



Service Manual Light Duty Trucks



FOREWORD

This manual includes procedures for diagnosis, maintenance and adjustments, minor service operations, removal disassembly and installation for components of GMC Truck & Coach Division 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 will enable the technician to better serve the owners of GMC Truck & Coach Division 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
Division of General Motors Corporation
Pontiac, Michigan 48053

IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended and described in this service manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various Cautions and Notices which should be carefully read in order to minimize the risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It also is important to understand that these Cautions and Notices are not exhaustive. The manufacturer could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, the manufacturer has not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

1982 LIGHT DUTY TRUCK (Series 10-35) SHOP MANUAL

CAUTION

These vehicles contain some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) 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 in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your dealer.

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SECTION 0A

GENERAL INFORMATION

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GENERAL

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 also appears on the Vehicle Certificates of Title and Registration.

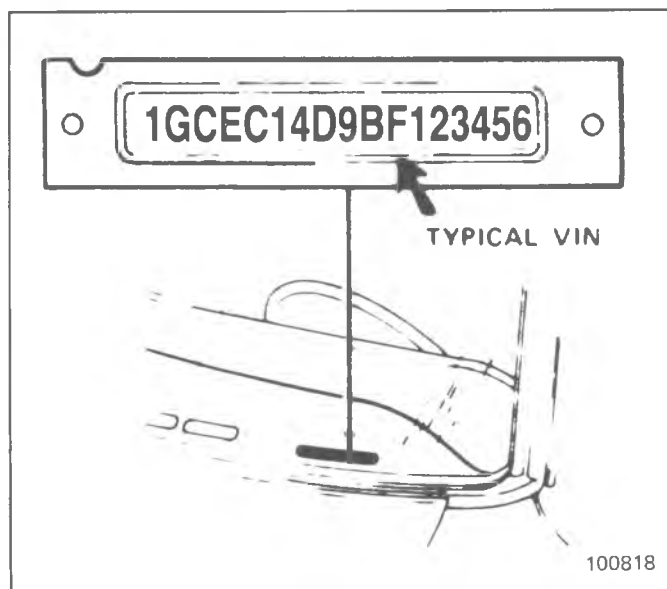


Fig. 0A-1--Vehicle Identification Number Location (CK and G)

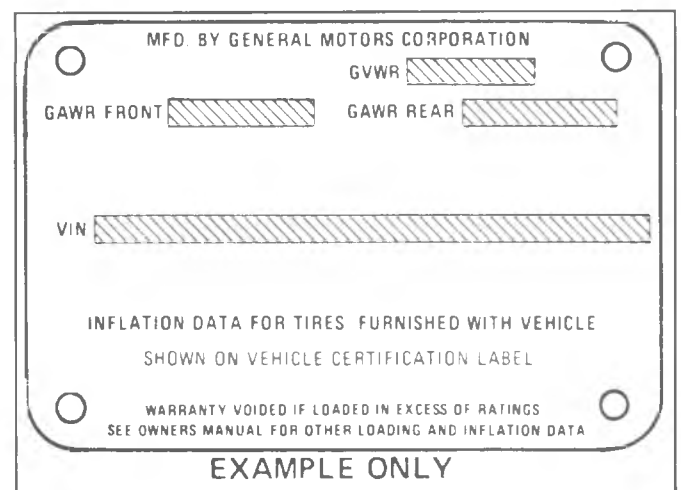


Fig. 0A-2--V.I.N. Rating Plate (P Model)

VEHICLE IDENTIFICATION NUMBER

1GCEC14D9CF123456

NATION OF ORIGIN
1 USA
2 CANADA

MANUFACTURER
G GENERAL MOTORS

MAKE AND TYPE
A BUS (VAN)
B INCOMPLETE VEHICLE
C TRUCK
8 MULTIPURPOSE PASS VEHICLE

GVWR/BRAKE SYSTEM

CODE	GVWR (IN POUNDS)	BRAKE SYSTEM
B	3001 - 4000	HYDRAULIC ONLY
*C	4001 - 5000	
D	5001 - 6000	
E	6001 - 7000	
F	7001 - 8000	
**G	8001 - 9000	
H	9001 - 10000	
J	10001 - 11,000	

* Includes El Camino
** Includes G Van Bus

LINE AND CHASSIS TYPE

CODE	LINE	MODELS	CHASSIS TYPE
C	CONVENTIONAL CAB	(C)	4 X 2
K	CONVENTIONAL CAB	(K)	4 X 4
P	FORWARD CONTROL CHASSIS	(P)	4 X 2
G	VAN, SPORT VAN & CUTAWAY VAN	(G)	4 X 2
W	EL CAMINO	(APU)	4 X 2

TRUCK SERIES

1	1/2 TON
2	3/4 TON
3	1 TON
8	1/2 TON (EL CAMINO)

TRUCK BODY TYPE

0	SEDAN PICKUP
1	HI CUBE/CUTAWAY VAN
2	FORWARD CONTROL
3	FOUR DOOR CAB
4	TWO DOOR CAB
5	VAN
6	SUBURBAN
7	MOTOR HOME
8	BLAZER
9	STAKE PLATFORM

MODEL YEAR

C	1982
D	1983
E	1984
F	1985
G	1986
H	1987
I	1988
K	1989
L	1990
M	1991

CHECK DIGIT

PLANT SEQUENTIAL NUMBER

ASSEMBLY PLANT

CODE	ASSEMBLY PLANT	CODE	ASSEMBLY PLANT
A	GMAD LAKEWOOD	5	GMAD ST LOUIS
B	GMAD BALTIMORE	V	GMT & C PONTIAC
D	GMAD - DORAVILLE	2	GMAD FREMONT
F	CHEVROLET FLINT	1	GM OF CANADA OSHAWA
J	GMAD - JANSVILLE	3	CHEVROLET DETROIT
K	GMAD - LEEDS	4	GM OF CANADA SCARBOROUGH
R	GMAD ARLINGTON	7	GMAD LORDSTOWN

* EL CAMINO PLANTS

ENGINE TYPE AND MAKE

CODE	TYPE	DISPLACEMENT LITRES	MAKE (GMI) PRODUCER	MODELS	RPO
C	6.2L V8 DIESEL		CHEVROLET	C-K	LN6
D	4.1L L6 288L		CHEVROLET	G	LE3
F	5.0L V8 488L		CHEVROLET	C-K G	LF3
H	5.0L V8 488L		CHEVROLET	C-K G	IE9
J	6.2L V8 DIESEL		CHEVROLET	C-K	LL4
L	5.7L V8 488L		CHEVROLET	C-K G	LS9
M	5.7L V8 488L		CHEVROLET	C-K G P	LT9
P	5.7L V8 288L		CHEVROLET	C-K	LF5
W	7.4L V8 488L		CHEVROLET	C-K P	LE8
T	4.8L L6 188L		CHEVROLET	C-K P	LT5

(FOR EL CAMINO ONLY)

V.I.N.	TYPE	MAKE (GMI) PRODUCER	MODEL	RPO
A	3.8L V6 288L	BUICK	EL CAMINO	LD5
H	5.0L V8 488L	CHEVROLET	EL CAMINO	LG4
J	4.4L V8 288L	CHEVROLET	EL CAMINO	LG3
K	3.8L V6 288L	CHEVROLET	EL CAMINO	LC3

Fig. 0A-3--Vehicle Identification Number

SERVICE PARTS IDENTIFICATION STICKER

The Service Parts Identification Sticker (Fig. 0A-6) is provided on all Truck models. On C and K models, the identification sticker be 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 a 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-7. Note that the axle or GVW capabilities are not exceeded.

ENGINE CODE NUMBER

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

F - Producing 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 engineers 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.

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.

SERVICE PARTS IDENTIFICATION			
V.I.N. _____		W/BASE _____ SE _____	
NOTE: THE SPECIAL EQUIPMENT LISTED BELOW HAS BEEN INSTALLED ON THIS VEHICLE. FOR PROPER IDENTIFICATION OF REPLACEMENT PARTS BE SURE TO SPECIFY THE APPLICABLE OPTION NUMBERS			
OPTION NO.	DESCRIPTION	OPTION NO.	DESCRIPTION
IMPORTANT: RETAIN THIS PLATE AS A PERMANENT RECORD			

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

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.

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 Transmissions, 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 Located on the Light Blue Plate on the Right Side of the Transmission.
- On the Automatic 700R4 Transmission, the Unit Number is stamped on the cover pan rail on the Right Side of the Transmission.

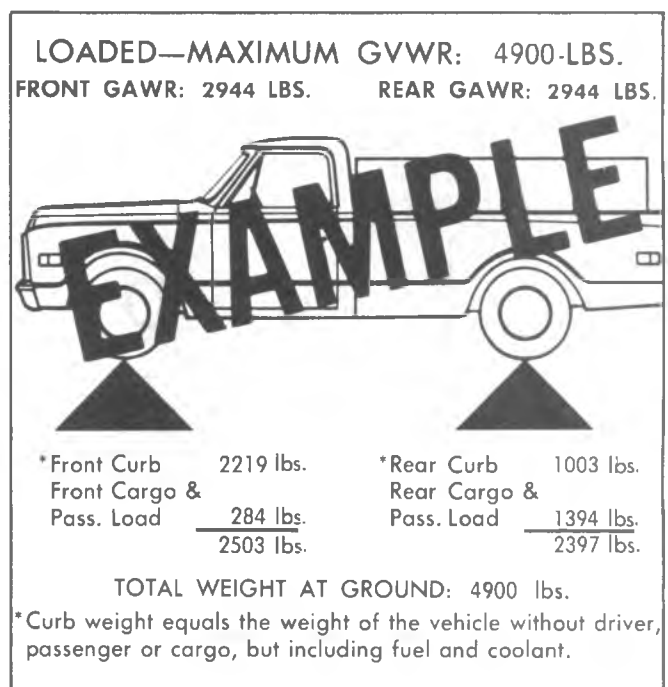
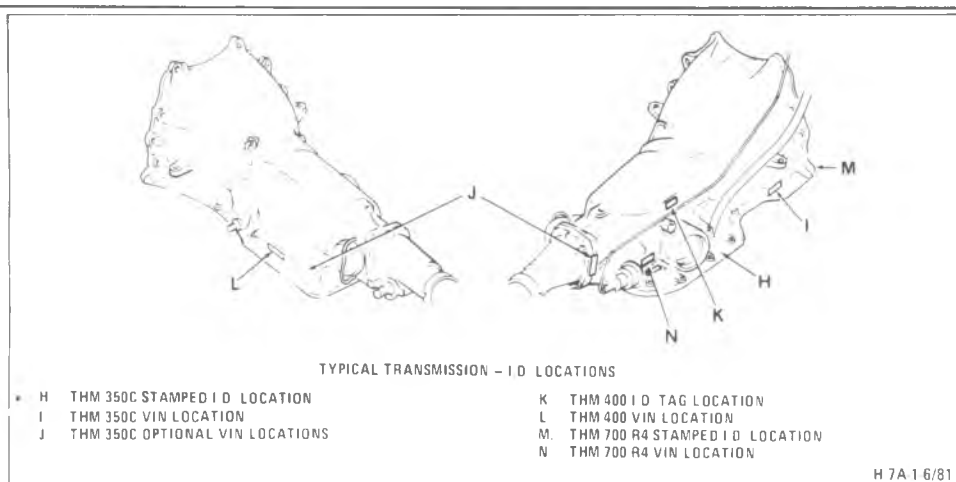


Fig. 0A-5--Typical Vehicle Loading Condition



TRANSMISSION IDENTIFICATION

FOR: THM 350C - TOLEDO PLANT, OHIO

Y 2 E 03 D

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

H 7A-8-6/81

TRANSMISSION NAMEPLATE
 YPSILANTI PLANT, MICHIGAN

THM 400

P • Z

82-PZ 86992

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

H 7A-12-6/81

TRANSMISSION NAMEPLATE
 BUICK FLINT PLANT, MICHIGAN
 THM 350C

L • D

9LD 001D 82

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

H 7A-9-6/81

TRANSMISSION IDENTIFICATION
 THM 700R4 - TOLEDO PLANT, OHIO

9 TA Y 2 M 12 D

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

H 7A-7-6/81

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

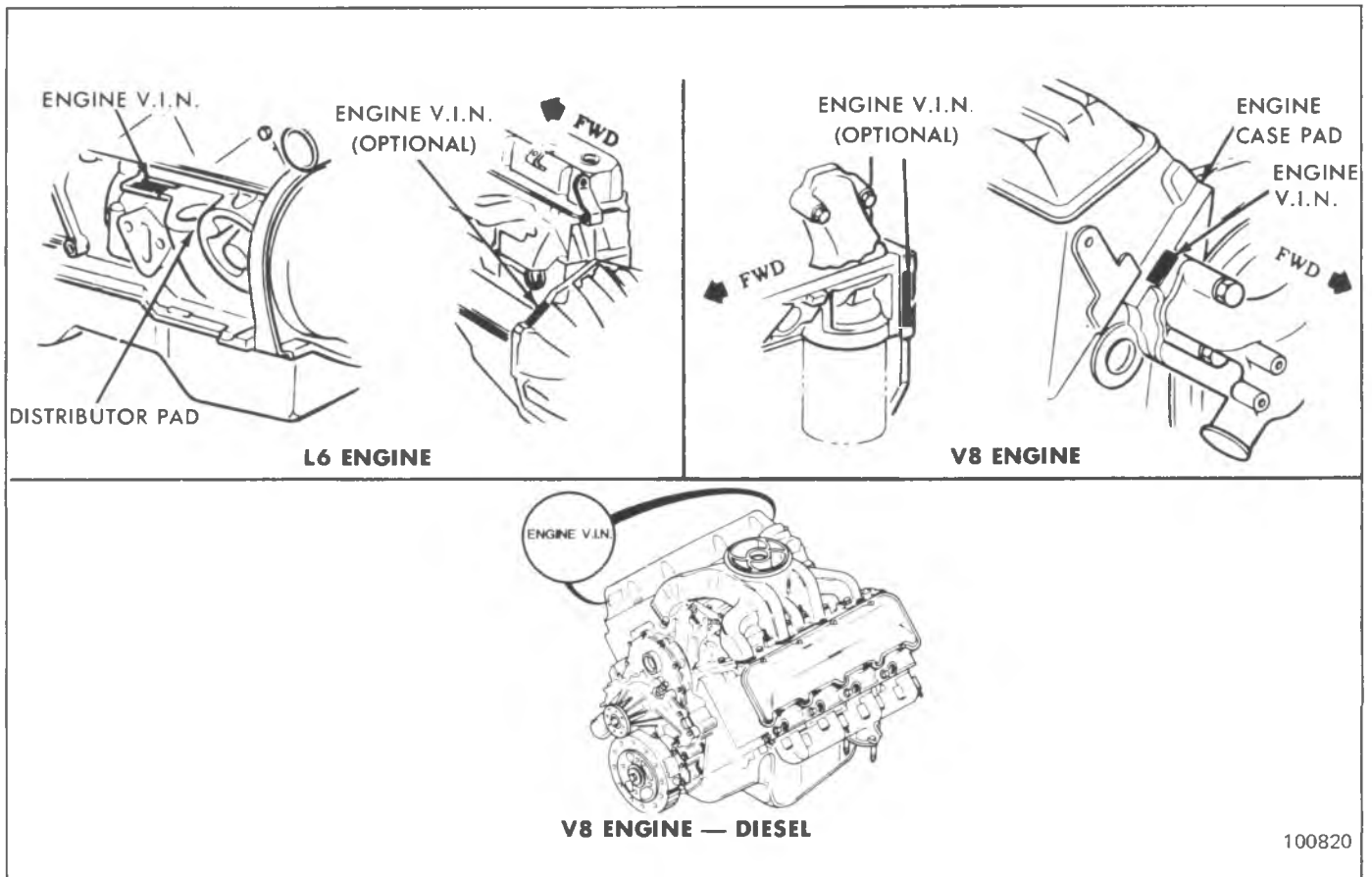


Fig. OA-7--Engine V.I.N. Location

Engines (Fig. OA-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.

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SECTION 0B

MAINTENANCE AND LUBRICATION

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1982 VEHICLE MAINTENANCE SCHEDULE

Item No.	To Be Serviced	When to Perform	7,500 Miles (12 000 km)	15,000 Miles (24 000 km)	22,500 Miles (36 000 km)	30,000 Miles (48 000 km)	37,500 Miles (60 000 km)	45,000 Miles (72 000 km)
SECTION A — GENERAL MAINTENANCE								
A-1	Chassis Lubrication	Lubricate every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-2	Fluid Levels	Check every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-3	Engine Oil and Filter*	See Explanation for service intervals						
A-4	Clutch	Inspect every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-5	Steering and Suspension		•	•	•	•	•	•
A-6	Exhaust System*	Inspect every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-7	Tires and Wheels	Inspect and rotate at 7,500 Miles (12 000 km), then every 15,000 Miles (24 000 km)	•		•		•	
A-8	Brakes	Inspect at 7,500 Miles (12 000 km), then every 15,000 Miles (24 000 km)	•		•		•	
	Disc Brakes							
	Brake Lines	Inspect every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
	Drum and Parking Brakes	Inspect every 12 Months or 15,000 Miles (24 000 km)		•		•		•
A-9	Engine Drive Belts*	Inspect every 12 Months or 15,000 Miles (24 000 km)		•		•		•
A-10	Fuel Tank, Cap, and Lines*			•		•		•
A-11	Throttle Linkage			•		•		•
A-12	Cooling System*	Service per Explanation every 12 Months or 15,000 Miles (24 000 km)		•		•		•
		Drain, flush and refill every 24 Months or 30,000 Miles (48 000 km)				•		
A-13	Manual Steering Gear	Inspect every 30,000 Miles (48 000 km)				•		
A-14	Final Drive	See Explanation for service intervals						
A-15	Wheel Bearings	Repack every 30,000 Miles (48 000 km)				•		
A-16	Transmission Fluid	See Explanation for service intervals						
SECTION B — EMISSION CONTROL MAINTENANCE								
B-1	Carburetor Choke and Hoses	Check at 6 Months or 7,500 Miles (12 000 km), then at 24 Month or 30,000 Mile (48 000 km) intervals. Also check B-1 and B-4 at 45,000 Miles (72 000 km).	•			•		•
B-2	Carburetor or Throttle Body Mounting ²		•			•		
B-3	Engine Idle Speed (See Explanation)		•			•		
B-4	Vacuum Advance System		•			•		•
B-5	Thermostatically Controlled Air Cleaner	Inspect at 7,500 Miles (12 000 km), then every 30,000 Miles (48 000 km)	•			•		
B-6	Spark Plug Wires and Distributor	Inspect every 15,000 Miles (24 000 km)		•		•		•
B-7	Spark Plugs	Replace every 30,000 Miles (48 000 km)				•		
B-8	PCV System Check and Service	See Explanation for service intervals						
B-9	Engine Timing	Adjust every 30,000 Miles (48 000 km)				•		
B-10	EGR System	Service every 36 Months or 30,000 Miles (48 000 km)				•		
B-11	Air Cleaner and PCV Filter	See Explanation for service intervals						
B-12	EFE System ³	Check at 7,500 Miles (12 000 km), then at 30,000 Miles (48 000 km)	•			•		
B-13	ECS	Check at 30,000 miles (48 000 km)				•		
B-14	Idle Stop Solenoid					•		
B-15	Fuel Filter	Service every 15,000 Miles (24 000 km)		•		•		•
B-16	Valve Lash Adjustment ¹			•		•		•

*Also an Emission Control Service

Altitude Adjustment: Your 1982 General Motors vehicle has been certified to meet emission standards at high and or low altitude. Certain vehicles sold for high altitude use have been adjusted prior to delivery for improved driveability and emission control at high altitude. These vehicles may be identified by an additional underhood tune-up label, "Supplemental Vehicle Emission Control Information." Information regarding adjustment of your vehicle, if permitted, can be obtained from the Consumer Relations Office shown in the Owner Assistance Section of your Owner's and Driver's Manual. Include your Vehicle Identification Number in your request.

¹ Only applicable to 1.9L engine, Engine Family C1G1 9T2HEC7.² All engines EXCEPT 1.9L, Engine Family C1G1 9T2HEC7³ Not applicable to 1.9L and 2.8L engines.

Fig. OB-1--Maintenance Schedule, Gasoline, Light Duty Emissions, 49 States

1982 VEHICLE MAINTENANCE SCHEDULE

Item No.	To Be Serviced	When to Perform	7,500 Miles (12 000 km)	15,000 Miles (24 000 km)	22,500 Miles (36 000 km)	30,000 Miles (48 000 km)	37,500 Miles (60 000 km)	45,000 Miles (72 000 km)
SECTION A — GENERAL MAINTENANCE								
A-1	Chassis Lubrication	Lubricate every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-2	Fluid Levels	Check every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-3	Engine Oil and Filter*	See Explanation for service intervals						
A-4	Clutch	Inspect every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-5	Steering and Suspension		•	•	•	•	•	•
A-6	Exhaust System*	Inspect every 12 Months or 7,500 Miles (12 000 km)	•	•	•	•	•	•
A-7	Tires and Wheels	Inspect and rotate at 7,500 Miles (12 000 km), then every 15,000 Miles (24 000 km)	•		•		•	
A-8	Brakes	Inspect at 7,500 Miles (12 000 km), then every 15,000 Miles (24 000 km)	•		•		•	
	Disc Brakes		•		•		•	
	Brake Lines		•	•	•	•	•	•
	Drum and Parking Brakes	Inspect every 12 Months or 15,000 Miles (24 000 km)		•		•		•
A-9	Engine Drive Belts*	Inspect every 12 Months or 15,000 Miles (24 000 km)		• ¹		•		• ¹
A-10	Fuel Tank, Cap, and Lines*			•		•		•
A-11	Throttle Linkage			•		•		•
A-12	Cooling System*	Service per Explanation every 12 Months or 15,000 Miles (24 000 km)		•		•		•
		Drain, flush and refill every 24 Months or 30,000 Miles (48 000 km)				•		
A-13	Manual Steering Gear	Inspect every 30,000 Miles (48 000 km)				•		
A-14	Final Drive	See Explanation for service intervals						
A-15	Wheel Bearings	Repack every 30,000 Miles (48 000 km)				•		
A-16	Transmission Fluid	See Explanation for service intervals						
SECTION B — EMISSION CONTROL MAINTENANCE								
B-1	Carburetor Choke and Hoses	Check at 6 Months or 7,500 Miles (12 000 km), then at 24 Month or 30,000 Mile (48 000 km) intervals. Also check B-1 at 45,000 Miles (72 000 km).	•			• ²		•
B-2	Carburetor or Throttle Body Mounting ⁴		• ²			•		
B-3	Engine Idle Speed (See Explanation)		• ²			•		
B-4	Vacuum Advance System	Check every 30,000 Miles (48 000 km)				•		
B-5	Thermostatically Controlled Air Cleaner	Inspect every 30,000 Miles (48 000 km)				•		
B-6	Spark Plug Wires and Distributor					•		
B-7	Spark Plugs	Replace every 30,000 Miles (48 000 km)				• ²		
B-8	PCV System Check and Valve Replacement	See Explanation for service intervals						
B-9	Engine Timing	Adjust every 30,000 Miles (48 000 km)				•		
B-10	EGR System	Service every 36 Months or 30,000 Miles (48 000 km)				•		
B-11	Air Cleaner and PCV Filter	See Explanation for service intervals ³				• ²		
B-12	EFE System ⁵	Check at 7,500 Miles (12 000 km), then at 30,000 Miles (48 000 km)	•			•		
B-13	Idle Stop Solenoid	Check at 30,000 miles (48 000 km)				•		
B-14	Valve Lash Adjustment ³	Adjust every 15,000 Miles (24 000 km)		• ²		• ²		• ²
B-15	Oxygen Sensor ³	Replace every 30,000 Miles (48 000 km)				•		

*Also an Emission Control Service

High Altitude Adjustment: Your 1982 General Motors vehicle has been certified to meet emission standards at low altitude. Certain vehicles sold for high altitude use have been adjusted prior to delivery for improved driveability and emission control at high altitude. These vehicles may be identified by an additional underhood tune-up label. "Supplemental Vehicle Emission Control Information." Information regarding adjustment of your vehicle, if permitted, can be obtained from the Consumer Relations Office shown in the Owner Assistance Section of your Owner's and Driver's Manual. **Include your Vehicle Identification Number in your request.**

¹ A separately driven air pump belt check is recommended but not required at 15,000 Miles (24 000 km) and 45,000 Miles (72 000 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.

³ Only applicable to 1.9L engine, Engine Family C1G1 9T2XBN0.

⁴ Not applicable to 1.9L engine, Engine Family C1G1 9T2XBN0.

⁵ Not applicable to 1.9L and 2.8L engines

Fig. 0B-2--Maintenance Schedule, Gasoline, Light Duty Emissions, California

1982 VEHICLE MAINTENANCE SCHEDULE

Item No.	To Be Serviced	When to Perform	6,000 Miles (9 600 km)	12,000 Miles (19 200 km)	18,000 Miles (28 800 km)	24,000 Miles (38 400 km)	30,000 Miles (48 000 km)	36,000 Miles (57 600 km)	42,000 Miles (67 200 km)	48,000 Miles (76 800 km)
SECTION A — GENERAL MAINTENANCE										
A-1	Chassis Lubrication	Every 4 Months or 6,000 Miles (9 600 km)	•	•	•	•	•	•	•	•
A-2	Fluid Levels		•	•	•	•	•	•	•	•
A-3	Engine Oil and Filter*	See Explanation for service intervals								
A-4	Clutch	Every 4 Months or 6,000 Miles (9 600 km)	•	•	•	•	•	•	•	•
A-5	Steering and Suspension		•	•	•	•	•	•	•	•
A-6	Exhaust System [▲]		•	•	•	•	•	•	•	•
A-7	Tires and Wheels		•	•	•	•	•	•	•	•
A-8	Brakes		•	•	•	•	•	•	•	•
	Disc Brakes		•	•	•	•	•	•	•	•
	Brake Lines		•	•	•	•	•	•	•	•
	Drum and Parking Brakes		•	•	•	•	•	•	•	•
A-9	Engine Drive Belts*	Every 12,000 Miles (19 200 km)		•		•		•		•
A-10	Fuel Tank, Cap and Lines*	Every 24 Months or 24,000 Miles (38 400 km)				•				•
A-11	Throttle Linkage	Every 12 Months or 12,000 Miles (19 200 km)		•		•		•		•
A-12	Cooling System*			•		•		•		•
A-13	Manual Steering Gear	Every 36,000 Miles (57 600 km)						•		
A-14	Final Drive	See Explanation for service intervals								
A-15	Wheel Bearings	Every 12,000 Miles (19 200 km)		•		•		•		•
A-16	Automatic Transmission	Every 24,000 Miles (38 400 km)				•				•
SECTION B — EMISSION CONTROL MAINTENANCE										
B-1	Engine Idle Speed Adjustment	At 1st 4 Months or 6,000 Miles (9 600 km) — then at 12 Month/12,000 Mile (19 200 km) intervals	•	•		•		•		•
B-2	Idle Stop Solenoid Check		•	•		•		•		•
B-3	Spark Plug Wire Check & Plug Replacement	Every 12,000 Miles (19 200 km)		•		•		•		•
B-4	Engine Timing Adjust. & Distributor Check [▲]			•		•		•		•
B-5	Air Cleaner Element Replacement [▲]			•		•		•		•
B-6	Carburetor Mounting Torque	Every 12 Months or 12,000 Miles (19 200 km)		•		•		•		•
B-7	Thermo. Controlled Air Cleaner Check [▲]			•		•		•		•
B-8	Manifold Heat Valve Check [▲]			•		•		•		•
B-9	Carburetor Fuel Filter Replacement			•		•		•		•
B-10	Throttle Return Control Check			•		•		•		•
B-11	PCV System Check			•		•		•		•
	— PCV Valve & Filter Service					•				•
B-12	ECS System Check	Every 24 Months or 24,000 Miles (38 400 km)				•				•
B-13	Engine Idle Mixture Adjust (4.8 L. L-6 only)					•				•
B-14	EFE System Check					•				•
B-15	Vacuum Advance System Check					•				•
B-16	Carburetor Choke Check					•				•
SECTION C — NOISE EMISSION CONTROL MAINTENANCE (Applicable only to vehicles sold only in the United States)										
C-1	Thermostatically Controlled Engine Cooling Fan	Every 12 Months or 12,000 Miles (19 200 km)		•		•		•		•
C-2	Shields and Underhood Insulation	Every 12,000 Miles (19 200 km)		•		•		•		•
C-3	Air Intake System			•		•		•		•
C-4	Governor	Every 48 Months or 48,000 Miles (76 800 km)								•

*Also an Emission Control Service

[▲]Also a Noise Emission Control Service

Fig. OB-3--Maintenance Schedule, Gasoline - Heavy Duty Emissions

1982 VEHICLE MAINTENANCE SCHEDULE

Item No.	To Be Serviced	When to Perform	5,000 Miles (8 000 km)	10,000 Miles (16 000 km)	15,000 Miles (24 000 km)	20,000 Miles (32 000 km)	25,000 Miles (40 000 km)	30,000 Miles (48 000 km)	35,000 Miles (56 000 km)	40,000 Miles (64 000 km)	45,000 Miles (72 000 km)
SECTION A — GENERAL MAINTENANCE											
A-1	Chassis	Lubricate every 12 Months or 5,000 Miles (8 000 km)	•	•	•	•	•	•	•	•	•
A-2	Fluid Levels	Check every 12 Months or 5,000 Miles (8 000 km)	•	•	•	•	•	•	•	•	•
A-3	Engine Oil & Filter*	See Explanation for service intervals									
A-4	Clutch	Inspect every 12 Months or 5,000 Miles (8 000 km)	•	•	•	•	•	•	•	•	•
A-5	Engine Drive Belts*	Inspect every 15,000 Miles (24 000 km)			•			•			•
A-6	Exhaust System*	Inspect at 5,000 Miles (8 000 km), then every 15,000 Miles (24 000 km)	•		•			•			•
A-7	Tires and Wheels	Inspect and rotate at 5,000 Miles (8 000 km), then every 15,000 Miles (24 000 km)	•			•			•		
A-8	Steering and Suspension	Inspect every 12 Months or 10,000 Miles (16 000 km)		•		•		•		•	
A-9	Brakes Disc Brakes & Brake Lines	Inspect every 12 Months or 10,000 Miles (16 000 km)		•		•		•		•	
	Drum & Parking Brakes	Inspect every 12 Months or 15,000 Miles (24 000 km)			•			•			•
A-10	Throttle Linkage	Inspect every 12 Months or 15,000 Miles (24 000 km)			•			•			•
A-11	Cooling System*	Service every 12 Months or 15,000 Miles (24 000 km)			•			•			•
		Drain, flush and refill every 24 Months or 30,000 Miles (45 000 km)						•			
A-12	Crankcase Ventilation System*	Service every 12 Months or 15,000 Miles (24 000 km)			•			•			•
A-13	Manual Steering Gear	Inspect every 30,000 Miles (48 000 km)						•			
A-14	Rear Axle	See Explanation for service intervals									
A-15	Wheel Bearings	Repack every 30,000 Miles (48 000 km)						•			
A-16	Automatic Transmission	See Explanation for service intervals									
SECTION B — EMISSION CONTROL MAINTENANCE											
B-1	Exhaust Pressure Regulator Valve	Inspect at 5,000 Miles (8 000 km), then every 15,000 Miles (24 000 km)	•		•			•			•
B-2	Engine Idle Speed	Check at 5,000 Miles (8 000 km), then at 30,000 Miles (48 000 km)	•					•			
B-3	Air Cleaner	Replace every 30,000 Miles (48 000 km) ⁽¹⁾						•			
B-4	Fuel Filters	Replace every 15,000 Miles (24 000 km)			•			•			•
SECTION C — NOISE EMISSION CONTROL MAINTENANCE (Applicable only to vehicles with Engine Family CGM06.2DAB3 and sold only in the United States)											
C-1	Thermostatically Controlled Engine Cooling Fan	Every 12 Months or 10,000 Miles (16 000 km)		•		•		•		•	
C-2	Shields and Underhood Insulation	Every 10,000 Miles (16 000 km)		•		•		•		•	
C-3	Air Intake System			•		•		•		•	

High Altitude Adjustment: Your 1982 General Motors vehicle, except with Engine Family CGM06.2DAB3, has been certified to meet emission standards at low altitude. Certain vehicles sold for high altitude use have been adjusted prior to delivery for improved driveability and emission control at high altitude. Information regarding adjustment of your vehicle, if permitted, can be obtained from the Consumer Relations Office shown in the Owner's Assistance Section of your Owner's and Driver's Manual. **Include your Vehicle Identification Number in your request.**

*Also An Emission Control Service

*Also a Noise Emission Control Service

⁽¹⁾For engines with Engine Family CGM06.2DAB3, replace element every 15,000 miles (24 000 km)

Fig. 0B-4--Maintenance Schedule - Diesel

MAINTENANCE SCHEDULE

This is an explanation of the service listed in the Vehicle Maintenance Schedule.

NORMAL VEHICLE USE-The maintenance instructions contained in the maintenance schedule are based on the assumption that the 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 (gasoline light duty emission only).

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections.

SECTION A

GENERAL MAINTENANCE

A-1 Chassis Lubrication

Large fluid loss in any of these units may point out a problem. Repair these problems promptly.

Lubricate the following system or units:

Steering Linkage and Suspension

Lubrication Intervals

- a. On C20, G30 and P20, lubricate every 4 months or 6,000 miles (9 600 km).
- b. On all other vehicles, lubricate every 12 months or 7,500 miles (12 000 km).

Maintain correct front end alignment to provide easy steering, longer tire life, and driving stability.

Check control arm bushings and ball joints for wear.

Lubricate tie rods, upper and lower control arms, and ball joints at fittings with water resistant EP chassis lubricant which meets GM Spec 6031M. Lubricate every 3 months (Light Duty), 2 months (Heavy Duty and Diesel), or 3,000 miles (4 800 km) whichever occurs first, under the following conditions:

- Driving in dusty or muddy conditions.
- Extensive off-road use.

Ball joints must be at 10°F (-12°C) or more before lubricating.

Transmission Shift Linkage

Lubricate shift linkage and manual transmission floor controls lever contacting faces with water resistant EP chassis lubricant which meets GM Spec 6031M.

Hood Latches

Lubricate hood latch assembly and hood hinge assembly as follows:

1. Wipe off any accumulation of dirt or contamination on latch parts.
2. Apply Lubriplate or equivalent to latch pilot bolts and latch locking plate.

3. Apply light engine oil to all pivot points in release mechanism, as well as primary and secondary latch mechanisms.

4. Lubricate hood hinges.

5. Make hood hinge and latch mechanism functional check to assure the assembly is working correctly.

Door Lock Cylinder

Use WD-40 or equivalent spray lubricant as necessary for free operation.

Gas Tank Filler Door Hinge

Clean area of dirt and old lubricant. Apply a few drops of engine oil to friction point of door hinge. Work door several times and wipe off excess lubricant.

Door Hinge Assembly

Wipe off dirt and apply a thin coat of engine oil. Open and close door several times to insure that the oil has worked in effectively.

Door Jamb Switch

Apply a thin coat of lubriplate or equivalent to end of surface of switch plunger.

Parking Brake Pulley, Cable and Linkage

Apply water resistant EP chassis lubricant which meets GM Spec 6031M, to parking brake cable at cable guides and at all operating links and levers.

Accelerator Linkage

Lubricate carburetor stud and carburetor lever and accelerator pedal lever at support with engine oil.

A-2 Fluid Levels

Check level in brake master cylinder, power steering pump, radiator, transmission and windshield washer. Keep engine freeze protection to -34°F (-37°C) or the lowest expected outdoor temperature. Engine coolant also prevents corrosion. Large fluid loss in any of these units may point out a problem. Repair these problems at once. A low fluid level in the brake master cylinder can indicate worn disc brake pads and should be checked.

Check battery and the following fluid levels:

Battery Care

The original equipment battery (two batteries on diesel engine) needs no periodic maintenance. Its top is permanently sealed (except for two small vent holes) and has no filler caps. Water will never have to be added.

The hydrometer (test indicator) in the top of the battery provides information for testing purposes only. See Section 6D for battery test procedures.

Brake Master Cylinder

Check fluid level in each reservoir and maintain 1/4" below lowest edge of each filler opening with Delco Supreme No. 11 or DOT-3 hydraulic brake fluid, or equivalent.

A low fluid level in the brake master cylinder can indicate worn disc brake pads, and should be checked accordingly.

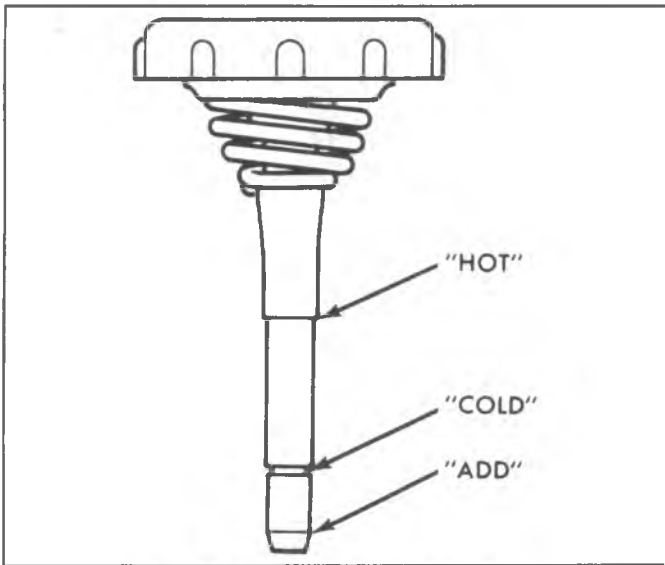


Fig. OB-5--Power Steering Filler Cap

Hydro-boost Brake System Hydraulic Pump

1. Vehicles Equipped With Power Steering.

- On vehicles equipped with power steering, the power steering pump is also used as the Hydro-boost pump. See section on power steering system when checking fluid level or adding fluid.

2. Vehicles Equipped With Manual Steering.

- The Hydro-boost pump installed in vehicles equipped with manual steering uses power steering fluid. See section on power steering system when checking fluid level or adding fluid.

NOTICE: Power steering fluid and brake fluid cannot be mixed, since seal damage may result.

Power Steering System

Check the fluid level in the power steering pump at each oil change and add GM Power Steering Fluid (GM 1050017) or equivalent as needed (Fig. OB-5):

- If fluid is warmed up (about 150°F or 66°C--hot to the touch), it should be between "Hot" and "Cold" marks on the filler cap indicator.
- If cool (about 70°F or 21°C), fluid should be between "Add" and "Cold" marks.

Fluid does not need periodic changing.

Rear Axle (Standard) Lubricant

Check lubricant level. Add lubricant, if necessary, to fill to level of filler plug hole. Use SAE 80W GL-5 or SAE 80W-90 GL-5 or GM 1052271/1052272 gear lubricant. For those vehicles driven in Canada, use SAE 80W GL-5 gear lubricant.

Rear Axle (Locking) Lubricant

Check lubricant level. Add lubricant, if necessary, to fill to level of filler plug hole. Use gear lubricant GM 1052271/1052272 or equivalent.

Automatic Transmission Fluid

Use only automatic transmission fluid labeled DEXRON®-II or equivalent.

Check the automatic transmission fluid level at each engine oil change period. Overfilling can cause foaming and

loss of fluid. Transmission damage can result. Low fluid level can cause slipping or loss of drive.

Automatic transmissions are sometimes overfilled because the fluid level is checked when the fluid is cold. When cold, the dipstick shows that fluid should be added. However, the low reading is normal, the level will rise as the fluid gets warm. The fluid level will increase more than 3/4 inch (19mm) as fluid warms up from 60°F to 180°F (16°C to 82°C).

Check the transmission fluid level with the engine running, the shift lever in "Park", and the vehicle level.

If the vehicle has just been driven for a long time at high speed or in city traffic in hot weather, or if the vehicle has been pulling a trailer, the correct fluid level cannot be read. Wait until the fluid has cooled down (about 30 minutes).

Remove the dipstick. Carefully touch the wet end of the dipstick to find out if the fluid is cool, warm or hot. Wipe it clean and push it back in until cap seats. Pull out the dipstick and read the fluid level (Fig. OB-6).

- If it felt cool, about room temperature, the level should be 1/8 to 3/8 inch (3 to 10mm) below the "Add" mark. The dipstick has two dimples below the "Add" mark to show this range.
- If it felt warm, the level should be close to the "Add" mark (either above or below).
- If it was too hot to hold, the level should be at the "Full" mark.
- It takes only one pint (0.5 liter) to raise level from "Add" to "Full" with a hot transmission.

Manual Transmission Lubricant

Check lubricant level. Add lubricant, if necessary, to fill to level of filler plug hole.

Use SAE 80W GL-5 or SAE 80W-90 GL-5 gear lubricant. For those vehicles driven in Canada, use SAE 80W GL-5 gear lubricant.

Windshield Washer Fluid

Fill the washer jar only 3/4 full during the winter to allow for expansion if the temperature should fall low enough to freeze the solution.

- Check the washer fluid level regularly--do it often when the weather is bad.
- Use a fluid such as GM Optikleen or equivalent to help prevent freezing damage, and for better cleaning.

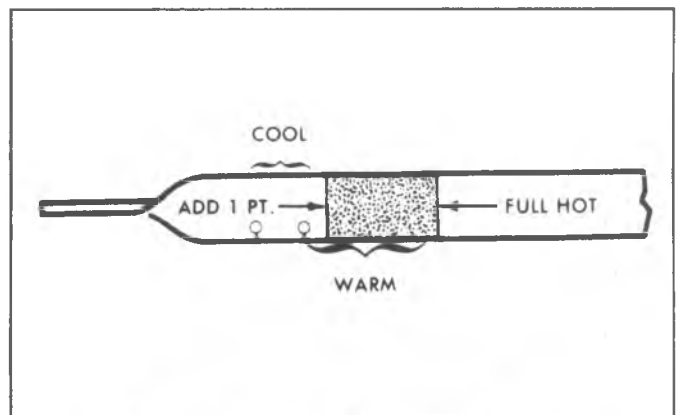


Fig. OB-6--Automatic Transmission Dipstick

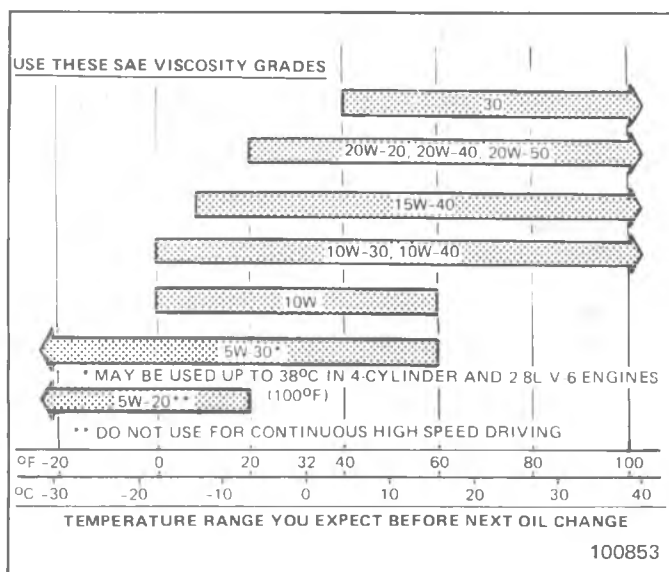


Fig. 0B-7--Oil Viscosity Chart (Gasoline)

- Do not use radiator antifreeze in the windshield washer; it could cause paint damage.
- In cold weather, warm the windshield with the defrosters before using the washer--to help prevent icing that may block the driver's vision.

Cooling System Care

Do not remove radiator cap to check coolant level. Instead, check by looking at the "see through" coolant recovery tank. Level should be at the "Full Cold" mark on the recovery tank when the system is cold; and at the "Full Hot" mark during engine operation. Add a 50/50 mixture of a good quality ethylene glycol antifreeze and water to the recovery tank when more coolant is needed. If frequent additions are needed, cooling system.

NOTICE: If the proper quality antifreeze is used, there is no need to add extra inhibitors or additives that claim to improve the system. They may be harmful to the proper operation of the system, and are an unnecessary expense.

A-3 Engine Oil and Filter

Engine Oil and Filter Recommendations

Gasoline Engine

- Engine oils are labeled on the containers with various API (American Petroleum Institute) designations of quality.
- Use only SF quality engine oils (see markings on containers).
- The oil and filter change intervals for the engine is based on the use of SF-quality oils and high quality filters. Using oils other than SF-quality oils, or oil change intervals longer than listed, could reduce engine life and might affect warranty.
- The engine was filled with an SF quality engine oil when it was built. You do not have to change this oil before the suggested change period. See your Maintenance Schedule folder for the oil change intervals.

Always change oil and filter as soon as possible after driving in a dust storm. Also, always use SF-Quality oils of

the proper viscosity. See Owner's Manual for further details.

Engine Oil Additives - The engine should not need these extra engine oil helpers or additives if SF quality engine oil is used and changed as suggested. If you think your engine has an oil related problem, refer to Section 6A.

Diesel Engine

Use ONLY engine oils labeled with the A.P.I. (American Petroleum Institute) designation "SF/CD" or "SF/CC". Do not use any other type of oil. The A.P.I. designations are listed somewhere on the oil can, usually on the top or label. The A.P.I. has several designations, such as: SC, SD, SE, CB, CC, CD.

Several different designations may appear on the can. Be sure the oil used has either "SF/CD" or "SF/CC" designations, regardless of the order in which they appear on the oil can.

Using any type of oil other than "SF/CD" or "SF/CC" may affect warranty.

NOTICE: Do NOT use engine oils labeled only SE or only CC. These oils will not give the protection and lubrication of diesel engine needs. When reading the can, be sure not to confuse the SE designation with the letters "SAE", which may also appear on the can.

The diesel engine was filled with a quality engine oil when it was built. You do not have to change the oil before the recommended change interval. Keep in mind the engine may use more oil when it is new. Check the oil level more often when the engine is new.

Engine Oil Additives - Do not use any supplemental additives. Using oil additives may cause engine damage and may affect warranty. If you think the engine has an oil related problem, see Section 6A.

Oil Viscosity

Engine oil viscosity (thickness) has an effect on fuel economy. Lower viscosity engine oils can provide increased fuel economy; however, higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. Figures 0B-7 and 0B-8 list the engine oil viscosities that will provide the best balance of fuel economy, engine life, and oil economy.

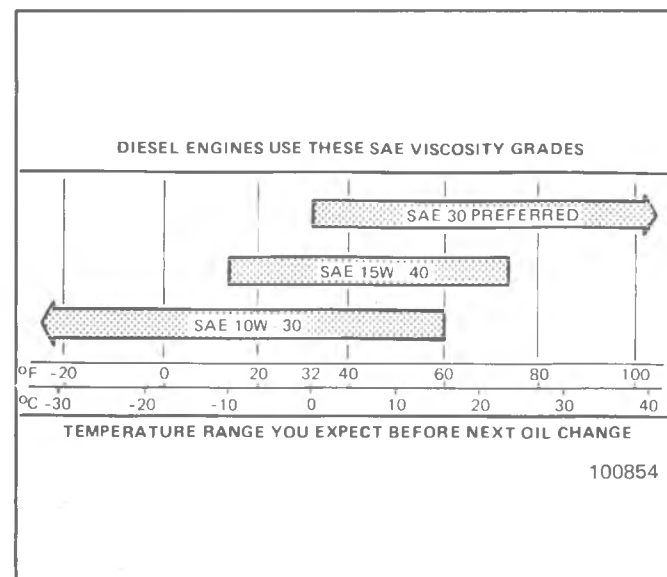


Fig. 0B-8--Oil Viscosity Chart (Diesel)

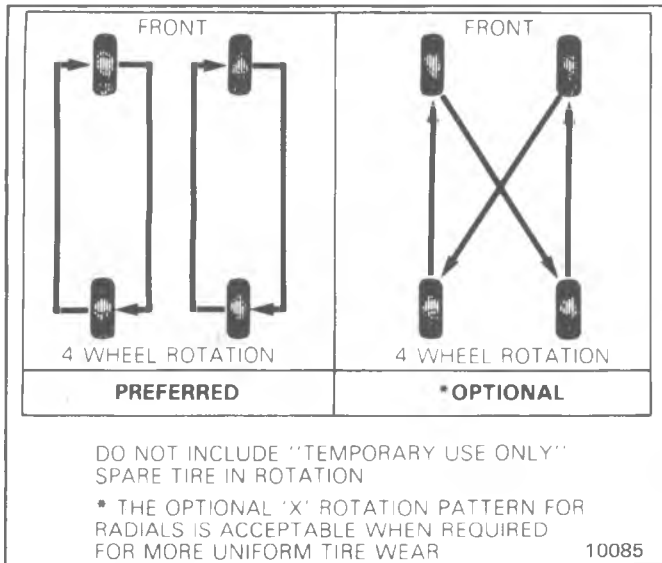


Fig. OB-9--Tire Rotation

Checking Oil

- **Warm-** The best time to check the engine oil level is when the oil is warm, such as during a fuel stop. First, allow about 5 minutes for the oil to drain back to the oil pan. Then pull the dipstick out, wipe it clean, and push it back down all the way. Now pull the dipstick out and look at the oil level on the dipstick. Some dipsticks are marked with "Add" and "Full" lines. Others are marked "Add 1 Qt" and "Operating Range". **In all cases, keep the oil level above the "Add" line.** Push the dipstick back down all the way after taking the reading. Add oil if needed.
- **Cold-** If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level.

A-4 Manual Transmission Clutch Adjustment

Clutch adjustment should be checked and adjusted as necessary to compensate for clutch facing wear. To check, depress pedal by hand until resistance is felt. Free travel should be approximately one inch; if very little or no free travel is evident, clutch adjustment is required.

A-5 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 hook-up, binding, leaks, cracks, chafing, etc. When rubbing or wear is noted on hoses or lines, the cause must be corrected at once.

Front Suspension and Steering Linkage

- On C20 and G30, lubricate every 4 months or 6,000 miles (9 000 km).
- On all other vehicles, lubricate every 12 months or 7,500 miles (12 000 km).
- 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.

A-6 Exhaust System

Inspect the complete exhaust system, including the catalytic converter. Inspect body areas near the exhaust system and also the tailgate. Look for broken, damaged, missing or out-of-position parts. Also, inspect for open seams, holes, loose connections, or other conditions which could cause a heat buildup in the floor pan, or could let exhaust fumes seep into the passenger compartment. Dust or water in the passenger compartment may indicate a leak in the area. Make needed repairs at once. To help maintain system integrity, replace the exhaust pipes and resonators rearward of the muffler whenever a new muffler is installed.

A-7 Tires

Inspection and Rotation

Front and rear tires perform different jobs and can wear differently depending on the types of roads driven, driving habits, etc. To obtain maximum tire life inspect and rotate tires regularly. (Fig. OB-9) If the truck is equipped with tires having different load ratings between the front and the rear, the tires should not be rotated front to rear. Vehicle handling could be adversely affected and the tires having the lower load rating could be overloaded.

CAUTION: Before installing wheels, remove any build up of corrosion on the wheel mounting surface and brake drum or disc mounting surface by scraping and wire brushing. Installing wheel without good metal-to-metal contact at the mounting surfaces can cause the wheel nuts to loosen, which can later allow a wheel to come off while the vehicle is moving, possibly causing loss of control.

Inflation Pressure

The cold inflation pressures for the factory installed tires are on the label on the rear of the driver's door. The tires must be inflated to these pressures to obtain the GVWR (Gross Vehicle Weight Rating) or GAWR (Gross Axle Weight Rating). Incorrect tire inflation pressures can have adverse effects on tire life and vehicle performance. Too low an air pressure causes increased tire flexing and heat buildup. This weakens the tire and increases the chance of damage or failure and can result in tire overloading,

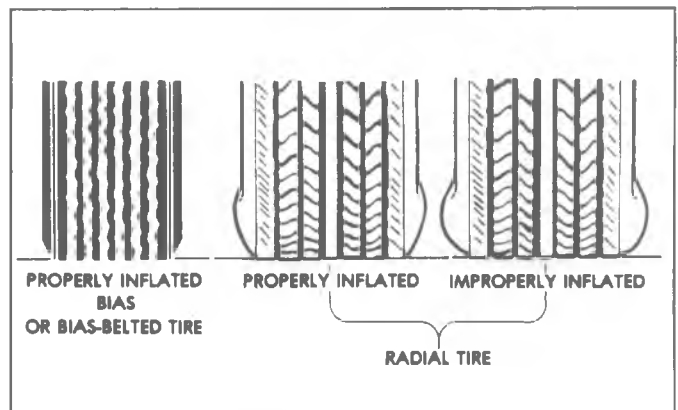


Fig. OB-10--Properly Inflated Tire

abnormal tire wear, adverse vehicle handling, and reduced fuel mileage. Too high an air pressure can result in abnormal wear, harsh ride, and also increase the chance of damage from road hazards. See Fig. 0B-10.

See your Owner's Manual for additional detailed information on proper tire care.

A-8 Brakes

Disc Brakes -- Inspect disc brake pads for wear, and rotors for surface condition when wheels are removed for rotation.

Brake Lines -- Inspect brake lines and hoses for proper hook-up, binding, leaks, cracks, chafing, etc. When rubbing or wear is noted on lines or hoses, the cause must be corrected at once.

Drum and Parking Brakes -- Inspect drum brake linings for wear and cracks. Inspect other brake parts including drums, wheel cylinders, etc., at the same time. Check parking brake adjustment.

INSPECT BRAKES MORE OFTEN IF HABITS OR CONDITIONS RESULT IN FREQUENT BRAKING.

A-9 Engine Drive Belts

Inspect belts driving the fan, AIR pump, generator, power steering pump, and the air conditioning compressor. Look for cracks, fraying, wear, and proper tension. Adjust or replace as needed.

A-10 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.

A-11 Throttle Linkage

Inspect for damaged or missing parts, interference or binding. Fix any problems at once.

A-12 Cooling System

The coolant recovery system is standard. The coolant in the radiator expands with heat, and the overflow is collected in the recovery tank. When the system cools down, the coolant is drawn back into the radiator.

The cooling system has been filled at the factory with a quality coolant. The coolant is a 50/50 mixture of water and ethylene glycol antifreeze.

Service

- Maintain cooling system freeze protection at -34°F (-37°C) to ensure protection against corrosion and loss of coolant from boiling. This should be done even if freezing temperatures are not expected.
- Add ethylene glycol base coolant when coolant has to be added because of coolant loss or to provide added protection against freezing at temperatures lower than -34°F (-37°C).

- Alcohol or methanol base coolants or plain water alone should not be used in a vehicle at any time.

The cooling system should be serviced each year as follows:

1. Wash radiator cap and filler neck with clean water.
2. Check coolant level and test for freeze protection.
3. Test system and radiator cap for proper pressure holding capacity, 15 psi (105 kPa). If replacement cap is needed, use a cap designed for coolant recovery systems and specified model.
4. Tighten hose clamps and inspect all hoses. Replace hoses if swollen, "checked", or otherwise deteriorated.
5. Clean frontal area of radiator core and air conditioning condenser.

Radiator Pressure Cap

The radiator cap, a 15 psi (105 kPa) pressure type, must be installed tightly, otherwise coolant may be lost and damage to engine may result from overheating. Radiator pressure cap should be checked periodically for proper operation.

Thermostat

The engine coolant temperature is controlled by a thermostat. It stops coolant flow through the radiator until a pre-set temperature is reached. This thermostat is installed on the engine block. The same thermostat is used in both winter and summer. Refer to Section 6B-Engine Cooling for additional information.

A-13 Manual Steering Gear

The 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.

Inspect 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 only with the proper Steering Gear Lubricant as noted in Fig. 0B-12.

NOTICE: Do not use EP chassis lube, meeting GM Specification 6031M, to lubricate the gear. **DO NOT OVER-FILL** the gear housing.

A-14 Final Drive

Trucks With Four Wheel Drive

Most lubrication recommendations and procedures for four wheel drive-equipped vehicles are the same for corresponding components of conventional drive vehicles.

In addition, the following items require lubrication each 4 months or 6,000 miles (9 600 km).

Transfer Case

Check the transfer case level at the interval and if necessary, add Dexron®II.

Front Axle

The front axle should be checked at the interval and refilled with SAE 80W-90 GL-5 gear lubricant when necessary. With the differential at operating temperature fill to the level of filler plug hole. If differential is cold, fill to level of 1/2 inch below the filler plug hole.

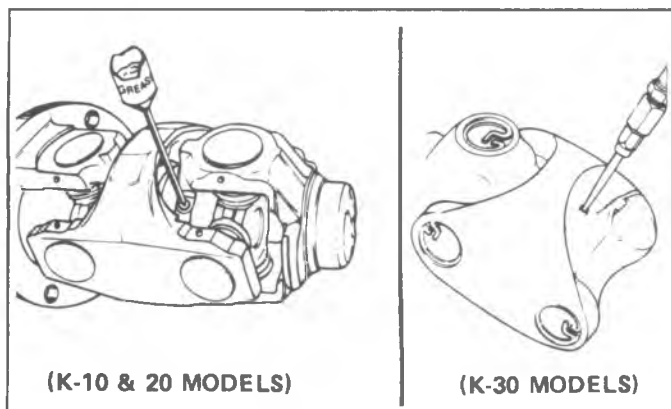


Fig. 0B-11--C/V Joint Lube Fitting

Propeller Shaft Slip Joints

Propeller shaft slip joints should be lubricated at the interval with water resistant EP Chassis lubricant which meets General Motors Specification GM 6031M.

Constant Velocity (C/V Joint)

A C/V joint is located at the transfer case end of the front propshaft and must be lubricated at the interval with GM lubricated part no. 1052497 or equivalent. See Fig. 0B-11 showing how the fitting may be lubricated from above the C/V joint, with a special adapter on the end of a flex hose.

Rear Axle

Drain and refill to level of filler plug hole every 7,500 miles (12 000 km) on light duty emissions or 12,000 miles (19 200 km) on heavy duty emissions when using vehicle to pull a trailer or severe operating conditions. Use lubricant shown in Fig. 0B-12. On 20 and 30 series trucks, change lubricant every 24,000 miles (38 400 km).

A-15 Wheel Bearings

For normal application, clean and repack front wheel bearings with a high melting point wheel bearing lubricant at each front brake lining replacement or 30,000 miles (48 000 km) on light duty emissions 12,000 miles (19 200 km) on heavy duty emission or 15,000 miles (24 000 km) on diesel engine vehicles which ever comes first. For heavy duty application such as police and taxi cabs, clean and repack front wheel bearings at each front brake lining replacement or 15,000 miles (24 000 km) which ever comes first.

"Long fiber" or "viscous" type lubricant should not be used. Do not mix wheel bearing lubricants. Be sure to thoroughly clean bearings and hubs of all old lubricant before repacking.

NOTICE: Tapered roller bearings used in this vehicle have a slightly loose feel when properly adjusted. They must never be over tightened (preloaded) or severe bearing damage may result.

Refer to Section 3C for proper detailed adjustment procedures and specifications.

A-16 Automatic Transmission Fluid

Refer to A-2 for checking automatic transmission. Change the transmission fluid and service screen every

15,000 miles (24 000 km) on light duty emissions or 12,000 miles (19 200 km) on heavy duty emission and diesel engine vehicles if the vehicle has been driven under one or more of these hot conditions:

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

If the vehicle was not used mainly under any of these conditions, change the fluid and service screen each 100,000 miles (160 000 km) on light duty emissions and diesel engine vehicle or 24,000 miles (38 400 km) on heavy duty emissions.

It takes only one pint (0.5 liter) to raise level from "Add" to "Full" with a hot transmission.

SECTION B

EMISSION CONTROL MAINTENANCE - GASOLINE

B-1 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.

B-2 Carburetor Mounting

Torque mounting bolts and/or nuts.

B-3 Engine Idle Speed

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

B-4 Vacuum Advance System and Hoses

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

B-5 Thermostatically Controlled Air Cleaner

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

B-6 Spark Plug Wires and Distributor

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.

B-7 Spark Plugs

Replace as shown on Schedule. Use the type listed in your Owner's and Driver's Manual.

B-8 PCV System Check and Service

Check that system works properly each 15,000 miles (24 000 km).

Replace the valve and any worn, plugged or collapsed hoses at 30,000 miles (48 000 km).

B-9 Engine Timing

Adjust timing to underhood label specifications.

B-10 Exhaust Gas Recirculation System (EGR)

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

B-11 Air Cleaner and PCV Filter

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

B-12 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.

B-13 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.

B-14 Idle Stop Solenoid and/or Dashpot

Check that parts work properly. Replace them as needed.

B-15 Fuel Filter

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

EMISSION CONTROL MAINTENANCE-DIESEL

B-1 Exhaust Pressure Regulator Valve

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

B-2 Engine Idle Speed

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

B-3 Air Cleaner Element

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

B-4 Fuel Filters

Replace primary and secondary fuel filters at mileage shown on Maintenance Schedule or sooner if clogged.

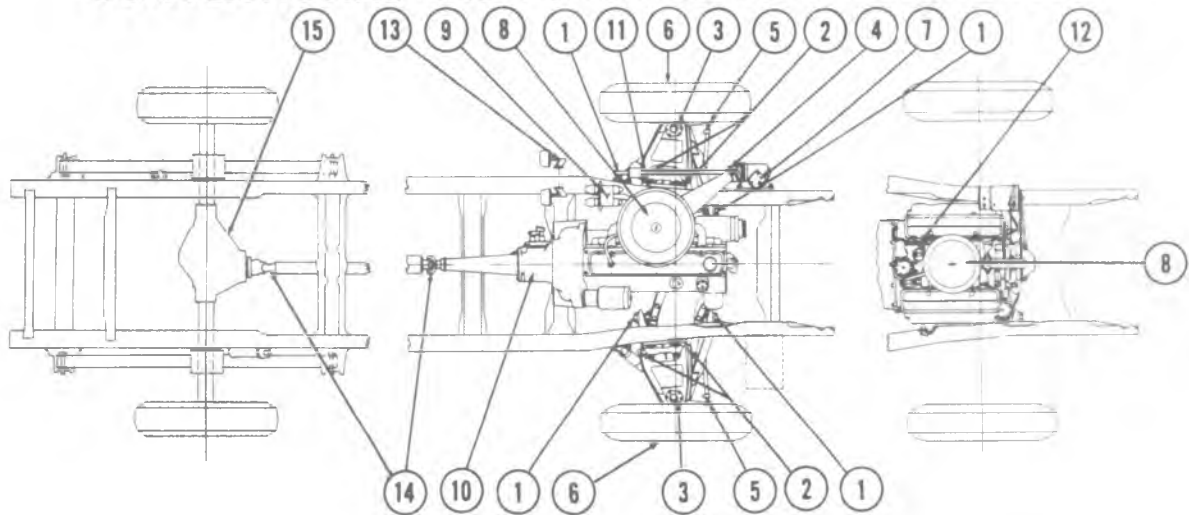
RECOMMENDED FLUIDS AND LUBRICANTS

USAGE	FLUID/LUBRICANT
Power steering system and pump reservoir	GM power steering fluid Part No. 1050017 or equivalent.
Transfer case	DEXRON®-II Automatic Transmission Fluid
Manual steering gear	Lubricant GM Part No. 1051052 or equivalent
Differential — Standard or Locking 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)
Brake system and master cylinder	Delco Supreme 11 fluid or DOT-3
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 6031-M
Manual Transmission Shift Linkage, column shift Propeller shaft slip joint	Chassis Grease
Shift Linkage, floor shift	Engine oil
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	a. Engine Oil b. Chassis Grease
Hood and Door Hinges	Engine Oil
Automatic Transmission Shift Linkage	Engine Oil
Chassis Lubrication	Chassis grease meeting requirements of GM 6031-M
Engine Oil (Gasoline)	"SF" or "SF/CC" or "SF/CD" Engine Oil conforming to GM Spec. 6048-M
Engine Oil (Diesel)	"SF/CC" or "SF/CD" Engine Oil conforming to GM specs GM 6049M
Constant Velocity Universal Joint	GM Lubricant Part No. 1052497 or equivalent
Automatic Transmission 4-Speed Manual Trans w/O.D. S10 Truck with Manual Trans.	DEXRON®-II Automatic Transmission Fluid
Parking Brake Cables	Chassis Grease meeting requirements of GM 6031-M
Front Wheel Bearings	Wheel bearings lubricant GM Part No. 1051344 (One Pound) 1052356 (35 pounds) or Exxon Ronex MP Grease or equivalent.
Body door hinge pins, tailgate hinge and linkage, folding seat, fuel door hinge	Engine Oil
Windshield Washer Solvent	GM Optikleen washer solvent Part No. 1051515 or equivalent
Engine Coolant	Mixture of water and high quality Ethylene Glycol base type antifreeze conforming to GM Spec. 1825-M
Key Lock Cylinder	WD-40 Spray Lubricant or equivalent

CAPACITIES

		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.
Engine Crankcase			
Code D	4.1L L6 – Drain & Refill – w/Filter Change	3.8L 4.7L	4 qts. 5 qts.
Code T	4.8L L6 – Drain & Refill – w/Filter Change	4.7L 5.7L	5 qts. 6 qts.
Code F-H L-M-P	5.0L V8 { – Drain & Refill 5.7L V8 { – w/Filter Change	3.8L 4.7L	4 qts. 5 qts.
Code W	7.4L V8 – Drain & Refill – w/Filter Change	5.7L 6.6L	6 qts. 7 qts.
Code C-J	6.2L V8 Diesel Including Filter	6.6L	7 qts.
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.
Four Wheel Drive			
Front Axle		2.4L	2.5 qts.
Transfer Case		2.4L	2.5 qts.

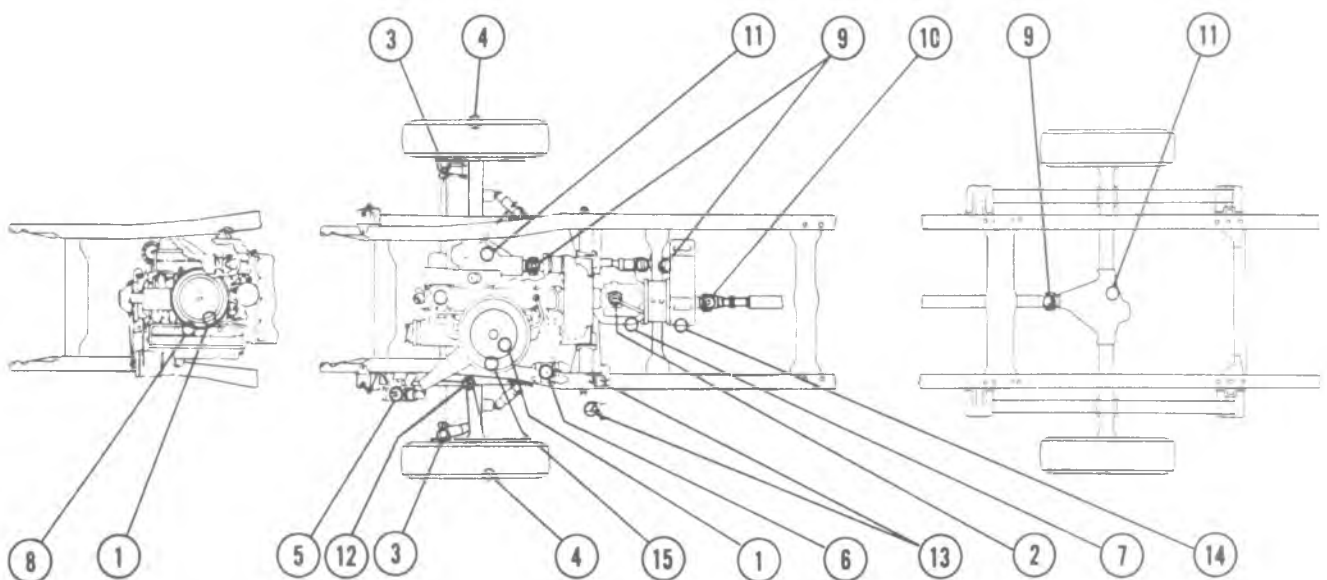
CONVENTIONAL AND FORWARD CONTROL MODELS



LUBRICATION POINTS

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

FOUR WHEEL DRIVE MODELS

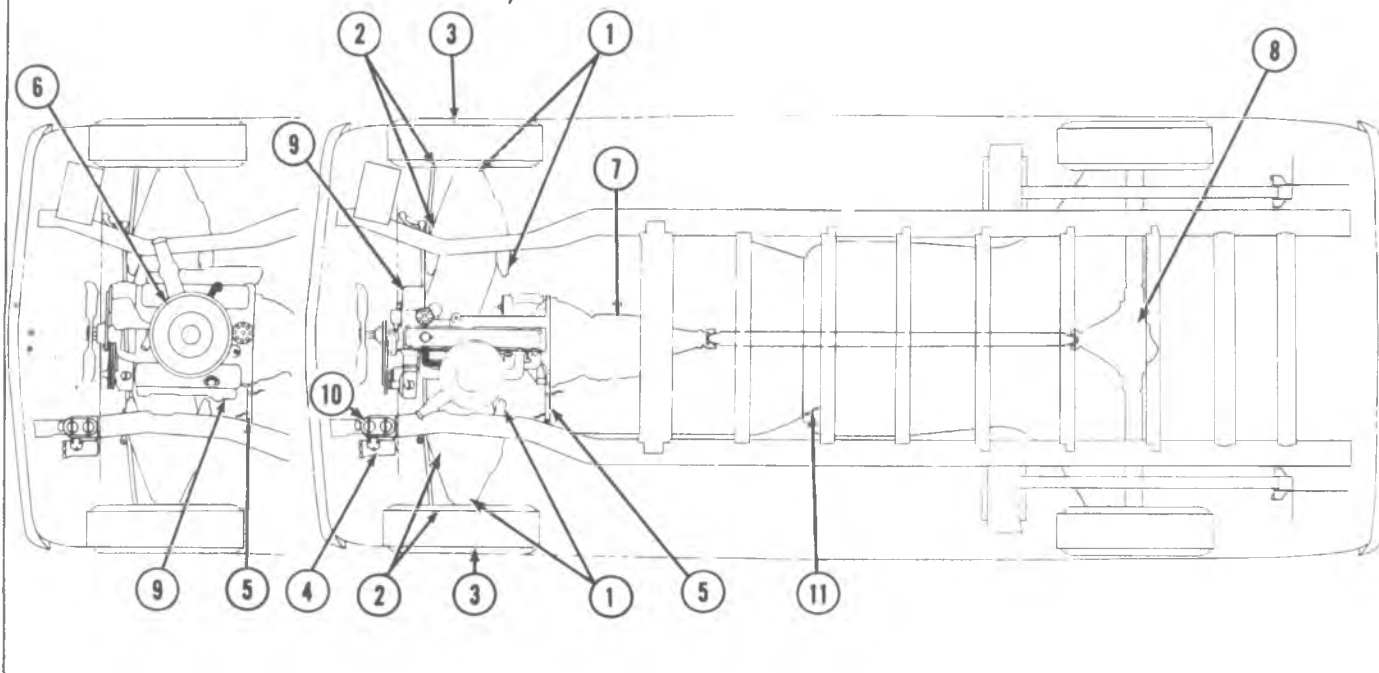


LUBRICATION POINTS

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

Fig. 0B-14--Lubrication Points (Conventional and Four Wheel Drive)

1/2 TON "G" MODELS



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 | 10 | Brake Master Cylinder |
| 4 | Steering Gear
Clutch Cross-Shaft | | - Automatic | 11 | Parking Brake Linkage |

Fig. OB-15--Lubrication Points (G Van)

SECTION 1A

HEATER

CONTENTS

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

STANDARD HEATER

INDEX

General Description.....	1A-1	Heater Hoses	1A-9
System Components	1A-1	Center Distributor Duct	1A-9
System Controls	1A-1	Defroster Duct.....	1A-9
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On Vehicle Service		Control Cables.....	1A-11
Blower Motor.....	1A-8	Blower Switch.....	1A-11
Heater Distributor and Core Assembly.....	1A-8	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. Located in the fuse block, in series between the blower motor and the battery, is a 25 amp. fuse C-K models, a 20 amp fuse on G models.

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 and 1A-3.

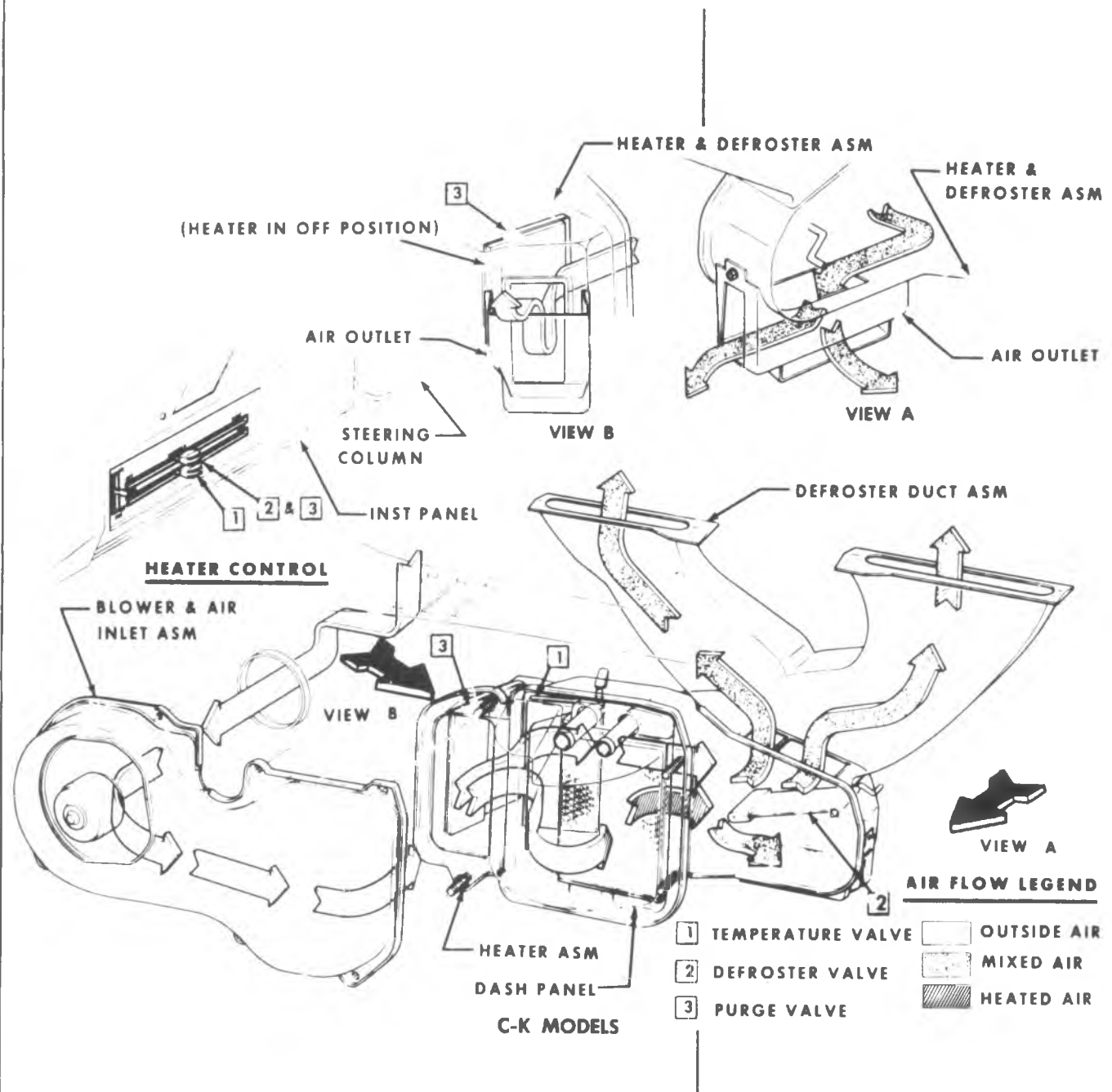


Fig. 1A-1--Heater Air Flow Schematic--C-K Models

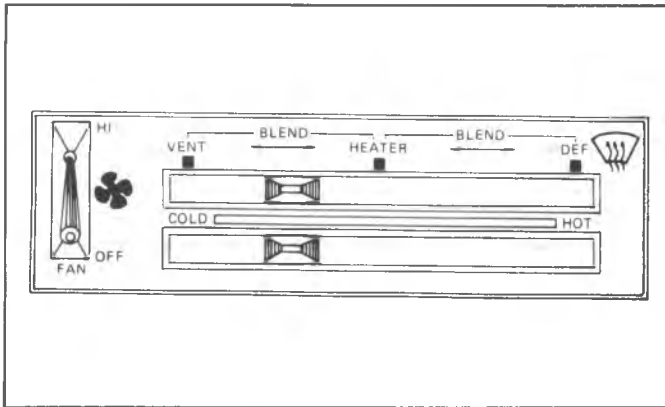


Fig. 1A-2--Heater Control-C-K Models

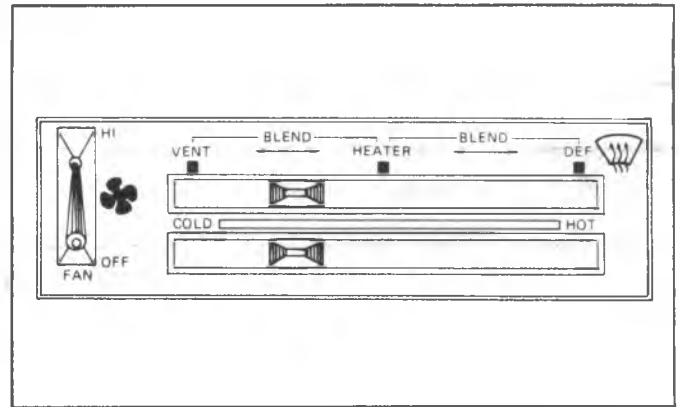


Fig. 1A-3--Heater Control-G Models

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.	<p>Check for body leaks such as:</p> <ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.	<ol style="list-style-type: none"> 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.

AIR FLOW

Adjust dump door for no air flow.

HIGH AIR FLOW

Adjust defroster door for low air flow.

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.

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.

OVER 10 VOLTS

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.

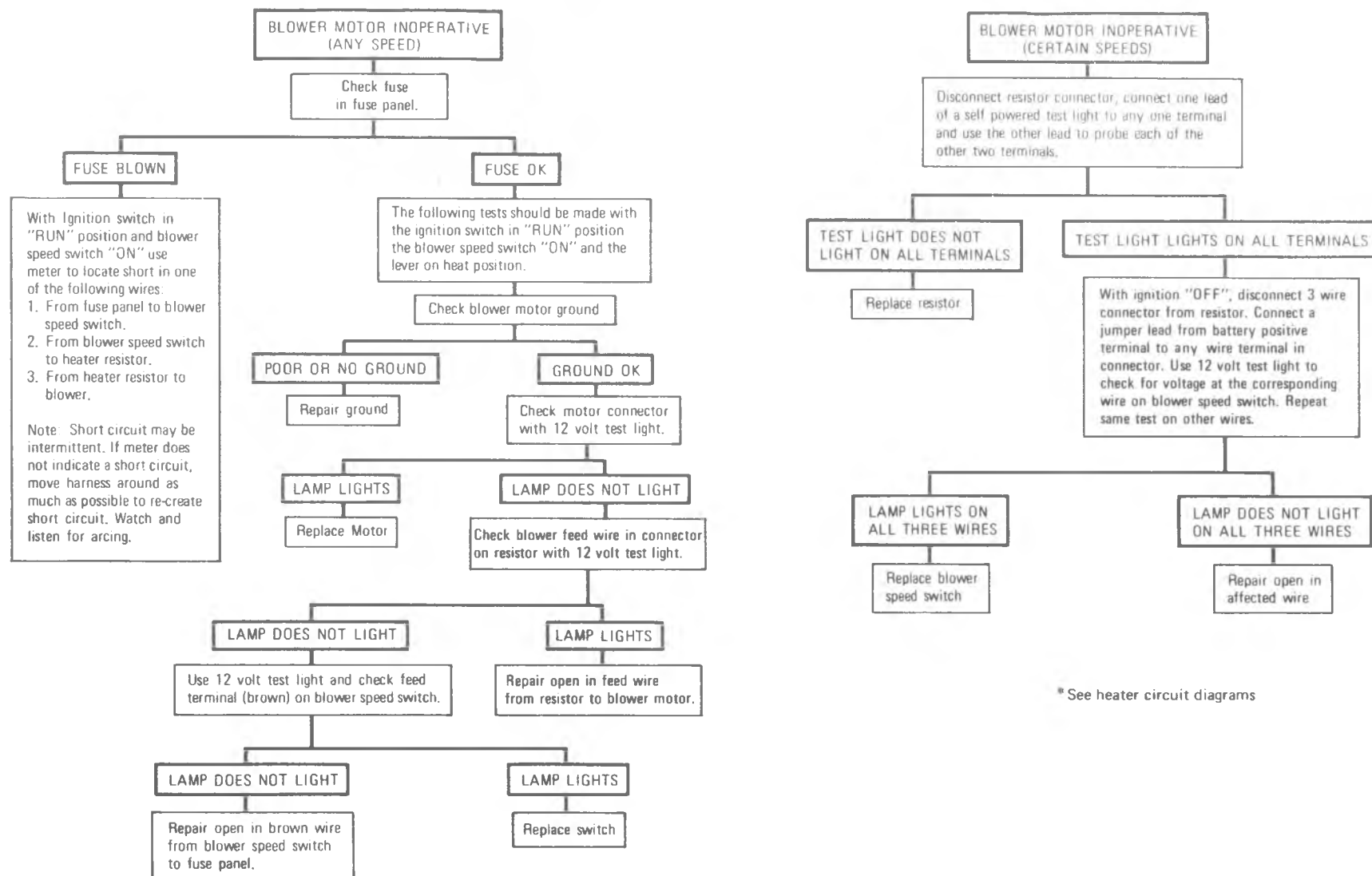
FUSE OK

FUSE OK - See Heater Circuit Diagnostic Chart.

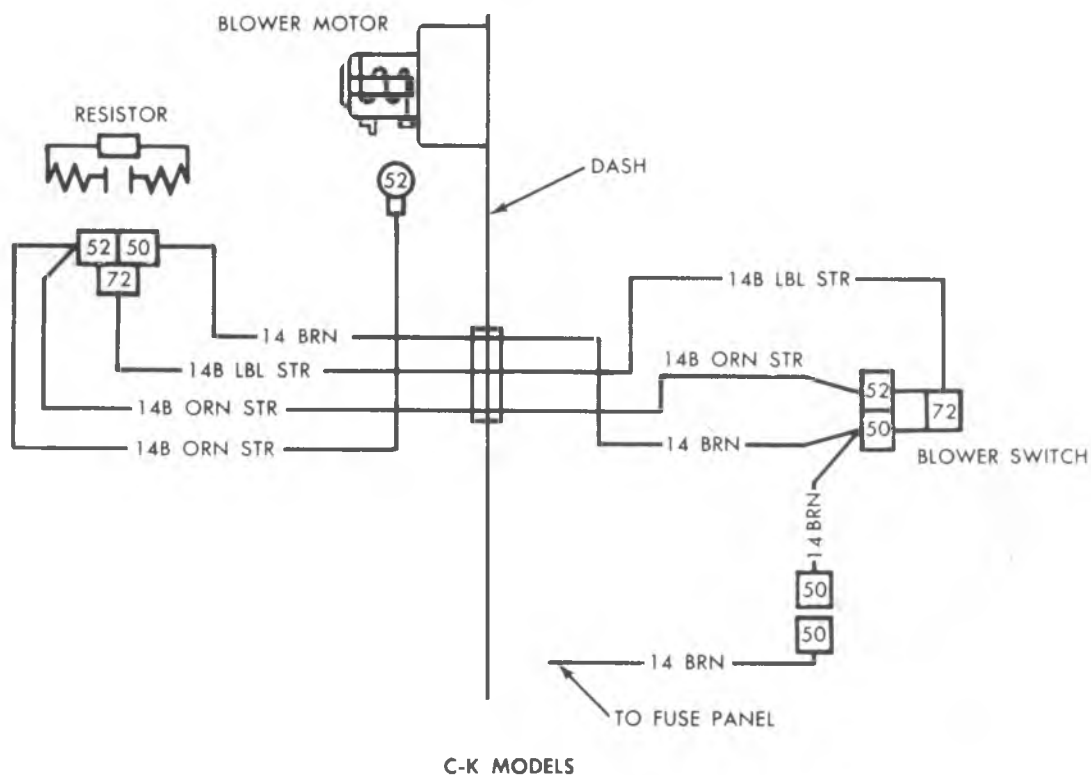
*CHECK FOR C K MODELS ONLY

**CHECK FOR G MODELS ONLY

HEATER CIRCUIT DIAGNOSIS*



* See heater circuit diagrams



	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

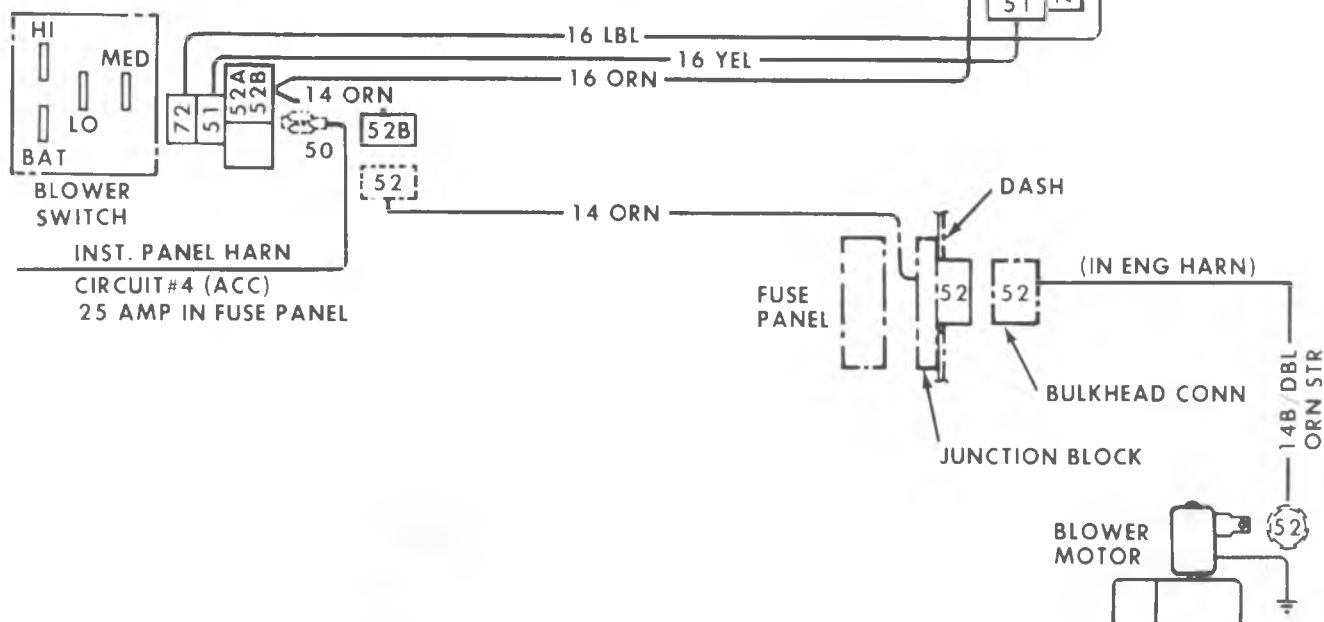
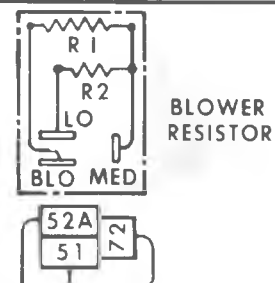


Fig. 1A-4--Heater Wiring Diagrams

ON VEHICLE SERVICE

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.

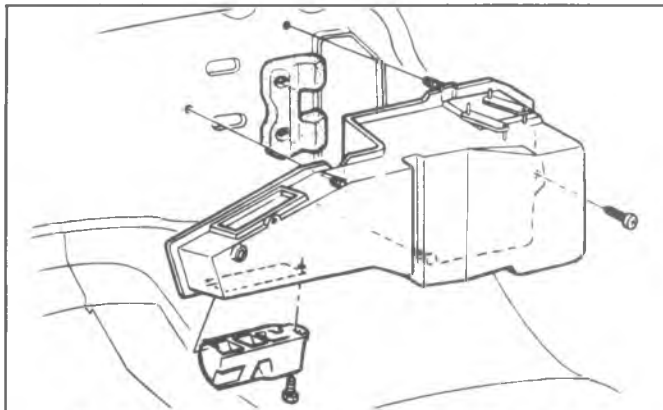


Fig. 1A-6--Heater Distributor Assembly--C-K Models

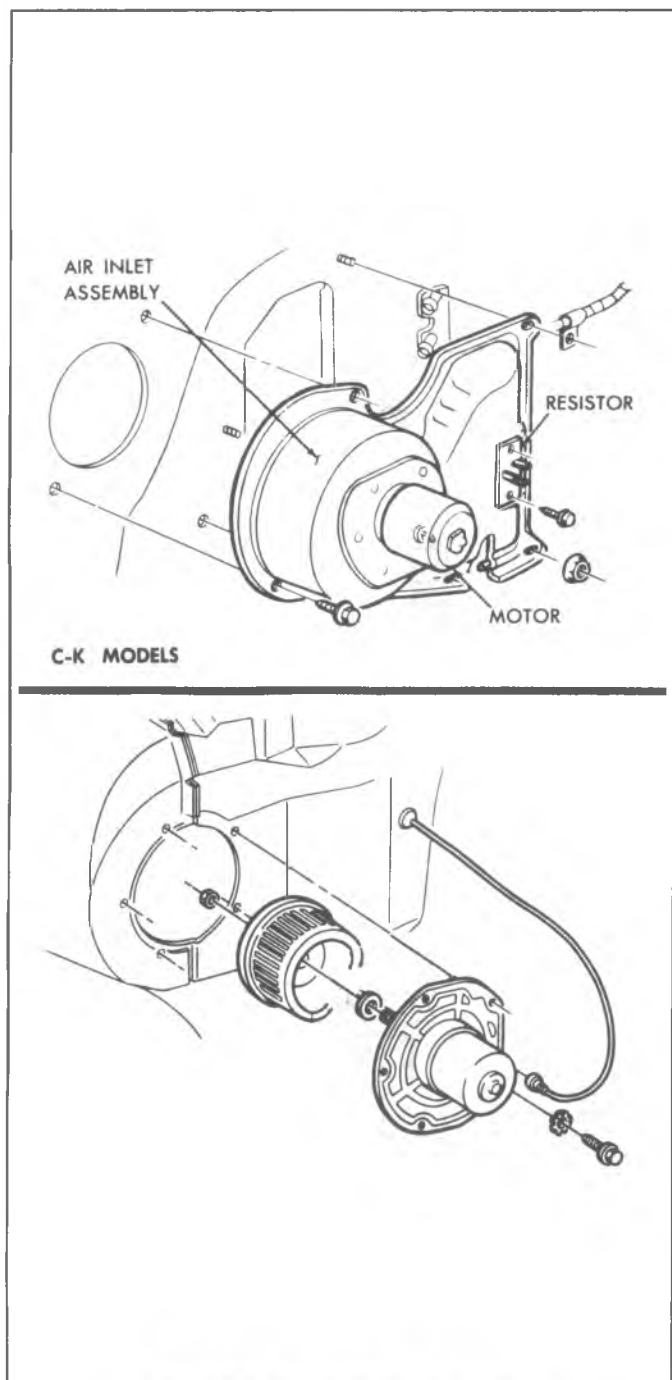


Fig. 1A-5--Blower Motor Assembly

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.

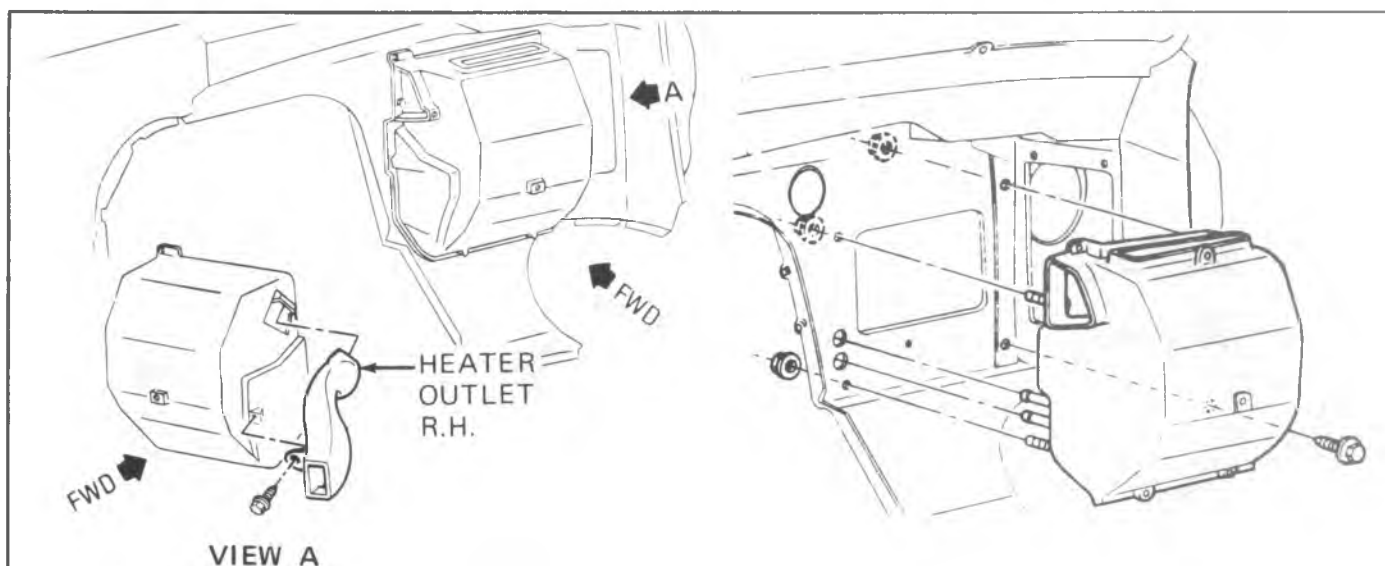


Fig. 1A-7--Heater Distributor - G Models

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

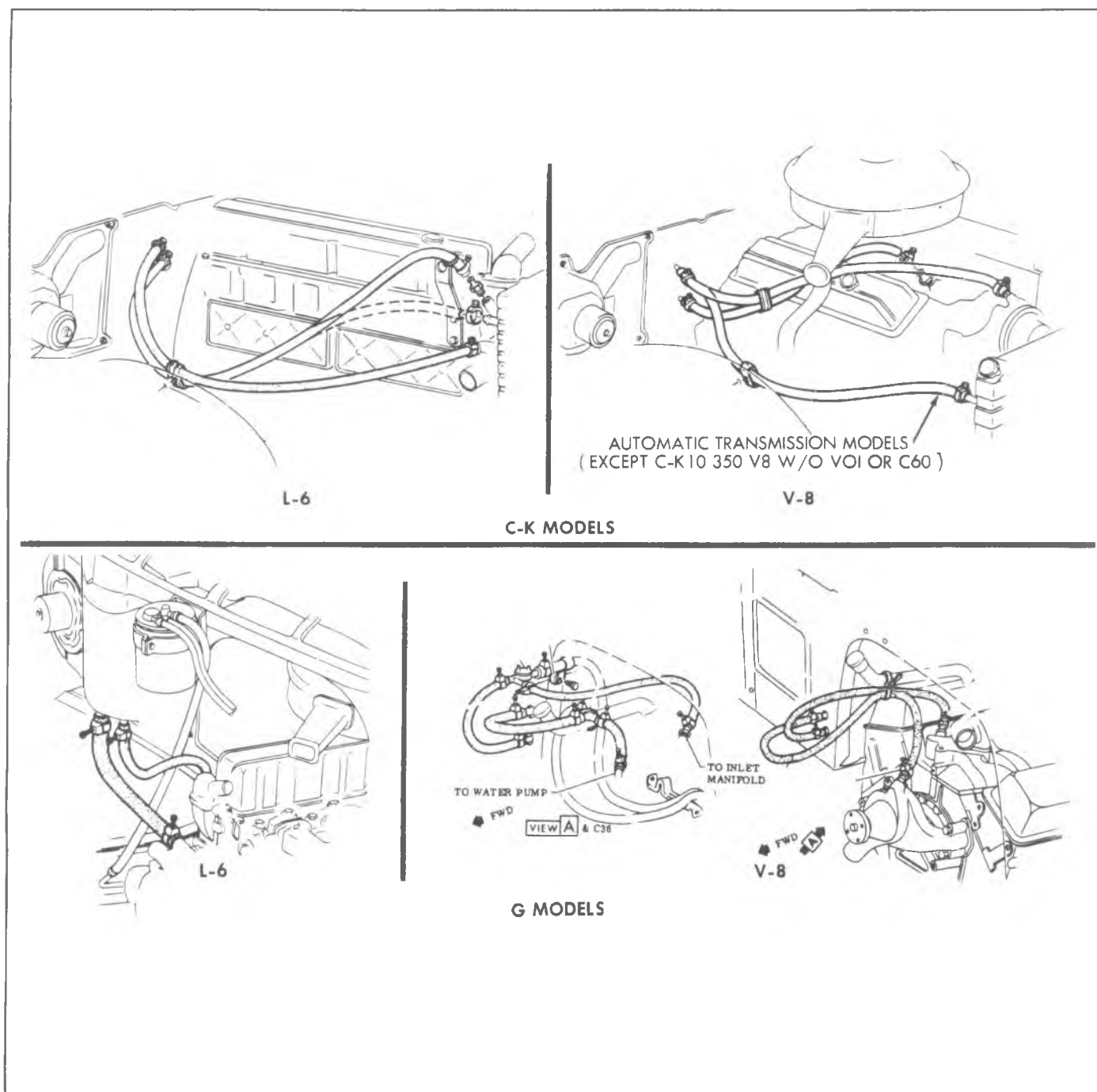


Fig. 1A-8--Heater Hose Routings

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.

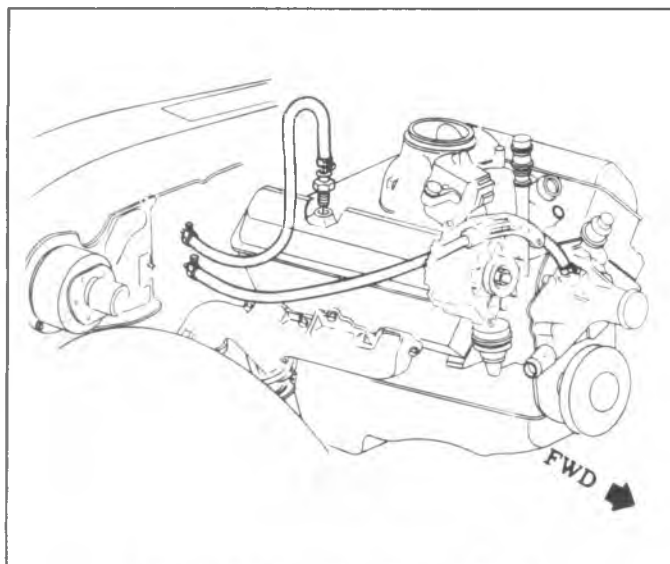


Fig. 1A-9--Heater Hose Routing-Diesel

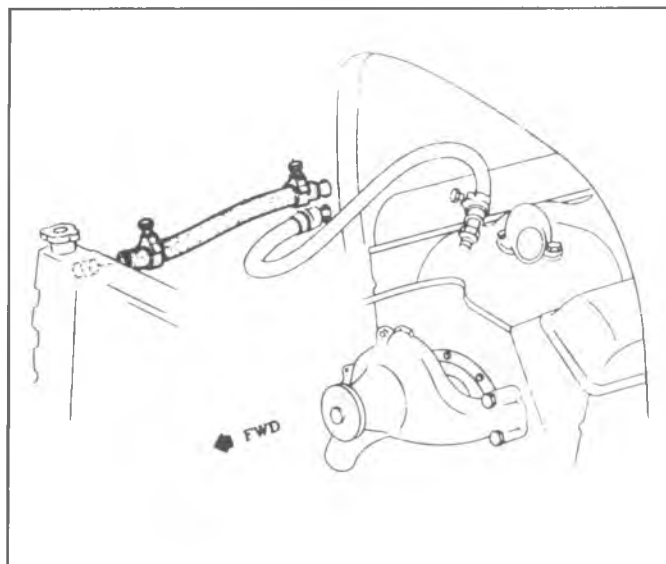


Fig. 1A-10--Heater Hose Routing V8

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.

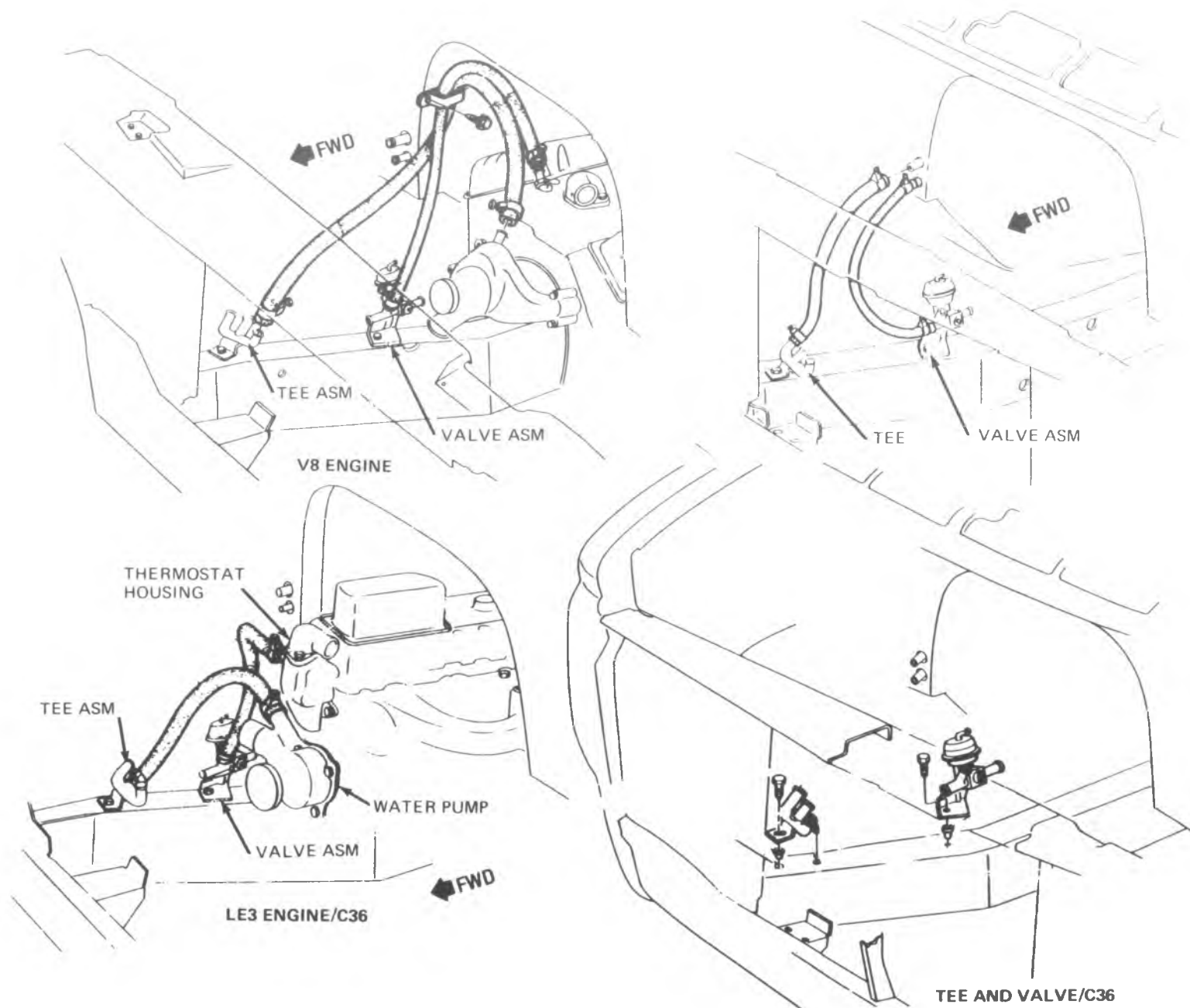


Fig. 1A-11-Heater Hose Routing G Series

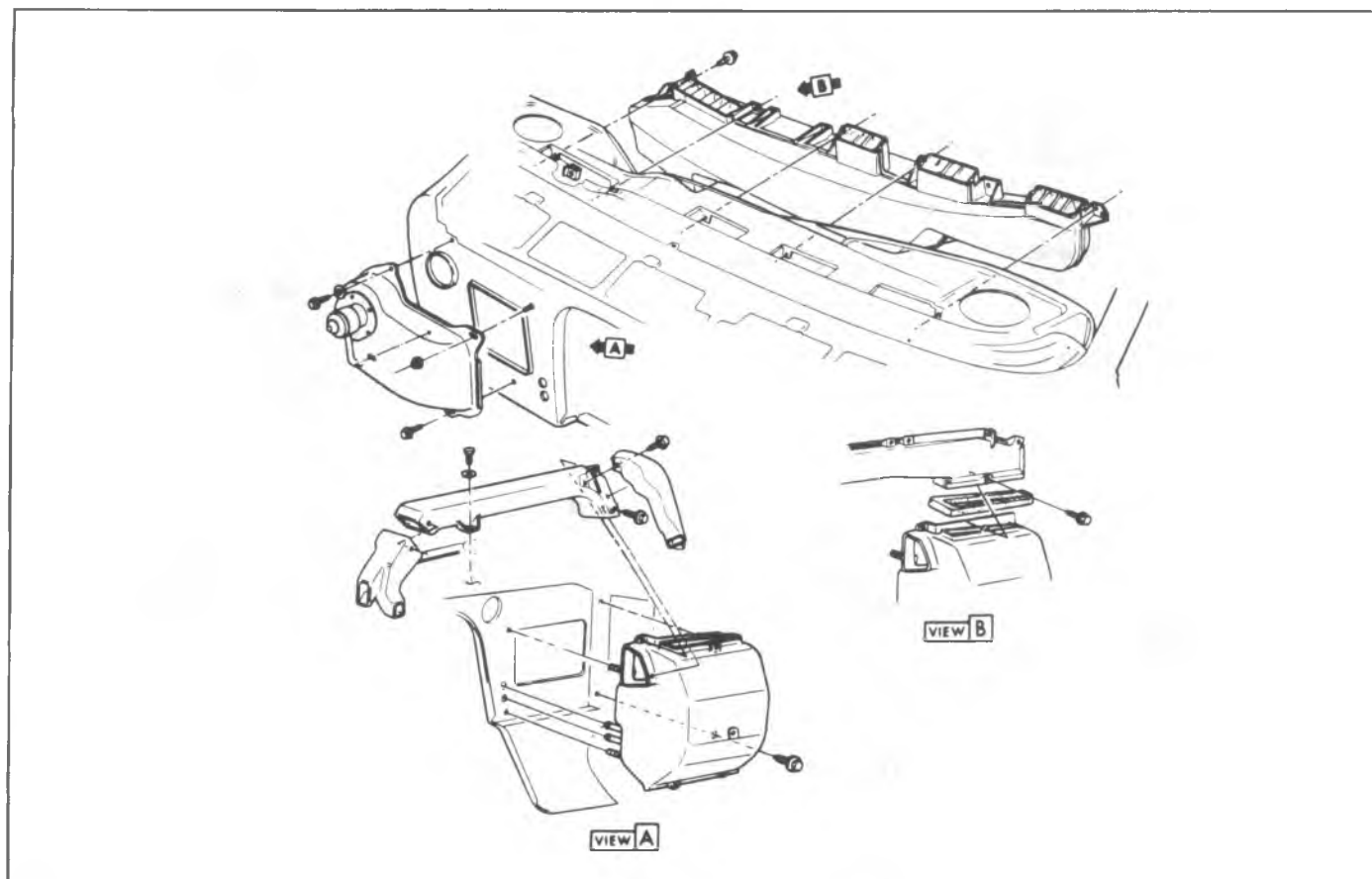


Fig. 1A-12--Distributor Ducts--G Models

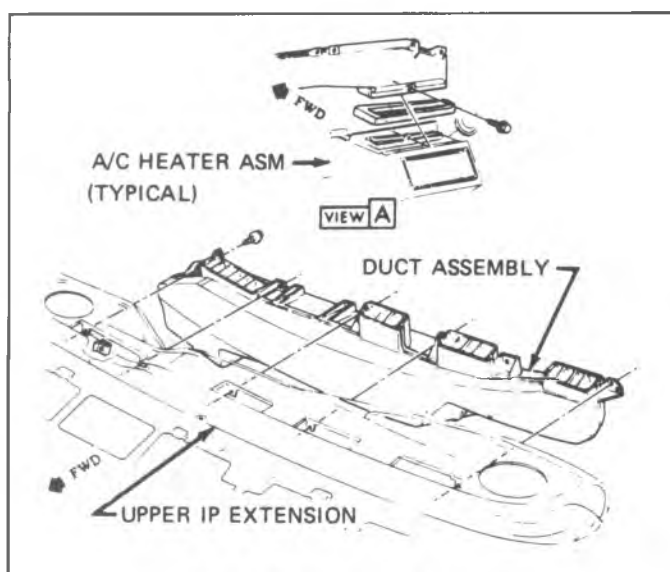


Fig. 1A-13--Defroster Outlets

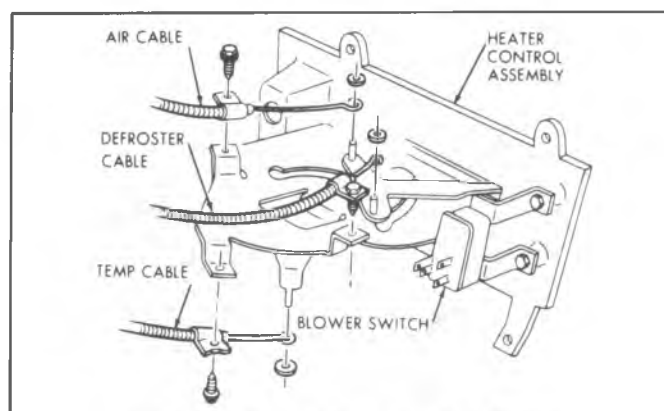


Fig. 1A-14--Control Assembly, C-K Models

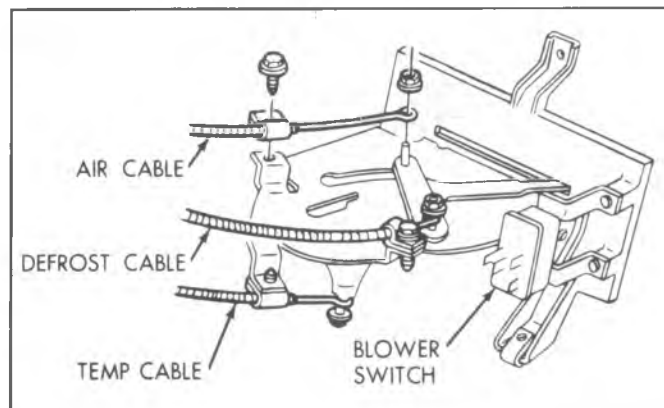


Fig. 1A-15--Control Assembly, G Models

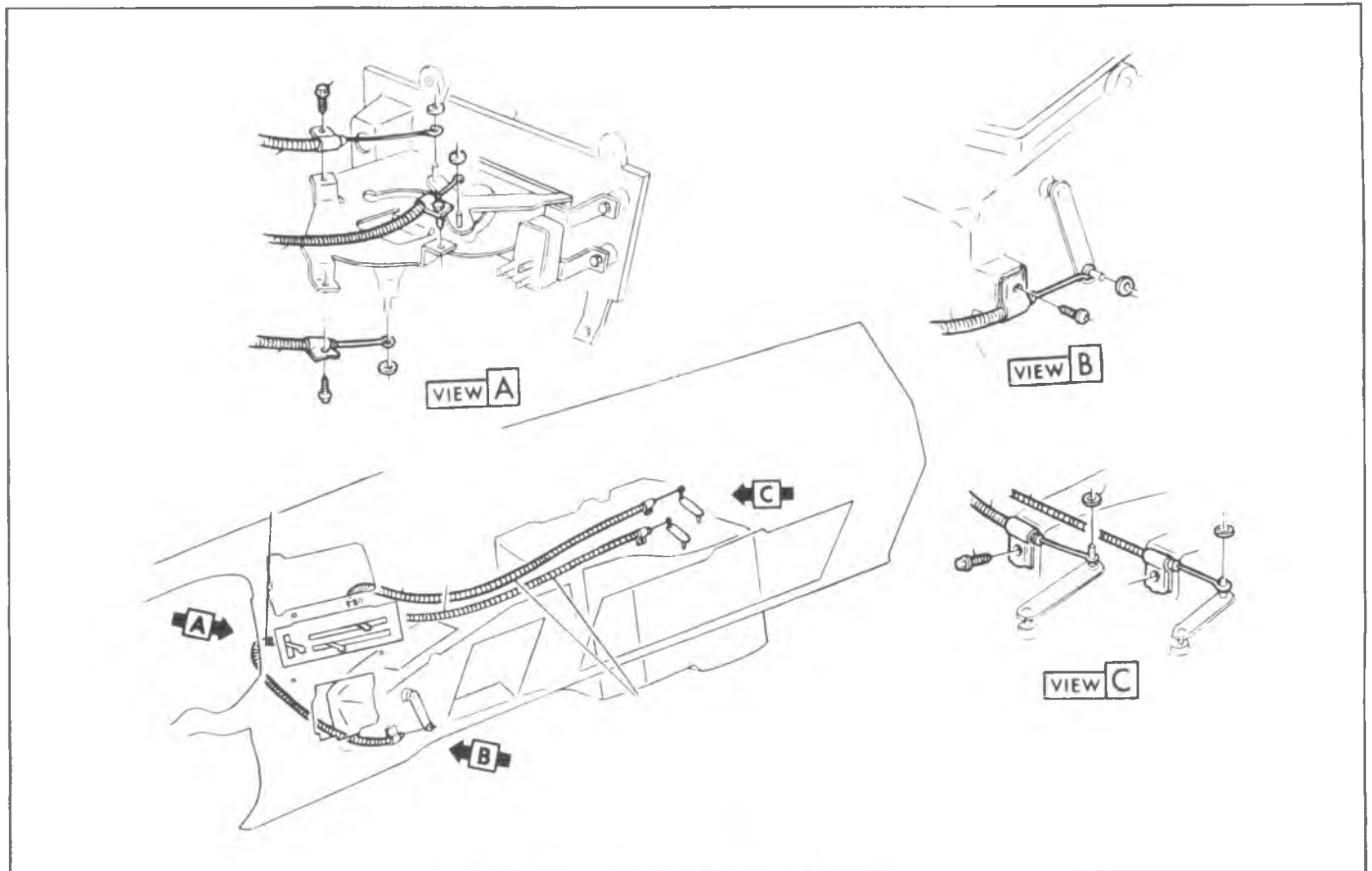


Fig. 1A-16--Control Cables, C-K Series

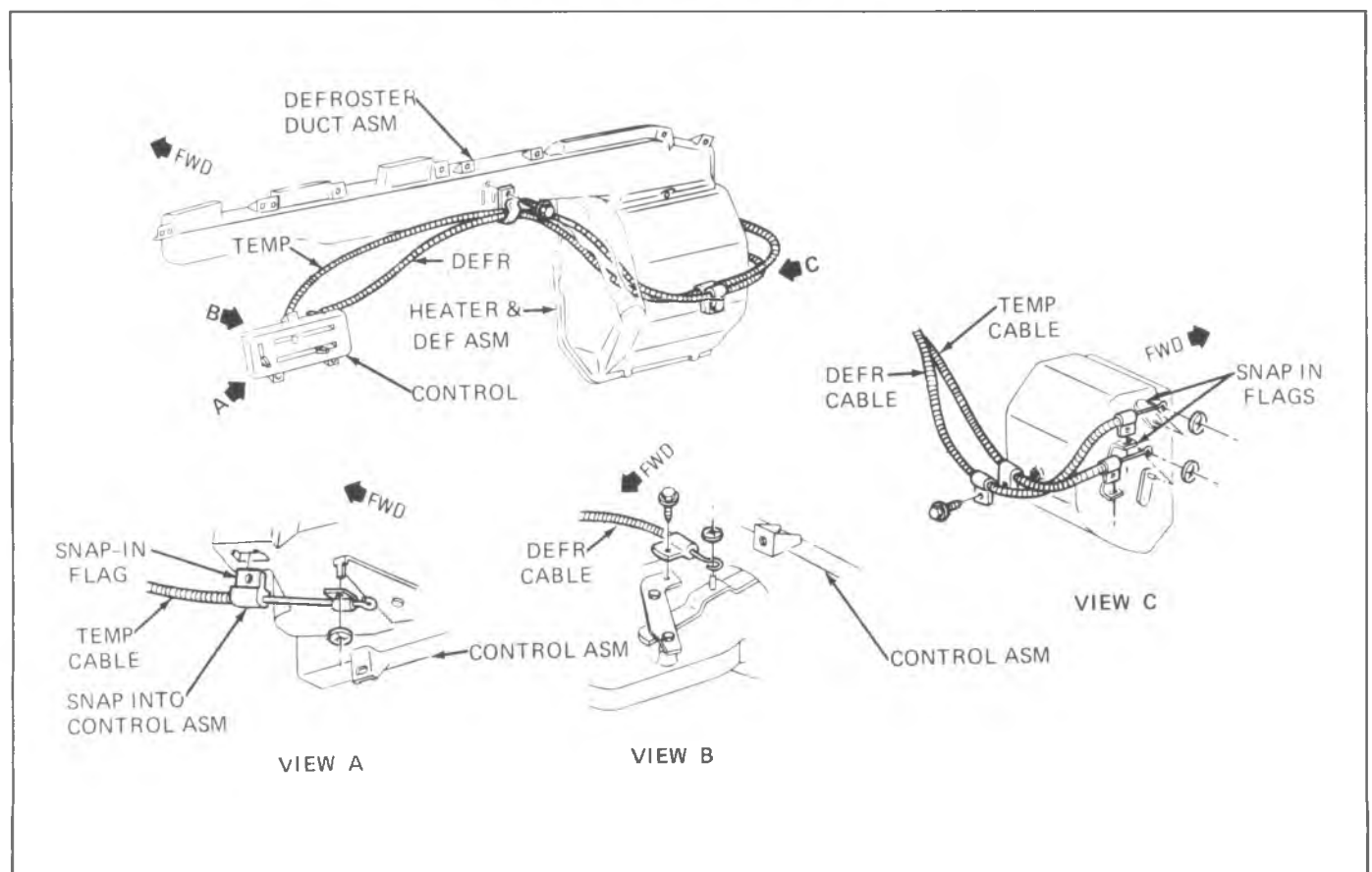


Fig. 1A-17--Control Cable Routing, G Models

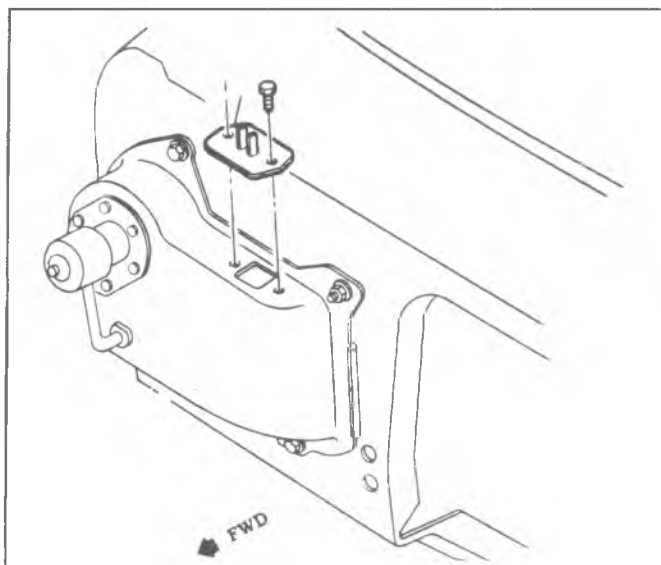


Fig. 1A-18--Resistor - G Models

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.

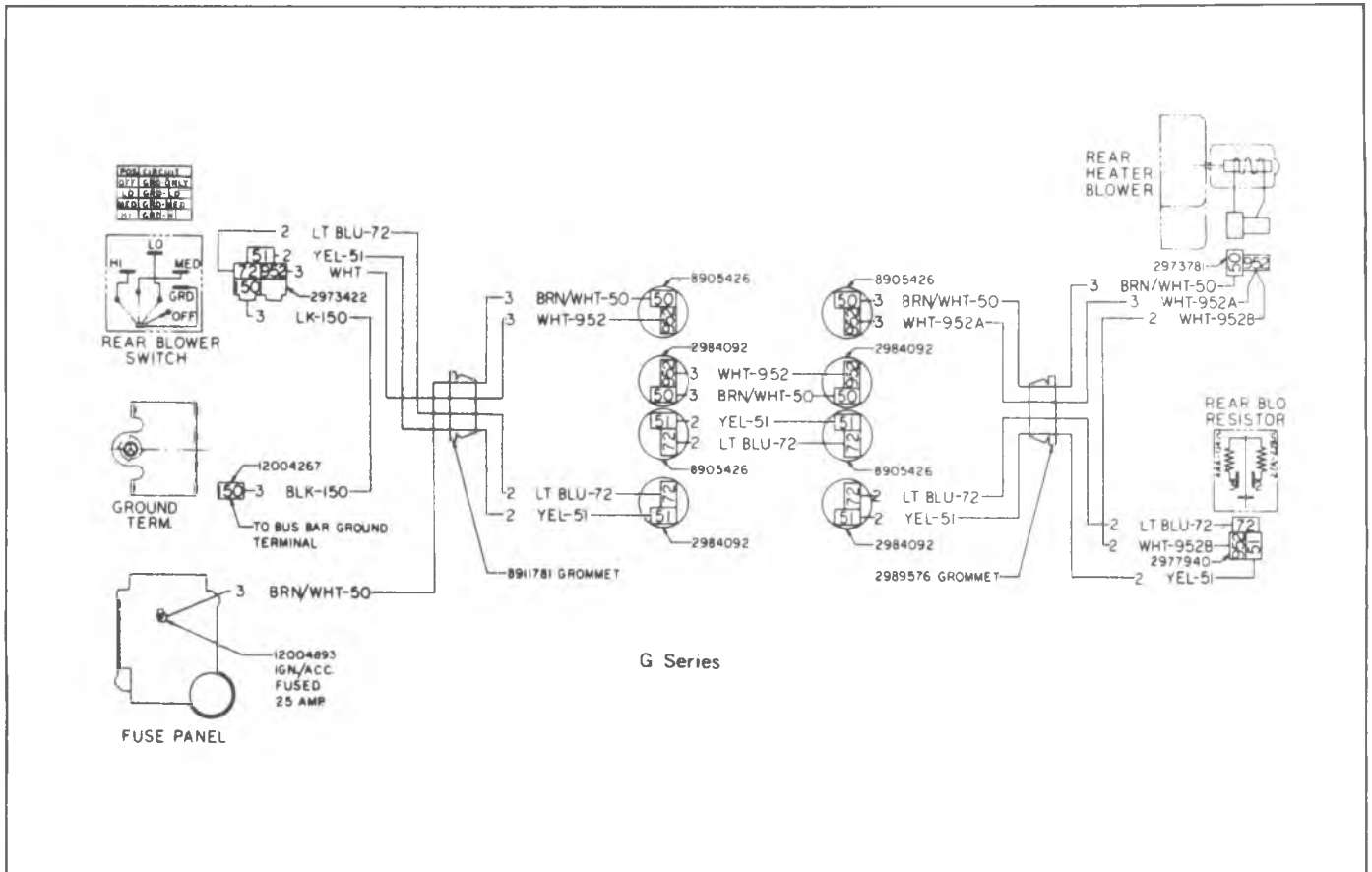


Fig. 1A-21--Electrical Diagram

ON VEHICLE SERVICE

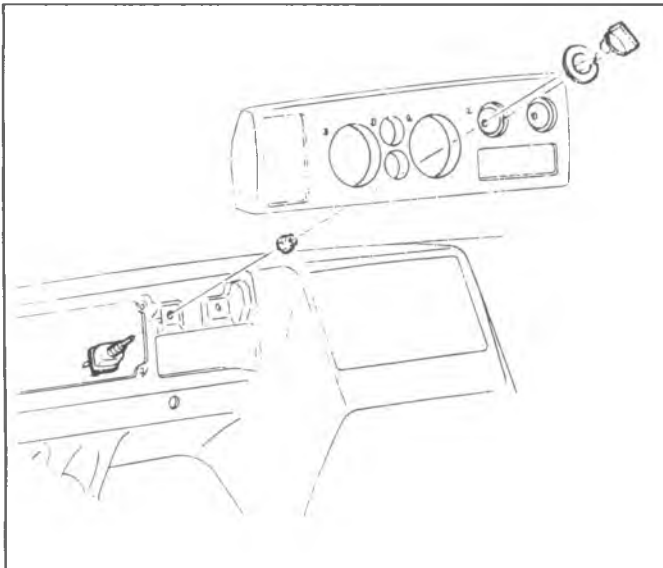


Fig. 1A-22--Control Mounting

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.

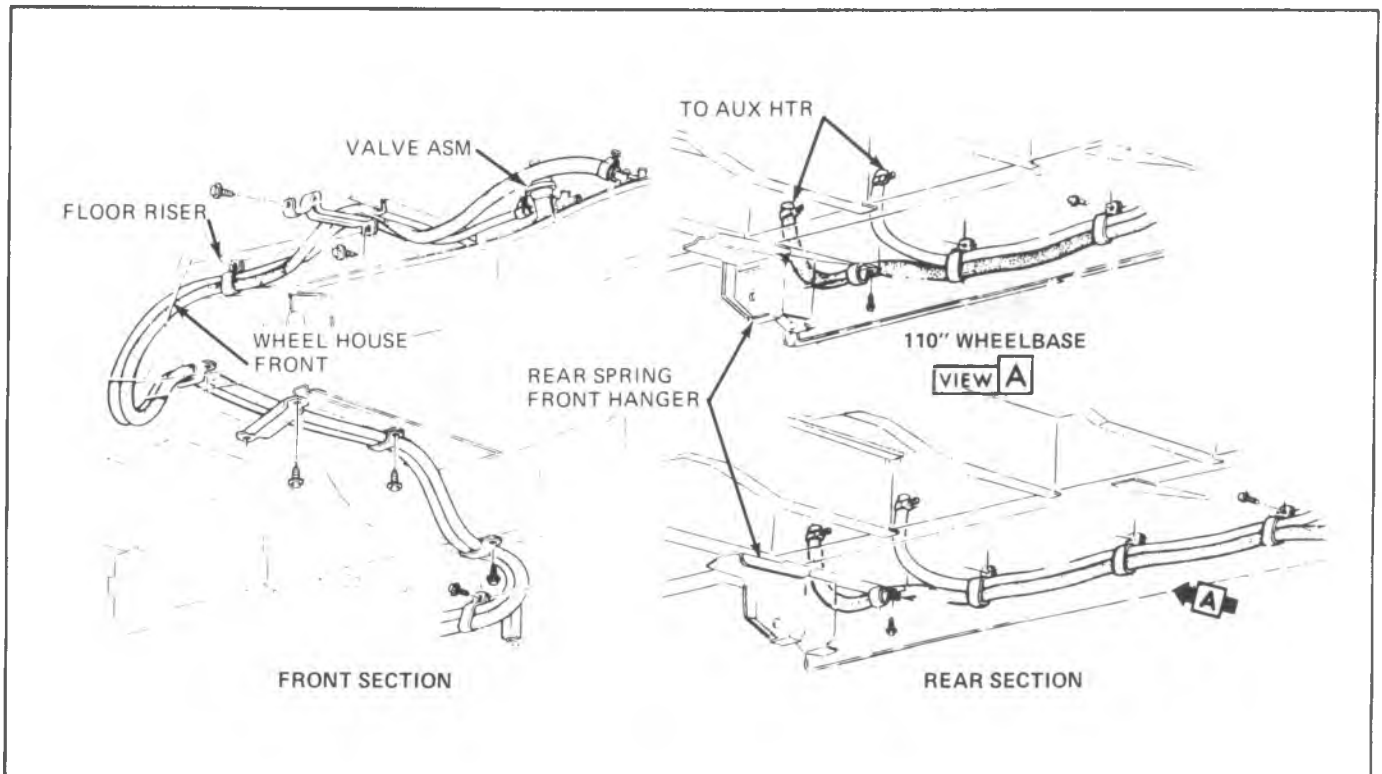


Fig. 1A-23--Auxiliary Heater Hose Routing

SPECIFICATIONS

SECTION 1A

HEATER

	<u>Volts</u>	<u>Amps. (Cold)</u>	<u>RPM (Cold)</u>
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

	<u>Volts</u>	<u>Amps. (Cold)</u>	<u>RPM (Cold)</u>
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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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

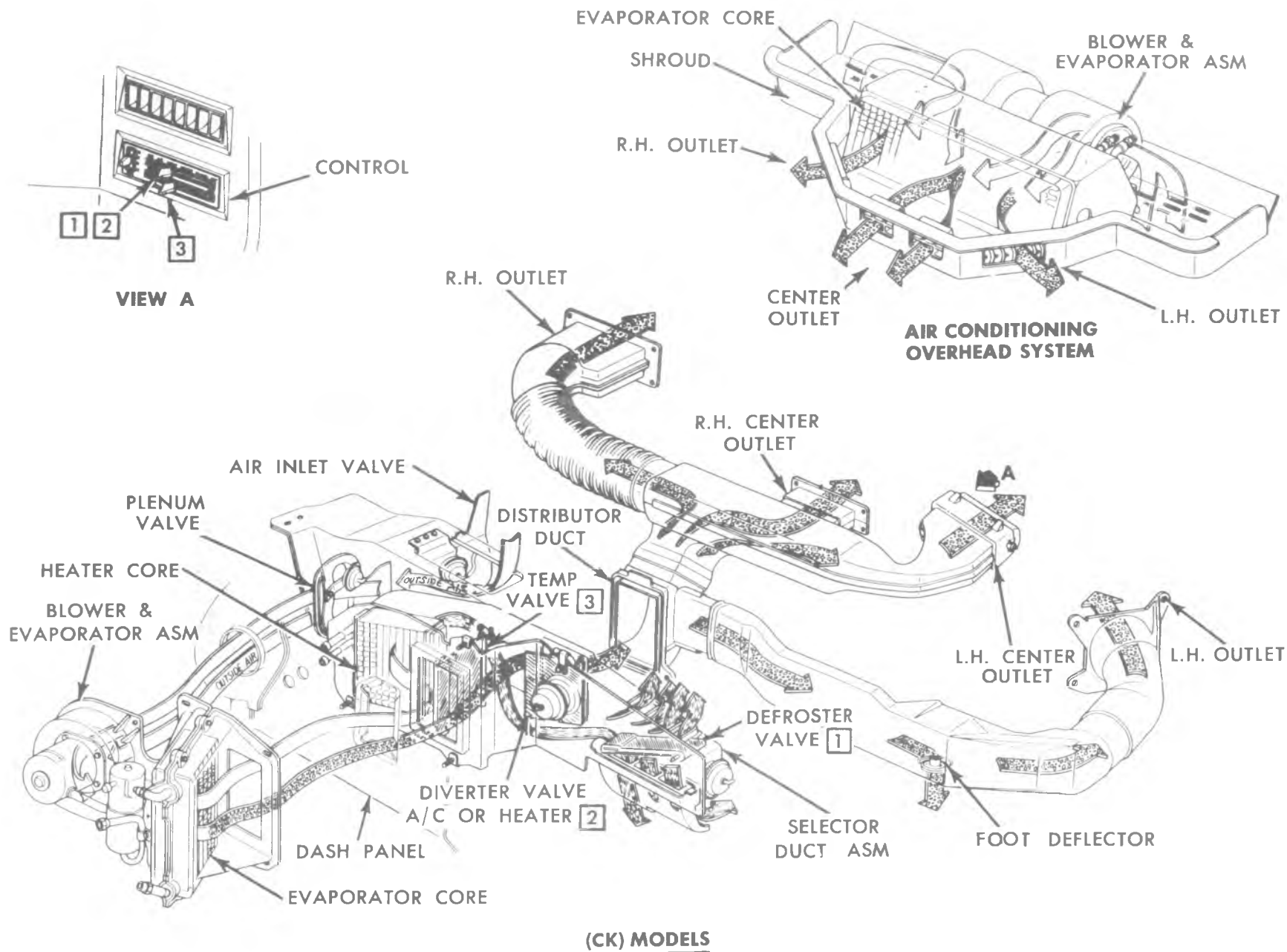


Fig. 1B-1--Airflow Chart - C-K Models

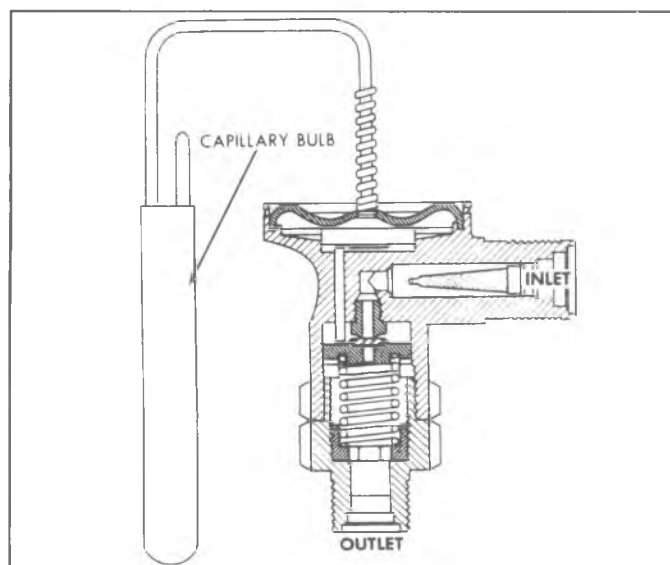


Fig. 1B-2--Expansion Valve

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 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

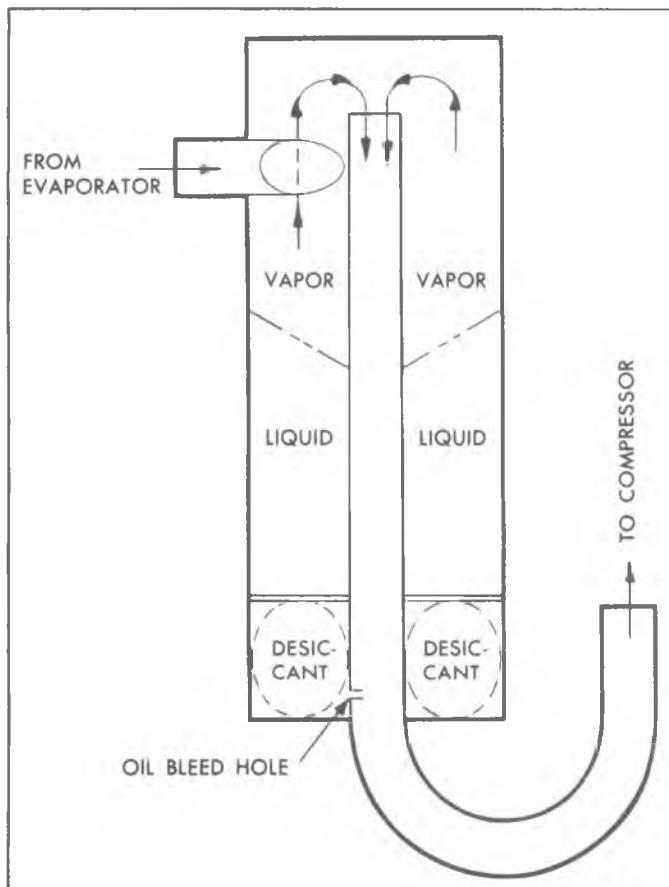


Fig. 1B-3--Accumulator-C-K, & G Series With C60

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).

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 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.

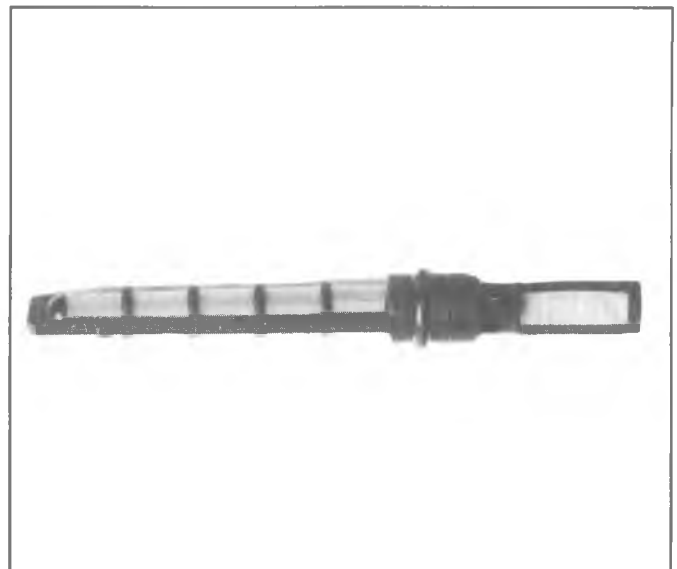
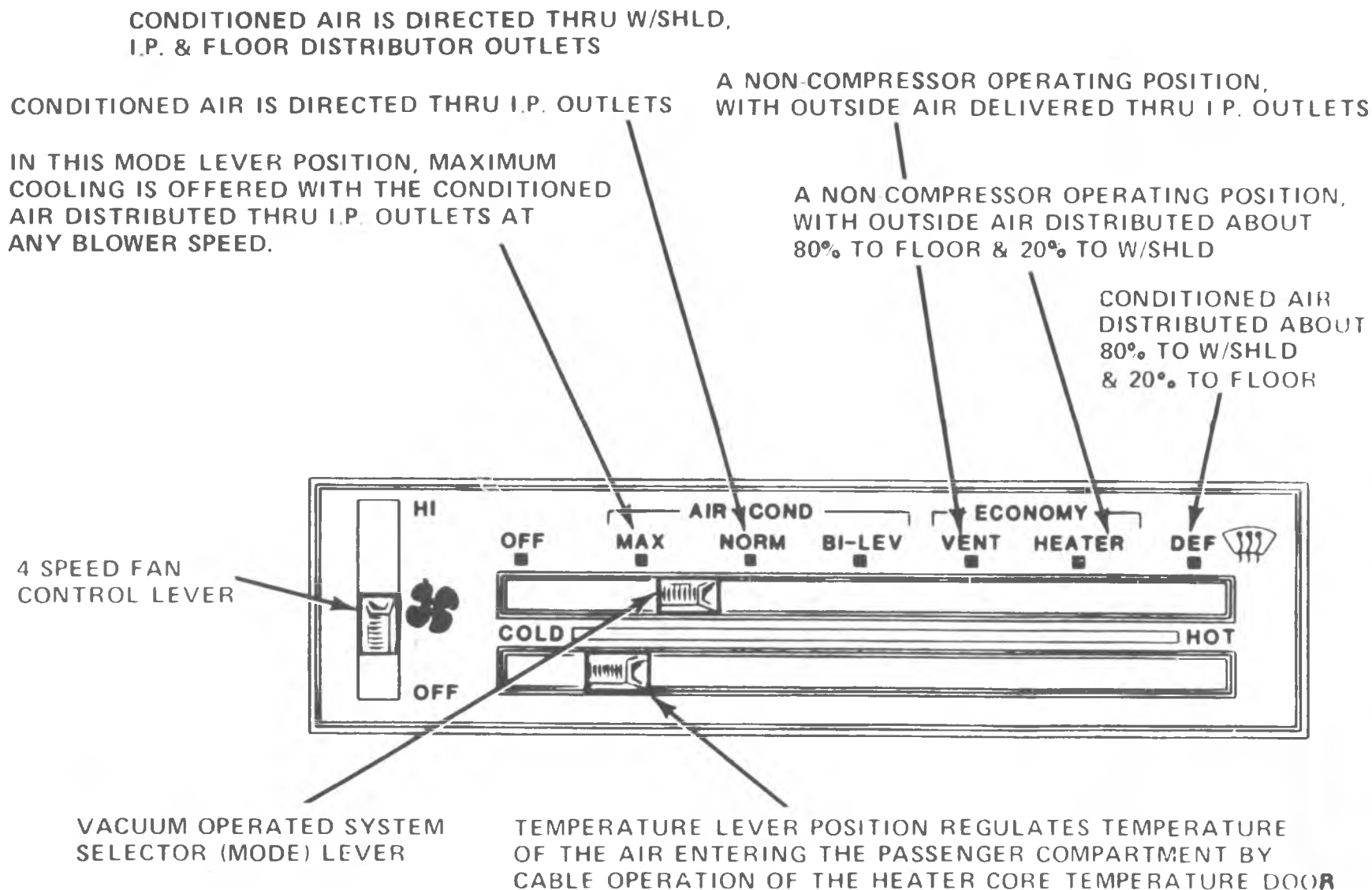


Fig. 1B-4--Expansion Tube



SYSTEM OPERATION - CK TRUCK

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

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.

Vacuum Schematic - G Models

G Model vacuum schematic is shown in Fig. 1B-9.

OVERHEAD SYSTEM (C-K & G 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-10).

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

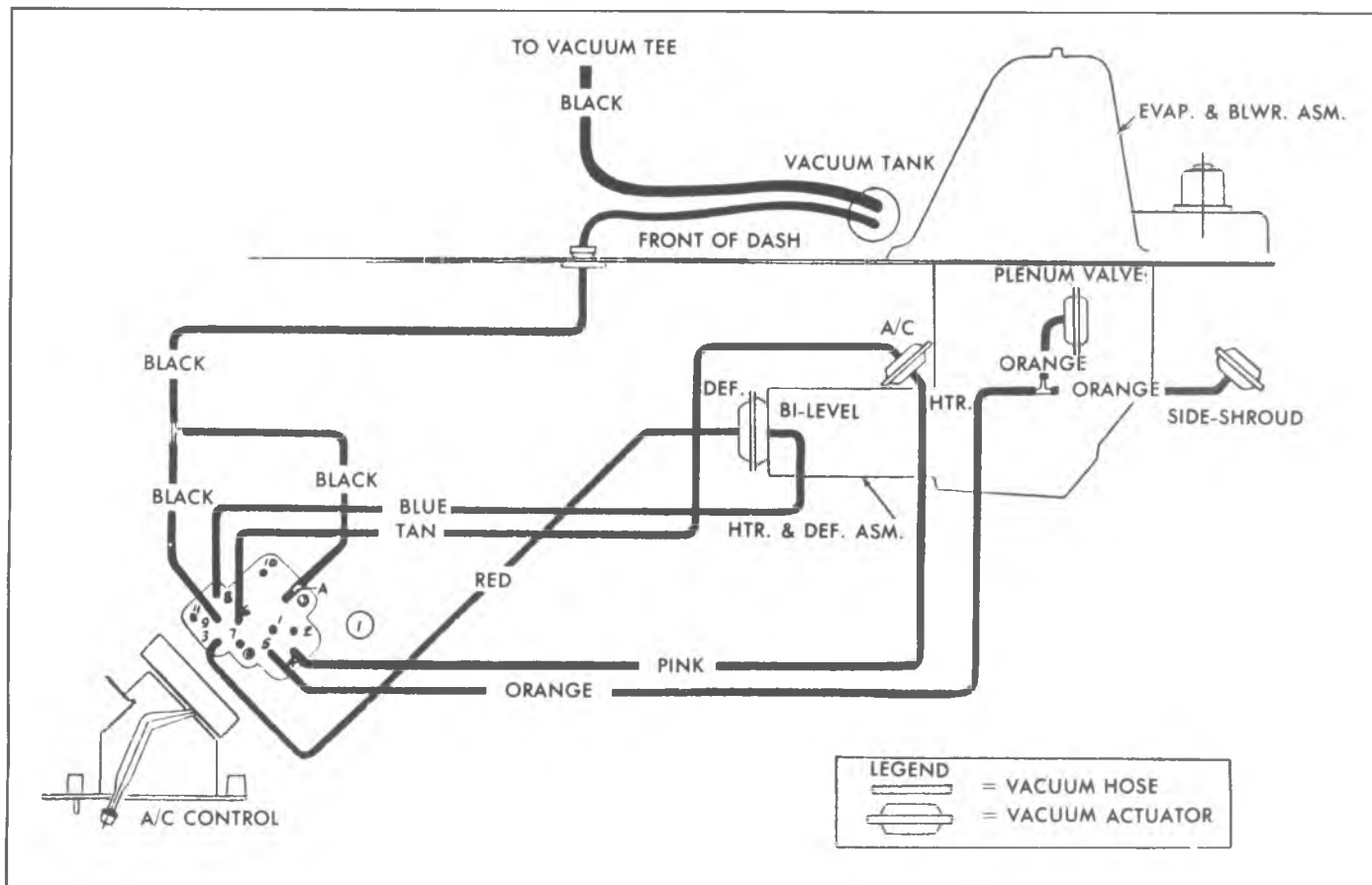


Fig. 1B-7--Air Conditioning Vacuum Schematic - C-K Truck

COMPRESSOR		BLOWER SPEEDS AVAIL	AIR SOURCE	AIR ENTERS VEHICLE	HEATER DEFROSTER DOOR	HEATER A/C DOOR
OFF	OFF	NONE	OUTSIDE	FLOOR OUTLETS	OPEN TO HEATER	OPEN TO 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

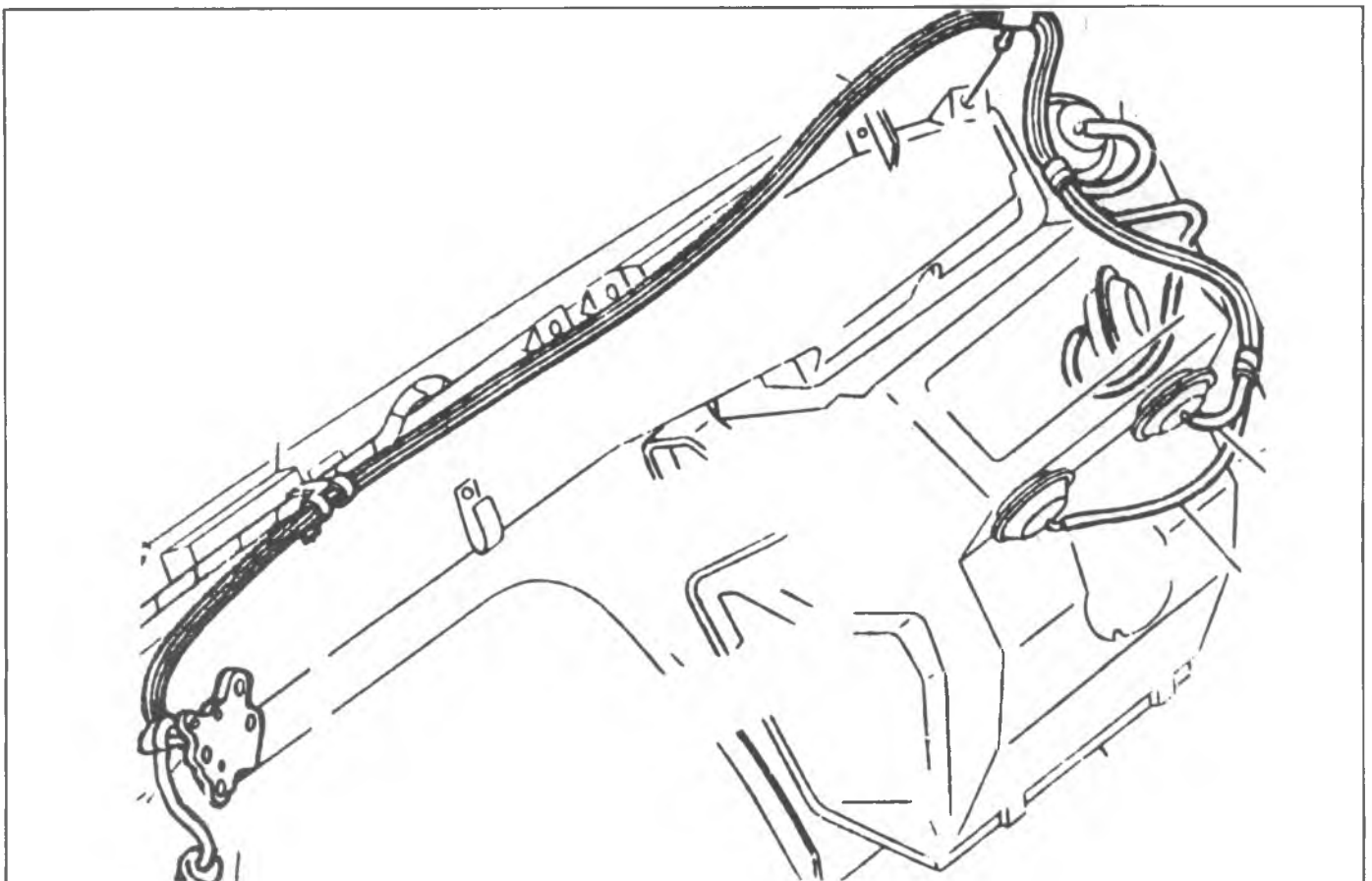


Fig. 1B-9--Vacuum Schematic - G Models

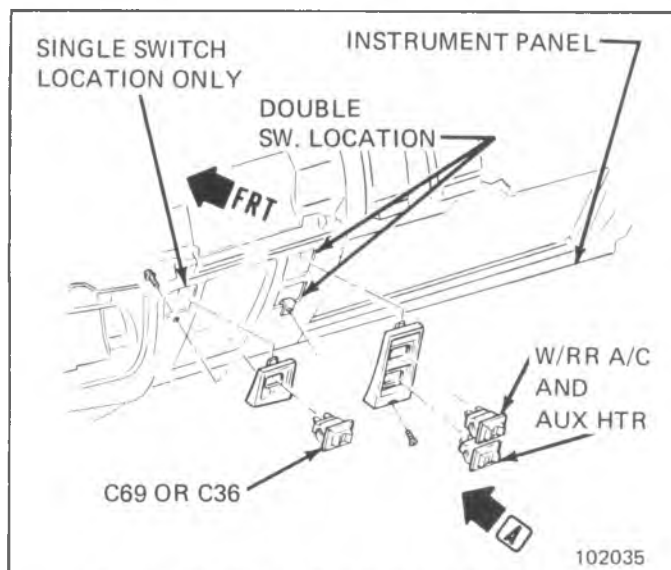


Fig. 1B-10--Overhead Unit Control (C-K Series)

three speed blower switch (Fig. 1B-11).

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-12).

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 provided 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.

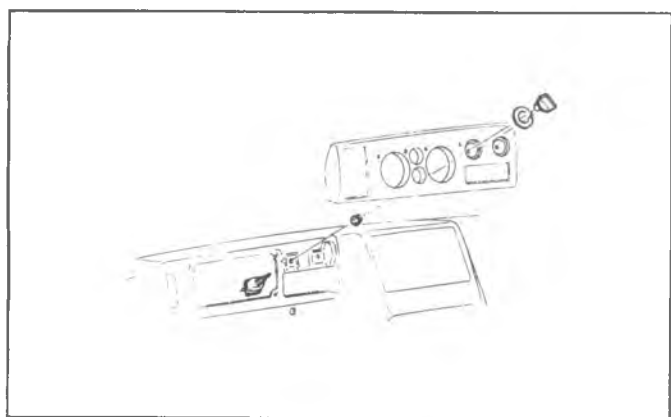


Fig. 1B-11--Overhead Unit Control (G Models)

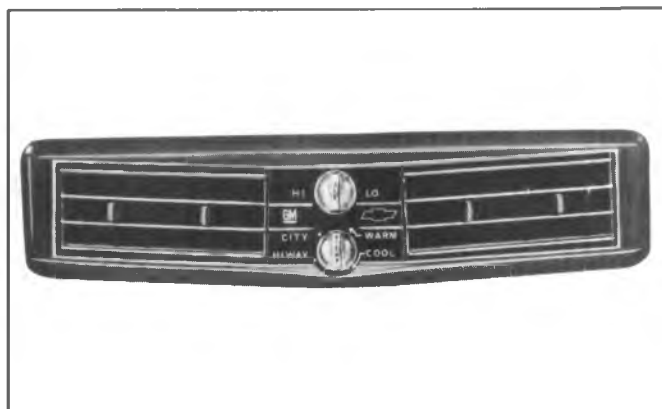


Fig. 1B-12--Motor Home Unit Control

CCOT SYSTEM COMPONENTS

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

Refrigerant and Oil Capacities

Refrigerant and oil charge is shown in Chart 1B-2.

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.

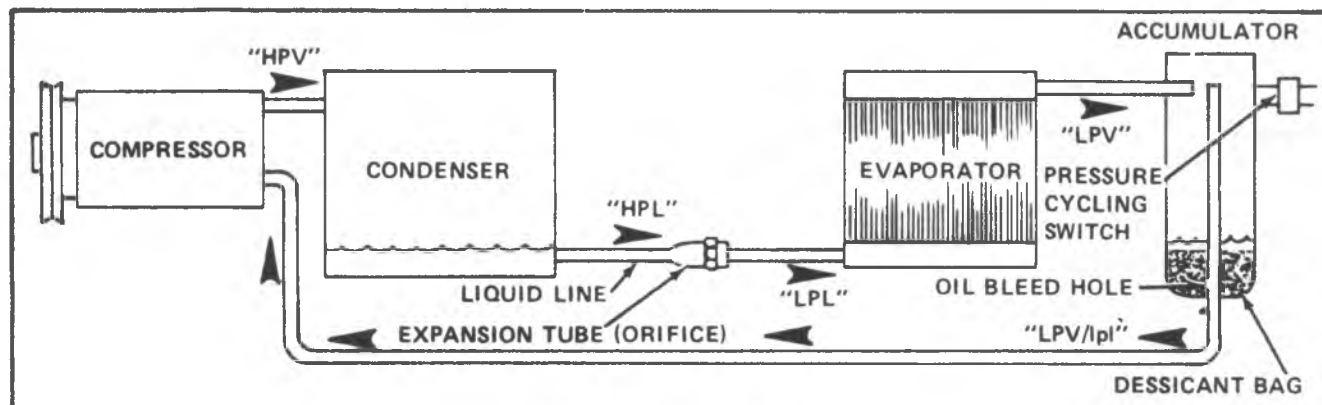
If Refrigerant-12 should come in contact with any part of the body, flush the exposed area with cold water and immediately seek medical help.

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



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-13-CCOT System Components

eyes. Any liquid Refrigerant-12 which may 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:

- Call a doctor or eye specialist immediately and obtain treatment as soon as possible.
- DO NOT RUB THE EYE. Splash the affected area with quantities of cold water to gradually get the temperature above the freezing point.

- 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

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)		(°F)(°C)		(PSIG)(kPa)	
-21.7	-29.8C	0	ATMOSPHERIC	55	12.7C	52.0	358.5
			PRESSURE)	60	15.5C	57.7	397.8
-20	-28.8C	2.4		65	18.3C	63.7	439.2
-10	-23.3C	4.5		70	21.1C	70.1	482.7
-5	-20.5C	6.8		75	23.8C	76.9	530.2
0	-17.7C	9.2		80	26.6C	84.1	579.9
5	-15.0C	11.8		85	29.4C	91.7	632.3
10	-12.2C	14.7		90	32.2C	99.6	686.7
15	-9.4C	17.7		95	35.0C	108.1	745.3
20	-6.6C	21.1		100	37.7C	116.9	806.0
25	-3.8C	24.6		105	40.5C	126.2	870.2
30	-1.1C	28.5		110	43.3C	136.0	937.7
32	0C	30.1		115	46.1C	146.5	1010.1
35	1.6C	32.6		120	48.8C	157.1	1083.2
40	4.4C	37.0		125	51.6C	167.5	1154.9
45	7.2C	41.7		130	54.4C	179.0	1234.2
50	10.0C	46.7		140	60.0C	204.5	1410.0

Refrigerant Charge		
	Overhead System	C60 System
C-K Models	5 lbs.-4 oz.	3 Lbs.- 12 oz.
G Models	5 lbs.	3 lbs.

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 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-7. Insufficient or excessive torque when tightening can 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 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 Chart 1B-11).

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation of the air conditioning refrigeration system is dependent upon the chemical 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. Diagnose A/C system according to C.C.O.T. System Diagnostic Procedure (Charts 1B-4 and 1B-5).

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, (Refer to Fig. 1B-21 & 1B-22) 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 Chart 1B-3 & 1B-4) 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.

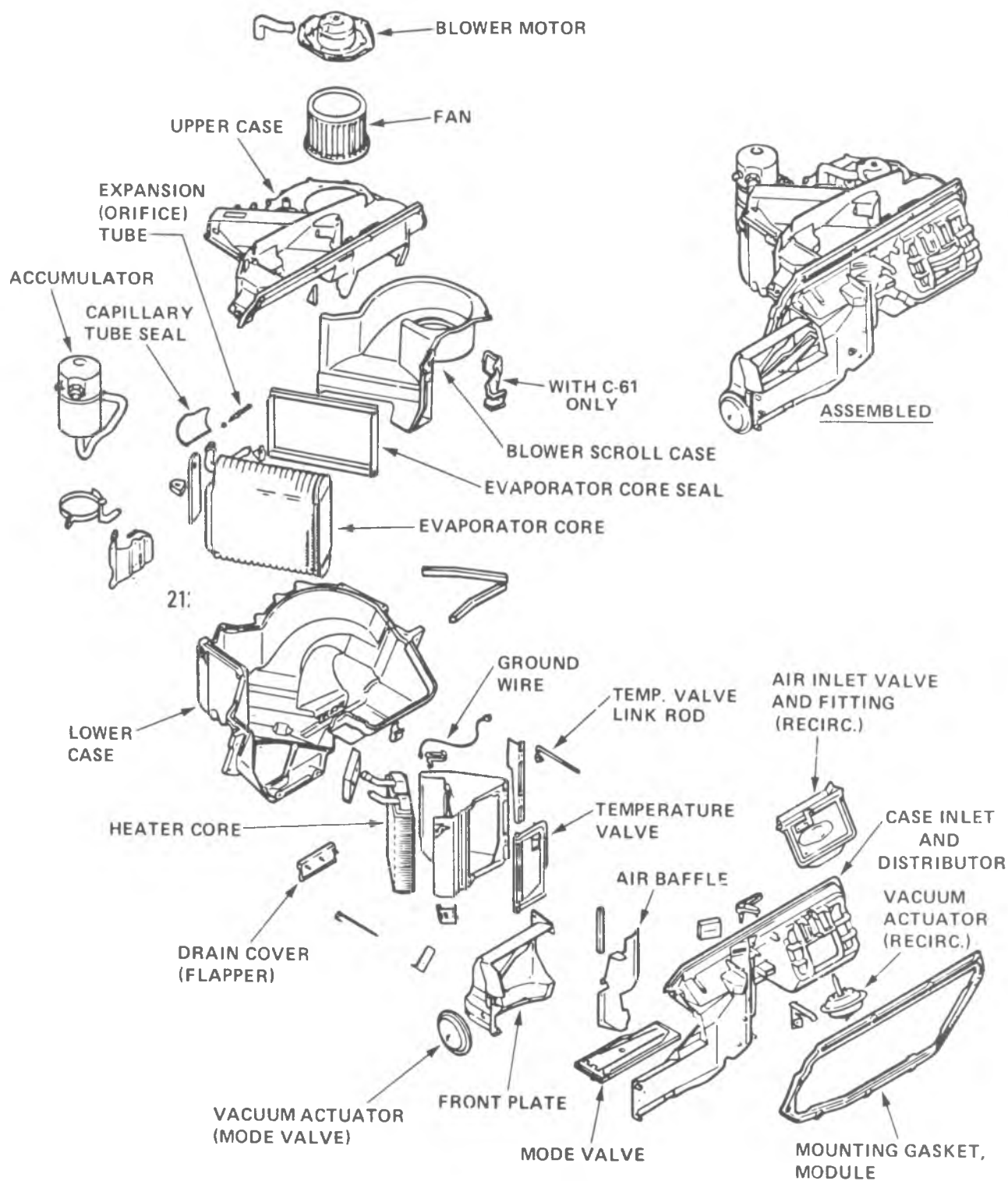


Chart 1B-3--Pressure Cycling CCOT System Diagnosis

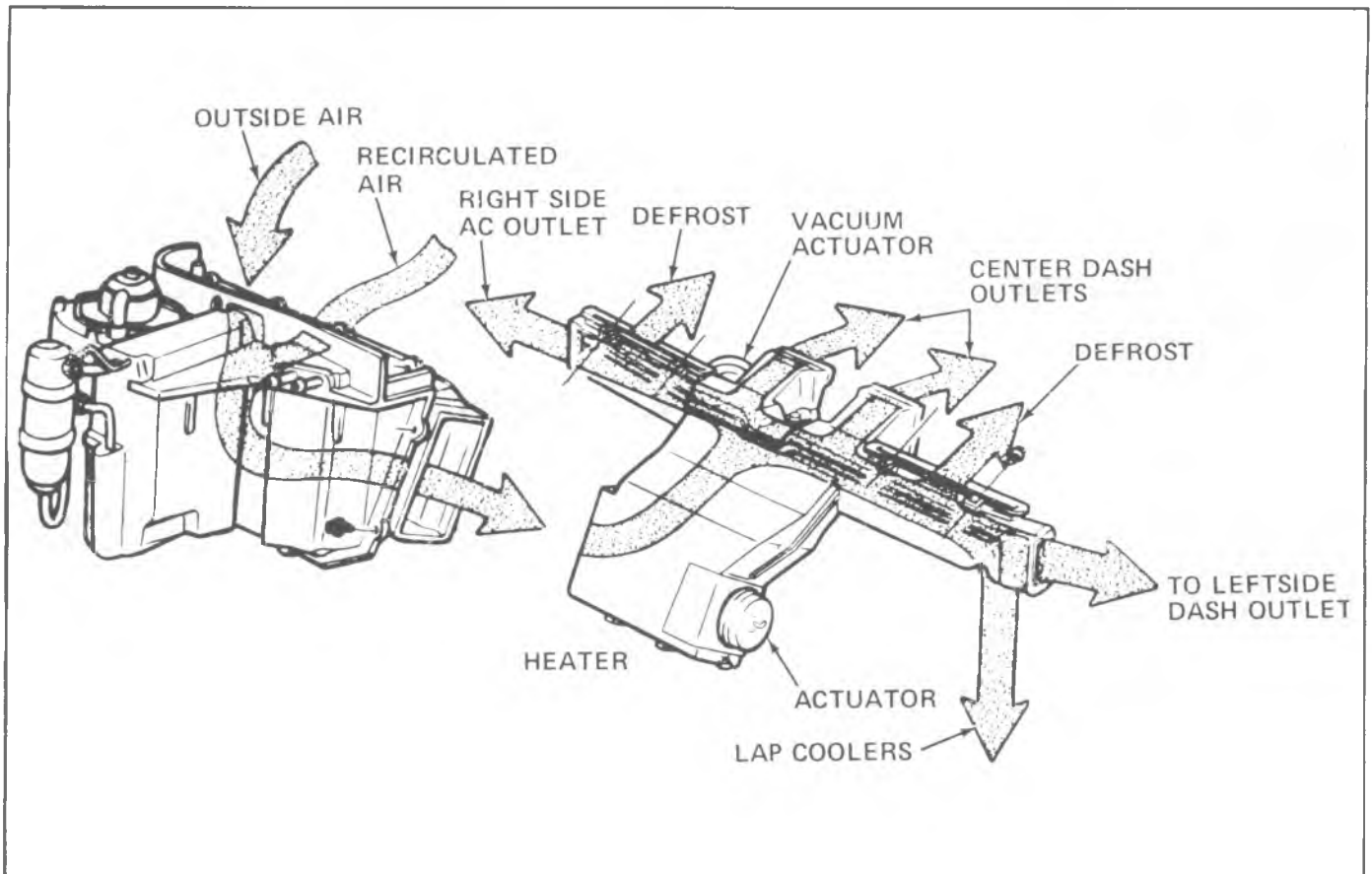


Chart 1B-4--Pressure Cycling CCOT System Diagnosis

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, air, vacuum and refrigeration systems are operating properly and efficiently, refer to Chart 1B-3.

