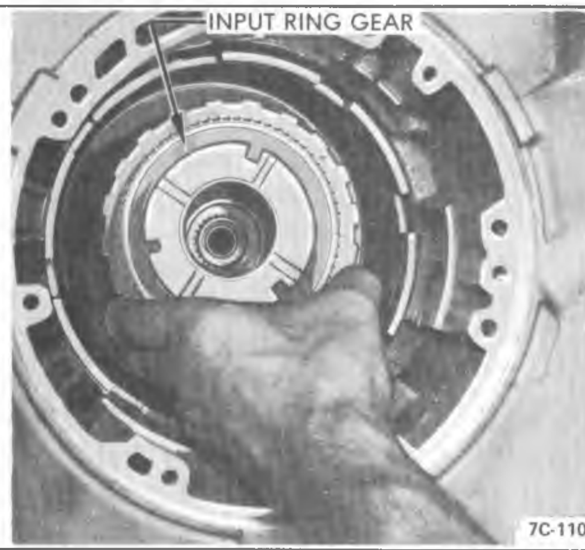


Figure 350C-33 Input Ring Gear Removal

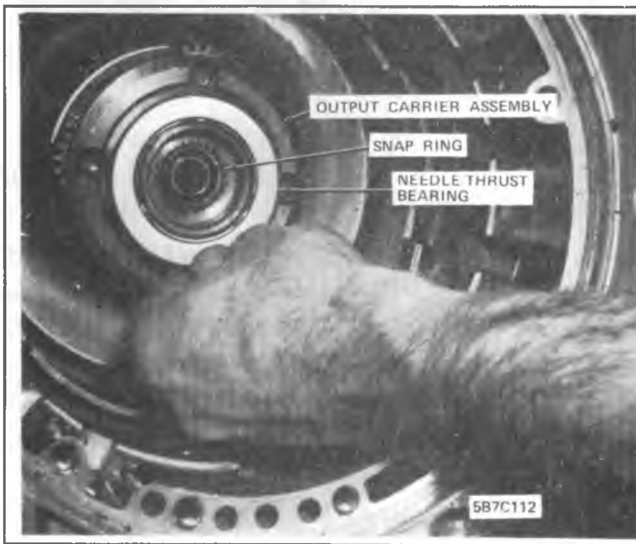


Figure 350C-34 Output Carrier Removal

3. Remove output carrier assembly.

Sun Gear Drive Shell Assembly

1. Remove sun gear drive shell assembly. See Figure 350C-35.

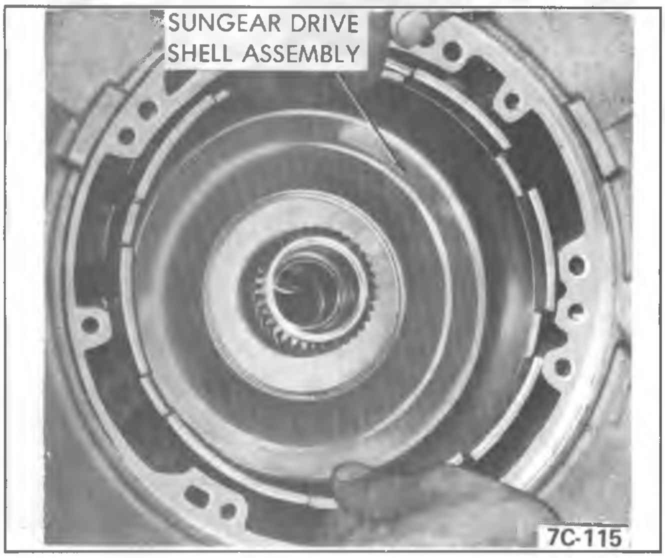


Figure 350C-35 Drive Shell Assembly Removal

Low and Reverse Clutch Support Assembly

1. Remove low and reverse roller clutch support to case retaining ring. See Figure 350C-36.
2. Grasp the output shaft. Pull up until the low and reverse roller clutch and the support assembly, clears the low and reverse clutch support retainer spring. Remove the support assembly.
3. Remove low and reverse clutch support retainer spring. See Figure 350C-36.

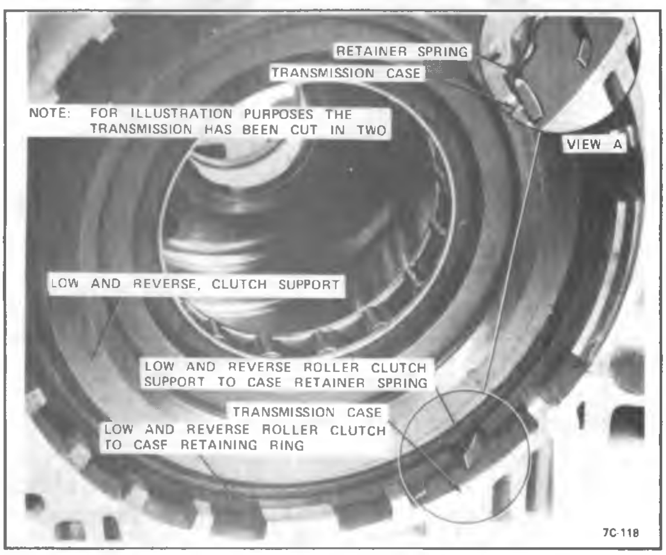


Figure 350C-36 Retainer Position

Low and Reverse Clutch Plates

1. Remove the low and reverse clutch composition plates and the steel separator plates. See Figure 350C-37.

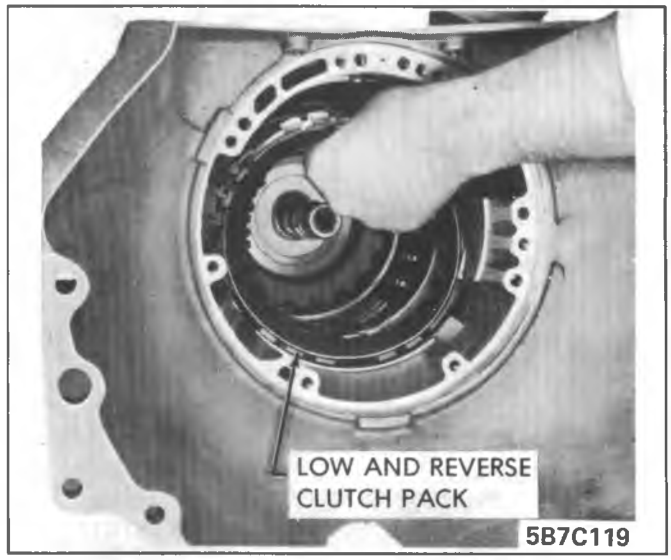


Figure 350C-37 Lo and Reverse Clutch Removal

Reaction Carrier Assembly

1. Remove reaction carrier assembly from output ring gear and shaft assembly. See Figure 350C-38.

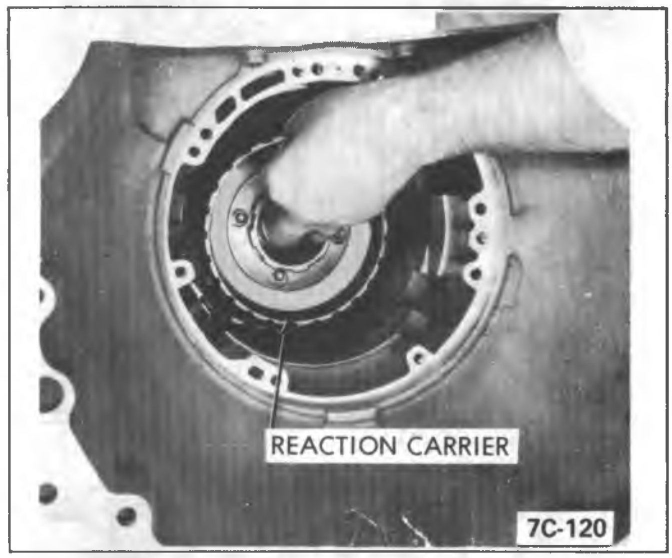


Figure 350C-38 Reaction Carrier Removal

Output Ring Gear and Shaft Assembly

1. Remove output ring gear and shaft assembly from case. See Figure 350C-39.
2. Remove reaction carrier to output ring gear needle thrust bearing.
3. Remove output ring gear to output shaft snap ring. Remove output ring gear from output shaft.
4. Remove output ring gear to case needle bearing. See Figure 350C-40.

Low and Reverse Clutch Piston

1. Using Tool J-23327 compress low and reverse clutch piston spring retainer and remove piston retaining ring, and spring retainer with springs. See Figure 350C-41.

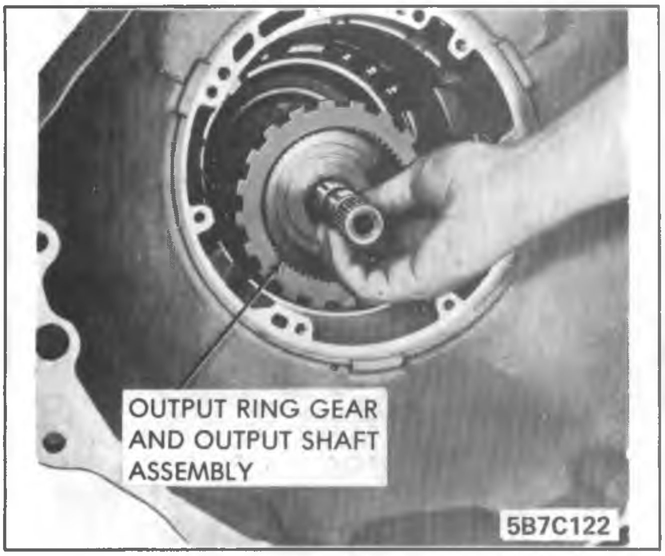


Figure 350C-39 Output Ring Gear and Shaft Assembly Removal

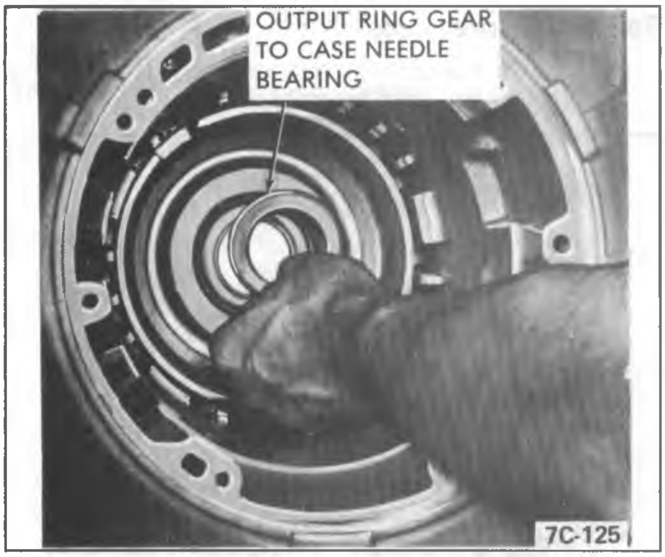


Figure 350C-40 Needle Bearing Removal

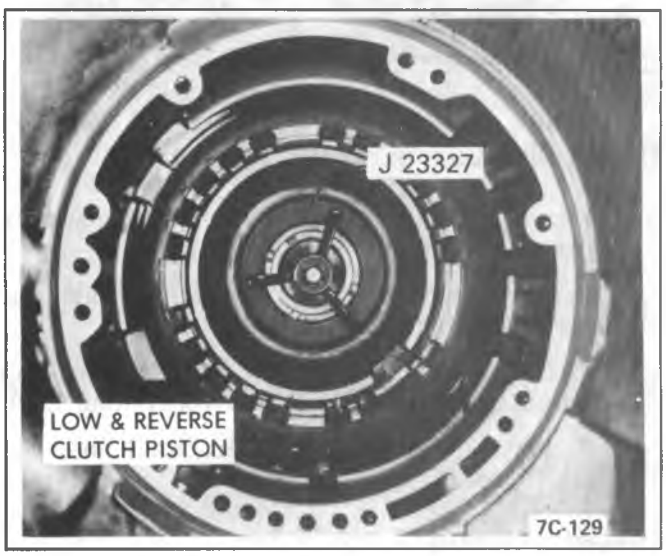


Figure 350C-41 Low and Reverse Piston Snap Ring Removal

2. Remove low and reverse clutch piston assembly. Aid removal with the use of compressed air in passage shown. See Figure 350C-42.

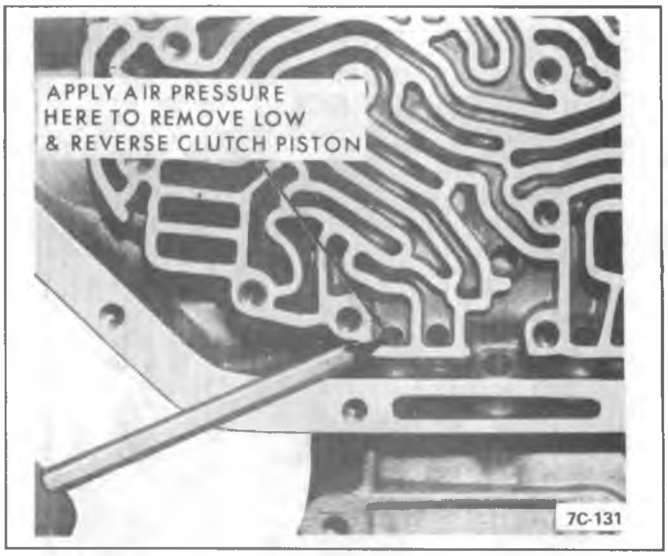


Figure 350C-42 Location for Air Pressure

Low and Reverse Clutch Piston Seals

1. Remove low and reverse clutch piston outer seal.
2. Remove low and reverse clutch piston center and inner seal. See Figure 350C-43.

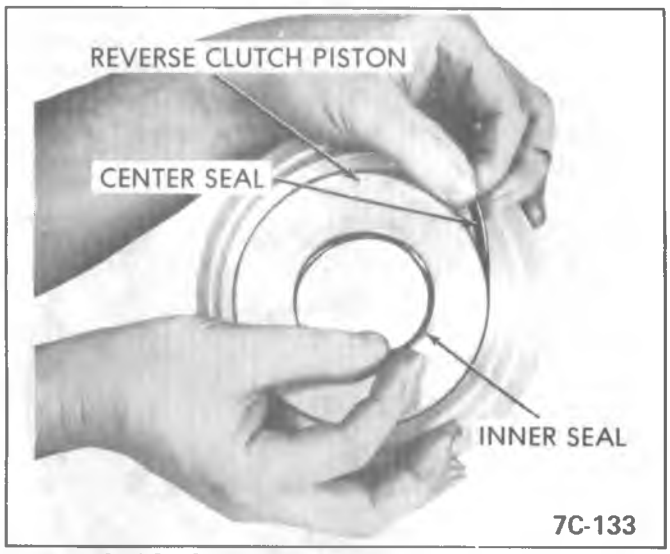


Figure 350C-43 Reverse Clutch Piston Center & Inner Seal Removal

Intermediate Clutch 1-2 Accumulator Piston

Removal and installation of intermediate clutch 1 - 2 accumulator can be done without removal of transmission from car. See On Car Service. If removal is required with the transmission out of the car, the oil pan must be installed to use tool J-23069.

1. Install Tool J-23069 to compress intermediate clutch 1-2 accumulator cover and remove retaining ring. See Figure 350C-44.
2. Remove intermediate clutch 1-2 accumulator piston cover and "O" ring seal from case. See Figure 350C-45.

Figure 350C-44 1-2 Accumulator Cover Removal

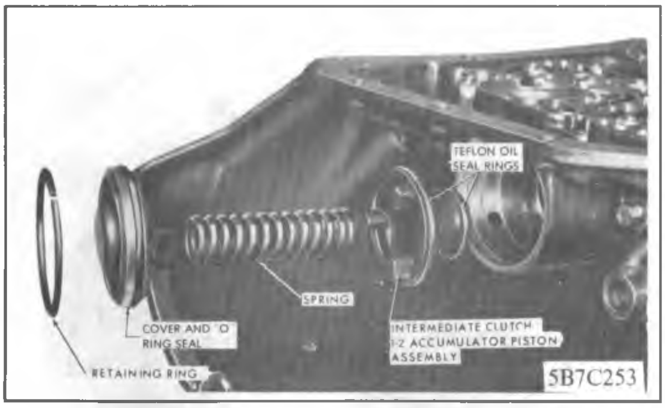


Figure 350C-45 Intermediate Clutch 1-2 Accumulator

3. Remove intermediate clutch 1-2 accumulator piston spring. See Figure 350C-45.

4. Remove intermediate clutch 1-2 accumulator piston assembly. *Inspect the inner and outer teflon oil seal rings for wearing or scoring. DO NOT REMOVE THESE TWO RINGS UNLESS THEY ARE DAMAGED.* If replacement of one or the other of the two rings is necessary, the piston assembly will have to be replaced. See Figure 350C-45. (Piston and Seal are one assembly).

Intermediate Clutch 1-2 Accumulator Piston

Installation

1. Install intermediate clutch 1-2 accumulator piston assembly and spring. See Figure 350C-45.

2. Place new "O" ring seal on intermediate clutch 1-2 accumulator piston cover, and install cover into case. See Figure 350C-45.

3. Install J-23069 tool and compress intermediate clutch 1-2 accumulator cover and install retaining ring. See Figure 350C-44.

INTERNAL PARTS

Disassembly, Inspection and Reassembly

Oil Pump

Disassembly

1. Place stator shaft side of pump assembly through hole in bench. Remove five (5) pump cover to body attaching bolts. See Figure 350C-47.
2. Remove intermediate clutch return spring seat retainer, springs and the intermediate clutch piston assembly. See Figure 350C-47.
3. Remove intermediate clutch piston inner and outer seals. See Figure 350C-47.
4. Remove three (3) direct clutch to pump hub oil rings. Remove pump cover to direct clutch drum needle thrust bearing. Inspect the two (2) forward clutch to pump hub teflon oil seal rings, (some rings will be solid, new type rings will be scarf cut for easier assembly with no expander ring behind) but do not remove them unless they are damaged. If replacement is necessary, use two metal hook type service replacement rings. See Figure 350C-47.
5. Check steady rest ring, if cut or frozen in bore remove and replace with the same color ring.

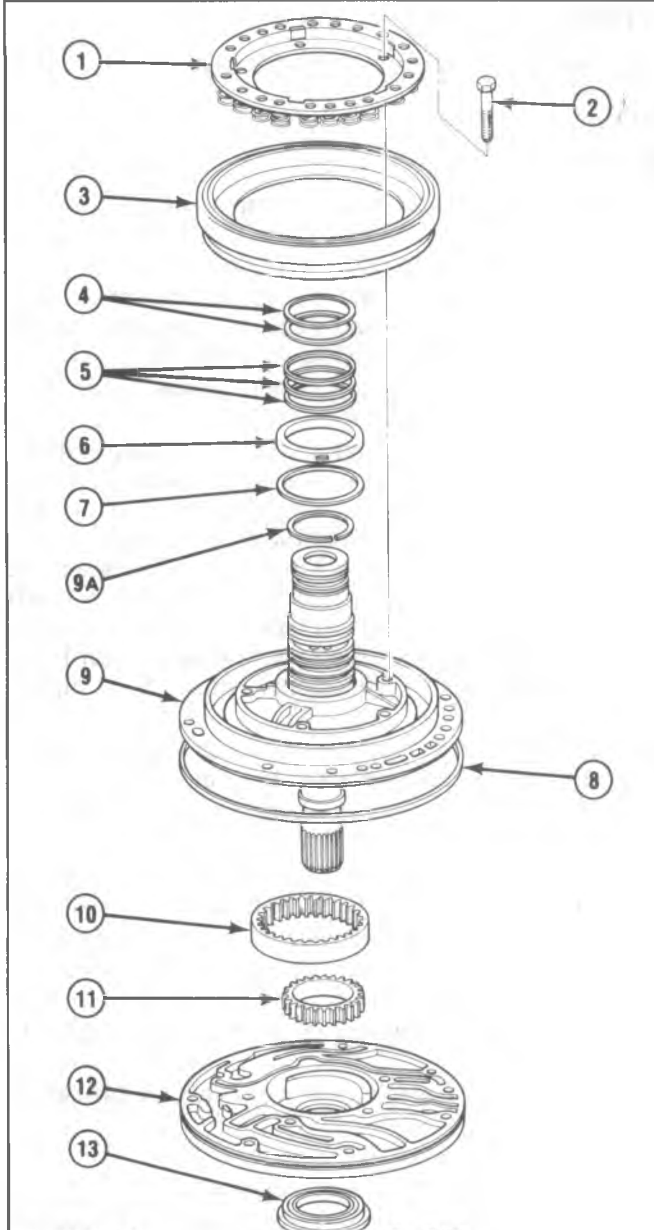
   The different colors compensate for groove depth.
6. Remove pump cover and stator shaft assembly from pump body. See Figure 350C-48.
7. Remove pump drive gear and driven gear from pump body. Inspect pump gears and cover for wear or scoring. See Figure 350C-49.

   The pump body assembly should be replaced only if:
   a. The drive and/or driven gears are broken or galled.
   b. Pump body galled.
   c. Uneven machined surfaces
   d. Pump body to case seal ring groove damaged.
   e. Pump seal drainback hole is unmachined.
8. Remove pump outside diameter to case square cut "O" ring seal. See Figure 350C-47.
9. Remove pump body to converter hub lip seal, if necessary. See Figure 350C-50.
10. Place pump on wood blocks so surface finish is not damaged and install pump to converter hub lip seal using Seal Driver J-21359. See Figure 350C-51.

    Make certain lip seal is not turned or nicked.

Inspection and Reassembly

1. Install pump drive gear and driven gear. Assemble drive gear with tang face up to prevent damage to converter. See Figure 350C-49.
3. Assemble pump cover to pump body. See Figure 350C-48.
4. Install intermediate clutch piston new inner and outer seals. See Figure 350C-47.
5. Install intermediate clutch piston assembly into pump cover with J-26744-A.



1. SPRING RETAINER
2. PUMP COVER TO PUMP BODY ATTACHING BOLTS (5)
3. INTERMEDIATE CLUTCH PISTON ASSEMBLY
4. FORWARD CLUTCH TO PUMP HUB SCARF CUT TYPE RINGS (2)
5. DIRECT CLUTCH TO PUMP HUB SCARF CUT OIL SEAL RINGS (3)
6. PUMP COVER TO DIRECT CLUTCH DRUM NEEDLE THRUST BEARING
7. .017 SHIM
8. SQUARE CUT "O" RING SEAL
9. PUMP COVER AND STATOR SHAFT ASSEMBLY

9A. STEADY REST RING

10. DRIVEN GEAR
11. DRIVE GEAR
12. PUMP BODY ASSEMBLY
13. PUMP TO CONVERTER HUB LIP SEAL

5B7C254B

Figure 350C-47 Oil Pump Assembly

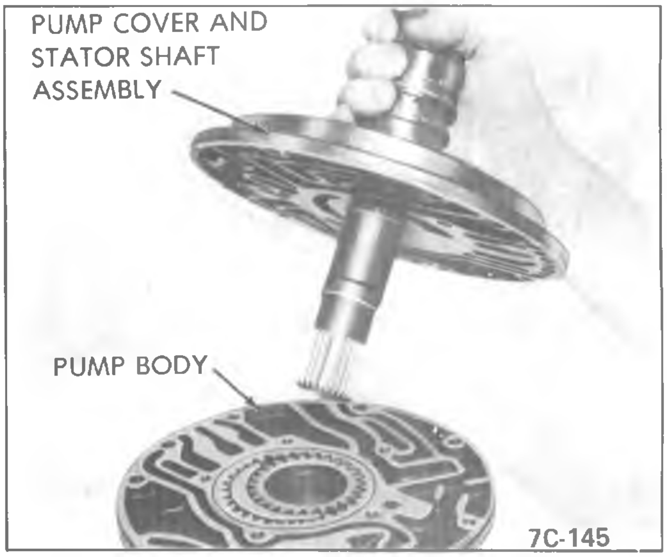


Figure 350C-48 Pump Cover Removal

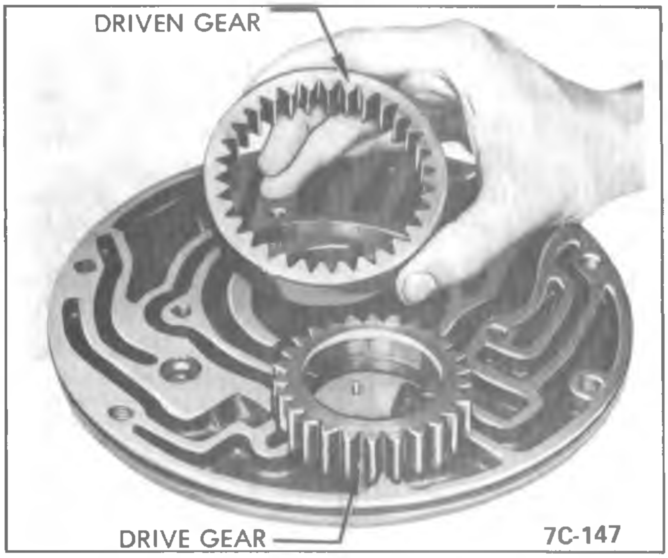


Figure 350C-49 Oil Pump Gears

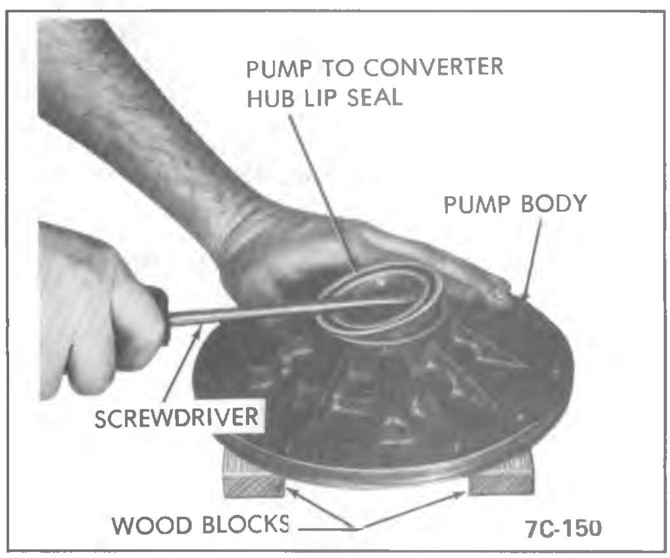


Figure 350C-50 Converter Seal Removal

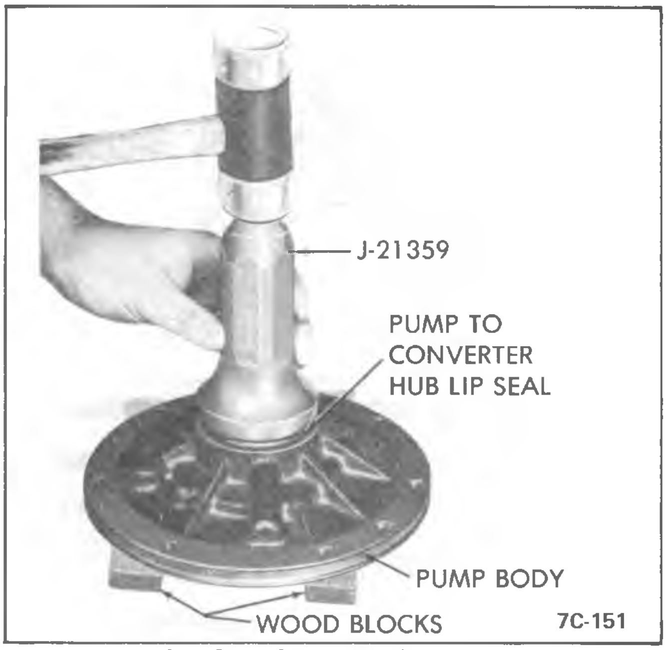


Figure 350C-51 Converter Seal Installation

6. Install spring retainer and install five (5) attaching bolts, finger tight. See Figures 350C-47 and 350C-46.
7. Place pump aligning strap, J-21368 over pump body and cover and tighten.
8. Torque attaching bolts to 18 ft. lbs. (24 N·m).
9. Install pump outside diameter to case square cut seal. See Figure 350C-47. Use new seal, if necessary.
10. Install three (3) direct clutch to pump hub scarf cut oil seal rings. Inspect two (2) forward clutch to pump hub oil seal rings, (some rings will be solid, new type rings will be scarf cut for easier assembly with no expander ring behind)for service if rings require replacement use hook type cast iron rings. See Figure 350C-47.
11. Check three (3) pump cover hub lube holes. Make certain they are not restricted. See Figure 350C-52.

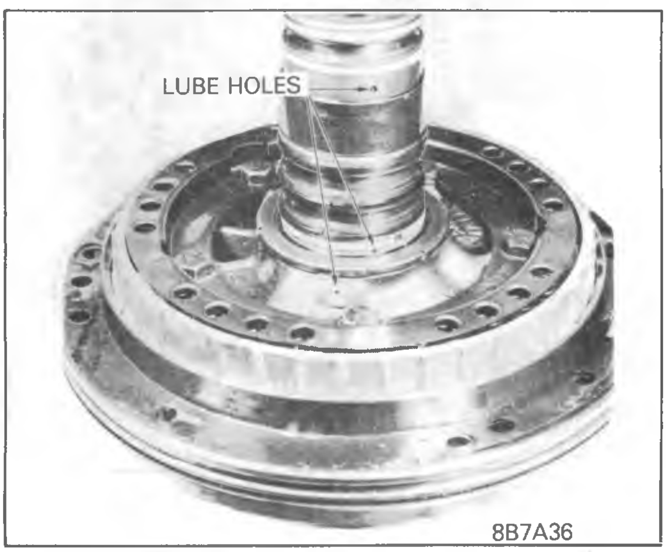


Figure 350C-52 Lube Hole Location

DIRECT CLUTCH

Disassembly

Refer to specifications in rear of this section to determine the required amount of composition and steel clutch plates to use with specific transmission model and engine combination. When replacing piston assembly specific part number must be used.

1. Remove intermediate overrun clutch front retainer ring and retainer. See Figure 350C-53.

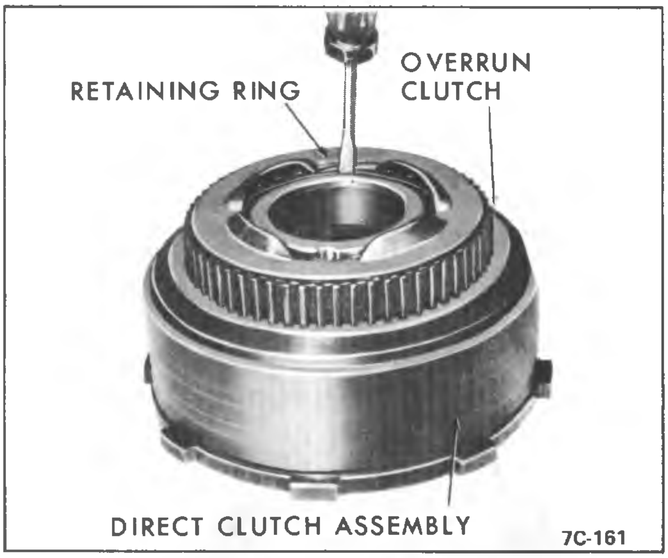


Figure 350C-53 Overrun Clutch Retaining Ring

2. Remove intermediate clutch overrun outer race. See Figure 350C-54.

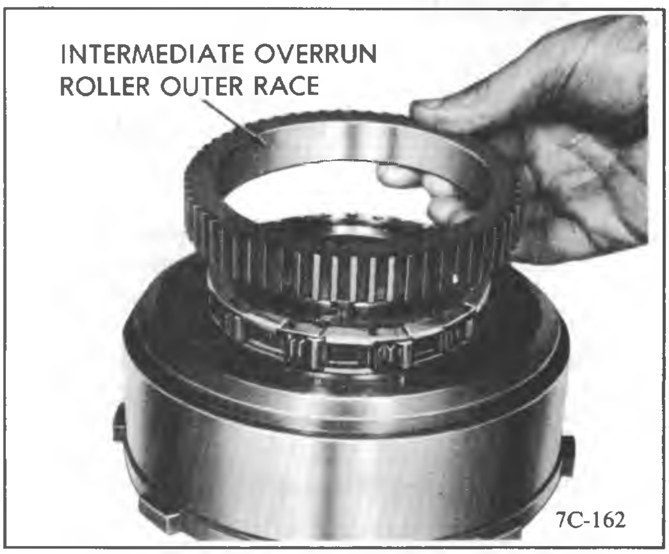


Figure 350C-54 Roller Clutch Outer Race

3. Remove intermediate overrun roller clutch assembly. See Figure 350C-54.
4. Remove direct clutch drum to forward clutch housing needle roller bearing. See Figure 350C-55.
5. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate. See Figure 350C-56.

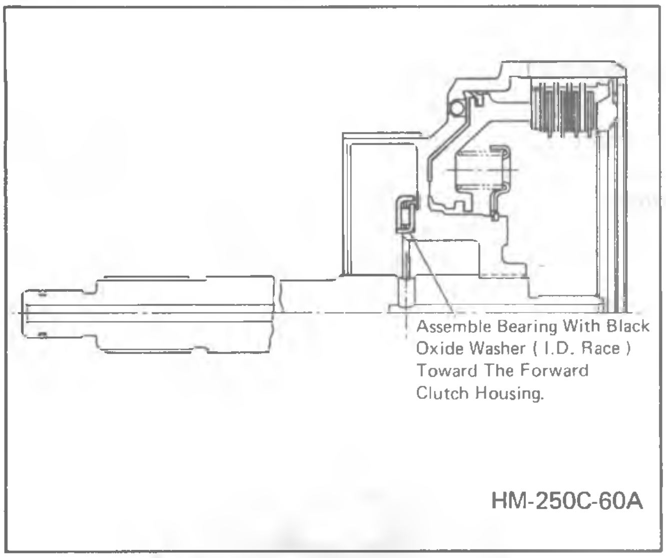


Figure 350C-55 Needle Bearing Assembly

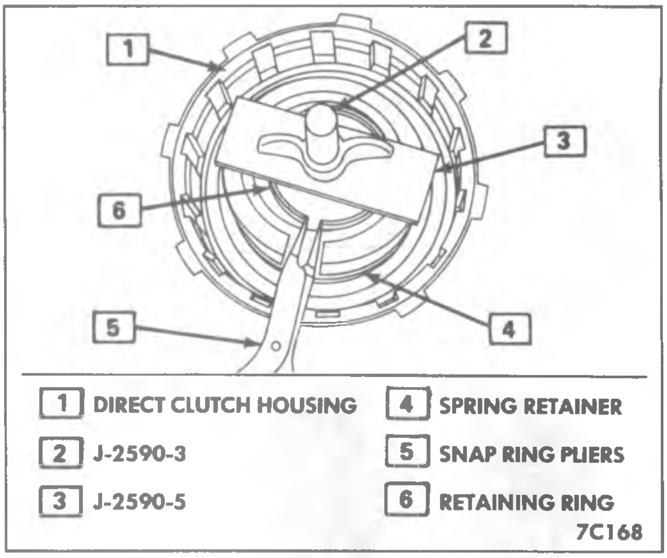


Figure 350C-57 Piston Snap Ring

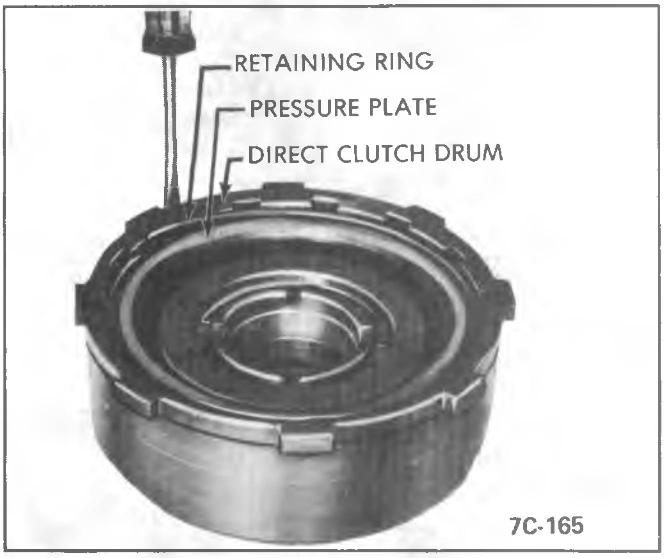


Figure 350C-56 Direct Clutch Disassembly

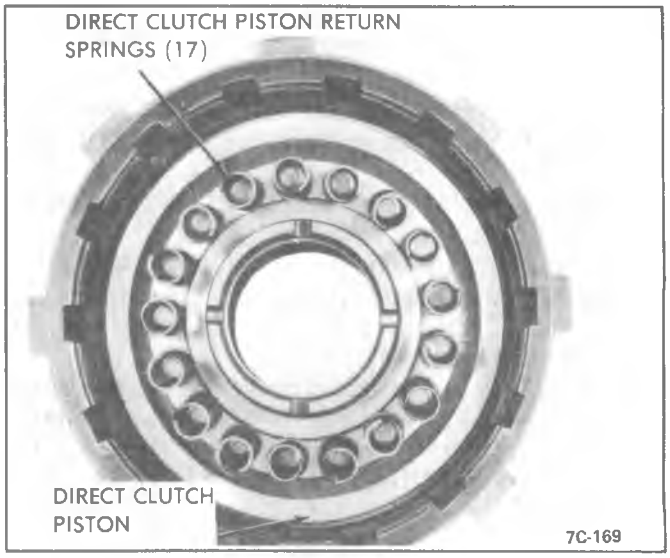


Figure 350C-58 Piston Return Springs

6. Remove composition plates, steel plates and one cushion spring from direct clutch housing.
7. Inspect condition of lined and steel plates. *Do not diagnose a composition drive plate by color.*
8. Remove direct clutch piston return spring seat retaining ring and spring seat by using Tools J-2590-3, J-2590-5, and snap ring pliers. See Figure 350C-57.
9. Remove spring retainer, springs and piston. See Figure 350C-58.
10. Inspect the return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.
11. Remove direct clutch piston inner and outer seals.
12. Remove direct clutch piston center seal. See Figure 350C-59.

Reassembly

1. Install new direct clutch piston outer seal and inner seal.

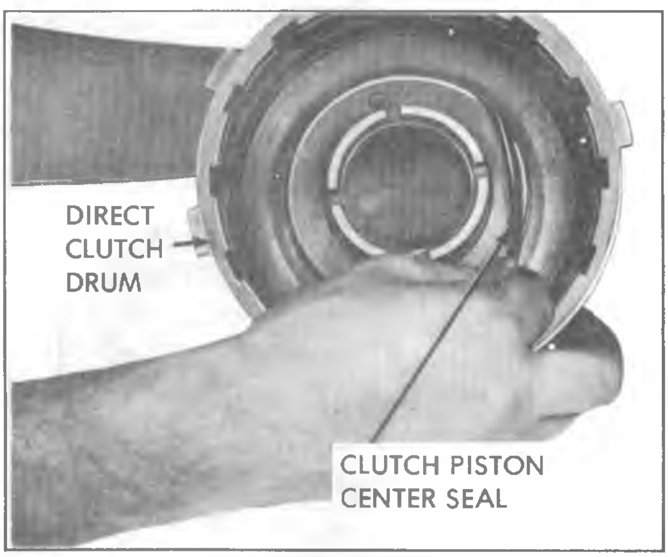


Figure 350C-59 Center Seal

2. Install new direct clutch piston center seal. See Figure 350C-59.

3. Install the direct clutch piston into housing with the aid of a piece of .020" music wire crimped into copper tubing. Use a liberal amount of transmission fluid during assembly. See Figure 350C-60.

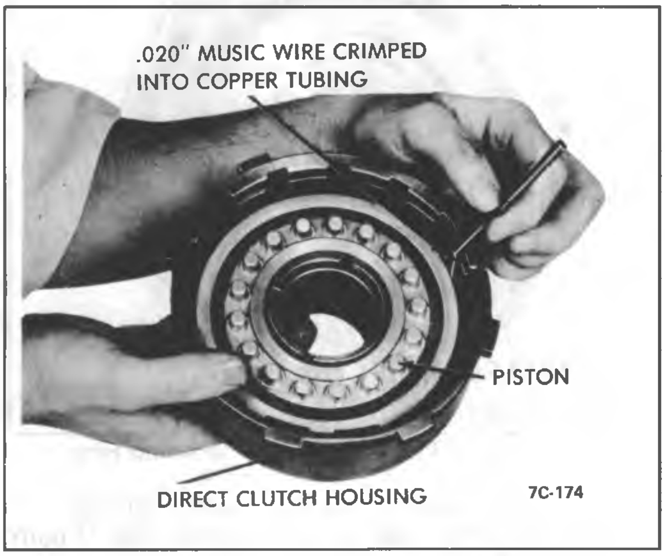


Figure 350C-60 Direct Clutch Piston Installation

4. Install spring retainer and springs. Compress spring retainer and install retaining ring, using Tools J-2590-3 and J-2590-5. See Figure 350C-57.
5. Lubricate with transmission fluid and install composition plates and steel plates starting with a steel plate and alternating steel and composition.
6. Install direct clutch pressure plate and retaining ring. See Figure 350C-56.
7. Install intermediate overrun roller clutch assembly. See Figure 350C-62. Roller clutch assembly must be assembled with four (4) holes up (toward front of transmission).
8. Install intermediate clutch overrun outer race. See Figure 350C-62.

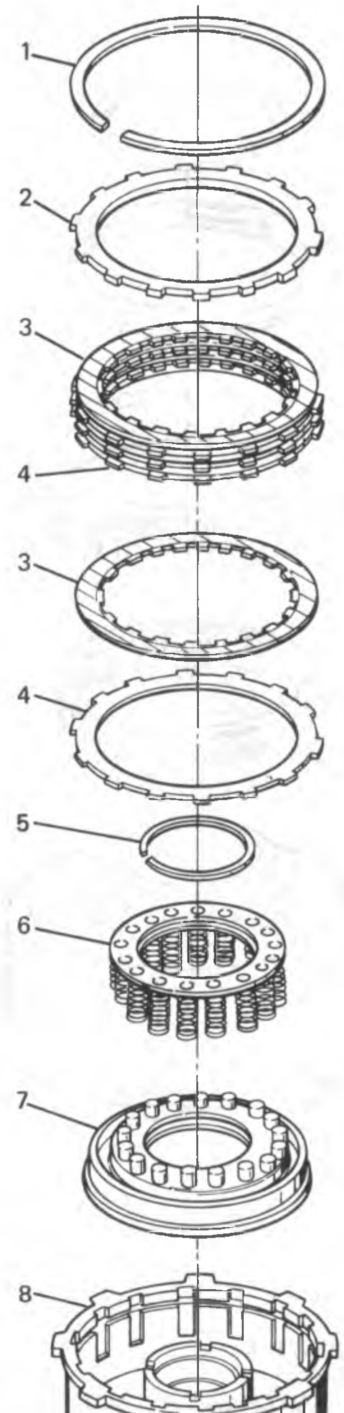
   When the intermediate overrun clutch outer race is installed, it should free wheel in the counterclockwise direction only.
9. Install intermediate overrun clutch retainer, and retaining ring. See Figure 350C-62.

Forward Clutch

Disassembly and Inspection

Refer to specifications in rear of this section to determine the required amount of composition and steel clutch plates to use with specific transmission model and engine combination. When replacing piston assembly specific part number must be used.

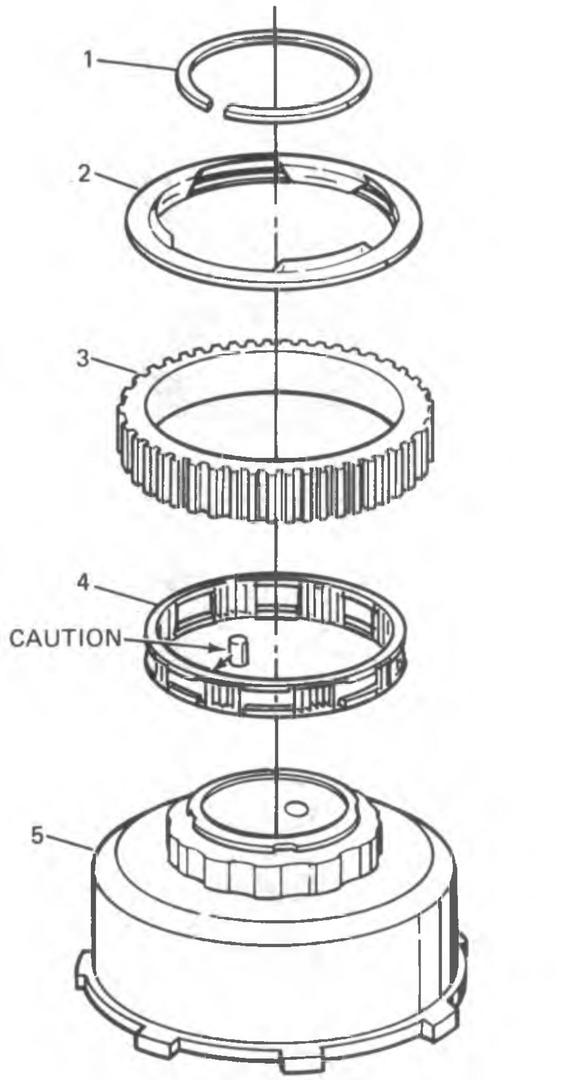
1. Remove forward clutch drum to pressure plate retaining ring. Remove forward clutch pressure plate. See Figure 350C-63.
2. Remove forward clutch housing faced plates, steel plates, and cushion spring.
3. Inspect condition of lined and steel plates. *Do not diagnose a drive plate by color.*



1 RETAINING RING
2 DIRECT CLUTCH PRESSURE PLATE
3 FACED PLATE
4 STEEL SEPARATOR PLATE
5 RETAINING RING
6 PISTON SPRING ASSEMBLY
7 DIRECT CLUTCH PISTON ASSEMBLY
8 DIRECT CLUTCH DRUM

7C-178-1

Figure 350C-61 Direct Clutch Assembly



1 RETAINING RING
2 RETAINER
3 INTER. CLUTCH OVERRUN OUTER RACE (LOCKS ON CLOCKWISE ROTATION)
4 ROLLER CLUTCH ASSEMBLY (POSITION WITH 4 HOLES TOWARD FRONT OF TRANSMISSION)

CAUTION: IF ROLLER FALLS OUT DURING ASM. OPERATION–REINSTALL ROLLER FROM INSIDE TO OUTSIDE CAGE DIRECTION, TO AVOID BENDING SPRING.

5 DIRECT CLUTCH DRUM & INTERMEDIATE CLUTCH OVERRUN INNER CAM

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Figure 350C-62 Intermediate Overrun Roller Clutch Assembly

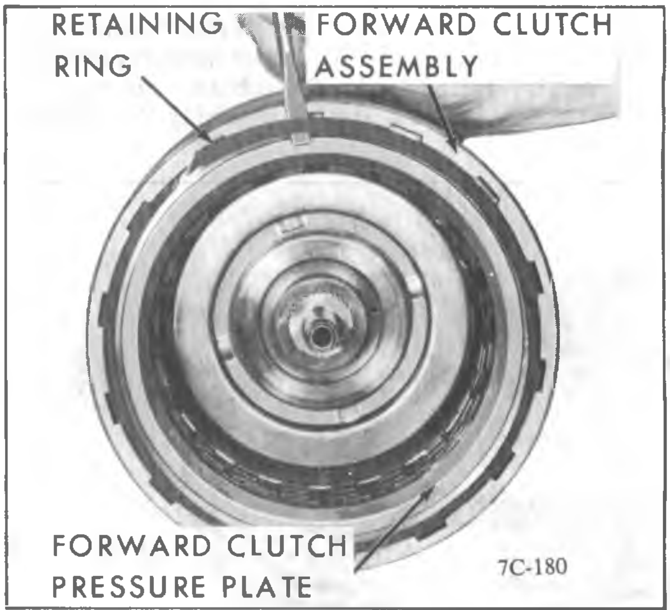


Figure 350C-63 Forward Clutch Retaining Ring

4. Remove spring retainer and springs by compressing with a ram press. See Figure 350C-64.

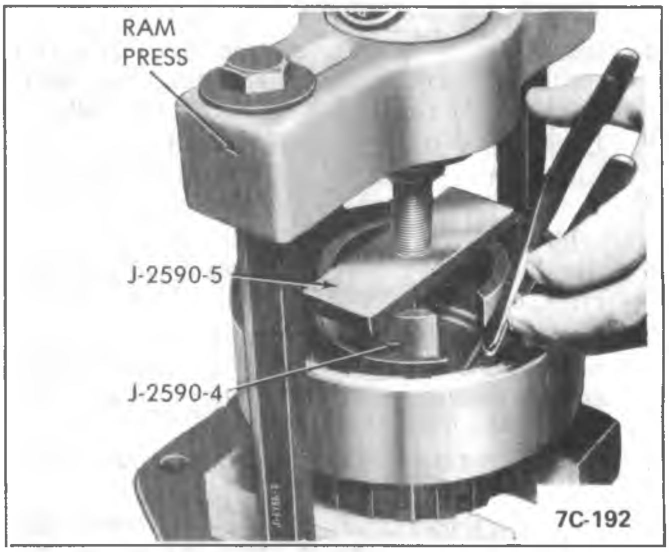
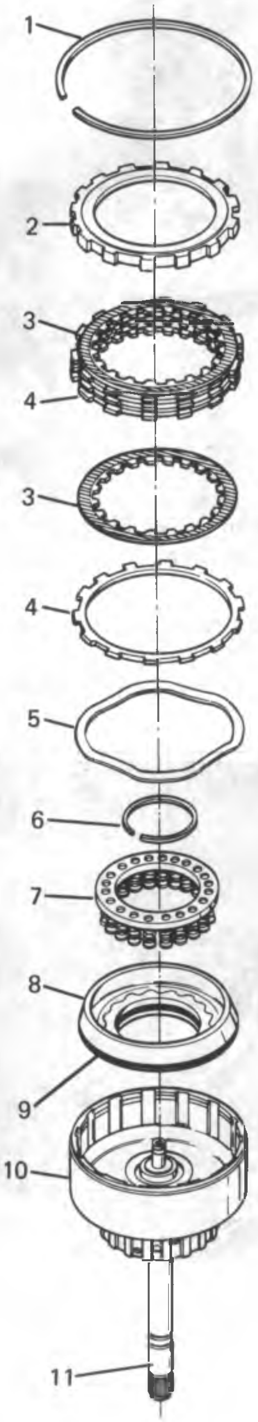


Figure 350C-64 Forward Clutch Piston Snap Ring Removal

5. Inspect the return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.
6. Remove forward clutch piston assembly.
7. Inspect the forward clutch piston inner and outer seals, for nicks or tears. Remove and replace if necessary. See Figure 350C-65.
8. Make certain forward clutch ball check exhaust is free of dirt, etc. See Figure 350C-66.
9. If the input shaft is scored excessively it may be replaced using the following procedure.
   a. Using wood blocks for support, press input shaft out of forward clutch housing.
   b. Carefully support forward clutch housing on rear thrust washer surface and press input shaft into housing until it is properly seated.



1 RETAINING RING
2 FORWARD CLUTCH PRESSURE PLATE
3 FACED PLATE
4 STEEL SEPARATOR PLATE
5 CUSHION SPRING
6 RETAINING RING
7 PISTON SPRING ASSEMBLY
8 FORWARD CLUTCH PISTON ASSEMBLY
9 SEAL
10 FORWARD CLUTCH DRUM
11 INPUT SHAFT

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Figure 350C-65 Forward Clutch Assembly

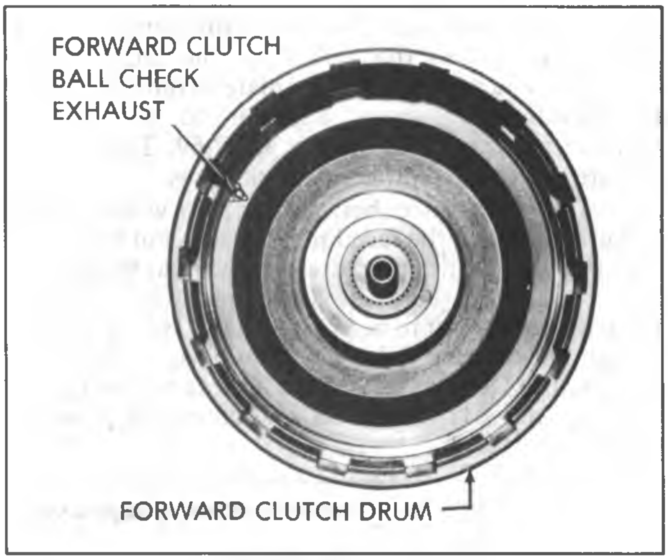


Figure 350C-66 Ball Exhaust Location

When pressing the input shaft into the forward clutch housing, care must be taken not to place excessive force on the pilot end of the input shaft as damage may result.

Reassembly

1. Install the forward clutch inner piston seal and outer piston seal, if previously removed.
2. Install the forward clutch piston assembly using a thin feeler gage. See Figure 350C-67.

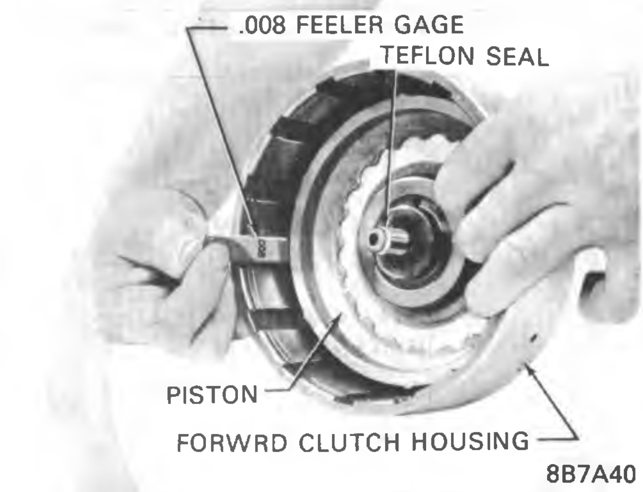


Figure 350C-67 Installing Forward Clutch Piston

3. Install spring retainer and springs. Compress spring retainer with an arbor press or ram press. See Figure 350C-64.
4. Lubricate with transmission fluid and install cushion spring, faced plates and steel separator plates, starting with the cushion spring and alternating steel and faced. See Figure 350C-65.
5. Install forward clutch pressure plate and retaining ring. Using a feeler gage check clearance between forward clutch pressure plate and faced plate. See Figure 350C-68.

The specifications for this transmission call for a clearance of no less than .011" and no greater than .082". There are three pressure plates available which are identified by tangs adjacent to the source identification mark. See Figure 350C-69. These three pressure plates have different thicknesses.

If the clearance between the forward clutch pressure plate and the faced plate checks out to be less than .011", a thinner pressure plate should be used to have a clearance between .011" and .082". If the clearance checks out to be greater than .082", a thicker pressure plate should be used to have a clearance between .011" and .082". If the clearance checks out to be between .011" and .082", no change of pressure plate is necessary.

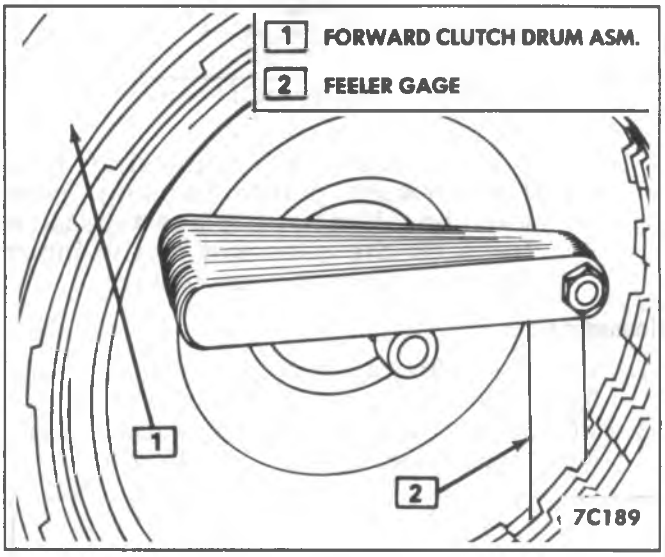


Figure 350C-68 Checking Pressure Plate Clearance

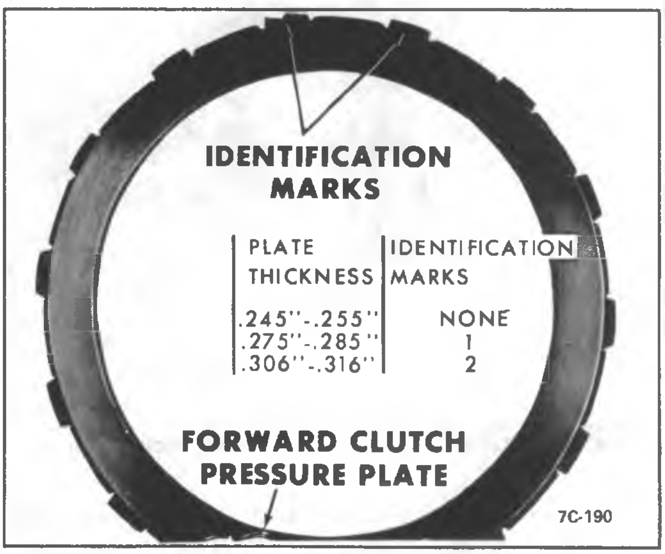


Figure 350C-69 Pressure Plate Selection

Sun Gear to Drive Shell

Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring. See Figure 350C-70.
2. Remove sun gear to drive shell flat rear thrust washer. See Figure 350C-70.

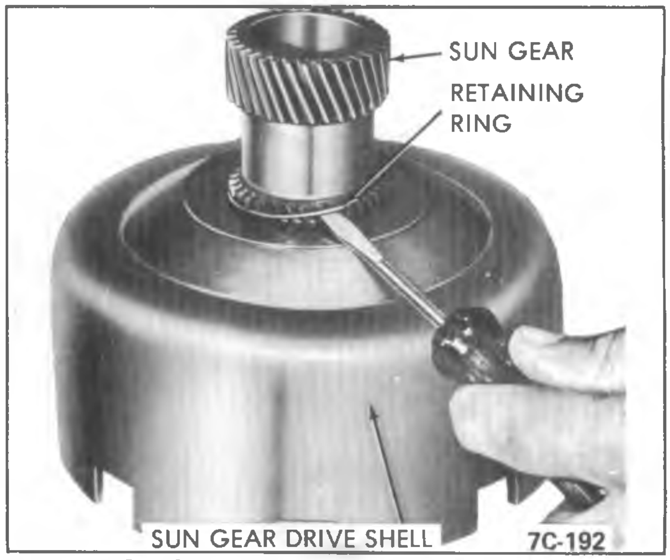


Figure 350C-70 Sun Gear Retaining Ring Removal

3. Remove front retaining ring from sun gear. See Figure 350C-71.
4. Inspect parts for wear or damage. Replace parts if necessary.

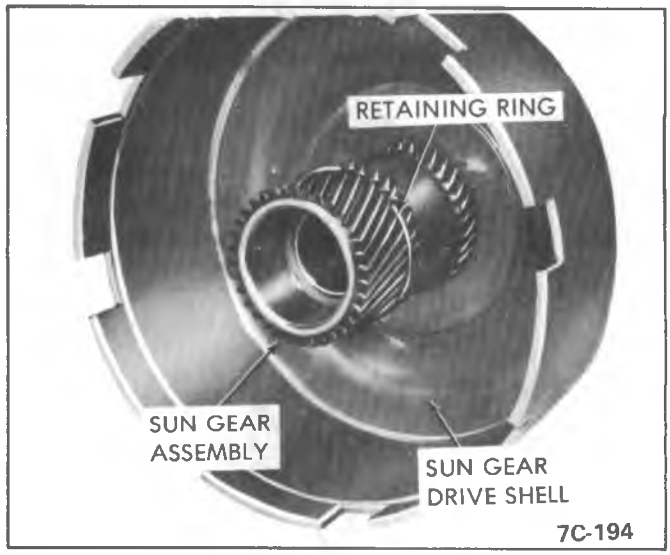


Figure 350C-71 Front Retaining Ring Removal

Reassembly

1. Install sun gear to drive shell front retaining ring, and install into drive shell. See Figure 350C-71. Use a new ring and do not overstress when installing.
2. Install sun gear to drive shell flat thrust washer.
3. Install sun gear to sun gear drive shell rear retaining ring. See Figure 350C-70. Use a new ring and do not overstress when installing.

Low and Reverse Roller Clutch (Refer to Figure 350C-72)

Disassembly

1. Remove low and reverse clutch to sun gear shell thrust washer.
2. Remove low and reverse overrun clutch inner race.

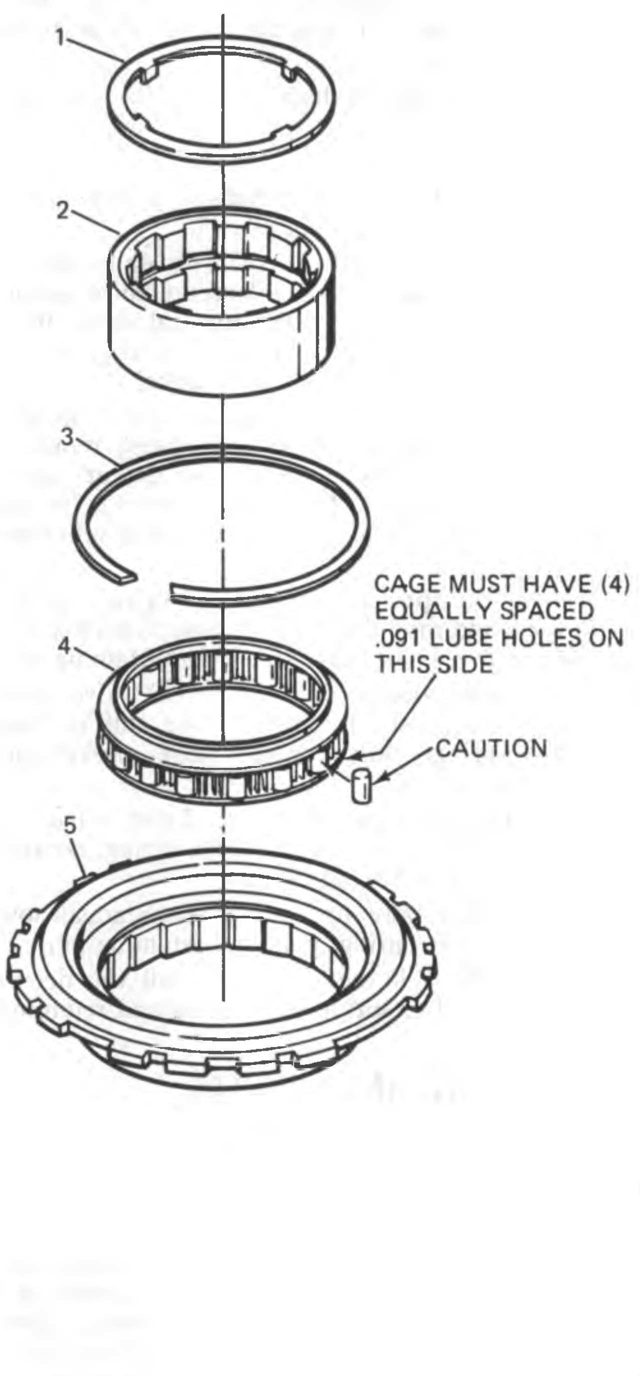


Figure 350C-72 Low and Reverse Clutch Support and Overrun Roller Clutch Assembly

3. Remove low and reverse roller clutch retaining ring.
4. Remove low and reverse roller clutch assembly and visually inspect the rollers for wearing and scoring and check for any springs that may be collapsed.

Reassembly

1. Install low and reverse roller clutch assembly to inner race. The inner race should free wheel in the clockwise direction only. (See Figure 350C-73).

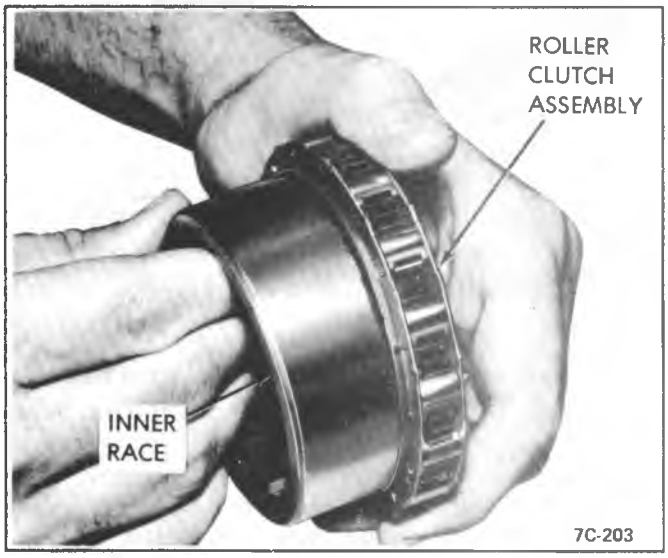


Figure 350C-73 Checking Roller Clutch

2. Install low and reverse overrun roller clutch assembly and inner race into the low and reverse clutch support. See Figure 350C-74. Assemble with four (4) holes down or to rear of transmission.

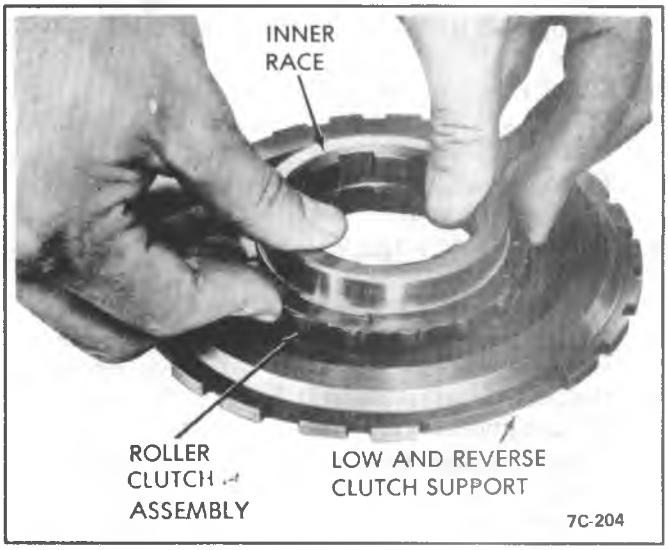


Figure 350C-74 Roller Clutch Inner Race Installation

3. Install low and reverse clutch to cam retaining ring. See Figure 350C-75.

4. Install low and reverse clutch to sun gear drive shell thrust washer. See Figure 350C-72.

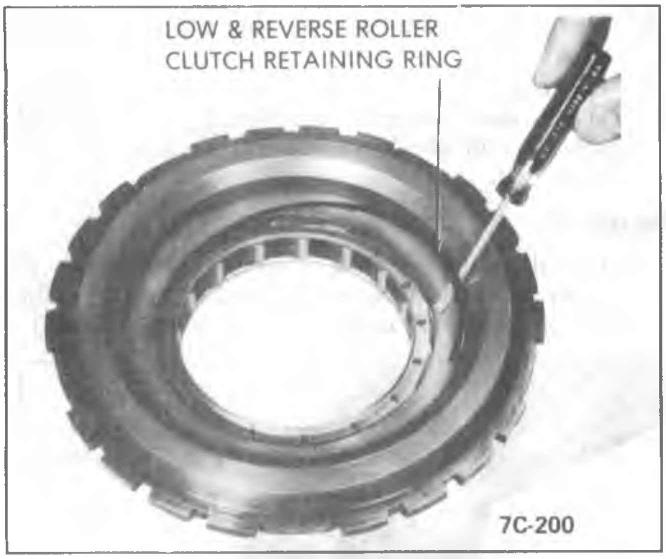


Figure 350C-75 Roller Clutch Retaining Ring Installation

Valve Body (Refer to Figure 350C-76)

Disassembly

1. Position valve body assembly with cored face up.
2. Remove manual valve from lower left hand bore (J).
3. From lower right hand bore (A) remove the pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring, and the pressure regulator valve.
4. From the next bore (B), remove the 2-3 shift valve train retaining pin, sleeve, control valve spring, 2-3 shift control valve, shift valve spring, and the 2-3 shift valve.
5. From the next bore (C), remove the 1-2 shift valve train retaining pin, sleeve, shift control valve spring, 1-2 shift control valve, and the 1-2 shift valve.
6. From the next bore (E), remove retaining pin, plug, manual low control valve spring, and the manual low control valve.
7. From the next bore (F), remove the retaining pin, spring, seat, and the detent regulator valve.
8. Install Tool J-22269, on direct clutch 2-3 accumulator piston and remove retaining "E" ring. (G) See Figure 350C-77.
9. Remove direct clutch 2-3 accumulator piston, and spring. (G) If the piston seal needs replacing the piston assembly will have to be replaced. (Piston and Seal are one assembly).
10. From the next bore down (D) from the direct clutch accumulator, remove the detent actuating lever bracket bolt, bracket, actuating lever and retaining pin, stop, spring retainer, seat, outer spring, inner spring, washer and the detent valve. Use care when handling valve body assembly as valve body sleeve retaining pins may fall out.

Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.
3. Check all springs for distortion or collapsed coils.

Reassembly

1. Install direct clutch accumulator piston spring and piston into valve body.
2. Install J-22269 and J-24675 (installs piston evenly) on direct clutch 2-3 accumulator piston and compress spring and piston and secure with retaining ring. See Figure 350C-77. Align piston and oil seal ring when entering bore.
3. Install the detent valve, washer, outer spring, inner spring, spring seat, and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque bolt to 52 lb. in. Assemble detent actuating lever with retaining pin.
4. Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.
5. In the next bore up, install 2-3 shift valve, shift valve spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin.
6. In the next bore up, install the 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin.
7. In the next bore up, install the manual low control valve, spring, plug and retaining pin.
8. In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin.

INTRNAL PARTS

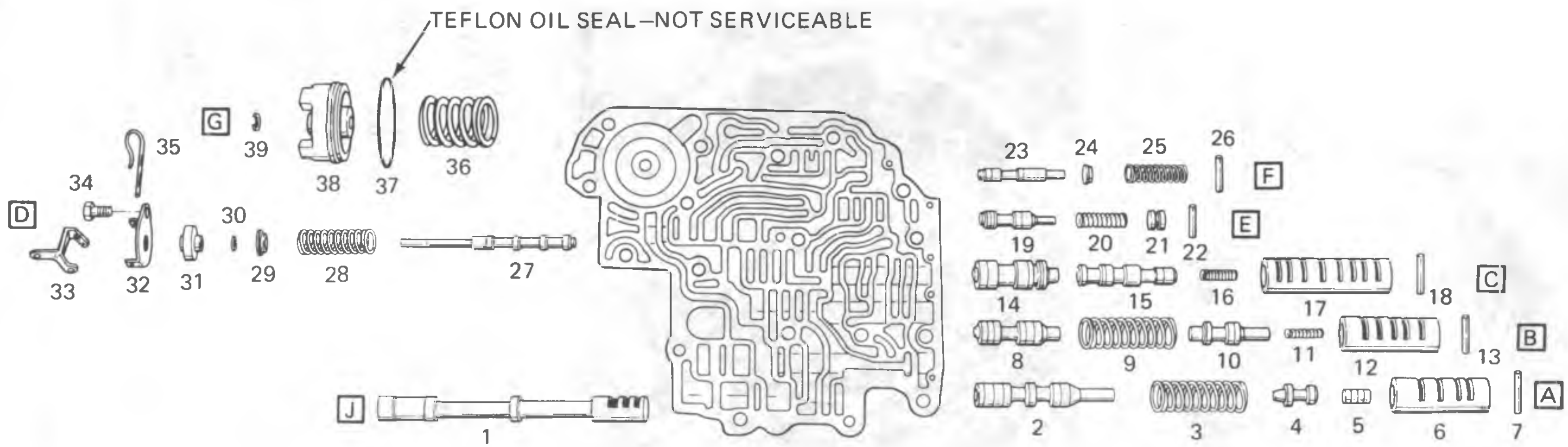
Installation

General Instructions

1. Before starting to assemble the transmission make certain that all parts are *absolutely clean.* Keep hands and tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed cover all openings with clean cloths.
2. When reassembling it is important that all thrust washer surfaces be given an initial lubrication. Bushings should be lubricated with transmission fluid. Thrust washers should be lubricated on both surfaces with petrolatum before installation.
3. Use care to avoid making nicks or burrs on parts, particularly on surfaces where gaskets are used.
4. It is extremely important to tighten all parts evenly and in proper sequence, to avoid distortion of parts and leakage at gaskets and other joints. *Use a reliable torque wrench to tighten all bolts and nuts to specified torque and in the specified sequence.*

Low and Reverse Clutch Piston

1. Install low and reverse clutch piston outer seal, if previously removed. See Figure 350C-78.



J — 1 MANUAL VALVE AND LINK ASSEMBLY

A
- 2 PRESSURE REGULATOR VALVE
- 3 PRESSURE REGULATOR VALVE SPRING
- 4 REVERSE & MODULATOR BOOST VALVE
- 5 INTERMEDIATE BOOST VALVE
- 6 BOOST VALVE SLEEVE
- 7 RETAINING PIN

B
- 8 2-3 SHIFT VALVE
- 9 2-3 SHIFT VALVE SPRING
- 10 2-3 SHIFT CONTROL VALVE
- 11 2-3 SHIFT CONTROL VALVE SPRING
- 12 2-3 SHIFT CONTROL VALVE SLEEVE
- 13 RETAINING PIN

C
- 14 1-2 SHIFT VALVE
- 15 1-2 SHIFT CONTROL VALVE
- 16 1-2 SHIFT CONTROL VALVE SPRING
- 17 1-2 SHIFT CONTROL VALVE SLEEVE
- 18 RETAINING PIN

E
- 19 MANUAL LOW CONTROL VALVE
- 20 MANUAL LOW CONTROL VALVE SPRING
- 21 PLUG
- 22 RETAINING PIN

F
- 23 DETENT REGULATOR VALVE
- 24 DET. REGULATOR VALVE SPRING SEAT
- 25 DETENT REGULATOR VALVE SPRING
- 26 RETAINING PIN

D
- 27 DETENT VALVE
- 28 DETENT VALVE OUTER SPRING
- 29 DETENT VALVE OUTER SPRING SEAT
- 30 DETENT VALVE SPRING RETAINER
- 31 DETENT VALVE STOP
- 32 DET. VALVE ACTUATING LEVER BRKT.
- 33 DETENT VALVE ACTUATING LEVER
- 34 RETAINING BOLT
- 35 RETAINING PIN

G
- 36 DIRECT CLUTCH ACCUMULATOR SPRING
- 37 OIL SEAL RING
- 38 DIRECT CLUTCH 2-3 ACCUM. PISTON
- 39 RETAINER RING

5B7C205-2

Figure 350C-76 Valve Body - Typical

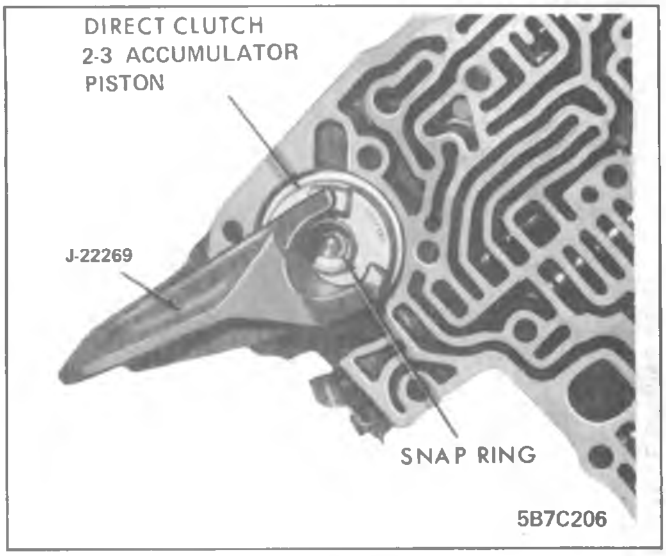


Figure 350C-77 2-3 Accumulator Removal

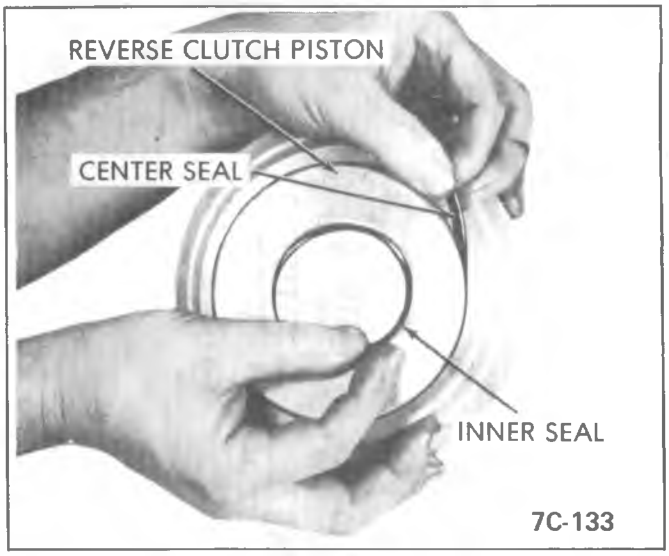


Figure 350C-79 Inner and Center Seal Installation

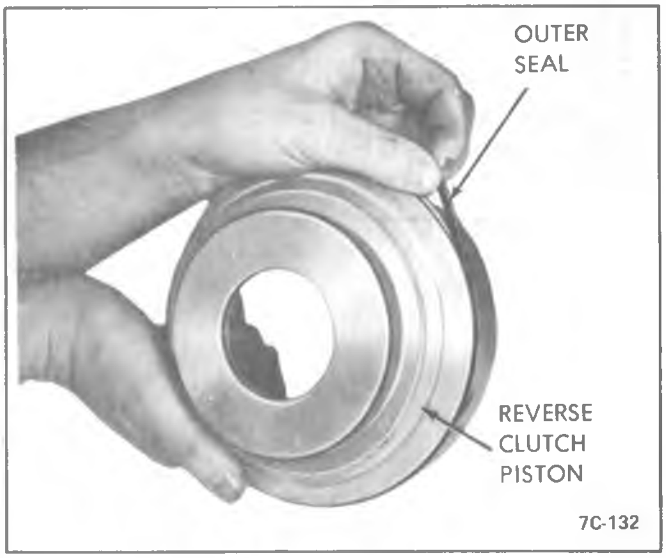


Figure 350C-78 Outer Seal Installation

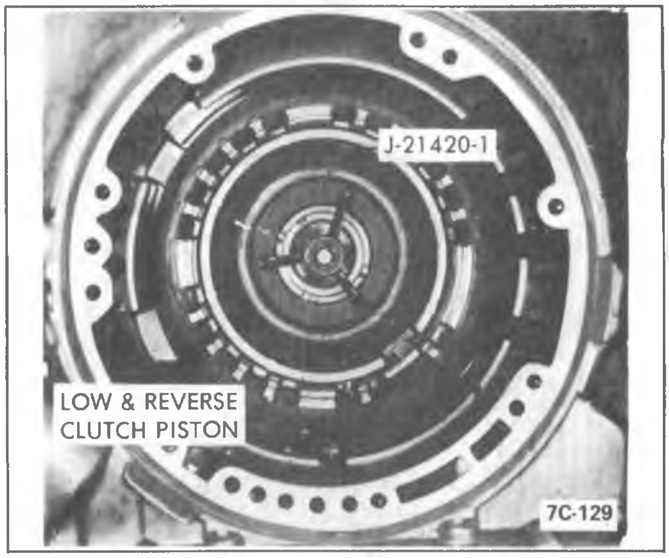


Figure 350C-80 Low and Reverse Piston Snap Ring

2. Install low and reverse clutch piston center and inner seal, if previously removed. See Figure 350C-79.
3. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl. See Figure 350C-80.
4. Position piston return seat and springs. Place snap ring on return seat so that ring may be easily installed when seat is compressed with Tool J-21420.
5. Using tool J-21420-1 compress return seat so spring retainer retaining ring may be installed with snap ring pliers. See Figure 350C-80.

   As spring retainer is compressed make certain inner edge of retainer does not hang up on snap ring groove.

Output Shaft and Reaction Carrier

1. Install output ring gear to output shaft and output ring gear to output shaft snap ring. See Figure 350C-81.

   DO NOT OVER STRESS SNAP RING ON ASSEMBLY. ALWAYS USE NEW RING ON REASSEMBLY.

2. Install reaction carrier to output ring gear needle thrust bearing with lip side face up. See Figure 350C-81.
3. Install output ring gear to case needle bearing assembly. See Figure 350C-82. Lip on inner race of bearing MUST point toward rear of transmission.
4. Install reaction carrier assembly into output ring gear and shaft assembly. See Figure 350C-83.
5. Install output shaft and reaction carrier assembly into case.

Low and Reverse Clutch Plates

Refer to specifications in rear of this section to determine the required amount of lined and steel clutch plates to use with specific transmission model and engine combination. When replacing piston assembly specific part number must be used.

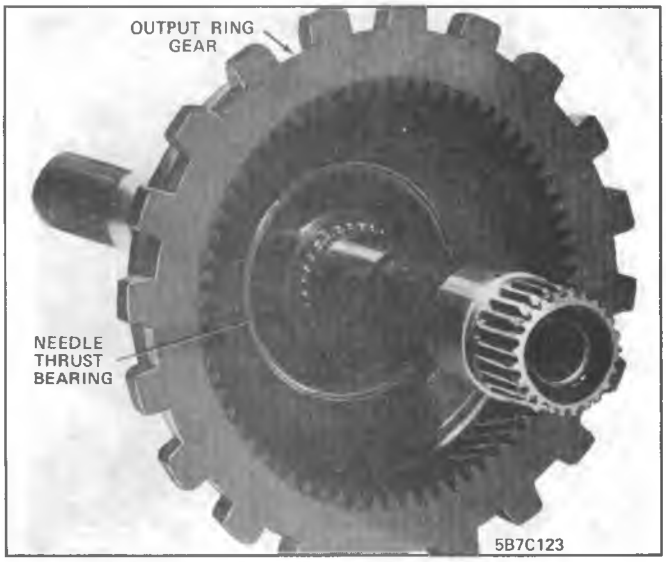


Figure 350C-81 Needle Bearing Assembly

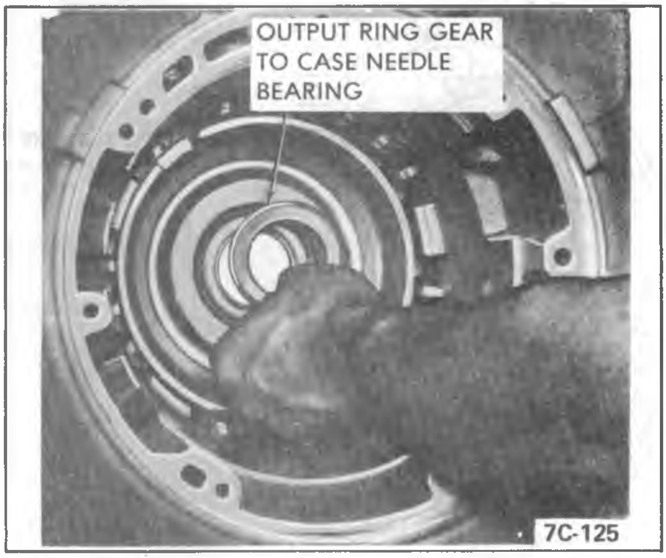


Figure 350C-82 Needle Bearing Assembly

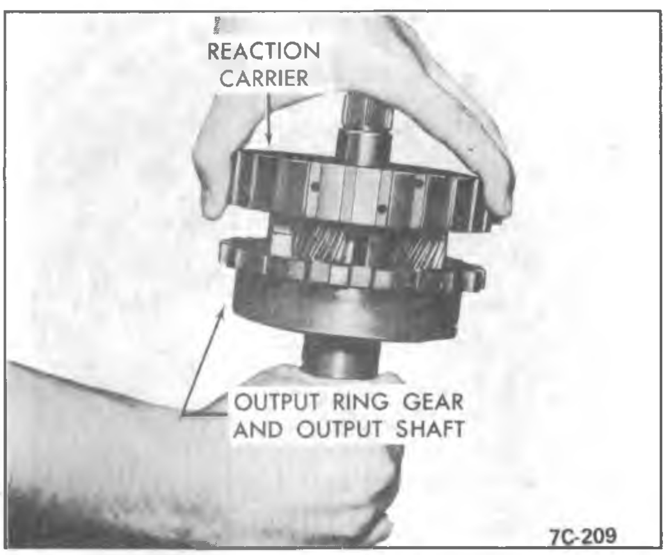


Figure 350C-83 Reaction Carrier Installation

1. Oil and install low and reverse clutch steel separator plates and faced plates, starting with a steel plate and alternating with faced plates. See Figure 350C-84.

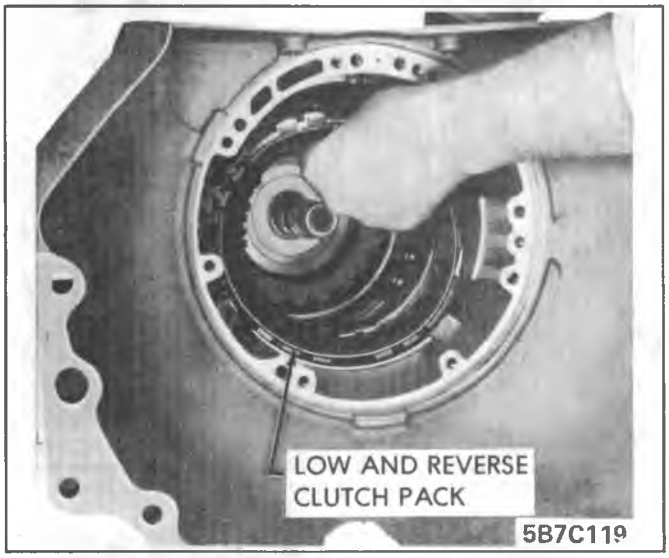


Figure 350C-84 Low and Reverse Clutch Plate Installation

2. Install low and reverse clutch support retainer spring. See Figure 350C-85.

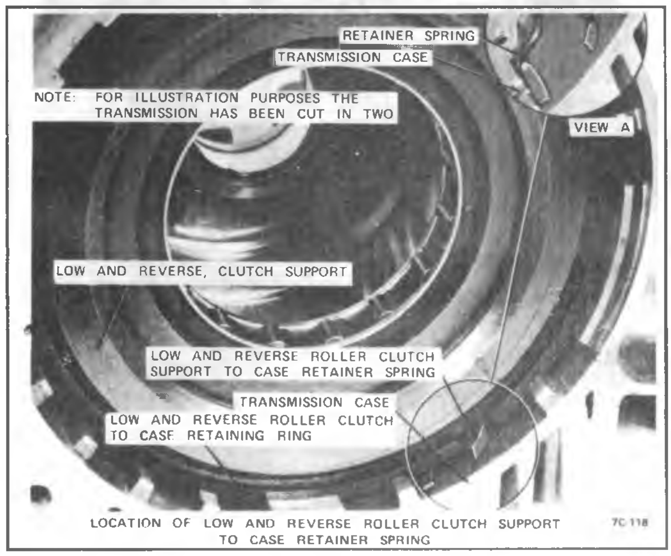


Figure 350C-85 Retainer Location

3. Install low and reverse clutch support assembly pushing firmly until support assembly is seated past top of low and reverse clutch support retainer spring so retaining ring can be installed. See Figure 350C-86.

   Make certain the splines on inner race of the roller clutch align with splines on reaction carrier.

4. Install low and reverse clutch support to case retaining ring. See Figure 350C-85.

Sun Gear Drive Shell Assembly

1. Install low and reverse clutch support inner race to sun gear drive shell thrust washer and install sun gear drive shell assembly. See Figure 350C-87.

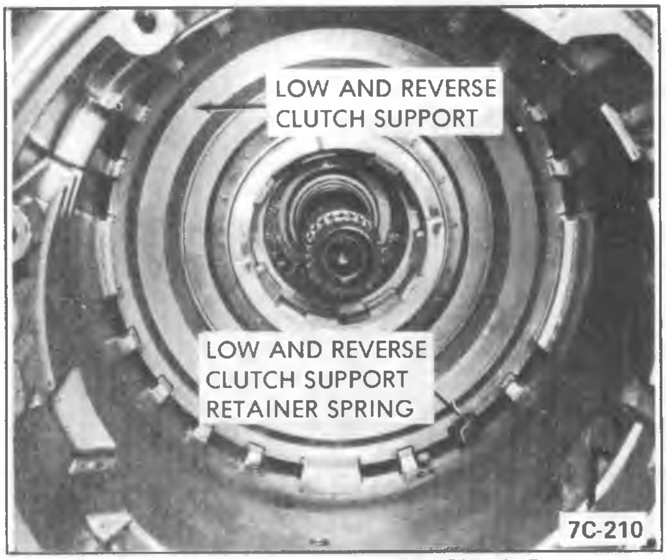


Figure 350C-86 Low and Reverse Clutch Support

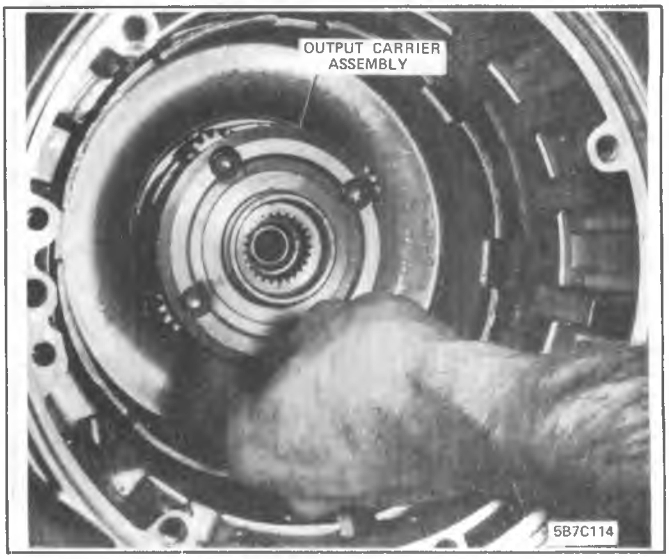


Figure 350C-88 Output Carrier Installation

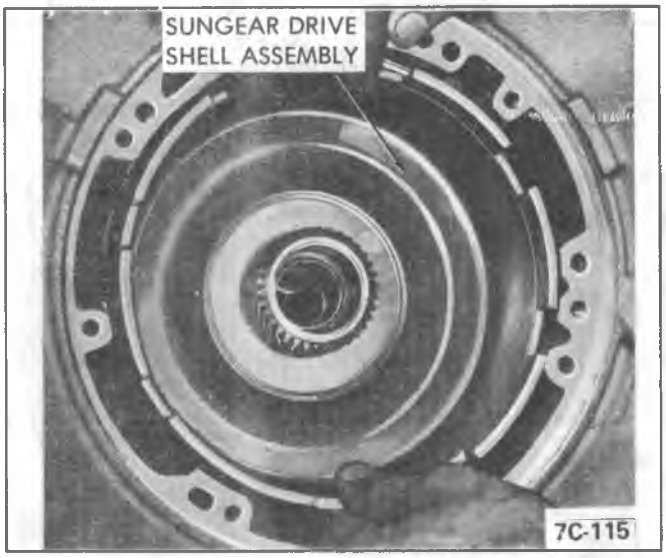


Figure 350C-87 Sun Gear Drive Shell Assembly

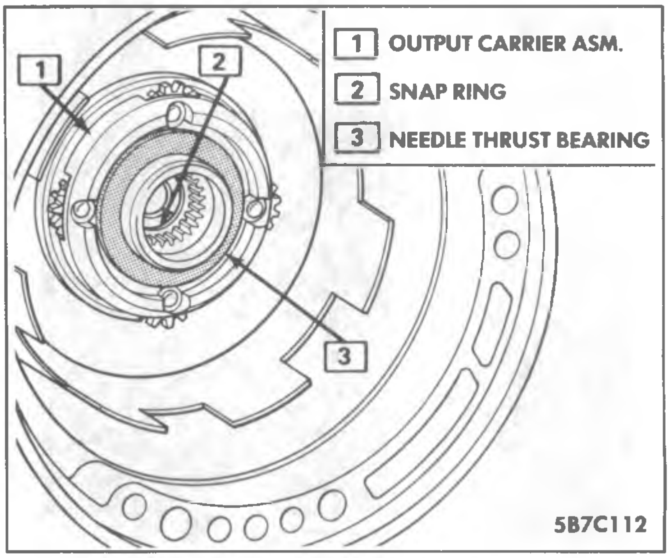


Figure 350C-89 Output Carrier Needle Bearing

Output Carrier Assembly

1. Install output carrier assembly. See Figure 350C-88.
2. Install input ring gear to output carrier needle thrust bearing lip side face down. See Figure 350C-89.
3. Install output carrier to output shaft snap ring.

   Use new snap ring and do not over stress on installing. See Figure 350C-89.

Input Ring Gear

1. Install input ring gear. See Figure 350C-90.
2. Install forward clutch housing to input ring gear front thrust washer. See Figure 350C-90. Washer has three (3) tangs.

Direct and Forward Clutch Assemblies

1. Install direct clutch drum to forward clutch housing needle roller bearing. See Figure 350C-91.

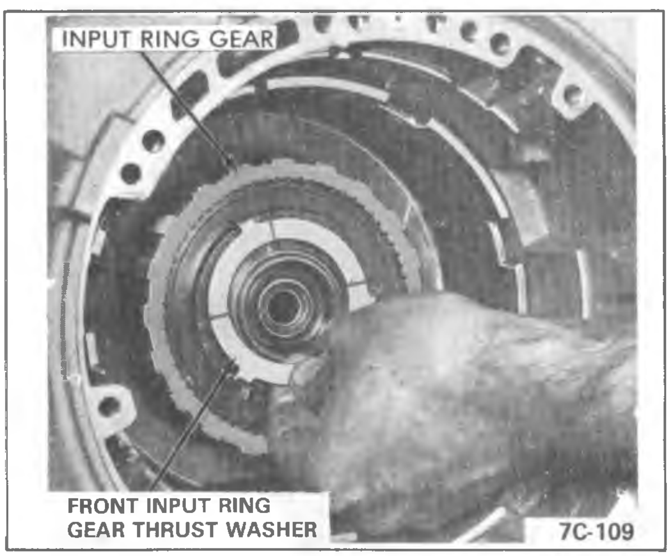


Figure 350C-90 Input Ring Gear Thrust Washer

2. Install direct clutch assembly to forward clutch assembly. Install assemblies into case making

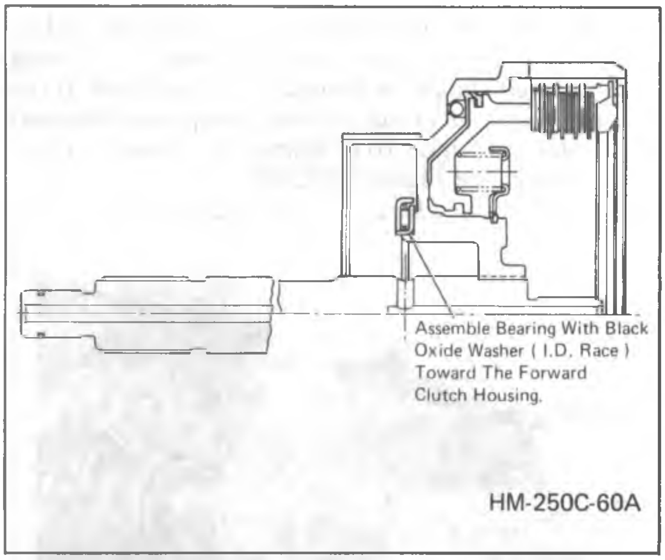


Figure 350C-91 Forward Clutch Needle Bearing

certain forward clutch faced plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shell. See Figure 350C-92.

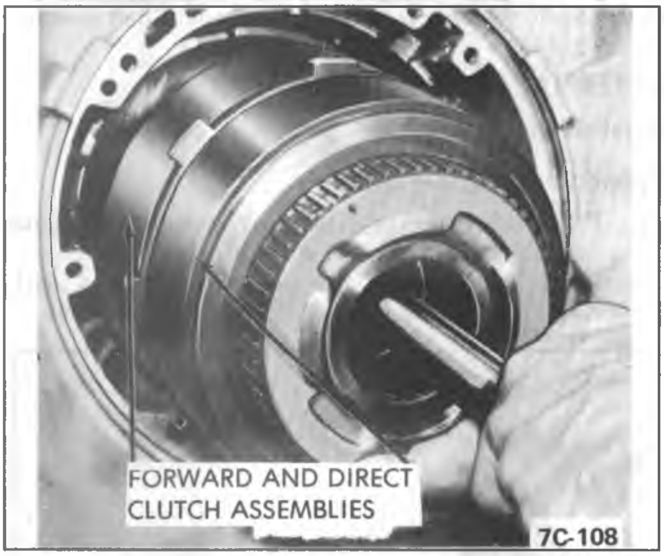


Figure 350C-92 Forward and Direct Clutch Assembly Installation

Intermediate Clutch Overrun Brake Band

1. Install intermediate clutch overrun brake band. See Figure 350C-93.

Intermediate Clutch Pressure Plate, Clutch Plates, and Cushion Spring

Refer to specifications in rear of this section to determine the required amount of composition and steel clutch plates to use with specific transmission model and engine. When replacing piston assembly specific part number must be used.

1. Install intermediate clutch pressure plate. See Figure 350C-94.
2. Oil and install composition and steel intermediate clutch plates, starting with a lined plate and alternating steel and lined.
3. Install intermediate clutch cushion spring.

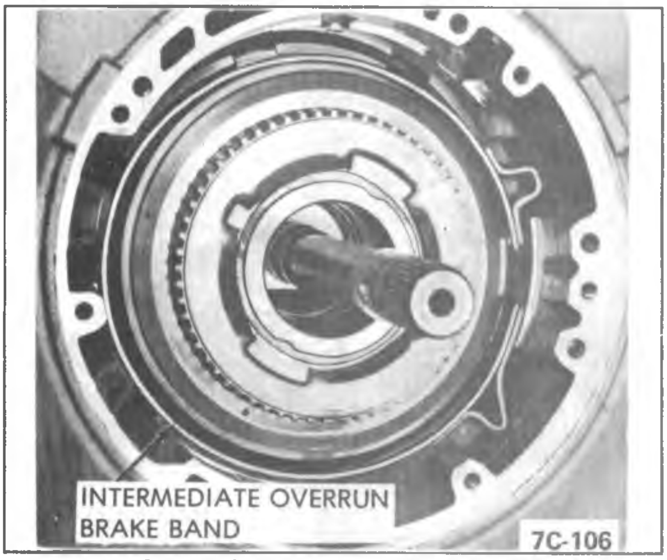


Figure 350C-93 Intermediate Band Installation

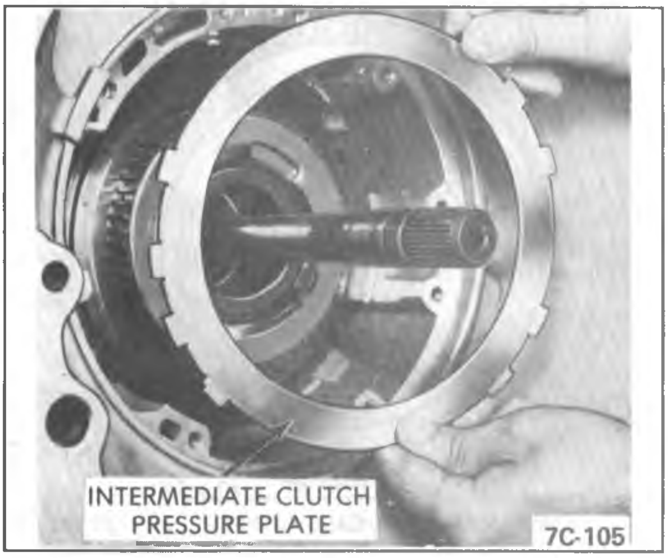


Figure 350C-94 Intermediate Clutch Pressure Plate

Oil Pump Assembly

1. Install original amount of .017 shims, and needle thrust bearing lip side face down on pump cover hub. Before installation apply petrolatum to both sides of shim and bearing. See Figure 350C-95.
2. Install new pump assembly to case gasket. See Figure 350C-96. Before installing pump lubricate case bore.
3. Install guide pins into case. Install pump assembly into case, remove guide pins and install pump to case bolts. Using new washer type seals tighten alternately to 20 ft. lbs. (27 N·m) torque. See Figure 350C-97.
4. If input shaft cannot be rotated as the pump is being pulled into place, the direct and forward clutch housings have not been properly installed to index the composition plates with their respective parts. This condition must be corrected before the pump is pulled into place.
5. Checking direct clutch to oil pump clearance, attach slide hammer bolt to threaded hole in oil pump. See Figure 350C-98. With flat of hand on

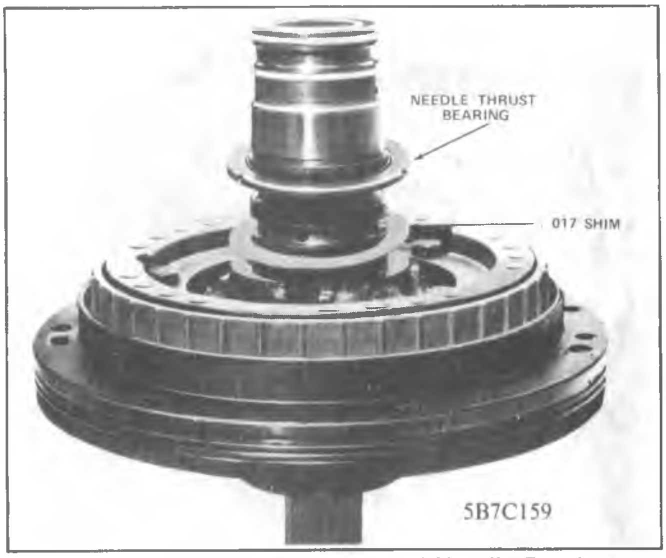


Figure 350C-95 Pump Shim and Needle Bearing

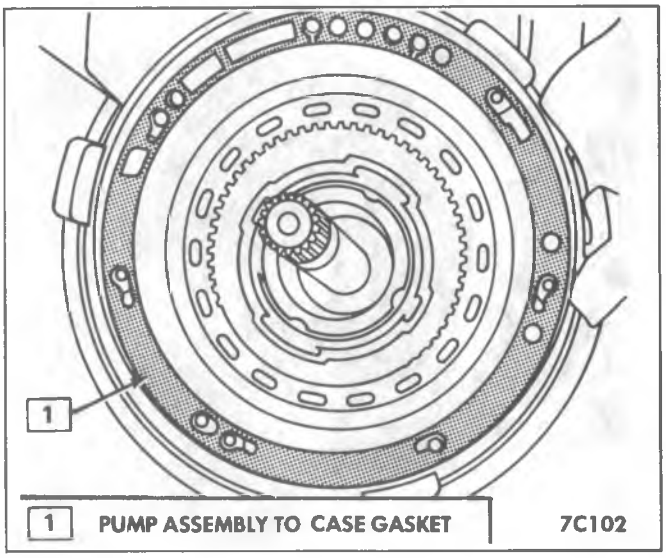


Figure 350C-96 Pump Gasket

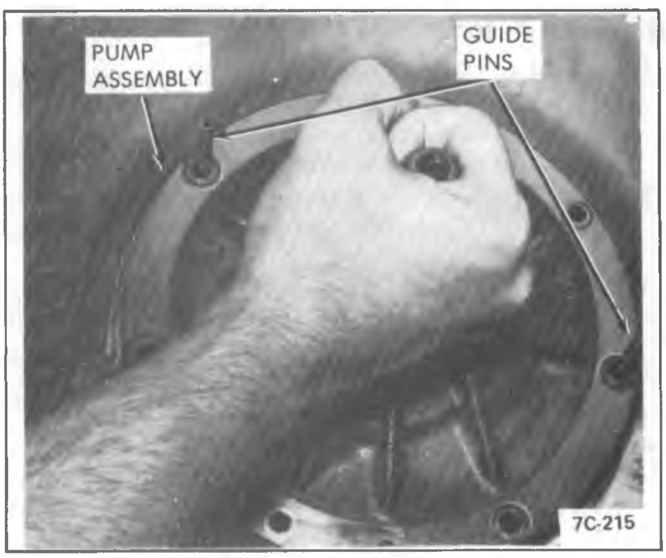


Figure 350C-97 Pump Installation

end of input shaft move shaft rearward. Install Dial Indicator Set J-8001 on rod and "O" dial indicator on end of input shaft. Push on end of output shaft to move shaft forward, the reading obtained should be between .010 and .044. If the reading is incorrect remove pump assembly and install enough .017 shims to obtain correct reading. See Figure 350C-95.

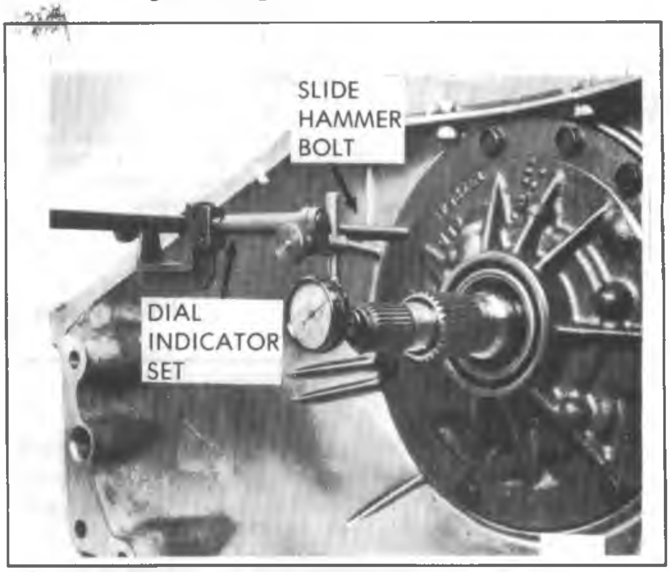


Figure 350C-98 Checking End-Play Output Shaft Sleeve & O Ring

EXTERNAL PARTS

Installation

Speedometer Drive Gear

1. Place speedometer drive gear retaining clip into hole in output shaft. See Figure 350C-99.
2. Align slot in speedometer drive gear with retaining clip and install. See Figure 350C-99.

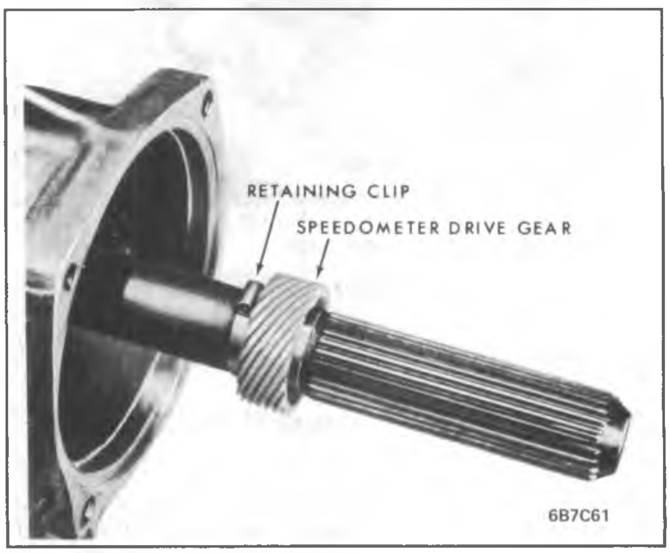


Figure 350C-99 Speedo Gear and Clip

Extension Housing

1. Install extension housing to case square cut seal. See Figure 350C-100.
2. Attach extension housing to case using attaching bolts. Torque to 35 ft.lbs. (47 N·m).

Figure 350C-100 Extension Oil Seal

3. Install speedometer driven gear, retainer and bolt. Torque bolt to 12 ft.lbs. (16 N·m).

Parking Pawl and Actuating Rod

If internal linkage was removed proceed as follows:

1. Install parking pawl, tooth toward the inside of case. See Figure 350C-101.
2. Install parking pawl shaft into case through disengaging spring. Install disengaging spring on parking pawl and slide shaft through parking pawl. See Figure 350C-101.

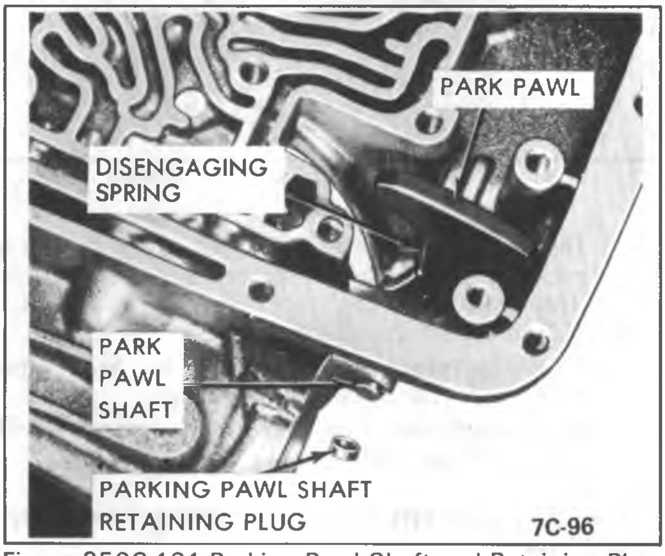


Figure 350C-101 Parking Pawl Shaft and Retaining Plug

3. Install parking pawl shaft retainer plug. Drive into case using a 3/8″ dia. rod, until retainer plug is flush to .010″ below face of case. Stake plug in three (3) places to retain plug in case. See Figure 350C-102.
4. Install park lock bracket, torque bolts to 29 ft.lbs. (39 N·m). See Figure 350C-103.
5. Install actuating rod under the park lock bracket, and parking pawl. See Figure 350C-104.

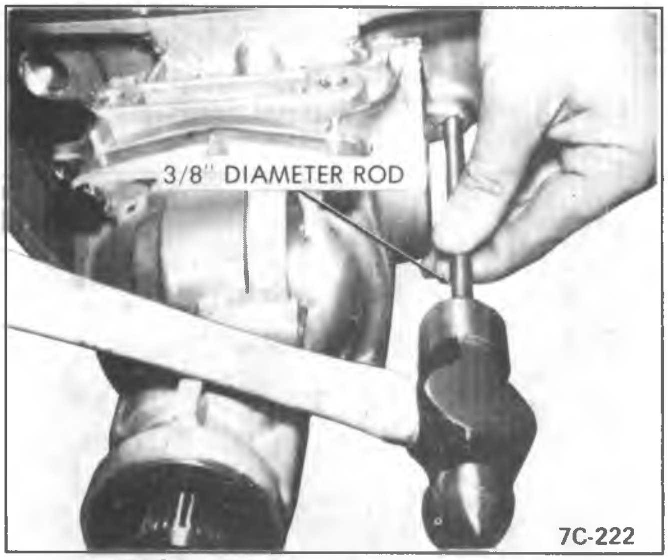


Figure 350C-102 Retaining Plug Installation

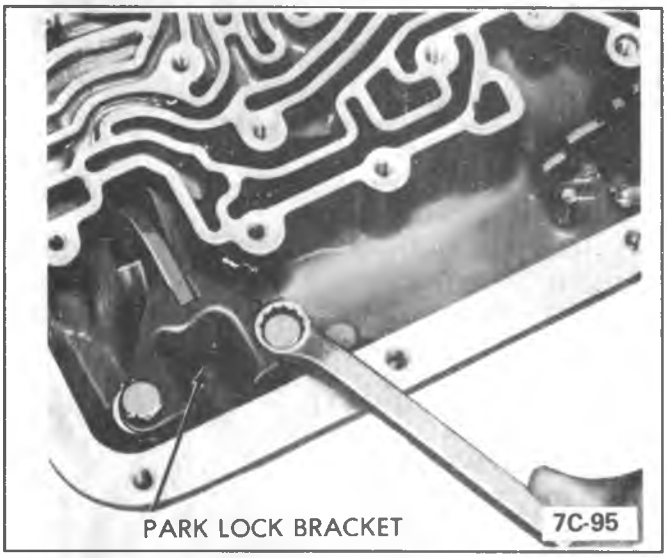


Figure 350C-103 Park Lock Bracket Installation

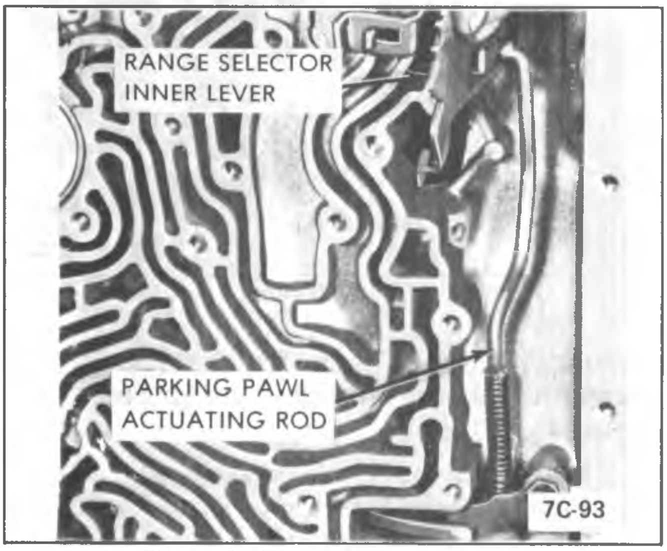


Figure 350C-104 Actuating Rod

Manual Shaft and Range Selector Inner Lever

1. If a new manual shaft to case lip seal is necessary, use a 7/8" diameter rod and seat flush with case. See Figure 350C-105.

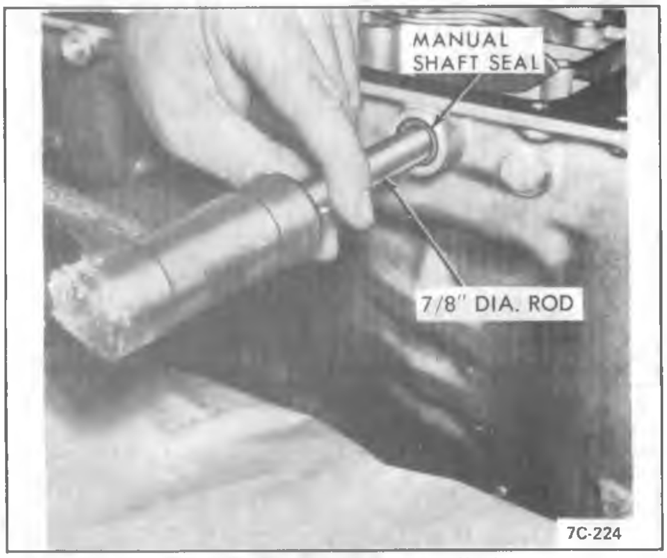


Figure 350C-105 Seal Installation

2. Install manual shaft through case and range selector inner lever.
3. Install retaining jam nut on manual shaft. Torque jam nut to 30 ft.lbs. (40 N·m). See Figure 350C-106. Install manual shaft to case retainer.

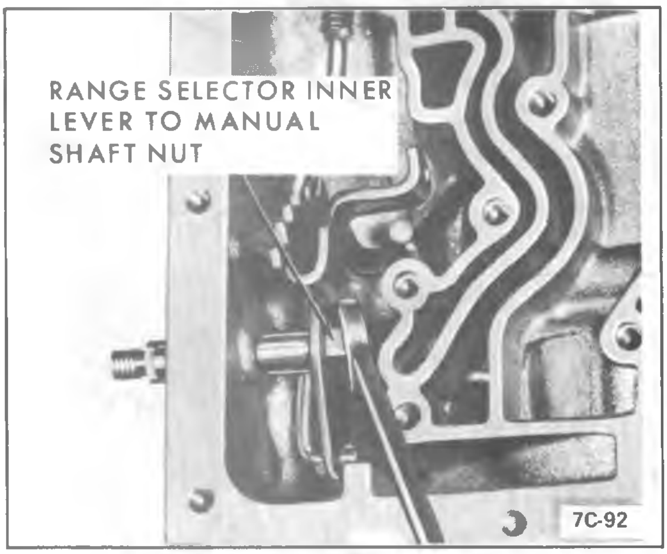


Figure 350C-106 Manual Shaft Nut

Intermediate Servo Piston, Check Balls, Oil Pump Pressure Screen and Governor Feed Screens

1. Install park lock bracket and special bolts.
2. Install intermediate servo piston, apply pin, spring seat. See Figure 350C-107.
3. Install 5 check balls into correct transmission case pockets. See Figure 350C-108. If number one (1) check ball is omitted or incorrectly placed, transmission failure will result due to minimum line pressure.

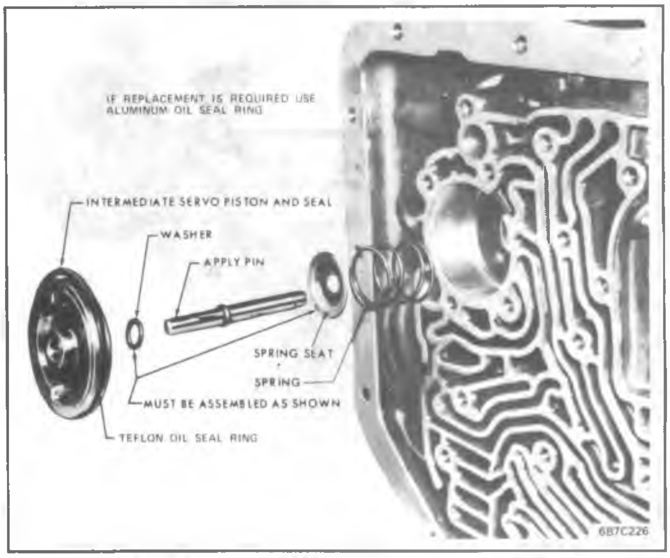


Figure 350C-107 Intermediate Servo Assembly

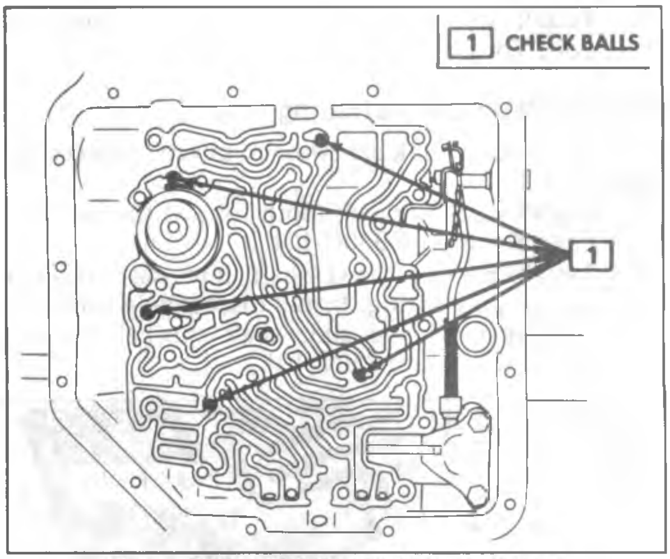


Figure 350C-108 Check Ball Locations

4. Install oil pump pressure screen in the oil pump pressure hole in case. Open end of screen must be installed toward case face. See Figure 350C-109. *(Clean before installing).*
5. Install governor screen in the case. See Figure 350C-110. *(Clean before installing).*
6. If removed, install case electrical connector with new "O" ring seal.

Valve Body, Detent Roller and Spring Assembly, and Filter

1. Install valve body spacer plate to case gasket, valve body spacer plate and spacer plate to valve body gasket. (This gasket has a yellow ink stripe for identification purposes.) See Figure 350C-111.
2. Install spacer support plate. Torque bolts to 13 ft. lbs. (18 N·m). See Figure 350C-112.
3. Install auxiliary valve body, torque bolts to 13 ft. lbs.
4. Install valve body. Connect manual control valve link to range selector inner lever. Install manual shaft retaining clip. Torque bolts in random

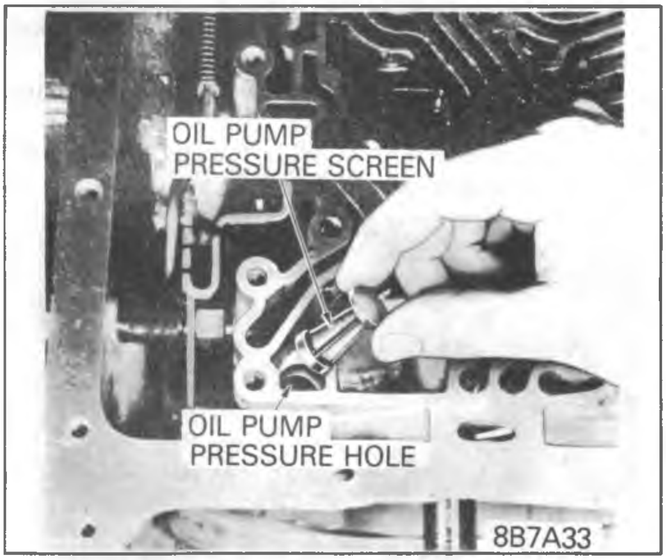


Figure 350C-109 Pump Screen

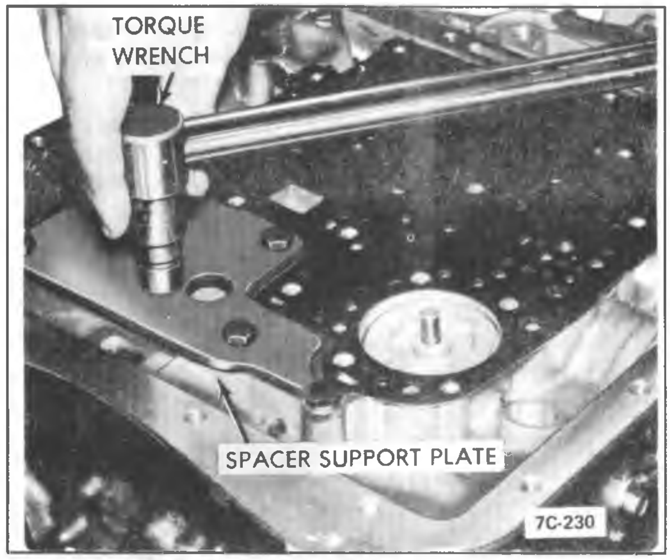


Figure 350C-112 Support Plate

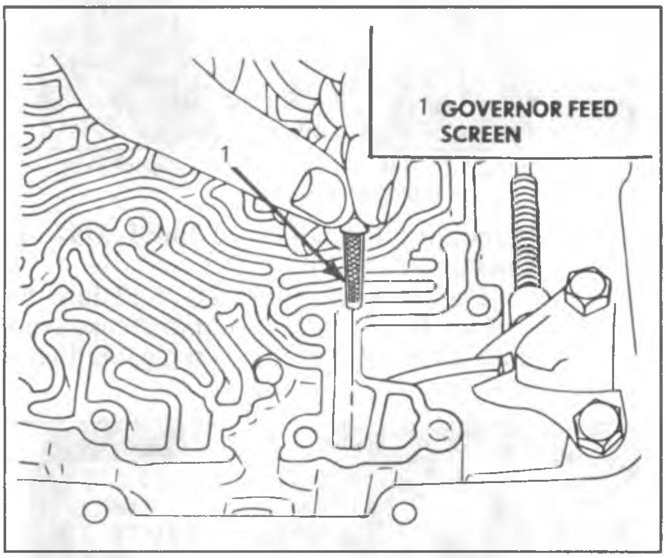


Figure 350C-110 Governor Feed Screen Installation

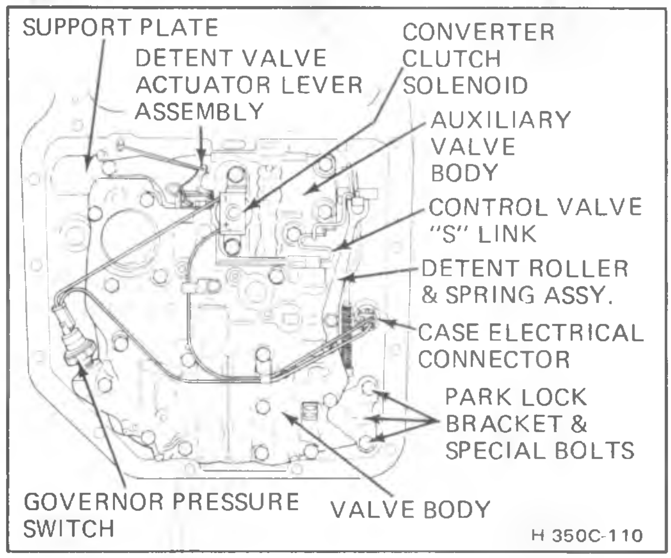


Figure 350C-113 Valve Body and Related Components

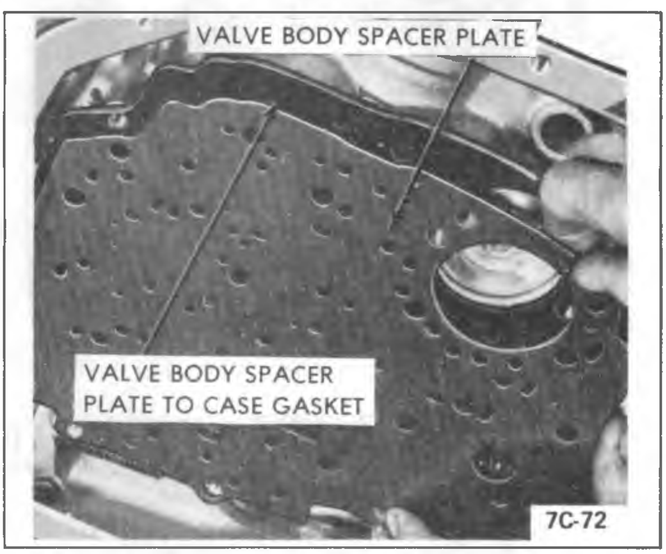


Figure 350C-111 Spacer Plate and Gaskets

sequence to 13 ft.lbs. leaving bolt loose for detent roller and spring assembly. See Figure 350C-113.

When handling valve body assembly do not touch sleeves as retainer pins may fall into transmission.

5. Install detent roller and spring assembly to valve body. See Figure 350C-113.
6. Install detent control valve wire to detent valve actuating lever, then attach lever to valve body.
7. Install solenoid and connect wires (if removed, install governor pressure switch).
8. Install filter and gasket assembly. Install filter and gasket exactly as shown. Always replace filter when foreign material is found to be present.

Oil Pan, Governor, and Modulator Valve

1. Install new bottom pan gasket and bottom pan.
2. Install governor assembly. Check governor dowel pin for proper dimension, and looseness. If pin is too high tap down to proper dimension. However, if the pin is installed too low or loose, the case must be replaced. See Figure 350C-115. Uniformly apply Loctite Cup Plug Sealant #2 or equivalent to governor cover O.D. and install by

gently tapping into place with a plastic or rawhide hammer. If cover is damaged it must be replaced.

3. Install vacuum modulator valve and modulator. See Figure 350C-114. Lubricate "O" ring seal to prevent damage, install retaining clip, and torque bolt to 12 ft. lbs. (16 N·m).

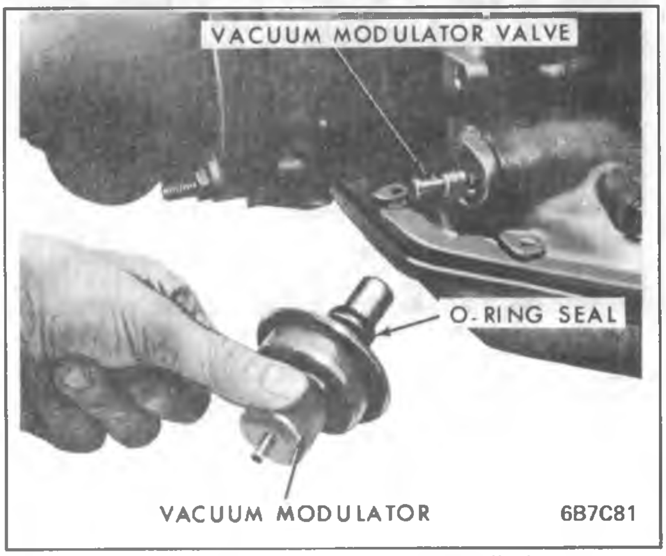


Figure 350C-114 Modulator Installation

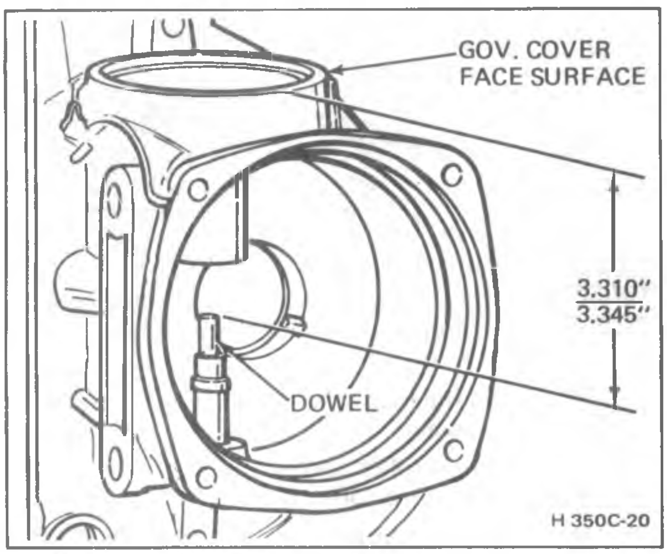


Figure 350C-115 Dowel Pin Dimension

Converter

1. Install converter, making sure that the converter hub engages the drive lugs inside the pump gear. If they are not correctly engaged, pump damage will occur.
2. Check the converter to be sure that it turns freely and is able to move forward to meet the flywheel.

BUSHING REPAIR

GOVERNOR BUSHING

Removal

1. Remove transmission from car.
2. Remove the output shaft, valve body, support plate, and governor from the case.
3. Assemble transmission case in fixture J-8763 and mount in a vise.
4. Clean off excess stock from the governor o- ring seal to case mating surface. See Figure 350C-116.

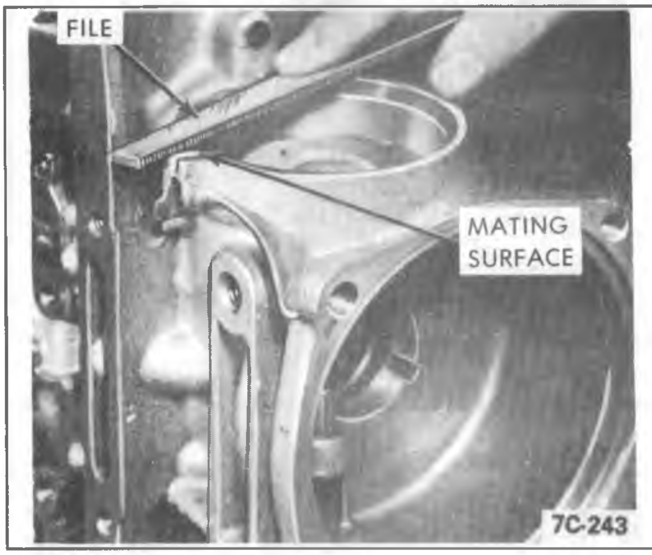


Figure 350C-116 Removing Excess Material From Governor Surface

5. Loosely bolt the drill bushing fixture J- 22976-11 to the case.
6. Place the alignment arbor J-22976-13 into the drill bushing fixture and down into the governor bore until it bottoms on the dowel pin. See Figure 350C-117.

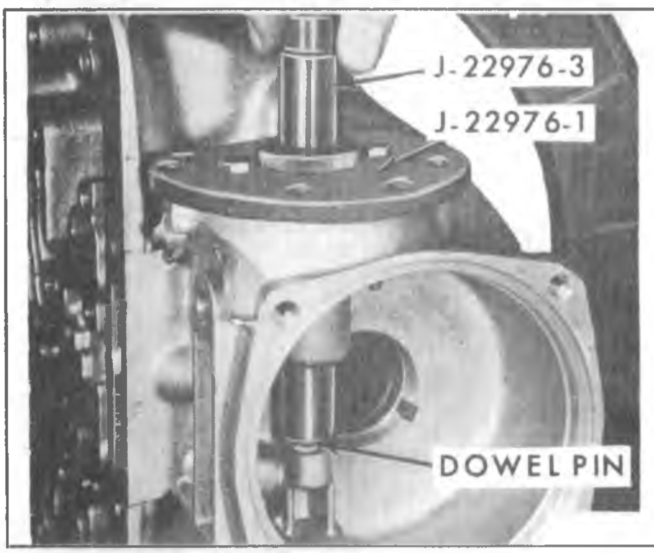


Figure 350C-117 Alignment Arbor

7. Torque the bolts on the drill bushing fixture 10 ft. lbs. (13 N·m). *Do not over torque and strip the threads.* The alignment arbor should be able to rotate freely after the bolts are properly torqued. If the alignment arbor cannot be rotated by hand, recheck the work performed in step 4.
8. Remove the alignment arbor.

9. Using reamer J-22976-9 and drive rachet, *hand* ream the governor bore using the following procedure: (*Hand Ream Only*)
   a. Oil the reamer, drill bushing, and governor bore.
   b. Use 7 lbs. of feeding force on the reamer. See Figure 350C-118.

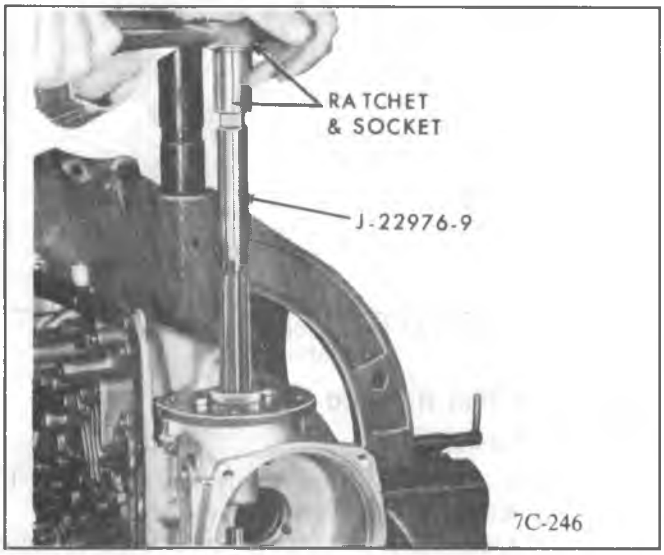


Figure 350C-118 Reamer

   c. *After each 10 revolutions* remove the reamer and dip it into a cup full of transmission oil. This will clean the chips from the reamer and lubricate it. See Figure 350C-119.

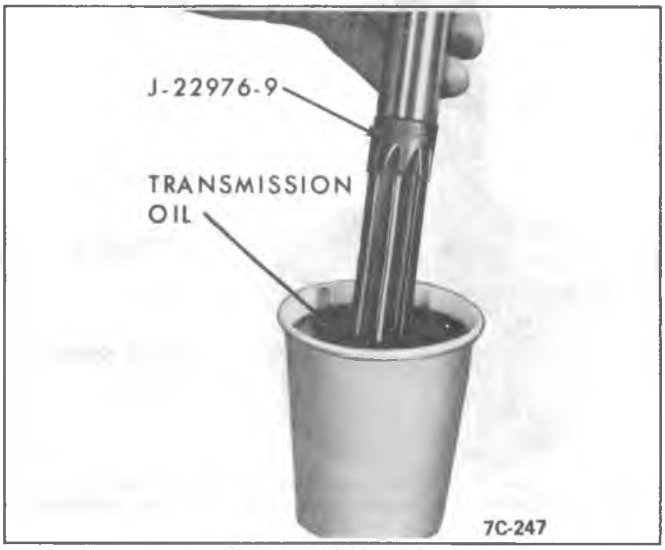


Figure 350C-119

   d. When the reamer reaches the end of the bore, continue reaming the bore until the reamer bottoms out on the dowel pin in the case. *At this point, rotate the reamer 10 complete revolutions.*

   e. Remove the reamer using a clockwise rotation and 7-10 lbs. force upward.

   Pulling the reamer out without rotating it may score the bore causing a leak between the case and the bushing.

10. Remove the drill bushing fixture from the case.
11. Thoroughly clean the chips from the case, visually check the governor feed holes to insure that they are free from chips.

Installation

1. Install the bushing using the following procedure:
   a. Note the two (2) notches at one end of the bushing.
   b. Position the notches so that one notch is toward the front of the case and the other is toward the bottom of the case. See Figure 350C-120.

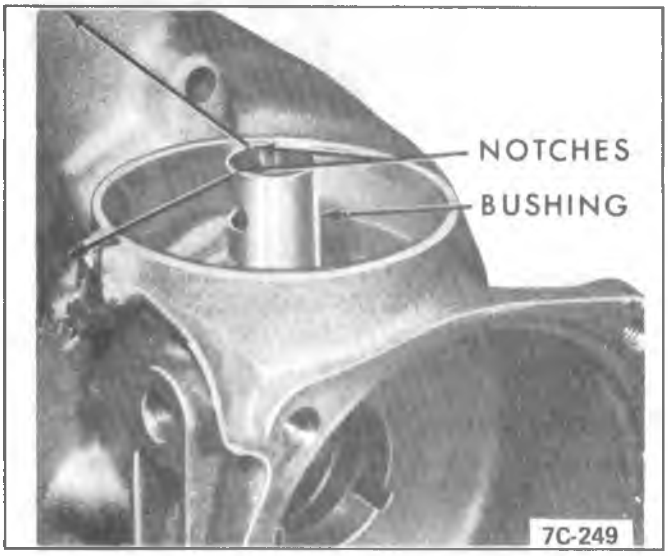


Figure 350C-120 Position Notches

   c. Use J-22976-13 alignment arbor and bushing installer to drive the bushing into the case. See Figure 350C-121. A brass hammer should be used to strike the hardened steel bushing installer tool.

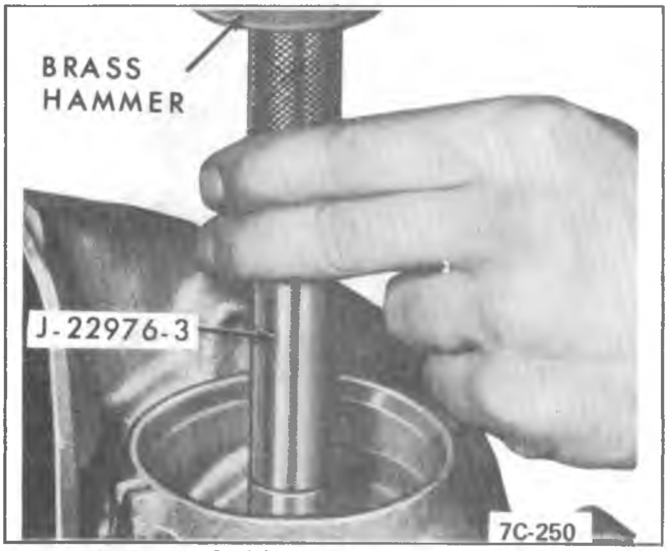


Figure 350C-121 Bushing Installer

d. Drive the bushing until it is flush with the top of the bore and seated properly in the case. See Figure 350C-122.

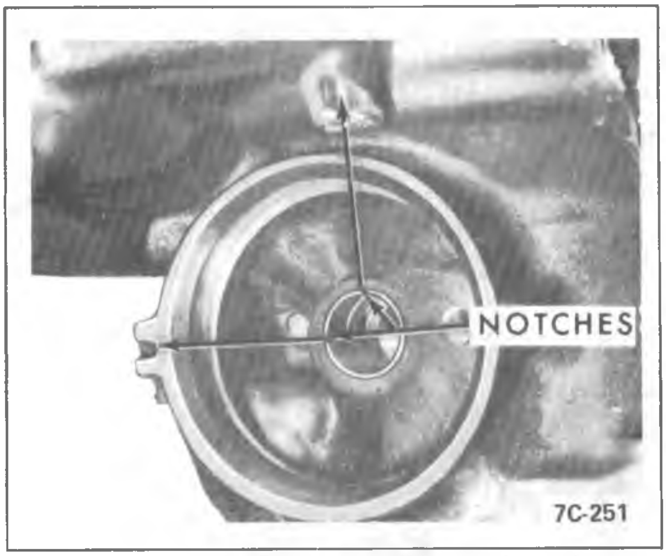


Figure 350C-122 Bushing Properly Seated

2. Oil a new governor and insert it into the installed bushing. The governor should spin freely. If slight honing on the bushing is necessary, use crocus or fine emery cloth and move in a circular one-way direction only.

Extension Housing Bushing

Removal

1. Remove extension housing bushing using screwdriver to collapse bushing. See Figure 350C-123.

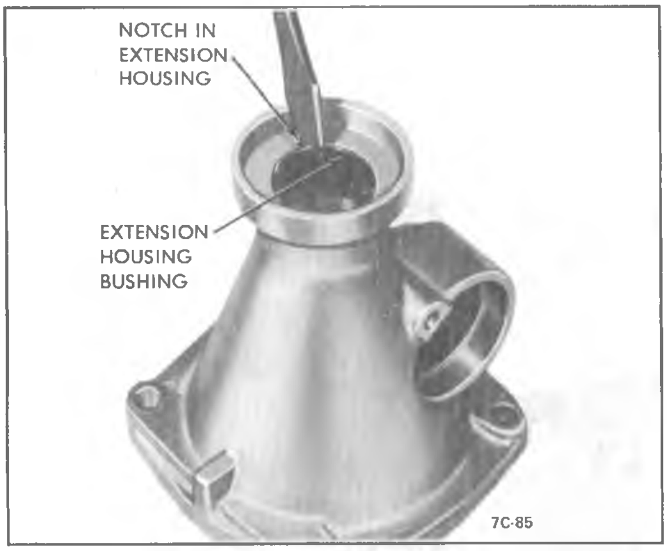


Figure 350C-123 Collapsing Bushing

Installation

1. Install extension housing bushing using drive handle J-8092 and Bushing Tool J-21424-9. See Figure 350C-124.

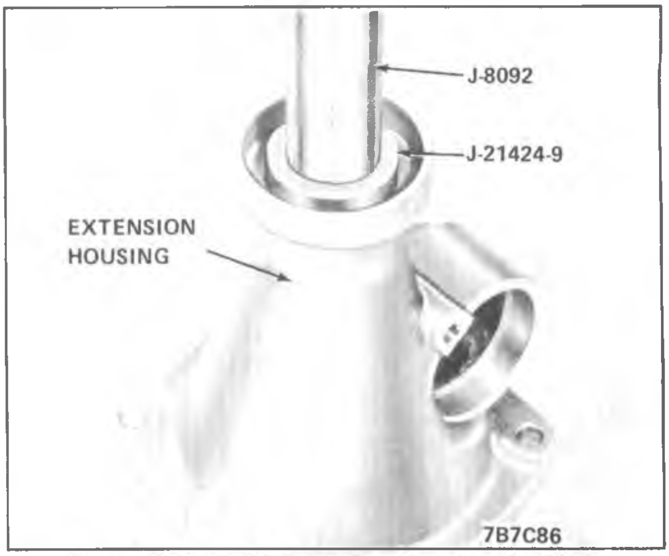


Figure 350C-124 Extension Housing Bushing Installation

Input Ring Gear Bushing

Removal and Installation

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:
   a. Thread Tool J-23062-15 on Drive Handle J-8092, and remove bushing from ring gear. See Figure 350C-125.
   b. Using Tool J-23062-15, press in new bushing .050″ to .060″ from inner surface of hub. See Figure 350C-125.

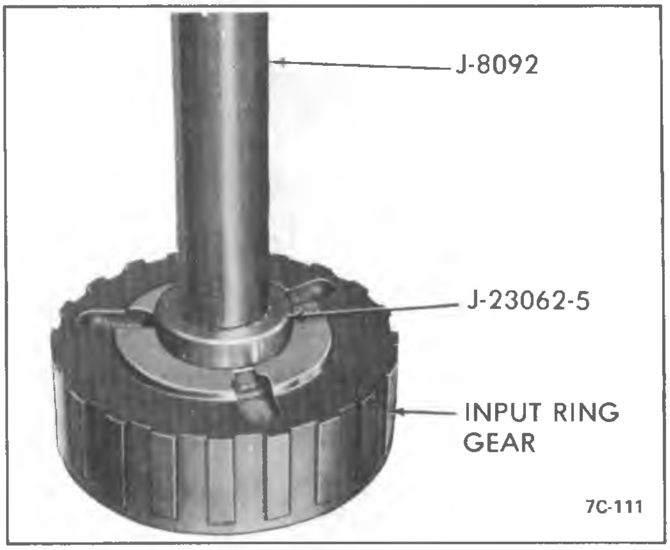


Figure 350C-125 Reaction Carrier Bushing Removal

Reaction Carrier Bushing

Removal and Installation

1. Inspect reaction carrier bushing for wear or galling. If replacement is necessary, proceed as follows:

   a. Thread Tool J-23062-13 on Drive Handle J-8092 and remove bushing. See Figure 350C-126.

b. Using Tool J-23062-13, press in new bushing flush to .010" from inner surface of hub. See Figure 350C-126.

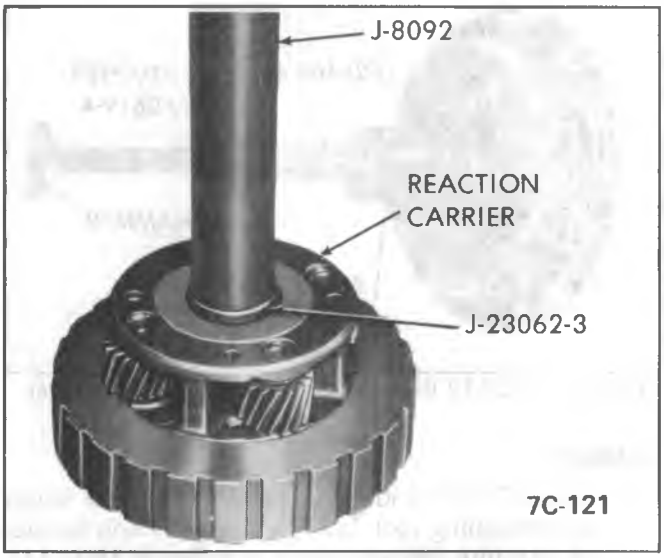


Figure 350C-126 Reaction Carrier Bushing Installation

Case Bushing

Removal

1. Inspect case bushing for nicks, scoring or excessive wear. If damaged, remove as follows: Assemble Tool J-23062-116 on Drive Handle J-8092. Place Tool J-23062-8 into back of case, insert assembly of drive handle J-8092 and Tool J-23062-116 into Tool J-23062-8 and remove bushing. See Figure 350C-127.

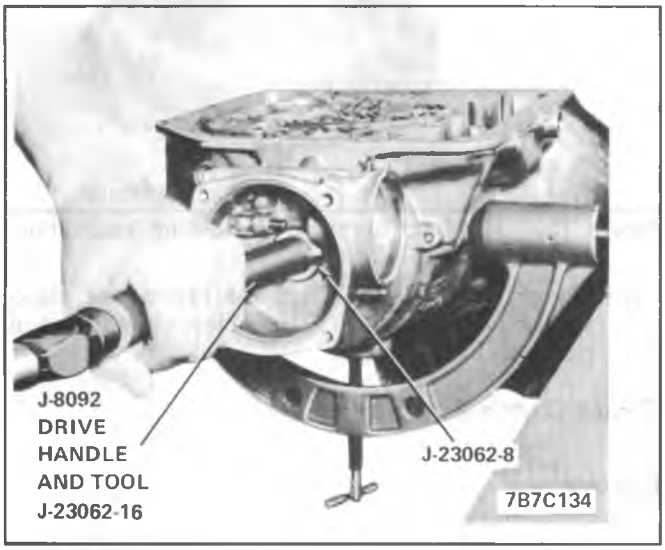


Figure 350C-127 Case Bushing Removal

Installation

1. Using Tool J-23062-11 and Drive Handle J-8092, press bushing to 1/5" below chamfered edge of case. Make certain split in bushing is opposite notch in case. See Figure 350C-128.

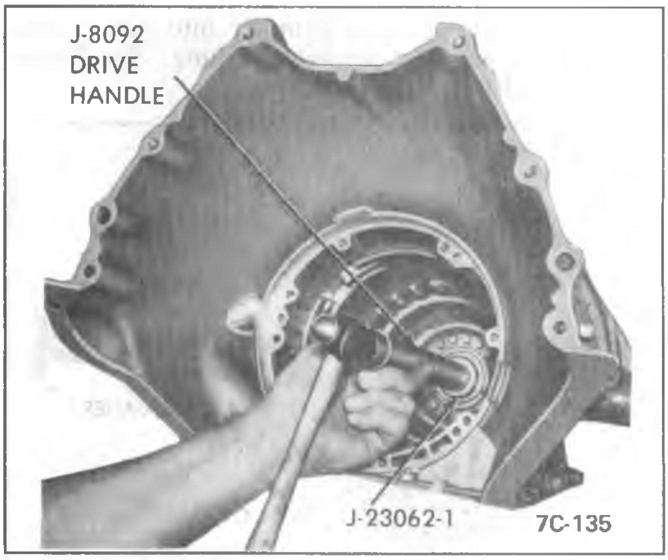


Figure 350C-128 Case Bushing Installation

Pump Body Bushing

Removal and Installation

1. Check oil pump bushing for nicks, severe scoring or wear. If bushing replacement is necessary, remove as follows: Support pump on wood blocks. Use Tool J-21465-117 and Drive Handle J-8092 to press bushing out of pump body. To install new oil pump bushing, use Tool J-21465-117 and Drive Handle J-8092 and press bushing into pump body from gear pocket face until it is flush to .010" below opposite face. (Front pump seal side). See Figure 350C-129.

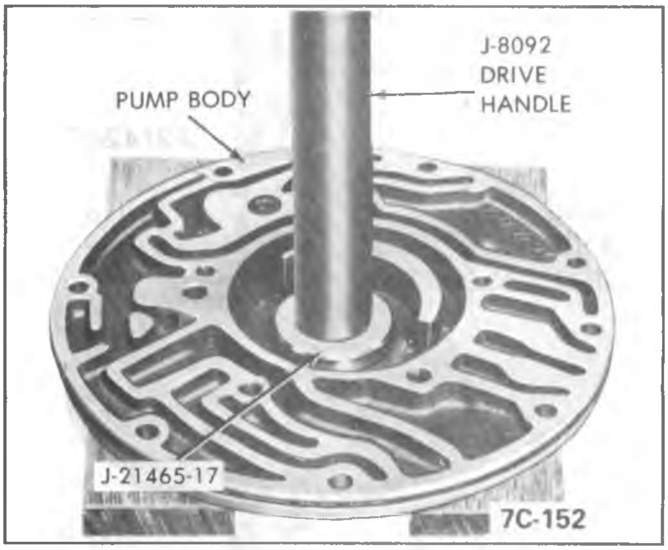


Figure 350C-129 Pump Bushing Removal

Front Stator Shaft Bushing

Removal

1. Check front stator shaft bushing for nicks, severe scoring or wear. If bushing replacement is necessary, remove as follows: Assemble bushing remover J-21465-115 to adapter J-2619-14. Assemble this assembly into slide hammer

J-2619. Clamp slide hammer into vise. Grasp stator shaft and remove bushing. See Figure 350C-130.

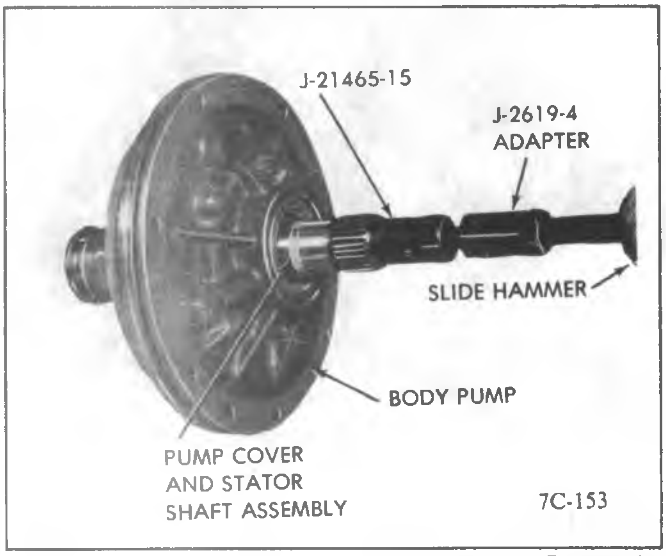


Figure 350C-130 Front Stator Shaft Bushing Removal

Installation

1. Install front stator shaft bushing as follows: Support pump assembly on J-21424-17 before installing bushing. Install bushing into the front end of stator shaft. Using installer J-21424-17 and Drive Handle J-8092, tap bushing into shaft 1/4 inch below top of stator shaft. See Figure 350C-131. Extreme care must be taken so bushing is not driven past shoulder.

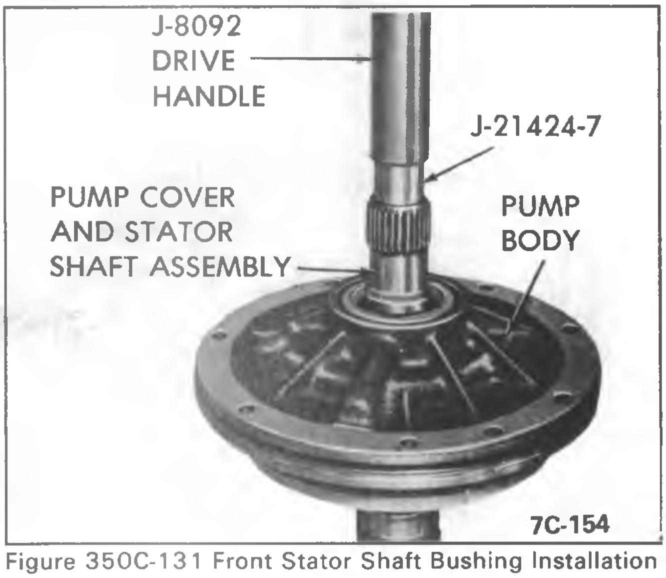


Figure 350C-131 Front Stator Shaft Bushing Installation

Rear Stator Shaft Bushings

Removal

1. If replacement at lower rear stator shaft bushing is required, proceed as follows: Thread Tool J-21465-115 into stator shaft lower rear bushing. Thread slide hammer J-2619 into remover. Clamp slide hammer into vise. Grasp stator shaft and remove bushing. See Figure 350C-132. If upper rear stator shaft bushing is required, repeat above procedure.

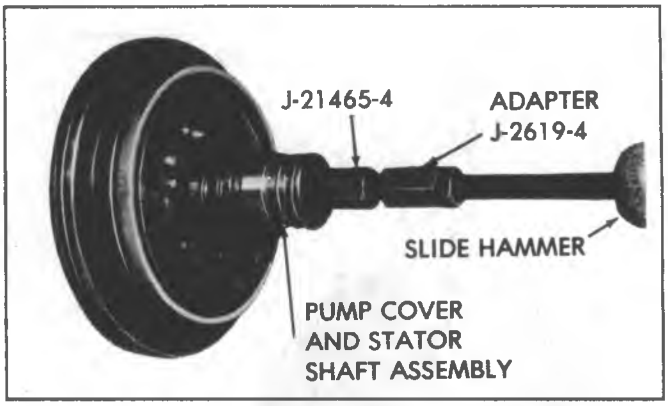


Figure 350C-132 Rear Stator Shaft Bushing Removal

Installation

1. Using Tool J-23062-12, press upper rear stator shaft bushing to 1-11/32 inch below top surface of oil pump delivery sleeve. See Figure 350C-133.

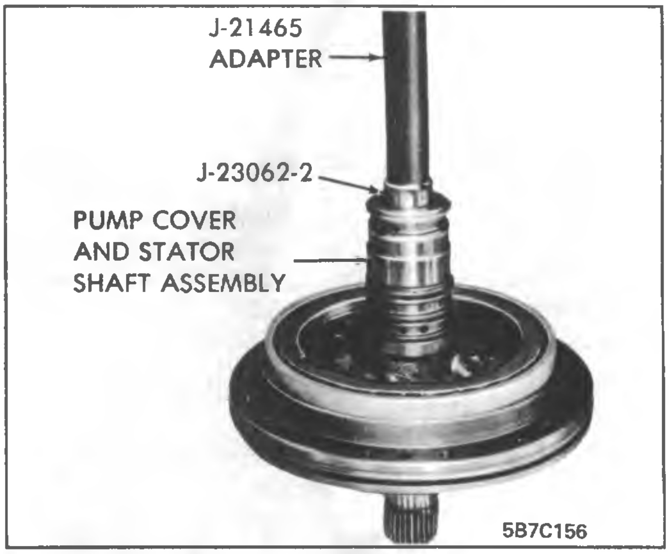


Figure 350C-133 Rear Stator Shaft Bushing Installation

2. Using Tool J-23062-12, press lower rear stator shaft bushing flush to .010" below chamfer on oil pump delivery sleeve.

Direct Clutch Bushing

Removal

1. If bushing replacement is necessary, use Tool J-23062-110 and Drive Handle J-8092 and remove the bushing. See Figure 350C-134.

Installation

1. Install direct clutch bushing using Tool J-23062-14, Drive Handle J-8092, and install .010" below slot in retainer hub. See Figure 350C-135.

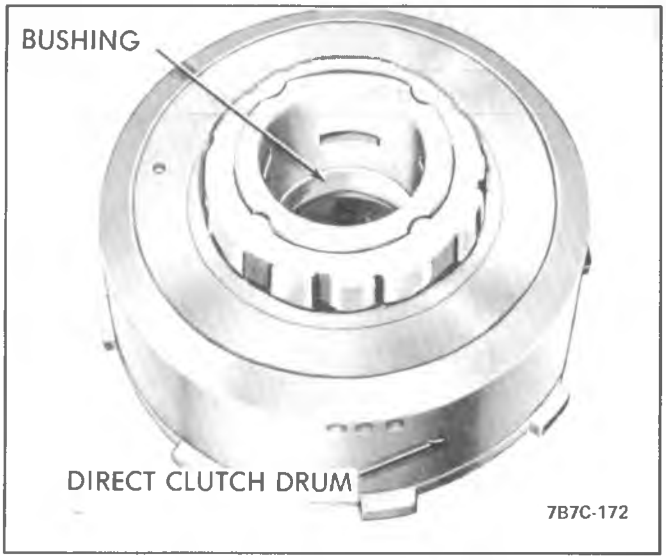


Figure 350C-134 Direct Clutch Bushing Removal

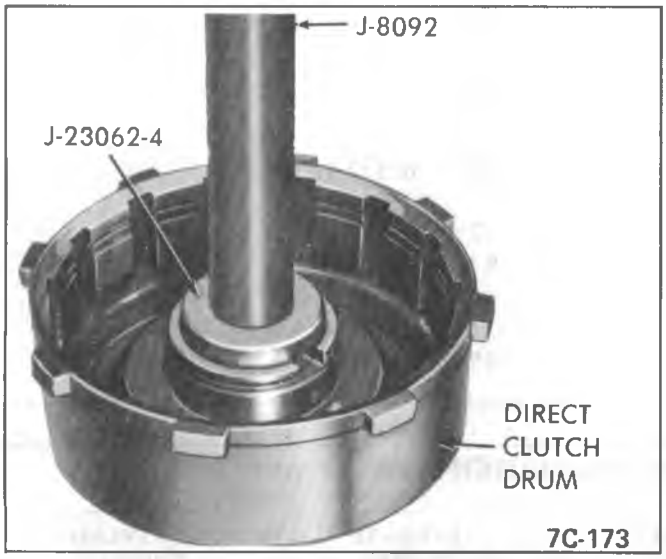


Figure 350C-135 Direct Clutch Bushing Installation

Sun Gear Bushing

Removal

1. If replacement of sun gear bushings is necessary, use Tool J-23062-13 and Drive Handle J-8092 and drive both bushings out through sun gear. See Figure 350C-136.

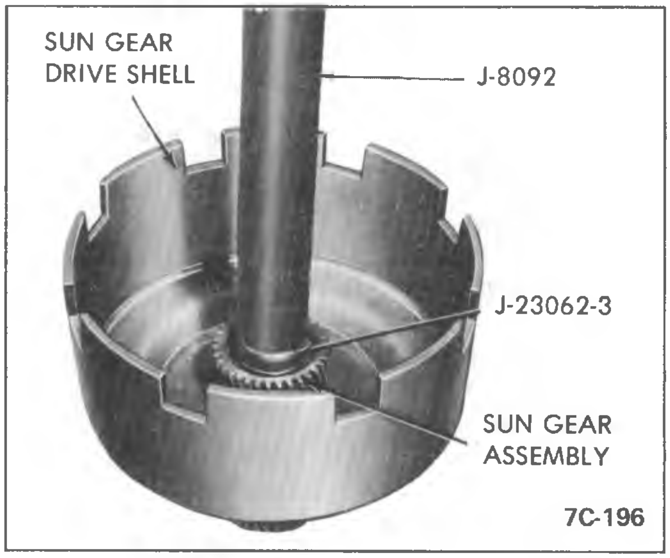


Figure 350C-136 Sun Gear Bushing Installation

Installation

1. Install sun gear bushings using Tool J-23062-13 and Drive Handle J-8092 and install flush to .010" below counter bores. See Figure 350C-136.

TORQUE SPECIFICATIONS

Location	Thread	Torque ft.lbs.
Oil Pan to Transmission Case	5/16-18	13
Pump Assembly to Transmission Case	5/16-18	20
Vacuum Modulator Retainer to Case	5/16-18	12
Valve Body Assembly to Case	5/16-18	13
Oil Channel Support Plate to Case	5/16-18	13
Pump Body to Pump Cover	5/16-18	15
Parking Lock Bracket to Case	5/16-18	29
Extension Housing to Case	3/8-16	35
Inside Shift Nut	3/8-16	30
External Test Plugs to Case	1/8-27	8
Transmission Mount to Transmission	M10-1.5	48 N·m (35 ft. lbs.)
Speedo sleeve retainer on Extension Housing	M6.0-1.0	17 N·m (150 lb. in.)
Detent Cable to Case	M6.0-1.0	8.5 N·m (75 lb. in.)
Nut on End of Selector Lever Shaft	M10-1.5	27 N·m (20 ft. lbs.)
Converter to Flywheel	M10-1.5	45 N·m (35 ft. lbs.)

1984 AUTOMATIC 350C TRANSMISSION CLUTCH PLATE USAGE

TRANS-MISSION I.D. CODE	SPEEDOMETER DRIVE GEAR		INTERMEDIATE CLUTCH			DIRECT CLUTCH			FORWARD CLUTCH			LO & REVERSE CLUTCH		
	Number Of Teeth	Gear Color	No. Of Faced Plates	No. Of Steel Plates	Clutch Piston Thick-ness	No. Of Faced Plates	No. Of Steel Plates	Clutch Piston Thick-ness	No. Of Faced Plates	No. Of Steel Plates	Clutch Piston Thick-ness	No. Of Faced Plates	No. Of Steel Plates	Clutch Plate Thick-ness
XA	10	Purple	3	3	.992	4	4	.833	5	5	1.405	5	5	3.106
WS, WA XS, XX	9	Green	3	3	.992	4	4	.833	5	5	1.223	5	5	2.921
WC XC, XN	8	Orange	3	3	1.184	3	3	1.014	4	4	1.391	4	4	3.106

H350C-200

Figure 350C-137

ESSENTIAL TOOLS — THM350C & THM250C

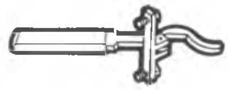
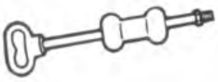
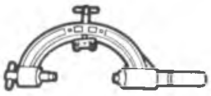
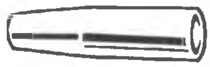
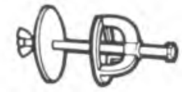
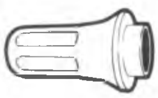
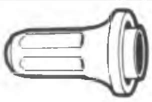
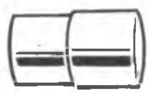
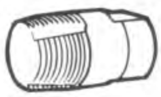
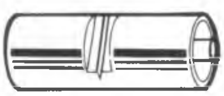
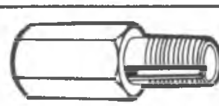
	J 2590-02 Clutch Spring Compressor		J 23069 Accumulator Cover Remover & Installer
	J 2619-A Slide Hammer (⅝" x 18" with ½" x 13 Adapter)		J 26744 Piston Seal Installer
	J 8763-02 Holding Fixture (Use with J3289-20)		J 22974 Seal Protector
	J 3289-20 Holding Fixture Base (Use with J 8763-02)		J 23327 Clutch Spring Compressor
	J 7004-1 Slide Hammers-Pair (⅜" x 16 Thread)		J 22269-01 Servo Remover-THM250 Direct Clutch Accumulator Remover & Installer
	J 8092 Driver Handle		J 24367 Band Adjuster-THM250C
	J 21359 Oil Pump Seal Installer		J 23062-01 Bushing Service Tool Set (use with J 8092)
	J 21426 Extension Housing Seal Installer		J 21424-7 Stator Shaft Bushing Installer (Front) (use with J 8098)
	J 21366 Converter Holding Strap		J 21424-9 Extension Housing Bushing Remover & Installer (use with J 8098)
	J 21369-B Converter Leak Test Fixture		J 22976 Governor Bore Bushing Installation Tool Set (use with J 8092)
	J 23134 Pump Check Valve Seat Remover		J 21465-13 Driver Handle Extension (J 8092)
	J 23112 Pump Check Valve Seat Remover		J 21465-15 Stator Shaft Bushing Remover (J 8092)
	J 24466 Modulator Checking Tool		J 21465-17 Converter Hub & Extension Housing Bushing Remover & Installer (Use with J 8092)
	J 26507 Low & Reverse Clutch Support Remover		J 9534-01 Output Shaft Bushing Remover

Figure 350C-138 Special Tools

SECTION 400

400 AUTOMATIC TRANSMISSION

GENERAL DESCRIPTION

The 400 Series transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, two roller clutch units, and two bands provide the friction elements required to obtain the desired functions of the compound planetary gear set, **Figure** 400-1 and **Figure** 400-2.

The torque converter, the clutches, and roller clutches, couple the engine to the planetary gears through oil pressure, providing three forward speeds and reverse. The torque converter, when required, will supplement the gears by multiplying engine torque.

The torque converter is of welded construction and is serviced as an assembly. The unit is made up of two vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is connected to the transmission.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels the oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical Signals - To operate an electrical detent solenoid.

Gear or torque ratios of the transmission are as follows:

First = 2.48:1 gear ratio

Second = 1.48:1 gear ratio

Third = 1.0:1 gear ratio

Reverse = 2.08:1 gear ratio

Each gear ratio can be multiplied by as much as 2, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to sense engine torque input to the transmission automatically. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and proper shift spacing is obtained at all throttle openings.

The detent solenoid is activated by a switch at the carburetor. When the throttle is opened sufficiently to close this switch, the solenoid in the transmission is activated, causing a downshift at speeds below approximately 110 Km/h (70 mph). At lower speeds, downshifts will occur at lesser throttle openings without use of the switch.

The oil cooler is located in the right hand tank of the radiator. The transmission is cooled by directing oil from the converter to the radiator. Oil returning from the radiator feeds the transmission lubrication system.

The oil system incorporates an intake pipe and filter assembly. The filter assembly should be replaced after 160,-000 Km (100,000 miles) of use under normal operating conditions. It should be replaced after the first 80,000 Km (50,000 miles) if heavy duty operation is encountered, such as constant use in heavy metropolitan traffic, pulling trailers, etc. In addition, replace filter assembly when a major transmission failure occurs and flush the oil cooler and cooler lines. This is particularly important in the case of a converter failure.

The transmission quadrant has six selector positions, that enable the driver to control the operation of the transmission under various driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right; P-park, R-reverse, N-neutral, DRIVE left, DRIVE right (intermediate) and L-lo.

P - Park position positively locks the output shaft to the transmission case by means of a locking pawl and prevents the vehicle from rolling either forward or backward. For this reason, it is recommended that the engine be started with transmission selector lever in Park position. If it is necessary to re-start the engine with the car rolling, place selector lever in Neutral.

R - Reverse enables the vehicle to be operated in a reverse direction.

N - Neutral position enables the engine to be started and run without driving the vehicle. It is recommended that Neutral be used to start the engine only if it is necessary to re-start the engine with the car rolling. At all other times Park should be used.

Drive (left) - is used for all normal driving conditions and maximum economy. Drive (left) has three gear ratios from starting to direct drive. Downshifts are available for safe passing, by depressing the accelerator pedal.

Drive (right) - adds performance for congested traffic or hilly terrain. This range has the same starting ratio as Drive (left), but prevents the transmission from shifting above second speed to retain acceleration when extra performance is desired. Engine braking is provided in this range.

L - Lo range permits operation at the lowest ratio, and should be used where only the lowest gear ratio is desired, such as in pulling a heavy load or descending a steep grade. When selector lever is moved from Drive to Lo range at normal highway speeds, the transmission will shift to second gear and remain in second gear until vehicle speed is reduced to approximately 45 mph. The transmission will then shift

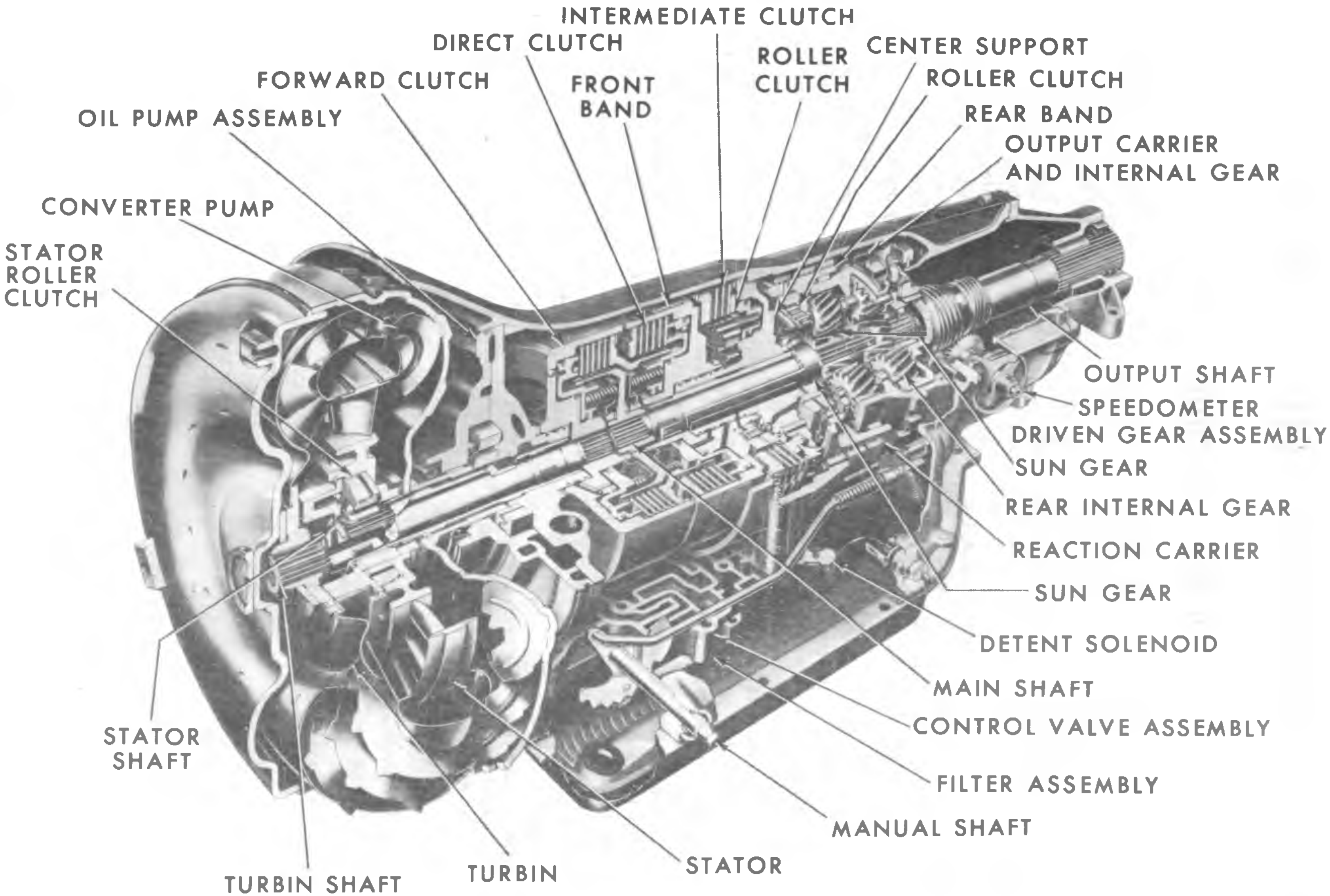
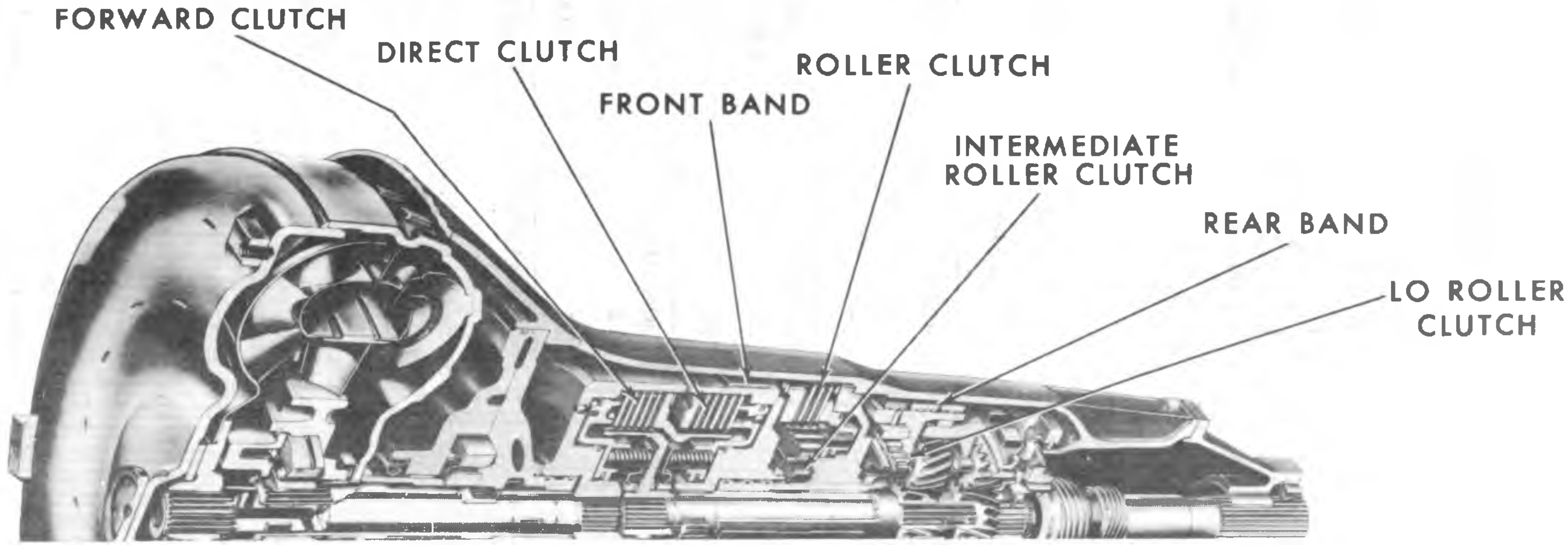


Figure400-1 400 Transmission - Cutaway View



RANGE	GEAR	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INT. CLUTCH	INT. ROLLER CLUTCH	LO ROLLER CLUTCH	REAR BAND
PARK–NEUT.		OFF	OFF	OFF	OFF	INEFFECTIVE	INEFFECTIVE	OFF
DRIVE	FIRST	ON	OFF	OFF	OFF	INEFFECTIVE	EFFECTIVE	OFF
	SECOND	ON	OFF	OFF	ON	EFFECTIVE	INEFFECTIVE	OFF
	THIRD	ON	ON	OFF	ON	INEFFECTIVE	INEFFECTIVE	OFF
INT.	FIRST	ON	OFF	OFF	OFF	INEFFECTIVE	EFFECTIVE	OFF
	SECOND	ON	OFF	ON	ON	EFFECTIVE	INEFFECTIVE	OFF
LO	FIRST	ON	OFF	OFF	OFF	INEFFECTIVE	EFFECTIVE	ON
	SECOND	ON	OFF	ON	ON	EFFECTIVE	INEFFECTIVE	OFF
REV.		OFF	ON	OFF	OFF	INEFFECTIVE	INEFFECTIVE	ON

Figure400-2 Band, Roller Clutch and Clutch Application Chart

to first gear and remain in first gear regardless of vehicle or engine speed, until selector lever is moved back into either of the Drive positions.

1981 transmission models and their applications are listed in **Figure** 400-3.

MODEL	CALIBRATION	AXLE RATIO	TRANS. MOD./TYPE
DEVILLE AND BROUGHAM	FED. CARB.	2.28:1 STD. 2.73:1 TTP	AE/400 AD/400
	CALIF. CARB.	2.56:1 STD.	AB/400
	DIESEL	2.41:1 STD.	AS-AX/200 C
LIMOUSINE AND COMMERCIAL CHASSIS	ALL	3.08:1 STD.	AD/400

Figure 400-3 Transmission Usage Chart

DIAGNOSIS

400 AUTOMATIC TRANSMISSION PROCEDURE

NOTICE: In the event of a major transmission malfunction, replace filter assembly, flush oil cooler and lines before installing new fluid. This is particularly important in the case of a converter or pump malfunction.

This Diagnosis Guide should be used in the following sequence to positively locate the problem:

1. Perform the "Preliminary Checking Procedure", in **Figure** 400-5 recording the readings in the Oil Pressure Reading row. After taking the pressure readings, place Low, Normal or High in each box of the Oil Pressure Pattern row.

2. Road test the car as described in Part B if problem is not known.

3. Refer to the "Transmission Malfunction Related to Oil Pressure" chart, in **Figure** 400-7. First determine if malfunction noted is in this chart. If so, compare Oil Pressure Pattern row, **Figure** 400-5 and **Figure** 400-7. A dash on the "Transmission Malfunction Related to Oil Pressure" chart means that the oil pressure reading has no significance under the test condition.

If transmission malfunction is found in this chart, follow the directions indicated in the Malfunction column. The oil pressure pattern will indicate where the malfunction is.

The only time it is necessary to determine a pressure drop (the control valve assembly-governor line pressure check, part b) is when there is "No 1-2 Upshift and/or Delayed Upshift" and all oil pressure readings are normal.

It will not be necessary to repeat oil pressure readings taken during preliminary checks should this be called for during further tests.

4. If malfunction cannot be determined by the chart, **Figure** 400-7, or if upon completion of these tests, it is not found, see the "Transmission Troubleshooting Guide", starting with Part C to locate malfunction not related to oil pressure.

All malfunctions, both those related to oil pressure and those that are not, are listed in the "Transmission Troubleshooting Guide". Always perform the "Preliminary Checking Procedure" first as it provides a positive means to isolate the problem if the malfunction can be diagnosed by this procedure.

5. After correcting malfunction, road test car as described in Part B Transmission Road Testing.

400 SERIES TRANSMISSION	
UPSHIFT	MINIMUM
1-2	15 MPH
2-3	30 MPH
UPSHIFT	MAXIMUM
1-2	44-48 MPH
2-3	77-83 MPH
DETENT DOWNSHIFT	MINIMUM
3-2	68-73 MPH
2-1	28-32 MPH

Figure 400-4 Shift Point Specifications

A. Preliminary Checking Procedure

Perform checking procedure shown in **Figure** 400-5.

B. Transmission Road Testing

Refer to Figure 400-4

1. Connect portable tachometer to engine. Engine rpm will identify shift points.

2. Place selector in "Drive" position and accelerate the vehicle from rest at a minimum throttle opening. The specifications for shift points are:

3. Place selector in "Intermediate" position and accelerate the vehicle from rest. A 1-2 shift should occur at all throttle openings. No 2-3 shift can be obtained in this range. Stop car.

all throttle openings. No 2-3 shift can be obtained in this range. Stop car.

4. Place selector in "Low". No upshift should occur in this range regardless of the throttle opening.

5. Position the selector in "Drive" and accelerate the vehicle to 35 mph and move the selector to "Intermediate". A 3-2 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration.

6. With the selector in "Intermediate" at approximately 25 mph, but not over 40 mph, at closed throttle, move the selector to "Low." A 2-1 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration. Stop car.

7. Place selector in "Reverse" and check for reverse operation.

E.G.R. SYSTEM

With Exhaust Gas Recirculation (EGR), the throttle is open enough in "Drive" range (1000 rpm) to cause the EGR valve to open. When the EGR valve opens, exhaust gas enters the intake manifold which lowers intake manifold vacuum. When intake manifold vacuum is lowered, the transmission line oil pressure raises accordingly, and may go above the upper specification limit. For this reason, if high line pressures are obtained, proceed as follows:

1. Disconnect the EGR vacuum line at the EGR valve and plug the vacuum line.

2. Recheck line pressures as indicated on the Preliminary Checking Procedure Chart, **Figure** 400-5.

3. If high line pressures are still obtained, it may be that the engine is not producing enough vacuum to lower transmission line pressure within specifications. The newer engines with emission controls characteristically have lower engine vacuum than older past model engines. To obtain line pressures suitable for evaluation, it is recommended that vacuum be applied to the modulator, using an external vacuum source such as J-23738 hand operated vacuum device or its equivalent. The unit allows definite amounts of vacuum to be applied to the modulator so that consistent line pressures may be obtained for evaluation as follows:

1. Disconnect the vacuum hose to the modulator at the modulator and plug the vacuum hose.

2. Attach the hand operated vacuum device and apply 20" of vacuum.

3. Recheck line pressures according to the Preliminary Checking Procedure Chart, **Figure** 400-5.

4. If line pressures are still high, proceed to the specific diagnosis chart that applies to the malfunction encountered.

5. If line pressures are normal with external vacuum applied, check engine vacuum and vacuum systems for leaks.

C. Cause of Low Line Pressure

1. Low Transmission Oil Level.

2. Modulator Assembly see Part V.

3. Filter.

A. Blocked or restricted.*

B. "O" Ring on intake pipe and/or grommet omitted or damaged.

C. Split or leaking intake pipe.

D. Wrong filter assembly.

4. Pump.

A. Pressure regulator or boost valve stuck.

B. Gear clearance, damaged worn. (Pump will become damaged if drive gear is installed backwards, or if converter pilot does not enter crankshaft freely).

C. Pressure regulator spring, too weak.

D. Not enough spacers in pressure regulator.

E. Pump to case gasket mispositioned.

F. Malfunctioning pump body and/or cover.

G. Mismatch pump cover/pump body.

5. Internal Circuit Leaks.

A. Forward clutch leak (pressure normal in neutral and reverse-pressure low in drive).

1. Check pump rings.

2. Check forward clutch seals.

B. Direct clutch leak (pressure normal in neutral, low, intermediate, and drive-pressure low in reverse).

1. Check center support oil seal rings.

2. Check direct clutch outer seal for damage.

3. Check rear servo and front accumulator pistons and rings for damage or missing.

6. Case Assembly.

A. Porosity in intake bore area.

B. Check case for intermediate clutch plug leak or missing plug.

C. Lo-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in Lo range).

*There is no approved service procedure for checking or cleaning the filter, if the filter is suspected of being plugged or restricted. It must be replaced.

D. Causes of High Line Pressure

1. Vacuum Leak

A. Full leak (vacuum line disconnected.)

B. Partial leak in line from engine modulator.

C. Improper engine vacuum.

D. Vacuum operated accessory leak. (Hoses, vacuum advance, etc.).

2. Damaged Modulator.

A. Stuck valve.

B. Water in modulator.

C. Not operating properly - Part V.

3. Detent System.

A. Detent switch actuated (plunger stuck) or shorted.

B. Detent wiring shorted.

C. Detent solenoid stuck open.

D. Detent feed orifice in spacer plate blocked.

E. Detent solenoid loose.

F. Detent valve bore plug damaged.

G. Detent regulator valve pin short.

4. Pump.

A. Pressure regulator and/or boost valve stuck.

B. Incorrect pressure regulator spring.

C. Too many pressure regulator valve spacers.

D. Pump casting bad.

E. Pressure boost valve installed backwards or malfunctioning.

DIAGNOSIS

PRELIMINARY CHECKING PROCEDURE

CHECK TRANS. OIL LEVEL (See Page **400-26**.)

CHECK OUTSIDE MANUAL LINKAGE AND CORRECT (See Page **400-24**.)

CHECK ENGINE TIMING AND IDLE (See Section 6-C & 6-D.)

INSTALL OIL PRESSURE GAGE (See Fig. **400-3**)

CONNECT TACHOMETER TO ENGINE

CAUTION: TOTAL RUNNING TIME FOR THIS COMBINATION NOT TO EXCEED 2 MINUTES.

CHECK OIL PRESSURES IN FOLLOWING MANNER

	RANGE	OIL PRESSURE READING	NORMAL P.S.I.	OIL PRESSURE PATTERN LOW–NORMAL–HIGH
1	NEUTRAL–BRAKES APPLIED ENGINE AT 1000 RPM		55 TO 70	
2	DRIVE IDLE SET ENGINE IDLE TO SPECIFICATIONS		60 TO 85	
3	DRIVE — BRAKES APPLIED ENGINE AT 1000 RPM		60 TO 90*	
4	2 OR 1 — BRAKES APPLIED ENGINE AT 1000 RPM		135 TO 160*	
5	REVERSE–BRAKES APPLIED ENGINE AT 1000 RPM		95 TO 150*	
6	DRIVE — BRAKES APPLIED ENGINE AT 1000 RPM DOWNSHIFT SWITCH ACTIVATED		90 TO 110	
7	GOVERNOR CHECK–FOR UPSHIFT PROBLEM SEE PROCEDURE, Page **400-3**		DROP OF 10 PSI OR MORE	
8	DRIVE – 30 MPH – CLOSED THROTTLE ON ROAD, OR ON HOIST**		55 TO 70	

* IF HIGH LINE PRESSURES ARE EXPERIENCED, SEE PAGE **400-7**

** VEHICLE ON HOIST, DRIVING WHEELS OFF GROUND, SELECTOR IN DRIVE, BRAKES RELEASED, RAISE ENGINE TO 3000 R.P.M., CLOSE THROTTLE AND READ PRESSURE BETWEEN 2000 AND 1200 R.P.M.

Figure 400-5 Preliminary Checking Procedure

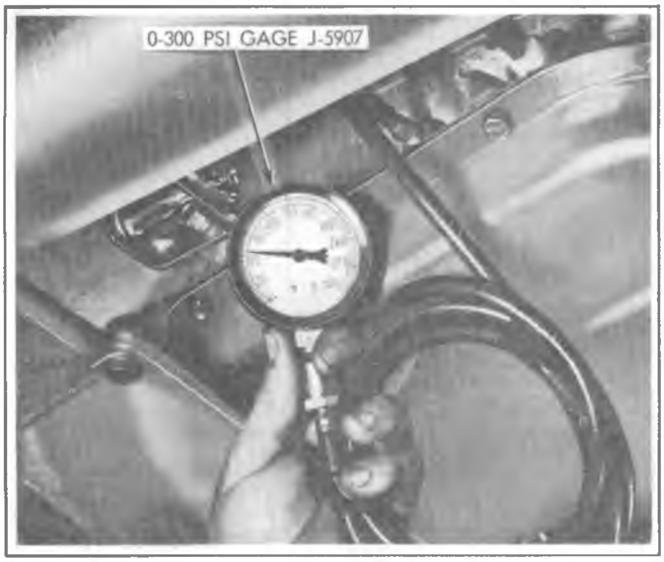


Figure400-6 Oil Pressure Test Gage

F. Aluminum bore plug has hole or otherwise malfunctioning.

G. Pressure boost bushing broken or otherwise malfunctioning.

5. Control Valve Assembly.

A. Spacer plate-to-case gasket off location.

B. Wrong spacer plate-to-case gasket,

E. Causes of Oil Leaks

1. Transmission Oil Pan Leaks.

A. Attaching screws not correctly torqued.

B. Improperly installed or damaged pan gasket.

C. Oil pan gasket mounting face not flat.

2. Case Extension Leak.

A. Attaching screws not correctly torqued.

B. Rear seal assembly - damaged or improperly installed. (Propeller shaft yoke damaged).

C. Gasket - (Extension to case) damaged or improperly installed.

D. Porous casting.

E. Output shaft "O" ring damaged.

3. Case Leak.

A. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine "Loading" one side of the "O" ring.

B. Modulator assembly "O" ring seal damaged or improperly installed.

C. Connector "O" ring seal damaged or improperly installed.

D. Governor cover, gasket and screws - damaged, loose; case face leak.

E. Damaged or porosity. Leak at speedometer driven gear housing or seal. Leak at speedometer hole plug.

F. Manual shaft seal - damaged, improperly installed.

G. Line pressure tap plug - stripped, lacking compound.

H. Vent pipe (refer to Item 5 below).

I. Porous case, or cracked at pressure plug boss.

4. Front End Leak.

A. Front seal - damaged (check converter neck for nicks, etc., also for pump bushing moved forward) garter spring missing.

B. Pump attaching screws, and seals - damaged, missing, screws loose.

C. Converter - leak in weld.

D. Pump "O" ring seal - damaged. (Also check pump oil ring groove and case bore).

E. Porous casting (pump or case).

F. Pump - drain back hole not open.

5. Oil Comes Out Vent Pipe.

A. Transmission over-filled.

B. Water in oil.

C. Filter "O" ring damaged or improperly assembled causing oil to foam.

D. Foreign material between pump and case or between pump cover and body.

E. Case - porous, pump face improperly machined.

F. Pump - insufficient metal, porous.

G. Pump to case gasket mispositioned.

H. Pump breather hole blocked or missing.

I. Hole in intake pipe.

6. Oil Cooler Lines.

A. Connections at radiator loose or stripped.

B. Connections at case loose or stripped.

7. Modulator Assembly. Diaphragm leaking - Part V.

F. Control Valve Assembly - Governor Line Pressure Check

1. Install oil pressure test gage, **Figure** 400-6.

2. Install tachometer.

3. Disconnect vacuum line to modulator.

4. With vehicle on hoist (driving wheels off ground), foot off brake, in drive, check line pressure at 1000 rpm.

5. Slowly increase engine rpm to 3000 rpm and determine if a line pressure drop occurs (10 psi or more).

6. If pressure drop of 10 psi or more occurs, disassemble, clean and inspect control valve assembly.

7. If pressure drop is less than 10 psi:

a. Inpect governor

1. Stuck valve.

2. Weight Freeness.

3. Restricted orifice in governor valve.

4. Check governor valve entry and exhaust (.020" min.). For procedure, refer to current service manual.

b. Governor feed system

1. Check screen in control valve assembly or case.

2. Check for restrictions in governor pipe.

3. Check for fit of governor pipes in case holes.

U. Downshift Solenoid Circuit Check

Before checking the downshift solenoid circuitry, make certain that the transmission downshift switch is properly adjusted.

1. With transmission shift lever in Park, turn ignition switch to "ON" position, but do not start car. Leave ignition switch "ON" throughout checking procedure.

2. Working under hood, slowly advance throttle linkage to wide open position. One click should be heard from transmission.

Malfunction	1 Neutral Brakes Applied 1000 rpm — Oil Pressure	2 Drive Idle — Oil Pressure	3 Drive Left — Brakes Applied 1000 rpm — Oil Pressure	4 Drive-R Brakes Applied 1000 rpm — Oil Pressure	5 Reverse Brakes Applied 1000 rpm — Oil Pressure	6 Drive Left — Brakes Applied 1000 rpm Downshift Switch Activated — Oil Pressure	7 Pressure Drop Occurs while Engine rpm Increases from 1000 to 3000 rpm Wheels Free to Move*	8 Drive 30 mph Closed Throttle — Oil Pressure	Possible Cause of Malfunction
No 1-2 Upshift and/or Delayed Upshift	Normal	Normal	Normal	Normal	Normal	Normal	10 psi Drop or More	Normal	Malfunction in Control Valve Assembly
	Normal	Normal	Normal	Normal	Normal	Normal	Less than 10 psi Drop	Normal	Malfunction in Governor or Governor Feed System
	Normal	High	High	Normal	Normal	Normal		High	Malfunction in Detent System
	High	High	High	Normal	High	—	—	—	Malfunction in Modulator or Vacuum Feed System to Modulator
Slipping-Reverse	Normal	Normal	Normal	Normal	Low	Normal		Normal	Oil Leak in Feed System to the Direct Clutch
Slipping-1st Gear	Normal	Low to Normal	Low to Normal	Low to Normal	Normal	Low to Normal	—	Low to Normal	Oil Leak in Feed System to the Forward Clutch
Downshift with Zero Throttle and No Engine Braking in Drive	Normal	High	Normal	Normal	Normal	—	—	High	Stator and Detent Wires Switched
No Detent Downshifts	Normal	Normal	Normal	Normal	Normal	Low		Normal	Malfunction in Detent System

*Drive range, vacuum line disconnected from modulator.

A dash (—) in the above chart means that the oil pressure reading has no meaning under the test condition.

Pressures obtained by the Preliminary Checking procedure

Figure400-7 Preliminary Diagnosis Procedure

H. NO. 1-2 UPSHIFT AND/OR DELAYED UPSHIFT

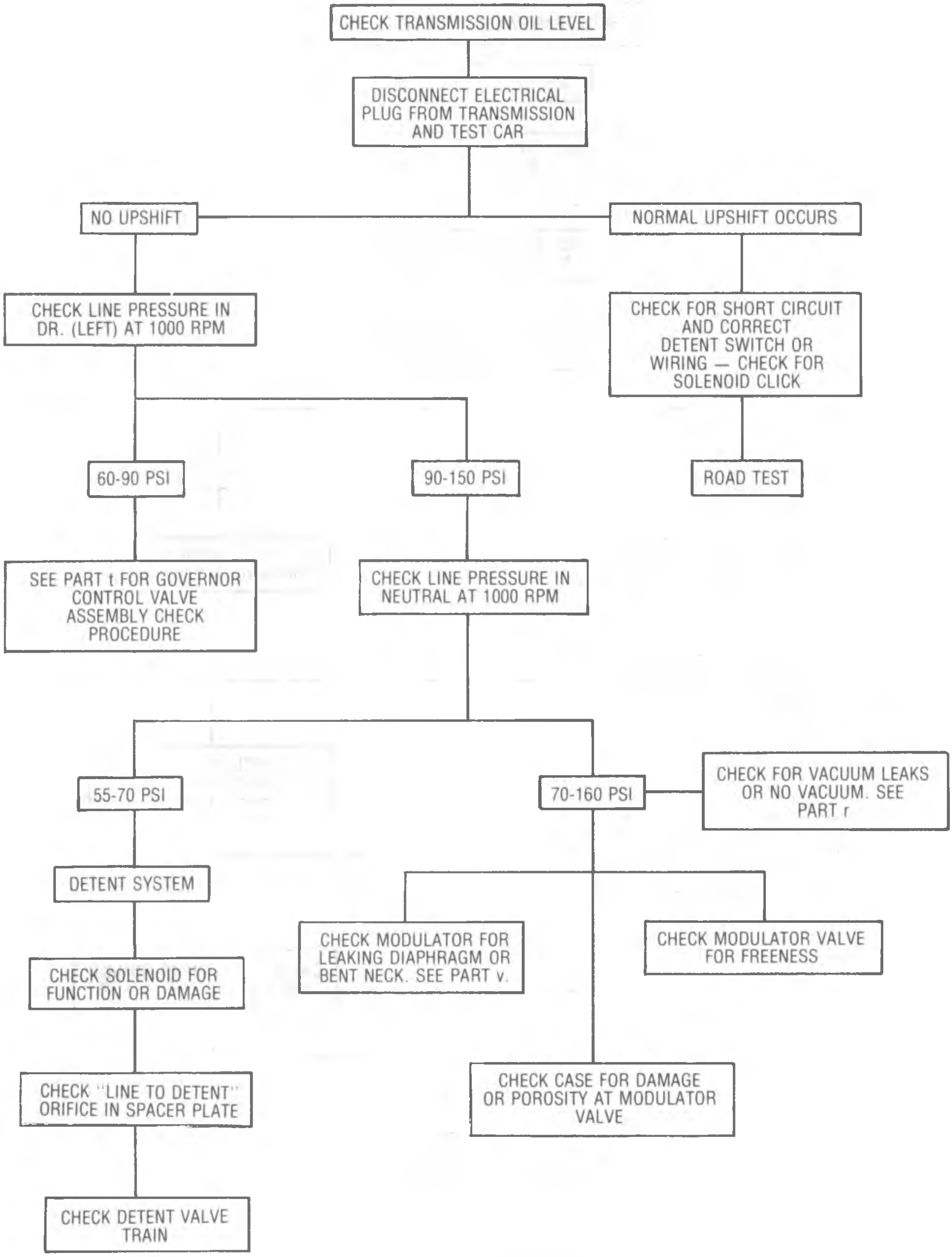


Figure400-8 Diagnosis

I. 1-2 SHIFT FEEL COMPLAINT — FIRM SHIFT

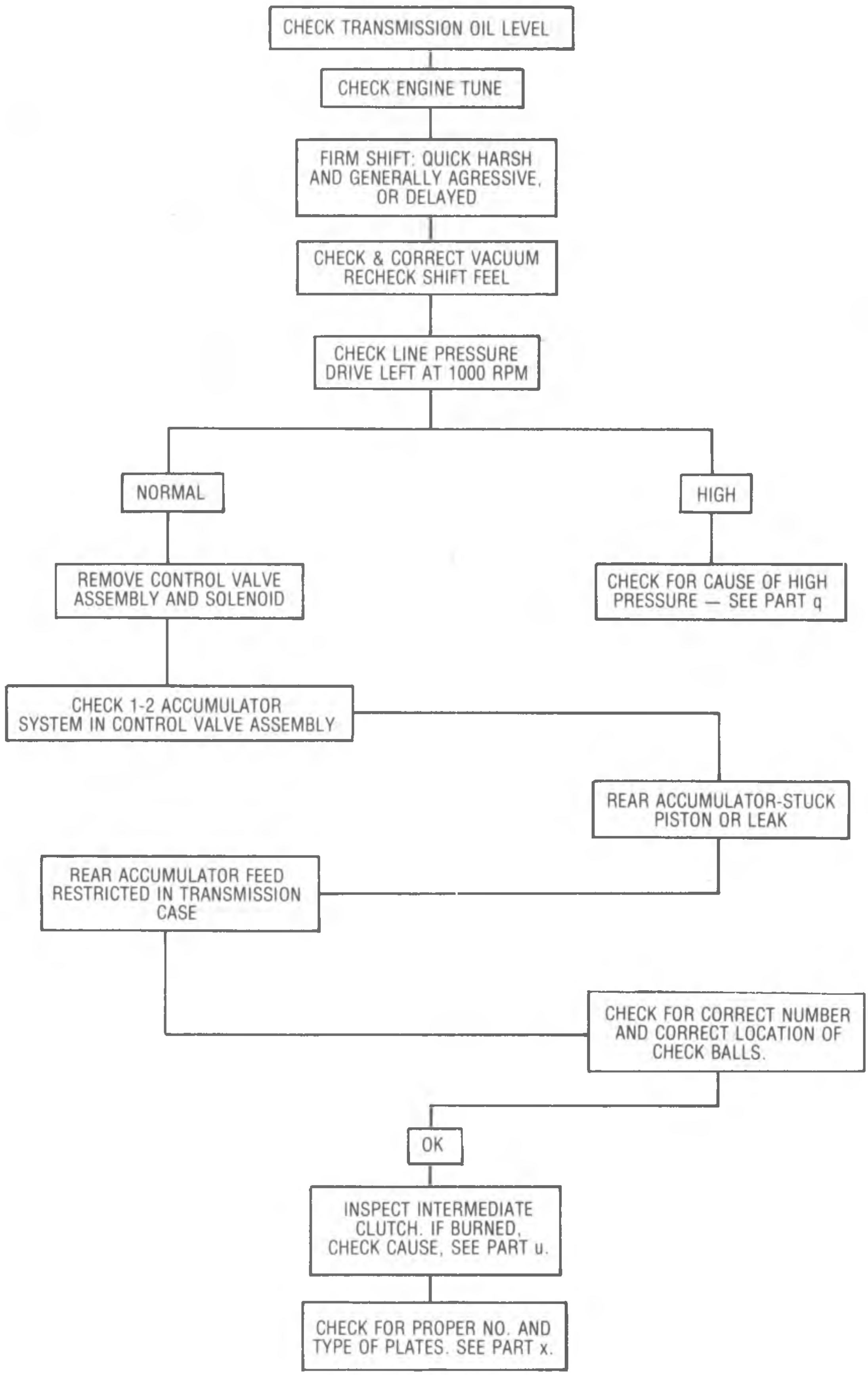


Figure 400-9 Diagnosis

J. 1-2 SHIFT FEEL COMPLAINT — SOFT SHIFT

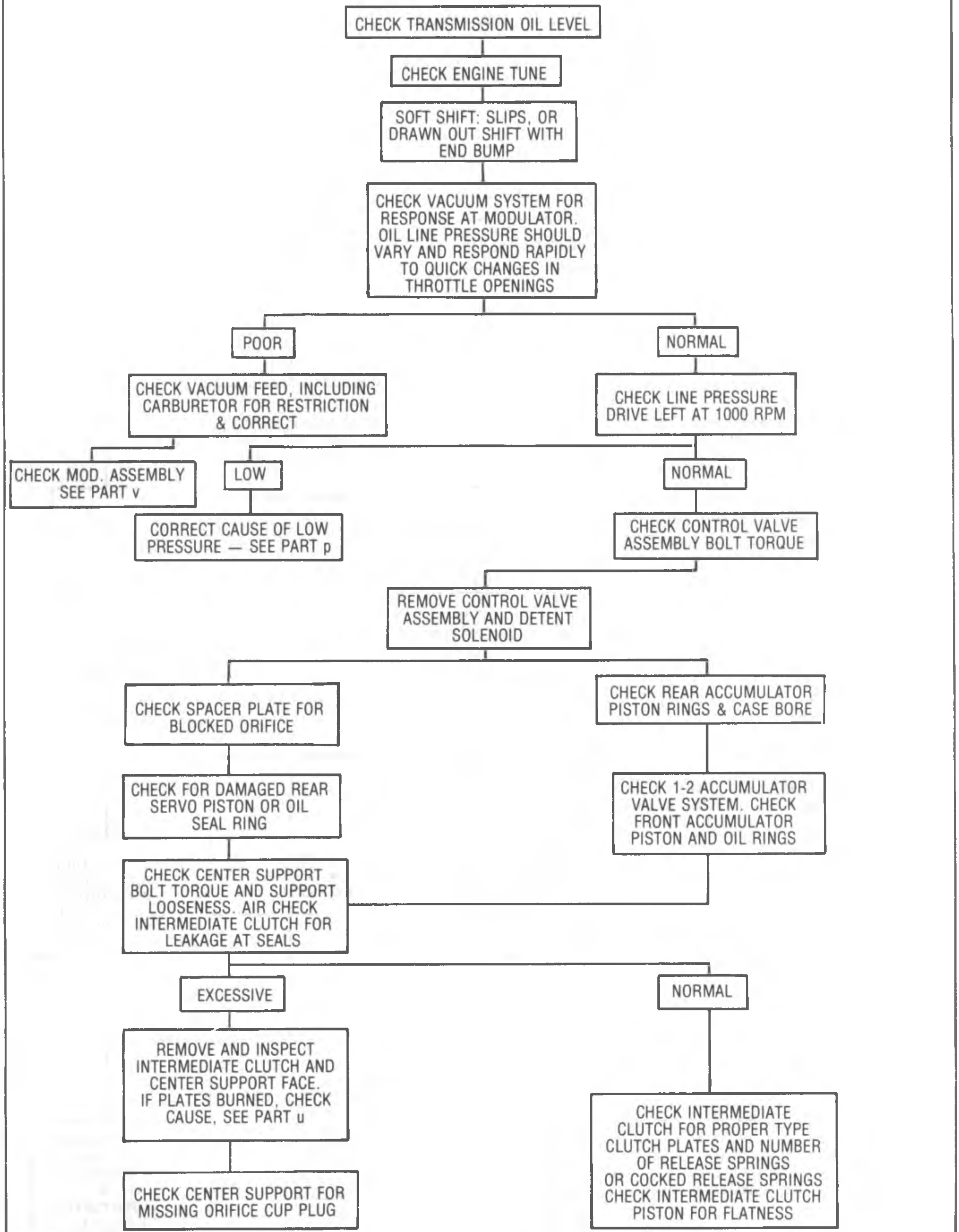


Figure 400-10 Diagnosis

K. 2-3 Shift Complaint

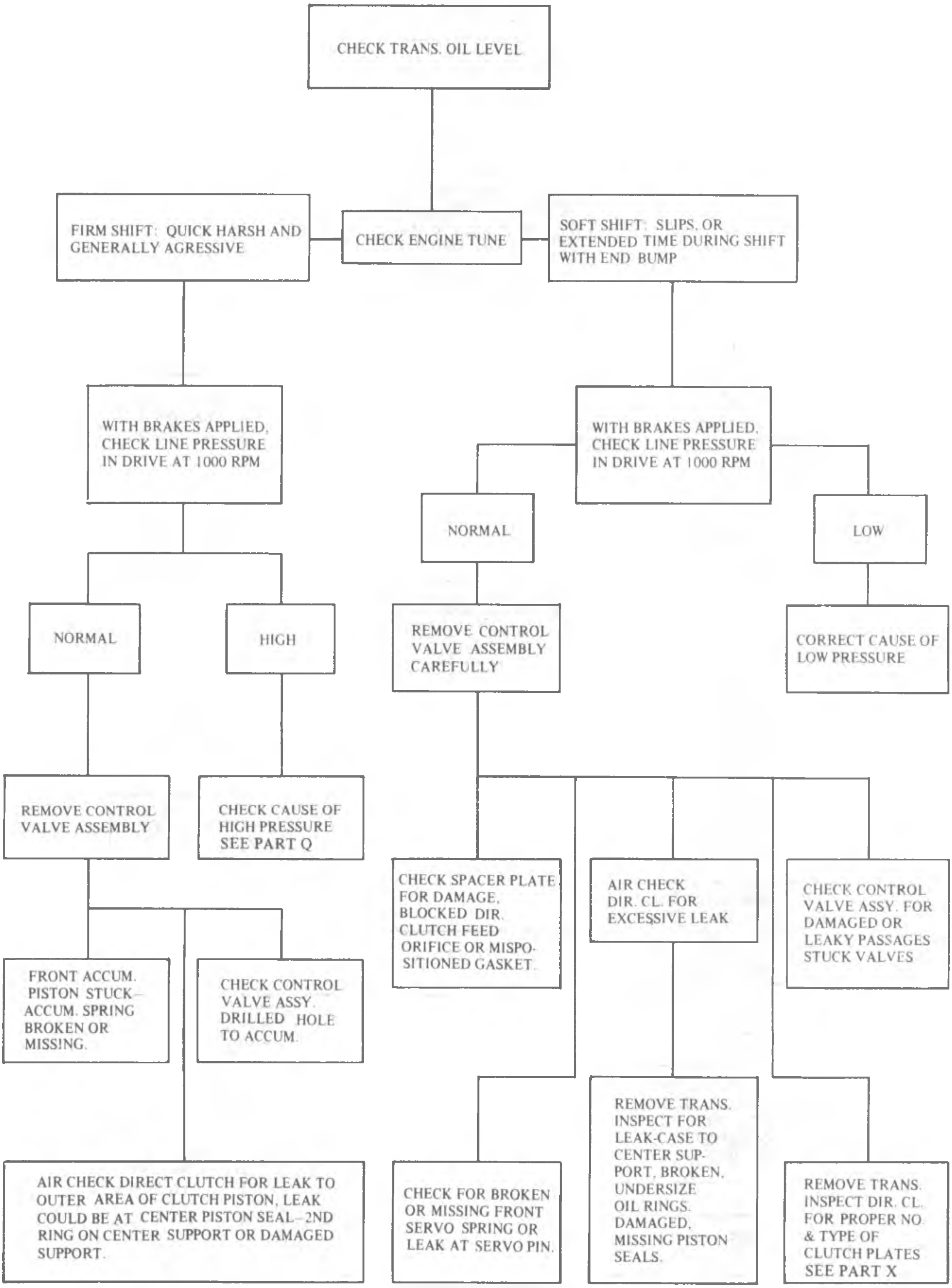


Figure 400-11 Diagnosis

L. Drive in Neutral

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

- INTERNAL LINKAGE -
MANUAL VALVE DISCONNECTED OR END BROKEN,
INSIDE DETENT LEVER PIN BROKEN

- PUMP ASSEMBLY -
TRANSMISSION FLUID PRESSURE LEAKING INTO
FORWARD CLUTCH APPLY PASSAGE

- FORWARD CLUTCH -
BURNED PLATES - CHECK CAUSE - PART u
INCORRECT CLUTCH PLATE USAGE - PART x

M. Will not Hold in Park or Will Not Release from Park

CHECK OUTSIDE MANUAL LINKAGE & CORRECT, PAGE 400-24

- INTERNAL LINKAGE -

1. Parking brake rod assembly (Check actuator for chamfer)
2. Parking pawl broken, chamfer omitted.
3. Parking brake bracket loose, burr or rough edges or incorrectly installed.
4. Parking pawl return spring missing, broken, incorrectly hooked.
5. Broken lugs on output carrier.

Figure 400-12 Diagnosis

N. No Engine Braking—Lo Range—1st Gear

- CASE ASSEMBLY -
LO-REVERSE CHECK BALL MISPOSITIONED OR MISSING.
CASE DAMAGED AT LO-REVERSE CHECK BALL AREA

- REAR SERVO -
OIL SEAL RING, BORE OR PISTON DAMAGED
REAR BAND APPLY PIN SHORT, IMPROPERLY ASSEMBLED

- REAR BAND -
BROKEN, BURNED (CHECK FOR CAUSE), NOT ENGAGED
ON ANCHOR PINS AND/OR SERVO PIN.

O. No Engine Braking—Intermediate Range—
2nd Gear

-FRONT SERVO & ACCUMULATOR-
OIL RINGS AND/OR BORES LEAKING OR FRONT
SERVO PISTON COCKED OR STUCK

-FRONT BAND-
BROKEN, BURNED (CHECK FOR CAUSE) NOT
ENGAGED ON ANCHOR PIN AND/OR SERVO PIN

Figure 400-13 Diagnosis

P. NO REVERSE OR SLIPS IN REVERSE

CHECK TRANSMISSION OIL LEVEL

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

WITH BRAKES APPLIED, CHECK LINE PRESSURE
IN REVERSE @ 1000 RPM

NORMAL

— CONTROL VALVE ASSEMBLY —
1. 2-3 VALVE TRAIN STUCK OPEN (THIS WILL ALSO CAUSE A 1-3 UPSHIFT IN DRIVE RANGE)
2. REVERSE FEED PASSAGE — CROSS CHANNEL LEAK, POROSITY IN CASE OR VALVE BODY PASSAGE, GASKETS LEAKING.

— REAR SERVO & ACCUMULATOR —
1. SERVO PISTON SEAL RING DAMAGED OR MISSING
2. SHORT BAND APPLY PIN (THIS MAY ALSO CAUSE NO OVERRUN BRAKING OR SLIPS IN OVERRUN BRAKING-LO RANGE)
REFER TO PIN SELECTION CHART
3. REAR SERVO PISTON OR BORE

— FORWARD CLUTCH —
CLUTCH DOES NOT RELEASE (WILL ALSO CAUSE DRIVE IN NEUTRAL)

— DIRECT CLUTCH BURNED —
CHECK CAUSE — PART u

— REAR BAND —
BROKEN, BURNED, LOOSE LINING, APPLY PIN OR ANCHOR PINS NOT ENGAGED.

CENTER SUPPORT
OIL SEAL RINGS OR GROOVES DAMAGED OR WORN

LOW

CORRECT CAUSE — PART p

Q. 1ST AND 2ND SPEEDS ONLY, NO 2-3 UPSHIFT

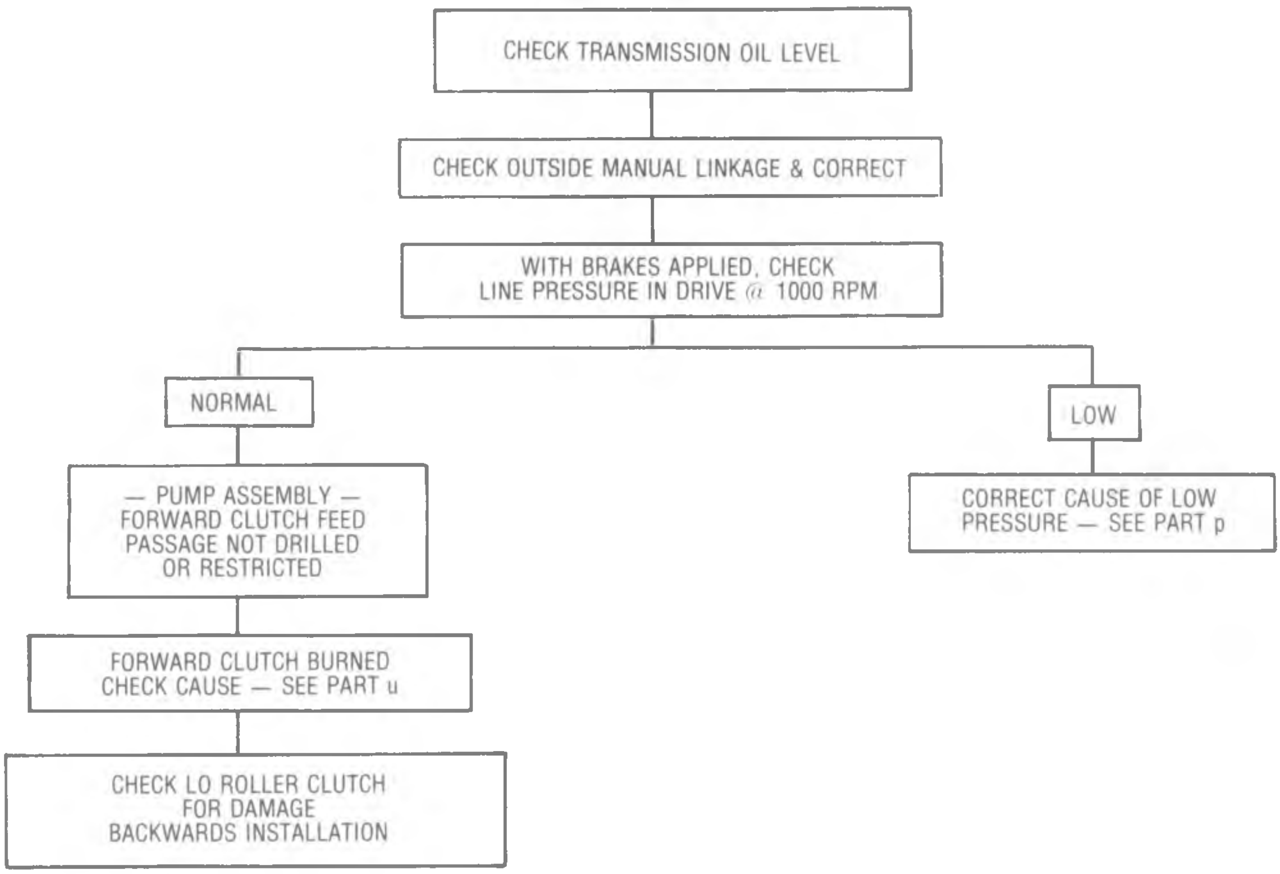
— CONTROL VALVE ASSEMBLY —
STUCK 2-3 VALVE, GASKET MISPOSITIONED OR LEAKING

— DIRECT CLUTCH —
BURNED, CHECK CAUSE — PART u

— IMPROPER VACUUM —
CHECK CAUSE, PART r

Figure 400-14 Diagnosis

R. NO DRIVE IN DRIVE RANGE



S. NO DETENT DOWNSHIFTS

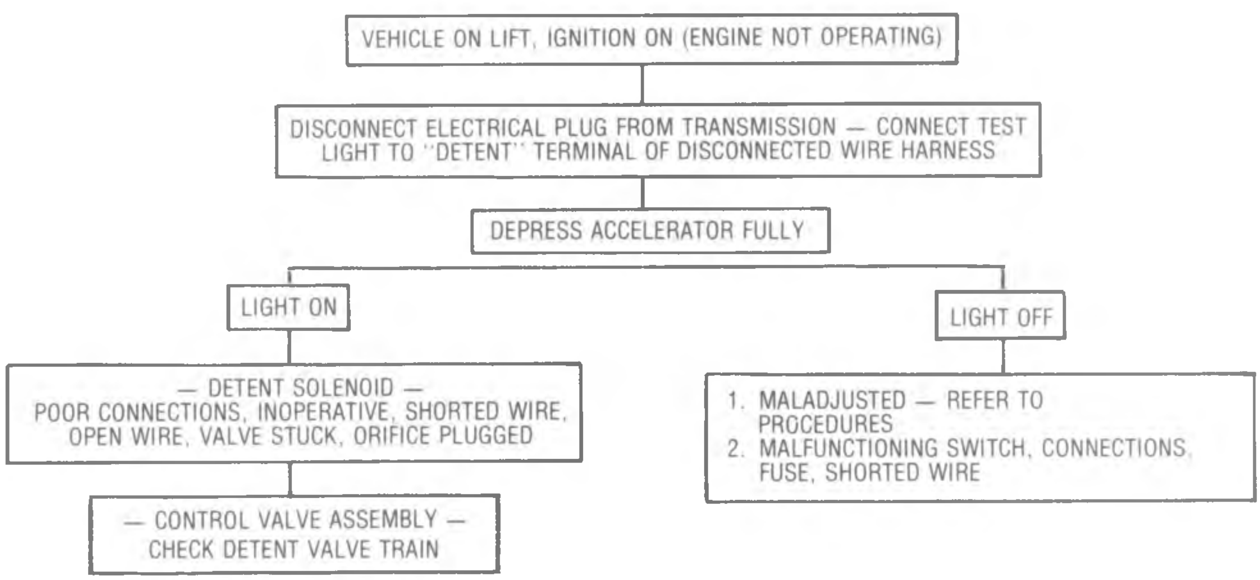


Figure 400-15 Diagnosis

T. Transmission Noisy

NOTE: Before checking transmission for what is believed to be "Transmission Noise," make certain the noise is not from the water pump, generator, air conditioner, power steering, etc. These components can be isolated by removing the proper belt and running the engine no more than two minutes at one time.

PARK, NEUTRAL & ALL DRIVING RANGES

– PUMP CAVITATION –

Oil level low - see PAGE 400-26. Plugged or restricted filter.* Wrong filter. Intake pipe "O" ring damaged. Intake pipe split, porosity in case intake pipe bore. Water in oil. Porosity or voids at transmission case (pump face) intake port. Pump to case gasket off location.

– PUMP ASSEMBLY –

Gears damaged, or malfunctioning, driving gear assembled backwards. Cresent interference. Buzzing noise-orifice cup plug in pressure regulator damaged or missing. Seal rings damaged or worn.

- CONVERTER –

Loose bolts (coverter to flywheel) converter damage.

FIRST, SECOND AND REVERSE

– PLANETARY GEAR SET –

Gears or thrust bearings damaged. Thoroughly clean thrust bearings & thrust races & closely inspect needles & surfaces for pitting and roughness. Front internal gear ring damaged.

DURING ACCELERATION – ANY GEAR

Transmission to cooler lines grounded to underbody.
Motor mounts loose or broken.

SQUEAK AT LOW VEHICLE SPEEDS

SPEEDOMETER DRIVEN GEAR SHAFT SEAL –
Seal requires lubrication or replacement.

EXTENSION HOUSING OIL SEAL –
Seal requires lubrication or replacement.

*There is no approved service procedure for checking or cleaning the filter. If the filter is suspected of being plugged or restricted, it must be replaced.

Figure 400-16 Diagnosis

1984 THM 400 CLUTCH PLATE APPLICATION CHART

MODEL	FORWARD CLUTCH				DIRECT CLUTCH			INTERMEDIATE CLUTCH		
	FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES
	NO.	THICKNESS								
AD, AN	4	2.32mm (.0915")	1	5	4	1	5	2	1	3
FI, FU, FS	5	2.32mm (.0915")	1	5	6	––	6	3	––	3
FK, FM, FQ, FA, FT, FJ, FP, FN, FH, FW, FB, FZ, FX, FD	4	1.97mm (.0775")	1	5	5	––	6	2	1	3

Figure 400-17 Clutch Usage Chart

3. Allow throttle to return to closed position. One click should be heard from transmission.

4. If system performed as described above, downshift circuit is operating properly. If system does not perform as described above, proceed to step 5.

5. Use test light to check brown wire at connector on side of transmission case. Test light should light with throttle wide open and go out when throttle is released.

a. If system operates as described above, but did not perform properly during steps 1-3, replace solenoid after first checking to see that internal wiring is operational. Solenoid installation is described in this section.

b. If light fails to light with throttle in wide open position, the circuit is open. Proceed to step 6.

c. If light lights with throttle closed, the circuit is shorted. Proceed to step 9.

6. Remove air cleaner. Remove orange wire connector location at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle wide open.

a. If test light lights, replace brown wire. Recheck system.

b. If test light fails to light, proceed to step 7.

7. Check black striped orange feed wire at transmission downshift switch with test light.

a. If test light lights, replace transmission downshift switch. Recheck system.

b. If test light fails to light, proceed to step 8.

8. Check transmission control fuse in fuse panel.

a. If necessary to replace fuse, recheck system.

b. If fuse is all right, it will be necessary to locate the open in the wiring. Test the circuit continuity from the black-striped orange wire at the downshift switch to the battery.

9. Remove air cleaner. Remove black-striped orange wire connector at transmission downshift switch. Use test light to check from the bare terminal at switch with throttle closed.

a. If test light fails to light, orange wire is shorted. Correct shorting condition.

b. If test light lights, proceed to step 10.

10. With throttle in closed position, check black striped orange feed wire at transmission downshift switch.

a. If test light fails to light, replace transmission downshift switch. Recheck system.

b. If test light lights, it will be necessary to locate the short in the wiring. Test the circuit from the black striped orange wire at the downshift switch to the battery.

OIL LEAKS

The precautions that must be observed to prevent fluid leaks are as follows:

1. Use new gaskets and O-ring seals whenever there is a disassembly.

2. Use a very small amount of petrolatum to hold gaskets and thrust washers in place during assembly, or to seal gaskets. Never use gasket paste or shellac.

3. Make sure that composition cork and paper gaskets are not wrinkled or creased when installed. Make sure that gaskets have not stretched or shrunk during storage.

4. Make sure the square type O-ring seals are installed squarely and are not twisted during assembly.

5. Make sure that mating surfaces of castings are flat and smooth, free of deep scratches, chips, and burrs.

6. Torque fasteners to proper torque. When checking for oil leaks, first determine whether leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. Red dye appearing in the leaking oil will give positive identification as to the location of the leak.

If oil leak is found to be in transmission, check for leak in following areas:

Front End

It will be necessary to remove lower cover at front of transmission case to determine location of leaks at front end. To correct leaks at front end, it will be necessary to remove transmission from car.

1. Pump oil seal leak - Check pump oil seal to make certain it is correctly installed and not damaged.

When installing a new pump oil seal, make certain that bore is free from foreign material and that garter spring on seal is correctly positioned. Check finish of converter neck and bearing surface in pump body.

2. Pump assembly-to-case square cut O-ring or gasket damaged.

3. Rubber coated-washers on pump attaching screws damaged or missing.

4. Converter - Inspect converter for indications of leakage.

5. Pump drain back hole not open **Figure** 400-23.

Extension Housing

1. Extension housing oil seal not installed properly or damaged.

2. Gasket (extension housing-to-case) improperly installed or damaged.

3. Extension housing-to-case attaching screws not torqued to specifications. Tighten to 32 N·m (23 foot-pounds).

4. Porous or cracked casting.

5. Propeller shaft front slip yoke scratched or corroded.

6. O-ring on output shaft, improperly installed or damaged.

Transmission Case

1. Speedometer driven gear housing retainer attaching screw loose. Tighten to 24 N·m (18 foot-pounds).

2. Speedometer driven gear housing O-ring or lip seal damaged.

3. Governor cover attaching screws not tight. Tighten screws to 24 N·m (18 foot-pounds).

4. Damaged governor gasket.

5. Electrical connector O-ring damaged.

6. Parking pawl shaft cup plug not properly installed.

7. Manual shaft seal damaged.

8. Vacuum modulator damaged.

9. Vacuum modulator retainer screw loose. Tighten to 24 N·m (18 foot-pounds).

10. Vacuum modulator diaphragm damaged.

A ruptured diaphragm would allow transmission oil to be drawn into intake manifold and vacuum line. Usually the exhaust will be excessively smoky due to transmission oil added to the combustion. Oil level of transmission will also be low with no visible external leak.

11. Bottom pan gasket damaged.

12. Bottom pan attaching screws loose. Tighten to 16 N·m (12 foot-pounds).

13. Line pressure plug not tight. Tighten to no more than 13.5 N·m (10 foot-pounds).

14. Porous or cracked casting.

15. Vent pipe.

a. Transmission over-filled.

b. Water in oil.

c. Pump to case gasket mispositioned.

d. Foreign material between pump and case, or between pump cover and body.

e. Case - Porous pump face improperly machined.

f. Pump - Shy of stock, porous. Breather hole in pump cover plugged, **Figure** 400-24.

g. Cut O-ring or intake on grommet on filter assembly.

Oil Cooler Pipe Connections

1. Outside oil cooler pipe connections improperly installed or damaged. Also connectors in radiator and transmission.

2. Oil cooler pipe connections not tight. Tighten to 28 N·m (21 foot-pounds).

3. Flare on oil cooler pipes damaged at radiator or transmission.

Leaking Out Filler Pipe

1. O-ring damaged or improperly installed on pipe.

2. Filler pipe not fully seated in case.

Blowing Out Filler Pipe

1. Transmission over-filled.

2. Plugged vent cap.

3. Plugged vent hole in pump.

4. Damaged pump gasket.

5. Engine overheating.

Internal Leaks

It will be necessary to remove bottom pan to determine location of internal leaks.

1. Governor pipes damaged.

2. Rear servo cover attaching screws not tight. Tighten to 24 N·m (18 foot-pounds).

3. Rear servo cover gasket damaged.

4. Control valve assembly spacer plate-to-case gasket damaged.

5. Control valve assembly attaching screws loose. Tighten to 11 N·m (8 foot-pounds).

6. Solenoid gasket damaged.

7. Solenoid attaching screws loose. Tighten to 13.5 N·m (10 foot pounds).

8. Intake pipe O-ring or filter grommet damaged causing a foaming condition.

9. Rear servo square cut O-ring improperly installed or damaged.

TRANSMISSION DOWNSHIFT SWITCH

Removal

1. Remove air cleaner.

2. Disconnect wire connectors.

3. Remove 2 screws that secure switch to switch bracket and remove downshift switch, **Figure** 400-25.

Installation

1. Hold switch in on-car position and rotate switch actuating shaft clockwise until it stops. Install lever on shaft with notch on inside and lever in straight-up position.

2. Insert shaft into hole on throttle adapter plate.

3. Insert two mounting screws through switch mounting to mounting bracket and lightly tighten.

4. Adjust switch as described in this section.

5. Connect wires to terminals on switch.

6. Replace air cleaner.

Adjustment

1. Remove carburetor air cleaner.

2. Make certain that carburetor is adjusted to specification and that throttle linkage is at low speed idle setting.

3. Loosen two mounting screws and insert a #42 (.094") wire gage size drill into the calibrating hole below lower wire terminal, **Figure** 400-25. Adjust position of switch so that lever just touches the carburetor adapter plate arm (stud on 6L).

With this adjustment the downshift switch should make contact above 60° throttle.

4. With switch positioned, tighten mounting screws and remove #42 (.094") gage from calibrating hole through switch.

5. Repeat step 3, if necessary.

6. Install air cleaner.

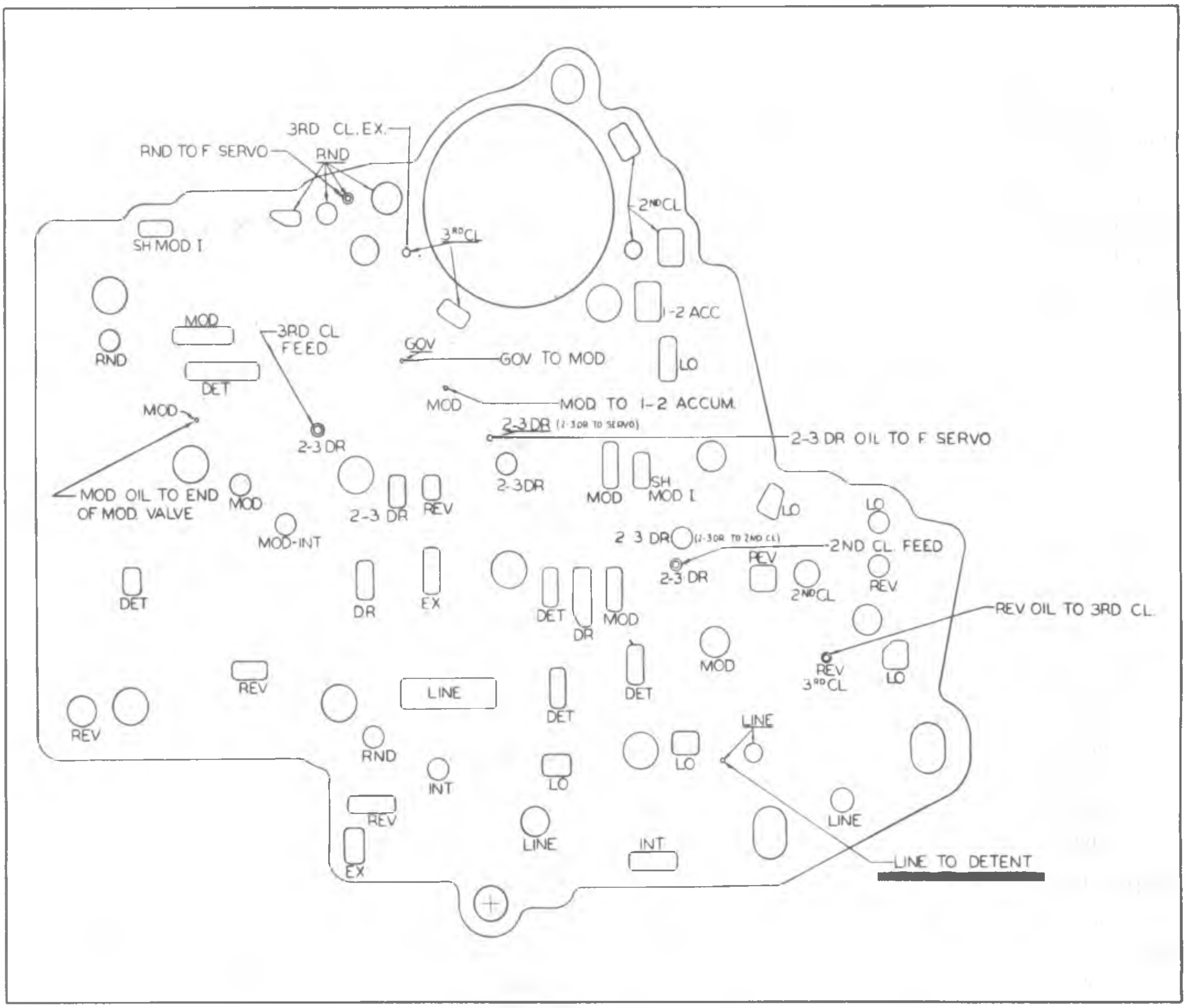


Figure 400-18 Spacer for Control Valve Assembly (Typical)

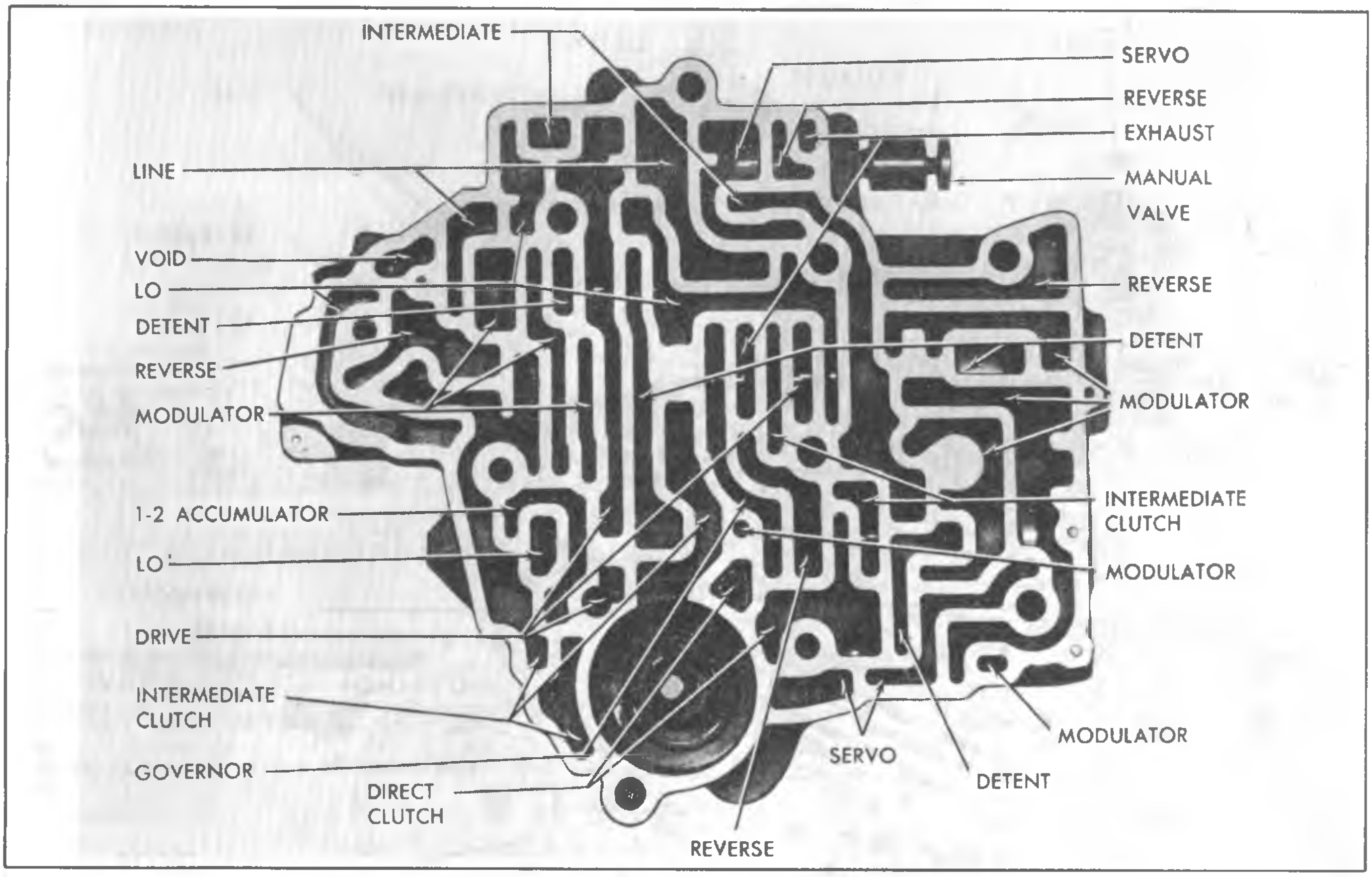


Figure 400-19 Control Valve Body Oil Passages

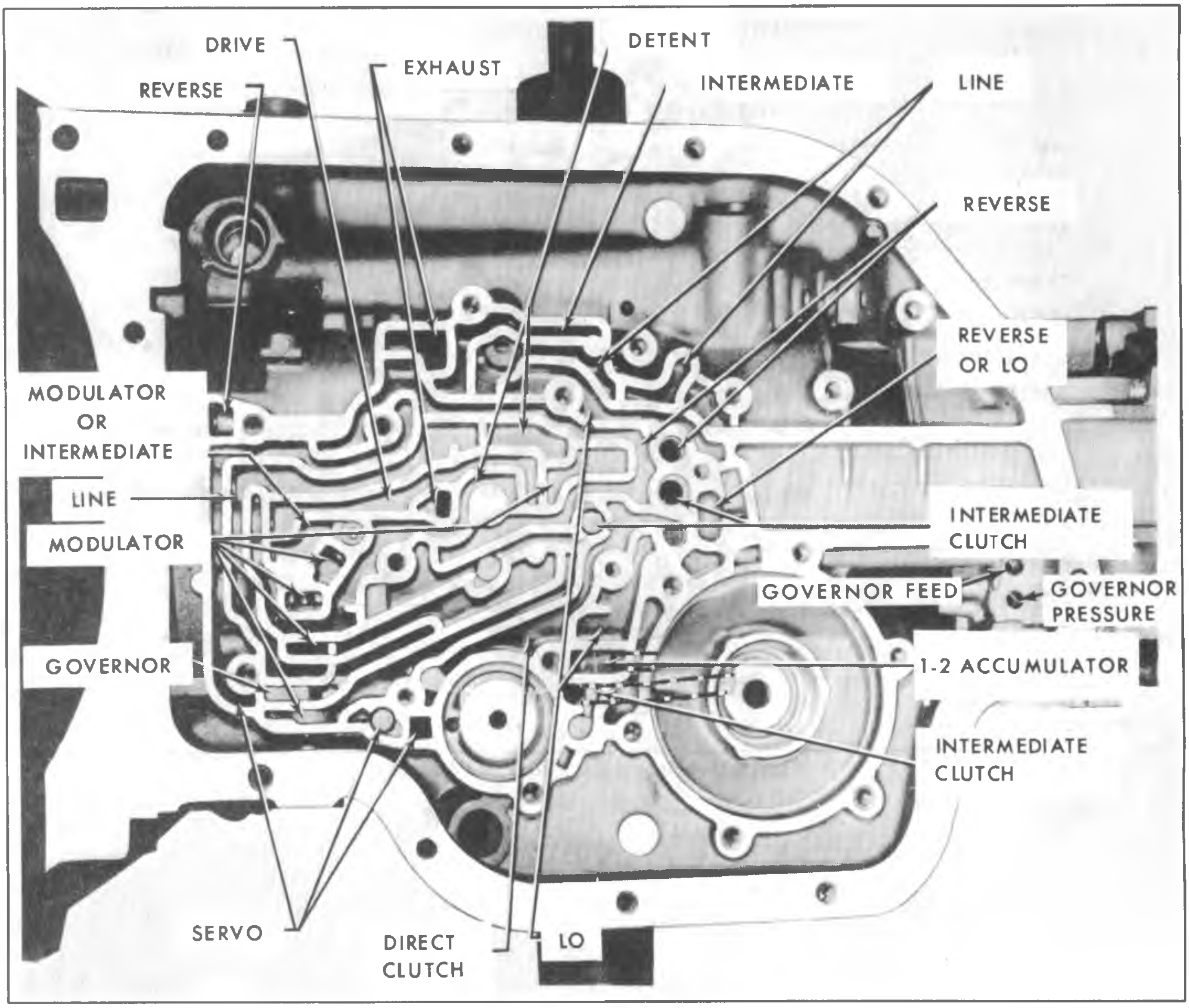


Figure400-20 Transmission Case Oil Passages - Bottom View

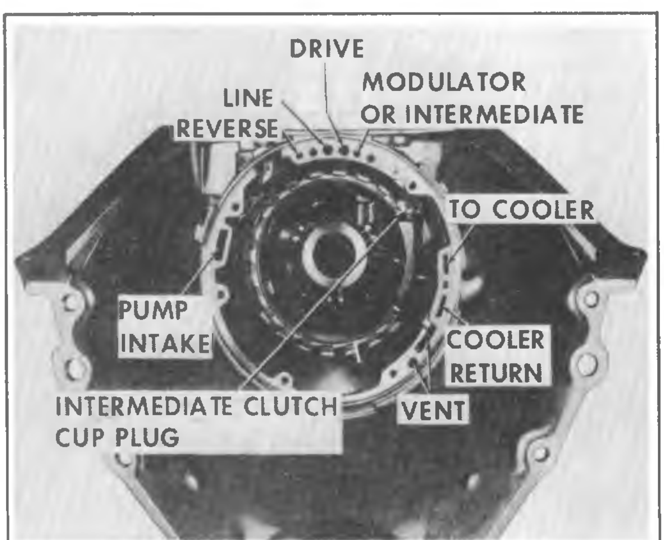


Figure400-21 Transmission Case Oil Passages

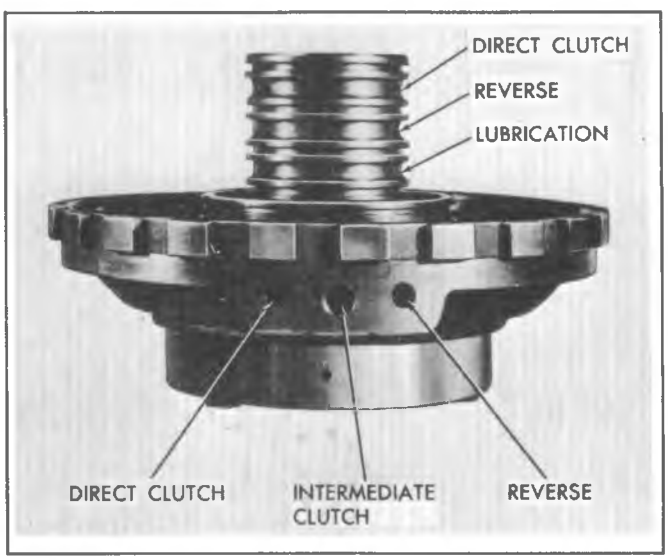


Figure400-22 Center Support Oil Passages

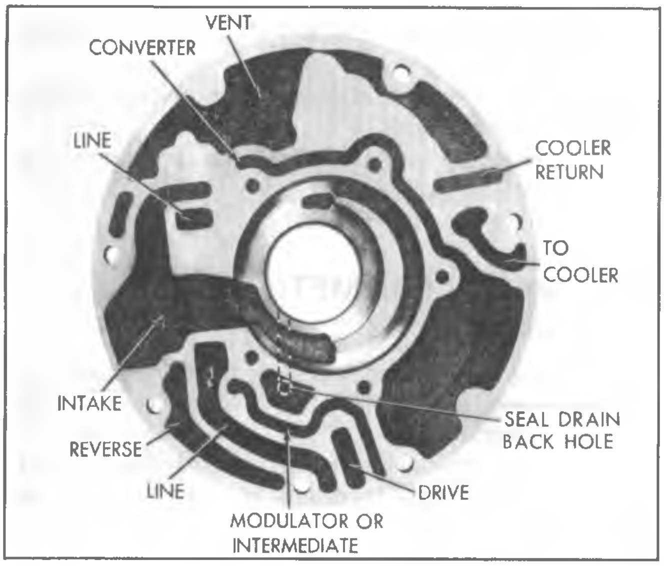


Figure400-23 Pump Body Oil Passages

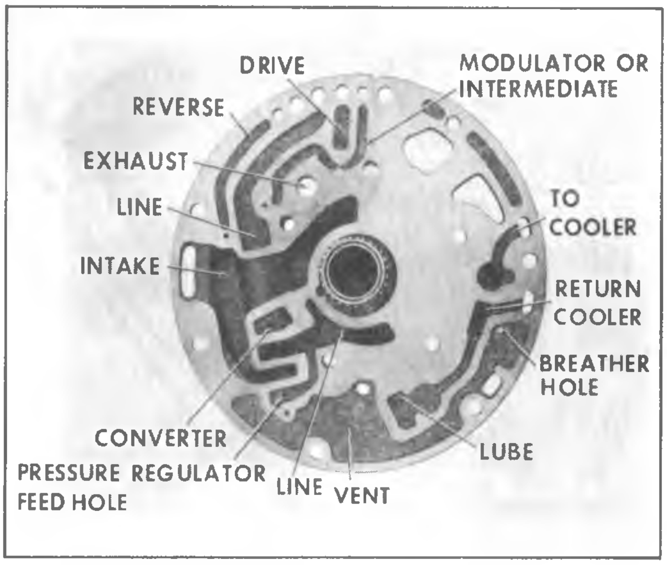


Figure400-24 Pump Cover Oil Passages

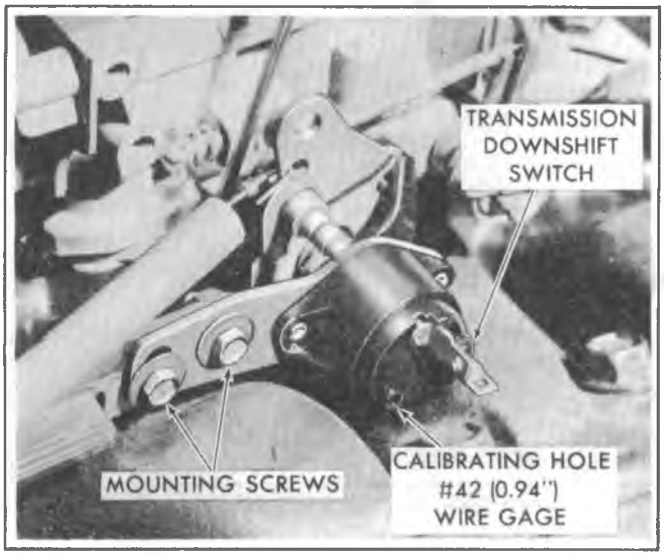


Figure400-25 Downshift Switch

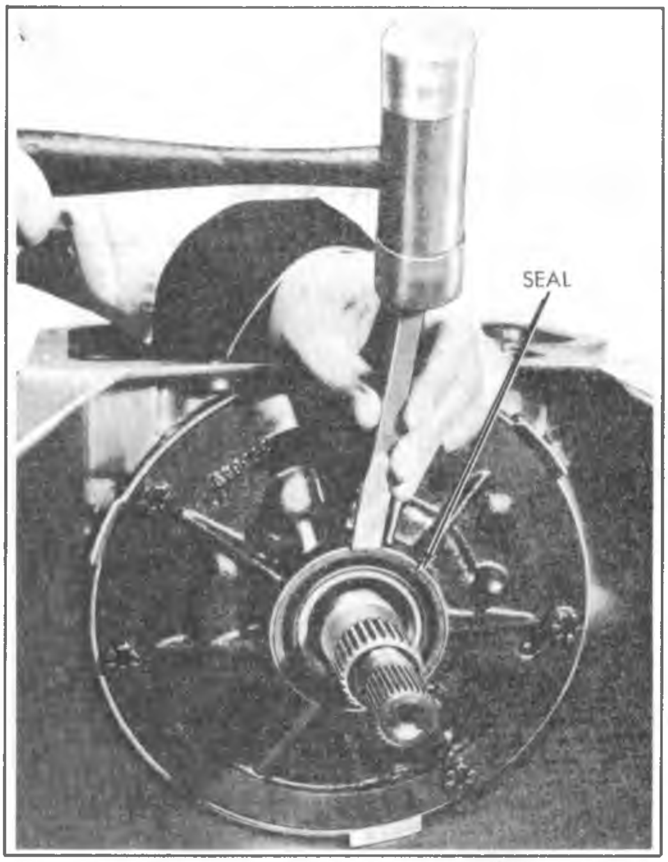


Figure400-26 Removing Pump Oil Seal

UNIT REPAIR

PUMP OIL SEAL REPLACEMENT

1. Remove transmission assembly from car as described in this section.

2. Use hammer to drive chisel under lip of oil seal and pry seal out of pump body, **Figure** 400-26.

3. Before installing new seal, make certain bore is free of foreign material and that garter spring on seal is correctly positioned. Also check finish of converter neck and bearing surface in pump body.

Use a non-hardening sealer on outside of seal body before installing seal.

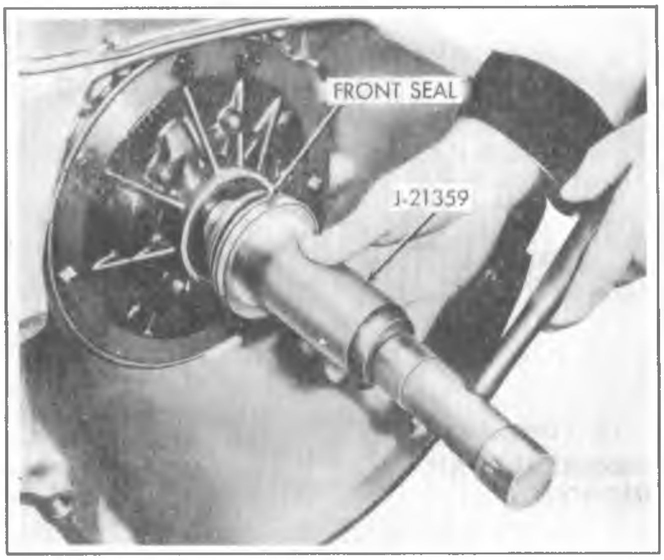


Figure 400-27 Installing Pump Oil Seal

4. Install new seal in pump body using Pump Oil Seal Installer, J-21359, **Figure** 400-27.

5. Install transmission assembly in car as described in this section.

TRANSMISSION HOLDING FIXTURE

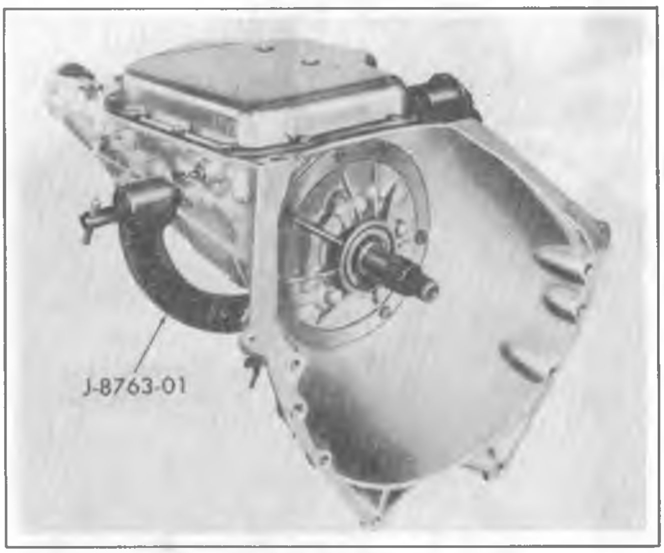


Figure400-28 Transmission in Holding Fixture

On the following operations when the transmission is out of car remove converter from transmission and install Holding Fixture, J-8763-02, on transmission so that vacuum modulator will be located on side of Holding Fixture nearest the bench. Install fixture and transmission into Holding Fixture Base, J-3289-21, with bottom pan facing up, **Figure** 400-28 and install lock pin in base. Provide container to catch any oil that may drain from transmission.

REMOVE GOVERNOR ASSEMBLY

Unit may be removed without removing transmission or bottom pan.

1. Remove four attaching screws, governor cover, and gasket. Discard gasket.

2. Remove two bolts attaching transmission extension housing to cross member.

3. Move rear of transmission sideways enough to allow clearance for governor removal.

4. Remove governor assembly.

REMOVE SPEEDOMETER DRIVEN GEAR ASSEMBLY

Unit may be removed without removing transmission or bottom pan, after removing speedometer cable from driven gear assembly.

1. Remove attaching screw and retainer from left side of case. Apply slight pressure to remove unit and speedometer driven gear.

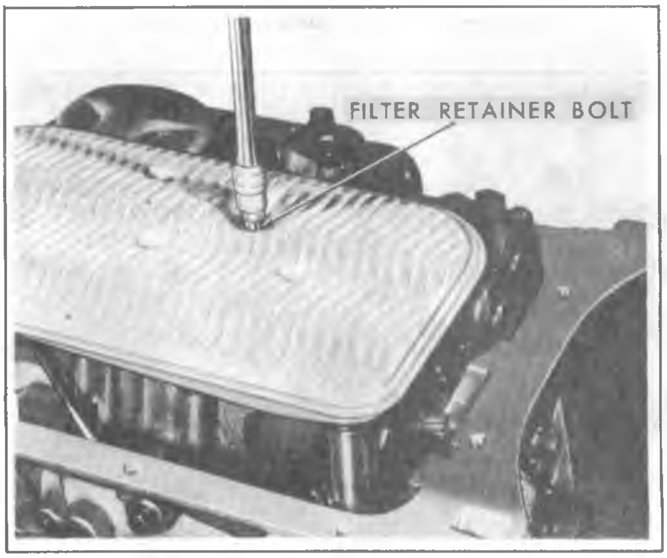


Figure400-29 Removing Filter Retaining Bolt

REMOVE INTAKE PIPE AND FILTER ASSEMBLY AND BOTTOM PAN

Unit may be removed with transmission in car. In cases of transmission malfunction, filter must be replaced.

1. Remove bottom pan attaching screws.

2. Remove bottom pan and gasket. Discard gasket. Drain oil from pan if transmission is in car.

3. Remove filter retainer bolt, **Figure** 400-29.

4. Lift out pump intake pipe and filter assembly, **Figure** 400-30.

5. Remove intake pipe from filter and discard filter.

6. Remove and discard intake pipe O-ring.

REMOVE CONTROL VALVE ASSEMBLY, GOVERNOR PIPES, AND DETENT SPRING AND ROLLER ASSEMBLY

Units may be removed with transmission in car, after removing bottom pan.

1. Remove attaching screw and remove detent spring and roller assembly.

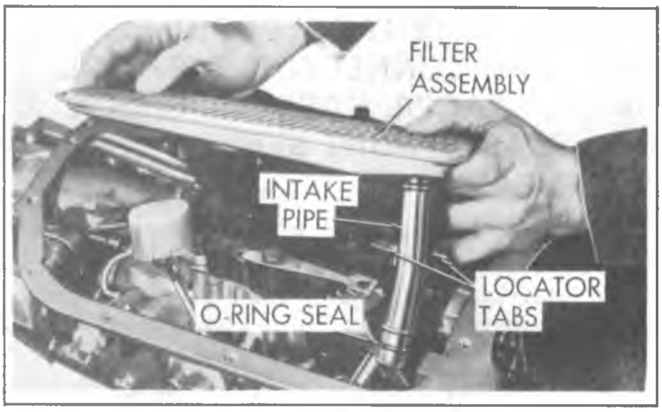


Figure400-30 Removing Intake Pipe and Filter Assembly

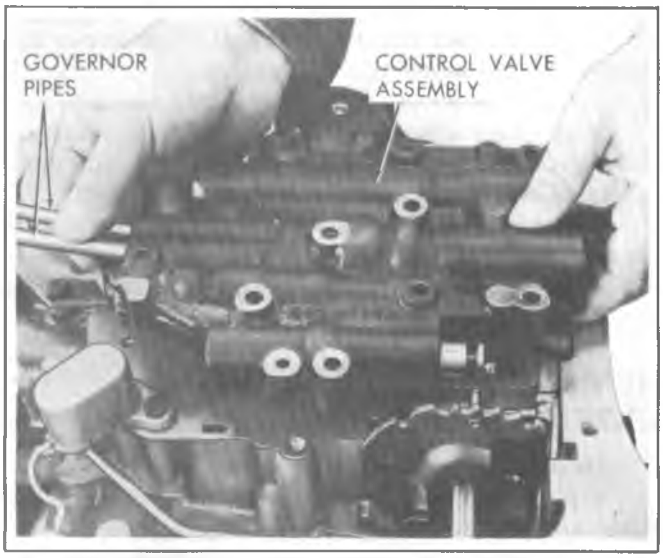


Figure400-31 Removing Control Valve Assembly

2. Remove ten remaining control valve assembly attaching screws. Do not remove solenoid attaching screws at this time.

3. Remove control valve assembly with the two governor pipes attached, **Figure** 400-31.

NOTICE: Do not allow manual valve to fall out of its bore in control valve assembly. If transmission is in car be careful not to drop front servo group which may drop out as control valve assembly is removed.

4. Remove governor screen assembly from end of governor feed pipe or governor feed pipe hole in case. **Figure** 400-32. Clean screen in clean solvent and air dry.

5. Remove governor pipes from valve body. Governor pipes are interchangeable and need not be identified.

REMOVE REAR SERVO ASSEMBLY

Unit may be removed with transmission in car after removing bottom pan and allowing fluid to drain.

1. Remove control valve assembly, and governor pipes as described in this section.

2. Remove six rear servo cover attaching screws, servo cover, and gasket. Discard gasket.

3. Remove rear servo assembly from transmission case, **Figure** 400-33.

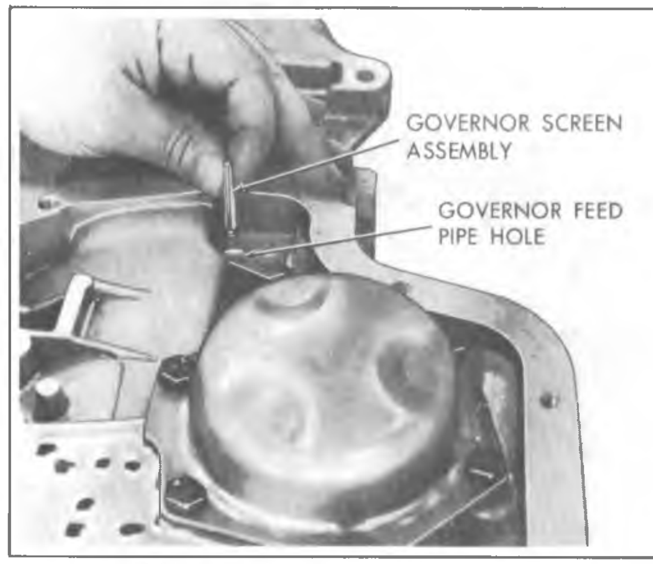


Figure400-32 Removing Governor Screen Assembly

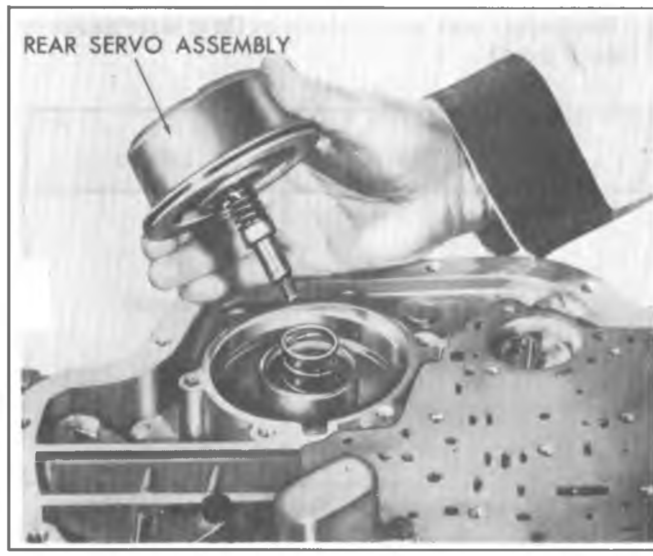


Figure400-33 Removing Rear Servo Assembly

4. Remove servo accumulator spring.

5. Make band apply pin selection check, **Figure** 400-35, to determine proper size pin to use at time rear servo is assembled.

BAND APPLY PIN SELECTION CHECK

Check may be made with transmission in car.

1. Remove bottom pan and allow fluid to drain.

2. Remove control valve assembly, governor pipes and rear servo.

3. Position Band Apply Pin Selector Gage, J-21370-6, on transmission case over rear servo bore, with hex nut on side of gage facing toward parking brake linkage, and smaller diameter end of Gage Pin, J-21370-5, in servo pin bore, **Figure** 400-34.

4. Secure gage with two 5/16-18 x 1 inch screws, tightening screws to 24 N·m (18 foot-pounds). Make certain that stepped gage pin is free to move up and down in both tool and servo pin bore. Stepped side of pin must face front of transmission case.

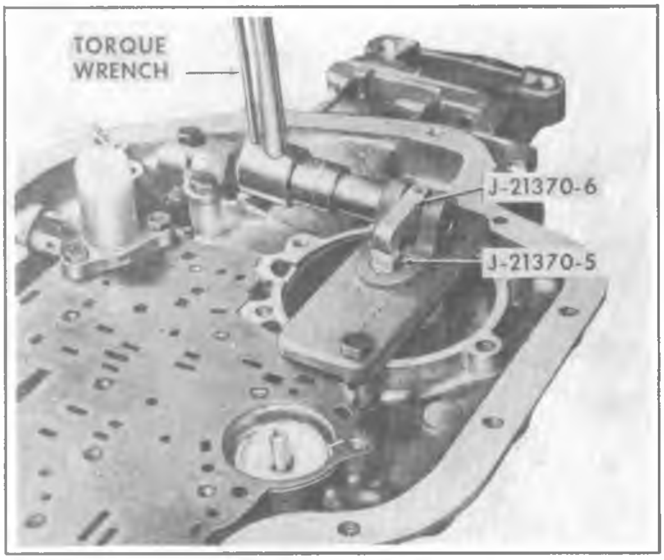


Figure400-34 Band Apply Pin Selection Check

Band apply pins are available in three sizes as shown in **Figure** 400-35.