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 (Refer to Vacuum Diagram). 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.

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.

- 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.

VACUUM AND WIRING DIAGRAMS

Refer to Fig. 1B-14 thru 1B-22.

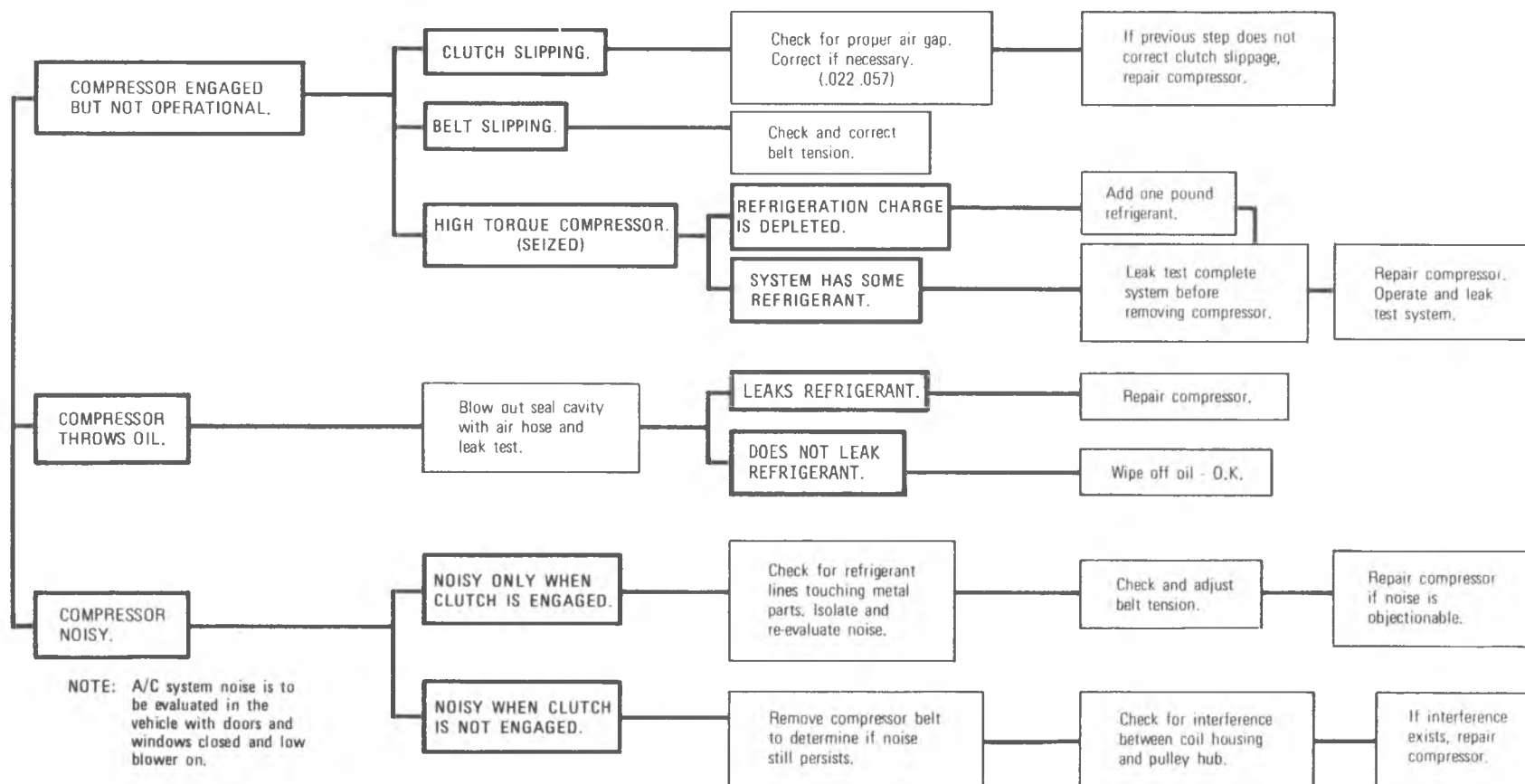
A/C REFRIGERANT SYSTEM DIAGNOSIS

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.

COMPRESSOR DIAGNOSIS



NOTE: A/C system noise is to be evaluated in the vehicle with doors and windows closed and low blower on.

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.

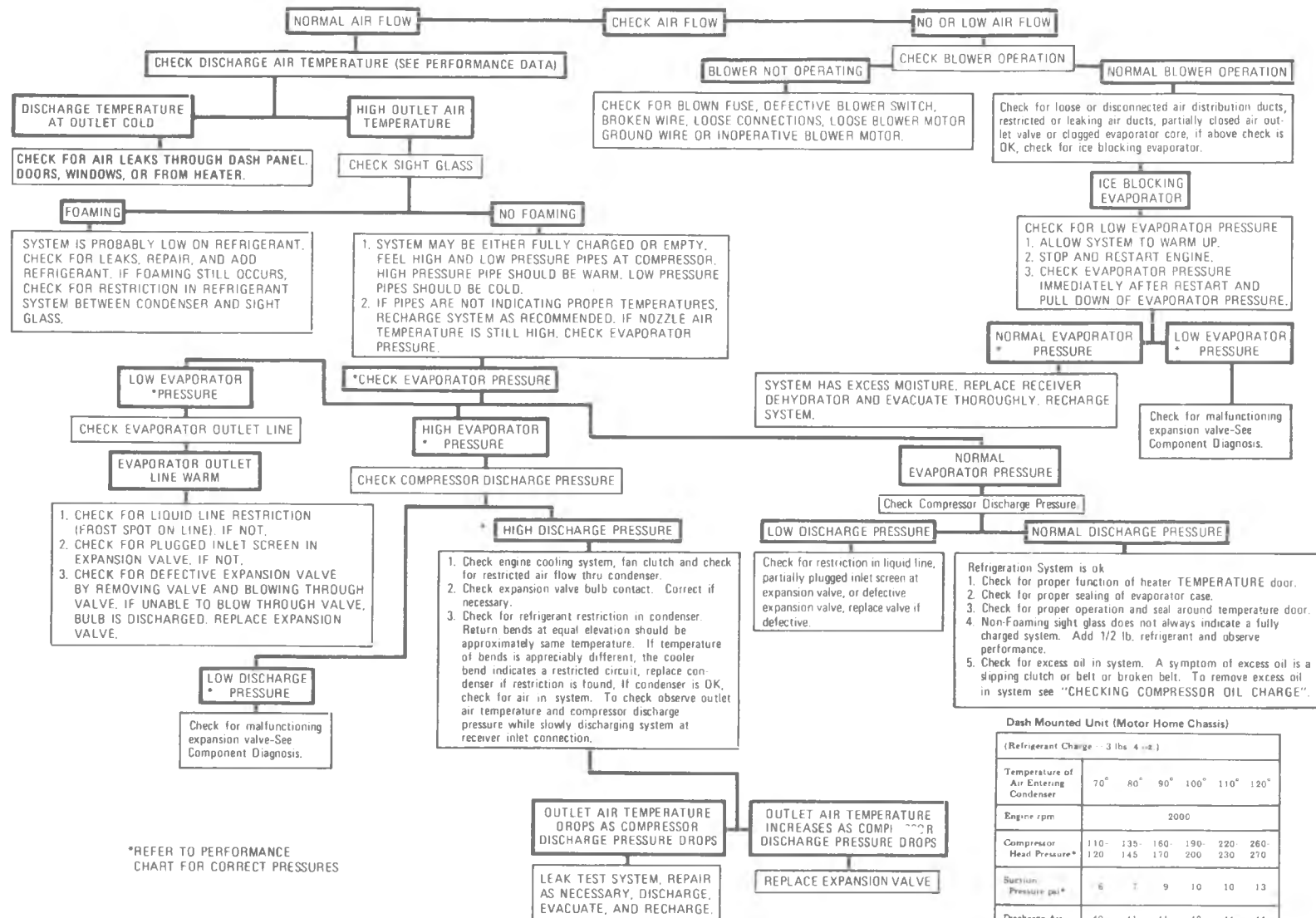
5. Check for condenser air blockage due to foreign material.

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.



*REFER TO PERFORMANCE CHART FOR CORRECT PRESSURES

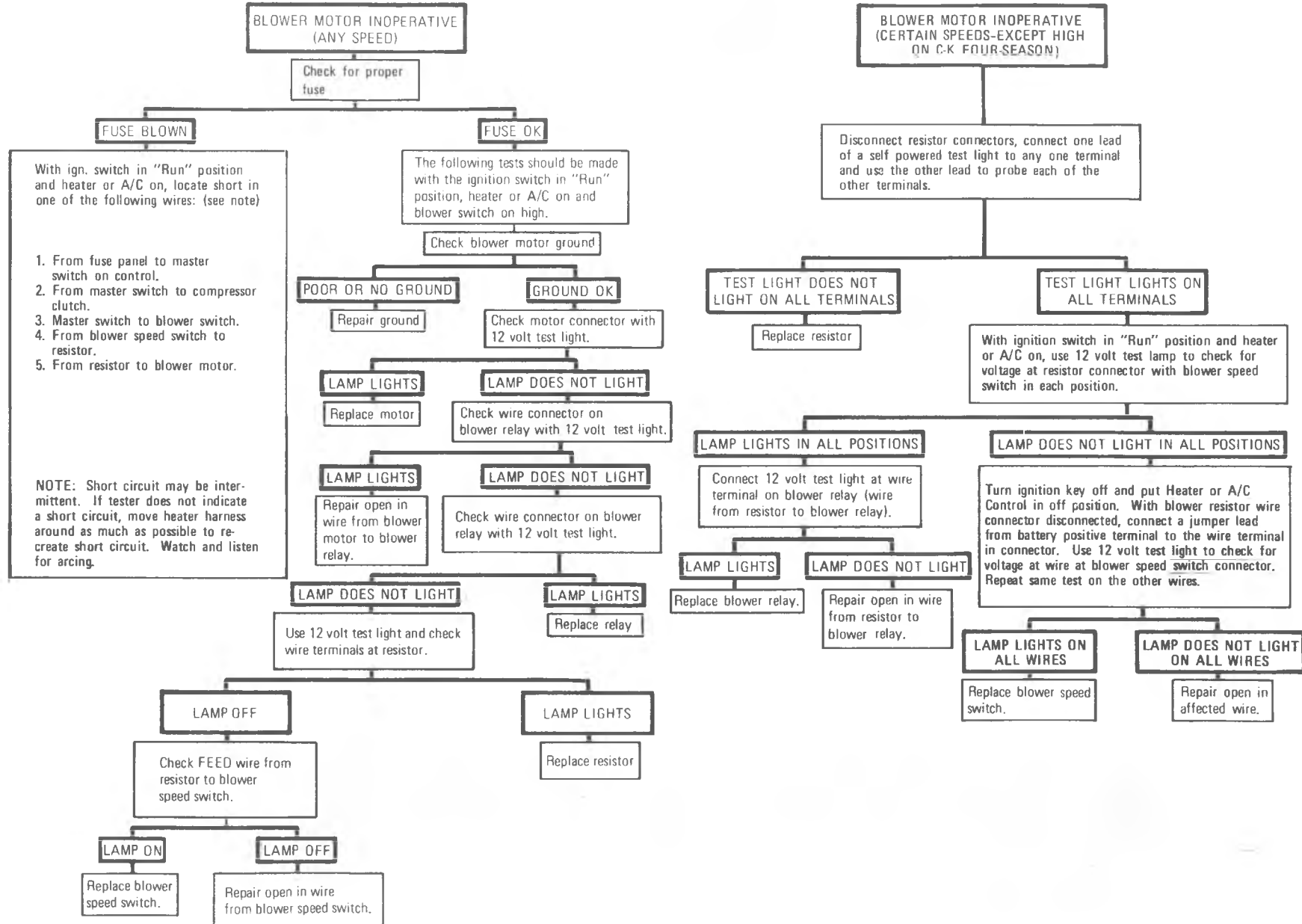
Dash Mounted Unit (Motor Home Chassis)

(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

ELECTRICAL SYSTEM DIAGNOSTIC CHART



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 BYPASS 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.

AIR FLOW

Adjust by-pass for no air flow.

HIGH AIR FLOW

Adjust defroster door for low air flow.

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.

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.

OVER 10 VOLTS

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.

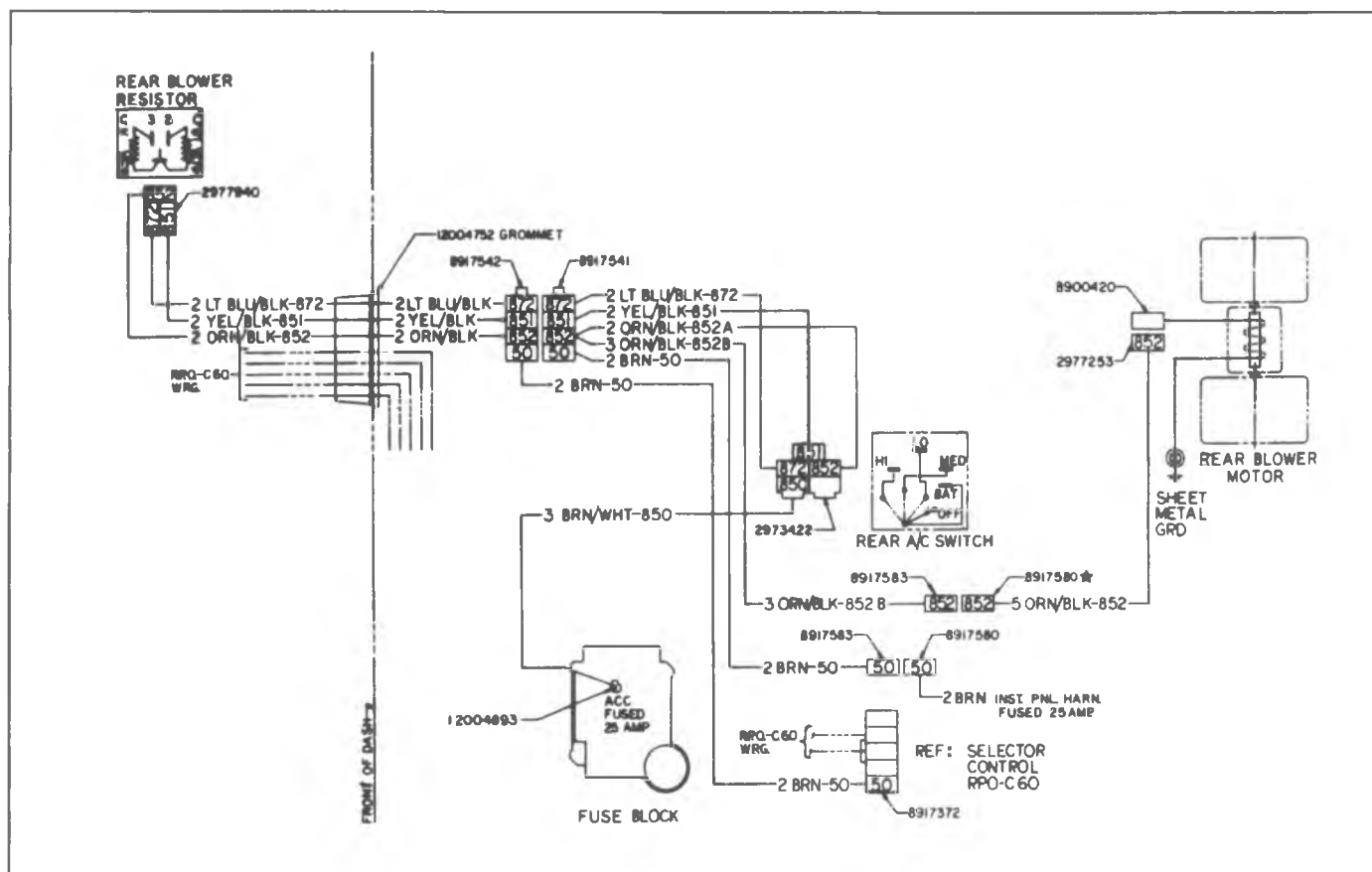
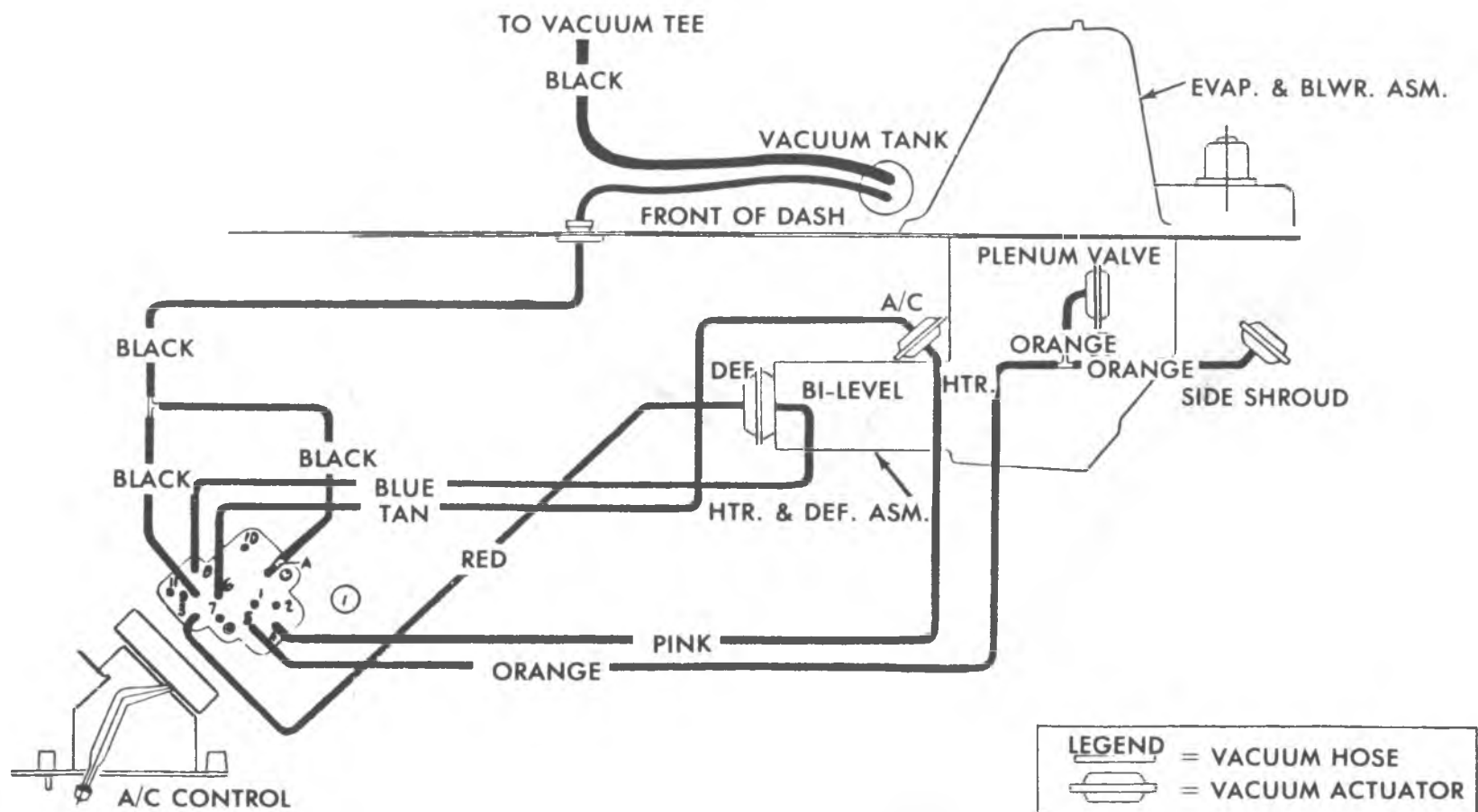


Fig. 1B-16--Overhead Systems Wiring Diagrams-All

Fig. 1B-17--C60 System Vacuum Diagram (C-K Series)



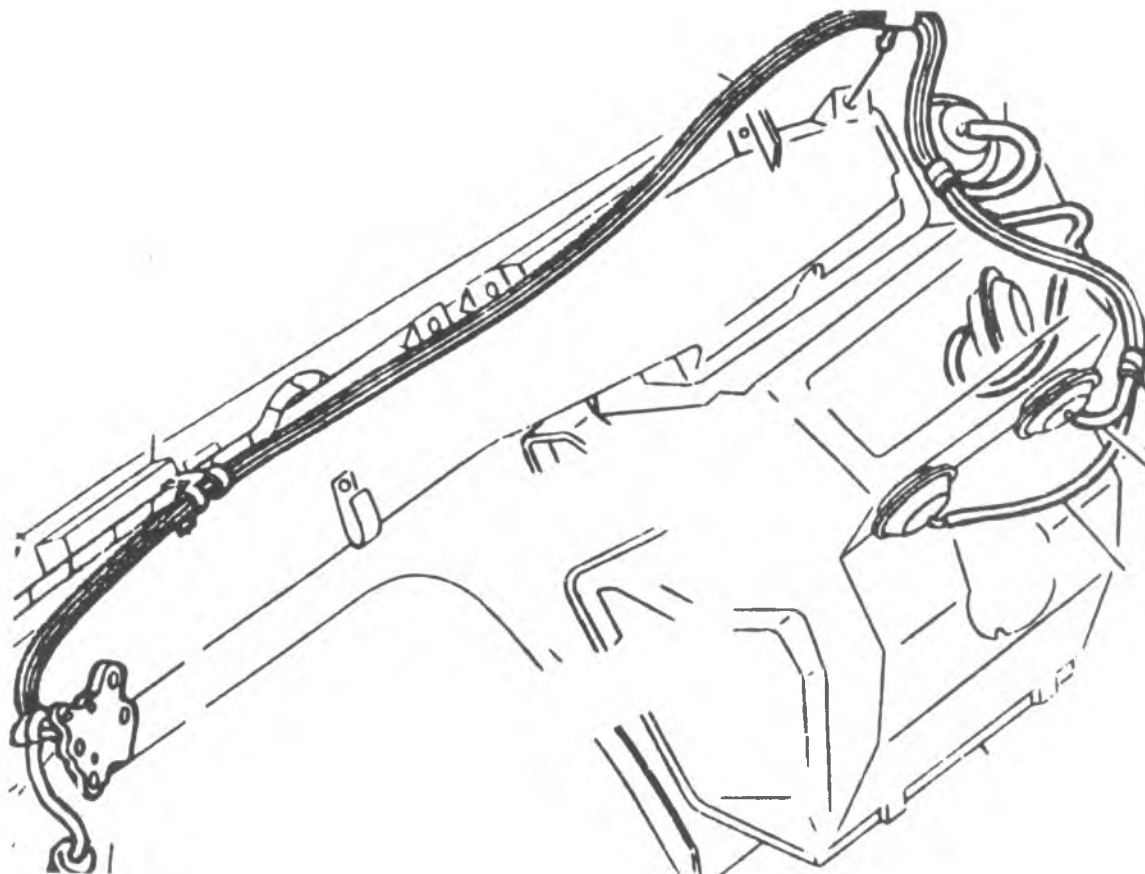
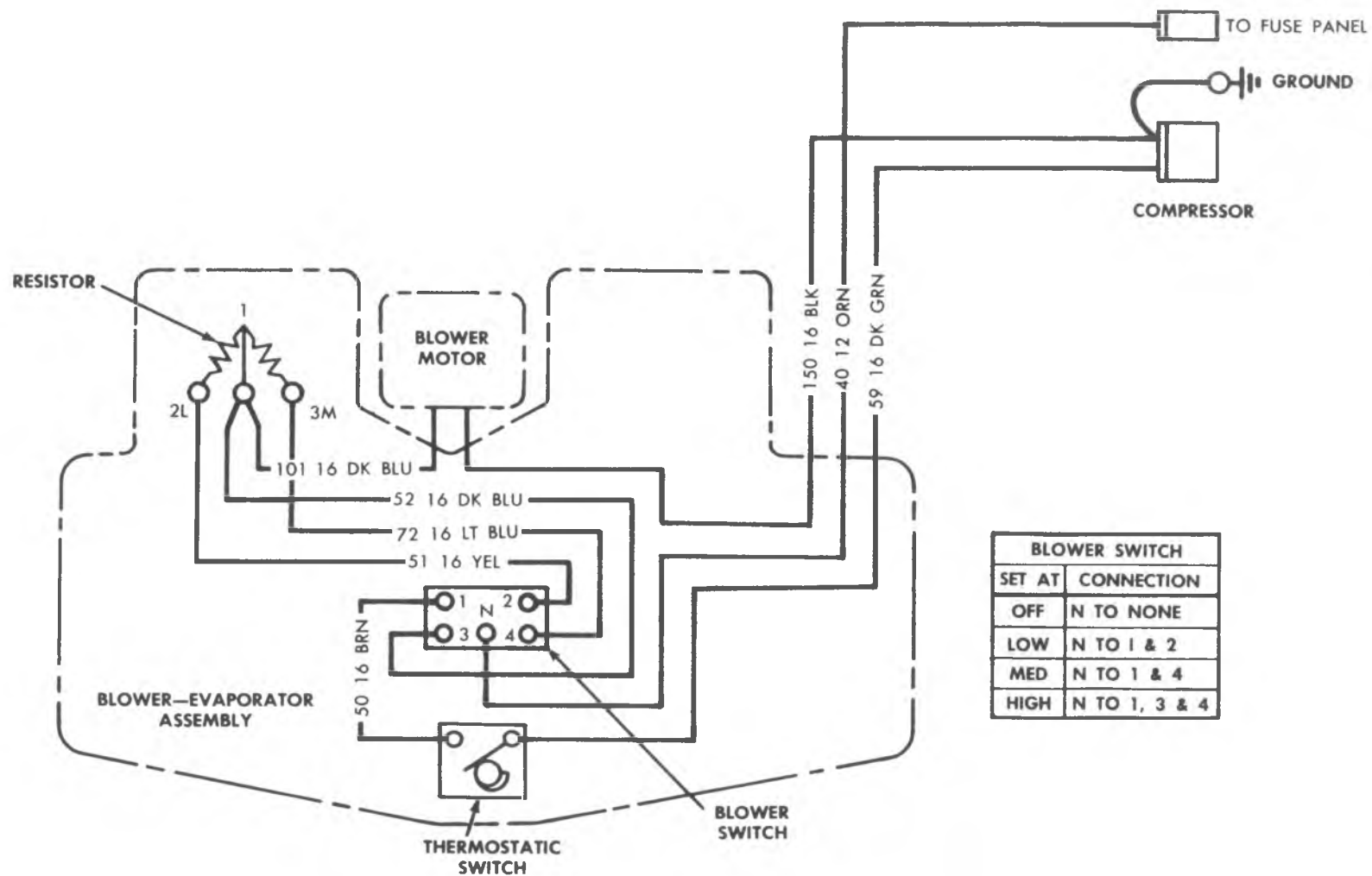


Fig. 1B-18--C60 System Vacuum Diagram (G Series)

Fig. 1B-19--C60 Motor Home Chassis Wiring Diagram



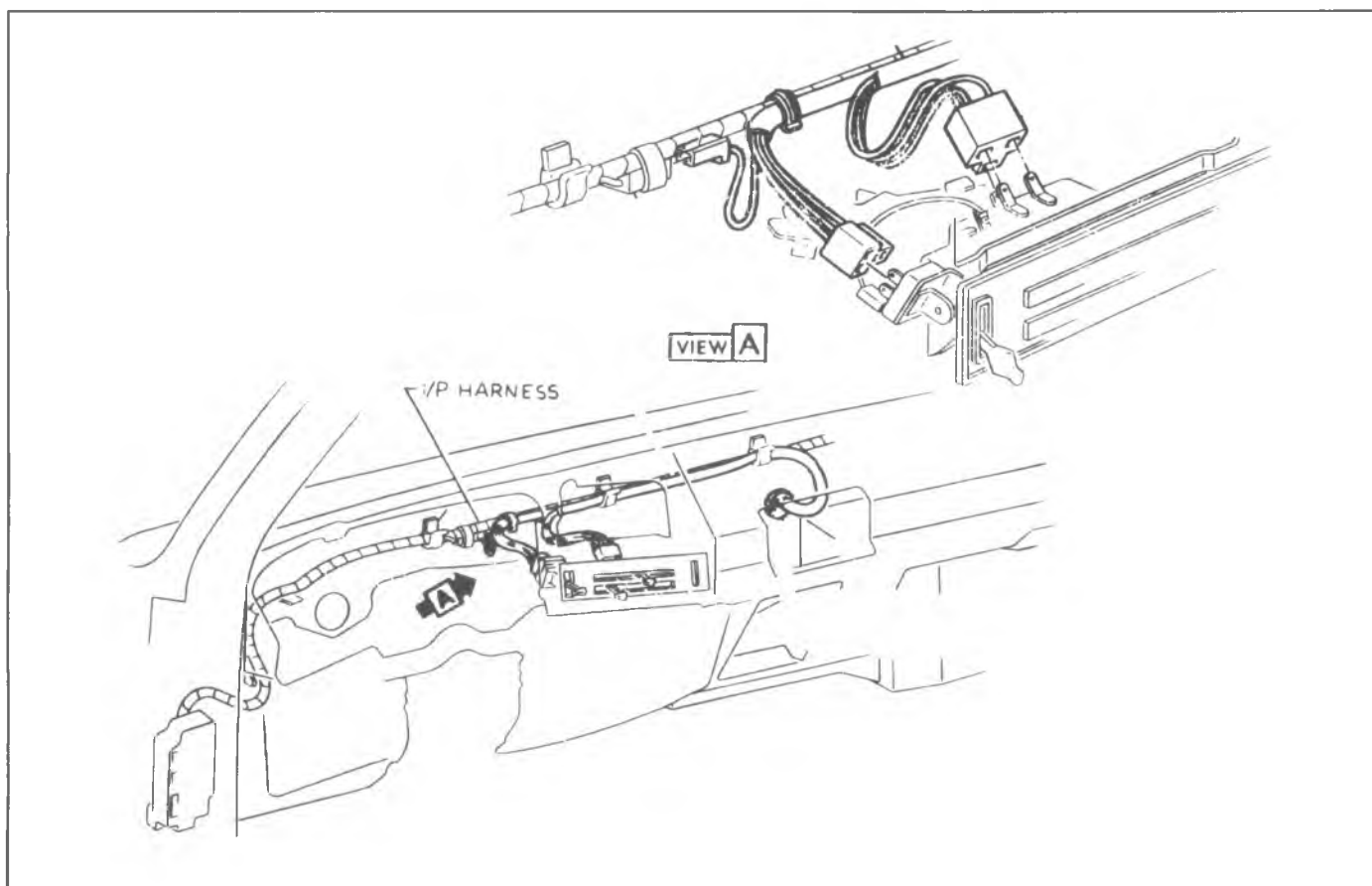


Fig. 1B-20--I.P. A/C Harness Wiring

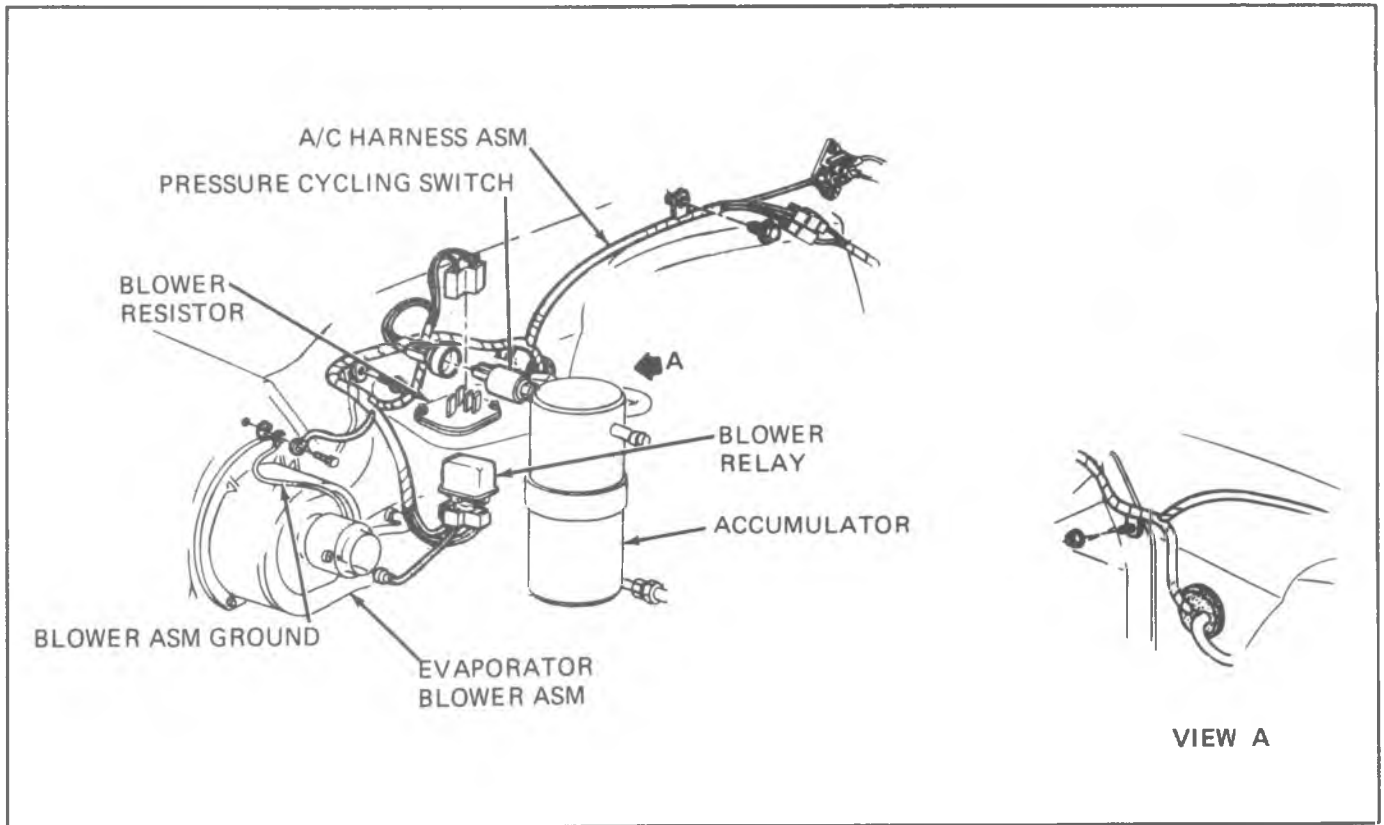


Fig. 1B-21--A/C Compressor wiring

ON VEHICLE SERVICE EVACUATING AND CHARGING PROCEDURES

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	28-37	1 1/16
3/4	1 1/16	30-35	41-48	28-33	38-45	1 1/4

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 1B-8. 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 are available (See A/C Special Tools).

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 Refrigerant-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

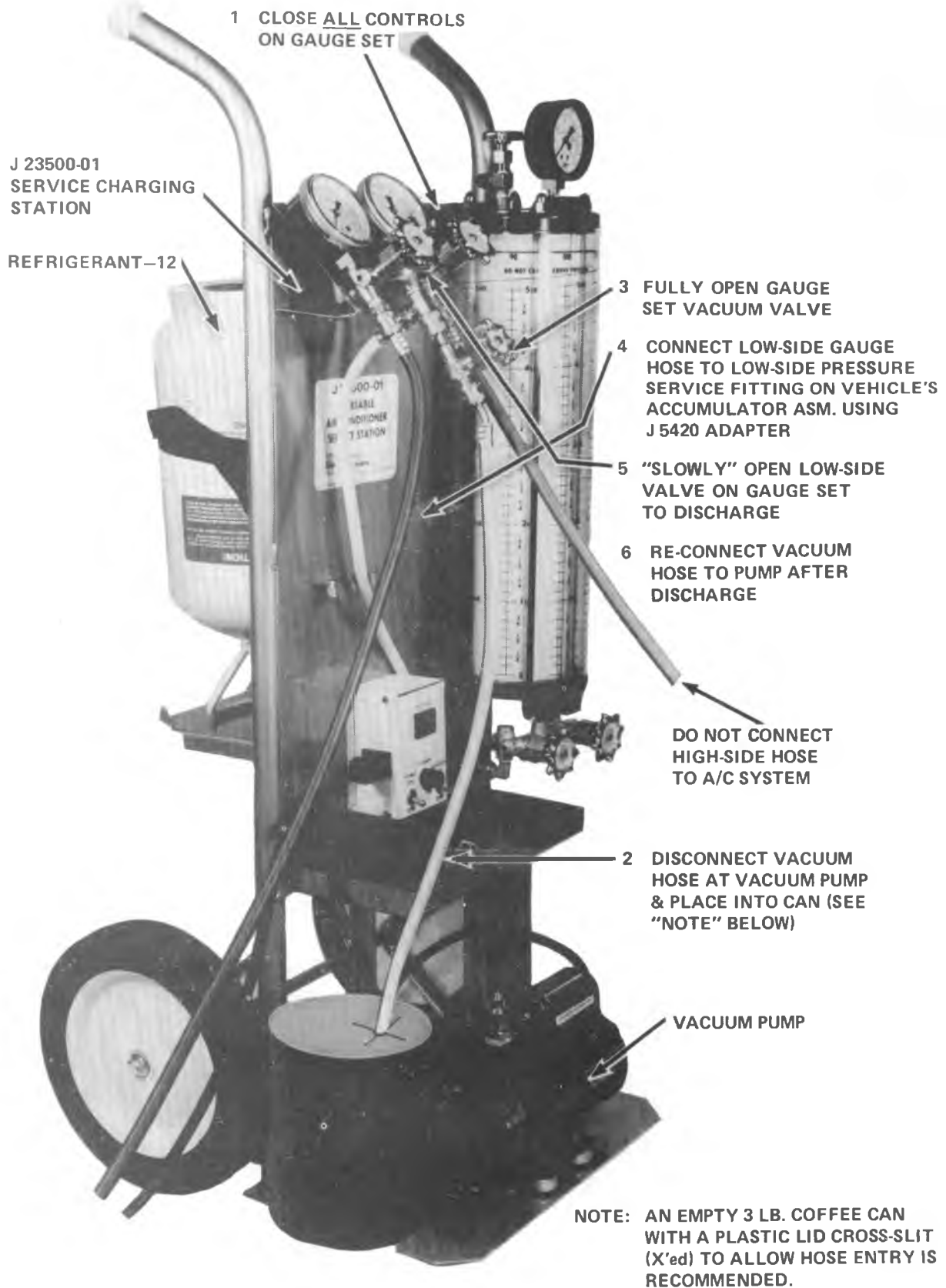
In replacing any of the air conditioning refrigeration components the system must be completely discharged of Refrigerant-12.

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-12.

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-12). 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).



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Fig. 1B-22--Discharging The CCOT System With J-23500-01 Charging Station

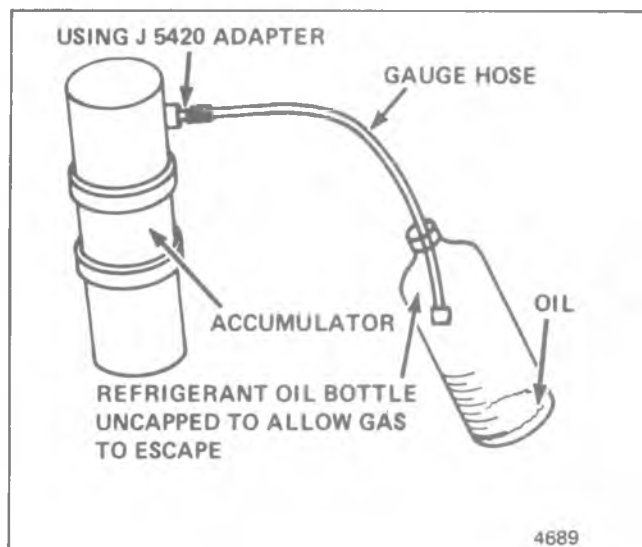


Fig. 1B-23--Discharging the CCOT A/C System Without Charging Station J-23500-01

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 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

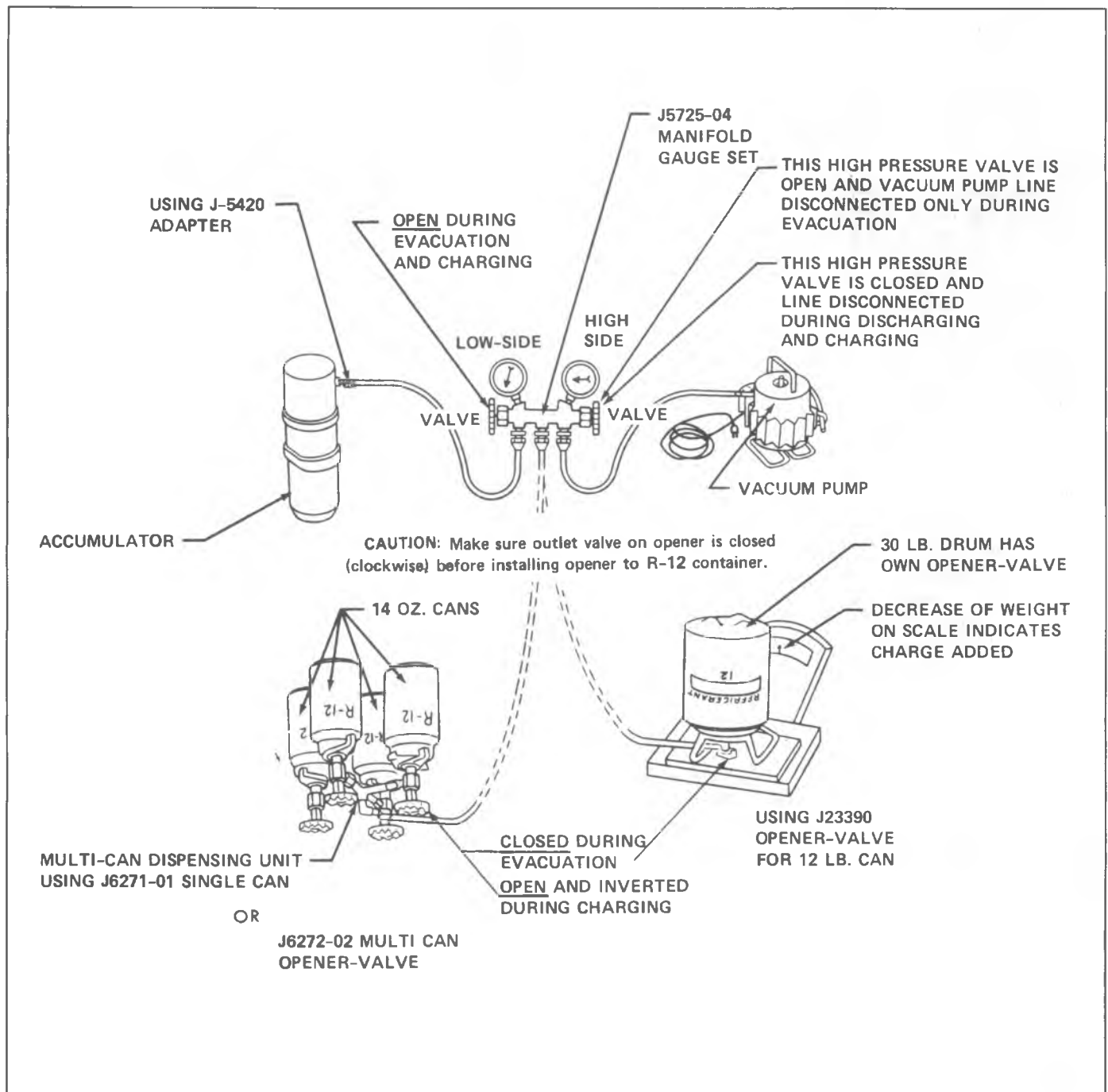


Fig. 1B-24--Charging the CCOT A/C System with Disposable Can or Refrigerant Drum.

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.

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-12.

- 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-13, 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 leak check. Discharge system again then repair leak as necessary. Repeat Evacuation procedure.

TO BEGIN 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-12).
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 line 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 Charts 1B-4 and 1B-5.

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 (Refer to "False Compressor Seizure"). 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.

NOTICE: 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 1 379 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 whether the refrigerant charge is sufficient. A shortage of liquid refrigerant is indicated

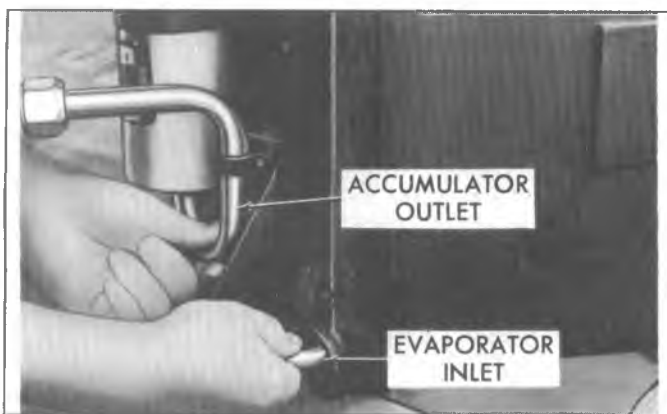


Fig. 1B-25--Checking Evaporator Inlet and Accumulator Outlet Temperatures

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.

COMPRESSOR

C-K SERIES

Removal (Fig. 1B-33)

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. Compressor servicing information is located in the Unit Repair Manual.

Installation

1. If oil previously drained from the compressor upon removal shows no evidence of contamination, replace a like 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

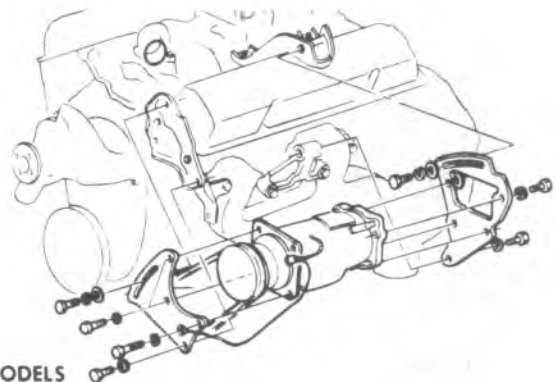
Removal (Fig. 1B-26)

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.

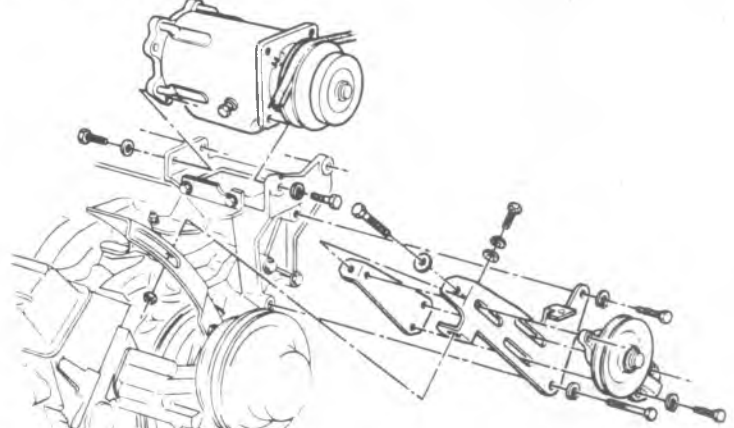
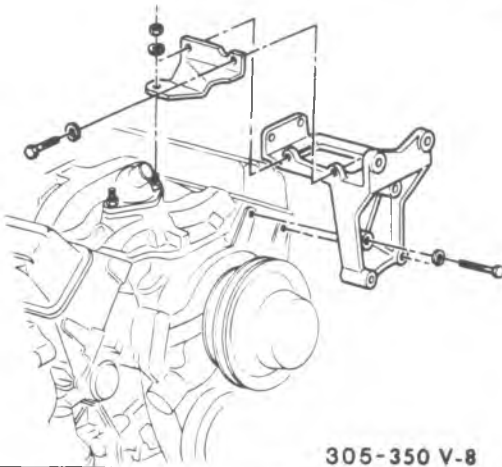
Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing. Compressor Servicing information is located in the Unit Repair Manual.

Installation

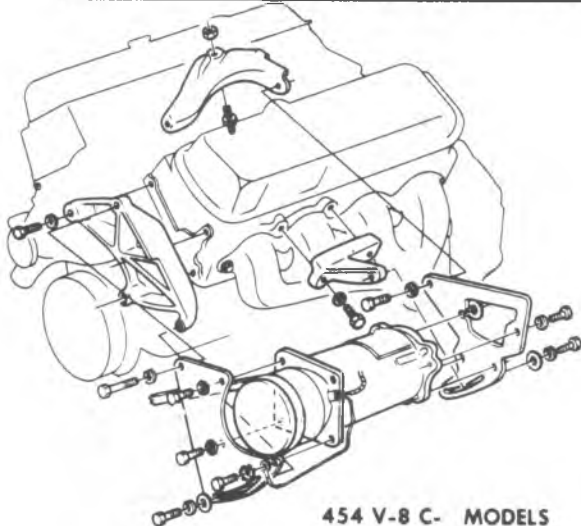
1. If the oil drained from the compressor showed no evidence of contamination replace the same amount of fresh refrigeration oil into the compressor before reinstallation. If it is necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil in the compressor. (Refer to Checking Compressor Oil Charge in the diagnosis section of this service manual.)
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.



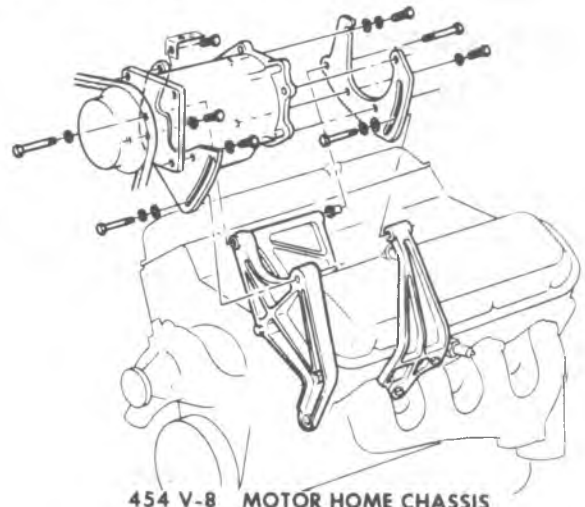
305-350 V-8 C-K MODELS



305-350 V-8 G MODELS AND MOTOR HOME CHASSIS



454 V-8 C- MODELS



454 V-8 MOTOR HOME CHASSIS

Fig. 1B-26--Compressor Mounting

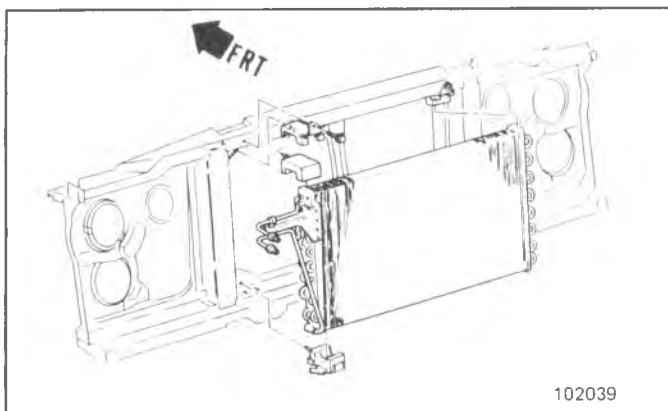


Fig. 1B-27--Condenser Installation (C-K Series)

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 (FIG. 1B-27)

Replacement (Fig. 1B-27)

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.

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-28)

1. Disconnect the battery ground cable.
2. Discharge system.
3. Remove the nuts from the selector duct studs projecting through the dash panel.

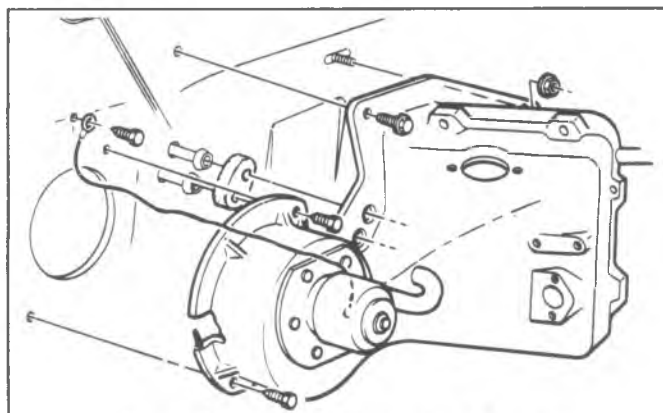


Fig. 1B-28--Blower-Evaporator (C-K Series)

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 connectins 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-30)

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.
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-31)

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 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-31)

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-32)

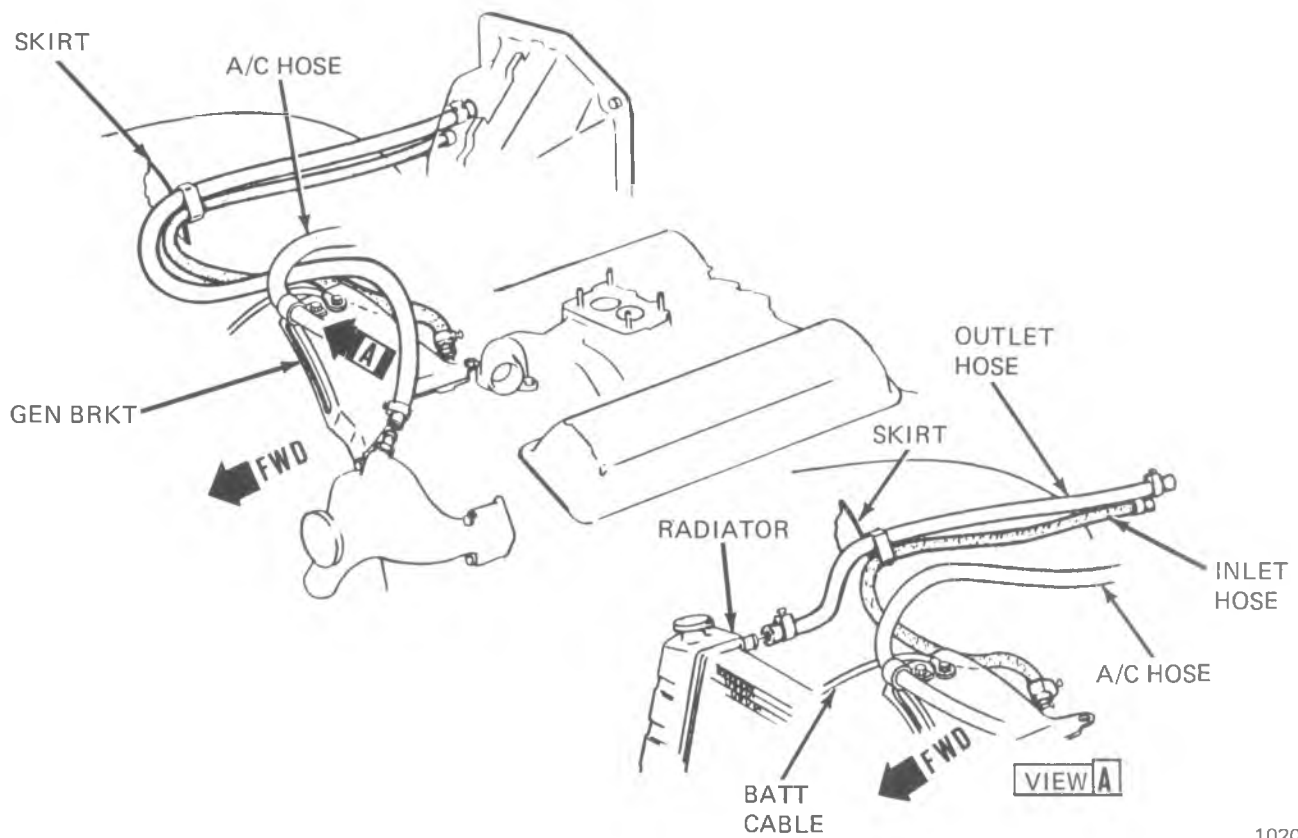
1. Disconnect the battery ground cable.
2. Remove the radio as outlined in Section 8 of this manual.
3. Remove the instrument panel bezel.
4. Remove the control to instrument panel screws and lower the control far enough to gain access to the control assembly.
Be careful not to kink the bowden cable.
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.



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Fig. 1B-29--Heater Hose Routings (C-K Series)

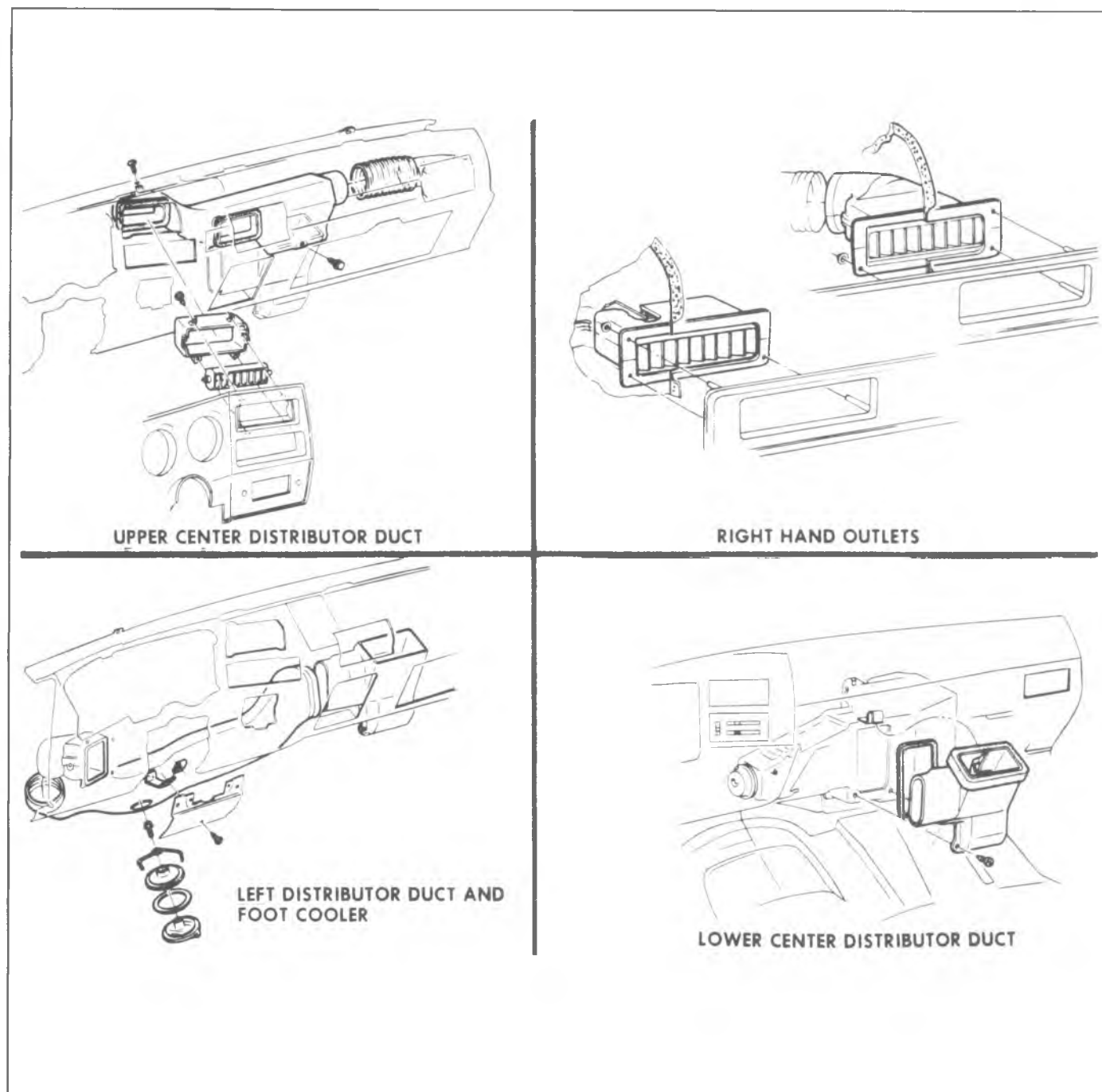


Fig. 1B-30--Air Selector and Ducts (C-K Series)

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-33).

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-35).

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

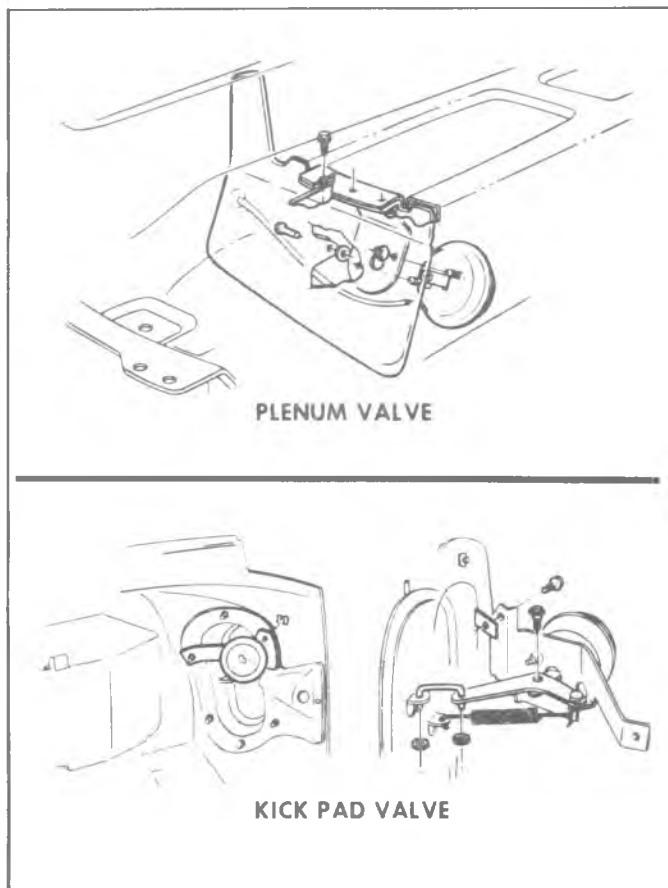


Fig. 1B-31--Air Inlet Valves (C-K Models)

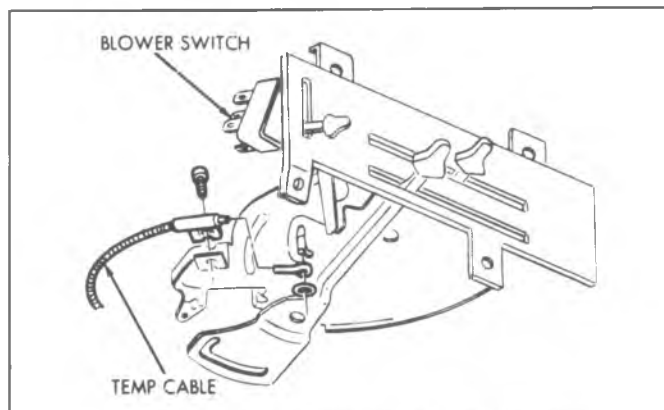


Fig. 1B-32--Control Assembly C-K, C60 System

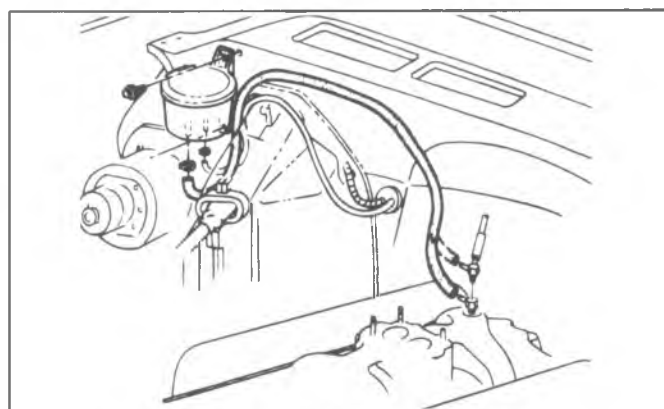


Fig. 1B-33--Vacuum Tank C-K Models

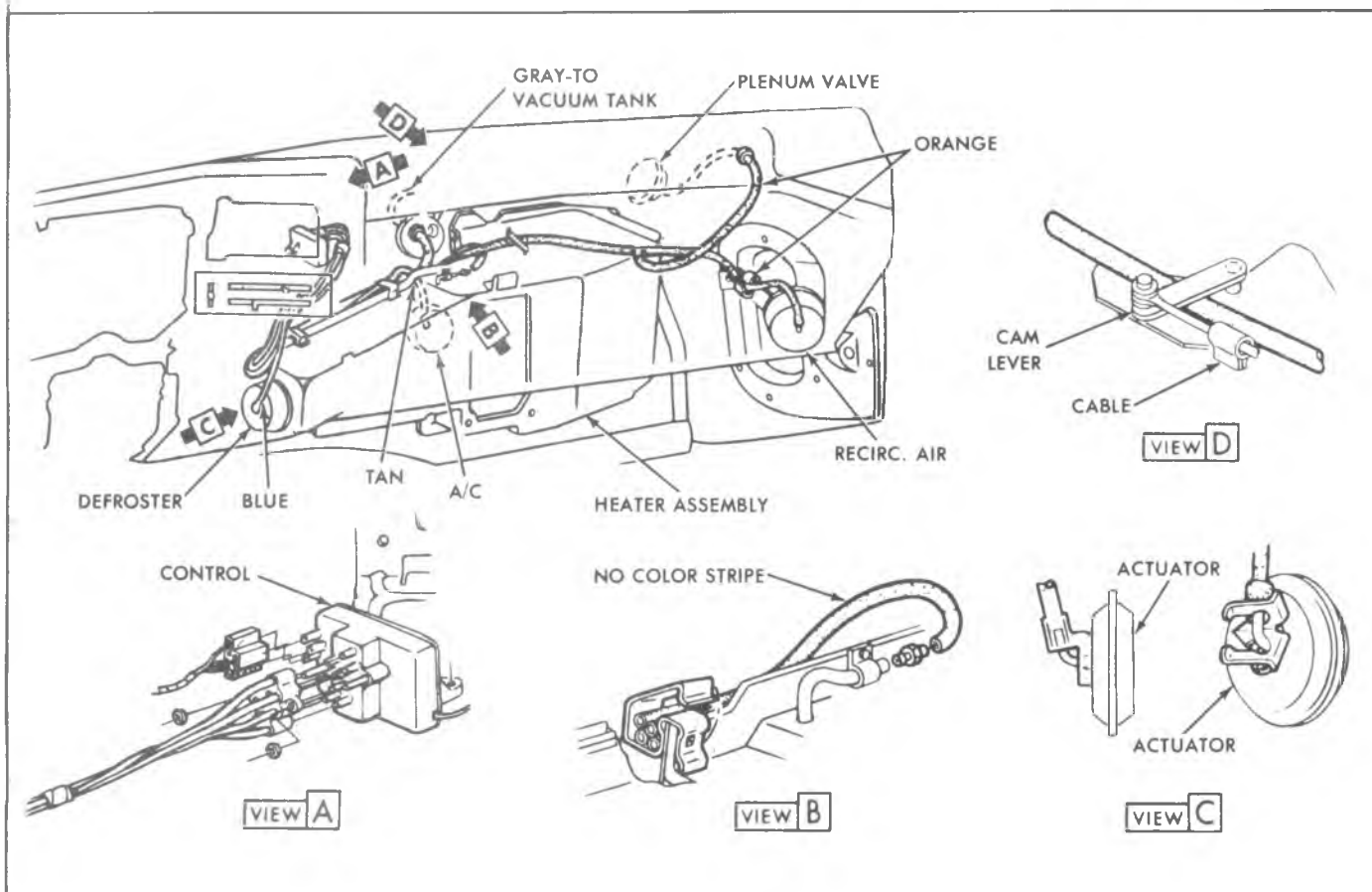


Fig. 1B-34--Vacuum Line Routing - C-K Models

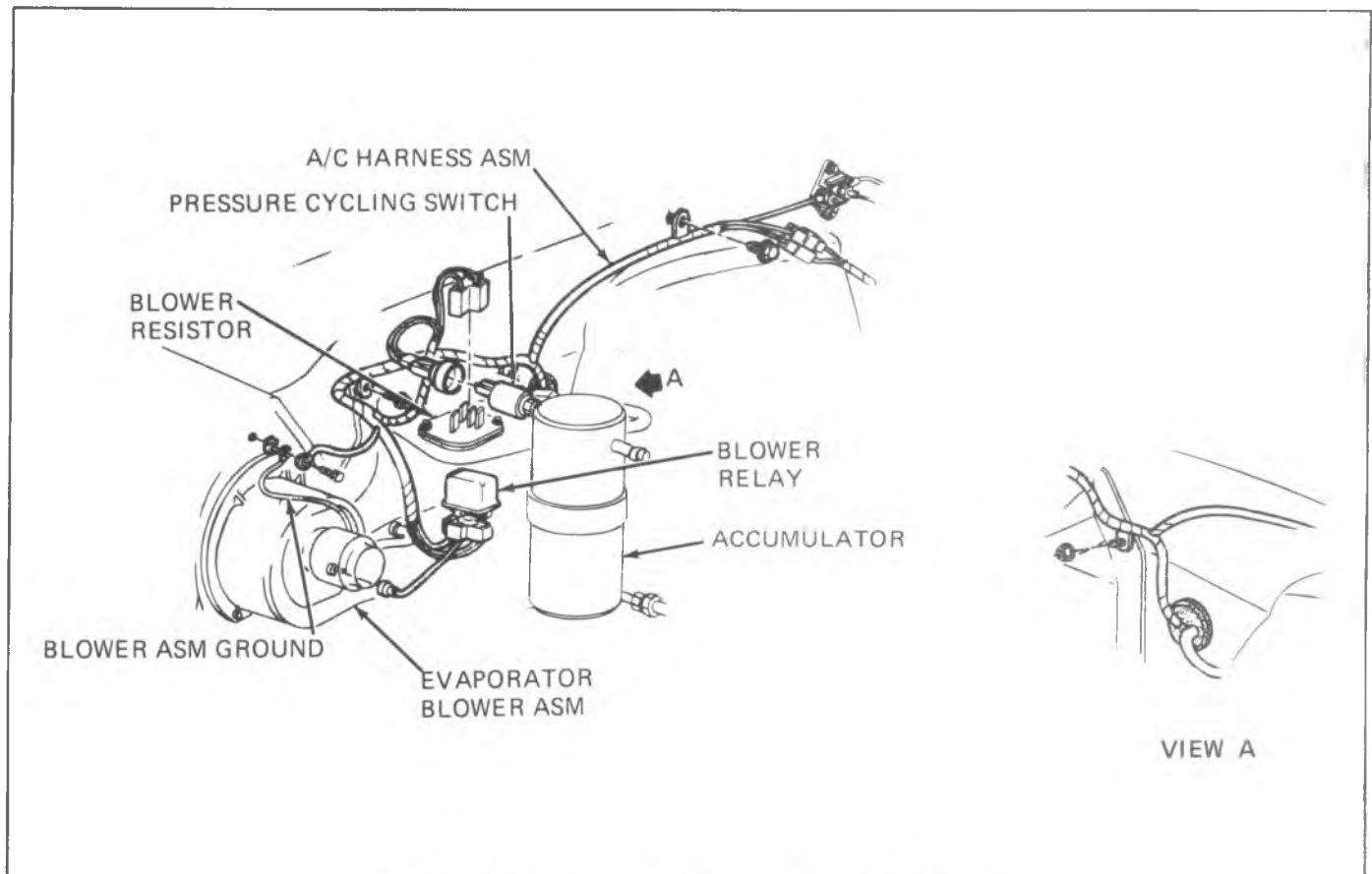


Fig. 1B-35--Engine Compartment Wiring Harness (C-K Models)

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. 35).

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.

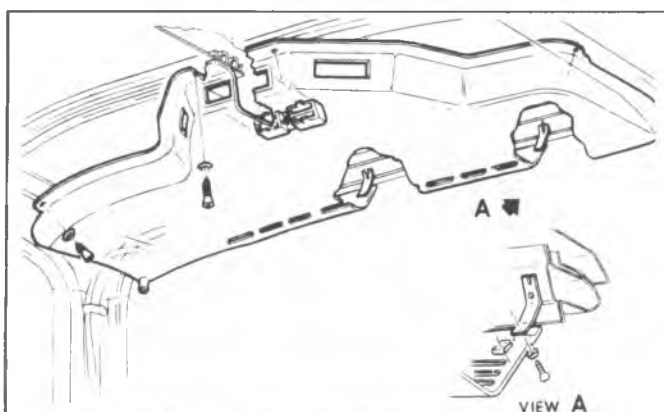


Fig. 1B-36--Rear Duct C-K & G Overhead System

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-36).

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.
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-37.

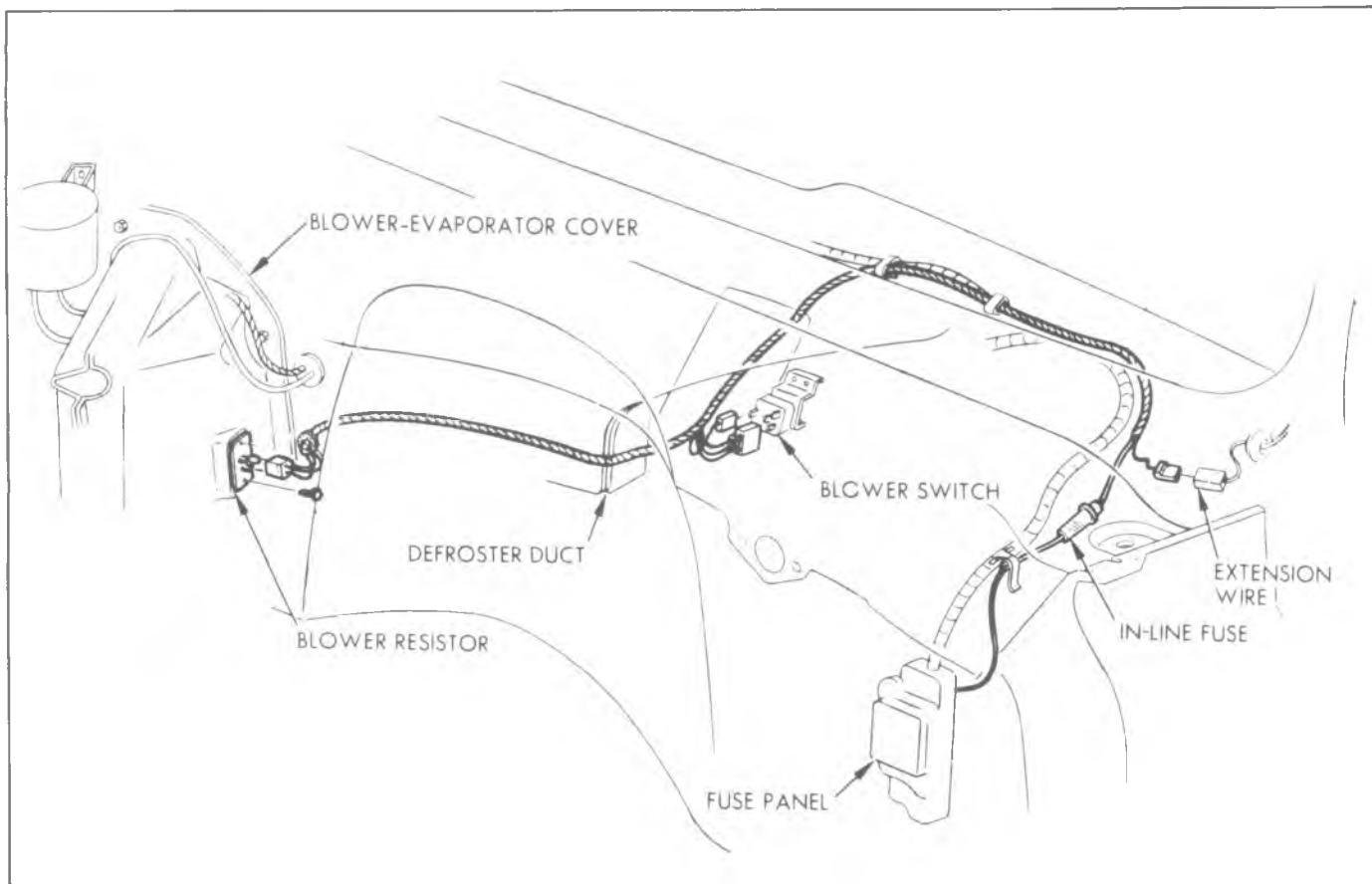


Fig. 1B-37--Overhead System Front Wiring (C-K Models)

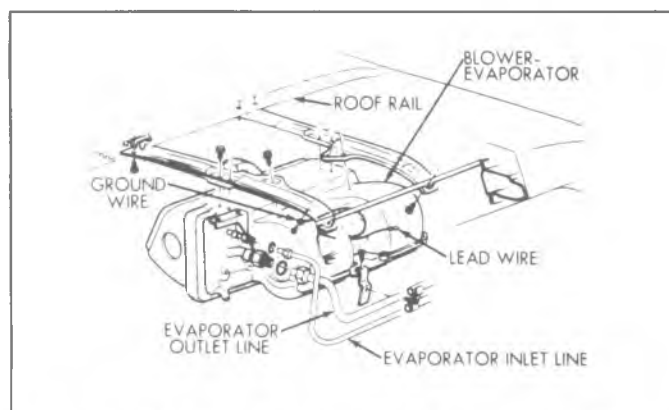


Fig. 1B-38--Blower-Evaporator (C-K Overhead System)

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.

BLOWER MOTOR ASSEMBLY

Removal (Fig. 1B-38)

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-39.

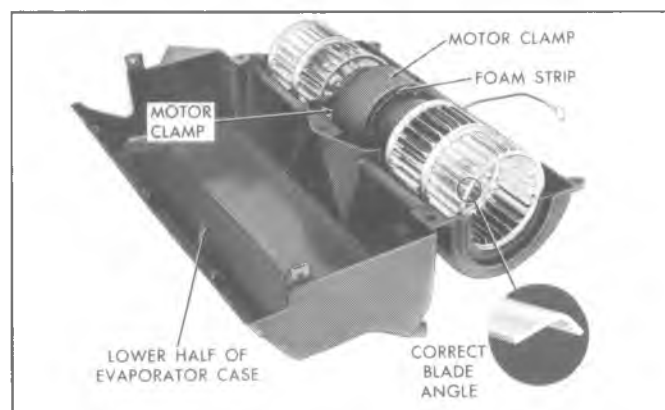


Fig. 1B-39--Blower Motor (C-K Overhead System)

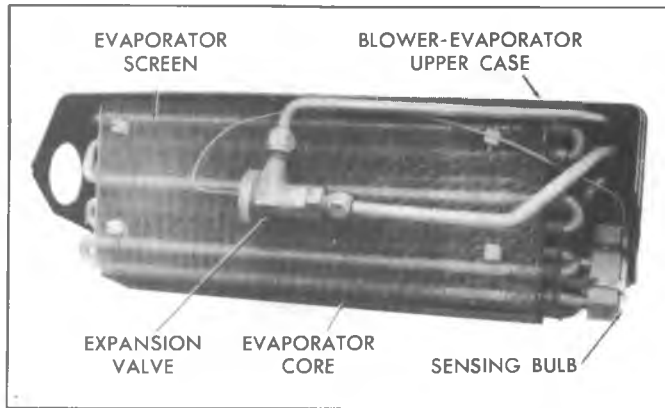


Fig. 1B-40-Expansion Valve C69 System

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 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 system incorporates an expansion valve which does not utilize an external equalizer line (Fig. 1B-40).

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.
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 (Fig. 1B-40)

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-44; 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.



Fig. 1B-41-Blower Switch (C-K Overhead System)

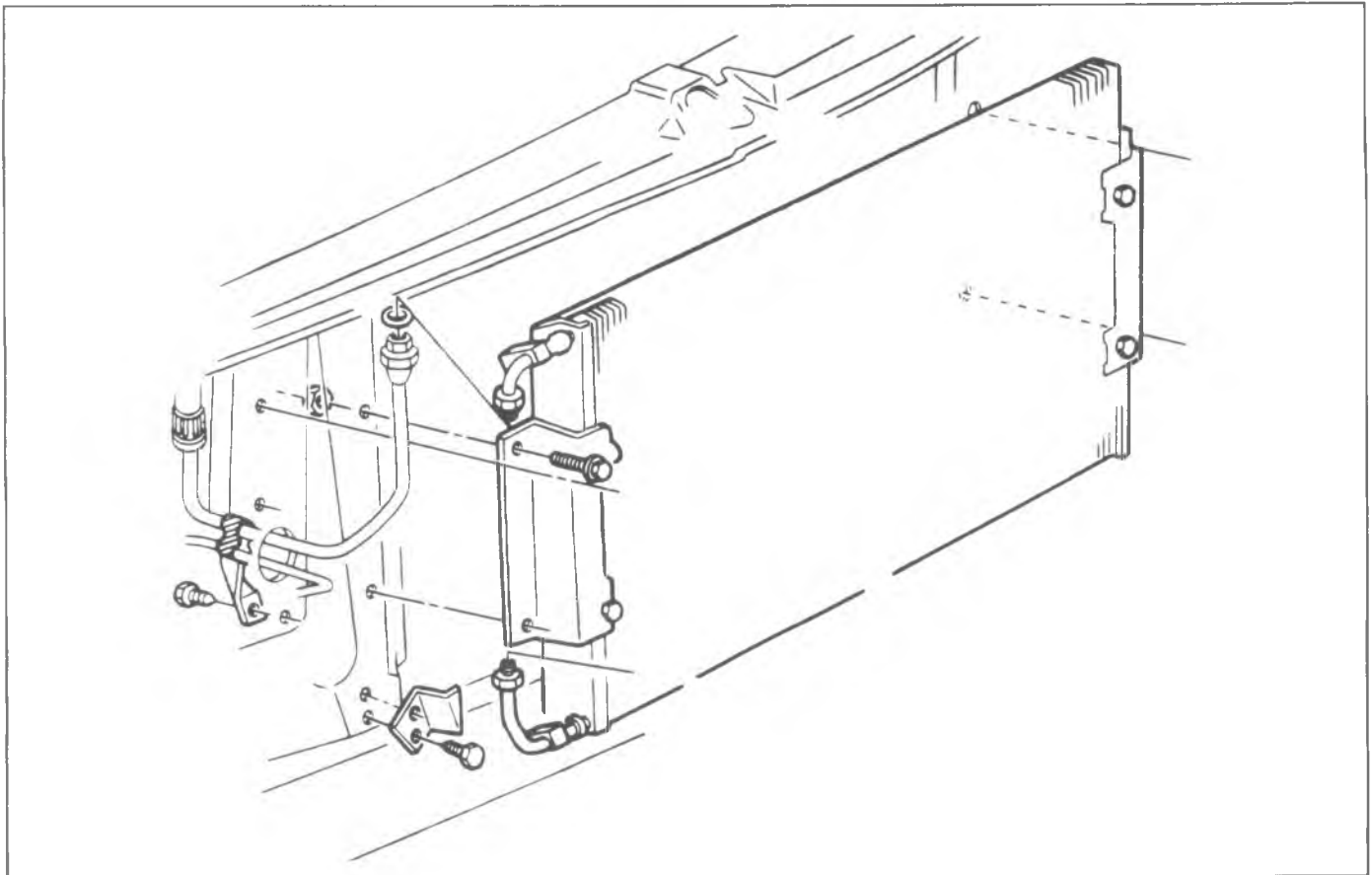


Fig. 1B-42--Condenser-G Series

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 (Fig. 1B-41).

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.

Refer to Fig. 1B-61 thru 1B-66 for condenser inlet and outlet connections, compressor refrigerant line connections, and general refrigerant line routing and connections.

HEATER AIR DISTRIBUTOR

AND EXTENSION DUCT - G SERIES

Replacement (Fig. 1B-43)

1. Disconnect battery ground cable.
2. Remove engine cover.
3. Remove evaporator-blower shield.
4. Remove shield bracket.
5. Remove left floor outlet deflector and bracket.
6. Loosen steering column to instrument panel reinforcement screws. Remove one screw. Torque both screws on installation.
7. Disconnect speedometer cable at meter.

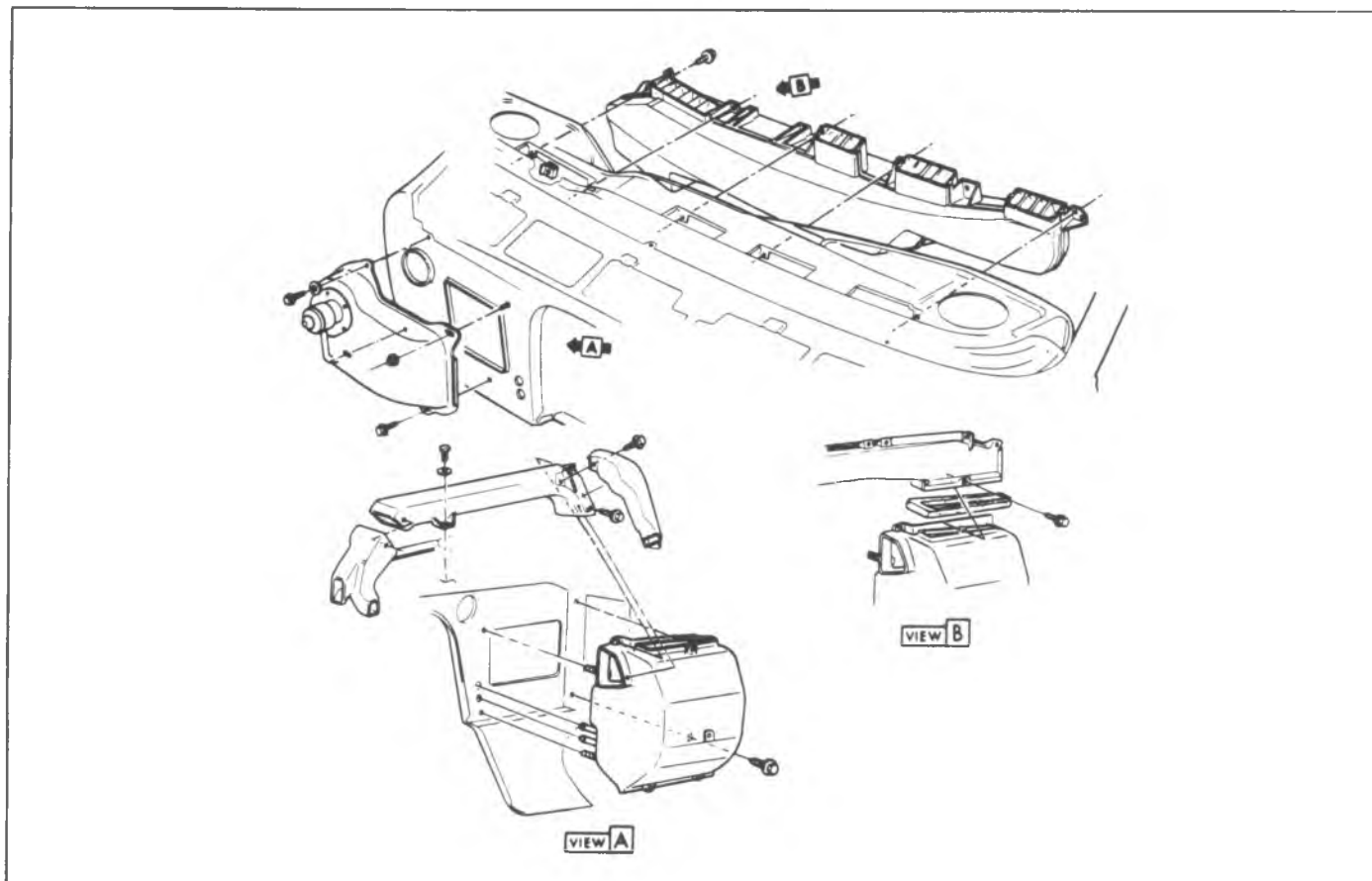


Fig. 1B-43--Heater Distributor Duct-G Series

HEATER CORE - G SERIES

Replacement

1. Disconnect battery ground cable.
2. Remove engine cover as outlined in Section 6A of this manual.
3. Remove steering column to instrument panel attaching bolts and lower column.
4. Remove upper and lower instrument panel attaching

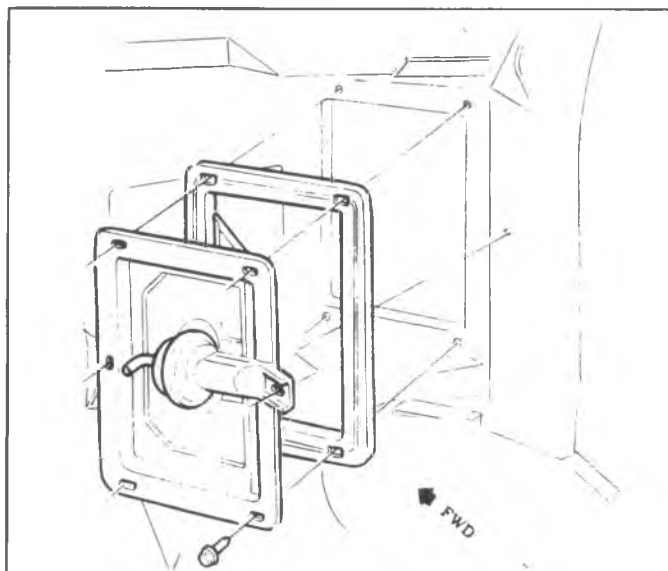


Fig. 1B-44--Recirculating Air Door Vacuum Actuator

- screws and radio support bracket attaching screw.
5. Raise and support right side of instrument panel.
6. Remove right lower instrument panel support bracket.
7. Remove recirculating air door vacuum actuator. Refer to Fig. 1B-44.
8. Disconnect temperature cable and vacuum hoses at distributor case.
9. Remove heater distributor duct, refer to Fig. 1B-45.
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.
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-46.
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.

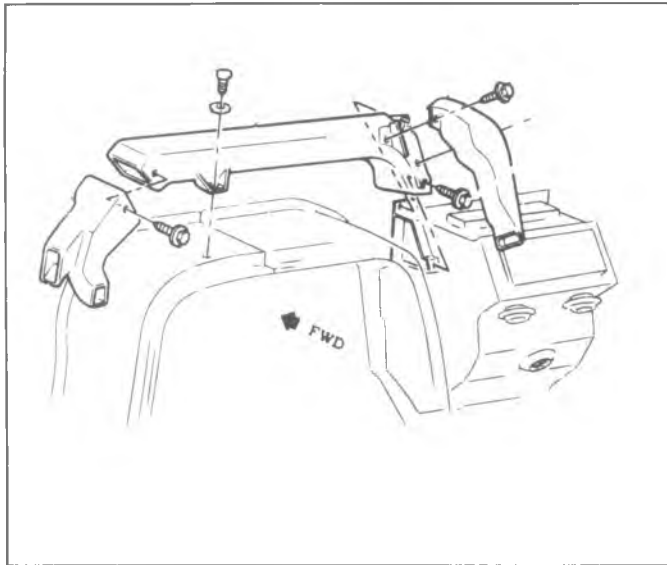


Fig. 1B-45--Heater Distributor Duct

BLOWER MOTOR - G SERIES

Replacement

1. Disconnect battery ground cable.
- G Series** - 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 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-54)

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.

TEMPERATURE DOOR CABLE - G SERIES

Replacement

Follow Steps 1 thru 10 of "Heater Air Distributor and Extension Duct Replacement" procedure.

11. Disconnect temperature door control cable at heater case.
12. Disconnect temperature door control cable at control.
13. Make up new cable.
14. To reassemble, Reverse Steps 1 thru 13.

CONTROL - G SERIES

Replacement (Fig. 1B-48)

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

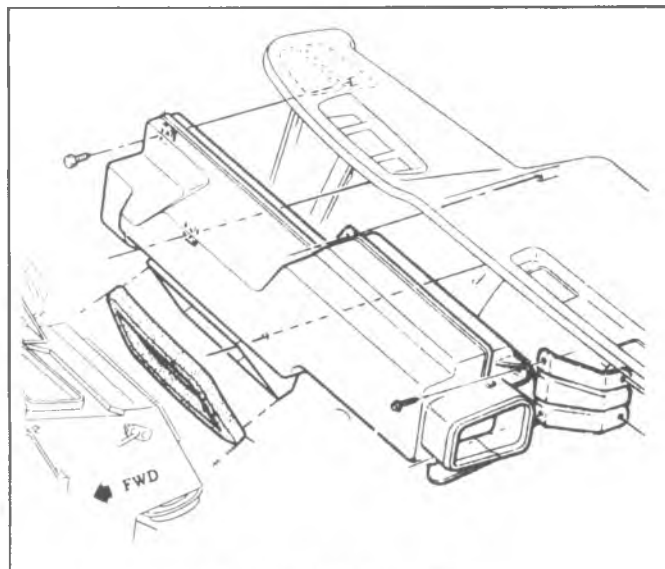


Fig. 1B-46--Distributor Gasket

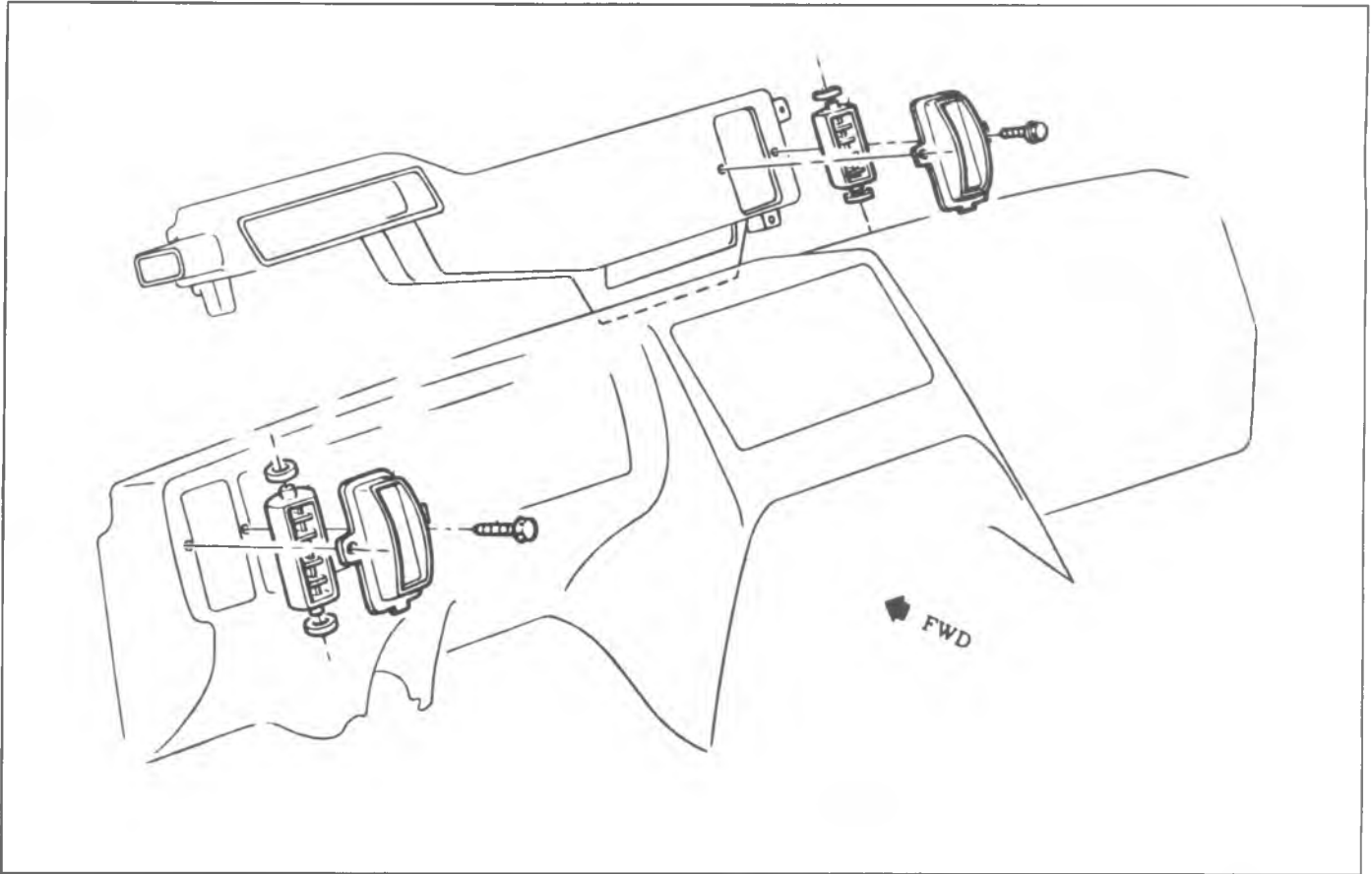


Fig. 1B-47--Air Deflector Outlets (G Series-C60 System)

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

RESISTORS

Replacement (Fig. 1B-49)

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-49)

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.

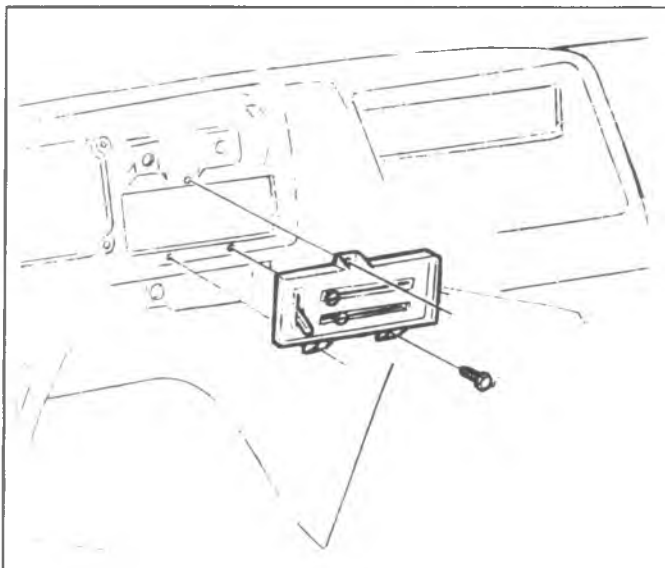


Fig. 1B-48--Control (G Series-C60 System)

BLOWER SWITCH

Replacement (Fig. 1B-48)

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.

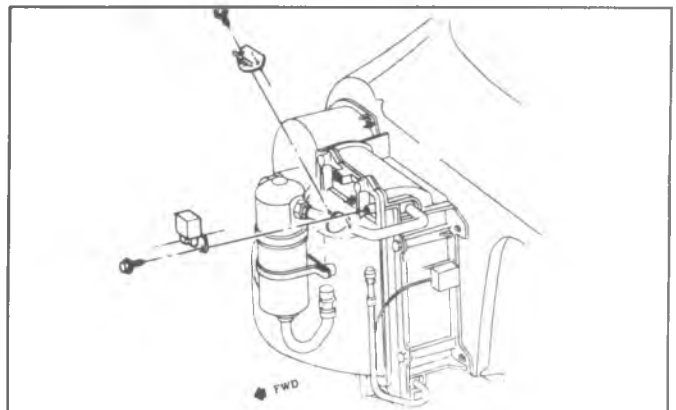


Fig. 1B-49--Blower Motor Relay

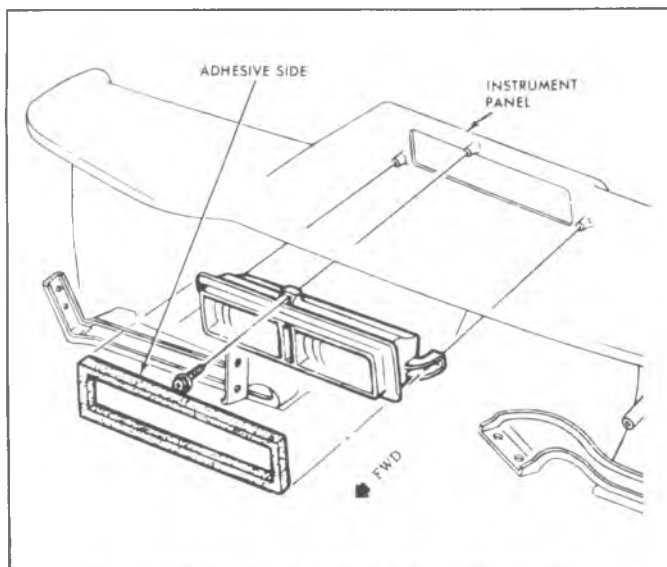


Fig. 1B-50--Center A/C Outlet Assembly-G Series

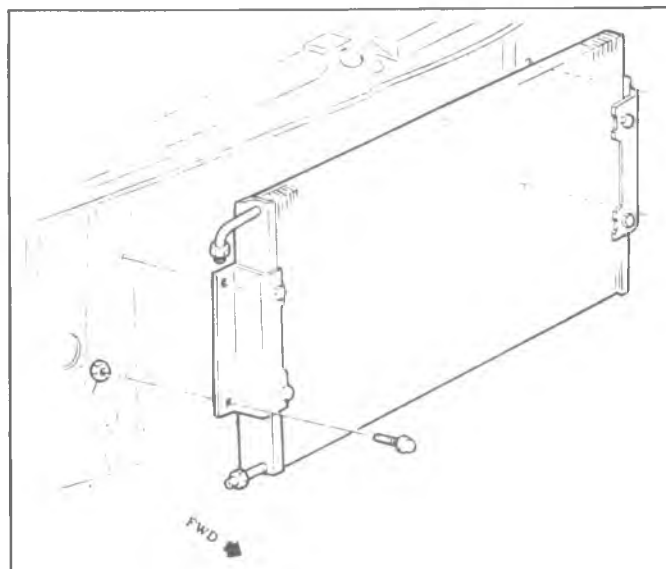


Fig. 1B-53--Condenser Installation-G Series

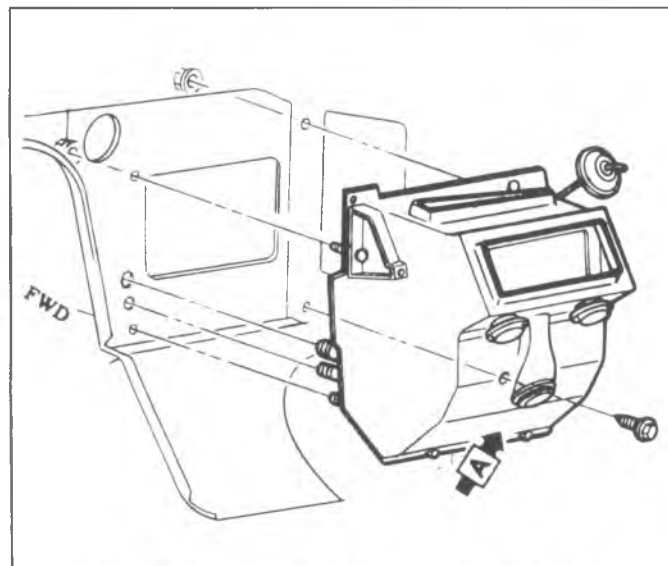


Fig. 1B-51--Heater Defroster Assembly-G Series

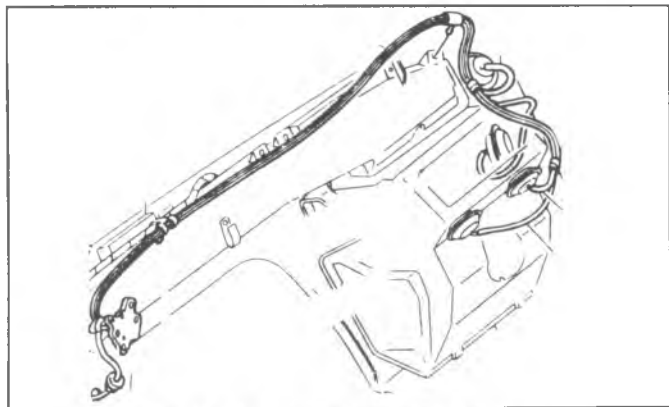


Fig. 1B-52--Vacuum Harness (G Series)

CENTER A/C OUTLET - G SERIES

Replacement

1. Disconnect negative battery cable.
2. Remove engine cover (Refer to Section 6A).
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.

VACUUM LINES-G VAN

Replacement

Vacuum line routing is illustrated in Fig. 1B-52.

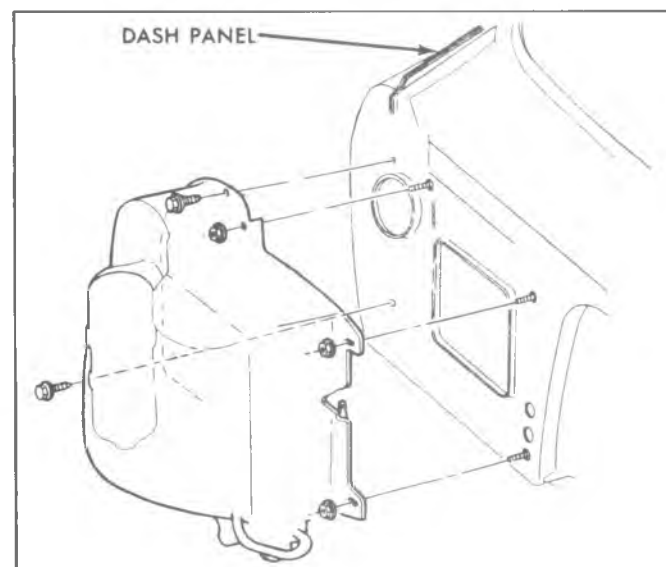


Fig. 1B-54--Evaporator Blower Assembly-G Series

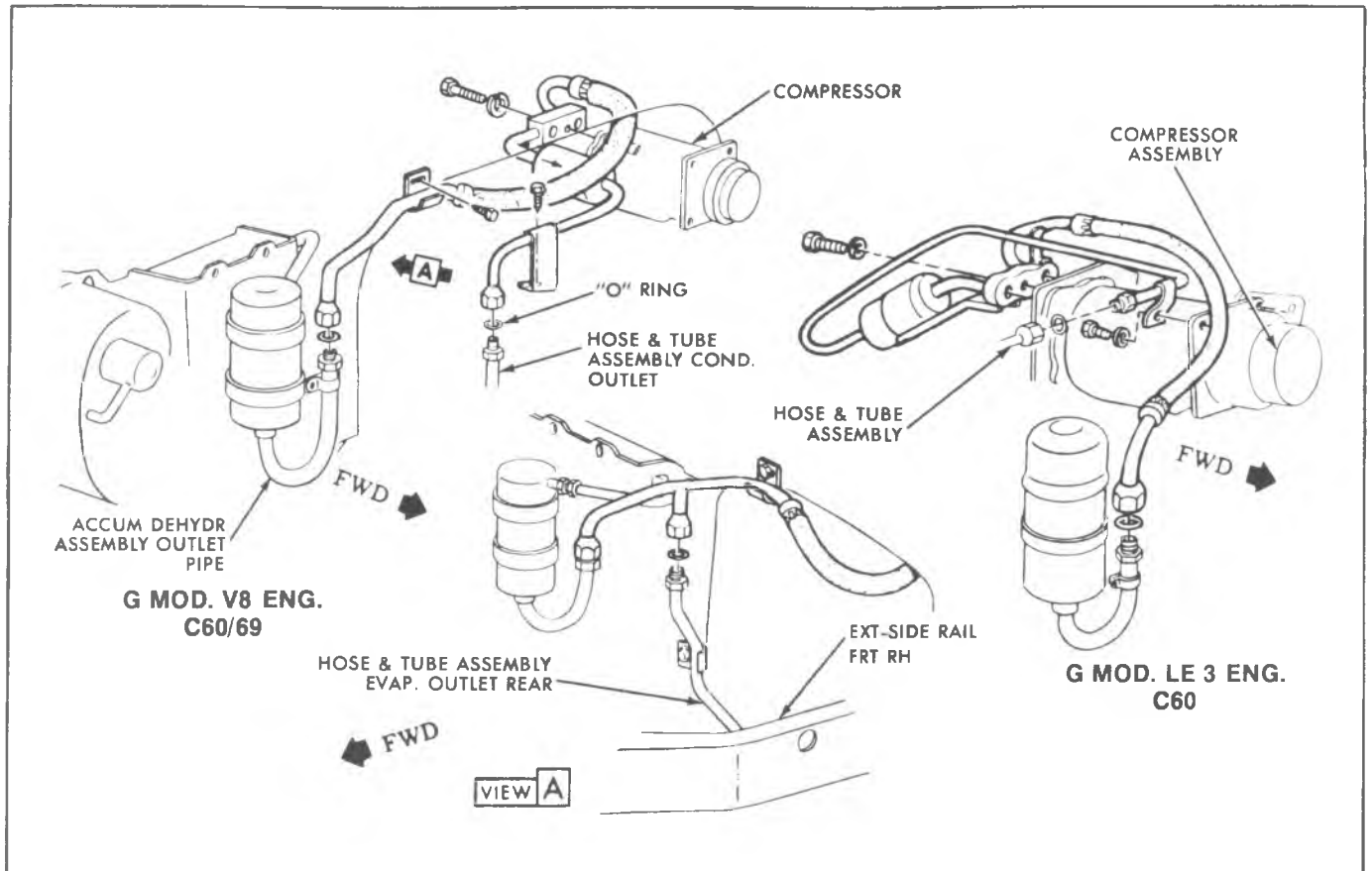


Fig. 1B-55-Refrigerant Lines - G Series

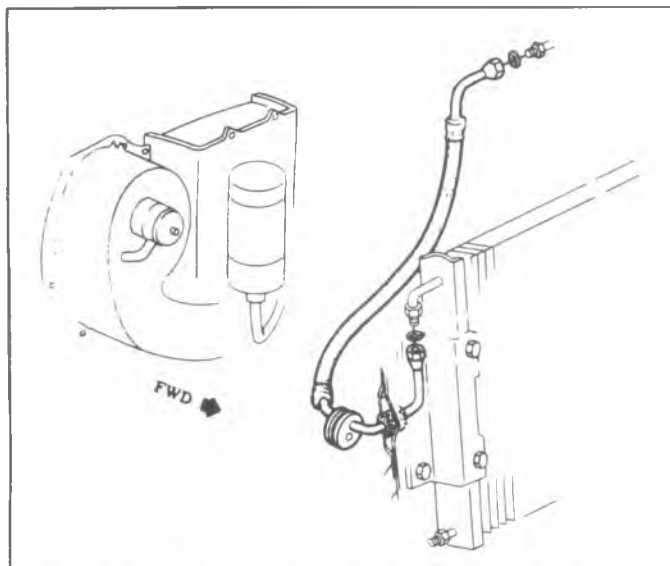


Fig. 1B-56--Refrigerant Lines-Condenser Inlet 6 Cyl Engine

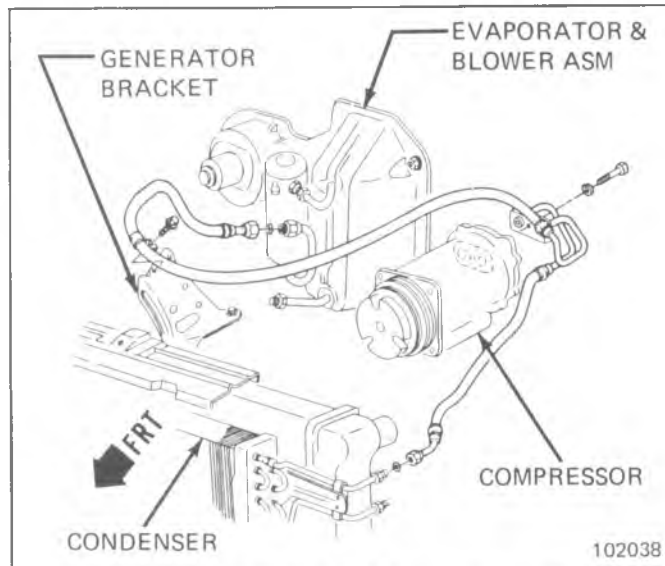


Fig. 1B-58--C-K Models Refrigerant Lines-V8

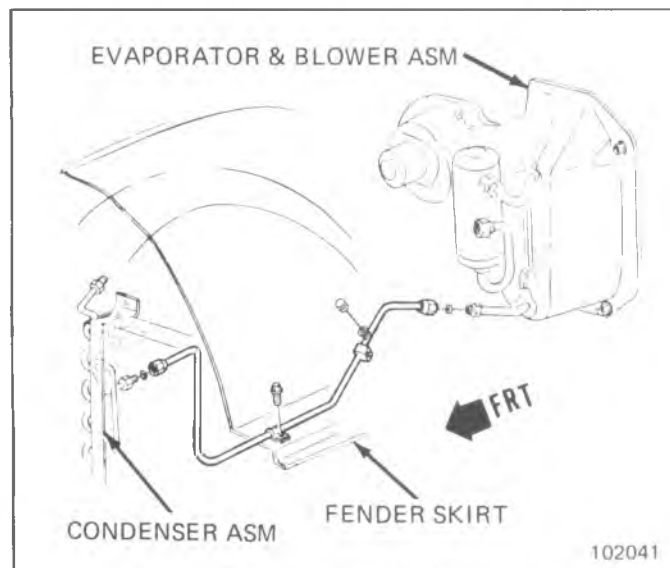


Fig. 1B-57--Refrigerant Lines-Diesel Engine

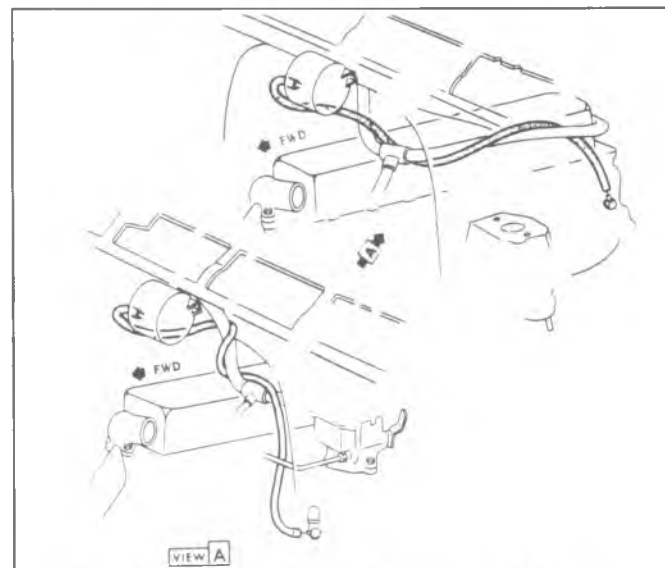


Fig. 1B-60--Vacuum Tank-G Series with 6 Cyl. Engine

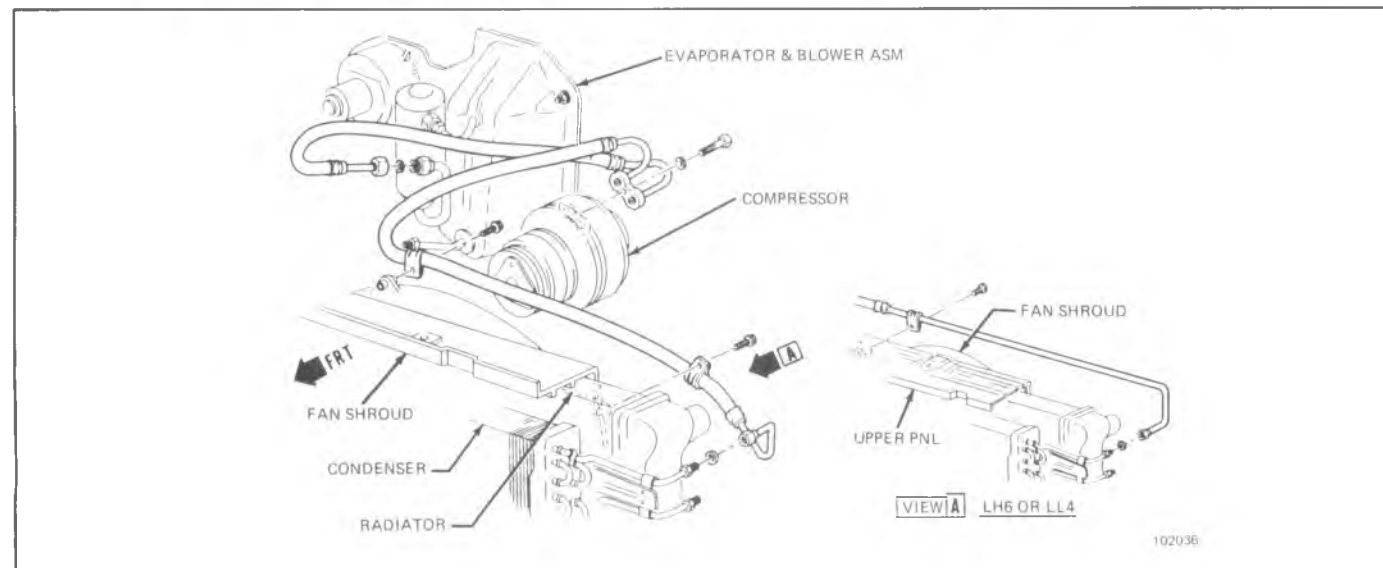


Fig. 1B-59--C-K Models Refrigerant Lines-L6

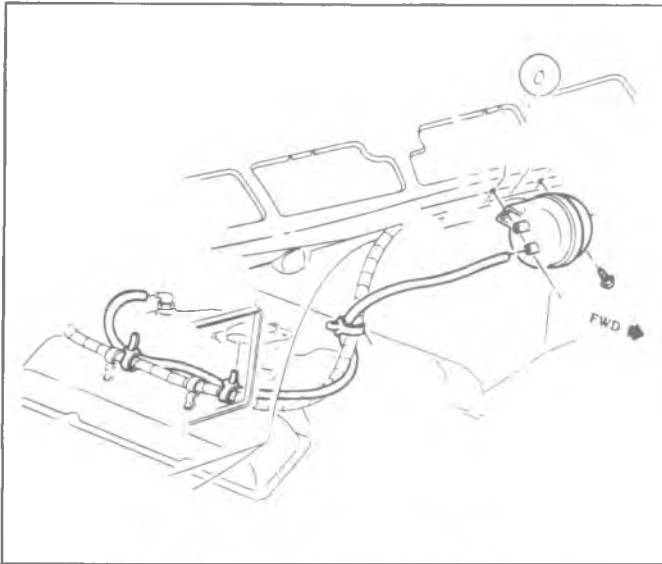


Fig. 1B-61--Vacuum Tank G Series-V8 Engine

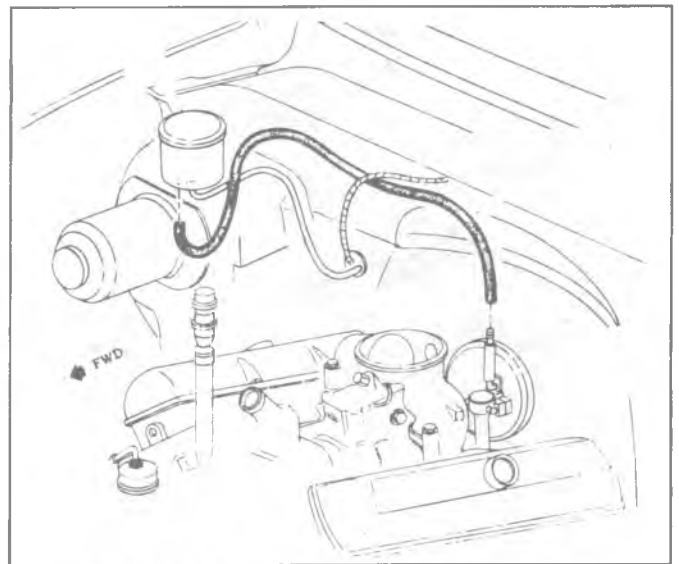


Fig. 1B-62--Vacuum Tank C-K Series-Diesel Engine

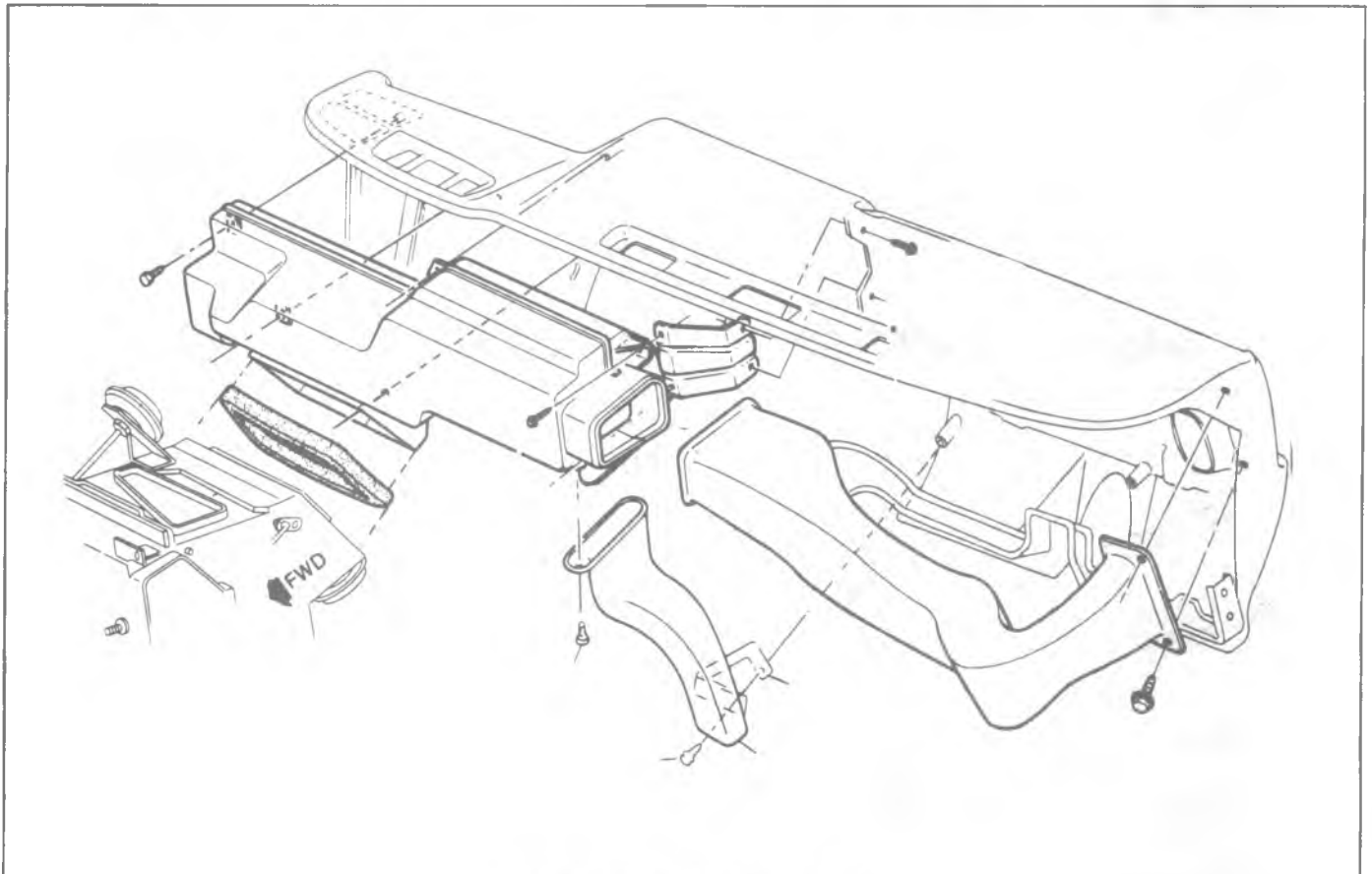


Fig. 1B-63--A/C Ducts-G Series

A/C DUCTWORK

Air Conditioning duct attachment is shown in Fig. 1B-63.

DEFROSTER DUCT

Defroster duct mounting is shown in Fig. 1B-64.

TEMPERATURE DOOR CABLE

Temperature cable attachment and routing is shown in Fig. 1B-65.

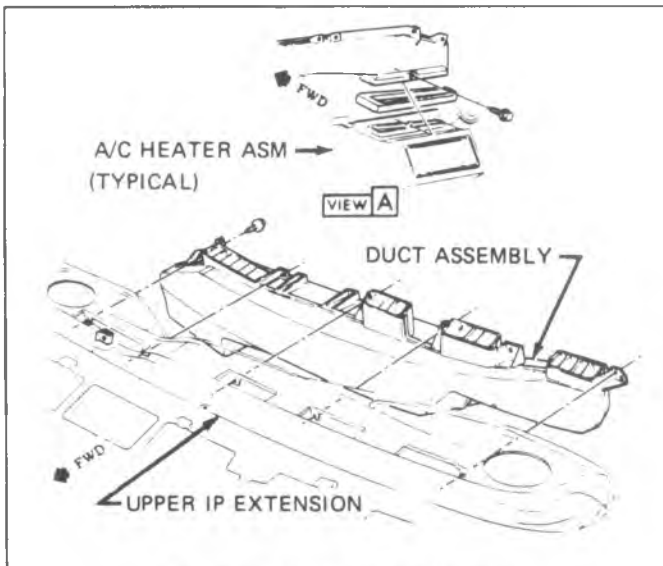


Fig. 1B-64--Defroster Duct-G Series

VACUUM TANK - G SERIES (Fig. 1B-60 & 1B-61)**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.

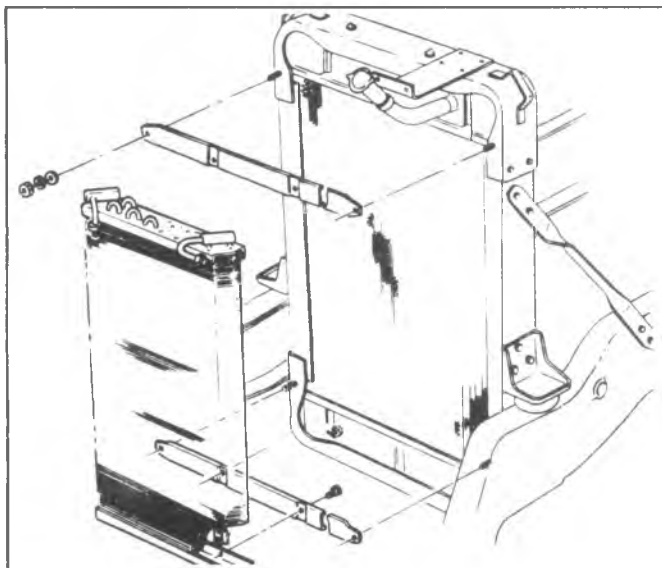
DASH MOUNTED SYSTEM--MOTOR HOME CHASSIS

Fig. 1B-66--Condenser (Motor Home Chasis Unit)

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

CIRCUIT BREAKER

The entire air conditioning system is protected by a 45 amp circuit breaker located on the left side of the dash, in

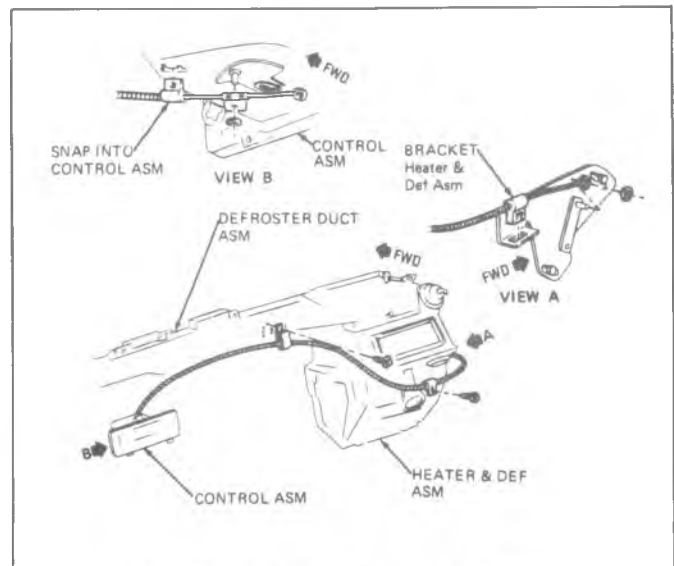


Fig. 1B-65--Temperature Cable-G Series

the engine compartment.

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.

reason, it will only be possible to give basic replacement procedures on some components.

CONDENSER**Replacement (Fig. 1B-66)**

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.
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 foud 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-67)**

1. Disconnect the battery ground cable.
2. Purge the system of refrigerant.
3. Disconnect the inlet and outlet lines at the

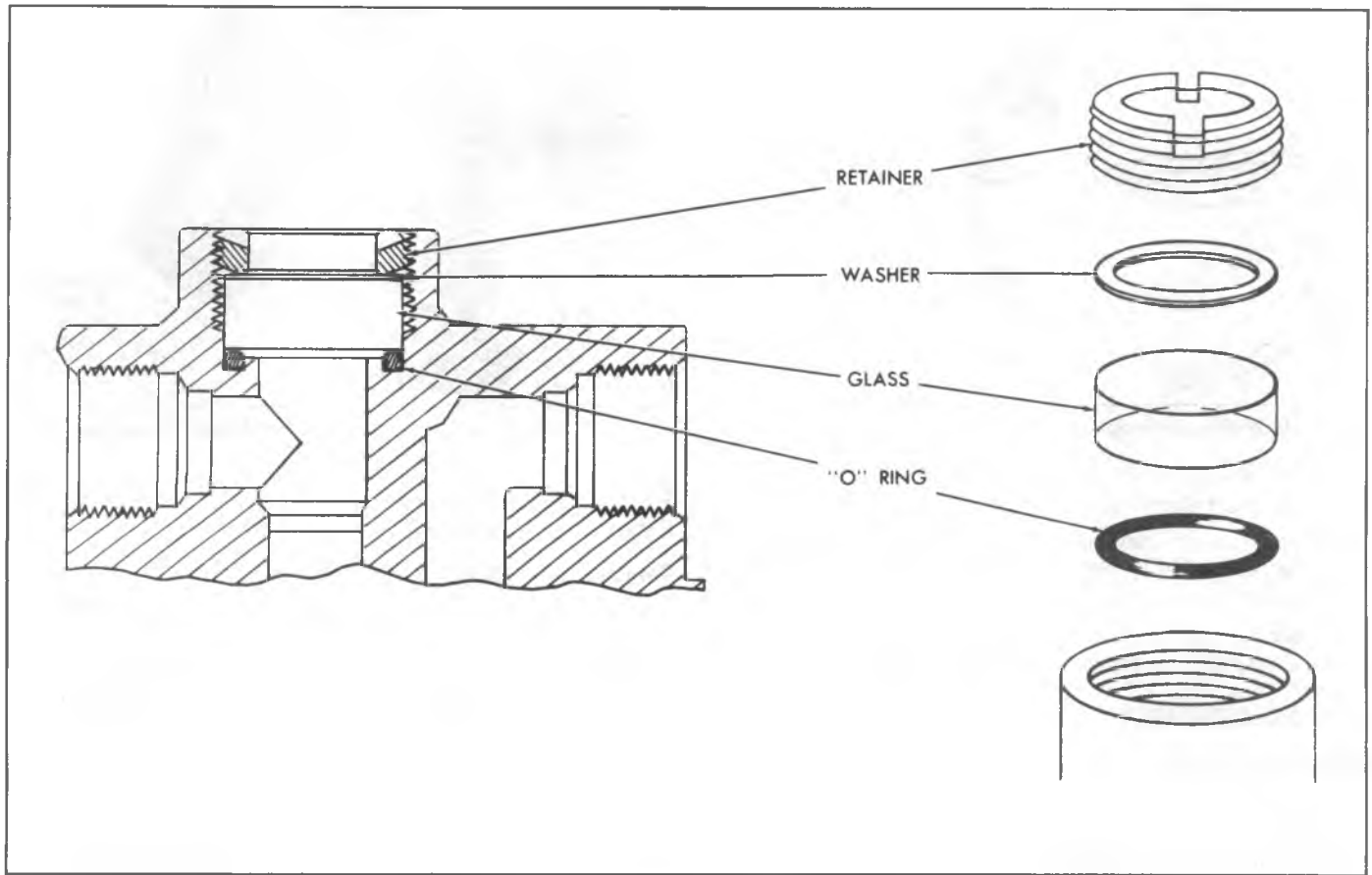


Fig. 1B-68--Sight Glass Replacement

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 installed. The kit contains the sight glass, seal and retainer. (Refer to Fig. 1B-68).

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 (Fig. 1B-69)

Removal

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-70) and allow connector to hang on ground wire.
6. Remove screws securing grommet retainer to dash

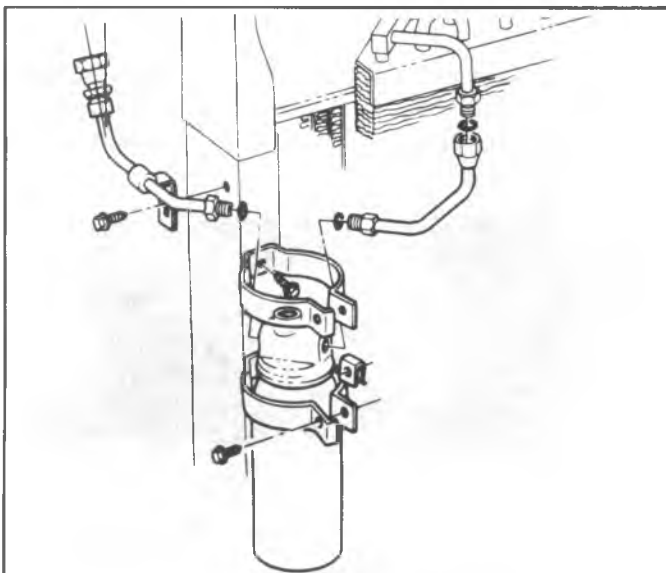


Fig. 1B-67--Receiver-Dehydrator (Motor Home Chassis Unit)

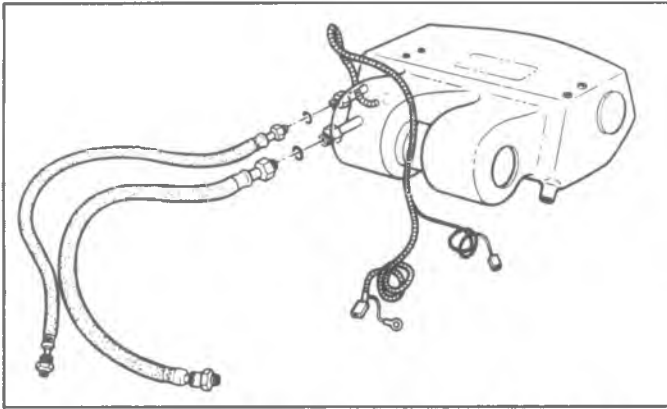


Fig. 1B-69--Blower-Evaporator (Motor Home Chassis Units)

- 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-71)

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-85.
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 plate.
4. Reverse Steps 1-8 on the "Blower-Evaporator Assembly" removal procedure.
5. Evacuate, charge and check the system.

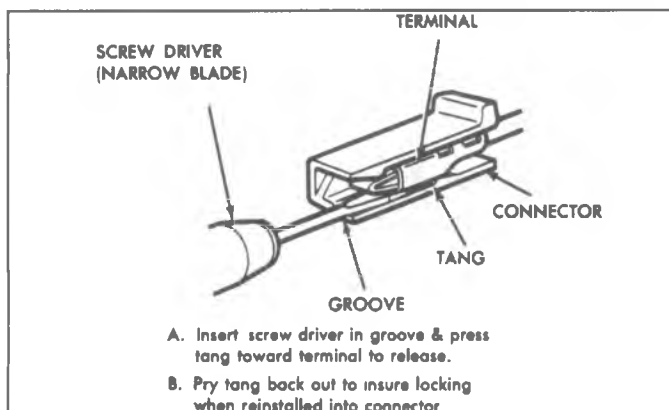


Fig. 1B-70--Terminal Removal

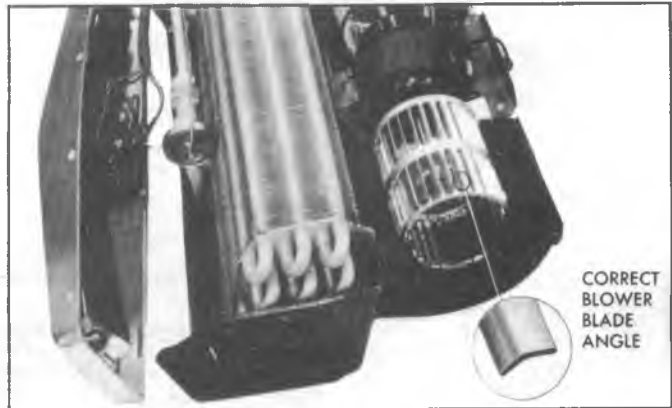


Fig. 1B-71--Blower Assembly (Motor Home Chassis Unit)

EXPANSION VALVE, EVAPORATOR AND/OR EVAPORATOR CASE

Removal (Fig. 1B-72)

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.
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-73).

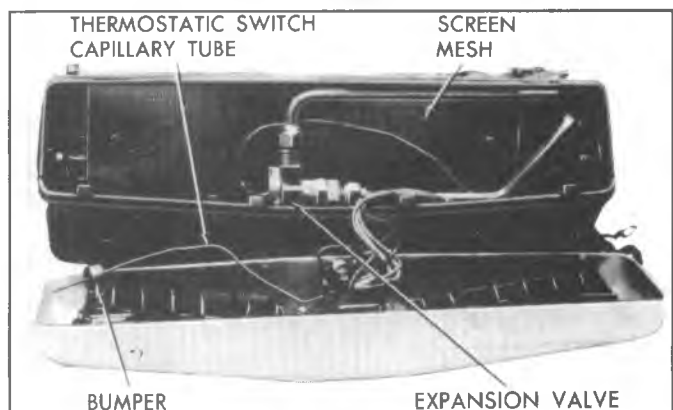


Fig. 1B-72--Expansion Valve (Motor Home Chassis Unit)

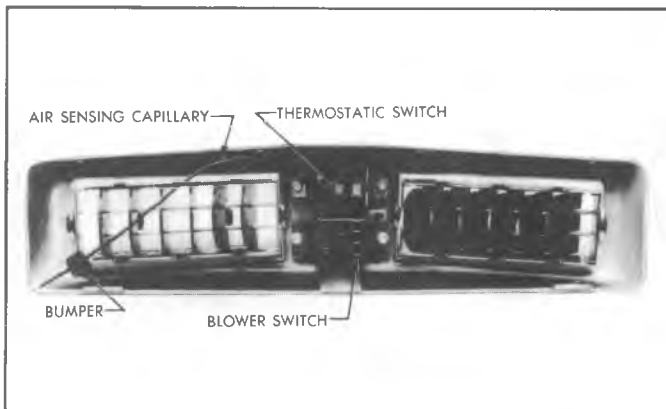


Fig. 1B-73--Thermostatic and Blower Switches

3. Install replacement switch, reinstall cover plate and reverse steps 1-8 of the "Blower-Evaporator Assembly" removal procedure.

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.

SPECIFICATIONS

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

	<u>Volts</u>	<u>Amps.</u> <u>(Cold)</u>	<u>RPM</u> <u>(Cold)</u>
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.

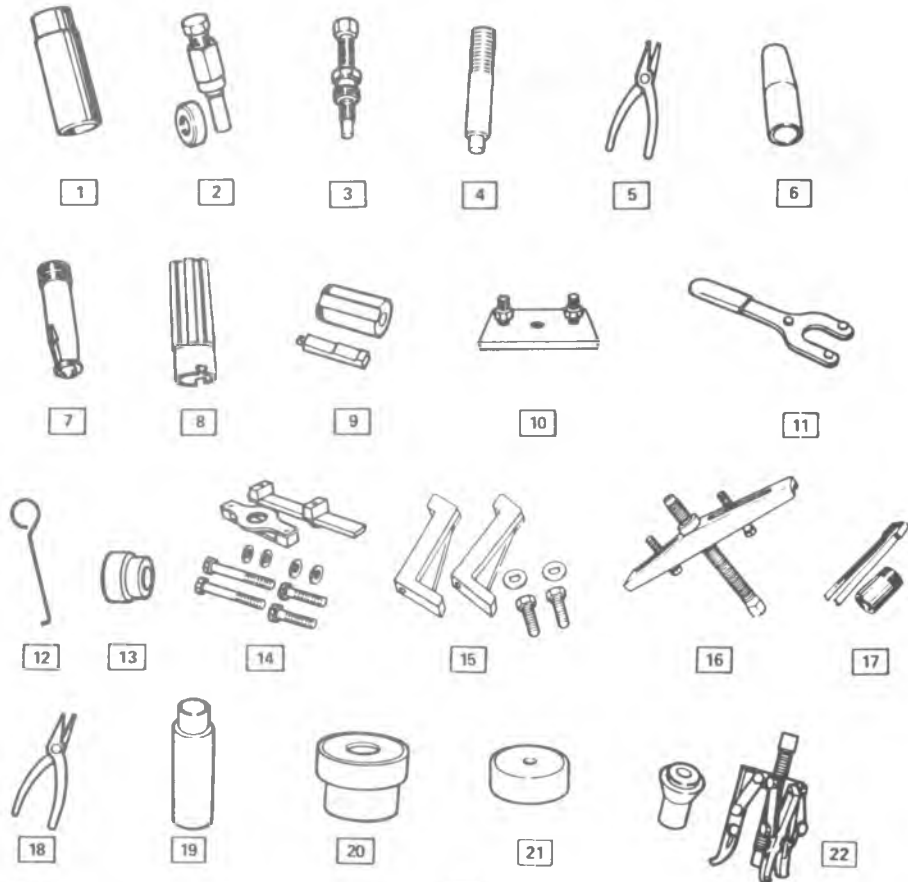
In-Line—

C-K Systems 25 Amp.
Motor Home Chassis Unit None

Circuit Breaker

G Model Systems 45 Amp.

SPECIAL TOOLS



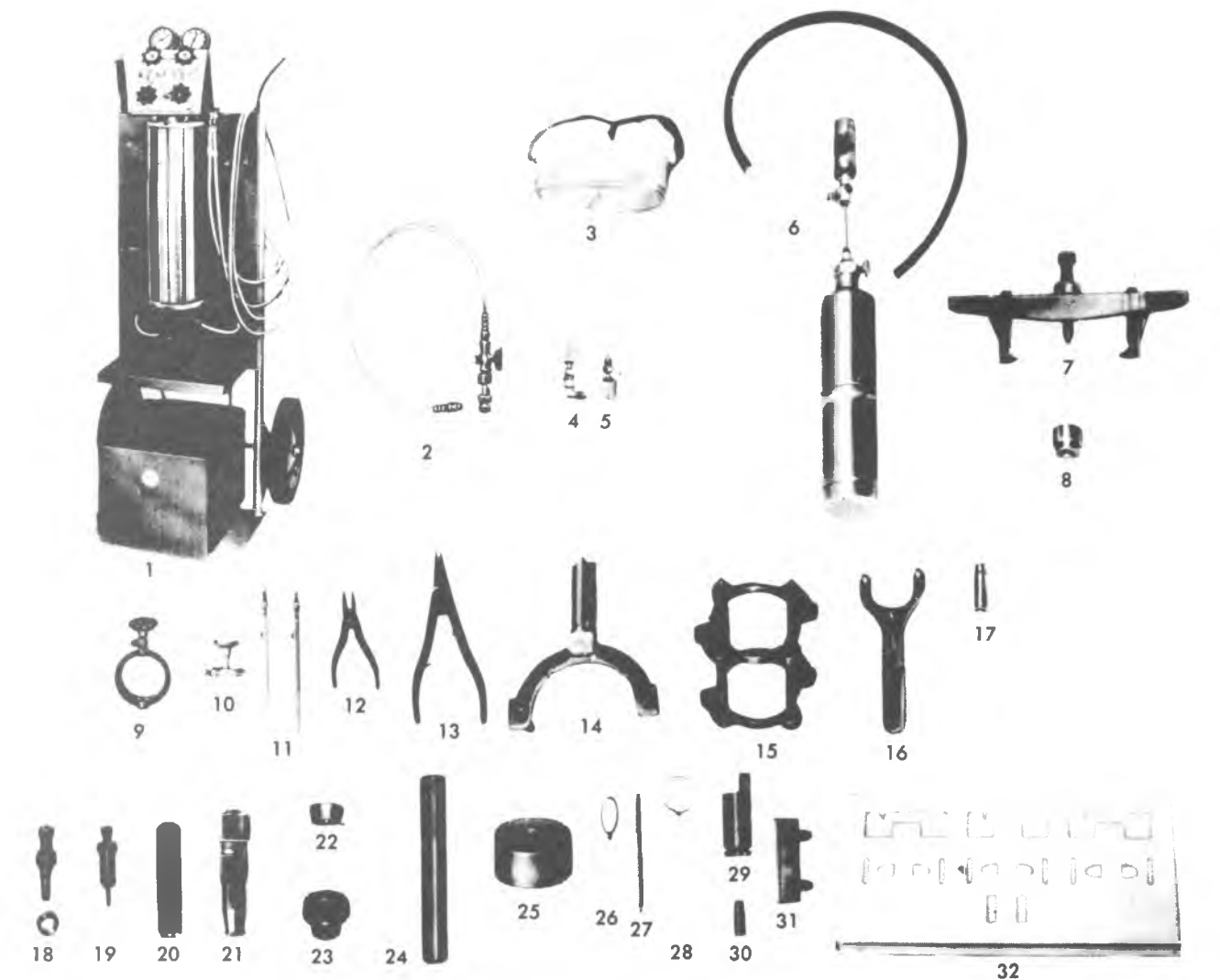
- 1 J 9399 9/16" THIN WALL SOCKET
 2 J 9480-01 HUB AND DRIVE PLATE ASSEMBLY INSTALLER
 3 J 9401 HUB AND DRIVE PLATE ASSEMBLY REMOVER
 4 J 8092 DRIVER HANDLE
 5 J 5403 SNAP RING PLIERS (# 21 INTERNAL)
 6 J 22974 SHAFT SEAL PROTECTOR
 7 J 23128 SEAL SEAT REMOVER AND INSTALLER
 8 J 9392 SHAFT SEAL REMOVER 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

210731

Fig. 1B-74--Air Conditioning Special Tools

SPECIAL TOOLS



- | | | | | | |
|---------------|----------------------------------|---------------|--|---------------|---------------------------------|
| 1. J-8393 | Charging Station | 11. J-5421-02 | Pocket Thermometers (2) | 22. J-9398 | Pulley Bearing Remover |
| 2. J-24095 | Oil Inducer | 12. J-5403 | No. 21 Snap Ring Pliers | 23. J-9481 | Pulley and Bearing Installer |
| 3. J-5453 | Goggles | 13. J-6435 | No. 26 Snap Ring Pliers | 24. J-8092 | Handle |
| 4. J-9459 | 7/16"-20 90° Gauge Line | 14. J-9396 | Compressor Holding Fixture | 25. J-21352 | Internal Assembly Support Block |
| 5. J-5420 | 3/8"-24 Adapter | 15. J-25030 | Compressing Fixture | 26. J-5139 | Oil Pickup Tube Remover |
| 6. J-6084 | 7/16"-20 Straight Gauge Line | 16. J-9403 | Clutch Hub Holding Tool | 27. J-9432 | Needle Bearing Installer |
| 7. J-8433 | 3/8" Adapter | 17. J-9399 | 9/16" Thin Wall Socket | 28. J-9553-01 | Seal Seat "O" Ring Remover |
| 8. J-9395 | Leak Detector | 18. J-9401 | Hub and Drive Plate Assembly Remover | 29. J-21508 | Seal Seat "O" Ring Installer |
| 9. J-23595 | Puller | 19. J-9480-01 | Hub and Drive Plate Assembly Installer | 30. J-22974 | Shaft Seal Protector |
| 10. J-6271-01 | Puller Pilot | 20. J-9392 | Seal Remover | 31. J-9625 | Pressure Test Connector |
| | Refrigerant Can Valve (Side-Tap) | 21. J-23128 | Seal Seat Remover | 32. J-9402 | Parts Tray |
| | Refrigerant Can Valve (Top-Tap) | | | | |

Fig. 1B-75--Air Conditioning Special Tools

SECTION 1C1

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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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 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 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).

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 drive system type.

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.

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. 1C1-3 and Fig. 1C1-4 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.

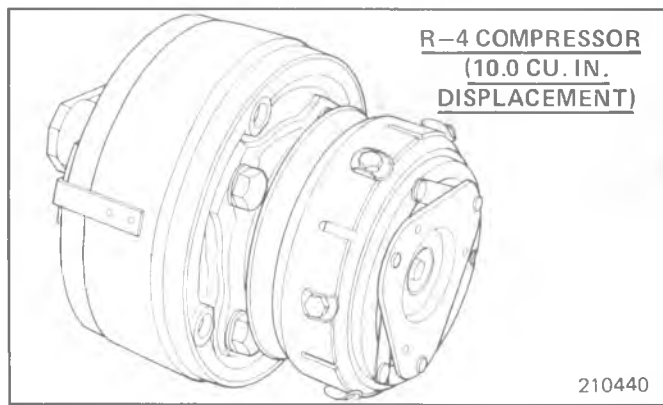


Fig. 1C1-1 R-4 Compressor, V Groove Pulley Type

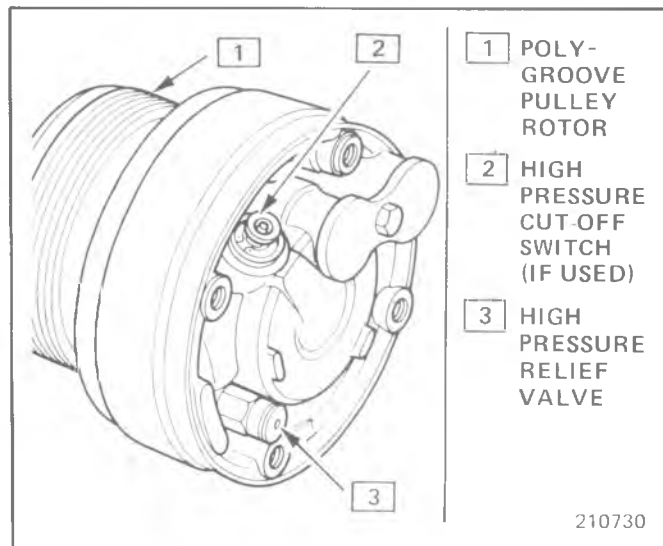


Fig. 1C1-2 R-4 Compressor, Poly Groove Pulley Type

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 25008-1, and clamp the Holding Fixture in a vise (Fig. 1C1-6).
 - Compressor mounting holes are metric. Use proper metric bolts with holding fixture J 25008-1.
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. 1C1-7.
3. Thread the Clutch Plate and Hub Assembly Remover J 9401, 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. 1C1-8).
4. Remove the shaft key.

Replace

1. Install the shaft key into the hub key groove (Fig. 1C1-9). 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 9480-01 as illustrated in Fig. 1C1-10.
5. Hold the hex portion of the Installer Body J 9480-1 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.

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.
2. Remove Rotor and Bearing assembly retaining ring, using Snap Ring Pliers J 6083, Fig. 1C1-11. Mark the location of the clutch coil terminals.
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. 1C1-12), 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 25031-2 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. 1C1-12 and 1C1-13), 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 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. 1C1-14. 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 bearing may be damaged (see Fig. 1C1-15).

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 with Universal Handle J 8092, drive the bearing fully into the hub (Fig. 1C1-16). 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"-.055" deep) the bearing in three places 120° apart as

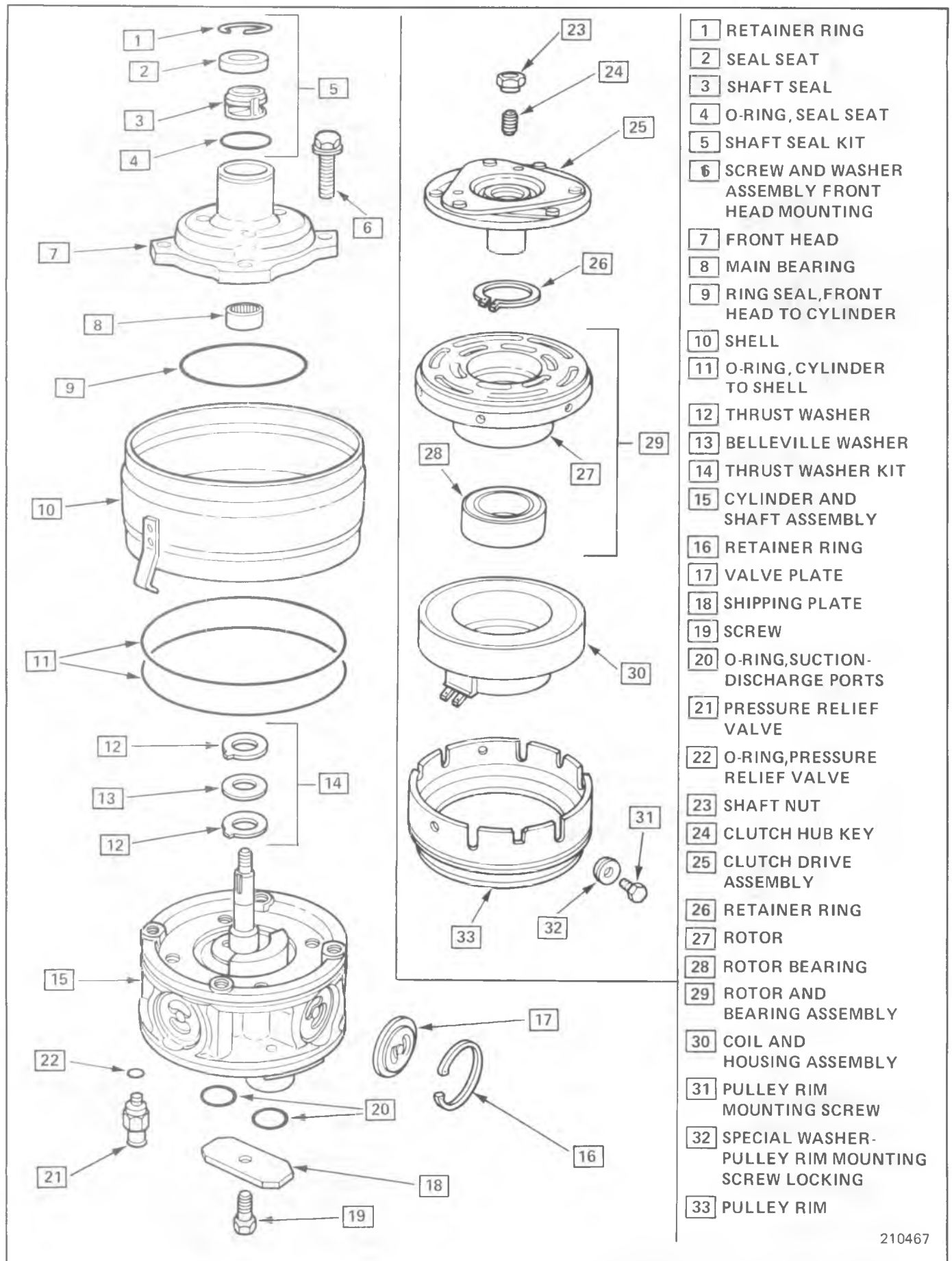


Fig. 1C1-3 Exploded View of R-4 Compressor

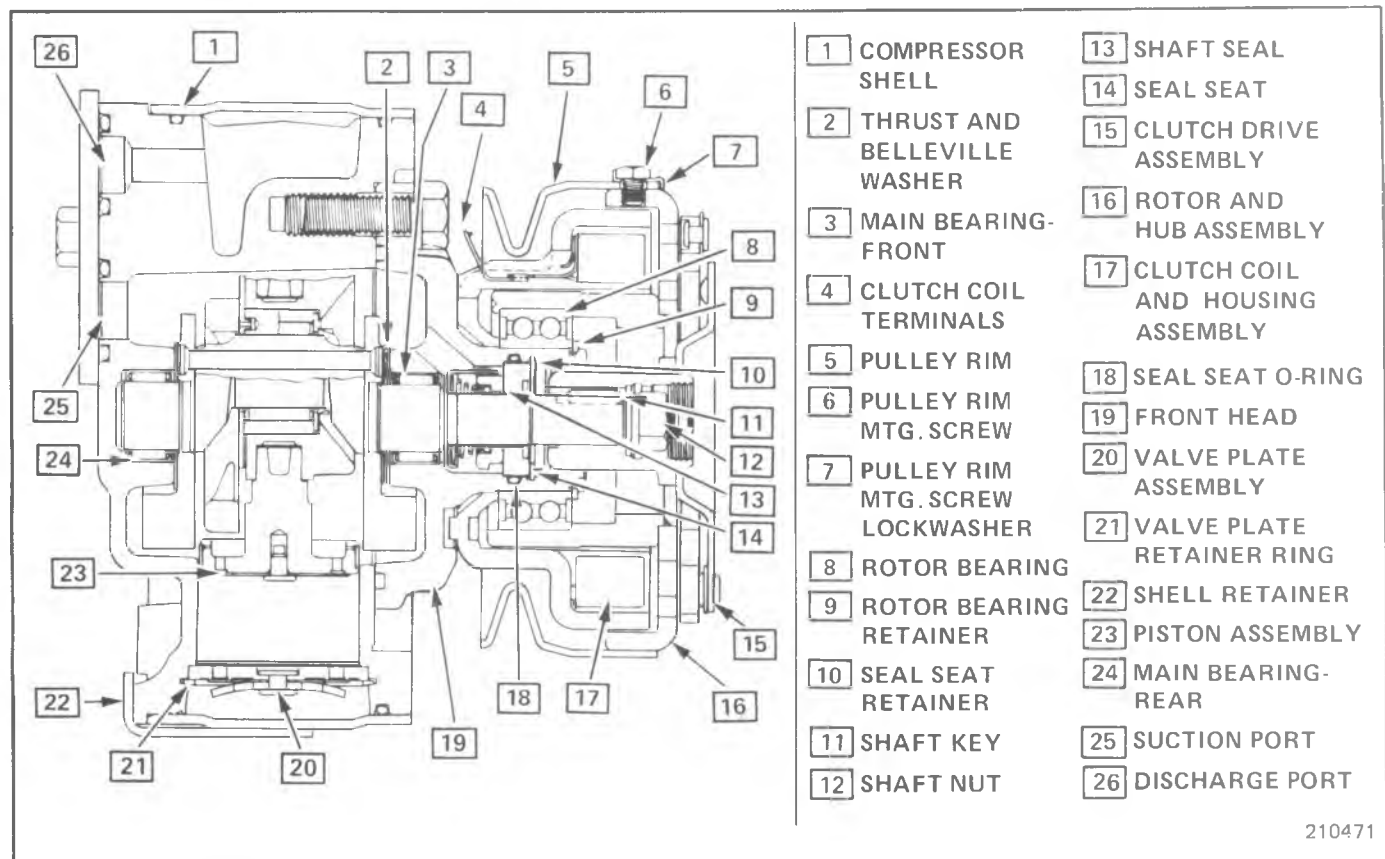


Fig. 1C1-4 R-4 Compressor Cross Section

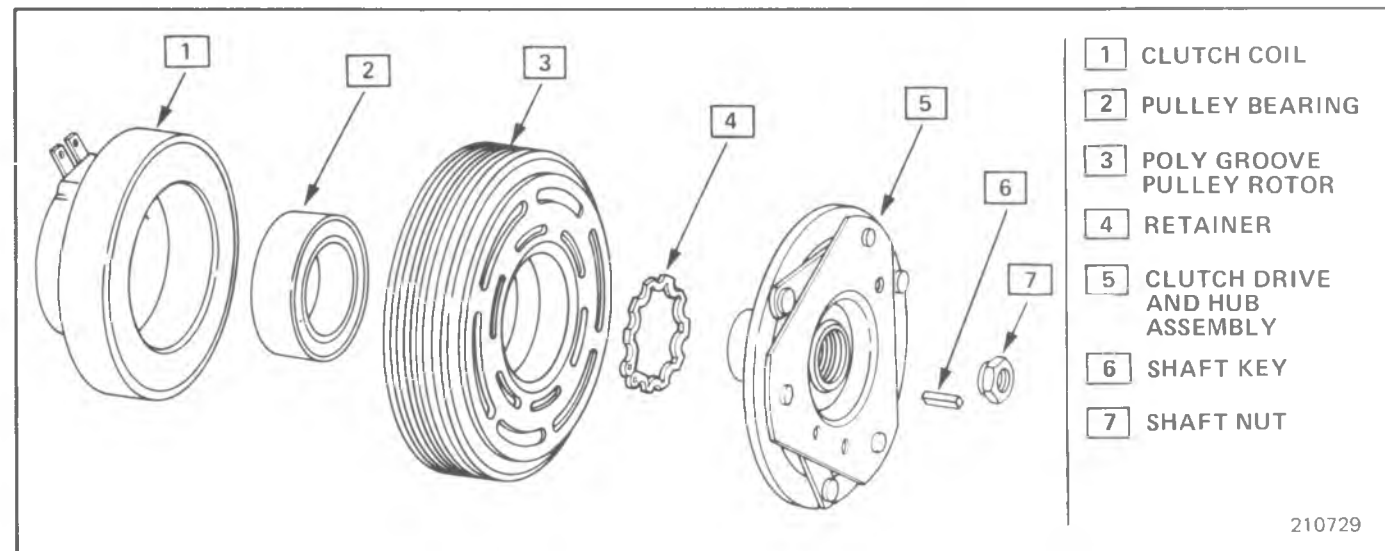


Fig. 1C1-5 Exploded View of Pulley Groove Pulley Drive

shown in Fig. 1C1-15, but do not stake too deeply to avoid distorting the outer race of the bearing.

4. Replace rotor and bearing assembly.

On Car

- Position the Rotor and Bearing assembly on the front head.
- With Rotor & Bearing Installer J 26271 (without driver handle) in position and Rotor and Bearing assembly aligned with the Front Head as shown in (Fig. 1C1-17), drive the assembly part way onto the head.
- 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. 1C1-11).