IDENTIFICATION	LENGTH
Three Rings	Long
Two Rings	Medium
One Ring	Short

Figure 400-35 Band Apply Pin Selection Chart

Identification ring is located on band lug end of pin. Selecting the proper pin is equivalent to adjusting band.

5. To determine proper size pin to use, apply 34 N·m (25 foot-pounds) torque on hex nut on side of gage, **Figure** 400-34. This will cause lever on top of gage to depress stepped gage pin into servo pin bore, simulating actual operating conditions. Note relation of steps on gage pin and machined surface on top of gage. Determine proper size pin as follows:

a. If machined surface on top of gage is even with or above upper step on gage pin, long size pin (three rings) is required.

b. If machined surface on top of gage is between upper and lower steps on gage pin, medium size pin (two rings) is required.

c. If machined surface on top of gage is even with or below step on gage pin, short size pin (one ring) is required.

6. If new pin is required, make note of pin size required, and remove gage from transmission case.

REMOVE DETENT SOLENOID, SOLENOID CONNECTOR, CONTROL VALVE SPACER, GASKETS, CHECK BALLS, AND FRONT SERVO ASSEMBLY

Units may be removed with transmission in car.

1. Remove bottom pan and drain transmission fluid.
2. To remove control valve spacer, gasket, check balls, and front servo, remove control valve assembly and governor pipes.
3. Disconnect detent solenoid wire from electrical connector terminal.
4. Compress tabs on case connector and remove connector and O-ring from case. Discard O-ring.
5. Remove two detent solenoid attaching screws and remove solenoid assembly and gasket.
6. Remove control valve spacer plate from case.

If operation is being performed on car, lower control valve spacer plate in a level plane so that check balls don't fall out. Then remove check balls from spacer plate.

7. Remove six check balls from cored passages in transmission case.
8. Lift front servo piston, retainer ring, pin, spring retainer, and spring out of transmission case.

REMOVE REAR OIL SEAL AND EXTENSION HOUSING

Units may be removed with transmission in car.

1. If required, use hammer to drive chisel under oil seal flange and pry seal out of extension housing.
2. Remove six extension housing attaching screws and remove extension housing.
3. Remove and discard gasket from extension housing.

FRONT UNIT END PLAY CHECKING PROCEDURE

Transmission must be removed from car.

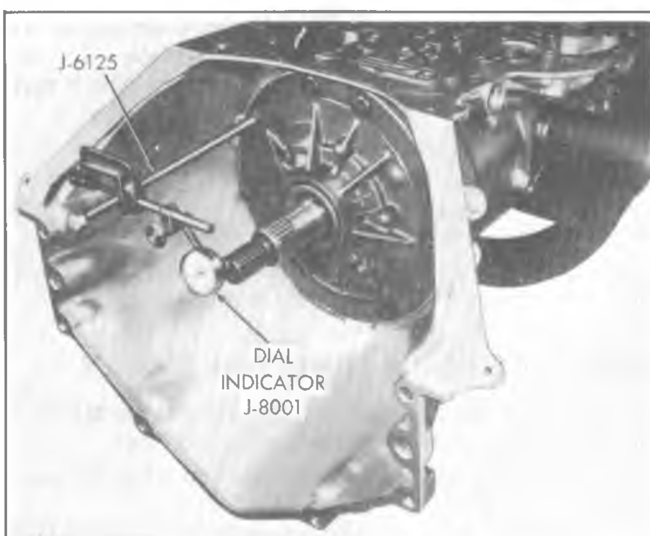


Figure400-36 Front Unit End Play Check

1. Remove one oil pump attaching screw and rubber-coated washer at either 10 o'clock or 5 o'clock position.

2. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, in screw hole where attaching screw was removed, **Figure** 400-36.

3. Mount Dial Indicator, J-8001-02, on slide hammer bolt and index indicator to register with flat surface on end of turbine shaft, **Figure** 400-36.

4. Hold output shaft forward while pushing turbine shaft rearward to its stop.

5. Set dial indicator to zero.

6. Pull turbine shaft forward, **Figure** 400-36.

Resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .003 inch - .024 inch. The selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from **Figure** 400-37.

THICKNESS (INCH)	COLOR	NO.
.060-.064	Yellow	0
.071-.075	Blue	1
.082-.086	Red	2
.093-.097	Brown	3
.104-.108	Green	4
.115-.119	Black	5
.126-.130	Purple	6

Figure400-37 Front Unit Washer Thickness Chart

An oil-soaked washer may tend to discolor. If necessary, measure washer for thickness.

7. Remove dial indicator. If oil pump is to be removed, do not remove slide hammer assembly at this time.

REMOVE OIL PUMP

Transmission must be removed from car.

1. If not done previously, perform the following steps:

a. Remove one oil pump attaching screw and rubber-coated washer at either 10 o'clock or 5 o'clock position.

b. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, in screw hole where attaching screw was removed, **Figure** 400-38.

2. Remove other pump attaching screws and washers.

3. Install Slide Hammer Bolt, J-6125-1, and Adapter, J-6125-2, into other threaded hole at 10 o'clock or 5 o'clock position in pump body and drive outward with slide hammers to remove pump assembly from transmission case, **Figure** 400-38.

NOTICE: Drive outward in unison on both slide hammer assemblies to prevent cocking pump assembly in case.

4. Remove slide hammer assemblies from pump.

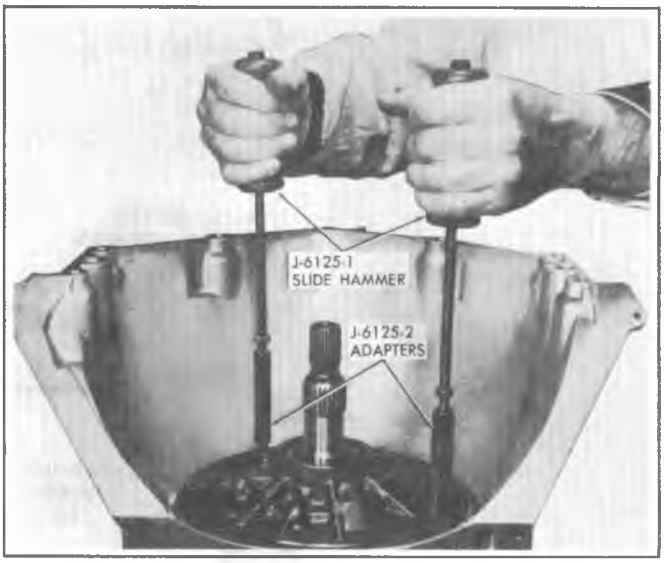


Figure400-38 Removing Pump Assembly

5. Remove and discard pump square cut O-ring and gasket.

REMOVE DETENT LEVER, MANUAL SHAFT, AND PARKING LINKAGE

Units may be removed with transmission in car.

1. Drain transmission fluid by removing bottom pan.

2. Remove manual linkage from manual lever and remove detent spring and roller assembly from control valve assembly, **Figure** 400-39.

3. Remove pin securing manual shaft to case.

If procedure is being performed on car, bend pin to remove it.

4. Loosen locknut securing inside detent lever to manual shaft.

5. Pry or work inside detent lever loose from manual shaft and remove locknut.

6. Remove manual shaft, parking actuator rod and detent lever from case. Inspect manual shaft lip seal as required, **Figure** 400-39.

7. Remove parking lock bracket attaching screws and remove bracket.

8. Remove parking pawl return spring.

The following steps are to be completed only if one or more of the parts involved require replacement.

9. Remove spring retainer from parking pawl shaft.

10. Remove parking brake pawl shaft cup plug by placing screwdriver between parking pawl shaft and case rib and prying outward, **Figure** 400-40.

11. Remove parking pawl shaft and parking pawl.

REMOVE TURBINE SHAFT, FORWARD CLUTCH HOUSING, DIRECT CLUTCH ASSEMBLY, SUN GEAR SHAFT, AND FRONT BAND

Transmission must be removed from car. Requires removal of oil pump.

1. Remove turbine shaft and forward clutch assembly from transmission, **Figure** 400-41.

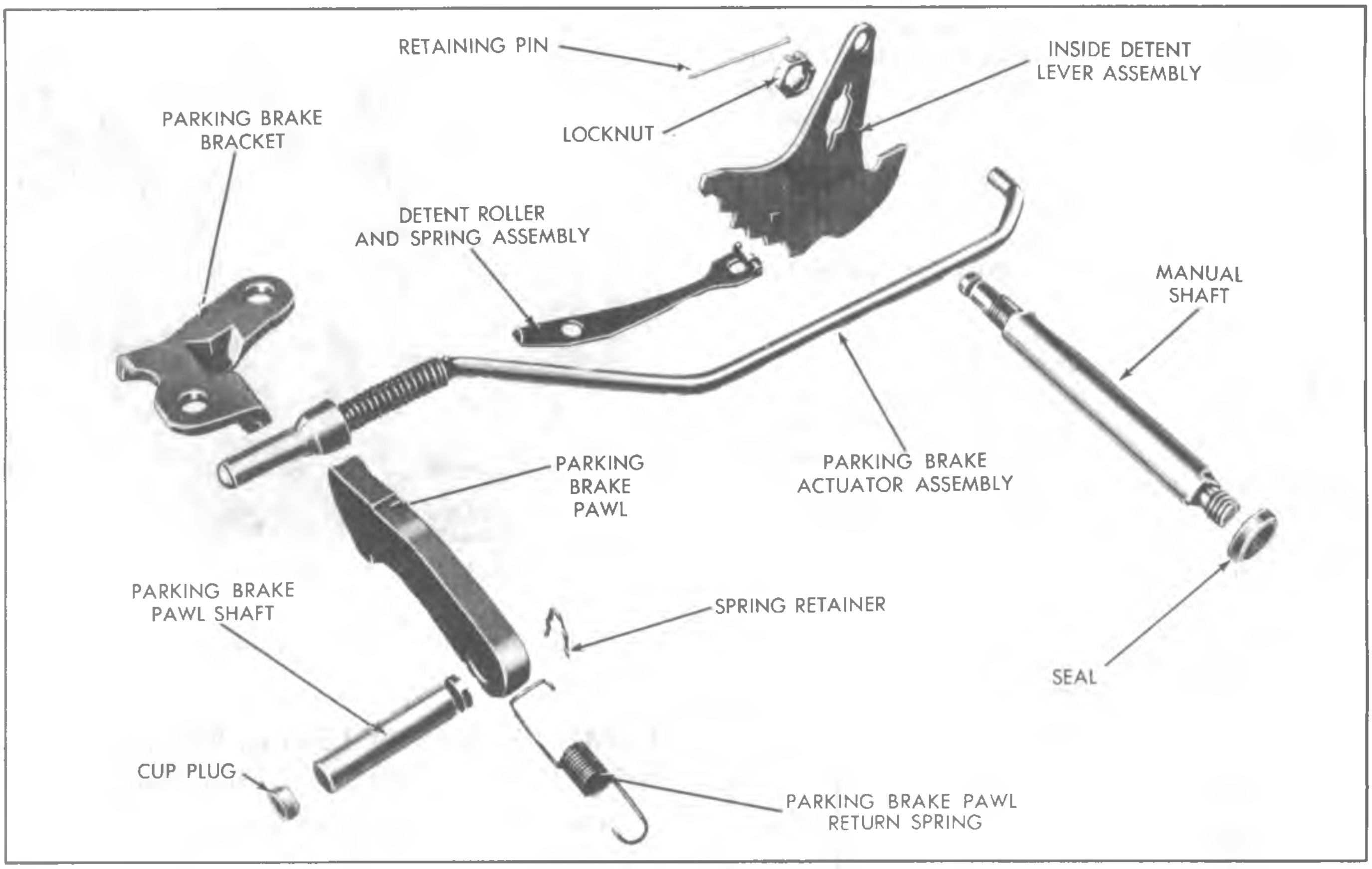


Figure 400-39 Manual and Parking Linkage

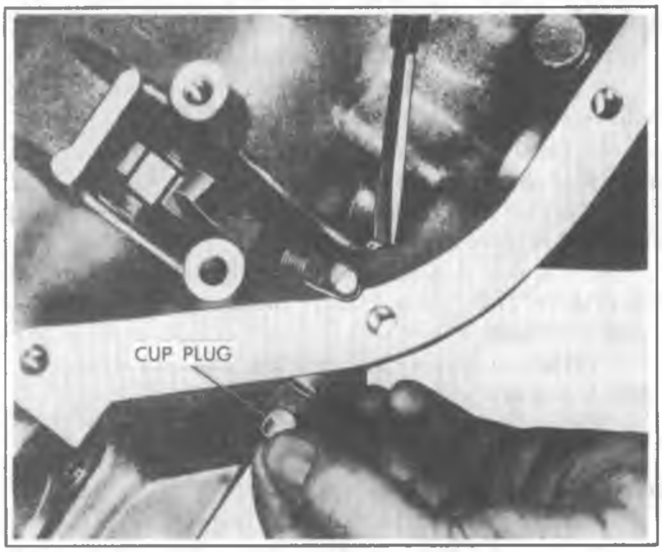


Figure 400-40 Removing Cup Plug

2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch assembly.

3. Remove direct clutch and intermediate roller assembly, **Figure** 400-42. Sun gear shaft may come out with direct clutch assembly.

4. Remove sun gear shaft if not previously removed. See **Figure** 400-43.

5. Remove front band assembly.

Check rear unit end play at this time. Proceed as follows:

Figure 400-41 Removing Forward Clutch Assembly

REAR UNIT END PLAY CHECKING PROCEDURE

Transmission must be removed from car. Requires removal of extension housing.

1. Install Speedometer Puller Bolt, J-21797, in one of the bolt holes on end of transmission case.

2. Mount Dial Indicator, J-8001, on Bolt, J-21797, and index indicator to register with flat surface on end of output shaft, **Figure** 400-44.

3. Set dial indicator to zero.

4. Move output shaft in and out. Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .007 inch - .019 inch.

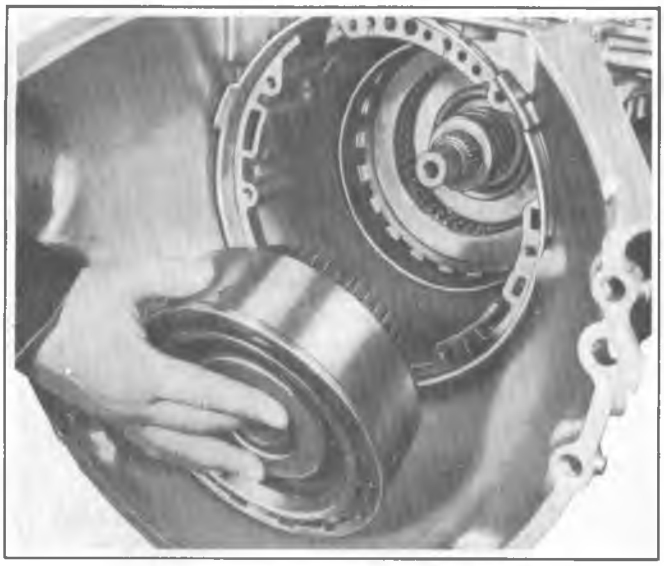


Figure400-42 Removing Direct Clutch and Intermediate Roller Assembly

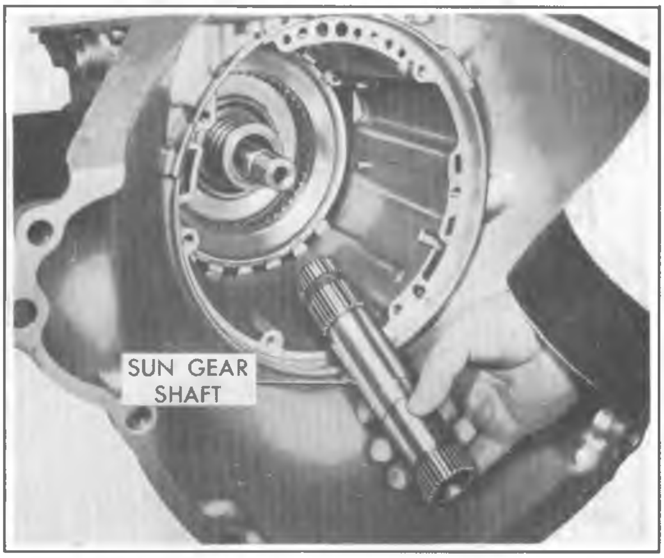


Figure 400 43 Removing Sun Gear Shaft

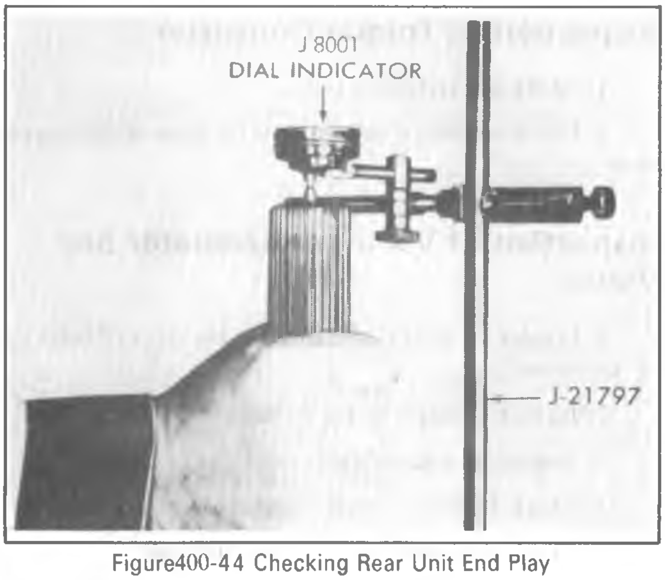


Figure400-44 Checking Rear Unit End Play

The selective washer controlling this end play is the steel washer with the three tabs, located between thrust washer and rear face of transmission case. Notches and/or numerals on the tabs serve to identify washer thickness.

If a different washer thickness is required to bring end play within specifications, it can be selected from **Figure** 400-45. The table will show identification notches numerals or both.

THICKNESS (INCH)	IDENTIFICATION NOTCH AND/OR NUMERAL	
.074-.078	None	1
.082-.086	On Side of 1 Tab	2
.090-.094	On Side of 2 Tabs	3
.098-.102	On End of 1 Tab	4
.106-.110	On End of 2 Tabs	5
.114-.118	On End of 3 Tabs	6

Figure400-45 Rear Unit Washer Thickness Chart

REMOVE REMAINING COMPONENTS

Transmission must be removed from car. Requires removal of bottom pan, control valve assembly and governor pipes, rear servo assembly, control valve spacer, two gaskets, check balls, front servo assembly, oil pump, turbine shaft, forward clutch housing, direct clutch assembly, sun gear shaft and front band.

1. Remove center support bolt from transmission case using 3/8 inch 12-point thin wall deep socket.

2. Remove intermediate clutch backing plate to case snap ring.

3. Remove intermediate clutch backing plate, and three composition and three steel clutch plates.

4. Using needle nose pliers, or screwdriver, remove center support to case snap ring.

5. Install Tool, J-21795, on end of main shaft so that tangs engage groove in shaft. Tighten screw on tool to secure tool on shaft and prevent movement of roller clutch during removal of gear unit assembly, **Figure** 400-46.

6. Install proper diameter length of pipe over output shaft to be used as a handle and to prevent spline damage to case bushing when removing gear unit, center support, and reaction carrier.

Loosen transmission holding fixture pivot pin slightly, so that gear unit assembly does not bind when it is removed from case.

7. With transmission case in a horizontal position, shift complete assembly toward front of case to facilitate removal of assembly from case. Remove complete gear unit assembly from case.

Be careful not to drop or bump assembly in transmission case during removal. This could result in damage to output shaft bushing in case as well as to assembly itself.

8. Remove output shaft to case thrust washer from output shaft or case.

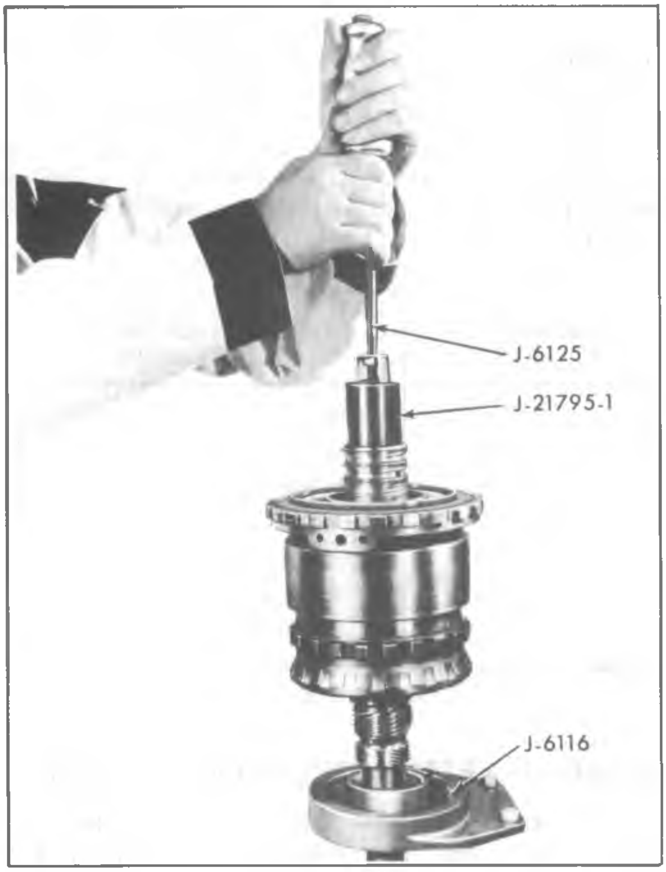


Figure 400-46 Gear Unit Holding Fixture

9. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116-01, place gear unit assembly in holding fixture with mainshaft pointing upward, **Figure** 400-46. Remove Tool J-21795.

10. Remove rear unit selective washer from transmission case.

11. Remove the center support to case spacer, refer to **Figure** 400-76.

12. Remove rear band assembly. To facilitate removal, rotate band lugs away from pins and pull band assembly out of transmission case.

13. Remove center support assembly from reaction carrier by lifting straight upward.

14. Remove center support to reaction carrier thrust washer, **Figure** 400-47.

Thrust washer may have stuck to back of center support. If so, remove from center support.

15. Remove reaction carrier and roller clutch assembly from output carrier, **Figure** 400-48, and remove roller clutch assembly from reaction carrier.

TRANSMISSION DISASSEMBLY, CLEANING, INSPECTION AND ASSEMBLY OF INDIVIDUAL UNITS

Inspect each part thoroughly after the transmission and individual units have been disassembled and cleaned, to determine which parts should be replaced. It is very important to distinguish between parts that are simply "worn-in", and those parts worn to the extent that they affect operation of the unit. Only "worn-out", broken or damaged parts should be replaced.

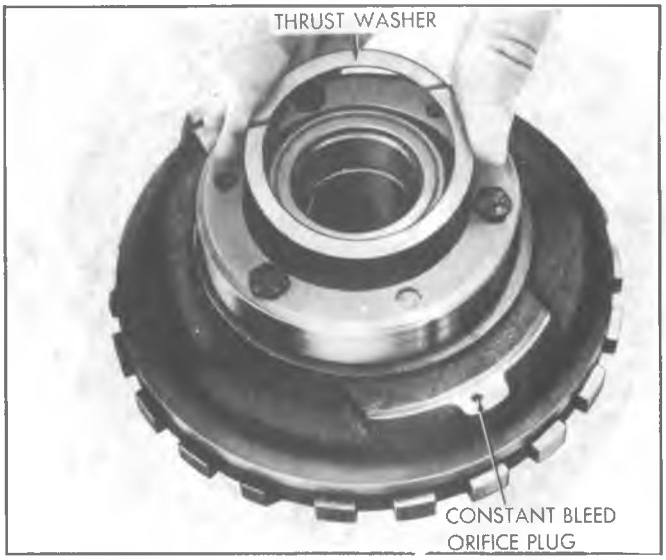


Figure 400-47 Removing Center Support to Reaction Carrier Thrust Washer

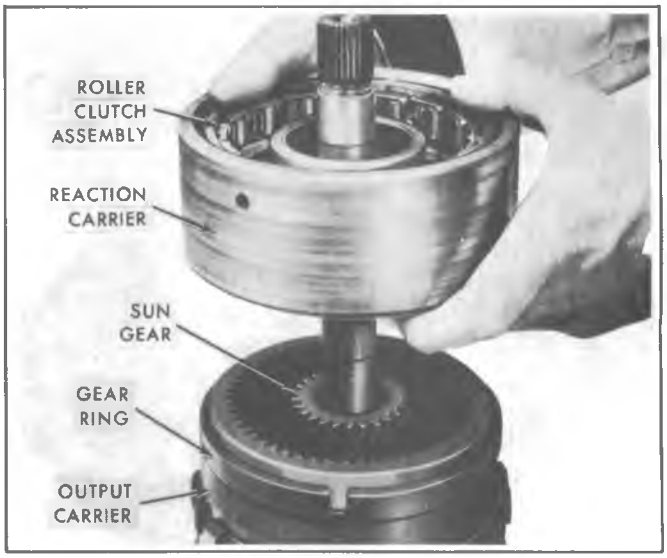


Figure 400-48 Roller Clutch Assembly

Inspection of Torque Converter

1. Check converter for leaks.

2. Check converter hub surfaces for signs of scoring or wear.

Inspection of Vacuum Modulator and Valve

1. Inspect vacuum modulator for any signs of bending or distortion.

2. Inspect O-ring seat for damage.

3. Inspect modulator valve for nicks or damage.

4. Check freeness of valve operation in case bore.

5. Check modulator for damaged bellows.

Modulator plunger is under approximately 16 pounds pressure. If bellows is damaged, plunger will have very little pressure. Use procedure outlined in Diagnosis Part V.

Inspection of Extension Housing

1. Inspect bushing and rear seal for excessive wear or damage.
2. Inspect gasket mounting face for damage.
3. Inspect housing for cracks or porosity.
4. Be sure rear seal drain back port is not blocked.

Inspection of Detent Lever, Manual Shaft, and Parking Linkage

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs.
2. Inspect actuator spring for damage.
3. Inspect actuator for a free fit on actuator rod.
4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft and lip seal for damage.
6. Inspect inside detent lever for cracks or a loose pin.
7. Inspect parking pawl return spring for deformed coils or ends.
8. Inspect parking bracket for cracks or wear.
9. Inspect detent spring and roller assembly.

Inspection of Transmission Case

1. Inspect case assembly for cracks, porosity or interconnected passages, **Figure** 400-20 and **Figure** 400-21.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect intermediate clutch driven plate lugs for damage or brinelling.
5. Inspect snap ring grooves for damage.
6. Inspect governor assembly bore for scratches or scoring.
7. Inspect modulator valve bore for scoring or damage.
8. Inspect cup plug inside case for good staking and sealing, **Figure** 400-21.

If the case assembly requires replacement, make sure the center support to-case spacer is removed from the old case and reinstalled in the new case.

If the case assembly requires replacement, remove the nameplate from the old case and reinstall it onto the new case, using the truss head nameplate attaching screw that is serviced with the case,

GOVERNOR ASSEMBLY

All components of the governor assembly, **Figure** 400-49, with the exception of the driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble the governor assembly in order to replace the driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights, and springs. Governor weights are interchangeable from side to side and need not be identified.
2. Remove governor valve from governor sleeve. Be careful not to damage valve.
3. Perform the following inspections and replace governor driven gear if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring and galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve opening at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward, **Figure** 400-50.
11. Check valve opening at exhaust (.020" minimum) with a feeler gage, holding governor as shown with governor weights completely inward, **Figure** 400-51.

Governor Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin using small punch, **Figure** 400-52.
2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press and, with a long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 3/16 inch plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch, and then while supporting governor in press, drill new hole through sleeve and gear using a 1/8 inch drill.
6. Install split retainer pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

Assembly

1. Install governor valve in bore of governor sleeve.
2. Install governor weights and springs, and thrust cap on governor sleeve.

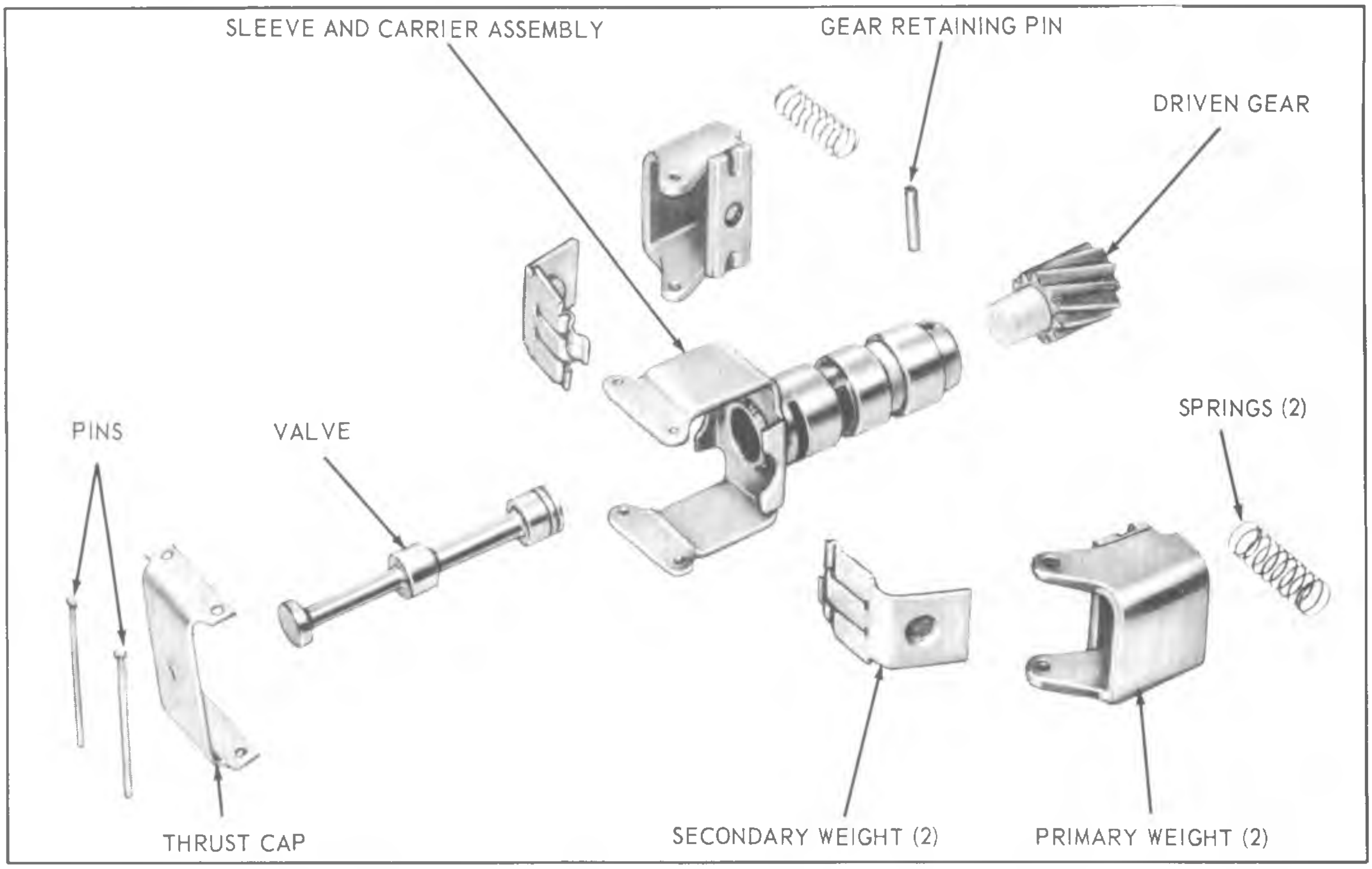


Figure400-49 Governor Assembly - Disassembled View

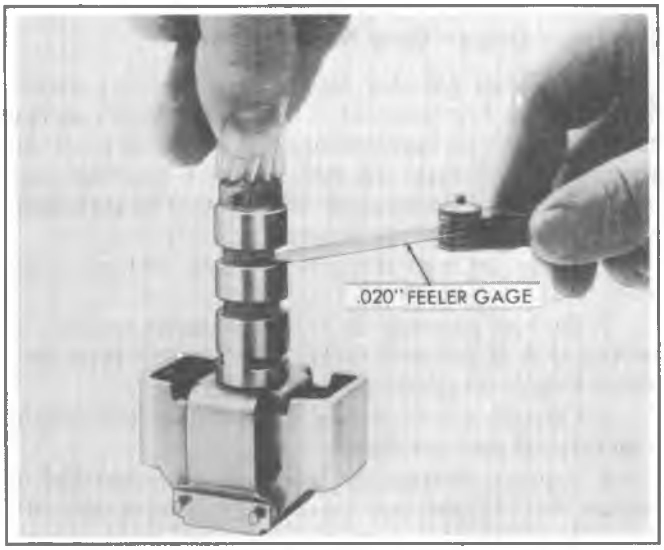


Figure400-50 Checking Valve Opening - Weights Extended

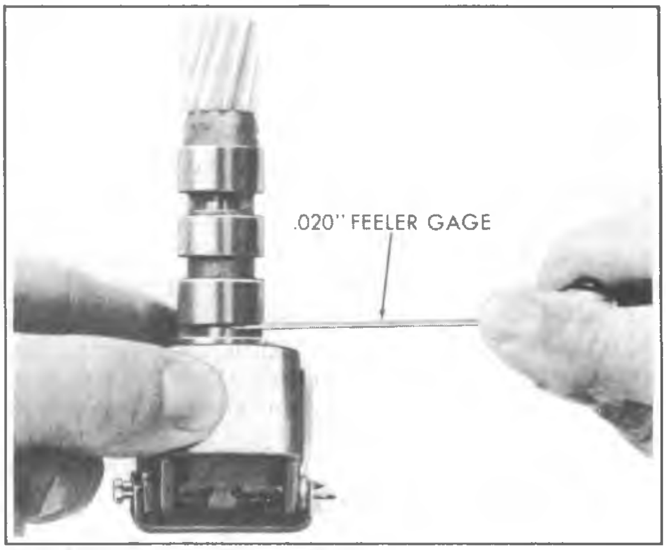


Figure400-51 Checking Valve Opening - Weights Inward

3. Align pin holes in thrust cap, governor weight assemblies, and governor sleeve, and install new pins. Crimp both ends of pins to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins and valve for freeness in sleeve bore.

SPEEDOMETER DRIVEN GEAR ASSEMBLY

Disassembly

1. Remove speedometer driven gear from sleeve.
2. Remove O-ring from speedometer driven gear sleeve.
3. Remove C-wire ring retaining sleeve to gear lip seal.
4. Remove lip seal.

Inspection

1. Inspect gear for damaged teeth or shaft.
2. Inspect sleeve or sensor for scores, damaged threads or cracks.
3. Inspect seals for cuts or damage.
4. Inspect sensor for corrosion on wire terminal.

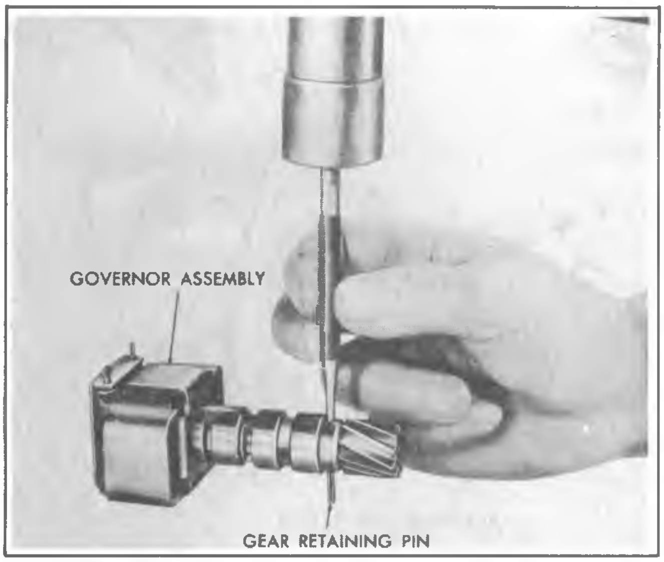


Figure400-52 Removing Governor Driven Gear Retaining Pin

Assembly

1. Install sleeve to gear lip seal.
2. Install C-wire retaining ring.
3. Install O-ring on speedometer driven gear sleeve.
4. Install gear in sleeve.

CONTROL VALVE ASSEMBLY

Disassembly

When disassembling control valve assembly, **Figure** 400-53, make certain that springs are accurately identified so that they can be properly reassembled.

1. Position control valve assembly with gasket surface up and accumulator pocket on bottom.

2. Remove manual valve from upper bore.

3. Install Control Valve Accumulator Piston Installer, J-21885 or J-22269-01, on accumulator piston, compress piston and remove E-ring retainer, **Figure** 400-54.

4. Remove Installer, J-21885 or J-22269-01, and remove accumulator piston and spring.

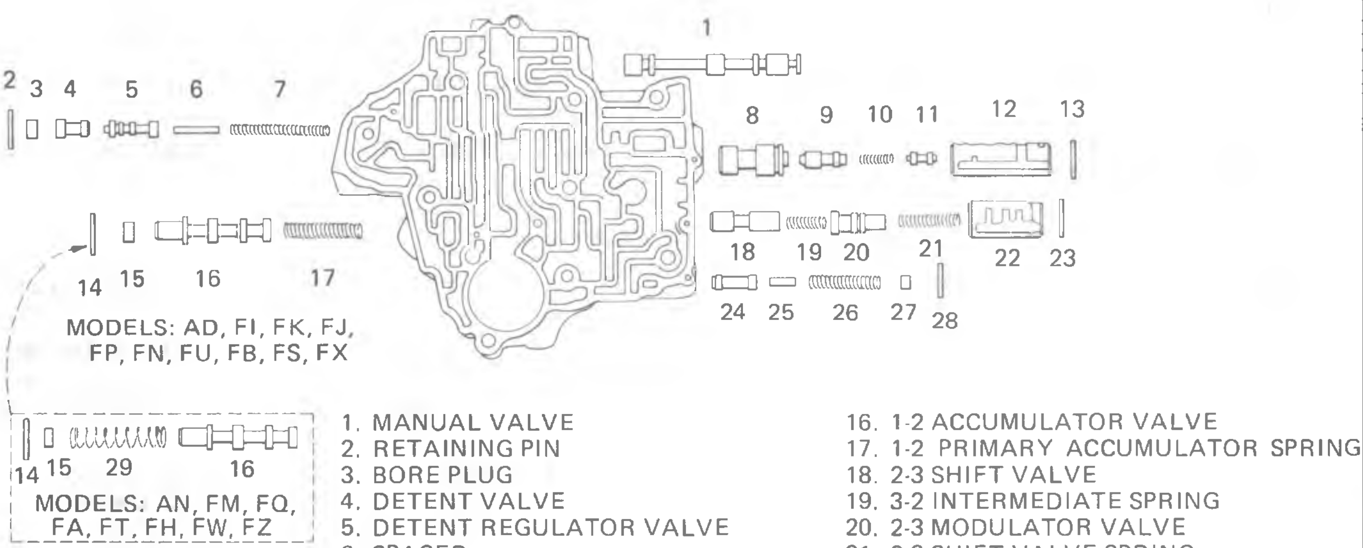
5. Using pin punch, remove retaining pin from upper right bore, pressing on pin from outer side of valve body. Remove 1-2 modulator bushing, 1-2 regulator valve and spring, 1-2 detent valve and 1-2 shift valve from upper right bore.

1-2 regulator valve and spring may be inside of 1-2 modulator bushing.

6. Using punch, remove retaining pin from center right bore, pressing on pin from outer side of valve body. Remove 2-3 modulator bushing, 2-3 shift valve spring, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve from center right bore.

2-3 modulator valve will be inside of 2-3 modulator bushing.

7. Using pin punch, remove retaining pin from lower right bore, pressing on pin from outer side of valve body.



1. MANUAL VALVE
2. RETAINING PIN
3. BORE PLUG
4. DETENT VALVE
5. DETENT REGULATOR VALVE
6. SPACER
7. DETENT REGULATOR VALVE SPRING
8. 1-2 SHIFT VALVE
9. 1-2 DETENT VALVE
10. 1-2 REGULATOR VALVE SPRING
11. 1-2 REGULATOR VALVE
12. 1-2 MODULATOR BUSHING
13. RETAINING PIN
14. RETAINING PIN
15. BORE PLUG
16. 1-2 ACCUMULATOR VALVE
17. 1-2 PRIMARY ACCUMULATOR SPRING
18. 2-3 SHIFT VALVE
19. 3-2 INTERMEDIATE SPRING
20. 2-3 MODULATOR VALVE
21. 2-3 SHIFT VALVE SPRING
22. 2-3 MODULATOR BUSHING
23. RETAINING PIN
24. 3-2 VALVE
25. SPACER
26. 3-2 VALVE SPRING
27. BORE PLUG
28. RETAINING PIN
29. 1-2 ACCUMULATOR VALVE SECONDARY SPRING

Figure400-53 Control Valve Assembly - Disassembled View

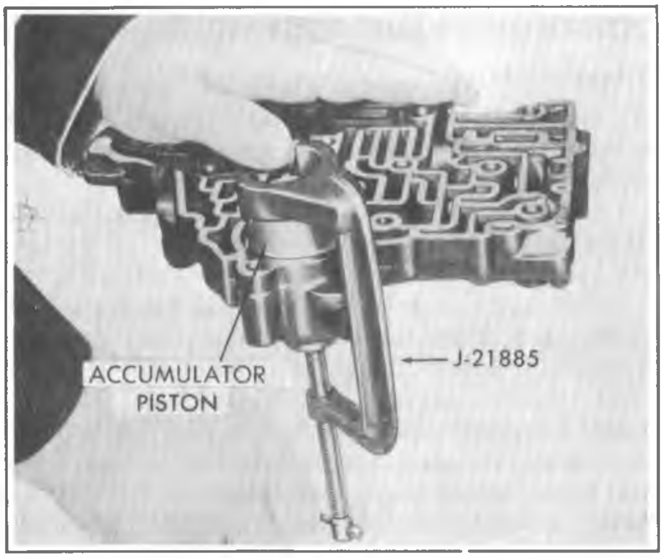


Figure400-54 Removing Front Accumulator Piston

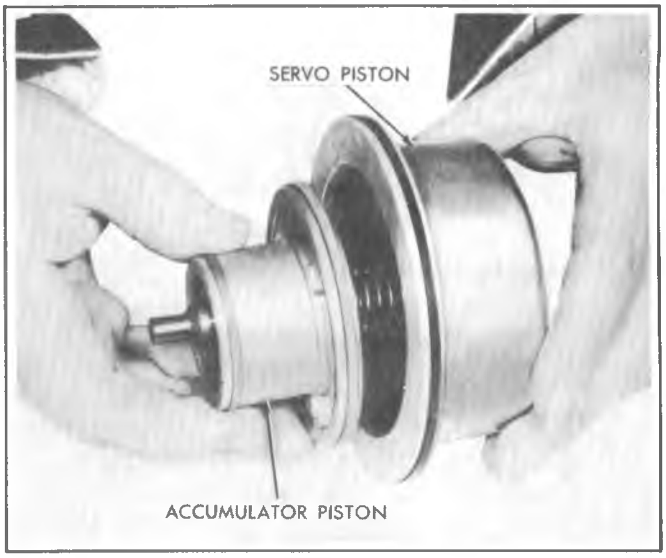


Figure 400-55 Front Accumulator Disassembled View

NOTICE: Hold hand over bore when removing retainer pin as 3-2 valve spring may force bore plug out.

8. Remove bore plug, 3-2 valve spring, spacer and 3-2 valve from lower right bore.

9. Using pin punch, remove retainer pin from upper left bore by pressing on outer side of valve body.

NOTICE: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS DETENT REGULATOR VALVE SPRING MAY FORCE OTHER COMPONENTS OUT OF BORE.

10. Remove bore plug, detent valve, detent regulator valve, spacer and detent regulator valve spring from upper left bore.

11. Remove grooved retaining pin from lower left bore by prying out with long nose pliers.

12. a. On all models except AD, AE, AH and AL, remove bore plug, 1-2 accumulator valve and primary spring from lower left bore.

b. On AD and AE models remove bore plug, 1-2 accumulator secondary spring and 1-2 accumulator valve from lower left bore.

Inspection

Do not remove the teflon oil seal from the front accumulator piston unless the oil seal ring requires replacement. The service oil seal ring is cast iron, **Figure** 400-55.

The type of front accumulator piston used in 1971 thru 1980 is not interchangeable with pre-1971 piston.

1. Wash control valve body, valves, and other parts in clean solvent.

NOTICE: Do not allow valves to bump together, as this might cause nicks and burrs.

2. Inspect all valves and bushings carefully to make sure that they are free from dirt and are not damaged in any respect. If burrs are present, they should be removed with a fine stone or fine grade of crocus cloth and light oil. Be careful not to round off shoulders of valves.

3. All valves and bushings should be tested in their individual bores to make certain that free movement can be obtained. All valves should fall freely of their own weight with a slight tapping action on the body. In checking, be careful to prevent valve damage in any way.

4. The manual valve is the only valve that can be serviced separately. If other valves are malfunctioning or damaged beyond repair, a new control valve assembly should be installed.

5. Inspect body for cracks or scored bores.

6. Check all springs for distortion or collapsed coils.

7. Inspect front accumulator piston and oil ring for damage.

Refer to **Figure** 400-19 for identification of control valve passages.

Assembly

1. Position front accumulator spring and piston into valve body.

2. Install Control Valve Accumulator Piston Installer, J-21885, or J-22269-01, on piston. Compress spring and piston, aligning spring and piston with bore, **Figure** 400-54.

NOTICE: Make certain that piston pin is correctly aligned with hole in piston and that oil seal ring does not catch on lip of bore when installing piston.

3. Secure piston and spring with E-ring retainer and remove Installer, J-21885 or J-22269-01.

4. Install the 1-2 accumulator valve train into lower left hand bore, **Figure** 400-53. Models AA, AE, AH, AC and AM.

a. Install the 1-2 accumulator spring and 1-2 accumulator valve, stem end out, into bore. Place the bore plug into valve bore and install grooved retaining pin from the cast surface side of the valve body, with the grooves entering the pin hole last. Tap pin with a hammer until flush with cast surface of valve body.

b. (Model AD) install the 1-2 accumulator valve, stem end out, and 1-2 accumulator secondary spring. Install the bore plug and compress spring until grooved retaining pin can be unseated from the cast surface of the valve body. Install retaining pin with the grooved end entering the pin hole last and tap in place until flush with cast surface of the valve body.

5. Insert spacer inside of detent regulator valve spring and install spring and spacer into upper left bore, making certain spring seats in bottom of bore.

6. Compress detent regulator valve spring and hold with a small screwdriver placed between end of spring and wall on cored side of valve body.

7. Install detent regulator valve, stem end out, and detent valve, small land first, into upper left bore.

8. Insert bore plug, hole out, into upper left bore and, pressing inward on bore plug, remove screwdriver and install retaining pin from cored side of valve body.

9. Install 3-2 valve in bottom right bore.

10. Insert spacer inside of 3-2 valve spring and install spring and spacer in bottom right bore.

11. Compressing 3-2 valve spring, install bore plug, hole end out, and secure with retaining pin from cored side of valve body.

12. Install 3-2 intermediate spring in open end of 2-3 shift valve, and install valve and spring, valve first, into center right bore. Make certain valve seats in bottom of bore.

13. Install 2-3 modulator valve, hole end first, into 2-3 modulator bushing and install both parts in center right bore.

14. Install 2-3 shift valve spring into hole in 2-3 modulator valve, and compressing spring, secure with retaining pin from cored side of control valve.

15. Install 1-2 shift valve, stem end out, in upper right bore, making certain valve seats in bottom of bore.

16. Install 1-2 regulator valve, larger stem first, spring and 1-2 detent valve, hole end first, into 1-2 bushing, and install in upper right bore of control valve body.

17. Compress bushing against spring and secure with retaining pin from cored side of control valve body.

18. Install manual valve with detent pin groove to the right.

REAR SERVO ASSEMBLY

Disassembly

1. Remove rear accumulator piston from rear servo piston. See **Figure** 400-56.

2. Remove E-ring retaining rear servo piston to band apply pin.

3. Remove rear servo piston and seal from band apply pin.

4. Remove washer, spring and retainer.

Inspection

1. Check freeness of oil seal rings in piston grooves.

See **Figure** 400-57. Do not remove the teflon oil seal rings from the rear accumulator piston, unless the oil seal rings require replacement.

If the teflon inner oil seal ring, (small diameter) requires replacement, for service, use the aluminum oil seal ring.

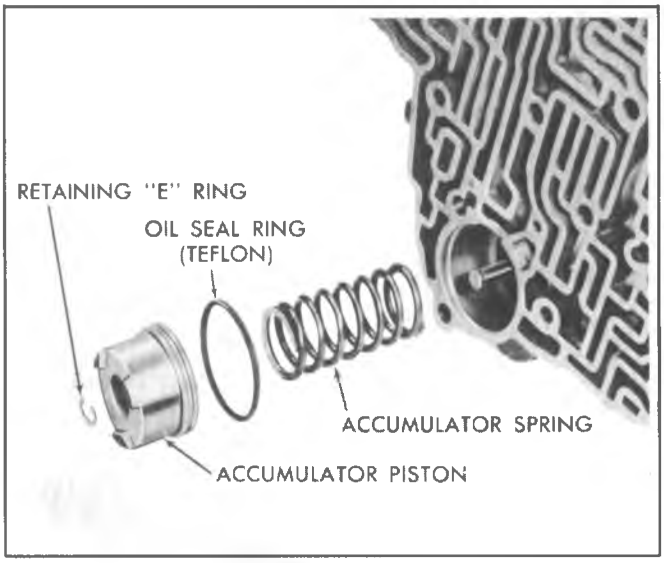


Figure400-56 Disassembling Rear Servo and Accumulator Piston

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring, if this requires replacement, use only the teflon oil seal ring.

2. Inspect fit of band apply pin in servo piston.

3. Inspect band apply pin for scores or cracks.

4. Inspect band apply pin for proper size as determined by pin selection check.

Assembly

1. Install spring retainer with cup side toward band apply servo pin, spring and washer on servo pin.

2. Install servo piston on pin and secure with E-ring retainer.

3. If removed, install oil seal ring on servo piston.

4. If removed, install outer and inner oil rings on accumulator piston.

5. Install accumulator piston into bore of servo piston.

FRONT SERVO ASSEMBLY

See **Figure** 400-58. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. The service oil seal ring is aluminum.

The spring retainer, servo pin, retainer ring and servo piston are identical for 1971 thru 1980 transmissions. These individual parts are not interchangeable with the pre-1971 parts.

Inspection

1. Inspect servo pin for damage.

2. Inspect piston and oil seal ring for damaged oil ring groove, check freedom of ring in groove.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston.

Assembly

1. Reassemble parts of front servo, making sure tapered end of servo pin is pointing through the spring and spring retainer. Make sure the retainer ring is in the servo pin groove.

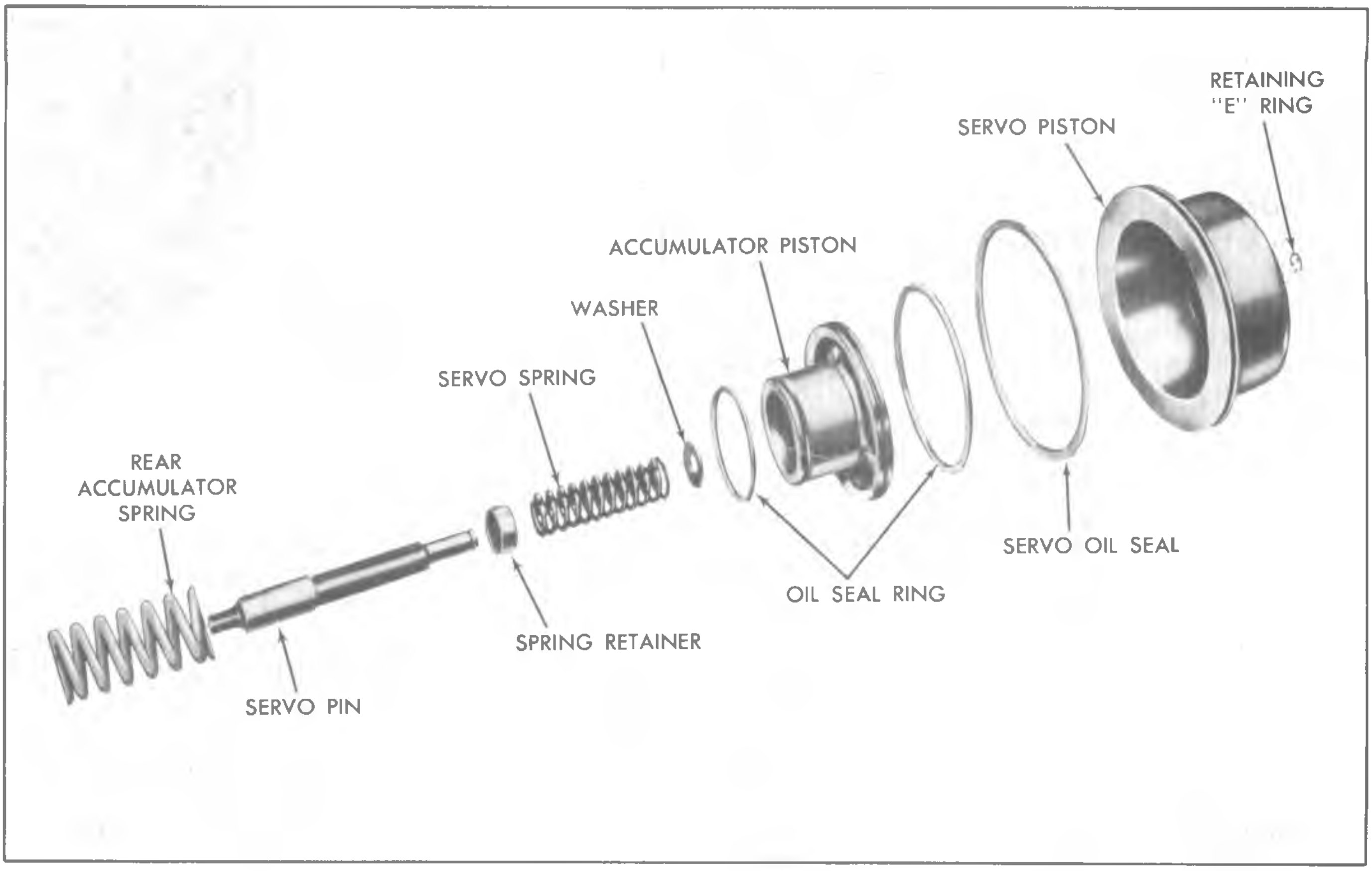


Figure400-57 Rear Servo and Accumulator

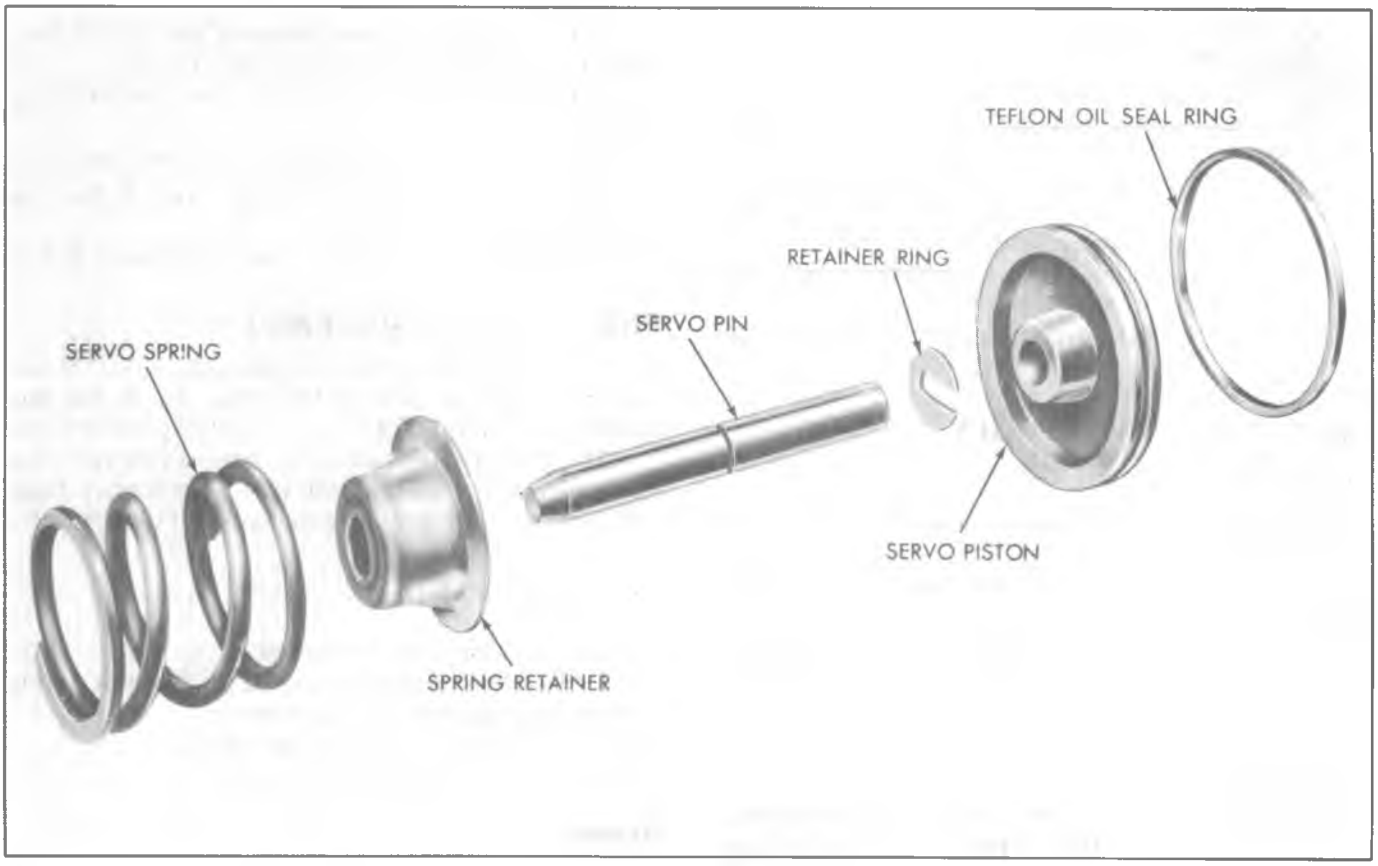


Figure400-58 Front Servo

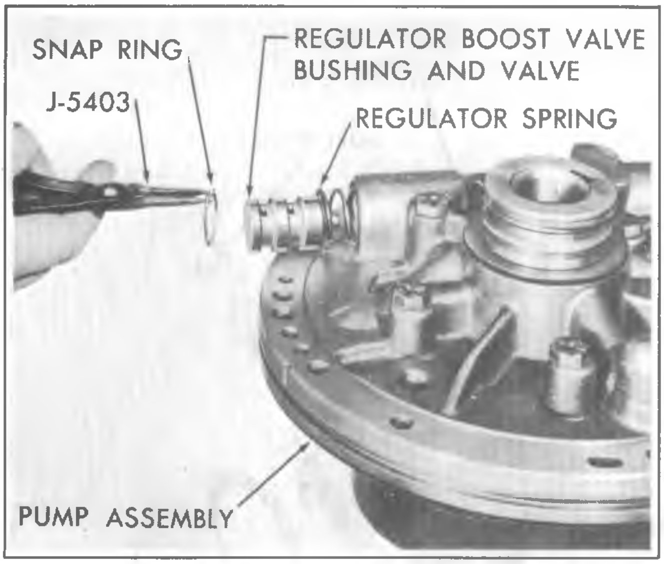


Figure400-59 Removing Pressure Regulator Valve Snap Ring

OIL PUMP ASSEMBLY

Disassembly

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116, place pump assembly in Holding Fixture with stator shaft pointing downward. Be careful not to damage shaft.

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring using Snap Ring Pliers J-5403 (#21), **Figure** 400-59.

NOTICE: PRESSURE REGULATOR SPRING IS TIGHTLY COMPRESSED

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove regulator valve, spring retainer, and spacer or spacers if present.

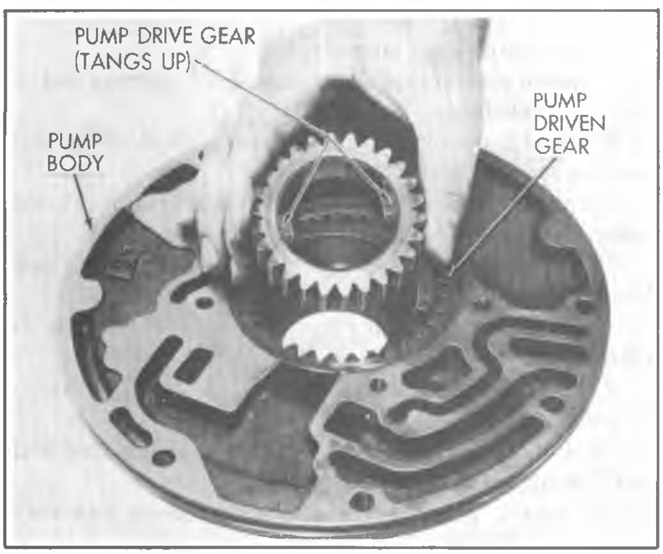


Figure400-60 Removing Pump Gears

6. Remove five pump cover attaching screws and remove pump cover from body.

7. Mark drive and driven gears for reassembly in same position and remove from pump body, **Figure** 400-60.

Installing the gears in the same position as removed, will assure the quietest operation, as the gear teeth will mesh in the established wear pattern.

8. Remove retaining pin and bore plug from end of regulator bore.

9. Remove two oil rings from pump cover.

10. Remove pump to forward clutch housing selective washer.

11. If necessary to replace front oil seal, pry seal from pump body, **Figure** 400-26.

Inspection of Pump Body

1. Inspect gear pockets and crescent for scoring, galling or other damage.

2. Place pump gears in pump body and check pump body face to gear face clearance. Clearance should be .02 mm-.09 mm (.0008 inch-.0035 inch), **Figure** 400-61.

Figure400-61 Pump Body Face to Gear Face Clearance

3. Check face of pump body for scores or nicks.

4. Check oil passages for proper opening and lack of porosity.

5. Check for damaged cover bolt attaching threads.

6. Check for overall flatness of pump body face.

7. Check bushing for scores or nicks.

Inspection of Pump Cover

1. Inspect pump cover face, **Figure** 400-62, for overall flatness.

2. Check for scores or dirt in pressure regulator bore.

3. Make certain all passages are open and not interconnected through porosity.

4. Check for scoring or damage at pump gear face.

5. Inspect stator shaft for damaged splines, or scored bushings.

6. Inspect oil ring grooves for damage or wear.

7. Inspect selective thrust washer face for wear or damage.

8. Inspect oil seal ring on pump body and remove if necessary.

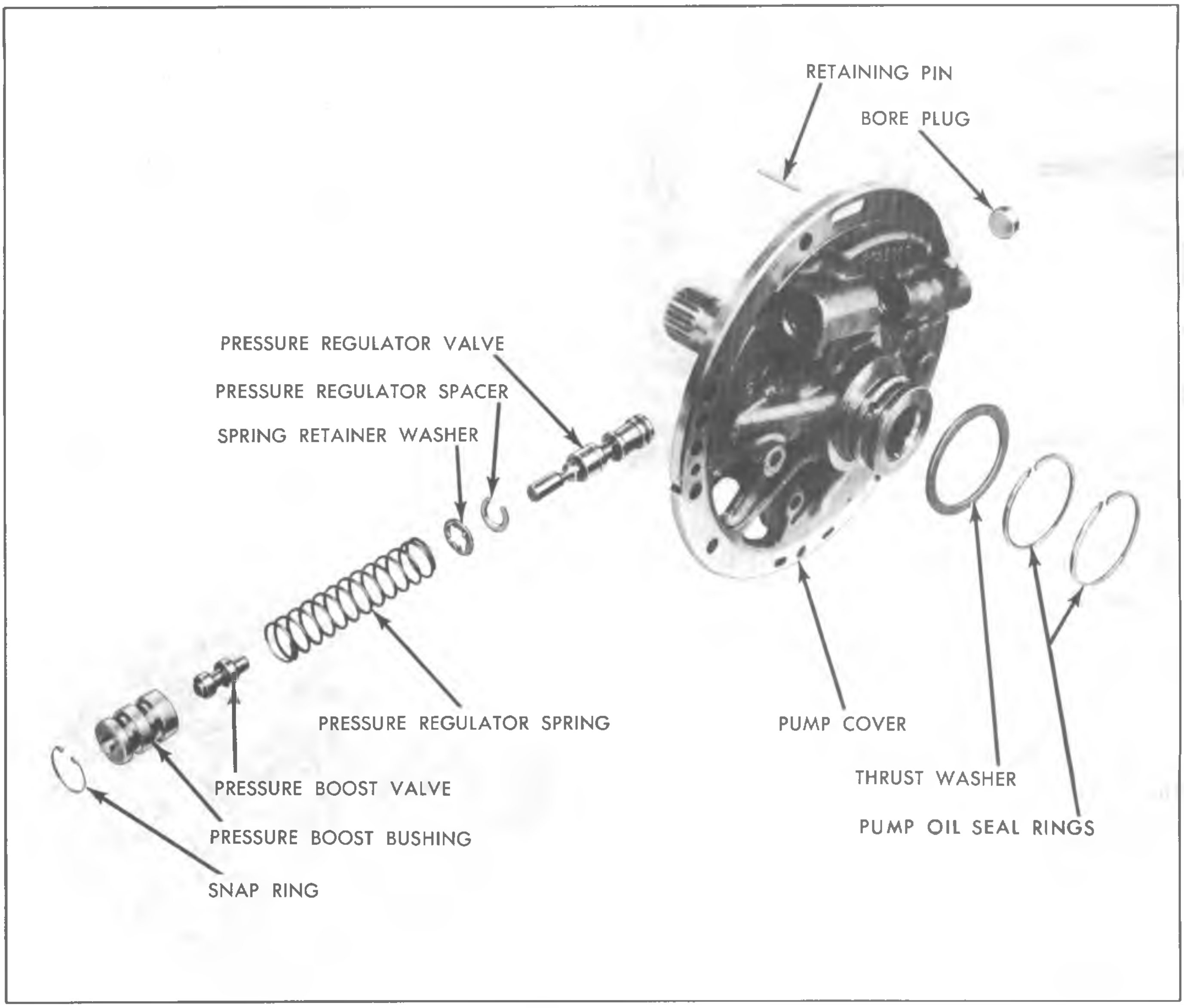


Figure400-62 Pump Cover Disassembled View

9. Inspect pressure regulator and boost valve for free operation.

The solid type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous pressure regulator valve. The solid style valve must only be used in the pump cover with the squared off pressure regulator boss, (Pressure boost bushing end). The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.

10. Inspect pump cover for open 1/8 inch diameter breather hole. See **Figure** 400-24.

Assembly

1. Install drive and driven pump gears into pump body with alignment marks up and mated. In this position the pump gear drive tangs will also be up.

2. Install pressure regulator spacer or spacers, if required, spring retainer and spring into pressure regulator bore.

3. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

4. Install retaining snap ring.

5. Install pressure regulator valve from opposite end of bore, stem end first.

6. Install pressure regulator valve bore plug and retaining pin into end of bore.

7. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

Proper washer size was determined at time of front unit end play check.

8. Install two oil seal rings. Be sure the lap joint is properly installed.

9. Place pump body in Rear Unit Holding Fixture, J-6116, with gasket surface facing up.

10. Lubricate pump gears with transmission fluid and install pump cover on pump body.

11. Install pump cover attaching screws following screw chart, **Figure** 400-63. Leave screws one turn loose at this time.

12. Install pump body and Cover Alignment Band, J-21368, around pump assembly. Tighten wing nut on alignment band to align pump cover with pump body, **Figure** 400-64.

13. Tighten pump cover attaching screws to 24 N·m (18 foot-pounds) and remove alignment band from pump.

BOLT	SIZE
A -	5/16 - 18 x 1
B -	5/16 - 18 x 1½
C -	5/16 - 18 x 1¾

Figure400-63 Pump Cover Attaching Screws

Figure400-64 Aligning Pump Cover and Body

14. Install new square cut O-ring on pump.

15. If necessary, install new pump oil seal using pump Oil Seal Installer, J-21359, **Figure** 400-27.

FORWARD CLUTCH ASSEMBLY DISASSEMBLY

Disassembly

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116-01, place forward clutch assembly in Holding Fixture with turbine shaft pointing downward. Be careful not to damage shaft.

2. Remove forward clutch housing to direct clutch hub snap ring.

3. Remove direct clutch hub.

4. Remove forward clutch hub and one thrust washer from each side of hub, **Figure** 400-65.

5. Remove composition and steel clutch plates as shown on **Figure** 400-65.

6. Place forward clutch assembly in arbor press with turbine shaft pointing downward.

7. Using Clutch Spring Compressor, J-4670-01, and Adapter, J-21664, compress spring retainer with arbor press and remove snap ring using Snap Ring Pliers, J-8059 or J-5586, **Figure** 400-66.

8. Remove tools, spring retainer and 16 clutch release springs. Keep springs separate from direct clutch springs.

9. Remove forward clutch piston from forward clutch housing.

10. Remove inner and outer seals from clutch piston.

11. Remove center piston seal from forward clutch housing.

12. It is not necessary to remove turbine shaft from forward clutch housing unless either shaft or housing is damaged and must be replaced. In such case proceed as follows:

a. Place forward clutch housing in arbor press with turbine shaft pointing downward.

b. Using 3/8 inch drive extension approximately 3 inches long, or similar tool as driver, press turbine shaft out of forward clutch housing.

Inspection

1. Inspect composition faced and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen release springs for collapsed coils or signs of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes, and thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, cracks and open oil passages.

6. Inspect operation of ball check in forward clutch housing.

7. Inspect turbine shaft for open lubrication passages at each end.

8. Inspect turbine shaft splines for damage.

9. Inspect bushing journals for damage.

10. Inspect turbine shaft for cracks or distortion.

Assembly

1. If turbine shaft was previously removed from forward clutch housing proceed as follows:

a. Place forward clutch housing on arbor press with flat side up.

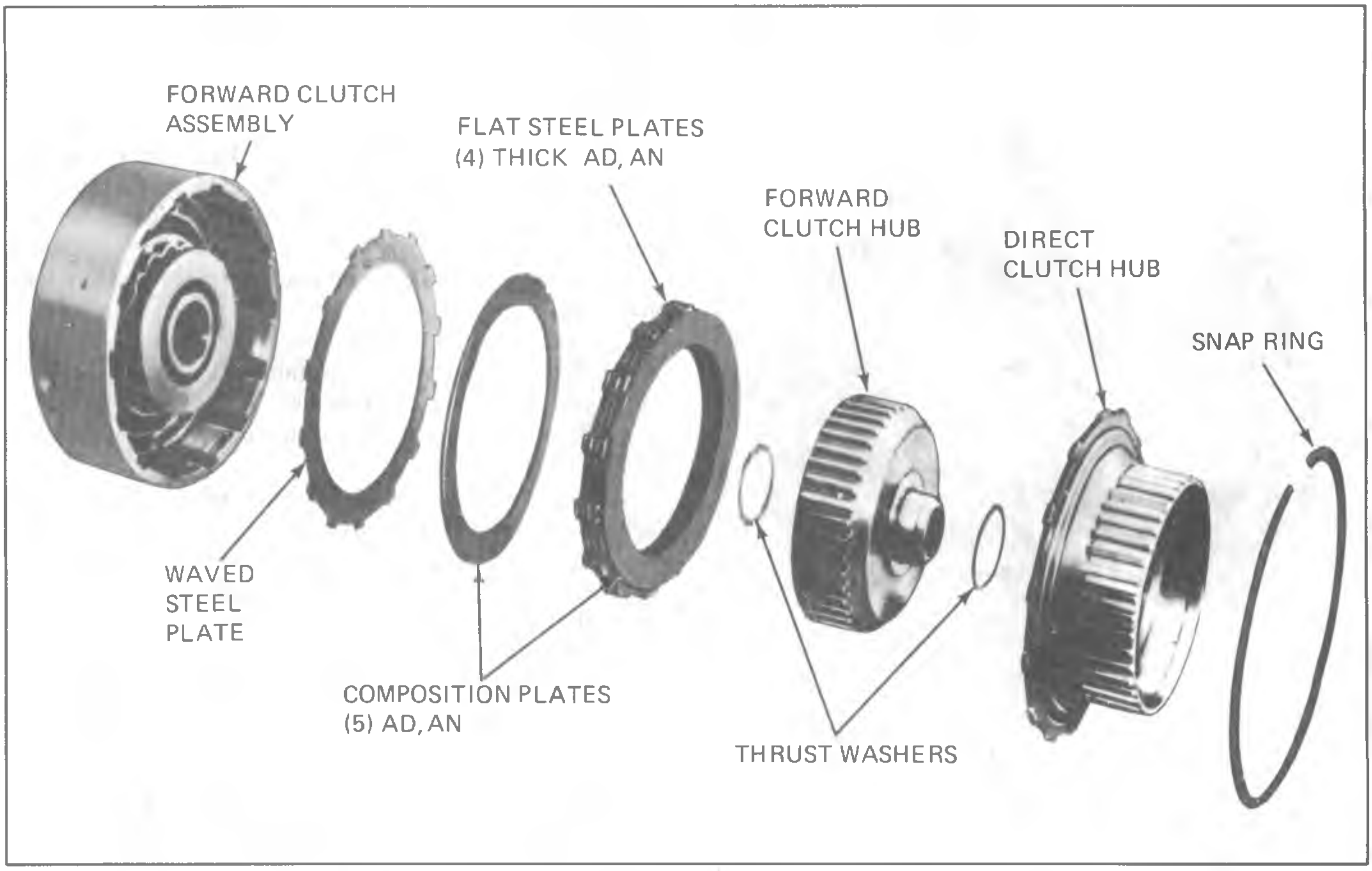


Figure400-65 Forward Clutch Assembly - Disassembled View

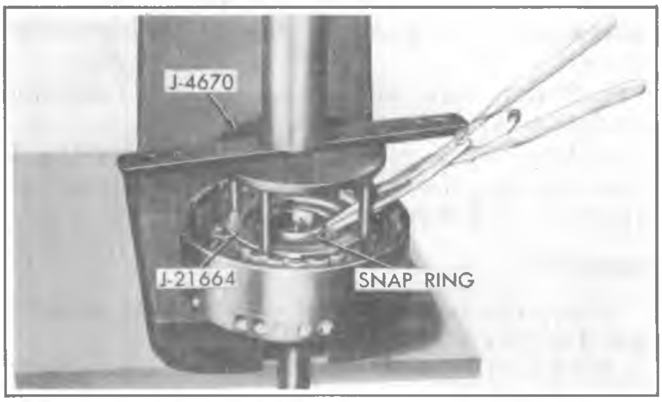


Figure400-66 Removing Forward Clutch Snap Ring

b. Align shorter splined end of turbine shaft with splines in forward clutch housing, and using arbor press, carefully press shaft into housing until shaft bottoms on hub of housing.

NOTICE: Start shaft into housing and back off on arbor press to allow shaft to straighten itself. Repeat this step several times until you are certain shaft is going in straight, otherwise, shaft or housing splines may be damaged.

2. Invert forward clutch housing on arbor press with turbine shaft pointing downward.

3. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in forward clutch piston with petrolatum and install seals with lips facing away from spring pockets.

4. Lubricate new center piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and install seal into clutch housing with lip facing up.

5. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over forward clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409. Insert assembly in forward clutch housing. **Figure** 400-67, and install clutch piston by rotating it slightly in a clockwise direction until seated.

6. Install sixteen clutch release springs into spring pockets in clutch piston.

7. Using Clutch Spring Compressor, J-4670-01, and Adapter, J-21664, compress spring retainer with arbor press, being careful that retainer does not catch in snap ring groove, and install snap ring using Snap Ring Pliers, J-8059 or J-5586, **Figure** 400-66. Remove tools.

Make certain clutch release springs are not leaning. If necessary, straighten with a small screwdriver.

8. Remove forward clutch assembly from arbor press and place in Holding Fixture, J-6116-01, with turbine shaft pointing down. Be careful not to damage shaft.

9. Install thrust washer on the outside of forward clutch hub. The bronze washer is installed on side of hub facing forward clutch housing.

10. Install forward clutch hub in forward clutch housing.

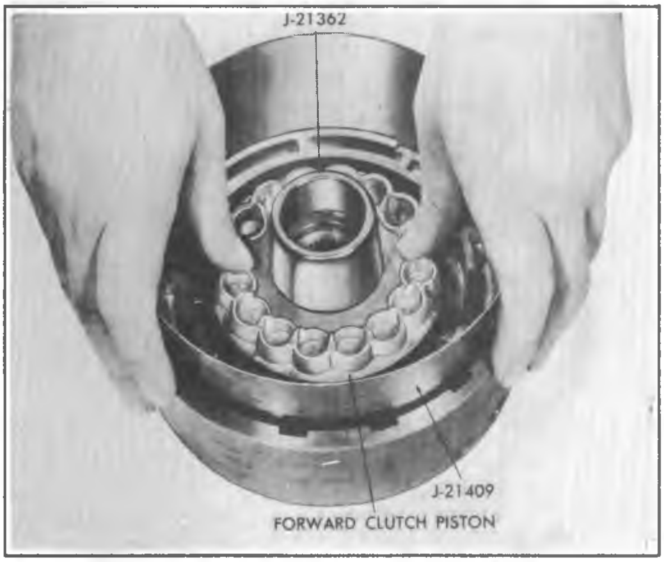


Figure400-67 Installing Forward Clutch Piston

11. a. Models AA, AB, AC, AE, AH lubricate and install one (1) waved steel (plate with "U" notch) three (3) thin flat steel (.077" thick) and four (4) composition-faced plates, starting with the waved plate and alternating flat steel and composition-faced plates.

b. Models AD, AM, lubricate and install one (1) waved steel (plate with "U" notch), four (4) thick flat steel (.091" thick) and five (5) composition-faced plates, staring with the waved plate and alternating flat steel and composition-faced plates.

12. Install direct clutch hub in forward clutch housing over clutch plates, and install snap ring.

13. Place forward clutch housing on pump delivery sleeve and air check clutch operation by applying air through forward clutch passage in pump, **Figure** 400-68 to actuate piston and move forward clutch.

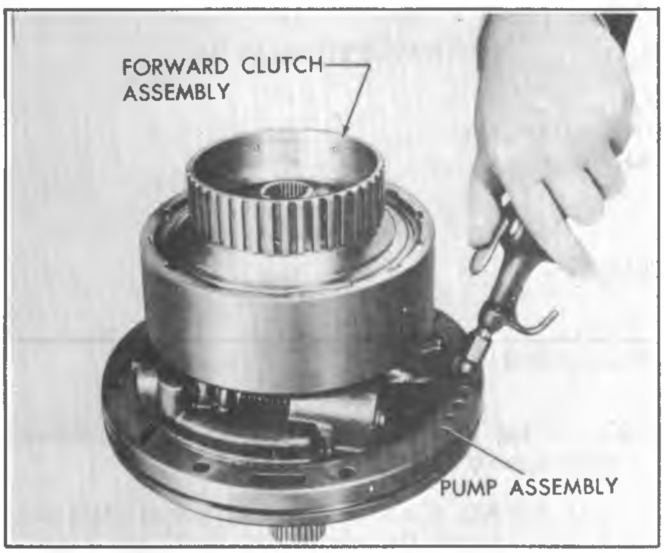


Figure400-68 Air Checking Forward Clutch

DIRECT CLUTCH AND INTERMEDIATE ROLLER ASSEMBLY

Disassembly

1. Remove roller retainer snap ring, and remove clutch retainer.

2. Remove roller outer race and remove roller assembly. See **Figure** 400-69.

3. Turn unit over and remove direct clutch backing plate to clutch housing snap ring.

4. Remove direct clutch backing plate and composition and steel clutch plates as shown on **Figure** 400-70.

5. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter J-21664. **Figure** 400-72 compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

6. Remove tools, spring retainer and 14 clutch release springs. Keep springs separate from forward clutch springs, **Figure** 400-71.

7. Remove direct clutch piston from direct clutch housing.

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from direct clutch housing.

Inspection

1. Inspect roller clutch assembly for damaged rollers, cage or springs.

2. Inspect cam and outer race for scratches or wear.

3. Inspect clutch housing for cracks, wear, proper opening of oil passages and wear on clutch plate drive lugs.

4. Inspect composition-faced and steel clutch plates for signs of wear or burning.

5. Inspect backing plate for scratches or other damage.

6. Inspect piston for cracks.

7. Inspect springs for collapsed coils or signs of distortion.

8. Inspect housing for face operation of check ball.

The 14 direct clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.

Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in direct clutch piston and install seals with lips facing away from spring pockets.

2. Lubricate new center seal with transmission fluid. Lubricate seal groove in direct clutch housing and install seal in clutch housing with lip facing up.

3. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over direct clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in direct clutch housing, **Figure** 400-73, and install clutch piston by rotating it slightly, in a clockwise direction.

4. Install 14's (16's if service) clutch release springs into spring pockets in clutch piston.

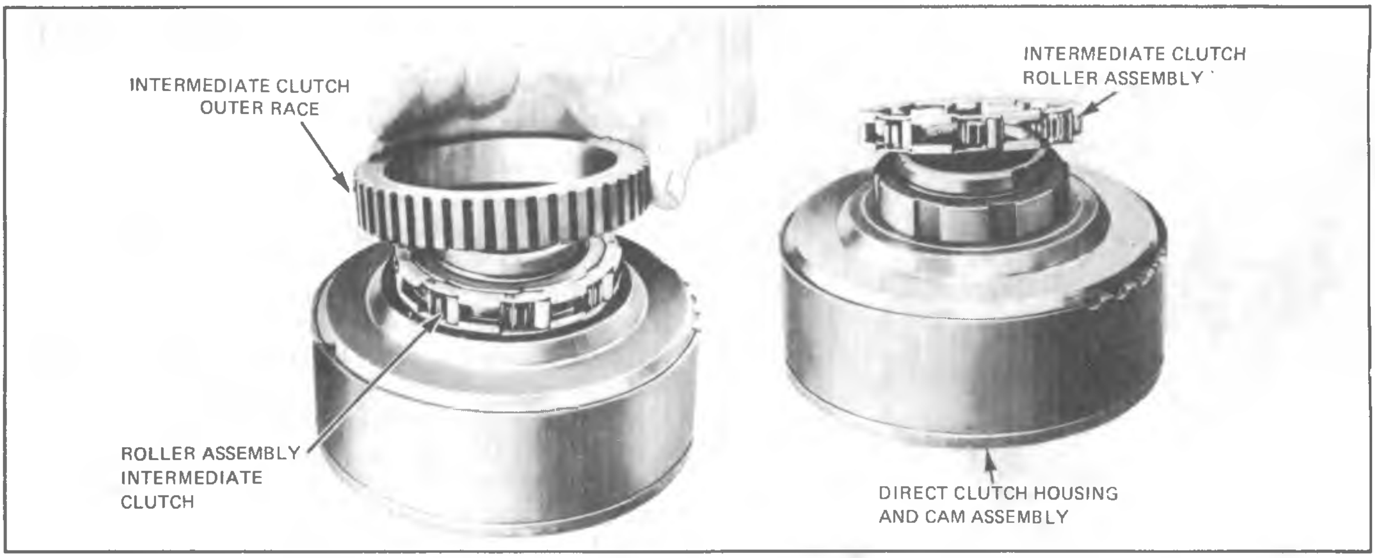


Figure400-69 Removing Roller Outer Race and Assembly

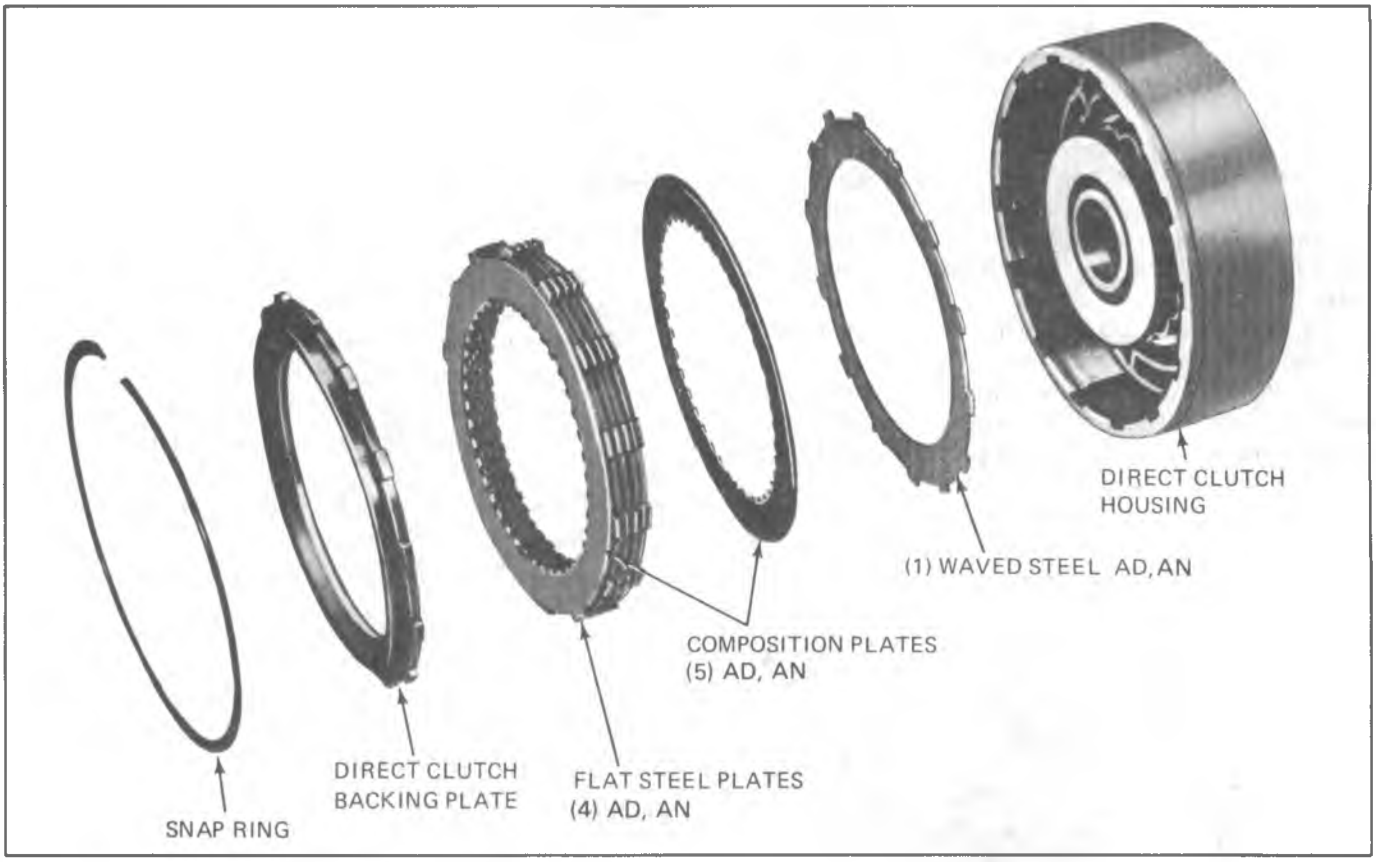


Figure400-70 Direct Clutch - Disassembled View

5. Place spring retainer and snap ring over springs.

6. Using Clutch Spring Compressor, J-4670-01, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, **Figure** 400-72, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586. Remove tools.

Make certain clutch release springs are not leaning. If necessary, straighten spring with a small screwdriver.

7a. Models AA, AB, AC, AE, AH, oil and install four (4) flat steel (.091" thick) and four (4) composition-faced plates, starting with a flat steel plate and alternating composition-faced and flat steel clutch plates.

b. Models AD, oil and install one (1) waved (plate with "U" notch), four (4) flat steel (.091" thick) and five (5) composition-faced plates, starting with the waved plate and alternating flat steel and composition-faced clutch plates.

c. Model AM, oil and install six (6) composition-faced plates, starting with a flat steel and alternating composition-faced and flat steel clutch plates.

Do not use radially grooved composition plates here.

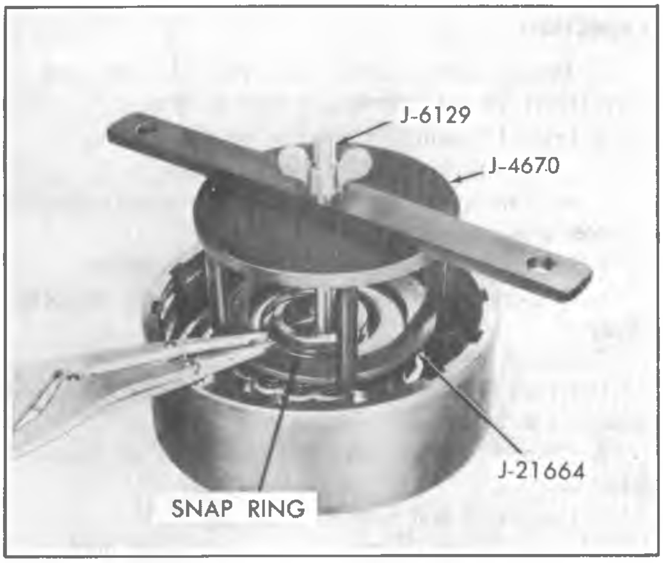


Figure 400-72 Removing Direct Clutch Snap Ring

All direct clutch flat steel plates are .091 in. thick.

8. Install direct clutch backing plate over clutch plates and install backing plate snap ring.

Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side.

Turn unit over and install the roller clutch assembly onto the intermediate clutch inner cam. Install the intermediate clutch outer race with a clockwise turning motion.

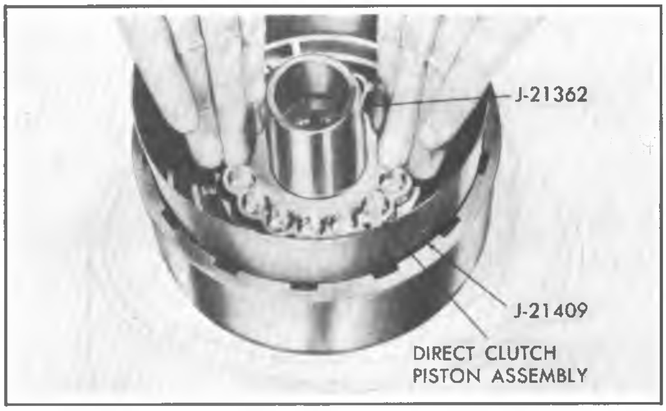


Figure 400-73 Installing Direct Clutch Piston

When installed, outer race should not turn counterclockwise, **Figure** 400-74.

9. Install roller clutch assembly retainer and snap ring.

10. Place direct clutch assembly on center support and air check operation of direct clutch, **Figure** 400-75.

If air is applied through reverse passage, (right oil feed hole) it will escape from direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch plates.)

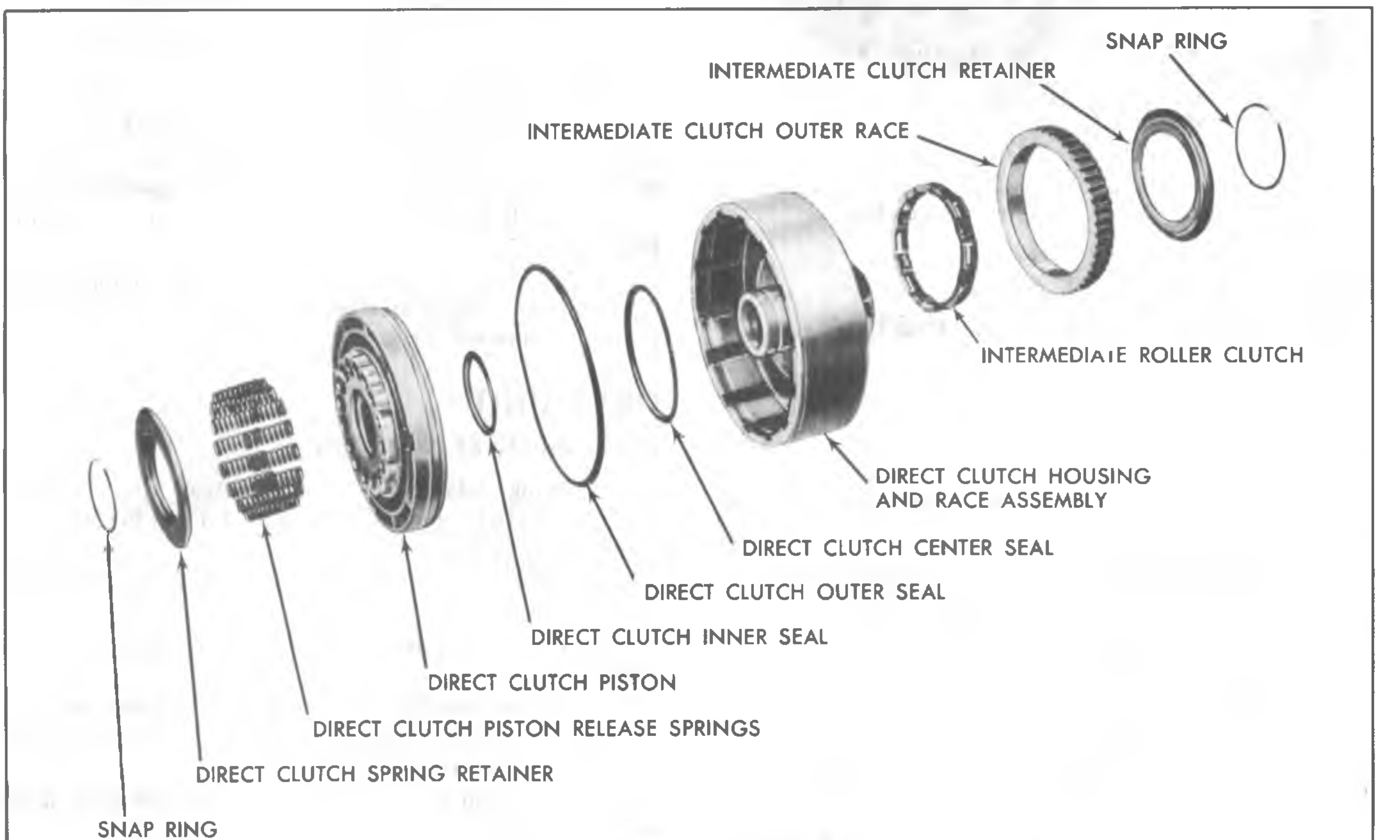


Figure 400-71 Direct Clutch and Piston

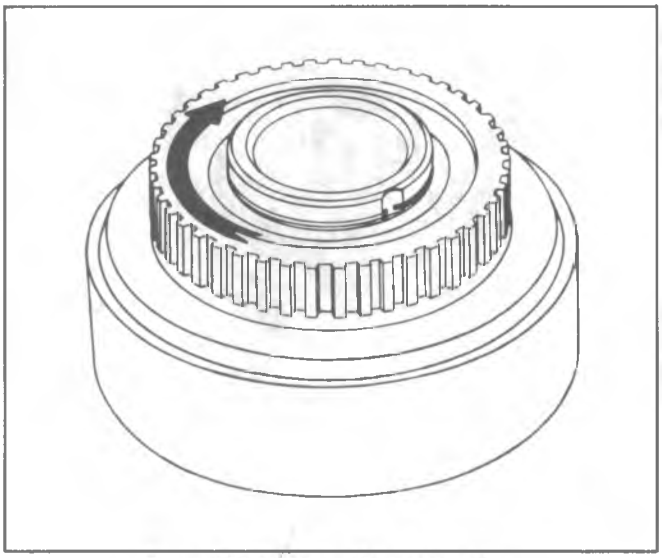


Figure 400-74 Roller Clutch Rotation

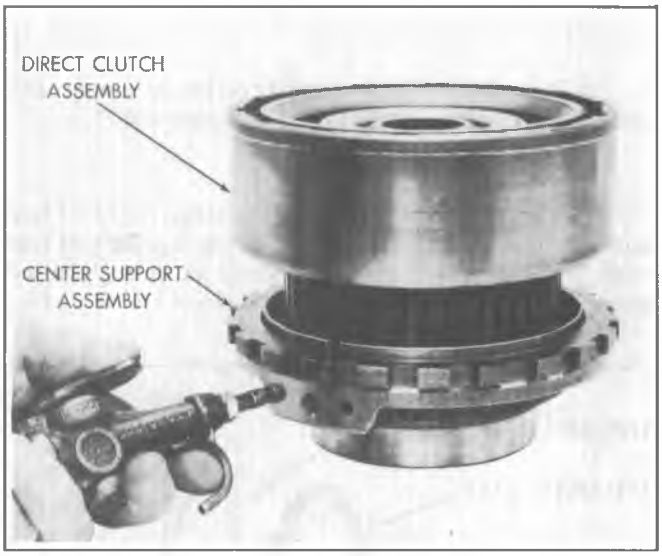


Figure 400-75 Checking Direct Clutch

CENTER SUPPORT AND INTERMEDIATE CLUTCH PISTON

Disassembly

1. Remove four oil rings from the center support, **Figure** 400-75.

2. Compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586, **Figure** 400-78.

3. Remove spring retainer and 3 intermediate clutch release springs.

4. Remove spring guide.

5. Remove intermediate clutch piston from center support.

6. Remove inner and outer seals from clutch piston.

Do not remove the three screws retaining roller clutch inner race to center support.

Inspection

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

2. Inspect bushing for scoring, wear or galling.

3. Check oil ring grooves for damage.

4. Air Check oil passages to be sure they are open and not interconnected.

5. Inspect piston sealing surfaces for scratches.

6. Inspect piston seal grooves for nicks or other damages.

7. Inspect piston for cracks.

Refer to **Figure** 400-22 for identification of oil feed passages and lands.

8. Inspect springs for collapsed coils or signs of distortion.

9. Inspect oil seal rings for damage.

All service center support oil seal rings are hook type cast iron.

10. Inspect to see that constant bleed orifice (approx. .020) is open, **Figure** 400-47.

Assembly

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in intermediate clutch piston and install seals with lips facing away from spring guide, **Figure** 400-79.

2. Place Intermediate Clutch Inner Seal Protector, J-21363, over center support hub, **Figure** 400-80, and install intermediate clutch piston, making certain it fully seats in center support. Remove J-21363.

3. Install plastic spring guide, **Figure** 400-81.

4. Install 3 clutch release springs, space equally into holes in spring guide, **Figure** 400-82.

5. Place spring retainer and snap ring over springs.

6. Compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586, **Figure** 400-78.

7. Install four oil seal rings on the center support, **Figure** 400-77.

8. Air check operation of intermediate clutch piston. Apply air through center oil feed hole to actuate clutch pistons, **Figure** 400-83.

GEAR UNIT

Disassembly of Gear Unit

1. Using Adapter, J-21364, in Rear Unit Holding Fixture, J-6116-01, place gear unit in Holding Fixture with output shaft pointing downward.

2. Remove center support to sun gear races and thrust bearing.

Outer race may have stuck to center support when it was removed.

3. Remove sun gear from output carrier assembly.

4. Remove reaction carrier to output carrier thrust washer and front internal gear ring.

5. Invert gear unit in Holding Fixture with main shaft pointing downward.

6. Remove snap ring securing output shaft to output carrier and remove output shaft. Remove O-ring from output shaft and discard.

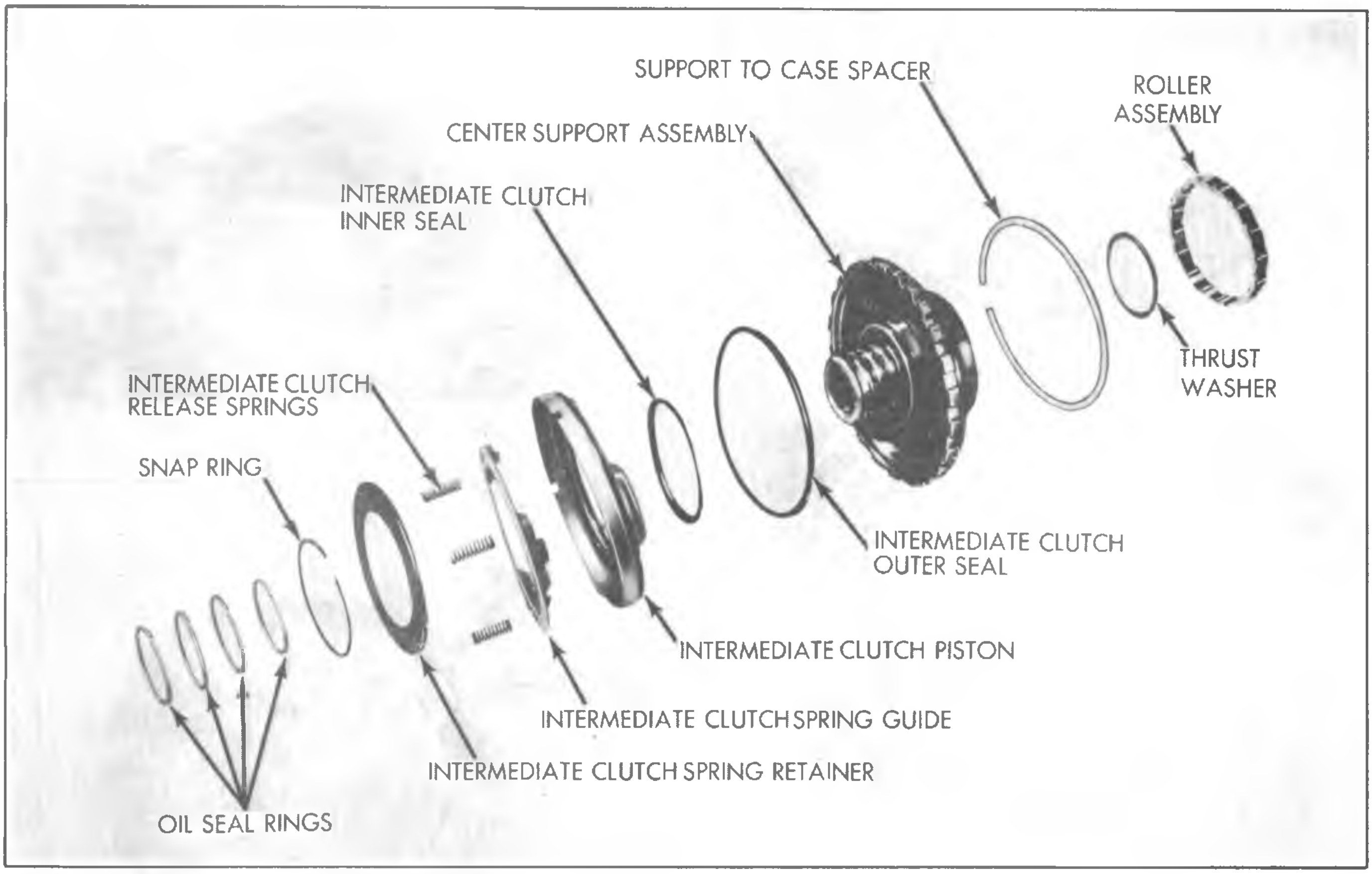


Figure 400-76 Center Support Assembly - Disassembled View

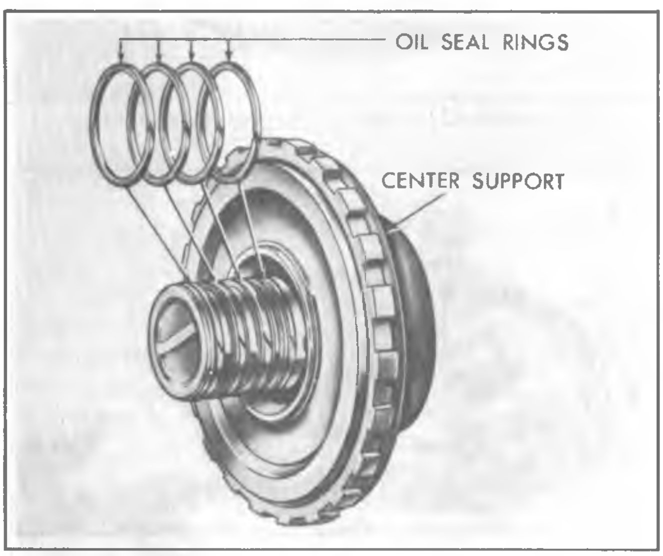


Figure 400-77 Center Support Oil Seal Rings

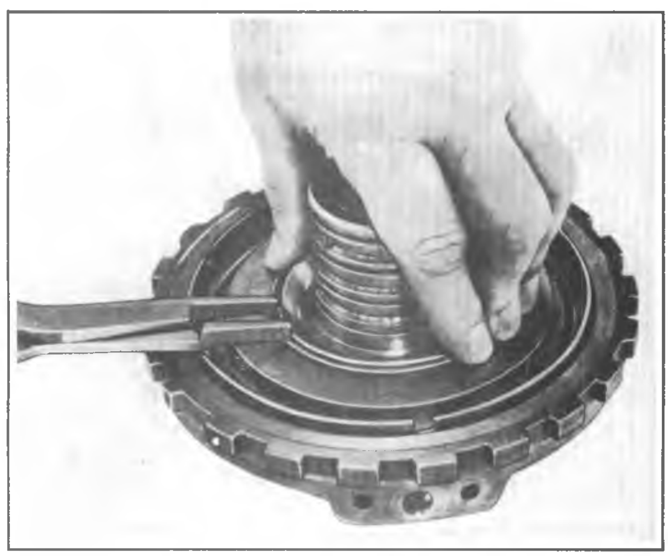


Figure 400-78 Removing Intermediate Clutch Snap Ring

7. Remove thrust bearing and races from rear internal gear.

8. Lift rear internal gear and main shaft out of output carrier and remove thrust bearing and races from inner face of rear internal gear.

9. Remove snap ring from end of main shaft and remove rear internal gear.

10. Remove output carrier from Holding Fixture.

Inspection of Output Shaft

1. Inspect bushing for wear or galling.

2. Inspect bearing and thrust washer surfaces for damage.

3. Inspect governor drive gear for rough or damaged teeth.

4. Inspect splines for damage.

5. Inspect drive lugs for damage.

6. Inspect speedometer drive gear for rough or damaged teeth. If replacement of drive gear is necessary, proceed as follows.

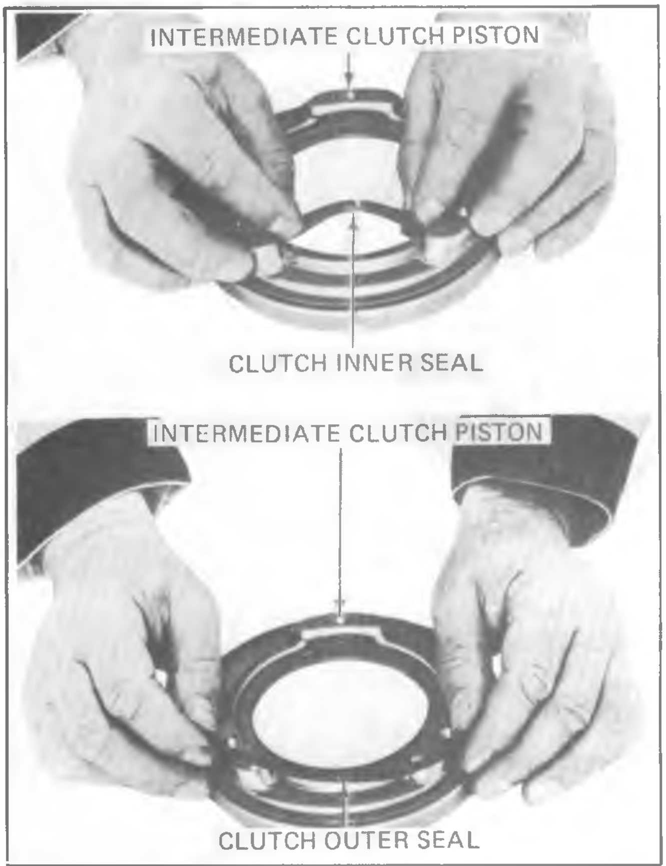


Figure400-79 Installing Intermediate Clutch Piston Seals

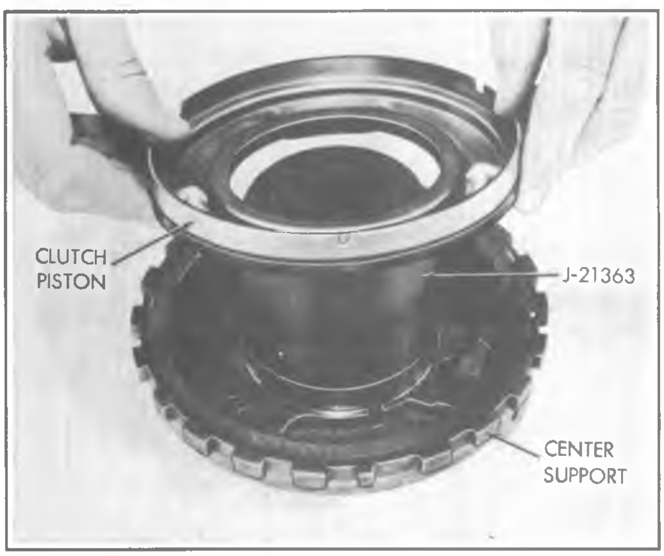


Figure400-80 Installing Intermediate Clutch Piston

Figure400-81 Installing Spring Guide

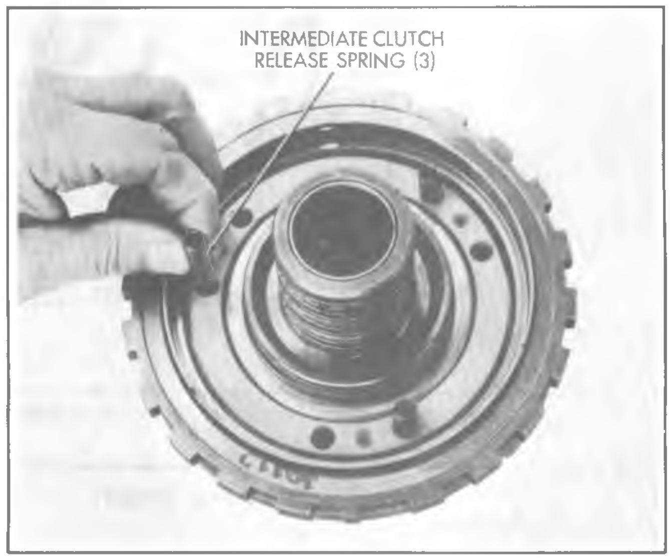


Figure400-82 Installing Clutch Release Spring

Figure400-83 Air Checking Intermediate Clutch

Speedometer Drive Gear Replacement

1. Install Speedometer Drive Gear Remover, J-21427-01, with Pulley Puller, J-8433, and attach on output shaft so that puller bolt indexes with end of shaft and flat face of remover tool is under front face of drive gear.

2. Tighten bolt on Pulley Puller, **Figure** 400-93 until gear is free on shaft. Remove tools and gear from shaft.

3. Support output shaft and install new steel speedometer drive gear using a piece of pipe.

NOTICE: Use a pipe that closely fits output shaft and does not contact gear teeth. Contact with gear teeth would result in damage to the gear as it is driven into place.

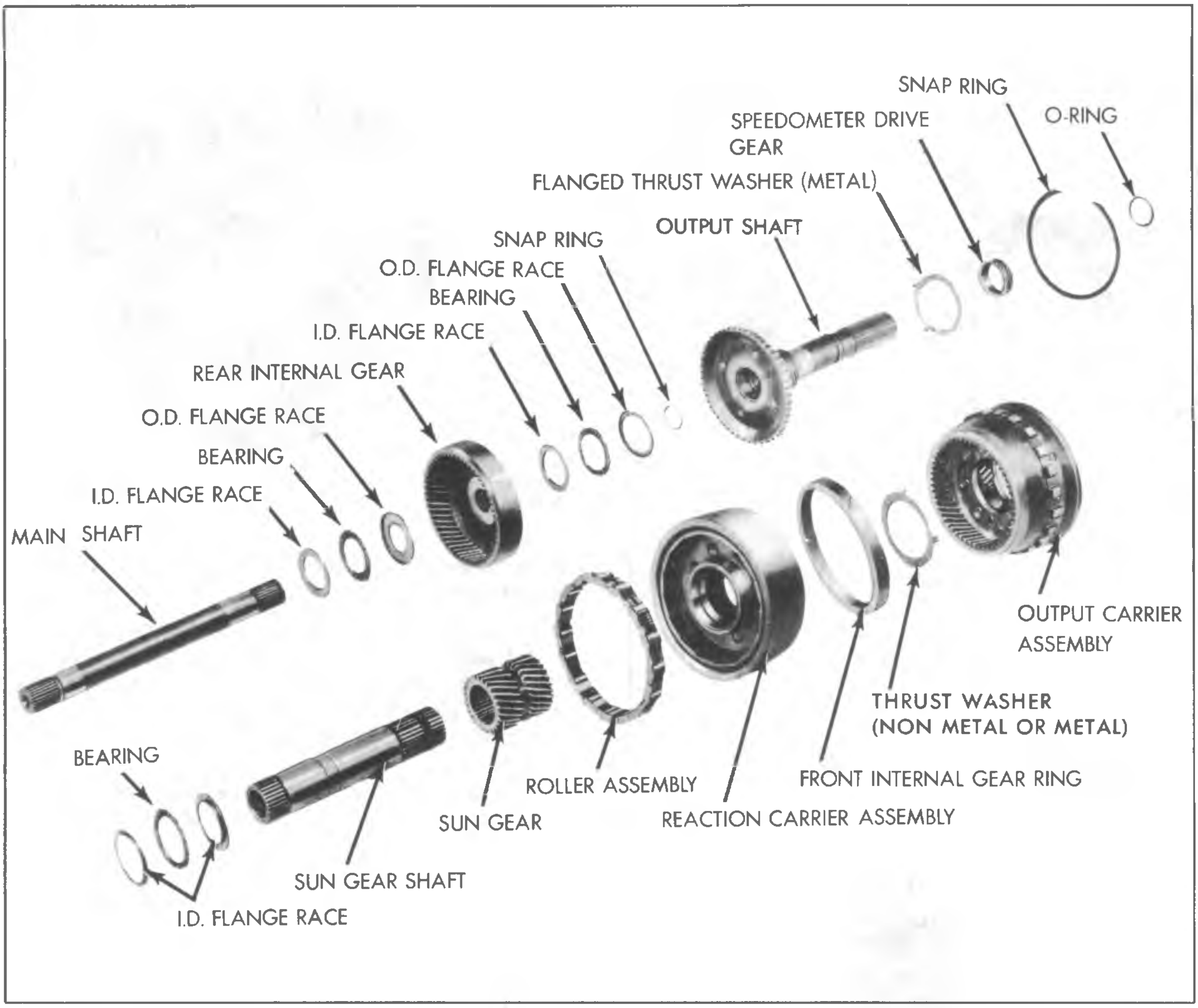


Figure400-84 Gear Unit - Disassembled View

4. Drive gear onto shaft until distance from rear face of gear to end of output shaft is 5-21/32", **Figure** 400-86.

Inspection of Main Shaft

1. Inspect shaft for cracks or distortion.
2. Inspect splines for damage.
3. Inspect ground bushing journals for damage.
4. Inspect snap ring groove for damage.
5. Make sure lubrication holes are open.

Inspection of Rear Internal Gear

1. Inspect gear teeth and bearing surfaces for damage or wear.
2. Inspect splines for damage.
3. Inspect gear for cracks.

Inspection of Output Carrier Assembly

1. Inspect front internal gear for damaged teeth.
2. Inspect pinion gears for damage, rough bearings or tilt.
3. Check pinion end play. Pinion end play should be .009 inch-.024 inch, **Figure** 400-87.
4. Inspect parking gear lugs for cracks or damage.
5. Inspect output shaft locating splines for damage.
6. Inspect front internal gear ring for flaking or cracks.

Inspection of Reaction Carrier Assembly

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect roller clutch outer cam for scoring or wear.
3. Inspect thrust washer surfaces for signs of scoring or wear.
4. Inspect bushing for damage. If bushing is damaged, carrier must be replaced.
5. Inspect pinion gears for damage, rough bearings or excessive tilt.
6. Check pinion end play. Pinion end play should be .009 inch-.024 inch.

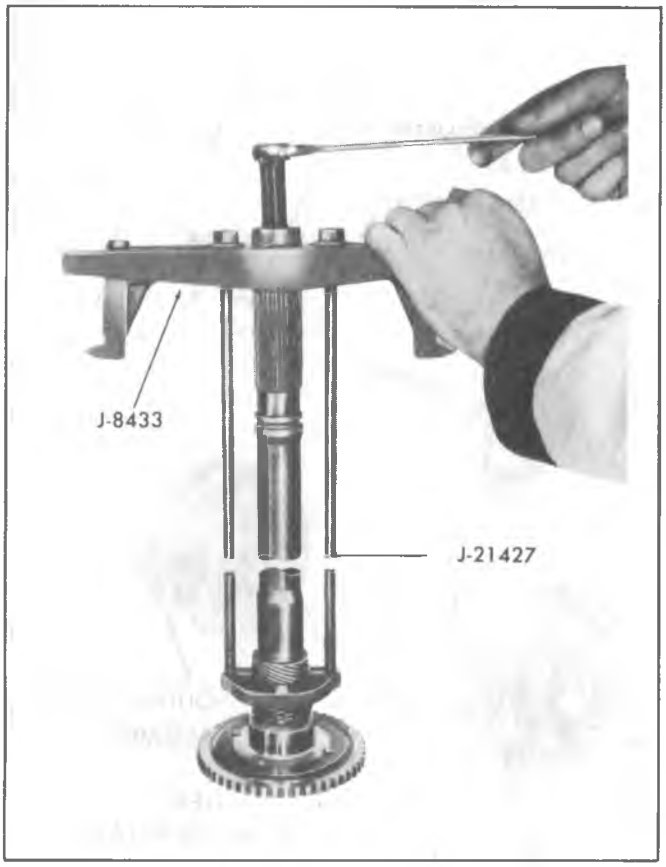


Figure400-85 Removing Steel Speedometer Drive Gear

Figure400-86 Installing Steel Speedometer Drive Gear

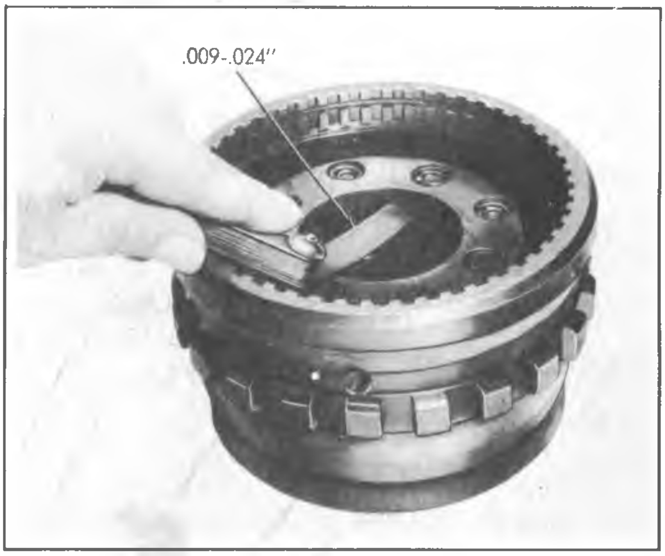


Figure400-87 Checking Output Carrier Pinion End Play

Pinion Gear Replacement - Reaction and Output Carrier Assemblies

1. Support carrier assembly on its FRONT face.
2. Using a 1/2 inch diameter drill, remove stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the possibility of cracking the carrier when pinion pins are pressed out.

NOTICE: Do not allow drill to remove any stock from the carrier as this will weaken the part and could result in a cracked carrier.

3. Using a tapered punch, drive or press pinion pins out of carrier.
4. Remove pinion gears, thrust washers, and roller needle bearings.
5. Inspect pinion pocket thrust faces for burrs and remove if present.
6. Install eighteen needle bearings into each pinion gear using petrolatum to hold bearings in place. Use a pinion pin as a guide.
7. Place a bronze and steel thrust washer on each side of pinion gear with steel washers against gear, **Figure** 400-88. Hold washers in place with petrolatum.
8. Place pinion gear assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.
9. Drive a new pinion pin into place from the front, while rotating pinion gear. Be sure that headed end is flush or below face of carrier.
10. Using a punch and bench vise for an anvil, stake opposite end of pinion pin in three places with a blunt radius chisel, **Figure** 400-89.

NOTICE: Both ends of pinion pins must lie below face of carrier or interference may occur.

11. Repeat installation procedure for each pinion gear.

Inspection of Roller Clutch Assembly

1. Inspect roller clutch for damaged rollers or springs.

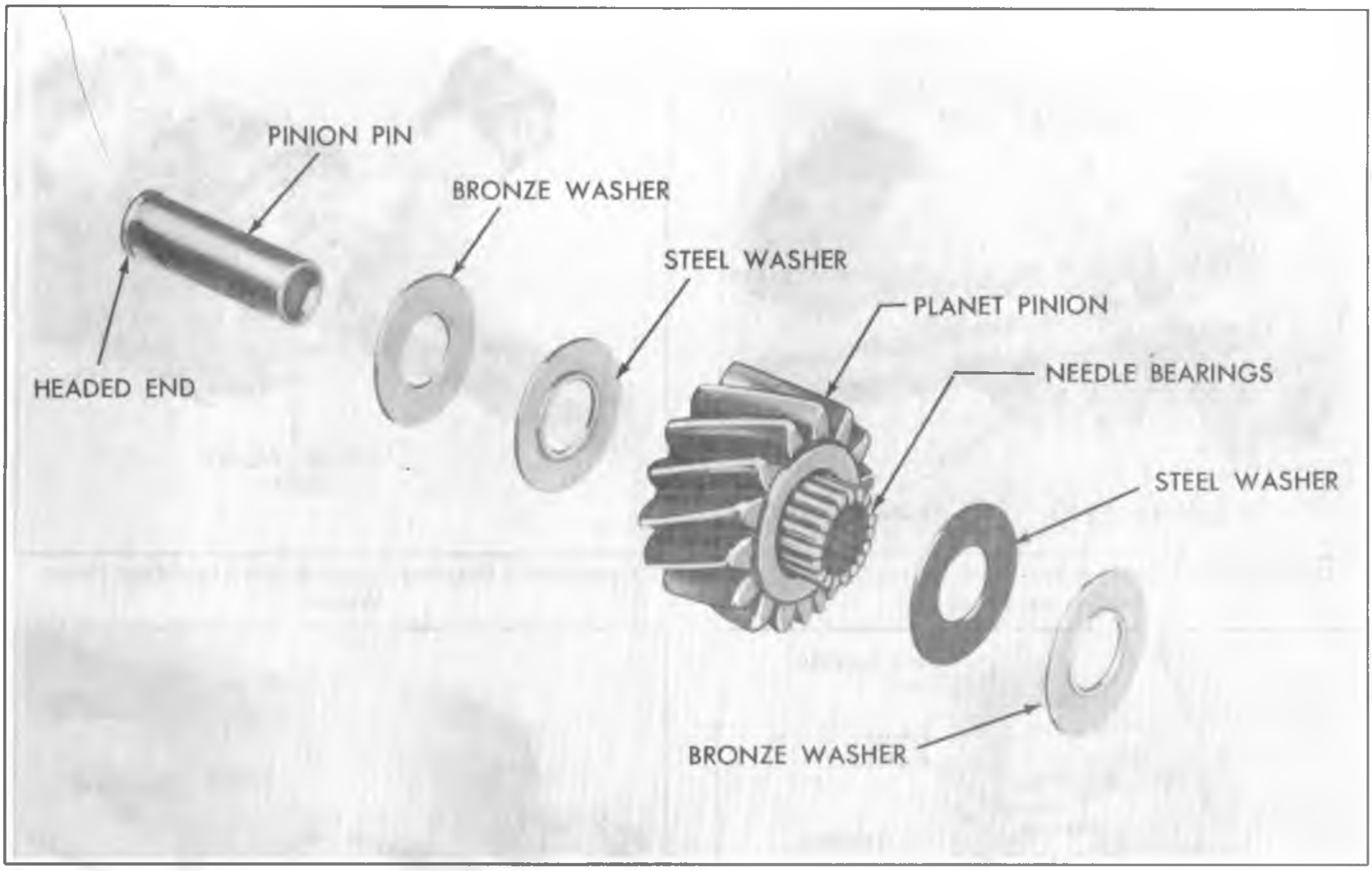


Figure400-88 Planet Pinion - Disassembled View

Figure400-89 Staking Pinion Pin

2. Inspect roller clutch cage for damage.

Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.
2. Inspect splines for damage.
3. Inspect bushings for scoring or galling.
4. Inspect ground bushing journals for damage.
5. Be sure oil lubrication hole is open.

ASSEMBLY OF COMPLETE GEAR UNIT

1. Install rear internal gear on end of mainshaft that has snap ring groove and install snap ring.

2. Install races and thrust bearing on inner face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install large diameter race first, with flange facing up, **Figure** 400-90.

b. Install thrust bearing in race.

c. Install small diameter race on bearing with inner flange facing down.

3. Lubricate pinion gears in output carrier with transmission fluid and install output carrier on mainshaft so that pinion gears mesh with rear internal gear.

4. Place assembly in Rear Unit Holding Fixture, J-6116-01, with mainshaft pointing downward. Be careful not to damage shaft.

5. Install races and thrust bearing on outer face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install small diameter (flanged I.D.) race first, with flange facing up, **Figure** 400-91.

b. Install thrust bearing in race.

c. Install large diameter (flanged O.D.) race on bearing with flange cupped over bearing.

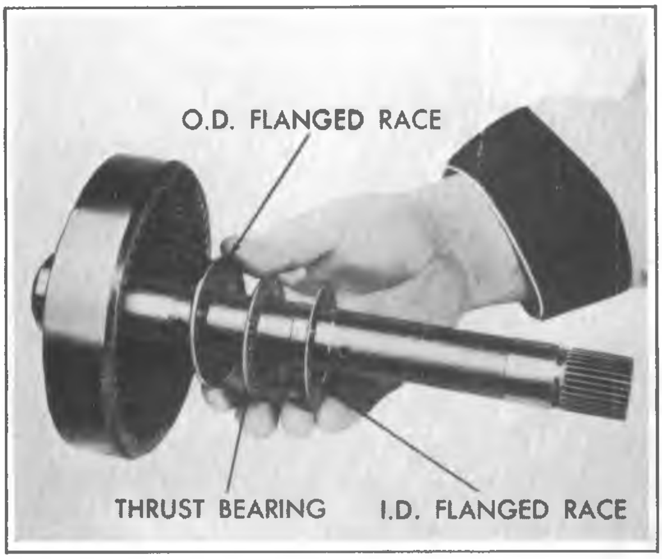


Figure400-90 Installing Rear Internal Gear-to-Sun Thrust Bearing and Races

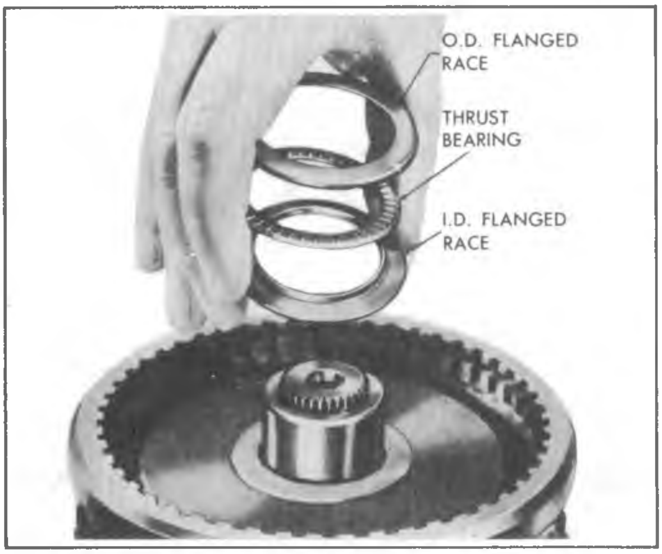


Figure400-91 Internal Gear, Thrust Bearing and Races

6. Install output shaft into output carrier and install snap ring. Install new O-ring on output shaft.

7. Invert assembly in Holding Fixture with output shaft pointing downward.

8. Lubricate tab side of reaction-to-output carrier thrust washer with petrolatum and install thrust washer in output carrier with tabs in tab pockets, **Figure** 400-92.

9. Install sun gear with end having chamfered I.D. facing down.

10. Install sun gear shaft with longer splined end down.

11. Install gear ring over output carrier.

12. Lubricate pinion gears in reaction carrier with transmission fluid and install reaction carrier on output carrier, **Figure** 400-93, so that pinion gears mesh with front internal gear.

When a new output carrier and/or reaction carrier is being installed, and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service ring. The front internal gear ring is a selective fit at the factory but not in service.

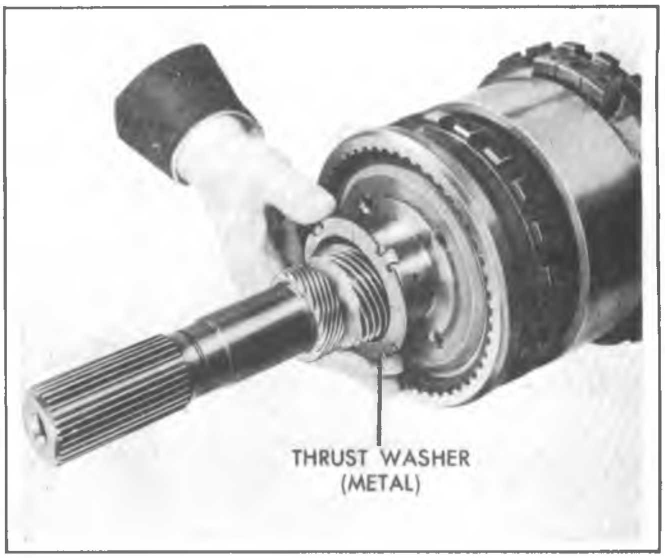


Figure400-92 Installing Case-to-Output Shaft Metal Thrust Washer

Figure400-93 Installing Reaction Carrier to Output Carrier

13. Install large diameter O.D. race on sun gear with flange facing up against sun gear shaft.

14. Install thrust bearing on race.

15. Lubricate small diameter race with petrolatum and install race on center support with flange facing toward lower end, **Figure** 400-94.

16. Lubricate reaction carrier to center support thrust washer with petrolatum and install washer in recess in center support, **Figure** 400-47.

17. Install rollers that may have come out of roller clutch cage, by compressing energizing spring with

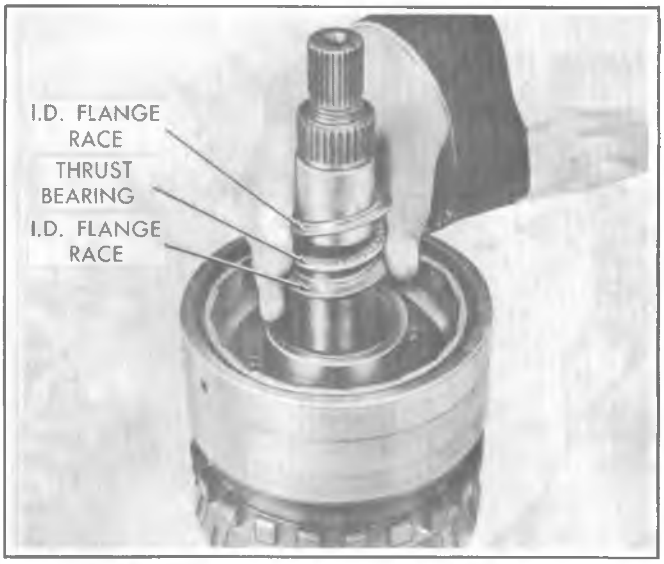


Figure400-94 Installing Center Support Thrust Bearing Over Sun Gear Shaft

forefinger and inserting roller from outer side, **Figure** 400-95.

Make certain that energizing springs are not distorted, and that curved end leaf of springs are positioned against rollers.

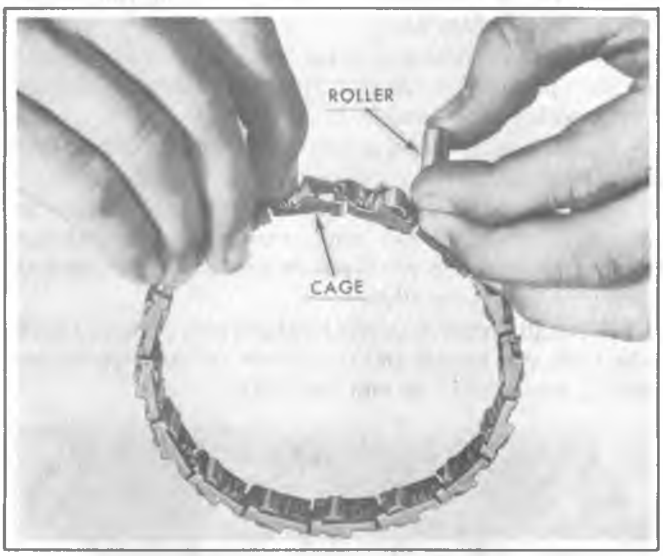


Figure400-95 Installing Rollers in Roller Clutch Cage

18. Install roller clutch assembly in reaction carrier, **Figure** 400-96.

19. Install center support assembly into roller clutch in reaction carrier, **Figure** 400-97.

Be sure that center support to reaction carrier thrust washer is in place before installing center support assembly into roller clutch in reaction carrier.

With reaction carrier held, center support should turn counterclockwise only.

20. Install Tool J-21365 or J-21795-02, on end of main shaft so that tangs engage groove in shaft. Tighten screw on tool to secure tool on shaft and prevent movement of the roller clutch during installation of the gear unit assembly.

21. Remove gear unit from Holding Fixture and lay unit on its side. Install thrust metal washer on rear face of output shaft with bent tabs in tab pockets. Retain thrust

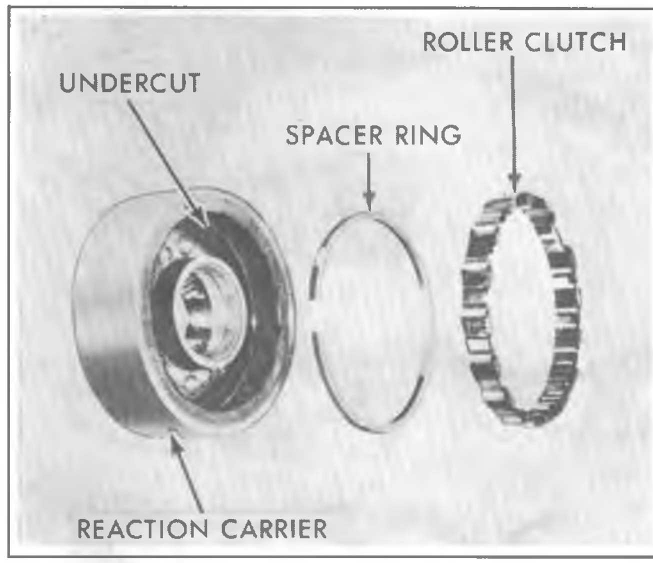


Figure400-96 Installing Spacer Ring and Roller Clutch Assembly

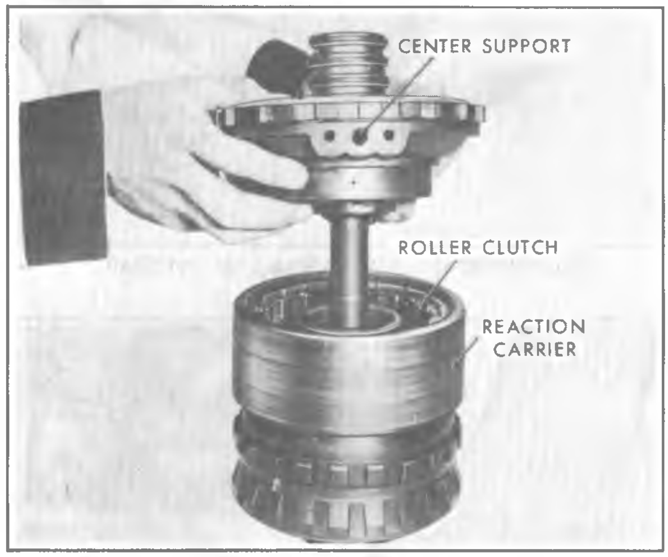


Figure400-97 Installing Center Support to Reaction Carrier

washer with petrolatum, **Figure** 400-92. This must be a metal washer.

MAJOR TRANSMISSION COMPONENTS INSTALLATION

Install Parking Pawl

1. Install parking pawl, tooth toward center of transmission, and install parking pawl shaft, **Figure** 400-98.

2. Install parking pawl shaft retainer clip.

3. Install parking pawl shaft cup plug by driving into the transmission case, using a 3/8 inch diameter rod, until the parking pawl shaft bottoms on the case rib, **Figure** 400-99.

4. Install parking pawl return spring with square end hooked on pawl.

5. Install parking pawl bracket with guides over parking pawl, **Figure** 400-100. Install two attaching screws and tighten screws to 24 N·m (18 foot-pounds).

Figure400-98 Installing Parking Pawl and Shaft

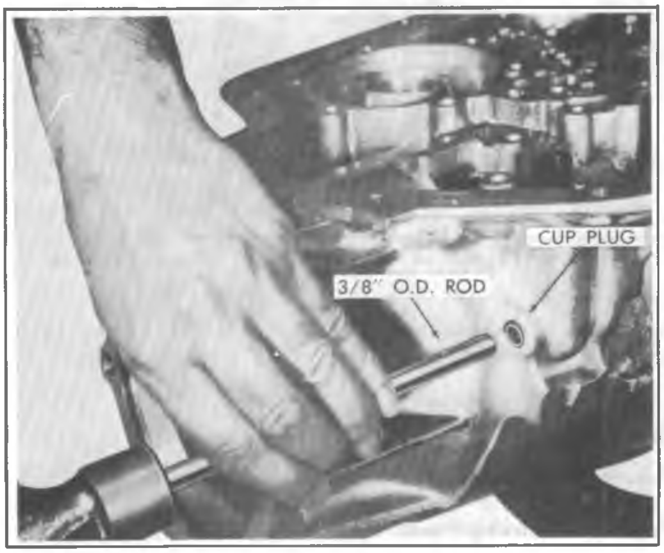


Figure400-99 Installing Cup Plug

Install Support to Case Spacer Rear Band and Complete Gear Unit Assembly

1. Inspect rear band for cracks or distortion and band ends for damage at anchor lugs and apply lug. Also inspect lining for cracks, flaking, burning and looseness.

2. Install rear band assembly in transmission case so that band lugs index with anchor pins, **Figure** 400-102.

3. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.

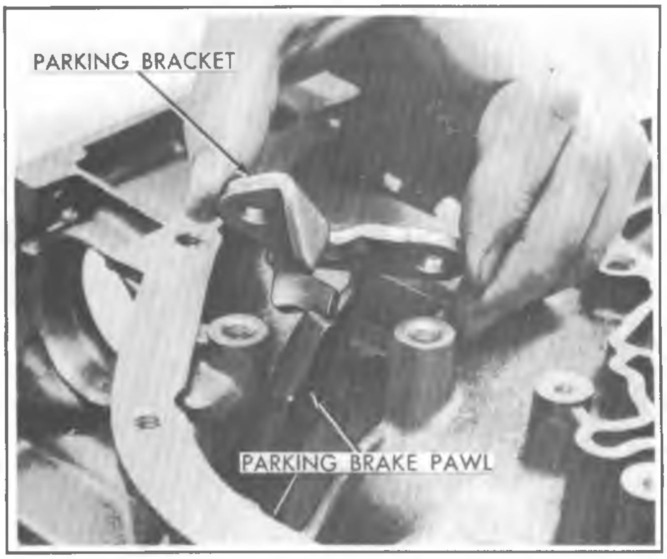


Figure400-100 Installing Parking Pawl Bracket

4. Install the support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin.

Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the backing plate to ease snap ring (.093" thick and both sides flat).

5. Install previously selected rear unit selective washer into slots provided inside rear of transmission case. Retain washer with petrolatum.

Proper washer size was determined at time of rear unit end play check.

6. Place transmission case in Holding Fixture in horizontal position. Do not over-tighten transmission Holding Fixture side pivot pin as this will cause binding when gear unit is installed.

7. Install proper diameter length of pipe to output shaft to be used as a handle and to prevent any damage to case bushing when installing unit assembly.

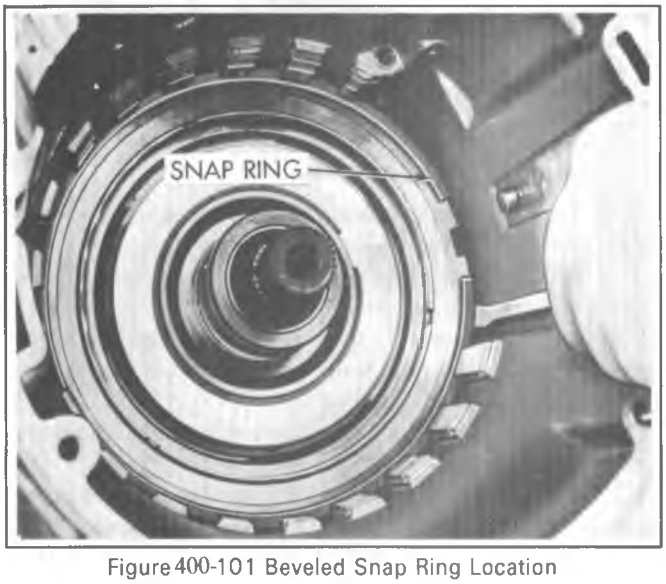


Figure400-101 Beveled Snap Ring Location

NOTICE: Be careful not to drop or bump assembly in transmission case during installation. This could result in damage to output shaft case bushing as well as to assembly itself.

8. Install gear unit with center support and reaction carrier, by lining up slots and carefully guiding complete assembly horizontally into transmission case, making certain the center support bolt hole is properly aligned with hole in case.

9. Position transmission vertically with front end of case facing upward. Remove tool, J-21365 or J-21795-02.

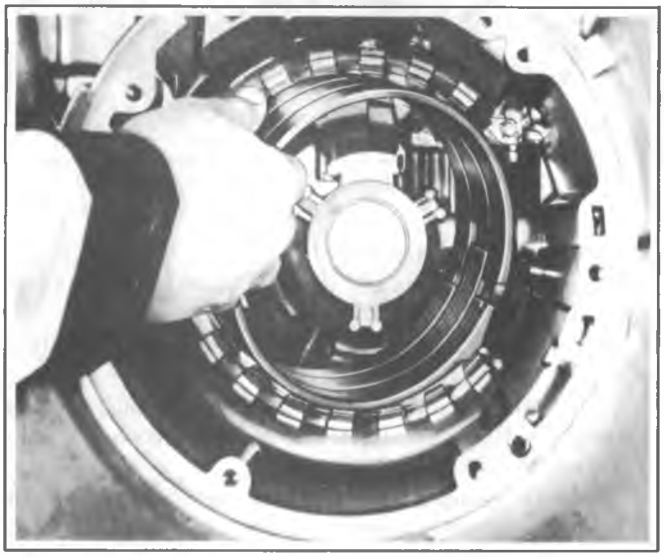


Figure 400-102 Installing Rear Band Assembly

10. Lubricate center support to case snap ring with transmission fluid and install snap ring in transmission case with beveled side up, flat side against center support, locating gap adjacent to front band anchor pin, **Figure** 400-101. Expand snap ring until center support is against shoulder of case.

11. Install case to center support bolt.

To correctly perform this operation, it will be necessary to use tool, J-23093 or to make the tool and follow the installation procedure described below.

Make the tool from 3/8" (.375" diameter) cold roll steel or from a screwdriver with a 3/8" diameter shank. The stock should be approximately 12" long. Grind the stock to a blunt point, tapering it 7/8" from the end of the bar to a 1/8" diameter at the end, **Figure** 400-103.

Bend the bar to a 45° angle 2-1/2" from the pointed end, **Figure** 400-103.

Place the center support locating tool into the direct clutch passage in the case, with the handle of the tool pointing to the right as viewed from the front of the transmission and parallel to the bell housing mounting face.

Apply pressure downward on the tool handle, which will tend to rotate the center support counterclockwise as viewed from the front of the transmission. While holding the center support firmly counterclockwise against the case splines, torque the case-to-center support bolt to 31 N·m (23 ft.lbs.) using a 3/8" thin wall deep socket.

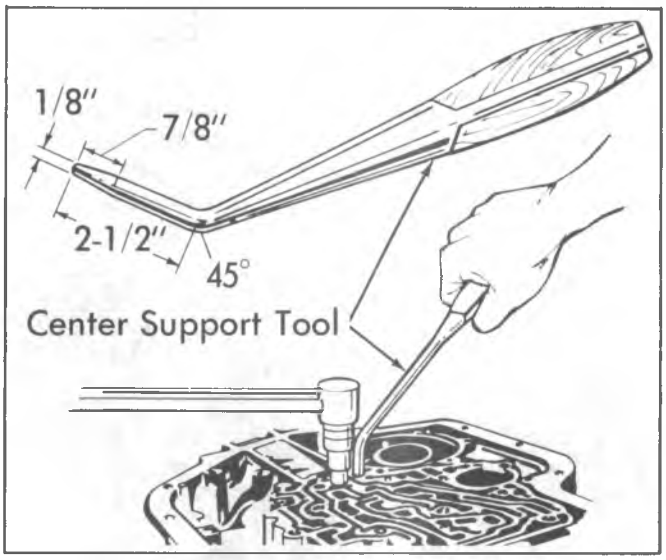


Figure 400-103 Locating Center Support

NOTICE: When using the locating tool, take care not to raise burrs on the case valve body mounting face.

12. Before installing intermediate clutch plates, inspect plates for signs of burning, scoring, and wear.

13. Lubricate three steel and three composition faced intermediate clutch plates with transmission fluid and install clutch plates in transmission case, **Figure** 400-104. **Start with the waved steel plate and alternate composition faced and flat steel plates.**

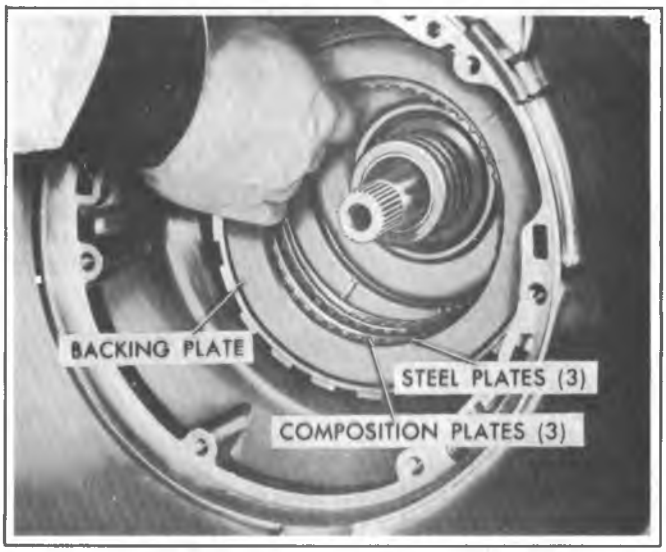


Figure 400-104 Installing Intermediate Clutch Plates

14. Install intermediate clutch backing plate with flat machined surface against clutch plates.

15. Install backing plate to case snap ring with snap ring gap on side of case opposite front band anchor pin.

Both sides of the snap ring are flat and it is approximately .093" thick.

16. Recheck rear unit end play, **Figure** 400-44.

Install Front Band and Remaining Clutch Assemblies

1. Inspect front band for cracks or distortion and band ends for damage at anchor lug and apply lug. Also inspect lining for cracks, flaking, burning, and looseness.

2. Install front band with band anchor hole over band anchor pin, and apply lug facing servo hole, **Figure** 400-105.

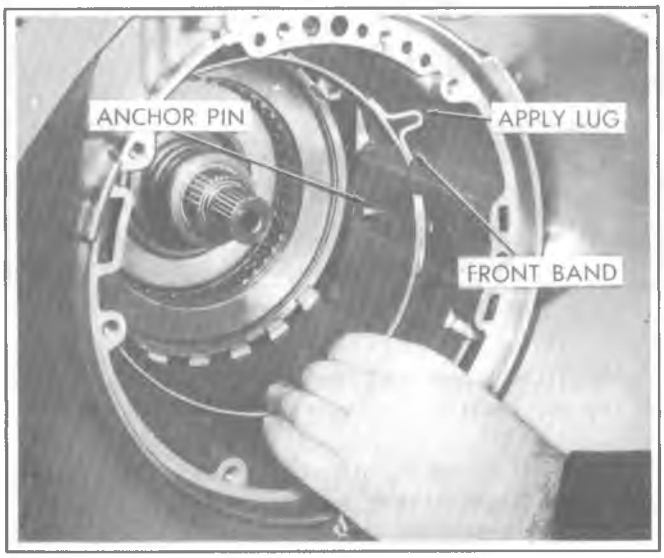


Figure 400-105 Installing Front Band

3. Install direct clutch housing and intermediate roller assembly. Make certain that clutch housing hub bottoms on sun gear shaft and splines on forward end of sun gear shaft are flush with splines in direct clutch housing. Clutch Alignment Tool J-24396 is available to position clutch plates for ease of installation.

It will be necessary to rotate clutch housing to allow roller outer race to index with intermediate clutch composition-faced plates. Removal of direct clutch composition and steel plates may be helpful and applying air pressure through the center support screw to apply the intermediate clutch plates may facilitate assembly.

4. Install forward clutch hub to direct clutch housing thrust washer on forward clutch hub. Retain with petrolatum.

5. Position transmission horizontally in Holding Fixture and install forward clutch assembly and turbine shaft, **Figure** 400-106. Make certain end of main shaft goes all the way into forward clutch hub. It will be necessary to rotate clutch housing to allow direct clutch driving hub to index with direct clutch composition plates. When forward clutch is seated, it will be approximately 32 mm (1-1/4 inches) from pump mounting face in case. **Measure this distance.**

Missing internal splines in forward clutch hub are lubrication passages and do not have to be indexed with any particular spline on main shaft.

Install Oil Pump

1. Lubricate turbine shaft journals with transmission fluid and lubricate teflon oil rings on pump delivery sleeve with petrolatum.

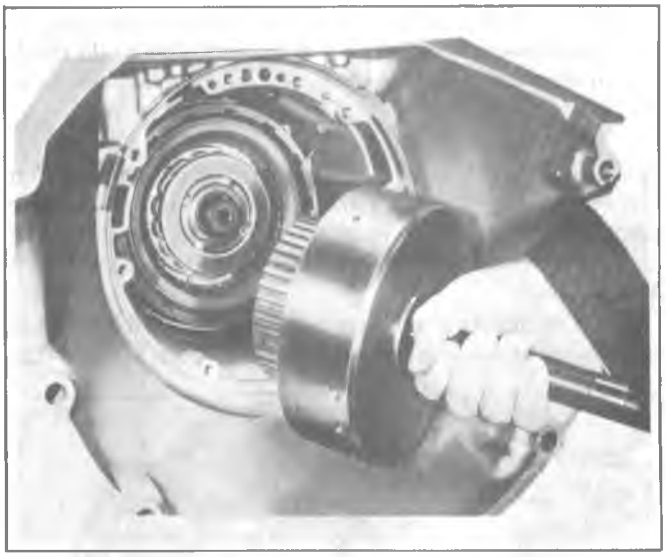


Figure 400-106 Installing Forward Clutch Assembly

2. Install Slide Hammer Bolts, J-6125-1, through two opposite unthreaded holes in pump assembly to serve as guide pins when installing pump.

3. Properly align pump to case gasket on case mounting face.

4. Position pump assembly in transmission case and thread Slide Hammer assemblies into their corresponding threaded holes in transmission case.

5. Install pump assembly in transmission case. Do not remove slide hammer bolts until last two pump attaching screws are installed.

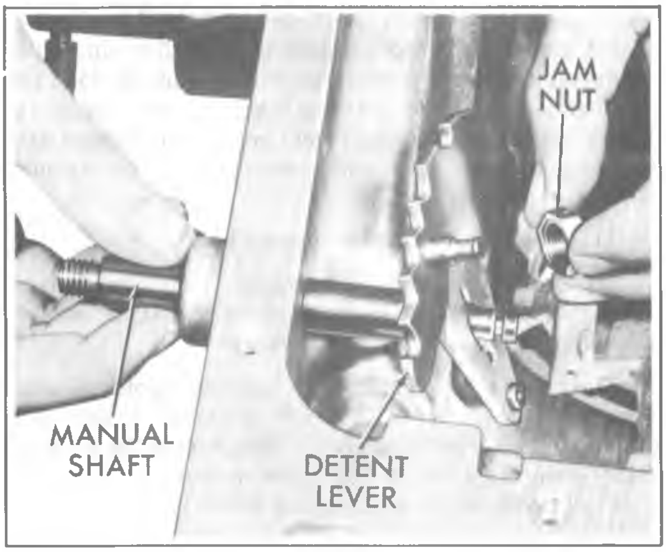


Figure 400-107 Installing Manual Shaft

6. Using six new rubber-coated washers on pump attaching screws, install all but one attaching screw at either 5 o'clock or 10 o'clock position so that front unit end play can be rechecked. Tighten screws to 24 N·m (18 foot-pounds).

If turbine shaft cannot be rotated as pump is being pulled into place, the forward or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place.

7. Recheck front unit end play.

8. Install remaining pump attaching screw using new rubber coated washer. Tighten screw to 24 N·m (18 foot-pounds).

9. Apply non-hardening sealer to outside of new seal and install new front seal using Pump Oil Seal Installer, J-21359.

Install Parking Linkage, Detent Lever, and Manual Shaft

1. If necessary install a new manual shaft lip seal into transmission case using a 3/4" diameter rod to seat the seal.

2. Insert actuator rod into manual detent lever from side opposite pin.

3. Install actuator rod plunger under parking bracket and over parking pawl.

4. Install manual shaft into case and through detent lever, **Figure** 400-107.

5. Install locknut on manual shaft. Tighten nut to 24 N·m foot-fpounds).

6. Install external manual yoke on manual shaft if removed. Tighten nut to 24 N·m (18 foot-pounds).

7. Install retaining pin in case, indexing it with groove in manual shaft, **Figure** 400-108.

If procedure is being performed with transmission in car, install and straighten bent pin.

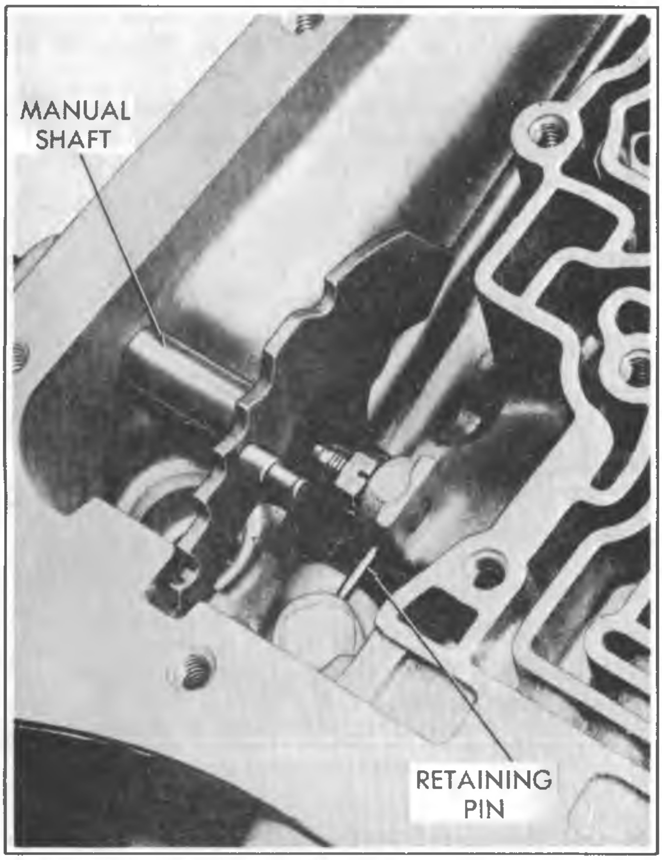


Figure400-108 Retaining Pin

Install Extension Housing

1. Install new gasket on extension housing, retaining with petrolatum.

2. Check O-ring on output shaft for any nicks or flattening and replace O-ring if either condition exists.

3. Secure extension housing to case with six attaching screws. Tighten screws to 31 N·m (23 foot-pounds).

4. If necessary, install a new extension housing oil seal using Oil Seal Installer, J-21359. Apply non-hardening sealer to outside of seal before installation.

Install Check Balls, Control Valve, Spacer Plate Gaskets, Detent Solenoid, Front Servo Assembly and Electrical Connector

1. Install two control valve assembly attaching bolts with heads cut off as guide pins as shown in **Figure**400-112.

2. Install five check balls into ball seat pockets in transmission case, **Figure** 400-109.

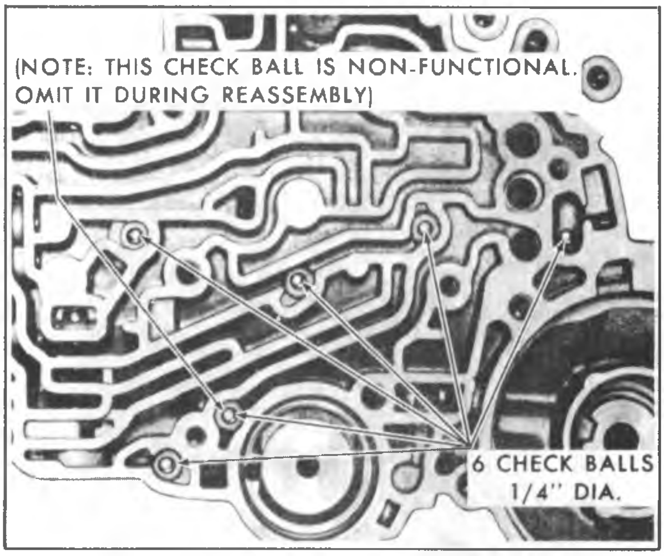


Figure400-109 Location of Check Balls

If transmission is in car, install check balls into ball seat pockets on spacer plate, **Figure** 400-110.

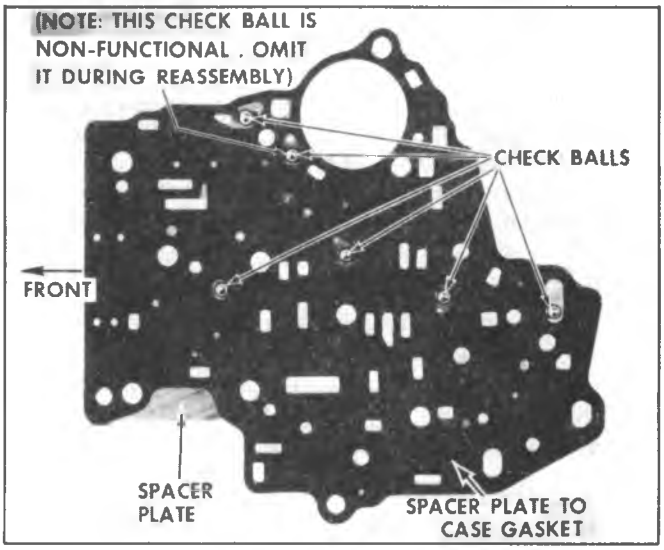


Figure400-110 Spacer Plate Gasket with Check Balls

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid and a "C" near front servo location).

4. Install control valve spacer plate.

5. Install detent solenoid gasket.

6. Install detent solenoid assembly with connector facing outer edge of case. **Do not tighten bolts at this time.**

7. Install front servo spring and spring retainer into transmission case.

8. Install retainer ring in front servo pin groove and install pin into case so that tapered end contacts band. Make certain retainer ring is installed in servo pin groove.

9. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan.

The ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.

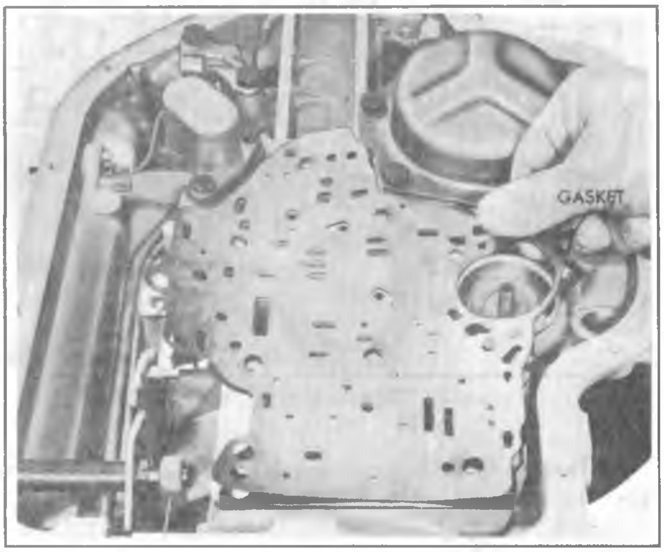


Figure400-111 Installing Spacer Gasket

If transmission is in car, assemble front servo group as shown in **Figure** 400-58 and install this group of parts into front servo bore in case and hold. Slip a length of straight, clean feeler gage or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group.

10. Install new O-ring on solenoid connector.

11. Install connector with lock tabs pointing into case. Position locator tab in notch on side of case.

12. Connect detent solenoid wire to connector terminal.

Install Rear Servo Assembly

1. Lubricate inner and outer rear servo bores in transmission case with transmission fluid and install rear accumulator spring in servo inner bore.

Before installing rear servo assembly, make certain that rear band apply lug is aligned with servo pin bore in transmission case. Otherwise servo pin will not apply band.

2. Position rear servo assembly in transmission.

3. Press down on rear servo assembly, making certain it is properly seated in case bore, and install rear servo cover and new gasket. Install six attaching screws, tightening screws to 24 N·m (18 foot-pounds).

Install Control Valve Assembly, Governor Pipes, Governor Screen Assembly

1. Install control valve assembly-to-spacer gasket (gasket with "VB" near front servo location).

2. Install governor pipes on control valve assembly. Governor pipes are interchangeable.

3. Install governor screen assembly, open end first; into governor feed pipe hole in case (hole nearest the center of transmission). **Figure** 400-32.

4. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen, **Figure** 400-112. Make certain gaskets and spacer do not become mispositioned. See **Figure** 400-111.

Check manual valve to make sure it is indexed properly with pin on detent lever and governor pipes to make certain they are properly seated in case holes.

5. Start control valve assembly attaching screws.

If transmission is in vehicle, remove feeler stock before tightening any control valve screws.

6. Remove guide pins and install detent roller and spring assembly and remaining screws, **Figure** 400-113. Torque bolts to 10 N·m (8 ft.lbs).

7. Tighten detent solenoid attaching screws to 14 N·m (10 foot-pounds). Solenoid screws should be zinc plated to provide a good electrical connection.

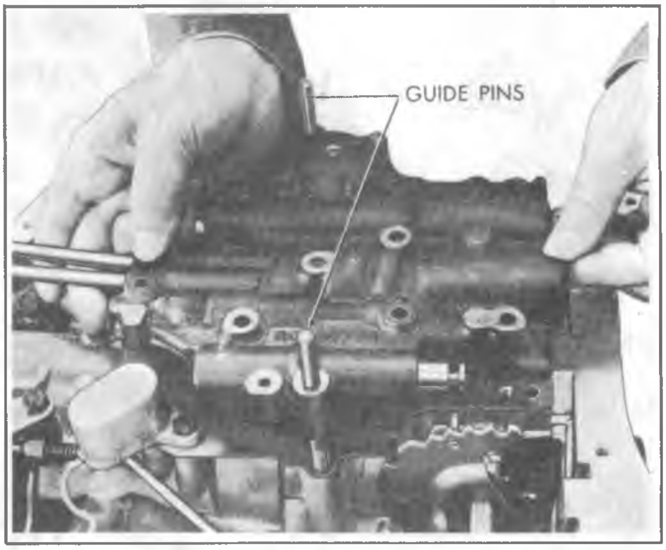


Figure 400-112 Installing Control Valve Assembly.

Install Modulator Valve and Vacuum Modulator

1. Install modulator valve into case with stem end out.

2. Install new O-ring on vacuum modulator.

3. Install vacuum modulator into case with vacuum hose pipe facing front of car and angled 5° toward top of case.

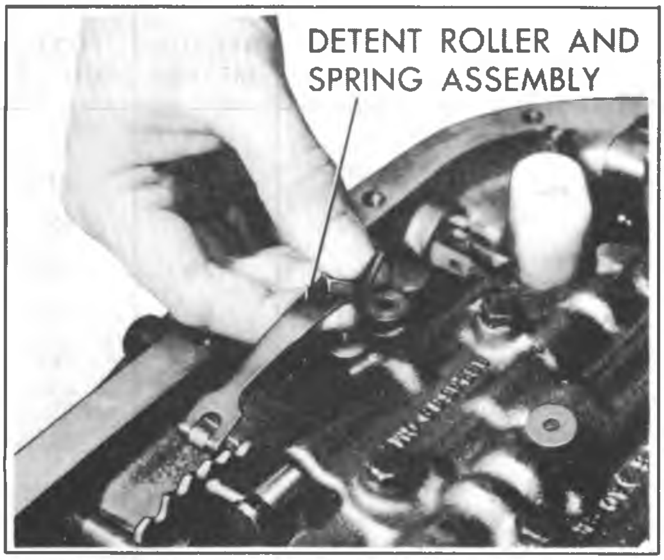


Figure 400-113 Installing Detent Roller and Spring

4. Install modulator retainer with curved side of tangs, inboard and install attaching screw. Tighten screw to 24 N·m (18 foot-pounds).

Install Governor Assembly

1. Install governor assembly into case.

2. Using a new gasket, attach governor cover to case with four attaching screws. Torque screws to 24 N·m (18 foot-pounds).

.If transmission is in car proceed as follows.

3. Install two bolts securing transmission extension housing to crossmember.

Install Speedometer Driven Gear Assembly

Speedometer driven gears are provided in three different tooth sizes. Driven gear and matching sleeve must be installed to correspond with axle ratio.

1. Lubricate driven gear selected from chart with a small amount of DEXRON ® - II transmission fluid and position driven gear.

2. Install speedometer driven gear retainer with tangs in sleeve positioning bosses, and install attaching screw. Tightening screw to 24 N·m (18 foot-pounds).

NOTICE: Never turn sleeve in transmission case as shaft centerline is eccentric with outside diameter and gear damage will result.

Install Intake Pipe and Filter Assembly and Bottom Pan

1. Install new intake pipe O-ring onto pipe and install pipe assembly into new filter assembly.

2. Install filter and intake pipe assembly into case bore, **Figure** 400-30.

3. Install filter retainer bolt, and tighten to 14 N·m (10 foot-pounds). **Figure** 400-29.

4. Install new gasket on bottom pan and install bottom pan.

5. Install 13 bottom pan attaching screws. Tighten screws to 16 N·m (12 foot-pounds).

Intake pipe is marked "filter" and "case" assemble "filter" end into filter.

Install Converter

1. Install converter on turbine shaft making certain that converter drive hub slots are fully engaged with the pump drive gear tangs.

2. Install Converter Holding Clamp, J-21366, on front of transmission case.

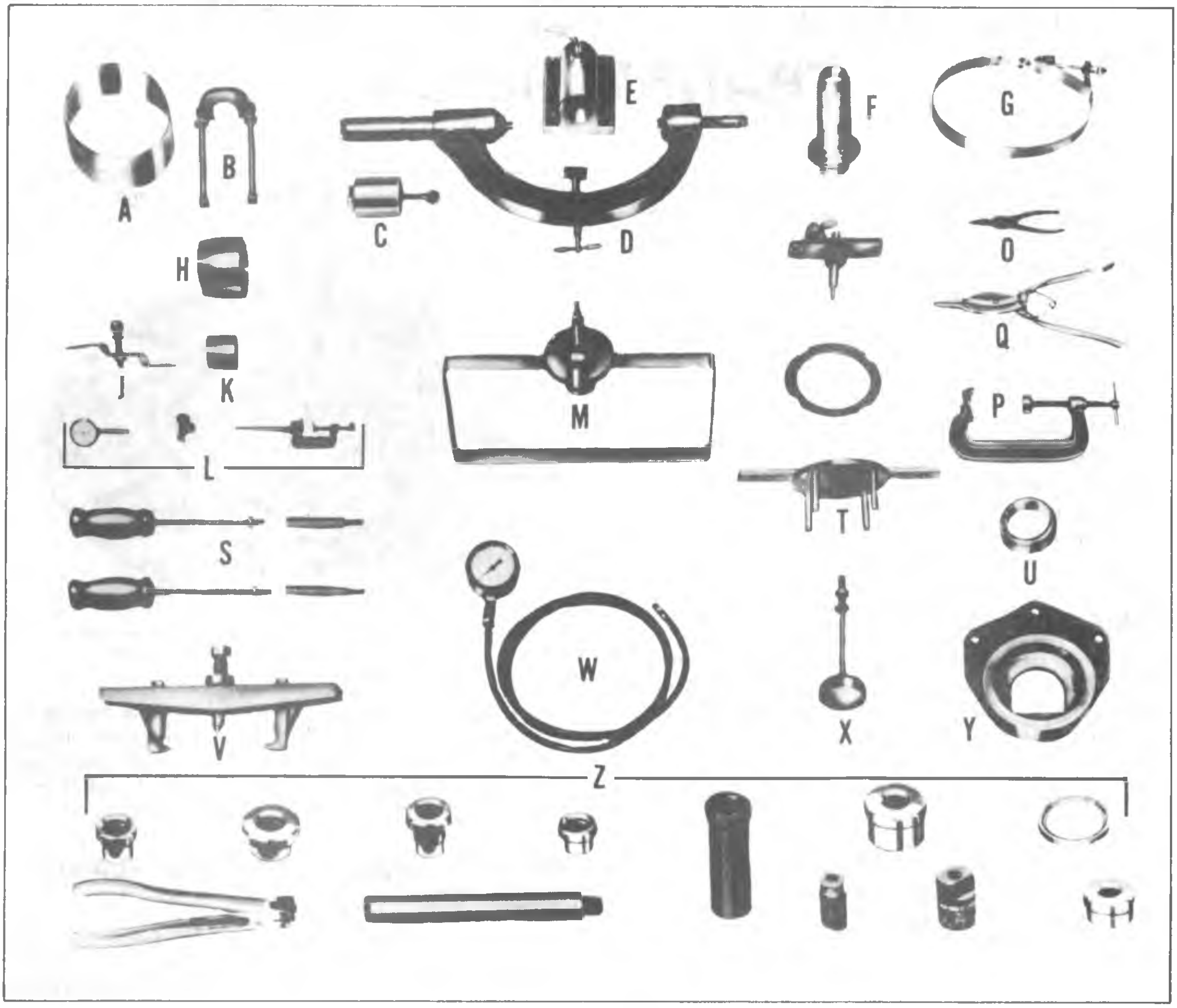
TRANSMISSION CASE REPAIRS

Repairing Tapped Holes

Thread repair inserts are available from various sources and are recommended for restoring damaged threads. The instructions provided with your specific repair kit should be followed.

APPLICATION	NEWTON-METRES	FOOT-POUNDS
FILTER TO VALVE BODY SCREW	13.5	10
SOLENOID TO CASE SCREW	13.5	10
CONTROL VALVE ASSEMBLY TO CASE SCREW	13.5	10
LINE PRESSURE PLUG	13.5	10
FLYWHEEL HOUSING COVER TO TRANSMISSION SCREW	8	5
PUMP BODY TO COVER SCREW	27	20
PUMP ASSEMBLY TO CASE SCREW	27	20
REAR SERVO COVER TO CASE SCREW	27	20
GOVERNOR COVER TO CASE	27	20
PARKING PAWL BRACKET TO CASE SCREW	27	20
VACUUM MODULATOR RETAINER TO CASE SCREW	27	20
SPEEDOMETER DRIVEN GEAR RETAINER TQ CASE SCREW	8	6
OIL PAN TO CASE SCREW	17.5	13
EXTENSION HOUSING TO CASE SCREW	47	35
MANUAL SHAFT TO DETENT LEVER NUT	27	20
MANUAL YOKE TO MANUAL SHAFT NUT	24	18
CASE TO CENTER SUPPORT SCREW	34	25
FLYWHEEL TO CONVERTER SCREW	47	35
TRANSMISSION CASE TO ENGINE SCREW	47	35
OIL COOLER PIPE CONNECTOR NUT AT CASE AND RADIATOR	27	20
COOLER PIPE CONNECTOR AT CASE	27	20
ENGINE REAR MOUNT TO TRANSMISSION BOLT	47	35
ENGINE REAR SUPPORT BRACKET TO FRAME NUT	47	35
NOTICE: REFER TO BACK OF MANUAL FOR BOLT AND NUT MARKING AND STEEL CLASSIFICATIONS.		

Figure 400-114 Torque Specifications



KEY	TOOL NO.	NAME
A	J-21409	Forward and Direct Coutch Piston Installer
B	J-21427	Speedometer Drive Gear Remover
C	J-21795	Gear Assembly Remover and Installer Adapter
D	J-8763-02	Transmission Holding Fixture
E	J-3289-20	Holding Fixture Base
F	J-21359	Pump Oil and Extension Housing Seal Installer
G	J-21368	Pump Body and Cover Alignment Band
H	J-21363	Intermediate Clutch Inner Seal Protector
J	J-21366	Converter Holding Clamp
K	J-21362	Forward and Direct Clutch Inner Seal Projector
L	J-8001	Dial Indicator Set

KEY	TOOL NO.	NAME
M	J-21369	Converter Leak Test Fixture
N	J-21370	Band Apply Pin Selector Gage (use J-21370-5 Pin)
O	J-5403	Snap Ring Pliers (#21)
P	J-21885	Control Valve Accumulator Piston Installer
Q	J-8059	Snap Ring Pliers
R	J-21664	Clutch Spring Compressor Adapter
S	J-6125	Slide Hammer Assemblies
T	J-4670	Clutch Spring Compressor
U	J-21364	Rear Unit Holding Fixture Adapter
V	J-8433	Pulley Puller
W	J-5907	0-300 PSI Pressure Case
X	J-6129	Rear Clutch Spring Compressor
Y	J-6116	Rear Unit Holding Fixture
Z	J-21465-01	Bushing Service Set

Figure400-115 Special Tools

BUSHING SERVICE 400 SERIES TRANSMISSION

When inspecting bushings, fit the mating part into the bushing and observe the amount of looseness. Bushing clearance is excessive if more than .008" exists when checked with a wire feeler gauge.

Bushings are available and can be replaced in the following units. Service bushings do not require reaming.

1. Pump Body
2. Sun Gear Shaft
3. Center Support
4. Output Shaft or Output Flange
5. Case
6. Extension Housing
7. Stator Shaft
   a. Front Bushing
   b. Rear Bushing

PUMP BODY BUSHING

1. With pump disassembled and front seal removed, support pump body on wood blocks. Drive bushing out as shown using J-8092 Drive Handle and J-21465-17 Bushing Remover and Installer. **Figure** 400-116. Use a lead or brass hammer to drive out bushing.

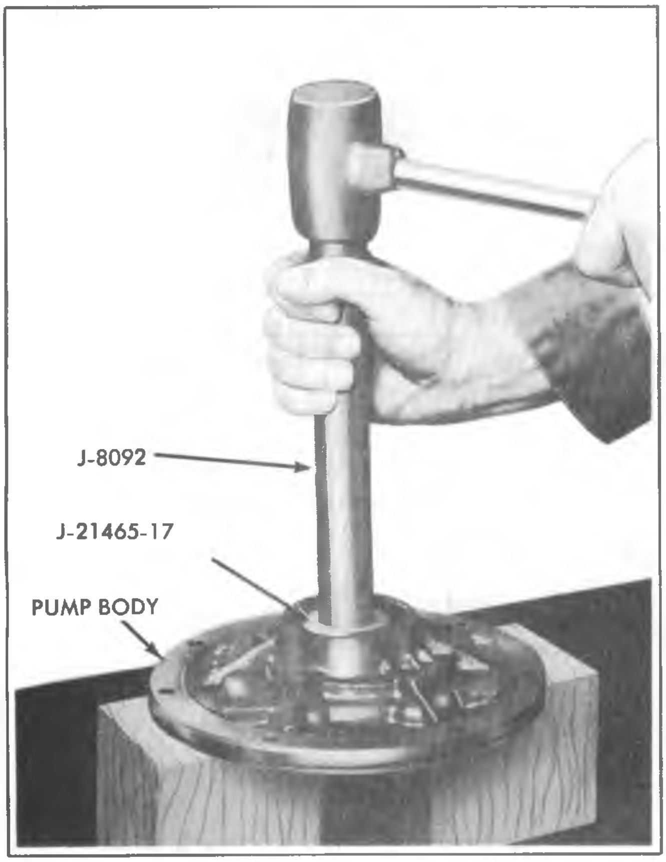


Figure400-116 400 Pump Bushing Removal

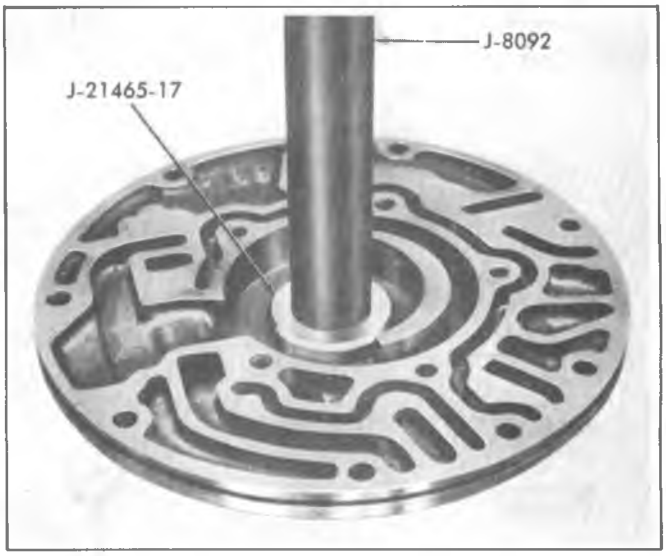


Figure400-117 Pump Bushing Installation

2. Clean pump bushing bore, install new bushing on shoulder of Tool J-21465-17 with J-8092; and drive bushing squarely into the bore until it is flush to .010" below gear pocket face. **Figure** 400-117. Remove tool and inspect bearing.

OUTPUT SHAFT OR OUTPUT FLANGE BUSHING

1. With output shaft or output flange properly supported using Tool J-21465-16, with Slide Hammer J-2619 and Adapter Tool J-2619-4, remove bushing, **Figure** 400-118.

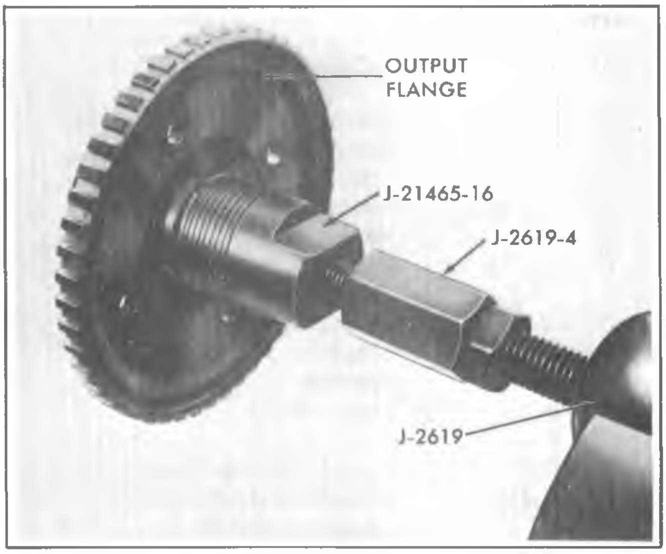


Figure400-118 Output Flange Bushing Removal

2. Using Tool J-21465-1, with Drive Handle J-8092, press or drive replacement bushing into place until tool bottoms, **Figure** 400-119.

Output flange bushing must be installed with oil hole in bushing aligned with oil hole in hub of output flange and notch in bushing outward.

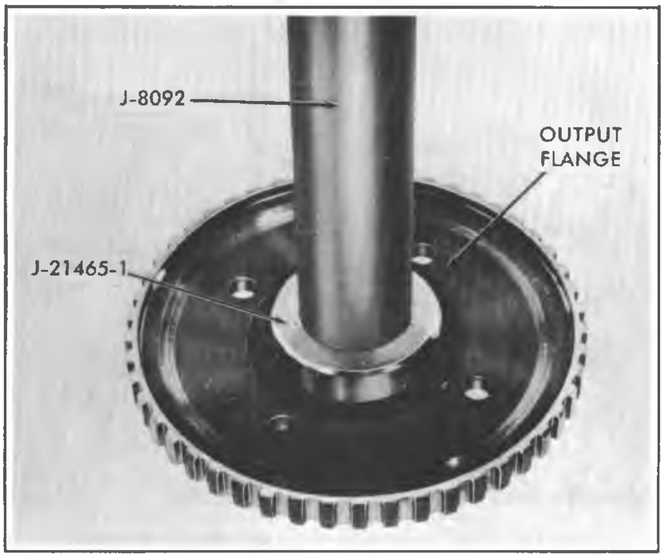


Figure400-119 Output Flange Bushing Installation

SUN GEAR SHAFT BUSHING - FRONT AND REAR

1. With sun gear shaft properly supported, using Tool J-21465-15, with Slide Hammer Tool J-2619 and Adapter J-2619-4, remove bushing, **Figure** 400-120

2. Using Tool J-21465-5 with Drive Handle J-8092, press or drive replacement bushing into place until tool bottoms, **Figure** 400-121.

CENTER SUPPORT BUSHING

1. Position center support, oil delivery sleeve down, on wooden blocks that are long enough to clear bushing during removal. Assemble remover Tool J-21465-6 to Drive Handle J-8092 and drive bushing out as shown in, **Figure** 400-122, using a lead or brass hammer.

2. Invert center support and using the same tools drive new bushing squarely into the bore until bushing is flush to .010" below end of oil delivery sleeve as shown in, **Figure** 400-123. Remove tools and inspect bushing and oil hole alignment.

NOTICE: Slot in bushing must be aligned with the drilled hole in the oil delivery sleeve closest to the piston.

TRANSMISSION CASE BUSHING

1. Position transmission case (converter end down). Assemble Remover Tool J-21465-8 on Drive Handle J-8092 and drive bushing out using a lead or brass hammer, as shown in, **Figure** 400-124.

2. Invert transmission case in holder. Assemble Drive Handle J-8092 and Adapter J-21465-13 on Installer J-21465-8. Assemble Adapter Ring J-21465-9 on installer and

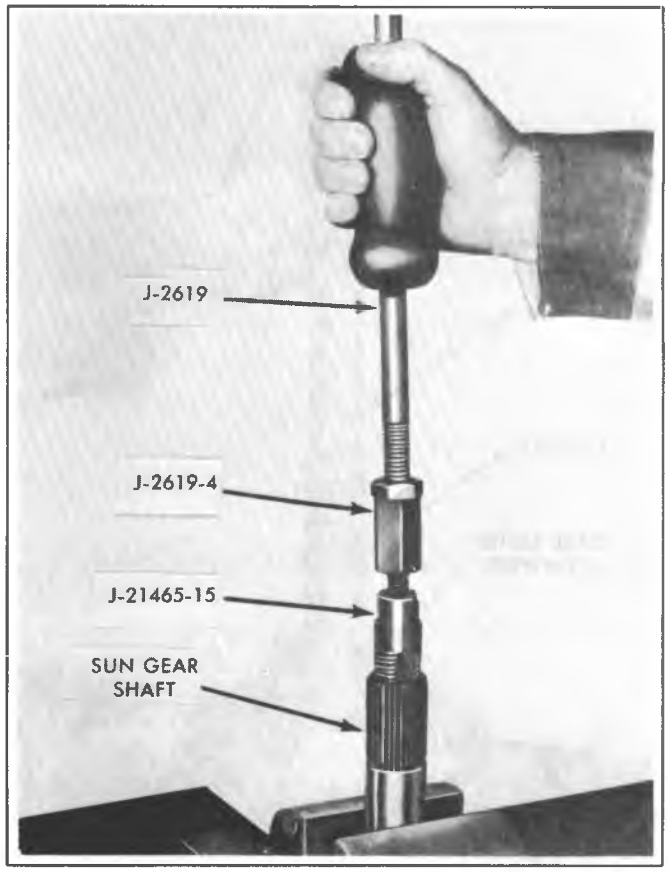


Figure400-120 Sun Gear Shaft Bushing Removal

Figure400-121 Sun Gear Shaft Bushing Installation

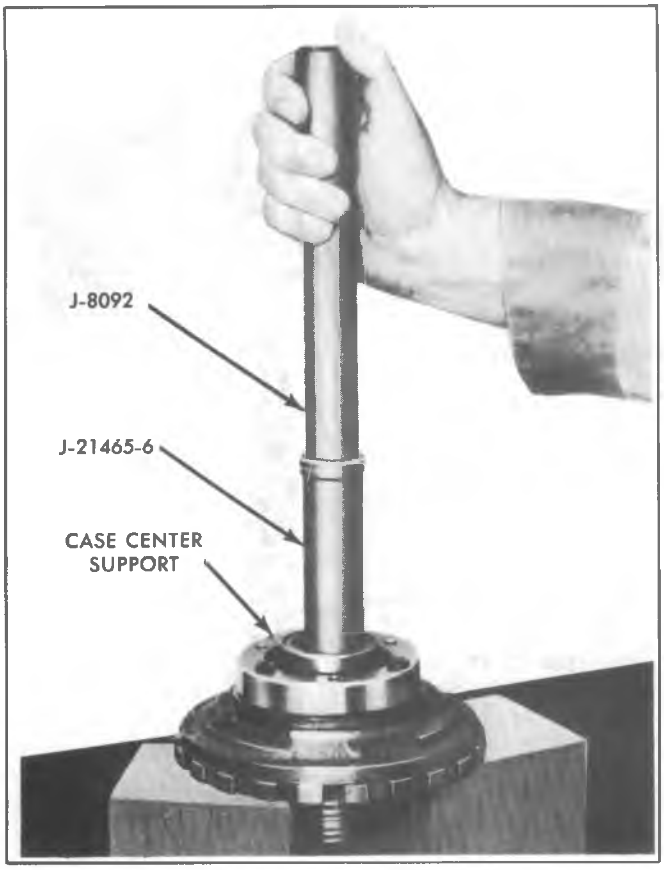


Figure 400-122 Center Support Bushing Removal.

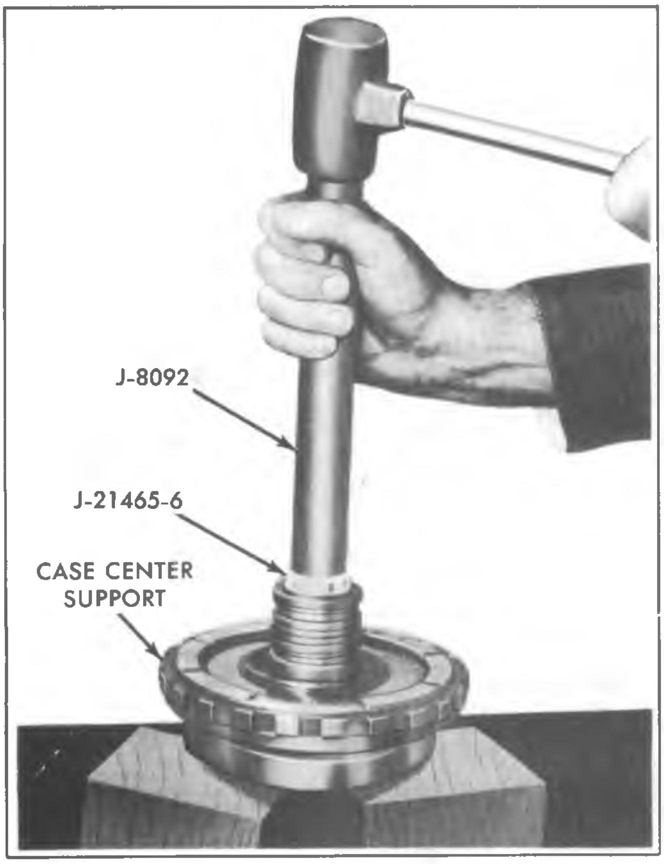


Figure400-123 Center Support Bushing Installation

install new bushing on shoulder of installer with lube passage facing adapter ring, see, **Figure** 400-125. Drive bushing squarely into bore with lead or brass hammer until adapter ring bottoms, as shown. This will leave the bushing. 040 to .055" above the selective thrust washer surface.

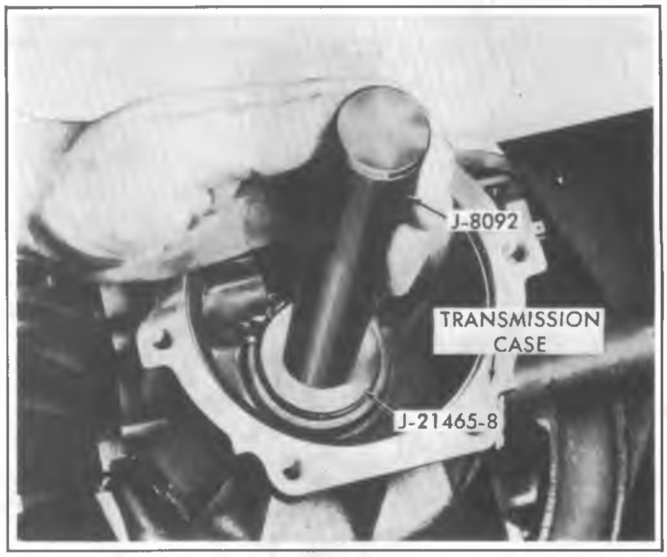


Figure 400-124 Transmission Case Bushing Removal

3. Remove tools and stake bushing with Tool J-21465-10 as shown in **Figure** 400-126. Stake marks must be in the bushing groove. ,Remove staking tool and inspect bushing.

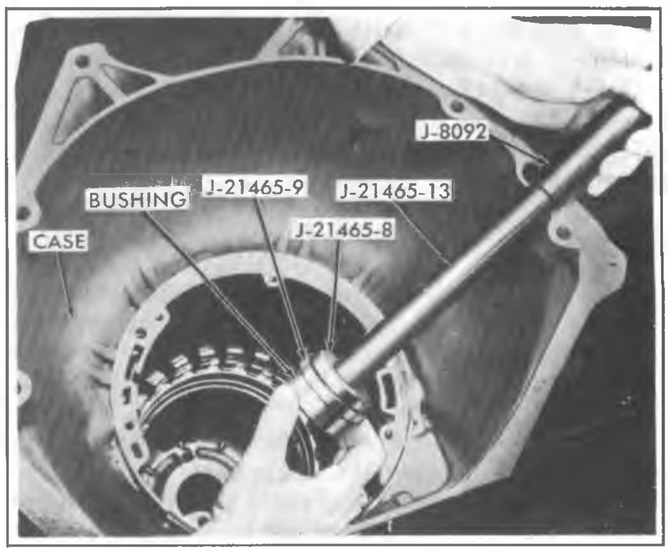


Figure400-125 Transmission Case Bushing Installation

EXTENSION HOUSING BUSHING

1. With rear seal removed, position extension housing on bench, seal end up. Assemble Remover J-21465-17 on Drive Handle J-8092 and drive out bushing with lead or brass hammer, as shown in, **Figure** 400-127.

2. Assemble Drive Handle J-8092 and new bushing on Tool J-21465-17 and drive bushing squarely into bore until flush to .010" below oil seal counter bore surface using a lead or brass hammer, as shown in, **Figure** 400-128.

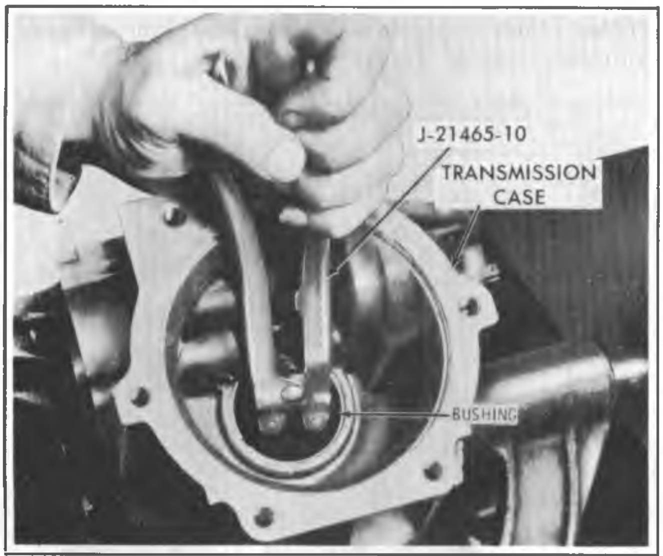


Figure 400-126 Staking Transmission Case Bushing

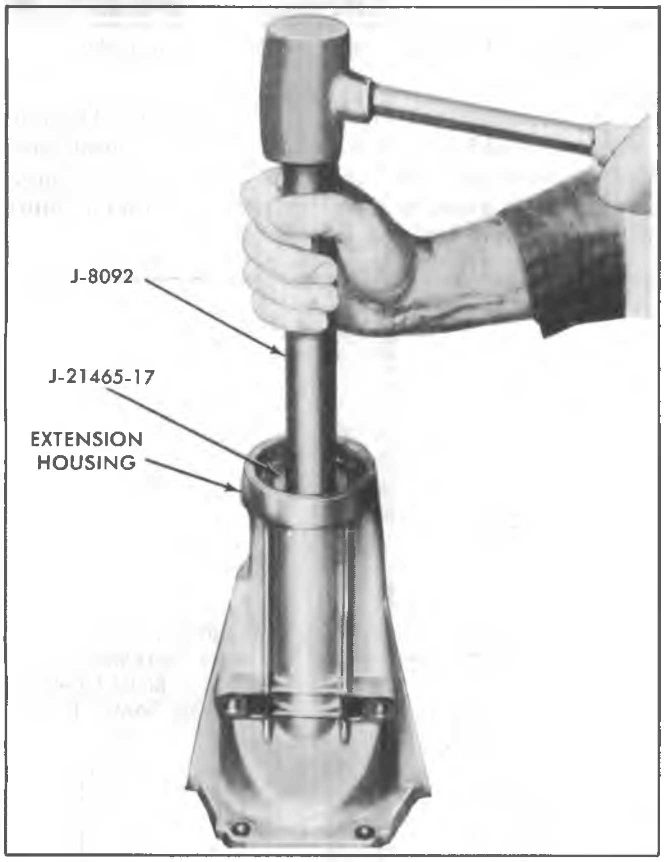


Figure 400-127 Removing Extension Housing Bushing

3. Remove tools and use Tool J-21465-10 to stake bushing in place. Stake marks must be in bushing lubrication grooves. Remove tool and inspect bushing.

Staking in production bushings may or may not be in lubrication grooves. Production equipment does not distort bushing surface making location of stakes optional.

STATOR SHAFT REAR BUSHING

1. Mount pump cover and stator shaft in vise as shown. Use brass jaws to protect shaft. Assemble Remover J-21465-15 to J-2619 Slide Hammer and J-2619-4 Adapter. Thread remover into rear bushing and remove bushing with slide hammer, **Figure** 400-129.

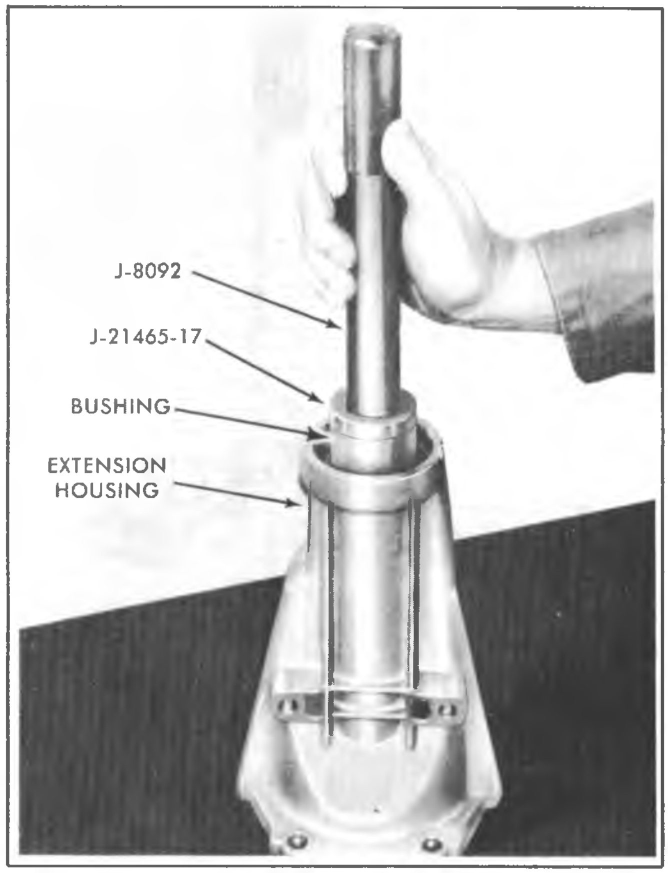


Figure 400-128 Installing Extension Housing Bushing

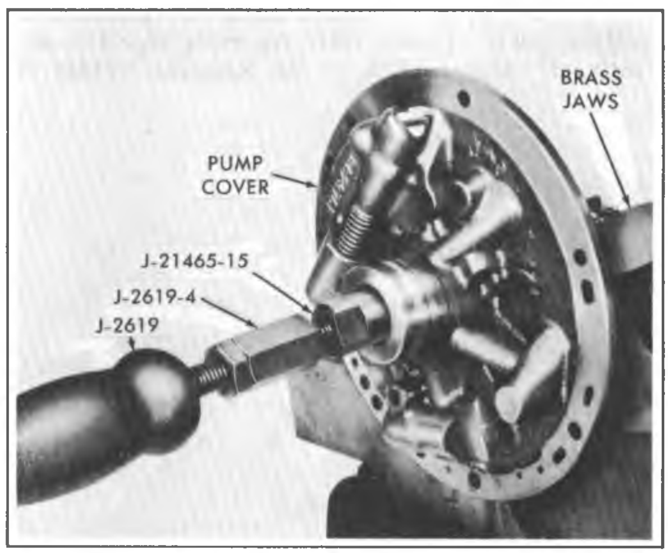


Figure 400-129 Removing Stator Shaft Rear Bushing

2. Clean all shavings from stator shaft bore. Install pump cover in vise supporting shaft on wood block. Assemble Installer J-21465-2 to J-8092 Drive Handle. Install new bushing on shoulder of installer and drive bushing squarely into the bore to a depth of 19/32", **Figure** 400-130. Remove tools and inspect bushing.

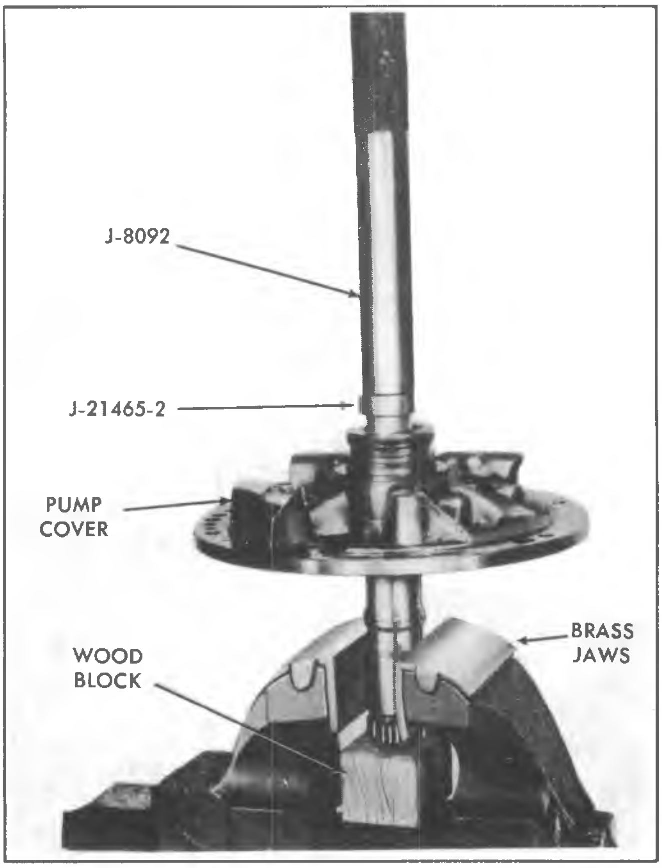


Figure 400-130 Installing Stator Shaft Rear Bushing.

STATOR SHAFT - FRONT BUSHING

1. Mount pump cover and stator shaft in vise as shown. Use brass jaws to protect shaft. Assemble Slide Hammer J-2619 and Adapter J-2619-4 on Remover J-21465-15. Thread remover into front bushing and remove bushing with slide hammer, **Figure** 7A-131.

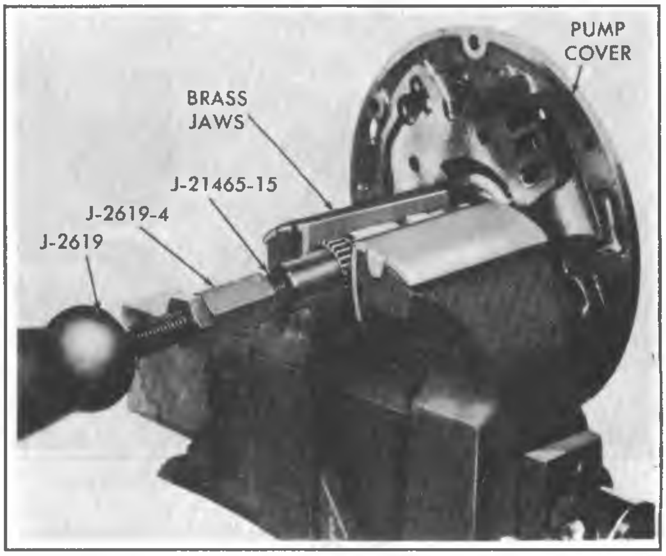


Figure 400-131 Removing Stator Shaft Front Bushing

2. Clean all shavings from stator shaft. Assemble installer J-21465-3 to Drive Handle J-8092. Locate new bushing on shoulder of installer and drive bushing squarely into bore with a lead or brass hammer, as shown in, **Figure** 400-132. Remove tool and inspect bushing.

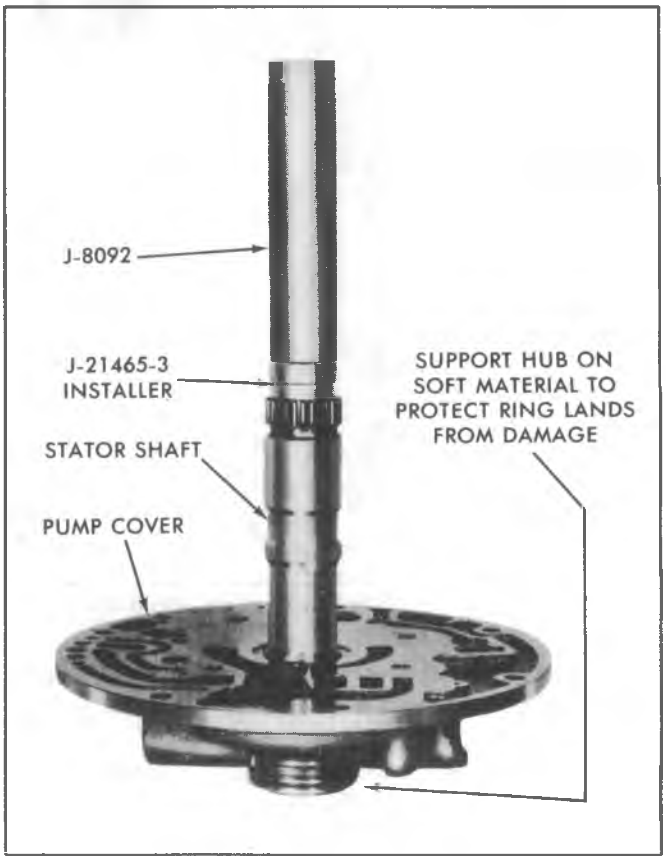


Figure 400-132 Installing Stator Shaft Front Bushing

SECTION 700-R4

MD9

THM 700-R4 AUTOMATIC TRANSMISSION DIAGNOSIS AND REPAIR

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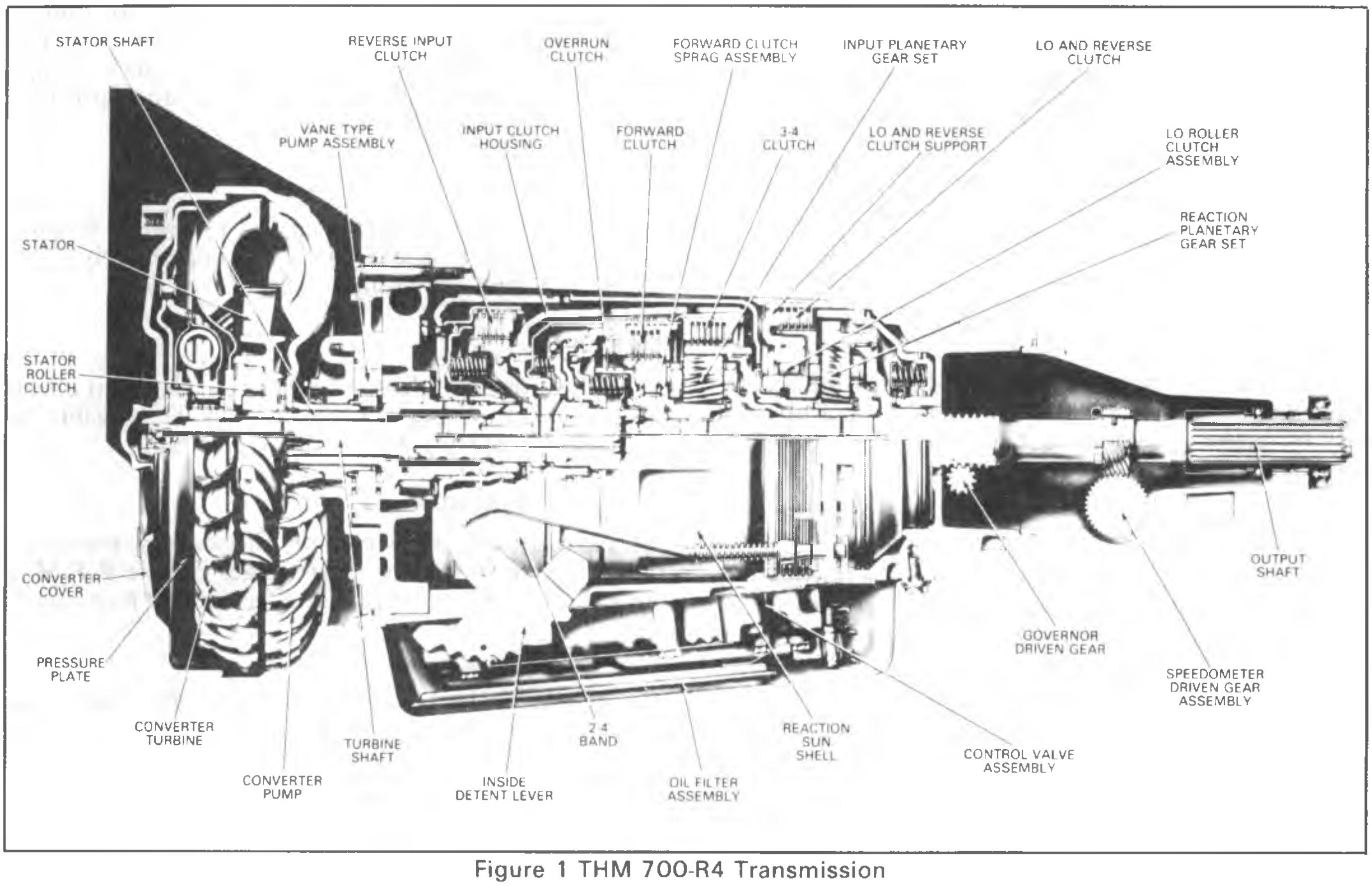


Figure 1 THM 700-R4 Transmission

GENERAL DESCRIPTION

The THM 700-R4 is a fully automatic transmission for rear wheel drive vehicles which provides four forward gear ranges and a reverse.

The major components of this transmission are:

- Torque Converter Clutch Asm.
- Vane Type Oil Pump
- 2-4 Band Asm.
- Five Multiple Disc Clutches
- Two Planetary Gear Sets
- One Sprag Clutch
- One Roller Clutch
- Valve Body Asm.

The oil pressure and shift points are controlled by throttle opening via a throttle valve cable. (See the 7A Section for T.V. cable information).

The transmission can be operated in any of seven different modes shown on the shift quadrant. (See Figure 2)

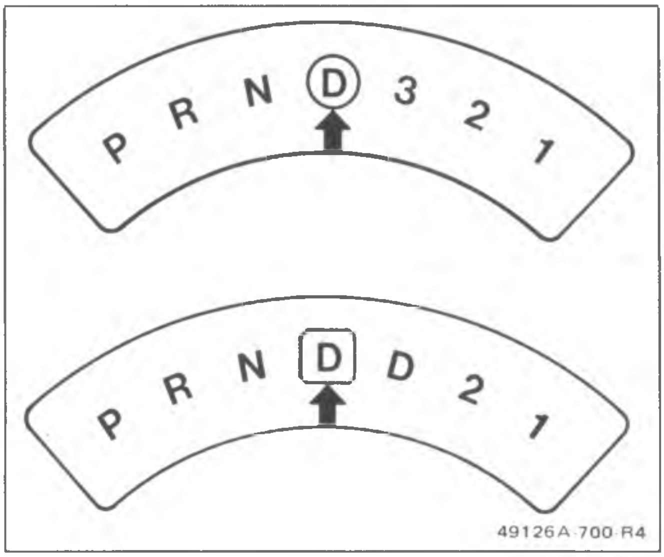


Figure 2 Shift Quadrants

P - Park position prevents the vehicle from rolling either forward or backward. (For safety reasons the parking brake should be used in addition to the park position).

R - Reverse allows the vehicle to be operated in a rearward direction.

N - Neutral allows the engine to be started and operated without driving the vehicle. If necessary this position may be selected if the engine must be restarted with the vehicle moving.

D or D - Overdrive is used for all normal driving conditions. It provides four gear ratios plus converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.

D or 3 - Drive position is used for city traffic, hilly terrain, and trailer towing. It provides three gear ranges plus converter clutch operation. Again, downshifts are available by depressing the accelerator.

2 - Manual second is used to provide acceleration and engine braking. This range may be selected at any vehicle speed.

1 - Manual Lo is used to provide maximum engine braking. This range may also be selected at any vehicle speed.

DIAGNOSIS INFORMATION

ROAD TEST PROCEDURE

Overdrive Range:

While stopped, position the range selector lever in overdrive range and accelerate. Check for a 1-2, 2-3, and 3-4 upshift. (Shift points will vary with throttle position.) Also, the converter clutch should apply in 2nd or 3rd gear depending on calibration. Check for part throttle downshifts by depressing the throttle to a 3/4 open position. Check for detent downshifts by depressing the accelerator to wide open position at various speeds.

Drive Range:

At road speed in fourth gear (overdrive range), manually shift the transmission to drive range. The transmission should shift to 3rd gear range immediately. It should not shift back to 4th gear range. Check for part throttle and detent downshifts.

Drive 2:

While in 3rd gear range, shift to manual second; the transmission should downshift immediately. Test for a 2-1 detent downshift.

Lo Range:

Position the selector lever in lo range and check operation. (In some vehicles it may be possible to obtain a 1-2 upshift while in this gear range.)

Overrun Braking:

Overrun braking can be checked by manually downshifting to a lower gear range. Engine R.P.M.'s should increase and a braking effect should be noticed.

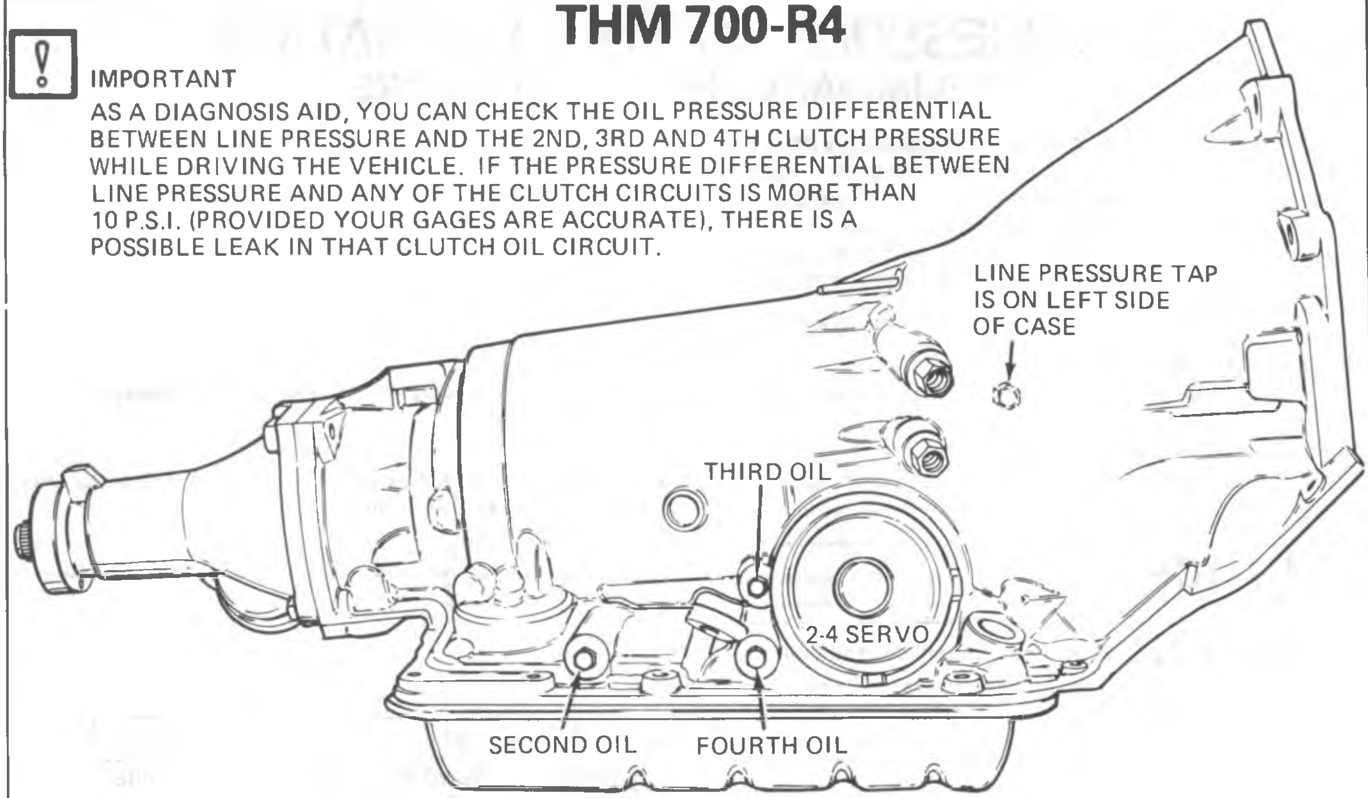
Reverse:

Position the selector lever in reverse and check reverse operation.

THM 700-R4

IMPORTANT

AS A DIAGNOSIS AID, YOU CAN CHECK THE OIL PRESSURE DIFFERENTIAL BETWEEN LINE PRESSURE AND THE 2ND, 3RD AND 4TH CLUTCH PRESSURE WHILE DRIVING THE VEHICLE. IF THE PRESSURE DIFFERENTIAL BETWEEN LINE PRESSURE AND ANY OF THE CLUTCH CIRCUITS IS MORE THAN 10 P.S.I. (PROVIDED YOUR GAGES ARE ACCURATE), THERE IS A POSSIBLE LEAK IN THAT CLUTCH OIL CIRCUIT.



OIL PRESSURE TAP LOCATIONS

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Figure 3 Oil Pressure Tap Locations

OIL PRESSURE CHECK INFORMATION
PRELIMINARY CHECK PROCEDURE

- CHECK TRANSMISSION OIL LEVEL
- CHECK AND ADJUST T.V. CABLE
- CHECK OUTSIDE MANUAL LINKAGE AND CORRECT
- CHECK ENGINE TUNE
- INSTALL OIL PRESSURE GAGE
- CONNECT TACHOMETER TO ENGINE
- CHECK OIL PRESSURE AS FOLLOWS:

Minimum T.V. Line Pressure Check
Set the T.V. cable to specification; and with the brakes applied, take the line pressure readings in the ranges and at the engine r.p.m.'s indicated in the chart below.

Full T.V. Line Pressure Check
Full T.V. line pressure readings are obtained by tying or holding the T.V. cable to the full extent of its travel; and with the brakes applied, take the line pressure readings in the ranges and at the engine r.p.m.'s indicated in the chart below.

***NOTICE** Total running time for this combination not to exceed 2 minutes.

CAUTION Brakes must be applied at all times.

AUTOMATIC TRANSMISSION OIL PRESSURES

RANGE	MODEL	NORMAL OIL PRESSURE AT MINIMUM T.V. kPa	NORMAL OIL PRESSURE AT MINIMUM T.V. PSI	NORMAL OIL PRESSURE AT FULL T.V. kPa	NORMAL OIL PRESSURE AT FULL T.V. PSI
PARK & NEUTRAL @ 1000 RPM	TC, MB, MC, MJ, VN	385 - 445	55 - 65	880 - 1,190	130 - 170
	TE, TH, TK, MD, ME, MK, MW, VH	385 - 445	55 - 65	880 - 1,190	130 - 170
	VA, ML, T7, MP, MS, PQ, YN, YK, YP, YG, YF, Y6	385 - 445	55 - 65	880 - 1,190	130 - 170
	T8, TZ, TM, MG, VE, MH, VJ, TL, TD, MR, TG, Y7, Y8	450 - 515	65 - 75	880 - 1,190	130 - 170
	YH	450 - 515	65 - 75	965 - 1,240	140 - 180
	Y9	385 - 445	55 - 65	965 - 1,240	140 - 180
REVERSE @ 1000 RPM	TC, MB, MC, MJ, VN	630 - 730	90 - 105	1,445 - 1,955	210 - 285
	TE, TH, TK, MD, ME, MK, MW, VH	630 - 730	90 - 105	1,445 - 1,955	210 - 285
	VA, ML, T7, MP, MS, PQ, YN, YK, YP, YG, YF, Y6	630 - 730	90 - 105	1,445 - 1,955	210 - 285
	T8, TZ, TM, MG, VE, MH, VJ, TL, TD, MR, TG, Y7, Y8	740 - 845	110 - 120	1,445 - 1,955	210 - 285
	YH	740 - 845	110 - 120	1,550 - 2,070	225 - 300
	Y9	630 - 730	90 - 105	1,550 - 2,070	225 - 300
OVERDRIVE & MANUAL THIRD @ 1000 RPM	TC, MB, MC, MJ, VN	385 - 445	55 - 65	880 - 1,190	130 - 170
	TE, TH, TK, MD, ME, MK, MW, VH	385 - 445	55 - 65	880 - 1,190	130 - 170
	VA, ML, T7, MP, MS, PQ, YN, YK, YP, YG, YF, Y6	385 - 445	55 - 65	880 - 1,190	130 - 170
	T8, TZ, TM, MG, VE, MH, VJ, TL, TD, MR, TG, Y7, Y8	450 - 515	65 - 75	880 - 1,190	130 - 170
	YH	450 - 515	65 - 75	965 - 1,240	140 - 180
	Y9	385 - 445	55 - 65	965 - 1,240	140 - 180
MANUAL SECOND & LO @ 1000 RPM	TC, MB, MC, MJ, VN	705 - 815	100 - 120	705 - 815	100 - 120
	TE, TH, TK, MD, ME, MK, MW, VH	705 - 815	100 - 120	705 - 815	100 - 120
	VA, ML, T7, MP, MS, PQ, YN, YK, YP, YG, YF, Y6	705 - 815	100 - 120	705 - 815	100 - 120
	T8, TZ, TM, MG, VE, MH, VJ, TL, TD, MR, TG, Y7, Y8	705 - 815	100 - 120	705 - 815	100 - 120
	YH	705 - 815	100 - 120	705 - 815	100 - 120
	Y9	705 - 815	100 - 120	705 - 815	100 - 120

Line pressure is basically controlled by pump output and the pressure regulator valve. In addition, line pressure is boosted in Reverse, Second and Lo by the reverse boost valve.

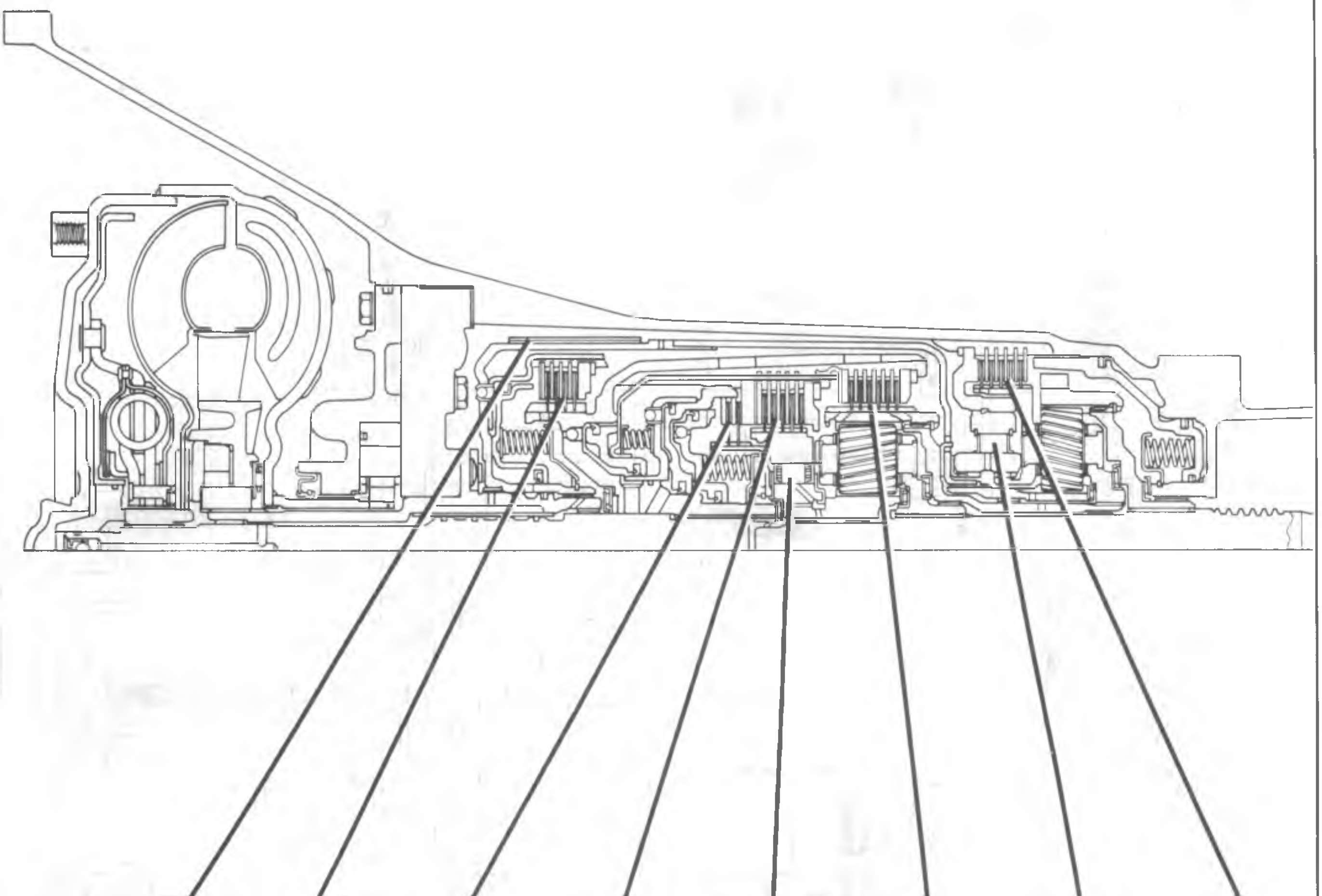
Also, in the Neutral, Drive, Intermediate and Reverse positions of the selector lever, the line pressure should increase with throttle opening because of the T.V. system. The pressure is controlled by the T.V. cable, the throttle lever and bracket assembly and the T.V. link, as well as the control valve assembly.

The main line pressure tap plug is located on the left side of the transmission above the outside manual lever. 49109C-700-R4

Figure 4 Oil Pressure Check Procedure

700 - GEAR RATIOS

FIRST	3.06	FOURTH	.70
SECOND	1.62	REVERSE	2.29
THIRD	1.00		



GEAR RANGE	2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO ROLLER CLUTCH	LO-REV. CLUTCH
1ST DR4				ON	ON		ON	
2ND DR4	ON			ON	ON			
3RD DR4				ON	ON	ON		
4TH DR4	ON			ON		ON		
3RD DR3			ON	ON	ON	ON		
2ND DR2	ON		ON	ON	ON			
1ST LO			ON	ON	ON		ON	ON
REV.		ON						ON

490214-700-R4

Figure 5 Clutch Application Chart

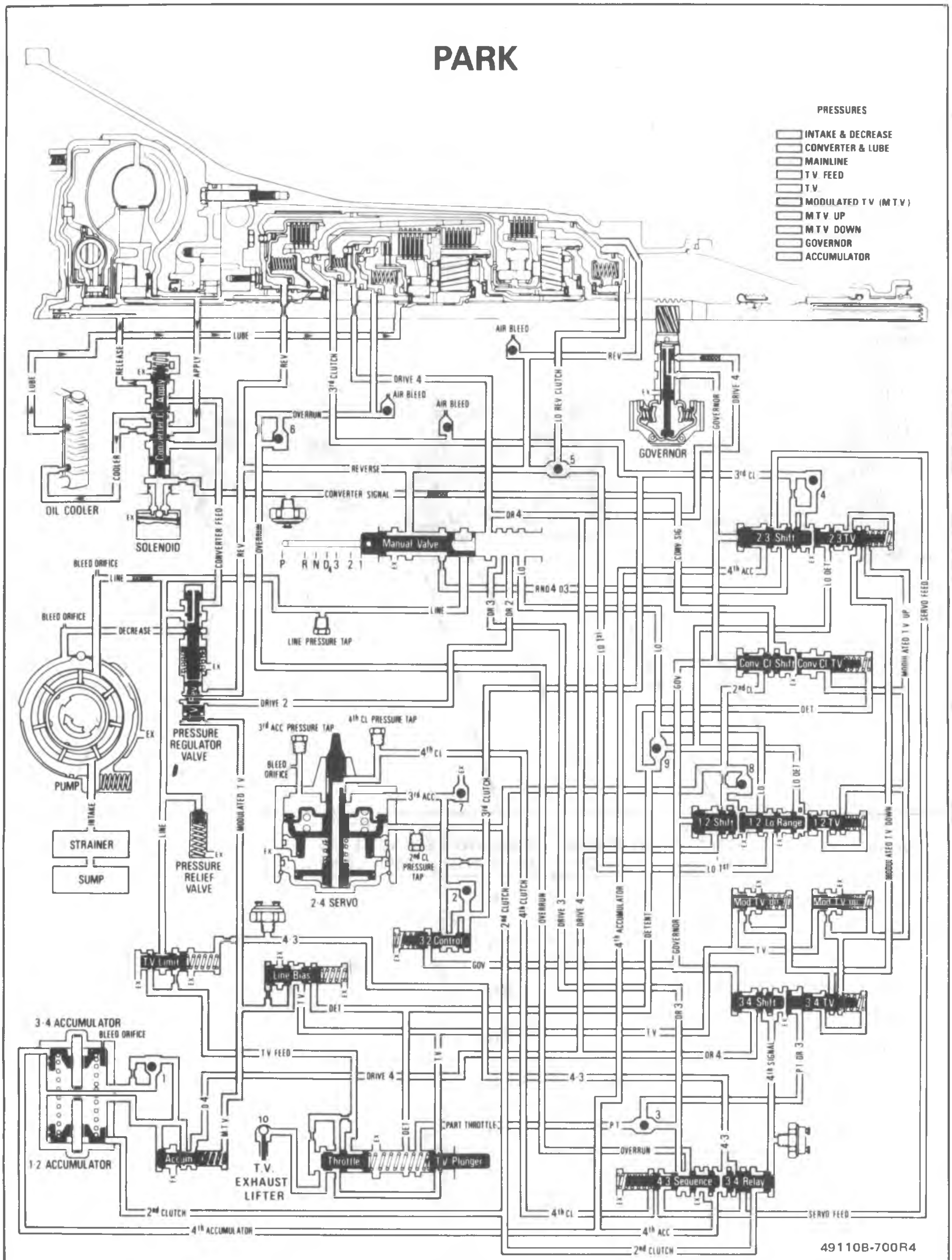


Figure 6 Oil Circuit Chart

GENERAL DIAGNOSIS GUIDE

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL LEAK To Correctly Identify Oil Leaks, Perform the Following Procedure: • Clean all residual oil from the transmission with electramotive cleanser or equivalent. • Dust the transmission with leak tracing powder or spray foot powder. • Bring the engine to normal operating temperature. • Turn the engine off and let the vehicle set for thirty minutes. • Check for leaks.	• Oil Pan	– Low bolt torque. – Cut or damaged oil pan gasket.
	• T.V. Cable Connector	– Connector cocked and interfering with mount. – Connector cracked. – Seal missing, cut or damaged.
	• Fill Tube	– Fill tube cracked or damaged. – Seal missing, cut, or damaged.
	• Electrical Connector	– Electrical connector cracked. – Seal missing, cut or damaged.
	• Manual Shaft	– Manual shaft nicked or damaged. – Manual shaft seal assembly missing, cut or damaged.
	• Governor Cover	– Gaps in sealant. (Remove & Reseal.)
	• Speedo Fitting	– Low bolt torque. – Seal missing, cut or damaged.
	• Servo Cover	– Porosity. – Sharp edges on case cut "O" ring seal.
	• Cooler Fittings	– Low torque. – Cracked fitting.
	• Converter Assembly	– Hub or seam weld leak.
	• Vent	– Oil overfill. – Engine coolant in transmission oil.
	• Oil Pump Assembly	– Low bolt torque. – Cut or damaged oil pump to case seal. – Damaged seal. (Restricted drainback passage.) – Porosity.
	• Rear Extension	– Damaged extension to case seal. – Porosity. – Damaged oil seal assembly.

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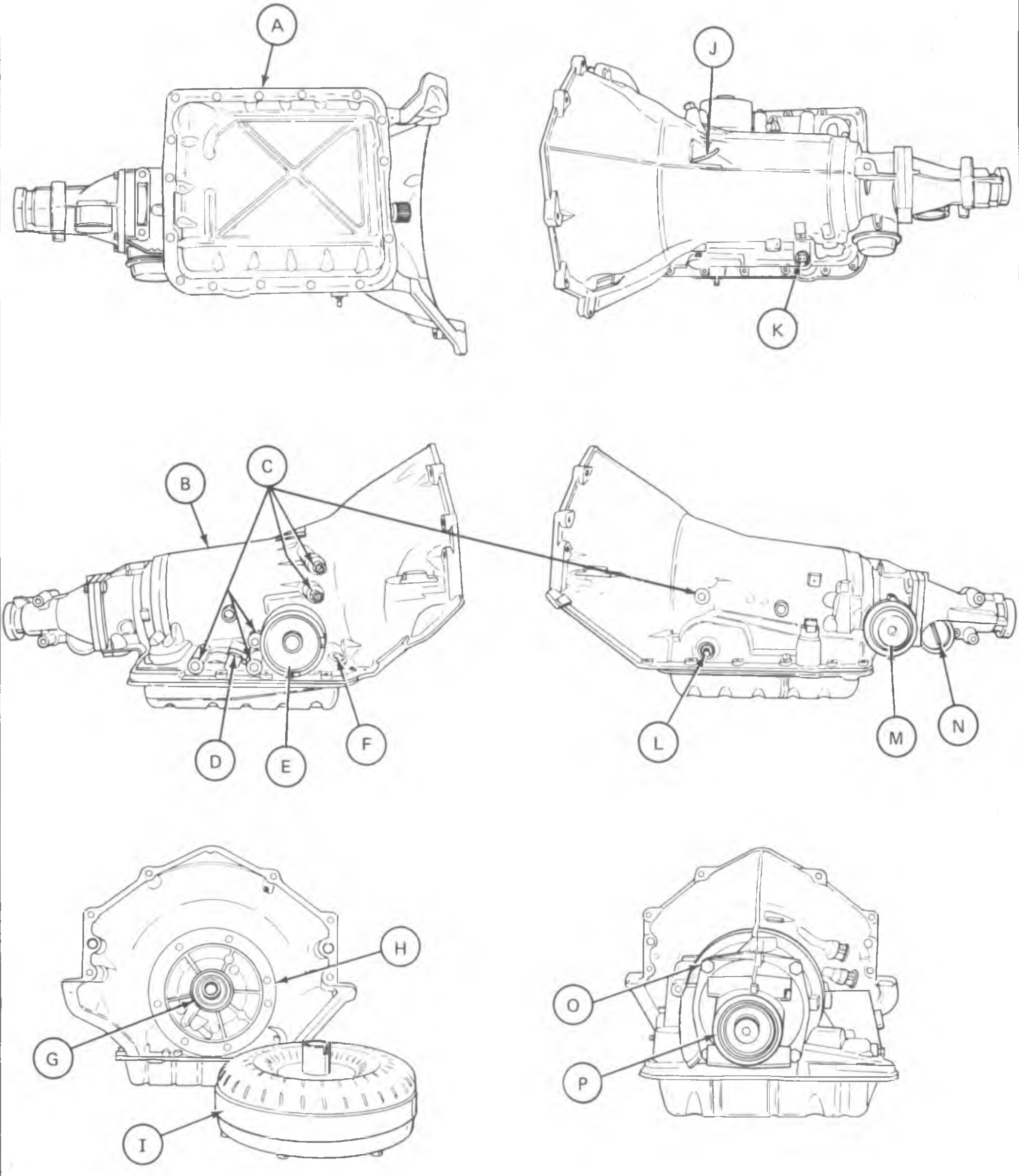
Figure 7 Diagnosis Chart A



A OIL PAN
B CASE
C COOLER CONNECTORS & PLUGS
D T.V. CABLE SEAL
E SERVO COVER
F OIL FILL TUBE SEAL
G OIL PUMP SEAL ASSEMBLY
H OIL PUMP TO CASE SEAL
I CONVERTER
J VENT
K ELECTRICAL CONNECTOR SEAL
L MANUAL SHAFT SEAL
M GOVERNOR COVER
N SPEEDO SEAL
O EXTENSION TO CASE SEAL
P EXTENSION OIL SEAL ASSEMBLY

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Figure 8 Possible Leak Points

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL PRESSURE HIGH OR LOW (Verify With Gage – Check Oil Level & Engine Tune.)	• Oil Pump Assembly	– Pressure regulator valve stuck. – Pressure regulator valve spring damaged. – Rotor guide omitted or misassembled. – Rotor cracked or broken. – T.V. valve, reverse boost valve or bushing stuck, damaged or incorrectly assembled. – Orifice hole in pressure regulator valve plugged. – Sticking slide or excessive rotor clearance. – Pressure relief ball not seated or damaged. – Porosity in pump cover or body. – Wrong pump cover. – Pump faces not flat.
	• Oil Filter	– Intake pipe restricted by casting flash. – Cracks in filter body or intake pipe. – "O" ring seal missing, cut or damaged.
	• T.V. Exhaust Ball	– Stuck or damaged.
	• Throttle Lever & Bracket Assy.	– Misassembled, binding or damaged.
	• Throttle Link	– Misassembled, binding or damaged.
	• Valve Body	– Manual valve scored or damaged. – Spacer plate or gaskets incorrect, mis-assembled or damaged. – Face not flat. – Throttle valve sticking. – Throttle valve sleeve rotated in bore or retaining pin not seated. – T.V. limit valve sticking. – Modulated downshift valve stuck. – Line bias valve stuck. – 2-3 shift valve stuck. – Check balls omitted or misassembled.
	• Case	– Case to valve body face not flat.
HIGH OR LOW SHIFT POINTS.	• T.V. Cable	– Binding or not correctly adjusted.
	• T.V. Exhaust Ball	– Stuck or damaged.
	• Throttle Lever & Bracket Assy.	– Misassembled, binding or damaged.
	• Oil Pump Assembly	– Stuck pressure regulator valve or T.V. boost valve. – Sticking pump slide.
	• Valve Body Assembly	– Sticking throttle valve or plunger. – Modulated T.V. up or down valves sticking. – T.V. limit valve sticking. – Spacer plate or gaskets misassembled, damaged or incorrect.

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Figure 9 Diagnosis Chart B

CONDITION	INSPECT COMPONENT	FOR CAUSE
1ST GEAR RANGE ONLY – NO UPSHIFT	• Governor Assembly	– Governor valve sticking. – Governor driven gear loose or damaged. – Governor driven gear retaining pin missing. – Nicks or burrs on output shaft. – Nicks or burrs on governor sleeve or case bore. – Governor support pin in case too long or short. – Governor weights or springs missing, binding or damaged.
	• Valve Body	– 1-2 shift valve sticking. – Spacer plate or gaskets mispositioned or damaged.
	• Case	– Case to valve body face not flat or damaged. – Governor screen restricted or damaged.
	• 2-4 Servo Assembly	– Restricted or blocked apply passages in case. – Nicks or burrs on servo pin or pin bore in case. – Missing or damaged piston or pin seals. – 4th servo piston in backwards.
	• 2-4 Band Assembly	– 2-4 band worn or damaged. – Band anchor pin not engaged.
SLIPS IN 1ST GEAR	• Forward Clutch Assembly	– Clutch plates worn. – Porosity or damage in forward clutch piston. – Forward clutch piston inner and outer seals missing, cut or damaged. – Input housing to forward clutch housing "O" ring seal missing, cut or damaged. – Damaged forward clutch housing. – Forward clutch housing retainer and ball assembly not sealing or damaged.
	• Input Housing & Shaft Assy.	– Turbine shaft seals missing, cut or damaged.
	• Valve Body	– Accumulator valve stuck. – Face not flat, damaged lands or interconnected passages. – Spacer plate or gaskets incorrect, mispositioned or damaged.
	• T.V. Cable	– Binding or broken.

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Figure 10 Diagnosis Chart C

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPS IN 1ST GEAR (Continued)	• 1-2 Accumulator Piston Assy.	– Porosity in piston or 1-2 accumulator cover and pin assembly. – Damaged ring grooves on piston. – Piston seal missing, cut or damaged. – 1-2 accumulator cover gasket missing or damaged. – Leak between piston and pin. – Broken 1-2 accumulator spring.
	• Oil Pressure	– (See Causes of High or Low Oil Pressure.)
	• 2-4 Servo Assembly	– 4th servo piston in backwards.
1-2 SHIFT SPEED – HIGH OR LOW	• T.V. Cable	– Binding or broken. – Not correctly adjusted.
	• Governor Assembly	– (See 1st Gear Range Only – No Upshift.)
	• Throttle Lever & Bracket Assy.	– Misassembled, binding or damaged. – T.V. link missing, binding or damaged.
	• Valve Body	– T.V. exhaust check ball stuck. – T.V. plunger sticking. – Face not flat.
	• Oil Pump Assembly or Case	– Face not flat.
SLIPPING OR ROUGH 1-2 SHIFT	• Throttle Lever & Bracket Assy.	– Incorrectly installed or damaged. – T.V. cable broken or binding.
	• Valve Body Assembly	– Throttle valve sticking. – T.V. bushing turned in its bore. – 1-2 shift valve train stuck. – Gaskets or spacer plate incorrect, mis-positioned or damaged. – Line bias valve stuck. – Accumulator valve stuck. – T.V. limit valve stuck. – Face not flat.
	• 2-4 Servo Assembly	– Apply pin too long or too short. – Servo seals or "O" ring seals missing, cut or damaged. – Restricted or missing oil passages. – Servo bore in case damaged.
	• 2nd Accumulator	– Porosity in 1-2 accumulator housing or piston. – Piston seal or groove damaged. – Nicks or burrs in 1-2 accumulator housing. – Missing or restricted oil passage.

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Figure 11 Diagnosis Chart D

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPPING OR ROUGH 1-2 SHIFT (Continued)	• 2-4 Band	– Worn or mispositioned.
	• Oil Pump Assembly or Case	– Faces not flat.
NO 2-3 SHIFT OR 2-3 SHIFT SLIPPING, ROUGH OR HUNTING	• Converter	– Internal damage.
	• Governor Assembly	– Valve stuck. – Drive gear retaining pin missing or loose. – Governor weights binding. – Governor drive gear damaged. – Governor support pin in case too long or too short.
	• Oil Pump	– Stator shaft sleeve scored or off location.
	• Valve Body	– 2-3 valve train stuck. – Accumulator valve stuck. – Spacer plate or gaskets incorrect, mispositioned or damaged. – Throttle valve stuck. – T.V. limit valve stuck.
	• Input Housing Assembly	– Clutch plates worn (3-4 or forward). – Excessive clutch plate travel. – Cut or damaged piston seals (3-4 or forward). – Porosity in 3-4 clutch housing or piston. – 3-4 piston check ball stuck, damaged or not sealing. – Restricted apply passages. – Forward clutch piston retainer and ball assembly not seating. – Sealing balls loose or missing.
	• Case	– 3rd accumulator retainer and ball assembly not seating.
	• 2-4 Servo Assembly	– 2nd apply piston seals missing, cut or damaged. – Servo pin seals missing, cut or damaged.
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT	• Governor	– Governor weights binding. – Governor valve stuck. – Governor drive gear retaining pin missing or loose. – Governor drive gear damaged. – Governor support pin in case too long or too short.
	• Oil Pump Assembly	– Faces not flat. – Pump cover retainer and ball assembly omitted or damaged.

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Figure 12 Diagnosis Chart E

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT (Continued)	• Valve Body Assembly	– Valves stuck. 2-3 shift valve train. Accumulator valve. Throttle valve. T.V. limit valve. 1-2 shift valve train. 3-2 control valve. – Manual valve link bent or damaged. – Spacer plates or gaskets incorrect, mispositioned or damaged.
	• 2-4 Servo Assembly	– Incorrect band apply pin. – Missing or damaged servo seals. – Porosity in pistons, cover or case. – Damaged piston seal grooves. – Plugged or missing orifice cup plug.
	• Case	– 3rd accumulator retainer and ball assembly leaking. – Porosity in 3-4 accumulator piston or bore. – 3-4 accumulator piston seal or seal grooves damaged. – Plugged or missing orifice cup plug. – Restricted oil passage.
	• Input Housing Assembly	– Refer to Slipping 2-3 Shift.
	• 2-4 Band Assembly	– Worn or misassembled.
NO REVERSE OR SLIPS IN REVERSE	• Input Housing Assembly	– 3-4 apply ring stuck in applied position. – Forward clutch not releasing. – Turbine shaft seals missing, cut or damaged.
	• Manual Linkage	– Not adjusted.
	• Oil Pump Assembly	– Retainer and Ball assembly missing or damaged. – Stator shaft seal rings or ring grooves damaged. – Stator shaft sleeve scored or damaged. – Reverse boost valve stuck, damaged or misassembled. – Cup plug missing. – Restricted oil passage. – Faces not flat. – Converter clutch apply valve stuck.
	• Valve Body Assembly	– 2-3 shift valve stuck. – Manual linkage not adjusted. – Spacer plate and gaskets incorrect, mispositioned or damaged.

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Figure 13 Diagnosis Chart F

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO REVERSE OR SLIPS IN REVERSE (Continued)	• Reverse Input Clutch	– Clutch plate worn. – Reverse input housing and drum assembly cracked at weld. – Clutch plate retaining ring out of groove. – Return spring assembly retaining ring out of groove. – Piston deformed or dished. – Seals cut or damaged. – Retainer and ball assembly not sealing. – Restricted apply passage.
	• Lo And Reverse Clutch	– Clutch plates worn. – Clutch plate retaining ring mispositioned. – Porosity in piston. – Seals damaged. – Return spring assembly retaining ring mispositioned. – Restricted apply passage.
	• Case	– Cover plate gasket missing or damaged. – Cover plate not torqued correctly. – Porosity.
NO PART THROTTLE OR DELAYED DOWNSHIFTS	• External Linkage	– Not adjusted.
	• 2-4 Servo Assembly	– Apply pin seal cut or damaged. – Servo cover retaining ring omitted or misassembled. – 4th apply piston damaged or misassembled. – Servo inner housing damaged or mis-assembled.
	• Governor Assembly	– Governor weights binding. – Governor valve stuck.
	• Valve Body Assembly	– Valves stuck. Throttle valve 3-2 control valve T.V. modulated downshift – T.V. sleeve turned in bore. – 4-3 sequence valve body channel blocked. – #5 check ball omitted from valve body.

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Figure 14 Diagnosis Chart G

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO OVERRUN BRAKING — MANUAL 3-2-1	• External Linkage	— Not adjusted properly.
	• Valve Body Assembly	— Valves stuck. 4-3 sequence valve Throttle valve — Check ball #3 mispositioned. — Spacer plate and gaskets incorrect, damaged or mispositioned.
	• Input Clutch Assembly	— Turbine shaft oil passages plugged or not drilled. — Turbine shaft seal rings damaged. — Turbine shaft sealing balls loose or missing. — Porosity in forward or overrun clutch piston. — Overrun piston seals cut or damaged. — Overrun piston check ball not sealing.
NO CONVERTER CLUTCH APPLY	• Electrical	— 12 volts not supplied to transmission. — Outside electrical connector damaged. — Inside electrical connector, wiring harness or solenoid damaged. — Electrical short (pinched solenoid wire). — Solenoid not grounded. — Incorrect or damaged pressure switches.
	• Converter	— Internal damage.
	• Oil Pump Assembly	— Converter clutch apply valve stuck or assembled backwards. — Converter clutch apply valve retaining ring mispositioned. — Pump to case gasket mispositioned. — Orifice cup plug plugged. — Solenoid "O" ring seal cut or damaged. — Orifice cup plug omitted from cooler in passage. — High or uneven bolt torque (pump body to cover).
	• Valve Body Assembly	— Valves stuck. Converter clutch shift valve Throttle valve
	• Input Housing And Shaft	— Turbine shaft "O" ring seal cut or damaged. — Turbine shaft retainer and ball assembly plugged.

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Figure 15 Diagnosis Chart H

CONDITION	INSPECT COMPONENT	FOR CAUSE
CONVERTER SHUDDER	• Torque Converter Assembly	– Internal damage.
	• Valve Body	– Converter clutch shift valve stuck.
	• Oil Pump Assembly	– Converter clutch apply valve stuck. – Restricted oil passage.
	• Oil Filter	– Crack in filter body. – Flash restricting filter neck. – "O" ring seal cut or damaged.
	• Miscellaneous	– Low oil pressure. – Engine not tuned properly.
	• Input Housing And Shaft Assy.	– Turbine shaft "O" ring cut or damaged. – Turbine shaft retainer and ball assembly damaged.
NO CONVERTER CLUTCH RELEASE	• Solenoid	– External ground.
	• Converter	– Internal damage.
	• Oil Pump Assembly	– Converter clutch apply valve stuck.
DRIVES IN NEUTRAL	• Forward Clutch	– Not releasing.
	• Manual Linkage	– Incorrectly adjusted. – Disconnected.
	• Case	– Face not flat. – Internal leakage.
2ND GEAR START (DRIVE RANGE)	• Governor Assembly	– Valve stuck. – Governor support pin too long or missing.
	• Forward Sprag Clutch	– Sprag assembly installed backwards.

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Figure 16 Diagnosis Chart I

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO PARK	• Parking Linkage	– Actuator rod assembly bent or damaged. – Actuator rod spring binding or improperly crimped. – Actuator rod not attached to inside detent lever. – Parking bracket damaged or not torqued properly. – Inside detent lever not torqued properly. – Detent roller mispositioned or not torqued properly. – Parking pawl binding or damaged.
RACHETING NOISE	• Parking Pawl	– Parking pawl return spring weak, damaged or misassembled.
OIL OUT THE VENT	• Oil Pump • Valve Body	– Chamfer in pump body rotor pocket too large. – T.V. limit valve stuck.
VIBRATION IN REVERSE AND WHINING NOISE IN PARK	• Oil Pump	– Broken vane rings.