F. Reassemble the Clutch Plate and Hub with the shaft key onto the shaft with Installer J 9480-1 until .5 - 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. With Installer assembled to the Universal Handle J 8092, as

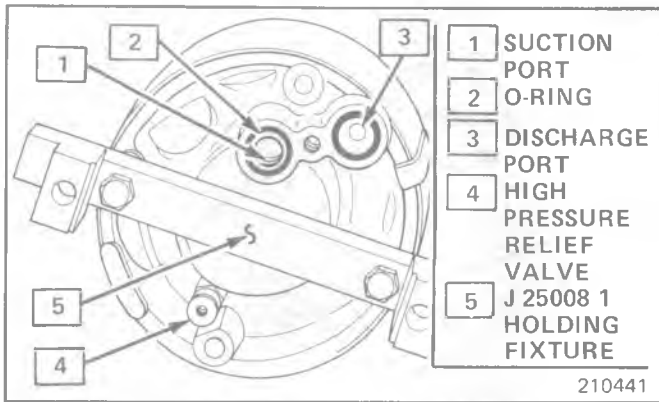


Fig. 1C1-6 Compressor In Holding Fixture

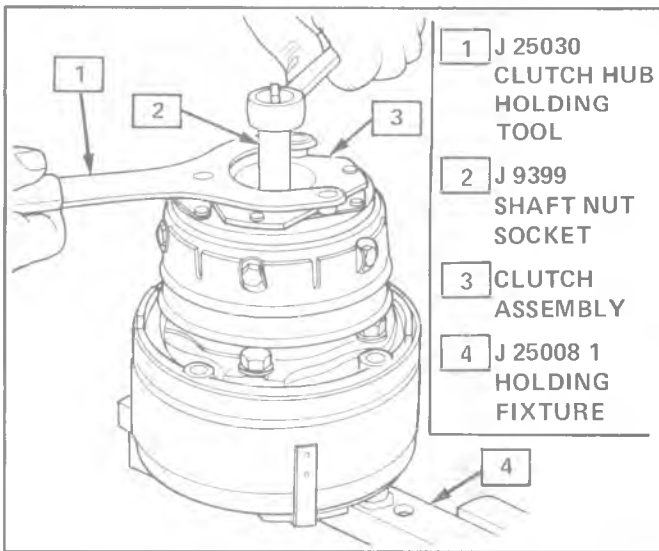


Fig. 1C1-7 Removing Shaft Nut

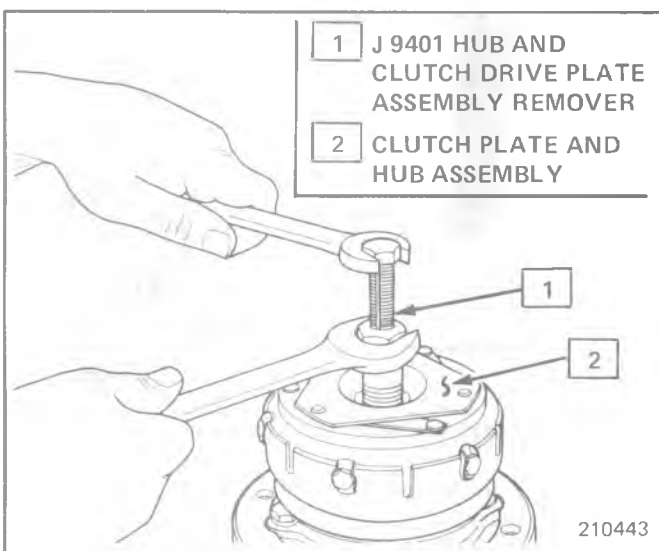


Fig. 1C1-8 Clutch Plate & Hub Asm. Removal

shown in Fig. 1C1-18, 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. 1C1-11).
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.

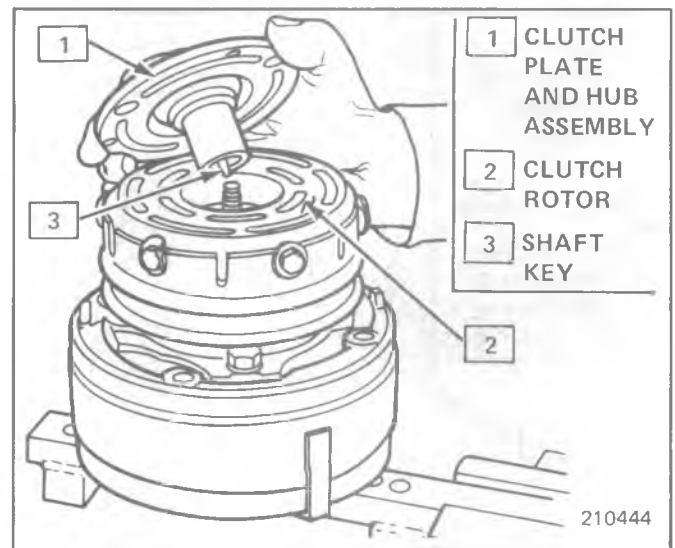


Fig. 1C1-9 Installing Shaft Key

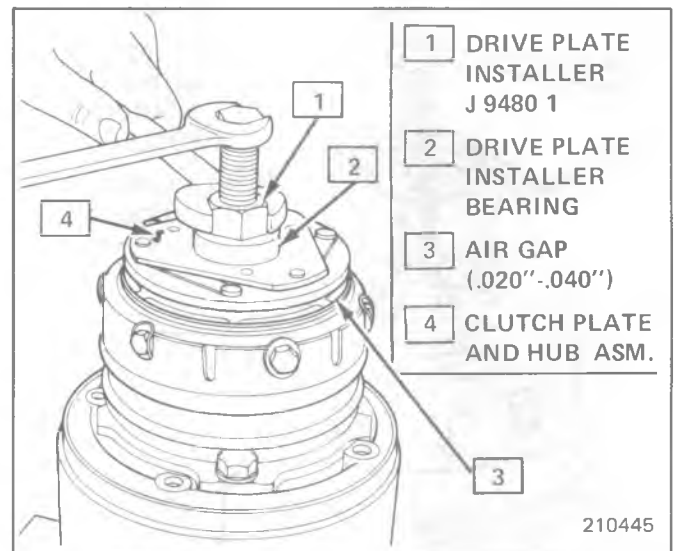


Fig. 1C1-10 Installing Clutch Plate & Hub Asm.

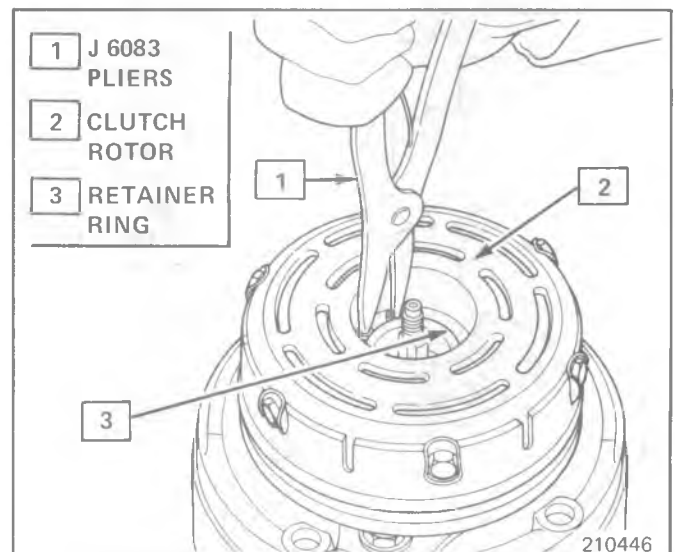


Fig. 1C1-11 Removing Rotor & Bearing Asm. Retainer Ring

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.

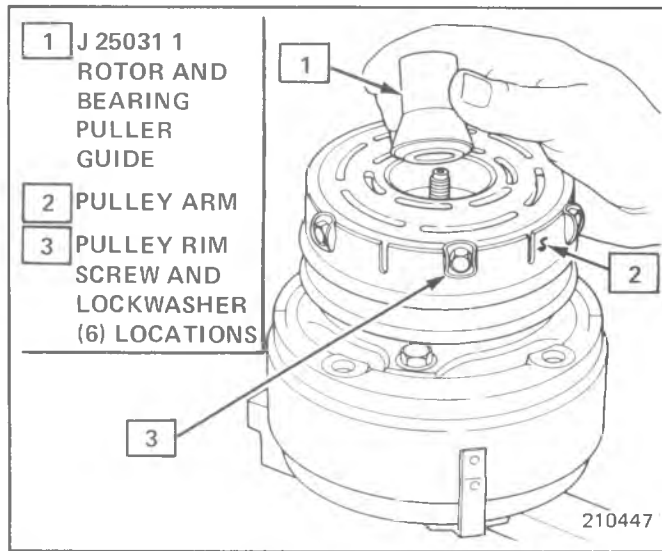


Fig. 1C1-12 Installing Rotor & Bearing Puller Guide

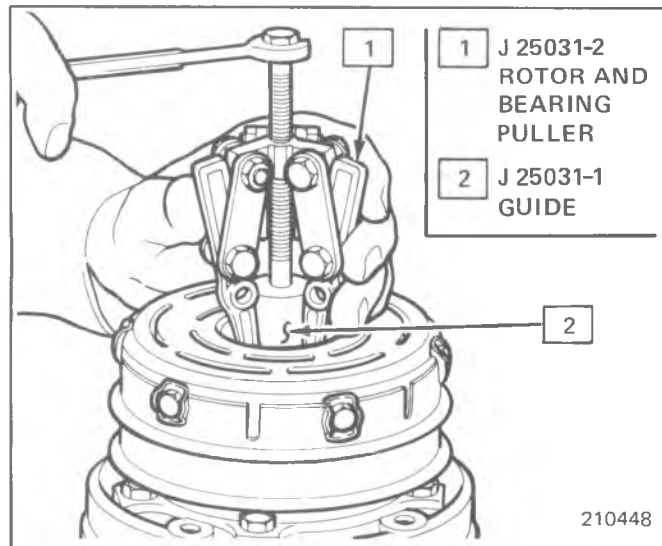


Fig. 1C1-13 Removing Clutch Rotor Asm.

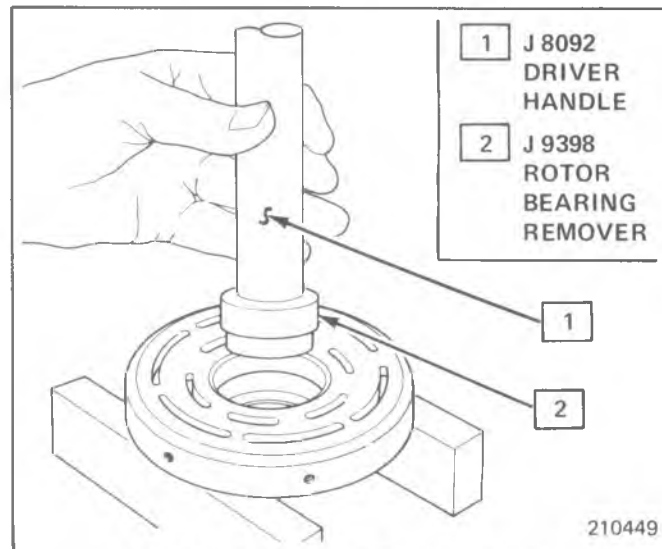


Fig. 1C1-14 Clutch Rotor Bearing Removal

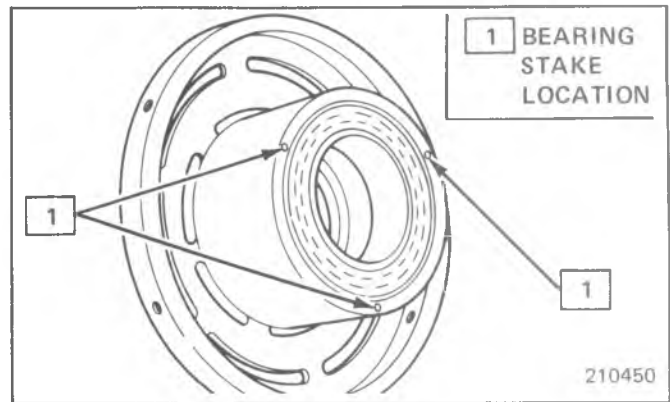


Fig. 1C1-15 Rotor & Bearing Asm.

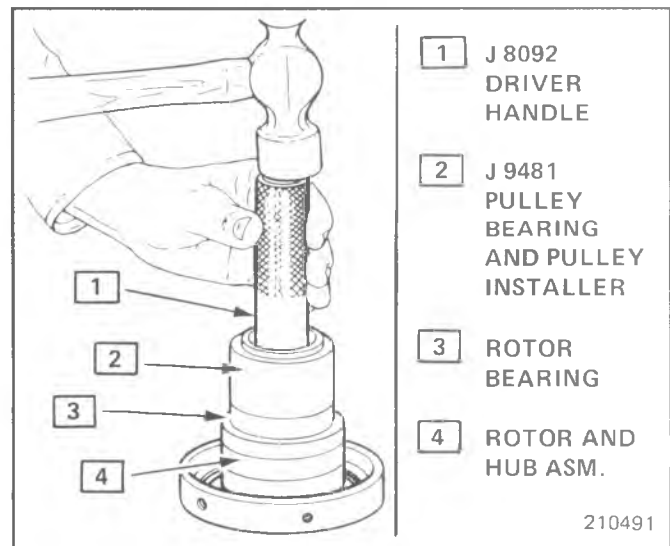


Fig. 1C1-16 Installing Clutch Rotor Bearing

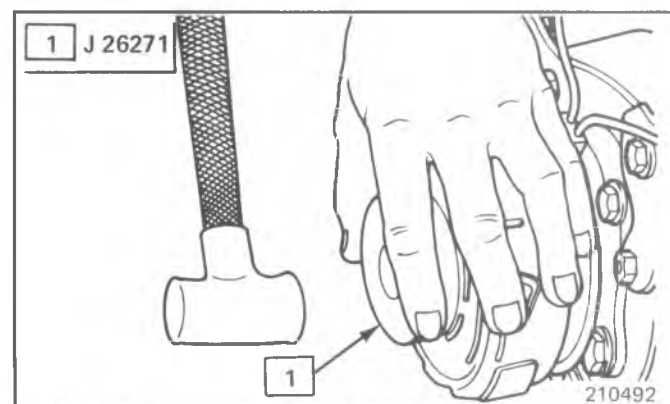


Fig. 1C1-17 Installing Rotor and Bearing Asm. (On Car)

special lock washers (Fig. 1C1-18), similar to original crimp and lock bends on washers.

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., 1C1-11).

8. Tighten pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock screw heads in place by bending

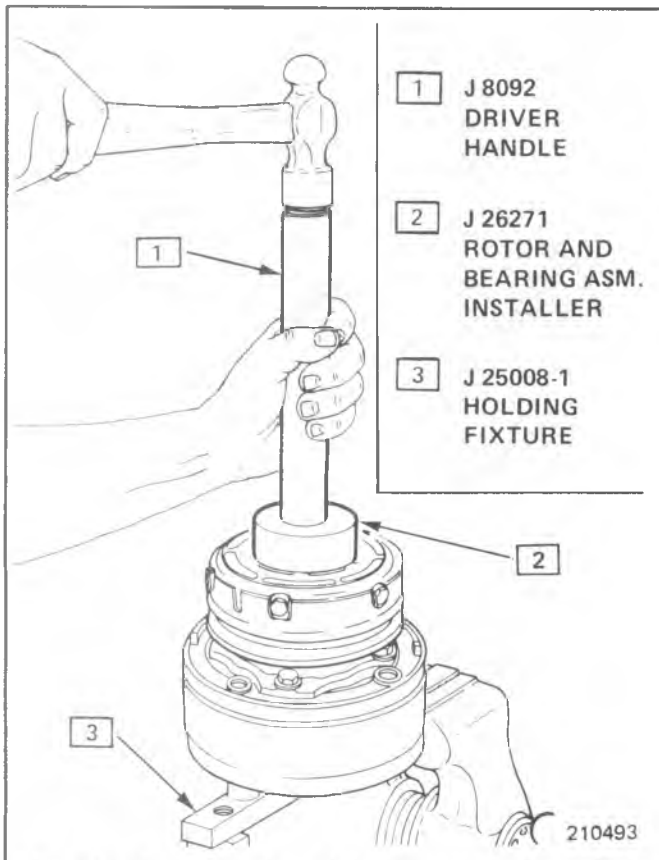


Fig. 1C1-18 Installing Rotor & Bearing Asm. V Groove Type

3. Install Rotor and Bearing Puller Guide J-25031-1 to the front head and install Rotor and Bearing Puller J-25031-2 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. 1C1-12 and 1C1-19), being careful not to drop the Puller Guide.
4. Place the pulley-rotor and bearing assembly on blocks similar to that shown in Fig. 1C1-14. 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 bearing may be damaged (see Fig. 1C1-15).

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. 1C1-16, and using Pulley and Bearing Installed J-9481 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 - 1.4 mm (0.45" - 0.55" deep) the bearing in three places 120° apart similar to that shown in Fig. 1C1-15. **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 and Universal Drive Handle J-8092 aligned in position with the pulley rotor and bearing assembly, Fig. 1C1-20, drive the assembly onto the front head.
5. Install the retainer ring (Fig. 1C1-11).

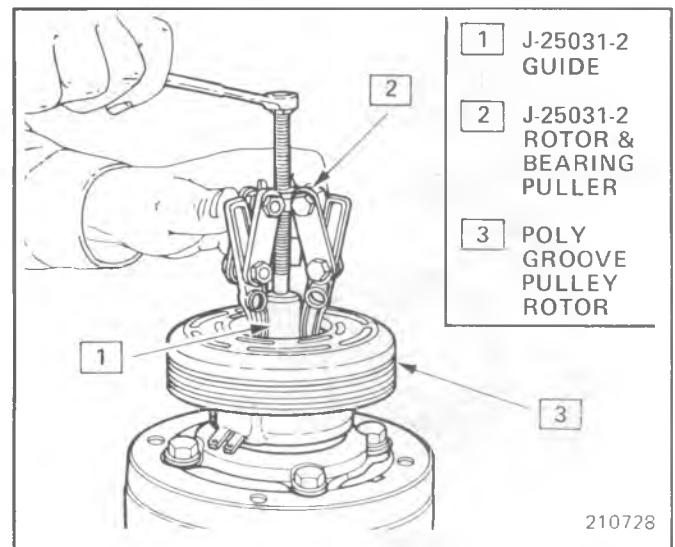


Fig. 1C1-19 Removing Clutch Rotor Asm. - Poly Groove Drive

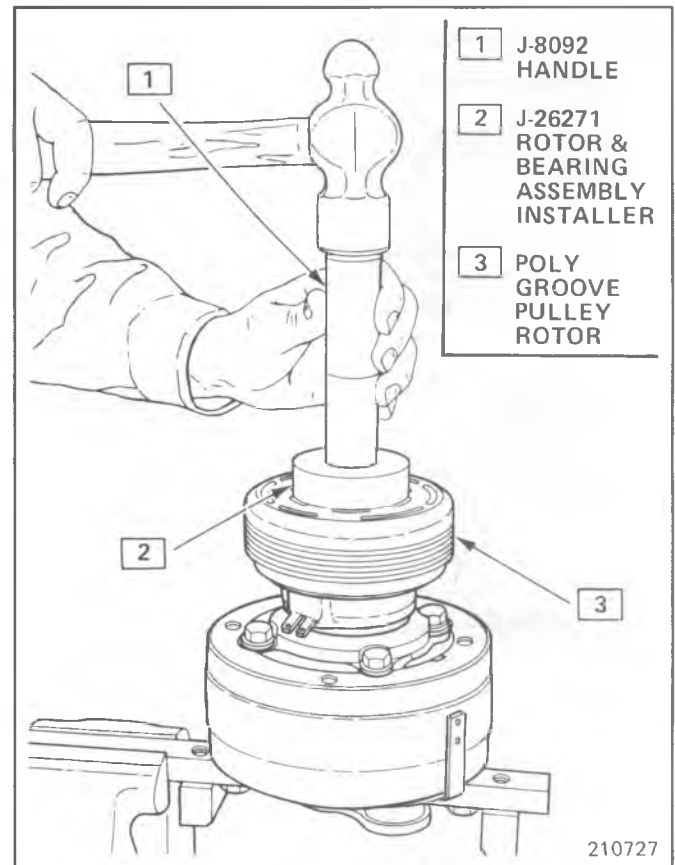


Fig. 1C1-20 Installing Rotor & Bearing Assembly, Poly Groove Type (On Bench)

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-25031-1 when removing the assembly.

1C1-8 AIR CONDITIONING COMPRESSOR OVERHAUL

2. Remove the pulley rim mounting screws and special lock washers. Discard the lock washers and screws.
3. Slide the pulley rim off the Rotor and Hub assembly. The Pulley Rim and the Clutch Coil (Fig. 1C1-21) are replaceable at this point.

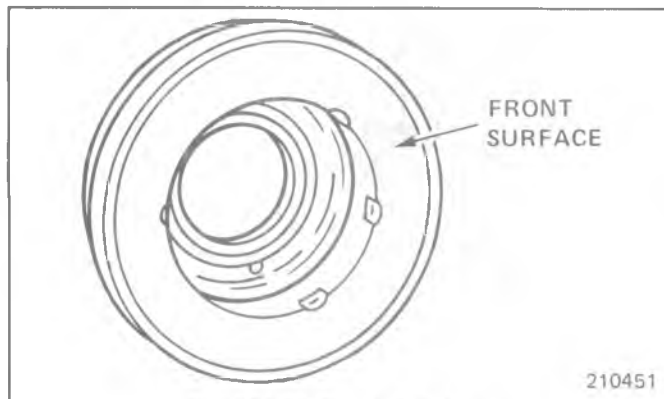


Fig. 1C1-21 Clutch Coil Asm.

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 J25031-1 (Fig. 1C1-12) to the front head and install Puller J-8433-1 with Poly-V-Belt Puller Leg Set J24092 and remove the clutch coil from the front head (Fig. 1C1-22).

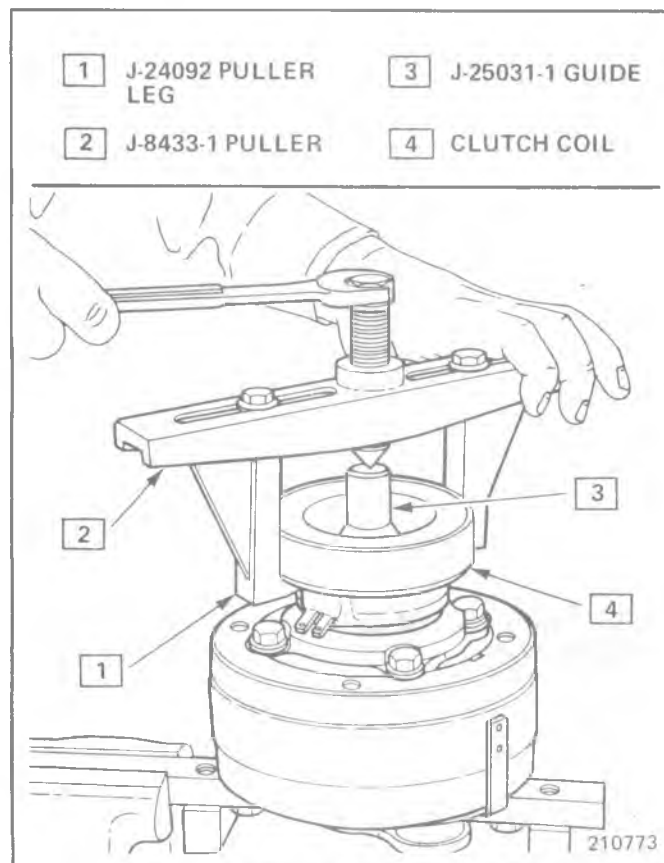


Fig. 1C1-22 Removing Poly Groove Clutch Coil

Replace - V Groove Drive

1. Assemble the Clutch Coil, Pulley Rim and the Clutch Rotor and Bearing assembly as shown in Fig. 1C1-23. 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.

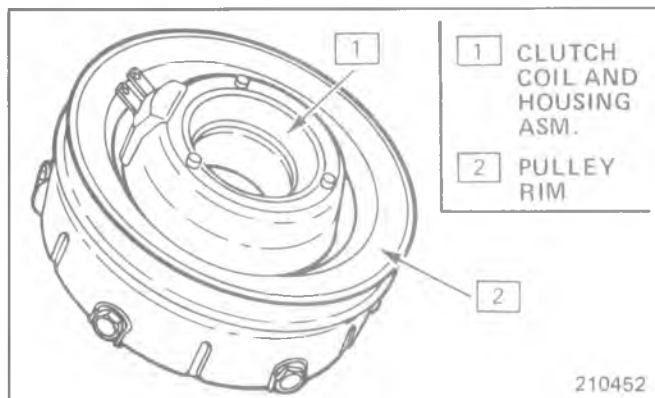


Fig. 1C1-23 Assembling Clutch Coil, Pulley Rim, Rotor & Bearing

2. Place the assembly on the neck of the Front Head and seat into place using Rotor & Bearing Installer J 26271 (Fig. 1C1-18).
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 - 1.0mm (.020 - .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. 1C1-18), 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. 1C1-18).
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 - 1.0 mm (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

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 1C1-24, 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.

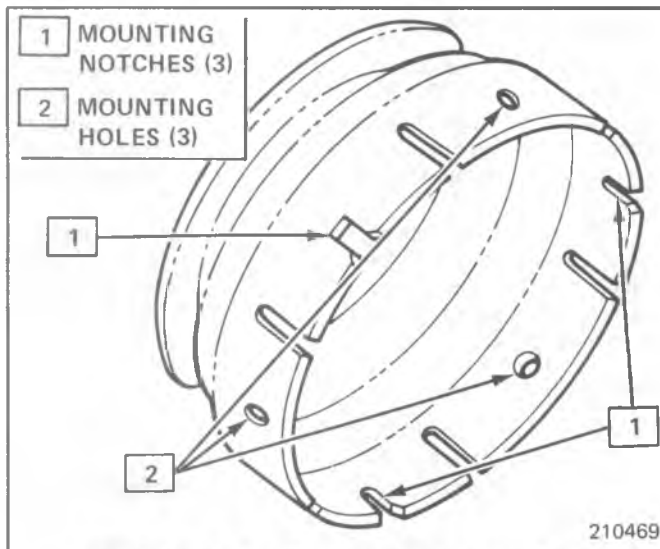


Fig. 1C1-24 Pulley Rim Mounting Location Detail

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 1C1-25, to move the ring into position.
5. Install a special lockwasher onto each 6.4mm-28 x 13.5mm (1/4"-28 X 17/32") mounting screw.
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.

- 1 CLEARANCE NOTCH
- 2 "LOCK" WASHER TO SIDES OF SCREW HEAD AND DOWN OVER NOTCH IN RING. (3 "MOUNTING HOLE" LOCATIONS)
- 3 "LOCK" WASHER TO SIDES OF SCREW HEAD AND DOWN OVER EDGE OF PULLEY RIM. (3 "MOUNTING NOTCH" LOCATIONS)
- 4 PULLEY RIM

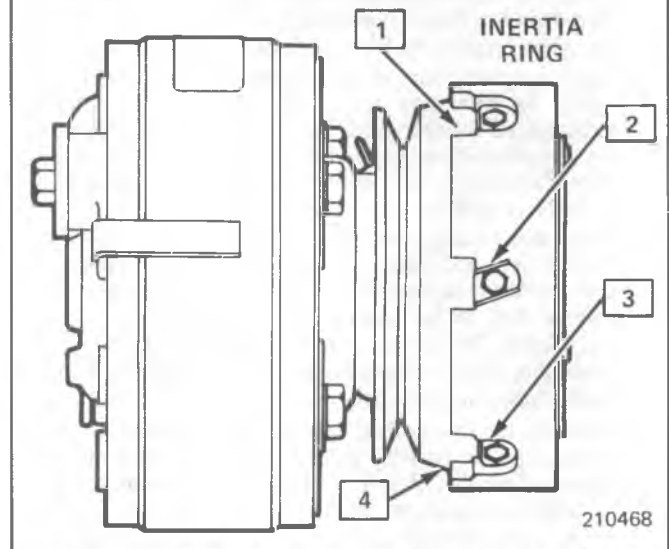


Fig. 1C1-25 Pulley Rim and Inertia Ring Mounting Detail

8. 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. 1C1-25. 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.
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 Asm." 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 1C1-24. 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. 1C1-25.
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 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. 1C1-25.
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

COMPLETELY PURGED OF REFRIGERANT before proceeding 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. 1C1-28) or pressure relief valve (see Fig. 1C1-3) 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

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 23400 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.
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. 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. 1C1-26). Discard the Seat. The handle must be hand-tightened securely. Do not use a wrench or plier.
7. With Seal Protector J 22974 still over the end of the shaft, set Seal Remover-Installer J 9392 down onto shaft end, turning clockwise, while pressing down to engage Remover

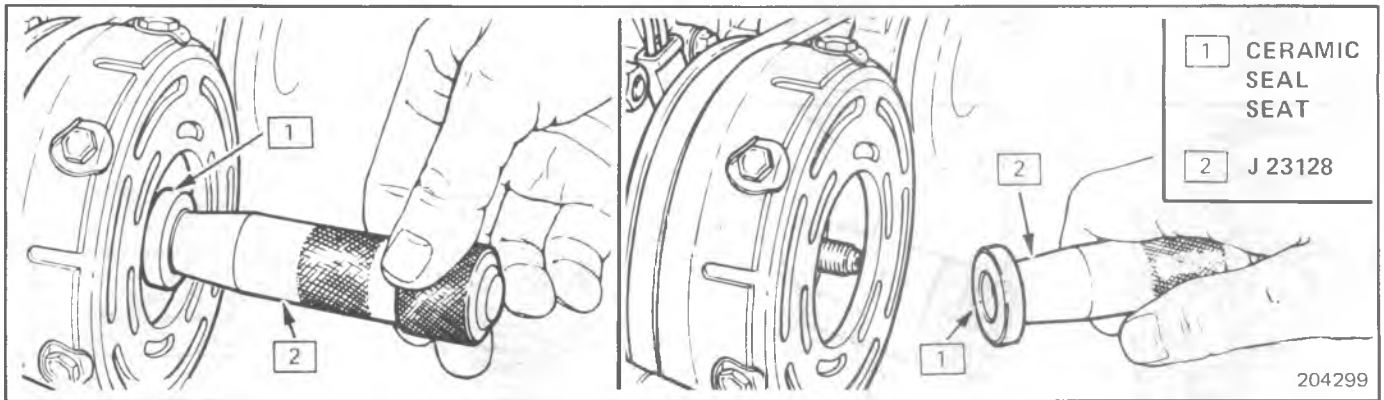


Fig.1C1-26 Removing and Installing Ceramic Seal Seat (On Car)

tangs with the tabs on the Seal assembly. Then lift the Shaft Seal assembly out (see Fig. 1C1-27). Discard the Seal.

8. Remove and discard the seal seat O-ring from the compressor, neck using O-Ring Remover J 9553 (Fig. 1C1-27).
9. 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.

Inspection

Seals should not be re-used. Always use a new specification service seal kit on rebuild (see Fig. 1C1-28). 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 (On Car)

1. Dip the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J 21508 (see Fig. 1C1-27).
2. Insert the O-Ring Installer J 21508 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. 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. 1C1-27).
4. Place Seal Protector J 22974 over end of compressor shaft and slide the new Seal assembly onto the shaft. 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 counterclockwise.
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. Install the Seat over the compressor shaft and J 22974 Seal Protector and push the Seat into place with a rotary motion (Fig. 1C1-26). Take care not to dislodge the seat O-ring. Be sure Seal Seat makes a good seal with O-ring. Remove Installer J 23128 and Seal Protector J 22974.
6. Install the new seal seat retainer ring with its flat side against the Seal Seat, using Snap-Ring Pliers J 5403. See Fig. 1C1-29. 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. 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. Re-install 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. 1C1-33) 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. 1C1-30, 1C1-31 and 1C1-32.

R-4 COMPRESSOR PRESSURE RELIEF VALVE

The Pressure Relief Valve, located in the compressor rear head casting (Fig. 1C1-3), 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.

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. 1C1-34).
3. Remove the high pressure cut-off switch retaining ring (Fig. 1C1-34) using J-5403 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.

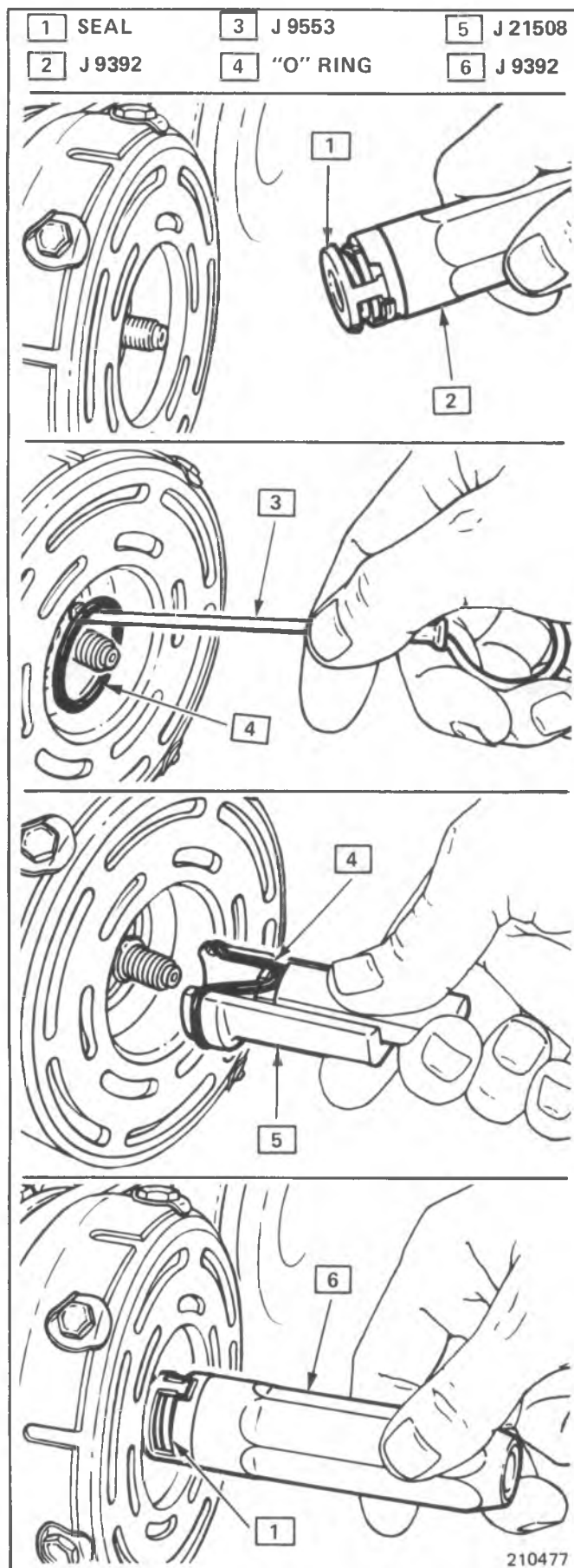


Fig. 1C1-27 Removing and Installing Seal and O-Ring (On Car)

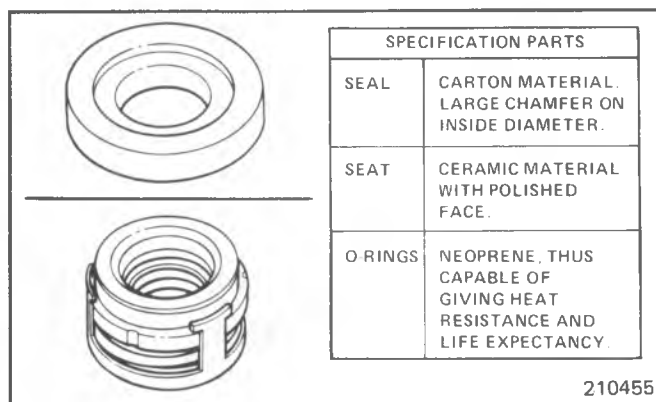


Fig. 1C1-28 Compressor Shaft Seals and O-Rings

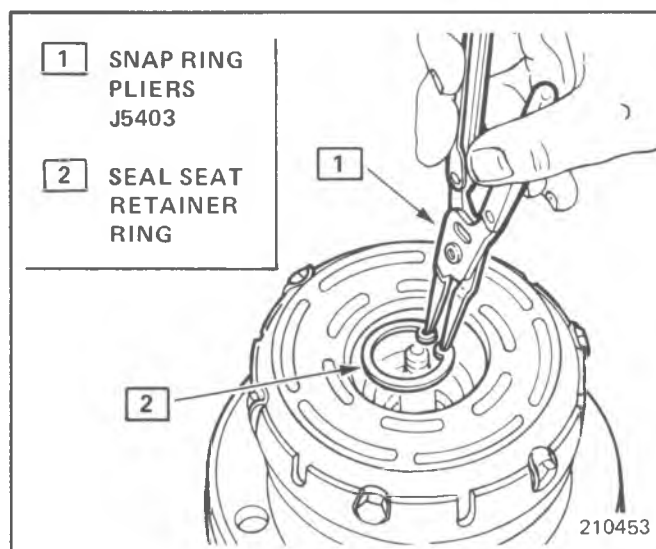


Fig. 1C1-29 Removing and Installing Shaft Seal Seat Retaining Ring

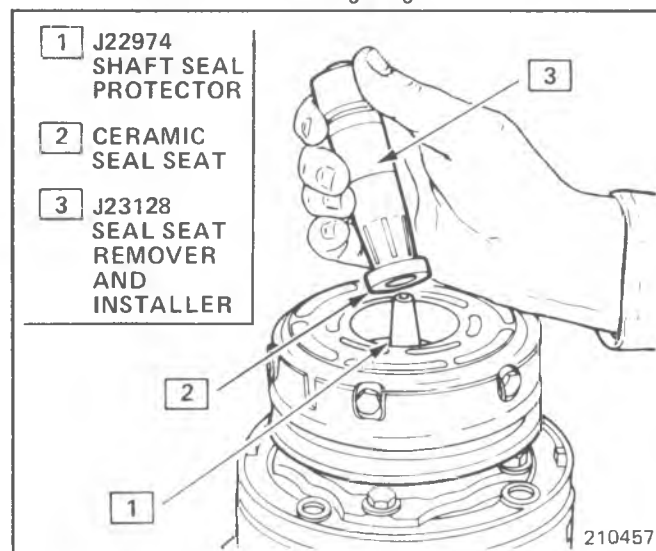


Fig. 1C1-30 Removing & Installing Seal Seat (Off Car)

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.

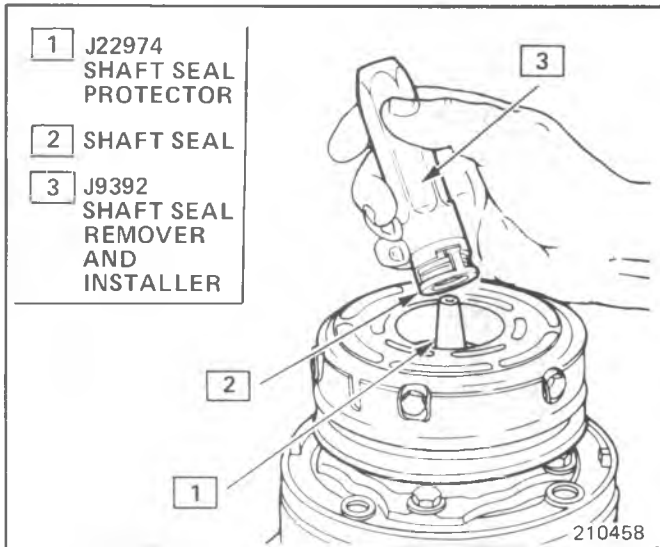


Fig. 1C1-31 Removing & Installing Seal (Off Car)

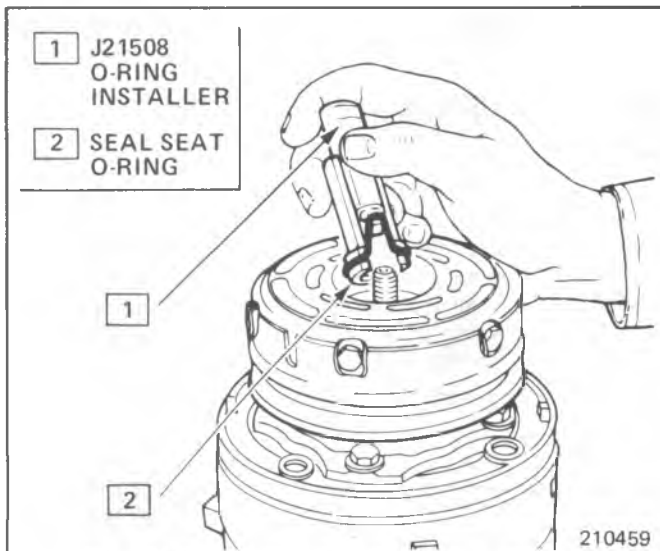


Fig. 1C1-32 Installing Seal Seat O-Ring (Off Car)

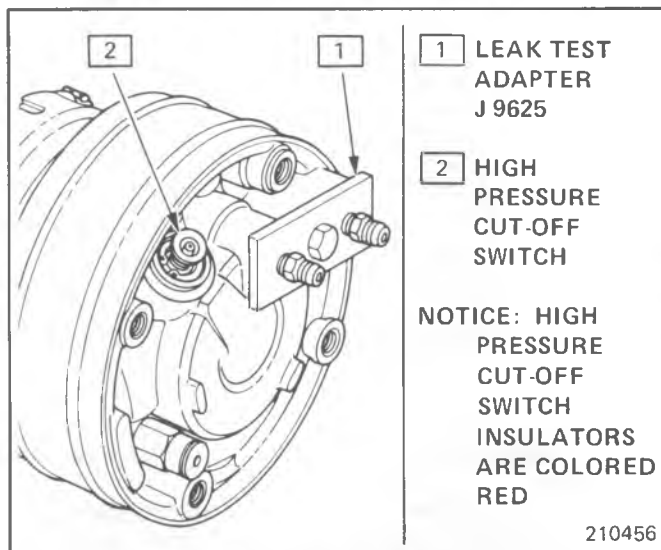


Fig. 1C1-33 Compressor Leak Testing Fixture

8. Using J-5403 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.

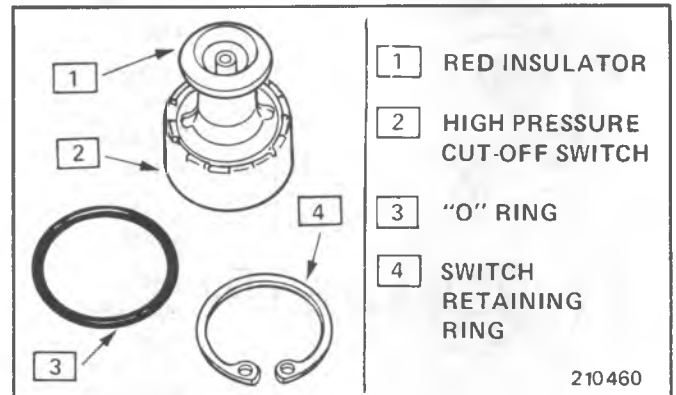


Fig. 1C1-34 High Pressure Cut-Off Switch and Retainer

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. 1C1-35) and remove the Front Head assembly (Fig. 1C1-36).

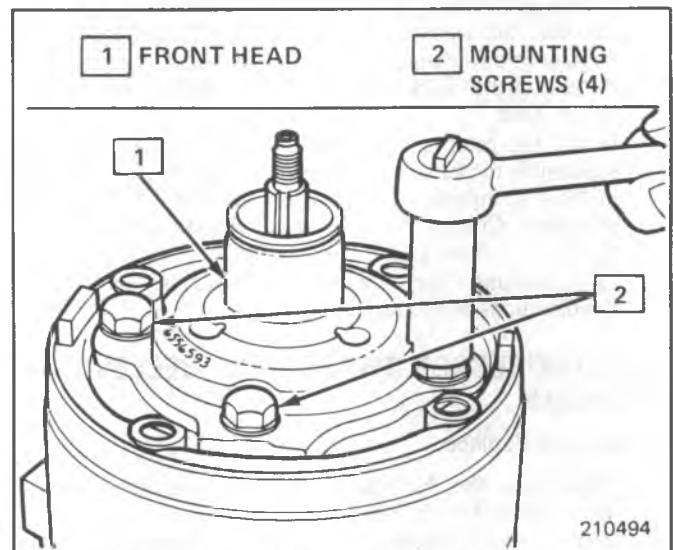


Fig. 1C1-35 Removing Front Head Mounting Screws

5. Remove and discard the front head O-ring.

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.

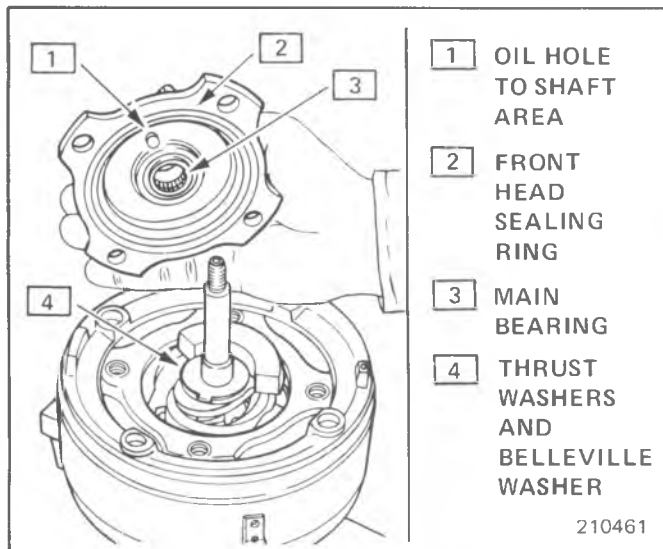


Fig. 1C1-36 Removing Front Head Asm.

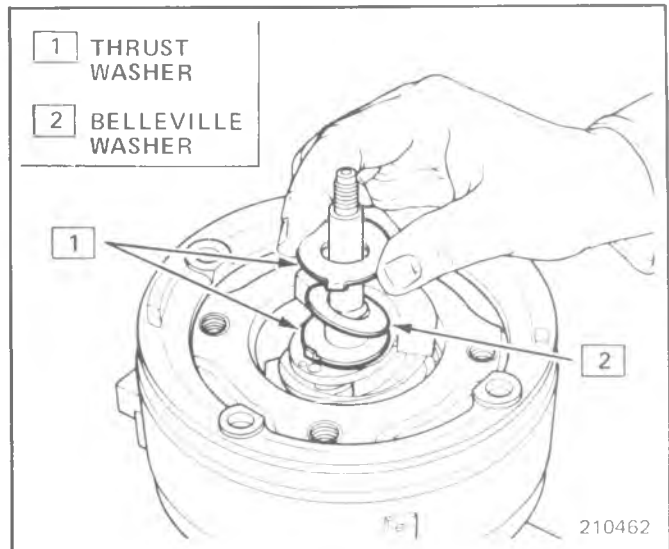


Fig. 1C1-37 Replacing Thrust and Belleville Washers

- Dip the new front head O-ring in clean 525 viscosity refrigerant oil and install in the seal groove on the front head (Fig. 1C1-36).
 - 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.
 - Install new specification Service Shaft Seal kit (Fig. 1C1-28) as described in "R-4 Compressor Shaft Seal" Replacement procedure.
 - Install the Clutch Rotor and Bearing assembly, Clutch Coil and Pulley Rim assembly to the Front Head, using Rotor and Bearing Installer J 26271 (Fig. 1C1-18).
- 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.
- 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.
 - "Evacuate and Charge the Refrigerant System" according to the directions in Section 1B1.

R-4 COMPRESSOR THRUST AND BELLEVILLE WASHERS

Remove and Replace

- "Discharge the Refrigerant System" according to the directions in Section 1B1.
- Remove the Front Head assembly as described in "Front Head" Removal procedure. Remove and discard the front head O-ring seal.
- Remove the two thrust washers and one belleville washer from the compressor shaft. Note the assembled position of the washers.
- Install a new thrust washer on the compressor shaft with the thrust washer tang pointing "up" (Fig. 1C1-37).
- Install the new belleville washer on the shaft with the high center of the washer "up."
- Install the remaining thrust washer on the shaft with the tang pointing "down" (Fig. 1C1-37).
- 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

- "Discharge the Refrigerant System" according to the direction in Section 1B1.
- Remove the Front Head assembly as described in "Front Head" Removal procedure. Discard front head O-ring.
- Place the Front Head assembly on two blocks, as shown in Fig. 1C1-38, and use Main Bearing Remover J 24896 to drive the Main Bearing out of the Front Head.

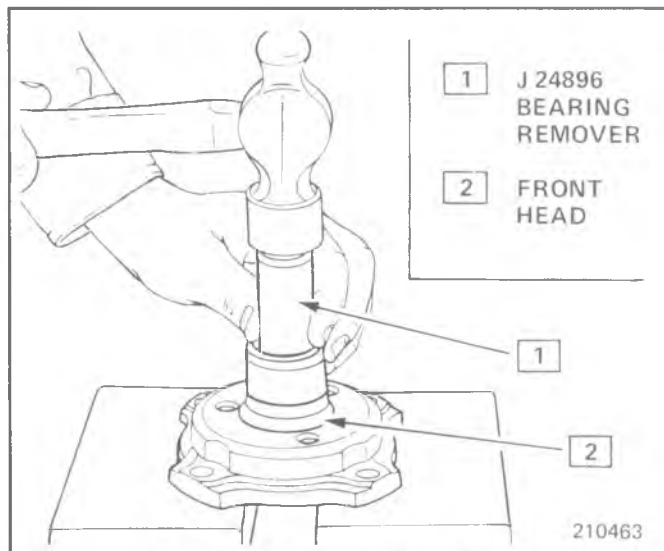


Fig. 1C1-38 Removing Main Bearing

Replace

- Place the Front Head "with neck-end down" on a flat, solid surface.
- 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. 1C1-39).
- Assemble the Front Head to the cylinder, using a new O-ring as described in "R-4 Compressor Front Head" Replacement procedure.

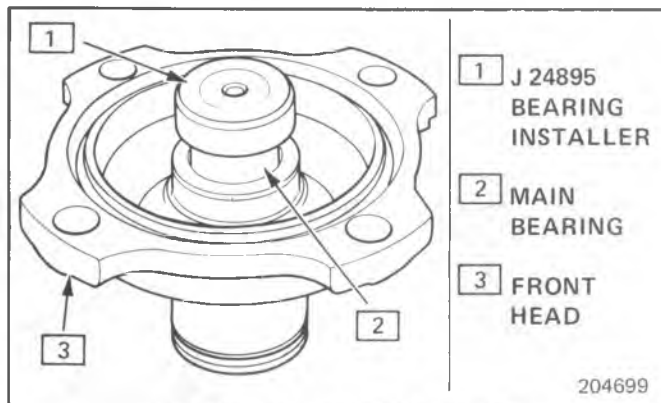


Fig. 1C1-39 Installing Main Bearing

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. 1C1-40).

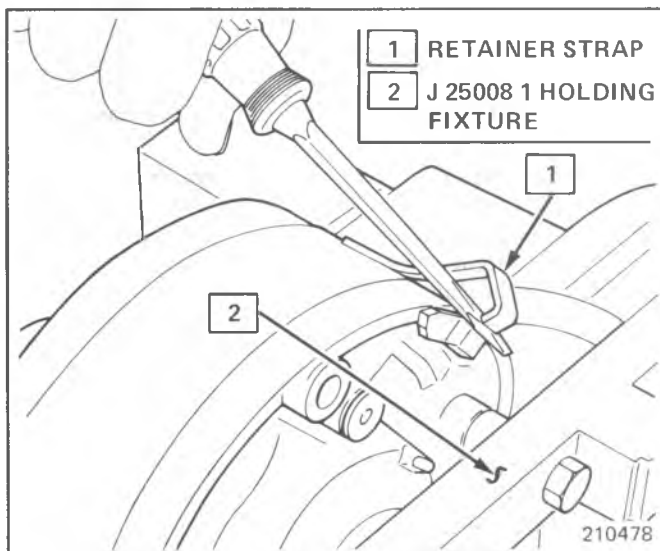


Fig. 1C1-40 Releasing Shell Retaining Strap

6. Remove Compressor Holding Fixture J 25008-1, 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. 1C1-40). 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.

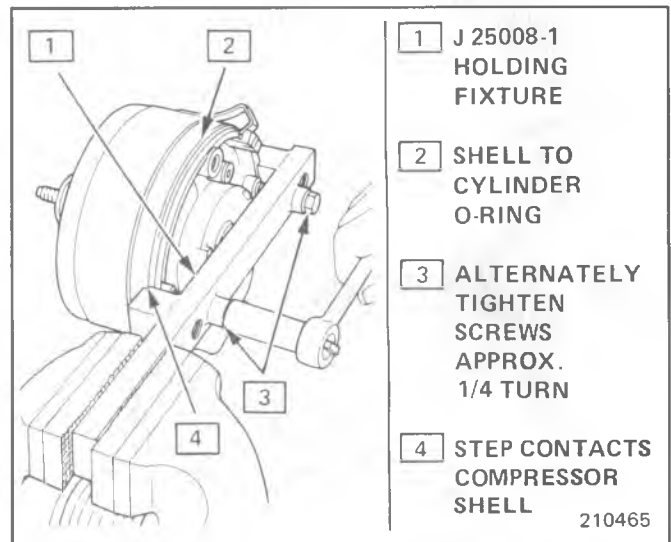


Fig. 1C1-41 Removing Shell

7. Alternately tighten each bolt approximately 1/4 turn to push the Shell free of the O-rings on the cylinder (Fig. 1C1-41). 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 25008-1 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 25008-2 to the Holding Fixture J 25008-1, using the long-bolts and plate washers of the set. Align the step projections of the Installing Fixture J 25008-2, to contact the compressor Shell evenly on both sides.
6. Push the compressor shell as close to the O-ring, Fig. 1C1-42, 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

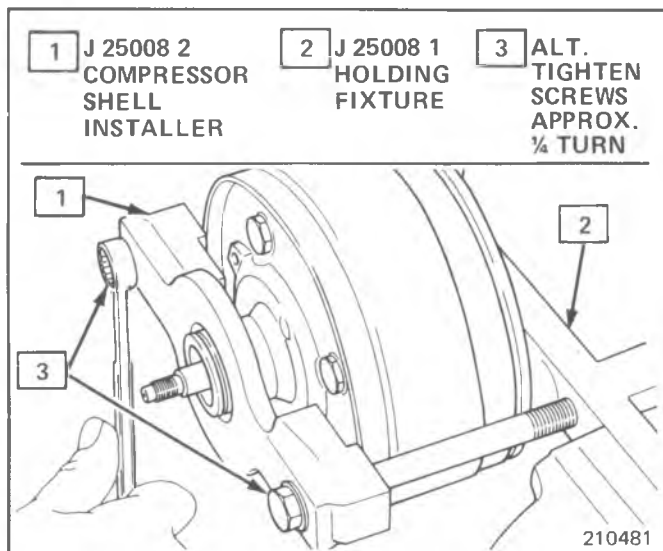


Fig. 1C1-42 Installing Shell

- 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 25008-2.
 9. Re-install Clutch Rotor and Bearing Asm., Clutch Coil and Pulley Rim as an assembly with Installer J 26271 (Fig. 1C1-11), and the Clutch Plate and Hub Assembly with Installer J 9480-01 (Fig. 1C1-10).
 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. 1C1-43. Remove Compressor Discharge Valve Plate (Fig. 1C1-44) 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 25008-1 in vise for access to the remaining two valve plates and retainers.

4. Install Discharge Valve Plates and/or Retainers as shown in Figs. 1C1-43 and 1C1-44. Reposition compressor and Holding Fixture in vise as necessary for access.
5. Re-install 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.

R-4 COMPRESSOR CYLINDER AND SHAFT ASM.

Remove

1. "Discharge the Refrigerant System" according to the directions in Section 1B1.

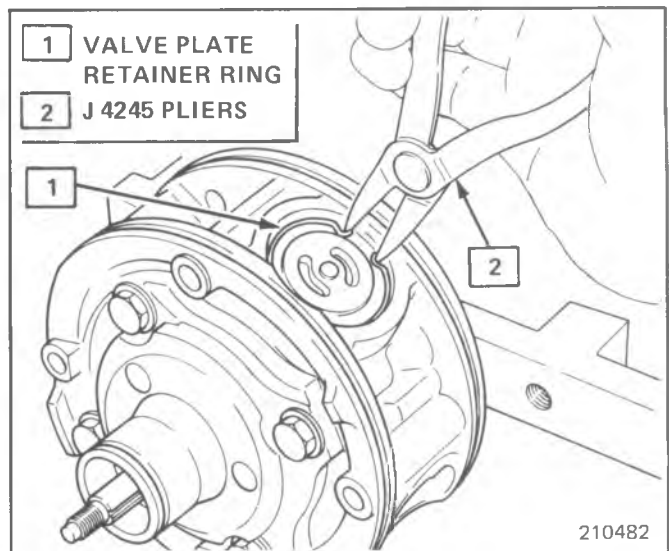


Fig. 1C1-43 Replacing Valve Plate Retainer

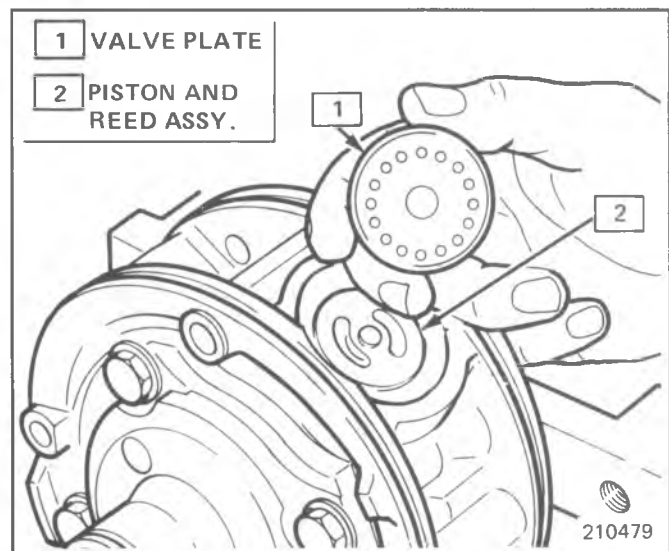


Fig. 1C1-44 Replacing Discharge Valve Plate

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

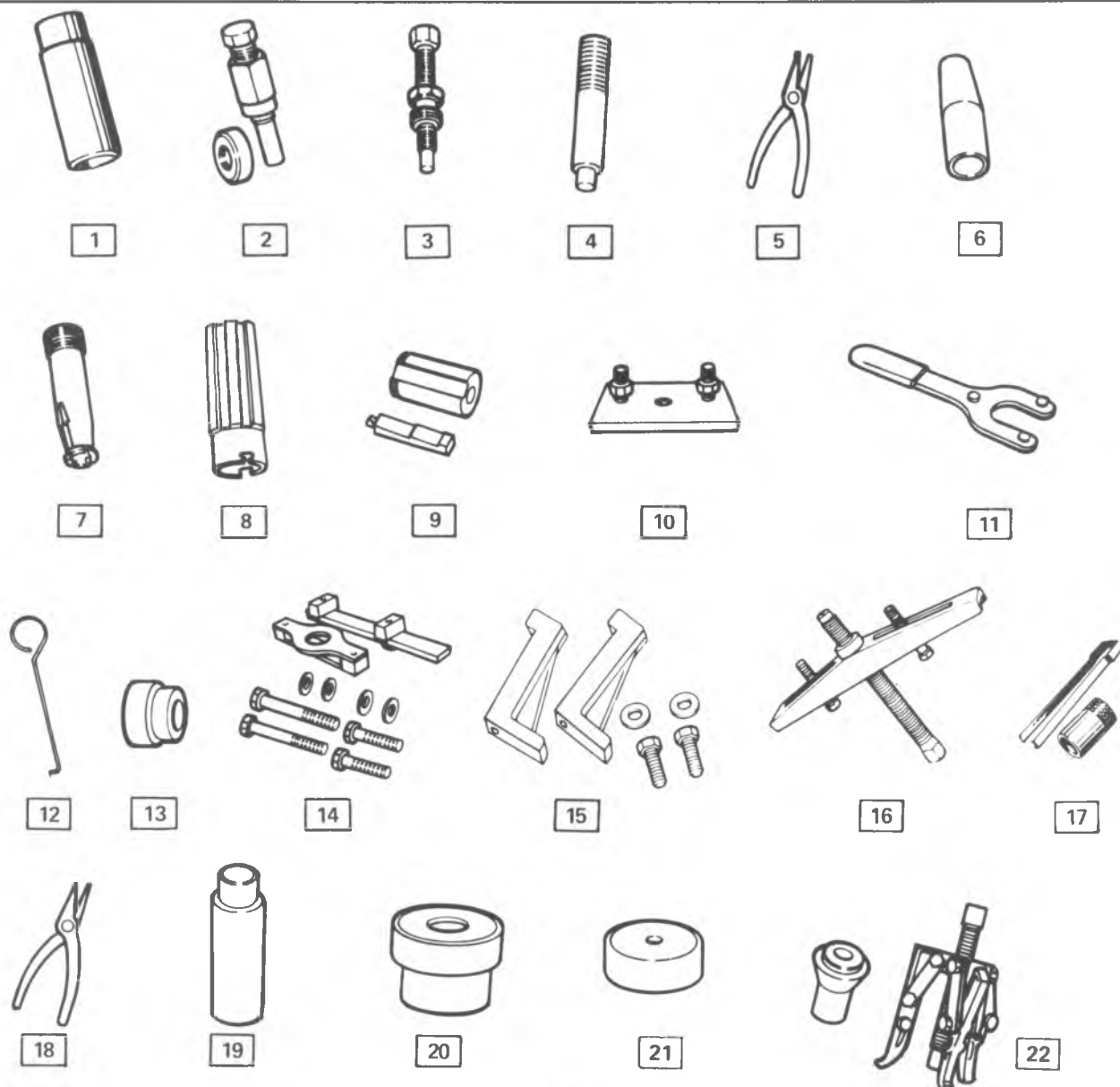
1. Replace above parts in opposite order.

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 25008-1 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 | 12 J 9553-01 | O-RING REMOVER |
| 2 J 9480-01 | HUB AND DRIVE PLATE ASSEMBLY INSTALLER | 13 J 9398 | ROTOR BEARING REMOVER |
| 3 J 9401 | HUB AND DRIVE PLATE ASSEMBLY REMOVER | 14 J 25008 | COMPRESSOR HOLDING FIXTURE |
| 4 J 8092 | DRIVER HANDLE | 15 J 24092 | PULLEY HUB ADAPTER SET (USED WITH J 8433) |
| 5 J 5403 | SNAP RING PLIERS (# 21 INTERNAL) | 16 J 8433 | COMPRESSOR PULLEY PULLER |
| 6 J 22974 | SHAFT SEAL PROTECTOR | 17 J 9393 | SEAL SEAT REMOVER & INSTALLER |
| 7 J 23128 | SEAL SEAT REMOVER AND INSTALLER | 18 J 6083 | SNAP RING PLIERS (# 24 EXTERNAL) |
| 8 J 9392 | SHAFT SEAL REMOVER AND INSTALLER | 19 J 24896 | BEARING REMOVER (FRONT HEAD) |
| 9 J 21508 | SEAL SEAT O-RING INSTALLER | 20 J 26271 | ROTOR AND BEARING INSTALLER (WITHOUT HANDLE) |
| 10 J 9625 | PRESSURE TEST CONNECTOR | 21 J 24895 | BEARING INSTALLER (FRONT HEAD) |
| 11 J 25030 | CLUTCH HUB HOLDING TOOL | 22 J 25031-2 | ROTOR AND BEARING PULLER WITH GUIDE |

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Fig. 1C1-45 Special Tools, R-4 A/C Compressor

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.

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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, its 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.

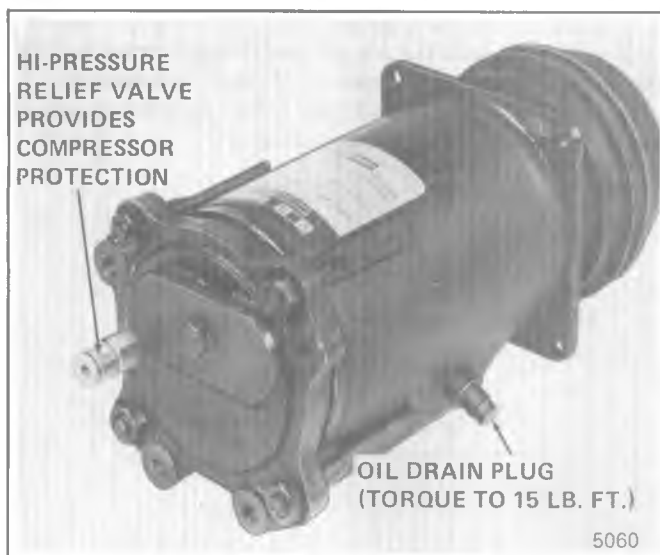


Fig. 1D-1 A-6 Compressor

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.

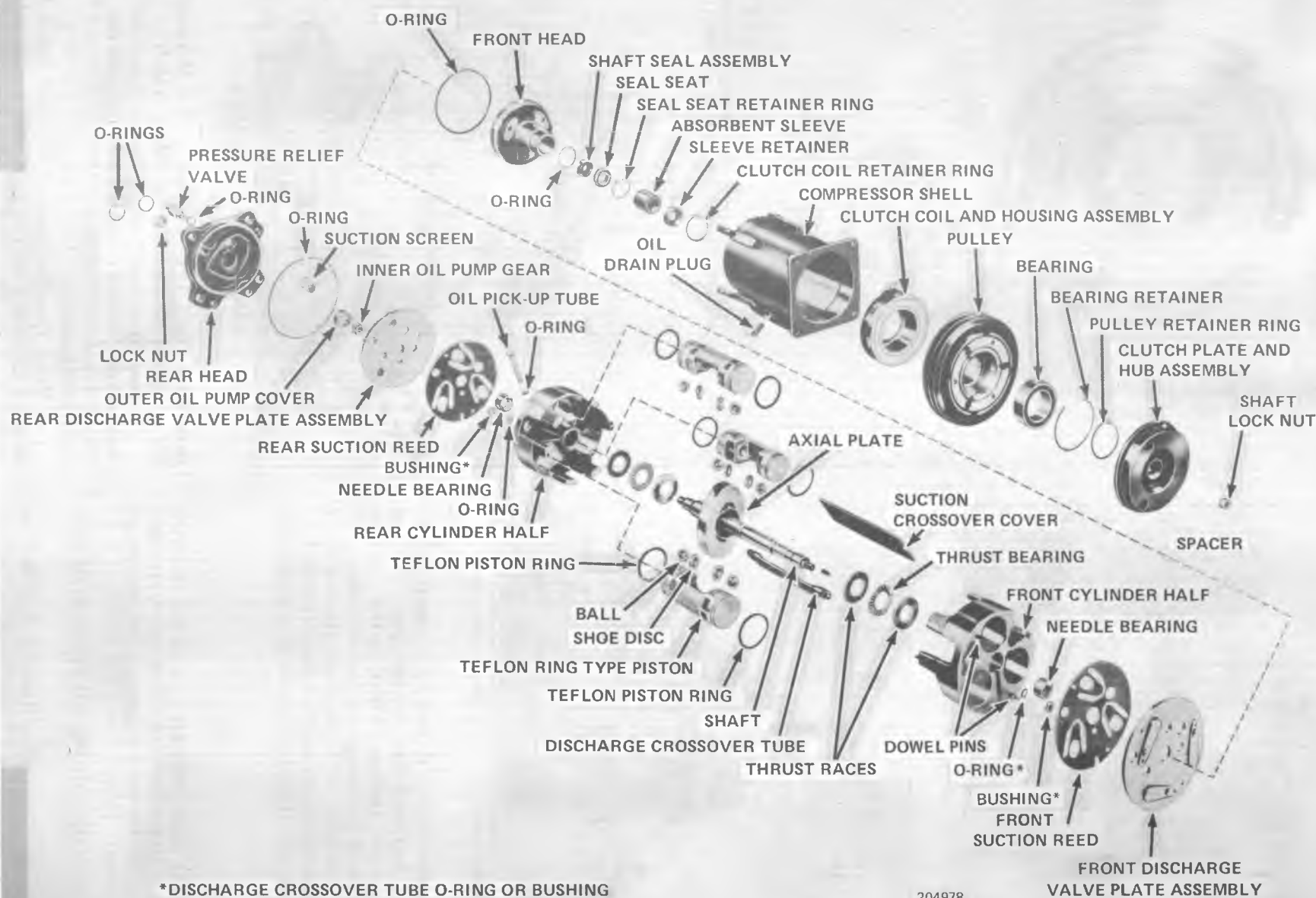
2. Keep clutch hub from turning with Clutch Hub Holder J 25030 or J 9403, and remove locknut from end of shaft using Thin Wall Socket J 9399 (Fig. 1D-3).

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).



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Fig. 1D-2 Exploded View of A-6 Compressor

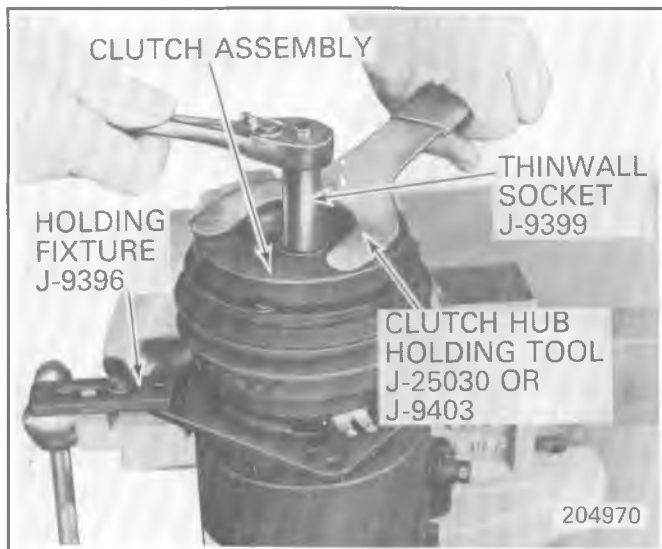


Fig. 1D-3 Removing A-6 Shaft Lock Nut

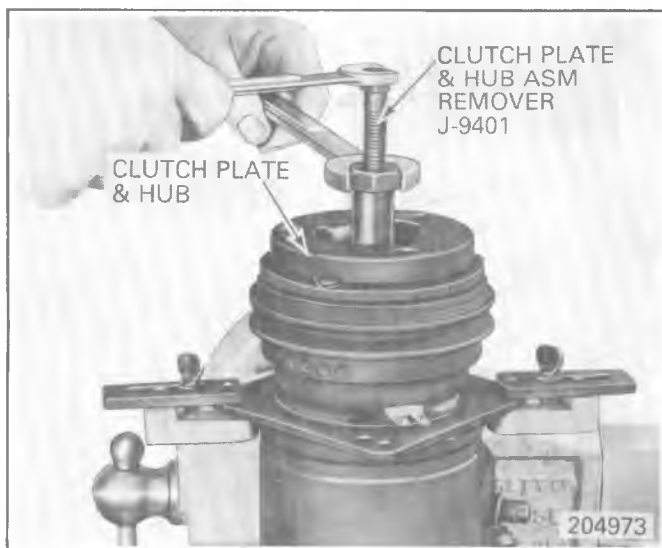


Fig. 1D-4 Removing A-6 Clutch Plate and Hub Asm.

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

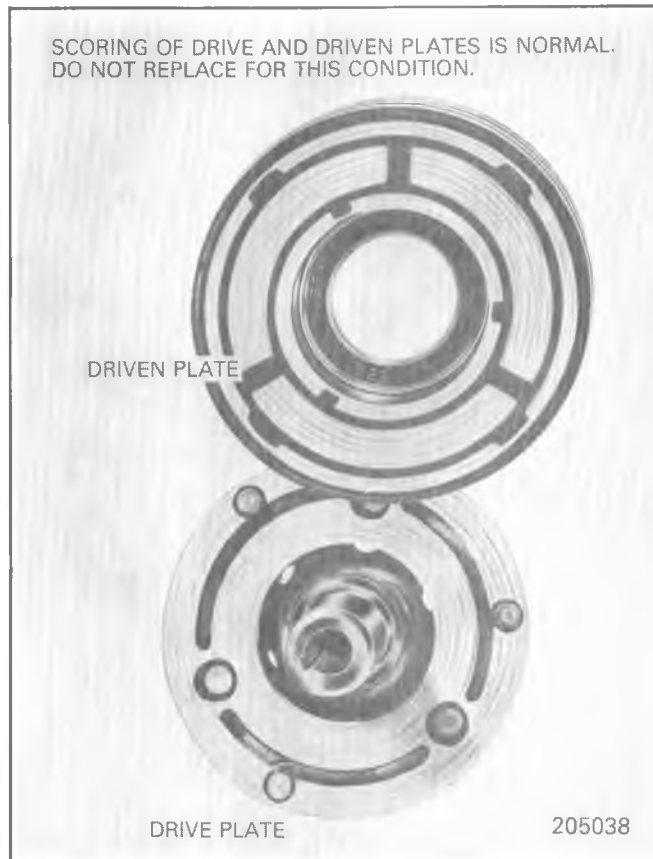


Fig. 1D-5 A-6 Clutch Driven Plate and Drive Plate

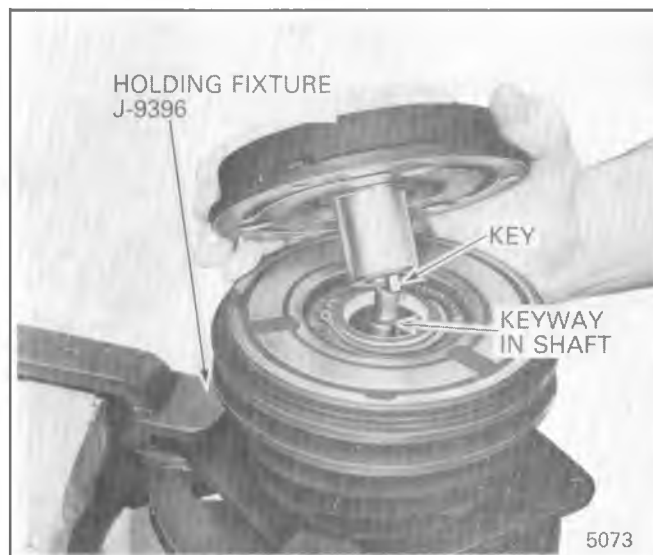


Fig. 1D-6 Aligning A-6 Drive Plate Key

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.

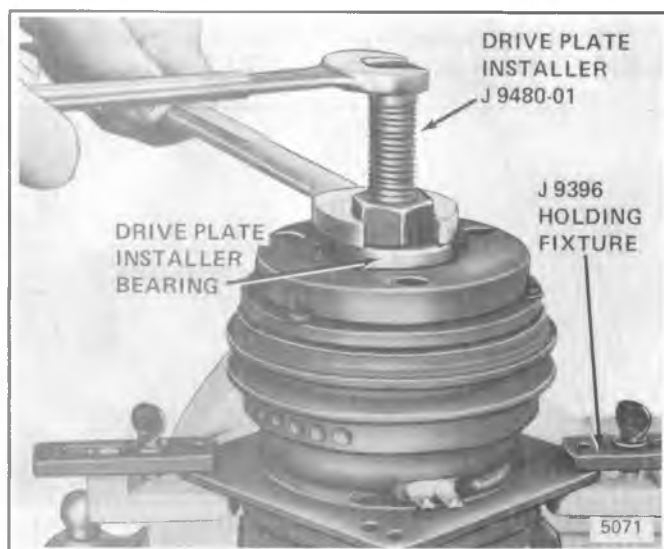


Fig. 1D-7 Installing A-6 Drive Plate

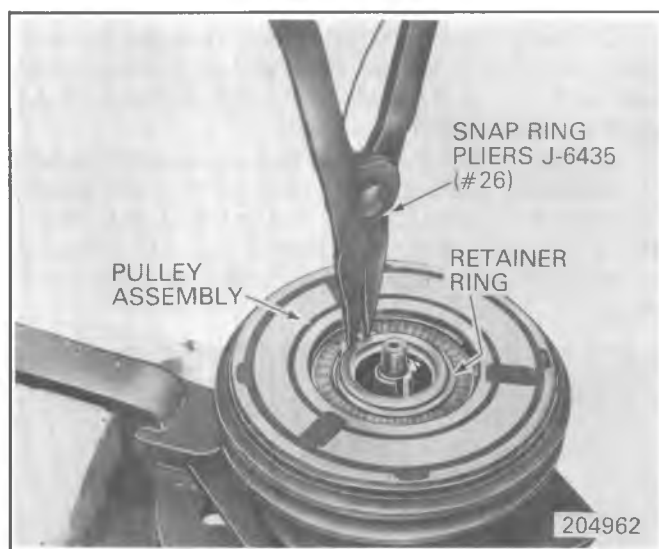


Fig. 1D-9 Removing A-6 Pulley Retainer Ring

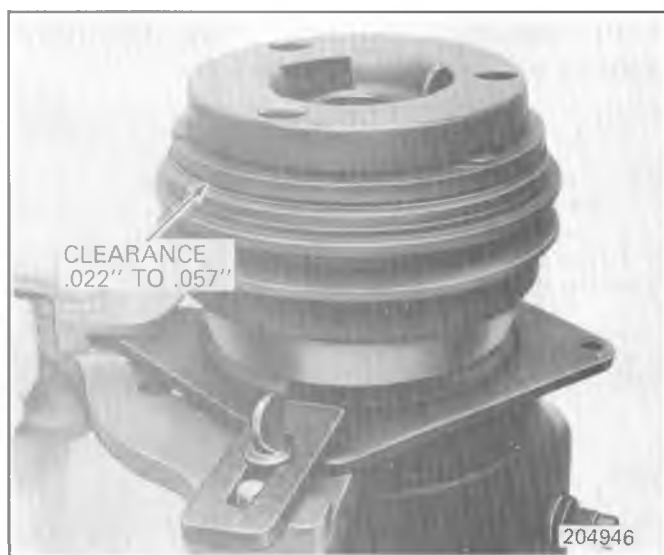


Fig. 1D-8 Checking A-6 Air Gap

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.

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).

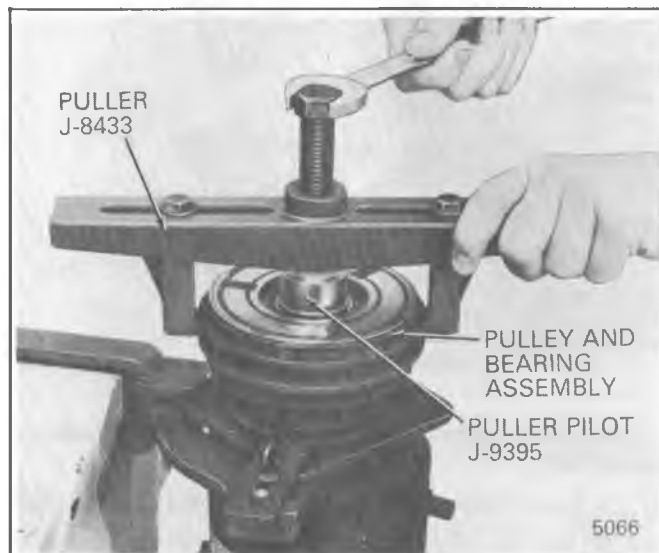


Fig. 1D-10 Removing A-6 Pulley and Bearing Asm.

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.

1D-6 AIR CONDITIONING COMPRESSOR OVERHAUL

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).

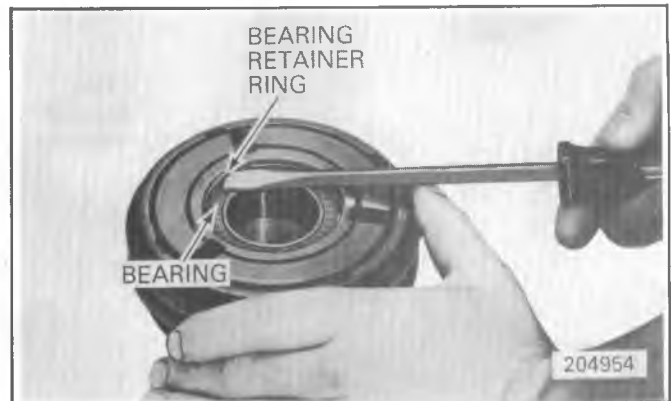


Fig. 1D-12 Removing A-6 Pulley and Bearing Retainer Ring

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

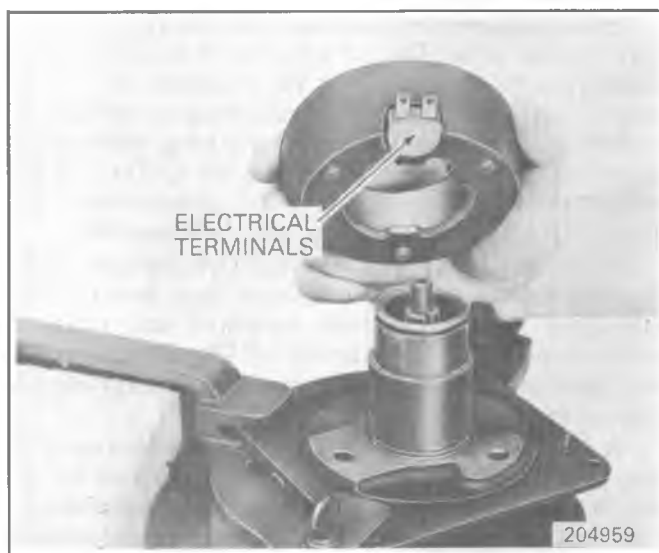


Fig. 1D-16 Installing A-6 Coil Housing

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, its 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.

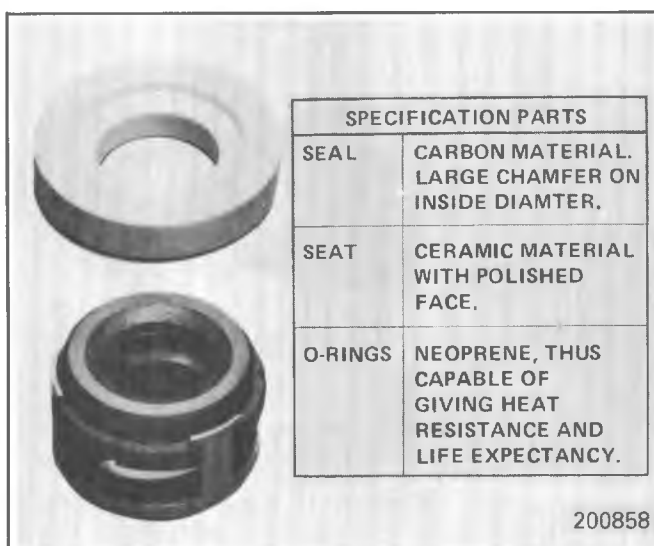


Fig. 1D-17 Specification A-6 and R-4 Compressor Shaft Seal Kit

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

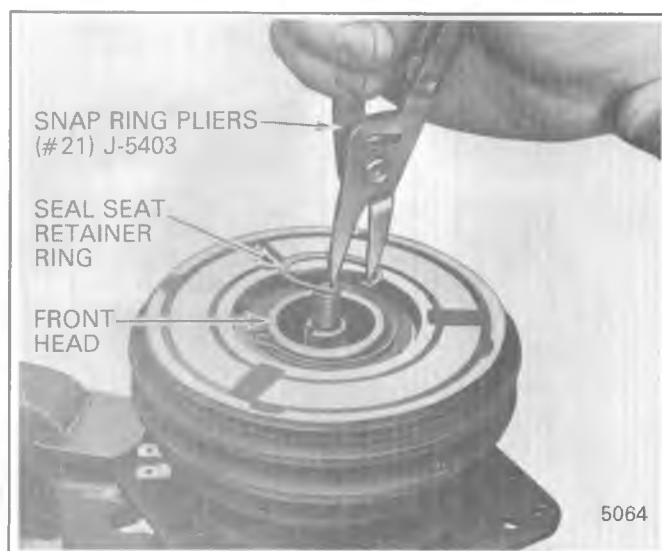


Fig. 1D-18 Removing or Installing A-6 Shaft Seal Seat Retaining Ring

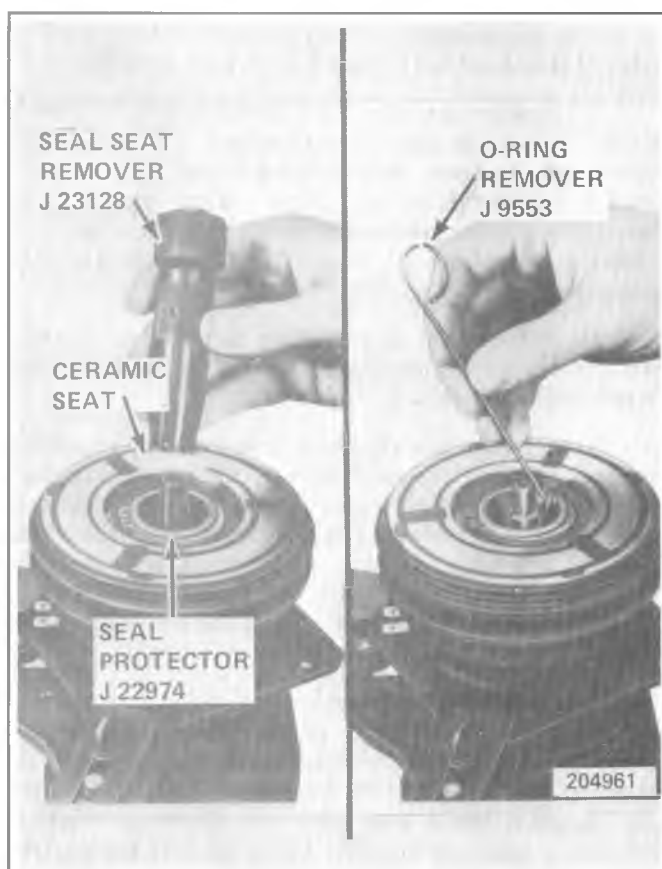


Fig. 1D-19 Removing A-6 Shaft Seal Seat and O-Ring

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.

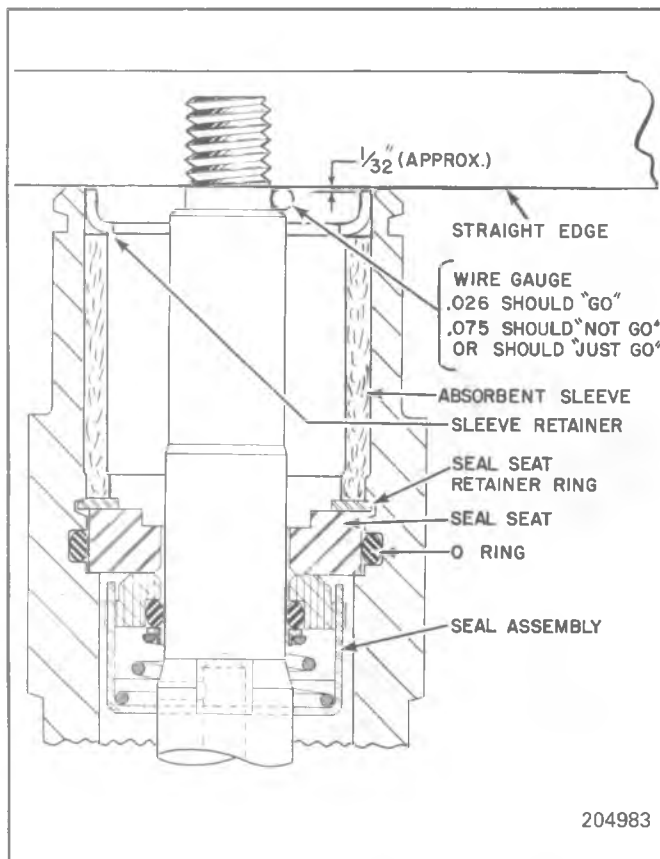


Fig. 1D-21 A-6 Compressor Shaft and Seal

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).

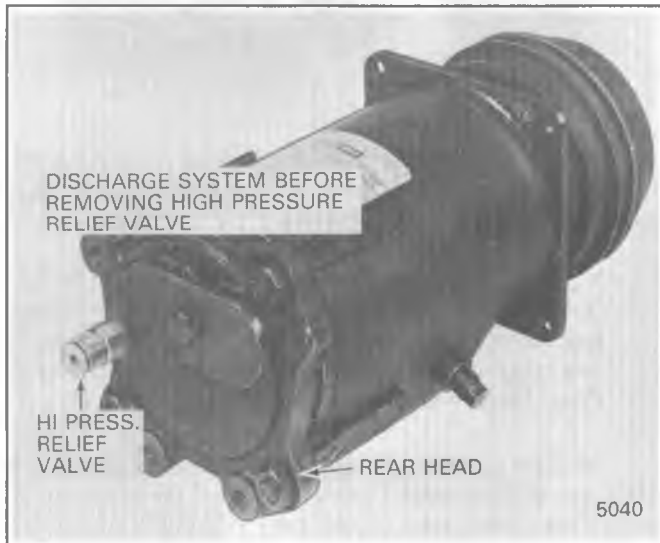


Fig. 1D-23 A-6 High Pressure Relief Valve

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.

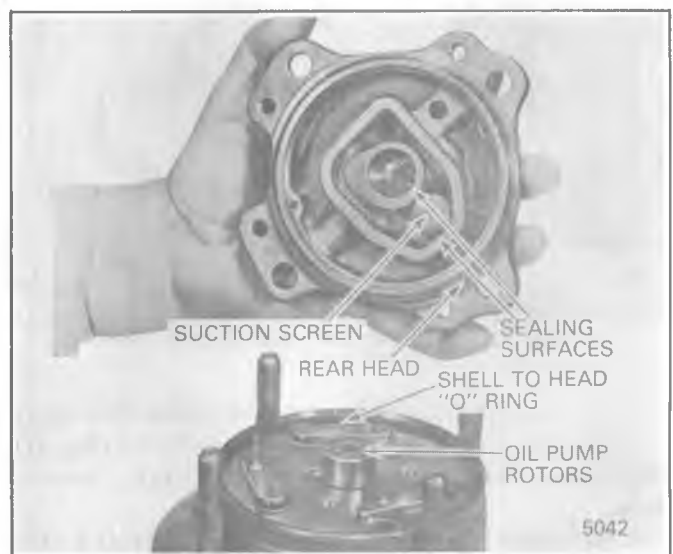


Fig. 1D-25 A-6 Rear Head Removal

6. Remove Suction Screen and examine for any damage or contamination. Clean or replace if necessary.

1D-12 AIR CONDITIONING COMPRESSOR OVERHAUL

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.

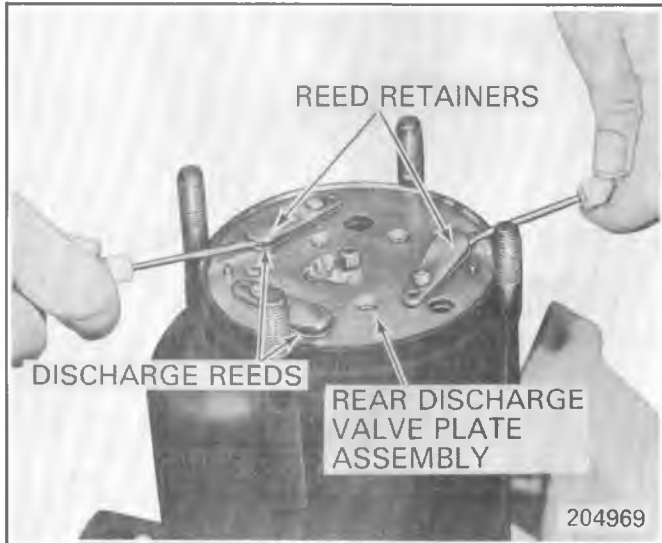


Fig. 1D-26 Removing A-6 Rear Discharge Valve Plate

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).

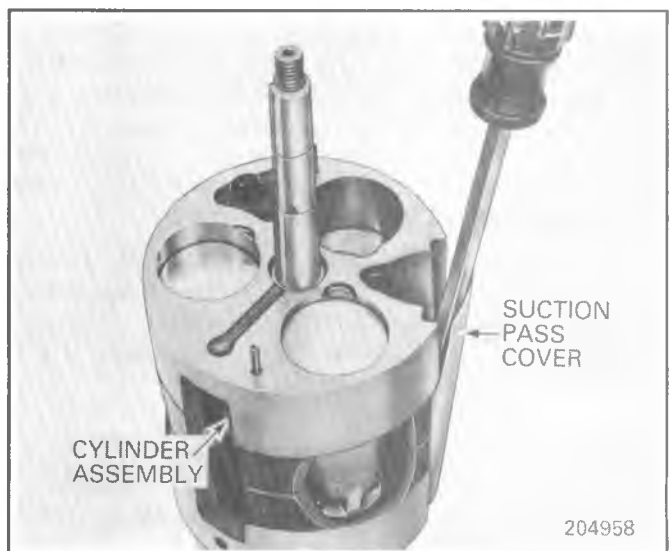


Fig. 1D-29 Removing A-6 Suction Cross-Over Cover

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).

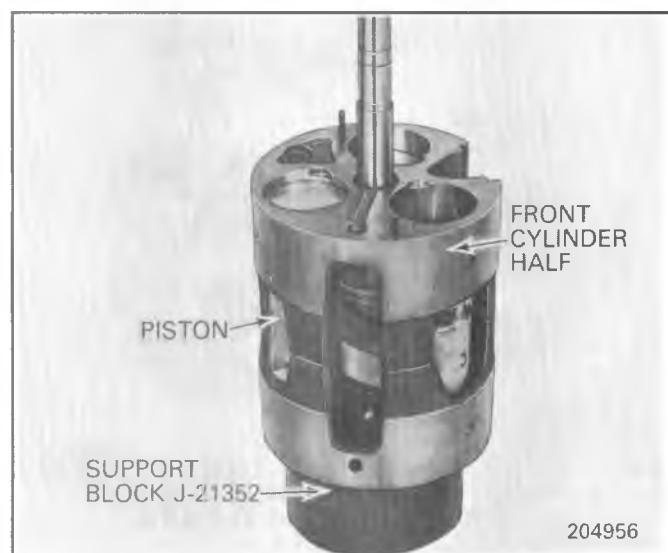


Fig. 1D-30 Numbering A-6 Piston and Cylinder Bores

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 Half, 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.

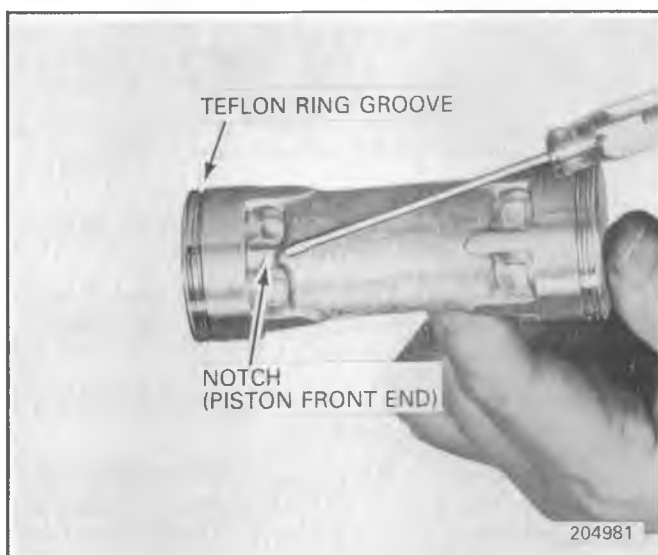


Fig. 1D-32 Notch Identifying Front End of A-6 Piston

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.

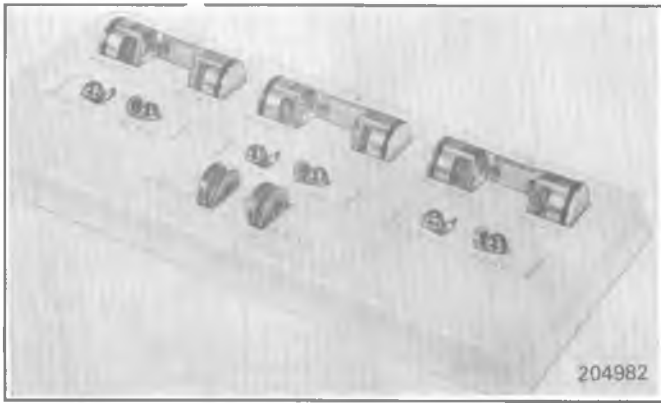


Fig. 1D-33 A-6 Parts Tray

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing (Fig. 1D-34).

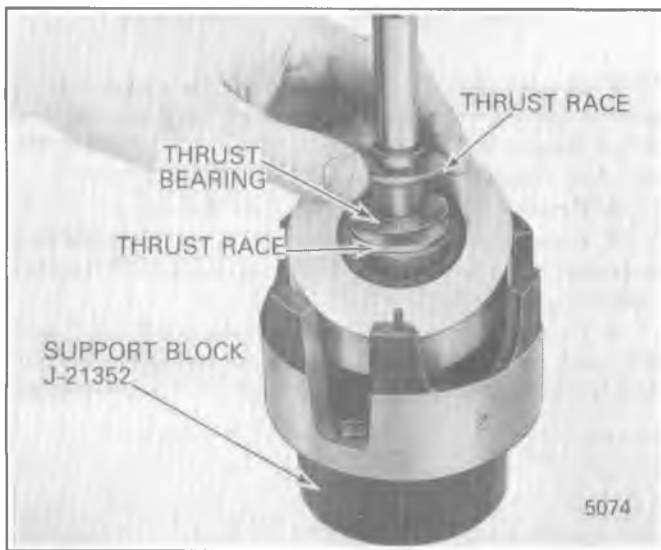


Fig. 1D-34 Removing A-6 Front Thrust Races and Bearings

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 swaged 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 COMPRESSOR 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.

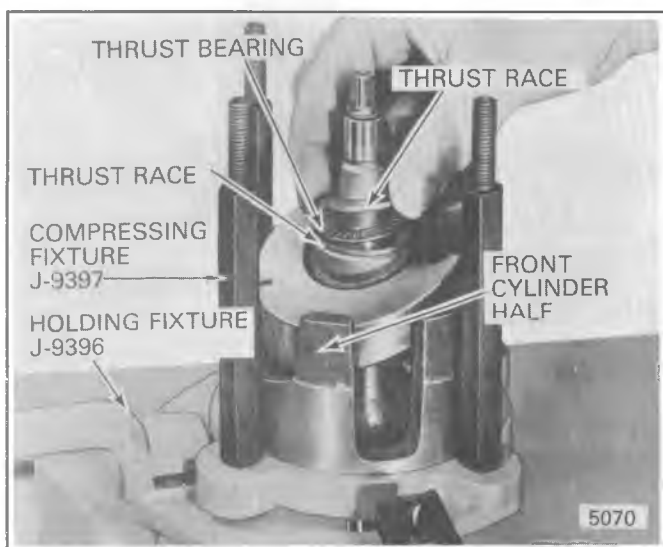


Fig. 1D-36 Installing A-6 Rear Thrust Races and Bearings

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.

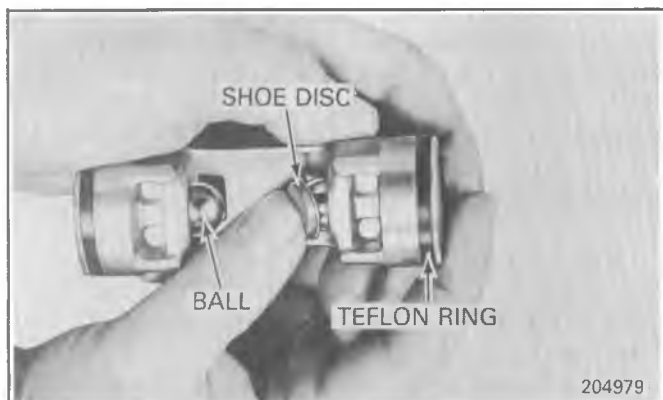


Fig. 1D-37 Installing A-6 Front Shoe Disc

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.

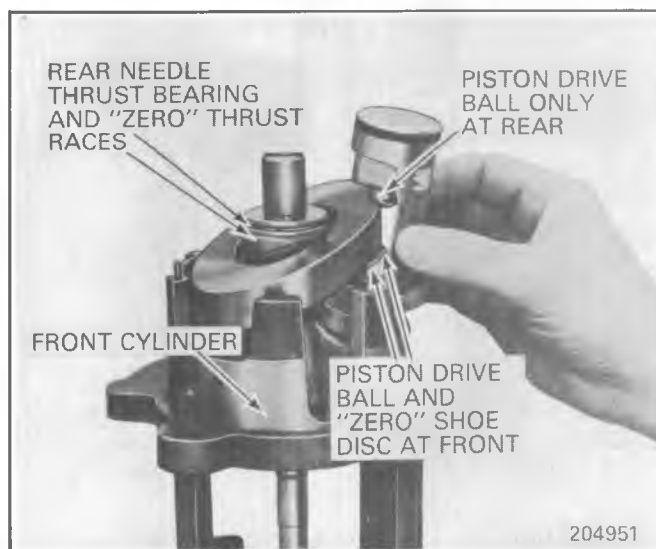


Fig. 1D-38 Installing A-6 Piston During Gaging Operation

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

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.

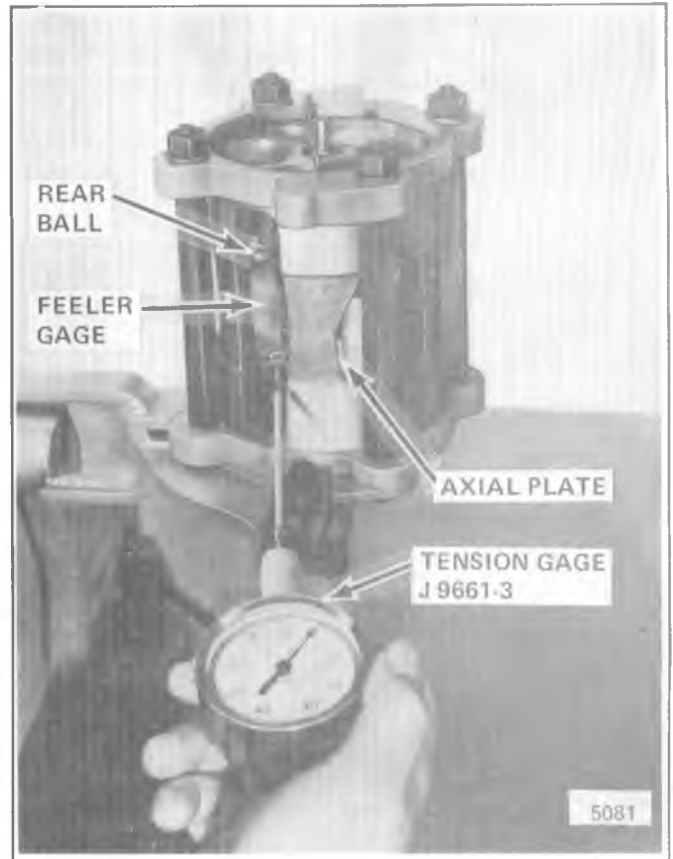


Fig. 1D-40 Gaging A-6 Rear Piston Ball

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

200914

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.

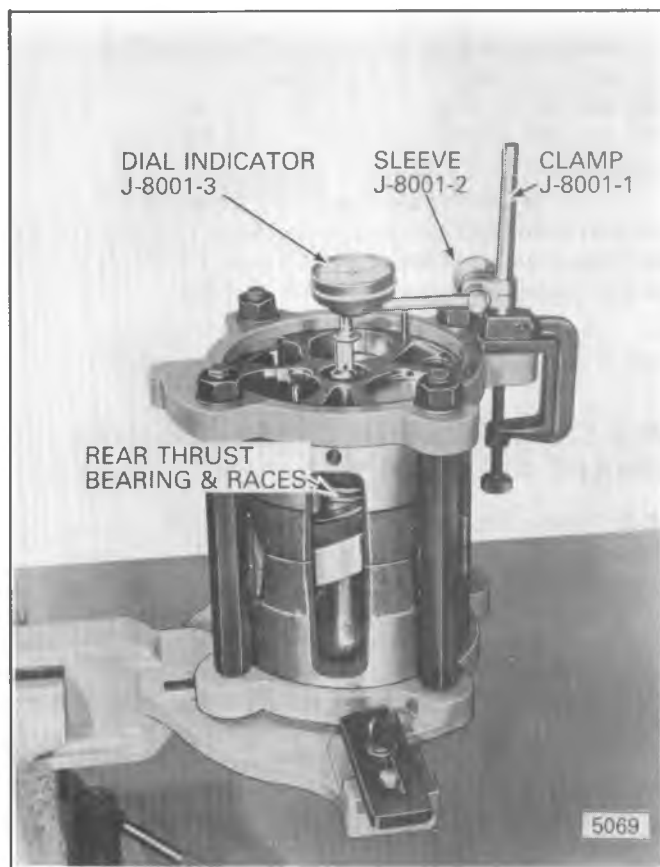


Fig. 1D-43 Gaging A-6 Rear Thrust Race

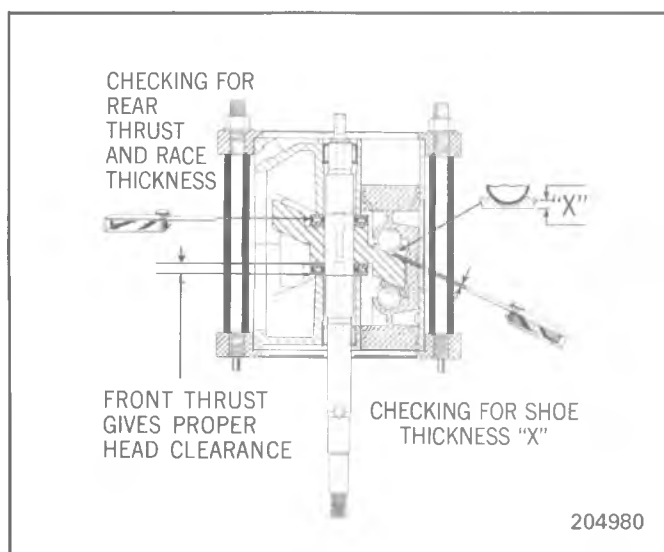


Fig. 1D-44 Checking A-6 Piston and Shaft End Play

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

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).

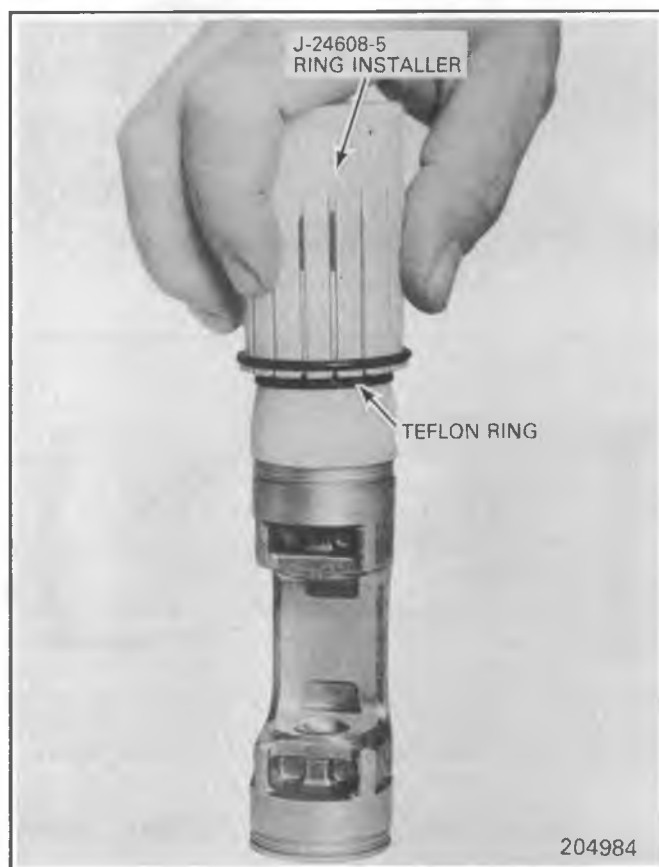


Fig. 1D-47 Installing A-6 Teflon Piston Ring

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.

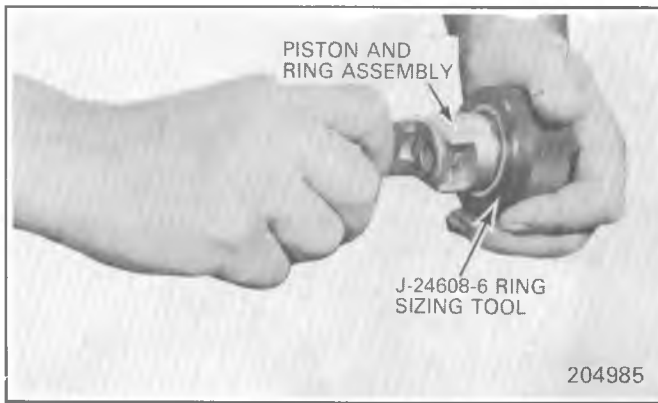


Fig. 1D-48 Turning A-6 Piston and Ring Asm. Into Ring Sizing Tool

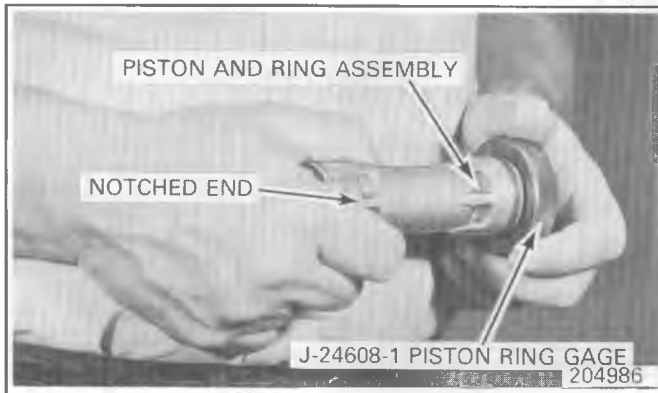


Fig. 1D-49 Gaging A-6 Piston Ring Size

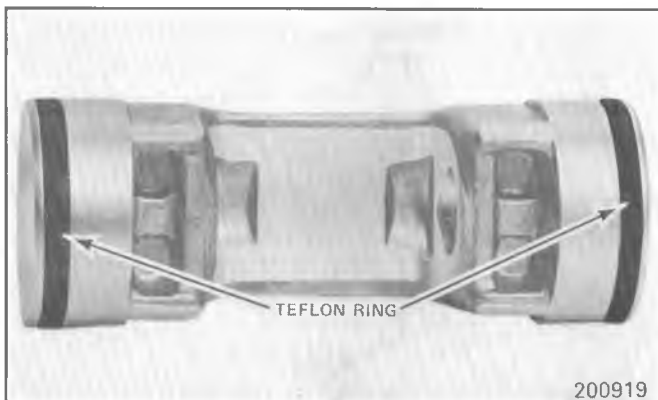


Fig. 1D-50 A-6 Teflon Piston Ring Installed in Piston Groove

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).

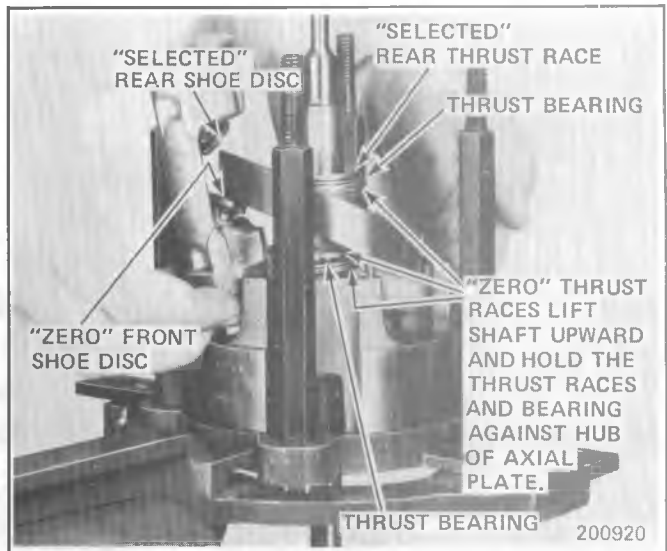


Fig. 1D-51 Installing 1st A-6 Piston Assembly Into Front Cylinder Half

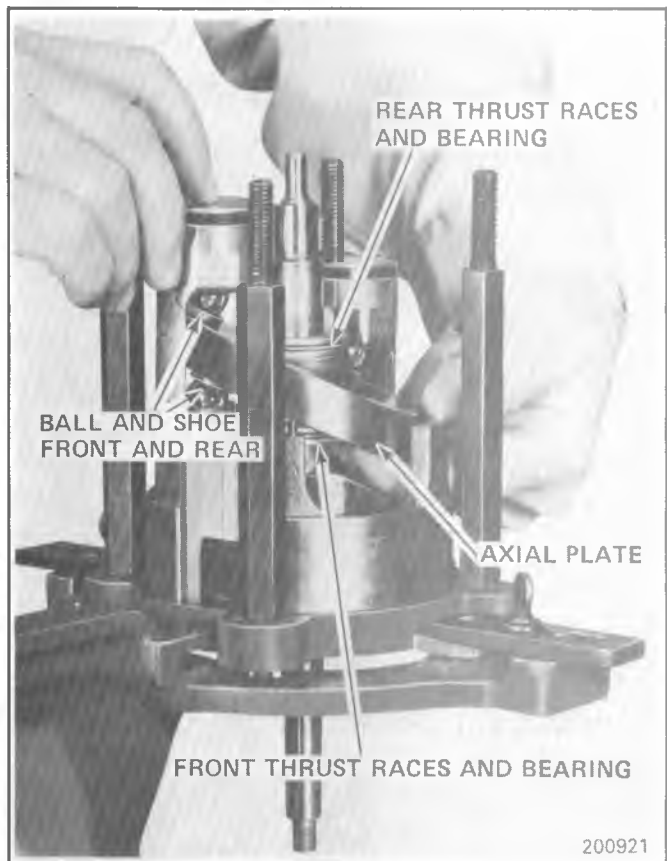


Fig. 1D-52 Installing 2nd A-6 Piston

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.

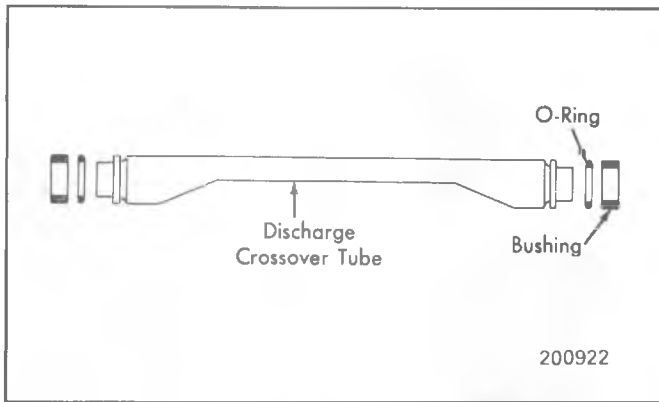


Fig. 1D-53 Service-type A-6 Discharge Cross-Over Tube

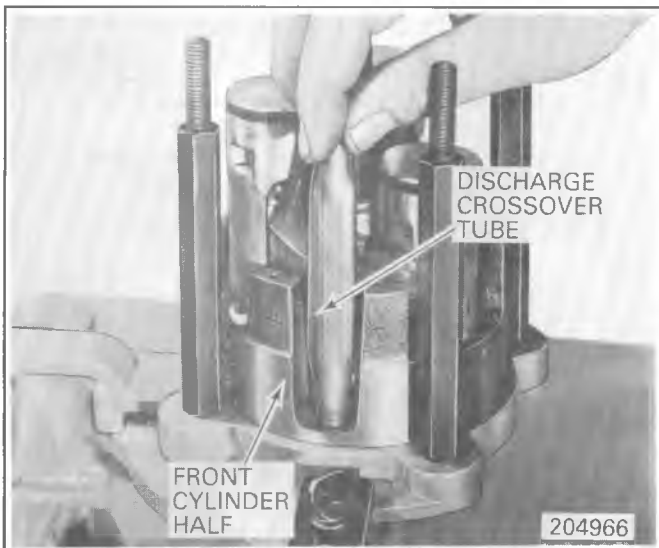


Fig. 1D-54 Installing A-6 Discharge Cross-over Tube

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.)

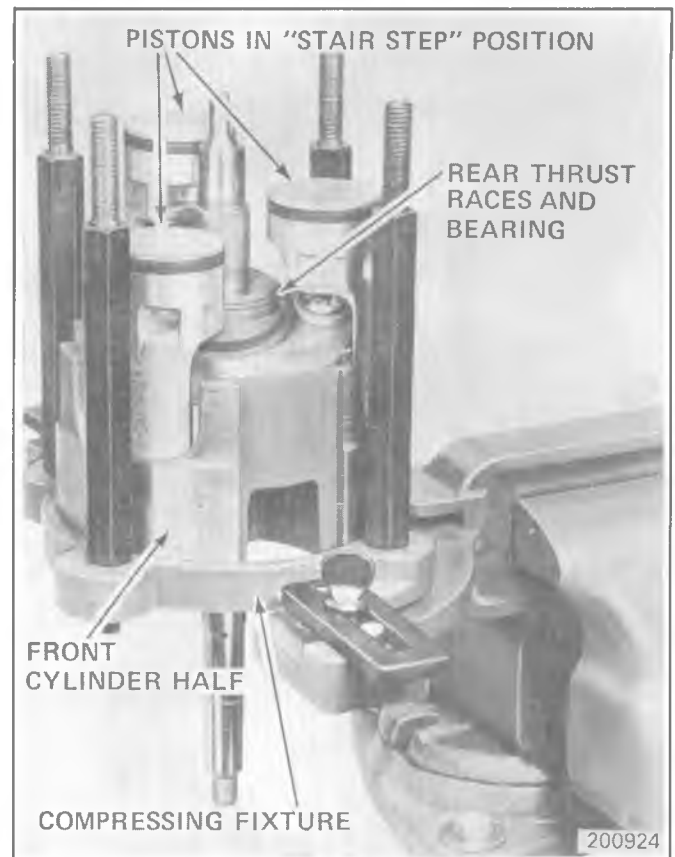


Fig. 1D-55 A-6 Pistons Positioned in Stair-Step Arrangement

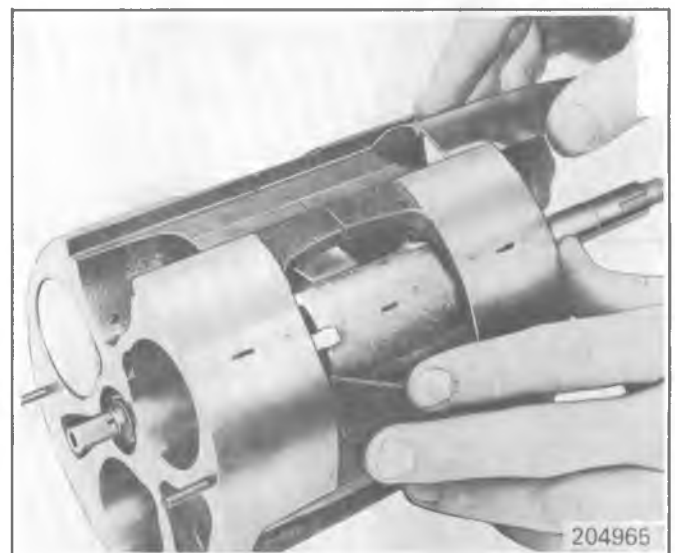


Fig. 1D-56 Installing A-6 Suction Cross-over Cover

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.

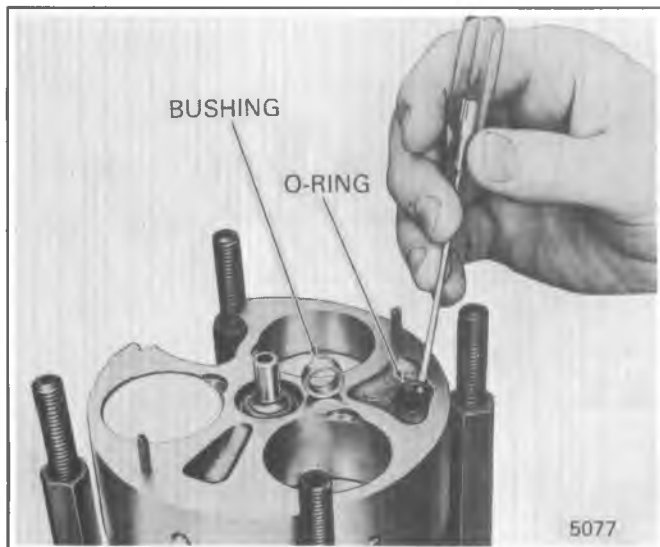


Fig. 1D-57 Installing O-Ring On A-6 Discharge Cross-Over Tube

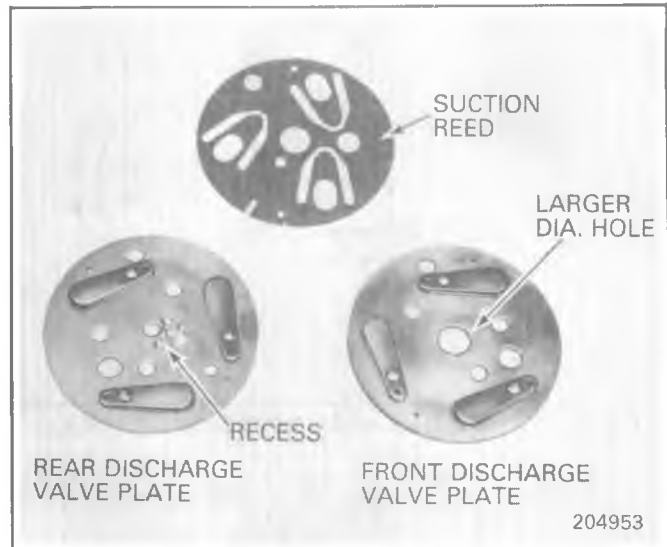


Fig. 1D-60 Front and Rear A-6 Discharge Valve Plates

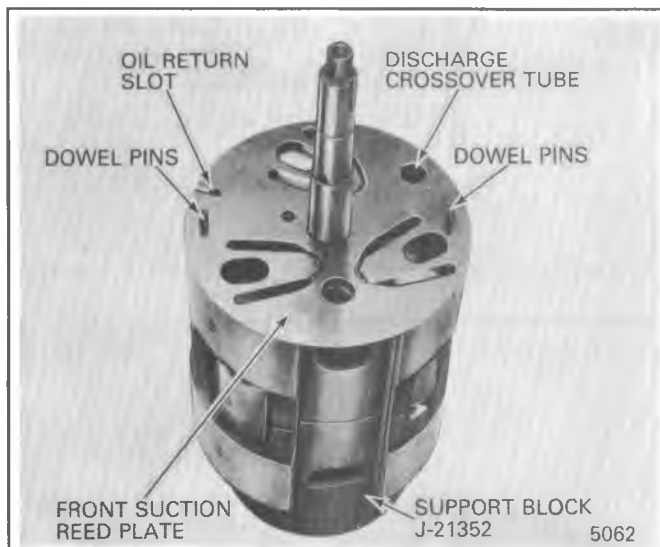


Fig. 1D-58 Installing A-6 Front Suction Reed

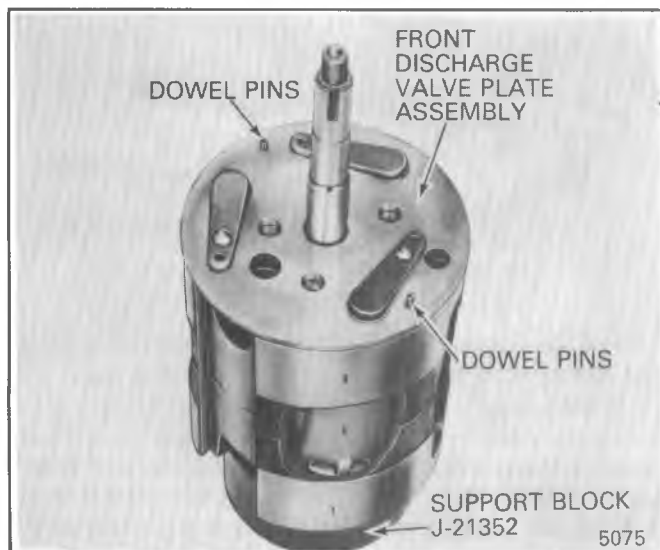


Fig. 1D-59 Installing A-6 Front Discharge Valve Plate



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).

1D-24 AIR CONDITIONING COMPRESSOR OVERHAUL

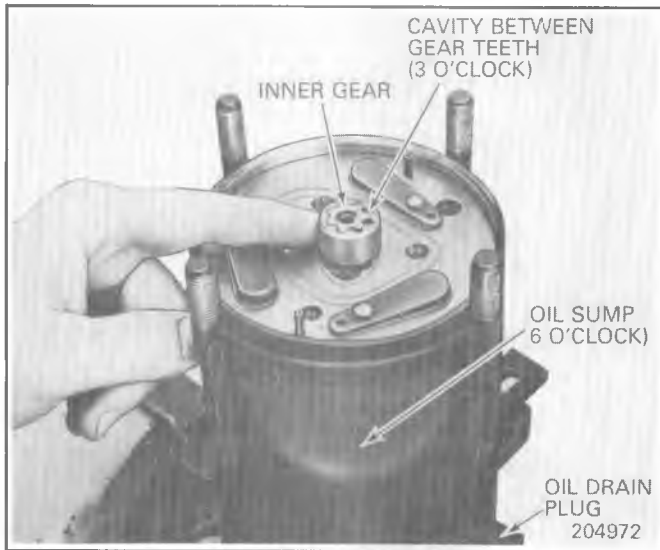


Fig. 1D-65 Positioning A-6 Oil Pump Gears



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 Procedures 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 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.

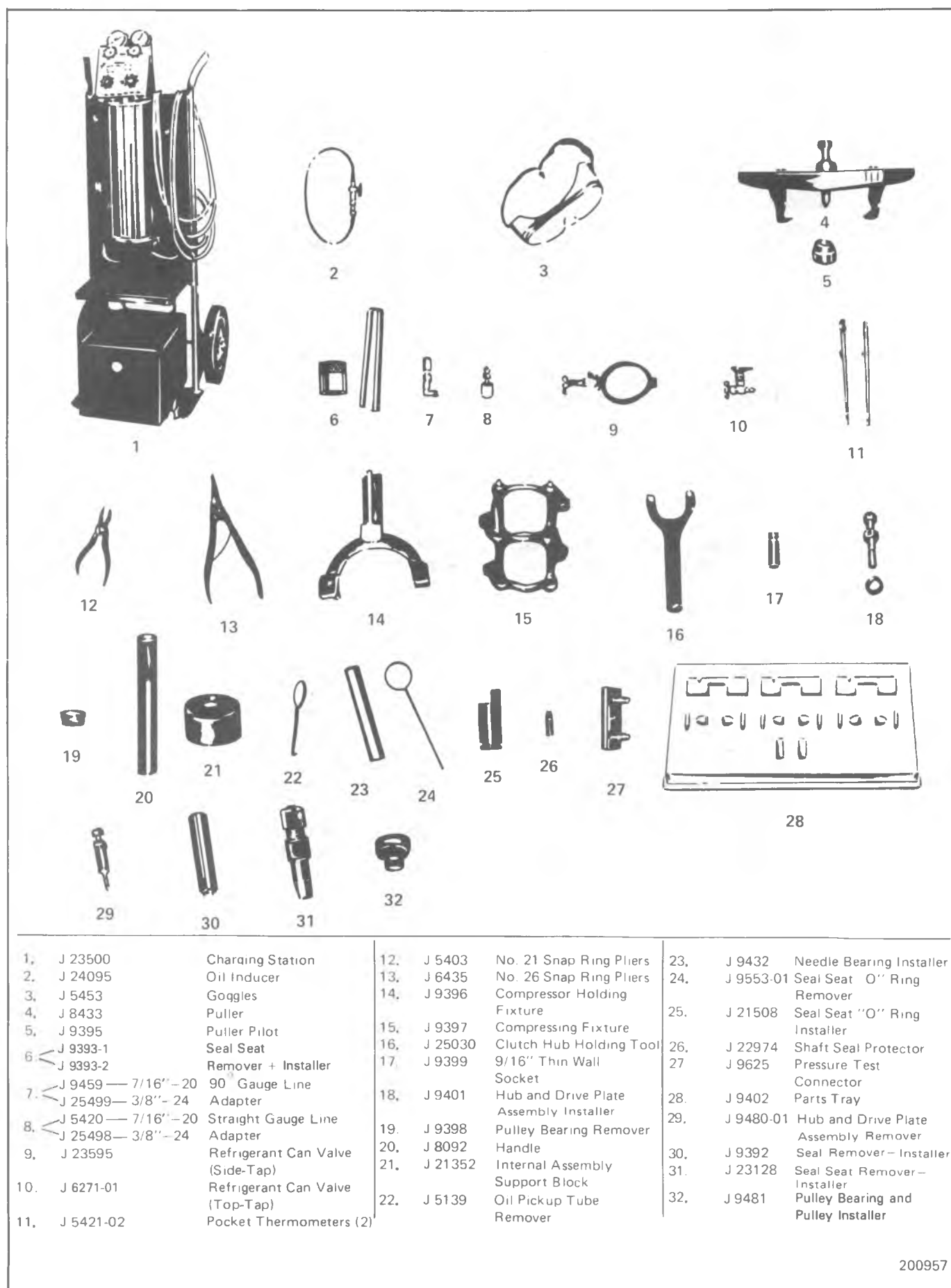


Fig. 1D-105 Special Tools, A/C Refrigerant System and A-6 Compressor

SECTION 2A

FRAME

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On Vehicle Service	2A-1
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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 $8\frac{1}{4}$ in. (206 mm), and at point E with a vertical pointer length of $5\frac{1}{4}$ 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.

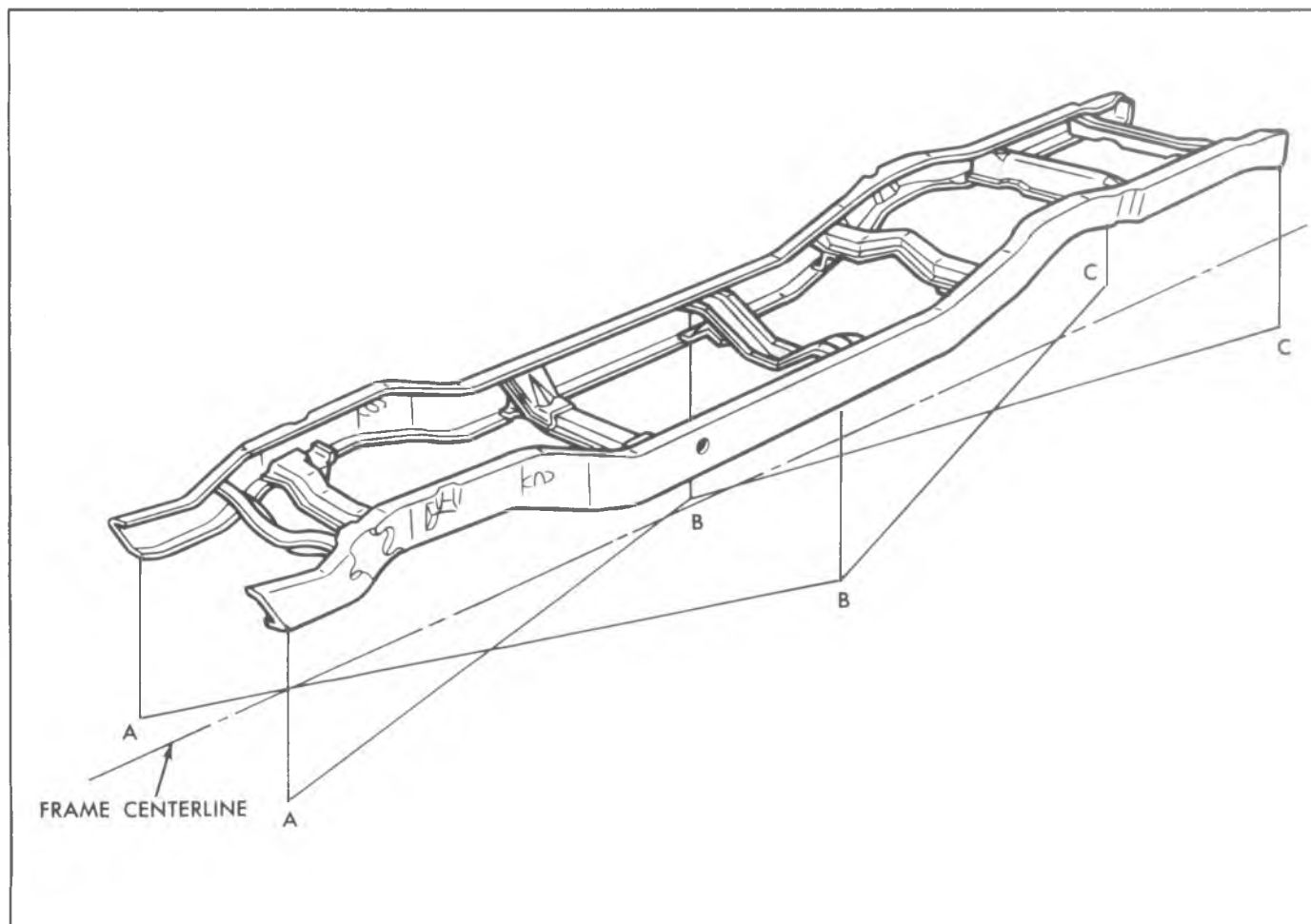


Fig. 2A-1—Frame Horizontal Checking—Typical

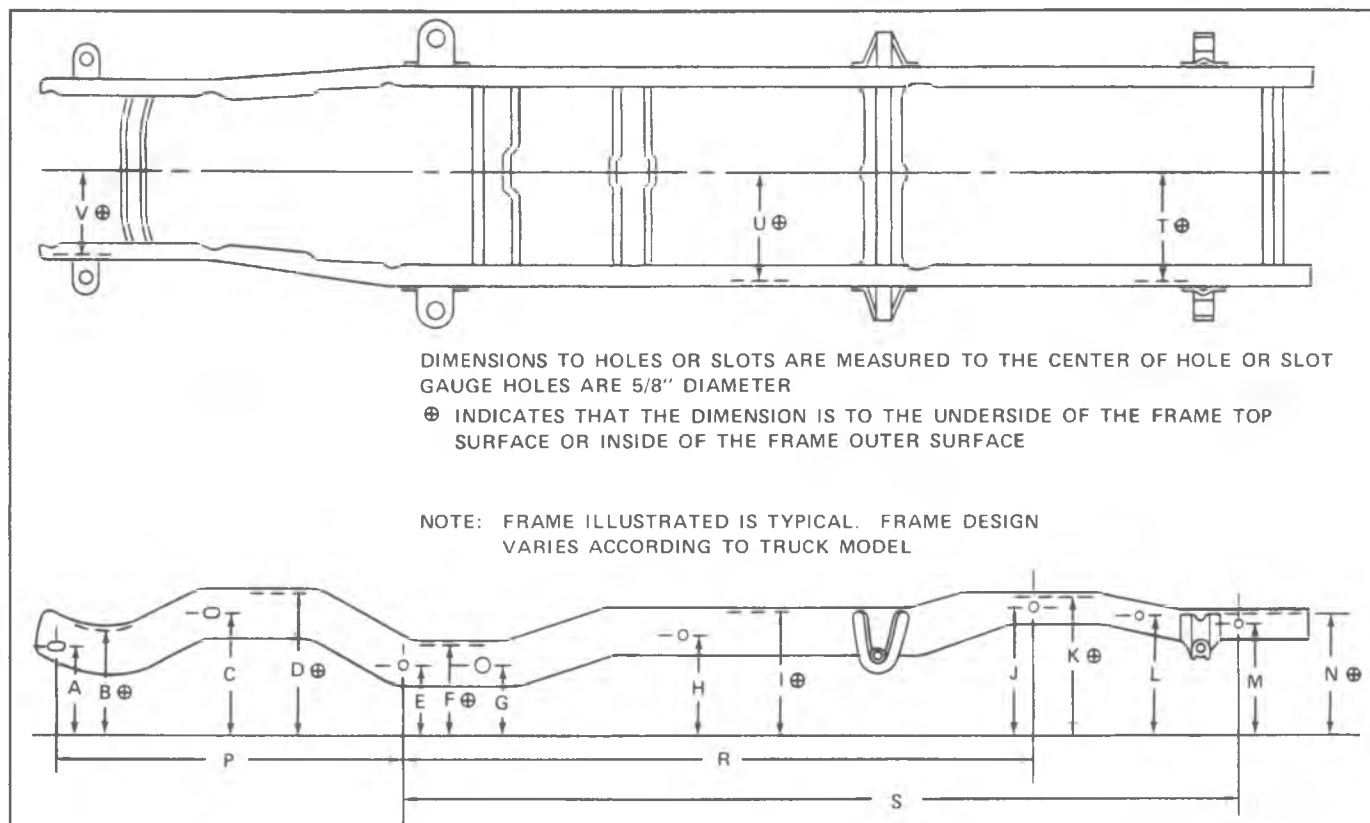


Fig. 2A-2--C-K-P Series Truck Frame

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

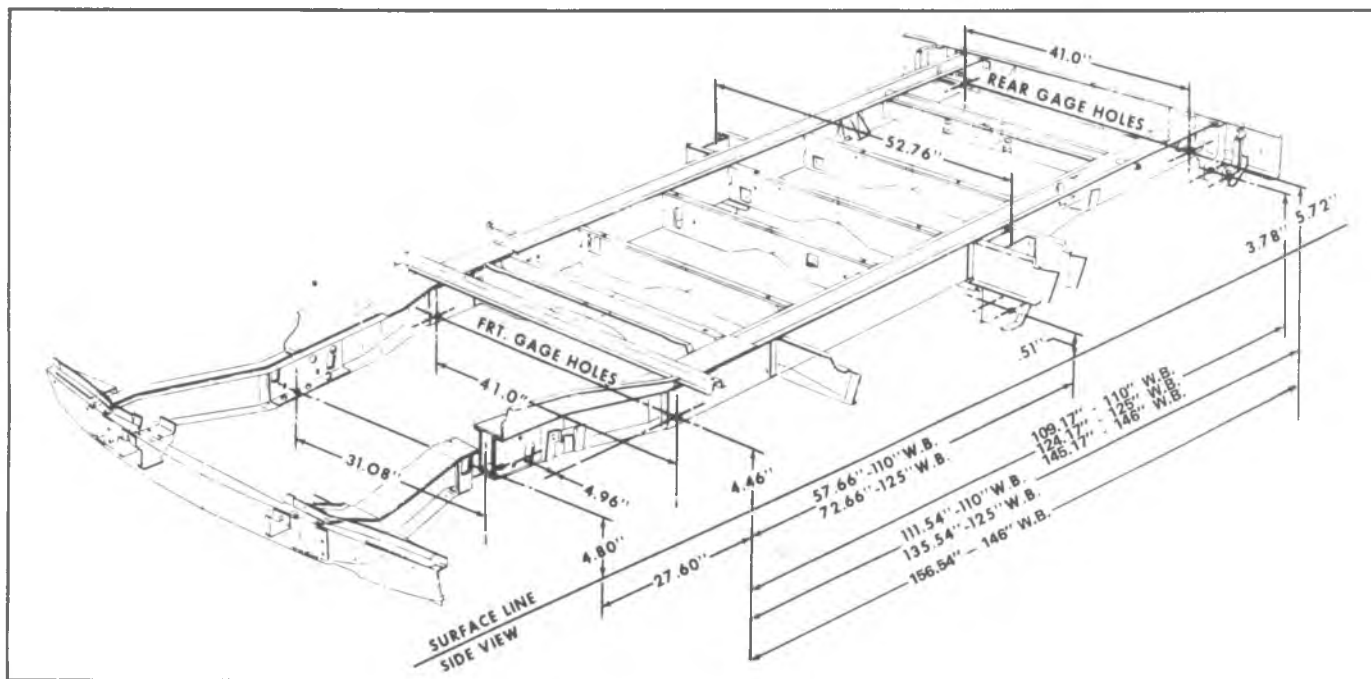


Fig. 2A-4--G Van Truck Reference Dimensions

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.

CONTENTS

General Description.....	2B-1	Rear Step Bumper - C and K Models	2B-2
Service Procedures - 10 thru 30 series	2B-1	Front Bumper G Series	2B-2
Front Bumper - C, K and P Models	2B-1	Rear Bumper G Series	2B-3
Rear Bumper - C and K Models.....	2B-2		

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

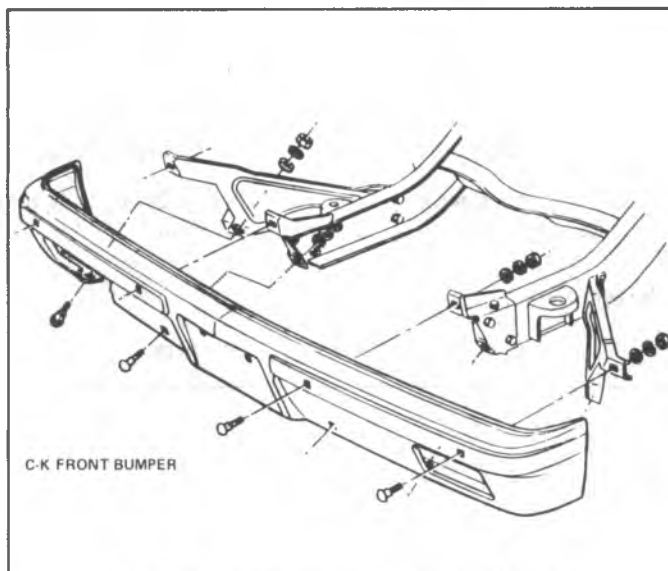


Fig. 2B-1--Front Bumper-C, K and P Models

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

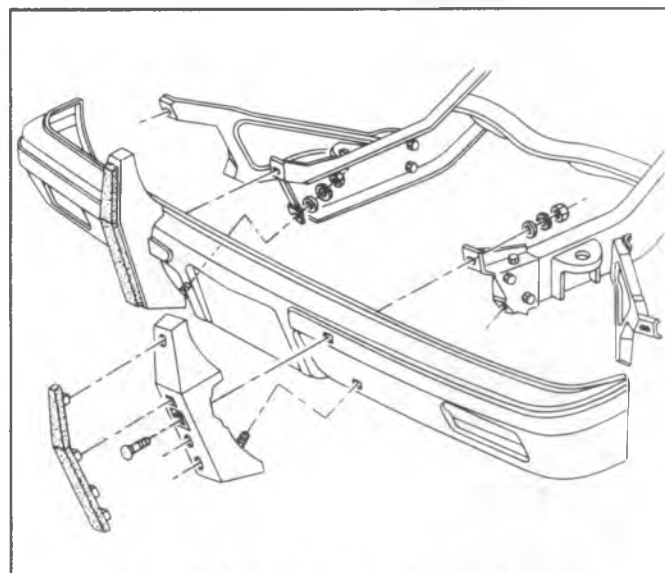


Fig. 2B-2--C, K Model Front Bumper Guards

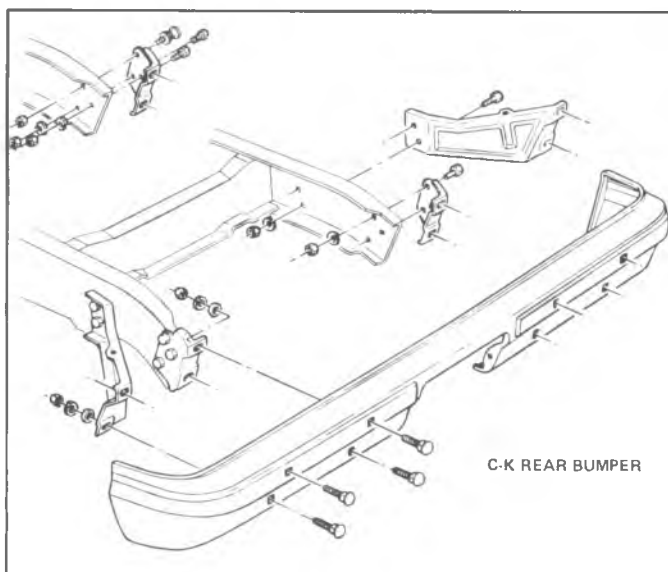


Fig. 2B-3--Rear Bumper - C, K Models

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.

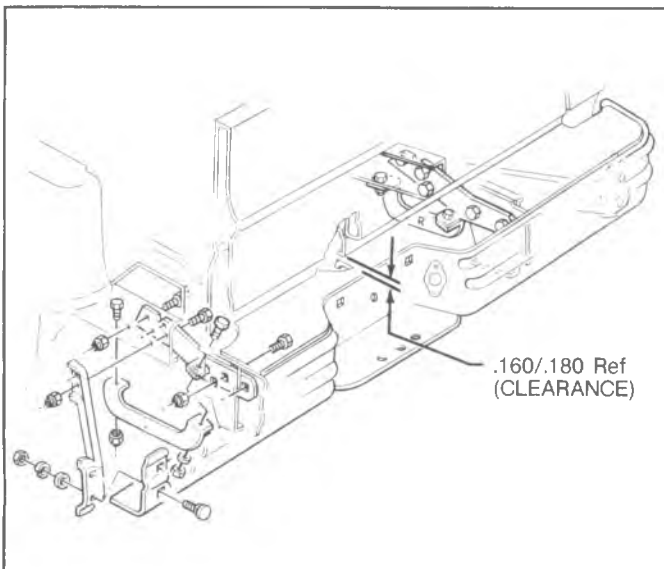


Fig. 2B-4--Rear Step Bumper C and K Models

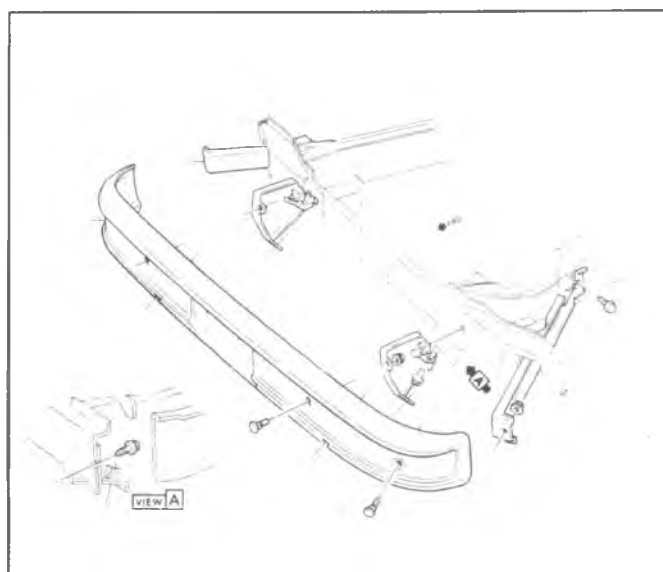


Fig. 2B-5--Front Bumper - G Models

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.

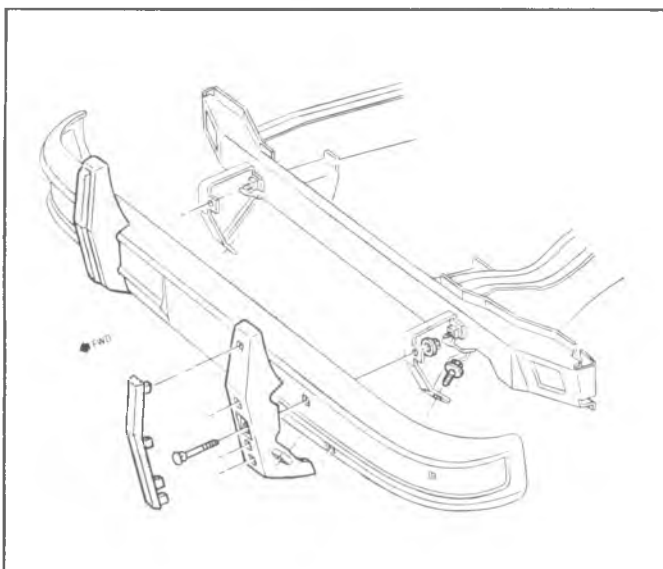


Fig. 2B-6--G-Models Front Bumper Guards

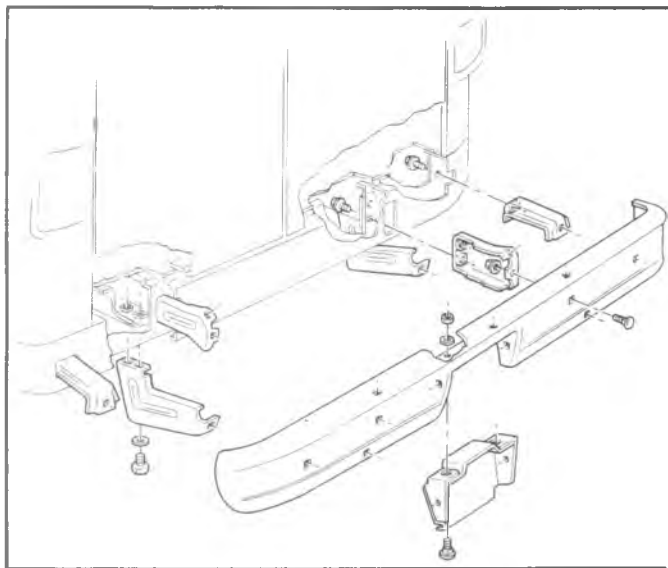


Fig. 2B-7--Rear Bumper-G Models

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

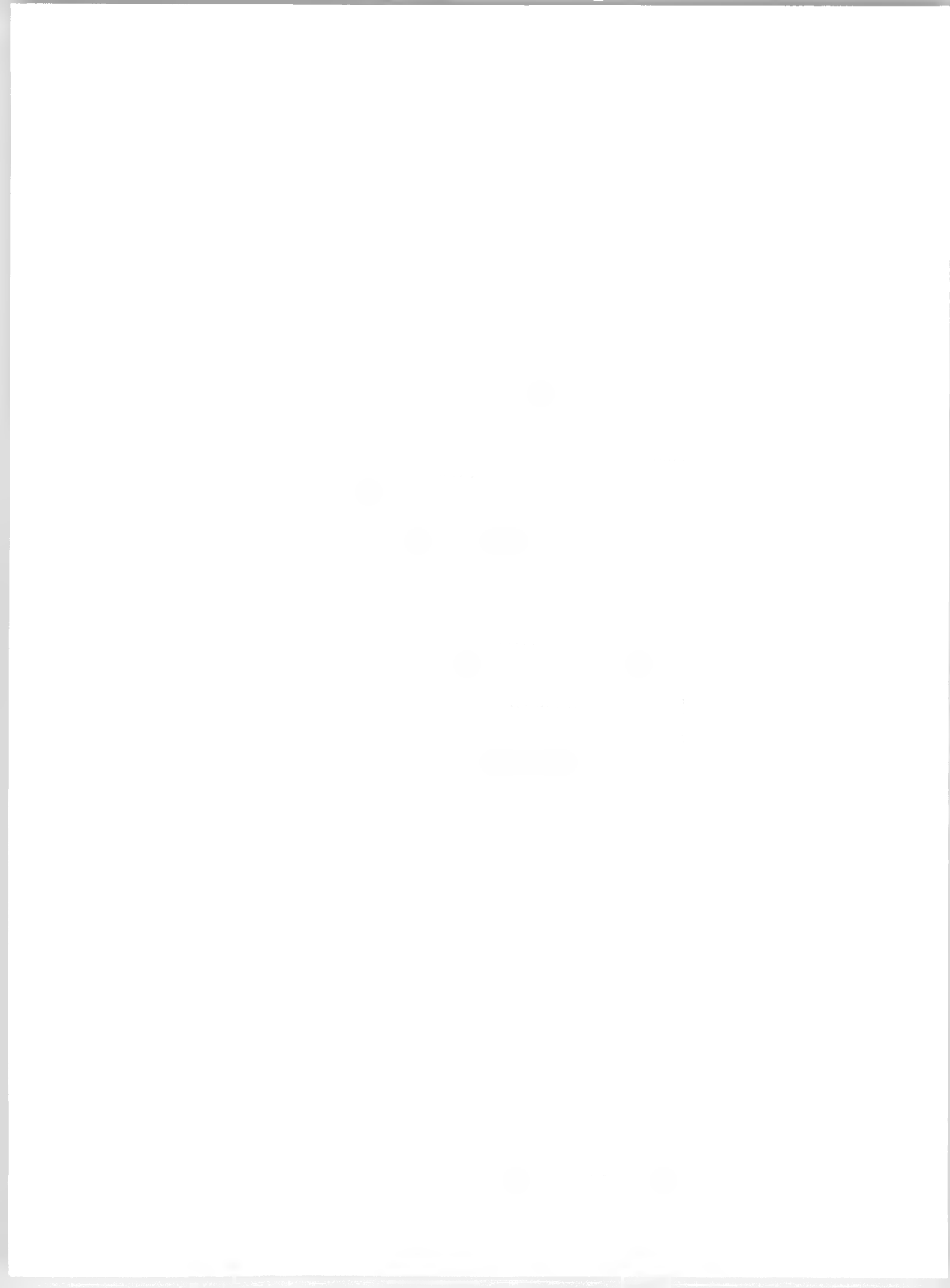
TORQUE SPECIFICATIONS C, P AND K

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

CHASSIS 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 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.

CONTENTS

General Description	2C-1	Front Sheet Metal	2C-6
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Hood - CK Models	2C-1	Front Fender	2C-8
Cowl Top Vent Panel	2C-1	Front Fender and Skirt	2C-8
Hood Hinge	2C-2	Running Board	2C-8
Hood Lock Mechanism	2C-2	Fender Skirt - P Series	2C-8
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Hood	2C-3	Wood Grain Applique	2C-9
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Hood Lock	2C-3	Specifications	2C-11
Hood Bumper	2C-5		

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.

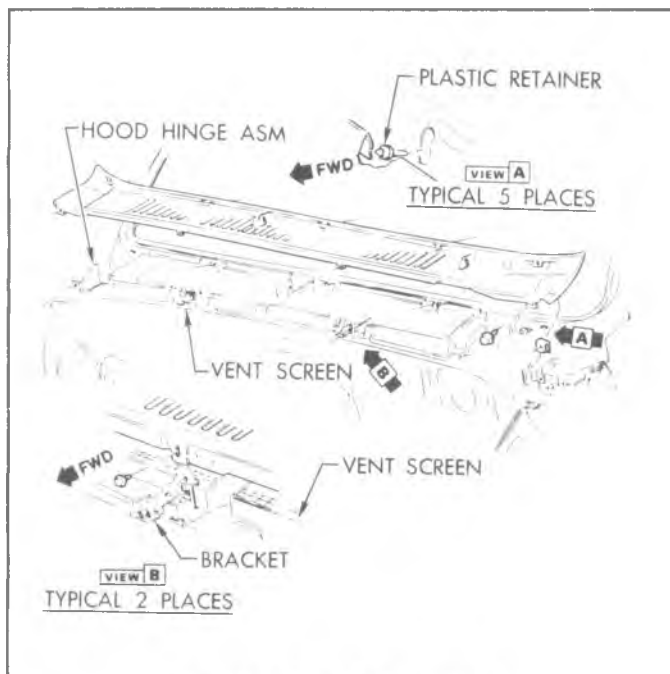


Fig. 2C-1--Cowl Top Vent Panel

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.

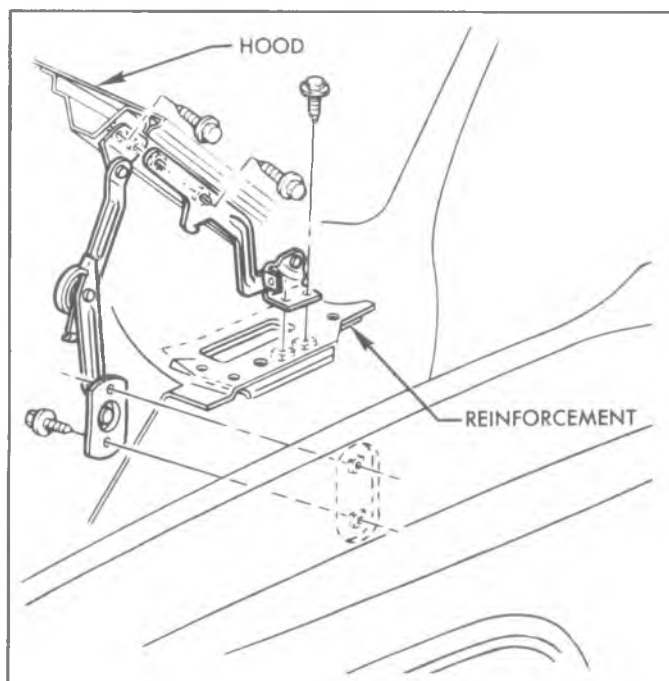


Fig. 2C-2--Hood Hinge -CK Models

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

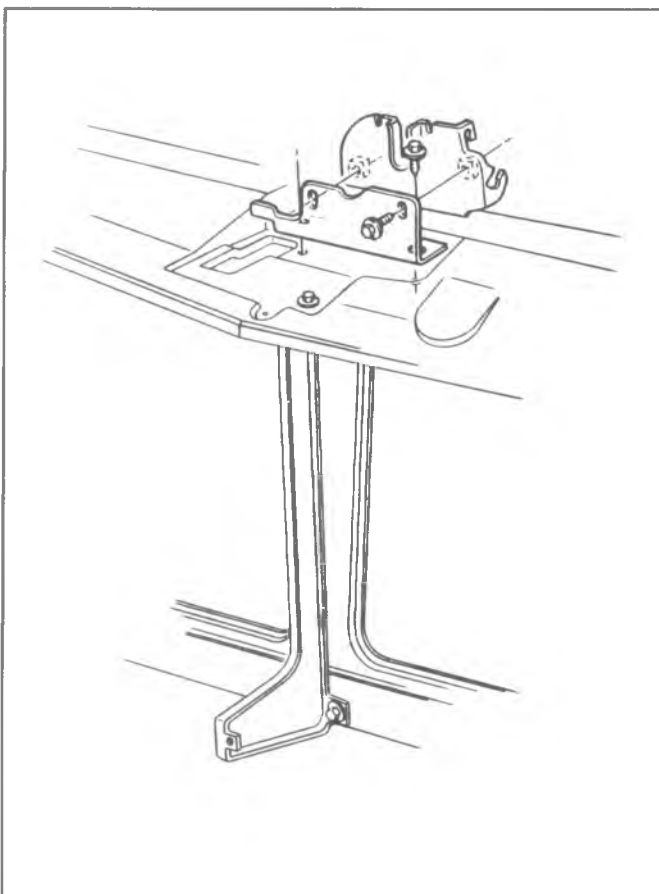


Fig. 2C-3--Primary Hood Latch -CK Models

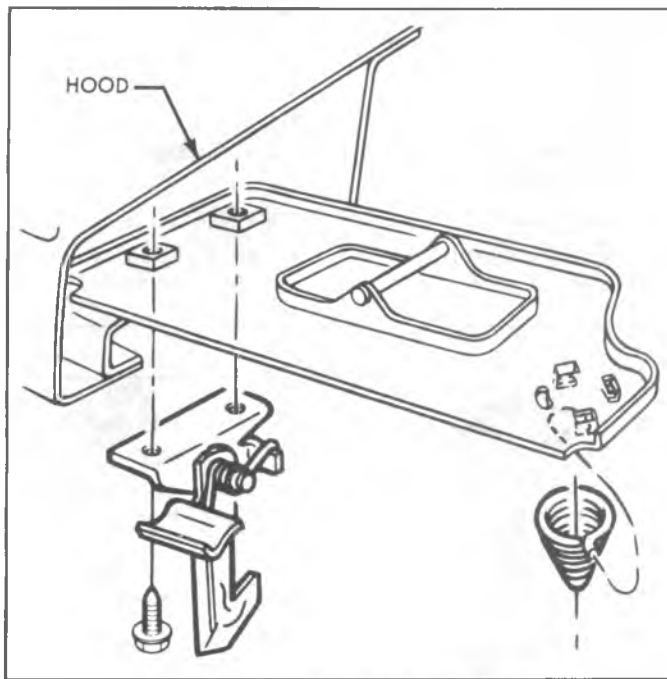


Fig. 2C-4--Secondary Latch -CK Models

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.

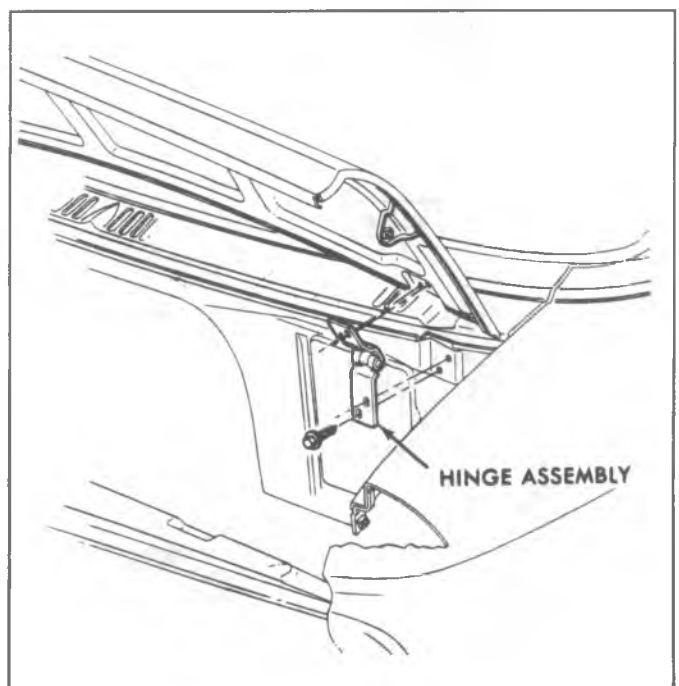


Fig. 2C-5--Hood Hinge-G Model

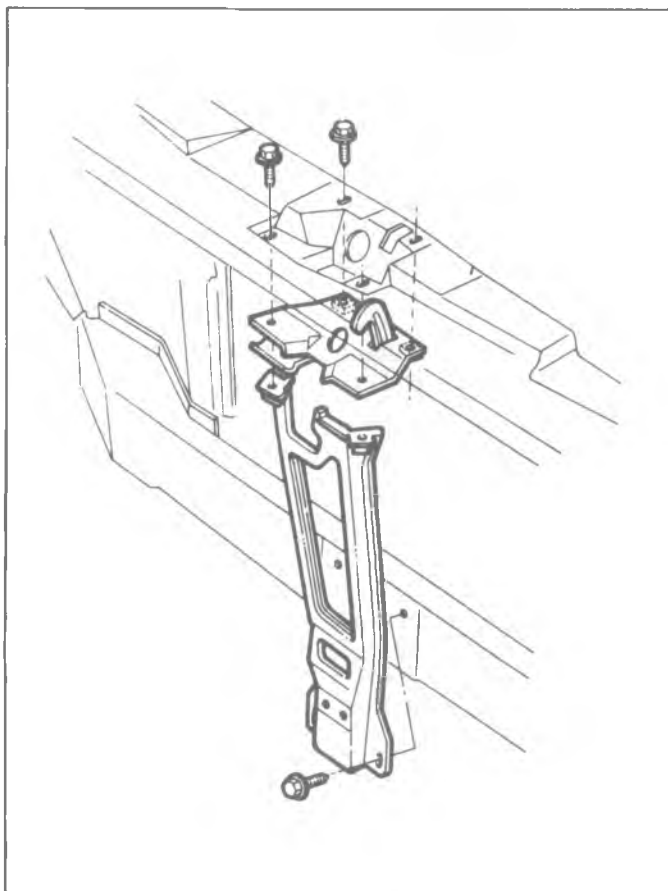


Fig. 2C-6--Hood Lock Catch Assembly-G Model

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.

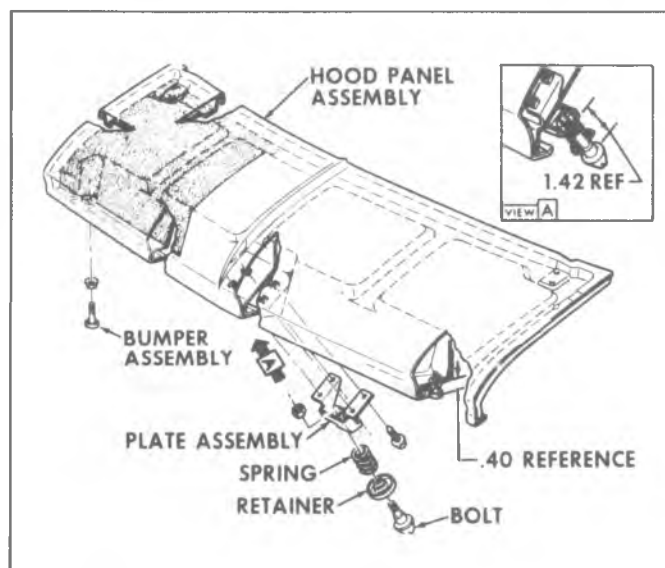


Fig. 2C-7--Hood, Bumpers and Latch-G Model

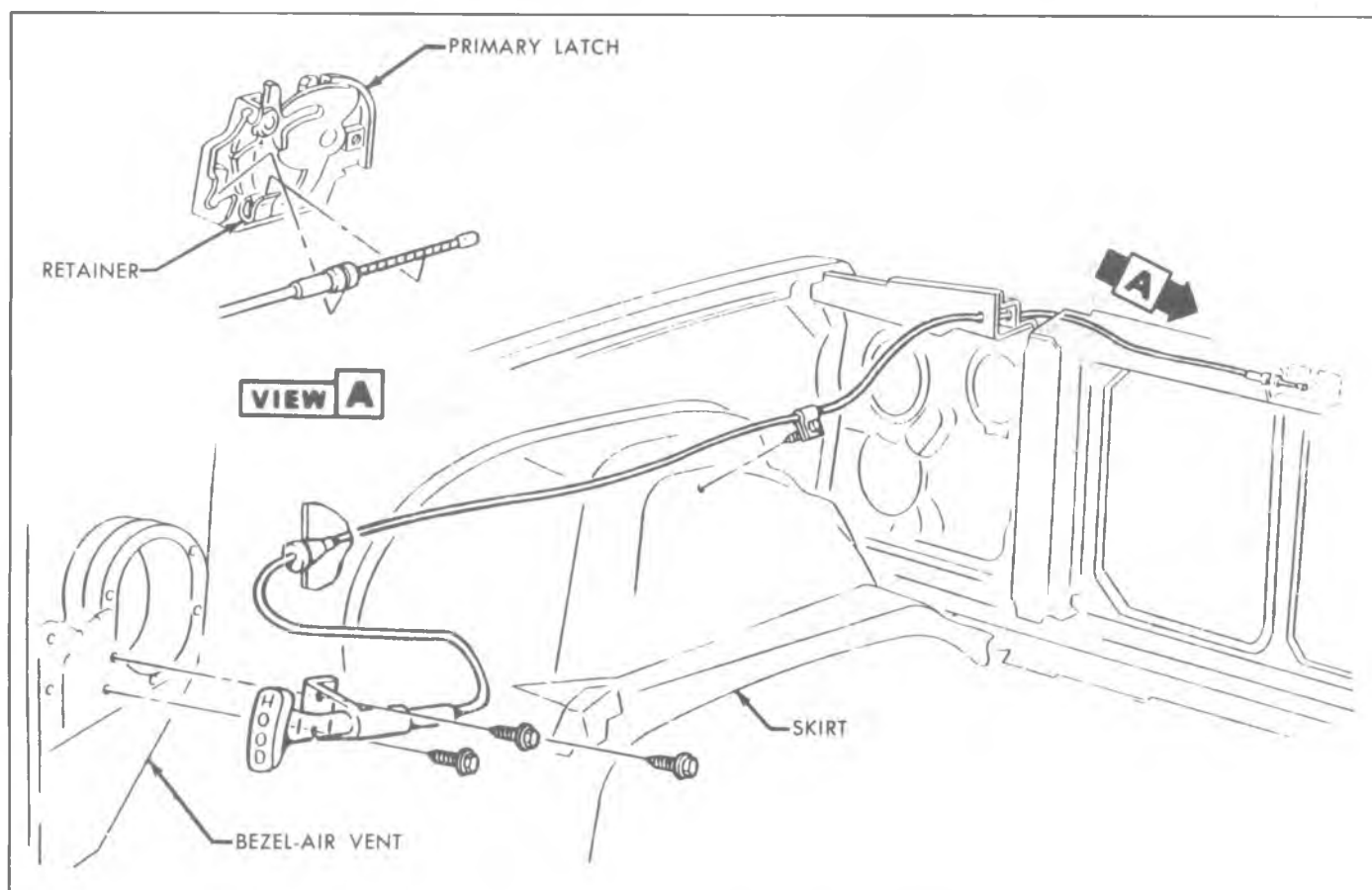


Fig. 2C-8--Hood Release Cable - CK Models

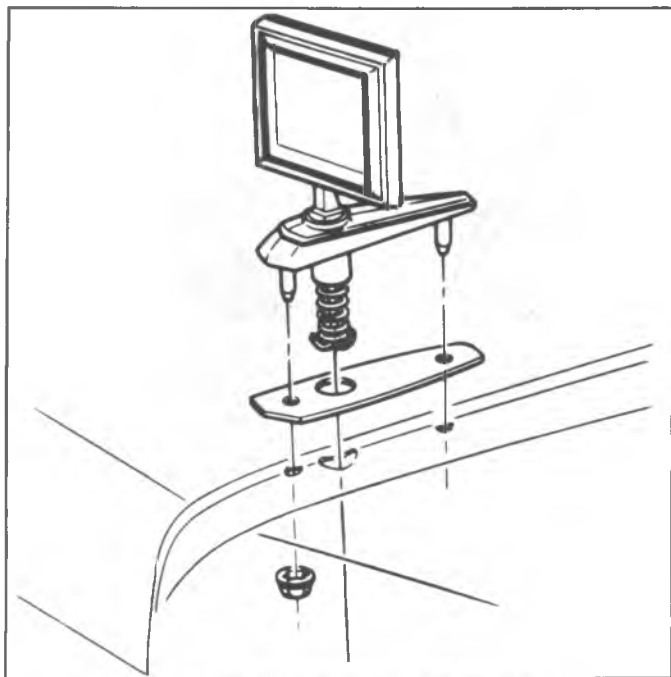


Fig. 2C-9--Hood Emblem - CK Models

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)

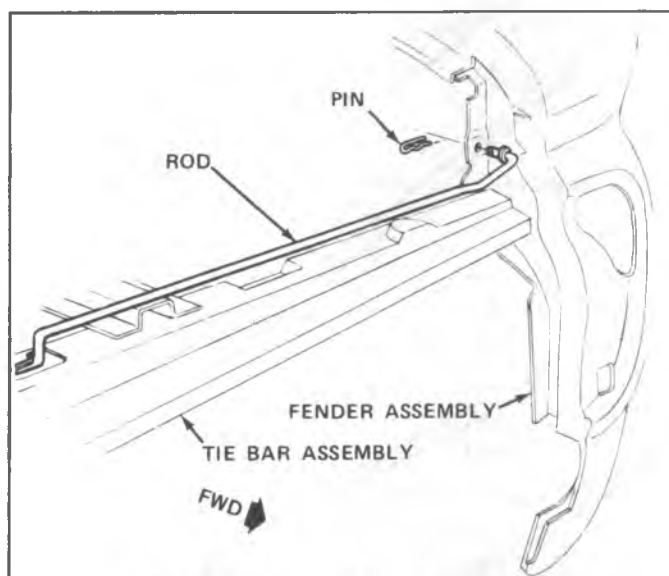


Fig. 2C-10--Hood Rod Support - G Model

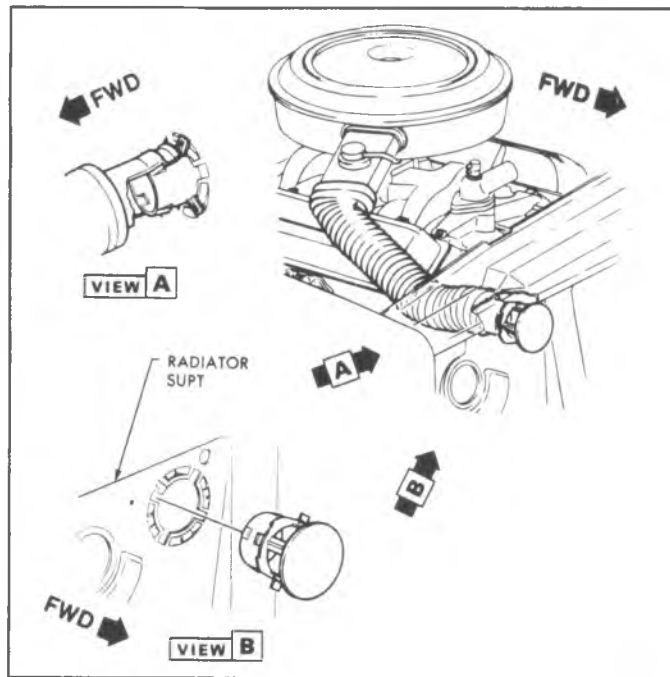


Fig. 2C-11--Typical Carburetor Air Inlet Snorkel - CK Model

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.

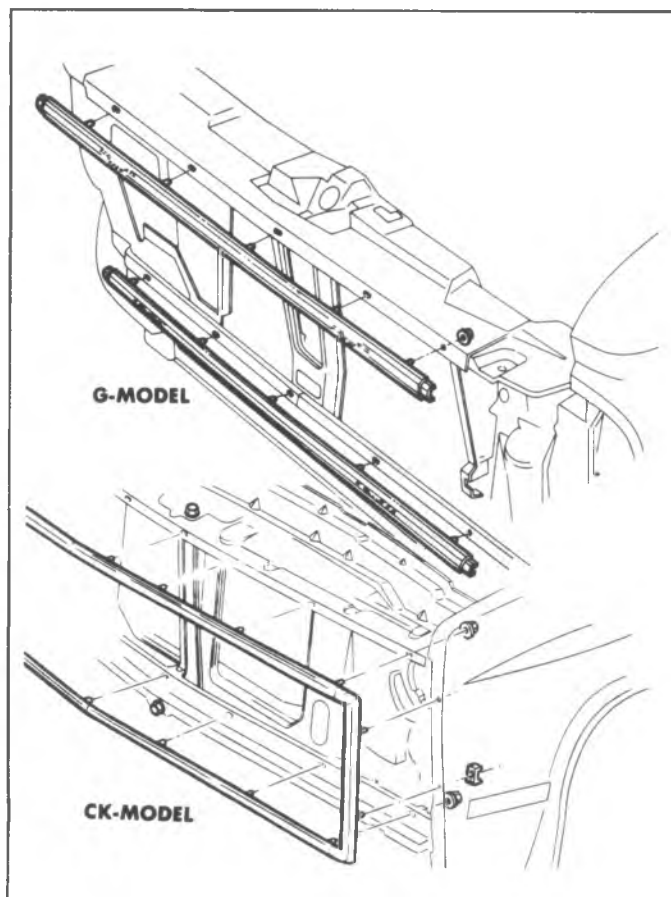


Fig. 2C-14-- Grille Moldings - CK, G Models

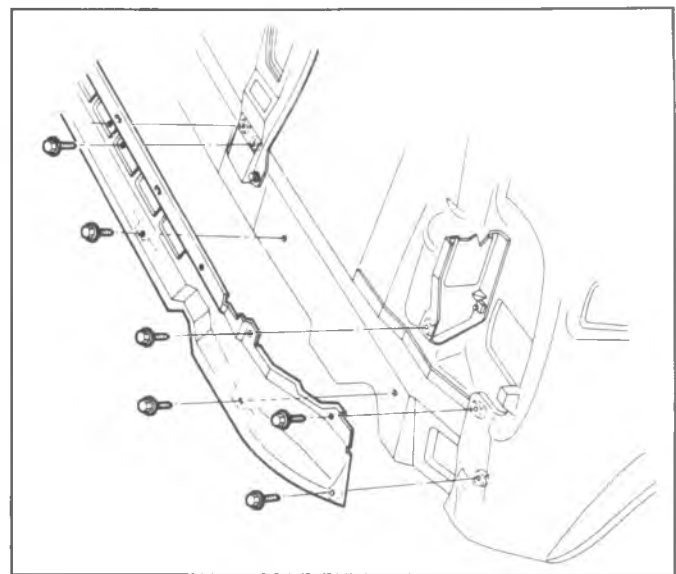


Fig. 2C-12--Lower Radiator Grille - G Models

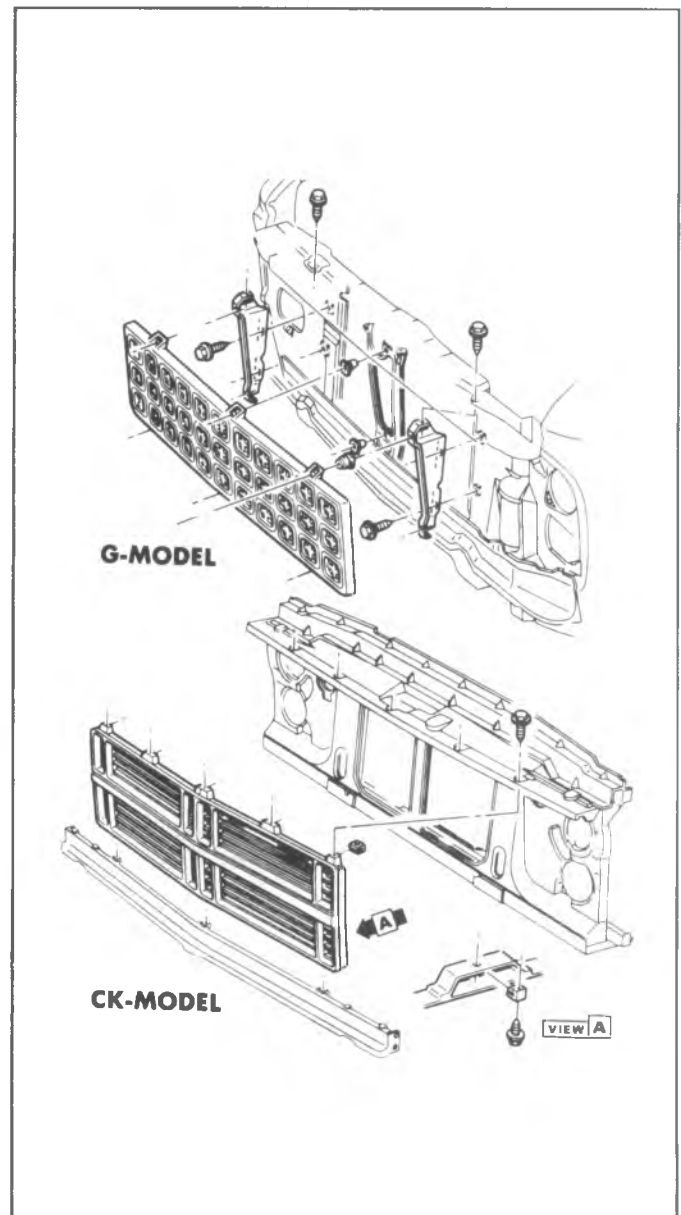


Fig. 2C-13--Grille Panel or Brackets

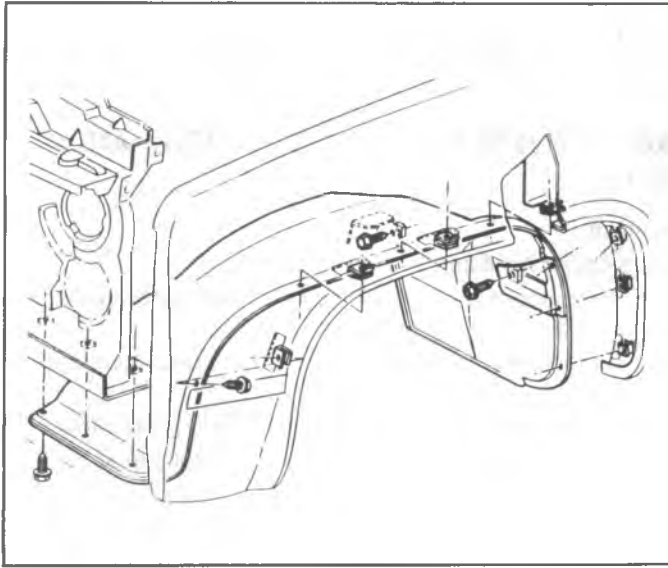


Fig. 2C-15--Fender Skirt Assembly-CK Model

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.

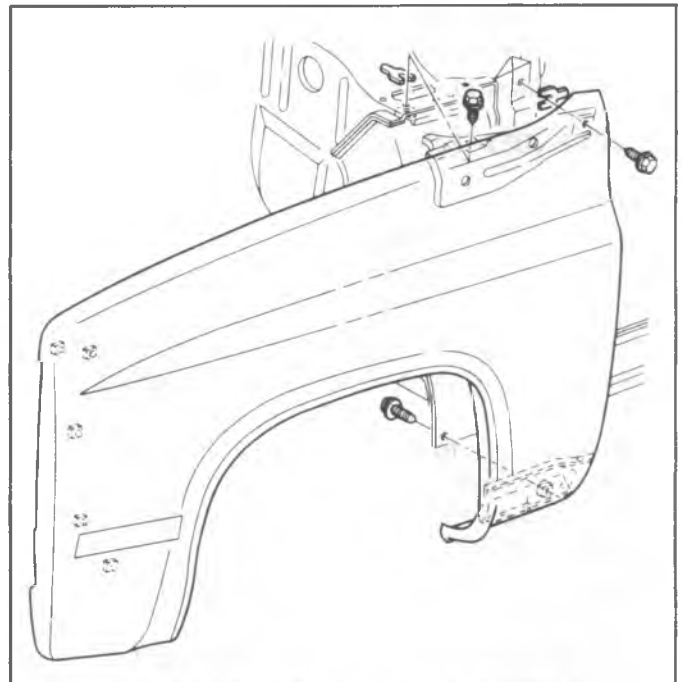


Fig. 2C-16--Front Fender Assembly-CK Model

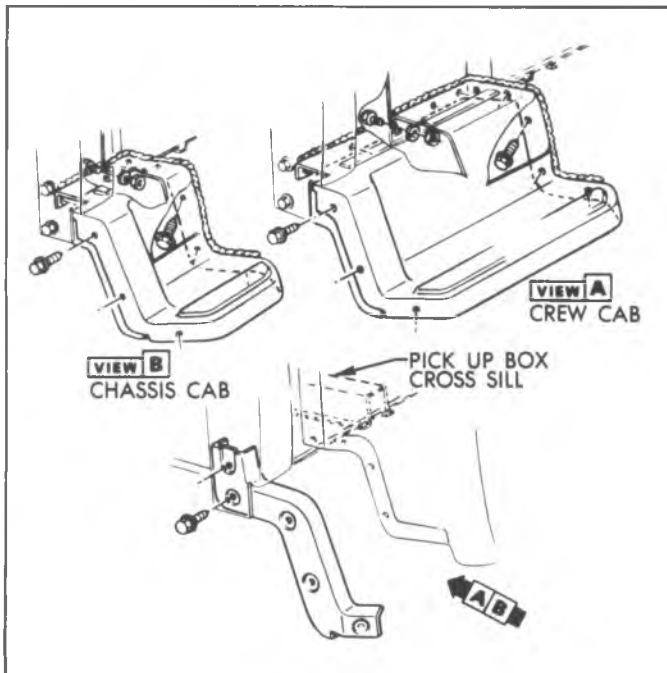


Fig. 2C-17--Running Boards-CK Models

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 naphtha 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.

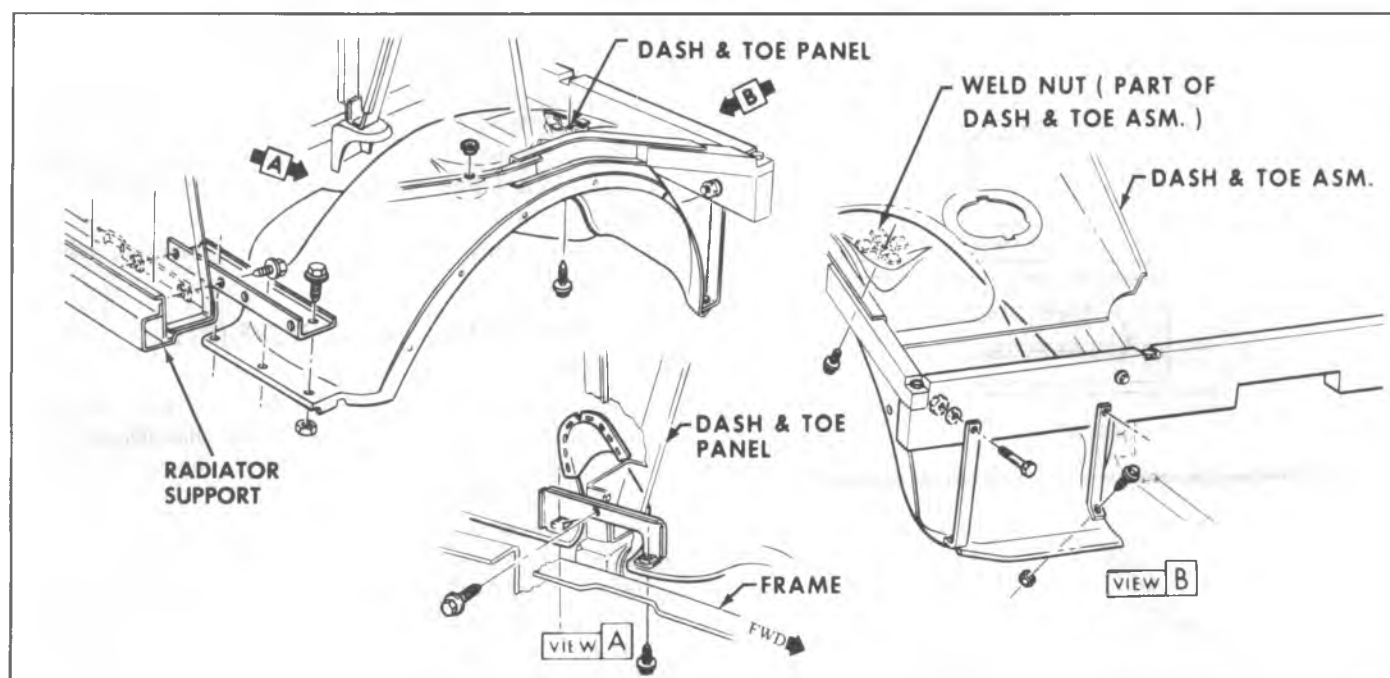


Fig. 2C-18--Fender Skirt, Dash and Toe Pan-P Series

- 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 pre-cut 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

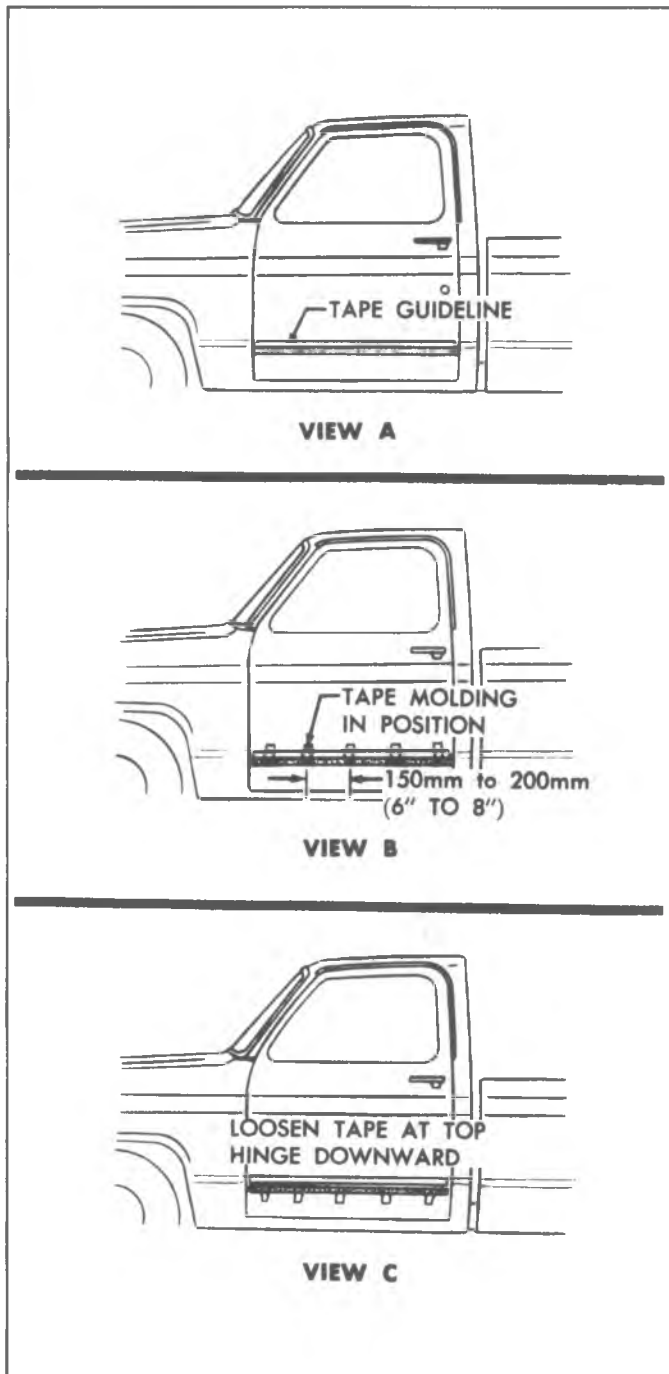


Fig. 2C-19--Molding Application

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, etc., 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 trapped 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

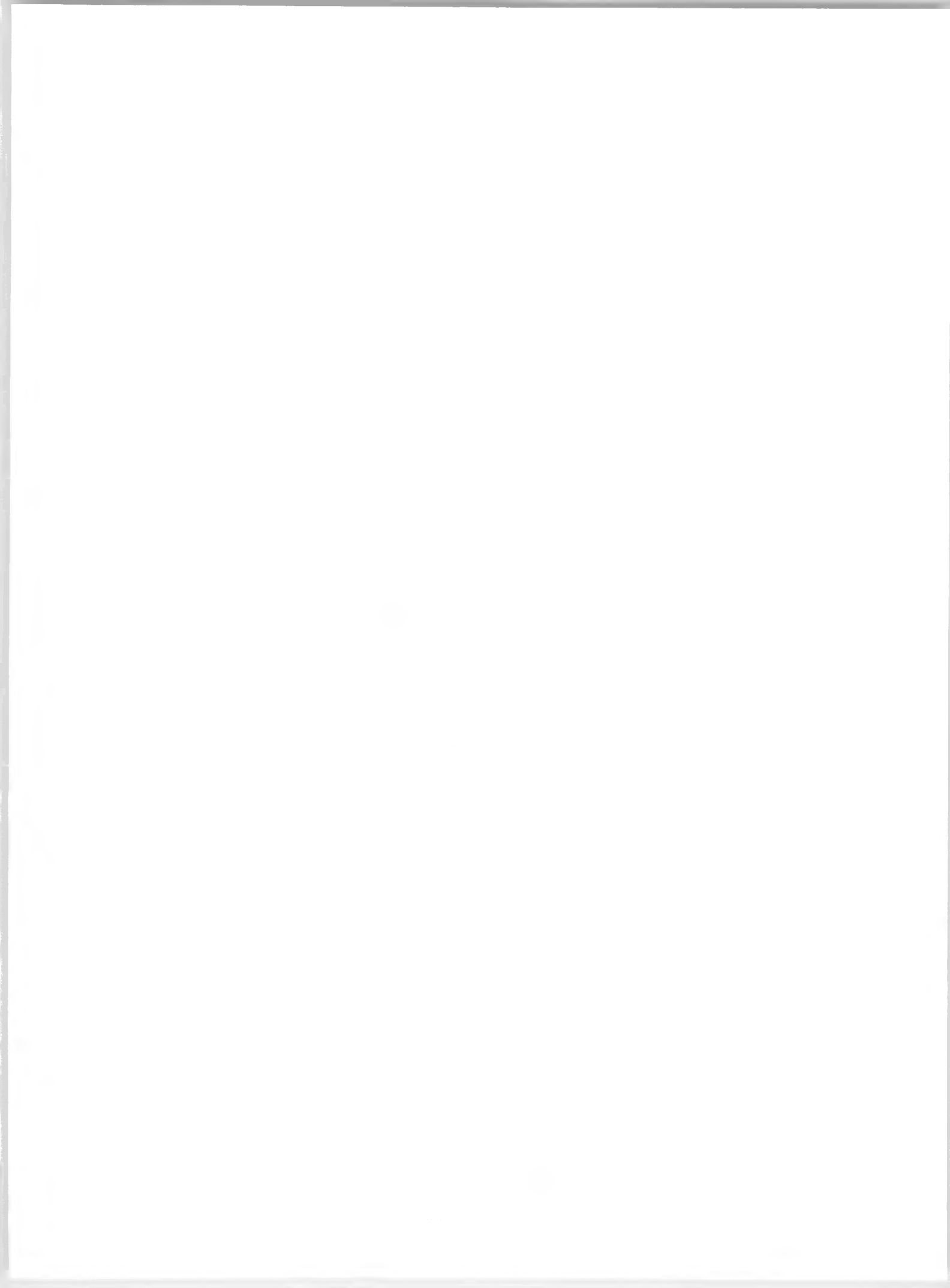
Removal of decal should cause it to be permanently damaged. Test to be conducted at an ambient temperature not to exceed 90°F (32°C) and after a minimum of 72 hours aging.

For Large Decals

1. Prior to application of transfer, 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.)	17 N·m (150 in. lbs.)
Lock Support to Hood		54 N·m (40 ft. lbs.)
Lock Bolt Nut		17 N·m (150 in. lbs.)
Bumper Bolt Nut		24 N·m (18 ft. 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 2D

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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On Vehicle Service	
C-K Models	2D-4
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Special Tools	2D-65

GENERAL DESCRIPTION

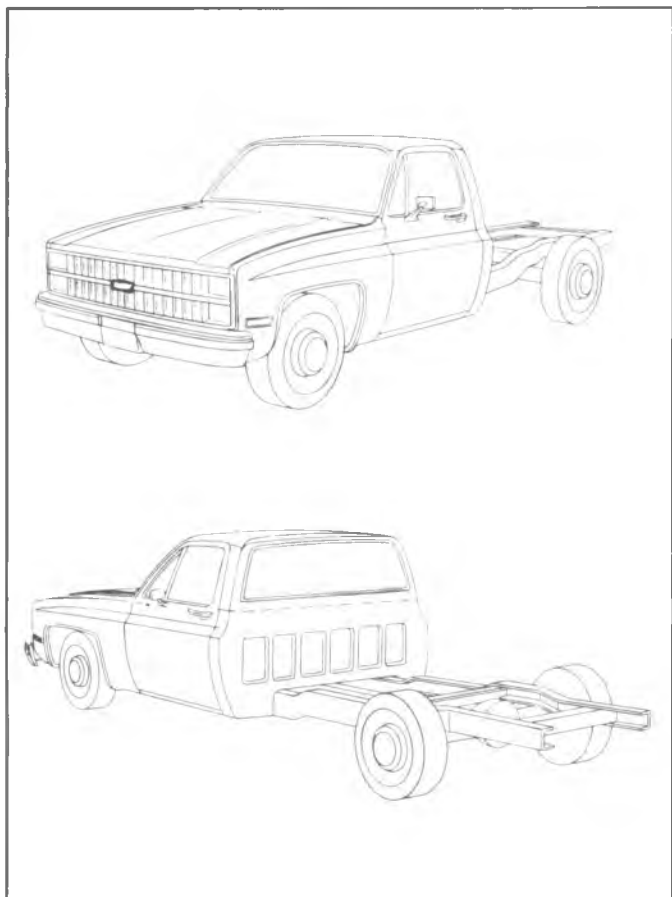


Fig. 2D-1--Typical Chassis/Cab Model

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 2D-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 2D-2. Optional pickup boxes are available.

Suburban

Suburban model see figure 2D-3. Base models have rear cargo doors. An optional endgate with moveable window is available.

Utility

Utility vehicle models see figure 2D-4. Are available with a removable roof or a convertible roof.

Vans

G-Series Vans are available in three models See figures 2D-5 and 2D-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 2D-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."

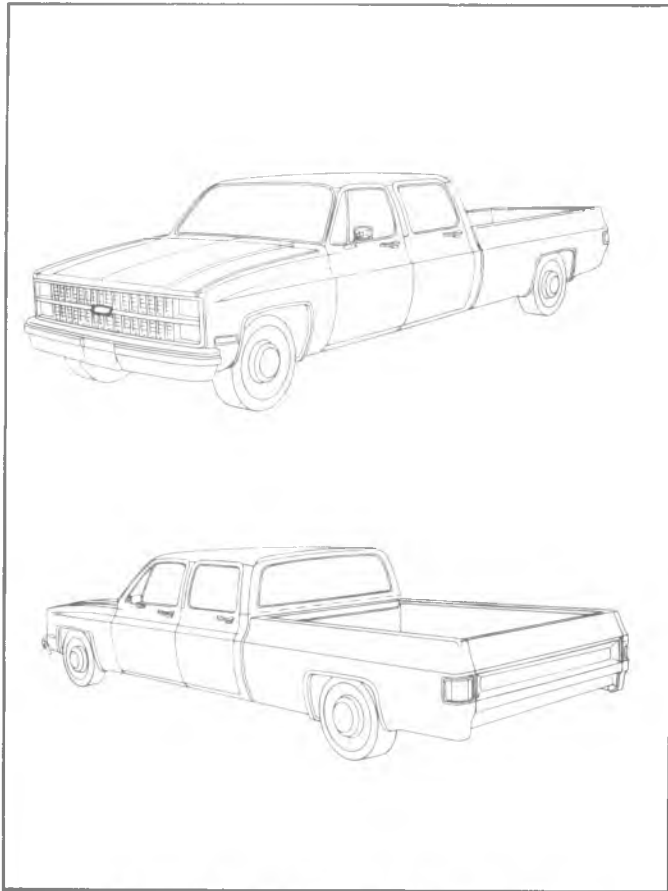


Fig. 2D-2--Typical Crew Cab/Chassis Model

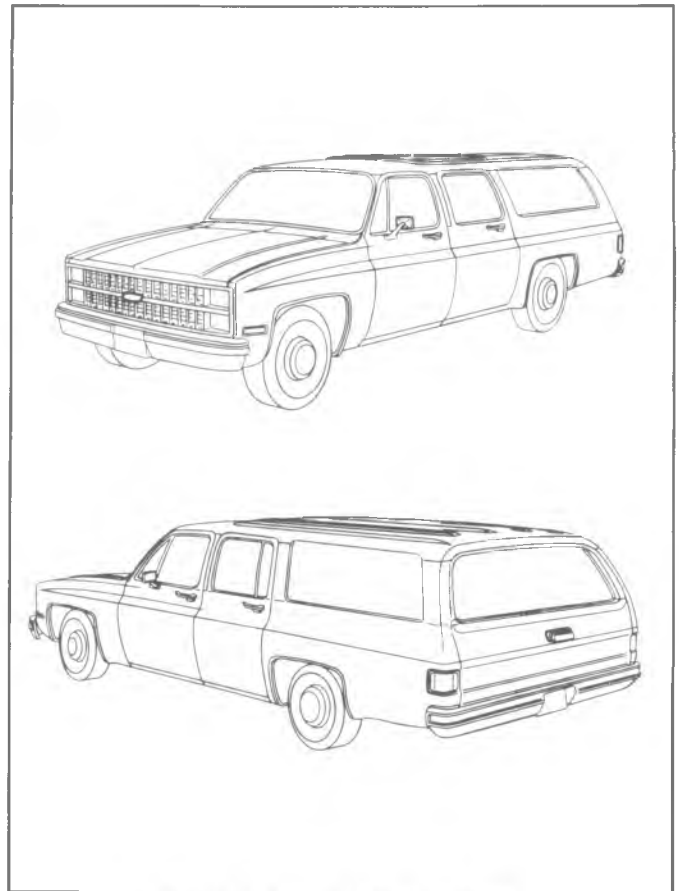


Fig. 2D-3--Typical Suburban Model

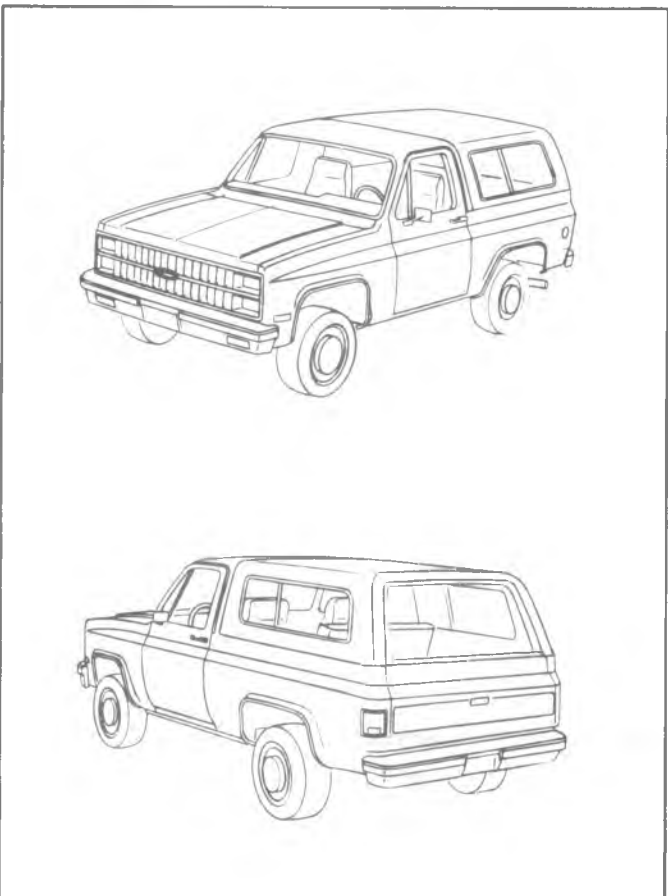


Fig. 2D-4--Typical Utility Vehicle Model

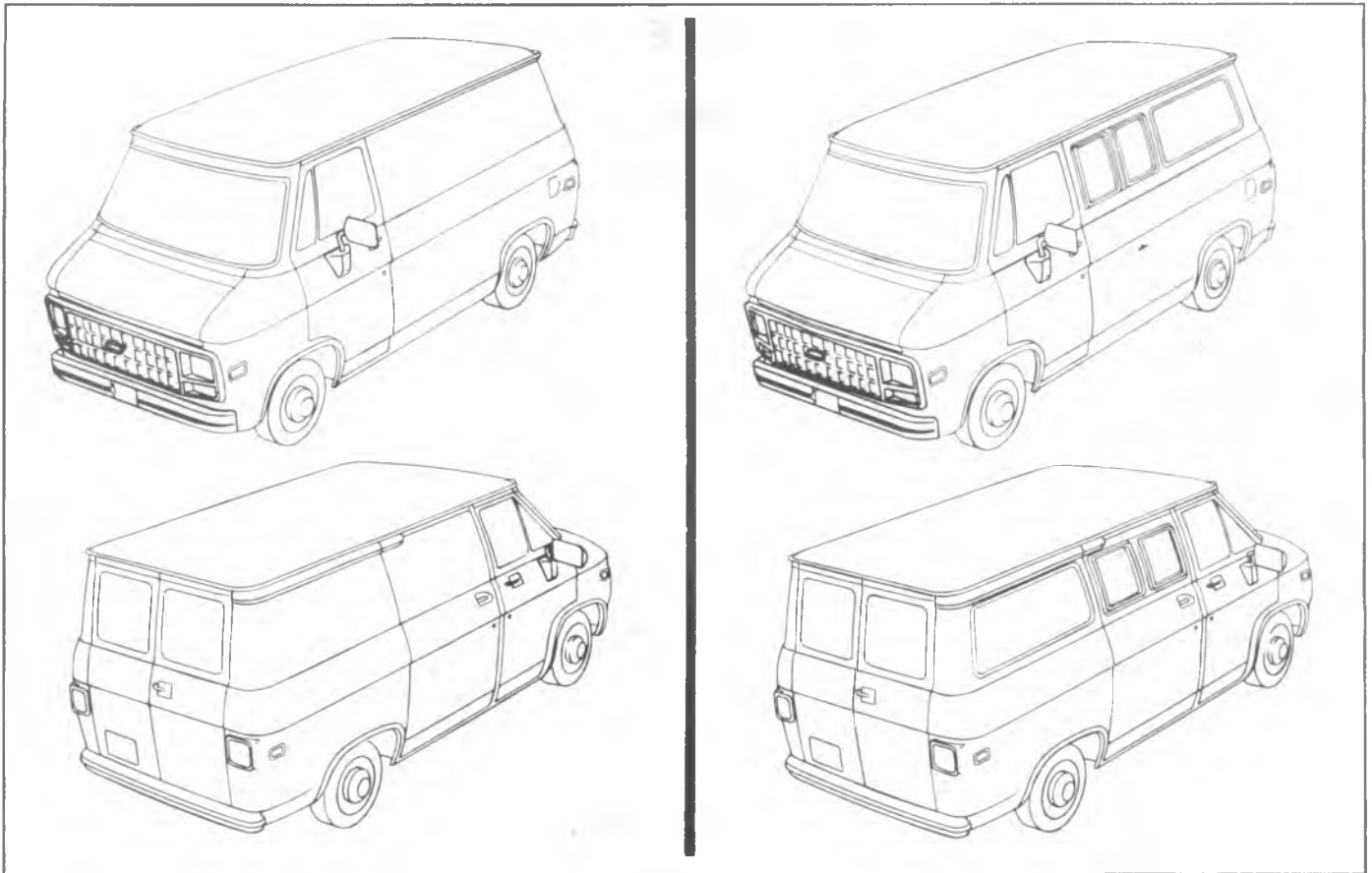


Fig. 2D-5--Typical Vans and Sport Vans Models

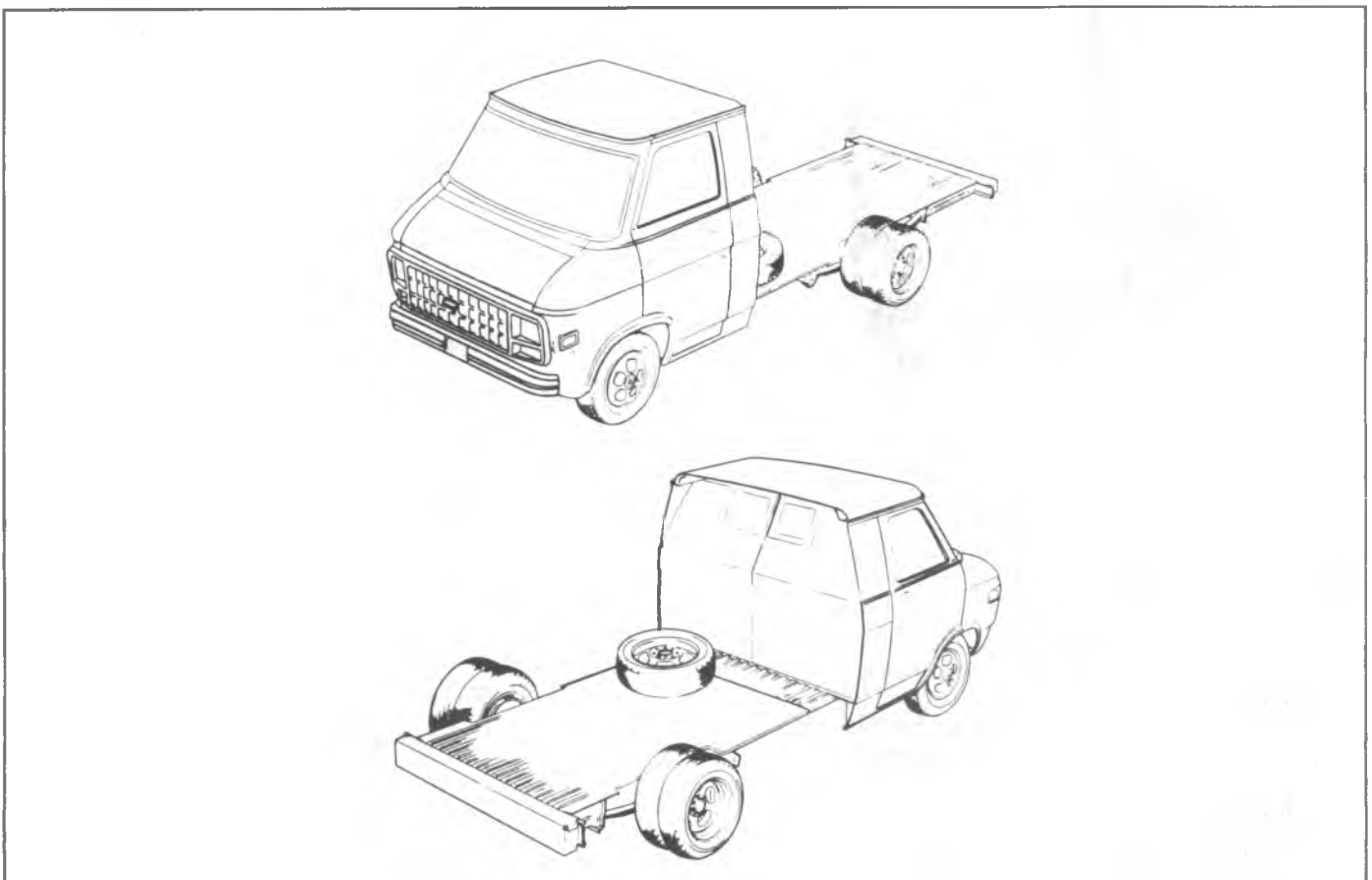


Fig. 2D-6--Typical Commercial Cutaway Model Van

ON VEHICLE SERVICE

C-K MODELS

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Replacement	2D-15		

FRONT END

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 2D-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.

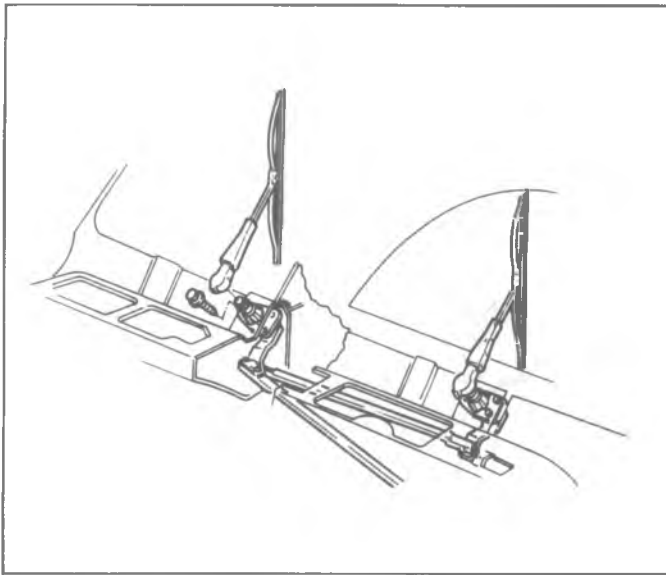


Fig. 2D-7--Windshield Wipers

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:

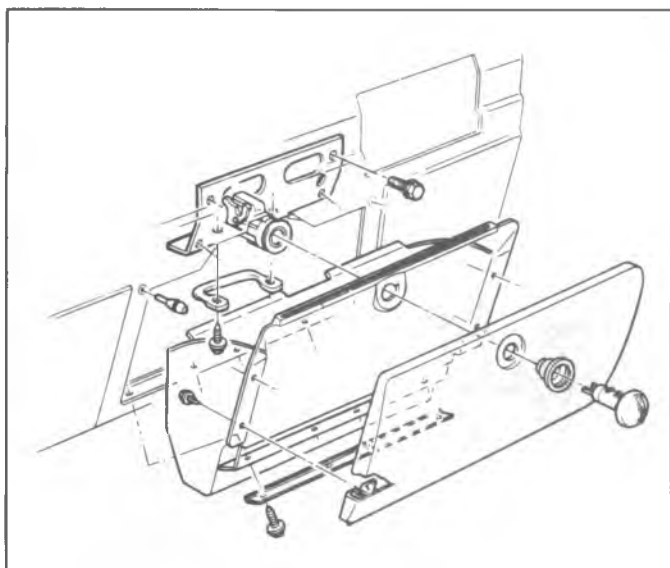


Fig. 2D-8--Glove Box

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 2D-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 2D-9, 2D-10 and 2D-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.

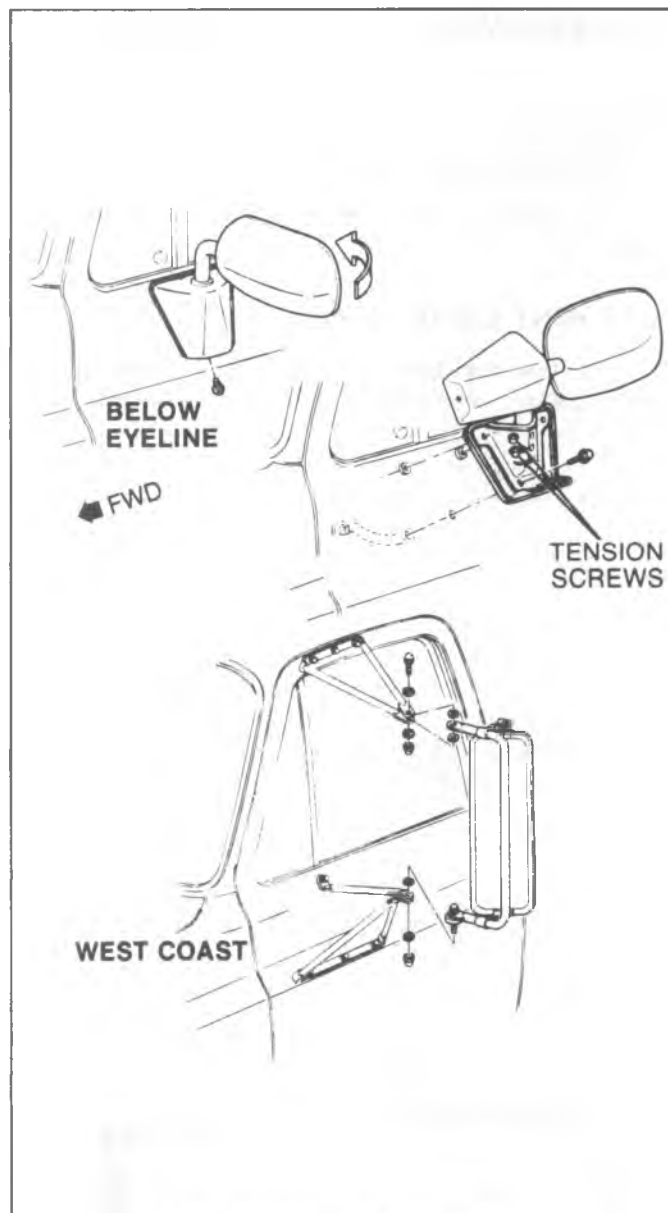


Fig. 2D-10--Rear View Mirrors

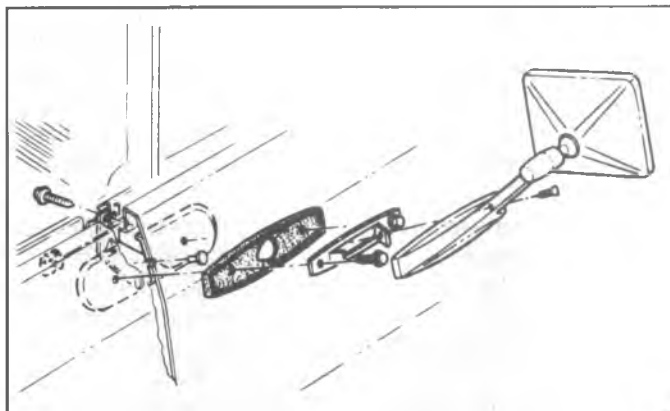


Fig. 2D-9--Rear View Mirror - Base

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 2D-12

Two styles are shown in Figure 2D-12. Removing the attaching screws allows removal of the valve from the side panels.

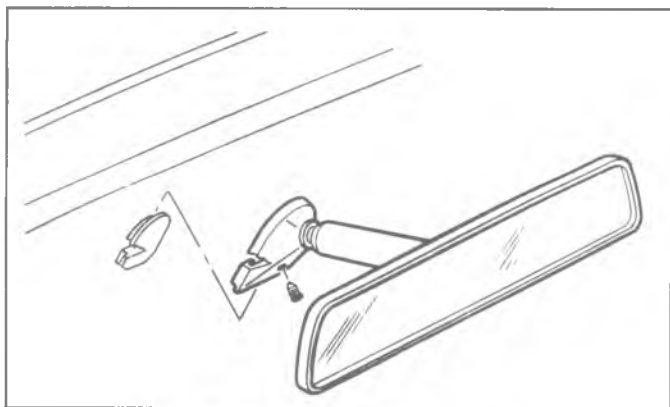


Fig. 2D-11--Inside Rear View Mirror

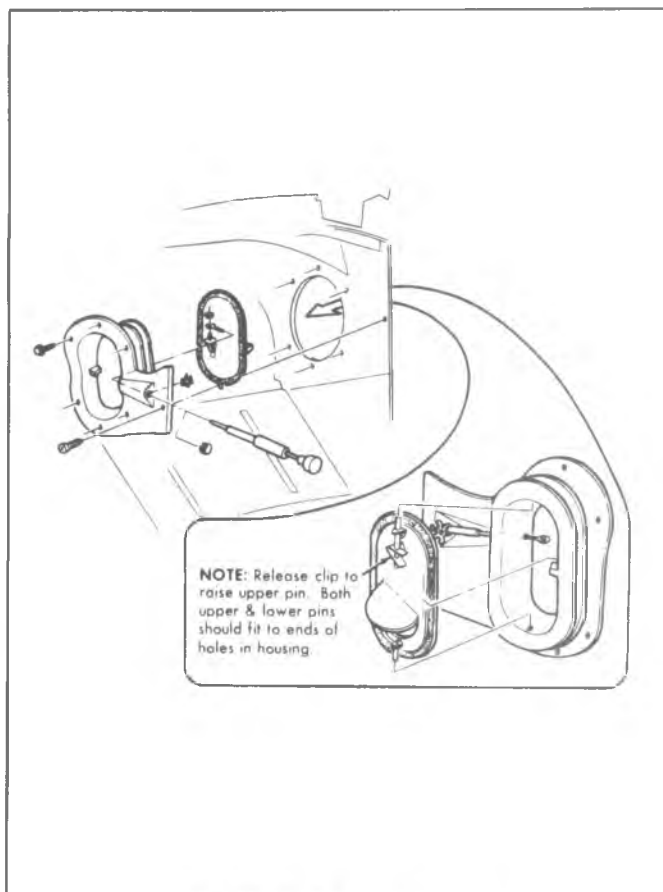


Fig. 2D-12--Cowl Vent Valves

BODY GLASS

CAUTION: Always wear gloves and eye glasses when handling glass to avoid personal injury.

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 2D-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 kits No. 1052420 and No. 9631000 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 kits (urethane) No. 1052420 and 9631000 are as follows:

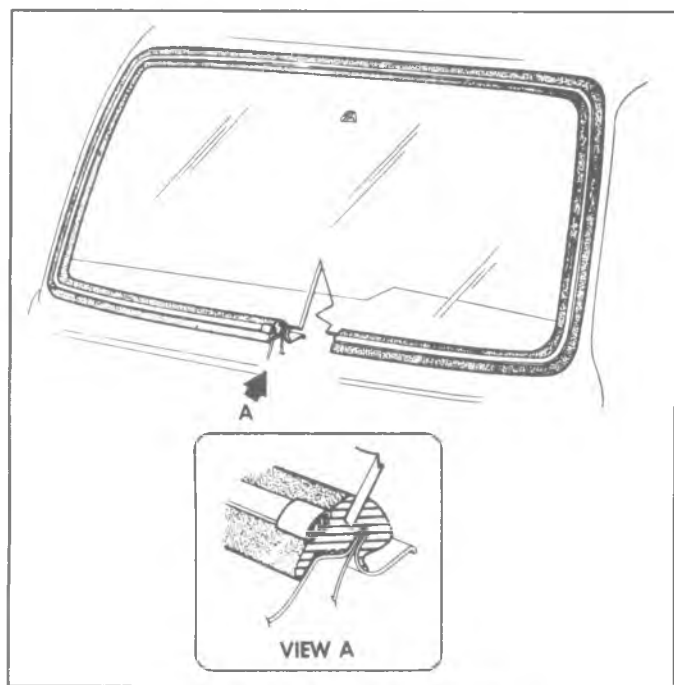


Fig. 2D-13--Typical Windshield



Fig. 2D-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 2D-14 and 2D-15.

4. With the aid of an assistant outside the cab, remove the windshield from the opening. See figure 2D-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 2D-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. 2D-15--Assisting Weatherstrip over Flange

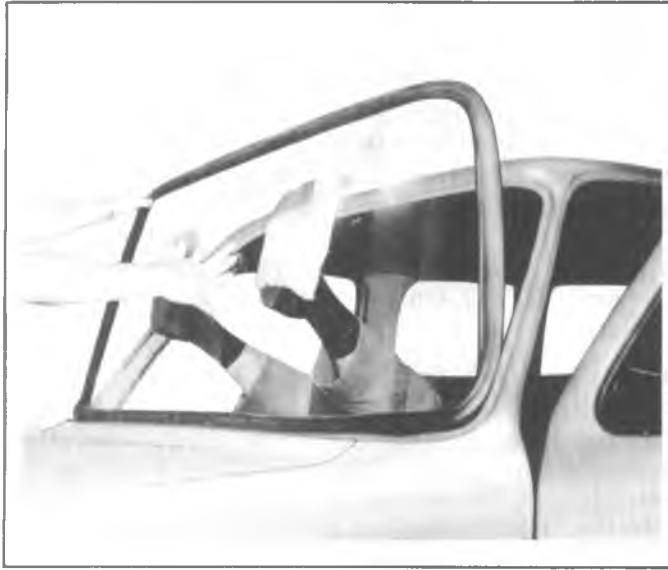


Fig. 2D-16--Removing Windshield from Opening

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 - Surfacers, 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. 2D-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. 2D-17--Checking Windshield Opening

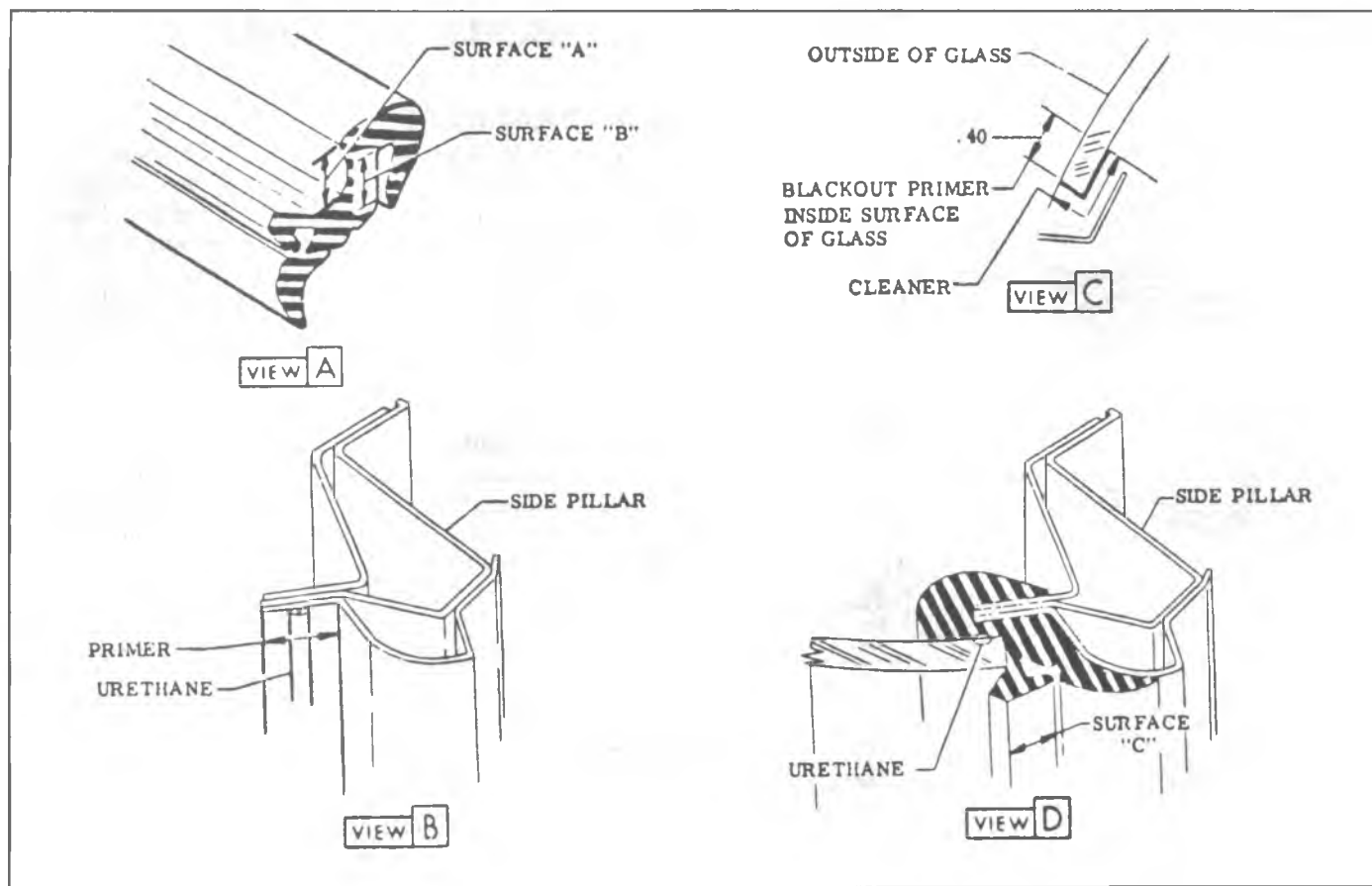


Fig. 2D-18--Windshield Installation-CK Truck

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. 2D-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 2D-20 and 2D-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.

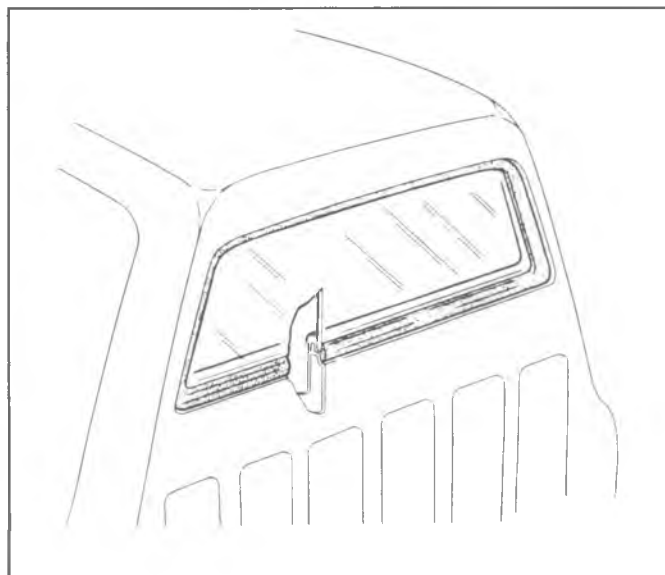


Fig. 2D-20--Back Window Glass

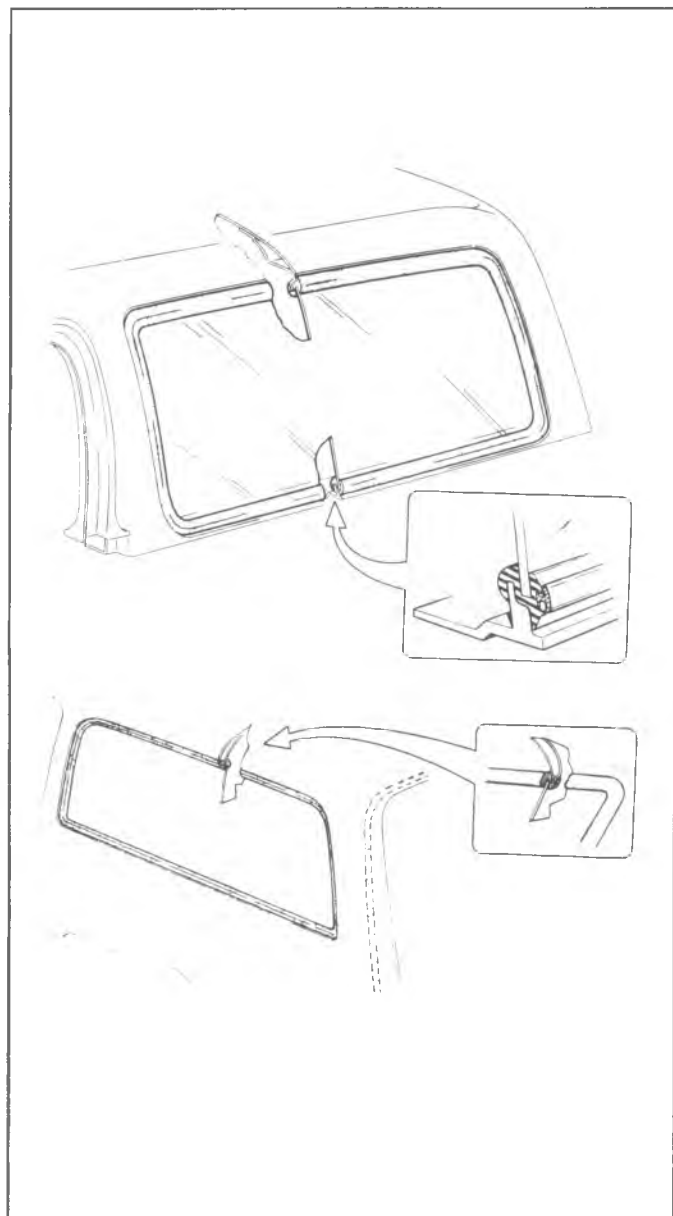


Fig. 2D-21--Body Side Window

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. 2D-22).

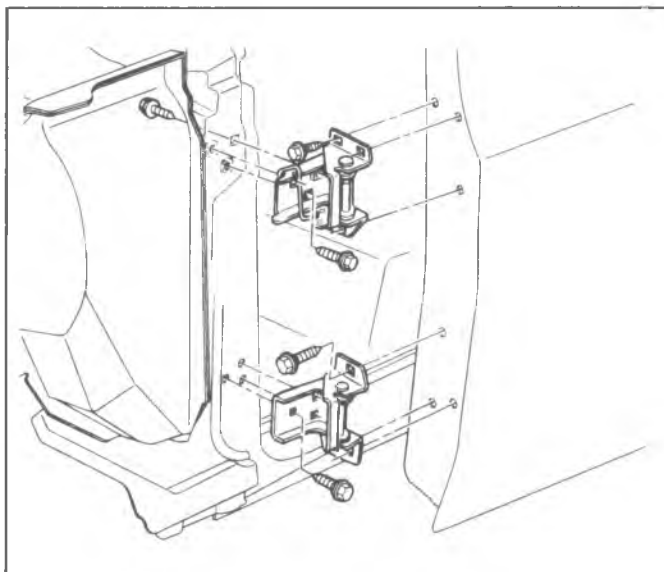


Fig. 2D-22--Door Hinge



Fig. 2D-23--Loosening Striker Bolt

Striker Bolt Adjustment

With the use of J-23457, shown in figure 2D-23, the striker bolt can be adjusted in any of three ways. See figure 2D-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 2D-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. 2D-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.

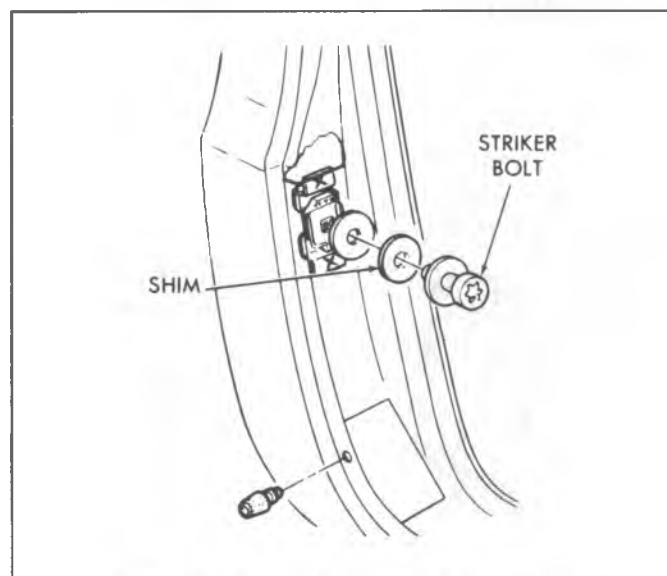


Fig. 2D-24--Typical Striker Bolt Adjustment

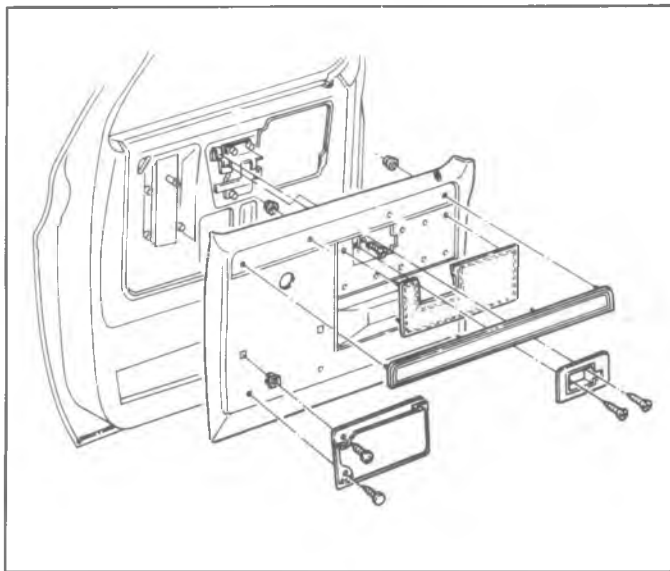


Fig. 2D-25--Door Trim Panel

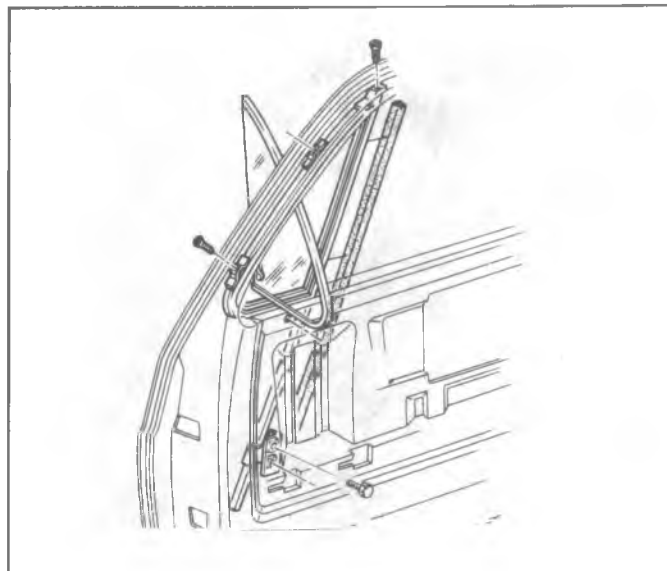


Fig. 2D-28--Door Ventilator Assembly

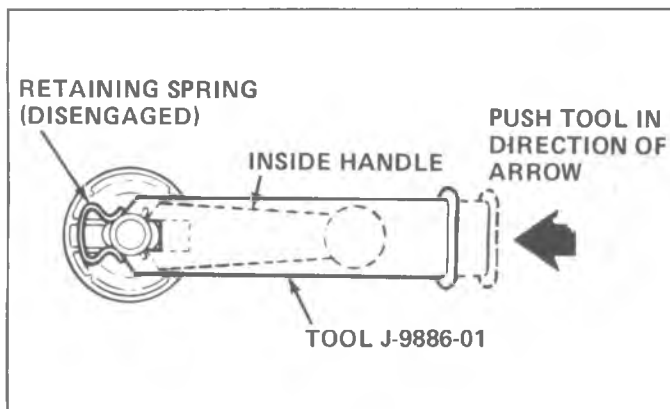


Fig. 2D-26--Clip Retained Inside Handle Removal

DOOR VENTILATOR ASSEMBLY--Fig. 2D-28

Removal

The channel between the door window glass and door vent is removed as part of the vent assembly.

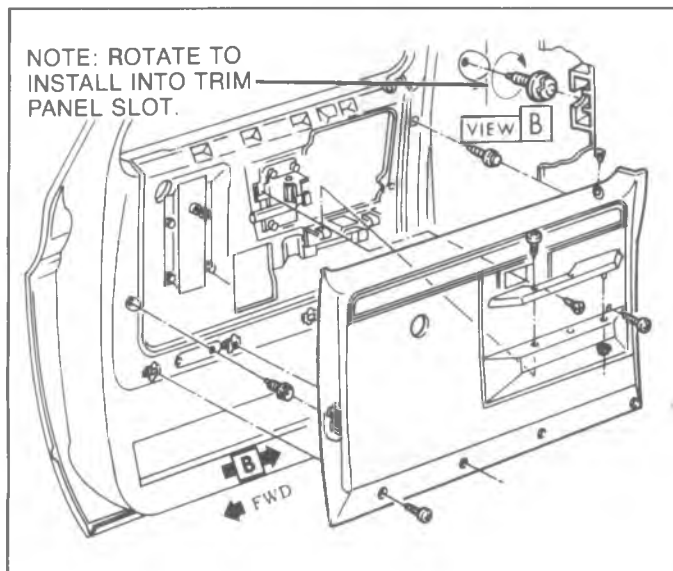


Fig. 2D-27--Door Trim Pad

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 2D-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 2D-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. 2D-29--Removing Ventilator Assembly



Fig. 2D-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 2D-30.
2. After making adjustment bend tabs over the hex nut on base of assembly. See figure 2D-31.
3. Install arm rest screws and trim panel.
4. Install window regulator handle.

DOOR WINDOW ASSEMBLY--FIG. 2D-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 2D-33.
6. Put window assembly in normal position (level) and raise straight up and out.
7. Reverse above procedure for installation.

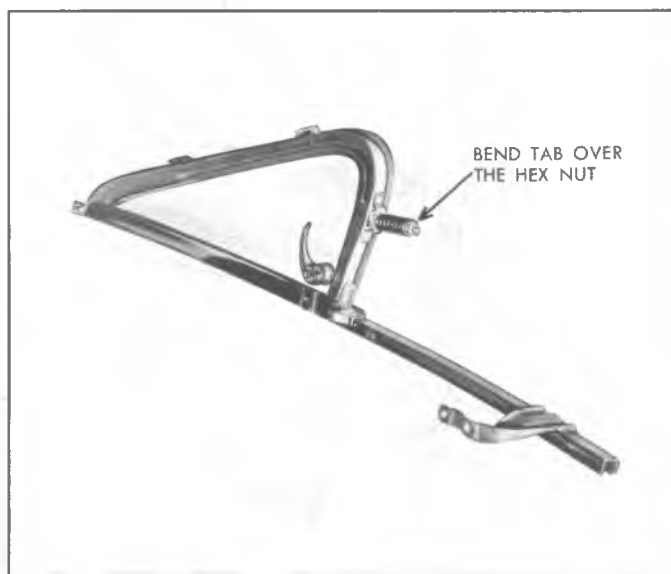


Fig. 2D-31--Bend Tabs Over Hex Nut

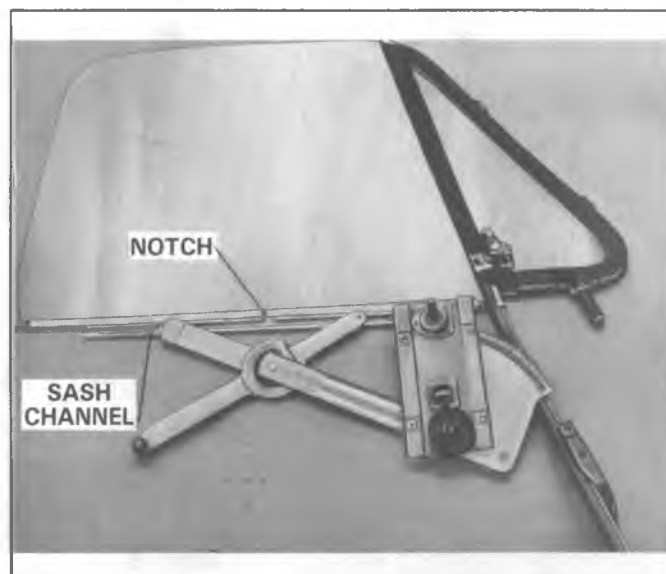


Fig. 2D-32--Door Window and Regulator

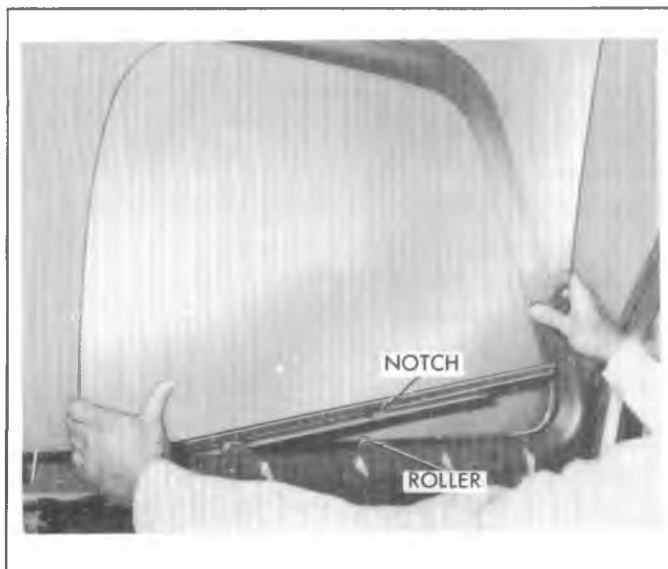


Fig. 2D-33--Removing Door Glass

WINDOW REGULATOR-MANUAL--FIG. 2D-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. 2D-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 2D-34 illustrates

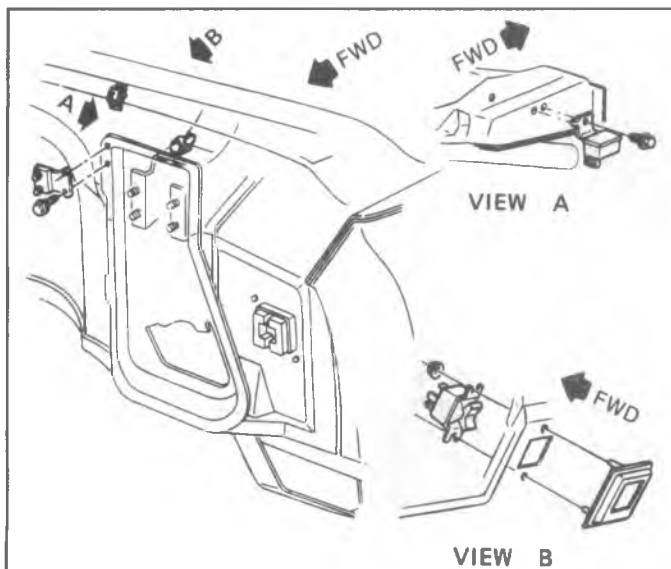


Fig. 2D-34--Power Window Switch, Relay and Breaker Assembly

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. Figure 2D-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. 2D-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.

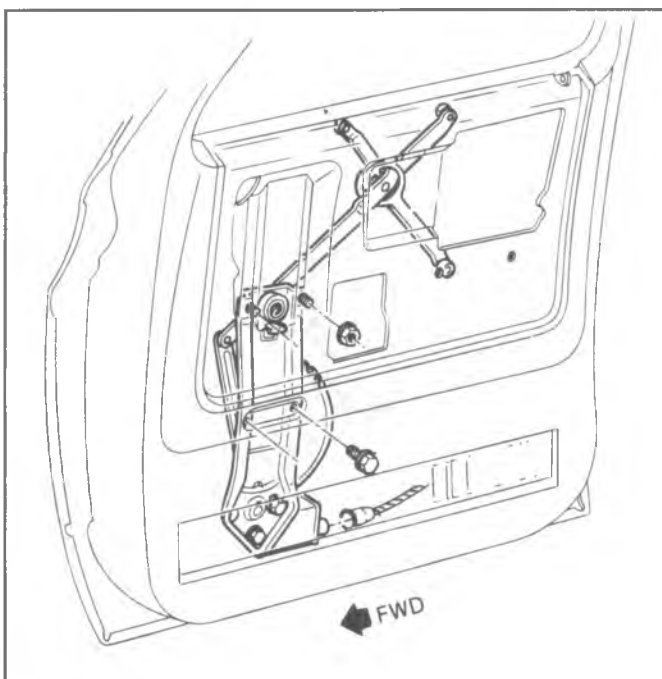


Fig. 2D-35--Power Window Regulator, Motor and Connector

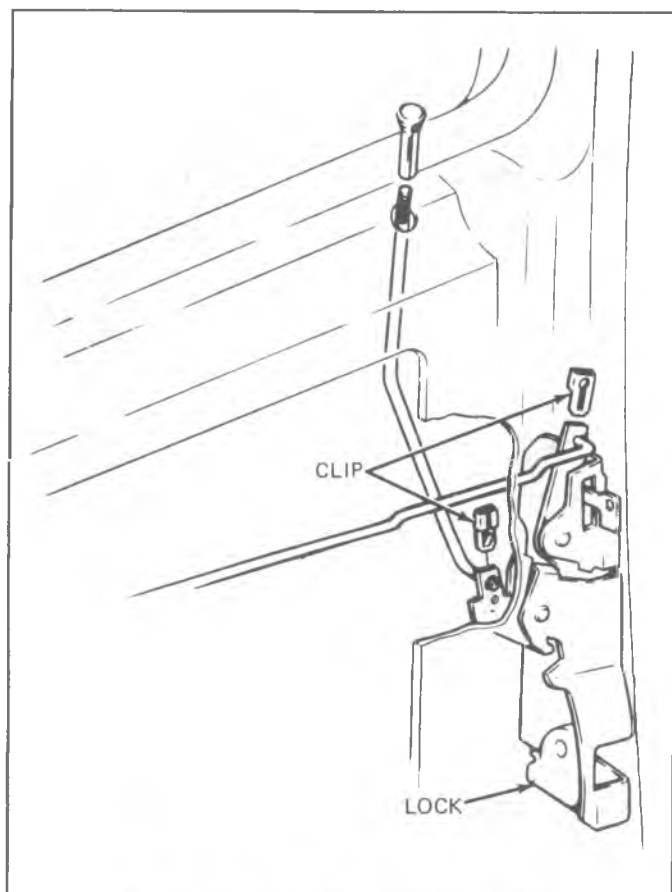


Fig. 2D-36--Door Lock Assembly and Rods

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. 2D-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. 2D-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 2D-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 2D-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. 2D-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.

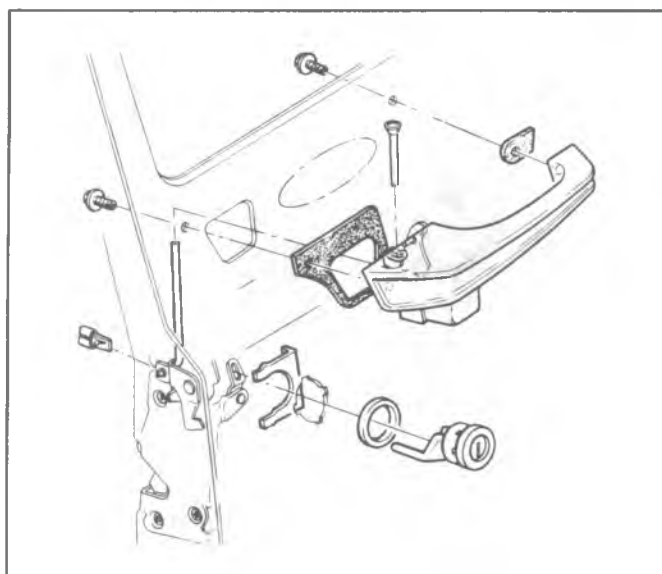


Fig. 2D-37--Outside Handle and Lock Cylinder

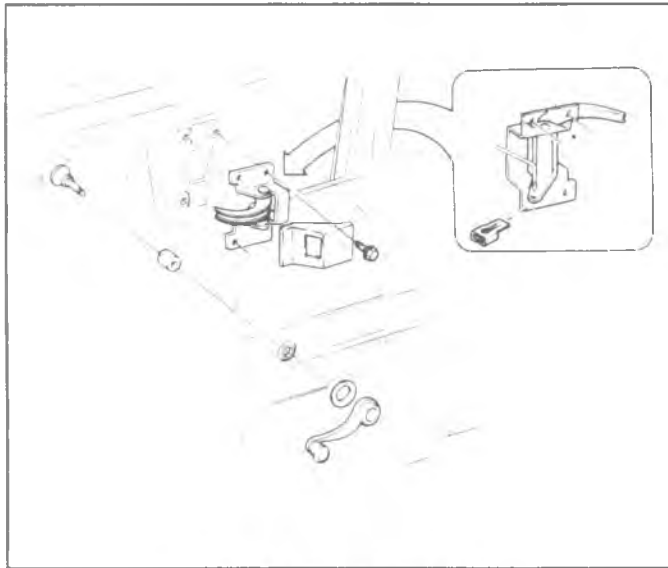


Fig. 2D-38--Inside Handle

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. 2D-40, 2D-41

Side door sealing incorporates an inner seal Fig. 2D-40 and a secondary seal Fig. 2D-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,

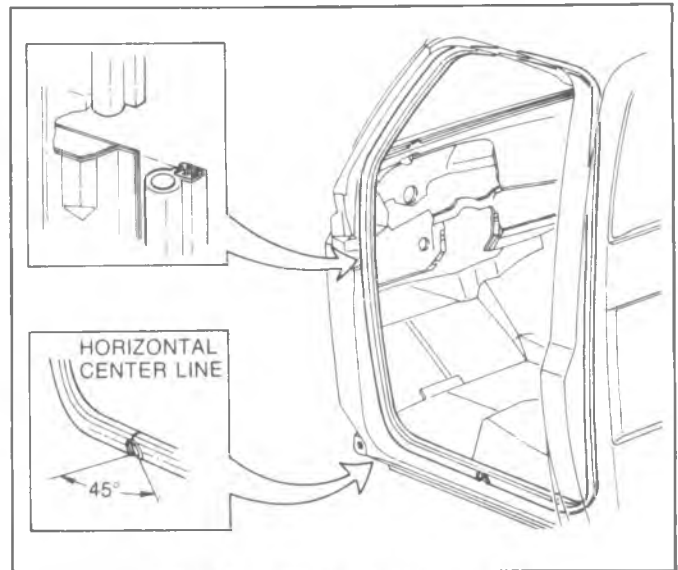


Fig. 2D-40--Door Weatherstrip CK

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 2D-42.

STATIONARY GLASS--REAR DOOR

Replacement

1. Lower window to full down position.
2. Remove remote control knob and window regulator handle.

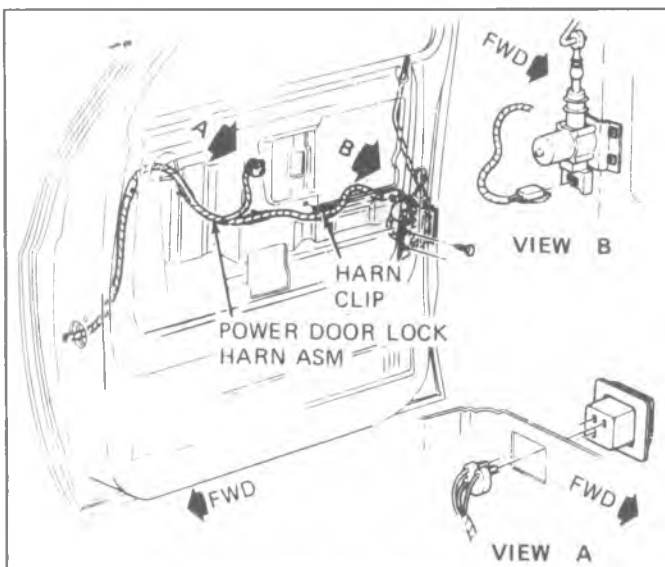


Fig. 2D-39--Power Door Lock Assembly

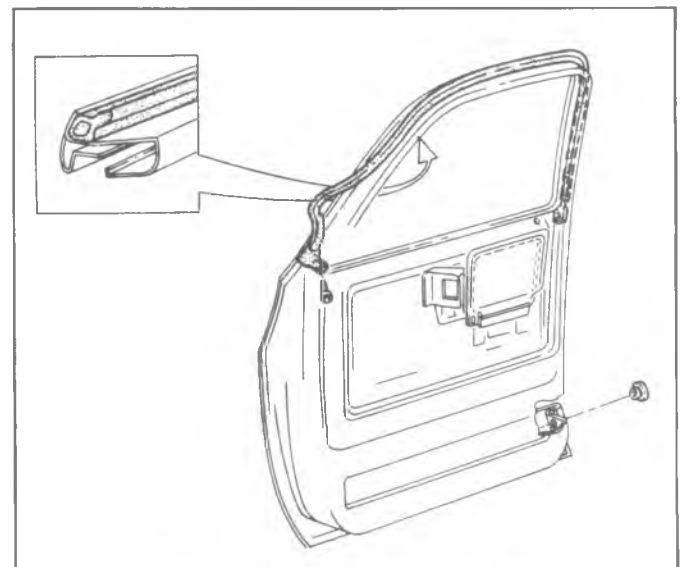


Fig. 2D-41--Door Secondary Seal

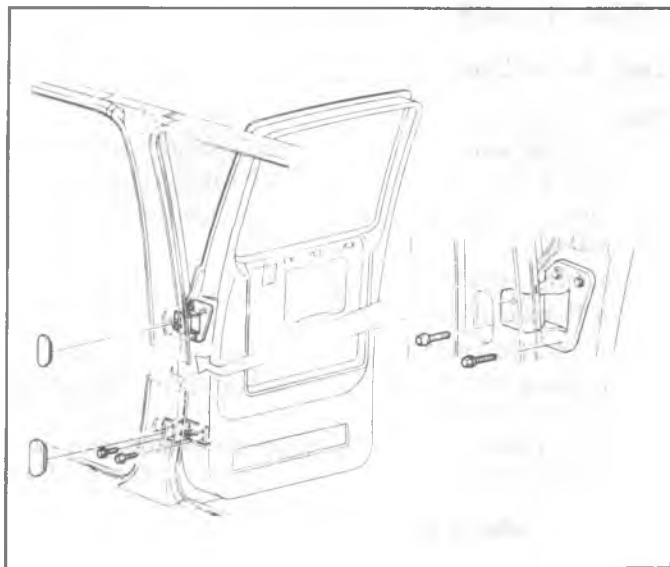


Fig. 2D-42--Rear Door Hinge Location

3. Remove screws retaining door trim pad, and remove trim pad. See figure 2D-43.
4. Remove glass run channel by removing screws retaining channel to door. See figure 2D-44.
5. Remove stationary glass.
6. Replace glass by reversing above procedure.

Glass Run Channel Adjustment

Figure 2D-45 illustrates the front run channel. At the lower end, a slotted bracket provides for in-and-out

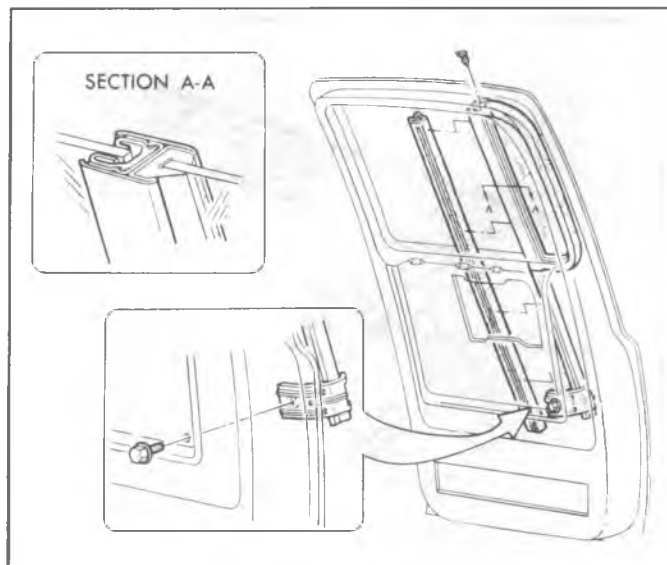


Fig. 2D-44--Glass Run Channel

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. 2D-46

Replacement

1. Lower glass to full down position.
2. Remove remote control push button 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 2D-46. Disengage roller from channel.



Fig. 2D-45--Glass Run Channel Adjustment

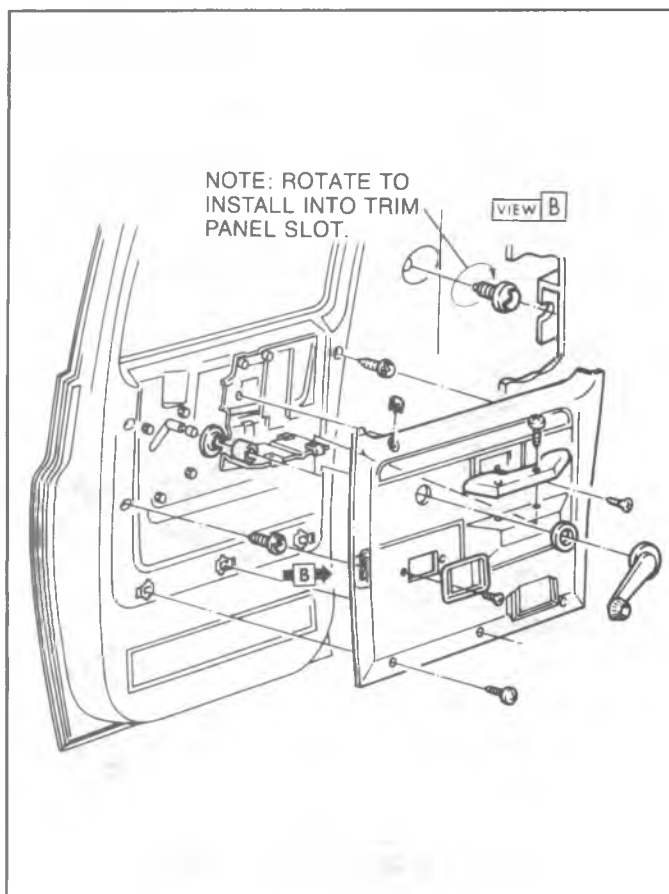


Fig. 2D-43--Side Rear Door Trim Pad

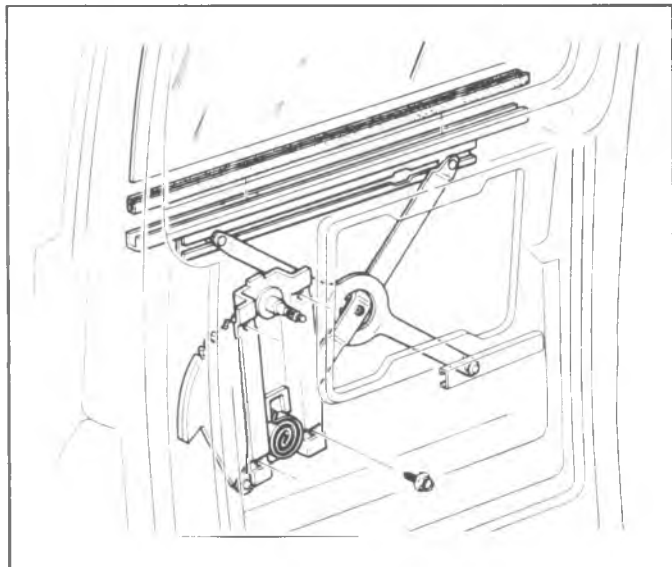


Fig. 2D-46--Window Glass and Regulator Assembly

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. 2D-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.

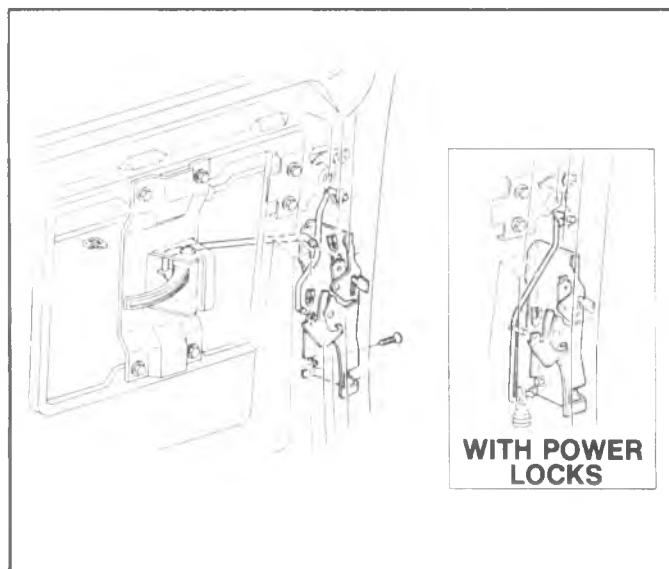


Fig. 2D-47--Lock Assembly and Inside Handle

LOCKS HANDLES AND RODS

Lock Assembly--Fig. 2D-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. 2D-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 2D-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. 2D-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.

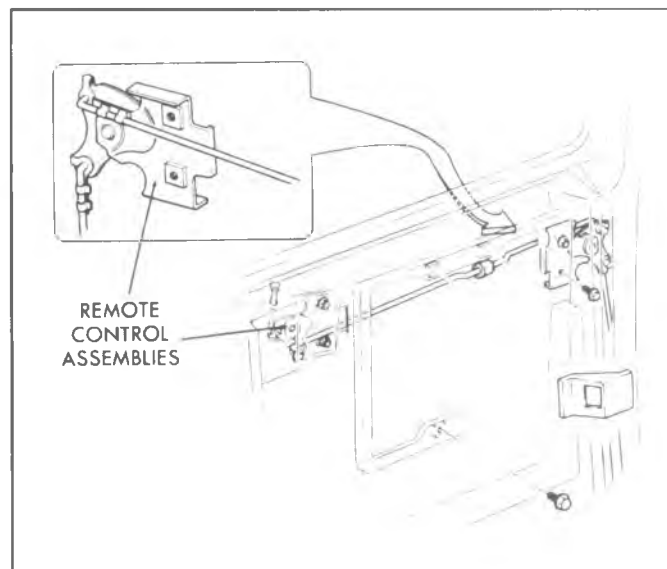


Fig. 2D-48--Remote Control Assembly

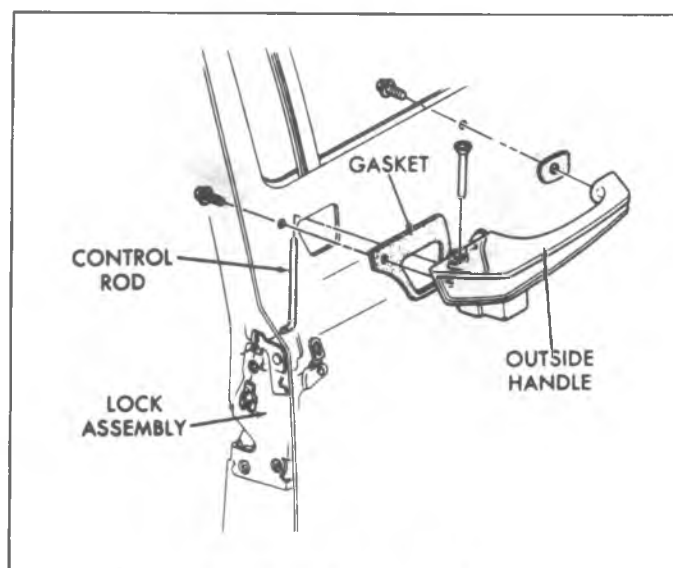


Fig. 2D-49--Outside Handle

Outside Handle--Fig. 2D-49

Replacement

1. Remove regulator handle, remote control rod and trim pad as outlined previously.
2. Disengage outside handle control rod from lock assembly by removing clip, as shown in figure 2D-49.
3. Remove two screws securing outside handle to door panel.
4. Remove handle assembly.
5. Replace by reversing above procedure.

WEATHERSTRIP--FIG. 2D-50

The procedure outlined in Front Door Weatherstrip may be applied to the Rear Side Door Weatherstrip, shown in figure 2D-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

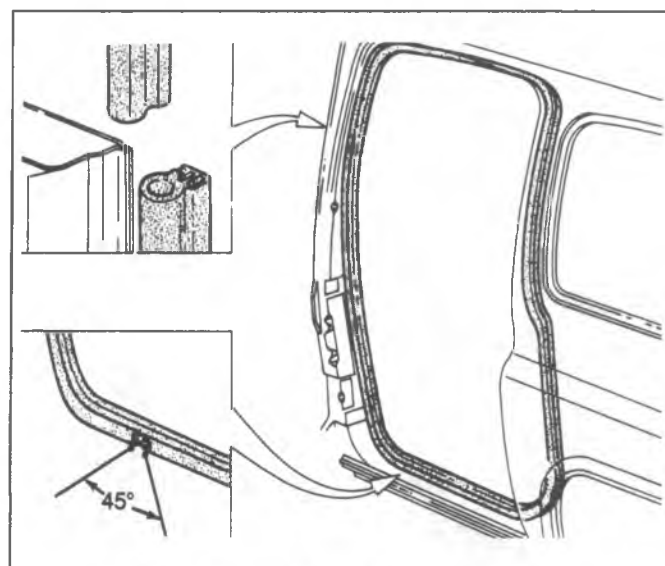


Fig. 2D-50--Side Rear Door Weatherstrip

retightening bolts. See figure 2D-54 for hinge bolt location. Rear door wedges and strikers should be adjusted as shown in figure 2D-55.

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 2D-51 and 2D-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 2D-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. 2D-55 and 2D-56. Proper installation is dependent on completely cleaning all foreign material from old installation and using a quality cement on the new installation.

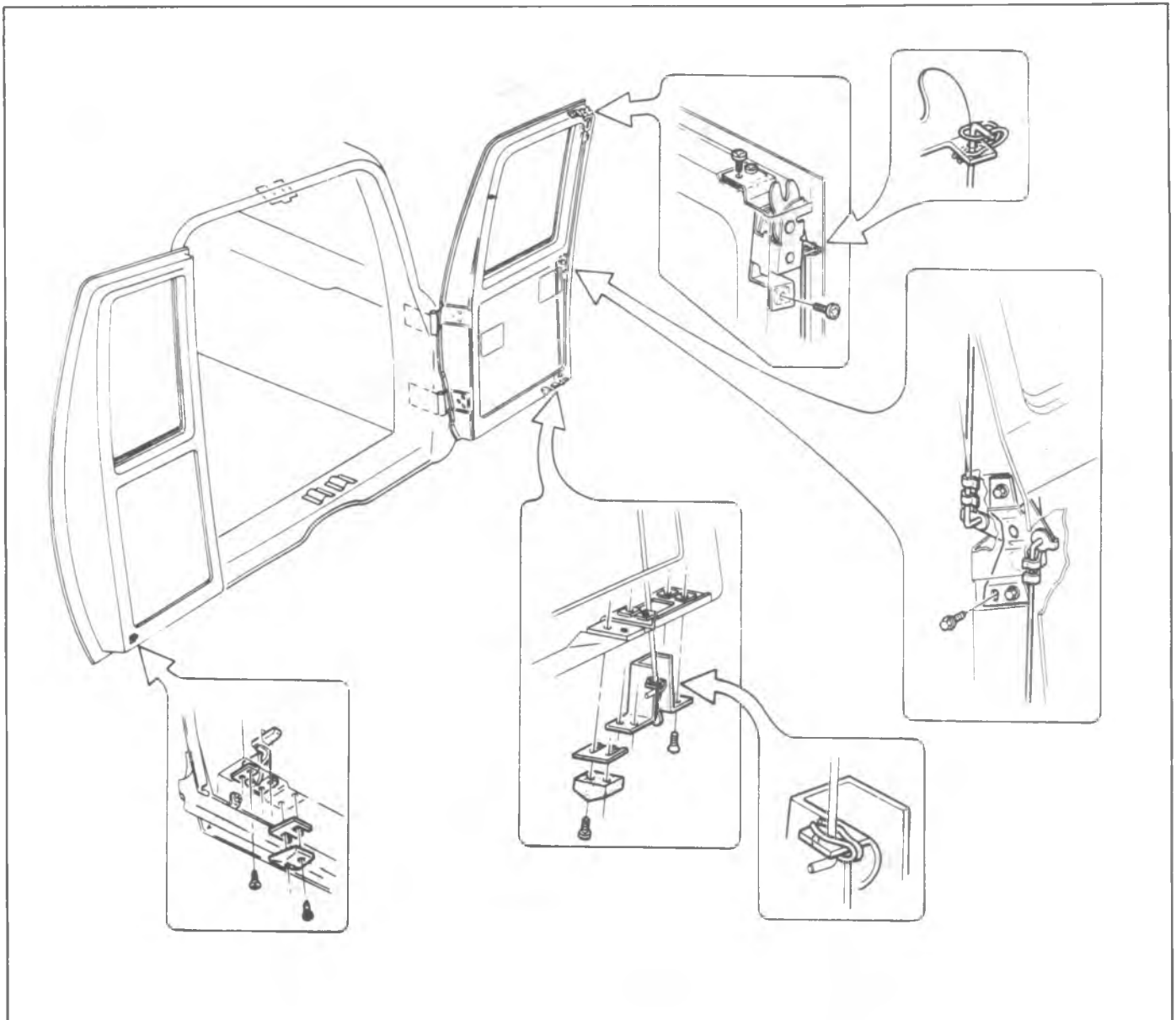


Fig. 2D-51--Rear Door Controls

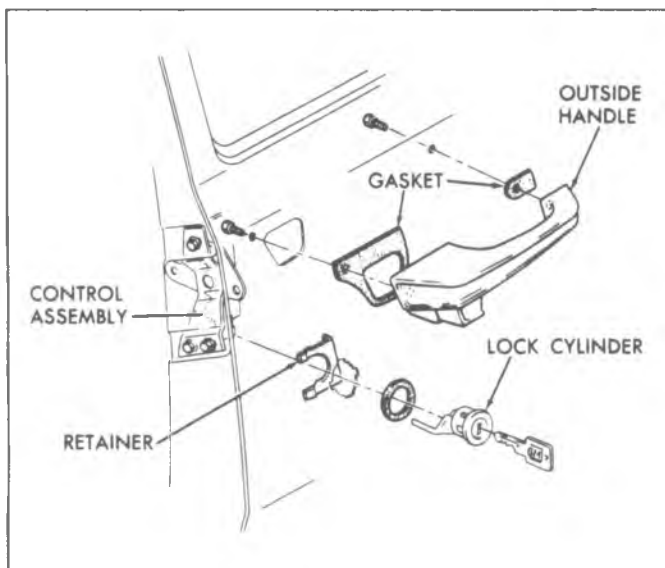


Fig. 2D-52--Rear Door Outside Handle and Lock Cylinder

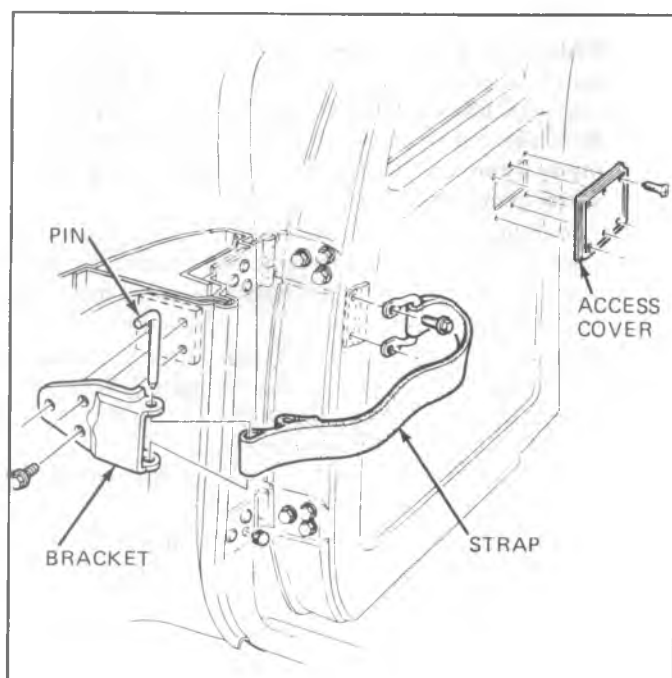


Fig. 2D-53--Rear Door Check Strap

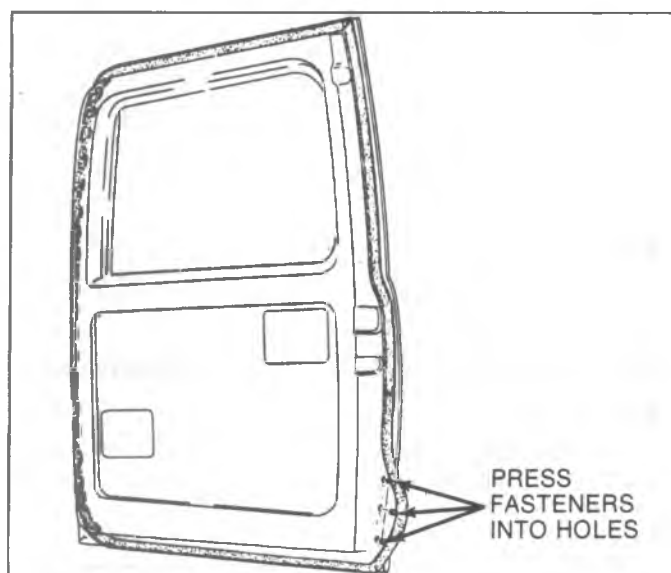


Fig. 2D-56--Weatherstrip--R.H. Rear Door

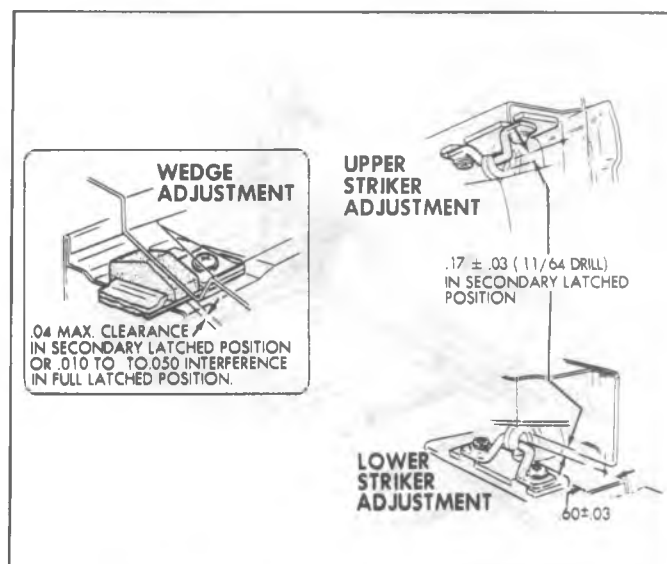


Fig. 2D-54--Wedge and Striker Adjustments

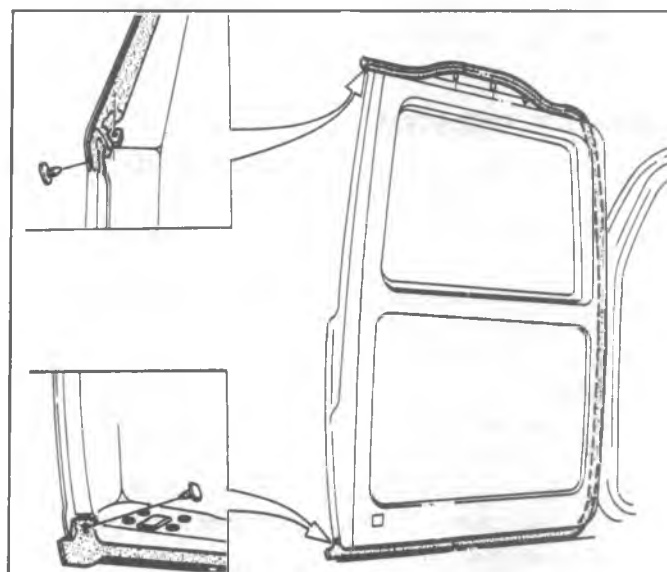


Fig. 2D-55--Weatherstrip - L.H. Rear Door

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 2D-57.
2. Remove endgate-to-hinge bolts.
3. Remove L.H. torque rod bracket, shown in figure 2D-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 2D-57.
2. Remove hinge assemblies. If the hinge pins are to

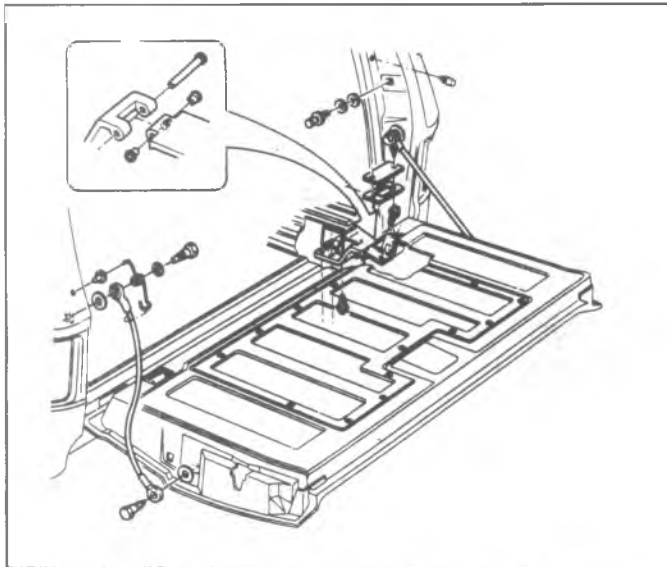


Fig. 2D-57--Endgate, Hinges and Supports--(Suburban)

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 2D-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 2D-58, then remove torque rod from endgate.
6. Remove screws connecting cam assemblies to sash assembly, figure 2D-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

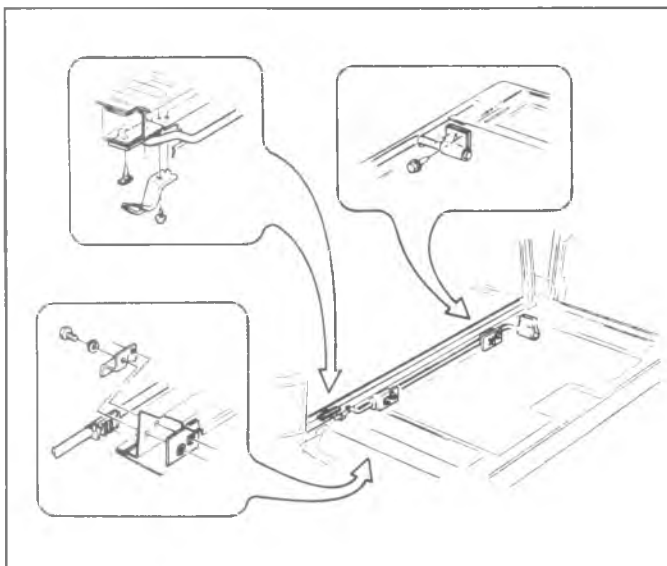


Fig. 2D-58--Torque Rod(Suburban)

to endgate, figure 2D-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 2D-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 2D-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. Remove side latch bolts and remove side latches with control rods. See figure 2D-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 2D-62. Disconnect wiring harness if so equipped.

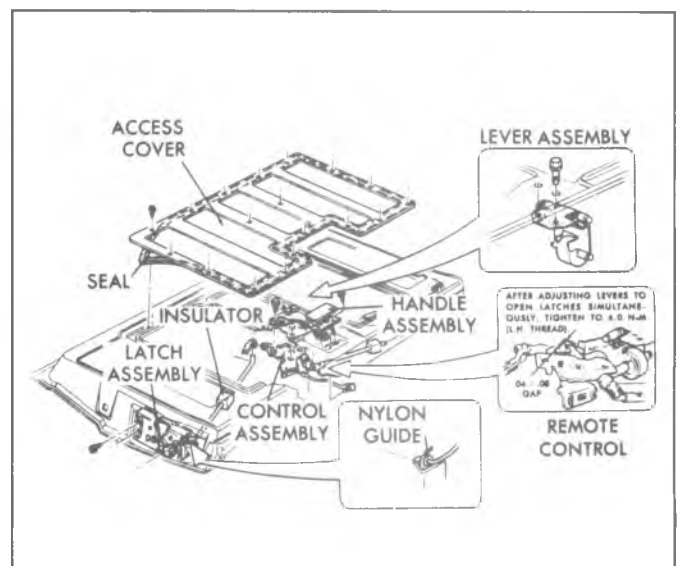


Fig. 2D-59--Latch and Remote Controls(Suburban)

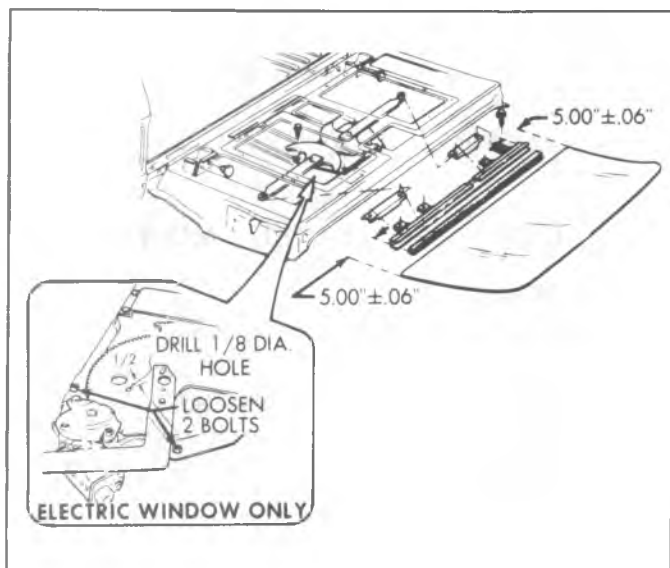


Fig. 2D-60--Window Glass and Regulator(Suburban)

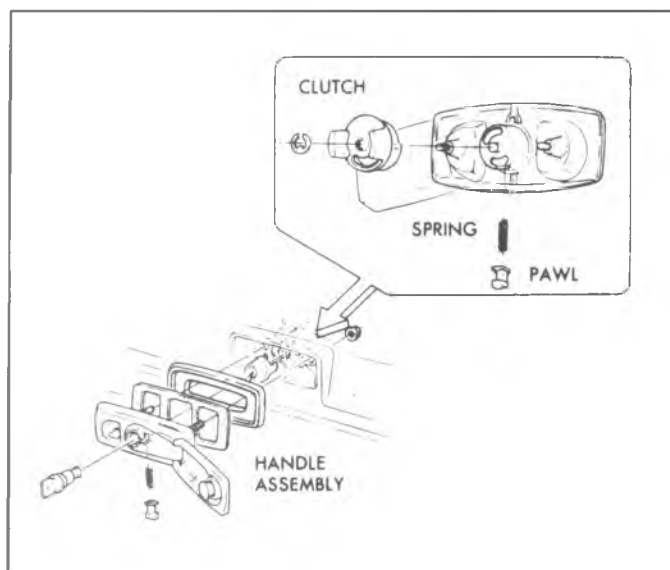


Fig. 2D-61--Outside Handle

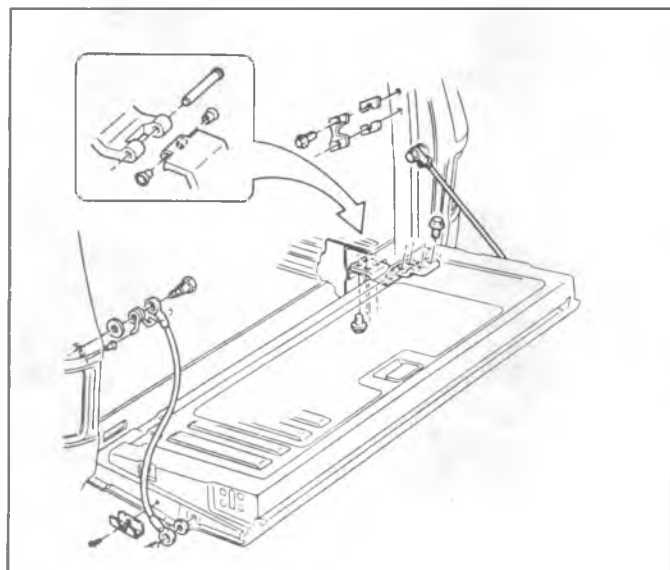


Fig. 2D-62--Endgate, Hinges and Support (Utility)



Fig. 2D-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 2D-66.
3. With an assistant, raise endgate part way, then disconnect support cables from endgate. See figure 2D-62.
4. Remove endgate by pulling disconnected hinge from body, figure 2D-63, then grasping torque rod with one hand and pulling torque rod over gravel deflector, as shown in figure 2D-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 2D-62.
2. At the other hinge, **loosen** the hinge-to-body bolts.
3. On the hinge to be replaced, remove the



Fig. 2D-64--Grasping Torque Rod (Utility)



Fig. 2D-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 2D-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 2D-65.
2. Disconnect torque rod anchor plate. It is necessary to remove the lower bolt only, then let plate swing down. See figure 2D-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 2D-66.

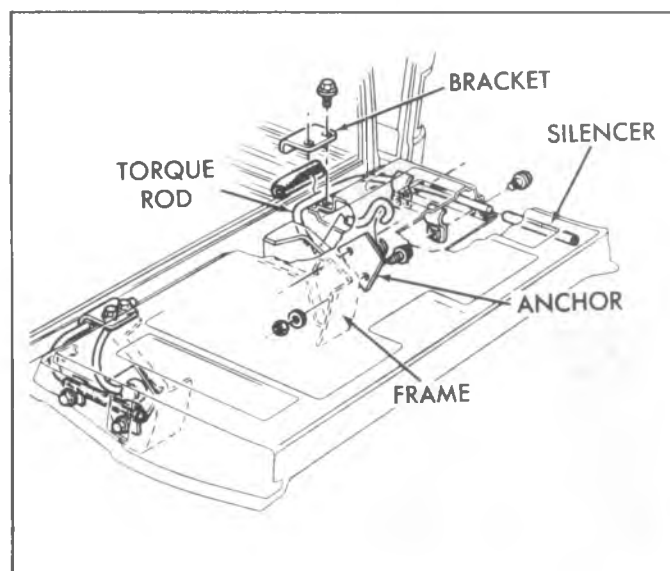


Fig. 2D-66--Torque Rod (Utility)

6. Remove torque rod retaining clip on side edge of endgate.
7. Lift torque rod up and slide from endgate as shown in figure 2D-67.
8. Reverse the procedure above for installation.

ENDGATE DISASSEMBLY-UTILITY MODELS ONLY

Manual Window

1. Lower endgate and remove access cover.
2. Disconnect side latch remote control rods from center control by removing retaining clips. See figure 2D-68.
3. Remove four screws from each side latch, and withdraw latch and control rod from endgate, as shown in figure 2D-69.
4. Disconnect control rod from latch.
5. Refer to figure 2D-70 for installation of latch control and blackout rod.
6. Disconnect blackout 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 2D-71.
10. Refer to figure 2D-72 for window and regulator installation.
11. Roll window to up position.
12. Disconnect sash from regulator as shown in figure 2D-73.
13. Remove glass from endgate.
14. Remove four regulator attaching screws and withdraw regulator from endgate as shown in figure 2D-74.

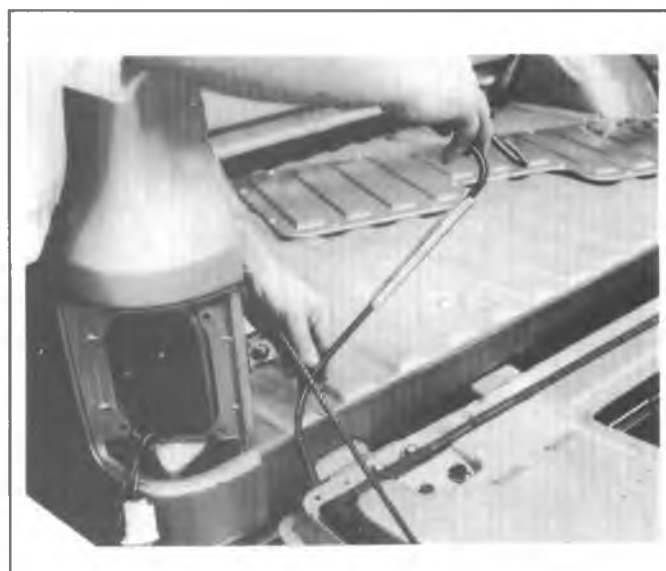


Fig. 2D-67--Removing Torque Rod (Utility)

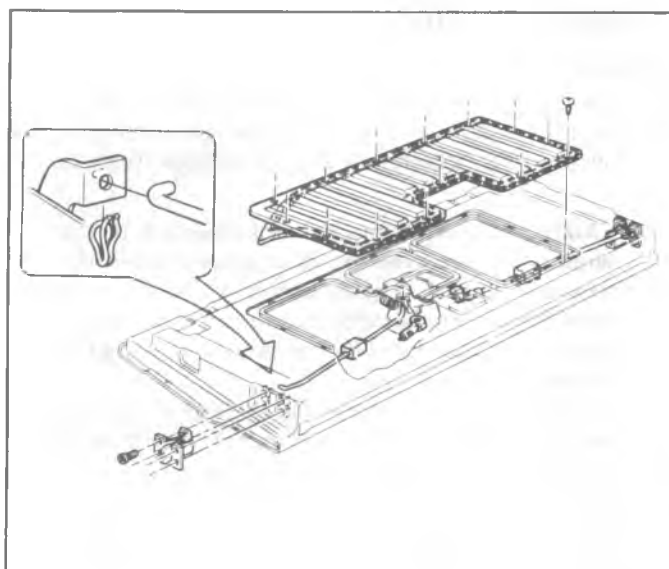


Fig. 2D-68--Latches and Rods



Fig. 2D-71--Removing Control Assembly and Inside Handle

15. Remove outside handle by removing nuts from inside of outer panel. See figure 2D-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. 2D-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.

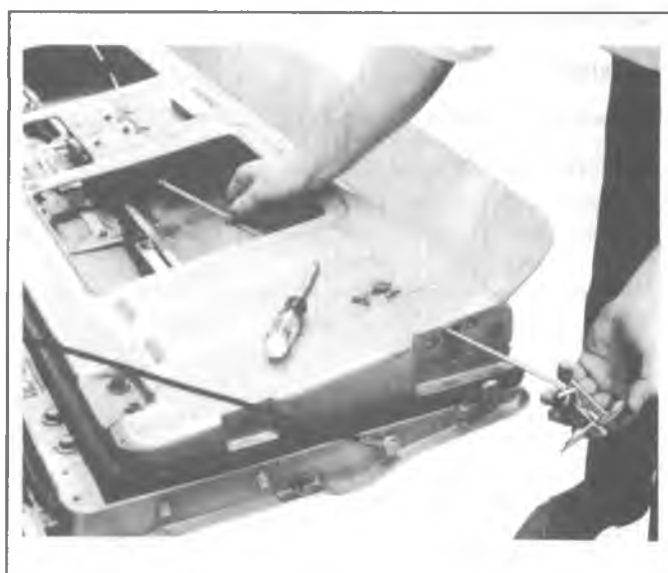


Fig. 2D-69--Removing Side Latch

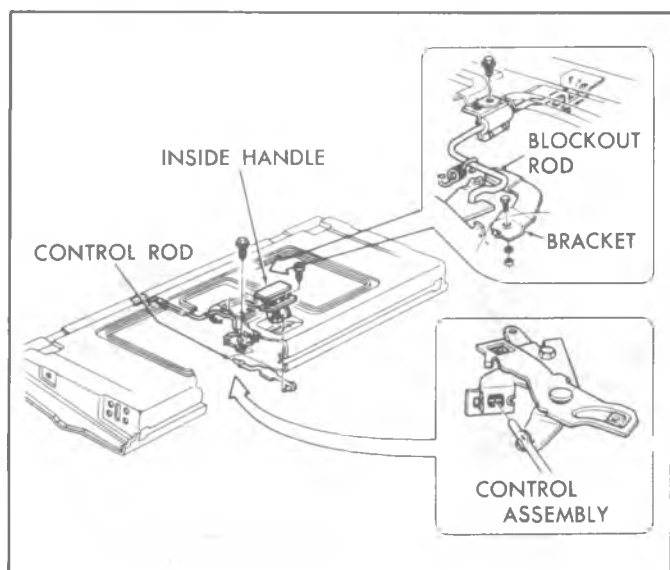


Fig. 2D-70--Control Assembly and Blockout Rod

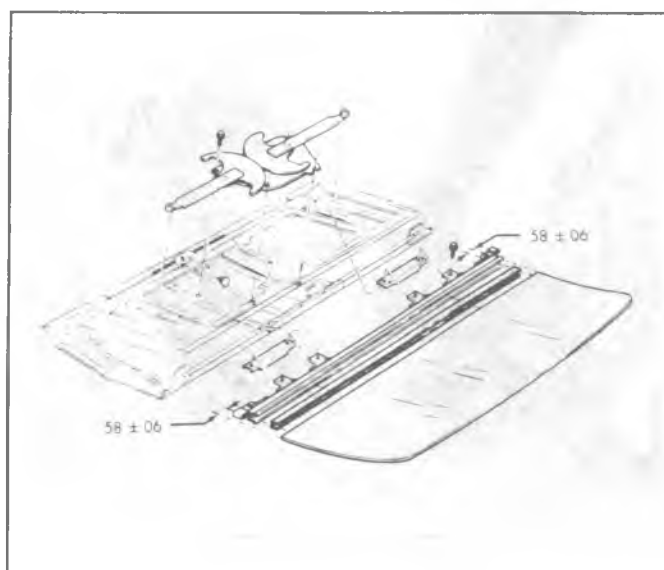


Fig. 2D-72--Window and Regulator

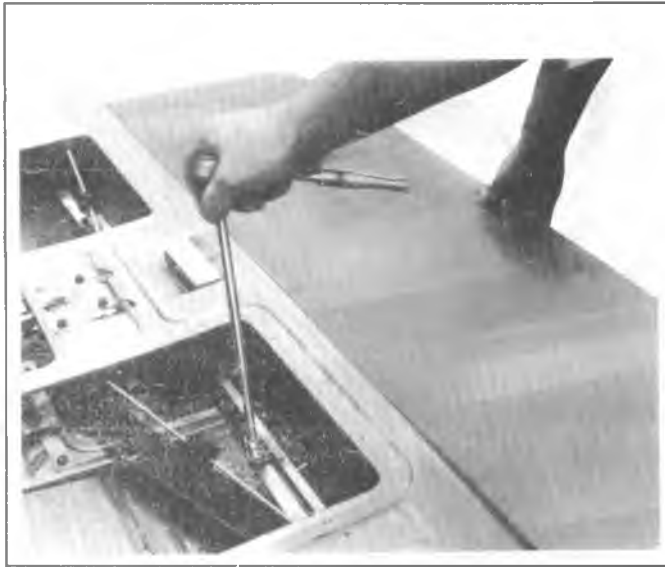


Fig. 2D-73--Disconnecting Sash from Regulator

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. 2D-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. 2D-74--Removing Regulator

Jackscrew (Fig. 2D-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. 2D-77)**

1. Open tailgate.
2. Remove screws attaching handle assembly to inner side of tailgate.

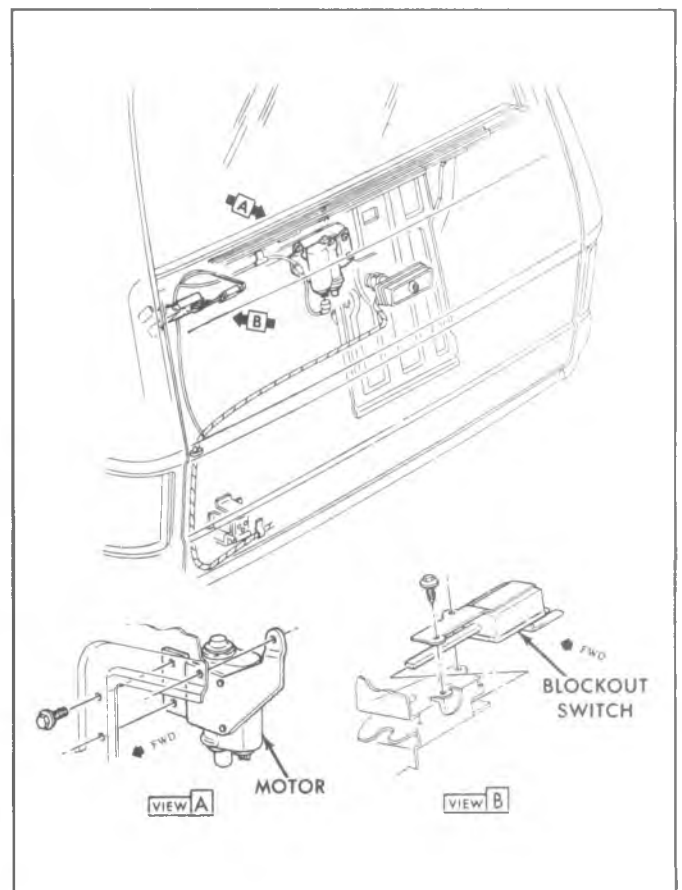


Fig. 2D-75--Power Window Motor and Switches (Utility)

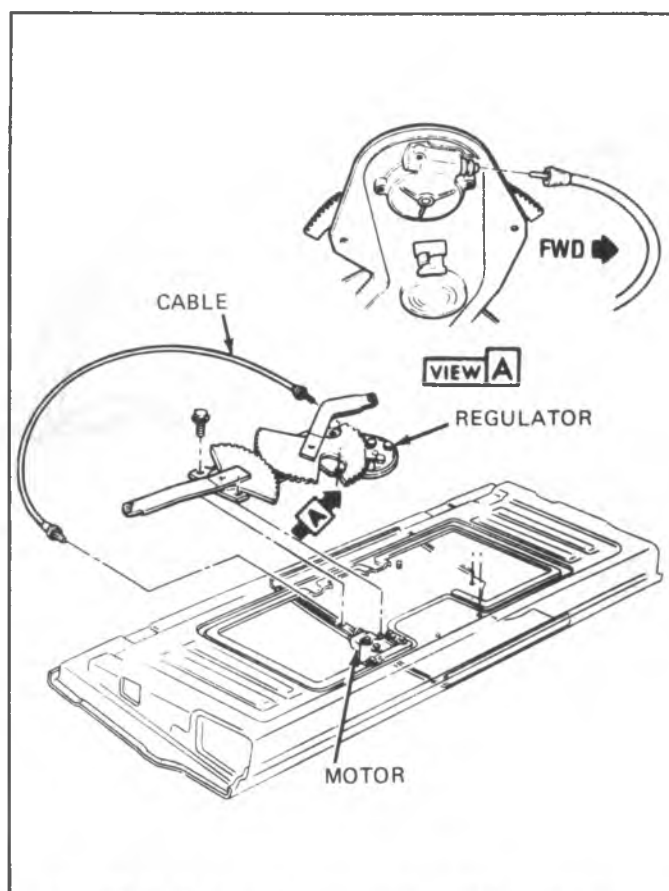


Fig. 2D-76--Endgate Regulator, Drive Cable and Motor

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. 2D-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.

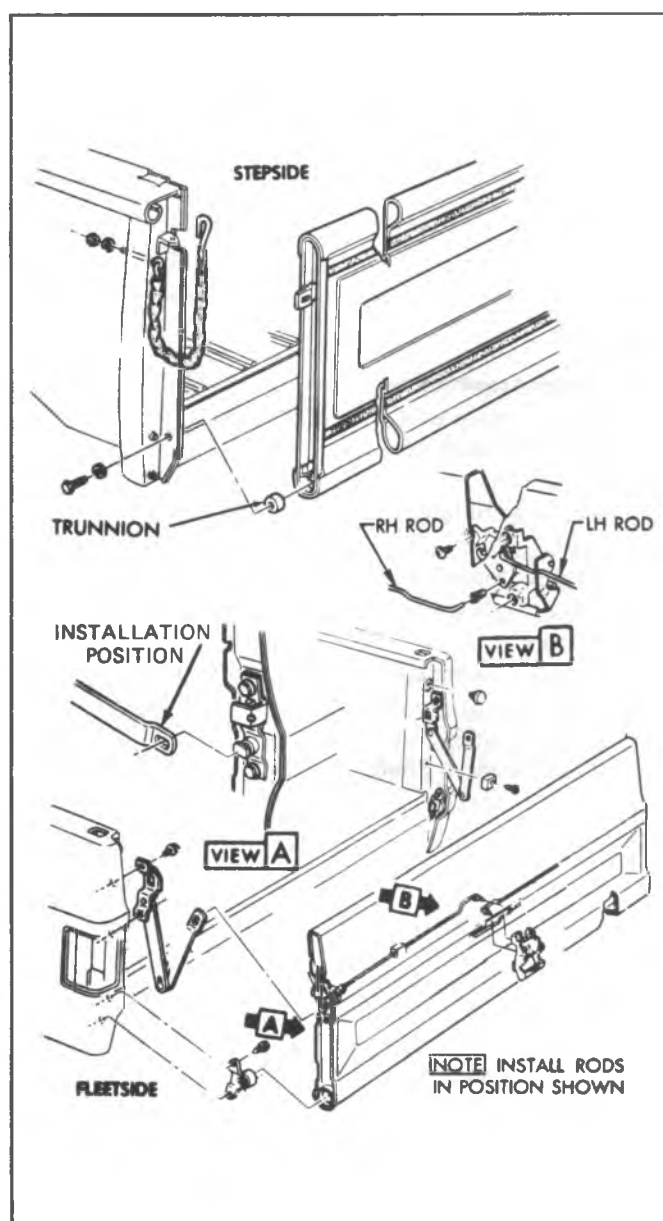


Fig. 2D-77--Tailgate

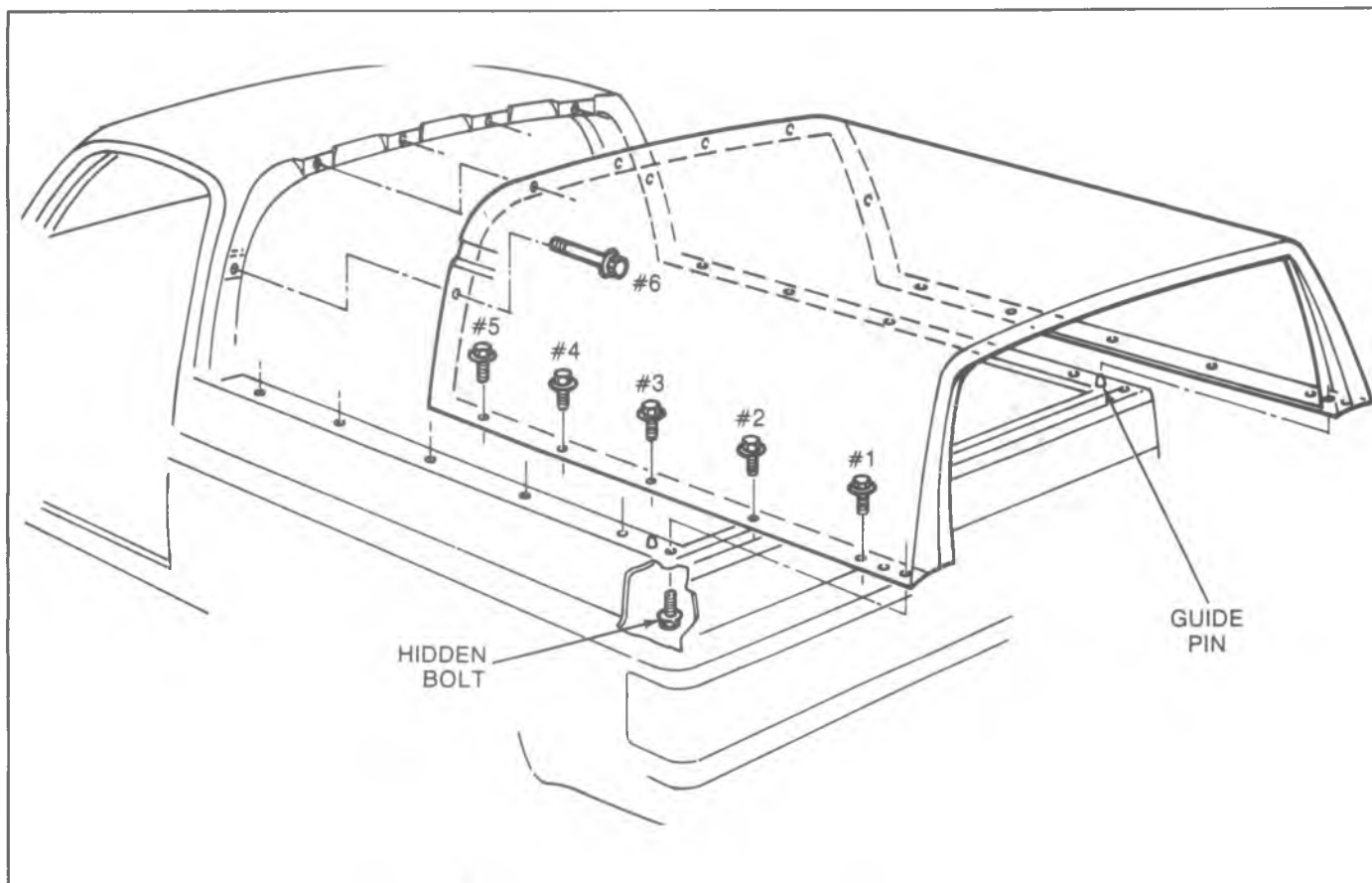


Fig. 2D-78--Removable Top

Mandatory Assembly Sequence (Fig. 2D-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.

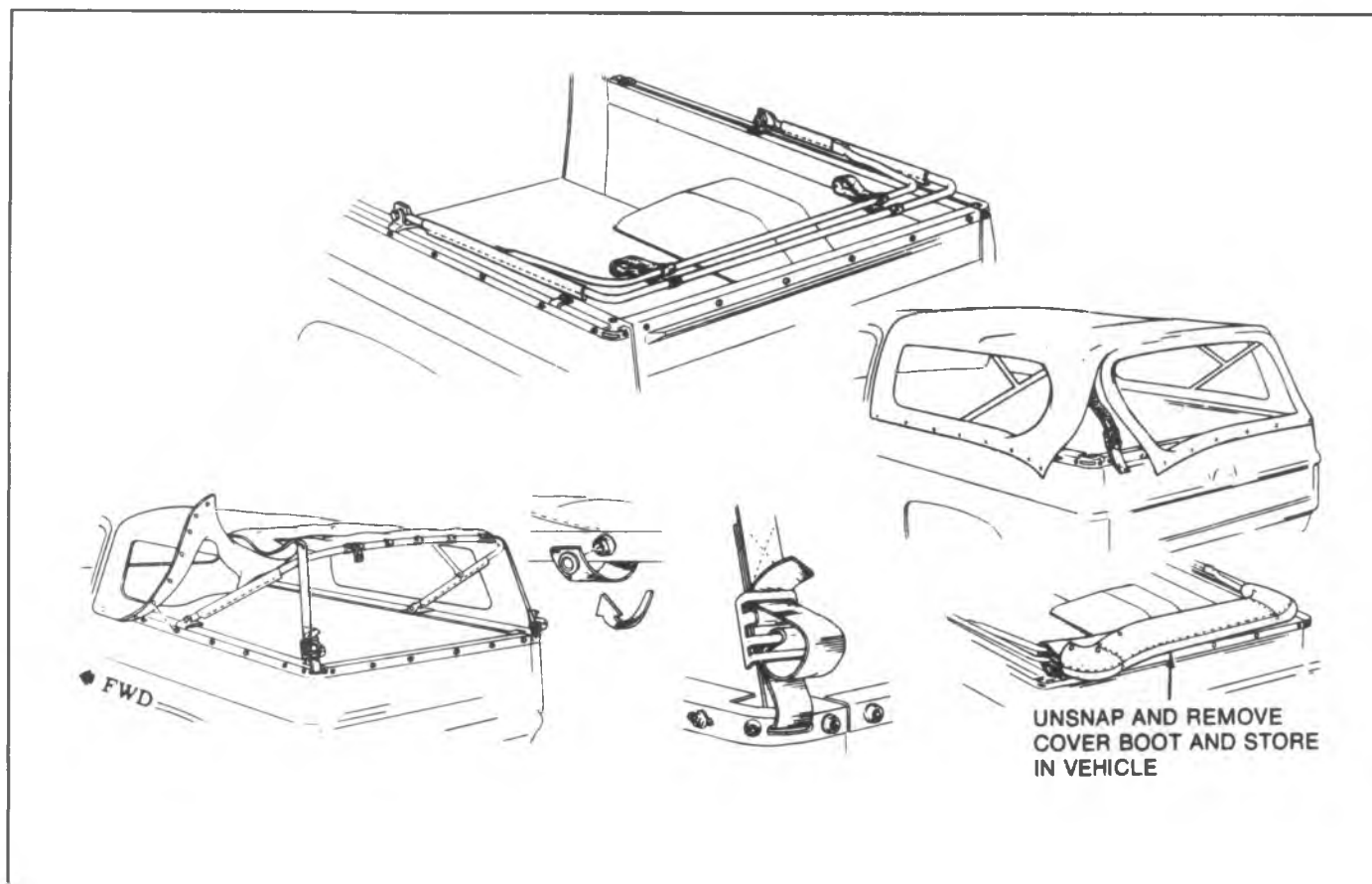


Fig. 2D-79--Folding Top Assembly

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 2D-83 through 2D-89.

NOTICE: See NOTICE on page 1 of this section regarding fasteners used on seats and seat belts.

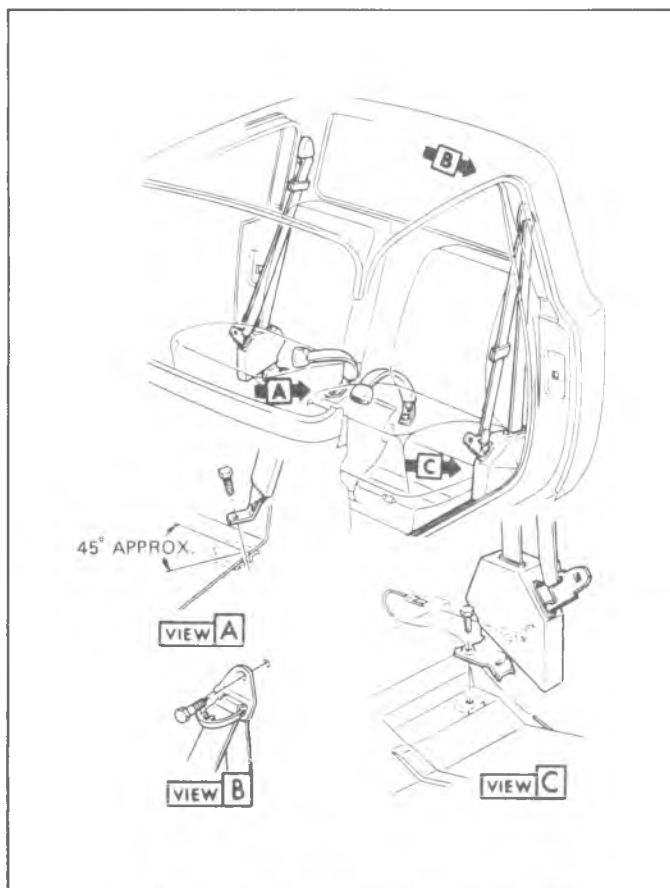


Fig. 2D-80--Seat Belt Installation (Chassis Cab)

SEAT SEPARATOR COMPARTMENT

Figure 2D-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

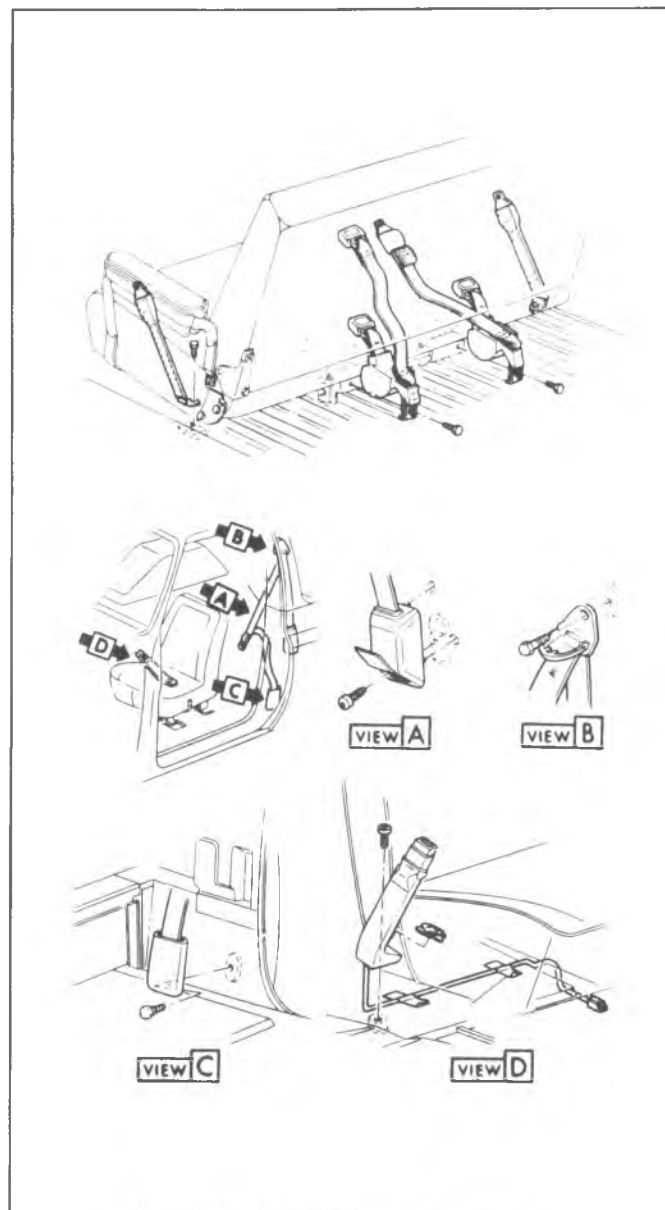


Fig. 2D-81--Seat Belt Installation (Utility)

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 2D-91 through 2D-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.