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Figure 17 Diagnosis Chart J

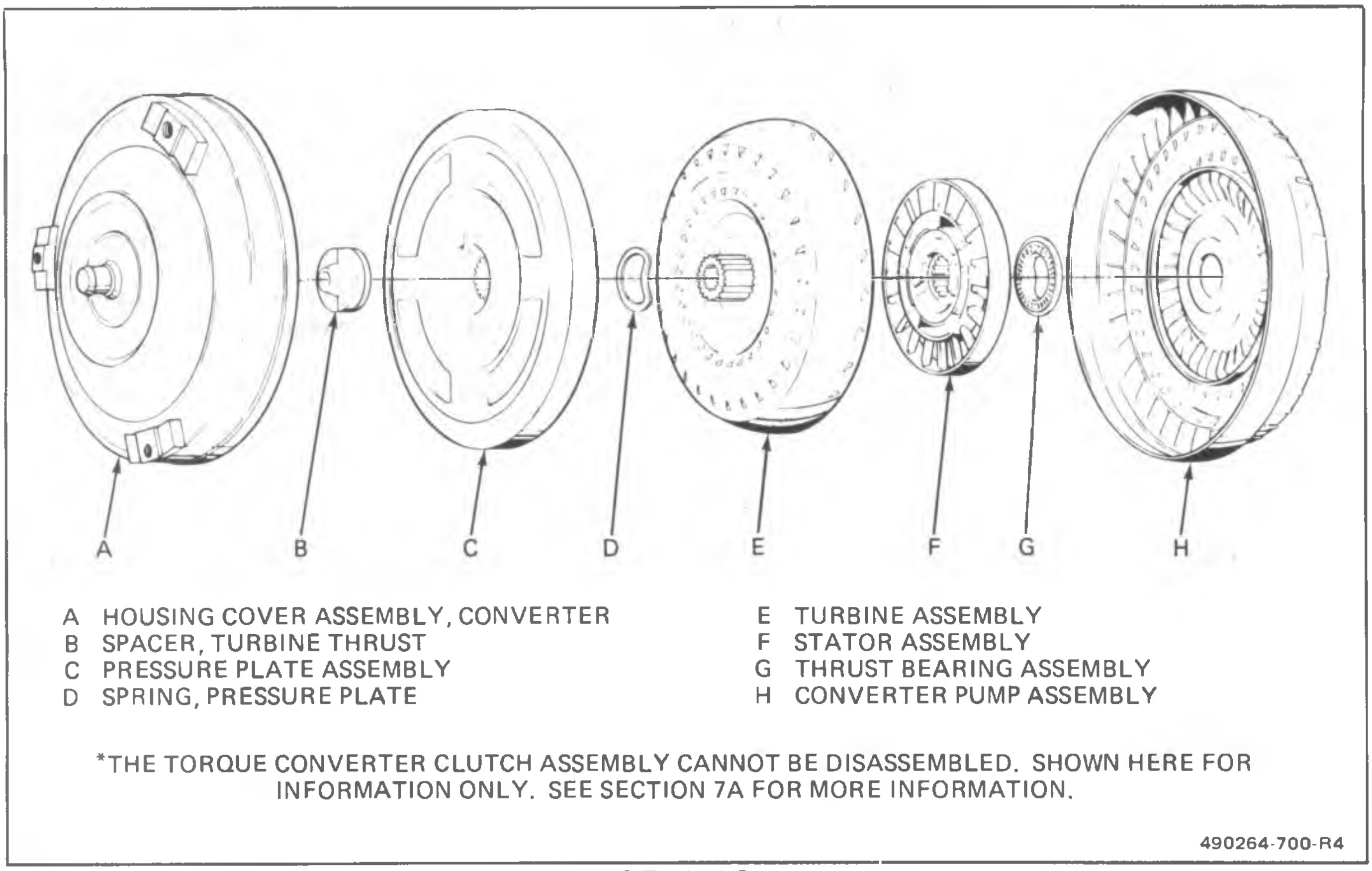


Figure 18 Typical Converter

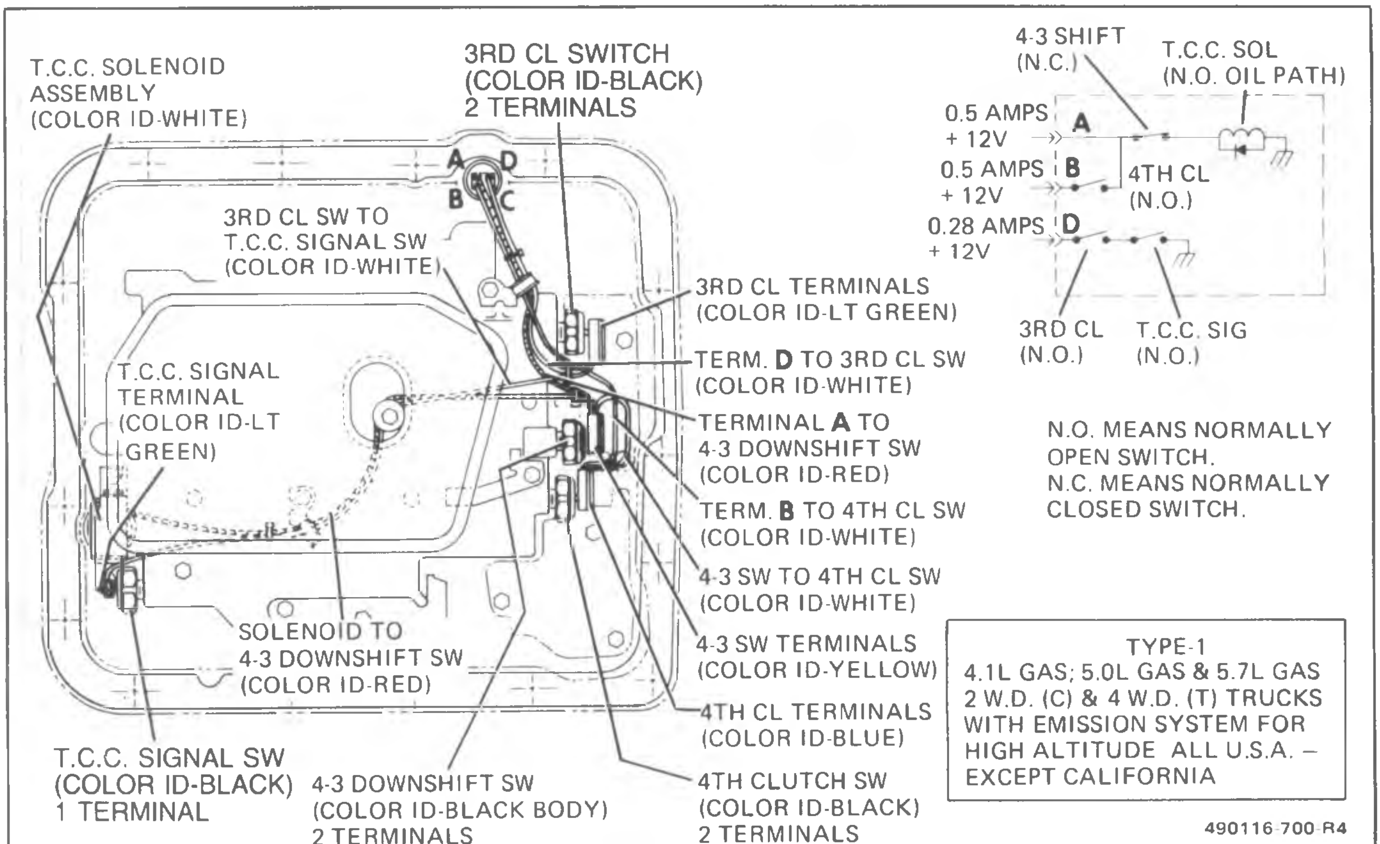


Figure 19 Wiring Diagram - Type 1

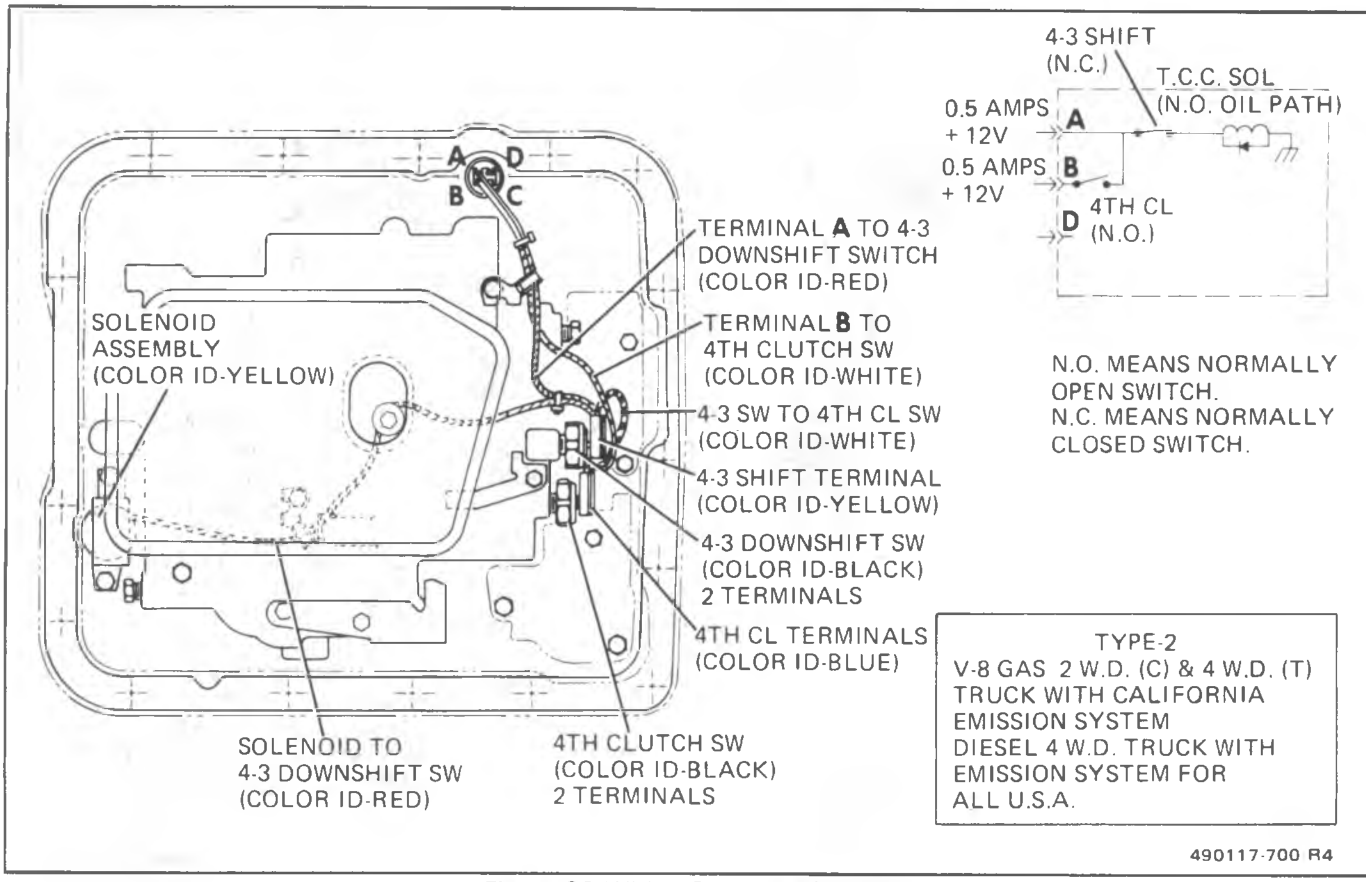


Figure 20 Wiring Diagram - Type 2

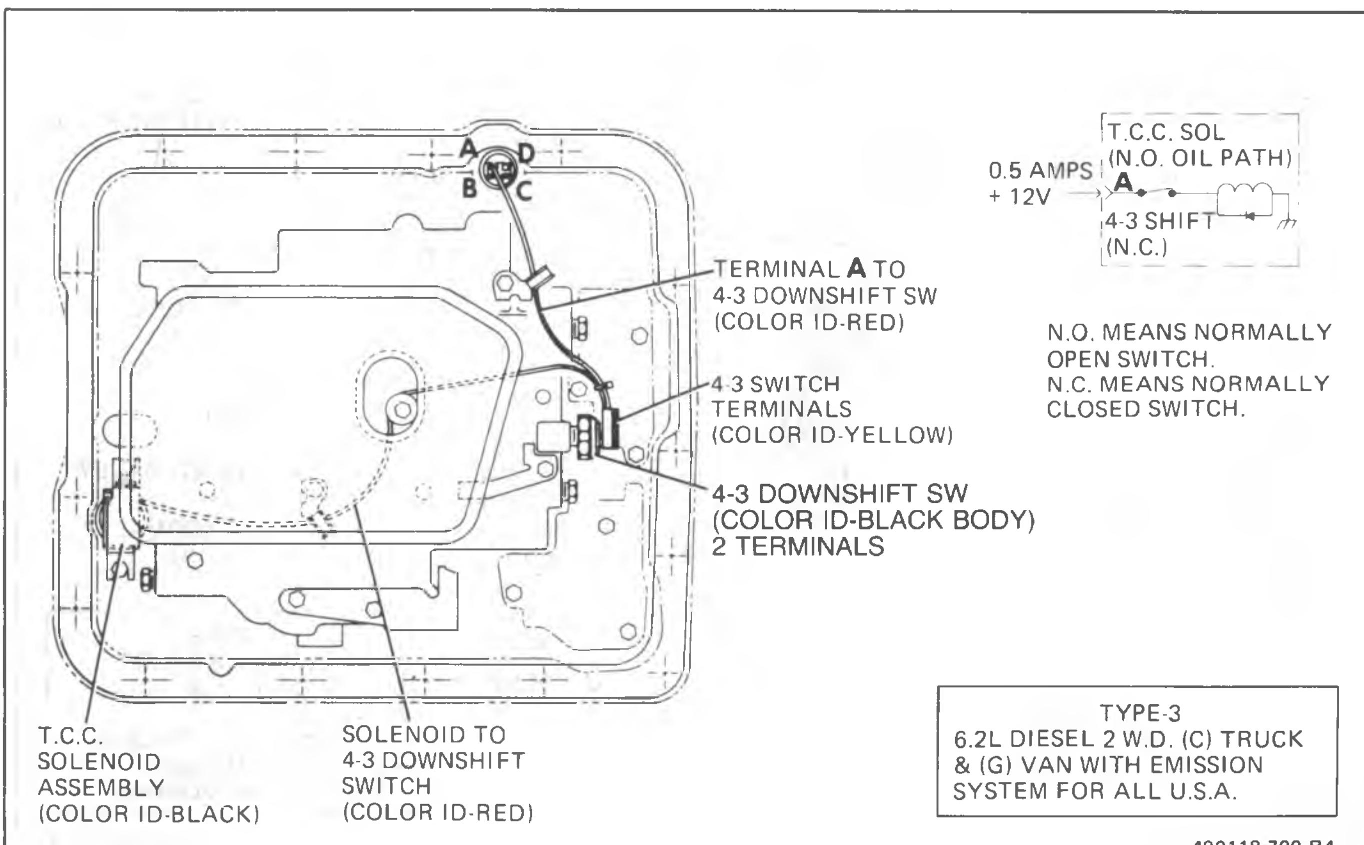


Figure 21 Wiring Diagram - Type 3

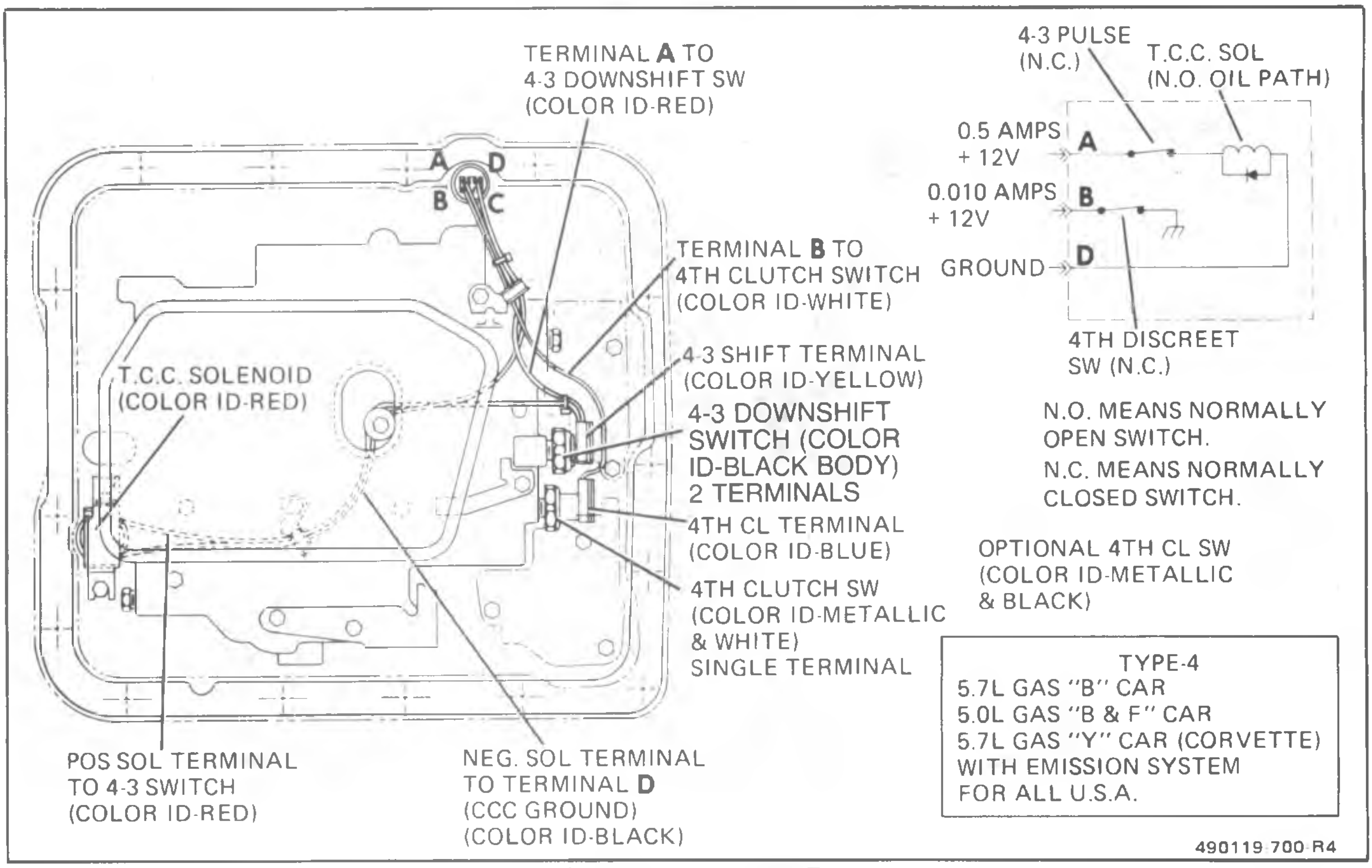


Figure 22 Wiring Diagram - Type 4

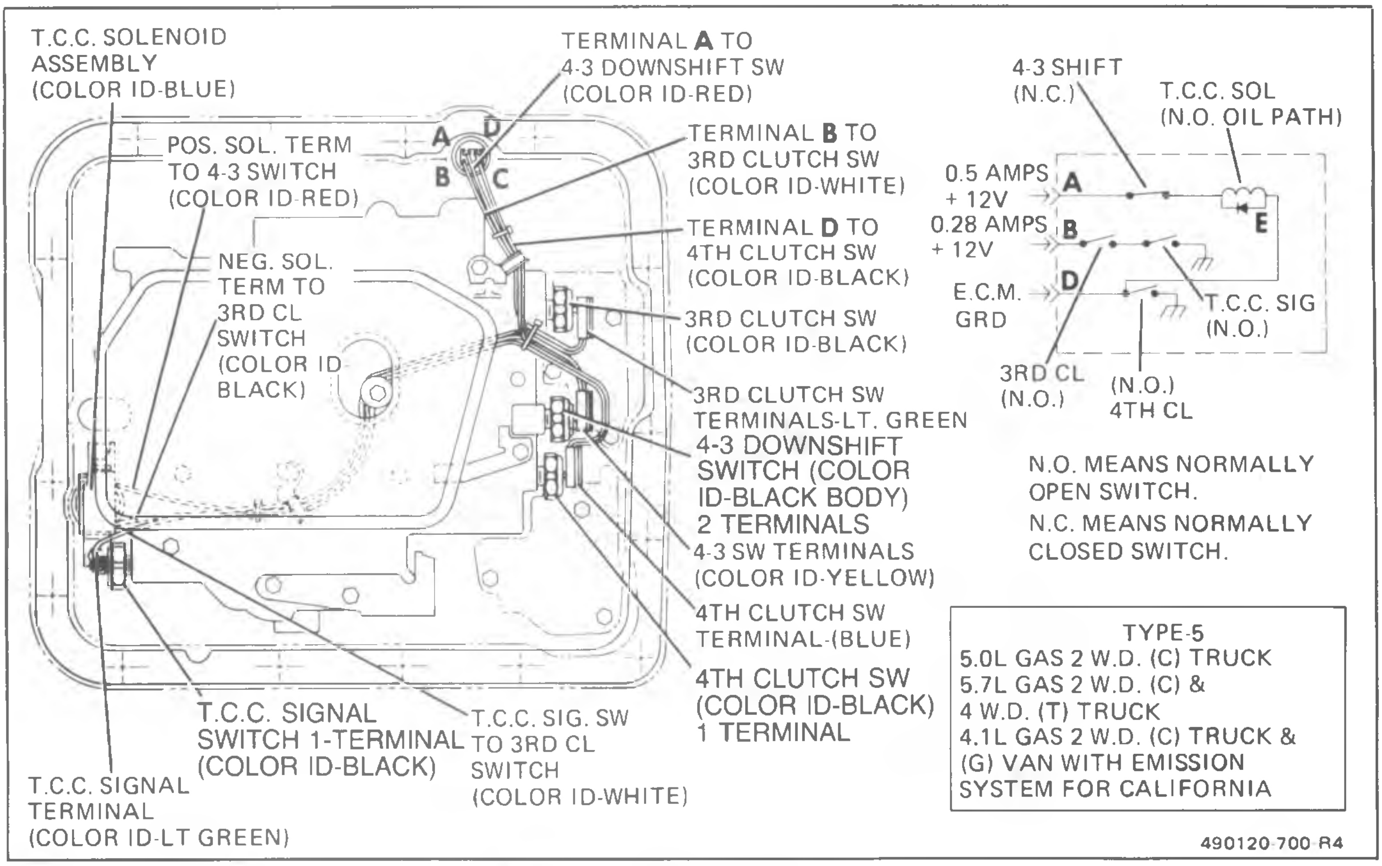


Figure 23 Wiring Diagram - Type 5

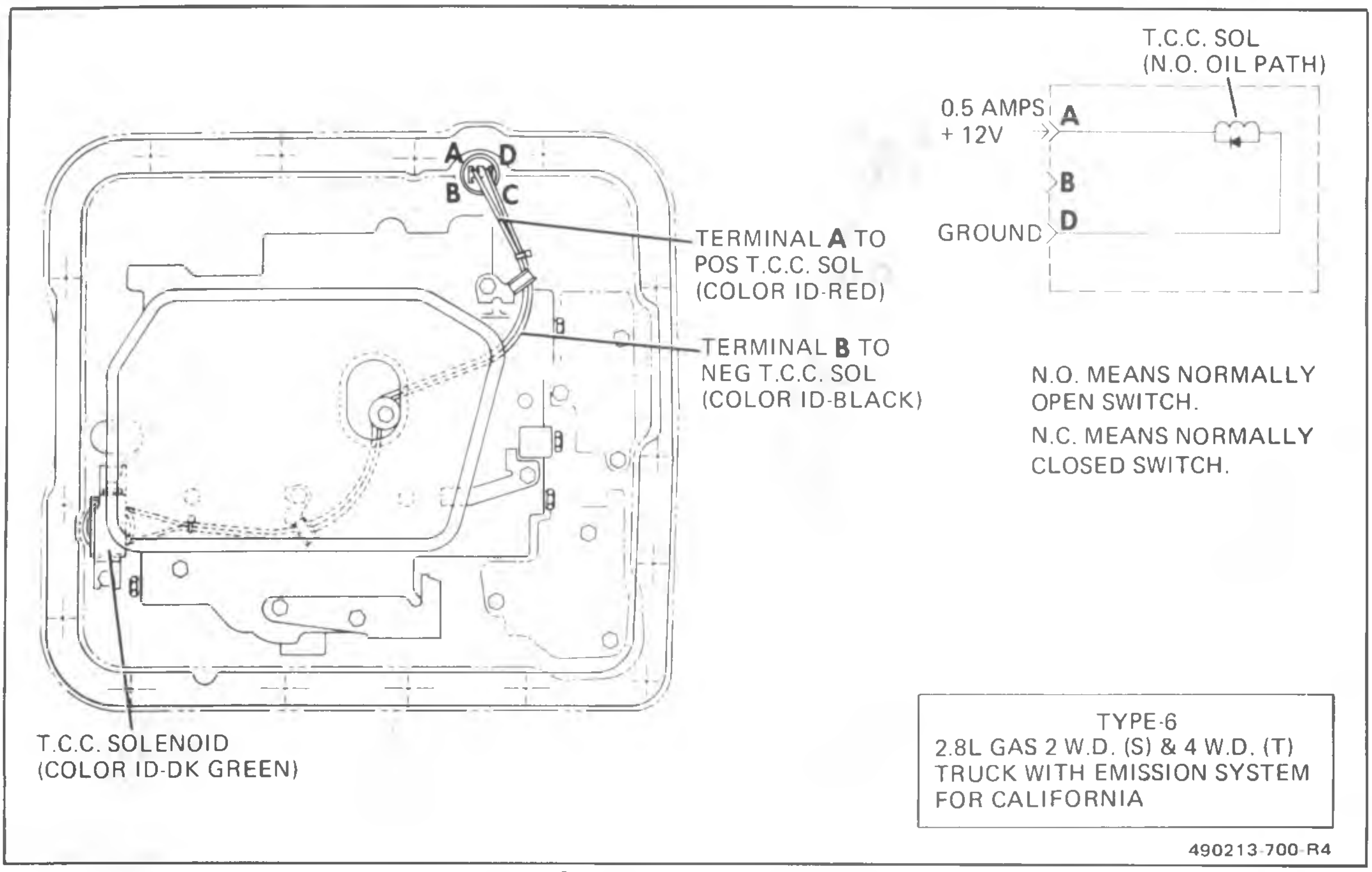


Figure 24 Wiring Diagram - Type 6

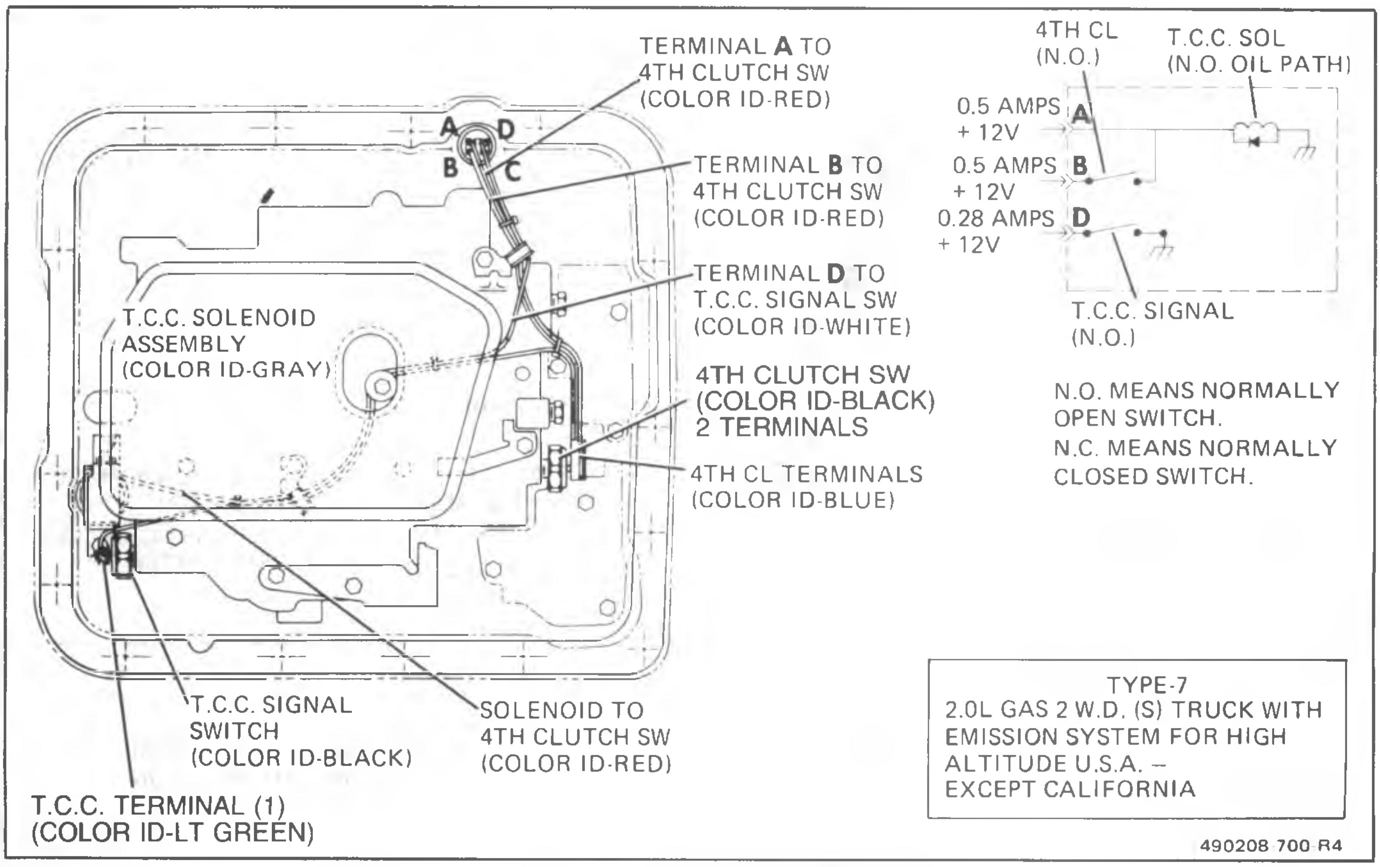


Figure 25 Wiring Diagram - Type 7

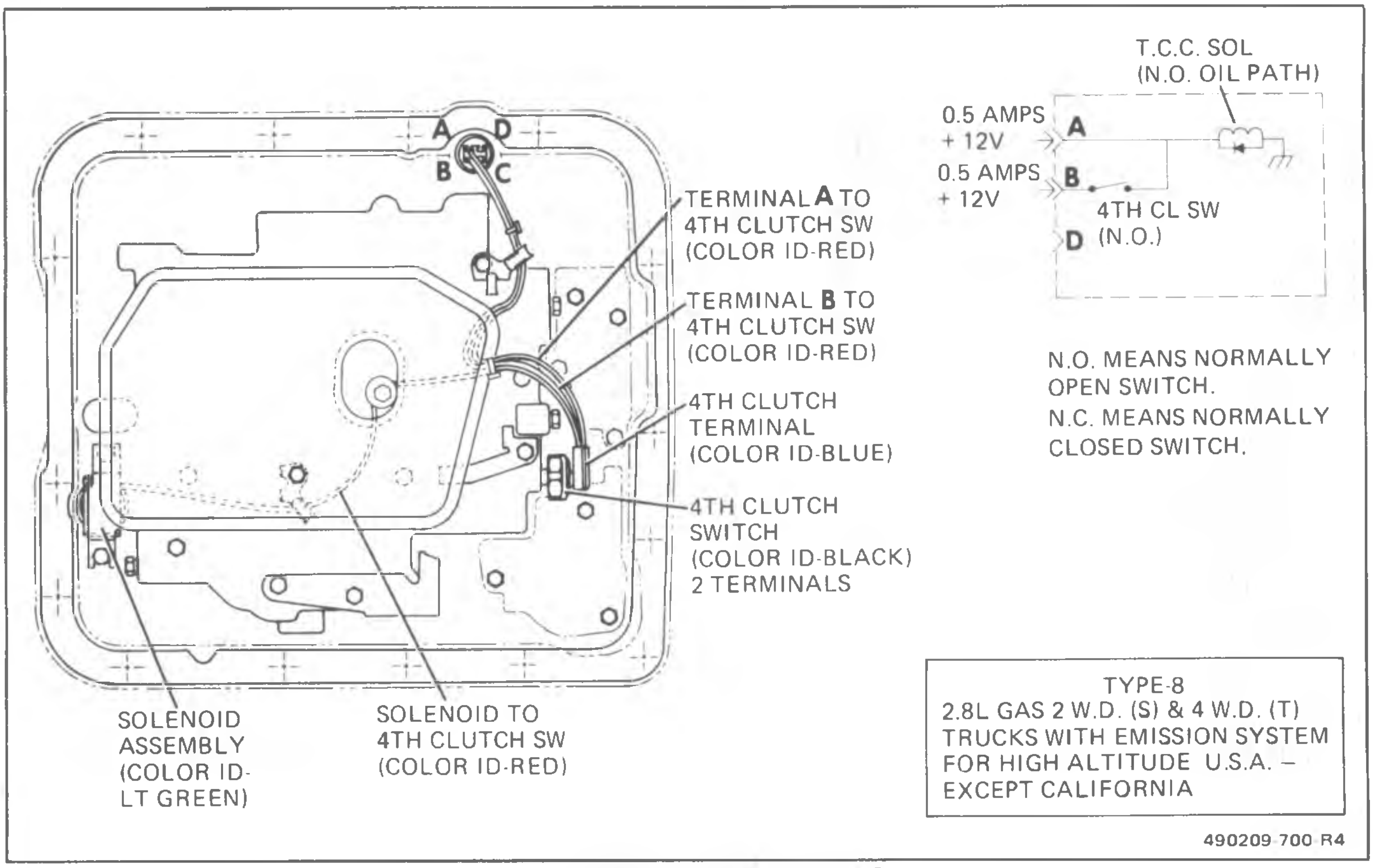


Figure 26 Wiring Diagram - Type 8

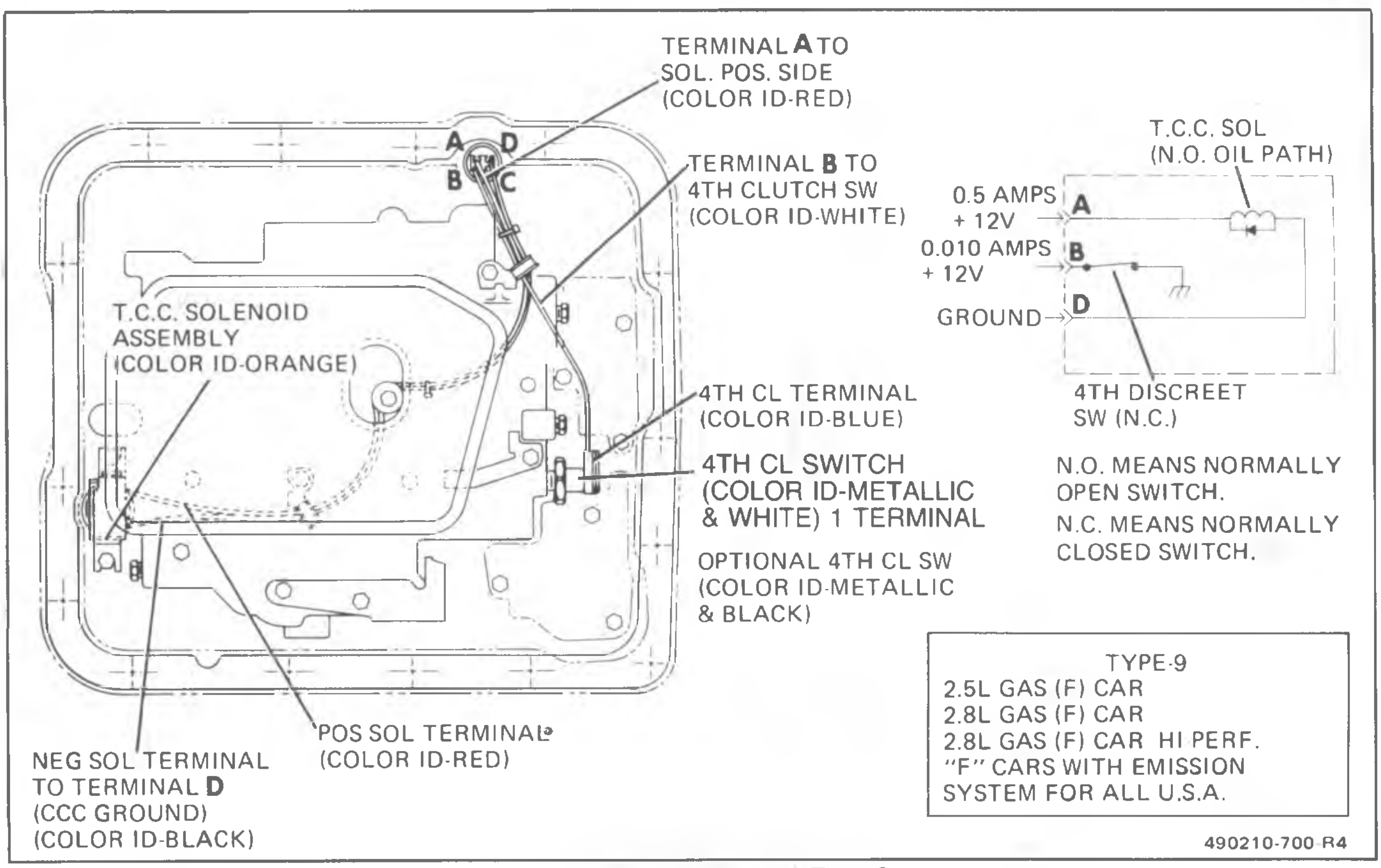


Figure 27 Wiring Diagram - Type 9

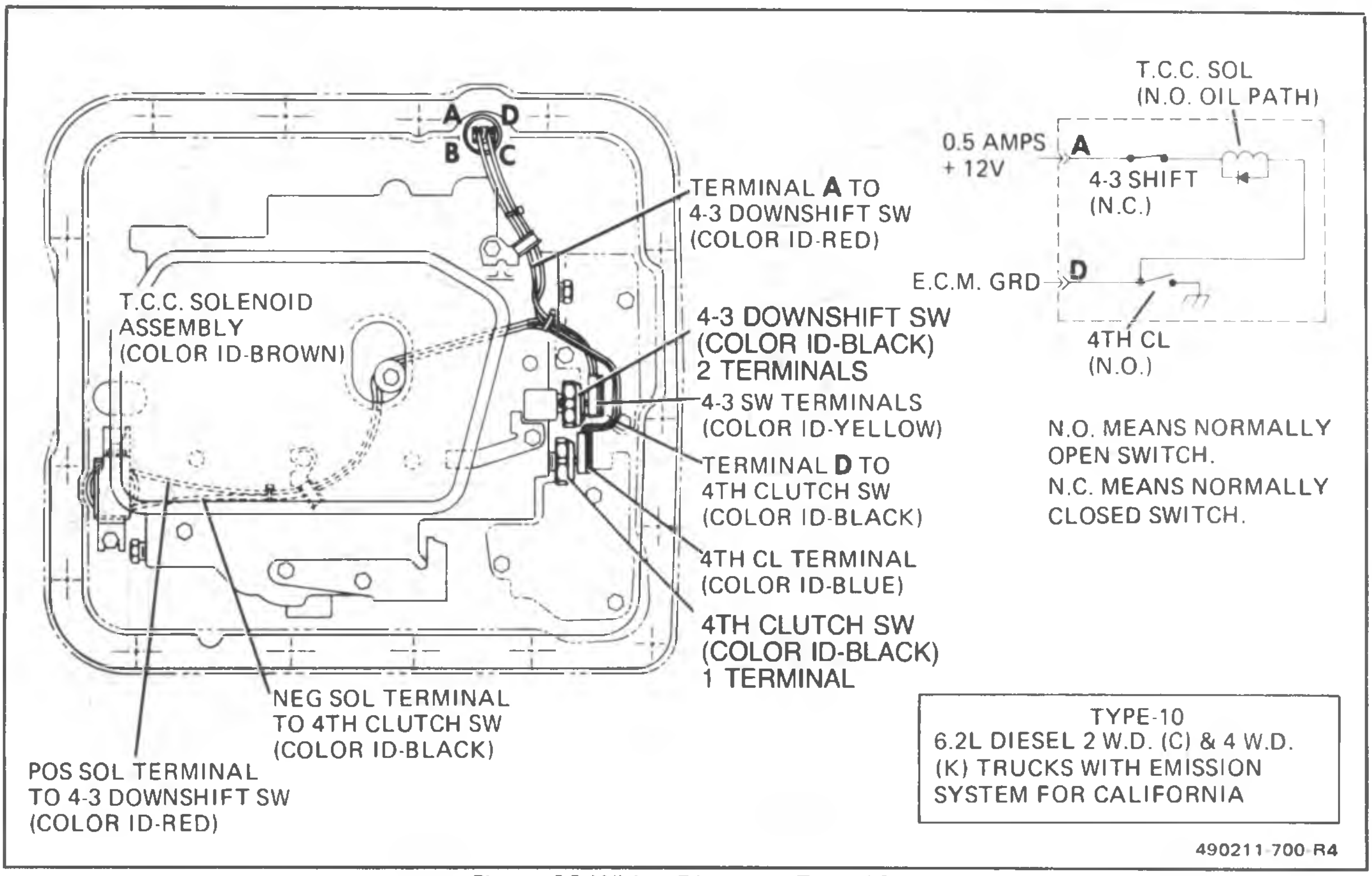


Figure 28 Wiring Diagram - Type 10

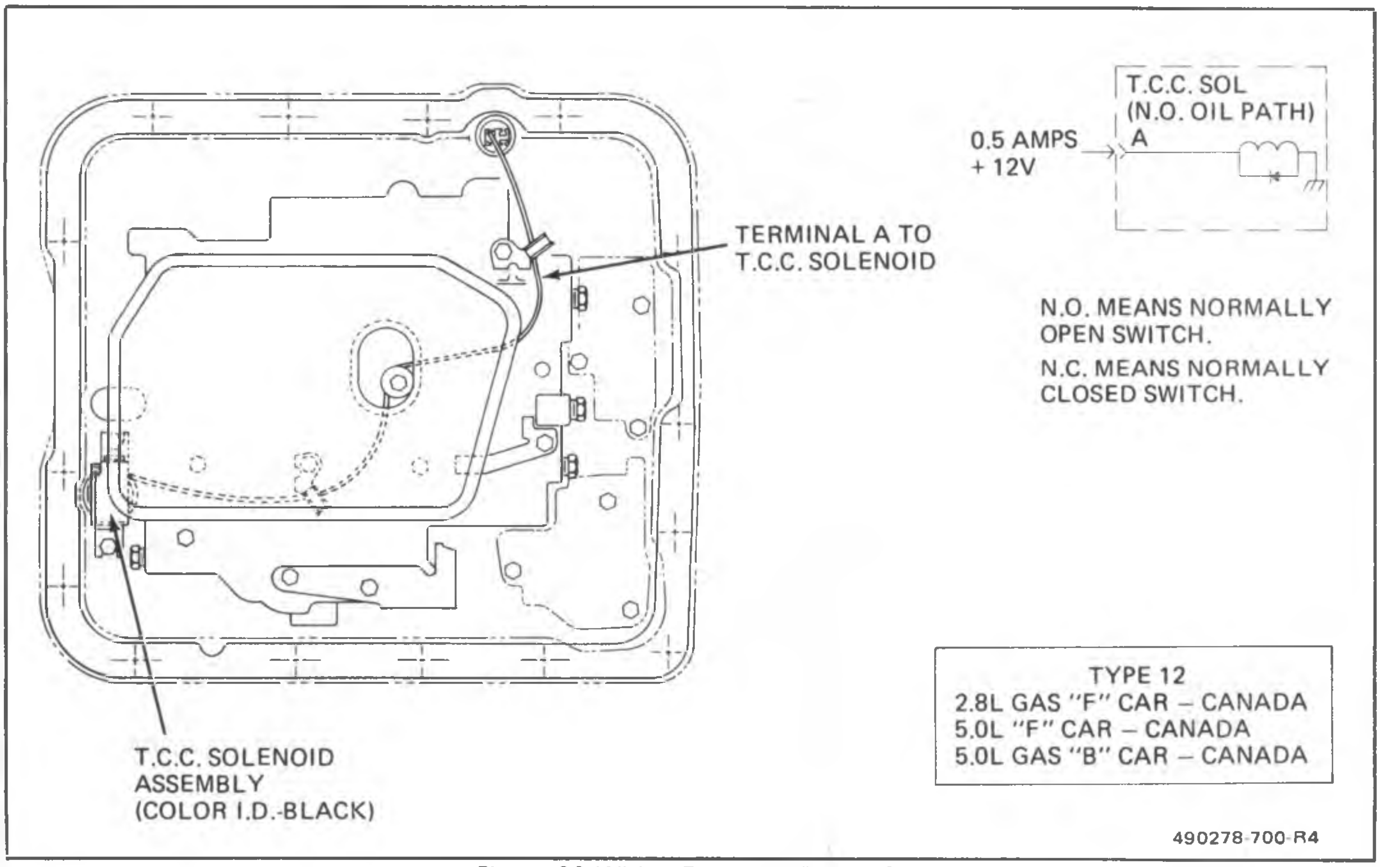
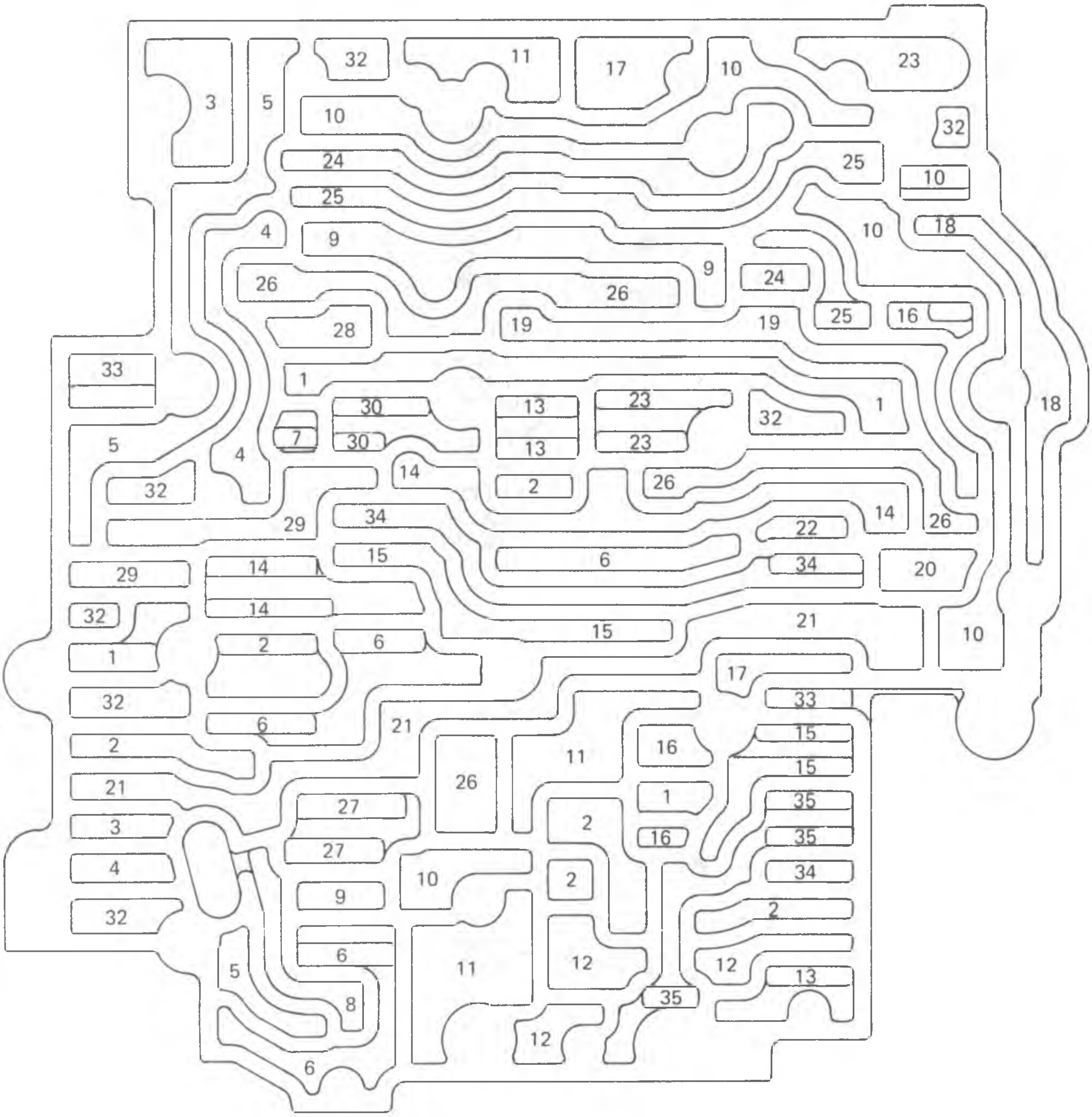


Figure 29 Wiring Diagram - Type 12



ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION
1	LINE	13	4TH SIGNAL	25	MOD. DOWN
2	D4	14	2ND CLUTCH	26	DETENT
3	D2	15	3-4 ACCUMULATOR	27	3-4 CLUTCH
4	LO	16	T.V.F.	28	DETENT/LO
5	REVERSE	17	OVERRUN CLUTCH	29	RND4-3
6	GOVERNOR	18	T.V. EX.	30	3RD CLUTCH
7	LO - 1	19	D3/PART THROTTLE	31	IDENTIFICATION
8	LO/REVERSE	20	PART THROTTLE	32	VOID
9	3RD ACCUMULATOR	21	D3	33	EXHAUST
10	T.V.	22	4TH CLUTCH	34	SF
11	M.T.V.	23	C.C. SIG.	35	4-3
12	ACCUMULATOR	24	MOD. UP		

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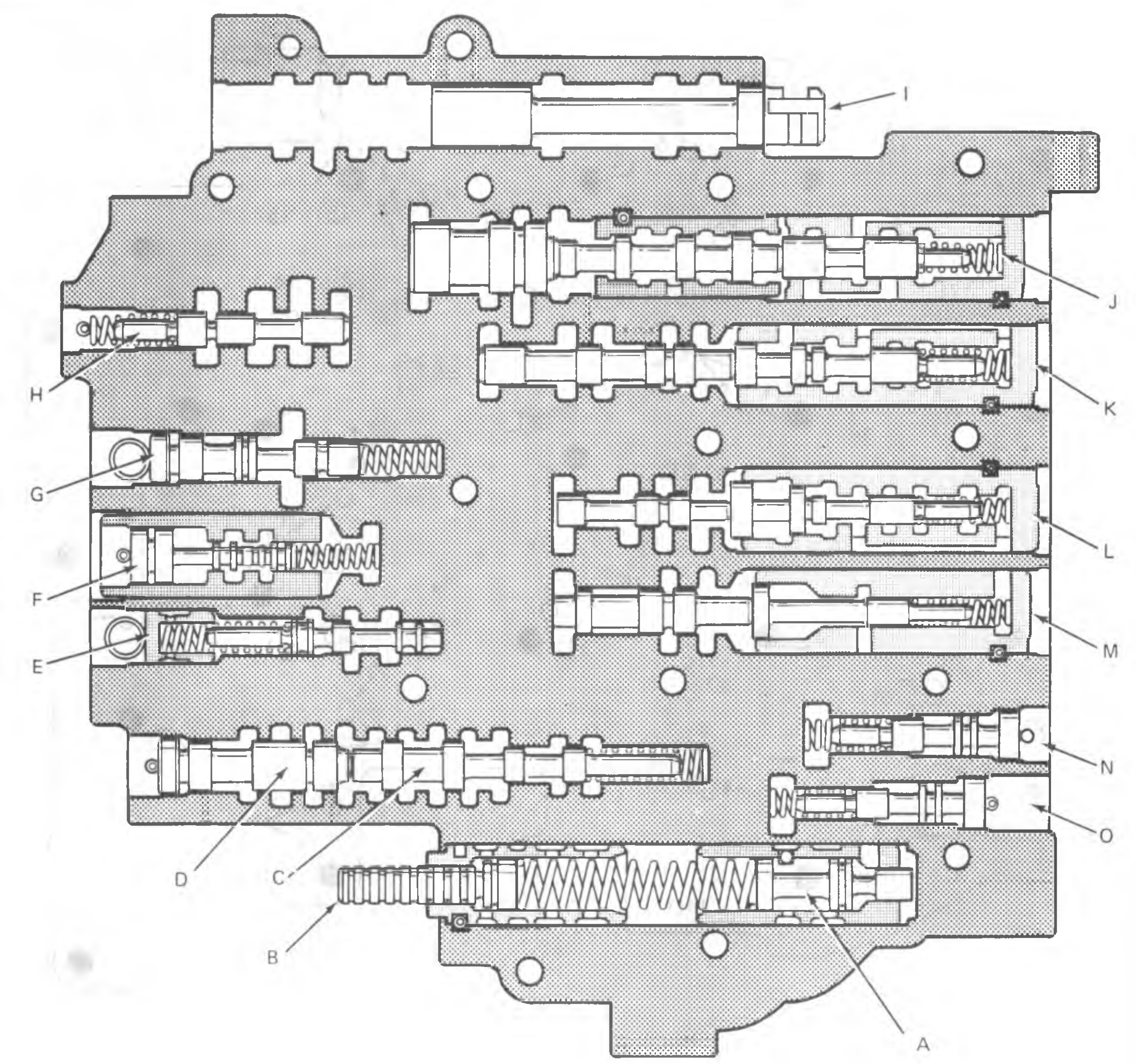
Figure 30 Valve Body Oil Passages



INDICATES VALVE BORE BUSHINGS

ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION
A	THROTTLE VALVE & BUSHING	I	MANUAL VALVE
B	T.V. PLUNGER & BUSHING	J	1 2 SHIFT VALVE TRAIN
C	4-3 SEQUENCE VALVE	K	2 3 SHIFT VALVE TRAIN
D	3-4 RELAY VALVE	L	3-4 SHIFT VALVE TRAIN
E	T.V. LIMIT VALVE TRAIN	M	CONVERTER CLUTCH SHIFT VALVE TRAIN
F	ACCUMULATOR VALVE TRAIN	N	M.T.V. UP VALVE TRAIN
G	LINE BIAS VALVE TRAIN	O	M.T.V. DOWN VALVE TRAIN
H	3-2 CONTROL VALVE TRAIN		

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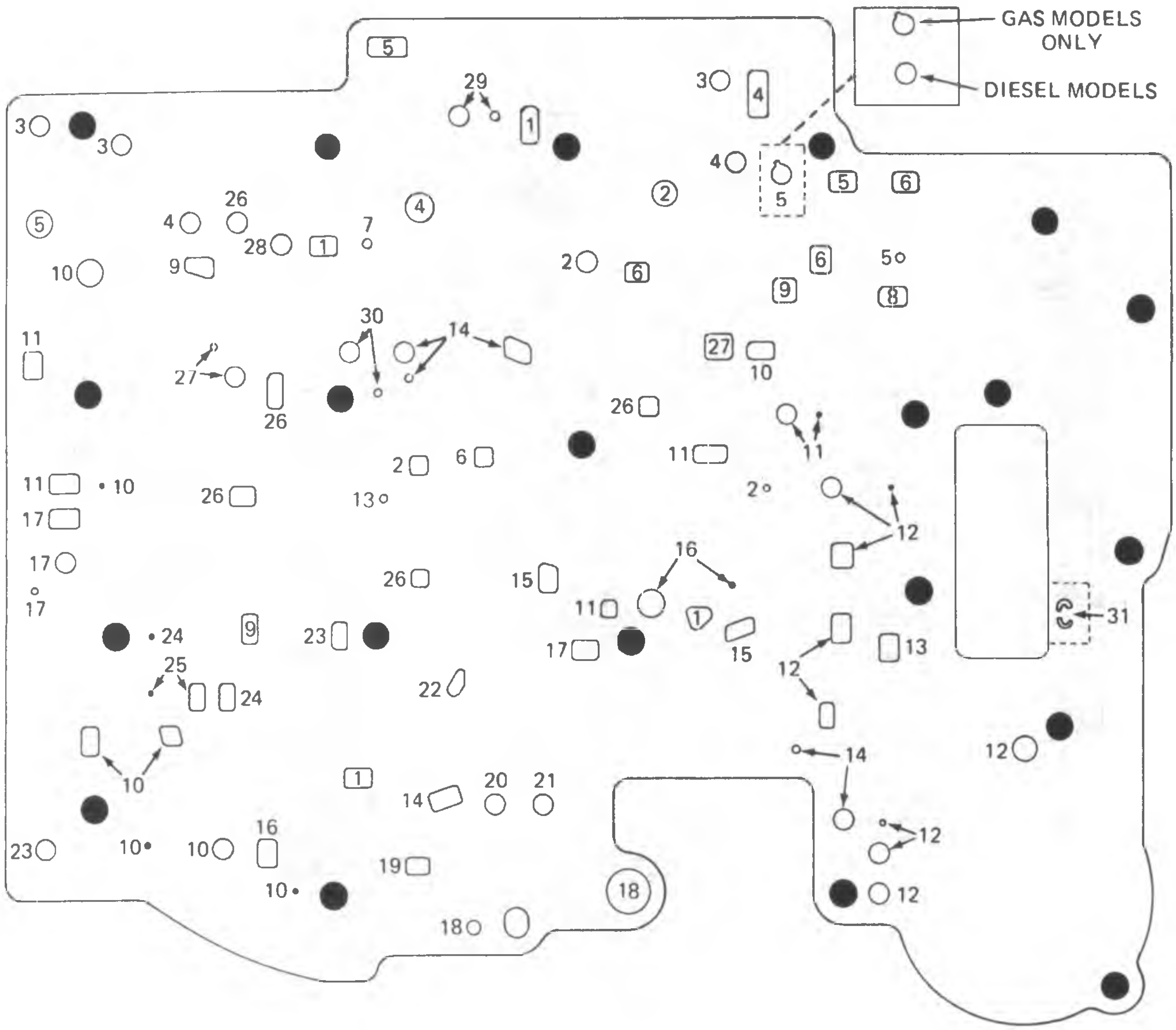
Figure 31 Valve Trains



ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION
1	LINE	12	ACCUMULATOR	22	4TH CLUTCH
2	D4	13	4TH SIGNAL	23	C.C. SIG.
3	D2	14	2ND CLUTCH	24	MOD. UP
4	LO	15	3-4 ACCUMULATOR	25	MOD. DOWN
5	REVERSE	16	T.V.F.	26	DETENT
6	GOVERNOR	17	OVERRUN CLUTCH	27	3-4 CLUTCH
7	LO - 1	18	T.V. EX.	28	DETENT/LO
8	LO/REVERSE	19	D3/PART THROTTLE	29	RND4-3
9	3RD ACCUMULATOR	20	PART THROTTLE	30	3RD CLUTCH
10	T.V.	21	D3	31	IDENTIFICATION
11	M.T.V.				
●	BOLT HOLES				

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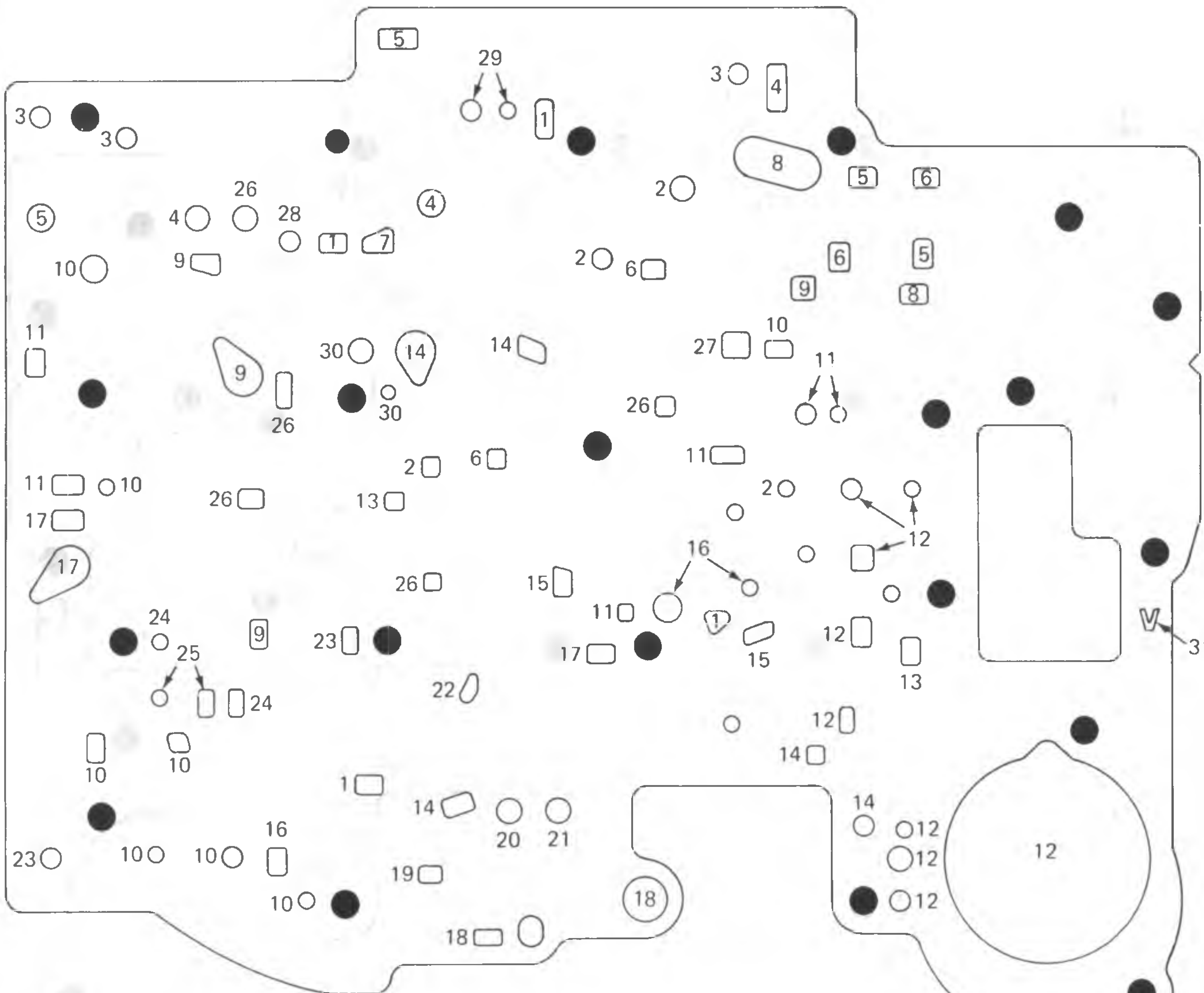
Figure 32 Typical Spacer Plate



ILL. NO.	DESCRIPTION
1	LINE
2	D4
3	D2
4	LO
5	REVERSE
6	GOVERNOR
7	LO - 1
8	LO/REVERSE
9	3RD ACCUMULATOR
10	T.V.
11	M.T.V.
●	BOLT HOLES

ILL. NO.	DESCRIPTION
12	ACCUMULATOR
13	4TH SIGNAL
14	2ND CLUTCH
15	3-4 ACCUMULATOR
16	T.V.F.
17	OVERRUN CLUTCH
18	T.V. EX.
19	D3/PART THROTTLE
20	PART THROTTLE
21	D3

ILL. NO.	DESCRIPTION
22	4TH CLUTCH
23	C.C. SIG.
24	MOD. UP
25	MOD. DOWN
26	DETENT
27	3-4 CLUTCH
28	DETENT/LO
29	RND4-3
30	3RD CLUTCH
31	IDENTIFICATION

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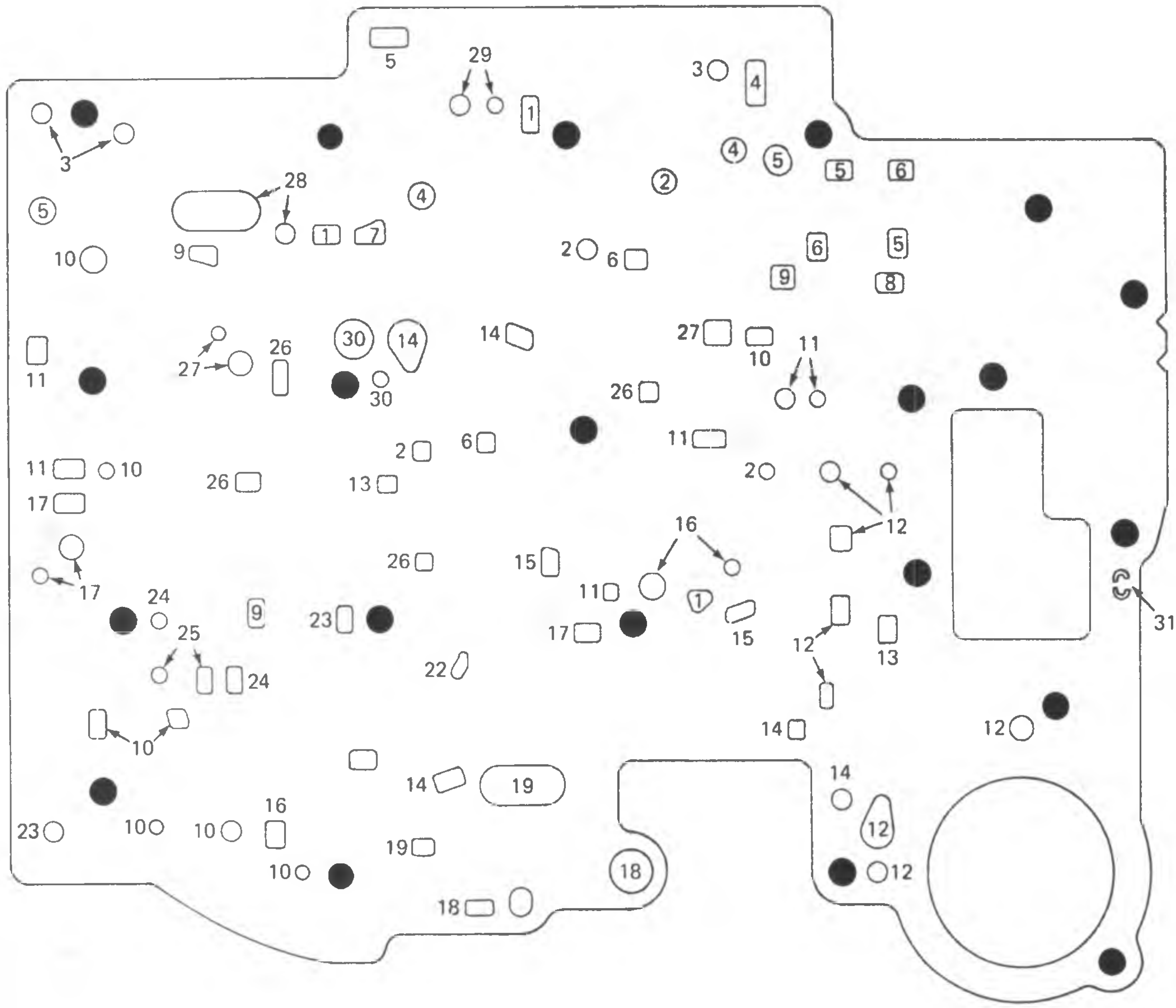
Figure 33 Spacer Plate to Valve Body Gasket



ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION
1	LINE	12	ACCUMULATOR	22	4TH CLUTCH
2	D4	13	4TH SIGNAL	23	C.C. SIG.
3	D2	14	2ND CLUTCH	24	MOD. UP
4	LO	15	3-4 ACCUMULATOR	25	MOD. DOWN
5	REVERSE	16	T.V.F.	26	DETENT
6	GOVERNOR	17	OVERRUN CLUTCH	27	3-4 CLUTCH
7	LO - 1	18	T.V. EX.	28	DETENT/LO
8	LO/REVERSE	19	D3/PART THROTTLE	29	RND4-3
9	3RD ACCUMULATOR	20	PART THROTTLE	30	3RD CLUTCH
10	T.V.	21	D3	31	IDENTIFICATION
11	M.T.V.				
●	BOLT HOLES				

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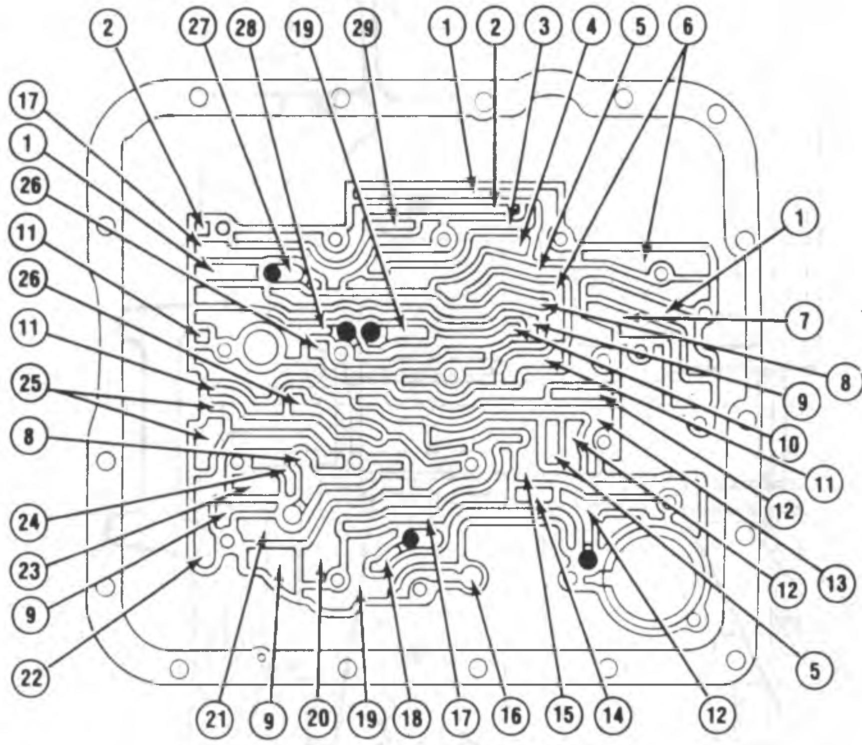
Figure 34 Spacer Plate to Case Gasket



1. REVERSE
2. D-2
3. LO
4. LO-1
5. D-4
6. GOVERNOR
7. LO REVERSE
8. 3 ACCUMULATOR
9. TV
10. 3-4 CLUTCH
11. MTV
12. ACCUMULATOR (4TH) — #1●
13. 4 SIG.
14. VOID
15. 3-4 ACCUMULATOR
16. TV – EX
17. LINE
18. PART THROTTLE-DRIVE 3 — #3●
19. 2ND (1-2) — #8●
20. TVF
21. 4TH
22. CC SIG.
23. MOD. DN.
24. MOD. UP
25. OR CLUTCH
26. DETENT
27. DET/LO — #9●
28. 3-4 CLUTCH (3-2 EX) — #4●
29. RND. 4-3

● CHECK BALLS

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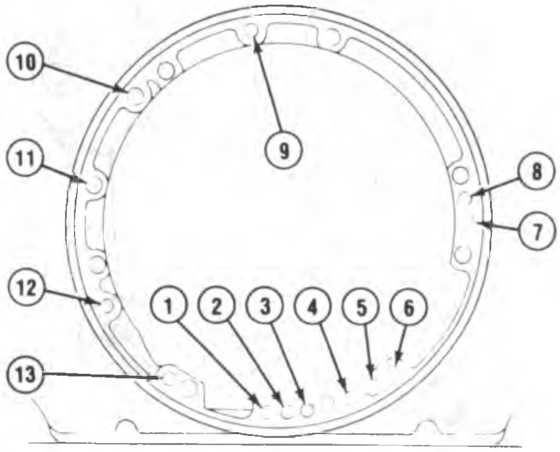
Figure 35 Case Oil Passages and Checkball Locations



CASE OIL PASSAGES

(1) 1-2-3 CLUTCH	(8) VOID
(2) M.T.V.	(9) VENT
(3) 3-4 CLUTCH	(10) LUBE (FROM COOLER)
(4) REVERSE	(11) TO COOLER
(5) LINE	(12) CONV. CL. SIG.
(6) DR-2	(13) O.R. CLUTCH
(7) LINE	

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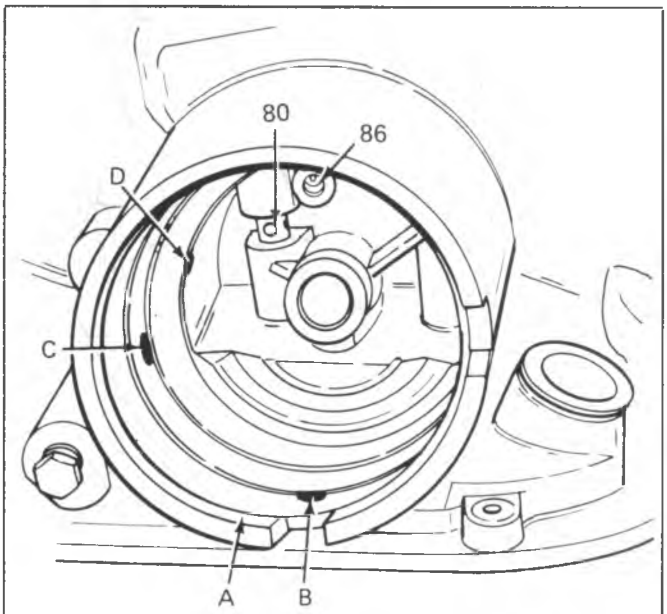
Figure 36 Pump to Case Oil Passages



A 2-4 SERVO BORE
B SERVO EXHAUST HOLE
C 2ND & 4TH BAND APPLY PASSAGE
D 3RD ACCUMULATOR PRESSURE TAP PASSAGE
80 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
86 PLUG, CASE SERVO

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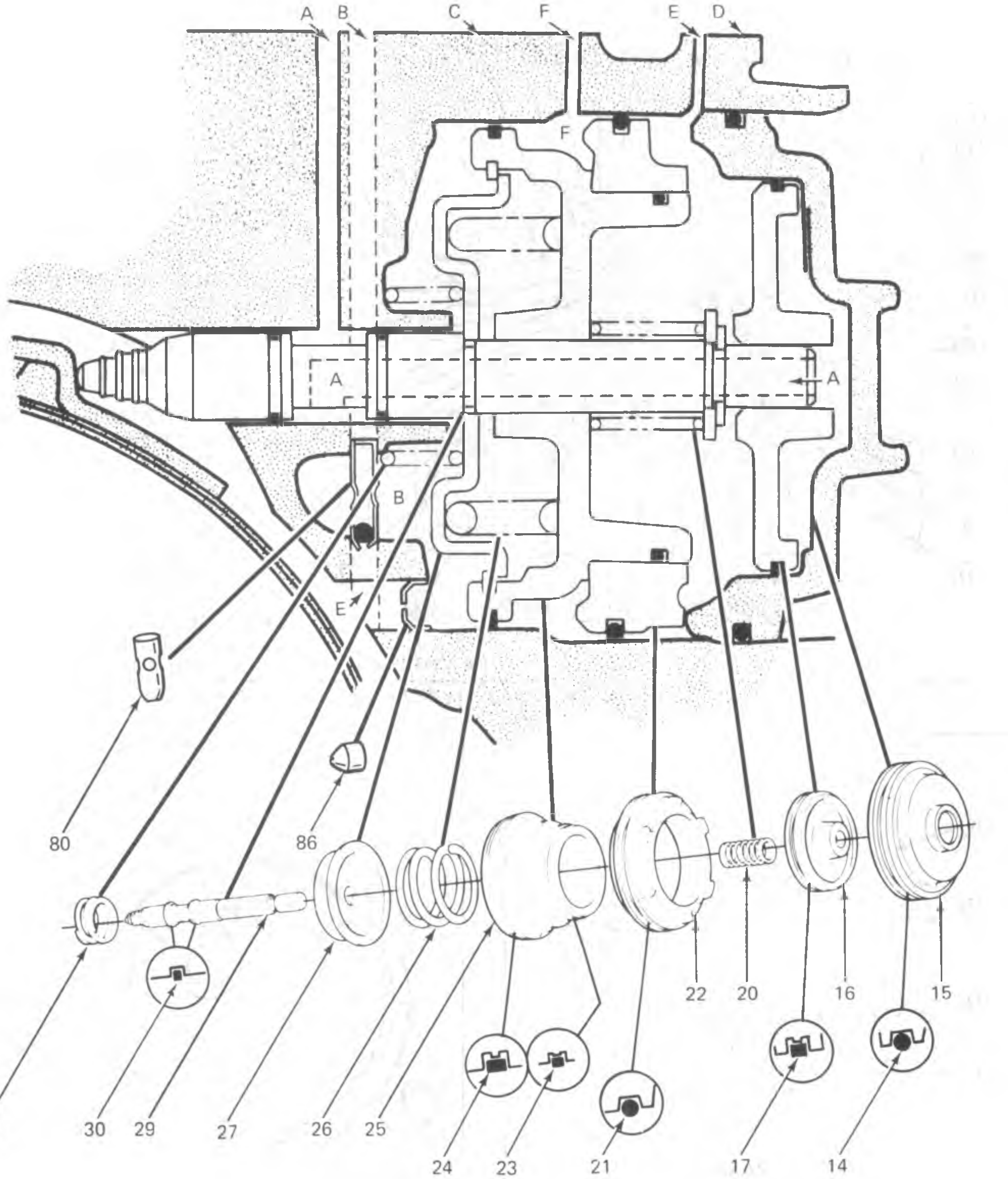
Figure 37 Servo Oil Passages



A 4TH OIL
B 3RD ACCUMULATOR, OIL
C VALVE BODY FACE
D OIL PAN FLANGE
E EXHAUST
F 2ND OIL
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON INNER
23 RING, OIL SEAL INNER (2ND APPLY PISTON)
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
29 PIN, 2ND APPLY PISTON
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN
80 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
86 PLUG, CASE SERVO

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Figure 38 Servo Assembly

1. VENT
2. LINE
3. DEC
4. EXHAUST
5. REV. CLUTCH
6. D-2
7. M.T.V.
8. 3-4 CLUTCH
9. O.R. CLUTCH
10. SEAL DRAIN
11. VOID
12. CONV. CLU. SIG.
13. TO COOLER
14. CONV. CLU. REL.
15. LUBE
16. CONV. FEED

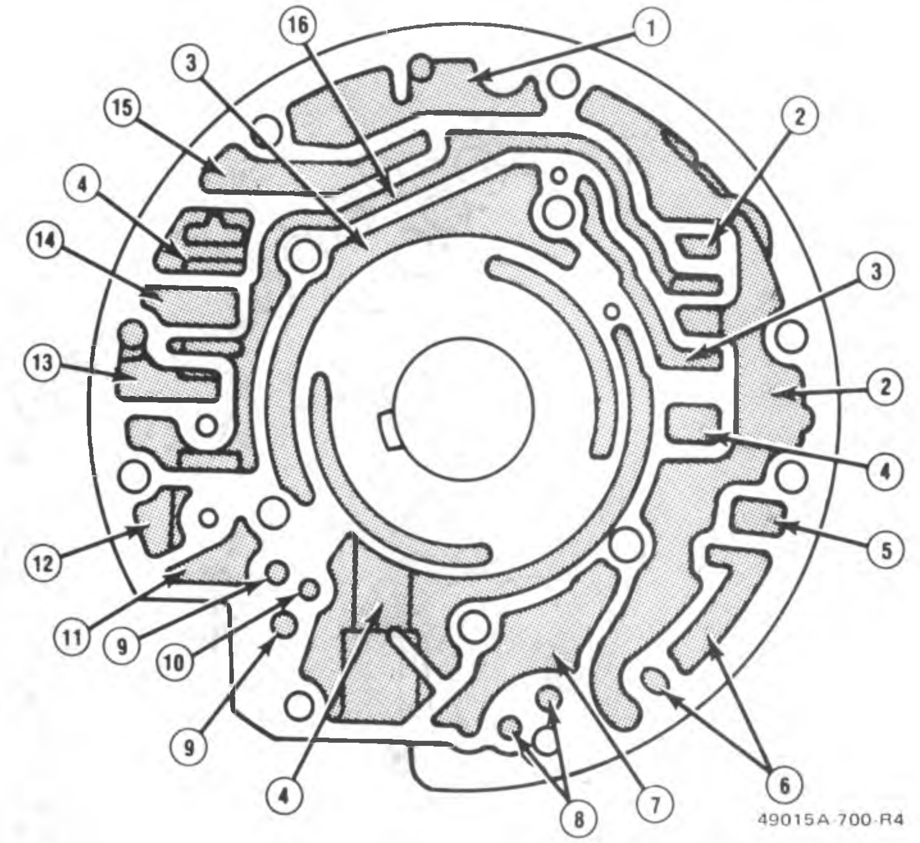

Figure 39 Pump Cover Oil Passages

1. CONV. FEED
2. VENT
3. LUBE
4. EXHAUST
5. CONV. CLU. REL.
6. TO COOLER
7. CONV. CW. SIG.
8. VOID
9. SEAL DRAIN
10. O.R. CLU
11. 3-4 CLUTCH
12. M.T.V.
13. D-2
14. REV. CLUTCH
15. LINE
16. DEC.

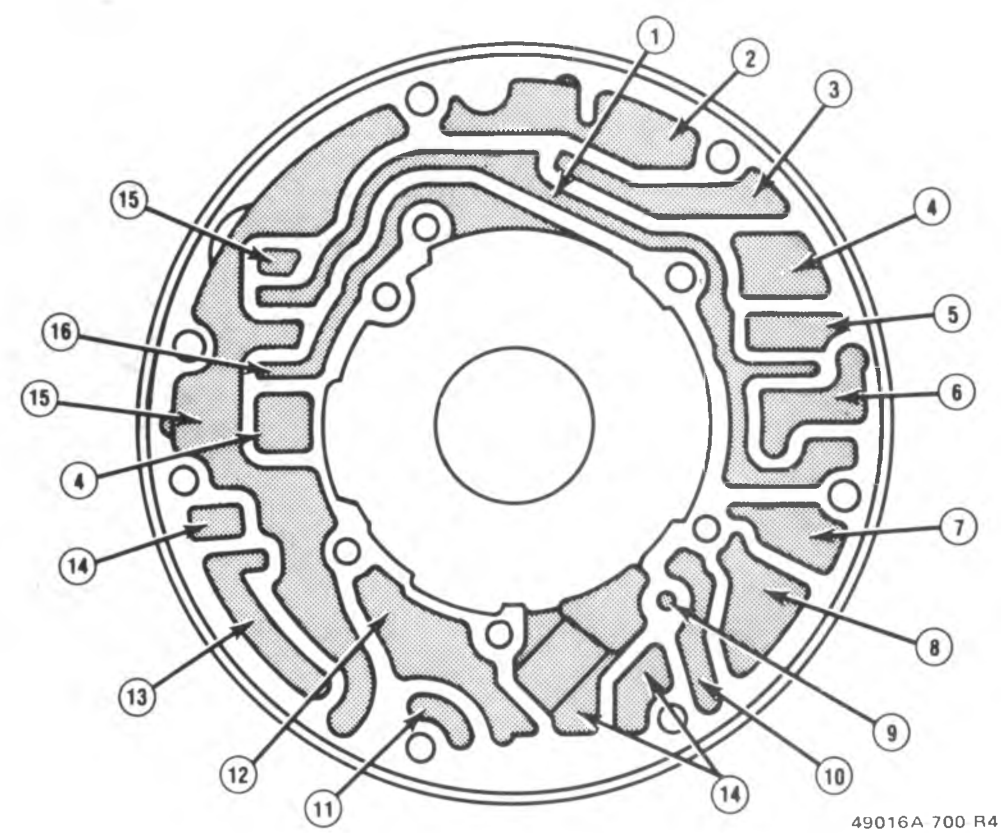

Figure 40 Pump Body Oil Passages

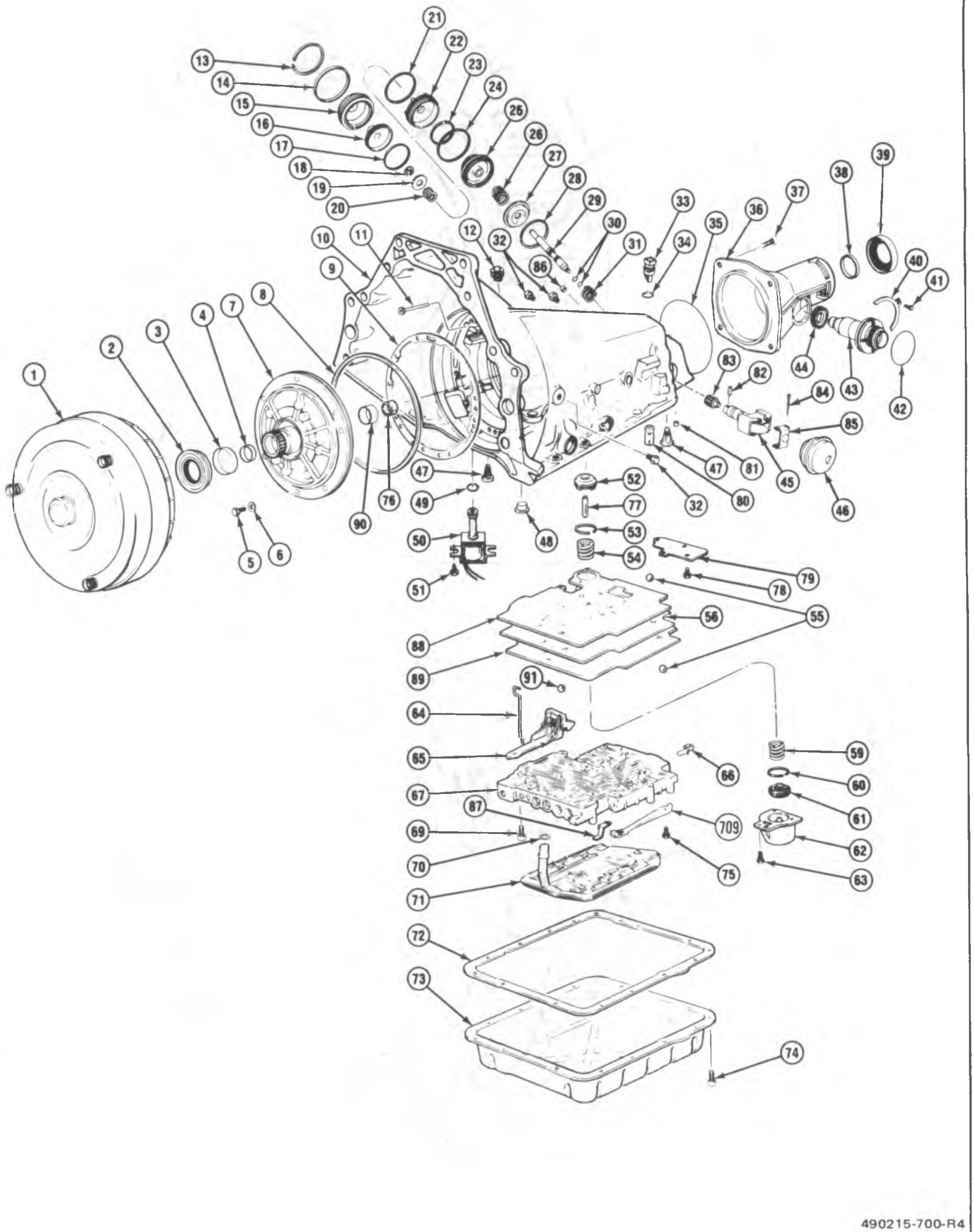

Figure 4 1 Case and External Parts

ILL. NO.	DESCRIPTION	ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY	46	COVER, GOVERNOR
2	SEAL ASSEMBLY, OIL	47	SCREEN, TRANSMISSION OIL PRESSURE (CONVERTER & GOVERNOR)
3	BUSHING, OIL PUMP BODY	48	PIN, BAND ANCHOR
4	BUSHING, STATOR SHAFT – FRONT	49	SEAL, "O" RING (SOLENOID)
5	BOLT, PUMP TO CASE	50	SOLENOID ASSEMBLY
6	WASHER, PUMP TO CASE BOLT	51	BOLT, HEX WASHER HEAD (SOLENOID)
7	PUMP ASSEMBLY, OIL	52	PISTON, ACCUMULATOR (3 4)
8	SEAL, OIL (PUMP TO CASE)	53	RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
9	GASKET, PUMP COVER TO CASE	54	SPRING, 3-4 ACCUMULATOR
10	CASE, TRANSMISSION	55	BALL (.25 DIAMETER)
11	VENT ASSEMBLY, TRANSMISSION	56	PLATE, VALVE BODY SPACER
12	CONNECTOR, OIL COOLER PIPE	59	SPRING, 1-2 ACCUMULATOR
13	RING, SERVO COVER RETAINING	60	RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
14	SEAL, "O" RING (2-4 SERVO COVER)	61	PISTON, 1 2 ACCUMULATOR
15	COVER, 2 4 SERVO	62	COVER & PIN ASSEMBLY, 1-2 ACCUM.
16	PISTON, 4TH APPLY	63	BOLT, ACCUMULATOR COVER
17	RING, OIL SEAL OUTER (4TH APPLY PISTON)	64	LINK, THROTTLE LEVER TO CABLE
18	RING, RETAINER (APPLY PIN)	65	LEVER & BRACKET ASSEMBLY, THROTTLE
19	WASHER, SERVO APPLY PIN	66	CLIP, ELECTRICAL WIRE
20	SPRING, SERVO APPLY PIN	67	VALVE ASSEMBLY, CONTROL BODY
21	SEAL, "O" RING	69	BOLT, VALVE BODY
22	HOUSING, SERVO PISTON – INNER	70	SEAL, "O" RING FILTER
23	RING, OIL SEAL – INNER (2ND APPLY PISTON)	71	FILTER ASSEMBLY, TRANSMISSION OIL
24	RING, OIL SEAL – OUTER (2ND APPLY PISTON)	72	GASKET, TRANSMISSION OIL PAN
25	PISTON, 2ND APPLY	73	PAN, TRANSMISSION OIL
26	SPRING, SERVO CUSHION	74	SCREW, SPEC. HEX WASHER HEAD (PAN)
27	RETAINER, SERVO CUSHION SPRING	75	BOLT, MANUAL DETENT SPRING
28	RING, RETAINER (2ND APPLY PISTON)	76	BUSHING, CASE
29	PIN, 2ND APPLY PISTON	77	PIN, ACCUMULATOR PISTON
30	SEAL, 2ND APPLY PISTON PIN	78	BOLT, OIL PASSAGE COVER
31	SPRING, SERVO RETURN	79	COVER, OIL PASSAGE
32	PLUG, PRESSURE	80	RETAINER & BALL ASSEMBLY, 3RD ACCUM.
33	CONNECTOR, ELECTRICAL	81	PLUG, TRANSMISSION CASE ACCUM. BLEED
34	SEAL, "O" RING (ELECTRICAL CONNECTION)	82	PIN, GOVERNOR GEAR RETAINER
35	SEAL, CASE EXTENSION TO CASE	83	GEAR, GOVERNOR DRIVEN
36	EXTENSION, CASE	84	PIN, GOVERNOR WEIGHT
37	BOLT, CASE EXTENSION TO CASE	85	CAP, GOVERNOR THRUST
38	BUSHING, CASE EXTENSION	86	PLUG, CASE SERVO
39	SEAL ASSEMBLY, CASE EXTENSION OIL	87	CLIP, FILTER RETAINER
40	RETAINER, SPEEDO DRIVEN GEAR FITTING	88	GASKET, SPACER PLATE TO CASE
41	BOLT & WASHER ASSEMBLY	89	GASKET, SPACER PLATE TO VALVE BODY
42	SEAL, "O" RING (SPEEDO CASE TO CASE EXTENSION)	90	BUSHING, STATOR SHAFT – REAR
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR	91	BALL, CARBON STEEL – T.V. EXHAUST
44	GEAR, SPEEDO DRIVEN	709	SPRING ASSEMBLY, MANUAL DETENT
45	GOVERNOR ASSEMBLY		

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Figure 41L

TRANSMISSION DISASSEMBLY

General Service Information

- Teflon Oil Seal Rings

  If any seal rings are damaged, cut, or do not rotate freely in their groove be certain to check the ring groove for debris, burrs, or damage.

- Thrust Washer Surfaces

  The thrust washer and thrust bearing surfaces may appear to be polished. This is a normal condition and should not be considered damage.

Clean

- Thoroughly clean the exterior of the transmission.

Remove or Disconnect

- Torque Converter

Install or Connect (Figure 42)

Tools Required:

J-8763-02 Holding Fixture and Base

1. J-8763-02 onto the transmission case.
2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid.

EXTERNAL PARTS

2-4 Servo Assembly

Remove or Disconnect (Figures 41, 41L, and 43)

TOOLS REQUIRED:

J-29714 Servo Cover Compressor

1. Install J-29714.

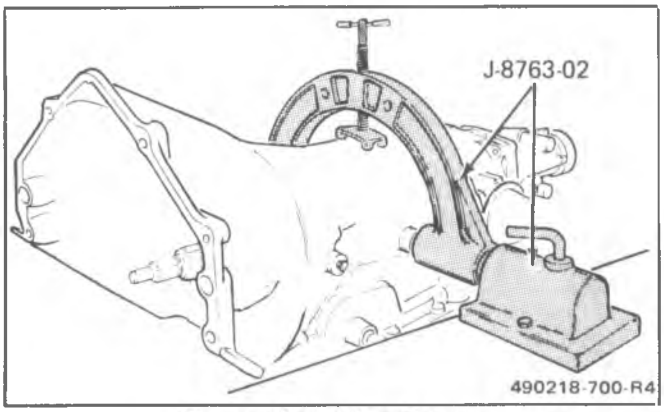


Figure 42 Holding Fixture

2. Servo cover retaining ring (13)
3. Servo cover and "O" ring seal (14 and 15)
4. 2-4 servo assembly (16-31)

Servo Pin Length

As a diagnostic aid, the servo pin length should now be checked. If the pin length is too short or too long be certain to inspect the 2-4 band and reverse input drum for damage or wear when disassembled.

Remove or Disconnect (Figures 43, 44, 45, 46)

TOOLS REQUIRED:
J-22269-01 Piston Compressor

1. 4th apply piston (16)
2. Servo return spring (31)
3. Servo pin retainer ring (18), washer (19), and apply pin spring (20)
4. 2nd apply piston pin (29).
5. Install J-22269-01.
6. Retainer ring (28)
7. Cushion spring retainer (27) and cushion spring (26)

Measure (Figure 47)

TOOLS REQUIRED:
J-33037 Band Apply Pin Tool

1. Install J-33037 as shown with apply pin (29).
2. Apply 11 N·m (100 in. lbs.) torque.
3. If white line "A" appears in gage slot "B" pin length is correct.
4. Use pin selection chart to determine correct pin length.

Governor and Extension

Remove or Disconnect (Figure 48)

1. Extension bolts (37) and case extension (36)
2. Extension seal ring (35)
3. Output shaft sleeve (690) and output shaft "O" ring seal (691)
   - Not all models use an output shaft sleeve and seal.
4. Speedometer drive gear (689) and clip (688)

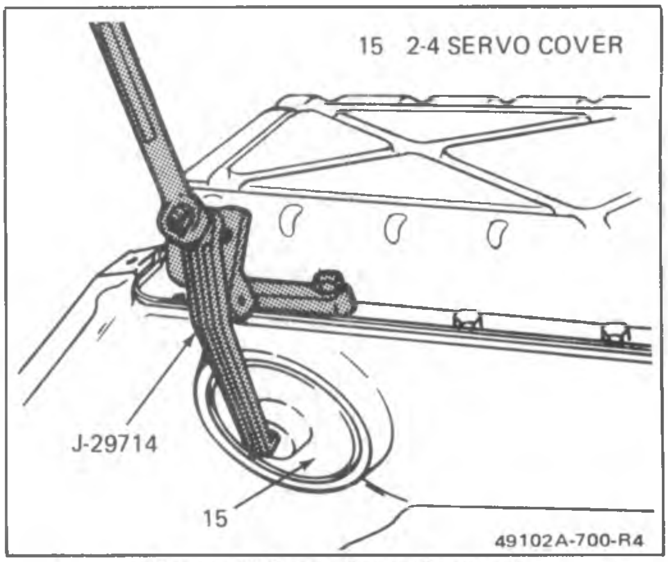


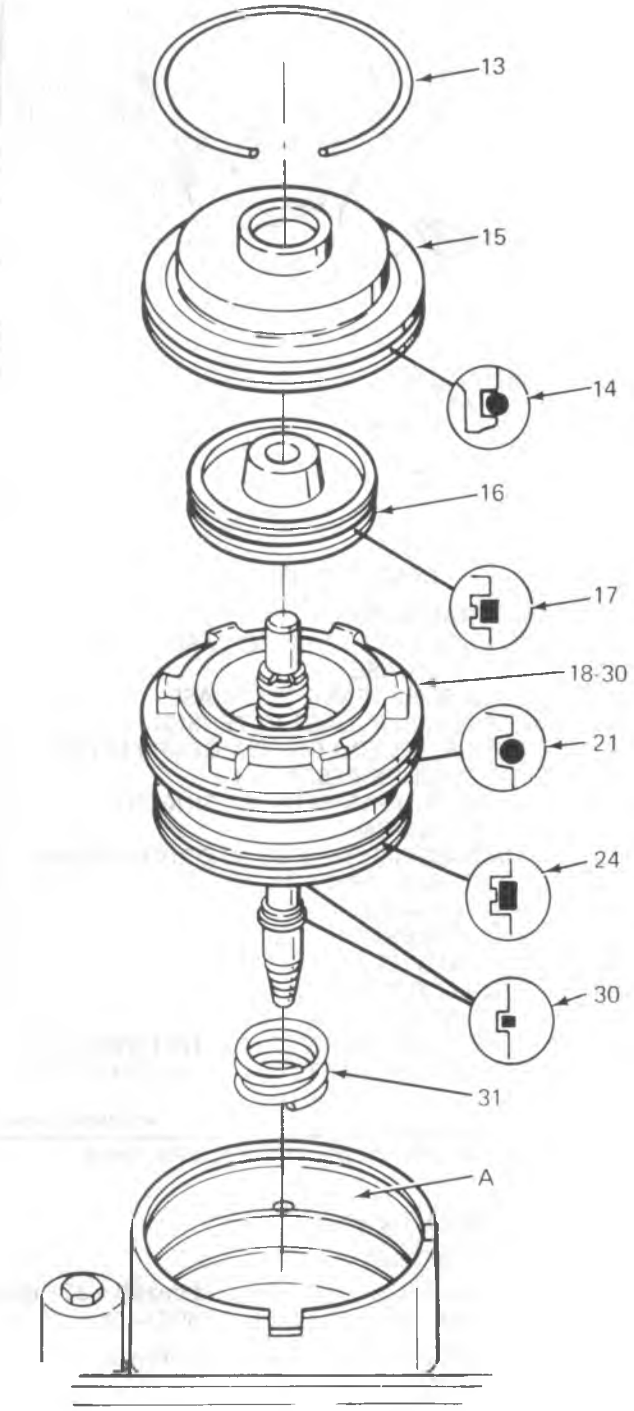
Figure 43 Servo Cover Removal

   - push tab of retaining clip down and tap speedometer gear off the output shaft. Use care not to damage the speedo gear.
5. Governor Cover (46)
   - tap around the cover flange with a punch to remove.
   - **DO NOT DAMAGE THE GOVERNOR COVER**
6. Governor assembly (45)

Valve Body and Wiring Harness

Remove or Disconnect (Figures 41, 49, 50, 51, 52, 53)

1. Bolts (74), oil pan (73), and gasket (72)
2. Oil filter (71) and "O" ring seal (70)
   - "O" ring seal may stick in the case.
3. Solenoid bolts (51), solenoid assembly (50), and "O" seal (49)
4. Outside electrical connector (33) and "O" ring seal (34)
5. Accumulator cover bolts (63) and 1-2 accumulator cover and pin assembly (62)
6. The 1-2 accumulator piston (61), seal (60), and spring (59)
7. Bolts (78) and oil passage cover (79)
8. Manual detent spring assembly (709)
9. Valve body bolts (69)
10. Electrical wire clips (66)
11. Wire harness retaining washer and the filter retainer clip (87)
12. Throttle bracket and lever assembly (65)
13. T.V. link (64)
14. Rod end clip (704)
15. Manual valve link (705)
16. Control body valve assembly (67)
17. Spacer plate (56) and spacer plate gaskets (88 and 89)
18. Nine checkballs (55 and 91)
    - four were located under the valve body and five are in the case. The large copper colored ball is the #10 checkball (91).



A CASE SERVO BORE
13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18-30 2ND APPLY PISTON ASSEMBLY
21 SEAL, "O" RING
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

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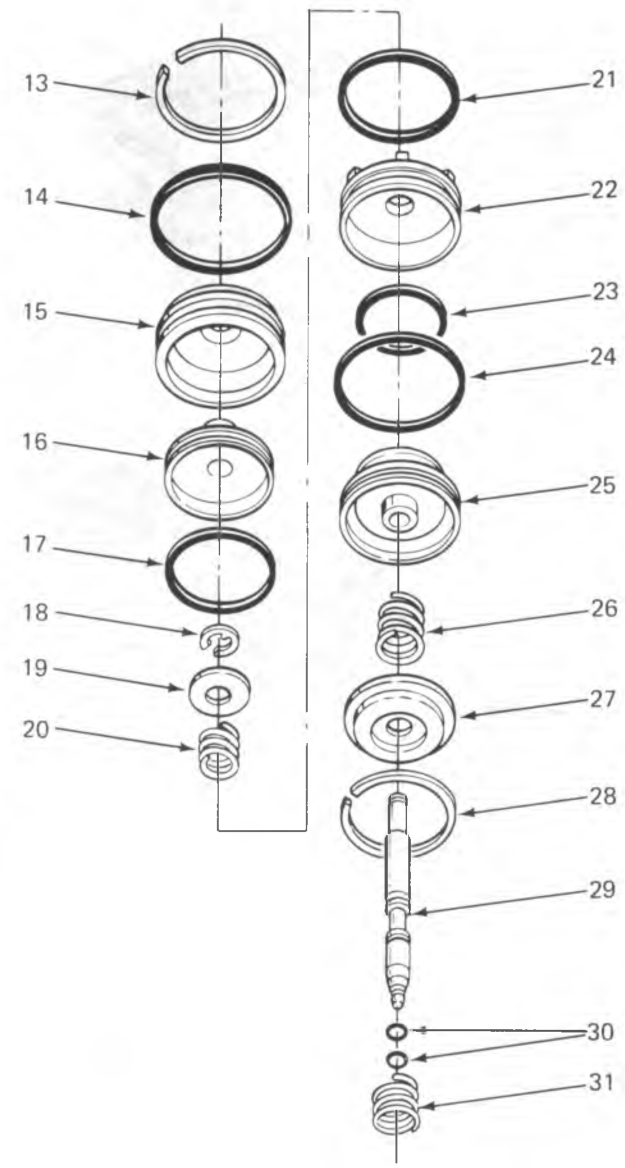
Figure 44 Servo Removal



13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4, SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON INNER
23 RING, OIL SEAL INNER (2ND APPLY PISTON)
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

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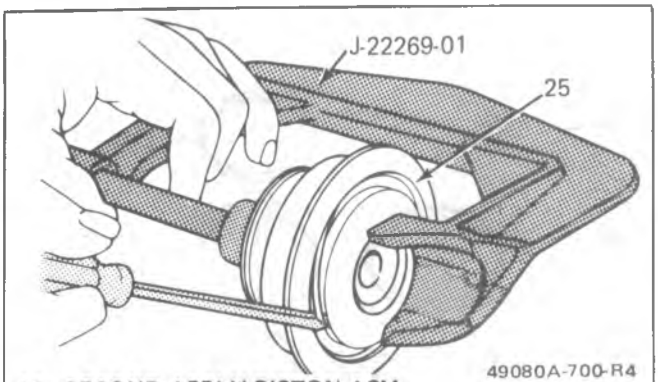
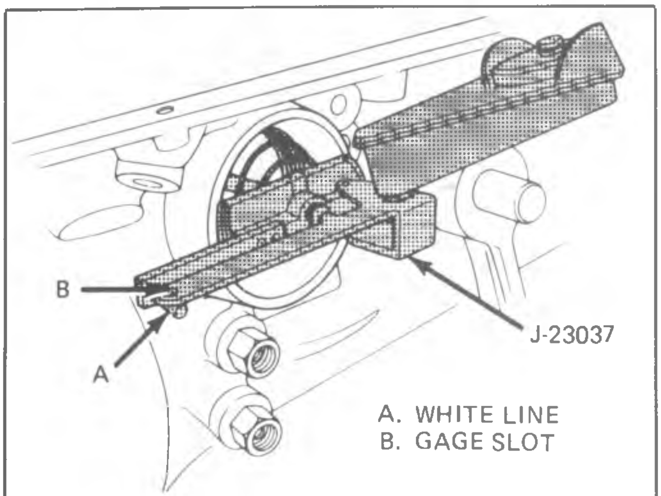
Figure 45 Servo Assembly



25 SECOND APPLY PISTON ASM.

Figure 46 Second Servo Piston Retaining Ring Removal



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION

PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 RINGS
67.74-68.04	2.67-2.68	3 RINGS
69.11-69.41	2.72-2.73	WIDE BAND

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Figure 47 Servo Pin Length

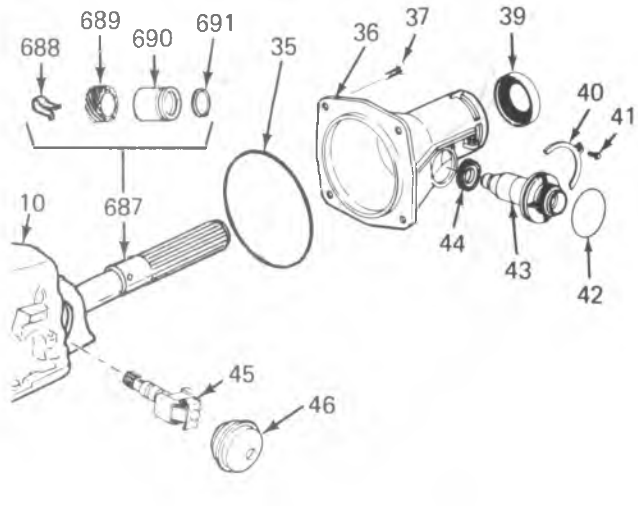
19. Converter clutch and governor screens (47)
20. The 3-4 accumulator spring (54), piston (52), seal (53) and pin (77)

Transmission End Play Check

As a diagnostic aid transmission end play should be checked prior to removing the internal parts. If the end play is not within specifications you should watch for possible worn or misassembled parts during disassembly.

Tighten (Figures 54 and 55)

TOOLS REQUIRED:
J-24773-A Oil Pump Remover
J-25022 End Play Adaptor (245 mm)
J-34725 End Play Adaptor (298 mm)



ILL. NO.	DESCRIPTION	
10	CASE, TRANSMISSION	
35	SEAL, CASE EXTENSION TO CASE	
36	EXTENSION, CASE	
37	BOLT, CASE EXTENSION TO CASE	
39	SEAL ASSEMBLY, CASE EXTENSION OIL	
40	RETAINER, SPEEDO DRIVEN GEAR FITTING	
41	BOLT & WASHER ASSEMBLY	
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)	
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR	
44	GEAR, SPEEDO DRIVEN	
45	GOVERNOR ASSEMBLY	
46	COVER, GOVERNOR	
687	SHAFT, OUTPUT	
688	CLIP, SPEEDO DRIVE GEAR	
689	GEAR, SPEEDO DRIVE	
690	SLEEVE, OUTPUT SHAFT	NOT USED ON ALL MODELS
691	SEAL, OUTPUT SHAFT	

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Figure 48 Extension and Associated Parts

J-25025-7A Post
Dial Indicator

1. Remove an oil pump bolt (5) and install a 278 mm (11 in.) bolt and locknut or J-25025-7A.
2. Install J-25022-A or J-34725 as shown.
3. Insall J-24773-A as shown.
4. Install dial indicator.
   - set to zero
   - pull up on J-24773-A
   - end play should be 0.13/0.92 mm (.005/.036 in.).

INTERNAL PARTS

Oil Pump, Reverse Input Clutch, and Input Clutch

Remove or Disconnect (Figures 56, 56L, 57 and 58)

TOOLS REQUIRED:
J-24773-A Oil Pump Remove

1. "O" ring seal (618)

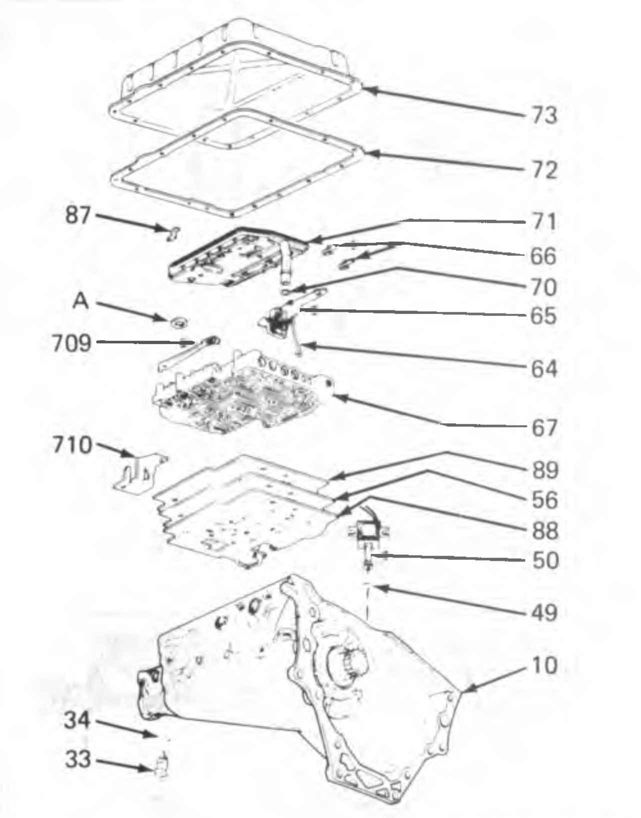

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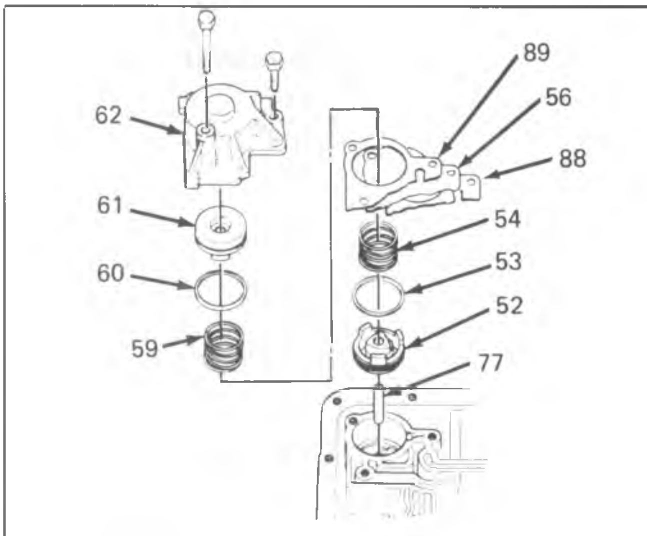
Figure 49 Case and Attaching Parts



52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUMULATOR
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

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Figure 50 Accumulator Assembly

ILL. NO.	DESCRIPTION
A	RETAINER, SOLENOID WIRE
10	CASE, TRANSMISSION
33	CONNECTOR, ELECTRICAL
34	SEAL, "O" RING – ELECTRICAL CONNECTOR
49	SEAL, "O" RING (SOLENOID)
50	SOLENOID ASSEMBLY
56	PLATE, VALVE BODY SPACER
64	LINK, THROTTLE LEVER TO CABLE
65	LEVER & BRACKET ASSEMBLY, THROTTLE
66	CLIP, WIRING HARNESS
67	VALVE ASSEMBLY, CONTROL BODY
70	SEAL, "O" RING FILTER
71	FILTER ASSEMBLY, TRANSMISSION OIL
72	GASKET, TRANSMISSION OIL PAN
73	PAN, TRANSMISSION OIL
87	CLIP, FILTER RETAINING
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY
709	SPRING ASSEMBLY, MANUAL DETENT
710	BRACKET, PARKING LOCK

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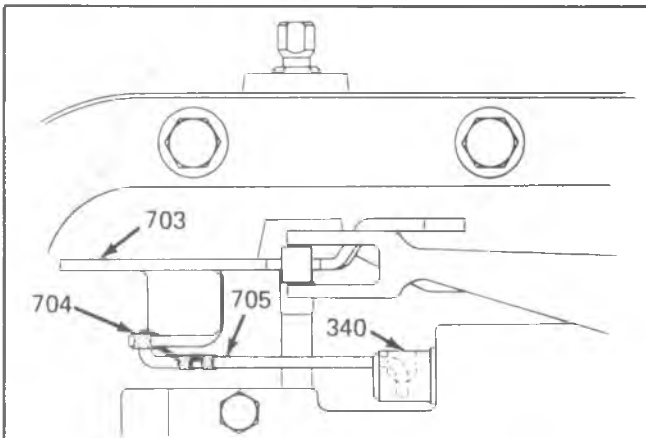
Figure 49L



703	INNER DETENT LEVER	705	MANUAL VALVE LINK
704	ROD, END CLIP	340	MANUAL VALVE

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Figure 51 Rod End Clip

2. All oil pump bolts (5) and washers (6)

   The solenoid asm. and oil filter must be removed before oil pump removal.

3. Oil pump assembly (7) with J-24773-A
4. Oil pump to case seal (8) and gasket (9)
5. Reverse input clutch to oil pump thrust washer (601)
6. Reverse input clutch (605) and input clutch (621), by lifting turbine shaft

2-4 Band and Input Gear Set

↔ Remove or Disconnect (Figures 56, 56L, 57, 58 and 59)

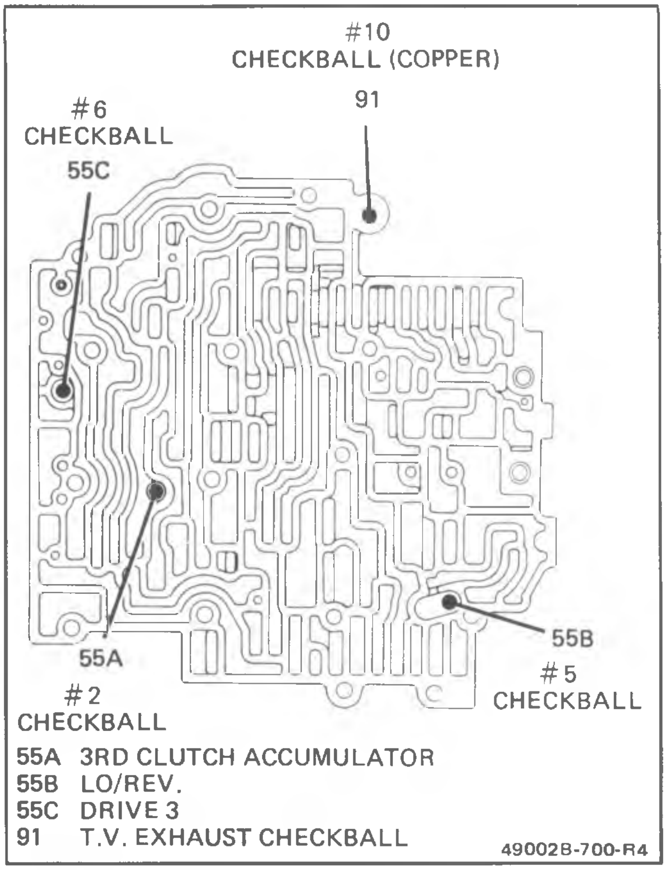

Figure 52 Valve Body Checkballs

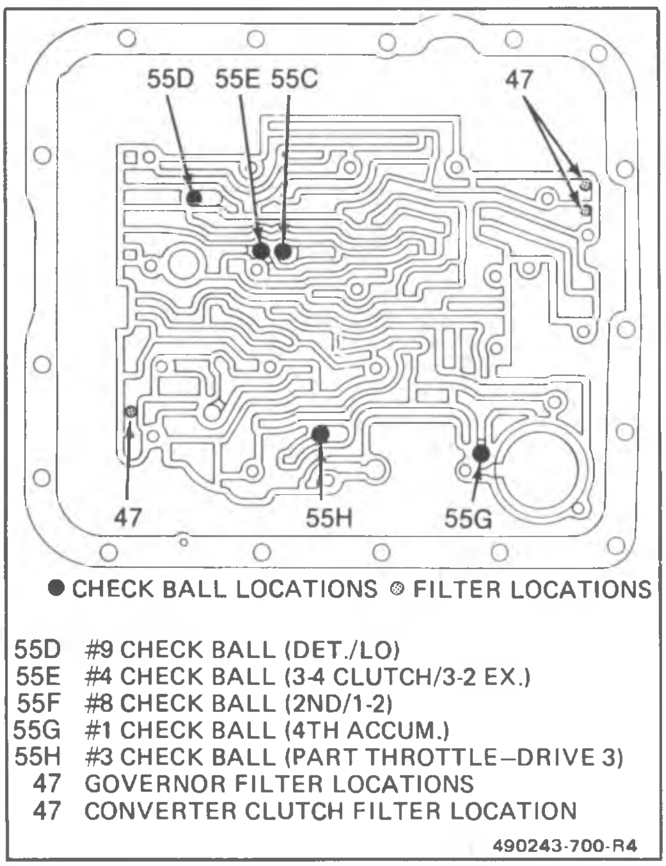

Figure 53 Case Checkballs and Filters

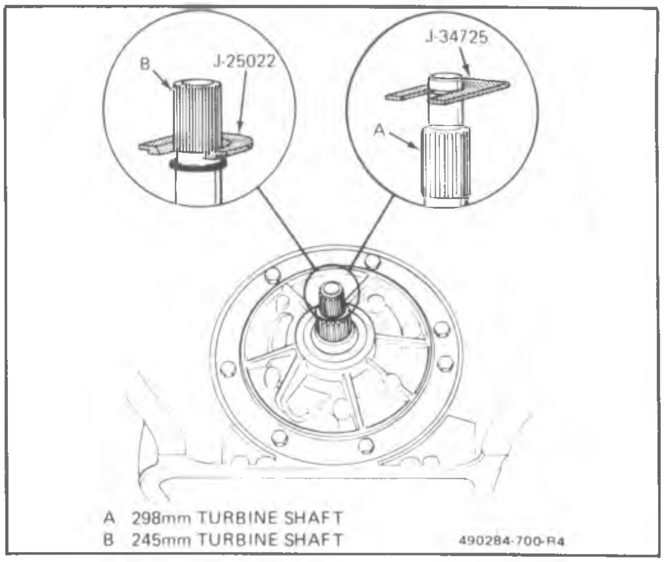

Figure 54 End Play Tool

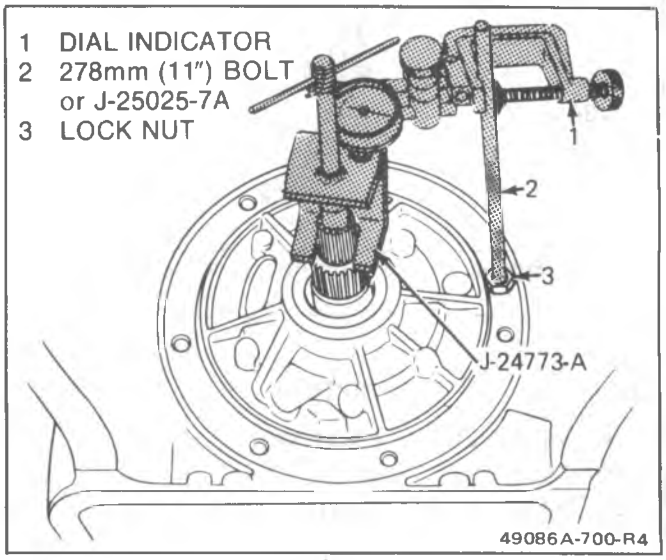

Figure 55 End Play Check

1. The 2-4 band assembly (602)
2. Band anchor pin (48)
3. Input sun gear (658)

Install or Connect (Figure 60)

TOOLS REQUIRED:
J-29837 Output Shaft Support Fixture

- J-29837 as shown

Important

- Output shaft (687) may fall free when input carrier retaining ring (661) is removed if J-29837 is not used.

Remove or Disconnect (Figure 61)

TOOLS REQUIRED:
J-34627 Snap Ring Pliers

1. Input carrier to output shaft retaining ring (661) with J-34627. Do no overexpand the ring.
2. Input carrier assembly (662) and thrust washer (660)

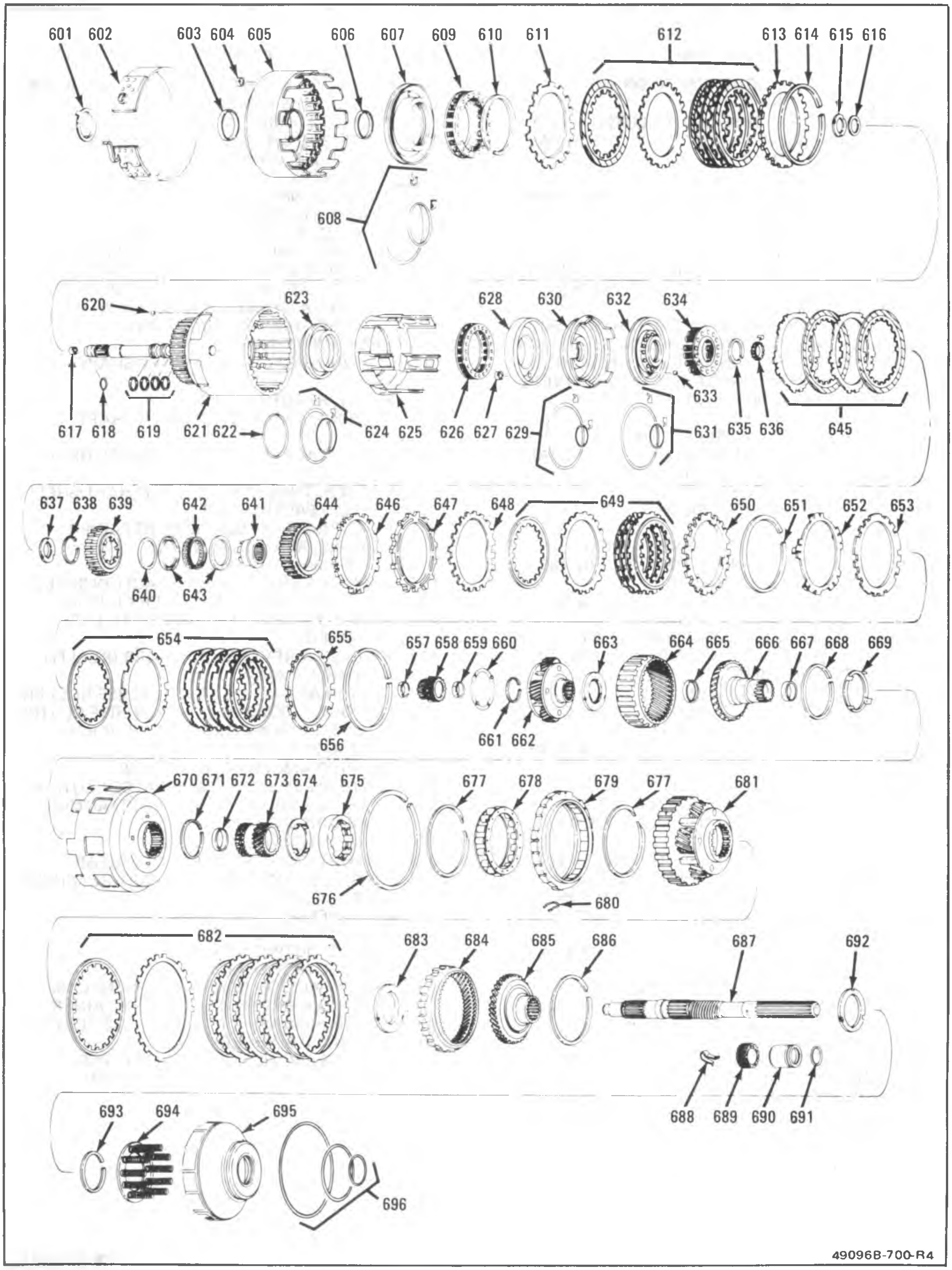

Figure 56 Transmission Internal Parts

ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
602	BAND ASSEMBLY, 2-4
603	BUSHING, REVERSE INPUT CLUTCH – FRONT
604	RETAINER & BALL ASSEMBLY, CHECK VALVE
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606	BUSHING, REVERSE INPUT CLUTCH – REAR
607	PISTON ASSEMBLY, REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH – INNER & OUTER
609	SPRING ASSEMBLY, REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CLUTCH (WAVED)
612	PLATE ASSEMBLY, REVERSE INPUT CLUTCH
613	PLATE, REVERSE INPUT CLUTCH BACKING
614	RING, REVERSE INPUT CLUTCH RETAINING
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
617	RETAINER & BALL ASSEMBLY, CHECK VALVE
618	SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
619	RING, OIL SEAL (TURBINE SHAFT)
620	BALL, CHECK VALVE
621	HOUSING & SHAFT ASSEMBLY, INPUT
622	SEAL, "O" RING INPUT TO FORWARD HSG.
623	PISTON, 3RD & 4TH CLUTCH
624	SEAL, 3RD & 4TH CLUTCH – INNER & OUTER
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
627	RETAINER & BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
629	SEAL, FORWARD CLUTCH – INNER & OUTER
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH – INNER & OUTER
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RETAINING
639	HUB, OVERRUN CLUTCH
640	WEAR PLATE, SPRAG ASSEMBLY
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH – OUTER
645	PLATE ASSEMBLY, OVERRUN CLUTCH
646	PLATE, FORWARD CLUTCH APPLY
647	PLATE, FORWARD CLUTCH SPACER (SOME MODELS ONLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
657	BUSHING, INPUT SUN GEAR – FRONT
658	GEAR, INPUT SUN
659	BUSHING, INPUT SUN GEAR – REAR
660	WASHER, THRUST (INPUT CARRIER/RACE)
661	RET., OUTPUT SHAFT TO INPUT CARRIER
662	CARRIER ASSEMBLY, INPUT – COMPLETE
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664	GEAR, INPUT INTERNAL
665	BUSHING, REACTION CARRIER SHAFT – FRONT
666	SHAFT, REACTION CARRIER
667	BUSHING, REACTION CARRIER SHAFT – REAR
668	RING, REACTION SHAFT/INTERNAL GEAR RETAINER
669	WASHER, THRUST (REACTION SHAFT/SHELL)
670	SHELL, REACTION SUN
671	RING, REACTION SUN GEAR RETAINER
672	BUSHING, REACTION SUN
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO & REVERSE ROLLER CLUTCH
676	RING, LO & REVERSE SUPPORT TO CASE RETAINER
677	RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER
681	CARRIER ASSEMBLY, REACTION
682	PLATE ASSEMBLY, LO & REVERSE CLUTCH
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
686	RING, REACTION GEAR/SUPPORT RETAINER
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT
691	SEAL, OUTPUT SHAFT
692	BRG., REACTION GEAR SUPPORT TO CASE
693	RING, LO & REVERSE CLUTCH RETAINER
694	SPRING ASSEMBLY, LO & REVERSE CLUTCH
695	PISTON, LO & REVERSE CLUTCH
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH – OUTER, CENTER – INNER)

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Figure 56L

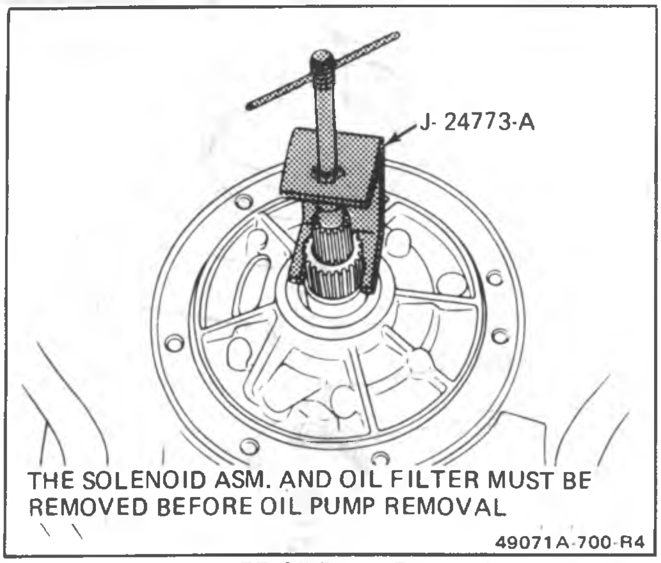


Figure 57 Oil Pump Removal

3. J-29837 and output shaft (687)

Important

- The manufacturer assembles the output shaft and reaction internal gear with adhesive for ease of assembly. If these parts have not become separated during use, the output shaft will come out later along with the reaction internal gear.

4. Thrust bearing assembly (663)

Reaction Gear Set

Remove or Disconnect (Figures 56, 56L, 62)

1. Input internal gear (664) and reaction carrier shaft (666)
2. Reaction sun shell (670) and thrust washer (669)
3. Reaction sun shell to inner race thrust washer (674)
4. Lo and reverse support to case retainer ring (676)
5. Lo and reverse clutch support retainer spring (680)
6. Reaction sun gear (673)
7. Lo and reverse inner race (675), roller assembly (678), support assembly (679), and reaction carrier assembly (681)
8. Lo and reverse clutch plates (682)
9. Reaction internal gear (684) and thrust bearing assembly (683)
10. Reaction gear support to case bearing (692)

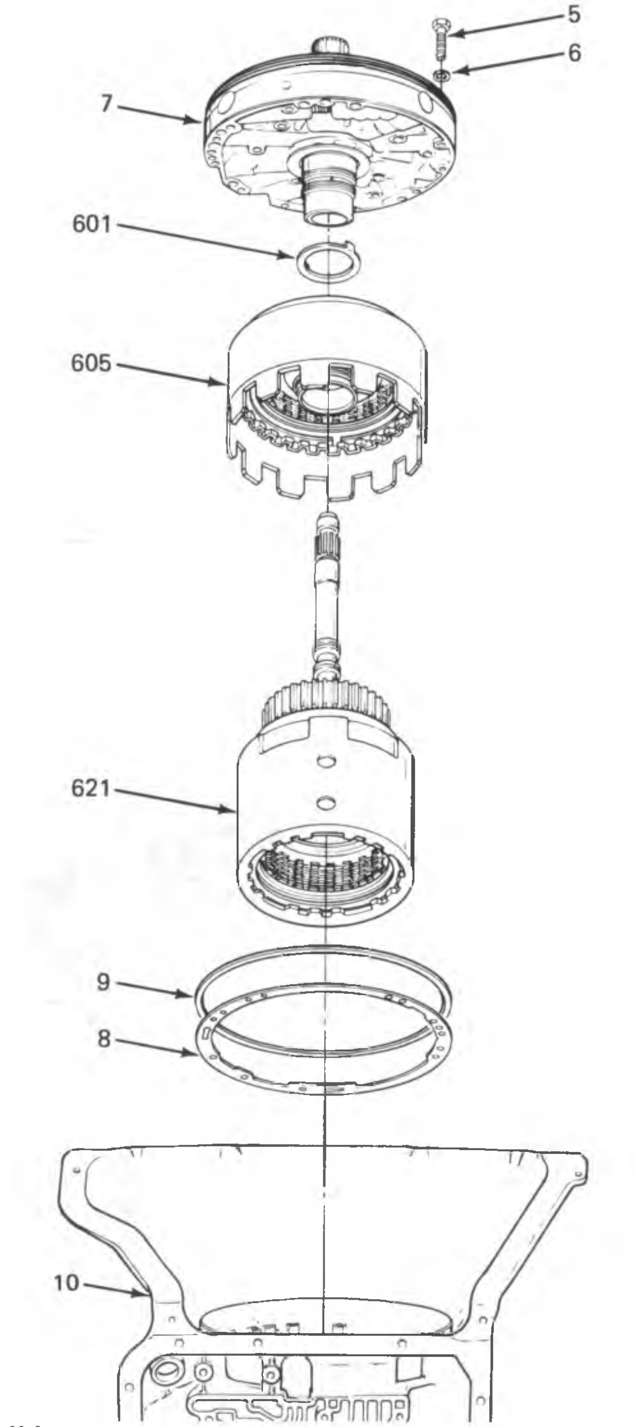
Lo and Reverse Clutch Parts

Remove or Disconnect (Figures 56, 56L, 62, 63 and 64)

TOOLS REQUIRED:

J-23327 Clutch Spring Compressor

1. Bolts (715) and parking lock bracket (710)



ILL. NO.	DESCRIPTION
5	BOLT, PUMP TO CASE
6	WASHER, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
601	WASHER, THRUST (PUMP TO DRUM)
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621	HOUSING & SHAFT ASSEMBLY, INPUT

490219-700-R4

700-R4 Figure 58 Input Clutch Removal

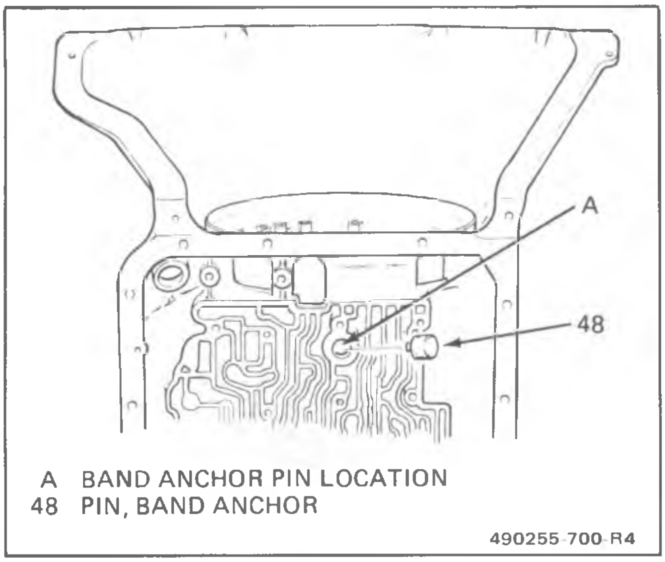


Figure 59 Band Anchor Pin Location

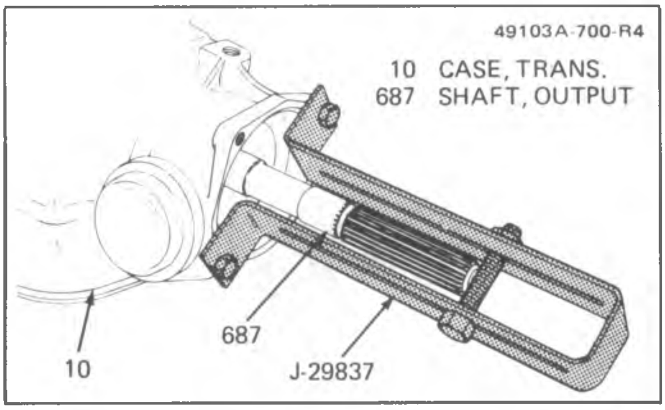


Figure 60 Output Shaft Support Fixture

Important

- Due to interference, the parking pawl (711) may have to be removed before removing or installing the low and reverse piston.

2. Steel cup plug (713) with a #4 screw extractor
3. Parking pawl shaft (712) with a magnet
4. Parking pawl (711) and return spring (714)
5. Install tool J-23327.
6. Lo and reverse clutch retainer ring (693)
7. Lo and reverse clutch spring assembly (694)
8. Lo and reverse clutch piston (695)
   - by application of air pressure in the case apply passage

COMPONENT REPAIR AND TRANSMISSION REASSEMBLY

CASE AND INTERNAL COMPONENTS

Inner Manual Linkage

Remove or Disconnect (Figure 64)

1. Hex head nut (702)
2. Manual shaft (707) and manual shaft retainer (706)

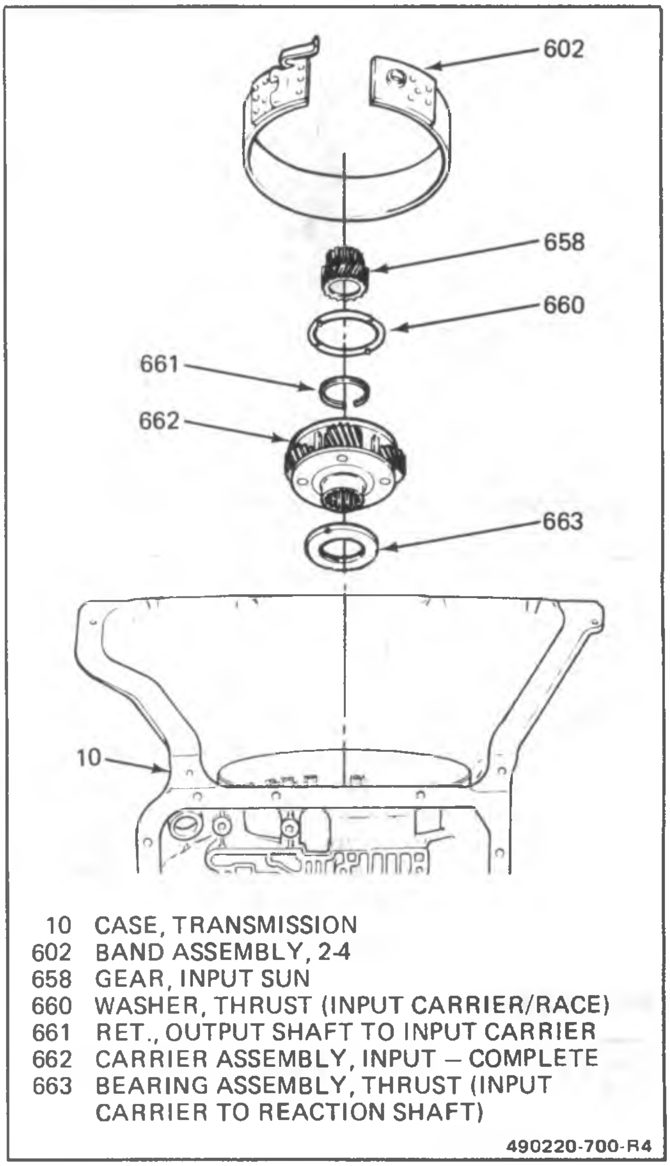


Figure 61 Input Carrier Removal

3. Parking lock actuator assembly (701) and inside detent lever (703)

Manual Shaft Seal Replacement

Remove or Disconnect (Figure 65)

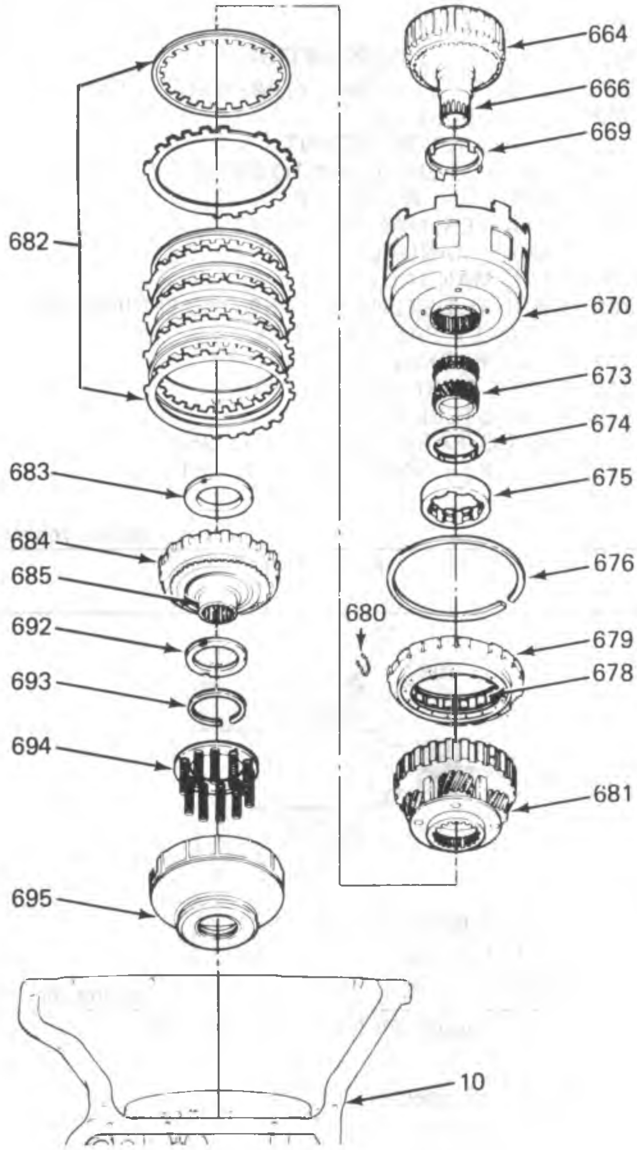
- Manual shaft seal (708)
  - pry out with a screwdriver

Install or Connect

- Tap a new seal in place
  - use a 14 mm socket

Inspect (Figures 64 and 65)

- Actuator rod (701) for damage
- Inside detent lever (703) for damage or cracks
- Manual shaft (707) for damage or burrs
- Manual detent spring assemby (709) for roller freeness or damage



10 CASE, TRANSMISSION
664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH
676 RING, LO & REVERSE SUPPORT TO CASE RETAINER
678 CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679 SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER
681 CARRIER ASSEMBLY, REACTION
682 PLATE ASSEMBLY, LO & REVERSE CLUTCH
683 BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684 GEAR, INTERNAL REACTION
685 SUPPORT, INTERNAL REACTION GEAR
692 BRG., REACTION GEAR SUPPORT TO CASE
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH

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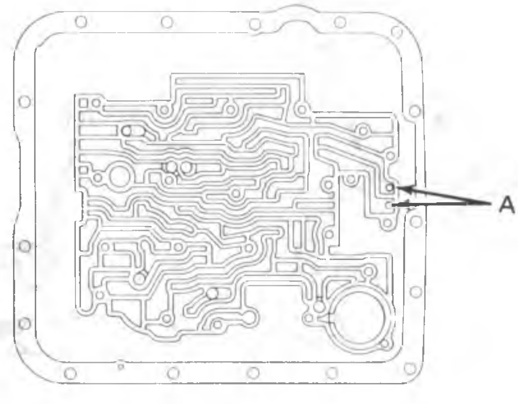
Figure 62 Reaction Gear Set Removal



A APPLY AIR PRESSURE HERE TO REMOVE LO & REVERSE PISTON FROM THE CASE

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Figure 63 Piston Removal

Install or Connect

- Parking lock actuator (701) onto inside detent lever (703)
- Manual shaft (707) into case (10) and inside detent lever (703)
- Inside manual shaft nut (702) onto manual shaft (707)
  - torque to 31 N·m (23 ft. lbs.)
- Manual shaft retainer (706) onto manual shaft (707)

Case

Inspect (Figures 41, 66, 67 and 68)

- Case (10) exterior for cracks or porosity
- Case to valve body face for damage, interconnected oil passages and flatness
  - the face flatness can be checked by inspecting the spacer plate to case gasket for proper land impressions.
- Vent assembly (11) for damage
- Air check all oil passages.
  - see diagnosis section for oil passage identification.
- 2-4 servo bore for
  - damage, porosity, or burrs
  - any sharp edges (i.e. - oil passages, slots for retaining ring removal - remove if found)
- Orifice cup plug (86) in servo bore for debris or damage
- 3-4 accumulator bore for
  - porosity, damage, or burrs
  - pin damage (77)
  - orifice cup plug (81) damaged or plugged
- Governor bore
  - damaged
  - sharp edges
  - porosity
- All bolt holes for thread damage
  - Heli-coil to repair

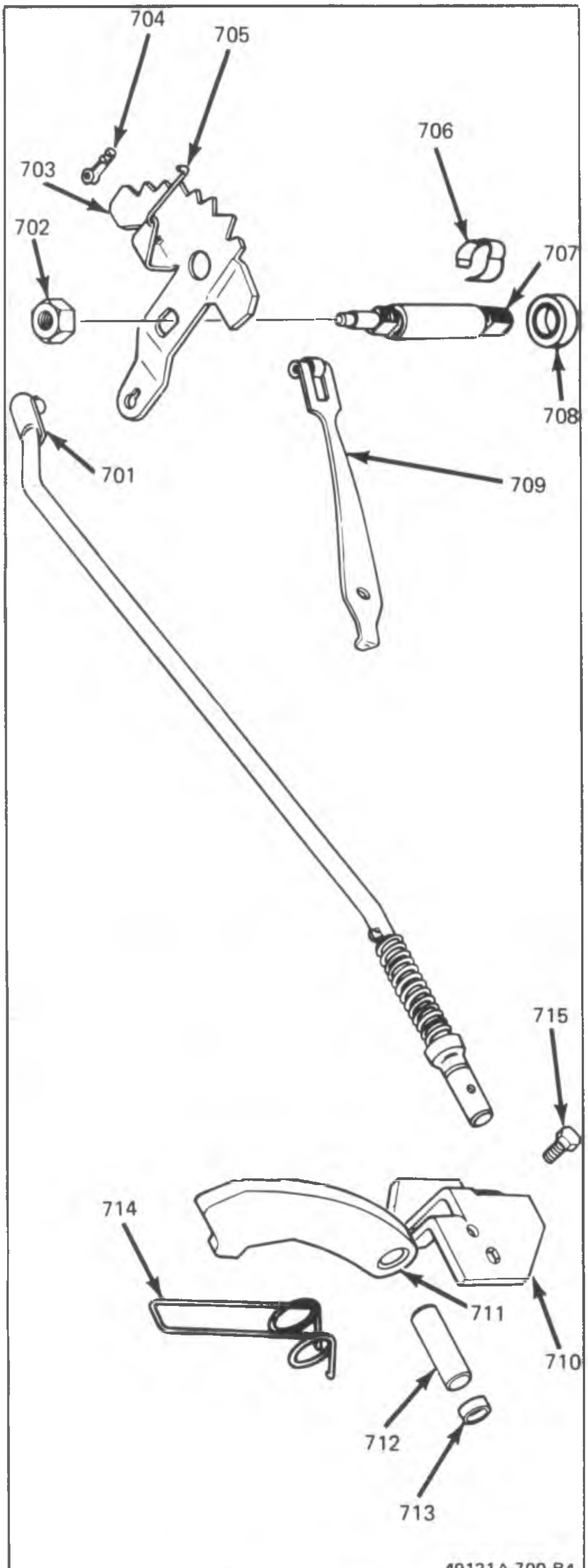

Figure 64 Parking Linkage

ILL. NO.	DESCRIPTION
701	ACTUATOR ASSEMBLY, PARKING LOCK
702	NUT, HEX HEAD
703	LEVER, INSIDE DETENT
704	CLIP, ROD END (LINK TO DETENT LEVER)
705	LINK, MANUAL VALVE
706	RETAINER, MANUAL SHAFT
707	SHAFT, MANUAL
708	SEAL, MANUAL SHAFT
709	MANUAL DETENT ROLLER AND SPRING ASM.
710	BRACKET, PARKING LOCK
711	PAWL, PARKING BRAKE
712	SHAFT, PARKING BRAKE PAWL
713	PLUG, STEEL CUP
714	SPRING, PARKING PAWL RETURN
715	BOLT, PARKING LOCK BRACKET

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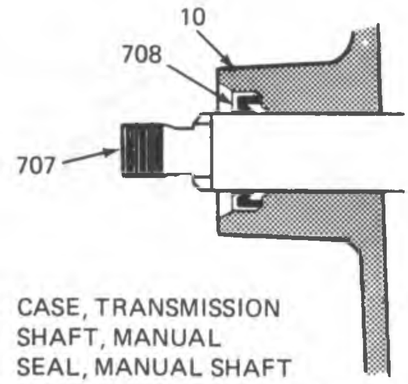
Figure 64L



10 CASE, TRANSMISSION
707 SHAFT, MANUAL
708 SEAL, MANUAL SHAFT

490608-700-R4

Figure 65 Manual Shaft Seal

- Cooler connectors (12) for
  - damage
  - proper torque 38 N·m (28 ft. lbs.)
- Case interior for
  - damaged ring grooves or casting flash
  - clutch plate lugs worn or damaged
  - bushing (76) scored, worn, or damaged (see Bushing Replacement)
  - governor support pin installation depth. (Incorrect installation depth will cause governor driven gear damage and shift problems.)

Third Accumulator Retainer and Ball Assembly (80)

Inspect

- Ball
  - missing
  - sticking or leaking
- Retainer
  - missing
  - loose
  - not seated correctly
  - feed slots restricted

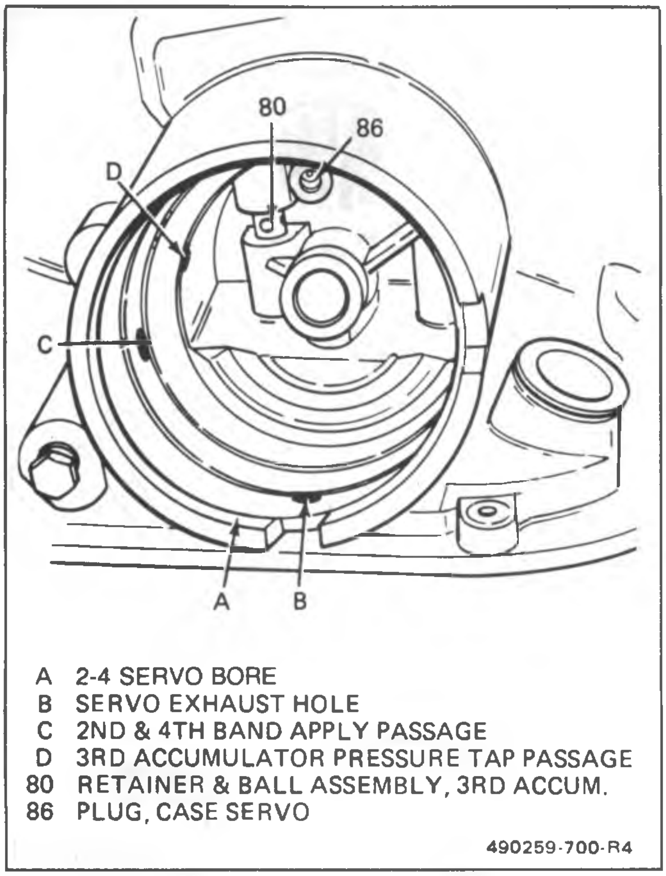


Figure 66 Servo Bore

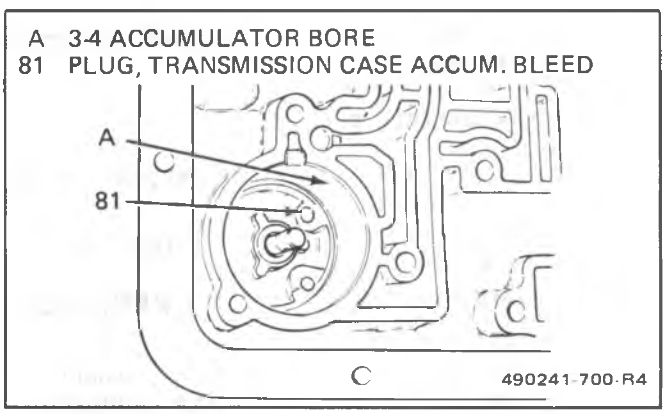


Figure 67 Third Accumulator Bore

Retainer and Ball Assembly Leak Check Procedure

Important (Figure 69)

1. Install the servo assembly into the servo bore.
2. Install the servo cover and retainer.
3. Pour solvent (olem or equivalent) into the accumulator bore (A).
4. Watch for leakage inside the case.
5. If leakage is observed, replace the third accumulator retainer and ball assembly.

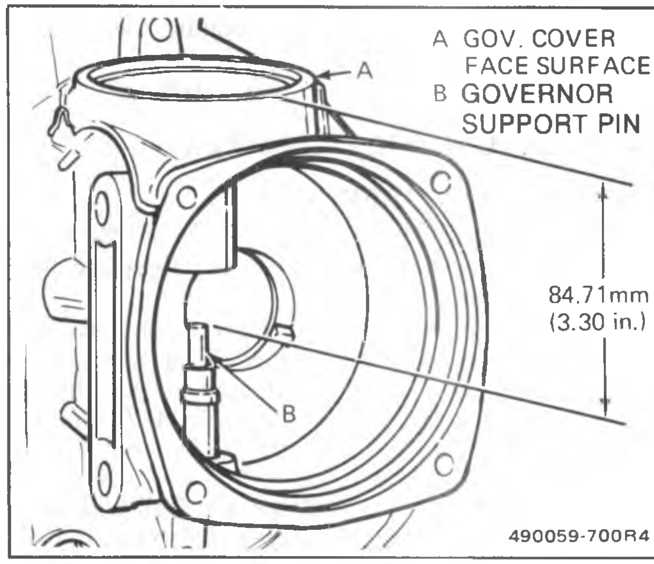


Figure 68 Governor Pin Location

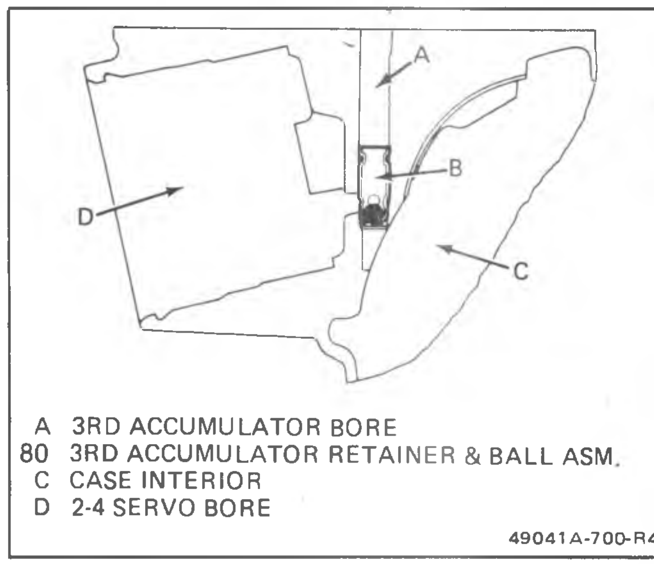


Figure 69 Leak Check - 3rd Accumulator

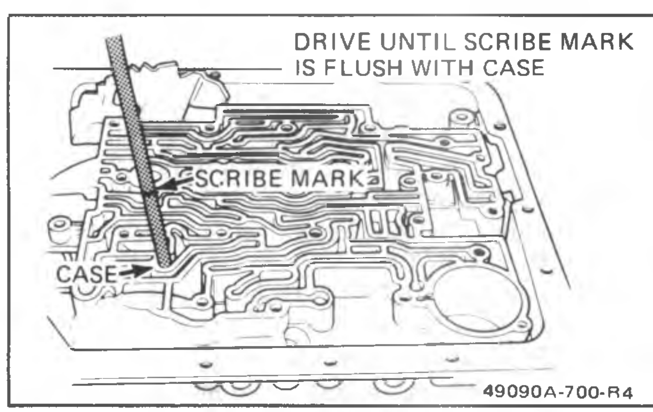


Figure 70 Third Accumulator Retainer and Ball Asm. - Installation

Replacement Procedure - Third Accumulator Retainer and Ball Assembly

Remove or Disconnect (Figure 69 and 70)

TOOLS REQUIRED:

6.3 mm (#4) Screw Extractor

- Third accumulator retainer and ball assembly (80)
  - use 6.3 (#4) screw extractor

Install or Connect (Figure 69 and 70)

TOOLS REQUIRED:
9.5 mm (3/8 in.) Diameter Metal Rod

- A new third accumulator retainer and ball assembly
  - oil feed slots in the retainer must line up with oil passage in the servo bore. To be certain of correct installation depth, scribe a mark at 42.0 mm (1. 653 in.) on the 9.5 mm (3/8") diameter metal rod. Use it to seat the third accumulator and ball assembly as shown. When the scribed line is flush with the case face, installation depth is correct.

Case Assembly

Clean

- Thoroughly with solvent
- Air dry
  - do not wipe with cloth.

Lo and Reverse Clutch Assembly

Inspect (Figures 56 and 71)

- Lo and reverse piston (695) for
  - porosity or damage
  - ring groove damage
- Piston seals (696) for nicks or cuts
- Spring assembly (694) for damage
- Retainer ring (693) overstressed

Install or Connect (Figures 56 and 71)

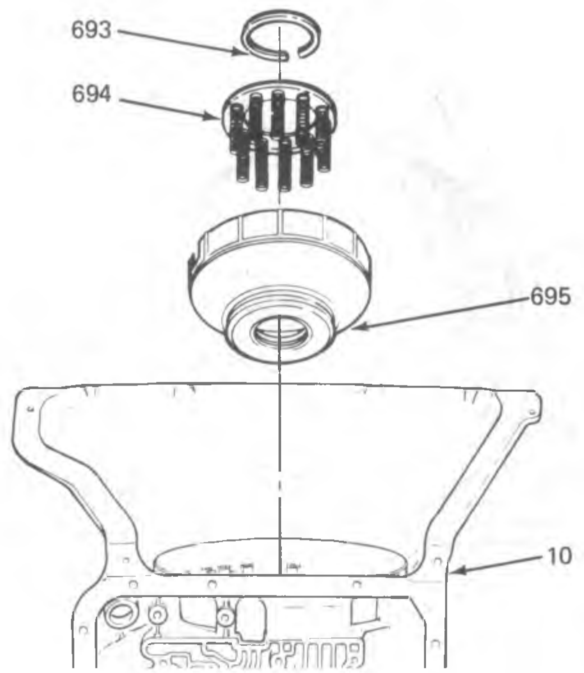
TOOLS REQUIRED:
J-23327 Clutch Spring Compressor

1. Piston seals (696) onto the piston (695)
   - lubricate with transmission fluid
2. Piston (695) into the case
   - index the piston with the notch in the bottom of the case.
3. Spring assembly (694) onto the piston
   - flat side of the retainer upward
4. J-23327 over the spring assembly
   - compress the spring assembly past the ring groove in the case hub.
5. Retainer ring (693) into the case hub ring groove

Parking Pawl

Inspect (Figure 72)

- Parking pawl (711) for cracks, burrs, or damage
- Parking pawl return spring (714) for distortion or damage



10 CASE, TRANSMISSION
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH

490083-700 R4

Figure 71 Lo and Reverse Piston

- Parking pawl shaft (712) for damage and freeness of fit with the parking pawl

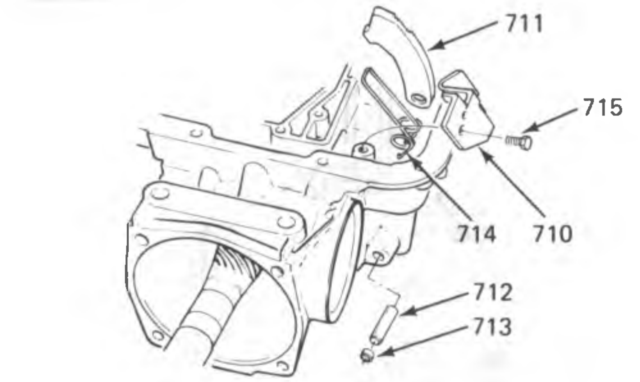
Install or Connect (Figure 58)

1. Parking pawl (711) and parking pawl return spring (714) into the case
2. Parking pawl shaft (712) into the parking pawl (711) and the case
   - **CHECK FOR PROPER OPERATION**
3. Steel cup plug (713) into the case
   - coat the plug with loc-tite sealant or equivalent and install it with a hammer and punch.

Reaction Internal Gear and Carrier Assembly

Inspect (Figures 73, 74 and 75)

- Reaction internal gear (684) and support (685) for
  - proper assembly
  - stripped splines
  - cracks
  - teeth or lug damage
- Thrust bearing assemblies (683 and 692) for damage
- Lo and reverse clutch plates (682)
  - Composition for wear, heat damage, or delamination
  - Steel for heat damage or surface finish damage



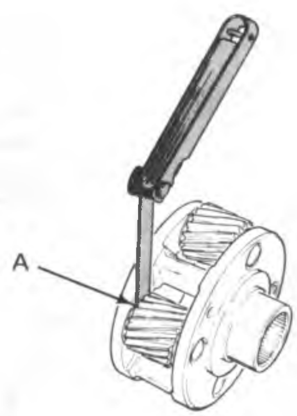
710 BRACKET, PARKING LOCK
711 PAWL, PARKING BRAKE
712 SHAFT, PARKING BRAKE PAWL
713 PLUG, STEEL CUP
714 SPRING, PARKING PAWL RETURN
715 BOLT, PARKING LOCK BRACKET

490240-700-R4

Figure 72 Parking Pawl Installation

- Reaction carrier assembly (681) for
  - pinion gear damage
  - excessive pinion washer wear (end play .20-.61 mm/.008-.024 in.)
  - proper pinion staking
  - keystoned pinion gears (pinions must turn free)
  - damaged or worn thrust bearing

    To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing. This check can be used for either the reaction carrier (681) or the input carrier (662).



A PINION GEAR END PLAY – .20/.60 MM (.008/.024 IN.)

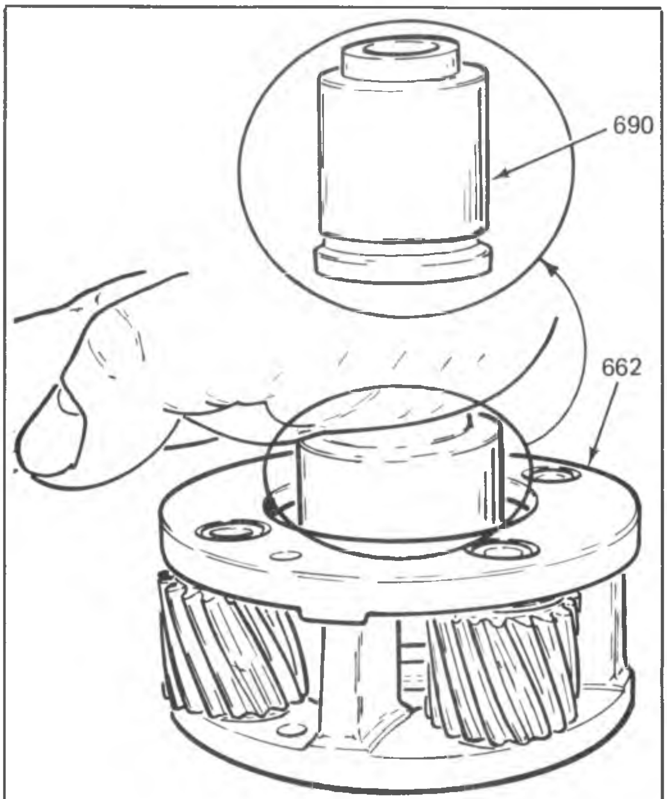
490242-700-R4

Figure 73 Pinion End Play Check

Reaction Internal Gear and Support

Install or Connect (Figures 76, 77 and 78)

1. Reaction gear support to case bearing (692) onto the case hub as shown



662 CARRIER ASSEMBLY, INPUT – COMPLETE
690 SLEEVE, OUTPUT SHAFT

490237-700-R4

Figure 74 Captured Bearing Check

   - Outside bearing race goes toward case hub.
   - retain with petrolatum.
2. Reaction internal gear and support (684 and 685) onto the bearing as shown
3. Reaction carrier to support thrust bearing assembly (683) onto the support (685)
   - outer bearing race goes toward the support
4. Reaction carrier (681) onto the thrust bearing
5. Lo and reverse clutch plates (682) into case lugs
   - start with a steel plate and alternate with composition.
   - index with the splines of the reaction carrier and the case as shown.
   - see the chart for the correct number of clutch plates.

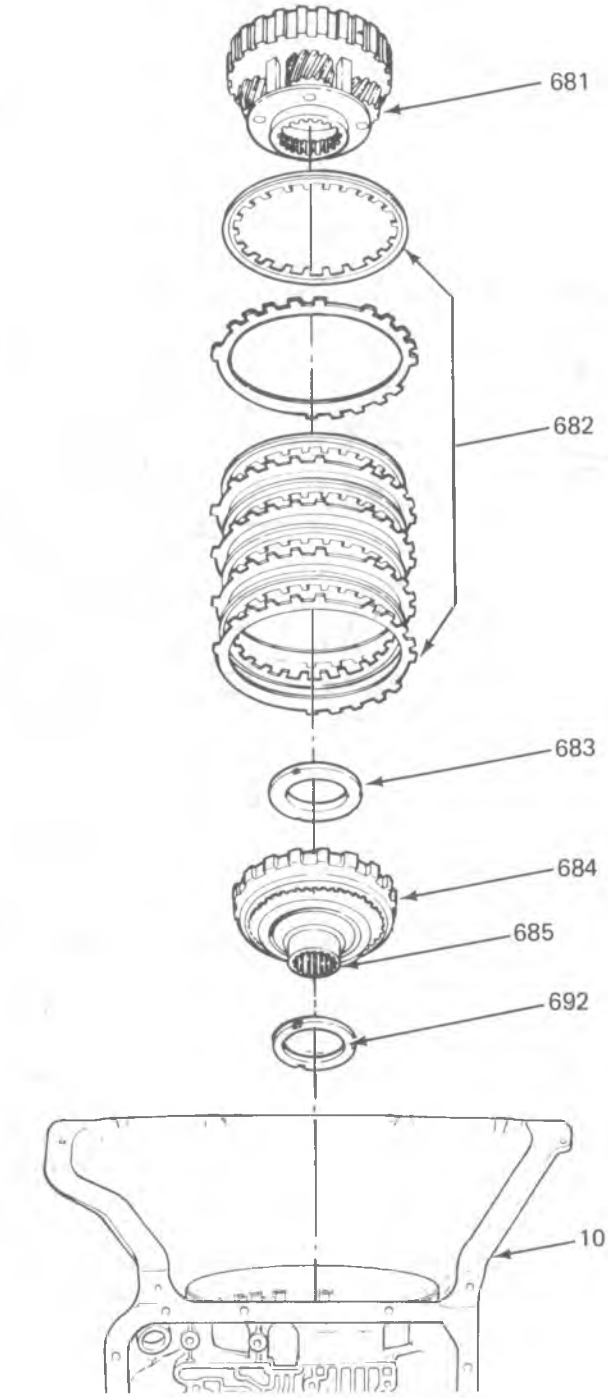
Lo and Reverse Support Assembly

Remove or Disconnect (Figure 79)

1. Inner race (675) from the support assembly (679)
2. One retainer ring (677)
3. Roller clutch assembly (678)

Inspect (Figure 79)

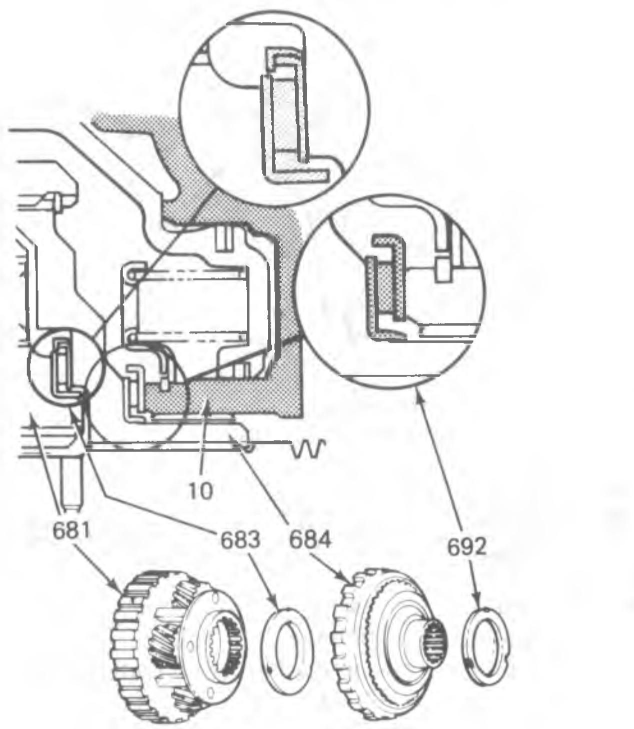
- Inner race (675) for damage and surface finish
- Roller clutch assembly (678) for
  - damaged rollers
  - broken springs
- Support assembly (679) for
  - loose cam



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
681	CARRIER ASSEMBLY, REACTION
682	PLATE ASSEMBLY, LO & REVERSE CLUTCH
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE

490223-700-R4

Figure 75 Reaction Internal Gear and Carrier Assembly Installation



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
681	CARRIER ASSEMBLY, REACTION
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE

49007A-700-R4

Figure 76 Reaction Internal Gear and Carrier Bearing Locations

49056A-700-R4

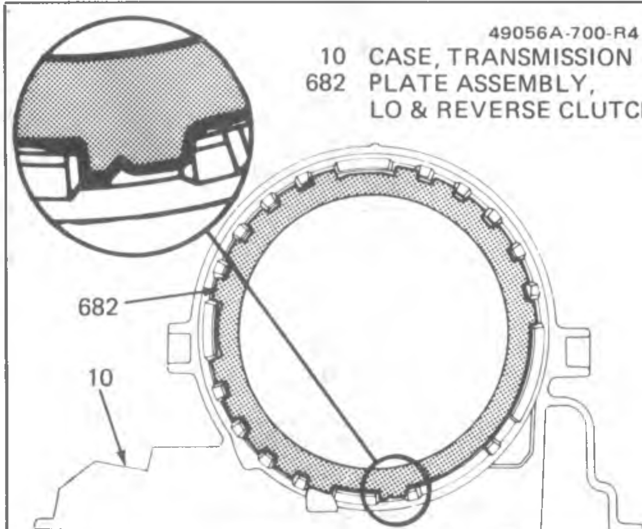


Figure 77 Lo and Reverse Clutch Plates Properly Installed

- surface finish
- cracks or damaged lugs.

49046C-700-R4

LO & REVERSE CLUTCH				
MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICK-NESS	NO.	THICK-NESS
MB,MC,MJ,VN,TC,T2,VA, ML,MP,MS,T7,YH,YF,PQ,Y7	4	1.77mm (.069")	4	2.25mm (.088")
ALL OTHERS	5	1.77mm (.069")	5	2.25mm (.088")

Figure 78 Lo and Reverse Clutch Plate Chart

Install or Connect (Figure 79 and 80 and 81)

1. Roller clutch assembly (678) into the support assembly (679)
2. Support and roller assembly into the case with the hub down
3. Inner race (675) into the roller assembly
   - rotate as shown in figure 79.
   - push down for full engagement.
   - bottom tangs will be flush with carrier hub when properly installed.
4. Support retainer spring (680) into the case
   - insert between the case lug and the one open notch in the support.

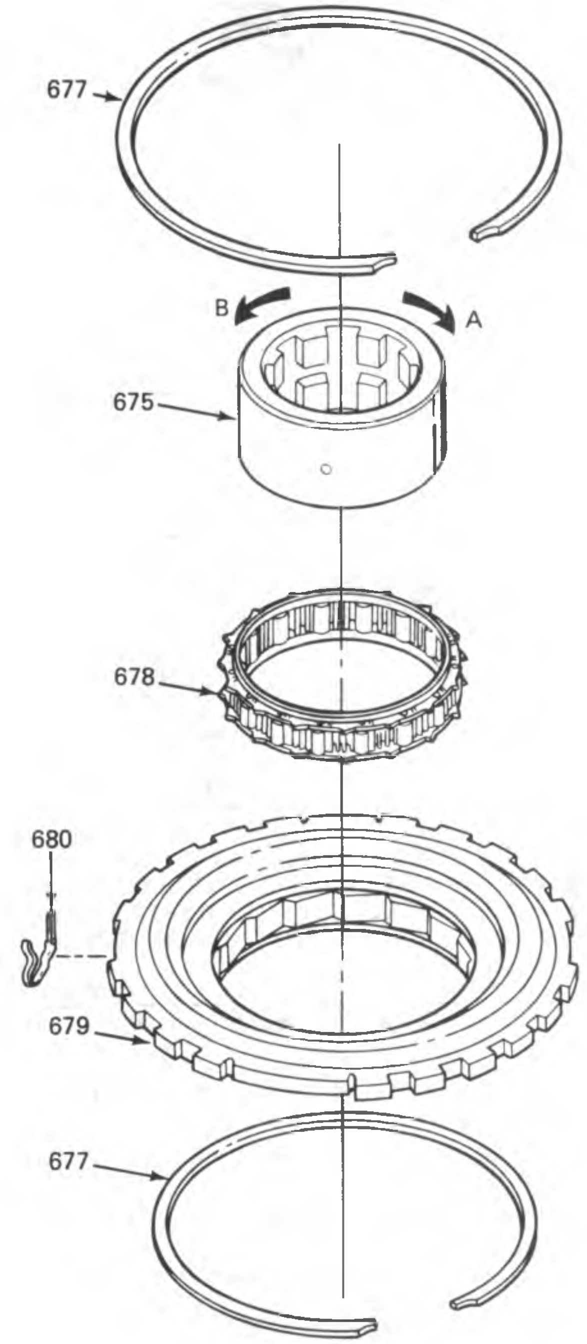
Reaction Sun Gear and Shell

Inspect (Figure 82)

- Reaction Sun Gear (673) for
  - nicked, scored, or worn bushing. (See Bushing Replacement).
  - damaged spline or teeth
  - loose or weak retaining ring (do not remove this ring, except to replace it.)
- Reaction sun shell (670) for
  - stripped or worn splines
  - broken hub
  - bent tangs
- Lo and reverse inner race to reaction sun gear shell thrust washer (674) for wear or damage
- Reaction shaft to reaction sun gear shell thrust washer (669) for wear or damage (bronze thrust washer).

Install or Connect (Figure 82 and 83)

1. Reaction sun gear retainer ring (671) onto the reaction sun gear, if previously removed.
2. Reaction sun gear (673) into the reaction carrier
   - index the teeth with the pinion gears.
3. Thrust washer (674) onto the lo and reverse support inner race
   - index the four locating gears into the race (675)
4. Reaction gear shell (670) onto the reaction sun gear (673)



ILL. NO.	DESCRIPTION
A	LOCKED UP
B	FREE WHEELS
675	RACE, LO & REVERSE ROLLER CLUTCH
677	RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER

490040 700 R4

Figure 79 Lo and Reverse Clutch Support Assembly

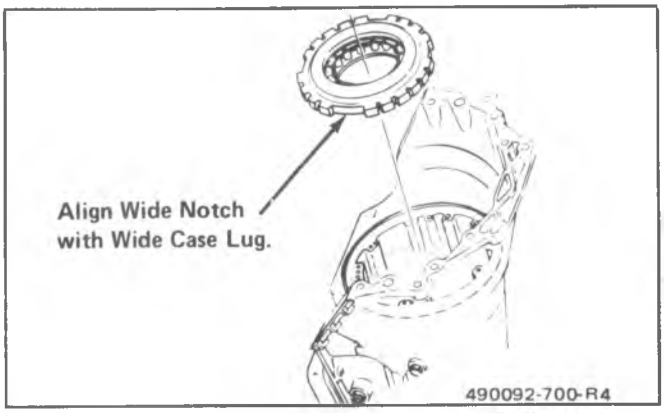
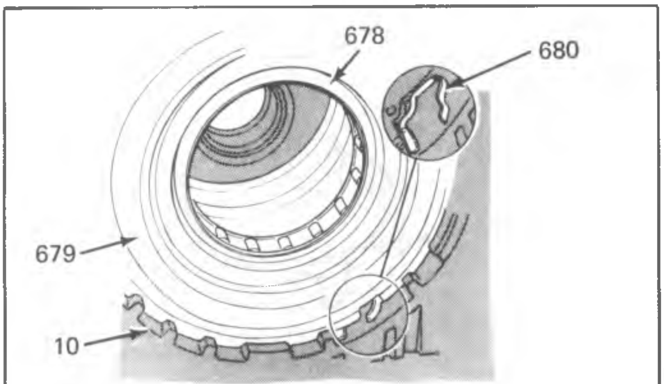


Figure 80 Lo and Reverse Support and Roller Asm. Installation



10	CASE, TRANSMISSION
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER

490254-700-R4

Figure 81 Support Spring - Installed

5. (Bronze) thrust washer (669) onto the reaction sun shell (670)
   - index tangs into the shell.

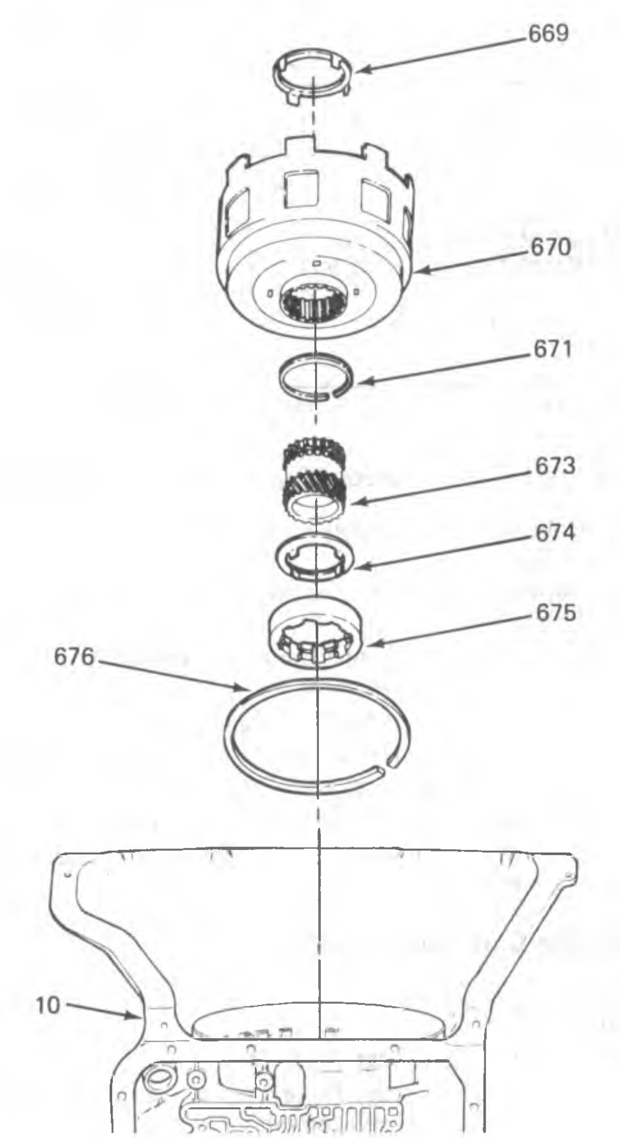
Input Internal Gear and Output Shaft

Remove or Disconnect (Figure 84)

1. Retainer ring (668) from input internal gear (664)
2. Reaction carrier shaft (666) from the input internal gear (664)

Inspect (Figures 83, 84 and 86)

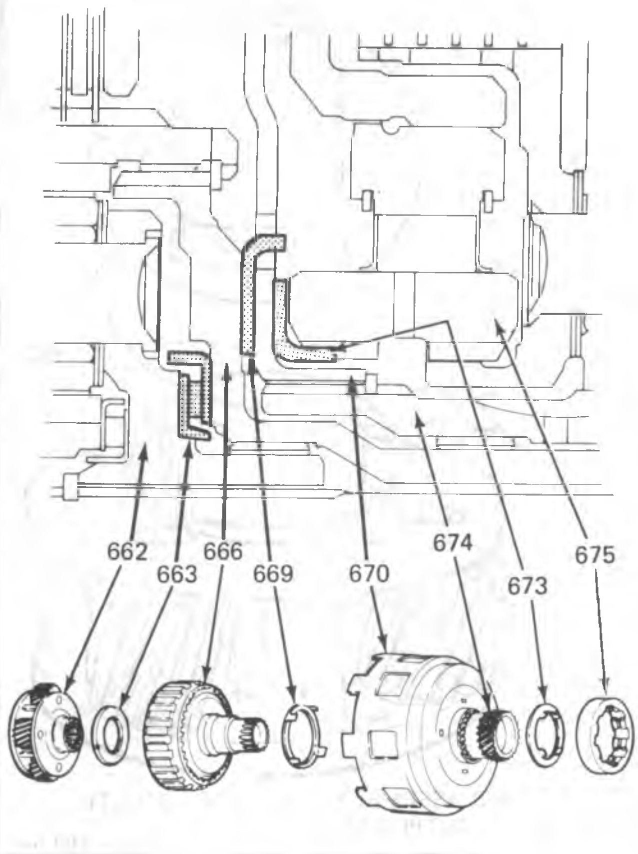
- Reaction Carrier Shaft (666) for
  - scored, damaged, or worn bushings (see Bushing Replacement)
  - cracked shaft
  - damaged spline or gear teeth
  - under cut around the shaft from interference with the sun gear
- Input internal gear (664) for
  - cracks
  - damaged spline or gear teeth
- Input carrier to reaction shaft thrust bearing (663) for wear or damage
- Output shaft (687)



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
669	WASHER, THRUST (REACTION SHAFT/SHELL)
670	SHELL, REACTION SUN
671	RING, REACTION SUN GEAR RFTAINER
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO & REVERSE ROLLER CLUTCH
676	RING, LO & REVERSE SUPPORT TO CASE RETAINER

490224-700 R4

Figure 82 Sun Gear and Shell Installation



662 CARRIER ASSEMBLY, INPUT — COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH

49008A-700-R4

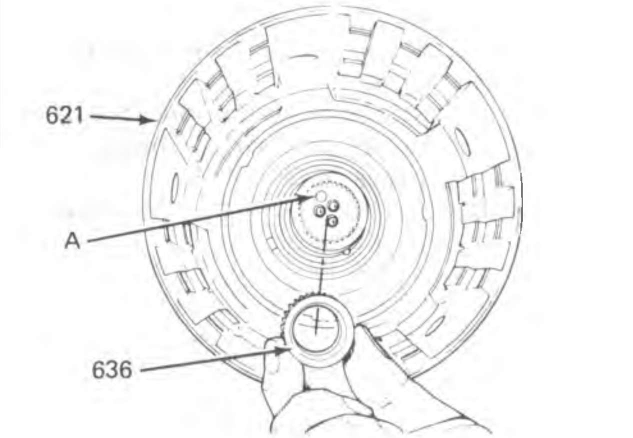
Figure 83 Input Carrier and Reaction Shell Bearing and Thrust Washer Locations

664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
668 RING, REACTION SHAFT/INTERNAL GEAR RETAINER

490225-700-R4

Figure 84 Input Internal Gear and Reaction Shaft

- plugged or restrictred lube passages
- damaged splines or ring groove
- damaged governor drive gear teeth
- burrs or damage to the front of the shaft at seal area. (Polish with crocus cloth if necessary)
- burrs or damage to bearing journals



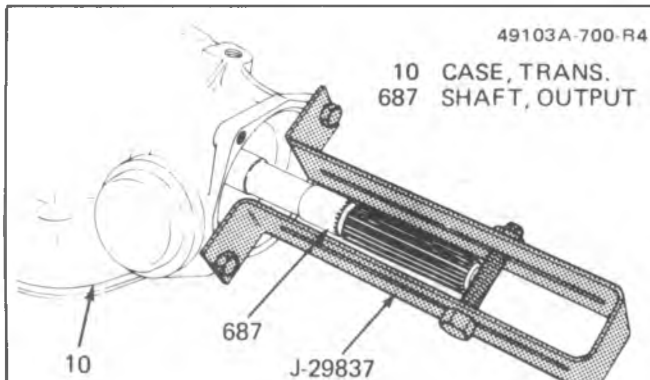
A LUBRICATION PASSAGE
621 HOUSING & SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT

490260-700-R4

Figure 85 Input Hsg. to Output Shaft Lip Seal

Install or Connect (Figures 84, 86 and 87)

1. Reaction shaft (666) into the input internal gear (664)
2. Retainer ring (668) into the input internal gear ear (664)
3. Input internal gear and shaft assembly into the sun gear shell
   - index the shaft spline into the reaction carrier.
4. Thrust Bearing (663) onto the reaction carrier shaft.
   - outer race goes toward the reaction carrier shaft.
5. Output shaft (687) into the transmission
   - index the splines with the mating parts.
6. J-29837 onto the case (10)
   - position upwards as far as possible to support the output shaft (687).



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10 CASE, TRANS.
687 SHAFT, OUTPUT

Figure 86 Output Shaft - Installation

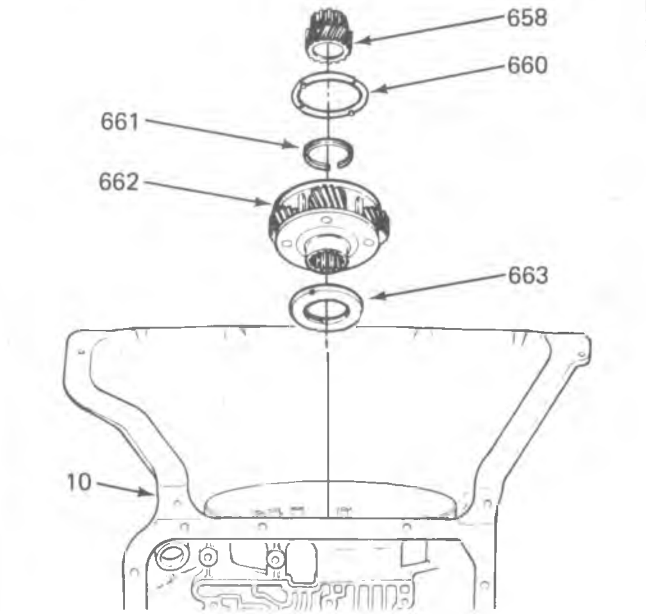
Input Carrier and Sun Gear

Inspect (Figures 87 and 88)

- Input carrier assembly (662) for
  - pinion gear damage
  - excessive pinion washer wear (end play .20-.61 mm/.008-.024 in.)

- proper pin stake
- keystoned pinion gears (pinion gears must rotate freely)
- damaged or worn thrust bearing (See fig. 88)

- Thrust washer (660) for wear or damage
- Input sun gear (658) for
  - bushing damage or wear (see Bushing Replacement Procedure).
  - cracks
  - damaged spline or gear teeth



10 CASE, TRANSMISSION
658 GEAR, INPUT SUN
660 WASHER, THRUST (INPUT CARRIER/RACE)
661 RET., OUTPUT SHAFT TO INPUT CARRIER
662 CARRIER ASSEMBLY, INPUT – COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)

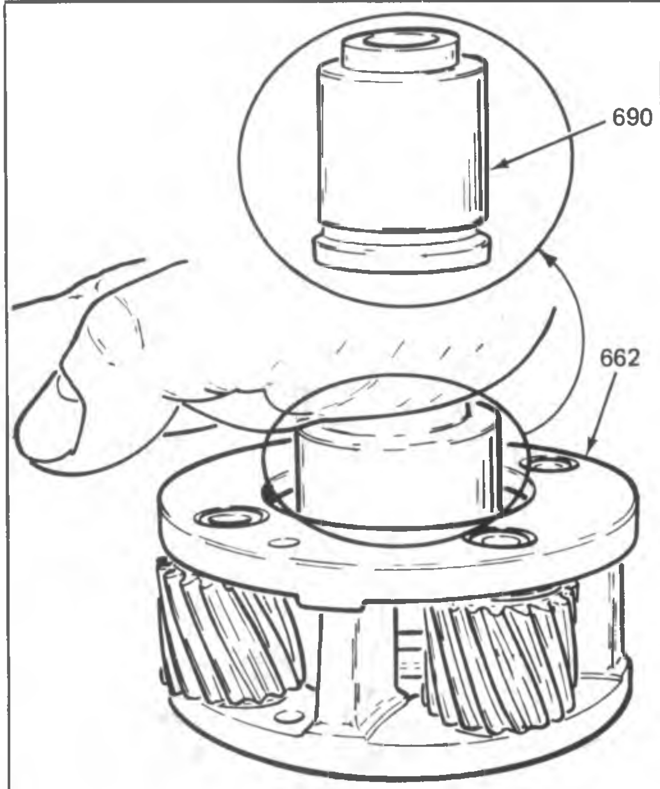
490226-700 R4

Figure 87 Input Carrier and Sun Gear - Installation

Install or Connect (Figure 87)

TOOLS REQUIRED:
J-34627 Snap Ring Pliers

1. Input carrier assembly (662) onto the output shaft
2. Retainer ring (661) into the output shaft ring groove
   - Do not reuse the old retainer ring if it has been overexpanded.
   - Use care not to overexpand th ring during installation.
3. Remove J-29837.
4. Thrust washer (660) onto the input carrier assembly
5. Input sun gear (658) into the input carrier
   - index the sun gear teeth into the pinion gear teeth.



662 CARRIER ASSEMBLY, INPUT – COMPLETE
690 SLEEVE, OUTPUT SHAFT

490237-700-R4

Figure 88 Checking Captured Thrust Bearing

Input Clutch Assembly

Remove or Disconnect (Figure 89)

- Reverse input clutch assembly (605) from the input clutch assembly (621)
- Oil pump to selective washer thrust bearing (615)
- Selective washer (616)

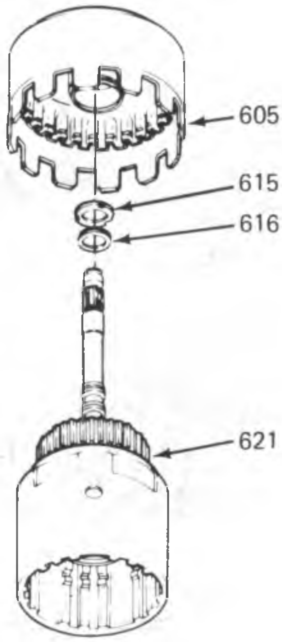
Disassemble (Figures 90 and 91)

TOOLS REQUIRED:
J-23456 Clutch Spring Compressor Press
J-25018 Clutch Spring Compressor

1. Place the input clutch assembly (621) on the bench with the turbine shaft through the bench hole.
2. The 3-4 clutch plate retainer ring (656) and the backing plate (655)
3. The 3-4 clutch plates (654)
4. The 3-4 clutch apply plate (653)
5. The 3-4 clutch ring retainer plate (652)
6. Forward clutch backing plate retainer ring (651) and backing plate (650)
7. Forward clutch sprag assembly (638 - 644)

Disassemble

1. Input sun gear bearing assembly (637)
2. Input housing to output shaft lip seal (636).
3. Forward clutch plates (649)
4. Forward wave plate (648)



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

490013-700-R4

Figure 89 Reverse Input and Input Clutches

5. Forward clutch apply plate (646) and spacer plate (647)
6. Overrun clutch plates (645)

Disassemble

1. Install J-23456 and J-25018
   - Compress overrun clutch spring assembly (634).
2. Overrun clutch retainer ring (635).
3. Overrun clutch spring assembly (634).
4. Overrun clutch piston (632)
   - inner and outer lip seals (631)
5. Forward clutch piston assembly (630)
   - inner and outer lip seals (629)
6. Forward clutch housing (628)
7. The 3-4 clutch spring assembly (626)
8. The 3-4 clutch apply ring (625) and piston (623)
   - inner and outer lip seals (624) from piston
9. Forward clutch to input housing "O" ring seal (622)
10. Four turbine shaft oil seal rings (619)

Inspect (Figures 92 and 94)

1. Input housing (621) for porosity or damage
2. Input housing and shaft assembly (621)
   - all splines for wear or damage
   - air check feed passages.
   - three turbine shaft sealing balls
     - the balls must **not** be loose or leaking.
     - the open hole is the lube oil passage which feeds the output shaft.
   - Four turbine shaft oil seal rings (619) and their ring grooves for damage, burrs, or cuts
     - these seals must fit freely into the ring grooves.
   - Check valve retainer and ball assembly (617) for damage
     - the ball must move freely in the retainer.
     - the retainer must be tight in the turbine shaft.

Check Valve Retainer and Ball Assembly - Replacement Procedures

Remove or Disconnect (Figure 92)

TOOLS REQUIRED:
#4 Screw extractor

1. Straighten the tangs of the retainer and remove the ball.
2. Check valve retainer
   - use #4 Screw Extractor

Install or Connect (Figures 92, 93 and 94)

TOOLS REQUIRED:
9.5 mm (3/8") diameter metal rod

- New check valve retainer and ball assembly (617)
  - use the 9.5 mm (3/8") metal rod.
  - seat the retainer 3.0 mm (1/8 in.) below top surface of the turbine shaft.
  - be certain the ball is loose.

Inspect

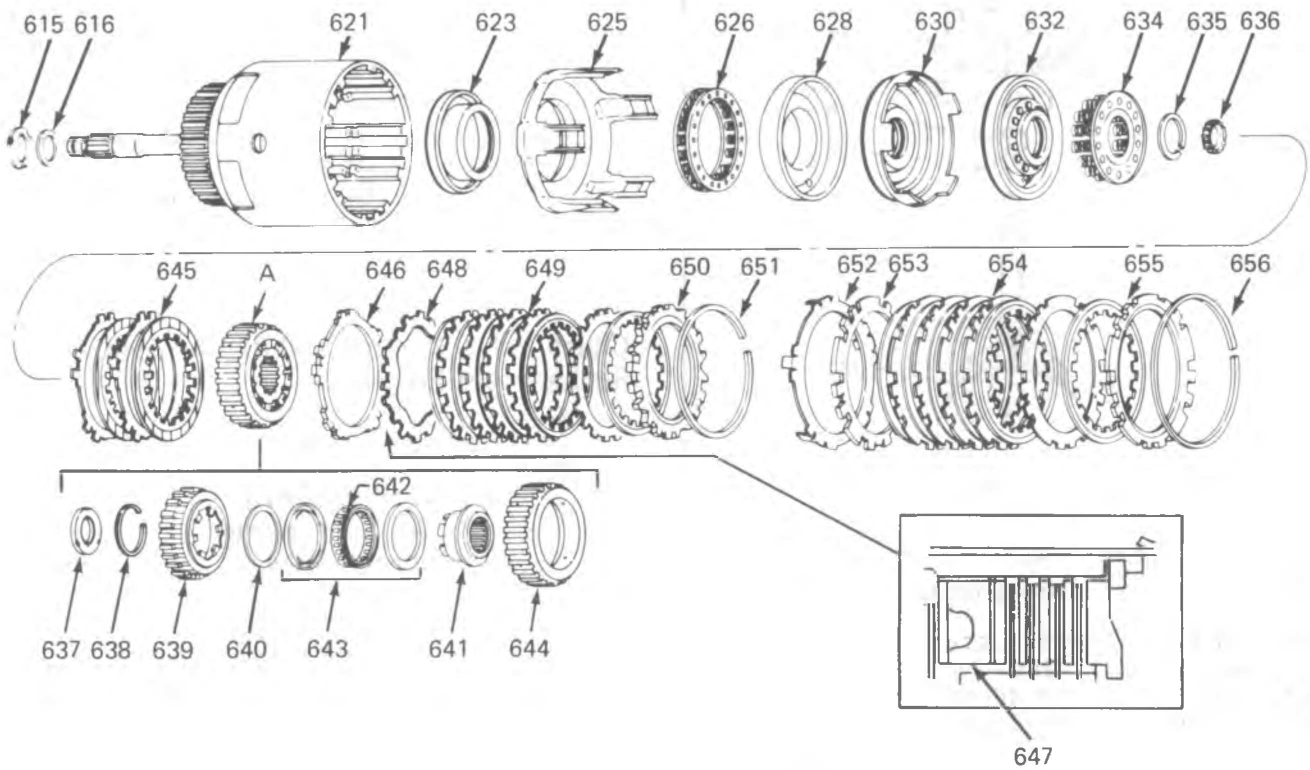
- Turbine shaft "O" ring seal (618) for nicks, cuts, or damage
- Input housing check valve ball (620).
  - the ball must move freely.
  - leak check the ball with solvent.

Important (Figure 93)

- If the 3-4 clutch plates are burned or worn and no cause is found during diagnosis or disassembly, replace the input housing and shaft assembly (621). The check valve ball may be operating erratically do to seat damage. **Do not** try to tap on the ball to form a new seat because it operates on a ramp angle and tapping will distort the seat. (See Figure 93)

Inspect (Figures 95, 96 and 97)

- The 3-4 clutch piston (623) for damage or porosity
- The 3-4 clutch apply ring (625) for
  - bent tangs
  - correct tang length (see chart)



INPUT CLUTCH ASSEMBLY (EXPLODED VIEW)

ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
632	PISTON, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
645	PLATE ASSEMBLY, OVERRUN CLUTCH
A	FORWARD CLUTCH SPRAG ASSEMBLY
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RET.
639	HUB, OVERRUN CLUTCH
640	WEAR PLATE, SPRAG ASSEMBLY
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH – OUTER

ILL. NO.	DESCRIPTION
646	PLATE, FORWARD CLUTCH APPLY
*647	PLATE, FORWARD CLUTCH SPACER (SOME MODELS ONLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING
656	RING, 3RD & 4TH CLUTCH BACKING

*ONLY USED WITH A 4 PLATE CLUTCH PACK.

49025C-700-R4

Figure 90 Input Clutch Assembly

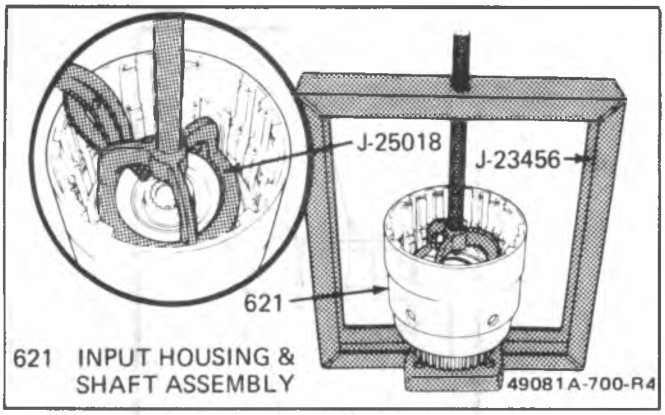


Figure 91 Overrun Clutch Retainer Ring - Removal

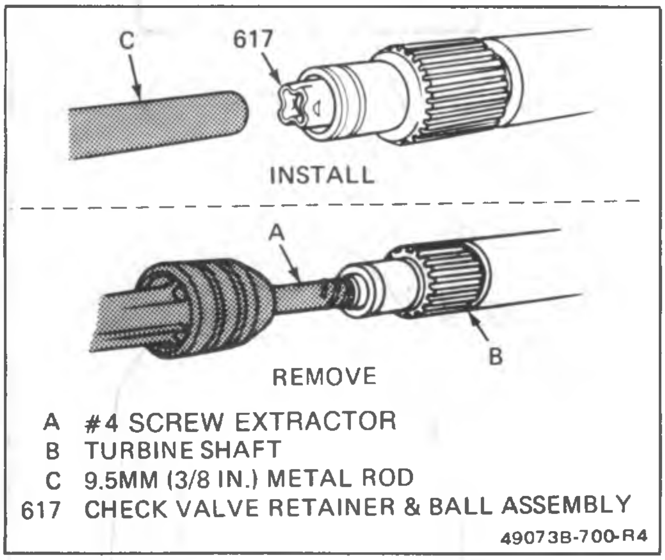


Figure 92 Retainer and Ball Assembly - Replacement

- The 3-4 clutch spring assembly (626) for damage or distortion

Assemble (Figure 96)

1. Position the input housing and shaft assembly (621) on the bench with the turbine shaft through a bench hole.
2. Inner and outer 3-4 clutch lip seals (624) on the 3-4 clutch piston (623)
   - seal lips must face away from the piston hub.
   - lubricate the seals with transmission fluid.
3. The 3-4 clutch piston (623) into the input housing as shown
   - use care not to damage the seals.

Inspect (Figures 90 and 97)

- Forward clutch housing (628) for
  - proper check ball operation
  - damage or distortion
  - burrs in seal areas
  - cracks
- Forward clutch piston (630) and overrun clutch piston (632) for
  - porosity or damage
  - ring groove damage
  - apply leg damage
- Overrun spring assembly (634) for damage or distortion
- Input housing to output shaft lip seal (636) for damage or wear

Assemble (Figures 97, 98 and 99)

TOOLS REQUIRED:

J-23456 Clutch Spring Compressor Press
J-25018 Clutch Spring Compressor
J-29882 Overrun Clutch Inner Seal Protector
J-29883 Forward Clutch Inner Seal Protector

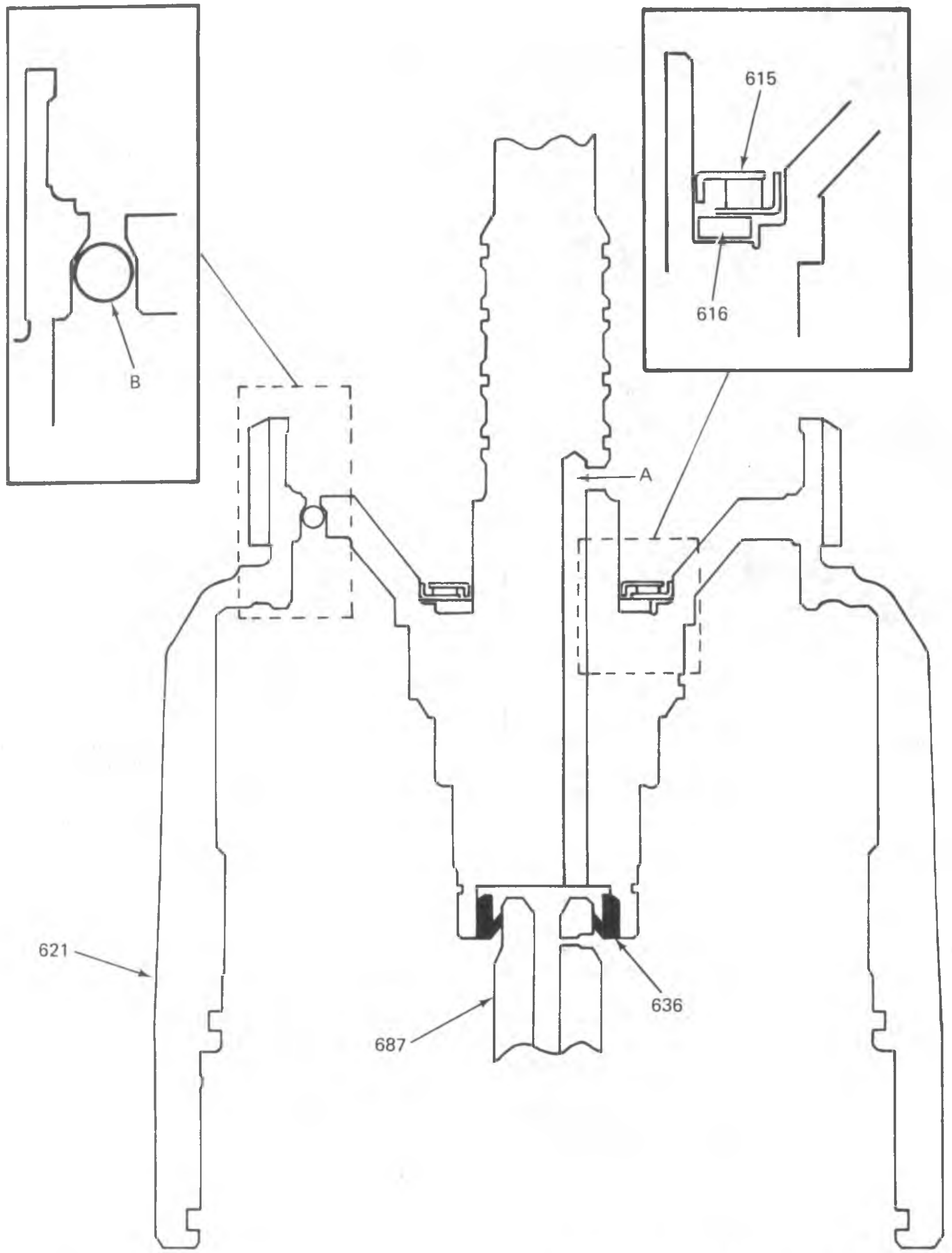
1. Forward clutch housing to input clutch housing "O" ring seal (622) as shown
   - lubricate with transmission fluid.
2. Inner and outer seals (629) on forward clutch piston
   - seal lips must face away from the piston tangs as shown.
   - lubricate with transmission fluid.
3. Forward clutch piston (630) into the forward clutch housing
   - use care not to damage the outer lip seal.
4. The 3-4 clutch spring assembly (626) onto the 3-4 clutch apply ring (625)
5. Forward clutch assembly onto the 3-4 clutch spring assembly
   - the forward clutch piston apply legs must be indexed with the 3-4 clutch apply ring legs.
6. J-29883 on the input housing as shown
7. Apply ring and forward clutch assembly into the input housing as shown
   - hold the assembly by the apply ring legs during installation.
   - do not let the forward clutch piston separate from the housing.
   - firmly seat the assembly.
8. J-29882 on the input housing as shown
9. Overrun clutch piston (632)
   - hub facing upward as shown.
   - if all parts are properly seated to this point, the overrun piston hub will be approximately 3/16 in. below the snap ring groove in the input housing hub.

Assemble (Figures 90, 99 and 100)

1. Overrun clutch spring assembly (634) onto the overrun clutch piston.
   - locate the springs on the piston tabs
2. J-23456 and J-25018 onto the overrun spring assembly.
   - compress springs (Do not over-compress).
3. Retainer snap ring (635) into the snap ring groove
4. Input housing to output shaft lip seal (636)

Inspect

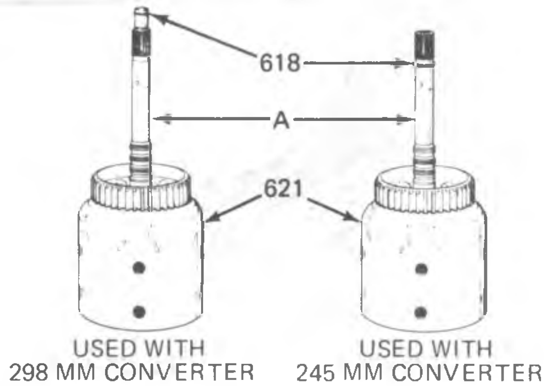
- Overrun clutch plates (645)



A	LUBE PASSAGE	621	HOUSING & SHAFT ASSEMBLY, INPUT
B	DO NOT TAP ON THIS CHECKBALL	636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER	687	SHAFT, OUTPUT
616	WASHER, THRUST (SELECTIVE)		

490256-700-R4

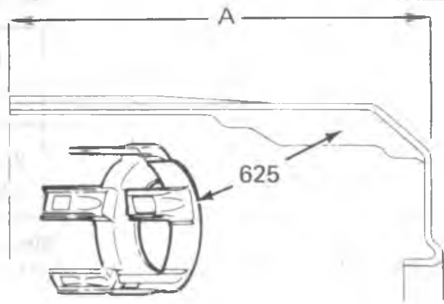
Figure 93 Input Housing Check Valve Ball



A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT

490261-700-R4

Figure 94 Views of the Input Housing

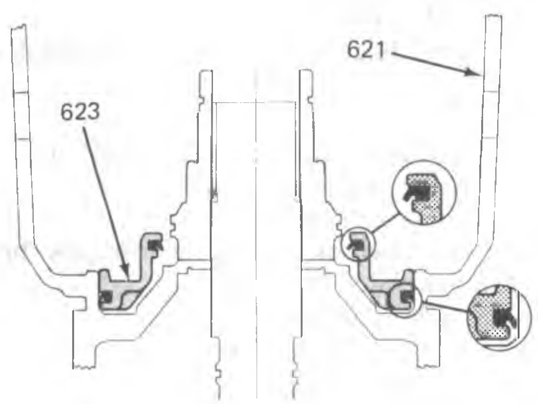


625 RING, 3RD & 4TH CLUTCH APPLY

	DIM A
T2,VA,ML,MP,MS,T7,YF, PQ,Y7,MB,MC,MJ,VN,TC	98.53 mm (3.88)
ALL OTHERS	94.13 mm (3.71)

49079D-700-R4

Figure 95 The 3-4 Clutch Apply Ring Chart

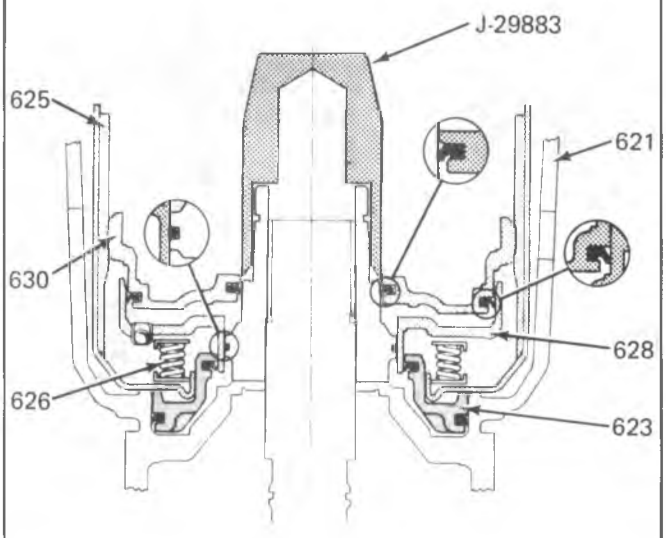


621 HOUSING & SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD & 4TH CLUTCH

490282-700-R4

Figure 96 Input Housing and 3-4 Piston

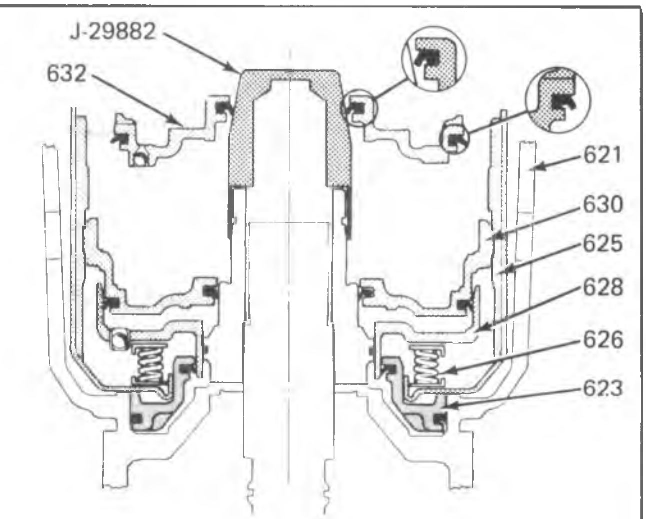
- Composition plates for damaged tangs, delamination, or excessive wear



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH

490227-700-R4

Figure 97 Forward Clutch and 3-4 Apply Ring - Installed



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
632	PISTON, OVERRUN CLUTCH

490101-700-R4

Figure 98 Overrun Piston - Installed

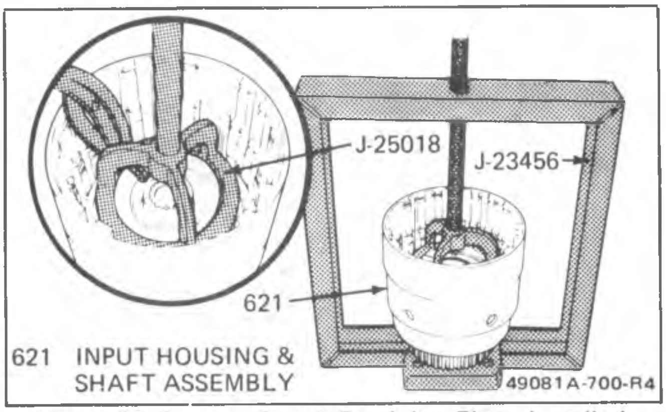


Figure 99 Overrun Clutch Retaining Ring - Installed

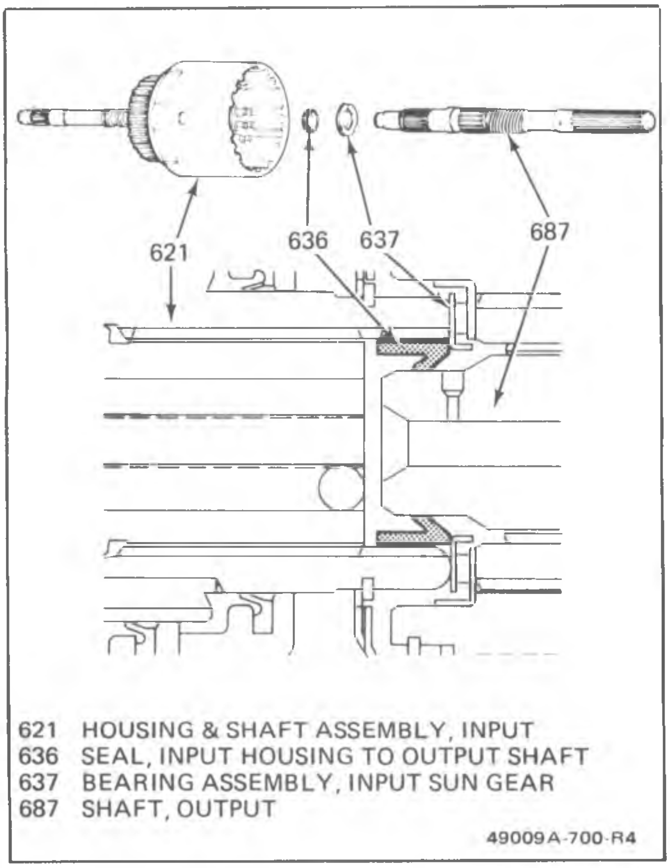
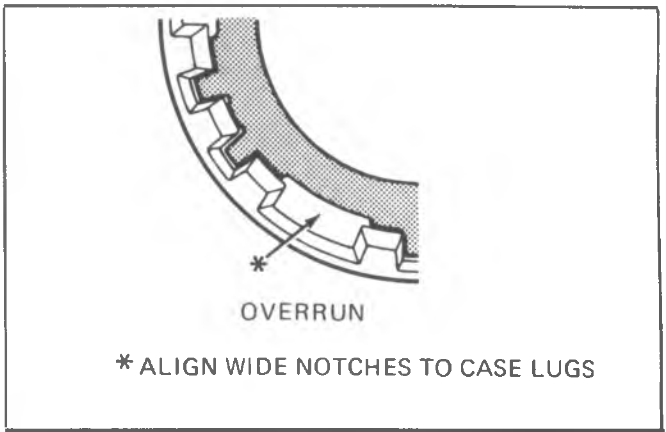


Figure 100 Input Hsg. to Output Shaft Lip Seal

- Steel plates for damaged tangs, wear, or heat damage
- Input sun gear bearing assembly (637) for wear, flatness or damage

Assemble (Figures 90, 101 and 102)

1. Overrun clutch plates (645) into the input housing.
   - overrun clutch plates are the smallest of the three sets of plates in the input housing.
   - index the plate as shown.
2. Thrust bearing assembly (637) onto the input clutch hub
   - the inside race must face the input housing hub.
   - retain with petrolatum.



OVERRUN CLUTCH				
MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICKNESS	NO.	THICKNESS
ALL MODELS	2	2.34 mm (.091")	2	2.03 mm (.079")

49043A-700-R4

Figure 101 Overrun Clutch Plate Chart

3. Align the tangs on the two composition overrun clutch plates.

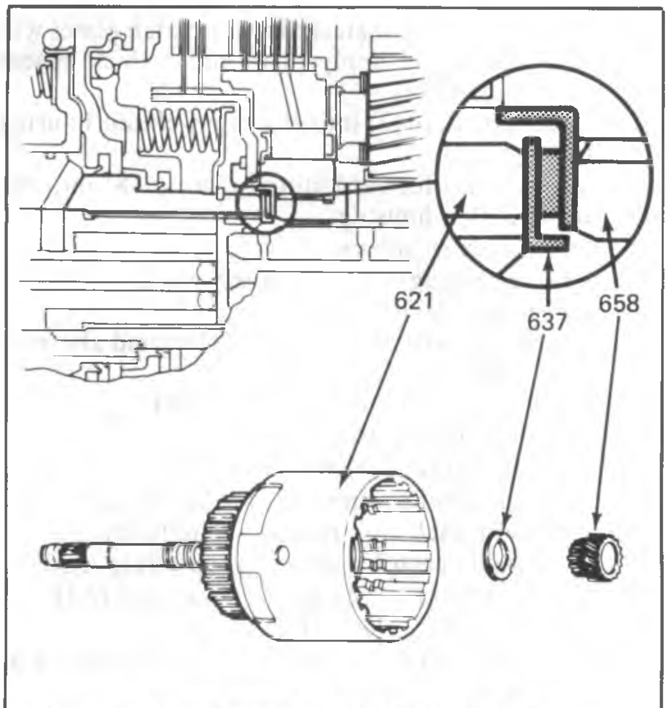
Forward Clutch Sprag Assembly

Disassemble (Figure 103)

1. Forward sprag outer race (644)
2. Overrun clutch hub retaining snap ring (638) and clutch hub (639)
3. Wear plate (640)
4. Forward clutch retainer and race assembly (641)

Inspect

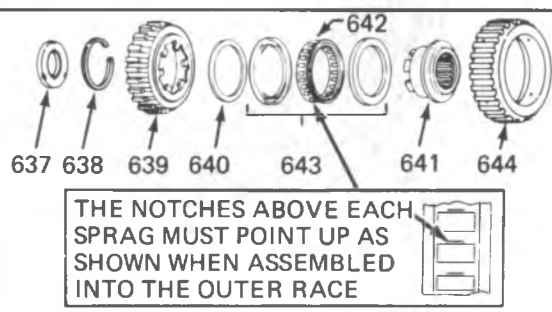
- Forward clutch sprag assembly (642) for
  - wear or damage
  - weak or broken springs
  - damaged or missing retainer caps (brass)
- Overrun clutch hub (639) for
  - spline damage
  - plugged lubrication holes
  - damaged tangs
  - cracks
- Wear plate (640) missing or damaged
- Forward clutch retainer and race assembly (641) for
  - spline damage
  - ring groove damage
  - surface finish damage
  - loose retainer
- Forward sprag outer race (644) for



621 HOUSING & SHAFT ASSEMBLY, INPUT
637 BEARING ASSEMBLY, INPUT SUN GEAR
658 GEAR, INPUT SUN

49057A-700-R4

Figure 102 Input Sun Gear Thrust Bearing



637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CLUTCH HUB RET.
639 HUB, OVERRUN CLUTCH
640 WEAR PLATE, SPRAG ASSEMBLY
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH – OUTER

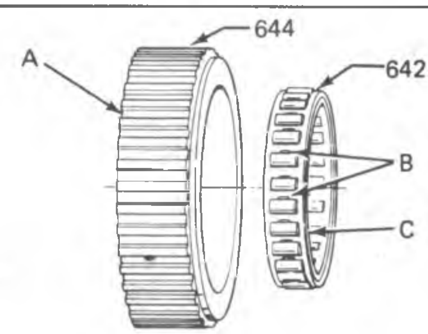
490231-700-R4

Figure 103 Forward Clutch Sprag Assembly

- spline damage
- surface finish damage
- plugged lubrication holes

Assemble (Figures 104, 105, 106)

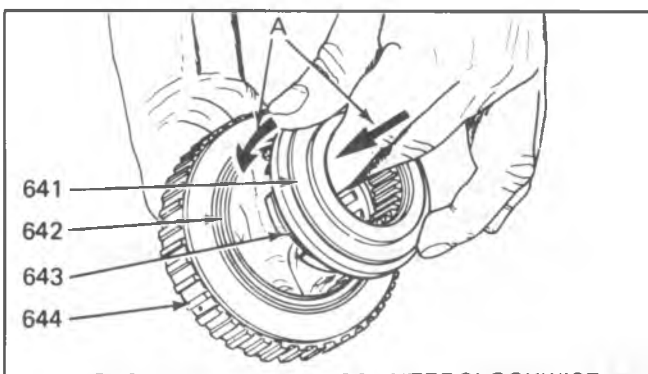
1. Forward clutch sprag assembly (642) into the outer race (644)
   - to correctly install, the notches in the sprag cage must face upward as shown.
2. One (brass) sprag retainer ring (643) onto the race and retainer assembly
   - the flange on the retainer ring must face away from the retainer.
3. Race and retainer assembly into the sprag assembly (642)
   - to assemble, hold the outer race in your left hand with your fingers supporting the sprag at the recessed side of the outer race.
   - insert the race and retainer assembly by pushing in and turning to the left.
4. The remaining (brass) retainer ring onto the sprag assembly
5. Wear plate (640) onto the retainer ring
6. Overrun clutch hub (639) onto the wear plate
7. Overrun clutch hub retaining snap ring (638) into the snap ring groove of the race and retainer assembly
8. Test the assembly for proper operation as shown.
   - If the assembly operates backwards, you have installed the sprag backwards. As such, disassembly and reassemble correctly.



A RECESSED FACE
B NOTCHES POINT UPWARD AS SHOWN
C LIPPED EDGE
642 FORWARD SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH – OUTER

490245-700-R4

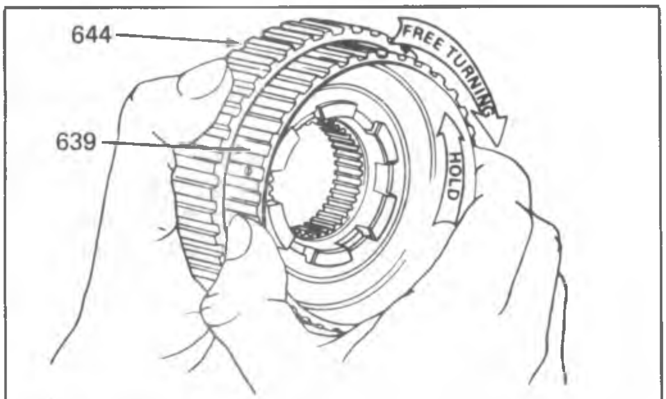
Figure 104 Sprag Assembly Procedure



A PUSH IN AND TURN COUNTERCLOCKWISE TO INSTALL
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH – OUTER

490246-700-R4

Figure 105 Sprag Race and Retainer Assembly Procedure



THE OVERRUN CLUTCH HUB MUST TURN CLOCKWISE, BUT NOT COUNTERCLOCKWISE

639 HUB, OVERRUN CLUTCH
644 RACE, FORWARD CLUTCH – OUTER

49112A-700-R4

Figure 106 Check Sprag for Proper Operation

Assemble

- Forward clutch sprag assembly into the input clutch housing
  - index the overrun clutch hub into the overrun clutch plates.

Inspect (Figure 107 and 108)

- Forward (649) and 3-4 clutch plates (654)
  - Composition plates for damaged tangs, delamination, or wear
  - Steel plates for damaged tangs, wear, or heat damage
- Forward (650) and 3-4 clutch backing plates (655) for
  - flatness
  - surface finish damage
  - burrs or nicks
- Forward clutch apply plate (646) and spacer plate (647) for
  - flatness
  - surface finish damage
  - burrs or nicks
- The 3-4 clutch apply plate (653) for
  - flatness
  - surface finish damage
- The 3-4 clutch ring retainer plate (652) for
  - bent tangs
  - flatness

Assemble (Figures 107, 108, 109, and 110)

1. Forward clutch apply plate (thick steel 646) into the input clutch housing (621)
   - index as shown.

   Important

   - A forward clutch which requires five steel forward clutch plates will use a single thick apply plate. A forward clutch which requires four steel forward clutch plates will use a thin apply plate and a thick spacer plate (647).
2. Spacer plate (647) into the input clutch housing (if required).
3. Waved steel forward clutch plate (648) into the input clutch housing
   - index as shown.
4. The remaining forward clutch plates (649) into the input clutch housing
   - start with a composition plate and alternate with steel.
5. Forward clutch backing plate (650)
   - chamfered side up.
6. Forward clutch retainer ring (651)
   - the smaller ring with the larger gap.
7. The 3-4 clutch ring retainer plate (652)
   - index each leg into the apply ring legs.
8. The 3-4 clutch apply plate (thick steel 653)
9. The 3-4 clutch plates (654)
   - start with composition and alternate with steel.
10. The 3-4 clutch backing plate (655) and retainer ring (656)
    - chamfered side up.

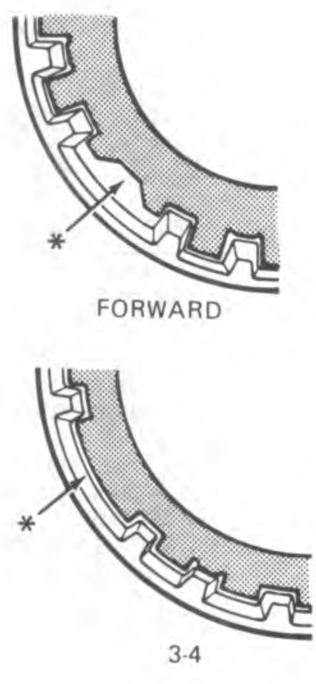
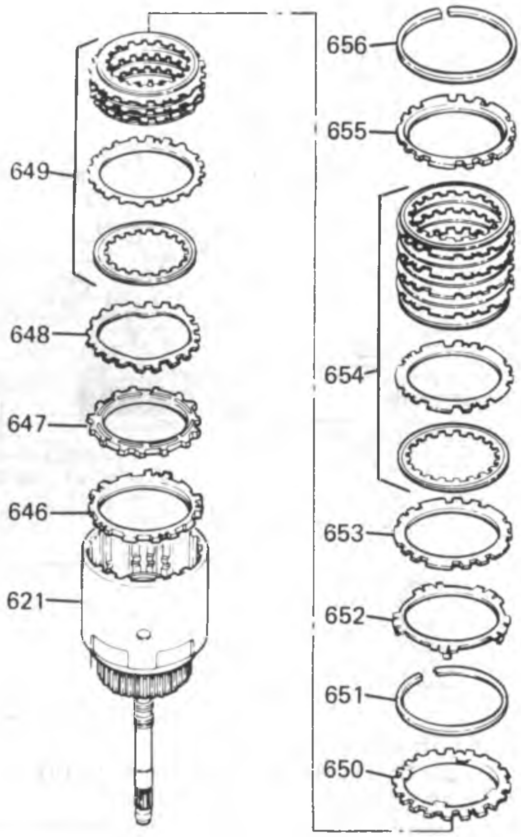


Figure 107 Forward and 3-4 Clutch Plates - Installed



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
646	PLATE, FORWARD CLUTCH APPLY
647	PLATE, FORWARD CLUTCH SPACER (SOME MODELS ONLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

490228-700-R4

Figure 108 Input Housing with Forward and 3-4 Clutch Plates

49045C-700-R4

FORWARD CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED	
		*A-MODELS	*B-MODELS
FLAT STEEL CLUTCH PLATE	1.97 mm (.077")	3	4
COMPOSITION FACED CLUTCH PLATES	2.03 mm (.079")	4	5
APPLY PLATE	6.44 mm (.251")	1	1
SPACER PLATE	8.45 mm (.330")	1	0
WAVED STEEL CLUTCH PLATE	2.03 mm (.079")	1	1

*A-MODELS	T2, VA, ML, MP, MS, T7, YF, YH, PQ, Y7, MB, MC, MJ, VN, TC
*B-MODELS	ALL OTHERS

Figure 109 Forward Clutch Plate Chart

49044C-700-R4

3-4 CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED	
		*A-MODELS	*B-MODELS
FLAT STEEL CLUTCH PLATE	1.97 mm (.077")	4	5
COMPOSITION FACED CLUTCH PLATES	2.03 mm (.079")	5	6
APPLY PLATE	3.30 mm (.128")	1	1
BACKING PLATE	SELEC-TIVE	1	1

*A-MODELS	T2, VA, ML, MP, MS, T7, YF, PQ, Y7, MB, MC, MJ, VN, TC
*B-MODELS	ALL OTHERS

Figure 110 3-4 Clutch Plate Chart

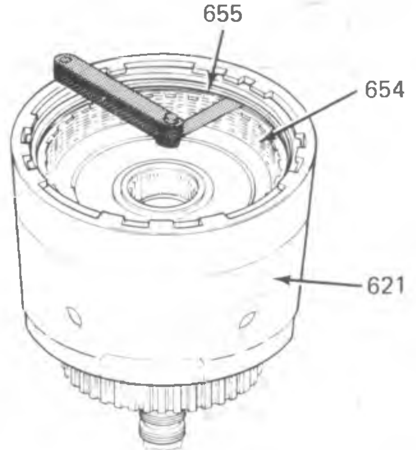
3-4 Clutch Piston Travel Check

Measure (Figure 111)

- Check the end clearance between the backing plate (655) and the first composition plate with a feeler gage.
- Select the proper backing plate from the chart to obtain the correct clearance.

3-4 BACKING PLATE SELECTION

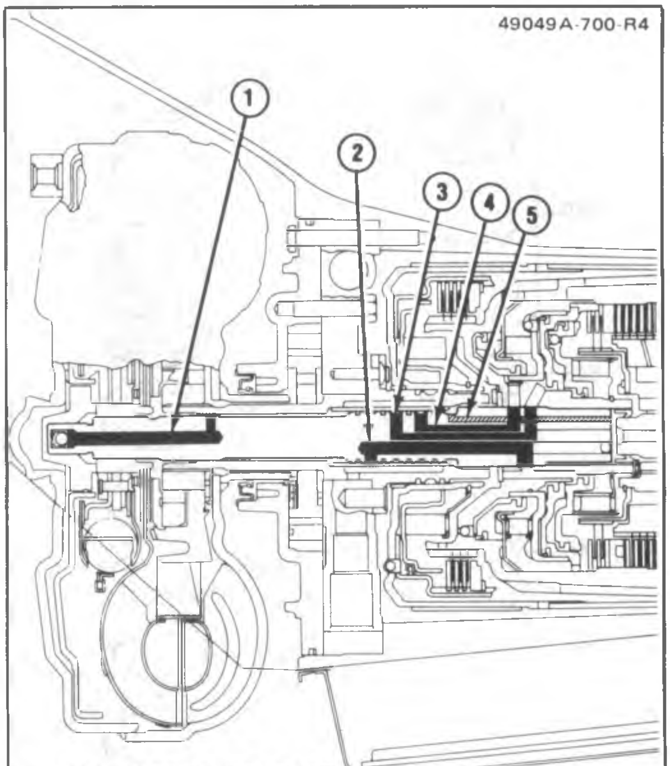
MODEL	BACKING PLATE TRAVEL	*BACKING PLATE	
		Use Backing Plate Which Gives Correct Travel	
		DIM	I.D.
T2, VA, ML, MP, MS, T7, YF, PQ, Y7, MB, MC, MJ, VN, TC	1.39 - 2.78 mm (.055" - .109")	7.125 mm (.278")	1
		6.125 mm (.239")	2
ALL OTHERS	1.25 - 2.87 mm (.049" - .113")	5.125 mm (.200")	3
		4.125 mm (.161")	4



621 HOUSING & SHAFT ASSEMBLY, INPUT
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING

49055G-700-R4

Figure 111 Backing Plate Selection Chart



1. CONVERTER RELEASE
2. OVERRUN CLUTCH
3. FORWARD CLUTCH
4. 3-4 CLUTCH
5. LUBE

Figure 112 Turbine Shaft Oil Passages

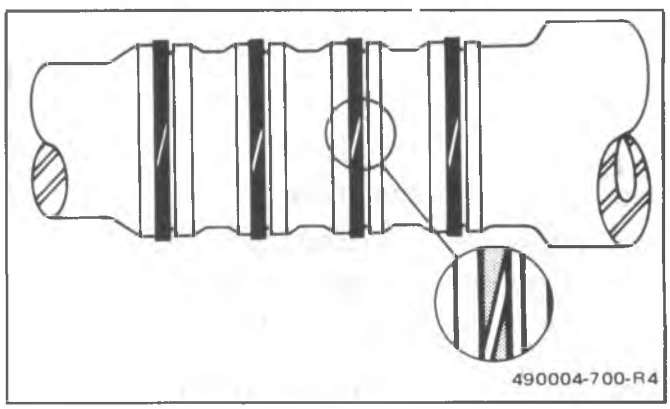


Figure 113 Turbine Shaft Oil Seal Rings

Clutch Air Check

(Figure 112)

Air check the 3-4, forward, and overrun clutches by applying air pressure at the feed holes in the turbine shaft. (When the overrun clutch is checked, the air well blow by the forward clutch piston lip seals and exit out the forward clutch feed hole in the turbine shaft.)

Assemble (Figure 113)

1. Four turbine shaft oil seal rings (619) into the turbine shaft ring grooves
   - retain with petrolatum.
   - the seal color identifies the manufacturer and does not affect assembly.

Reverse Input Clutch Assembly

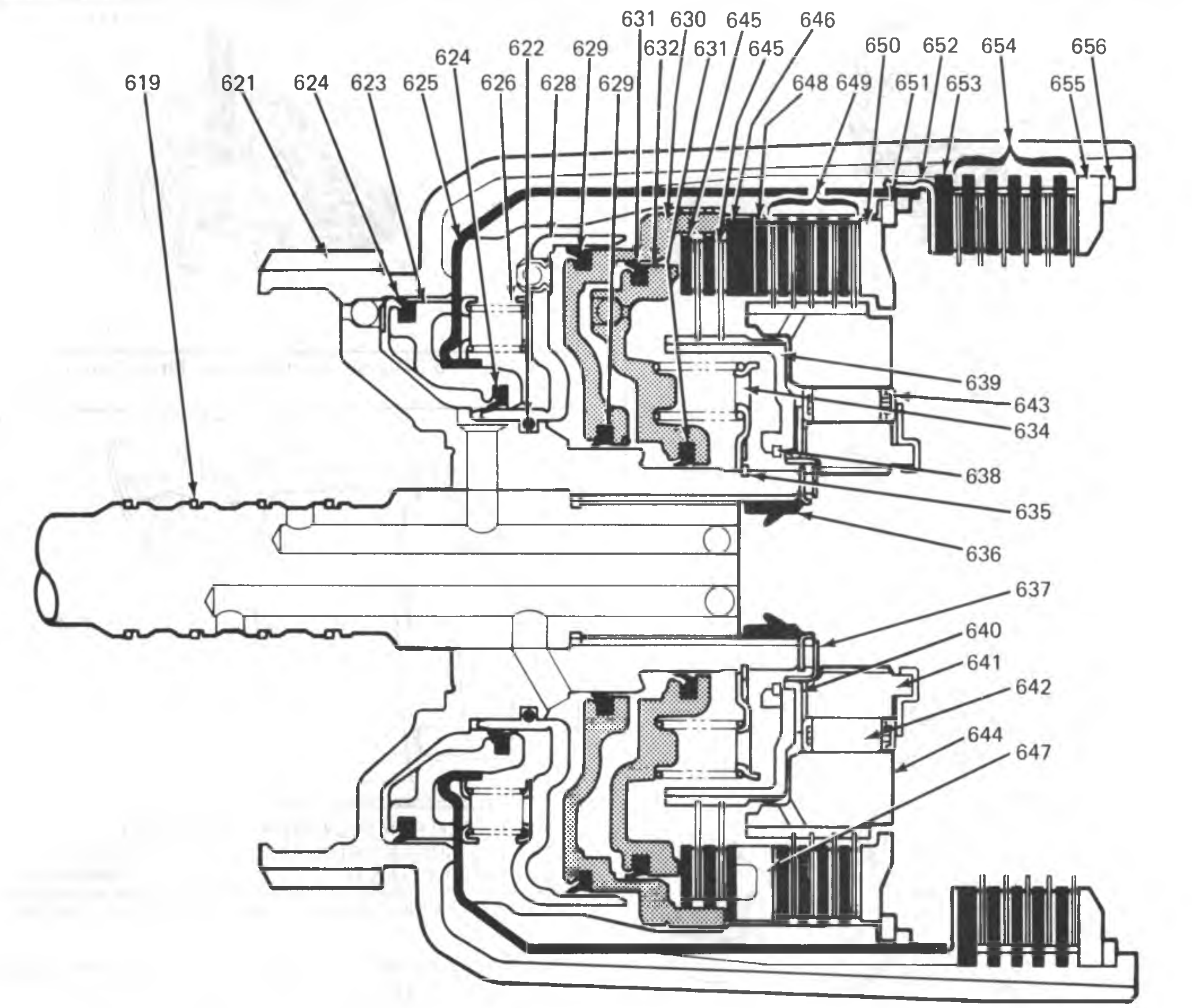
Disassemble (Figure 115 and 116)

TOOLS REQUIRED:

J-23327 Clutch Spring Compressor

J-25018 Clutch Spring Compressor Adaptor

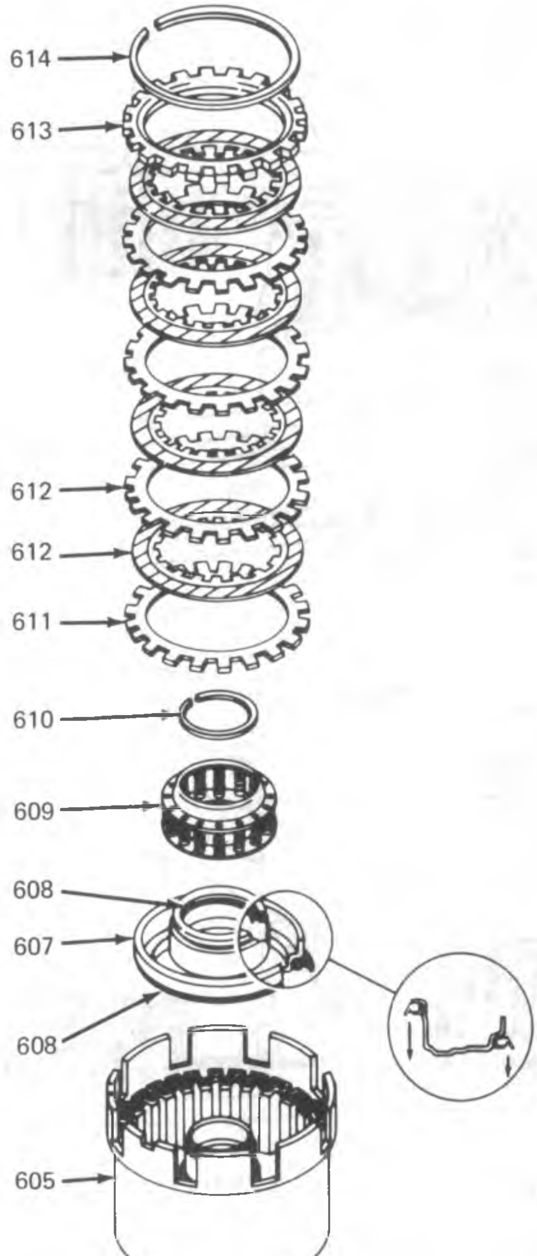
1. Retaining ring (614) from reverse input housing
2. Backing plate (613)
3. Clutch plates (612) and waved steel plate (611)
4. Install J-23327 and J-25018.
   - compress the spring assembly (609)



ILL. NO.	DESCRIPTION
619	RING, OIL SEAL (TURBINE SHAFT)
621	HOUSING & SHAFT ASSEMBLY, INPUT
622	SEAL, "O" RING INPUT TO FORWARD HSG.
623	PISTON, 3RD & 4TH CLUTCH
624	SEAL, 3RD & 4TH CLUTCH – INNER
624	SEAL, 3RD & 4TH CLUTCH – OUTER
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
629	SEAL, FORWARD CLUTCH – INNER
629	SEAL, FORWARD CLUTCH – OUTER
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH – INNER
631	SEAL, OVERRUN CLUTCH – OUTER
632	PISTON, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RET.
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CLUTCH HUB RET.
639	HUB, OVERRUN CLUTCH
640	WEAR PLATE, SPRAG ASSEMBLY
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH – OUTER
645	PLATE ASSY., OVERRUN CLUTCH – STEEL
645	PLATE ASSY., OVERRUN CLUTCH – COMP.
646	PLATE, FORWARD CLUTCH APPLY
647	PLATE, FORWARD CLUTCH SPACER (USED WITH FOUR CLUTCH PLATES ONLY)
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING
651	RING, FORWARD CL. BACKING PLATE RET.
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

49099B-700-R4

Figure 114 Input Clutch Assembly



ILL. NO.	DESCRIPTION
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607	PISTON ASSEMBLY, REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH – INNER
608	SEALS, REVERSE INPUT CLUTCH – OUTER
609	SPRING ASSEMBLY, REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RET.
611	PLATE, REVERSE INPUT CLUTCH (WAVED)
612	PLATE ASSEMBLY, REVERSE INPUT CLUTCH (COMPOSITION)
612	PLATE ASSEMBLY, REVERSE INPUT CLUTCH (STEEL)
613	PLATE, REVERSE INPUT CLUTCH BACKING
614	RING, REVERSE INPUT CLUTCH RETAINING

49037A-700-R4

Figure 115 Reverse Input Clutch Assembly

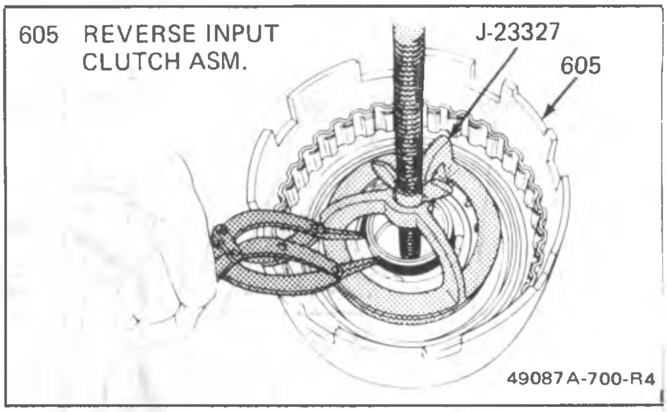


Figure 116 Reverse Input Retainer Ring - Removal

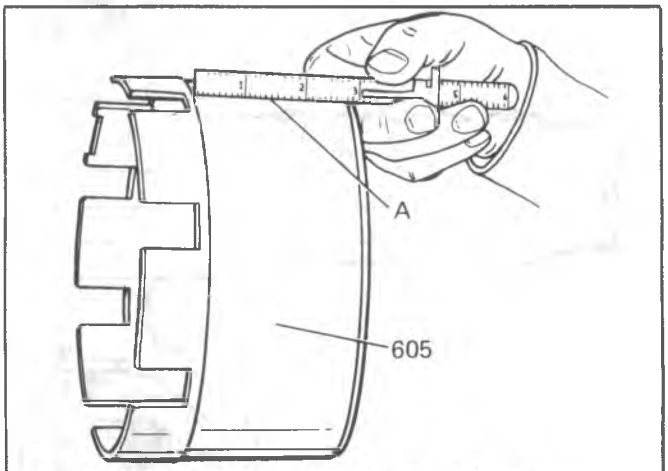


Figure 117 Check Reverse Input Housing For Dishing

5. Spring assembly retainer ring (610) and spring assembly (609)
6. Reverse input clutch piston (607)
   - inner and outer lip seals (608) from piston

Inspect (Figures 117 and 118)

- Backing plate (613) for
  - damage
  - distortion or flatness
  - burrs or surface finish damage
- Clutch Plates (612)
  - Composition for tang damage, delamination, or wear
  - Steel for tang damage, wear, or heat damage
- Spring assembly (609) for distortion or damage
- Piston (607) for
  - dishing or deforming
  - seal retaining rings loose
- Housing and drum assembly (605) for
  - damaged or worn bushings (603 and 606)
  - surface on the hub and outer housing
  - retainer and ball assembly moving freely (leak check with solvent).
  - leak at the weld

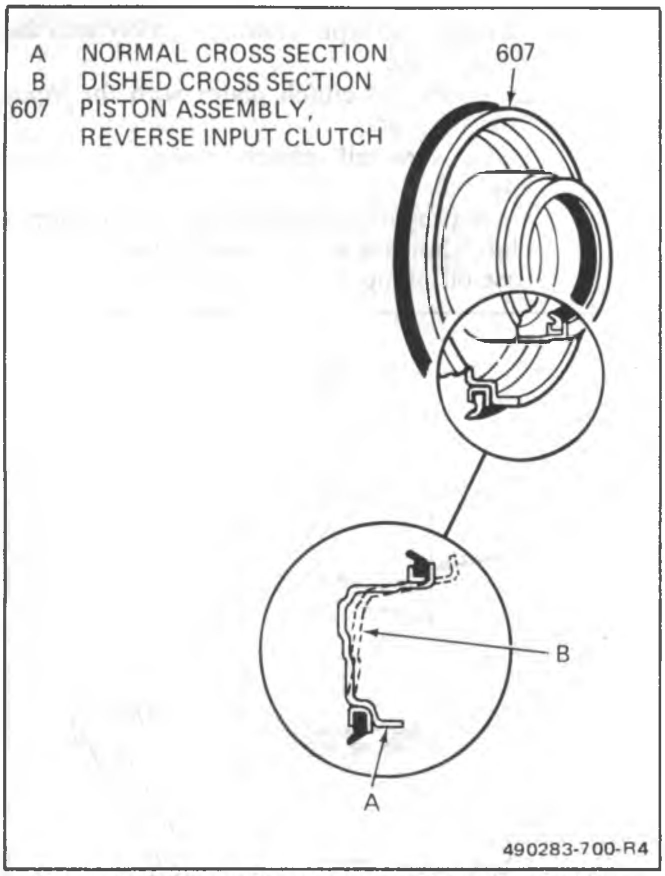


Figure 118 Check Reverse Input Piston For Dishing

Assemble (Figures 115, 116, 119 and 120)

TOOLS REQUIRED:

J-23327 Clutch Spring Compressor

J-25018 Clutch Spring Compressor Adaptor

1. Inner and outer seals (608) on the piston (607)
   - lips must face away from the hub as shown.
   - lubricate with transmission fluid.
2. Piston (607) into the housing and drum assembly (605)
   - use an 8 mm feeler gage to position the lip seals.
   - use care not to damage the seals.
3. Spring assembly (609)
   - large opening in the assembly goes towards the piston.
4. Install J-23327 and J-25018.
   - compress the spring assembly
   - install the retainer ring (610).
5. Waved steel clutch plate (611)
6. Clutch plates (612).
   - start with a composition and alternate with steel
   - see chart for correct number of clutch plates.
7. Backing plate (613)
   - chamfered side up
8. Retaining ring (614)

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REV. INPUT CLUTCH

MODEL	FLAT STEEL		COMP. FACED		WAVED STEEL	
	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS
T2,VA,ML,MP, MS,T7,YH,YF, PQ,Y7,MB,MC, MJ,VN	2	1.97mm (.077")	3	1.97mm (.077")	1	2.03mm (.079")
ALL OTHERS	3	1.97mm (.077")	4	1.97mm (.077")	1	2.03mm (.079")

Figure 119 Reverse Input Clutch Plate Chart

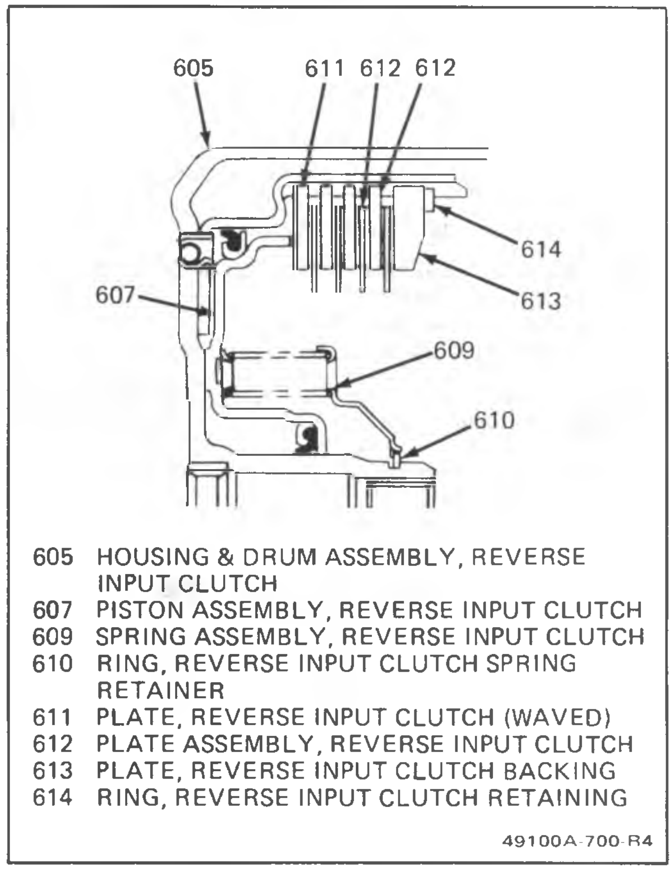


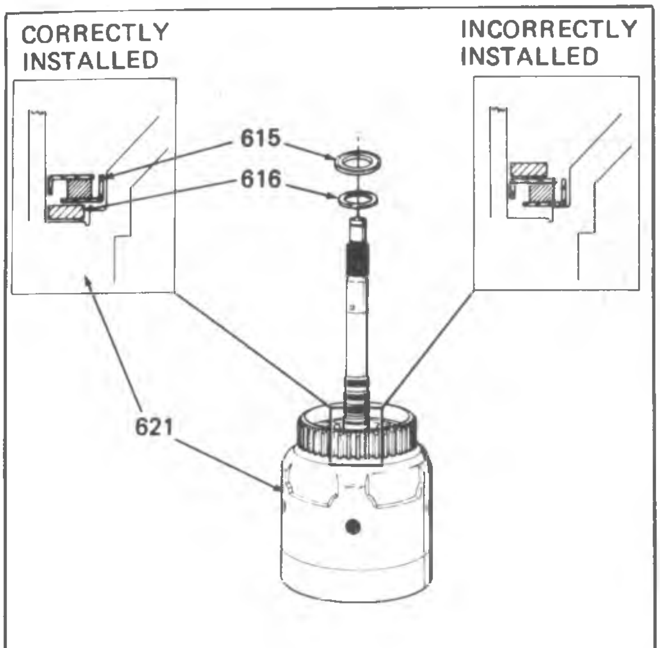
Figure 120 Reverse Input Clutch

Reverse Input and Input Clutches

Assemble (Figures 121 and 122)

1. Selective thrust washer (616) onto the input housing
2. Bearing assembly (615)
   - inside (black race) goes toward the oil pump.
3. Reverse input clutch assembly (605) onto the input clutch assembly (621)
   - index the reverse input clutch plates with the input clutch hub.
   - make certain all clutches are fully engaged.

Assemble (Figure 123)

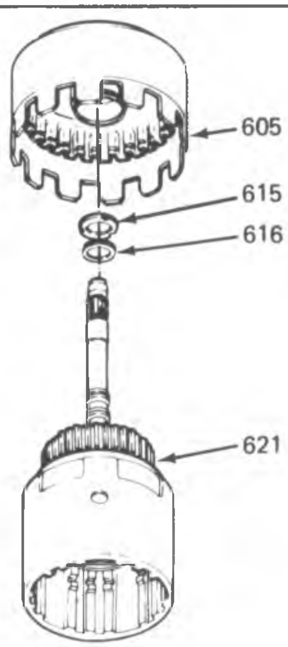


ILL.
NO. DESCRIPTION

615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

490279-700-R4

Figure 121 Thrust Bearing and Selective Washer Location

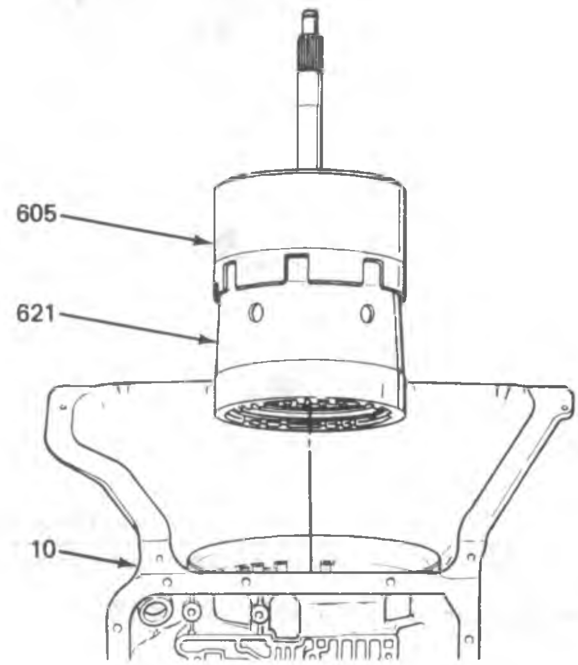


605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

490013-700-R4

Figure 122 Reverse Input and Input Clutches

- Reverse input and input clutch assembly into the transmission case
  - index the 3-4 clutch plates with the input internal gear.
  - make sure all clutch plates are fully engaged.
  - when properly assembled, the reverse input clutch housing will be located just below the case oil pump face.



10 CASE, TRANSMISSION
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621 HOUSING & SHAFT ASSEMBLY, INPUT

490281-700-R4

Figure 123 Installing Input Clutch

2-4 Band Assembly

Inspect

- 2-4 band assembly (602) for damage or wear

Assemble (Figure 124)

1. The 2-4 band assembly (602) into the case
   - index the band anchor pin end with the case pin hole.
2. Band anchor pin (48) into the case
   - index the pin into the 2-4 band.

Oil Pump Assembly

Remove or Disconnect (Figure 41, 125, 126 and 126L)

1. Thrust washer (601)
2. Pump cover to case gasket (9)
3. Pump to case oil seal (8)
4. Pump cover to body bolts (236)
5. Pump cover (217) from pump body (203)

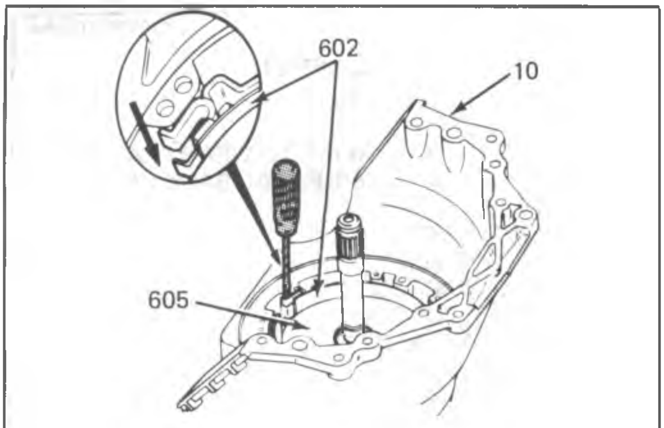


Figure 124 2-4 Band Assembly - Installed

Pump Body

Disassemble (Figures 126 and 126L)

1. Pump slide spring (209)
   - compress with needle nose pliers.
   - pull straight out.

   CAUTION: Spring is under very high pressure. Place covering over spring to prevent possible injury.
2. From the pump pocket
   - Pump vane rings (212)
   - Pump vanes (215)
   - Pump rotor (214)
   - Rotor guide (213)
   - Slide (206)
   - Slide Seal (211)
   - Slide Seal Support (210)
   - Pivot slide pin (208) and spring (207)
   - Slide seal ring (204) and slide back up seal (205)
3. Oil seal assembly(2) (if replacement is necessary)
   - pry out with a screwdriver.

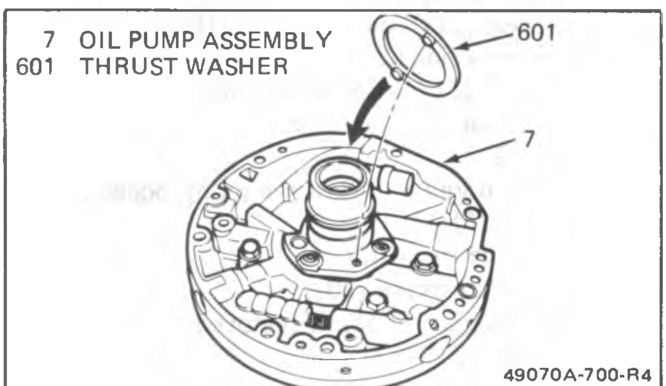


Figure 125 Oil Pump Thrust Washer

Oil Pump Cover

Disassemble (Figures 126 and 126L)

1. Converter clutch apply valve train
   - compress converter clutch apply valve spring (228) with a screwdriver.
   - remove retaining ring (225).
   - slowly release the spring tension.
   - stop valve (226), converter clutch apply valve (227), and two converter clutch valve springs (228 & 229)
2. Pressure relief ball (231)
   - ball is under strong spring pressure.
   - cover the ball with a cloth when removed.
3. Oil pump screen (235), if used
   - "O" ring seal (234) from the screen
4. Pressure regulator assembly (218-224).
   - follow the same procedure used to remove the converter clutch valve.

Inspect

- Pressure regulator valve assembly (218-224) and converter clutch apply valve assembly (225-229) for
  - chips, burrs, distortion, plugged oil passage, and freeness of bore fits
  - remove burrs with crocus cloth
- Pressure relief assembly (230-232) for damage or distortion
- Pump screen (235) for
  - cut "O" ring seal (234)
  - damage or distortion
- Pump cover (217) and pump body (203) for
  - worn or damaged bushings (see Bushing Replacement Procedure)
  - foreign material or debris
  - porosity
  - scored or out of flat mating faces
  - cross channel leaks
  - ring groove damage
- Rotor (214) and slide (206) for cracks
- Oil seal assembly for damage or wear

Clean

- Wash and air dry all parts.
  - do not wipe dry with a cloth.

Pump Body

Assemble (Figures 126, 126L, 127 and 128)

TOOL REQUIRED:
J-25016 Seal Installer

1. "O" ring seal (205) and oil seal ring (204) into the groove on the back side of the slide
   - retain with petrolatum.
2. Pivot pin spring (207) and pivot pin (208) into the pump body
3. Slide (206)

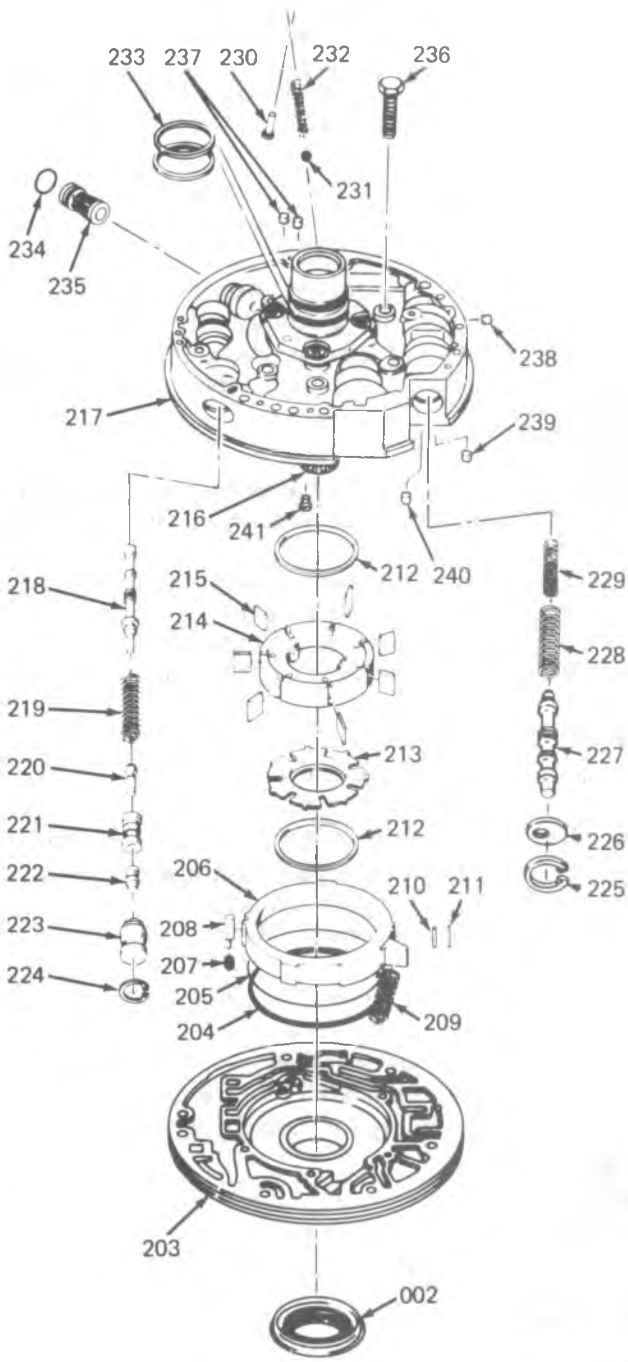


Figure 126 Oil Pump Assembly

490235-700-R4

ILL. NO.	DESCRIPTION
002	SEAL ASSEMBLY, OIL
203	BODY, PUMP
204	RING, OIL SEAL - SLIDE TO WEAR PLATE
205	SEAL "O" RING (SLIDE SEAL BACK-UP)
206	SLIDE, PUMP
207	SPRING, PIVOT PIN
208	PIN, PIVOT SLIDE
209	SPRING, PUMP SLIDE
210	SUPPORT, PUMP SLIDE SEAL
211	SEAL, PUMP SLIDE
212	RING, PUMP VANE
213	GUIDE, ROTOR
214	ROTOR, OIL PUMP
215	VANE, PUMP
216	SHAFT, STATOR
217	COVER, PUMP
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REV. BOOST VALVE RET.
225	RING, OIL PUMP CONV. CL. VALVE RET.
226	STOP VALVE
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONV. CL. VALVE (OUTER)
229	SPRING, CONV. CL. VALVE (INNER)
230	RIVET, PRESSURE RELIEF BOLT
231	BALL, PRESSURE RELIEF
232	SPRING, PRESSURE RELIEF
233	RING, OIL SEAL (STATOR SHAFT)
234	SEAL, OIL PUMP COVER SCREEN
235	SCREEN, OIL PUMP COVER
236	BOLT, M8 X 1.25 X 40 (COVER TO BODY)
237	PLUG, OIL PUMP AIR BLEED
238	PLUG, OIL PUMP COVER
239	PLUG, OIL PUMP COOLER FEED
240	PLUG, OIL PUMP CONVERTER CL. SIGNAL
241	RETAINER & BALL ASM., PUMP COVER

Figure 126L

- index the notch in the slide with the pivot pin.
- the oil seal ring must face downward into the pump pocket.

4. Slide seal (211) and support (210)
5. Pump vane ring (212)
6. Rotor guide (213) onto the rotor
   - retain with petrolatum.
7. Rotor (214)
   - with guide toward the pump pocket.
8. Vanes (215)
9. Pump vane ring (212)
10. Pump slide spring (209)
11. Oil seal assembly (2), if removed.
    - use J-25016

Oil Pump Cover

Assemble (Figures 126, 126L and 129)

1. "O" ring (234) onto the oil pump screen (235)
2. Oil pump screen (235) into the pump cover (217)

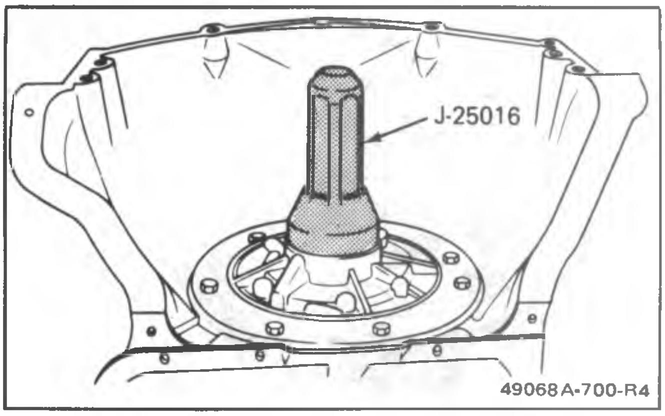


Figure 127 Oil Pump Seal

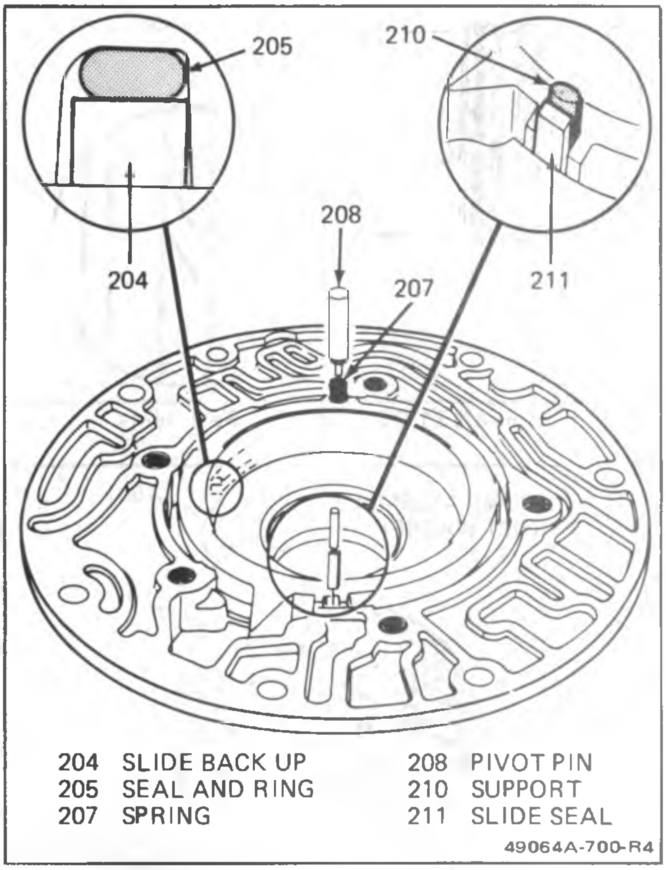


Figure 128 Slide Back Up and Slide Seal

3. Pressure relief ball (231), spring (232) and rivet (230)
4. Inner (229) and outer (228) converter clutch valve springs into the converter clutch valve bore
5. Converter clutch valve (227)
6. Stop valve (226)
7. Retaining ring (225)
8. Pressure regulator valve (218) into the pressure regulator bore
9. Pressure regulator valve spring (219)
10. T.V. boost valve (222) into the T.V. bushing (223)
    - long land of the valve into the large hole of the bushing.
    - retain with petrolatum.
11. Reverse boost valve (220) into the reverse boost valve sleeve (221)
    - small end of the valve first.
    - retain with petrolatum.
12. Reverse boost valve sleeve (221) into the pressure regulator bore
13. T.V. boost valve bushing (223) into the pressure regulator bore
14. Retainer ring (224)

Oil Pump Cover and Body

Assemble (Figures 130, 131, and 132)

TOOLS REQUIRED:
J-21368 Oil Pump Body and Cover Alignment Band

1. Oil pump cover (217) onto oil pump body (203)
   - stator shaft through a bench hole.
2. Pump cover to body bolts (236)
   - leave finger tight.
3. Align pump cover and pump body with J-21368.
   - place a screwdriver through a bolt hole and into a hole in the bench.
4. Torque attaching bolts to 22 N·m (18 ft. lbs.)
5. Pump to case gasket (009) onto case
   - retain with petrolatum.
6. Oil seal rings (233), if removed previously, onto the pump cover hub
   - retain with petrolatum.
7. Pump to case oil seal (008)
   - do not twist the seal.
   - lubricate with transmission fluid.
8. Thrust washer (601)

Install or Connect (Figure 133)

TOOLS REQUIRED:
J-25025-1 Alignment Pins

1. J-25025-1 into the case as shown
2. Oil pump assembly into the case
   - align all holes properly.
3. Bolts and washers (5 and 6)
   - torque to 22 N·m (18 ft. lbs.)

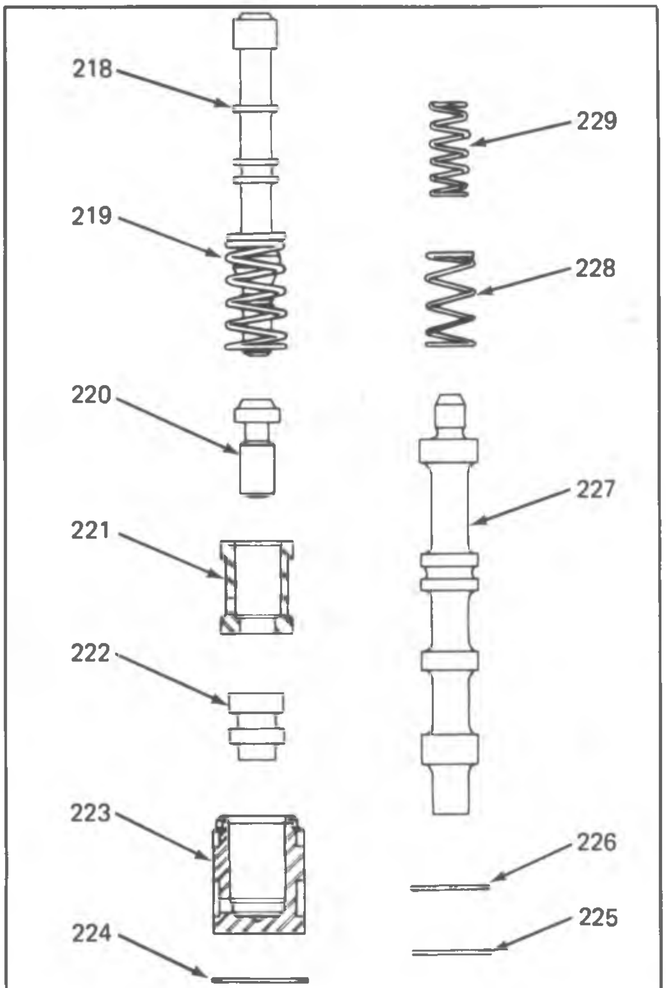
Important

Rotate the transmission to a horizontal position. If the transmission is assembled properly the turbine shaft should turn by hand. If not identify and correct the misassembly now.

Transmission End Play Check

Measure (Figures 135, 136, 137 and 138)

TOOLS REQUIRED:
J-24773-A End Play Checking Fixture
J-25022 End Play Checking Fixture Adaptor (245 mm)
J-34725 End Play Checking Fixture Adaptor (298 mm)
278 mm (11 in.) Bolt and Nut or J-25025-7A Post



ILL. NO.	DESCRIPTION
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	STOP VALVE
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)

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Figure 129 Pressure Regulator and Converter Clutch Apply Valve Trains

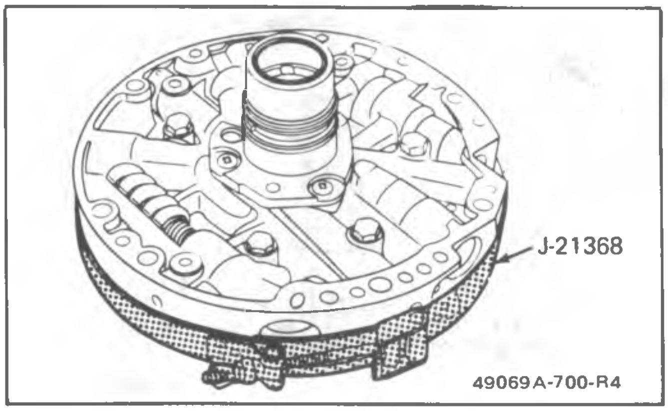


Figure 130 Assembly of Oil Pump

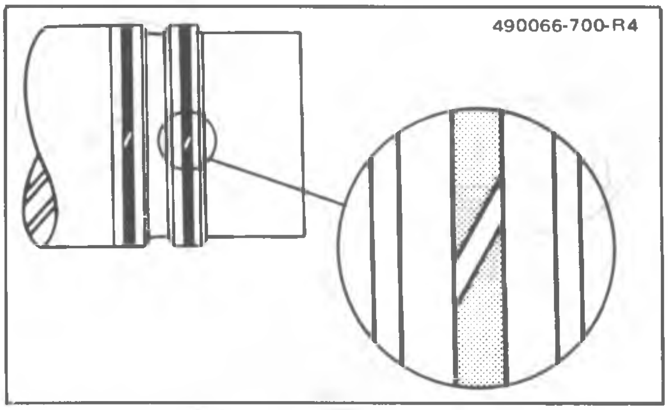


Figure 131 Oil Pump Hub Seal Rings

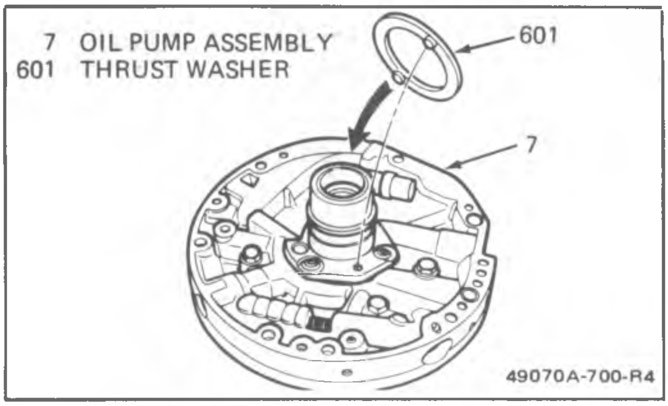


Figure 132 Oil Pump Thrust Washer

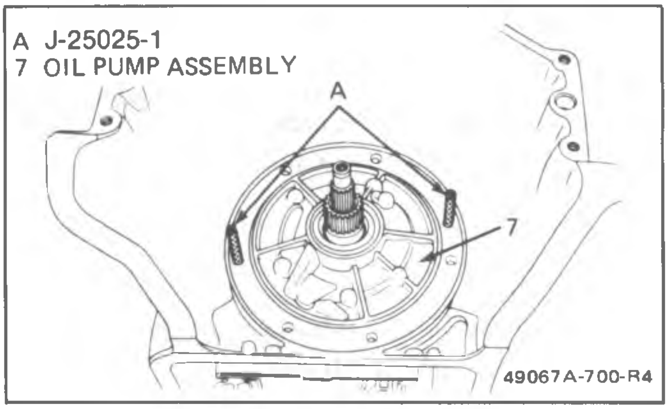


Figure 133 Oil Pump and Case

Dial Indicator

1. Remove an oil pump to case bolt and install a 278 mm (11 in.) bolt and lock nut or J-25025-7A.
2. Install J-25022 - or J-34725 as shown.
3. Install J-24773-A as shown.
4. Install a dial indicator.
   - set to zero.
5. Pull up on J-24773-A.
   - End play should be 0.13 - 0.92 mm (.005 - .036 in.).