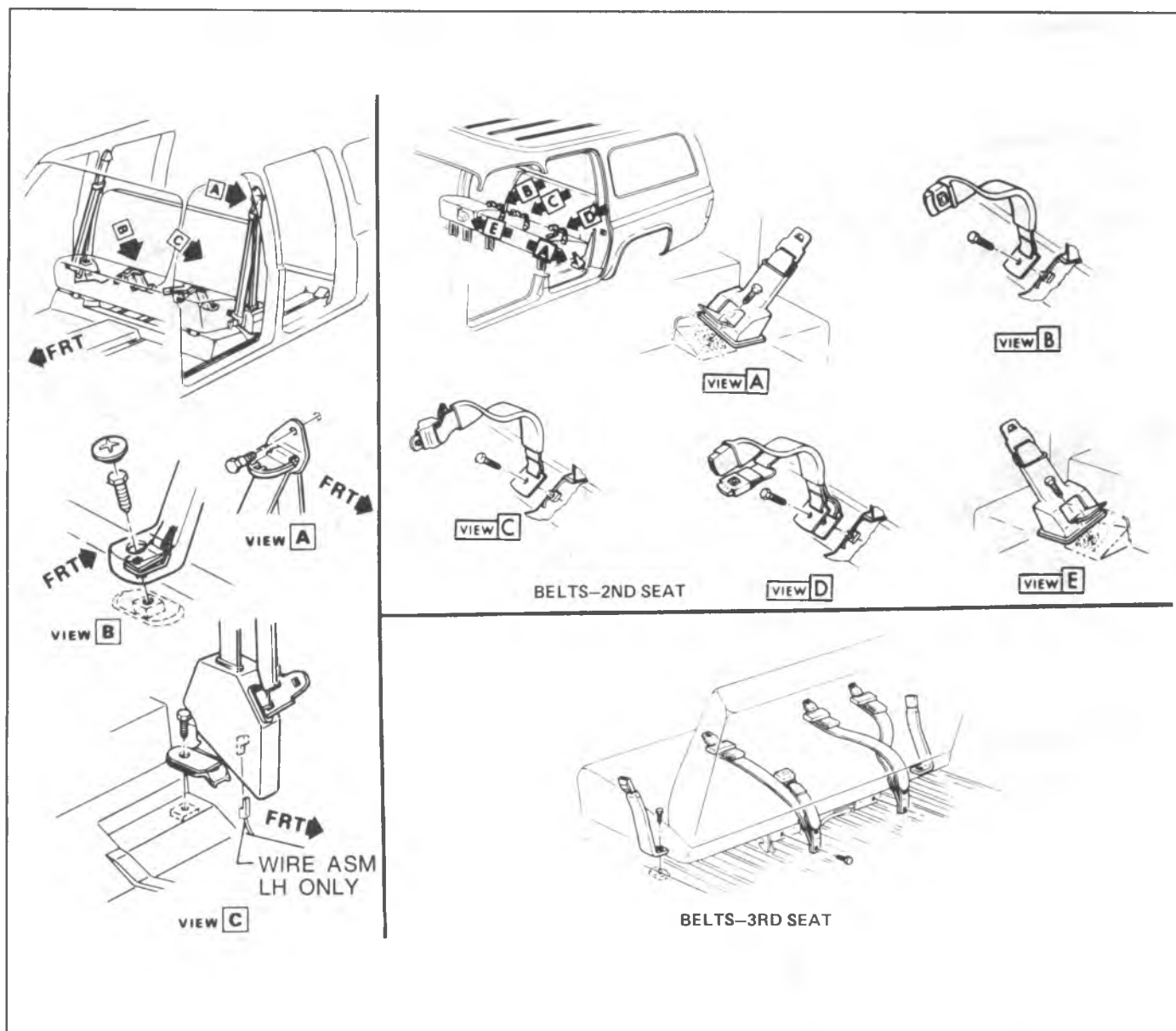


Fig. 2D-82--Seat Belt Installation (Suburban)

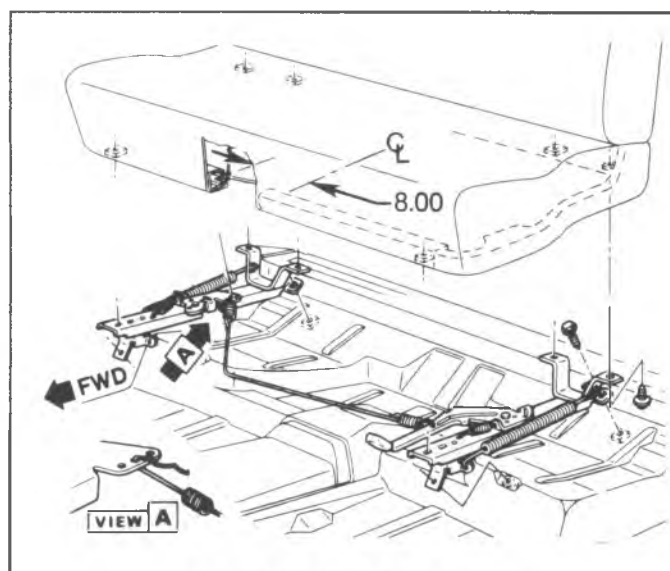


Fig. 2D-83--Front Bench Seat

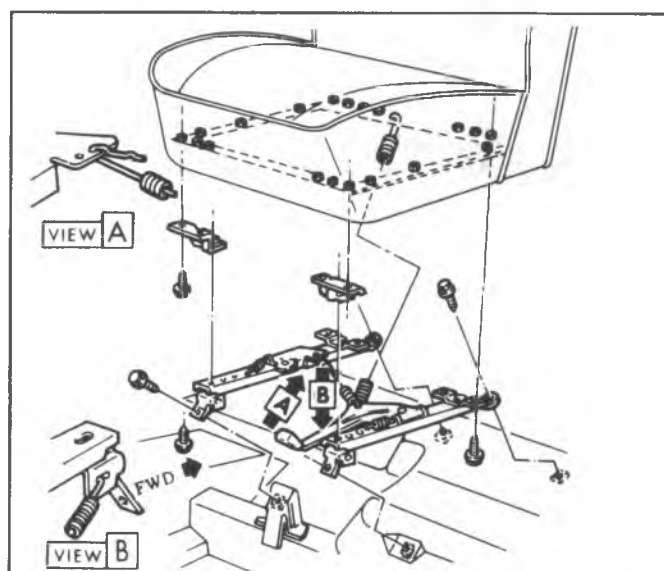


Fig. 2D-84--Driver's Bucket Seat (Chassis Cab) Passenger and Driver Seat (Suburban)

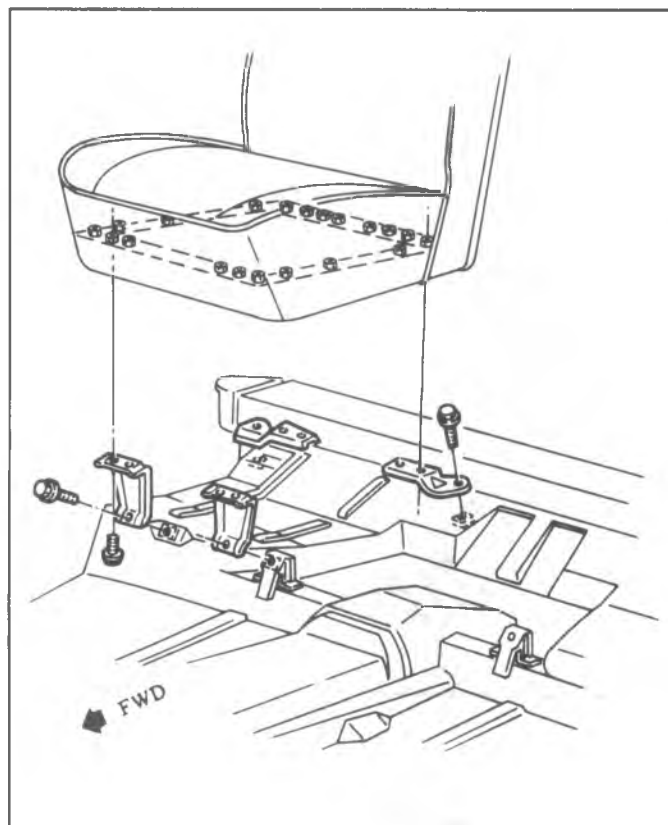


Fig. 2D-85--Passenger's Bucket Seat (Chassis Cab)

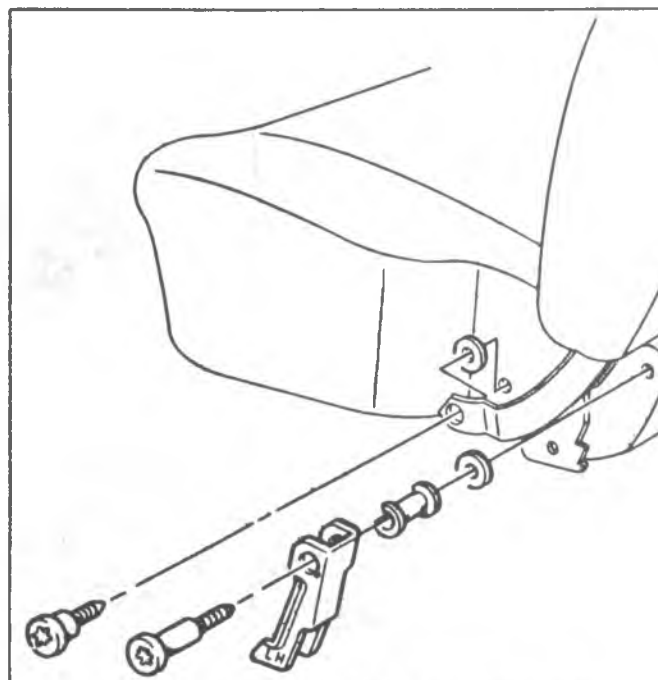


Fig. 2D-86--Folding Seat Back Catch and Striker

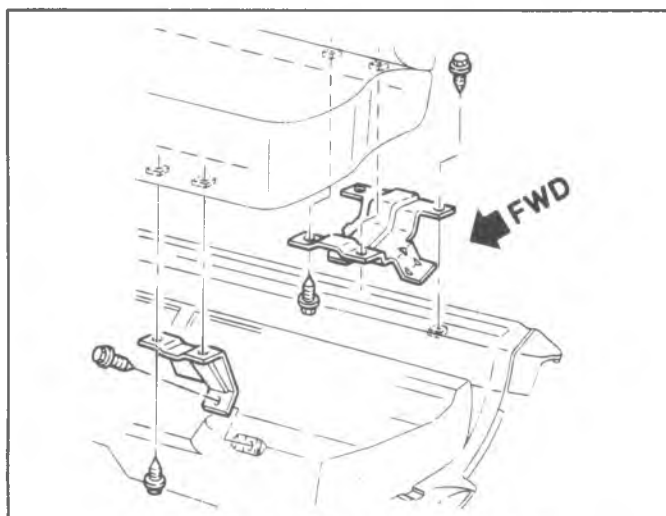


Fig. 2D-87--Rear Bench Seat (Crew Cab)

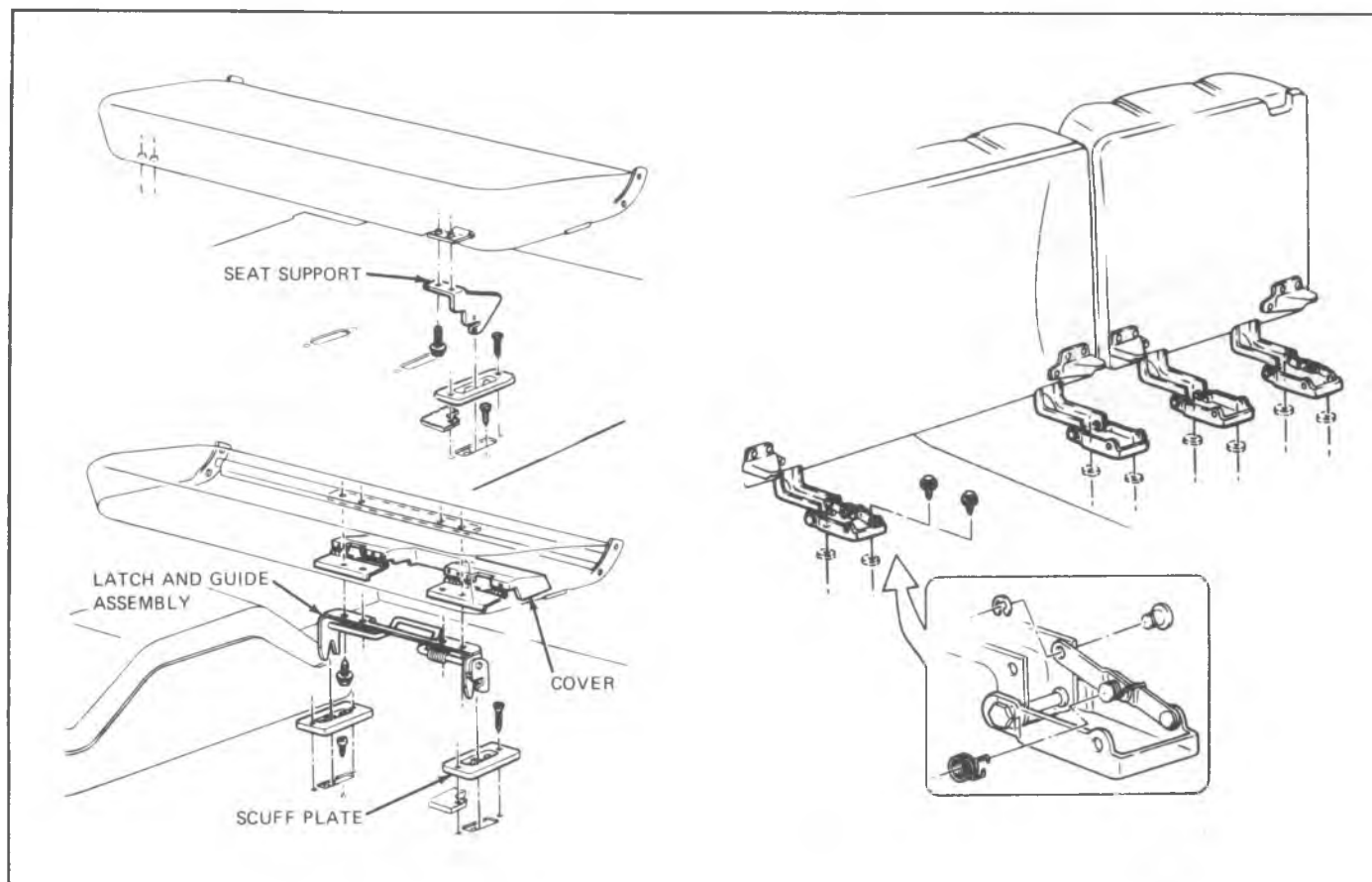


Fig. 2D-88--Rear Bench Seats (Suburban)

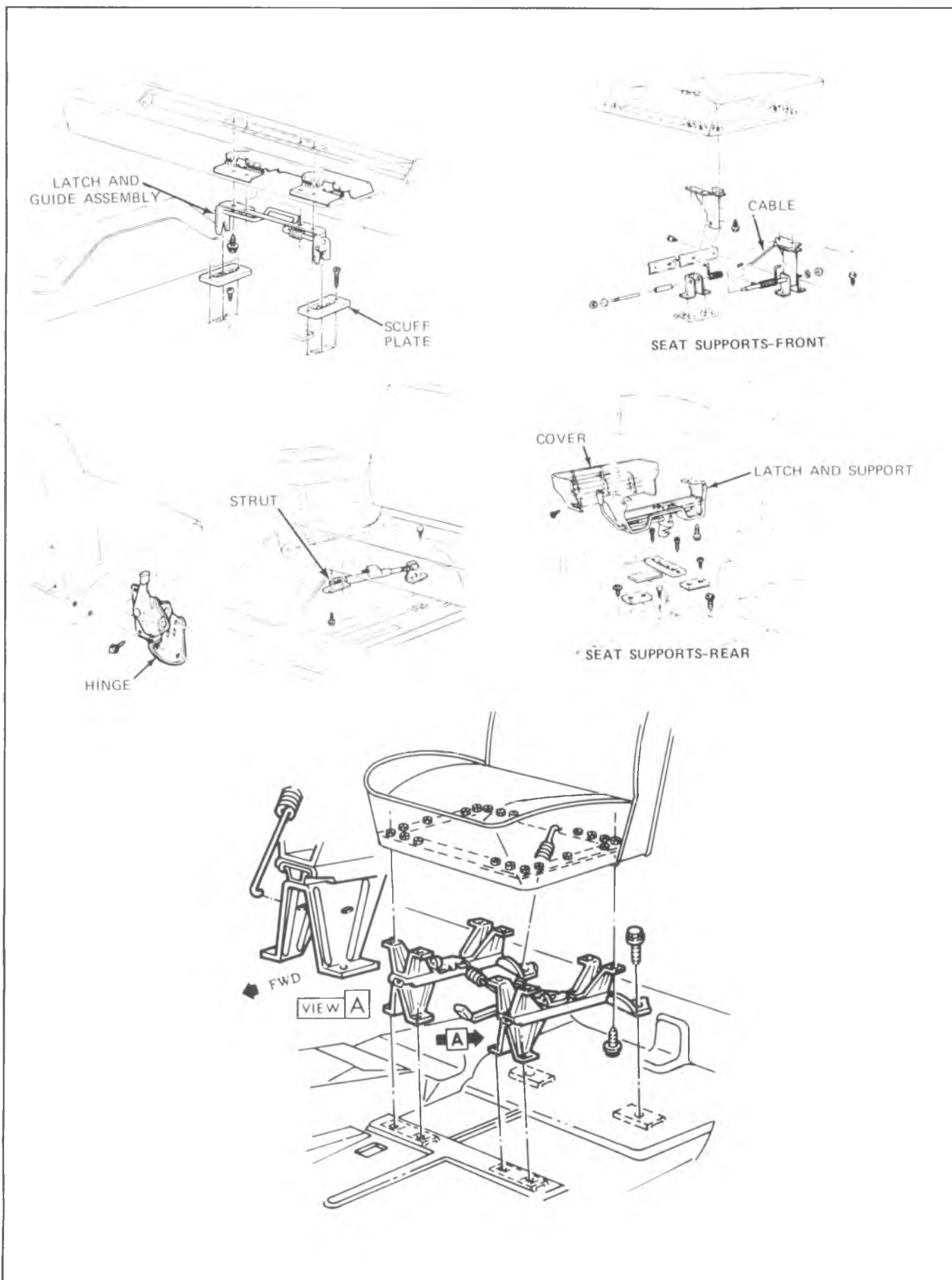


Fig. 2D-89--CK Utility Seat Attachments

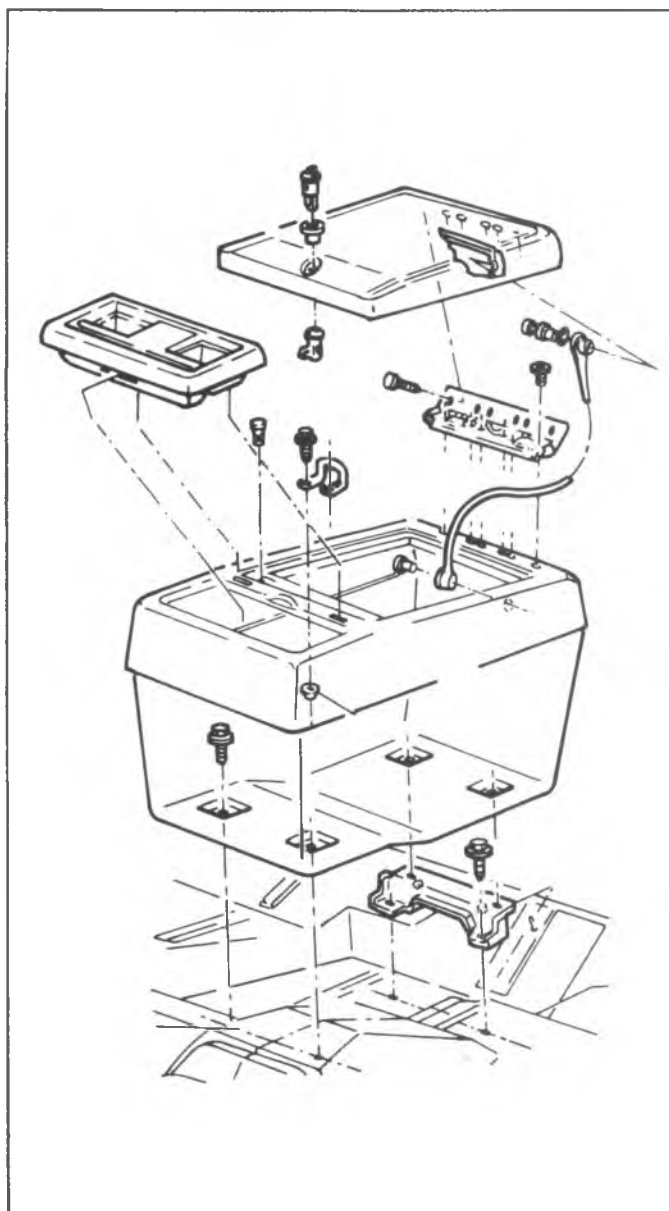


Fig. 2D-90--Seat Separator Compartment and Door--CK Models

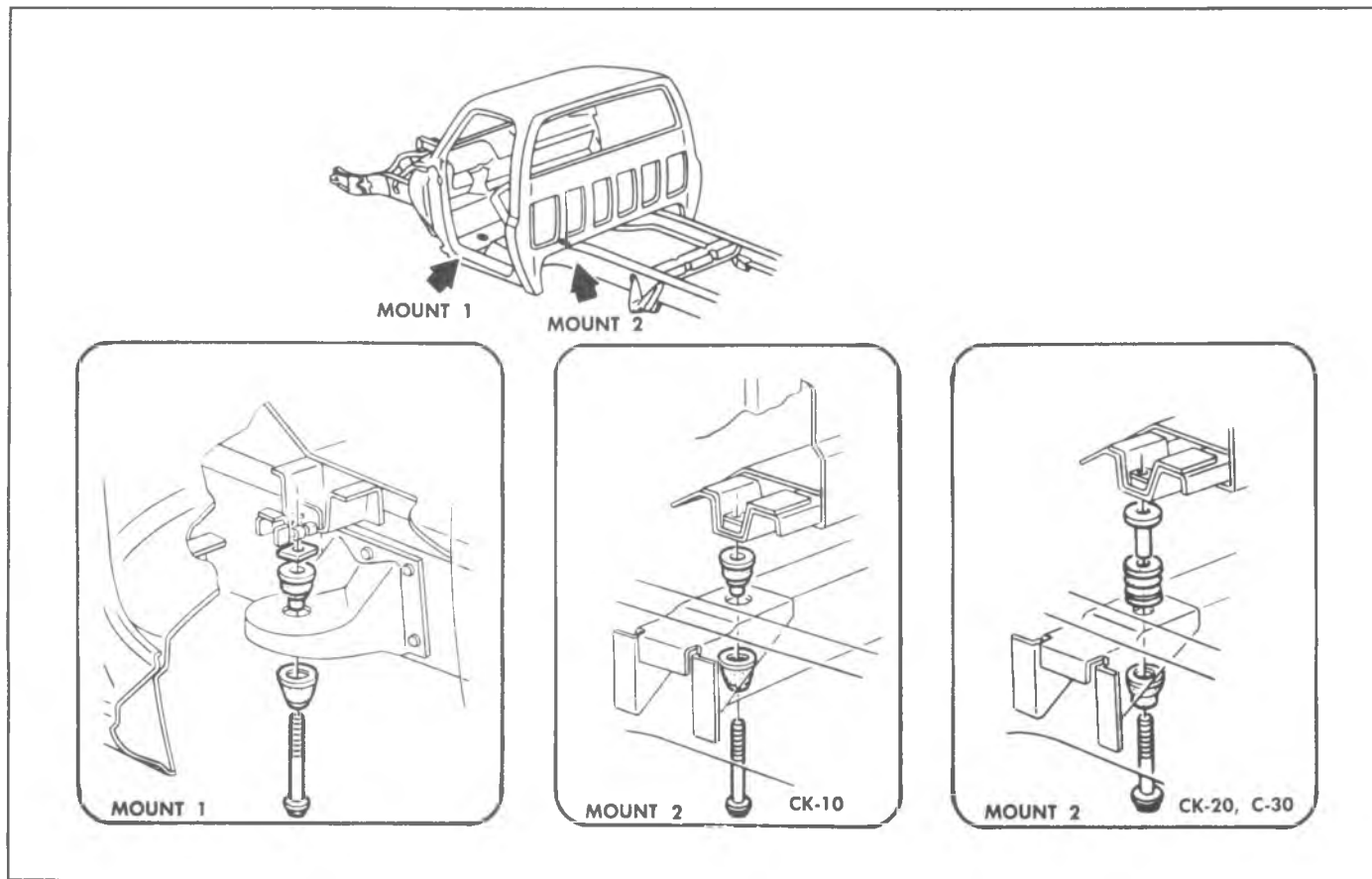


Fig. 2D-91--Body Mounting (Chassis Cab)

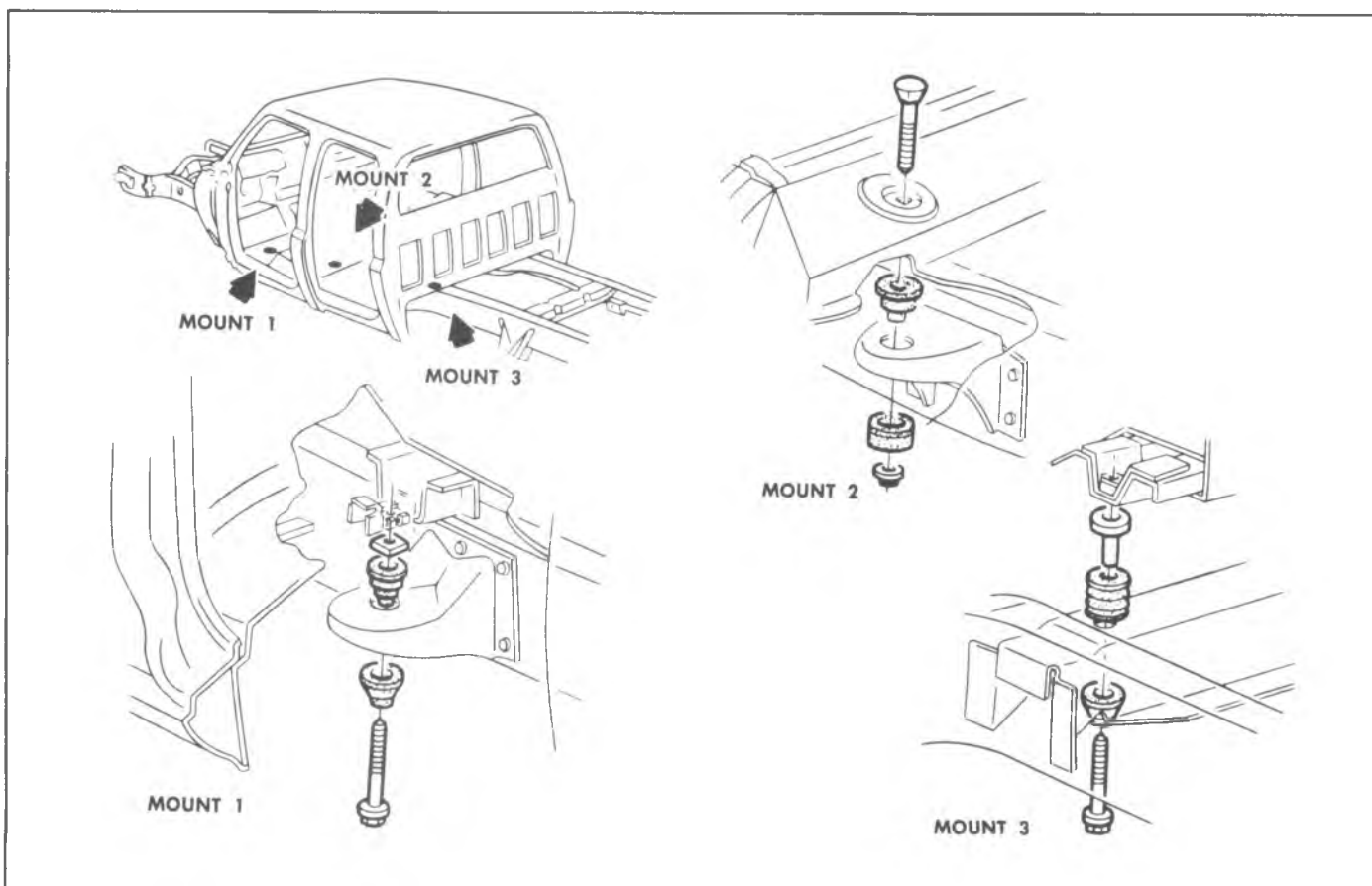


Fig. 2D-92--Body Mounting (Crew Cab)

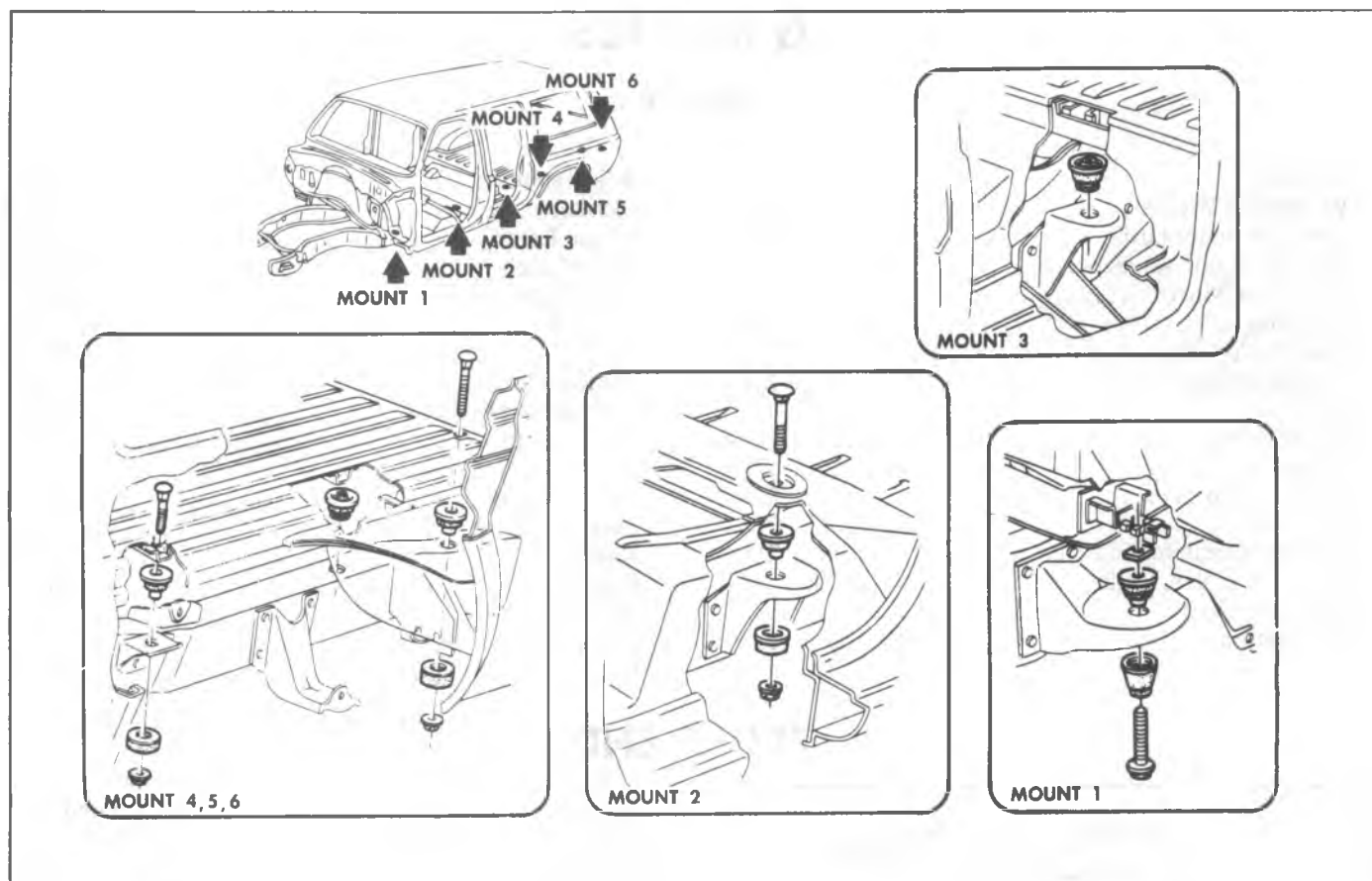


Fig. 2D-93--Body Mounting (Suburban)

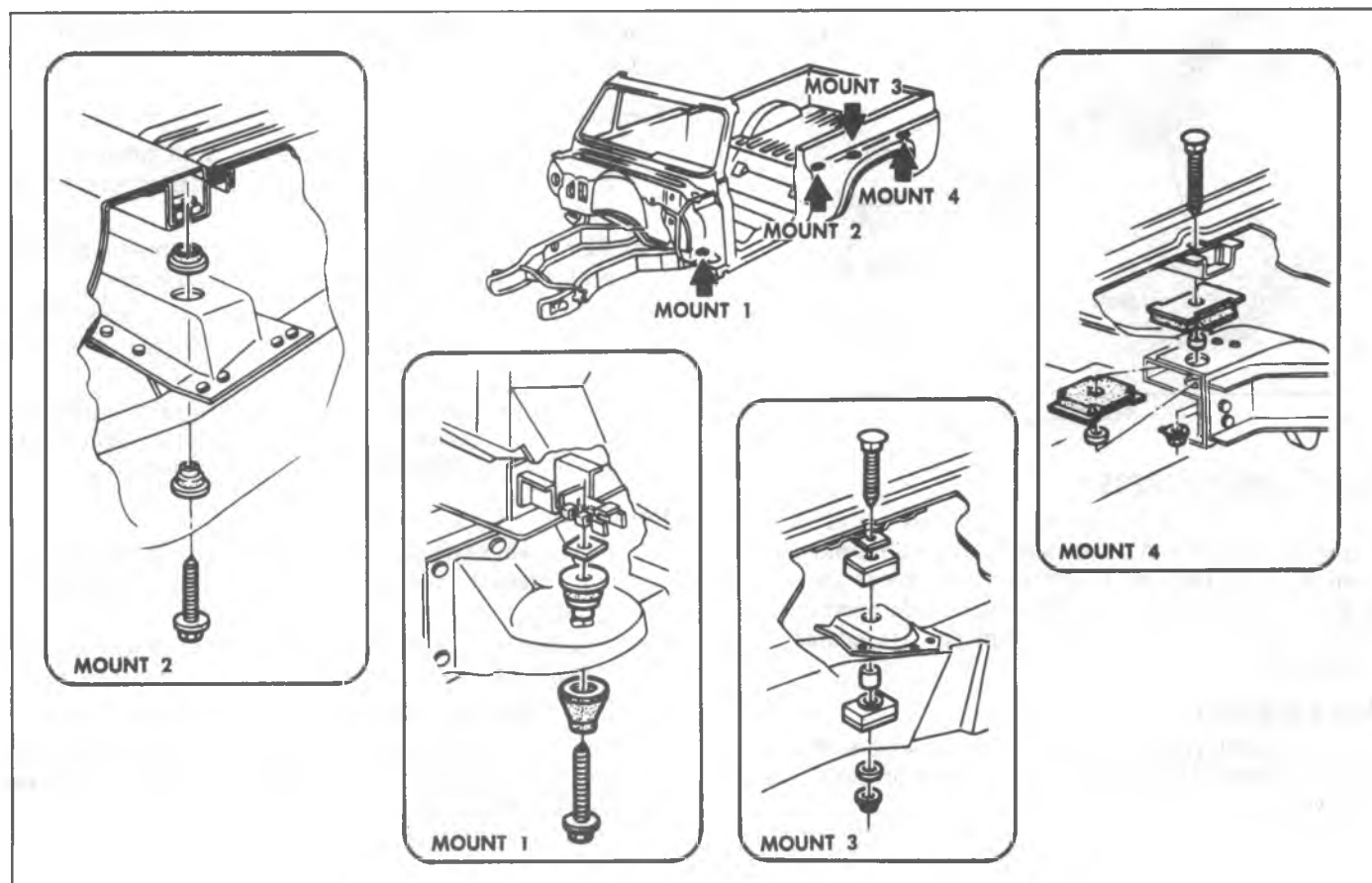


Fig. 2D-94--Body Mounting (Utility)

G MODELS

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FRONT END

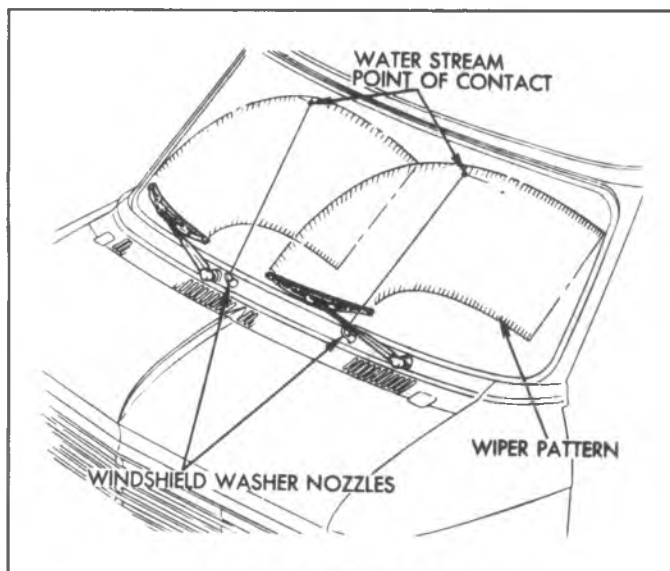


Fig. 2D-95--Wiper Pattern

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 2D-95.

WIPER ARM PIVOT SHAFTS AND LINK ROD-FIG. 2D-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.

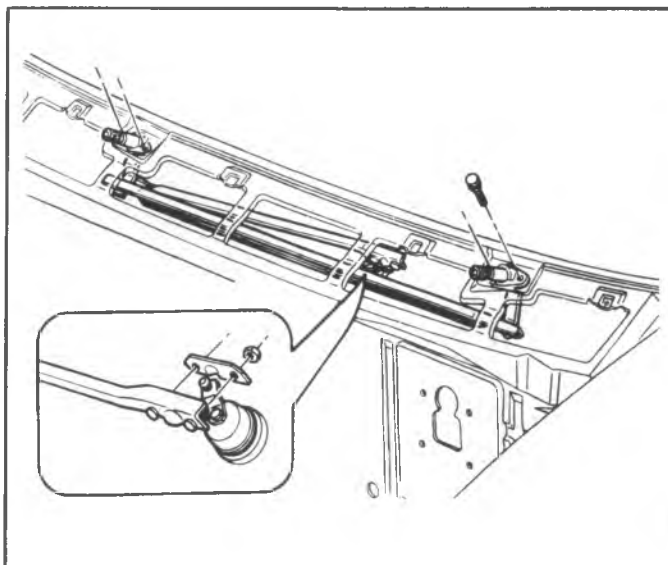


Fig. 2D-96--Windshield Wiper Linkage

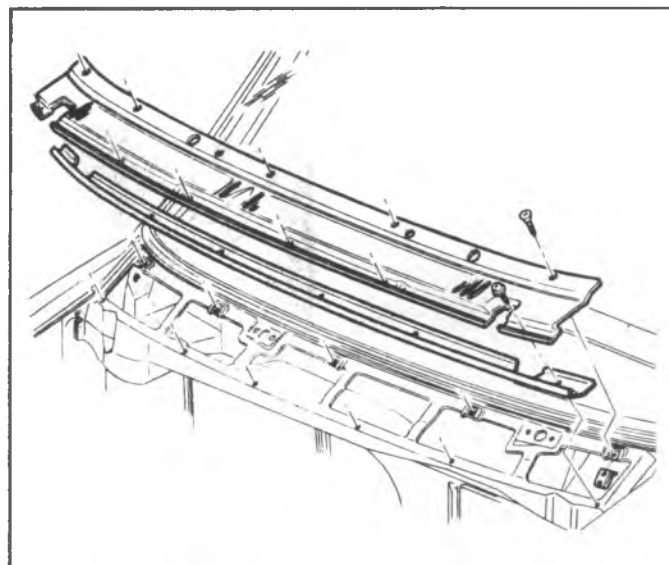


Fig. 2D-97--Cowl Ventilator Grille

COWL VENTILATOR GRILLE

Replacement

1. Remove windshield wiper arms.
2. Remove screws retaining grille, figure 2D-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 2D-98.
2. Remove valve assembly by depressing pins at top and bottom of valve.

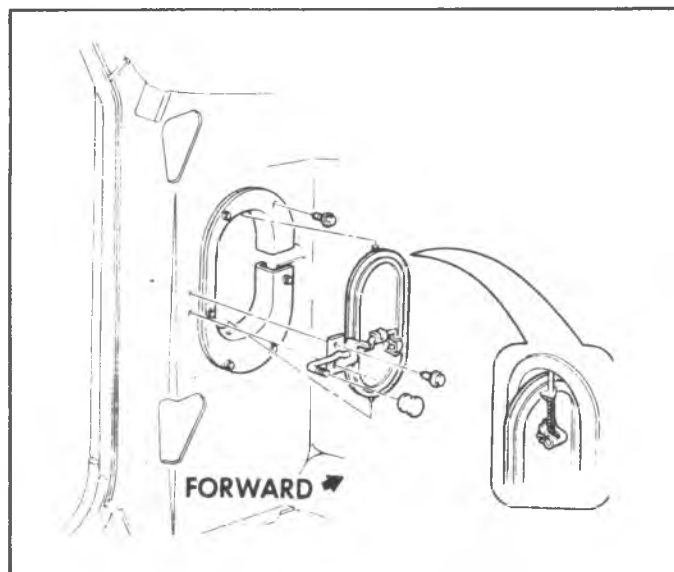


Fig. 2D-98--Side Cowl Ventilator

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. 2D-99).

Outside Rear View Mirrors

Outside rear view mirror installations are shown in figure 2D-100. Occasional tightening of mounting and assembly bolts and screws will sharply decrease occurrence of failure due to door slamming or road shock.

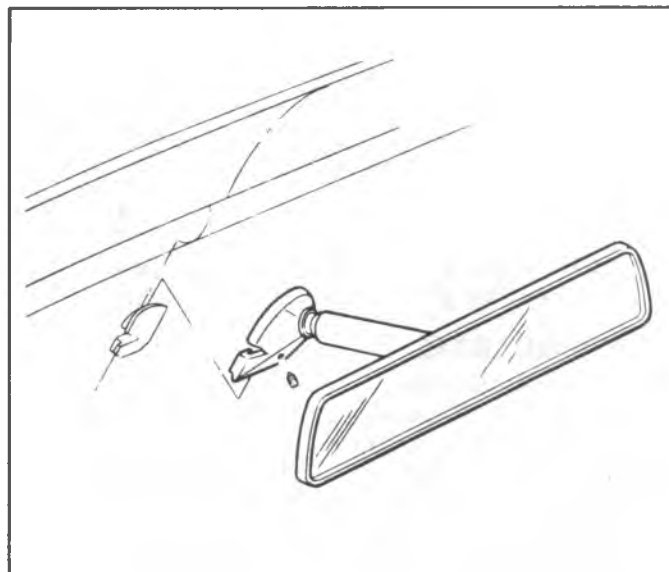


Fig. 2D-99--Inside Rear View Mirror

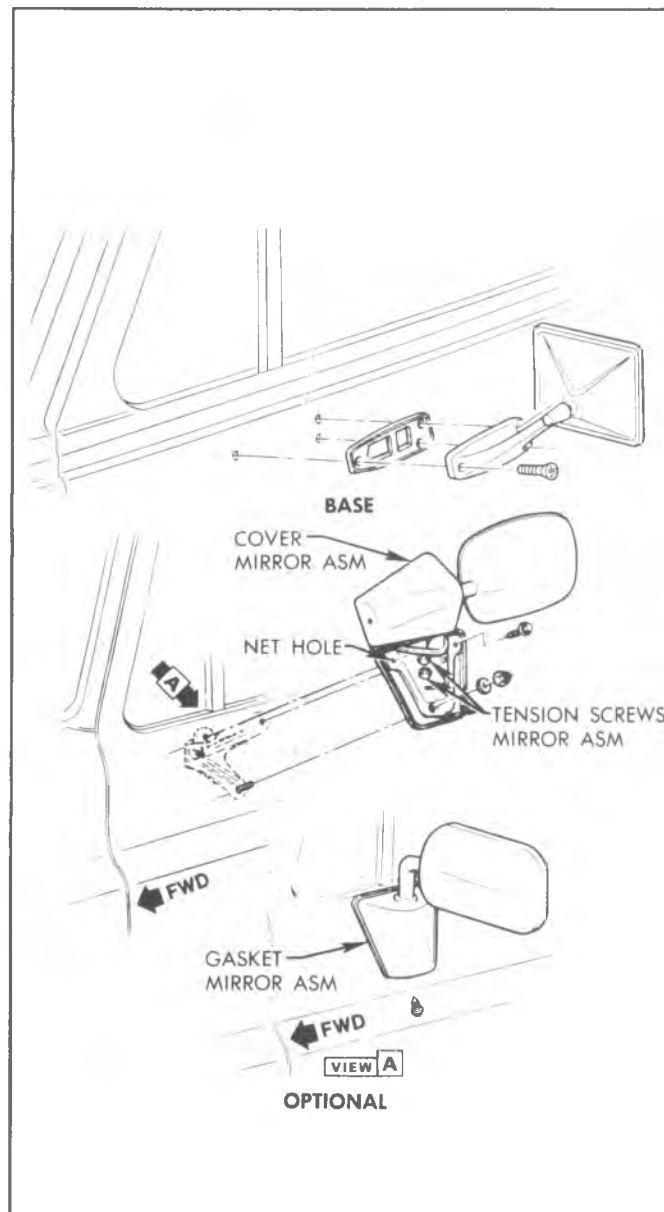


Fig. 2D-100--Outside Rear View Mirrors

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

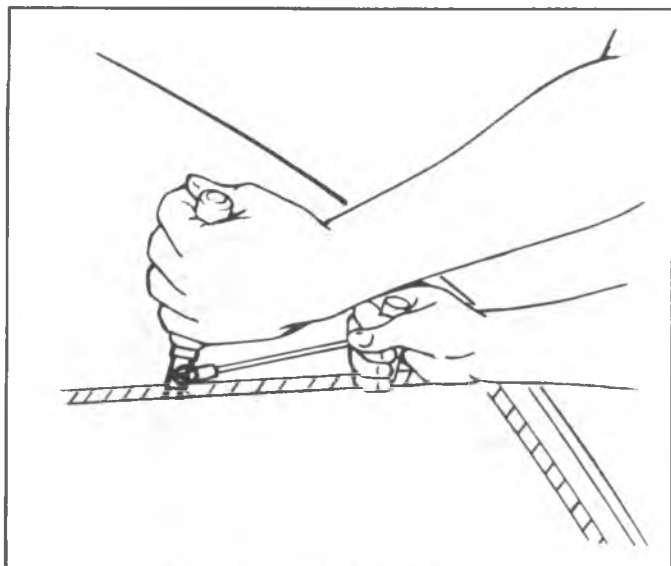


Fig. 2D-101 Knife Removal Method

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. 2D-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. 9631000 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. 9631000 (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 9631000) 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 refinishing 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. 2D-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. 2D-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. 9631000 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. 2D-102.
4. Apply the black glass primer in the urethane

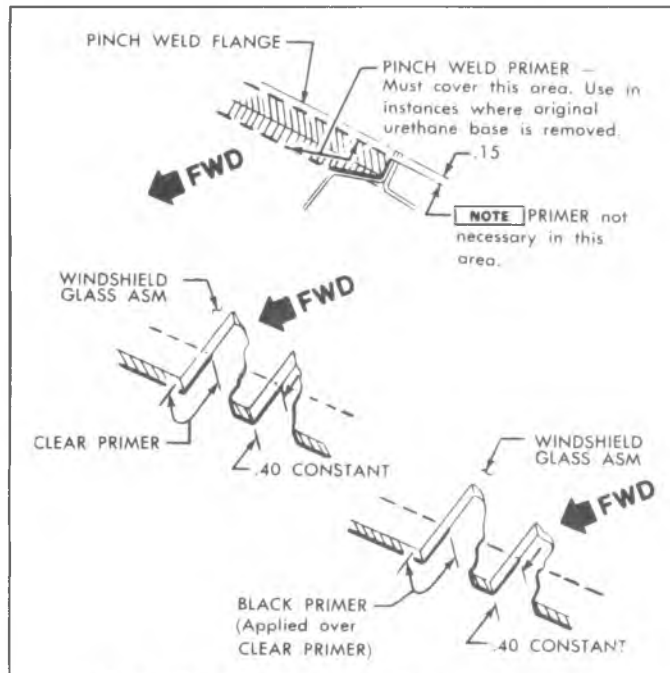


Fig. 2D-102 Windshield Installation Preparation

adhesive kit 9631000 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. 2D-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. 2D-104.
6. Cut the tip of the adhesive cartridge to make a small 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. 2D-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

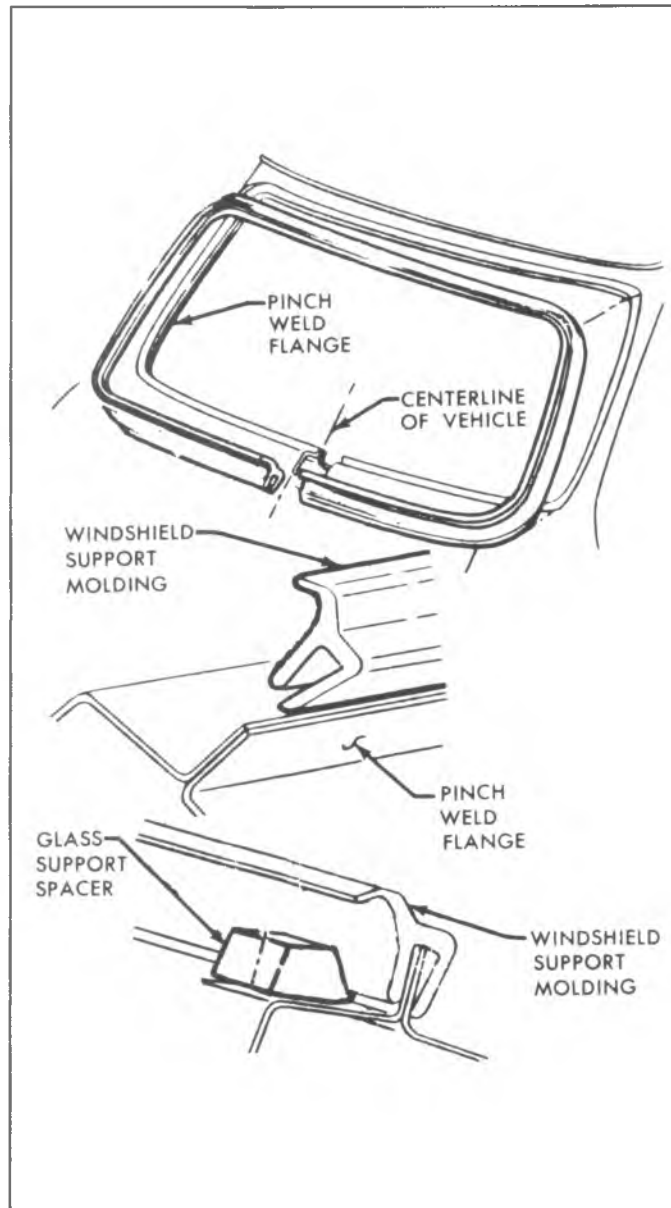


Fig. 2D-103 Support Molding Installation

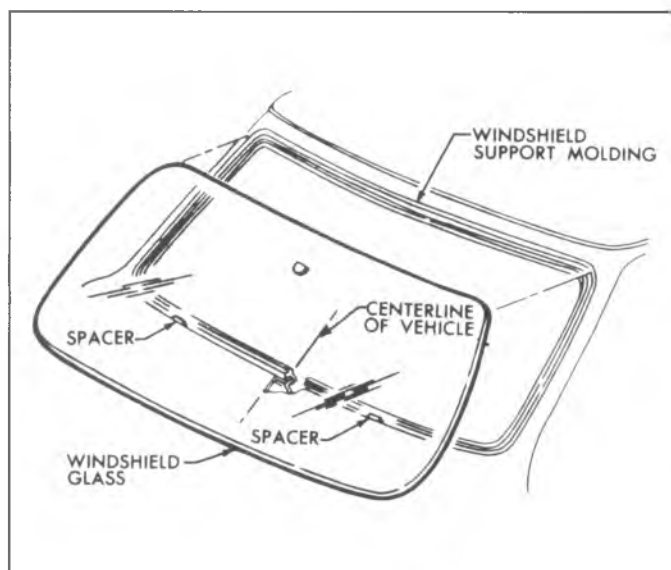


Fig. 2D-104 Windshield Installation

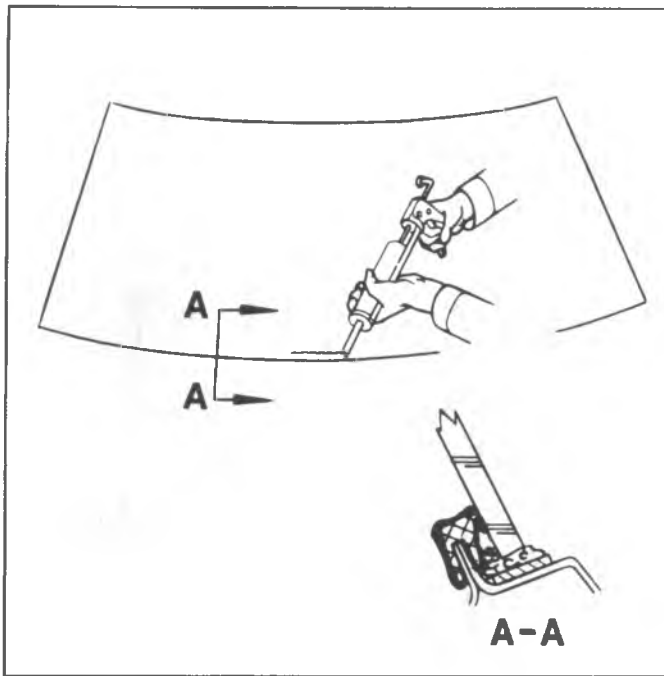


Fig. 2D-105 Adhesive Material Application

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. 2D-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, waterleaks 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 Fig. 2D-107.

1. Remove garnish molding if so equipped.
2. Remove the windshield support molding from the pinchweld. Pry up one end and pull the molding away from the pinchweld.
3. Identify cause and location of the leak. If the leak is due to a disruption in the urethane bond to the glass, the

leak can be repaired with addition urethane adhesive. Use the adhesive material furnished in Kit. No. 9631000 or Essex 551.2 or equivalent.

NOTICE: Water may be leaking through a pinchweld seam and not the urethane bead. In these instances, the entry point must be determined and correction made at that point in the pinchweld. (Voids in roof gutter sealer may also produce this type of leak.)

4. Clean up any dirt, foreign material or loose urethane in the area of 3 to 4 inches on either side of the point of the leak. Make sure the area is dry.
5. Prime this area with the primer found in the urethane adhesive Kit. No. 9631000 or Essex SCD 435-20 or equivalent. Thoroughly agitate the primer before using. Allow the primer to dry for five minutes.
6. Apply the urethane adhesive to the prepared area. Use a flat stick or other suitable flat bladed tool to work the adhesive material well into the leak point and onto the original material to obtain a water-tight seal.

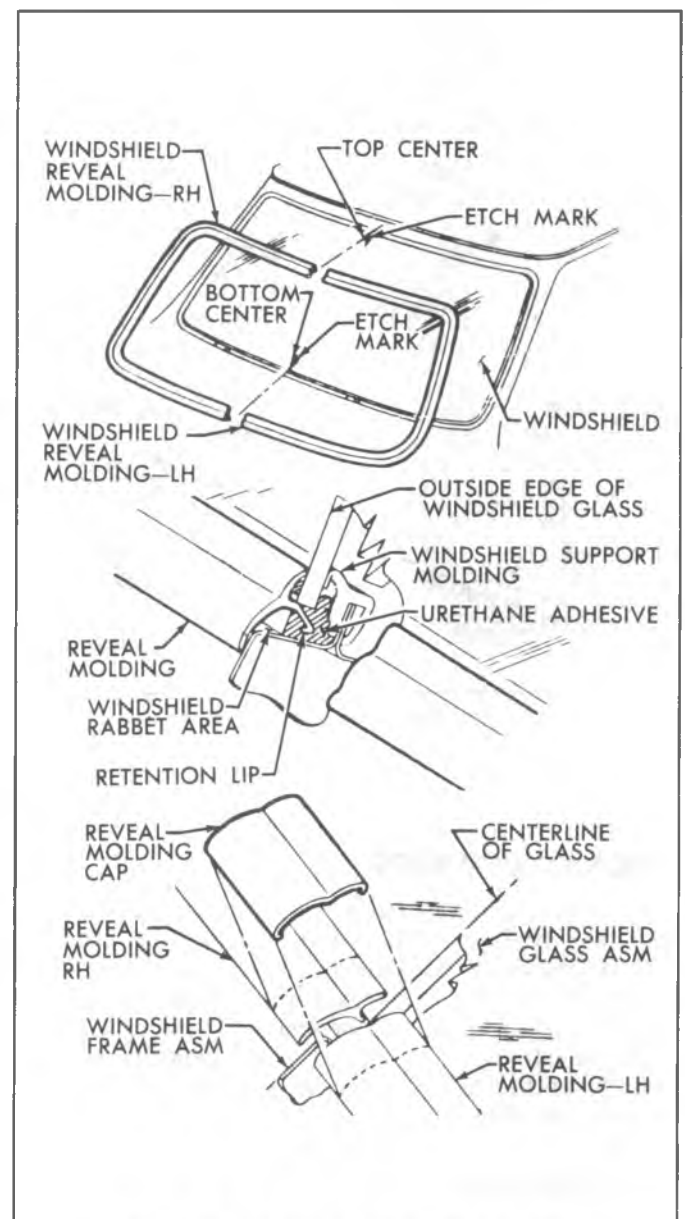


Fig. 2D-106 Reveal Molding Installation

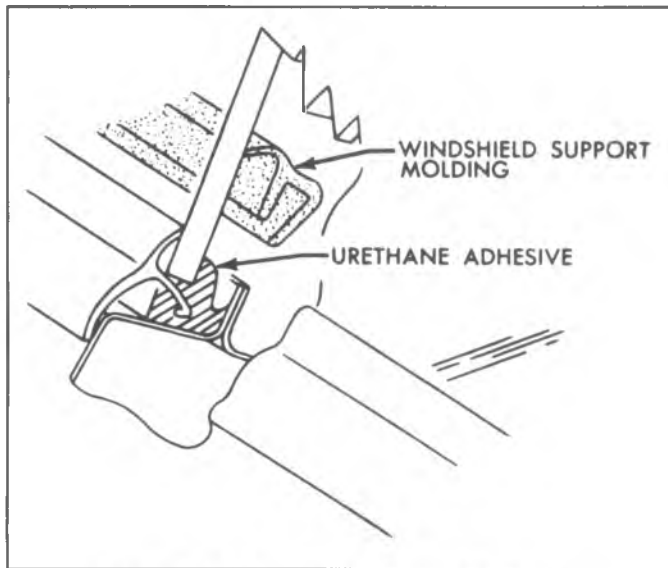


Fig. 2D-107--Support Molding and Adhesive

7. Using warm or hot water, leak test to assure that the leak has been corrected.

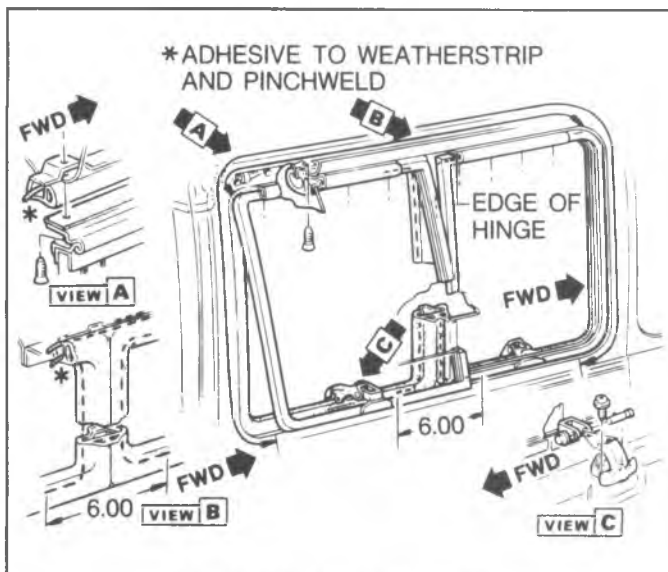


Fig. 2D-109--Swingout Window

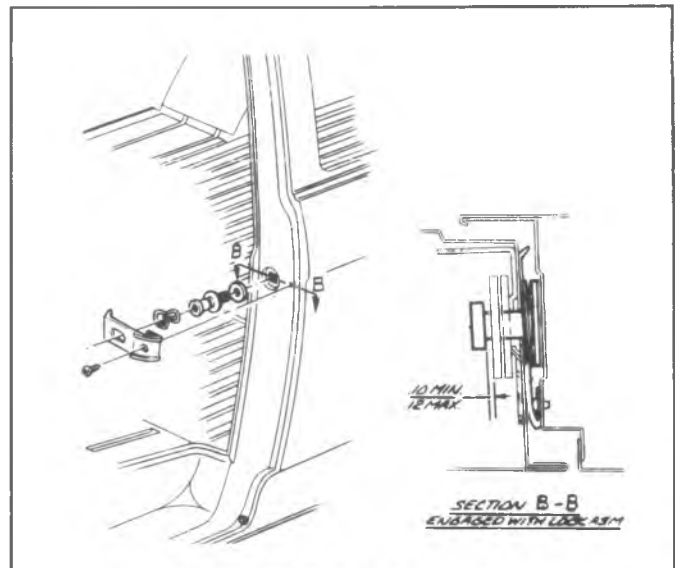


Fig. 2D-108--Body Window Glass

8. Install the support molding immediately.

SWINGOUT WINDOW

Replacement

1. Swing out the window. See figure 2D-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 2D-110, for typical adjustments.

Striker Bolt Adjustment

With the use of J-23457, shown in figure 2D-111, the striker bolt can be adjusted in any of three ways. See figure 2D-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.

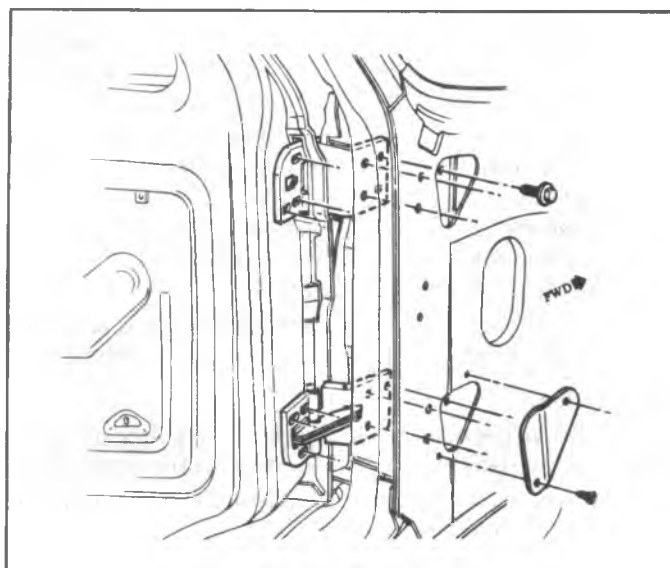


Fig. 2D-110--Door Hinge

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 2D-110.

Installation

1. Install hinge to door and body. Snug bolts.
2. Remove door supports.

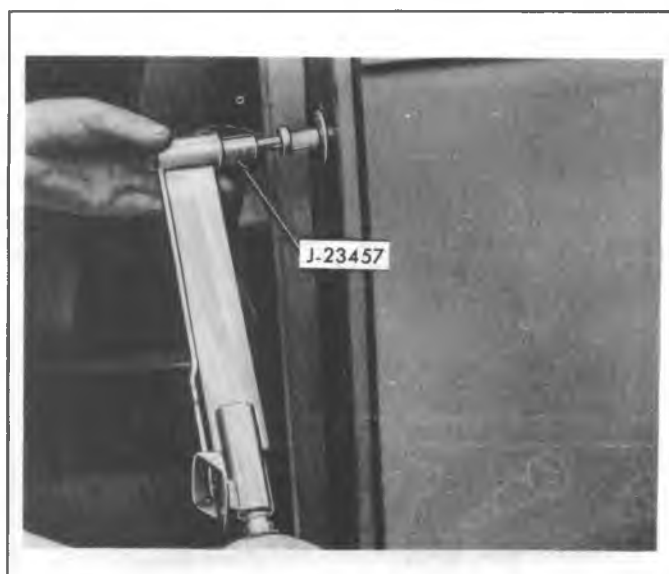


Fig. 2D-111--Loosening Striker Bolt

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.

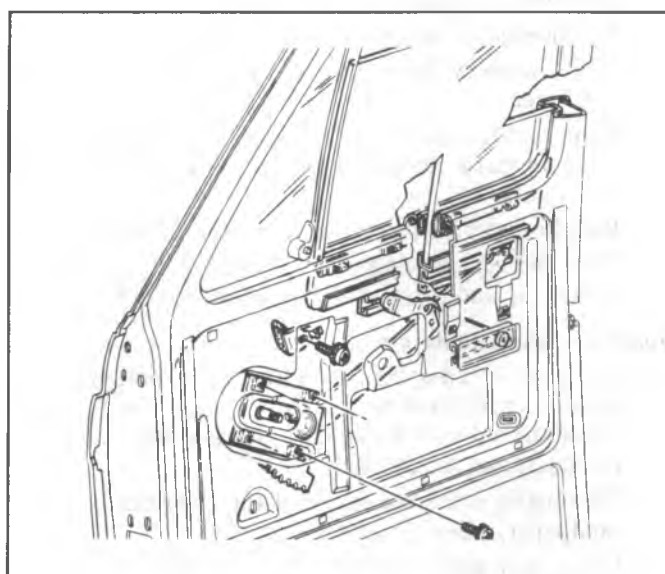


Fig. 2D-112--Typical Striker Bolt Adjustment

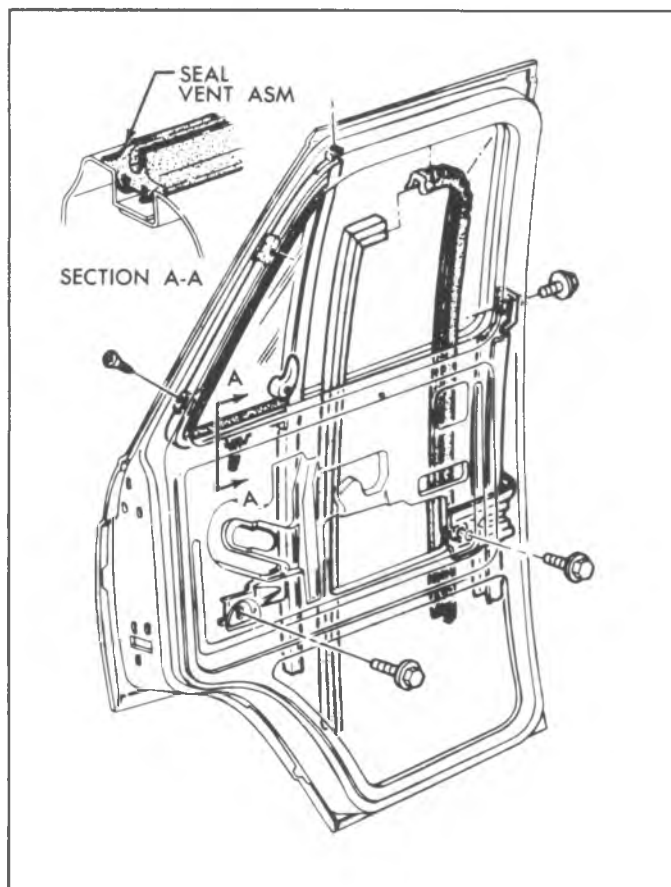


Fig. 2D-113--Channel, Run and Ventilator Assembly

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 2D-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 2D-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 2D-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. 2D-114--Removing Ventilator

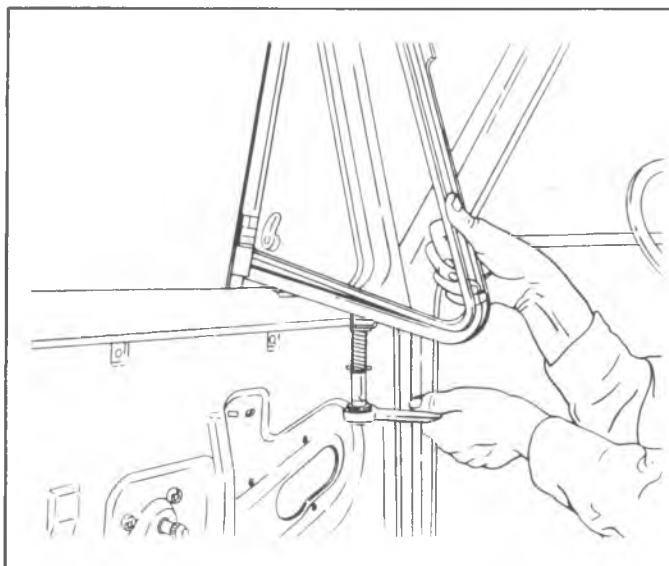


Fig. 2D-115--Adjusting Ventilator Tension

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 2D-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. 2D-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. 2D-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 2D-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.

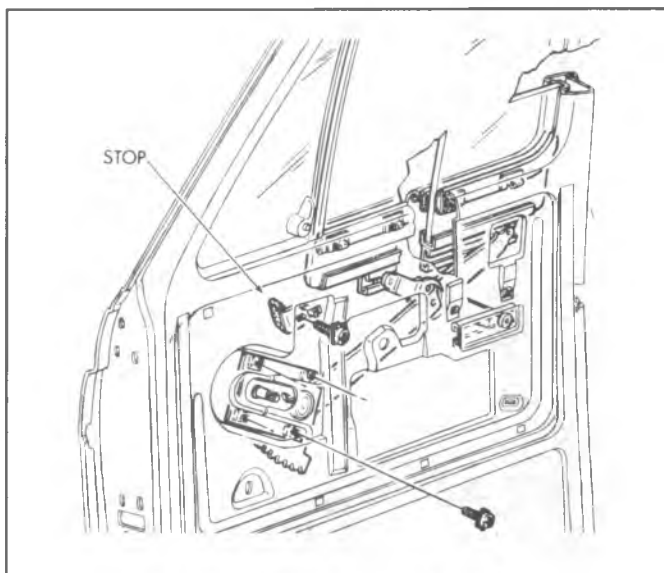


Fig. 2D-116--Window and Regulator

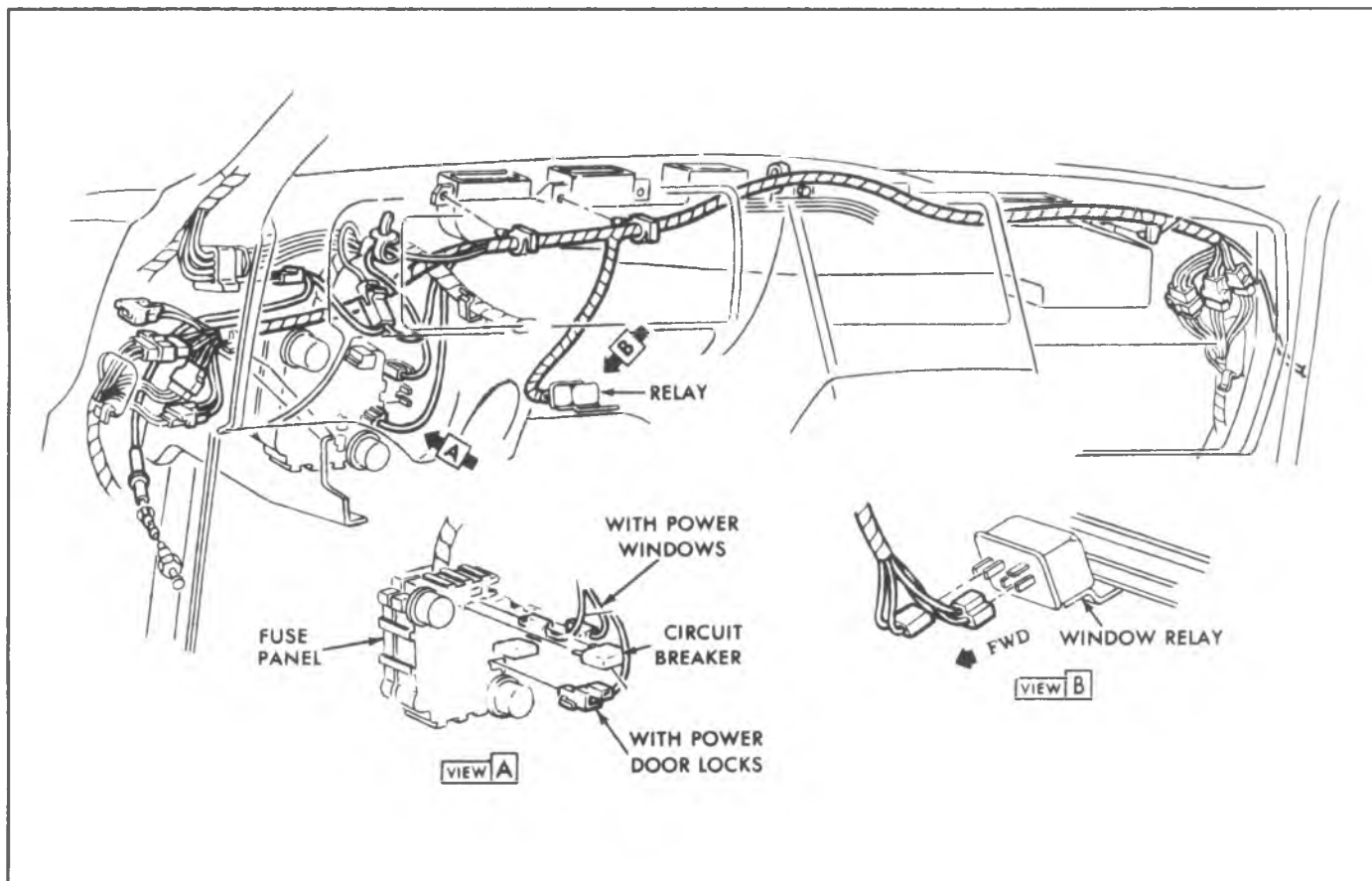


Fig. 2D-117--Power Window and Power Door Lock Wiring

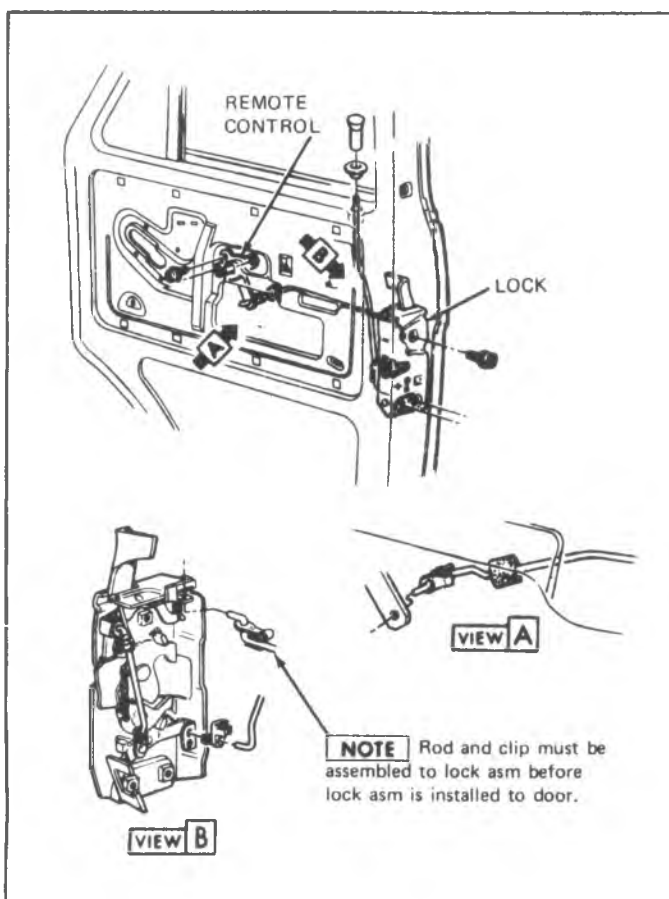


Fig. 2D-118--Lock and Remote Control Assembly

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 2D-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.

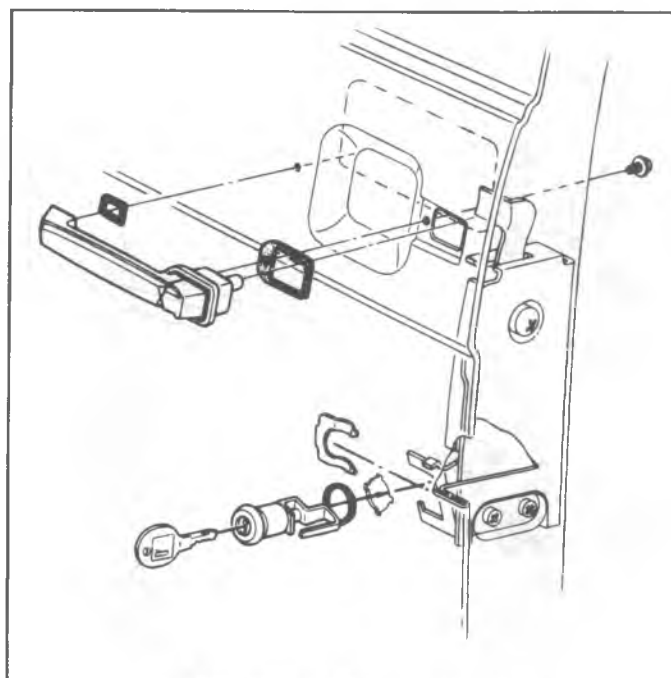


Fig. 2D-119--Lock Cylinder Assembly

REMOTE CONTROL AND CONNECTING

ROD--Fig. 2D-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. 2D-120). See Figure 2D-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. 2D-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.

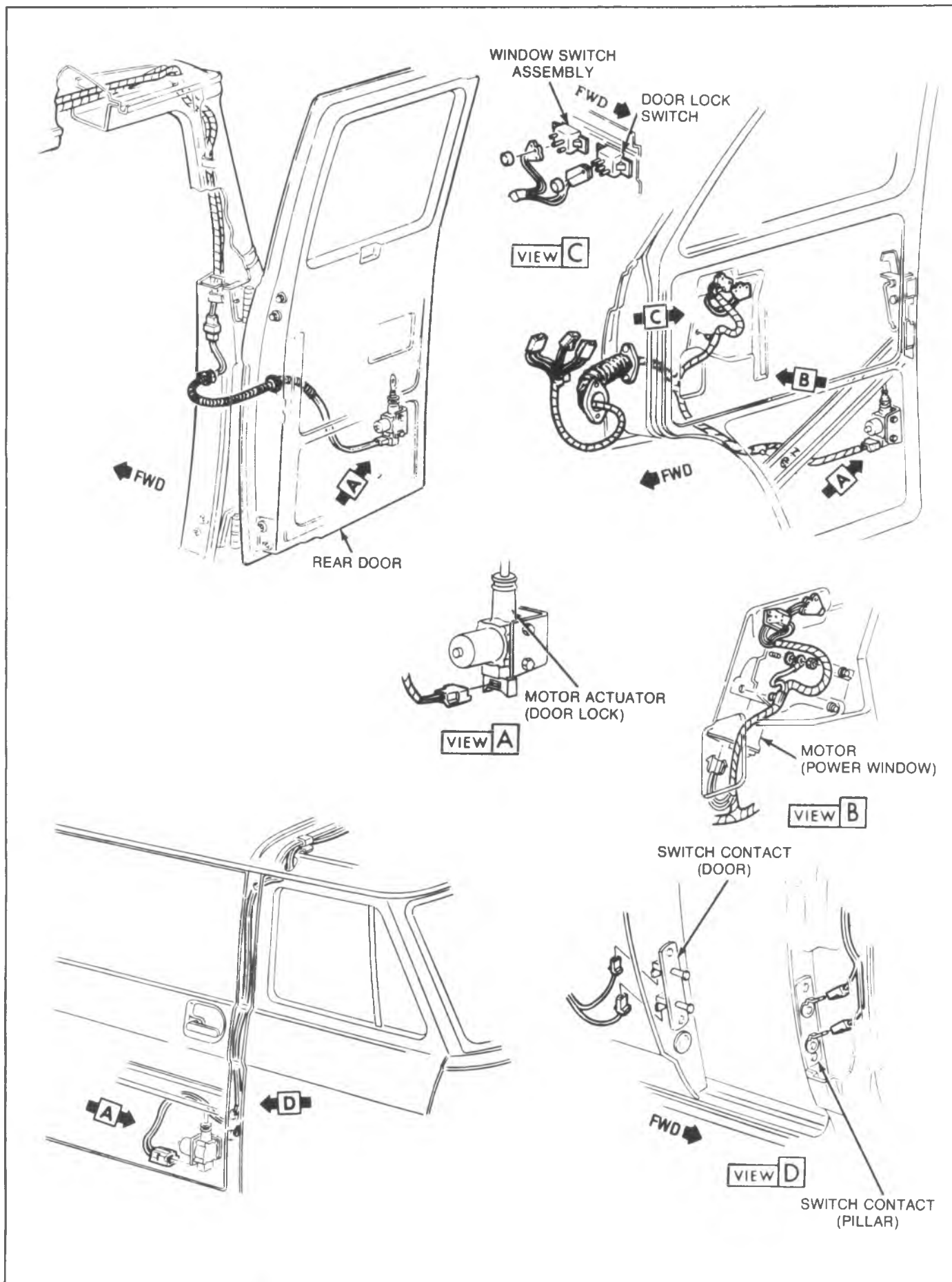


Fig. 2D-120—Power Door Lock Actuators, Power Window Motor, Wiring and Switches

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 2D-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 2D-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 2D-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 2D-121, and by a slotted upper bracket, view B of figure 2D-121. Rear in and out adjustment is provided by adjusting the rear latch striker, view E of figure 2D-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 2D-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 2D-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 2D-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 2D-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

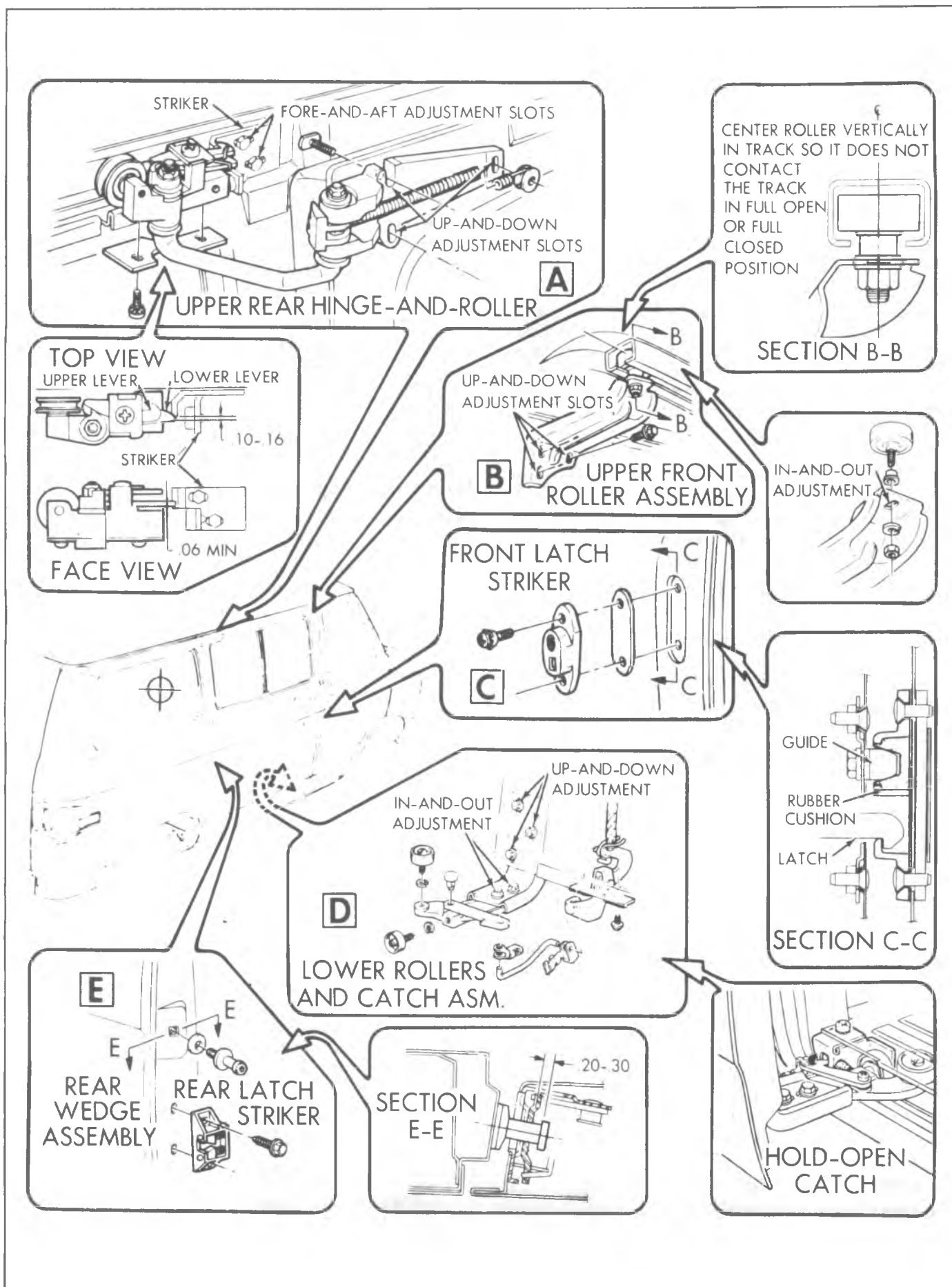


Fig. 2D-121--Sliding Side Door Adjustment Locations

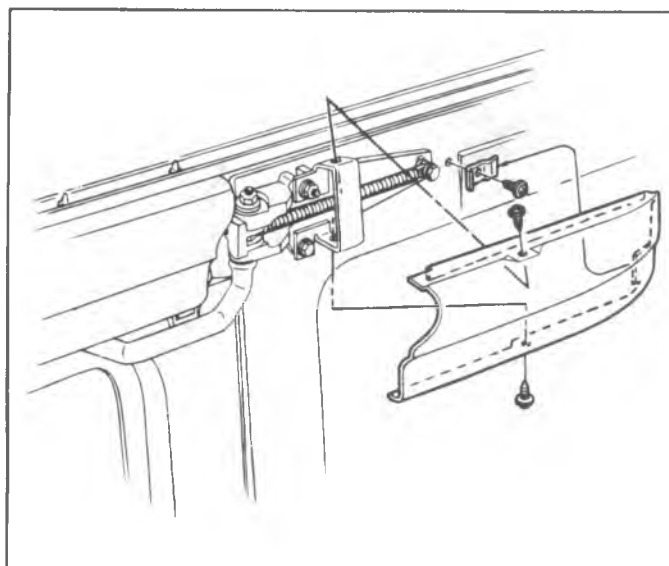


Fig. 2D-122--Hinge Cover

view A of figure 2D-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 2D-123. The catch engages a striker installed at the rear of the lower roller channel, view D of figure 2D-121.

1. Loosen the screws retaining the catch rod bracket to bottom of door.



Fig. 2D-123--Hold-Open Catch

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 2D-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 2D-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.

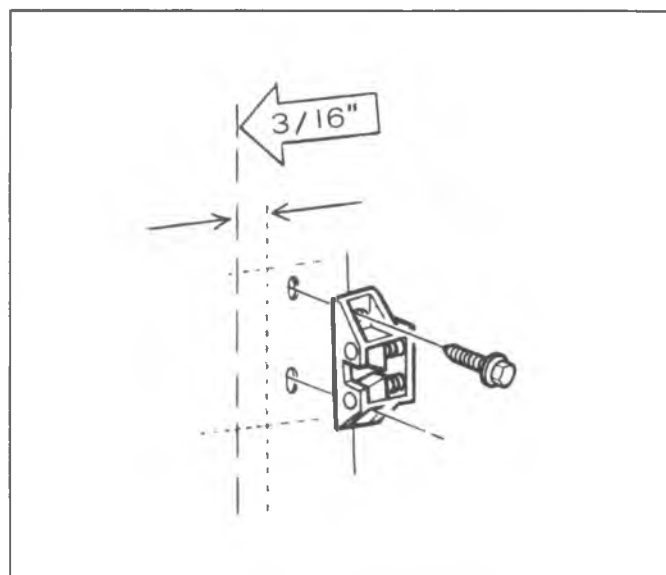


Fig. 2D-124--Adjusting the Rear Wedge Assembly

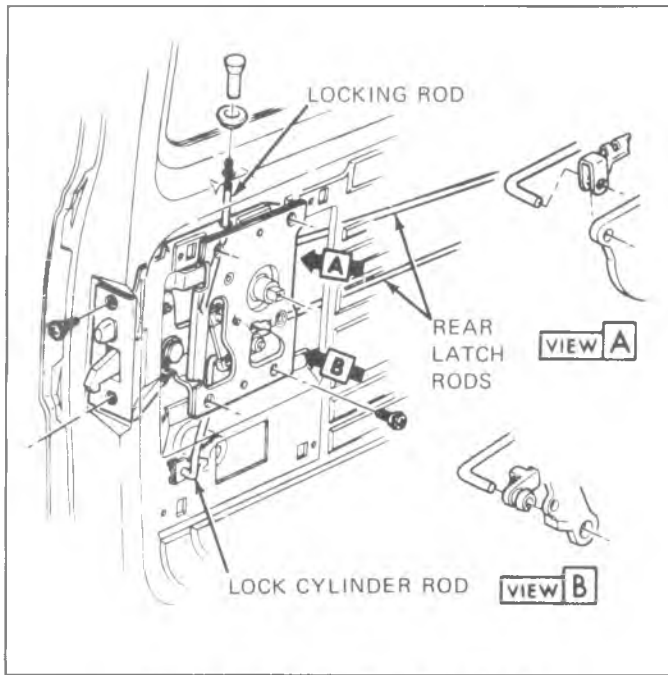


Fig. 2D-125--Sliding Door Front Latch

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 2D-125.
4. Remove rear latch attaching screws. See figure 2D-126.
5. Slide rear latch toward front of door until rod clips become exposed. Disconnect rod clips and remove latch from door.

Installation

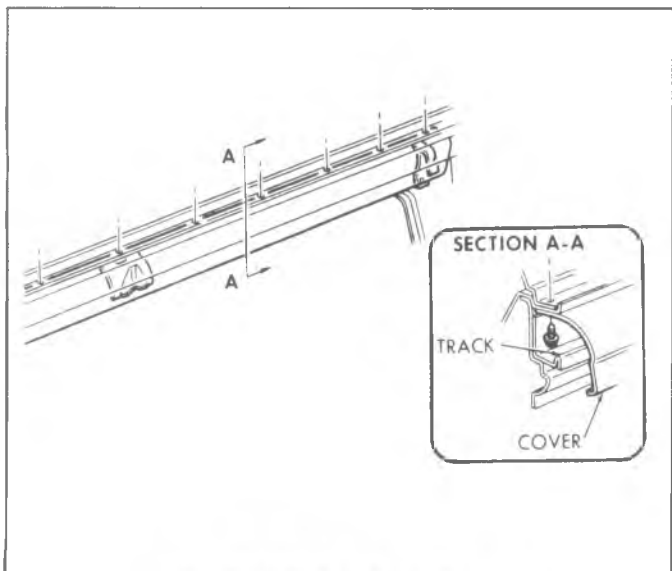


Fig. 2D-127--Rear Track Cover

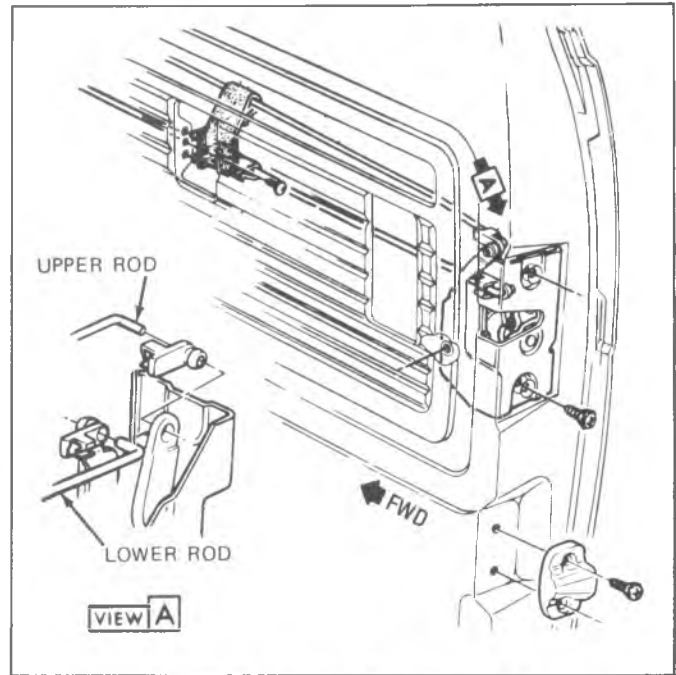


Fig. 2D-126--Sliding Door Rear Latch

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 2D-122 and 2D-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 2D-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 2D-121. The rear striker can be removed with J-23457 as in figure 2D-111, and the front striker can be removed by removing attaching screws. Refer to "Adjustments" when reinstalling.

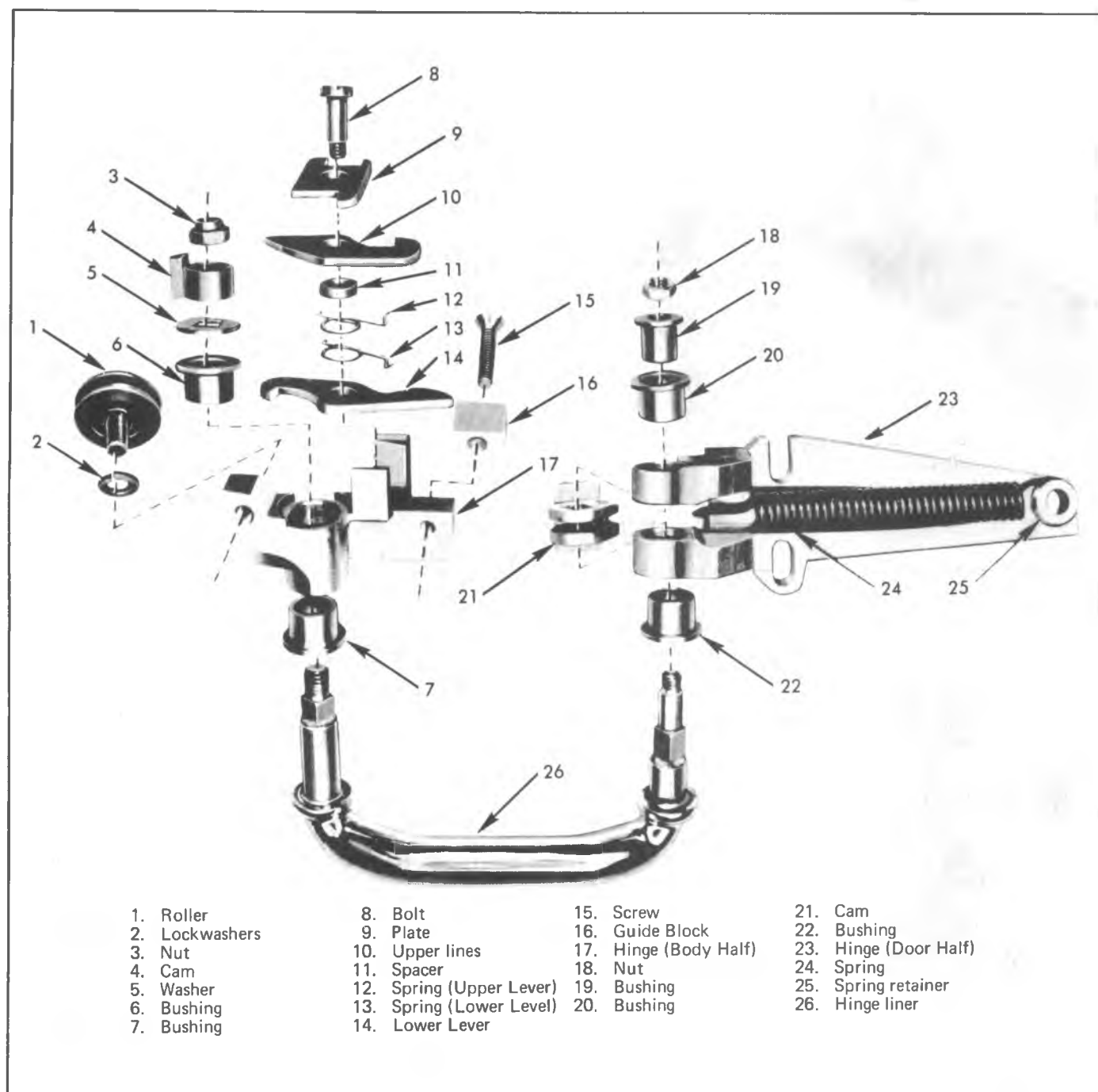


Fig. 2D-128--Upper Rear Hinge Components



Fig. 2D-129--Checking Assembly of Hinge

REAR DOORS

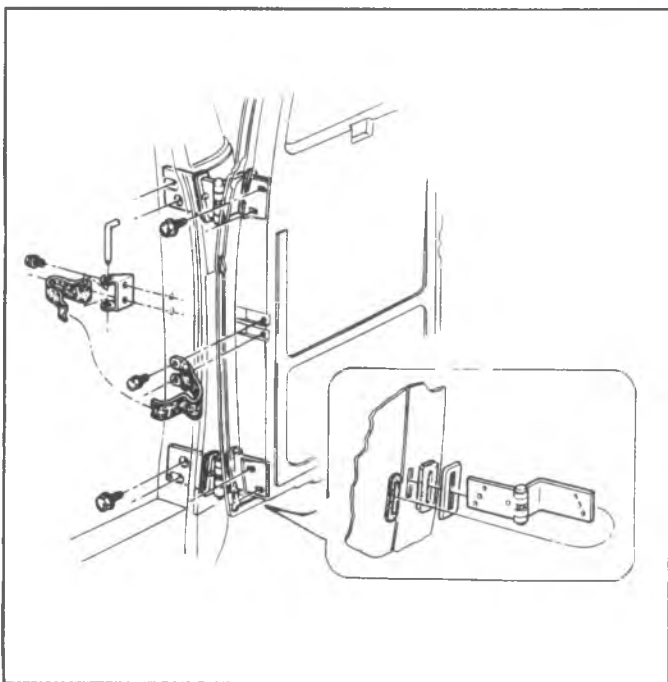


Fig. 2D-130--Rear Door Hinges and Strap

REAR DOOR HINGE STRAP

Replacement

1. Remove strap release pin. See figure 2D-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 removing retaining clips. See figure 2D-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.

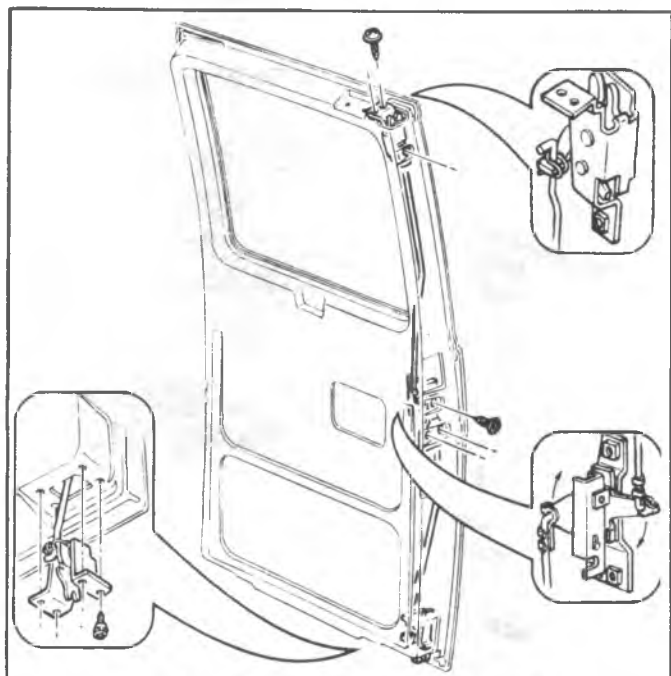


Fig. 2D-131--Remote Control and Latch

REAR DOOR UPPER OR LOWER LATCHES AND/OR LATCH RODS

Removal

1. Remove trim panel.
2. Disengage rod from remote control assembly. See figure 2D-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 2D-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.

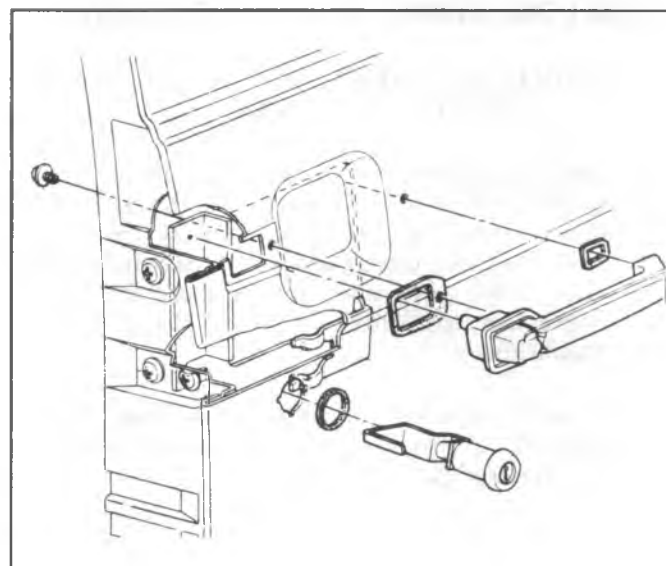


Fig. 2D-132--Outside Handle and Lock Cylinder

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 regarding Rear Door Striker fasteners.

1. Adjust striker by adding or deleting shims as necessary to obtain dimension as shown in figure 2D-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 2D-133.

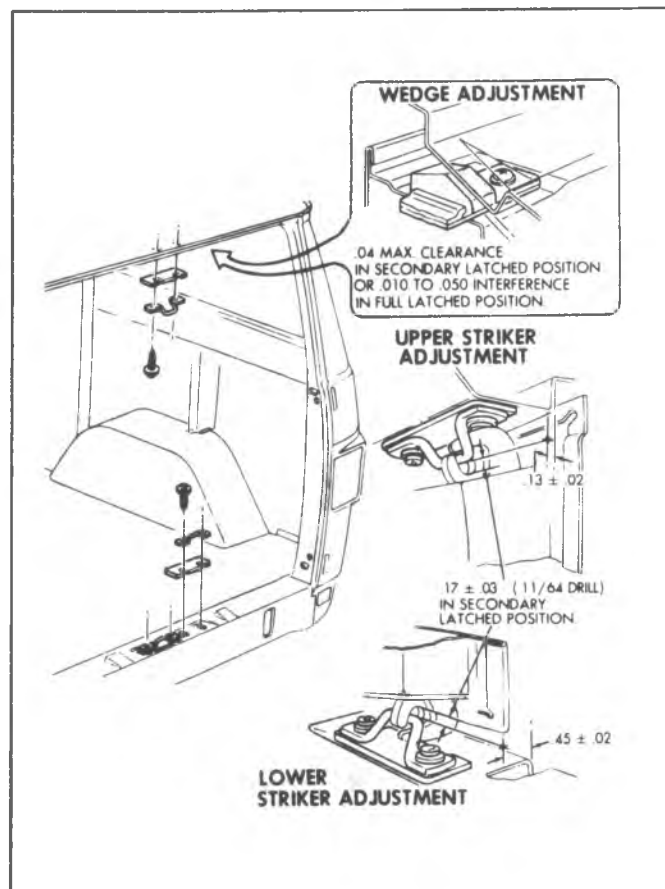


Fig. 2D-133--Rear Door Striker and Wedge Adjustment

SEATS

DRIVERS SEAT

Seat Adjuster

Replacement

1. Remove seat by removing nuts securing seat adjuster to seat riser.
2. Remove adjuster from seat. See figure 2D-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 2D-135.

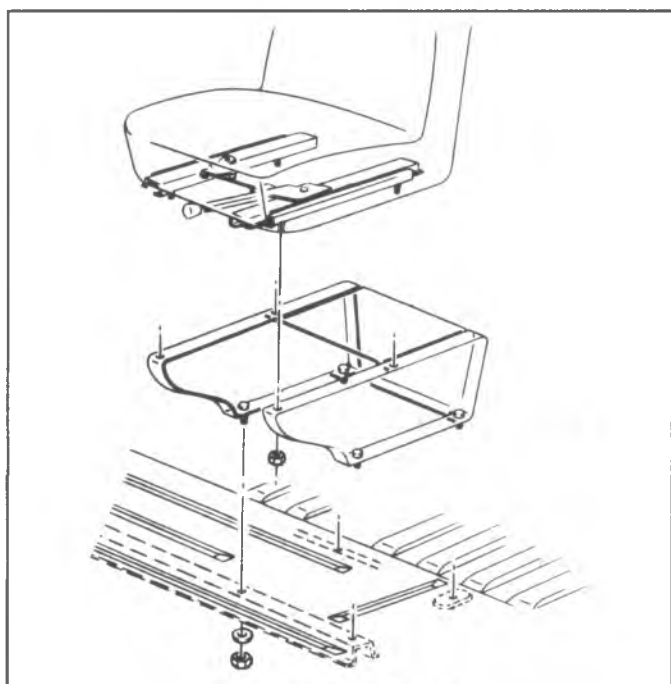


Fig. 2D-134--Driver's Seat

NOTICE: See NOTICE on page 1 of this section regarding fasteners used on seats and seat belts.

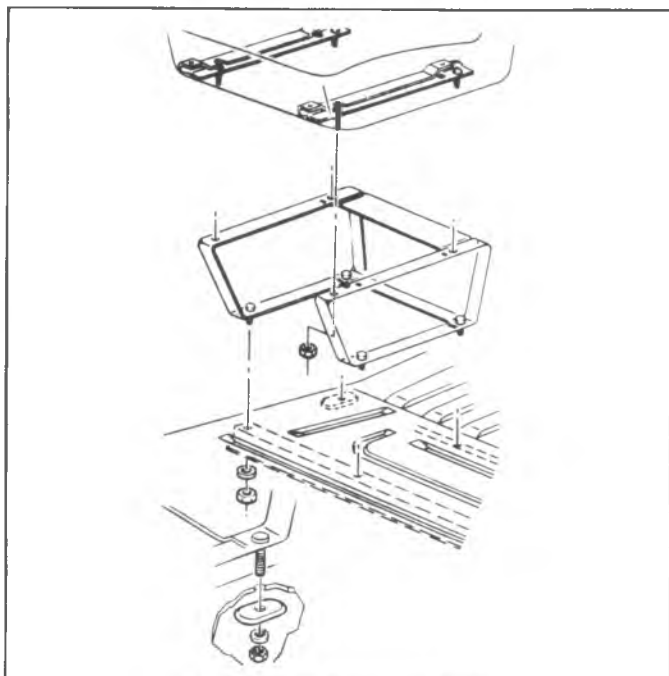


Fig. 2D-135-Passenger Seat

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 2D-137 for swivel Bucket Seat Assembly installation.

ROOF VENT - G MODELS

Roof vent installation is illustrated in Figure 2D-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 2D-139 through 2D-141 and select the appropriate illustration for removing and installing lap belts.

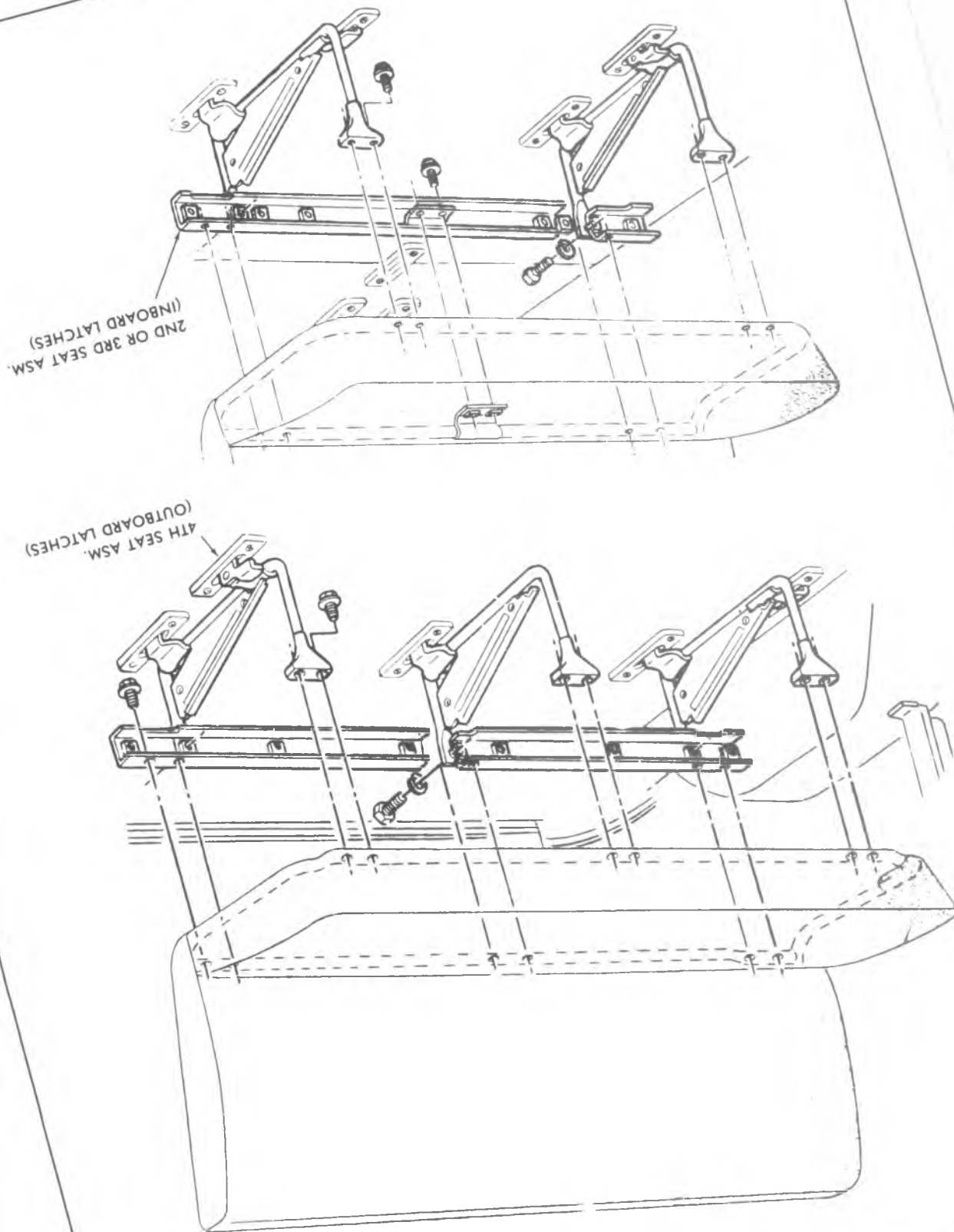
DECAL APPLIQUE PROCEDURE

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. 2D-136-Quick Release Seat Assembly



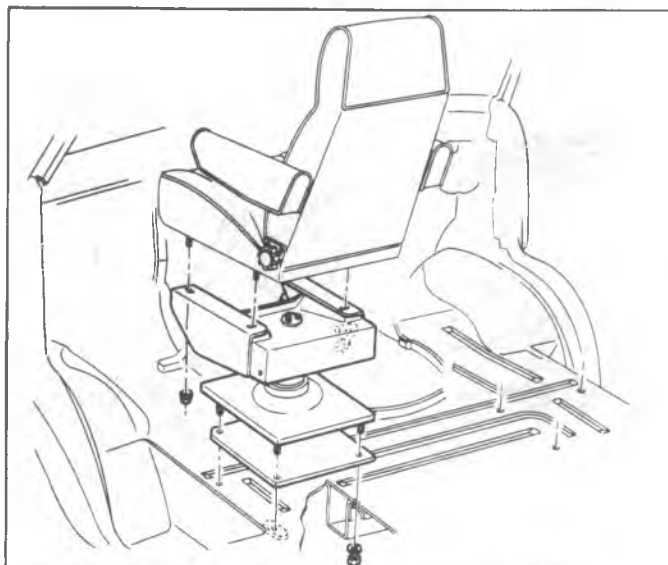


Fig. 2D-137--Swivel Bucket Seat Assembly - G Series

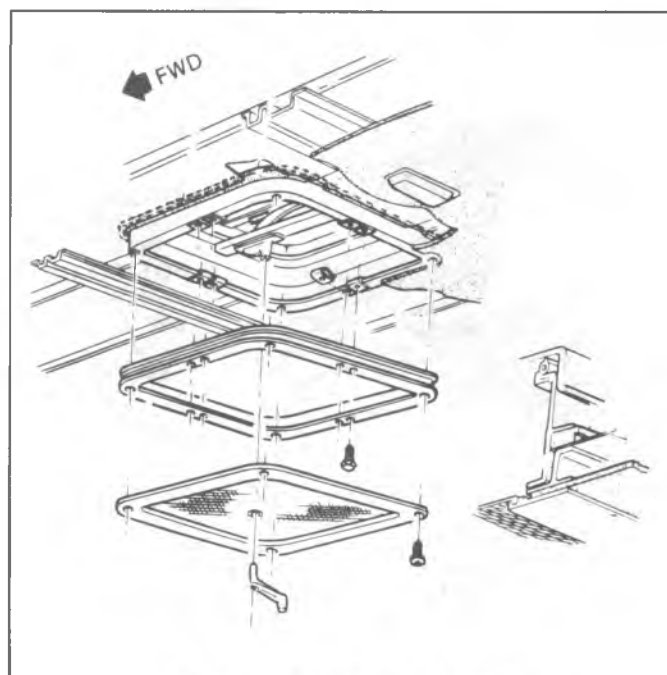


Fig. 2D-138--Roof Vent - G Series

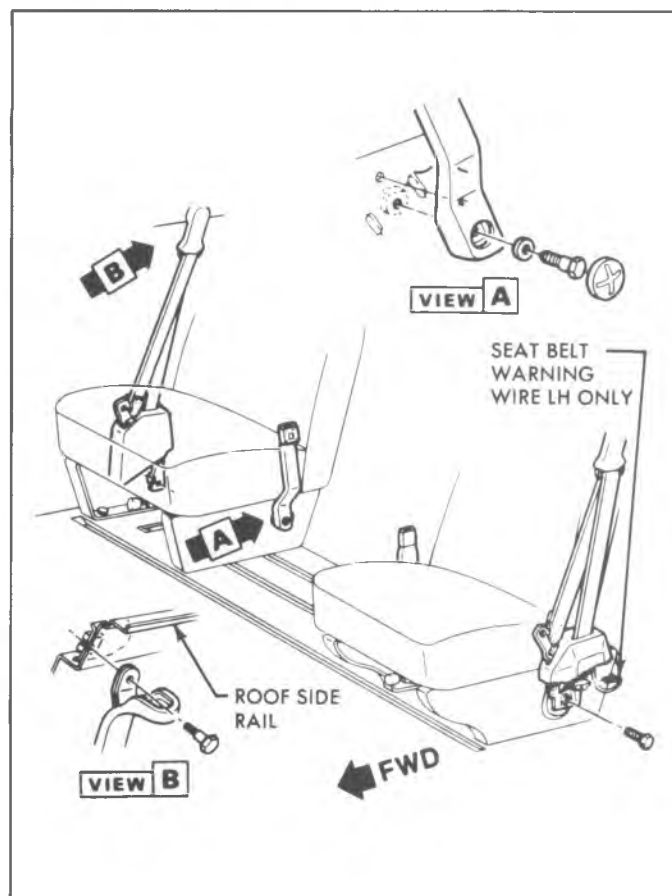


Fig. 2D-139--Front Seat Belt Installation

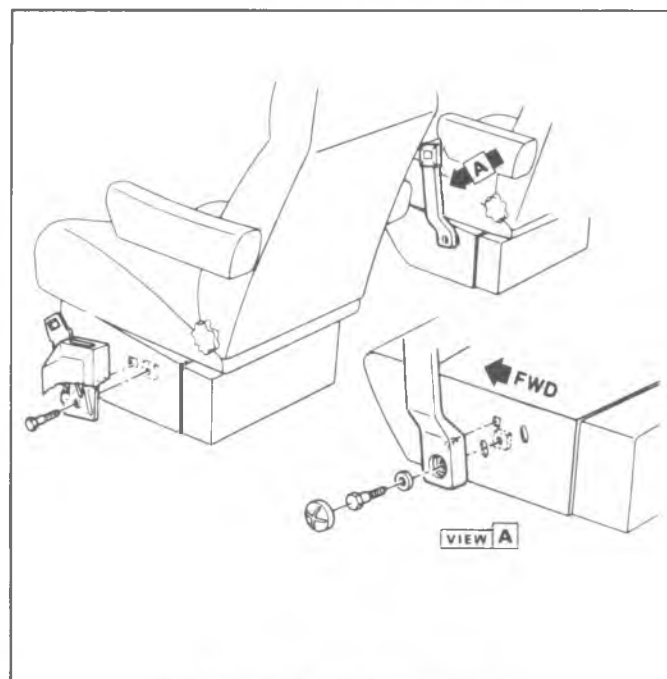


Fig. 2D-140--Seat Belt Swivel Bucket

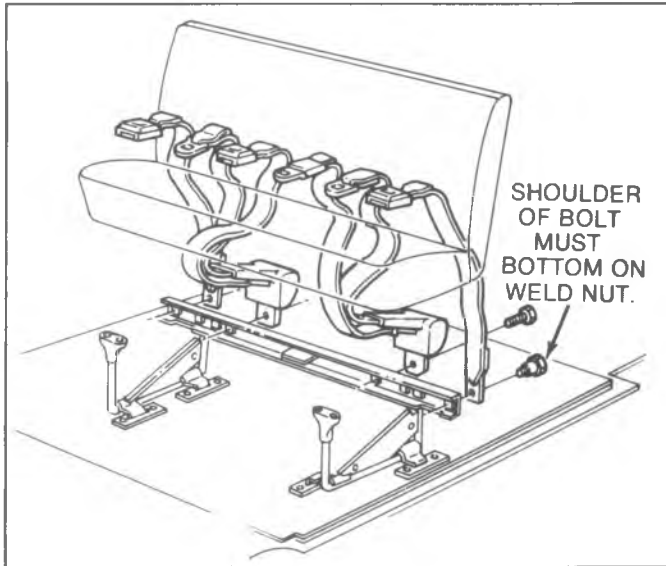


Fig. 2D-141--2nd and 3rd Seat Lap Belt Installation

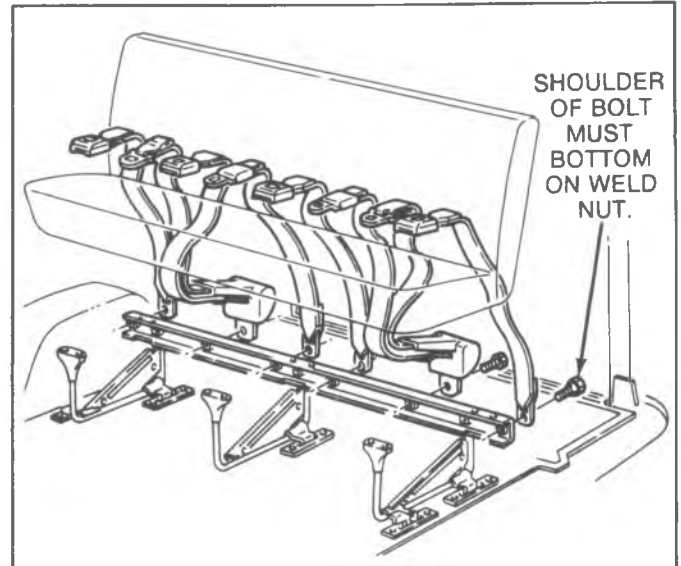


Fig. 2D-142--4th Seat Lap Belt Installation

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

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

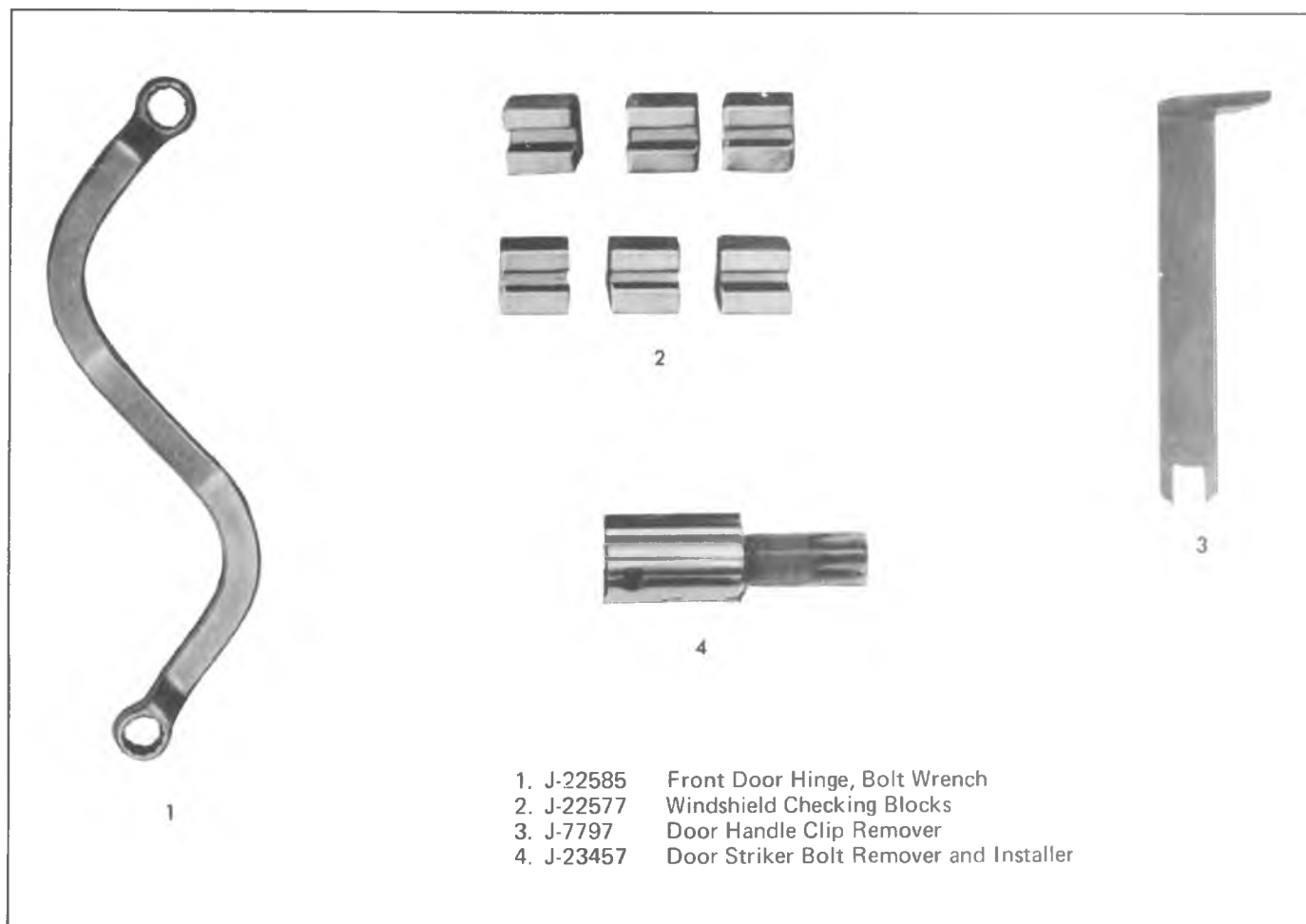
SLIDING SIDE DOOR

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

SPECIAL TOOLS



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.

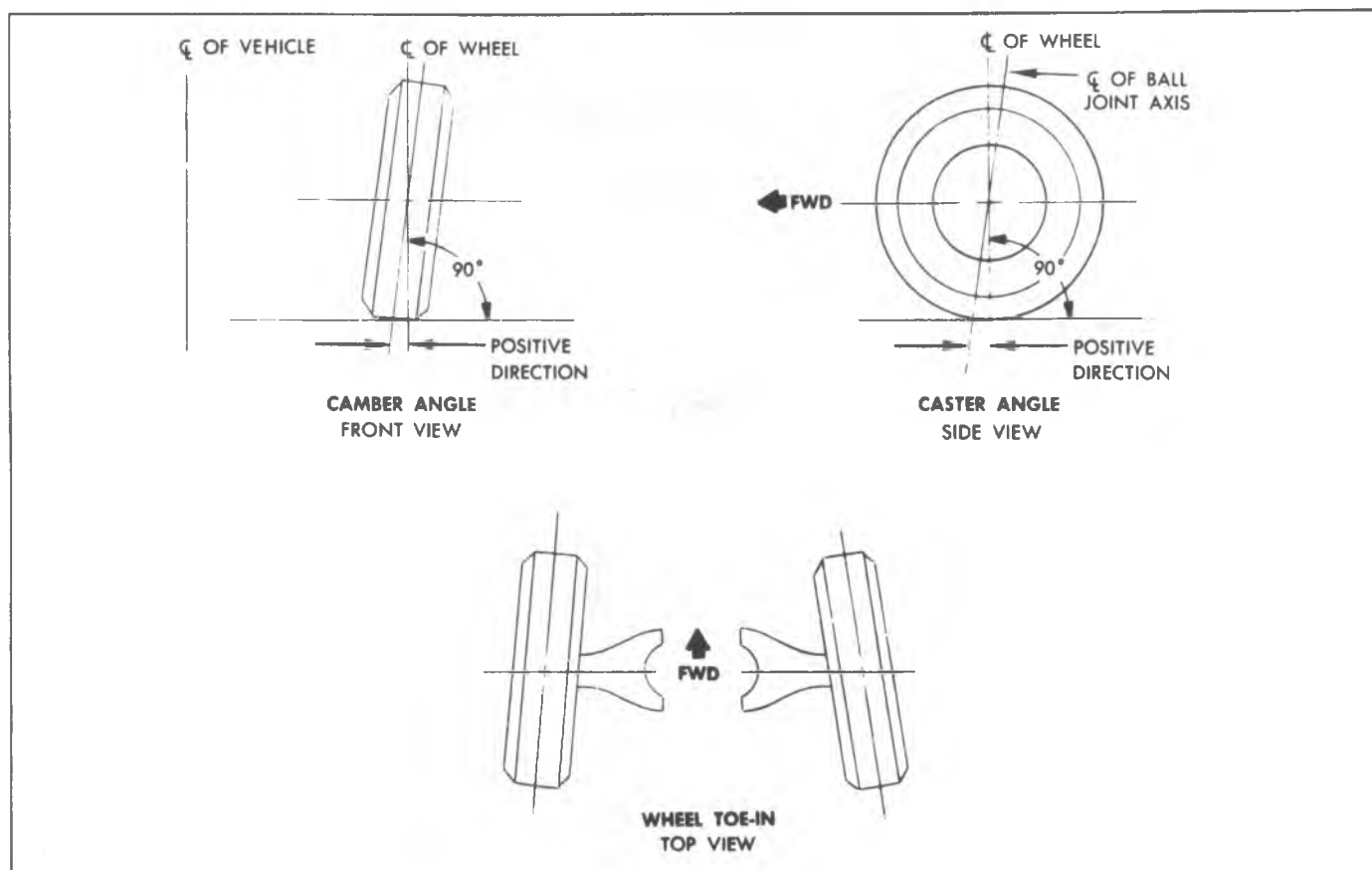


Fig. 3A-1--Caster - Camber - Toe-In

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.

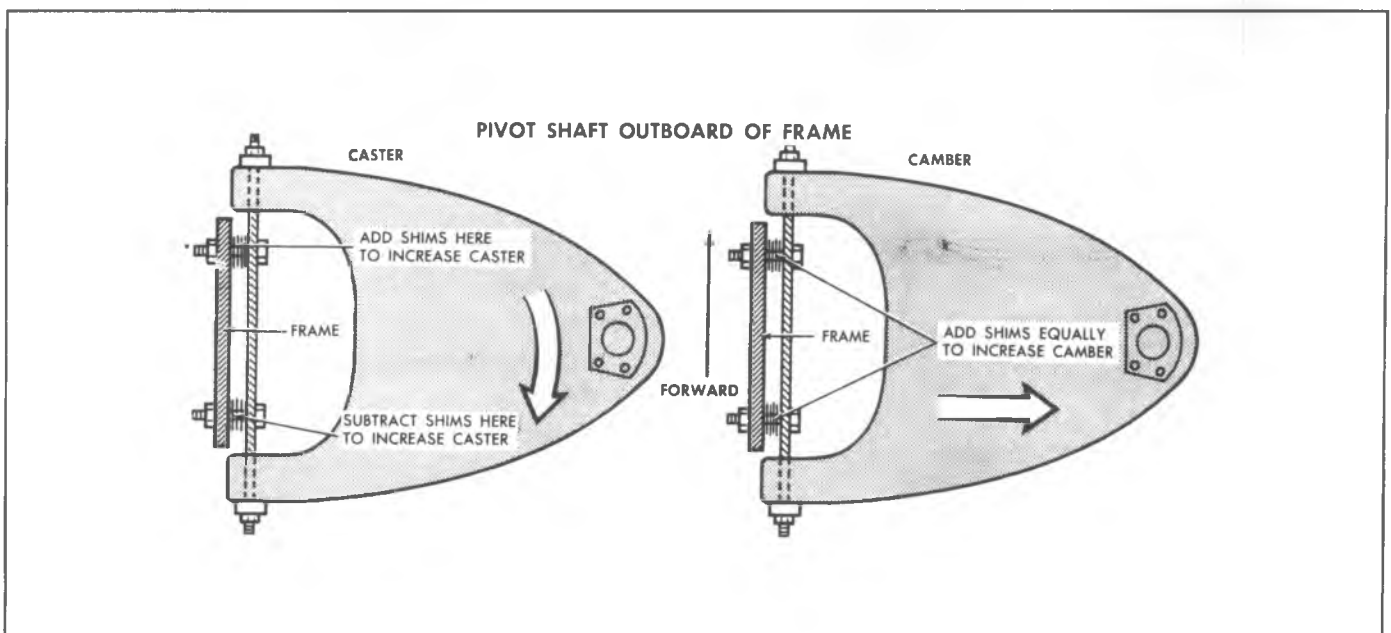


Fig. 3A-2--Caster - Camber Adjustment

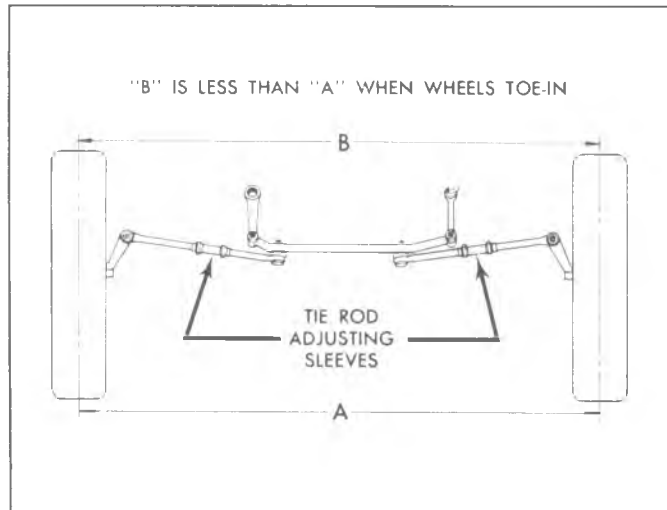


Fig. 3A-3--Toe-In Adjustment

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.

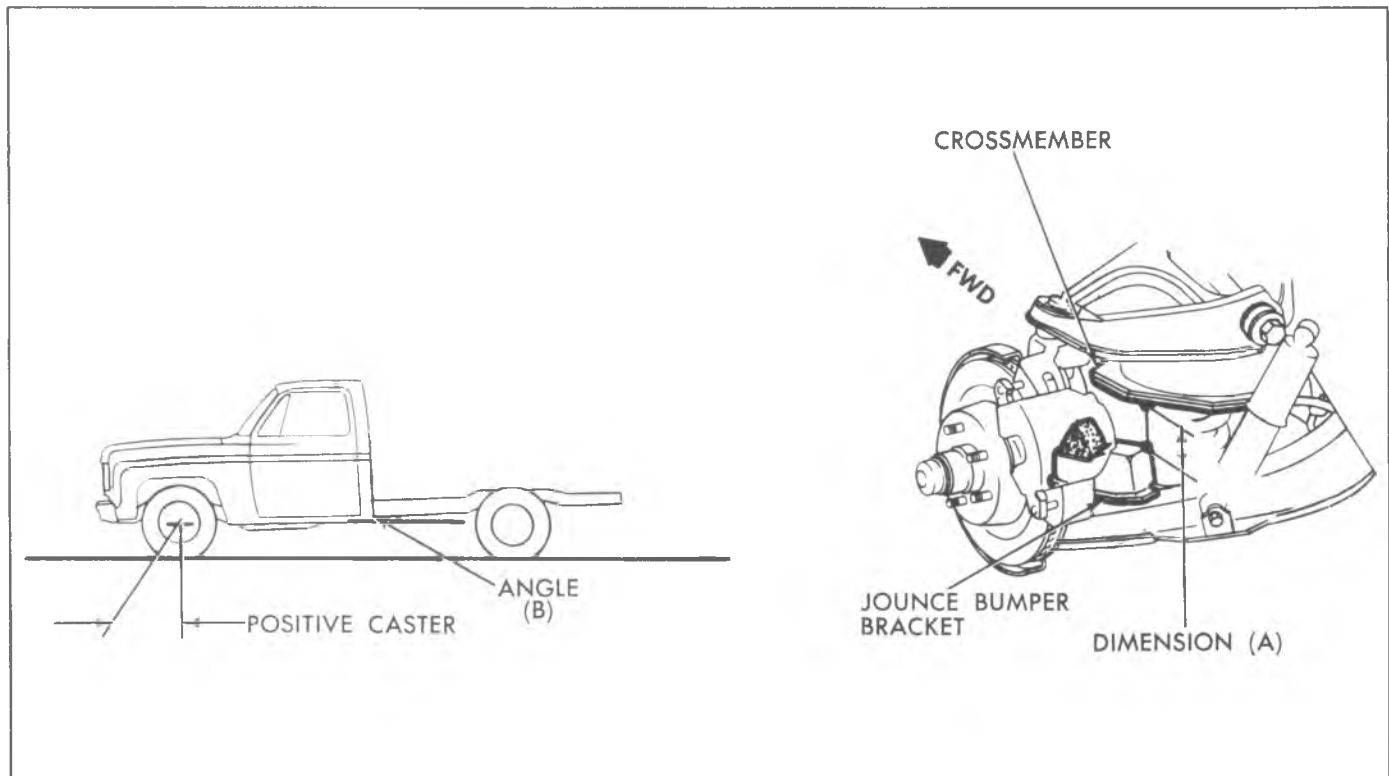


Fig. 3A-4--Determining Caster

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS CASTER

DIMENSION "A"

MODELS (mm)	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"	4¾"	5"	
	63.5	69.8	76.2	82.5	89.0	95.2	102.0	107.9	114.3	121.6	127.0	
C10	3.6°	3.4°	3.1°	2.8°	2.6°	2.4°	2.0°	1.8°	1.5°	1.2°	1.0°	
C20, 30	1.5°	1.2°	0.9°	0.6°	0.3°	0.1°	0°	-0.1°	-0.7°	-1.0°	-1.2°	
K10,20,30	(8°) (NO ADJUSTMENT PROVISION)											
(mm)	1½"	1¾"	2"	2¼"	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"
	38.0	44.4	51.0	57.1	63.5	69.8	76.2	82.5	89.0	95.2	102.0	107.9
G10, 20	3.5	3.3	3.1	2.9	2.7		2.4	2.2	2.1	1.9	1.8	1.6
G30	2.8	2.5	2.2	1.9	1.6		1.0	.7	.5	.2	0	-0.2
(mm)	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"	4¾"	5"	
	63.5	69.8	76.2	82.5	89.6	95.2	102.0	107.9	114.3	120.6	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"	2¼"	2½"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"	4¾"
	51.0	57.1	63.5	69.8	76.2	82.5	89.0	95.2	102.0	107.9	114.3	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"	2¾"	3"	3¼"	3½"	3¾"	4"	4¼"	4½"	4¾"	5"	
	63.5	69.8	76.2	82.5	89.0	95.2	102.0	107.9	114.3	120.6	127.0	
	5.5°	5.3°	5.0°	4.7	4.4°	4.1°	3.8	3.6	3.3	3.1°	2.9°	

CAMBER

MODEL	
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)

SECTION 3B1

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.

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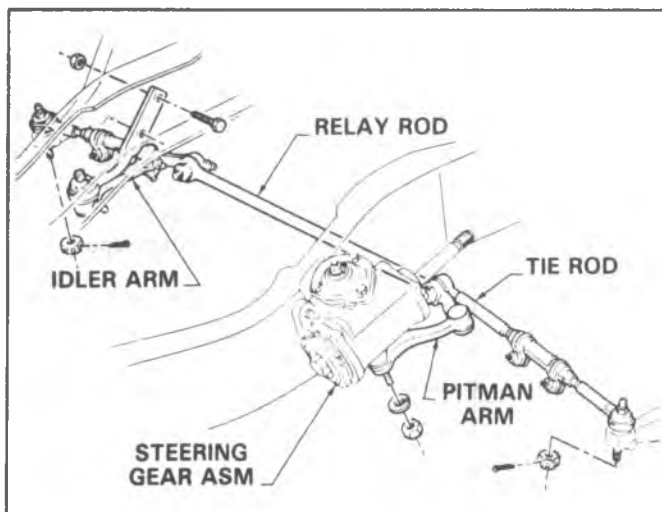


Fig. 3B1-1--Typical Steering Linkage

GENERAL DESCRIPTION

The steering linkage is located forward of the front crossmember. Refer to Fig. 3B1-1, 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.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Play or Looseness in Steering System.	<p>Front wheel bearings loosely adjusted.</p> <p>Worn steering shaft couplings.</p> <p>Worn upper ball joints.</p> <p>Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.</p> <p>Steering gear thrust bearings loosely adjusted.</p> <p>Excessive over-center lash in steering gear.</p> <p>Worn intermediate rod or tie rod sockets.</p>	<p>Adjust bearings to obtain proper end play.</p> <p>Replace part.</p> <p>Check and replace if necessary.</p> <p>Tighten to specified torque, or replace if necessary.</p> <p>Adjust preload to specification.</p> <p>Adjust preload to specification.</p> <p>Replace worn part.</p>
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. 3B1-2-Steering Linkage Diagnosis Chart A

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Steering – Excessive Effort Required at Steering Wheel.	<p>Low or uneven tire pressure.</p> <p>Steering linkage or bolt joints need lubrication.</p> <p>Tight or frozen intermediate rod, tie rod or idler socket.</p> <p>Steering gear to column misalignment.</p> <p>Steering gear adjusted too tightly.</p> <p>Front wheel alignment incorrect. (manual gear)</p>	<p>Inflate to specified pressures.</p> <p>Lube with specified lubricant.</p> <p>Lube replace or reposition as necessary.</p> <p>Align column.</p> <p>Adjust over-center and thrust bearing preload to specification.</p> <p>Check alignment and correct as necessary.</p>
Poor Returnability.	<p>Steering linkage or ball joints need lubrication.</p> <p>Steering gear adjusted too tightly.</p> <p>Steering gear to column misalignment.</p> <p>Front wheel alignment incorrect. (Caster)</p>	<p>Lube with specified lubricant.</p> <p>Adjust over-center and thrust bearing preload to specifications.</p> <p>Align column.</p> <p>Check alignment and correct as necessary.</p>

Fig. 3B1-3--Steering Linkage Diagnosis Chart B

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.

STEERING DAMPER CHECK

(Fig. 3B1-4)

This type of steering damper is nonadjustable, nonre-fillable 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 Functional 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

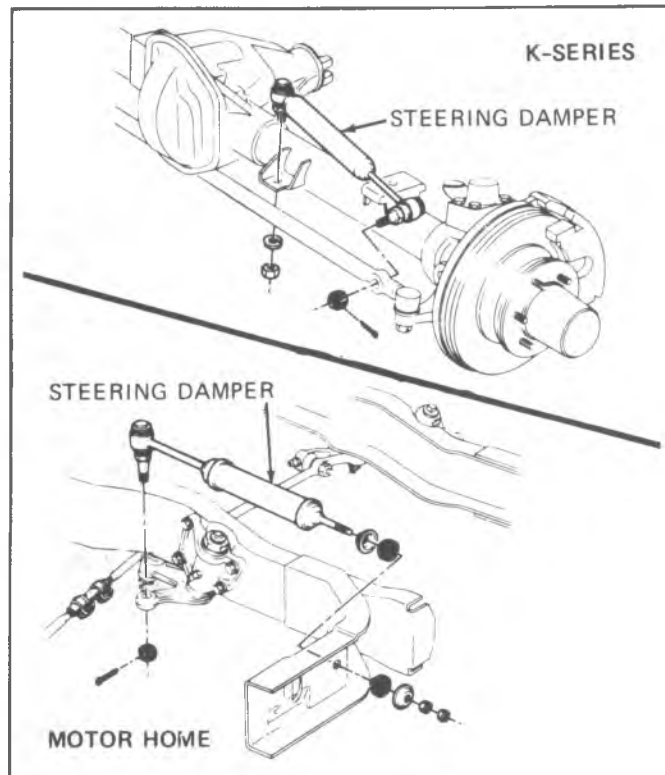
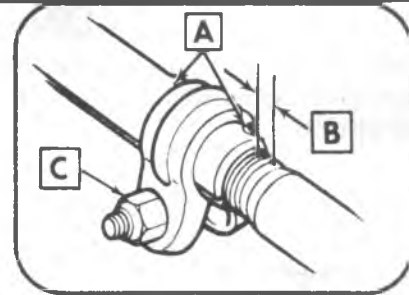
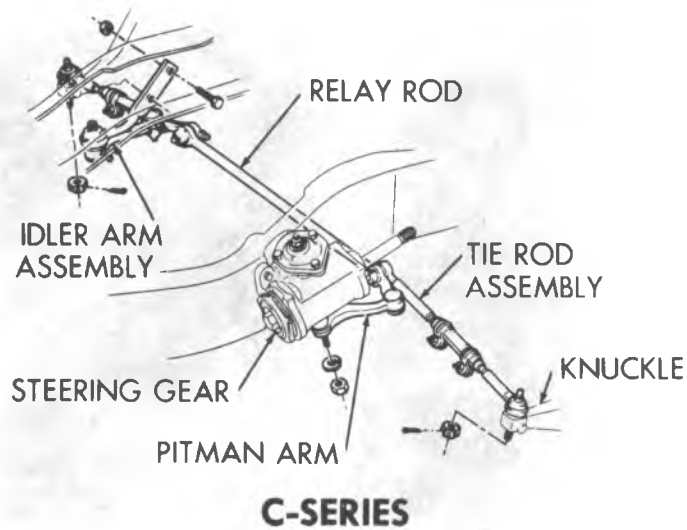


Fig. 3B1-4--Steering Dampers

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.**



- A CAUTION** All clamps must be between & clear of dimples before torquing nut.
- B** Exposed socket thread length must be equal within ± 0.06 at each end of adjusting sleeve on L.H. & R.H. tie rod asm.
- C** All bolts must be installed in directions shown -

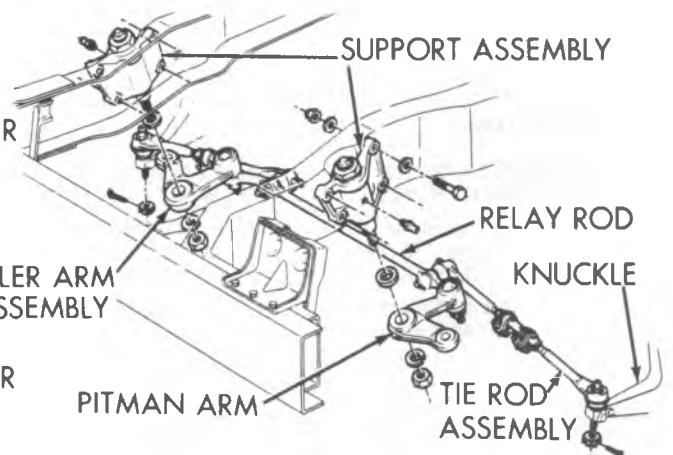
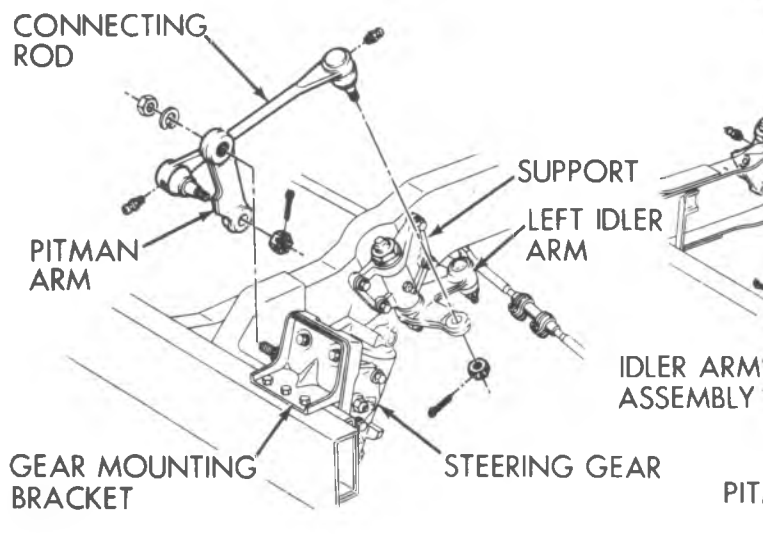
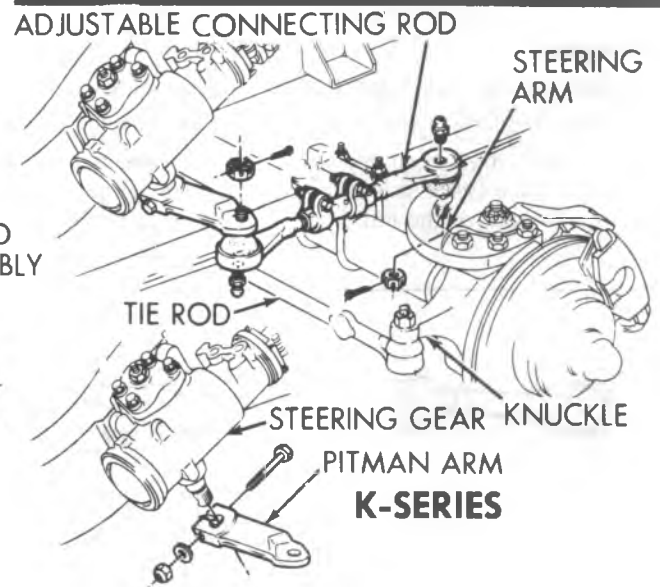
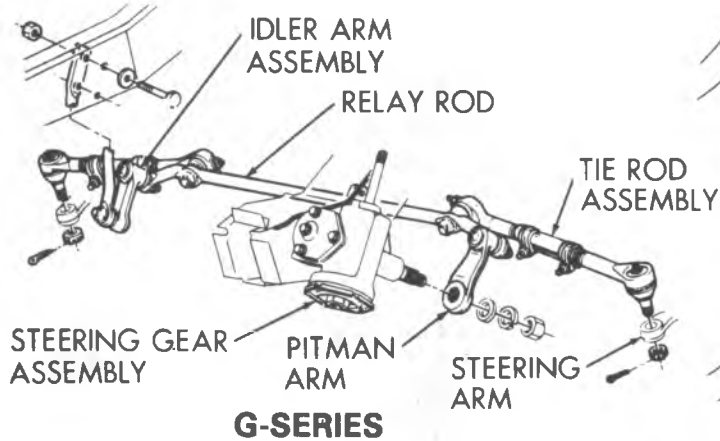


Fig. 3B1-5-Steering Linkage

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 (Fig. 3B1-7).
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.



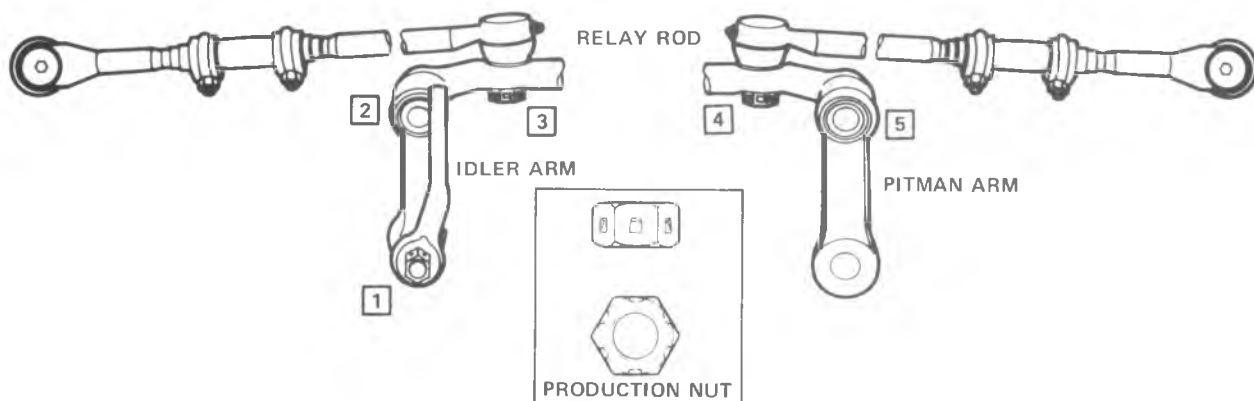
Fig. 3B1-7--Ball Stud Removal-Typical

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.



IMPORTANT

WHENEVER ANY OF THE CRIMP NUTS OR STUDS AT THE (5) LOCATIONS SHOWN ARE LOOSENEED 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. 3B1-6--Typical Crimp Nut Locations

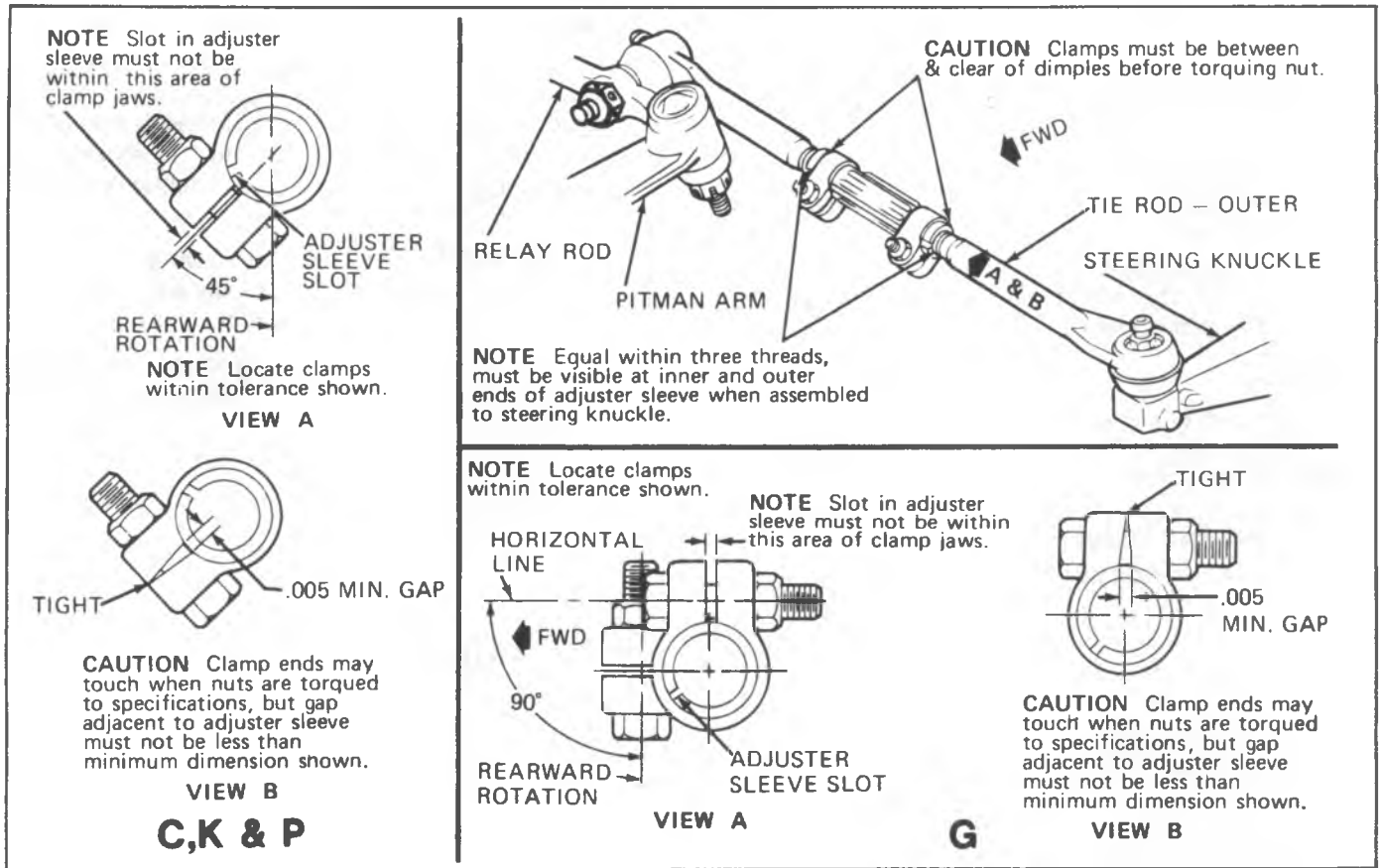


Fig. 3B1-8--Tie Rod Clamp Relationship

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.
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 a free-spinning $\frac{5}{8}$ -18 nut to seat the tapers, per Fig. 3B1-6.
4. 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 3B1-8.

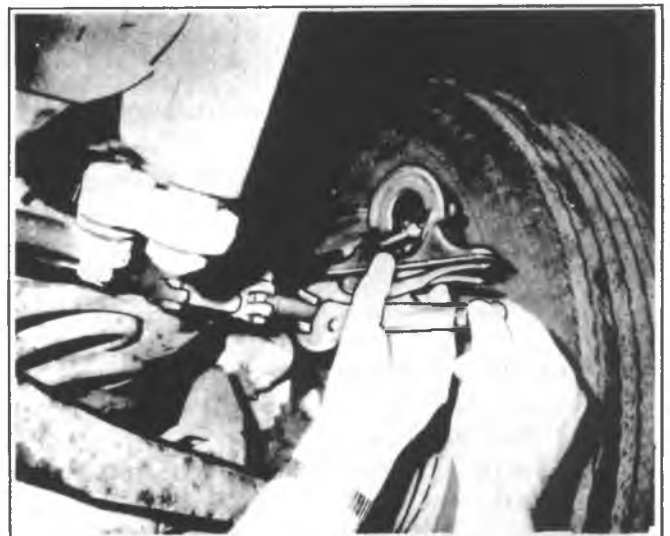


Fig. 3B1-9--Tie Rod Inspection

- c. The relationship of the clamp slot with the slit in the sleeve should be maintained as shown in Figure 3B1-8.
- d. Rotate both inner and outer tie rod housing rearward to the limit of ball joint travel before tightening clamps. Tighten clamps to 22N•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 (Fig. 3B1-9).

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 as shown in Figure 3B1-9. 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.

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. 3B1-7).
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, per Fig. 3B1-6.
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 push pull type 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 $\pm 1/8$ inch for a total acceptable movement of $1/4$ inch (Figure 3B1-10). It is necessary to ensure that the correct load is applied to the arm since it will move more when higher loads are applied.

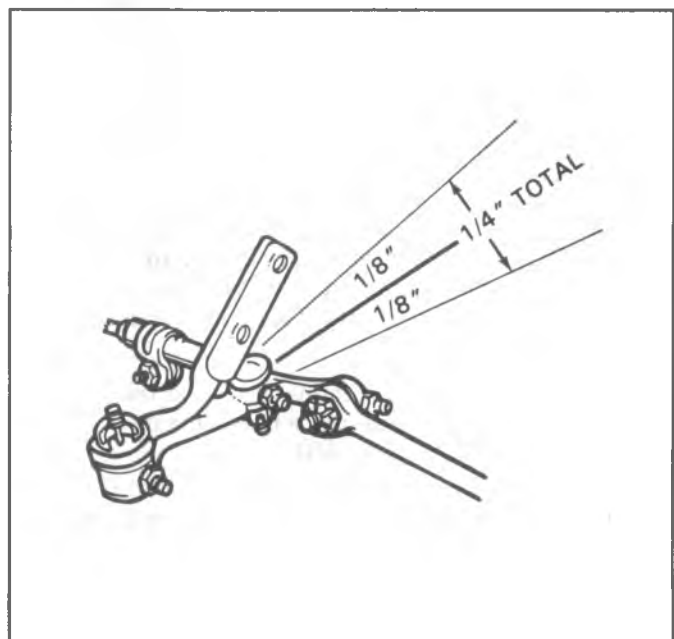


Fig. 3B1-10--Checking Idler Movement, Typical

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 (Fig. 3B1-7).
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 40N•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 $\frac{5}{8}$ -18 free-spinning nut to seat the tapers, per Fig. 3B1-6.
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 $\pm 1/16$ 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 $\frac{1}{8}$ of a turn ($\frac{1}{2}$ 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, 260 N•m; K, 125 N•m; P, 180 N•m).
 4. Position ball stud onto pitman arm or relay rod. Use a $\frac{5}{8}$ -18 free-spinning nut to seat the tapers, per Fig. 3B1-6.
 5. Lubricate ball studs.
 6. Lower the vehicle to the floor.

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 (similar to method shown in (Fig. 3B1-7).

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 in steering arm and pitman arm. (Be sure to install the long end of the connecting rod assembly to the pitman arm, as shown in Fig. 3B1-5).
3. Install ball stud nuts and torque to 95 N•m (70 ft. lbs.) Never back off nut to align cotter pin, always tighten nut to next slot that lines up with hole in stud.
4. Install cotter pins and lubricate ball studs. For proper alignment and orientation of connecting rod clamps see Figure 3B1-11.

SPECIFICATIONS AND SPECIAL TOOLS

Refer to Specifications and Special Tools at end of Section 3B4.

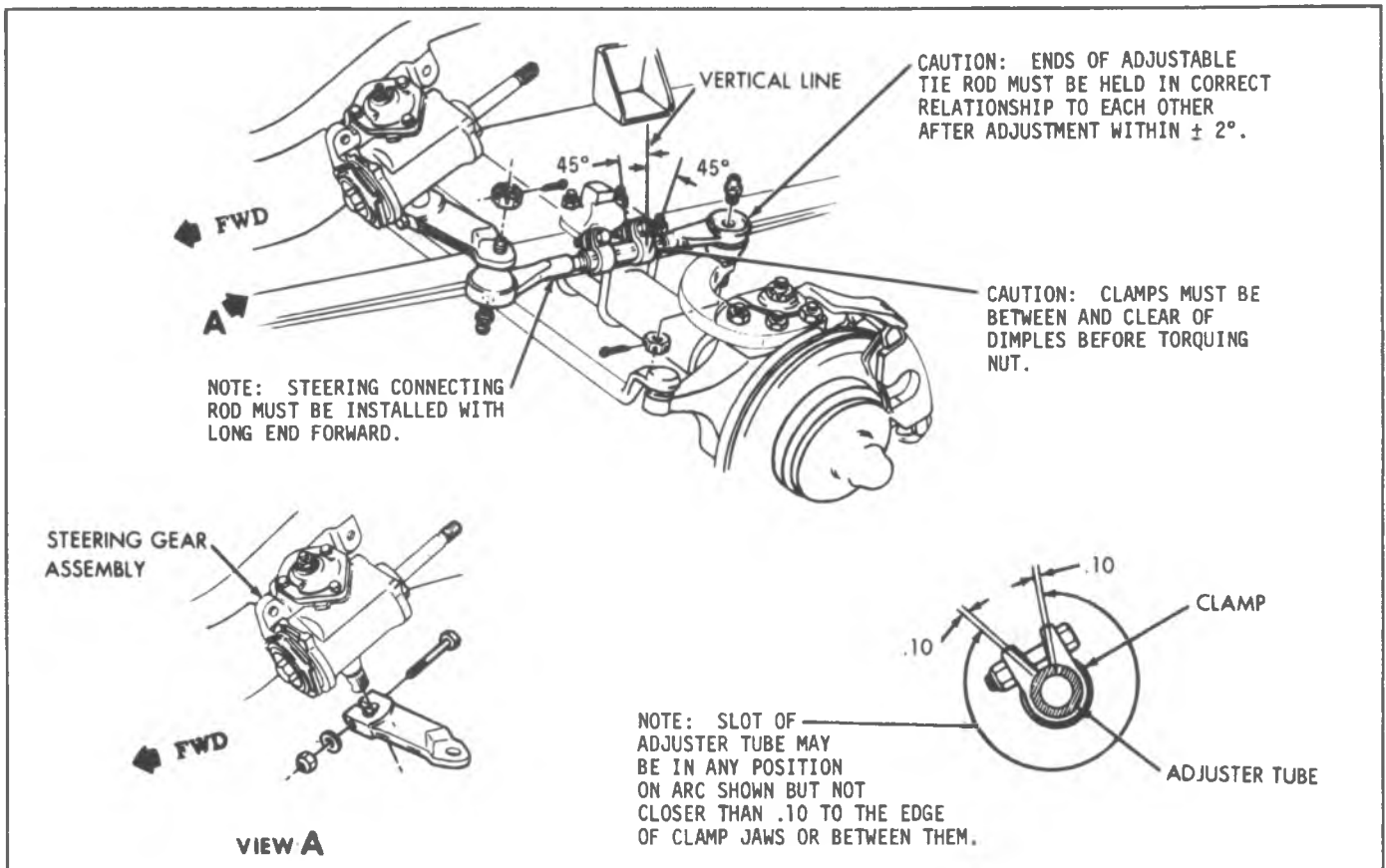


Fig. 3B1-11--Adjustable Connecting Rod Assembly-K Series

SECTION 3B2

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.

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On-Vehicle Service.....	3B2-5
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Pitman Shaft Seal.....	3B2-6
Unit Repair	3B2-8

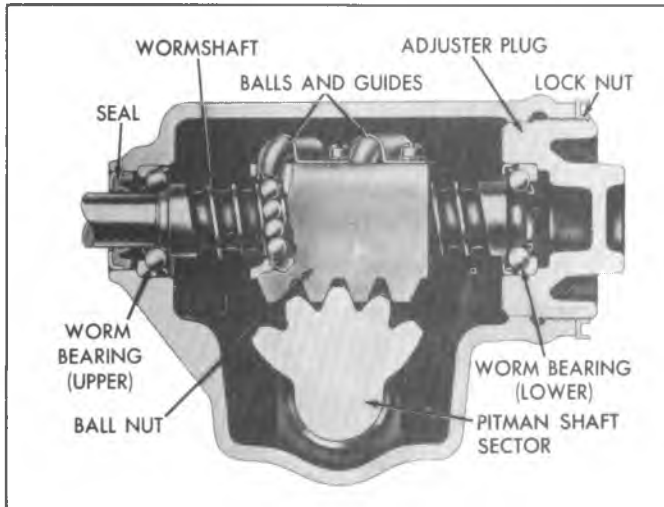


Fig. 3B2-1--Manual Steering Gear

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.

DIAGNOSIS

This section contains diagnostic information to help locate the cause of steering problems that may be related to the manual steering gear. 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.

CONDITION	POSSIBLE CAUSE	CORRECTION
Rattle or Chuck in Steering Gear.	<p>Insufficient or improper lubricant in steering gear.</p> <p>Pitman arm loose on shaft or steering gear mounting bolt loose.</p> <p>Loose or worn steering shaft bearing.</p> <p>Excessive over-center lash or worm thrust bearings adjusted too loose.</p> <p>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.</p>	<p>Add lube specified.</p> <p>Tighten to specified torque.</p> <p>Replace steering shaft bearing.</p> <p>Adjust steering gear to specified preloads.</p>
Poor Returnability	<p>Steering column misaligned.</p> <p>Insufficient or improper lubricant in steering gear or front suspension.</p> <p>Steering gear adjusted too tight.</p> <p>Front wheel alignment incorrect (Caster)</p>	<p>Align column.</p> <p>Lubricate as specified.</p> <p>Adjust over-center and thrust bearing preload to specifications.</p> <p>Adjust to specifications.</p>

Fig. 3B2-2--Manual Gear Diagnosis Chart A

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Play or Looseness in Steering System.	<p>Front wheel bearings loosely adjusted.</p> <p>Worn upper ball joints.</p> <p>Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball nuts.</p> <p>Excessive over-center lash.</p> <p>Worm thrust bearings loosely adjusted.</p>	<p>Adjust to obtain proper end play.</p> <p>Check and replace ball joints if necessary.</p> <p>Tighten to specification, replace if worn or damaged.</p> <p>Adjust over-center preload to specifications.</p> <p>Adjust worm thrust bearing preload to specifications.</p>
Hard Steering – Excessive Effort Required at Steering Wheel	<p>Low or uneven tire pressure.</p> <p>Insufficient or improper lubricant in steering gear or front suspension.</p> <p>Steering shaft flexible coupling misaligned.</p> <p>Steering gear adjusted too tight.</p> <p>Front wheel alignment incorrect. (Manual Gear)</p>	<p>Inflate to specified pressures.</p> <p>Lubricate as specified. Re-lubricate at specified intervals.</p> <p>Align column and coupling.</p> <p>Adjust over-center and thrust bearing preload to specifications.</p> <p>Adjust to specifications.</p>

Fig. 3B2-3--Manual Gear Diagnosis Chart B

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 3B2-4.
4. Loosen the steering gear adjuster plug locknut and back the adjuster plug off 1/4 turn (Fig. 3B2-5).
5. Remove the horn shroud or button cap.



Fig. 3B2-4--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. 3B2-6). 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

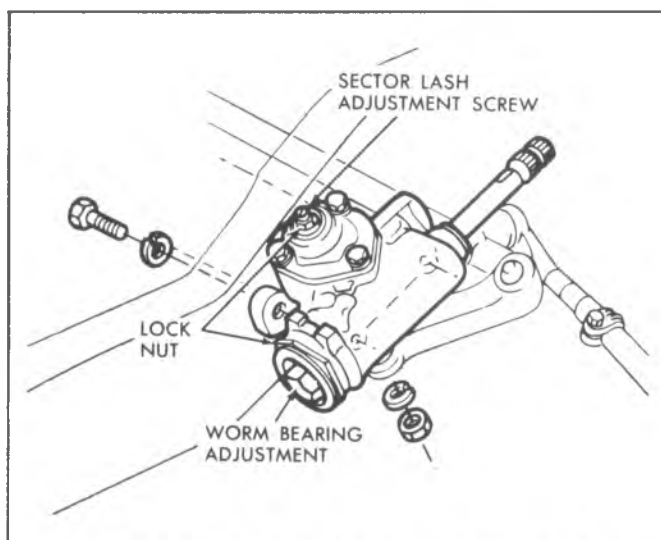


Fig. 3B2-5--Steering Gear Adjustment Points-Typical

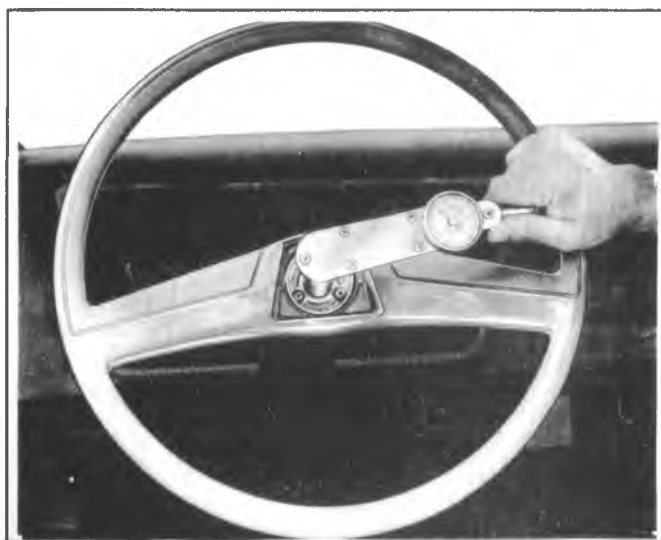


Fig. 3B2-6--Checking Torque at Steering Wheel

improper adjustment; the gear must be disassembled and inspected for replacement of damaged parts.

9. Adjust "over-center preload" as follows:

- 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.
- 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.
- 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.
- 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.

- Install the horn button cap or shroud and connect the battery ground cable.
- Lower the vehicle to the floor.

STEERING GEAR HIGH POINT CENTERING

- 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.
- 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.
- 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.
- 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.
- Readjust toe-in as outlined in Section 3A (if necessary).
- Be sure to properly orient sleeves and clamps when fastening and torquing clamps to proper specifications.

ON-VEHICLE SERVICE

STEERING GEAR

Removal

- Set the front wheels in straight ahead position by driving vehicle a short distance on a flat surface.

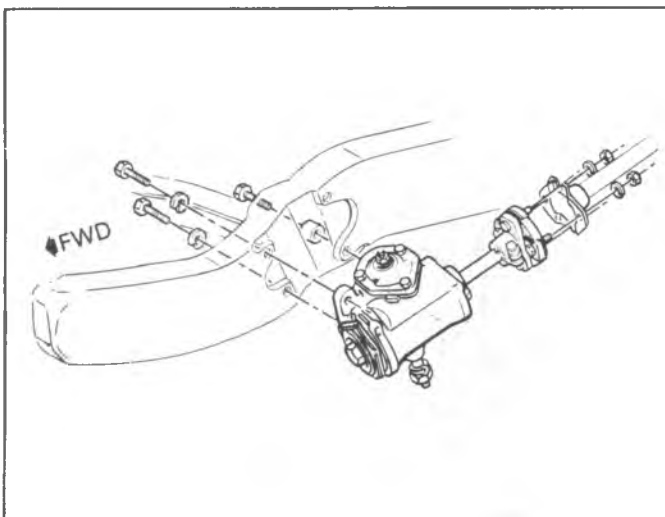


Fig. 3B2-7--Steering Gear Attachment, C-K Models

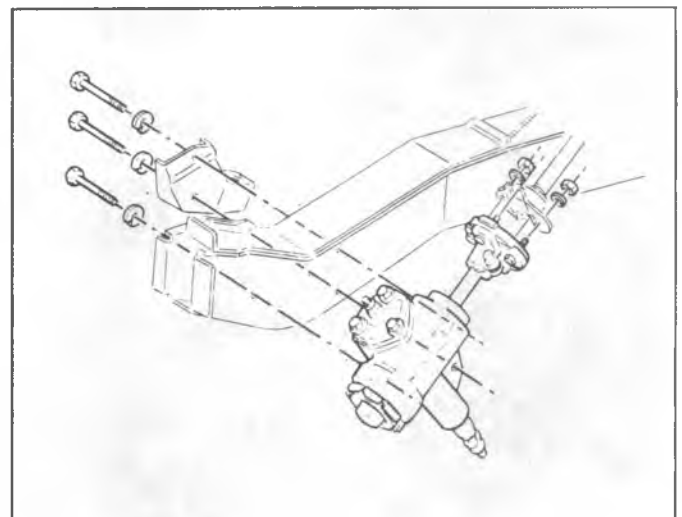


Fig. 3B2-8--Steering Gear Attachment, G-P Models

- 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.
- 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. 3B2-9).

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 half-way, 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. 3B2-10.

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. 3B2-9--Removing Pitman Arm-Typical

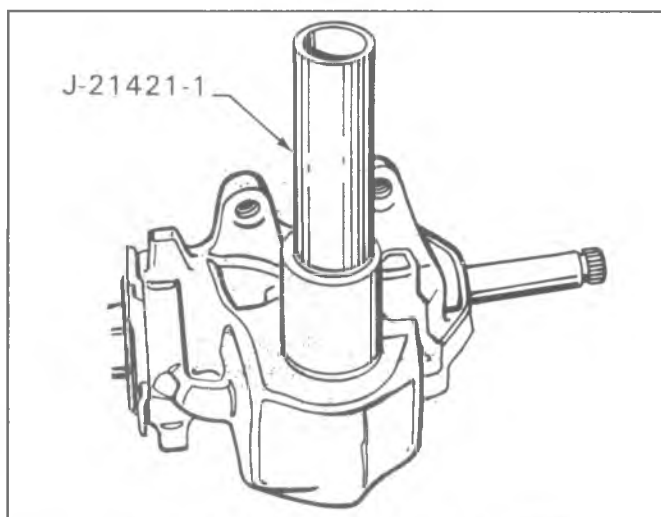


Fig. 3B2-10--Pitman Shaft Seal Replacement

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 steering gear adjustment and install the pitman arm as outlined 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.

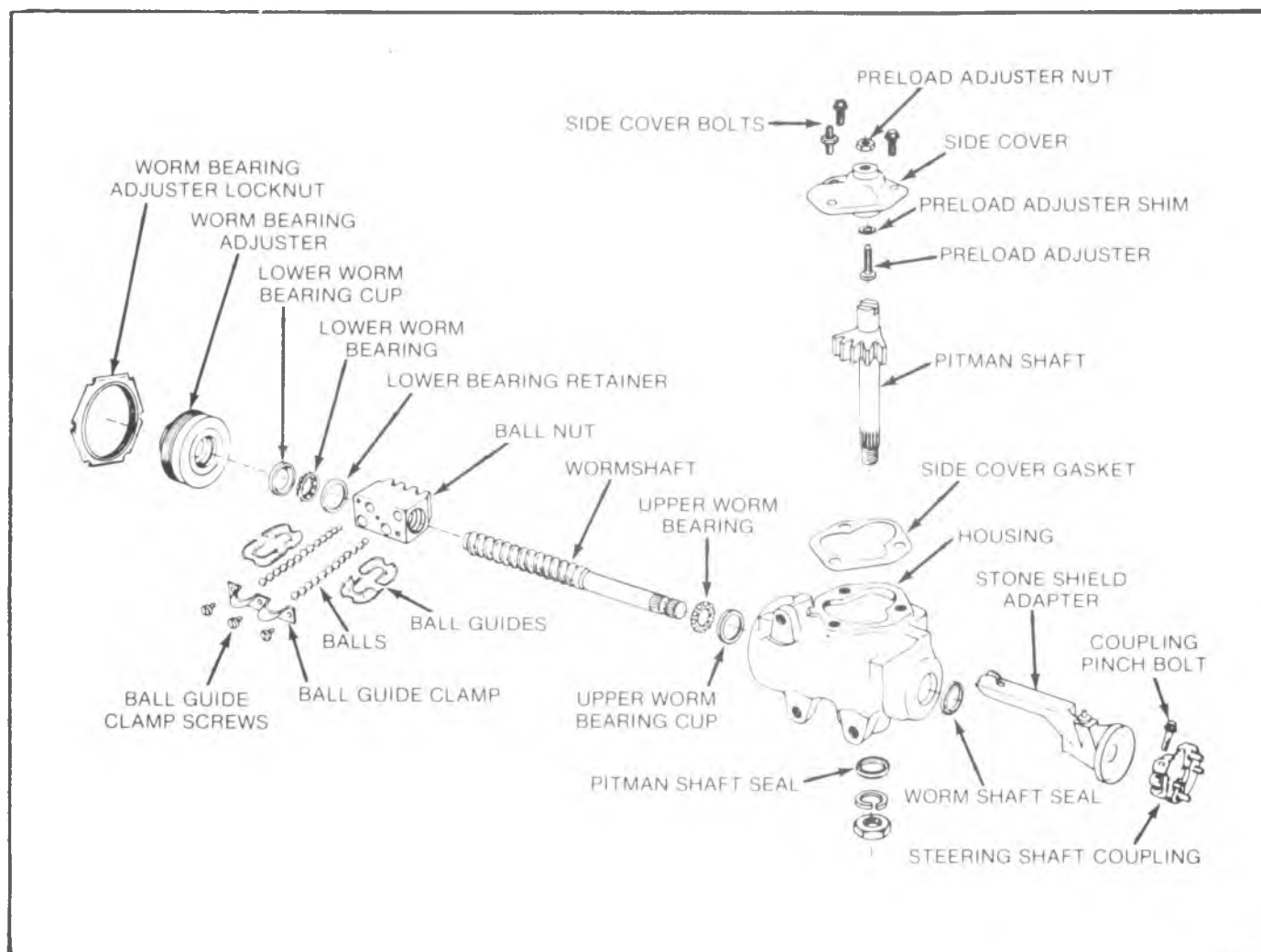
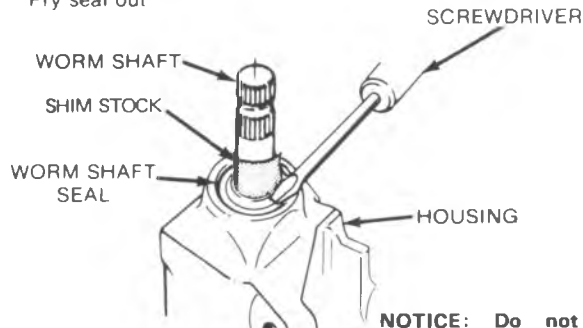


Fig. 3B2-11--Manual Steering Gear, Exploded View

1. REMOVE AND INSTALL WORM SHAFT SEAL-GEAR ASSEMBLED

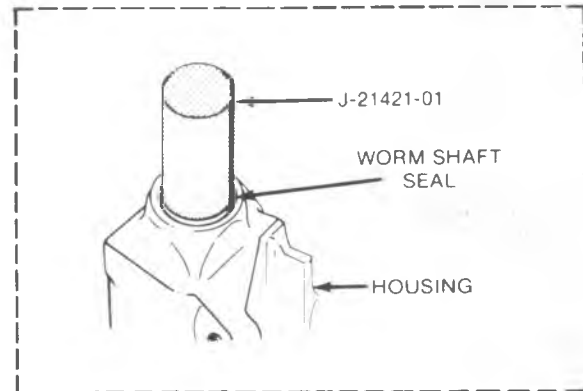
REMOVE

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.

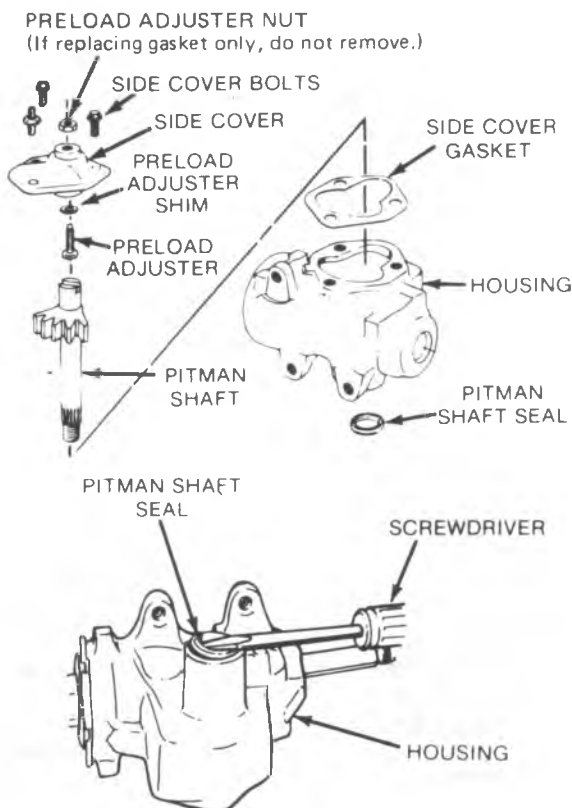
2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

1. Center steering gear.
2. Remove parts as shown.

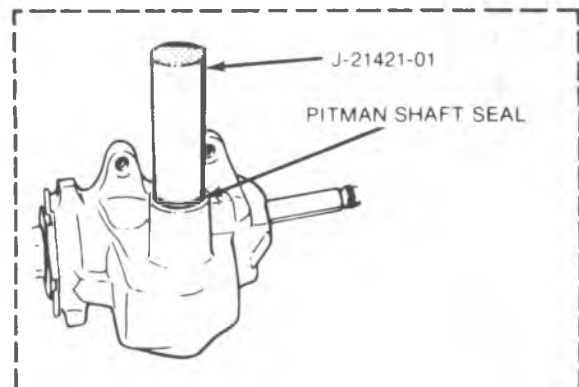
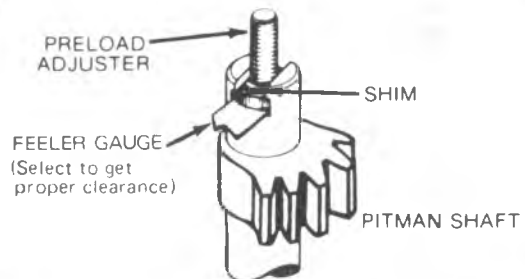
INSTALL

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. 3B2-12--Manual Gear Overhaul, Chart A

3. REMOVE AND INSTALL WORMSHAFT AND BALL NUT

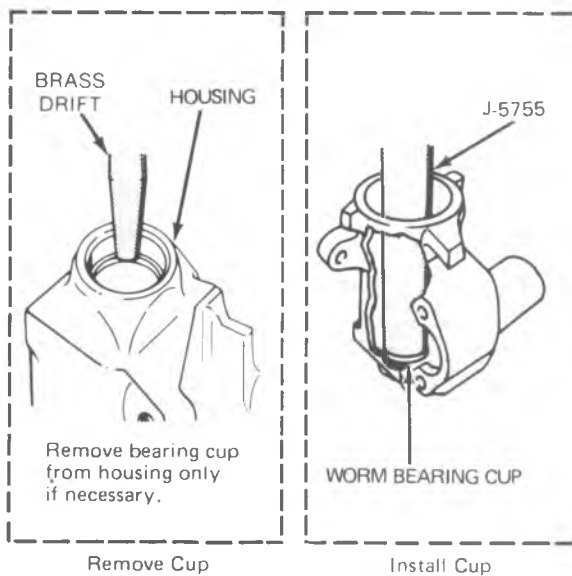
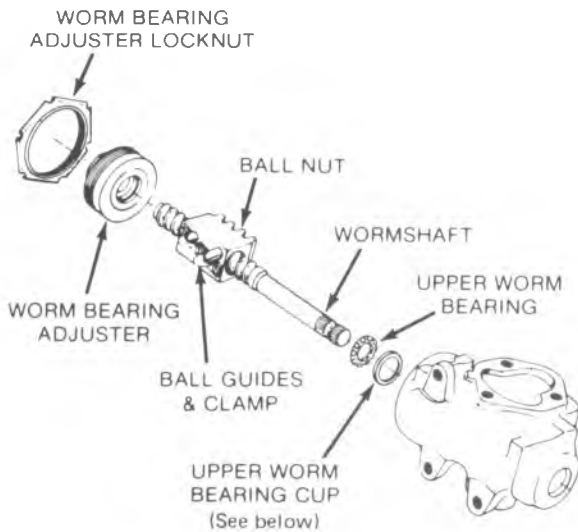
REMOVE

1. Loosen lock nut. Use punch against edge of slot.
2. Remove parts as shown.

INSTALL

1. Install 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.



4. DISASSEMBLE AND ASSEMBLE WORM BEARING ADJUSTER

DISASSEMBLE

1. Pry lower bearing retainer out with screwdriver.
2. Remove cup using J-5822 puller and slide hammer.

ASSEMBLE

1. Press cup into adjuster using J-5755.
2. Install parts as shown.

WORM BEARING ADJUSTER



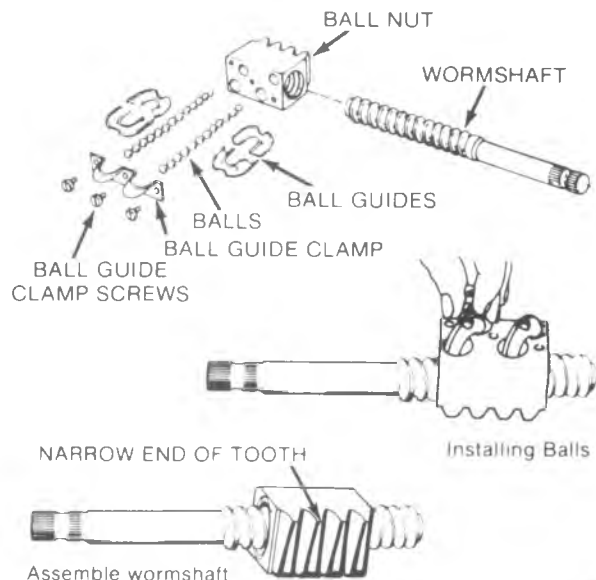
5. DISASSEMBLE AND ASSEMBLE WORMSHAFT AND BALL NUT

DISASSEMBLE

1. Disassemble parts as shown.
2. Clean and inspect all parts for excessive wear.

ASSEMBLE

1. Assemble parts as shown.
2. Refer to Fig A for number of balls used.



Dimension A—Measure land between ball grooves

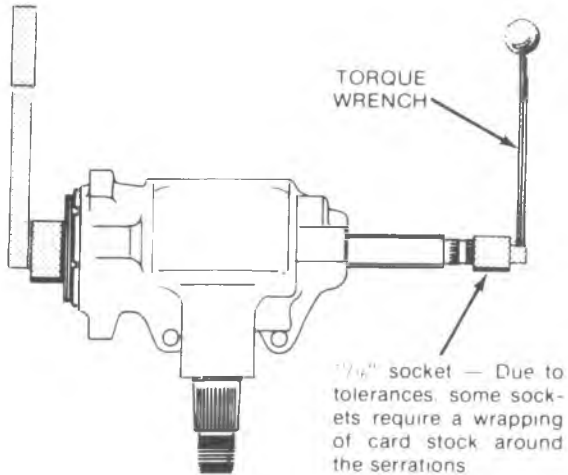
Dim A		Balls per circuit
mm	in	
1.0	0.04	25
2.5	0.10	27
5.0	0.20	27

WORMSHAFT

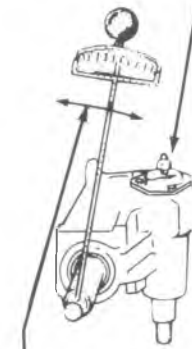
Fig A

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.

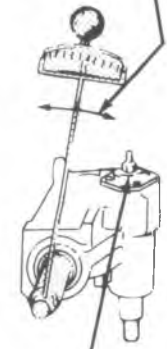
**7. ADJUST "OVER CENTER" PRELOAD**

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 torquing 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 InstallerJ-5822 Worm Bearing
Adjuster Cup Puller

Fig. 3B2-14--Manual Gear Overhaul, Chart C

SECTION 3B3

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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General Description.....	3B3-1
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On-Vehicle Service	3B3-12
Power Steering Gear	3B3-12
Power Steering Pump.....	3B3-13
Power Steering Hoses.....	3B3-15
Specifications	3B3-15
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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.

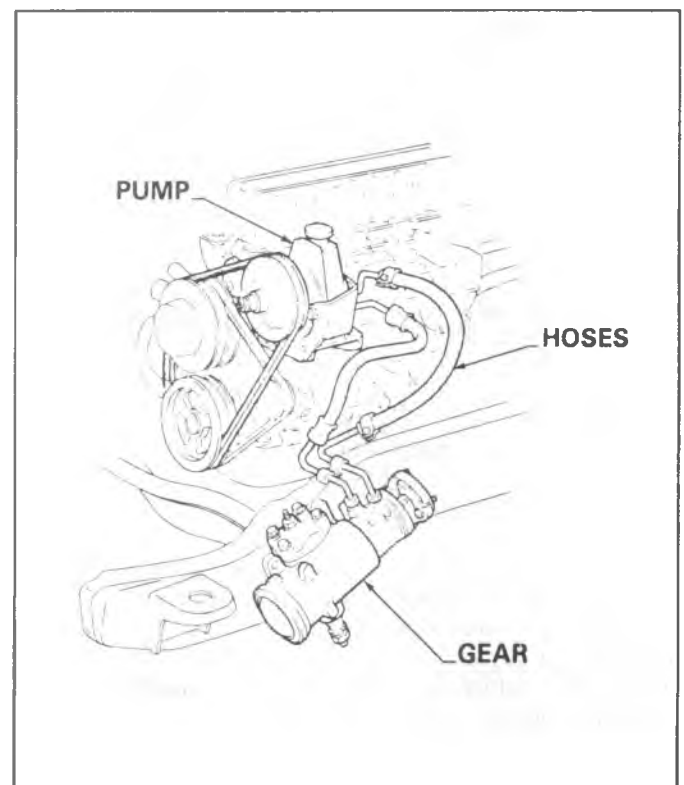


Fig. 3B3-1--Power Steering System

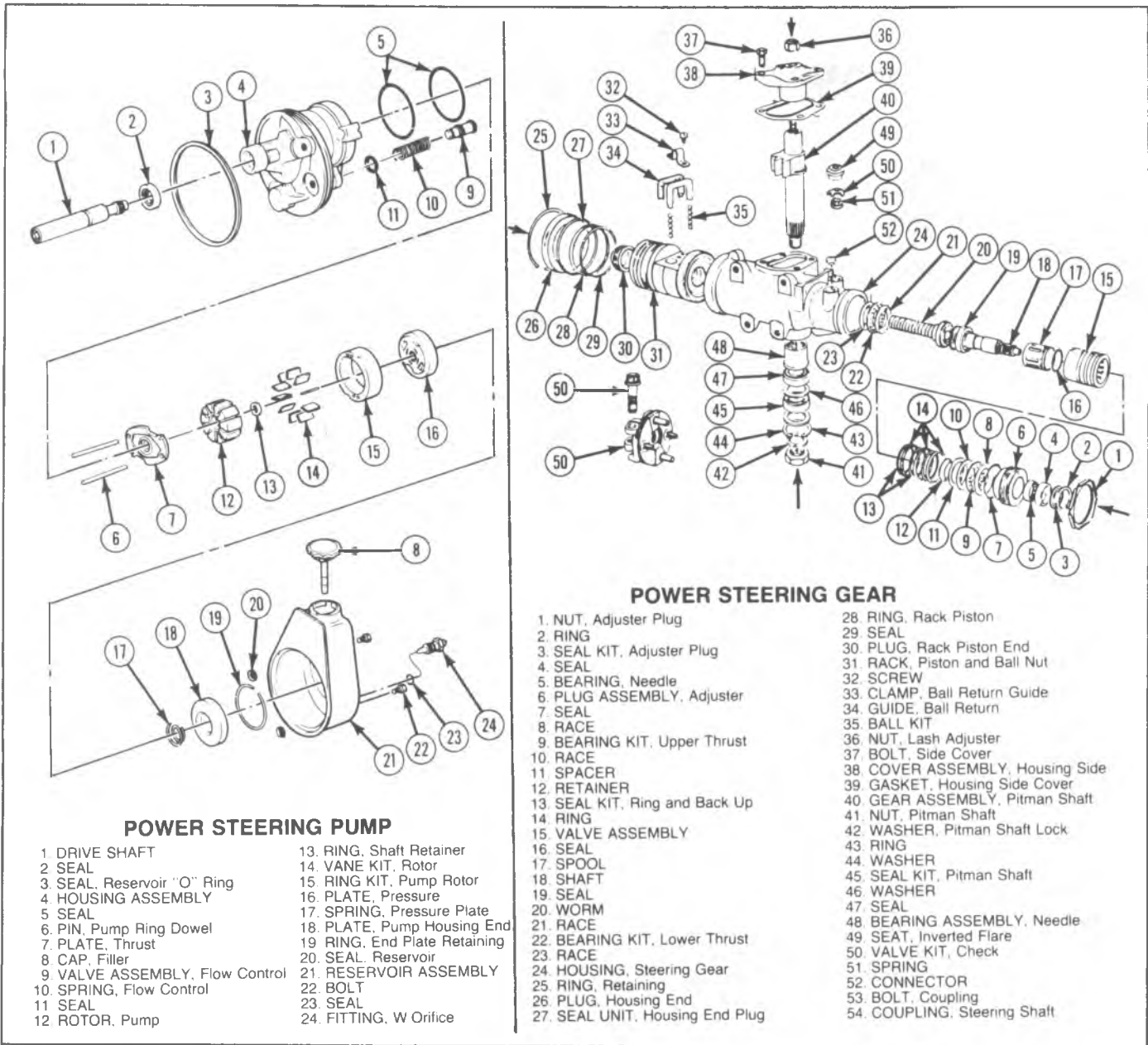


Fig. 3B3-2 -- Pump and Gear Cross-Section

DIAGNOSIS (FIGS. 3B3-3 THROUGH 3B3-8)

Complaints of faulty steering are frequently the result of problems other than the steering gear or pump. Those areas of the steering system which can be easily checked and quickly corrected without disassembly and overhaul of any major components should be attempted first.

Conditions such as hard or loose steering, road shock or vibrations are not always due to the steering gear or pump, but are often related instead to such factors low tire pressure and front end alignment. These factors should be checked and corrected before any adjustment or disassembly of the power steering gear or pump is attempted.

System Checks

Many factors affect power operation of the steering system, of which the most common are:

1. Fluid level and condition.
2. Drive belt tension.
3. Loose component mountings.
4. Loose pump pulley.

These factors must be checked and corrected before making any further diagnosis of the steering system. The need for proper diagnosis cannot be over-emphasized.

After the source of the problem has been found, determine the cause. For example, if the oil level in the reservoir is found to be low, refill and check the entire hydraulic system for oil leaks. Refilling the reservoir will not necessarily correct the problem.

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. Loose pump pulley nut Pump vanes not installed properly. Pump vanes sticking in rotor slots.	Adjust hose position. Replace nut, torque to specs. Install properly. 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. Loose pitman arm. Gear loose on frame.	Adjust to specifications. Tighten to specifications 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. 3B3-3--Power Steering System Diagnosis Chart 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. Extreme wear of pump cam ring.	Replace affected parts, flush system. 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. Air in system. Excessive "over-center" lash. Loose thrust bearing preload adjustment. Worn poppet valve (Gear) Steering gear loose on frame. Steering gear flexible coupling too loose on shaft or rubber disc mounting screws loose. Steering linkage ball studs worn enough to be loose. Front wheel bearings incorrectly adjusted or worn.	Adjust parts affected or replace worn parts. Add oil to pump reservoir and bleed by operating steering. Check all connections. Adjust to specification. Adjust to specification. Replace poppet valve. Tighten attaching bolts to 70 foot-pounds. Tighten flange pinch bolts to 30 foot-pounds, if serrations are not damaged. Tighten upper flange to coupling nuts to 20 foot-pounds. Replace loose components. Adjust bearings or replace with new parts as necessary.
Poor return of steering.	Tires under-inflated. Lower coupling flange rubbing against steering gear adjuster plug. Steering wheel rubbing against directional signal housing. Tight or frozen steering shaft bearings. Steering linkage or ball joints binding. Steering gear to column misalignment. Tie rod pivots not centralized. Lack of lubricant in suspension ball joints and steering linkage	Inflate to specified pressure. Loosen pinch bolt and assemble properly. Adjust steering jacket. Replace bearings. Replace affected parts. Align steering column. Adjust tie rod ends as required to center pivots. Lubricate and relubricate at proper intervals

Fig. 3B3-4--Power Steering System Diagnosis Chart B

CONDITION	POSSIBLE CAUSE	CORRECTION
Poor return of steering. (Cont'd.)	Steering gear adjustments over specifications. Sticky or plugged valve spool. Rubber spacer binding in shift tube. Improper front suspension alignment. Tight steering shaft bearings.	Check adjustment with pitman arm disconnected. Readjust if necessary. Remove and clean or replace valve. Make certain spacer is properly seated. Lubricate inside diameter with silicone lubricant. Check and adjust to specifications. 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 Steering shaft rubbing ID of shift tube. 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. Steering linkage not level.	Adjust to specifications. Align column. Replace valve. Adjust as required.
Steering wheel surges or jerks when turning with engine running especially during parking.	Low oil level in pump. Loose pump belt. Sticky flow control valve. Insufficient pump pressure. Steering linkage hitting engine oil pan at full turn.	Check oil level, add as necessary. Adjust tension to specification. Inspect for varnish or damage, replace if necessary. Check pump pressure. (See pump pressure test). Replace relief valve if defective. Correct clearance.
Momentary increase in effort when turning wheel fast to right or left.	Pump belt slipping. Low oil level in pump. High internal leakage.	Tighten or replace belt. Check oil level, add as necessary. Check pump pressure (Test)
Hard steering or lack of assist.	High internal leakage. (Gear or pump) Loose pump belt. Low oil level in reservoir.	Check pump pressure. (See pump pressure test). Adjust belt tension to specification. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage, torque to specs.

Fig. 3B3-5--Power Steering Diagnosis Chart C

CONDITION	POSSIBLE CAUSE	CORRECTION
Hard Steering or lack of assist (Continued)	<p>Lack of lubricant in suspension or ball joints.</p> <p>Tires not properly inflated.</p> <p>Steering gear to column misalignment.</p> <p>Steering gear adjusted too tight.</p> <p>Excessive friction in steering linkage.</p> <p>Lower coupling flange rubbing against steering gear adjuster plug.</p> <p>Sticky flow control valve.</p> <p>Frame bent.</p> <p>Front springs weak and sagging.</p> <p>Insufficient oil pressure.</p>	<p>Lubricate, relubricate at proper intervals.</p> <p>Inflate to recommended pressure.</p> <p>Align steering column.</p> <p>Test steering system for binding with front wheels off floor. Adjust as necessary.</p> <p>Check tie rod pivot points for excessive friction. Replace the affected pivot.</p> <p>Loosen pinch bolt and assemble properly.</p> <p>Replace or clean valve.</p> <p>Check frame for proper alignment or cracking. Repair or replace as necessary.</p> <p>Check standing height. Weak or sagging springs should be replaced with new ones.</p> <p>If above checks do not reveal cause of hard steering, diagnose hydraulic system to determine problem.</p>
Low oil pressure due to restriction in hoses:	<p>Check for kinks in hoses.</p> <p>Foreign object stuck in hose.</p>	<p>Remove kink.</p> <p>Remove hoses and remove restricting object or replace hose.</p>
<p>Low oil pressure due to steering gear:</p> <p>(See pump pressure test)</p>	<p>Pressure loss in cylinder due to worn piston ring or scored housing bore.</p> <p>Leakage at valve rings, valve body to worm seal.</p> <p>Loose fit of spool in valve body or leaky valve body.</p> <p>Damaged poppet valve.</p>	<p>Remove gear from car for disassembly and inspection of ring and housing bore. Replace affected parts.</p> <p>Remove gear from car for disassembly and replace seals.</p> <p>Replace valve.</p> <p>Replace valve.</p>

Fig. 3B3-6--Power Steering System Diagnosis Chart D

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Low oil pressure due to steering pump: (See pump pressure test.)</p> <p>Note: Steering system external leakage</p>	<p>Loose belt.</p> <p>Low oil level.</p> <p>Air in the oil.</p> <p>Defective hoses or steering gear.</p> <p>Flow control valve stuck or inoperative.</p> <p>Loose screw in end of flow control valve.</p> <p>Cracked or broken thrust or pressure plate.</p> <p>Pressure plate not flat against cam ring.</p> <p>Extreme wear of cam ring.</p> <p>Scored pressure plate, thrust plate or rotor.</p> <p>Vanes not installed properly.</p> <p>Vanes sticking in rotor slots.</p>	<p>Adjust tension to specification</p> <p>Fill reservoir to proper level.</p> <p>Locate source of leak and correct. Bleed system.</p> <p>Correct as necessary.</p> <p>Remove burrs or dirt or replace.</p> <p>Tighten.</p> <p>Replace part.</p> <p>Replace pressure plate.</p> <p>Replace parts, flush system</p> <p>Replace parts. (If rotor, replace with rotating group kit), flush system</p> <p>Install properly. Radius edge to outside.</p> <p>Free-up by removing burrs, varnish or dirt.</p>
<p>Foaming milky power steering fluid, low level and possible low pressure.</p>	<p>Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.</p>	<p>Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration 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.</p>

Fig. 3B3-7--Power Steering System Diagnosis Chart E

POWER STEERING SYSTEM EXTERNAL LEAKAGE

General Procedure

1. Wipe suspected area dry.
2. Check for overfilled reservoir.
3. Check for oil aeration and overflow.
4. Check hose connections - tighten if necessary.
5. Verify exact point of leakage.

Example: Torsion bar, stub shaft and adjuster seals are close together; exact leakage point could be confused.

Example: The point oil drips from is not necessarily the leakage point - oil overflowing from reservoir for instance.

6. When service is required:
 - a. Clean leakage area upon disassembly.
 - b. Replace leaking seal.
 - c. Check component sealing surfaces for damage.
 - d. Reset bolt torque to specifications where required.

Customer Descriptions

Some of the customer complaints associated with the power steering system may be reported as:

1. Oil leakage on garage floor.
2. Oil leaks visible on steering gear, pump, or anywhere else on the left side of engine compartment.
3. Growling noise especially when parking or when engine is cold.
4. Loss of power when parking.
5. Heavy steering effort.

For the purpose of trouble shooting complaints of this nature, assume that there is an external leak in the power steering system.

Leakage Diagnosis (Fig. 3B3-8)

This section is a guide, which will enable you to locate, identify, and repair leaks in the power steering system. It contains:

- A. Diagram of the complete power steering system with the areas of potential leakage identified.
- B. Recommended procedure for locating external leakage in the vehicle.
- C. Areas of leakage to be checked, which can be serviced at once.
- D. Part replacement recommendations.
- E. Diagram of the actual areas where leakage will be observed and the action recommended to repair this leakage.

Leakage Check

The purpose of the diagnostic procedure is to pin-point the location of the leak. The method outlined in this manual can be followed to locate the leak and repair it.

In some cases you will be able to locate the leak easily. However, seepage type leaks may be more difficult to isolate. For seepage leaks, the following method is recommended.

- A. With the vehicle's engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).
- B. Check oil level in pump's reservoir and adjust as directed in maintenance section.
- C. Start engine and turn steering wheel from stop to stop several times. Do not hold in corner for any length of time as this can damage the power steering pump. It is easier if someone else operates the steering wheel while you search for the seepage.
- D. Find the exact area of leakage.
- E. Refer to the diagnostic chart to find the recommended method of repair.

Quick Fixes

The purpose of this section is to acquaint you with the types of leakage which can be repaired very easily. It contains information on reservoir oil level, the hoses and the hose connections.

An overfilled pump reservoir can be a cause for leakage complaint. The oil in the steering system expands as heated during normal usage. If overfilled the excess is forced through the breather cap hole and may be sprayed over the engine by air blast. Operate the engine and steering system until normal operating temperature is obtained. Remove the reservoir cap and check the graduated level on the dipstick. Adjust the oil level as required.

Seepage at the hose connections can be a cause for leakage complaint and can be due to loose connection nuts. If leakage is observed at the hose connections, and the nut is not cross threaded, tighten the nuts at the gear to 30 foot pounds.

The nut at the power steering pump should be tightened to 40 foot pounds. If tightening to this torque does not stop the leak, refer to the diagnostic chart.

If either the return hose or the pressure hose leaks, replace the hose.

Component Replacement

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft, at the stud shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

Housing or Cover Seepage - Both the power steering gear and pump assemblies are leakage checked before shipment. However, occasionally oil seepage may occur from the gear or pump other than the seal areas. If this type of leakage is found, replace the leaking part.

Fig. 3B3-8 has been prepared to show the potential areas of leakage. If leakage occurs in the zones shown, replace the part listed using the service manual as a guide.

GEAR AND PUMP LEAK DIAGNOSIS

START ENGINE AND TURN STEERING WHEEL FROM STOP TO STOP SEVERAL TIMES. DO NOT HOLD AT STOP FOR ANY LENGTH OF TIME AS THIS CAN DAMAGE THE POWER STEERING PUMP.

1. CHECK OIL LEVEL. IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND THE CAP TIGHT, REPLACE CAP.
2. CRACKED OR BENT RESERVOIR, REPLACE RESERVOIR.
3. REPLACE RESERVOIR "O" RING.
4. REPLACE FRONT SEAL. MAKE CERTAIN THAT DRIVE SHAFT IS CLEAN AND FREE OF PITTING IN SEAL RIDE AREA.
5. TORQUE HOSE FITTING NUT TO 27 N·m (20 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE "O" RING SEAL.
6. TORQUE FITTING TO 48 N·m (35 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE BOTH "O" RING SEALS.
7. TORQUE NUT TO 27 N·m (20 FT. LBS.). REPLACE NUT IF LEAKAGE PERSISTS.
8. TORQUE SIDE COVER BOLTS TO 60 N·m (45 FT. LBS.). REPLACE SIDE COVER SEAL IF LEAKAGE PERSISTS.
9. REPLACE ADJUSTER PLUG "O" RING SEAL.
10. REPLACE ROTARY VALVE ASSEMBLY.
11. REPLACE ADJUSTER PLUG SEALS.
12. SEAT BALL FLUSH WITH PUNCH AND RESTAKE. IF SEEPAGE PERSISTS, REPLACE HOUSING.
13. REPLACE BOTH PITMAN SHAFT SEALS.
14. REPLACE END PLUG "O" RING SEAL.
15. REPLACE SIDE COVER "O" RING SEAL.
16. REPLACE DUST SEAL AND PITMAN SHAFT SEAL.
17. TORQUE NUT TO 48 N·m (35 FT. LBS.). REPLACE NUT IF LEAKAGE PERSISTS.

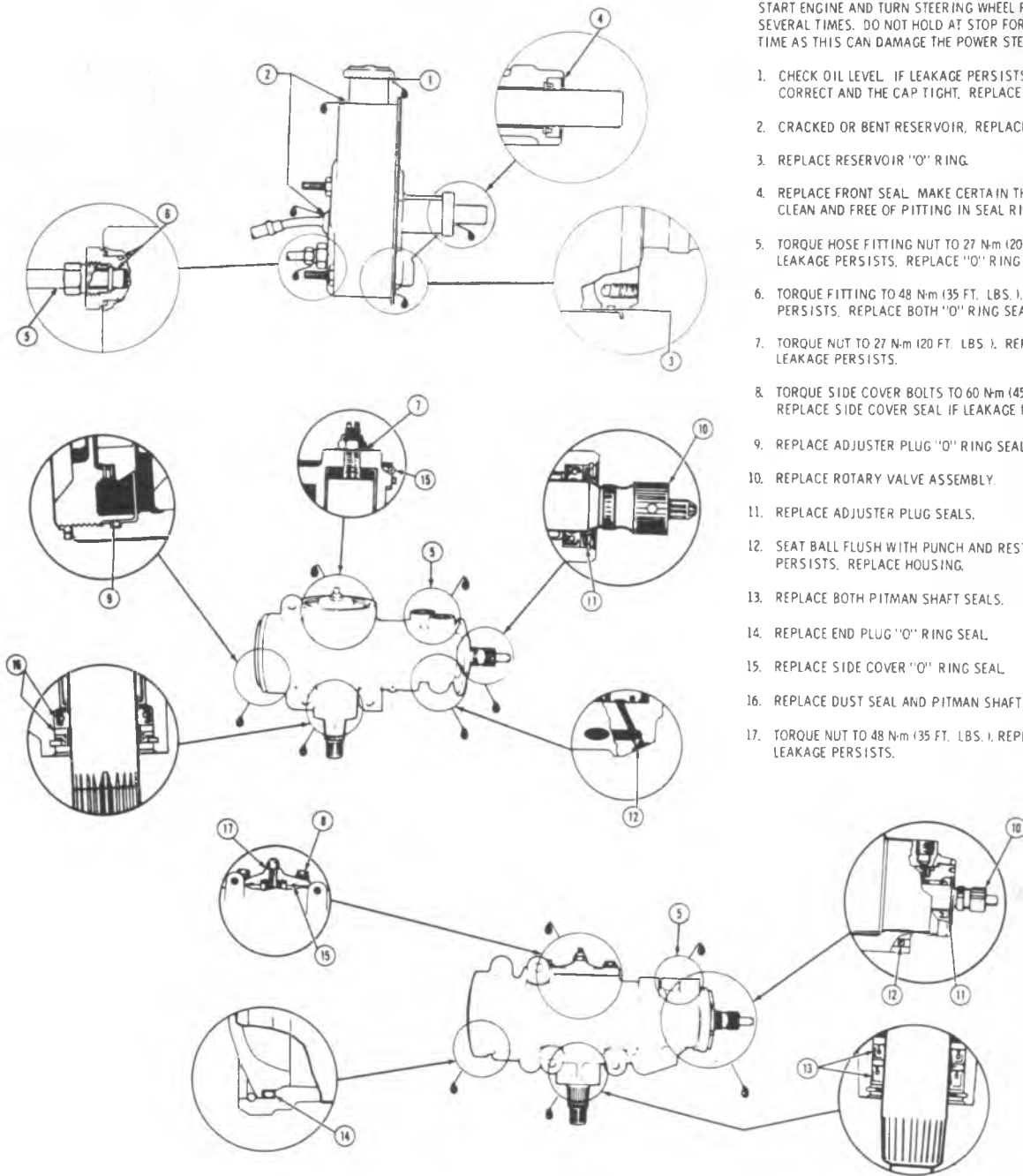


Fig. 3B3-8--Gear and Pump Leak Diagnosis

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 this section.

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.

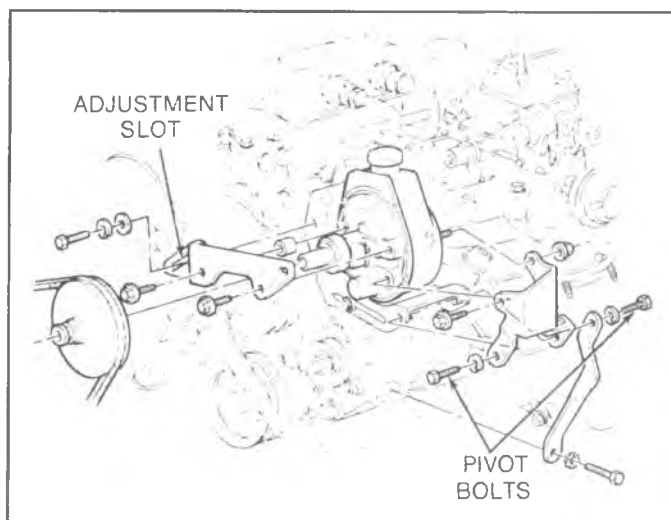


Fig. 3B3-9--Adjusting Pump Position

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.
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. 3B3-9.

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. 3B3-10). See Figure 3B3-11.
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

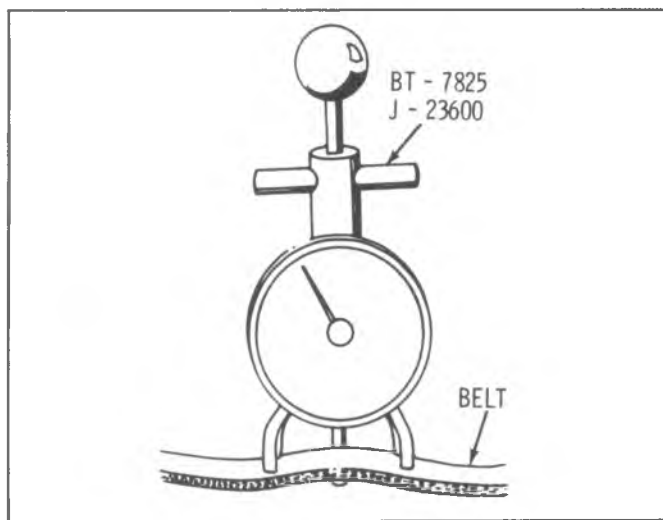


Fig. 3B3-10--Checking Belt Tension with J-23600

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.

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. 3B3-11--Belt Tension Chart

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:

1. With engine **NOT** running disconnect pressure hose from pump and install Tool J-5176 using a spare pressure hose between gauge and pump. Gauge must be between shut-off valve and pump (Fig. 3B3-12). Open shut-off valve.
2. Remove filler cap from pump reservoir and check fluid level. Fill pump reservoir to full mark on dip stick. 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.

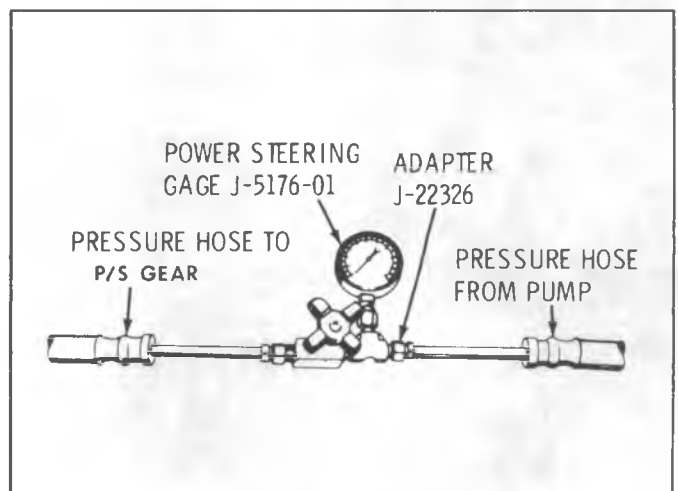


Fig. 3B3-12--Checking Power Steering Pressures

6. Close gate valve fully 3 times. Record the highest pressures attained each time.

NOTICE: Do not leave valve fully closed for more than 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 within 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 and compare with the maximum pump pressure 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 gauge, 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 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. 3B3-13).
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.



Fig. 3B3-13--Removing Pitman Arm

Installation (Fig. 3B3-14)

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 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.
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 bottomed 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.

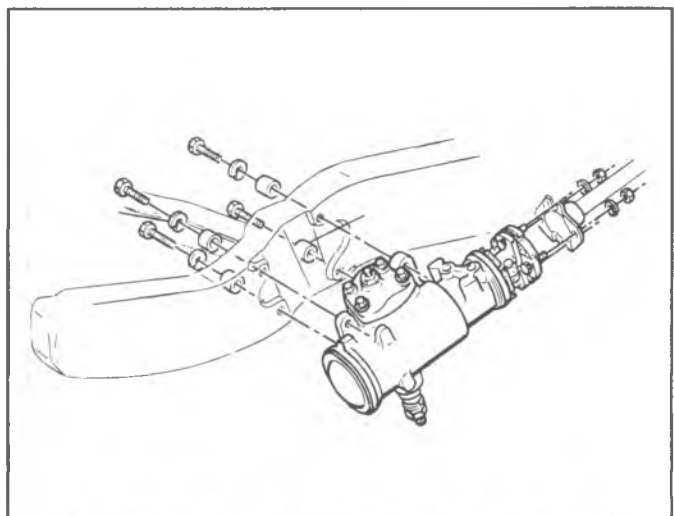


Fig. 3B3-14--Power Steering Gear Mounting-Typical

P Models

- a. Place the steering gear in position, guiding the stub 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 (3B3-15 THROUGH 3B3-26)**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 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."

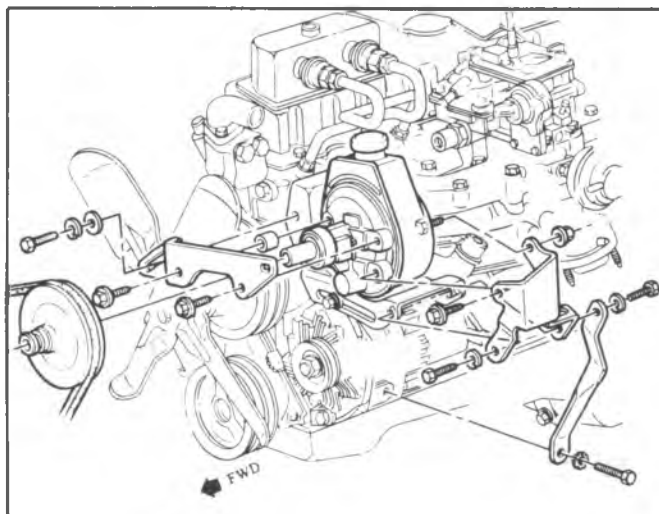


Fig. 3B3-15--P/S Pump Mounting; CK100, CK200 (03) with LE3 Engine

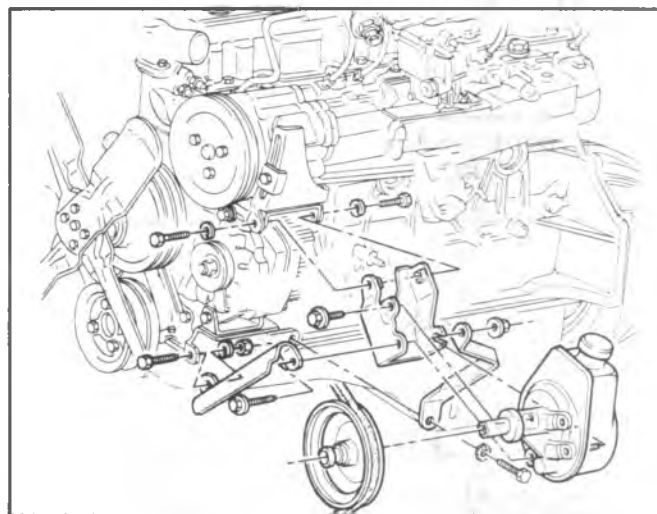


Fig. 3B3-16--P/S Pump Mounting; CK200, CK300 with L25 Engine

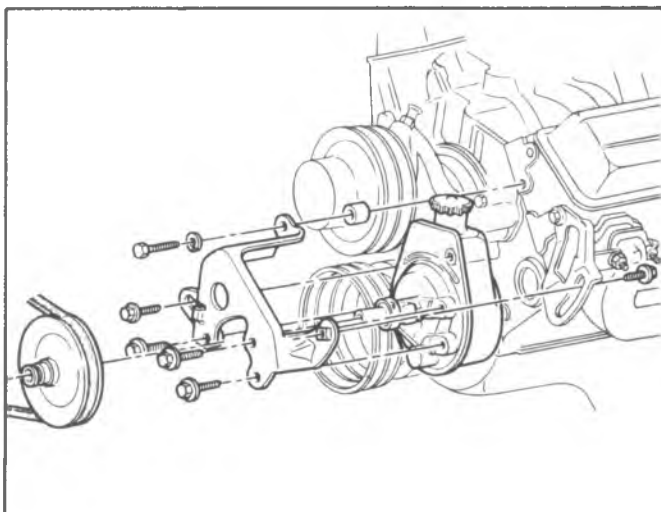


Fig. 3B3-17--P/S Pump Mounting; CK100, CK200, CK300 - LE4, LG9, LS9, LT9 (Exc. C60, JB8)

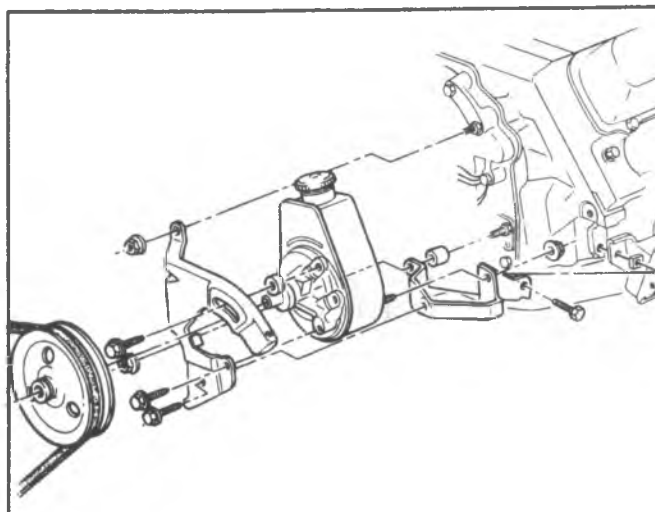


Fig. 3B3-20--P/S Pump mounting; CK100 (03) with IF9 Engine

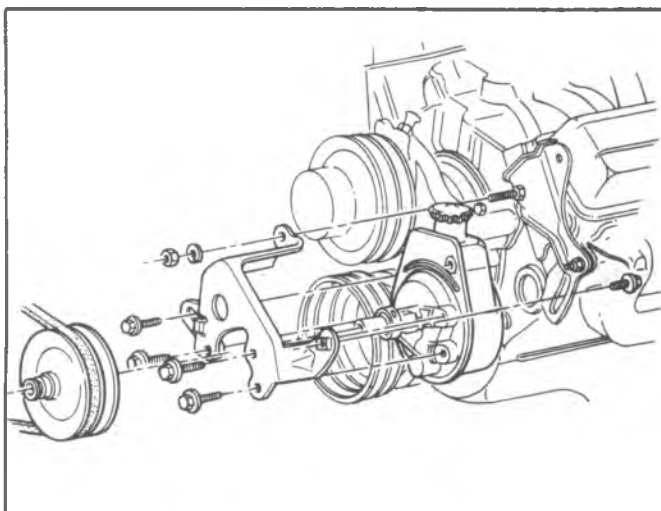


Fig. 3B3-18--P/S Pump Mounting; CK100, CK200, CK300 - LE4, LG9, LT9 and C60

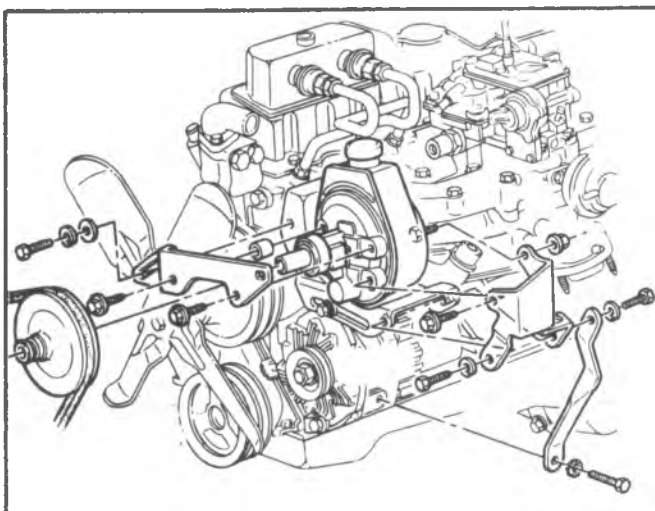


Fig. 3B3-21--P/S Pump Mounting; G100, G200, G300 with LE3 Engine

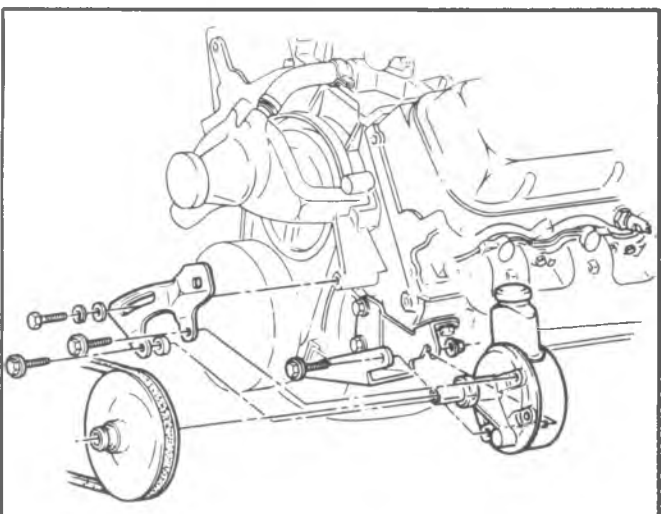


Fig. 3B3-19--P/S Pump Mounting; C100, C200, C300 with LE8 Engine

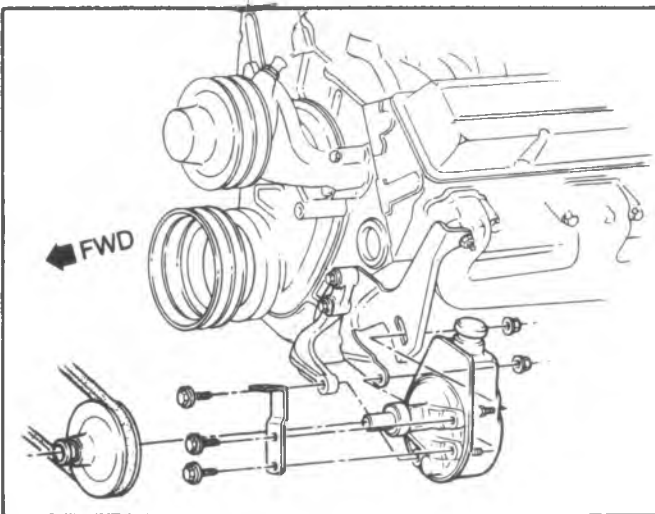


Fig. 3B3-22--P/S Pump Mounting; G100, G200, G300 - LE4, LF4, LG9, LS9, LT9

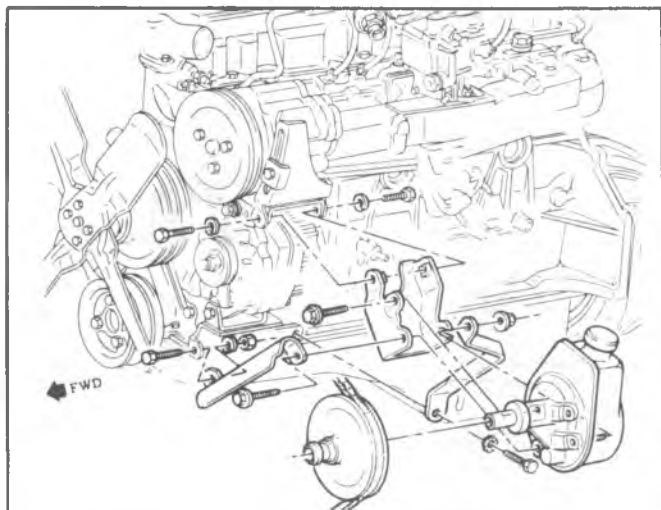


Fig. 3B3-23--P/S Pump Mounting; P200, P300 (42)
with L25 Engine

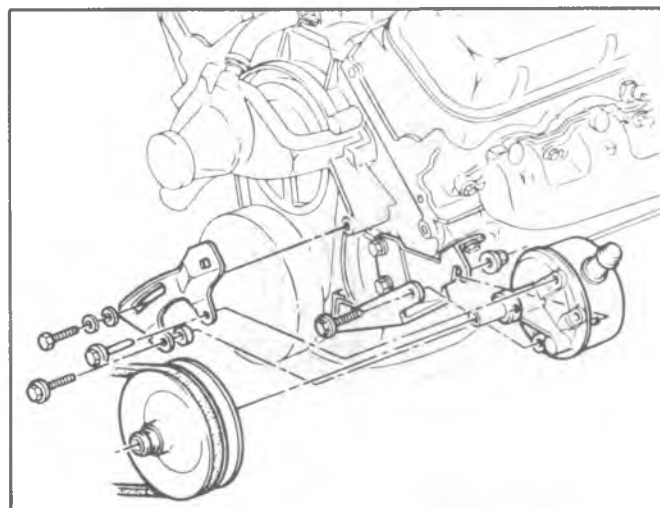


Fig. 3B3-26--P/S Pump Mounting; P300 (32) with LE8
Engine

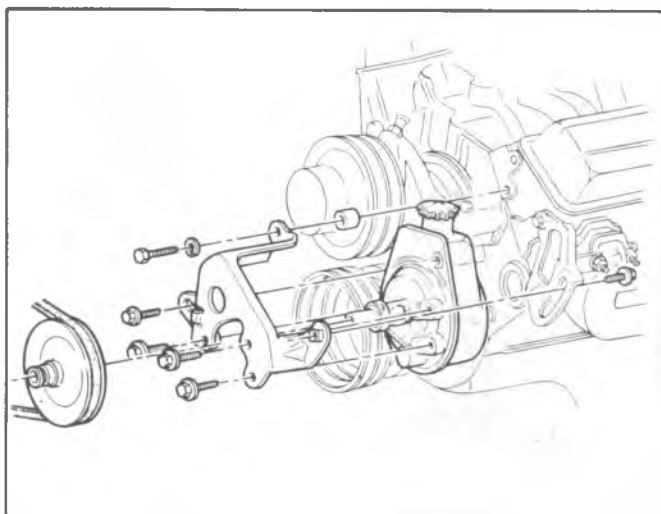


Fig. 3B3-24--P/S Pump Mounting; P200, P300 (42)
with LT9 (Exc. JB8)

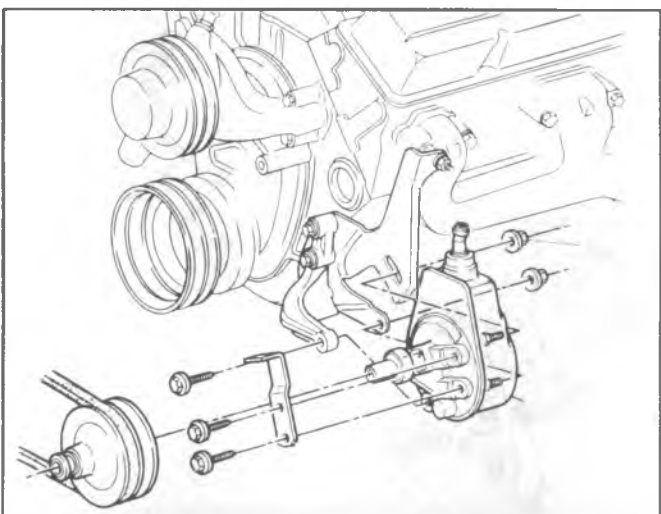


Fig. 3B3-25--P/S Pump Mounting; P200, P300 (32)
with LT9 Engine

POWER STEERING HOSES

When servicing the power steering hoses be sure to align the hoses in their correct position as shown in Figs. 3B3-27 through 3B3-42.

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 AND SPECIAL TOOLS

Refer to Specifications and Special Tools at end of Section 3B4.

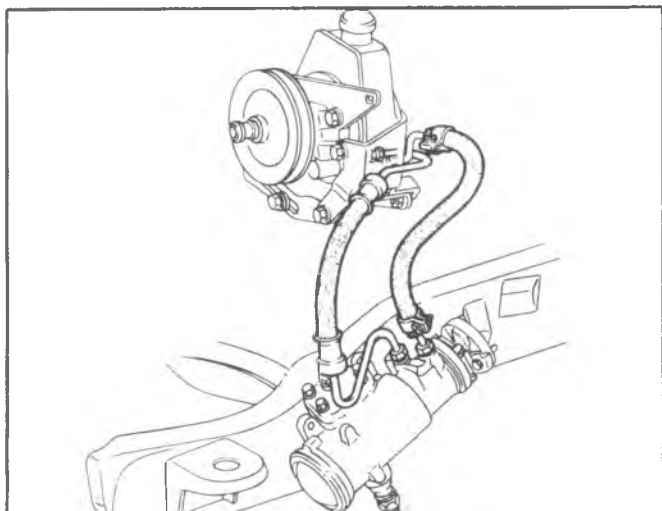


Fig. 3B3-27--P/S Hose Routing; CK100, CK200 (03)
with LE3 Engine

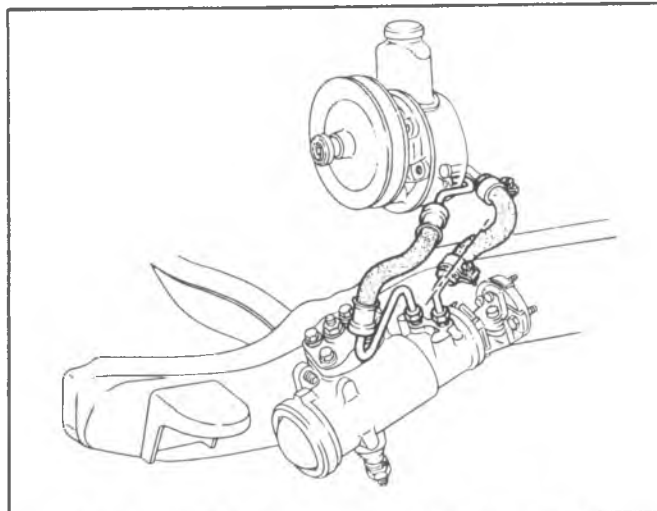


Fig. 3B3-30--P/S Hose Routing; C100, C200, C300
with LE8 Engine

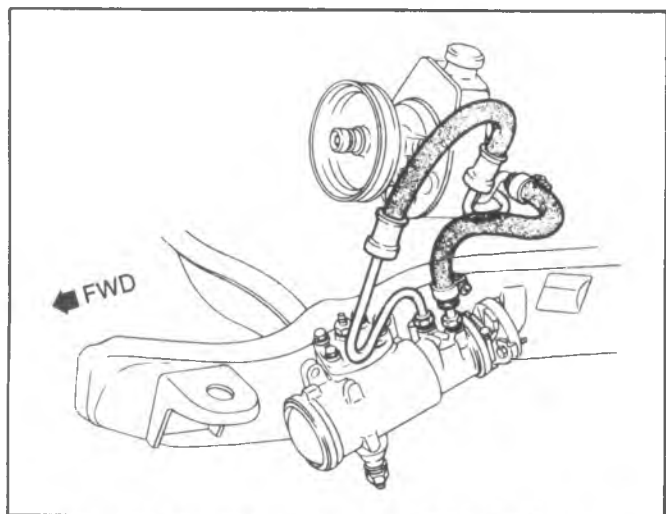


Fig. 3B3-28--P/S Hose Routing; CK200, CK300 with
L25 Engine

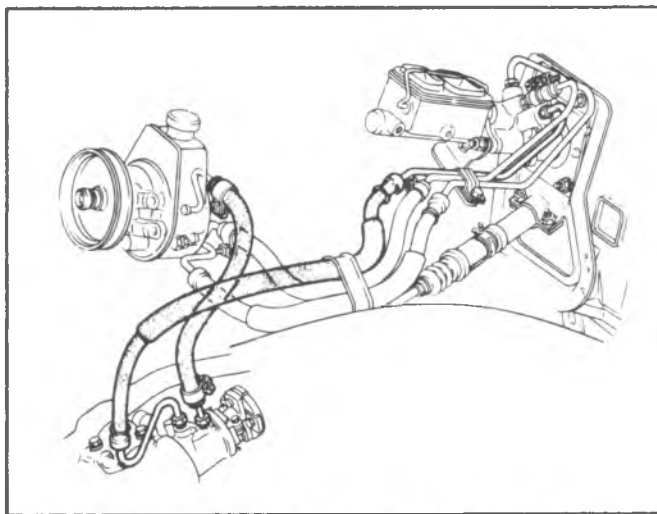


Fig. 3B3-31--P/S Hose Routing; CK300 with L25 and
JB8

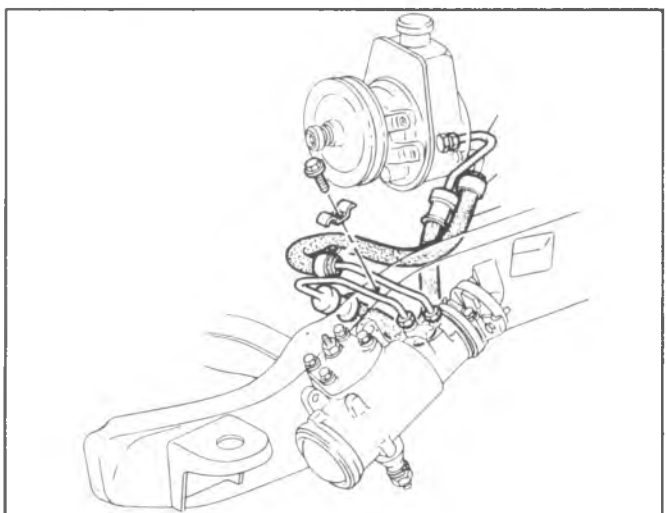


Fig. 3B3-29--P/S Hose Routing; CK100, CK 200, CK
300 - LE4, LG9, LS9, LT9 (Exc. C60, JB8)

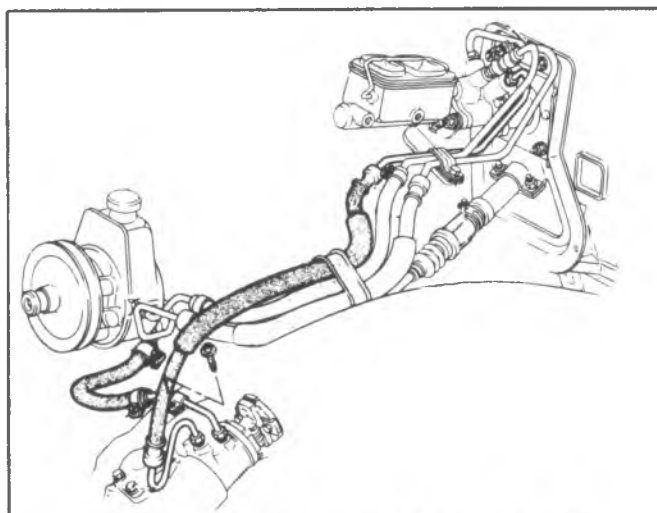


Fig. 3B3-32--P/S Hose Routing; CK300 - LE4, LF5,
LT9 and JB8

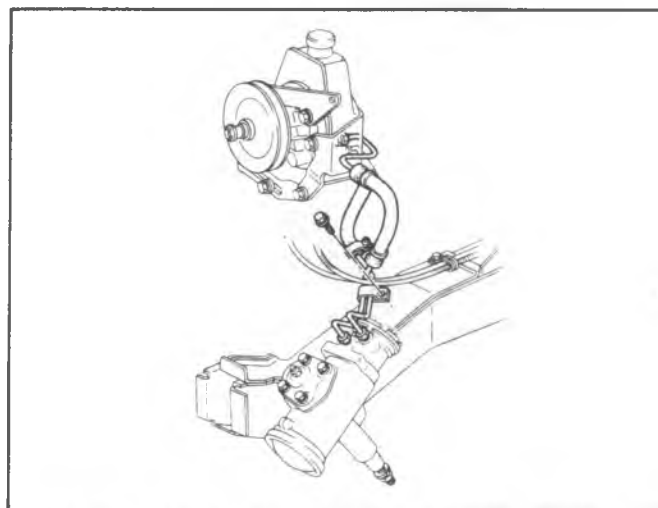


Fig. 3B3-36--P/S Hose Routing; G100, G200, G300 - with LE3 Engine

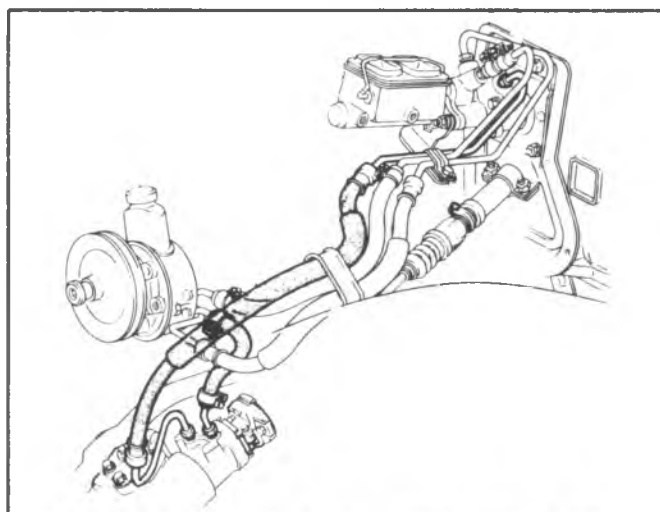


Fig. 3B3-34--P/S Hose Routing; C300 - LE8 and JB8 (Exc. HC4)

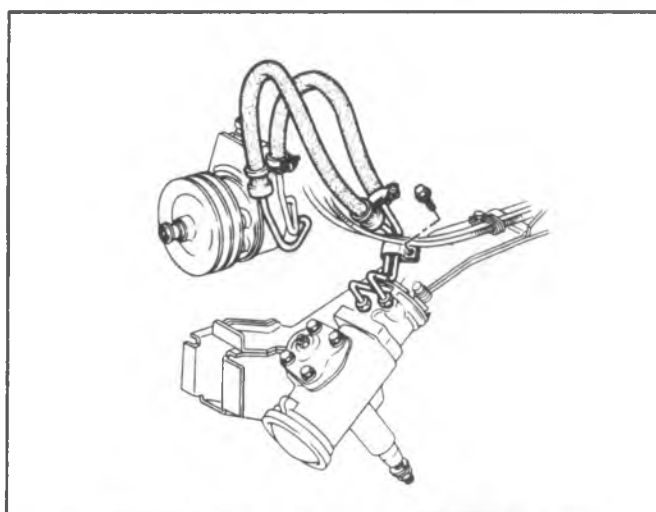


Fig. 3B3-37--P/S Hose Routing; G100, G200, G300 - LE4, LG9, LF4, LS9, LT9 and JB7

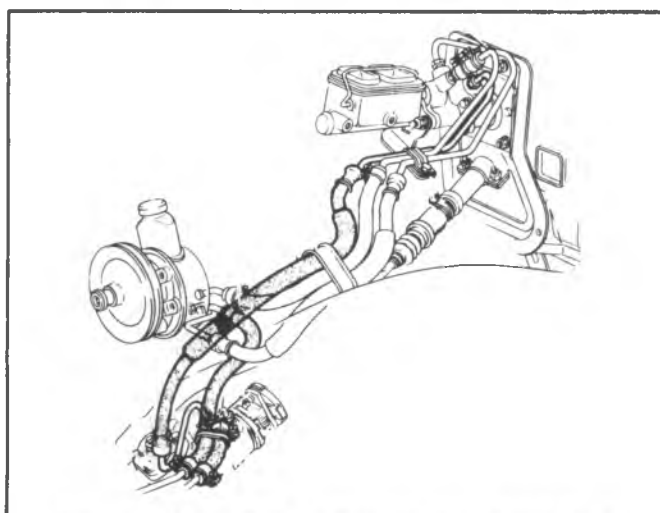


Fig. 3B3-35--P/S Hose Routing; C300 - LE8 and JB8 / HC4

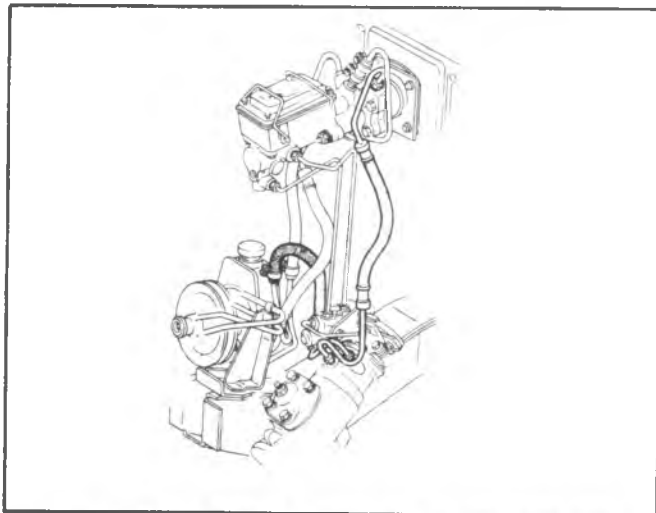


Fig. 3B3-38--P/S Hose Routing; G300 - LE4, LG9, LT9 and JB8

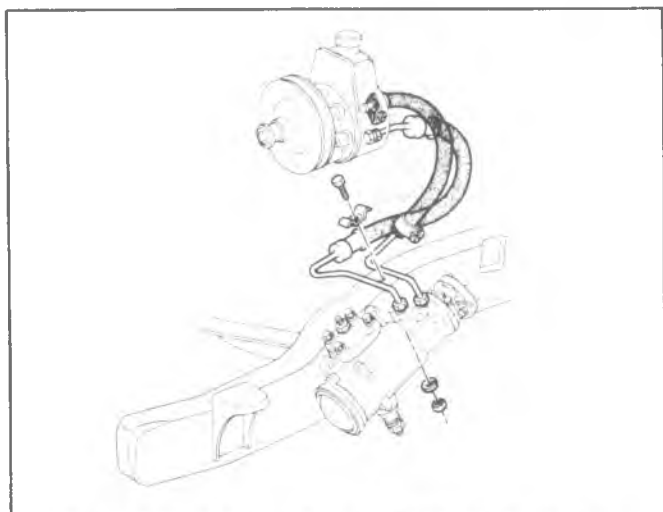


Fig. 3B3-39--P/S Hose Routing; P200, P300 (42) with L25 Engine and JB7

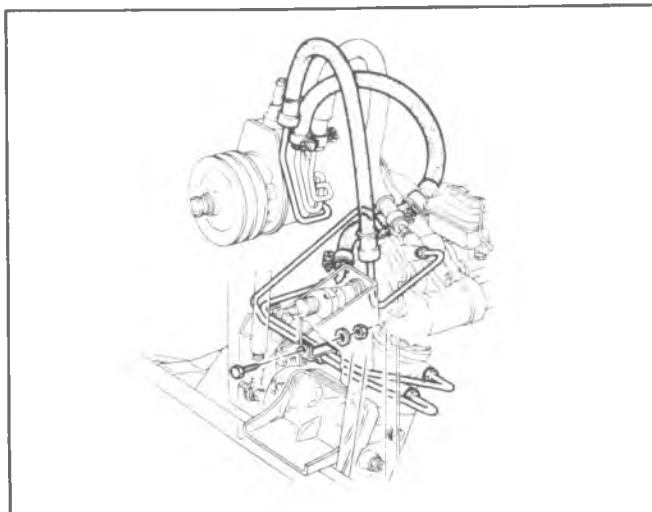


Fig. 3B3-41--P/S Hose Routing; P300 (32) with LT9 Engine

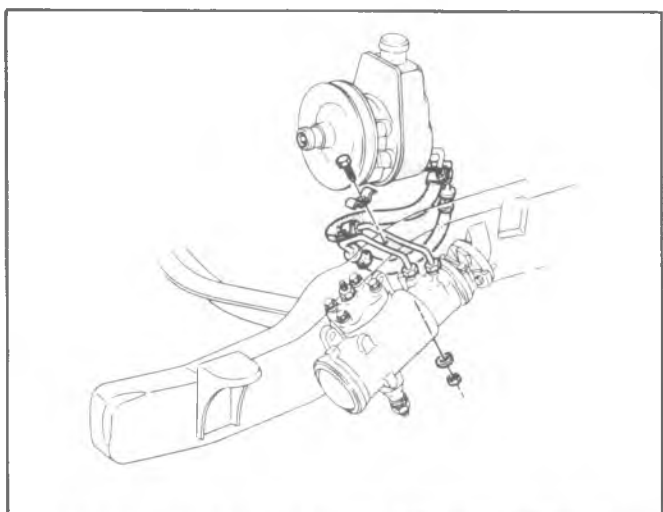


Fig. 3B3-40--P/S Hose Routing; P200, P300 (42) with LT9 Engine and JB7

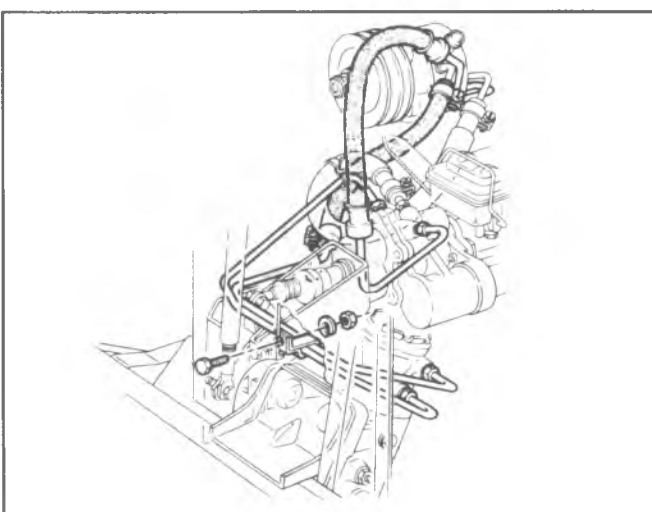
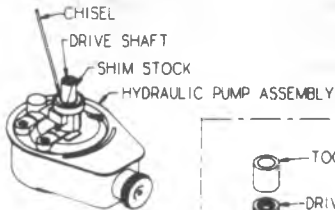


Fig. 3B3-42--P/S Hose Routing; P300 (32) with LE8 Engine

1. REMOVE AND INSTALL DRIVE SHAFT SEAL WITHOUT DISASSEMBLING THE PUMP.

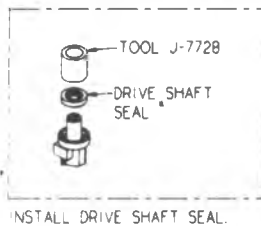
REMOVE

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.



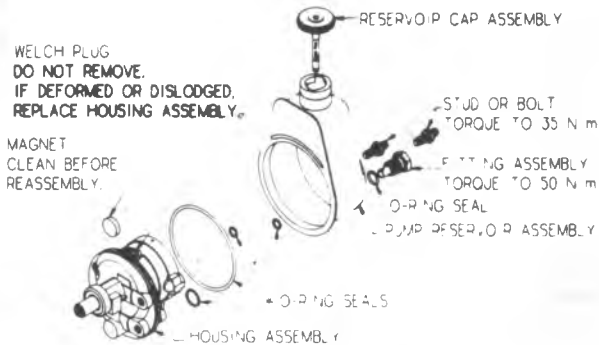
2. REMOVE AND INSTALL PUMP RESERVOIR ASSEMBLY

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.



3. REMOVE AND INSTALL END PLATE.

REMOVE

1. REFER TO INSET FOR RETAINING RING REMOVAL.

SCREWDRIVER
PUNCH



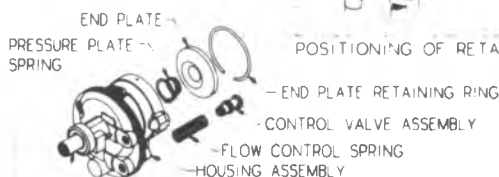
REMOVE RETAINING RING

INSTALL

1. LUBRICATE END PLATE AND RETAINING RING. INSTALL PARTS AS SHOWN. REFER TO INSET FOR POSITIONING OF RETAINING RING IN HOUSING.

PRESS RETAINING RING
LOCATE RING GAP
AT POSITION SHOWN

POSITIONING OF RETAINING RING.



1. 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.

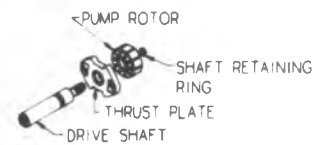
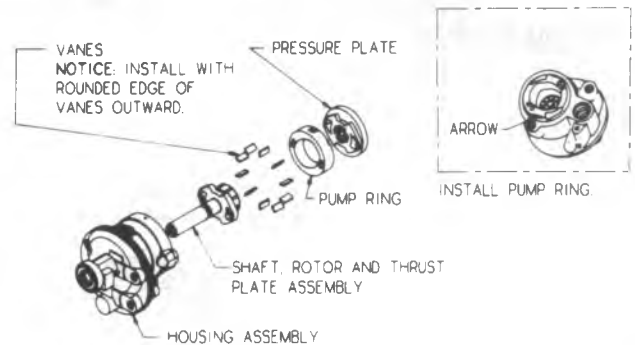
4. REMOVE AND INSTALL ROTATING GROUP.

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.



RETAINING RING REMOVAL

5. REMOVE AND INSTALL DRIVE SHAFT AND O-RING SEALS.

REMOVE

1. REMOVE PARTS AS SHOWN.

TOOL J-7728



INSTALL DRIVE SHAFT SEAL

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.

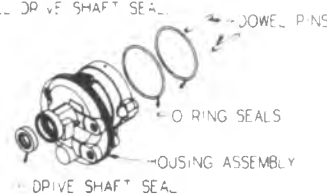


Fig. 3B3-50--Power Steering Pump Overhaul

POWER STEERING GEAR (605 MODEL)

GENERAL DESCRIPTION

This Integral Power Steering Gear has 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.

Whenever a part which forms a sealing surface for an "O" ring seal 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.

Round side cover — held in place with retaining ring



(605 MODEL)

Key No. Part Name

- 1-HOUSING, STEERING GEAR
- 2-RETAINER, STRG. COUPLING SHIELD
- 3-BEARING ASSY., NEEDLE (STUB SHAFT)
- 4-SEAL, STUB SHAFT
- 5-SEAL, STUB SHAFT DUST
- 6-RING, RETAINING (STUB SHAFT SEAL)
- 7-BEARING ASSY., NEEDLE (PITMAN SHAFT)
- 8-SEAL, PITMAN SHAFT
- 9-WASHER, SEAL BACK-UP (PITMAN SHAFT)
- 10-SEAL, PITMAN SHAFT DUST
- 11-RING, RETAINING (PITMAN SHAFT SEAL)
- 12-WASHER, LOCK (PITMAN SHAFT)
- 13-NUT, PITMAN ARM
- 14-BEARING ASSY., RACE & UPPER
- 15-RING, VALVE BODY (3)
- 16-SEAL, "O" RING (VALVE BODY) (3)
- 17-BODY ASSY., VALVE
- 18-SEAL, "O" RING (DAMPNER)
- 19-SPOOL, VALVE

Key No. Part Name

- 20-SHAFT ASSY., STUB
- 21-SEAL, "O" RING (SHAFT TO WORM)
- 22-WORM ASSY., PIN & STRG.
- 23-RING, RETAINING (SHAFT TO WORM)
- 24-RING, RACK PISTON
- 25-SEAL, "O" RING (RACK PISTON)
- 26-RACK-PISTON-NUT
- 27-BEARING ASSY., SUPPORT & LWR. THR.
- 28-SEAL, "O" RING (ADJUSTER PLUG)
- 29-PLUG, ADJUSTER
- 30-NUT, ADJUSTER LOCK
- 31-SPRING, SIDE COVER
- 32-SEAL, "O" RING (SIDE COVER)
- 33-GEAR ASSY., PITMAN SHAFT
- 34-COVER, ASSY., HOUSING SIDE
- 35-RING, RETAINING (SIDE COVER)
- 36-NUT, PRELOAD ADJUSTER SEALING
- 37-CONNECTOR, INVERTED FLARE (2)

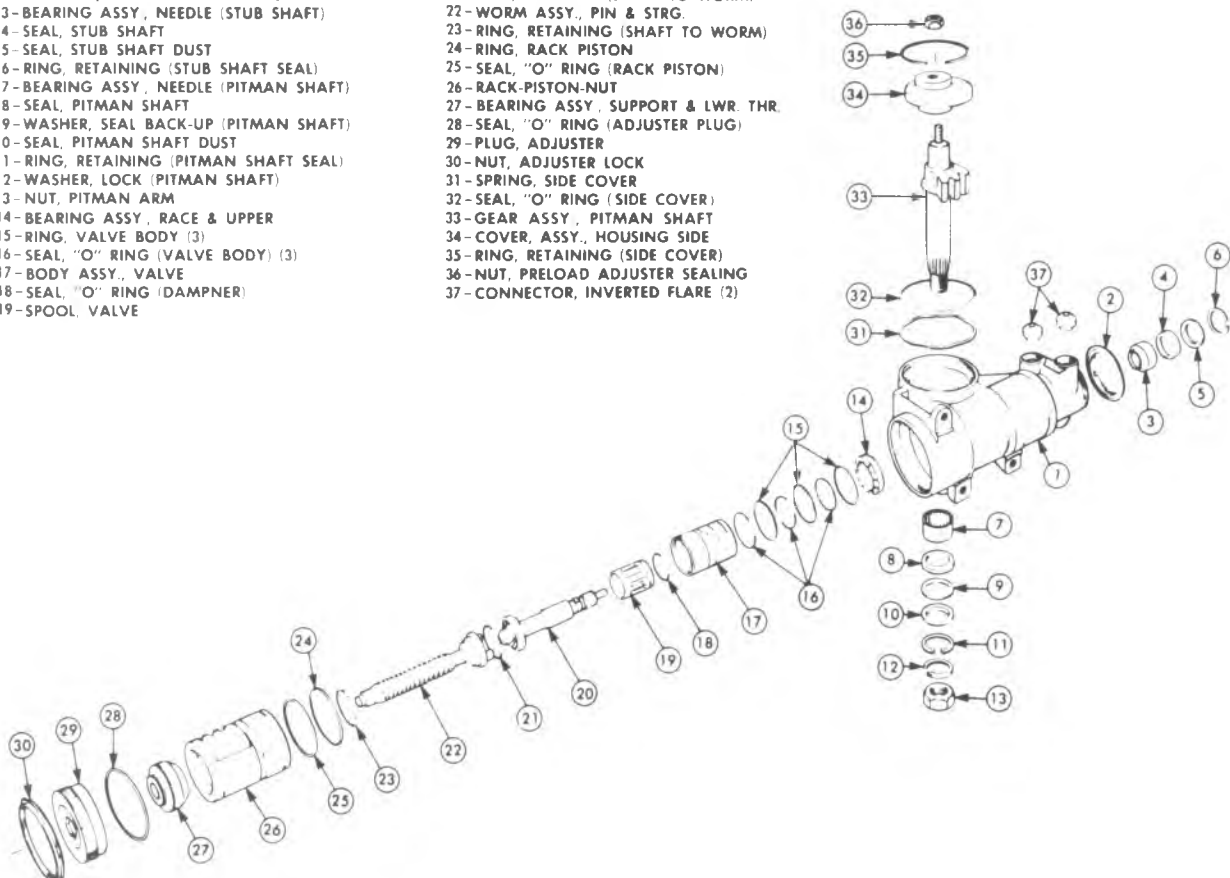


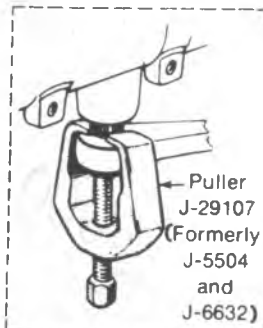
Fig. 3B3-51--Overhaul 605 Gear, Chart A

1. REMOVE AND INSTALL PITMAN SHAFT SEALS IN CAR

REMOVE

1. Clean exposed end of pitman shaft and end of housing after removing arm.
2. Remove retaining ring.
3. Start engine and turn wheels fully to the right to force seals and washer out.
4. Turn off engine.
5. Inspect housing and shaft.

PITMAN SHAFT —
Inspect seal surface for roughness and pitting



Remove Pitman Arm

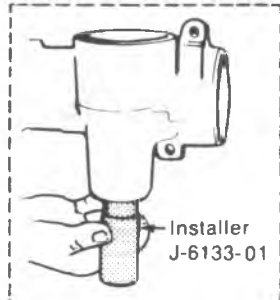
INSTALL

1. Install parts as shown

HOUSING ASSEMBLY
Inspect for burrs.



NUT — Torque to
250 Newton Meters
(185 Ft. Lbs.)



Install Seals

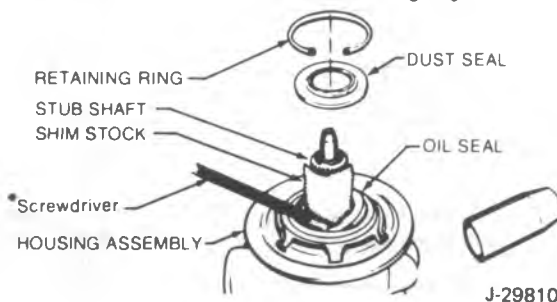
2. REMOVE AND INSTALL STUB SHAFT SEALS WITHOUT DISASSEMBLING GEAR

REMOVE

1. Remove retaining ring and dust seal. Take care not to scratch shaft.
2. Wrap 0.1mm to 0.2mm (.005" to .008") shim stock around shaft and insert between shaft and sealing lip until it bottoms. Pry seal out.*

INSTALL

1. Install stub shaft seal protector J-29810 on stub shaft. Install stub shaft seal. Coat top of seal with anhydrous calcium grease.
2. Install dust seal just deep enough to clear retaining ring groove, then install retaining ring.



J-29810

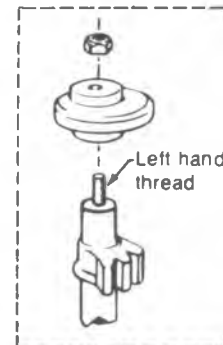
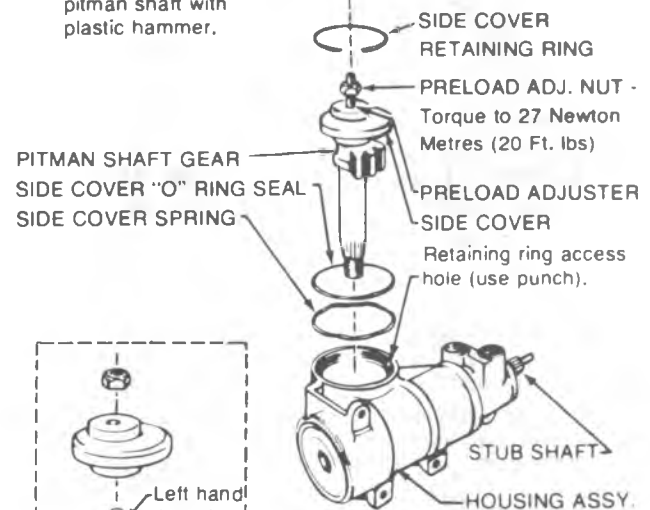
3. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

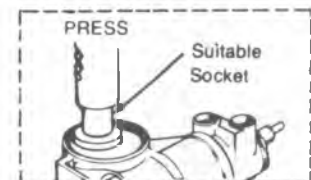
1. If pitman shaft and side cover are to be separated, remove preload adjuster nut. IT IS A LEFT HAND THREAD.
2. Rotate stub shaft to center gear, then remove parts as shown. Tap on thread end of pitman shaft with plastic hammer.

INSTALL

1. Install parts as shown. Use new retaining ring, make sure that open end of retaining ring is approx. 13mm (1/2") from access hole.
2. Side cover must be depressed to install retaining ring. (SEE BELOW)*



Separate pitman shaft from side cover if required



* Depress side cover

4. REMOVE AND INSTALL LOWER BEARING AND ADJUSTER

REMOVE

1. Loosen lock nut. Use punch against edge of one slot.
2. Remove parts as shown
3. Inspect lower thrust bearing assembly.

INSTALL

1. Install parts as shown.
2. Adjust thrust bearing preload (see adjustment procedure) before tightening lock nut.

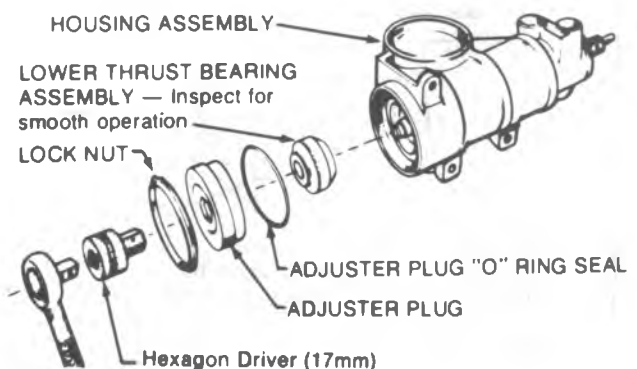


Fig. 3B3-52--Overhaul 605 Gear, Chart B

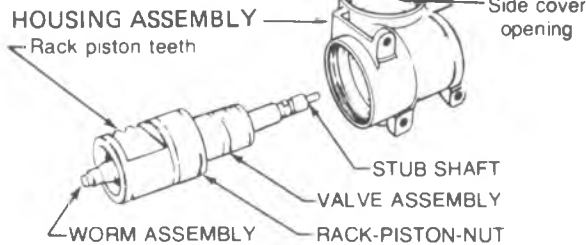
5. REMOVE AND INSTALL RACK PISTON AND VALVE ASSEMBLY

REMOVE

1. Remove parts as shown. Push on stub shaft. DO NOT remove upper bearing assembly (see stub shaft seal removal)

INSTALL

1. Install parts as shown. Make sure rack piston teeth are positioned toward side cover opening.



6. REMOVE AND INSTALL VALVE AND WORM ASSEMBLY FROM RACK PISTON

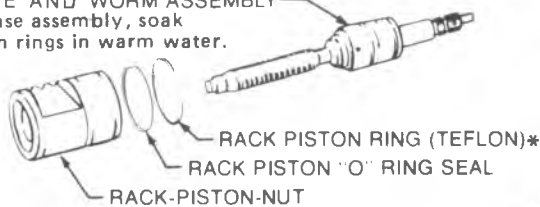
REMOVE

1. Unscrew valve and worm from rack.
2. Remove teflon ring and rack piston "O" ring from rack piston

INSTALL

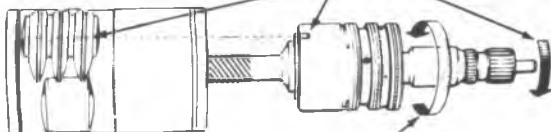
1. Install "O" ring and teflon ring as shown.
2. Screw worm and valve into rack piston. See procedure below.

VALVE AND WORM ASSEMBLY
* To ease assembly, soak teflon rings in warm water.



A. Assemble worm and valve to rack piston

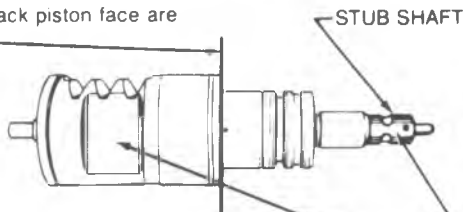
- a. Hold rack teeth and worm drive pin in relation shown with light pressure to hold worm thread against piston.
- b. Turn worm and valve counterclockwise slowly until one "Click" is felt.



- c. Turn worm and valve clockwise to complete assembly.

B. Check relation of stub shaft and rack piston

- a. Screw worm and valve into rack piston until valve face and rack piston face are flush.



- b. With rack piston in position shown, flats on stub shaft and piston are to be parallel. If not parallel, disassemble and repeat "A" above.

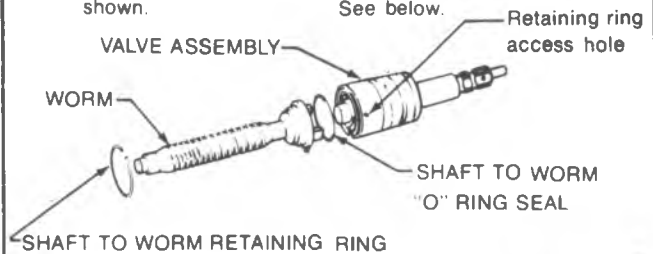
7. REMOVE AND INSTALL VALVE ASSEMBLY FROM WORM ASSEMBLY

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown. See below.



Assemble worm to valve

RETAINING RING — Install with "curved in end" on same side as access hole.

WORM ASSEMBLY — Retaining ring access hole

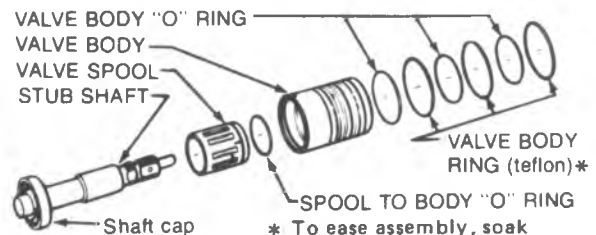
8. DISASSEMBLE AND ASSEMBLE VALVE

DISASSEMBLE

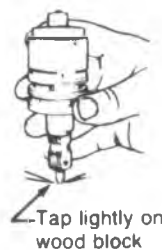
1. Disassemble parts as shown.

ASSEMBLE

2. Assemble parts as shown.

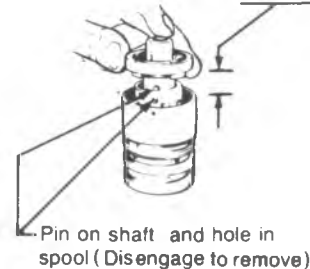


A. Loosen shaft cap



B. Remove and install stub shaft

Pull cap out approx. 6 mm (1/4")

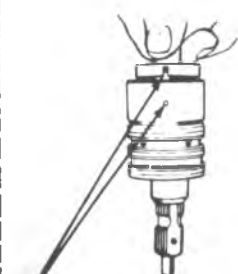


C. Remove and install spool



Lubricate spool and body with power steering fluid.

D. Engage stub shaft



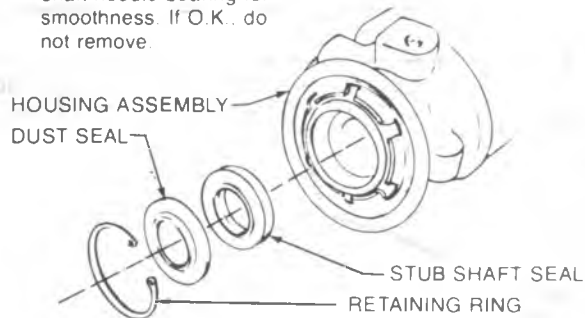
9. REMOVE AND INSTALL STUB SHAFT SEALS AND BEARINGS

REMOVE

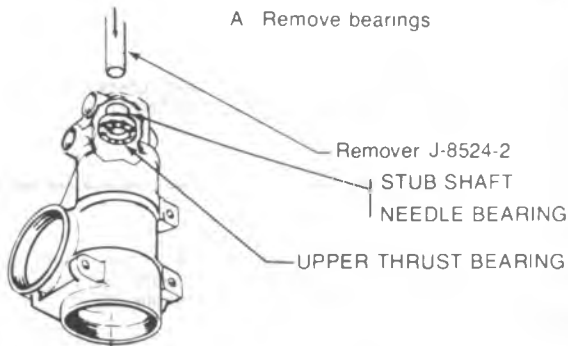
1. Clean end of housing to prevent dirt from entering gear.
2. Remove parts as shown, being careful not to score housing bore.
3. Remove stub shaft needle bearing and upper thrust bearing if required. Put a finger into the stub shaft cavity and hook it onto the upper thrust bearing race. Turn the race while pulling up. If bearing operation is smooth, it does not need removal. Check the stub shaft needle bearing for smoothness. If O.K., do not remove.

INSTALL

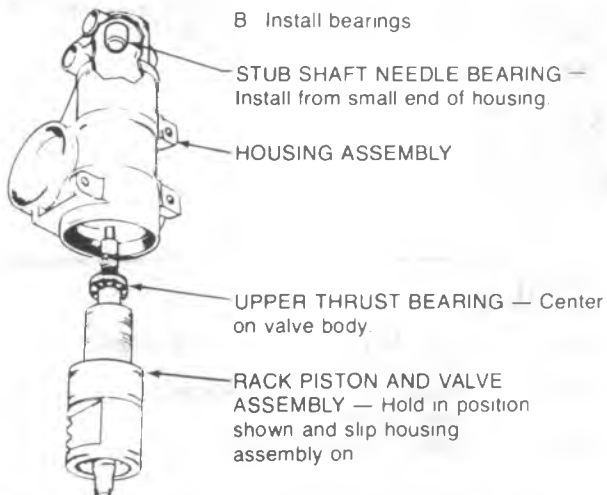
1. If removed, install new stub shaft needle bearing. Bottom tool on housing counterbore.
- SERVICE thrust bearing DOES NOT SNAP ON needle bearing. If removed, install as shown below.**
2. Install stub shaft seal. Librally coat top of seal with anhydrous calcium grease.
 3. Install dust seal just deep enough to clear retaining ring groove, then install retaining ring.



A Remove bearings



B Install bearings



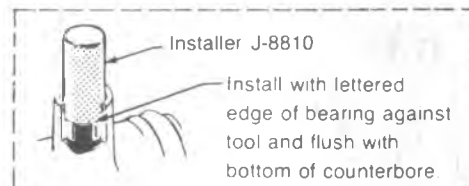
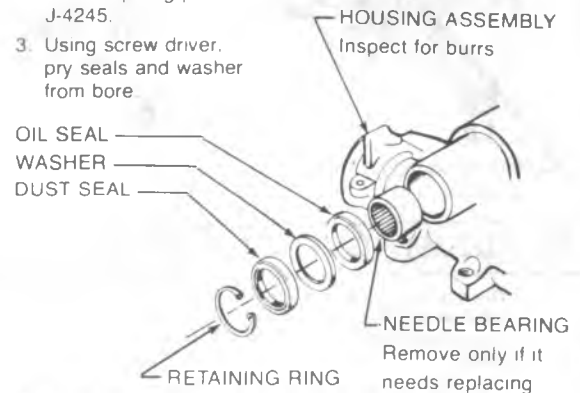
10. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

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 washer from bore.

INSTALL

1. Bottom oil seal in counterbore. Install washer. Coat seal lip and washer face with anhydrous calcium grease.
2. Install remaining parts as shown.



Remove and install bearing (not necessary unless bearing is to be replaced)

11. REMOVE AND INSTALL CONNECTORS

REMOVE

1. Remove parts as shown.

Some models will not use these connectors.

INSTALL

1. Install parts as shown.

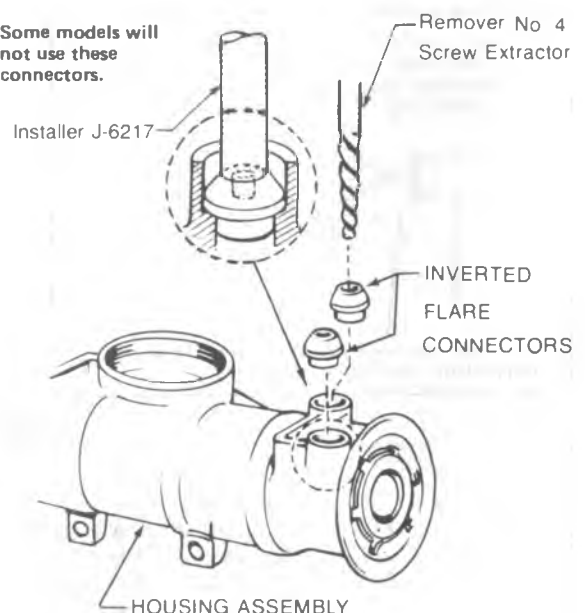
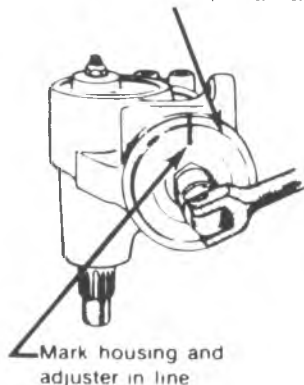


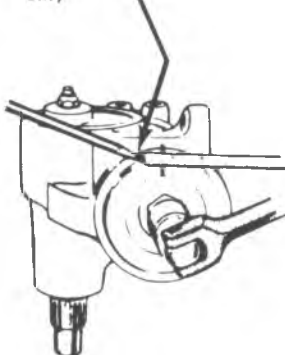
Fig. 3B3-54--Overhaul 605 Gear, Chart D

12. ADJUST WORM BEARING PRELOAD

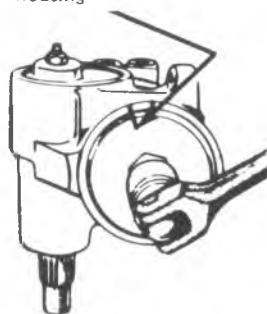
- A Tighten adjuster plug until it bottoms (use 17mm hex. driver). Torque to approx. 40 Newton meters (30 ft. lbs.)



- B Measure 13mm (1/2") counter-clockwise and mark housing only



- C Turn adjuster back until mark lines up with second mark on housing



- D Tighten lock nut. Use punch in notch



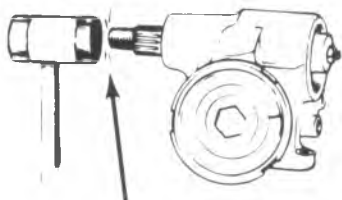
13. ADJUST "OVER CENTER" PRELOAD

- A. Whenever a power steering gear requires adjustment, the gear should be drained of hydraulic fluid.



To drain the fluid, position the assembly with hydraulic line ports pointing downward over a container and cycle the rack-piston-nut from stop to stop three or four times.

- B. When a unit has been disassembled for any reason, the side cover must be firmly seated against its retaining ring before any adjustment is attempted.



To seat the side cover, tap on the end of the pitman shaft with a soft hammer.

- C. Back off preload adjuster (LEFT HAND THREAD) until it stops, then turn it in one full turn.



With gear at center of travel, check torque to turn stub shaft (reading No. 1)

- D. Turn adjuster in until torque to turn stub shaft is 0.6 to 1.2 Newton meters (6 to 10 in. lbs.) more than reading No. 1.



Torque adjuster lock nut to 27 Newton meters (20 ft. lbs.) Prevent adjuster screw from turning while torquing lock nut.

SPECIAL TOOLS

J-4245 — Snap Ring Pliers
J-29107 — Pitman Arm Puller
J-6133-01 — Pitman Shaft Seal Installer
J-6217 — Connector Seat Installer
J-7754 — 0-5 Newton-meter Torque Wrench (0-25 inch-pounds)

J-8058 — 0-125 Newton-meter Torque Wrench (0-50 foot-pounds)
J-8810 — Pitman Shaft Bearing Remover And Installer
J-25323 — Power Steering Analyzer

Fig. 3B3-55--Overhaul 605 Gear, Chart E

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.

Repair procedures for these two models are different. Note the side cover differences in the sketch below.

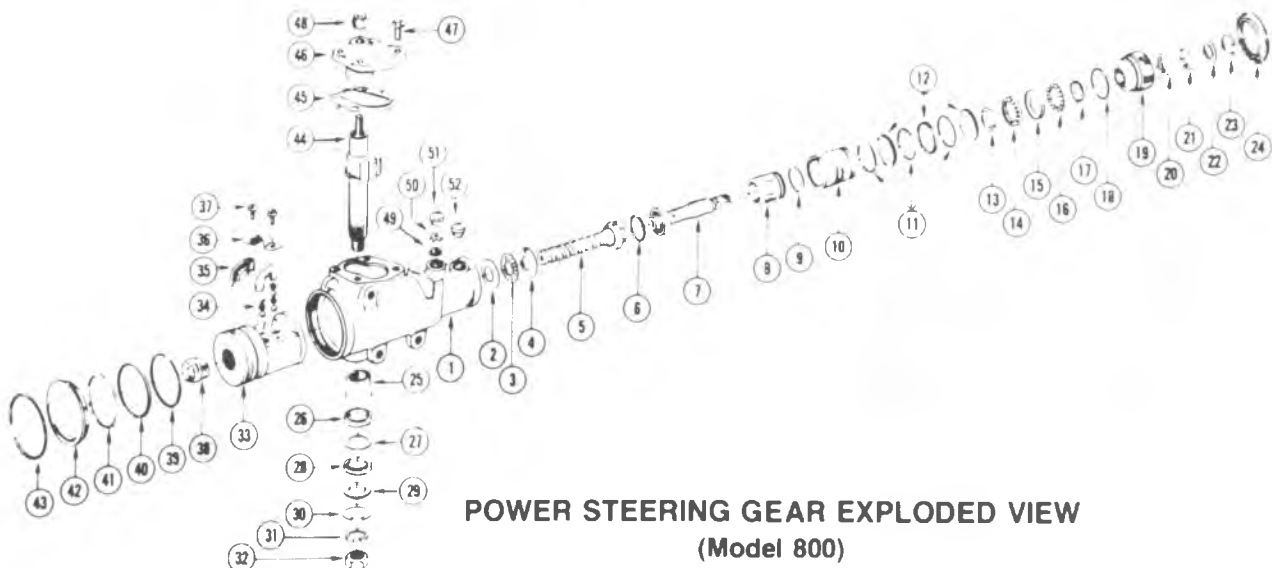
Whenever a part which forms a sealing surface for an "O" ring is removed, the "O" ring seal should also be removed and replaced with a new seal. Whenever one of the Pitman shaft or stub shaft seals are removed all adjacent seals should be removed and replaced with new seals. Lubricate all new seals with power steering fluid to ease assembly.



Rectangular side cover held in place with four bolts

(800 MODEL)

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 BEARING (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		

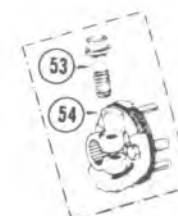


POWER STEERING GEAR EXPLODED VIEW
(Model 800)

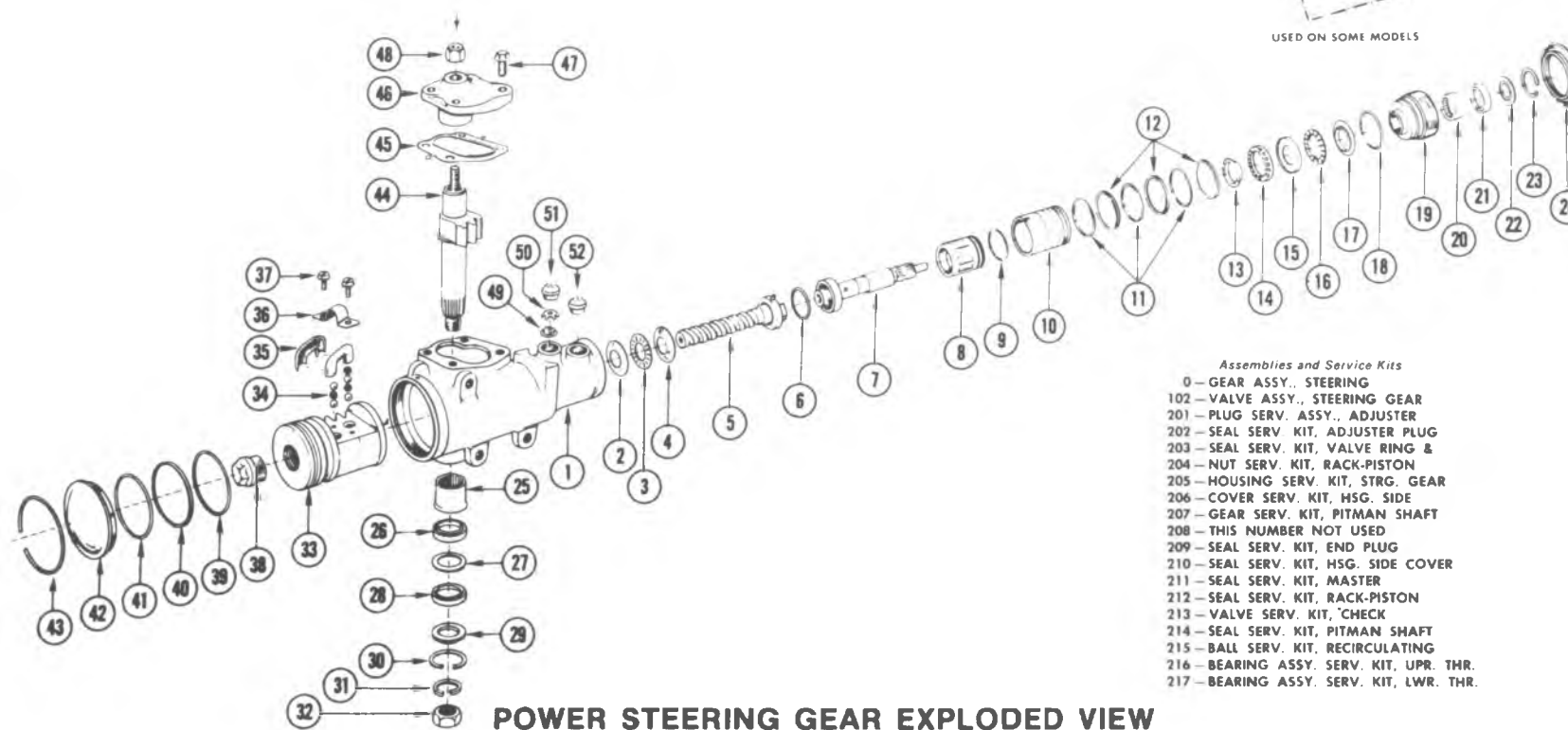
Key No.	Part Name
1	HOUSING, STEERING GEAR
2	RACE, THRUST BEARING (WORM)
3	BEARING ASSY., ROLLER THRUST (WORM)
4	RACE, THRUST BEARING (WORM)
5	WORM, STEERING
6	SEAL, "O" RING (STUB SHAFT)
7	SHAFT, STUB
8	SPOOL, VALVE
9	SEAL, "O" RING (SPOOL)
10	BODY, VALVE
11	RING, VALVE BODY (3)
12	SEAL, "O" RING (VALVE 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

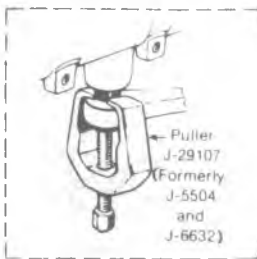
- 0 - GEAR ASSY., STEERING
- 102 - VALVE ASSY., STEERING GEAR
- 201 - PLUG SERV. ASSY., ADJUSTER
- 202 - SEAL SERV. KIT, ADJUSTER PLUG
- 203 - SEAL SERV. KIT, VALVE RING &
- 204 - NUT SERV. KIT, RACK-PISTON
- 205 - HOUSING SERV. KIT, STRG. GEAR
- 206 - COVER SERV. KIT, HSG. SIDE
- 207 - GEAR SERV. KIT, 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.

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.

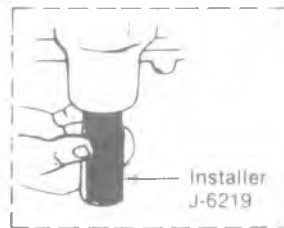
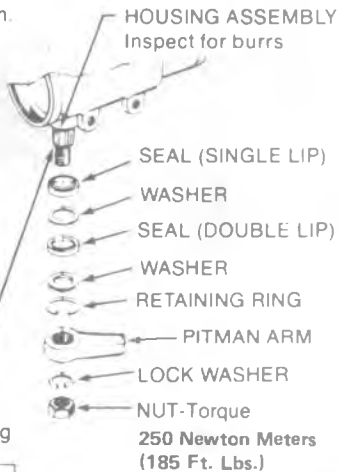
PITMAN SHAFT
Inspect seal surface for roughness and pitting



Remove Pitman Arm

INSTALL

1. Install parts as shown.

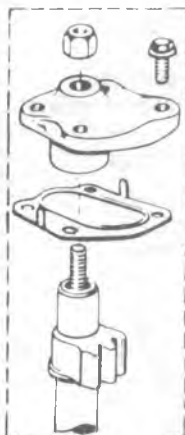


Install Seals

2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

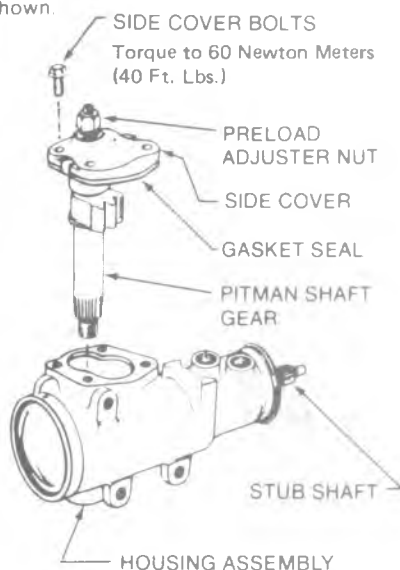
1. If pitman shaft and side cover are to be separated, remove preload adjuster nut.
2. Rotate stub shaft to center gear, then remove parts as shown.



Separate pitman shaft and gasket seal from side cover if required

INSTALL

1. If removed, install gasket seal by bending tabs around cover edges.
2. Install parts as shown.



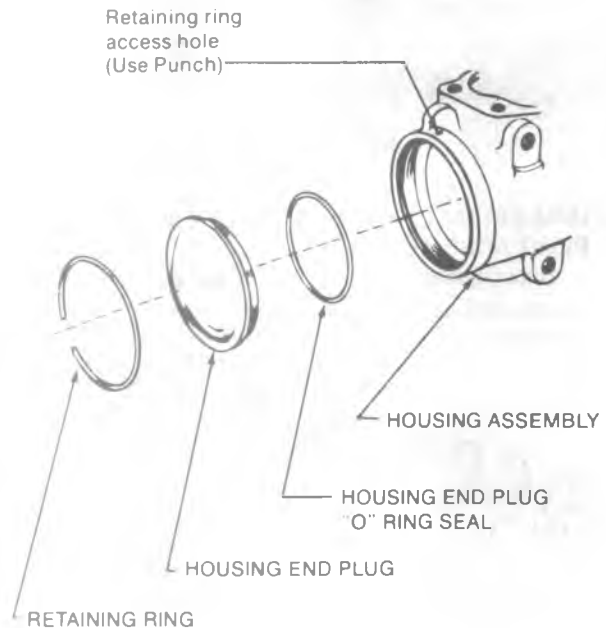
3. REMOVE AND INSTALL HOUSING END PLUG

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.



4. REMOVE AND INSTALL RACK PISTON

REMOVE

1. Remove parts as shown.

INSTALL

When installing rack, care should be taken not to cut teflon seal, rack piston seal compressor J-7576 or J-8947 may be used to compress seal.

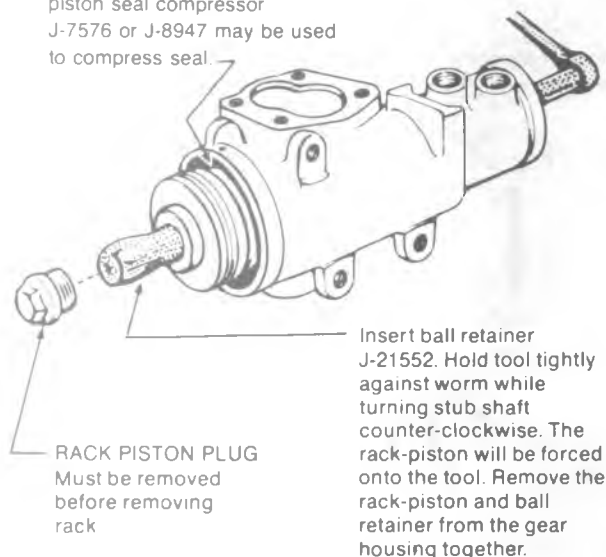


Fig. 3B3-58--Overhaul 800/808 Gear, Chart C

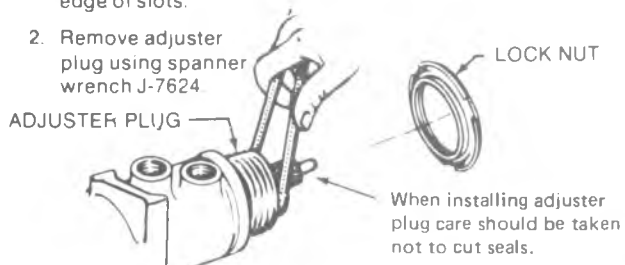
5. REMOVE AND INSTALL ADJUSTER PLUG ASSEMBLY

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.



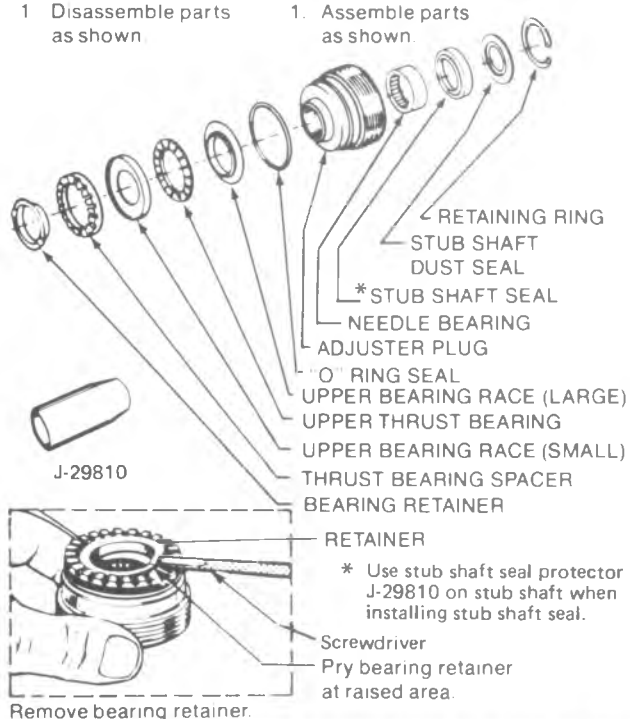
6. DISASSEMBLE AND ASSEMBLE ADJUSTER PLUG ASSEMBLY

DISASSEMBLE

1. Disassemble parts as shown.

ASSEMBLE

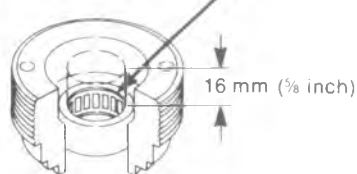
1. Assemble parts as shown.



Remove bearing retainer.

Use suitable size arbor to press bearing in place.

Bearing to be pressed 16 mm (5/8 inch) into adjuster with stamped I.D. end up and from direction of arrow.



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.

INSTALL

1. Install parts as shown.

Separate the valve from the worm. Note how the pin in the worm fits the slot in the valve.

THRUST BEARING AND RACES

VALVE ASSEMBLY

WORM ASSEMBLY

When reassembling gear make sure angle of thrust races are as shown.

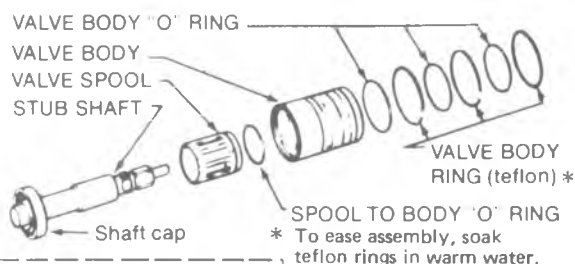
8. DISASSEMBLE AND ASSEMBLE VALVE

DISASSEMBLE

1. Disassemble parts as shown.

ASSEMBLE

1. Assemble parts as shown.



A. Loosen shaft cap



Tap lightly on wood block

B. Remove and install stub shaft

Pull cap out approx. 6 mm (1/4")



Pin on shaft and hole in spool (Disengage to remove)

C. Remove and install spool

Rotate while removing or installing



Lubricate spool and body with power steering fluid.

D. Engage stub shaft



Notch must fully engage pin and cap must seat against shoulder.

9. DISASSEMBLE AND ASSEMBLE RACK PISTON

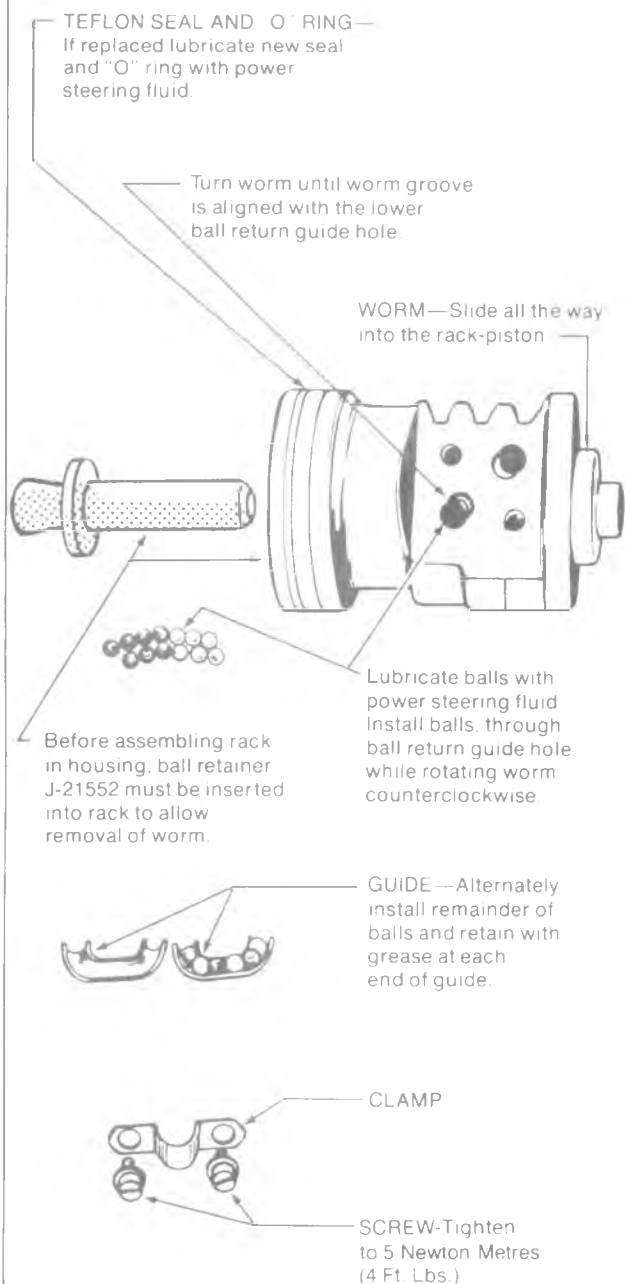
DISASSEMBLE

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.

HOUSING ASSEMBLY
Inspect for burrs.

PITMAN SHAFT SEAL (SINGLE LIP)

PITMAN SHAFT SEAL (DOUBLE LIP)

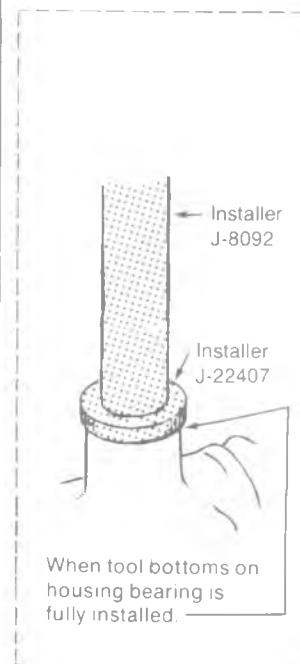
RETAINING RING

SEAL BACK UP WASHER

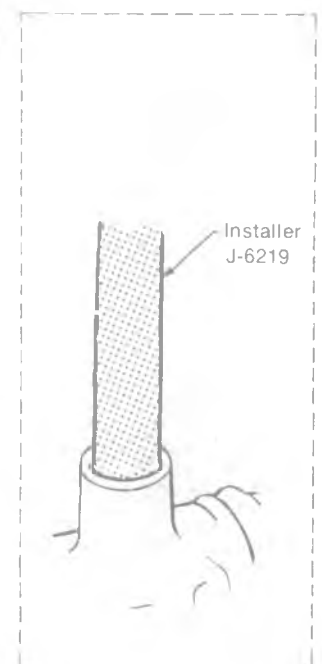
NEEDLE BEARING
Remove only if it needs replacing.



Removing bearing



Install Pitman shaft bearing

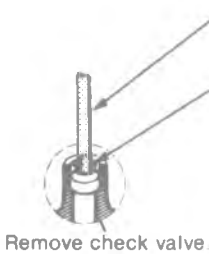


Install Pitman shaft seals

11. REMOVE AND INSTALL CHECK VALVE

REMOVE

1. Remove 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.

INSTALL

1. Install parts as shown.

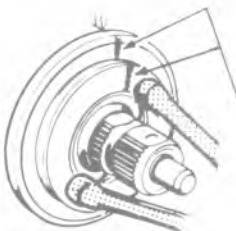


Using a piece of 3/8 tubing, 4 inches long, carefully drive the check valve into the housing.

Install check valve.

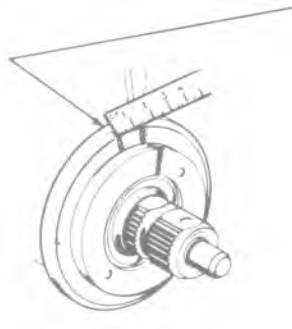
12. ADJUST THRUST BEARING PRELOAD

- A. Using spanner wrench J-7624, tighten adjuster plug until thrust bearing is firmly bottomed, 27 Newton Metres (20 Ft. Lbs.)



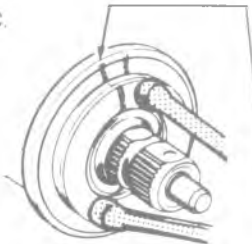
Mark housing and face of adjuster plug.

- B.



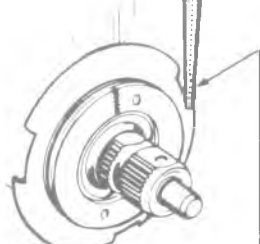
Measure back counter-clockwise 13 mm (1/2") and place a second mark on housing.

- C.



Turn adjuster counter-clockwise until mark on face of adjuster lines up with second mark on housing.

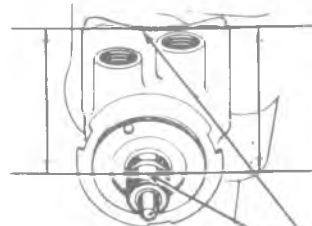
- D.



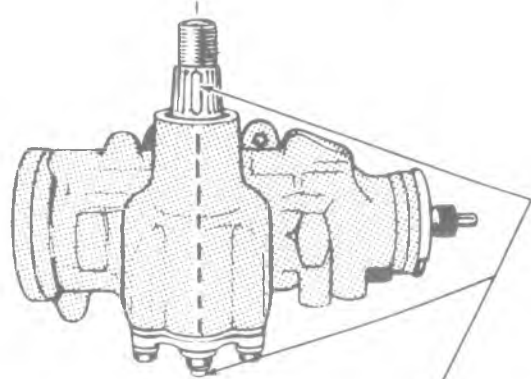
Using punch in notch tighten lock nut securely. Hold adjuster plug to maintain alignment of the marks.

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.



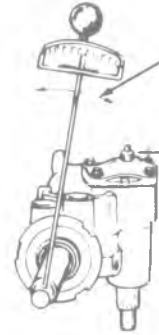
The block tooth on the Pitman shaft is in line with the over-center preload adjuster

- 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.

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
---------------------	----	----

Reservoir Duct	48	35
Flow Control Fitting	48	35

Pressure Hose	27	20
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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.
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Capacity (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.
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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
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Side Cover Bolts	60	45
------------------	----	----

Side Cover Bolts	60	45
Adjuster Plug Locknut	110	80

Adjuster Plug Locknut	110	80
Coupling Flange Nuts	27	20

Coupling Flange Nuts	27	20
Return Guide Clamp Screws	5	4

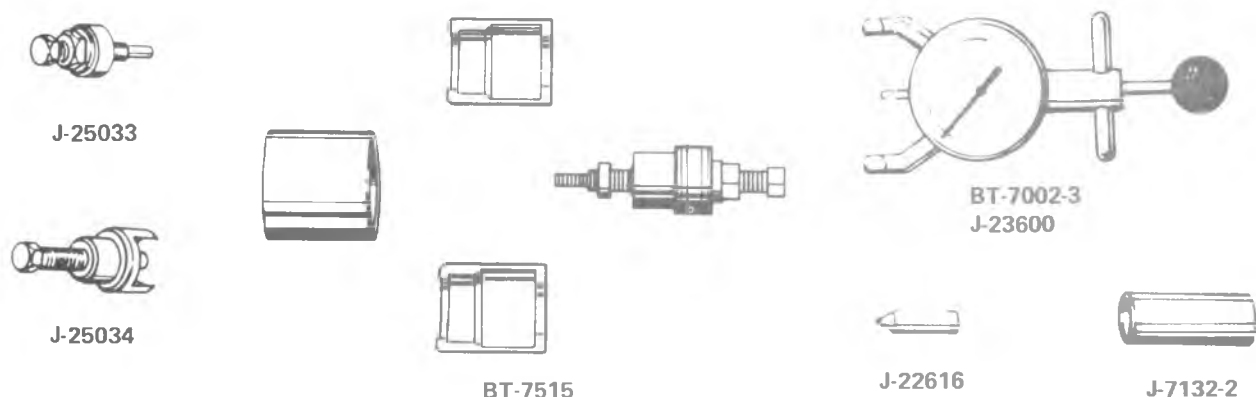
Return Guide Clamp Screws	5	4
Rack-Piston Plug	100	75

Rack-Piston Plug	100	75
Pitman Shaft Nut	240	185

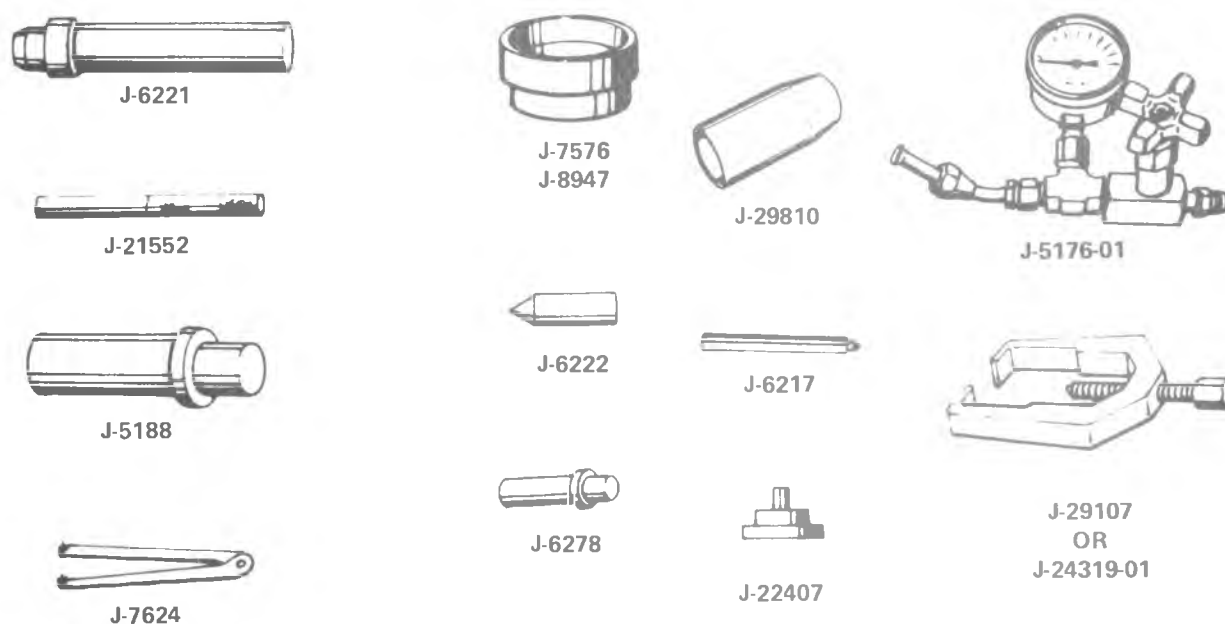
Coupling Flange Bolt	40	30
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Fig. 3B3-62--Overhaul 800/808 Gear, Chart G

POWER STEERING PUMP



POWER STEERING GEAR



J-5176-01	Pressure Testing Manifold	J-7576	Rack-Piston Teflon Ring Compressor
J-5188	End Cover Seal and Needle Bearing Installer	J-7624	Spanner Wrench
J-6217	Hose Connector Installer	J-8947	Rack-Piston Teflon Ring Compressor
J-6221	Bearing Installer	J-21552	Ball Retainer
J-6222	End Cover Seal Protector (Used for Installing Adjuster Plug)	J-24319-01	Puller
J-6278	Pitman Shaft Bearing Remover and Installer	J-22407	Pitman Bearing Installer
J-6278-2	Adapter (Used with J-6278 for Installing Pitman Shaft Seals and Bearing)	J-22616	Seal Protector
BT-7002-3	Belt Tension Gage	J-23600	Belt Tension Gage
J-7132-2	Seal Installer	J-25033	Power Steering Pump Pulley Installer
BT-7515	Pulley Remover and Installer	J-25034	Power Steering Pump Pulley Remover
		J-29107	Pitman Arm Puller
		J-29810	Stub Shaft Seal Protector

Fig. 3B3-63--Special Tools

SECTION 3B4

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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C-Series, K-Series	3B4-18
G-Series, P-Series	3B4-35
Specifications	3B4-51
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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 absorbing column may be easily disassembled and reassembled. The serviceman should be aware that 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.

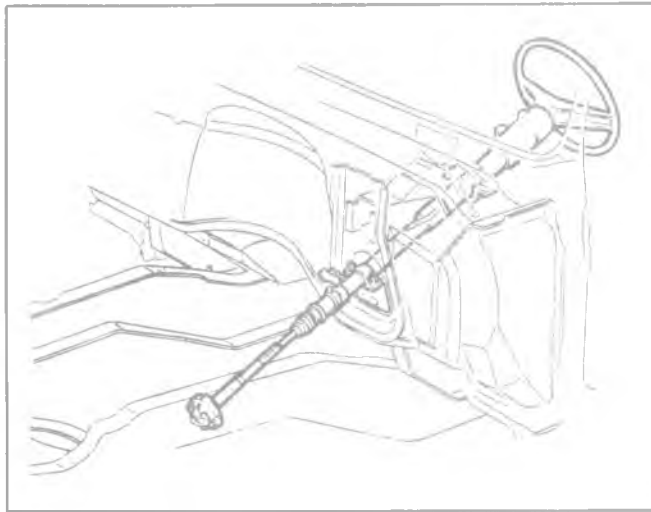


Fig. 3B4-1—Steering Column

DIAGNOSIS

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 (Fig. 3B4-2)

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", "RIGHT", "HAZARD", "BLUZZER".



Fig. 3B4-2—Steering Column Electrical Analyzer J-23980

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 (Fig. 3B4-2).

COLLISION DIAGNOSIS (FIGS. 3B4-3 THROUGH 3B4-8)

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.

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.

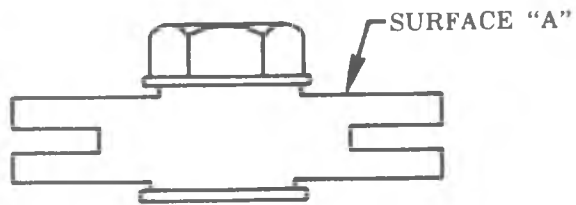
METHOD TO DETERMINE COLUMN COLLAPSE

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".

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. 3B4-3--Automatic Transmission Column Diagnosis Chart 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. 3B4-4—Automatic Transmission Column Diagnosis Chart B

**IGNITION SYSTEM – ELECTRICAL SYSTEM –
WILL NOT FUNCTION (CONT'D.)**

Cause	Solution
D. Defective ignition switch. E. Ignition switch not adjusted properly.	D. Replace ignition switch. E. Readjust ignition switch.
SWITCH WILL NOT ACTUATE MECHANICALLY	

Cause	Solution
A. Defective ignition switch.	A. Replace ignition switch.

SWITCH CAN NOT BE SET CORRECTLY

Cause	Solution
A. Switch actuator rod deformed. B. Sector to rack engaged in wrong tooth (tilt).	A. Repair or replace switch actuator rod. B. Engage sector to rack correctly.

NOISE IN COLUMN

Cause	Solution
A. Coupling bolts loose. B. Column not correctly aligned. C. Coupling pulled apart. D. Sheared intermediate shaft plastic joint. E. Horn contact ring not lubricated. F. Lack of grease on bearings or bearing surfaces. G. Lower shaft bearing tight or frozen. H. Upper shaft tight or frozen. I. Shaft lock plate cover loose. J. Lock plate snap ring not seated. K. Defective buzzer dog cam on lock cylinder. L. One click when in "off-lock" position and the steering wheel is moved.	A. Tighten pinch bolts to specified torque. B. Realign column. C. Replace coupling and realign column. D. Replace or repair steering shaft and realign column. E. Lubricate with lubriplate. F. Lubricate bearings. G. Replace bearing. Check shaft and replace if scored. H. Replace housing assembly. I. Tighten three screws or, if missing, replace. CAUTION: Use specified screws. (15 in. lbs.) J. Replace snap ring. Check for proper seating in groove. K. Replace lock cylinder. L. Normal condition - lock bolt is seating.

Fig. 3B4-5--Automatic Transmission Column Diagnosis Chart 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. 3B4-6--Automatic Transmission Column Diagnosis Chart 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
<ul style="list-style-type: none"> A. Defective upper shift lever. B. Defective shift lever gate. C. Loose relay lever on shift tube. 	<ul style="list-style-type: none"> A. Replace shift lever. B. Replace shift lever gate. C. Replace shift tube assembly.
HIGH SHIFT EFFORT	

Cause	Solution
<ul style="list-style-type: none"> A. Column not aligned correctly in car. B. Lower bowl bearing not assembled correctly. C. Improperly installed seal. D. Wave washer in lower bowl bearing defective. E. Improper adjustment of lower shift levers. F. Lack of grease on seal, bearing areas or levers. G. Damaged shift tube in bearing areas. 	<ul style="list-style-type: none"> A. Realign column. B. Reassemble correctly. C. Remove and replace. D. Replace wave washer. E. Readjust (see Sec. 7). F. Lubricate seal, levers and bearings. G. Replace shift tube assembly.
IMPROPER TRANSMISSION SHIFTING	

Cause	Solution
<ul style="list-style-type: none"> A. Loose relay lever on shift tube. 	<ul style="list-style-type: none"> A. Replace shift tube assembly.

Fig. 3B4-7—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. 3B4-8--Tilt Column Diagnosis

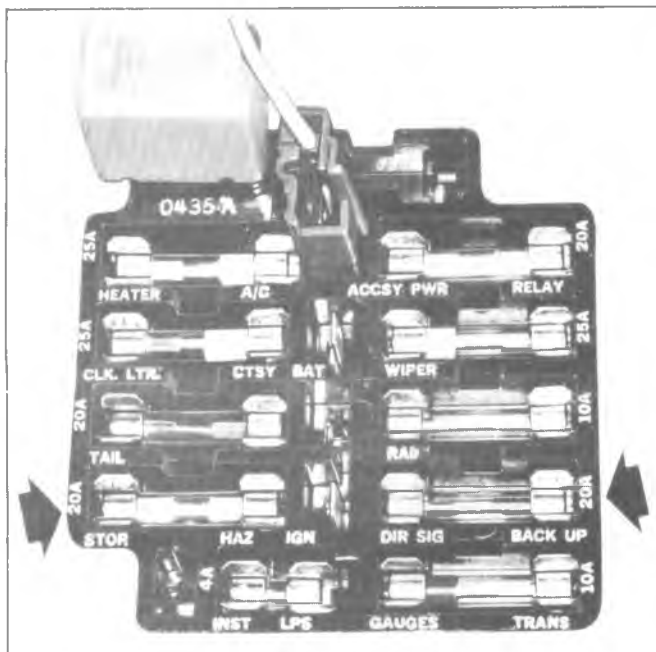


Fig. 3B4-9--Checking Fuses on Fuse Block

TURN SIGNAL DIAGNOSIS C AND K SERIES

Figs. 3B4-9 Through 3B4-16

When a complaint is made involving the turn signal system, it must first be determined whether the problem is mechanical or electrical. If mechanical, the switch itself is at fault and must be repaired or replaced. If electrical, J-23980 should be used to determine whether the switch, or the chassis wiring is in need of repair or replacement.

This diagnostic procedure has been designed to guide the mechanic through the proper diagnosis and repair of the turn signal system. The service section is to be used where assembly and/or disassembly procedures are required. The wiring diagram, found in Section 12, should be used to trouble shoot the chassis and body wiring after the problem has been isolated.

The nature of the customer complaint will generally point to the problem area.

Electrical

Chassis Electrical

The most common turn signal system problems are generally electrical and may easily, be fixed by the replacement of **fuses, bulbs, or flashers**.

First make these checks and replace any non-operative components.

1. **Check fuses** (Figure 3B4-9). Replace if blown. If new fuse blows, replace flasher in system. (There are 2 flashers in the signal switch system. The hazard warning flasher and turn signal flasher are located on the fuse block.
2. Check for secure connection at the chassis to switch connector. This is the harmonica connector on the column (Figure 3B4-10). Secure if loose. Check all individual wire terminals for proper seating in the connector bodies. Terminals should be locked in place.
3. Depress hazard warning button and check all lights in signal switch system. Replace any which do not work.

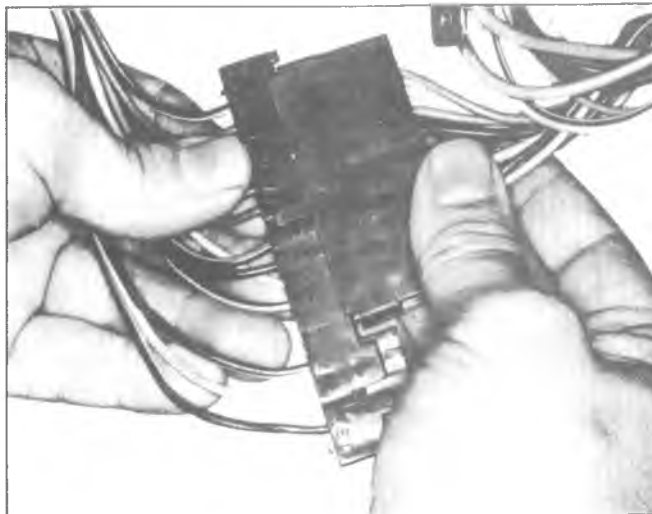


Fig. 3B4-10--Checking Harmonica Connector on Column

If **all** lamps light when hazard warning is depressed, but flashing does not occur, replace hazard warning flasher. (On fuse block) (Figure 3B4-11).

4. If **all** directional lamps light when lane change or turn indicator is actuated, but no flashing occurs, replace the turn signal flasher.

The above four steps will, in most cases, cure the common signal switch system troubles. If the system is still not operating correctly, use J-23980 to determine whether the chassis wiring or the signal switch itself is at fault.

Mechanical

1. If the customer's complaint indicates the problem is in the switch, function check as to return from full left and full right turns.

Actuate the turn lever into a full turn position in either direction, then turn the steering wheel (motor on - power steering) at least 1/4 turn in the direction indicated and then

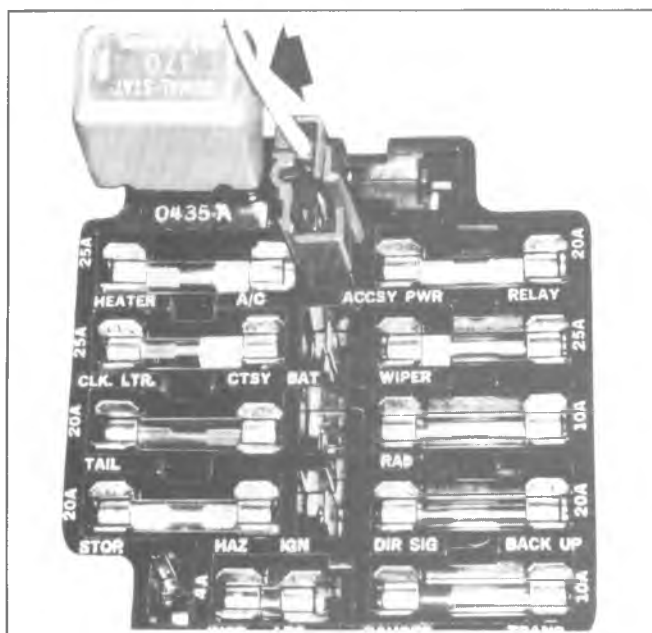


Fig. 3B4-11--Checking Hazard Warning Flasher

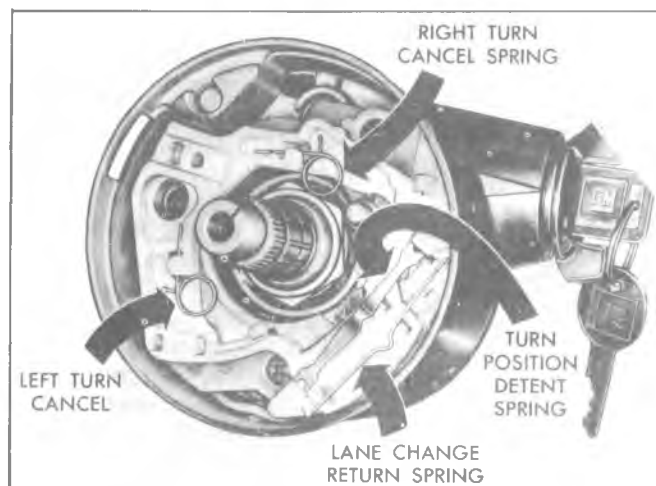


Fig. 3B4-12—Checking Turn Signal Switch Visually

back to center. Do this in both directions. If the lever does not return to the neutral position, disassemble the upper part of the column until the switch is visible.

2. Check the return from lane change by holding the lever in lane change and releasing (both left and right). If the lever does not return to neutral, disassemble the upper part of the column.

3. If the hazard warning button cannot be depressed or released, the switch must be replaced.

Switch Visual Inspection

1. With the upper part of the column disassembled so that the signal switch is visible (Figure 3B4-12) check for missing springs. Replace any spring that is missing, inspecting the molded pins which secure them. If these pins are broken, the switch must be replaced.

2. Check the position of the switch in the bowl. If it appears cocked or crooked, loosen the securing screws (3) and visually inspect the switch. If any of the plastic is broken or badly deformed, the switch must be replaced.

3. If the switch appears undamaged, replace it being careful to seat the pilot into the housing, tighten the screws to 25 lbs. in. of torque.

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. 3B4-13--Turn Signal Switch Diagnosis Chart 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. 3B4-14—Turn Signal Switch Diagnosis Chart B

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Front or rear turn signal lights not flashing	<p>A. Burned out fuse</p> <p>B. Burned out or damaged turn signal bulb</p> <p>C. High resistance connection to ground at bulb socket</p> <p>D. Loose chassis to column connector</p> <p>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.</p> <p>F. If vehicle lights do not operate, check chassis wiring harness to light sockets for opens, grounds, etc.</p>	<p>A. Replace fuse and check operation</p> <p>B. Replace bulb</p> <p>C. Remove or repair defective connection and check operation</p> <p>D. Connect securely and check operation</p> <p>E. Replace turn signal switch.</p> <p>F. Repair chassis wiring as required using manual as guide</p>
Stop light not on when turn indicated	<p>A. Burned out fuse</p> <p>B. Loose column to chassis connection</p> <p>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</p> <p>D. If brake lights do not work check connector to stop light sockets for grounds, opens, etc.</p>	<p>A. Replace fuse and check operation</p> <p>B. Connect securely and check operation</p> <p>C. Replace signal switch</p> <p>D. Repair connector to stop light circuits using manual as guide.</p>
Turn indicator panel lights not flashing	<p>A. Burned out bulbs</p> <p>B. High resistance to ground at bulb socket</p> <p>C. Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights</p>	<p>A. Replace bulbs</p> <p>B. Replace socket</p> <p>C. Locate and repair as required. Use shop manual as guide.</p>

Fig. 3B4-15--Turn Signal Switch Diagnosis Chart C

SIGNAL SWITCH DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Turn signal lights flash very slowly	<p>A. Inoperative turn signal flasher</p> <p>B. System charging voltage low</p> <p>C. High resistance ground at light sockets</p> <p>D. Loose chassis to column connection</p> <p>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.</p> <p>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.</p>	<p>A. Replace turn signal flasher</p> <p>B. Increase voltage to specified. See Sec. 6Y</p> <p>C. Repair high resistance grounds at light sockets</p> <p>D. Connect securely and check operation</p> <p>E. Replace signal switch</p> <p>F. Locate and repair as required. Use manual as guide. See Section 12</p>
Hazard signal lights will not flash — turn signal functions normally	<p>A. Blown fuse</p> <p>B. Inoperative hazard warning flasher</p> <p>C. Loose chassis to column connection</p> <p>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.</p> <p>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.</p>	<p>A. Replace fuse and check operation</p> <p>B. Replace hazard warning flasher</p> <p>C. Connect securely and check operation</p> <p>D. Replace the turn signal switch</p> <p>E. Replace fuse block (See Sec. 12)</p>

Fig. 3B4-16—Turn Signal Switch Diagnosis Chart D

MAINTENANCE AND ADJUSTMENTS

STEERING WHEEL ALIGNMENT

On all series vehicles, check steering gear for high point centering as shown in Sections 3B2 and 3B3 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. 3B4-17), 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

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 3B4-18.
3. Tighten clamp bolt to specified torque.

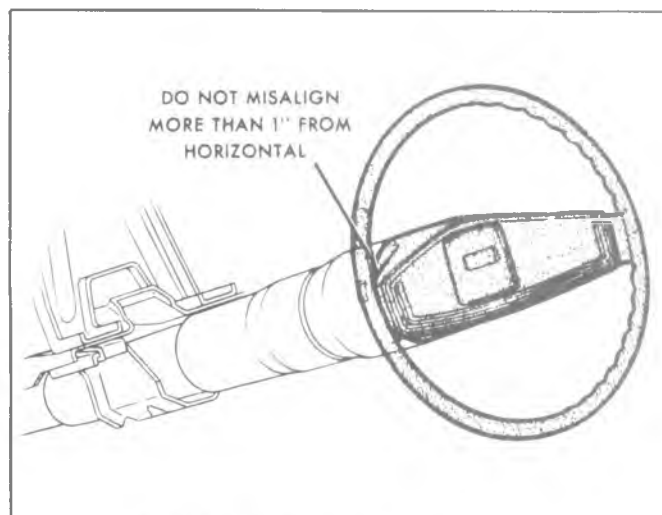


Fig. 3B4-17--Steering Wheel Alignment

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. 3B4-19).
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. 3B4-20).
3. Tighten the adjusting ring clamp screws to 70 in. lbs.

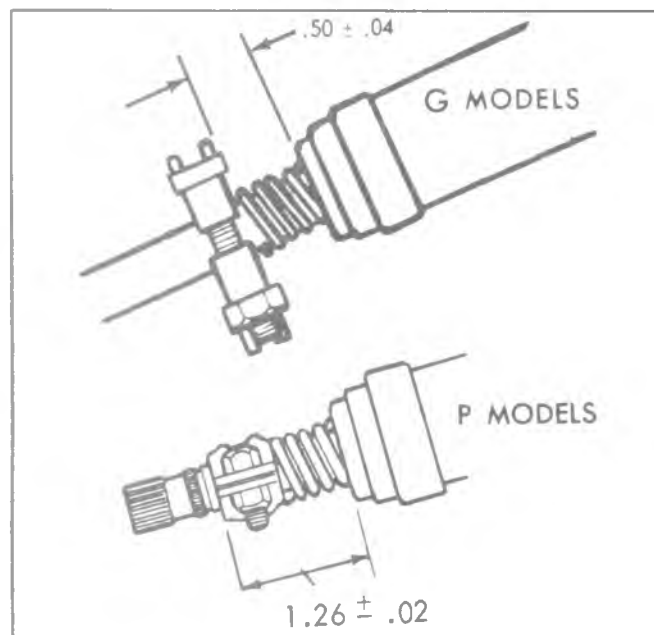


Fig. 3B4-18--Steering Column Lower Bearing Adjustment

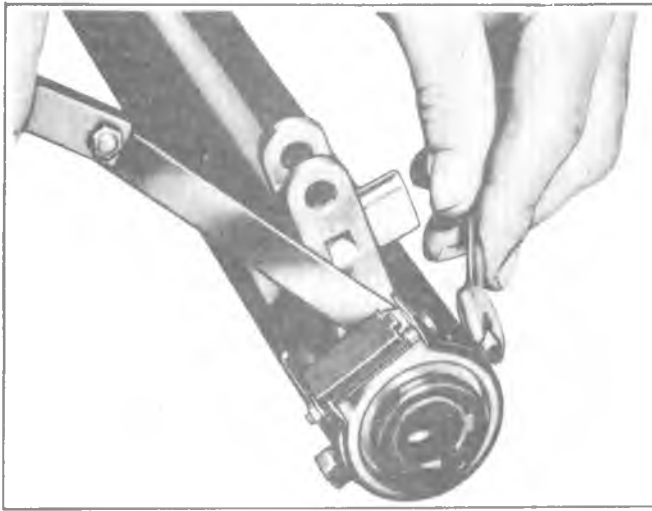


Fig. 3B4-19-Shift Tube Adjustment-3 Speed Manual Transmission

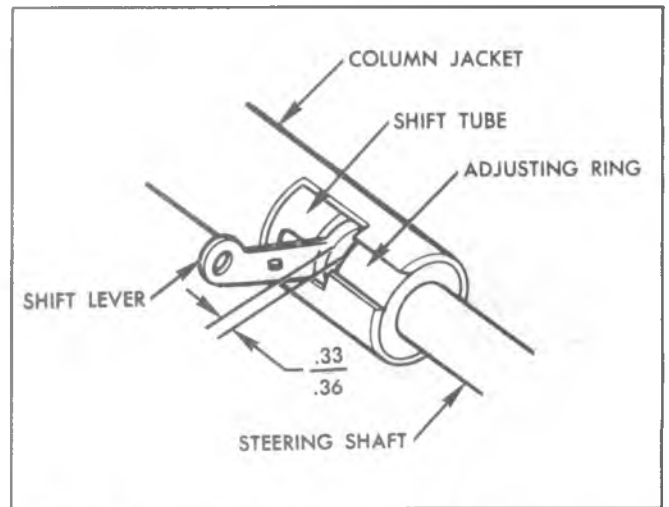


Fig. 3B4-20-Shift Tube Adjustment-Automatic Transmission

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. 3B4-21. 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.

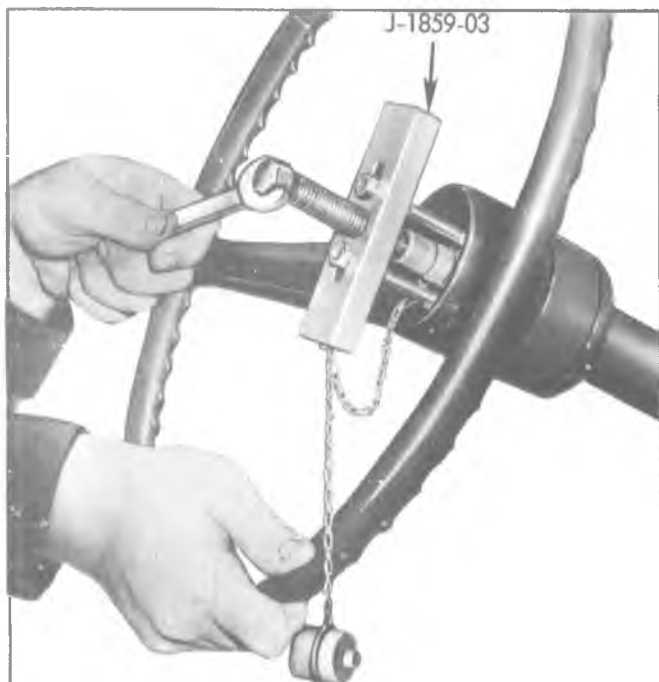


Fig. 3B4-21-Steering Wheel Removal

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 1.

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 (Fig. 3B4-22)

1. Remove the coupling to steering shaft flange bolt nuts.

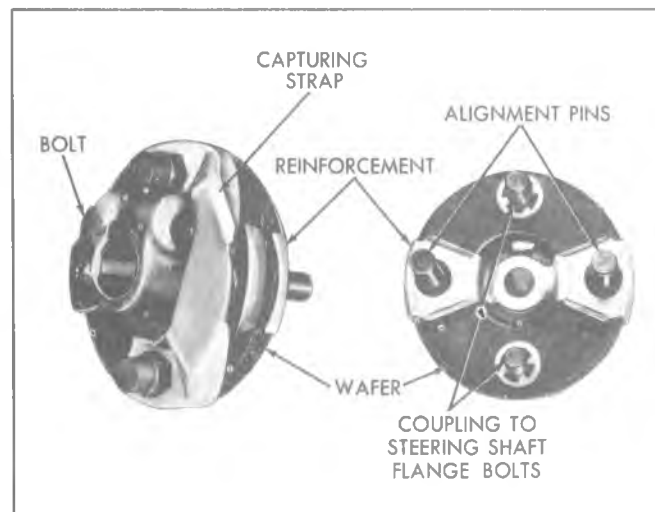


Fig. 3B4-22-Flexible Type Steering Coupling

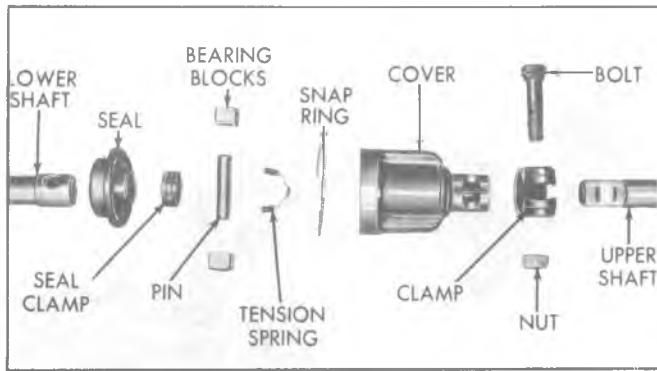


Fig. 3B4-23--Steering Shaft Intermediate Coupling

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.

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 (Fig. 3B4-23)

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

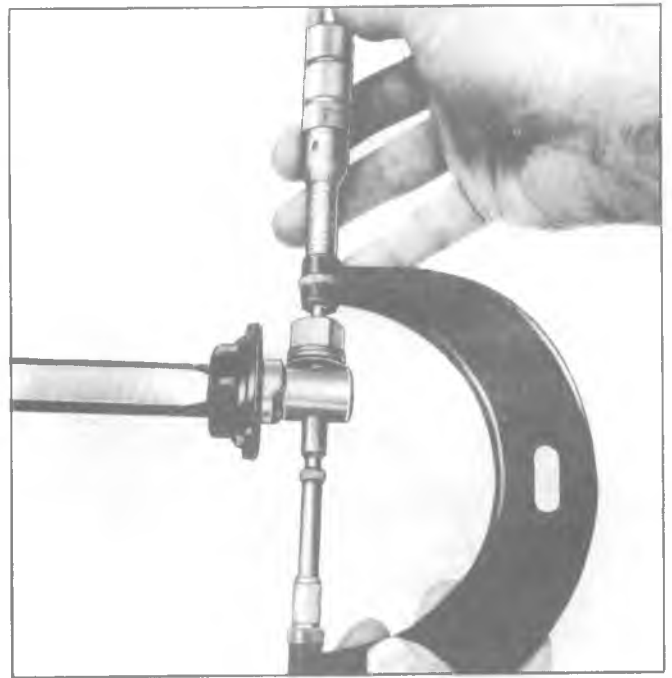


Fig. 3B4-24--Checking Coupling Pin Centering

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. 3B4-24).

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.

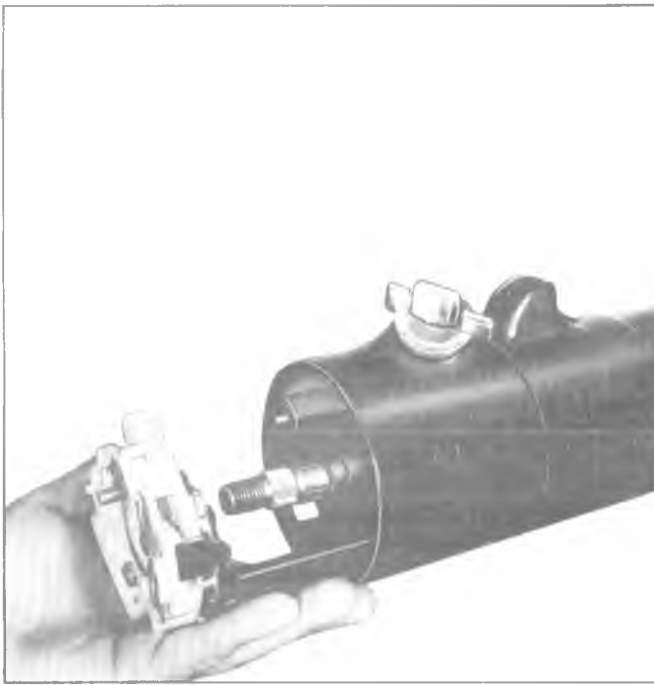


Fig. 3B4-25--Directional Signal Switch

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.

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.

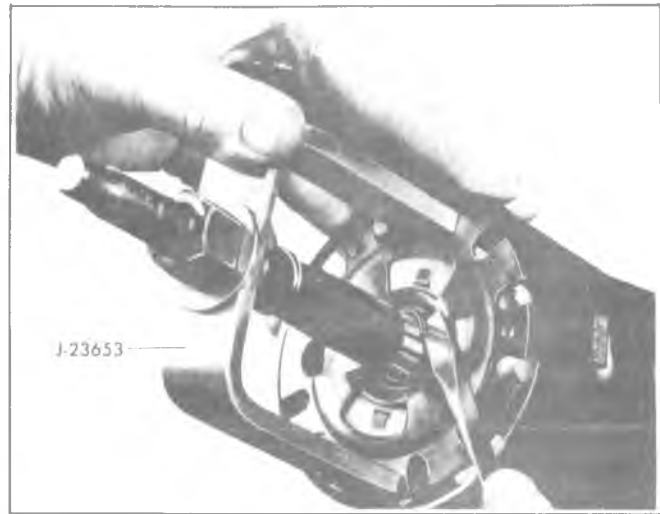


Fig. 3B4-26--Removing Lock Plate Retaining Ring

Removal (Fig. 3B4-25)

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. 3B4-26). 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.

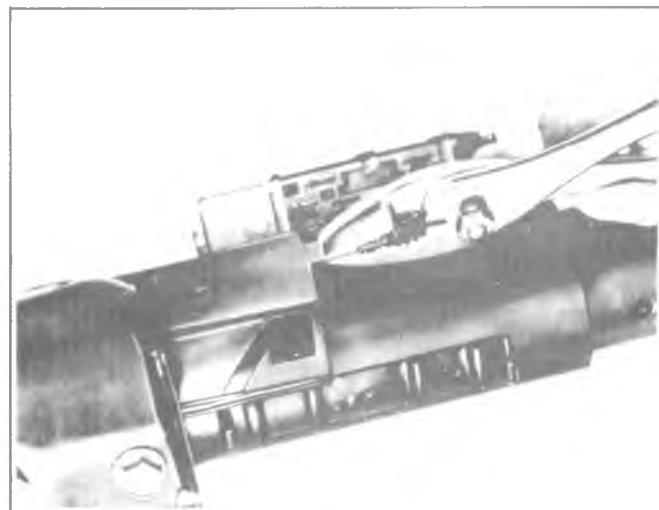


Fig. 3B4-27--Removing Directional Signal Wire Protector

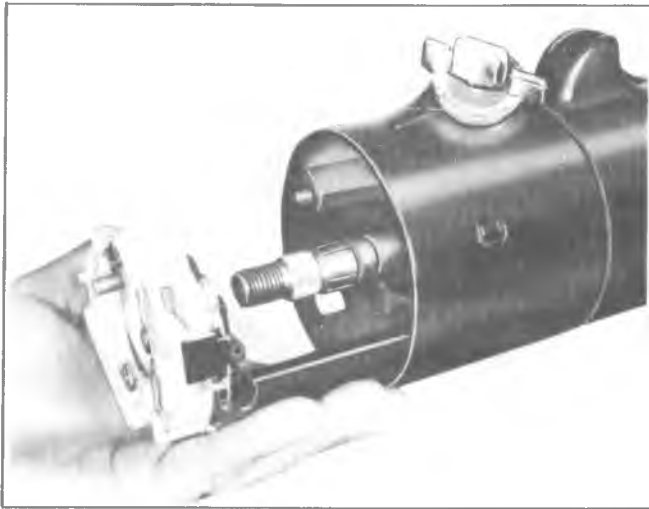


Fig. 3B4-28--Removing Directional Signal Switch Assembly

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. 3B4-27).
- 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. 3B4-28).



Fig. 3B4-29--Installing Switch Connector Onto Jacket Clips



Fig. 3B4-30--Installing Snap Ring

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. 3B4-29).

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. 3B4-30). 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.

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.

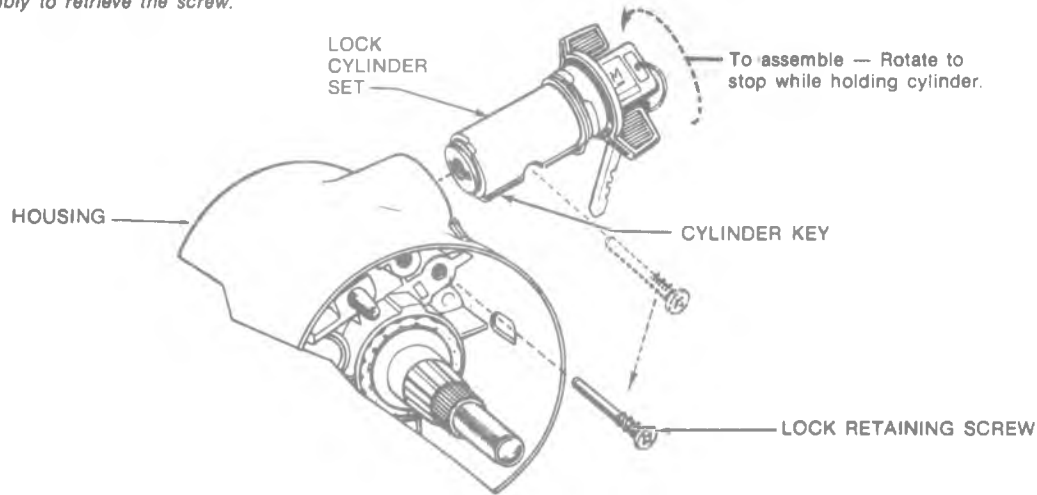


Fig. 3B4-31—Lock Cylinder Removal

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. 3B4-31 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 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.

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. 3B4-32); 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.