     The selective washer which controls end play is located between the input housing and the thrust bearing on the oil pump hub. If more or less end play is required, select the proper washer from the chart and install. If dial indicator shows no end play, the selective thrust washer (616) and bearing assembly (615) have been misassembled.

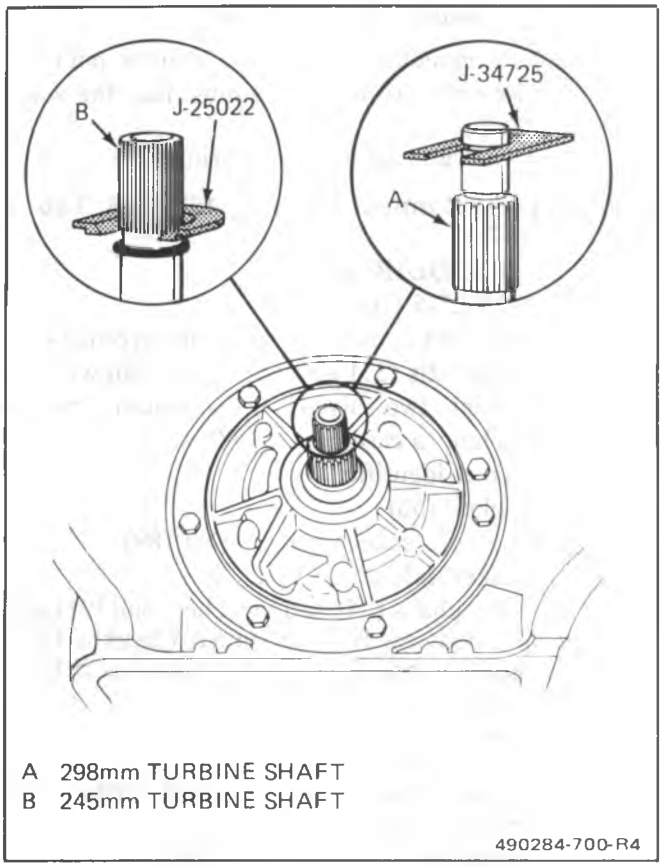


Figure 134 End Play Tool

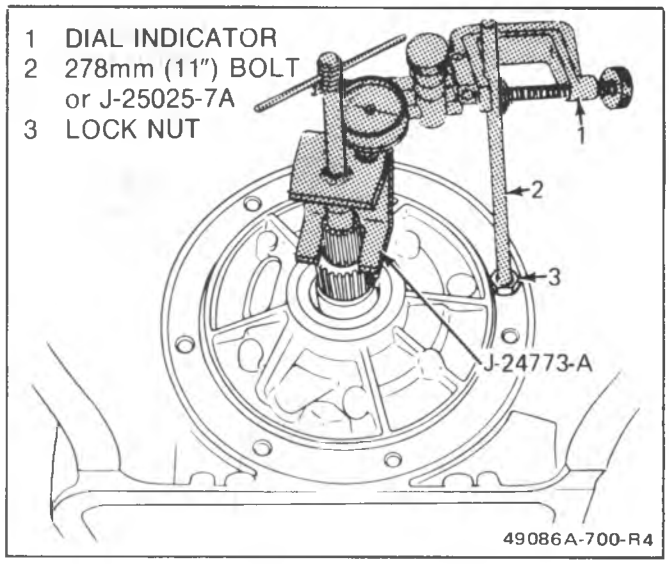


Figure 135 J-25022-A Installed

TRANSMISSION END PLAY WASHER SELECTION CHART 490047-700-R4		
WASHER THICKNESS		I.D.
1.87 - 1.97 mm	(.074" - .078")	67
2.04 - 2.14 mm	(.080" - .084")	68
2.21 - 2.31 mm	(.087" - .091")	69
2.38 - 2.48 mm	(.094" - .098")	70
2.55 - 2.65 mm	(.100" - .104")	71
2.72 - 2.82 mm	(.107" - .111")	72
2.87 - 2.99 mm	(.113" - .118")	73
3.06 - 3.16 mm	(.120" - .124")	74

Figure 136 End Play Chart

Assemble (Figure 138)

1. "O" ring seal (618) into the groove in the end of the turbine shaft.

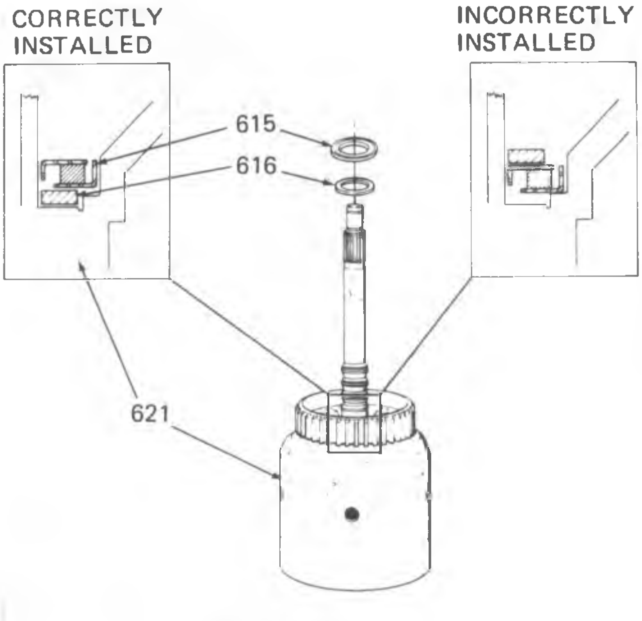
Important (Figure 139)

- There is a designed in clearance between the reverse input clutch and the reaction sun gear shell. This clearance can be observed at the point shown in Figure 139. **Do not** try to shim the internal parts because of this clearance.

EXTERNAL PARTS

Inspect (Figure 41 & 143)

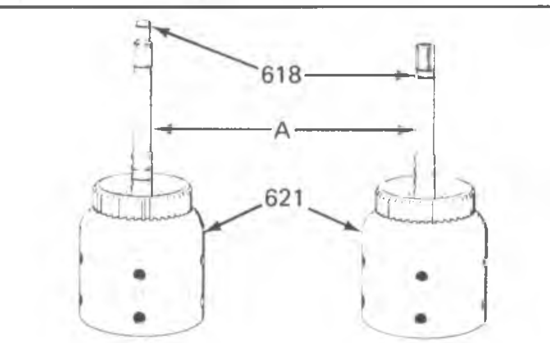
- The 1-2 accumulator cover and pin assembly (62) for
  - porosity or damage
  - scored piston wall
  - plugged oil passage
- 1-2 accumulator piston (61) and the 3-4 accumulator piston (52) for
  - porosity
  - ring groove damage
  - pin hole damage
- 1-2 accumulator (59) and 3-4 accumulator (54) springs for distortion or damage
- Spacer plate (56) and gaskets (88 and 89) for damage
- Checkballs (55) for damage
- T.V. Link (64) for damage
- Manual detent spring (709) for damage
- Oil filter (71) for
  - cut or damaged "O" ring seal (70)
  - cracks in the neck or body
  - casting flash in the neck
- Solenoid assembly (50) for



ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
621	HOUSING & SHAFT ASSEMBLY, INPUT

490279 700 R4

Figure 137 Selective Washer and Thrust Bearing Properly Installed



A	SHAFT, TURBINE
618	SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621	HOUSING & SHAFT ASSEMBLY, INPUT

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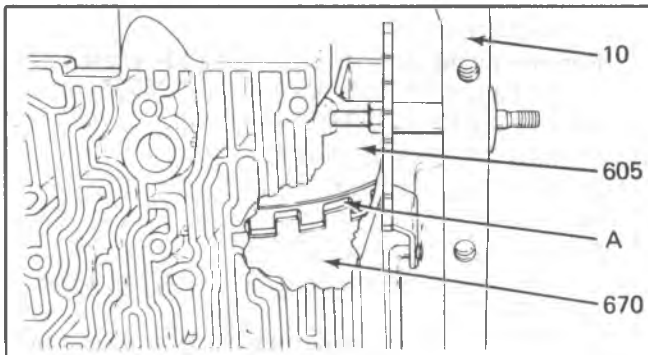
Figure 138 Turbine Shaft "O" Ring Seal

- damage
- cut or pinched wires
- damaged connectors
- cut or damaged "O" ring (49)

Valve Body and Associated Parts

Install or Connect (Figure 143 and 144)

1. The 3-4 accumulator pin (77) into the case
2. The 3-4 accumulator piston seal (53) onto the 3-4 accumulator piston (52)



A	AS INSTALLED THESE TWO PARTS HAVE A NORMAL END CLEARANCE OF APPROX. 3.8 MM (.150 IN)
10	CASE, TRANSMISSION
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
670	SHELL, REACTION SUN

490247-700-R4

Figure 139 Clearance Between Reverse Input Clutch and the Sun Gear Shell

3. The 3-4 accumulator piston (52) onto the pin (77)
   - the end with three legs must face the valve body.
4. The 3-4 accumulator piston spring (54)

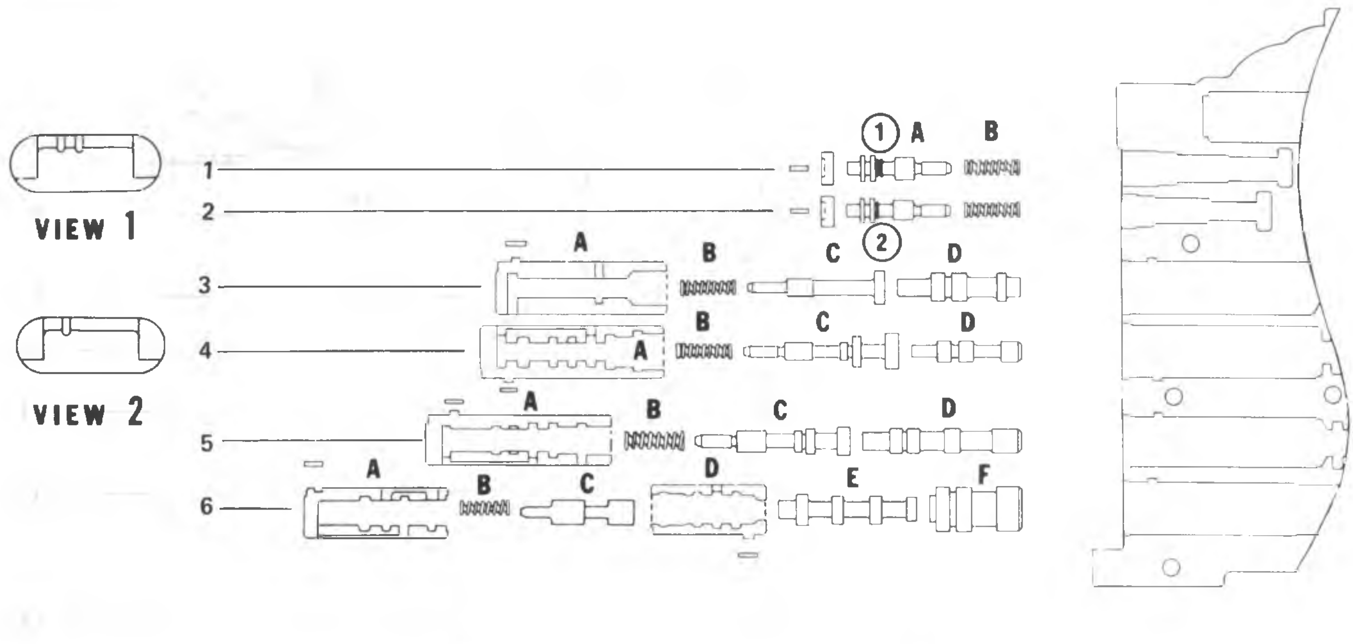
Install or Connect (Figures 143, 145, 146 and 147)

TOOLS REQUIRED:
J-25025-5 Guide Pins

1. Governor and converter clutch oil screens (47)
2. Five checkballs (55) into the case as shown
3. J-25025-5 into two valve body bolt holes in the case
4. Spacer plate to case gasket (88)
   - gasket identified by a "C"
5. Spacer plate (56)
6. Valve body to spacer plate gasket (89)
   - gasket indentified by a "V"
7. Three checkballs (55) and one checkball (91) into the valve body assembly as shown. Checkball (91) is the larger copper colored ball shown as #10 on Figure 146.
   - retain with petrolatum.
8. Valve body assembly (67)
   - connect the manual valve link (705) to the inside detent lever (703).
   - retain with rod end clip (704).

Install or Connect (Figures 64, 148, 149 and 150)

1. T.V. link (64) onto the T.V. lever and bracket asm. (65) as shown
2. T.V. lever and bracket assembly (65) onto the valve body as shown
   - attach with two valve body to case bolts (69).
3. Wire harness clips (66), filter retaining clip (87), manual detent spring assembly (709), wire retaining washer, and all remaining valve body to case bolts (69)
   - Torque to 11.0 N·m (8 ft.lbs.).
4. "O"ring seal (34) onto the electrical connector (33)



1 (A) T.V. Modulator. (B) T.V. Modulator Downshift Valve Spring.	3 (A) Converter Clutch Valve Sleeve. (B) Converter Clutch Throttle Valve Spring. (C) Converter Clutch Throttle Valve. (D) Converter Clutch Shift Valve.	5 (A) 2-3 Throttle Valve Sleeve. (B) 2-3 Throttle Valve Spring. (C) 2-3 Throttle Valve. (D) 2-3 Shift Valve.
2 (A) T.V. Modulator Upshift Valve. (B) T.V. Modulator Upshift Valve Spring.	4 (A) 3-4 Throttle Valve Sleeve. (B) 3-4 Throttle Valve Spring (C) 3-4 Throttle Valve. (E) 3-4 Shift Valve.	6 (A) 1-2 Throttle Valve Sleeve. (B) 1-2 Throttle Valve Spring. (C) 1-2 Throttle Valve. (D) Lo Range Sleeve. (E) 1-2 Lo Range Valve. (F) 1-2 Shift Valve.

VALVE BODY DISASSEMBLY

As each part of the valve train is removed, place the individual part in the order that it was removed and in the same relative location as its true position in the valve body. All parts must be reassembled in the same location as they were removed.

Remove all outside roll pins by pushing through from the rough casting side of the valve body assembly.

Removal of the inner roll pins can be made as follows:

(a) Grind a taper to one end of the #49 or 1/16 inch drill.

(b) Lightly tap the tapered end into the roll pin.

(c) Pull the drill and pin out.

The spring retaining sleeves can be removed by compressing with needle-nose pliers and moving upward through the exposed hole.

Some of the roll pins have applied pressure against them. When removing, care should be taken to prevent the possible loss of parts.

Do not remove the pressure switches unless they require replacement.

Remove the (3) three check balls from the passage side of the body - if present.

Position the valve body machined side up: positioning the manual valve lower right and remove the link and retaining clip, if attached.

1. **T.V. Modular Downshift Valve**

   From the No. 1 bore, remove the retaining pin, valve bore plug, T.V. modulator downshift valve and T.V. modulator downshift valve spring.

2. **T.V. Modulator Upshift Valve**

   From bore No. 2, remove the retaining pin, valve bore sleeve, T.V. modulator upshift valve and T.V. modulator upshift valve spring.

3. **Converter Clutch Valve**

   From bore No. 3, remove the retaining pin. Remove the converter clutch throttle sleeve, converter clutch throttle valve spring and valve, and the converter clutch shift valve.

4. **3-4 Shift Valve**

   From bore No. 4, remove the retaining pin, 3-4 throttle valve sleeve, 3-4 throttle valve spring, 3-4 throttle valve and 3-4 shift valve.

5. **2-3 Shift Valve**

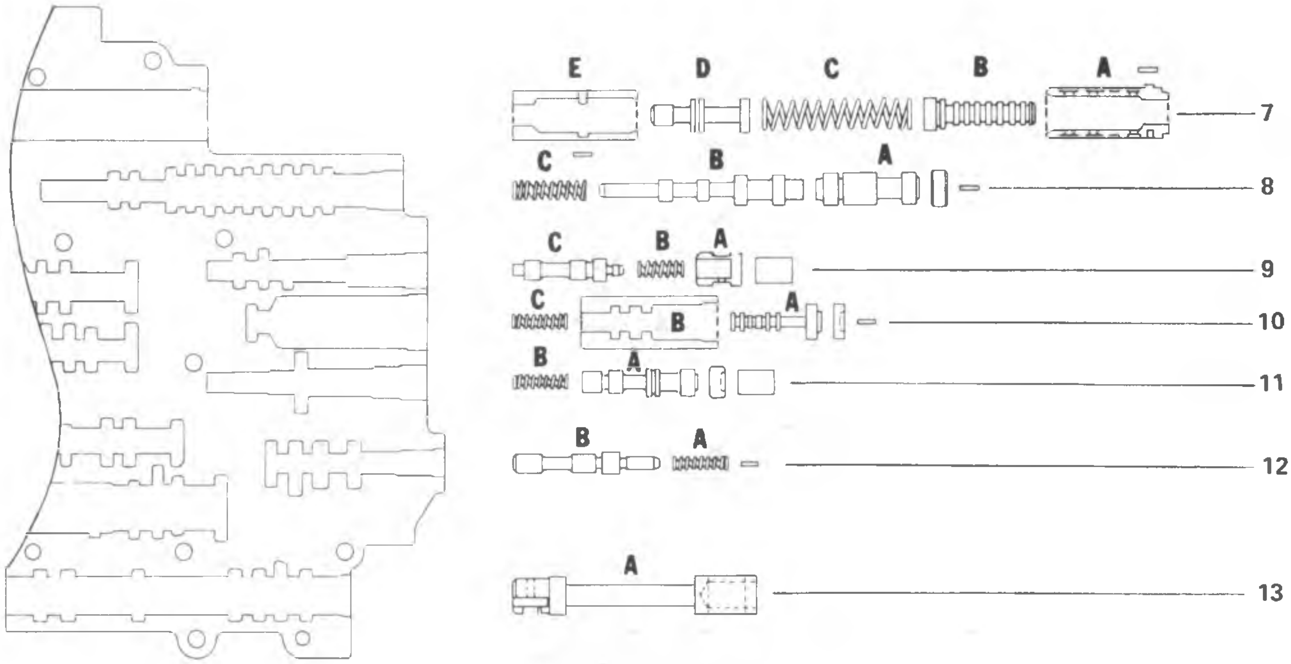
   From bore No. 5, remove the retaining pin. Remove the 2-3 throttle valve sleeve and 2-3 throttle valve spring, 2-3 throttle valve and 2-3 shift valve.

6. **1-2 Shift Valve**

   From bore No. 6, remove the outer roll pin. Remove the 1-2 throttle valve sleeve, 1-2 throttle valve spring, 1-2 throttle valve and lo range valve. Remove the inner retaining pin and remove the lo range valve sleeve and 1-2 shift valve.

490012-700-R4

Figure 140 Typical Valve Body Assembly



7 (A) Throttle Valve Plunger Sleeve. (B) Throttle Valve Plunger. (C) Throttle Valve Spring. (D) Throttle Valve. (E) Throttle Valve Sleeve.	9 (A) T.V. Limit Plug. (B) T.V. Limit Valve Spring. (C) T.V. Limit Valve.	11 (A) Line Bias Valve. (B) Line Bias Spring.
8 (A) 3-4 Relay Valve. (B) 4-3 Sequence Valve. (C) 4-3 Sequence Valve Spring.	10 (A) Accumulator Valve. (B) Accumulator Sleeve. (C) Accumulator Spring.	12 (A) 3-2 Control Valve Spring. (B) 3-2 Control Valve. 13 (A) Manual Valve.

7. **Throttle Valve Assembly**

   From bore No. 7, remove the outer roll pin from the rough casting side, the throttle valve plunger sleeve, throttle valve plunger and throttle valve spring. Remove the inner roll pin and valve.

8. **3-4 Relay and 4-3 Sequence Valve**

   From bore No. 8, remove the retaining roll pin and plug. Remove the 3-4 relay valve, 4-3 sequence valve and spring.

9. **T.V. Limit Valve**

   From bore No. 9, using needle nose pliers, compress and remove the spring retainer. Remove the T.V. limit plug and spring valve.

10. **T.V. Accumulator Valve**

    From bore No. 10, remove the retaining roll pin and plug. Remove the 1-2 accumulator valve, spring and sleeve.

11. **Line Bias Valve**

    From bore No. 11, using needle nose pliers, compress the line bias valve spring retainer and remove the plug, line bias and spring.

12. **3-2 Control Valve**

    From bore No. 12, remove the roll pin, 3-2 control valve spring and 3-2 control valve.

13. Remove the manual valve from bore No. 13.

INSPECTION

1. Wash the control valve body, clean solvent and air dry. Clean valve train parts one at a time, place in the same position as they were removed and inspect as follows:
   - Inspect valve for scoring, cracks and free movement in their bores.
   - Inspect all bushings for cracks or scored bores.
   - Inspect the valve body for cracks, damage or scored bores.
   - Lands should be flat with no cross leaks.

ASSEMBLY

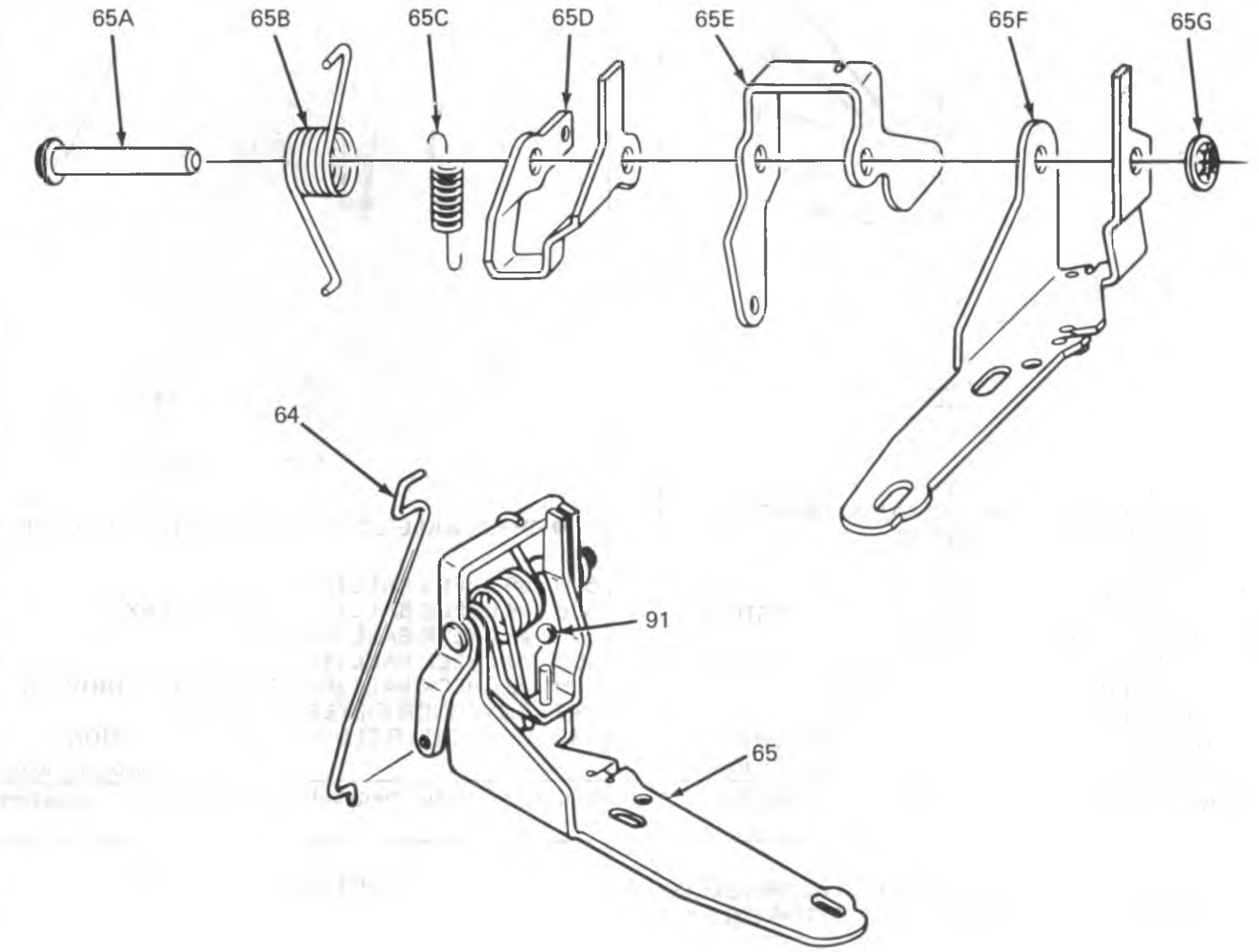
Install all parts in the reverse order as they were removed Assemble all bore plugs against the retaining pins with the recessed holes outboard. All the roll pins must be installed so they do not extend above the flat machined face of the valve body pad. Install all flared coiled pins with the flared end out.

Make certain all retaining or roll pins are installed into the proper locating slots in the sleeves, Not in the oil passage holes.

The bushing for the 1-2 accumulator valve train must be assembled with the small hole for the roll pin facing the rough casting side of the valve body.

490014-700-R4

Figure 141 Typical Valve Body Assembly



64	THROTTLE LINK	65E	THROTTLE LEVER
65	LEVER & BRACKET ASSEMBLY, THROTTLE	65F	LINK, THROTTLE LEVER TO CABLE
65A	PIN	65G	RETAINING NUT
65B	LINE BOOST SPRING	91	BALL, CARBON STEEL – T.V. EXHAUST (LOCATED IN VALVE BODY)
65C	TORSION LEVER SPRING		
65D	LINE BOOST LEVER		

INSPECT THE THROTTLE LEVER AND BRACKET ASSEMBLY FOR STICKING, BINDING OR DAMAGE. ALSO MAKE CERTAIN THE OPERATION IS FREE AND WITHOUT RESTRICTIONS.

IF ANY PARTS REQUIRE REPLACEMENT, PROCEED AS FOLLOWS.

DISASSEMBLY

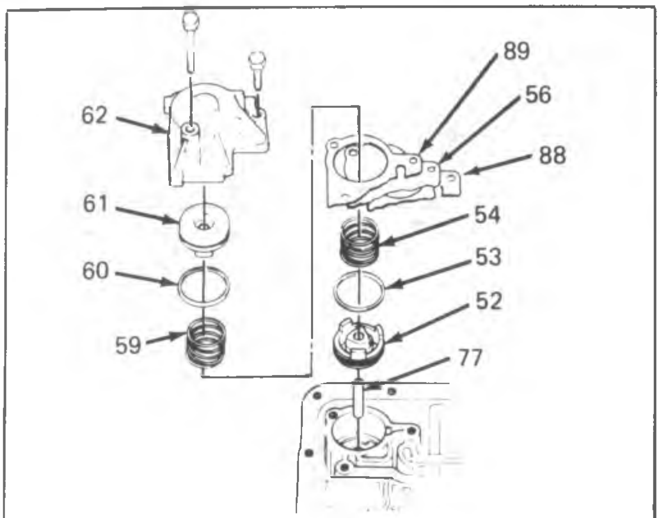
1. UNHOOK AND REMOVE THE LINE BOOST SPRING
2. REMOVE THE RETAINING NUT FROM THE PIN.
3. REMOVE THE PIN, TORSION LEVER SPRING, LINE-BOOST LEVER, THROTTLE LEVER AND BRACKET

ASSEMBLY

1. POSITION ALL THROTTLE BRACKET PARTS AS SHOWN, INDEXING WITH A SMALL PUNCH.
   LEAVE THE SHORT END OF THE TORSION LEVER SPRING UNHOOKED AND REARWARD OF THE TOP THROTTLE LEVER. ASSEMBLY IS DIFFICULT WITH SPRING TENSION.
2. INSTALL THE PIN AS SHOWN, AND AT THE SAME TIME REMOVE THE PUNCH.
3. POSITION THE SHORT END OF THE LOOSE TORSION SPRING UNDER THE BRACKET AND LOCATE IN NOTCH
4. INSTALL THE RETAINING NUT ON THE END OF THE PIN

49026B-700-R4

Figure 142 Throttle Lever and Bracket Assembly



52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUMULATOR
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

49031A-700-R4

Figure 143 1-2 and 3-4 Accumulator Assembly

1984 MODELS	1-2 ACCUMULATOR SPRING COLOR	3-4 ACCUMULATOR SPRING COLOR
VA, PQ, YH, ML, MP, MS, T7, YF, Y7, Y8, Y9, TC, MB, MC, MJ, VN, TG, TD, MR, TE, TK, MD, ME, MK, TH, MW, VH	RED	RED
Y6, YG, YK, YP, YN, T8, TZ, MH, VJ, TL, TM, MG, VE	VIOLET	RED

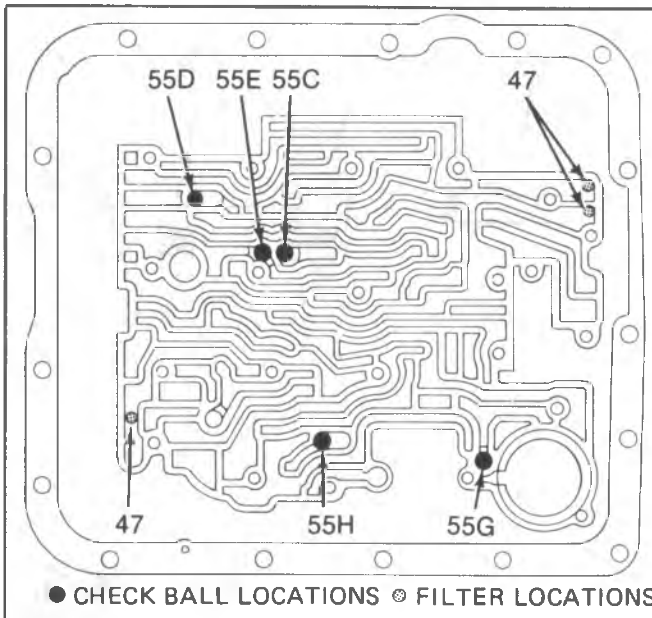
490248-700-R4

Figure 144 1-2 and 3-4 Accumulator Spring Chart

- lubricate with transmission fluid.

5. Electrical connector (33) into the case
6. "O" ring seal (49) on the solenoid assembly (50)
7. Solenoid assembly (50) into the case
   - attach with two solenoid bolts (51)
   - torque to 11 N·m (8 ft. lbs.)
   - to correctly route and hook up the wires see the wiring diagrams in the 700-R4 diagnosis section.

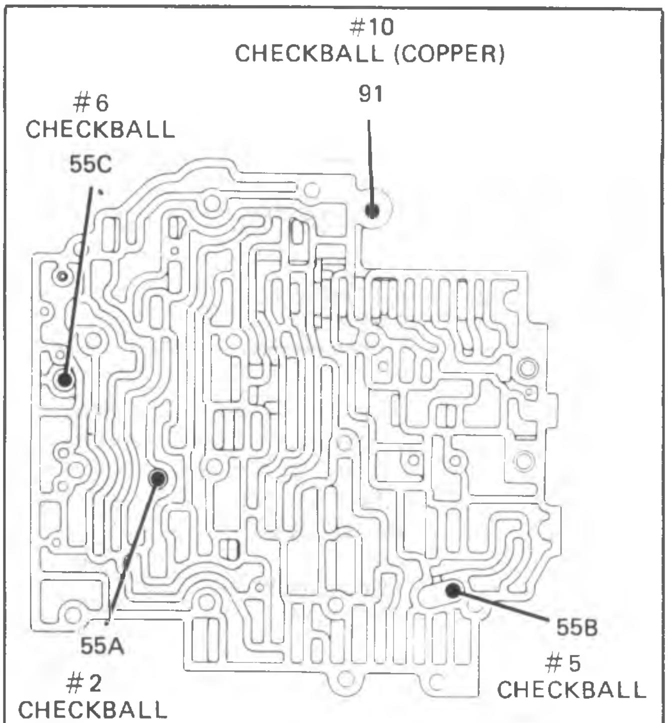
   The wire connectors are color coded to correspond to the information in the wiring diagram. On switches which take two



55D #9 CHECK BALL (DET./LO)
55E #4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F #8 CHECK BALL (2ND/1-2)
55G #1 CHECK BALL (4TH ACCUM.)
55H #3 CHECK BALL (PART THROTTLE–DRIVE 3)
47 GOVERNOR FILTER LOCATIONS
47 CONVERTER CLUTCH FILTER LOCATION

490243-700-R4

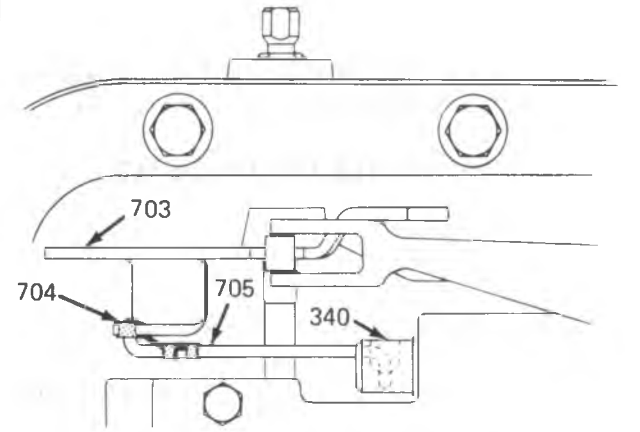
Figure 145 Case Checkballs and Oil Screens - Location



55A 3RD CLUTCH ACCUMULATOR
55B LO/REV.
55C DRIVE 3
91 T.V. EXHAUST CHECKBALL

49002B-700-R4

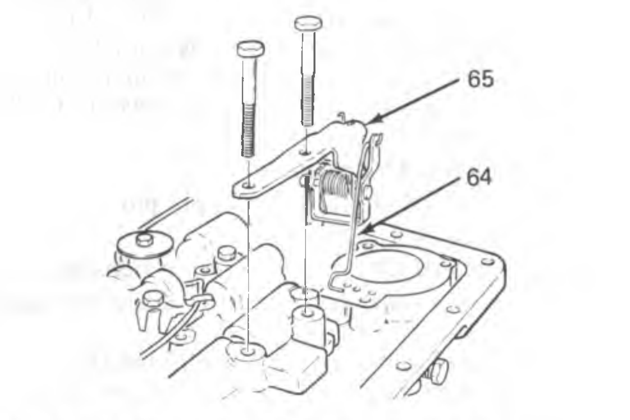
Figure 146 Valve Body Checkball Locations



703 INNER DETENT LEVER
704 ROD, END CLIP
705 MANUAL VALVE LINK
340 MANUAL VALVE

49082A-700-R4

Figure 147 Manual Valve Link and Clip



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE

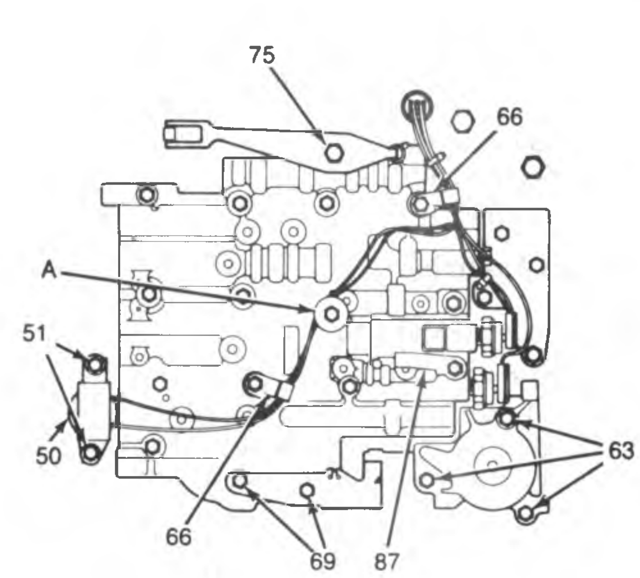
490249-700-R4

Figure 148 T.V. Lever and Bracket

connectors, the terminals are reversible. It will be necessary to identify and use the wiring diagram chart which corresponds to the type of vehicle you are working on. (See the Diagnosis Section for the wiring diagrams.)

Install or Connect (Figure 143 & 150)

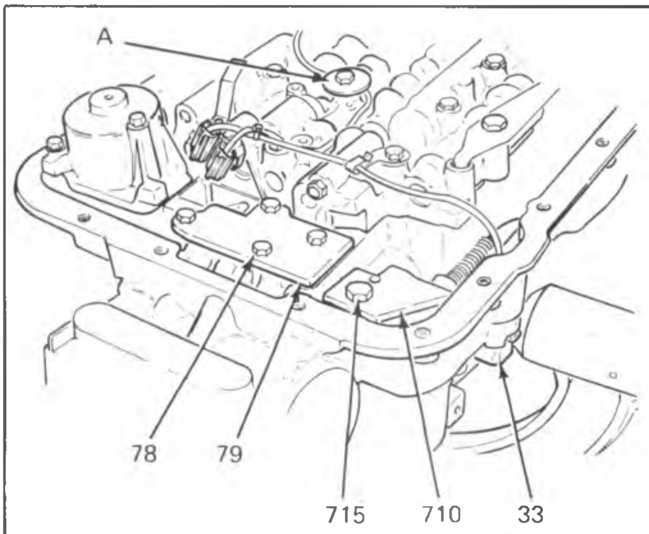
1. Parking bracket (710) and bolts (715)
   - torque to 22 N·m (18 ft. lbs.)
2. Oil passage cover (79) and bolts (78)
   - torque to 11 N·m (8 ft. lbs.)
3. The 1-2 accumulator piston seal (60) onto the 1-2 accumulator piston ((61)
4. The 1-2 accumulator piston (61) into the 1-2 accumulator cover and pin assembly (62)
   - the three legs on the piston must face up toward the case when installed.
5. The 1-2 accumulator spring (59) onto the piston
6. The 1-2 accumulator cover and pin assembly (62) onto the case



A WASHER WIRE RETAINER
50 SOLENOID ASM.
51 SOLENOID BOLTS
63 ACCUMULATOR HOUSING BOLTS
66 WIRE HARNESS CLIPS
69 T.V. LEVER AND BRACKET BOLTS
75 MANUAL DETENT SPRING ROLLER ASSM. BOLT
87 FILTER CLIPS

49077A-700-R4

Figure 149 Valve Body Bolt Locations



ILL. NO.	DESCRIPTION
A	WASHER, WIRE RETAINING
33	CONNECTOR, ELECTRICAL
78	BOLT, OIL PASSAGE COVER
79	COVER, OIL PASSAGE
710	BRACKET, PARKING LOCK
715	BOLT, PARKING LOCK BRACKET

490239-700-R4

Figure 150 Outside Electrical Connector

- torque to 11 N·m (8 ft. lbs.)

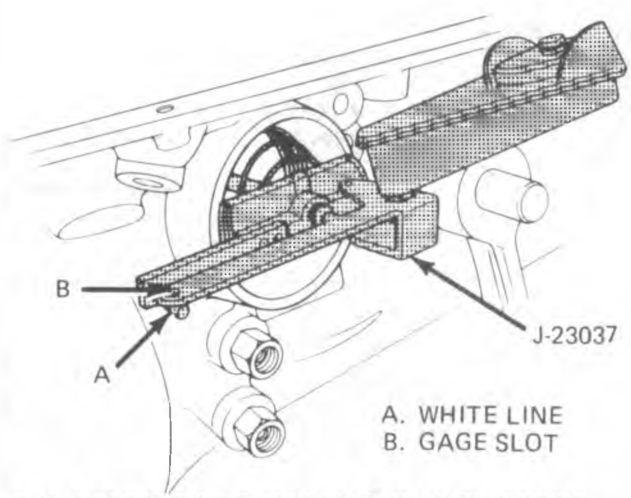
7. "O" ring seal (70) onto the oil filter (71)
   - lubricate with transmission fluid.
8. Oil filter (71)
9. Oil pan gasket (72)
10. Oil pan (73) and bolts (74)
    - torque to 16 N·m (12 ft. lbs.)

2-4 Servo Assembly

Measure (Figure 151, 152)

TOOLS REQUIRED:
J-33037 Band Apply Pin Tool

1. Install J-33037 as shown with apply pin (29).
2. Apply 11.0 N·m (100 in. lbs.) torque.
3. If white line "A" appears in the gage slot "B", pin length is correct.
4. Use pin selection chart to determine the correct pin length.



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION		
PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 RINGS
67.74-68.04	2.67-2.68	3 RINGS
69.11-69.41	2.72-2.73	WIDE BAND

49048D-700-R4

Figure 151 Servo Pin Length

Inspect

- Pistons (16 & 25) for
  - porosity or damage
  - ring groove damage
- Cover (15) for porosity or damage
- Seals for
  - nicks or cuts
  - freeness in the seal groove
- Springs (20, 26, 31) for distortion
- Pin (29) for wear or burrs

Important

Check servo bore in the case for any wear or sharp edges which may cut the servo seals.

Assemble (Figures 152, 153, 154 and 155)

TOOLS REQUIRED:
J-22269-01
J-29714

1. Cushion spring (26) into the 2nd apply piston (25)
2. Cushion spring retainer (27) on the cushion spring (26)
3. Install J-22269-01.
   - compress the retainer (27) passed the snap ring groove in the 2nd apply piston (25).
   - install the retainer ring (28).
4. The 2nd apply piston (25) onto the apply pin (29)
   - retainer goes toward the shoulder of the pin.
5. Servo apply pin spring (20) on the pin (29)
6. Servo apply pin washer (19) and retaining ring (18)
7. Inner (23) and outer (24) oil seals rings on the 2nd apply piston
   - retain with petrolatum.
8. Apply pin seals (30) on the apply pin
   - retain with petrolatum.
9. "O" ring seal (21) on servo piston housing
10. Servo piston inner housing (22) on the 2nd apply piston (25)
11. Seal ring (17) onto the 4th apply piston (16)
12. The 4th apply piston (16) onto the apply pin (29)
13. Return spring (31) on the pin (29)
14. Servo piston assembly into the servo bore
15. "O" ring seal (14) on the servo cover
    - lubricate the seal with transmission fluid.
16. Servo cover (15) into the servo bore
17. Install J-29714.
    - compress the servo cover.
    - install the retainer ring (13)

Governor Assembly (45)

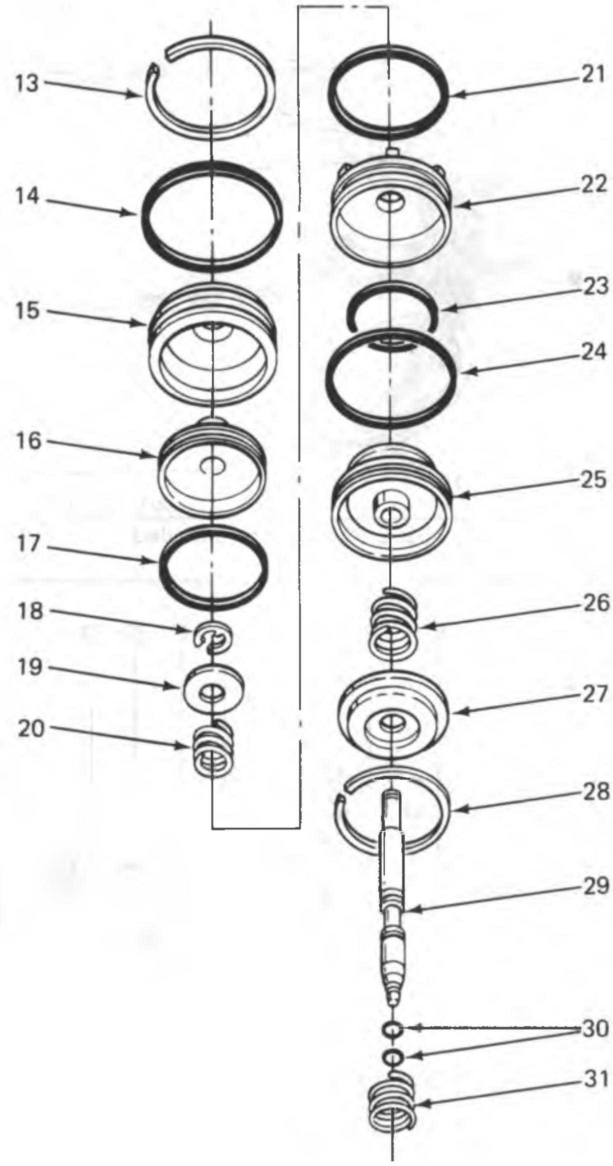
Inspect (Figure 156)

- Valve for free operation
- Weights for free operation
- Springs - missing or distorted
- Sleeve for nicks, burrs, scored or galled
- Driven gear (83) for damage

Disassemble

DO NOT DISASSEMBLE EXCEPT, FOR CLEANING OR PART REPLACEMENT.

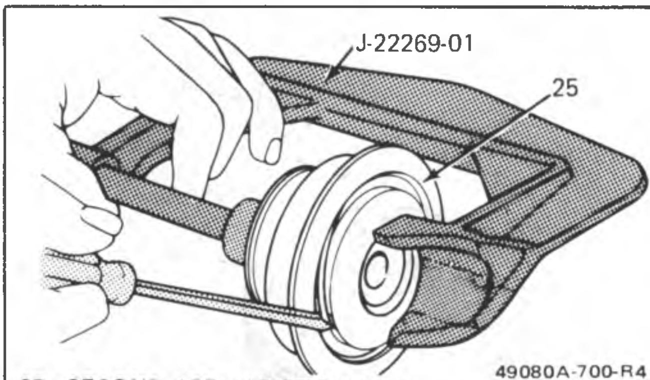
1. Cut off one end of each governor weight pin.
2. Pins (84)
3. Weights
4. Valve
5. Driven gear (83)



13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4, SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON INNER
23 RING, OIL SEAL INNER (2ND APPLY PISTON)
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

490217-700-R4

Figure 152 2-4 Servo Assembly



25 SECOND APPLY PISTON ASM.

Figure 153 2nd Servo Piston - Assembly

- Drive out the retainer pin (82) with a small punch.
- Support the governor assembly sleeve on plates installed in the exhaust slots. Push out the gear with an arbor press and a long punch.

Clean

- Wash all parts in solvent.
- Air dry and blow out passages.

Assemble

1. Install a new governor driven gear (83).
   - support the governor or plates through the exhaust slots.
   - press gear (83) into the sleeve until seated.
   - drill a new retaining pin hole in the sleeve ninety degrees from the existing hole. Use a 3.0 mm (1/8 in.) drill.
   - Install retainer pin (82) and stake.
2. Valve into the sleeve
3. Weights, springs, and thrust cap onto the governor assembly
4. Retaining pins (84) into the thrust cap (85) and governor assembly
5. Stake the retaining pins (84).
6. Check for free operation of the valve and weights.

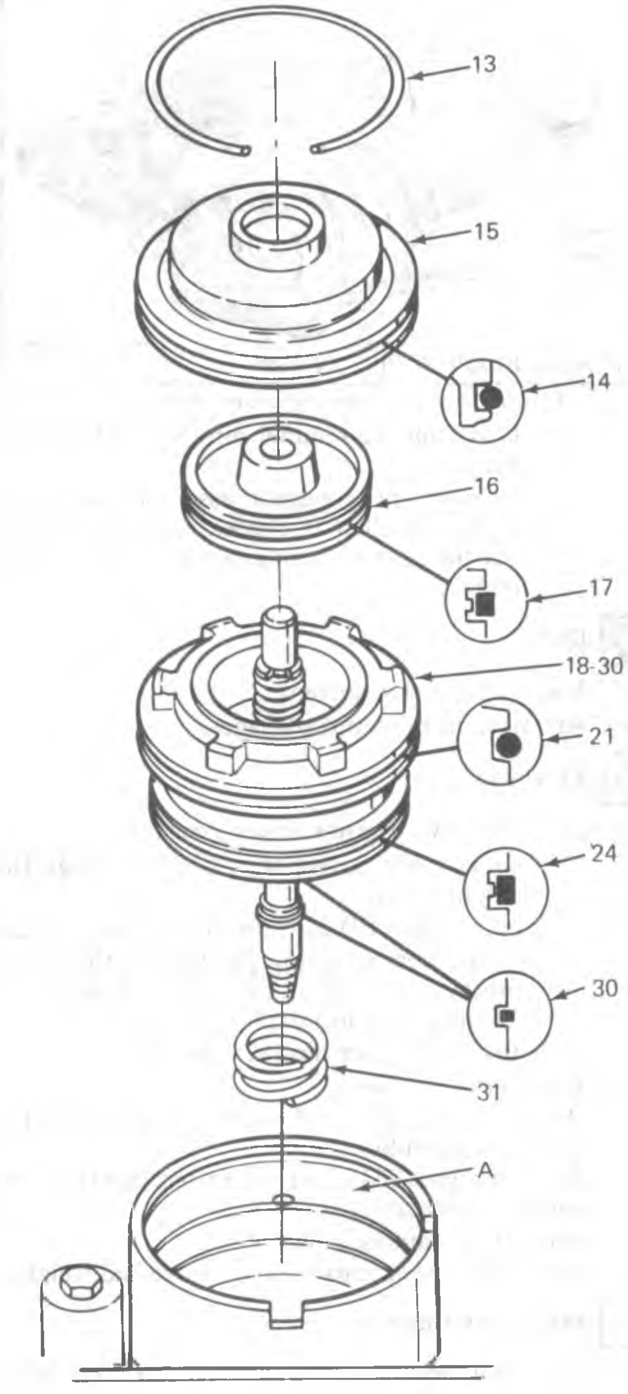
Install or Connect

1. Governor assembly (45) into the governor bore
2. Governor Cover (46)
   - apply sealant, such as loctite cup plug sealant #11 or equivalent to cover flange before installation.

Install or Connect (Figures 160 & 162)

TOOLS REQUIRED:
J-23103 or J-25016 Seal Installer
J-21426 Seal Installer

1. Speedometer drive gear (689) and clip (688)
   - if the output shaft has two speedometer locating holes, use the hole nearest the yoke spline for Corvette vehicles only.
2. "O" ring seal (691) on the output shaft sleeve
3. Output shaft sleeve (690) on the output shaft
   - use J-25016 or J-23103.



A CASE SERVO BORE
13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18-30 2ND APPLY PISTON ASSEMBLY
21 SEAL, "O" RING
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

49032C-700-R4

Figure 154 2-4 Servo Bore

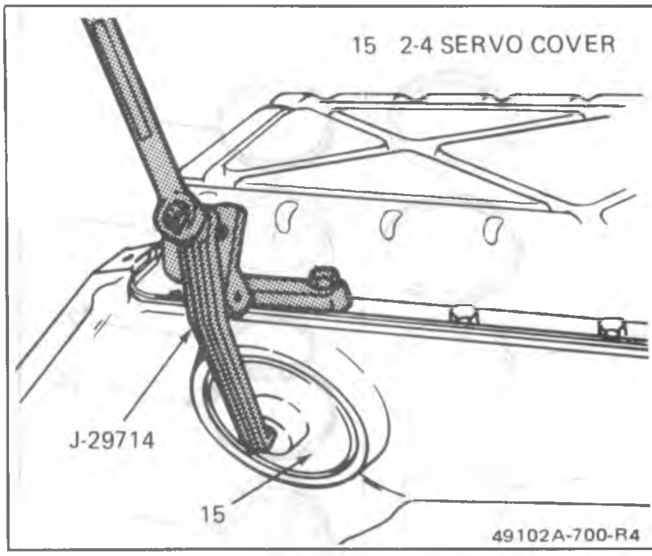
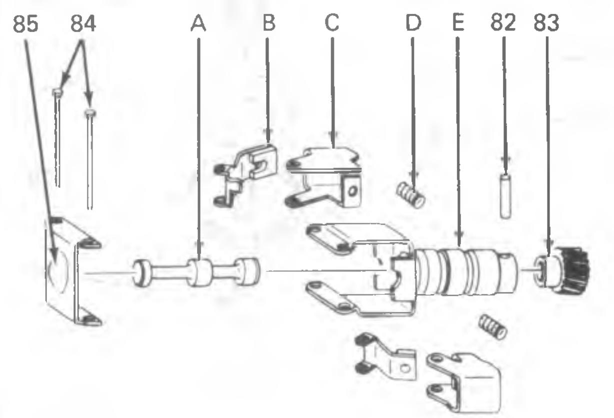


Figure 155 Servo Cover - Installed



GOVERNOR ASSEMBLY

A VALVE
B SECONDARY WEIGHT
C PRIMARY WEIGHT
D WEIGHT SPRING
E SLEEVE AND CARRIER
82 DRIVEN GEAR RETAINING PIN
83 DRIVEN GEAR
84 WEIGHT PINS
85 THRUST CAP

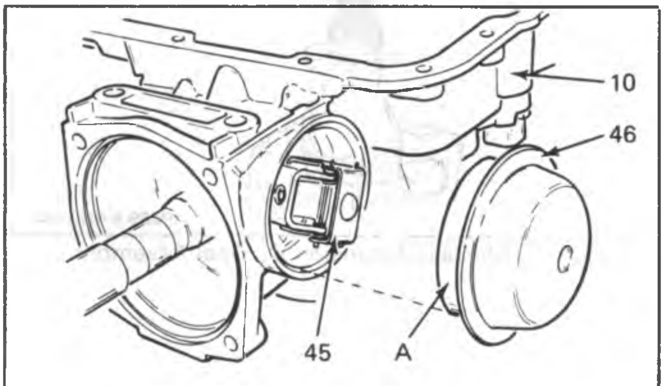
49005A-700-R4

Figure 156 Governor Assembly

- do not push the sleeve past the machined surface on the output shaft.

4. Seal ring (35) on the case extension
5. Case extension (36) and bolts (37)
   - position extension so the speedometer bore is on the governor side of the case.
   - torque to 34 N·m (26 ft. lbs.)
6. If extension oil seal asm. (39) requires replacement
   - pry out with a screwdriver.
   - install a new seal with J-21426.

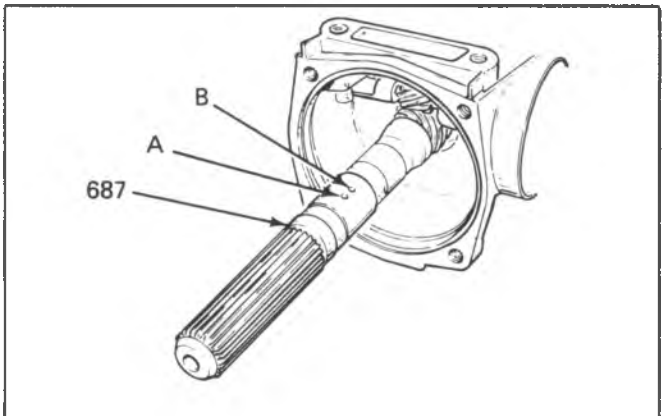
7. All remaining outside connectors such as the driven speedometer gear and adaptor, the outside manual lever and nut.
8. Remove the transmission from the holding fixture and install the torque converter (1).



A APPLY SEALANT ON THIS FLANGE BEFORE INSTALLATION
10 CASE, TRANSMISSION
45 GOVERNOR ASSEMBLY
46 COVER, GOVERNOR

490250-700-R4

Figure 157 Governor Cover

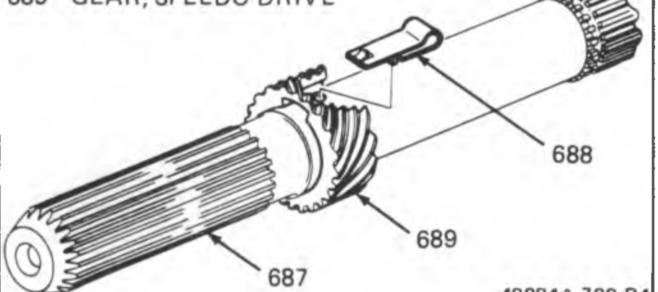


A SPEEDO CLIP HOLE FOR CORVETTE ONLY
B SPEEDO CLIP HOLE FOR ALL OTHER VEHICLES
687 SHAFT, OUTPUT

490238-700-R4

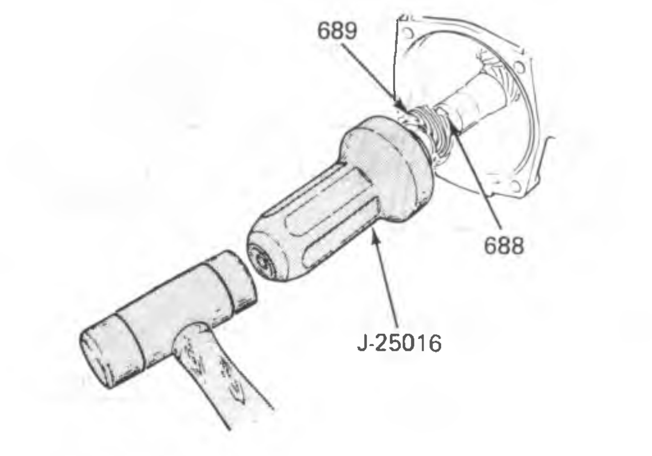
Figure 158 Speedo. Clip Holes

687 SHAFT, OUTPUT
688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE



49084A-700-R4

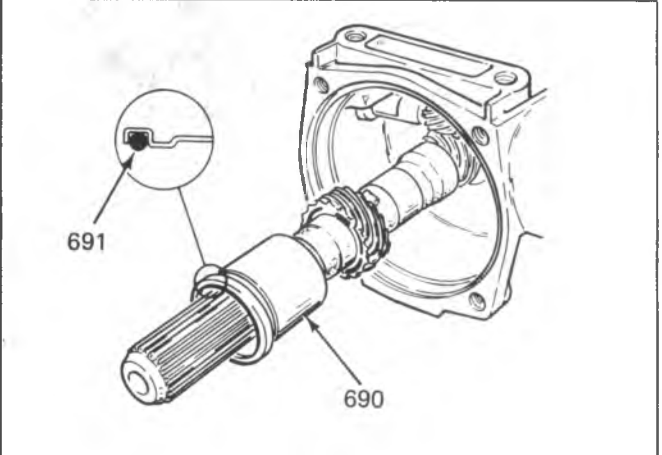
Figure 159 Speedometer Gear



688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE

490253-700-R4

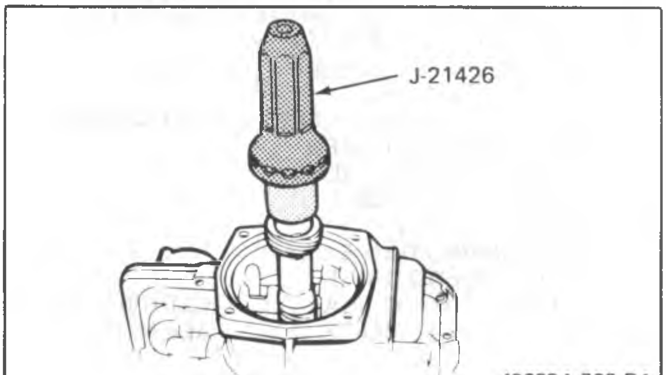
Figure 160 Speedo. Gear - Installation



690 SLEEVE, OUTPUT SHAFT
691 SEAL, OUTPUT SHAFT

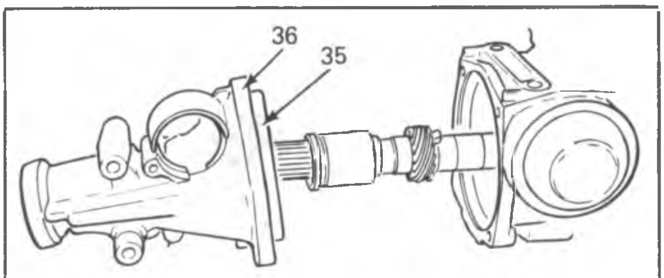
490251-700-R4

Figure 161 Output Shaft Sleeve and Seal



49088A-700-R4

Figure 162 Output Shaft Sleeve - Installation



35 SEAL, CASE EXTENSION TO CASE
36 EXTENSION, CASE

490252-700-R4

Figure 163 Case Extension and Seal

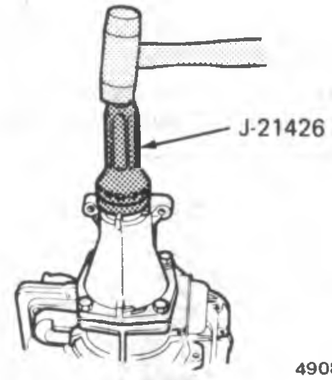


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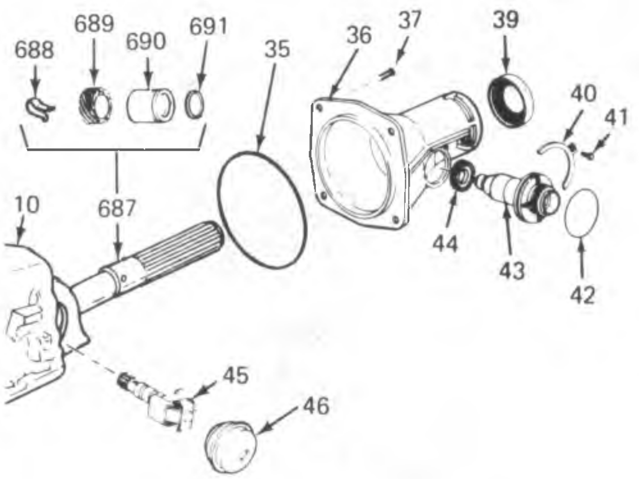
Figure 165 Case Extension Oil Seal Assembly



ILL. NO.	DESCRIPTION	
10	CASE, TRANSMISSION	
35	SEAL, CASE EXTENSION TO CASE	
36	EXTENSION, CASE	
37	BOLT, CASE EXTENSION TO CASE	
39	SEAL ASSEMBLY, CASE EXTENSION OIL	
40	RETAINER, SPEEDO DRIVEN GEAR FITTING	
41	BOLT & WASHER ASSEMBLY	
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)	
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR	
44	GEAR, SPEEDO DRIVEN	
45	GOVERNOR ASSEMBLY	
46	COVER, GOVERNOR	
687	SHAFT, OUTPUT	
688	CLIP, SPEEDO DRIVE GEAR	
689	GEAR, SPEEDO DRIVE	
690	SLEEVE, OUTPUT SHAFT	NOT USED ON ALL MODELS
691	SEAL, OUTPUT SHAFT	NOT USED ON ALL MODELS

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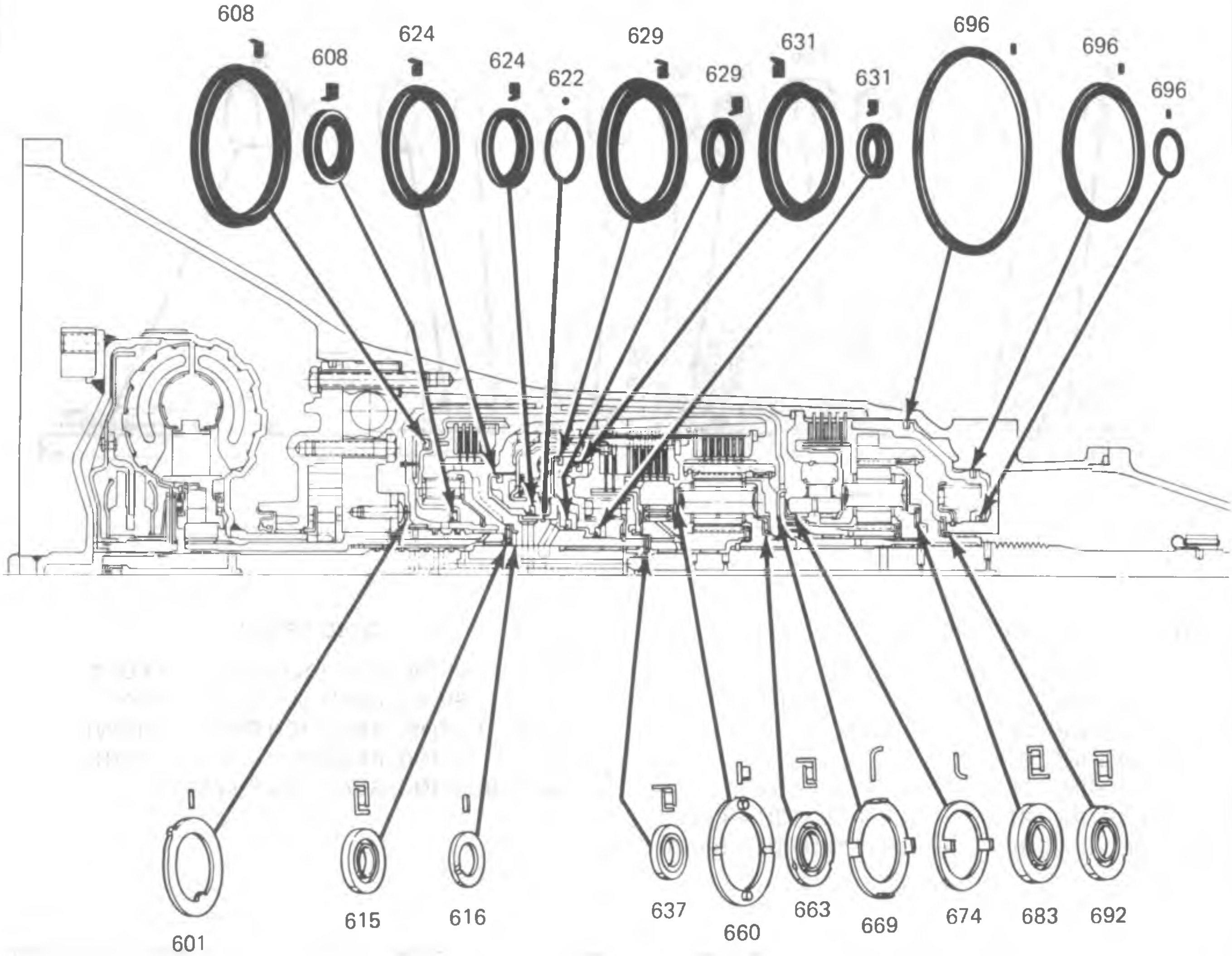
Figure 164 Case Extension and Associated Parts



ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
608	SEALS, REVERSE INPUT CLUTCH – INNER & OUTER
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
622	SEAL, "O" RING INPUT TO FORWARD HSG.
624	SEAL, 3RD & 4TH CLUTCH – INNER & OUTER
629	SEAL, FORWARD CLUTCH – INNER & OUTER
631	SEAL, OVERRUN CLUTCH – INNER & OUTER
637	BEARING ASSEMBLY, INPUT SUN GEAR
660	WASHER, THRUST (INPUT CARRIER/RACE)

ILL. NO.	DESCRIPTION
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
669	WASHER, THRUST (REACTION SHAFT/SHELL)
674	WASHER, THRUST (RACE/REACTION SHELL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
692	BEARING, REACTION GEAR SUPPORT TO CASE
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH – OUTER, CENTER – INNER)

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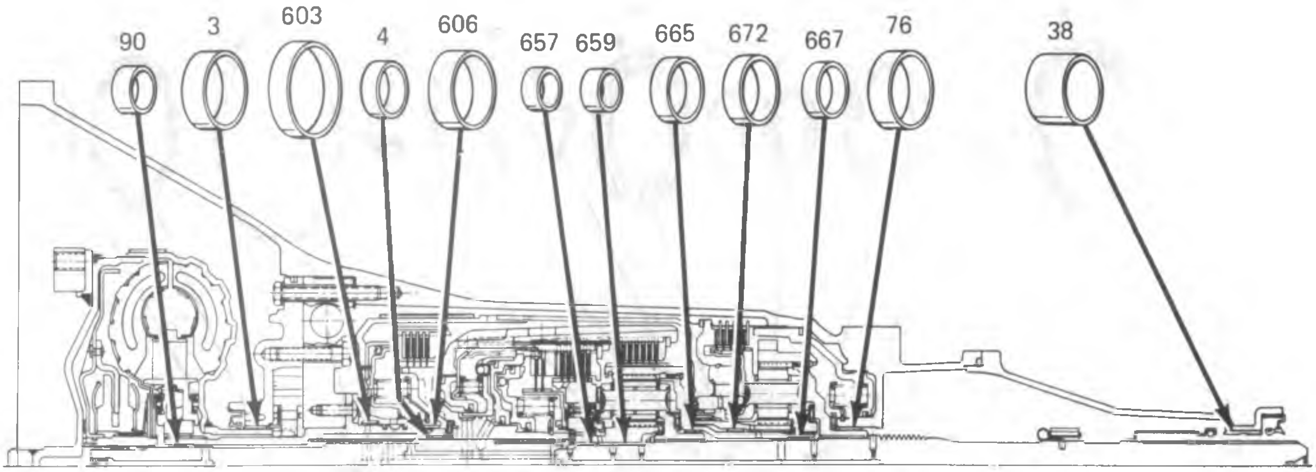
Figure 166 Seals and Bearing Locations



ILL. NO.	DESCRIPTION
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT – REAR
38	BUSHING, CASE EXTENSION
76	BUSHING, CASE
90	BUSHING, STATOR SHAFT – FRONT
603	BUSHING, REVERSE INPUT CLUTCH – FRONT
606	BUSHING, REVERSE INPUT CLUTCH – REAR
657	BUSHING, INPUT SUN GEAR – FRONT
659	BUSHING, INPUT SUN GEAR – REAR
665	BUSHING, REACTION SHAFT – FRONT
667	BUSHING, REACTION SHAFT – REAR
672	BUSHING, REACTION SUN GEAR

TORQUE SPECIFICATIONS

LOCATION	QTY.	SIZE	TORQUE	LOCATION	QTY.	SIZE	TORQUE
ACCUMULATOR COVER TO CASE	2	1.0 X 30.3	11 N·m (8 FT. LB.)	PARK BRAKE BRACKET TO CASE	2	1.25 - 20.00	22 N·m (18 FT. LB.)
ACCUMULATOR COVER TO CASE	1	1.0 X 60.0	11 N·m (8 FT. LB.)	PUMP COVER TO BODY	5	1.25 - 40.00	22 N·m (18 FT. LB.)
DETENT SPRING TO VALVE BODY	1	1.75 X 20.0	22 N·m (18 FT. LB.)	PUMP ASSY. TO CASE	7	1.25 - 60	22 N·m (18 FT. LB.)
VALVE BODY TO CASE	15	1.0 X 50.0	11 N·m (8 FT. LB.)	CASE EXTENSION TO CASE	4	1.50 - 30.0	34 N·m (26 FT. LB.)
OIL PASSAGE COVER TO CASE	3	1.0 X 16.0	11 N·m (8 FT. LB.)	MANUAL SHAFT TO INSIDE DET LEVER	1	1.50 NUT	31 N·m (23 FT. LB.)
SOLENOID ASSY. TO PUMP	2	1.0 X 12.0	11 N·m (8 FT. LB.)	PRESSURE PLUGS	1-4	1/8 - 27	11 N·m (8 FT. LB.)
TRANSMISSION OIL PAN TO CASE	16	1.25 X 16	16 N·m (12 FT. LB.)	PRESSURE PLUGS	3	1/4 - 18	24 N·m (18 FT. LB.)
PRESSURE SWITCHES	1-3	1/8 - 27	11 N·m (8 FT. LB.)	CONNECTOR COOLER PIPE	2	1/4 - 18	38 N·m (28 FT. LB.)

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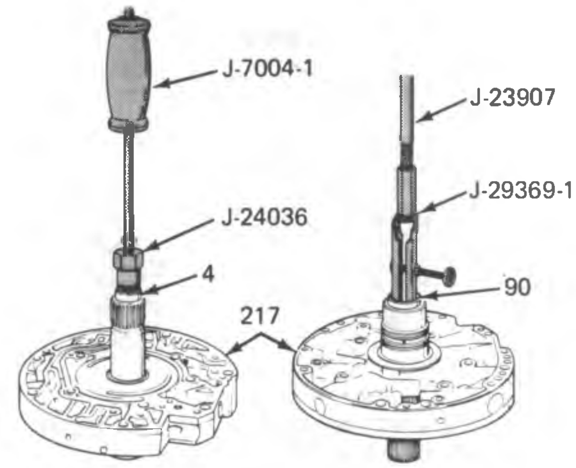
Figure 167 Torque Specifications and Bushing Locations

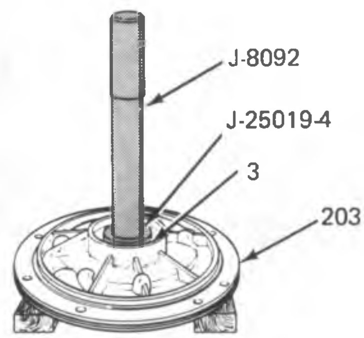
BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

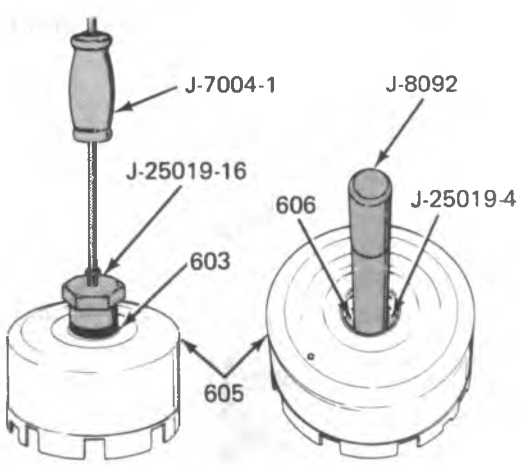
REMOVE AS SHOWN



4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP

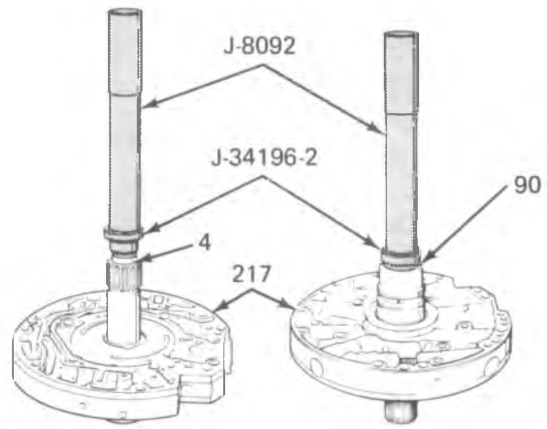


3 BUSHING, OIL PUMP BODY
203 BODY, PUMP

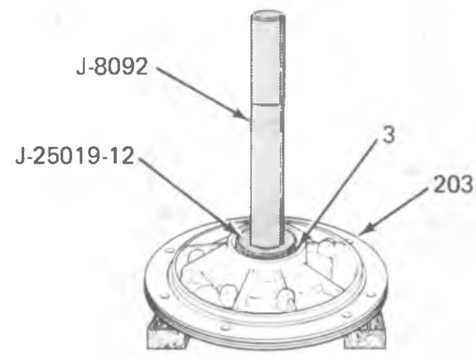


603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

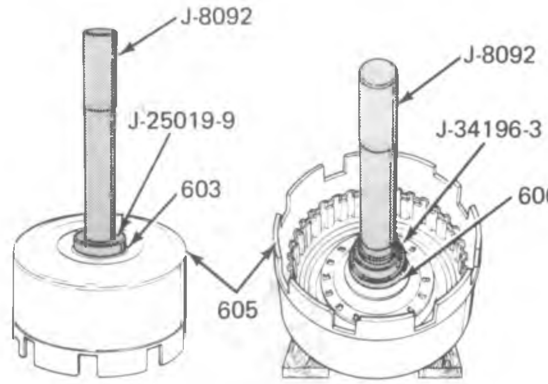
INSTALL AS SHOWN



4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP



3 BUSHING, OIL PUMP BODY
203 BODY, PUMP



603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

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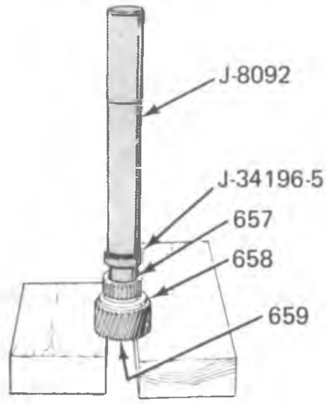
Figure 168 Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE

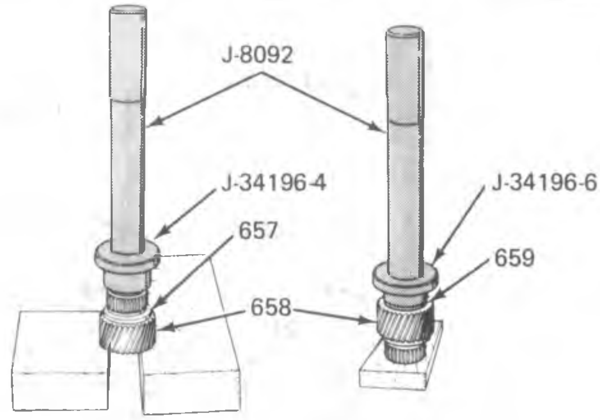
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

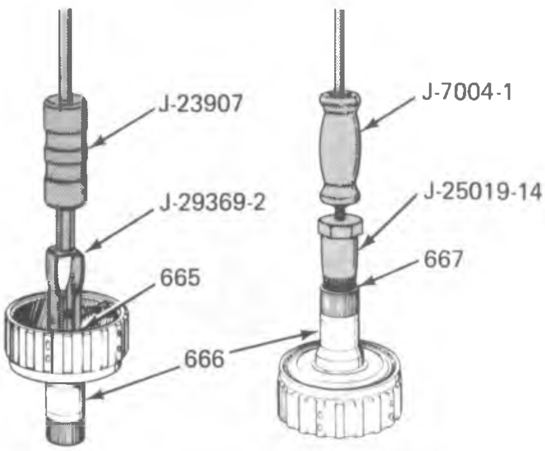


657 BUSHING, INPUT SUN GEAR – FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR – REAR

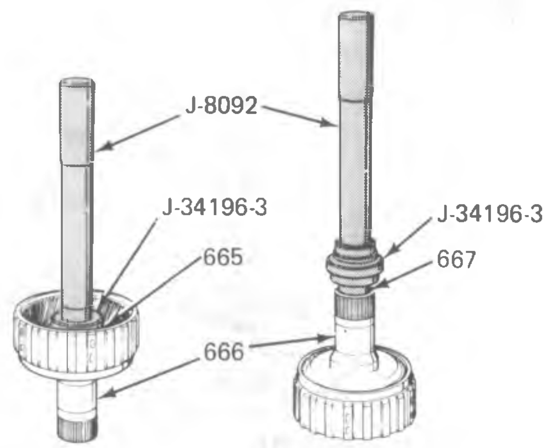
INSTALL AS SHOWN



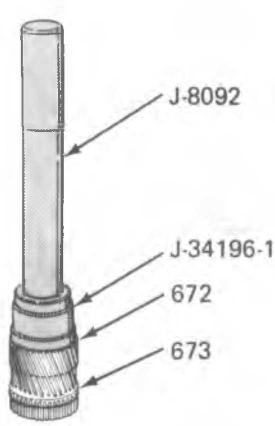
657 BUSHING, INPUT SUN GEAR – FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR – REAR



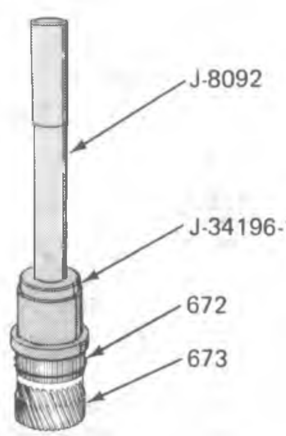
665 BUSHING, REACTION CARRIER SHAFT – FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT – REAR



665 BUSHING, REACTION CARRIER SHAFT – FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT – REAR



672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN



672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN

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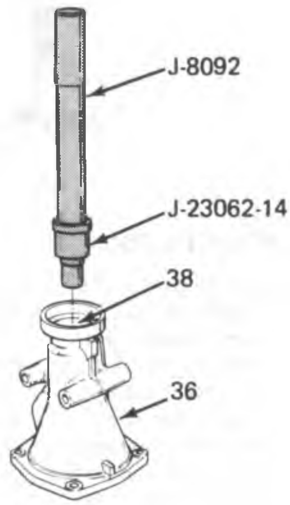
Figure 169 Bushing Replacement Procedure

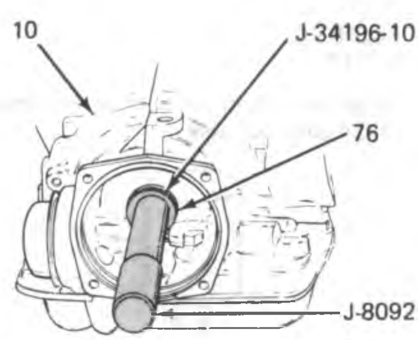
BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

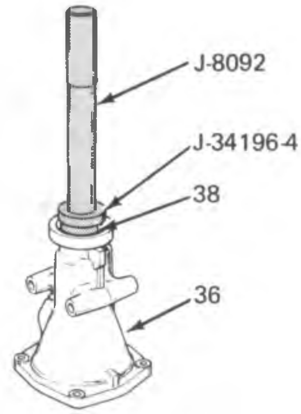


36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION

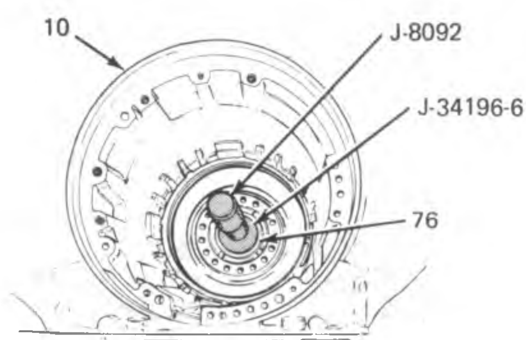


10 CASE, TRANSMISSION
76 BUSHING, CASE

INSTALL AS SHOWN



36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION



10 CASE, TRANSMISSION
76 BUSHING, CASE

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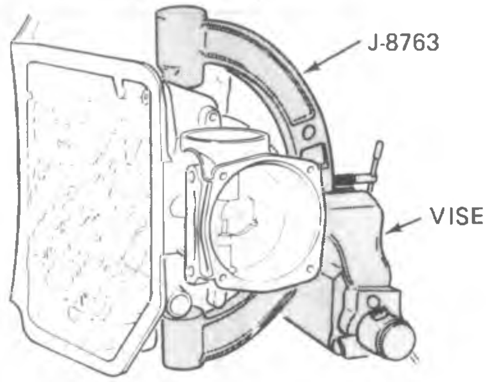
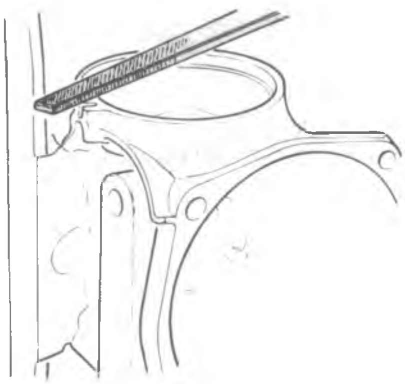
Figure 170 Bushing Replacement Procedure

GOVERNOR BORE REPAIR PROCEDURE

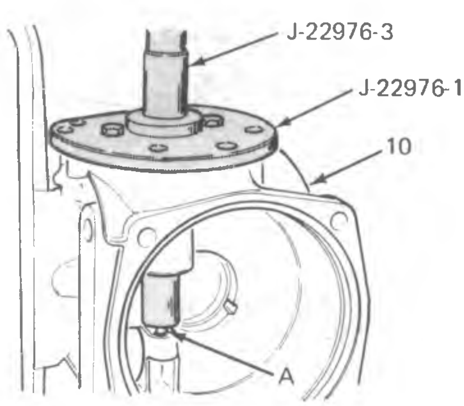
FOLLOW STEPS 1-6 TO REPAIR THE GOVERNOR BORE



STEP 1 Install holding fixture J-28763 and mount in vise.

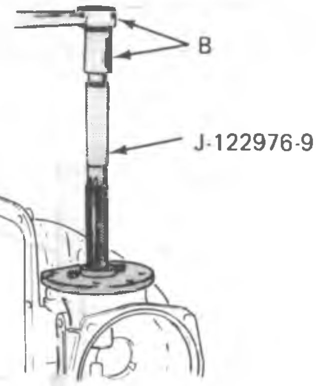


STEP 2 Remove (file) any excess material from the governor face.



A PIN, GOVERNOR SUPPORT
10 CASE, TRANSMISSION

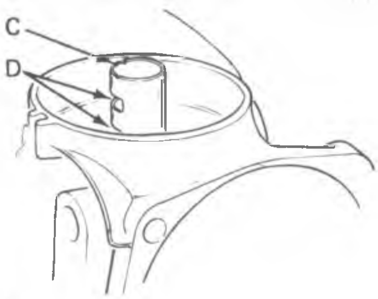
STEP 3 Install J-22976-3 and J-22976-1. Torque bolts to 13 N·m (10 ft.-lbs.). Make sure J-22976-3 rotates freely and then remove it.



B RATCHET & SOCKET

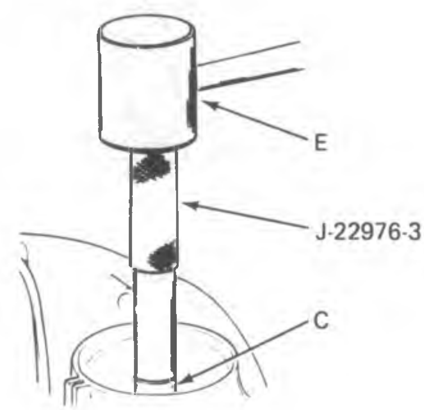
STEP 4 Ream the governor bore as follows:

- Oil J-122976-9, J-22976-1 and the governor bore with transmission fluid.
- After each ten revolutions, remove the reamer and dip in transmission fluid to clean.
- After the reamer reaches the end of the bore and bottoms on the governor support pin, rotate the reamer ten additional revolutions.
- Remove the reamer. Be certain to rotate during removal to prevent scoring the bore.
- Remove the tools and thoroughly clean the case.



C BUSHING
D SLOTS

STEP 5 Align the slots in the bushing with the slots in the governor bore.



C BUSHING
E BRASS HAMMER

STEP 6 Install the bushing until the slots in the bushing align with the feed holes in the governor bore.

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Figure 171 Governor Bore Repair Procedure

Figure 172 Special Tools

SECTION 7B

MANUAL TRANSMISSION

CONTENTS

General Description 7B-1
Maintenance and Adjustments 7B-2
Free Pedal Travel 7B-3
Spin Down Time 7B-3
Shift Effort 7B-4
Transmission Alignment 7B-5
Diagnosis 7B-6
76MM (3 Speed) 1
89MM (4 Speed) 1
117MM (4 Speed) 1

GENERAL DESCRIPTION

THREE-SPEED TRANSMISSIONS

3-Speed 76mm (7B1-4)

Manual transmissions are designated according to: (A) the number of forward gears, and (B) the measured distance between centerlines of the mainshaft and the countergear.

The three speed synchromesh transmission are representative of a constant-mesh transmission design. Fundamental components of these units are the case, which house the gears and shaft; the shift control mechanism and the various shafts and gears. The input shaft has an integral main drive gear and rotates with the clutch driven plate; that is, the shaft rotates all the time the clutch is engaged and the engine is running. The input shaft is supported in the case by a ball bearing and at the front end by an oil impregnated bushing mounted in the engine crankshaft. The drive gear is in constant mesh with the countershaft drive gear. Since all gears in the countershaft cluster are integral to the shaft, they also rotate at the time the clutch is engaged. The countergear is carried on roller bearings at both ends and thrust is absorbed by thrust washers located between the countergear and thrust bosses in the case. The transmission mainshaft is held in line with the input shaft by a pilot bearing at its front end, which allows it to rotate or come to rest independently of the input shaft. In the 76mm unit, the mainshaft is carried at the rear by a ball bearing mounted in the front face of the extension housing.

Helical gears are incorporated throughout the transmission. The mainshaft gears are free to rotate independently on the mainshaft and are in constant mesh with the countershaft gears. The reverse idler gear is carried on a bushing, finish bored in place, and thrust is taken on the thrust bosses of the case.

The transmission is fully synchronized in all forward speeds; however, reverse gear is not. The synchronizer assemblies consist of a hub, sleeve, two key springs and three synchronizer keys. The synchronizer hubs are splined to the mainshaft and retained by snap rings. These assemblies permit gears to be selected without clashing, by synchronizing the speeds of mating parts before they engage.

In the 76mm unit, the driven gear, second speed gear, first speed gear and reverse gear are rigidly connected to the countergear. driven clutch gear drives the countergear through a constant mesh countershaft driven gear. The countergear rotates in a direction opposite, or counter, to the rotation of the clutch gear. Forward speed gears on the countergear remain in constant mesh with two nonsliding mainshaft gears giving first and second speed. Third speed is a direct drive with the clutch gear engaged directly to the mainshaft. Forward gears are engaged through two sliding synchronizer sleeves mounted on the mainshaft. Engagement of the constant mesh mainshaft gears to the mainshaft is accomplished through blocker ring-type synchronizers.

FOUR-SPEED TRANSMISSION

4-Speed 89mm (Fig. 7B3-4)

The four speed transmission with overdrive has an 89mm center distance and is designed to combine normal performance in the city with improved fuel economy on the highway. Gear ratios are: first 3.09 to 1; second 1.67 to 1; third 1.00 to 1; fourth (overdrive) 0.73 to 1. All forward gears are fully synchronized. The synchronizer assemblies consist of a hub, sleeve, two key springs and three synchronizer keys. The synchronizer hubs are splined to the mainshaft and retained by snap rings. These assemblies permit gears to be selected without clashing, by synchronizing the speeds of mating parts before they engage.

The drive pinion (input shaft) is supported by a ball bearing in the transmission case and an oil impregnated bushing pressed in the end of the crankshaft.

The mainshaft front end is supported by roller bearings in the end of the main drive pinion and a ball bearing in the front of the extension housing. The output end of the mainshaft is splined to the sliding universal joint yoke, which is supported by a bushing in the extension housing.

The countershaft gear is supported by a double row of needle type roller bearings at each end and the thrust is taken on thrust washers between the ends of the gear and the transmission case. The alignment of the needle type roller bearings within the gear is maintained by a tubular spacer in the center and four thrust washers (one being used between the rows of roller bearings and one at each end). The countershaft is not a press fit in the case bores, but has .127mm (.005 inch) diameter clearance. An expansion plug is pressed into a counter bore at the front of the case to prevent oil leakage around the countershaft.

The reverse idler gear is supported on a bronze bushing, pressed into the gear. A magnetic disc is attached to bottom, near rear of case under countershaft gear. This magnet collects and prevents circulation of chips in transmission oil.

4-Speed 117mm (Fig. 7B4-4)

The 117mm, Model CH 465 truck transmission uses a constant mesh first gear that engages with the second speed synchronizer sleeve. Second, third and fourth gears are synchronized. The clutch gear is supported by a heavy duty ball bearing. The forward end of the mainshaft is supported by a loose collar-type bearing inside the clutch gear, while the rear is carried on a ball bearing in the case. End play is taken up by the rear flange retaining nut. The countergear is supported at the rear of a single row ball bearing which takes the thrust load, and by a roller bearing at the front. Incorporated in the cover is a ball pin type interlock which prevents simultaneous engagement of two gears. As one rod is moved, it pushes a ball out that engages the other two rods to prevent their movement.

Gearshift levers on manual transmissions are located either on the steering column or on the floorpan. Regardless of location, the lever performs two operations: It selects the gear assembly to be moved, and moves it either forward or backward into the desired gear position. The transmission action is the same whether a floor-type shift lever or a steering column shift lever is used. When the shift lever is moved, the movement is carried by linkage to the transmission.

MAINTENANCE AND ADJUSTMENTS

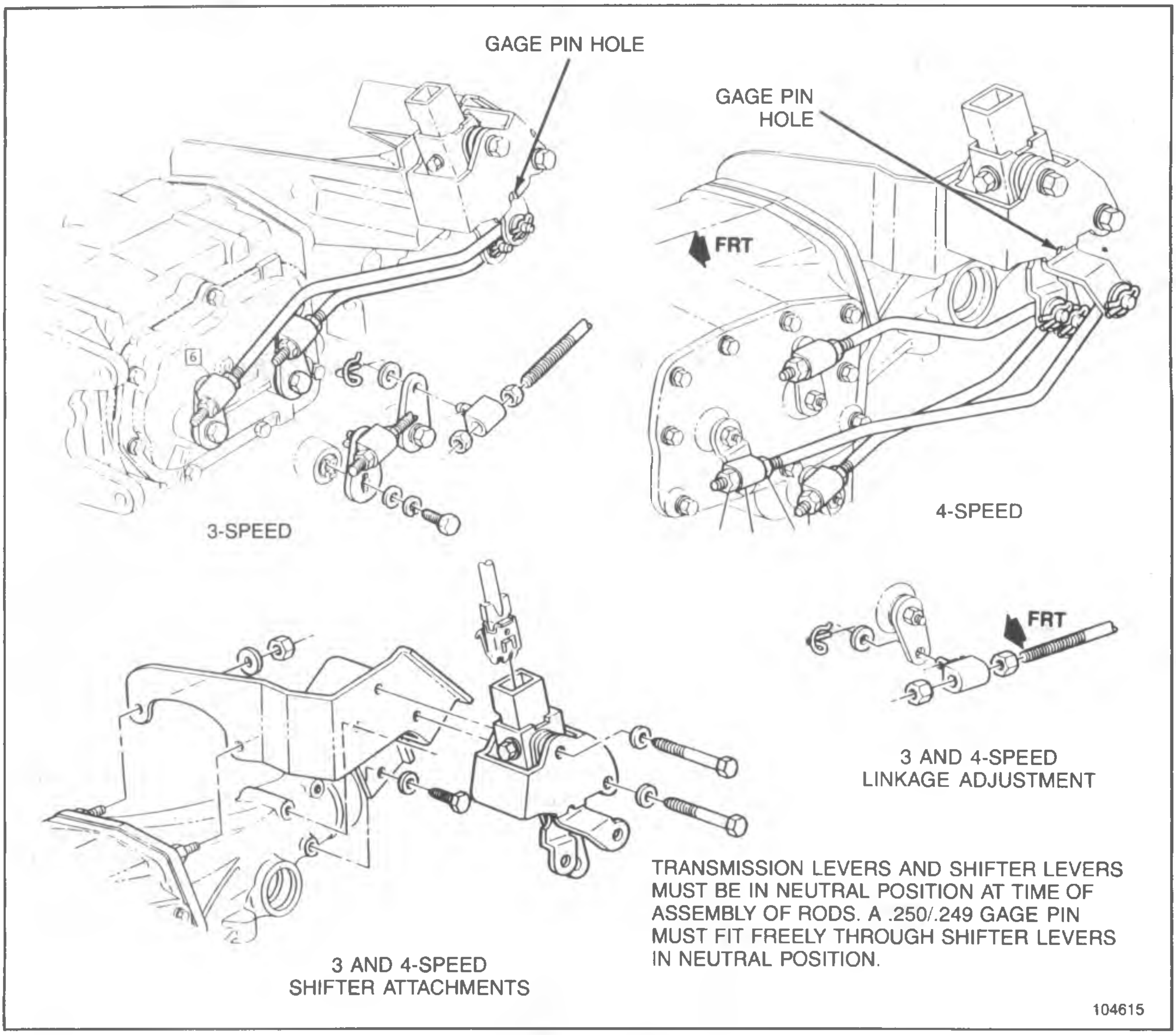
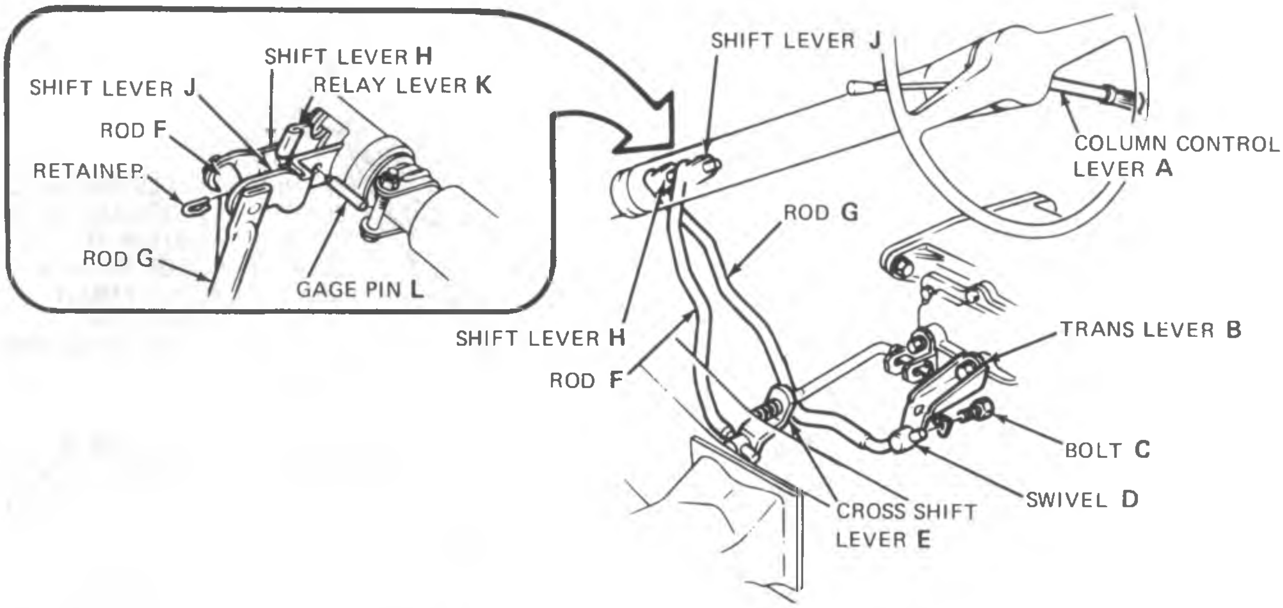


Fig. 7B-1--G-Truck Shift Linkage



TRANSMISSION CONTROL LINKAGE ADJUSTMENT

1. Set Levers (A) and (B) in "REVERSE" position and turn ignition switch to "LOCK" position. **NOTE** Obtain "REVERSE" position by moving Trans Lever (B) clockwise to forward detent.
2. Attach Rod (G) to Shift Lever (J) with retainer. See View A. Slide swivel (D) onto Rod (G). Insert Swivel (D) into Lever (B) and loosely assembly with bolt (C) and washer at this time.
3. Remove column "LASH" by rotating Lever (J) in a downward direction and complete attachment of Rod (G) to Lever (B) by tightening Bolt (C) using recommended torque.
4. Turn ignition key to "UNLOCK" position and position Levers (A), (B) and (E) in "NEUTRAL". **NOTE** Obtain "NEUTRAL" position by moving Levers (B) and (E) clockwise to forward detent then counter-clockwise one detent.
5. Align gage holes in Levers (H), (J) and (K) and insert Gage Pin (L).
6. Repeat steps 2 & 3 for Rod (F) & Levers (E) & (H).
7. Remove Gage Pin (L).

NOTE With shift lever in "REVERSE" the ignition key must move freely to "LOCK" position. It must not be possible to obtain ignition "LOCK" position in "NEUTRAL" or any gear other than "REVERSE".

102706

Fig. 7B-2--C Truck Column Shift Linkage

Before attempting to repair the clutch, transmission or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or transmission blockout. When any of these problems occur a careful analysis of these difficulties should be accomplished, and the following checks and adjustments performed in the presented sequence before removing the clutch or transmission for repairs.

CLUTCH ADJUSTMENT

Clutch Free Pedal Travel

1. The clutch free pedal travel adjustment should be made as outlined in Section 7C.
2. Check clutch linkage for lost motion caused by loose or worn swivels, deflection of mounting brackets or damaged cordon shaft.

Clutch Spin Down Time

1. Run the engine at a normal idle with transmission in neutral and clutch engaged.
2. Disengage the clutch, wait nine seconds and shift the transmission to reverse. No grinding noise should be heard. A grinding noise indicates incorrect clutch adjustment, lost motion, clutch misalignment, or internal problems such as failed dampers, facings, cushion springs, diaphragm spring fingers, pressure plate drive straps, etc.

SHIFT LINKAGE ADJUSTMENT

Steering Column Shift Control

1. Remove the shift control rods from the column levers.
2. Check shift effort at the shift control lever knob. (Effort should not exceed 2 lb. with transmission linkage removed.)
3. If binding is felt, refer to the adjustment

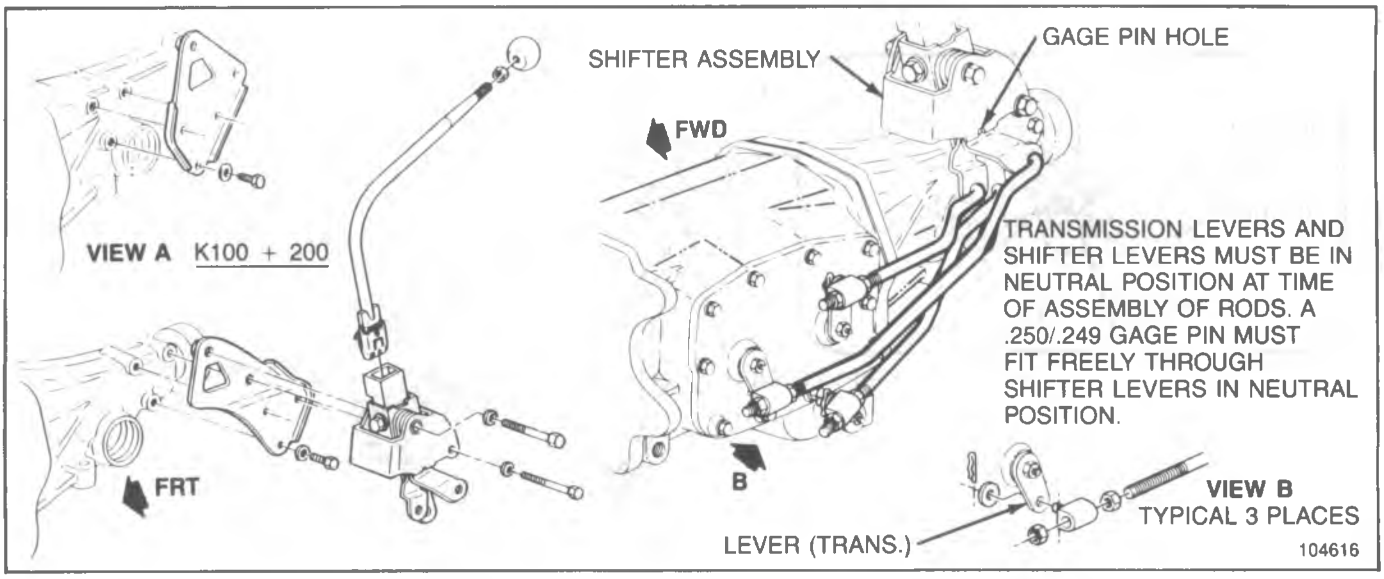


Fig. 7B-3--C-K Truck (89mm) Shift Linkage

procedure for the steering column lower bearing in Section 3B.

4. Lubricate all rod and swivel connections and recheck shift effort afer installation.
5. If shift linkage is free from binding, the column levers should be checked for end play. A .005" feeler gage should fit between the levers and control lever.
6. Connect control rods and check steering column control levers for alignment. In neutral, the column control lever tangs should line up with the slot in the main control lever.

Floor Shift Control

All swivels, rods and mountings should be checked for lost motion and repaired or replaced as necessary. Transmission control levers should be checked for wear and repaired or replaced as necessary.

TRANSMISSION SHIFT EFFORT

Transmission Shift Effort Checking Procedures

1. Remove the shift rods at the transmission and align the sleeve, blocker ring and gear by shifting into the offending gear and then back into neutral.
2. Check the torque required to shift into gear with an inch pound torque wrench on the shift lever attaching bolt. If more than the specified torque 5 N·m (50 in. lbs.) is required, the transmission shift lever should be checked for rust or dirt binding the lever.
3. Clean levers, lubricate and recheck the torque value.

   NOTICE: If at this point in the procedure, it is found that high shift effort or blockout still exists, an anti-chatter lubricate (positraction additive) should be used. The lubricant is available in a plastic bottle and can be squirted in the transmission through the filler plug.

Transmission Internal Problems Related to Shift Effort

When the above procedures have been checked and the problem still exists, the transmission will have to be removed and disassembled for further diagnosis. There are three basic types of transmission internal problems reflected by shifting effort.

1. Hard Shifting - The effort to shift is excessive, but the gears engage. The lever moves with excessive effort throughout the entire travel range. If the static shift effort is high, (clutch depressed, engine not running), the synchronizer sleeve and hubs should be checked for a tight fit. With the three synchronizer keys removed, the sleeve should be loose on the hub. If the hub and sleeve are not a loose fit, replace the synchronizer assembly.
2. Blockout - The lever moves freely until the synchronizer is engaged. Synchronization should be heard to take place, but the gear will not engage. When it does engage, a double bump is generally felt in the lever. The synchronized blocker ring can be damaged by excessive force on gear cones that are finished improperly. The blocker ring material may stick to the synchronizer gear cone causing it to be a yellowish brass color, in streaks, which results in hard shifts when present. The gear cone should be a bring silver color. Polish the gear cone with 400 grit paper to a bright silver when this condition is present. The blocker rings should be replaced if the thread is damaged or worn.

   Clash - Gear clash is a sound which sometimes occurs when the sleeve and gear chamfer contact each other in the unsynchronized state. The characteristics of clash are a grating or loud buzzing sound from the transmission. The shift lever load will be lower, but a vibration should be felt. The noise (clash) can be for a short instant or long enough to keep the gear from being engaged. This condition should not be confused with hard shifting or reported as such. Hard shifting and clash are directly opposit conditions. When the clash is slight, the load will build up on the shift lever and then fall off rapidly followed by the grating sound.

If the transmission has been clashing, the sleeve ends should be examined for chipping and burrs. If the sleeves are damaged, the synchronizer assemblies and blocker rings should be replaced. Synchronizer sleeve ends should have an angular surface. The surfaces should be even from side to side and the radii indicated should be very small. Any chipping will require synchronizer replacement.

Check the synchronizer load. When the keys are installed, the spring ends on one side of the hub should be hooked in one key and the spring on the opposite side of the synchronizer should not be hooked on the same key. A definite load should be felt when the sleeve is moved on the hubs with the keys and springs in proper position.

TRANSMISSION ALIGNMENT

In some instances where excessive gear whine or high speed gear hop out, particularly at 50 mph (80 km/h) and up, are encountered, and after all other probable causes have been checked, an alignment check of the transmission and clutch housing may be helpful.

A special tool, on which a dial indicator is mounted, is necessary to check the transmission case rear bore alignment. This tool may be made from a new or good used clutch gear which has a good bearing surface on the crankshaft pilot end and at the front main bearing location.

The splines on the clutch gear shaft and the teeth on the clutch gear should be ground off so the shaft may be rotated in a clutch disc hub without interference when assembled in the car. Weld a piece of 6.3mm (1/4 in.) rod in the mainshaft pilot bore long enough to extend out the case rear bore. Assemble a good bearing on the clutch gear shaft and secure it with the clutch gear bearing snap ring. Attach a suitable dial indicator to the rod.

1. Remove the transmission from the vehicle and completely disassemble, except for the reverse idler gear. In any case where the clutch gear pilot or pilot bearing is excessively loose or worn, the pilot bearing should be replaced before checking the transmission case rear bore alignment by the dial indicator method.
2. Carefully install the special tool with the dial indicator in the transmission case with the face of the indicator to the rear of the case and with the tracing finger contacting the I.D. of the case rear bore. Secure in place with a clutch gear bearing retainer.
3. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely. Be sure to clean off any paint or other foreign material on the mating faces of the clutch housing and transmission as any foreign material on these faces will change alignment; also, check carefully for dings or burrs on these mating surfaces and remove carefully as necessary.
4. Dial indicate the transmission case rear bore and record the indicator readings in the 12, 3, 6 and 9 o'clock positions. It is best to start the reading at the 3, 6, 9 or 12 o'clock position closest to the point where the indicator plunger reaches its maximum outward travel. Se the dial indicator at "0" at this location and then record the 3, 6, 9 and 12 o'clock readings in rotation.
5. Install temporary slotted shims between the transmission case and the clutch housing in the quantities and at the bolt locations as necessary to bring misalignment at the transmission case rear bore to a maximum of .127mm (0.005 in.) indicator reading in either the vertical or horizontal direction. EXAMPLE: If the maximum indicator reading is at the 12 o'clock position, put shims on the two bottom bolts.
6. After the position and quantity of shims has been determined and recorded, the transmission case may be removed.

   NOTICE: The clutch housing should then be stamped, showing the position where shims are to be installed and the thickness of shims at each location.
7. Inspect the external clutching teeth of the clutch gear and second speed gear. Inspect the second and third speed clutch internal clutching teeth. If the teeth are worn or tapered, even slightly, the gears should be replaced. Reassemble the transmission.
8. Install the transmission assembly to the clutch housing, using the correct number of shims at the proper locations as previously determined. Shims are available by unit part number with each unit consisting of the following shims:

   4--.002" shims identification--two corners cut off.

   2--.005" shims identification--one corner cut off.

   1--.010" shims identification--all corners square.

   These special shims have a tab on one end for ease of installation. Do not slot the shims for the permanent installation.

MANUAL TRANSMISSION DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Slips out of High Gear	a. Transmission loose on clutch housing b. Shift rods interfere with engine mounts or clutch throw-out lever c. Shift linkage does not work freely; binds d. Damaged mainshaft pilot bearing e. Main drive gear retainer broken or loose f. Dirt between transmission case and and clutch housing g. Misalignment of transmission h. Stiff shift lever seal i. Pilot bearing loose in crankshaft j. Worn or improperly adjusted linkage	a. Tighten mounting bolts b. Replace or bend levers and rods to eliminate interference c. Adjust and free up shift linkage d. Replace pilot bearing e. Tighten or replace main drive gear f. Clean mating surfaces g. Refer to TRANSMISSION ALIGNMENT h. Replace seal i. See Section 6 for brg. fits j. Adjust or replace linkage as required
Noisy in All Gears	a. Insufficient lubricant b. Worn countergear bearings c. Worn or damaged main drive gear and countergear d. Damaged main drive gear or main shaft bearings e. Worn or damaged countergear anti-lash plate	a. Fill to correct level b. Replace countergear bearings and shaft c. Replace worn or damaged gears d. Replace damaged bearings or main drive gear e. Replace countergear
Noisy in High Gear	a. Damaged main drive gear bearing b. Damaged mainshaft bearing c. Damaged high speed gear synchronizer	a. Replace damaged bearing b. Replace damaged bearing c. Replace synchronizer
Noisy in Neutral with Engine Running	a. Damaged main drive gear bearing b. Damaged or loose mainshaft pilot bearing c. Worn or damaged countergear anti-lash plate d. Worn countergear bearings	a. Replace damaged bearing b. Replace pilot bearings. See Section 6 for bearing fits c. Replace countergear d. Replace countergear bearings and shaft
Noisy in all Reduction Gears	a. Insufficient lubricant b. Worn or damaged main drive gear or countergear	a. Fill to correct level b. Replace faulty or damaged gears
Noisy in Second Only	a. Damaged or worn second-speed constant mesh gears b. Worn or damaged countergear rear bearings c. Damaged or worn second-speed synchronizer	a. Replace damaged gears b. Replace countergear bearings and shaft c. Replace synchronizer
Noisy in Third Only (Four Speed)	a. Damaged or worn third-speed constant mesh gears b. Worn or damaged countergear bearings	a. Replace damaged gears b. Replace damaged countergear bearings and shaft

Fig. 7B-4--Manual Transmission Diagnosis Chart A

MANUAL TRANSMISSION DIAGNOSIS (CONT'D.)

CONDITION	PROBABLE CAUSE	CORRECTION
Noisy in Reverse Only	a. Worn or damaged reverse idler gear or idler bushing b. Worn or damaged reverse gear on mainshaft c. Damaged or worn reverse countergear d. Damaged Shift mechanism	a. Replace reverse idler gear assembly b. Replace reverse gear c. Replace countergear assembly d. Inspect linkage and adjust or replace damaged parts
Excessive Backlash in all Reduction Gears	a. Worn countergear bearings b. Excessive end play in countergear	a. Replace bearings b. Replace countergear thrust washers
Main Drive Gear Bearing Retainer Burned or Scored by Input Shaft	a. Loose or damaged mainshaft pilot bearing b. Misalignment of transmission	a. **Replace bearing. Refer to Clutch Section for bearing fit** b. Align transmission
Leaks Lubricant	a. Excessive amount of lubricant in transmission b. Loose or broken main drive gear bearing retainer c. Main drive gear bearing retainer gasket damaged d. Side cover loose or gasket damaged e. Rear bearing retainer oil seal leaks f. Countershaft loose in case g. Shift lever seals leak	a. Drain to correct level b. Tighten or replace retainer c. Replace gasket d. Tighten cover or replace gasket e. Replace seal f. Replace case g. Replace seal

Fig. 7B-5--Manual Transmission Diagnosis Chart B

SHIFTING DIFFICULTY DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
High Shift Effort-Column Shift (Effort exceeds 2 ft. lbs. at lever knob with transmission linkage disconnected.)	Binding of column levers	**Adjust column as outlined in the Steering Column Section.** Clean and lubricate all rod and swivel connections.
	Lever end play exceeds .005 in.	Adjust levers
	Misalignment of column control levers.	Adjust levers
Gear Clash and binding	Improper linkage Adjustment	Adjust Shift linkage
Lost motion	Loose or worn swivels and grommets. Deflection of Mounting Brackets. Loose shift levers. Damaged Cordon Shaft	Replace defective parts

Fig. 7B-6--Shifting Difficulty Diagnosis Chart

SECTION 7B
3-SPEED 76MM TRANSMISSION

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ON VEHICLE SERVICE

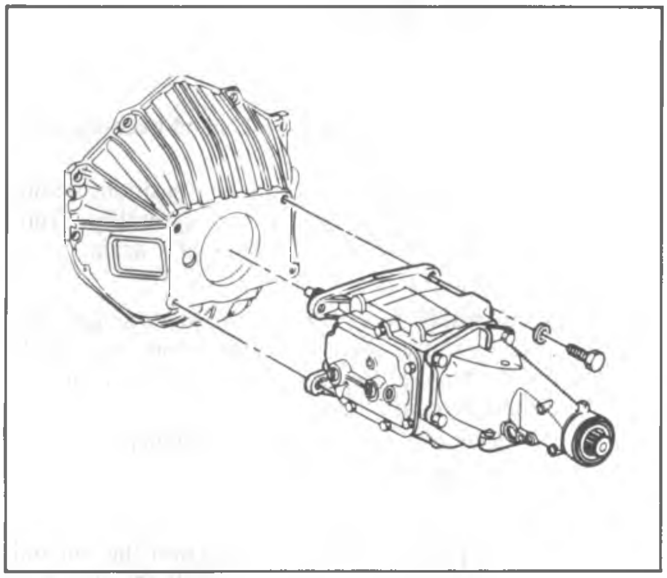


Fig. 7B1-1--Transmission To Engine Attachment

TRANSMISSION (Fig. 7B1-1)

Removal

1. Raise vehicle on suitable hoist and drain lubricant from transmission.
2. Disconnect speedometer cable.
3. Remove shift controls from transmission.
4. Disconnect parking brake lever and controls (when used) and back up lamp switch wire.
5. Disconnect propeller shaft from transmission as described in Section 4A.
6. Position a suitable dolly or jack under the vehicle and adjust to carry the weight of the transmission.
7. Visually inspect to determine if other equipment, lines or brackets must be removed to permit removal of the transmission. Remove crossmember.

   NOTICE: Be sure to support the clutch release bearing and support assembly during removal of the transmission main drive gear from the flywheel housing. This will prevent the release bearing from falling out of the flywheel housing when the transmission is removed.
8. Remove transmission-to-clutch housing mounting bolts.

   NOTICE: When removing the transmission, do not allow the weight of the transmission to hang on the clutch disc hub, as the disc may become distorted, seriously affecting clutch operation.
9. Move the transmission assembly straight away from the engine, using care to keep the transmission main drive gear shaft in alignment with the clutch disc hub. Refer to Fig. 7B1-1.
10. When the transmission is free from the engine, lower the transmission and move from under the vehicle.
11. If desired, a careful check of clutch components should be made after the transmission has been removed. If the clutch requires repair, refer to Section 7C before transmission is reinstalled in the vehicle.

Installation

1. Apply a light coating of high temperature grease to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly.

   NOTICE: Do not apply an excessive amount of grease in the above areas, as under normal operation this grease could be thrown onto clutch facing resulting in clutch problems.
2. Shift the transmission into high gear. Mount transmission on dolly or jack and move into position under the vehicle. Avoid springing the clutch when the transmission is being installed to the engine. Do not force the transmission into the clutch disc hub. Do not let the transmission hang unsupported in the splined portion of the clutch disc.
3. Align the transmission main drive gear shaft with the clutch disc hub by rotating the transmission companion flange or output yoke. Move the transmission forward, guiding the main drive gear shaft into the clutch disc splines.
4. Install transmission-to-clutch housing mounting

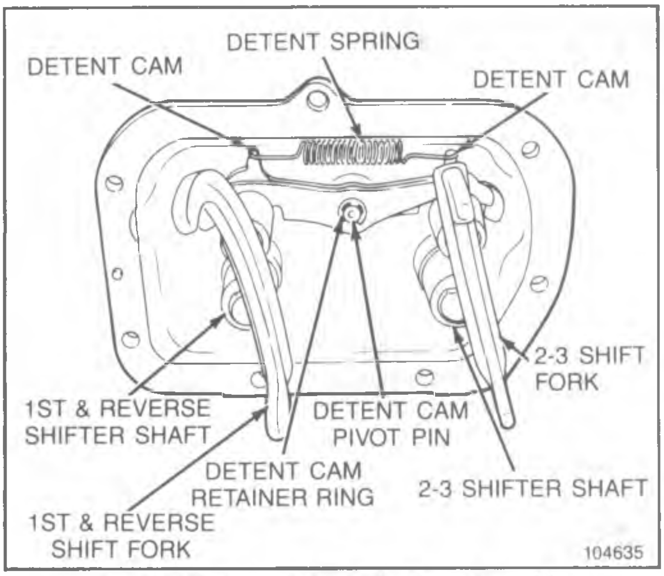


Fig. 7B1-2--Transmission Side Cover Assembly

bolts and washers. Tighten bolts to specifications.

5. Install crossmember.
6. Connect propeller shaft to transmission as described in Section 4A. Remove transmission jack.
7. Connect parking brake lever and control (if used). Adjust brakes as outlined in Section 5.
8. Reconnect speedometer cable at transmission.
9. Reinstall shift controls on transmission.
10. If other equipment (exhause pipe, support brackets, etc.) was removed, reinstall these parts.
11. Refill transmission with lubricant recommended in Section 0B of this manual.
12. If necessary, adjust clutch or transmission control linkage to achieve proper transmission operation.
13. Lower vehicle.

EXTENSION HOUSING OIL SEAL

Removal

1. Raise vehicle.
2. Drain lubricant from transmission.
3. Disconnect propeller shaft from transmission as described in Section 4A.
4. Pry seal out of extension housing.

Installation

1. Coat outer diameter of new oil seal with sealing cement. Install new oil seal using extension housing oil seal installer (J-21426 or J-21359).
2. Reconnect propeller shaft to transmission as described in Section 4A.
3. Refill transmission with lubricant recommended in Section 0B.
4. Lower vehicle.

SPEEDOMETER DRIVEN GEAR

Removal

1. Raise vehicle.
2. Disconnect speedometer cable, then remove lock plate to housing bolt and lock washer and remove lock plate. Insert screw driver in lock plate slot in fitting and pry fitting, gear and shaft from housing. Pry "O" ring from groove in fitting.

Installation

1. Install new "O" ring in groove in fitting, coat "O" ring and driven gear shaft with transmission lubricant and insert shaft.
2. Hold the assembly so slot in fitting is toward lock plate boss on housing and install in housing. Push fitting into housing until lock plate can be inserted in groove and attached to housing. Connect speedometer cable.
3. Lower vehicle.

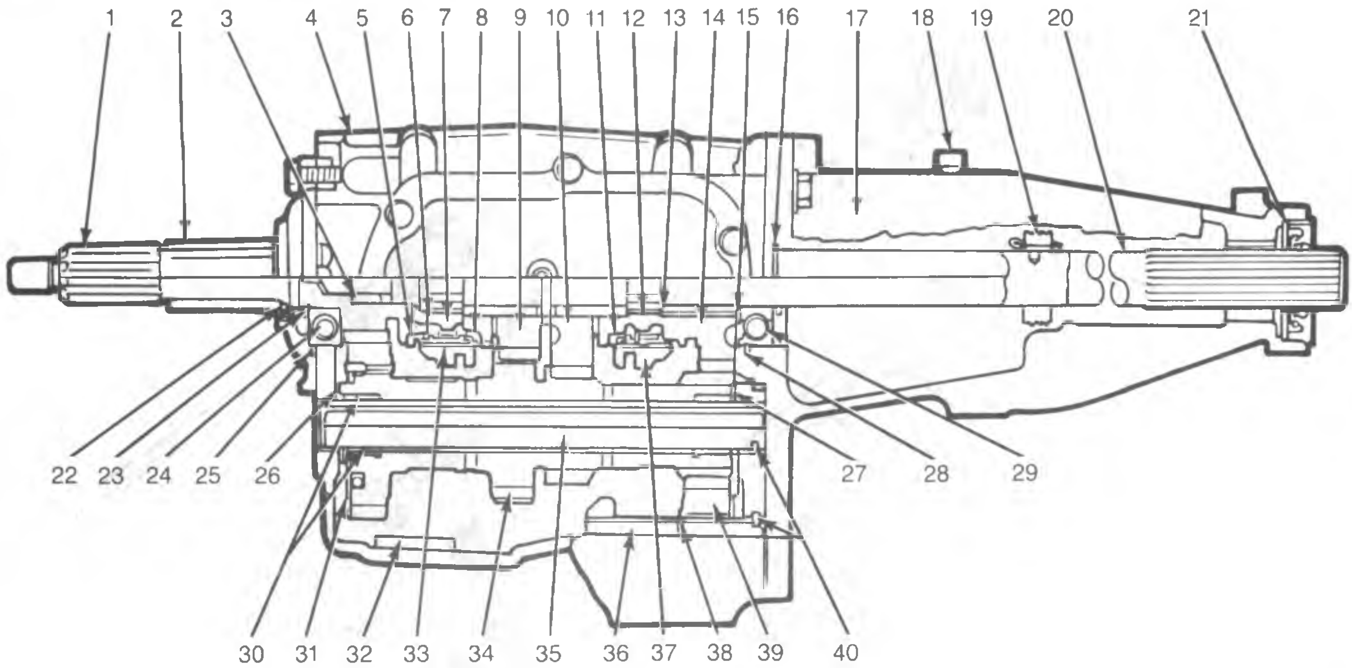
SIDE COVER (Fig. 7B1-2)

Removal

1. Raise vehicle.
2. Disconnect control rods from levers and back-up lamp wiring.
3. Shift transmission into neutral detent positions before removing cover. Remove cover assembly from transmission case carefully and allow oil to drain.
4. Remove the outer shifter levers.
5. Remove both shift forks from shifter shaft assemblies. Remove both shifter shaft assemblies from cover. Seals around shifter shaft may now be pried out if replacement is required because of damage.
6. Remove detent cam spring and pivot retainer "C" ring. Remove both detent cams.

Installation

1. With detent spring tang projecting up over the 2nd and 3rd shifter shaft cover opening, install the first and reverse detent cam onto the detent cam pivot pin. With the detent spring tang projecting up over the first and reverse shifter shaft cover hole install the 2nd and 3rd detent cam.
2. Install detent cam retaining "C" ring to pivot shaft, and hook spring into detent cam notches.
3. Install both shift shaft assemblies in cover being careful not to damage seals. Install both shift forks to shifter shaft assemblies, lifting up on detent cam to allow forks to fully seat into position.
4. Install outer shifter levers, flat washers, lock washers and bolts.
5. Shift shifter levers into neutral detent (center) position and slide cover into place making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves.
6. Install cover attaching bolts and tighten evenly to specified torque, then connect wiring.
7. Remove filler plug and add lubricant specified in Section 0B to level of filler plug hole.
8. Lower vehicle.



1. CLUTCH GEAR
2. BEARING RETAINER
3. PILOT BEARINGS
4. CASE
5. 3RD SPEED BLOCKER RING
6. 2-3 SYNCH. SNAP RING
7. 2-3 SYNCH. HUB
8. 2ND SPEED BLOCKER RING
9. 2ND SPEED GEAR
10. 1ST SPEED GEAR
11. 1ST SPEED BLOCKER RING
12. 1ST SPEED SYNCH. HUB
13. 1ST SPEED SYNCH. SNAP RING
14. REVERSE GEAR
15. REVERSE GEAR THRUST AND SPRING WASHERS
16. SNAP RING — BEARING TO MAINSHAFT
17. EXTENSION
18. VENT
19. SPEEDOMETER DRIVE GEAR AND CLIP
20. MAINSHAFT
21. REAR OIL SEAL
22. RETAINER OIL SEAL
23. SNAP RING — BEARING TO GEAR
24. CLUTCH GEAR BEARING
25. SNAP RING — BEARING TO CASE
26. THRUST WASHER — FRONT
27. THRUST WASHER — REAR
28. SNAP RING — BEARING TO EXTENSION
29. REAR BEARING
30. COUNTERGEAR ROLLER BEARINGS
31. ANTI-LASH PLATE ASSEMBLY
32. MAGNET
33. 2-3 SYNCH. SLEEVE
34. COUNTERGEAR
35. COUNTER SHAFT
36. REVERSE IDLER SHAFT
37. 1ST SPEED SYNCH. SLEEVE
38. "E " RING
39. REVERSE IDLER GEAR
40. WOODRUFF KEY

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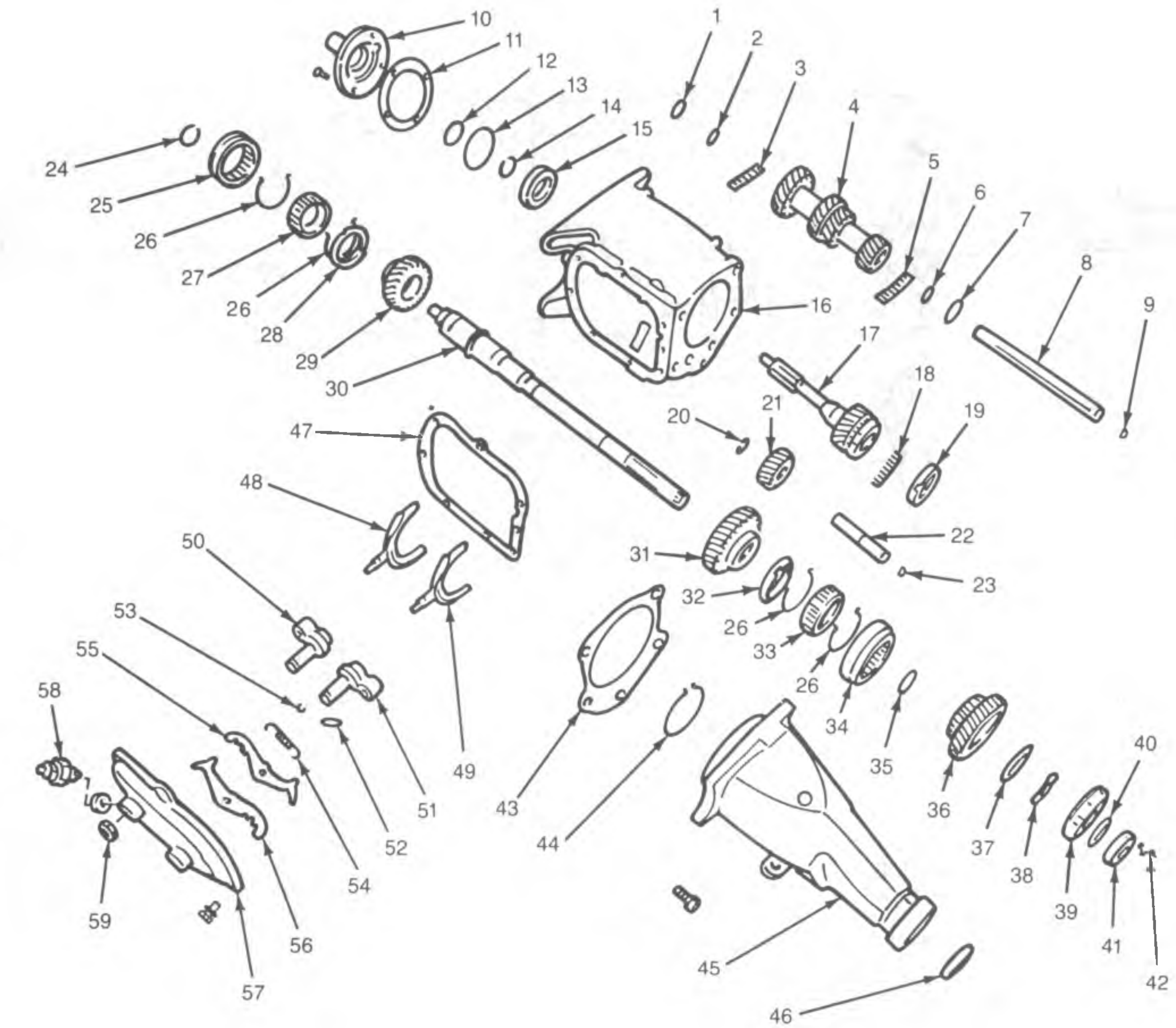
Fig. 7B1-3--3 Speed 76mm Cross Section



1. THRUST WASHER — FRONT
2. BEARING WASHER
3. NEEDLE BEARINGS
4. COUNTERGEAR
5. NEEDLE BEARINGS
6. BEARING WASHER
7. THRUST WASHER — REAR
8. COUNTER SHAFT
9. WOODRUFF KEY
10. BEARING RETAINER
11. GASKET
12. OIL SEAL
13. SNAP RING — BEARING TO CASE
14. SNAP RING — BEARING TO GEAR
15. DRIVE GEAR BEARING
16. CASE
17. DRIVE GEAR
18. PILOT BEARINGS
19. 3RD SPEED BLOCKER RING
20. "E" RING
21. REVERSE IDLER GEAR
22. REVERSE IDLER SHAFT
23. WOODRUFF KEY
24. SNAP RING — HUB TO SHAFT
25. 2-3 SYNCHRONIZER SLEEVE
26. SYNCHRONIZER KEY SPRING
27. 2-3 SYNCHRONIZER HUB ASSEMBLY
28. 2ND SPEED BLOCKER RING
29. 2ND SPEED GEAR
30. MAINSHAFT
31. 1ST SPEED GEAR
32. 1ST SPEED BLOCKER RING
33. 1-2 SYNCHRONIZER HUB ASSEMBLY
34. 1-2 SYNCHRONIZER SLEEVE
35. SNAP RING — HUB TO SHAFT
36. REVERSE GEAR
37. THRUST WASHER
38. SPRING WASHER
39. REAR BEARING
40. SNAP RING — BEARING TO SHAFT
41. SPEEDOMETER DRIVE GEAR
42. RETAINING CLIP
43. GASKET
44. SNAP RING — REAR BEARING TO EXTENSION
45. EXTENSION
46. OIL SEAL
47. GASKET
48. 2-3 SHIFT FORK
49. 1ST AND REVERSE SHIFT FORK
50. 2-3 SHIFTER SHAFT ASSEMBLY
51. 1ST AND REVERSE SHIFTER SHAFT ASSEMBLY
52. "O" RING SEAL
53. "E" RING
54. SPRING
55. 2ND AND 3RD DETENT CAM
56. 1ST AND REVERSE DETENT CAM
57. SIDE COVER
58. TCS SWITCH AND GASKET
59. LIP SEAL

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Fig. 7B1-4--3-Speed 76mm Exploded View

UNIT REPAIR

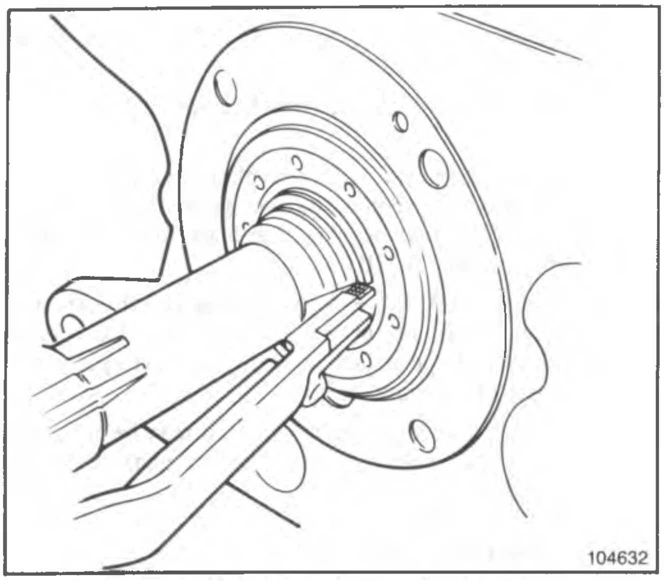


Fig. 7B-5--Clutch Gear Bearing Retaining Ring

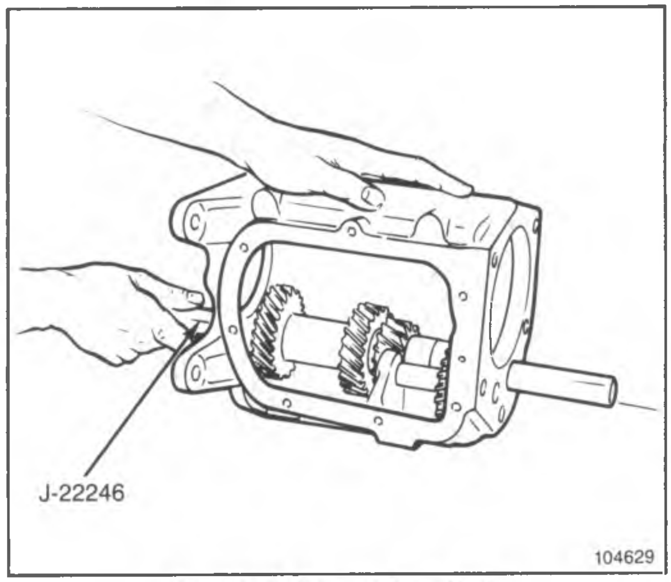


Fig. 7B1-8--Counter Gear Shaft

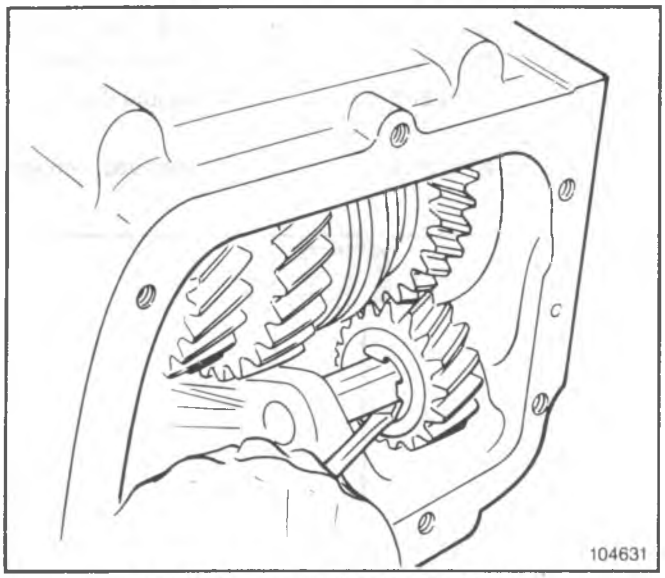


Fig. 7B1-6--Reverse Idler Shaft "E" Ring

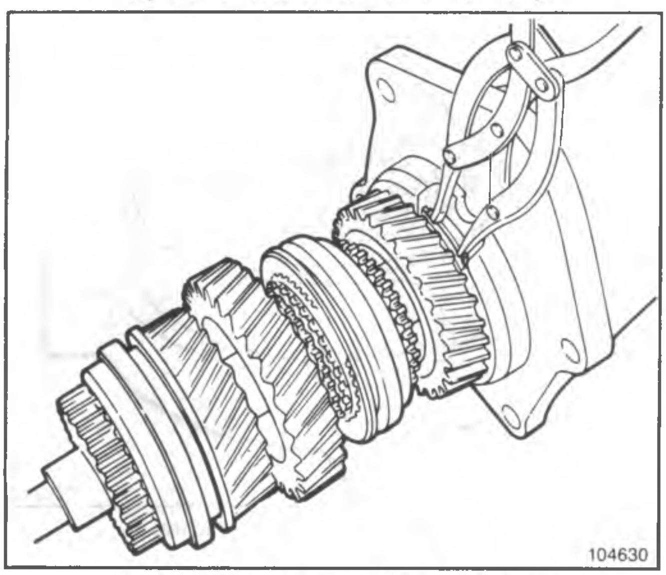


Fig. 7B1-7--Rear Extension From Main Shaft

TRANSMISSION

Disassembly (Fig. 7B1-4)

1. Remove side cover attaching bolts and side cover assembly.
2. Remove drive gear bearing retainer and gasket.
3. Remove drive gear bearing-to-gear stem snap ring, then remove clutch gear bearing by pulling outward on clutch gear until a screwdriver or other suitable tool can be inserted between bearing large snap ring and case to complete removal (Fig. 7B1-5). The clutch gear bearing is a slip fit on the gear and into the case bore. (This provides clearance for removal of clutch gear and mainshaft assembly).
4. Remove speedometer driven gear from extension.
5. Remove extension to case attaching bolts.
6. Remove the reverse idler shaft "E" ring (Fig. 7B1-6).
7. Remove drive gear, mainshaft and extension assembly together through the rear case opening. Remove drive gear, needle bearings and synchronizer ring from mainshaft assembly.

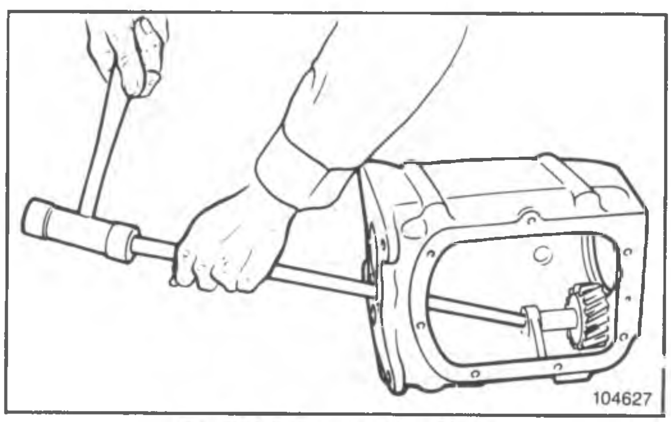


Fig. 7B1-9--Reverse Idler Shaft

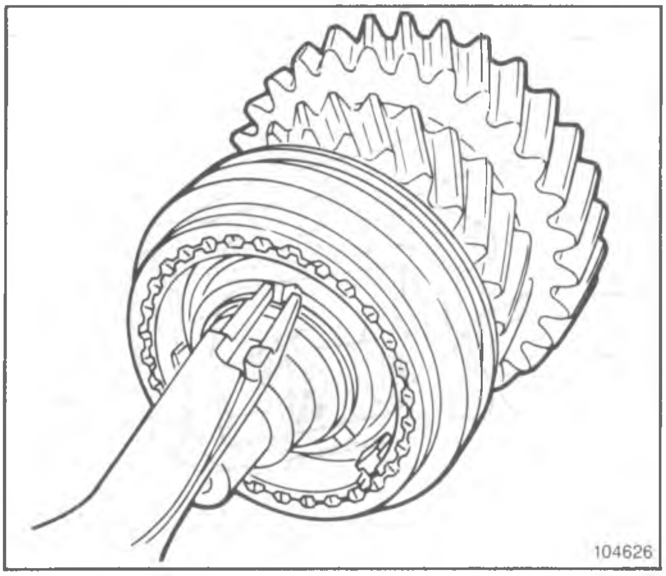


Fig. 7B1-10--2nd-3rd Clutch Hub Retaining Ring

8. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B1-7) and remove the extension.
9. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case (Fig. 7B1-8). Tool J-22246 will now hold the roller bearings in position within the countergear bore. Remove the gear, bearings and thrust washers.
10. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (Fig. 7B1-9).

MAINSHAFT

Disassembly

1. Using snap ring pliers, remove the 2nd and 3rd speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, second speed blocker ring and second speed gear from front of mainshaft. See Fig. 7B1-10.

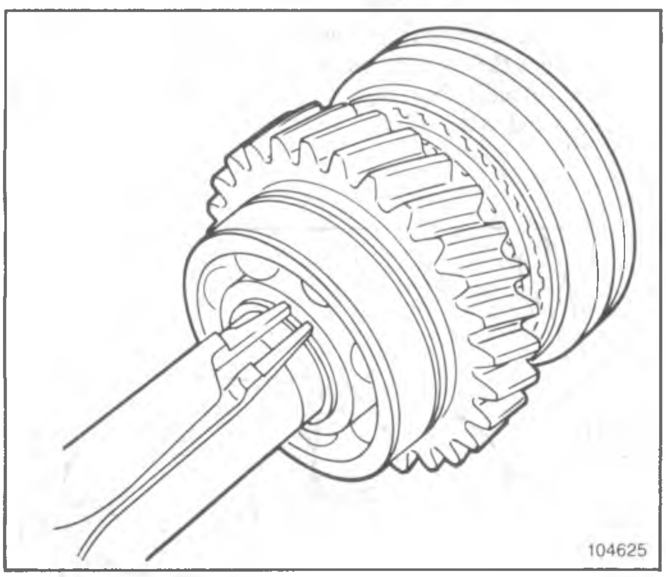


Fig. 7B1-11--Rear Bearing Retaining Ring

2. Depress speedometer retaining clip and slide or tap gear from mainshaft.
3. Remove rear bearing snap ring from mainshaft groove. See Fig. 7B1-11.
4. Support reverse gear with press plates and press on rear of mainshaft to remove reverse gear, thrust washer, spring washer, rear bearing, and snap ring from rear of mainshaft. See Fig. 7B1-12.
5. Remove the 1st and Reverse sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 1st speed blocker ring and first speed gear from rear of the mainshaft.

   Under certain tolerance conditions, it may be necessary to press the synchronizer hub and gear from the mainshaft.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.
3. Check bearing bores in case and, if damaged, replace case.

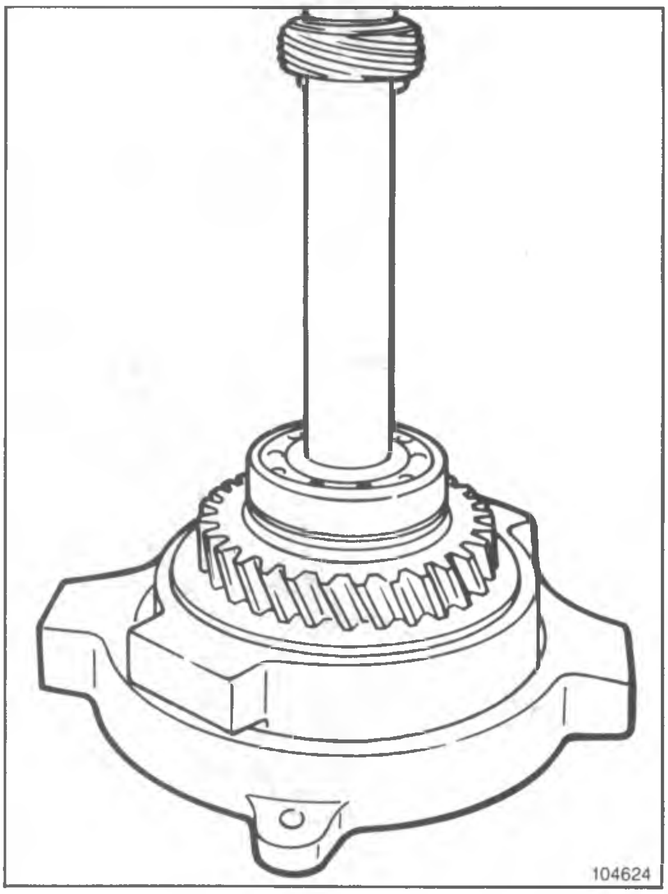


Fig. 7B1-12--Rear Bearing From Mainshaft

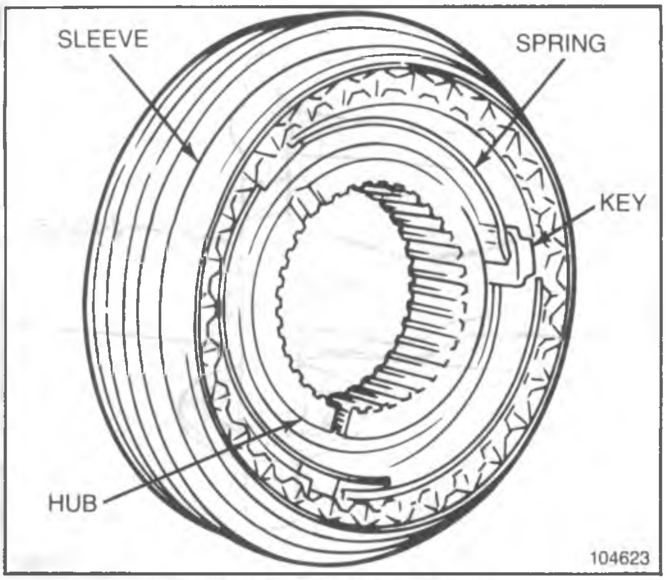


Fig. 7B1-13--Synchronizer Assembly

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

   NOTICE: Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings may damage the race and balls.
3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

Bearing Rollers

All clutch gear and counter gear bearing rollers should be inspected closely and replace if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Inspect reverse gear bushing and if worn or damaged, replace the entire gear. Reverse gear bushing is not serviced separately.
3. Check both clutch sleeves to see that they slide freely on their hubs.

Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finished bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

REPAIRS

Clutch Keys and Springs

Replacement

The clutch hubs and sliding sleeves are a selected assembly and should be kept together as orignally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so that they they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub) so all three keys are engaged by both springs (Fig. 7B1-13). The tanged end of each synchronizer spring should be installed into different key cavities on either side. Slide the sleeve onto the hub aligning the marks made before disassembly.

   A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a greater recess depth.

Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-21465-15 or J-23062-14 to drive bushing into extension housing (Fig. 7B1-14). Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J-21426 or J-21359 (Fig. 7B1-15).

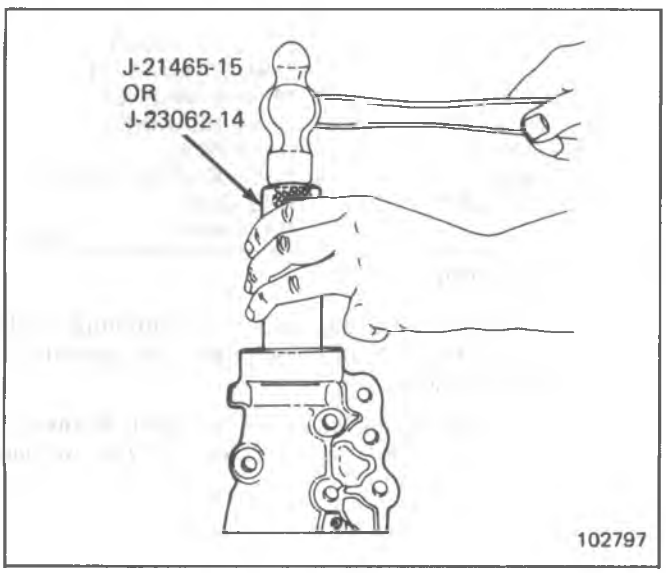


Fig. 7B1-14--Removing/Installing Rear Extension Bushing

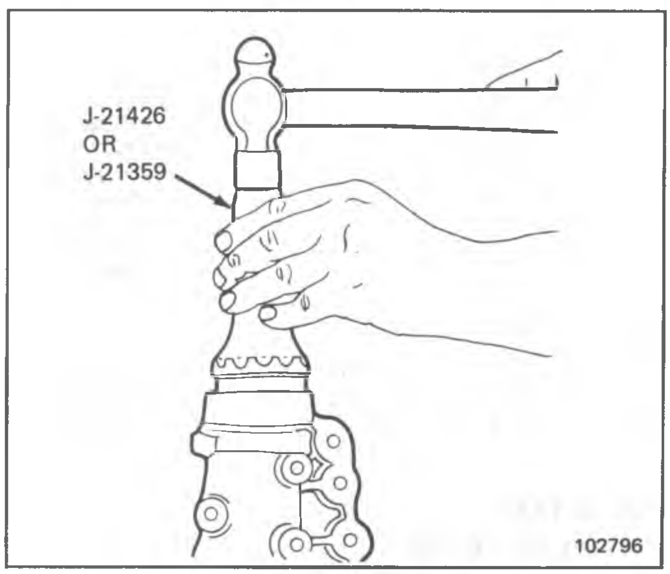


Fig. 7B1-15--Rear Extension Seal

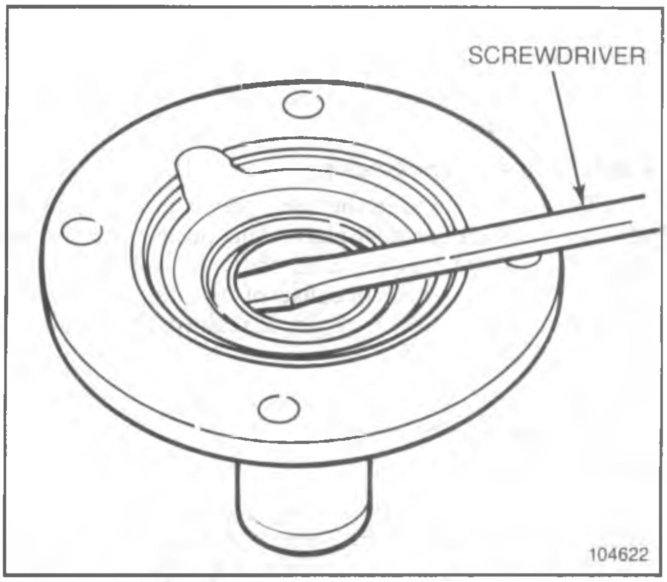


Fig. 7B1-16--Drive Gear Bearing Retainer Seal

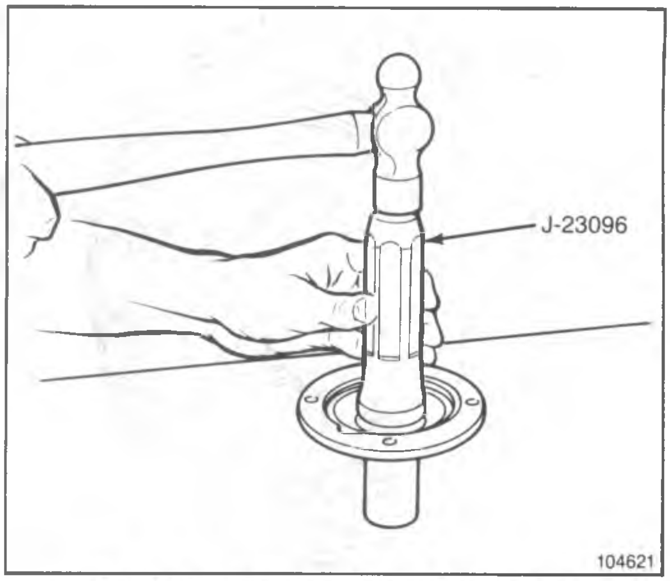
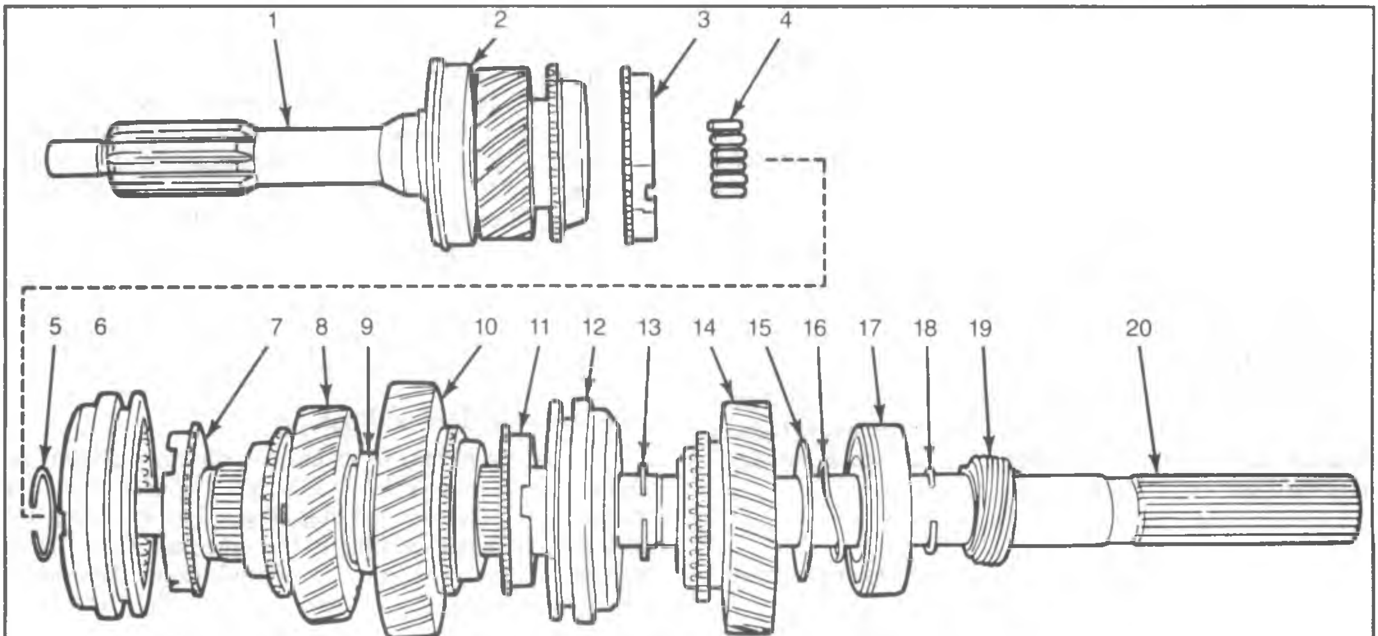


Fig. 7B1-17--Drive Gear Bearing Retainer Seal



1. DRIVE GEAR
2. DRIVE GEAR BEARING
3. 3RD SPEED BLOCKER RING
4. MAINSHAFT PILOT BEARINGS (14)
5. SNAP RING
6. 2-3 SYNCHRONIZER ASSEMBLY
7. 2ND SPEED BLOCKER RING
8. 2ND SPEED GEAR
9. SHOULDER (PART OF MAIN SHAFT)
10. 1ST SPEED GEAR
11. 1ST SPEED BLOCKER RING
12. 1ST SPEED SYNCHRONIZER ASSEMBLY
13. SNAP RING
14. REVERSE GEAR
15. REVERSE GEAR THRUST WASHER
16. SPRING WASHER
17. REAR BEARING
18. SNAP RING
19. SPEEDO DRIVE GEAR AND CLIP
20. MAINSHAFT

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Fig. 7B1-18--Drive Gear And Mainshaft Assembly

Drive Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement; pry the old seal out (Fig. 7B1-16) and replace with a new seal using Installer Tool J-23096, or similar tool, until seal seats in its bore (Fig. 7B1-17).

MAINSHAFT

Assembly (Fig. 7B1-18)

Turn the front of the mainshaft upward. Install the following components of the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second

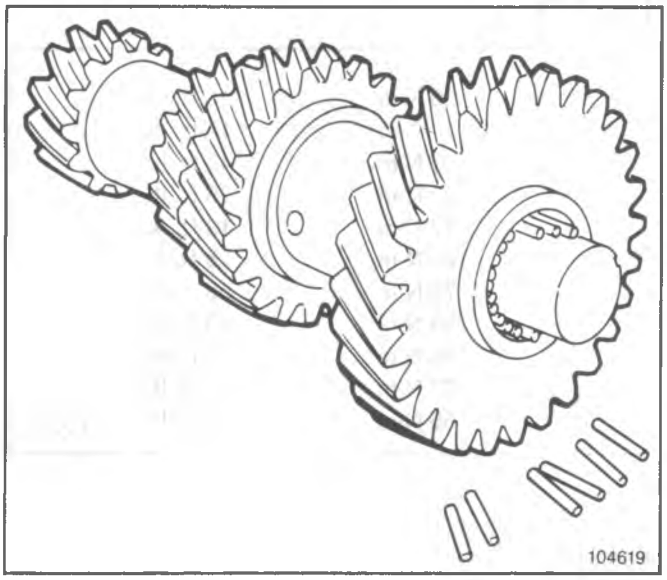

Fig. 7B1-19--Loading Countergear

speed gear. All three blocker rings used in this transmission are identical.

3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies used in this transmission are identical. (If sleeve becomes removed from 2-3 hub; notches on hub O.D. face forward end of mainshaft). Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.
4. Install snap ring retaining synchronizer hub to mainshaft. Both synchronizer snap rings are identical. Turn the rear of the mainshaft upward. Install the following components on the mainshaft.
5. Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.
7. Install the first and reverse synchronizer assembly with fork slot downward; push it onto splines on the mainshaft.
8. Install synchronizer hub to mainshaft snap ring. Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.
9. Install reverse gear with clutching teeth downward.
10. Install reverse gear thrust washer (steel).
11. Install reverse gear spring washer.
12. Install rear ball bearing with snap ring slot downward; press onto mainshaft.
13. Install rear bearing to mainshaft snap ring.
14. Install speedometer drive gear and retaining clip.

TRANSMISSION (Fig. 7B1-4)

Assembly

1. Using Tool J-22246 load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (Fig. 7B1-19).
2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case. Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.
3. Install reverse idler gear and shaft with its woodruff key from the rear of case. Do not install idler shaft "E" ring yet.
4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove (Fig. 7B1-7).
5. Load the mainshaft pilot bearing (14) into the clutch gear cavity and assemble the 3rd speed blocker ring onto the clutch gear clutching surface with its teeth toward the gear.
6. Pilot the clutch gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet. Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.
7. Place extension to case gasket at rear of case holding in place with grease and, from the rear of case, assemble the clutch gear, mainshaft and extension to case as an assembly.
8. Install extension to case retaining bolts.
9. Install front bearing outer snap ring to bearing and position bearing over stem of clutch gear and into front case bore.
10. Install snap ring to clutch gear stem, and clutch gear bearing retainer and gasket to case. The retainer oil return hole should be at the bottom.
11. Install reverse idler gear retainer "E" ring to shaft.
12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.
13. Install speedometer driven gear in extension.
14. Tighten all bolts to specified torque.
15. Rotate clutch gear shaft and shift transmission to free rotation in all gears.

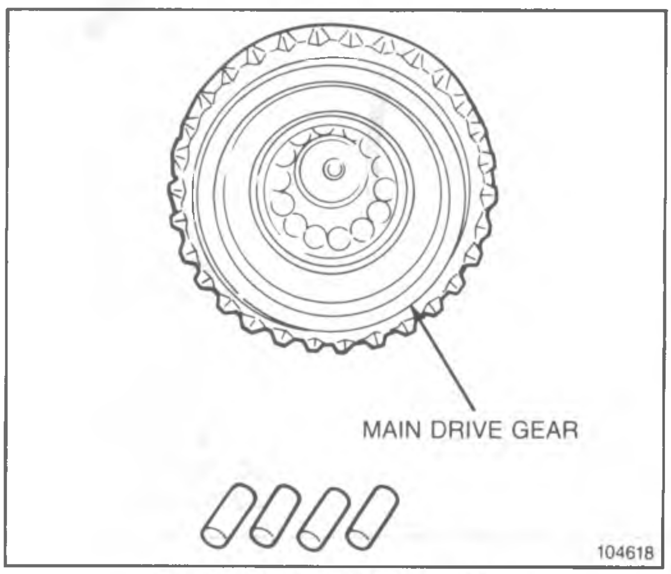

Fig. 7B1-20--Loading Pilot Bearings

SPECIFICATIONS

Drive Gear Retainer to Case Bolts	20 N·m	15 ft. lb.
Side Cover to Case Bolts	20 N·m	15 ft. lb.
Extension to Case Bolts	61 N·m	45 ft. lb.
Shift Lever to Shifter Shaft Bolts	32 N·m	25 ft. lb.
Lubrication Filler Plug	17 N·m	13 ft. lb.
Transmission Case to Clutch Housing Bolts	101 N·m	75 ft. lb.
Crossmember to Frame Bolts	75 N·m	55 ft. lb.
Crossmember to Mount Bolts	54 N·m	40 ft. lb.
2-3 Cross Over Shaft Bracket Retaining Nut	24 N·m	18 ft. lb.
1 — Rev. Swivel Attaching Bolts	27 N·m	20 ft. lb.
Mount to Transmission Bolt	55 N·m	40 ft. lb.

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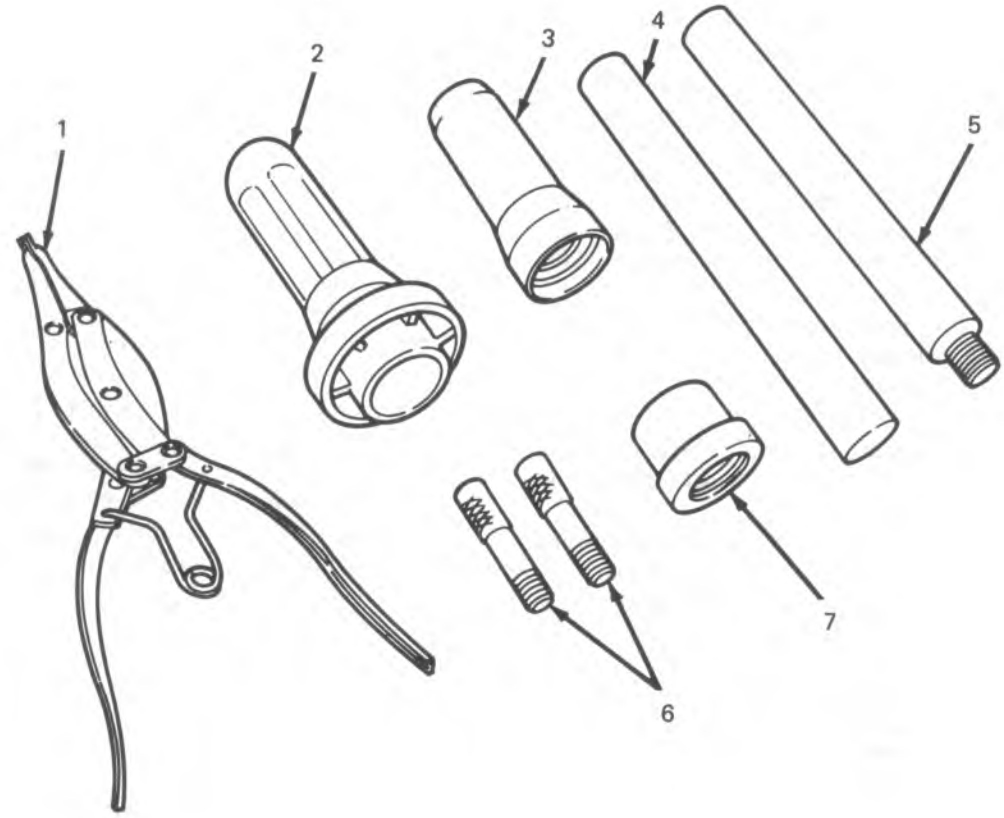
SPECIAL TOOLS



1. J-8059 Snap Ring Pliers
2. J-21426 Rear Extension Seal Installer
   J-21359
3. J-23096 Drive Gear Brg. Retainer Seal Installer
4. J-22246 Countergear Loading Tool
5. J-8092 Driver Handle
6. J-1126 Transmission Guide Pins
7. J-21465-15 Extension Bushing Remover and Installer
   J-23062-14

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SECTION 7B
4-SPEED 89MM TRANSMISSION

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ON VEHICLE SERVICE

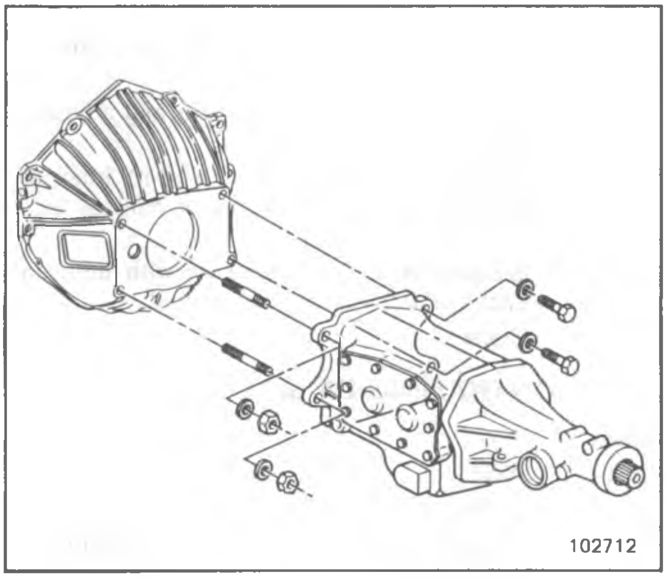


Fig. 7B3-1--Transmission To Engine Attachment

TRANSMISSION (Fig. 7B3-1)

Removal (Except K Series)

1. Raise vehicle on suitable hoist and drain lubricant from transmission.
2. Disconnect speedometer cable.
3. Remove shift controls from transmission.
4. Disconnect back up lamp switch wire.
5. Disconnect propeller shaft from transmission as described in Section 4A.
6. Position a suitable dolly or jack under the vehicle and adjust to carry the weight of the transmission.
7. Visually inspect to determine if other equipment, lines or brackets must be removed to permit removal of the transmission. Remove crossmember.

   NOTICE: Be sure to support the clutch release bearing and support assembly during removal of the transmission main drive gear from the flywheel housing. This will prevent the release bearing from falling out of the flywheel housing when the transmission is removed.
8. Remove transmission-to-clutch housing mounting bolts.

   NOTICE: When removing the transmission, do not allow the weight of the transmission to hand on the clutch disc hub, as the disc may become distorted, seriously affecting clutch operation.
9. Move the transmission assembly straight away from the engine, using care to keep the transmission main drive gear shaft in alignment with the clutch disc hub. Refer to Fig. 7B3-1.
10. When the transmission is free from the engine, lower the transmission and move from under the vehicle.
11. If desired, a careful check of clutch components should be made after the transmission has been removed. If the clutch requires repair, refer to Section 7C before transmission is reinstalled in the vehicle.

Installation

1. Apply a light coating of high temperature grease to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly.

   NOTICE: Do not apply an excessive amount of grease in the above areas, as under normal operation this grease could be thrown onto clutch facing resulting in clutch problems.
2. Shift the transmission into high gear. Mount transmission on dolly or jack and move into position under the vehicle. Avoid springing the clutch when the transmission is being installed to the engine. Do not force the transmission into the clutch disc hub. Do not let the transmission hang unsupported in the splined portion of the clutch disc.
3. Align the transmission main drive gear shaft with the clutch disc hub by rotating the transmission companion flange or output yoke. Move the transmission forward, guiding the main drive gear shaft into the clutch disc splines.

4. Install transmission-to-clutch housing mounting bolts and washers. Tighten bolts to specifications.
5. Install crossmember.
6. Connect propeller shaft to transmission as described in Section 4A. Remove transmission jack.
7. Connect back up lamp switch wire.
8. Reconnect speedometer cable at transmission.
9. Reinstall shift controls on transmission.
10. If other equipment (exhaust pipe, support brackets, etc.) was removed, reinstall these parts.
11. Refill transmission with lubricant recommended in Section 0B of this manual.
12. If necessary, adjust clutch or transmission control linkage to achieve proper transmission operation.
13. Lower vehicle.

Removal (K-Series)

1. Raise vehicle on hoist.
2. Drain transfer case and transmission. Disconnect the speedometer cable.
3. Disconnect propeller shaft front and rear U-joint yokes at case, and tie up out of way.
4. Disconnect transfer case shift lever at transfer case.
5. Support transfer case in a suitable cradle. Remove bolts attaching transfer case to adapter, and remove the transfer case.
6. Disconnect shift control rods from the shifter levers at the transmission.
7. Support rear portion of engine. Remove two (2) adapter mount bolts.
8. Visually inspect to determine if other equipment, lines or brackets must be removed to permit removal of the transmission. Remove crossmember.
9. Remove the 2 top transmission to clutch housing cap screws and insert 2 transmission guide pins, Tool J-2216 in these holds.
10. Remove the 2 lower transmission-to-clutch housing cap screws.
11. Slide the transmission and adapter assembly straight back on guide pins until the clutch gear is free of splines in the clutch disc. The use of the 2 guide pins during this operation will support the transmission and prevent damage to the clutch disc through springing.
12. Remove the transmission and adapter as an assembly from under the body.
13. Remove adapter from transmission.

Installation (K-Series)

1. Apply a light coating of high temperature grease to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly.

   NOTICE: Do not apply an excessive amount of grease in the above areas, as under normal operation, this grease could be thrown onto clutch facings, resulting in clutch problems.
2. Shift the transmission into high gear. Mount transmission on dolly or jack and move into position under the vehicle. Avoid springing the clutch when the transmission is being installed to the engine. Do not force the transmission into the clutch disc hub. Do not let the transmission hang unsupported in the splined portion of the clutch disc.
3. Align the transmission main drive gear shaft with the clutch disc hub by rotating the transmission companion flange or output yoke. Move the transmission forward, guiding the main drive gear shaft into the clutch disc splines.
4. Install transmission-to-clutch housing mounting bolts and washers. Tighten bolts to specifications.
5. Install crossmember and torque bolts to specifications. Install transmission mount bolts and torque to specifications.
6. Support transfer case in a suitable cradle and move into position under the vehicle. Align transfer case to adapter plate and install attaching bolts. Torque bolts to specifications.
7. Connect propeller shaft to transmission as described in Section 4A.
8. Connect speedometer cable.
9. Reinstall shift control at transfer case and adjust as outlined in Section 7E.
10. Reinstall shift controls at transmission and adjust as previously outlined in this section.
11. If other equipment (exhaust pipe, support brackets, parking brake cable, etc.) was removed, reinstall these parts.
12. Refill transmission and transfer case with lubricant recommended in Section 0B of this manual.
13. Lower vehicle.

EXTENSION HOUSING OIL SEAL

Removal

1. Raise vehicle.
2. Drain lubricant from transmission.
3. Disconnect propeller shaft from transmission as described in Section 4A.
4. Remove slip joint yoke from rear of transmission mainshaft.
5. Pry seal out of extension housing.

Installation

1. Coat outer diameter of new oil seal with sealing cement. Install new oil seal using extension housing oil seal installer (J-21426).
2. Install slip joint yoke on rear of transmission mainshaft.
3. Reconnect propeller shaft to transmission as described in Section 4A.
4. Refill transmission with lubricant recommended in Section 0B.
5. Lower vehicle.

SPEEDOMETER DRIVEN GEAR

Removal

1. Raise vehicle.
2. Disconnect speedometer cable, then remove lock plate to housing bolt and lock washer and remove lock

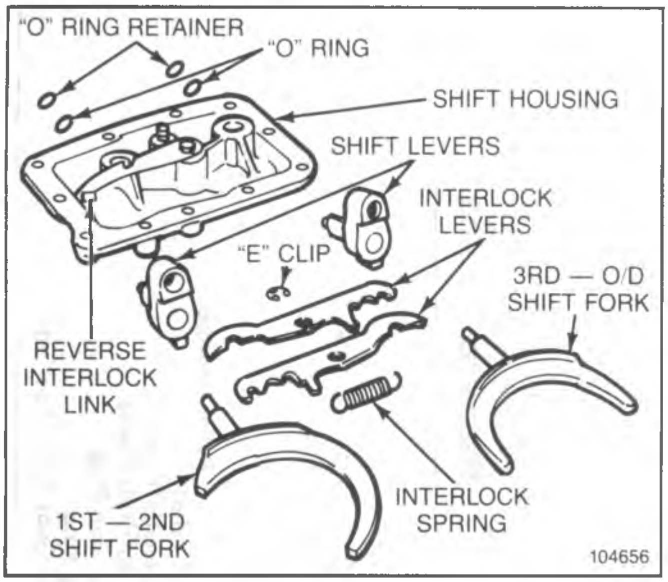


Fig. 7B3-2--Transmission Side Cover Assembly

plate. Insert screw driver in lock plate slot in fitting and pry fitting, gear and shaft from housing. Pry "O" ring from groove in fitting.

Installation

1. Install new "O" ring in groove in fitting, coat "O" ring and driven gear shaft with transmission lubricant and insert shaft.
2. Hold the assembly so slot in fitting is toward lock plate boss on housing and install in housing. Push fitting into housing until lock plate can be inserted in groove and attached to housing. Connect speedometer cable.
3. Lower vehicle.

SIDE COVER (FIG 7B2-3)

Removal

1. Raise vehicle.
2. Disconnect control rods from levers and shift the transmission levers into neutral position.
3. Remove reverse shift lever, side cover bolts, side cover and shift forks. Remove cover assembly from transmission case carefully as the reverse detent spring and ball will fall out when the cover is removed.
4. Remove nuts attaching shift levers to the shaft. Disengage levers from flats on shafts and remove. Makes sure shafts are free of burrs before removal, otherwise the bores may be scored resulting in leakage.
5. Pull gearshift lever shafts out of cover.
6. Remove "O" ring retainers and "O" rings from housing.
7. Remove "E" ring from interlock lever pivot pin and remove interlock levers and spring from cover.

Installation

1. Install interlock levers on pivot pin and fasten with "E" ring. Use pliers to install spring on interlock lever hangers.
2. Grease housing bores and push each shaft into its proper bore followed by greased "O" ring and retainer.
3. Install shift levers and torque retaining nuts to specifications. Be sure 3rd-O/D operating lever points downward.
4. Install new side cover gasket on case using grease to retain it. Install reverse detent ball followed by the spring into its bore.
5. Install the side cover onto case guiding the 3rd-O/D shift fork into its synchronizer groove, then lead the shaft of the 1-2 shift fork into its bore in the side cover. Hold the reverse interlock link against the 1-2 shift lever to provide clearance for the side cover. To seat the side cover, use a screwdriver and raise the interlock lever against its spring tension to allow the 1-2 shift fork to slip under the levers. Be sure the reverse detent spring is positioned in the cover bore.
6. Install side cover bolts finger tight and shift through all gears to insure proper operation. Tighten cover bolts evenly and torque to specifications.
7. Connect control rods to transmission shift levers and adjust if necessary.
8. Remove filler plug and add lubricant specified in Section 0B to level of filler plug hole. Reinstall filer plug.
9. Lower vehicle.

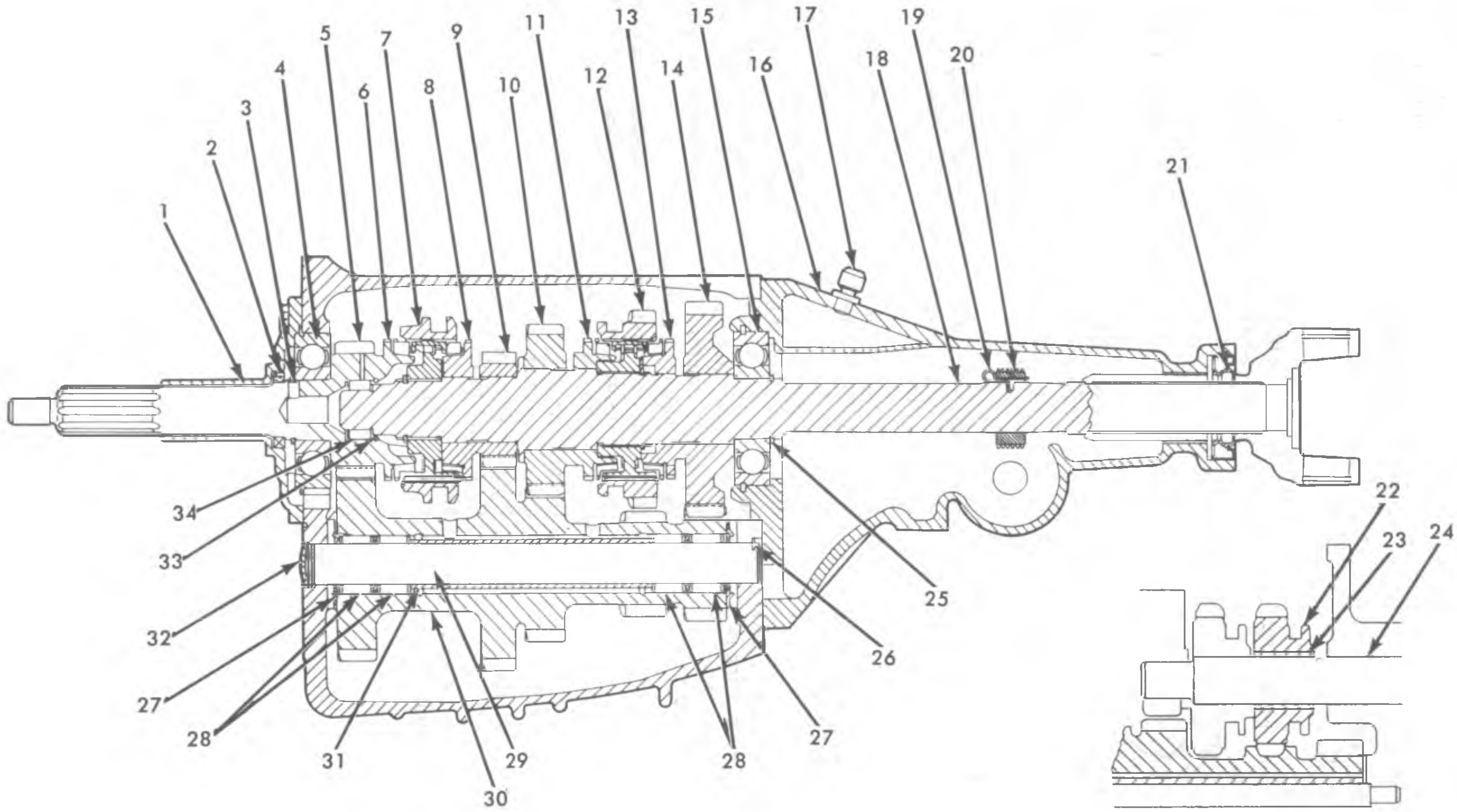


Fig. 7B3-3-4-Speed, 89mm, Cross-Section

1. Drive Gear Bearing Retainer
2. Seal
3. Snap Ring
4. Drive Gear Bearing
5. Drive Gear
6. Stop Ring
7. 3rd & O/D Speed Clutch Assy
8. Stop Ring
9. Overdrive Gear
10. Second Gear
11. Stop Ring
12. 1st & 2nd Speed Clutch Assy
13. Stop Ring
14. First Gear
15. Rear Main Bearing
16. Extension Housing
17. Vent Plug
18. Mainshaft
19. Retainer Clip
20. Speedometer Gear
21. Rear Oil Seal
22. Reverse Idler Gear
23. Reverse Idler Gear Bushing
24. Reverse Idler Shaft
25. Snap Ring
26. Woodruff Key
27. Thrust Washer
28. Countershaft Roller Bearings
29. Countershaft
30. Countershaft Gear
31. Countershaft Sleeve
32. Expansion Plug
33. Snap Ring
34. Drive Gear Roller Bearings

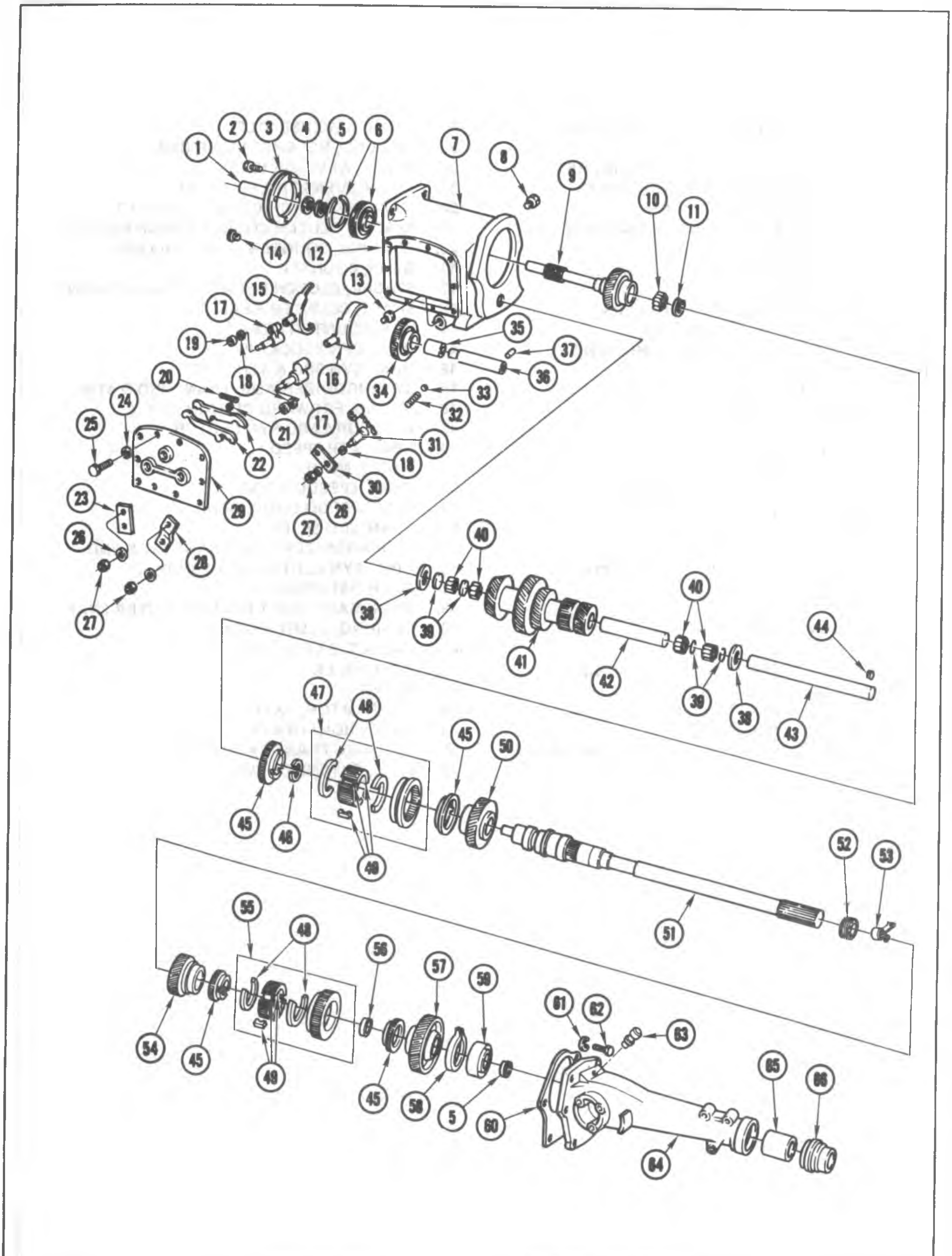


Fig. 7B3-4--4-Speed, 89mm, Exploded View

1. RETAINER, CLUTCH GEAR BEARING
2. BOLT
3. GASKET, CLUTCH GEAR BEARING RETAINER
4. SEAL, CLUTCH GEAR BEARING OIL
5. RING, MAIN DRIVE GEAR SNAP
6. BEARING, W/SNAP RING, MAIN DRIVE GEAR
7. CASE, TRANS
8. PLUG, SQ HD, FILLER
9. GEAR, CLUTCH
10. BEARING, MAINSHAFT ROLLERS
11. RING, PILOT BEARING SNAP
12. GASKET, CONTROL LEVER HOUSING
13. PLUG, DRAIN
14. PLUG, EXPANSION
15. FORK, SHIFT 3RD & 4TH
16. FORK, SHIFT 1ST & 2ND
17. SHAFT, FORWARD SHIFT
18. RING, "O" SHIFT SHAFT SEAL
19. RETAINER, SHIFT SHAFT SEAL
20. SPRING, DETENT
21. RING, "E"
22. CAM, DETENT
23. LEVER, CONTROL SHIFT 3RD & 4TH
24. WASHER, LK
25. BOLT
26. WASHER, FLAT
27. NUT
28. LEVER, CONTROL SHIFT 1ST & 2ND
29. COVER, TRANS
30. LEVER, REVERSE SHIFT
31. SHAFT, REVERSE SHIFT
32. SPRING, REVERSE SHIFT SHAFT DETENT BALL
33. BALL, STEEL
34. GEAR, REVERSE IDLER
35. BUSHING, REVERSE IDLER GEAR
36. SHAFT, REVERSE IDLER
37. KEY, REVERSE IDLER SHAFT
38. WASHER, CLUTCH COUNTER GEAR THRUST
39. SPACER, CLUTCH COUNTER GEAR BEARING
40. BEARING, COUNTER GEAR ROLLERS
41. GEAR, COUNTER
42. SPACER, CLUTCH COUNTER GEAR BEARING
43. SHAFT, COUNTER GEAR
44. KEY, COUNTER GEAR
45. RING, SYN BLOCKING
46. RING, SYN 3RD & 4TH SNAP
47. SYNCHRONIZER ASM, TRANS 3RD & 4TH
48. SPRING, FORWARD CLUTCH KEY
49. KEY, FORWARD SYN CLUTCH
50. GEAR, 4TH SPEED
51. SHAFT, MAIN
52. GEAR, SPEEDO DRIVE
53. CLIP, SPEEDO DRIVE GEAR
54. GEAR, 2ND SPEED
55. SYNCHRONIZER ASM, TRANS 1ST & 2ND
56. RING, SYN CLUTCH GEAR SNAP
57. GEAR, 1ST SPEED
58. RING, MAIN SHAFT BEARING OUTER SNAP
59. BEARING, CLUTCH GEAR
60. GASKET, EXTENSION
61. WASHER, LK
62. SCREW
63. VENTILATOR, EXTENSION
64. EXTENSION, TRANS
65. BUSHING, TRANS EXTENSION
66. SEAL, EXTENSION OIL

Fig. 7B3-5--89mm Identification

UNIT REPAIR

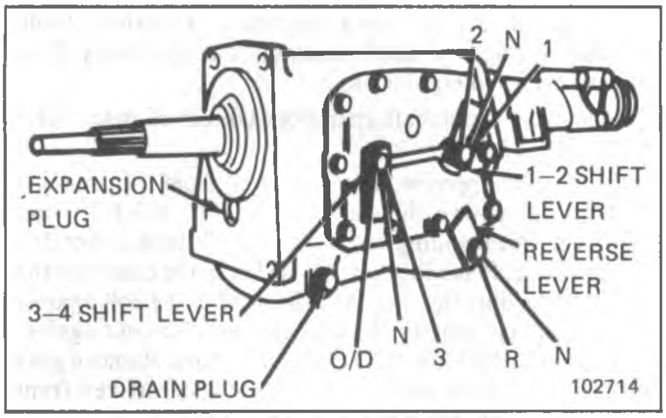


Fig. 7B3-6--Transmission Shift Levers

TRANSMISSION

Disassembly

1. Thoroughly clean the exterior of the transmission assembly.
2. Remove drain plug and drain lubricant from transmission.
3. Shift transmission into neutral position. Remove reverse shift lever, side cover bolts, side cover and shift forks. Refer to Fig. 7B3-6. Remove reverse detent spring and ball from base in side of case.

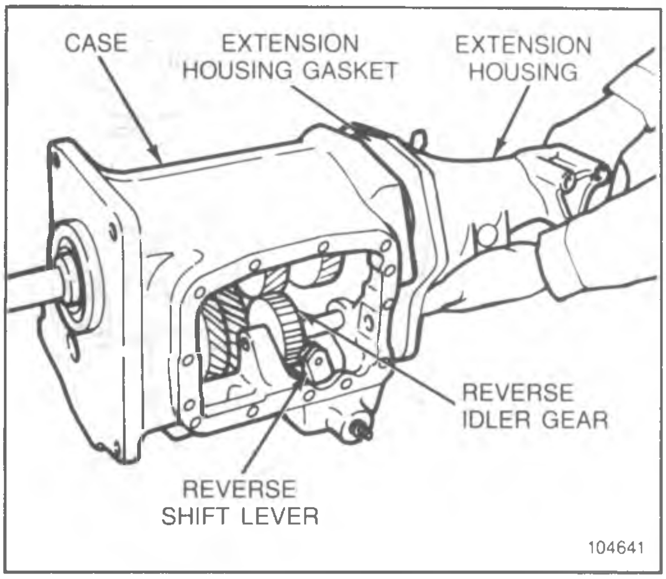


Fig. 7B3-8--Extension Housing and Mainshaft Assembly

4. Remove extension housing bolts and rotate the extension on the output shaft to expose the rear of the countershaft. Clearance has been provided on the extension flange to enable one bolt to be reinstalled to hold the extension in the inverted position to gain access for the countershaft removal. Refer to Fig. 7B3-7.
5. With a centerpunch or drill, make a hole in the countershaft expansion plug at the front of the case.

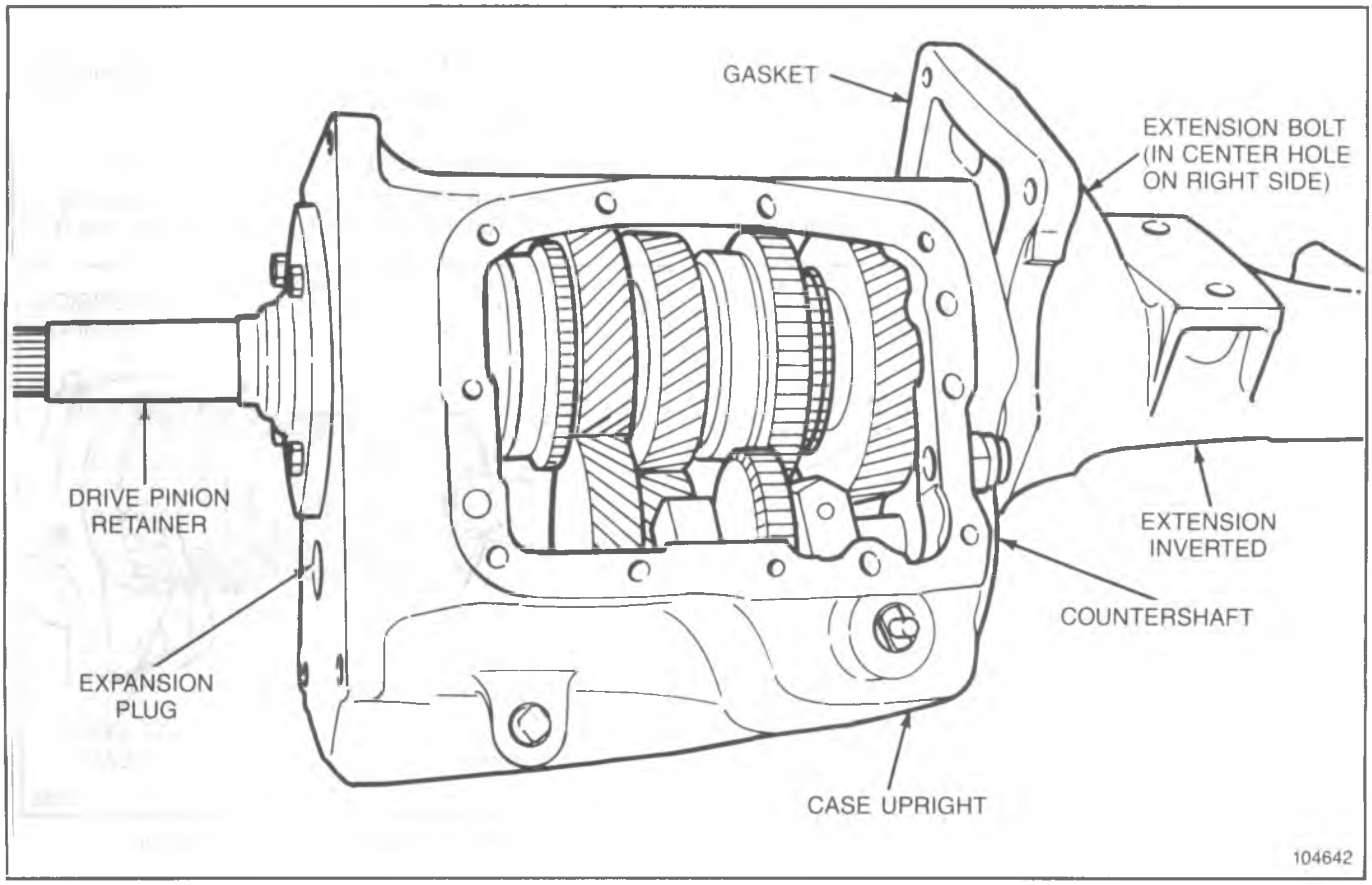


Fig. 7B3-7--Rotating Extension Housing

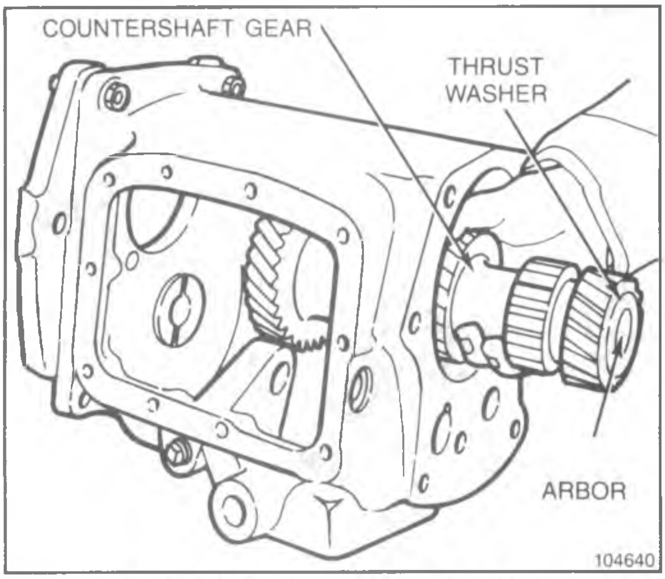


Fig. 7B3-9--Countershaft Gear and Arbor

6. Using this hole, push the countershaft rearward until the woodruff key is exposed. Remove key and push the countershaft forward against the expansion plug. Using a brass drift, tap the countershaft forward until the plug is driven out of the case.
7. Using tool J-29793 at the front of the countershaft, drive the shaft out the rear of the case. Tool J-29793 will now hold the roller bearings in position within the gear bore. Lower countershaft gear to bottom of case.
8. Rotate the extension housing back to its normal position.
9. Remove drive gear bearing retainer bolts and slide retainer and gasket off the gear assembly.
10. Using a brass drift, tap the gear and bearing assembly forward and remove through front of case. Replacement of the drive gear or bearing require no further disassembly of the transmission. Replace the failed part and reassemble the transmission.
11. Slide third and overdrive (O/D) synchronizer sleeve slightly forward, slide reverse idler gear to center of its shaft, then using a soft faced hammer, tap on extension housing in a rearward direction. Slide housing and mainshaft assembly out and away from case. Refer to Fig. 7B3-8.
12. Remove countershaft gear from bottom of case. Refer to Fig. 7B3-9.
13. Remove the reverse idler gear shaft from transmission case. To remove the shaft, use a 3/8" x 3-1/2" bolt with a free spinning nut and a 7/16" deep socket 3/8 inch drive. Place the bolt and socket in the case with the socket against the shaft and the head of the bolt against the case. Holding the head of the bolt, turn nut against the socket pushing shaft through its bore. Remove gear from shaft and remove shaft with woodruff key from transmission case. Refer to Fig. 7B3-10.
14. Remove reverse gear shift lever shaft from case by pushing shaft inward and remove it from the case. Remove "O" ring and retainer from case bore.
15. Remove backup light switch from case.

MAINSHAFT

Disassembly

Refer to Fig. 7B3-11 for locations of various gears, synchronizer sleeves and clutches before disassembling mainshaft.

1. Remove snap ring that retains 3rd and O/D synchronizer clutch gear and sleeve assembly. Then slide 3rd and O/D synchronizer assembly off end of mainshaft. Refer to Fig. 7B3-12.
2. Slide O/D gear and stop ring off mainshaft. Mark and separate synchronizer parts for cleaning and inspection.
3. Using long nose pliers, spread snap ring that retains mainshaft ball bearing in extension housing, then pull mainshaft assembly out of the extension housing. Refer to Fig. 7B3-13.
4. Remove speedometer drive gear from mainshaft.
5. Remove snap ring that retains mainshaft bearing on the shaft. Refer to Fig. 7B3-14. Remove bearing from

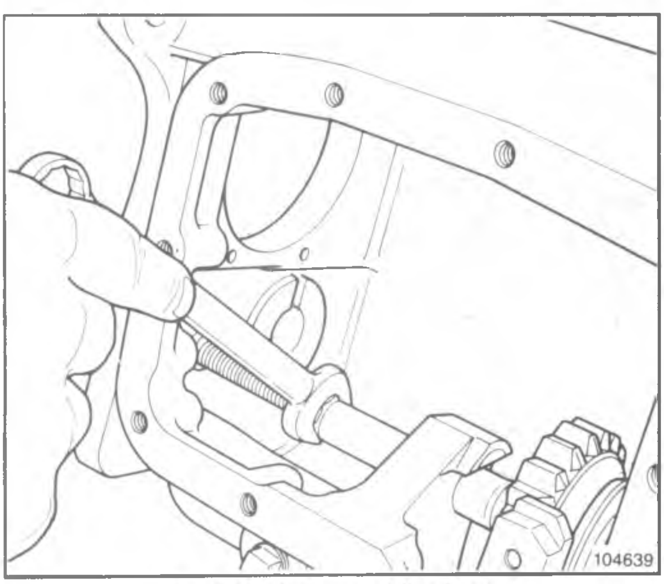


Fig. 7B3-10--Reverse Idler Shaft

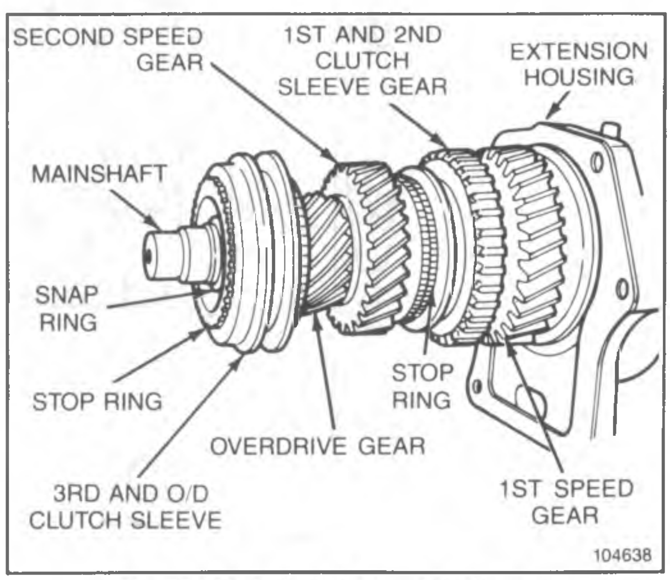


Fig. 7B3-11--Mainshaft Gear Identification

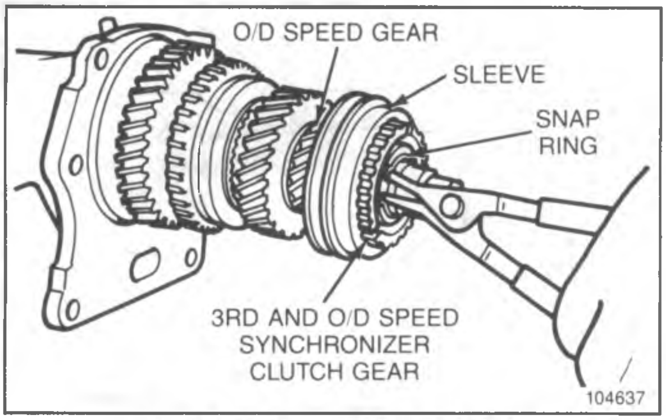


Fig. 7B3-12--Disassembling Mainshaft

mainshaft by inserting steel plate on the front side of 1st gear, then press mainshaft through bearing. (Be carefuly not to damage gear teeth).

6. Remove bearing, bearing retainer ring, 1st gear, and 1st speed stop ring from the shaft.
7. Remove snap ring that retains 1st and 2nd clutch gear and sleeve assembly. Then slide 1st and 2nd gear and sleeve assembly from the mainshaft. Remove 2nd gear. Before cleaning, mark all parts for reassembly. Refer to Fig. 7B3-15.
8. Inspect mainshaft gear bearing surfaces for signs of wear, scoring, or any condition that would not allow shaft to be used.
9. Remove tool J-29793 from the countershaft gear, 76 needle type bearings, thrust washers, and spacers.
10. Remove outer snap ring on the drive gear. Using an arbor press, remove bearing from drive gear, if bearing is to be replaced.
11. Remove inner snap ring and 16 bearing rollers from cavity of drive gear.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside using a suitable solvent, then inspect the case for

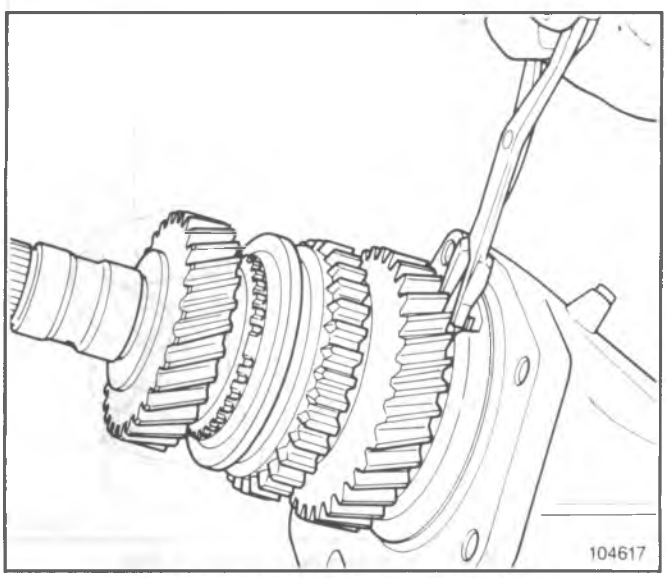


Fig. 7B3-13--Mainshaft Bearing Snap Ring

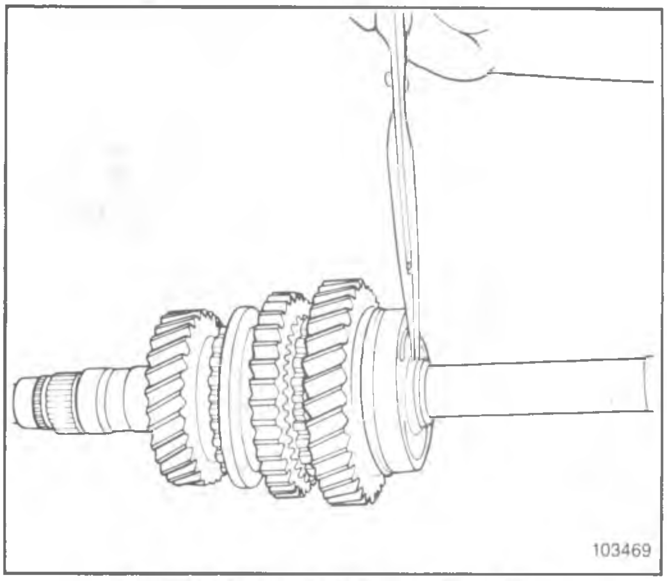


Fig. 7B3-14--Mainshaft Bearing Snap Ring

cracks. The magnetic disc is glued in place, wipe with a clean cloth.

2. Check the front and rear faces for burrs and if present, dress them off with a fine mill file.

Roller Bearings and Spacers

1. All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn spacers.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

   NOTICE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the race and balls.

3. Lubricate bearings with a light oil and check them

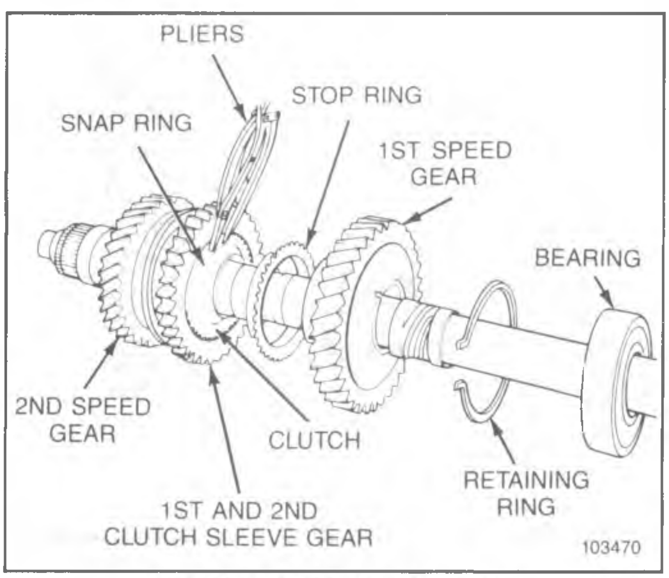


Fig. 7B3-15--Clutch Gear Snap Ring

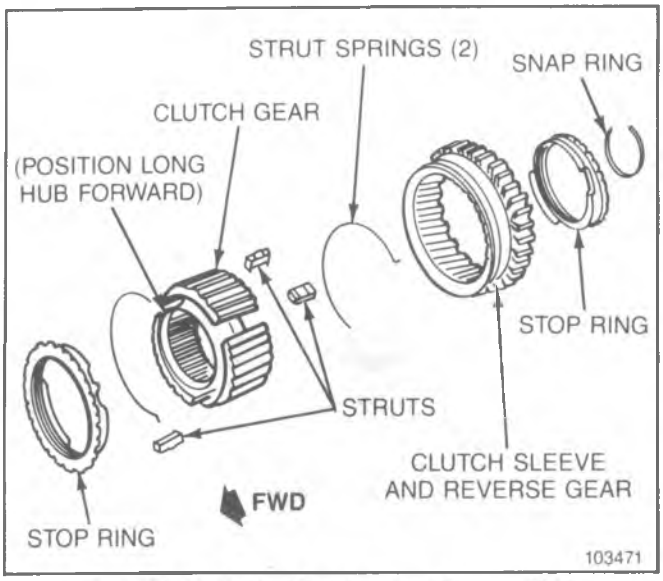


Fig. 7B3-16--1st-2nd Synchronizer Disassembled

for roughness by slowly turning the race by hand.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Check oil seal contact area on the drive gear shaft, if its pitted, rusted or scratched, a new gear is recommended for best seal life.
3. Inspect interlock levers for cracks at detent and clearance notches at each end of levers.
4. Inspect shift forks for wear on pads and shafts. Inspect the fork shaft bores in the shift lever for galling.

REPAIRS

Synchronizer Keys and Springs

Replacement

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and springs may be replaced if worn or broken.

1. If relation of hub and sleeve are not already marked, mark for assembly purposes. Refer to Fig. 7B3-16 and 7B3-17.
2. Push the hub from the sliding sleeve, the keys will fall free and the spring may be easily removed.
3. Place the keys in position and while holding them in place, slide the sleeve onto the hub, aligning the marks made before disassembly.
4. Place the two springs in position (one on each side of hub), so all three keys are engaged by both springs.

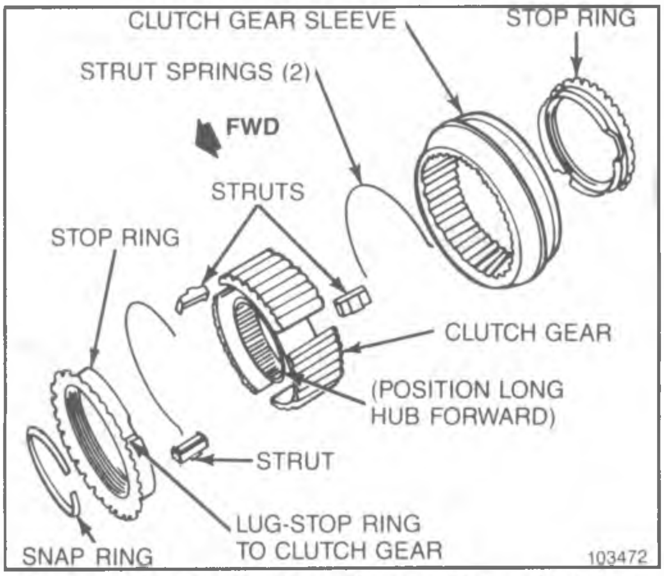


Fig. 7B3-17--3rd-O/D Synchronizer Disassembled

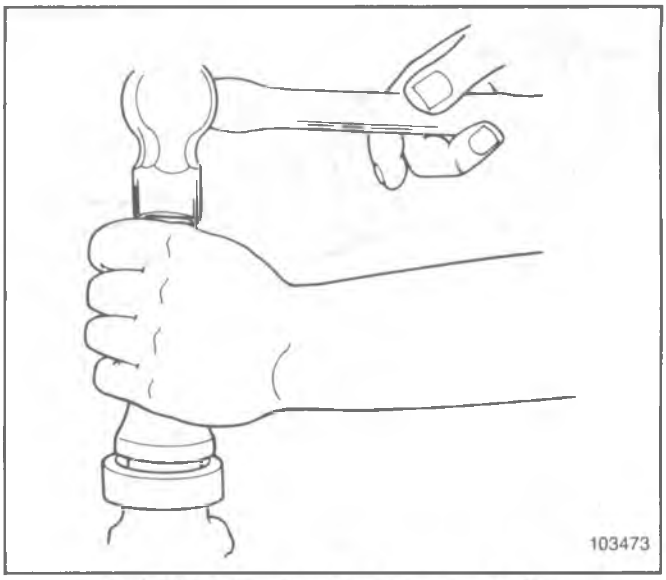


Fig. 7B3-18--Installing Rear Extension Bushing

Extension Oil Seal and/or Bushing

Replacement

1. Pry oil seal out of extension housing, using a screwdriver or small chisel.
2. Drive the brushing out of housing, using tool J-8092 with J-21424-9.

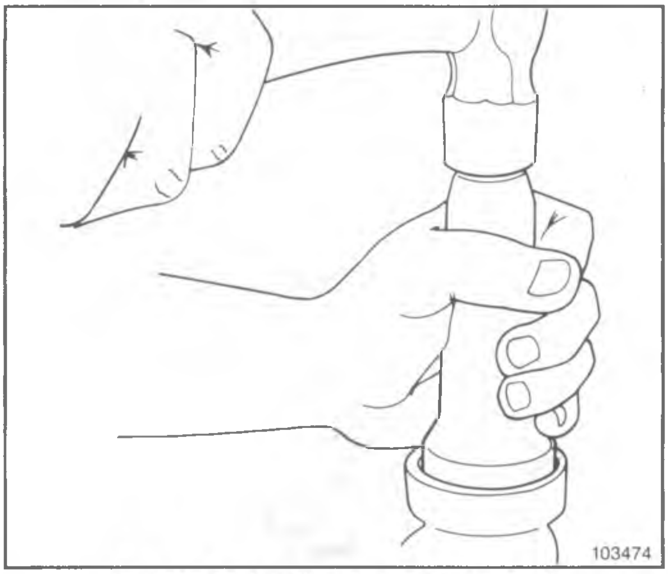


Fig. 7B3-19--Installing Rear Extension Seal

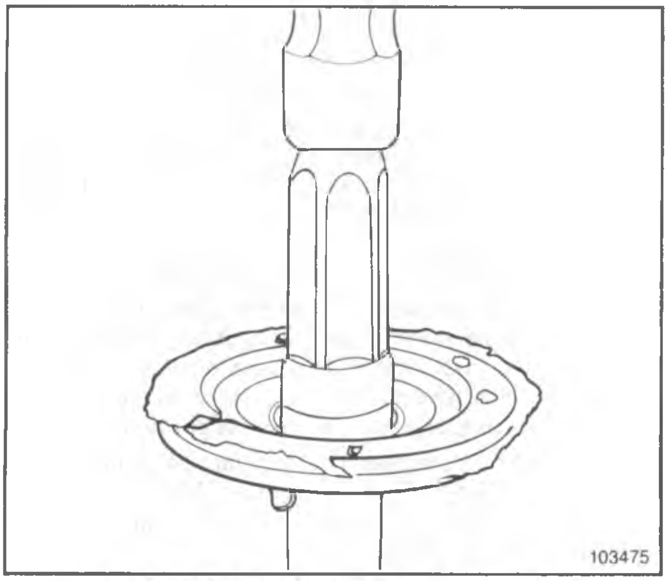


Fig. 7B3-20--Drive Gear Bearing Retainer Seal

3. Slide a new brushing on tool J-23596 and drive bushing into place. Refer to Fig. 7B3-18.
4. Position a new seal in opening of extension housing and drive it into the housing with tool J-21426. Refer to Fig. 7B3-19.

Drive Gear Bearing Retainer Oil Seal

Replacement

1. Pry out old seal.
2. Using a new seal, install new seal into retainer using Tool J-23096 until it bottoms in bore. Refer to Fig. 7B3-20. Lubricate I.D. of seal with transmission lubricant.

Transmission Side Cover (Fig. 7B3-21)

The following three steps need only be done if oil leakage is visible around gearshift lever shifts, or the interlock levers are cracked.

1. Remove nuts that attach shift operating levers to the shafts. Disengage levers from flats on shafts

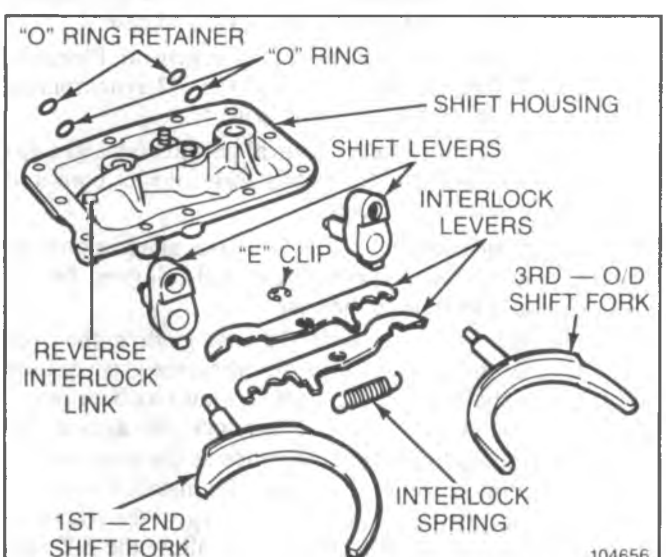


Fig. 7B3-21--Side Cover Exploded View

and remove. Makes ure shafts are free of burrs before removal, otherwise the bores may be scored resulting in leakage after reassembly.

2. Pull gearshift lever shafts out of cover.
3. Remove "O" ring retainers and "O" rings from housing.
4. Remove "E" ring from interlock lever pivot pin and remove interlock levers and spring from cover.
5. To assemble side cover, install interlock levers on pivot pin and fasten with "E" ring. Use pliers to install spring on interlock lever hangers.
6. Grease housing bores and push each shaft into its proper bore followed by greased "O" ring and retainer.
7. Install operating levers and torque retaining nuts to specifications. Be sure 3rd-O/D operating levers point downward.

COUNTERGEAR

Assembly

1. Coat inside bore of countergear at each end with a thin film of grease and install spacer with Tool J-29793 into gear. Center spacer and arbor.
2. Install 19 roller bearings, followed by a spacer ring and 19 more bearings and a spacer ring into each end of gear.
3. If countershaft thrust washers are worn or scored, install new thrust washers. Coat washers with grease and install one at the front of the countergear on the arbor with the tang side facing the case bore. Install the other washer after the countergear assemble is positioned in the bottom of the case.

DRIVE GEAR

Assembly

1. Press drive gear bearing on drive gear seating bearing fully against shoulder on gear. Be sure outer snap ring groove is toward the front. Refer to Fig. 7B3-22.
2. Install a new snap ring on shaft to retain bearing. Be sure snap ring is seated. This snap ring is a select fit for minimum end play.
3. Place drive gear in a vise (with soft jaws), then install 16 bearing rollers in cavity of shaft. Coat bearing rollers with grease, then install retaining snap ring in its groove.

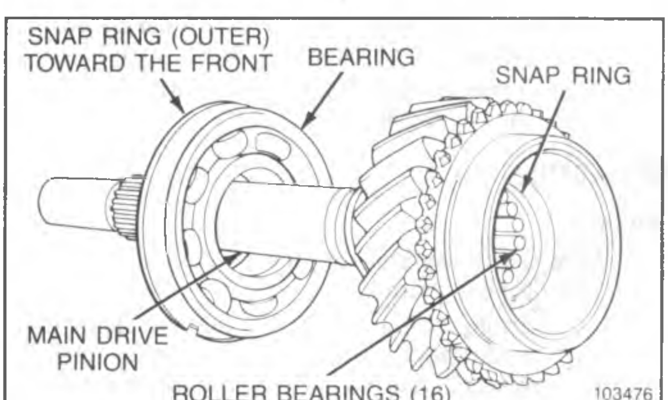


Fig. 7B3-22--Drive Pinion and Bearing Assembly

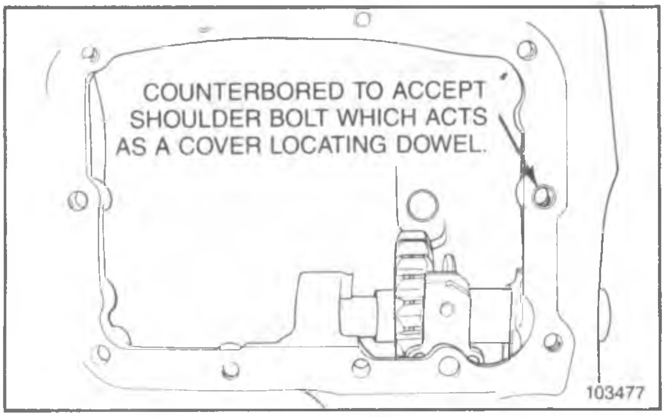


Fig. 7B3-23--Side Cover Bolt Identification

MAINSHAFT

Assembly

1. Slide second gear over mainshaft (synchronizer cone toward rear) and down against shoulder on shaft. Refer to Fig. 7B3-15.
2. Slide 1st-2nd synchronizer assembly (including stop ring with lugs indexed in hub slots) over mainshaft, down against 2nd gear cone and secure with a new snap ring. Slide next stop ring over shaft and index lugs into clutch hub slots. Refer to Fig. 7B3-15.
3. Slide first gear (synchronizer cone toward clutch sleeve gear just installed) over mainshaft into position against clutch sleeve gear.
4. Install mainshaft bearing retainer ring, followed by mainshaft rear bearing. Using an arbor and a suitable tool, drive or press bearing down into position. Install a new snap ring on shaft to secure bearing. Refer to Fig. 7B3-14. This snap ring is a select fit for minimum end play.
5. Install partially assembled mainshaft into extension housing far enough to engage bearing retaining ring in slot in extension housing. Expand snap ring with pliers so that mainshaft ball bearing can move in and bottom against its thrust shoulder in extension housing. Release ring and seat it all around its groove in extension housing. Refer to Fig. 7B3-13.
6. Slide overdrive gear over mainshaft (with synchronizer cone toward front) followed by O/D gear stop ring.
7. Install 3rd-O/D synchronizer clutch gear assembly on mainshaft (shift fork slot toward rear) against O/D gear. Be sure to index rear stop ring with clutch gear struts. Install retaining snap ring. Refer to Fig. 7B3-12.
8. Using grease, position front stop ring over clutch gear, again indexing ring lugs with struts.

TRANSMISSION

Assembly

1. Place the transmision case on its side with the shift cover opening toward the assembler.
2. Install countergear assembly into the case aligning the tangs on the front washer with the slots in the case. Next install the rear washer aligning the tans with the slot at the rear of the case and then let the countergear rest in the bottom of the case. (Be sure thrust washers stay in position). Refer to Fig. 7B3-9).
3. Coat a new extension gasket with grease, then place it in position on the extension.
4. Insert mainshaft assembly into the case tilting it as required to clear the countershaft gear.
5. Rotate the extension housing to expose the rear of the countershaft bore. Install one bolt to hole the extension in inverted position and prevent it from moving rearward. Refer to Fig. 7B3-7.
6. Install drive gear assembly through the front of the case and position it in the front bore. Install outer snap ring in bearing groove. Tap lightly into place using a soft faced hammer. If everything is in proper position, the outer snap ring will bottom onto the case face without excessive effort. If not, check to see if a strut, roller bearing, or a stop ring is out of position.
7. Raise the countergear assembly into position with the teeth meshed with the drive gear. Make sure thrust washer remain in position on ends of the arbor and tangs are aligned with slots in case.
8. Start the countershaft into the rear bore of the case and push forward until the shaft is approximately half way through the gear. Install woodruff key and push the shaft forward until end is flush with case. Remove arbor Tool J-29793.
9. Install reverse shift lever shaft in case bore followed by greased "O" ring and retainer.
10. Remove extension housing bolt and rotate extension to provide clearance for installation of the reverse idler gear in end of case.
11. Push the shaft in far enough to position reverse idler gear on protruding end of shaft with fork slot toward rear. At the same time, engage slot with reverse shift fork.
12. Install woodruff key on shaft and drive shaft in flush with end of case.
13. Align extension housing to case and install bolts. Torque housing bolts to specifications.
14. Install drive gear bearing retainer and gasket. Coat threads with sealing compound, then install bolts and torque to specifications.
15. Install new expansion plug coated with sealing compound in countershaft bore at front of case.
16. Position both synchronizer sleeves in neutral. Place the 1-2 shift fork into the groove of the 1-2 synchronizer sleeve. Slide reverse idler gear to neutral.
17. Rotate each shift lever to neutral position (straight up) and install 3rd/overdrive shift fork into its bore and under both interlock levers.
18. Position side cover gasket on case using grease to retain it. Install reverse detent ball followed by the spring into its bore in the case.
19. Lower the side cover onto the case guiding the 3rd/overdrive shift fork into its synchronizer groove, then lead the shaft of the 1-2 shift fork into its bore in the side cover. Hold the reverse interlock link against the 1-2 shift lever to provide clearance as the side cover is lowered into position. To finish the installation of the side cover, use a screwdriver and raise the interlock lever against its spring tension to allow the 1-2 shift fork to slip under the levers. Be sure the reverse detent spring is positioned in the cover bore.

20. Eight of the side cover bolts are shoulder bolts with one having a longer shoulder which acts as a dowel to accurately locate the side cover. The remaining two bolts are standard bolts. Install cover bolts finger tight and shift through all gears to insure proper operation. Refer to Fig. 7B3-23 for location of cover bolts.

21. Tighten side cover bolts evenly and torque to specifications.

22. Install reverse shift lever, retaining nut and torque to specifications.

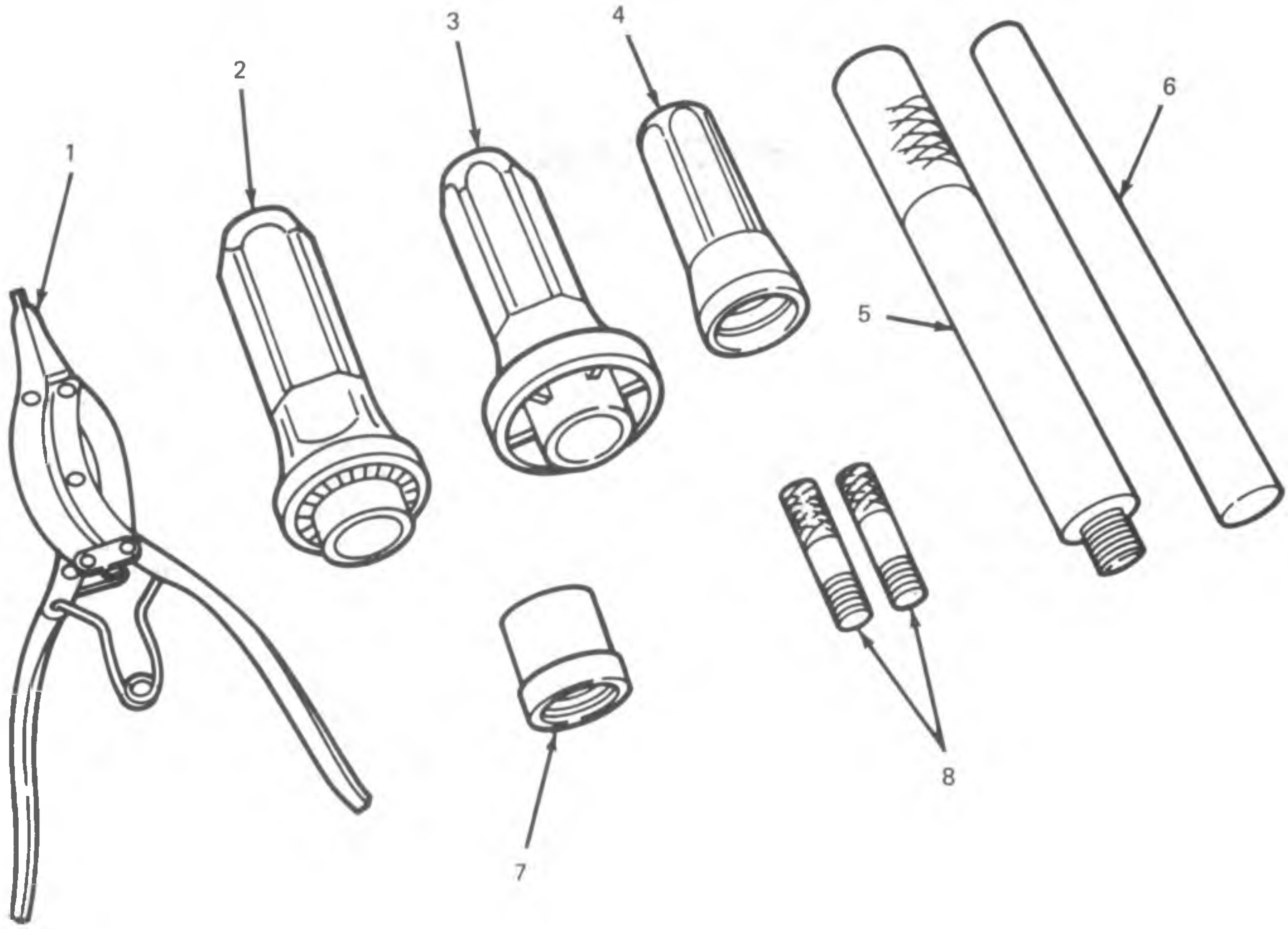
23. Shift the transmission into each gear to insure correct shift travel and smooth operation. The reverse shift lever and 1-2 shift lever have cam surfaces which mate in reverse position to lock the 1-2 lever, fork and synchronizer in neutral position. Slight motion of the 1-2 shift lever toward low gear is normal during shifting into reverse gear.

24. Install backup light switch and torque to specifications.

SPECIFICATIONS

Shift Lever Retaining Nuts	24 N·m	18 ft. lb.	
Extension to Case Bolts	68 N·m	50 ft. lb.	
Drive Gear Bearing Retainer Bolts	41 N·m	30 ft. lb.	
Side Cover to Case Bolts	20 N·m	15 ft. lb.	
Backup Light Switch	20 N·m	15 ft. lb.	
Lubrication Filler Plug	20 N·m	15 ft. lb.	
Transmission to Clutch Housing Bolts	100 N·m	75 ft. lb.	
Crossmember to Frame Bolts	75 N·m	55 ft. lb.	
Crossmember to Mount Bolts	55 N·m	40 ft. lb.	
Shift Lever and Bracket To Transmission	50 N·m	36 ft. lb.	
Control Rod Adjusting Nuts	20 N·m	15 ft. lb.	
Mount to Transmission Bolts	55 N·m	40 ft. lb.	102709

SPECIAL TOOLS



1. J-8059 Snap Ring Pliers
2. J-23596 Rear Extension Bushing Installer
3. J-21426 Rear Extension Seal Installer
4. J-23096 Drive Gear Retainer Seal Installer
5. J-8092 Driver Handle
6. J-29793 Countergear Loading Tool
7. J-21424-9 Rear Extension Bushing Remover
8. J-1126 Transmission Guide Pins

SECTION 7B
4-SPEED 117MM TRANSMISSION

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ON VEHICLE SERVICE

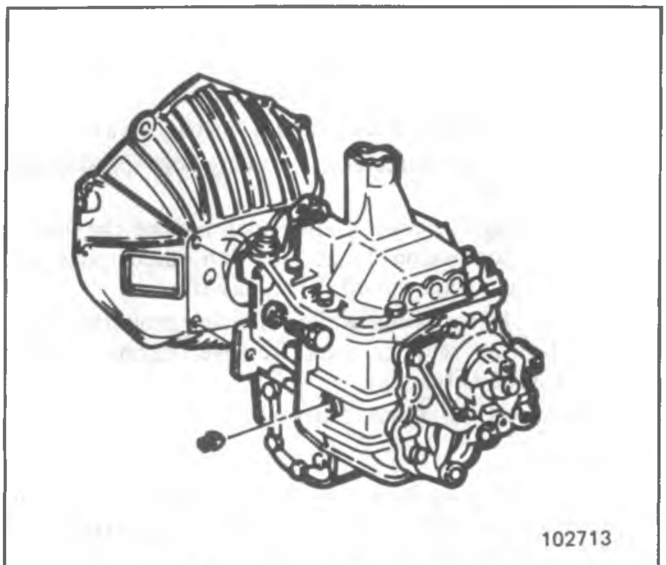


Fig. 7B4-1--Transmission To Engine Attachment

TRANSMISSION (Fig. 7B4-1)

Removal (Except K Series)

1. Remove attaching screws from transmission shift lever boot retainer. Slide boot and retainer up lever and remove transmission shift lever.

   To remove shift lever, push down on collar and turn counter-clockwise.
2. Raise vehicle and support engine with a suitable floor stand.
3. Drain transmission and disconnect the speedometer cable from transmission.
4. Disconnect propeller shaft front U-joint at transmission yoke, and tie up out of way.
5. Disconnect exhaust pipes at exhaust manifolds.
6. Remove transmission mount-to-crossmember bolts.
7. Support transmission with a suitable floor stand. Remove frame to crossmember bolts and remove crossmember from vehicle.
8. Remove transmission-to-clutch housing attaching bolts. Remove upper bolts first and install transmission guide pins J-1126. Use of the guide pins will prevent damage to the clutch assembly.
9. Slide transmission rearward until main drive gear clears the clutch assembly and lower assembly from vehicle.
10. If desired, a careful check of clutch components should be made after the transmission has been removed. If the clutch requires repair, refer to Section 7C before transmission is reinstalled in the vehicle.

Installation

1. Apply a light coating of high temperature grease to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly.

   NOTICE: Do not apply an excessive amount of grease in the above areas, as under normal operation this grease could be thrown onto clutch facing resulting in clutch problems.
2. Position transmission to the clutch housing and install attaching bolts. Torque bolts to specification.
3. Position frame crossmember and install retaining bolts. Install transmission mount-to-crossmember bolts. Torque bolts to specifications.
4. Connect propeller shaft at transmission and torque bolts to specification.
5. Connect speedometer cable.
6. Connect exhaust pipes to exhaust manifolds.
7. Fill transmission with lubricant specified in Section 0B.
8. Remove supports and lower vehicle.
9. Install transmission shift lever, boot, retainer and attaching screws.

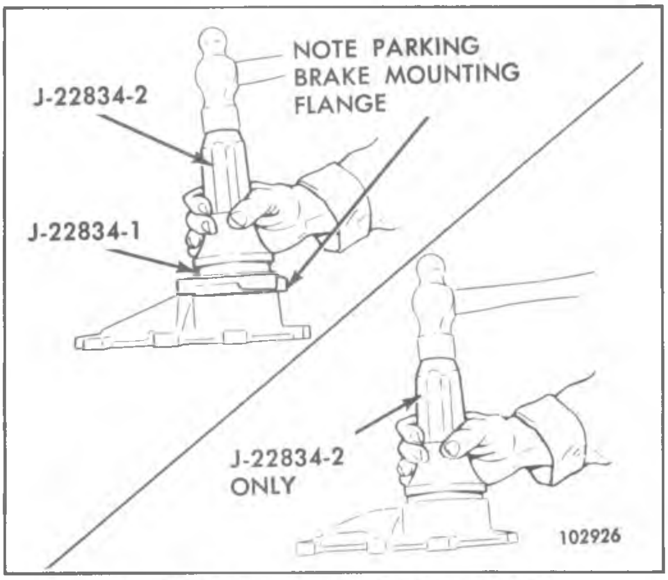


Fig. 7B4-2--Rear Bearing Retainer Oil Seal

Remove (K-Series)

1. Remove attaching screws from transmission shift lever boot retainer. Slide boot and retainer up lever and remove transmission shift lever.

   To remove shift lever, push down on collar and turn counter-clockwise.
2. Raise vehicle and support engine with a suitable floor stand. Drain transfer case and transmission.
3. Disconnect speedometer cable.
4. Disconnect propeller shafts at transfer case and tie up, away from work area.
5. Support transfer case in a suitable cradle. Remove bolts attaching transfer case to adapter, and remove transfer case. Refer to Section 7E.
6. Disconnect exhaust pipes at exhaust manifolds.
7. Remove transmission mount-to-crossmember bolts.
8. Support transmission and remove frame to crossmember bolts. Rotate crossmember to clear frame rails and remove from vehicle.
9. Remove transmission-to-clutch housing attaching bolts. Remove upper bolts first and install transmission guide pins J-1126. Use of the guide pins will prevent damage to the clutch assembly.
10. Slide transmission rearward until main drive gear clears the clutch assembly and lower assembly from vehicle.
11. If desired, a careful check of clutch components should be made after the transmission has been removed. If the clutch requires repair, refer to Section 7C before transmission is reinstalled in the vehicle.

Installation

1. Apply a light coating of high temperature grease to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly.

   NOTICE: Do not apply an excessive amount of grease in the above areas, as under normal operation this grease could be thrown onto clutch facings resulting in clutch problems.
2. Position transmission-to-clutch housing. Install bolts attaching transmission to clutch housing and torque to specifications.
3. Position crossmember and install attaching bolts. Install transmission mount to crossmember bolts. Torque bolts to specifications.
4. Position transfer case to adapter and install attaching bolts. Torque bolts to specifications.
5. Connect propeller shafts to transfer case. Torque bolts to specifications.
6. Connect speedometer cable.
7. Connect exhaust pipes to exhaust manifolds.
8. Fill transmission and transfer case with lubricant recommended in Section OB of this manual.
9. Remove supports and lower vehicle.
10. Install transmission shift lever, boots, retainers and attaching screws.

EXTENSION HOUSING OIL SEAL (Fig 7B4-2)

Removal

1. Raise vehicle.
2. Drain lubricant from transmission.
3. Disconnect propeller shaft and tie up out of way.
4. Disconnect speedometer cable and remove speedometer driven gear.
5. Using flange or yoke holding tool, remove the output yoke or companion flange nut. Pull output yoke and companion flange nut off the mainshaft.
6. Support transmission while removing mounting bolts and bearing retainer bolts. Remove bearing retainer and gasket. Discard gasket.
7. Remove oil seal. Discard oil seal.

Installation

1. Clean gasket surfaces. Coat outer diameter of new oil seal with sealing cement. Install oil seal using Tool J-22834-2 as shown in Fig. 7B4-2.
2. Install the rear bearing cap with a new gasket on the transmission. Install attaching bolts and torque to specifications.
3. Install output yoke on mainshaft. Using a flange or yoke holding tool, install retaining nut. Torque retaining nut to specification.
4. Install speedometer driven gear, then connect speedometer cable.
5. Connect propeller shaft to transmission as described in Section 4A.
6. Fill transmission with lubricant recommended in Section 0B.
7. Lower vehicle.

SPEEDOMETER DRIVEN GEAR

Removal

1. Raise vehicle.
2. Disconnect speedometer cable, then remove lock plate to housing bolt and lock washer and remove lock plate. Insert screwdriver in lock plate slot in fitting and pry fitting, gear and shaft from housing. Pry "O" ring

from groove in fitting.

Installation

1. Install new "O" ring in groove in fitting, coat "O" ring and driven gear shaft with transmission lubricant and insert shaft.
2. Hold the assembly so slot in fitting is toward lock plate boss on housing and install in housing. Push fitting into housing until lock plate can be inserted in groove and attached to housing.
3. Install speedometer cable and lower vehicle.

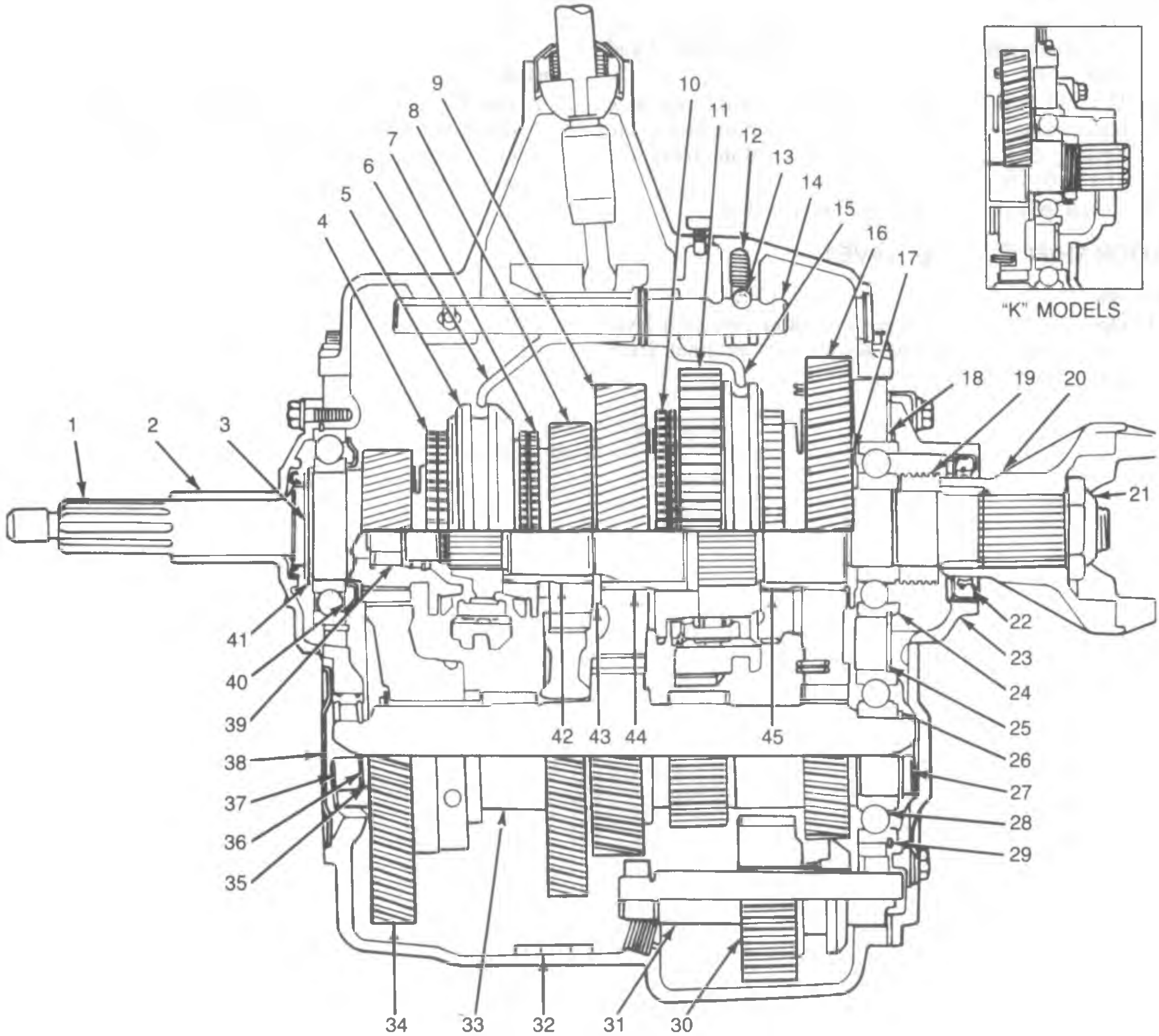
FLOOR SHIFT CONTROL LEVER

Removal

1. On K-Series models, remove transfer case shift lever boot retainer attaching screws and retainer from compartment floor.
2. Remove transmission shift lever boot retainer attaching screws.
3. Slide boot and retainer up on shift lever and remove the shift lever.

Installation

1. Install transmission shift lever. Slide boot and retainer down shift lever and install attaching screws.
2. On K-Series models, install transfer case shift lever boot, retainer and attaching screws.



1. MAIN DRIVE GEAR
2. DRIVE GEAR BEARING RETAINER
3. SNAP RING — OUTER
4. 3RD AND 4TH SYNCHRONIZER RING
5. 3RD AND 4TH SYNCHRONIZER COLLAR
6. 3RD AND 4TH SHIFT FORK
7. 3RD AND 4TH SPEED SYNCHRONIZER RING
8. 3RD SPEED GEAR
9. 2ND SPEED GEAR
10. 1ST AND 2ND SYNCHRONIZER ASSEMBLY
11. REVERSE DRIVEN GEAR
12. POPPET SPRING
13. POPPET BALL
14. SHIFT RAIL
15. 1ST AND 2ND SHIFT FORK
16. 1ST SPEED GEAR
17. THRUST WASHER
18. BEARING SNAP RING
19. SPEEDOMETER DRIVE GEAR
20. OUTPUT YOKE
21. FLANGE NUT
22. REAR BEARING RETAINER OIL SEAL
23. REAR BEARING RETAINER
24. MAINSHAFT REAR BEARING
25. REAR BEARING SNAP RING
26. SNAP RING
27. COUNTERSHAFT
28. COUNTERSHAFT REAR BEARING
29. BEARING SNAP RING
30. REVERSE IDLER GEAR
31. REVERSE IDLER SHAFT
32. CASE MAGNET
33. SPACER
34. COUNTERGEAR
35. THRUST WASHER
36. SNAP RING
37. FRONT COUNTERSHAFT BEARING
38. COUNTERGEAR FRONT COVER
39. PILOT BEARING ROLLERS
40. CLUTCH GEAR OIL SLINGER
41. SNAP RING
42. 3RD SPEED GEAR BUSHING
43. THRUST WASHER
44. 2ND SPEED GEAR BUSHING
45. 1ST SPEED GEAR BUSHING

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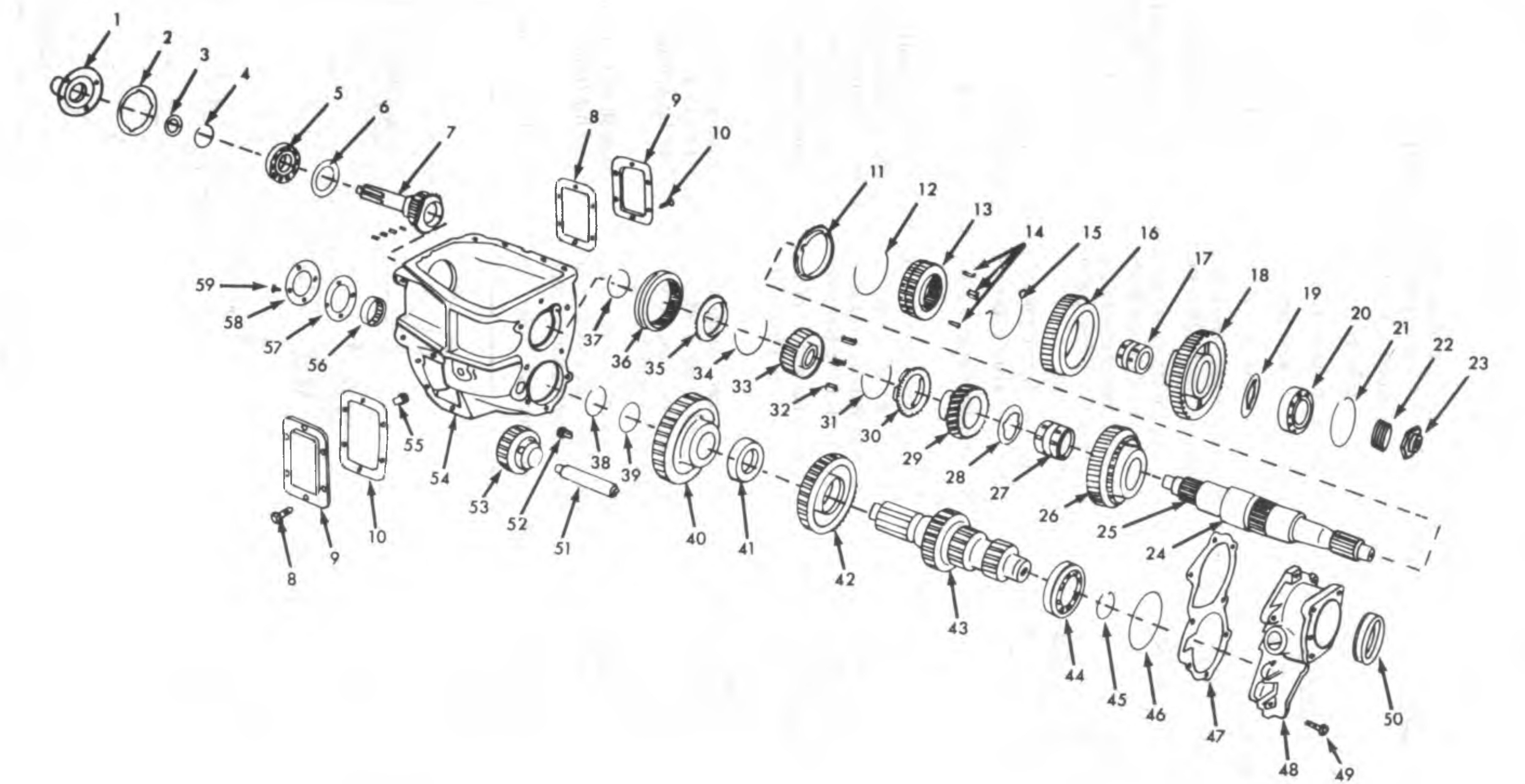
Fig. 7B4-3--4-Speed 117mm Transmission-Cross Section



1. Drive Gear Bearing Retainer
2. Retainer Gasket
3. Lip Seal
4. Snap Ring
5. Drive Gear Bearing
6. Oil Slinger
7. Drive Gear and Pilot Bearings
8. Power Take-Off Cover Gasket
9. Power Take-Off Cover
10. Retaining Screws
11. 1st-2nd Speed Blocker Ring
12. Synchronizer Spring
13. 1st-2nd Speed Synchronizer Hub
14. Synchronizer Keys
15. Synchronizer Spring
16. Reverse Driven Gear
17. 1st Gear Bushing
18. 1st Gear
19. Thrust Washer
20. Rear Main Bearing
21. Bearing Snap Ring
22. Speedometer Gear
23. Rear Mainshaft Lock Nut
24. 2nd Speed Bushing (On Shaft)
25. Mainshaft
26. 2nd Speed Gear
27. 3rd Gear Bushing
28. Thrust Washer
29. 3rd Speed Gear
30. 3rd Speed Blocker Ring
31. Synchronizer Spring
32. Synchronizer Keys
33. 3rd-4th Synchronizer Hub
34. Synchronizer Spring
35. 3rd-4th Speed Blocker Ring
36. 3rd-4th Speed Synchronizer Sleeve
37. Snap Ring
38. Snap Ring
39. Thrust Washer
40. Clutch Countergear
41. Spacer
42. 3rd Speed Countergear
43. Countergear Shaft
44. Countergear Rear Bearing
45. Snap Ring
46. Bearing Outer Snap Ring
47. Rear Retainer Gasket
48. Rear Retainer
49. Retainer Bolts
50. Retainer Lip Seal
51. Reverse Idler Shaft
52. Drain Plug
53. Reverse Idler Gear
54. Case
55. Fill Plug
56. Countergear Front Bearing
57. Gasket
58. Front Cover
59. Cover Screws

Fig. 7B4-4-4-Speed 117mm Transmission-Exploded View

UNIT REPAIR

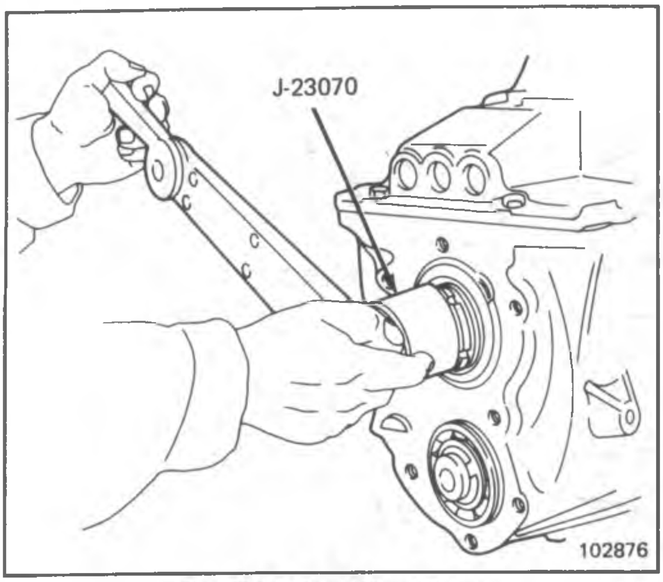


Fig. 7B4-5--Four Wheel Drive

TRANSMISSION

Disassembly (Fig. 7B4-3, 7B4-4)

1. Mount transmission in suitable holding fixture and remove cap screws attaching transmission cover assembly to transmission case. If required, insert two 5/16 x 18 screws in cover flange threaded holes and turn evenly to raise cover dowel pins from case.

   Move reverse shifter fork so that reverse idler gear is partially engaged before attempting to remove cover. Forks must be positioned so rear edge of the slot in the reverse fork is in line with the front edge of the slot in the forward forks as viewed throught tower opening.

2. Place transmission in two gears at once to lock gears. Remove the universal joint flange nut, universal joint front flange and brake drum assembly.

   On models equipped with 4-wheel drive transfer case, use Tool J-23070 to remove mainshaft rear lock nut (Fig. 7B4-5.)

3. Remove parking brake and brake flange plate assembly on model equipped with propeller shaft parking brake. Refer to Section 5, Truck Shop Manual.
4. Remove rear bearing retainer and gasket.
5. Slide speedometer drive gear off mainshaft.
6. Remove drive gear bearing retainers and gasket.
7. Remove countergear front bearing cap and gasket.
8. Pry countergear front bearing out by inserting a two-pronged puller J-28509 through the cast slots in case.
9. Remove countergear rear bearing retaining rings (snap ring) from shaft and bearing. Using Tool J-22832 and J-8433-1, remove countergear rear bearings (Fig. 7B4-6). This will allow countergear assembly to rest on bottom of case.

   Make sure Tool J-22832 engages full circumference of groove in bearing to prevent tool damage.

10. Remove drive gear bearing outer race to case retaining ring.
11. Remove drive gear and bearing by tapping gently on bottom side of drive gear shaft and prying directly opposite against the case and bearing snap ring groove at the same time. Remove 4th gear synchronizer ring.

    Index cut out section of drive gear in down position with countergear to obtain clearance for removing clutch gear.

12. Remove rear mainshaft bearing retainer ring (snap ring) and using Tool J-22832 and J-8433-1, remove bearing from case (Fig. 7B4-7). Slide 1st speed gear thrust washer off mainshaft.
13. Raise rear of mainshaft assembly and push rearward in case bore, then swing front end up and lift from case. Remove synchronizer cone from shaft.
14. Slide reverse idler gear rearward and move

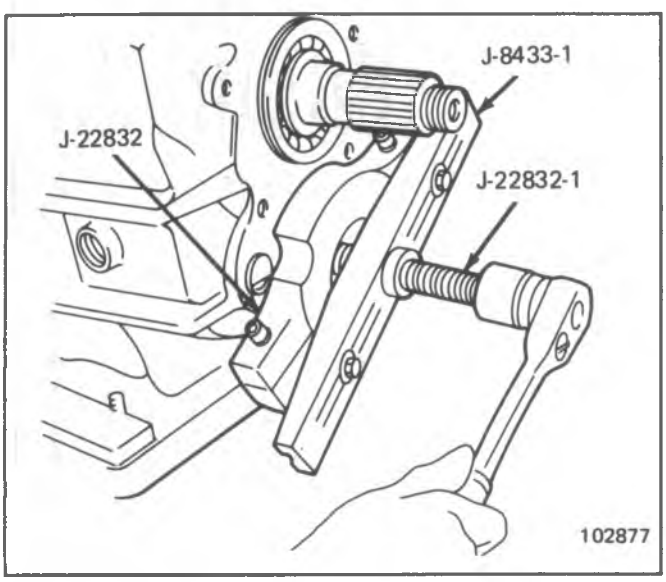


Fig. 7B4-6--Countergear Rear Bearing

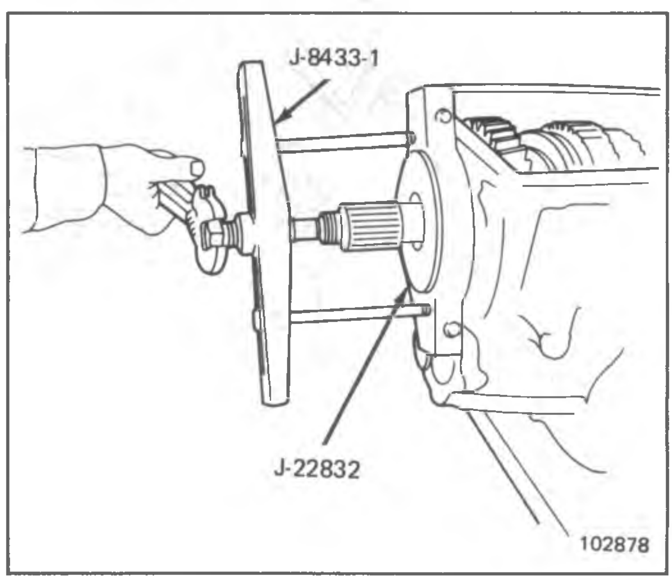


Fig. 7B4-7--Mainshaft Rear Bearing

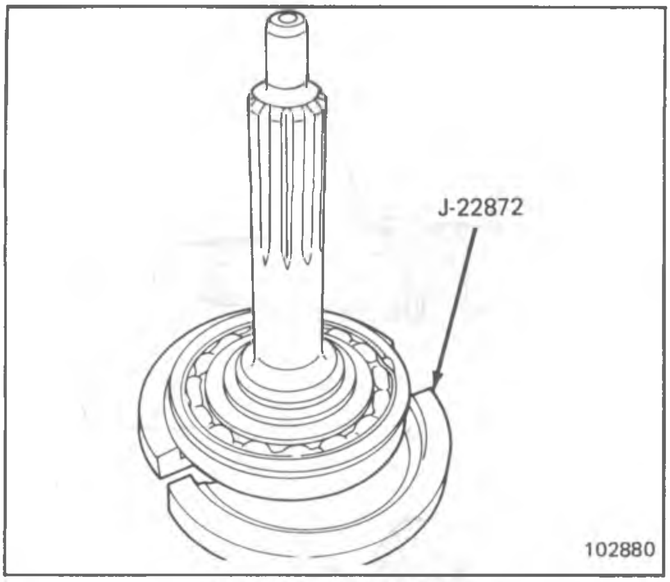


Fig. 7B4-8–Tool J-22872

countergear rearward until front end is free of case, then lift to remove from case.

15. To remove reverse idler gear, drive reverse idler gear shaft out of case from front to rear using a drive. Remove reverse idler gear from case.

DRIVE GEAR

Disassembly

1. Remove mainshaft pilot bearing rollers (17) from drive gear if not already removed, and remove roller retainer. Do not remove snap ring on inside of drive gear.
2. Remove snap ring securing bearing on stem of drive gear.
3. To remove bearing, position Tool J-22872 to the bearing (Fig. 7B4-8 and using an arbor press and Tool J-358-1 press gear and shaft out of bearing (Fig. 7B4-9).

MAINSHAFT ASSEMBLY

Disassembly (Fig. 7B4-10)

1. Remove first speed gear and thrust washer.
2. Remove snap ring in front of 3rd-4th synchronizer assembly.
3. Remove reverse driven gear.
4. Press behind second speed gear to remove 3rd-4th synchronizer assembly, 3rd speed gear and 2nd speed gear along with 3rd speed gear bushing and thrust washer (Fig. 7B4-11).
5. Remove 2nd speed synchronizer ring.
6. Supporting 2nd speed synchronizer hub at front face, press mainshaft through removing 1st speed gear bushing and 2nd speed synchronizer hub.
7. Split 2nd speed gear bushing and chisel and remove bushing from shaft. Exercise care not to damage mainshaft.

COUNTERSHAFT

Disassembly

1. Remove front countergear retaining ring and thrust washer. Discard snap ring.
2. Install Tool J-22832 or suitable press plates on countershaft, open side to spacer, (Fig. 7B4-12); support assembly in an arbor press and press countershaft out of clutch countergear assembly. Countergear is a slip fit and pressing may not be required.
3. Remove clutch countergear rear retaining ring.
4. Remove 3rd speed countergear retainining ring.
5. Position assembly on an arbor press and press shaft from 3rd speed countergear.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside using a suitable solvent, then inspect the case for cracks. The magnetic disc is glued in place, wipe with a clean cloth.
2. Check the front and rear faces for burrs and if present, dress them off with a fine mill file.

Roller Bearings and Spacers

1. All bearing rollers should be inspected closely and replaced if they show wear. Replace all worn spacers.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

   NOTICE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the race and balls.
3. Lubricate bearings with a light engine oil and check them for roughness by slowly turning the race by hand.

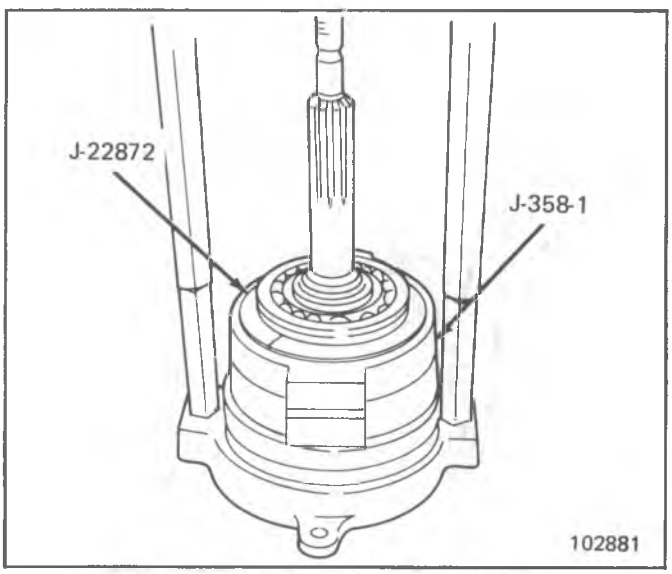
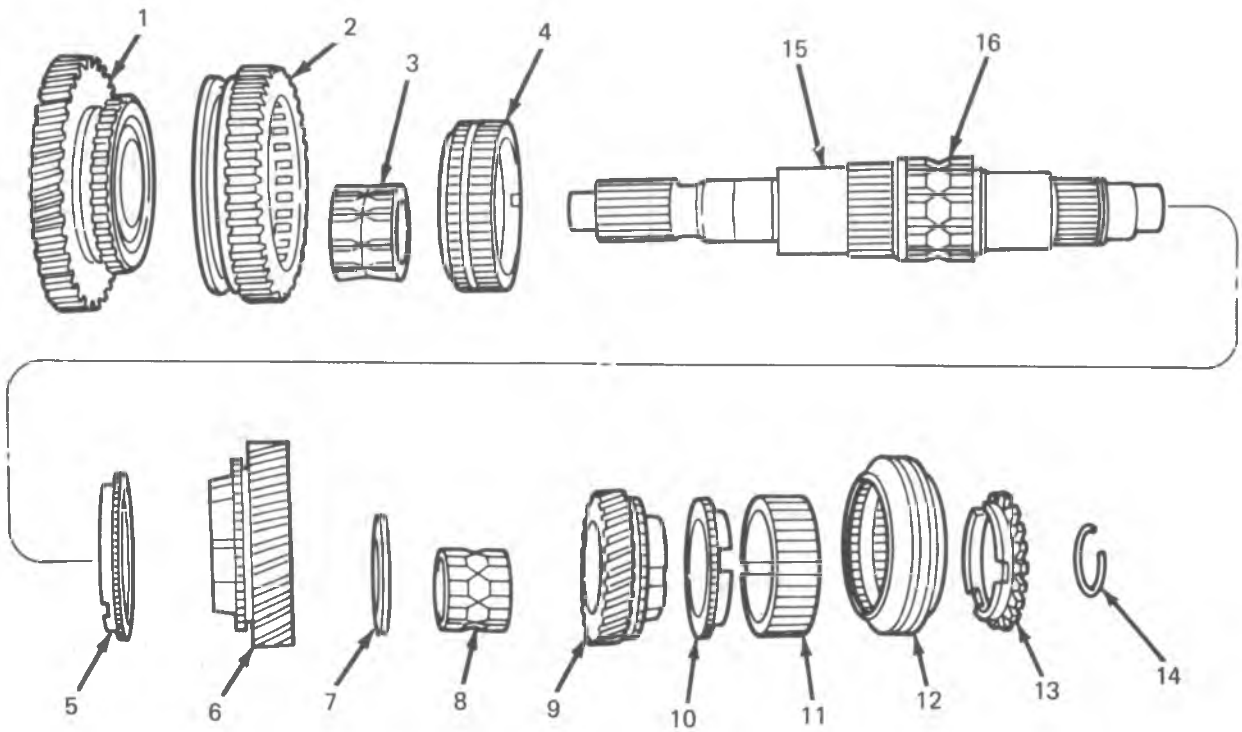


Fig. 7B4-9--Removing Drive Gear Bearing



1. 1st Speed Gear
2. Reverse Driven Gear
3. 1st Gear Bushing
4. 1st-2nd Gear Synchronizer Hub Assembly
5. 2nd Speed Blocker Ring
6. 2nd Speed Gear
7. Thrust Washer
8. 3rd Speed Bushing
9. 3rd Speed Gear
10. 3rd Speed Blocker Ring
11. 3rd-4th Speed Synchronizer Hub Assembly
12. 3rd-4th Speed Synchronizer Sleeve
13. 4th Speed Blocker Ring
14. Snap Ring
15. Mainshaft
16. 2nd Speed Gear Bushing

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Fig. 7B4-10--Mainshaft Assembly

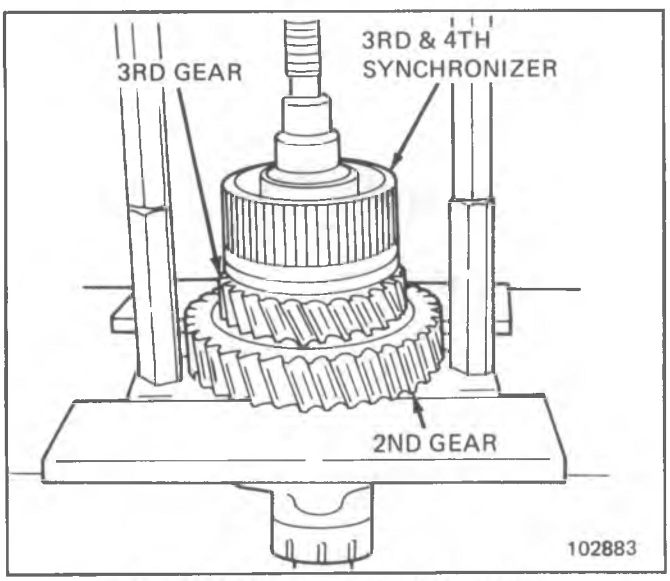


Fig. 7B4-11--Disassembly of Mainshaft

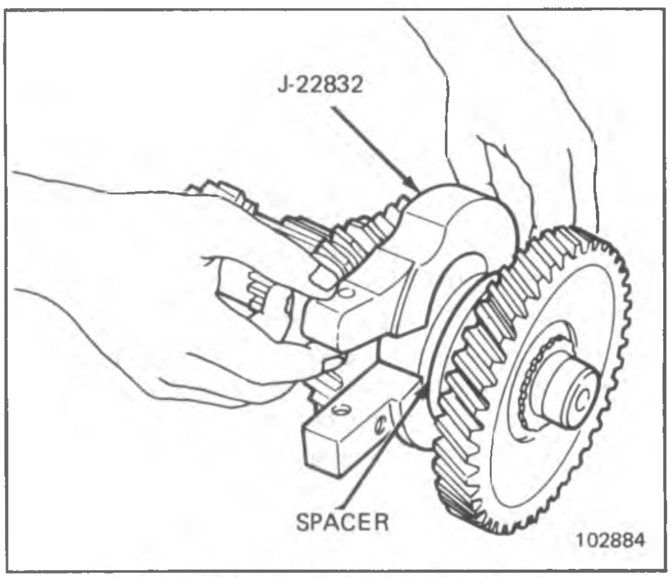


Fig. 7B4-12--Positioning Tool J-22832

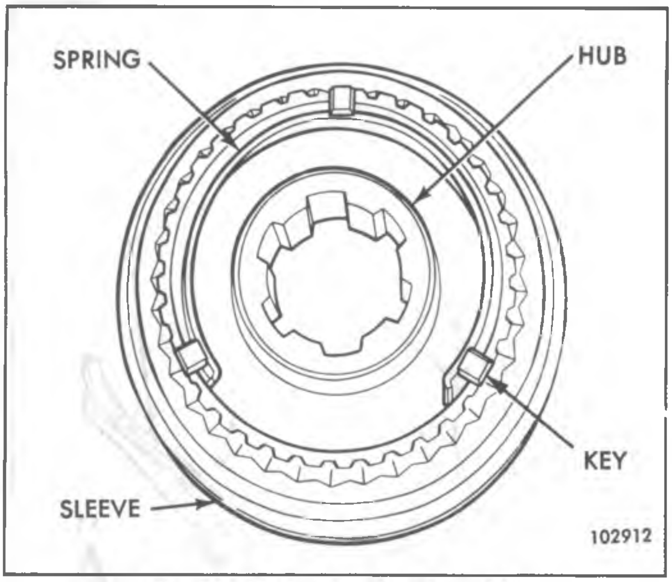


Fig. 7B4-13--Synchronizer Assembly

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Check clutch sleeves to see that they slide freely on their hubs.

REPAIRS

Synchronizer Keys and Springs

Replacement

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. If relation of hub and sleeve are not already marked, mark for assembly purposes.
2. Push the hub from the sliding sleeve; the keys will fall free and the springs may be easily removed.
3. Place the two springs in position (one on each side of hub), so all three keys are engaged by both springs (Fig. 7B4-13).

   Place the keys in position and while holding them in place, slide the sleeve onto the hub, aligning the marks made before disassembly.

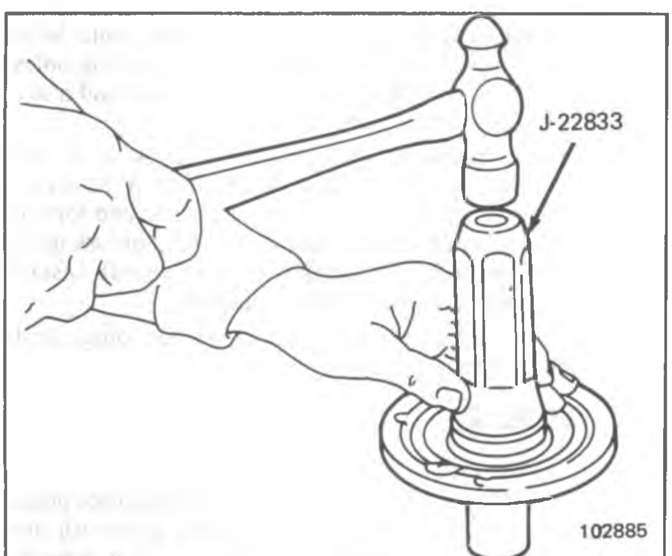


Fig. 7B4-14--Installing Bearing Retainer Oil Seal

Drive Gear Bearing Retainer Oil Seal (Fig. 7B4-14)

Replacement

1. Remove retainer and oil seal assembly and gasket.
2. Pry oil seal out of retainer.
3. Install new seal on Tool J-22833 with lip of seal toward flange of tool.
4. Support front surface of retainer in press, start seal and tool in retainer bore and drive seal into retainer until flange of tool bottoms on retainer (Fig. 7B4-14).
5. Install new gasket on retainer and install retainer on transmission case (when assembling transmission).

TRANSMISSION COVER (Fig. 7B4-15, 16)

Disassembly

1. Using a small punch, drive out pins retaining 1st-2nd and 3rd-4th shifter forks to shifter shafts and also drive out expansion plugs.

   The pin retaining the third and fourth shifter fork to the shaft must be removed, and the shifter fork removed from the cover before the reverse shifter head pin can be removed.
2. With shifter shafts in neutral position, drive shafts out of cover and shifter forks.

   NOTICE: Exercise care so shaft detent balls, springs and innerlock pin located in the cover are not lost as the shifter shafts are removed.
3. Drive out pin holding reverse shifter head and drive out the shaft.

   NOTICE: Exercise care during shaft removal since detent balls are under spring tension in the rear rail boss holes.

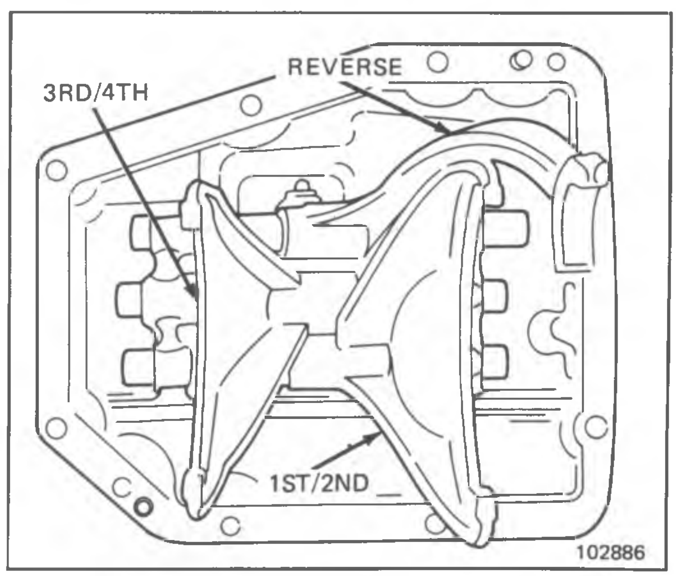
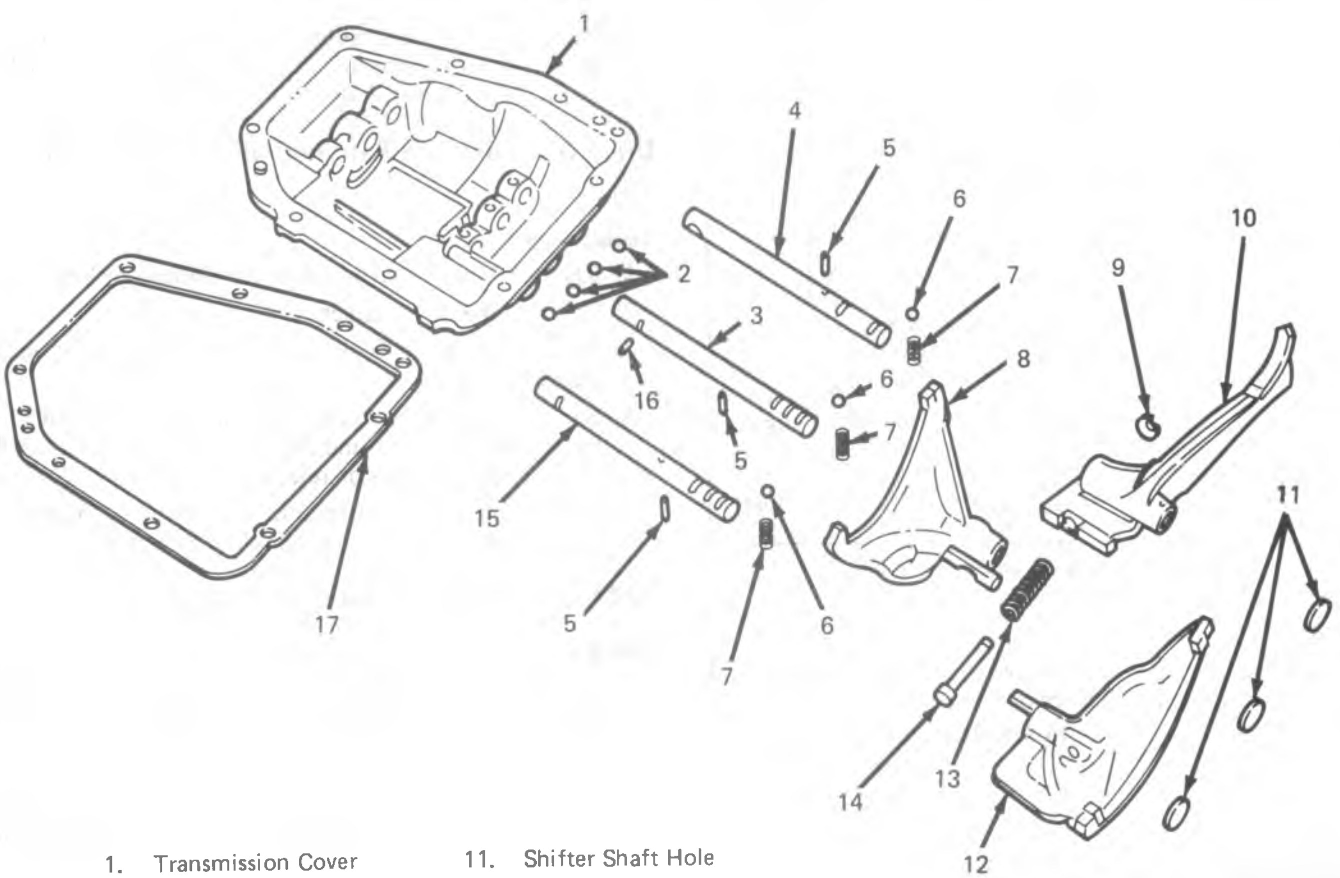


Fig. 7B4-15--Cover Assembly



1. Transmission Cover
2. Interlock Balls
3. 3rd-4th Shifter Shaft
4. Reverse Shifter Shaft
5. Fork Retaining Pin
6. Detent Ball
7. Detent Spring
8. 3rd-4th Shifter Fork
9. "C" Ring Lock Clip
10. Reverse Shifter Fork
11. Shifter Shaft Hole Plugs
12. 1st-2nd Shifter Fork
13. Interlock Plunger Spring
14. Reverse Interlock Plunger
15. 1st-2nd Shifter Shaft
16. Interlock Pin
17. Cover Gasket

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Fig. 7B4-16--Cover Assembly Exploded View

Assembly (Fig. 7B4-16)

1. In reassembling the cover, care must be used in installing the shifter shafts. They should be installed in the order shown in Fig. 7B4-15, namely, reverse, 3rd-4th, and 1st-2nd. Fig. 7B4-16 illustrates the difference in the shafts.
2. Place fork detent ball springs and balls in position in holes in cover.
3. Start shifter shafts into cover, depress detent balls with small punch and push shafts on over balls. (See Fig. 7B4-17). Hold reverse fork in position and push shaft through yoke. Install split pin in fork and shaft, then push fork in neutral position.
4. Hold 3rd and 4th fork in position and push shaft through yoke, but not through front support bore.
5. Place two interlock balls in cross-bore in front support boss between reverse and 3rd and 4th shifter shaft. Install the interlock pin in the 3rd and 4th shifter shaft hole. Apply grease to hold in place. Push 3rd and 4th shaft through fork and cover bore, keeping both balls and pin in position between shafts until retaining holes line up in fork and shaft. Install retaining pin and move to neutral position.
6. Place two interlock balls between the 1st and 2nd shifter shaft and 3rd and 4th shifter shaft in the cross-bore of the front support boss. Hold 1st and 2nd fork in position and push shaft through cover bore in fork until retainer hole and fork line up with hole in shaft. Install retainer pin and move to neutral position.
7. Install new shifter shaft hole expansion plugs and expand in place.

COUNTERGEAR

Assembly

1. Position 3rd speed countergear and shaft on arbor press and press the gear onto the shaft. Install gear with the machined surface to mate with the snap ring, toward the front (rear side of the gear is undercut). The 3rd speed gear must be installed with a load of 1500 lb. If

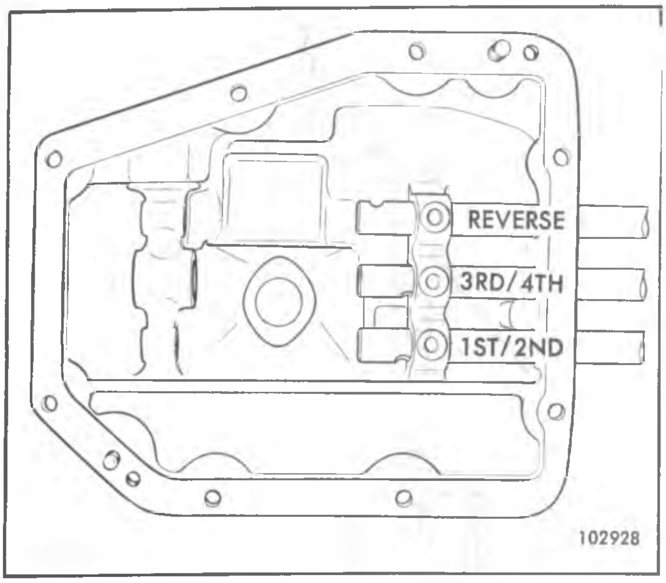

Fig. 7B4-17--Shifter Shaft Installation

the gear requires less than 1500 lbs., another gear must be selected for installation. The press fit is required for proper operation.

2. Install spacer, then press front gear on countershaft and using snap ring pliers, install snap ring.
3. Install new clutch countergear rear retaining ring using Tool J-22830-A, J-22873 and snap ring pliers as follows:

   Install Tool J-22830-A on end of shaft and position snap ring on tool (Fig. 7B4-18). Using Tool J-22873, push down on snap ring until it engages groove on shaft. Using snap ring pliers, carefully expand ring until it just slides onto splines, then push ring down shaft until it engages groove on shaft.

   NOTICE: Do not over stress snap ring or damage may occur.
4. Position clutch countergear and spacer on shaft and press countergear onto shaft against snap ring using Tool J-22873, (Fig. 7B4-19). Countergear is a slip fit and pressing may not be required.
5. Install clutch countergear thrust washer and front retaining ring using Tool J-22830-A and J-22873 (Fig. 7B4-18).

   NOTICE: Do not over stress snap ring, or damage may occur. Ring should be tight in groove without side play.

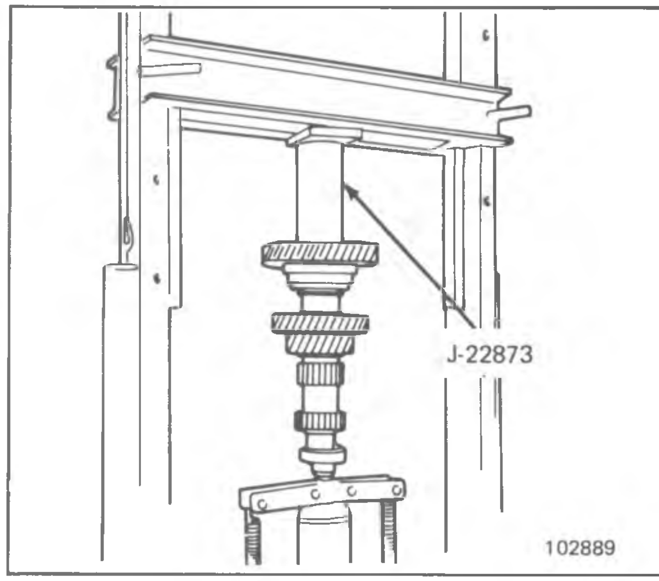

Fig. 7B4-19--Clutch Countergear

DRIVE GEAR (Fig. 7B4-20)

Assembly

1. Press bearing and new oil slinger onto drive gear shaft using Tool J-22872 (Fig. 7B4-20). Slinger should be located flush with bearing shoulder on drive gear. See Figure 7B4-21 for direction of slinger installation.

   NOTICE: Exercise care to prevent distortion of the oil slinger.
2. Install snap ring to secure bearing on drive gear shaft.

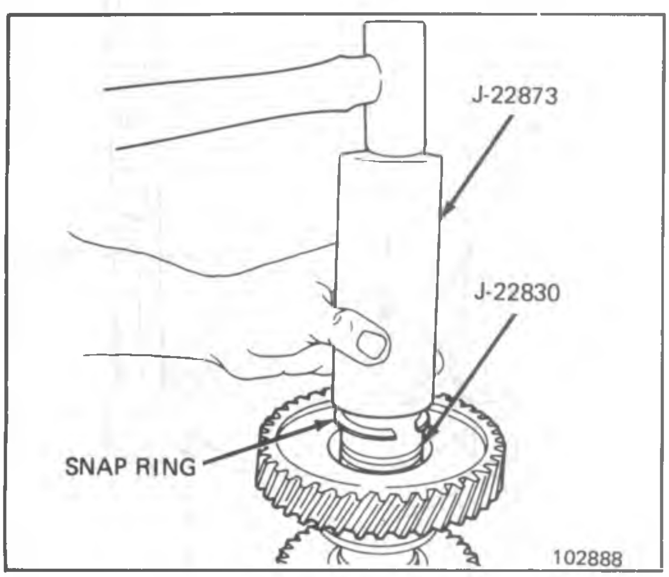

Fig. 7B4-18--Counter Gear Snap Ring

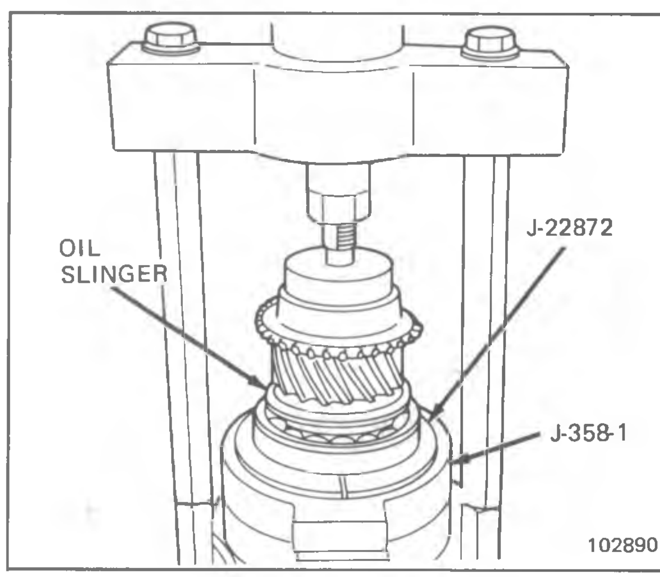

Fig. 7B4-20--Drive Gear Bearing

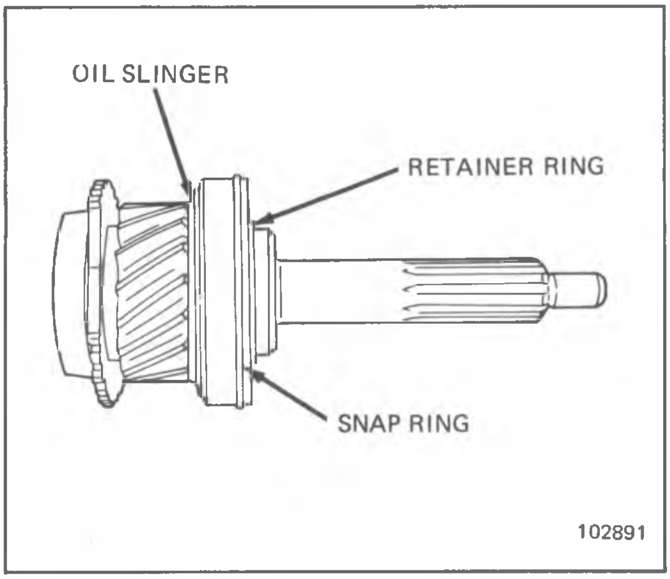

Fig. 7B4-21--Drive Gear Assembly

3. Install bearing retainer ring in groove on O.D. of bearing. The bearing must turn freely, after it is installed on the shaft.
4. Install snap ring on I.D. of mainshaft pilot bearing bore in clutch gear (if previously removed).
5. Apply a small amount of grease to bearing surface in shaft recess, install transmission mainshaft pilot roller bearings (17) and install roller bearing retainer (Fig. 7B4-22).

   This roller bearing retainer holds bearing in position and in final transmission assembly is pushed forward into recess by mainshaft pilot.

MAINSHAFT

Assembly

1. Using Tool J-22873 press 2nd speed bushing onto mainshaft until it bottoms against shoulder (Fig. 7B4-23). Lubricate bushing with E.P. oil before pressing.

   NOTICE: 1st, 2nd and 3rd speed gear bushings are

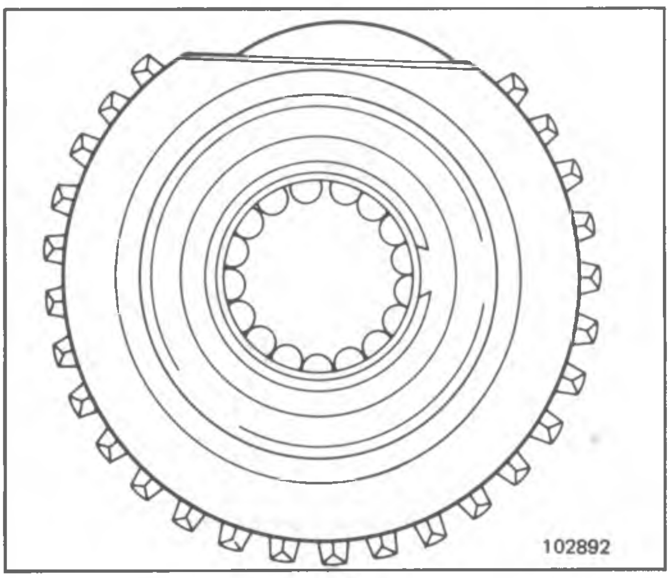

Fig. 7B4-22--Pilot Roller Bearing

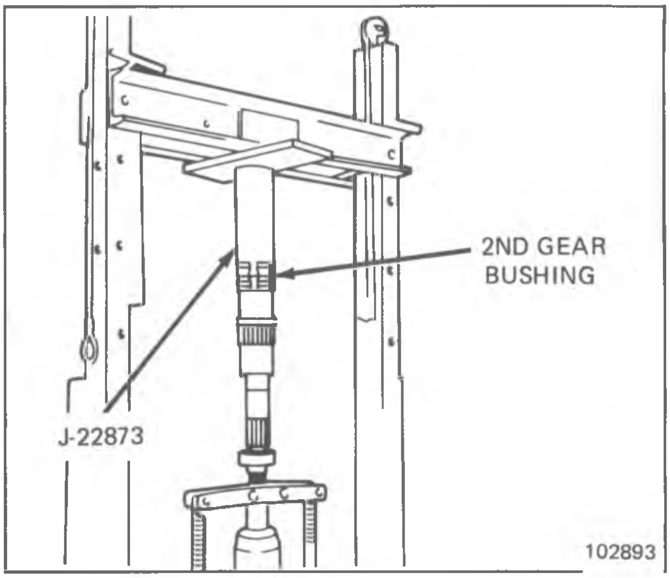

Fig. 7B4-23--2nd Speed Gear Bushing

sintered iron, exercise care when installing or damage may occur.

2. Press 1st and 2nd speed synchronizer hub onto mainshaft until it bottoms against shoulder with annulus toward rear of shaft.
3. Install 1st and 2nd synchronizer keys and springs (if previously removed).
4. Using Tool J-22873 press 1st speed gear bushing onto mainshaft until it bottoms against hub (Fig. 7B4-24). Lubricate all bushings with E.P. oil before

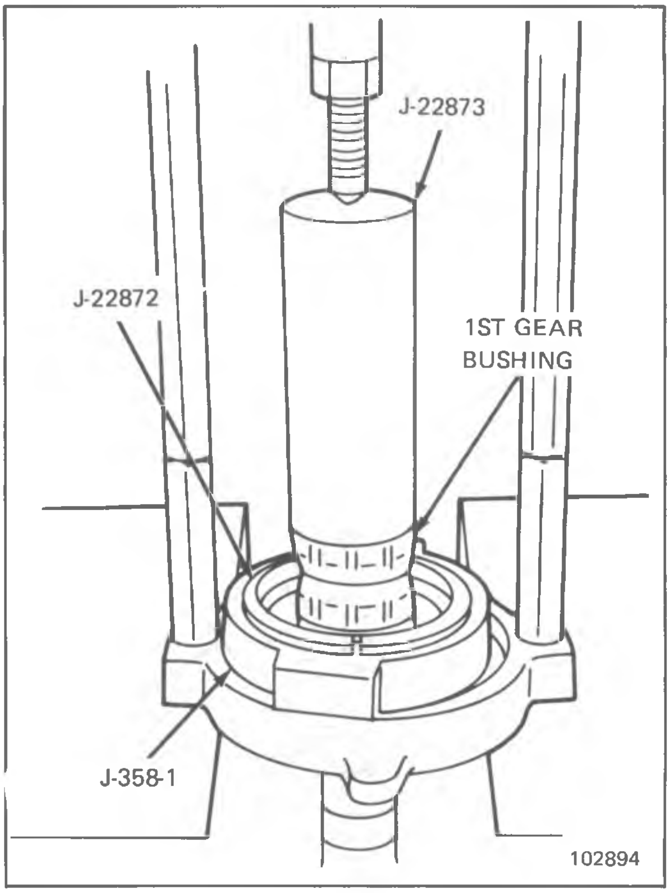

Fig. 7B4-24--1st Speed Gear Bushing

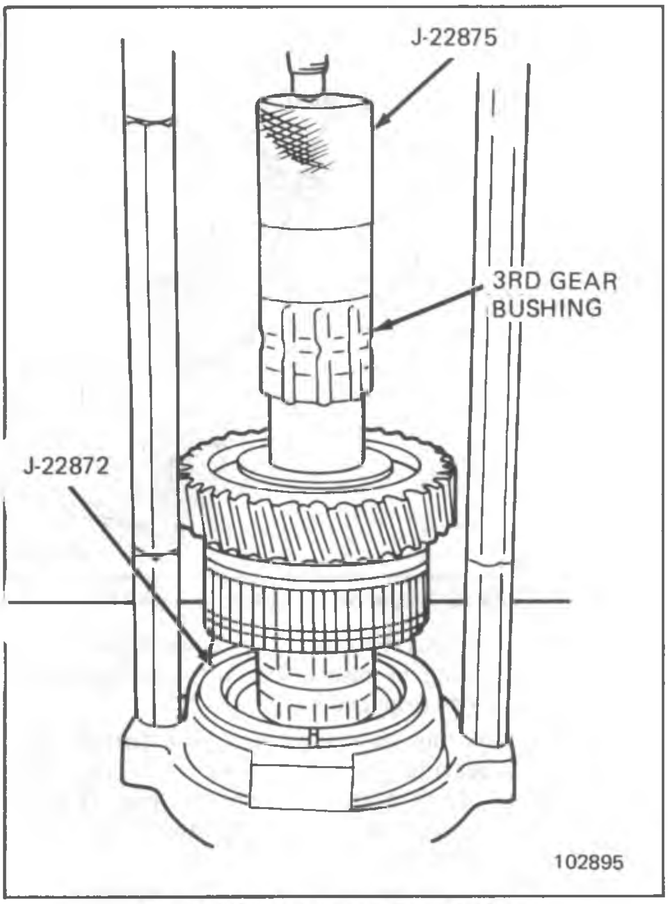

Fig. 7B4-25--3rd Speed Gear Bushing

installation of gears.

5. Install synchronizer blocker ring and 2nd speed gear onto mainshaft and against synchronizer hub. Index synchronizer key slots with keys in synchronizer hub.

6. Install 3rd speed gear thrust washer onto mainshaft with tang on thrust washer in slot on shaft and against 2nd speed gear bushing. Then press 3rd speed gear bushing onto mainshaft using Tool J-22875 until it bottoms against thrust washer (Fig. 7B4-25).

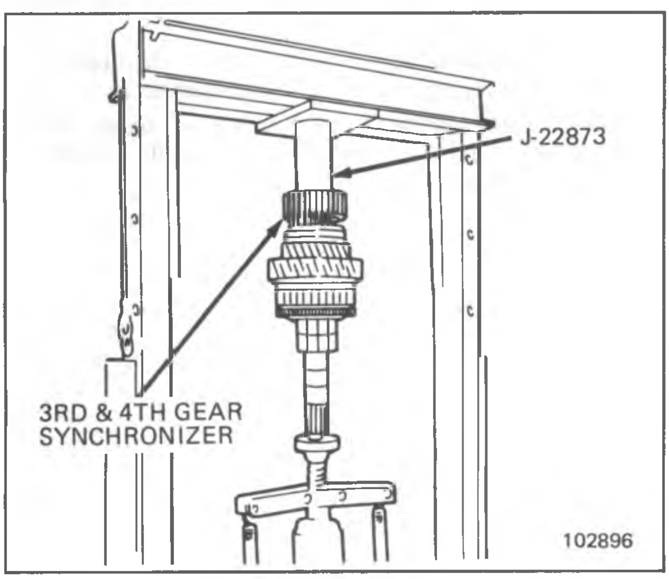

Fig. 7B4-26--3rd and 4th Gear Synchronizer

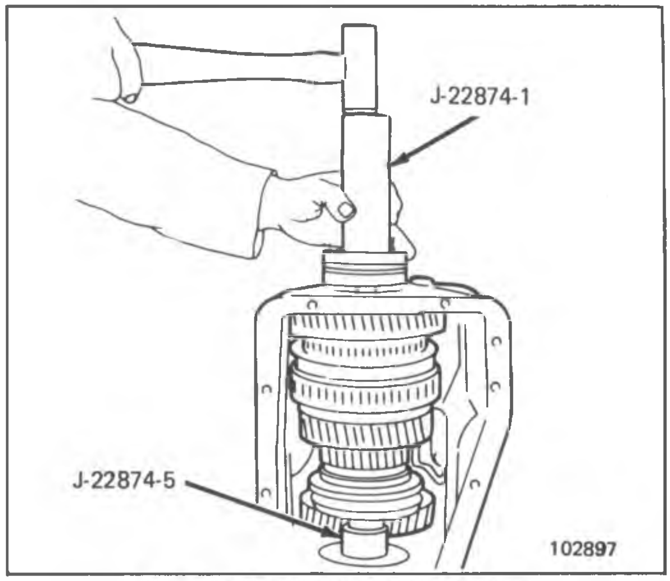

Fig. 7B4-27--Mainshaft Rear Bearing

7. Install 3rd speed gear synchronizer blocker ring and 3rd speed gear onto mainshaft, against 3rd speed gear thrust washer.
8. Index synchronizer ring key slots with synchronizer assembly keys and press 3rd and 4th synchronizer assembly onto mainshaft using Tool J-22875 and against 3rd speed gear bushing thrust face toward 3rd speed gear (Fig. 7B4-26). Retain synchronizer assembly with snap ring.
9. Install reverse driven gear with fork groove toward rear.
10. Install 1st speed gear onto mainshaft and against 1st and 2nd synchronizer hub. Install 1st speed gear thrust washer.

TRANSMISSION

Assembly

1. Lower the countergear into the case until it rests on bottom of case.
2. Place reverse idler gear in transmission case with

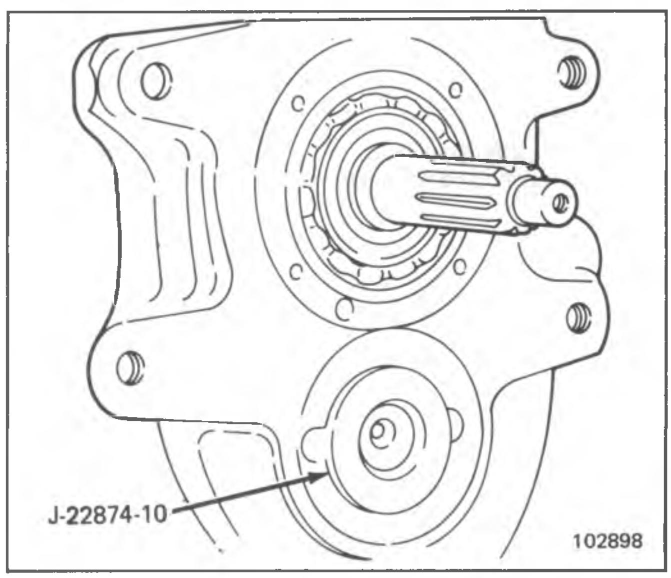

Fig. 7B4-28--Countergear Front Support Tool

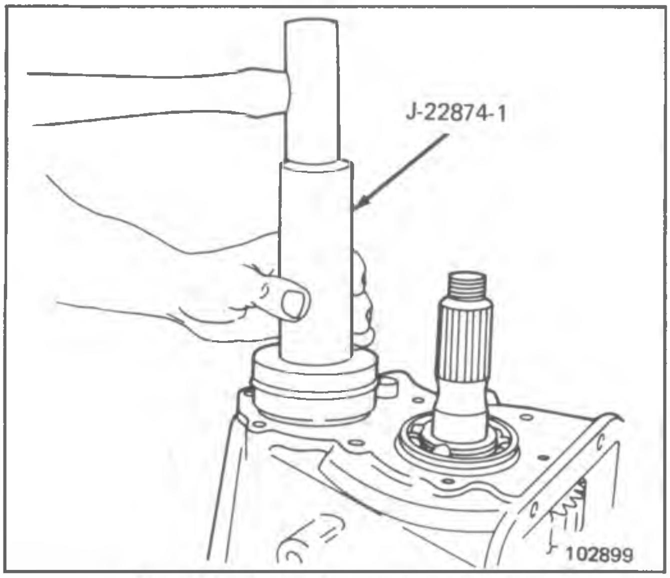

Fig. 7B4-29--Countergear Rear Bearing

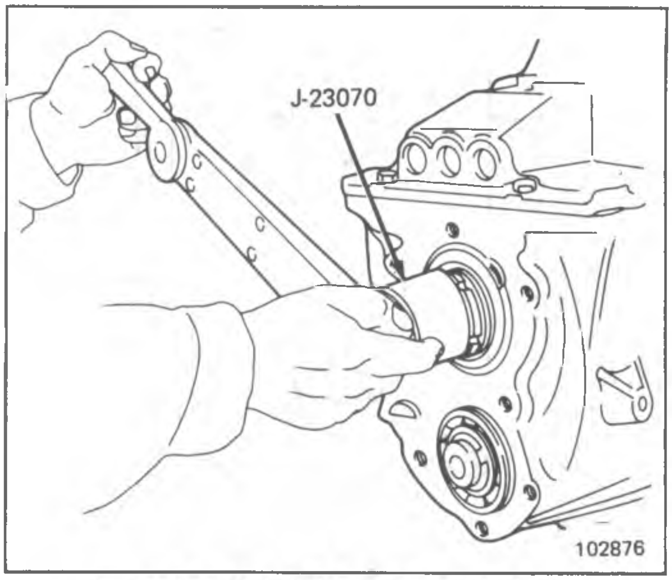

Fig. 7B4-30--Mainshaft Rear Bearing Lock Nut

gear teeth toward the front. Install idler gear shaft from rear to front, being carefuly to have slot in end of shaft in facing down. Shaft slot face must be at least flush with case.

3. Install mainshaft assembly into case with rear of shaft protruding out rear bearing hole in case. Position Tool J-22874 in clutch gear case opening and engaging front mainshaft (Fig. 7B4-27). Rotate case onto front end.

   Install 1st speed gear thrust washer on shaft, if not previously installed.
4. Install snap ring on bearing O.D. and position rear mainshaft bearing on shaft. Using Tool J-22874-1 drive bearing onto shaft and into case (Fig. 7B4-27). Rotate case and remove Tool J-22874-5.
5. Install synchronizer cone on pilot end of mainshaft and slide rearward to clutch hub. Make sure three cut out sections of 4th speed synchronizer cone align with three clutch keys in clutch assembly.
6. Install snap ring on drive gear bearing O.D. Index cut out portion of drive gear teeth to obtain clearance over countershaft drive gear teeth, and install clutch gear assembly onto case. Raise mainshaft to get clutch gear started and tap bearing outer race with plastic tip hammer.
7. Install drive gear bearing retainer using a new gasket, install bolts and torque to specifications.
8. Install appropriate tool in countergear front bearing opening in case to support countergear and rotate case onto front end. (Fig. 7B4-28).
9. Install snap ring on countergear rear bearing O.D. position, bearing on countergear and using Tool J-22874-1, drive bearing into place (Fig. 7B4-29). Rotate case, install snap ring on countershaft at rear bearing and then remove Tool J-22874-1.
10. Tap countergear front bearing assembly into case.
11. Install countergear front bearing cap and new gasket. Torque screws to specifications.
12. Slide speedometer drive gear over mainshaft to bearing.
13. Install rear bearing retainer with new gasket. Be sure snap ring ends are in lube slot and cut out in bearing retainer. Install bolts and torque to specifications. Install brake backing plate assembly on models equipped with propeller shaft brake.

    On models equipped with 4-wheel drive, install rear lock nut and washer using Tool J-23070 (Fig. 7B4-30). Torque lock nut to specifications and bend washer tangs to fit slots in nut.
14. Install parking brake drum and/or universal joint flange. Apply light coat of oil to seal surface.
15. Lock transmission in two gears at once. Install universal joint flange locknut and torque to specifications.

SPECIFICATIONS

Drive Gear Bearing Retainer to Case Bolts	32 N·m	25 ft. lb.
Cover to Case Bolts	27 N·m	20 ft. lb.
Extension and Retainer to Case Bolts — (Upper)	27 N·m	20 ft. lb.
Extension and Retainer to Case Bolts — (Lower)	40 N·m	30 ft. lb.
Lubrication Filler Plug	40 N·m	30 ft. lb.
Shift Lever to Shifter Shaft Nut	27 N·m	20 ft. lb.
Crossmember to Frame Nuts	75 N·m	55 ft. lb.
Crossmember to Mount Bolts	55 N·m	40 ft. lb.

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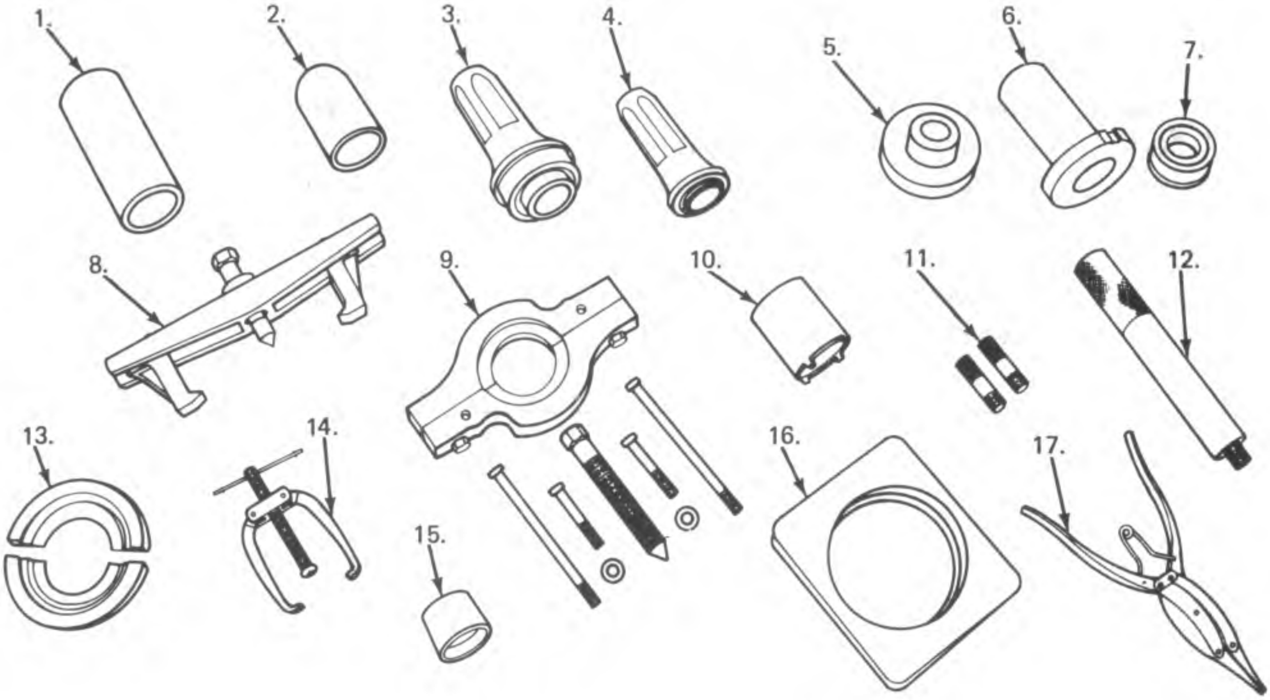
SPECIAL TOOLS



1.	J-22873	2nd Speed Bushing Installer
2.	J-22875	3rd Speed Bushing Installer
3.	J-22834	Rear Retainer Seal Installer
4.	J-22833	Front Bearing Retainer Seal Installer
5.	J-22874-1	Mainshaft Rearing Bearing Installer
6.	J-22874-5	Mainshaft Rearing Bearing Installer
7.	J-22874-10	Countergear Front Support
8.	J-8433	Bearing Puller
9.	J-22832-01	Countergear Rear Bearing Remover
10.	J-23070	Mainshaft Bearing Locknut Installer
11.	J-1126	Transmission Guide Pins
12.	J-8092	Driver Handle
13.	J-22872	Driver Gear Bearing Remover/Installer
14.	J-28509	Countergear Front Bearing Remover
15.	J-22830-A	Snap Ring Installer
16.	J-358-1	Press Plate Holder
17.	J-8059	Snap Ring Pliers

SECTION 7C
CLUTCH

CAUTION: When servicing clutch parts, do not create dust by grinding or sanding clutch disc or by cleaning parts with a dry brush or with compressed air. (A water dampened cloth — NOT SOAKED — should be used) The clutch disc contains asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

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GENERAL DESCRIPTION

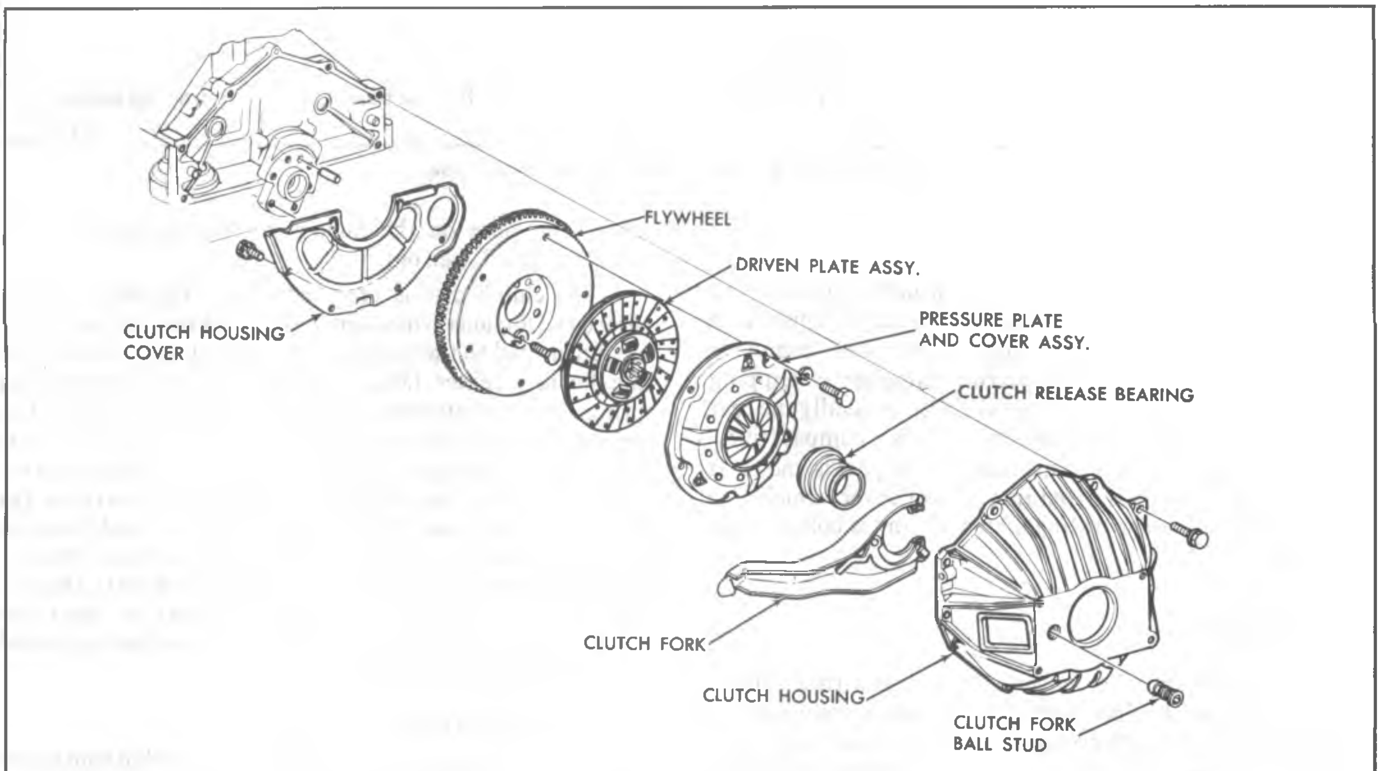


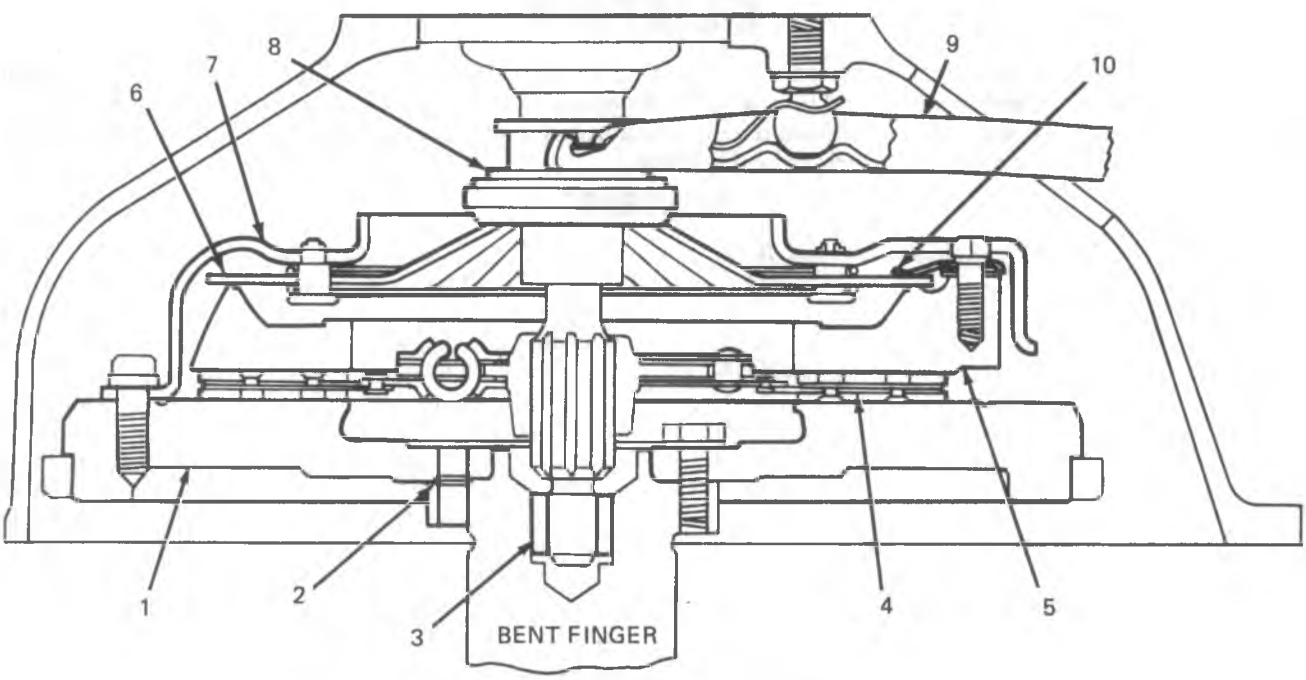
Fig. 7C-1--Clutch System Components

CLUTCH SYSTEMS

DIAPHRAGM SPRING CLUTCH

Principal Components

The principal parts of a diaphragm-type clutch system are: the driving members, attached to the engine and turning with it; the driven members attached to the transmission and turning with it; the operating members which include the spring or springs and the linkage required to apply and release the pressure which holds the driving and driven members in contact with each other. Fig. 7C-1 shows a clutch cutaway so operating members can be seen.



1. Flywheel
2. Dowel-hole
3. Pilot Bushing
4. Driven Disc.
5. Pressure Plate
6. Diaphragm Spring
7. Cover
8. Clutch Release Bearing
9. Fork
10. Retracting Spring

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Fig. 7C-2--Cross-Section View of Diaphragm-Type

Driving Members

The driving members of a clutch usually consist of two iron plates or flat surfaces machined to a smooth finish. Iron is desirable because it contains enough graphite to provide some lubrication when the driving member is slipping during engagement. One of these surfaces is usually the rear face of the engine flywheel, and the other is a comparatively heavy flat ring with one side machined. This part is known as the pressure plate. It is fitted into a steel cover, which also contains some of the operating members, and is bolted to the flywheel.

Driven Members

The driven member is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the clutch shaft, but which drives the shaft through these same splines. Grooves on both sides of the clutch disc lining prevent sticking of the plate to the flywheel and pressure plate. Suitable frictional facings are attached to each side of the clutch disc by means of brass rivets. These facings must be heat resistant since friction produces heat. The most commonly used facings are made of cotton and asbestos fibers woven or molded together and impregnated with resin or similar binding agents. Very often, copper wires are woven, or pressed into material to give it additional strength.

In order to make clutch engagement as smooth as possible and eliminate chatter, the steel segments attached to the splined hub are slightly waved, which causes the contact pressure on the facings to rise gradually as the waved springs flatten out.

The clutch disc is provided with a flexible center to absorb the torsional vibration of the crankshaft which would be transmitted to the power train unless it were eliminated. The flexible center takes the form of steel compression springs placed between the hub and the steel plate. The springs permit the disc to rotate slightly with relation to its hub until the springs are compressed and relative motion stops. Then the disc can rotate slightly backward as the springs decompress. This slight backward and forward rotation permitted by the springs allows the clutch shaft to rotate at a more uniform rate than the crankshaft, thereby eliminating some of the torsional vibration from the crankshaft and preventing the vibration from being carried back through the transmission.

Operating Members

The driving and driven members are held in contact by spring pressure. This pressure may be exerted by a one-piece conical or diaphragm spring. In the diaphragm design clutch, the clutch release bearing moves forward against the spring fingers forcing the diaphragm spring to pivot around the pivot ring, dishing the fingers toward the flywheel. The outer circumference of the spring now lifts the pressure plate away from the driven disc, through a series of retracting springs placed around the outer circumference of the pressure plate.

The clutch release bearing is a ball-thrust bearing contained in the clutch housing, mounted on a sleeve attached to the front of the transmission case.

The release bearing is moved by the clutch fork to contact the release levers and move the pressure plate to the rear, thus separating the clutch driving members from the driven member when the clutch pedal is depressed by the driver.

A return spring preloads clutch linkage, removing looseness due to wear, keeping the bearing clear of the spring fingers.

The clutch free pedal travel, therefore, will increase with linkage wear and decrease with driven disc wear. The free travel felt at the clutchpedal is release bearing lash.

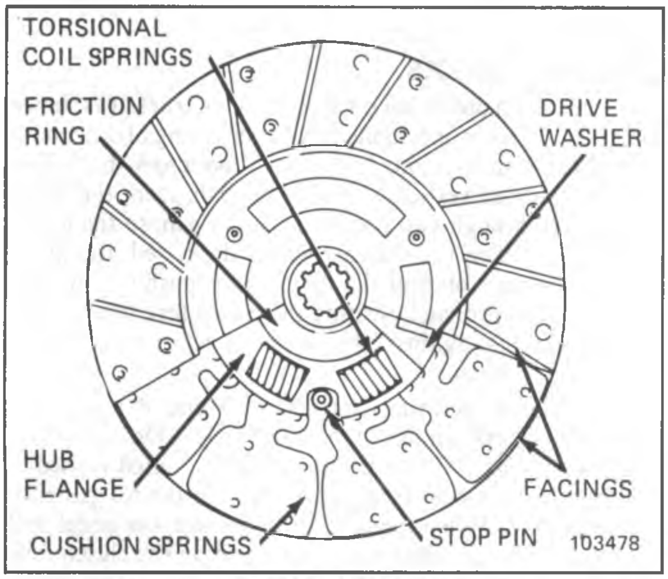


Fig. 7C-3--Clutch Disc

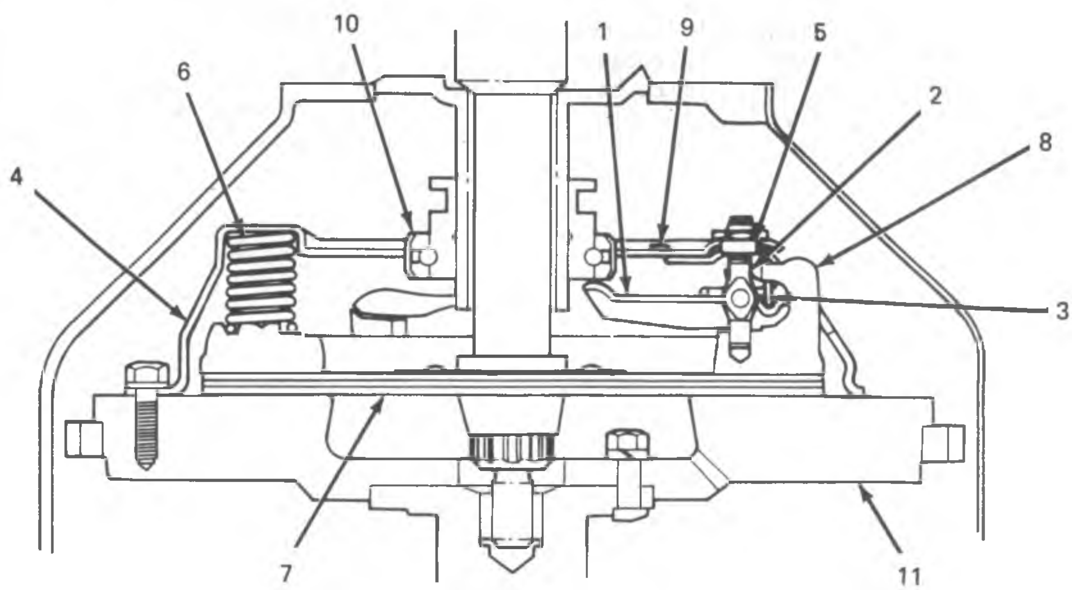
Clutch Spring Operation

In diaphragm spring type clutches, a diaphragm spring is used instead of coil springs. It is a conical piece of spring steel punched to give it greater flexibility. The diaphragm is positioned between the cover and the pressure plate so that the diaphragm spring is nearly flat when the clutch is in the engaged position. The action of this type of spring is similar to that of the bottom of an ordinary oil can. The pressure of the outer rim of the spring on the pressure plate decreases as the flat position is passed. The outer rim of the diaphragm is secured to the pressure plate and is pivoted on rings approximately 25mm (1 in.) in from the outer edge so that the application of the pressure at the inner section will cause the outer rim to move away from the flywheel and draw the pressure plate away from the clutch disc, releasing or disengaging the clutch. When the pressure is released from the inner section, the oil-can action of the diaphragm causes the inner section to move out, and the movement of the outer rim forces the pressure plate against the clutch disc, thus engaging the clutch.

COIL SPRING CLUTCH

The coil spring single plate clutch (Fig. 7C-4) is a dry disc type and no adjustment for wear is provided in the clutch itself. An individual adjustment is provided for locating each lever in manufacturing but the adjusting nut is locked in place and should never be disturbed, unless the clutch assembly is dismantled for replacement of parts.

When the clutch pedal is depressed the release bearing is moved toward the flywheel and contacts the inner ends of



1. Release Lever
2. Eyebolt
3. Strut
4. Cover
5. Adjustment Nut
6. Coil Spring
7. Drive Disc
8. Pressure Plate
9. Anti-Rattle Spring
10. Clutch Release Brg.
11. Flywheel

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Fig. 7C-4--Cross-Section View of Coil Spring Type

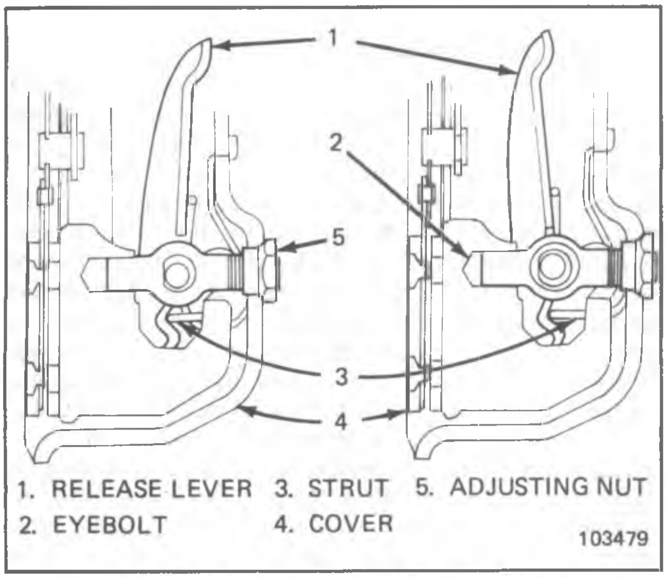

Fig. 7C-5--Release Lever, Coil Spring Type

the release levers, (refer to item 1 in Fig. 7C-5). Each release lever is pivoted on a floating pin which remains stationary in the lever and rolls across a short flat portion of the enlarged hole in the eyebolt (refer to item 2). The outer end of each release lever engages the pressure plate lug by means of a strut (3), which provides knife-edge contact between the outer end of the lever and the lug. The outer ends of the eyebolts extend through holes in the stamped cover (4), and are fitted with adjusting nuts (5) to correctly position the levers.

When the clutch system is fully engaged, the clutch disc is firmly clamped between the flywheel and the pressure plate by the pressure of the springs. When the driver disengages the clutch by depressing the pedal, the release fork is moved on its pivot, and the pressure is applied to the release bearing. The rotating race of the release bearing presses against the clutch release levers and moves them on their pivot pins. The outer ends of the release levers, being fastened to the cover, move the pressure plate to the rear, compressing the clutch springs and allowing driving members to rotate independently of the driven member. The release fork moves only on its pivot, which contacts the clutch fork ball stud. All parts of the clutch system, except the clutch release bearing and collar, rotate with the flywheel when the clutch is engaged.

When the clutch is disengaged, the release bearing rotates with the flywheel, but the driven plate and the clutch shaft rotate as dictated by the transmission gear range and vehicle speed.

CLUTCH CONTROLS

The clutch operating controls for C-K trucks (as shown in Fig. 7C-6) are a mechanical type consisting of a pendant type pedal, return spring, pedal push rod, cross-shaft, fork push rod, routed vertically, inside the cab, from the pedal lever down through two boots on the toe pan, to the cross-shaft lever. When the clutch pedal is depressed, the pedal push rod moves rotating the cross-shaft, pushing the fork push rod rearward, and pivoting the clutch fork to move the release bearing against the clutch release fingers and releasing the clutch.

The clutch operating controls for 'G' and 'P' models are a mechanical type similar to the C-K models. On 'G' models (as shown in Fig. 7C-7) a pedal pull rod is routed vertically from the clutch pedal lever down through the toe-panel to the cross-shaft. When the pedal is depressed, the pedal pull rod moves, rotating the cross-shaft, pushing the clutch fork rod rearward and pivoting the clutch fork. This action moves the release bearing against the clutch release fingers, releasing the clutch.

"P" model controls (as shown in Fig. 7C-8) have an upper pull rod connected from the clutch pedal shaft to a bell crank and a lower pull rod from the bell crank to the cross-shaft. When the pedal is depressed, the pull rods are moved rotating the cross-shaft and pushing the clutch fork rearward, thus subsequently activating the clutch release mechanism.

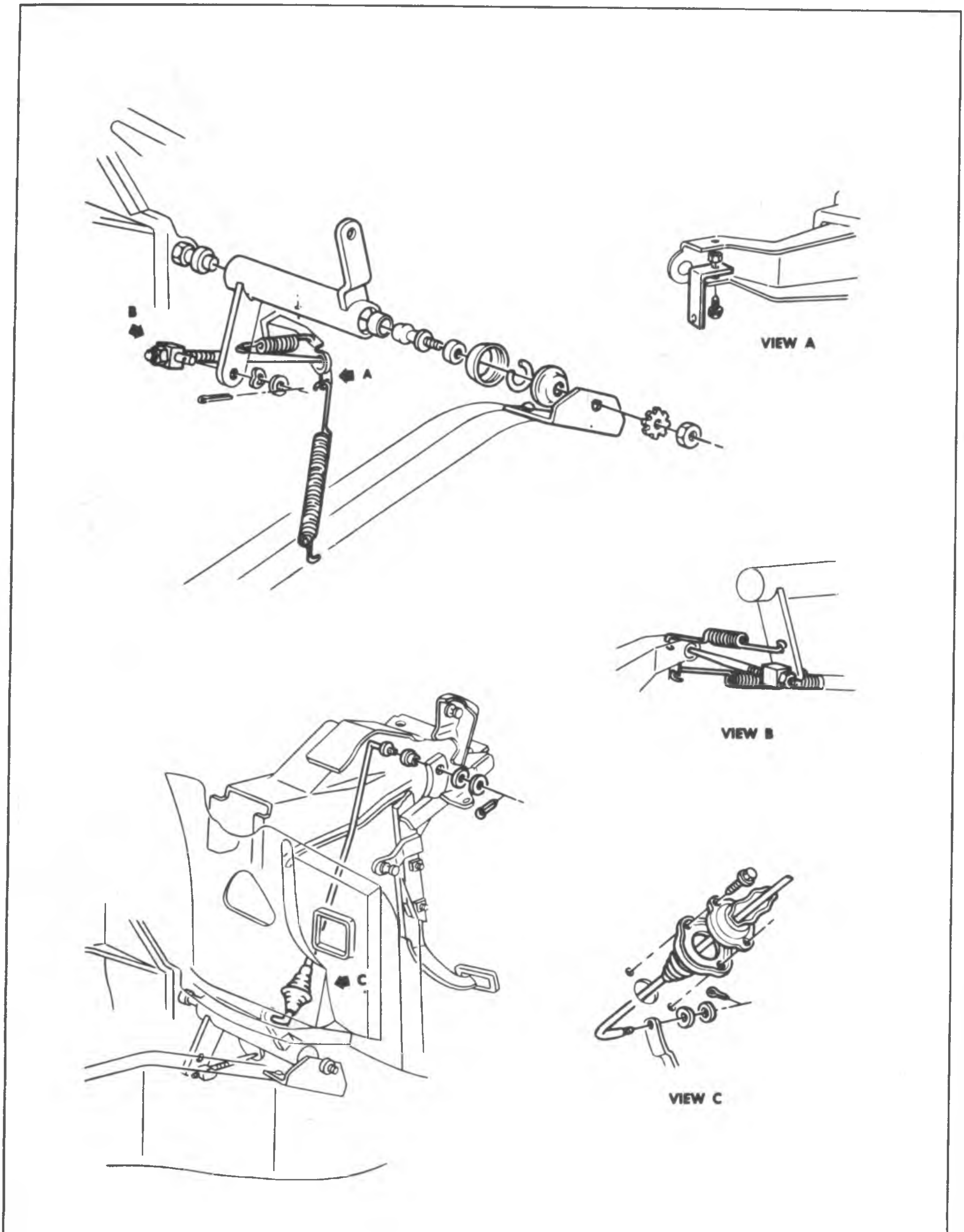

Fig. 7C-6--C-K Truck Clutch Controls

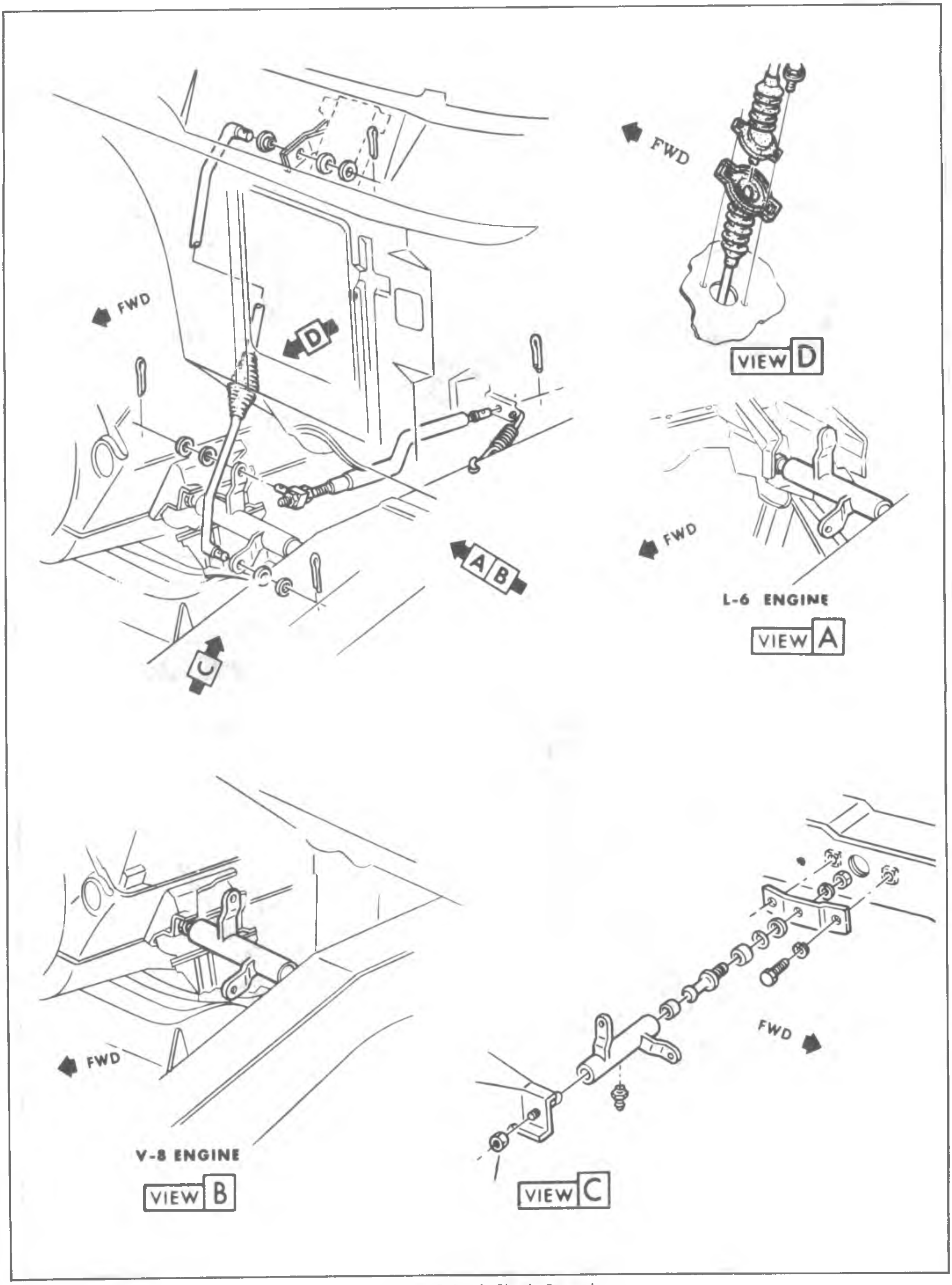

Fig. 7C-7--G-Truck Clutch Controls

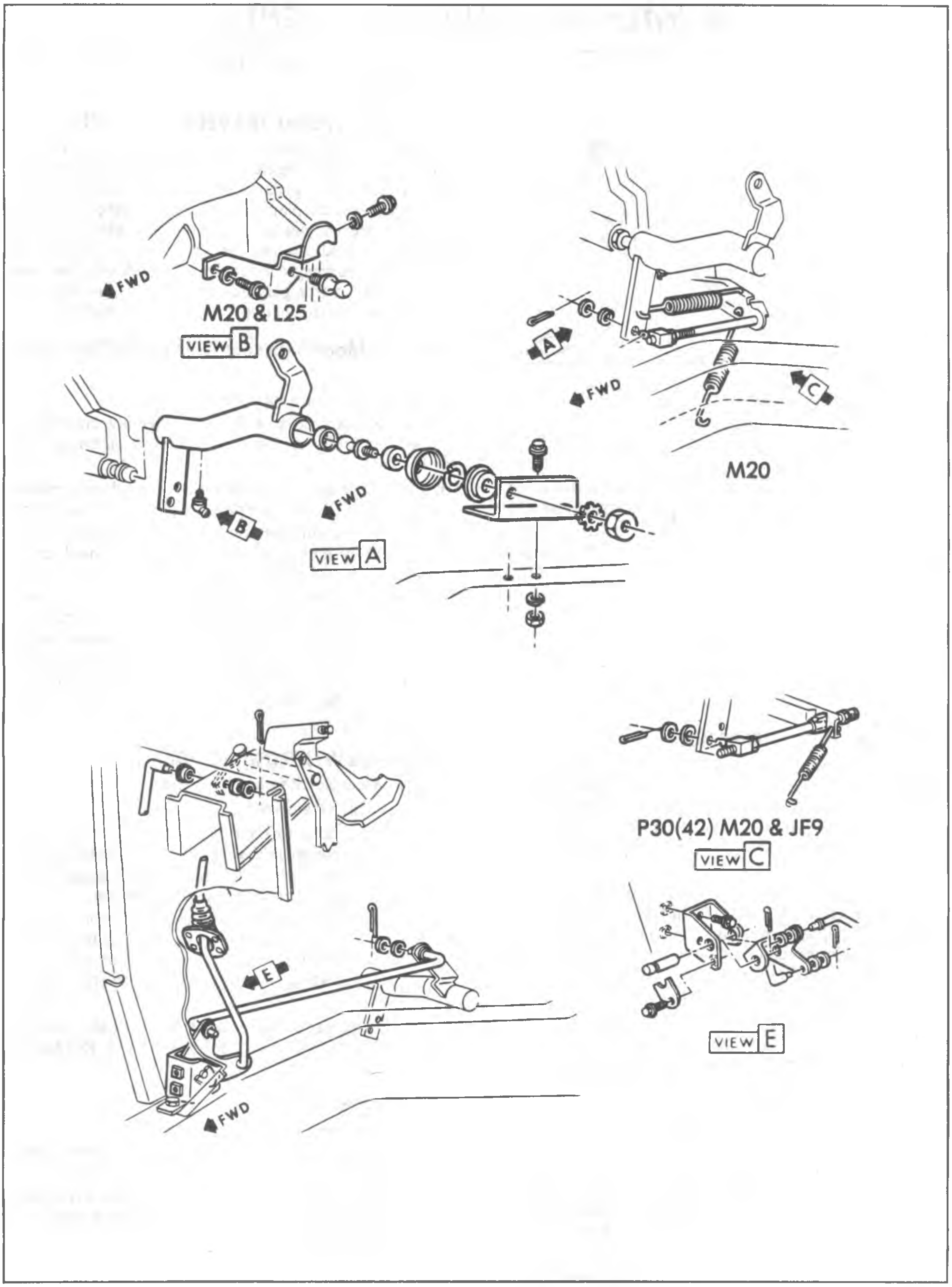

Fig. 7C-8--P-Truck Clutch Controls

MAINTENANCE AND ADJUSTMENTS

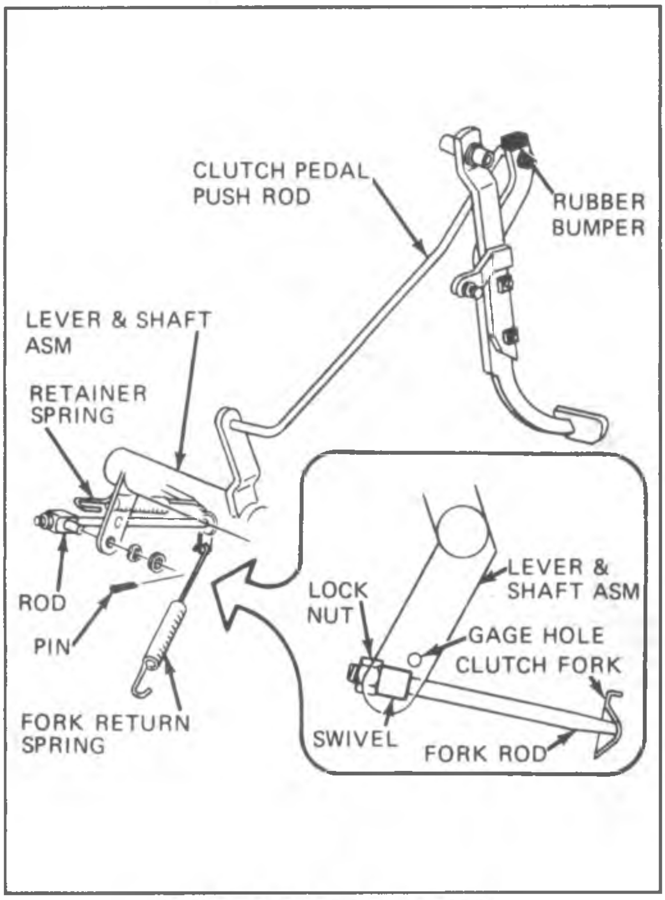

Fig. 7C-9--CK-Free Pedal Travel

CLUTCH LINKAGE INSPECTION

There are several things which affect good clutch operations. Therefore, it is necessary, before performing any major clutch operations, to make preliminary inspections to determine whether trouble is actually in the clutch.

Check the clutch linkage to be sure the clutch releases fully as follows:

1. With engine running, hold the clutch pedal approximately 12.7mm (1/2 in.) from floor mat and move shift lever between first and reverse several times. If this can be done smoothly, the clutch is fully releasing. If shift is not smooth, clutch is not fully releasing and adjustment is necessary.
2. Check clutch pedal bushings for sticking or excessive wear.
3. Check fork for proper installation on ball stud. Lack of lubrication on fork can cause fork to be pulled off the ball.
4. Check for bent, cracked or damaged cross shaft levers or support bracket.
5. Loose or damaged engine mounts may allow the engine to shift its position causing a bind on clutch linkage at the cross shaft. Check to be sure there is some clearance between cross-shaft, both mount brackets, and ball studs.
6. Check clutch release bearing end clearance between spring fingers and front bearing retainer on the transmission. If no clearance exists, fork may be improperly installed on ball stud or clutch disc may be worn out.

CLUTCH FREE PEDAL TRAVEL ADJUSTMENT

Only one adjustment is necessary to compensate for all normal clutch wear. The clutch pedal should have free travel (measured at clutch pedal pad) before the release bearing engages the clutch diaphragm spring or levers. Lash is required to prevent clutch slippage which would occur if the bearing was held against the fingers or to prevent the bearing from running continually. A clutch that has been slipping prior to free play adjustment may still slip right after the new adjustment due to previous heat damage.

C, K and P Models (Except P30 W/JF9) (Fig. 7C-9)

1. Disconnect return spring at clutch fork.
2. Rotate clutch lever and shaft assembly until clutch pedal is firmly against rubber bumper on brake pedal bracket.
3. Push outer end of clutch fork rearward until release bearing lightly contacts pressure plate fingers or levers.
4. Loosen lock nut and adjust rod length so that swivel slips freely into gauge hole. Increase pushrod length until all lash is removed from system.
5. Remove swivel from gauge hole and insert into lower hole on lever. Install two washers and cotter pin. Tighten lock nut being careful not to change rod length.
6. Reinstall return spring and check pedal free travel. Pedal travel should be 35 to 41mm (1 3/8 to 1 5/8 in.) on "C-K" Models and 31 to 37mm (1 1/4 to 1 1/2 in.) on "P" models.

P-30 Models W/JF9 (Fig. 7C-10)

1. Disconnect clutch fork return spring.
2. Loosen nut 'G' at swivel.
3. Move the clutch fork rod against fork to eliminate all clearance between release bearing and clutch fingers.
4. Rotate shaft lever until clutch pedal contacts the bumper mounted on the brake pedal bracket.
5. Rotate the fork rod until a clearance of approximately 6.35 to 7.9mm (1/4 to 5/16 in.) is obtained between the shoulder on the fork rod and the adjustment nut.
6. Tighten nut 'G' against swivel and install clutch return spring.
7. Check free pedal clearance at pedal. Pedal clearance should be 35 to 41mm (1 3/8 to 1 5/8 in.). Readjust as required.

G-Models (Fig. 7C-11)

1. Disconnect clutch fork return spring at fork.
2. Loosen nut 'A' and back off from swivel approximately 12.7mm (1/2 in.).
3. Hold clutch fork push rod against fork to move release bearing against clutch fingers (push rod will slide through swivel at cross-shaft).

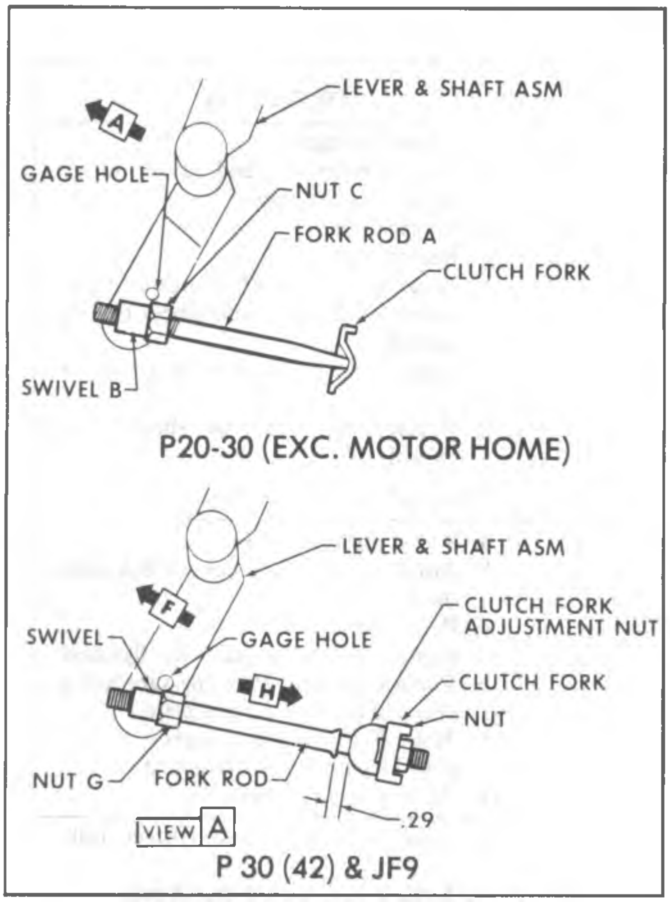

Fig. 7C-10--P-Truck Free Pedal Travel

4. Adjust nut 'B' to obtain approximately 6.35mm (1/4 in.) clearance between nut "B" and swivel.
5. Release push rod, connect return spring and tighten nut 'A' to lock swivel against nut 'B'.
6. Check free pedal clearance at pedal 31 to 37mm (1 1/4 to 1 1/2 in.) is proper clearance). Readjust if necessary.

INSUFFICIENT CLUTCH RELEASE

Where complaints of first or reverse gear clash due to insufficient clutch release are encountered, the following

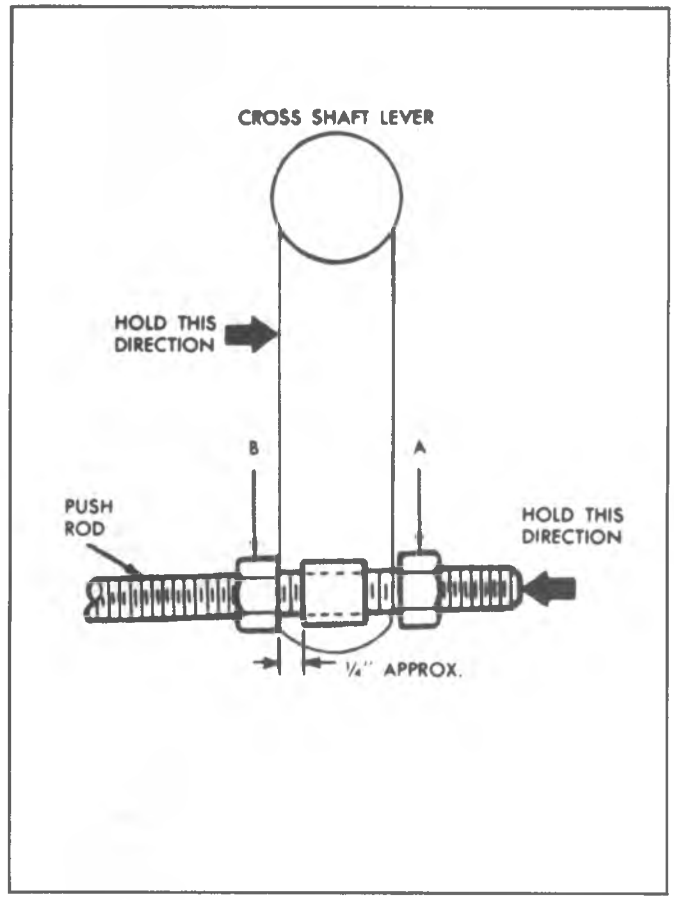

Fig. 7C-11--G-Truck Free Pedal Travel

may be helpful. Cut off the existing clutch pedal stop bumper to a height of 9.5mm (3/8 in.). Since shortening the bumper increases the lash and not the usable stroke, the lash must be reduced to specifications in order to gain the additional stroke benefit.

DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to Release (Pedal pressed to floor-shift lever does not move freely in and out of reverse gear	a. Improper linkage Adjustment b. Improper pedal travel c. Loose linkage d. Faulty pilot bearing e. Faulty driven disc f. Fork off ball stud g. Clutch disc hub binding on clutch gear spline h. Clutch disc warped or bent	a. Adjust Linkage b. Trim bumper stop and adjust linkage c. Replace as necessary d. Replace bearing e. Replace disc f. Install properly and* lubricate fingers at release bearing with wheel bearing grease. g. Repair or replace clutch gear and/or disc. h. Replace disc (run-out should not exceed .020"). *Very lightly lubricate fingers
Slipping	a. Improper Adjustment (no lash) b. Oil Soaked driven disc c. Worn facing or facing torn from disc. d. Warped pressure plate or flywheel e. Weak diaphragm spring f. Driven plate not seated in g. Driven plate overheated	a. Adjust linkage to spec. b. Install new disc and correct leak at its source c. Replace disc d. Replace pressure plate or flywheel e. Replace pressure plate (Be sure lash is checked before replacing plate.) f. Make 30 to 40 normal starts CAUTION: Do Not Overheat g. Allow to cool – check lash
Grabbing (Chattering)	a. Oil on facing. Burned or glazed facings. b. Worn splines on clutch gear. c. Loose engine mountings. d. Warped pressure plate or flywheel. e. Burned or smeared resin on flywheel or pressure plate.	a. Install new disc and correct leak. b. Replace transmission clutch gear. c. Tighten or replace mountings. d. Replace pressure plate or flywheel. e. Sand off if superficial, replace burned or heat checked parts.
Rattling-Transmission Click	a. Weak retracting springs. b. Clutch fork loose on ball stud or in bearing groove. c. Oil in driven plate damper. d. Driven plate damper spring failure.	a. Replace pressure plate. b. Check ball stud and retaining. c. Replace driven disc. d. Replace driven disc.
Release Bearing Noise with Clutch Fully Engaged	a. Improper adjustment. No Lash. b. Release bearing binding on transmission bearing retainer. c. Insufficient tension between clutch fork spring and ball stud. d. Fork improperly installed. e. Weak linkage return spring.	a. Adjust linkage. b. Clean, relubricate, check for burrs, nicks, etc. c. Replace fork. d. Install properly. e. Replace spring.
Noisy	a. Worn release bearing. b. Fork off ball stud (heavy clicking). c. Pilot Bearing loose in crankshaft.	a. Replace bearing. b. Install properly and lubricate fork fingers at bearing. c. See Section 6 for bearing fits.
Pedal Stays on Floor When Disengaged	a. Bind in linkage or release bearing. b. Springs weak in pressure plate. c. Springs being over traveled.	a. Lubricate and free up linkage and release bearing. b. Replace pressure plate. c. Adjust linkage to get proper lash, be sure proper pedal stop (bumper) is installed.
Hard Pedal Effort	a. Bind in linkage. b. Driven plate worn.	a. Lubricate and free up linkage. b. Replace driven plate.

ON VEHICLE SERVICE

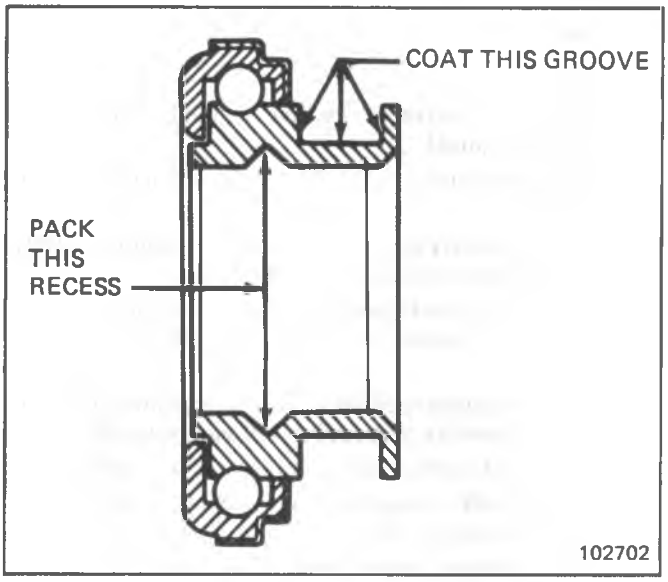

Fig. 7C-13--Lubrication Points on Clutch Release Bearing

PRELIMINARY INSPECTION

There are many things which affect good clutch operation. Therefore, it is necessary, before performing any major clutch operations, to make a preliminary inspection to determine whether or not the trouble is actually in the clutch.

1. Check the clutch pedal and make sure that the pedal has proper free travel, as described in 'Maintenance and Adjustments'.
2. Check the clutch pedal bushing for wear and for sticking on the shaft or loose mountings.
3. Lubricate the pedal linkage.
4. Tighten all front and rear engine mounting bolts.

CLUTCH DISC AND PRESSURE PLATE

(DIAPHRAGM TYPE)

Removal

1. Remove transmission as outlined in Section 7B.
2. Disconnect clutch fork push rod and pull back spring.
3. Remove clutch and flywheel housing.
4. Remove clutch fork by pressing it away from its ball mounting with a screwdriver, until the fork snaps loose from the ball or remove ball stud from rear of clutch housing. Remove release bearing from clutch fork.

   The retainer may be removed from the fork by prying out with a small screwdriver.
5. Install Tool J-5824 or a used clutch drive gear to support the clutch assembly during removal.

   Before removing clutch from flywheel, mark the flywheel, clutch cover and one pressure plate lug, so that these parts may be assembled in their same relative positions, as they were balanced as an assembly.
6. Loosen the clutch attaching bolts one turn at a time to prevent distortion of clutch cover until diaphragm spring is released.
7. Remove clutch pilot tool and remove clutch assembly from vehicle.

   The flywheel should be inspected for cracks, heat checking, flatness and other defects.

Installation

1. Install the pressure plate in the cover assembly lining up the notch mark on pressure plate with notch mark on flange of cover.
2. Install pressure plate retracting springs, lockwashers and drive strap to pressure plate bolts. Tighten to 15 N·m (11 ft. lb.) torque. The clutch is now ready to be installed.
3. Hand crank the engine until 'X' mark on flywheel is at the bottom.
4. Install clutch disc, pressure plate and cover assembly and support them with Tool J-5824 or a used clutch drive gear.
5. Turn clutch assembly until 'X' mark or painted white letter on clutch cover flange lines up with 'X' mark on flywheel.
6. Install attaching bolts and tighten each one a turn at a time to prevent distorting the cover as the spring pressure is taken up.
7. Remove clutch pilot tool.
8. Pack clutch fork ball seat with a small amount of high melting point grease. On 'P' models with J76, install a new retainer in the groove of the clutch fork if the old retainer is worn or damaged.

   Install retainer with high side up, away from bottom of the ball socket and with open end of retainer on the horizontal.

   NOTICE: Be careful not to use too much lubricant. Excessive lubricant may get on clutch fingers and cause slippage or damage may result to the clutch.
9. Replace clutch fork ball if removed from the clutch housing and snap clutch fork onto the ball.
10. Pack lubricant in the recess on the inside of the release bearing collar and coat the clutch fork groove with a small amount of graphite grease, as shown in Fig. 7C-13.
11. Install release bearing assembly to the clutch fork. Install clutch and flywheel housing to engine.
12. Assemble transmission as outlined in Section 7B.
13. Align push rod to clutch fork and attach return spring to clutch fork.
14. Adjust clutch linkage as described in 'Maintenance and Adjustments.'

CLUTCH DISC AND PRESSURE PLATE

(COIL SPRING TYPE)

Removal

1. Remove transmission as outlined in Section 7B.
2. Disconnect clutch fork push rod and pull back spring.
3. Remove clutch and flywheel housing.

4. Remove clutch fork by pressing it away from its ball mounting with a screwdriver, until the fork snaps loose from the ball or remove ball stud from rear of clutch housing. Remove release bearing from clutch fork.

   The retainer may be removed from the fork by prying out with a small screwdriver.
5. Install Tool J-5824 or a used clutch drive gear to support the clutch assembly during removal.

   Before removing clutch from flywheel, mark the flywheel, clutch cover and one pressure plate lug, so that these parts may be assembled in their same relative positions, as they were balanced as an assembly.
6. Loosen the holding screws a turn or two at a time to avoid bending rim of cover. It is advantageous to place wood or metal spacers (approximately 9.5mm-3/8 in. thick) between the clutch levers and the cover to hold the levers down as the holding screws are removed or when clutch is removed from engine. When removing driven plate be sure to mark flywheel side.
7. Remove clutch pilot tool and remove clutch assembly from vehicle.

   Inspect flywheel for heat defects, cracks, flatness, or other defects.

Installation

1. Assemble driven plate and clutch cover assembly to flywheel in accordance with marking on driven plate for flywheel side. Use Tool J-5824 or a dummy shaft to support assembly.
2. Line up the clutch assembly with 'X' mark or painted white letter with 'X' mark on flywheel, before tightening cover holding screws.
3. Tighten holding screws, a turn at a time, before removing dummy shaft.
4. Remove clutch pilot tool.
5. Pack clutch fork ball seat with a small amount of high melting point grease and install a new retainer in the groove of the clutch fork if the old retainer is worn or damaged.

   Install retainer with high side up, away from bottom of the ball socket and with open end of retainer on the horizontal.

   NOTICE: Be careful not to use too much lubricant. Excessive lubricant may get on clutch fingers and cause slippage, this may cause damage to the clutch.
6. Replace clutch fork ball if removed from the clutch housing and snap clutch fork onto the ball.
7. Pack lubricant in the recess on the inside of the release bearing collar and coat the clutch fork groove with a small amount of graphite grease, as shown in Fig. 7C-13.
8. Install release bearing assembly to the clutch fork. Install clutch and flywheel housing to engine.
9. Assemble transmission as outlined in Section 7B.
10. Align push rod to clutch fork and attach return spring to clutch fork.
11. Adjust clutch linkage as described in 'Maintenance and Adjustments.'

CLUTCH PEDAL ARM, PUSH ROD OR BUSHING REPLACEMENT (Fig. 7C-14)

C-K Models

Removal

1. Disconnect battery negative ground cable at the battery terminal.
2. Disconnect clutch push rod at the cross shaft under the vehicle.
3. Remove steering column covers. Remove screws retaining push rod boots to bulkhead.
4. Remove air conditioning duct from lower left side of instrument cluster is so equipped. (Refer to Section 1A).

   Maintain pressure on lower arm. When lower attaching bolt is removed upper section will snap upward.
5. Disconnect clutch neutral start switch from pedal arm.
6. Remove bolts attaching lower section of clutch pedal arm to the upper arm.
7. Remove lower arm and push rod from vehicle.
8. Remove pedal return spring.
9. Remove pedal pivot shaft retaining nut and pivot shaft. Insert a dummy shaft or rod through the support to hold the brake pedal components in place.
10. Remove the clutch pedal assembly from the support assembly.
11. Remove pedal bushings and spacer from pedal arm. Check pedal bumper for wear and replace as required.

Installation

1. Install new bushings and spacer in pedal arm. Components should be lubricated prior to assembly.
2. Position clutch pedal upper arm in support bracket and install pivot bolt through support and pedal arms.

   Bolt must be installed in direction shown in Fig. 7C-14 in order to clear return spring.
3. Install pivot bolt retaining nut and torque to specifications.
4. Install pull back spring to support and pedal arm.

   If previously removed connect pedal push rod to clutch pedal arm.
5. Position lower pedal arm to upper arm and install upper attaching bolt. Push down on pedal and install lower bolt. Torque to specifications.
6. Install clutch neutral start switch.
7. Install air conditioning duct.
8. Install steering column covers. Install screws retaining push rod boots to bulk head.
9. Check operation of clutch assembly and adjust clutch as required.

G and P Models (Fig. 7C-14)

Removal

1. Apply parking brake firmly. Disconnect neutral start switch from pedal arm.
2. Remove bolt at clutch pedal push rod lever, then remove lever from pedal shaft.

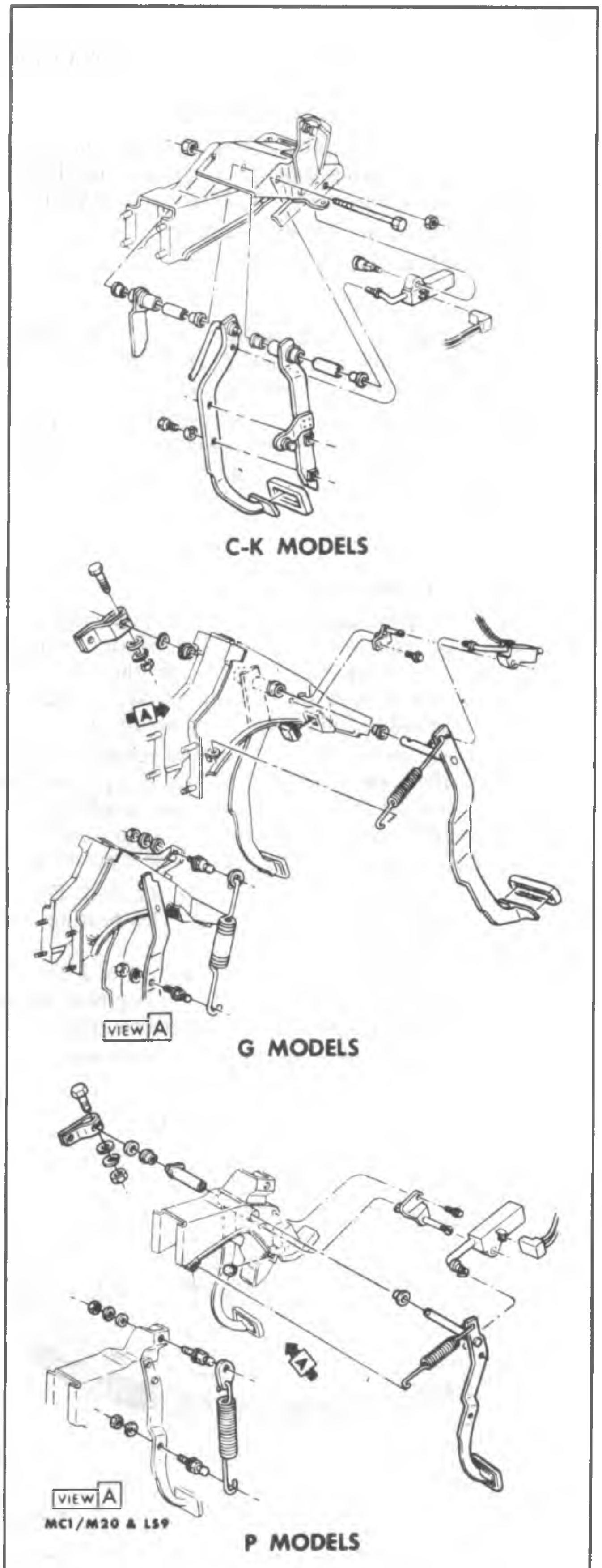

Fig. 7C-14--Clutch Pedal Mounting Attachment

3. Hold pedal pad with one hand and slide clutch pedal and shaft assembly outboard enough to clear pedal stop. Insert a dummy shaft or rod through support and brake pedal assembly to hold components in place while removing clutch pedal shaft. Allow return spring (or center spring) to pull pedal up high enough to unhook spring from pedal arm.
4. Remove pedal and shaft assembly from support bracket.

Inspection

1. Check clutch pedal bushings for excessive wear and replace as necessary.
2. Check clutch pedal shaft for wear and alignment. Straighten or replace as necessary.

Installation

Use new shaft bushing if needed. Lubricate with petrolatum.

1. Slide one pedal shaft bushing over shaft, install shaft in support enough to still clear pedal bumper stop, hook pedal return (or overcenter) spring to pedal, then rotate pedal forward of bumper stop; slide shaft into position in support and release pedal against bumper stop.
2. Install clutch pedal shaft bushing over pedal shaft end and into place in sleeve.
3. Assemble pedal push rod lever over pedal shaft and install bolts, washers, and nut.
4. Connect neutral start switch to pedal arm.
5. Adjust clutch pedal free travel as needed.

CLUTCH CROSS-SHAFT REPLACEMENT

(Fig. 7C-6, 7 and 8)

1. Disconnect clutch fork return spring at fork.
2. Disconnect pedal push rod at cross-shaft lever and allow clutch fork push rod to hang free from lower lever.
3. On C-K models, remove ball stud retaining nut, at frame end and slide shaft toward engine. Then lift cross-shaft up to clear bracket and remove shaft from the engine ball stud. On G models, remove frame bracket retaining bolts, then remove shaft from engine ball stud.
4. Remove clutch fork push rod from cross-shaft lever.
5. Reverse removal procedure to install.

UNIT REPAIR

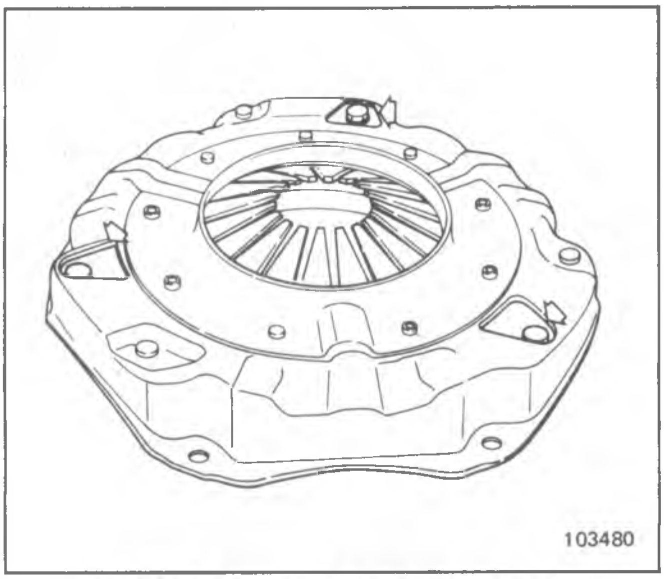

Fig. 7C-15--Retracting Spring Location (Typical)

SINGLE PLATE DIAPHRAGM CLUTCH

Disassembly (Fig. 7C-15)

NOTICE: When disassembling, mark edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

1. Remove three drive-strap to pressure plate bolts and retracting springs and remove pressure plate from clutch cover.
2. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage and if there is a defect, it is necessary to replace the complete cover assembly.

Inspection

1. Check drive straps for looseness at the clutch cover and evidence of looseness at pressure plate bolt holes.
2. Wash all parts, except driven disk and release bearing, in cleaning solvent.

   NOTICE: The release bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this will dissolve the lubricant.
3. Inspect pressure plate and flywheel for scores on the contact surfaces. Use a straight-edge and check for flatness of contact surfaces.
4. Check release bearing for roughness and free fit on the sleeve of the transmission clutch gear bearing retainer. Replace retainer if rough.
5. Inspect clutch disc for worn, loose or oil soaked facings, broken springs, loose rivets, etc. Replace if necessary.
6. Examine splines in hub and make sure they slide freely on splines of transmission clutch shaft. If splines are worn, the clutch disc or clutch gear should be replaced as necessary.
7. Inspect clutch fork ball socket and fingers for wear and ball retaining spring for damage. Spring should hold fork tightly to ball stud.

   NOTICE: Ball spring on fork may be bent in toward fork if necessary.
8. Inspect ball stud for wear. Replace if scored.
9. Check run out of transmission pilot hole in clutch housing by removing a flywheel bolt and installing a dial indicator. The run out should be within .000-.015'.
10. Lubricate ball stud before reassembly.
11. Lubricate bearing I.D. and groove before reassembly.

Assembly

1. Install the pressure plate in the cover assembly, lining up the punch marks on the edge of the pressure plate with the punch marks on the edge of the cover.
2. Install pressure plate retracting springs and drivestrap to pressure plate bolts and lock washers and tighten to 15 N·m (11 ft. lbs.) torque. The clutch is now ready to be installed.

Pilot Bearing

Replacement (Except Diesel)

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

To remove, install Tool J-1448 and remove bearing from crankshaft, as shown in (Fig. 7C-16). In replacing this bearing, use Tool J-1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.

The clutch pilot bearing used with the 6.2L Diesel Engine, is a Torrington bearing design. This bearing is a sealed unit and does not require lubrication.

To remove the bearing, use bearing puller J-23907. To install bearing, use installer J-34140. Place bearing on pilot of tool and drive into crankshaft until tool bottoms out.

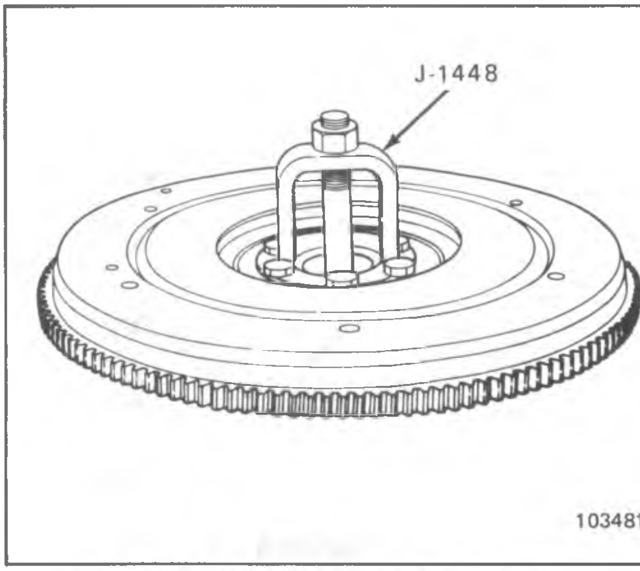

Fig. 7C-16--Clutch Pilot Bearing Removal (Typical)

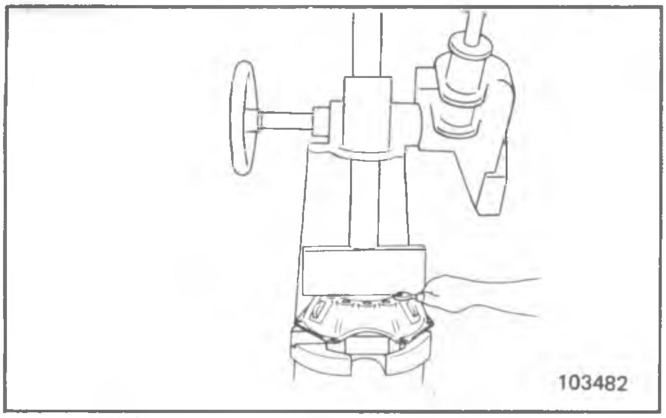

Fig. 7C-17--Compressing Clutch

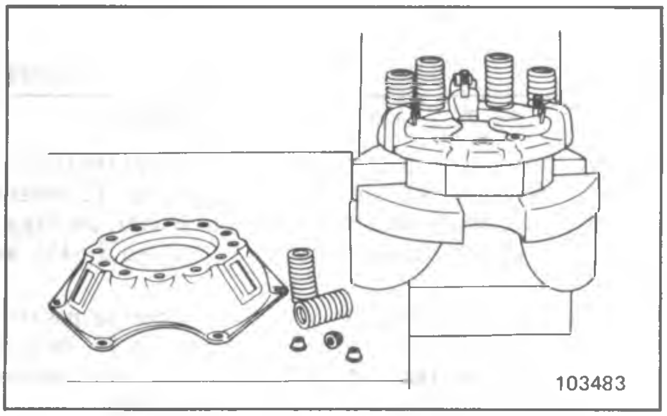

Fig. 7C-18--Disassembly of Clutch

SINGLE PLATE COIL SPRING CLUTCH

Disassembly

1. Place the cover assembly on the bed of an arbor or drill press with a block under the pressure plate so arranged that the cover is left free to move down.
2. Place a block or bar across the top of the cover with the spindle. Hold compressed while the adjusting nuts are removed, as shown in Fig. 7C-17. Then slowly release pressure to prevent springs flying out.
3. Lift off cover and all parts will be available for inspection. Note carefully the location of all parts including arrangement of springs. See Fig. 7C-18.
4. To remove levers grasp lever and eyebolt between thumb and fingers as shown in Figure 7C-19, so that inner end of lever and upper end of eyebolt are close together, keeping eyebolt pin seated in its socket in lever.

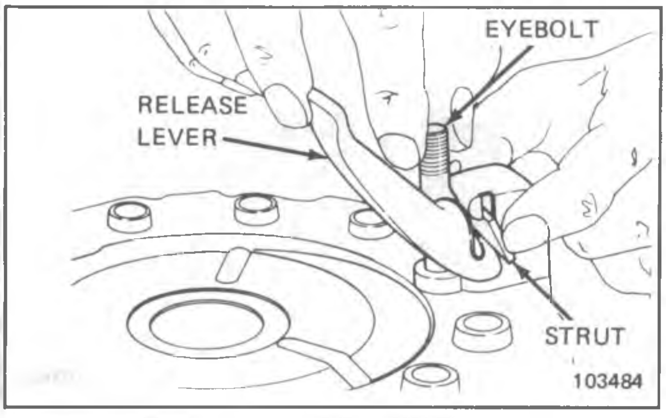

Fig. 7C-19--Grasping Lever and Strut

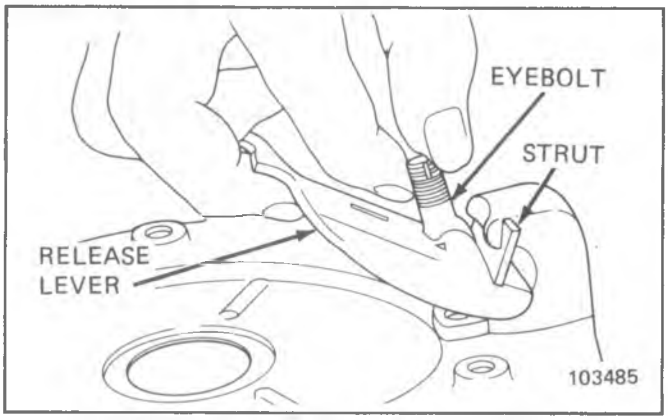

Fig. 7C-20--Removing or Installing Lever

5. Lift strut over ridge on end of lever, as in Fig. 7C-20.
6. Lift lever and eyebolt off pressure plate.

NOTICE: It is important to replace all parts which show wear, to avoid damaging other components.

Inspection

In addition to applicable items listed under Diaphragm Clutch Inspection, check the following items.

1. Check driving lugs for wear.
2. Check clutch cover for distortion or cracks.
3. Check release levers for wear or cracks.

Assembly

1. Lay the pressure plate on the block in the press and coat the lugs with a thin film of approved lubricant such as lubriplate. See Fig. 7C-21.
2. Assemble lever, eyebolt and pin, holding eyebolt and lever as close together as possible and with the other hand grasp strut as shown in Fig. 7C-22.
3. Insert strut in the slots in the pressure plate lug, drop slightly and tilt the lower edge until it touches vertical milled surface of lug.
4. Insert lower end of eyebolt in hole in pressure plate. The short end of the lever will then be under the hook of the pressure plate and near the strut, as in Fig. 7C-20.

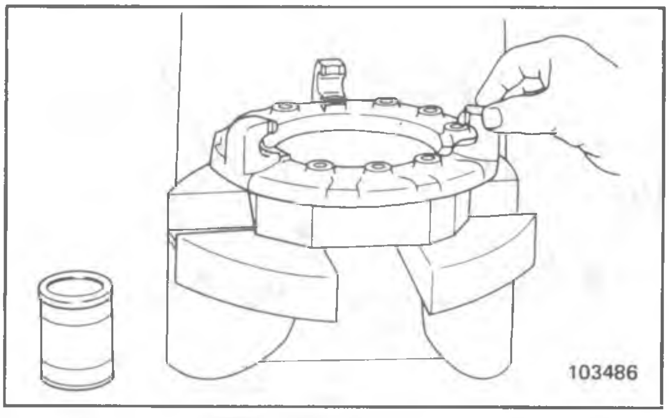

Fig. 7C-21--Greasing Lug

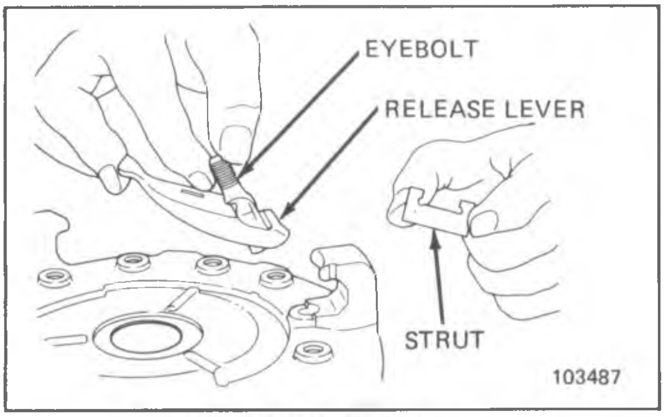

Fig. 7C-22--Installing Lever

5. Slide the strut upward in the slots of the lug, lifting it over the ridge on the short end of the lever and drop it into the groove in the lever, as shown in Fig. 7C-19.
6. Assemble the pressure springs, on the small bosses of the pressure plate in accordance with Fig. 7C-23 in order to retain original balance.

   NOTICE: If there are spaces for more springs than specified for the particular assembly, or if two different colors of springs are used, Fig. 7C-23 shows the proper sequence. It is very important that each group be arranged in like sequence.
7. Assemble anti-rattle springs in cover. See Fig. 7C-24. The spring to the left is in operating position.
8. Lower the cover on top of the assembled parts, as in Fig. 7C-25. Be sure that the anti-rattle springs are in correct position and also that the punch marks made before dismantling are matched to insure retaining the original balance.
9. Place a bar across the cover and slowly compress, guiding the holes in the cover over the pressure plate lugs and all springs into their spring seats in the cover.
10. Assemble adjusting nuts on the eyebolts and screw them down until their tops are flush with the tops of the eyebolts. Slowly release pressure of spindle and remove cover assembly from press.

Adjusting Levers

While no wear adjustment is needed because of the coil spring design, it is imperative that the clutch release

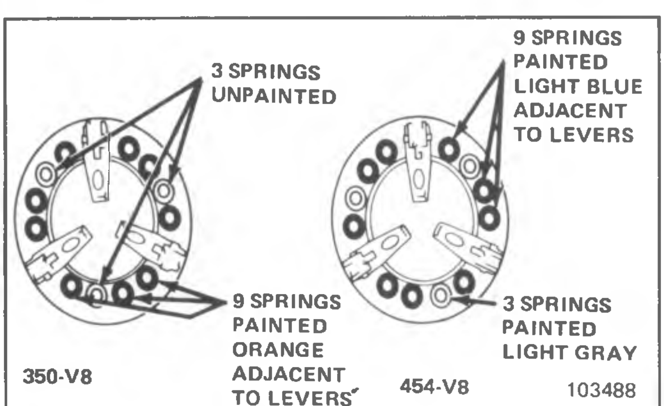

Fig. 7C-23--Spring Arrangement Diagram

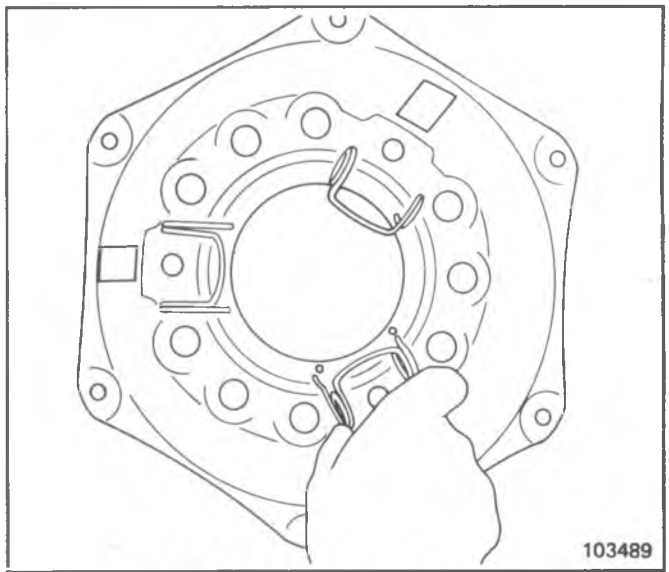

Fig. 7C-24--Installing Anti-Rattle Spring

levers are each set to exactly the same height at the time of rebuild to insure uniform clutch application. To obtain exactly the same adjustment at each release lever, use gauge plate J-1048 and release lever height gauge J-6456 as follows:

1. Place gauge plate J-1048 on the flywheel in position normally occupied by driven plate. See Fig. 7C-26. It is recommended that a spare flywheel be obtained so that this operation may be performed at the bench.
2. Bolt cover on flywheel with gauge plate center. (On assemblies with three levers, the three flat machined lands of the gauge plate must be located directly under the levers.)
3. Depress each lever several times with a hammer handle to settle all parts into working position, as shown in Fig. 7C-27.
4. Position height gauge J-6456-01 on the hub of the gauge plate and the bearing surface of one lever. Refer to Fig. 7C-28. Turn adjusting nut until lever is flush with the 12' step of J-6456-01. Adjust remaining levers in same manner.

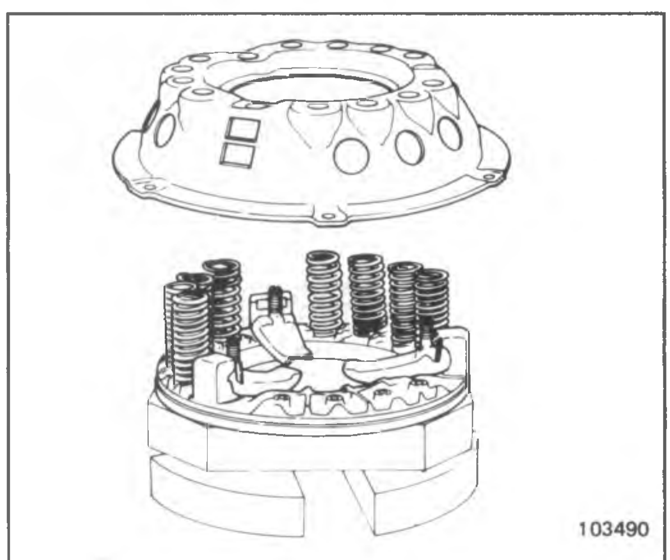

Fig. 7C-25--Assembling Cover and Pressure Plate

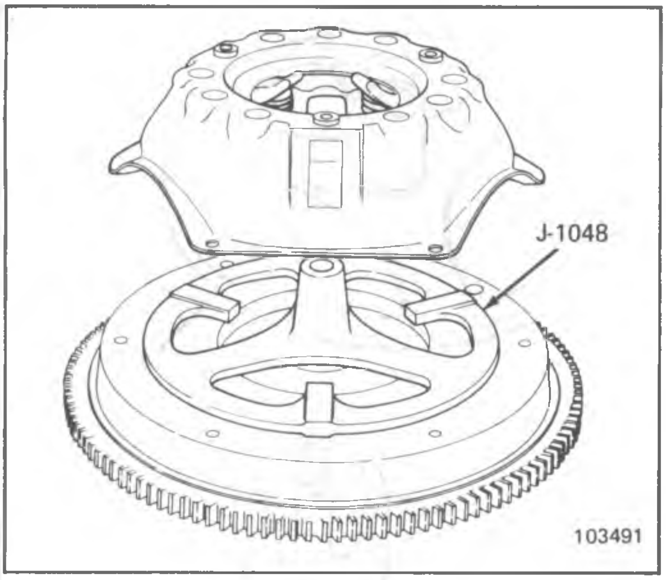

Fig. 7C-26--Gauge Plate Position

5. Stake adjusting nut, as shown in Fig. 7C-29, to eyebolt with a dull punch to lock adjustment.
6. Loosen the cover to flywheel bolts a turn or two at a time and in rotation until spring pressure is relieved to allow clutch and gauge plate to be removed.

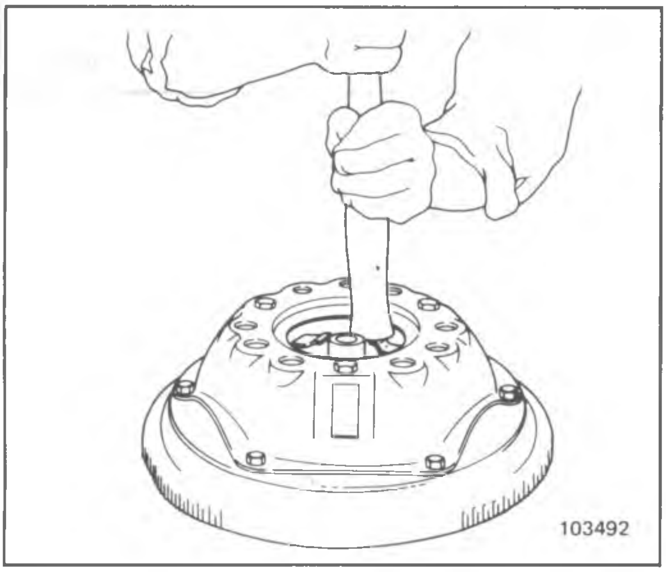

Fig. 7C-27--Depressing Lever

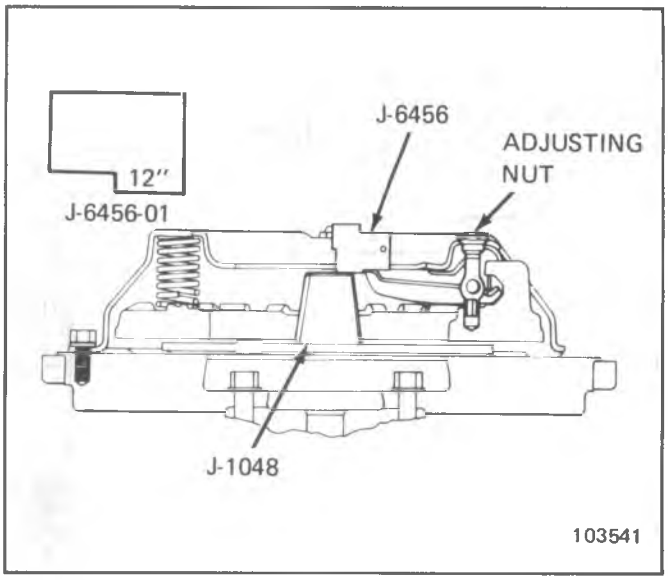

Fig. 7C-28--Coil Spring Clutch Adjustment

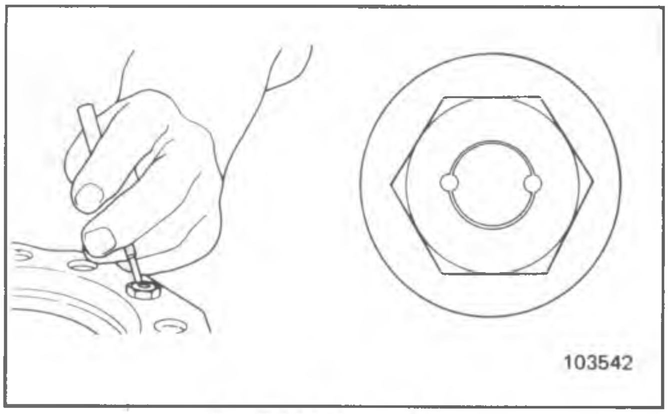

Fig. 7C-29--Staking Nut

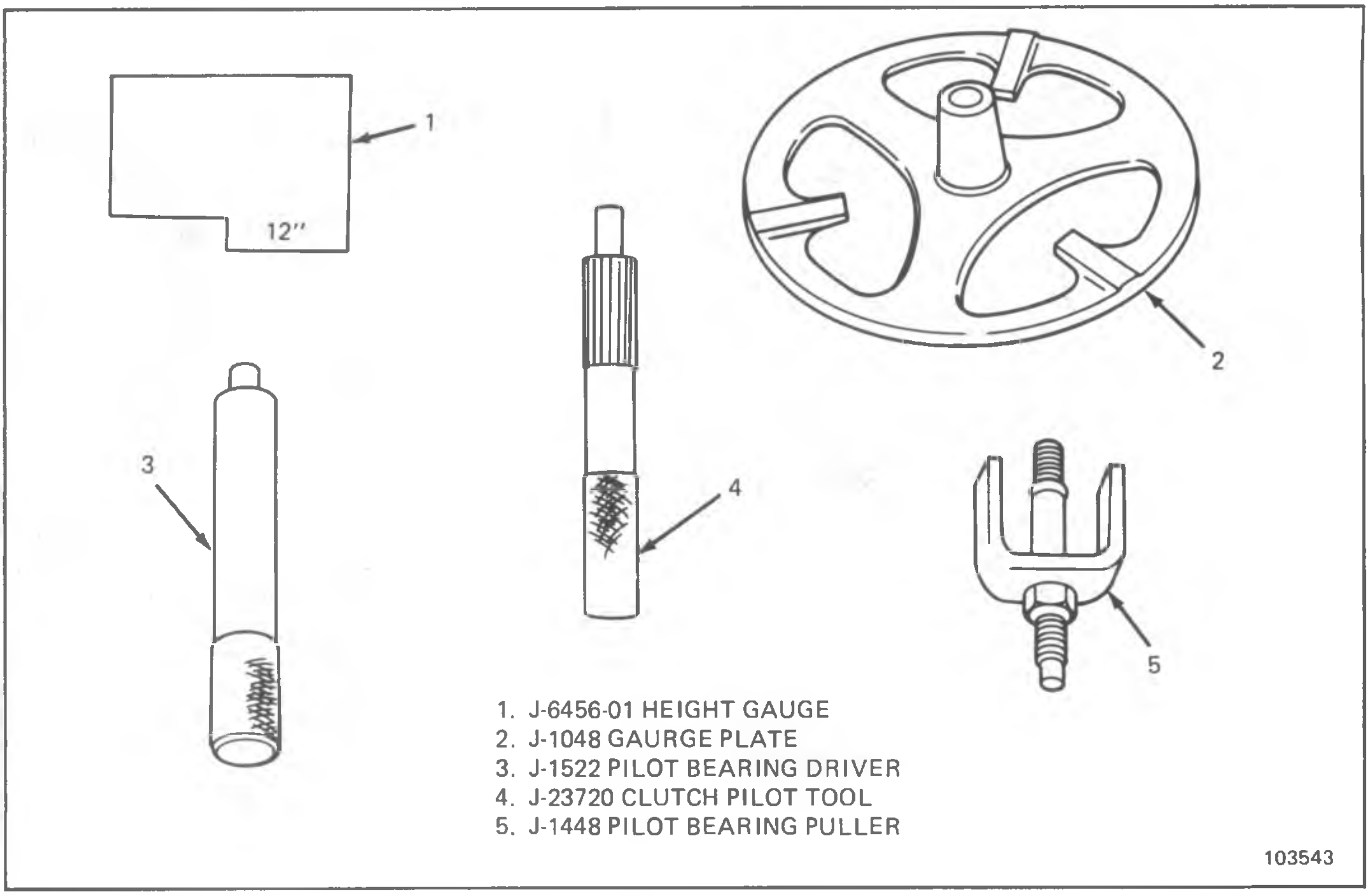

Fig. 7C-ST--Clutch Special Tools

SECTION 7D
205 TRANSFER CASE

CONTENTS

Model 205 Transfer Case (30 Series)

- General Description 7D- 1
- Maintenance and Adjustments 7D- 3
- Diagnosis 7D- 3
- On Vehicle Service 7D- 3
  - Transfer Case 7D- 3
  - Skid Plate 7D- 5
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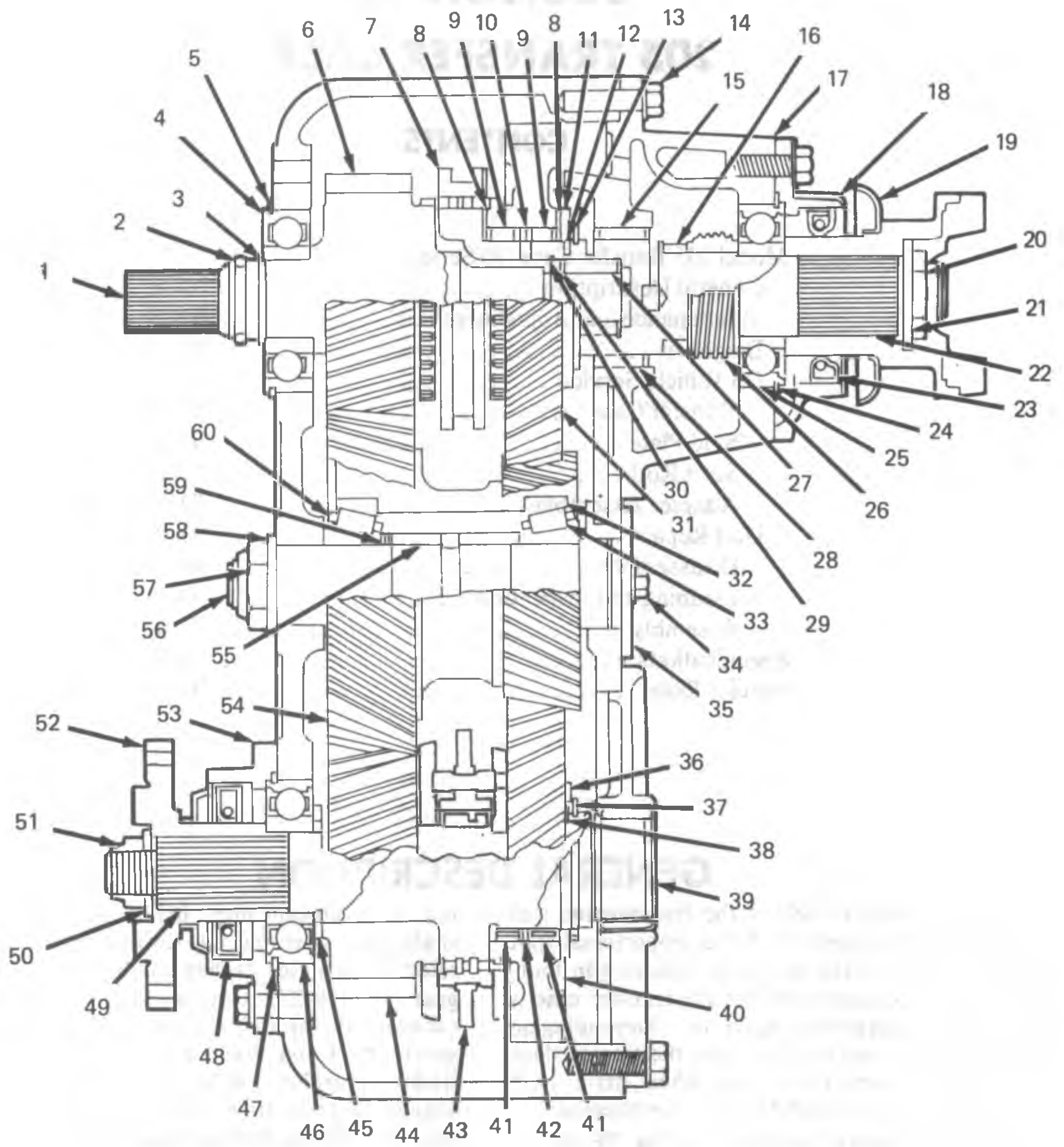
GENERAL DESCRIPTION

A transfer case mounts behind the transmission and allows drive torque to be transmitted in a proportional split to both the front axle and the rear axle, resulting in four-wheel drive. The shift control lever for the transfer case is floor-mounted in the passenger compartment. Depending on the type of transfer case and the shift lever position, various combinations of rear wheel drive, four wheel drive, high traction (gear reduction) or direct drive may be selected.

The model 205 transfer case shown in Fig. 7E-36 is a two-speed unit which can be used for either two-wheel or four-wheel drive. Direct drive (1:1 ratio) is available in two modes, 2H for two-wheel drive, or 4H for four-wheel drive. Gear reduction (1.96:1 ratio) is used in the 4L position. This unit uses constant mesh helical gears to connect the input shaft, idler gear and two output gears, thus allowing gear selection to match driving conditions. The front input shaft gear (Item #27) is in constant mesh with the idler gear (#44) and, through the idler gear, with the front output gears (#59 and #67) and the rear output gear (#17). Sliding clutches (#26, #64) allow for selective gear engagement resulting in High or Lo range, and two-wheel or four-wheel drive. Ball bearings support the input shaft, rear output shaft and front output shaft. Tapered roller bearings are used on the idler shaft. When driving in a four-wheel mode (4L or 4H) the hubs on the front wheels must be turned to the "Locked" position.



1. Input Shaft
2. "O" Ring
3. Snap Ring
4. Bearing
5. Snap Ring
6. Input Shaft Gear
7. Sliding Clutch
8. Tanged Bronze Thrust Washer
9. Roller Bearings
10. Spacer
11. Thrust Washer
12. Thrust Washer Pin
13. Snap Ring
14. Bolt and Lockwasher
15. Needle Bearings
16. Spacer
17. Rear Output Shaft Housing
18. Rear Bearing Retainer
19. Rear Yoke Assembly
20. Locknut
21. Washer
22. Rear Output Shaft
23. Bearing Retainer Seal
24. Snap Ring
25. Bearing
26. Speedometer Gear
27. Pilot Bearings
28. Rear Output Shaft Front Bearing
29. Washer
30. Bearing Retainer
31. Rear Wheel Drive Low Gear
32. Idler Gear Shaft Bearing Cup
33. Idler Shaft Bearing Cone
34. Idler Shaft Cover Bolts and Lockwasher
35. Idler Shaft Gear Cover and Gasket
36. Thrust Washer
37. Snap Ring
38. Thrust Washer Pin
39. Rear Bearing Retainer and Output Shaft Cover
40. Front Wheel Drive Low Gear
41. Roller Bearings
42. Spacer
43. Synchronizer
44. Front Wheel Hi-Gear
45. Spacer
46. Bearing
47. Snap Ring
48. Seal
49. Front Output Shaft
50. Washer
51. Locknut
52. Output Yoke
53. Bearing Retainer
54. Idler Gear
55. Idler Gear Spacer
56. Idler Shaft
57. Locknut
58. Washer
59. Bearing Cone
60. Bearing Cup

102818

Fig. 7E-36--Model 205 Transfer Case (Cross Section)

MAINTENANCE AND ADJUSTMENTS

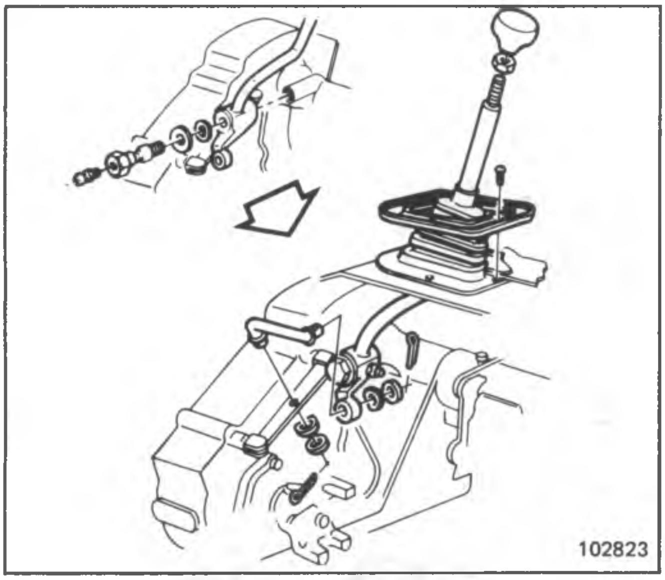


Fig. 7E-37--Model 205 Linkage

LUBRICATION INFORMATION

Refer to Section 0B of this manual for detailed information on recommended intervals and types of lubricant.

LINKAGE ADJUSTMENT AND INSPECTION

The control linkage for the transfer part-time case is shown in Fig. 7E-37. Periodically inspect the linkage system for freedom of operation, proper engagement, loose attaching bolts foreign material, etc. Adjust, clean and tighten as necessary.

DIAGNOSIS

COMPLAINT	POSSIBLE CAUSES	REMEDIES
Excessive Noise	1. Lubricant level-low 2. Worn or damaged bearings 3. Misalignment of drive shafts or universal joints 4. Yoke bolts loose 5. Loose adapter bolts	1. Fill as required 2. Replace 3. Align 4. Torque to specs. 5. Torque to specs.
Shifter Lever Difficult to Move	1. Binding inside transfer case	1. Repair as required
Shifter Lever Disengages from Position	1. Gears worn or damaged 2. Shift rod bent 3. Missing detent ball or spring	1. Replace 2. Replace 3. Replace
Lubricant Leaking	1. Excessive lubricant in case 2. Leaking seals or gaskets 3. Loose bolts 4. Scored yoke in seal contact area	1. Adjust level 2. Replace 3. Tighten 4. Refinish or replace

Fig. 7E-38--Transfer Case Diagnosis

ON VEHICLE SERVICE

TRANSFER CASE

Removal (Fig. 7E-39)

1. Raise and support vehicle on hoist. Drain transfer case.
2. Disconnect speedometer cable.
3. Remove skid plate and crossmember supports as necessary.
4. Disconnect rear prop shaft from transfer case and tie up away from work area.
5. Disconnect front prop shaft from transfer case and tie up shaft away from work area.
6. Disconnect shift lever rod from shift rail link.
7. Support transfer case and remove bolts attaching transfer case to transmission adapter.
8. Move transfer case to rear until input shaft clears adapter and lower assembly from vehicle.

Installation

1. Support transfer case in suitable stand and position case to transmission adapter. Install bolts attaching case to adapter and torque to 61 N·m (45 ft. lb.).
2. Remove stand.
3. Install connecting rod to shift rail link or connect shift

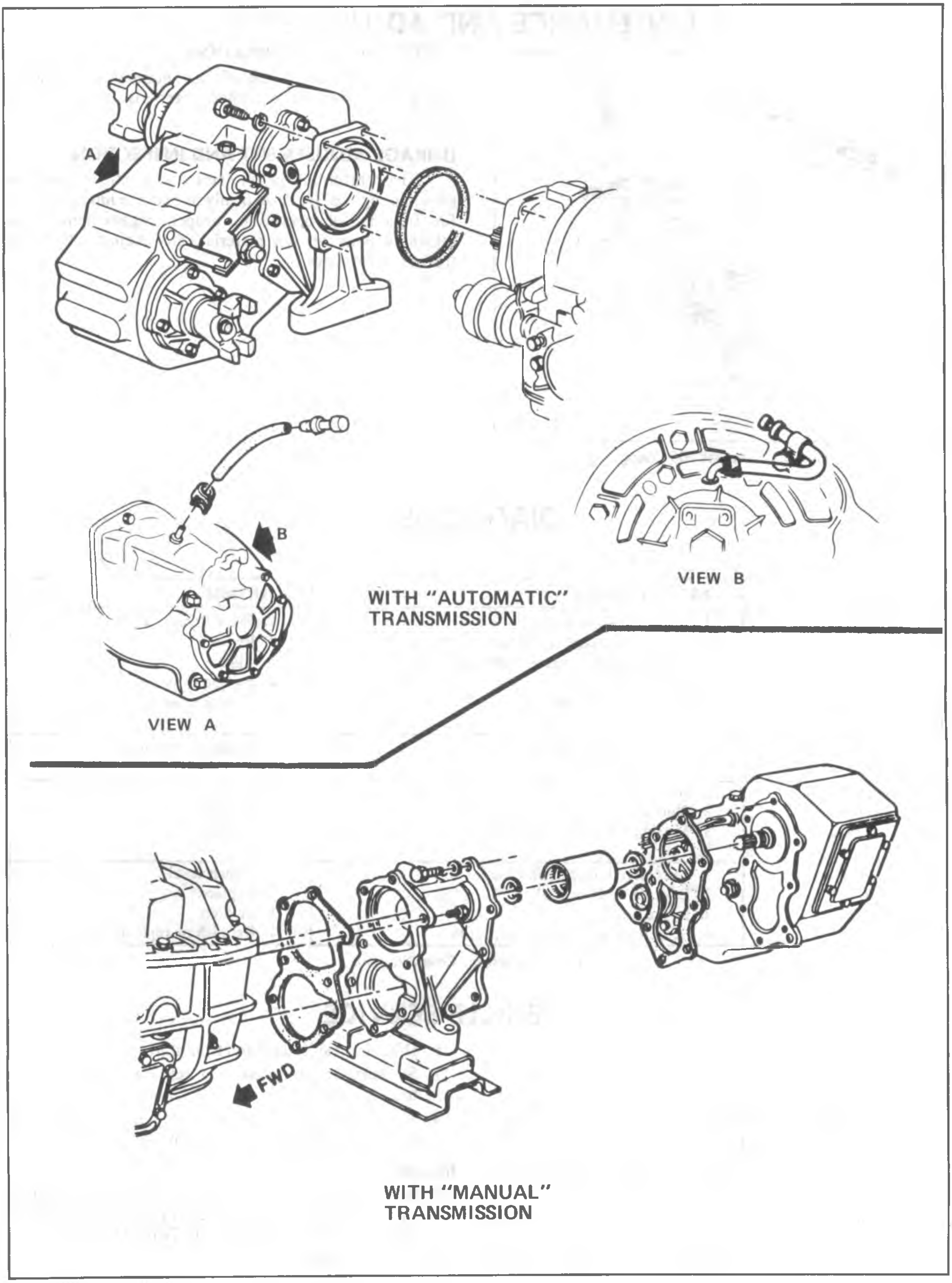


Fig. 7E-39--Transfer Case Attachment-Typical levers to transfer case, as applicable.

4. Connect front prop shaft to transfer case front output flange or yoke.
5. Connect rear prop shaft to transfer case rear output yoke.
6. Install crossmember support and skid plate, if removed.
7. Connect speedometer cable.
8. Fill transfer case to proper level with lubricant specified in Section 0B.
9. Lower and remove vehicle from hoist.
   Check and tighten all bolts to specified torques.
   Before connecting prop shafts to companion flanges, be sure locknuts are torqued to specifications.

SKID PLATE
STRUT ROD
ADAPTER ASSEMBLIES

Attachment of the above items is shown in Fig. 7E-39, 40 and 41. Refer to these figures when removing or replacing these components.

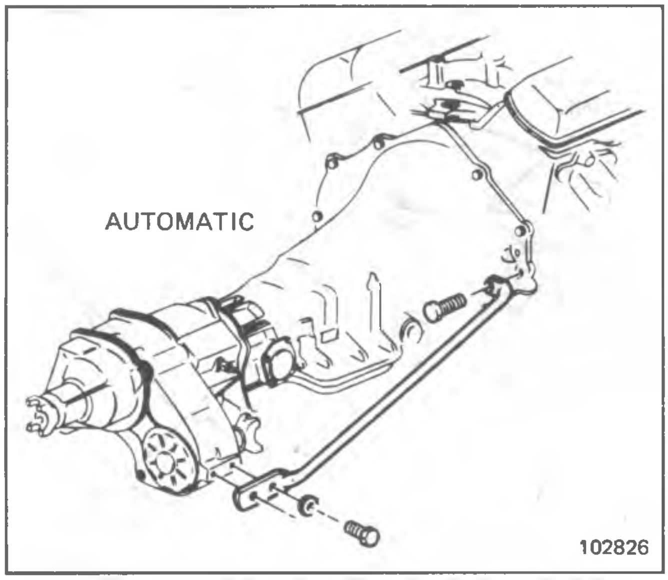


Fig. 7E-41--Strut Rods

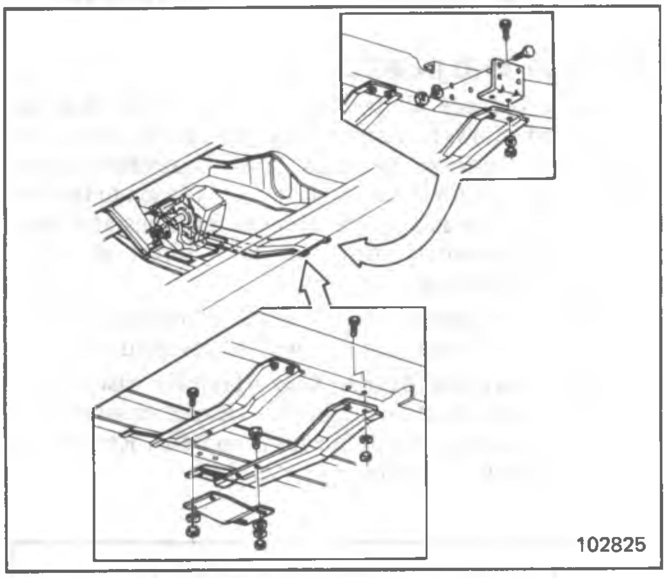


Fig. 7E-40--Skid Plates

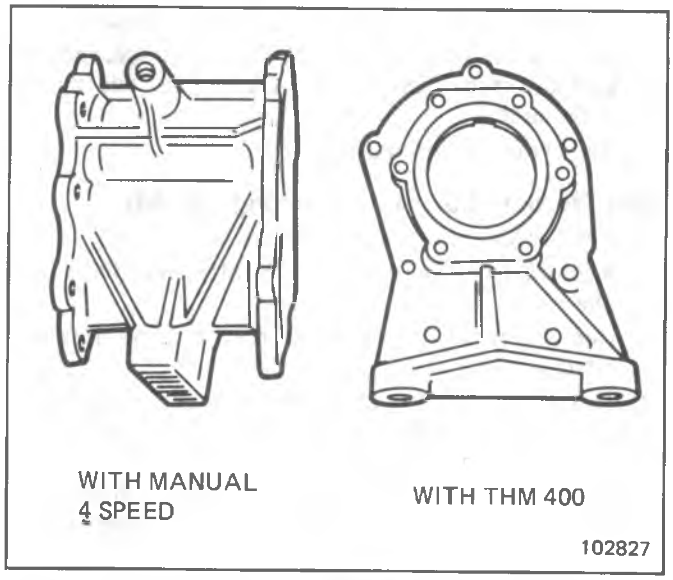


Fig. 7E-42--Adapter Assembles

UNIT REPAIR

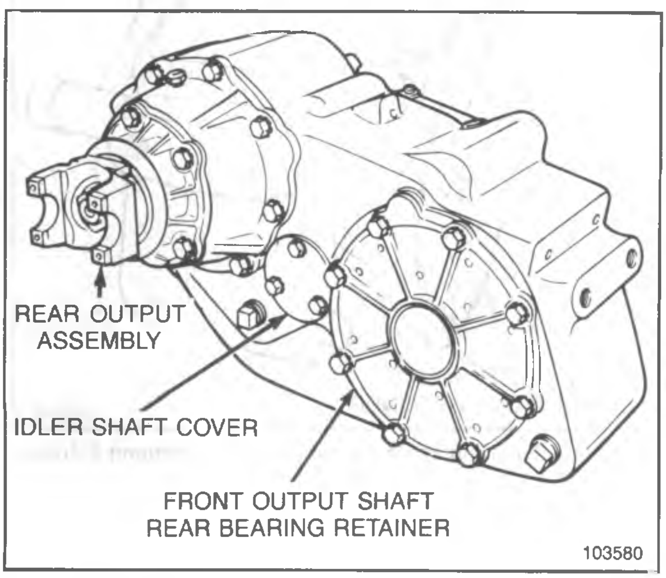


Fig. 7E-43--Rear View of Transfer Case

DISASSEMBLY OF TRANSFER CASE (FIG. 7E-46)

Rear Output Shaft and Yoke Assembly (Fig. 7E-43)

1. Loosen rear output shaft yoke nut.
2. Remove rear output shaft housing bolts and remove housing and retainer assembly from case.
3. Remove retaining nut and yoke from shaft, then remove shaft assembly from housing.
4. Remove snap ring using Tool J-23432 and discard.
5. Remove thrust washer and washer pin.
6. Remove tanged bronze washer. Remove gear needle bearings (32 per row), spacer and second row of needle bearings.

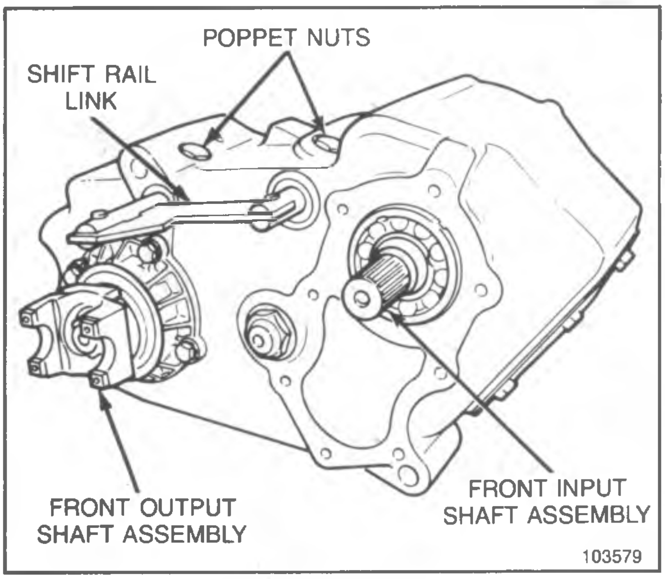


Fig. 7E-44--Front View of Transfer Case

7. Remove tanged bronze thrust washer from shaft.
8. Remove pilot rollers (15), retainer ring and washer.
9. Remove oil seal retainer, ball bearing, speedometer gear and spacer. Discard all gaskets. Press out bearing as required.
10. Remove oil seal from the retainer.

Front Output Shaft Assembly (Fig. 7E-44)

1. Remove lock nut, washer and yoke.
2. Remove front bearing retainer attaching bolts and retainer.
3. Remove front output shaft rear bearing retainer attaching bolts.
4. Tap on output shaft with a soft hammer (Fig. 7E-45) and remove shaft, gear assembly, and rear bearing retainer from case.

   Remove the synchronizer from output high gear, washer, and bearing which will have remained in the case.
5. Using large snap ring picks, such as J-23432-1, remove the gear retaining ring from the shaft (Fig. 7E-47) and discard.
6. Remove thrust washer and pin from shaft.
7. Remove gear, needle bearings (32 per row) and spacer.
8. If necessary to replace front output shaft rear bearing, support cover and press bearing from cover. Position new bearing to outside face of cover and using a piece of pipe or wood to cover outside diameter of bearing, press bearing into cover until flush with opening.

Shift Rail and Fork Assemblies

1. Remove the two poppet nuts on top of case, two poppet springs, and using a magnet, remove the poppet bails.
2. Drive cup plugs into case using a 6.35mm (1/4 in.) punch.
3. Position both shift rails in neutral and using a long, narrow punch, drive shift fork pins through shift rails into the case (Fig. 7E-48).
4. Remove clevis pins and shift rail link.
5. Remove shift rails (Fig. 7E-49), upper (range) rail first, then lower (4-wheel) rail.
6. Remove shift forks and sliding clutch from case.
7. Remove the front output high gear, washer, and bearing from the case. Remove the shift rail cup plugs and pins from the case.
8. Remove snap ring in front of bearing. Using a soft hammer, tap shaft out rear of case. Tap bearing out front of case.
9. Tip case on PTO and remove two interlock pins from inside of case.

Idler Gear

1. Remove idler gear shaft nut.
2. Remove idler shaft rear cover.
3. Remove idler gear shaft using a soft hammer and tool J-23429 (Fig. 7E-50).
4. Roll idler gear to front output shaft hole and remove from case.
5. Remove bearing cups (2) as required from idler gear.

CLEANING AND INSPECTION

Bearings--Place all bearings and rollers in cleaning solution and allow to remain long enough to loosen all accumulated lubricant. Bearings should be sloshed up and down and turned slowly below surface of solution to remove as much lubricant as possible. Remove bearings and blow out with compressed air, being careful to direct air across bearing so that bearings do not spin.

Shafts and Gears--Clean all shafts in cleaning solution to remove all accumulations. Dry with compressed air.

Case, Cover and Bearing Cups--Transfer case, cover, and bearing cups must be thoroughly cleaned in solution to remove all accumulation of lubricant and dirt. Remove all trace of gaskets from surface where used.

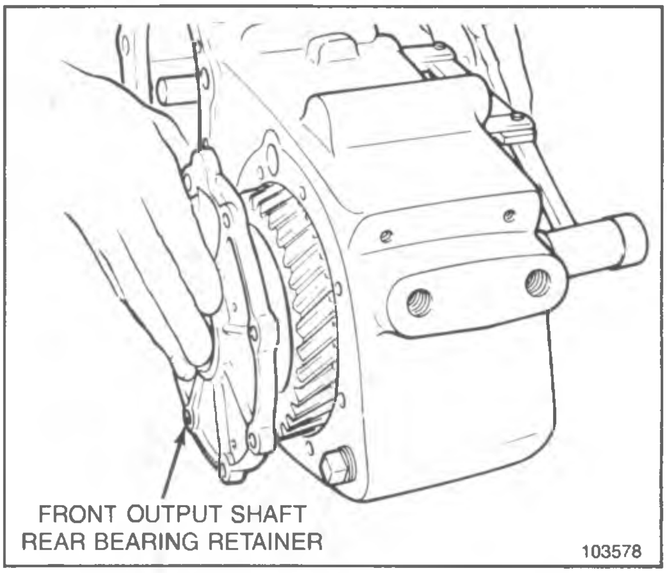
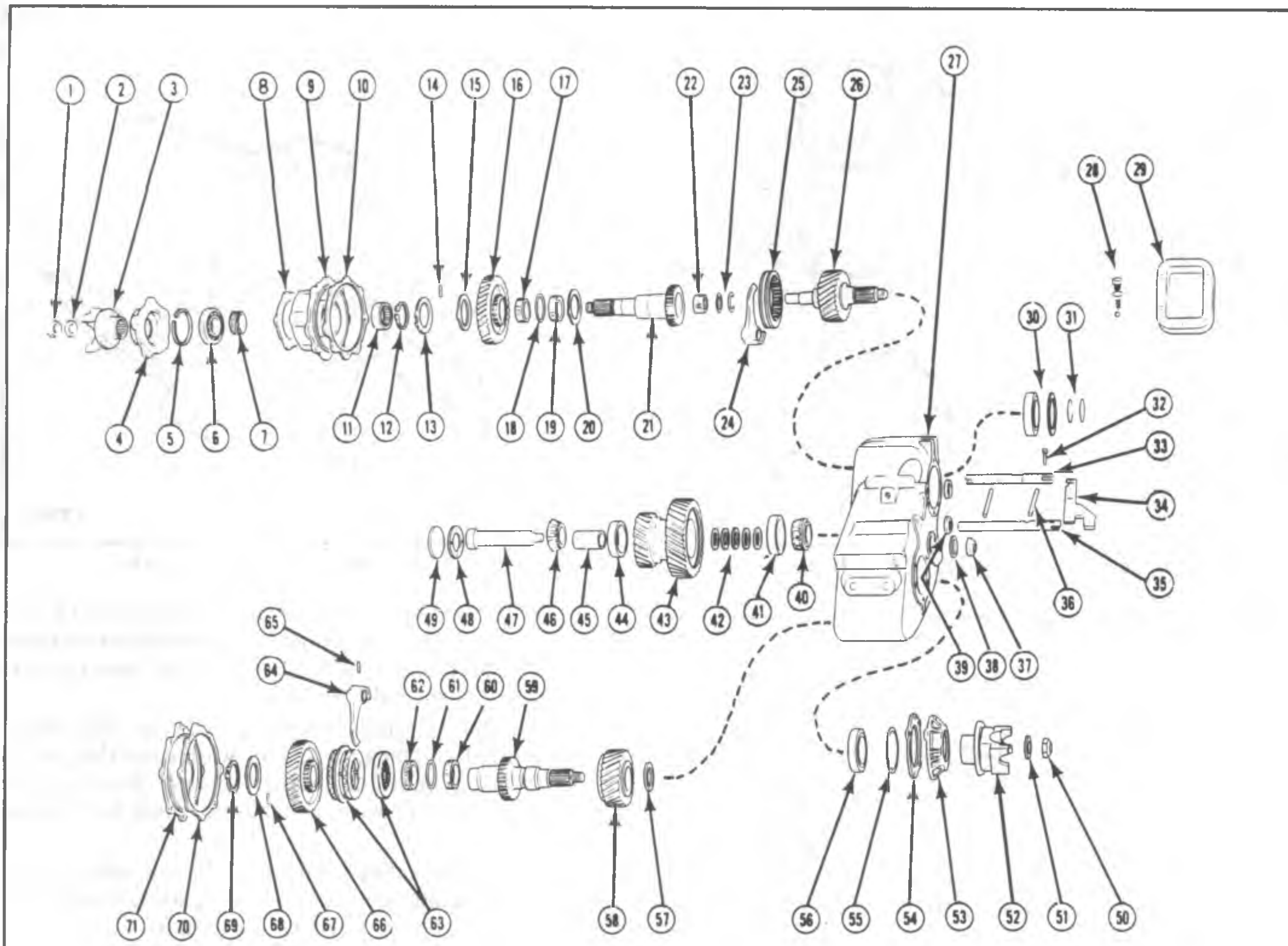


Fig. 7E-45--Removing Front Output Shaft Rear Bearing Retainer



1 Rear Output Shaft Locknut
2 Washer
3 Yoke
4 Bearing Retainer and Seal Assembly
5 Snap Ring
6 Bearing
7 Speedometer Gear
8 Gasket
9 Housing
10 Gasket
11 Bearing
12 Snap Ring
13 Thrust Washer
14 Thrust Washer Lock Pin
15 Thrust Washer (Tanged)
16 Low Speed Gear
17 Needle Bearings
18 Spacer
19 Needle Bearings
20 Tanged Washer
21 Rear Output Shaft
22 Needle Bearings
23 Washer and Retainer
24 Shift Fork
25 Sliding Clutch
26 Input Shaft
27 Transfer Case
28 Poppet Spring & Ball, Light Switch Spring & Ball
29 P T O Gasket and Cover
30 Input Shaft Bearing and Snap Ring
31 Snap Ring and Rubber "O" Ring
32 Shift Link Clevis Pin
33 Range Shift Rail
34 Shift Rail Connector Link
35 Front Wheel Drive Shift Rail
36 Interlock Pins
37 Rear Idler Lock Nut
38 Washer
39 Shift Rail Seals
40 Idler Shaft Bearing
41 Bearing Cup
42 Shims
43 Idler Gear
44 Bearing Cup
45 Spacer
46 Idler Shaft Bearing
47 Idler Shaft
48 Cover Gasket
49 Rear Cover
50 Front Output Shaft Locknut
51 Washer
52 Yoke
53 Bearing Retainer and Seat
54 Gasket
55 Snap Ring
56 Front Bearing
57 Thrust Washer
58 Front Wheel High Gear
59 Front Output Shaft
60 Needle Bearings
61 Spacer
62 Needle Bearing
63 Synchronizer
64 Shift Fork
65 Roll Pin
66 Front Output Low Gear
67 Thrust Washer Lock Pin
68 Thrust Washer
69 Snap Ring
70 Rear Cover Gasket
71 Rear Cover and Bearing

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Fig. 7E-46--Model 205 Transfer Case-Exploded View

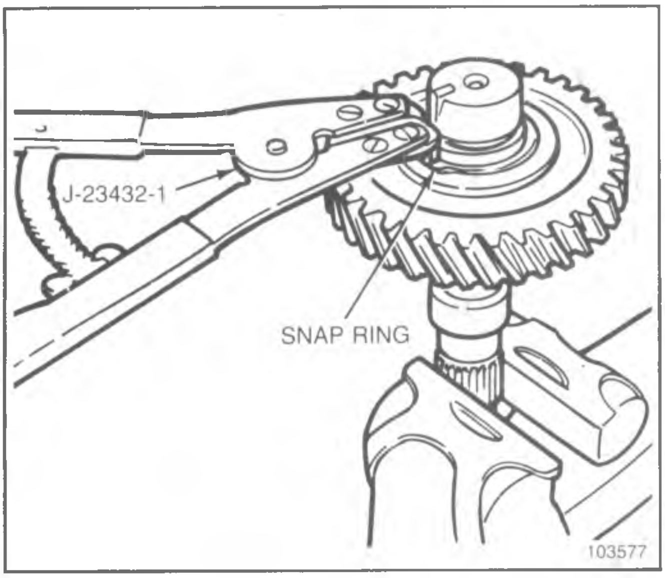

Fig. 7E-47--Removing Gear Retaining Ring

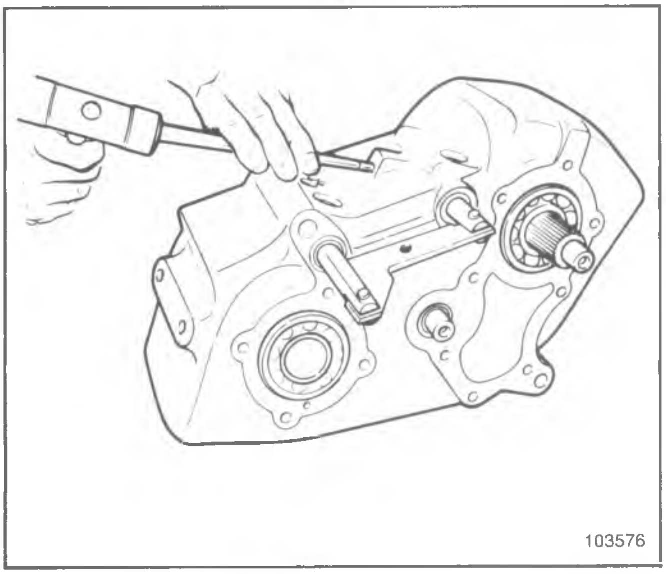

Fig. 7E-48--Removing Shift Fork Pins

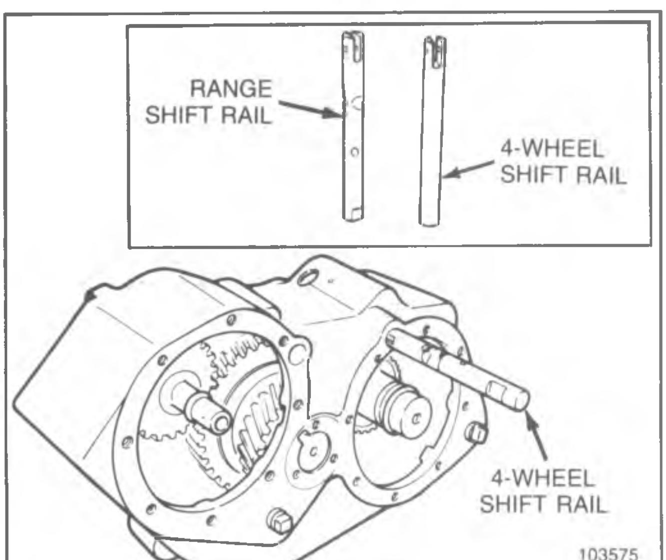

Fig. 7E-49--Shift Rail Removal

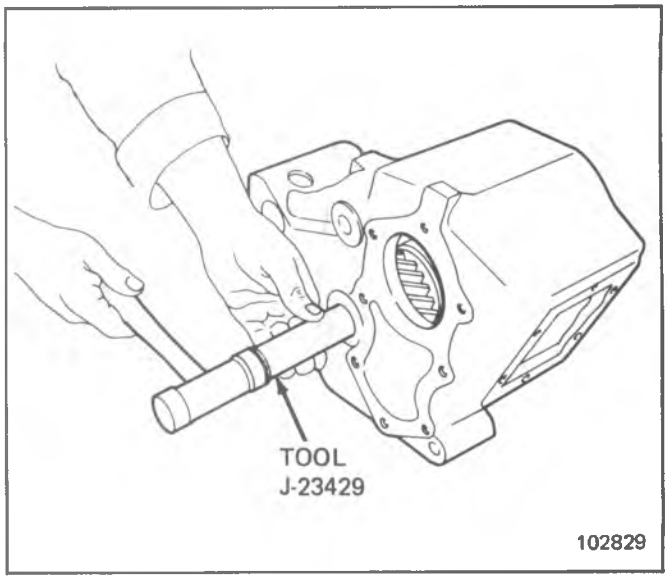

Fig. 7E-50--Removing Idler Gear Shaft

Synchronizer--The synchronizer can be installed in any direction as the sides are identical. Synchronizer wear could occur on engagement side, if wear is present, use opposite side of synchronizer and reassemble.

Inspection--Carefully inspect all bearings and rollers for evidence of chipping, cracks, or worn spots that would render bearing unfit for further service. Bearings are nonadjustable and if worn or damaged, must be replaced with new parts.

Inspect shaft splines and gears. If any indication of failure, such as chipped teeth or excessive wear, is indicated, those parts should be replaced with new parts.

ASSEMBLY OF TRANSFER CASE (FIG. 7E-46)

Idler Gear

1. Press the two bearing cups in the idler gear (if previously removed) using Tool J-9276-2 and Handle J-8092 (Fig. 7E-51).
2. Assemble the two bearing cones, spacer, shims and idler gear on dummy shaft J-23429 with bore up. Check

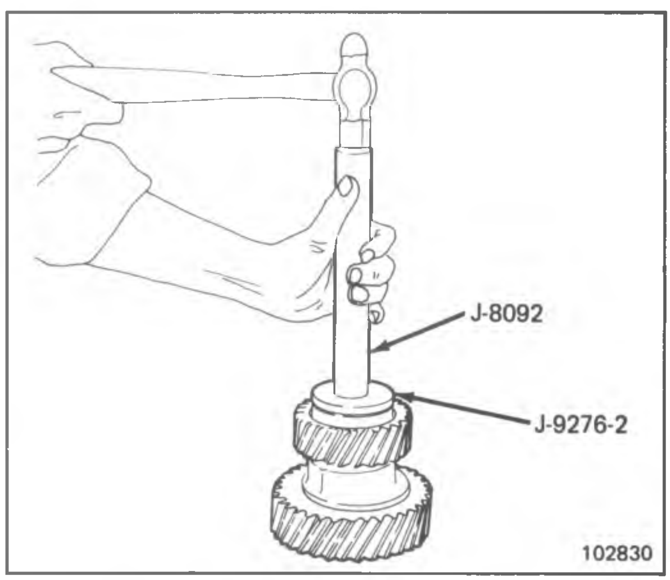

Fig. 7E-51--Installing New Bearing Cups

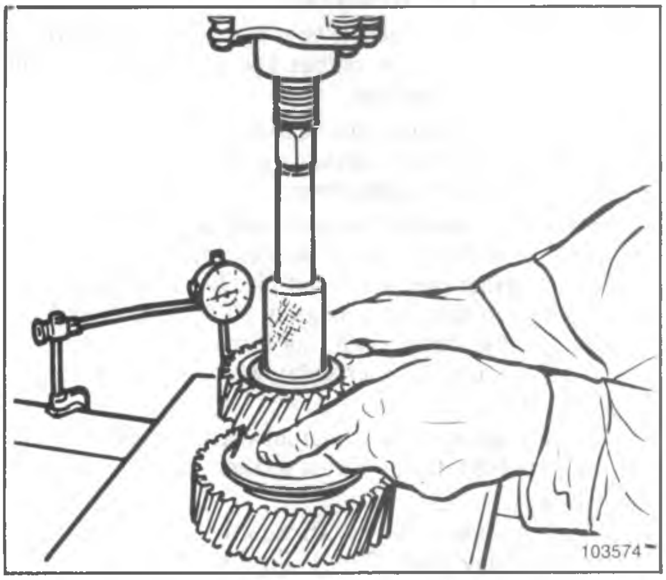

Fig. 7E-52--Checking Idler Gear End Play

end play (Fig. 7E-52). Limits are 0.001 to 0.002 inch.

3. Install idler gear assembly with dummy shaft into case through front output bore, large end first (Fig. 7E-53).
4. Install idler shaft from large bore side and drive through using a soft hammer (Fig. 7E-54).
5. Install washer and new locknut. Check for end play and free rotation. Torque nut to 202 N·m (150 ft. lb.).
6. Install idler shaft cover and gasket. Torque bolts to 27 N·m (20 ft. lb.).

   Flat on cover must be located adjacent to front output shaft rear cover (Fig. 7E-55).

Shift Rail and Fork Assemblies .

1. Press the two rail seals into the case. Seals should be installed with metal lip outward.
2. Install interlock pins through large bore or PTO opening.

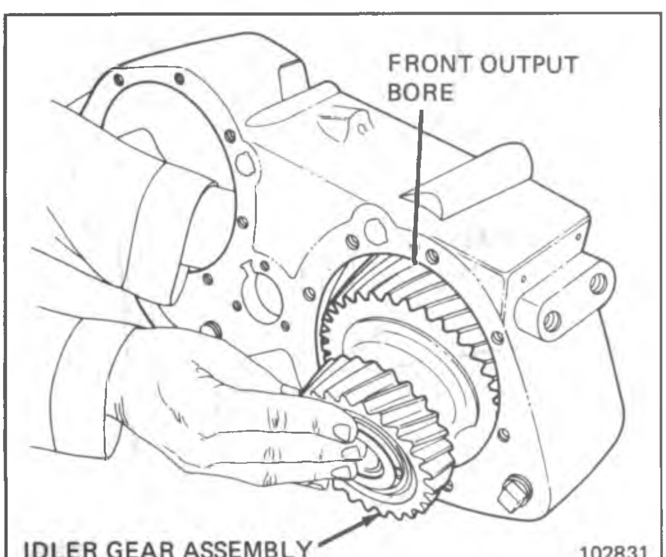

Fig. 7E-53--Installing Idler Gear

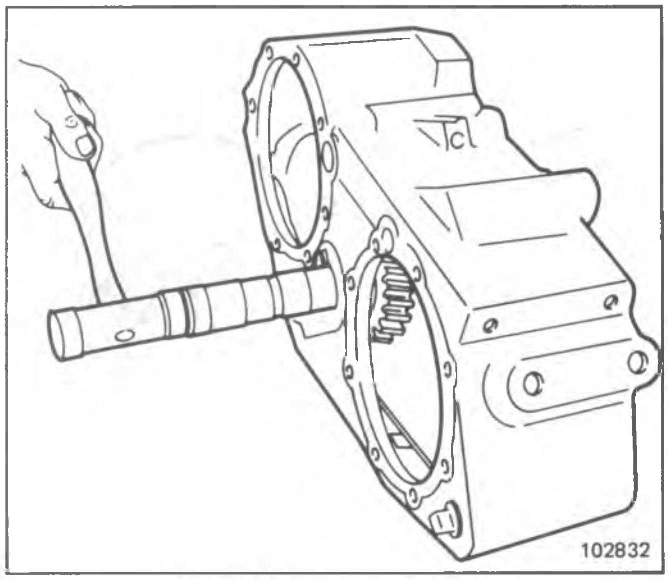

Fig. 7E-54--Installing Idler Shaft

3. Start front output drive shift rail into case from back, slotted end first, with poppet notches up.
4. Install shift fork (long end inward) into rail, push rail through to neutral position.
5. Install input shaft bearing and shaft into case.
6. Start range rail into case from front, with poppet notches up.
7. Install sliding clutch onto fork, place over input shaft in case. Position to receive range rail and push rail through to neutral position.
8. Install new lock pins through holes at top of case and drive them into the forks (Fig. 7E-56). Tip case on PTO opening when installing range rail lock pin.

Front Output Shaft and Gear Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer in the front low output gear and retain with a sufficient amount of grease.
2. Place front output shaft in soft jawed vise, spline end down. Install front low gear over shaft with clutch

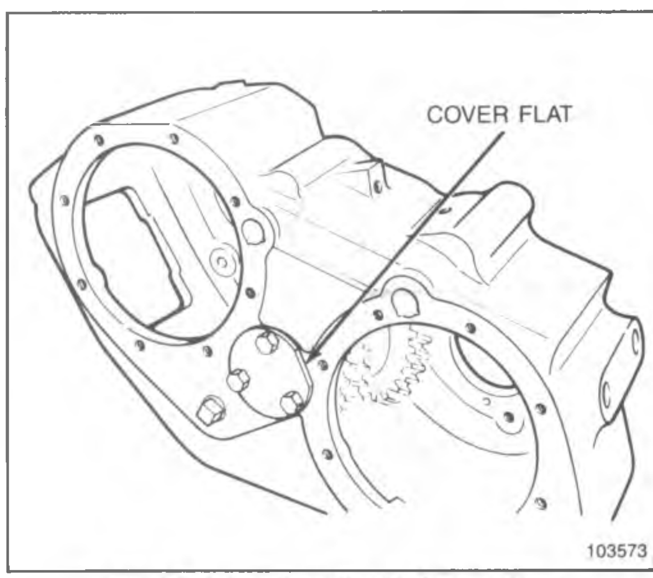

Fig. 7E-55--Installing Idler Shaft Rear Cover

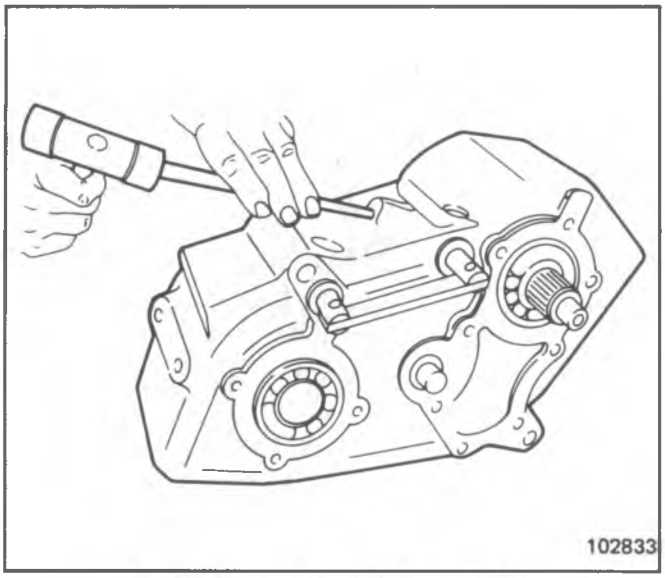

Fig. 7E-56--Installing Shift Rail Lock Pins

gear facing down and install thrust washer pin, thrust washer and new snap ring using Tool J-23432. Position the snap ring so that the opening is opposite the pin.

3. Position front wheel hi-gear and washer in case. Install synchronizer in the shift fork, then put fork and rail in the front wheel drive (4-H) position with the clutch teeth in mesh with the teeth of the front wheel hi-gear.
4. Line up washer, high gear, and synchronizer with bearing bore. Insert front output shaft and low gear assembly through the high gear assembly.
5. Install new seal in bearing retainer using Tool J-22836 (Fig. 7E-57) and install the front output bearing and retainer in the case.
6. Clean and grease rollers in front output rear bearing retainer. Install onto case using one gasket. Dip bolts into sealant. Install bolts and to 40 N·m (30 ft. lb.).
7. Install front output yoke, washer and lock nut. Torque nut to 202 N·m (150 ft. lb.).

Rear Output Shaft Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer into the output low gear. Use sufficient grease to retain needles.
2. Install thrust washer onto rear output shaft, tang down in clutch gear groove. Install output low gear onto shaft with clutch teeth facing down.
3. Install thrust washer over gear with tab pointing up and away from gear. Install washer pin and also large thrust washer over shaft and pin. Rotate washer until tab fits into slot approximately 90 degrees away from pin. Finally, install snap ring using Tool J-23423 and J-23423-1 and check end play which should be within 0.002 to 0.027 in..
4. Grease pilot bore or rear output shaft and install needle bearings (15). Install thrust washer and new snap ring in bore.
5. Clean, grease, and install new bearing in retainer housing using Tool J-23431 (Fig. 7E-58).
6. Install housing onto output shaft assembly, install spacer and speedometer gear, then install bearing (Fig. 7E-59).
7. Install rear bearing retainer seal using Tool J-21359 or J-22834-2 (Fig. 7E-60).
8. Install bearing retainer assembly onto housing with one or two gaskets, depending on clearance. Torque bolts to 40 N·m (30 ft. lb.).
9. Install yoke, washer, and lock nut output shaft.
10. Position range rail in "high" and install output shaft and retainer assembly on transfer case. Torque housing bolts to 40 N·m (30 ft. lb.).

Miscellaneous

1. Install PTO cover and gasket. Torque bolts to20 N·m (15 ft. lb.).
2. Install and seal cup plugs at rail pin holes, if not previously done.
3. Install drain and filler plugs and torque to 40 N·m (30 ft. lb.).
4. Install shift rail cross link, clevis pins and lock pins.

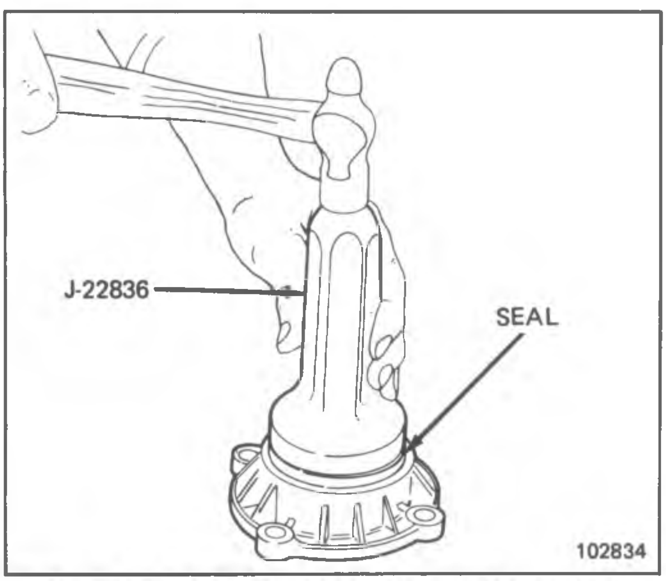

Fig. 7E-57--Installing Front Output Bearing Retainer Seal

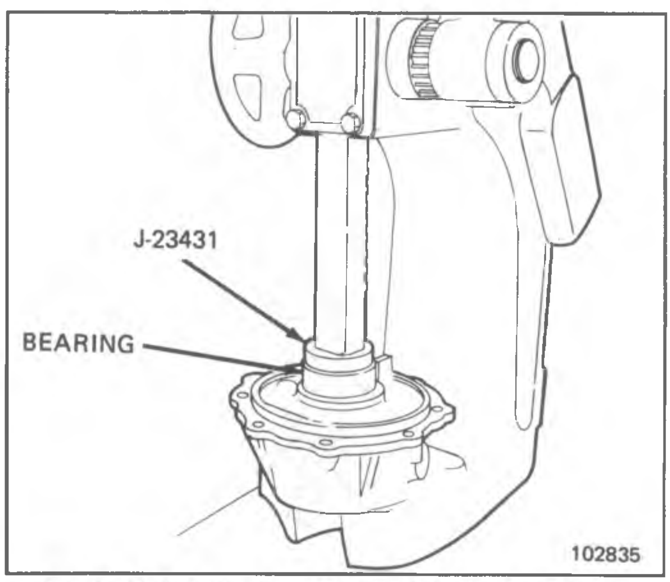

Fig. 7E-58--Installing Rear Output Shaft Housing Bearing

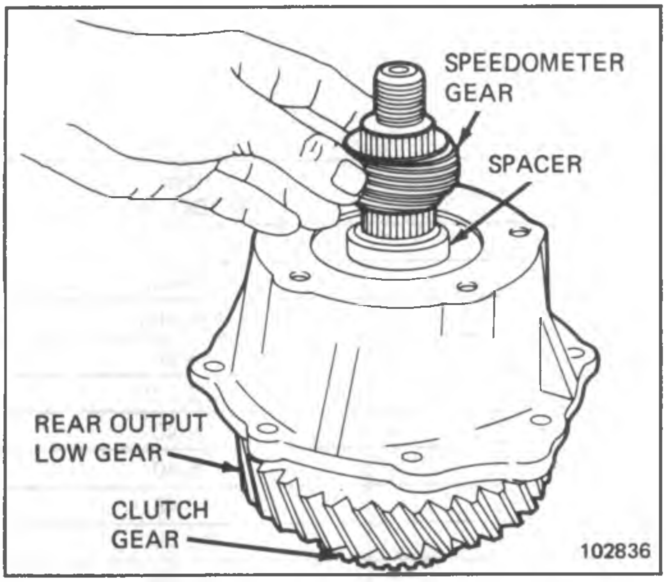

Fig. 7E-59--Installing Rear Output Shaft Spacer and Speedometer Gear

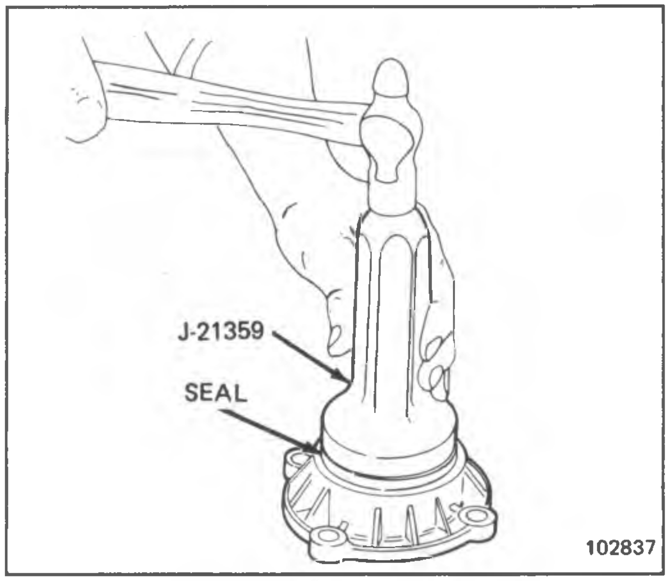

Fig. 7E-60--Installing Rear Bearing Retainer Seal

	N·m MODEL 205
NUT, SHIFT LEVER-TO-SHIFTER ASSEMBLY	—
NUT, KNOB ASSEMBLY-TO-SHIFT LEVER	26-40
BOLT, SHIFTER ASSEMBLY-TO-TRANSFER CASE	120-150
NUT, SHIFT ARMS-TO-CASE	14-20
SCREW, SHIFT LEVER BOOT RETAINER	2.2-3.2
BOLT, ADAPTER-TO-TRANSMISSION	26-40
BOLT, ADAPTER-TO-TRANSFER CASE	26-40
FILLER PLUG	40-48
BOLTS P.T.O. COVER	20-24
NUT, SKID PLATE-TO-CROSSMEMBER	55-70
BOLT, SUPPORT STRUT ROD	
— TRANSMISSION END	40-54
— TRANSFER CASE END	150-200

MODEL NO.	205 (PART TIME)
AVAILABILITY	ALL K30 SERIES
RATIOS: HI RANGE LO RANGE	1.00 TO 1 1.96 TO 1
LEVER POSITIONS	4-LO (ALL WHEEL UNDERDRIVE) N (NEUTRAL) 2-HI (REAR WHEEL DRIVE) 4-HI (ALL WHEEL DIRECT DRIVE)
LEVER LOCATION	REAR OF TRANSMISSION SHIFT LEVER
POWER TAKE-OFF DATA: OPENING AND LOCATION	SAE 6-BOLT; LEFT SIDE
LUBRICANTS: OIL CAPACITY	5.2 PINTS*
TYPE, GRADE	SEE OWNER'S MANUAL

*TO BE FILLED WITHIN ONE INCH OF FILL PLUG.

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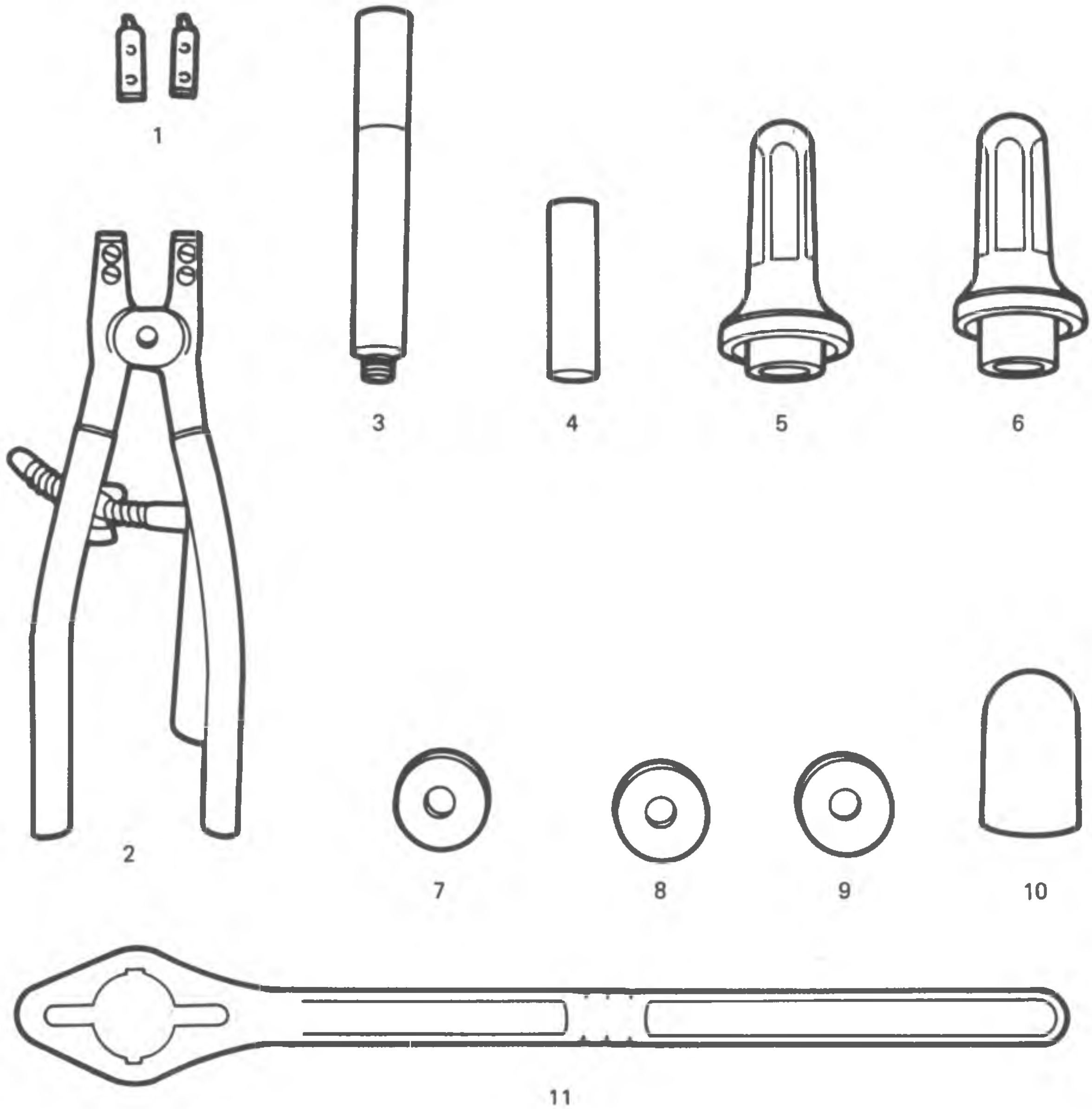

1.	J-23432-1	Snap Ring Picks.
2.	J-23432	Snap Ring Pliers.
3.	J-8092	Handle.
4.	J-23429	Intermediate Shaft Remover and Installer.
5.	J-22836	Front Output Shaft Bearing Retainer Seal Installer.
6.	J-21359	Rear Output Shaft Bearing Retainer Seal Installer.
7.	J-23431	Rear Output Shaft Housing Bearing Remover and Installer.
8.	J-8611-01	Adapter Seal Installer.
9.	J-9276-2	Intermediate Gear Bearing Cup Installer.
10.	J-22875	Rear Output Shaft Rear Bearing Installer.
11.	J-8614-1	Companion Flange Remover.

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Fig. 7E-ST2--205--Special Tools

SECTION 7D
208 TRANSFER CASE

CONTENTS

Model 208 Transfer Case (10 and 20 Series)
General Description 7D- 1
Diagnosis 7D- 3
Maintenance and Adjustments 7D- 3
Skid Plate 7D- 5
Strut Rod 7D- 5
Adapter Assemblies 7D- 6

On Vehicle Service 7D- 8
Transfer Case 7D- 8

Unit Repair 7D- 10
Disassembly 7D- 10
Cleaning and Inspection 7D- 10
Subassembly Overhaul 7D- 11
Assembly 7D- 15

GENERAL DESCRIPTION

The Model 208 transfer case (as shown in Fig. 7E-1) is an aluminum case, chain drive, four position unit providing four-wheel drive high and low ranges, a two-wheel high range, and a neutral position. The model 208 is a part-time four-wheel drive unit. Torque input in four-wheel high and low ranges is undifferentiated. The range positions on the Model 208 are selected by a floor mounted gearshift lever.

The Model 208 case is a two-piece aluminum case containing front and rear output shafts, two drive sprockets, a shift mechanism and a planetary gear assembly. The drive sprockets are con- nected and operated by the drive chain. The planetary assembly which consists of a four pinion carrier and an annulus gear provide the four-wheel drive low range when engaged. Reduction ratio is 2.61:1 in this range.

Shift Pattern

A floor mounted shift lever is used to select the various operating ranges on the 208 model. The shift lever is located on the floorpan transmission tunnel adjacent to the transmission gearshift lever. Furthermore, the transfer case shift pattern is not in a straight line for 208 models, the range positions are shown in Fig. 7E-2.

Four-Wheel Drive Indicator Lamp

An indicator lamp is mounted in the instrument panel to alert the driver whenever the vehicle is being operated in four-wheel range. The lamp is controlled by an indicator switch in the transfer case (Fig. 7E-3). The switch is a ball and plunger unit that is activated by the transfer case range sector when four-wheel range is selected.

Identification

An identification tag is attached to the rear half of the transfer case (Fig. 7E-3). This tag provides the transfer case model number, low range reduction ratio, and assembly number. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, it should be reattached using an adhesive sealant such as Loctite 312, or equivalent.

Lubrication

The Model 208 transfer case lubricant should be changed at the intervals specified in the Maintenance Schedule. When adding lubricant to or refilling the transfer case after service, use Dexron®II. Refer to the maintenance and adjustments section for lubricant change procedures and fill level.

Power Flow

In all drive range positions input torque is transmitted to the transfer case gear train through the transfer case input gear.

In 2H range, torque flows from the input gear to the planetary assembly and annulus gear which rotate as a unit. Torque is transferred to the mainshaft through the planetary carrier which is splined to the mainshaft. Torque flow continues through the mainshaft and rear yoke which is splined to the mainshaft, and finally to the rear propeller shaft and axle. In 2H range, the sliding clutch remains in a neutral position and does not lock the drive sprocket to the mainshaft. As a result, torque is not transferred to the driven sprocket.

In 4H range, input torque from the input gear is

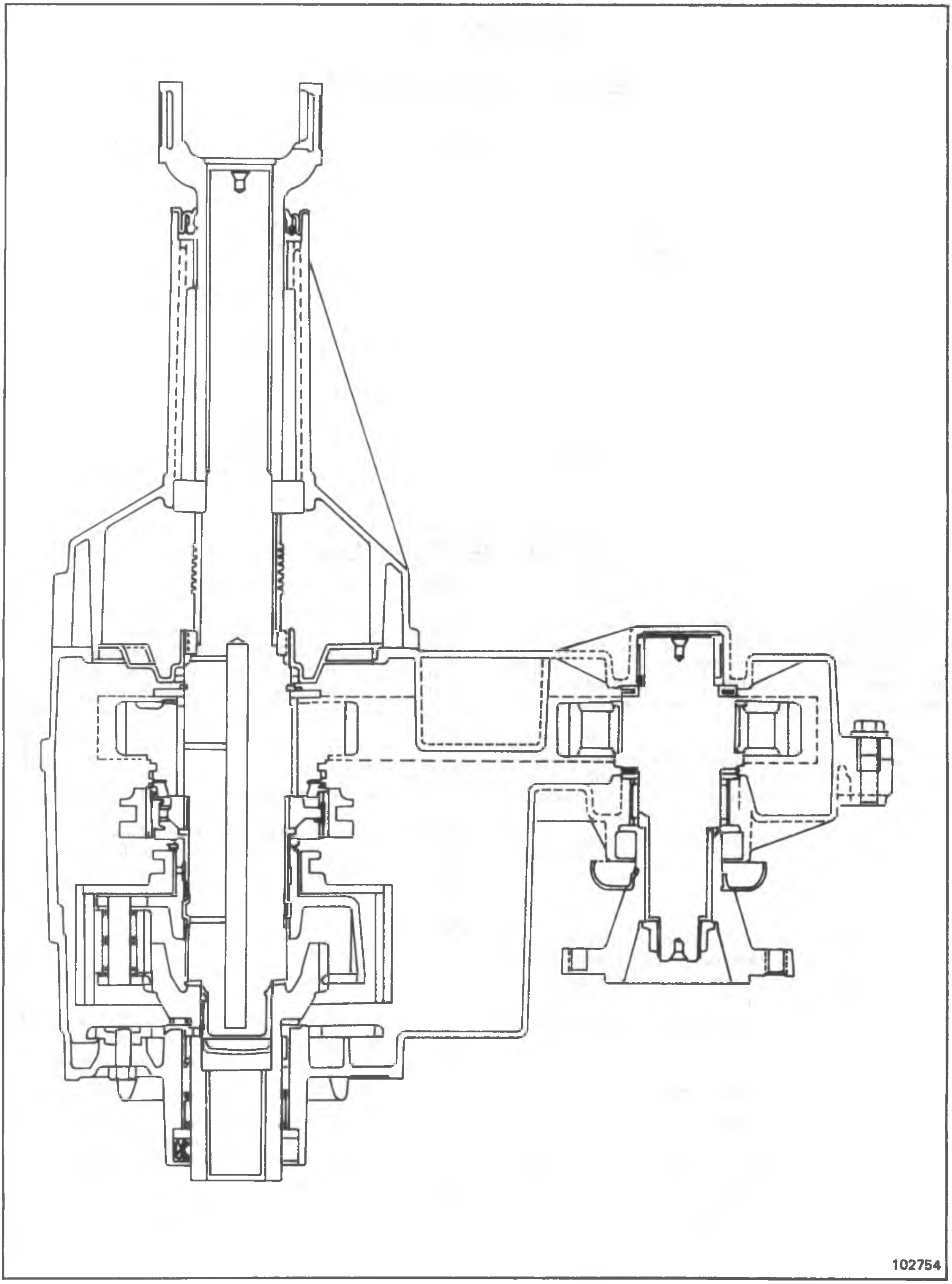


Fig. 7E-1 Model 208 Transfer Case (Cross Section)

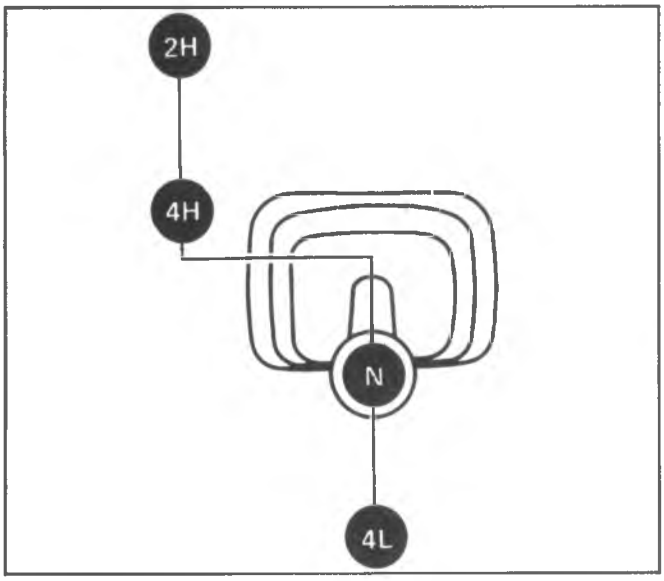


Fig. 7E-2 Model 208 Shift Pattern

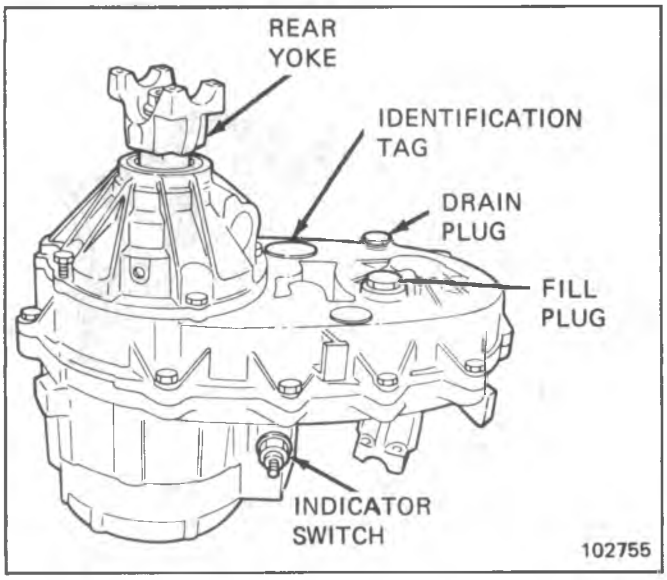


Fig. 7E-3 Model 208 Indicator Switch, Identification Tag, and Drain and Fill Plug Location

transmitted through the planetary and annulus gear and through the mainshaft in exactly the same fashion as in 2H range. However, in 4H position, the sliding clutch is shifted forward and into engagement with the mainshaft clutch gear. This locks the drive sprocket to the mainshaft through the sliding clutch. Torque is now transmitted through the drive sprocket to the driven sprocket by the connecting drived chain. Since the front output shaft is splined to the driven sprocket, torque now flows through the front output shaft to the front propeller shaft and axle resulting in high range four-wheel drive.

In 4L range, the path of torque through the transfer case is exactly the same as in 4H range but with one major difference. In 4L range, the annulus gear is shifted forward and into engagement with the lock plate. Since the lock plate is fixed in the case, the annulus gear is held stationary and does not rotate. This causes the planetary pinions to rotate about the annulus gear internal teeth producing a gear reduction ratio of 2.61:1.

SERVICE DIAGNOSIS

GENERAL

Before attempting to repair a suspected transfer case malfunction, check all other driveline components. The actual cause of a problem may be related to such items as the front hubs, axles, propeller shafts, wheels and tires, transmission, or clutch instead. If all other driveline components are in good condition and operating properly, refer to the Service Diagnosis Chart for further information.

MAINTENANCE AND ADJUSTMENTS

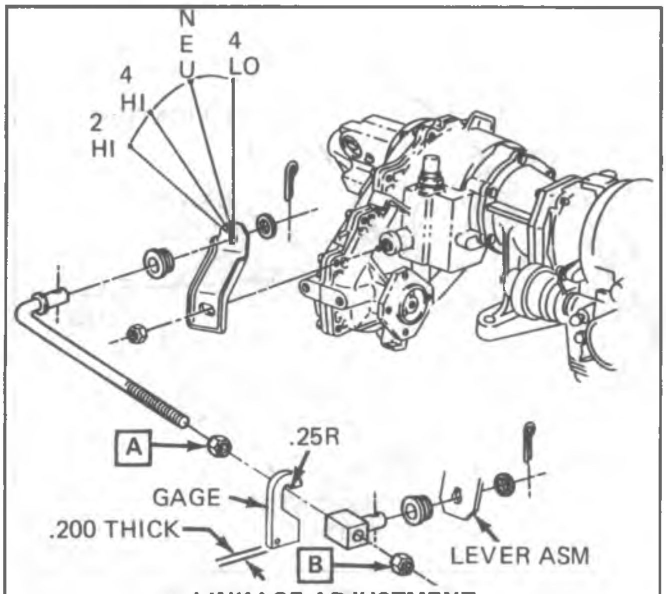
CASE-OIL CHANGE

1. Raise vehicle.
2. Position drain pan under transfer case.
3. Remove drain and fill plugs and drain lubricant.
4. Install drain plug. Tighten plug to 24 N·m (18 ft. lb.).
5. Remove drain pan.
6. Fill transfer case to edge of fill plug opening with Dexron®II.
7. Install fill plug. Tighten plug to 24 N·m (18 ft. lb.).
8. Lower vehicle.

LINKAGE ADJUSTMENT AND INSPECTION (Fig. 7E-4)

The control linkages and attachments for the 208 transfer case are shown in Fig. 7E-4 and 7E-5.

Periodically inspect the linkage system for freedom of operation, proper engagement, loose attaching bolts, foreign material, etc. Adjust, clean and tighten as necessary.



LINKAGE ADJUSTMENT

1. Put Transfer Case Lever in 4HI detent.
2. Push Lower Shifter Lever forward to 4HI stop.
3. Install Rod Swivel in Shift Lever Hole.
4. Hang .200 thick Gage Cover Rod behind Swivel.
5. Run Rear Rod Nut [A] against Gage with Shifter against 4HI stop.
6. Remove Gage & Push Swivel rearward against Nut [A] .
7. Run Front Rod Nut [B] against Swivel and tighten.

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Fig. 7E-4--Linkage Adjustment

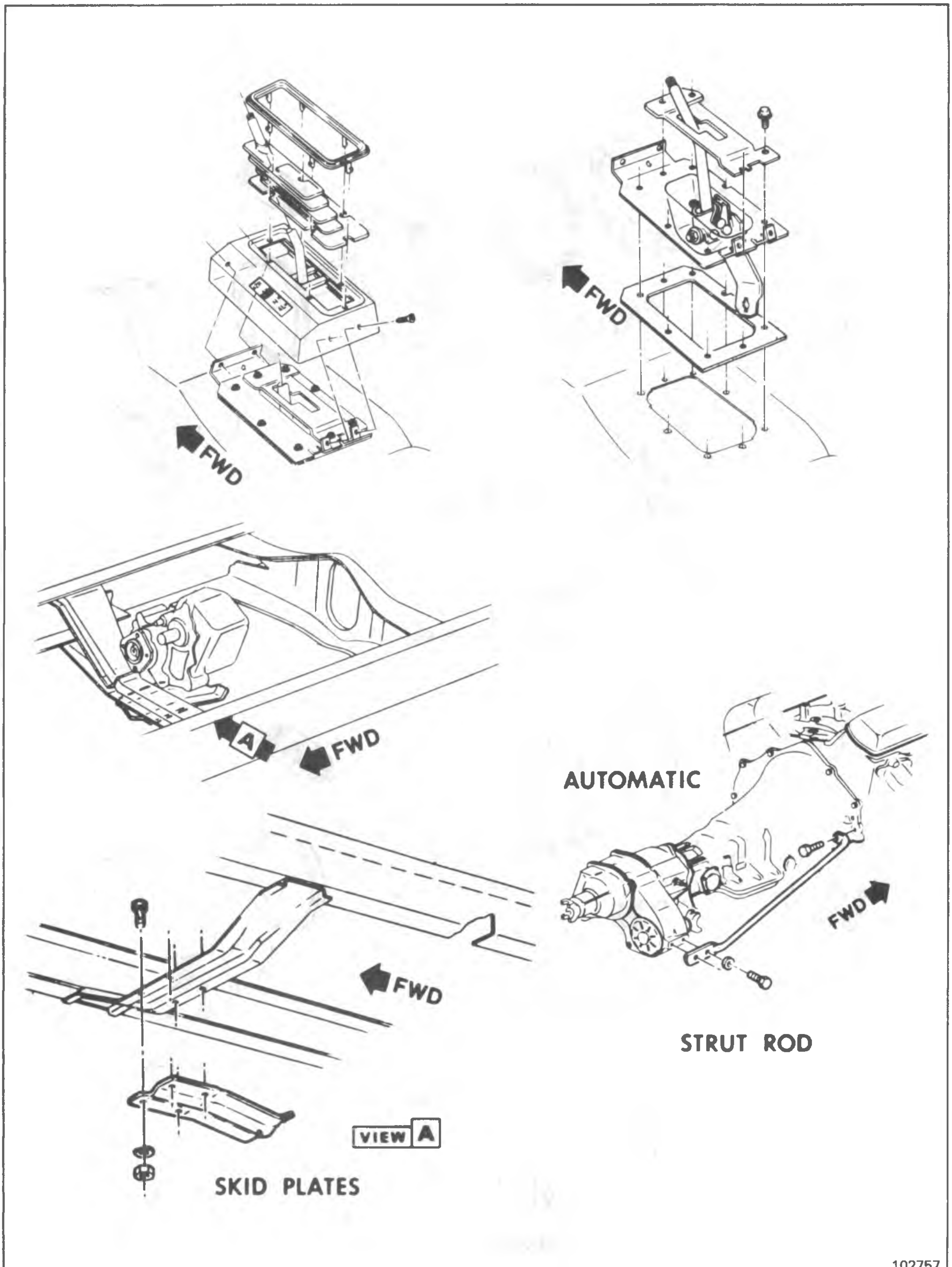


Fig. 7E-5 Transfer Case Shifter, Skid Plates and Strut Rods

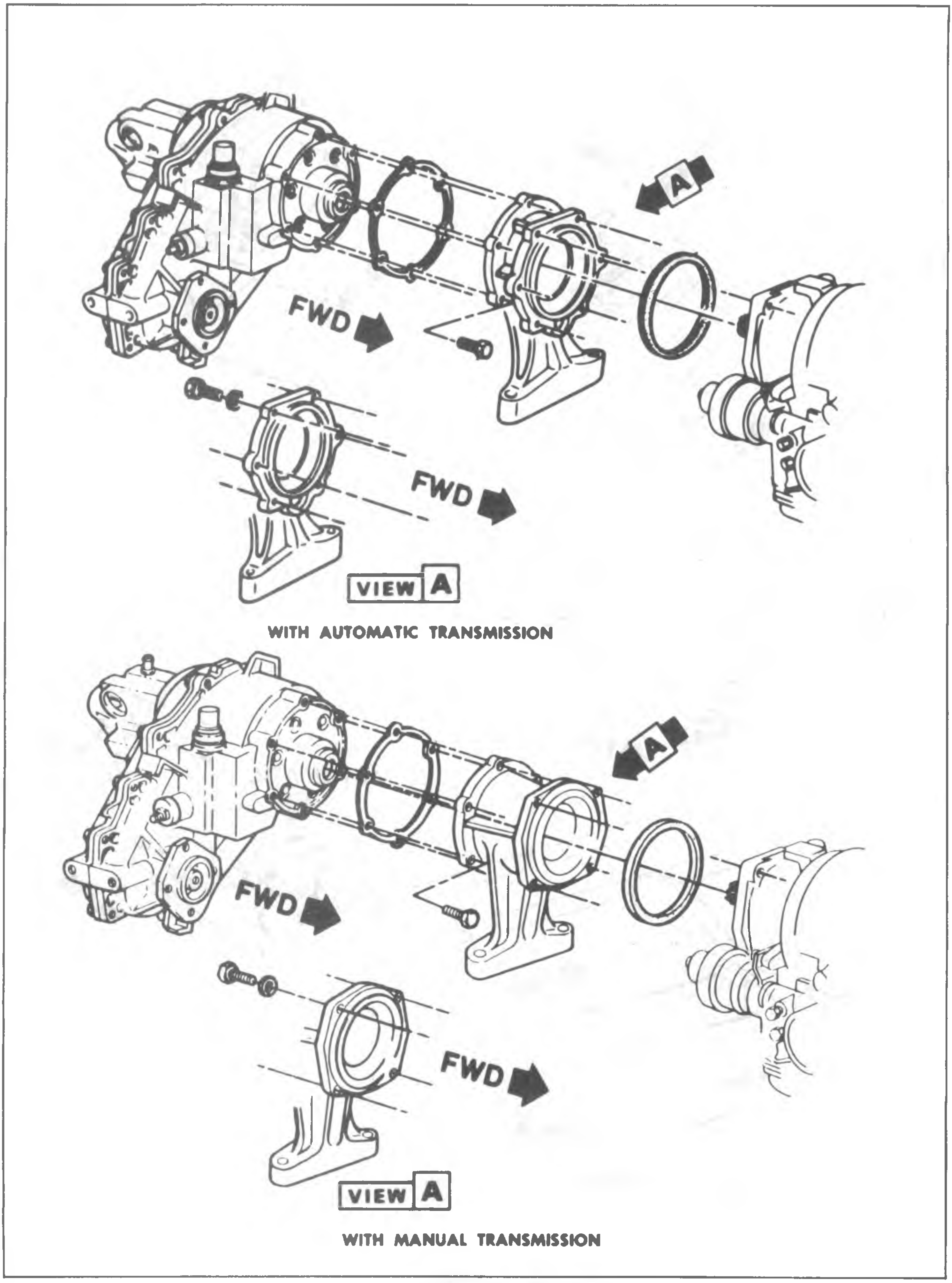


Fig. 7E-6 Transfer Case Attachments

Service Diagnosis

Condition	Possible Cause	Correction
TRANSFER CASE DIFFICULT TO SHIFT OR WILL NOT SHIFT INTO DESIRED RANGE	(1) Vehicle speed too great to permit shifting.	(1) Stop vehicle and shift into desired range. Or reduce speed to 2-3 mph (3-4 km/h) before attempting to shift.
	(2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficult shifting.	(2) Stop vehicle, shift transmission to neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces.
	(3) Transfer case external shift linkage binding.	(3) Lubricate or repair or replace linkage, or tighten loose components as necessary.
	(4) Insufficient or incorrect lubricant.	(4) Drain and refill to edge of fill hole with DEXRON®-II only.
	(5) Internal components binding, worn, or damaged.	(5) Disassemble unit and replace worn or damaged components as necessary.
TRANSFER CASE NOISY IN ALL DRIVE MODES	(1) Insufficient or incorrect lubricant.	(1) Drain and refill to edge of fill hole with DEXRON®-II only. Check for leaks and repair if necessary. Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.
NOISY IN — OR JUMPS OUT OF FOUR WHEEL DRIVE LOW RANGE	(1) Transfer case not completely engaged in 4L position.	(1) Stop vehicle, shift transfer case in Neutral, then shift back into 4L position.
	(2) Shift linkage loose or binding.	(2) Tighten, lubricate, or repair linkage as necessary.
	(3) Range fork cracked, inserts worn, or fork is binding on shift rail.	(3) Disassemble unit and repair as necessary.
	(4) Annulus gear or lockplate worn or damaged.	(4) Disassemble unit and repair as necessary.
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled.	(1) Drain to correct level.
	(2) Vent closed or restricted.	(2) Clear or replace vent if necessary.
	(3) Output shaft seals damaged or installed incorrectly.	(3) Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores, nicks with fine sandpaper or replace yoke(s) if necessary.
ABNORMAL TIRE WEAR	(1) Extended operation on dry hard surface (paved) roads in 4H range.	(1) Operate in 2H on hard surface (paved) roads.

Fig. 7E-7-Service Diagnosis Chart

ON VEHICLE SERVICE

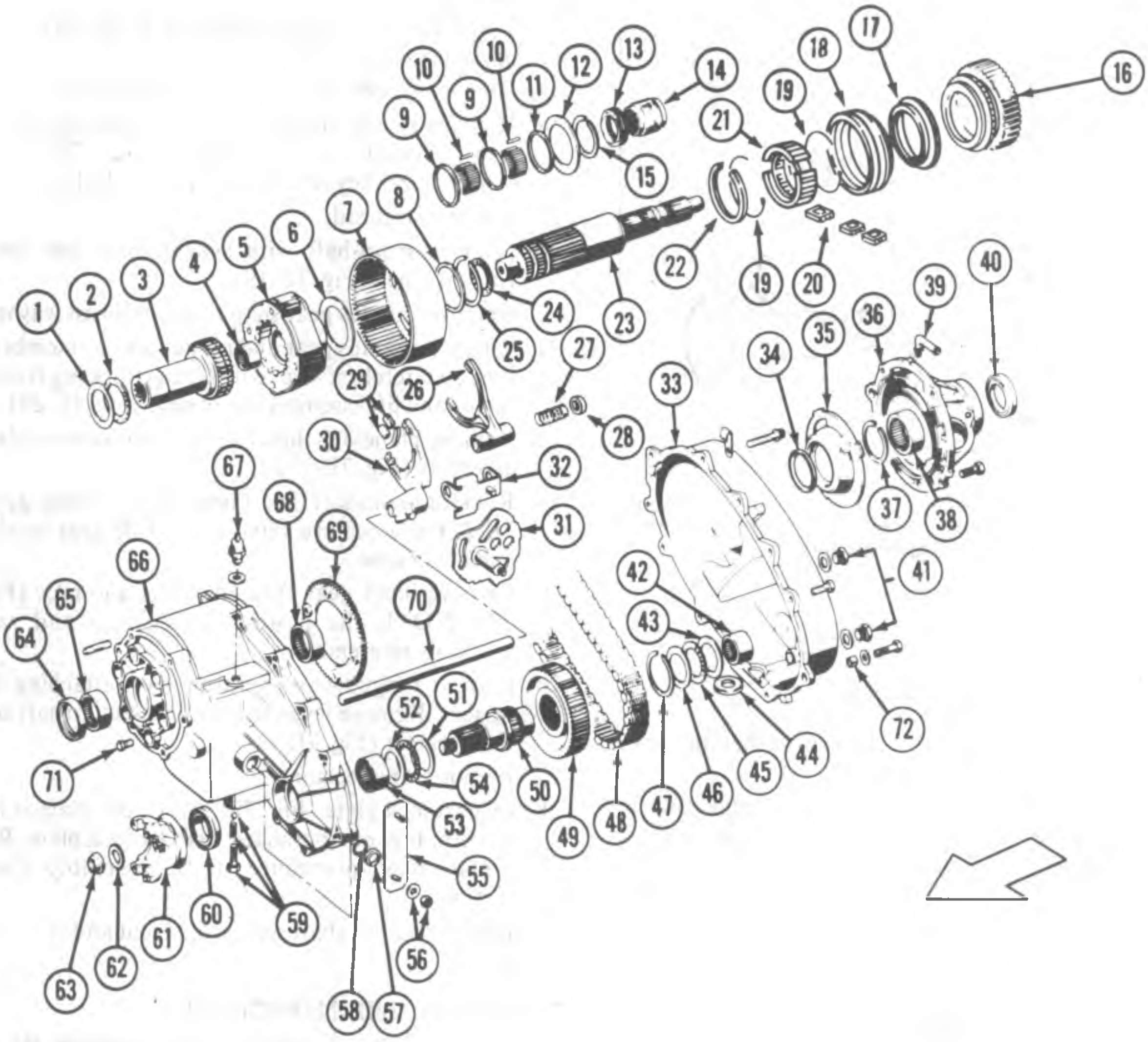
TRANSFER CASE

Removal

1. Place transfer case in 4H.
2. Raise vehicle.
3. Drain lubricant from transfer case.
4. Remove cotter pin from shift lever swivel.
5. Mark transfer case front and rear output shaft yokes and propeller shafts for assembly alignment reference.
6. Disconnect speedometer cable and indicator switch wires.
7. Disconnect front propeller shaft at transfer case yoke.
8. Disconnect parking brake cable guide from pivot located on right frame rail, if necessary.
9. Remove engine strut rod from transfer case on automatic transmission models.
10. Place support under transfer case and remove transfer case-to-transmission adapter bolts.
11. Move transfer case assembly rearward until free of transmission output shaft and remove assembly.
12. Remove all gasket material from rear of transmission adapter housing.

Installation

1. Install transmission-to-transfer case gasket on transmission.
2. Shift transfer case to 4H position if not done previously.
3. Rotate transfer case output shaft (by turning yoke) until transmission output shaft gear engages transfer case input shaft. Move transfer case forward until case seats against transmission. Be sure the transfer case is flush against the transmission. Severe damage to the transfer case will result if the attaching bolts are tightened while the transfer case is cocked or in a bind.
4. Install transfer case attaching bolts. Tighten bolts to 41 N·m (30 ft. lb.).
5. Connect speedometer driven gear to transfer case.
6. Connect front and rear propeller shafts to transfer case. Be sure to align shafts-to-yokes using reference marks made during removal. Tighten shaft-to-yoke clamp strap nuts to 20 N·m (15 ft. lb.).
7. Remove support stand from under transfer case.
8. Connect parking brake cable if disconnected.
9. Attach cotter pin to shift lever swivel.
10. Connect engine strut to transfer case on automatic models.
11. Fill transfer case with Dexron®II.
12. Lower vehicle.



1. INPUT GEAR THRUST WASHER
2. INPUT GEAR THRUST BEARING
3. INPUT GEAR
4. MAINSHAFT PILOT BEARING
5. PLANETARY ASSEMBLY
6. PLANETARY THRUST WASHER
7. ANNULUS GEAR
8. ANNULUS GEAR THRUST WASHER
9. NEEDLE BEARING SPACERS
10. MAINSHAFT NEEDLE BEARINGS (120)
11. NEEDLE BEARING SPACER
12. SPACER WASHER
13. OIL PUMP GEAR
14. SPEEDOMETER GEAR
15. DRIVE SPROCKET SNAP RING
16. DRIVE SPROCKET
17. BLOCKER RING
18. SYNCHRONIZER SLEEVE
19. SYNCHRONIZER SPRING
20. SYNCHRONIZER KEY
21. SYNCHRONIZER HUB
22. SYNCHRONIZER HUB SNAP RING
23. MAINSHAFT
24. MAINSHAFT THRUST BEARING
25. INTERNAL GEAR SNAP RING
26. MODE FORK
27. SPRING
28. SPRING RETAINER
29. RANGE FORK PADS
30. RANGE FORK
31. RANGE SECTOR
32. MODE FORK BRACKET
33. REAR CASE
34. SEAL
35. PUMP HOUSING
36. REAR RETAINER
37. BEARING SNAP RING
38. REAR OUTPUT BEARING
39. VENT TUBE
40. REAR SEAL
41. DRAIN AND FILL PLUGS
42. FRONT OUTPUT SHAFT REAR BEARING
43. FRONT OUTPUT SHAFT REAR THRUST BEARING RACE (THICK)
44. CASE MAGNET
45. FRONT OUTPUT SHAFT REAR THRUST BEARING
46. FRONT OUTPUT SHAFT REAR THRUST BEARING RACE (THIN)
47. DRIVEN SPROCKET RETAINING RING
48. DRIVE CHAIN
49. DRIVEN SPROCKET
50. FRONT OUTPUT SHAFT
51. FRONT OUTPUT SHAFT FRONT THRUST BEARING RACE (THIN)
52. FRONT OUTPUT SHAFT FRONT THRUST BEARING RACE (THICK)
53. FRONT OUTPUT SHAFT FRONT BEARING
54. FRONT OUTPUT SHAFT FRONT THRUST BEARING
55. OPERATING LEVER
56. WASHER AND LOCKNUT
57. RANGE SECTOR SHAFT SEAL RETAINER
58. RANGE SECTOR SHAFT SEAL
59. DETENT BALL, SPRING AND RETAINER BOLT
60. FRONT SEAL
61. FRONT YOKE
62. YOKE SEAL WASHER
63. YOKE NUT
64. INPUT GEAR OIL SEAL
65. INPUT GEAR FRONT BEARING
66. FRONT CASE
67. LOCK MODE INDICATOR SWITCH AND WASHER
68. INPUT GEAR REAR BEARING
69. LOCKPLATE
70. SHIFTER FORK SHAFT
71. LOCKPLATE BOLTS
72. CASE ALIGNMENT DOWELS

Fig. 7E-8-208 Transfer Case (Exploded View)

103581

UNIT REPAIR

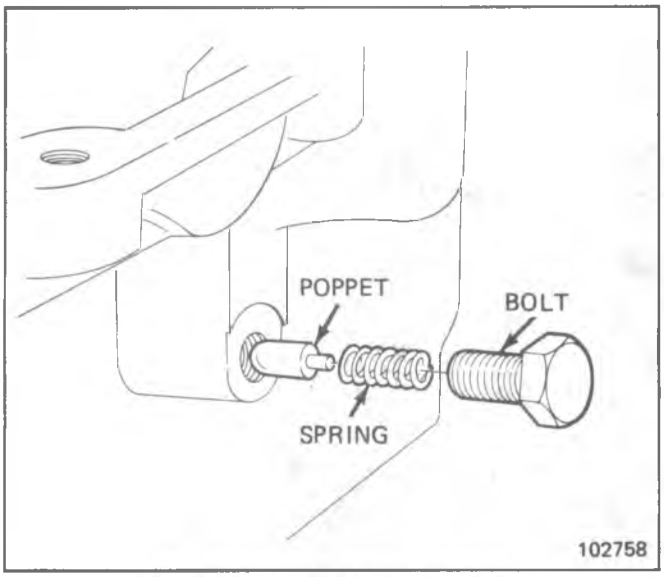


Fig. 7E-9-Poppet, Spring and Bolt

TRANSFER CASE

Disassembly

1. Remove fill and drain plugs (Fig. 7E-8).
2. Remove front yoke. Discard yoke seal washer and yoke nut.
3. Turn transfer case on end and position front case on wood blocks. Cut "V" notches in wood blocks to clear mounting studs in front case if necessary.
4. Remove lock mode indicator switch and washer (Fig. 7E-8).
5. Remove detent bolt, spring and ball (Fig. 7E-9).
6. Remove rear retainer attaching bolts and remove retainer and pump housing as assembly (Fig. 7E-10). Tap retainer from case using plastic mallet only. DO NOT pry.
7. Remove pump housing from retainer and remove pump seal from housing (Fig. 7E-10). Discard seal.
8. Remove speedometer drive gear from mainshaft.
9. Remove oil pump from mainshaft. Note the position of pump for assembly reference. Side facing case interior has recess in it (Fig. 7E-11).
10. Remove bolts attaching rear case to front case and remove rear case. To remove the rear case, insert screwdrivers into the slots cast in the case ends and gently pry upward. DO NOT attempt to wedge the case halves apart at any point on the mating surfaces.
11. Remove retainer and spring from shift rod.
12. Remove front output shaft rear thrust bearing assembly (Fig. 7E-12). Note position of bearing and races for assembly reference.
13. Remove driven sprocket retaining snap ring (Fig. 7E-13).
14. Remove drive sprocket retaining snap ring and remove spacer washer (Fig. 7E-14).
15. Remove drive and driven sprockets and drive chain as assembly (Fig. 7E-15). Lift evenly on both sprockets to remove assembly. Mainshaft roller bearings may drop out of driven sprocket.
16. Remove front output shaft and front thrust bearing assembly (Fig. 7E-16).
17. Remove synchronizer blocker ring (Fig. 7E-17).
18. Remove synchronizer, mode fork bushing, mode fork and bracket as assembly (Fig. 7E-18). The synchronizer keys may fall free from the hub.
19. Remove shift rail.
20. Remove mainshaft with synchronizer hub and snap ring attached (Fig. 7E-19).
21. Remove annulus gear snap ring and thrust washer.
22. Remove annulus gear and range fork as assembly. Turn fork counterclockwise to disengage fork lug from range sector and lift assembly out of case (Fig. 7E-20).
23. Remove planetary thrust washer and remove planetary assembly (Fig. 7E-21).
24. Remove mainshaft thrust bearing from input gear (Fig. 7E-22) and remove input gear. Lift gear straight up and out of case.
25. Remove input gear thrust bearing and race (Fig. 7E-23). NOTE the position of bearing and race for assembly reference.
26. Remove range sector operating lever attaching nut and washer. Remove lever and remove sector shaft seal and seal retainer (Fig. 7E-8).
27. Remove range sector.
28. Inspect lock plate (Fig. 7E-23). If lock plate is loose or is worn, broken or cracked, remove lock plate. Refer to replacement procedure in Subassembly Overhaul section.
29. Remove output shaft seals from front and rear case seal bores.

CLEANING AND INSPECTION

Wash all parts thoroughly in clean solvent. Be sure all old lubricant, metallic particles, dirt, or foreign material

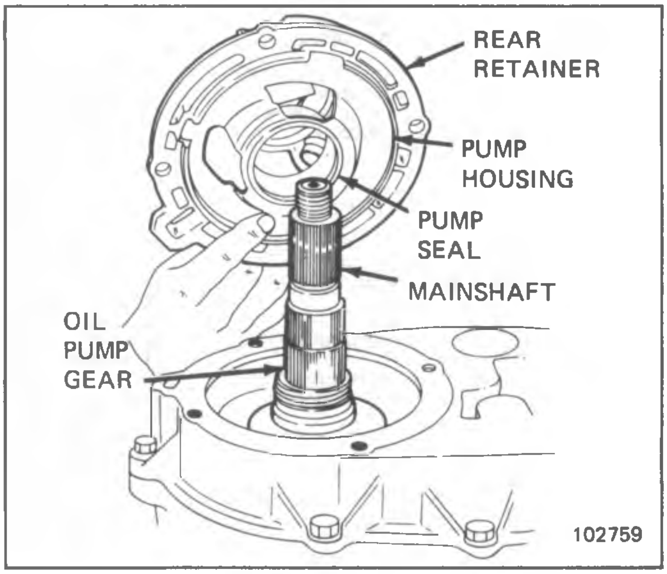


Fig. 7E-10-Rear Retainer

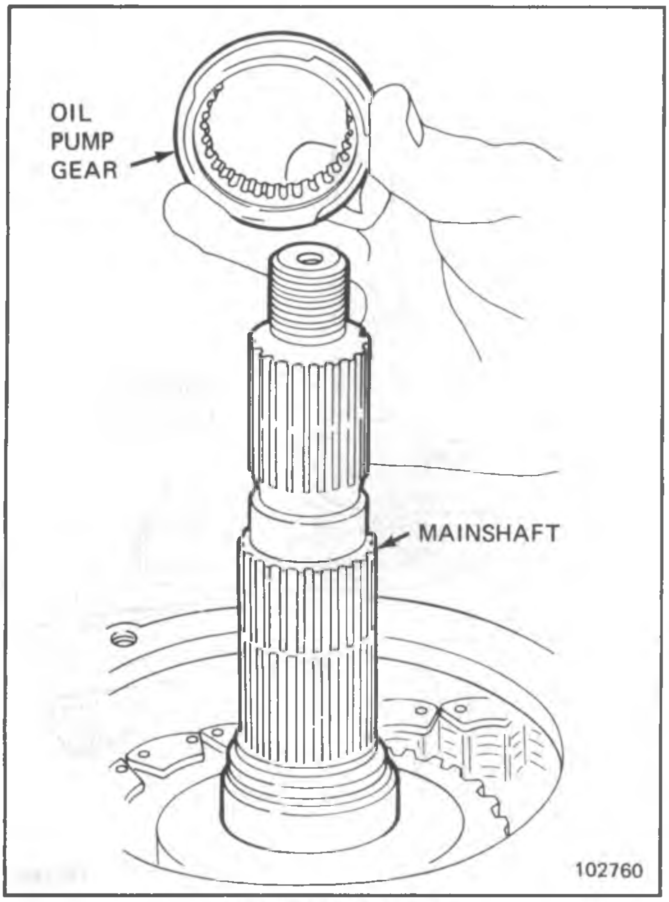


Fig. 7E-11-Oil Pump

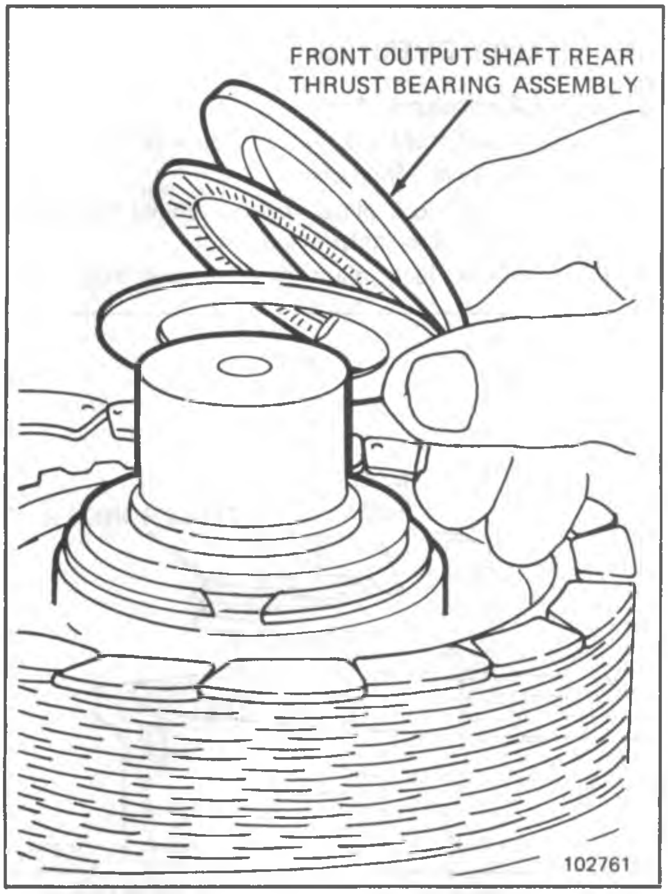


Fig. 7E-12-Front Output Shaft Rear Thrust Bearing

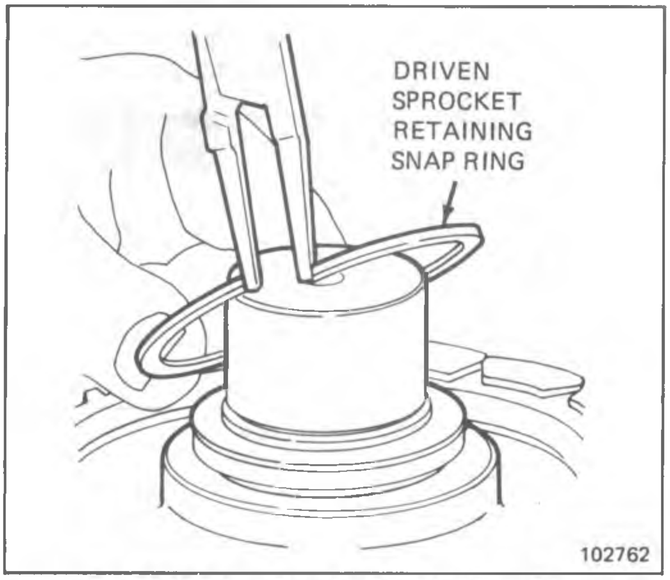


Fig. 7E-13-Driven Sprocket Retaining Snap Ring

are removed from the surfaces of every part. Apply compressed air to each oil feed port and channel in each case half to remove any obstructions or cleaning solvent residue.

Inspect all gear teeth for signs of excessive wear or damage and check all gear splines for burrs, nicks, wear or damage. Remove minor nicks or scratches on oil stone. Replace any part exhibiting excessive wear or damage.

Inspect all snap rings and thrust washers for evidence of excessive wear, distortion or damage. Replace any of

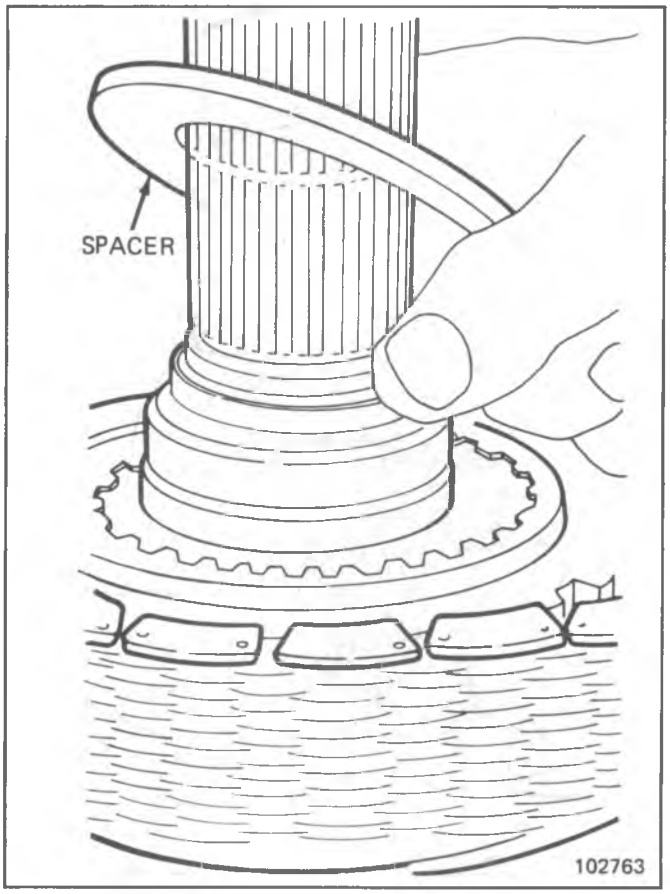


Fig. 7E-14-Drive Sprocket Thrust Washer

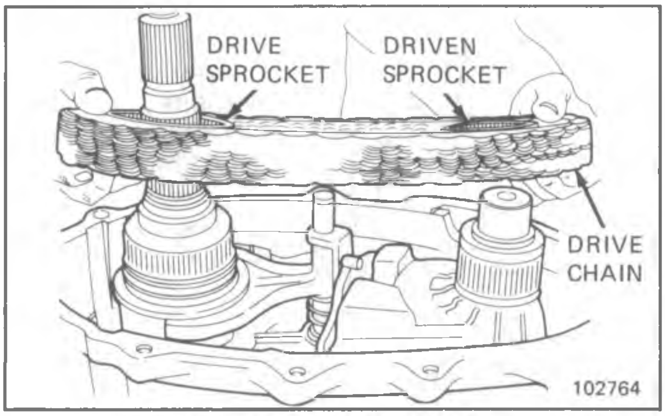


Fig. 7E-15-Sprocket and Chain

these parts if they exhibit these conditions.

Inspect the two case halves for cracks, porosity, damaged mating surfaces, stripped bolt threads, or distortion. Replace any part that exhibits these conditions. Inspect the low range lock plate in the front case. If the lock plate teeth or the plate hub is cracked, broken, chipped, or excessively worn, replace the lock plate and the lock plate attaching bolts. Refer to the Lock Plate Replacement procedure.

Inspect the condition of all needle, roller and thrust bearings in the front and rear case halves and the input gear. Also, check the condition of the bearing bores in both cases and in the input gear, rear output shaft, side gear, and rear retainer. Replace any part that exhibits signs of excessive wear or damage. If the case or input gear bearings require replacement, refer to Bearing Replacement.

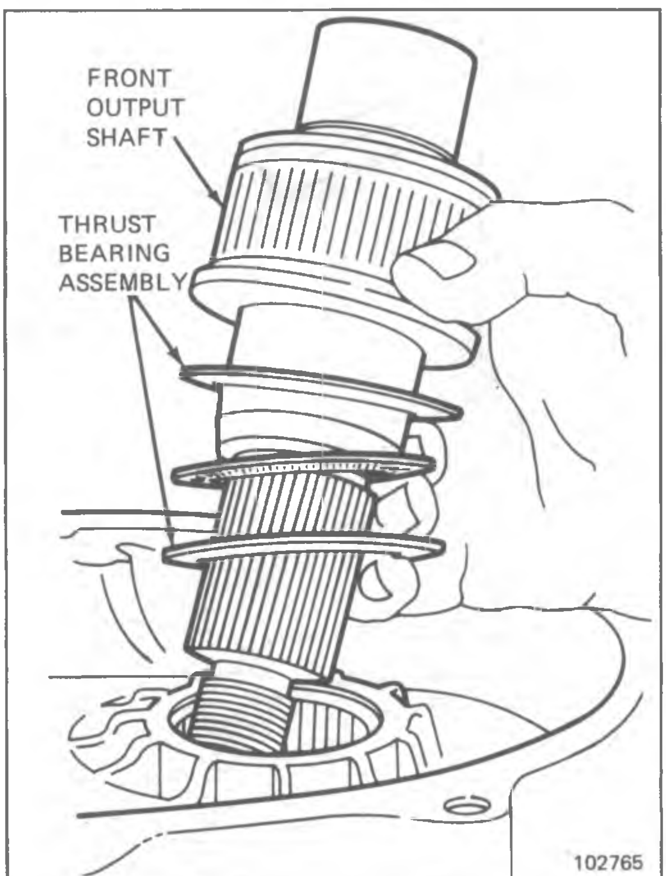


Fig. 7E-16-Front Output Shaft and Front Thrust Bearing Assembly

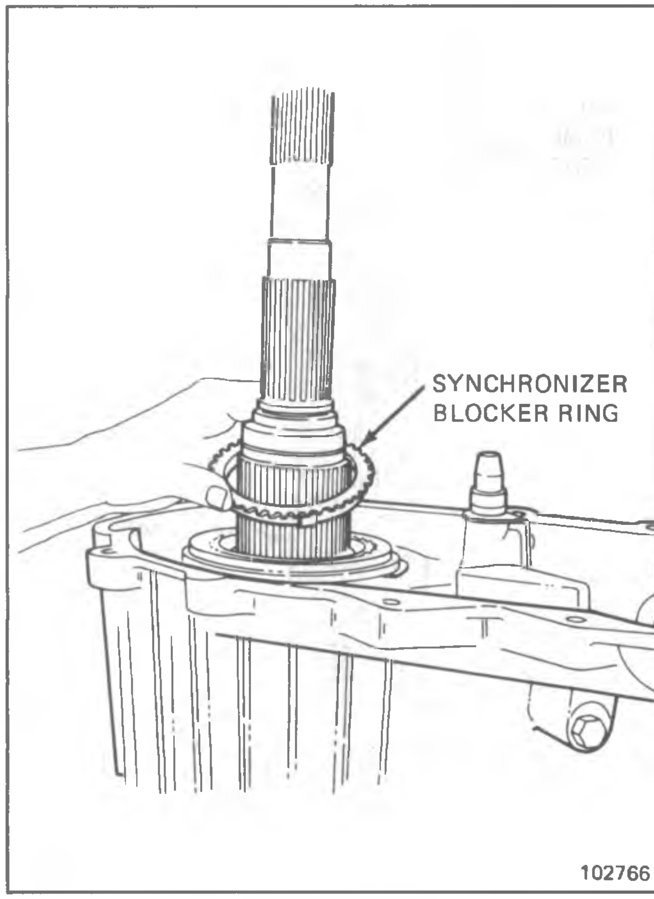


Fig. 7E-17-Synchronizer Blocker Ring

SUBASSEMBLY OVERHAUL

Lock Plate Replacement

1. Remove and discard lock plate attaching bolts.
2. Remove lock plate from case.
3. Coat case and lock plate surfaces around bolt holes with Loctite 515 sealant, or equivalent.
4. Position new lock plate in case and align bolt

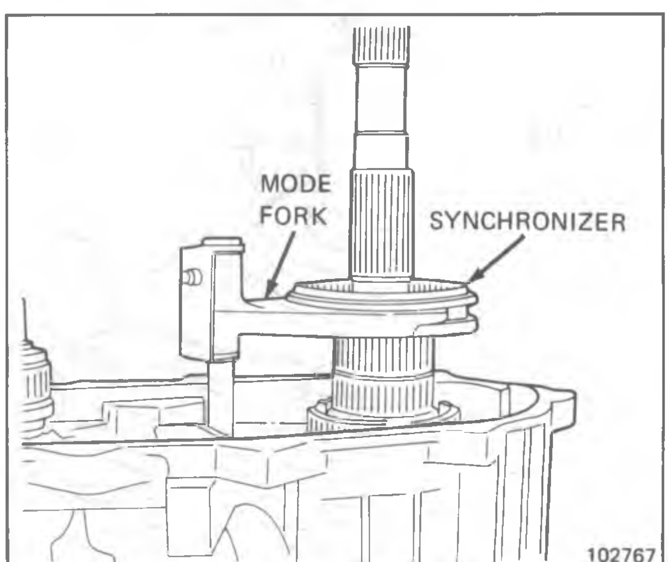


Fig. 7E-18-Synchronizer, Mode Fork Bushing, Mode Fork and Bracket

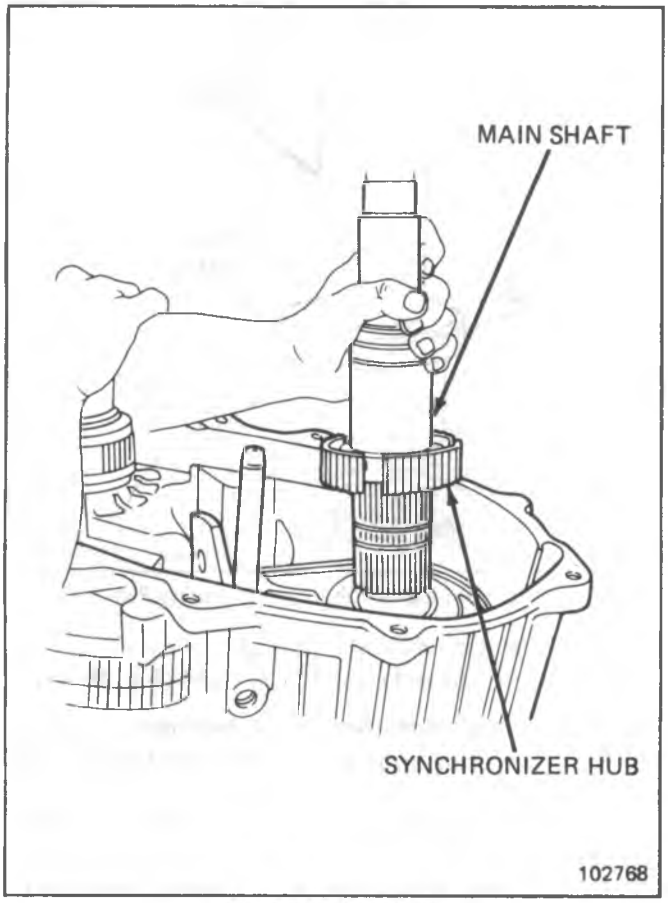


Fig. 7E-19-Mainshaft

holes in lock plate and case.

5. Coat new lock plate attaching bolts with Loctite 271 sealant, or equivalent.
6. Install and tighten lock plate attaching bolts to 41 N·m (30 ft. lb.).

Bearing and Bushing Replacement

All of the bearings used in the transfer case must be correctly positioned to avoid covering the bearing oil feed holes. After replacing any bearings check the bearing

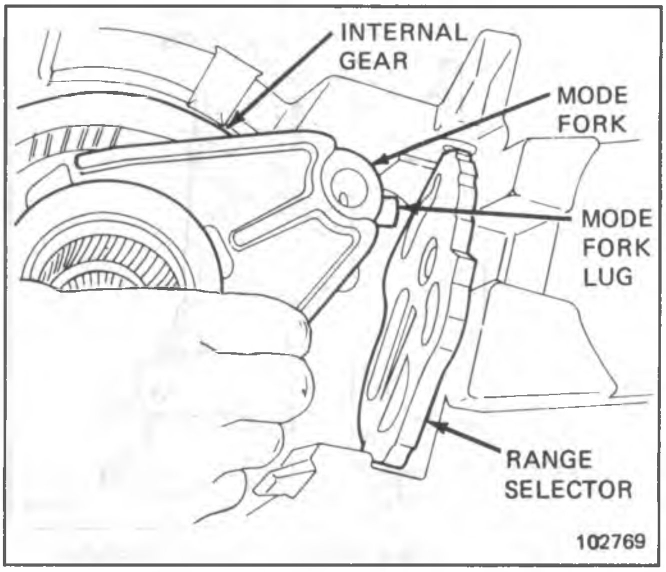


Fig. 7E-20-Annulus Gear and Mode Fork

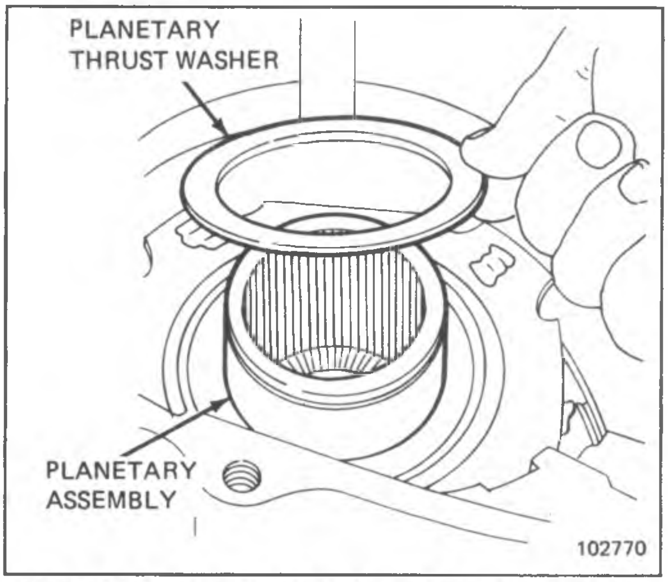


Fig. 7E-21-Planetary Thrust Washer and Planetary Assembly

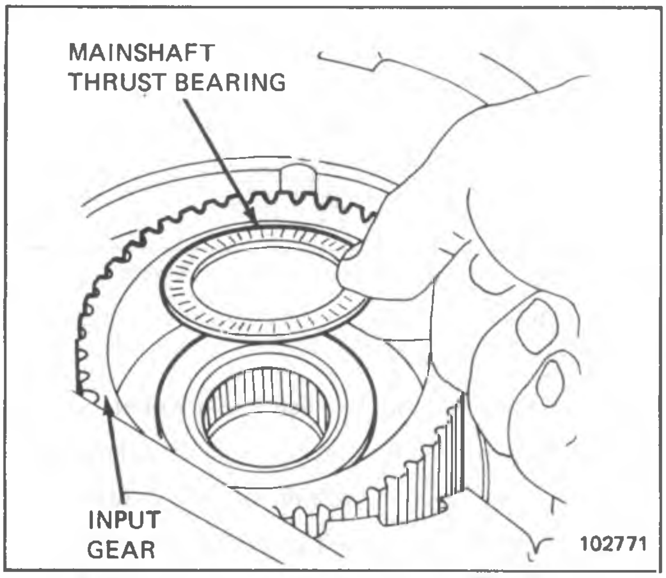


Fig. 7E-22-Mainshaft Thrust Bearing and Input Gear

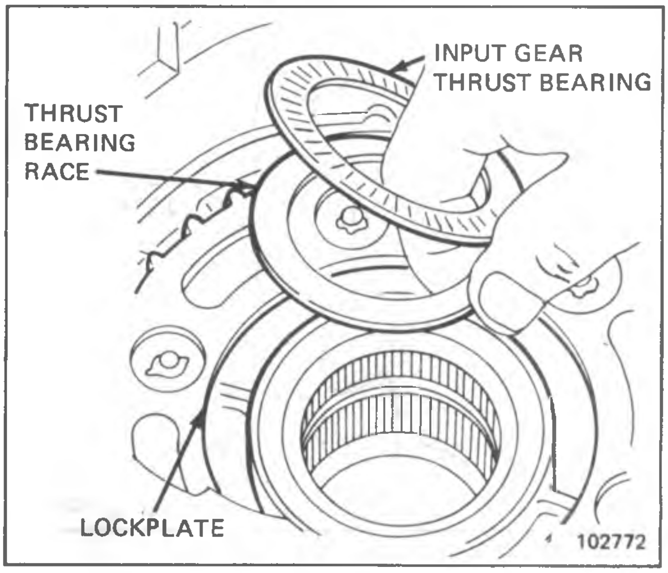


Fig. 7E-23-Input Gear Thrust Bearing and Race

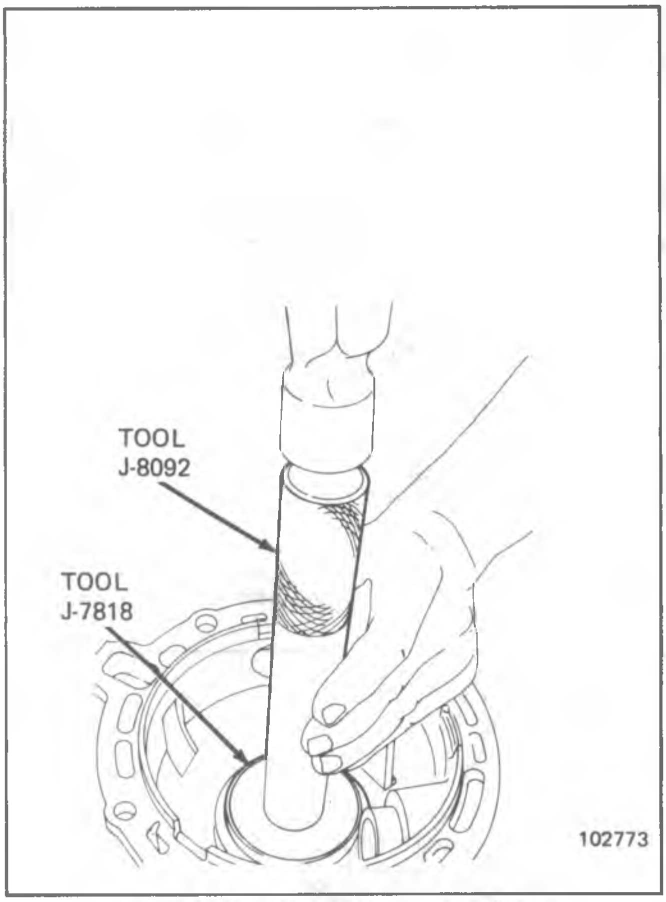


Fig. 7E-24-Rear Output Bearing Installation

position to be sure the feed hole is not obstructed or blocked by a bearing.

Rear Output Bearing and Rear Seal Replacement

1. Drive bearing out of retainer using mallet or brass drift.
2. Remove rear seal using screwdriver or brass drift.
3. Install new bearing using Tool J-7818 (Fig. 7E-24). Be sure shielded side of bearing faces interior of case.

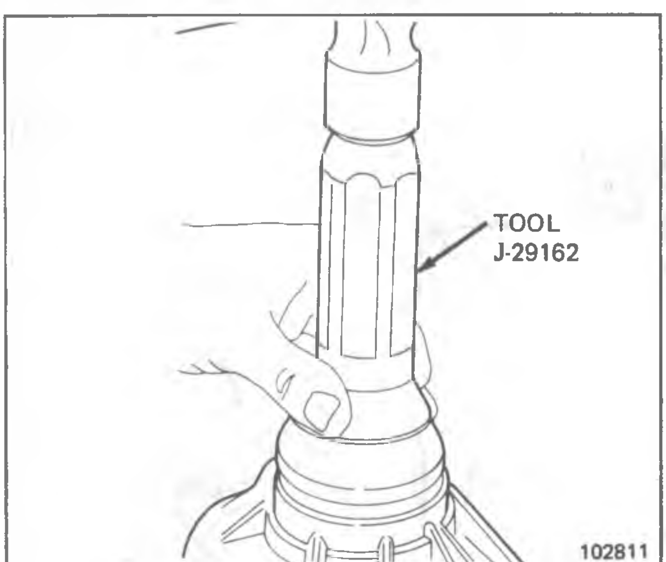


Fig. 7E-25-Rear Seal Installation

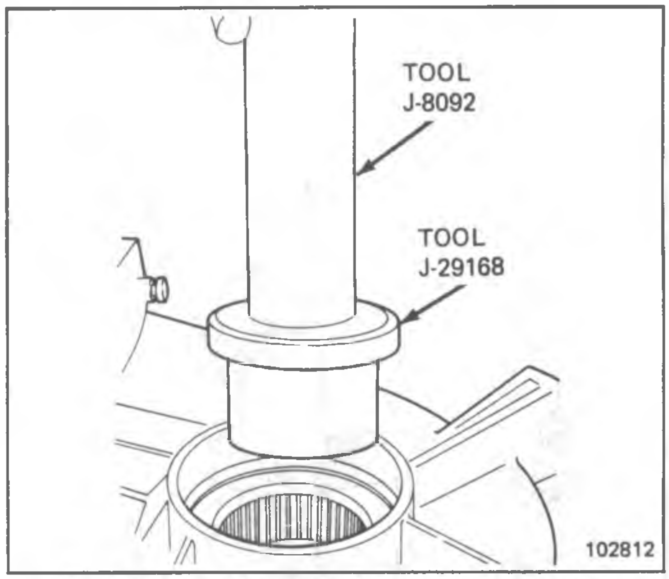


Fig. 7E-26-Front Output Shaft Front Bearing Removal

4. Install bearing retaining snap ring.
5. Install new rear seal using Tool J-29162 (Fig. 7E-25).

Front Output Shaft/Front Bearing Replacement

1. Remove bearing using Tools J-8092 and J-29168 (Fig. 7E-26).
2. Install new bearing using Tools J-8092 and J-29167 (Fig. 7E-27).
3. Remove installer tools and check bearing position to be sure oil feed hole is not covered.

Front Output Shaft Rear Bearing Replacement

1. Remove bearing using Remover J-26941 and Slide Hammer J-2619-01 (Fig. 7E-28).
2. Install new bearing using Driver Handle J-8092 and Installer J-29163 (Fig. 7E-29).
3. Remove installer tools and check bearing position to be sure oil feed hole is not covered. Also, be sure bearing is seated flush with edge of case bore to allow room for thrust bearing assembly.

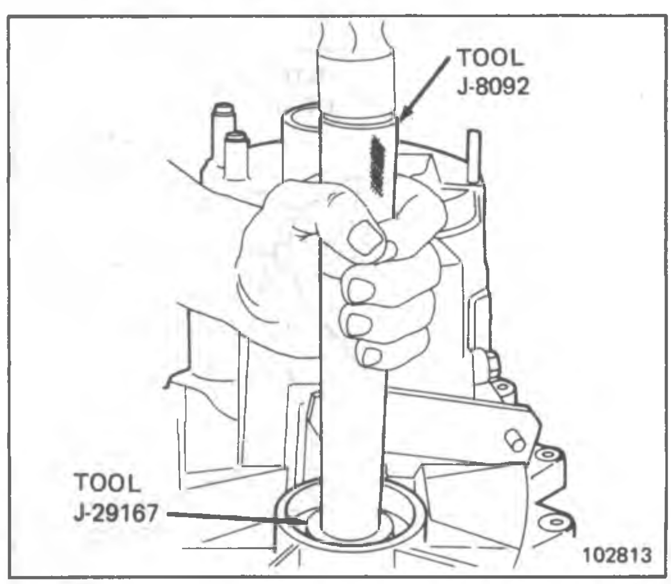


Fig. 7E-27-Front Output Shaft Front Bearing Installation

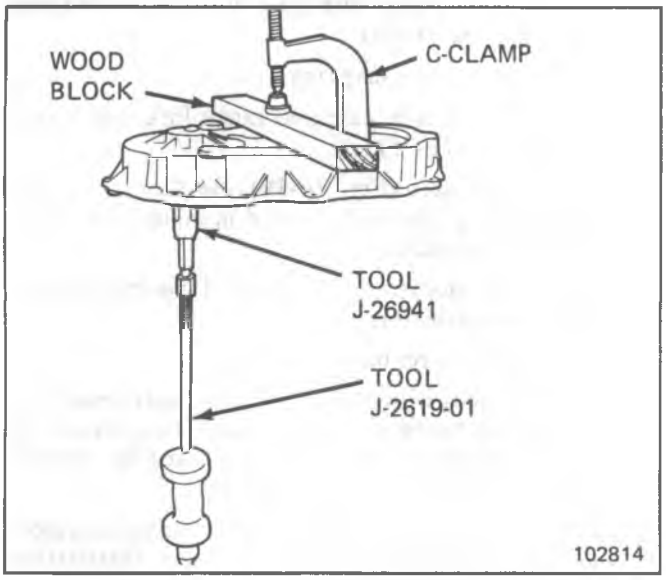


Fig. 7E-28-Front Output Shaft Rear Bearing Removal

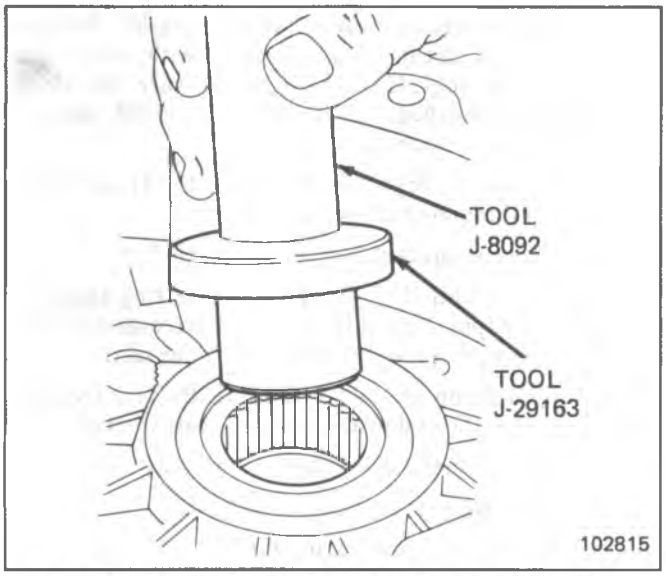


Fig. 7E-29-Front Output Shaft Rear Bearing Installation

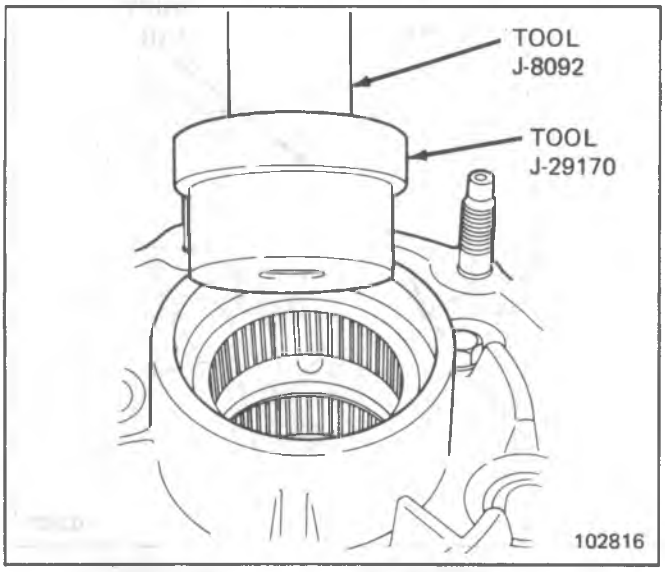


Fig. 7E-30-Input Gear Bearing Removal

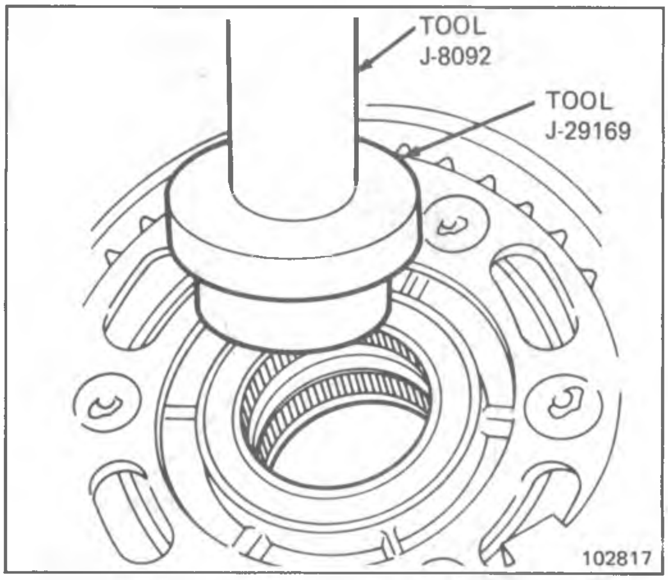


Fig. 7E-31-Input Gear Bearing Installation

Input Gear Front/Rear Bearing Replacement

1. Remove both bearings simultaneously using Driver Handle J-8092 and Remover J-29170 (Fig. 7E-30).
2. Install new bearings one at a time. Install rear bearing first; then install front bearing. Use Driver Handle J-8092 and Installer J-29169 (Fig. 7E-31).
3. Remove installer tools and check bearing position to be sure oil feed holes are not covered. Also, be sure bearings are flush with case bore surfaces.

Mainshaft Pilot Bearing Replacement

1. If bearing cannot be removed by hand, remove it using Slide Hammer J-2619-01 and Remover J-29369-1 or similar internal type blind hole bearing puller (Fig. 7E-32).
2. If necessary, install new bearing using Driver Handle J-8092 and Installer J-29174 (Fig. 7E-33).
3. If bearing was seated using installer tools, check bearing position to be sure oil feed hole is not covered. Also, be sure bearing is seated flush with edge of oil hole.

REASSEMBLY AND INSTALLATION

During assembly, lubricate components with Dexron ® II or petroleum jelly.