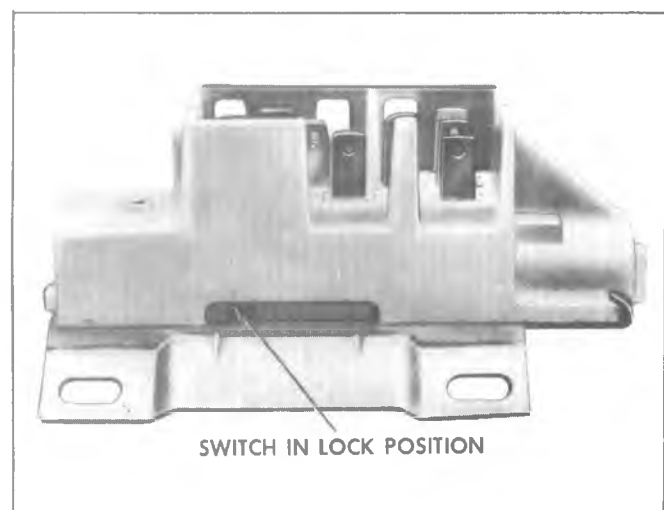


Fig. 3B4-32—Ignition Switch Assembly

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.

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

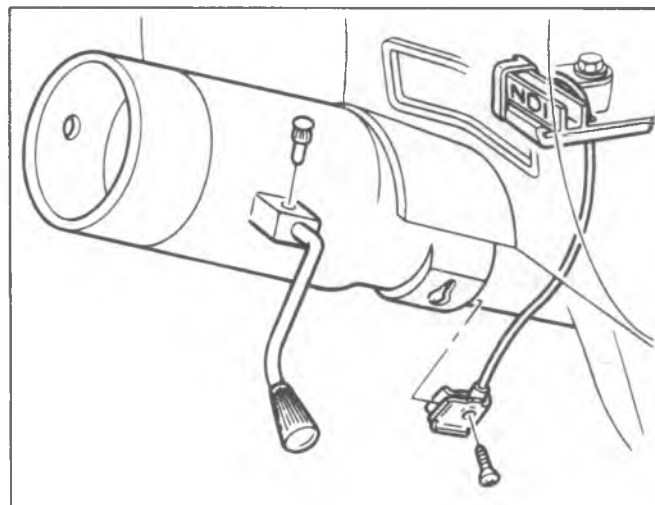


Fig. 3B4-33--Automatic Transmission Indicator Connection-CK-Typical

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.

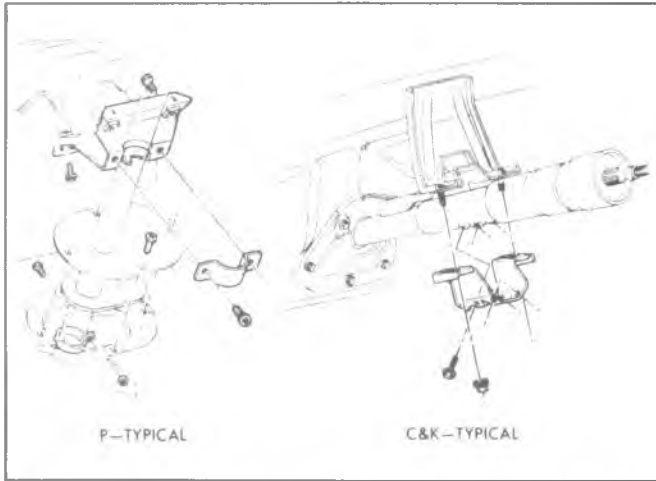


Fig. 3B4-34-Steering Column to Dash Panel-C, K Typical

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. 3B4-33).
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. 3B4-34).
9. Move the front seat as far back as possible to provide maximum clearance.

10. Remove the two column bracket-to-instrument panel nuts and carefully remove from vehicle. Additional help should be obtained to guide the lower shift levers through the firewall opening.

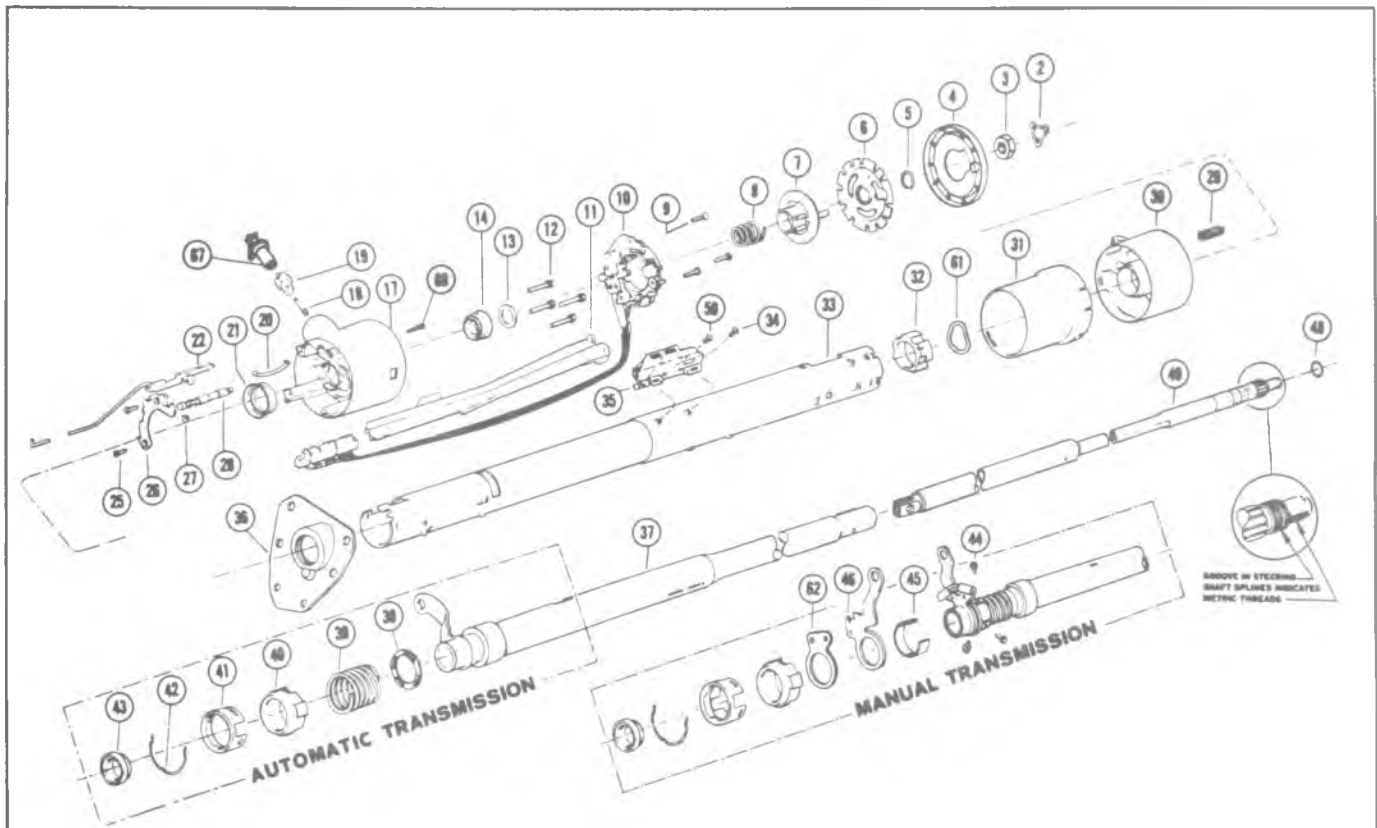
C and K Series, Standard Column - (Fig. 3B4-40)

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 3B4-41. 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. 3B4-42).
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. 3B4-43).
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. 3B4-44).
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.



- | | |
|------------------------------------|------------------------------------|
| 1. STEERING COLUMN | 30. BOWL, Gearshift Lever |
| 2. RETAINER | 31. SHROUD, Shift Bowl |
| 3. NUT, Hexagon Jam | 32. BEARING, Bowl Lower |
| 4. COVER, Shaft Lock | 33. JACKET ASM, Steering Column |
| 5. RING, Retaining | 34. SCREW, Washer Head |
| 6. LOCK, Steering Shaft | 35. SWITCH ASM, Ignition |
| 7. CAM ASM, Turn Signal Cancelling | 36. SEAL, Dash |
| 8. SPRING, Upper Bearing | 37. TUBE ASM, Shift |
| 9. SCREW, Pan Head Cross Recess | 38. WASHER, Spring Thrust |
| 10. SWITCH ASM, Turn Signal | 39. SPRING, Shift Tube Return |
| 11. PROTECTOR, Wiring | 40. ADAPTER, Lower Bearing |
| 12. SCREW, Hex Washer Head Tapping | 41. RETAINER, Bearing Adapter |
| 13. WASHER, Thrust | 42. CLIP, Lower Bearing Adapter |
| 14. BEARING ASM | 43. BEARING ASM |
| 17. HOUSING, Steering Column | 44. SCREW ASM, Lockwasher & |
| 18. SHAFT, Sector | 45. SPACER, Lower Shift Lever |
| 19. SECTOR, Switch Actuator | 46. LEVER, Lower Shift |
| 20. SPRING, Rack Preload | 47. BUSHING ASM, Steering Shaft |
| 21. CUP, Thrust | 48. RING, Retaining |
| 22. RACK ASM, Rod & | 49. SHAFT ASM, Steering |
| 23. SCREW, Dimmer Switch Mounting | 50. SCREW, Flat Head |
| 24. SWITCH ASM, Dimmer | 51. ROD, Dimmer Switch Actuator |
| 25. SCREW, Flat Head Cross Recess | 61. WASHER, Wave |
| 26. GATE, Shift Lever | 62. PLATE, Support & Alignment |
| 27. WASHER, Spring Thrust | 67. LOCK CYLINDER SET, Strg Column |
| 28. BOLT ASM, Spring & | 68. SCREW, Lock Retaining |
| 29. SPRING, Upper Shift Lever | |

Fig. 3B4-40a-Std. Column; Auto. Trans. or 3-Speed

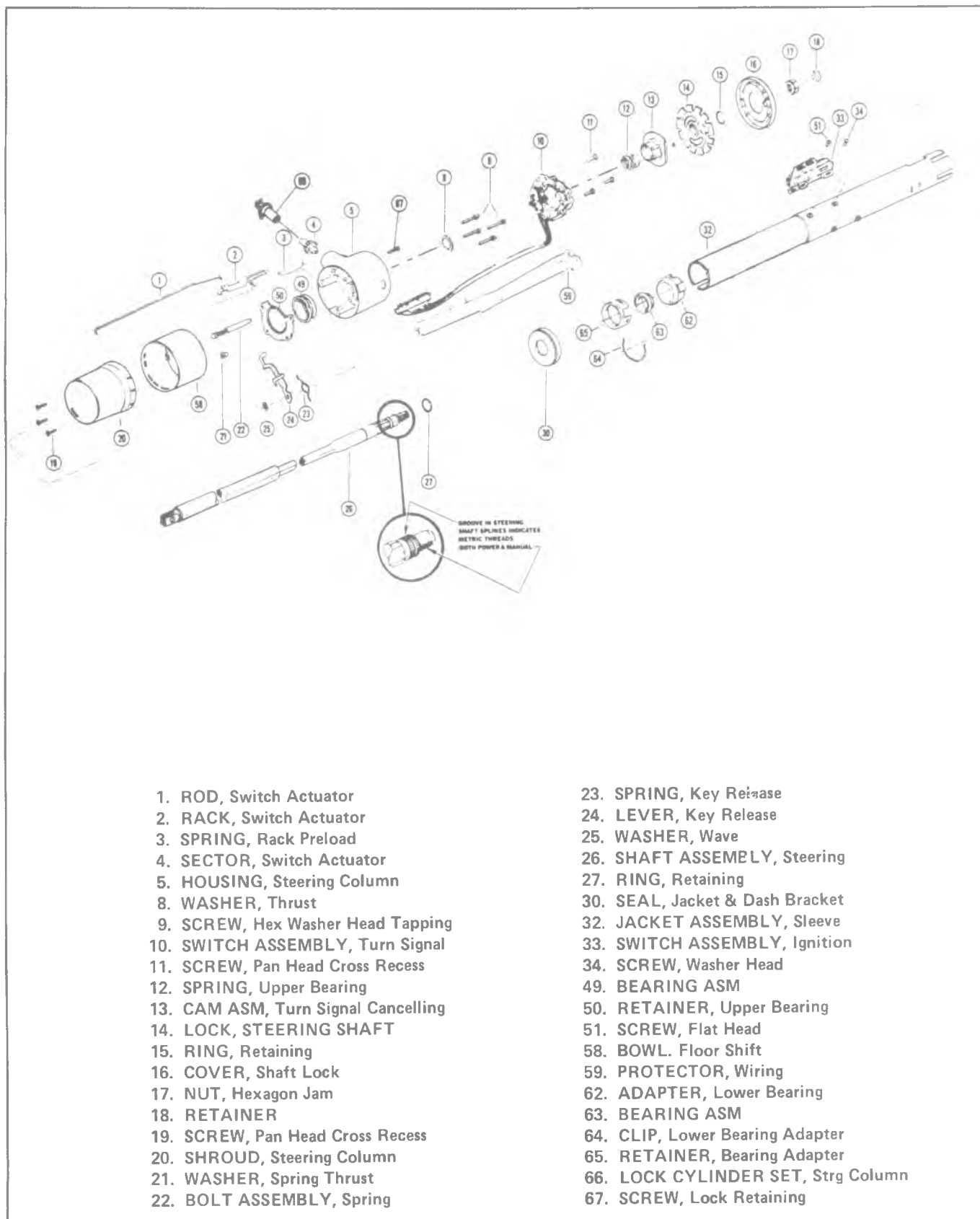


Fig. 3B4-40b-Std. Column, 4-Speed Trans.

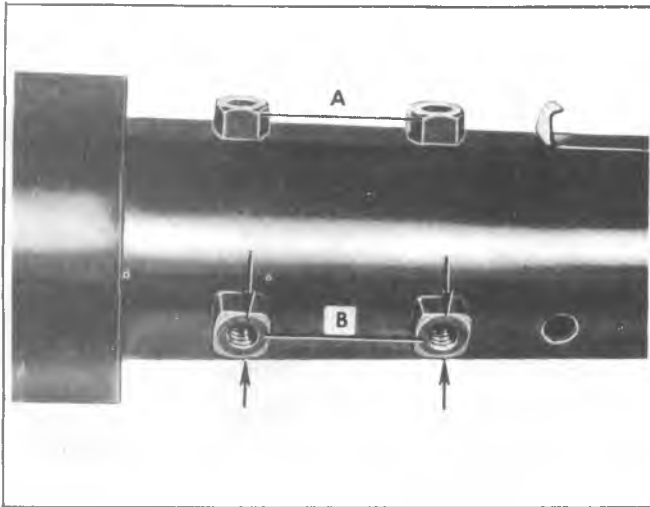


Fig. 3B4-41—Installing Steering Column in Vise

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. 3B4-45).

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. 3B4-46).

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. 3B4-43). 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. 3B4-47). 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. 3B4--48 for adjustment procedure.

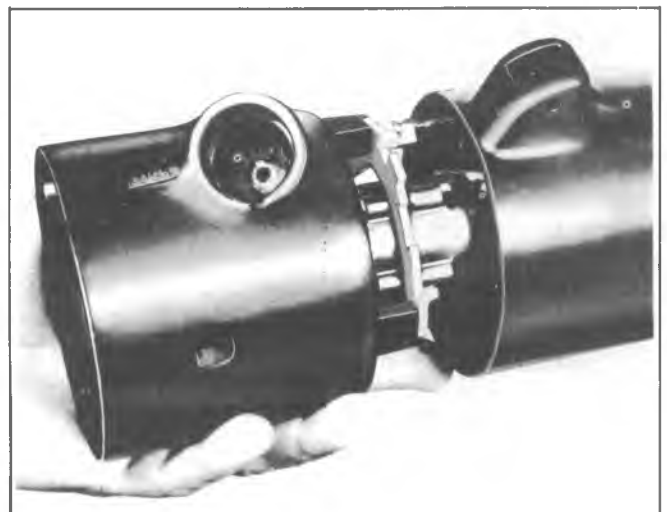


Fig. 3B4-42—Removing Turn Signal Housing

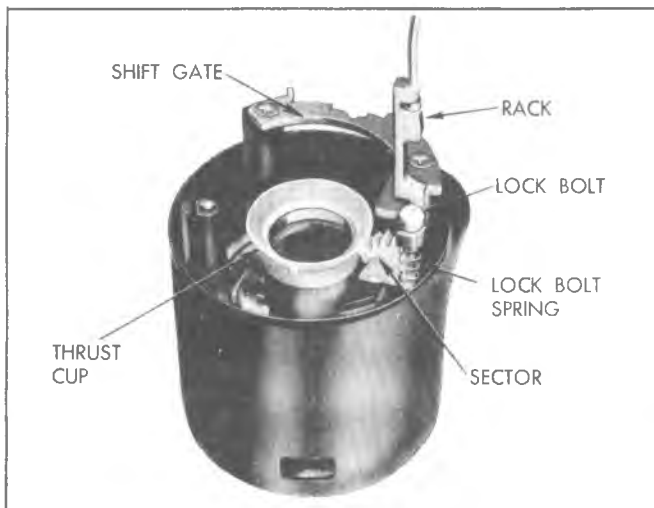


Fig. 3B4-43--Turn Signal Housing Assembly

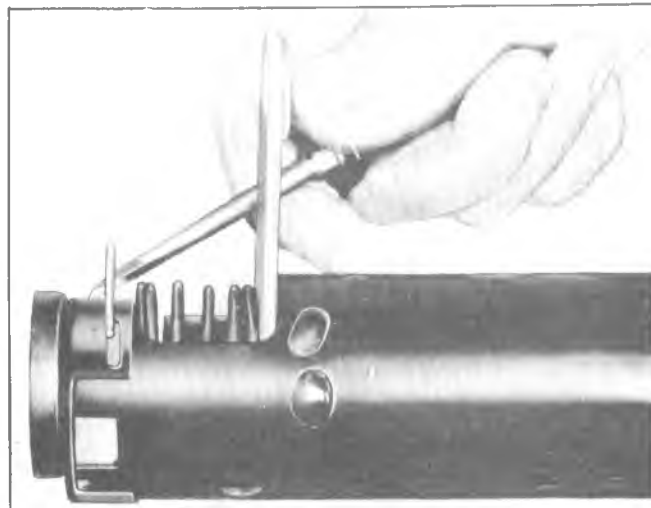


Fig. 3B4-45--Removing Lower Bearing Retainer



Fig. 3B4-44--Removing Ignition Switch Actuator Sector

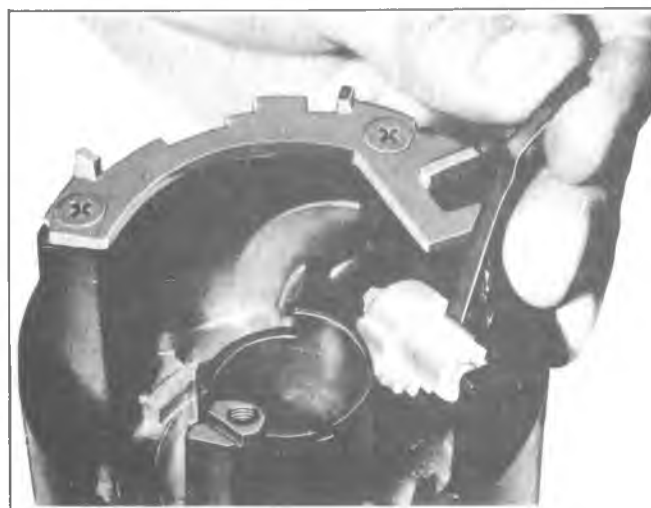


Fig. 3B4-46--Installing Rack Preload Spring

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.

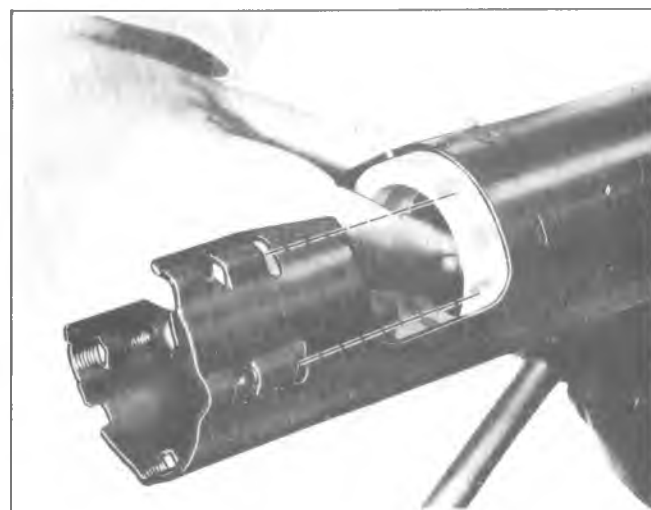


Fig. 3B4-47--Installing Gearshift Housing Lower Bearing

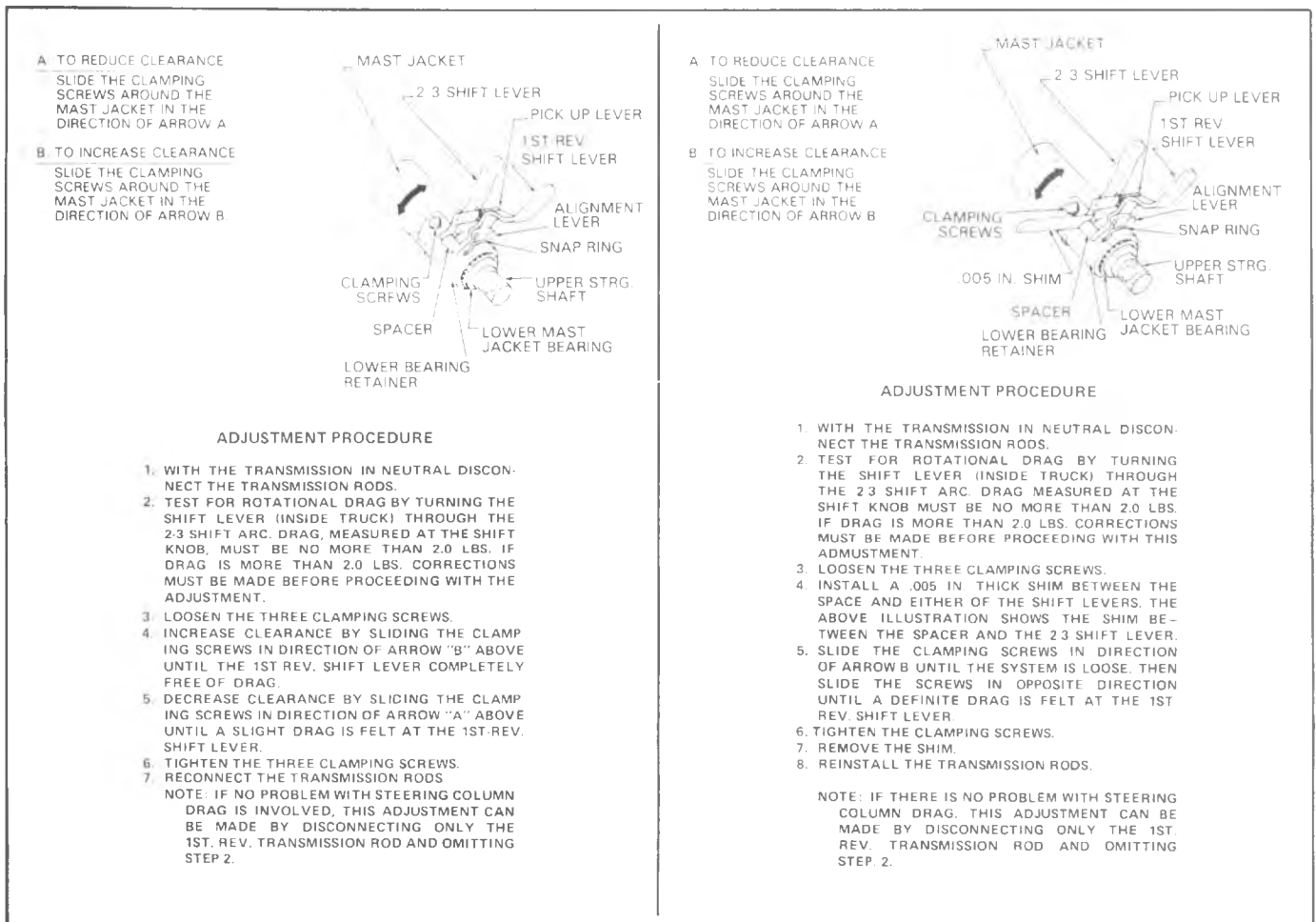


Fig. 3B4-48--Adjusting Lower Bearing-Typical

Disassembly-Tilt Columns (Fig. 3B4-49)

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.

2. Mount the column in a vise using both weld nuts of either Set A or B as shown in Figure 3B4-41. 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, 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. 3B4-50).

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.

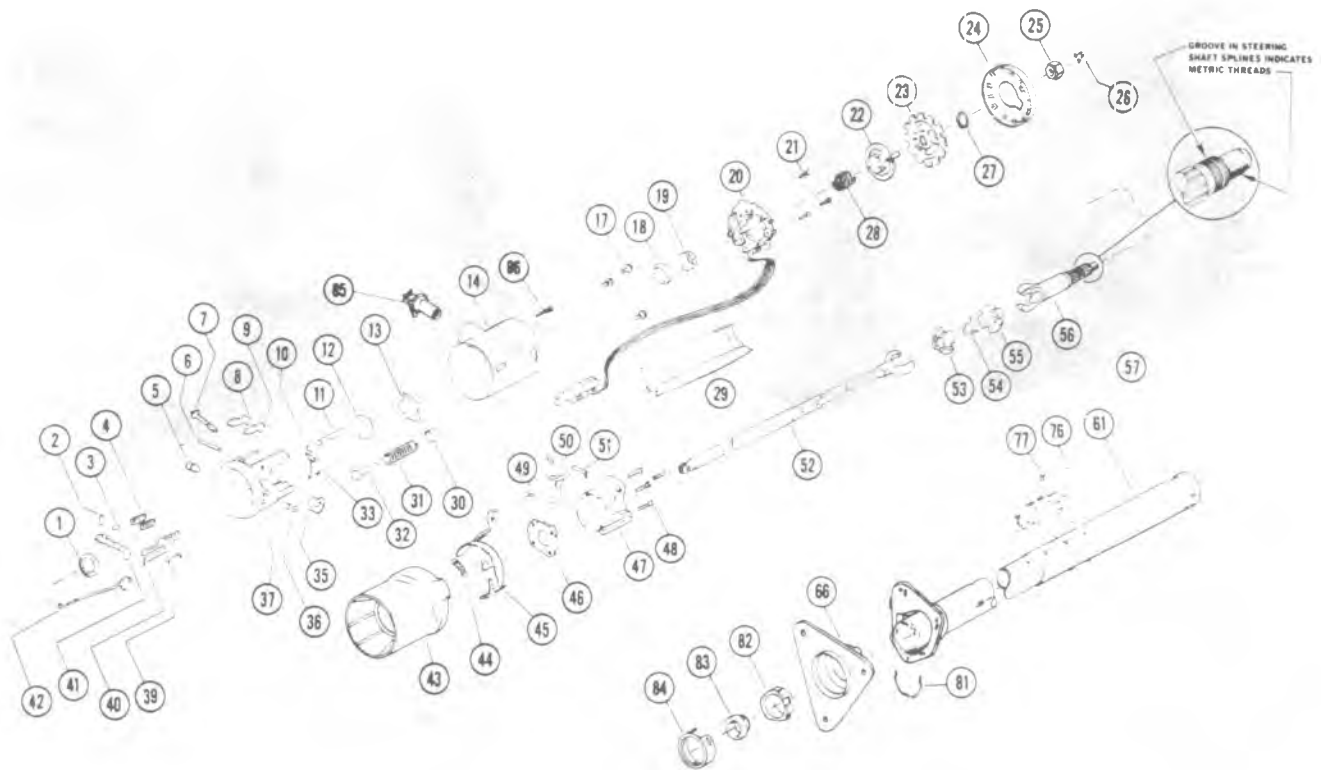
8. Remove the upper bearing housing pivot pins using Tool J-21854-1 (Fig. 3B4-51).

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.



Fig. 3B4-49a--Tilt Column With Auto. Trans.



- | | | |
|-------------------------------------|--------------------------------------|---------------------------------------|
| 1. BEARING ASM | 26. RETAINER | 51. PIN, Dowel |
| 2. PIN, Release Lever | 27. RING, Retainer | 52. SHAFT ASM, Lower Steering |
| 3. SPRING, Release Lever | 28. SPRING, Upper Bearing | 53. SPHERE, Centering |
| 4. SPRING, Shoe | 29. PROTECTOR, Wiring | 54. SPRING, Joint Preload |
| 5. PIN, Pivot | 30. RETAINER, Spring | 55. SPHERE, Centering |
| 6. PIN, Dowel | 31. SPRING, Wheel Tilt | 56. SHAFT ASM, Race & Upper |
| 7. SHAFT, Drive | 32. GUIDE, Spring | 57. SWITCH ASM, Ignition |
| 8. SHOE, Steering Wheel Lock | 33. SCREW, Hex. Washer Head | 61. JACKET ASM, Sleeve & |
| 9. SHOE, Steering Wheel Lock | 35. SECTOR, Switch Actuator | 62. BEARING ASM, Adapter & |
| 10. SPRING, Lock Bolt | 36. PIN, Pivot | 63. BEARING ASM |
| 11. BOLT, Lock | 37. HOUSING, Steering Column | 64. SPACER, Steering Shaft |
| 12. BEARING ASM | 39. SPRING, Rack Preload | 65. SEAL, Jacket & Dash Bracket |
| 13. SHIELD, Tilt Lever Opening | 40. RACK, Switch Actuator | 66. BRACKET ASM, Column Dash |
| 14. COVER, Lock Housing | 41. LEVER, Shoe Release | 76. SCREW, Washer Head (#10-24 x .25) |
| 17. SCREW, Oval Head Cross Recess | 42. ACTUATOR ASM, Switch | 77. SCREW, Flat Head (#10-24 x .31) |
| 18. RACE, Inner | 43. SHROUD, Column Housing | 81. CLIP, Lower Bearing Adapter |
| 19. SEAT, Upper Bearing Inner Race | 44. SPRING, Key Release | 82. ADAPTER, Lower Bearing |
| 20. SWITCH ASM, Turn Signal | 45. LEVER, Key Release | 83. BEARING ASM |
| 21. SCREW, Binding HD Cross Recess | 46. PLATE, Lock | 84. RETAINER, Bearing Adapter |
| 22. CAM ASM, Turn Signal Cancelling | 47. SUPPORT, Steering Column Housing | 85. LOCK CYLINDER SET, Strg Column |
| 23. LOCK, Shaft | 48. SCREW, Support | 86. SCREW, Lock Retaining |
| 24. COVER, Shaft Lock | 49. SCREW, Oval Head Cross Recess | |
| 25. NUT, Hexagon Jam (9/16-18) | 50. PLATE, Shroud Retaining | |

Fig. 3B4-49b--Tilt Column With 4-Speed

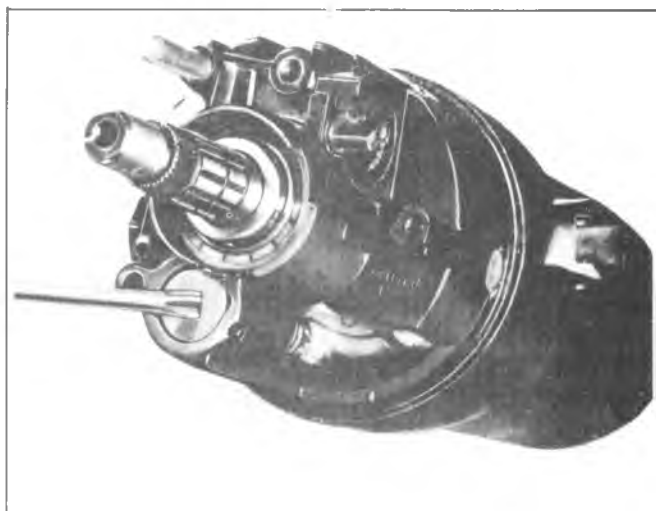


Fig. 3B4-50--Removing Tilt Lever Spring Retainer



Fig. 3B4-52--Removing Shift Tube

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. 3B4-52). 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.



Fig. 3B4-51--Removing Bearing Housing Pivot Pins

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. 3B4-53).

c. Remove the snap ring from the sector drive shaft. With a small punch, lightly tap the drive shaft from the sector (Fig. 3B4-54). 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)

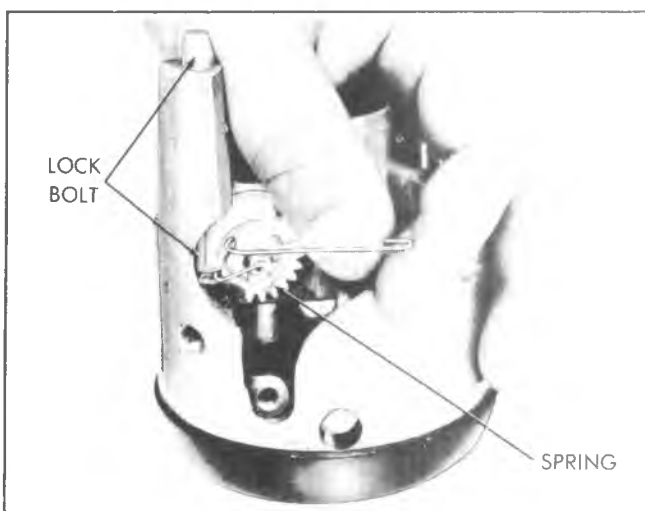


Fig. 3B4-53--Replacing Lock Bolt Spring

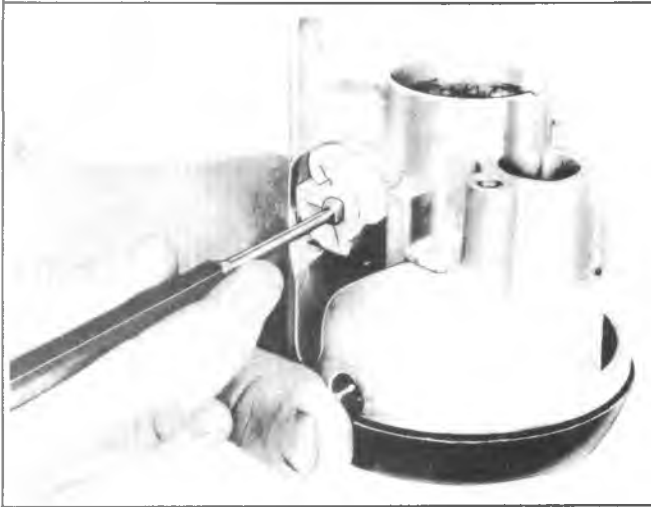


Fig. 3B4-54—Removing Sector Drive Shaft

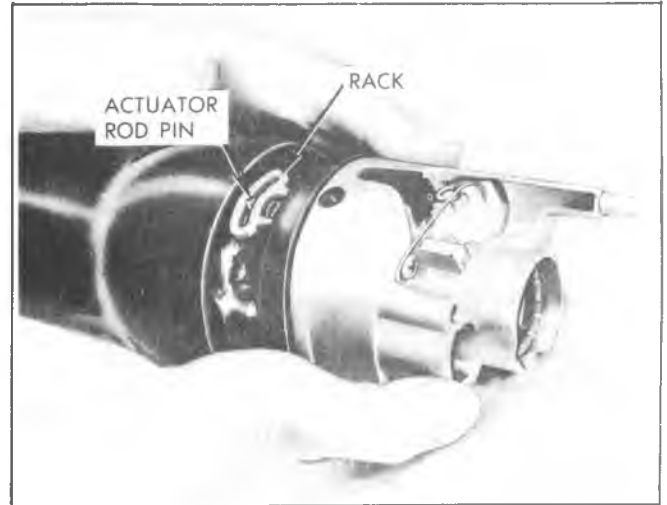


Fig. 3B4-56—Installing Bearing Housing

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.

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. 3B4-55). Install the external tilt release lever.

f. Install the lock bolt spring and retaining screw (Fig. 3B4-50). Tighten the screw to 35 in. lbs.

2. Install the shift lever spring into the housing by winding 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.

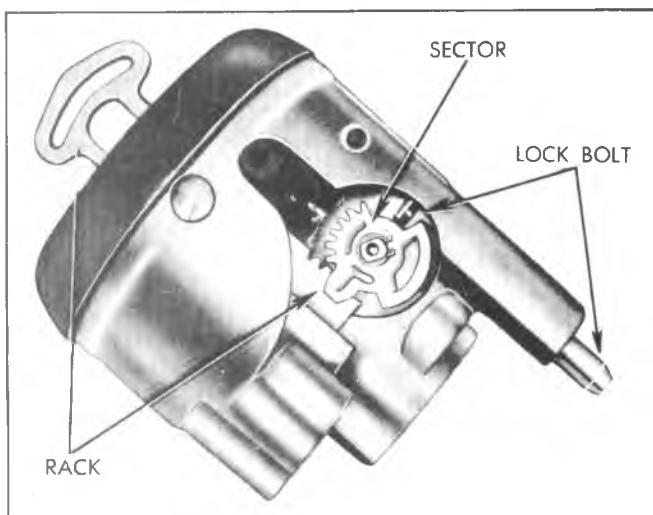


Fig. 3B4-55—Installing Lock Bolt and Rack Assemblies

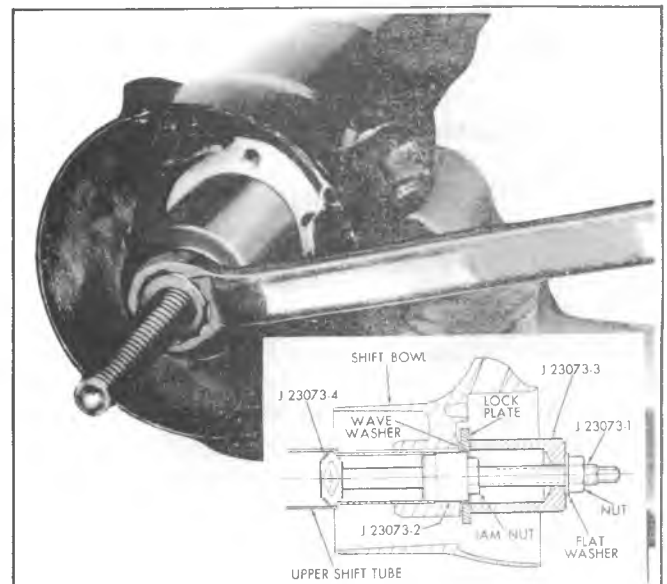


Fig. 3B4-57—Installing Shift Tube

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. 3B4-57). 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. 3B4-56).

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.

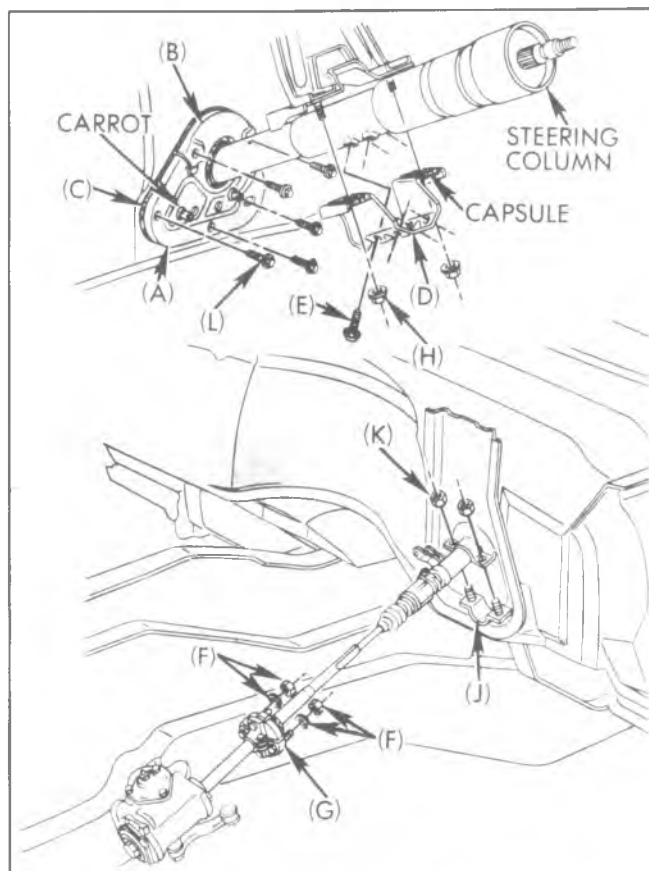


Fig. 3B4-58--Steering Column Installation-CK

20. Install the lock cylinder, turn signal switch and ignition switch as outlined previously in this section.

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 $1\ 1/2^\circ \pm 4^\circ$.
2. Flexible coupling must not be distorted greater than $\pm .06$ 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. 3B4-59).

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fastener referred to in step 2.

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.

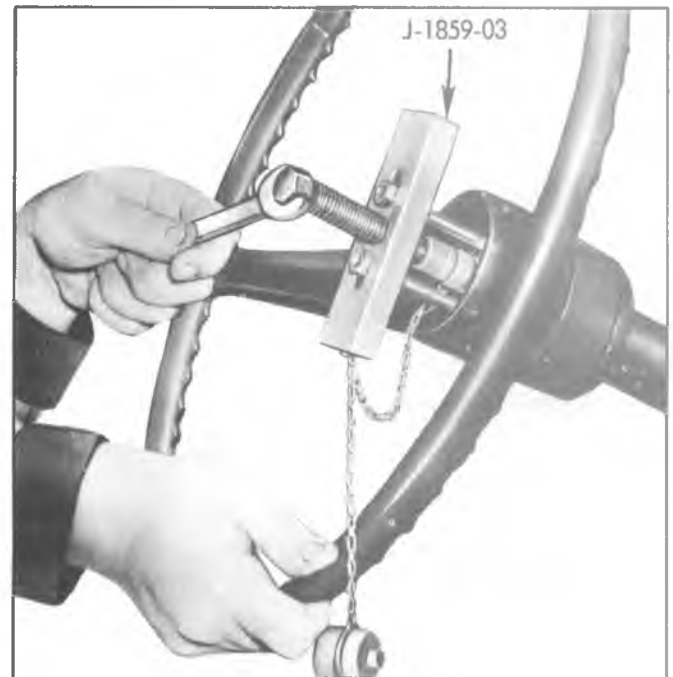


Fig. 3B4-59--Steering Wheel Removal-Typical

STEERING COUPLING (FLEXIBLE TYPE)

Removal (Fig. 3B4-60)

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.

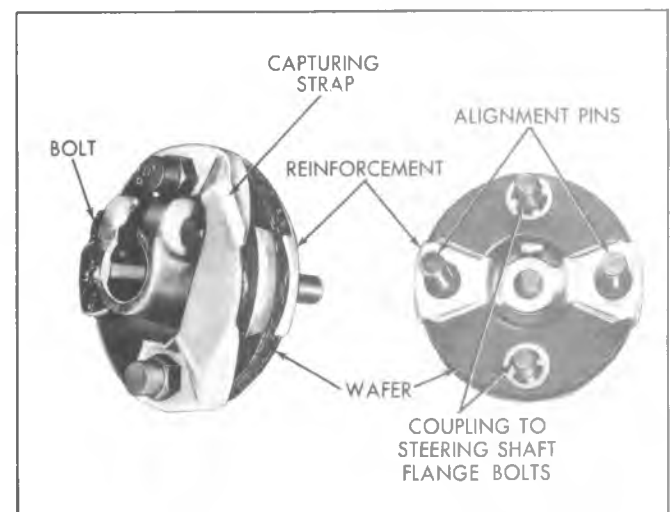


Fig. 3B4-60--Flexible Type Steering Coupling

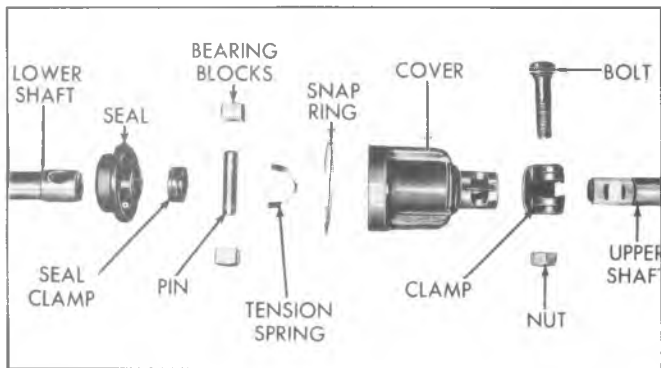


Fig. 3B4-61—Steering Shaft Intermediate Coupling

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 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. 3B4-61)

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

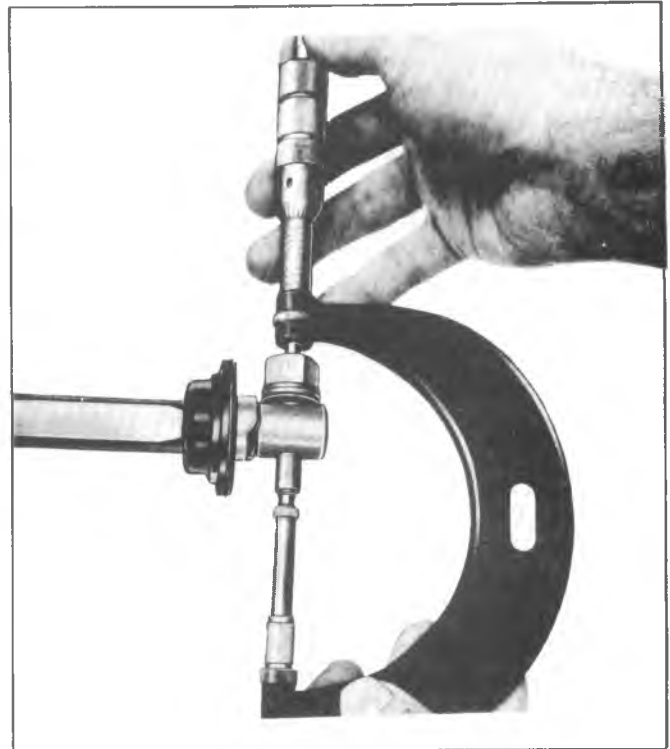


Fig. 3B4-62—Checking Coupling Pin Centering

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. 3B4-62).

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.

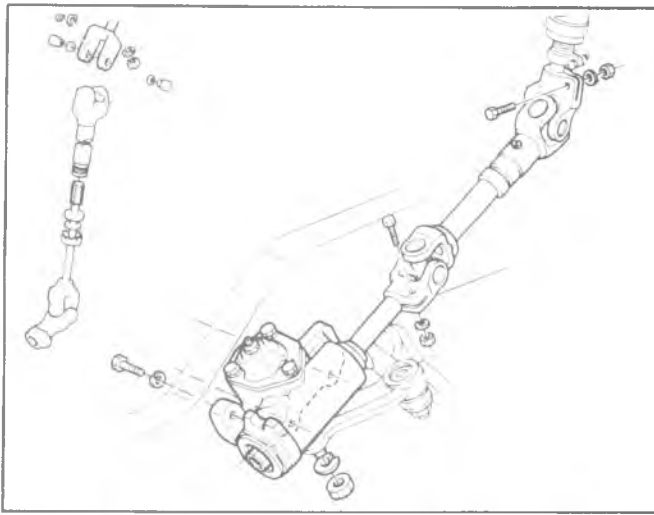


Fig. 3B4-63-Intermediate Steering Shaft-P Series

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. 3B4-63)

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 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.

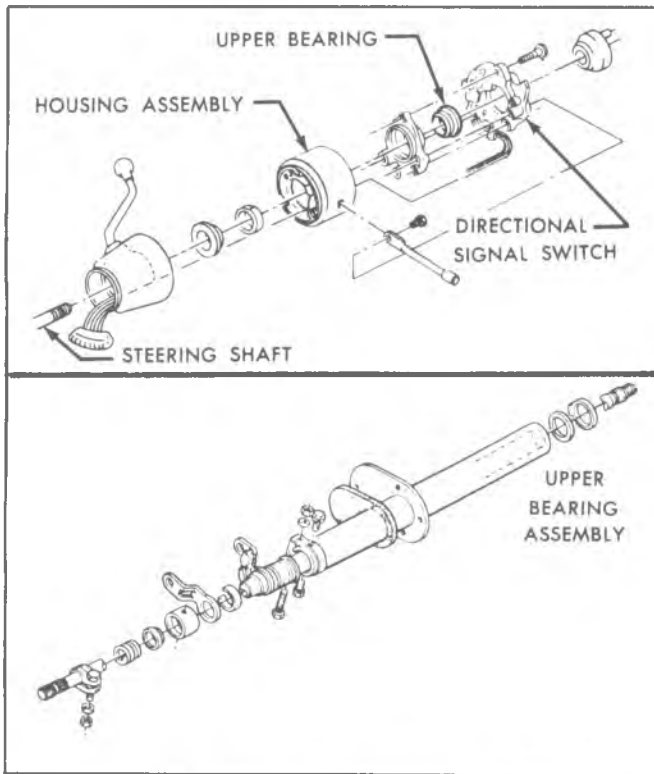


Fig. 3B4-64-Steering Column Upper Bearing

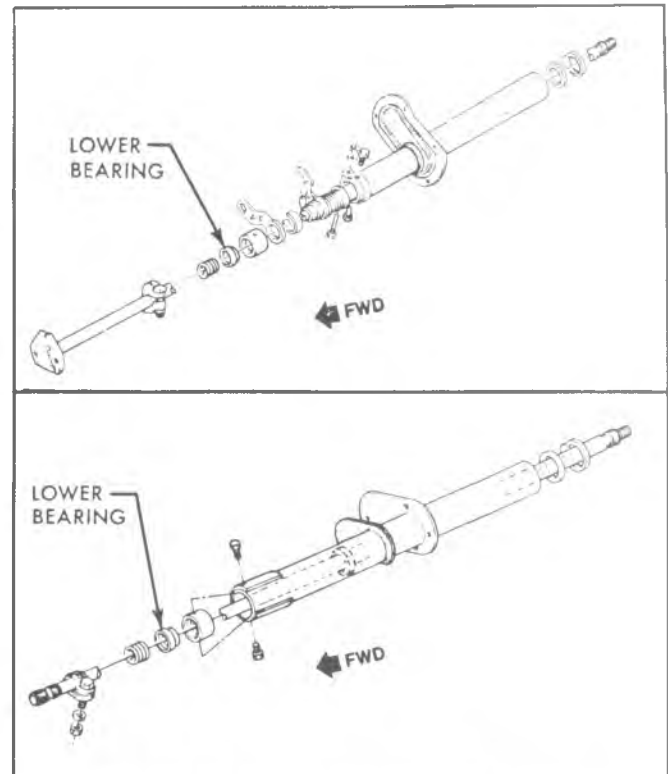


Fig. 3B4-65-Steering Column Lower Bearing

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 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.

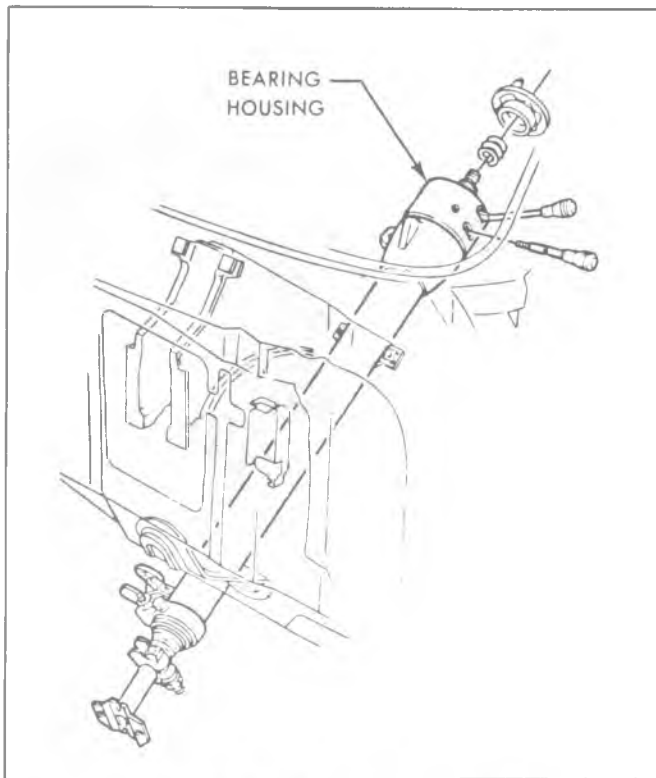


Fig. 3B4-66-Tilt Column Bearing Housing

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 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".

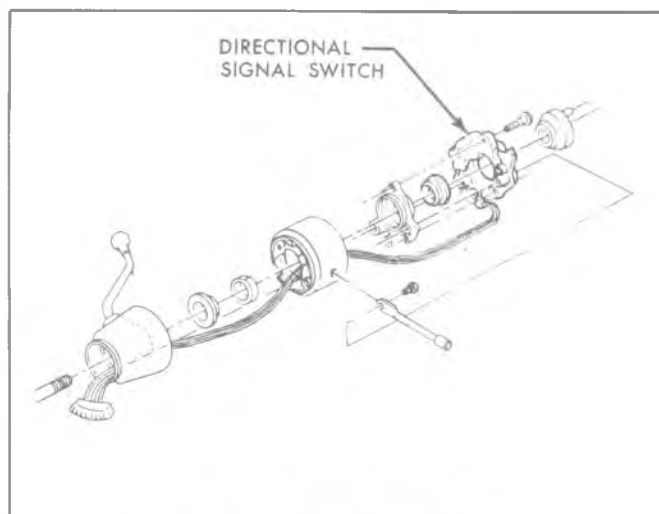


Fig. 3B4-67--Directional Signal Switch

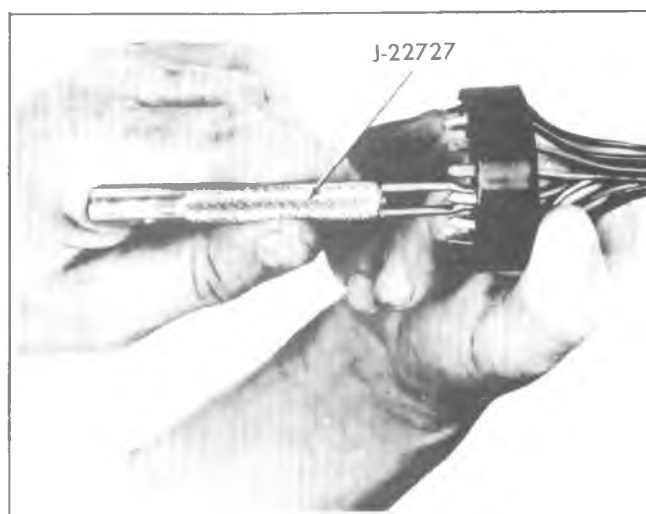


Fig. 3B4-69--Removing Wires from Connector

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.

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 3B4-68.

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. 3B4-69). 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. 3B4-70). Turn the tool center screw clockwise to pull the cover from the housing.

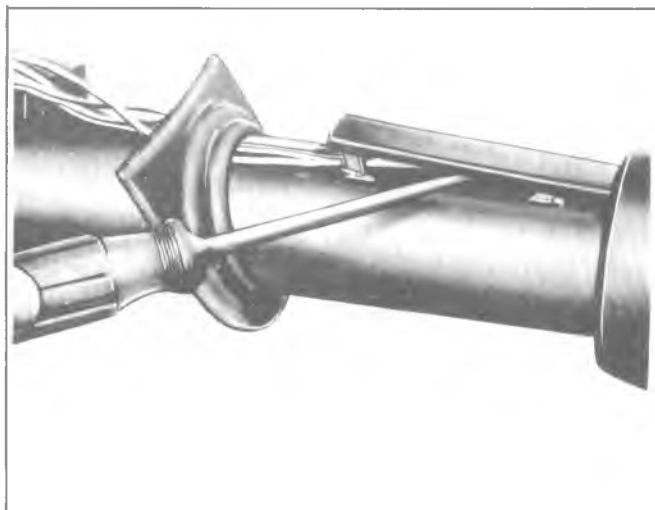


Fig. 3B4-68--Removing Wiring Harness Protector

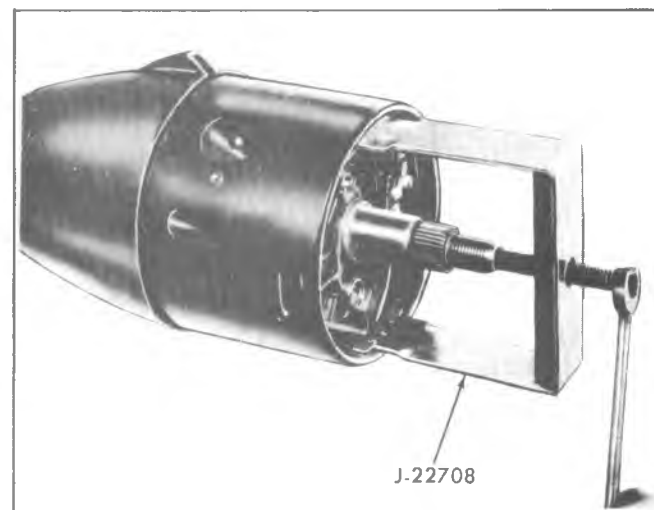


Fig. 3B4-70--Removing Directional Signal Housing Cover

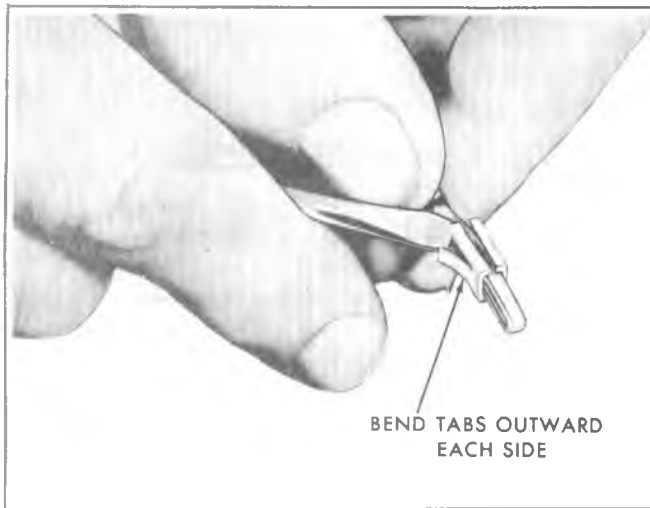


Fig. 3B4-71—Preparing Wire Retaining Tabs for Installation

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)

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.

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 3B4-71; 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).

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. 3B4-74)

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.

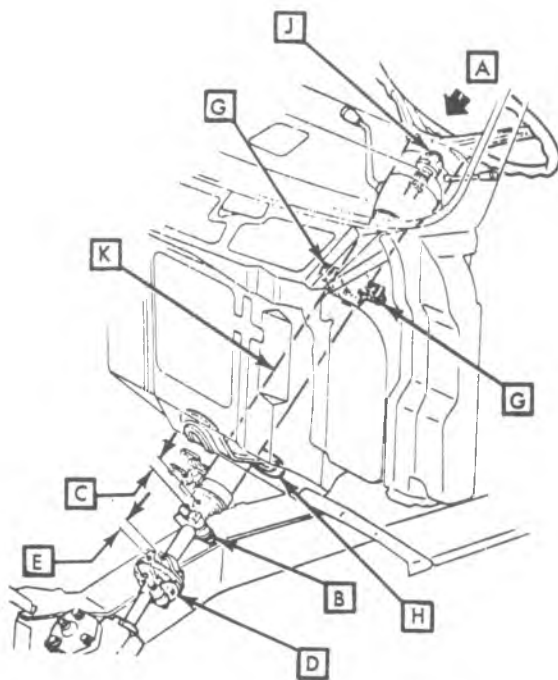
4. Drive out the shift lever pivot pin and remove the shift lever.

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.

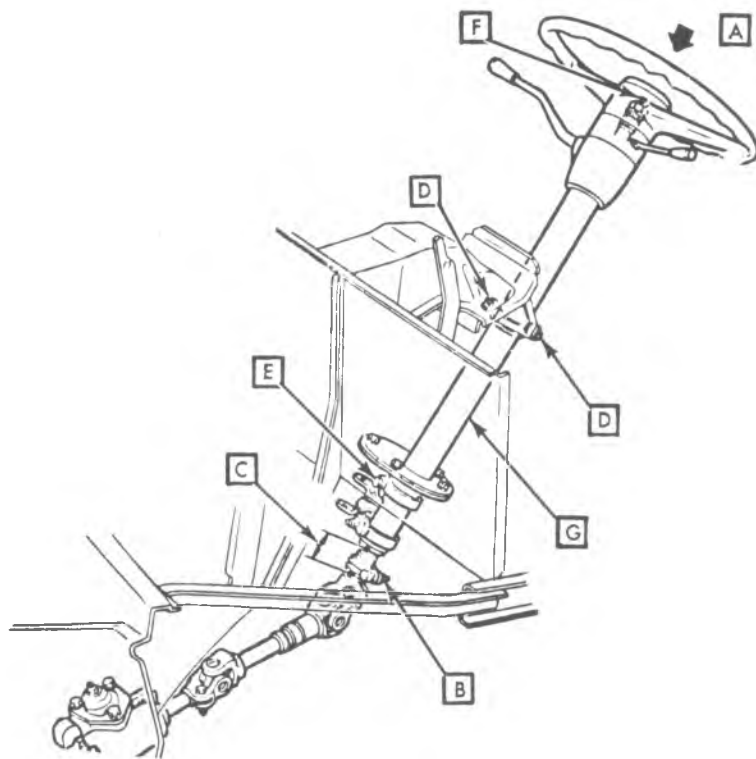


STEERING SYSTEM MANDATORY REQUIREMENTS

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 $.50 \pm .04$ 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. 3B4-72--Steering Column Attachment-G Series

9. Remove the plastic thrust washer assembly and then remove the shift lever housing (or extension housing) from



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 $1.26 \pm .02$ 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. 3B4-73--Steering Column Attachment - P Series

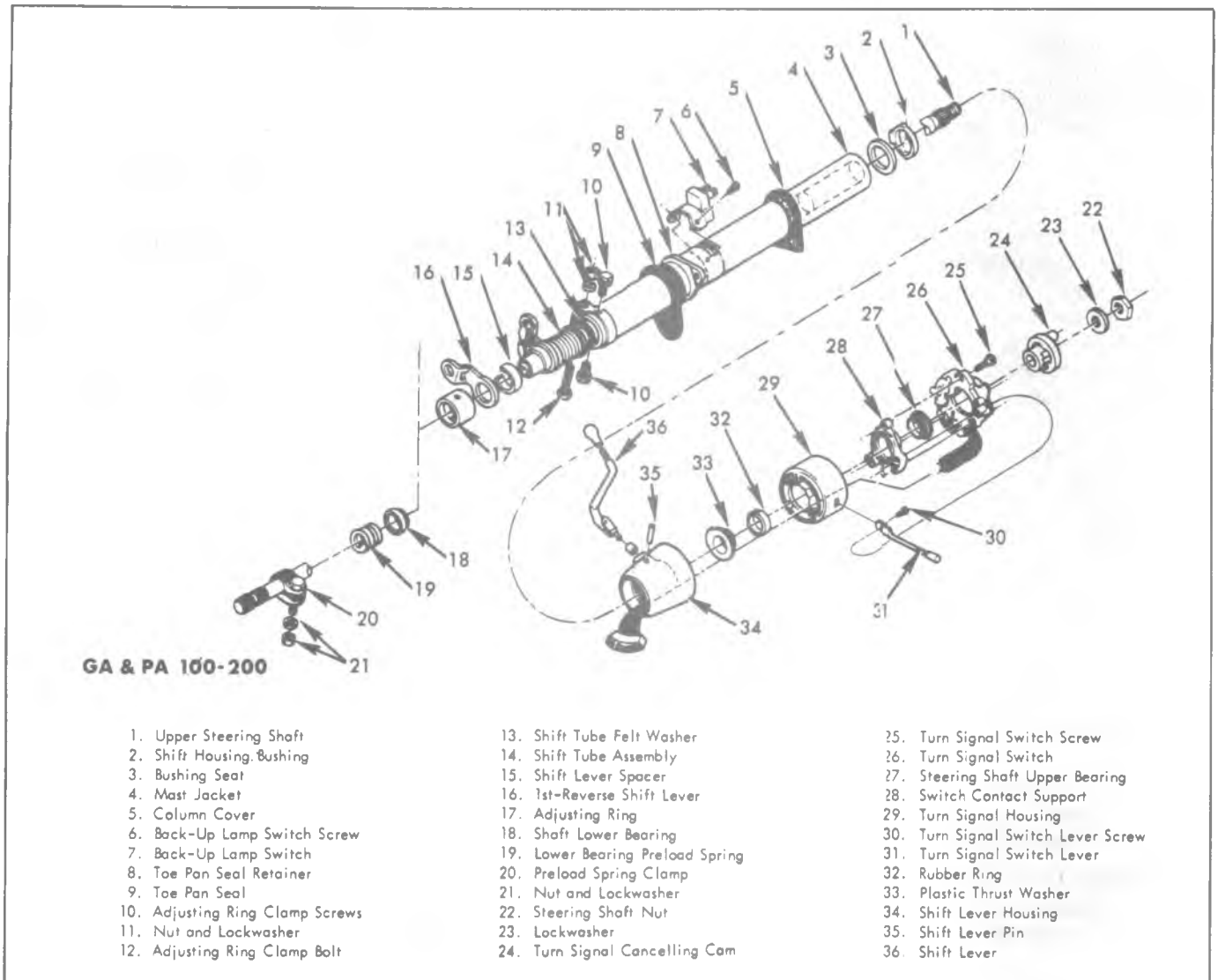


Fig. 3B4-74--Standard Column-Typical G & P

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. 3B4-75)

1. If the column is removed from the vehicle, place the column in a bench vise using Holding Fixtures J-22573 (Fig. 3B4-76).

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. 3B4-77). 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. 3B4-78).

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. 3B4-79).

c. Remove the tilt release lever.

d. Drive out the shoe release lever pivot pin using Tool J-22635 or a suitable punch (Fig. 3B4-80). 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. 3B4-81). 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. 3B4-82). 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. 3B4-83). 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 3B4-84. 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.

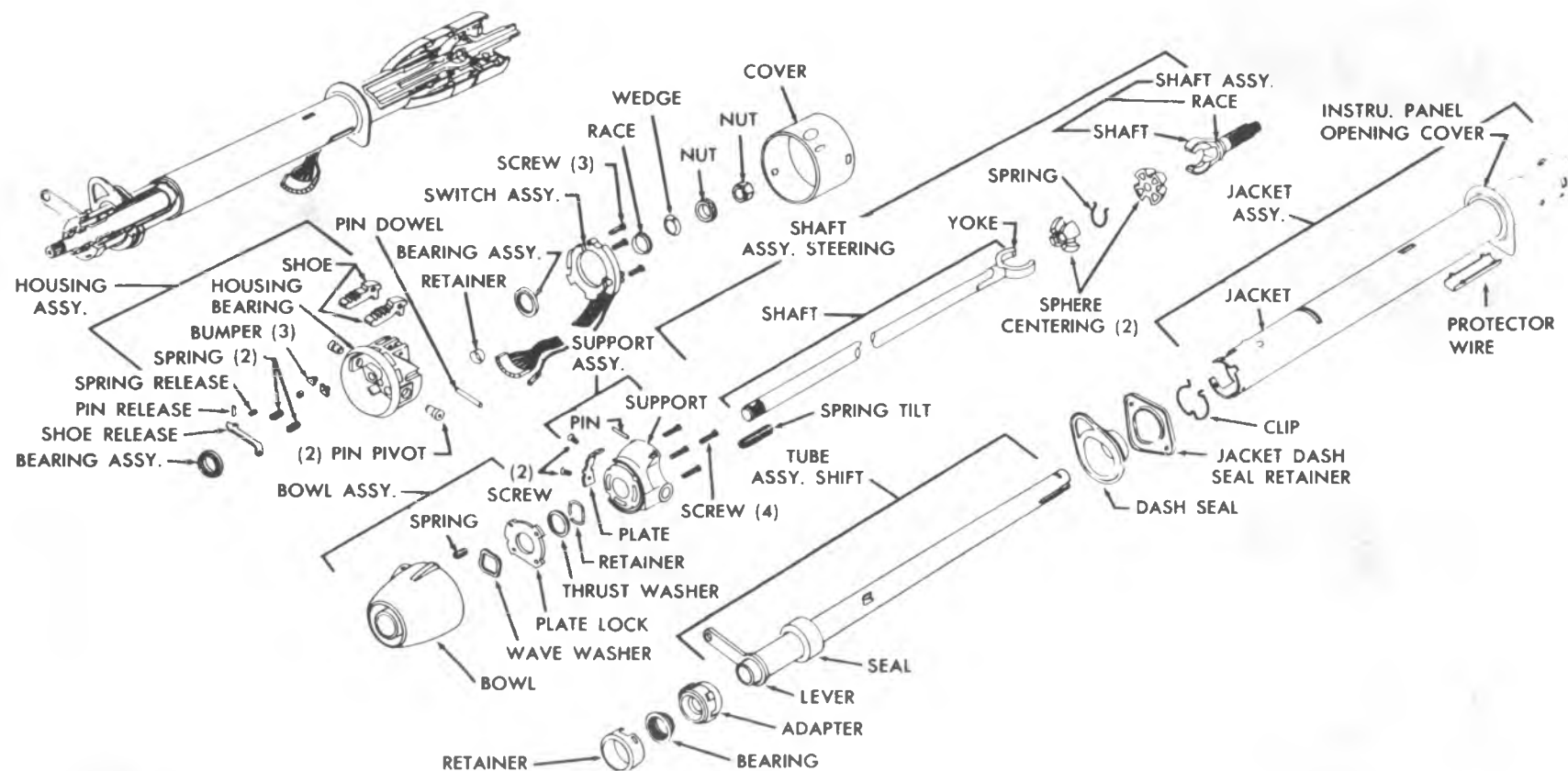
18. If necessary, remove the dash panel seal, mounting plate and the instrument panel seal from the column jacket.

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.

Fig. 3B4-75-Tilt Steering Column-G & P



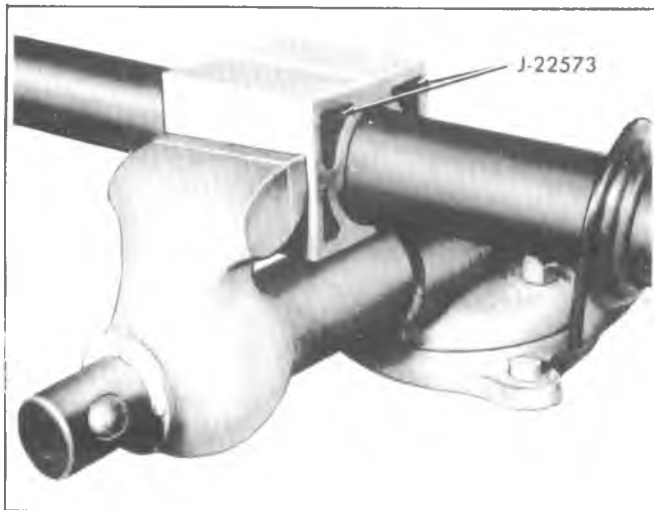


Fig. 3B4-76--Securing Column with J-22573

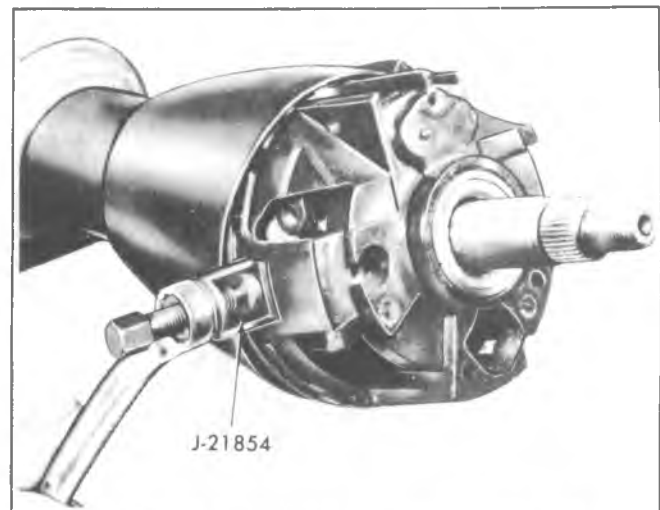


Fig. 3B4-78--Removing Bearing Housing Pivot Pin

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. 3B4-85). 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 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°.

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".

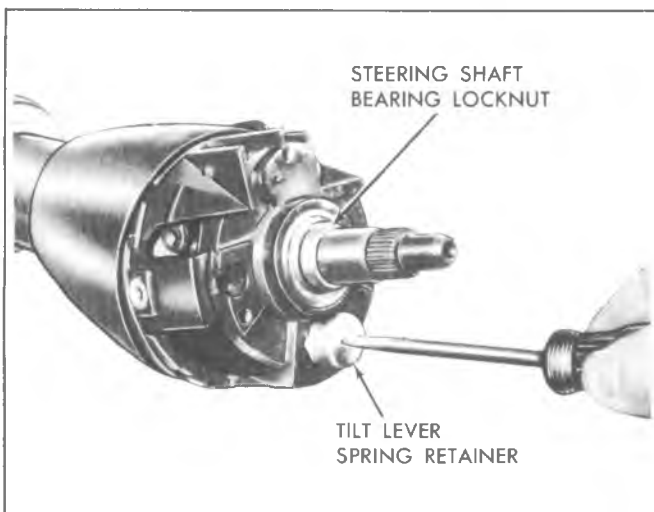


Fig. 3B4-77--Removing Tilt Spring and Retainer

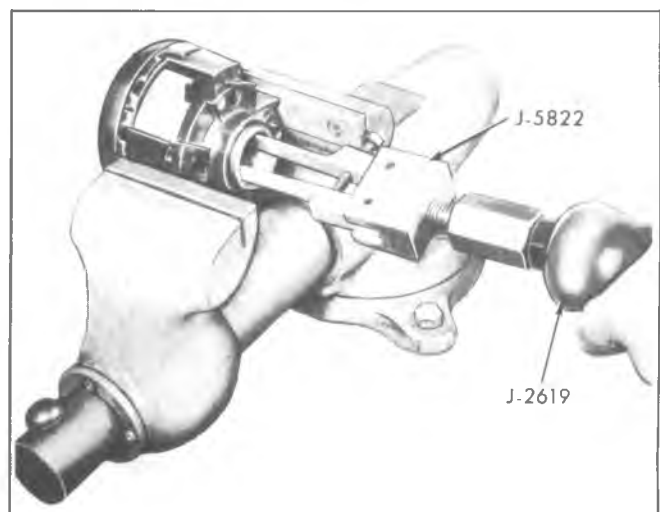


Fig. 3B4-79--Removing Bearing Race



Fig. 3B4-80—Removing Release Lever Pivot Pin

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.
 - 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.

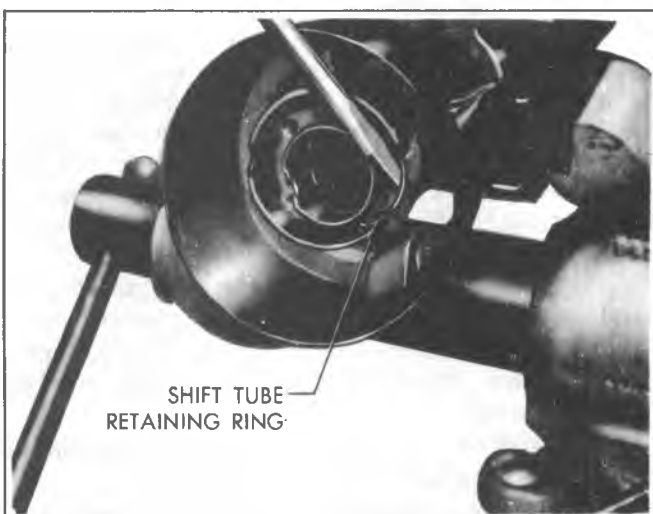


Fig. 3B4-81—Removing Shift Tube Retaining Ring

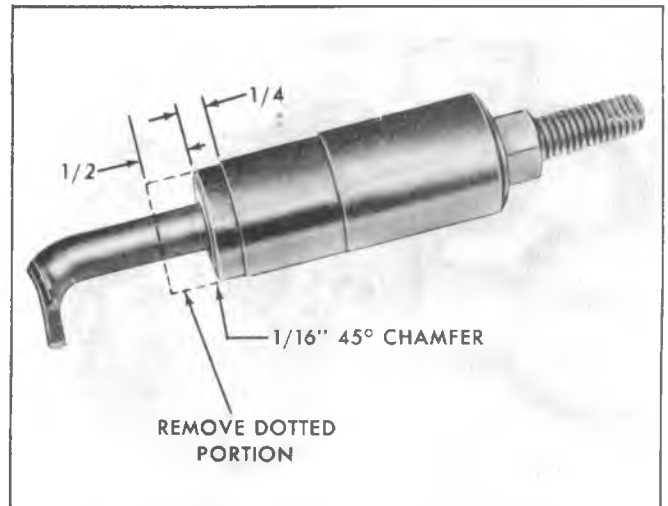


Fig. 3B4-82—Revised Shift Tube Removing Tool J-22551

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.

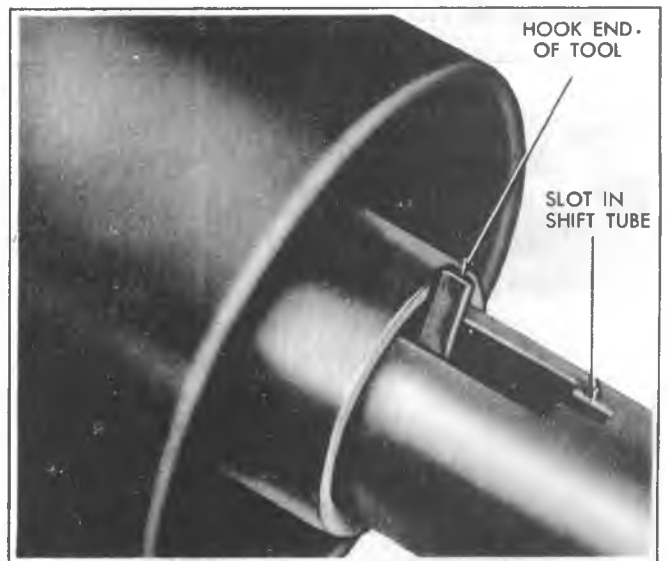


Fig. 3B4-83—Removing Shift Tube Assembly

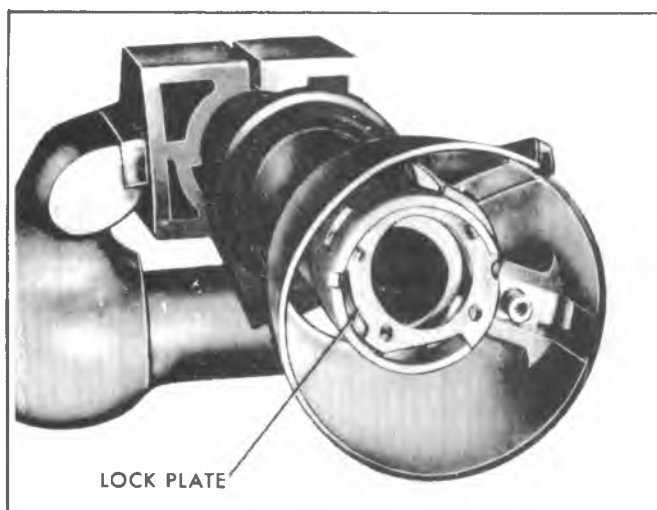


Fig. 3B4-84—Removing Lock Plate Assembly

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.

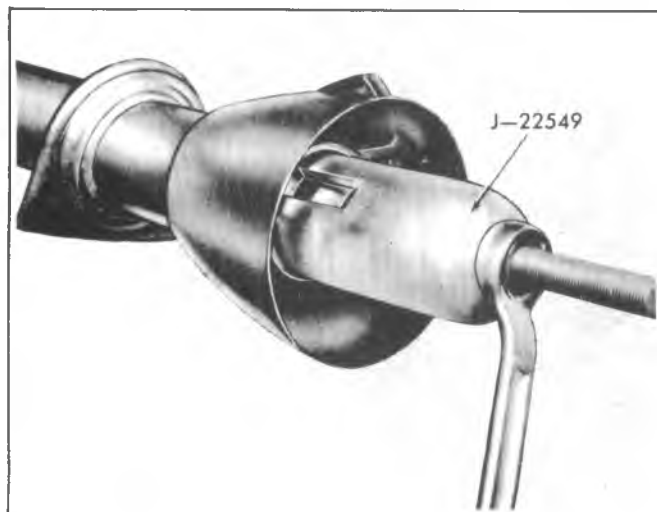


Fig. 3B4-85—Installing Shift Pin Tube

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.

The alignment pin plastic spacers must be removed before the vehicle can be driven.

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. 3B4-87.

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 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 protrusions 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 3B4-87. 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.

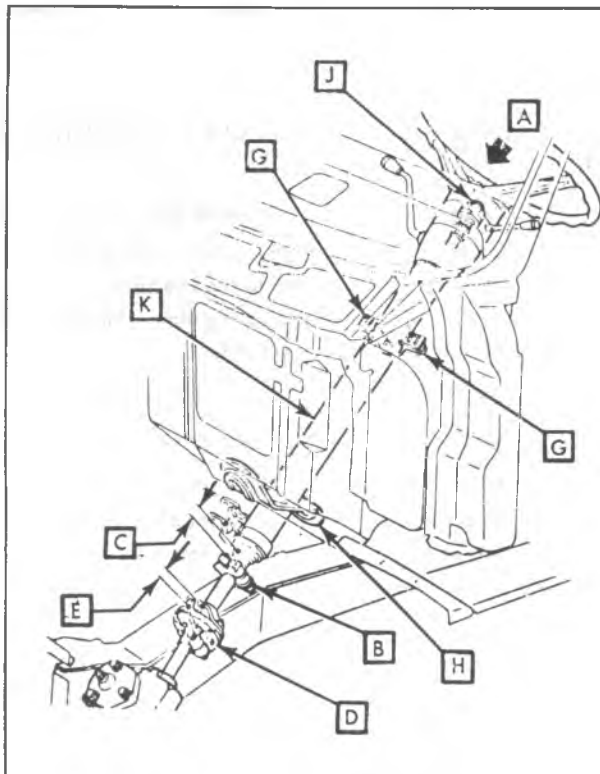
4. Position the steering column to dash panel bracket, install the attaching bolts and torque to specifications.

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.



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 $.50 \pm .04$ 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. 3B4-86-Mandatory Sequence For Installation Of G Series Column

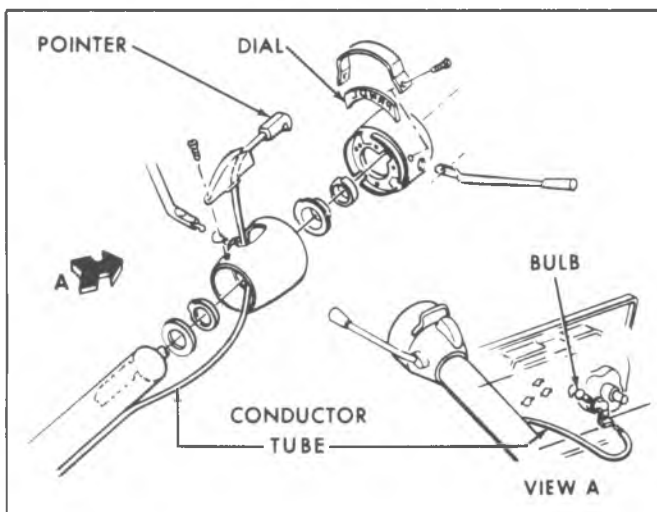


Fig. 3B4-87-Conductor Tube For Automatic Transmission Indicator

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. 3B4-88).

10. Install steering wheel as outlined under "Steering Wheel-Installation".

11. Connect battery ground cable.

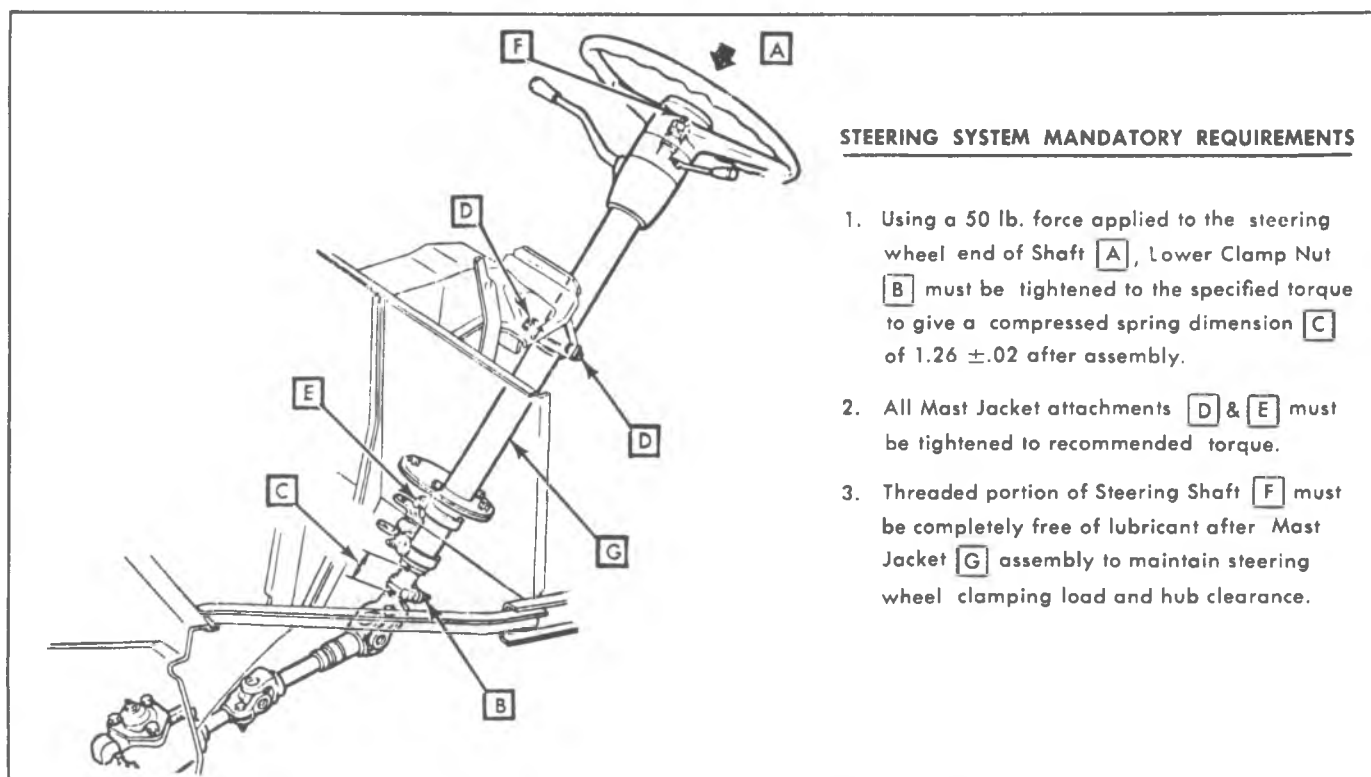


Fig. 3B4-88--Mandatory Sequence For Installation of P Series Column

SPECIFICATIONS

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.

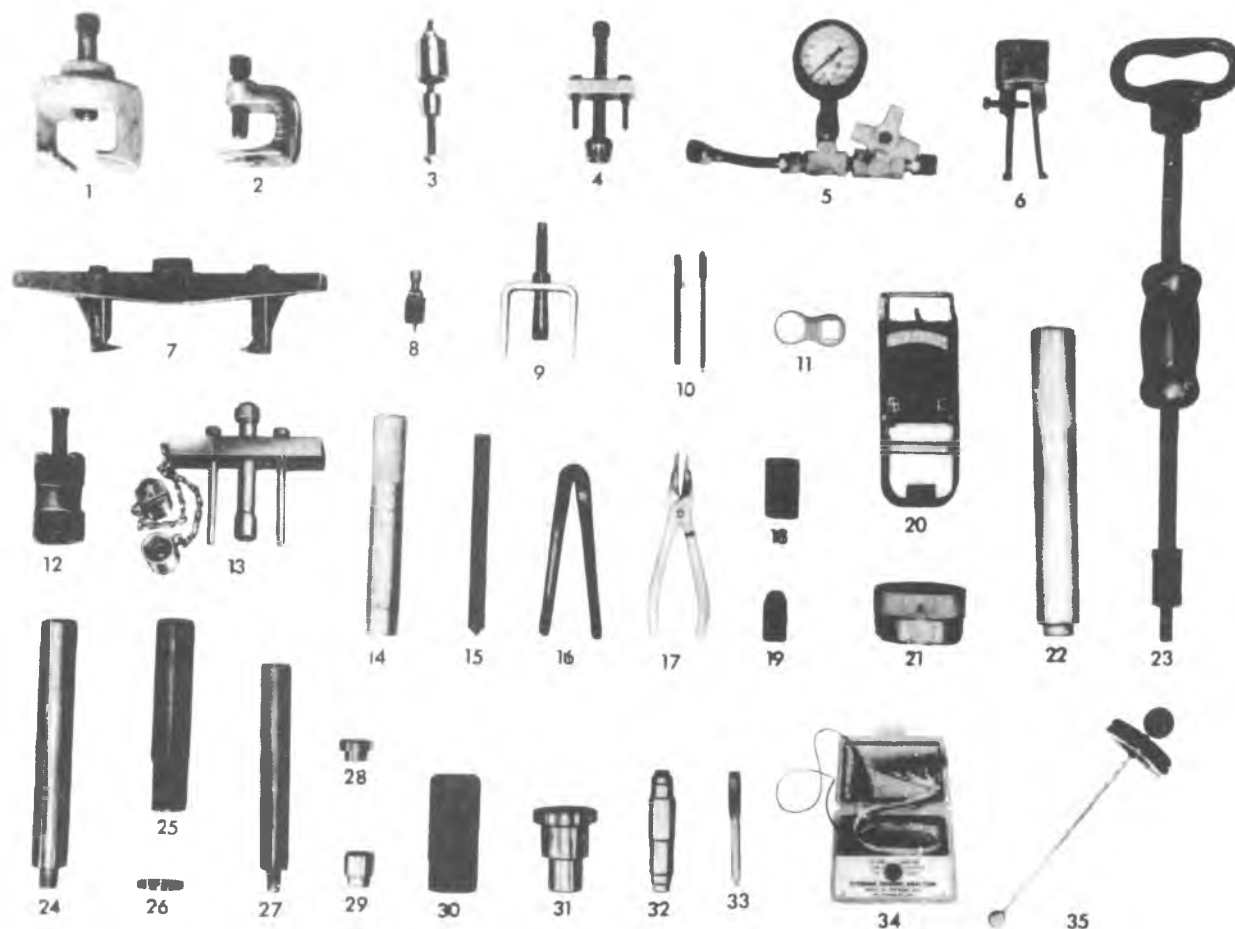
* In excess of thrust bearing preload.

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	

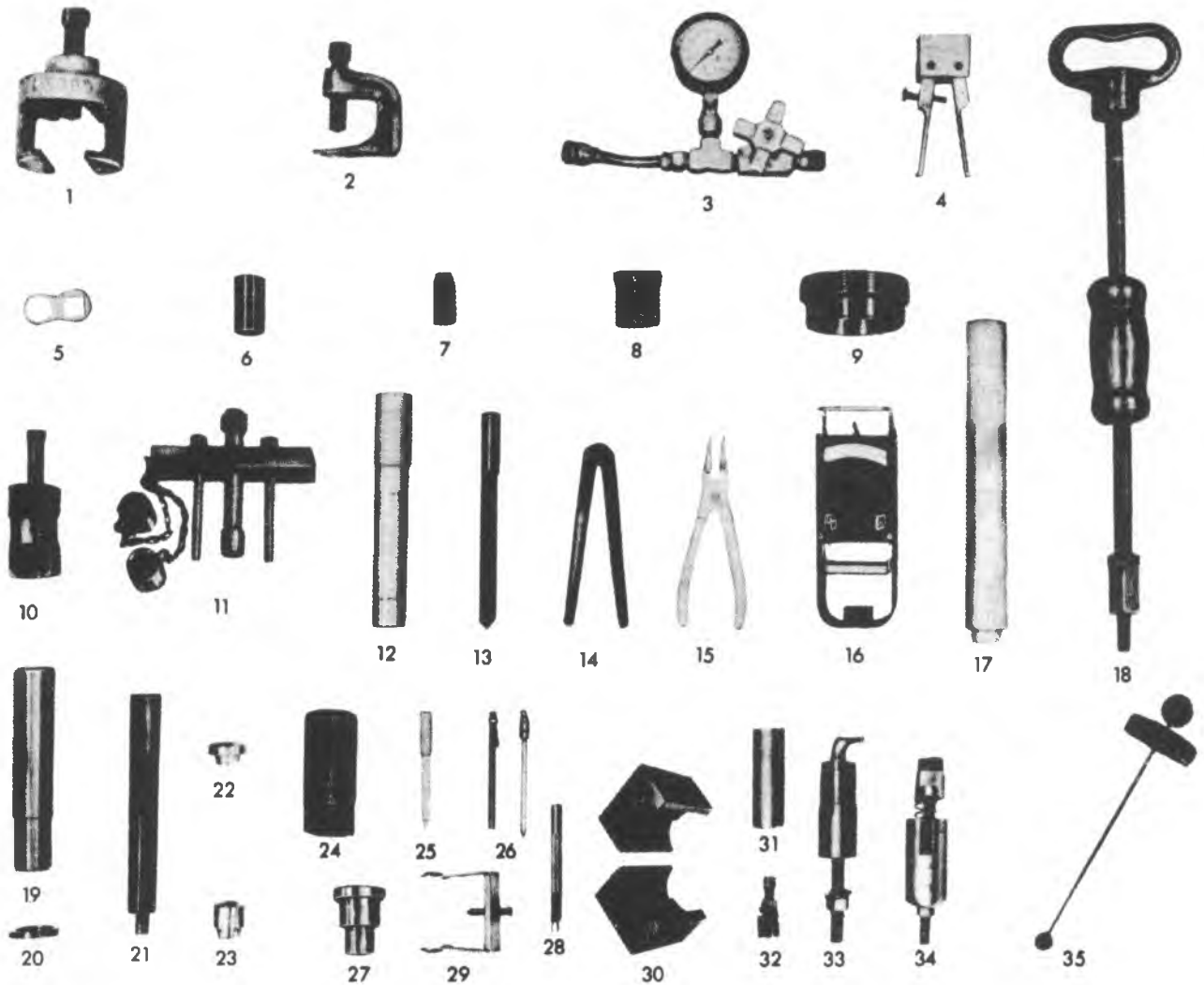
Fig. 3B4-Specs

SPECIAL TOOLS



- | | | | |
|-------------|--------------------------------------|--------------|-------------------------------------|
| 1. J-6632 | Pitman Arm Puller | 19. J-6222 | Shaft Seal Protector |
| 2. J-5504 | Pitman Arm Puller | 20. J-23600 | Belt Tension Gauge |
| 3. J-23073 | Shift Tube Installer | 21. J-8947 | Rack-Piston Seal Compressor |
| 4. J-23072 | Shift Tube Remover | 22. J-5755 | Wormshaft Bearing Race Installer |
| 5. J-5176 | Oil Pressure Gauge | 23. J-2619 | Slide Hammer |
| 6. J-5822 | Wormshaft Bearing Cup Remover | 24. J-8092 | Handle |
| 7. J-8433 | Pump Pulley Remover (Cast Pulley) | 25. J-6278 | Pitman Shaft Bearing Remover |
| 8. J-21854 | Column Pivot Pin Remover | 26. J-6278-2 | Pitman Shaft Bearing Installer |
| 9. J-23653 | Lock Plate Compressor | 27. J-7079-2 | Handle |
| 10. J-5421 | Thermometer | 28. J-8524-1 | Adjuster Plug Bearing Installer |
| 11. J-5860 | Torque Wrench Adapter | 29. J-8524-2 | Adjuster Plug Bearing Remover |
| 12. J-21239 | Pump Pulley Remover (Stamper Pulley) | 30. J-6219 | Pitman Shaft Seal Installer |
| 13. J-2927 | Steering Wheel Puller | 31. J-22407 | Pitman Shaft Bearing Installer |
| 14. J-1614 | Sector Shaft Bushing Remover | 32. J-8937 | Ball Seal Remover |
| 15. J-7539 | Ball Retainer | 33. J-6217 | Connector Seat Installer |
| 16. J-7624 | Spanner Wrench | 34. J-23980 | Steering Column Electrical Analyzer |
| 17. J-4245 | #23 Internal Pliers | 35. | Torque Wrenches |
| 18. J-22670 | Pump Shaft Seal Installer | | |

Fig. 3B-1ST--Special Tools C and K Models



- | | | | |
|-------------|---------------------------------|--------------|---------------------------------|
| 1. J-6632 | Pitman Arm Puller | 19. J-6278 | Pitman Shaft Bearing Remover |
| 2. J-5504 | Pitman Arm Puller | 20. J-6278-2 | Pitman Shaft Bearing Installer |
| 3. J-5176 | Pressure Gauge | 21. J-7079-2 | Drive Handle |
| 4. J-5822 | Wormshaft Bearing Cup Puller | 22. J-8524-1 | Adjuster Plug Bearing Installer |
| 5. J-5860 | Torque Wrench Adapter | 23. J-8524-2 | Adjuster Plug Bearing Remover |
| 6. J-22670 | Pump Shaft Seal Installer | 24. J-6219 | Pitman Shaft Seal Installer |
| 7. J-6222 | Shaft Seal Protector | 25. J-6217 | Connector Seat Installer |
| 8. J-9226 | Pitman Shaft Bushing Replacer | 26. J-5421 | Thermometer |
| 9. J-7576 | Rack-Piston Seal Compressor | 27. J-22407 | Pitman Shaft Bearing Installer |
| 10. J-21239 | Pump Pulley Remover | 28. J-22727 | Terminal Remover |
| 11. J-2927 | Steering Wheel Puller | 29. J-22708 | Turn Signal Cover Remover |
| 12. J-1614 | Sector Shaft Bushing Remover | 30. J-22573 | Steering Column Holding Fixture |
| 13. J-7539 | Ball Retainer | 31. J-22599 | Lock Nut Socket |
| 14. J-7624 | Spanner Wrench | 32. J-21854 | Pivot Pin Remover |
| 15. J-4245 | #23 Internal Pliers | 33. J-22551 | Shift Tube Remover |
| 16. J-23600 | Belt Tension Gauge | 34. J-22549 | Shift Tube Installer |
| 17. J-5755 | Wormshaft Bearing Cup Installer | 35. | Torque Wrenches |
| 18. J-2619 | Slide Hammer | | |

Fig. 3B-2ST-Special Tools G and P Models



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-2
Front Suspension (K-Series)	3C-23

FRONT SUSPENSION, TWO-WHEEL DRIVE

INDEX

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Maintenance and Adjustments	3C-3	Lower Control Arm Shaft	3C-16
Diagnosis	3C-4	Upper Control Arm	3C-17
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Wheel Hubs, Bearings	3C-14	Ball Joint	3C-20
Shock Absorber	3C-15	Steering Knuckle	3C-21
Stabilizer	3C-15	Suspension Unit	3C-22
Coil Spring	3C-15	Specifications	3C-39
		Special Tools	3C-40

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 and 3C-2. The control arms are of unequal length (S.L.A. Type).

This suspension system consists of upper and lower control arms pivoting on steel threaded 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 and are used on all models.

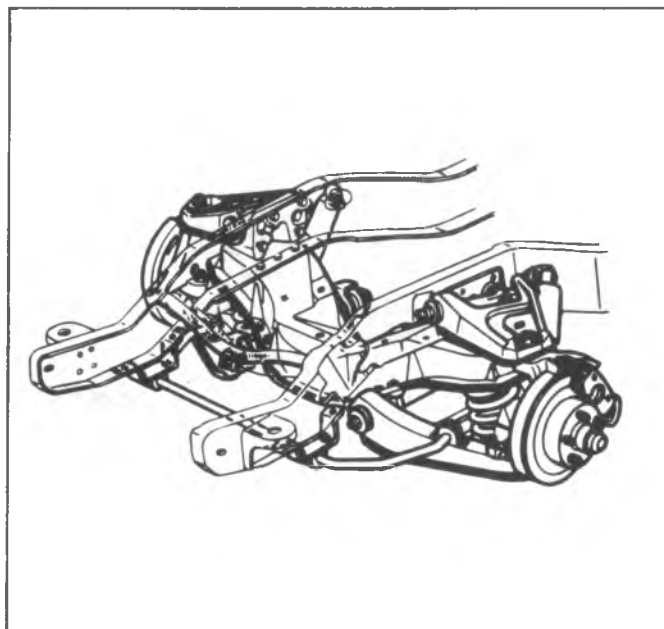


Fig. 3C-1--Front Suspension, C-P Series

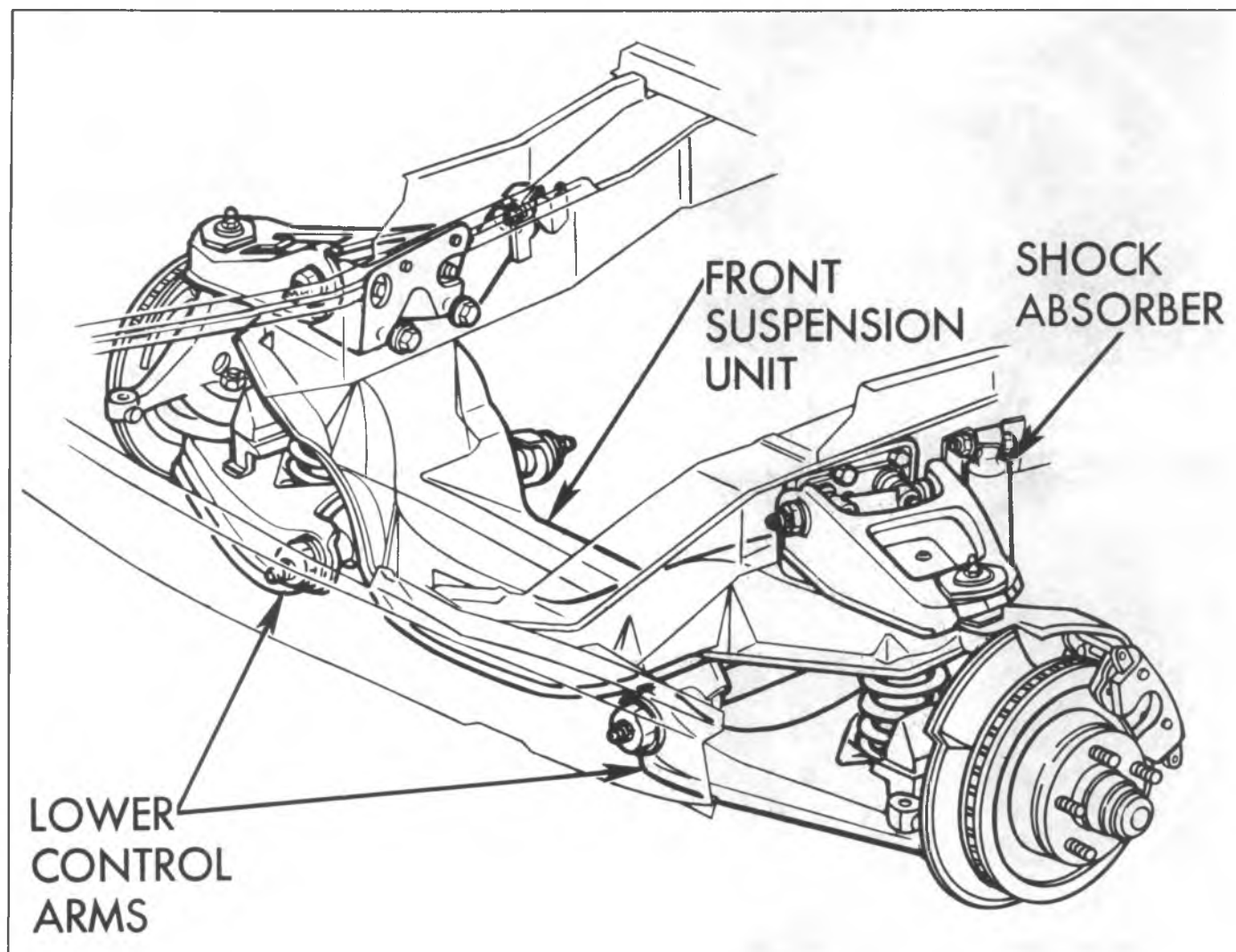


Fig. 3C-2--Front Suspension - G-Typical

MAINTENANCE AND ADJUSTMENTS

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 are used on all series vehicles and they have a slightly loose feel when properly adjusted. A design feature of front wheel taper roller bearings is that they must NEVER be preloaded. 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 "Wheel Hubs, Bearings" under "Component Parts Replacement."

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.

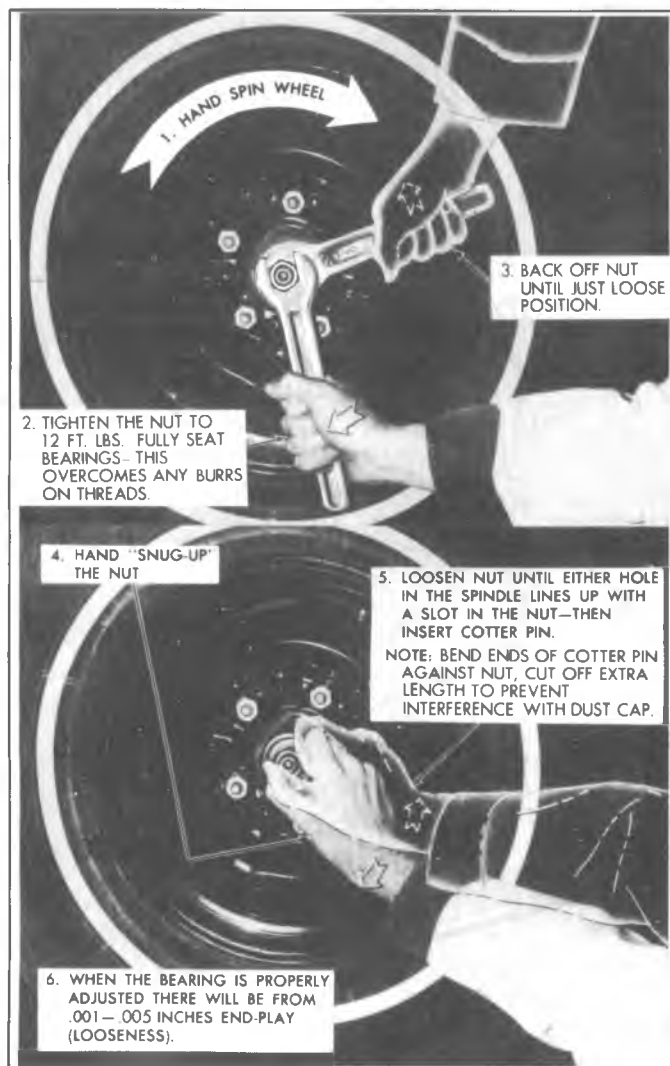


Fig. 3C-3--Wheel Bearing Adjustment

ADJUSTMENT OF WHEEL BEARINGS (FIG. 3C-3)

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-3.
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.

DIAGNOSIS**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 rechecked 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

HARD STEERING**Probable Cause**

- a. Ball joints and steering linkage need lubrication
- b. Low or uneven front tire pressure
- c. Power steering partially or not operative
- d. Steering gear not properly adjusted
- e. Incorrect front wheel alignment (manual steering)

Probable Remedy

- a. Lubricate ball joints and linkage
- b. Inflate tires to the proper recommended pressure
- c. Check power steering components for proper operation
- d. Adjust steering gear
- e. Check and align front suspension

POOR DIRECTIONAL STABILITY

- a. Ball joints and steering linkage need lubrication
- b. Low or uneven front or rear tire pressure
- c. Loose wheel bearings
- d. Steering Gear not on high point
- e. Incorrect front wheel alignment (caster)
- f. Broken springs
- g. Malfunctioning shock absorber.
- h. Broken stabilizer bar, or missing link

- a. Lubricate at proper intervals
- b. Inflate tires to the proper recommended pressure
- c. Adjust wheel bearings
- d. Adjust steering gear
- e. Check and align front suspension
- f. Replace springs
- g. Diagnose shock absorbers.
- h. Replace stabilizer or link

**FRONT WHEEL SHIMMY
(SMOOTH ROAD SHAKE)**

- a. Tire and wheel out of balance, or out of round
- b. Worn or loose wheel bearings
- c. Worn tie rod ends
- d. Worn ball joints
- e. Malfunctioning shock absorber

- a. Balance tires, check run-out
- b. Adjust wheel bearings
- c. Replace tie rod end
- d. Replace ball joints
- e. Diagnose shock absorbers

**VEHICLE PULLS TO ONE SIDE
(NO BRAKING ACTION)**

- a. Low or uneven tire pressure
- b. Front or rear brake dragging
- c. Broken or sagging front spring
- d. Incorrect front wheel alignment (Camber)

- a. Inflate tires to the proper recommended pressure
- b. Adjust brakes
- c. Replace spring
- d. Check and align front suspension

EXCESSIVE PLAY IN STEERING

- a. Incorrect steering gear adjustment
- b. Worn steering gear parts

- a. Adjust steering gear
- b. Overhaul Gear

Fig. 3C-4--Front Suspension Diagnosis Chart A

(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.

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. Over loaded 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. 3C-5--Front Suspension Diagnosis Chart B

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.

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. Over loaded 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. 3C-6--Front Suspension Diagnosis Chart C

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 sub-divided into two general areas, (1) Inspecting Shocks for Loss of Hydraulic Fluid and (2)

BALL JOINT DIAGNOSTIC PROCEDURE

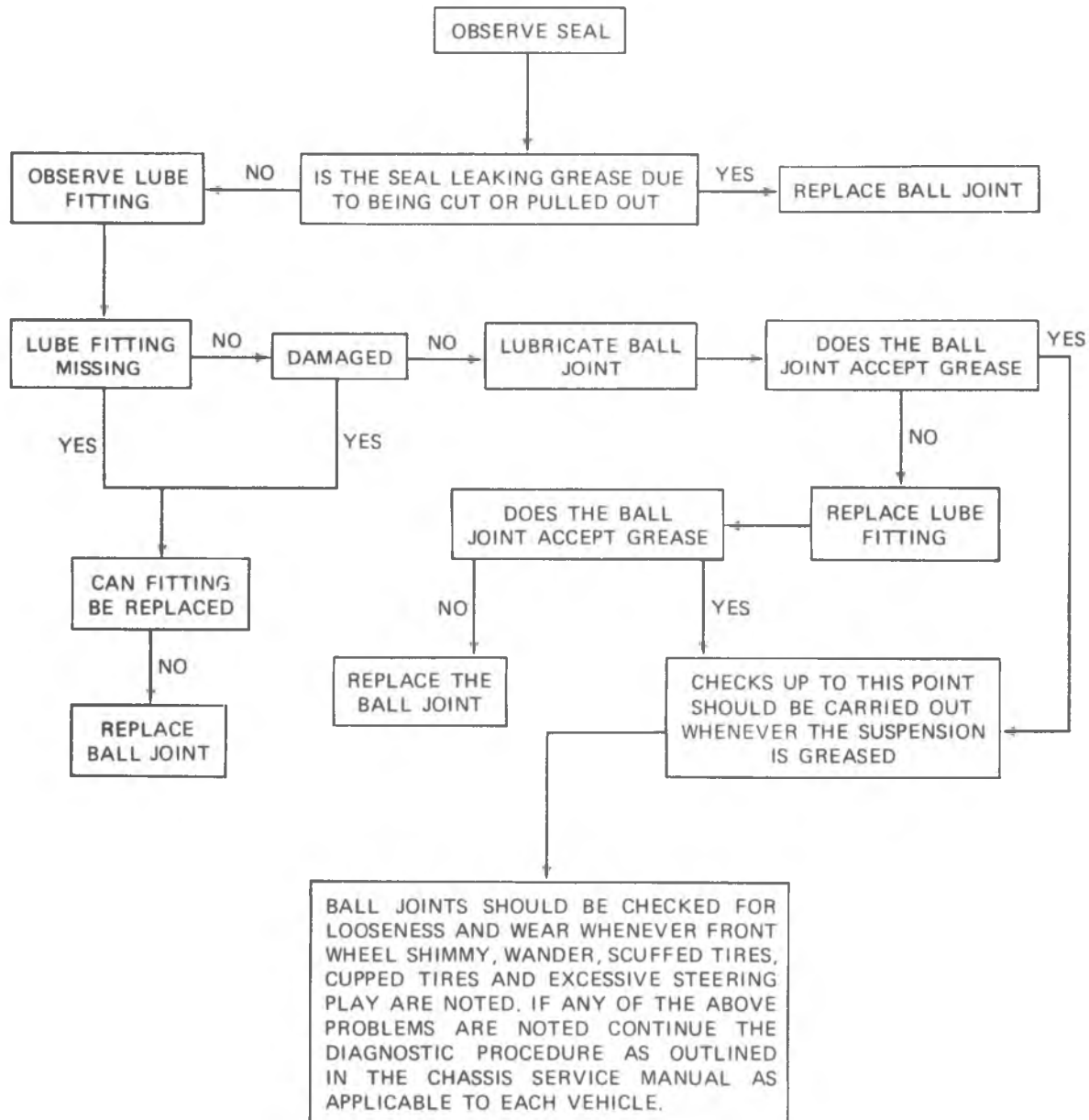


Fig. 3C-7--Ball Joint Diagnostic Procedure

Manually Operating Shock. It should aid the technician to localize defective shocks caused by internal noise in the shock, weak, leaking, etc.

1. Inspecting Shocks for Possible Loss of Hydraulic Fluid.

- Disconnect each shock lower mounting as required and pull down on the shock until it is fully extended.
- 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 (Figure 3C-8).

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.

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.

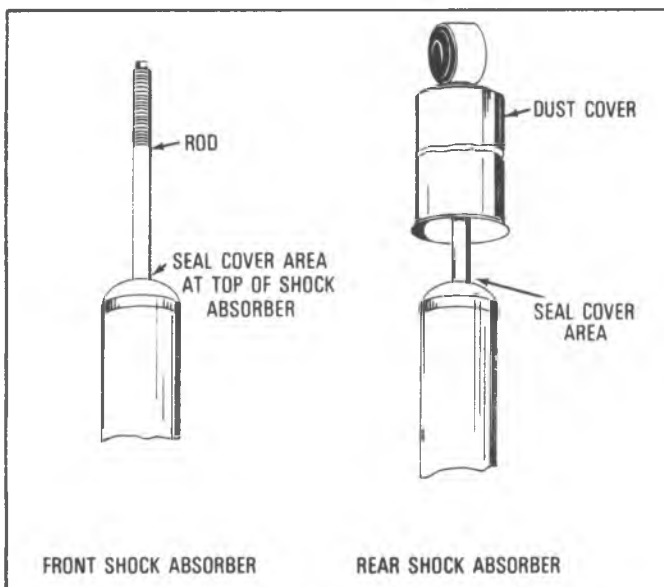


Fig. 3C-8--Seal Cover Area of Shock

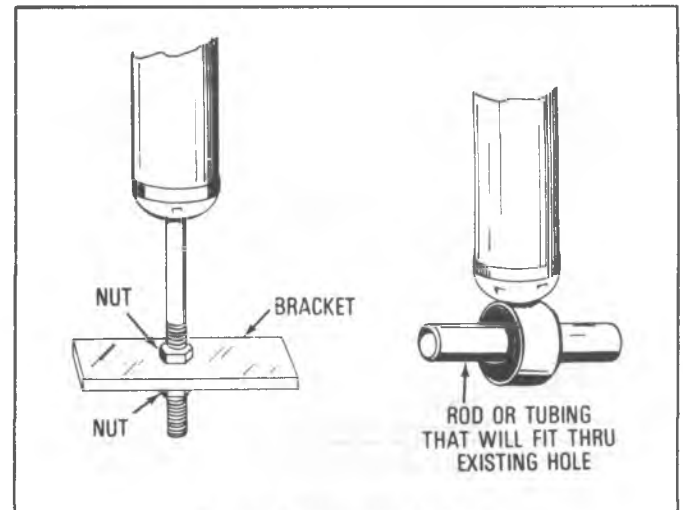


Fig. 3C-9--Gripping Methods

- (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.

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: (Refer to Figure 3C-10)

- Holding the shock in its normal vertical position (top end up), fully extend shock.
- Hold the top end of the shock **down** and fully collapse the shock.
- Repeat Steps (a) and (b) at least five (5) times to assure air is purged.

Bench Test Procedure

- This is a comparison type test. If possible, obtain a new or known good shock with same part number as shock under test.

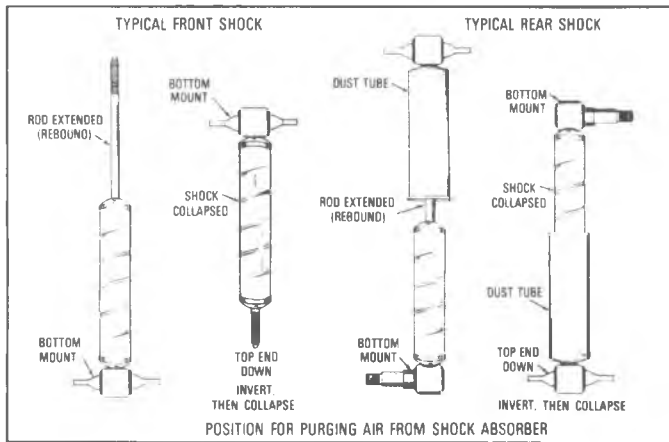


Fig. 3C-10--Position for Purging Air From Shocks

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.

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. Fretting of bearing seats.
11. Brinelling from impact loads and shipping.
12. Manufacturing defects.

BEARINGS AND RACES

FRONT WHEEL, PINION, DIFFERENTIAL SIDE AND REAR WHEEL ROLLER BEARINGS

DIAGNOSIS

	EXCESS NOISE COMPLAINT DIAGNOSTIC PROCEDURE
Road Test	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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

Fig. 3C-11--Bearing Diagnosis Chart

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.

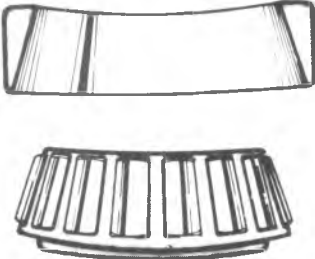
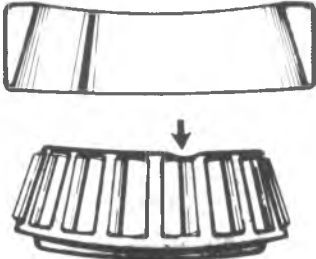
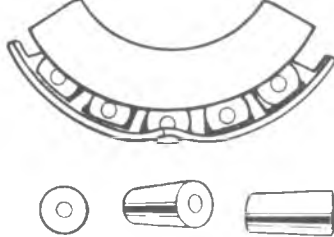
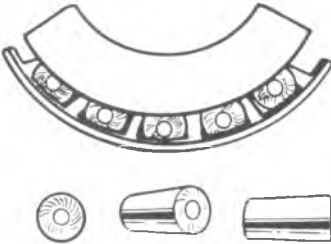
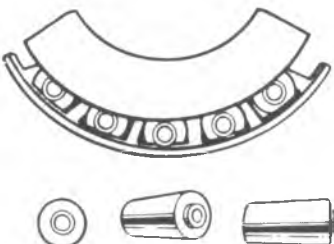
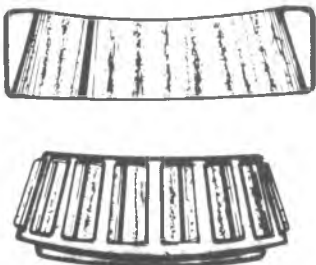
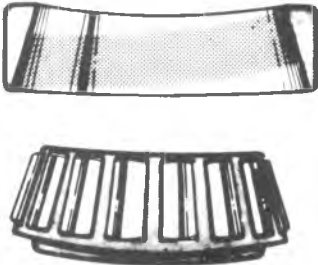
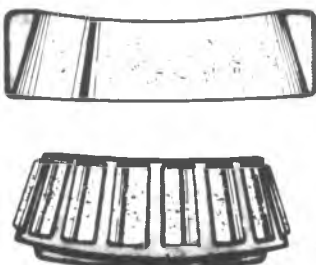
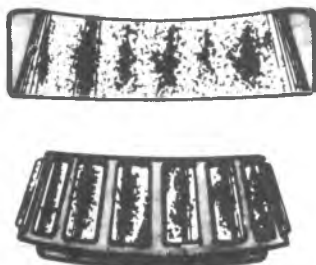
 <p style="text-align: center;">GOOD BEARING</p>	 <p style="text-align: center;">BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>	 <p style="text-align: center;">BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p style="text-align: center;">GALLING</p> <p>METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD.</p> <p>REPLACE BEARING – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p style="text-align: center;">ABRASIVE STEP WEAR</p> <p>PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p style="text-align: center;">ETCHING</p> <p>BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.</p> <p>REPLACE BEARINGS – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>
 <p style="text-align: center;">MISALIGNMENT</p> <p>OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.</p> <p>CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.</p>	 <p style="text-align: center;">INDENTATIONS</p> <p>SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.</p> <p>CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.</p>	 <p style="text-align: center;">FATIGUE SPALLING</p> <p>FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.</p> <p>REPLACE BEARING – CLEAN ALL RELATED PARTS.</p>

Fig. 3C-12--Bearing Diagnosis Illustration A

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

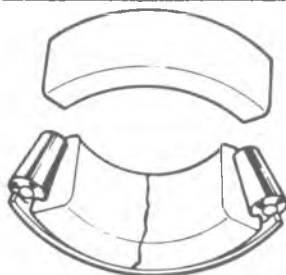
WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION. CHECK SEALS AND REPLACE BEARINGS.



ABRASIVE ROLLER WEAR

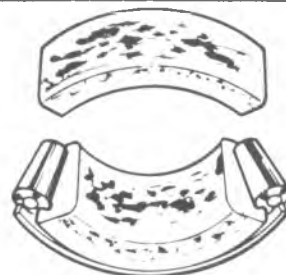
PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

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.

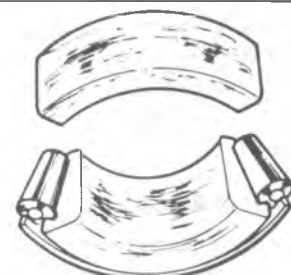


SMEARS

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 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.



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. 3C-13--Bearing Diagnosis, Illustration B

COMPONENT PARTS REPLACEMENT

WHEEL HUBS, BEARINGS (Fig. 3C-14)

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 withdraw cotter pin.
2. Remove the brake caliper and hang by wire to the suspension. Do not allow the caliper assembly to hang by the brake flex line.
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.
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.

Repairs

Replacement of Bearing Cups

If 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.

NOTICE: Use care when installing new race to start it squarely into hub, to avoid distortion and possible cracking.

Wheel Stud Replacement (Fig. 3C-14)

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 be 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 of the bearing. This provides extra grease availability to the bearing.
9. Final wheel bearing adjustment should be performed as previously outlined.

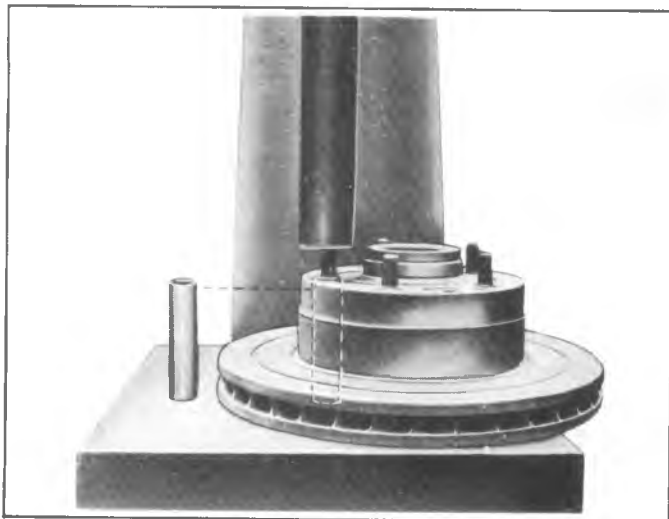


Fig. 3C-14--Pressing Hub Bolt

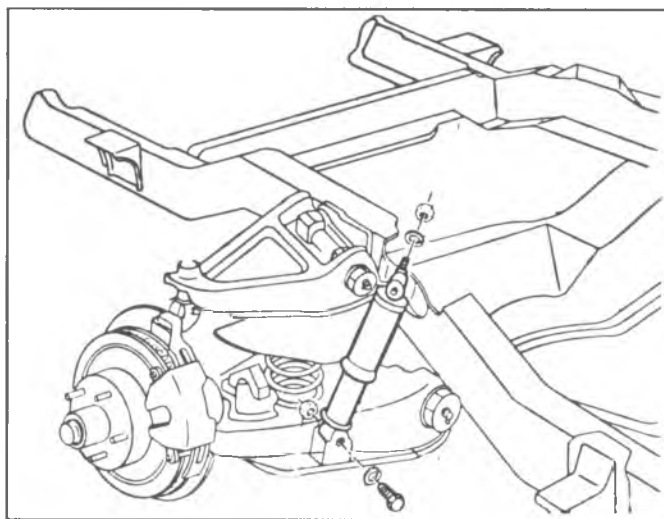


Fig. 3C-15--Shock Absorber Attachments

SHOCK ABSORBER

Removal (Fig. 3C-15)

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

Removal (Fig. 3C-16)

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.

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.

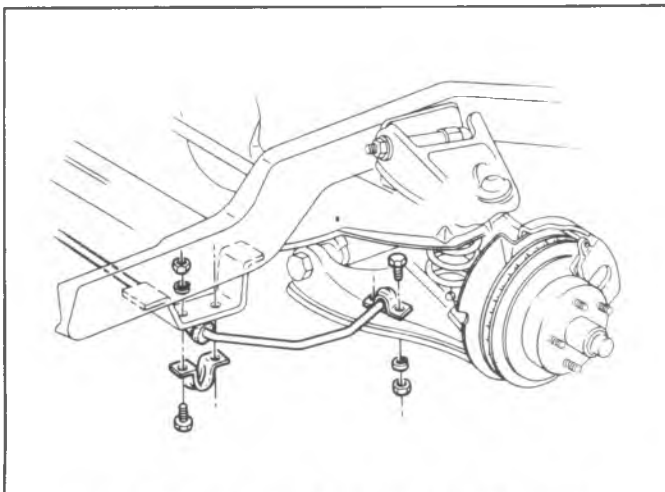


Fig. 3C-16--Stabilizer Bar - C, P and G Typical

COIL SPRING

Removal (Fig. 3C-17)

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. Disconnect the stabilizer bar attachments to the lower control arm.
3. Bolt Tool J-23028 to a suitable jack.
4. 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.
5. 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 crossshaft and lower control arm keeps the coil spring compressed. Use care when lowering.
6. Lower control arm by slowly releasing the jack until spring can be removed. Be sure all compression is relieved from spring.
7. Remove spring.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to 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 \pm 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.



Fig. 3C-17--Removing Coil Spring with Tool J-23028

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-18.

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.
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-19 shows correct final positioning of shaft. Check shaft for free rotation and install grease fittings.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 3, 5 and 6.

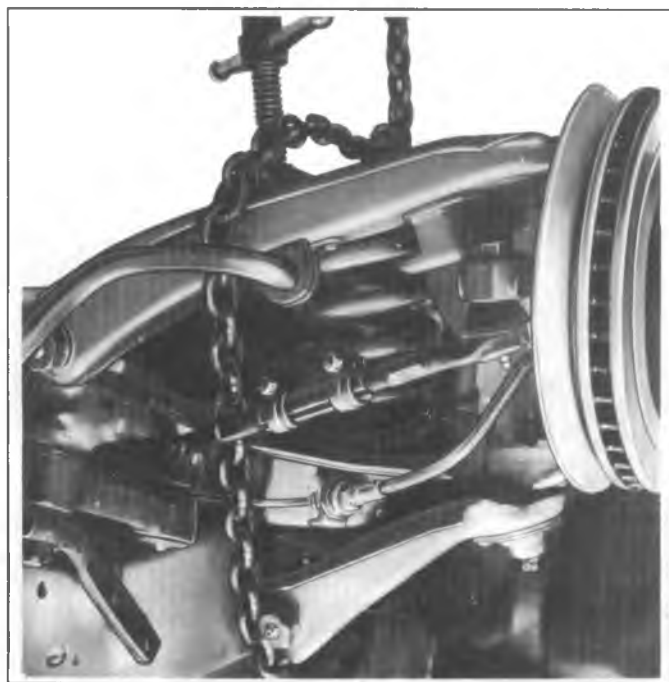


Fig. 3C-18--Removing Inner Pivot Shaft

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-19 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-18)

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-18). 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.

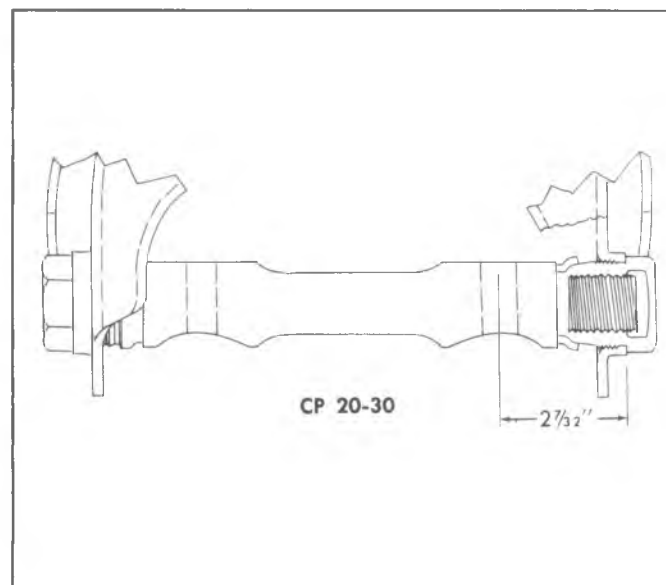


Fig. 3C-19--Positioning U.C.A. Shaft (Steel Bushings)

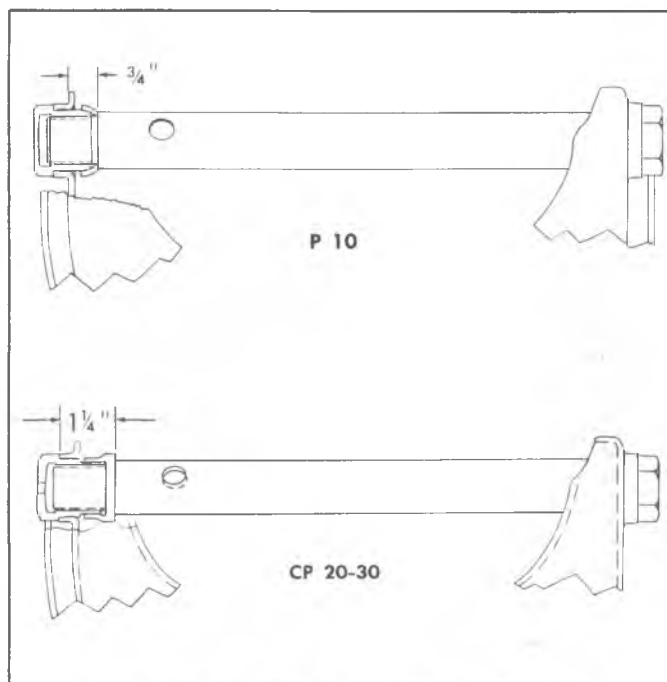


Fig. 3C-20--Positioning L.C.A. Shaft (Steel Bushings)

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-20 shows correct final positioning of shaft.

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.

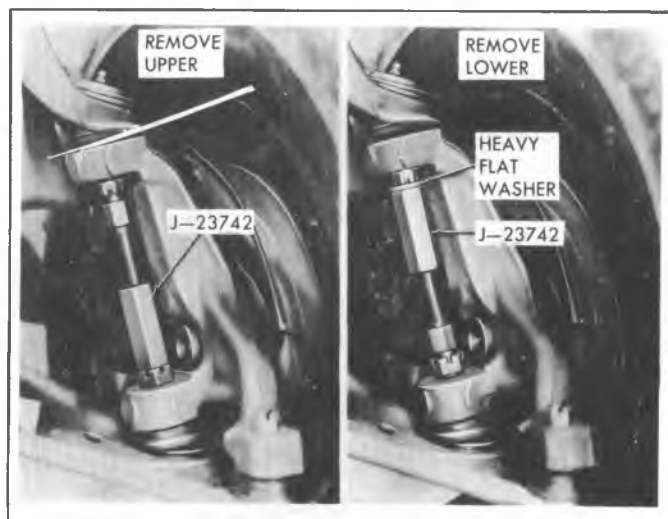


Fig. 3C-21--Disconnecting Ball Joints from Knuckle

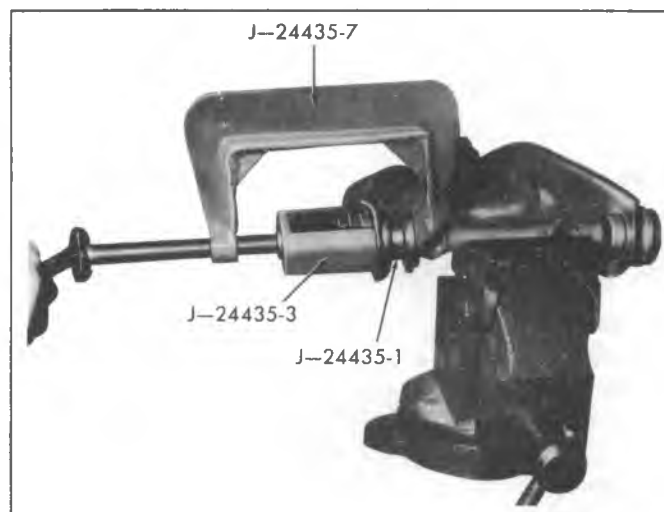


Fig. 3C-22--U.C.A. Rubber Bushing Removal

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.

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-21. Remove the nut from the ball stud and raise upper arm to clear steering knuckle.

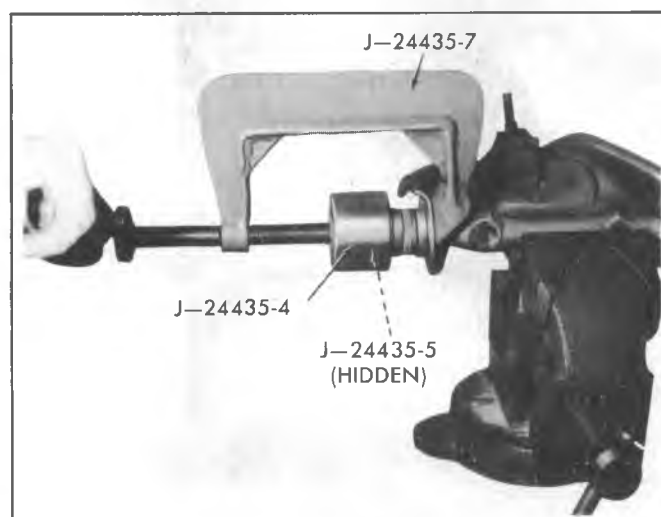


Fig. 3C-23--U.C.A. Rubber Bushing Installation

5. Remove nuts securing control arm shaft to frame. 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-22)

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-22.
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.

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-23 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.

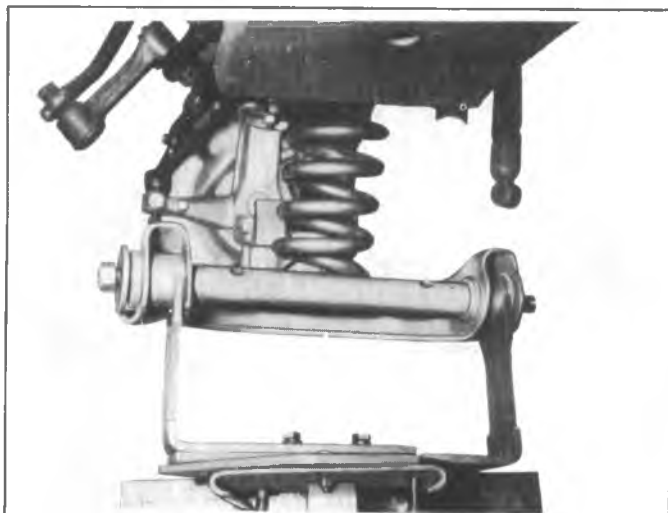


Fig. 3C-24--Lowering Control Arm for Bushing Replacement

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.

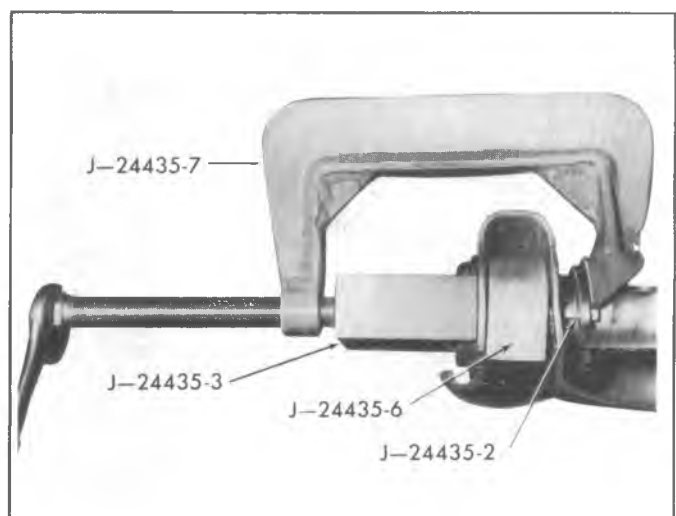


Fig. 3C-25--L.C.A. Rubber Bushing Removal

Lower Control Arm Inner Pivot Shaft and/or Bushing Replacement-On Vehicle

C10 (Rubber Bushings)

Removal (Figs. 3C-24, 3C-25)

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-24) 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-25.
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 8-12.

Bushing Installation (Fig. 3C-26)

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-26 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-26 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-25.
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-26 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-26 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.

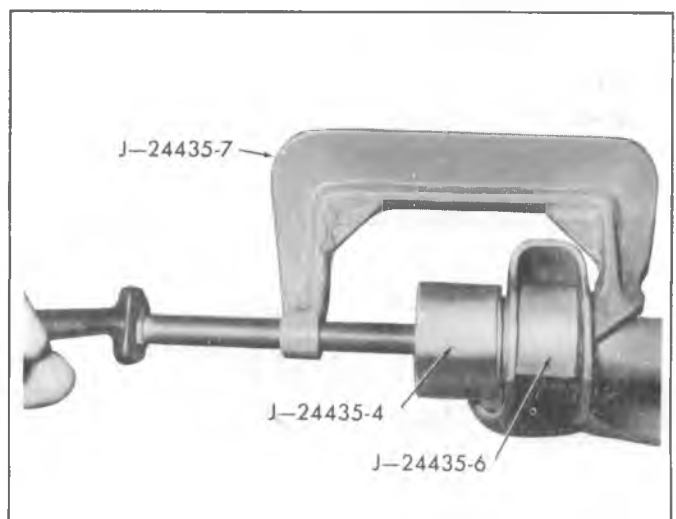


Fig. 3C-26--L.C.A. Rubber Bushing Installation

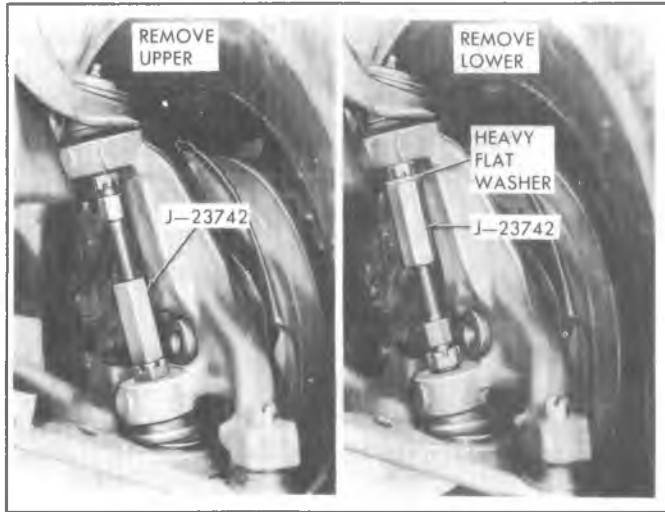


Fig. 3C-27--Disconnecting Ball Joints-Typical

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.

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-27.
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.

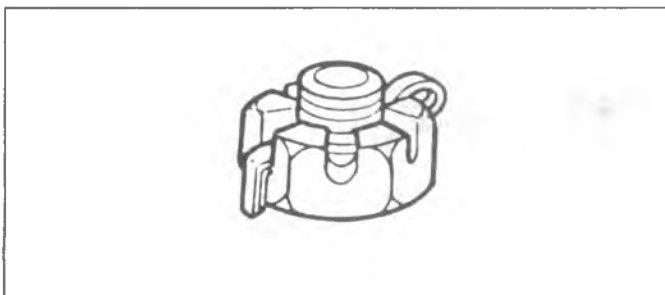


Fig. 3C-28--Cotter Pin Installation

1. Install new service ball joint, using bolts and nuts supplied with joint, to upper arm. Torque nuts to 60 N·m (45 ft. lbs.).
2. Mate ball stud to steering knuckle and install stud nut.
3. Torque the ball stud nut as follows:
 - A. 10 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 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-28.
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-29).

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-29--Checking Lower Ball Joint

4. Install J-23742 between the ball studs as shown in Figure 3C-27.

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 J-9519-10 and J-9519-2 and J-9519-29 as shown in Fig. 3C-30.
8. Turn hex head screw until ball joint is free of control arm.
9. Remove tools and the ball joint.

Installation (Fig. 3C-31)

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 J-9519-10 and J-9519-16 as shown. 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.

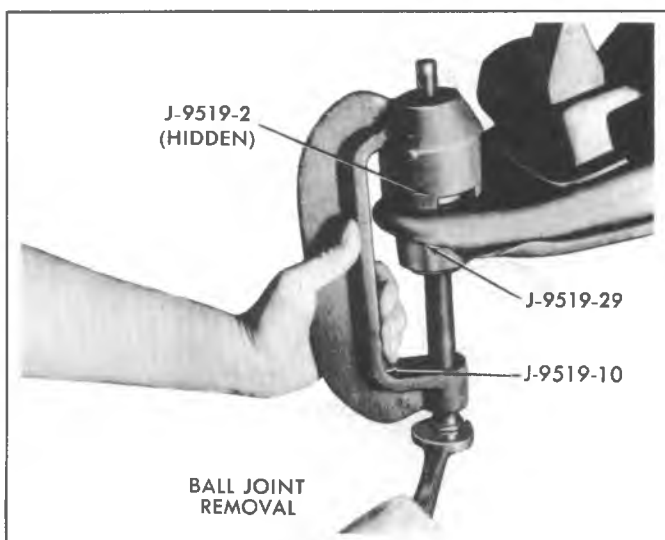


Fig. 3C-30--Ball Joint Removal

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.

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 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.).

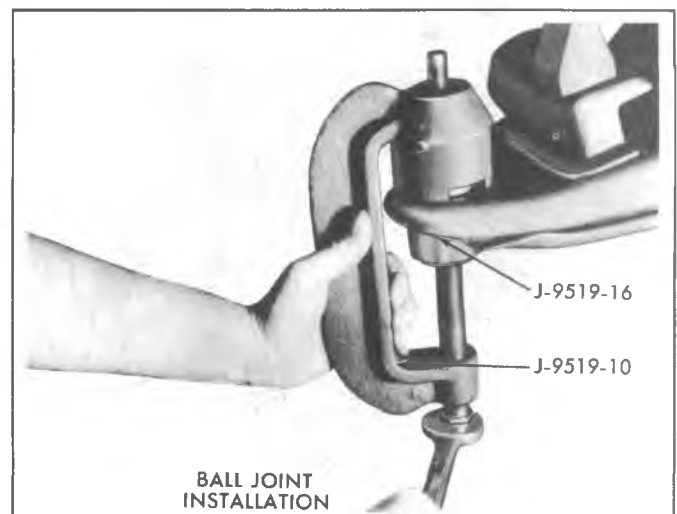


Fig. 3C-31--Installing Ball Joint

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-32)

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.

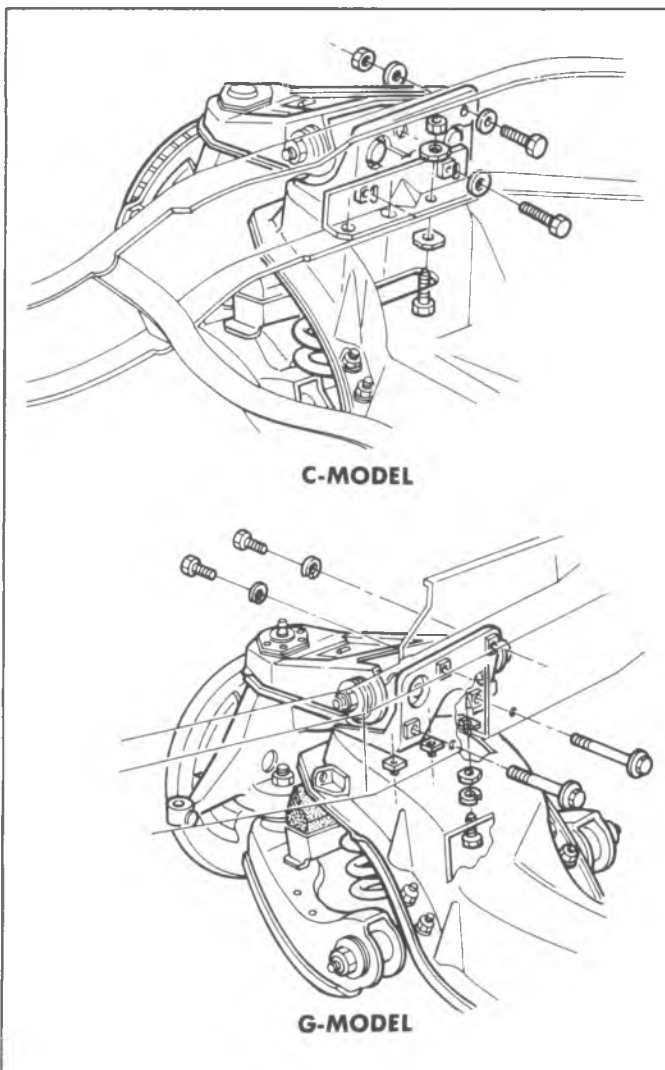


Fig. 3C-32--Suspension Unit to Frame

9. Disconnect from 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.

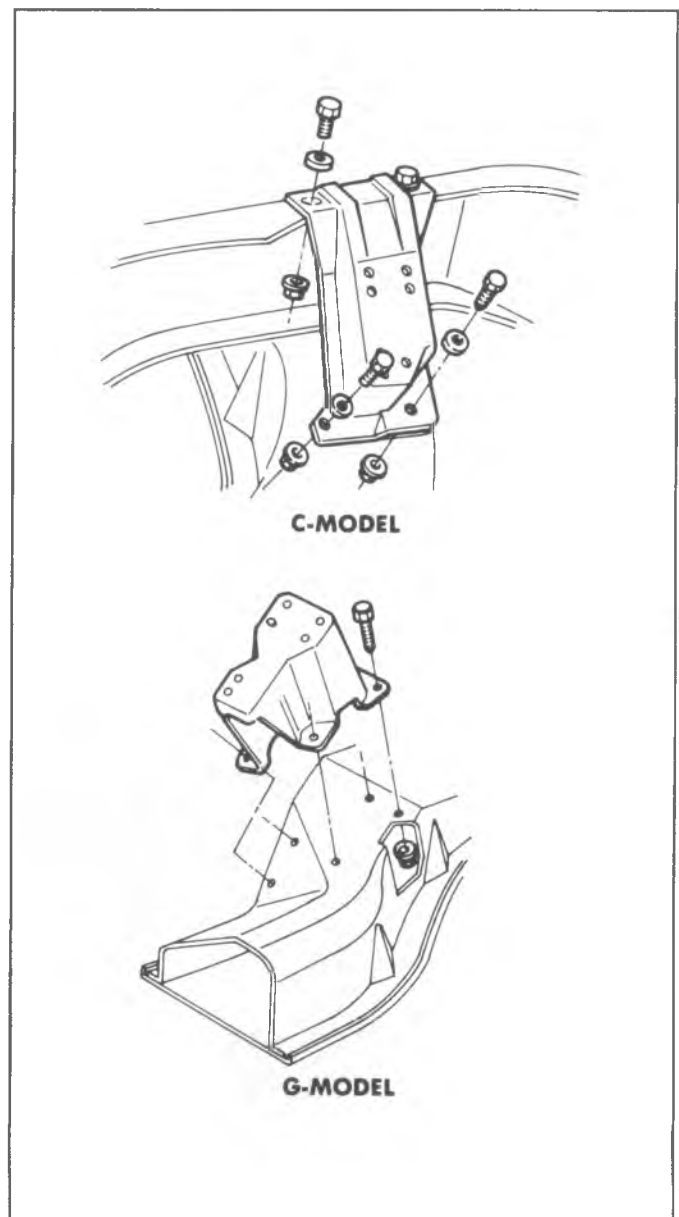


Fig. 3C-33--Engine Front Mounting Bracket

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 2-14.
2. Assemble (finger-tight) upper control arm bracket bolts and crossmember bolts to frame rails.
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

INDEX

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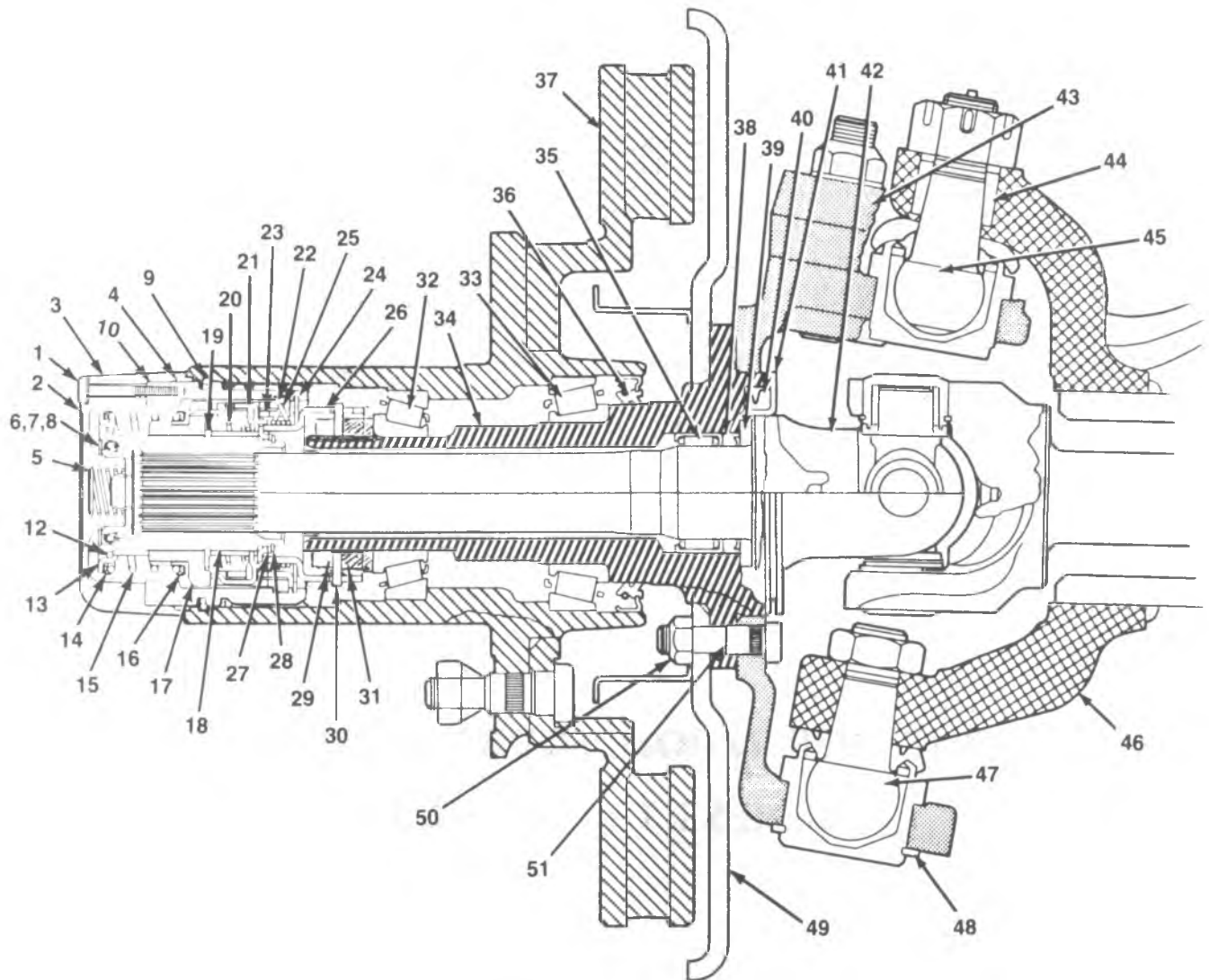
GENERAL DESCRIPTION**Knuckle Attachment**

At the wheel ends of the axle tubes, two types of steering knuckle attachment are used. Figure 3C-1K shows the K10 and K20 knuckle attached with ball joints. Figure 3C-2K 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.



- | | | | |
|--|-----------------------------|---------------------------|-----------------------------|
| 1. RETAINING SCREW | 14. SPRING RETAINER | 27. SPACER | 40. DUST SEAL |
| 2. COVER PLATE | 15. RETURN SPRING | 28. RETAINING RING | 41. DEFLECTOR |
| 3. COVER | 16. SPRING RETAINER | 29. LOCK NUT | 42. AXLE OUTER SHAFT |
| 4. SEALING RING | 17. CLUTCH GEAR | 30. RETAINING WASHER | 43. KNUCKLE |
| 5. SPRING, BEARING RACE | 18. HUB SLEEVE | 31. ADJUSTING NUT | 44. ADJUSTING SLEEVE |
| 6. } BEARING ASSEMBLY | 19. 'C' TYPE RETAINING RING | 32. OUTER-WHEEL BEARING | 45. UPPER BALL JOINT |
| 7. } BEARING ASSEMBLY | 20. CONICAL SPRING | 33. INNER-WHEEL BEARING | 46. YOKE |
| 8. } BEARING ASSEMBLY | 21. CAM FOLLOWER | 34. SPINDLE | 47. LOWER BALL JOINT |
| 9. WIRE RETAINING RING | 22. OUTER CAGE | 35. SPINDLE BEARING | 48. RETAINING RING |
| 10. OUTER CLUTCH HOUSING | 23. INNER CAGE | 36. SEAL | 49. CALIPER SUPPORT BRACKET |
| 11. SEAL BRIDGE — RETAINER (NOT SHOWN) | 24. SNAP RING | 37. HUB-AND-DISC ASSEMBLY | 50. SPINDLE RETAINING NUT |
| 12. RETAINING RING | 25. BRAKE BAND | 38. OIL SEAL | 51. SPINDLE RETAINING BOLT |
| 13. SPRING SUPPORT WASHER | 26. DRAG SLEEVE AND DETENT | 39. SPACER | |

Fig. 3C-1K--K10, K20 with Auto. Locking Hub and Ball Joints

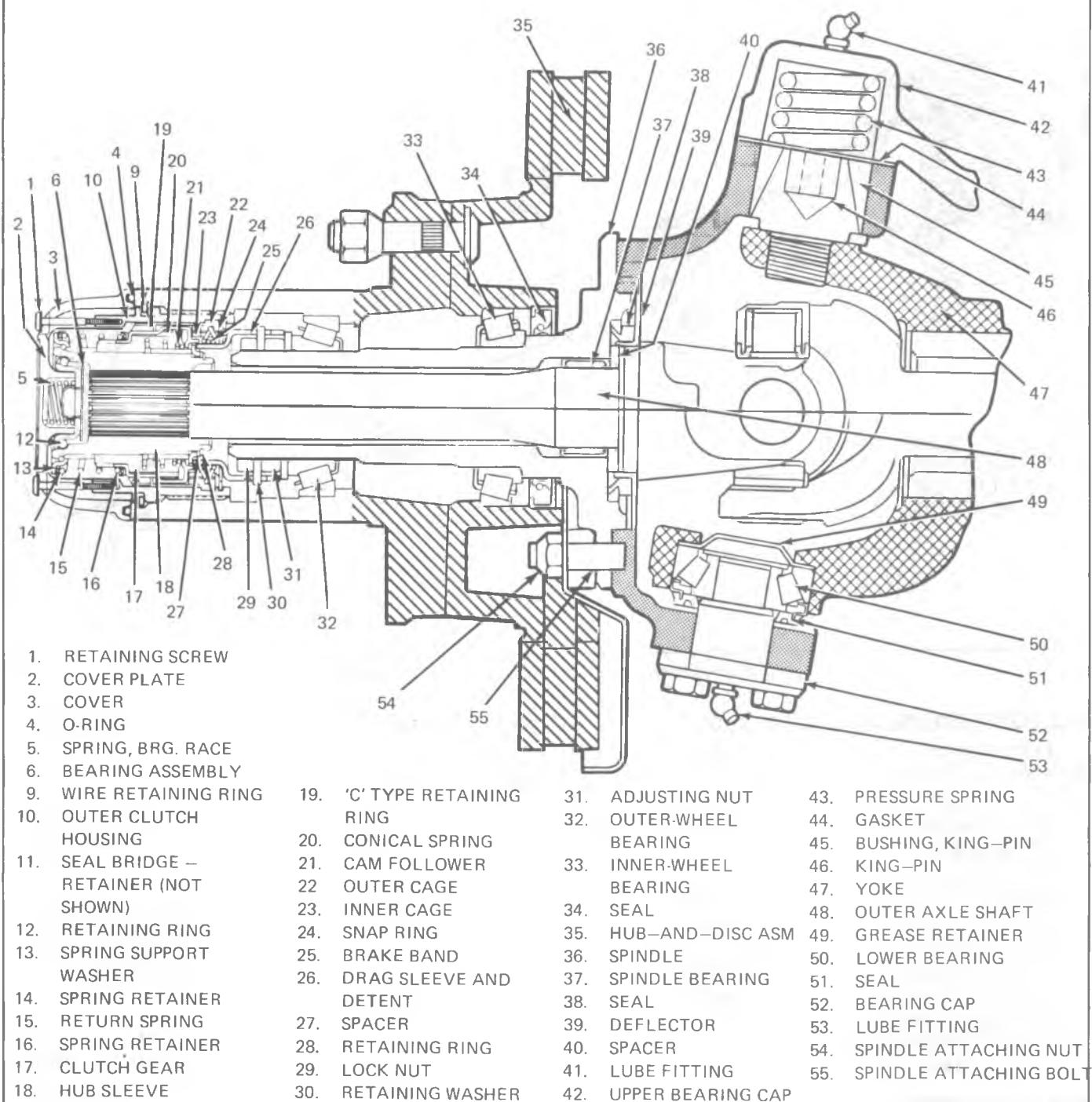


Fig. 3C-2K-K30 with Auto. Locking Hub and King-Pins

MAINTENANCE AND ADJUSTMENTS

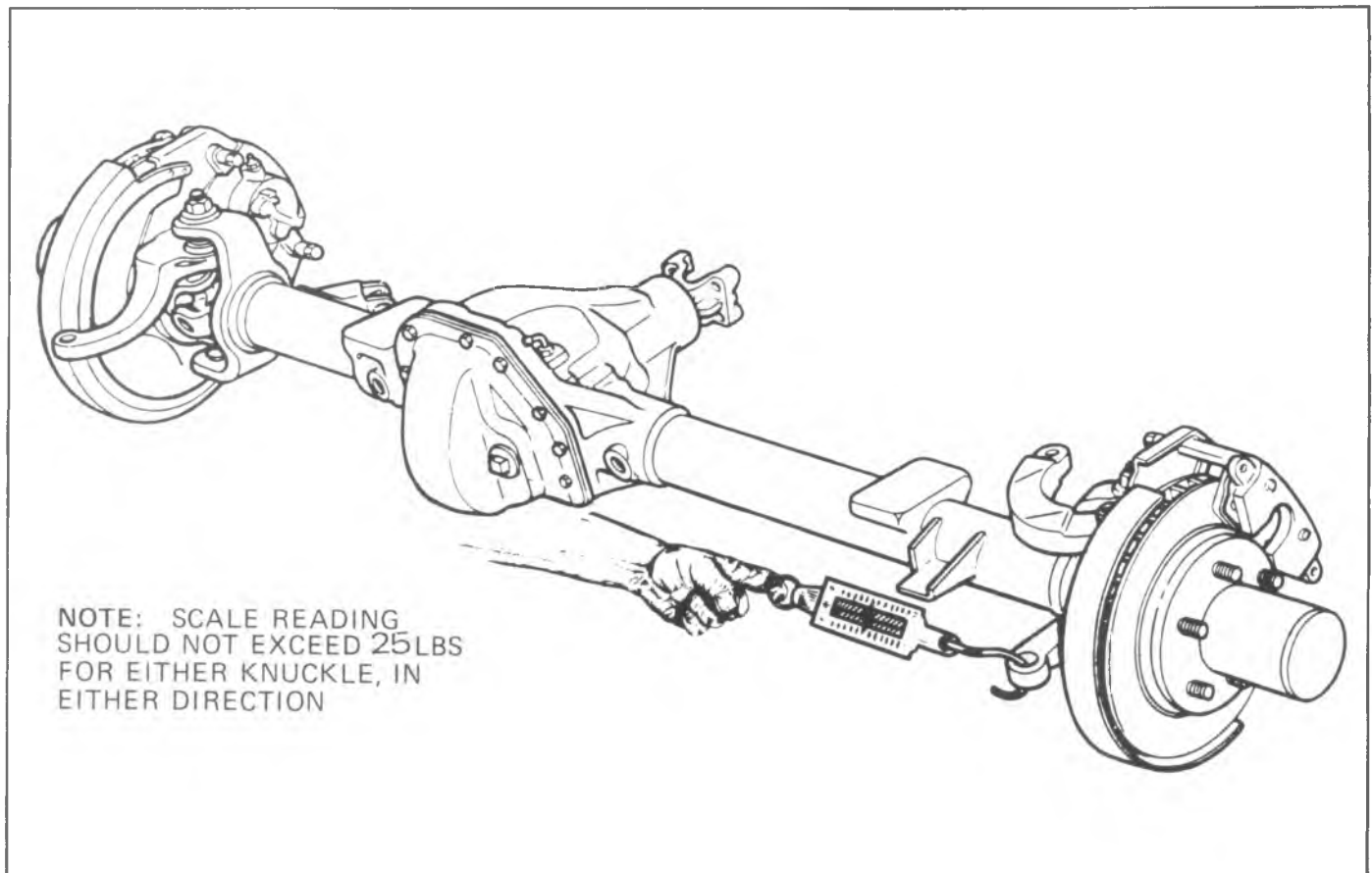


Fig. 3C-3K--Determining Front Axle Ball Joint Turning Effort

BALL JOINT ADJUSTMENT (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-3K.

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-6K.

WHEEL BEARING ADJUSTMENT

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-3K). 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.

COMPONENT REPLACEMENT

HUB 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 (All Models)

The Automatic Locking Hub, shown in Fig. 3C-4K, engages or disengages to lock the front axle shaft to the hub of the front wheel. Engagement occurs whenever the vehicle is operated in four-wheel drive. Disengagement occurs whenever two-wheel drive has been selected and the vehicle is moved rearward. Disengagement will not occur when the vehicle is moved rearward if four-wheel drive is selected and the hub has already been engaged.