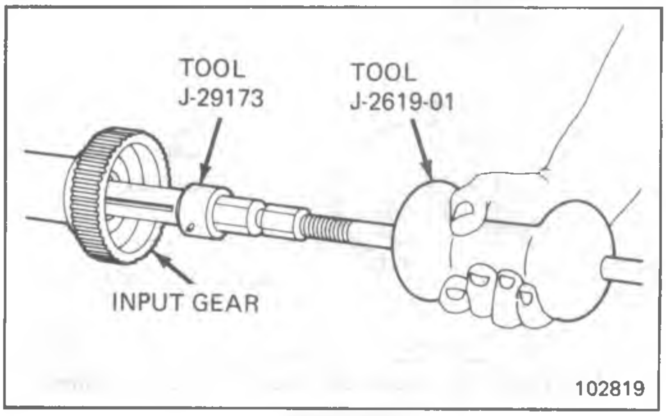


Fig. 7E-32 Mainshaft Pilot Bearing Removal

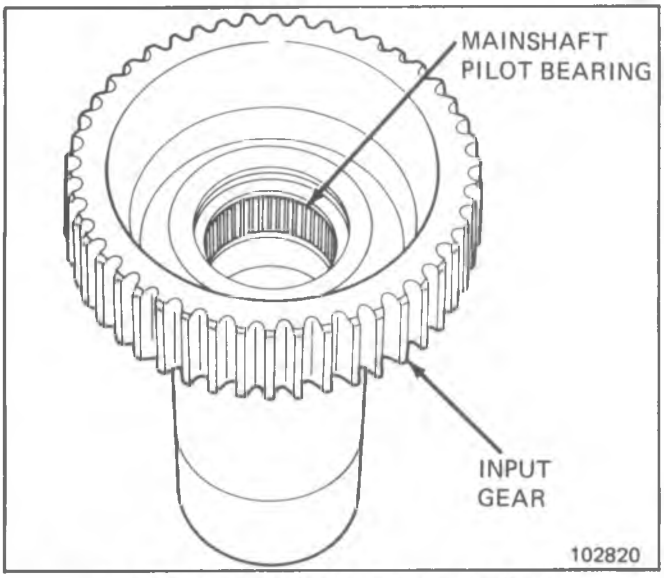


Fig. 7E-33-Mainshaft Pilot Bearing Installation

1. Install input gear race and thrust bearing in front case (Fig.7E-23).
2. Install input gear.
3. Install mainshaft thrust bearing in input gear (Fig. 7E-34).
4. Install range sector shaft seal and seal retainer (Fig. 7E-8).
5. Install range sector.
6. Install operating lever on range sector shaft. Install shaft washer and tighten locknut to 24 N·m (18 ft. lb.).
7. Install planetary assembly over input gear (Fig. 7E-34). Be sure planetary is fully seated and meshed with gear.
8. Install planetary thrust washer on planetary hub (Fig. 7E-21).
9. Install inserts in range fork, if removed.
10. Engage range fork in annulus gear and install annulus gear over planetary assembly (Fig. 7E-35).

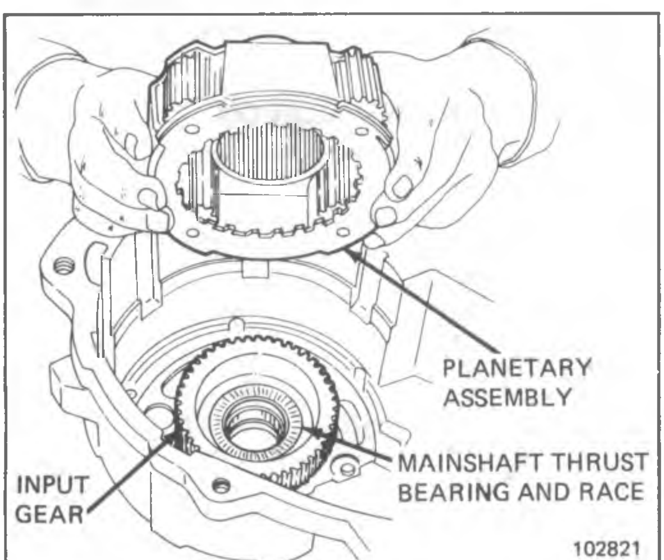


Fig. 7E-34-Input Gear, Mainshaft Thrust Bearing and Planetary Installation

Be sure that the range fork lug is fully inserted in range sector slot (Fig. 7E-20).

11. Install annulus gear snap ring.
12. Align shaft bores in case and range fork, and install shift rail (Fig. 7E-35).
13. Install mainshaft (Fig. 7E-19). Be sure mainshaft thrust bearing is properly seated in input gear before installing mainshaft.
14. Position synchronizer keys and install synchronizer and mode fork as assembly.
15. Install synchronizer blocker ring.
16. Coat mainshaft with liberal amount of petroleum jelly and position bearing retainer. Install two rows of 60 needle bearings on mainshaft separated by bearing retainer. Total of 120 bearings are used.
17. Install front output shaft front thrust bearing assembly in front case (Fig. 7E-16). Correct installation sequence is thick race-thrust bearing-thin race.
18. Install front output shaft.
19. Install sprockets and drive chain as assembly. Position sprockets in chain, align sprockets with shafts and install assembly (Fig. 7E-15). Be sure the drive sprocket is installed with the tooth side of the sprocket facing the case interior.
20. Install spacer on drive sprocket (Fig. 7E-14) and install sprocket retaining snap ring.
21. Install driven sprocket snap ring (Fig. 7E-13).
22. Install front output shaft rear thrust bearing assembly on front output shaft (Fig. 7E-12). Correct installation sequence is thin race-thrust bearing- thick race.
23. Install oil pump gear on mainshaft. Be sure recessed side of pump faces downward toward case interior.
24. Install speedometer drive gear on mainshaft.
25. Install magnet in front case, if removed.
26. Install spring and retainer on shift rail.
27. Apply Loctite 515 sealant, or equivalent, to mating

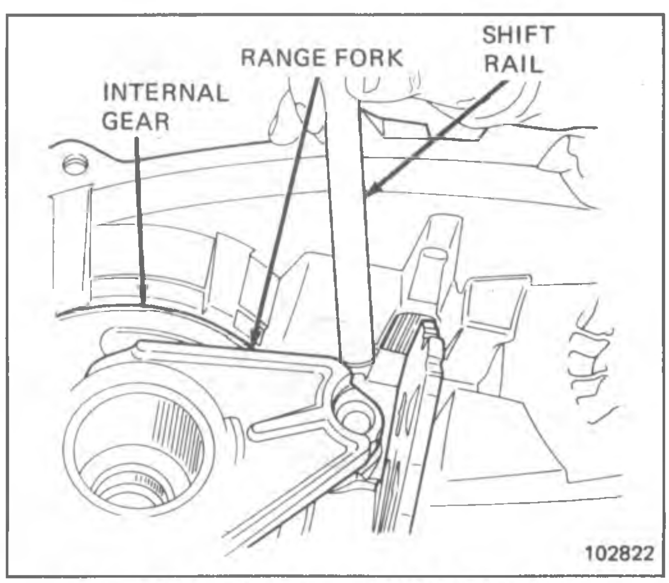


Fig. 7E-35-Annulus Gear and Shift Rail Installation surface of front case and install rear case on front case. Be sure front output shaft rear thrust bearing assembly is seated in the rear case.

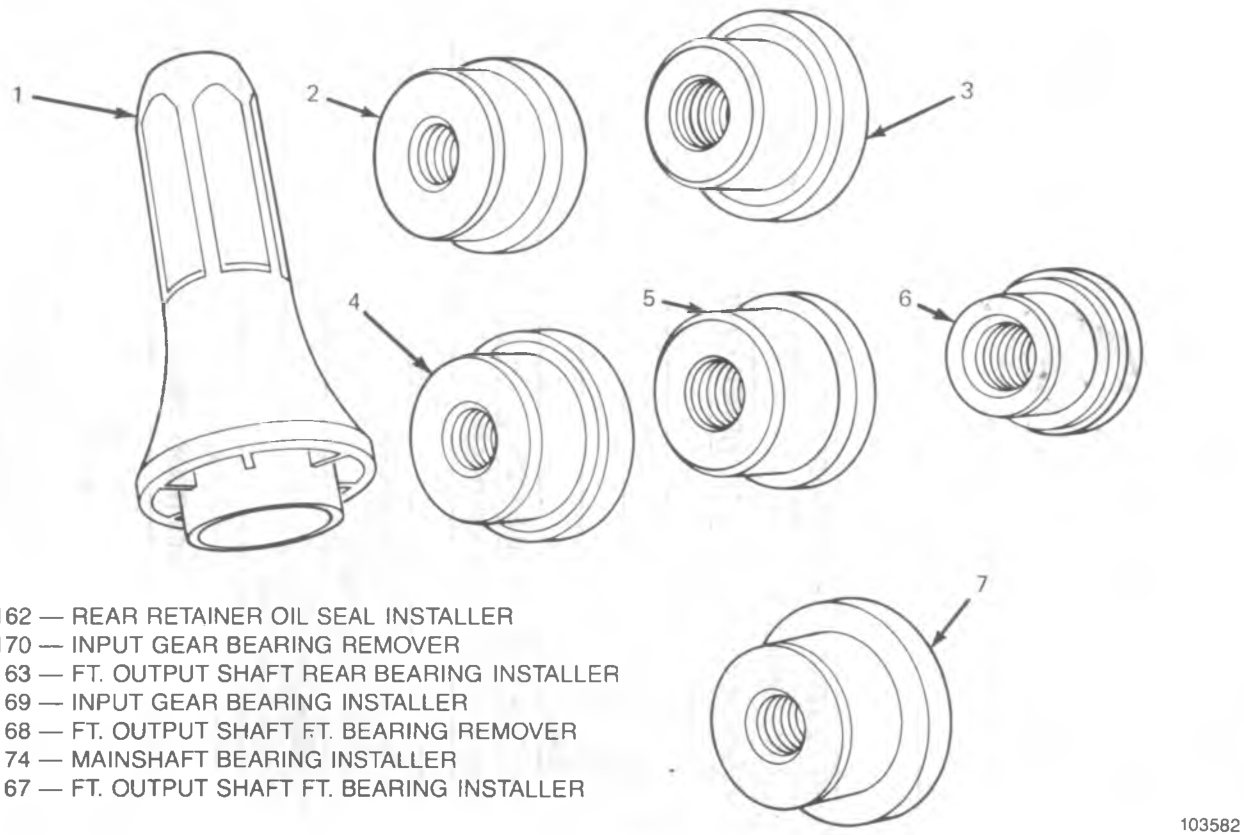
28. Align case bolt holes and alignment dowels and install bolts. Tighten bolts alternately and evenly to 31 N·m (23 ft. lb.). Besure to install flat washers on the two bolts installed at the opposite ends of the case.
29. Install seal in pump housing. Apply petroleum jelly to pump housing tabs and install housing in rear retainer.
30. Apply Loctite 515 sealant, or equivalent, to mating surface of rear retainer.
31. Align rear retainer and case index marks and install retainer. Install and tighten retainer bolts to 31 N·m (23 ft. lb.).
32. Install oil seal in rear retainer bore. Coat seal lip with petroleum jelly before installation.
33. Install washer and indicator switch. Tighten switch to 24 N·m (18 ft. lb.).
34. Apply small quantity of Loctite 515 sealant, or equivalent, to detent retainer bolt and install detent ball, spring and bolt (Fig. 7E-9). Tighten bolt to 31 N·m (23 ft. lb.).
35. Install drain plug and gasket. Tighten plug to 24 N·m (18 ft. lb.).
36. Install oil seal in front case output shaft bore.
37. Install front yoke.
38. Install yoke seal washer and yoke nut. Tighten nuts to 163 N·m (120 ft. lb.).
39. Pour 10 pints of Dexron® II into transfer case through fill plug hole and install and tighten fill plug to 24 N·m (18 ft. lb.).

	N·m MODEL 208
NUT, SHIFT LEVER-TO-SHIFTER ASSEMBLY	19-27
NUT, KNOB ASSEMBLY-TO-SHIFT LEVER	26-40
BOLT, SHIFTER ASSEMBLY-TO-TRANSFER CASE	120-140
NUT, SHIFT ARMS-TO-CASE	14-20
SCREW, SHIFT LEVER BOOT RETAINER	2.2-3.2
BOLT, DETENT RETAINER	27-34
SWITCH, INDICATOR	122-176
BOLT, ADAPTER-TO-TRANSMISSION	26-40
BOLT, ADAPTER-TO-TRANSFER CASE	26-40
FILLER PLUG	40-54
NUT, SKID PLATE-TO-CROSSMEMBER	55-70
BOLT, SUPPORT STRUT ROD	
— TRANSMISSION END	40-54
— TRANSFER CASE END	150-200

MODEL NO.	205 (PART TIME)	208 (PART TIME)
RATIOS: HI RANGE LO RANGE	1.00 TO 1 1.96 TO 1	2.61 TO 1
LEVER POSITIONS	4-LO (ALL WHEEL UNDERDRIVE) N (NEUTRAL) 2-HI (REAR WHEEL DRIVE) 4-HI (ALL WHEEL DIRECT DRIVE)	4-LO (ALL WHEEL UNDERDRIVE) N (NEUTRAL) 2-HI (REAR WHEEL DRIVE) 4-HI (ALL WHEEL DIRECT DRIVE)
LEVER LOCATION	REAR OF TRANS. SHIFT LEVER	REAR OF TRANS. SHIFT LEVER
LUBRICANTS: OIL CAPACITY	5.2 PINTS*	10 PINTS*
TYPE, GRADE	SEE OWNER'S MANUAL	SEE OWNER'S MANUAL

* TO BE FILLED TO EDGE OF FILL PLUG HOLE.

Fig. 7E-SP Specifications



1. J-29162 — REAR RETAINER OIL SEAL INSTALLER
2. J-29170 — INPUT GEAR BEARING REMOVER
3. J-29163 — FT. OUTPUT SHAFT REAR BEARING INSTALLER
4. J-29169 — INPUT GEAR BEARING INSTALLER
5. J-29168 — FT. OUTPUT SHAFT FT. BEARING REMOVER
6. J-29174 — MAINSHAFT BEARING INSTALLER
7. J-29167 — FT. OUTPUT SHAFT FT. BEARING INSTALLER

Fig. 7E-ST1--208--Special Tools

SECTION 8B

CHASSIS ELECTRICAL

General Description.................... 8B-1
Lights and Lighting Circuits.................... 8B-1
Horn.................... 8B-2
Ignition Switch.................... 8B-2
Neutral Start Switches.................... 8B-2
Park/Neutral Start Switch.................... 8B-2
Manual Transmission-Clutch Operated Start Switch 8B-2
Automatic Transmission-Combination Neutral/Start/ Backup Lamp Switch.................... 8B-2
Seat Belt Warning System.................... 8B-2
Seat Belt, Key, Headlight Audio Alarm Warning.................... 8B-2
Windshield Wiper System.................... 8B-4
Standard Washer System.................... 8B-4
Fluidic Washer System.................... 8B-4
Fuse Block.................... 8B-4
Fusible Link.................... 8B-4
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For vehicles sold in Canada and equipped with non-colosed loop engines, also refer to the appropriate Canadian Service Manual Supplement.

The following information will aid in diagnosis and switch and bulb replacement when used with the circuit information provided in Section 8B. All diagnostic information in this section assumes that all wires are connected and routed as designed. Disconnected and rerouted wires must be corrected or taken into account before any diagnosis can be performed.

GENERAL DESCRIPTION

LIGHTS AND LIGHTING CIRCUITS

The headlights are controlled by a light switch located on the instrument panel. This switch also controls the parking lights, side marker lights, taillights, license plate light, instrument panel lights, and interior lights.

The parking lights, taillights, license plate light, side marker lights and instrument panel lights operate whenever the parking light switch is partially activated. The headlights turn on, in addition to lights activated by the parking light switch, when the headlight switch is fully activated. Intensity of instrument panel lights can be varied from off to bright by rotating the light switch or panel control. Rotating the control fully up past the detent will turn on passenger compartment interior lights.

A side relex reflector is provided in the side marker lights with rear reflex installed in either combination rear lights or backup lights.

Directional signal lights are combined with the parking lights in front and with the stop and taillights in the rear. The ignition must be "ON" for the directional signal lights to be operated with the turn signal switch.

With the directional signal switches in neutral position, stepping on the brake pedal will illuminate the rear stop lights on both sides. If the switch is operating either side as a directional signal, stepping on the brake pedal will turn on the stop light only on the side which is not flashing. The flasher used in this circuit controls only the directional signals and is located on the fuse panel.

The lane-change directional signal switch is standard equipment. When making a partial turn, such as when changing lanes, the driver has the option of moving the switch lever to a detent stop. The signal lamps will continue to flash as long as the lever is held in this position and will cancel automatically when the lever is released. By using the detent position, a shallow turn or lane change can be signaled without possibility of failure to cancel.

Moving the directional signal switch lever past the detent position to the limit of its travel for either turn will provide conventional turn signal operation. Front side marker lights, when separate from the park and turn signal lights, will flash with turn signal lights when park lights and headlights are off. When parking lights or headlights are on, the front side marker lights will flash alternately with the turn signal lights on the same side of the vehicle.

With the headlight switch in the "ON" position, the turn signal lever functions also as the headlight dimmer switch. Pulling the lever toward the driver and releasing it, switches the headlights to high or low beam.

On models with "Flash to Pass" feature, pulling the lever towards the driver will turn on the high beam headlights, as long as the lever is held in this position. This function is independent of the headlight switch operation.

A Hazard Warning flasher is included in the directional signal circuit. Pushing the switch control button (on right side of steering column) inward will disconnect the regular directional signal flasher and energize the Hazard Warning flasher regardless of ignition switch or directional signal switch position. Pulling the button collar outward will cancel the Hazard Warning flasher.

When the Hazard Warning flasher is operating, the directional signal indicator lights, and all front and rear turn signal lights will flash, as well as front side marker ilghts if separate from park and signal lights. If the brake pedal is depressed while the Hazard Warning flasher is operating, all signal lights will burn continuously.

The backup lights are connected to operate with the ignition "ON". This is through the neutral start switch on automatic transmission or a transmission or a transmission-mounted switch on manual transmission. Placing the vehicle shift lever in "REVERSE", cycles the switch turning the backup lights on both dayor night.

Most problems in vehicle lighting can be visually diagnosed and easily corrected. Problems such as bulb burnout, cracked lens, loose or cut wires, etc., constitute the majority of problems and involve only replacement of a defective or damaged part. For more difficult problems, see Diagnosis Charts.

Where removal of a part involves special procedures (lens and housing assembly sealed together, etc.), follow special instructions normally included in replacement package. Where removal of a part involves special seal items, such as seal washers under the heads of the lens retaining screws, be sure to replace items when reinstalling. Likewise, any body sealing (grommets, etc.) disturbed by wiring repairs or replacement, should be restored during service to maintain passenger compartment sealing.

The wiring harnesses use a standardized color code common to all vehicles. Under the color code, the color of the wire designates a particular circuit. The harness title indicates the type of harness, single or multiple wire, and also describes the location of the harness. Circuit Identification Charts and wiring diagrams are shown in the rear of this manual.

HORN

A single horn is standard on some models, while dual horns are standard on some models and optional on others.

Each horn utilizes a solenoid-actuated diaphragm to develop a resonating air column in horn projector.

A relay is used in the horn circuit because of high currrent required to operate horns. The relay reduces the length of heavy gage wire required and provides a more direct connection between horns and battery. Consequently, high voltage is available at the horns and better performance is obtained by eliminating voltage drop which otherwise would be in the horn button wiring circuit.

IGNITION SWITCH

The ignition switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEEERING, Section 3B.

The ignition and starting switchis key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch used on all cars has five positions: Two "OFF" positions ("OFF" and "OFF-LOCKED") "ACCESSORY," "RUN" and "START", "OFF" is the center position of the key-lock cylinder and "OFF-LOCKED" is the next position to the left.

"ACCESSORY" is located one more detent to the left of "OFF-LOCKED". Turning the key to the right of the "OFF" position until spring pressure is felt will put the ignition switch in the "RUN" position, and when turned fully to the right against spring pressure, the switch will be in the "START" position.

The connections to the ignition switch are shown in the Wiring Diagrams at the end of this manual. The charts included on the diagrams show how the switches are internally connected in each switch position. Fig. 8B-1 also shows how the switch is internally connected.

NEUTRAL START SWITCHES

PARK/NEUTRAL-START SWITCH

The neutral start switch, used on most models, prevents the engine from being started in gear. Some models with automatic transmission use a mechanical lock-out to prevent starting, except in "Neutral" or ".

MANUAL TRANSMISSION-CLUTCH OPERATED START SWITCH

This system prevents starting the engine in any gear, unless the clutch is disengaged (cluth pedal depressed firmly to the floor). Installation and adjustment of switch is covered in "On-Car Service".

AUTOMATIC TRANSMISSION COMBINATION NEUTRAL/START/BACKUP LAMP SWITCH

This system, used with automatic transmission, combines the neutral start and backup lamp switches in a single switch mounted on transmission shift mechanism on the steering column. Adjustment of the switch is covered in "On-Car Service".

SEAT BELT WARNING SYSTEM

The seat belt warning system is the "8-SECOND-ON" system.

This system will activate a warning lamp and buzzer for approximately 8 seconds when the ignition key is turned to the "ON" position if the driver's seat belt is not buckled. Rapid cycling of the system will result in a decrease in the time period. The warning lamp and buzzer with timer sequence of operation is as follows:

1. "DRIVER'S BELT UNFASTENED" Turn ignition switch "ON" - warning lamp and buzzer both come on for approximately 8 seconds, then go off and stay off. If belt buckle is fastened prior to 8 second turn-off time, buzzer will go off and warning lamp stays on for balance of 8 seond delay time.
2. "DRIVER'S BELT FASTENED" Turn ignition switch "ON" - warning lamp comes on; buzzer does not. At end of approximately 8 seconds, warning lamp goes off and stays off. If buckle is unfastened prior to 8 second turnOoff time, buzzer and warning lamp both stay on for balance of 8 second delay time. Warning lamp always comes on for full 8 second time, while the buzzer is controlled by the driver's seat belt buckle switch or seat belt retractor switch. Warning lamp is controlled only by ignition switch and timer.

SEAT BELT, KEY, HEADLIGHT AUDIO ALARM WARNING

Some models use an audio alarm system to remind the driver to fasten seat belts, remove ignition key, and to turn off the headlights.

This system uses a tone generator which will sound approximately three to five times and activate a warning light on the instrument panel when the ignition key is

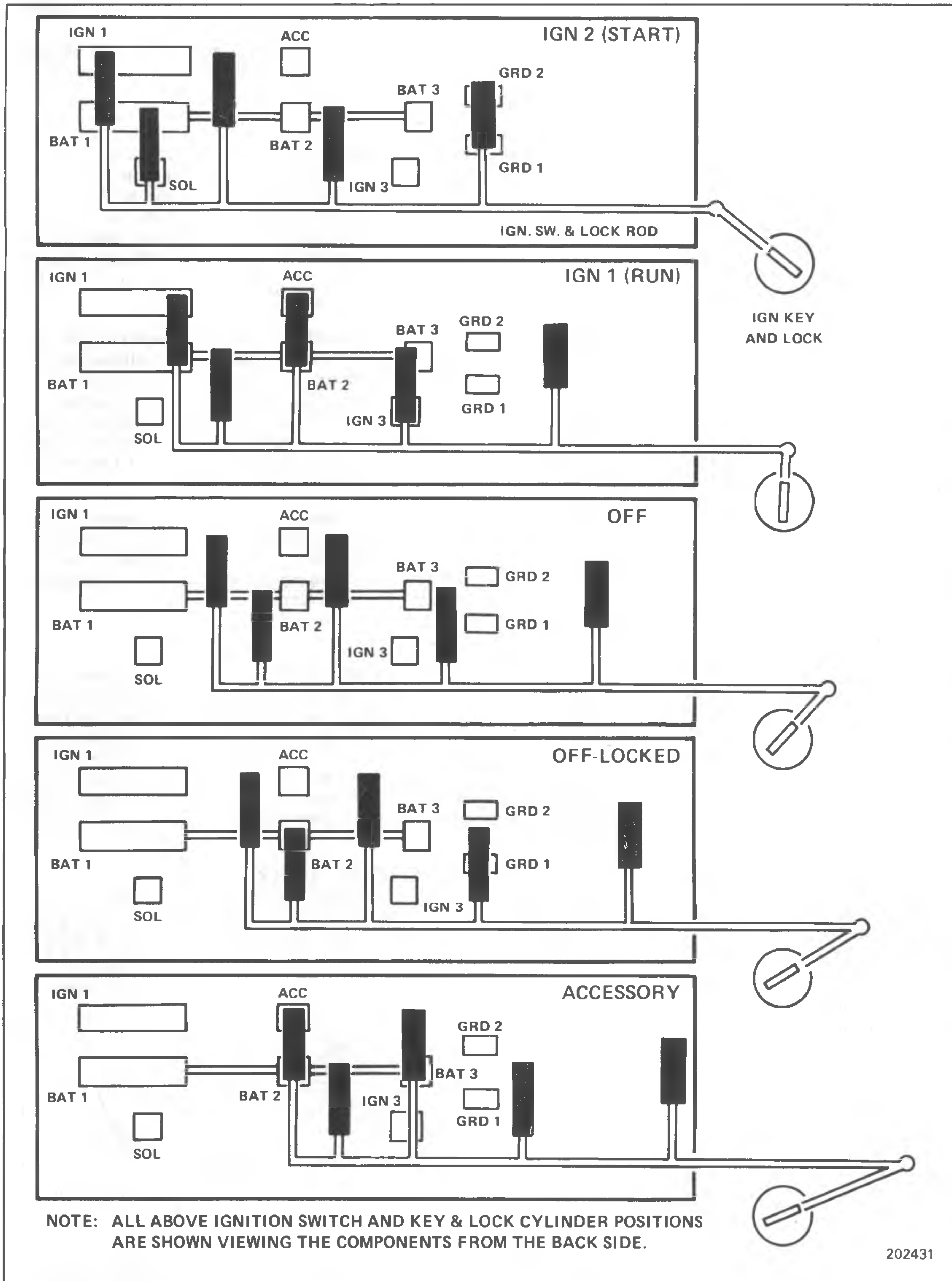


Fig. 8B-1--Ignition Switch Operation

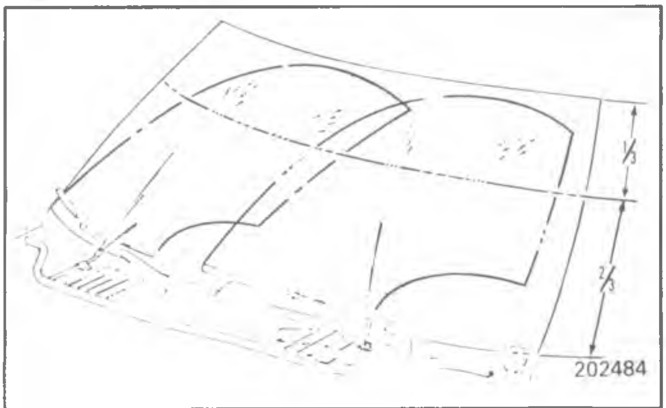


Fig. 8B-2--Windshield Washer Target Area

turned to the "ON" position if the driver's seat belt is not buckled. If the ignition key is turned to the "OFF" position and the headlights are on, the tone generator will sound (chime) to remind the driver that the headlights are on. If, however, the I.P. light dimmer thumbwheel is turned to the full "OFF" position and the headlights are "ON", the tone generator will not sound when the key is turned to the "OFF" position. If the driver's door is opened and the key is left in the ignition, the tone generator will also sound. The tone generator location is shown in "On-Vehicle Service".

WINDSHIELD WIPER AND WASHER SYSTEM

Windshield Wiper System

The windshield wiper motor and all connection linkage are covered in the Body Service Manual.

Electrical diagnosis of the windshield wiper system is covered in Section 8C.

Controlled cycle wiper systems are covered in the Accessory Section.

Standard Washer System

The washer system is a pulse system which operates for a pre-determined number of pulses when the washer button is depressed or a continuous-run system that provides fluid as long as the washer button is depressed.

Refer to Sections 3B and 9 for replacement of multi-function switch mounted in steering column.

Any time washer nozzles must be replaced, insure that the spray pattern falls within the area shown in Figures 8B-2 and 8B-3.

Fluidic Washer System

Some models use a fluidic windshield washer system. The system consists of a fluid container, pump, wiper motor, fluidic hoses and pipes, nozzle mounts, nozzle(s) and wiper arms.

The fluidic washer system is controlled by a small plastic element designed into the washer nozzle. As water is forced through this insert, the design of the mechanism creates an oscillating power stream. This fluidic washer system produces larger, more widely dispersed droplets, resulting in a more efficient cleaning action than with conventional spray nozzles.

A correctly operating system should deliver a spray patter just below the lower edge of the windshield upper reveal molding. The bottom edge of the spray pattern should fall on a line about 254mm (10") below the upper edge of the windshield (Fig. 8B-2).

Spray pattern level can be adjusted by shimming as shown in "On-Vehicle Service".

If the nozzles become plugged, they can be serviced only by replacement Pump and wiper motor service remain unchanged.

FUSE BLOCK

The fuse block on some models is a swing-down unit located in the underside of the instrument panel adjacent to the steering column. Access to the fuse block on some models is gained through the glove box opening. All models use a fuse block for miniaturized fuses, designed for increased circuit protection and greater reliability. Various convenience connectors, which snap-lock onto the fuse block, add to the serviceability of this unit.

A miniaturized fuse is used with the fuse block. This compact fuse, with blade terminal design, allows finger tip removal and replacement. Fuses of different ratings are physically interchangeable, but amperage values are molded in bold, color coded, easy-to-read numbers on the fuse body. Be sure that only fuses of proper ratings are used for replacement. Replacing a fuse with one of a higher than recommended value is not recommended.

A suspected blown fuse can easily be pulled out and examined. The clear plastic body gives full view of the element to blade construction for visual checking for defects. In addition, blade terminal tips are exposed in the fuse body, allowing for continuity checking if desired.

FUSIBLE LINK

Added protection is provided in all battery feed circuits and other selected circuits by a fusible link. This link is a short piece of copper wire approximately 4" long inserted in series with the circuit and acts as a fuse. The link is four (4) or more gages smaller in size than the circuit wire it is protecting and will burn out without damage to the circuit in case of current overload. The chassis electrical wiring diagrams at the end of the manual show the locations and colors of these fusible links.

CONVENIENCE CENTER

The Convenience Center on some models is a swing-down unit located on the underside of the instrument panel. The swing-down feature provides central location and easy access

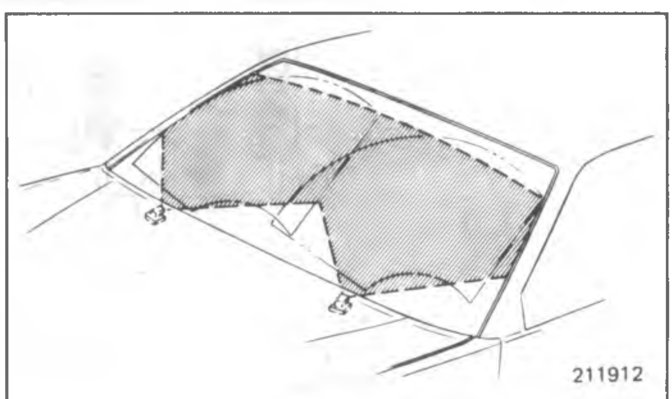


Fig. 8B-3--Windshield Washer Target Area-Fluidic Nozzles to buzzers, relays and flasher units. All units are serviced by plug-in replacement. Location of Convenience Center on specific models is covered in Section 8C.

DIAGNOSIS-LIGHTS AND LIGHTING CIRCUITS

Troubles in the lighting circuits are caused by loose connections, open or shorted wiring, burned out bulbs, failed switches, inadequate ground or blown fuses. In each, trouble diagnosis requires following through the circuits until the source of difficultyis found. To aid inmaking an orderly check, refer to the wiring diagrams shown in Section 8C.

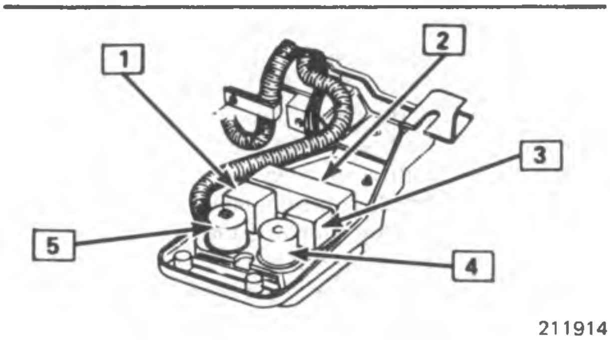


Fig. 8B-5--Convenience Center and Components - Typical

ON-VEHICLE SERVICE

MAINTENANCE

Maintenance of the lighting units and wiring system consists of an occasional check to see that all wiring connections are tight and clean, that the lighting units are tightly mounted to provide good ground and that the headlights are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to generator and charging circuit. Wire harnesses must be replaced if insulation becomes deteriorated. Whenever it is necessary to splice a wire or repair one that is broken, always use rosin core solder to bond the splice. Use insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct gage size be used. Never replace a wire with one of a smaller gage size.

Each harness and wire must be held securely in place by clips or other holding devices to prevent chafing or wearing of the insulation due to virbration.

By referring to the wiring diagrams, circuits may be tested for continuous circuit or shorts with a conventional test light or low reading voltmeter.

WIRING HARNESS SERVICE AND REPAIR

Special connectors known as Weather-Pack connectors (Fig. 8B-6) require a special tool (J-28742) for servicing. This special tool is required to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good change that the terminal will be bent or deformed. Unlike standard blade-type terminals, these terminals cannot be straightened once they are bent.

Make sure that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge-type flap provides a backup, or secondary locking feature for the terminals. They are used to improve the connector reliability by retaining the terminals if the

HEADLIGHT DIAGNOSIS

Condition	Possible Cause	correction
One headlight inoperative or intermittent	1. Loose connection	1. Secure connections to sealed beam including ground (black wire)
	2. Defective sealed beam unit.	2. Replace sealed beam.
One or more headlights are dim.	1. Open ground connection at headlight.	1. Repair black wire connection between sealed beam and body ground.
	2. Black ground wire mislocated in head-light connector (three-wire, hi-lo, connector only)	2. Relocate black wire in connector.
One or more headlights	1. Charge circuit	1. Refer to Section 6D,

short life	problem.	charging system diagnosis.
All headlights inoperative or intermittent	1. Loose connection.	1. Check and secure connections at dimmer switch and light switch.
	2. Defective dimmer switch.	2. Check voltage at dimmer switch with test light. Refer to Section 8A for test points.
	3. Open wiring - light switch to dimmer switch.	3. Check yellow wire with test light. If bulb lights at light switch yellow wire terminal but not at dimmer switch, repair open wire.
	4. Open wiring - light switch to battery.	4. Check red wire terminal at light switch with test light. If bulb does not light, repair open red wire circuit to battery (possible open fusible link).
	5. Shorted ground circuit.	5. If, after a few minutes operation, headlights flicker "ON" and "OFF" and or a thumping noise can be heard from the light switch (circuit breaker opening and closing), repair short to ground in circuit between light switch and headlights. After repairing short, check for headlight flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and light switch must be replaced.
	6. Defective light switch.	6. Check red and yellow wire terminals at light switch with test light. If bulb lights at red wire terminal but not at yellow terminal, replace light switch.
Upper or lower beam will not light or intermittent.	1. Open connection or defective dimmer switch.	1. Check dimmer switch terminals with test light. If bulb lights at light green or tan wire terminals, repair open wiring between dimmer switch and headlights. If bulb will not light at either of these terminals, depending upon switch position, replace dimmer switch.

	2. Short circuit to ground.	2. Follow diagnosis above (all headlights inoperative or intermittent)

SIDE MARKER LIGHT DIAGNOSIS

Condition	Possible Cause	Correction
One light inoperative	1. Turn signal bulb burnt out (front light)	1. Switch turn signals on. If signal bulb does not light, replace bulb. (Bulb filament provides ground path for marker lamp bulb through the dark blue or brown wires.)
	2. Side marker bulb burnt out.	2. Replace bulb.
	3. Loose connection or open in wiring.	3. Using test light, check brown wire terminal at bulb socket. If test bulb lights, repair open ground circuit. If bulb does not light, repair open in brown wire circuit.
Front or rear lights inoperative.	1. Loose connection or open ground circuit.	1. If associated tail or park lights do not operate, check all connectors in brown wire circuit. If park and turn lights inoperative, repair open ground connections.
	2. Multiple bulbs burnt out.	2. Replace burnt out bulbs.
All lights inoperative	1. Blown fuse	1. If park and taillights do not operate, replace blown fuse. If new fuse blows, check for short to ground between fuse panel and lights.
	2. Loose connection	2. Secure connector to light switch.
	3. Open in wiring	3. Check taillight fuse with test light. If test bulb lights, repair open wiring between fuse and light switch. If not, repair open wiring between fuse and battery. (Possible open fusible link.)
	4. Defective light switch	4. Check light switch with test light. If test bulb lights at orange wire but not at brown wire, replace light switch.

TAIL, PARK AND LICENSE LIGHT DIAGNOSIS

Condition	Possible Cause	Correction
One side inoperative	1. Bulb burnt out	1. Replace bulb.
	2. Open connection at at bulb socket or ground wire terminal	2. Jumper bulb base socket connection to ground. If bulb lights, repair open ground circuit.
Both sides inoperative	1. Tail light fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through light switch to lights.
	2. Loose connection	2. Secure connector at light switch.
	3. Open wiring	3. Using test light, check circuit on both sides of fuse. If test bulb does not light on either side, repair open circuit between fuse panel and battery (possible open fusible link). If test bulb lights at light switch brown wire terminal, repair open wiring between light switch and lamps.
	4. Multiple bulb burnout	4. If test bulb lights at lamp socket brown wire terminal, replace bulb(s).
	5. Defective light switch	5. If test bulb lights at light switch orange wire but not at brown wire, replace defective light switch.

TURN SIGNAL AND HAZARD WARNING LIGHT(S)

Condition	Possible Cause	Correction
Turn signals inoperative one side	1. Bulb(s) burnt out (flasher cannot be heard)	1. Turn hazard warning system "ON." If one or more bulbs are inoperative, replace bulbs as necessary.
	2. Open wiring or ground connector	2. Turn hazard warning system on. If one or more bulbs are inoperative, use test light and check circuit at bulb socket. If test bulb lights, repair open ground connection. If not, repair open wiring between bulb socket and turn signal switch.

	3. Improper bulb or defective turn signal switch.	3. Turn hazard warning system on. If all front and rear lights operate, check for improper bulb (see bulb chart). If bulbs are OK, replace defective turn signal switch.
	4. Short to ground. (Flasher can be heard, no bulbs operate)	4. Locate and repair short to ground by disconnecting front and rear circuits separately.
Turn signals inoperative	1. Blown turn signal fuse	1. Turn hazard warning system on. If all lights operate, replace blown fuse. If new fuse blows, repair short to ground between fuse and lamps.
	2. Defective flasher (located in convenience center near steering column)	2. If turn signal fuse is OK and hazard warning system will operate lights, replace defective turn signal flasher.
	3. Loose connection	3. Secure steering column connector.
Hazard Warning Inoperative	1. Blown stop-hazard fuse	1. Switch turn signals "ON." If lights operate, replace stop-hazard fuse if blown. If new fuse blows, repair short to ground. (Could be in stop light circuit.)
	2. Defective hazard warning flasher. (Located in convenience center).	2. If stop-hazard fuse is OK, switch turn signals on. If lights operate, replace defective hazard flasher.
	3. Open in wiring or defective turn signal switch.	3. Using test light, check brown wire in turn signal steering column connector. If test bulb does not light, repair open circuit between flasher and connector. If test light indicates power on brown wire and connection is good, use test light to check output terminals (lt. blue, blue, yellow and dark green wires) see Section 8A.

BACKUP LIGHT

Condition	Possible Cause	Correction
One light inoperative or intermittent	1. Loose or burnt out bulb. 2. Loose connection 3. Open ground connections.	1. Secure or replace bulb. 2. Tighten connectors. 3. Repair bulb ground circuit.
Both lights inoperative or intermittent.	1. Gear selector switch misadjusted (open when shifter lever is in reverse position)	1. Readjust gear selector switch.
	2. Loose connection or open circuit	2. Check all connectors. If OK, check continuity of circuit from fuse to light on either side of fuse, correct open circuit from battery to fuse.
	3. Blown fuse	3. Replace fuse. If new fuse blows, repair short to ground in circuit from fuse through gear selector or from fuse through gear selector or backup light switch to backup lights.
	4. Defective gear selector or backup light switch	4. With ignition "ON," check switch terminals in backup position with test light. If test bulb lights at dark blue wire terminal but not at light green wire terminal, replace light switch.
	5. Defective ignition switch	5. If test bulb lights at ignition switch battery terminal but not as output terminal, replace ignition switch.
Light will not turn off	1. Gear selector switch misadjusted (closed when shift lever is not in reverse position)	1. Readjust gear selector switch.

STOP LIGHTS

Condition	Possible Cause	Correction
One bulb inoperative	1. Bulb burnt out.	1. Replace bulb.
One side inoperative (multi-bulb design)	1. Loose connection, open wiring or defective bulbs.	1. Turn on directional signal. If light does not operate, check bulbs. If bulbs are OK, check all connections.

		If light still does not operate, use test light and check for open wiring.
	2. Defective directional signal switch or cancelling cam	2. If light will operate by turning directional signal on, the switch is not centering properly during cancelling operation. Replace defective cancelling cam or directional signal switch.
All stop lights inoperative	1. Stop-hazard fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in circuit between fuse and lights.
	2. Open in wire from fuse to stop-switch	2. Check for power at brown wire at stop-switch and at fuse. If there is power at fuse but not at switch, check for open in brown wire.
	3. Stop-switch mis-adjusted or defective	3. With brake pedal depressed, check white wire terminal in steering column connector with test light. If bulb does not light, check stop switch for proper adjustment. If adjustment is OK, jumper stop switch. If stop lights operate, replace stop switch.
Will not turn off	1. Stop switch misadjusted or defective	1. Readjust switch. If switch still malfunctions, replace.

small terminal lock tangs are not positioned properly.

Molded-on-connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. Environmental connections cannot be replaced with standard connections.. Instructions are provided with Weather-Pack connector and terminal packages.

With the low current and voltage levels found in some circuits, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in Fig. 8B-7.

Use care when probing the connections or replacing terminals in them, it is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible that damage may be done to certain components. Always use jumper wires between connectors for circuit checking. Never probe through the Weather-Pack seals.

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This shoud always be considered when an open circuit is indicated while troubleshooting. Intermittent problems may also be caused by oxidized or loose connections.

FUSIBLE LINK-REPLACEMENT

Remove and Replace

1. Disconnect battery.
2. Located burned out link. This may require use of the chassis wiring diagrams.

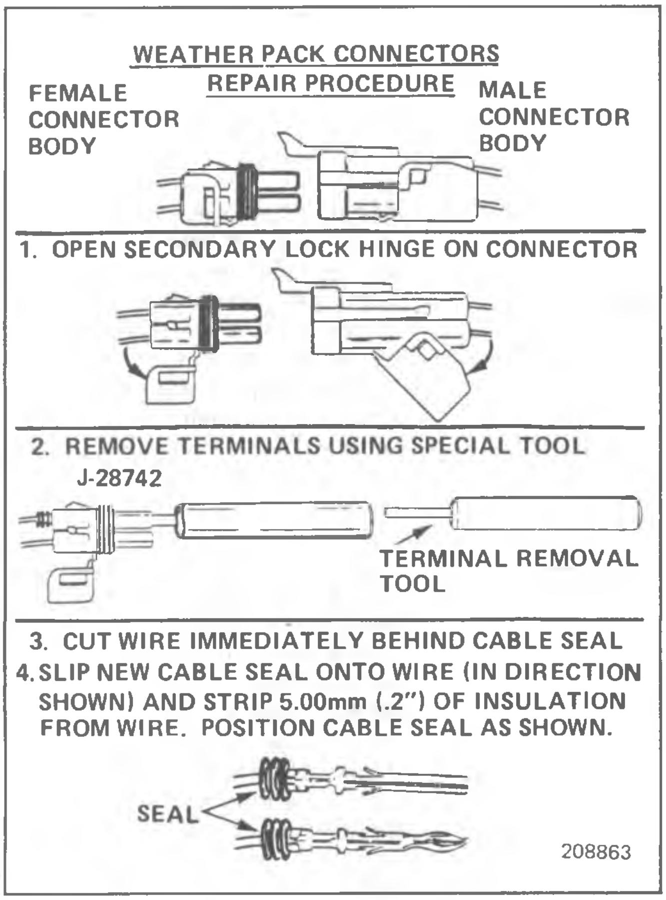


Fig. 8B-6--Weather-Pack Terminals

3. Strip away all melted harness insulation.
4. Cut burned link ends from circuit wire.
5. Strip circuit wire back approximately 1/2" to allow soldering of new link.
6. Using fusible link four(4) gages smaller than protected circuit (approximately 10" long), solder new link into circuit.

   NOTICE: Use only resin core solder. Under no circumstances should an acid solder be used nor should link be connected in any other manner except by soldering. Use of acid core solder may result in corrosion.
7. Tape soldered ends securely using suitable electrical tape.
8. After taping wire, tape harness leaving an exposed loop of wire approximately 5" in lenght.
9. Reconnect battery.

FRONT LIGHTING ADJUSTMENTS

LIGHT AIMING

The front lights (headlights, fog lights, driving lights, etc.) must be properly aimed in order to provide maximum allowable road illumination. When using mechanical aimers, follow equipment manufacturers instructions.

Front lights should be checked for proper aim at new car predelivery, every 12 months, after installing a new sealed beam unit or if front end sheet metal is adjusted or repaired. Replacement of a bulb in a nonsealed beam unit will normally not require unit aiming readjustment. Aiming of headlights can be performed without removing headlight bezels (Figure 8B-8).

Horizontal and vertical aiming of each headlight sealed beam unit is provided by two (2) adjusting screws which move the mounting ring in the body against the tension of the coil spring. There is no adjustment for focus since the sealed beam unit is set for proper focus during manufacturing assembly.

Some state and local authorities have specific requirements for front light aiming adjustments and these requirements should be followed.

ON-VEHICLE SERVICE

SEALED BEAM UNIT

Replacement (Figs. 8B-9 and 8B-10)

1. Remove bezel retaining screws and bezel.
2. Remove retaining ring.

   Do not disturb adjusting screw setting.
3. Disconnect wiring harness connector located at rear of unit in engine compartment and remove sealed beam unit.
4. Attach wiring harness connector to unit.
5. Position new sealed beam unit in mounting ring and install retaining ring.

   The number molded into lens face must be at top.
6. Install retaining ring then check operation of unit and install bezel.

PARKING LAMP BULB

Replacement (Figs. 8B-9 and 8B-10)

1. Remove lens retaining screws and remove lens from the housing.
2. Replace bulb and check lamp operation.
3. Install lens and retaining screws.

PARKING LAMP HOUSING

C-K Models

Replacement (Fig. 8B-9)

1. Remove parking lamp lens screws and remove the lens.
2. Remove lamp housing retaining screws and pull housing forward.
3. Disconnect parking lamp wiring harness from housing by rotating bulb socket counterclockwise.
4. Connect wiring harness to new housing by inserting bulb socket into housing and rotating clockwise.
5. Install bulb if removed during disassembly. Install lens and retaining screws.

G Models

Replacement (Fig. 8B-10)

Right Side

1. Remove both headlamp bezels.
2. Remove both parking lamp lens.
3. Remove grille.
4. Remove battery and battery box.

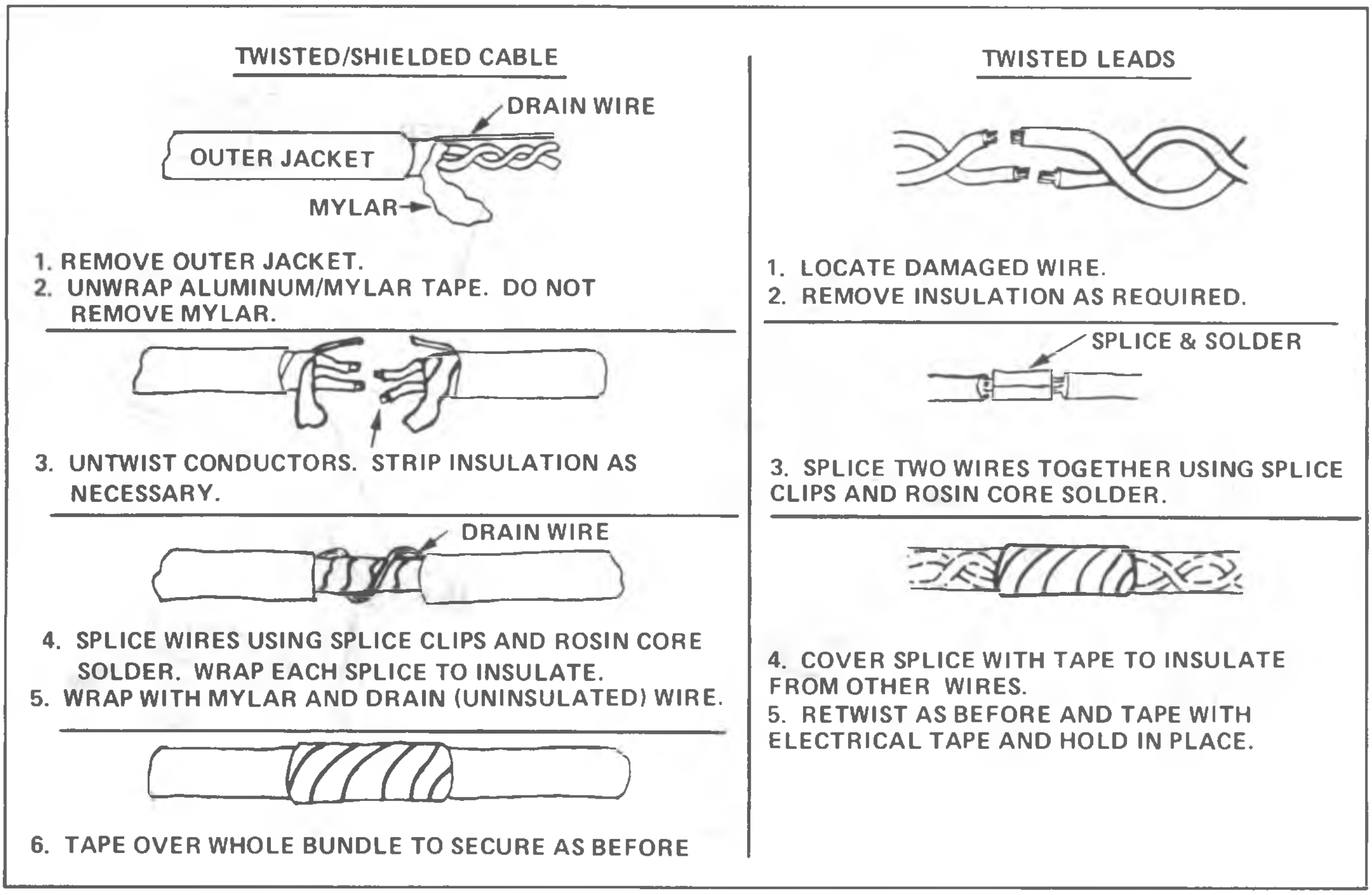


Fig. 8B-7--Wiring Repair

5. Disconnect wiring harness at connector.
6. Remove housing stud nuts and remove housing with pigtail.
7. To install, reverse removal steps.

Left Side

1. Remove two screws and parking lamp lens.
2. Disconnect wiring harness at connector.
3. Remove housing stud nuts and remove housing with pigtail.

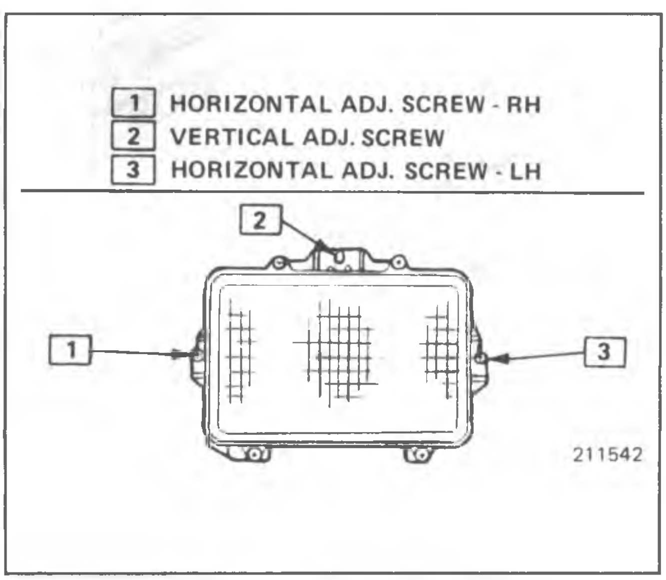


Fig. 8B-8--Headlight Aiming Screws

4. To install, reverse removal steps.

FRONT SIDE MARKER LAMP BULB AND/OR HOUSING

All Models

Replacement

For housing replacement follow procedure for the right side bulb replacement below.

1. **Left Side** - Raise hood.
   Right Side - Remove lamp assembly retaining screws and pull outward on assembly.
2. Twist wiring harness socket 90° counterclockwise and remove harness and bulb from housing.
3. Replace bulb and check lamp operation.
4. Insert bulb into housing, press in on harness socket and twist 90° clockwise. Check that socket is securely attached.
5. **Left Side** - Lower hood.
   Right Side - Install housing in opening and install retaining screws.

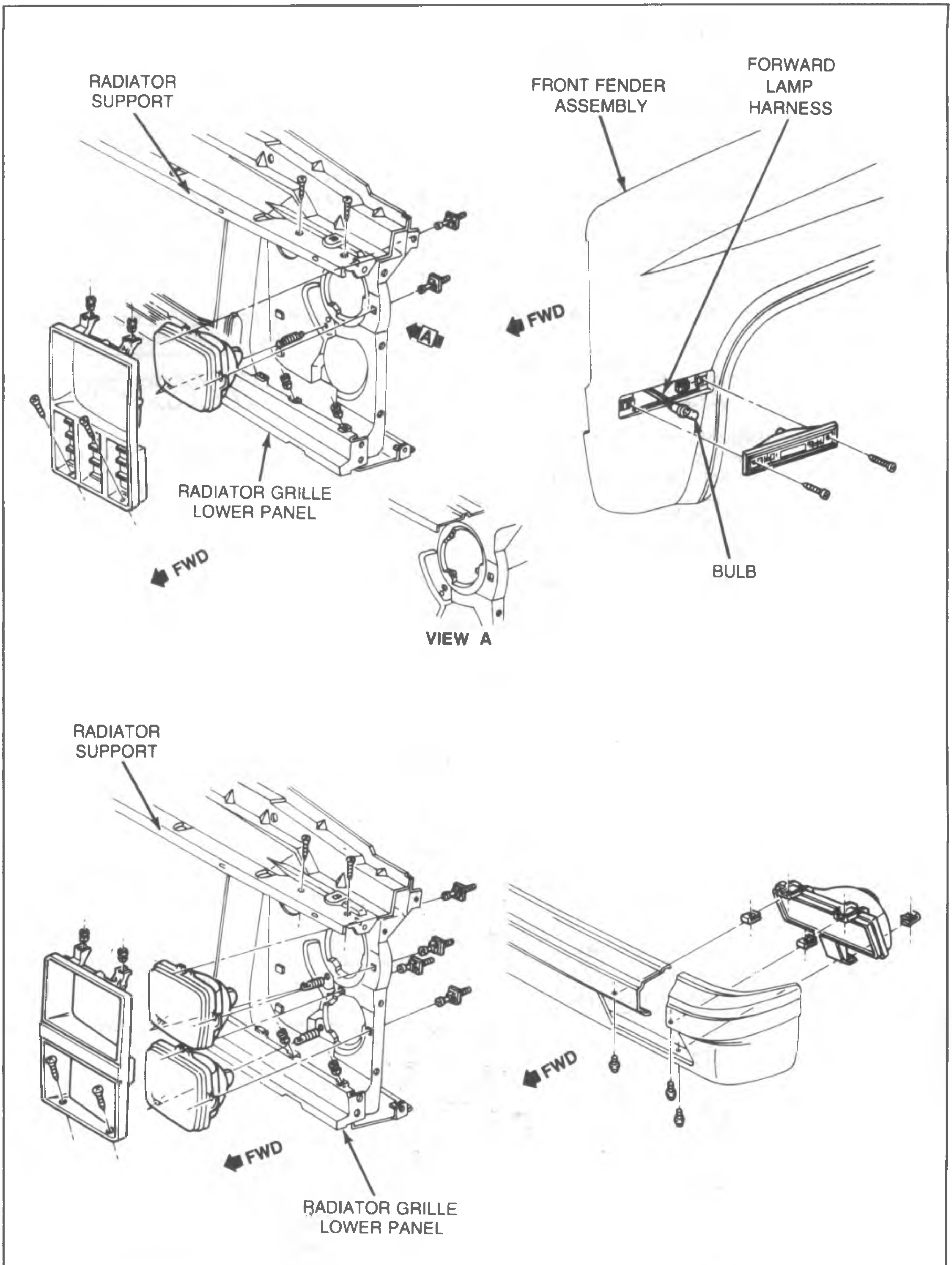


Fig. 8B-9--Front Lighting (C-K Models)

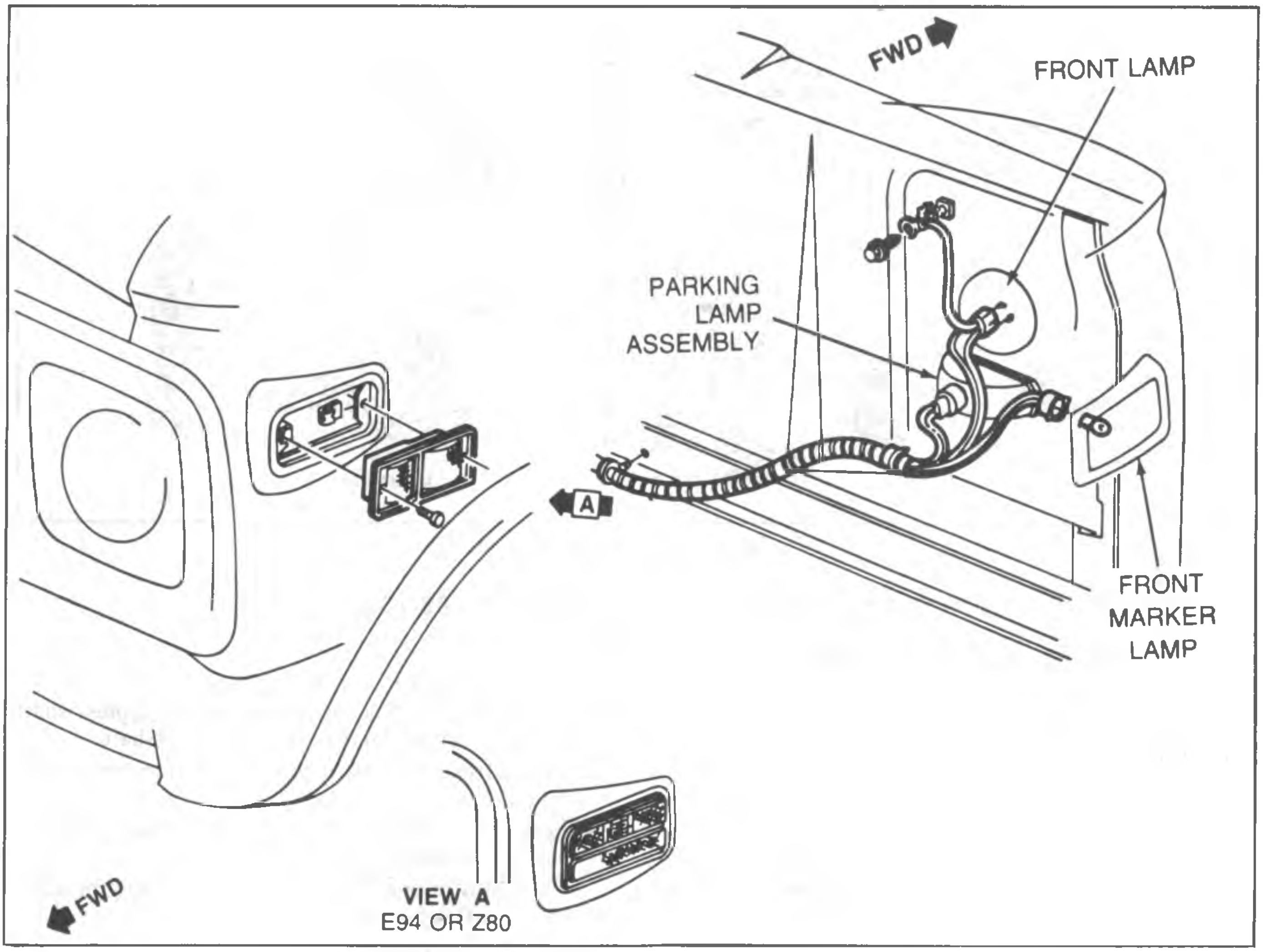


Fig. 8B-10--Front Lighting (G Models)

REAR SIDE MARKER LAMP BULB AND/OR HOUSING

C-K 03 models with E62 and G Models

Replacement

Same as Right Front Side Marker Lamp Bulb and/or Housing Replacement - All Vehicles. Bulb on G Models without interior trim may be removed from inside the vehicle.

C-K 16, 03 and 63 with E63, and 06 Models

Replacement

1. Remove lens to housing four screws.
2. Replace bulb and check operation.
3. Position lens and install four attaching screws.

Platform and Stake Rack Models (E56)

Exploded view of the different rear lighting arrangements are shown in Figures 8B-13 and 8B-14. The bulbs may be replaced by removing the lamp lens attaching screws and lamp lens. The lamp housings may be replaced by removing housing attaching nuts or screws, or by removing nuts and bolts from bracket.

TAIL, STOP AND BACKUP LAMP BULBS

Replacement

1. Remove lens to housing attaching screws.
2. Replace bulb and check operation.
3. Position lens and install attaching screws.

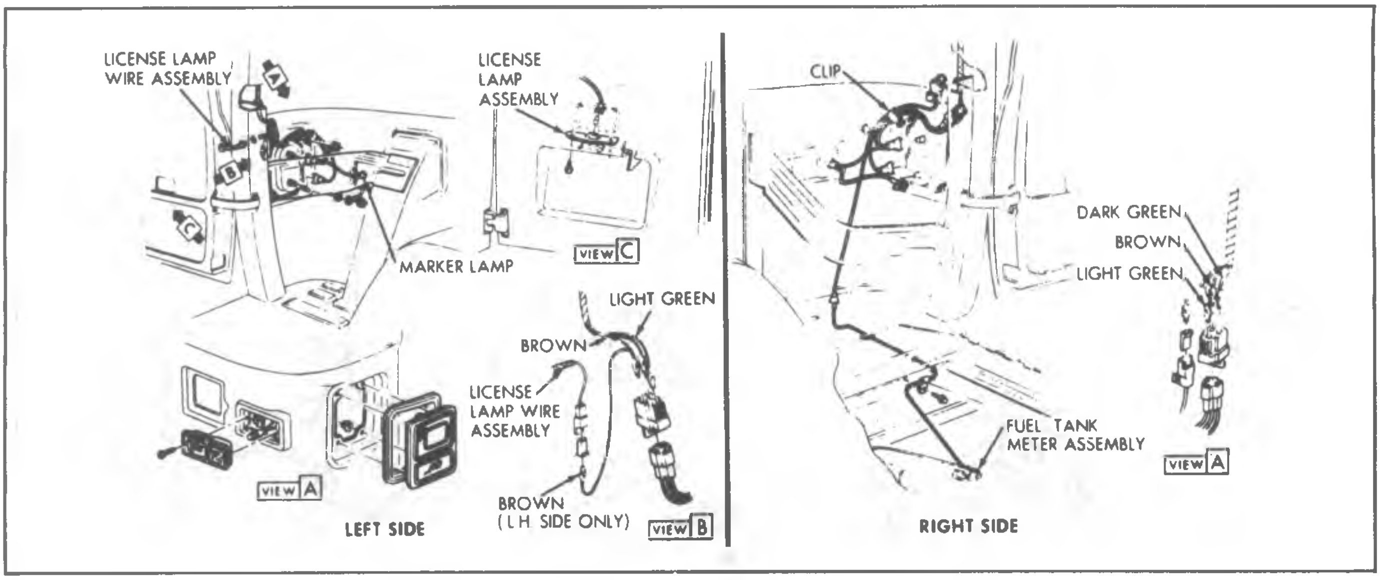


Fig. 8B-11--Rear Lighting (G Models)

TAIL, STOP AND BACKUP LAMP HOUSING

C-K 16, 03 and 63 w/E63 and 06 Models

All G Models

Replacement

1. Remove lens to housing attaching screws.
2. Remove bulbs from sockets.
3. Remove housing attaching screws (nuts on G Models).
4. Rotate wiring harness sockets counterclockwise and remove housing.
5. To install, reverse Steps 1-4 above.

DIRECTIONAL SIGNAL LAMPS

Directional signal lamps are an integral part of parking and tail lamp assemblies. Refer to the applicable lamp or bulb replacement procedures covered previously.

CLEARANCE, LICENSE PLATE AND IDENTIFICATION LAMPS

Refer to Figures 8B-16 and 8B-17 for clearance, license plate and identification lamp installations.

LIGHT SWITCH

C-K Series (Fig. 8B-18)

Replacement

1. Disconnect battery ground cable.
2. Reaching up behind instrument cluster, depress shaft retaining button and remove switch knob and rod.
3. Remove instrument cluster bezel screws on left end. Pull out on bezel and hold switch nut with a wrench.
4. Disconnect multiple wiring connectors at switch terminals.
5. Remove switch by rotating while holding switch nut.
6. To install, reverse Steps 1-5 above.

G Series (Fig. 8B-18)

Replacement

1. Disconnect battery ground cable.
2. Reaching up behind instrument panel, depress shaft retaining button and remove switch knob-shaft.
3. From front of instrument panel remove switch retaining nut.
4. Push switch from panel opening and remove multiple electrical connector at switch terminals.
5. To install, reverse Steps 1-4, making sure grounding ring is installed on switch.

NEUTRAL START SWITCH

C-K Models (Fig. 8C-23)

Replacement and Adjustment

1. Disconnect battery ground cable.
2. Disconnect electrical harness at switch.
3. Remove switch mounting screws and remove switch.
4. Position shift lever in neutral gate notch.
5. Insert .096" (2.4mm) gage pin to depth of 3/8 inch (9.5mm) into switch gage hole. switch assembly is fixed in neutral position with internal plastic shear pin.
6. Assemble the switch to column by inserting the switch carrier tang in the shift tube slot and fasten in position by assembling mounting screws to retainers. If retainer strips out it must be replaced.
7. Remove .096" gage pin.
8. Move shift lever out of neutral gate notch to park gate position to shear switch internal plastic pin.
9. Return shift lever to neutral gate notch.
10. Switch (2.0mm) gage hole will freely admit .080" gage pin to a depth of 3/8 inch (9.5mm).
11. If pin will not freely enter gage hole, switch must be reset as below.
12. Connect battery ground cable and electrical harness.

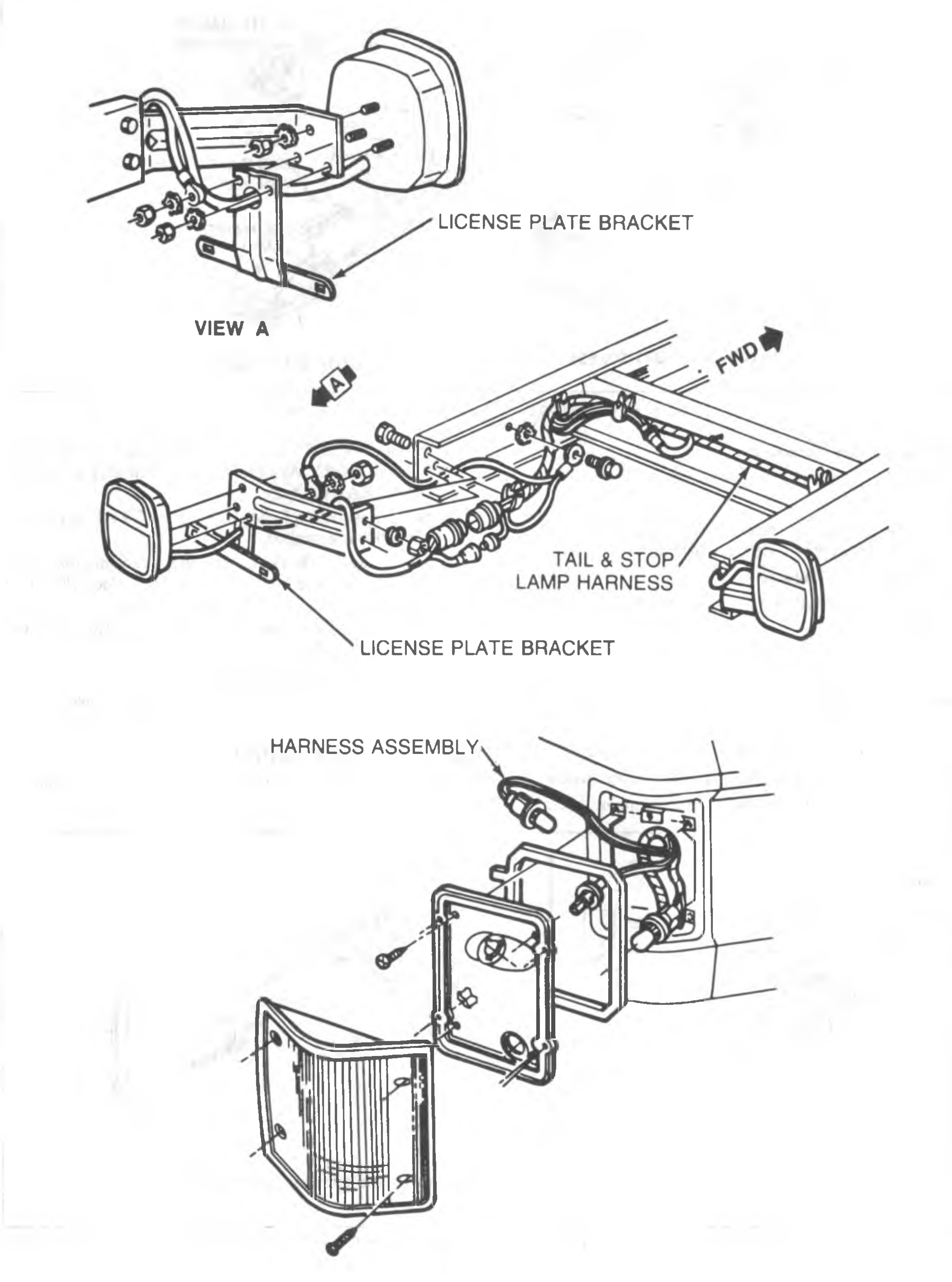
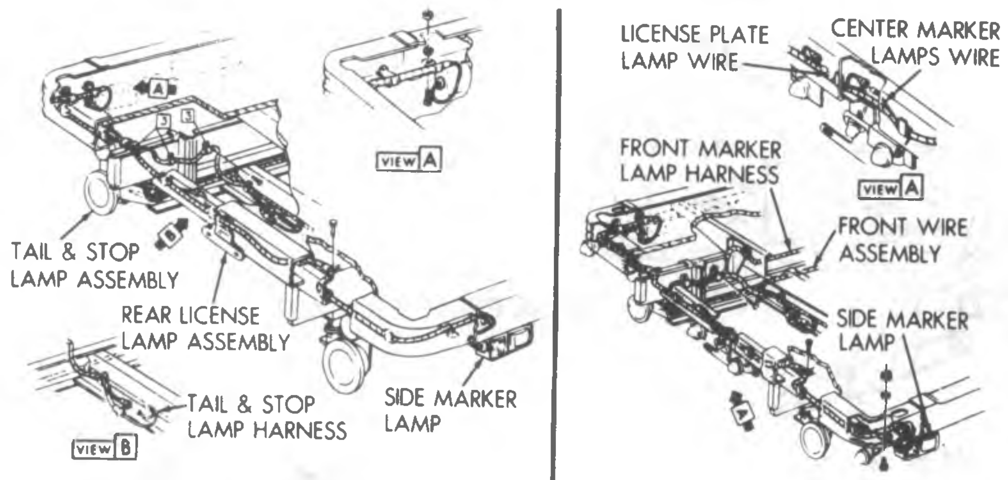


Fig. 8B-12--Rear Lighting (C-K Models Except with E56 or E62)



C209 (03) WITH OPTION E56

C310 (03) WITH OPTION E56

Fig. 8B-13--Rear Lighting (C-K Platform and Stake Rack Models)

Reset Installation Procedure

1. Place shift lever in neutral gate notch.
2. Loosen attaching screws.
3. Rotate switch on column and insert .096" (2.4mm) gage pin to depth of 3/8 inch (9.5mm).
4. Tighten attaching screws.
5. Repeat installation procedure Steps 7 through 12 above.

G-P Series

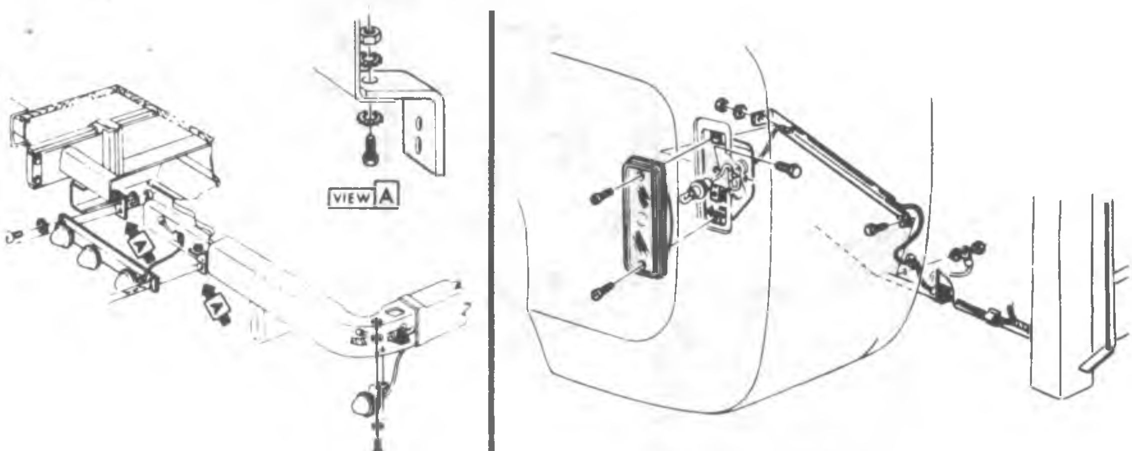
Replacement (Fig. 8C-23)

1. Raise vehicle on a hoist.
2. Disconnect the switch harness from the switch.
3. Remove switch mounting bolts and remove switch.
4. Assemble new switch loosely to mounting bracket.
5. Align .093/.097" (2.3/2.4mm) hole in Lever (B) with hole in Switch Assembly. Insert Pin (A) to hold in NEUTRAL position.
6. Set Transmission Lever (C) in NEUTRAL position by the following method.

   Obtain NEUTRAL by moving Transmission Lever counterclockwise to L1 detent, then clockwise three detents to the NEUTRAL detent position.
7. Install Rod into Transmission Lever and Switch Lever. Secure with clips.
8. Tighten switch attaching screws.
9. Lower vehicle from hoist and carefully check switch operation.

BACKING LAMP SWITCH

See "Neutral Start Switch" for automatic transmission models.



C30 (03) WITH OPTION E56

CK 10-20 AND C309 (03) WITH OPTION E62

Fig. 8B-14--Rear Lighting (C30 03 Models with E56 and C-K Models with E62)

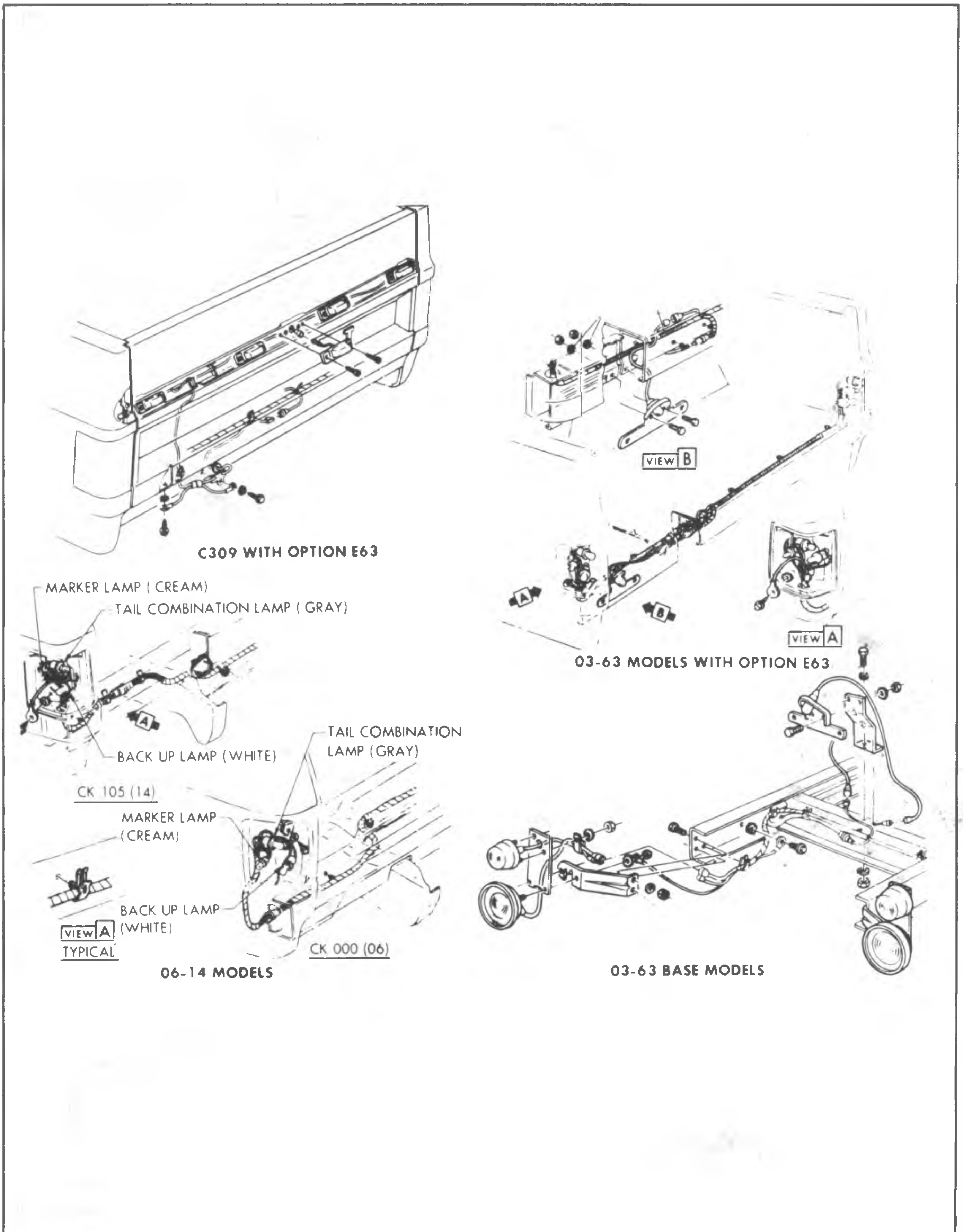


Fig. 8B-15--Rear Lighting CK 03 and 43 Models exc E62 or E6E

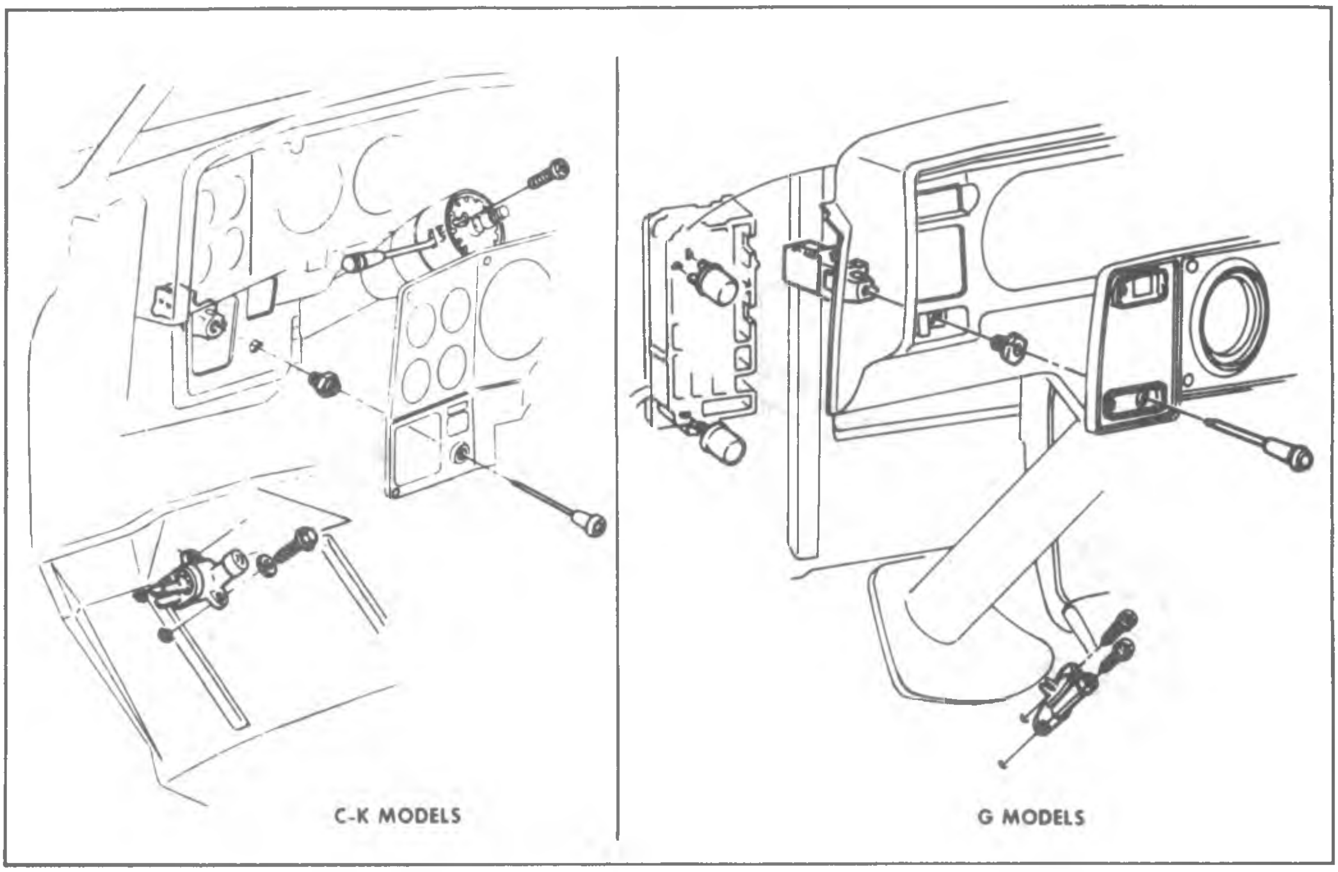


Fig. 8B-18--Light and Headlamp Beam Selector Switches

Column Mounted Switch (Manual Transmission)

Replacement

1. Disconnect battery ground cable.
2. Disconnect switch wiring harness.
3. Remove column mounting screws and remove switch.
4. Assemble the switch to the column. Fasten in position by installing mounting screws.
5. Install battery ground cable.
6. Check operation to make sure back-up lights come on in reverse gear only.

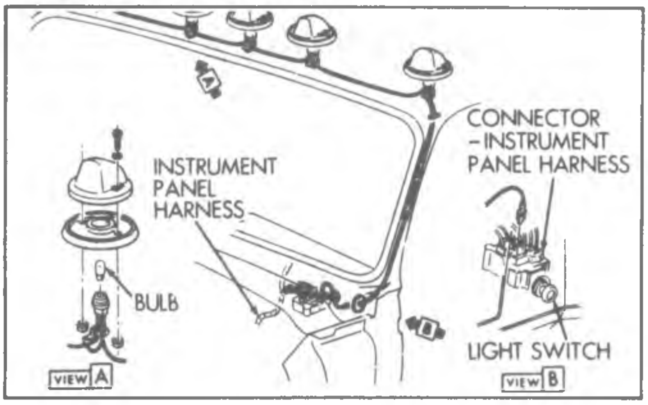


Fig. 8B-16--Clearance Lamps

Transmission Mounted Switch

Replacement

1. Raise vehicle on a hoist.
2. Disconnect switch wiring harness.
3. Remove switch from transmission.
4. To install a new switch, reverse Steps 1-3 above.

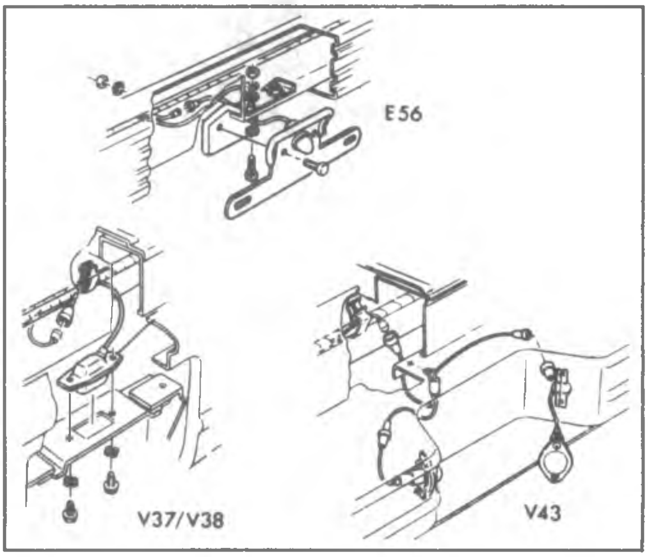


Fig. 8B-17--License Plate Lamps (C-K Series)

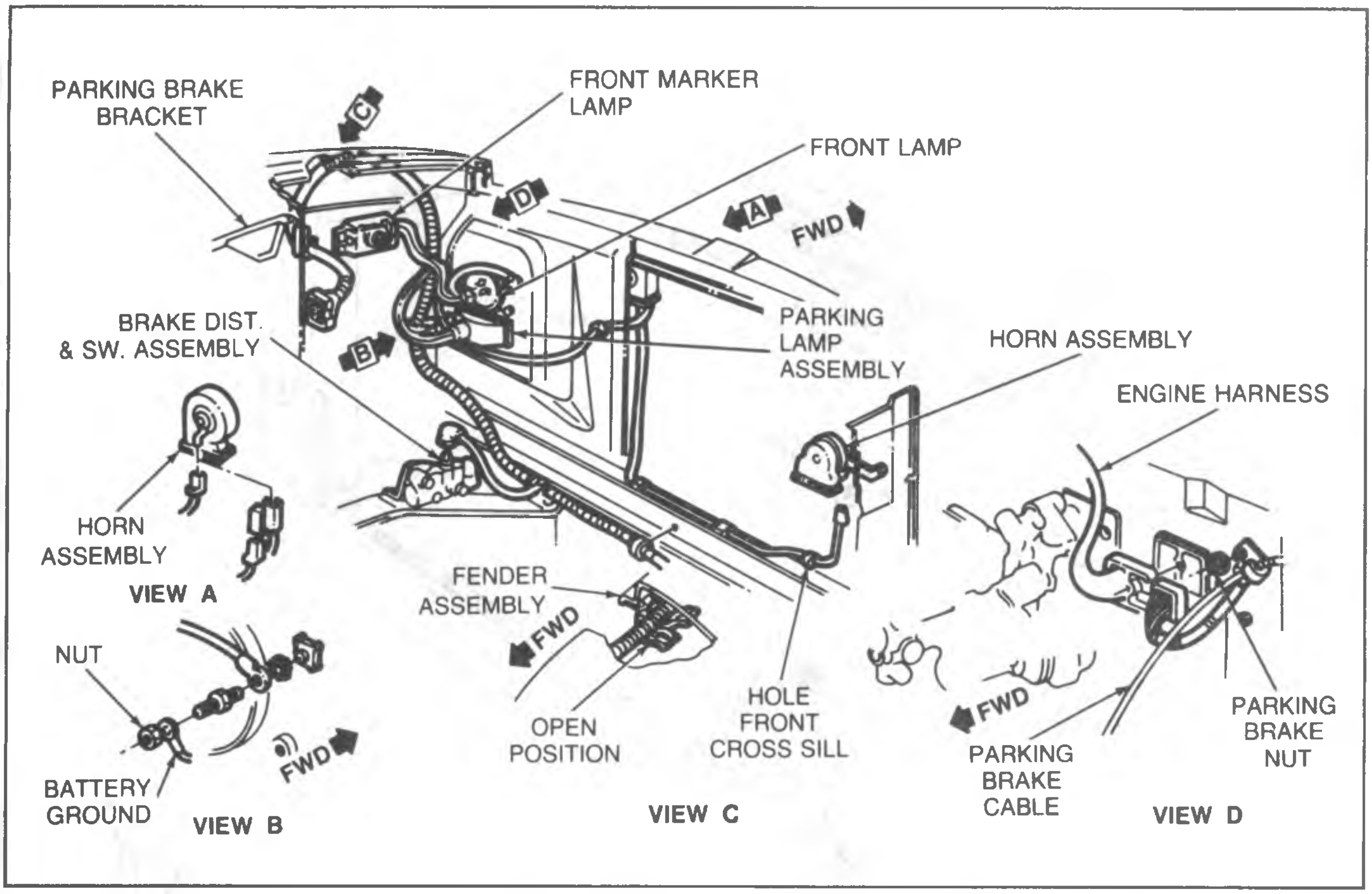


Fig. 8B-19--G Series Forward Lamp Wiring

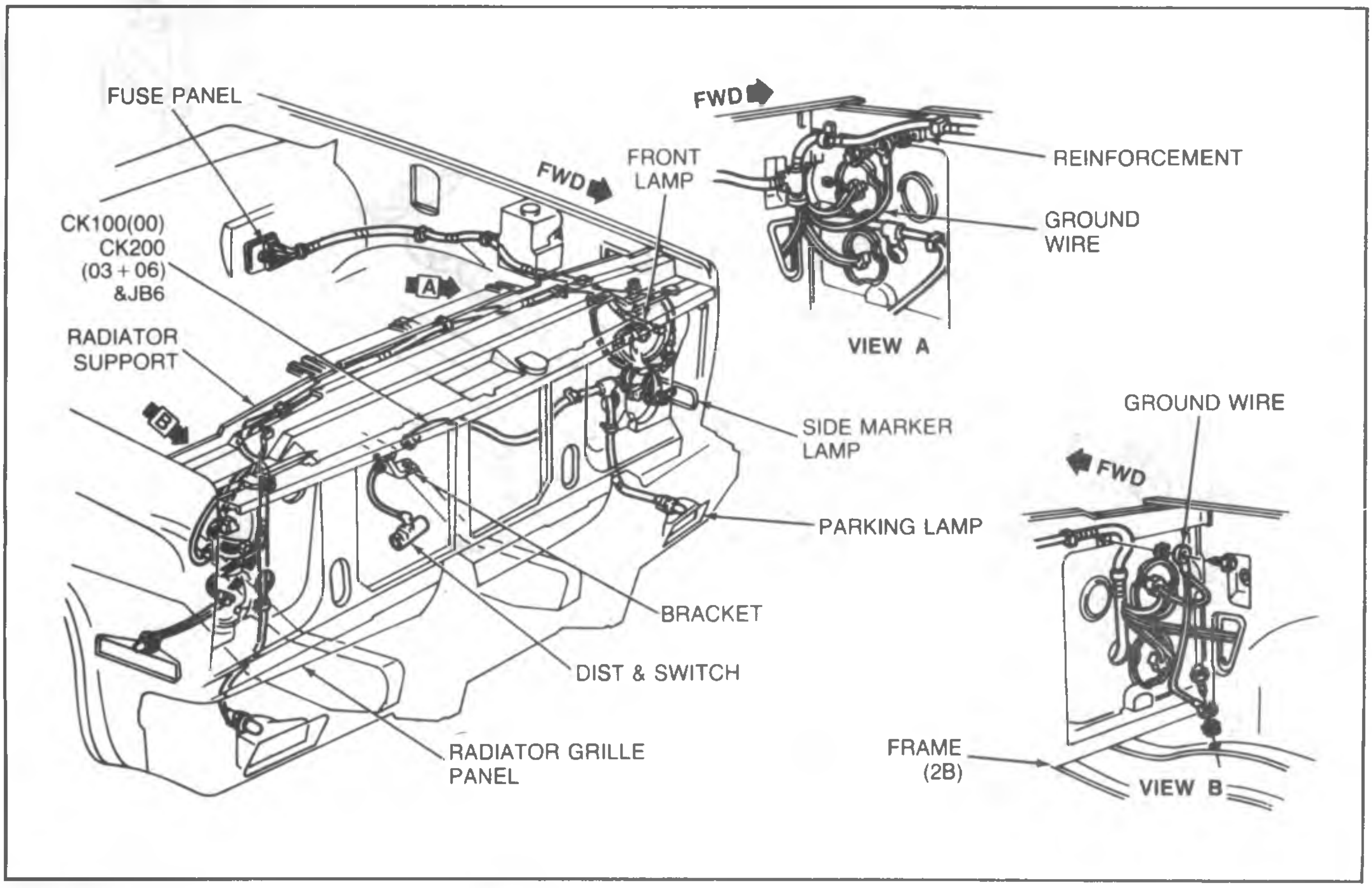


Fig. 8B-20--CK Series Forward Lamp Wiring

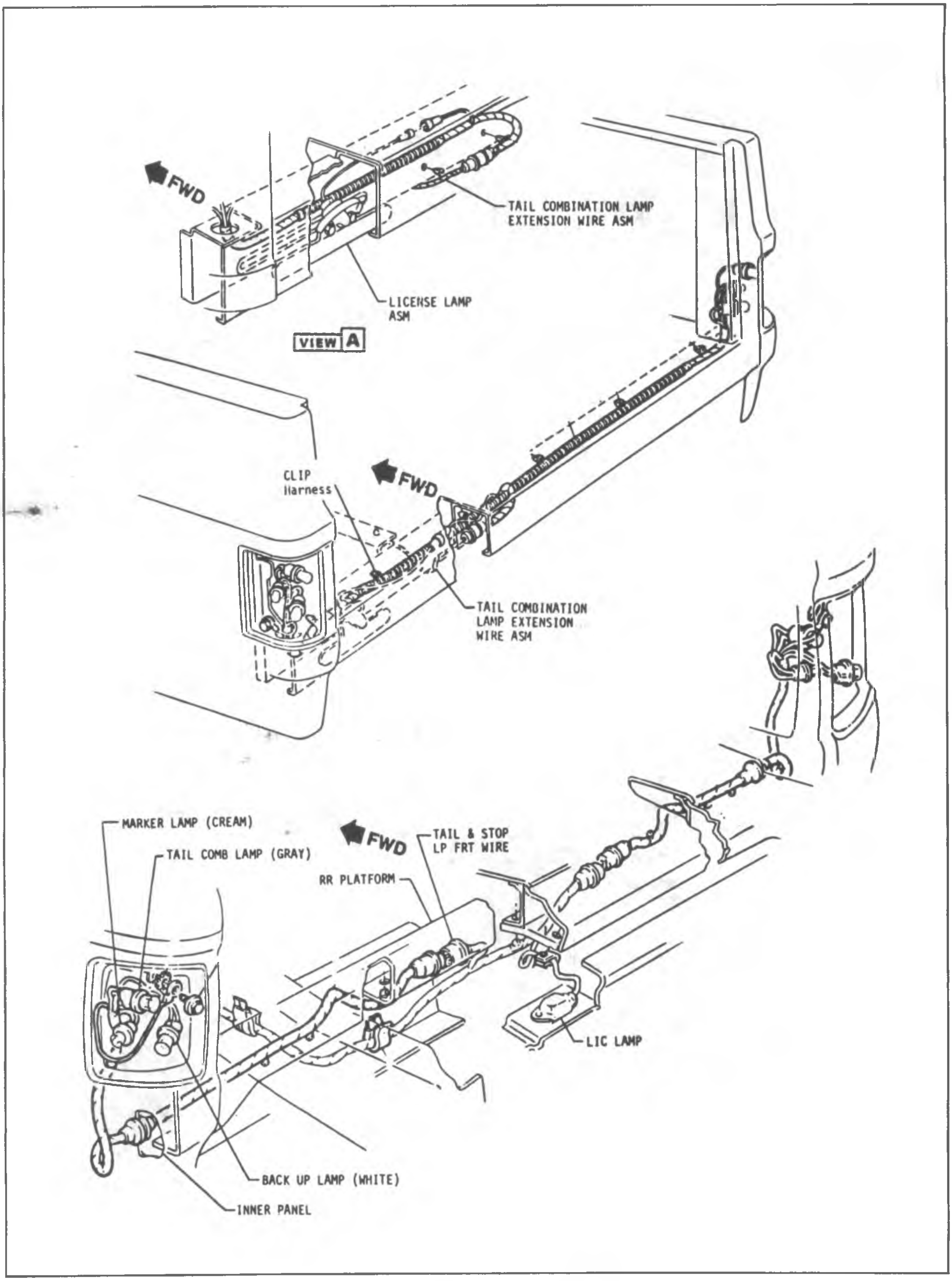


Fig. 8B-21--CK Series Rear Lamp Wiring

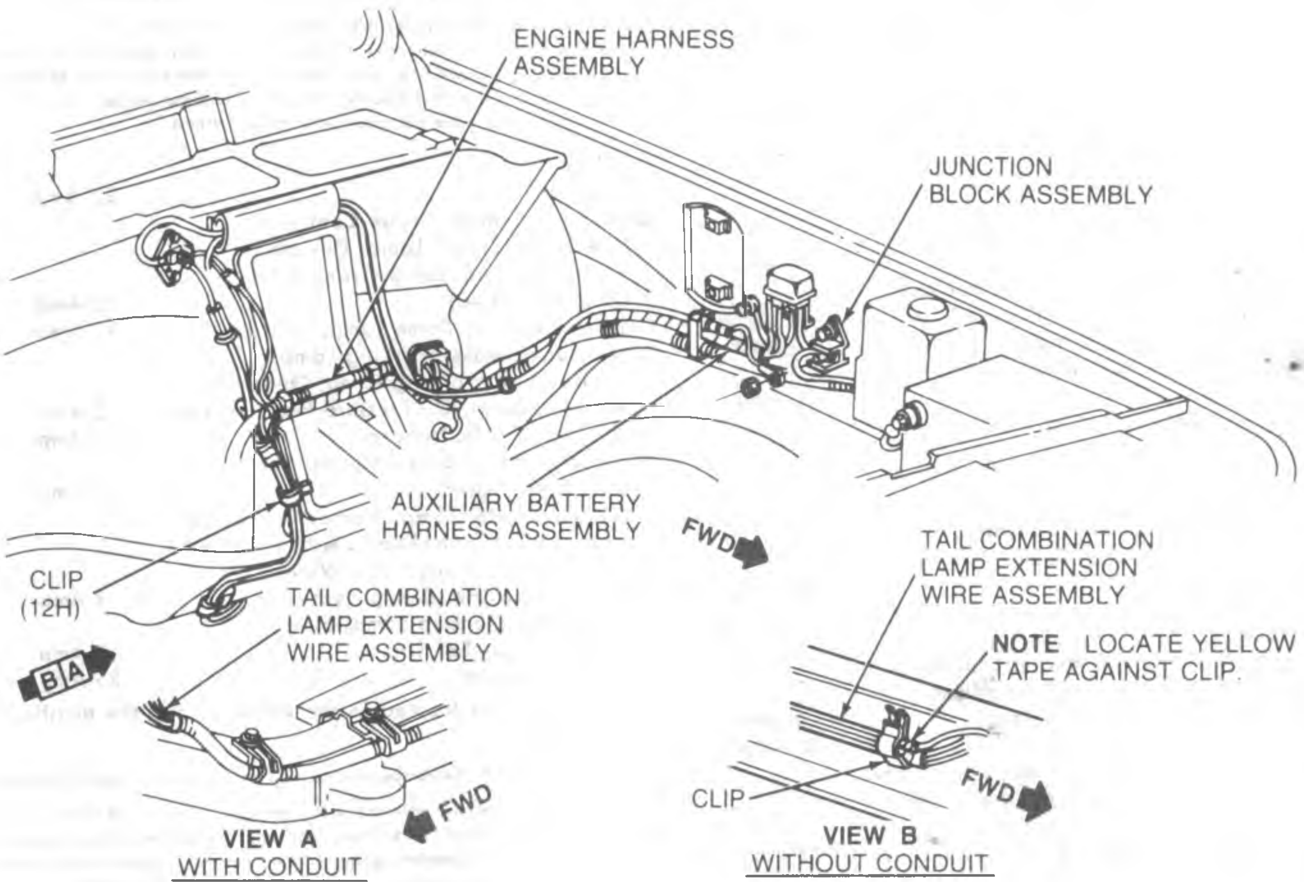


Fig. 8B-22--CK Series Auxiliary Wiring

FUSES — CIRCUIT BREAKERS

The wiring circuits are protected from short circuits by a combination of fuses, circuit breakers, and fusible thermal links in the wiring itself. This greatly reduces the hazard of electrically caused fires in the vehicles.

The headlamp circuits are protected by a circuit breaker in the light switch. An electrical overload on the breaker will cause the lamps to go on and off, or in some cases to remain off.

In addition to a fuse, the windshield wiper motor is also protected by a circuit breaker. If the motor overheats, due to overloading caused by heavy snow, etc., the wipers will remain stopped until the motor cools.

Fuses located in the Junction Block beneath the dash on the drivers side are:

C-K TRUCK

Heater, Front A/C, Generator Warning Lamp	20 Amp
Idle Stop Solenoid, Aux. Battery, Radio, Time Delay Relay, Emission Control Solenoid, Transmission Downshift (M40)	15 Amp
Cigarette Lighter, Clock, Dome Lamp, Cargo Lamp	20 Amp
Fuel Gauge, Brake Warning Lamp, Temperature Warning Lamp, Oil Pressure Warning Lamp	4 Amp
Courtesy Lamp, Roof Marker Lamp, License Plate Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp, Clearance Lamp	20 Amp
Directional Signal Indicator Lamp, Stop Lamp, Traffic Hazard	15 Amp
Instrument Cluster Lamp, Heater Dial Lamp, Radio Dial Lamp, Cruise Control Lamp, Windshield Wiper Switch Lamp	4 Amp
Windshield Wiper/Washer	25 Amp
Cruise Control, Rear Window Aux., Fuel Tank, Tachometer, Back-up Lamp, Directional Signal Indicator Lamp, Directional Signal Lamp, Headlamp Buzzer	15 Amp

P TRUCK

Heater†, Air Conditioning†	25 Amp
Instrument Cluster Lamp, Windshield Wiper Switch Lamp	3 Amp
Directional Signal Indicator Lamp, Stop Lamp, Traffic Hazard	15 Amp
Fuel Gauge, Brake Warning Lamp	3 Amp
License Plate Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp, Clearance Lamp, Identification Lamp	15 Amp
Windshield Washer/Wiper	25 Amp
Cigarette Lighter†, Clock†, Courtesy†, Dome Lamp†	15 Amp
Auxiliary Battery†, Back-up Lamp, Radio	15 Amp
Idle Stop Solenoid, Cruise Control†, Directional Signal Lamp, Time Delay Relay, Emission Control Solenoid, Transmission Downshift (M40)	10 Amp

In-line fuses are located in the auxiliary heater circuits (C-K-P models) and underhood lamp, front and rear A/C circuits (C-K models)

†When incorporated by body builder

Do not use fuses of higher amperage than those recommended above

The following wiring harnesses are protected by a "fusible link" which is a special wire incorporated in the circuit headlamp hi-beam indicator, horn, air conditioning high blower, ignition circuits (C-K-P models) starter solenoid (pull-in and hold) circuit (C-K models). Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

G TRUCK

Heater, A/C	25 Amp
Idle Stop Solenoid, Cruise Control, Directional Signal Lamp, Directional Signal Indicator Lamp, Transmission Downshift (M-40)	10 Amp
Cigarette Lighter, Dome Lamp, Spot Lamp	15 Amp
Fuel Gauge, Brake Warning Lamp, Temperature Warning Lamp, Generator Warning Lamp, Oil Pressure Warning Lamp	3 Amp
Stop Lamp, Traffic Hazard	15 Amp
Auxiliary Battery, Backing Lamp, Radio Dial Lamp, Radio	15 Amp
Instrument Cluster Lamp, Heater Dial Lamp, Transmission Control Lamp with Tilt Wheel, Cruise Control Lamp, W/S Wiper Switch Lamp, Headlamp Buzzer	3 Amp
License Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp	15 Amp
Windshield Wiper	25 Amp

An in-line fuse is located in the Ammeter and the auxiliary heater circuits.

Do not use fuses of higher amperage rating than those recommended above

The following wiring harnesses are protected by a "fusible link" which is a special wire incorporated in the circuit, ignition, horn and headlamp hi-beam indicator circuits, air conditioning high blower. Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

CIRCUIT BREAKERS

DEVICE OR CIRCUIT PROTECTED	MODELS	AMPERES	LOCATION
Headlamp and parking lamp circuit	C-K-P-G	15	Light switch
Tailgate window motor	C-K	30	Dash (forward side)
Rear A/C (C69 overhead)	G	35	Dash (forward side)

SPECIFICATIONS

LAMP BULB DATA C-K-P TRUCK

USED IN	QUANTITY	TRADE #	POWER
Dome Lamps:			
Cab	1	1004	15 CP
Utility & Suburban	1	211-2	12 CP
Oil Pressure indicator lamp[1]	1	168	3 CP
Generator indicator lamp[1]	1	168	3 CP
Instrument cluster lamps[2]	5	168	3 CP
Headlamp beam indicator lamp	1	168	3 CP
Lamp assembly - tail & stop lamp	2	1157	3-32 CP
License Lamp[4]	1	67	4 CP
Directional signal (front park lamps)[6]	2	1157	3-32 CP
Head Lamps	2	6014	50-60 W
Temperature indicator lamp	1	168	3 CP
Directional signal indicator lamp	2	168	3 CP
Clearance and marker lamps	4	168	3 CP
Roof marker lamps[5]	5	194	2 CP
Brake warning indicator	1	168	3 CP
Transmission control (auto)	1	1445	0.7 CP
Backing lamp (exc. motor home)	2	1156	32 CP
Backing lamp (motor home)	2	1295	50 CP
Heater or A/C	1	161	1 CP
Corner marker lamps (platform)	7	67	4 CP
Cargo lamp (C-K cab)	1	1142	21 CP
Radio dial lamp - AM	1	1816	3 CP
- AM/FM	1	216	1 CP
Courtesy lamp	1	1003	15 CP
Windshield wiper switch	1	161	1 CP
Clock	1	168	3 CP
Rear identification[7]	10	1895	2 CP
Underhood lamp	1	93	15 CP
Seat belt warning	1	168	3 CP
Cargo/dome lamp	2	211-2	12 CP
Four wheel drive indicator	1	161	1 CP
Choke heater Ind	1	168	3 CP

1 On CA, KA 10-35 instrument clusters only.
2 3 lamps used on instrument cluster on P models or C-K w/o gauges.
3 Double filament sealed beam 60W high beam, 50W low beam.
4 2 lamps used with step bumper and P models.
5 4 required on P models.
6 1157 NA, 2.2-24 CP on C-K models.
7 Wideside Pickup.
8 'P' truck only.

LAMP BULB DATA G TRUCK

USED IN	QUANTITY	TRADE#	POWER
Dome lamps	2	211-2	12 CP
Oil pressure indicator lamp	1	161	1 CP
Generator indicator lamp	1	194	2 CP
Instrument cluster lamps[11]	1	161	1 CP
Headlamp beam indicator lamp	1	161	1 CP
Park, directional signal lamps	2	1157	3-32 CP
Tail, stop lamps	2	1157	3-32 CP
License lamp	1	67	4 CP
Head lamps[12]	2	6014	50-60 W
Temperature indicator lamp	1	194	2 CP
Directional signal indicator lamp	2	194	2 CP
Marker lamps	4	168	3 CP
Brake warning indicator lamp	1	194	2 CP
Back-up lamp	2	1156	32 CP
Radio dial lamp	1	1893	2 CP
Heater or A/C control	1	194	2 CP
Transmission control w/tilt wheel	1	1445	0.7 CP
W/S wiper switch lamp	1	161	1 CP
Transmission control	1	73	.3 CP
Choke heater ind	1	1893	2 CP
Seat belt warning	1	194	2 CP
Instrument cluster lamps[9]	5	194	2 CP
Instrument cluster lamps[10]	1	168	3 CP

9 'G' model w/o gauges; 1 lamp with gauges
10 'G' model w/o gauges; 3 lamps with gauges
11 'G' model with gauges only
12 Double filament sealed beam 60W high beam, 50W low beam.

SECTION 8C

INSTRUMENT PANEL AND GAGES

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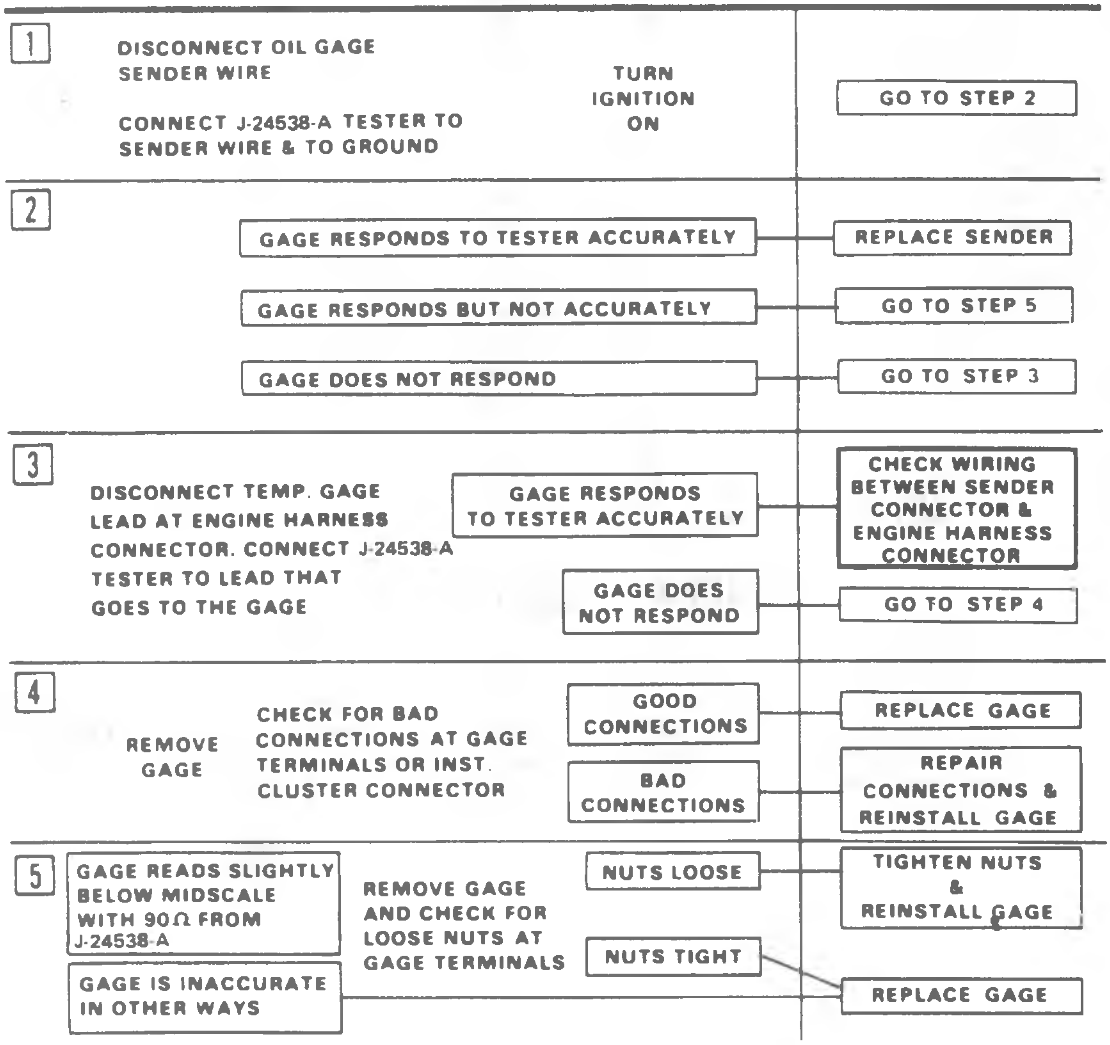
GENERAL DESCRIPTION

All instruments and gages are installed in the instrument cluster. Instruments and gages can be serviced in the vehicle (C-K Series); however, the entire cluster must be removed from the vehicle for servicing of the instruments and gages (G Series). Illuminating and indicator lamps may be replaced without removing the cluster from the vehicle. Bulbs are installed in plastic holders which lock into the cluster housing.

Regular maintenance is not required on the instrument cluster or its components other than maintaining clean, tight electrical connections, replacing defective parts and keeping the speedometer cable properly lubricated.

DIAGNOSIS

OIL PRESSURE GAGE DIAGNOSIS



TEMPERATURE GAGE DIAGNOSIS

Step	Procedure	Result	Action
1	DISCONNECT TEMP. GAGE SENDER WIRE CONNECT J-24538-A TESTER TO SENDER WIRE & TO GROUND	TURN IGNITION ON	GO TO STEP 2
2		GAGE RESPONDS TO TESTER ACCURATELY	REPLACE SENDER
		GAGE DOES NOT RESPOND OR IS INACCURATE	GO TO STEP 3
		GAGE INDICATES WELL BEYOND "HOT" END OF SCALE	GO TO STEP 5
3	DISCONNECT TEMP. GAGE LEAD AT ENGINE HARNESS CONNECTOR. CONNECT J-24538-A TESTER TO LEAD THAT GOES TO THE GAGE	GAGE RESPONDS TO TESTER ACCURATELY	CHECK WIRING BETWEEN SENDER CONNECTOR & ENGINE HARNESS CONNECTOR
		GAGE DOES NOT RESPOND	GO TO STEP 4
4	REMOVE GAGE CHECK FOR BAD CONNECTIONS AT GAGE TERMINALS OR INST. CLUSTER CONNECTOR OR LOOSE NUTS AT GAGE TERMINALS	GOOD CONNECTIONS	REPLACE GAGE
		BAD CONNECTIONS	REPAIR CONNECTIONS & REINSTALL GAGE
5	REMOVE GAGE CHECK FOR LOOSE NUTS AT GAGE TERMINALS OR LACK OF GROUND CONNECTION TO GAGE	GOOD CONNECTIONS	REPLACE GAGE
		BAD CONNECTIONS	REPAIR CONNECTIONS & REINSTALL GAGE

FUEL GAGE DIAGNOSIS

Step	Procedure	Result	Action
1	DISCONNECT FUEL GAGE SENDER WIRE IN REAR COMPARTMENT & CONNECT J-24538-A TESTER TO SENDER WIRE & TO GROUND	TURN IGNITION ON	GO TO STEP 2
2		GAGE RESPONDS TO TESTER ACCURATELY	GO TO STEP 3
		GAGE RESPONDS BUT NOT ACCURATELY	GO TO STEP 6
		GAGE DOES NOT RESPOND	GO TO STEP 4
3	CHECK REAR COMPARTMENT CONNECTOR & WIRES TO SENDER	OK	REPLACE SENDER
		~~OK~~	REPAIR WIRE OR CONNECTOR
4	DISCONNECT FRONT BODY CONNECTOR. CONNECT J-24538-A TESTER TO LEAD THAT GOES TO THE GAGE	GAGE RESPONDS TO TESTER ACCURATELY	CHECK WIRING BETWEEN REAR COMPARTMENT & FRONT BODY CONNECTOR
		GAGE DOES NOT RESPOND	GO TO STEP 5
5	REMOVE GAGE — CHECK FOR BAD CONNECTIONS AT GAGE TERMINALS OR INST. CLUSTER CONNECTOR	GOOD CONNECTIONS	REPLACE GAGE
		BAD CONNECTIONS	REPAIR CONNECTIONS & REINSTALL GAGE
6	GAGE READS BETWEEN 1/4 & 1/2 WITH 90 Ω FROM J-24538-A — REMOVE GAGE AND CHECK FOR LOOSE NUTS AT GAGE TERMINALS	NUTS LOOSE	TIGHTEN NUTS & REINSTALL GAGE
		NUTS TIGHT	REPLACE GAGE
	GAGE IS INACCURATE IN OTHER WAYS		REPLACE GAGE

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DIAGNOSIS - SPEEDOMETER SYSTEM

COMPLAINT	POSSIBLE CAUSE	PROCEDURE
Noisy	Kinked, pinched or burned casings.	Replace both the cable and casing. Recheck for noise.
"	Bent cable tips.	Replace both the cable and casing. Recheck for noise.
"	Improper or insufficient lubrication of cable.	Lubricate cable core with P/N 6478535 or equivalent. Pack ferrule with grease.
"	Faulty driven gear or rough drive gear.	Remove driven gear assembly from transmission. Check for free rotation of gear in sleeve. Check for burrs, flash or unusual worn spots. If gears appears faulty, replace and recheck for noise.
Whine	Oversize driven gear stem in transmission binds with adapter.	Replace driven gear and stem.
Buzzing sound with manual transmission.	Shift linkage vibration.	Adjust transmission shift linkage.
Tick or ringing sound with jumpy pointer between 0 and 30 MPH.	Faulty speedometer head.	Remove speedometer head for repair.
Sticky speedometer pointer.	Speedometer pointer is bent and rubs.	Remove speedometer cluster or lens and straighten pointer. Recheck speedometer operation.
Incorrect calibration.	Wrong transmission adapter, drive gear or sleeve.	Check speedometer gear reference for correct application and replace if necessary.
"	Oversize or undersize tires.	Check calibration using correct tire size.
"	Faulty speedometer head.	Remove speedometer for repair.

ON-VEHICLE SERVICE

WINDSHIELD WASHER / WIPER SWITCH

C-K Models

Replacement

1. Disconnect battery ground cable.
2. Remove instrument panel bezel screws and bezel.
3. Remove switch attaching screws.
4. Pull out on switch assembly and disconnect electrical harness - remove switch.
5. To install, reverse Steps 1-4 above. Check switch operation before reinstalling instrument panel bezel.

G Models

Replacement

1. Disconnect battery ground cable.
2. Reach up behind left side of instrument panel, and:
   a. Remove plug connector from rear of switch.
   b. Remove (3) mounting screws securing bezel and ground wires to switch.
3. Replace switch, installing ground wire and connector. Check operation of switch, first observing washer solvent level.

IGNITION SWITCH

See Section 3B - Steering, for ignition switch replacement procedure.

INSTRUMENT CLUSTER

C-K Series

Replacement (Fig. 8C-1)

1. Disconnect battery ground cable.
2. Remove headlamp switch control knob.
3. Remove radio control knobs.
4. Remove four screws and remove steering column cover.
5. Remove eight screws and remove instrument bezel.
6. Reach up under instrument cluster and disconnect speedometer by first depressing tang on rear of speedometer head, then pulling cable free from head as tang is depressed.
7. Remove cluster to bench for further disassembly (laminated printed circuit, speedometer head, gages).
8. Install cluster in reverse order of removal.

G Series

Replacement (Fig. 8C-3)

1. Disconnect battery ground cable.
2. Reach up under instrument cluster and disconnect speedometer cable by first depressing tang on rear of speedometer head, then pulling cable free from head as tang is depressed.
3. Remove clock set stem knob.

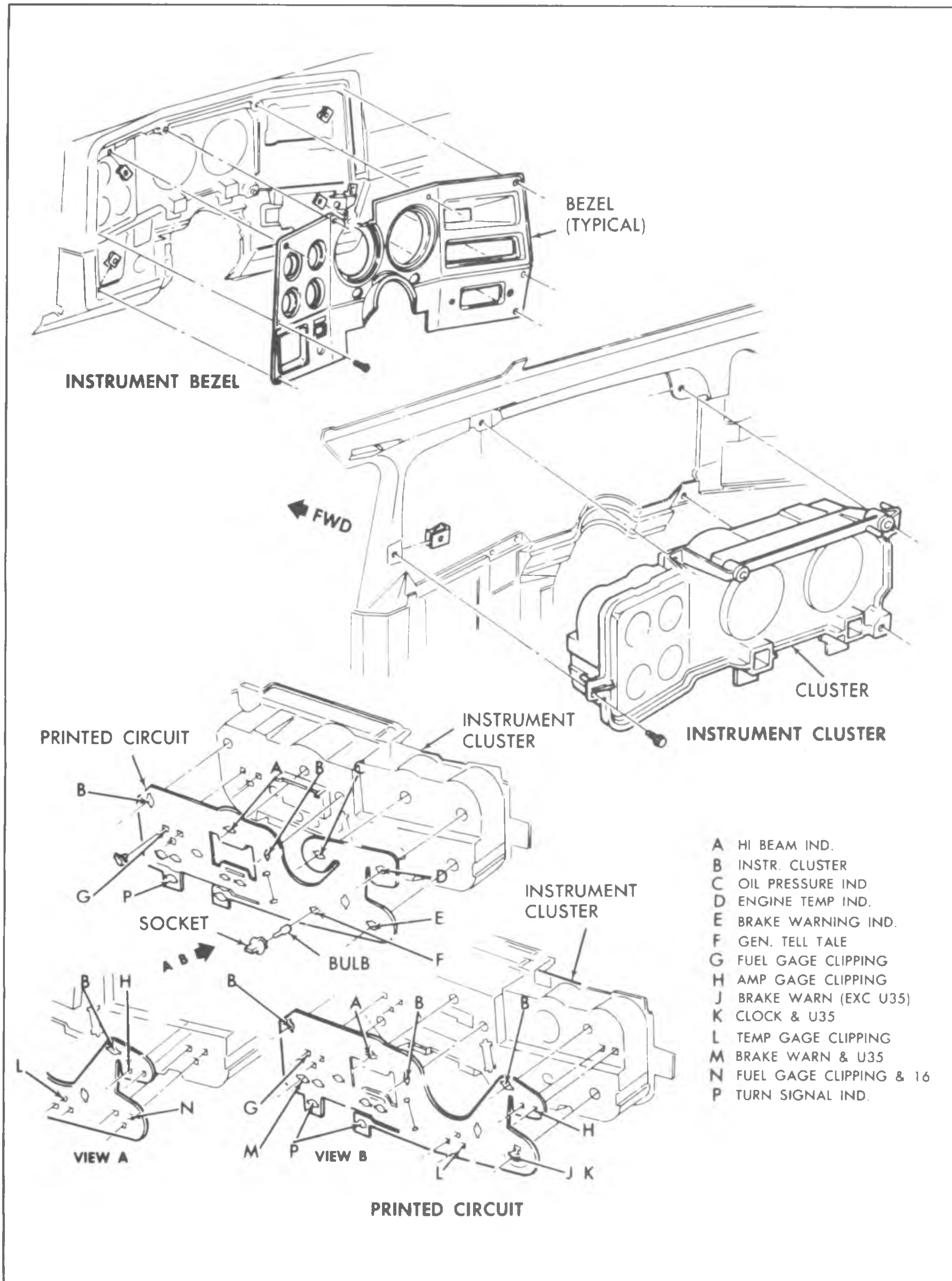


Fig. 8C-1--Instrument Cluster Assembly (C-K Series)

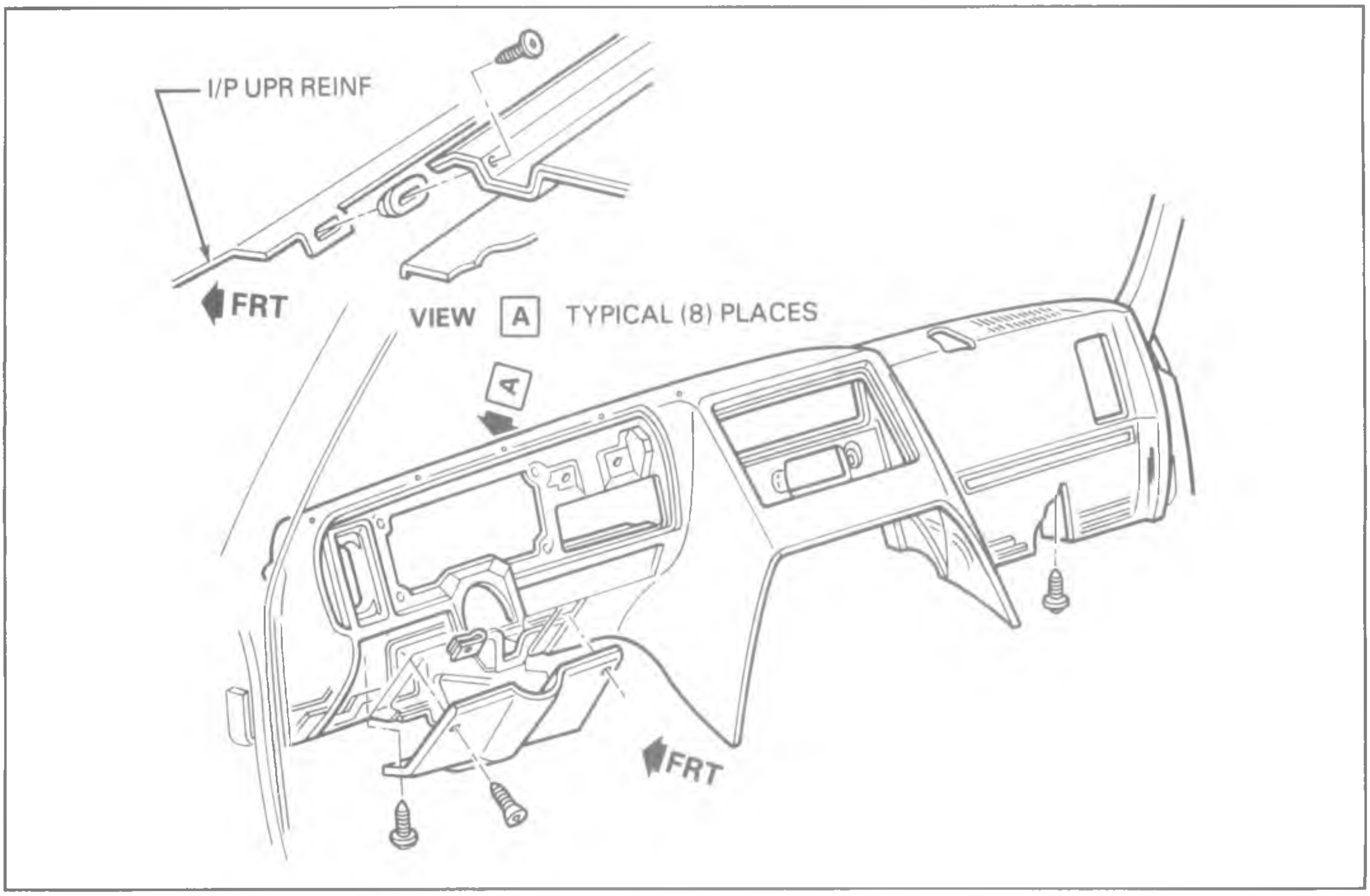


Fig. 8C-2--Instrument Panel (G Series)

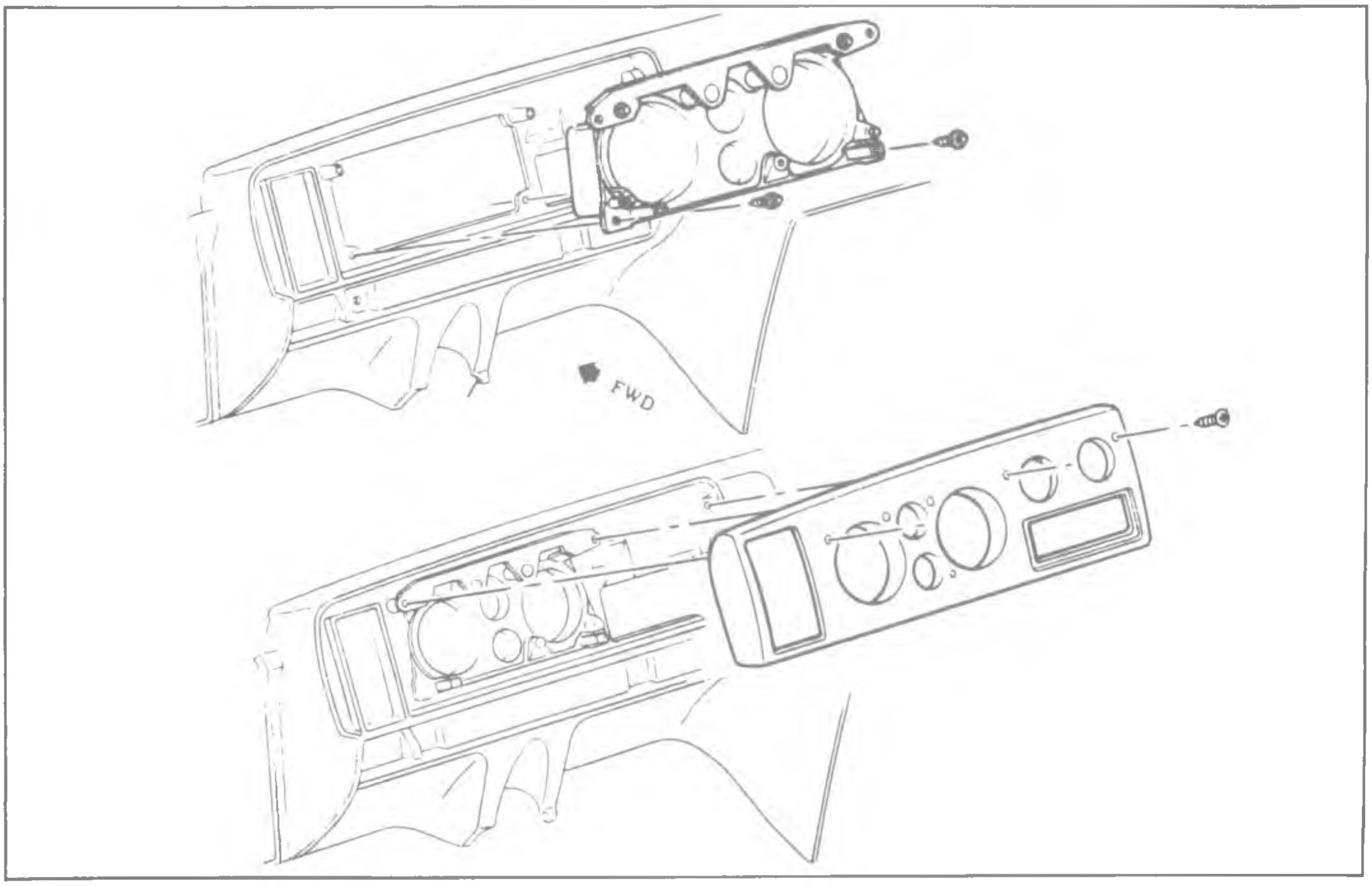


Fig. 8C-3--Instrument Cluster Assembly (G Series)

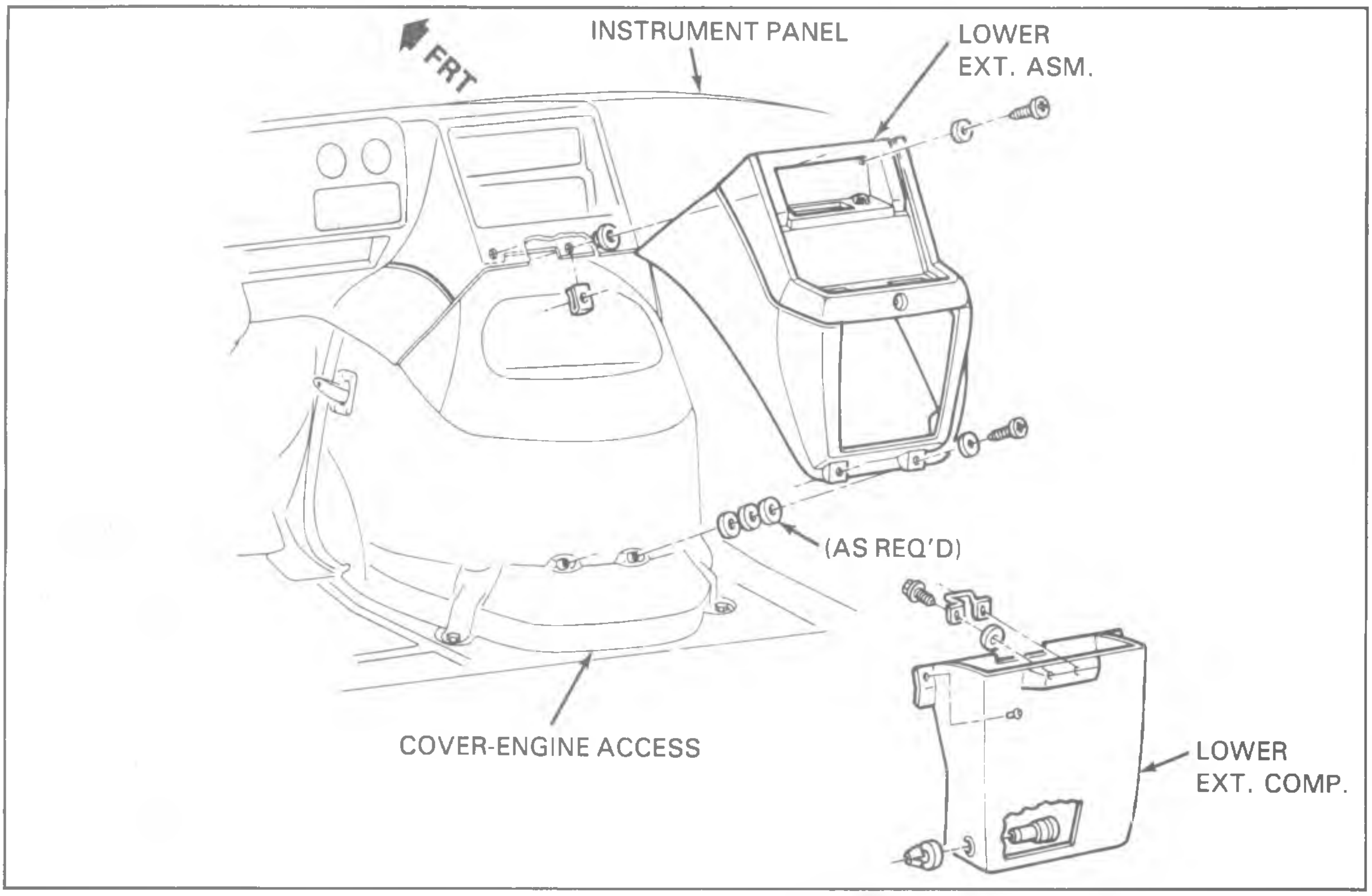


Fig. 8C-4--I.P. Lower Extension Asm-(G Series)

4. Remove screws attaching instrument cluster bezel to instrument panel and remove bezel.
5. Remove two lower cluster attachment screws.
6. Pull top of cluster away from instrument panel and lift out bottom of cluster.
7. Unplug instrument panel harness connector from printed circuit.
8. Remove cluster to bench for further disassembly (laminated printed circuit, speedometer head, gages).

INDICATOR AND ILLUMINATING BULBS

All Models

Replacement (Figs. 8C-1 and 8C-3)

1. Reach up under instrument panel and turn bulb holder counterclockwise to remove from cluster housing.
2. Pull bulb straight out to remove from holder.
3. Install replacement bulb in holder, press inward to lock in place.
4. Insert holder into housing, with lugs on holder entering notches in case, and turn clockwise to lock holder against printed circuit.

LAMINATED (PRINTED) CIRCUIT

All Models

Replacement

1. Remove instrument cluster assembly as previously described in this section.
2. Remove all instrument cluster lamp bulb assemblies.
3. Remove laminated circuit retaining screws.

   These screws serve as a ground for the circuit and must be reinstalled to provide the proper connection of the gage terminals to the printed circuit.
4. **G Series** - Remove fuel, temperature and ammeter terminal nuts retaining laminated circuit to rear of cluster.
5. Lift laminated circuit from cluster cover.
6. To install, reverse Steps 1-5 and check electrical operation of all affected components.

SPEEDOMETER

Servicing of the speedometer assembly should only be performed by trained technicians having the proper test equipment.

When replacing a speedometer or odometer assembly, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires the replacement odometer be set to zero and a label be installed on the driver's door frame to show the previous odometer reading and the date of replacement.

C-K Models

Replacement

1. Disconnect battery ground cable.
2. Remove headlamp switch control knob.
3. Remove radio control knobs and clock adjuster stem.
4. Remove instrument cluster bezel and steering column

cover.
5. Remove instrument cluster lens.
6. Remove transmission PRNDL indicator and case front cover.
7. Remove speedometer to cluster screws and speedometer assembly.
8. To install, reverse removal procedure. Check speedometer operation.

G Series

Replacement

1. Remove instrument cluster as previously described in this section.
2. Remove screws retaining speedometer dial to cluster case.
3. Remove two hex head screws and rubber grommets securing speedometer assembly to cluster cover.
4. To install, reverse removal procedure and check operation of speedometer assembly.

   NOTICE: Use care to prevent kinking the speedometer cable during removal and installation.

SPEEDOMETER CABLE CORE

All Vehicles

Replacement

1. Disconnect battery ground cable.
2. Disconnect speedometer cable from speedometer head by reaching up under instrument panel, depressing spring clip and pulling cable from head.
3. Remove old core by pulling it out at end of speedometer cable casing. If old cable core is broken it will be necessary to remove lower piece from transmission end of casing. It is also important to replace both casing and core.
4. Lubricate entire length of cable core with speedometer cable lubricant.
5. To install, reverse Steps 1-3 above.

   NOTICE: Use care to prevent kinking speedometer cable core during installation.

FUEL GAGE

C-K Series

Replacement

1. Perform Steps 1-6 of "Speedometer - Replacement".
2. Remove fuel gage attaching screws and remove the gage.
3. To install, reverse Steps 1-2 above. Check gage operation.

G Models

Replacement

1. Remove instrument cluster assembly as previously described.
2. Remove instrument cluster bulb holders, ground screws, nuts and washers retaining laminated circuit to cluster case.
3. Remove 6 screws to release front cover from cluster case.
4. Remove screws retaining fuel gage dial to case.
5. Lift gage away from laminated circuit and rear cluster cover.
6. To install, reverse Steps 1-4 and check operation of fuel gage.

   Observe assembly sequence of nuts, insulator strip, and resistor bar to insure proper reinstallation of gages.

TEMPERATURE GAGE

C-K Series

Replacement

1. Perform Steps 1-6 of "Speedometer - Replacement".
2. Remove temperature gage attaching screws and remove the gage.
3. To install, reverse Steps 1 and 2 above and check gage operation.

   Be sure gage studs engage clips holding laminated circuit to back of cluster housing.

G Models

Replacement

1. Remove instrument cluster assembly as previously described in this section.
2. Remove terminal nuts and bulb holders retaining laminated circuit to cluster case.
3. Remove attaching screws, cover and gage assembly from cluster housing.
4. Replace entire volt-temp-oil gage assembly.
5. To install, reverse removal procedure and check opeation of gage.

TEMPERATURE SENDING UNIT

All Models

Replacement

CAUTION: Do not remove cap with engine hot, allow vehicle to cool off first.

1. Relieve cooling system pressure by loosening radiator cap to first stop. Tighten cap after pressure is relieved.
2. Disconnect sending unit wiring harness.
3. Remove sending unit from the engine.
4. Install new sending unit and connect electrical harness.
5. Check coolant level and unit operation.

   Coolant must have at least 0°F (-18°C) freeze protection for sending unit to function properly.

OIL PRESSURE GAGE

C-K Series

Replacement

1. Perform Steps 1 of Speedometer - Replacement procedure.
2. Remove gage to cluster attaching screws and remove gage.
3. To install, reverse Steps 1-3 above and check gage operation.

G Models

Replacement

1. Remove instrument cluster as previously described in this section.
2. Remove and replace volt-temp-oil gage assembly as previously described.

OIL PRESSURE SENDING UNIT

All Models

Replacement

1. Disconnect wiring harness connector from sending unit terminal located in block above starter on L-6 engines, at left front of distributor on V-8 (except 454 V-8) or rear left side of block (454 V-8) engines.
2. Remove sending unit using Tool J21757. Replace with new unit and check operation.

VOLTMETER

C-K Series

Replacement

1. Perform Steps 1-6 of "Speedometer - Replacement" procedure.
2. Remove gage to instrument panel screws and remove meter.
3. To install, reverse Steps 1 and 2 above and check meter operation.

   Be sure meter studs engage clips holding printed circuit to back of cluster housing.

G Models

Replacement

1. Remove instrument cluster assembly as previously described in this section.
2. Remove and replace volt-temp-oil gage assembly as previously described.

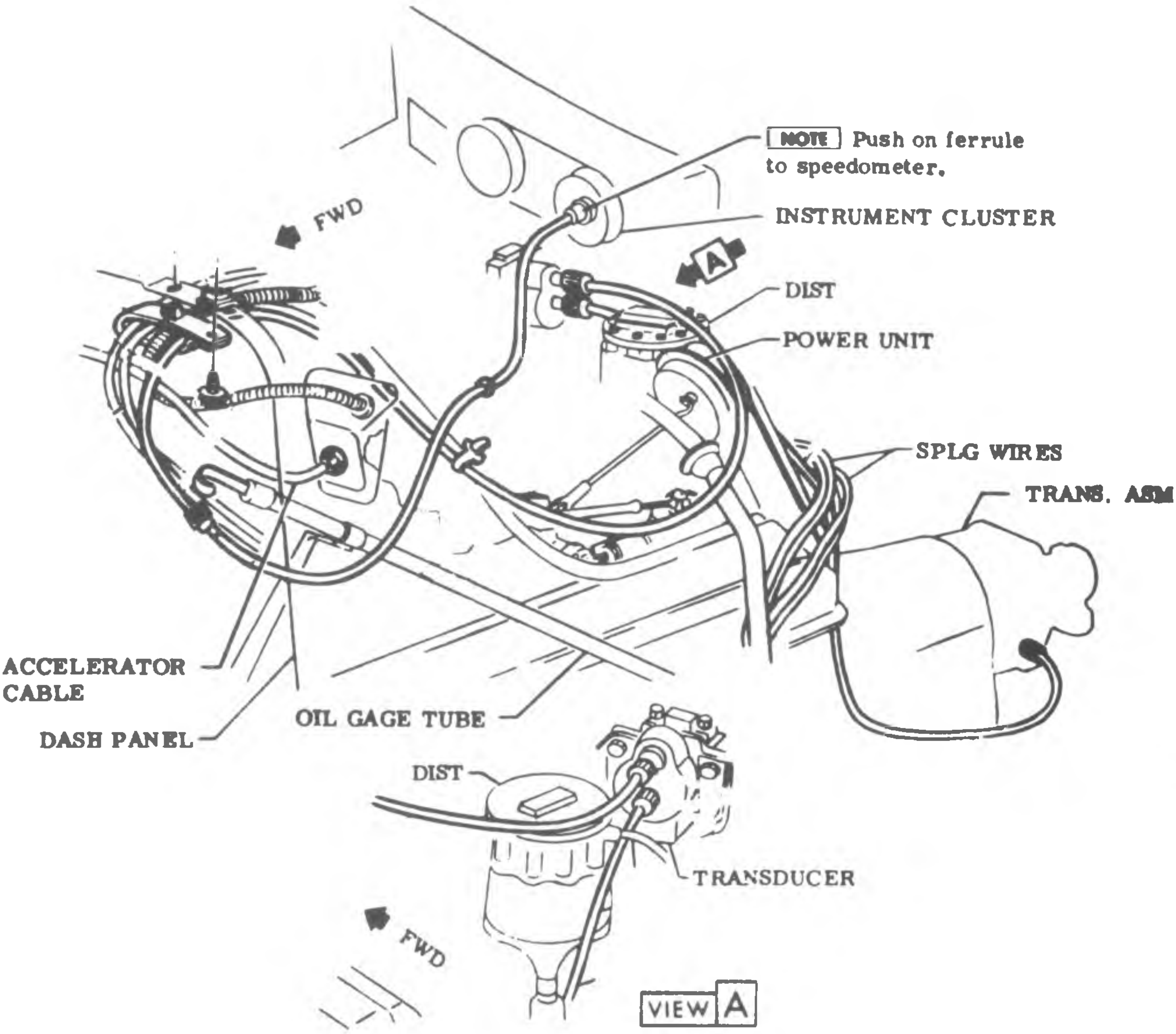


Chart 8C-F2--Speedometer Cable Routing

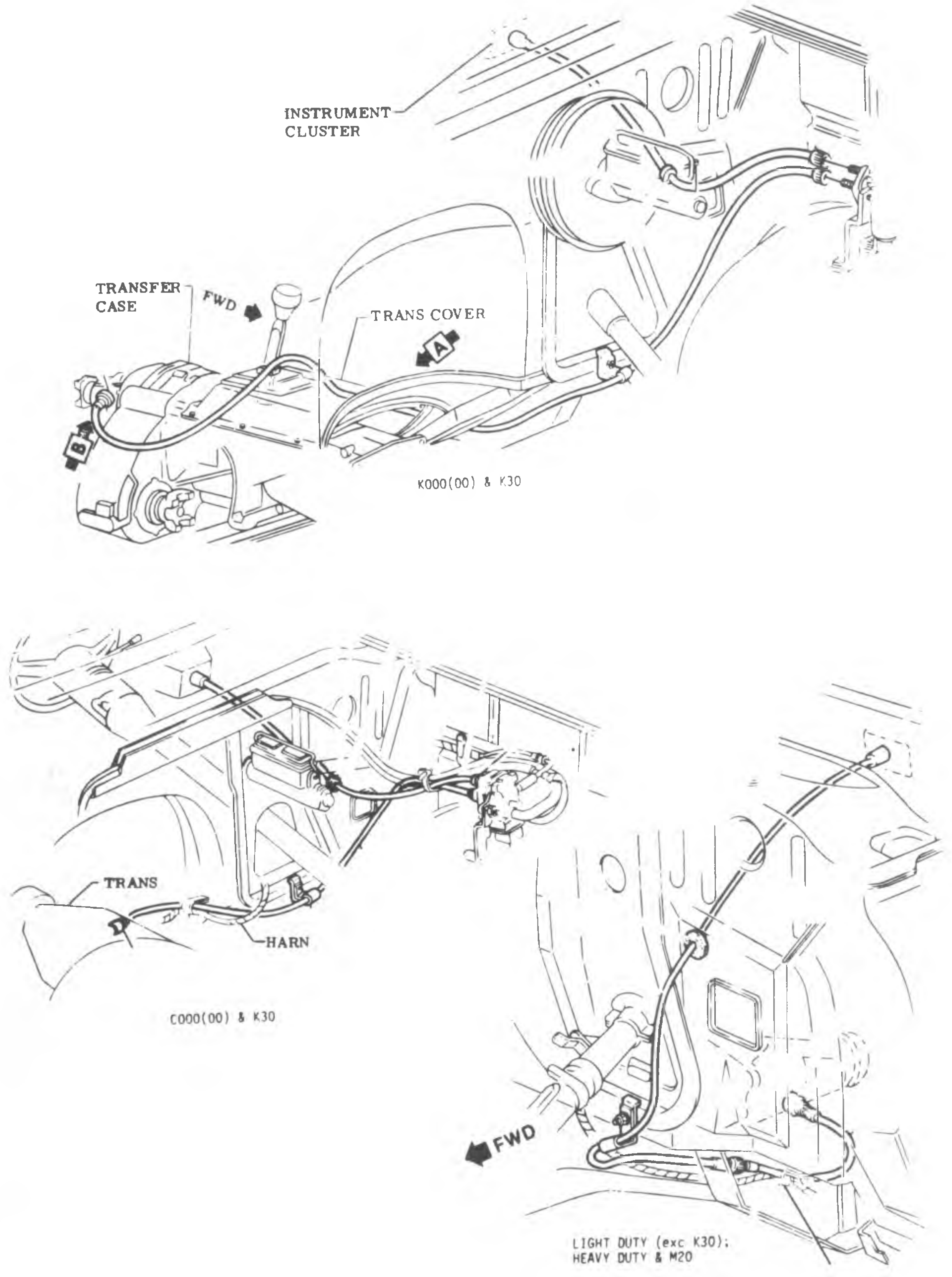


Chart 8C-G2--Speedometer Cable Routing

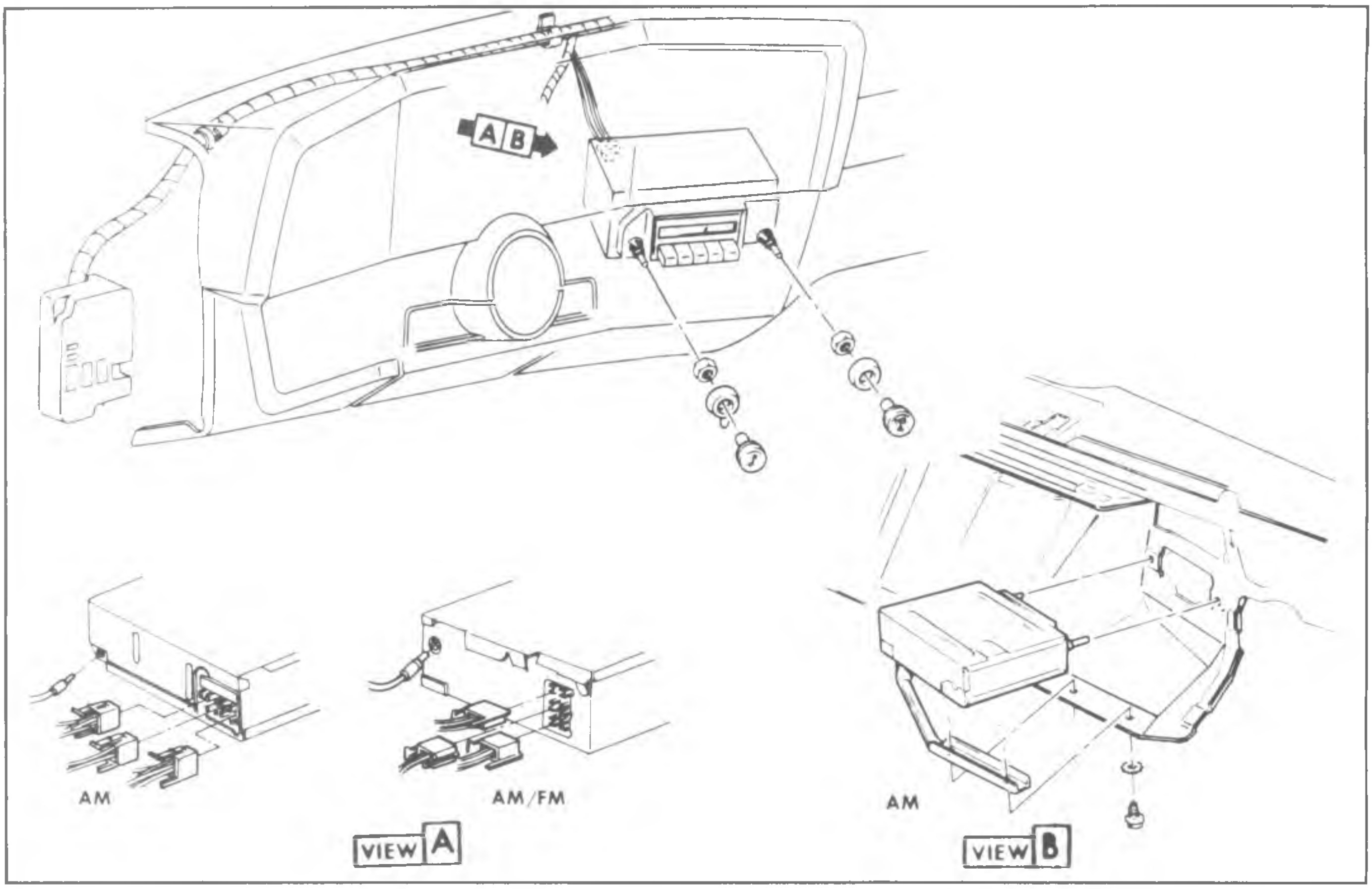


Fig. 8C-5--Radio Receiver (C-K Series)

RADIO RECEIVER

REMOVAL AND INSTALLATION

C-K Series

Replacement (Fig. C-5)

1. Disconnect battery ground cable.
2. Pull off radio control knobs and remove knob bezels. Remove nuts and washers from control shafts using a deep well socket.
3. **AM Radio** -Remove the radio support bracket stud nut and lockwasher.

   AM/FM Radio -Remove radio support bracket to instrument panel screws.
4. Lift up on the rear edge of radio. Then push radio forward until control shafts clear instrument panel. Lower control far enough to disconnect electrical harness.
5. Disconnect power feed, speaker and antenna lead wires and remove radio.
6. To install, reverse Steps 1-5 above.

G Models

Replacement (Fig. 8C-6)

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove air cleaner cover and element.
4. Remove radio control knobs and retaining nuts.
5. Remove rear mounting bracket.
6. Push radio forward in vehicle and then lower assembly and disconnect electrical harnesses and antenna lead.
7. Remove radio receiver from vehicle.
8. To install, reverse Steps 1-7 above.
9. Check operation.

   NOTICE: Always attach speaker wiring harness before applying power to the radio to prevent receiver damage.

RADIO DIAL BULB

AM and AM/FM radio dial bulbs can be replaced with the radio in the truck. Tape player radios must be removed from the vehicle for dial bulb replacement.

It is not recommended that CB Radio dial bulb be replaced except by a qualified radio repair service.

Replacement (All Models)

AM Radio

1. Slide radio dial lens upward, approximately 1/8 inch.
2. Tip bottom edge of lens outward (toward technician) and remove lens.
3. Pull out bulb section and remove bulb.
4. Install new bulb into socket and then reinstall bulb section.
5. Reinstall dial lens.

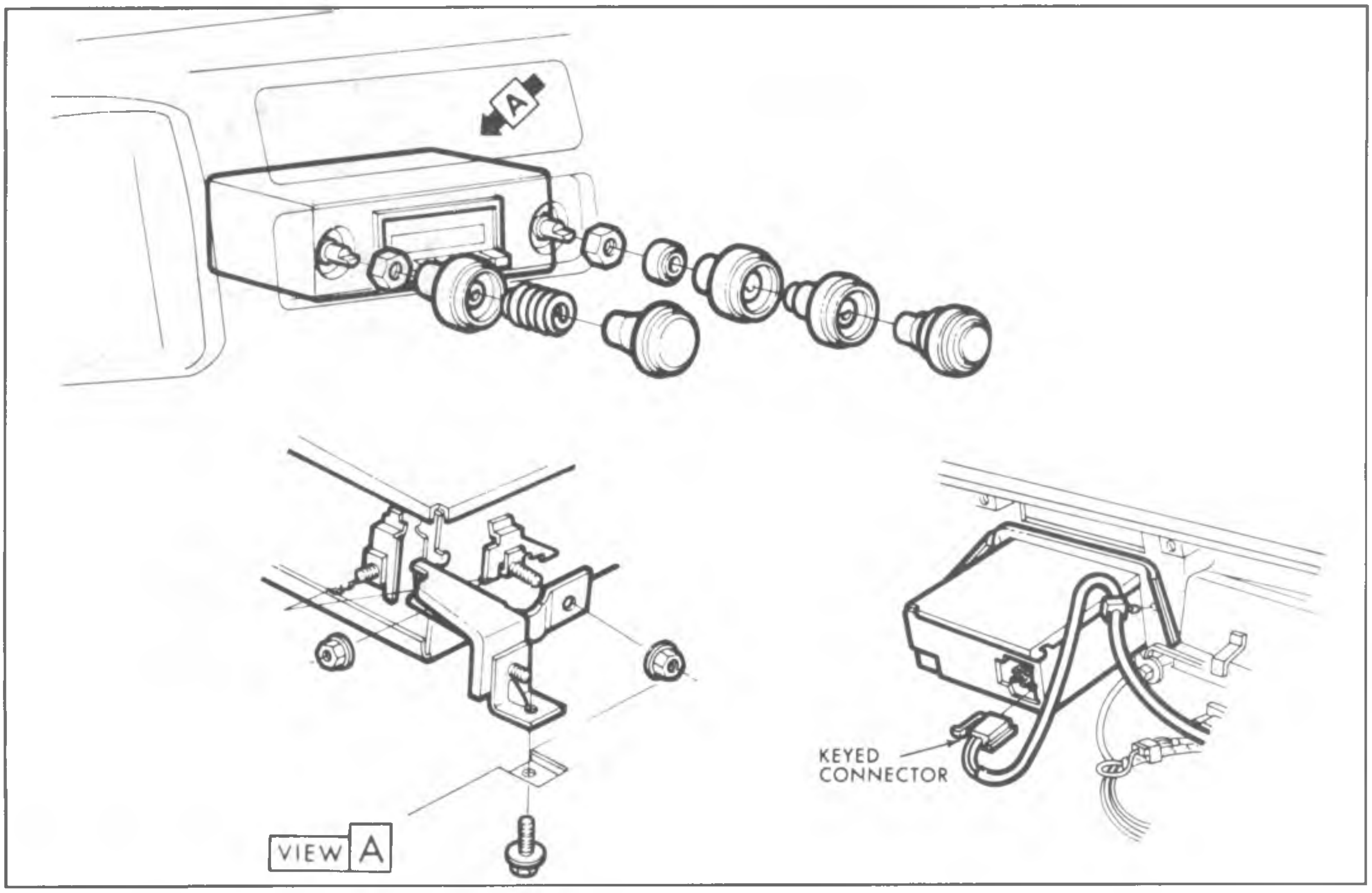


Fig. 8C-6--Radio Receiver Installation--G Models

AM-FM And Stero Radio

1. Slide radio dial lens upward approximately 1/8 inch.
2. Tip bottom edge of lens outward (toward technician) and remove lens.
3. Remove rear dial plate screw. Place dial pointer at 16 and remove plate.
4. Remove bulb.

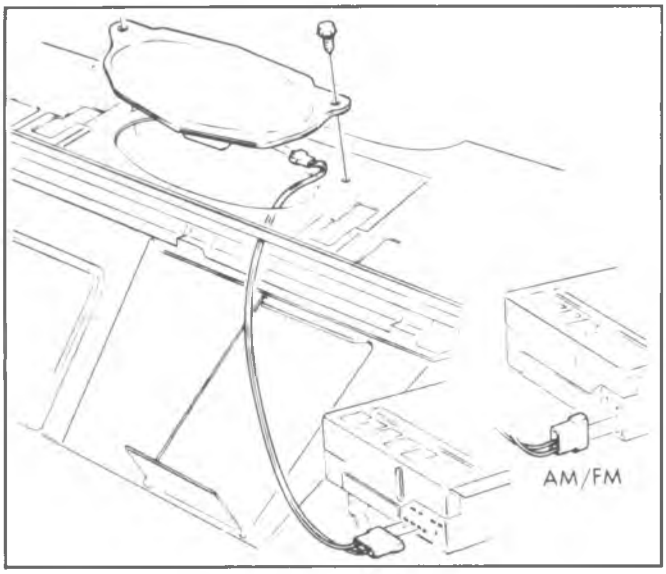


Fig. 8C-7--Radio Front Speaker (C-K Series)

5. To install, reverse steps 1-4 above.

Tape Player Radio

1. Remove radio from vehicle.
2. Remove radio top cover.
3. Remove bulb.
4. To install, reverse steps 1-3 above.

FRONT SPEAKER

C-K Models

Replacement (Fig. 8C-7)

1. Disconnect battery ground cable.
2. Remove instrument cluster bezel upper four screws.
3. Remove instrument panel pad screws and remove pad.
4. Remove speaker to dash panel screws.
5. Lift up on speaker, disconnect speaker wiring harness and then remove speaker.
6. To install, reverse Steps 1-5 above.

G Models

Replacement (Fig. 8C-4)

G Models--Left Side

1. Disconnect battery ground cable.
2. Remove instrument panel bezel.
3. Remove instrument cluster.
4. Remove speaker attaching screws, disconnect wiring harness and remove speaker.
5. To install, reverse Steps 1-4 above.
6. Check operation.

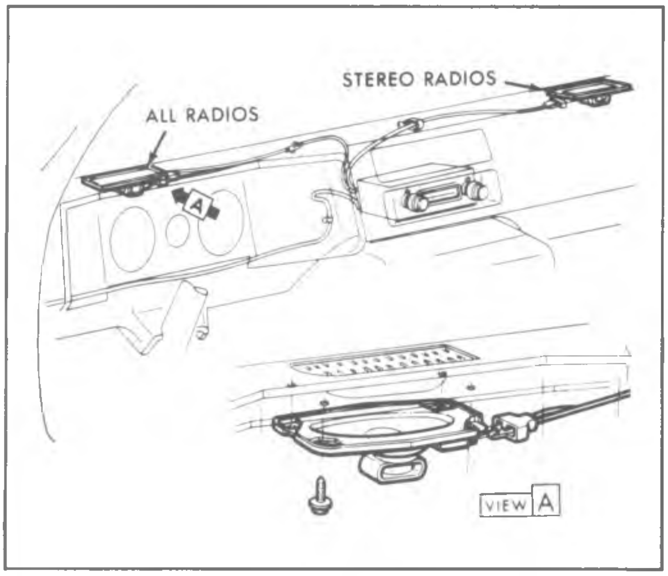


Fig. 8C-8--Speaker Installation--G Series

G Models--Right Side

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove steering column brace bolts.
4. Remove radio support bracket bolt and instrument panel upper and lower attaching screws.
5. Pull instrument panel assembly rearward to gain access to speaker.
6. Remove speaker attaching screws, disconnect speaker wiring harness and remove speaker.
7. To install, reverse Steps 1-6 above.
8. Check operation.

REAR SPEAKER

C-K Series

Replacement (Fig. 8C-9)

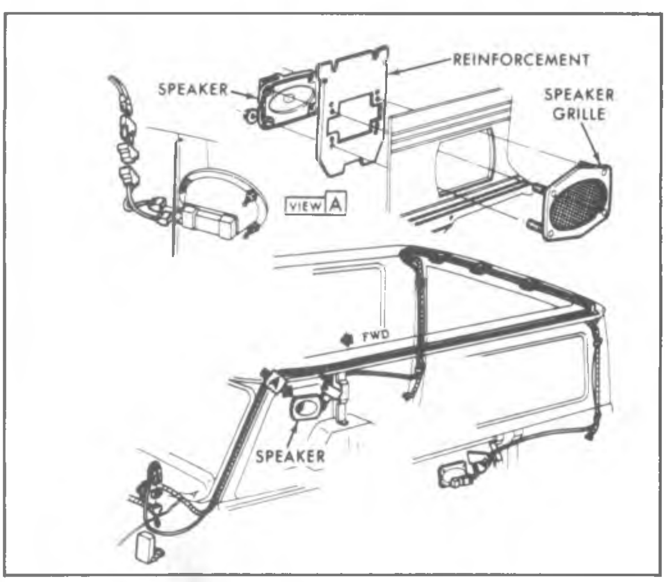


Fig. 8C-11--Rear Speaker (G (06) Truck)

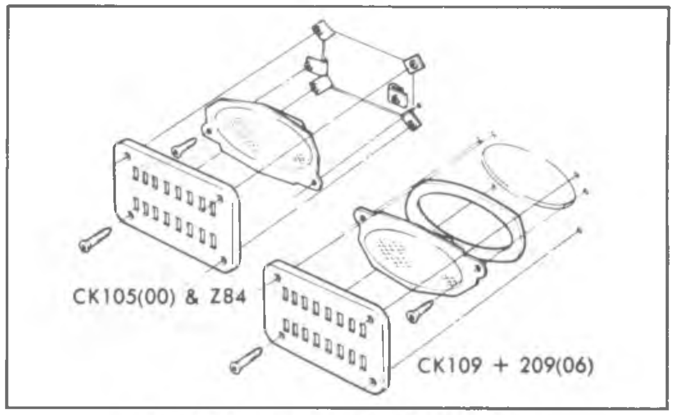


Fig. 8C-9--Rear Speaker (C-K Models)

1. Remove four screws securing speaker grille to trim panel and remove grille.
2. Disconnect electrical connector from speaker.
3. Remove two screws securing speaker to trim panel and remove speaker. On 109 and 209 (06) models, there is a gasket between speaker and trim panel.
4. Install replacement speaker in reverse order of removal.

G Models

Replacement (Figs. 8C-10 and 8C-11)

1. Remove the four most forward lower screws securing right rear trim panel. Pull trim panel outward slightly for access to speaker.
2. Disconnect electrical connector from speaker.
3. Remove four nuts securing speaker to grille studs and remove speaker.
4. Install replacement speaker in reverse order of removal.

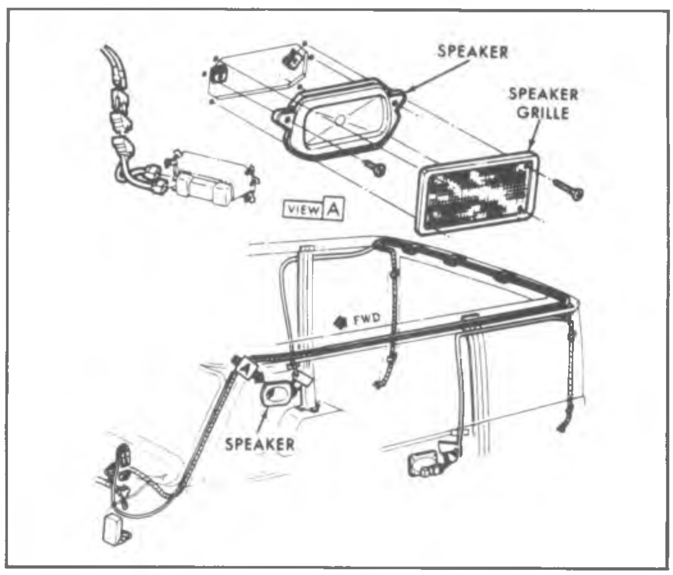


Fig. 8C-10--Rear Speaker (G (05) Truck)

DIRECTIONAL SIGNAL SWITCH

The directional signal switch is a self-contained unit which incorporates the hazard warning switch and the lane changing signal.

The hazard warning circuit is activated by a push-pull switch which is located on the right side of the steering column, opposite the directional signal lever. The switch knob must be pulled to cancel circuit.

The lane changing circuit is activated by holding the directional signal lever in the first detent position; there is no lock in or cancelling device in this position.

See Section 3B "Steering" for all servicing procedures.

INSTRUMENT PANEL WIRING HARNESSES

Refer to Figs. 8C-12 thru 8C-15.

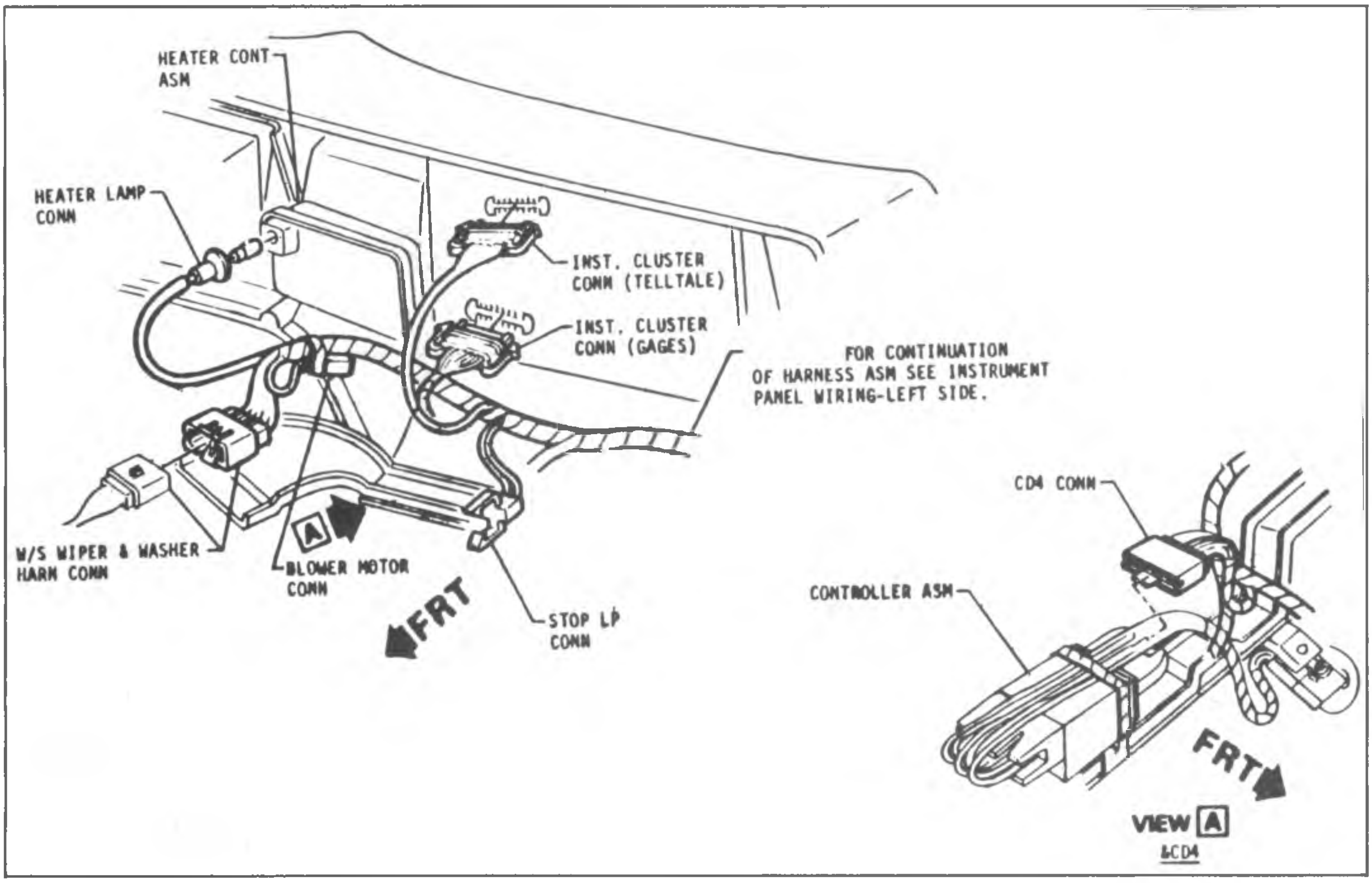


Fig. 8C-12--Instrument Panel Wiring - R.H. - G Models

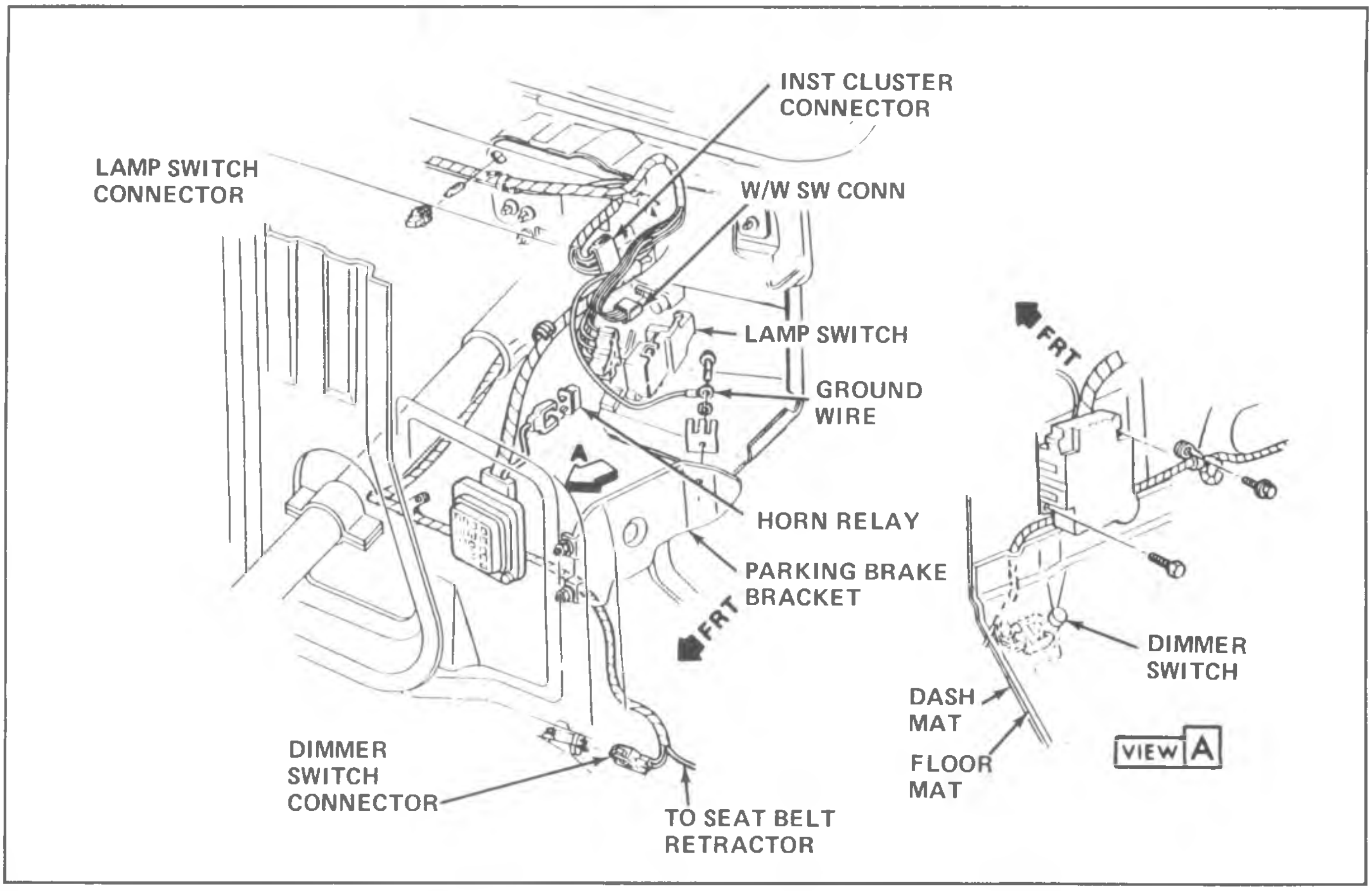


Fig. 8C-13--Instrument Panel Wiring - L.H. - G Models

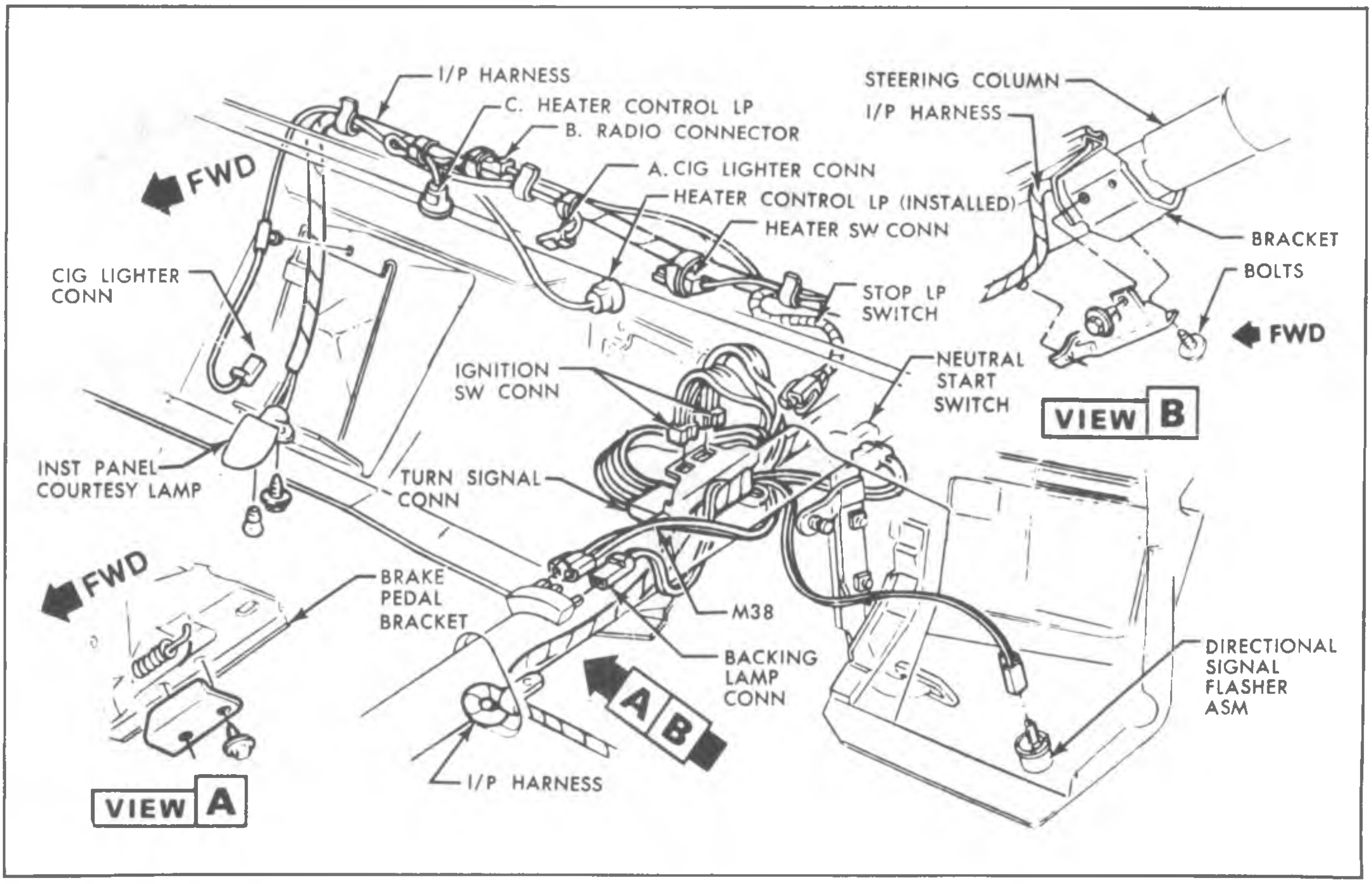


Fig. 8C-14--Instrument Panel Wiring R.H. - CK Models

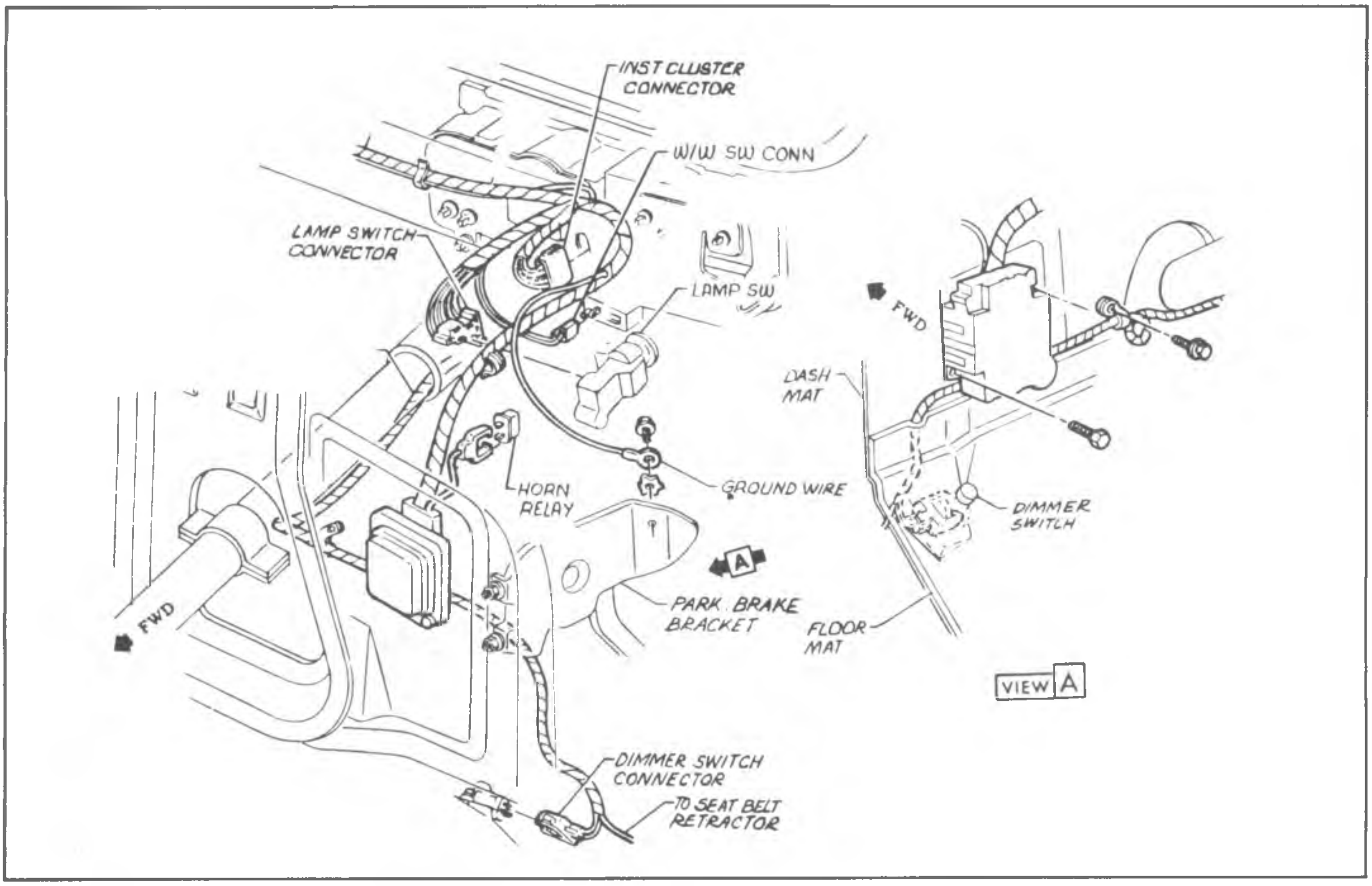


Fig. 8C-15--Instrument Panel Wiring - L.H. - CK Models

WINDSHIELD WIPER AND WASHER

C-K-G Series

GENERAL DESCRIPTION

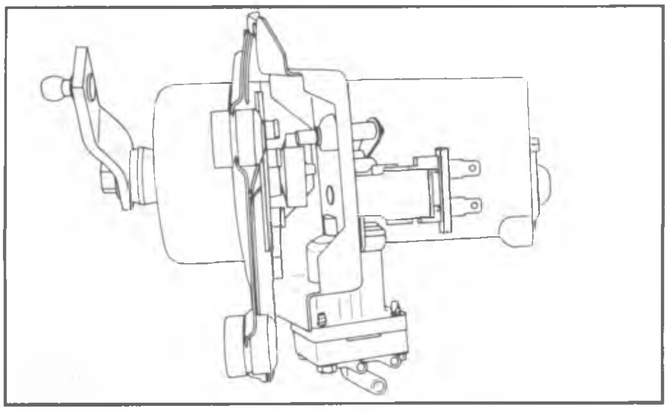


Fig. 8C-16--Wiper Motor Housing

A permanent magnet type wiper is used on CK & G Series. The motor parts-field magnets, armature, drive gear etc. are enclosed in a two piece sheet metal housing. For purposes of explanation the housing halves are referred to as upper and lower housings. The two housings are attached to each other by ten extrusions which are staked over. Figure 8C-16.

As shown in Figure 8C-9, the washer pump parts are assembled on the outside surface of the upper half of the sheet metal housing. Thus, the washer pump becomes an integral part of the wiper motor assembly.

The wiper motor is protected by an automatic reset type circuit breaker located on the motor brush holder assembly. A fuse located in the fuse block protects the vehicle wiring.

The wiper motor can be operated only when the ignition switch is in the "run" or "accessory" position.

Referring to figure 8C-17 note that there are seven terminals which are numbered.

The function of each terminal is covered in the explanation that follows.

NOTICE: Wipers are equipped with locking type connectors for attaching vehicle wiring and care should be used when disconnecting wiring from wiper to avoid damaging the connector or terminals.

As shown in figure 8C-17, the wiper motor has three brushes which are referred to as "common", "Lo speed" and Hi speed. When the ignition switch is "ON", 12 V(positive) circuit is completed to the common brush via no. 1 terminal. The Lo and Hi speed brushes are connected to motor terminals two and three.

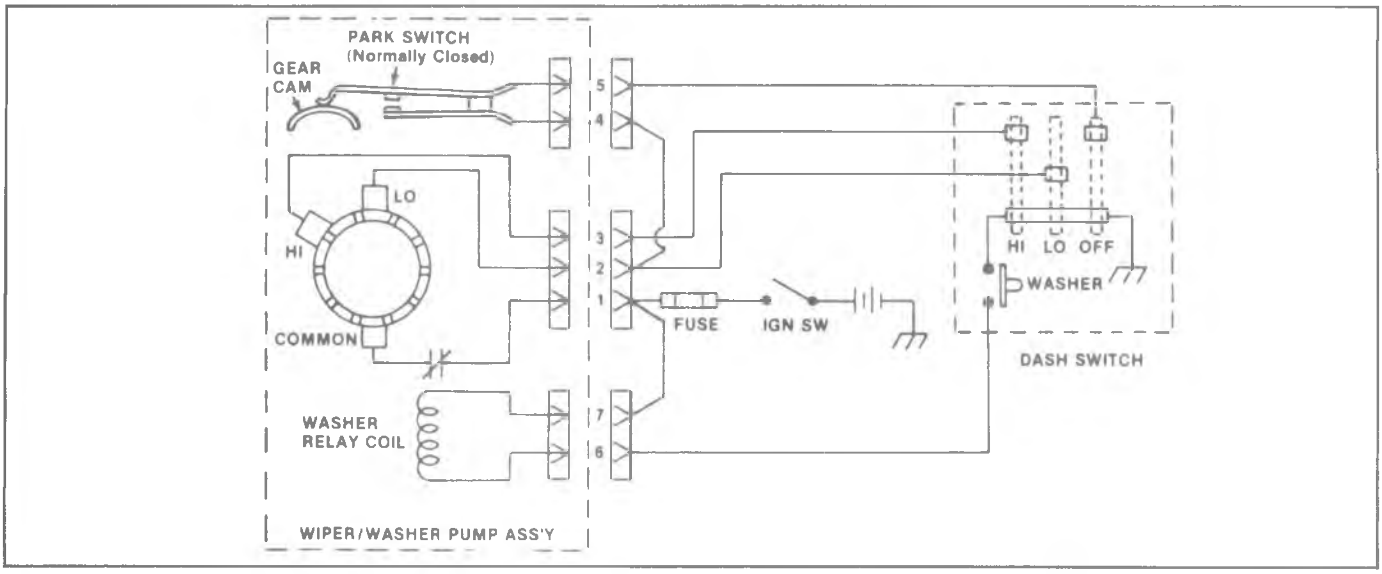


Fig. 8C-17--Wiper Motor Schematic

LO AND HI SPEED CIRCUITS

Moving the dash switch to the "Lo" or "Hi" speed position completes the respective brush circuit to ground at the dash switch and wiper motor runs at that speed.

WASHER PUMP OPERATION

The washer pump is an integral part of the wiper motor and cannot be replaced as a separate assembly as was possible with previous motors.

SHUTTING OFF THE WIPER

This explanation covers that portion of wiper operation when the owner first turns the wiper "off" at the dash switch and the wiper blades have not reached their normal park position, (approximately 1 1/2-2" above the lower windshield molding).

In order to have the blades stop in their normal park position and the wiper motor shut off properly, the motor operates in "Lo" speed. This is accomplished as follows: with the dash switch in the "OFF" position, the Lo speed brush circuit is completed to ground at the dash switch through a park switch located in the gear housing (Terminals 4 and 5). The park switch contacts are normally closed and this permits the wiper to continue to run.

When the blades reach their park position, a cam on the gear opens the normally closed part switch contacts shutting off the wiper.

WASHER PUMP CIRCUIT

Actuating the washer portion of the dash switch completes the washer pump magnet coil circuit to ground and mechanically moves the wiper motor switch to the Lo speed position. This dual function starts the wiper motor and washer operation simultaneously. When the wash cycle (10 squirts at full pressure) is completed, the wiper will continue to run until the owner returns the switch to the "off" position.

WASHER PUMP OPERATION

Pumping Mechanism

The basic pump consists of a spring loaded piston enclosed in a plastic cylinder housing. Attached to the piston and extending out of cylinder housing is an actuator plate. Attached to the end of the cylinder housing is a valve assembly consisting of two exhaust check valves and one intake check valve. Figure 8C-18.

Note the cam follower pin that extends through an elongated opening in the piston actuator plate. When the wiper motor is running, a 4 lobe cam, which is part of the wiper gear, moves the cam follower back and forth.

Pump Idling (No Pumping Action)

Refer to Fig. 8C-19 and note that a tang on the piston actuator plate is resting against a ramp on the lower surface of the ratchet gear. This, in effect, holds the piston actuator plate in a lock-out position. With actuator plate in this position and the wiper running, the cam-follower pin merely moves back and forth in the elongated slot of the piston actuator plate and no pumping action can occur.

The ratchet gear, which, if rotated, would move the ramp away from the tang of the actuator plate releasing the pump action, is prevented from rotating as follows: The relay assembly, consisting of a coil and armature, is constructed in such a way that the ratchet gear pawl extends through an opening in the relay armature (Fig. 8C-19), preventing it from engaging the ratchet gear teeth.

Starting the Pump

Actuating the washer button to obtain windshield washer pump operation starts the wiper motor and energizes the relay. When relay is energized, the relay armature is pulled toward the coil, allowing the ratchet gear pawl to drop out of the relay armature opening and engage the teeth of the ratchet gear.

The ratchet pawl, which is actuated by the same cam-follower pin that moves the piston actuating plate, begins to rotate the ratchet gear. Rotating the ratchet gear one tooth moves the ratchet wheel ramp away from the tang of the piston actuating plate (Fig. 8C-20), permitting the

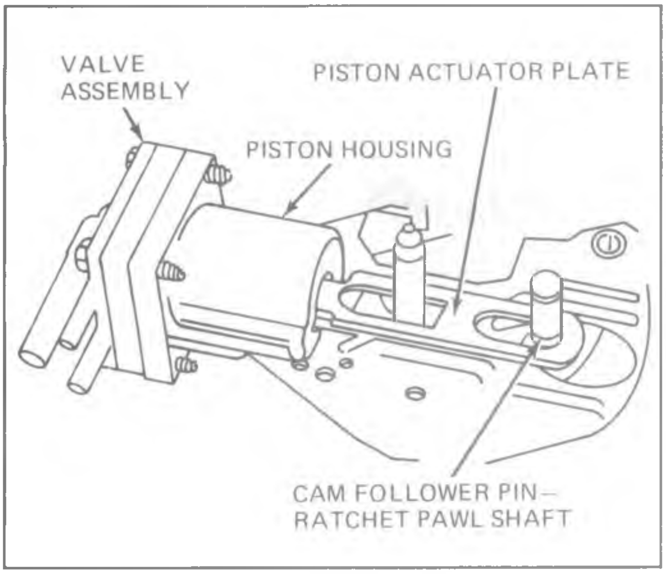


Fig. 8C-18--Washer Valve Assembly

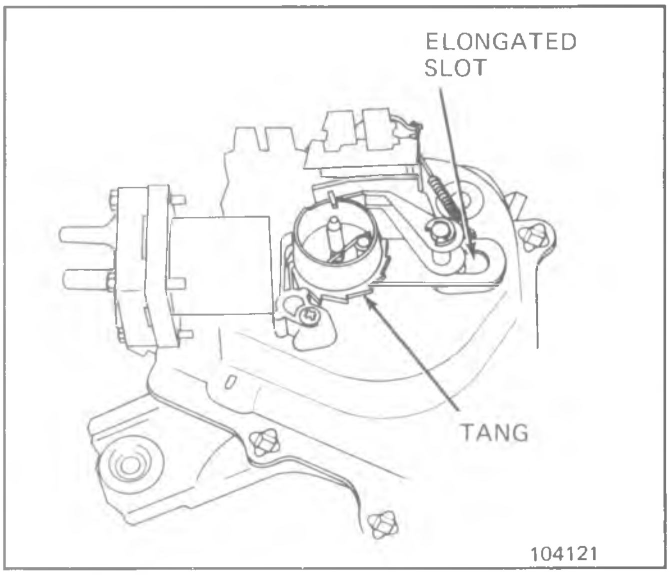


Fig. 8C-19--Ratchet Gear Pawl

piston spring to expand which in turn forces the piston toward the valve assembly resulting in the first exhaust stroke. This sequence then repeats through the remaining cycles.

Intake Stroke

When the cam-follower moves in the direction indicated by the arrow in Fig. 8C-21, the cam-follower pin, which extends through the piston actuating plate, pulls the actuator plate away from the valve assembly compressing the piston spring. As the piston moves away from the valve assembly, a vacuum is created in the cylinder which opens the intake valve, drawing washer solution into the cylinder (Fig. 8C-21).

Exhaust Stroke

As the 4-lobe cam continues to rotate, the cam follower moves in the opposite direction described in the intake stroke. This permits the piston spring to expand which in turn pushes the piston toward the valve assembly creating pressure between the piston and valve assembly. This pressure "build-up" forces the two exhaust valves open compelling the washer solution to flow to the nozzles. See Fig. 8C-21.

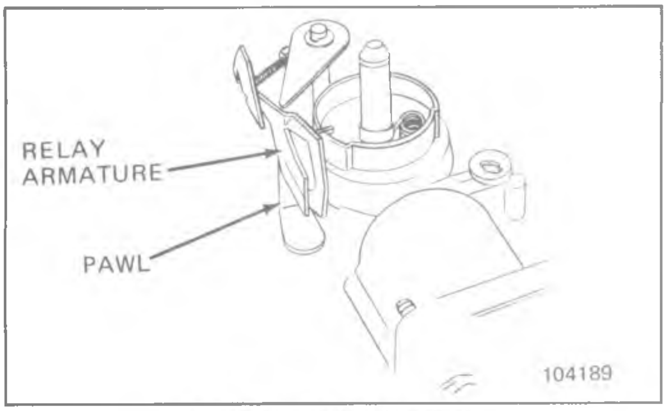


Fig. 8C-20--Relay Armature

For purposes of explanation, only one exhaust valve opening is shown in Fig. 8C-21.

The intake and exhaust stroke cycle will occur four times for each revolution of the wiper drive gear while the washer pump is operating.

Stopping the Pump (Completion of the Wash Cycle)

The pumping operation is terminated automatically when the ratchet gear has rotated a full 360° and the 12th cycle is completed. This is accomplished as follows.

As the ratchet gear approaches the completion of its 360° travel, two functions occur simultaneously:

1. A leg on the relay armature rides up a ramp located on the outer surface of the ratchet gear. When the leg reaches the top of the ramp, it moves over the top edge of the ratchet gear. This action allows the ratchet gear pawl to re-enter the armature opening preventing further rotation of the ratchet gear until the next time the relay coil is energized from the washer button. (Refer to Fig. 8C-21 for position of armature leg while pump is idling.)
2. The tang on the piston actuating plate is resting once more against the ramp on the lower side of the ratchet gear (Fig. 8C-18).

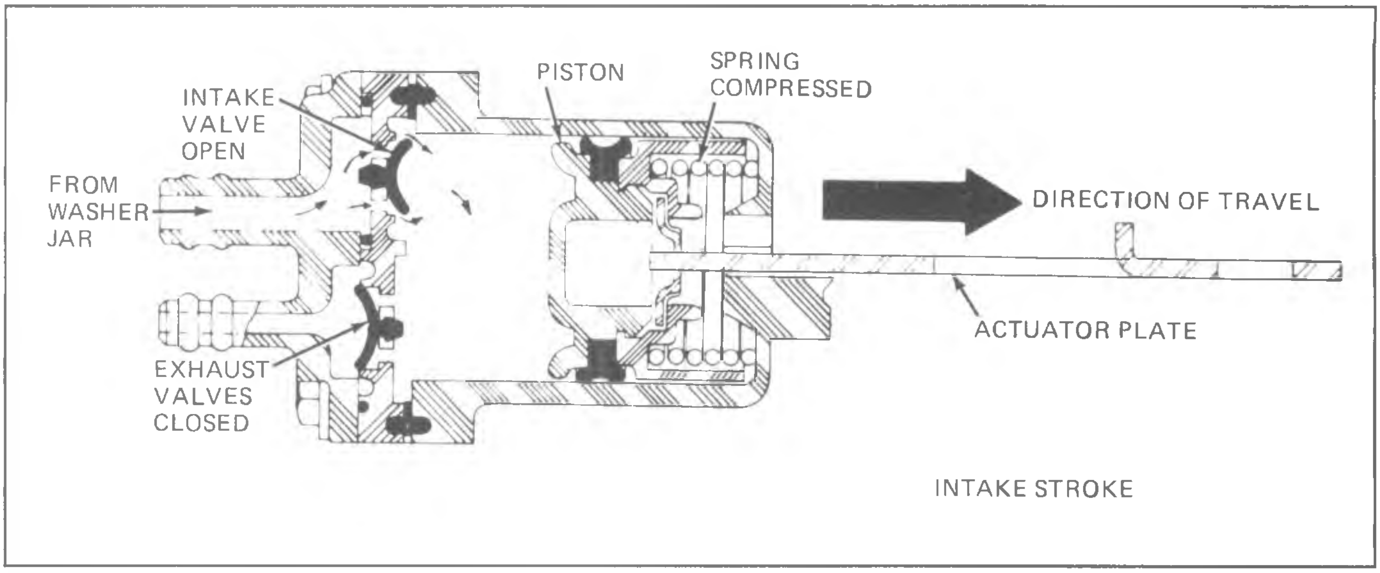


Fig. 8C-21--Pump Operation

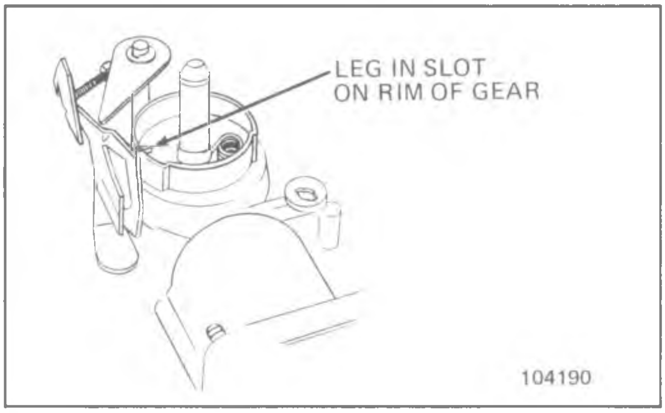


Fig. 8C-22--Armature Leg Position

DIAGNOSIS

WIPER - ON VEHICLE

Troubleshooting with wiper installed on the vehicle consists of two basic steps: (A) Preliminary inspection and (B) Operating wiper independent of vehicle wiring and dash switch.

Preliminary Inspection Procedure

A. Preliminary Inspection - Check the following items:

1. Body wiring securely connected to wiper unit and dash switch.
2. Wiper ground connection to vehicle chassis.
3. Dash switch is mounted securely.
4. Fuse.

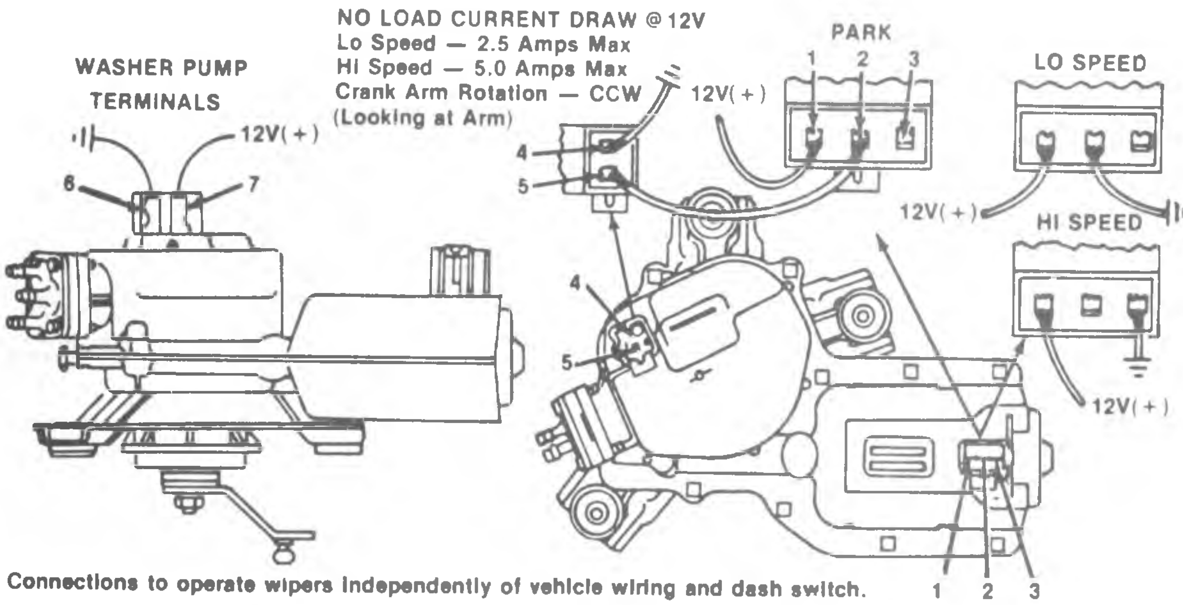
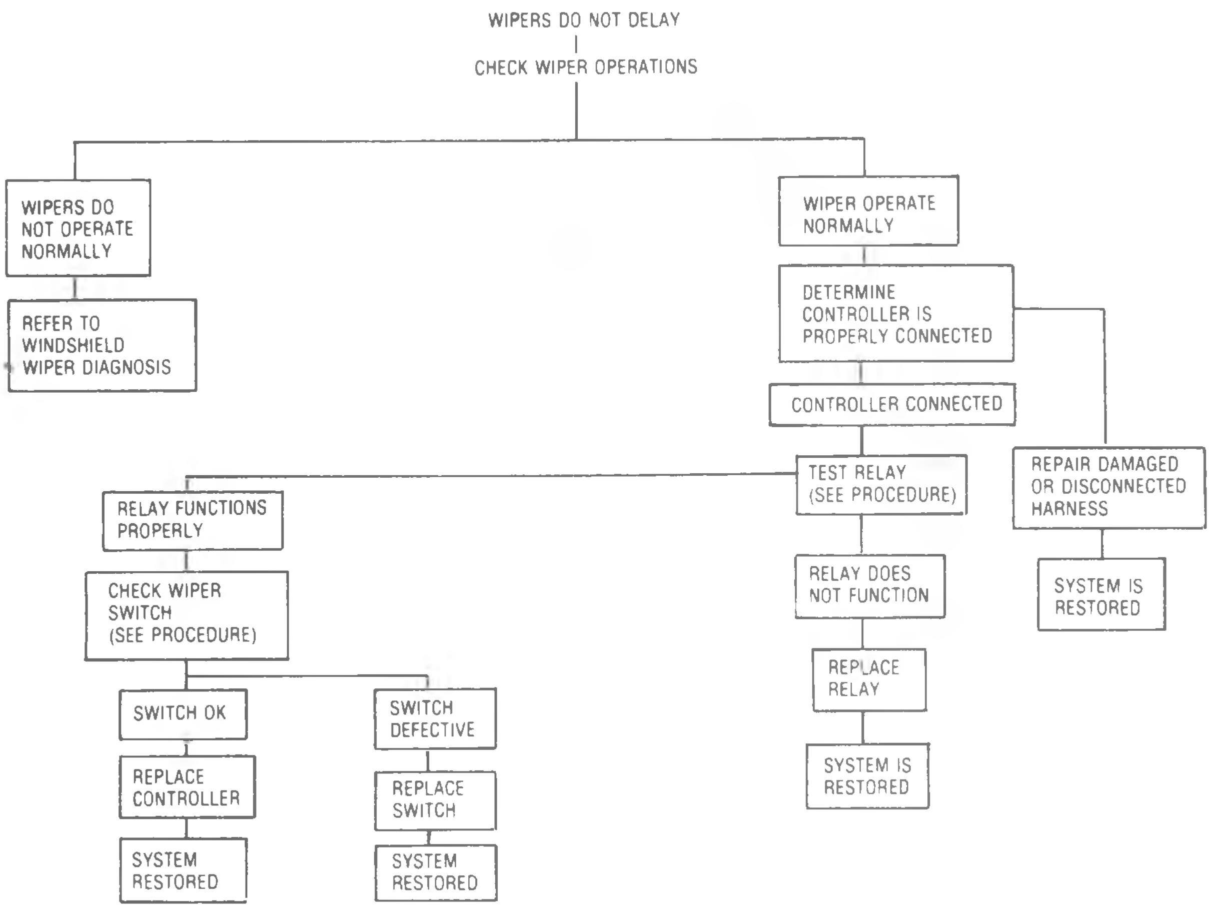


Fig. 8C-23--Wiper Motor Diagnosis Diagram

Diagnosis



Selector Switch Checking Procedure

If the wiper/washer selector switch is suspected of being faulty, it can be checked with an ohm meter as indicated in table below. Before performing any continuity check on selector switch, disconnect both harness connectors from switch to controller. Next, place selector switch in mode desired and perform a continuity check between the individual leads as indicated in table below, Figure 15. If there is a meter reading at each check but no indication of shorts, switch can be assumed to be good.

	Mist	Off	Delay	Delay (Rotate Control full clockwise)	LO	HI	Wash (Off Mode — press in on control)
Dark Blue							X
Light Blue	X				X	X	X
Green	X	X			X	X	X
Black	X	X	X		X	X	X
Black Wht Str	X	X	X		X		X
Orange				X			
White				X			

DIAGNOSIS CHART

SYMPTOM	PROCEDURE NO.
1) Wiper Inoperative - Both Lo and Hi	1
2) Lo speed only - inoperative in Hi	2
3) Hi speed only - inoperative in Lo	3
4) One speed - same in both Lo and Hi	4
5) Blades stop at random positions when wiper is turned off. (Do Not Return to Park Position)	5
6) Wiper will not shut off	6
7) Intermittent operation	7
8) Wiper motor runs but blades don't move	8
9) Washer pump inoperative	9
10) Washer won't shut off	10

PROCEDURE I (Wiper Inoperative)

STEP 1

Ignition switch "ON". Using a test light check for voltage at wiper terminal no. 1. Figure 9.

Voltage OK

Go To STEP 5

No Voltage

Go To STEP 2

STEP 2

Check Fuse

Fuse Blown

Go To STEP 3

Fuse OK

Locate and Repair open in wire from fuse block to wiper.

Procedure 1 (cont.)

STEP 3

Remove blown fuse and connect an ammeter 0-30 amp. across fuse block terminals. Operate wiper motor and observe if current draw exceeds capacity of original fuse.

Current Draw High

Go To STEP 4

Current Draw OK

Replace fuse and recheck system

STEP 4

Disconnect wiring from wiper motor; replace fuse and actuate wiper dash switch several times. Recheck fuse. Ignition switch ON.

Fuse Blown

Locate and repair shorted or grounded condition in wiring

Fuse OK

Problem is in motor refer to "wiper repair" page

STEP 5

Ignition switch "ON". Leave wiring connected to wiper motor. Connect jumper wire from terminal no. 2 to ground. Figure

Wiper Runs

Check dash switch ground wire connection. If OK, replace dash switch.

Wiper Inop.

Problem is in motor refer to "wiper repair" Page

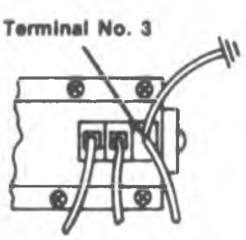
PROCEDURE 2 (Lo Speed Only) (Inop in Hi)

STEP 1

Ignition switch "ON". Leave wiring connected to wiper. Connect jumper wire from terminal no. 3 to ground. **Dash switch in "HI" speed position!!**

Wiper Runs in Hi

Problem is an open wire from terminal no. 3 to dash switch. or Dash Switch.



Wiper Inop.

Repair wiper motor. (Look for Hi speed hung brush)

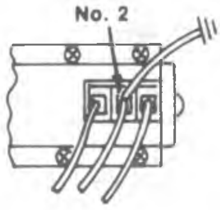
PROCEDURE 3 ("Hi" Speed Only) (Inop in Lo)

STEP 1

Ignition switch "ON". Dash switch in "Lo" speed position. Leave wiring connected to wiper and connect jumper wire from terminal no. 2 to grd.

Wiper Runs in Lo

Problem is on open wire from wiper terminal no. 2 to dash switch or The Dash Switch.



Wiper Inop.

Repair wiper motor (Look for Lo speed hung brush.)

PROCEDURE 4 (One speed - same in both Lo and Hi).

STEP 1

Remove wiring from wiper motor terminals 1, 2 and 3 and operate wiper in Lo and Hi as shown in Figure (NOTE: Current draw is usually above normal - approx. 6.0 amps.

Wiper operates correctly

Problem is in wiring between dash switch and wiper or a defective dash switch.

Problem still present

Repair wiper motor. Check for Lo and Hi speed brush leads shorting together internally.

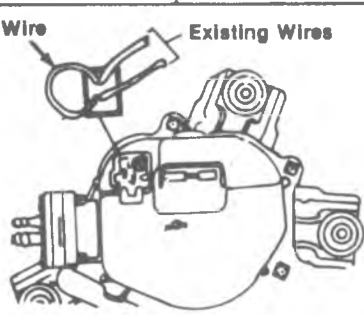
PROCEDURE 5
(Wiper shuts off but blades don't return to park position)

STEP 1

Ignition switch "ON". Dash switch in "OFF". Leave wiring connected to wiper and connect a jumper wire across terminals 4 and 5.

Wiper Runs

Replace wiper park switch assy.



Wiper Inop.

Wire from wiper terminal no. 5 to dash switch open or dash switch is problem

PROCEDURE 6 (Wiper will not shut off)

STEP 1

Ignition switch "ON". Dash switch in "OFF" position. Disconnect wiring from wiper terminals 4 & 5.

- **Wiper Stops**
  Repair wiper Motor
  (Replace park switch assy.)
- **Wiper Still Runs**
  Go To STEP 2

STEP 2

Remove wiring from wiper terminals 1, 2, 3. Connect 12v + to wiper terminal 1 only.

- **Wiper Doesn't Run**
  Locate and repair grd. condition in wires from wiper to terminals 2 or 3 to dash switch.
- **Wiper Still Runs**
  Repair wiper motor (Look for internal grd. condition in "Lo" or "Hi" brushes)

PROCEDURE 7 (Intermittent Operation) (Wiper has both speeds)

STEP 1

Remove wiper fuse from fuse block and connect an ammeter (0-30 amp) across the fuse block terminals where the fuse was. Turn ignition switch "ON" and run wiper in "Hi" speed with windshield dry. Note the **lowest** current draw reading.

- **Current Draw: less than 5.0 Amp.**
  A weak circuit breaker is indicated. Replace motor end cap assy.
- **Current Draw: exceeds 5.0 Amps.**
  Go To STEP 2

STEP 2

Remove arms and blades and repeat Step 1

- **Current Draw OK**
  Replace blade elements
- **Current Draw Hi**
  Go To Step 3

STEP 3

Disconnect wiper linkage from wiper crank arm and repeat Step 1.

- **Current Draw OK**
  Check wiper linkage for a binding condition and repair or replace as req'd.
- **Current Draw Hi**
  Problem is in wiper motor. Check for armature end play, shorted or grounded armature.

PROCEDURE 8 (Wiper Runs But Blades Don't Move)

STEP 1

Check wiper linkage connection to wiper crank arm

- **Linkage Connected**
  Wiper gear stripped. Replace wiper motor.
- **Linkage Disconnected**
  Connect linkage and check system.

PROCEDURE 9 (Washer Pump Inoperative)

STEP 1

Check washer jar for adequate supply of washer solution, hoses are attached to washer pump nozzles and washer reservoir; screen on jar hose not plugged

- **Items OK**
  Go To STEP 2
- **Discrepancy Noted**
  Make necessary repair or correction and check system. If system still inoperative *Go To STEP 2*

STEP 2

Ignition switch "ON". Turn wiper motor to "Lo" speed position first, then push wash button and listen for relay "click".

- **No Click**
  Go To STEP 3
- **Clicks**
  Go To STEP 4

STEP 3

Ignition switch "ON". Leave wiring connected to wiper terminals. Connect test light lead to ground and probe both wiring terminals connected to washer pump terminals 6 and 7. (Refer to Fig. 9)

- **Light "off" at both**
  Look for open in B+ circuit to pump.
- **Light "on" at one**
  Replace relay coil-park switch assy. Page 13.
- **Light "on" at both - One Dim**
  Ground the "dim" light terminal. If pump runs OK check for open in wire between pump and dash switch or a def. dash sw. Otherwise, Go To Step 4

STEP 4

Remove washer pump cover and re-connect wiring to wiper motor terminals 1, 2 and 3. Turn on wiper motor and observe if ratchet pawl is moving back and forth.

Not moving

Check the following:
1) Pawl spring properly connected.
2) Cam-follower not binding.

Moves back and forth

Leave wiper running and Go To STEP 5

STEP 5

Connect 12(+) volts to one of washer pump terminals (6 or 7) and ground the other for approx. 2 seconds. Observe it relay armature is pulled toward the relay coil; armature leg drops down on gear ramp and ratchet pawl starts rotating ratchet gear. Refer to view in STEP 4.

Operates OK

Go To STEP 6

Relay armature operates correctly but ratchet gear doesn't rotate.

Check ratchet gear teeth and/or ratchet gear dog spring engages gear teeth. Refer to above Illustration.

Armature Leg doesn't clear rim on ratchet gear. Drops back in slot area on edge of rim.

Check the following:
a) Relay coil-sw. assy. correctly assembled to washer frame
b) Burr on end of armature leg. File off as required.
c) Loose coil on pole piece.

STEP 6

Observe if piston actuator plate move back and forth with the cam follower pin. Refer to view in STEP 4.

Piston Moves back and forth

Replace valve assembly and recheck pump. If washer pump still fails to pump solution, replace piston and housing assembly.

Piston Not Moving.

Replace piston and housing assembly.

PROCEDURE 10 (Washer Pumps Continuously)

STEP 1

Have wiper running and disconnect wiring from washer pump terminals 6 and 7. Observe if pump completes wash cycle and stops pumping.

Pump stops

Check for grounded wire between pump terminal and dash switch or a defective dash sw.

Pump keeps running

Go To STEP 2

STEP 2

Disconnect wiring from wiper unit; remove washer pump cover and re-connect wiring to wiper-washer. Turn on wiper and check the following items.

a) Ratchet gear dog spring engaging ratchet gear teeth.
b) Weak spring tooth on ratchet gear.
c) Ratchet gear tooth damaged
d) Cam-follower damaged.

Replace item(s) as required.

DELAY WIPER SYSTEM OPERATION AND DIAGNOSIS

Light duty trucks use a separate control assembly to operate the windshield wipers over a variable delay of 1 to 20 seconds. The control assembly plugs into the selector switch at two different connectors. One of these connectors has a piggy-back connector that connects to the regular wiper harness. There is also a lead from the control that plugs into the accessory cavity of the fuse panel. Moving the control knob of the selector switch to the extreme left position and holding it there, will result in a MIST mode. The mist mode feature provides momentary low speed wiper operation as long as the control knob is held in position. This position is spring loaded and will only remain activated as long as the knob is held in position. Upon releasing the control knob, it will automatically return to OFF position. By positioning the control knob in the first detent right of OFF, the selector switch is in the DELAY mode. Rotation of the control knob while in the delay mode regulates the delay period between the time it takes the wiper to make one sweep and momentarily stop.

Shifting the control knob right to next detent position will put the wipers in a LOW speed wiper mode. By moving the control again to the right (right most detent) will activate the HIGH speed wiper mode.

Depressing the control knob, in any mode, will result in washer fluid being squirted on the windshield.

Depressing the control knob on light duty trucks for one or two seconds will send a measured amount of fluid onto the windshield and then the washer will shut off. If the wiper control knob is any position other than HIGH, the wipers will continue to operate at low speed until they are manually turned OFF.

In the HIGH mode, depressing the knob results in washer fluid being dispensed with the wipers operating at the high speed mode.

Selector Switch Checking Procedure

If the wiper washer selector switch is suspected of being faulty, it can be checked with an ohmeter as indicated in Chart 8-16. Before performing any continuity check disconnect both harness connectors from switch to controller.

Next, place selector switch in mode desired and perform a continuity check between the individual leads as indicated in the chart. If there is a meter reading at each check but no indication of shorts, the switch can be assumed to be good.

ON-VEHICLE SERVICE

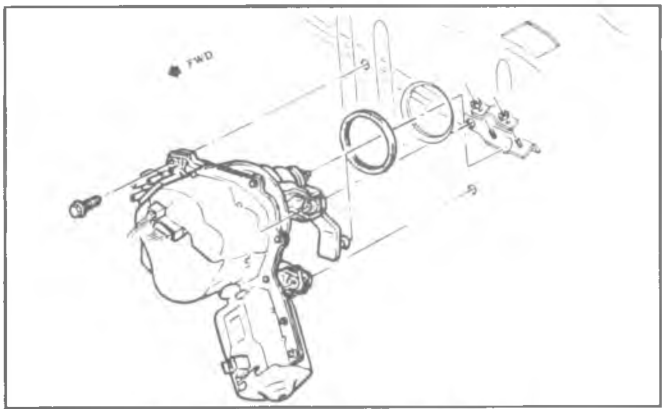


Fig. 8C-24--Wiper Motor (C-K Series)

WIPER MOTOR

C-K Models

Replacement (Fig. 8C-24)

1. Make sure wiper motor is in Park position.
2. Open hood and disconnect ground cable from battery.
3. Disconnect electrical harness at wiper motor and hoses at washer pump.
4. Reach down through access hole in plenum and loosen wiper drive rod attaching screws. Remove drive rod from wiper motor crank arm.
5. Remove wiper motor to dash panel attaching screws and remove the motor assembly.
6. To install, reverse Steps 1-5 above.

   Lubricate wiper motor crank arm pivot prior to reinstallation.

G Series

Replacement (Fig. 8C-25)

1. Make sure wiper motor is in Park position.
2. Open hood and disconnect battery ground cable.
3. Remove wiper arms from wiper transmission linkage.
4. Remove remaining screws securing cowl panel cover and lift off.
5. Loosen nuts holding transmission linkage to wiper motor crank arm and lift linkage off arm.
6. Disconnect power feed to wiper motor at multiple connector.
7. Remove left dash defroster outlet from flex hose and push hose aside for access to wiper motor screws.
8. Remove one screw securing left hand heater duct to engine cover shroud and slip heater duct down and out.
9. Protect carpet, then remove windshield washer hoses from washer pump.
10. Remove three screws securing wiper motor to cowl and lift wiper motor out from under dash for further disassembly on bench.
11. To install, reverse Steps 1-10 above.

NOTICE: Install wiper in the PARK position. Lube wiper motor crank arm pivot prior to installation.

UNIT REPAIR

WIPER MOTOR

Repairs to the motor/gear box section of the wiper are limited to the switch, armature, and cap and brush holder assy., plus the external parts such as the crank arm, spacer/seal (plastic) and output shaft seal.

PARK SWITCH

This is part of the washer pump relay coil assembly. Refer to figure 8C-26.

Removal

1. Disconnect wiring from wiper assembly and remove washer pump cover.
2. Remove pawl spring.
3. Push in retainer tab to release relay coil-park switch assembly from washer frame.
4. To re-assemble, reverse steps 1 thru 3 and check wiper operation, figure 8C-19.

ARMATURE ASSEMBLY END CAP-BRUSH HOLDER ASSEMBLY

Replacement

1. Bend retainer tabs as required to provide clearance for removing end cap assembly. Figure 8C-27.
2. To assist in pushing the end of the motor housing, rotate crank arm clock-wise (looking at crankarm).
3. Pull end cap assembly off the armature shaft and pull armature out of wiper housing.

Replace

1. Release brush spring tension figure 8C-28 and slide brushes back in their respective brush holders.
2. Assemble armature in end cap assembly and re-position brush spring legs behind their respective tabs, figure 8C-29.
3. To maintain the end cap in its assembled position on armature shaft during re-assembly of armature in the wiper housing proceed as follows: Using small wire such as tag wire, tie armature to end cap assembly as shown in figure 8C-30.
4. Guide armature worm shaft through the housing bearing.

   The strong magnetic field will pull armature toward one of the magnets. It will be necessary to overcome the magnetic force to start shaft into the bearing.
5. Guide terminal housing of end cap into the slot area of the wiper housing.
6. Remove wire used to attach armature to end cap. This should be done before end cap enters the housing.
7. After wire is removed, rotate crank arm slightly to permit armature worm shaft to engage gear teeth. The end cap assembly can then be pushed into the housing until it bottoms against the end of the housing.
8. Bend the 4 tabs as required to secure the end cap in position figure 8C-30.

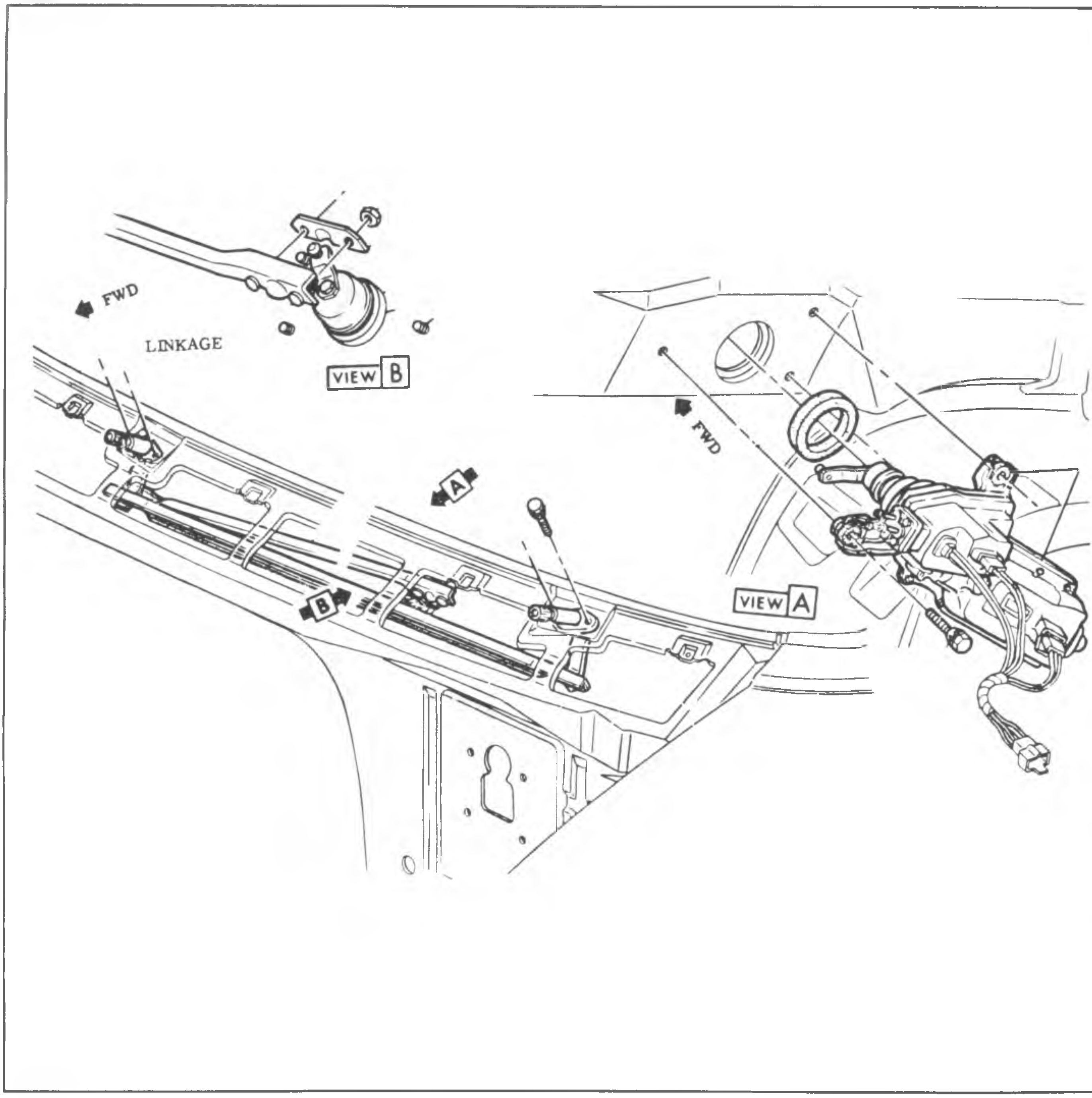


Fig. 8C-25--Wiper Motor (G Series)

9. Check wiper operation.

CRANK ARM, SPACER, SEAL Refer to Figure 8C-31

Replacement

1. Remove crank arm retaining nut, crank arm, shaft seal and spacer in the order indicated.

   When re-assembling the shaft seal, be sure flat side is toward crank arm.

2. When re-assembling the crank arm, be sure wiper motor is in park (refer to figure 8C-32), and assemble crank arm on shaft in position shown in Figure 8C-32.

WASHER PUMP

Relay Coil

This is part of park switch assembly. Refer to "Park switch" for disassembly-assembly procedure.

Ratchet Pawl

Refer to Figure 8C-33.

1. Disconnect pawl spring.
2. Remove "e" type retainer ring and slip pawl off of shaft.

Dog Spring: Refer to Figure 8C-33

1. Remove screw that attaches dog spring to washer frame.

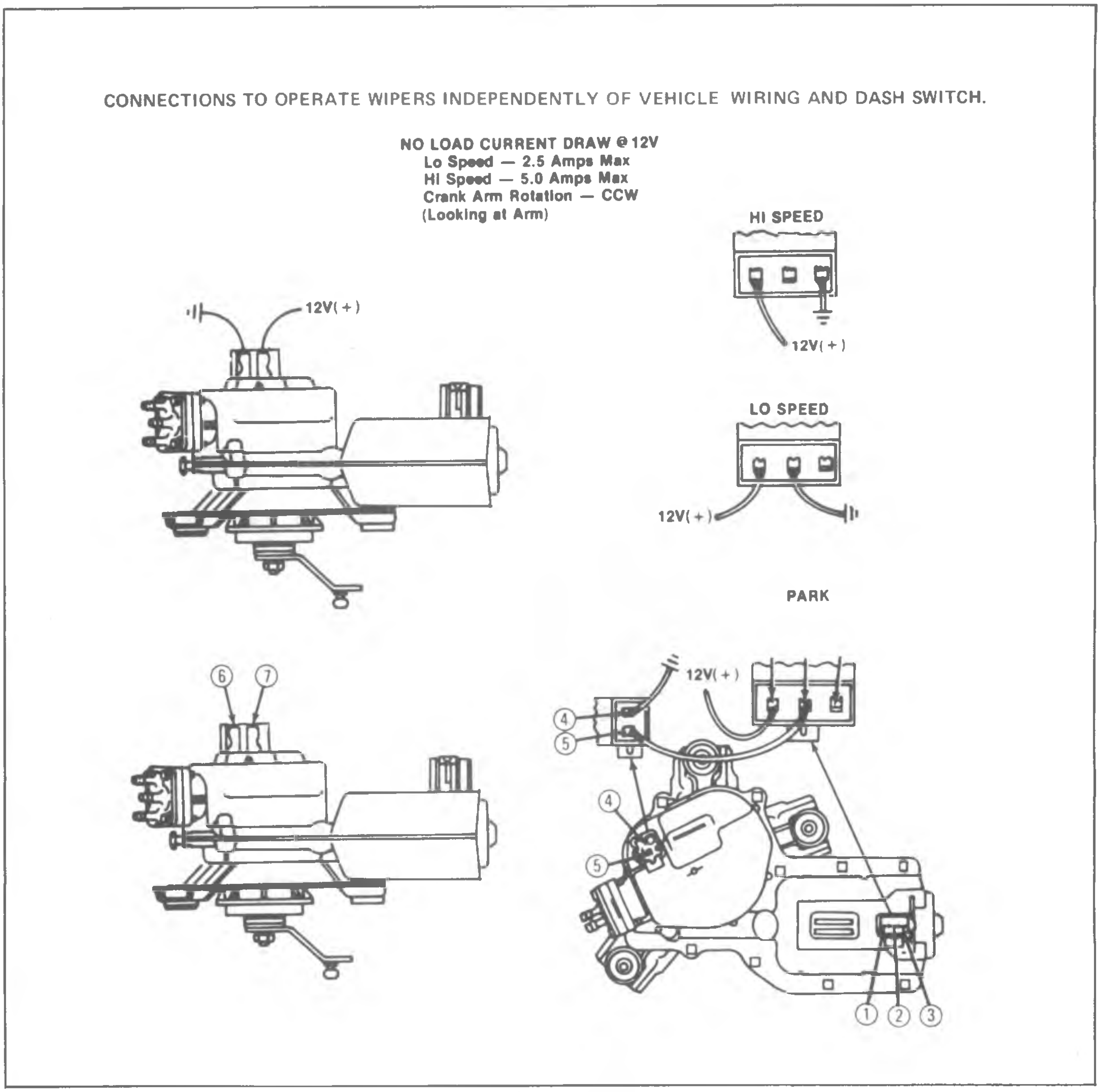


Fig. 8C-26--Checking Motor Operation

Ratchet Gear: Refer to Figure 8C-33

1. Remove dog spring and ratchet pawl.
2. Move leg of retainer spring out of shaft groove and slide ratchet gear off shaft. Be careful not to lose retainer spring.
3. To re-assemble gear, reverse steps 1 and 2 but read note.

   In order to push gear on shaft until it bottoms, move ratchet pawl shaft in a direction away from the gear. This will allow gear collar to slide past the tab on the piston actuator plate. (Refer to Figure 8C-24).

Piston and Housing Assy:

Refer to Figure 8C-34.

1. Remove ratchet pawl, dog spring and ratchet gear.
2. Pull piston housing away from frame until the mounting grooves clear the frame. During this step the piston spring is being compressed.
3. Remove valve assembly as required.
4. To re-assemble, reverse steps 1 thru 3.

Valve Assembly: Refer to Figure 8C-33.

1. Remove the four (4) attaching screws and remove valve assembly and gasket ring.
2. During re-assembly, be sure seal is properly installed in piston housing and valve assembly grooves.

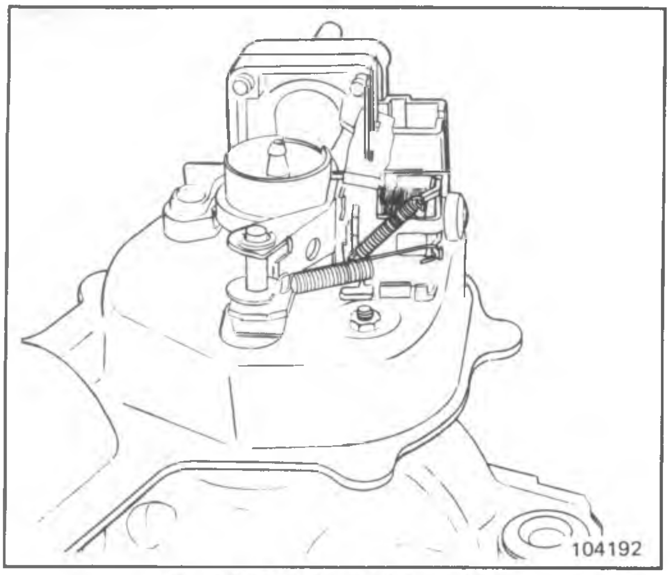


Fig. 8C-27--Relay Coil Assembly

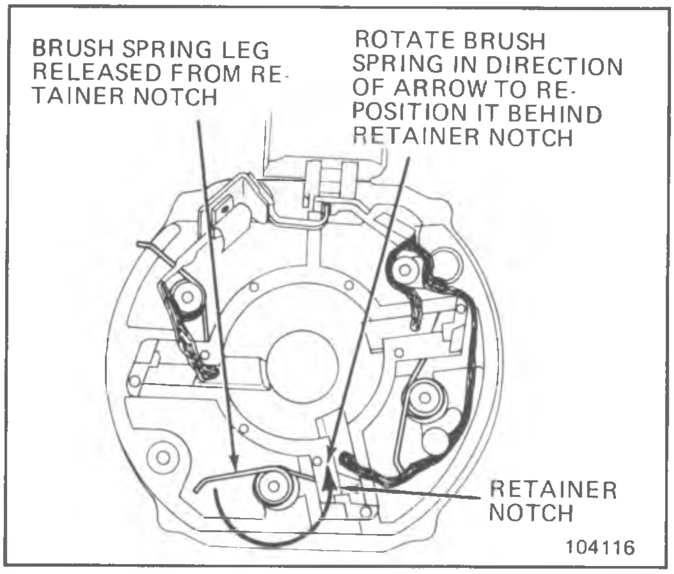


Fig. 8C-28--Releasing Brush Spring Tension

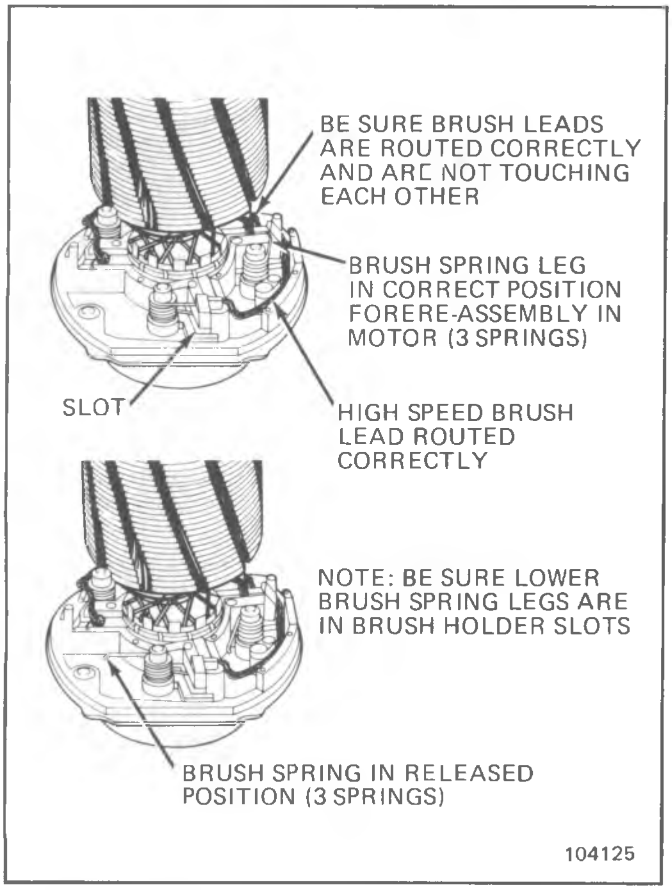


Fig. 8C-29--Brush Spring--Brush Spring-Released Position

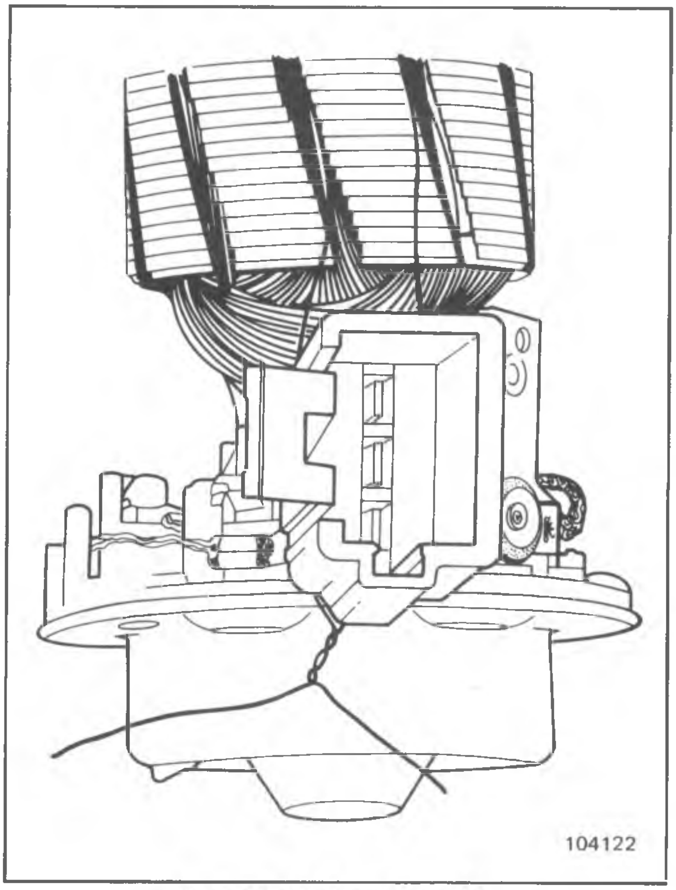


Fig. 8C-30--End Cap Assembly

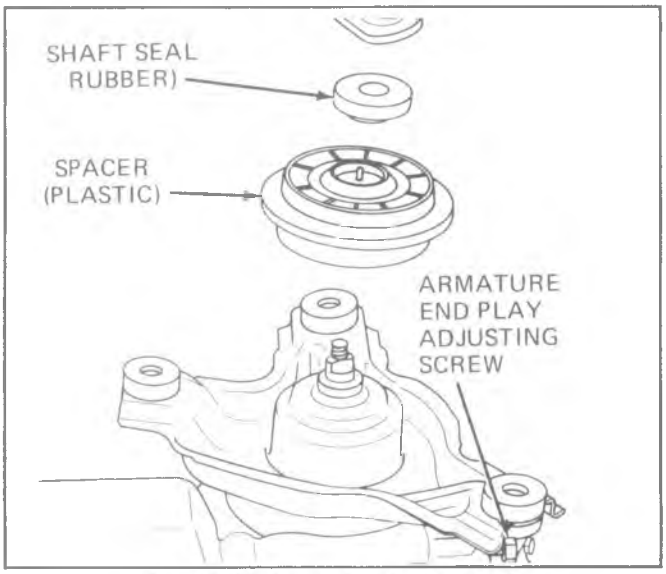


Fig. 8C-31--Crank Arm Spacer Seal

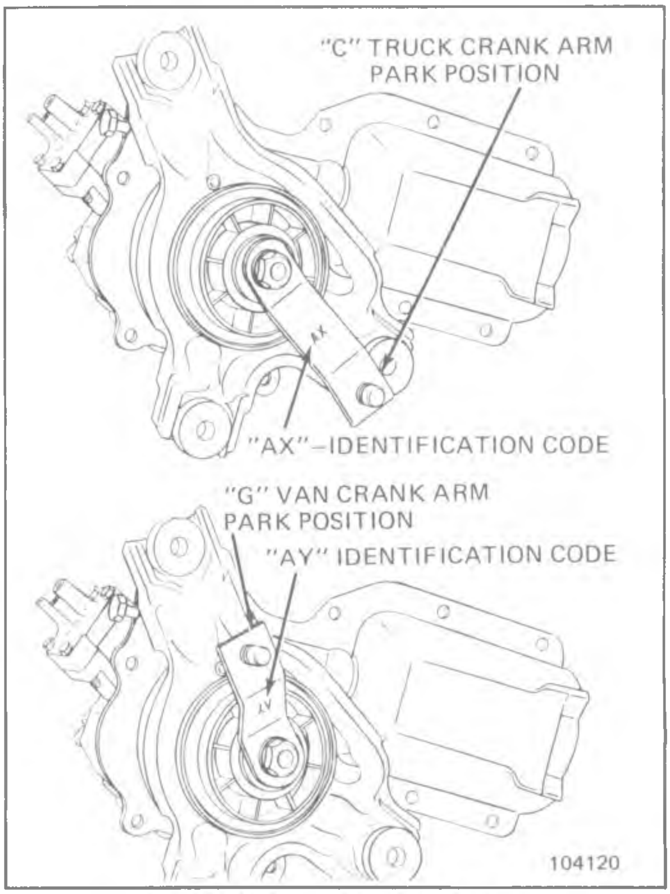


Fig. 8C-32--Crank Arm Park Position

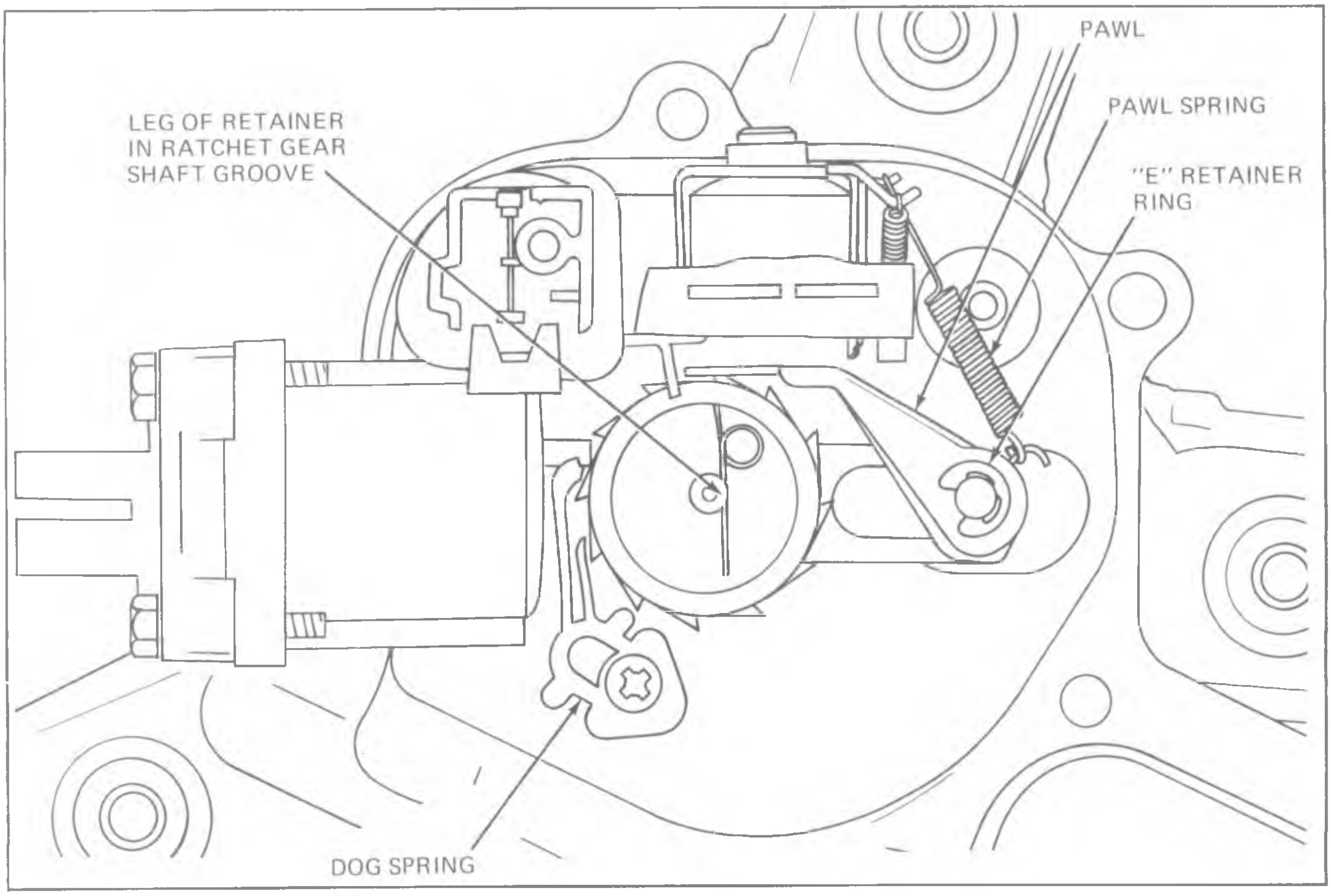


Fig. 8C-33--Washer Pump Assembly

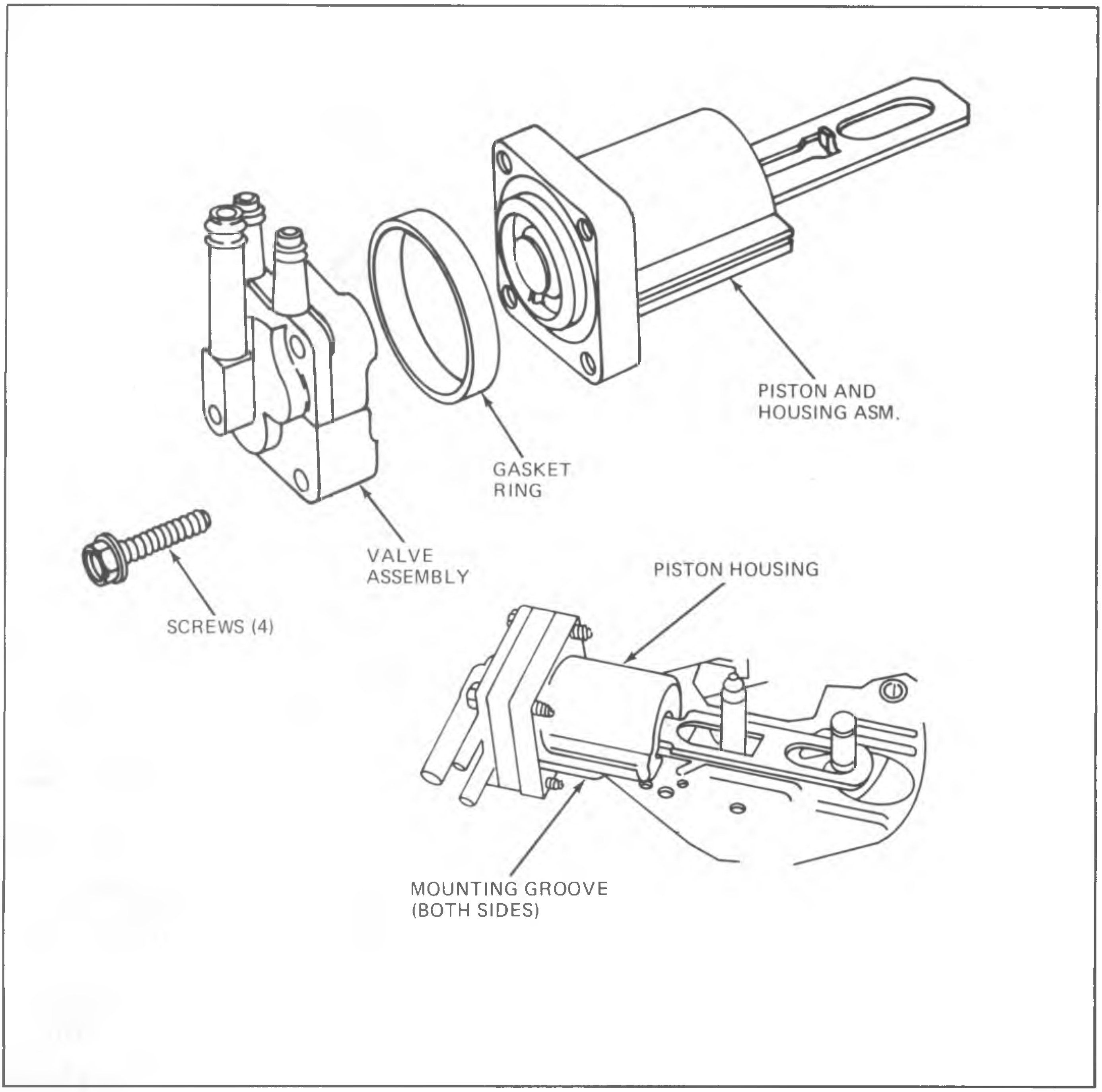


Fig. 8C-34--Washer Pump Exploded View

WINDSHIELD WIPER AND WASHER

P MODELS

GENERAL DESCRIPTION

The system consists of a compound wound rectangular-shaped motor attached to a gear box containing a parking switch in addition to the gear train. The gear train consists of a motor armature helical gearshaft which drives an intermediate gear and pinion assembly. The pinion gear of the intermediate gear and pinion drives an output gear and shaft assembly.

Turning the wiper switch to the LO speed position completes the circuits from the wiper terminals 1 and 3 to ground. Current then flows from the battery via wiper terminal No. 2 through the series field and divides; (1) part passes through the armature to ground via wiper terminal No. 1 to the wiper switch and (2) the second part passes through the shunt field to ground through wiper terminal No. 3 to the wiper switch (fig. 8C-35).

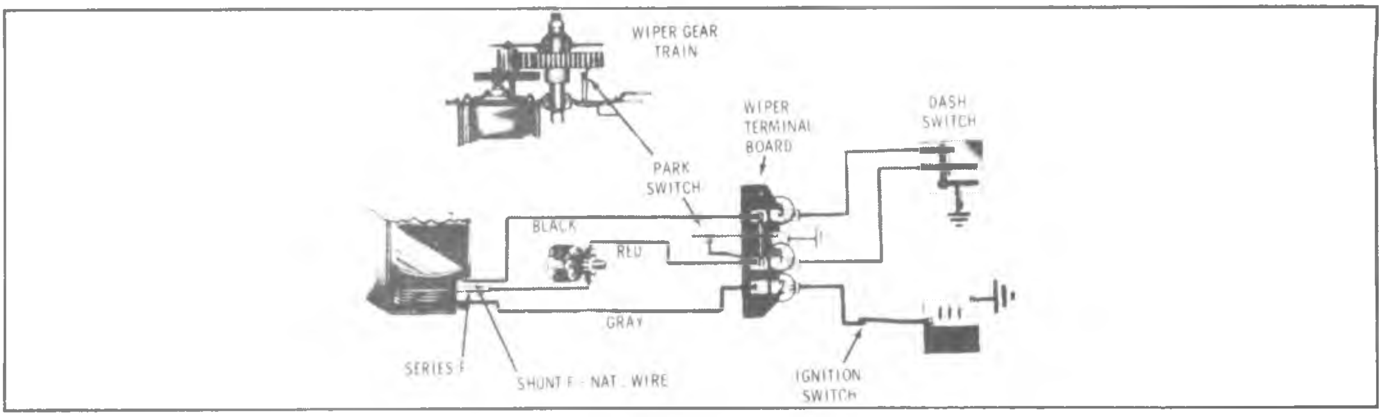


Fig. 8C-35--LO Speed Circuit

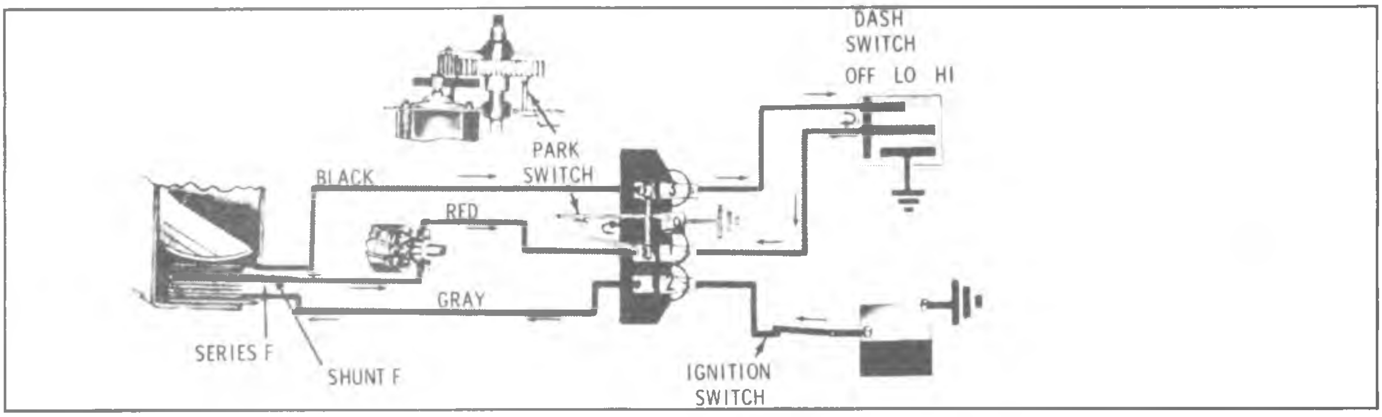


Fig. 8C-37--PARKING Circuit

The wiper switch must be securely grounded to body metal.

Moving the wiper switch to the HI speed position opens the shunt field circuit to ground at the switch. However, the shunt field is connected to a 20 ohm resistor which is connected across wiper terminals 1 and 3. The shunt field current then flows via terminal No. 3 through the resistor to terminal No. 1 to the switch, to ground (fig. 8C-36).

The parking circuit covers that portion of wiper operation when the wiper switch is turned "off" and the wiper blades have not reached the park position.

When the wiper blades are not in the normal park position, the parking switch contacts are still closed. The wiper will continue to operate until the wiper output gear is turned to a position where its cam opens the park switch. Referring to Figure 8C-37, it can be seen that the wiper motor circuits are completed to ground through the parking switch.

The wiper motor must be securely grounded to body metal.

The shunt field circuit is completed from terminal No. 3 via the switch to terminal No. 1 through the parking switch to ground. The series field and armature circuit is also completed from terminal No. 1 through the parking switch to ground.

The shunt field is connected direct to ground, by-passing the resistor. This results in LO speed operation during the parking operation.

When the output gear cam opens the park switch contacts, the wiper is OFF.

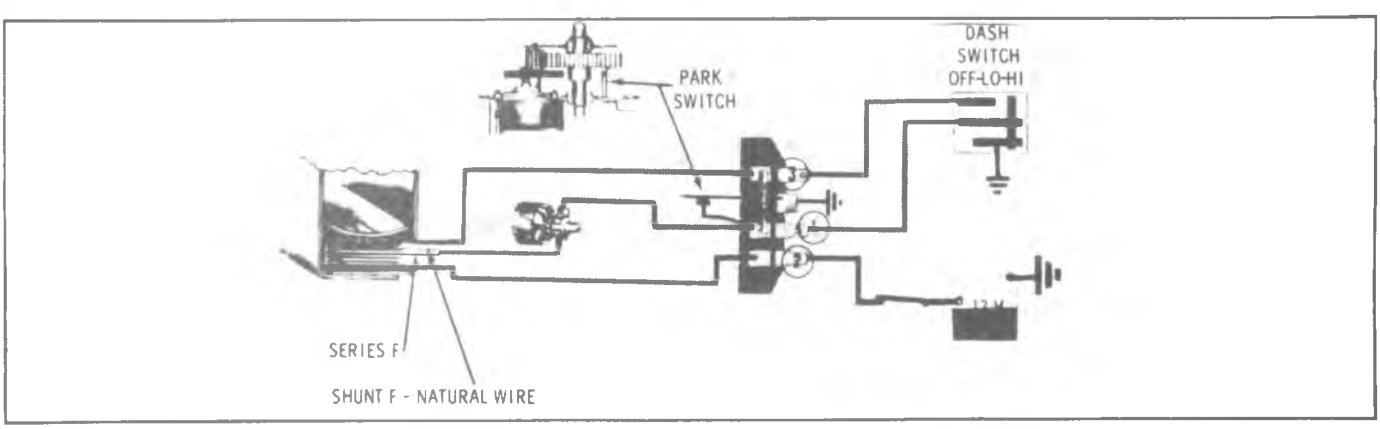


Fig. 8C-36--HI Speed Circuit

DIAGNOSIS

WIPER - ON VEHICLE

1. Inspect for the following items:
   a. Wiring harness is securely connected to wiper and switch.
   b. Wiper motor is securely grounded to body.
   c. Wiper switch is securely mounted and grounded.
   d. Check fuse.
2. If items in Step 1 check out, try operating wiper in both "LO" and "HI" speeds, then turn wiper off (blades should return to park position). If wiper fails to operate correctly, proceed to Step 3.
3. Disconnect wiring harness from wiper and try operating wiper as shown in Figure 8C-31
   a. If wiper operates correctly independently of switch and vehicle wiring, refer to the DIAGNOSIS CHART - WIPER ON VEHICLE.
   b. If wiper still fails to operate correctly in Step 3, disconnect wiper linkage from motor crankarm and try operating wiper again. If wiper opeates correctly independently of linkage, check linkage for cause of wiper malfunction.
   c. If wiper fails to operate correctly independently of linkage, remove wiper motor from vehicle and refer to DIAGNOIS CHART-WIPER OFF VEHICLE.

CONDITION	APPARENT CAUSE	CORRECTION
1. Wiper Inoperative or intermittent	A. Blown fuse	A. Locate short circuit and repair. Replace fuse.
	B. Open circuit in feed wire (No. 2 terminal on wiper motor)	B. Locate broken wire and repair
	C. Loose mounting of wiper switch	C. Tighten switch mounting
	D. Defective wiper switch	D. Replace switch
	E. Open circuit in wire to wiper switch (No. 1 terminal on wiper motor)	E. Locate broken wire and repair
2. Wiper will not shut off: A. Wiper has both "Lo" and "Hi" speeds	A. Grounded Wire (No. 1 terminal on wiper motor) to wiper switch	A. Locate short circuit and repair
B. Wiper has "Lo" speed only	A. Defective wiper switch	A. Replace wiper switch
	B. Grounded wire (No. 3 terminal on wiper motor) to wiper switch	B. Locate and repair short circuit
C. Wiper has "Hi" speed only	A. Defective wiper switch	A. Replace wiper switch
	B. Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch	B. Locate and repair broken wire
3. Wiper has "Hi" speed only	A. Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch	A. Locate broken wire and repair
4. Wiper has "Lo" speed only	A. Grounded wire (No. 3 terminal on wiper motor) to wiper switch	A. Locate short circuit and repair
	B. Defective wiper switch	B. Replace wiper switch
5. Blades do not return to full park position	A. Loose wiper ground strap connection	A. Tighten strap connection

CONDITION	APPARENT CAUSE	CORRECTION
1. Wiper Inoperative or Intermittent	A. Broken or damaged gear train (only if inoperative)	A. Replace gears as required
	B. Poor solder connections at terminal board	B. Resolder wires at terminals
	C. Loose splice joints at brush plate	C. Recrimp or solder splice joints
	D. Brushes binding in brush holder	D. Clean holder or replace brush, spring or brush plate assembly.
	E. Open circuit in armature	E. Replace armature
2. Wiper will not shut-off: A. Wiper has normal "Hi" and "Lo" speed	A. Defective park switch	A. Replace terminal board assembly
	B. Grounded red lead wire	B. Repair short circuit in red wire
B. Wiper has "Lo" speed only	A. Grounded shunt field coil	A. Replace frame and field assembly
	B. Grounded black wire	B. Repair short circuit in black wire
C. Wiper has "Hi" speed only	A. Open circuit in shunt field coil	A. Replace frame and field assembly
	B. Open circuit in black wire	B. Repair broken wire or poor solder connection
3. Wiper shuts off - but not in park position	A. Park switch defective or contacts dirty	A. Replace terminal board assembly or clean contacts
4. "Hi" speed too fast	A. Resistor defective	A. Replace terminal board assembly

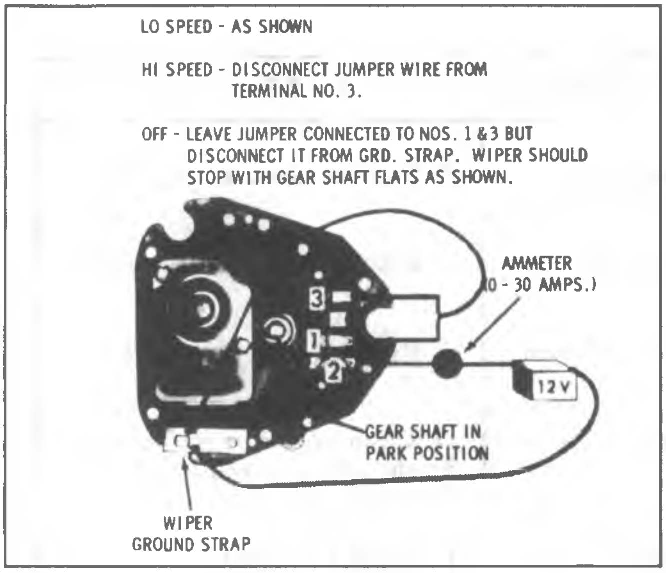


Fig. 8C-38--Jumper Wire Connections

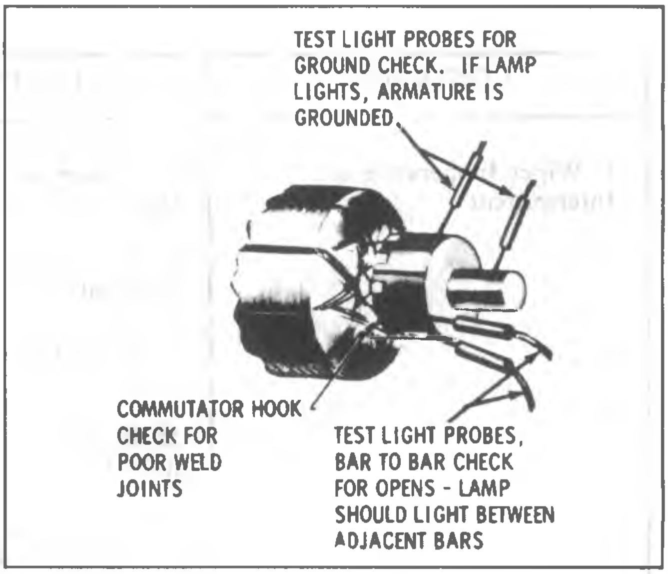


Fig. 8C-39--Checking Armature

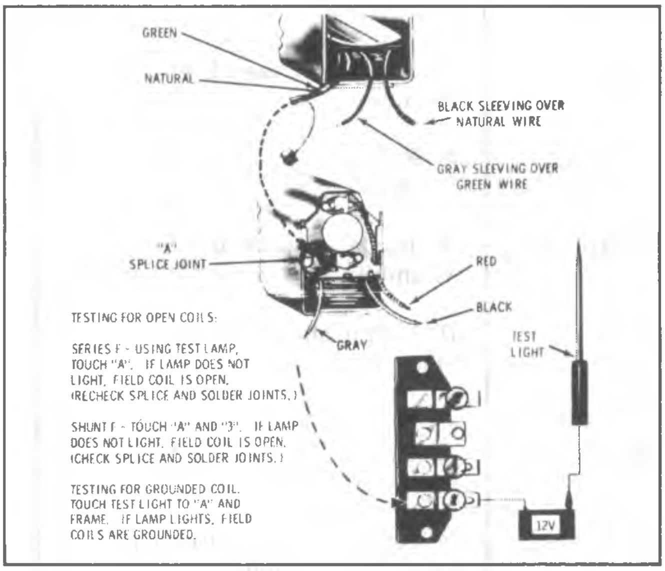


Fig. 8C-40--Testing Field Coils

CONDITION	APPARENT CAUSE	CORRECTION
1. Washers inoperative	A. Inadequate quantity of washer solution	A. Add washer solution
	B. Hoses damaged or loose	B. Cut short length off end of hose to insure air tight connection or replace hose
	C. Plugged screen at end of jar cover hose	C. Clean screen
	D. Loose electrical connection to washer pump or wiper switch	D. Check electrical connections and repair if necessary
	E. Open circuit in feed wire to ratchet relay coil	E. Locate open circuit and repair
	F. Wiper switch defective	F. Replace wiper switch
	G. Ratchet relay coil defective	G. Replace ratchet relay
	H. Washer nozzles plugged	H. Clean washer nozzles
	I. Ratchet wheel tooth missing	I. Replace ratchet wheel
	J. Ratchet pawl spring missing	J. Replace ratchet pawl spring
	K. Defective pump valve assembly	K. Replace pump valve assembly
2. Washer pumps continously when wipers are operating	A. Grounded wire from ratchet relay to switch	A. Locate grounded wire and repair
	B. Wiper switch defective	B. Replace wiper switch
	C. Ratchet wheel tooth missing	C. Replace ratchet wheel
	D. Ratchet wheel dog broken or not contacting ratchet wheel teeth	D. Replace of repair ratchet wheel dog
	E. Lock-out tang broken or bent on piston actuating plate	E. Replace piston actuating plate

ON-VEHICLE SERVICE

WIPER MOTOR

Wiper motor replacement procedures are not included here since installation is performed by the individual body manufacturers; however, disassembly of the unit will be covered.

UNIT REPAIR

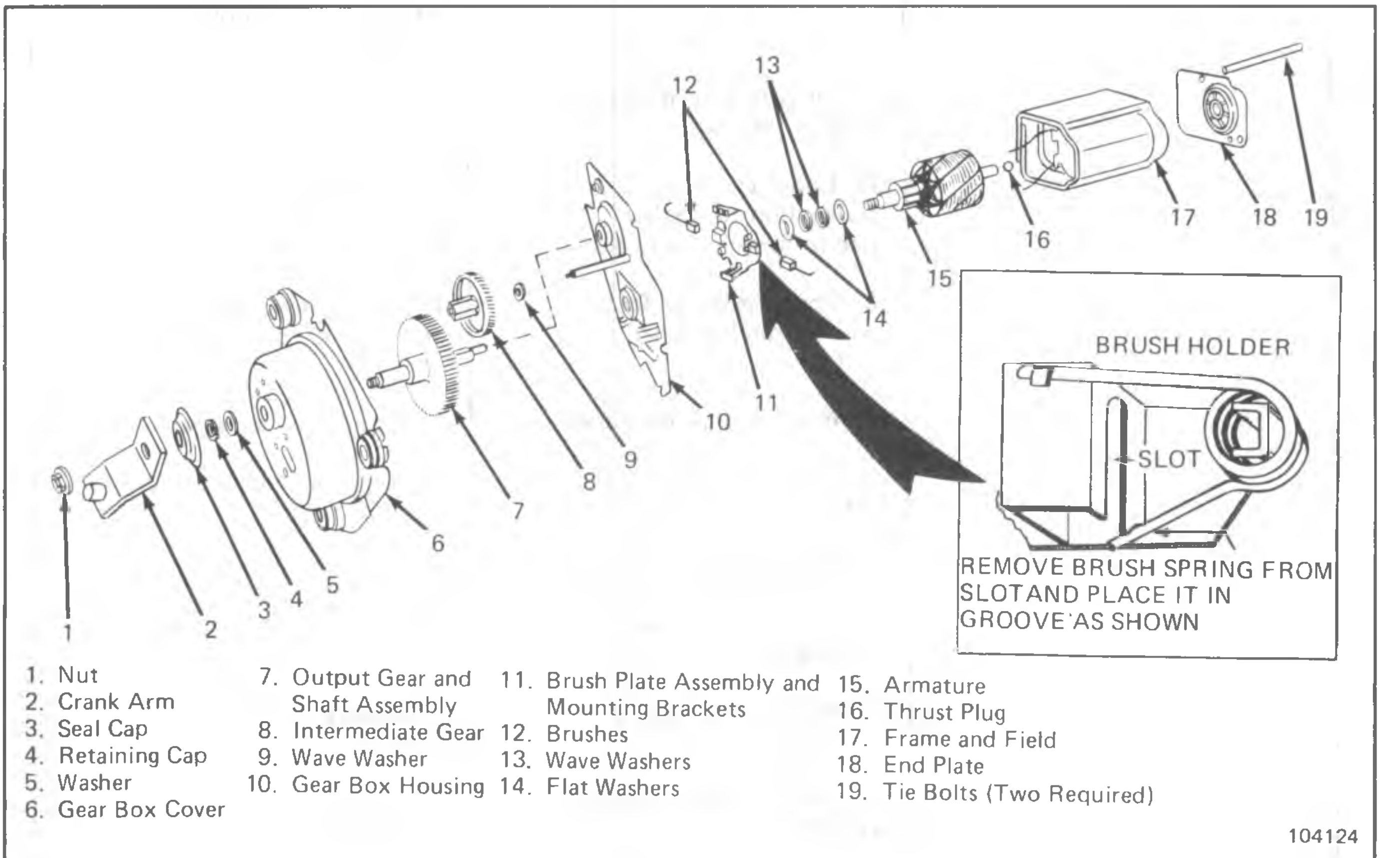


Fig. 8C-41--Wiper Motor and Gear Box Assembly

WIPER MOTOR

Disassembly (Fig. 8C-41)

Gear Box

1. Remove the two washer pump mounting screws and lift pump off washer.
2. Remove washer pump drive cam as required (figs. 8C-40 and 8C-41). The cam is pressed on the shaft but can be wedged off by using two screwdrivers between cam and plate.
3. Clamp crank arm in a vise and remove crank arm retaining nut.

   NOTICE: Failure to clamp crank arm may result in stripping of wiper gears.
4. Remove crank arm, seal cap, retaining ring, and end-play washers.

   Seal cap should be cleaned and repacked with a waterproof grease before reassembly.
5. Drill out gear box cover retaining rivets, remove cover from gear train.

   Screws, nuts and lockwashers for reassembling cover to wiper are contained in the service repair package.
6. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft.
7. If necessary, remove terminal board and park switch assembly as follows:
   a. Unsolder motor leads from terminals. Code motor leads.
   b. Drill out rivets securing terminal board and park switch ground strap to mounting plate. Screws, nuts and washers for attaching a replacement terminal board park switch assembly are included with the replacement assembly.

Motor

1. Follow Steps 1 through 7b under gear box disassembly.
2. Remove motor through bolts, tap motor frame lightly, and remove motor from mounting plate.
3. Remove brush spring tension (fig. 8C-41), slide armature and end plate from motor frame. Pull end plate from armature.

   Thrust plug located between armature shaft and end

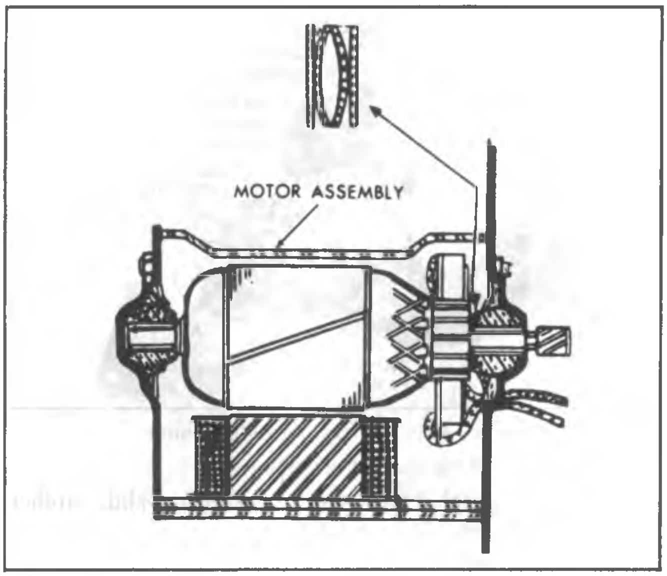


Fig. 8C-42--End Play Wave Washer Installation

plate.

4. Remove end play adjusting washers from armature, noting arrangement for proper reinstallation.

Inspection

Check and inspect all parts for wear; replace as necessary. All parts can be replaced individually except motor frame and field, which is serviced as an assembly. Service kits also provide screws, nuts and washers to replace gear cover and terminal board rivets.

Assembly

Refer to Figure 8C-41 for exploded view of motor and gear train.

Motor

Reassemble motor using reverse of disassembly procedure.

Armature end play is controlled by end play washers. See Figure 8C-42 for proper assembly of end play washers. Lubricate armature shaft bushings with light machine oil.

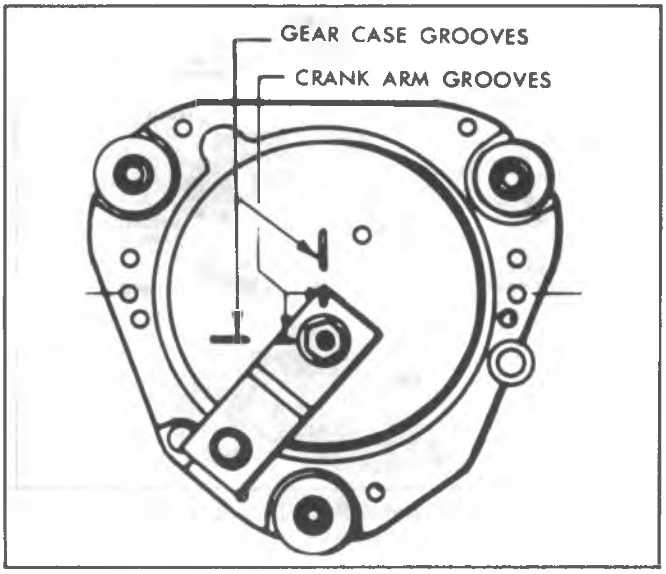


Fig. 8C-43--Wiper Motor Crank Arm in Park Position

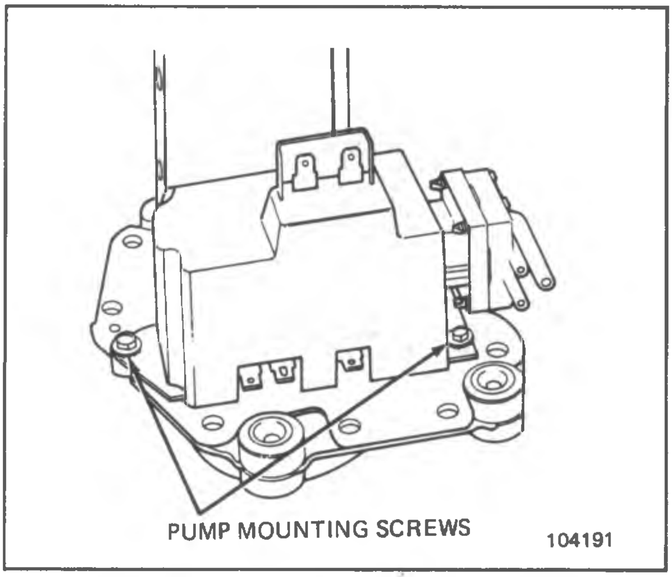


Fig. 8C-44--Washer Pump Attaching Screws

Gear Box

1. Assemble gear box using reverse of disassembly procedure.

   Lubricate gear teeth with Delco Cam and Ball Bearing lubricant (or equivalent). Be sure cover is properly located over dowel pins and be sure to reinstall ground strap.
2. Place wiper in park position and install crank arm on output shaft, rotate crank so alignment marks line up with those on cover (fig. 8C-43).
3. Replace retaining nut, place crank arm in vise, tighten retaining nut.

WINDSHIELD WASHER

The positive displacement washer pump used on the two-speed non-depressed park wipers (fig. 8C-44) use a pump mechanism consisting of a piston, piston spring and valve arrangement driven by a (4) lobe cam, and follower assembly (fig. 46). The cam is attached to one shaft of the wiper motor output gear (fig. 8C-45). Programming is accomplished

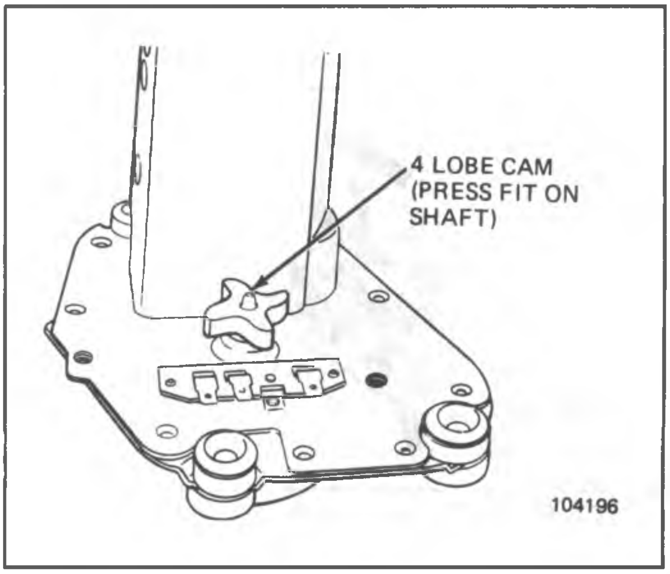


Fig. 8C-45--Washer Pump Drive Cam

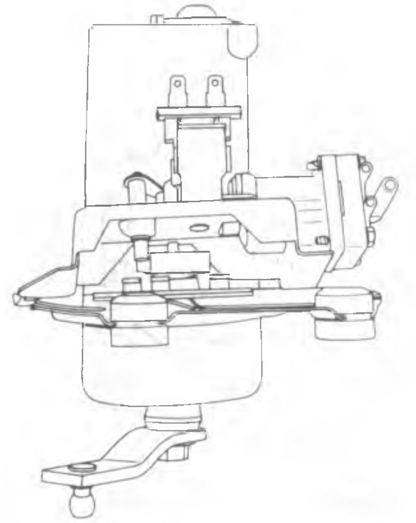


Fig. 8C-46--Washer Pump Drive Cam and Actuator

electrically and mechanically by a relay assembly and ratchet wheel arrangement.

Replacement

1. Disconnect battery ground cable.
2. Remove two pump mounting bolts.
3. Remove washer pump assembly.
4. To install reverse Steps 1-3 above. Install washer multiplug harness connector with battery lead on terminal with no tang (fig. 8C-44). Incorrect installation of connector will result in direct ground and destroy wiper motor fuse.

Disassembly-Assembly (Figures 8C-47 thru 8C-50)

1. Remove washer pump cover by squeezing.
2. Solenoid assembly - ratchet dog.
   a. Remove ratchet dog retaining screw. Hold spring loaded solenoid plunger in position and carefully lift solenoid assembly and ratchet dog off frame of pump.
   b. Separate ratchet dog from solenoid mounting plate as required.
3. Ratchet pawl.

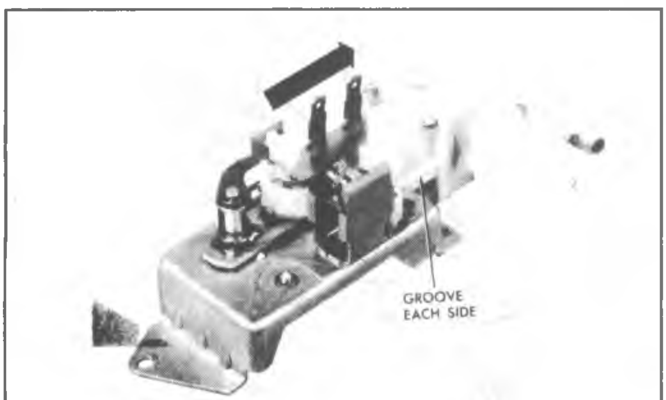


Fig. 8C-49--Releasing Pump From Lockout Position

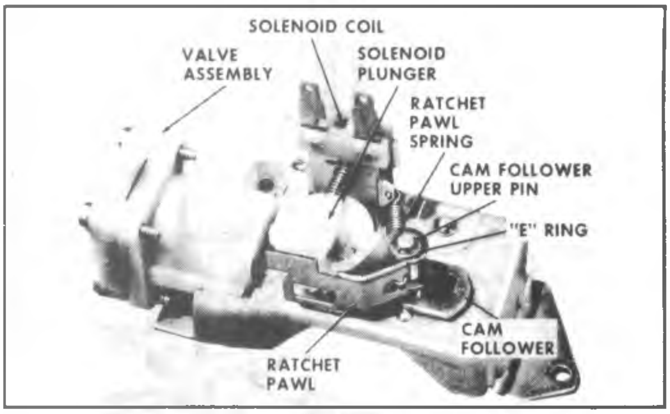


Fig. 8C-47--Washer Pump Mechanism

   a. Disconnect ratchet pawl spring.
   b. Remove ratchet pawl retaining ring and slide ratchet pawl off cam follower shaft.
4. Ratchet wheel.
   a. Follow Step 1 under solenoid - ratchet dog disassembly.
   b. Move ratchet wheel spring out of shaft groove and slide ratchet wheel off its shaft.
5. Pump and actuator plate assembly.
   a. Remove solenoid assembly - ratchet pawl and ratchet wheel as outlined in their respective procedures.
   b. To seperate pump and pump actuator plate from frame, pull pump housing in direction of the arrow until grooves in housing clear the frame. Then remove actuator plate from ratchet wheel and cam follower shafts.
6. Valve assembly.
   a. Remove four screws that attach the valve assembly to pump housing.

During assembly, be sure gasket between housing and valve plate is properly positioned in housing and valve plate grooves. Also be sure triple "O" ring is properly installed between valve body and pipe assembly.

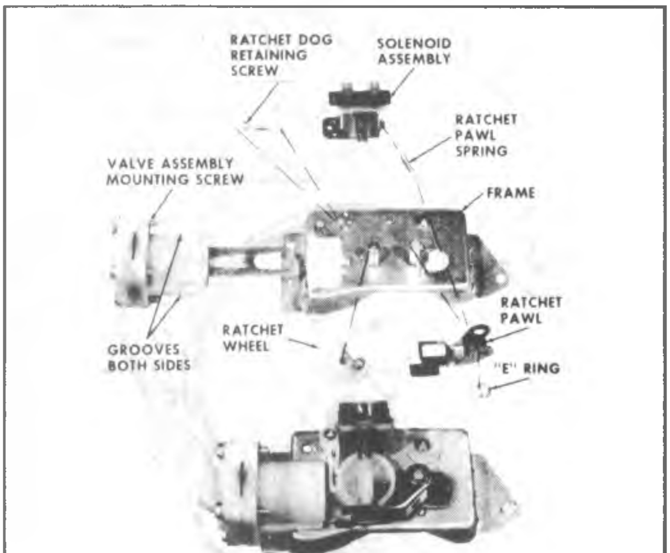


Fig. 8C-48--Washer Pump-Exploded View

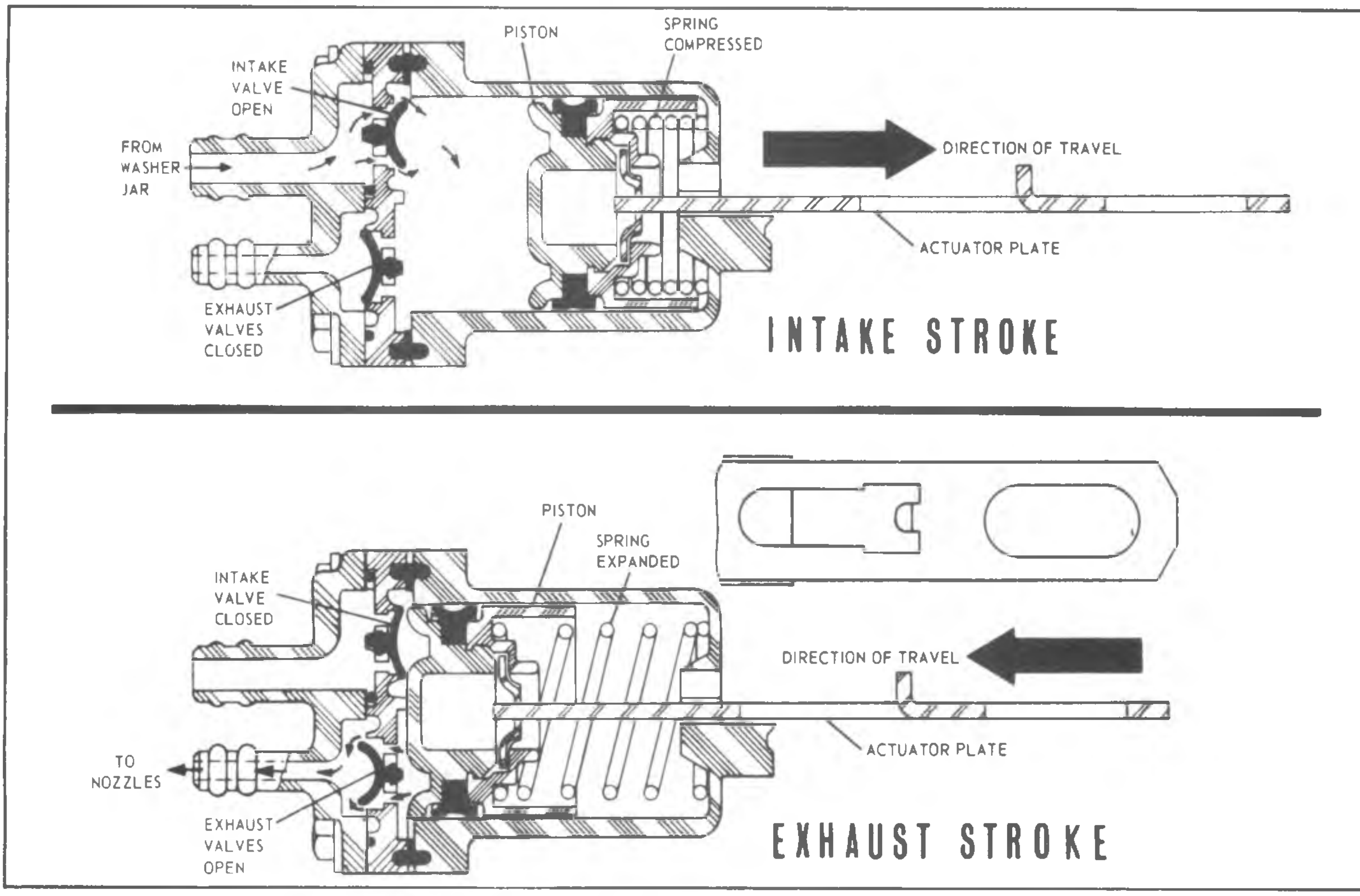


Fig. 8C-50--Cross Section of Windshield Washer Pump Valve

SECTION 9

ACCESSORIES

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Operation 9-1
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CRUISE CONTROL

GENERAL DESCRIPTION

Cruise control is a speed control system which maintains a desired car speed under normal driving conditions. However, steep grades up or down may cause variations in the selected speeds. The electronic cruise control system has the capability to cruise, coast, resume speed, accelerate, and "tap-up" and "tap-down".

The main parts of the cruise control system are the mode control switches, controller (module), servo unit, speed sensor, vacuum supply, electrical and vacuum release switches, and electrical harness.

The cruise control system uses vacuum to operate a throttle servo unit. The servo unit maintains a desired car speed by trapping vacuum in the servo unit at the proper servo position. The controller monitors vehicle speed and servo position and operates the vacuum and vent valves in the servo to maintain desired speed. The controller contains a low speed limit which will prevent system engagement below a minimum speed, about 25 mph. The operation of the controller is controlled by mode control switches located in the end of the directional signal lever. To disengage the system, two release switches are provided. An electrical release switch mounted on the brake pedal bracket (and clutch pedal bracket on cars equipped with manual transmission disengages the system electrically when the brake pedal (or clutch pedal) is depressed. A vacuum release valve, mounted on the brake pedal bracket, vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed, allowing the servo unit to quickly return the throttle to idle position.

OPERATION

OFF/ON/RESUME/ACCEL SWITCH

The Off/On/Resume/Accel Switch, Figure 9B-1, has three positions. This switch turns the cruise control system ON and OFF and also returns cruise control operation to the last speed setting when MOMENTARILY moved towards the R/A position after braking. (Do not hold the slider in the R/A position ... release it immediately.) If the slider is held in the R/A position for more than one second, the system reverts to the Accel mode. To accelerate the car, move the slider switch to the R/A position and hold it there until the car reaches the desired increased speed. When the slider switch is released, the speed the car accelerated to becomes the new cruise speed. In order to use the Accel mode, the cruise OFF/ON/Resume/Accel switch must be in the "On" position and the car must be above the low speed inhibit lockout (25 mph). The slide switch can also be used to "tap-up" car speed. In order to do this the cruise must be engaged and operating. "Tapping-up" is done by quickly pressing the slide switch toward the R/A position and quickly releasing it, or "tap" the lever. Do not hold the lever in the R/A position or the system will revert to the Accel mode. "Tap-up" is a function in which cruise speed can be increased by 1 mph increments (one tap = 1 mph increase) up to ten times, after 10 times the system must be reset to a new speed to continue this function.

SET/COAST BUTTON SWITCH

The cruise control Set/Coast Switch (located in the end of the turn signal lever), Figure 9B-1, has two positions - "Normal" and "Depressed".

- **The Set Position** - With the button switch depressed and then released (car speed must exceed the low speed limit point, and the Off/On/Resume/Accel Switch must be in the ON

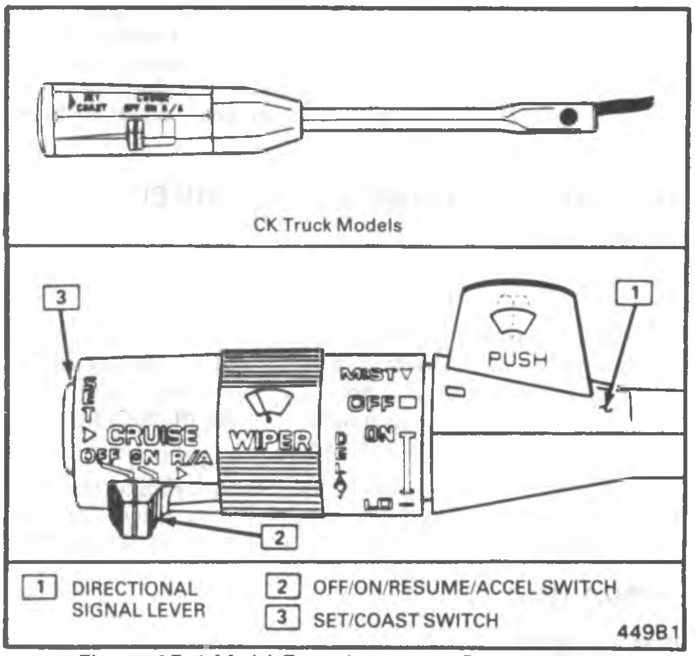


Figure 9B-1 Multi-Function Lever G Van Models position) the cruise speed will be set at the particular speed the car was at when the button was released. Car cruise speed will be within ± 1 mph of the actual speed at engaged speed. The system will cruise until either the Off/On/Resume/Accel Switch is moved to OFF, the ignition switch is turned off, and/or the Set/Coast Button is pushed in fully and held. Pushing the brake pedal (or clutch pedal) releases the cruise but not the resume capability.

- **The Coast (Trim) Position** - With the button switch fully depressed, the driver can raise or lower his control speed. To increase control speed, the driver would accelerate to a new speed, fully depress the switch (controller releases previously set speed) and release the button. Upon releasing the button a new speed is set. An increased control speed can also be more easily set by the Off/On/Resume/Accel Switch as previously described. To decrease cruise speed, the button switch is held in (depressed position) disengaging the cruise system, and allowing the throttle to return to the idle position. When the car has slowed to the desired lower cruise speed, releasing the switch will re-engage the system.
- **The "Tap-Down" Position** - In order to do this the cruise must be engaged and operating. "Tapping-down" is done by quickly pressing the Set/Coast Button to the depressed position and quickly releasing it, or "tap" the button. Do not hold the button in the depressed position or the system will revert to the "coast" mode. "Tap-down" is a function in which cruise speed can be decreased by 1 mph increments (one tap = 1 mph decrease). The system can "tap-down" until it reaches the low speed lockout (25 mph), after this cruise will not operate.

  The accelerator may be depressed at any time to override the cruise system. Release of the accelerator will return the car to the previous set cruise speed.

NOTICE: To keep the vehicle under control, and to prevent possible vehicle damage, it is not advisable to use the Resume Cruise Control on slippery roads. It is not recommended to use the cruise control in conditions such as on winding roads or in traffic of heavy or varying volume. When traveling down a steeply graded hill, the cruise control should be disengaged by depressing the brake pedal lightly. The transmission can then be shifted into a lower gear range to help control vehicle speed.

ELECTRONIC CONTROLLER (MODULE)

(See Figure 9B-2)

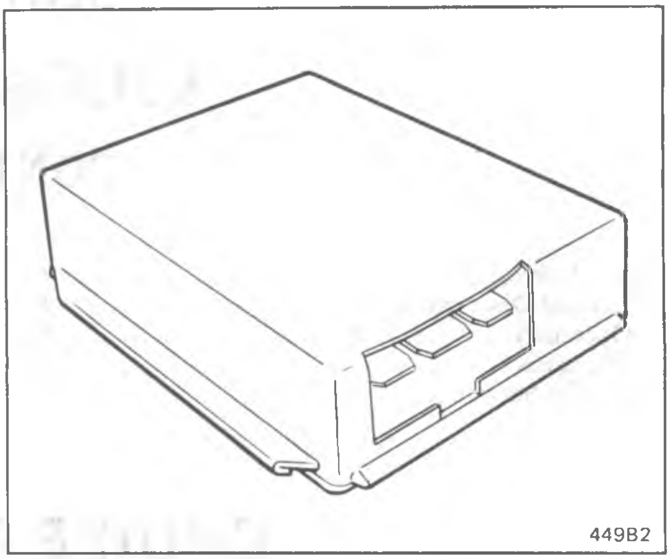


Figure 9B-2 Controller (Module)

The controller interprets the position of the servo, the position of the mode control switches and the output of the speed sensor. In response to these inputs, the controller electrically signals the opening or closing of the vent and vacuum solenoid valves in the servo.

The controller is usually mounted on the accelerator pedal bracket. For specific mounting location and removal procedure, turn to the On-Car Service portion of this section.

SERVO UNIT

(See Figure 9B-3)

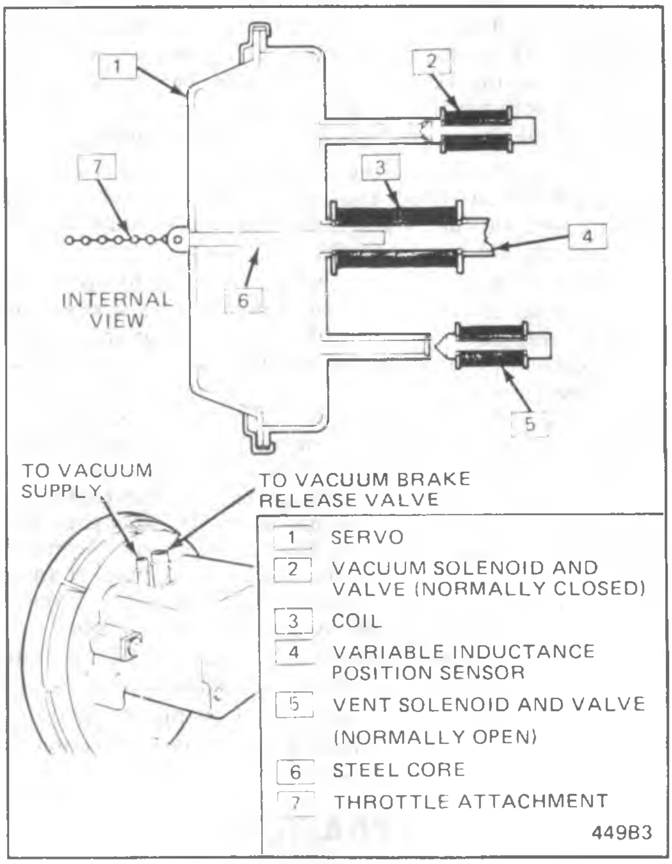


Figure 9B-3 Servo Unit

The servo consists of a vacuum operated diaphragm, a normally open solenoid valve to vent the diaphragm chamber to atmosphere, a normally closed solenoid valve to connect the diaphragm chamber to the vacuum source, and a variable inductance position sensor. The Servo operates the throttle in response to signals from the electronic controller as follows:

- **Steady Cruise State** (system engaged and operating) - Both vacuum and vent valves are closed or sealed. The servo has a constant vacuum on the diaphragm and places no-flow requirements on the vacuum source. Vacuum is trapped in diaphragm chamber.

- **Vehicle Losing Speed** (due to steep grades or driver wishes to increase speed by operating mode control switches) - The controller energizes the vacuum solenoid to open the vacuum valve to the vacuum source. This increases the vacuum level in the servo to increase the throttle opening. The vent remains closed.
- **Vehicle Gaining Speed** (due to steep grades or driver wishes to decrease speed by operating mode control switches) - The controller de-energizes the vent solenoid to open the vent valve to the atmosphere which reduces vacuum in the servo and allows the throttle return spring to decrease the throttle opening. The vacuum valve remains closed.

When the cruise system is engaged and operating (without any interference from the driver via the mode control switches), no speed correction will be made until the car exceeds approximately $\pm 1/4$ mph of set speed.

When the controller senses an over or underspeed condition it will pulse the opening of the vent or vacuum valve. The average duration of one pulse will be 10 milliseconds. The pulse will be repeated, as required, until the speed correction required brings the car to the set speed. From any set speed, under normal road load conditions, the vacuum valve will remain in a completely open position when vehicle speed has dropped 5 mph below set speed. Likewise, when vehicle speed has exceeded 3 mph over the set speed, such as down a steep grade, the vent will go into constant open position.

The servo incorporates a steel core which moves within a coil. Its resulting variable inductance provides a continuous (voltage) servo position signal to the controller. This voltage signal is constantly compared to the vehicle speed signal. This comparison determines if the pulses issued have corrected the speed error or if additional pulses are required. This comparison is also used to lengthen the average pulse when it is not enough to compensate for the speed error, such as a steep grade.

The servo will go into an open vent valve position under the following conditions:

- When the brake (or clutch) pedal is depressed.
- An open variable inductance position sensor coil in the servo.
- A loss of electrical power to the system.
- The ignition is turned off.

SPEED SENSORS

VSS Buffer Amplifier (See Figure 9B-4)

This is the device that will supply the vehicle speed input to the controller. The optic head portion of the VSS is located in the speedometer frame. A reflective blade is attached to the speedometer cable/head assembly. The reflective blade spins like a propeller, with its blades passing through a light beam from a L.E.D. in the optic head. As each blade enters the L.E.D. light beam, light is reflected back to a photocell in the optic head causing a low power speed signal to be sent to a buffer for amplification and signal conditioning. This amplified signal is then sent to the controller.

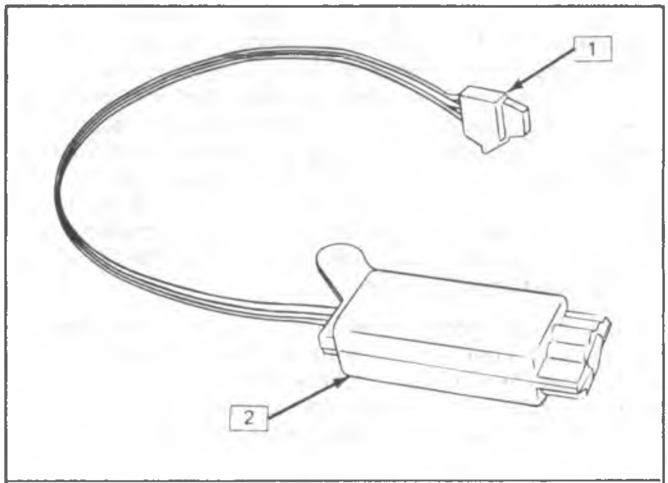


Figure 9B-4 VSS (Vehicle Speed Sensor)

VACUUM SUPPLY

The vacuum supply to operate the Cruise Control system is routed to the servo. This can be done by routing manifold vacuum straight to the servo or from manifold through a vacuum storage tank, or straight from a vacuum pump.

ELECTRICAL AND VACUUM RELEASE SWITCHES

These switches are used to disengage the cruise control system. An electrical release switch mounted on the brake pedal bracket (and clutch pedal bracket on cars equipped with manual transmission) disengages the system electrically when the brake (or clutch) pedal is depressed. This is done by interrupting the flow of current to the controller. A vacuum release valve, mounted on the brake pedal bracket vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed, allowing the servo unit to more quickly retain the throttle to idle position. This is done by routing a separate hose directly to the servo from the normally closed vacuum switch. These two types of switches will also sometimes be combined with stop light switch, TCC switch, etc.

ELECTRICAL HARNESS

For specific wiring and connector locations, see the Electrical Diagnosis Section of the Service Manual.

DIAGNOSIS

Problems can be either mechanical, electrical, and/or vacuum. In resolving any cruise system operating problem, first make a visual inspection. Check the system to ensure there are no bare, broken, or disconnected wires or any pinched, damaged, or disconnected vacuum hoses. The servo and throttle linkage should operate freely and smoothly. The servo linkage should be adjusted as described in the On-Car Service portion of this section.

If preliminary inspection reveals no solution and the system is inoperative, follow the six diagnostic charts, Figures 9B-5 through 9B-11, to isolate the problem. Chart 9B-12 has also been provided as supplementary information on what the controller, servo, and control switch voltages and resistances are when the system is operating properly.

Since any problem in this sytem is either vacuum, mechanical, or electrical, the technician should be able to quickly diagnose problems without using the 6 diagnostic charts after he has gone through them the first few times. This can be done by first eliminating a vacuum or mechanical problems by starting engine and using finger to feel for source vacuum at servo and visual inspection of vacuum release valve and throttle linkage. If these things check out you have isolated it to a electrical problem, and after checking the fuse, following Chart 9B-12 should quickly isolate problem area.

A quick check box will be made available through Kent-Moore Tool Company under Tool Number J-34185 (or equivalent). This quick check box will plug in in place of the controller and determine which part of the system has a problem. Instructions on the operation of this tool will be provided with the tool.

CRUISE SYSTEM SURGES

- The servo and throttle linkages should operate freely and smoothly. This linkage should be adjusted as described in the On-Car Service portion of this section.
- Check hose routing for pinches or leaks or restrictions. (See vacuum schematics in the On-Car Service portion of this section.)
- Follow the servo test chart, Figure 9B-6 and 7.
- If no system problem is noted, replace the electronic controller (module).

CRUISE SET SPEED HIGH OR LOW

- Check vacuum hoses for proper routing, restrictions or leaks. Adjust or replace as required. (See vacuum schematics in the On-Car Service portion of this section.)
- Check servo linkage for excess slack and adjust as described in the On-Car Service portion of this section.
- If no system problem is noted, replace the electronic controller (module).

EXCESSIVE CRUISE SPEED LOSS ON HILLS

- Check hoses for vacuum leaks. (See vacuum schematics in the On-Car Service portion of this section.)
- Determine if check valve is functional where applicable.

CRUISE -TAP-UP- & -TAP-DOWN- DOES NOT OPERATE

If all other functions of cruise control are working except "tap-up" and "tap-down" the controller (module) is at fault.

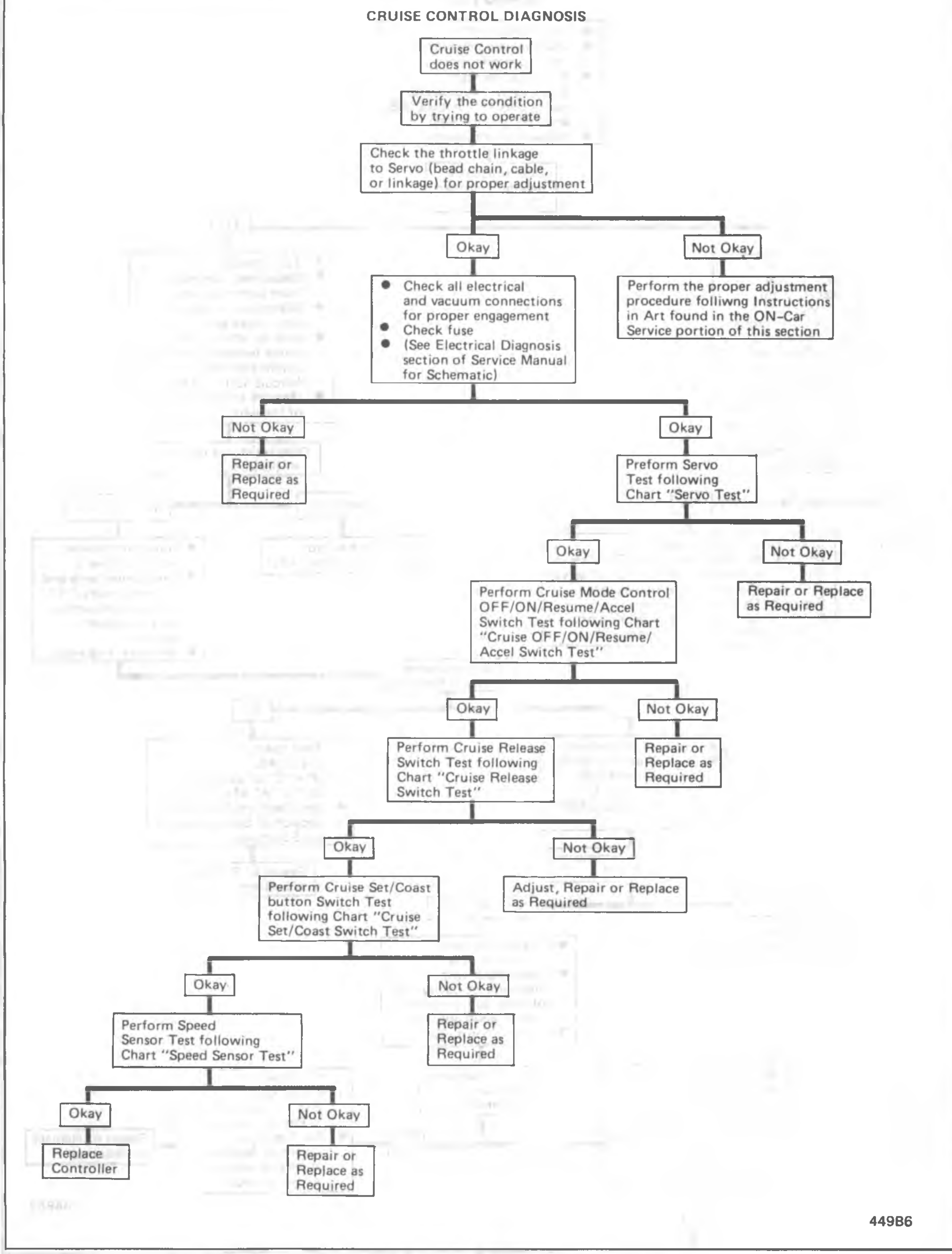


Figure 9B-5 Cruise Diagnostic Chart #1

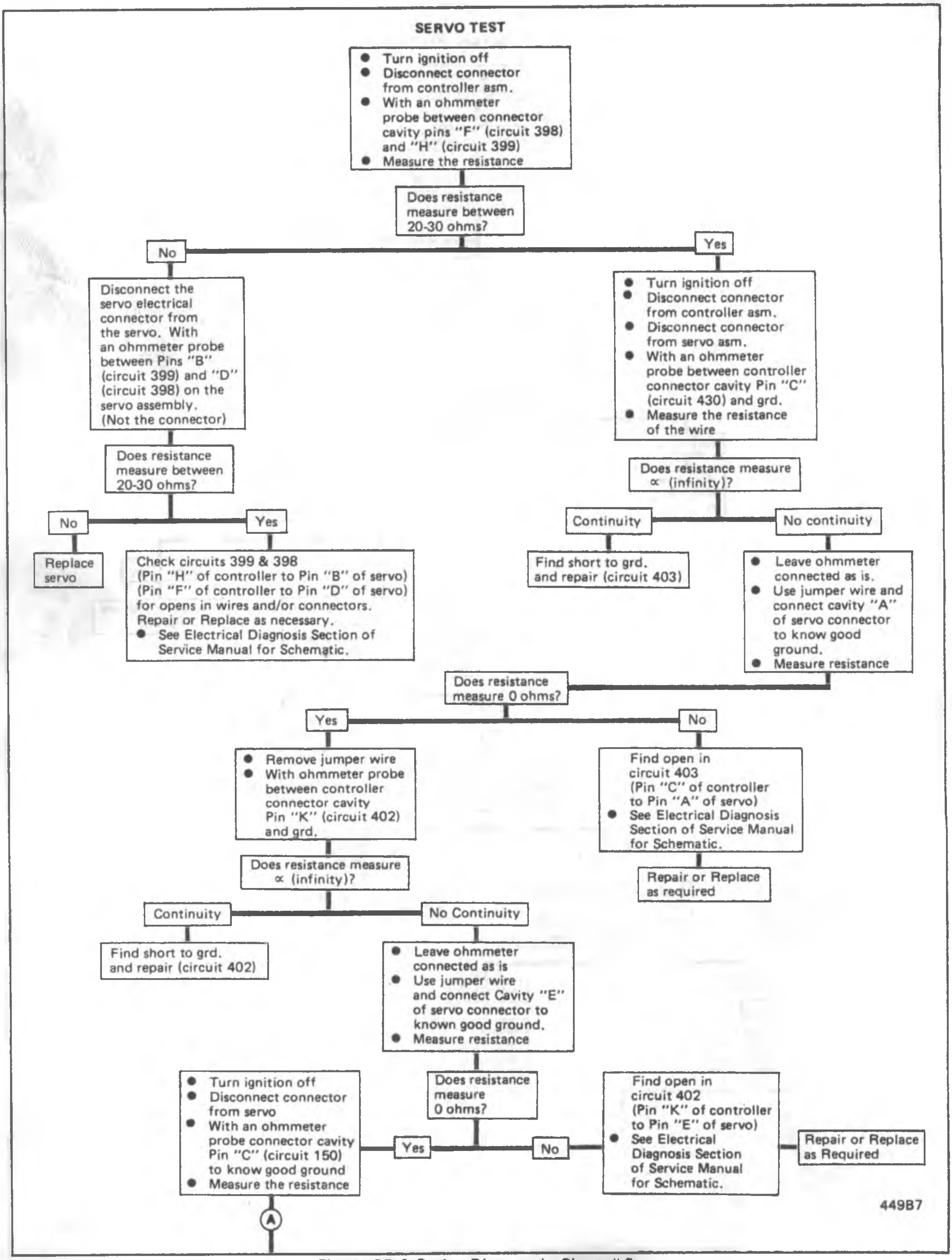


Figure 9B-6 Cruise Diagnostic Chart #2

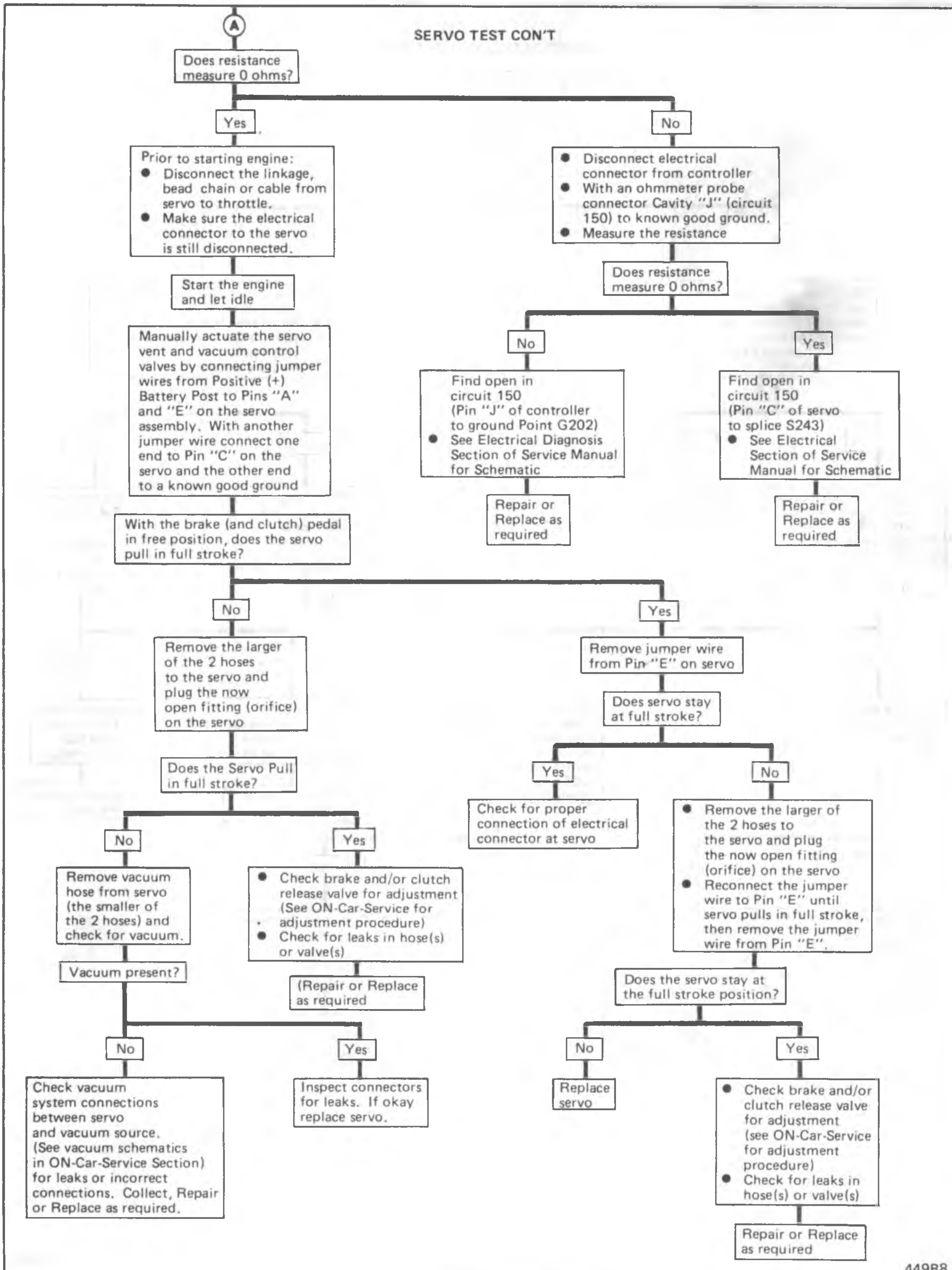


Figure 9B-7 Cruise Diagnostic Chart #2 Continued

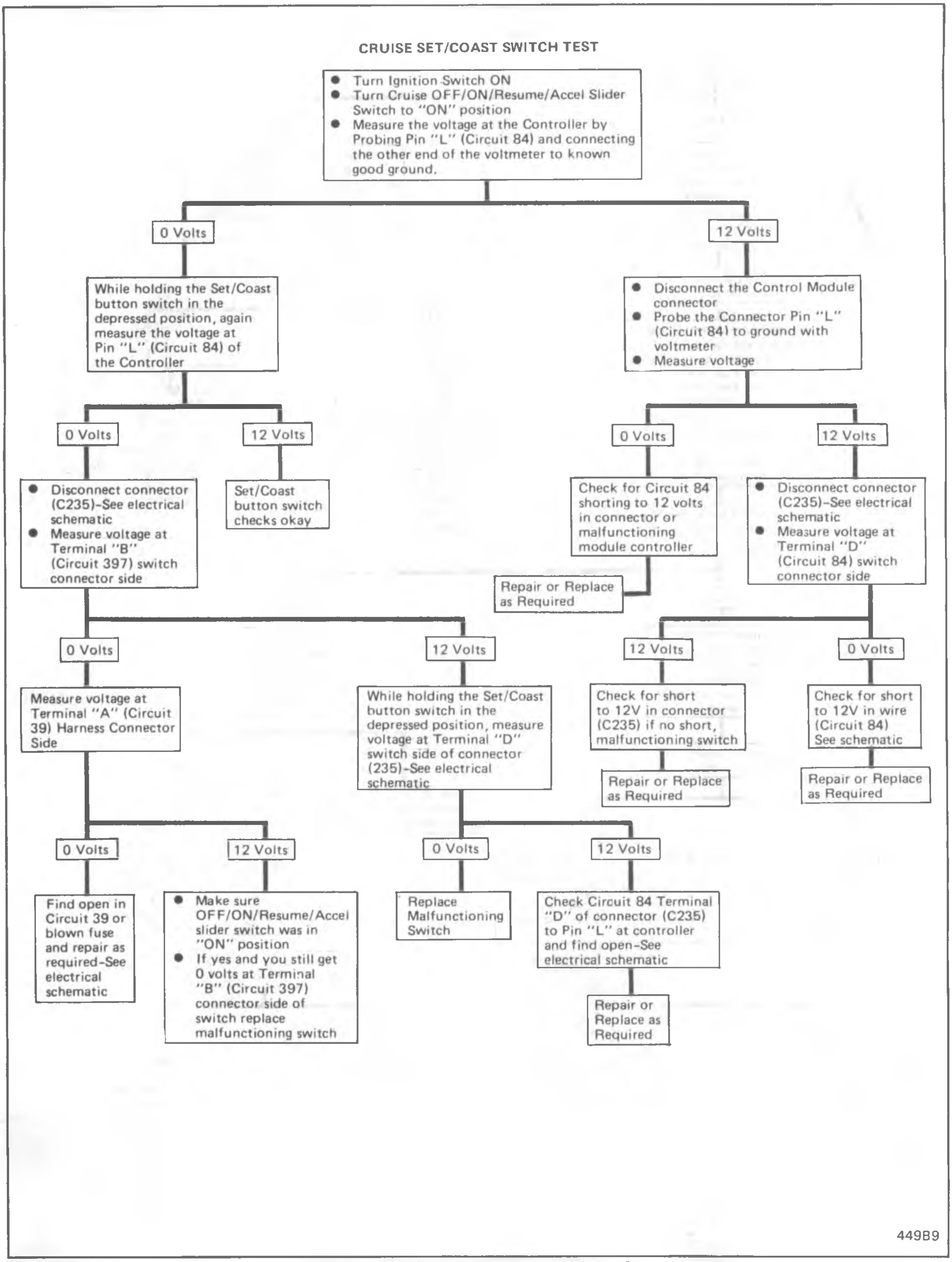


Figure 9B-8 Cruise Diagnostic Chart #3

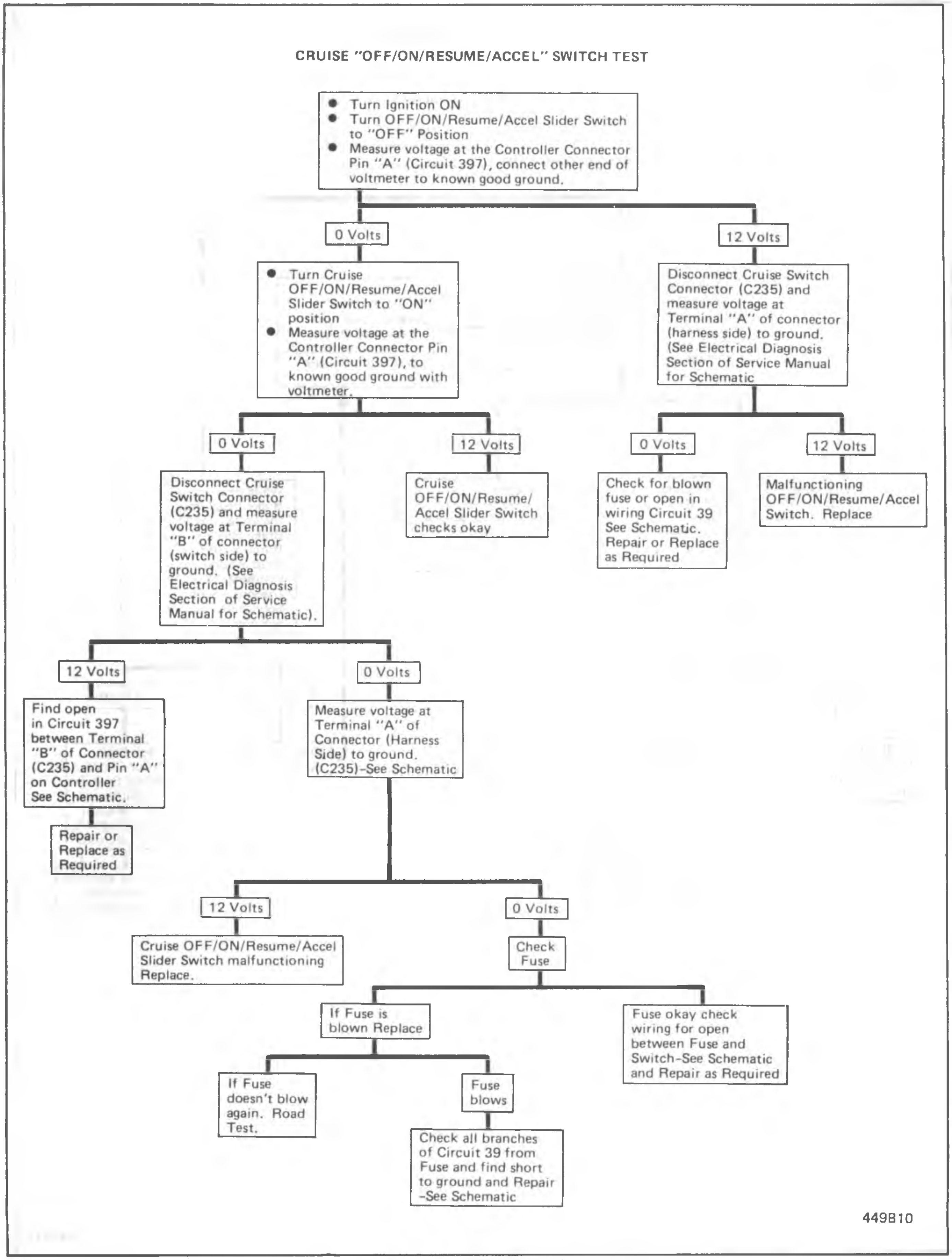


Figure 9B-9 Cruise Diagnostic Chart #4

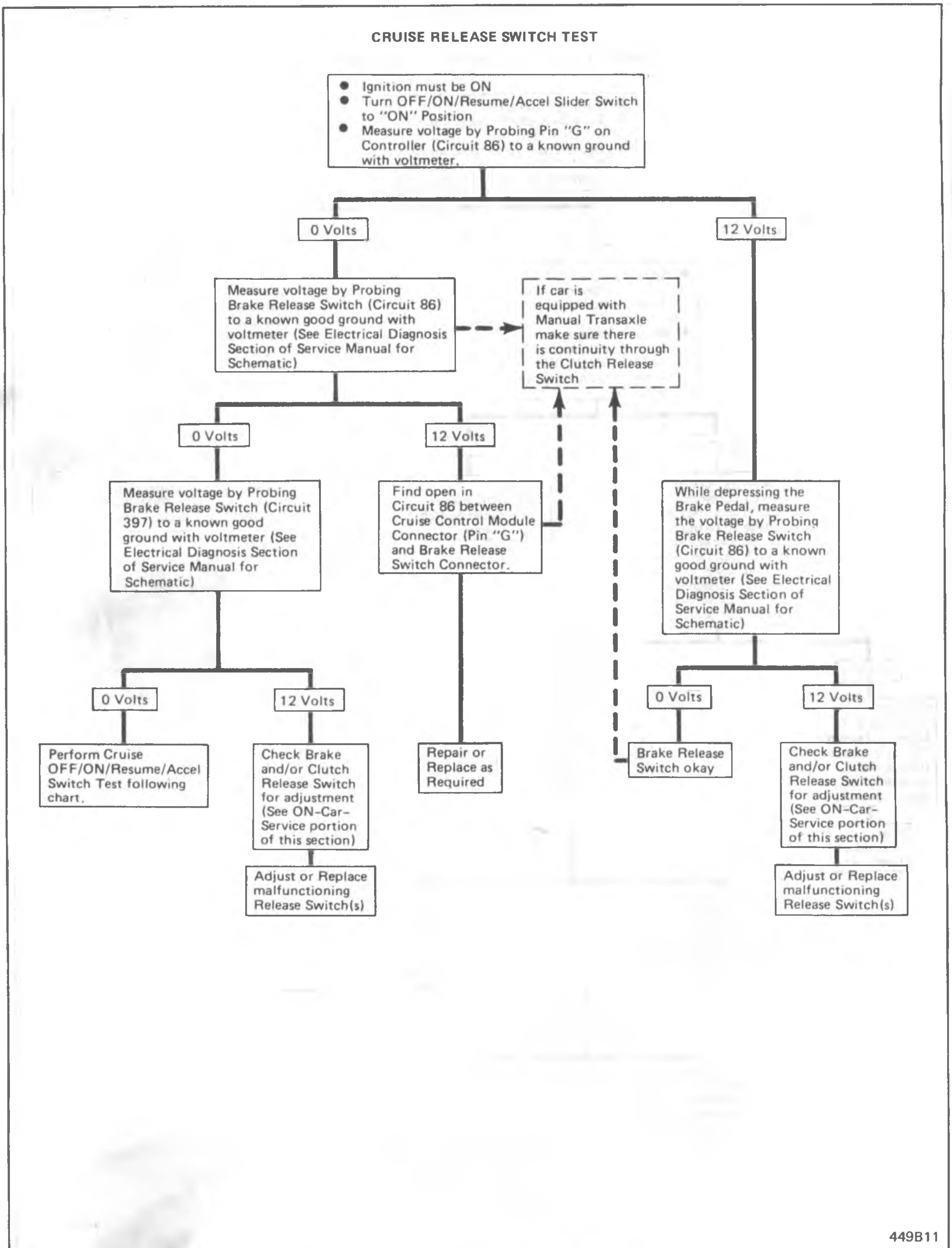


Figure 9B-10 Cruise Diagnostic Chart #5

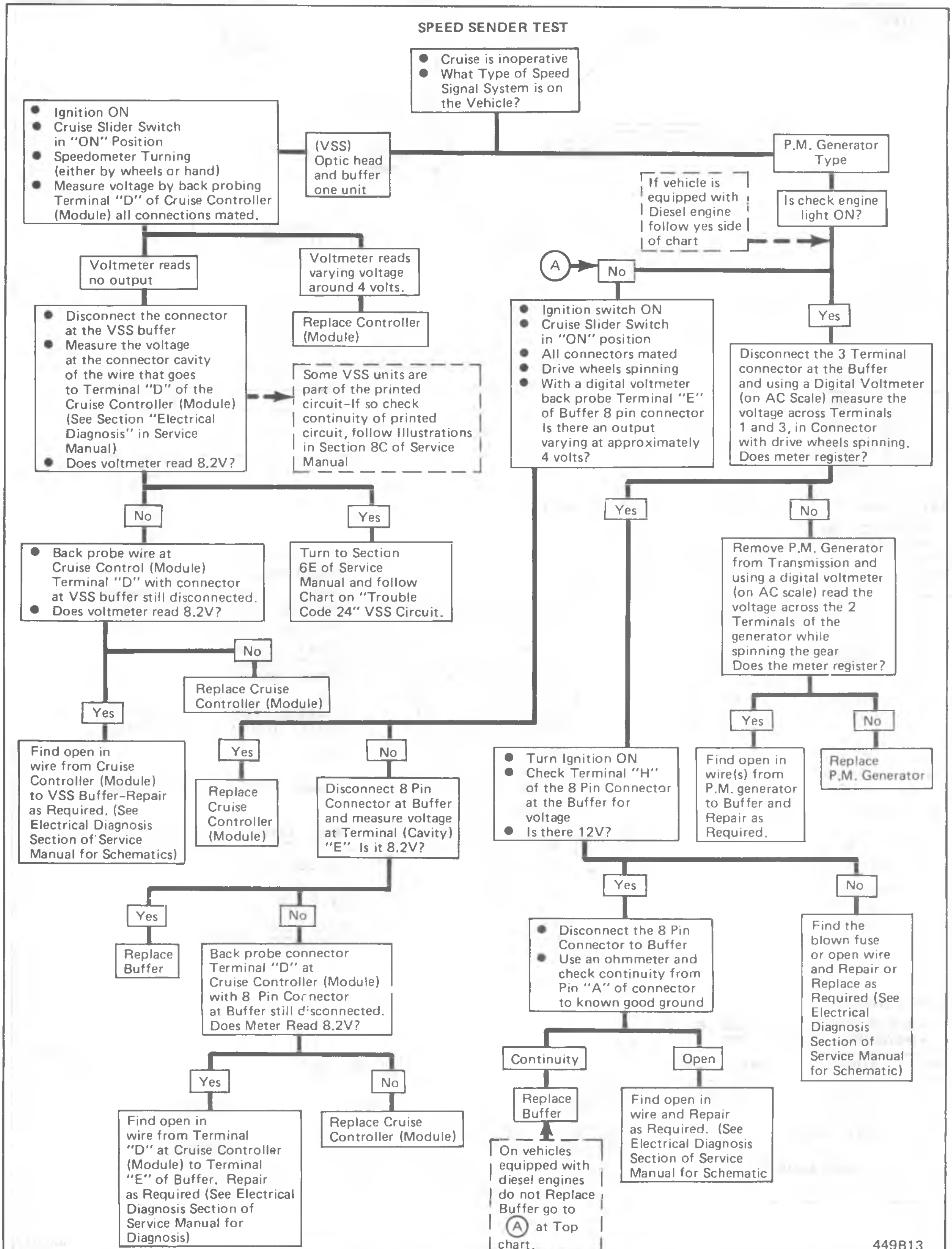
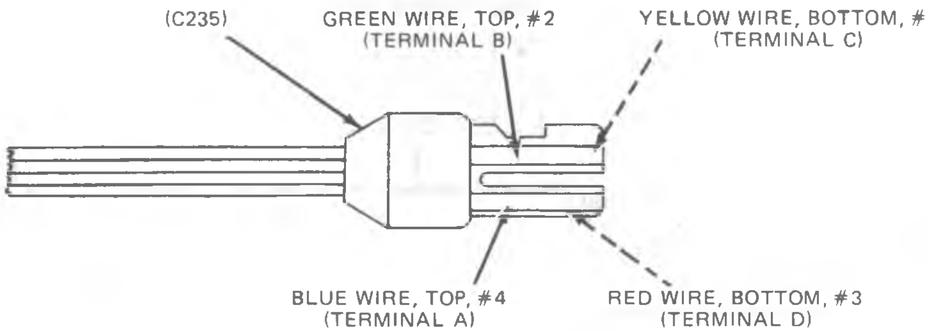


Figure 9B-11 Cruise Diagnostic Chart #6

CONTROL SWITCH
CONTINUITY CHECK



C – CLOSED

O – OPEN

SET/COAST (S/C) SW	POSITION SLIDER	1-2	1-3	1-4	2-3	2-4	3-4
NORMAL	OFF	O	O	O	O	O	O
NORMAL	ON	O	O	O	O	C	O
NORMAL	R/A	C	O	C	O	C	O
DEPRESSED	OFF	O	O	O	C	O	O
DEPRESSED	ON	O	O	O	C	C	C
DEPRESSED	R/A	C	C	C	C	C	C

CRUISE CONTROLLER (MODULE) CHECKS AT CONNECTOR

- **IGNITION ON**
- **CONTROLLER DISCONNECTED**

PIN	FUNCTION	VOLTAGE TO GND	RESISTANCE	CONDITIONS
G	BRAKE INPUT	12 V 0 V	– –	BRAKE (AND CLUTCH) NOT DEPRESSED SLIDER SWITCH "ON" BRAKE (AND/OR CLUTCH) DEPRESSED SLIDER SWITCH "ON"
L	SET/COAST INPUT	12 V 0 V 0 V	– – –	SLIDER SWITCH "ON" – SET/COAST DEPRESSED SLIDER SWITCH "ON" – SET/COAST NORMAL SLIDER SWITCH "OFF" – SET/COAST NORMAL
M	RESUME/ ACCEL. INPUT	12 V 0 V 0 V	– – –	SLIDER SWITCH "R/A" POSITION SLIDER SWITCH "ON" – SET/COAST DEPRESSED OR NORMAL SLIDER SWITCH "OFF" – SET/COAST DEPRESSED OR NORMAL
J	GROUND	–	0 Ω	MEASURED TO VEHICLE GROUND
A	ON/OFF INPUT	12 V 0 V	– –	SLIDER SWITCH "ON" SLIDER SWITCH "OFF" – SET/COAST DEPRESSED OR NORMAL
B	INDICATOR LAMP	12 V	–	CRUISE ARMED
F H	SPS HIGH SPS LOW	– –	20 - 30 Ω ∞ Ω	MEASURED BETWEEN PINS F & H – SERVO CONNECTED MEASURED BETWEEN PINS F & H – SERVO DISCONNECTED
D	SPEED SIGNAL	→	→	SEE CHART (DIAGNOSTIC) ON SPEED SENDER TEST
K	VACUUM VALVE CONTROL	– –	30 - 50 Ω ∞ Ω	MEASURED TO GROUND – SERVO CONNECTED MEASURED TO GROUND – SERVO NOT CONNECTED
C	VENT VALVE CONTROL	– –	30 - 50 Ω ∞ Ω	MEASURED TO GROUND – SERVO CONNECTED MEASURED TO GROUND – SERVO NOT CONNECTED

SERVO CHECKS

- **SERVO CONNECTOR DISCONNECTED**
- **MEASURE AT SERVO PINS**

PIN	FUNCTION	RESISTANCE	CONDITIONS
D B	SPS HIGH SPS LOW	20 - 30 Ω	MEASURED BETWEEN PINS D AND B (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)
A	VENT VALVE	30 - 50 Ω	MEASURED BETWEEN PINS A AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)
E	VACUUM VALVE	30 - 50 Ω	MEASURED BETWEEN PINS E AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)

449B12

Figure 9B-12 Controller, Servo & Control Switch Check

ON – CAR – SERVICE

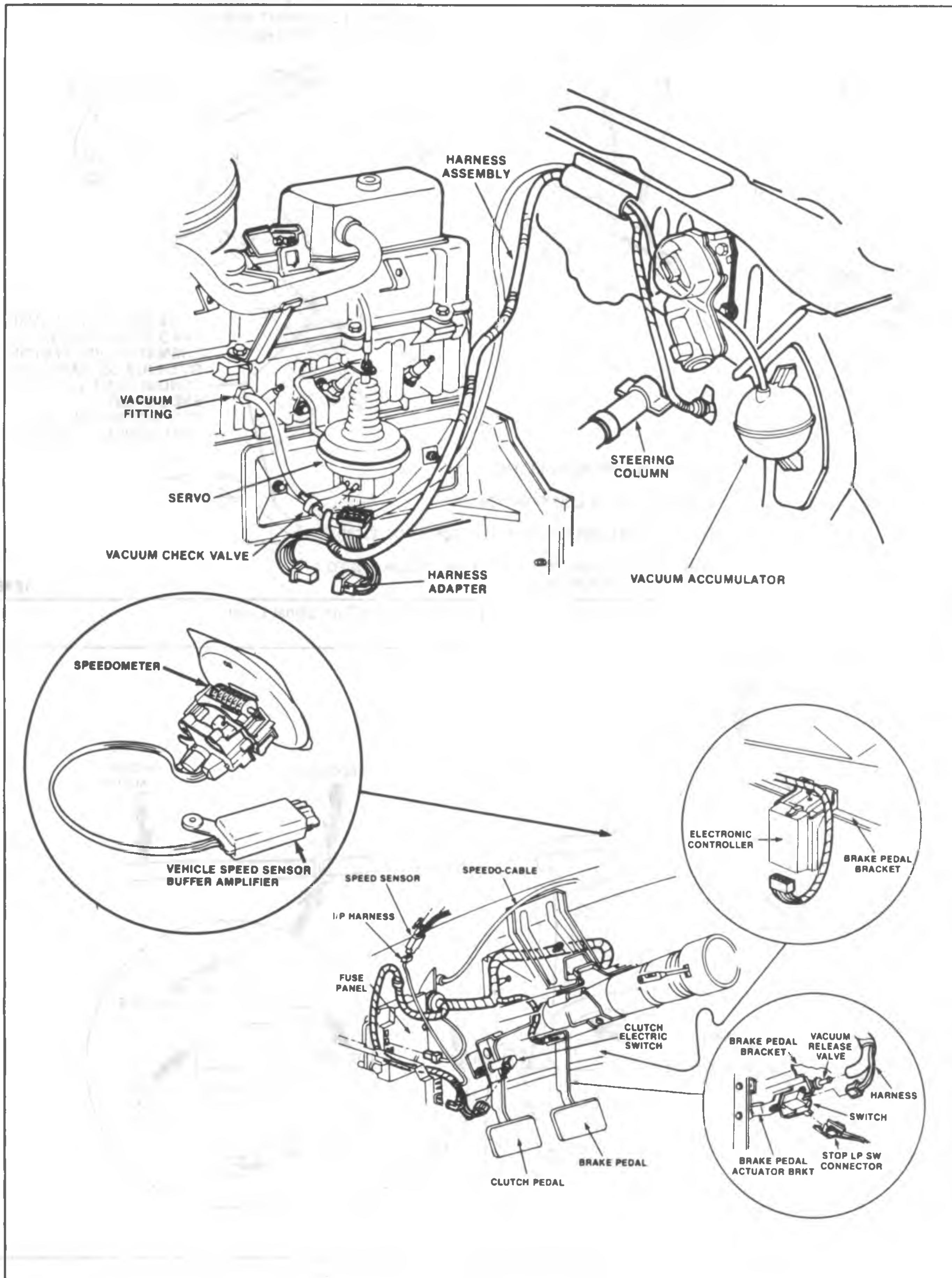


Figure 9B-13—Typical Installation-Custom Cruise 111 System

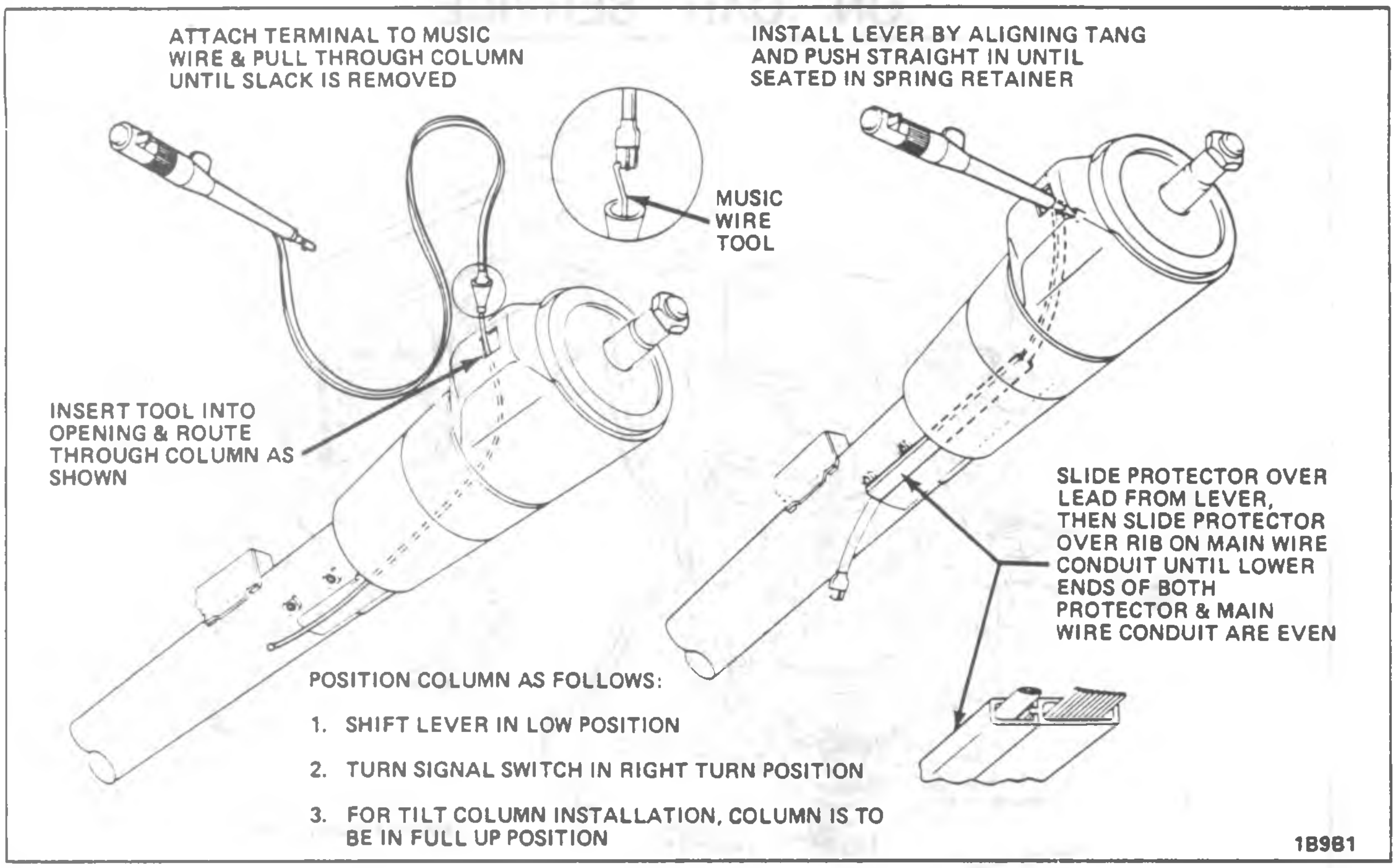


Figure 9B-14—Cruise Control Lever Assembly (Turn Signal Lever)

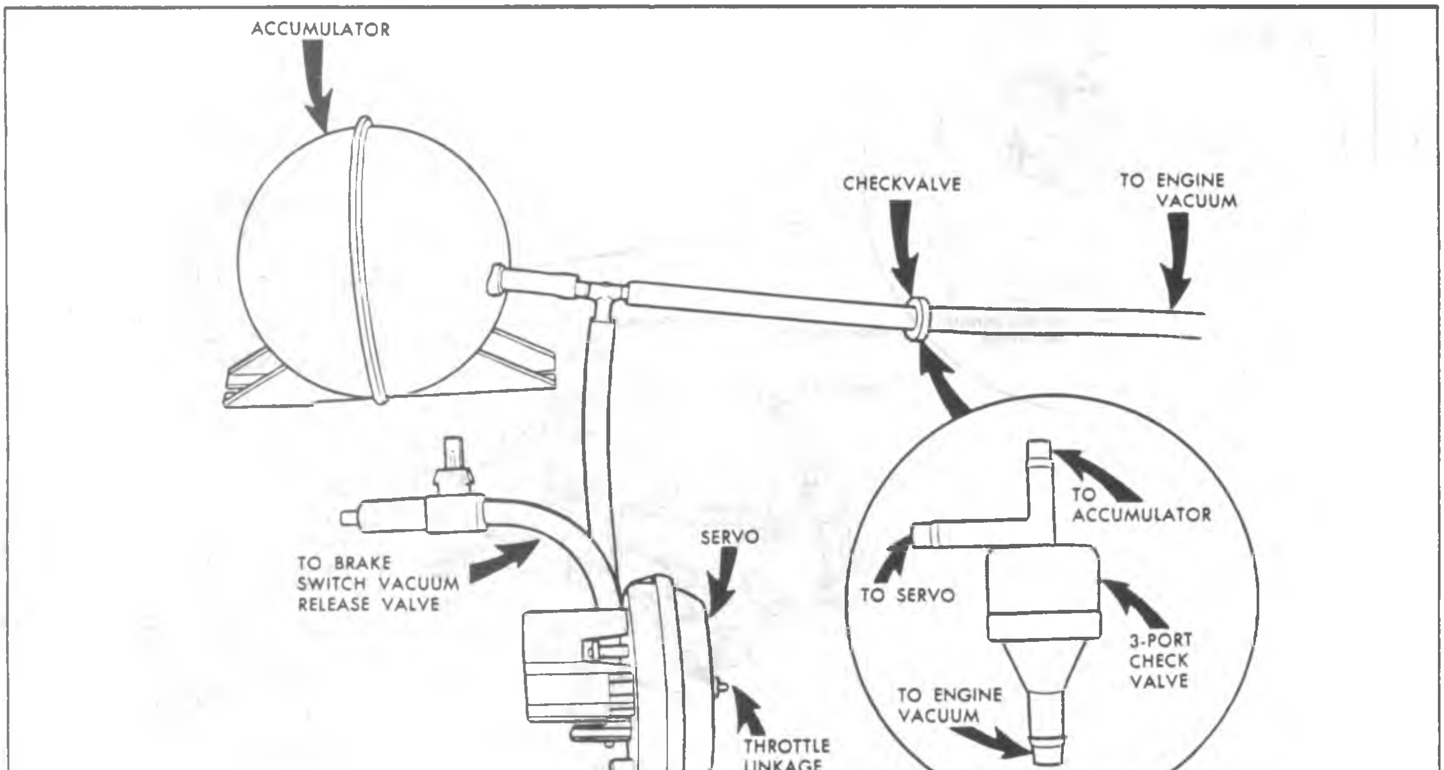
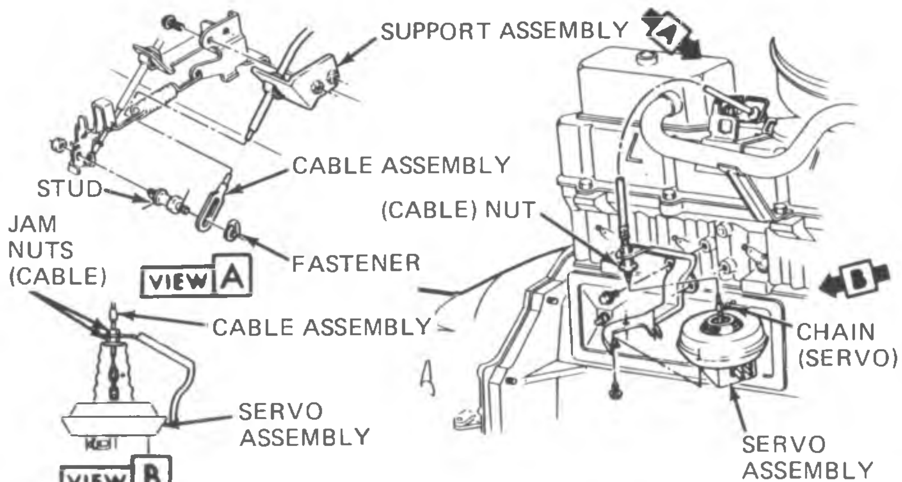


Figure 9B-15—Typical Pneumatic System

CKG TRUCKS
CRUISE CONTROL SERVO ADJUSTMENT

CRUISE CONTROL CABLE ADJUSTMENT

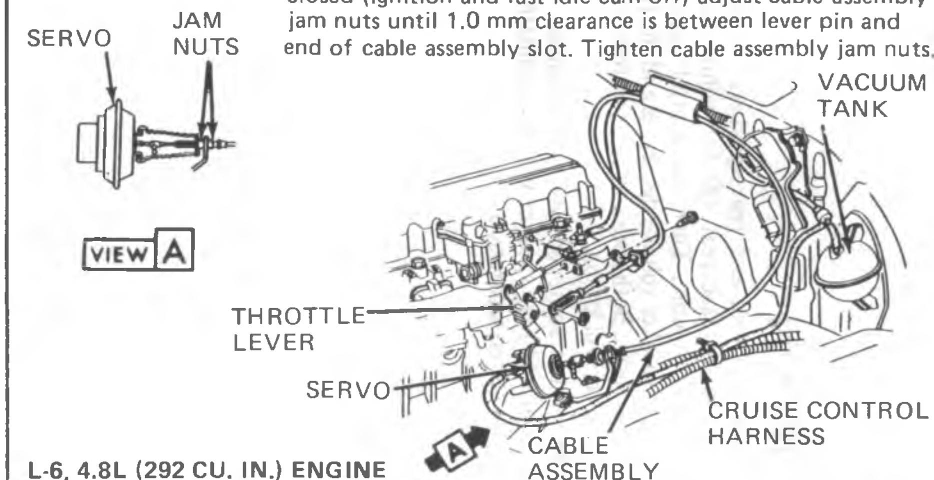
Using third ball only on servo chain, and with throttle completely closed (ignition off and fast idle cam off) adjust cable jam nuts until 1.0 mm clearance is between stud pin and end of slot. Tighten jam nuts.



L-6; 250 CU. IN. ENGINE

CRUISE CONTROL CABLE ADJUSTMENT

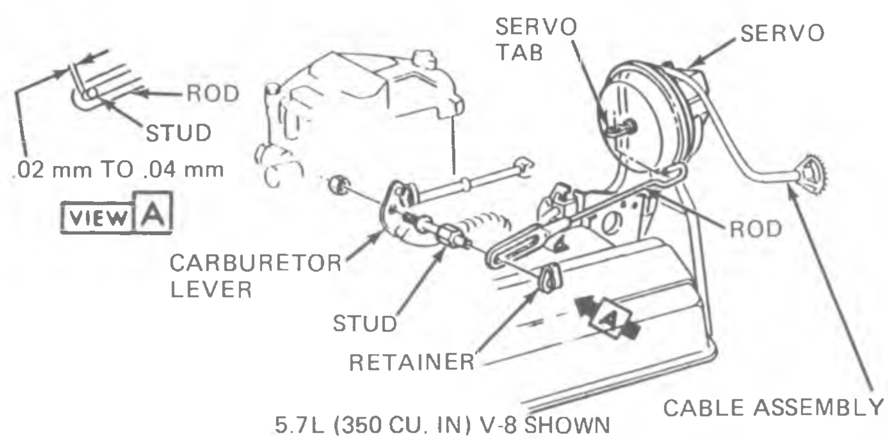
With cable assembly installed and using second ball only on servo assembly chain, install servo assembly chain on cable assembly (see View A). With throttle completely closed (ignition and fast idle cam off) adjust cable assembly jam nuts until 1.0 mm clearance is between lever pin and end of cable assembly slot. Tighten cable assembly jam nuts.



L-6, 4.8L (292 CU. IN.) ENGINE

SERVO ASSEMBLY TO CARBURETOR ADJUSTMENT

With ignition off and fast idle cam off and throttle completely closed, adjust length so that rod assembles over end of stud as shown (see View A). Install retainer.

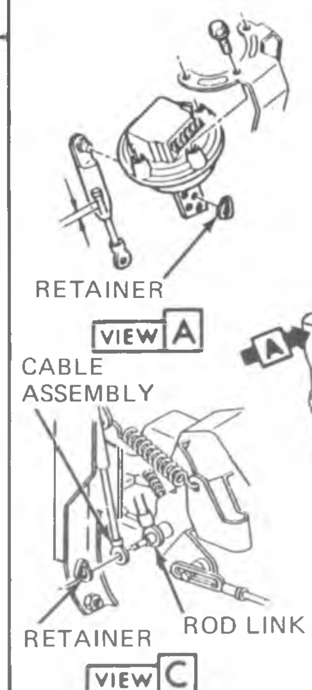


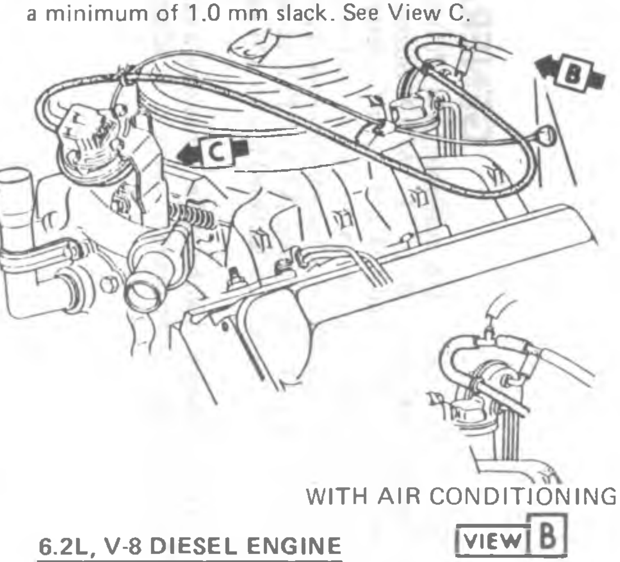
5.7L (350 CU. IN) V-8 SHOWN

ALL V-8 GAS ENGINES

SERVO ASSEMBLY ROD LINK ADJUSTMENT

With engine not running and idle screw against stop, assemble lower end of rod link to throttle lever and upper end to hole closest to servo which will provide a minimum of 1.0 mm slack. See View C.





6.2L, V-8 DIESEL ENGINE

Figure 9B-16—Custom Cruie 111 - Servo Adjustment - CKG Truck Models

RADIO

GENERAL DESCRIPTION

Six types of radios are available: AM Pushbutton, AM/Stereo 8-Track Tape, AM/FM, AM/FM Stereo, AM/FM Stereo/Stereo tape, and AM/FM Stereo Cassette Tape. The left knob operates the on-off switch and volumne control, the left ring operates the tone control. The right hand knob controls manual tuning. All AM/FM radios have five push buttons (10 station selections) five on AM and five on FM.

On models equipped with auxiliary speakers, a variable control located behind the manual tuning knob adjusts the volume of the front and rear speakers. Turn the control clockwise to increase rear speaker volume and decrease front speaker volume. Turn the control counterclockwise and the rear speaker volume decreases and the front speaker volume increases. Both speakers are controlled toegether by the volume control knob.

On models equipped with stereo radios, this control varies front and rear speaker volume to obtain the desired balance for stereo separation.

DIAGNOSIS

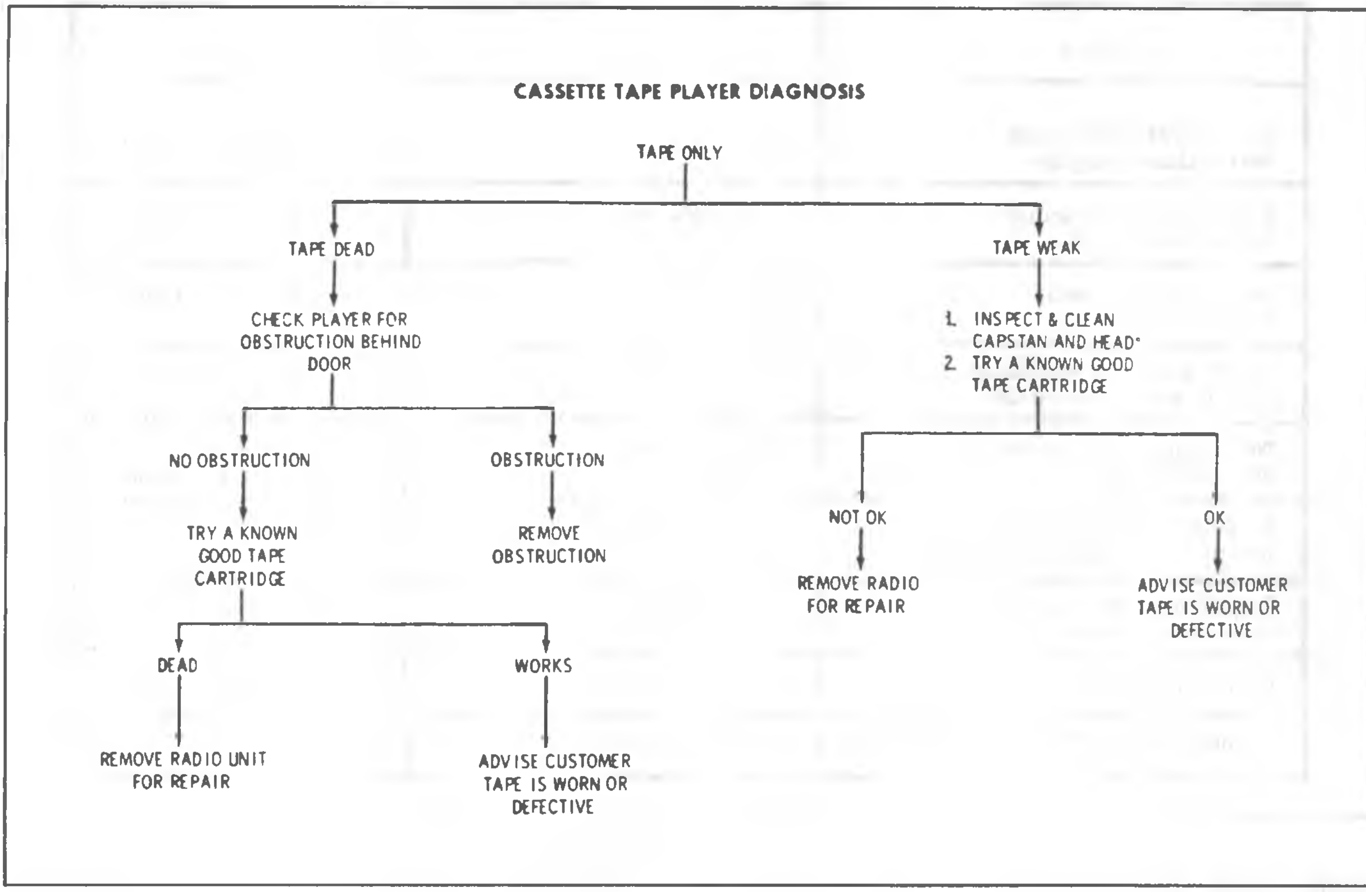


Fig. 9-1R--Cassette Tape Player Diagnosis

CASSETTE TAPE PLAYER DIAGNOSIS

Diagnosis of radio portion of cassette-AM/FM is shown on the diagnosis charts. For cassette diagnosis, refer to Fig. 9-1R. If unit must be removed, it must be repaired by an authorized service station. See Section 8 for removal procedures and connections for speaker and power wiring.

EIGHT-TRACK STEREO TAPE DIAGNOSIS

The tape player trouble diagnosis guide is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of electronics and without special test equipment. If the suggestions given here do not effect a correction, further testing should be done only be a trained radio technician having proper test equipment. It should first be determined if the owner's tape and not the player is at fault. Substituting a known good tape cartridge for the owner's is a simple check.

Because tape player service problems are generally corrected by a radio repair shop, there is a tendency for many technicians to remove a set when a problem is reported. Removal of the tape player can frequently be avoided if the diagnosis chart is used to eliminate problems which can be easily fixed or which are not caused by a faulty player.

In diagnosing radio/tape problems the main point to remember is that you now have both a radio and a tape player to diagnose as part of the stereo system. By inserting test tape, J-22683-01, you can quickly determine whether the tape speed is proper. Since only the pre-amps and audio are common to both radio and tape, by listening for distortion with the tape playing and comparing it to the radio signal, you can further isolate the problem to either radio or tape; See the Diagnosis Chart.

STATIC AND NOISE DIAGNOSIS

Refer to figure 9-3R for radio static suppression on the vehicle. Ground strap connections must be clean and tight, spark plug cables must be TVRS type and in good condition and resistance type spark plugs used. Extra electrical equipment added to the car could cause static if not properly grounded or wiring was improperly routed. Radio and antenna lead-in grounding must be clean and tight. An improperly trimmed antenna adjusting screw could result in poor sensitivity and static/noise on AM stations only.

Weak FM station reception will be affected by near-by buildings, car speed, direction and windshield wiper operation. These "flutter," "swish" and "fading" conditions are characteristics of weak FM signals.

POPPING NOISE DIAGNOSIS

Operating switches such as turn signal, pushing in cigarette lighter, operating stop lights, etc., may cause a popping noise on distant AM (weak) signals. Adjusting the antenna trimmer, if it is out of adjustment, will minimize the noise.

TESTING WINDSHIELD ANTENNA (Fig. 9-4R)

All C-K model trucks with factory installed radios are

DIAGNOSIS AM/FM-CB RADIO COMBINATION

PROBLEM	CHECK	ACTION
No AM, FM or CB sound No CB channel display.	Check Fuse	Remove radio for repair.
No AM, FM or CB sound Channel display OK	Mode Switch Squelch control	Remove radio for repair
No AM, or FM sound; CB sound OK	Mode switch Squelch	Remove radio for repair
No CB sound and no channel display; AM/FM sound OK	Mode switch	Remove radio for repair
No CB sound, channel display OK; AM/FM OK.	Mode switch Squelch	Replace antenna Remove radio for repair
Irregular channel stepping & unit not coordinated with display	Cable connections	Remove radio for repair
Display segments missing or segment contrast not uniform	Mode switch	Remove radio for repair
Channel display won't change	Selector switch	Remove radio for repair
Channel display indicates only "O"	Power connector	Remove radio for repair

Fig. 9-2R--AM/FM-CB Radio Diagnosis

equipped with windshield antennas. To positively identify antenna failure and eliminate the possibility of unnecessary windshield replacement, Windshield Antenna Tester J-23520 should be used to determine continuity of the thin antenna wire.

When antenna failure is suspected, the following checks should be made before replacing the windshield.

1. Check Tester J-23520 for operation on any vehicle radio antenna that is operating normally to test for a weak or dead battery.
2. Check all antenna connectings to insure that antenna is electrically coupled to the radio.
3. Turn ignition switch to accessory position, turn radio "ON", select AM band if receiver is AM/FM and tune radio to an off station position.
4. Hold tester to antenna beginning at the upper corner of antenna:

   NOTICE: The plastic shield must be on tester at all times to avoid scratching windshield.

   a. If a shrill sound is emitted through the speaker when both antenna wires are tested, antenna is operational.
   b. If no sound is emitted through one or both antenna wires, move tester along the wire toward center of windshield and down toward radio.
   c. If a shrill sound is picked up, find exact location where the noise begins, this is the area of the defect. Replace windshield.
   d. If no noise is heard over entire length of antenna, unplug antenna lead at radio and touch tester to antenna socket in radio.
   e. If radio now makes a shrill sound, check connectors and antenna lead for possible defect before replacing windshield.
   f. If no noise is emitted, radio, speaker, or fuse is defective.

   Make sure that antenna tester is turned off after completing antenna test.

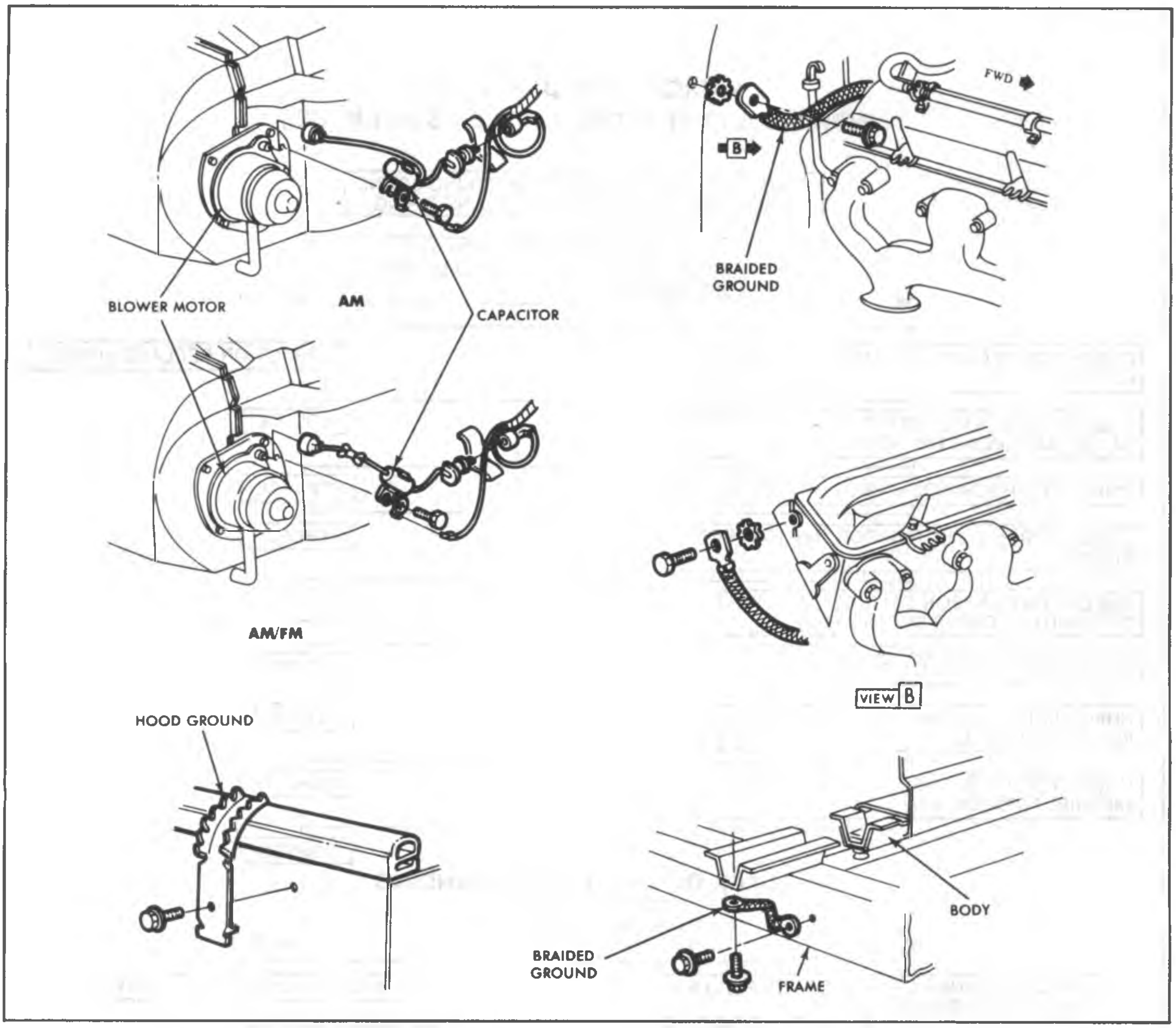


Fig. 9-3R--Radio Static Suppression--Typical

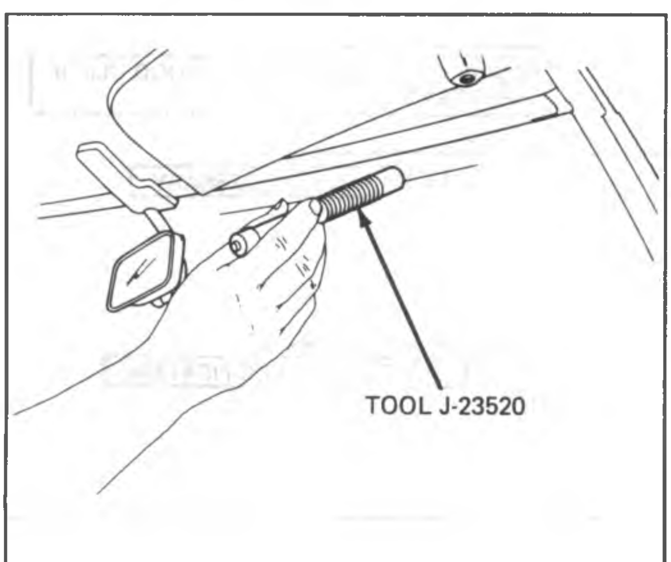


Fig. 9-4R--Testing Windshield Antenna (Typical)

RADIO NOISE DIAGNOSIS

IMPROPERLY OPERATING IGNITION SYSTEM (HEI)

START ENGINE AND LISTEN FOR TICKING SOUND OR NOISE PRODUCED BY THE ENGINE FIRING.

CHECK SPARK PLUG WIRES FOR DIRT AND CORROSION ON CONTACTS, BREAKS IN WIRES, AND LOOSE CONNECTIONS.

OK	NOT OK
CHECK FOR BROKEN CONTACT BUTTON ON ROTOR.	CORRECT OR REPLACE WIRES.
CHECK FOR WORN CONTACT SPRING ON ROTOR OR SPRING BINDING IN HOLDER.	REPLACE.
CHECK FOR POOR INDEXING OF ROTOR SPRING.	REPLACE.
CHECK FOR BAD DISTRIBUTOR CAP (CARBON ERODED).	REPLACE.
CHECK THAT CARBON CYLINDER IN DISTRIBUTOR CAP IS MOVING FREELY.	REPLACE
CHECK FOR GREASE ON ROTOR.	CORRECT.
CHECK FOR LOOSE GROUND SCREW ON IGNITION MODULE.	CLEAN.
CHECK FOR LOOSE GROUND SCREW ON DISTRIBUTOR CONDENSER.	TIGHTEN.
	TIGHTEN.

LACK OF SHIELDING/GROUNDING

CHECK ENGINE TO BULKHEAD BOND.

OK	NOT OK
CHECK ANTENNA LEAD-IN SHIELD FOR LESS THAN 1 OHM RESISTANCE.	ADD CLIP OR GROND STRAP.
CHECK FOR A GOOD GROUND OF THE HOOD (HOOD GROUND CLIP).	REPLACE IF NECESSARY.
CHECK THAT WIPER HOSES ARE NON-CONDUCTIVE TYPE (BLACK WITH WHITE STRIPE).	CORRECT — USE OPTIONAL HOOD CLIP IF NECESSARY.
CHECK THAT ANTENNA (EXTERNAL MOUNT) MOUNTING NUT ON TOP OF FENDER IS TORQUED TO SPECIFICATION. ON A POWER ANTENNA, CHECK THAT ANTENNA LEAD-IN FITTING IS TORQUED TO SPECIFICATION AT THE ANTENNA. ALSO CHECK THAT LEAD-IN IS WELL GROUNDED (WINDSHIELD AND FENDER MOUNT).	REPLACE IF NECESSARY.
CONSULT APPLICABLE SERVICE BULLETINS (WHICH MAY BE RELEASED SUBSEQUENT TO THIS MANUAL), OR RADIO EXCHANGE/REPAIR CENTER.	TORQUE TO SPECIFICATION.

Fig. 9-5R--Radio Diagnosis, Chart A

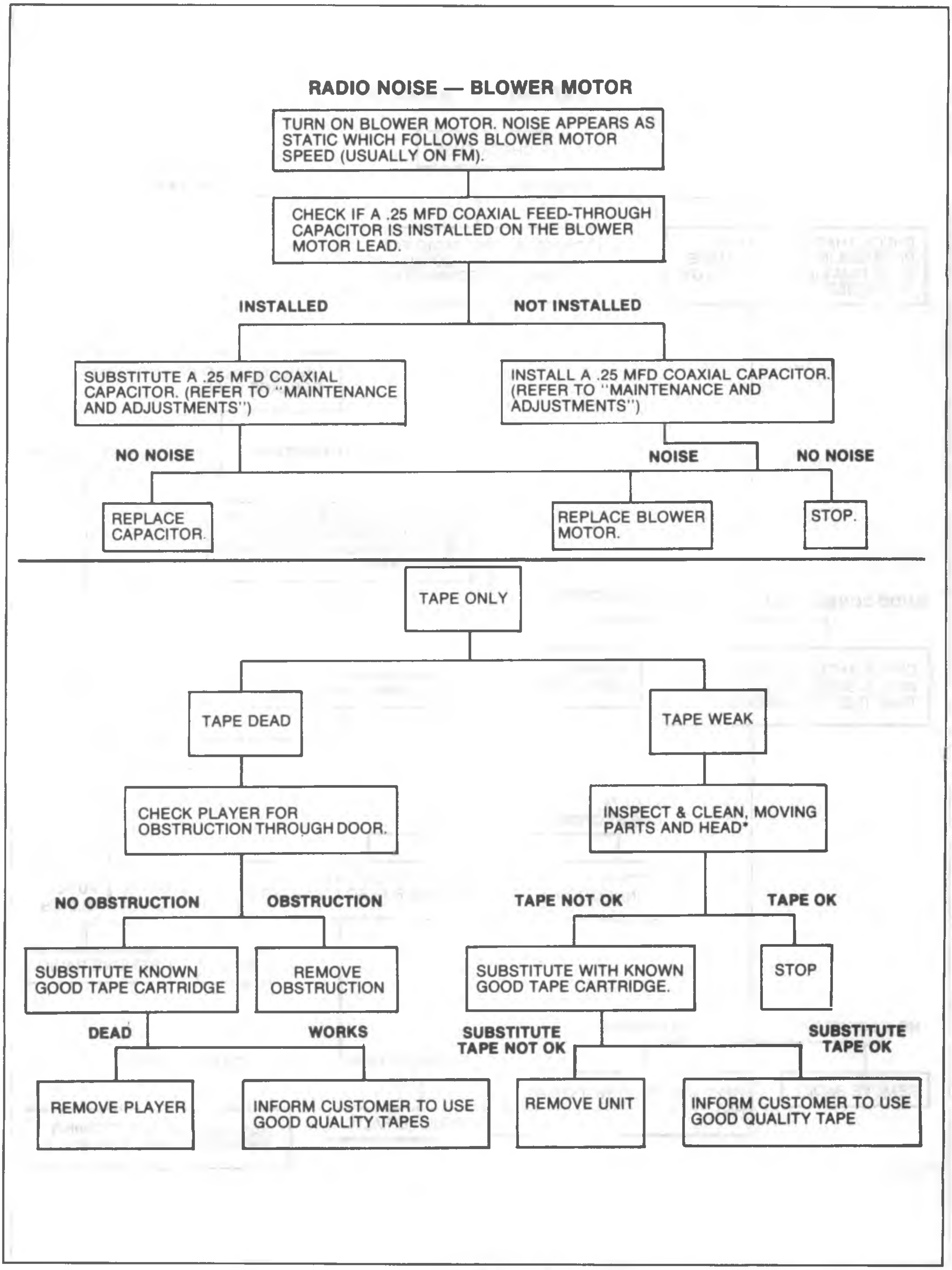


Fig. 9-6R--Radio Diagnosis, Chart B

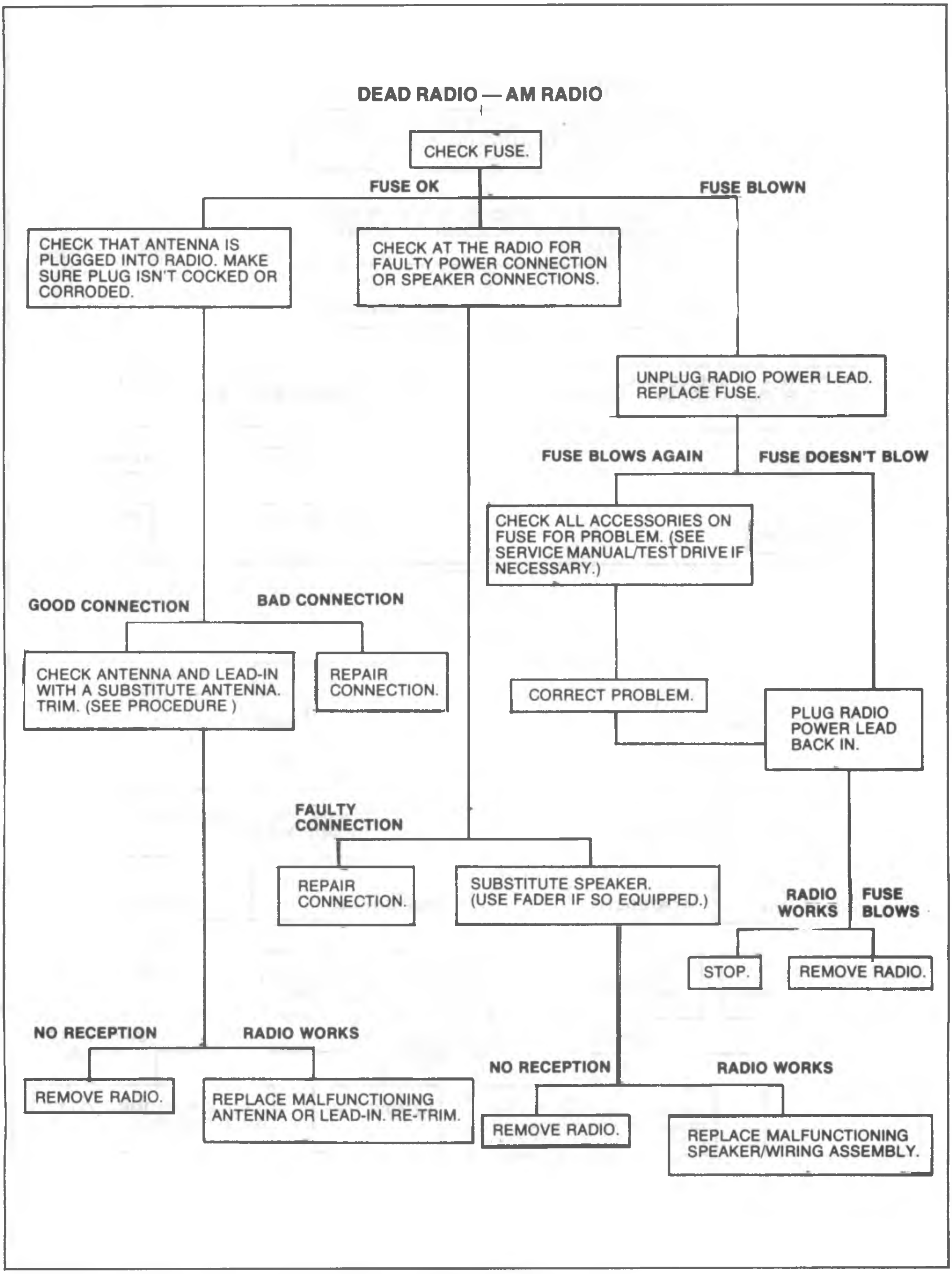


Fig. 9-7R--Radio Diagnosis, Chart C

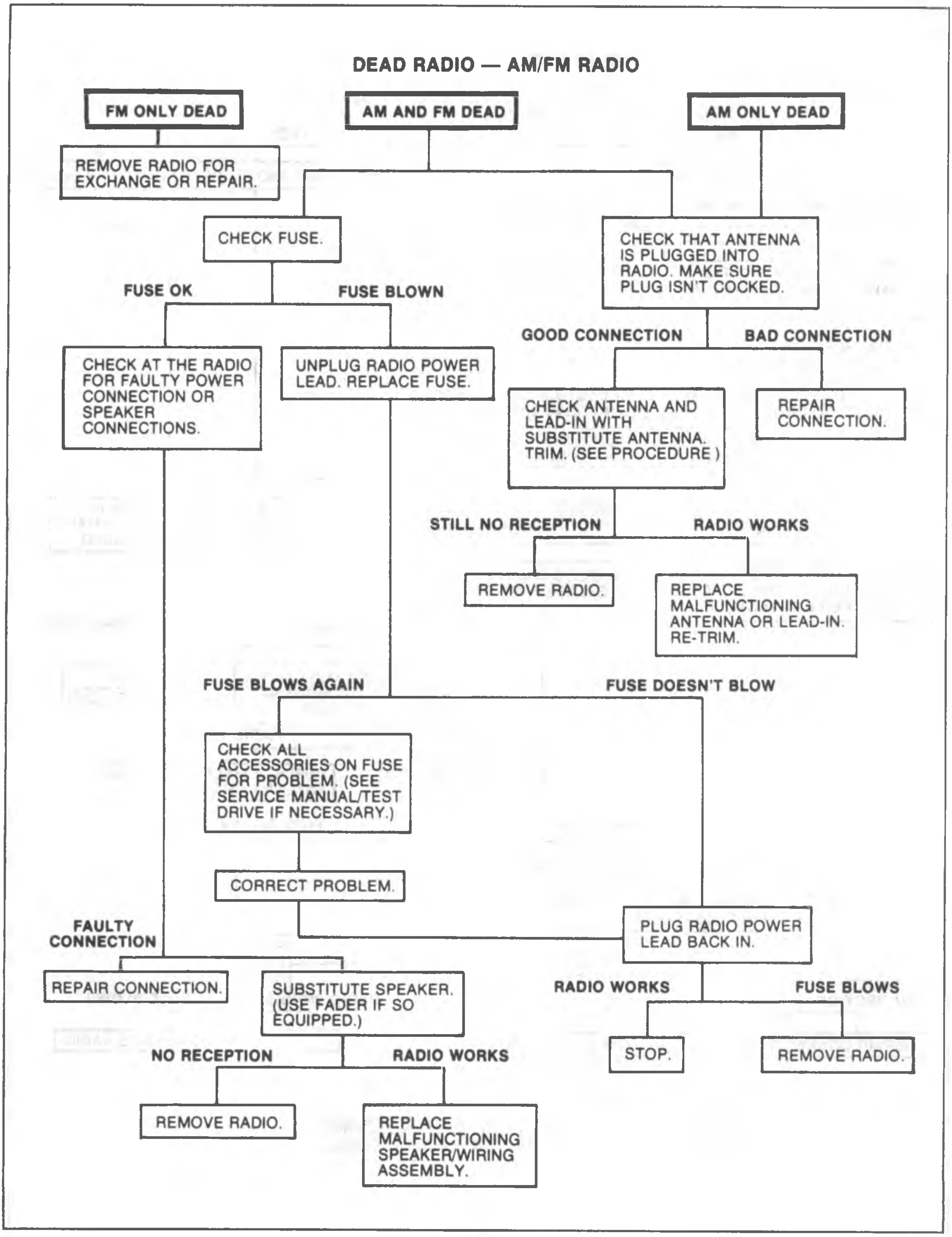


Fig. 9-8R--Radio Diagnosis, Chart D

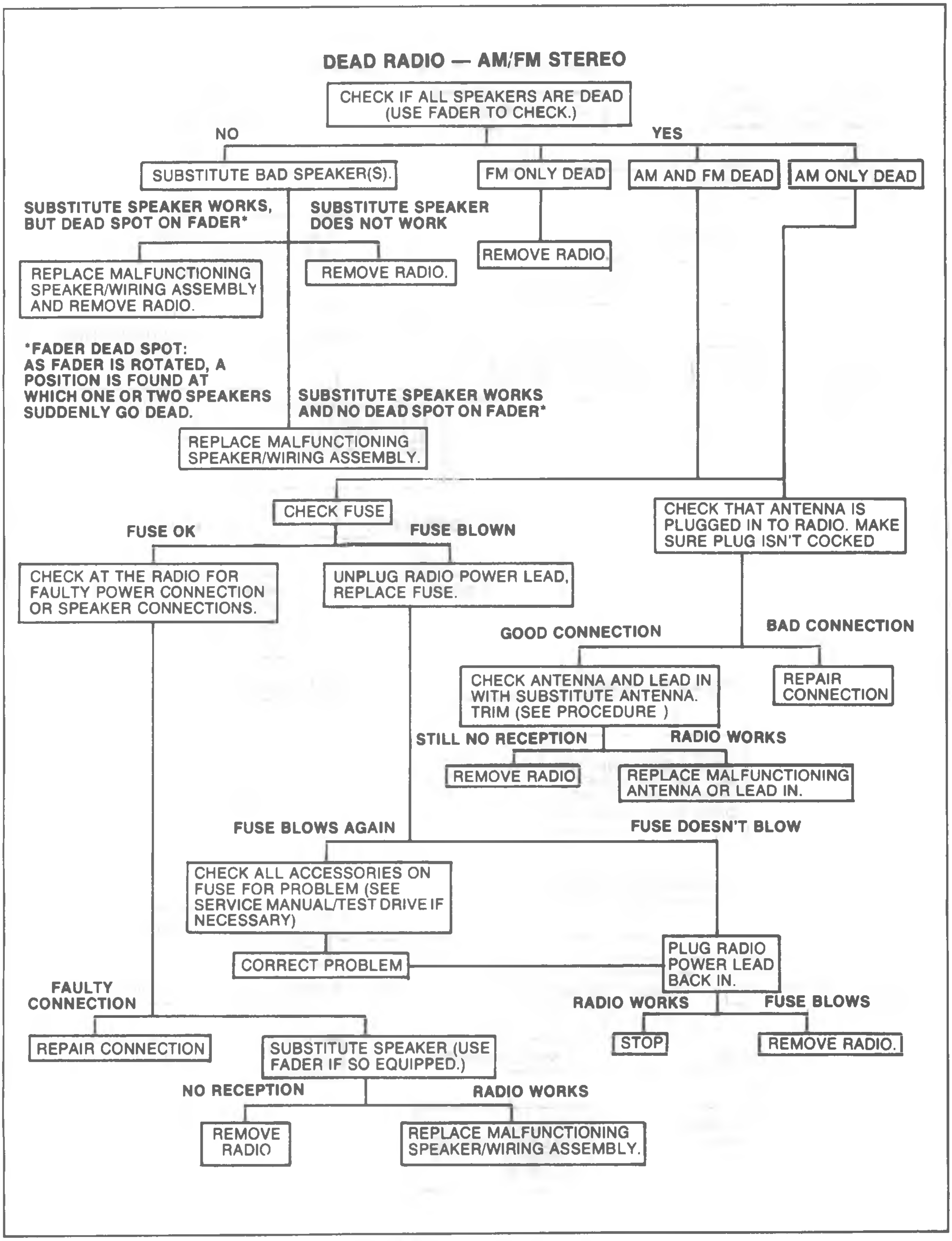


Fig. 9-9R--Radio Diagnosis, Chart E

SLIMLINE POWER ANTENNA DIAGNOSIS

ANTENNA WILL NOT TRAVEL TO FULL UP OR DOWN POSITIONS OR DOESN'T MOVE (MOTOR RUNS) (BE SURE MAST IS CLEAN)

Pull up on top section of mast. If section moves freely, plastic drive cable is broken.

- NOT BROKEN
  - Remove mast and support tube. Check mast sections for free movement.
    - FREE
      - Check drive cable for broken hook. If OK replace gear and spool assembly.
    - BINDING
      - Free up sections or replace mast and support tube.
- BROKEN DRIVE CABLE
  - Replace mast and support tube.

ANTENNA WILL NOT LOWER (MOTOR DOES NOT RUN) CHECK FUSE CIG-CLK-DM

- FUSE OK
  - Probe orange wire terminal at antenna relay with 12V. test light.
    - LIGHT ON
      - Use a 12 volt test light and probe white wire at antenna relay connector.
        - LIGHT OFF
          - Replace Relay
        - LIGHT ON
          - Check white wire from relay to antenna for open circuit. If OK probe dk. green wire.
            - LIGHT ON
              - Check relay connections; ground wire (black) and ground screw. If OK, replace relay.
            - NO LIGHT
              - Check dk. green wire relay to connector and connector to antenna for loose connection or open circuit. If OK repair motor assembly.
    - NO LIGHT
      - Locate and repair open circuit in orange wire from relay to fuse panel.
- FUSE BLOWN
  - Disconnect connector with orange wire at relay. Install new fuse and recheck.
    - FUSE BLOWN
      - Repair short in orange wire.
    - FUSE OK
      - Disconnect other connector. Connect orn wire connector, recheck fuse.
        - FUSE BLOWN
          - Replace relay.
        - FUSE OK
          - Check and repair white wire to antenna. If OK repair antenna motor assembly.

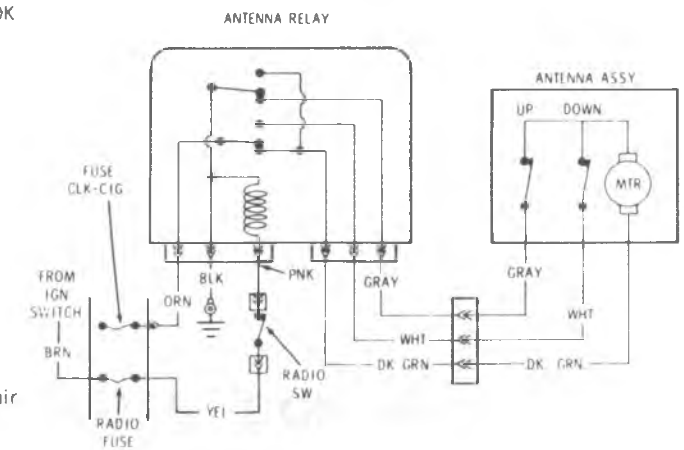


Fig. 9-10R--Slimline Power Antenna Diagnosis, Chart F

POWER ANTENNA

General Description and Operation

The power antenna automatically raises the antenna mast to its full height whenever the radio and ignition are turned on. The antenna retracts into the fender when either the ignition or radio is turned off.

The power antenna drive unit is housed in a 2 piece plastic housing attached to the mast and tube assembly. A permanent magnet motor with worm drive moves the antenna mast up and down with a plastic cable attached to the top mast section. No clutch is used in this unit. Upper and lower travel limits are controlled by switches opened by armature shaft thrust as the mast reaches the end of its travel. A circuit breaker is used to protect the motor armature from over heating.

Two types of power antennas are used depending on the type of radio used in the car:

1) AM-FM Type
2) AM-FM-CB (Tri-Band) Type

The AM-FM antenna extends to a maximum height of 794 mm (31 1/4"). The AM-FM-CB (Tri-Band) antenna extends to a height of 914 mm (36"). The tri-band antenna has a load coil mounted on the center mast section to tune it to the CB radio band and a stub antenna lead taped to the support tube. The stub matches the antenna to the FM band and should not be removed except for replacement.

On Car Service

There is no on car service of the AM-FM antenna other than cleaning of the mast sections. On the Tri-Band antenna the load coil and tip are servicable in the event of damage or loss. The load coil has an adjustable band to set SWR (Standing Wave Ratio) for CB operation. The SWR is preset on complete antenna assemblies but replacement load coils must be checked and/or adjusted using available SWR meters.

Checking SWR

NOTICE: SWR checking procedures require transmitter operation and FCC regulations governing CB radio operation apply. The following options are available.

- Have SWR test performed by a technician who has a CB license.
- Acquire a dealership CB radio operator's license which allows technicians to use license during business hours.
- Ask owner or an operator possessing a permanent CB Radio license to properly operate transmitter during the test.

Adjustments or repairs referred to in the procedure that follows are limited to the antenna itself or the antenna lead in and connections.

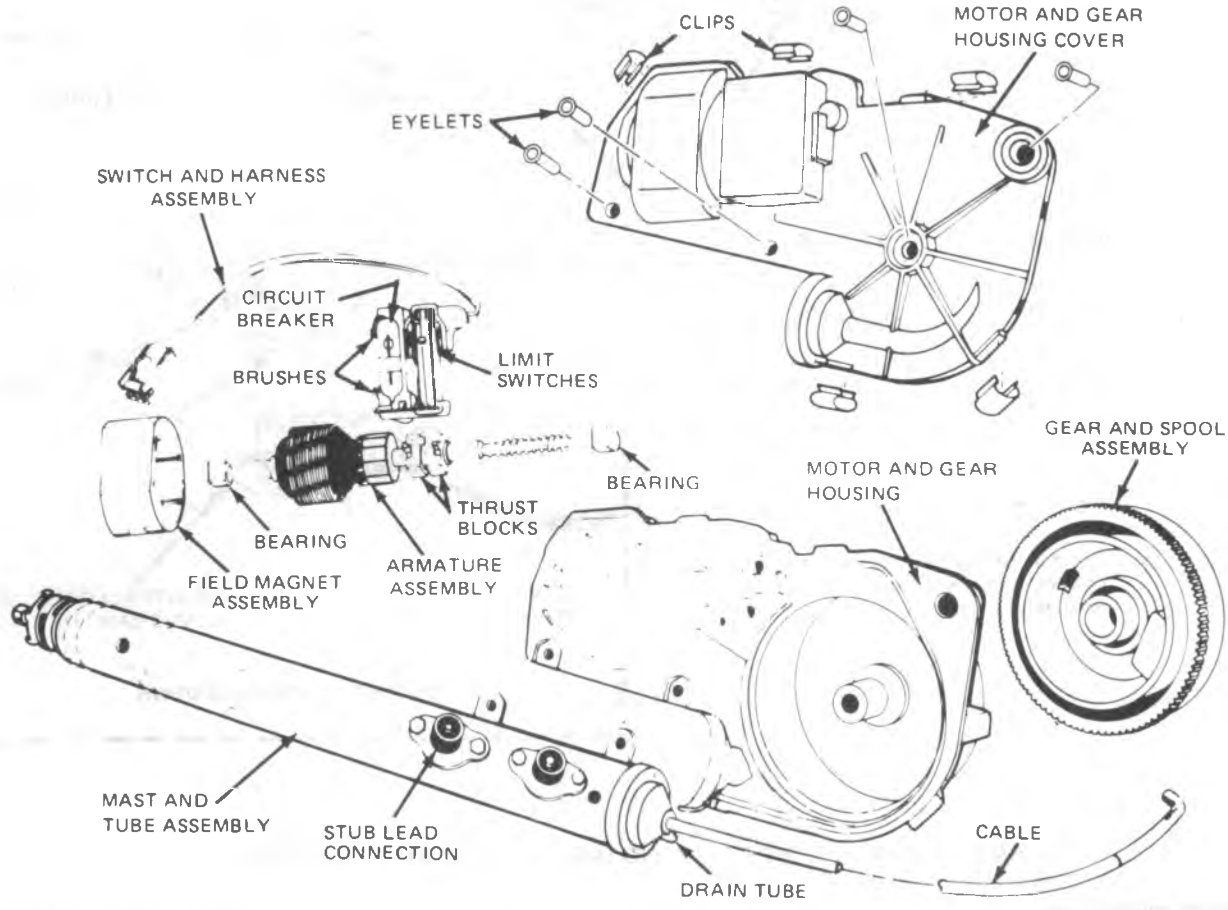


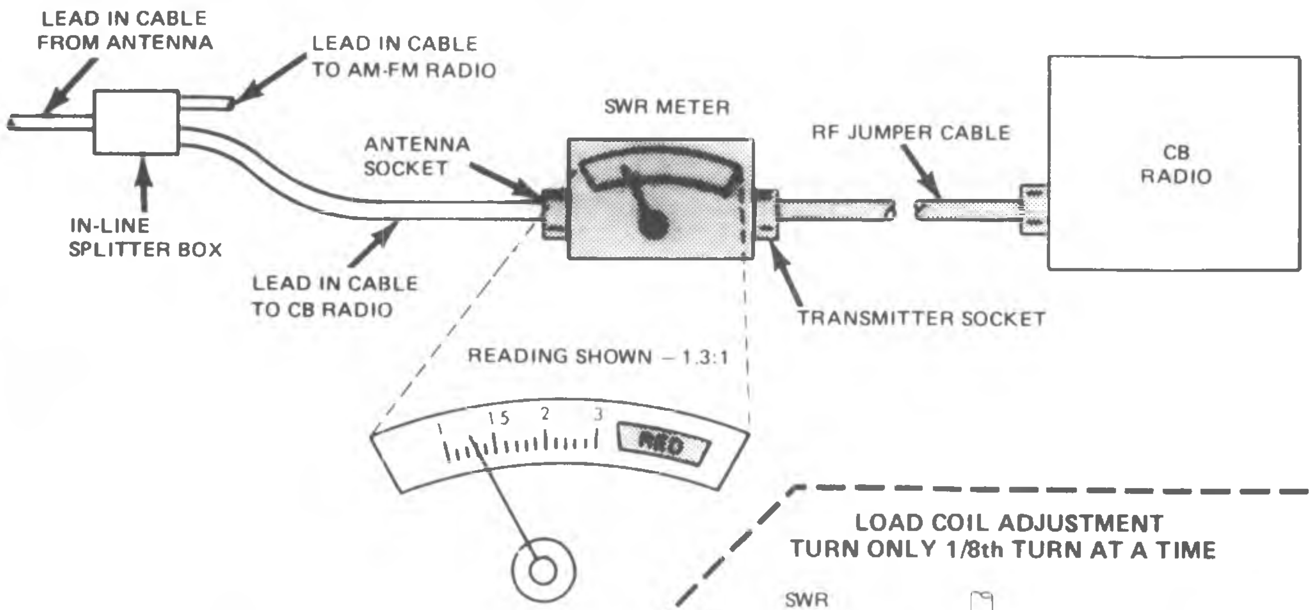
Fig. 9-12R--Slimline Power Antenna Diagnosis, Chart H

SWR (STANDING WAVE RATIO) CHECK

1. With Ignition and Radio off install an SWR meter as shown following meter manufacturers instructions.

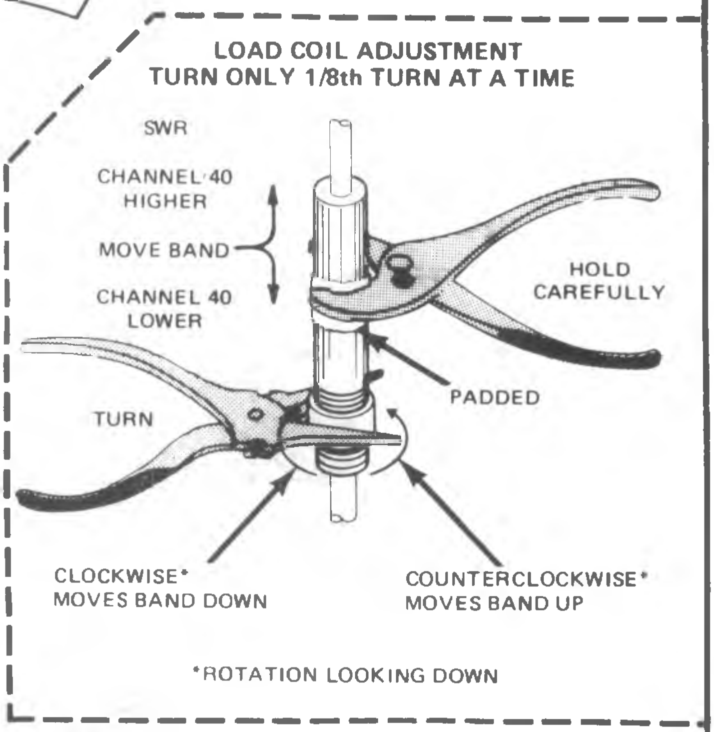
NOTICE: Operation of transmitter requires FCC CB Operators License.
When making this check, car should be at least 20 feet away from any building, hood closed and no one should be standing close to the antenna.

2. Turn on Ignition and Radio.
3. Check Antenna height – Must be fully extended.
   914 mm (36") from fender to tip
   286 mm (11-1/4") top of load coil to tip.
4. After adjustment is complete apply a small amount of thread cement to adjusting band.



POSSIBLE SWR READINGS

1. Initial readings taken on Channel 1, 20, 40
   a. SWR of 2:1 or lower on Channel 20 and nearly equal on Channels 1 and 40 is considered good. No adjustment required.
   b. SWR higher than 2 1 on Channel 20. Adjustment required.
   c. Unequal SWR on Channels 1 and 40 (one channel in red) indicates adjustment required.



ANY READING IN THE RED BAND (ABOVE 3:1 SWR) CHECK FOR:

- Antenna mounting screws tight making a good ground connection between antenna mounting surface and car sheet metal.
- Lead in cable connections to radio, splitter and antenna are tight.
- Lead in cables not pinched and cutting the insulation.

Fig. 9-13R--Slimline SWR Check

ON VEHICLE SERVICE

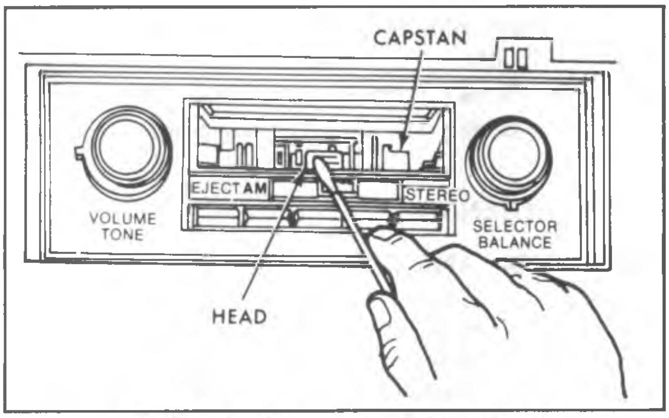


Fig. 9-14R--Cleaning Tape Player Head

MAINTENANCE AND ADJUSTMENTS

TAPE PLAYER MAINTENANCE

The only required maintenance on tape players is periodic cleaning of the tape player head and capstan. This service should be performed every 100 hours of operation. Since you can reach them through the tape door, you can leave the tape player in the truck.

To clean the head and capstan, use a cotton swab dipped in ordinary rubbing alcohol. Wipe the head and capstan as shown in Figure 9-14R.

No lubricants should be used since they will cause the player to operate improperly, especially at extreme temperatures.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cartridge played in the player will be degraded.

To operate the tape player, completely insert a cartridge into the unit. This turns the tape player on, automatically removes power from the radio, and switches the speakers from the radio to the tape player. This feature prevents accidental damage to the radio should the owner attempt to operate it while the tape player is in use.

After the tape player is in operation, the front panel controls of the player are then adjusted for the most pleasant stereo listening.

The tape player is equipped with a cartridge locking arm to hold the cartridge in a rigid position against the capstan drive for minimum wow and flutter. As the cartridge is withdrawn from the player, the on/off switch at the other side of the cartridge is not completely disengaged when the cartridge lock arm reaches a detent point on the cartridge. Always withdraw the cartridge just beyond the detent point for normal operation from the radio.

Tape cartridges should be handled carefully and should be kept clean and out of direct sunlight. A cartridge should not be left inserted fully in the player. This may cause permanent damage to the cartridge.

1. TURN RADIO ON AND TUNE RADIO FOR WEAK STATION AT OR NEAR 1400 KC.
2. REMOVE RIGHT HAND KNOBS.
3. TURN VOLUME UP.
4. CAREFULLY TURN ANTENNA TRIMMING SCREW BACK AND FORTH UNTIL MAXIMUM VOLUME IS OBTAINED. SET TRIMMER AT PEAK VOLUME.

NOTE: ON CARS WITH POWER ANTENNA, TRIM WITH MAST FULLY EXTENDED.

Fig. 9-15R--Trimming Radio

ANTENNA TRIMMER ADJUSTMENT-ALL RADIOS (Fig. 9-15R)

The antenna trimmer adjustment must be made any time the radio is removed and installed, a new windshield or lead-in is installed or if weak, AM reception is noted. (Fig. 9-15R).

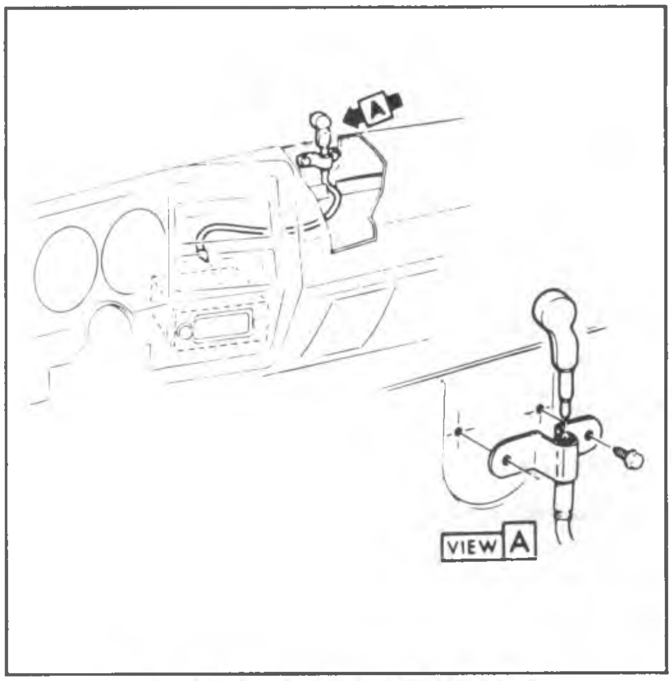


Fig. 9-16R--Antenna Lead (C-K Models)

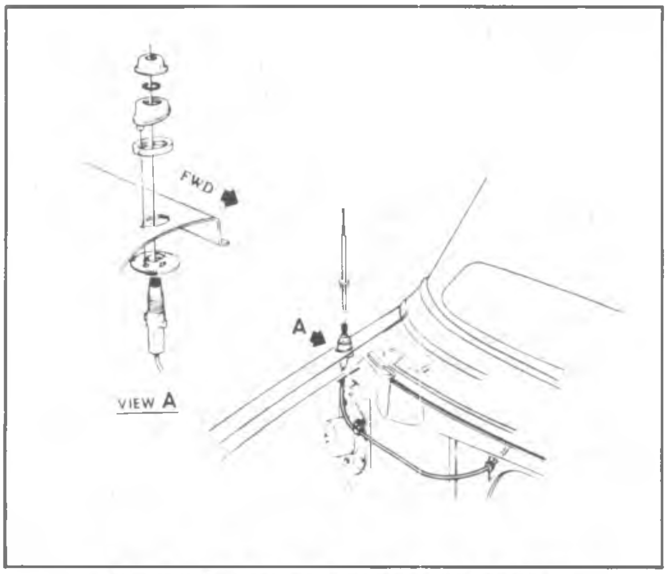


Fig. 9-17R--Antenna Installation (G Models)

COMPONENT PART REPLACEMENT

RADIO OR RADIO TAPE REMOVAL

(Refer to Section 8).

RADIO DIAL LAMP REMOVAL

(Refer to Section 8).

RADIO SPEAKER REMOVAL

(Refer to Section 8).

ANTENNA

C-K Models

Antenna Replacement

Refer to Section 2 of this manual "Windshield Replacement" procedure.

Cable Replacement (Fig. 9-16R)

1. Disconnect battery ground cable.
2. Unsnap antenna cable from windshield.
3. Remove bracket to dash panel screws.
4. Disconnect cable at rear of radio receiver and remove cable assembly.

G Models

Antenna Replacement (Fig. 9-17R)

1. Unscrew mast nut. Prevent the cable assembly from turning by using two separate wrenches. Remove rod and mast assembly.
2. To install, insert rod and mast assembly into cable assembly and tighten mast nut. Prevent cable assembly from turning by using a second wrench.

Cable Assembly Replacement (Fig. 9-17R)

1. Disconnect battery ground cable.
2. Remove antenna assembly as described above.
3. Remove cable body nut and then remove seal, bezel, gasket and ring ground.
4. Perform Steps 2-8 of "Radio Receiver Removal". Refer to Section 8.
5. Disconnect cable at rear of receiver.
6. Insert new cable through the dash panel (from the forward side).
7. Reverse Steps 1-5 above to complete installation.

   Be sure cable grommet is properly positioned in dash panel.

POWER ANTENNA

DESCRIPTION AND OPERATION

The power antenna used on "G" models operates automatically whenever the radio is turned on. The drive gear unit on the automatic system consists of a drive gear and pulley assembly and a spool for storing the excess nylon drive cable when the mast is in the retracted position, plus two limit switches and a gear operated cam system to actuate the switches. The limit switches are used to open the motor circuits when the mast reaches the full up or down positions.

When the motor circuit is completed by the radio or ignition switch, the motor drives the gear and pulley to extend the drive cable and antenna.

The gear is coupled to the drive pulley by a torque limiting clutch that permits continued gear rotation when the mast reaches the limit of travel. The antenna mast fully retracts into the fender or extends 31-1/4" and has no intermediate position.

POWER ANTENNA - G MODELS

Replacement (Fig. 9-18R and 9-19R)

1. Lower antenna by turning off radio or ignition.
2. Disconnect battery ground cable.
3. Remove coolant recovery bottle.
4. Remove motor lower bracket retaining nut and upper bracket screws.

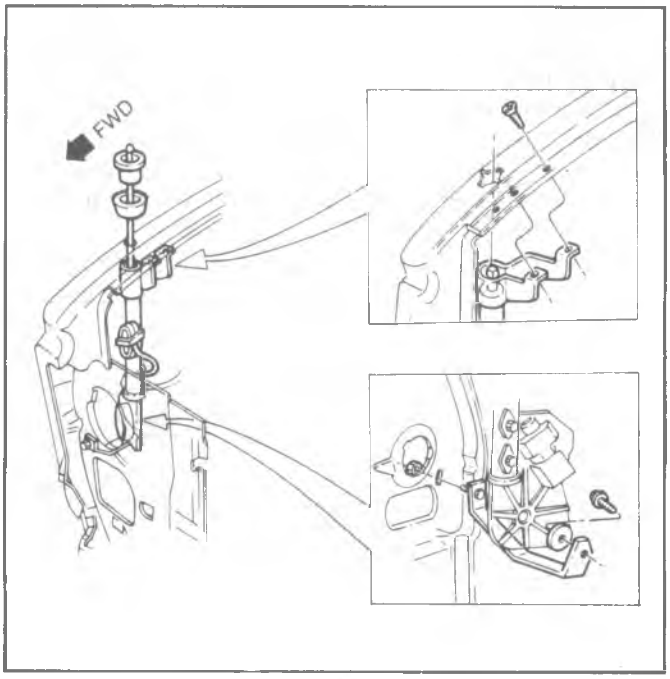


Fig. 9-18R--G Model Power Antenna

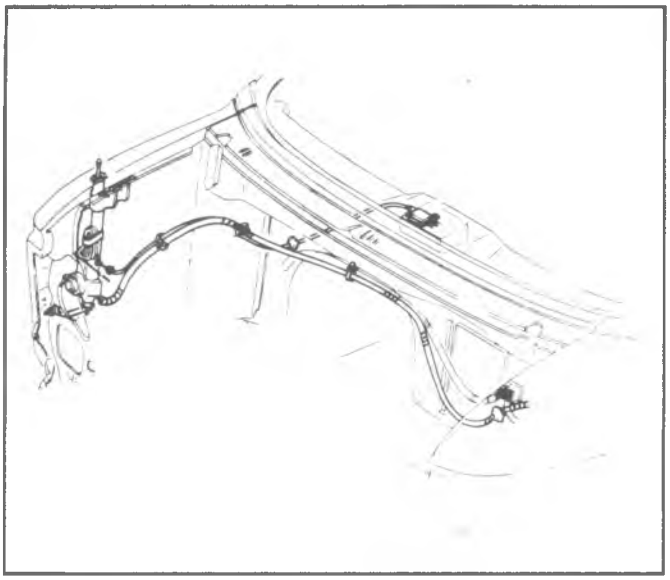


Fig. 9-19R--G Model Power Antenna Wiring

5. Disconnect electrical leads and remove antenna and motor assembly.
6. To install, reverse steps 1-5 above.

POWER ANTENNA RELAY

The power antenna relay is bracket mounted to the parking brake assembly as illustrated in figure 9-20R.

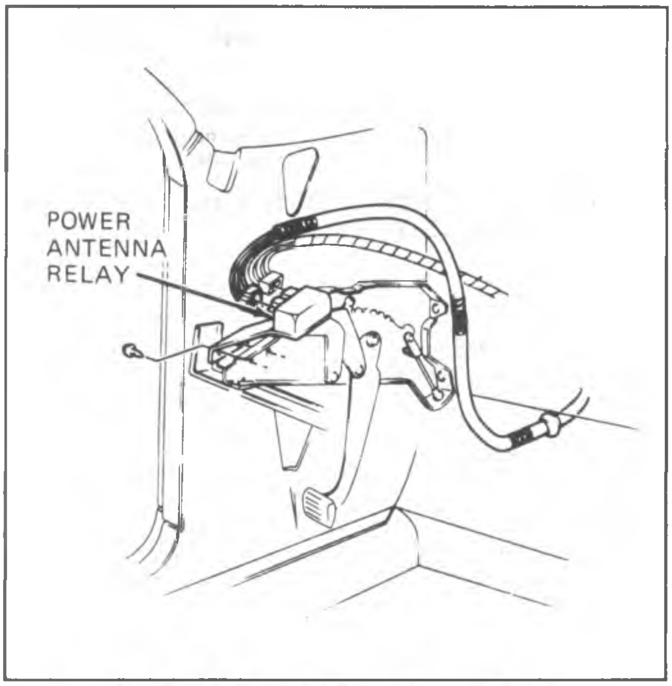


Fig. 9-20R--G Model Power Antenna Relay

POWER ANTENNA DISASSEMBLY-SLIMLINE

NOTICE: With the exception of load coil on the tri-band antenna, all service operations require opening the motor and gear housing. All disassembly will require a bolt and clip package.

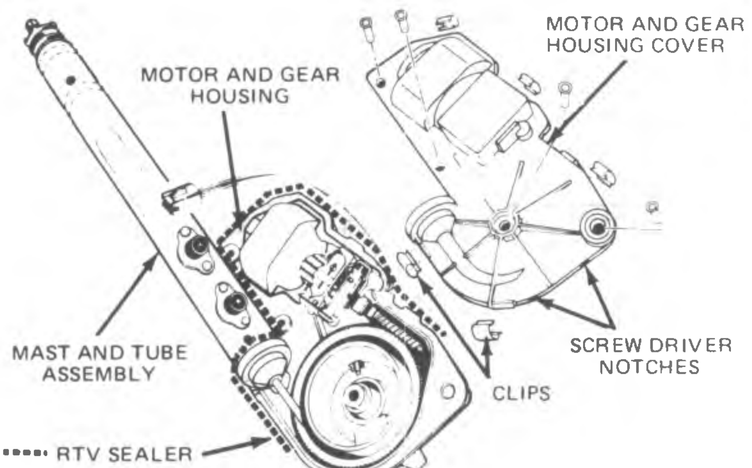
1. REMOVE AND INSTALL MOTOR AND GEAR HOUSING COVER.

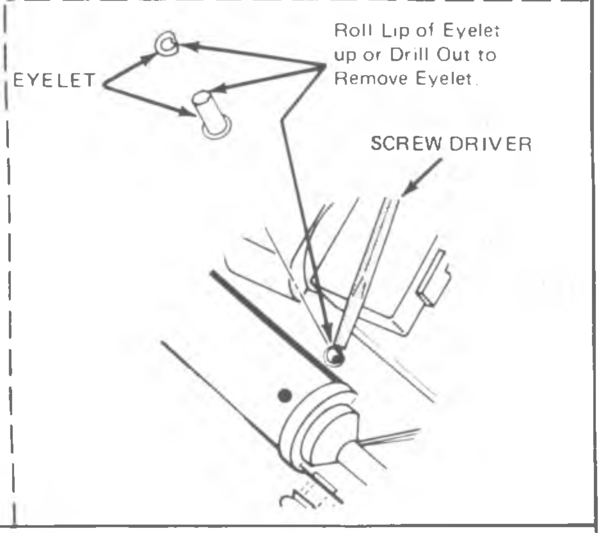
REMOVAL

1. Remove parts shown.
2. Seperate housing and cover as shown.

INSTALL

1. Re move loose or excess sealer and reassemble using 3 bolts and nuts, from service package and the 5 clips.
2. Apply RTV sealer around support tube and along seam on top half of housing.





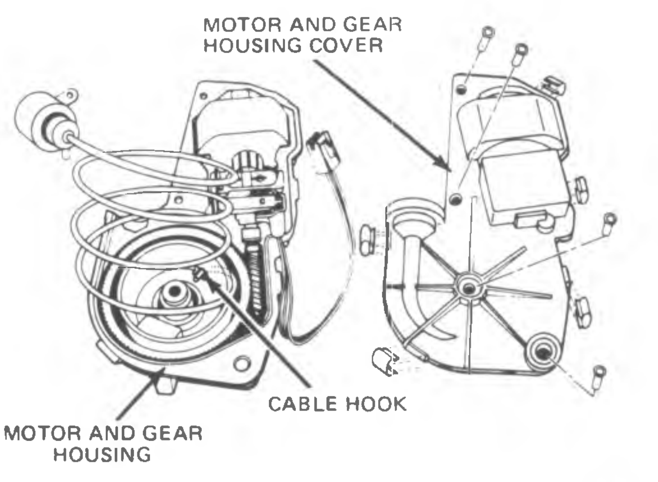
2. REMOVE AND INSTALL MAST AND TUBE ASSEMBLY.

REMOVAL

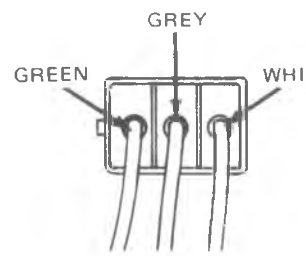
1. Remove parts as shown.

INSTALL

1. Reassemble as shown with mast extended to reduce length of cable.
2. Run motor to lower mast into support tube. Reseal housing and support tube.



Disengage cable from gear by rotating cable 90°



CONNECT BATTERY LEADS

TO RAISE	**TO LOWER**
GREEN +	WHITE +
GREY −	GREEN −

Fig. 9-21R--Slimline Disassembly I

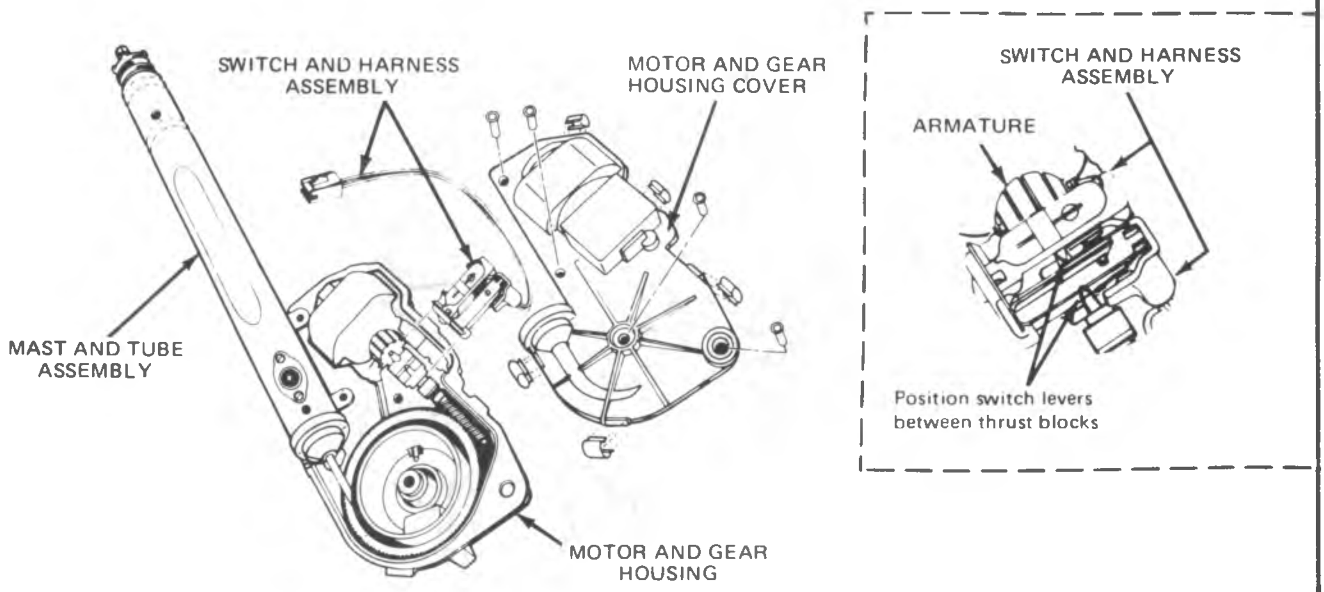
3. REMOVE AND INSTALL SWITCH AND HARNESS ASSEMBLY.

REMOVAL

1. Remove parts as shown.
2. Remove excess sealer where wire goes through housing.

INSTALL

1. Position switch.
2. Reseal area where wires come out of housing. Reseal housing.



4. REMOVE AND INSTALL ARMATURE AND MAGNET ASSEMBLY.

REMOVAL

1. Remove parts as shown.
2. Cleanout old grease.

INSTALL

1. Lubricate worm and gear with lithium soap grease such as Sun Oil Prestige #2 or equivalent.
2. Apply drop of light oil to bearings.
3. Reassemble and seal housing.

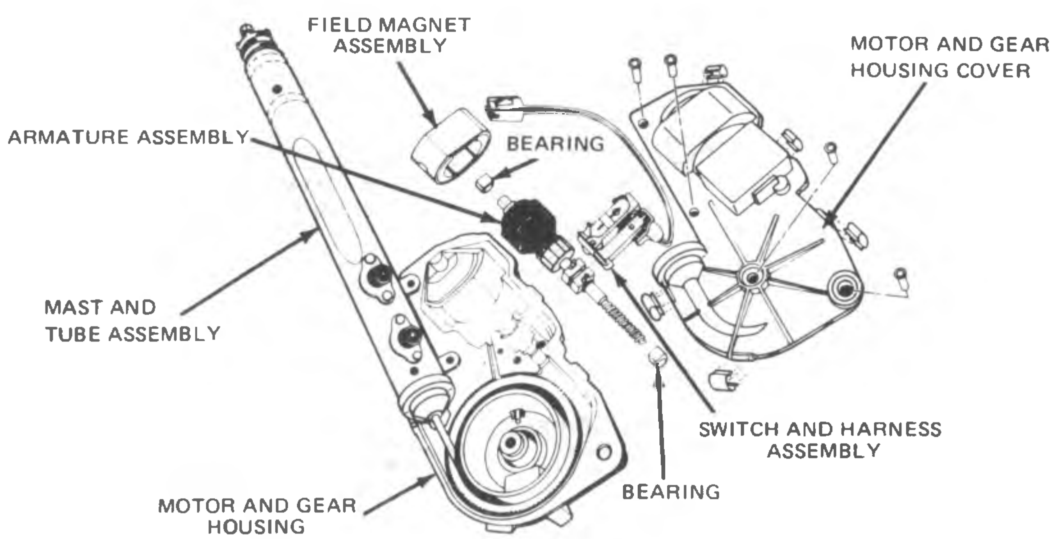


Fig. 9-22R--Slimline Disassembly II

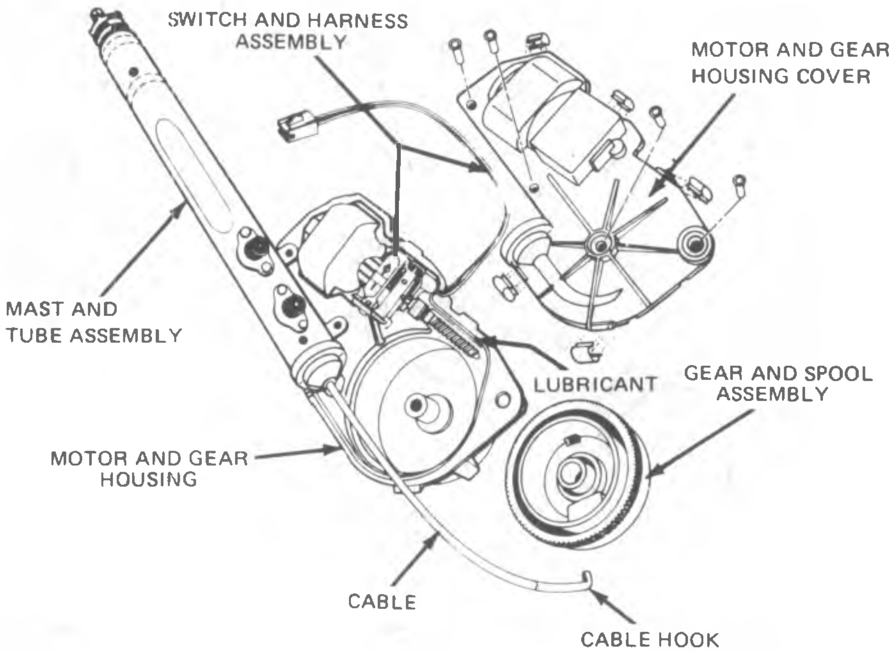
5. REMOVE AND INSTALL GEAR ASSEMBLY.

REMOVAL

1. Disassemble as shown.
2. Clean out old lubricant.

INSTALL

1. Apply lubricant to worm and gear.
2. Reassemble and seal housing.



6. REMOVE AND INSTALL CB LOAD COIL AND/OR TIP.

REMOVAL

1. Disconnect Neg. Battery Cable.
2. Turn on ignition and radio then connect battery long enough to raise antenna about half way.
3. Remove parts as shown using padded pliers.

INSTALL

1. Reassemble as shown using thread cement to lock in place.
2. Adjust S.W.R. (See SWR adjustment procedure)

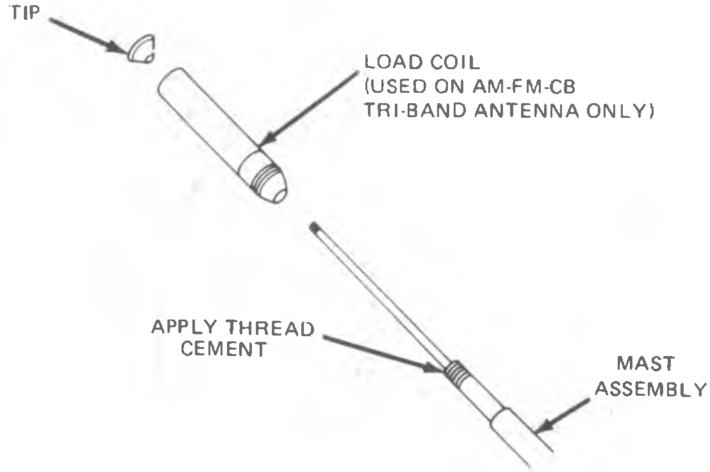


Fig. 9-23R--Slimline Disassembly III

SECTION 10

CAB AND BODY

NOTICE Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque valves must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 10.

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Specifications 10-63
Special Tools 10-65

GENERAL DESCRIPTION

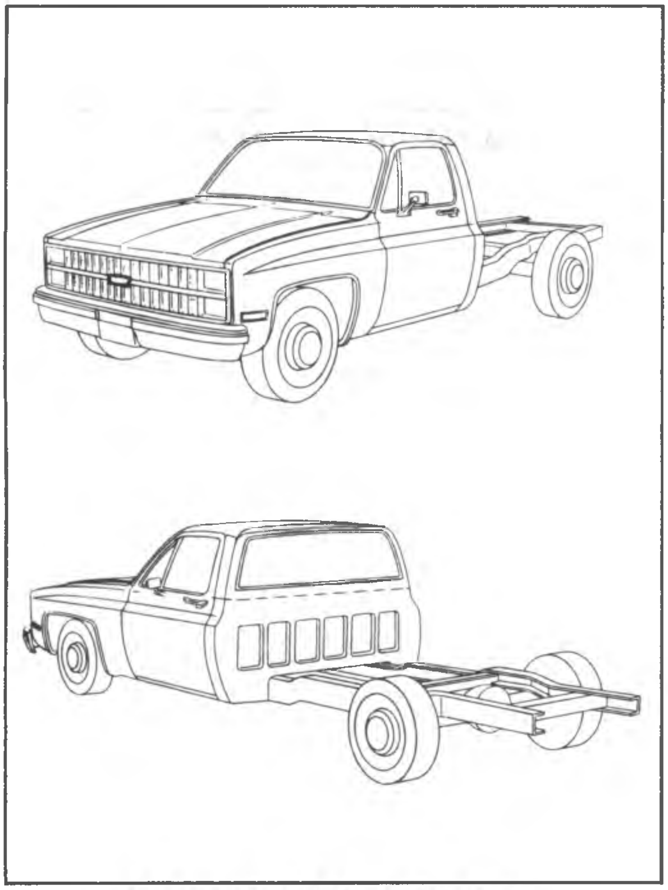

Fig. 10-1 --Typical Chassis/Cab Model

On the following pages, service procedures will be given for components on all 10-20-30 series trucks in C, K and G models. Reference will be made, both in text and illustrations, to vehicle model lines and to individual model numbers within these model lines.

As an aid to identification of specific models, the following general descriptions are given.

Chassis/Cabs

Chassis cab models see figure 10-1. Two-wheel drive units come in C10, C-20 and C-30 series. Four-wheel drive units may be either K-10 or K-20. Optional pickup boxes are available.

Crew Cab/Chassis

Crew cab/chassis models see figure 10-2. Optional pickup boxes are available.

Suburban

Suburban model see figure 10-3. Base models have rear cargo doors. An optional endgate with moveable window is available.

Utility

Utility vehicle models see figure 10-4. Are available with a removable roof or a convertible roof.

Vans

G-Series Vans are available in three models See figures 10-5 and 10-6. Vans without body windows and/or passenger seats, sport vans with body windows and passenger seats and commercial cutaway vans as shown in figure 10-6.

Anti-Corrosion Information

"Anti-corrosion materials have been applied to the interior surfaces of some metal panels to provide rust resistance. When servicing these panels, areas on which this material has been disturbed should be properly recoated with service-type anti-corrosion material."

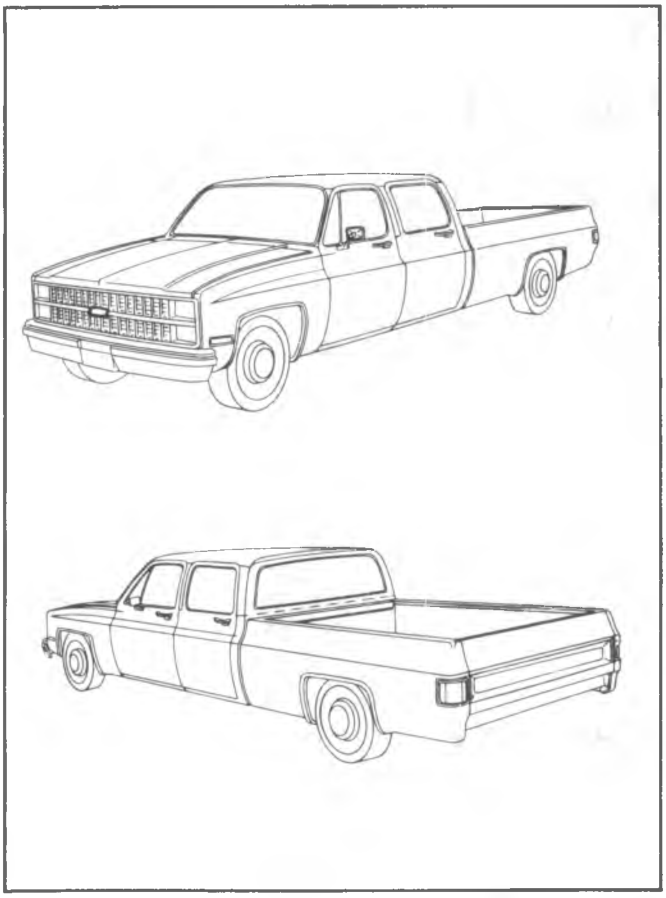

Fig. 10-2--Typical Crew Cab/Chassis Model

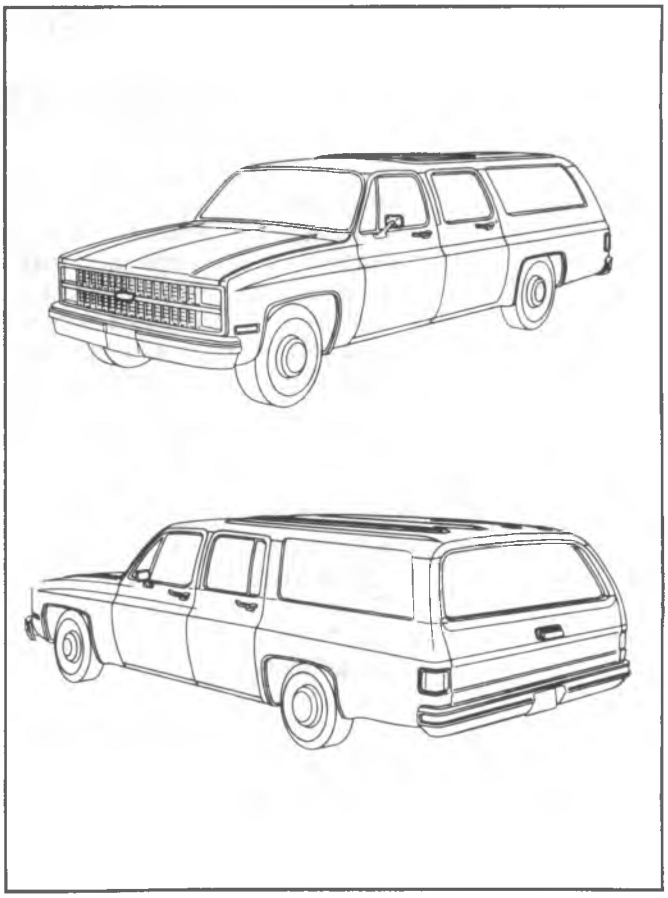

Fig. 10-3--Typical Suburban Model

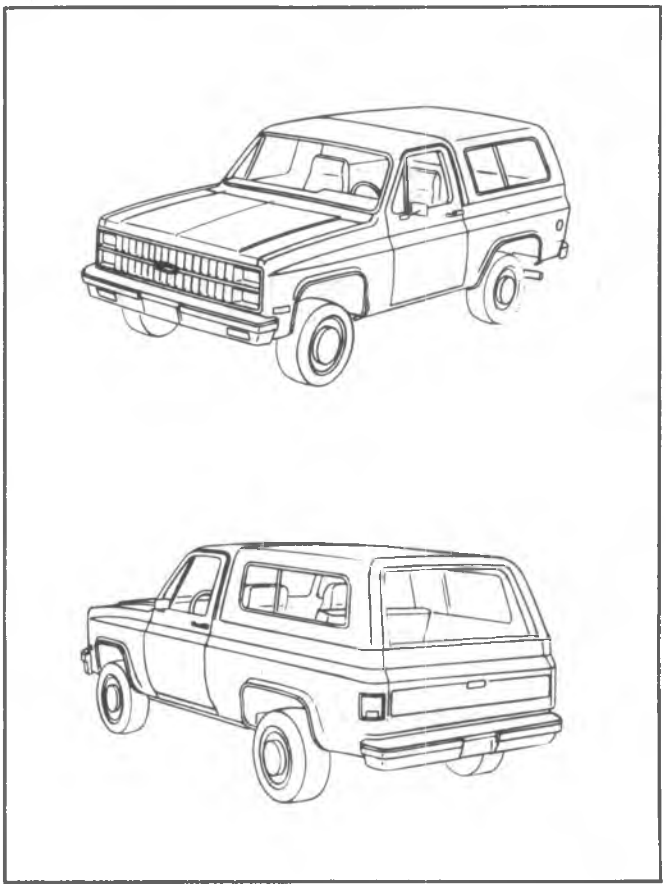

Fig. 10-4--Typical Utility Vehicle Model

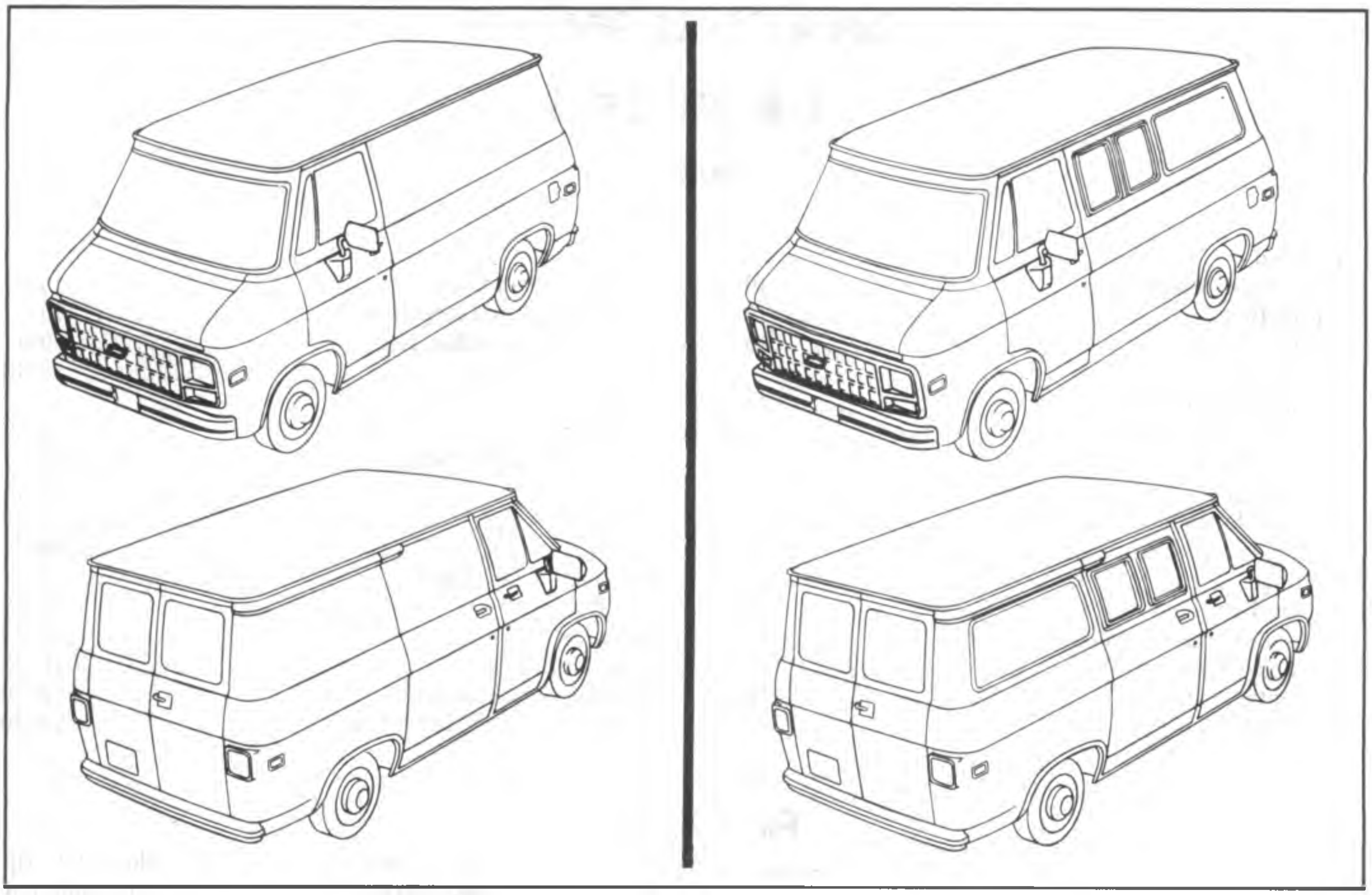

Fig. 10-5--Typical Vans and Sport Vans Models

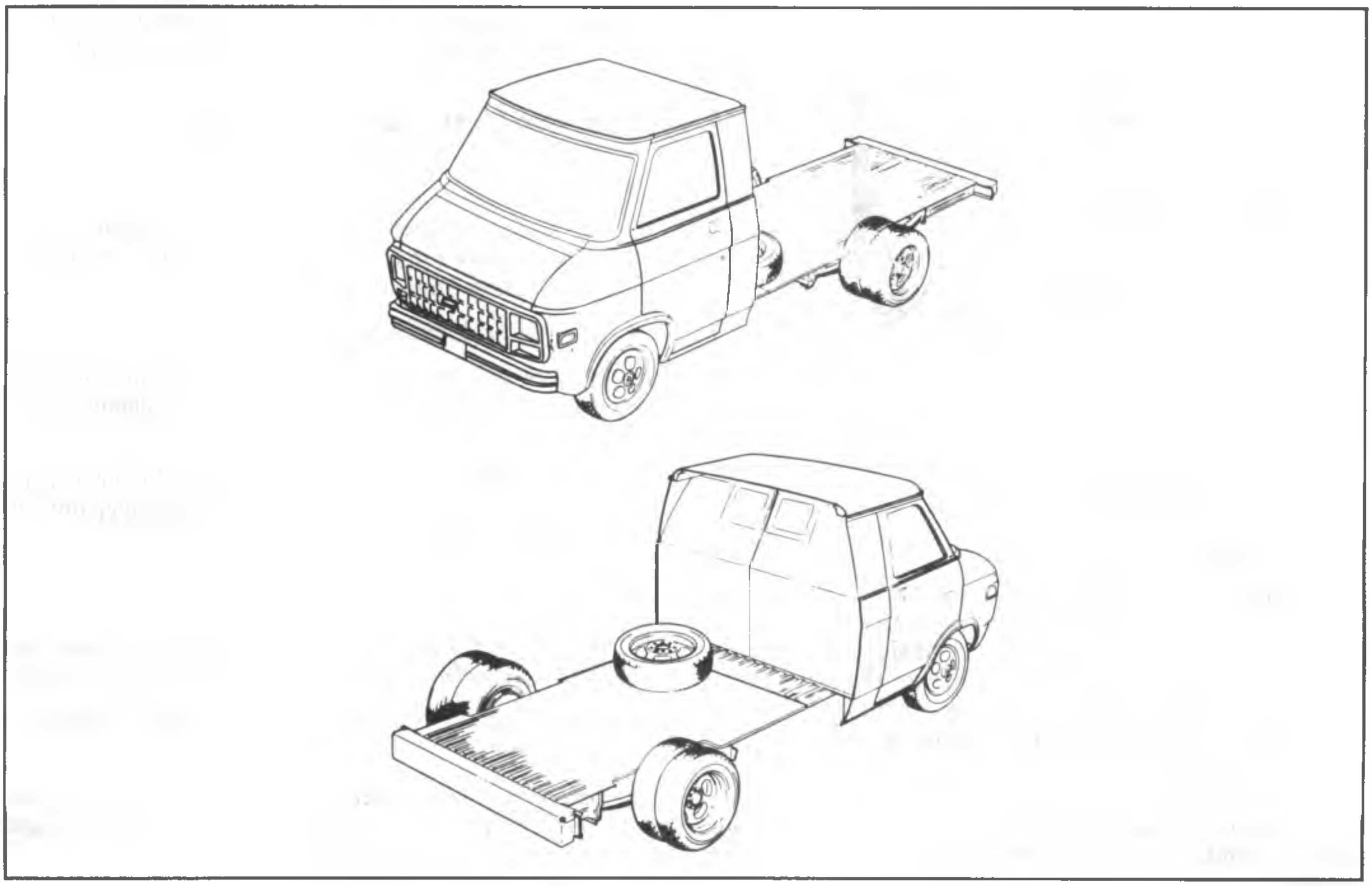

Fig. 10-6--Typical Commercial Cutaway Model Van

ON VEHICLE SERVICE

C-K MODELS

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FRONT END

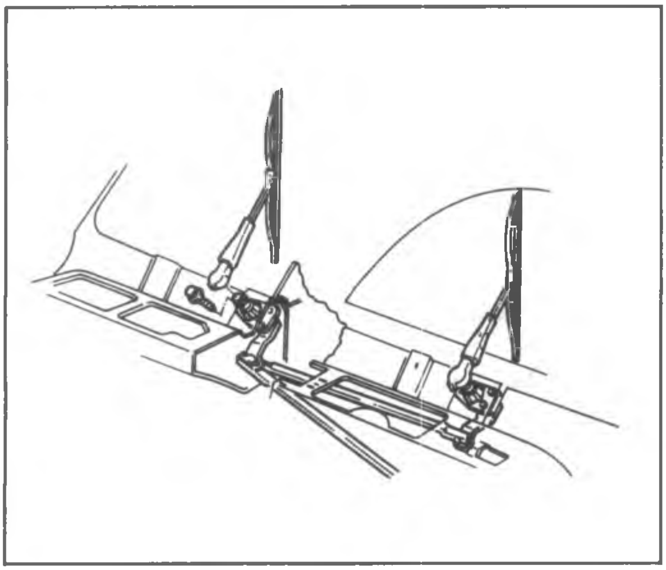

Fig. 10-7 --Windshield Wipers

WINDSHIELD WIPERS

Windshield wiper units on all models are of the two-speed electric type. A single wiper motor unit, mounted to the left side of the dash panel inside the engine compartment, powers both wiper arms. The wiper arm operating link rods and pivot mountings on these models are located in the outside air inlet plenum chamber.

Arm Adjustment

To adjust sweep of blades, turn on wipers and note sweep of arms. If necessary, remove one or both arms as follows:

Pull outer end of arm away from glass which will trip lock spring at base of arm and release spring from undercut of pivot shaft. While holding arm in this position, pull outward on cap section at base of arm to remove arm. Arm can be reinstalled in any one of several positions due to serrations on pivot shaft and in arm cap. See figure 10-7.

Wiper Arm Pivot Shafts and Linkage

Removal

1. Remove windshield wiper arms from pivot shafts. Procedure for removing arms is explained previously under "Arm Adjustment".
2. Remove cowl ventilator grille.
3. Remove two nut and lock washer assemblies from the connector link to motor drive arm via the plenum access hole.
4. Remove two screws from each transmission pivot shaft assembly to windshield frame. Remove wiper linkage and transmission from plenum.

Installation

1. Place wiper linkage and transmission into position. Secure assembly with two screws at each transmission.
2. Attach end of cross rod to drive arm of motor assembly. Secure rod.
3. Before installing wiper arms or cowl ventilator grille, operate wiper motor momentarily which should rotate pivot shafts to park position.
4. Install arms, grille and shafts.

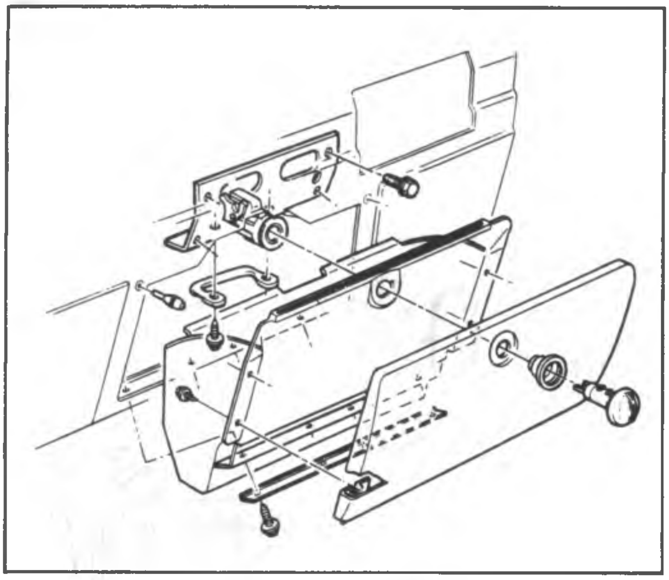

Fig. 10-8 --Glove Box

INSTRUMENT PANEL COMPARTMENT AND LOCK

Replacement

Removal of the entire assembly including door may be accomplished by removing four screws which attach hinge just below box. See figure 10-8. The outer door panel may be removed, leaving the compartment intact, by removal of four screws. Access to the door stop bumper is gained by reaching into compartment opening with door partially open.

Adjustment

Engagement of lock in striker may be adjusted by loosening striker retaining screws and moving the striker to desired position.

OUTSIDE REAR VIEW MIRRORS

Rear view mirror installations are shown in figure 10-9, 10-10 and 10-11. Occasional tightening of mounting and assembly bolts and screws will sharply decrease occurrence of failure due to door slamming or road shock.

Camper mirror installation is similar to the below eyeline mirror installation.

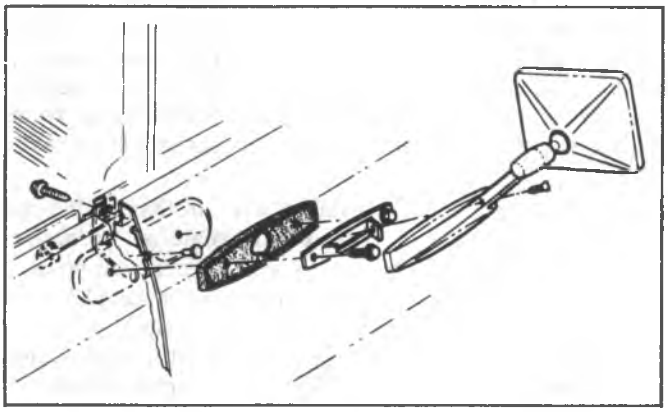

Fig. 10-9--Rear View Mirror - Base

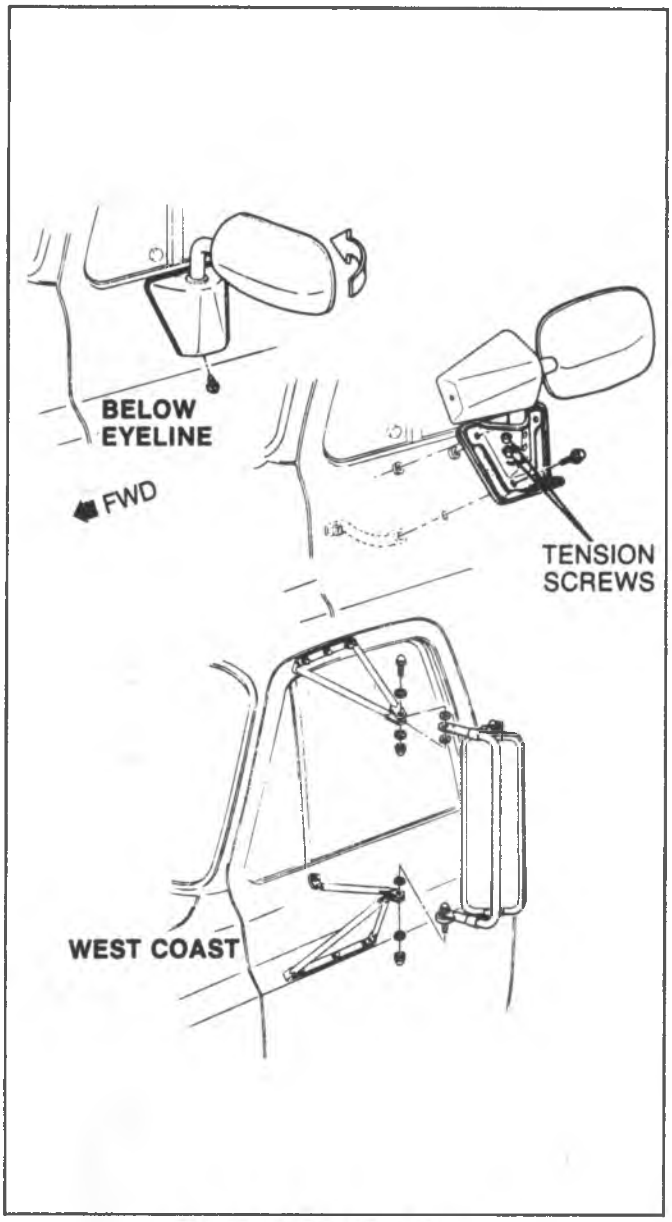

Fig. 10-10--Rear View Mirrors

INSIDE REAR VIEW MIRROR - FIGURE 2D-11

Replacement

1. Remove screw retaining mirror to its glass-mounted bracket and remove mirror.
2. Install mirror into its mounting bracket. Torque screw to specifications.

COWL VENT VALVE - FIGURE 10-12

Two styles are shown in Figure 10-12. Removing the attaching screws allows removal of the valve from the side panels.

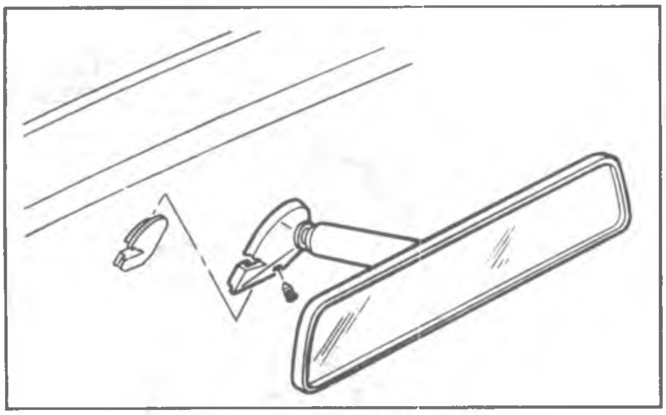

Fig. 10-11--Inside Rear View Mirror

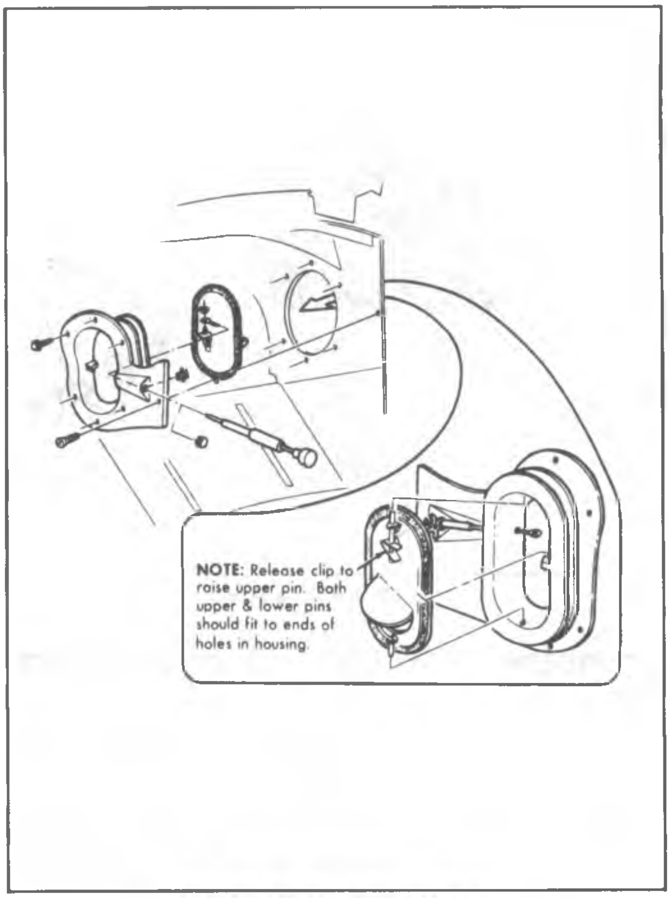

Fig. 10-12--Cowl Vent Valves

BODY GLASS

CAUTION: Always wear gloves and eye glasses when handling glass to avoid personal injury.

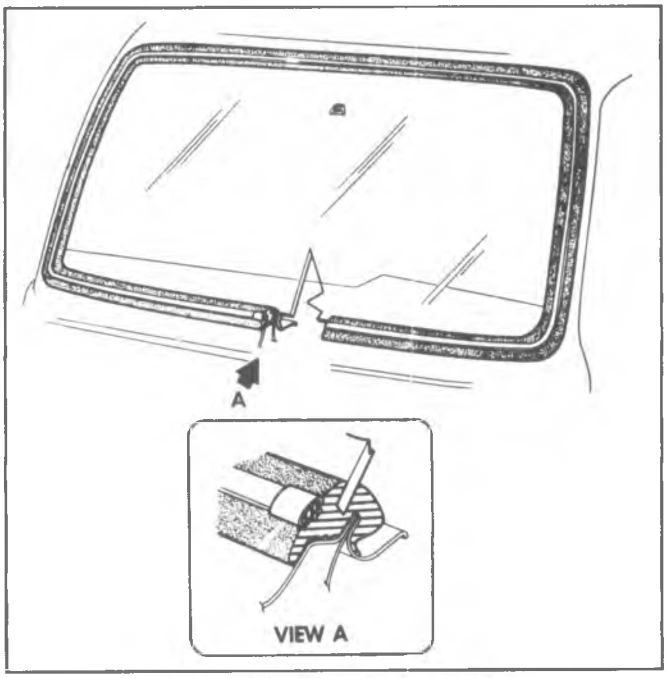

Fig. 10-13--Typical Windshield

CK TRUCK WINDSHIELD REPLACEMENT

The windshield is a one-piece type and is retained in the windshield opening by a urethane bonded rubber weatherstrip. See figure 10-13.

When replacing a cracked windshield glass, it is very important that the cause of the glass breakage be determined and the condition corrected before a new glass is installed. Otherwise, it is highly possible that a small obstruction or high spot somewhere around the windshield opening will continue to crack or break the newly installed windshield especially when the strain on the glass caused by this obstruction is increased by such conditions as wind pressures, extremes of temperature, motion of the vehicle, etc.

To replace a window installed with urethane adhesive requires replacement of the adhesive material. Adhesive service kit No. 9636067 contain some of the materials needed to remove and replace a urethane adhesive installed glass. These kits and other materials that may be required can be obtained through the service parts system. The components of glass adhesive kit (urethane) No. 9636067 are as follows:

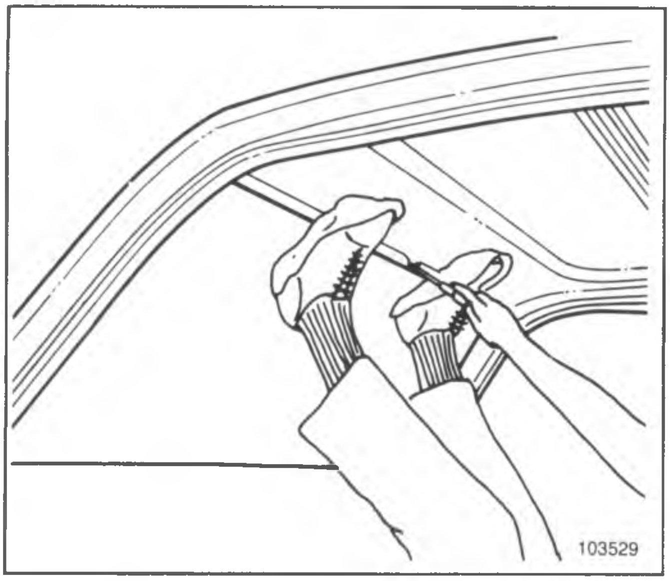

Fig. 10-14--Applying Pressure to Windshield

1. One tube of urethane adhesive material.
2. One dispensing nozzle.
3. Steel music wire.
4. Rubber cleaner.
5. Rubber primer.
6. Pinch-weld primer.
7. Blackout primer.
8. Filler strip (for use on windshield installations on vehicles equipped with embedded windshield antenna).
9. Primer applicators.

Additional Material Required:

1. Rubber lubricant No. 1051717 (available through the service parts system).
2. Alcohol for cleaning edge of glass.
3. Adhesive dispensing gun No. J-24811 or a standard household cartridge type gun reworked as follows:
   a. Widen end slot to accept dispensing end of adhesive material tube.
   b. Reduce diameter of plunger disc on rod so that disc can enter large end of adhesive material tube.
4. Commercial type razor knife (for cutting around edge of glass).
5. Weatherstrip tool set J-2189.
6. Six glass spacers J-22577 (for checking windshield glass to opening).

Removal

1. Before removing the windshield, mark the location of the break on the windshield rubber channel and the body. Protect the paint finish inside of the cab. Mask around the windshield opening and outside, lay a suitable covering across the hood and fenders.
2. Remove windshield reveal molding (lock strip) and reveal molding cap.
3. To free windshield rubber channel of weatherstrip loosen the lip of the windshield weatherstrip from the pinchweld flange along the top and at the sides by applying firm, controlled pressure to the edge of the glass. At the same time assist the lip of the rubber weatherstrip channel over the pinchweld flange with a flat bladed tool. See figures 10-14 and 10-15.
4. With the aid of an assistant outside the cab, remove the windshield from the opening. See figure 10-16.
5. Remove all excess urethane adhesive and any remaining pieces of weatherstrip from pinch-weld flange.
6. If sheet metal and paint repairs are required, refer to "Repairing and Refinishing Pinchweld Flange" of this section.

Checking Windshield Opening

Due to the expanse and contour of the windshield it is imperative in the event of a stress crack that the windshield opening be thoroughly checked before installing a replacement windshield. The replacement glass is used as a template.

1. Check for the following conditions at the previously marked point of fracture.
   a. Chipped edges on glass.
   b. Irregularities in body opening.
   c. Irregularities in rubber channel weatherstrip.
2. Check flange area for solder, weld high spots, or hardened spot-weld sealer. Remove all high spots.
3. Check windshield glass to opening, by supporting glass with six spacers contained in packet J-22577. See figure 10-17.

   NOTICE: Do not strike glass against body metal. Chipped edges on the glass can lead to future breaks.
4. With the windshield supported and centered in its opening, check the relationship of the glass to the body opening flange around the entire perimeter of the glass.
5. Check the relationship of glass to opening as follows:
   a. Inside edge of glass to body flange.
   b. Outer edge of glass to parallel body metal.
6. Mark areas of body metal or flange to be reformed. Remove glass and correct as outlined in this section.

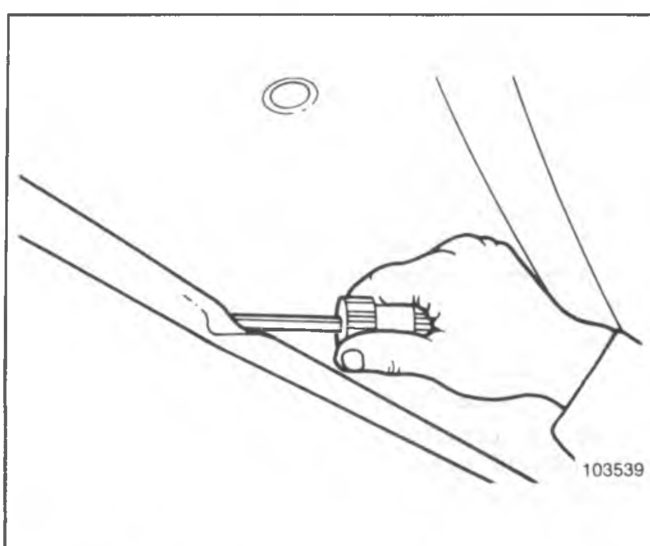

Fig. 10-15--Assisting Weatherstrip over Flange

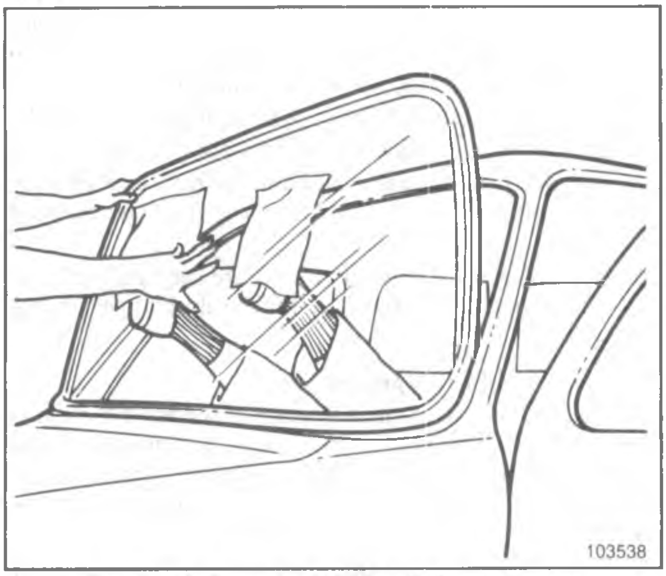

Fig. 10-16--Removing Windshield from Opening

7. Recheck windshield in its opening and if satisfactory proceed as follows:

Repairing and Refinishing Pinch-Weld Flange and/or Surrounding Areas

1. Repair all metal deformations in the windshield opening area for appearance.
2. Sand to smooth surface using No. 320 sandpaper.
3. Apply primer - surfacer (DuPont 80 S Primer - Surfacer, PPG 204-1000 Red Flash Primer or PPG 700-345 - Repair Primer/or equivalent) and sand smooth for required surface.
4. Apply color coats of 9984024 acrylic enamel (or equivalent) catalyzed as indicated.

Installation (Fig. 10-18)

Installation of the windshield requires a number of timed (cure time) steps. This timing is important and must be followed. All cure times are minimum, unless indicated otherwise. When performing a step that requires a cure time, it is not necessary to stop and wait for the cure time to elapse. Make a note of the cure time and move on to any following step that does not interfere with the timed sequence.

1. Wipe pinch-weld clean with a dry cloth. Make sure most of the previous urethane has been removed.
2. Apply pinch-weld primer with a new applicator to pinch-weld as shown in View B.

   Primer must be thoroughly stirred and agitated prior to application.

   Allow primer to cure for at least 30 minutes (100 hour maximum). Pinch weld flange must not exceed 160°F (38°C) at time of primer application.
3. Apply rubber cleaner with a new applicator to both channels of rubber weatherstrip as shown in View A. Allow cleaner to remain for at least 5 minutes (4 hour maximum), then wipe both channels with a clean dry cloth.
4. Apply rubber primer to both channels of rubber weatherstrip that were cleaned in the previous step and are shown in View A. Allow primer to cure for at least 30 minutes (30 day maximum).
5. Thoroughly clean surface of glass to which blackout primer will be applied (around edge of inside surface) by wiping with a clean, alcohol dampened cloth. Allow to air dry.

   NOTICE: When cleaning windshield glass, avoid contacting edge of plastic laminate material (on edge of glass) with volatile cleaner. Contact may cause discoloration and deterioration of plastic laminate by wicking action. DO NOT use a petroleum base solvent such as kerosene or gasoline. The presence of oil will prevent adhesion of new material.
6. Apply blackout primer to the same area of the windshield glass that was cleaned in the previous step and is shown in View C. Allow to dry to touch.
7. Apply a 3/16 inch minimum diameter bead of urethane adhesive around pinch-weld flange as shown in View B. Windshield glass must be installed within 20 minutes after performing this step.
8. Apply a mist of plain water to the urethane bead on the pinch-weld flange, wetting it fully.
9. Install rubber weatherstrip to the pinch-weld flange.
10. Apply a 3/16 inch minimum diameter bead of urethane adhesive to rubber weatherstrip glass channel as shown in View D.
11. Apply a mist of lubricant to surface "C" or weatherstrip as shown in View D, wetting it fully. Install windshield within 5 minutes after performing this step.
12. On windshields equipped with embedded antenna, tape pigtail of antenna to inside surface of windshield glass in a convenient and accessible position.
13. With the aid of a helper, lift glass into window opening. Suction cups may be used but are not mandatory. Then, install glass in channel of weatherstrip.
14. Apply lubricant to lockstrip channel. Windshield must be seated prior to application of lubricant.

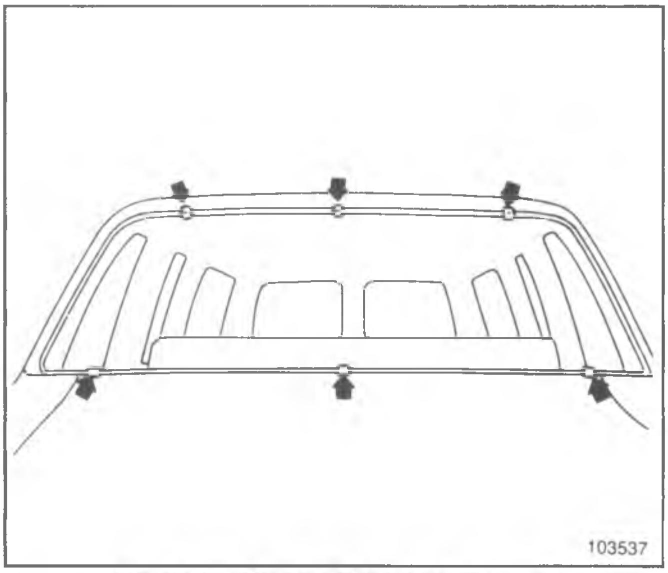

Fig. 10-17--Checking Windshield Opening

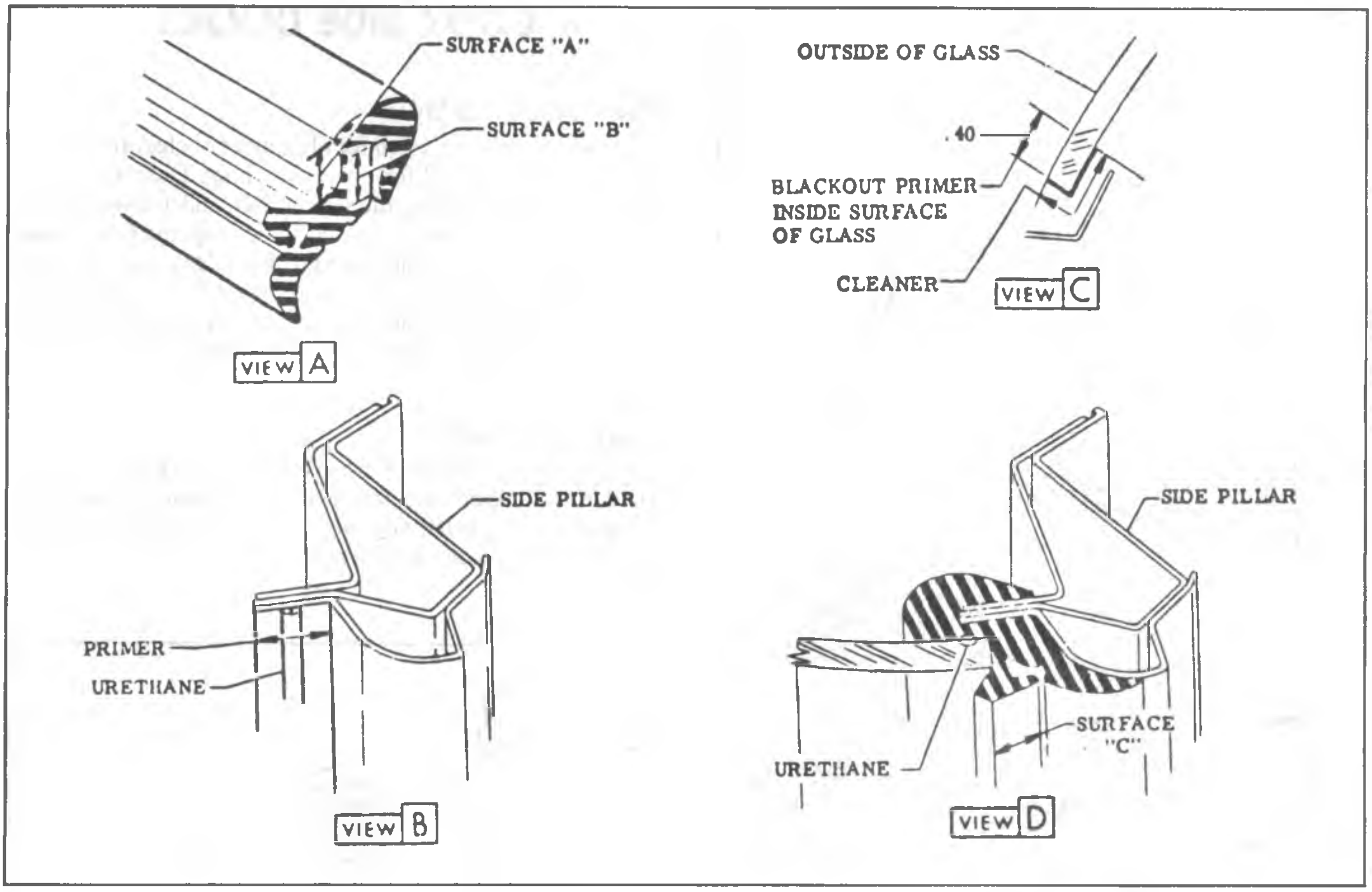

Fig. 10-18--Windshield Installation-CK Truck

15. Use J-2189 weatherstrip tool set and install lockstrip in channel of weatherstrip. Install lockstrip cap at lockstrip joint.
16. Install windshield wiper arms and blades.
17. On windshields equipped with embedded antenna, connect antenna pigtail to radio antenna lead.
18. Install inside trim panels.
19. Install rear view mirror to windshield.

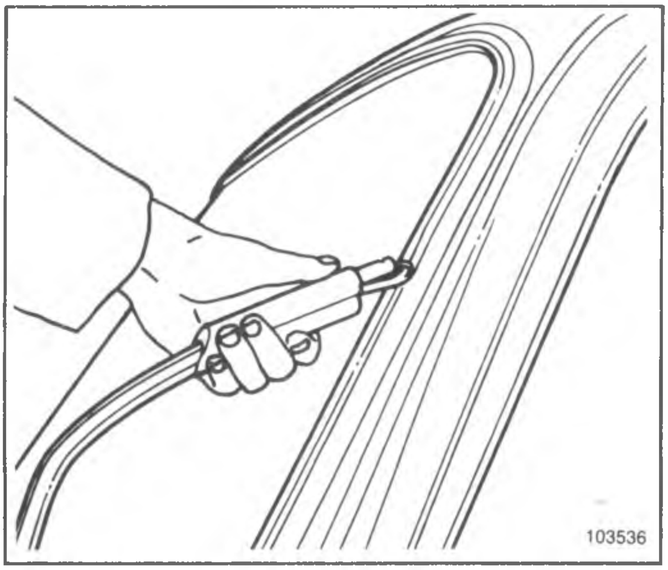

Fig. 10-19--Installing Reveal Molding

STATIONARY BODY GLASS

Replacement

The method used to remove the windshield glass may be applied to other stationary glass, such as shown in figures 10-20 and 10-21. Remember to check for cause of breakage, and to always wear gloves when handling glass. Installation procedure is similar to "Windshield Replacement" found earlier in this section with exception of steps relating to urethane adhesive.

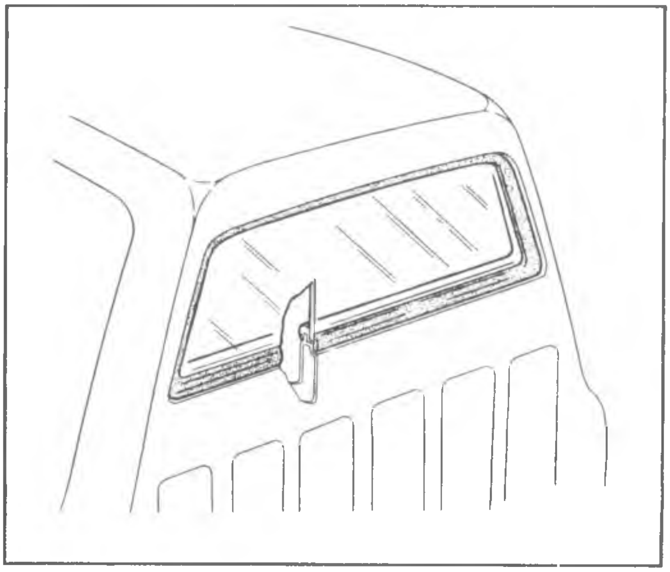

Fig. 10-20--Back Window Glass

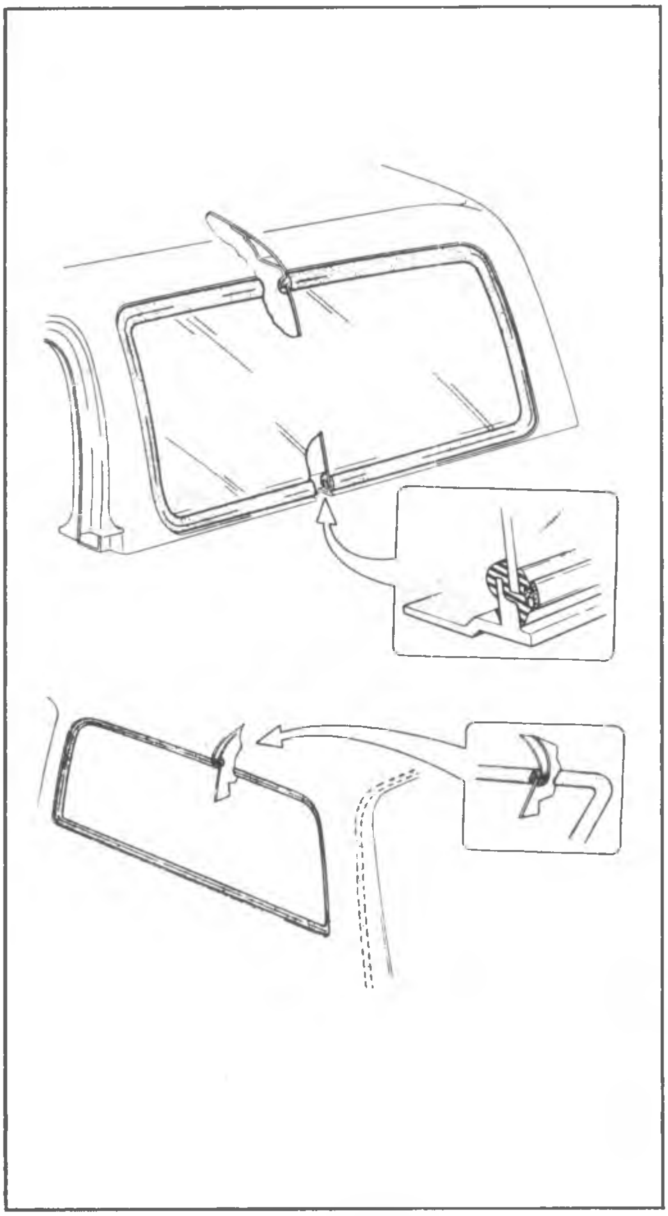

Fig. 10-21 --Body Side Window

BODY SIDE DOORS

DOOR ADJUSTMENTS

Doors can be adjusted for alignment of clearance in the cab door opening, and for proper latching. Door alignment adjustments are made at the striker bolt, and at door hinges. The door, when properly located in door opening, will have .19 inch clearance at the top and side edges, and .25 inch clearance at the bottom. The door should be adjusted in the opening so the edge of the door across the top and also at the lock side is parallel with the body opening as nearly as possible.

Hinge Adjustment

Door hinge bolt holes are oversized to make adjustment possible. Alignment adjustments can be made by loosening the proper hinge bolts, aligning door to proper position, and tightening bolts securely (fig. 10-22).

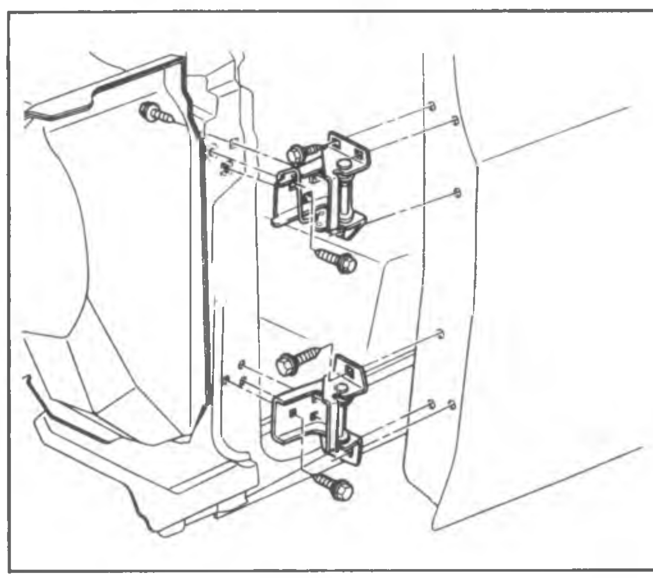

Fig. 10-22--Door Hinge

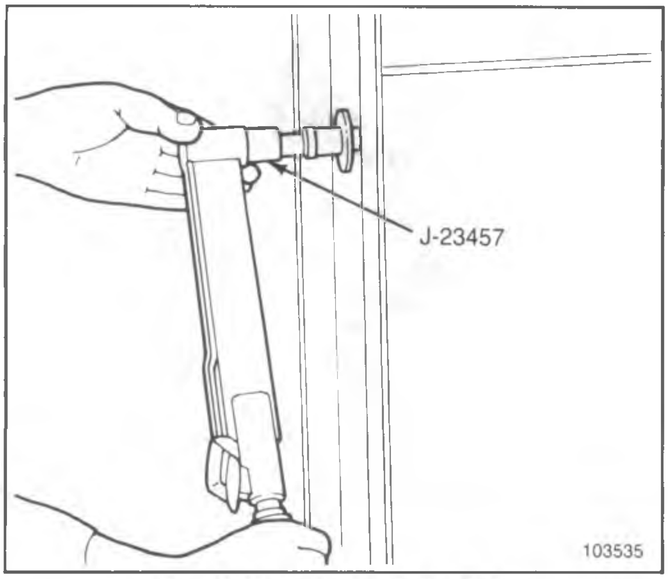

Fig. 10-23--Loosening Striker Bolt

Striker Bolt Adjustment

With the use of J-23457, shown in figure 10-23, the striker bolt can be adjusted in any of three ways. See figure 10-24.

1. **Up and down** - To adjust striker up or down, loosen bolt, adjust to desired height, and tighten bolt securely.

   This adjustment is important to assure that the right proportion of door's weight will rest on striker bolt when door is closed. If bolt is positioned too high on pillar, rapid wear will occur to the lock cam; if too low, an extra load will be placed on door hinges as well as pull door downward and out of alignment.
2. **In and Out** - To adjust striker in and out, loosen bolt, adjust horizontally to desired position and tighten bolt securely.
3. **Forward and Rearward**--To make this adjustment, loosen striker bolt, shim to desired position, and tighten bolt securely.

FRONT SIDE DOOR

Replacement

Remove the door assembly from the body by removing the hinge-to-door attaching bolts.

DOOR HINGE

The door check is part of the front door upper hinge. The front door torque rod check holds the door in either of two positions between full open and closed. The front door check-hinge assembly is replaced as a complete unit as follows. See figure 10-22.

Removal

1. Loosen front fender rear bolts.
2. With special Tool J-22585 remove 3 bolts securing front door upper hinge to cowl pillar.
   a. Remove the door to upper hinge retaining bolts.
   b. With aid of an assistant to support weight of door, remove the door to lower hinge retaining bolts and remove door.

Installation

1. Install hinge snugly on pillar in same location as hinge removed.
2. With the aid of an assistant fasten the door to the hinge.
3. Adjustment of the door lock and striker plate should be made after the door is positioned in the opening.

DOOR TRIM PANELS - CK MODELS

Removal

1. Using tool J-9886-01, remove clip retaining window crank (fig. 10-26).
2. Remove door lock knob.
3. Remove (4) screws securing lower edge of trim panel.
4. Remove (2) arm rest attaching screws and remove arm rest pad.
5. Remove (1) screw at door handle cover plate and (1) screw located under arm rest pad.
6. If equipped assist strap, remove (2) screws retaining assist strap.
7. Remove trim panel by carefully prying out at trim retainers located around perimeter of panel.

Installation

Before installing door trim assembly, check that all trim retainers are securely installed to the assembly and are not damaged.

1. To install door trim assembly, pull door inside handle inward; then position trim assembly to inner panel, inserting door handle through handle hole in panel.
2. Position trim assembly to door inner panel so trim retainers are aligned with attaching holes in panel and tap retainers into holes with a clean rubber mallet.
3. Install previously removed items.

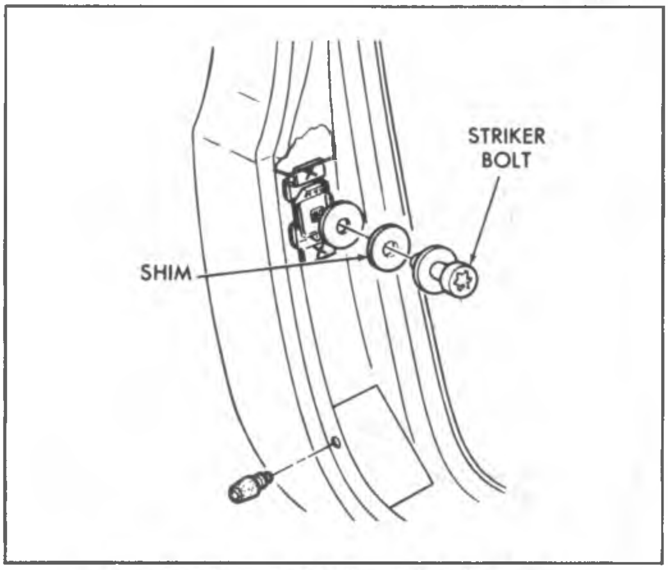

Fig. 10-24--Typical Striker Bolt Adjustment

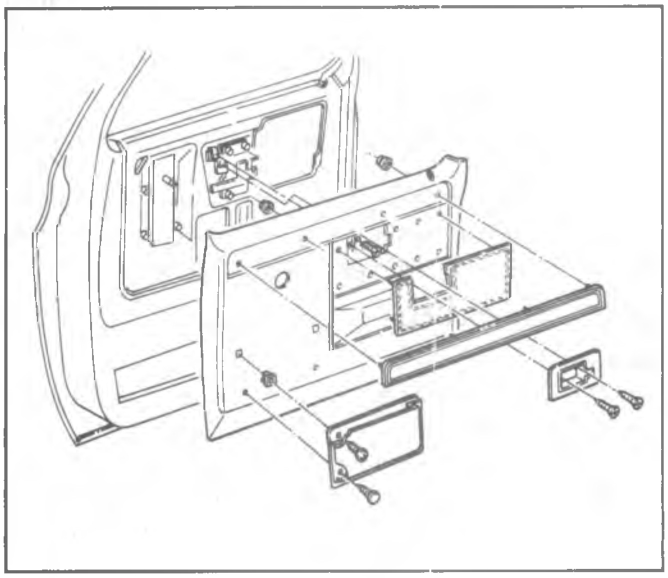

Fig. 10-25--Door Trim Panel

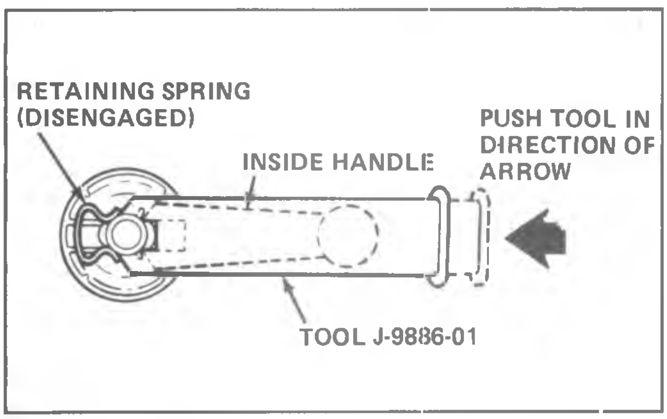

Fig. 10-26--Clip Retained Inside Handle Removal

DOOR VENTILATOR ASSEMBLY--Fig. 10-28

Removal

The channel between the door window glass and door vent is removed as part of the vent assembly.

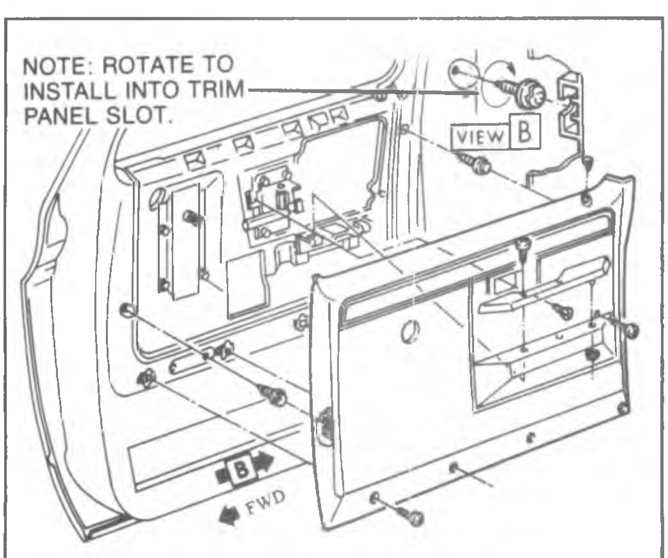

Fig. 10-27--Door Trim Pad

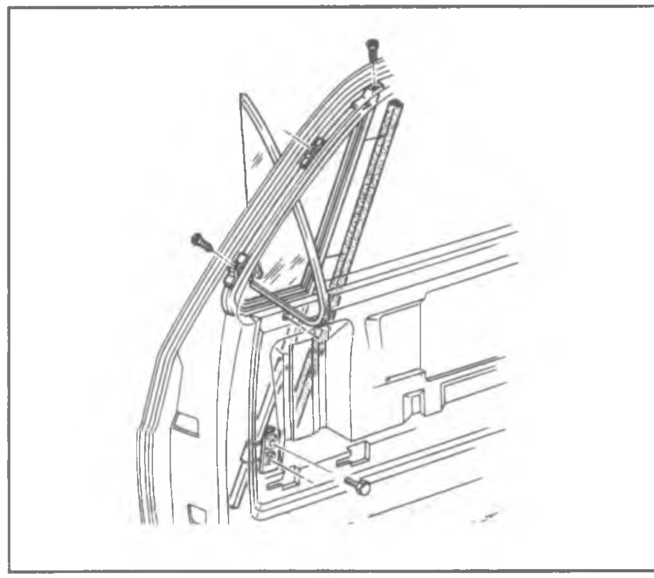

Fig. 10-28--Door Ventilator Assembly

1. Regulate the door window glass to the full down position.
2. Remove clip from the window regulator handle, and knob from lock rod.
3. Remove arm rest screws and trim panel. See figure 10-27.
4. Remove screws attaching ventilator lower assembly to door panel.
5. Remove three screws at the upper front of the door frame.
6. Pull upper portion of vent assembly rearward and raise upward while rotating counter clockwise.
7. Turn vent assembly 90° and carefully remove by guiding up and out. See figure 10-29.

Ventilator Glass Replacement

1. Using an oil can or similar means, squirt prepsol or equivalent on the glass filler all around the glass channel or frame to soften the old seal. When

Fig. 10-29--Removing Ventilator Assembly

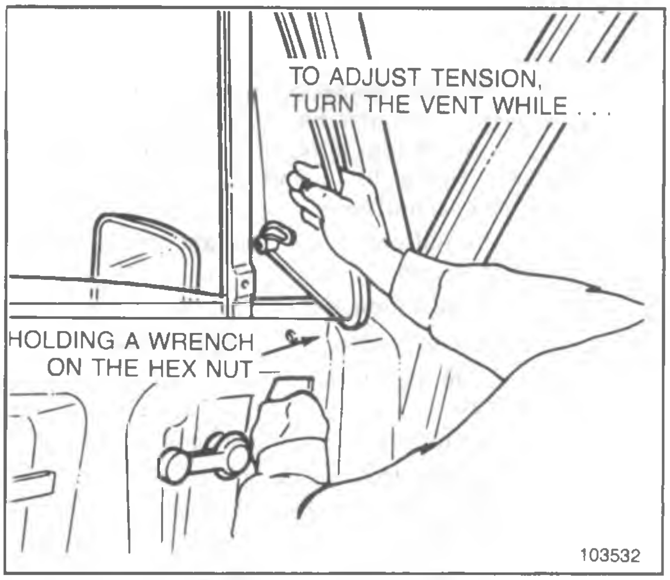

Fig. 10-30--Adjusting Tension

the seal has softened, remove the glass from the channel.

2. Thoroughly clean the inside of the glass channel with sandpaper, removing all rust, etc.
3. Using new glass channel filler, cut the piece to be installed two inches longer than necessary for the channel. Place this piece of filler (soapstoned side of filler away from glass) evenly over the edge of the glass which will fit in the channel. The extra filler extending beyond the rear edge of the glass should be pinched together to hold it in place during glass installation.

   One side of this filler (the outside of the roll) is soapstoned. This is the side which goes into the metal channel.
4. Brush the inside of the metal glass channel freely with ordinary engine oil. This will enable the glass and filler to slide freely into the channel. Push the glass with the filler around it into the channel until it is firmly seated. After the glass is firmly in place, the oil softens the filler, causing it to swell, thereby making a watertight seal. Trim off the excess filler material around the channel and at the ends of the channel.

   Glass should be installed so that rear edge is parallel to the division post. Allow full cure before water testing.

Installation

1. Lower the ventilator assembly into the door frame.
2. Make certain the rubber lip is positioned inside the inner and outer panel before tightening screws.
3. Reinstall all screws and tighten.
4. Install and tighten the three screws at the upper front of the door.

Adjustment

1. Adjust the ventilator by placing wrench on adjusting nut thru access hole and **turning vent window** to the desired tension. See figure 10-30.
2. After making adjustment bend tabs over the hex nut on base of assembly. See figure 10-31.
3. Install arm rest screws and trim panel.
4. Install window regulator handle.

DOOR WINDOW ASSEMBLY--FIG. 10-32

Replacement

1. Completely lower glass to bottom of door.
2. Remove door arm rest and trim pad as outlined in this section.
3. Mask or cover upper portion of door window frame. Remove ventilator assembly as previously outlined.
4. Slide glass forward until front roller is in line with notch in sash channel. Disengage roller from channel.
5. Push window forward and tilt front portion of window up until rear roller is disengaged. See figure 10-33.
6. Put window assembly in normal position (level) and raise straight up and out.
7. Reverse above procedure for installation.

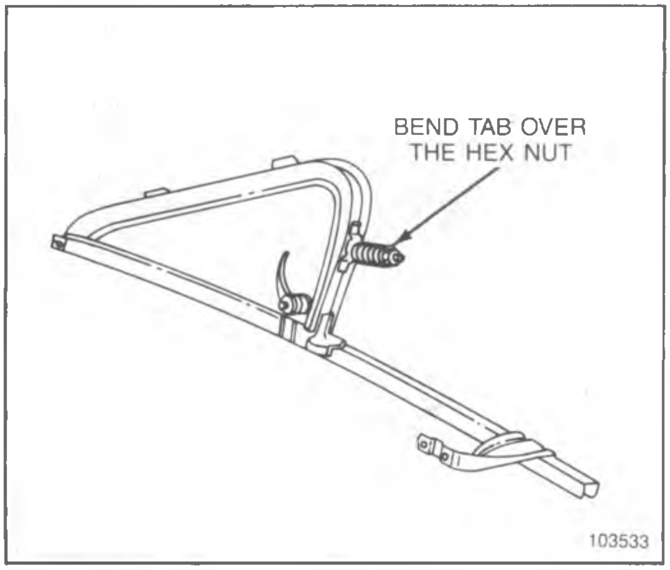

Fig. 10-31--Bend Tabs Over Hex Nut

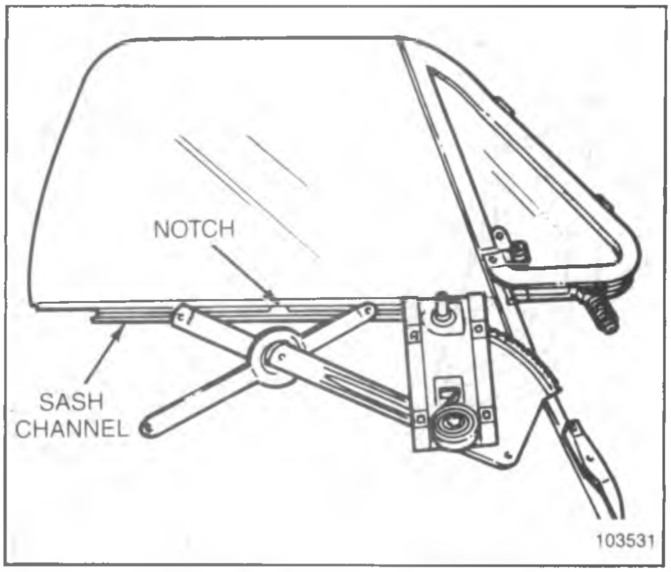

Fig. 10-32--Door Window and Regulator

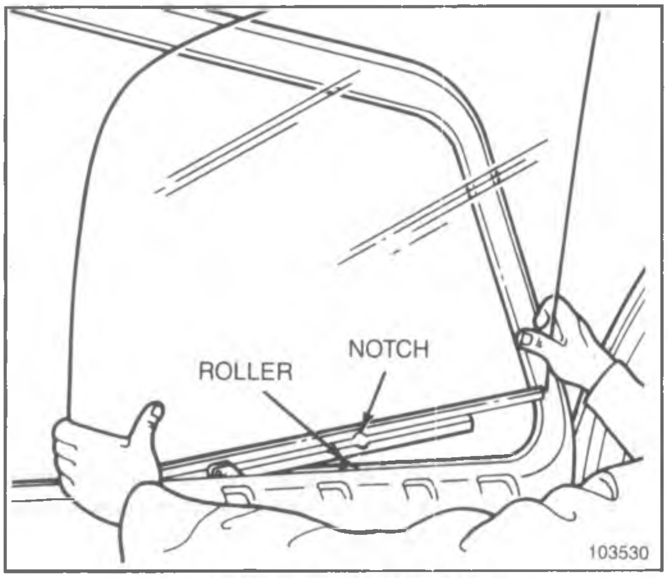

Fig. 10-33--Removing Door Glass

WINDOW REGULATOR-MANUAL--FIG. 10-32

Replacement

1. Raise window and tape glass in full up position using cloth body tape.
2. Remove trim panel as outlined previously.
3. Remove screws attaching regulator to door inner panel.
4. Remove regulator by sliding regulator rearward, disengaging rollers from sash channel.

   A notch is provided in the sash channel to allow disengagement of the forward roller on the window regulator (Fig. 10-32).
5. Install regulator by reversing above steps. Lubricate regulator gear with lubriplate or equivalent.

WINDOW REGULATOR - POWER - CK MODELS

In the case that window will not operate, check electrical connections first. Figure 10-34 illustrates location of junctions, switch, relay and circuit breaker.

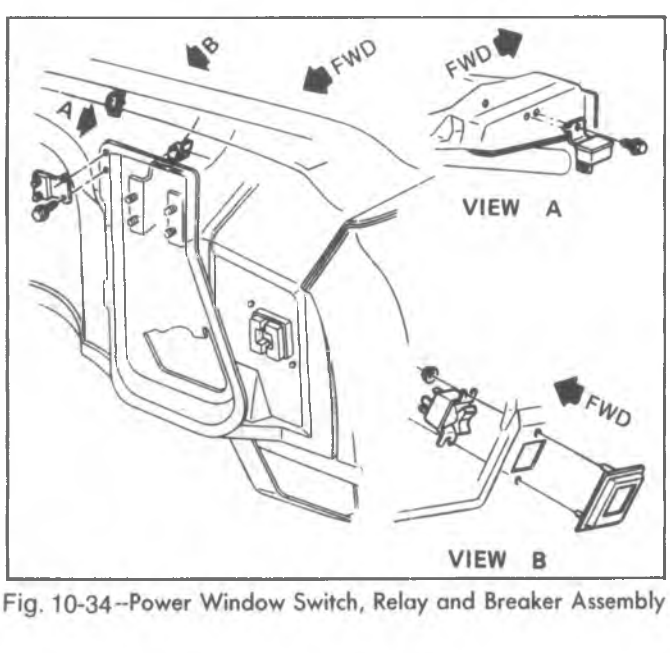

Fig. 10-34--Power Window Switch, Relay and Breaker Assembly

Replacement

CAUTION: Electrical connectors must be removed from window lift motor before performing any operation on the regulator, or personal injury could occur. Figure 10-35 illustrates location of regulator on door and wiring.

1. Raise glass to full up position and tape to door frame using cloth body tape.
2. Disconnect battery ground cable.
3. Remove door trim panel as previously outlined.
4. Remove remote control bolts and lay control assembly aside for access.
5. Remove regulator to door panel attaching screws.
6. Disconnect harness from regulator.
7. Slide regulator assembly rearward, disengaging rollers from sash channel.

   A notch is provided in the sash channel to allow disengagement of the forward roller on the window regulator (fig. 10-32).
8. Remove regulator assembly through access hole in door.

   CAUTION: Step 9 must be performed when regulator is removed from door. The regulator lift arms are under tension from the counterbalance spring and can cause serious injury if the motor is removed without locking the sector gear in position.
9. Drill a hole through the regulator sector gear and back plate. DO NOT drill hole closer than 1/2" (12.7mm) to edge of sector gear or back plate. Install a pan head sheet metal tapping screw (No. 10 - 12 x 3/4) in drilled hole to **lock** sector gear in position.
10. Remove motor to regulator attaching screws.
11. Remove motor from regulator.

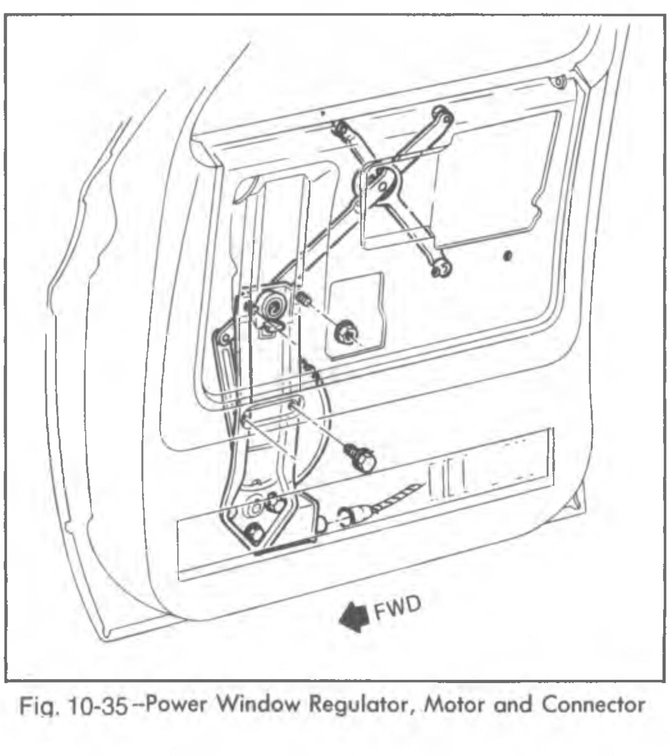

Fig. 10-35--Power Window Regulator, Motor and Connector

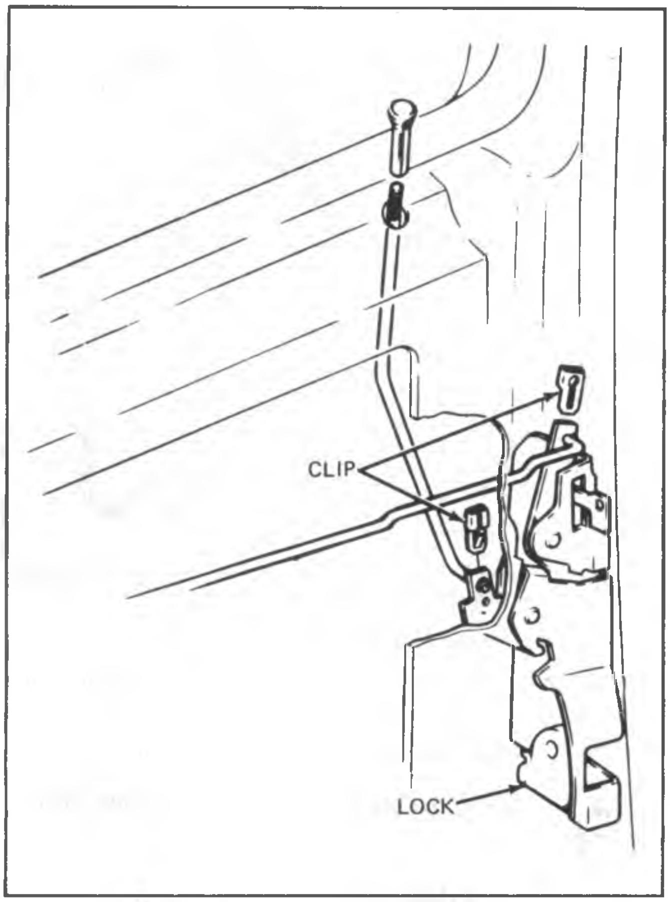

Fig. 10-36--Door Lock Assembly and Rods

12. Prior to installation, lubricate the motor drive gear and regulator sector teeth. The lubrication used must be cold weather approved to a minimum of minus 20° Fahrenheit (-29°C).
13. Install regulator motor to regulator. Make sure the motor pinion gear teeth mesh properly with the sector gear teeth before installing the three motor attaching screws.
14. Remove screw locking sector gear in a fixed position.
15. Insert regulator into door in such a position that motor connector can be installed onto motor.
16. Reinstall regulator into door.

LOCKS, HANDLES AND RODS

Door Lock Assembly--Fig. 10-36

Replacement

1. Raise window to full up position.
2. Remove trim panel as outlined in this section.
3. Remove clip from inside handle rod-to-lock.
4. Remove clip from outside handle rod-to-lock.
5. Remove screws which attach lock assembly to door panel.
6. Remove lock and remote control rod as an assembly.
7. To install lock assembly, reverse above steps. Be sure to replace all clips removed earlier.

Door Outside Handle--Fig. 10-37

Replacement

1. Raise window to full up position.
2. Remove trim panel as outlined.
3. Remove clip from outside handle rod-to-lock.
4. Remove screws which retain outside handle to door panel.
5. Remove handle and control rod.
6. Reverse above procedures to install outside handle.

Door Lock Cylinder -Fig 10-37

Replacement

1. Raise door window.
2. Remove trim panel as outlined.
3. Use a screwdriver or other suitable tool to slide the lock cylinder retaining clip out of engagement with the lock cylinder.
4. Remove lock cylinder.
5. To install, reverse the above steps.

Door Inside Handle

Replacement

1. Remove trim panel as outlined.
2. Disconnect control rod from inside handle, as shown in figure 10-38.
3. Remove screws retaining inside handle to door.
4. Remove inside handle.
5. Reverse above steps to install.

POWER DOOR LOCKS - CK MODELS (Fig. 10-39)

Replacement

1. Disconnect battery ground cable.
2. Remove door trim panel to gain access to power door lock motor.
3. Disconnect electrical connector from motor.
4. Remove screws attaching motor to door inner panel.

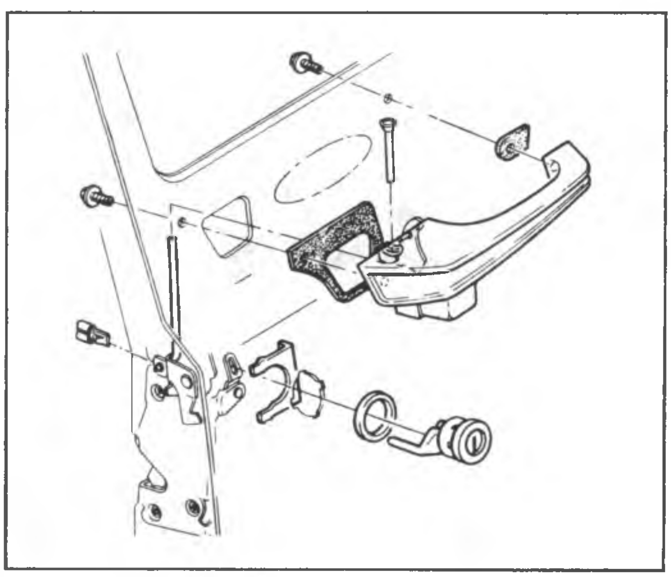

Fig. 10-37--Outside Handle and Lock Cylinder

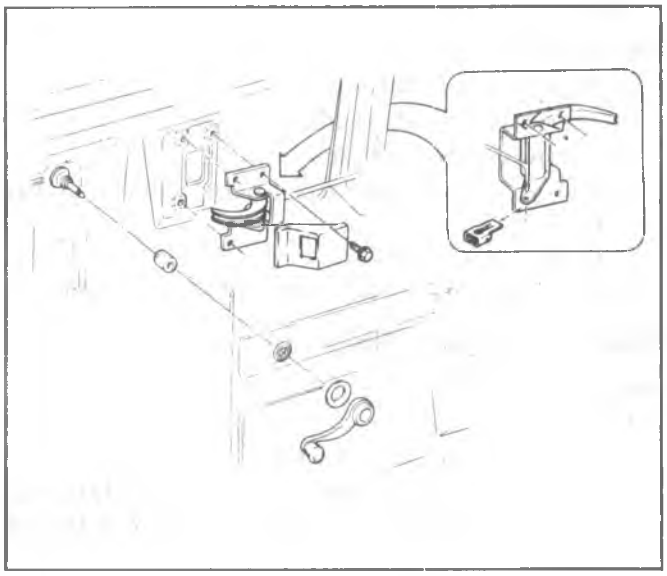

Fig. 10-38--Inside Handle

5. Remove door lock lever from rubber mount at top of motor actuator and remove motor through access hole.
6. To install, reverse steps 1 through 5 above.

DOOR TO BODY OPENING WEATHERSTRIP--FIG. 10-40, 10-41

Side door sealing incorporates an inner seal Fig. 10-40 and a secondary seal Fig. 10-41. The inner seal is mounted on the body opening welding flange and goes completely around the periphery of the opening. The secondary seal is adhered to the upper portion of the door by adhesive and a screw at either end of the seal. The molded weatherstrip material of the inner seal is snapped in place. After removing all foreign material from door opening surface proceed as follows:

1. Open door and block open.
2. Remove sill plate retaining screws and remove sill plate.
3. Remove side door inner weatherstrip seal.
4. Starting at the bottom center of the door opening,

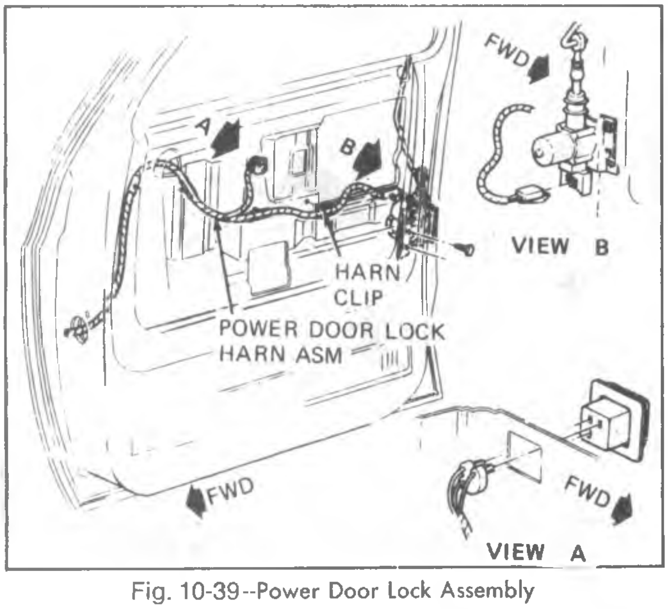

Fig. 10-39--Power Door Lock Assembly

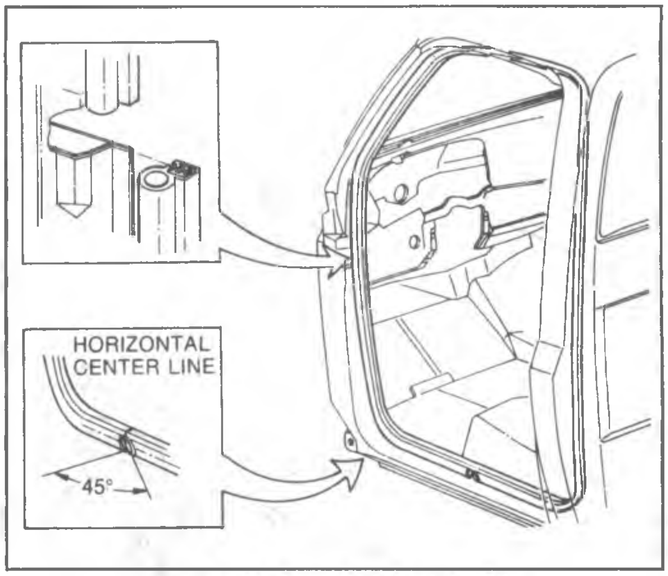

Fig. 10-40--Door Weatherstrip CK

install seal on welded flange.

5. Trim inner weatherstrip with a notch and butt ends together.
6. Reinstall sill plate and sill plate retaining screws.

REAR SIDE DOOR-CREW CAB AND SUBURBAN MODELS

Adjustments and Hinge Replacement

The procedures for hinge replacement, and for hinge and striker bolt adjustment are similar to those detailed in the front door adjustment procedure. Access to the hinges of the rear door is shown in figure 10-42.

STATIONARY GLASS--REAR DOOR

Replacement

1. Lower window to full down position.
2. Remove remote control knob and window regulator handle.

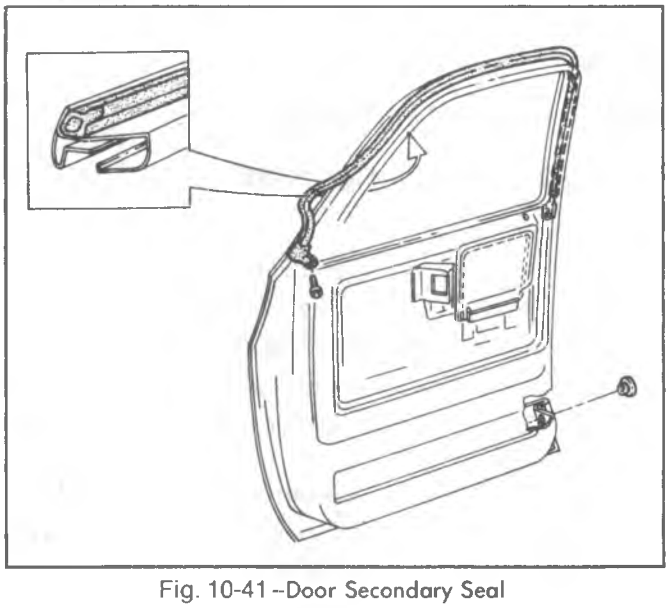

Fig. 10-41 --Door Secondary Seal

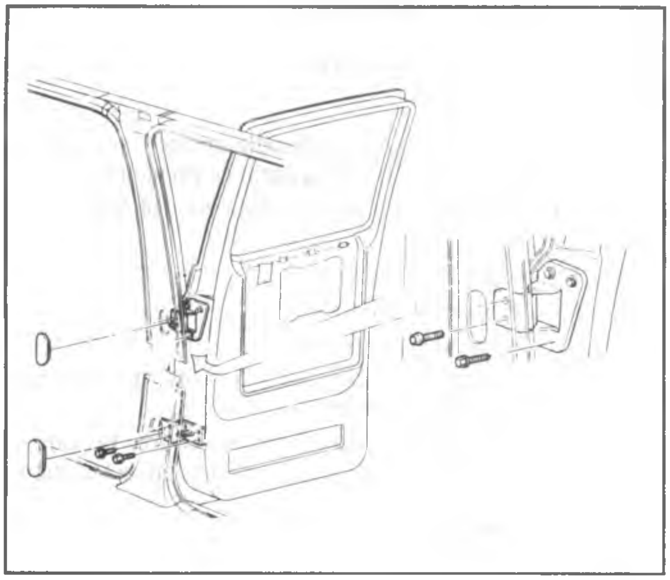

Fig. 10-42--Rear Door Hinge Location

3. Remove screws retaining door trim pad, and remove trim pad. See figure 10-43.
4. Remove glass run channel by removing screws retaining channel to door. See figure 10-44.
5. Remove stationary glass.
6. Replace glass by reversing above procedure.

Glass Run Channel Adjustment

Figure 10-45 illustrates the front run channel. At the lower end, a slotted bracket provides for in-and-out

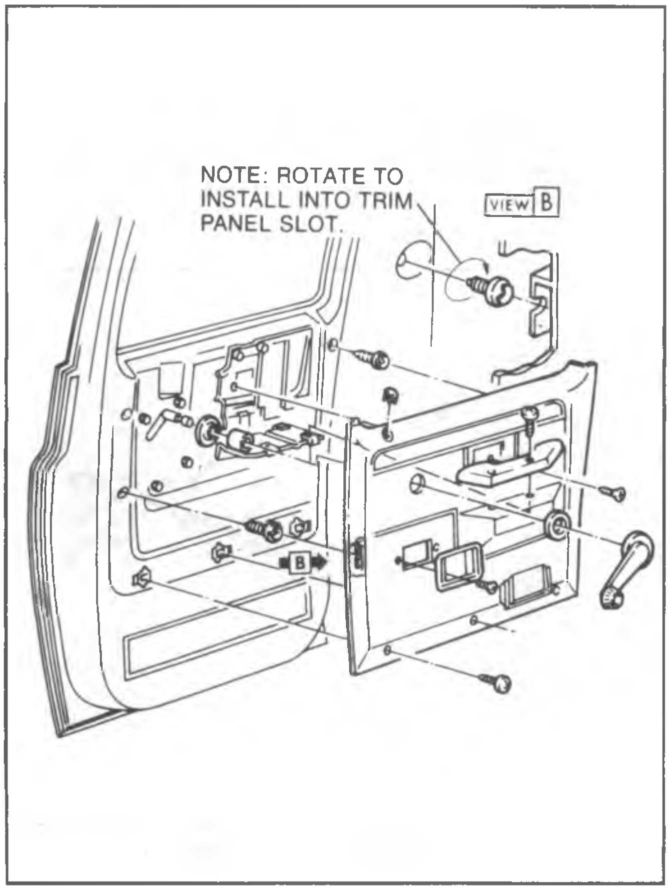

Fig. 10-43--Side Rear Door Trim Pad

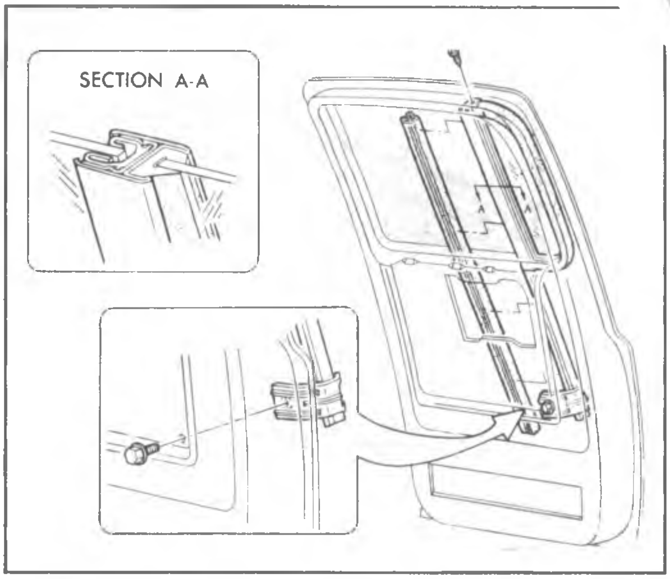

Fig. 10-44--Glass Run Channel

adjustment. The screw and locknut at that bracket allow fore-and-aft adjustment. Together, this allows proper alignment of the glass to the rear glass run channel for full up and down travel.

WINDOW GLASS--FIG. 10-46

Replacement

1. Lower glass to full down position.
2. Remove remote control push botton knob, window regulator handle and trim pad.
3. Remove stationary glass as previously outlined. Remove screws from rear division channel, and slide channel rearward in the opening.
4. Raise glass as far as possible, then slide glass until the roller is in line with the notch in the sash channel. See figure 10-46. Disengage roller from channel.

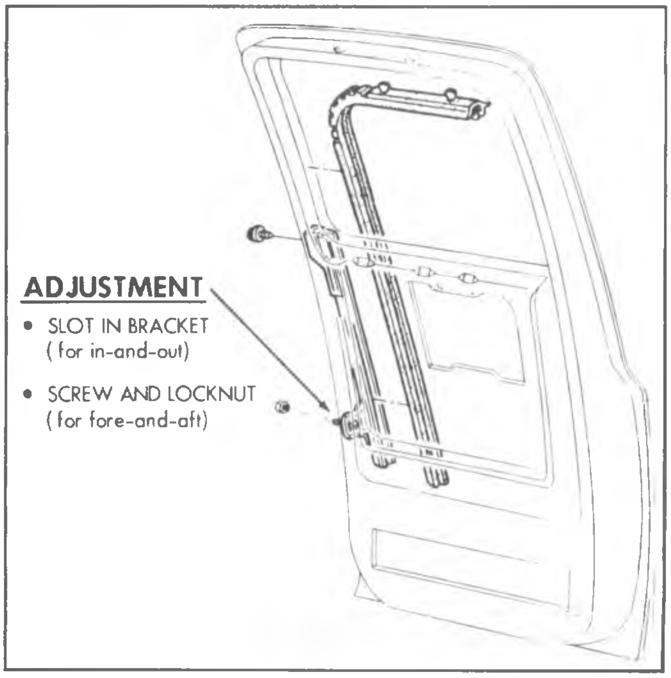

Fig. 10-45--Glass Run Channel Adjustment

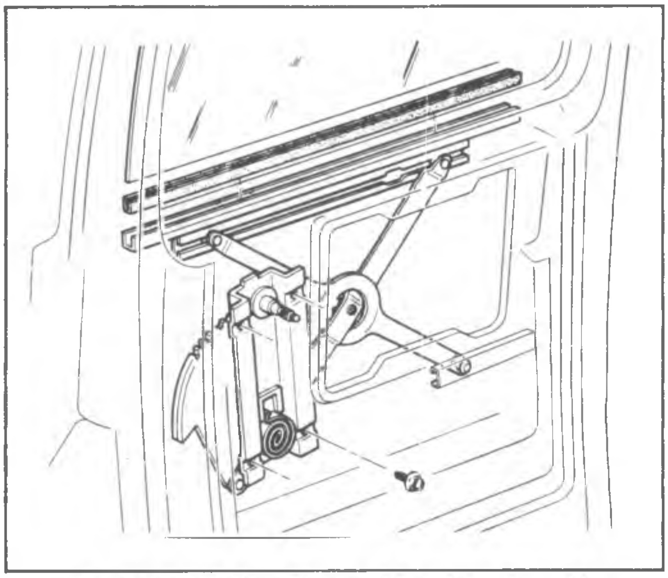

Fig. 10-46--Window Glass and Regulator Assembly

5. Tilt window outboard and move until other roller can be removed from channel.
6. Raise window up and out.
7. Reverse above procedure for installation.

WINDOW REGULATOR ASSEMBLY--FIG. 10-46

Replacement

1. Remove trim pad, stationary glass, and window glass as outlined earlier.
2. Remove screws attaching regulator assembly to door inner panel.
3. Remove regulator assembly through opening in door.
4. Install regulator by reversing above procedure. Lubricate regulator gear with lubriplate or equivalent.

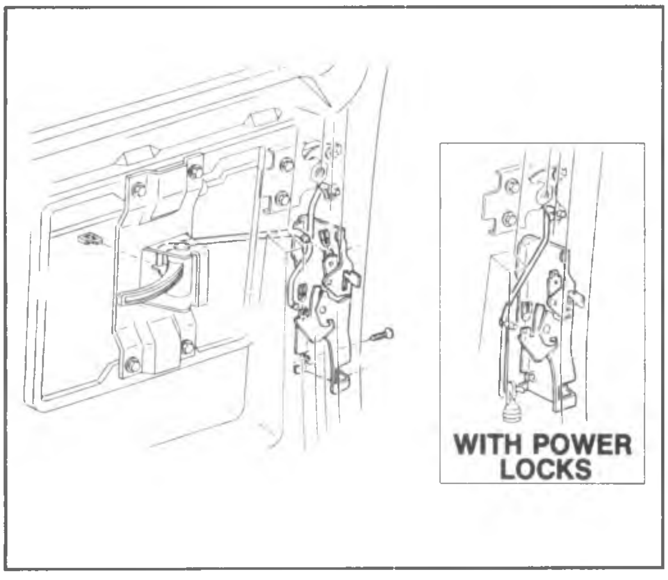

Fig. 10-47--Lock Assembly and Inside Handle

LOCKS HANDLES AND RODS

Lock Assembly--Fig. 10-47

Replacement

1. Remove window regulator handle, remote control push button knob and trim pad as outlined previously.
2. Disengage three clips which retain control rods to lock assembly.
   a. Inside handle control rod.
   b. Remote control lower rod.
   c. Outside handle control rod.
3. Remove screws retaining lock assembly to door panel, then remove lock assembly.
4. Install lock by reversing above procedure. Be sure to replace all clips removed with new clips on installation.

Inside Handle--Fig. 10-47

Replacement

1. Remove regulator handle, remote control knob and trim pad as outlined previously.
2. Disconnect control rod from inside handle by removing clip as shown in figure 10-47.
3. Remove inside handle by removing four screws which secure handle to door panel.
4. Replace handle by reversing above procedure.

Remote Control--Fig. 10-48

Replacement

1. Remove regulator handle, remote control knob and trim pad.
2. Disconnect remote control lower rod from door lock assembly.
3. Remove two screws securing each remote control lever to door panel.
4. Remove remote control levers and rods through door opening.
5. Replace by reversing above procedure.

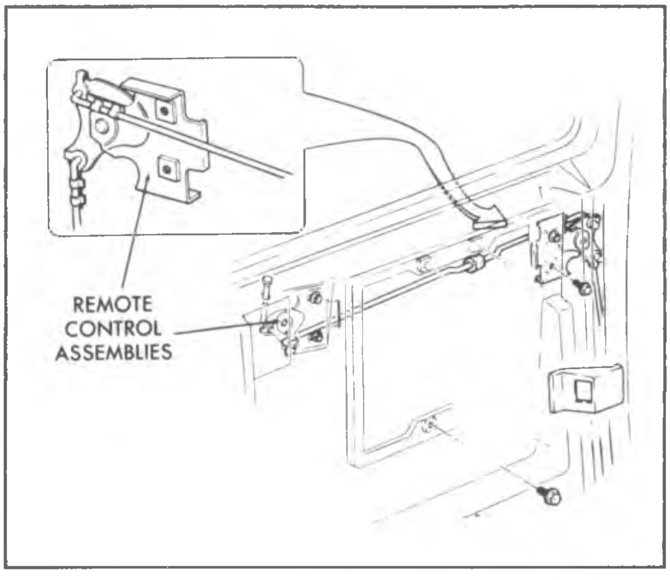

Fig. 10-48--Remote Control Assembly

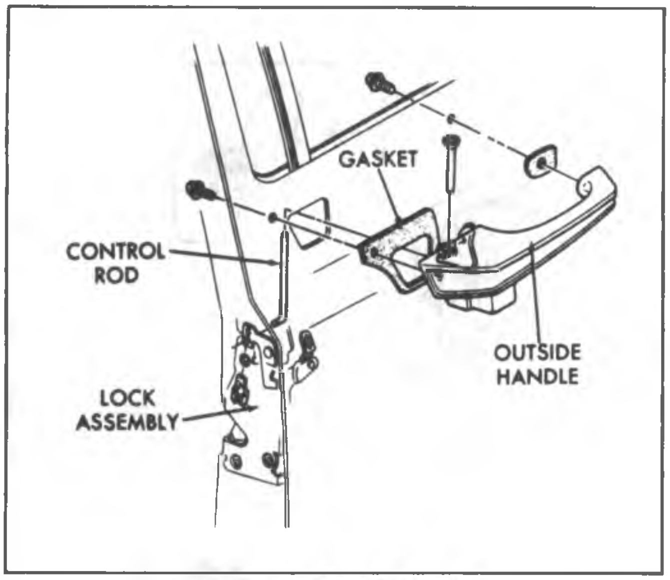

Fig. 10-49--Outside Handle

Outside Handle--Fig. 2D-49

Replacement

1. Remove the trim pad as outlined previously.
2. Remove two screws securing the handle to the door. Press the handle button and pull the handle control rod and securing clip thru the opening in the door panel. See Fig. 10-49.
3. Disengage the outside handle control rod from the handle by removing the pin at the handle assembly.
4. Replace by reversing this procedure.

WEATHERSTRIP--FIG. 10-50

The procedure outlined in Front Door Weatherstrip may be applied to the Rear Side Door Weatherstrip, shown in figure 10-50 with the following exception:

a. Begin installation by positioning the weatherstrip "internal core" (approximately 6" long) center in the upper front corner of the door opening.
b. Proceed as outlined previously.

REAR DOORS SUBURBAN MODEL ONLY

Adjustments

Rear doors may be adjusted in the body opening by loosening hinge bolts and repositioning door, then retightening bolts. See figure 10-54 for hinge bolt location. Rear door wedges and strikers should be adjusted as shown in figure 10-55.

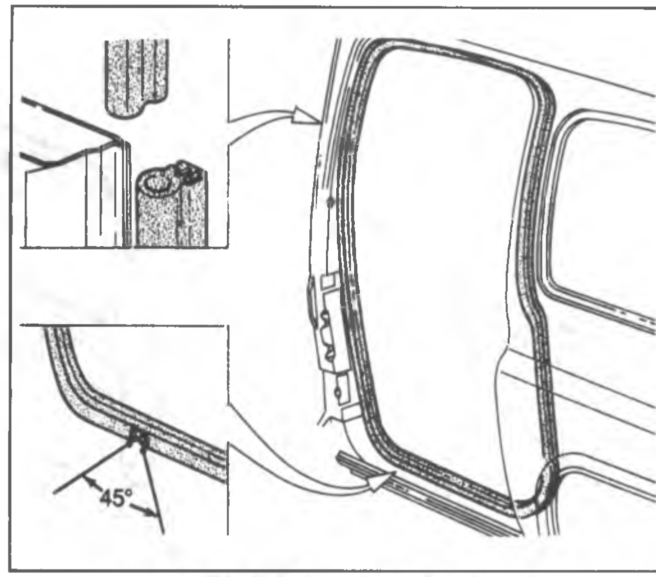

Fig. 10-50--Side Rear Door Weatherstrip

Be sure that adjustments are as shown to insure proper latching of the rear doors.

LOCKS, HANDLES AND RODS

The rear door lock, outside handle, lock cylinder, control rods and latch are shown in figures 10-51 and 10-52. The rods can be disconnected from the lock, latch or handle by disengaging the retaining clips, as shown. The lock cylinder is removed in the same manner as the front side door lock cylinder.

REAR DOOR CHECK STRAP

Figure 10-53 shows the cloth check strap used for rear doors. The door may be completely opened by removing the strap pin from the bracket. The bracket attaches to the pillar with three screws; the strap is fastened to the door panel with two screws and an attaching bar.

WEATHERSTRIP

Weatherstrip installation is shown in Figs. 10-55 and 10-56. Proper installation is dependent on completely cleaning all foreign material from old installation and using a quality cement on the new installation.

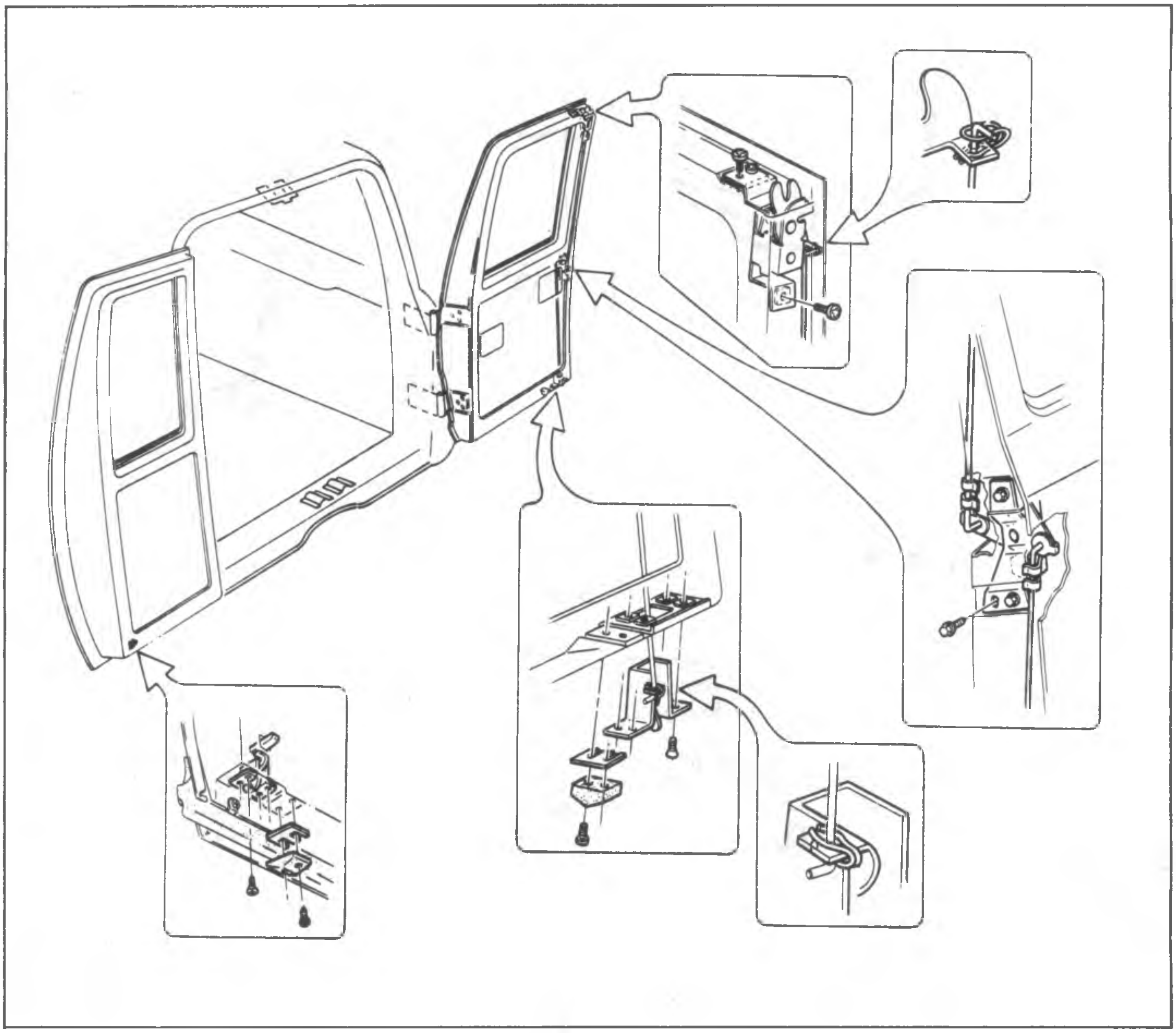

Fig. 10-51--Rear Door Controls

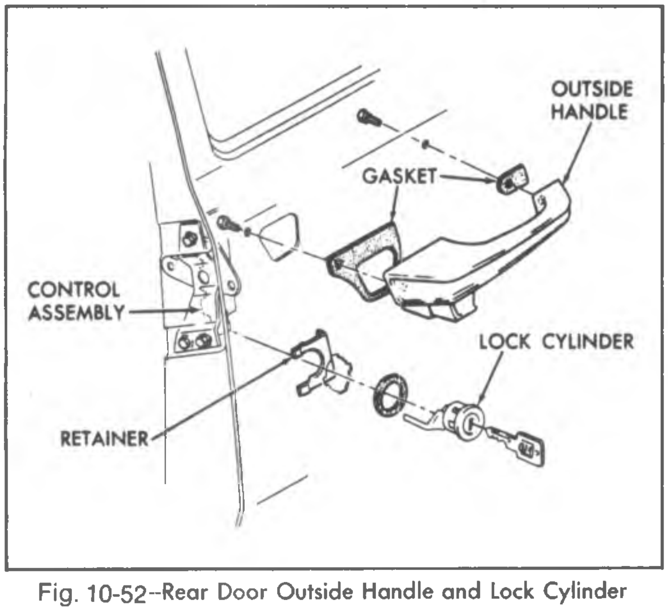

Fig. 10-52--Rear Door Outside Handle and Lock Cylinder

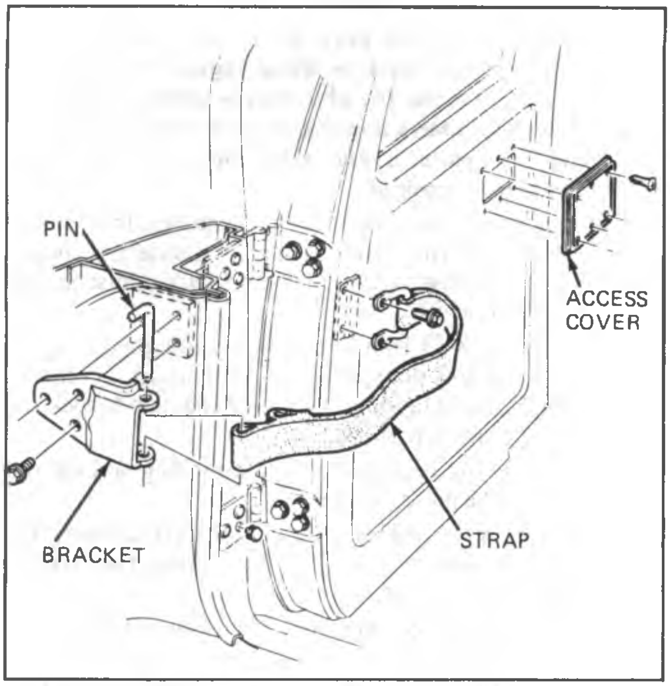

Fig. 10-53--Rear Door Check Strap

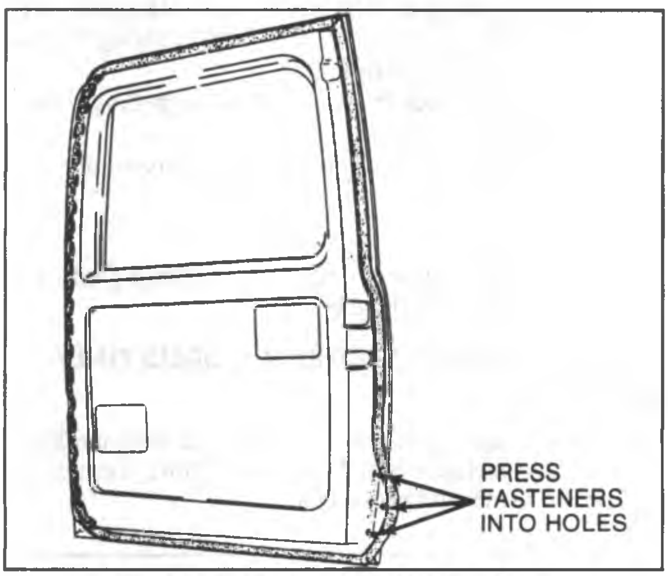

Fig. 10-56--Weatherstrip--R.H. Rear Door

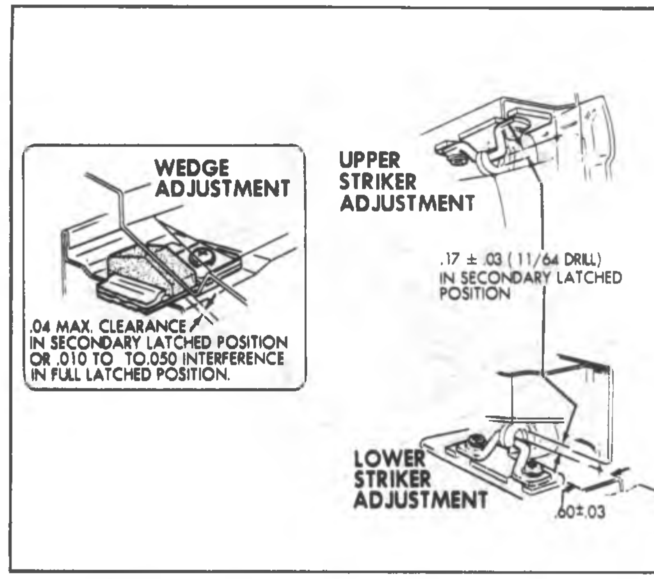

Fig. 10-54--Wedge and Striker Adjustments

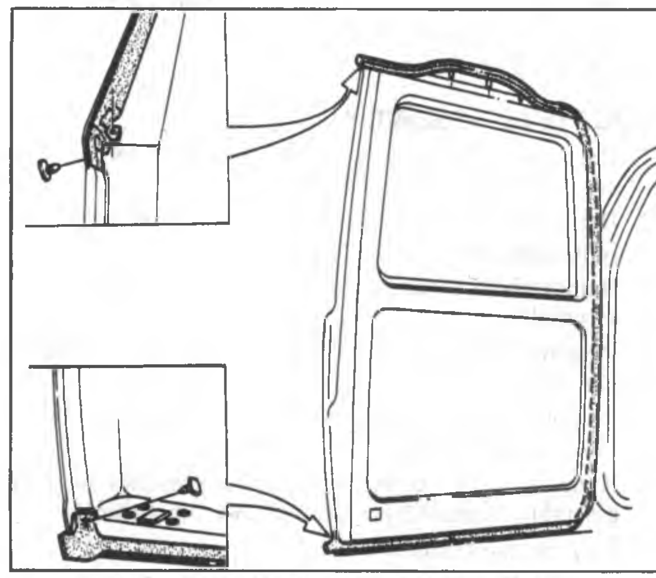

Fig. 10-55--Weatherstrip - L.H. Rear Door

ENDGATES SUBURBAN AND UTILITY MODELS

Suburban and utility models use endgates of similar, yet distinct design. Separate procedures follow for service on each of these endgates.

ENDGATE ASSEMBLY - SUBURBAN MODELS ONLY

Replacement

1. Lower endgate, and removed hinge access covers. See figure 10-57.
2. Remove endgate-to-hinge bolts.
3. Remove L.H. torque rod bracket, shown in figure 10-58.
4. If equipped with electric powered window, disconnect wiring harness.
5. Lift endgate to almost closed position and remove support cables.
6. Remove endgate with torque rod.
7. To install, reverse removal procedure.

HINGES

Replacement

If necessary to remove hinges, remove endgate as outlined previously, and proceed as follows:

1. Remove bolts from each of the hinge assemblies on the underside of the body. See figure 10-57.
2. Remove hinge assemblies. If the hinge pins are to

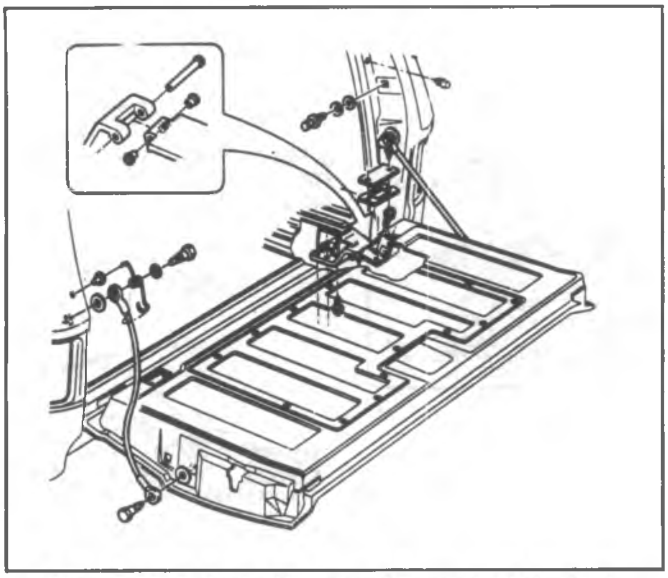

Fig. 10-57--Endgate, Hinges and Supports--(Suburban)

be removed, note the position of bushings so they may be reinstalled in the same position.

3. Reverse procedure to install.

ENDGATE DISASSEMBLY

1. Remove access cover shown in figure 10-59, to gain access to interior components.
2. Detach remote control rods from lock assembly by removing clips.
3. Remove bolts securing lock assembly, and remove lock assembly.
4. Remove handle assembly bolts and remove inside handle.
5. Remove R.H. torque rod bracket screws, figure 10-58, then remove torque rod from endgate.
6. Remove screws connecting cam assemblies to sash assembly, figure 10-60, then remove cam assemblies.
7. Remove glass from endgate.
8. Unclip and remove inner and outer seal assemblies.
9. Remove screws connecting window regulator assembly to endgate, figure 10-60, and remove regulator.

CAUTION: Step 10 must be performed if the window is removed or disengaged from the regulator lift arms. The lift arms are under tension from the counter-balance spring, and can cause injury if the motor is removed without locking the sector gears in position.

10. For endgates with electric window, secure the window regulator lift arms before removing the electric motor, when the window glass has been removed or disengaged from the lift arms.
    a. Drill a 1/8 (3.1mm) inch hole through the sector gear and back plate, as shown in figure 10 -60. Install a sheet metal tapping screw into the hole to lock the sector gears in position.
    b. Remove the regulator motor attaching screws and remove the motor assembly.
11. From inside the endgate, remove the nuts fastening the outside handle to endgate and remove the outside handle. See figure 10-61.

    If equipped with power tailgate window, detach wiring harness from motor.
12. Remove side bolts connecting left and right glass channels to endgate and remove channels.
13. Removed side latch bolts and remove side latches with control rods. See figure 10-59. Detach wiring harness from R.H. latch if so equipped.
14. Separate side latch from control rod by pulling control rod thru nylon guide.
15. Reverse the above procedure for reassembly and installation.

Adjustments

Loosen bolts, adjust at either endgate hinge position or endgate latch, then retighten bolts.

ENDGATE ASSEMBLY--UTILITY MODELS ONLY

Replacement

1. Lower endgate, then remove four bolts securing hinge to body on each side. See figure 10-62. Disconnect wiring harness if so equipped.

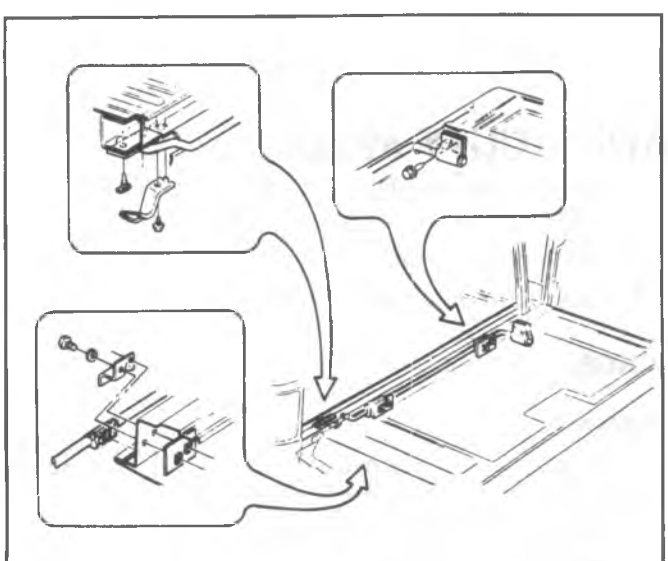

Fig. 10-58--Torque Rod(Suburban)

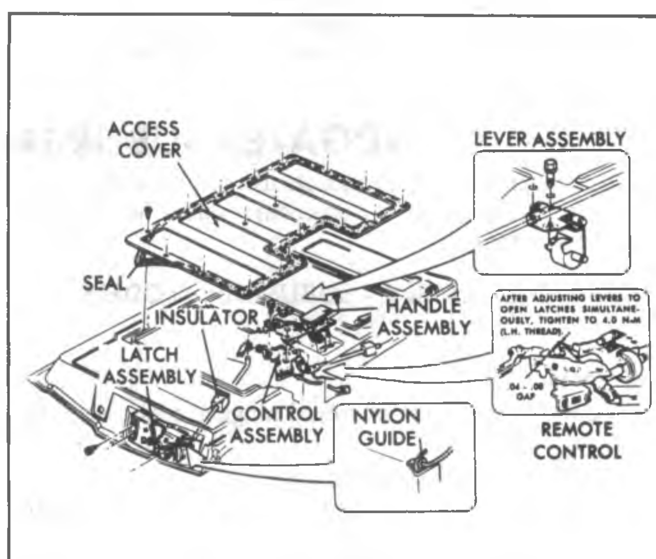

Fig. 10-59--Latch and Remote Controls(Suburban)

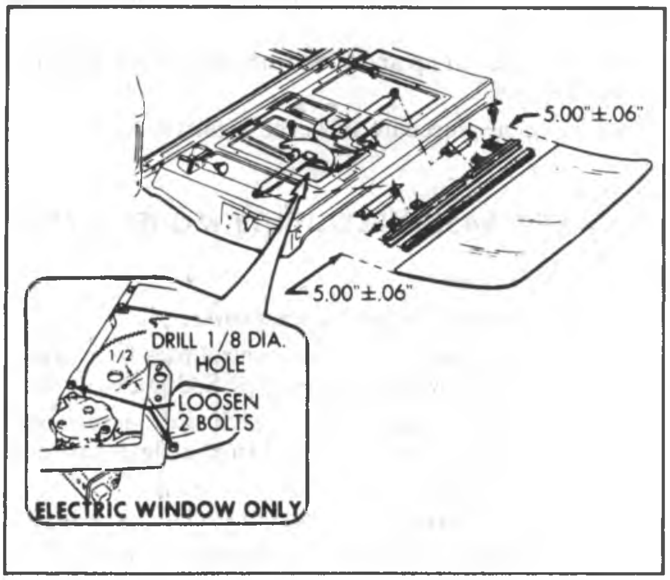

Fig. 10-60–Window Glass and Regulator(Suburban)

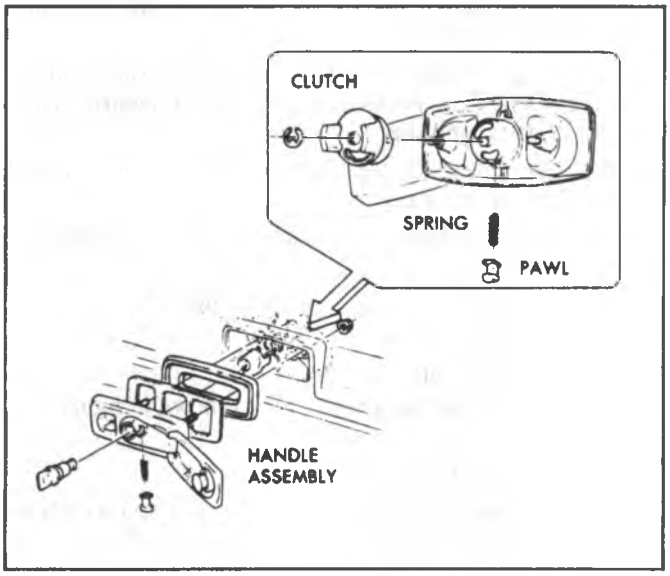

Fig. 10-61–Outside Handle

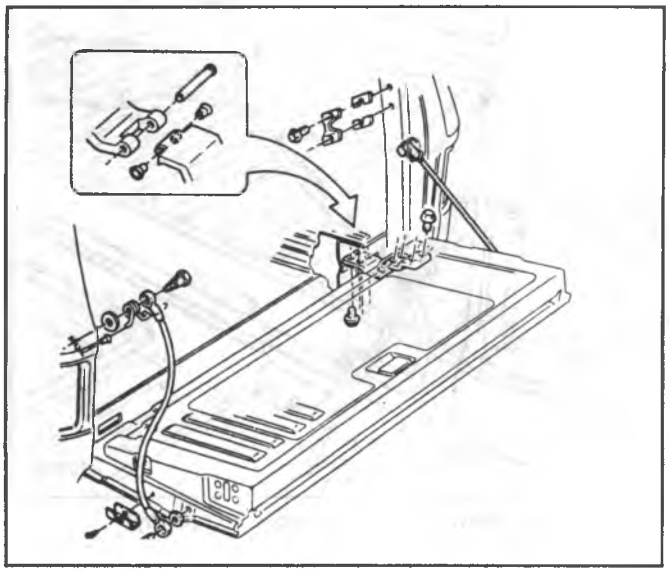

Fig. 10-62–Endgate, Hinges and Support (Utility)

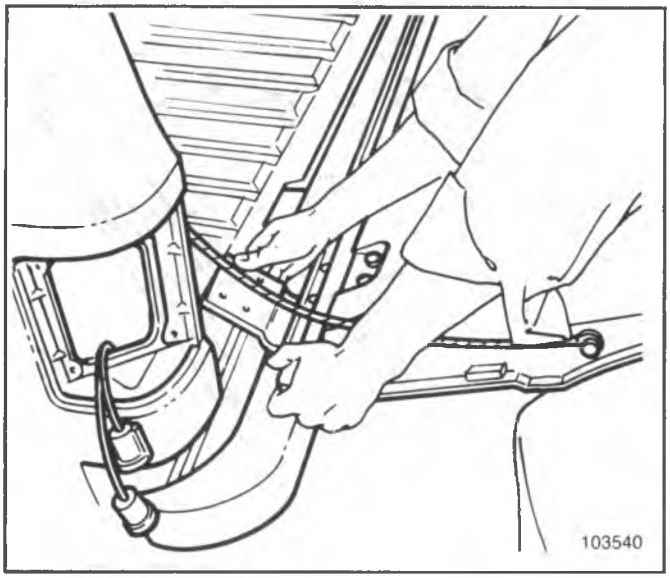

Fig. 10-63–Pulling Hinge Away From Body (Utility)

2. Disconnect torque rod anchor plate on each side. It is necessary to remove lower bolt only, then let plate swing down. See figure 10-66.
3. With an assistant, raise endgate part way, then disconnect support cables from endgate. See figure 10-62.
4. Remove endgate by pulling disconnected hinge from body, figure 10-63, then grasping torque rod with one hand and pulling torque rod over gravel deflector, as shown in figure 10-64.
5. Individual components may be removed from the endgate now, or after reinstallation.
6. To install endgate, reverse the above procedure.

HINGE

Replacement

1. Lower endgate and disconnect hinge to be replaced by removing hinge-to-body bolts. See figure 10-62.
2. At the other hinge, **loosen** the hinge-to-body bolts.
3. On the hinge to be replaced, remove the

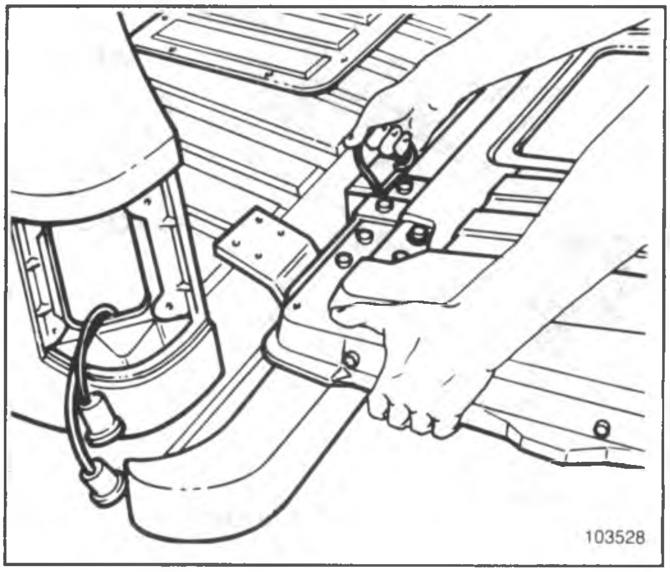

Fig. 10-64–Grasping Torque Rod (Utility)

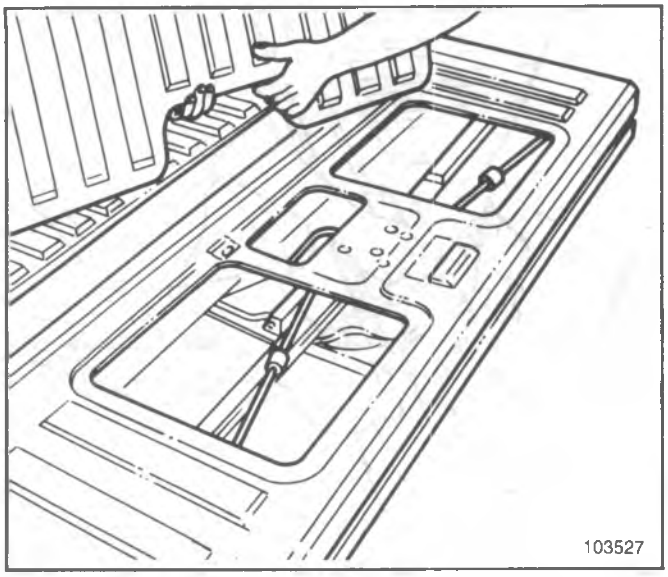

Fig. 10-65--Removing Access Cover (Utility)

hinge-to-endgate bolts.

4. Pull the endgate away from the body several inches and withdraw hinge from body. Then lift endgate slightly to allow removal of hinge from endgate. See figure 10-63.
5. To install hinge, reverse the above procedure. Be sure to install hinge into endgate first, then into the body.

TORQUE ROD

Replacement

1. Lower endgate and remove access cover, as shown in figure 10-65.
2. Disconnect torque rod anchor plate. It is necessary to remove the lower bolt only, then let plate swing down. See figure 10-66.
3. Loosen four bolts retaining endgate hinge to body.
4. Move endgate slightly away from body.
5. Remove torque rod retaining bracket on lower edge of endgate. See figure 10-66.
6. Remove torque rod retaining clip on side edge of endgate.
7. Lift torque rod up and slide from endgate as shown in figure 10-67.
8. Reverse the procedure above for installation.

ENDGATE DISASSEMBLY-UTILITY MODELS ONLY

Manual Window

1. Lower endgate and remove acess cover.
2. Disconnect side latch remote control rods from center control by removing retaining clips. See figure 10-68.
3. Remove four screws from each side latch, and withdraw latch and control rod from endgate, as sown in figure 10-69.
4. Disconnect control rod from latch.
5. Refer to figure 10-70 for installation of latch control and blockout rod.
6. Disconnect blockout rod from control assembly by detaching spring and removing two screws retaining rod to inner panel.
7. Disconnect inside handle control rod from control assembly, then remove screws which secure inside handle to inner panel.
8. Remove three screws which retain remote control assembly to inner panel.
9. Remove control assembly and inside handle as shown in figure 10-71.
10. Refer to figure 10-72 for window and regulator installation.
11. Roll window to up position.
12. Disconnect sash from regulator as shown in figure 10-73.
13. Remove glass from endgate.
14. Remove four regulator attaching screws and withdraw regulator from endgate as shown in figure 10-74.

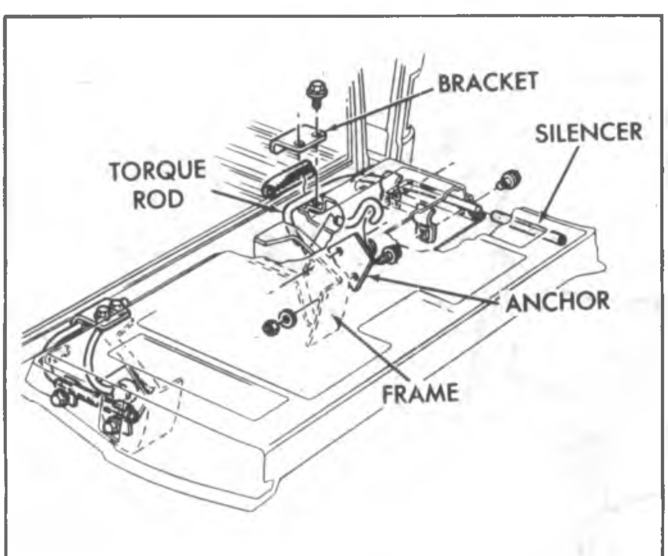

Fig. 10-66--Torque Rod (Utility)

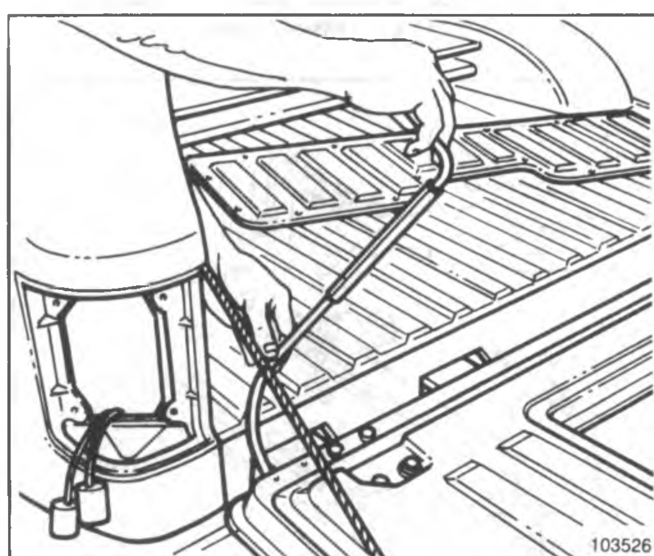

Fig. 10-67--Removing Torque Rod (Utility)

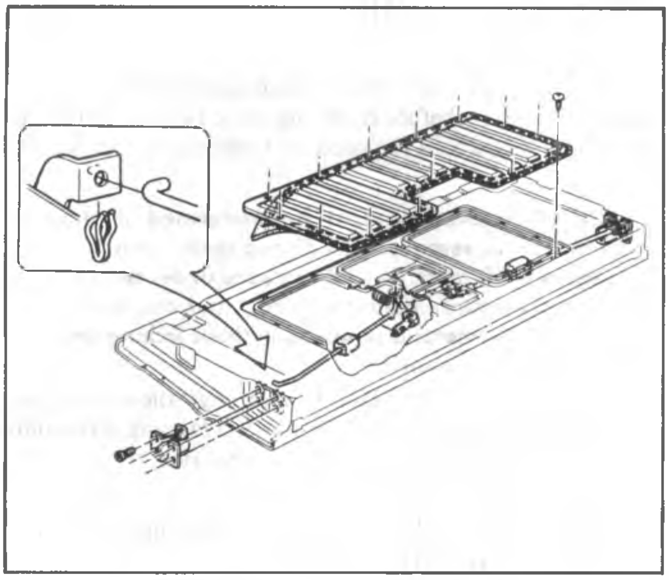

Fig. 10-68--Latches and Rods

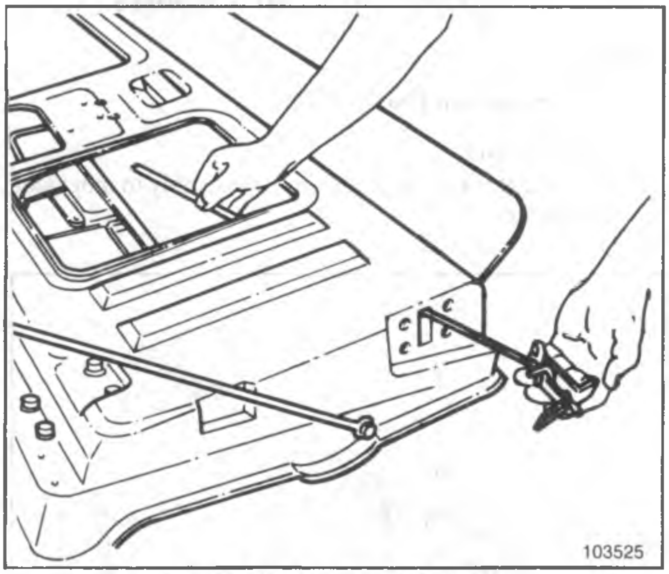

Fig. 10-69--Removing Side Latch

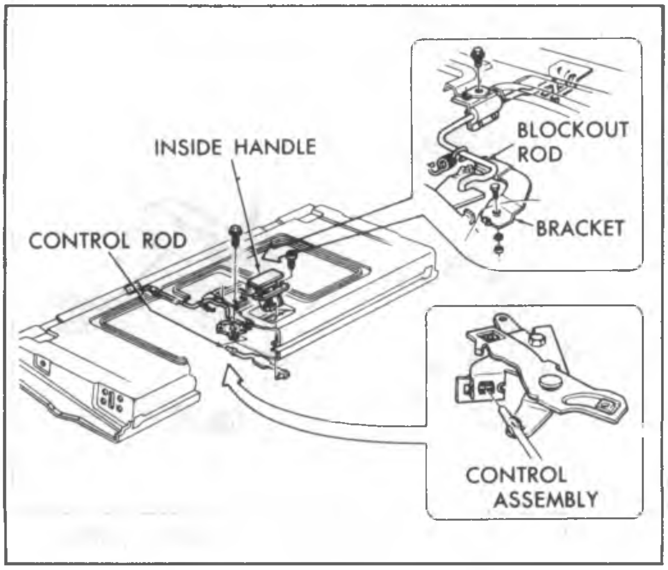

Fig. 10-70--Control Assembly and Blockout Rod

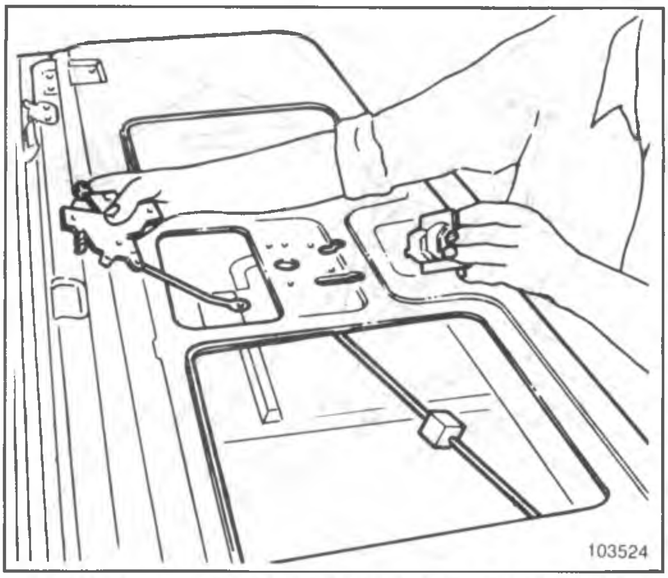

Fig. 10-71--Removing Control Assembly and Inside Handle

15. Remove outside handle by removing nuts from inside of outer panel. See figure 10-61.

16. Reverse the above steps for reassembly.

ELECTRIC WINDOW-UTILITY MODELS

The window is controlled by a jackscrew mounted to the regulator, drive cable and a 12V DC reversible motor mounted to the endgate inner panel. This circuit also includes a block out switch to prevent operation of the window while the endgate is open (fig. 10-75).

Service procedures for endgate disassembly are the same as outlined above with the following exceptions:

Drive Cable

The drive cable can be replaced by disengaging the cable from the motor and jackscrew assembly and removing the cable. Reverse removal procedure to reinstall cable.

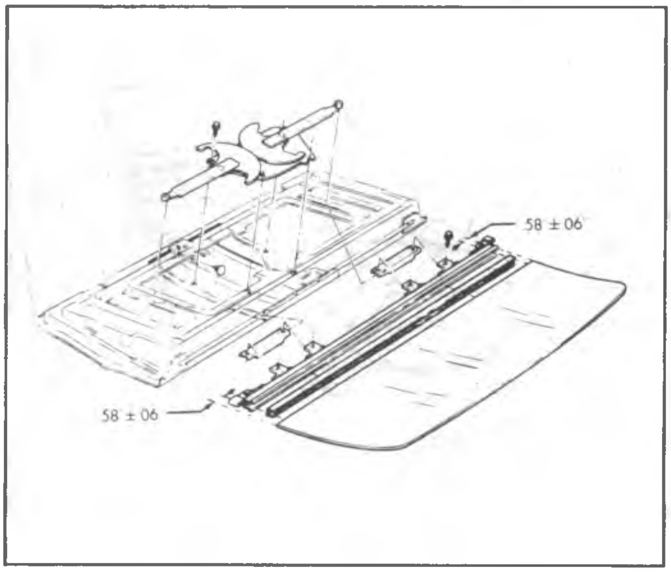

Fig. 10-72--Window and Regulator

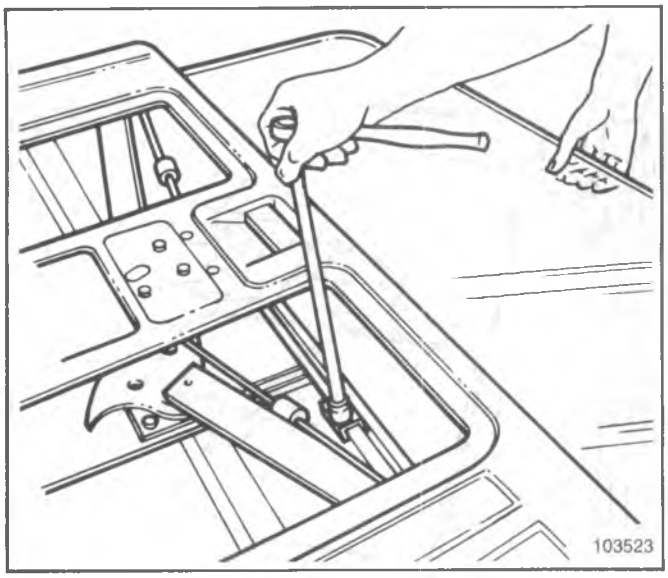

Fig. 10-73--Disconnecting Sash from Regulator

Motor (Fig. 2D-76)

Removal

1. Disconnect drive cable from motor.
2. Disconnect wiring harness from motor.
3. Remove (3) motor attaching screws and remove motor.
4. To install, reverse removal procedure.

Blockout Switch (Fig. 10-75)

Removal

1. Disconnect L.H. side latch remote control rod from center control by removing retaining clip.
2. Remove side latch retaining screws and disconnect blockout switch wiring.
3. Remove side latch assembly and remove screws retaining switch to side latch.
4. Reverse removal procedures for installation.

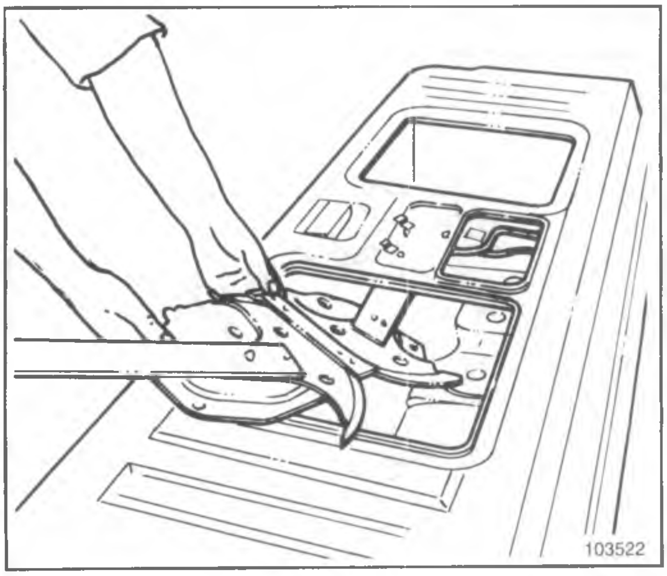

Fig. 10-74--Removing Regulator

Jackscrew (Fig. 10-76)

Removal

For endgates with electric window, secure the window regulator lift arms before removing the jackscrew when the window glass has been removed or disengaged from the lift arms.

CAUTION: Step 1 must be performed if the window is removed or disengaged from the regulator lift arms. The lift arms are under tension from the counterbalance spring, and can cause injury if the motor is removed without locking the sector gears in position.

1. Drill a 1/8 (3.1mm) inch hole through the sector gear and back plate. Install a sheet metal tapping screw into the hole to lock the sector gears in position.
2. Disconnect drive cable at jackscrew.
3. Remove the regulator jackscrew attaching screws and remove the jackscrew assembly.
4. Reverse removal procedure for installation.

TAILGATES-PICKUP AND UTILITY MODELS

Fleetside

Handle Replacement (Fig. 10-77)

1. Open tailgate.
2. Remove screws attaching handle assembly to inner side of tailgate.

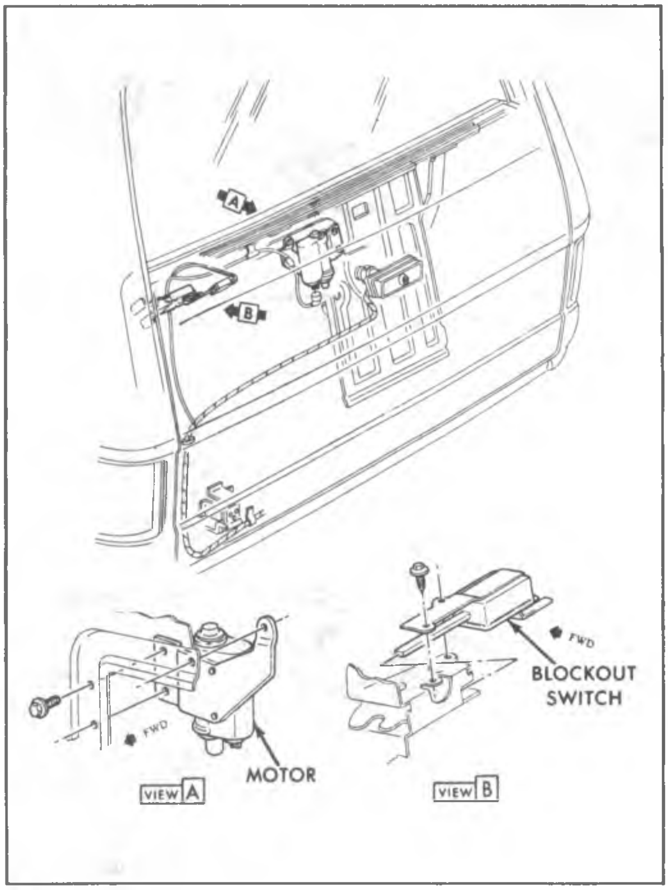

Fig. 10-75--Power Window Motor and Switches (Utility)

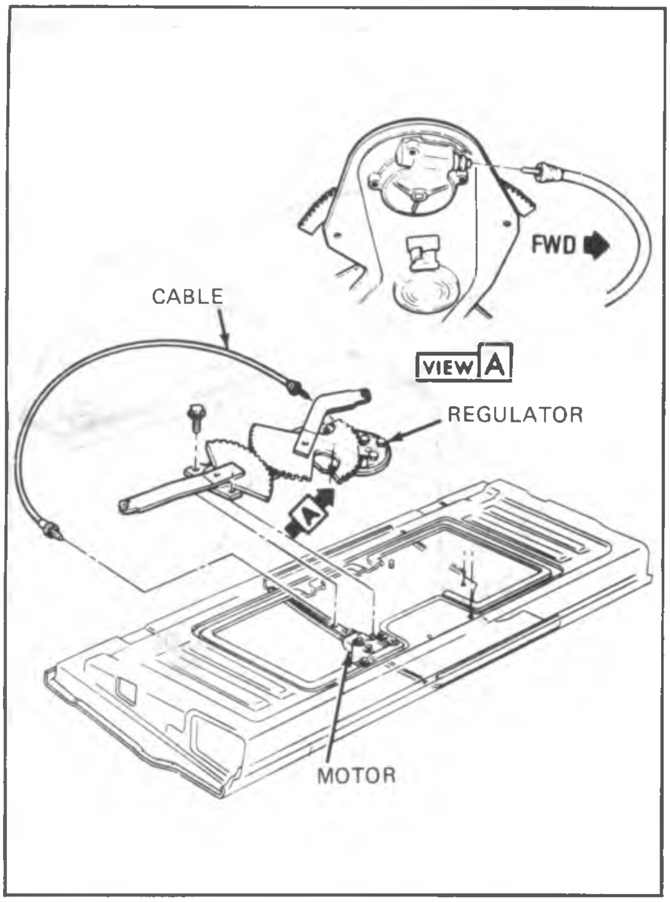

Fig. 10-76--Endgate Regulator, Drive Cable and Motor

3. Remove clips from handle assembly and remove handle.
4. Remove screws from each latch assembly and lift off, with actuating rods.

Replacement of Trunnion Assembly

1. Lower tailgate half way.
2. Remove both retaining straps.
3. Lift up tailgate at the right side and pull out at the left side to remove tailgate assembly.
4. Remove two screws from trunnion and remove trunnion.

Stepside

Endgate Replacement (Fig. 10-77)

1. Unhook endgate chain assembly at each side.
2. Remove bolt and lock washer from each trunnion in carrier box endgate.
3. Remove endgate.
4. Reverse procedure for installation. Align slot in trunnion to coincide with hole in endgate to permit using a tool to hold trunnion while tightening nut.

REMOVABLE TOP-FOLDING TOP-UTILITY MODELS

Removal

1. Remove access and disconnect courtesy light.
2. Lower the tailgate window and lower the tailgate.
3. Remove six top-to-roof mounting bolts.
4. Remove ten top-to-side panel mounting bolts (5 on each side).
5. Remove upper spare tire brace by removing brace bolt. The spare tire brace must be reinstalled after top is removed.
6. Remove only the rear attaching screws for the side trim panel (12 for LH panel and 11 for RH panel) so that the rear of panel can be pulled away to gain access for removal of hidden top bolt.

   If rear roll bar equipment is present, it is necessary to remove all the attaching screws, 20 on LH side and 19 on RH side, and the 1 bolt attaching the shoulder belt retractor located behind the access plate on retractor. Then the trim panel is raised and moved forward approx. 2-1/2 inches so that access can be gained through the cut out in trim panel to remove hidden top bolt.
7. With assistance, lift the top and move rearward for removal. The top should be removed carefully to prevent flexing of the sides and possible damage.

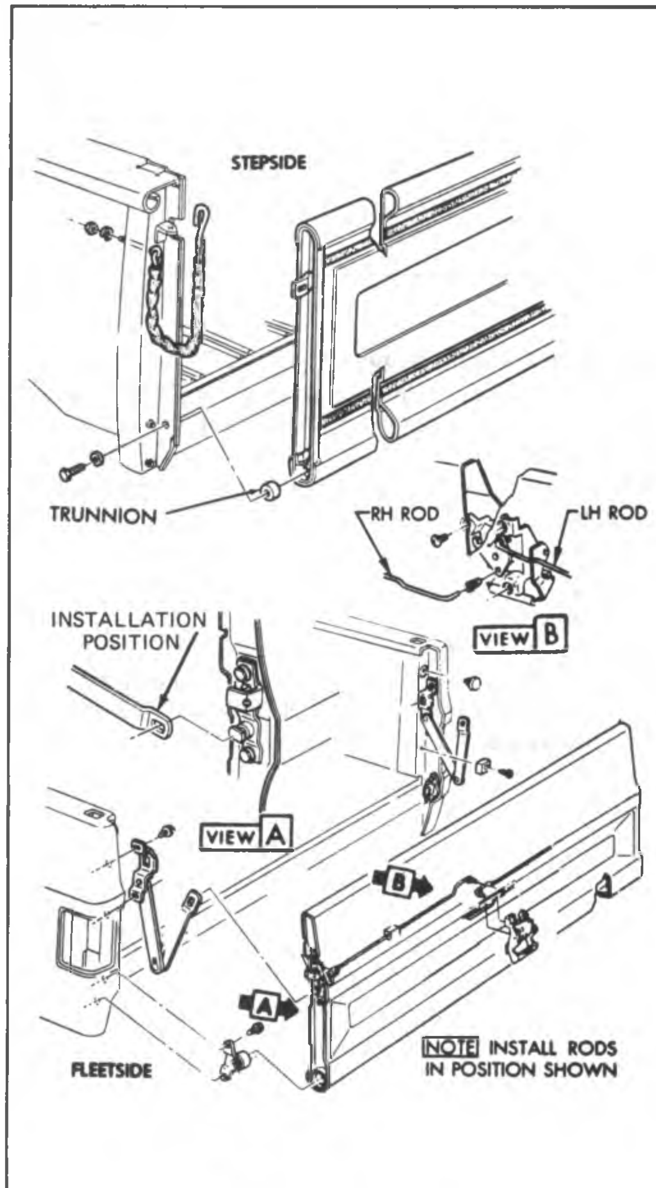

Fig. 10-77--Tailgate

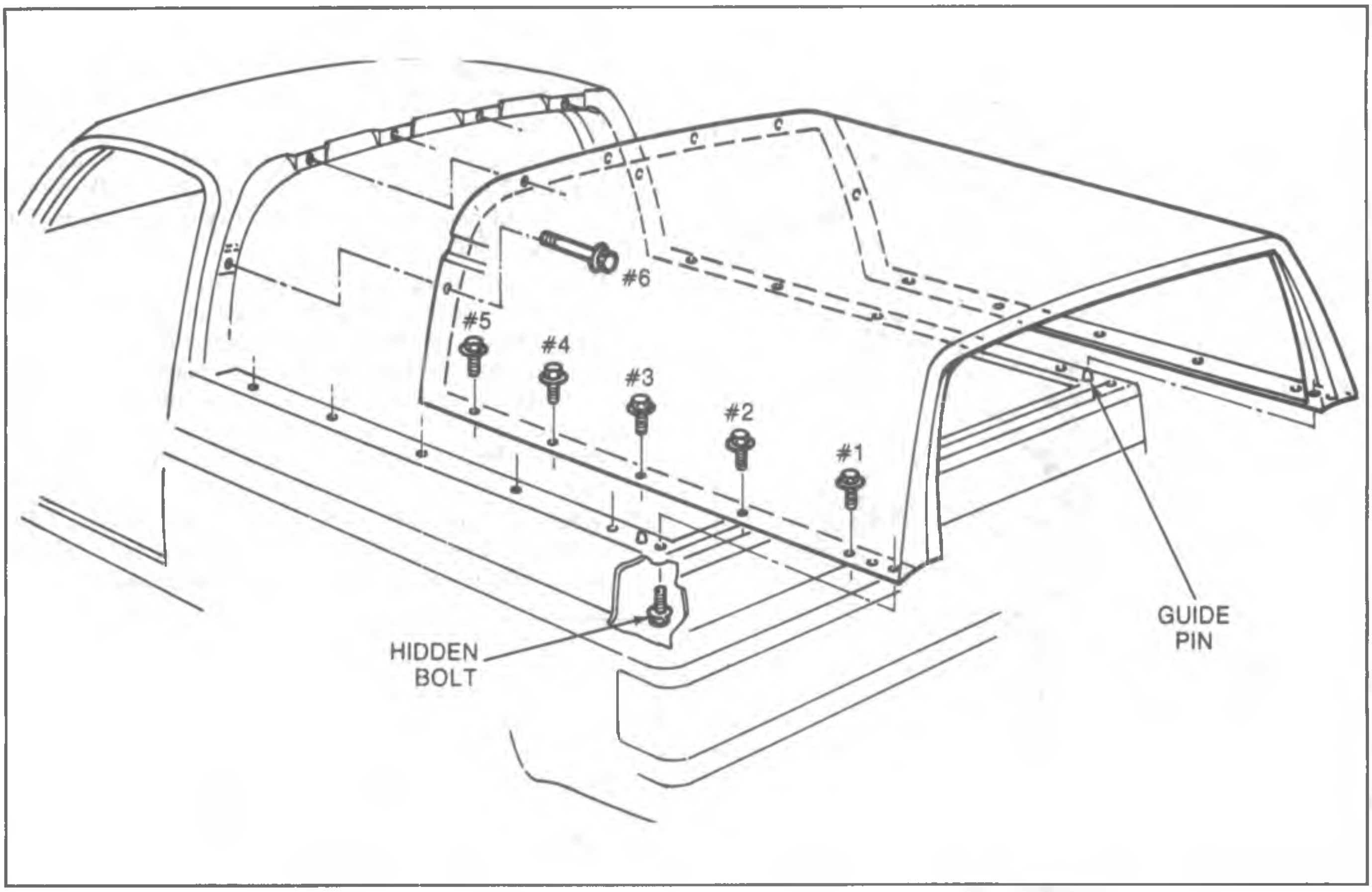

Fig. 10-78--Removable Top

Mandatory Assembly Sequence (Fig. 10-78)

To prevent possible damage to the top and to ensure proper weatherstrip sealing, the following procedure must be followed:

1. Remove the upper spare tire brace by removing (2) bolts.
2. Remove the necessary side trim panel screws.
3. Place top on box using the two rear guide pins as locators.
4. Install bolts #6 on both sides and tighten.
5. Bolting must start with the rear vertical bolt #1. Now going forward install #2 LH side only, #3 and #4. **The RH side #2 bolt will be installed later.**
6. Loosen bolts #6 on both sides.
7. Install and tighten bolts #5 on both sides.
8. Re-tighten bolts #6 on both sides.
9. Install and tighten remaining bolts to cab.
10. Install and tighten the 2 rear hidden bolts.
11. Install the side trim panel screws that were removed including the shoulder belt retractor bolt if it had to be removed.
12. Finally, reconnect the courtesy light and reinstall the upper spare tire brace using 2 bolts, with one of the bolts being the #2 R.H. top-to-side panel bolt.

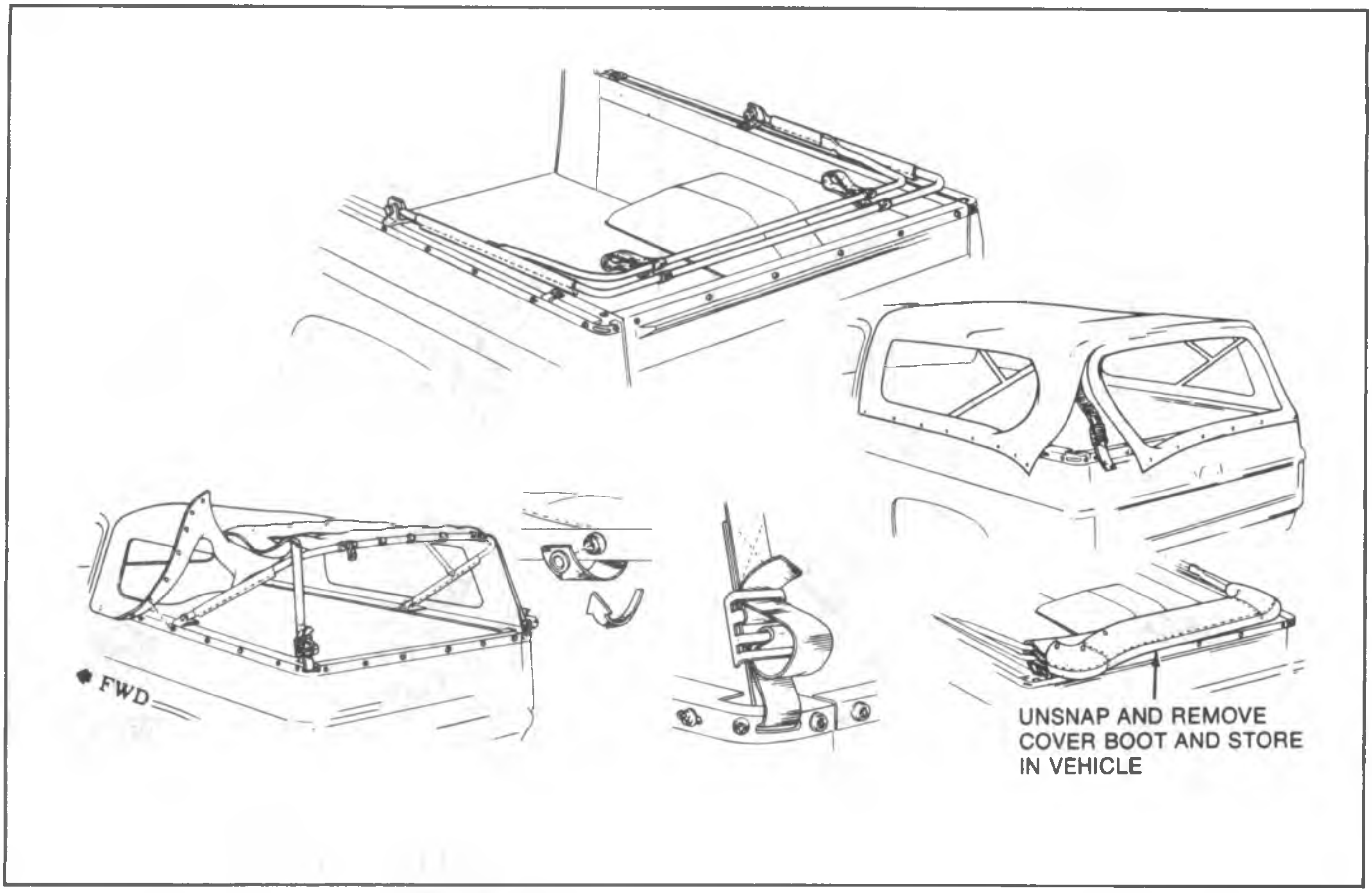

Fig. 10-79--Folding Top Assembly

LAP BELTS AND SHOULDER BELTS (ALL MODELS)

Before servicing or replacing lap and shoulder belts, including single loop belt systems, refer to the following precautionary items:

1. Lap and shoulder belts will be serviced as follows:
   a. All belts will be serviced in complete sets.
   b. Do not intermix standard and deluxe belts on front or rear seats.
2. Keep sharp edges and damaging objects away from belts.
3. Avoid bending or damaging any portion of the belt buckle or latch plate.
4. Do not bleach or dye belt or strap webbing (clean with a mild soap solution and water).
5. When installing lap or shoulder belt anchor bolt, start bolt by hand to assure that bolt is threaded straight.
6. Do not attempt repairs on lap or shoulder belt retractor mechanisms or lap belt retractor covers. Replace defective assemblies with new service replacement parts.
7. Do not attempt to remove seat belt retractor cover. The cover and the long rivet securing the cover to the retractor are not available as service replacement parts.

The shoulder belts and lap belts are attached to the front seat lap belt latch plate and connected to an inertia locking retractor installed to the floor or quarter inner panel above the right and left side of the front seat. The belts remain unlocked to allow occupants to move freely while the vehicle is being operated. When the vehicle decelerates or changes direction abruptly, the belts are locked in position by a pendulum that causes a locking bar to engage a cog of the retractor mechanism.

Removal and Installation

Refer to illustrations on following pages and select the appropriate illustration for removing and installing lap belts and shoulder belts.

Internal drive thread-forming anchor bolts are used to secure lap belts to the floor pan. To remove or install internal drive anchor bolts, use door lock striker and lap belt anchor bolt removal tool J-23457 or equivalent. Start bolt by hand to assure that bolt is threaded straight.

SEAT MOUNTING

Typical Seat Mounting provisions are shown in figures 10-83 through 10-89.

NOTICE: See NOTICE on page 1 of this section regarding fasteners used on seats and seat belts.

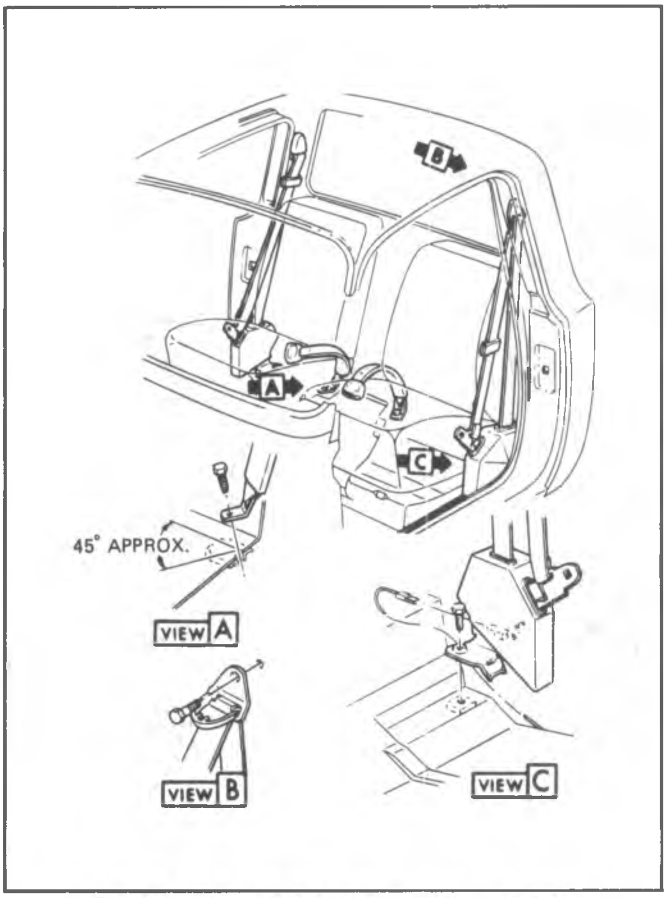

Fig. 10-80--Seat Belt Installation (Chassis Cab)

SEAT SEPARATOR COMPARTMENT

Figure 10-90 illustrates assembly and installation of the CK model seat separator compartment.

BODY MOUNTING

The removal of anyone bodymount necessitates the loosening of adjacent body mountings to permit the frame to be separated from the body. Care should be exercised to prevent breakage of plastic fan shroud, or damage to frame attachments such as steering column, brake pipes, etc., during replacement of body mounts.

During installation of a body mount, caution should be used to insure that the body mount is properly seated in the frame mounting hole, otherwise a direct metal to metal contact will result between the frame and body. The tube spacer should be in all bolt-in body mounts and the insulator or metal washer positioned to prevent contact with the frame side rail. Do not over-torque the body mount or a stripped bolt may result.

Do not use lubricants of any kind on the rubber parts of the mounts. Proper clamping by the mount depends on clean and dry surfaces. If the body mount bolt does not screw in

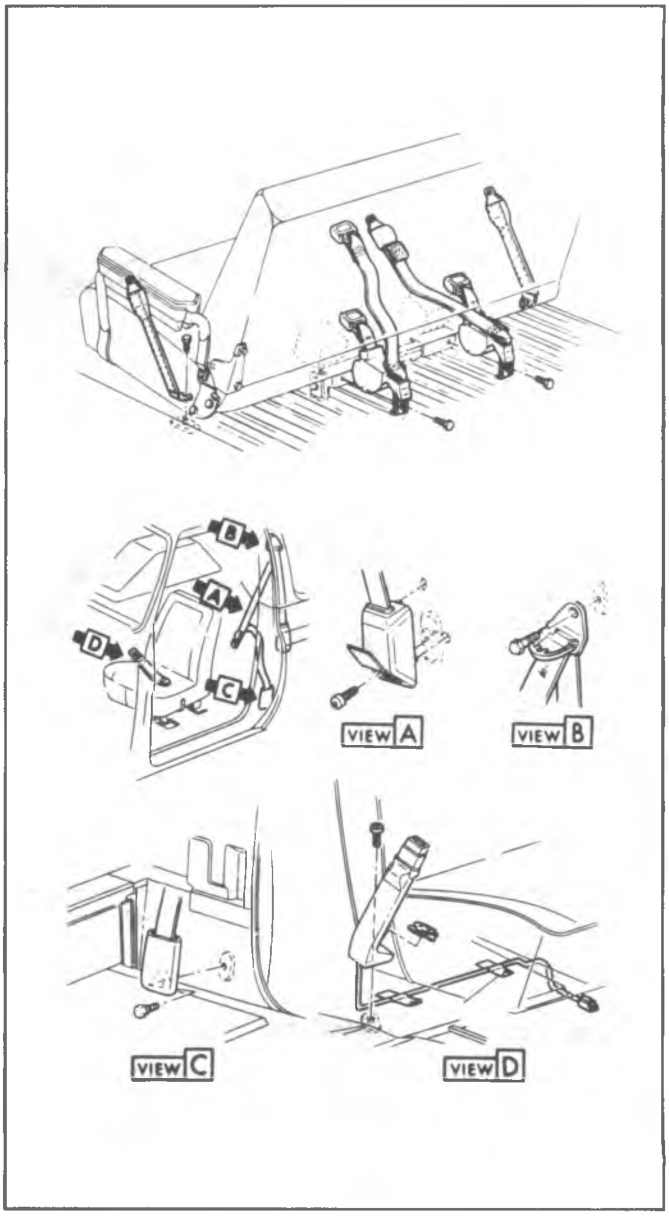

Fig. 10-81 --Seat Belt Installation (Utility)

smoothly, it maybe necessary to run a tap through the cage nut in the body to remove foreign material. Caution should also be used to insure that tap doesn't punch through underbody.

The sequence of mounting attachments is shown in figures 10-91 through 10-94.

APPLIQUE PROCEDURES

Refer to Section 2C, Chassis Sheet Metal, for procedures relating to decal and woodgrain appliques.

ADHESIVE BODY SIDE MOLDING

Refer to Section 2C, Chassis Sheet Metal, for procedures relating to installation of adhesive moldings.

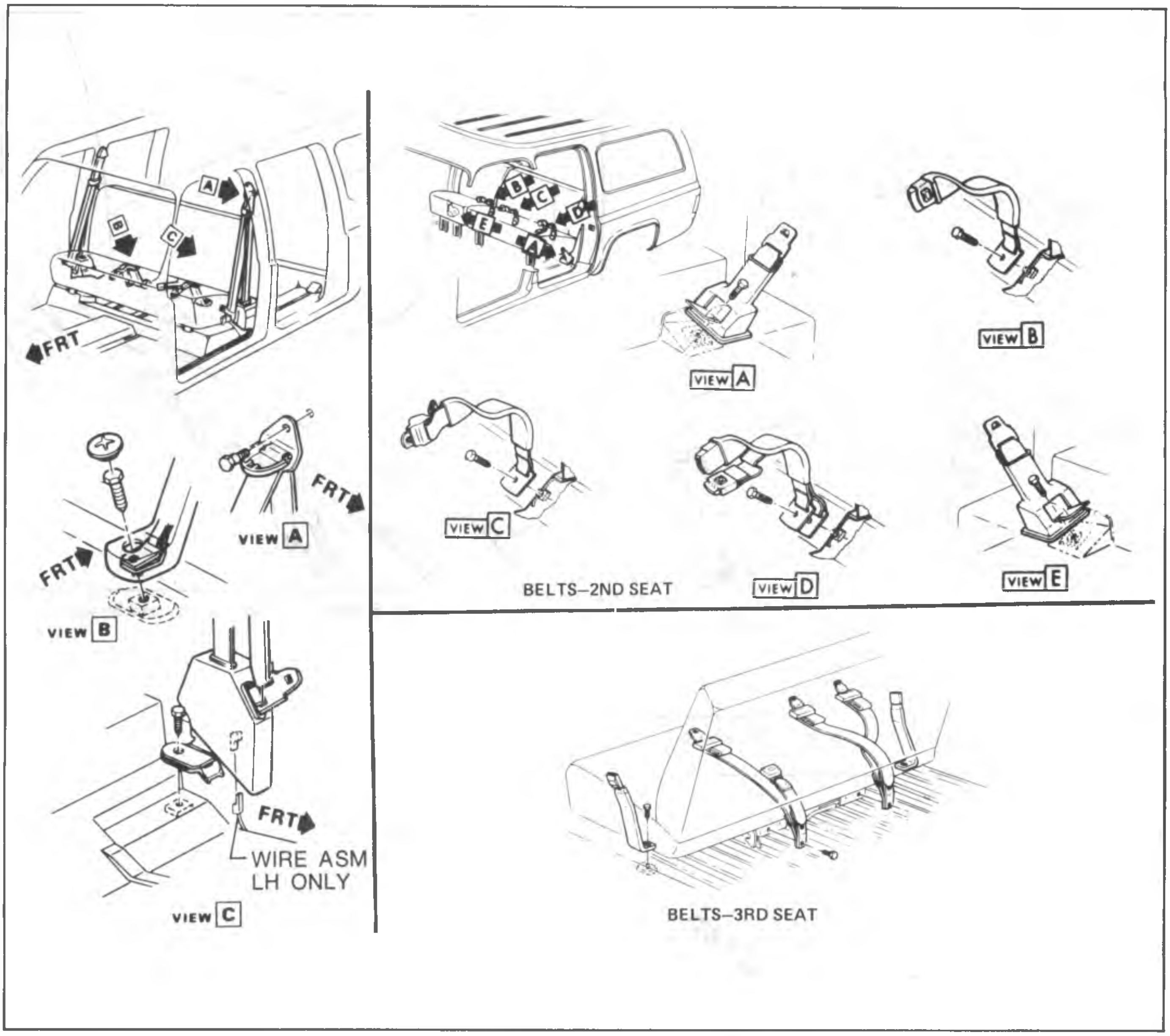

Fig. 10-82--Seat Belt Installation (Suburban)

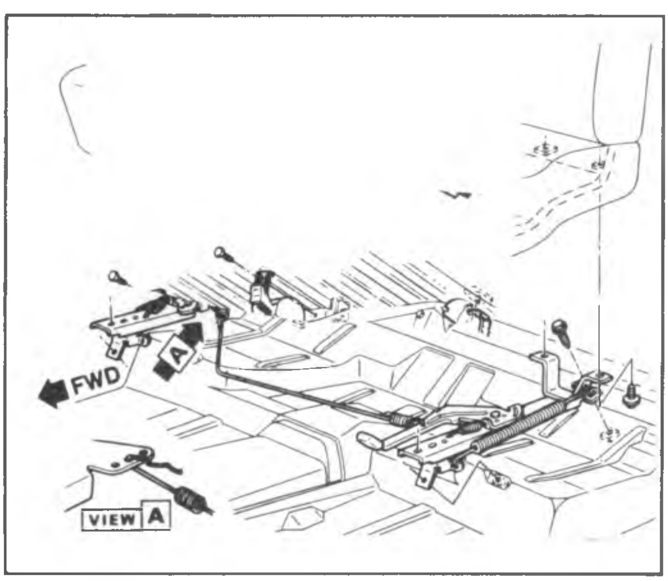

Fig. 10-83--Front Bench Seat

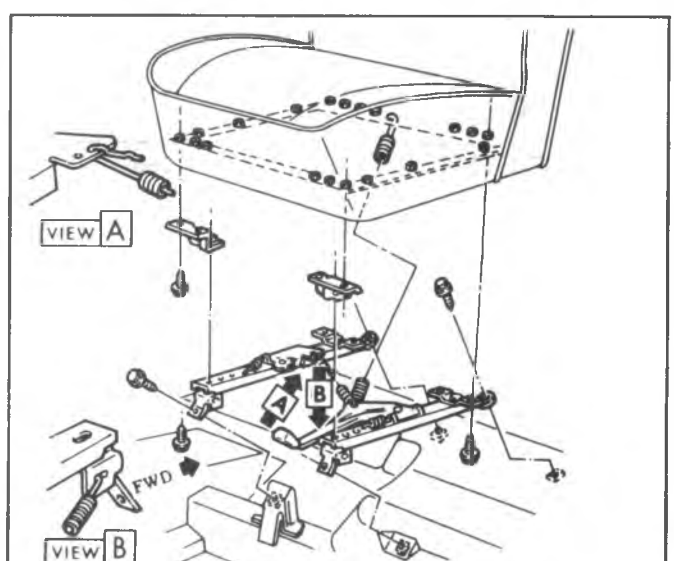

Fig. 10-84--Driver's Bucket Seat (Chassis Cab) Passenger and Driver Seat (Suburban)

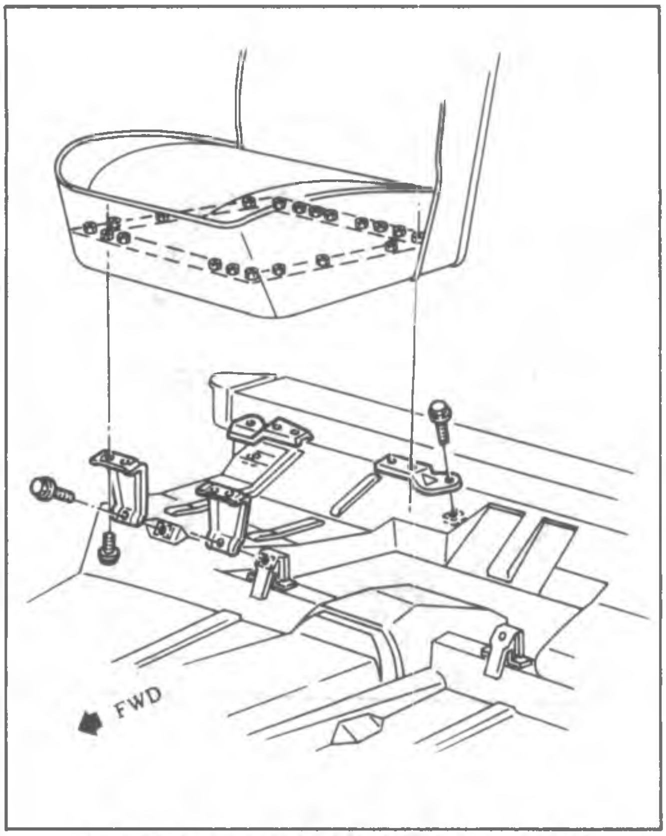

Fig. 10-85--Passenger's Bucket Seat (Chassis Cab)

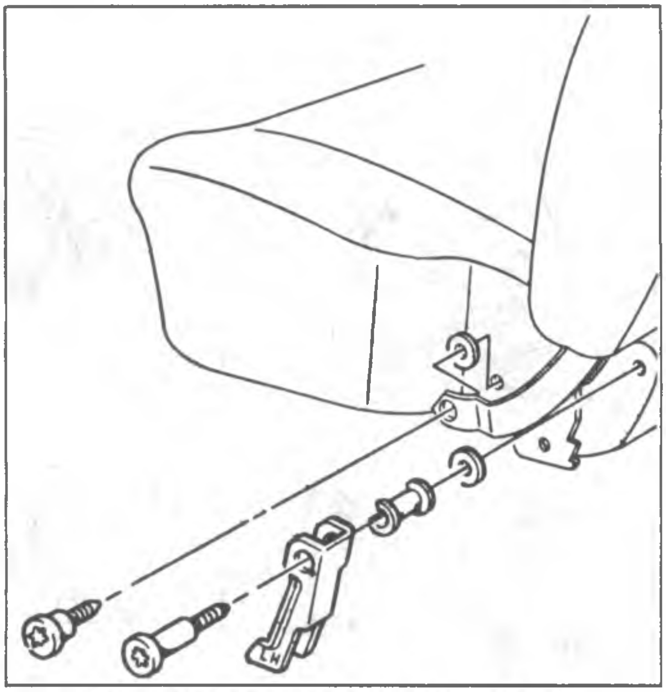

Fig. 10-86--Folding Seat Back Catch and Striker

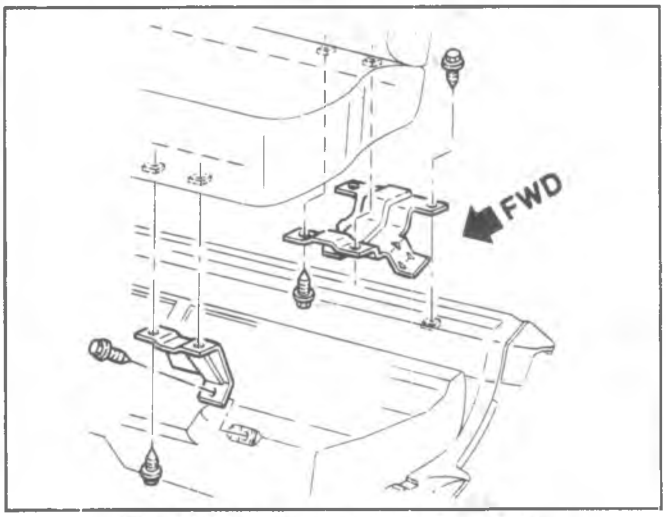

Fig. 10-87--Rear Bench Seat (Crew Cab)

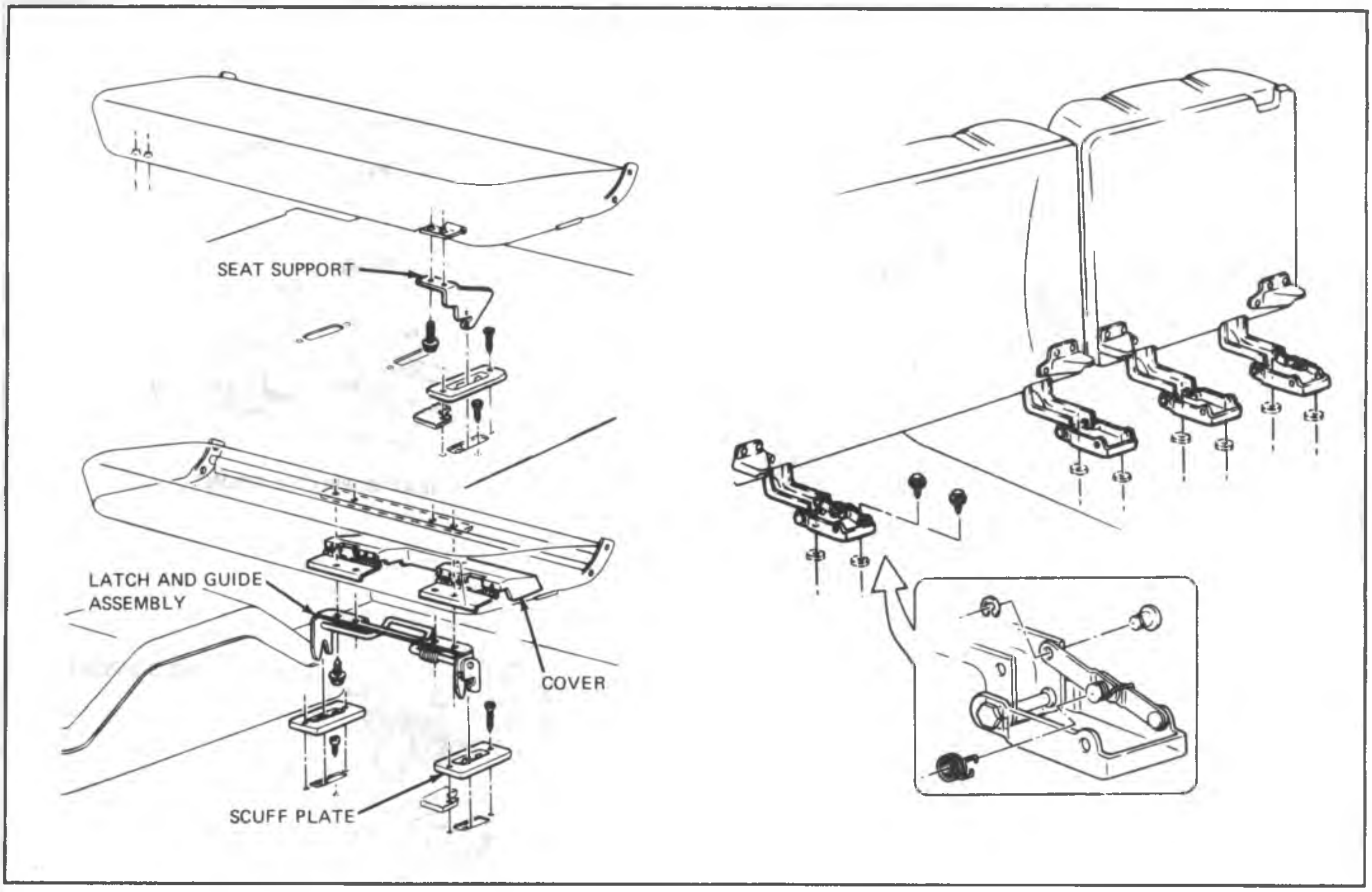

Fig. 10-88--Rear Bench Seats (Suburban)

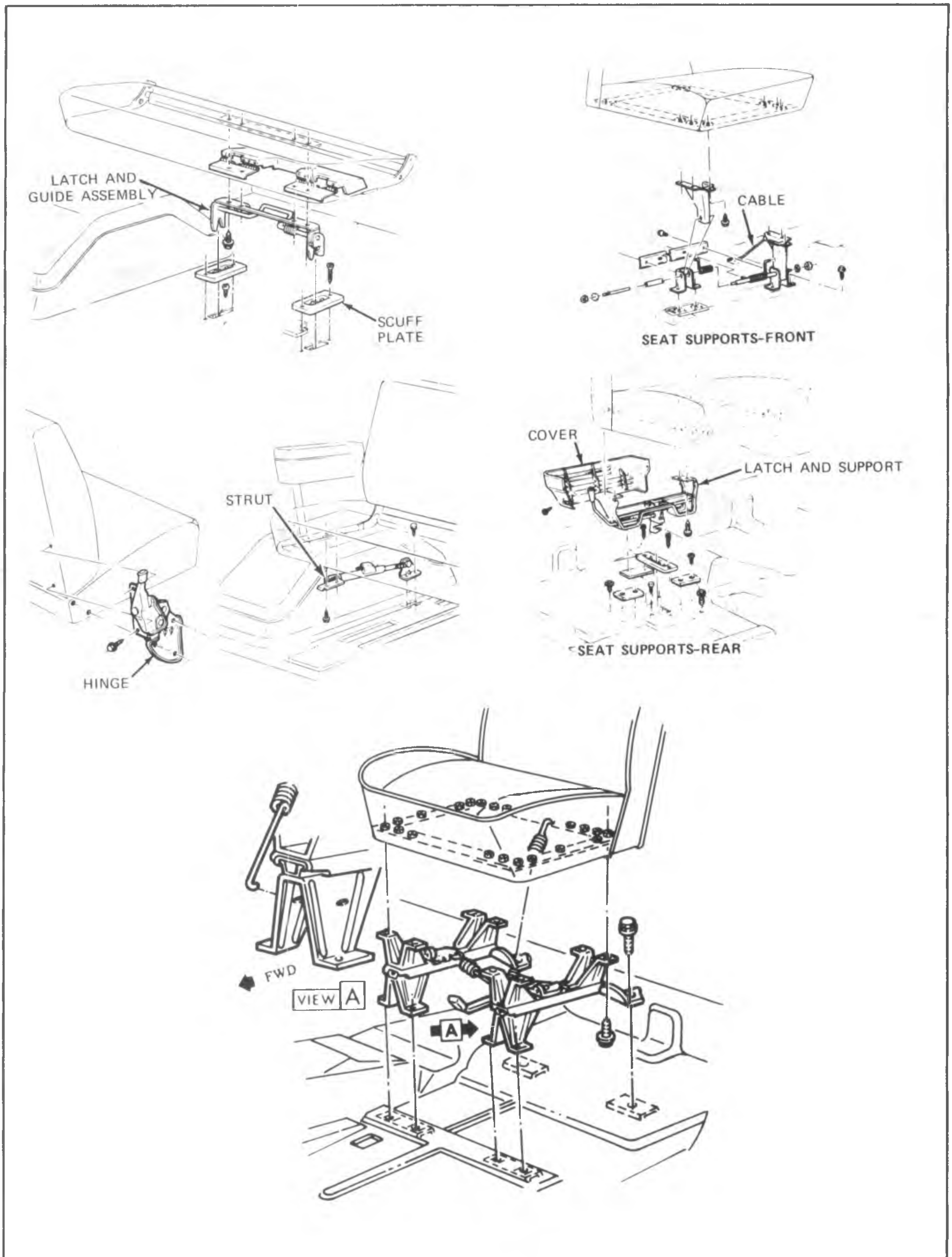

Fig. 10-89--CK Utility Seat Attachments

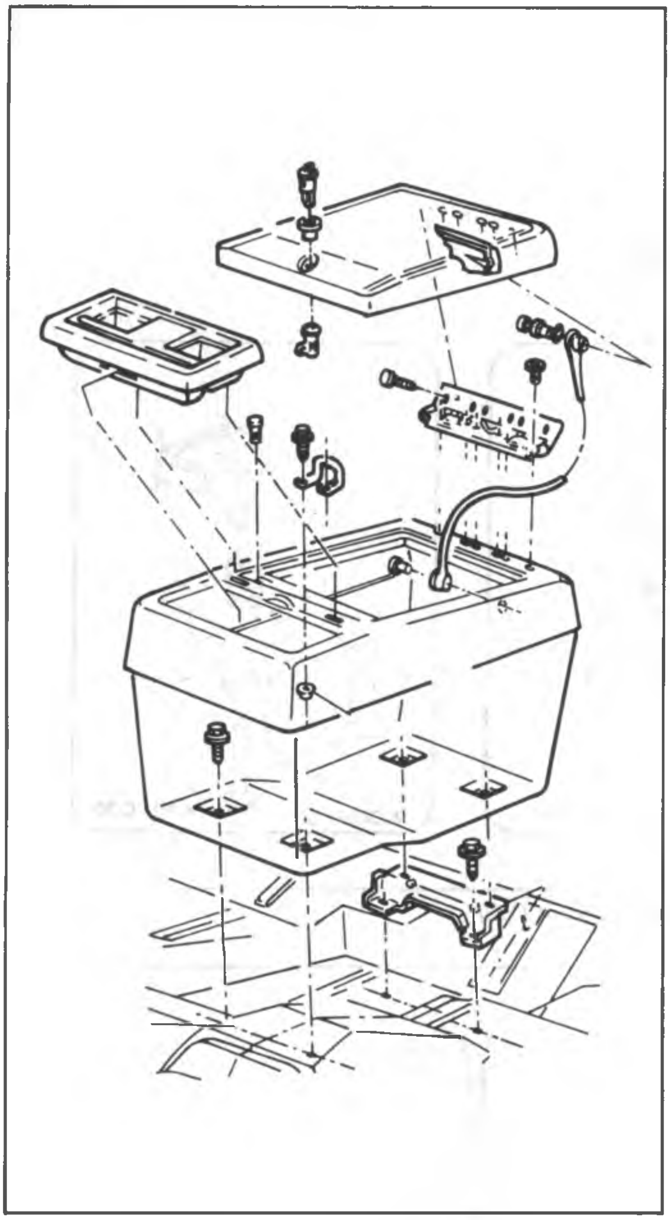

Fig. 10-90--Seat Separator Compartment and Door--CK Models

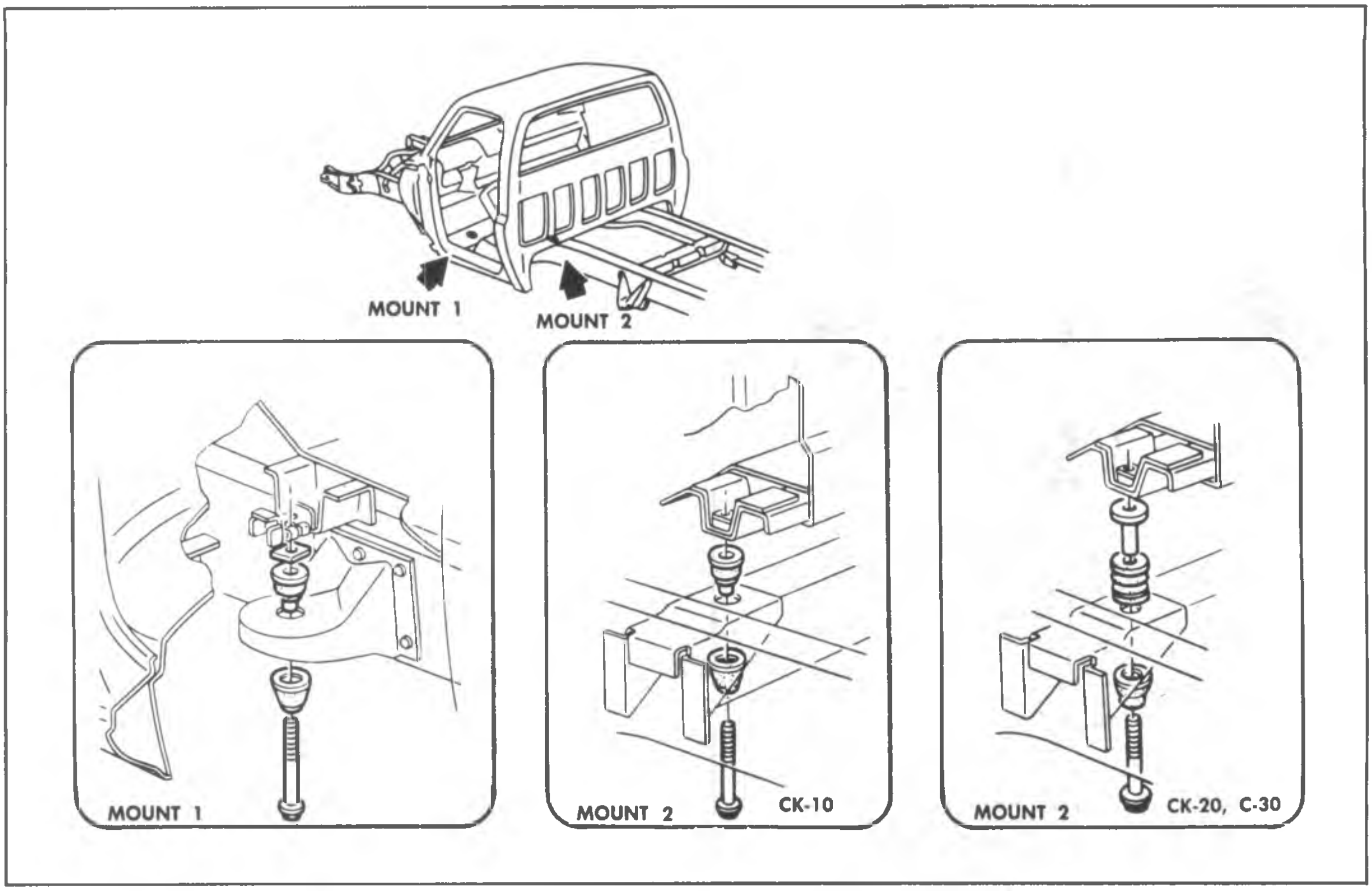

Fig. 10-91 --Body Mounting (Chassis Cab)

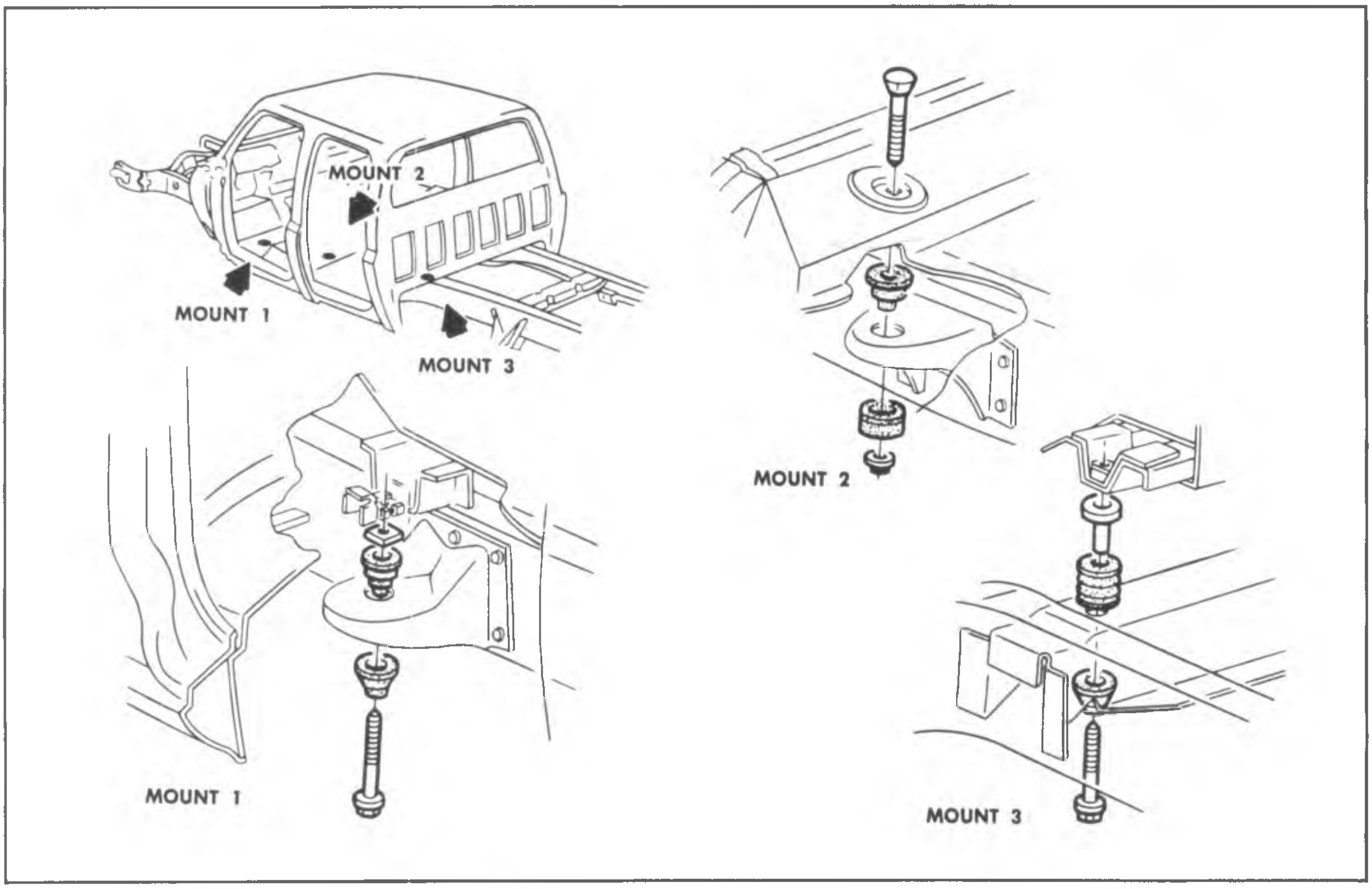

Fig. 10-92--Body Mounting (Crew Cab)

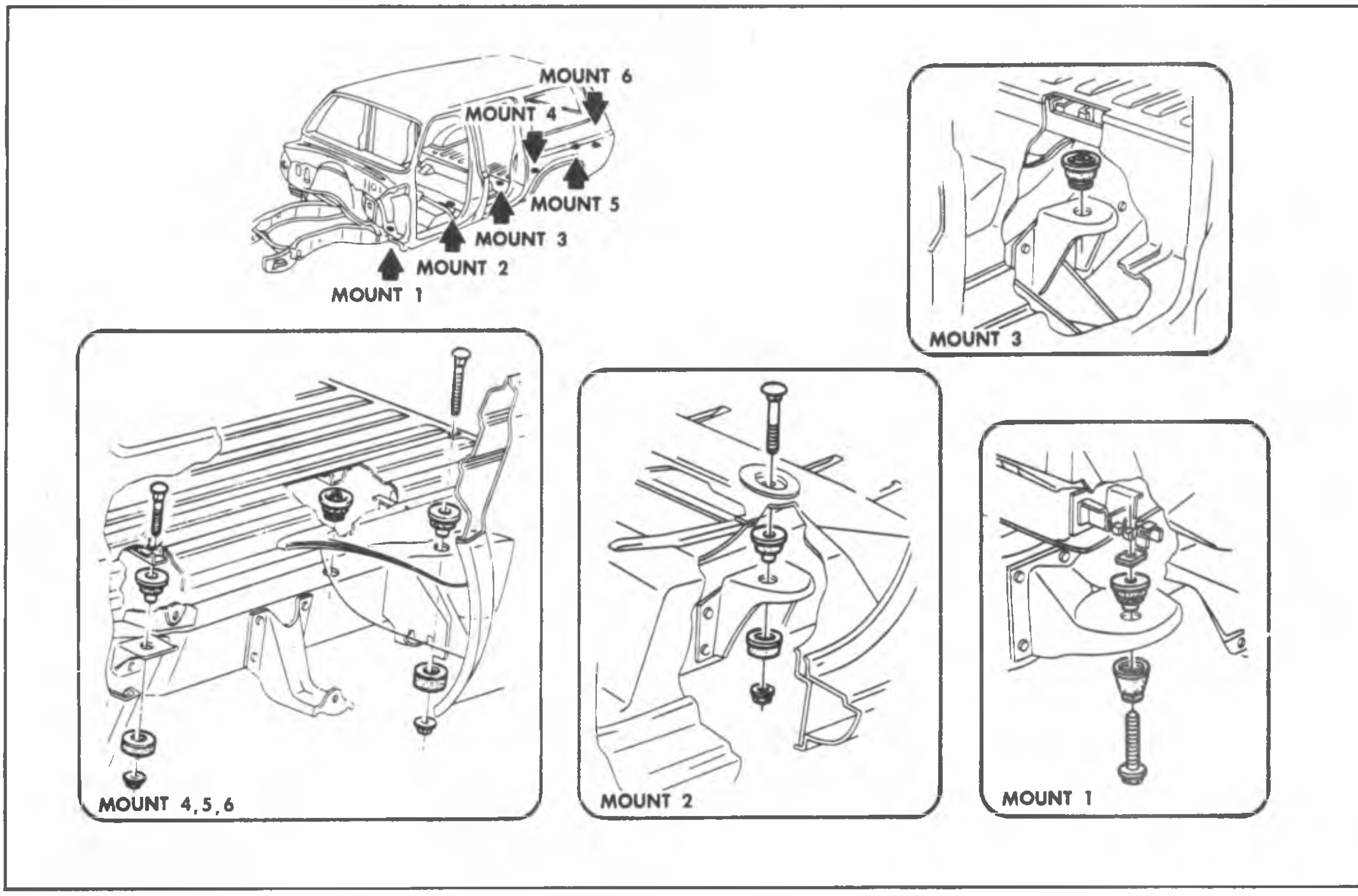

Fig. 10-93--Body Mounting (Suburban)

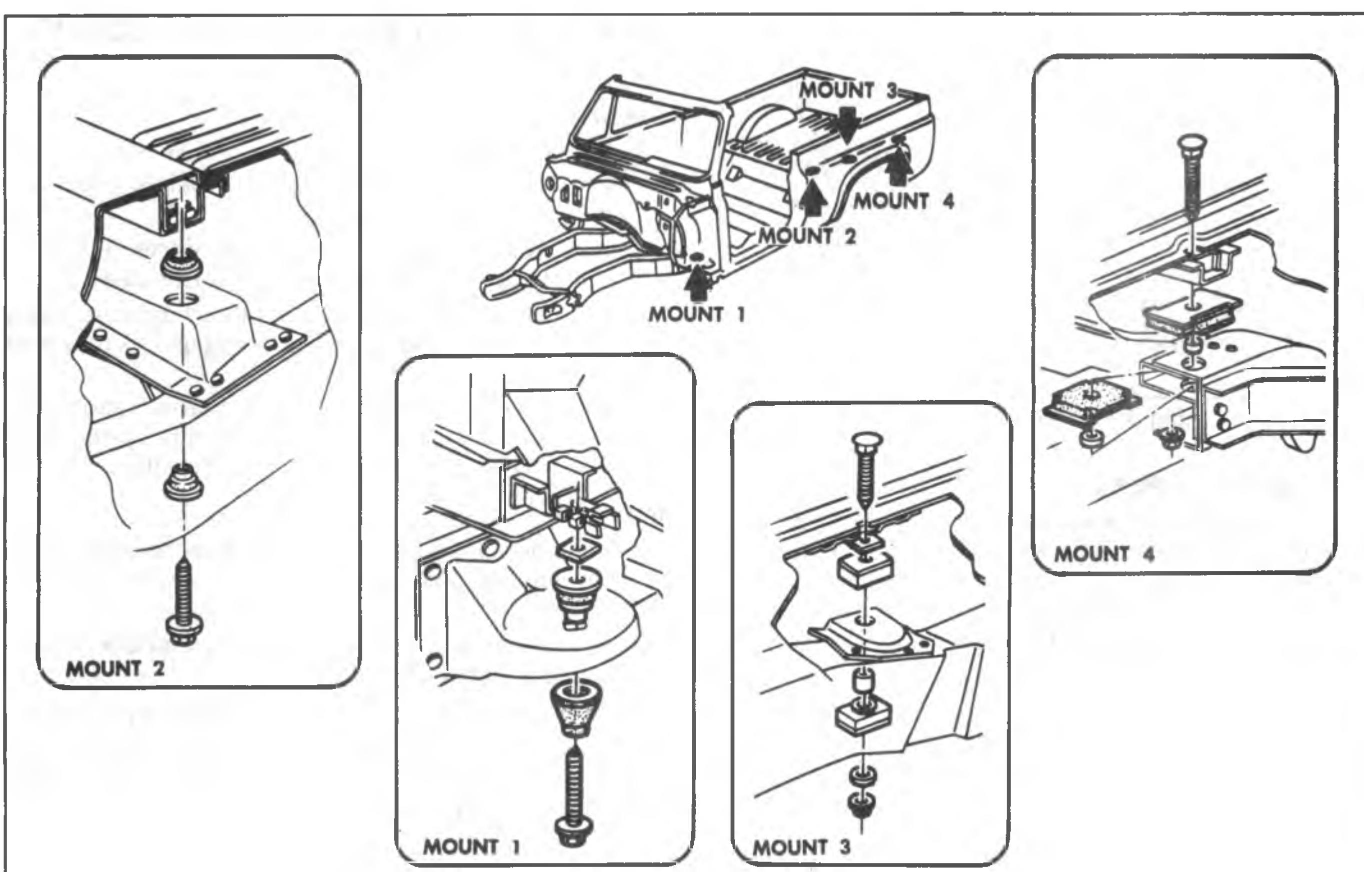

Fig. 10-94--Body Mounting (Utility)

G MODELS

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FRONT END

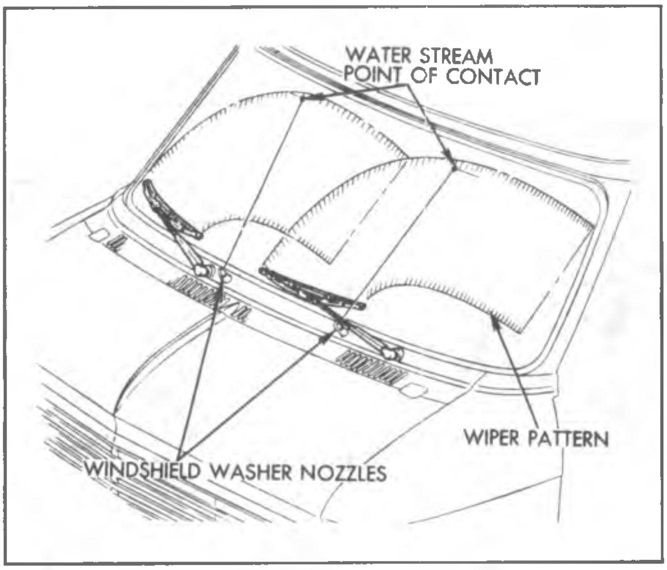


Fig. 10-95--Wiper Pattern

WINDSHIELD WIPERS

Windshield wiper units on all models are of the two-speed electric type. A single wiper motor unit, mounted to dash panel at top and to left of engine cover inside cab, powers both wiper blades. The wiper blade operating link rods and pivot mountings on these models are located in the outside air inlet plenum chamber.

Arm Adjustment

To adjust sweep of blades turn on wipers, then note sweep of arms. If necessary, remove one or both arms as follows:

Pull outer end of arm away from glass which will trip lock spring at base of arm and release spring from undercut of pivot shaft. While holding arm in this position, pull outward on cap section at base of arm to remove arm. Arm can be reinstalled in any one of several positions due to serrations on pivot shaft and in arm cap. See figure 10-95.

WIPER ARM PIVOT SHAFTS AND LINK ROD-FIG. 10-96

Removal

1. Remove windshield wiper arms from pivot shafts. Procedure for removing arms is explained previously under "Arm Adjustments."
2. Remove screws which attach outside air cowl ventilator grille to cowl. Carefully remove grille from cowl.
3. At center of cowl, remove two attaching nuts which attach link rod to motor drive. Disengage link rods from pins.
4. Remove screws which attach each arm transmission pivot shaft assembly to cowl. Remove pivot shaft assembly with link rod from plenum chamber.

Installation

1. Place pivot shaft assembly with link rod into position at cowl bracket. Secure assembly to bracket with two screws.
2. Attach end of link rod to motor drive and arm. Secure rod with the two attaching nuts.
3. Install outside air cowl ventilator grille to top of cowl.
4. Before installing wiper arms, operate wiper motor momentarily which should rotate pivot shafts to park position. Install arms.

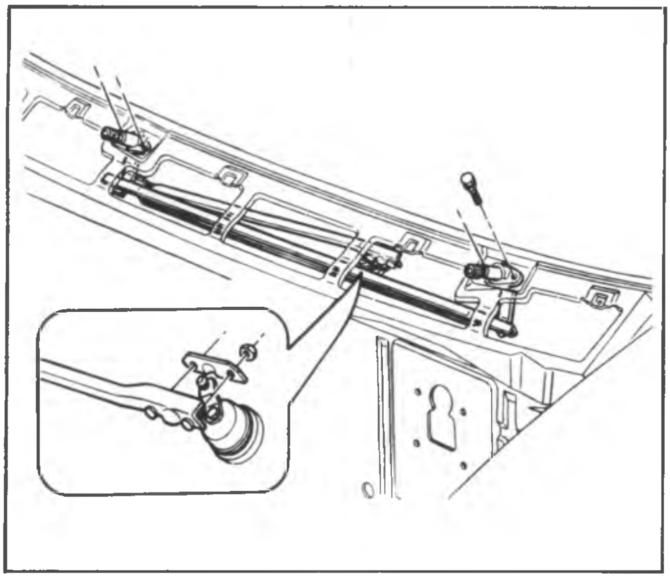


Fig. 10-96--Windshield Wiper Linkage

COWL VENTILATOR GRILLE

Replacement

1. Remove windshield wiper arms.
2. Remove screws retaining grille, figure 10-97.
3. Remove grille and seal.
4. Reverse above steps to install grille.

SIDE COWL VENTILATOR

Replacement

1. Remove screws retaining valve guide to panel, as shown in figure 10-98.
2. Remove valve assembly by depressing pins at top and bottom of valve.

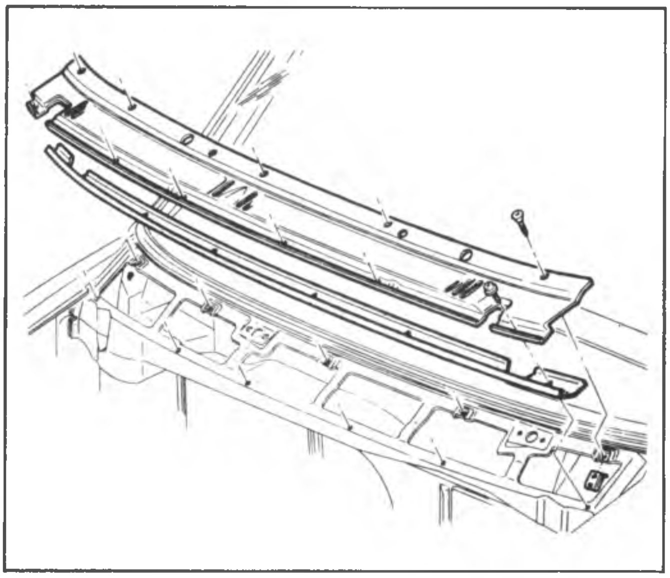


Fig. 10-97--Cowl Ventilator Grille

3. Reverse the above steps for installation.

REAR VIEW MIRRORS

Inside Rear View Mirror

Replacement

The inside mirror may be removed by removing screw retaining mirror to its glass-mounted bracket, and lifting mirror off bracket (fig. 10-99).

Outside Rear View Mirrors

Outside rear view mirror installations are shown in figure 10-100. Occasional tightening of mounting and assembly bolts and screws will sharply decrease occurence of failure due to door slamming or road shock.

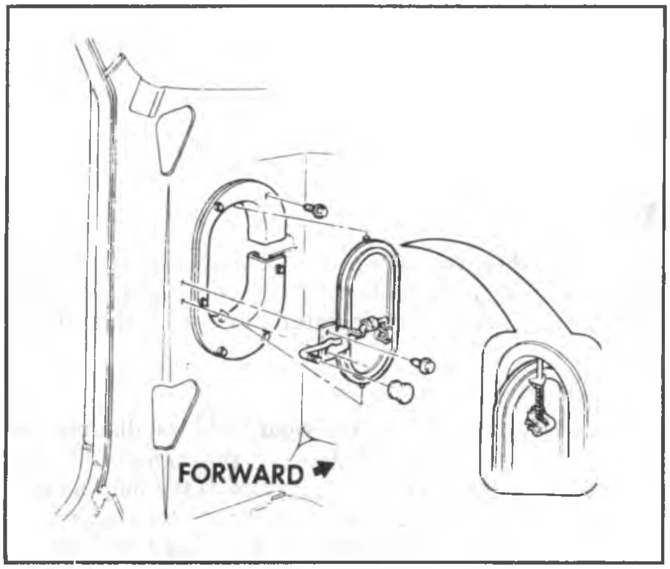


Fig. 10-98--Side Cowl Ventilator

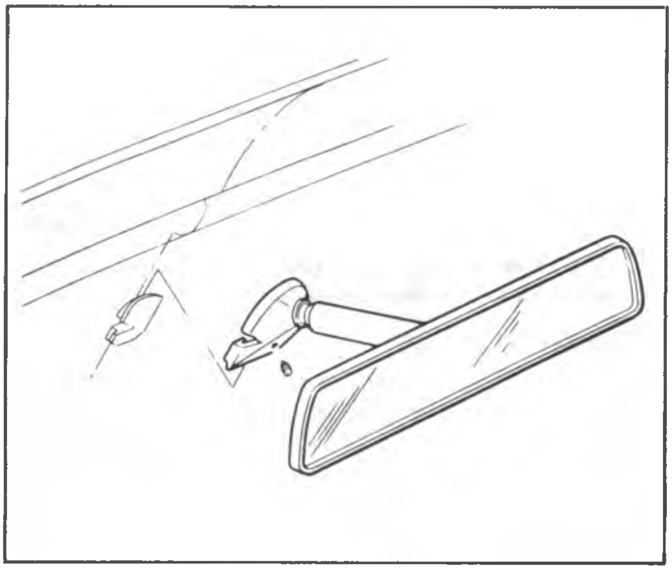


Fig. 10-99--Inside Rear View Mirror

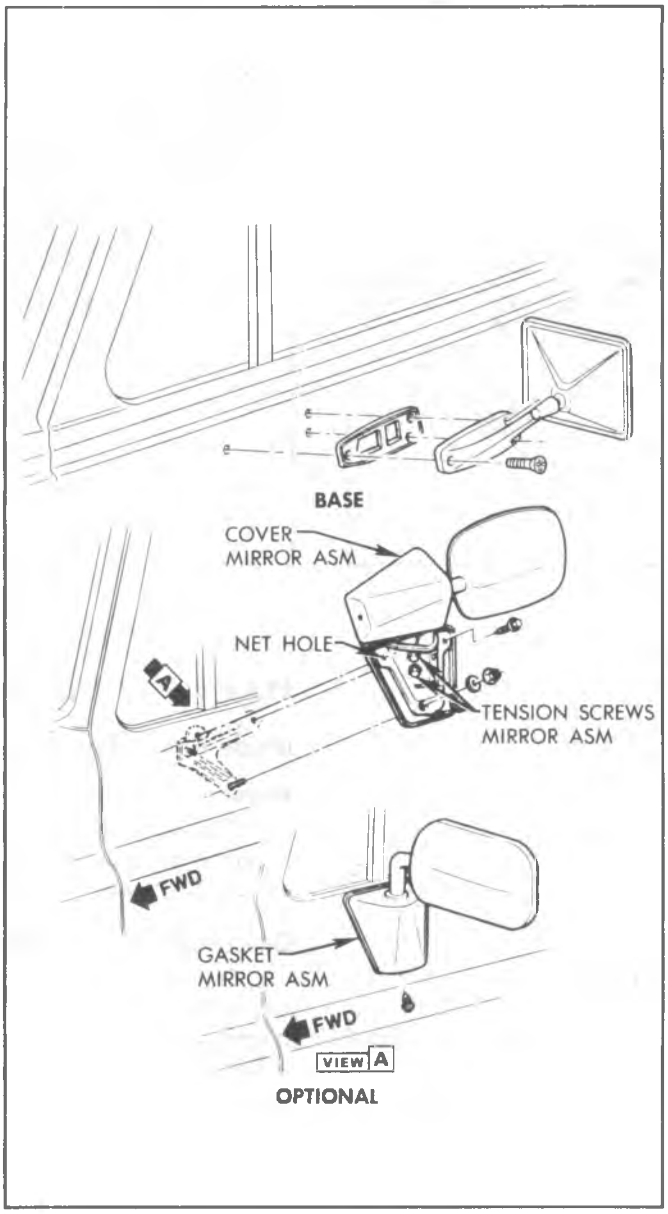


Fig. 10-100--Outside Rear View Mirrors

BODY GLASS

CAUTION: Always wear gloves and eye glasses when handling glass to avoid personal injury.

WINDSHIELD GLASS

The windshield glass is retained to the body by urethane adhesive. The windshield reveal moldings are vinyl and are retained by two strips of butyl adhesive on the underside of the molding, attaching to the body on one side and the glass on the other and also by a retention lip in the urethane which retains the glass. The windshield rests upon the support molding which is secured to the pinchweld by a bead of butyl adhesive.

When replacing a cracked windshield glass, it is very important that the cause of the glass breakage be determined and the condition corrected before a new glass is installed. Otherwise, it is possible that a small obstruction or high spot somewhere around the windshield opening will continue to crack or break the newly installed windshield, especially when the strain on the glass caused by this obstruction is increased by such conditions as wind pressures, extremes of temperature, motion of the vehicle, etc.

Removal

There are two methods of windshield installation. The windshield removal procedure is the same for both installation methods with one exception. If the short method installation is to be used, more care must be used during removal to make certain that an even bead of adhesive material remains on window opening to serve as a base for replacement glass, there should not be any loose pieces of adhesive left in the opening. Cut away a sufficient amount of material to allow for the installation of the reveal moldings.

1. Place protective coverings around the area where the glass is being removed.
2. Remove windshield wiper arms, exterior reveal

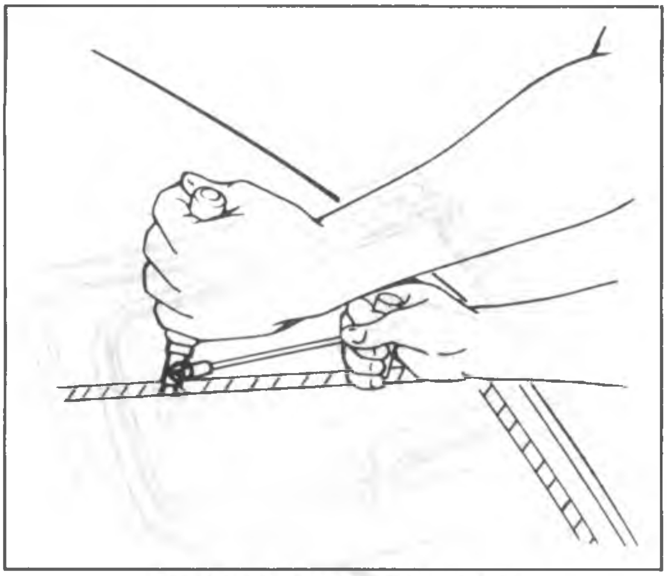


Fig. 10-101 Knife Removal Method

moldings, interior garnish molding and support molding from the pinchweld. Clean up any remaining adhesive left on the body from the reveal molding.

The reveal moldings can be removed from the urethane adhesive by taking one end of the molding and pulling it away from the adhesive. The support molding is removed in the same manner from inside the vehicle , pry up one end of the molding and pull it away from the pinchweld. These molding are to be removed prior to windshield removal.

3. Use a knife as shown in Fig. 10-101 to cut the adhesive completely around the perimeter of the glass. Knife, J-24402-A or equivalent may be used. With help from an assistant, carefully remove the glass.
4. If original glass is to be reinstalled, place it on a protected bench or holding fixture; remove old material using a razor blade or sharp scraper. Any remaining traces of adhesive material can be removed with denatured alcohol or lacquer thinner dampened cloth.

   When cleaning windshield glass, avoid contacting edge of plastic laminate material (on edge of glass) with volatile cleaner. Contact may cause discoloration and deterioration of plastic laminate by wicking action. DO NOT use a petroleum base solvent such as kerosene or gasoline. The presence of oil will prevent adhesion of new material.

When replacing the windshield, urethane adhesive (part no. 9636067 or Essex SCD 551.2 or equivalent) **must** be used in order to maintain original installation integrity.

The short method as described previously can be used where original adhesive material left on window opening pinchweld flanges after glass removal serves as a base for the new adhesive to the glass. This method would be used in cases of cracked windshields or removal of windows that are still intact. The amount of adhesive left in window opening can be controlled during glass removal.

However, in some instances all the material must be removed, to make a metal repair or to perform a paint-refinishing operation. In these cases, an additional cleaning and priming step is required before applying the urethane adhesive. See the instructions at the beginning of "Installation".

Adhesive Service Kit or Cartridge

Material listed have a short shelf life. Be sure materials are fresh.

Urethane adhesive cartridge Essex SDC 551.2 or the equivalent are provided singularly. Adhesive Kit No. 9636067 (urethane adhesive) or equivalent contains some of the items needed to remove and replace a urethane adhesive installed glass.

Additional items required:

1. Pinchweld primer for enamel painted surface Essex SCD 435.34 or equivalent.
2. Clear glass primer, Essex SCD 435.18 or equivalent.
3. Black glass primer (included in kit 9636067) or Essex SCD 435.20 or equivalent.
4. Solvent for cleaning edge of glass (preferably alcohol) and adhesive dispensing gun No. J-24811 or an equivalent standard household cartridge type gun reworked as follows:
   a. Widen end slot to accept dispensing end of adhesive material tube.
   b. Reduce diameter of plunger disc on rod so that disc can enter large end of adhesive material tube.
5. Commercial type razor knife.
6. Urethane cutting knife No. J-24402-A or equivalent or two pieces of wood for wire handles.
7. Two rubber support spacers.

Installation

Steps 1 through 11 are to be used for installing glass onto the original urethane adhesive left behind when the windshield was removed. In those instances where the adhesive was entirely removed, to make a metal repair or to perform a paint refinish operation, it is necessary to follow this extra step, before starting Step 1.

- Thoroughly clean the metal area surrounding the windshield opening by wiping with a clean alcohol-dampened cloth. Allow to air dry. Then apply primer for enamel painted surface Essex SCD 435.34 or equivalent, to the same area, being careful not to allow any spill over onto exposed paint surfaces as this primer will damage the paint finish. The surface should not exceed 38°C (100°F) at the time of the application. Refer to Fig. 10-102. Allow the primer to dry for thirty minutes.

1. From inside the vehicle, install the support molding onto the pinchweld flange, the joint is to be located at bottom center of the opening. See Fig. 10-103.
2. Thoroughly clean the edge of the glass to which the adhesive material will be applied by wiping with a clean alcohol-dampened cloth. Allow to air dry.

   When replacing the windshield, urethane adhesive Part No. 9636067 or Essex SCD 551.2 or equivalent must be used in order to maintain original installation integrity.
3. Apply clear glass primer, Essex SCD 435.18 or equivalent around the entire perimeter of glass edge. Refer to Fig. 10-102.
4. Apply the black glass primer in the urethane

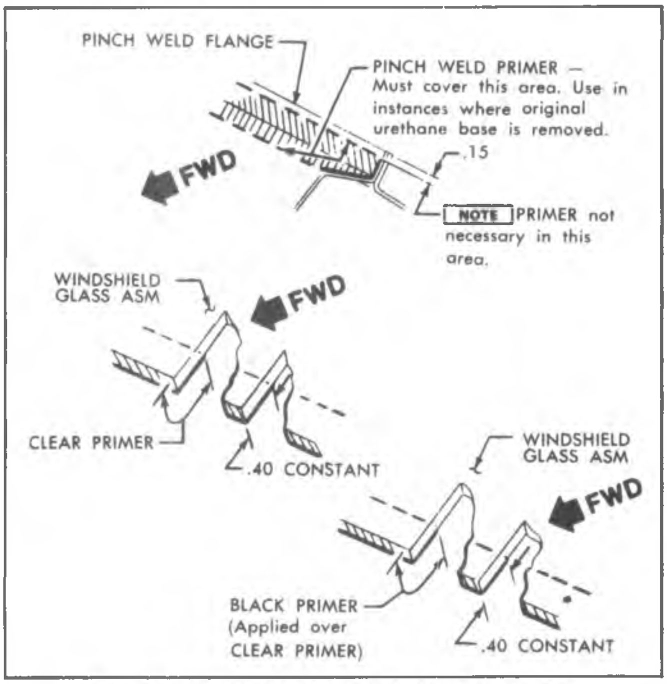


Fig. 10-102 Windshield Installation Preparation

adhesive kit 9636067 or Essex SCD 435.20 or equivalent around the entire perimeter of the glass edge. Allow to dry to touch (approximately 10 minutes). Refer to Fig. 10-102.

5. With the aid of a helper, lift the glass into the opening. Carry the glass with one hand on the inside of glass, and one hand on the outside. At the windshield opening, set the glass in a horizontal position. While one partner holds the glass in this position, the other can reach one arm around the pillar and support the glass from the inside, while the first person assumes the same position.

   With the glass centered in the opening, place the glass against the inside support molding, use small rubber blocks to support the glass in the correct position. Use the last screw on either side of the cowl grille cover as a guide for the positioning of these blocks in the windshield opening. Be sure to center the glass so that gaps on opposite sides and top-to-bottom are equalized. Trim rubber blocks as necessary. If the short method is used, check reveal molding fit and cut away additional solidified urethane base as necessary. See Fig. 10-104.

6. Cut the tip of the adhesive cartridge to make asmall opening of approximately 3/16 inch. First, fill in behind and around spacer blocks with urethane.

7. Then apply a smooth, continuous bead of urethane. Direct the flow of urethane down into gap as shown in Fig. 10-105. The material should fill the gap between the glass edge and the sheet metal. If necessary, use a flat-bladed instrument to paddle material into position. Be sure that adhesive contacts the entire edge of the glass, and extends to fill the gap between the glass and primed sheet metal or solidified urethane base from the original installation.

8. Spray a mist of water onto the urethane. This adhesive is moisture curing. Water will assist in the

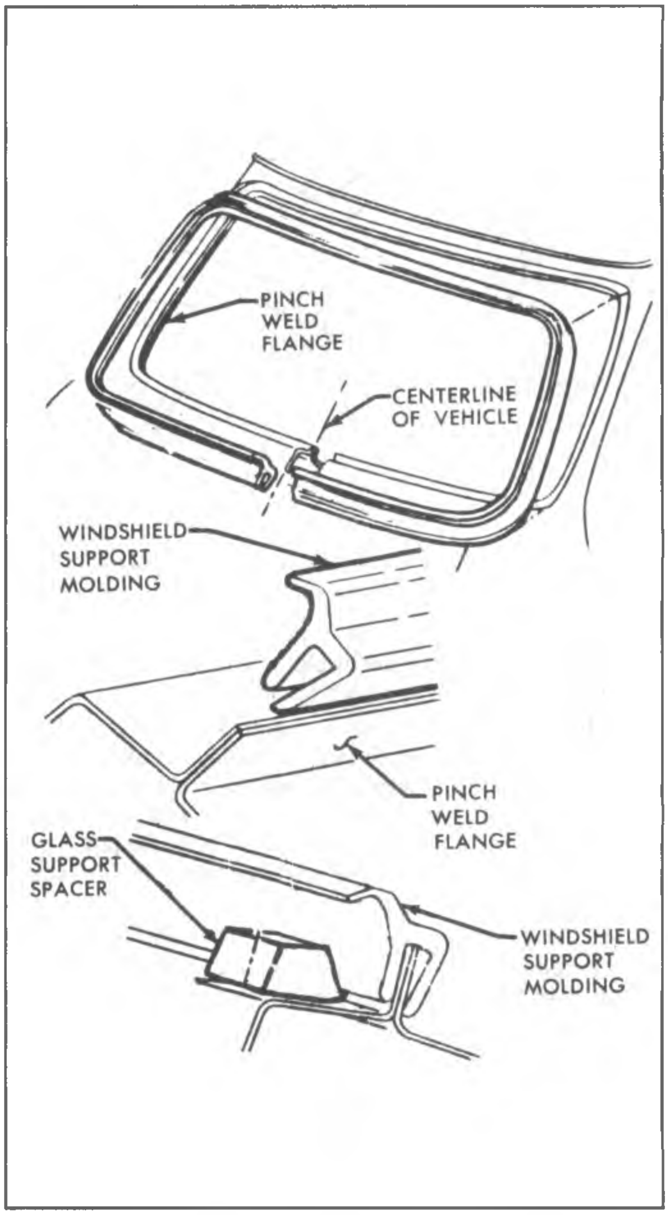


Fig. 10-103 Support Molding Installation

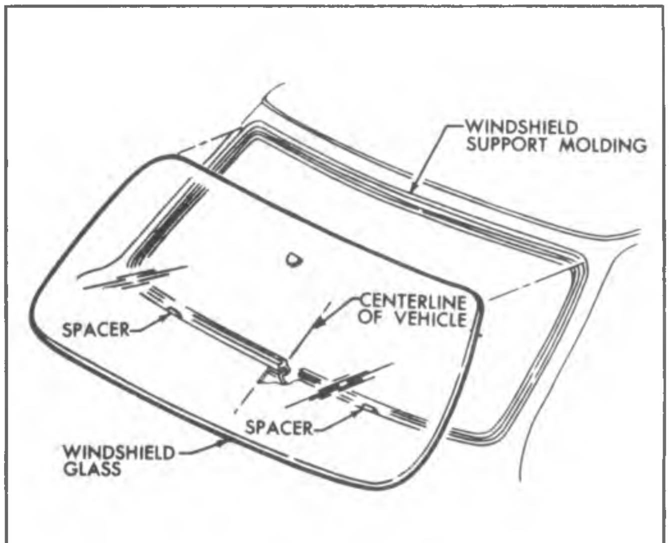


Fig. 10-104 Windshield Installation

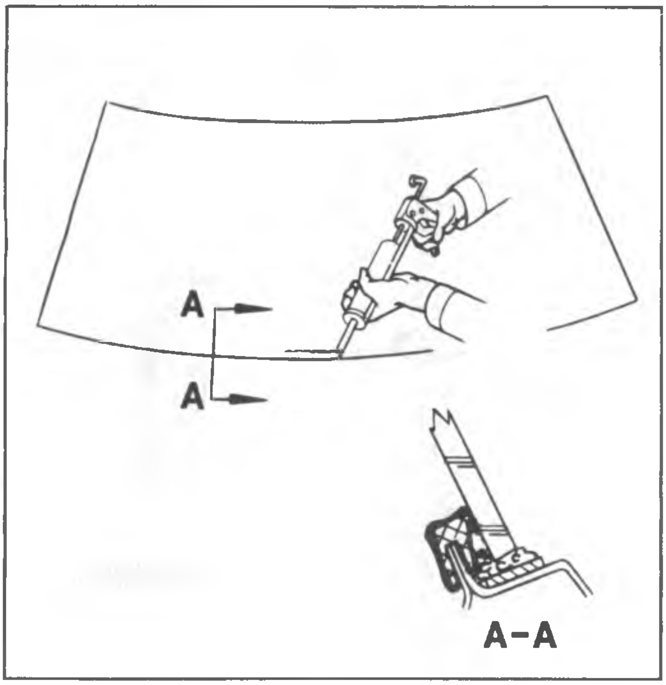


Fig. 10-105 Adhesive Material Application

curing process. Dry the area where the reveal molding will contact the glass and the body.

9. To install the outside reveal moldings. If new moldings are installed, remove the protective tape covering the butyl adhesive on the underside of the molding. If the original moldings are reusable, remove any excessive butyl or urethane. Push molding caps on to either end of one of the reveal moldings. Press the molding retention lip into the urethane adhesive against the edge of the windshield as shown in Fig. 10-106 taking care to seat the molding in the corners. Be sure the lip fully contacts the adhesive all around and that the gap is entirely covered by the crown of the molding. Slide molding caps into position between moldings connecting them. Use tape to hold the molding down in the correct position against the body and glass until the adhesive cures.
10. Install wiper arms, and clean up surrounding areas as required.

    Vehicle should not be driven and remain at room temperature for **six hours** to allow proper cure of adhesive.
11. Water leak test the vehicle. If a leak is found, refer to Windshield Waterleak Correction procedure.

WINDSHIELD WATERLEAK CORRECTION

With the urethane bonded glass on the G model, water leaks can be corrected without the removal of the reveal moldings or glass from inside the vehicle. Removal of the garnish and support molding will expose the urethane bond from the glass to the body. Refer to Figure 10-106.

It is not necessary to remove the plastic reveal molding to correct water leaks in most cases.

1. To locate the source of a water leak, remove the windshield garnish molding if so equipped, from the inside of the vehicle.
2. Remove the windshield support molding, Figure 10, from the inside of the vehicle without removing the windshield.
3. Locate the piston of the water leak by applying low air pressure to the urethane seal around inside of the windshield while water or a soapy solution is sprayed to the exterior windshield reveal molding area. If bubbles appear at the windshield area, a water leak exists in the urethane seal. A minor leak can be repaired with the addition of urethane adhesive (Kit No. 9636067 Essex SCD 435-20 or equivalent).

   To apply sealer in the windshield reveal molding and urethane area, use a heat gun to warm the area slightly and then carefully move the plastic reveal molding with a flat bladed tool sufficiently to allow the sealer to be inserted in the leak area.
4. Water may be leaking through a pinch weld seam in the top of the windshield opening because of sealer voids in the front roof drip rail and not the urethane bond.

   To determine if a water leak exists in the roof drip rail sealer, remove one sun visor assembly. Apply low pressure air through the sun visor assembly opening and at the same time, apply water or a soapy solution to the exterior roof drip rail area. If a leak exists in this area, bubbles should appear in the water being applied to the outside roof drip rail area. In these instances the roof drip rail should initially be prepped with a cleaner (such as is available from Kent Part No. 32180 or Dominion Sure Seal Part No. B.S.S.). Then joint and seam sealer, which can later be painted (such as is available from Kent No. 32130 or Dominion Sure Seal Part No. C.S.C.), should be applied.

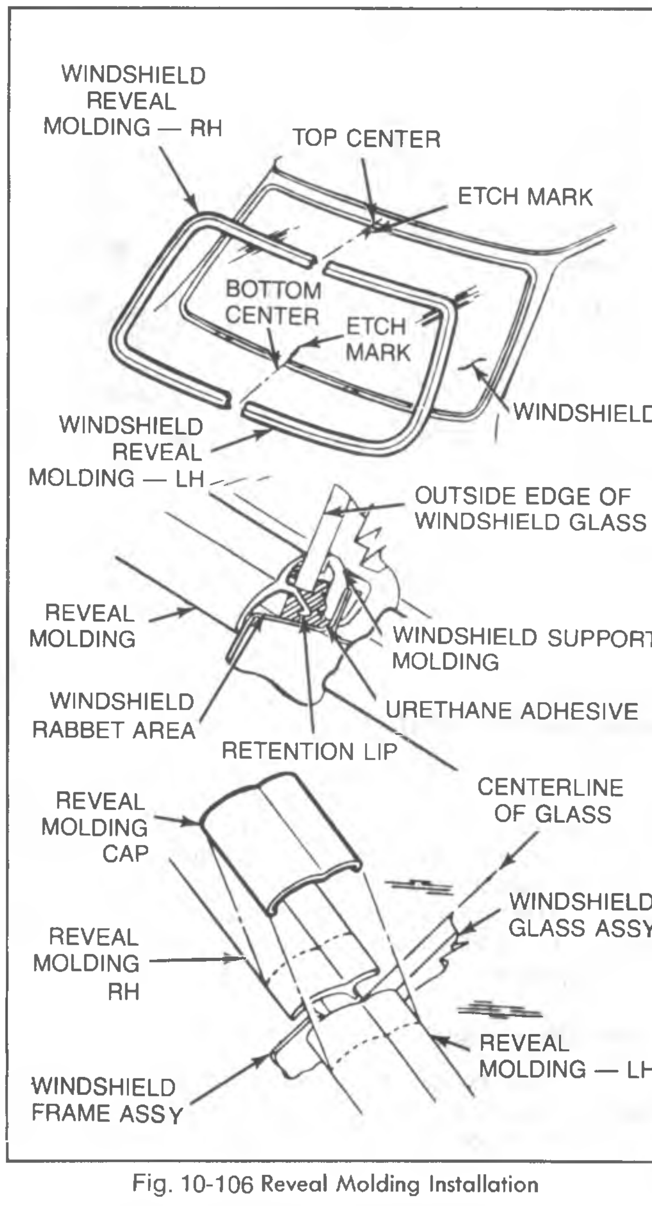


Fig. 10-106 Reveal Molding Installation

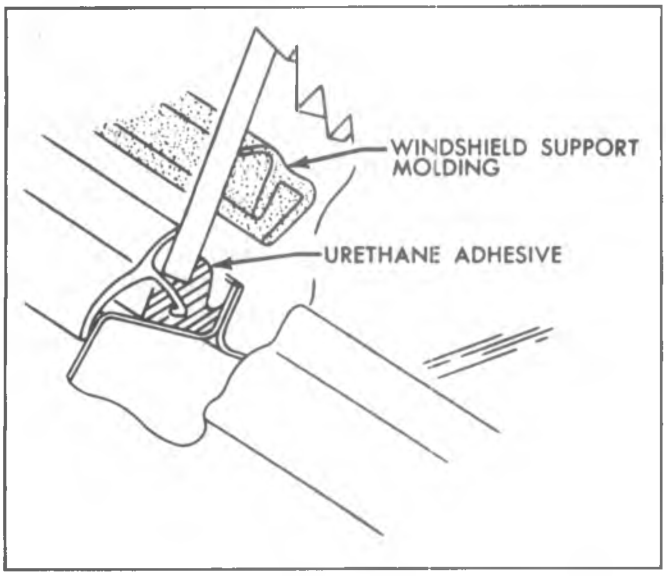


Fig. 10-107--Support Molding and Adhesive

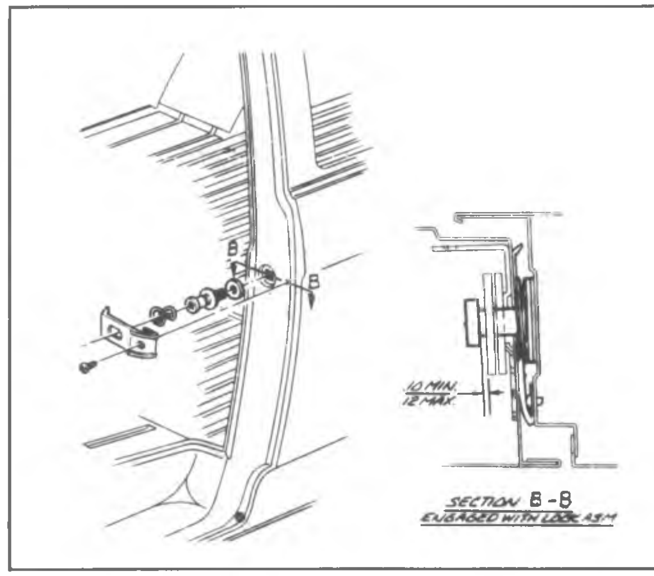


Fig. 10-108--Body Window Glass

5. Using warm or hot water, leak test to assure that the leak has been corrected.

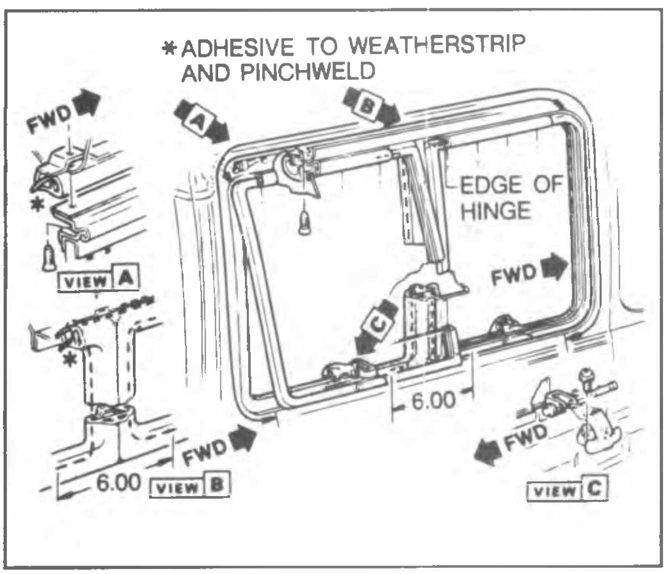


Fig. 10-109--Swingout Window

6. Install the support molding immediately.

SWINGOUT WINDOW

Replacement

1. Swing out the window. See figure 10-109.
2. Remove screws retaining latch to body.
3. Remove window by swinging glass out, separating assembly at hinge.
4. Remove latch from glass by twisting and pulling out.
5. Reverse removal procedure to install swingout window.

LATCH SWINGOUT WINDOW

Replacement

1. Swing out the window.
2. Remove latch to body attaching screws.
3. Twist and pull latch to remove from glass.
4. Reverse above steps for installation.

FRONT DOOR

DOOR ADJUSTMENTS

Doors can be adjusted for alignment of clearance in the cab door opening, and for proper latching. Door alignment adjustments are made at the striker bolt, and at door hinges. The door, when properly located in door opening, will have equal clearance around its perimeter. The door should be adjusted in the opening so the edge of the door across the top and also at the lock side is parallel with the body opening as nearly as possible.

Hinge Adjustment

Door hinge bolt holes are oversized to make adjustment possible. Alignment adjustments can be made by loosening the proper hinge bolts, aligning door to proper position, and tightening bolts securely. See figure 10-110, for typical adjustments.

Striker Bolt Adjustment

With the use of J-23457, shown in figure 10-111, the striker bolt can be adjusted in any of three ways. See figure 10-112.

1. **Up and down**-To adjust striker up or down, loosen bolt, adjust to center of lock entry, and tighten bolt securely.

   This adjustment is important to assure that the right proportion of door's weight will rest on striker bolt when door is closed. If bolt is positioned too high on pillar, rapid wear will occur to the lock cam; if too low, an extra load will be placed on door hinges as well as pulling door downward and out of alignment.

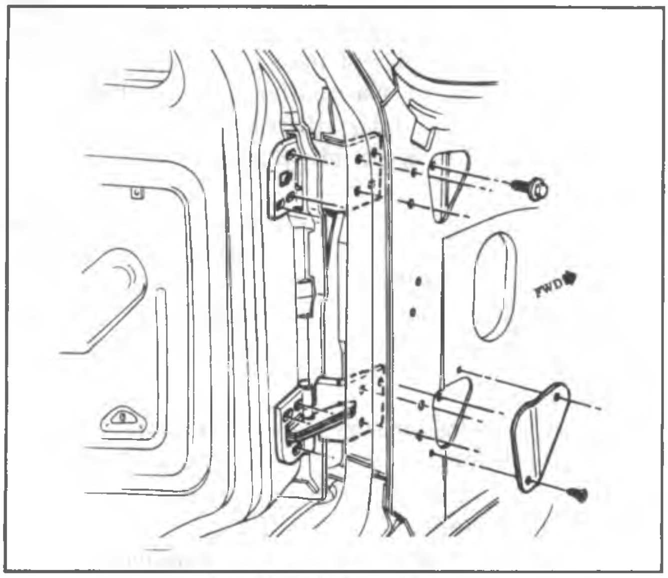


Fig. 10-110--Door Hinge

2. **In and Out**-To adjust striker in and out, loosen bolt, adjust horizontally to match the door surface to the body surface, and tighten bolt securely.
3. **Forward and Rearward**-To make this adjustment, loosen striker bolt, shim to desired position, and tighten bolt securely.

DOOR HINGE

Remove

1. Remove hinge access hole cover from door hinge pillar.
2. If removing one hinge, support door in such a manner that weight is taken off other hinge, and that the door will not move.
3. Remove hinge screws from both body and from door and remove hinge. See figure 10-110.

Installation

1. Install hinge to door and body. Snug bolts.
2. Remove door supports.
3. Adjust door as outlined under "Door Adjustment".
4. Torque bolts to specifications.
5. Install hinge access hole covers.

DOOR WEATHERSTRIP

Success of weatherstrip replacement depends entirely upon the quality of the cement used and the care with which it is applied. All rust, road dirt and grease or oil must be completely removed as should all old cement and bits of old weatherstrip. After removing all foreign material from door opening surface, wipe down with prepsol or its equivalent. Use only a good quality cement which is made specially for weatherstrip installation, following the manufacturer's directions. Proceed as follows:

1. Open door and block open.
2. Remove side door weatherstrip.
3. Remove used adhesive from door with adhesive or cement remover, and remove all plastic nails.
4. Apply adhesive to door.
5. Position weatherstrip by locating part number at top of vent window, making sure that plastic nails align with holes in door.
6. Install weatherstrip by pressing each nail into the door.

TRIM PANEL, ARM REST AND HANDLES

Removal

1. Remove screws retaining arm rest to trim panel.
2. Remove door and window handles with Tool J-9886-01 and pull from shaft.
3. Remove trim panel screws and remove panel. If plastic water shield seal is damaged, replace seal.

Installation

1. Install trim panel.
2. Install arm rest. Install door and window handle washers and handles.

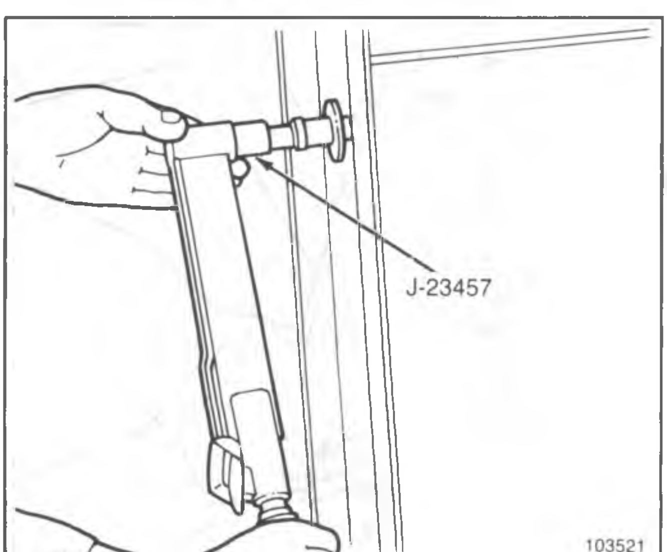


Fig. 10-111--Loosening Striker Bolt

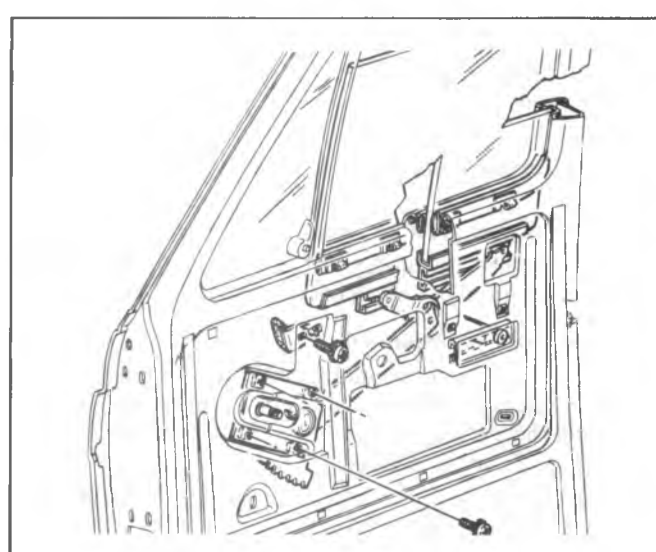


Fig. 10-112--Typical Striker Bolt Adjustment

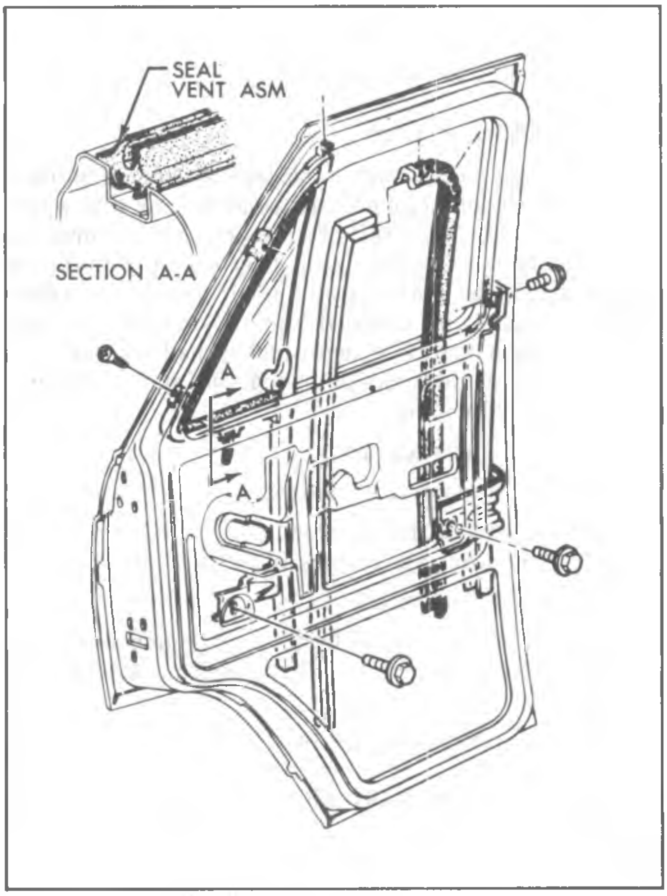


Fig. 10-113--Channel, Run and Ventilator Assembly

DOOR VENTILATOR ASSEMBLY

Removal

The channel between the door window glass and door vent is removed as part of the vent assembly.

1. Regulate the door window glass to the full down position.
2. Remove door and window handles with Tool J-9886-01.
3. Remove trim panel and water shields.
4. Remove rear window run channel screws.
5. Slide door window glass rearward away from ventilator.
6. Remove three screws at the upper front of the door and lower forward channel screw, as shown in figure 10-113.
7. Pull the upper portion of the ventilator rearward.
8. Turn the vent assembly 90° and carefully remove by guiding up and out, as shown in figure 10-114.

Ventilator Glass Replacement

1. Using an oil can or similar means, squirt prepsol on the glass filler all around the glass channel or frame to soften the old seal. When the seal has softened, remove the glass from the channel.
2. Thoroughly clean the inside of the glass channel with sandpaper, removing all rust, etc.
3. Using new glass channel filler, cut the piece to be installed two inches longer than necessary for the channel. Place this piece of filler (soapstoned side of filler away from glass) evenly over the edge of the glass which will fit in the channel. The extra filler extending beyond the rear edge of the glass should be pinched together to hold it in place during glass installation.

   One side of this filler (the outside of the roll) is soapstoned. This is the side which goes into the metal channel.
4. Brush the inside of the metal glass channel freely with ordinary engine oil. This will enable the glass and filler to slide freely into the channel.

   Glass should be installed so that rear edge is parallel to the division post. Allow full cure before water testing.

Installation

Replace the door window glass and regulate to the full down position before installing the door ventilator assembly.

1. Lower the ventilator assembly into the door frame. Center into position.
2. Make certain the rubber lip is positioned before tightening screws.
3. Slide door glass forward engaging glass in vent channel.
4. Reinstall all screws and tighten.
5. Install and tighten the three screws at the upper front of the door.

Adjustment

1. Adjust the ventilator adjusting nut by turning clockwise to increase operating tension, as shown in figure 10-115.
2. After making adjustment bend tabs over the hex nut.
3. Install trim panel.
4. Install door and window regulator handles.

DOOR WINDOW ASSEMBLY

Replacement

1. Completely lower glass to bottom of door.
2. Remove door arm rest, trim pad and water shields.
3. Mask or cover upper portion of door window frame.

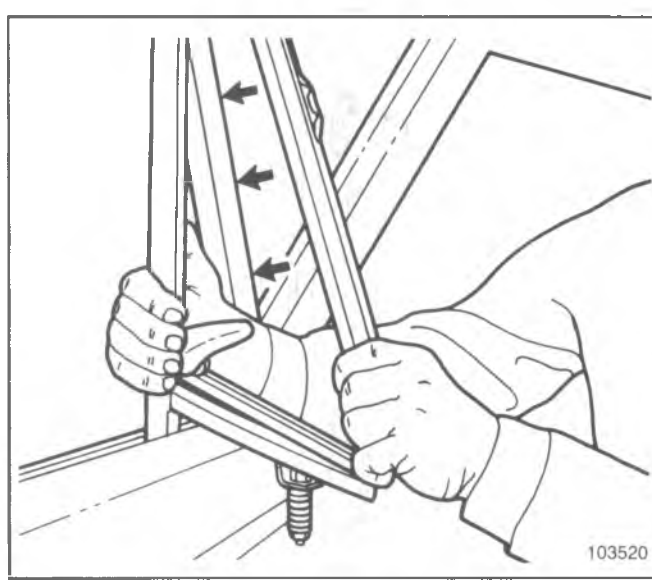


Fig. 10-114--Removing Ventilator

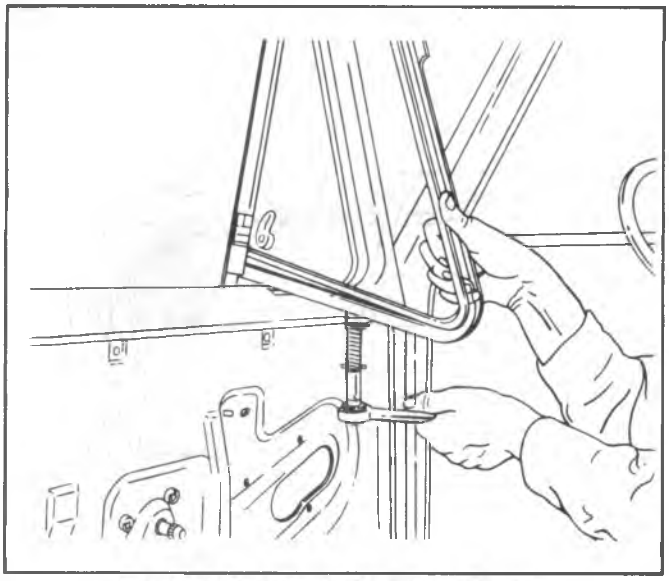


Fig. 10-115--Adjusting Ventilator Tension

4. Remove ventilator assembly as previously outlined.
5. Raise window until regulator arms are level with access hole in door.
6. Slide glass forward until front roller is in line with notch in sash channel. Disengage roller from channel. See figure 10-116.
7. Push window forward and tilt front portion of window up until rear roller is disengaged.
8. Put window assembly in normal position (level) and raise straight up and out.
9. Reverse above procedure for installation.

DOOR WINDOW ADJUSTMENT

To perform the adjustments listed, the door trim panels must be removed.

Glass Height (Fig. 10-116)

Loosen the bolt and adjust the stop assembly located above the regulator sprocket so that the glass height in the lowered position is flush with the top of the sill, then tighten stop assembly bolt.

Regulator Raising and Lowering Effort (Fig. 10-109)

The lower bolt on the run channel assembly provides fore and aft movement to ease regulator effort.

WINDOW REGULATOR - MANUAL

Replacement

1. Wind window all the way up.
2. Remove inside door handles with Tool J-7797.
3. Remove door trim pad.
4. Remove screws securing regulator to inner panel.
5. Push regulator out of door opening while holding rear of assembly, then slide assembly to the notches in the carrier channel and out through the door access hole.
6. Install regulator in reverse order of removal, lubricate regulator gears with lubriplate or equivalent.

WINDOW REGULATOR - POWER

In the case that window will not operate, check electrical connections first. Figure 10-118 illustrates location of junctions, switch, relay and circuit breaker.

Replacement

CAUTION: Electrical connectors must be removed from window lift motor before performing any operation on the regulator, or personal injury could occur.

1. Disconnect battery ground cable.
2. Remove door trim panel.
3. Disconnect harness from regulator.
4. Remove screws securing regulator to inner panel.
5. Push regulator out of door opening while holding rear of assembly, then slide assembly to the notches in the carrier channel and out through the door access hole.

CAUTION: Step 6 must be performed when regulator is removed from door. The regulator lift arms are under tension from the counterbalance spring and can cause serious injury if the motor is removed without locking the sector gear in position.

6. Drill a hole through the regulator sector gear and back plate. DO NOT drill hole closer than 1/2" (12.7mm) to edge of sector gear or back plate. Install a pan head sheet metal tapping screw (No. 10 - 12 x 3/4) in drilled hole to lock sector gear in position.
7. Remove motor to regulator attaching screws.
8. Remove motor from regulator.
9. Prior to installation, lubricate the motor drive gear and regulator sector teeth.

   The lubrication used must be cold weather approved to a minimum of minus 20° fahrenheit (-29°C).
10. Install regulator motor to regulator. Make sure the motor pinion gear teeth mesh properly with the sector gear teeth before installing the three motor attaching screws.

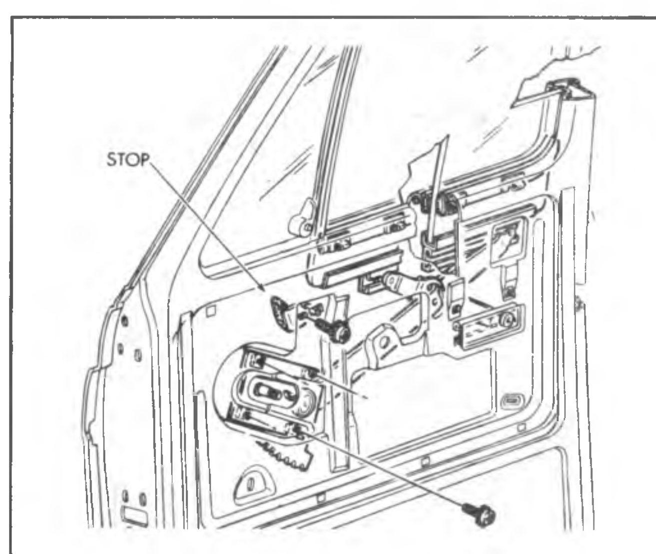


Fig. 10-116--Window and Regulator

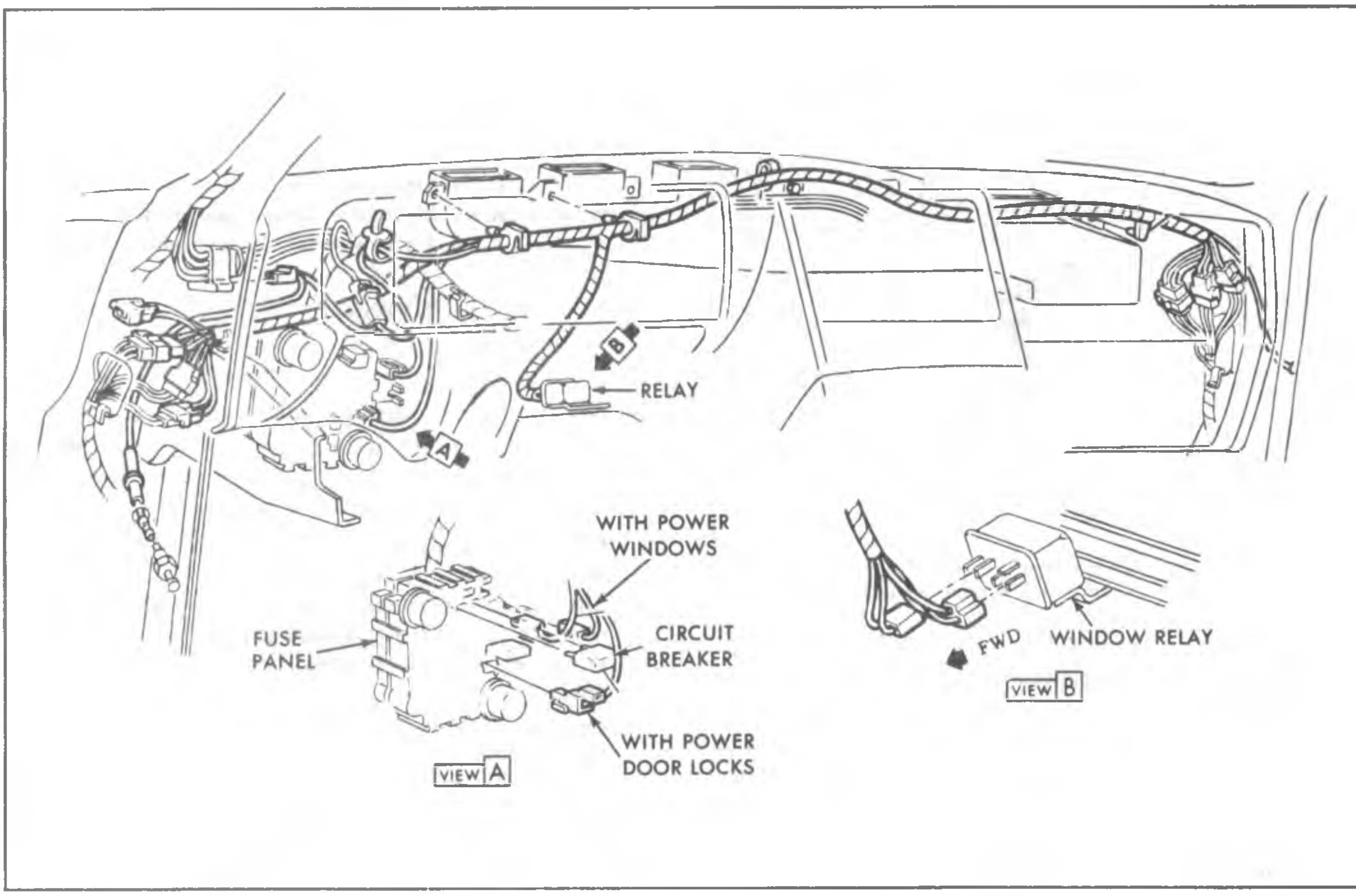


Fig. 10-117--Power Window and Power Door Lock Wiring

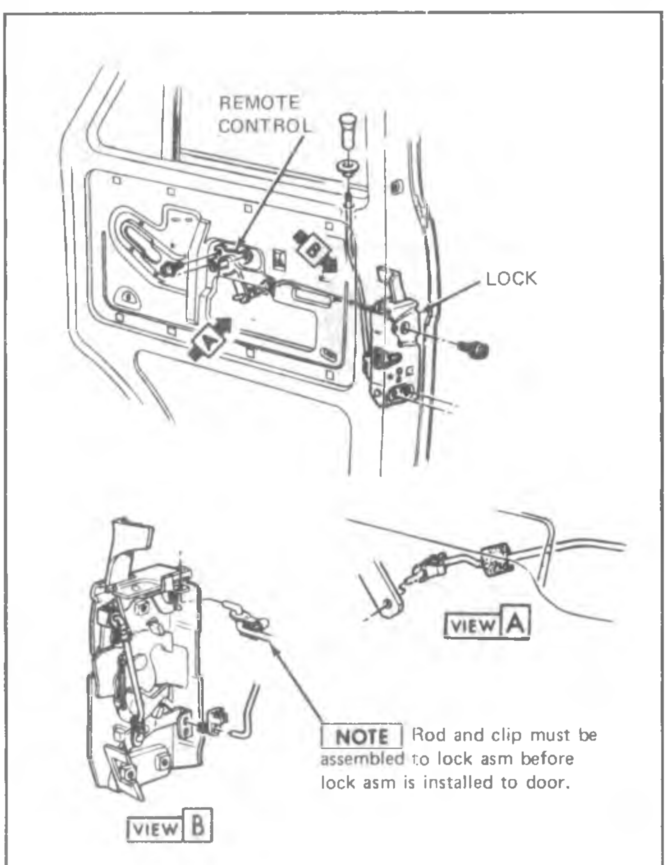


Fig. 10-118--Lock and Remote Control Assembly

11. Remove screw locking sector gear in a fixed position.
12. Install regulator in reverse order of removal, lubricate regulator gears and rollers with lubriplate or equivalent.

DOOR LOCK-FIGURE 10-118

Removal

1. Raise window.
2. Remove inside handles with Tool J-9886-01.
3. Remove trim panel.
4. Remove door lock knob.
5. From outside the door remove screws retaining lock to door edge and lower the lock assembly.
6. Remove screws retaining remote control.
7. Remove screws securing glass run guide channel.
8. Remove lock, push button rod and remote control rod as an assembly.

Installation

1. Transfer remote rod with clip to new lock.
2. Connect remote door handle rod to lock after lock is positioned.
3. Secure lock screws and glass run guide channel.
4. Secure remote handle.
5. Check all controls for proper operation before reinstalling trim and handles.
6. Install door lock knob.

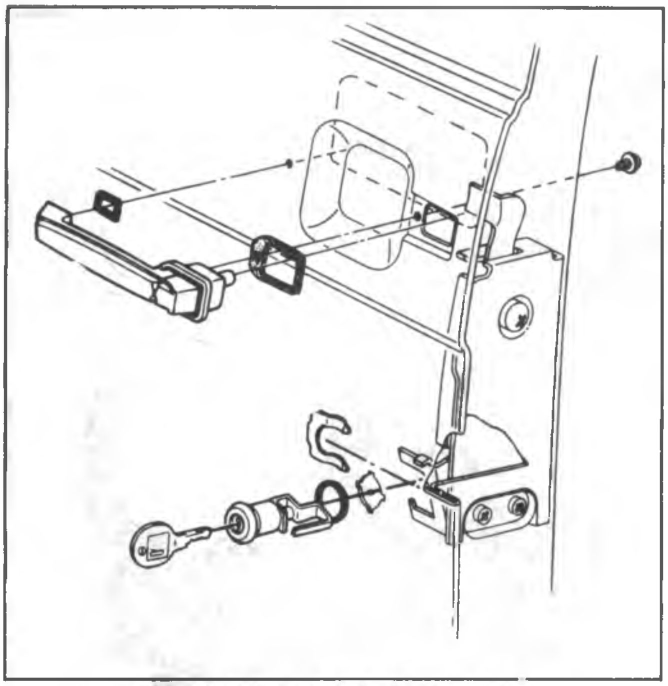


Fig. 10-119--Lock Cylinder Assembly

REMOTE CONTROL AND CONNECTING

ROD--Fig. 10-118

Replacement

1. Raise door window and remove door trim pad.
2. Remove bolts securing remote control to door inner panel.
3. Pivot remote inboard slightly, to disengage connecting rod, and remove remote control from door.

   Connecting rod can be removed at this point by disconnecting spring clip from lock.
4. To install, reverse removal procedure.

POWER DOOR LOCKS

The power door lock system incorporates a motor actuator in each door which actuates the lock through linkage (fig. 10-120). See Figure 10-117 for switches, relay and wire routing.

Replacement

1. Disconnect battery ground cable.
2. Remove door trim panel to gain access to power door lock motor.
3. Disconnect electrical connector from motor.
4. Remove screws attaching motor to door inner panel.
5. Remove door lock lever from rubber mount at top of motor actuator and remove motor through access hole.
6. To install, reverse steps 1 through 5 above.

LOCK CYLINDER ASSEMBLY--FIG. 10-119

Replacement

1. Raise door window and remove door trim pad.
2. With a screwdriver, or other suitable tool, slide lock cylinder retaining clip (on door outer panel) out of engagement and remove lock cylinder.
3. To install, reverse removal procedure.

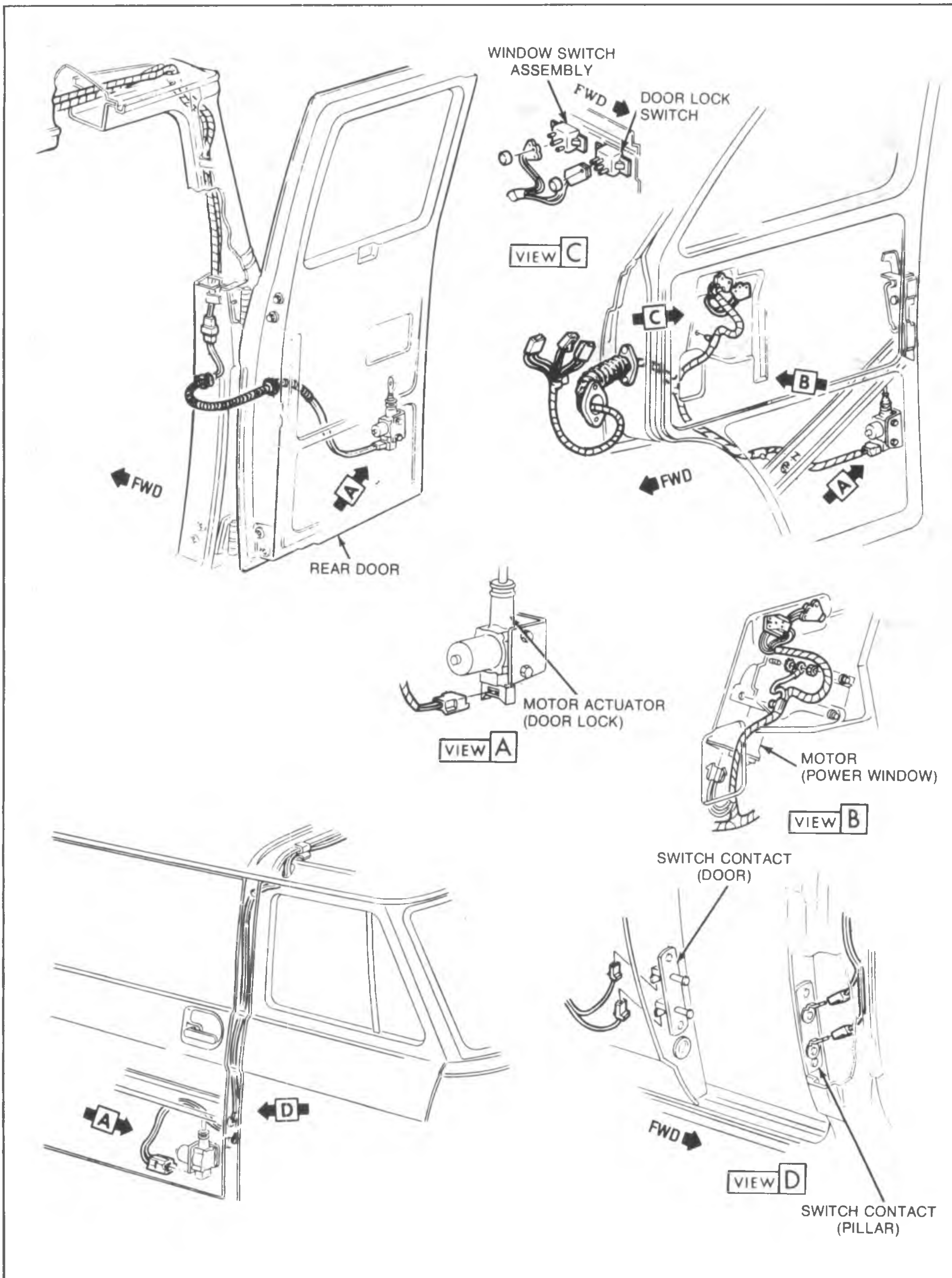


Fig. 10-120--Power Door Lock Actuators, Power Window Motor, Wiring and Switches

SLIDING SIDE DOOR

DESCRIPTION

The weight of the sliding side door is supported by the upper rear hinge-and-roller assembly, and by the lower front catch-and-roller assembly. The front and rear latches retain the door in the locked position, while the rear wedge assembly restricts door vibration on rough road surfaces.

ADJUSTMENTS

NOTICE: See NOTICE on page 1 of this section regarding all sliding door fasteners and adjustments found below.

The side door can be adjusted for alignment and/or clearance in the body opening and for proper latching. When properly positioned in the body opening, the door should have equal clearances around its perimeter. Adjustments for door positioning and proper latching can be made at the locations shown in figure 10-121.

Up and Down

Up and down adjustments are provided by means of slotted holes located at the upper front roller, view B of figure 10-121; at the lower front catch-and-roller, view D; and at the upper rear hinge-and-roller assembly. view A. To reposition the door up or down:

1. Partially open door and loosen front latch striker on pillar.
2. Remove upper rear hinge cover, shown in figure 10-122.
3. Loosen upper rear hinge-to-door bolts.
4. Loosen rear lock striker and door wedge assembly.
5. Align rear edge of door up or down, then tighten upper rear hinge-to-door bolts to specifications.
6. Loosen upper front roller bracket-to-door bolts.
7. Partially close door and align front edge of door up or down by loosening front lower hinge-to-door bolts. When door is correctly positioned, tighten bolts to specifications.
8. Position upper front roller in center of track, then tighten roller bracket to door.
9. Adjust front and rear strikers and rear wedge assembly as outlined in their respective procedures later in this section.

In and Out

Front in and out adjustments are provided by means of an adjustable lower roller mounting bracket, view D of figure 10-121, and by a slotted upper bracket, view B of figure 10-121. Rear in and out adjustment is provided by adjusting the rear latch striker, view E of figure 10-121. To position the door in or out:

1. Loosen front latch striker.
2. Loosen upper front roller from its bracket.
3. Loosen lower front roller bracket-to-arm bolts.
4. Adjust front of door in or out, then tighten bolts to specifications.
5. Adjust door hold open catch bracket, rear wedge assembly, rear latch striker, upper front roller and front latch striker as outlined later in "Adjustments".

Fore and Aft

Fore and aft adjustment is provided at the upper rear hinge striker by means of a slotted bracket mounted to the body, view A of figure 10-121.

1. Partially open door and remove front latch striker and rear lock striker.
2. Loosen rear wedge assembly.
3. Remove upper rear track cover.
4. Loosen upper rear hinge striker.
5. Move door assembly forward or rearward, then tighten striker bolts to specifications.
6. Reinstall upper rear track cover.
7. Reinstall front and rear latch strikers.
8. Adjust latch strikers and rear wedge assembly as outlined below.

Latch Striker Adjustments

Front Striker

1. Loosen front latch striker screws, view C of figure 10-121.
2. Visually align latch-to-striker relationship and adjust if necessary.
3. Slide door slowly toward striker. The guide on the door, just above the latch, must fit snugly within the rubber-lined opening on the striker assembly.
4. Assure that the latch engages fully into the striker. Add or delete shims behind the striker as necessary.
5. Tighten striker screws to specified torque.

Rear Striker

1. Loosen striker with J-23457.
2. Loosen rear wedge assembly.
3. Center the striker vertically to door striker opening.
4. Adjust the striker laterally to match outer panel to the body panel surfaces, view E of figure 10-121.
5. Apply grease to the striker.
6. Gently push the door in until the rear lock contacts the striker enough to make an impression in the grease.
7. Open the door and measure the distance from the rear of the striker head to the impression. The distance should be between .20 inch (5mm) and .30 inch (8mm). Refer to view E of figure 10-121.
8. Adjust position of striker by adding or deleting shims between the striker and the pillar.
9. Adjust rear wedge assembly as outlined later in this section, and torque all fasteners to specifications.

Upper Rear Hinge-To-Striker Adjustment

NOTICE: If door has been removed and is being reinstalled, adjust striker-to-lower hinge lever before closing door. Failure to do so may cause possible lever breakage.

The upper rear hinge must be positioned as shown in

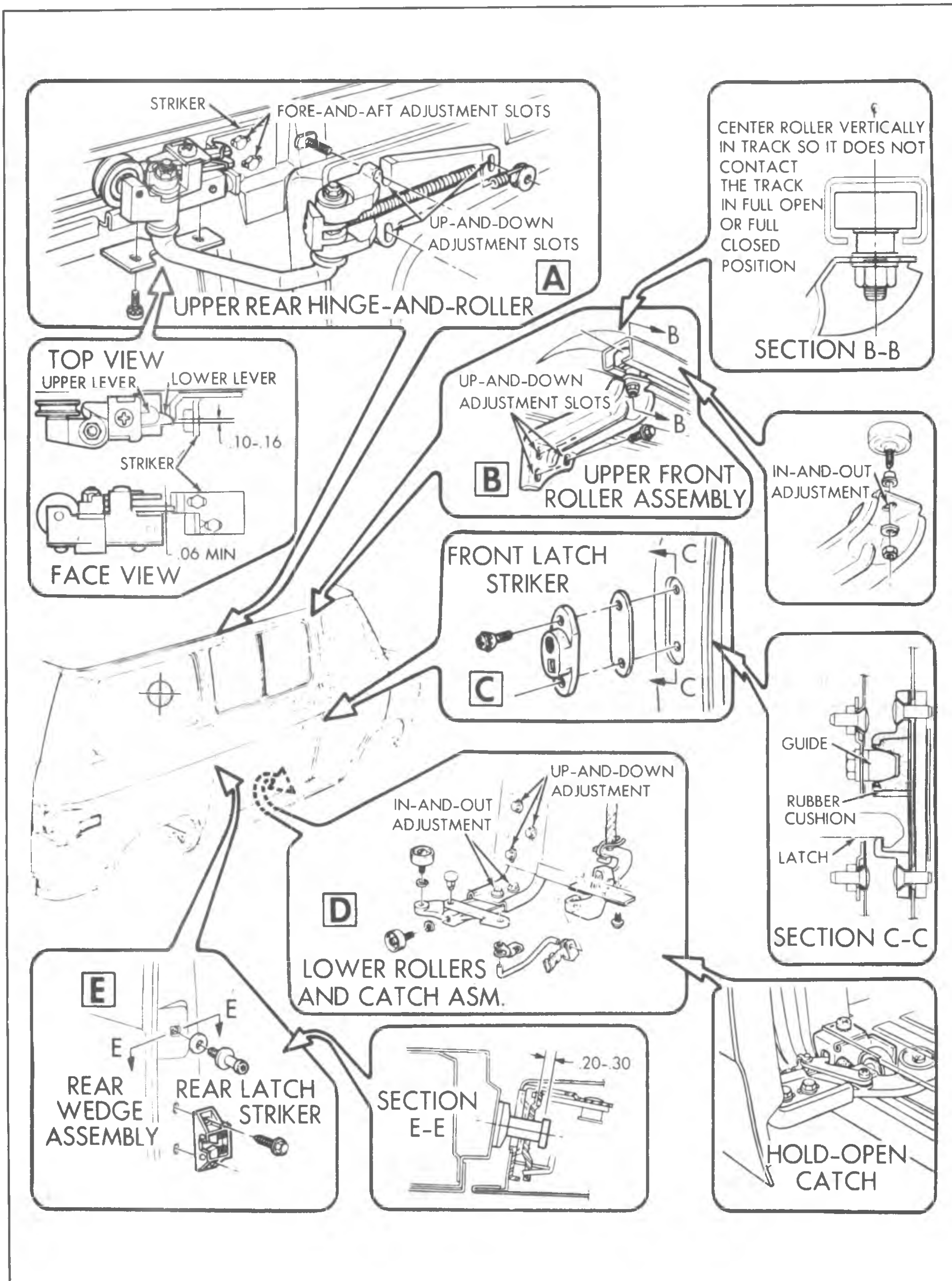


Fig. 10-121 --Sliding Side Door Adjustment Locations

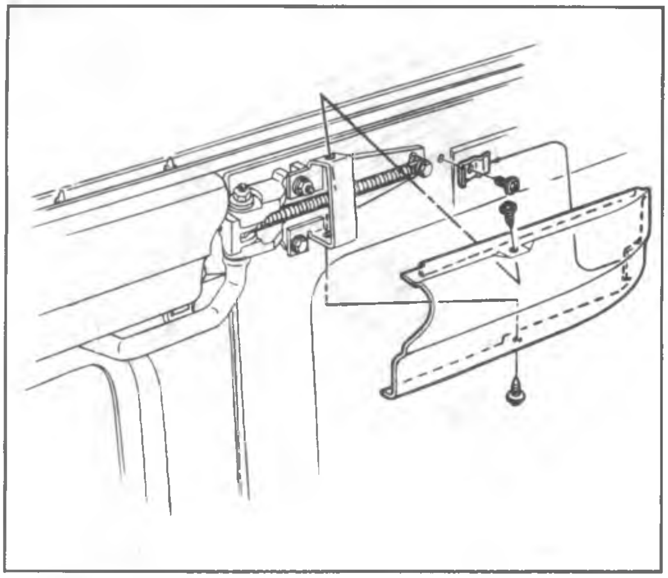


Fig. 10-122--Hinge Cover

view A of figure 10-121, in order to insure proper latching.

1. The hinge lower lever must contact the striker at least .06 inch above the lower edge of the striker tang.
2. The lower lever must extend at least .10 inch (2.5mm) outboard of the striker tang. Add or delete shims between the striker and the body as necessary.
3. If necessary to shim roller away from guide, shims are added between the nylon block and hinge and between roller and hinge. They must be installed in pairs. For example, if one shim is added behind the nylon block another must be added behind the roller.

Door Hold-Open Catch Adjustment

This catch, mounted on the lower front roller bracket, holds the door in the full open position. See figure 10-123. The catch engages a striker installed at the rear of the lower roller channel, view D of figure 10-121.

1. Loosen the screws retaining the catch rod bracket to bottom of door.
2. Adjust catch-to-striker engagement by sliding the bracket laterally. Catch should fully engage striker.

Rear Wedge Assembly Adjustment

1. Loosen screws attaching rear wedge assembly to the body pillar, then close the door to the fully latched position.
2. Center the wedge assembly on the door wedge, as shown in figure 10-124, and scribe a line around the wedge assembly.
3. Open the door, and move the wedge assembly 3/16 inch.

FRONT LATCH ASSEMBLY

Removal

1. Remove trim panel, if so equipped.
2. Remove access cover.
3. Unscrew door lock knob from rod.
4. Disconnect the following rods from latch, shown in figure 10-125.
   a. Rear latch rods.
   b. Lock cylinder rod.
   c. Door lock rod.
5. Remove door handle.
6. Remove screws retaining latch assembly to door.
7. Slide latch rearward and lift front of latch. Disconnect rod leading to lower hinge door catch by pushing rod out of hole and rotating rod clear of latch.
8. Remove latch assembly from door.

Installation

1. Install latch assembly into door by working latch assembly behind the lower hinge door catch.
2. Connect lower hinge door catch, lock cylinder rod, door lock rod, and both rear latch rods.
3. Install latch assembly-to-door attaching screws. Torque to specifications.
4. Install door lock knob and door handle.
5. Install access cover and trim panel.

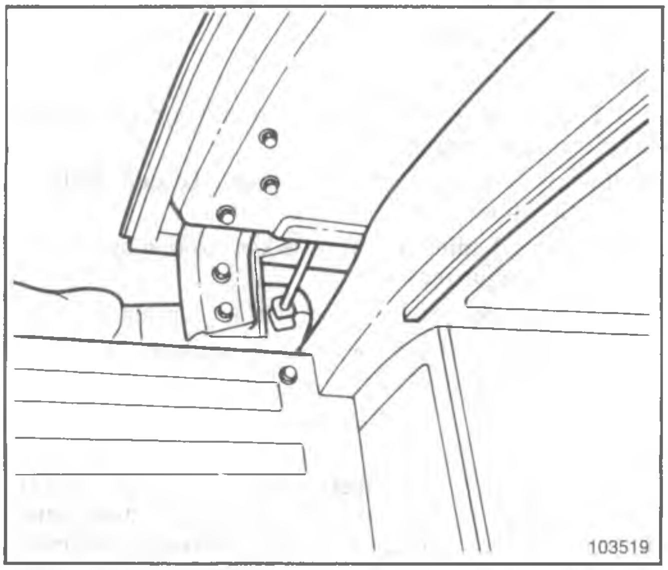


Fig. 10-123--Hold-Open Catch

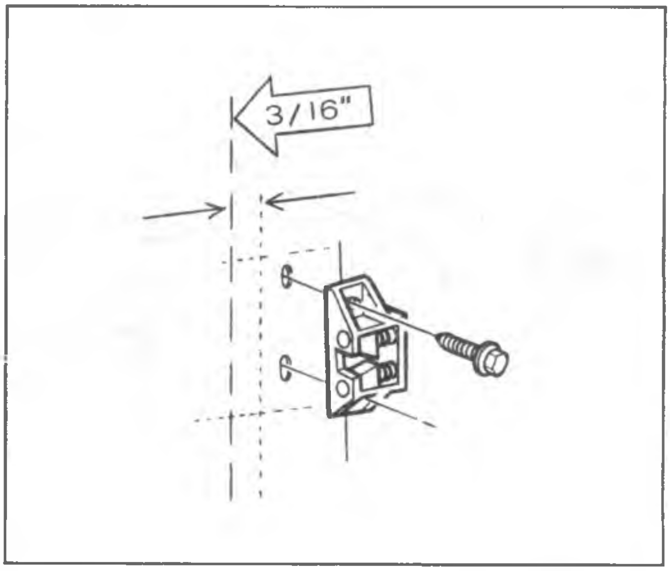


Fig. 10-124--Adjusting the Rear Wedge Assembly

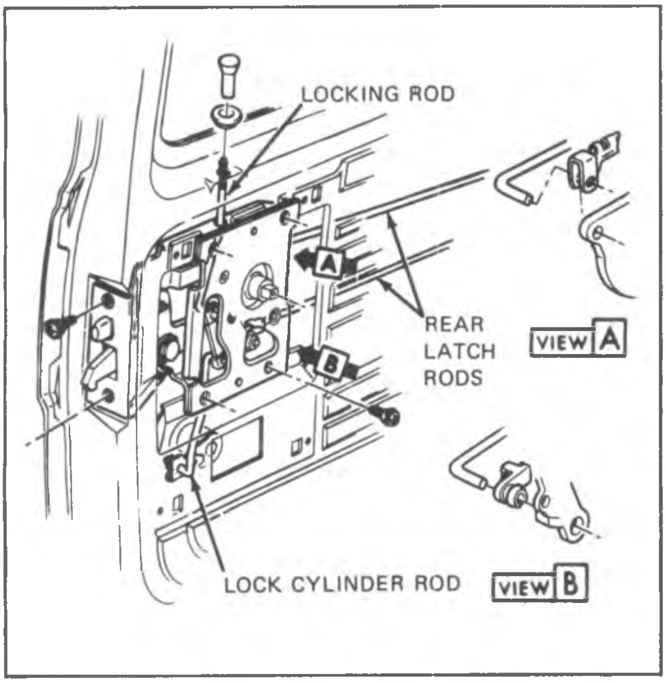


Fig. 10-125--Sliding Door Front Latch

6. Adjust door front striker as outlined earlier under "Adjustments".

REAR LATCH AND/OR LATCH ACTUATING RODS

Removal

1. Remove trim panel (if so equipped).
2. Remove front latch assembly access cover.
3. Disconnect rear latch rods from front latch assembly, shown in figure 10-125.
4. Remove rear latch attaching screws. See figure 10-126.
5. Slide rear latch toward front of door until rod clips become exposed. Disconnect rod clips and remove latch from door.

Installation

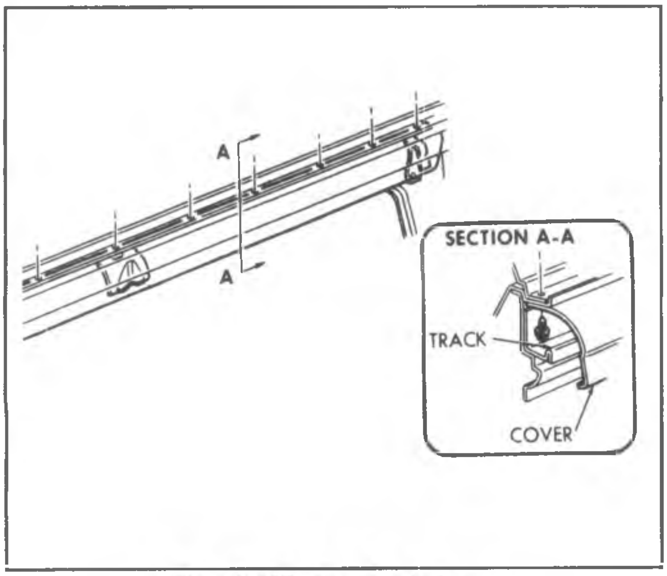


Fig. 10-127--Rear Track Cover

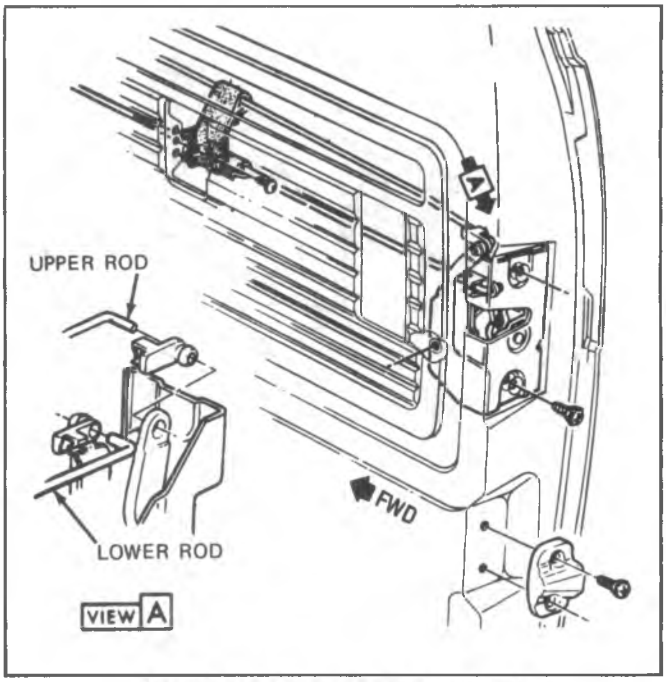


Fig. 10-126--Sliding Door Rear Latch

1. Connect rods to latch and install latch to door. Torque screws to specifications.
2. Connect rods to front latch assembly.
3. Install access covers and trim panels (if so equipped).
4. Adjust rear latch striker as outlined earlier under "Adjustments".

UPPER REAR HINGE

Removal

1. Remove the hinge cover and rear track cover. See figures 10-122 and 10-127.
2. Open the door.
3. Disengage spring from bolt, using a spring removal tool.
4. Close the door.
5. Remove the hinge assembly.

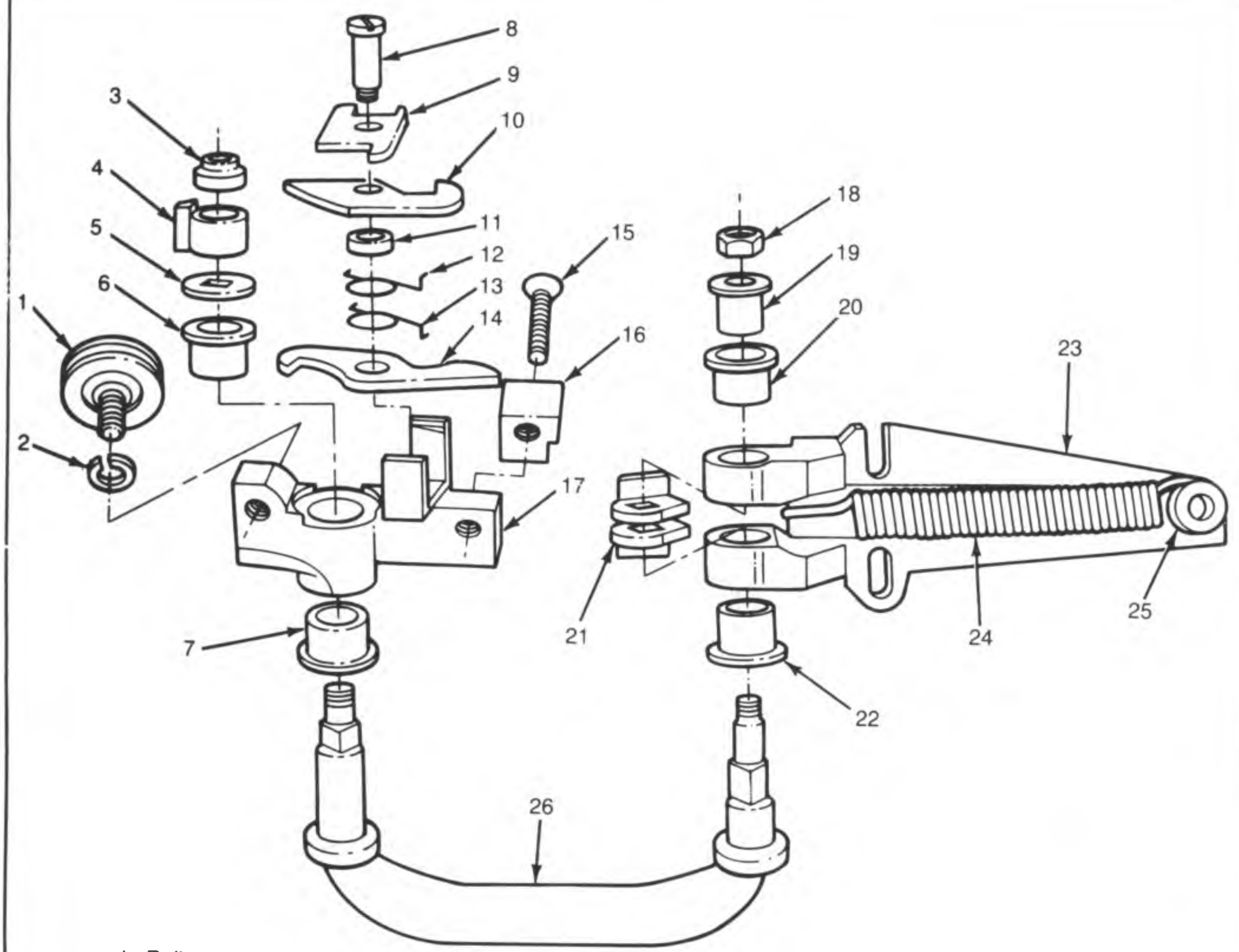
Installation

When holding hinge assembly as in figure 10-129, the lower latch must engage cam.

1. Install hinge assembly to door. Torque bolts to specifications.
2. Check and adjust latch to striker position as outlined under "Adjustments".
3. Open the door and reconnect the hinge spring.
4. Install the rear track cover and hinge cover.
5. Check the operation of the door hinge.

STRIKERS

The front and rear strikers are shown in figure 10-121. The rear striker can be removed with J-23457 as in figure 10-111, and the front striker can be removed by removing attaching screws. Refer to "Adjustments" when reinstalling.



1. Roller
2. Lockwashers
3. Nut
4. Cam
5. Washer
6. Bushing
7. Bushing
8. Bolt
9. Plate
10. Upper lines
11. Spacer
12. Spring (Upper Lever)
13. Spring (Lower Lever)
14. Lower Lever
15. Screw
16. Guide Block
17. Hinge (Body Half)
18. Nut
19. Bushing
20. Bushing
21. Cam
22. Bushing
23. Hinge (Door Half)
24. Spring
25. Spring retainer
26. Hinge liner

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Fig. 10-128--Upper Rear Hinge Components

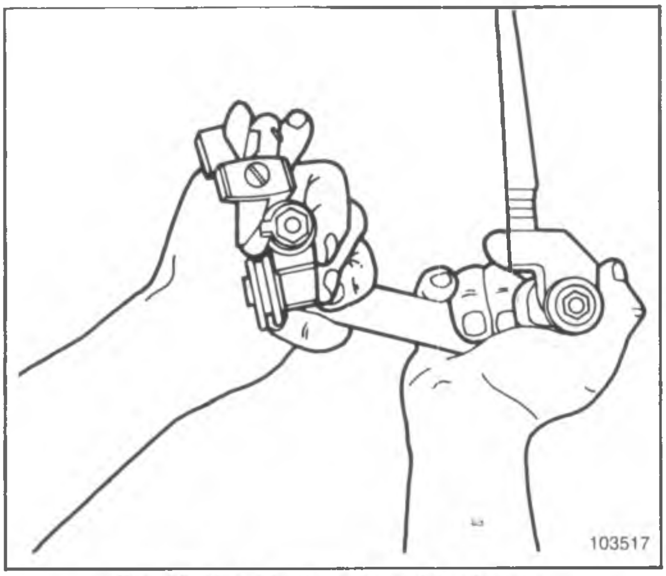


Fig. 10-129--Checking Assembly of Hinge

REAR DOORS

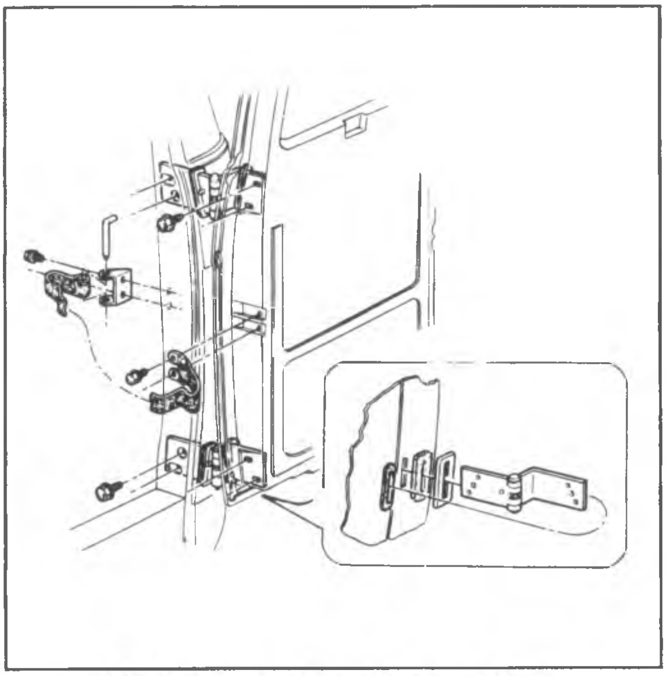


Fig. 10-130--Rear Dooor Hinges and Strap

REAR DOOR HINGE STRAP

Replacement

1. Remove strap release pin. See figure 10 -130.
2. Remove screws retaining strap to door.
3. Install strap to door. Torque retaining screws to specifications.

REAR DOOR HINGE

Removal

1. Open door. Support door so that when hinge screws are removed door weight will be on support.
2. Remove hinge strap release pin.
3. Remove hinge-to-door bolts and remove door assembly.
4. Remove hinge-to-body bolts and hinge.

Installation

1. Install grommet into door hinge opening (if removed).
2. Install hinge into door. Snug bolts.
3. Install seal and retainer on body half of hinge (if removed).
4. Install hinge into body opening and install bolts.
5. Take care to compress seal between body and retainer and snug bolts.
6. Install hinge strap and its retaining pin.
7. Adjust door and torque hinge bolts to specification

REAR DOOR REMOTE CONTROL

Removal

1. Remove trim panel.
2. Disengage upper and lower latch rods from control by remmoving retaining clips. See figure 10 -131.
3. Remove remote control by removing its retaining screws.

Installation

1. Install remote control screws loosely.
2. Attach upper and lower control rods.
3. Rotate remote control lever clockwise, and hold in this position while torquing the screws to specifications.
4. Install the trim panel.

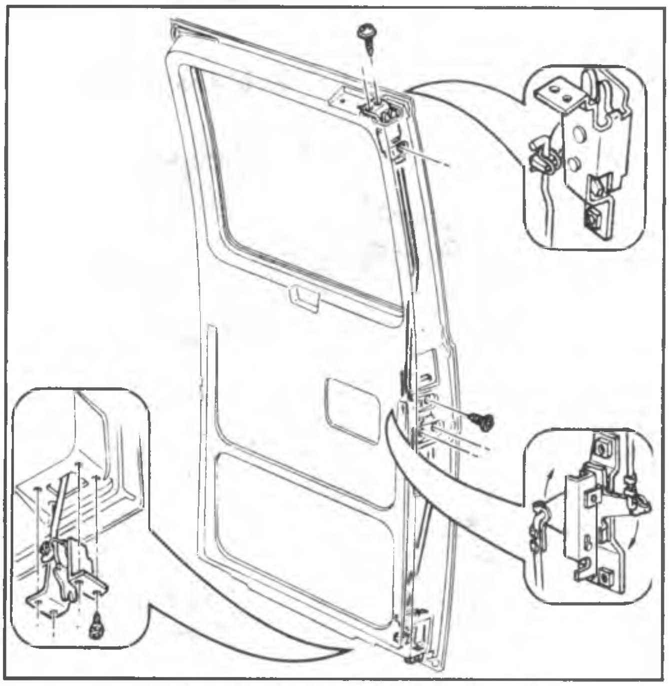


Fig. 10-131--Remote Control and Latch

REAR DOOR UPPER OR LOWER LATCHES AND/ OR LATCH RODS

Removal

1. Remove trim panel.
2. Disengage rod from remote control assembly. See figure 10-131.
3. Remove latch retaining screws and withdraw latch and control rod.
4. Remove spring clip retaining rod to latch.

Installation

1. Install latch rod to latch.

   When reinstalling the lower latch rod to control, the short straight section attaches to the latch.
2. Install latch and rod assembly into door and connect rod to remote control. Lube all moving parts.
3. Install latch retaining screws and torque to specifications.
4. Adjust latch to strikers.

REAR DOOR OUTSIDE HANDLE

Removal

1. Remove trim panel.
2. Remove door handle retaining screws, handle and gaskets. See figure 10-132.

Installation

1. Apply grease to remote control where handle plunger makes contact.
2. Install handle and gaskets. Torque screws to specifications.
3. Install trim panel.

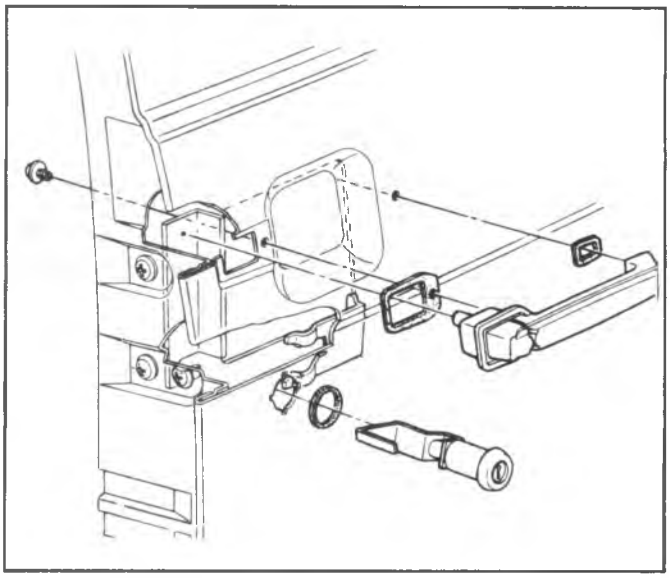


Fig. 10-132--Outside Handle and Lock Cylinder

REAR DOOR LOCK CYLINDER

Removal

1. Remove trim panel.
2. Remove remote control.
3. Remove lock cylinder retainer and lock cylinder.

Installation

1. Install lock cylinder and retainer.
2. Install remote control. Torque screws to specifications.
3. Install trim panel.

REAR DOOR GLASS AND WEATHERSTRIP

Removal and installation procedures are the same as for the stationary body side windows. Refer to those procedures for rear door glass and weatherstrip replacement.

REAR DOOR ADJUSTMENTS

Door adjustments are provided by slotted holes, at hinge attachment, in body and door.

1. Remove or loosen door strikers and wedges.
2. Loosen door hinge bolts and adjust door to provide equal clearances between body and door around perimeter of door.
3. Adjust door in and out so that door panel is flush with body.
4. Install door strikers and wedges and adjust as outlined under door striker adjustment.

REAR DOOR STRIKER AND WEDGE ADJUSTMENT

NOTICE: See NOTICE on page 1 of this section regaring Rear Door Striker fasteners.

1. Adjust striker by adding or deleting shims as necessary to obtain dimension as shown in figure 10 -133. This dimension can be checked by applying grease to the latch and slowly closing door until striker fully engages latch. Then open door and measure from grease impression to bottom of latch slot. Torque to specifications.

2. Adjust door wedge by adding or deleting shims as necessary so that wedge contact ramp on body when door is closed. See figure 10 -133.

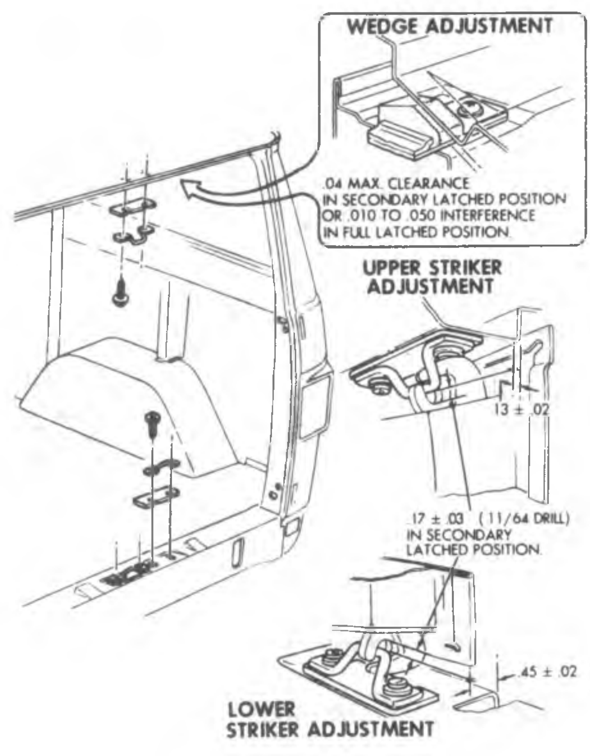


Fig. 10-133--Rear Door Striker and Wedge Adjustment

SEATS

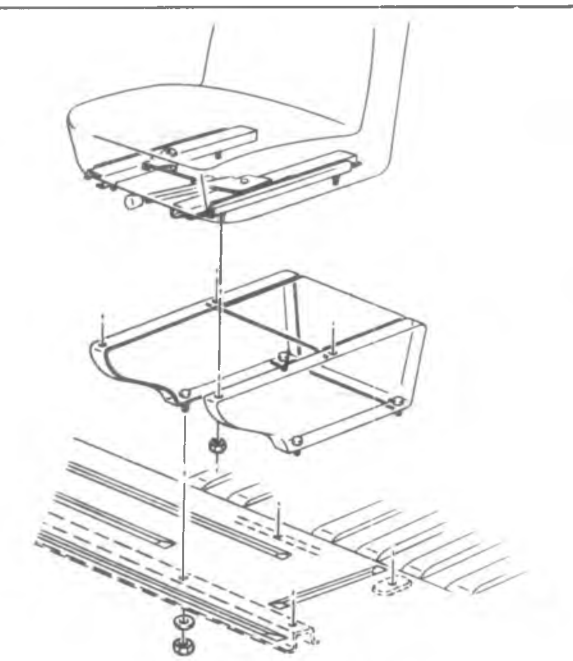


Fig. 10-134--Driver's Seat

NOTICE: See NOTICE on page 1 of this section regarding fasteners used on seats and seat belts.

DRIVERS SEAT

Seat Adjuster

Replacement

1. Remove seat by removing nuts securing seat adjuster to seat riser.
2. Remove adjuster from seat. See figure 10 -134.
3. Install seat adjuster to seat. Torque bolts to specifications.
4. Install seat onto seat riser, and torque nuts to specifications.

SEAT RISER

Replacement

1. Remove seat and adjusters as an assembly by removing nuts securing seat to riser.
2. Remove nuts securing seat riser to floor.
3. Install seat riser to floor. Torque nuts to specifications.
4. Install seat and torque nuts to specifications.

PASSENGER SEAT--MOUNTING BRACKETS

Removal

1. Remove seat and brackets from seat riser. See figure 10 -135.

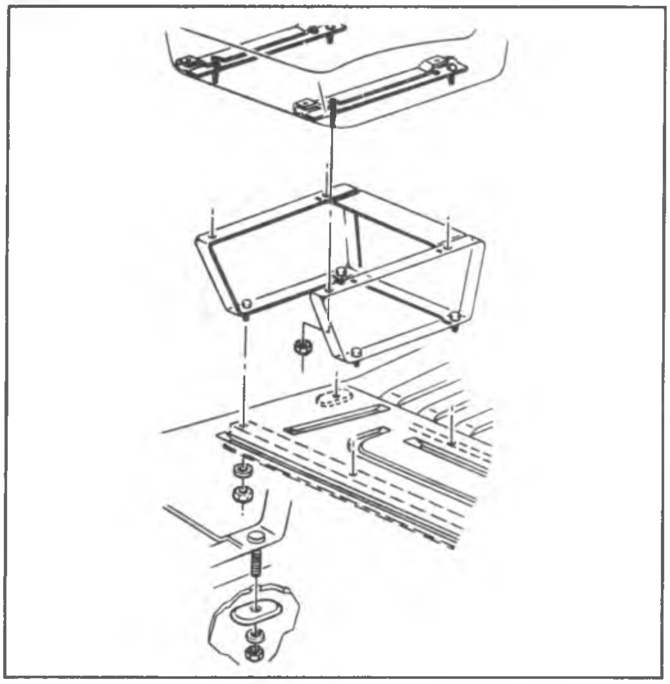


Fig. 10-135--Passenger Seat

2. Remove brackets from seat.

Installation

1. Install brackets to seat. Torque to specifications.
2. Install seat to seat riser. Torque to specifications.

SEAT RISER

Removal

1. Remove seat and mounting bracket as an assembly.
2. Remove riser from floor.

Installation

1. Install riser to floor. Torque nuts to specifications.
2. Install seat riser. Torque nuts to specifications.

REAR BENCH SEATS

All models equipped with 2nd, 3rd and 4th bench seat assemblies feature a quick release mechanism which facilitates removal of the seats for added cargo space.

Instead of the conventional clamp and bolt method of seat retention, cam type latch assemblies and hooked retainers, which fit onto anchor pins in floor anchor plates are used. When the latch assemblies are depressed, their cams and the hooks of the retainers are drawn tightly onto the anchor pins for secure seat attachment.

Removal is accomplished using the following procedure:

1. Pull up on quick release latches located at lower front of seat legs (right and left hand sides).
2. Tilt up front of seat and push seat rearward to clear anchor pins located beneath floor at front and rear of seat legs.
3. Lift seat up and remove from van.
4. To replace, reverse steps 1 to 3.

NOTICE: When replacing seats make sure that seat retainer hooks are fully engaged with anchor pins and latching assembly is fully depressed into place.

SWIVEL BUCKET SEATS - G MODELS

Refer to the illustration in Figure 10 -137 for swivel Bucket Seat Assembly installation.

ROOF VENT - G MODELS

Roof vent installation is illustrated in Figure 10 -138.

SERVICING LAP BELTS

Service precautionary items are outlined in the CK portion of this section.

Internal drive thread-forming anchor bolts are used to secure lap belts to the floor pan. To remove or install internal drive anchor bolts, use door lock striker and lap belt anchor bolt removal tool J-23457 or equivalent. Start bolt by hand to assure that bolt is threaded straight.

Refer to figures 10 -139 through 10-141 and select the appropriate illustration for removing and installing lap belts.

DECAL APPLIQUE PROCEDURE

Refer to Section 2C, Chassis Sheet Metal, for procedure relating installation of decals or stripes.

ADHESIVE BODY SIDE MOLDING

Refer to Section 2C, Chassis Sheet Metal, for procedures relating to installation of adhesive moldings.

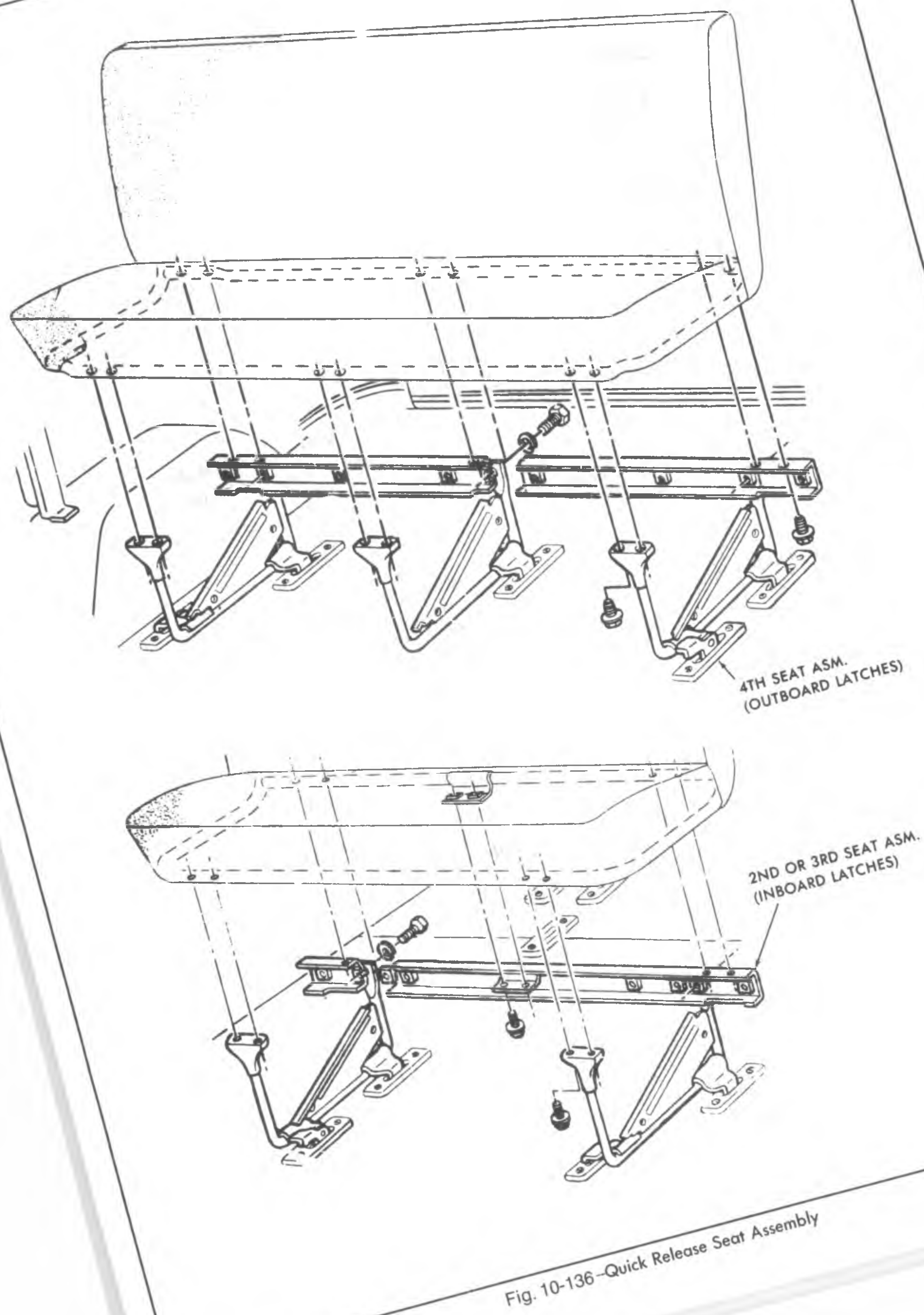


Fig. 10-136–Quick Release Seat Assembly

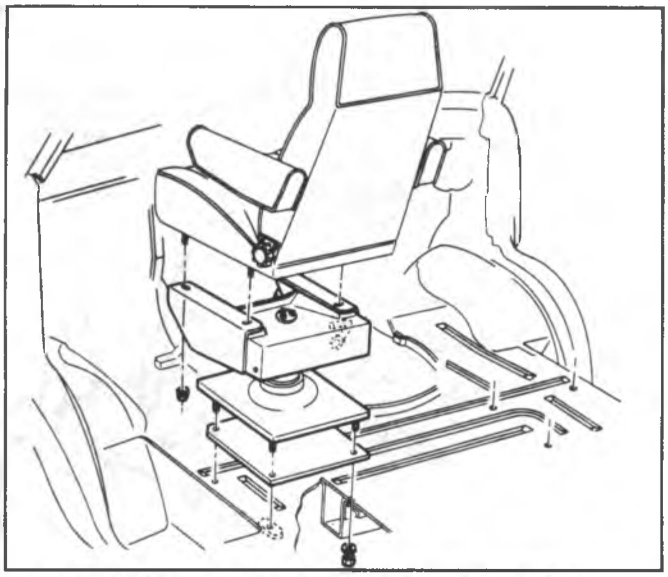


Fig. 10-137--Swivel Bucket Seat Assembly - G Series

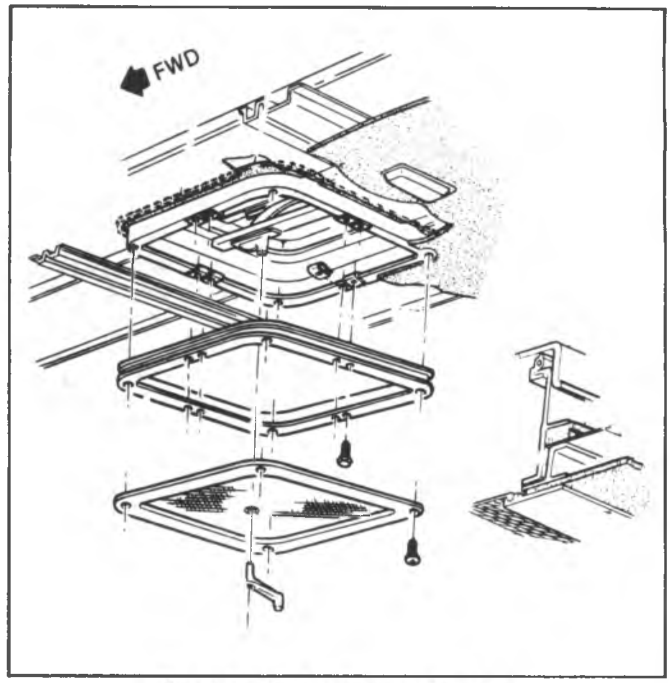


Fig. 10-138--Roof Vent - G Series

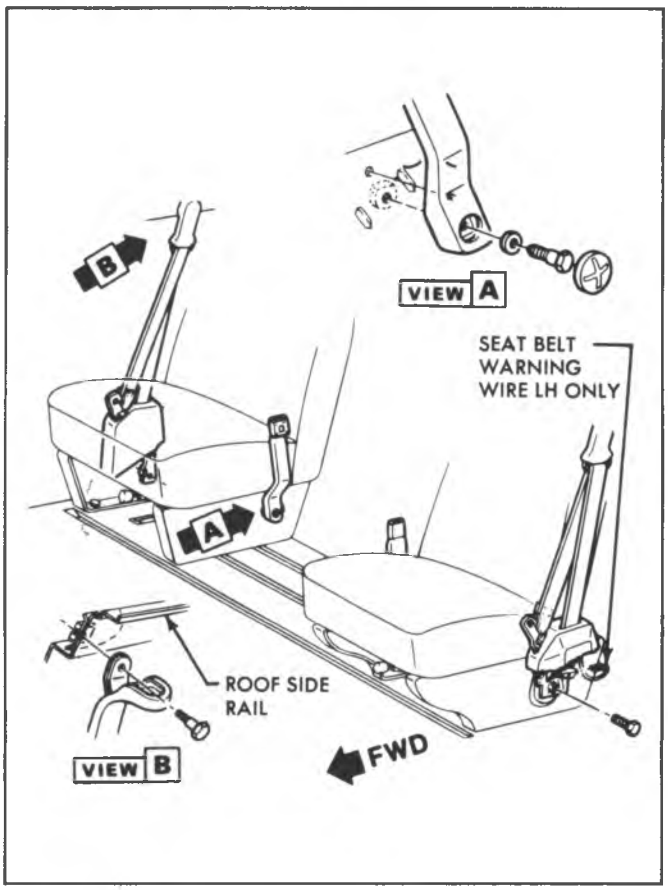


Fig. 10-139--Front Seat Belt Installation

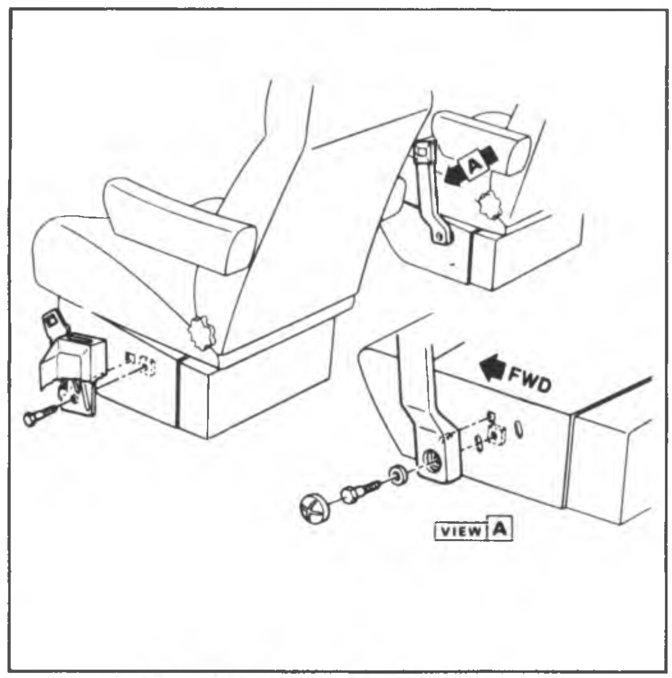


Fig. 10-140--Seat Belt Swivel Bucket

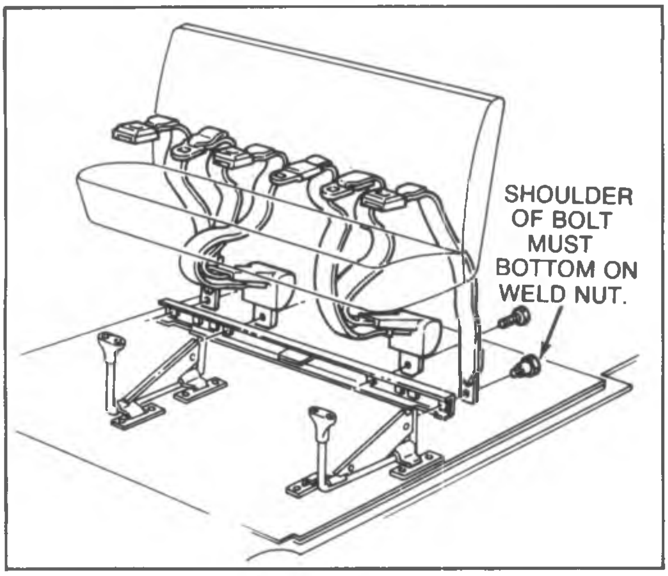


Fig. 10-141--2nd and 3rd Seat Lap Belt Installation

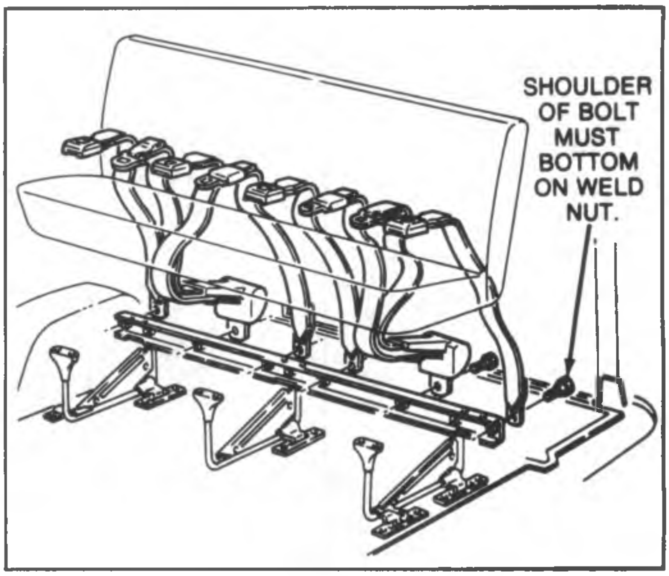


Fig. 10-142--4th Seat Lap Belt Installation

FRONT END

Sunshade Support....................18 in. lb. 2. N·m
Outside Rear View Mirror to Door Panel
    Base Mirror....................18 in. lb. 2. N·m
    West Coast Mirror-
    Lower Bracket to Door...........18 in. lb. 2. N·m
    Upper Bracket to Door...........18 in. lb. 2. N·m

DOORS

Window Regulator Assembly
to Door Panel.......................85 in. lb. 9.5 N·m
Remote Control Door Lock
to Door Panel.......................45 in. lb. 8. N·m
Lock Striker to Body Pillar...........45 ft. lb. 60. N·m
Outside Door Handle..................85 in. lb. 9.5 N·m
Inside Door Handle...................85 in. lb. 9.5 N·m
Hinges to Body and Door..............31 ft. lb. 42. N·m
Front Door-Window Rear Channel
    Upper Bolt Assembly............85 in. lb. 9.5 N·m
    Lower Bolt Assembly............85 in. lb. 9.5 N·m
Front Door-Ventilator and Glass Run Assembly
    Top Vent Screw..................20 in. lb. 2.2 N·m
    Side Vent Screws and Spacers.....22 in. lb. 2.5 N·m
    Lower Vent Channel Bolts........85 in. lb. 9.5 N·m
Side Rear Door-Run Channel
    Front Upper Bolt to Door.........85 in. lb. 9.5 N·m
    Rear Upper Screw to Door........20 in. lb. 2. N·m
    Front Lower Nut to Door......... 45 in. lb. 5. N·m
    Rear Lower Bolt to Door......... 85 in. lb. 9.5 N·m
    Lock Lever to Door............. 85 in. lb. 9.5 N·m
Rear Door-
Lock Striker (Suburban)..............19 ft. lb. 26. N·m
Rear Door-Latch LH and RH
to Door (Suburban)..................85 in. lb. 9.5 N·m
Rear Door-Latch Control Assembly to Door (Suburban)
    Upper Assembly................19 ft. lb. 26. N·m
    Lower Assembly................85 in. lb. 9.5 N·m

END GATE

Hinges-Body Half and Gate Half.......35 ft. lb. 48. N·m
Support Assembly-Cable Bolts........35 ft. lb. 48. N·m
Torque Rod to Hinge Pocket.......... 85 in. lb. 9.5 N·m
Torque Rod to Body.................. 18 ft. lb. 2. N·m
Latch Assembly to End Gate.......... 33 ft. lb. 44. N·m
Latch Control Assembly
to End Gate......................... 45 in. lb. 5. N·m
Handle to Latch Control Assembly..... 45 in. lb. 5. N·m
Glass Channel (Suburban)............ 45 in. lb. 5. N·m
Glass Channel (Utility)............... 85 in. lb. 9.5 N·m
Outside Handle...................... 55 in. lb. 6. N·m
Cap Assembly to Channel Assembly....24 in. lb. 2.6 N·m
Striker-Body Mounted................25 ft. lb. 34. N·m

TAILGATE-FLEETSIDE

Trunnion Assembly.................. 18 ft. lb. 24. N·m
Linkage and Striker Assembly-
Support.............................18 ft. lb. 24. N·m

TAILGATE-STEPSIDE

Trunnion Assembly...................18 ft. lb. 24. N·m
Chain Support Assembly..............90 in. lb. 10. N·m

SEATS

Front Bench Seat
    Adjuster-to-Seat............... 50 in. lb. 17. N·m
    Adjuster-to-Floor.............. 25 ft. lb. 34. N·m
Front Bucket Type
    Driver
        Adjuster-to-Seat.......... 18 ft. lb. 24. N·m
        Adjuster-to-Floor......... 25 ft. lb. 34. N·m
    Passenger Chassis Cab
        Support-to-Seat.......... 18 ft. lb. 24. N·m
        Support-to-Floor
        (Front)...................25 ft. lb. 34. N·m
        Support-to-Floor
        (Rear)....................40 ft. lb. 54. N·m
    Passenger Suburban
        Latch Support
        to Seat (Rear).............18 ft. lb. 24. N·m
        Striker to Floor
        (Rear)................... 25 ft. lb. 34. N·m
        Support (Upper)
        to Seat (Front)............ 18 ft. lb. 24. N·m
        Support (Lower)
        to Floor (Front)...........25 ft. lb. 34. N·m
        Support (Upper)
        to Support (Lower)........ 30 ft. lb. 40. N·m
Rear Bench Utility, Suburban
    Support-to-Seat................18 ft. lb. 24. N·m
    Support-to-Floor...............50 ft. lb. 70. N·m
Rear Bench Crew Cab
    Support-to-Seat............... 150 in. lb. 17. N·m
    Support-to-Floor............... 35 in. lb.
Folding Rear Seat Suburban
    Support Asm-to-Floor..........150 in. lb. 17. N·m
    Seat-to-Support Asm............18 in. lb. 24. N·m

Fig. 10-143 Torque Specifications

BODY MOUNTING (C-K MODELS)

MODEL	#1	#2	#3	#4	#5	#6
CHASSIS CAB	55 ft. lb. 75 N·m	55 ft. lb. 75 N·m				
CREW CAB	55 ft. lb. 75 N·m	35 ft. lb. 48 N·m	55 ft. lb. 75 N·m			
SUBURBAN	55 ft. lb. 75 N·m	35 ft. lb. 48 N·m		35 ft. lb. 48 N·m		35 ft. lb. 48 N·m
UTILITY	55 ft. lb. 75 N·m	45 ft. lb. 60 N·m	35 ft. lb. 48 N·m	35 ft. lb. 48 N·m		

G MODELS

MIRRORS AND SUNSHADE

Outside Rear View Mirror to Panel....150 in. lb. 17. N·m
Sunshade Support to Header Panel......15 in. lb. 1.6 N·m

SIDE WINDOW (SWINGOUT)

Latch to Body........................40 in. lb. 4.6 N·m
Hinge to Body........................55 in. lb. 6.0 N·m

FRONT SIDE DOORS

Door Hinges.........................30 ft. lb. 40. N·m
Remote Control Retaining Screws......45 in. lb. 5. N·m
Door Lock Striker....................45 ft. lb. 60. N·m
Door Lock to Door ....22 ft. lb. 30. N·m
Outside Door Handle..................90 in. lb. 10. N·m
Regulator Assembly...................90 in. lb. 10. N·m

REAR DOOR

Hinge (to body and door)...............40 ft. lb. 54. N·m
Remote Control RH
Retaining Screws.....................70 in. lb. 8. N·m
Latch-to-Door Retaining
Screws Upper........................19 ft. lb. 26. N·m
Latch-to-Door Retaining
Screws Lower........................70 in. lb. 8. N·m
Door Strikers-to-Body................18 ft. lb. 24. N·m
Outside Door Handle..................90 in. lb. 10. N·m

SLIDING SIDE DOOR

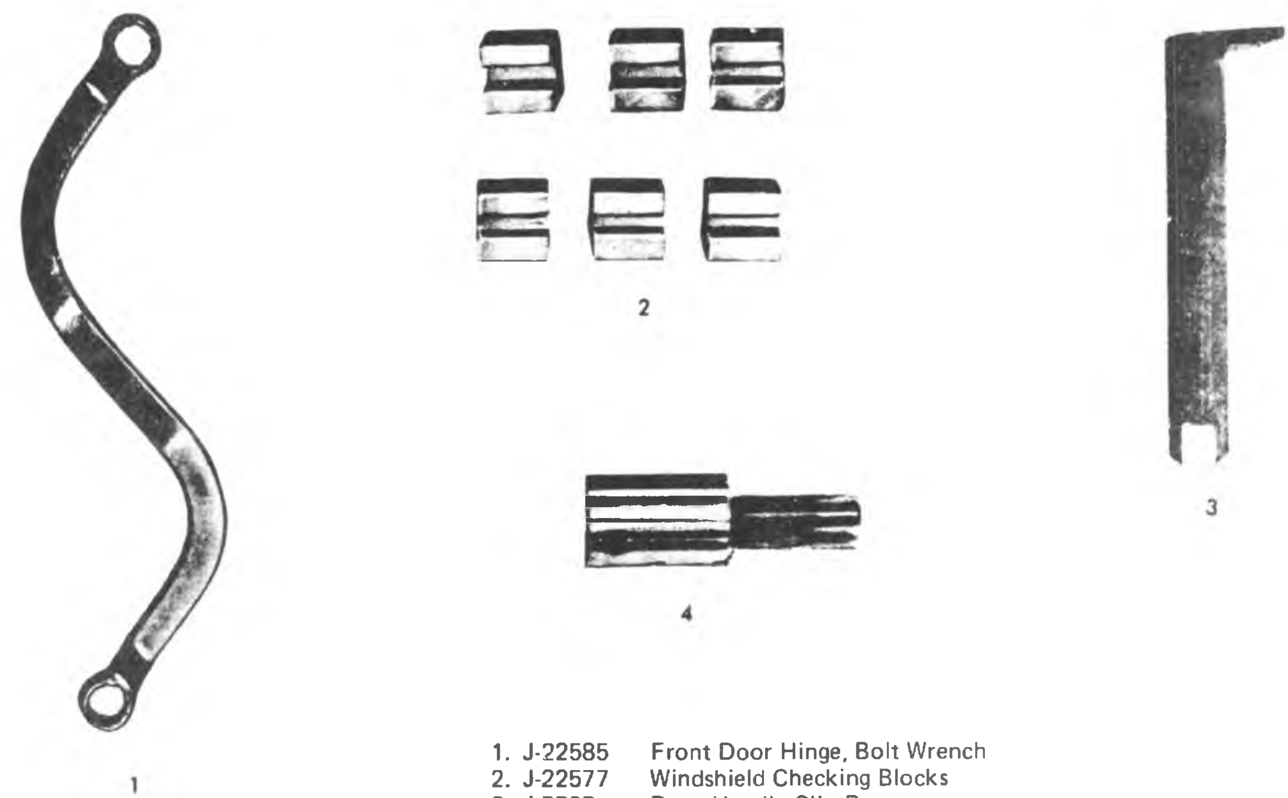
Remote Control (front latch)
to Door...............................90 in. lb. 10. N·m
Rear Latch to Door.....................90 in. lb. 10. N·m
Lower Front Roller and Roller Support
  Support-to-Door....................24 ft. lb. 32. N·m
  Support to Roller Bracket ....24 ft. lb. 32. N·m
  Lower Control Assembly ....90 in. lb. 10. N·m
Upper Front Roller Bracket
  Bracket to Door ....24 ft. lb. 32. N·m
  Roller to Bracket...................20 ft. lb. 27. N·m
Upper Rear Hinge (Door Half)
  Hinge to Door ....25 ft. lb. 34. N·m
Upper Rear Hinge (Body Half)
  Roller to Hinge.....................20 ft. lb. 27. N·m
  Guide Block to Hinge................45 in. lb. 5. N·m
  Lever Arm-to-Hinge
  Retaining Nut ....120 in. lb. 14. N·m
  Lever Retaining Screw ....45 in. lb. 5. N·m
Rear Striker to Body (Upper Stop)........20 ft. lb. 27. N·m
Rear Striker Bolt (Body Mounted)........45 ft. lb. 60. N·m
Front Striker Retaining Screws
(Body Mounted) ....90 in. lb. 10. N·m

SEATS

Seat Belt to Seat ....37 ft. lb. 50. N·m
Passenger and Drivers
  Seat to Adjuster
  (Mounting Bracket) ....18 ft. lb. 24. N·m
  Seat to Riser.......................18 ft. lb. 24. N·m
  Seat Riser-to-Floor ....50 ft. lb. 70. N·m
Bench Seats
  Seat to Seat Support ....18 ft. lb. 24. N·m
  Seat Support to Leg Assembly.......130 ft. lb. 170 N·m

Fig. 10-144 Torque Specifications

SPECIAL TOOLS



1. J-22585 Front Door Hinge, Bolt Wrench
2. J-22577 Windshield Checking Blocks
3. J-7797 Door Handle Clip Remover
4. J-23457 Door Striker Bolt Remover and Installer

Fig. 10-145 --Special Tools

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS

Circuit Number	Circuit Color	Circuit Name
2	Red	Feed, Battery - Unfused
3	Pink	Feed, Ign. Sw. "On & Crank" Controlled, Unfused
4	Brown	Feed, Ign. Sw. "Accsy & On" Controlled, Unfused
5	Yellow	Neutral Safety Start Sw. or Start Relay Feed
6	Purple	Starter Solenoid Feed
7	Yellow	Primary Ignition Resistance By-Pass
8	Gray	Instrument and Panel Lights (Fused No. 44 Cir.)
9	Brown	Tail, License, Park and Side Marker Lamp Feed
10	Yellow	Dimmer Sw. Feed
11	Light Green	Headlamp Feed, Hi-Beam
12	Tan	Headlamp Feed, Lo-Beam
13	Purple	Front Parking Lamps
14	Light Blue	L.H. Indicator and Front Directional Lamps
15	Dark Blue	R.H. Indicator and Front Directional Lamps
16	Purple	Directional Signal Sw., Feed From Flasher
17	White	Directional Signal Sw., Feed From Stop Sw.
18	Yellow	Stop and Directional Lamp or Directional Lamp Only - Rear L.H.
19	Dark Green	Stop and Directional Lamp or Directional Lamp Only - Rear R.H.
20	Light Blue	Stop Lamp (Only)
21	Pink	Spot Light
22	White	Direct Ground - Trailer
24	Light Green	Back Up Lamp Feed
25	Brown	Feed, Voltage Regulator Controlled
26	Dark Blue	Field Circuit (F) (Gen/Reg.)
27	Brown	Traffic Hazard Sw., Feed From Hazard Flasher
28	Black	Ground, Horn Sw. Controlled
29	Dark Green	Horn Feed
30	Pink	Fuel Gauge to Tank Unit
31	Tan	Oil Pressure, Engine
32	Yellow	Map Light Feed
33	Tan-White	Warning Light - Brake
34	Purple	Fog or Drive Lamp
35	Dark Green	Ground, Eng. Coolant Temp. Sw. or ECM Controlled (Hot)
36	Light Green	Ground, Eng. Temp. Sw. Controlled (Cold)
37	Light Green	Ground, Eng. Metal Temp. Sw. Controlled (Hot)
38	Dark Blue	Flasher Fused Feed
39	Pink-Black	Feed, Ign. Sw. "On and Crank" Controlled - Fused
40	Orange	Feed, Battery - Fused
41	Brown-White	Feed, Ign. Sw. "Accsy and On" Controlled - Fused
42	Yellow	Feed, A/C Auto Relay Controlled
43	Yellow	Radio Feed
44	Dark Green	I.P. and Lights Feed (Usually Light Sw. to Fuse)
45	Black	Marker and Clearance Lamps (Trailers)
46	Dark Blue	Rear Seat Speaker Feed From Single Radio or Right Stereo
47	Dark Blue	Auxiliary Circuit (Trailer)
48	Gray	Tail Lp. - Headlamp Sw. "On" - or Dir. Signal and Stop - Headlamp Sw. "Off" Rear L.H.
49	Dark Blue	Tail Lp. - Headlamp Sw. "On" - or Dir. Signal and Stop - Headlamp Sw. "Off" Rear R.H.
50	Brown	Feed, Ign. Sw. "On" Controlled - Fused
51	Yellow	Blower Resistor Feed - Low
52	Orange	Feed, Blow Sw. "Hi" or Selector Sw. "Max Cold" Controlled
53	Light Green	Valve Release Solenoid to Control Box
54	Dark Green	Control to Shield
55	Orange	Kick Down Solenoid Feed
56	Tan	Amplifier to Transducer
57	Orange	L.H. Cornering Lamp Feed
58	Black	R.H. Cornering Lamp Feed
59	Dark Green	Compressor Feed
60	Orange-Black	Feed, Battery, Circuit Breaker Protected
61	Yellow	Ground, Resistive, Auto A/C Amb. Sensor Controlled
62	Light Green	Ground, Resistive, Auto A/C Feed Back Pot Conrolled
63	Tan	Feed, Blower Sw. "Medium 1" Controlled
64	Brown	Blower Sw. Feed From A/C Selector Sw.
65	Purple	Blower Motor Feed
66	Light Green	Feed, A/C Selector Sw. Controlled (Comp. Ct.)
67	Light Blue	Feed, A/C Freon Press, Cut-Out Sw. Controlled

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
68	Yellow-Black	Ground, Resistive, Low Coolant Probe Controlled
69	Gray	Ground Low Coolant Module Controlled
70	Pink	Feed, Relay Controlled, Ign. Sw. Controlled
71	Black	Ground, A/C Selector Sw. "Def" Controlled
72	Light Blue	Feed, Blower Sw. "Medium 2" Controlled
73	Purple-White	Feed, Blower Sw. "Medium 3" Controlled
74	Light Green	Feed to Throttle Switch
75	Dark Blue	Feed, Ign. Sw. "On and Crank" Controlled - Fused
76	Pink	Feed, Ign. Sw. Controlled
78	Light Blue	Electric Choke Feed
80	Light Green	Ground Key Warning Buzzer
81	Nat. White	Electric Remote Mirror, Right
82	Light Blue	Electric Remote Mirror, Left
83	Dark Green	Feed, Cruise Engage Sw. "Retard" Controlled
84	Dark Blue	Feed, Cruise Engage Sw. "Engage" Controlled
85	White	Ground, Cruise Indicator Regulator Controlled
86	Brown	Feed, Cruise Brake Release Sw. Controlled
87	Gray-Black	Feed, Resume Solenoid, Brake Switch Controlled
88	Yellow	Electric Remote Mirror, Up
89	Light Green	Electric Remote Mirror, Down
90	Pink	Feed, Cutout Sw. Controlled, Cir. Brkr. Protected
91	Gray	Windshield Wiper - Low
92	Purple	Windshield Wiper - Hi
93	White	Windshield Wiper Motor Feed
94	Pink	Windshield Washer Sw. to Washer
95	Dark Green	Ground, Pulse Wiper Sw. Controlled
96	Brown	Feed, Pulse Wiper Rheostat Sw. Controlled
97	Light Blue	Windshield Wiper, Pulse Low
98	Orange	Feed, Dynamic Break, "B-Plus" Switch Wiper Motor
99	Black-White	Windshield Washer Low Fluid
101	Dark Blue	Resistor Output to Blower Relay
102	White	SL Alternator - Regulator Sensing Circuit
105	Black	Ammeter - Generator
106	Gray	Ammeter - Battery

Circuit Number	Circuit Color	Circuit Name
107	Dark Blue	Over Speed Warning Light
111	Black	Ground, Anti-Ski Low Air Sw. Controlled
112	Dark Green	Telltale Temperature Gauge (Hot)
115	Light Blue	Speaker Return, RT rr Stereo
116	Yellow	Speaker Return, LF rr Stereo
117	Dark Green	Speaker Return, RT Frt. Stereo
118	Gray	Speaker Return, LF Frt. Stereo
119	White	Generator (Alternator) to Regulator
120	Purple	Electric Fuel Pump Feed
121	White	Tachometer to Coil
125	Yellow	Door Jamb Switch
126	Black	Seat Back Lock Feed
130	Brown-White	Generator (Alternator) Ext. Resist. 2 Ohms/Foot
131	Black-Pink	Generator (Alternator) Ext. Resist. 1 Ohm/Foot
132	White	Ground, Fuel Economy Sw. Controlled, Amber Telltale
133	Yellow	Ground, Fuel Economy Sw. Controlled, Grn. Telltale
135	Dark Green White	Ground, Resistive, Temp. Gauge Sensor Controlled
136	Dark Blue	Ground, Vacuum Switch Controlled, Turbo Boost Telltale
137	Natural-White	Ground, Vacuum Switch Controlled, Turbo Boost Economy Telltale
139	Pink-Black	Feed, Ign. Sw. "On and Crank" Controlled - Fused
140	Orange	Feed, Battery - Fused
141	Brown-White	Feed, Ign. Sw., "Accsy and On" Controlled
142	Black	Rr Compartment Lid Lock Release
143	Pink	Feed Radio Sw. "On" Controlled
144	Yellow	Feed to Pwr Ant Sw.
145	Dark Green	Feed, Pwr Ant Up, Relay Controlled
146	Dark Green	Ground, Trunk Release Tell-Tale
150	Black	Ground Circuit - Direct
151	Black	Ground Circuit - Direct
152	Black	Ground Circuit - Direct
153	Black	Ground Circuit - Direct
154	Black	Ground Circuit - Direct
155	Black	Ground Circuit - Direct

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
156	White	Ground Circuit - Sw. Controlled Body Interior Lamps - Such as Dome, Courtesy, Map, Warning, etc.
157	Gray	Ground Circuit - Sw. Controlled - Body Interior Lamps - Such as Dome, Courtesy, Map, Warning etc.
158	Black-Orange	Ground Circuit - Sw. Controlled - Body Interior Lamps - Such as Dome, Courtesy, Map, Warning etc.
159	Tan	Ground, Key Warning Buzzer
160	White	Power Antenna Down
161	Black	Power Antenna Up
162	Gray	Power Top - Up
163	Purple	Power Top - Down
164	Dark Blue	Window Control LF Up
165	Brown	Window Control LF Down
166	Dark Blue-White	Window Control RF Up
167	Tan	Window Control RF Down
168	Dark Green	Window Control LR Up
169	Purple	Window Control LR Down
170	Light Green	Window Control RR Up
171	Purple-White	Window Control RR Down
172	Light Green	Vent Control LF Close
173	Yellow	Vent Control LF Open
174	Dark Green	Vent Control RF Close
175	Purple	Vent Control RF Open
176	Dark Green	Power Seat Fore
177	Yellow	Power Seat Aft or Recline
178	Dark Green	Power Seat - 6-Way Fore and Aft
179	Tan	Power Seat - 6-Way Solenoid - Rear - Up and Down
180	Light Green	Power Seat - 6-Way Solenoid - Front - Up and Down
181	Light Blue	Power - Solenoid - Fore and Aft
182	Yellow	Power Seat - 6-Way - Aft and Down
183	Light Blue	Tailgate or Center Partition Window Up
184	Tan-White	Tailgate or Center Partition Window Down
185	Tan	Vent Control LR Open
186	Gray	Vent Control LR Close
187	Dark Blue	Vent Control RR Open
188	Light Blue	Vent Control RR Close
189	Dark Green	Power Seat - 4-Way - Fore and Down

Circuit Number	Circuit Color	Circuit Name
190	Yellow	Power Seat - 4-Way - Aft and Up
191	Light Green	Power Seat - 4-Way Solenoid - Up and Down
192	Purple	Defogger - Hi or Single Speed
193	Purple-White	Defogger - Low Speed - 0.38 Ohms per foot
194	Black	Electric Door Lock - Unlock
195	Light Blue	Electric Door Lock - Lock
198	Light Green Black	Ground, Resistive, A/C In-Car Sensor Controlled
199	Brown	Rear Seat Speaker - Feed from Radio Left Stereo
200	Light Green	Front Speaker - Feed from Radio Single or Right Stereo
201	Tan	Front Speaker - Feed from Radio Left Stereo
202	Black	Ground, Compressor over Heat Sw. Controlled
203	Light Blue	Rear A/C Potentiometer Feed
204	Dark Blue	Thermal Limiter Feed
205	White-Black	Seat Belt Seat Sensor to Belt Retractor (Grd)
206	Dark Blue	Neutral Start Sw. to Buzzer and Lamp
207	Yellow	Seat Sensor to Neutral Start Sw. (Lamp and Buzzer Grd)
208	Gray	Sw. Controlled Ground (TCS)
209	Purple	Park Brake Warning Lamp
210	White	Power Seat - 6-Way - Fore and Down - "A" Body
211	Dark Blue	Power Seat - 6-Way - Aft and Up - "A" Body
212	Yellow-Black Stripe	LH Seat Sensor
213	Dark Blue	Center Seat Sensor
214	Gray	RH Seat Sensor
215	Tan-Black	LH Sw.
216	Dark Blue-White	Center Buckle Sw. (Feed)
217	Gray-White	RH Sw.
218	Dark Green	Interlock Relay - Ground (Provided by Electronics)
219	Light Green-Black	Starter Interlock Controlled Starter Feed
220	Yellow	Starter Interlock Buz and Lp Feed
221	Brown	Passenger Initiator Feed, Low Level, IR
222	Dark Blue	Passenger Initiator Return, Low Level, IR

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
223	Light Blue	Sensor Detector Hi Return, Low Level, IR
224	Light Green	Sensor Detector Lo Feed, Lo Feed, Low Level, IR
225	Dark Green	Warning Lamp Ground IR
226	Orange	Warning Lamp Sensor
227	Tan	Recorder to Sensor Power Feed
228	Yellow	Warning Lamp Feed
229	Pink	Sensor Detector Hi Feed, Lo Level IR
230	Pink	Recorder Power Feed
231	Orange	Driver Initiator Feed, IR
232	White	Driver Initiator Return, IR
233	Dark Green	Hi Level Actuation Passenger (Inactive)
234	Yellow	IR Feed, Ign. Sw. Controlled, Unfused
235	Yellow	Sensor Detector Hi Feed - Hi Level IR
236	Gray	Sensor Detector Hi Return - Hi Level IR
237	Yellow	Feed, Belt Warn Timer Controlled (Timed 39 Ct.)
238	Black	Seat Belt Warn System - Buzzer Ground to Belt Assy Sw.
239	Pink-Black	Feed, Ign. Sw. "On & Crank" Controlled - Fused
240	Orange	Feed, Battery - Fused
241	Purple	Sensor Detector Lo Feed, Hi Level, IR
242	Tan	Feed, Throttle Control Spark Valve Controlled
243	Black-White	Feed, Drive Selector Sw. Controlled
244	Purple	Feed, LT F/D Solenoid Relay Controlled
245	Dark Blue	Feed, RT F/D Solenoid Relay Controlled
246	Dark Green	Feed, ADL Lock Relay Coil
247	Brown	Feed, to A/C Shut-Off Relay
248	Dark Blue	Feed, to A/C Compressor Harn Relay Controlled
249	Dark Green	Feed, From A/C Harn
250	Brown	Feed, Ign. Sw. on Controlled, Fused
251	Orange	Passenger Initiator Feed
252	Yellow	Ground, ADL Module Unlock Output Controlled
253	Dark Brown	Ground, ADL Module Lock Output Controlled
254	Light Green	Ground, ADL LT Unlock Relay Coil
255	Yellow	Ground, ADL RT Unlock Relay Coil
256	Dark Blue	Ground, Module Controlled, Lamp Out Indicator
257	Brown	Ground, A/C Press, Sw. Controlled
258	White	Passenger Initiator Return Hi Level, IR
259	Purple	IR Crank Start Signal - Fused 6 Cir.
260	Black	Theft Deterrent - Hood Sw.
261	Yellow	Theft Deterrent - Alarm Arm
262	Light Green	Theft Deterrent - Key - Door Unlock and Alarm Disarm
263	Light Blue	Theft Deterrent - Alarm
264	Dark Green	Theft Deterrent - Arm Indication
265	Black-White	Theft Deterrent - Alarm Output
266	Pink	Theft Deterrent - Alarm Arm Abort
267	Dark Green	Pwr Seat - Fore and Up Recliner
268	Yellow	Pwr Seat - Aft and Down Recliner
269	Light Green	Pwr Seat - Sol Up and Down Recliner
270	Black-Yellow	Feed, Amplifier to Potentiometer
271	Purple	Ground, Potentiometer Controlled
272	Light Green	Feed, Potentiometer Rheostat Controlled
273	Orange	Feed, Hdlp Sw. to Amplifier, Hdlp Sw. Controlled
274	Dark Green-White	Feed, Hdlp Sw. to Amplifier
275	Light Green	Feed, Neut. Saf. Start Sw. "Park" Controlled
276	Light Green	Recl. Mtr. Feed, Power St. Fwd.
277	Light Blue	Recl. Mtr. Feed, Power St. Recliner
278	White	Amplifier to Photocell
279	Black	Headlamp Sw. to Photocell
280	Pink	Feed, P.M. Motor Up Cycle (Deck Lid Pull Down)
281	White	Ground, Relay Coil Down Cycle (Deck Lid Pull Down)
282	Yellow	Power Seat, Rear Vert Up - Motor
283	Light Blue	Power Seat, Rear Vert Down - Motor
284	Light Green	Power Seat, Aft Motor
285	Tan	Power Seat, Fore Motor
286	Dark Green	Power Seat, Front Vert Up - Motor
287	Dark Blue	Power Seat, Front Vert Down - Motor

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
288	Yellow-Black	Power Seat, Rear Vert Up Relay
289	Light Blue-Black	Power Seat, Rear Vert Down Relay
290	Light Green-Black	Power Seat, Aft Relay
291	Dark Blue	Ground, Heated Glass Timer, On-Off Sw. Controlled
292	Light Blue	Feed, Heated Glass Timer, On-Off Sw. Controlled
293	Purple-White	Feed, Heated Glass Timer Controlled
294	Tan	Door Lock Motor - Unlock
295	Gray	Door Lock Motor - Lock
296	Brown	Power Seat, Fore Relay
297	Gray	Power Seat, Front Vert Up Relay
298	Purple	Power Seat, Front Vert Down Relay
300	Orange	Feed, Ign. Sw., "On" Controlled - Unfused
318	Yellow-Black Stripe	Relay Activated Left Directional Lamp
319	Dark Green-White	Relay Activated Right Directional Lamp
339	Pink-Black	Feed, Ign. Sw. On and Crank Controlled Fused
340	Orange	Feed, Battery - Fused
350	Pink-White	Feed, Ign. Sw. "On" Controlled - Fused
351	Dark Blue	Feed, Inverter to Opera Lamp
352	White	Opera Lamp to Inverter Return
370	Pink	Feed, Avl
382	Light Blue-Black	Low Vacuum Switch to Four Wheel Drive Relay
383	Light Blue	Convert Clutch Release Sw. to Vac. Sw.
384	Light Green	Vac. Sw. to Transmission Sw. Sol
385	Purple	Hi Vac Sw. to Transmission Sw. Sol
386	Yellow	Exhaust Gas Recirculation Bleed Solenoid to Torque Converter Clutch Pressure Switch
387	Orange	Torque Converter Clutch Pressure Switch to Transmission Solenoid
390	Tan	Feed to Side Marker and License Lamp - Export Only
391	Gray	Rear Window Wiper Low
392	Dark Green	Feed, Rear Window Wiper Switch to Washer
393	White	Feed, Rear Window Wiper
394	Light Green Black	Ground, LT F/D Remote Handle Sw. Controlled

Circuit Number	Circuit Color	Circuit Name
395	Light Blue	Ground, RT F/D Remote Handle Sw. Controlled
402	Light Green	Feed, Electronic Cruise Control Valve
403	Dark Blue	Feed, Electronic Cruise Shut-Off Valve
404	Light Green	EST Pickup Coil to HEI Module, High
405	White	EST Pickup Coil to HEI Module, Low
406	White-Green	ESC Module to HEI Module, Signal Lead
407	Black	Emergency Signal Lead, ECM to HEI Module
408	Tan-White	ECM to ESC Bypass
410	Yellow	ECM to Coolant Temp Sensor
411	Light Blue	ECM to Fuel Metering Sol
412	Purple	O_2 Sensor Sig
413	Tan	O_2 Sensor Low
414	Pink	O_2 Sensor Heater High
415	Light Green	ECM to Enrichment Sw.
416	Gray	ECM 5V Reference Voltage
417	Dark Blue	ECM to Throttle Position Sensor Signal
418	Brown	ECM to Adaptive Sw.
419	Brown-White	ECM to Check Eng Lp
420	Purple	ECM to Break Sw.
421	Dark Blue-White	ECM to Cold Start Program Modifier
422	Tan-Black	ECM to TCC Solenoid
423	White	EST Signal
424	Tan-Black	EST Bypass
425	Light Blue	ECM to ISC-Motor Extend
426	Dark Blue	ECM to ESC-Motor Retract
427	Pink	ECM to ISC-Sw.
428	Dark Green-Yellow	ECM to Canister Purge
429	Black-Pink	ECM to Air Control Solenoid
430	Purple-White	ECM Ref Pulse High
431	Light Green-Black	8V Ref Voltage
432	Light Green	ECM to Map Sig
433	Gray-Black	ECM to Baro Sig
434	Orange-Black	ECM to Neutral Park Sw
435	Gray	Electronic Control Module to Exhaust Gas Recirculation Solenoid
436	Brown	ECM to Air Switch Solenoid
437	Brown	ECM to Vehicle Speed Sensor
438	Dark Green-White	ECM to High Gear Switch

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
439	Pink-Black	Feed Ign. Sw. "On & Crank" Controlled - Fused
440	Orange	Feed, Battery - Fused
441	Light Blue-Red	Electronic Control Module to Idle Air Control Coil A, High
442	Light Blue-Black	Electronic Control Module to Idle Air Control, Coil A, Low
443	Light Green-Red	Electronic Control Module to Idle Air Control, Coil B, High
444	Light Green-Black	Electronic Control Module to Idle Air Control, Coil B, Low
450	Black-White	CLCC ECM Power Grd
451	White-Black	Diagnostic Enable
452	Black	Low Level Ground
453	Black-Red	EST Ref Pulse Low
454	Black-White	Critical Ground Circuit
460	Black-Orange	Feed, Battery Circuit Breaker Protected
461	Orange	IMC to ECC, Serial Data for MPG or Diagnostics
462	Pink-Black	Ground, IMC, Set Timing
463	Black-Orange	IMC to Trip Computer Signal, Fuel Flow Data (Injector on Time)
464	Tan-Black	MPG Reset Signal
465	Dark Green-White	Feed, Electric Fuel
466	Gray	IMC to Trip Computer, RPM Data
467	Light Blue	Low Side of Injector "A" IMC Controlled
468	Light Green	Low Side of Injector "B" IMC Controlled
469	Black-Orange	Map Return, Low Level Ground
470	Black	Coolant Temp and Manifold Temp Return, Low Level Grd
471	Pink-Black	Baro Reference Voltage, 5V
472	Tan	Manifold Air Temp Sig
473	Black-Light Blue	Baro Return, Low Level Ground
474	Gray	Throttle Position Sensor Excitation, 5V
475	Pink-White	Map Reference Voltage, 5V
476	Black-Pink	Throttle Position Sensor Return, Low Level Grd
477	Brown	MPG Request Signal
478	Purple	Fuel Economy Indicator (Grn), IMC Controlled
479	Light Green-Black	Fuel Economy Indicator (Amber), IMC Controlled
480	Orange	Feed, IMC Battery Controlled, Fused
481	Red	Feed, for Injector "A" Fused

Circuit Number	Circuit Color	Circuit Name
482	White	Feed, for Injector "B" Fused
483	Green	ESC Reference Pulse High
484	White	ESC Reference Pulse Low
485	Black	ESC Signal
486	Brown	ESC Distributor Grd
496	Dark Blue	ESC Denotation Sensor Input
500	Black-White	Module - PTC, Ground Plane
501	Purple	Sensor, Secondary PTC
502	Gray	Sensor, Primary PTC
503	Orange	Glow Plug, Feed or Sensor
504	Brown-White	Feed, Voltage Regulator Control (Diode Isolated)
505	Yellow	Feed, Glow Plug Relay
506	Light Blue	Return, Glow Plug Relay
507	Dark Blue	Wait Lamp
508	Yellow-Black	Switched Grd for "Water-in-Tank" Indicator
509	Orange-Black	Glow Plug, Feed or Sense, Passenger Side
610	Tan	Power Seat - 6-Way - Fore and Down Relay to Motor
611	Light Blue	Power Seat - 6-Way - Aft and Up, Relay to Motor
618	Yellow-Black	Feed, Lt Side Trailer and Direction
619	Green-White	Feed, Rt Side Trailer and Direction
666	Dark Blue	Wdo Control Rf Up - Passenger Sw.
667	Brown	Wdo Control Rf Down - Passenger Sw.
668	Dark Blue	Wdo Control Lr Up - Lr Sw.
669	Brown	Wdo Control Lr Down - Lr Sw.
670	Dark Blue	Wdo Control RR Up - RR Sw.
671	Brown	Wdo Control RR Down - RR Sw.
756	Dark Green-White	Feed, Vac Sol Controlled (For Electronic Distributor)
801	Brown	Feed, EFI Battery Controlled, Fusible Link Protected
804	Purple	Feed, EFI, Ign. Sw. "Crank" Controlled, Fusible Link Protected
807	Purple	Feed, EFI Battery Controlled, Fused
808	Dark Blue	Feed, EFI Module Fast Idle Valve Output and 3 Circuit Controlled - Fused
810	Tan	Feed, Distributor Electronics Controlled
811	White	Feed, EFI Module Group Two Injector Output Controlled Fusible Link Protected
812	Pink	Feed, EFI Module Group One Injector Output Controlled Fusible Link Protected

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
813	White	Feed, EFI Distributor Trigger and 815 Circuit Controlled, Fused
814	Yellow	Feed, EFI Distributor Trigger and 815 Circuit Controlled, Fused
815	Black	Feed, EFI Module Distributor Trigger Output Controlled, Fused
816	Pink	Accelerator Enrichment Input #2
817	Tan	Accelerator Enrichment Input #1
818	Light Green	Accelerator Enrichment Sw. Supply Voltage
819	Black-White	Clossed Throttle Sw.
820	Orange	Wide Open Throttle Switch

Circuit Number	Circuit Color	Circuit Name
821	Dark Green	Ground, EFI Module Coolant Temp. Sensor Output Controlled
822	Dark Blue	Ground Resistive, Coolant Temp. Sensor Controlled
823	Gray	Ground, EFI Module Air Temp. Sensor Output Controlled
824	Orange	Ground, Resistive Air Temp. Sensor Controlled
827	Dark Green	Feed, EFI Module Elec Fuel Pump Output Controlled - Fused
828	Gray	Feed, EFI, Ign. Sw. "On & Crank" Controlled Fused
831	Brown	Feed, EFI Module EGR Solenoid Output Controlled, Fused