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.

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 above.

Removal of Hub Lock Assembly

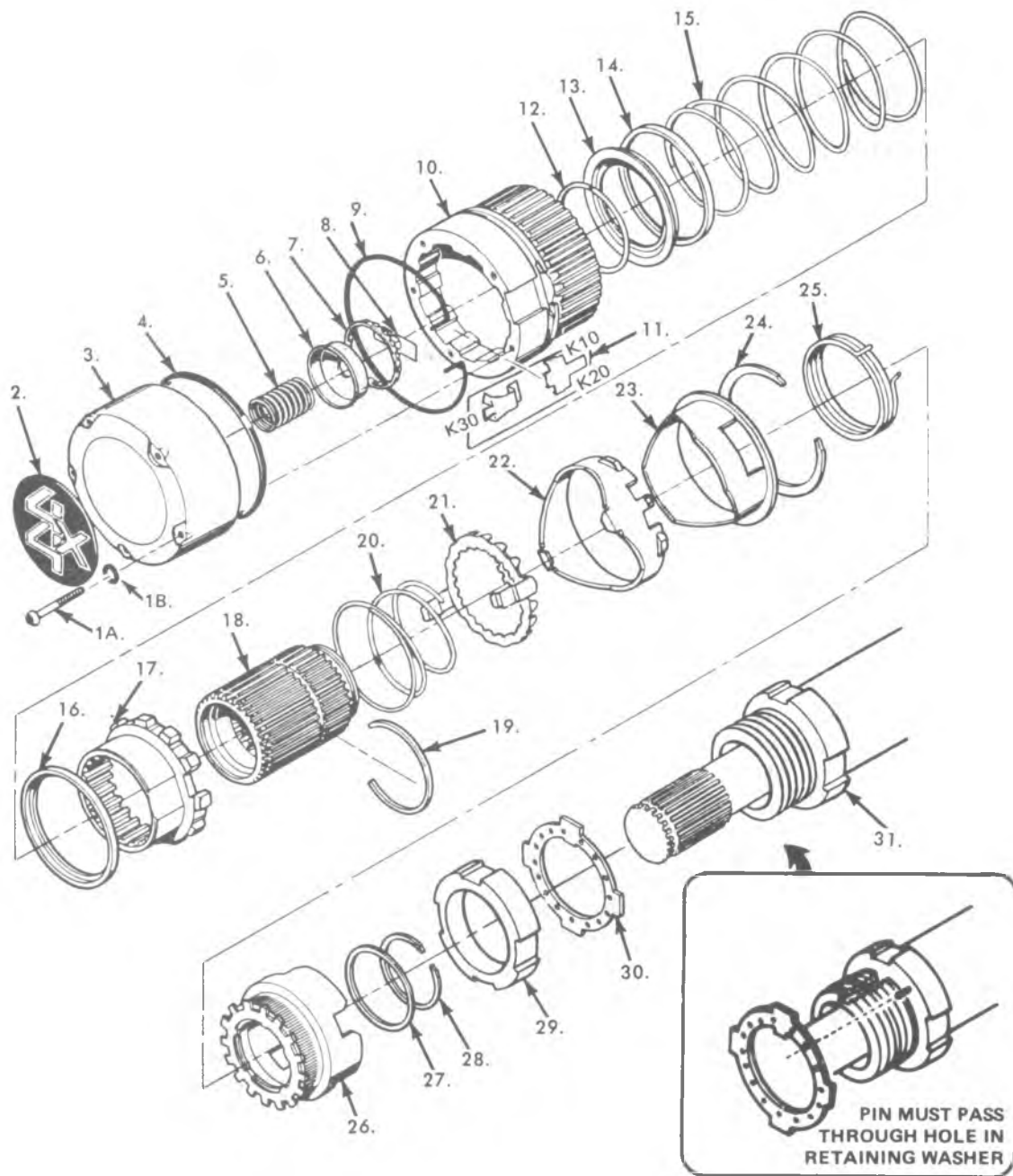
1. Remove the five screws (item #1, Fig. 3C-4K) which retain the cover (#3) to the outer clutch housing (#10).
2. Remove the cover, seal (#4), seal bridge (#11), and bearing components (#5, 6, 7, 8).
3. Use needle-nose pliers to compress the wire retaining ring (#9), and pull the remaining components from the wheel.

DISASSEMBLE LOCKING HUB COMPONENTS

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-5K. 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).



- 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-4K--Automatic Locking Hubs

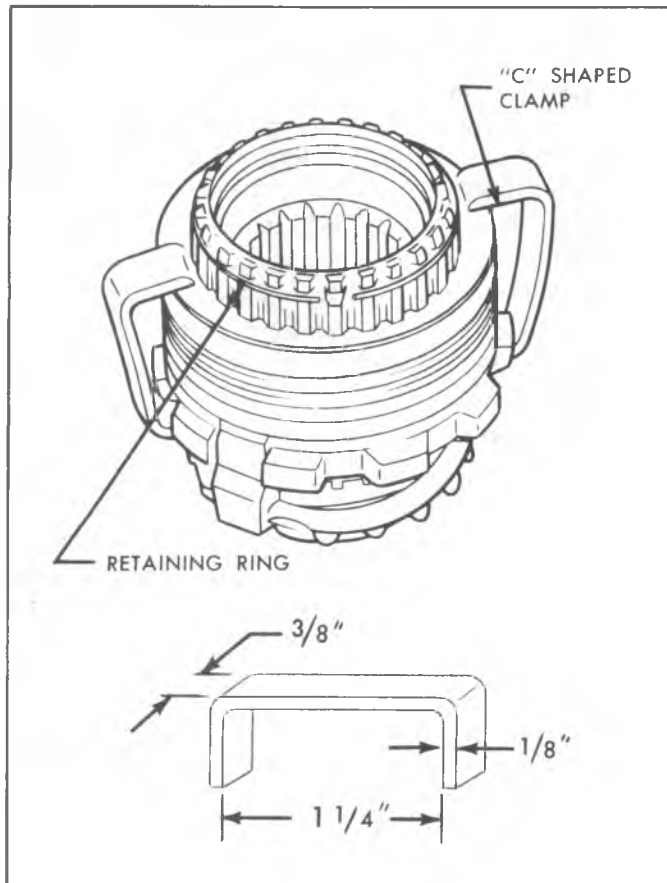


Fig. 3C-5K--Using Clamp and Vise to Compress Return Spring

REASSEMBLE LOCKING HUB COMPONENTS

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-4K.
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.
In the event that the original lubricant has been removed or contaminated, Part No. 14050324, 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 O-ring over the seal

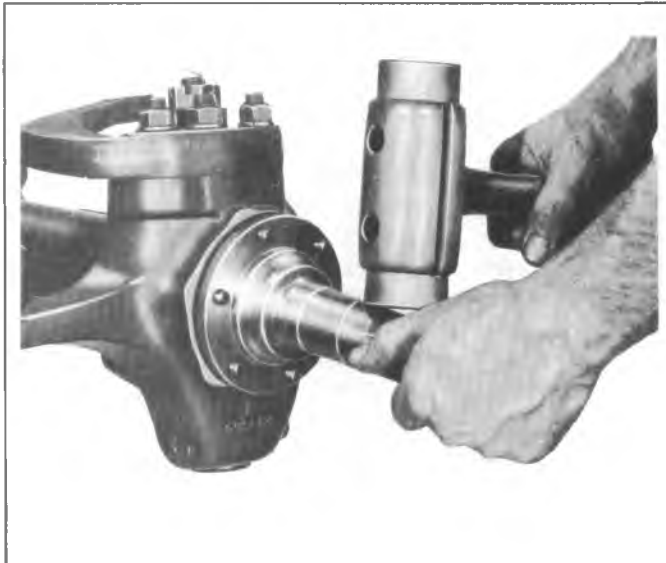


Fig. 3C-6K--Removing Spindle and Thrust Washer

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 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 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.
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.).

HUB-AND-DISC

Removal

1. Remove automatic locking hub as described earlier.
2. Remove the wheel bearing outer lock nut, retaining washer, and wheel bearing inner adjusting nut using Tool J-6893 and Adapter J-23446 or Tool J-6893-01.
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-6K. Replace the thrust washer if excessive wear has occurred.

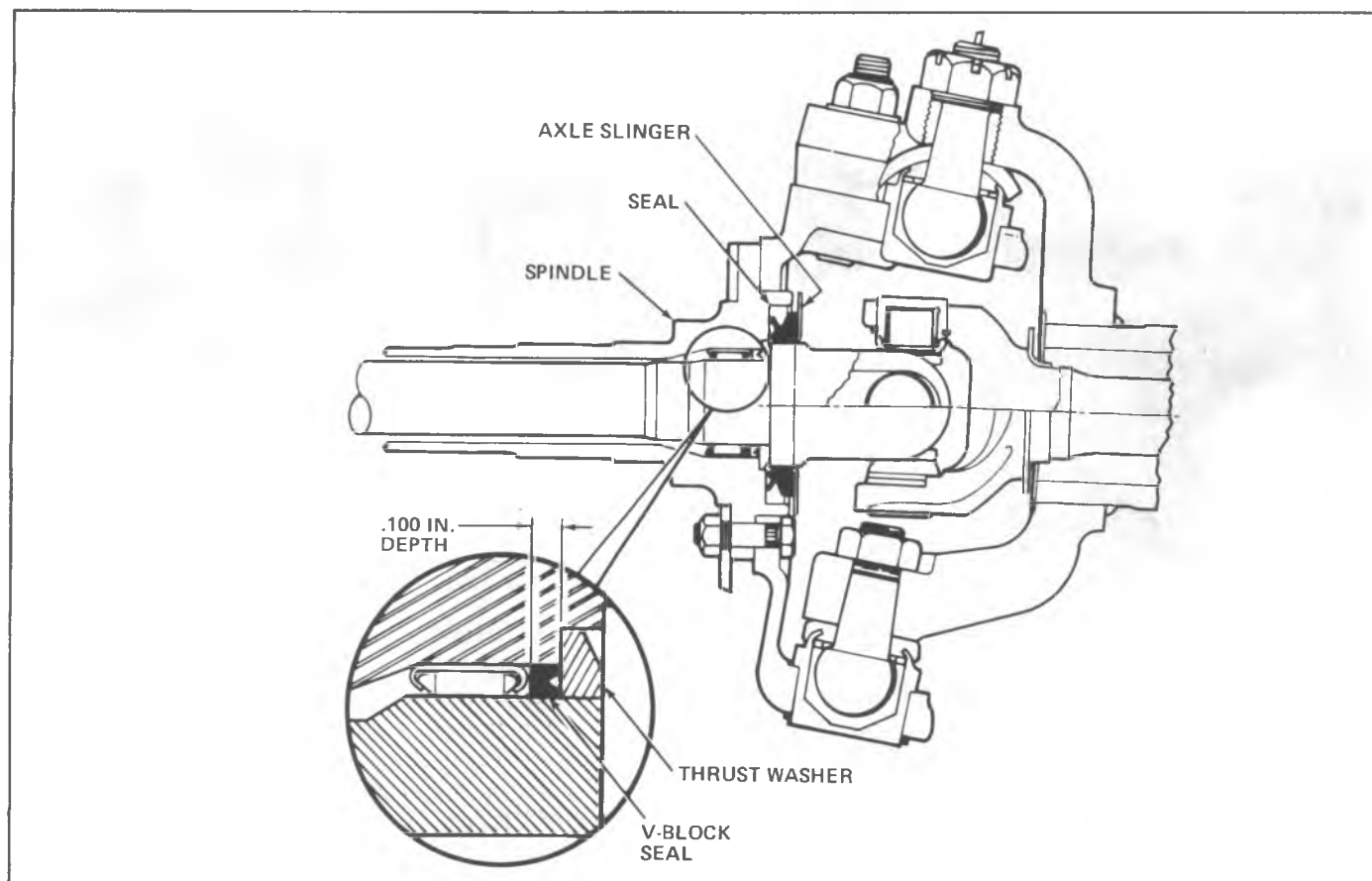


Fig. 3C-7K--Front Spindle Grease Seals

Servicing Spindle Components

When servicing the spindle check the spindle grease seals (Fig. 3C-7K).

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-8K.
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 arm.
 - c. Remove nuts and disconnect the tie rod. If it is necessary to remove the steering arm, discard the

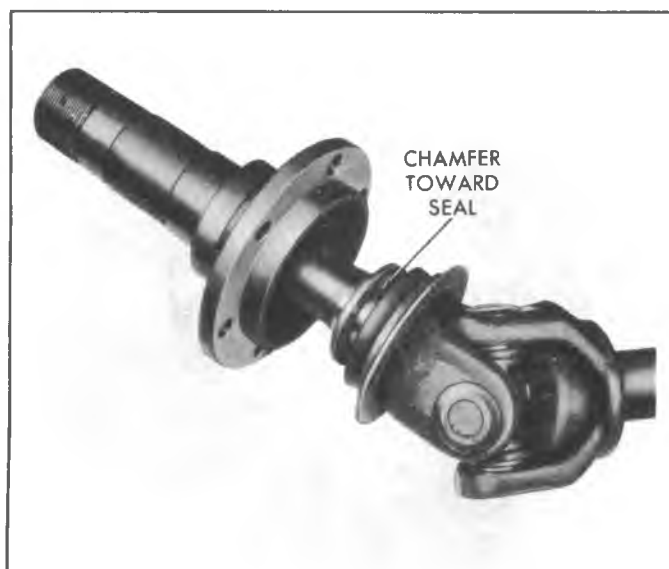


Fig. 3C-8K--Installing Spindle and Thrust Washer

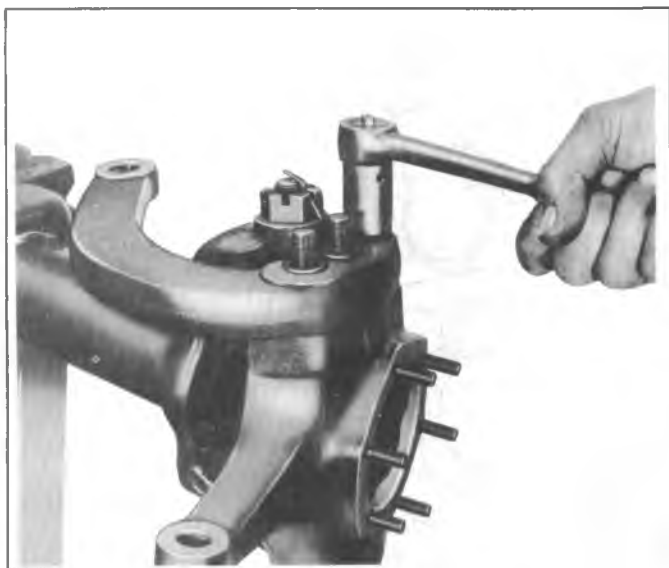


Fig. 3C-9K--Removing Steering Arm Nuts

self-locking nuts (Fig. 3C-9K) 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-10K.
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 3C-15K. 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.



Fig. 3C-10K--Removing Ball Socket Retaining Nut

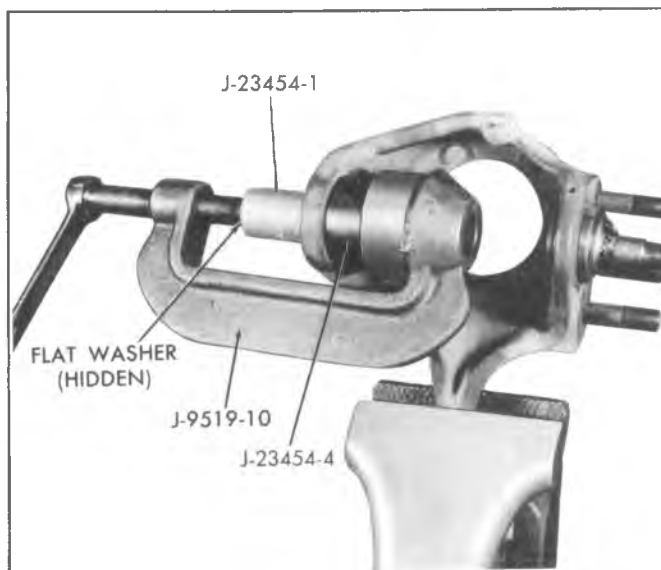


Fig. 3C-11K--Removing Lower Ball Joint

- 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-11K.

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-12K.
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-13K and install snapring.

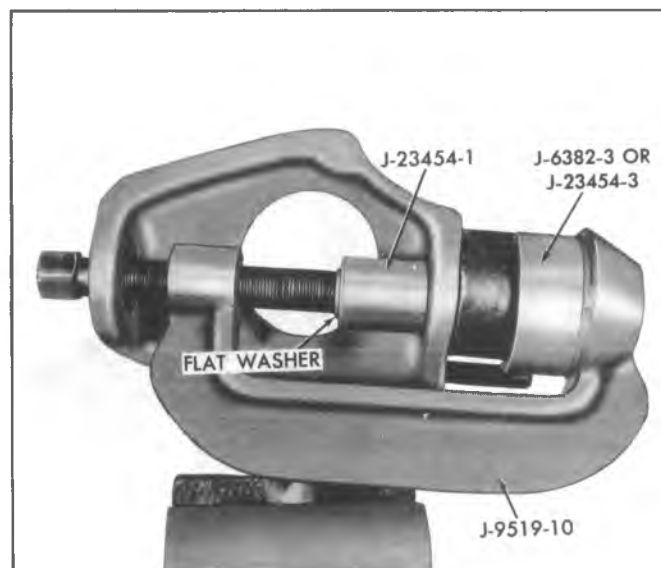


Fig. 3C-12K--Removing Upper Ball Joint

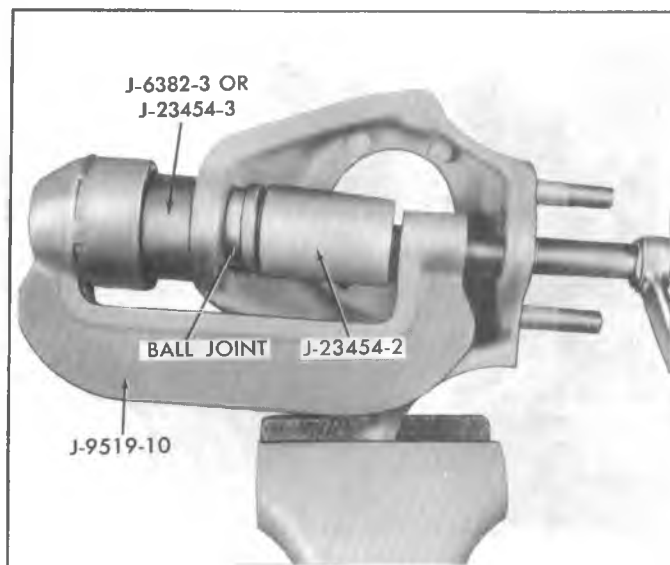


Fig. 3C-13K--Installing Lower Ball Joint

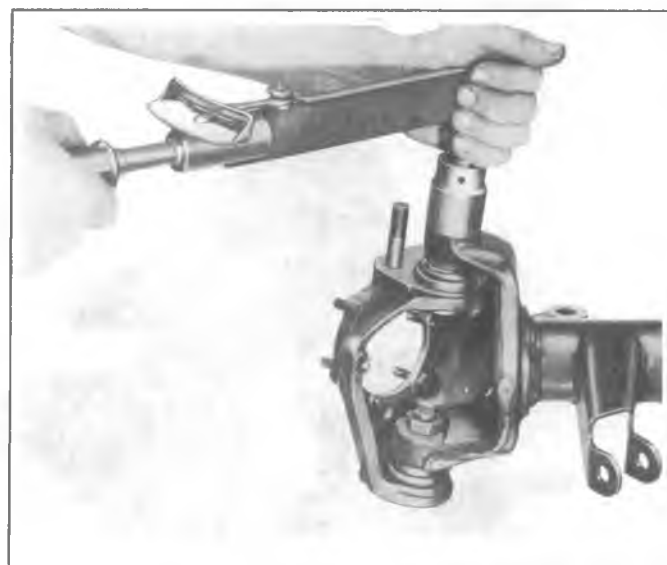


Fig. 3C-16K--Torquing Upper Ball Socket Nut

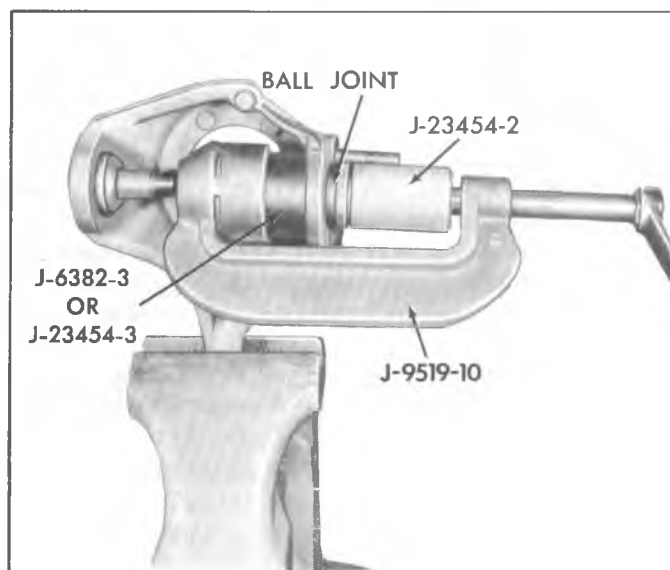


Fig. 3C-14K--Installing Upper Ball Joint

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-14K.

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-15K.

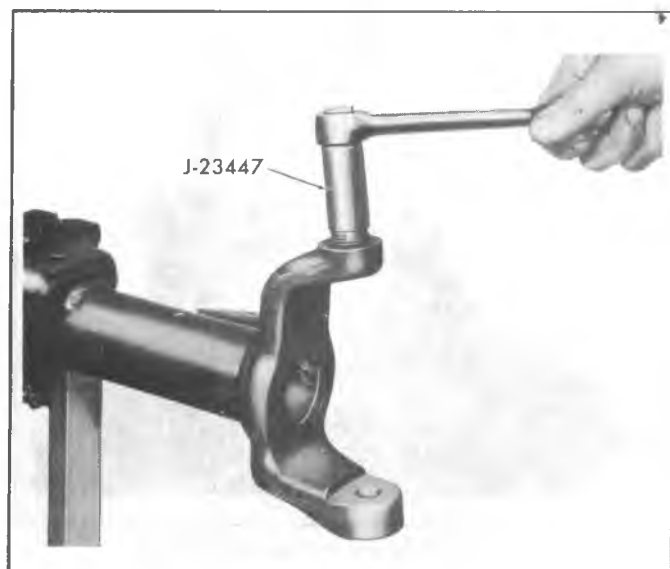


Fig. 3C-15K--Ball Stud Adjusting Sleeve

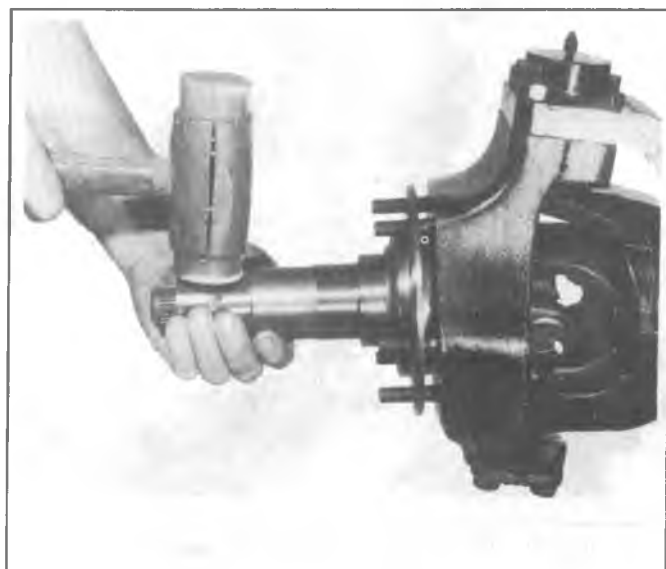


Fig. 3C-17K--Removing Spindle

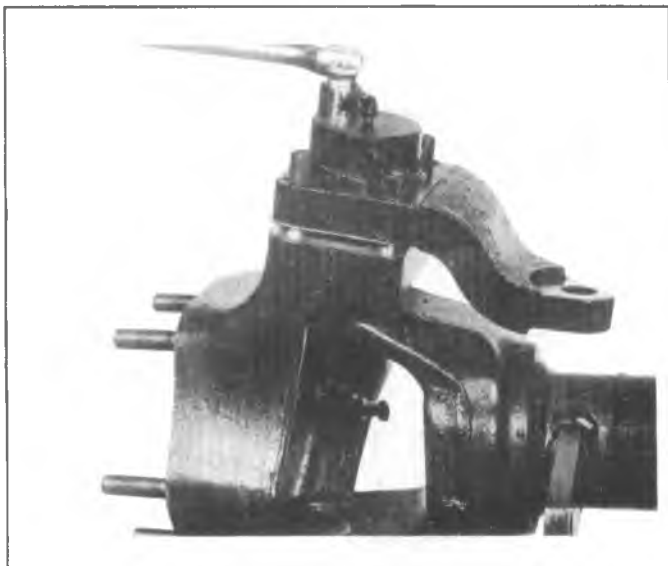


Fig. 3C-18K--Removing Nuts Alternately

4. Torque the upper ball socket nut to 100 ft. lbs. as shown in Figure 3C-16K. 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.

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

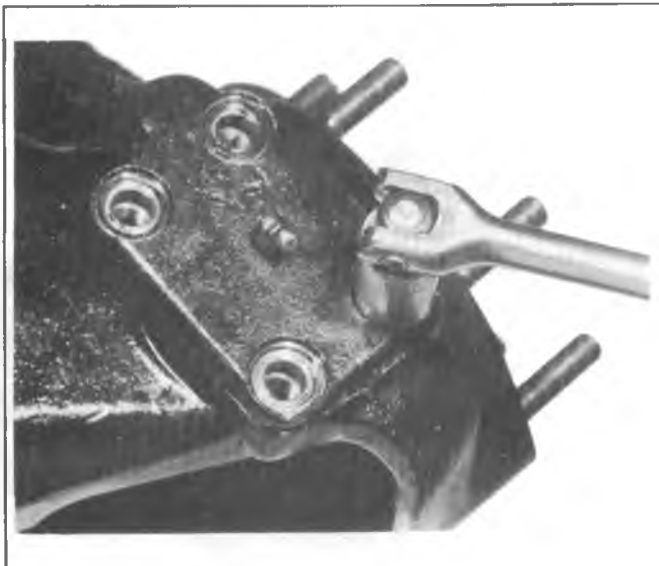


Fig. 3C-20K--Removing Lower Bearing Cap

- between axle shaft joint assembly and bearing. If wear is evident, replace with a new one. See Figure 3C-17K.
2. Remove four nuts from upper king pin cap. Remove nuts alternately as compression spring will force cap up. Refer to Figure 3C-18K.
3. Remove cap, compression spring, and gasket, as shown in Figure 3C-19K. 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 3C-20K.
5. Remove upper king pin tapered bushing and knuckle from yoke. Remove king-pin felt seal. See Figure 3C-21K. Remove knuckle.
6. Remove upper king-pin from yoke with large breaker bar and J-26871, as seen in Figure 3C-22K.
Torque specification is 677-813 N·m (500-600 ft. lbs.).



Fig. 3C-19K--Removing Cap, Spring and Gasket



Fig. 3C-21K--Removing Tapered Bushing

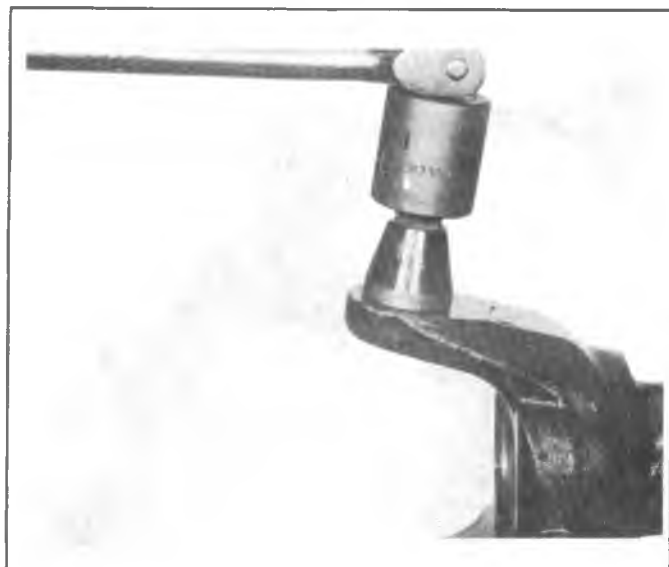


Fig. 3C-22K--Removing Upper King Pin



Fig. 3C-25K--Installing Oil Seal



Fig. 3C-23K--Removing Cup, Cone and Seal

7. Remove lower king pin bearing cup, cone, grease retainer, and seal all at the same time, as shown in Figure 3C-23K. 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-24K.
2. Fill the area in grease retainer with specified grease, then grease the bearing cone and install. Install new lower king pin bearing oil seal, using J-22281, as shown in Figure 3C-25K.

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-26K. Torque to 677.50-813.00 N·m (500-600 ft. lbs.).



Fig. 3C-24K--Installing Grease Retainer



Fig. 3C-26K--Installing Upper King-Pin

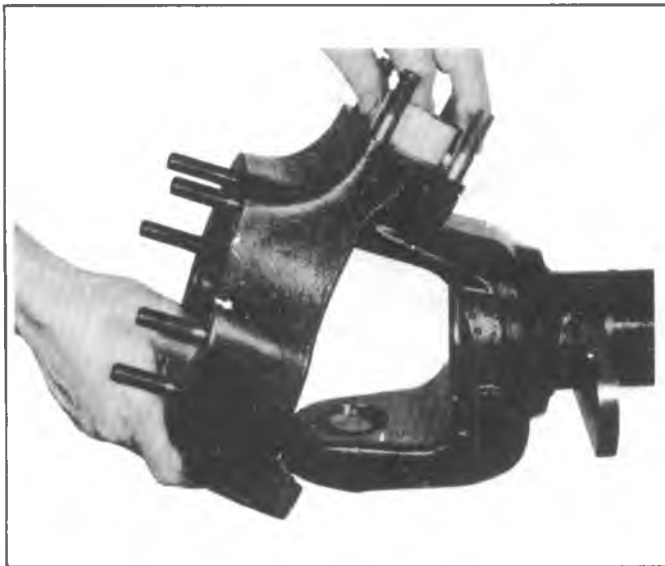


Fig. 3C-27K--Installing Knuckle to Yoke

4. Assemble felt seal to king pin, assemble knuckle, assemble tapered bushing over king pin, as shown in Figure 3C-27K.
5. Assemble lower bearing cap-and-king pin with four cap screws. Tighten cap screws alternately and evenly; see Figure 3C-28K. 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-29K.

SHOCK ABSORBER

Removal (Fig. 3C-30K)

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

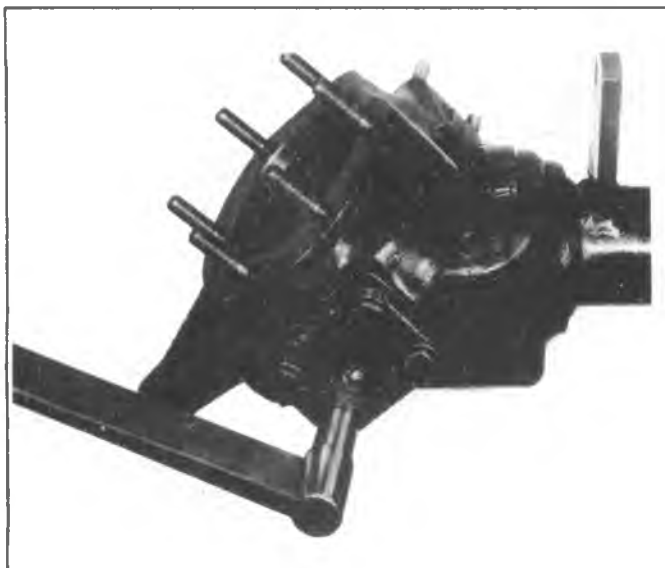


Fig. 3C-28K--Installing Lower Bearing Cap-and-King Pin

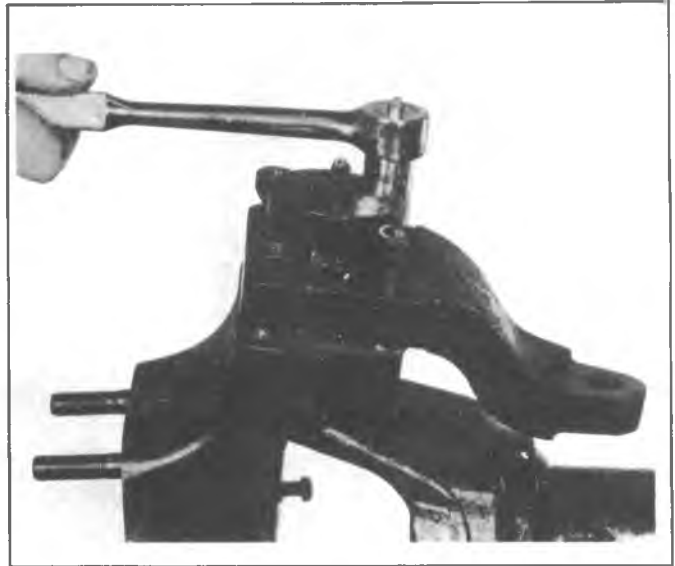


Fig. 3C-29K--Installing Bearing Cap/Steering Arm

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-31K)

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.

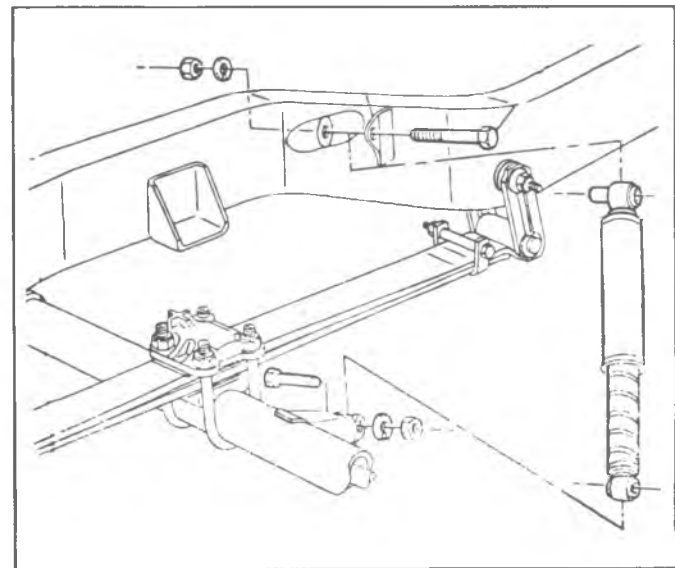


Fig. 3C-30K--Shock Absorber Attachment

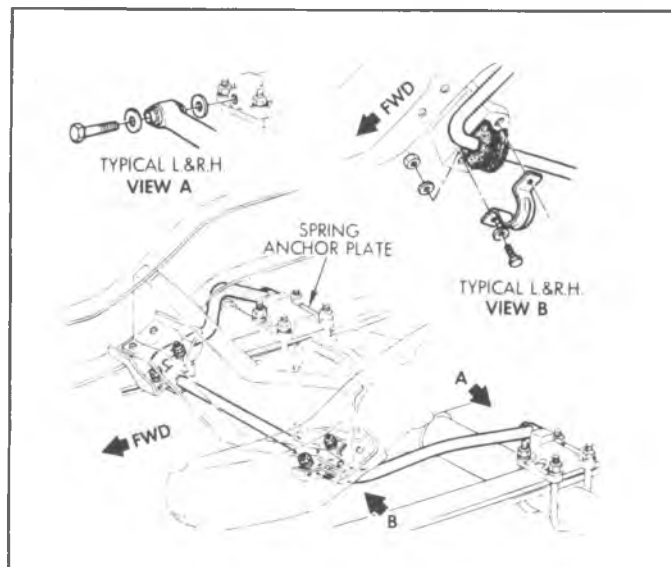


Fig. 3C-31K--Stabilizer Bar Attachment

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-32K and 3C-33K)

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.

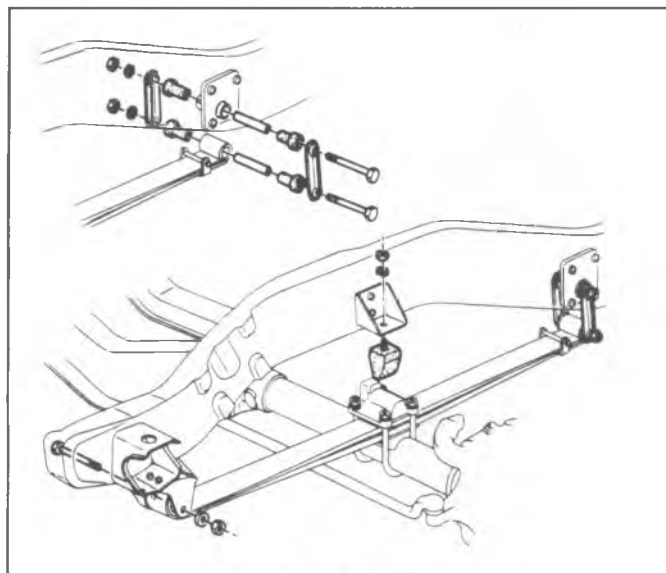


Fig. 3C-32K--Leaf Spring Assembly

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.

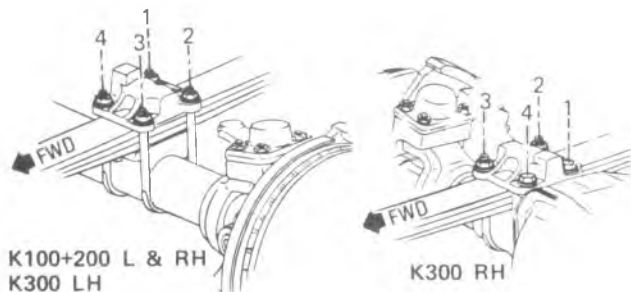


Fig. 3C-33K--U-Bolt Tightening Sequence

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.
5. Install lower spring pad and spring retainer plate. Torque bolts to specifications, Fig. 3C-33K.
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	—	—	Inner 35 Outer •••	—	
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.

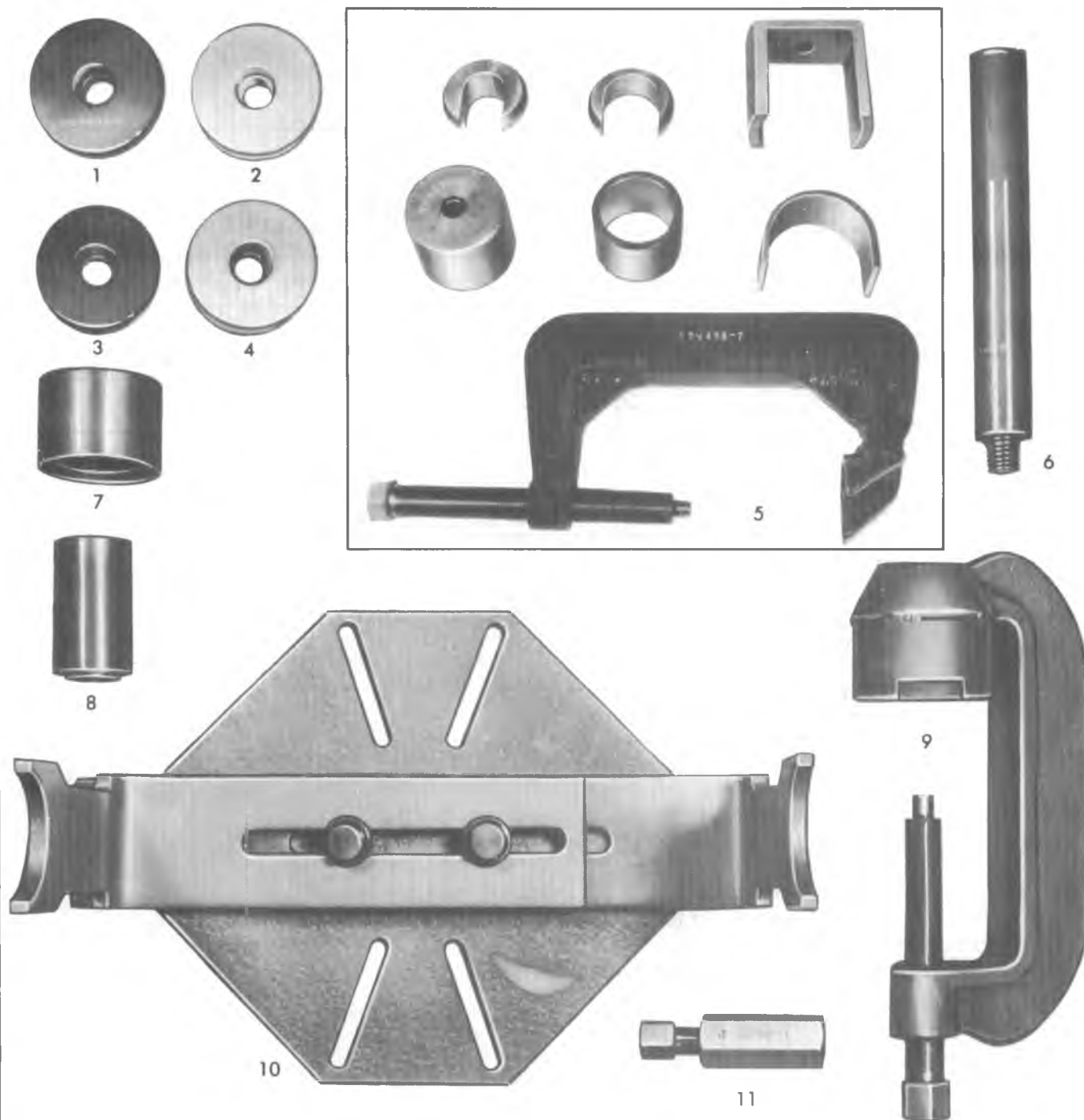
†† C10, G10-20 Rubber Bushings; C20-30, P10-30 Steel Bushings.

• 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 | 6. | J-8092 | Driver Handle |
| 2. | J-8458 | Bearing Race Installer | 7. | J-9519-9 | Ball Joint Installer |
| 3. | J-8849 | Bearing Race Installer | 8. | J-9519-7 | Ball Joint Remover |
| 4. | J-9276-2 | Bearing Race Installer | 9. | J-9519-10 | "C" Clamp |
| 5. | J-24435-1 | Bushing Replacement | 10. | J-23028-01 | Spring Remover |
| | thru 7 | C 10, G 10-20 | 11. | J-23742-1 | Ball Joint Remover |

Fig. 3C-ST--Special Tools

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

All 10-30 series vehicles use a leaf spring/solid rear axle suspension system. Typical systems are illustrated in Fig. 3D-1, 3D-2 and 3D-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.

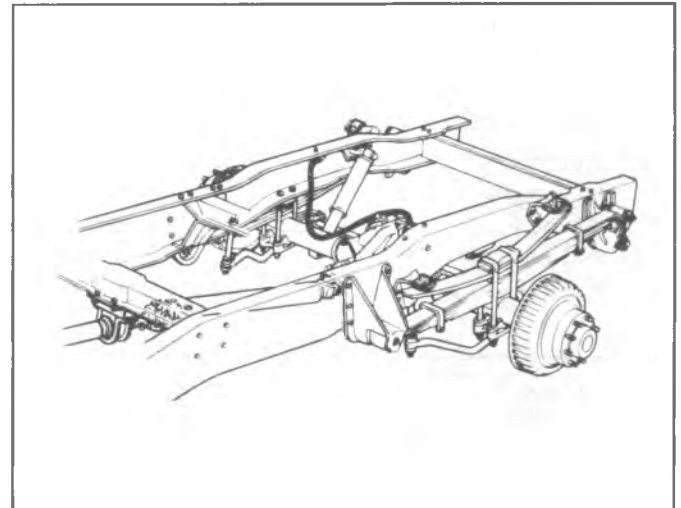


Fig. 3D-1--Typical C-30 H.D. Truck Rear Suspension

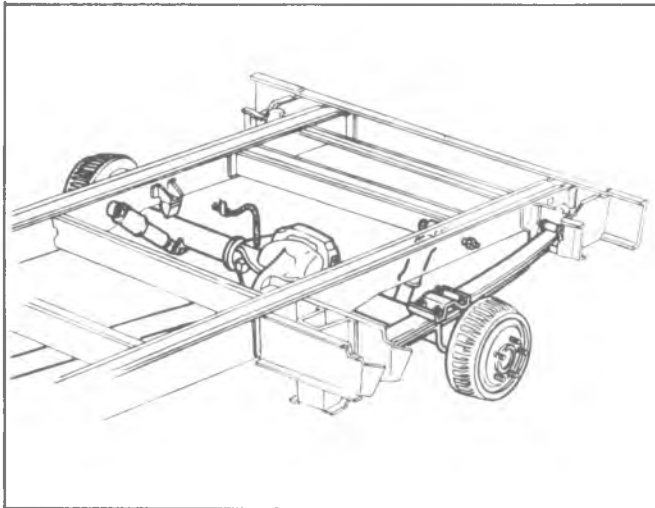


Fig. 3D-2--Typical G-Truck Rear Suspension

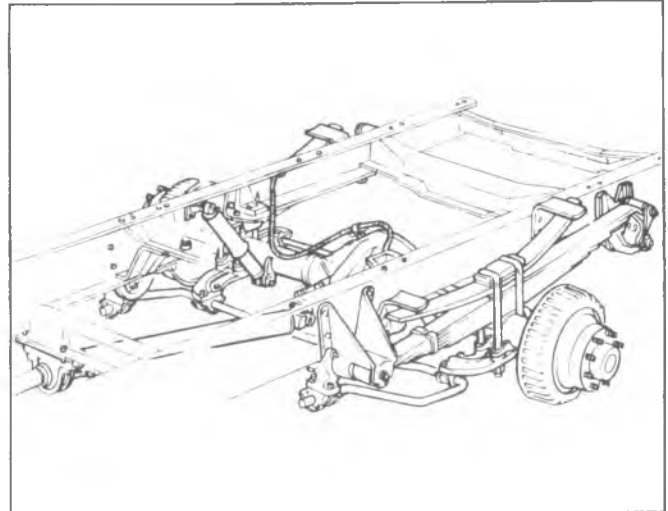


Fig. 3D-3--Typical P-30 H.D. Truck Rear Suspension

COMPONENT PARTS REPLACEMENT

SHOCK ABSORBERS

Replacement

Refer to Figs. 3D-4 through 3D-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, 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.

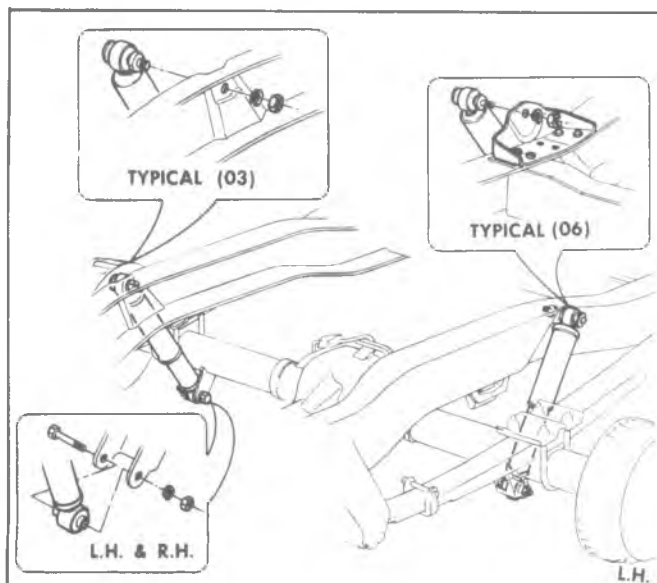


Fig. 3D-4--Shock Absorber-CK-10, CK-20 (03, 06)

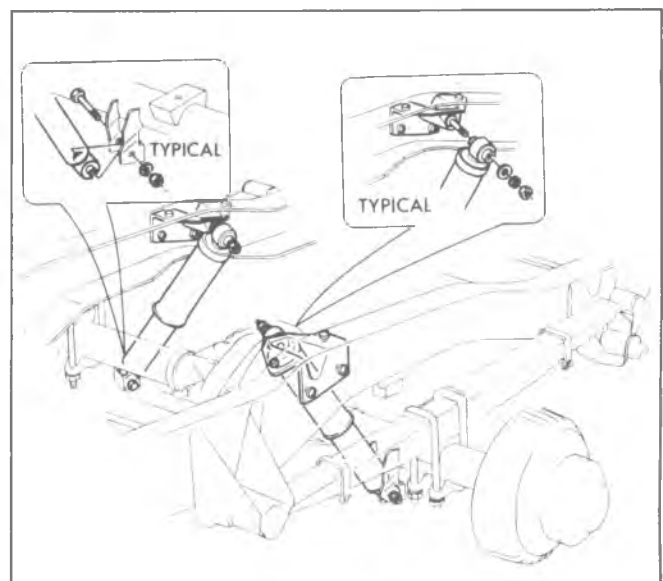


Fig. 3D-5--Shock Absorber-CK-20 (43), CK30

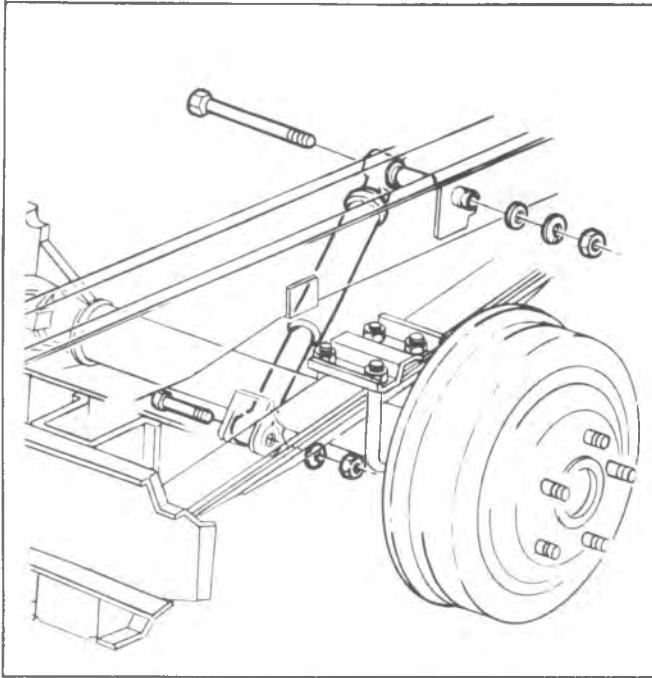


Fig. 3D-6--Shock Absorber-G-10, 20, 30

STABILIZER SHAFTS

Refer to Fig. 3D-9, 3D-10 and 3D-11 for specific rear stabilizer shaft mounting on C and P models.

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.
3. Withdraw link bolt, washers, grommets and spacer.

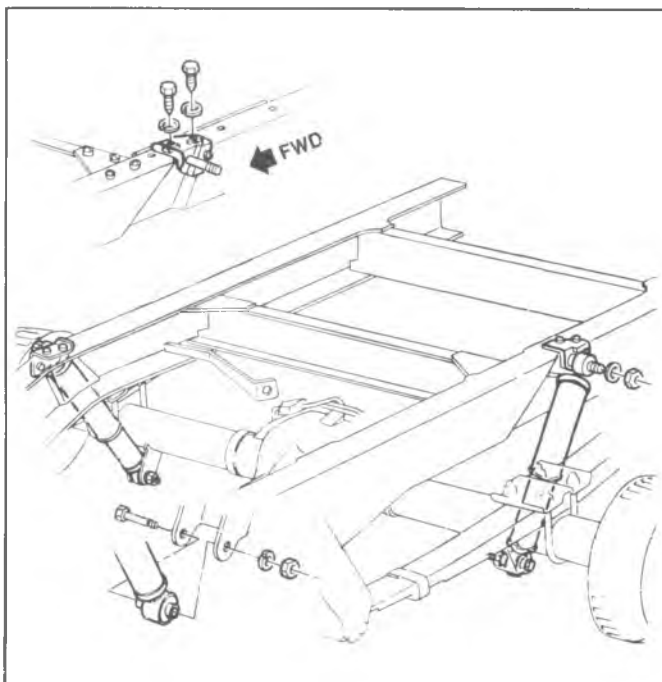


Fig. 3D-7--Shock Absorber-P-10, 20

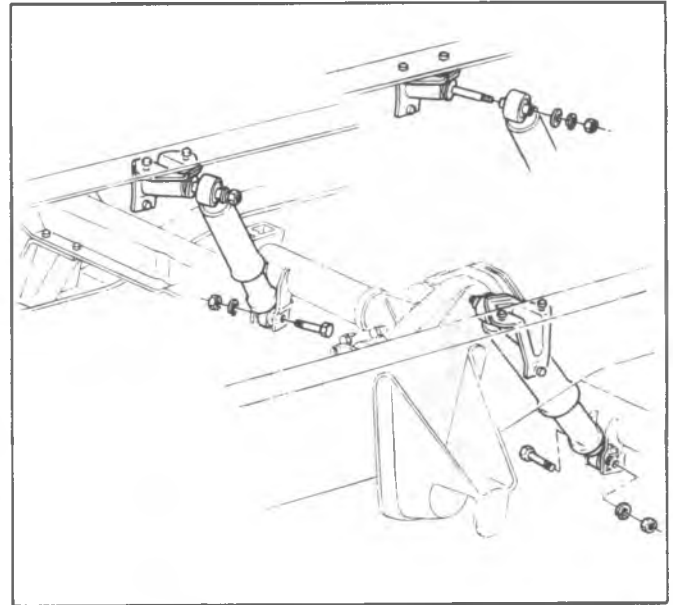


Fig. 3D-8--Shock Absorber-P30

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 stabilizer fasteners.

8. Lower hoist and remove vehicle.

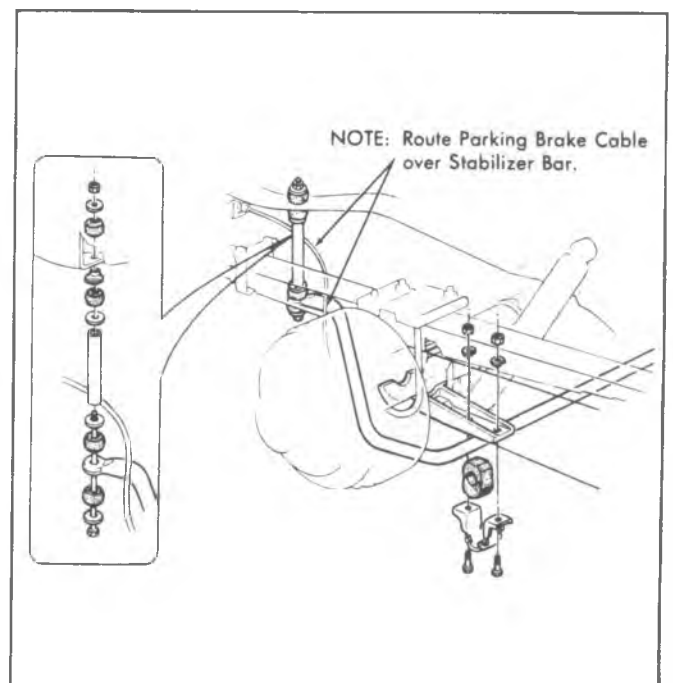


Fig. 3D-9--Rear Stabilizer Shaft-C-20(03)

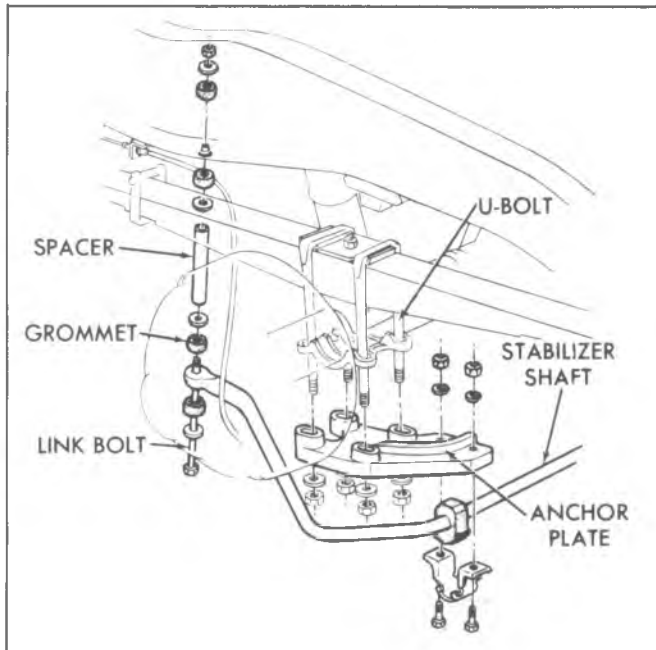


Fig. 3D-10--Rear Stabilizer Shaft-C-20(43), C-30

LEAF SPRING ASSEMBLY

Refer to Figs. 3D-12 - 3D-21 for specific leaf spring mounting provisions of C, K, G and P models. Fig. 3D-22 illustrates a typical U-bolt anchor plate installation with the mandatory tightening sequence.

NOTICE: See NOTICE on page 1 of this section, 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. 3D-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.

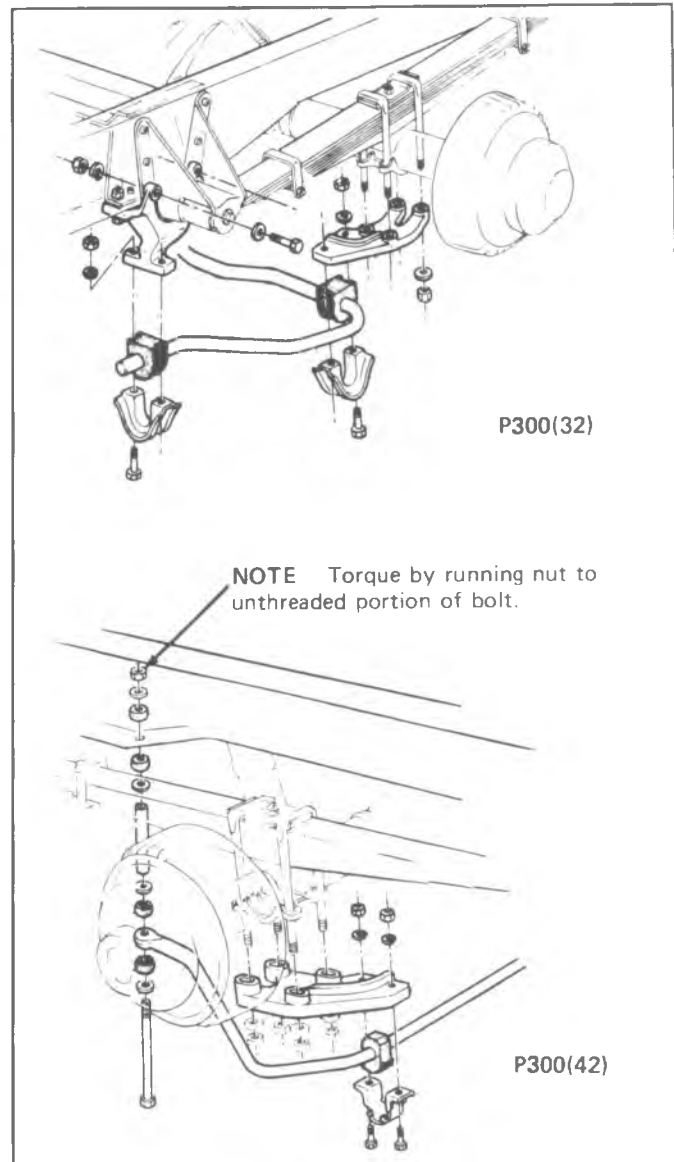


Fig. 3D-11--Rear Stabilizer Shaft-P30

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.

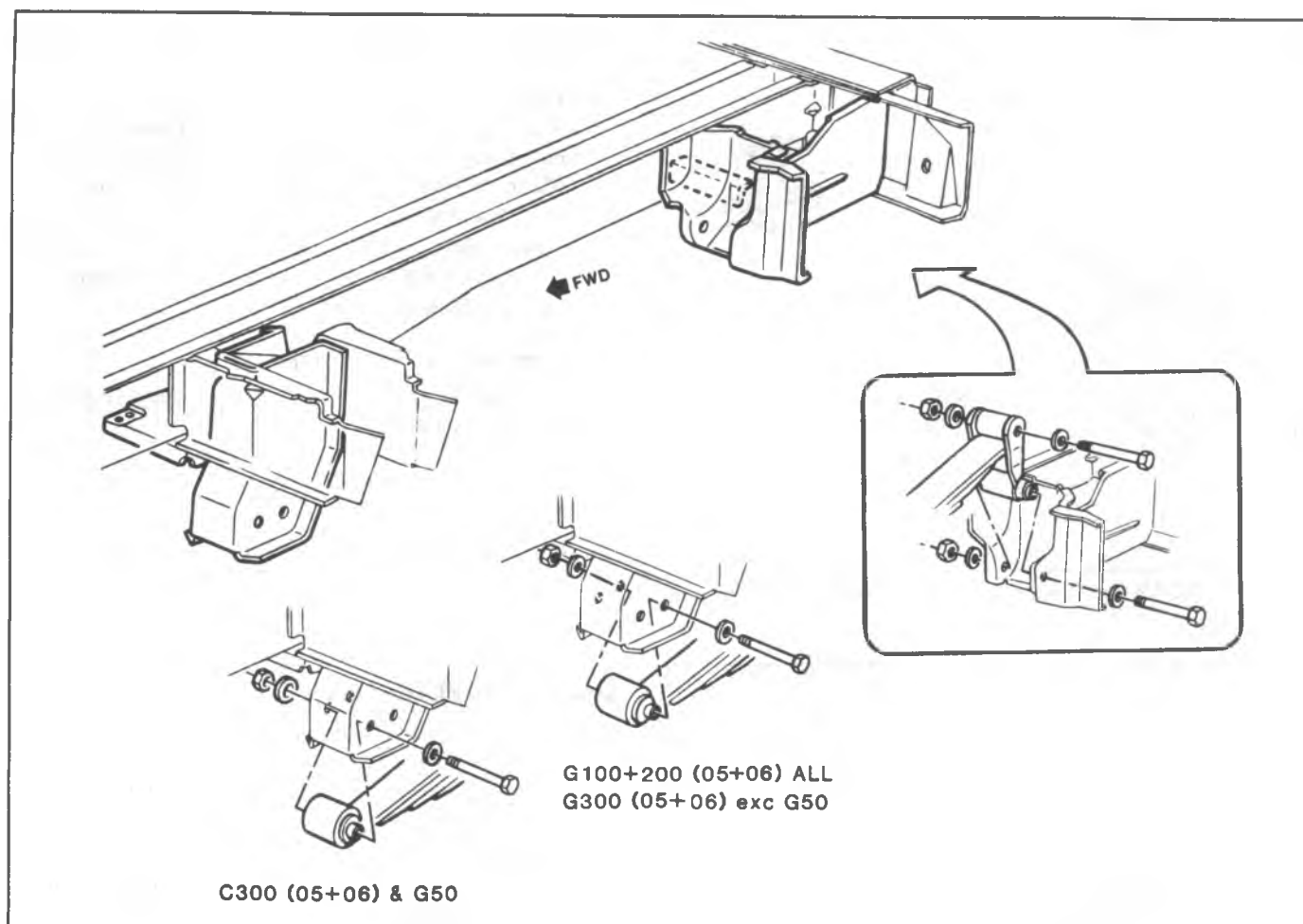


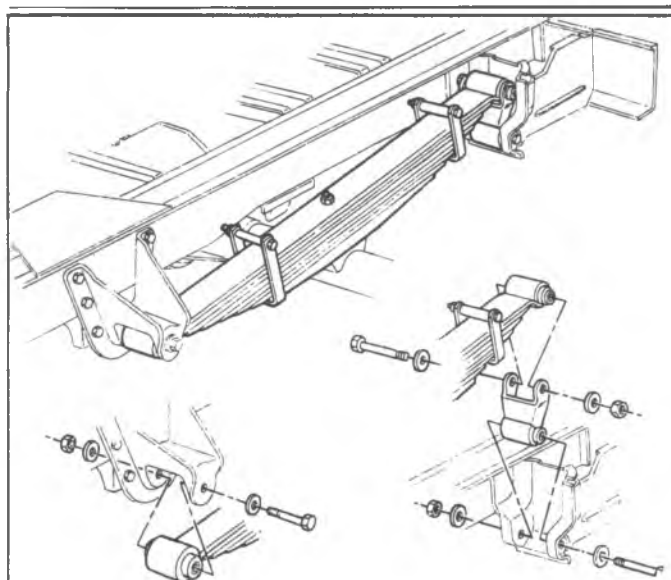
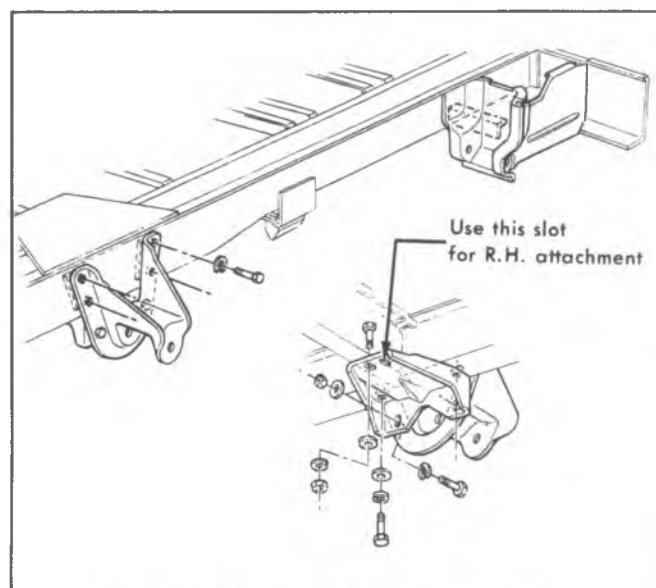
Fig. 3D-12--Rear Spring Hangers And Installation-G Models

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.


Fig. 3D-13--Rear Spring Installation - G Models
(Cutaway Vans)

Fig. 3D-14--Rear Spring Hangers - G Models
(Cutaway Vans)

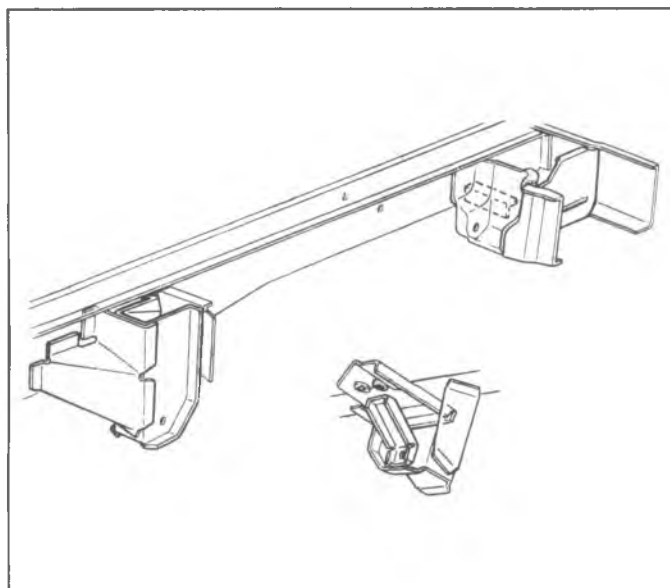


Fig. 3D-15--Rear Spring Hangers-G Models (Cutaway Vans)

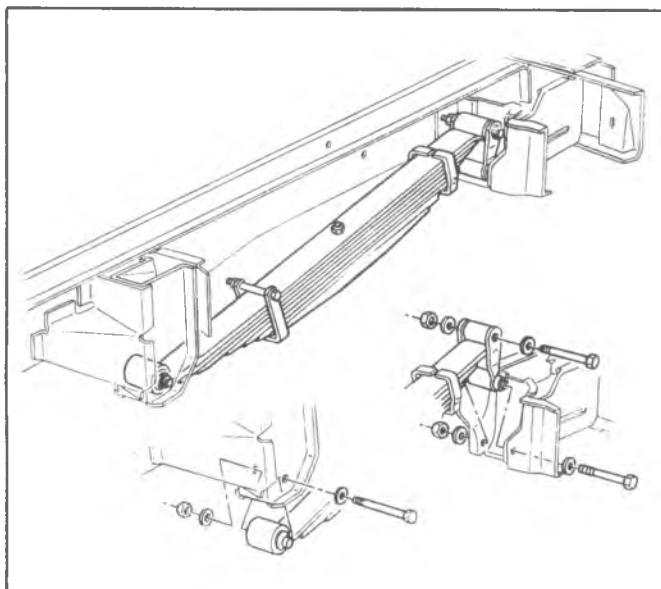


Fig. 3D-16--Rear Spring Installation - G Models (Cutaway Vans)

3. Jack frame 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. 3D-23 illustrates the mandatory sequence of tightening U-bolt nuts.

NOTICE: See NOTICE on page 1 of this section, regarding "U"-Bolt fasteners.

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.

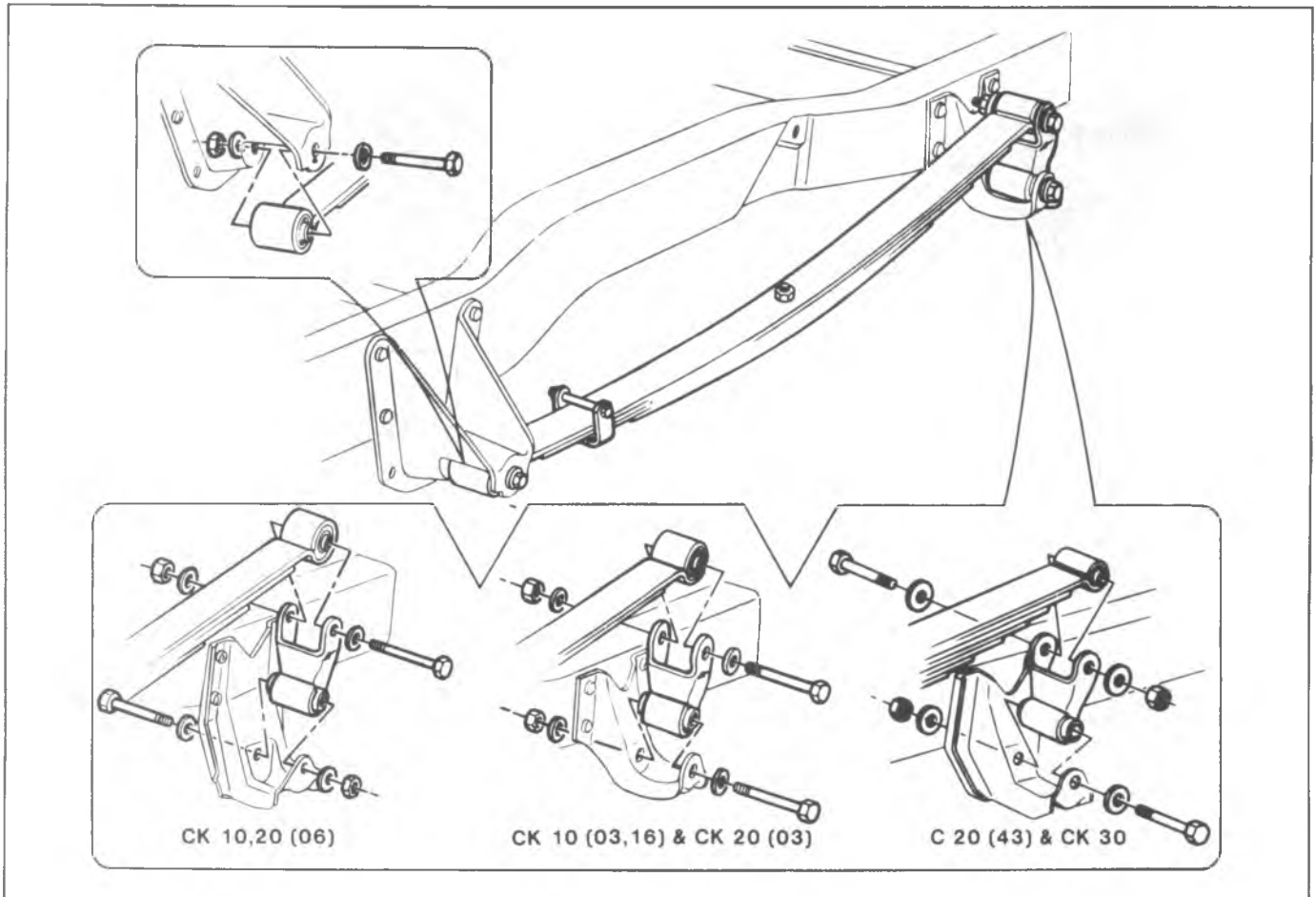


Fig. 3D-17--Rear Spring Installation-C-K Models

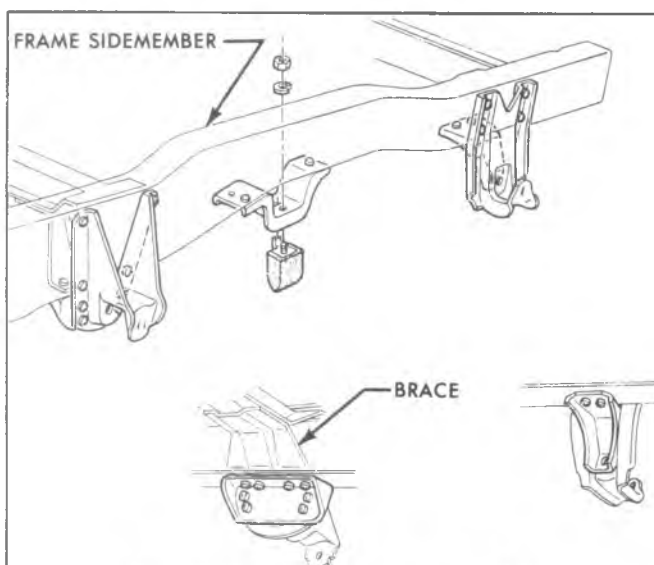


Fig. 3D-18--Rear Spring Hangers (K30)

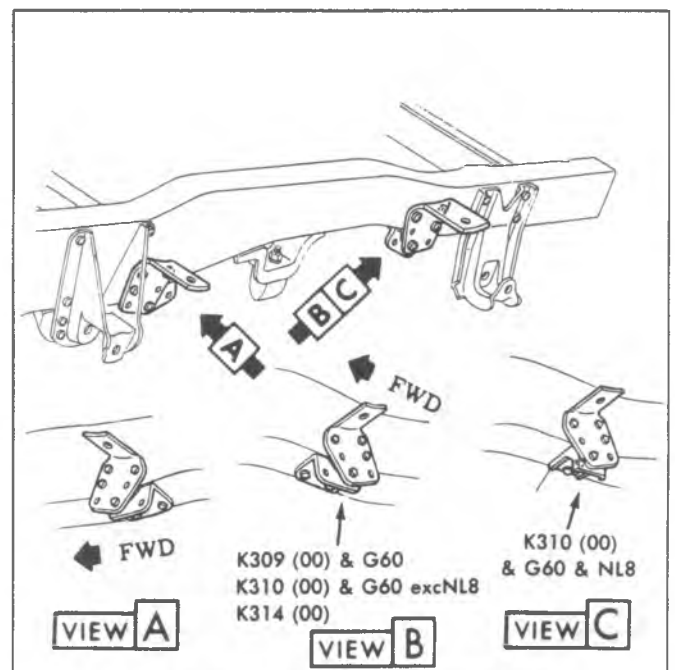


Fig. 3D-19--Auxiliary Spring Bracket (K30)

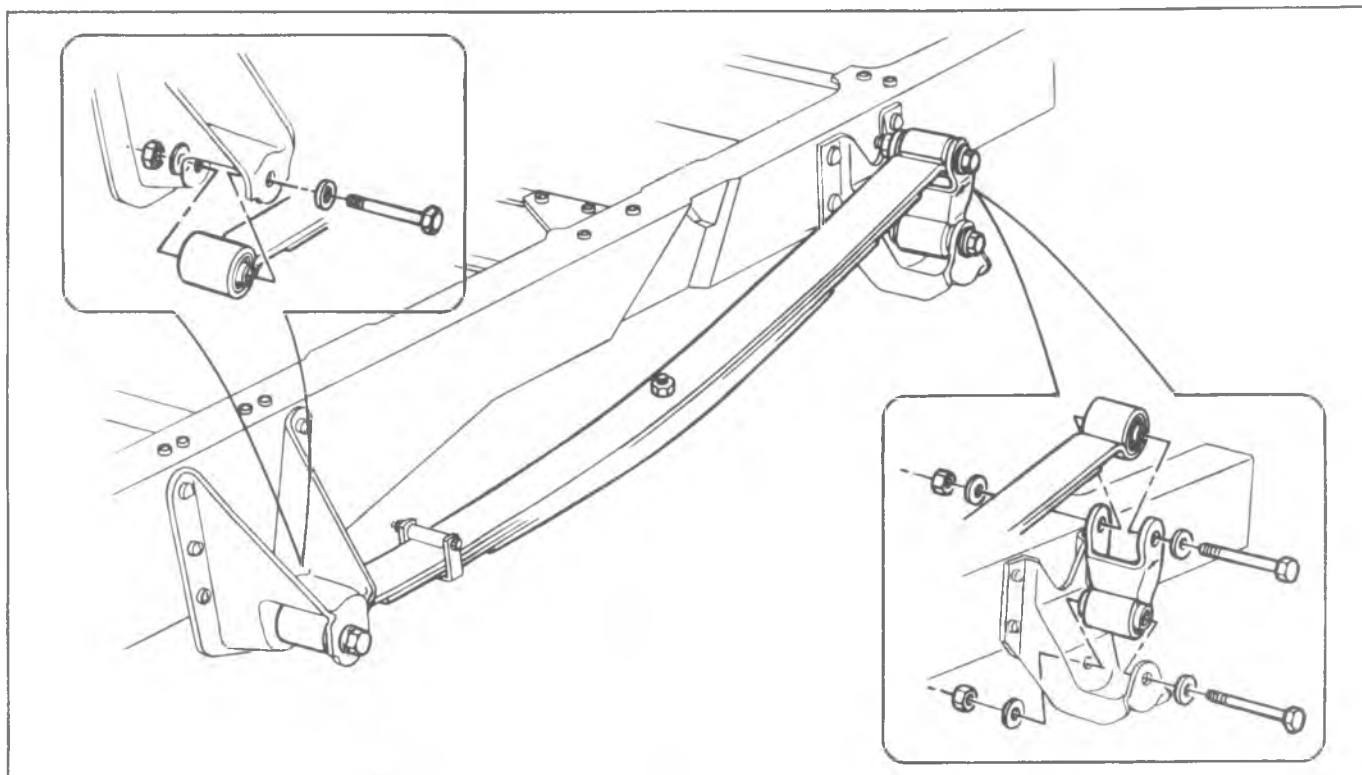


Fig. 3D-20--Rear Spring Installation-P10,20

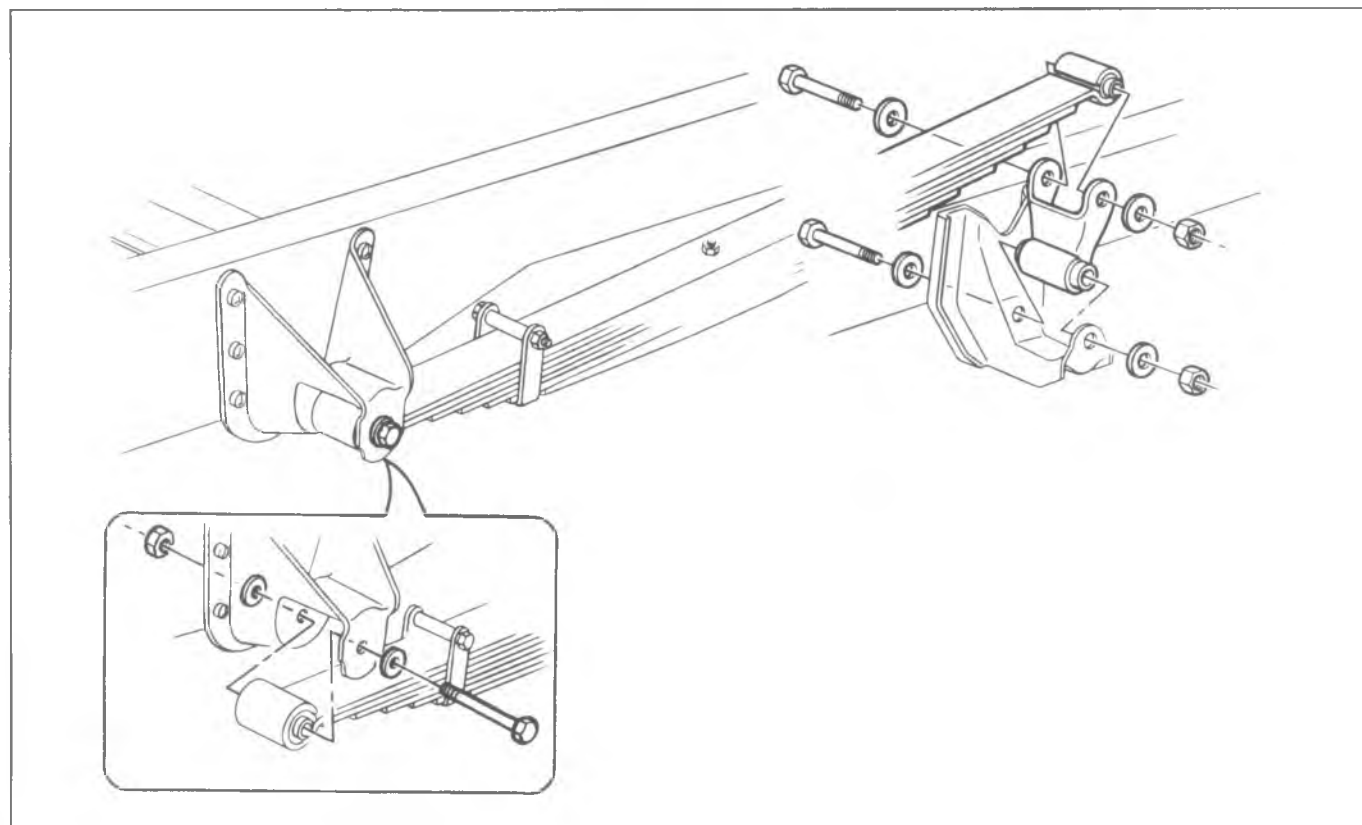


Fig. 3D-21--Rear Spring Installation-P30

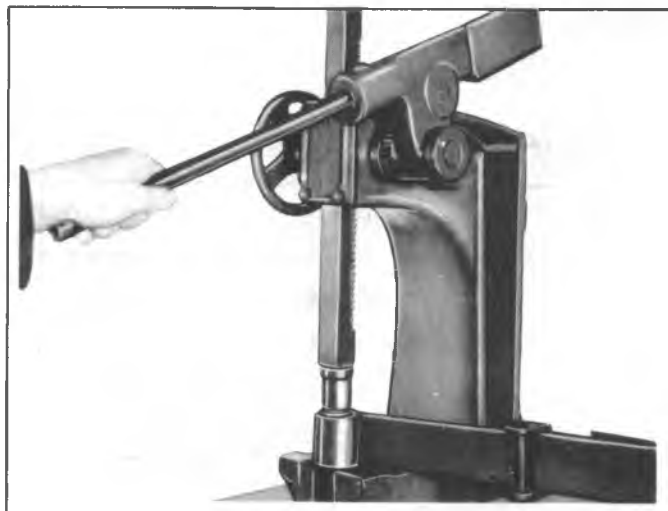
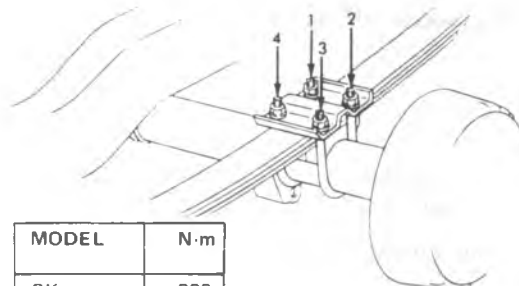
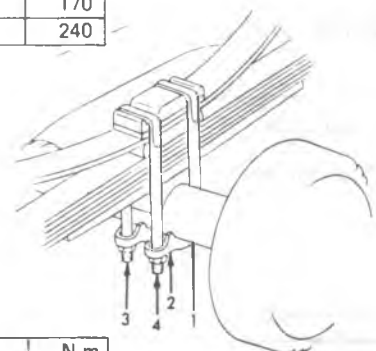


Fig. 3D-22--Pressing Out Bushing

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
CK	200
G10, G20	170
G30	240



MODEL	N·m
CK	230
G	240

100828

Fig. 3D-23--U-Bolt Installation

SPECIFICATIONS

(FT-LBS) TORQUE SPECIFICATION

	C-K	G	P
Spring-to-Axle "U" Bolt Nuts			P10 140 P20 140 P30 170 (Exc. W/3/4" Bolt) 200 (W/3/4" Bolt)
Leaf Spring			
—Front Bushing Bolt	110	90/135* (G316 . . .90)	110
—Rear Shackle Bolt	110	90/135* (G316 . . .90)	110
Shock Absorber			
—Upper Attachment	150	75	P10 25 P20 140 P30 50
—Lower Attachment	115	75	115
Propeller Shaft			
To Rear Axle (Strap)	12-17	12-17	12-17
To Rear Axle ("U" Bolt)	18-22	18-22	18-22
Bearing Support-to-Hanger	20-30	20-30	20-30
Hanger-to-Frame	40-50	—	—
Rear Stabilizer-to-Anchor Plate	20-30	—	20-30

*90 Ft. Lbs. when tightening the nut.

135 Ft. Lbs. when tightening the bolt.

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-4) 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.

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 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.

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.

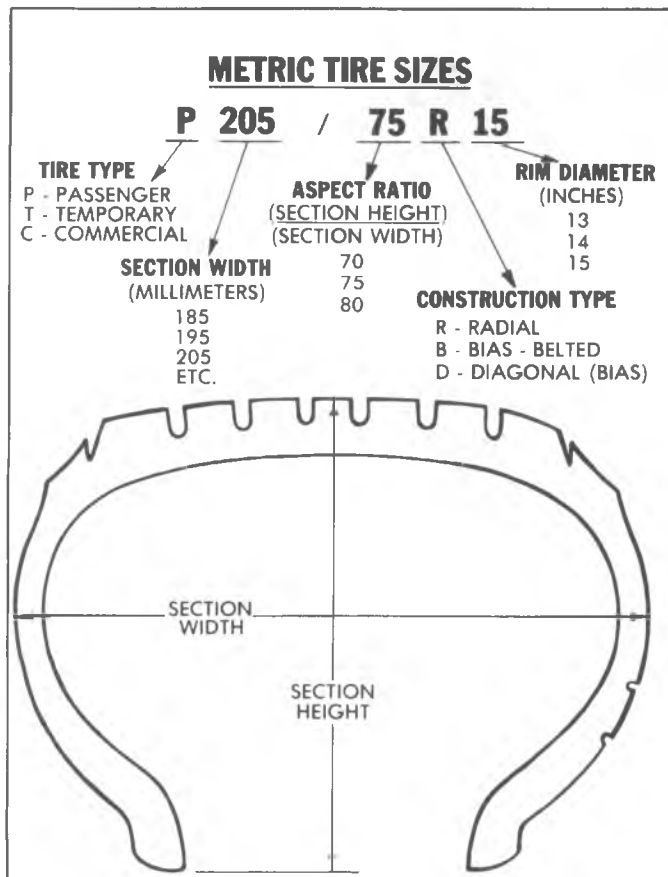


Fig. 3E-1--Metric Tire Size Format

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,

MFD. BY GENERAL MOTORS CORP.			
	08/78	GAWR FRT 4000/1814	GAWR RR 10000/4536
LB/kg	GVWR 14000/6350	10 5 X 16 5D	10 5 X 16 5D
TIRES		16 5 X 9 75	16 6 X 9 75
RIMS		36/248	42/290
PSI/kPa	COLD DUAL		
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS			
IN EFFECT	ON THE DATE MANUFACTURE SHOWN ABOVE CGQ1691100001 BUS - NOT SCHOOL BUS		
SEE OWNERS MANUAL FOR ADDITIONAL INFORMATION			

EXAMPLE ONLY

Fig. 3E-3--Certification Label

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

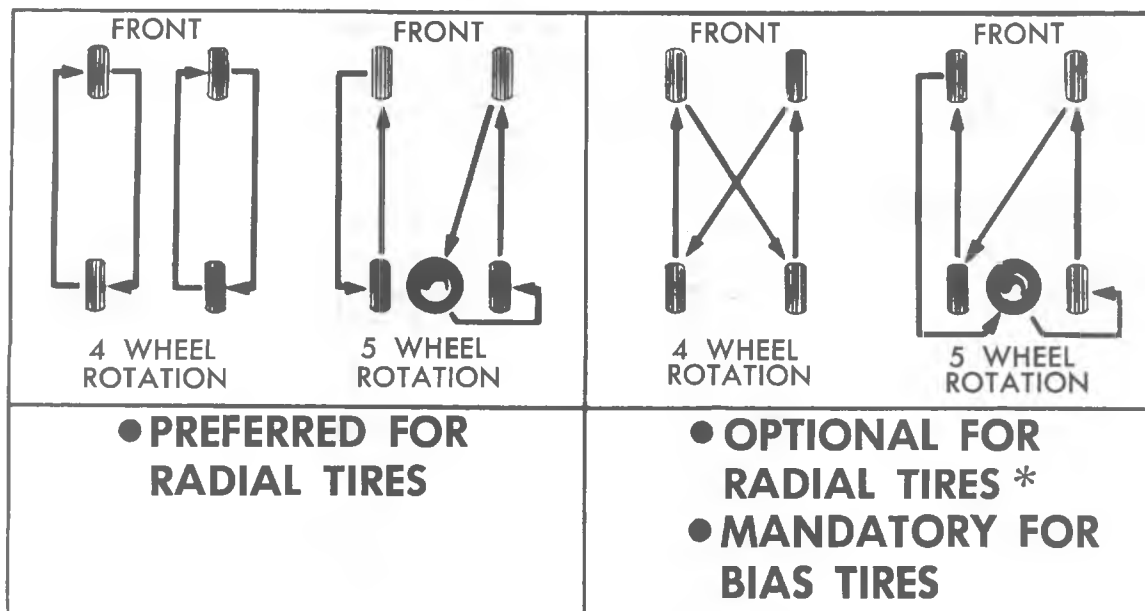
width, offset and mounting configurations to those originally installed on the vehicle.

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.



Fig. 3E-4--Tread Wear Indicators



* THE OPTIONAL 'X' ROTATION PATTERN FOR RADIALS IS ACCEPTABLE WHEN REQUIRED FOR MORE UNIFORM TIRE WEAR.

Fig. 3E-5--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-4, 3E-5)

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 faster wear of the outer tire. 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-5, 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

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 - LBS (kg)

Tire Size	Load Range	Inflation Pressure - PSI (kPa)						
		36 (250)	44 (300)	51 (350)	58 (400)	65 (450)	73 (500)	80 (550)

METRIC RADIAL TIRES USED AS SINGLES

LT215/85R16	C	1532 (695)	1742 (790)	1940 (880)				
LT215/85R16	D	1532 (695)	1742 (790)	1940 (880)	2127 (965)	2315 (1050)		
LT235/85R16	D	1742 (790)	1984 (900)	2205 (1000)	2425 (1100)	2623 (1190)		
LT235/85R16	F*	1742 (790)	1984 (900)	2205 (1000)	2425 (1100)	2623 (1190)	2844 (1290)	3042 (1380)

METRIC RADIAL TIRES USED AS DUALS

LT215/85R16	C	1389 (630)	1587 (720)	1764 (800)				
LT215/85R16	D	1389 (630)	1587 (720)	1764 (800)	1918 (870)	2105 (955)		

BIAS TIRE SIZE AND LOAD LIMITS - LBS (kg)

Tire Size	Load Range	Inflation Pressure - PSI (kPa)							
		30 (207)	35 (241)	40 (276)	45 (310)	50 (345)	55 (379)	60 (414)	65 (448)

BIAS TIRES USED AS SINGLES

7.50-16	C	1620 (735)	1770 (803)	1930 (875)	2060 (934)				
7.50-16	D	1620 (735)	1770 (803)	1930 (875)	2060 (934)	2190 (993)	2310 (1048)	2440 (1107)	
7.50-16	E	1620 (735)	1770 (803)	1930 (875)	2060 (934)	2190 (993)	2310 (1048)	2440 (1107)	2560 (1161)

BIAS TIRES USED AS DUALS

7.50-16	C	1430 (649)	1565 (710)	1690 (767)	1815 (823)				
7.50-16	D	1430 (649)	1565 (710)	1690 (767)	1815 (823)	1930 (875)	2040 (925)	2140 (971)	

WHEEL CODE AND LIMITS

Code	Wheel Size	Max Load Lbs (kg)	Max Pressure PSI (kPa)
AA	16x6.5 L	3045 (1381)	90 (621)
AF	16x6 K	2440 (1107)	75 (517)
BF	16x6.5 L	2780 (1261)	85 (586)
BJ	15x8 JJ	1910 (866)	40 (276)
BK	15x7 JJ	1670 (757)	40 (276)
BM	15x8 JJ	2030 (921)	40 (276)

Code	Wheel Size	Max Load Lbs (kg)	Max Pressure PSI (kPa)
CF	15x7 JJ	1670 (757)	40 (276)
CK	15x8 JJ	1910 (866)	40 (276)
UW	15x7 JJ	2030 (921)	41 (283)
UX	15x7 JJ	2030 (921)	41 (283)
XH	15x6 JJ	1585 (719)	40 (276)
XW	15x6 JJ	1910 (866)	70 (483)
XX	15x6 JJ	2040 (925)	70 (483)
ZC	15x8 JJ	2030 (921)	40 (276)

Fig. 3E-6--Tire/Wheel Load and Inflation Pressure

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 cambered 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

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 – LBS (kg)

Tire	Load	Inflation Pressure – PSI (kPa)										
Size	Range	30 (207)	35 (241)	40 (276)	45 (310)	50 (345)	55 (379)	60 (414)	65 (448)	70 (483)	75 (517)	80 (552)

BIAS TIRES USED AS SINGLES

8.00-16.5	C	1360 (617)	1490 (676)	1610 (730)	1730 (785)							
8.00-16.5	D	1360 (617)	1490 (676)	1610 (730)	1730 (785)	1840 (835)	1945 (882)	2045 (928)				
8.75-16.5	D	1570 (712)	1720 (780)	1850 (839)	1990 (903)	2110 (957)	2240 (1016)	2350 (1066)				
8.75-16.5	E	1570 (712)	1720 (780)	1850 (839)	1990 (903)	2110 (957)	2240 (1016)	2350 (1066)	2470 (1120)	2570 (1166)	2680 (1216)	

BIAS TIRES USED AS DUALS

8.00-16.5	C	1195 (542)	1310 (594)	1415 (642)	1520 (689)							
8.00-16.5	D	1195 (542)	1310 (594)	1415 (642)	1520 (689)	1620 (735)	1710 (776)	1800 (816)				

RADIAL TIRES USED AS DUALS

8.75R16.5	E		1570 (712)	1720 (780)	1850 (839)	1990 (903)	2110 (957)	2240 (1016)	2350 (1066)	2470 (1120)	2570 (1166)	2680 (1216)
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WHEEL CODE AND LIMITS

Code	Wheel Size	Max Load Lbs (kg)	Max Pressure PSI (kPa)	Code	Wheel Size	Max Load Lbs (kg)	Max Pressure PSI (kPa)
BR	15x7 JJ	1690 (767)	40 (276)	YD	16.5x6	2680 (1216)	85 (586)
CD	15x6.5 JJ	1690 (767)	40 (276)	YH	16.5x6	2680 (1216)	85 (586)
XH	15x6 JJ	1585 (719)	40 (276)	YJ	16.5x6.75	2680 (1216)	85 (586)
XW	15x6 JJ	1910 (866)	70 (483)	NO CODE	15x6.5 JJ	1690 (207)	40 (276)

Fig. 3E-7--Tire/Wheel Load and Inflation Pressure-G 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)

RADIAL TIRE SIZE AND LOAD LIMITS -- LBS (kg)

Tire Size	Load Range	Inflation Pressure - PSI (kPa)						
		36 (250)	44 (300)	51 (350)	58 (400)	65 (450)	73 (500)	80 (550)

METRIC RADIAL TIRES USED AS SINGLES

LT215/85R16	C	1532 (695)	1742 (790)	1940 (880)				
LT215/85R16	D	1532 (695)	1742 (790)	1940 (880)	2127 (965)	2315 (1050)		
LT235/85R16	D	1742 (790)	1984 (900)	2205 (1000)	2425 (1100)	2623 (1190)		
LT235/85R16	E	1742 (790)	1984 (900)	2205 (1000)	2425 (1100)	2623 (1190)	2844 (1290)	3042 (1380)

METRIC RADIAL TIRES USED AS DUALS

LT215/85R16	C	1389 (630)	1587 (720)	1764 (800)				
LT215/85R16	D	1389 (630)	1587 (720)	1764 (800)	1918 (870)	2105 (955)		

Tire Size	Load Range	Inflation Pressure - PSI (kPa)						
		45 (310)	50 (345)	55 (379)	60 (414)	65 (448)	70 (483)	75 (517)

RADIAL TIRES USED AS SINGLES

8R19.5	D			2110 (957)	2270 (1030)	2410 (1093)	2540 (1152)	2680 (1216)	2800 (1270)
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RADIAL TIRES USED AS DUALS

8R19.5	D	1850 (839)	1990 (903)	2110 (957)	2230 (1012)	2350 (1066)	2460 (1116)		
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BIAS TIRE SIZE AND LOAD LIMITS -- LBS (kg)

Tire Size	Load Range	Inflation Pressure - PSI (kPa)									
		30 (207)	35 (241)	40 (276)	45 (310)	50 (345)	55 (379)	60 (414)	65 (448)	70 (483)	75 (517)

BIAS TIRES USED AS SINGLES

7.50-16	C	1620 (735)	1770 (803)	1930 (875)	2060 (934)						
7.50-16	D	1620 (735)	1770 (803)	1930 (875)	2060 (934)	2190 (993)	2310 (1048)	2440 (1107)			
7.50-16	E	1620 (735)	1770 (803)	1930 (875)	2060 (934)	2190 (993)	2310 (1048)	2440 (1107)	2560 (1161)	2670 (1211)	2780 (1261)
8-19.5	D, E					2110 (957)	2270 (1030)	2410 (1093)	2540 (1152)	2680 (1216)	2800 (1270)

BIAS TIRES USED AS DUALS

7.50-16	C	1430 (649)	1565 (710)	1690 (767)	1815 (823)						
7.50-16	D	1430 (649)	1565 (710)	1690 (767)	1815 (823)	1930 (875)	2040 (925)	2140 (971)			
8-19.5	D			1850 (839)	1990 (903)	2110 (957)	2230 (1012)	2350 (1066)	2460 (1116)		
8-19.5	E			1850 (839)	1990 (903)	2110 (957)	2230 (1012)	2350 (1066)	2460 (1116)	2570 (1166)	2680 (1216)

WHEEL CODE AND LIMITS

Code	Wheel Size	Max Load Lbs (kg)	Max Pressure PSI (kPa)
AA	16x6.5 L	3045 (1381)	90 (621)
AF	16x6 K	2440 (1107)	75 (517)
BF	16x6.5 L	2780 (1261)	85 (586)
ZT	19.5x6	2540 (1152)	80 (552)
ZY	19.5x6	2780 (1261)	95 (655)

Fig. 3E-8--Tire/Wheel Load and Inflation Pressure-P Models

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 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 current 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 truck 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 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 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 eliminated. 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 put on loosely, turn the wheel

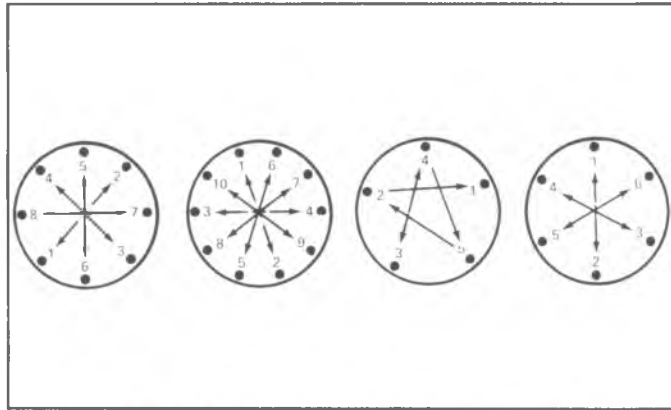


Fig. 3E-9--Wheel Nut Tightening Sequence

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 and evenly to avoid excessive runout.

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-9.

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 demount 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-10).

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 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:

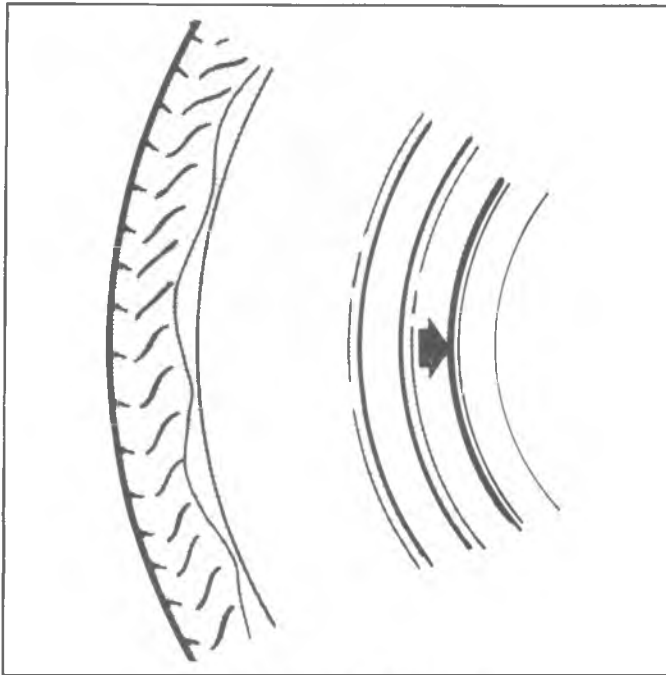


Fig. 3E-10--Tire Locating Rings

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. These instructions can be obtained from the tire manufacturer.

ALUMINUM WHEEL MAINTENANCE

Aluminum wheels can be cleaned, coated and painted using the following procedure. Care should be taken during entire procedure to avoid scratching or damaging the shiny aluminum surfaces.

Materials Required

1. Amercian Sure Seal paint remover, product STRIP OFF - stock SSQ or equivalent.
2. 360 grit sand paper.
3. Nylon auto glass type scraper.
4. Amercian Sure Seal Silicone Remover - stock DSR or 3M #8985 Wax Remover.
5. Paint thinners.
6. American Sure Seal Aluminum Cleaner - stock DWC or equivalent.
7. DuPont 228S conversion coating or equivalent.
8. Enamel color coat paint.
9. American Sure Seal Coricone 1700 Wheel Protector.
10. General purpose pads. 3M #7448 or equivalent.
11. American Sure Seal Glaze Cleaner - stock DGC or 3M #5979 clean and glaze.
12. American Sure Seal Wheel Polish - stock DAP or equivalent.

PROCEDURE

1. Remove the wheel and tire assembly from the car. After marking the wheel-tire relationship, remove tire from wheel. If wheel and tire are not separated, mask off the tire prior to painting and

mark the weights and remove.

2. Using the general purpose pad and glaze cleaner, vigorously rub over the machine surface to remove corrosion and restore the luster of the bright machined surfaces on the wheel.
3. Wipe over the cleaned surface with the wheel polish to obtain maximum luster.
4. Using the silicone remover, clean the entire wheel. Wash off with clean water and air blow dry.

CAUTION: USE OF RUBBER GLOVES AND EYE GOGGLES IS NECESSARY TO PREVENT PERSONAL INJURY.

5. Using the "Strip Off " paint remover, spray the entire wheel surface with this product. Wait two to three minutes and then remove with a high pressure water hose.

Steps 6 through 12 are to be used only on aluminum wheels with painted surfaces.

6. If peeling or discoloration is extremely bad, it may be necessary to use the Strip Off more than once. Scrape off any loose paint with a nylon scraper and/or 360 grit sand paper.
7. Wipe entire wheel clean with the silicone remover and flush off again with water, followed by blow drying.
8. Mask off areas of wheel **not** to be painted.

9. Wipe over the painted surface with the aluminum cleaner, then apply the conversion coating, following label directions. (This is a two-step operation which will improve the adhesion of the primer.)
10. To ensure coverage in all areas, an application of zinc chromate primer should be applied to the wheel painted surface in four light applications, rotating the wheel 90°F (32°C) between applications.
11. Apply the color coat using the same procedure as for the primer.
12. After ten minutes of air drying, heat may be applied to the paint to reduce drying time.
13. When the color coat is completely dry, remove masking tape. Wheel must be perfectly clean of foreign material and dry before applying Coricone 1700, and clean the masked area with wax or silicone remover to eliminate tape residue.
14. Spray two light coatings of Coricone 1700 wheel protector on wheel allowing two or three minutes between coats. The clear coat will put an invisible coating on top of the painted surface and the polished aluminum.
15. **Do not** use heat on clear coat, allow to air dry for 24 hours.
16. Reinstall the tire and wheel (realign the index marks and/or the balance weight).

WHEEL NUT TORQUES

Series	Description	Torque
K	7/16" Bolts (6)	70-90 Ft. Lbs.
C10, P10, G10, G20	1/2" Bolts (5)	75-100 Ft. Lbs.
C20, P20 C30, P30 and K20, G30 Single Wheels	9/16" Bolts (8)	90-120 Ft. Lbs.
CKPG30 Dual Wheels	9/16" Bolts (8)	110-140 Ft. Lbs.
	Heavy Duty Wheels 5/8" Bolts (10)	130-180 Ft. Lbs.

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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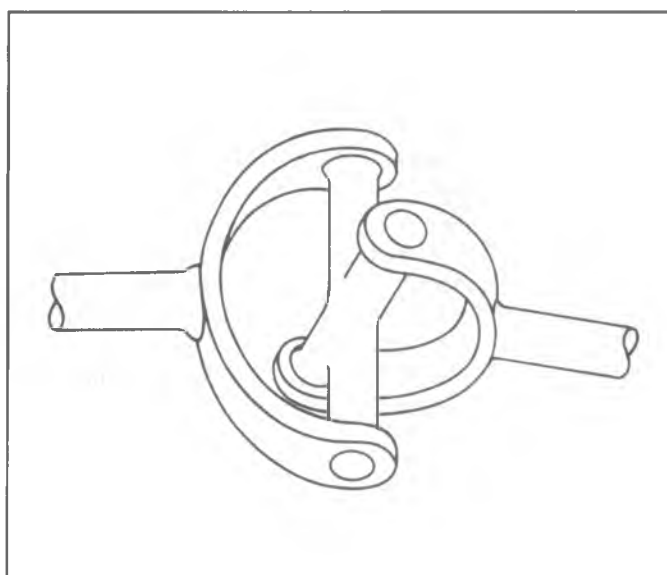


Fig. 4A-1--Simple Universal Joint

GENERAL DESCRIPTION

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. See figure 4A-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. Refer to figure 4A-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.

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

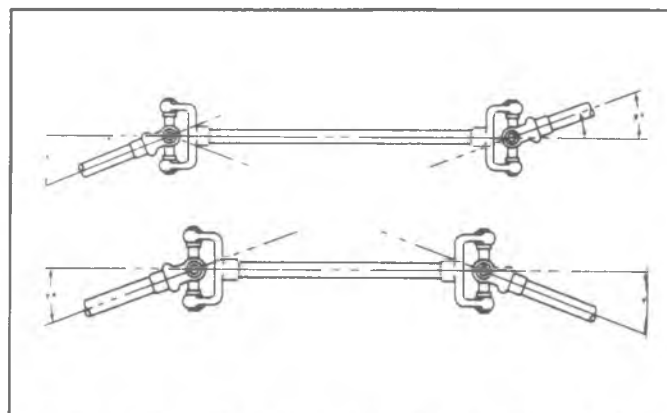


Fig. 4A-2--Universal Joints Arranged for Constant Velocity

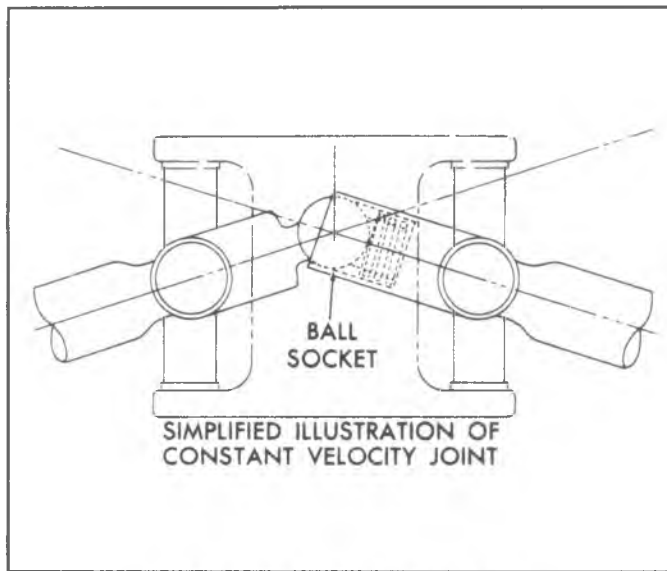


Fig. 4A-3--Ball-Socket Location

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. See figure 4A-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

Checking and Correcting

Propeller Shaft Unbalance

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.

DIAGNOSTIC CHART

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Leak at front slip yoke. <div>NOTE: An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.</div>	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. <div>NOTE: Usually occurs on initial load application after transmission has been put into gear, either forward or reverse.</div>	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.

COMPLAINT	POSSIBLE CAUSE	CORRECTION
<p>Roughness, Vibration or Body Boom at any speed.</p> <p>NOTE: With tachometer installed in car, 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 car at same engine speed (rpm) at which vibration was noted before. Note the effect on the vibration.</p> <p>If vibration occurs at the same engine speed (rpm), regardless of transmission gear range selected, drive shaft assembly is <u>not</u> at fault, since the shaft speed (rpm) varies.</p> <p>If vibration decreased, or is eliminated, in a different gear range but at the same engine speed (rpm), check the possible causes:</p>	<ul style="list-style-type: none"> a. Bent or dented drive shaft. b. Undercoating on drive shaft. c. Tire unbalance. (30-80 mph, not throttle conscious) d. Excessive U-bolt torque. e. Tight universal joints. f. Worn universal joints. g. Burrs or gouges on companion flange. Check snap ring locating surfaces on flange yoke. h. Drive shaft or companion flange unbalance. i. Excessive looseness at slip yoke spline. j. Drive shaft runout (50-80 mph throttle conscious) 	<ul style="list-style-type: none"> a. Replace. b. Clean drive shaft. c. Balance or replace as required. d. Check and correct to specified torque. e. Impact yokes with a hammer to free up. Overhaul joint if unable to free up or if joint feels rough when rotated by hand. f. Overhaul, replacing necessary parts. g. Rework or replace companion flange. h. Check for missing balance weights on drive shaft. Remove and reassemble drive shaft to companion flange, 180° from original position. i. Replace necessary parts. j. 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.
Roughness usually at low speeds, light load, 15-35 mph.	<ul style="list-style-type: none"> a. U-bolt clamp nuts excessively tight. 	<ul style="list-style-type: none"> a. Check and correct torque to that specified. If torque was excessive or if brenelled pattern on trunnions is evident, replace joints.
Scraping noise.	<ul style="list-style-type: none"> a. Slinger, companion flange, or end yoke rubbing on rear axle carrier. 	<ul style="list-style-type: none"> a. Straighten slinger to remove interference.
Roughness on heavy acceleration (short duration.)	<ul style="list-style-type: none"> a. Double cardan joint ball seats worn. Ball seat spring may be broken. 	<ul style="list-style-type: none"> a. Replace joint and shaft assembly.
Roughness -- above 35 mph felt and/or heard.	<ul style="list-style-type: none"> a. Tires unbalanced or worn. 	<ul style="list-style-type: none"> a. Balance or replace as required.

Fig. 4A-5--Diagnosis Chart B

ON-VEHICLE SERVICE

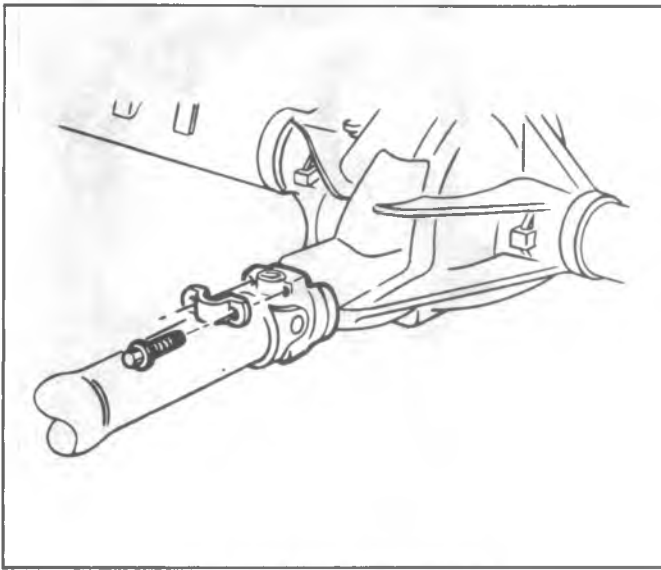


Fig. 4A-6--Strap Attachment

PROPELLER SHAFT

The rear universal joint to propshaft bolt on some models requires a #10 "Six Lobed Socket" (J-33051), for proper removal and installation.

Removal

1. Raise vehicle on hoist. Mark relationship of shaft to companion flange and disconnect the rear universal

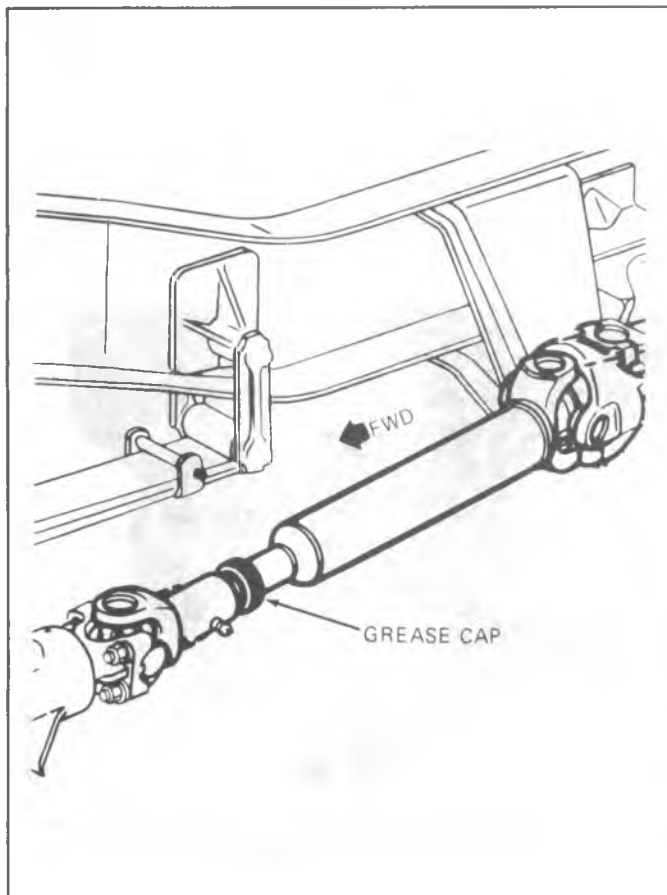


Fig. 4A-7--Proper Alignment

joint by removing trunnion bearing "U" bolts or straps. Tape bearing cups to trunnion to prevent dropping and loss of bearing rollers.

2. For models with two-piece shafts remove bolts retaining bearing support to hanger.
3. Slide propeller shaft forward disengaging trunnion from axle flange, then slide assembly rearward disengaging from transmission.

For models using strap or U-bolt attachments to transmission or transfer case use same removal procedure as above.

Universal Joints

On models with between center slip propshaft it is important that components are marked prior to disassembly for proper phasing.

Except for P models with disc brakes, 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 Fig. 4A-8 and 4A-9.

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. See figures 4A-8 and 4A-9. The bearing cup cannot be fully pressed out.

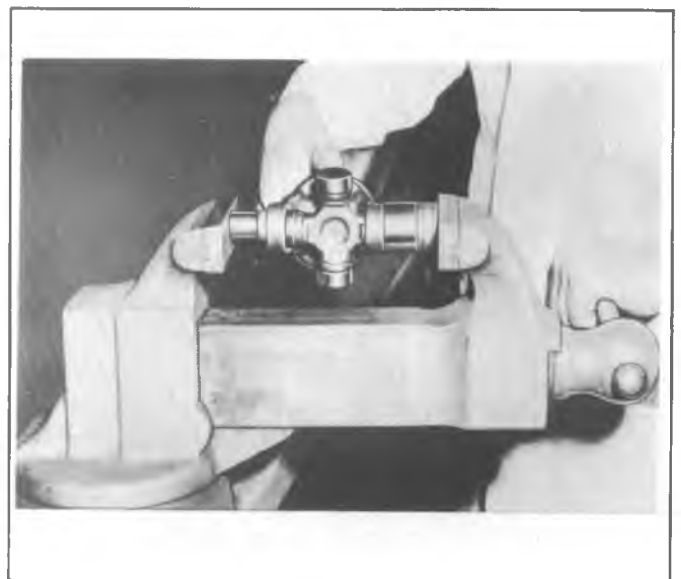


Fig. 4A-8--Bearing Cup Removal with Vise

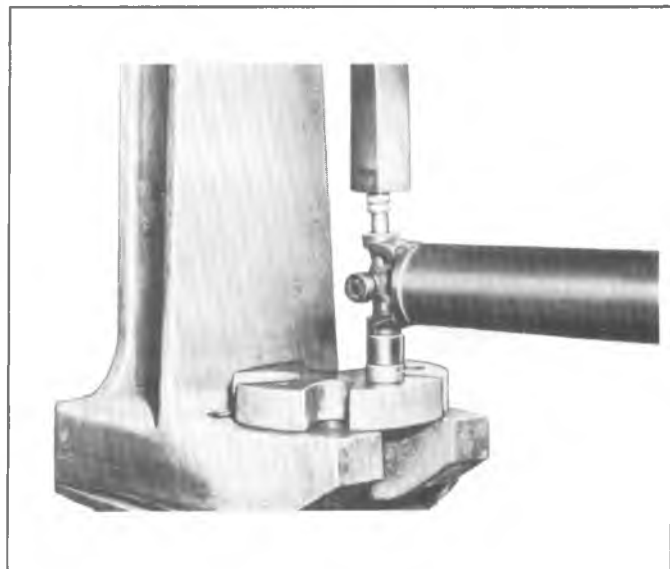


Fig. 4A-9--Bearing Cup Removal with Press

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 Section 0.

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. 4A-10

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.

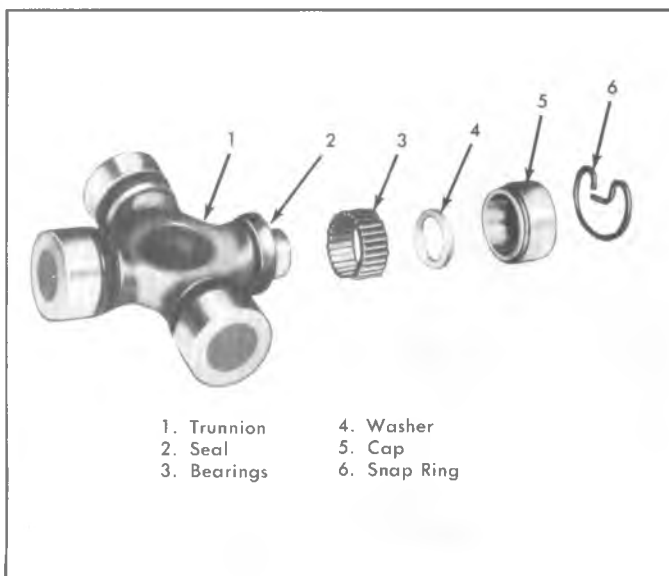


Fig. 4A-10--Universal Joint Repair Kit

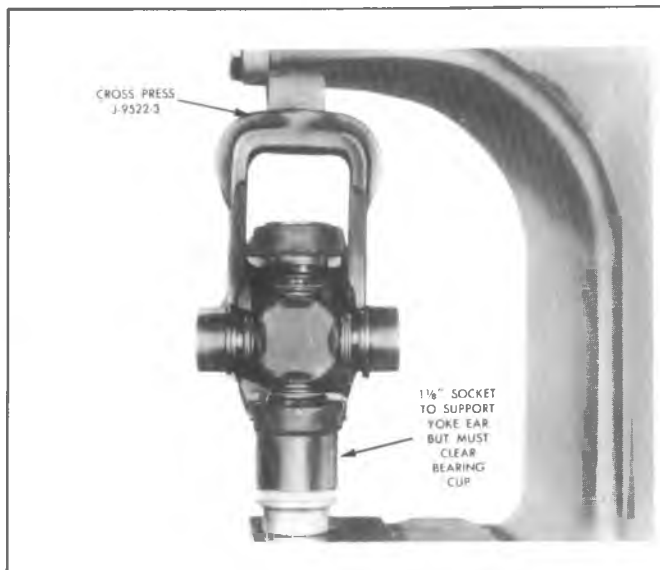


Fig. 4A-11--Pressing Out Bearing Cup

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 figure 4A-11. This will shear the plastic retaining the lower 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 figure 4A-12.

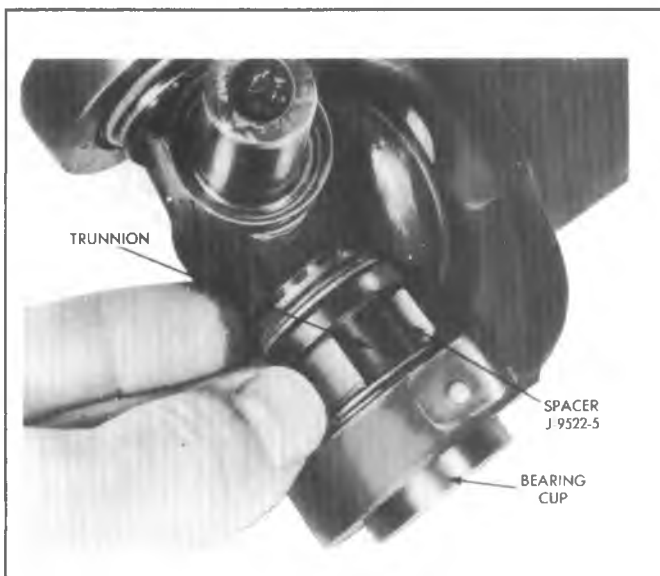


Fig. 4A-12--Using Spacer to Remove Bearing Cup

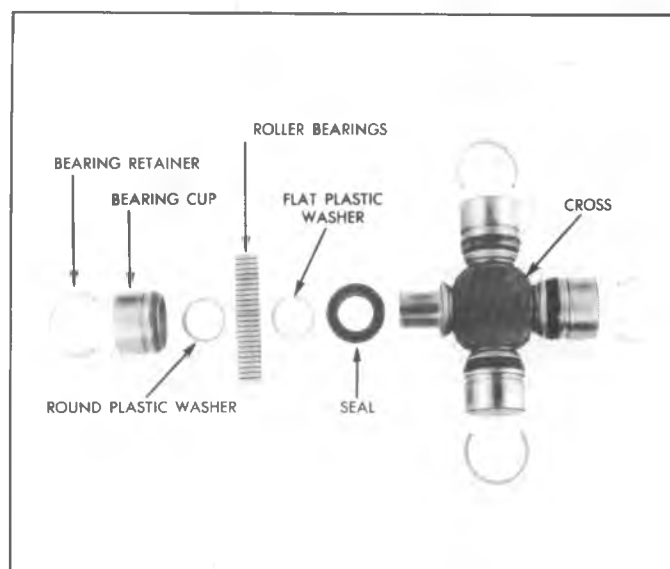


Fig. 4A-13--Repair Kit

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, remove the pair of bearing cups from the slip yoke in the same manner.



Fig. 4A-14--Installing Trunnion into Yoke

Reassembly

A universal joint service kit is used when reassembling this joint. See figure 4A-13. 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 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 figure 4A-14.
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 figure 4A-15.
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. This springs the yoke ears slightly. See figure 4A-16.
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.

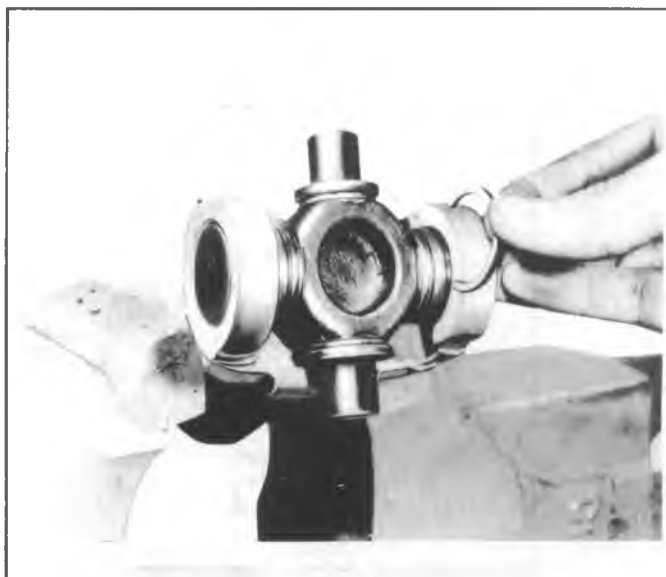


Fig. 4A-15--Installing Snap Ring to Retain Trunnion



Fig. 4A-16--Seating Snap Rings

CENTER SUPPORT BEARING-FIG. 4A-17

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.

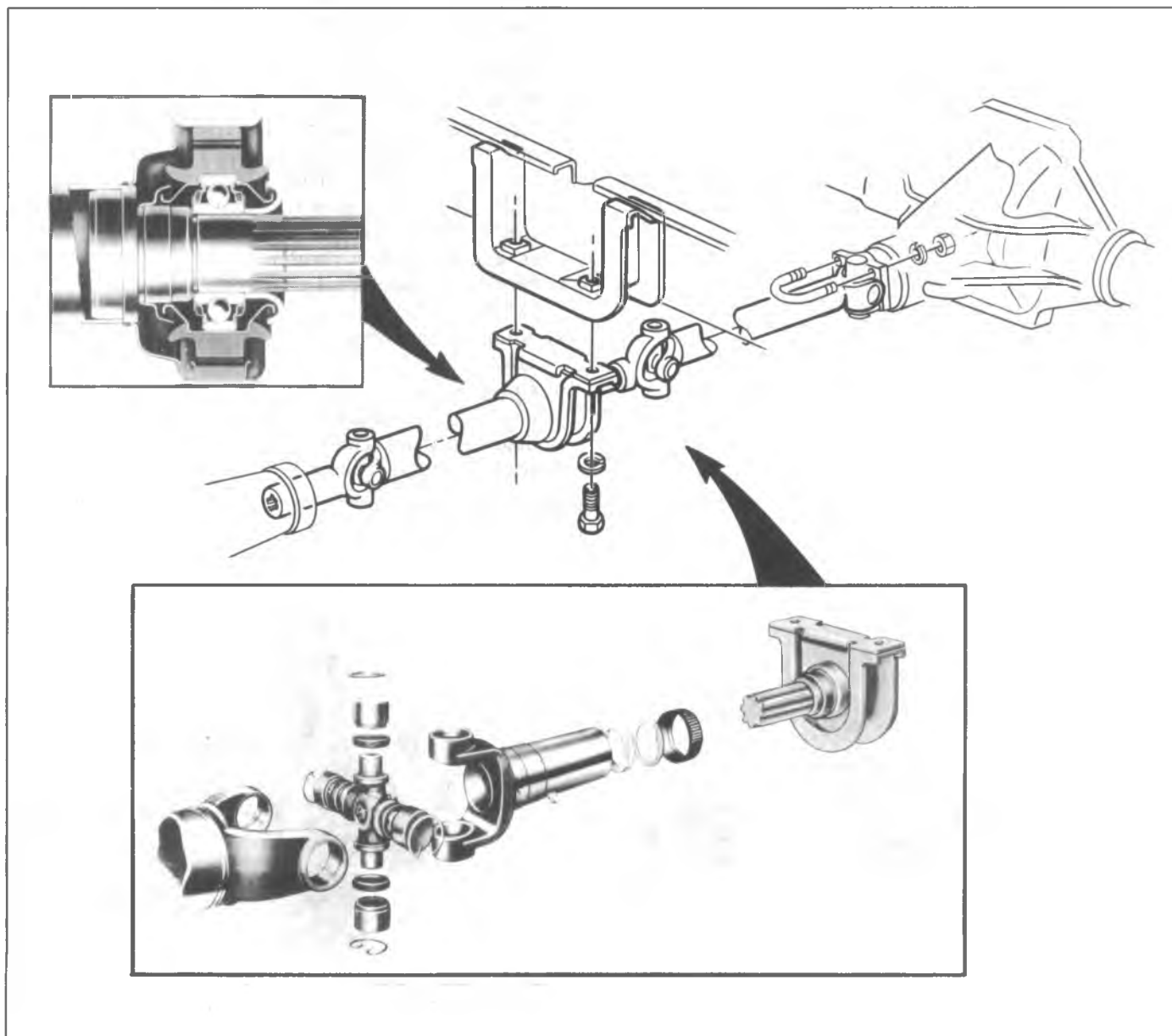


Fig. 4A-17--Propeller Shaft, Universal Joint and Bearing Support

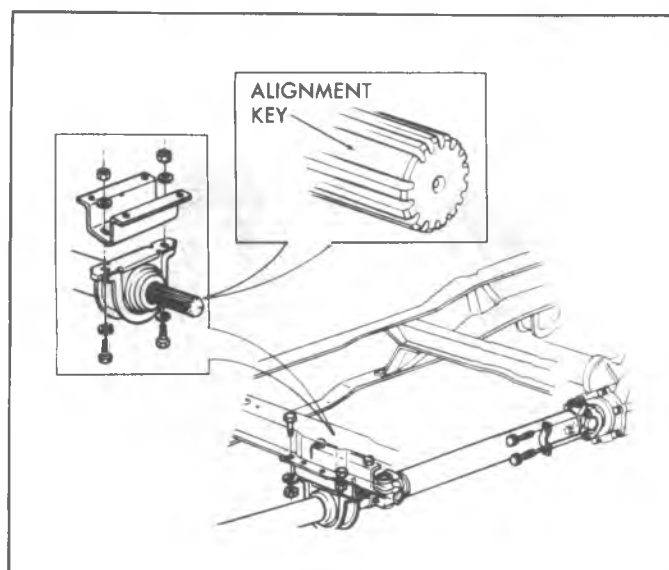


Fig. 4A-18--Alignment Key

- 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.

NOTICE: All models with 32 splines use an alignment key, as shown in figure 4A-18, to obtain proper phasing. The shafts can mate only in the correct position.

NOTICE: G and K models with 16 splines must be phased as shown in figure 4A-19.

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 only,

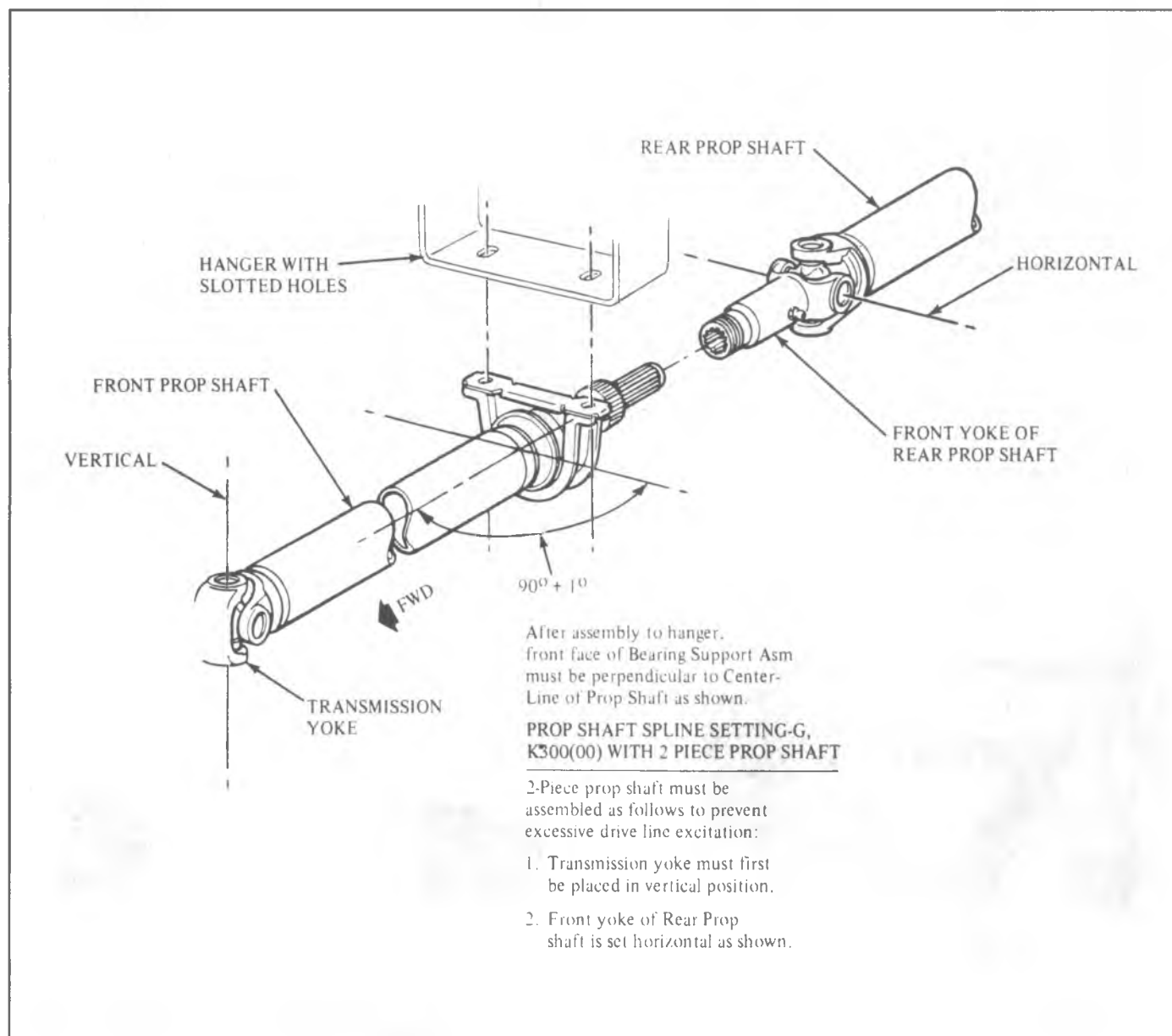


Fig. 4A-19--Alignment for Phasing

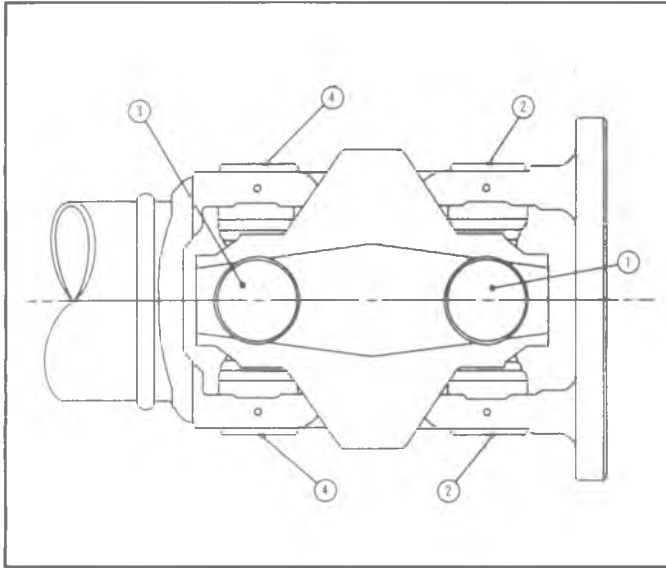


Fig. 4A-20--Bearing Cap Removal Sequence

apply a small amount (approximately 18 grams) of grease 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 figure 4A-18.
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. See figure 4A-19.
 - c. Take rear propeller shaft and before installing, align U-joint trunnions as shown in figure 4A-19. Attach rear U-joint to axle. Tighten grease cap.
 - d. Torque bearing support to crossmember and U-joint to axle attachments.

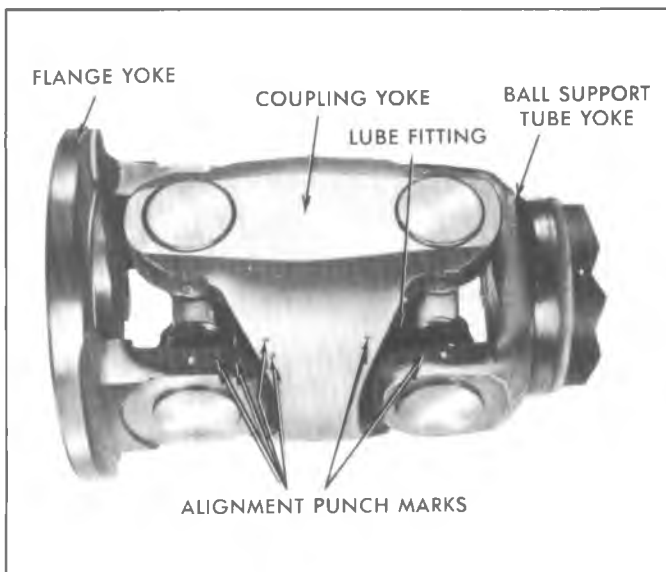


Fig. 4A-21--Reassembling Coupling Yoke

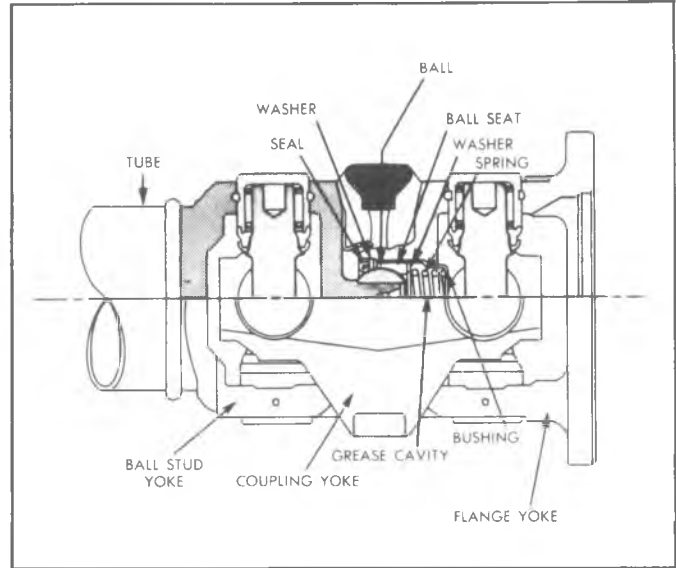


Fig. 4A-22--Cross Sectional View of CV Joint

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 figure 4A-20. Mark the flange yoke and coupling yoke for reassembly in the same position, as shown in figure 4A-21.

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. See figure 4A-22. Pry the seal from the ball socket and remove washers, spring and the three ball seats as illustrated in figure 4A-23.

1. Clean and inspect ball seat insert bushing for wear. If bushing is worn, replace flange yoke and cross assembly.

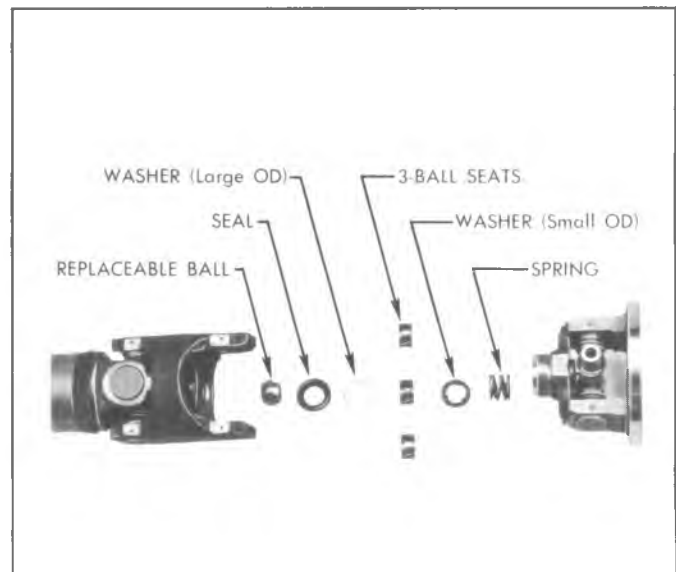


Fig. 4A-23--Exploded View of Centering Ball Mechanism

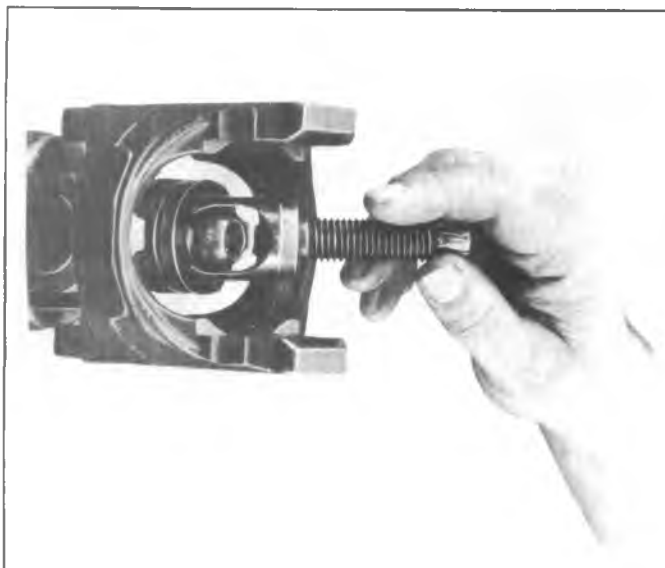


Fig. 4A-24--Installing Tool J-23996 Over Ball

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 figure 4A-24.
2. Place outer cylinder of Tool J-23996 over outside of ball as shown in figure 4A-25.
3. Thread nut on Tool J-23996 and draw ball off stud, using wrench as shown in figure 4A-27.
4. Place the replacement ball on stud.
5. Using Tool J-23996, drive ball onto stud as in

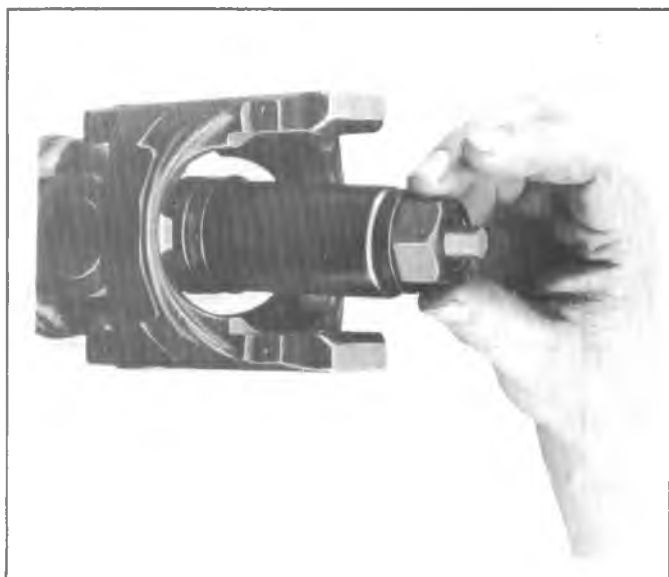


Fig. 4A-25--Installing Outer Cylinder of Tool J-23996 Over Ball



Fig. 4A-26--Removing Centering Ball

figure 4A-27, 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 figure 4A-28. Sealing lip should tip inward.
8. Fill cavity with grease provided in kit.
9. Install flange yoke to centering ball as shown in figure 4A-29, making sure alignment marks are correctly positioned. Install trunnion and bearing caps as previously outlined.

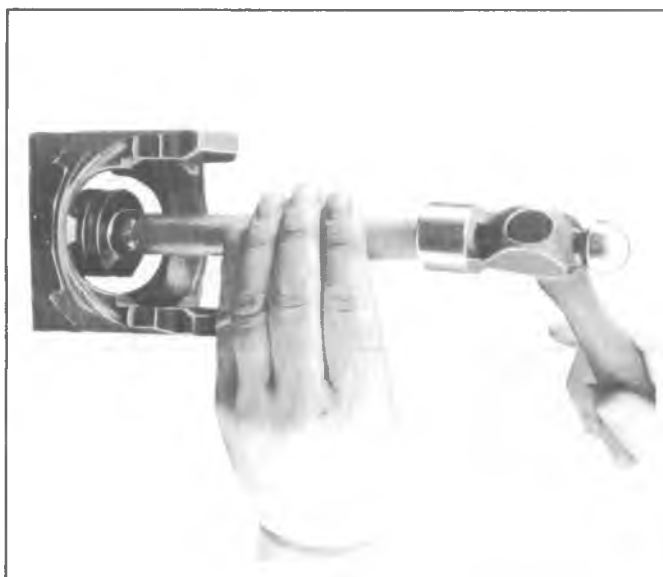


Fig. 4A-27--Installing Centering Ball



Fig. 4A-28--Installing Centering Ball Seal



Fig. 4A-29--Reassembling Flange Yoke

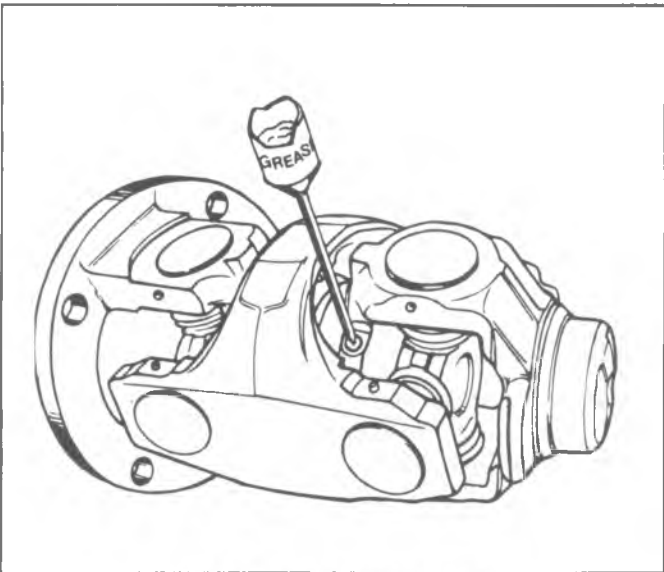


Fig. 4A-30--Lubrication Fitting

LUBRICATION

The front axle propshaft found on all four-wheel drive trucks requires special lubrication procedures 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 (see Section 0) with special lubricant, #1050679, or equivalent. If the fitting cannot be seen from beneath the vehicle Figure 4A-30 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.).

SPECIFICATIONS

PROPELLER SHAFT			
	CK	G	P
Propeller Shaft			
To Rear Axle (Strap)	12-17*	12-17*	12-17
Bearing Support-to-Hanger	20-30	20-30	20-30
Hanger-to-Frame	40-50	—	—
To Transfer Case	70-80	—	—

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.

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 seven different axles, categorized by ring gear diameter, they are as follows:

8-1/2", AND 8-7/8" 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.

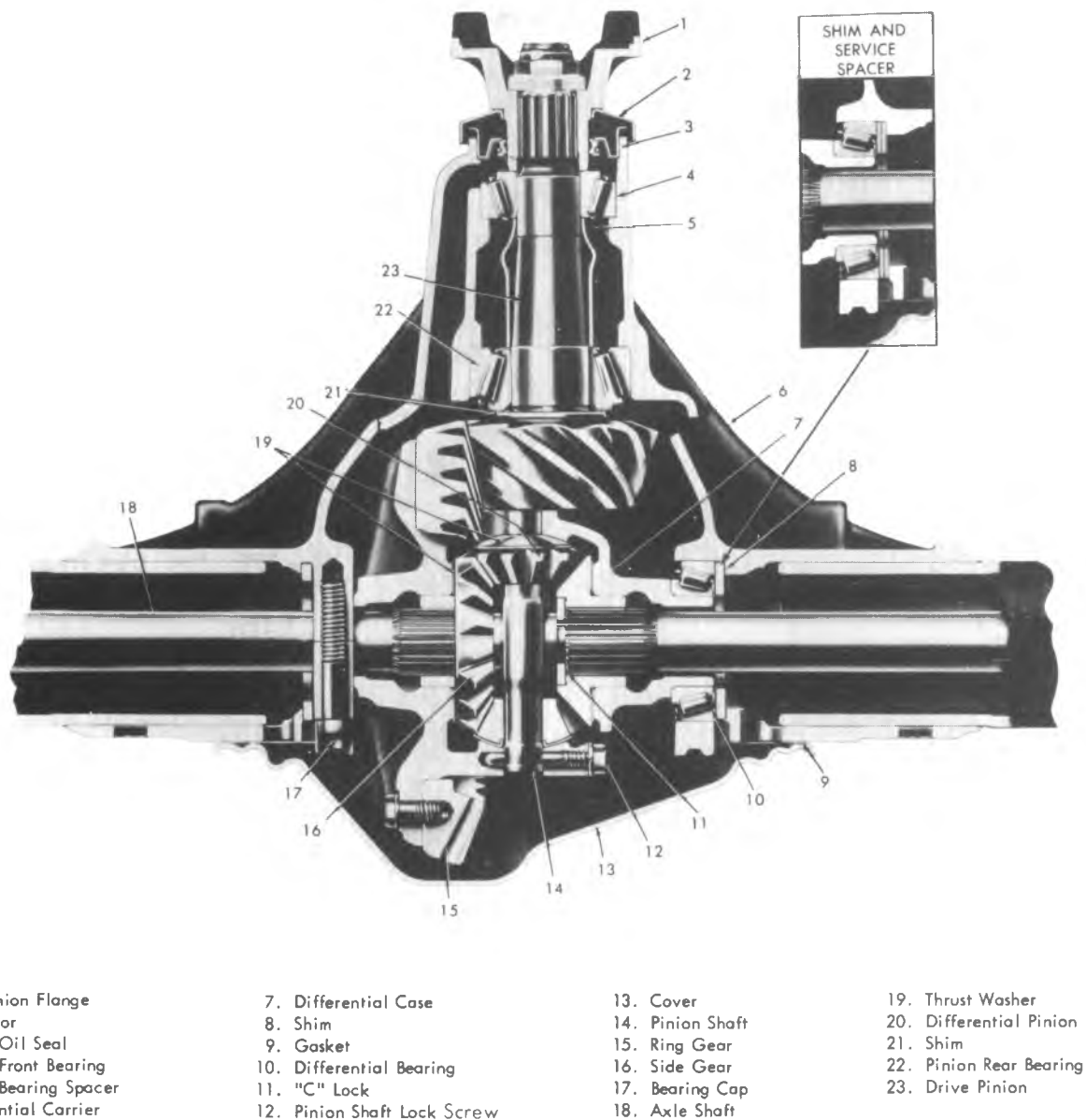


Fig. 4B-1--8-1/2" and 8-7/8" Ring Gear Axle Cross-Section Typical

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-pinon 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.

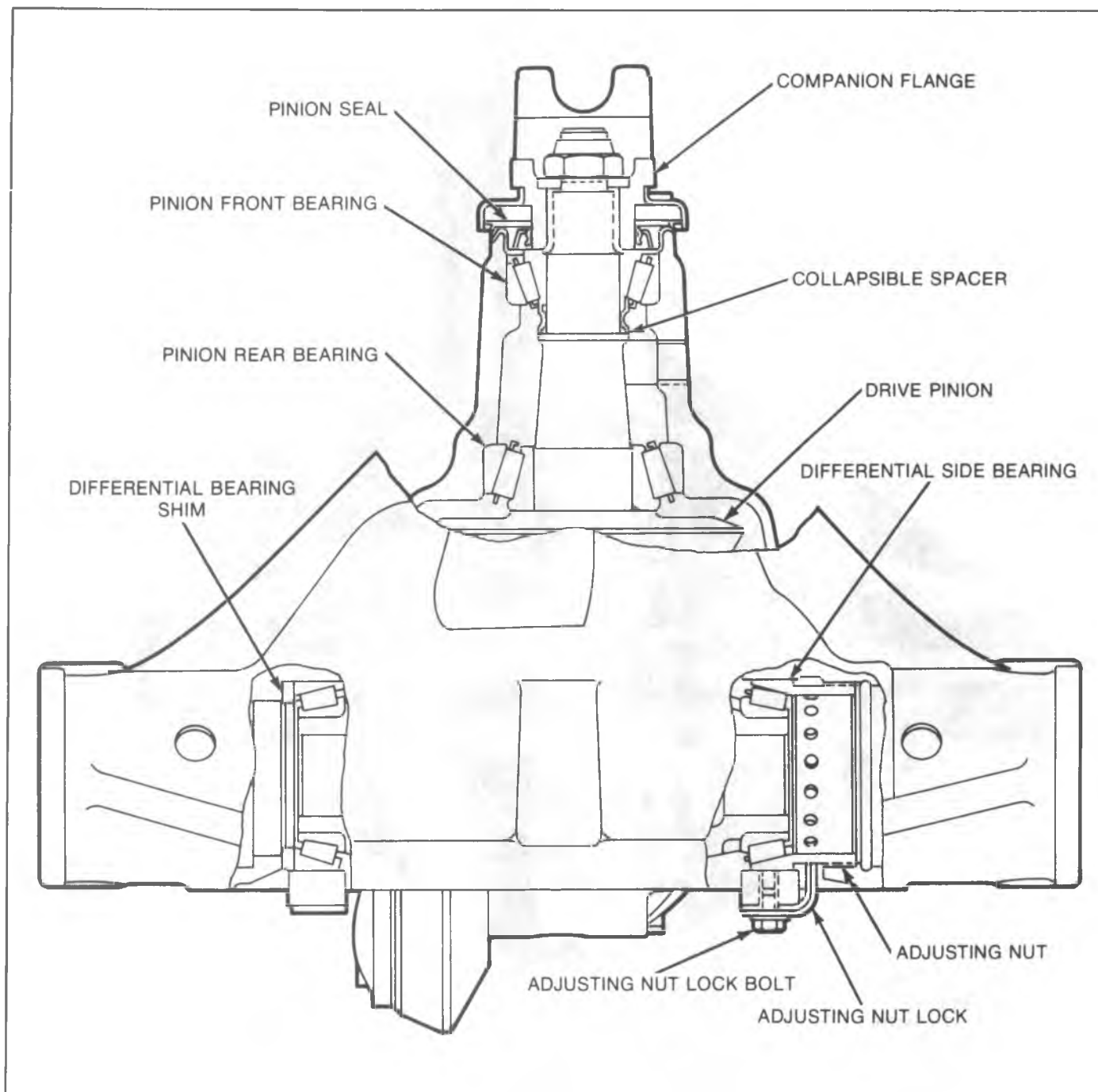
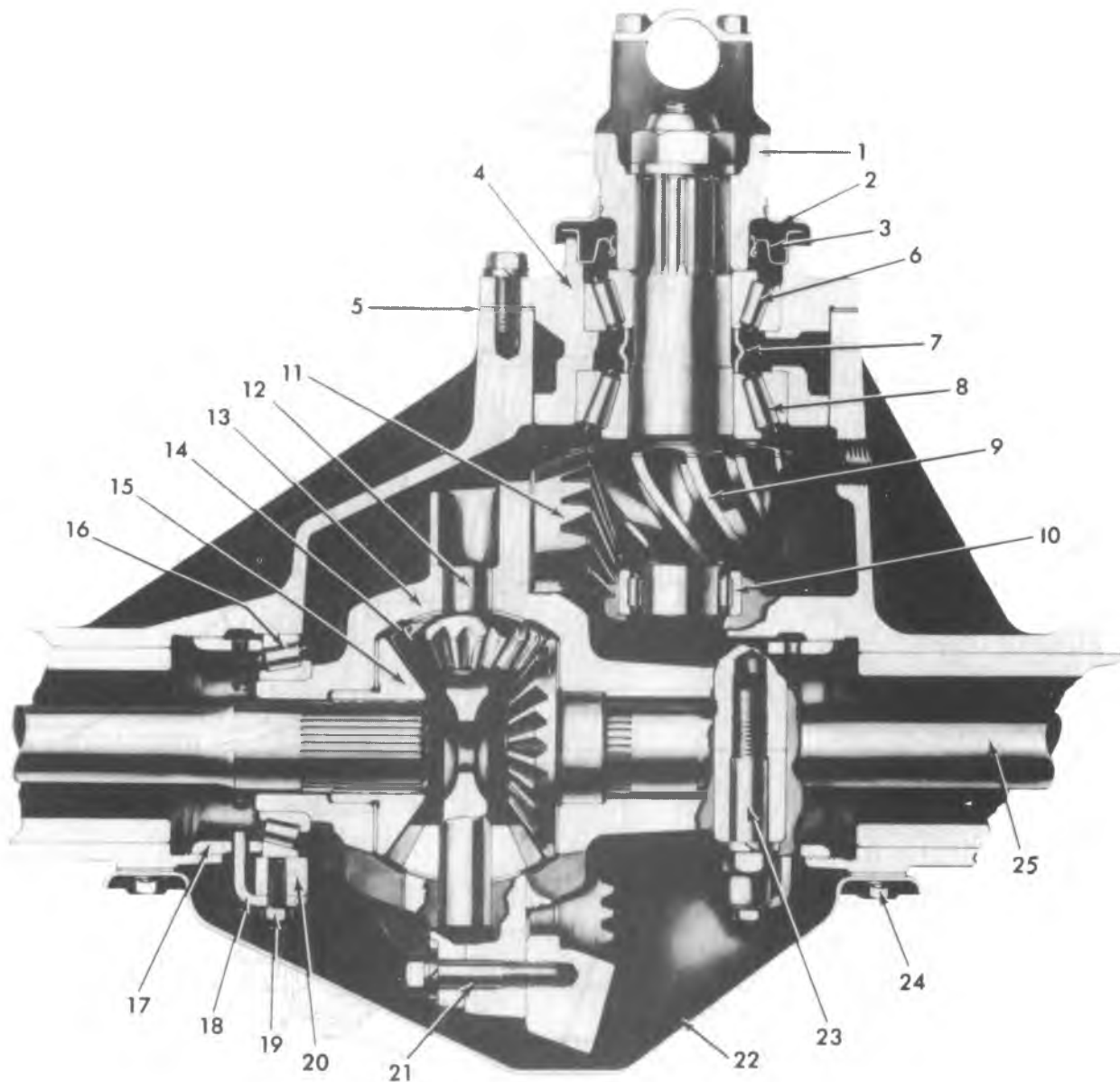


Fig. 4B-2-9 1 1/2" Ring Gear Axle

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. Companion Flange | 10. Straddle Bearing | 19. Retainer Screw |
| 2. Oil Deflector | 11. Ring Gear | 20. Bearing Cap |
| 3. Oil Seal | 12. Differential Spider | 21. Case-to-Ring Gear Bolt |
| 4. Bearing Retainer | 13. Differential Case | 22. Differential Cover |
| 5. Shim | 14. Differential Pinion | 23. Bearing Cap Bolt |
| 6. Pinion Front Bearing | 15. Differential Side Gear | 24. Cover Screw |
| 7. Collapsible Spacer | 16. Side Bearing | 25. Axle Shaft |
| 8. Pinion Rear Bearing | 17. Side Bearing Adjusting Nut | |
| 9. Drive Pinion | 18. Adjusting Nut Retainer | |

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.

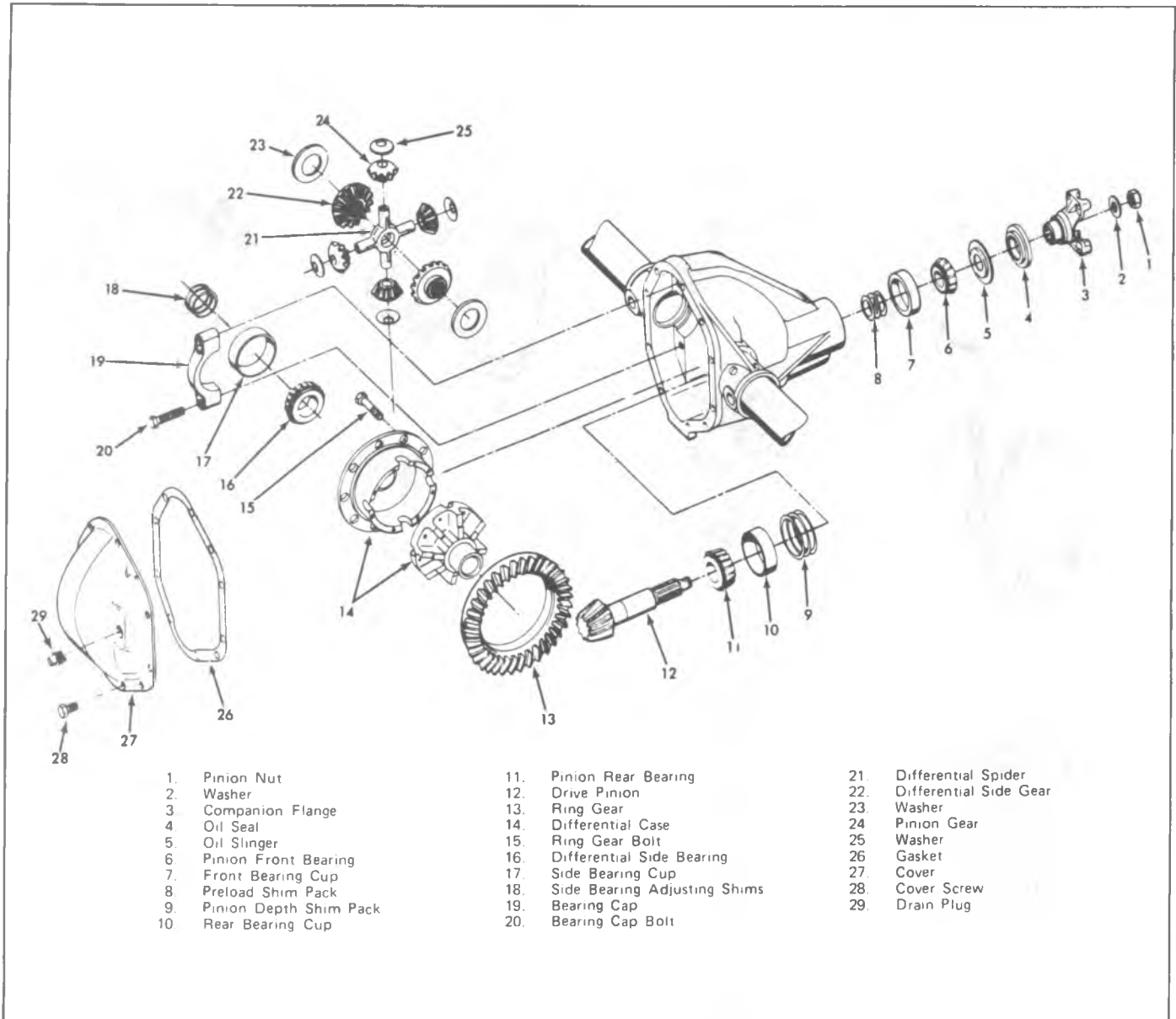


Fig. 4B-4--Dana 10-1/2" Ring Gear Axle Exploded View

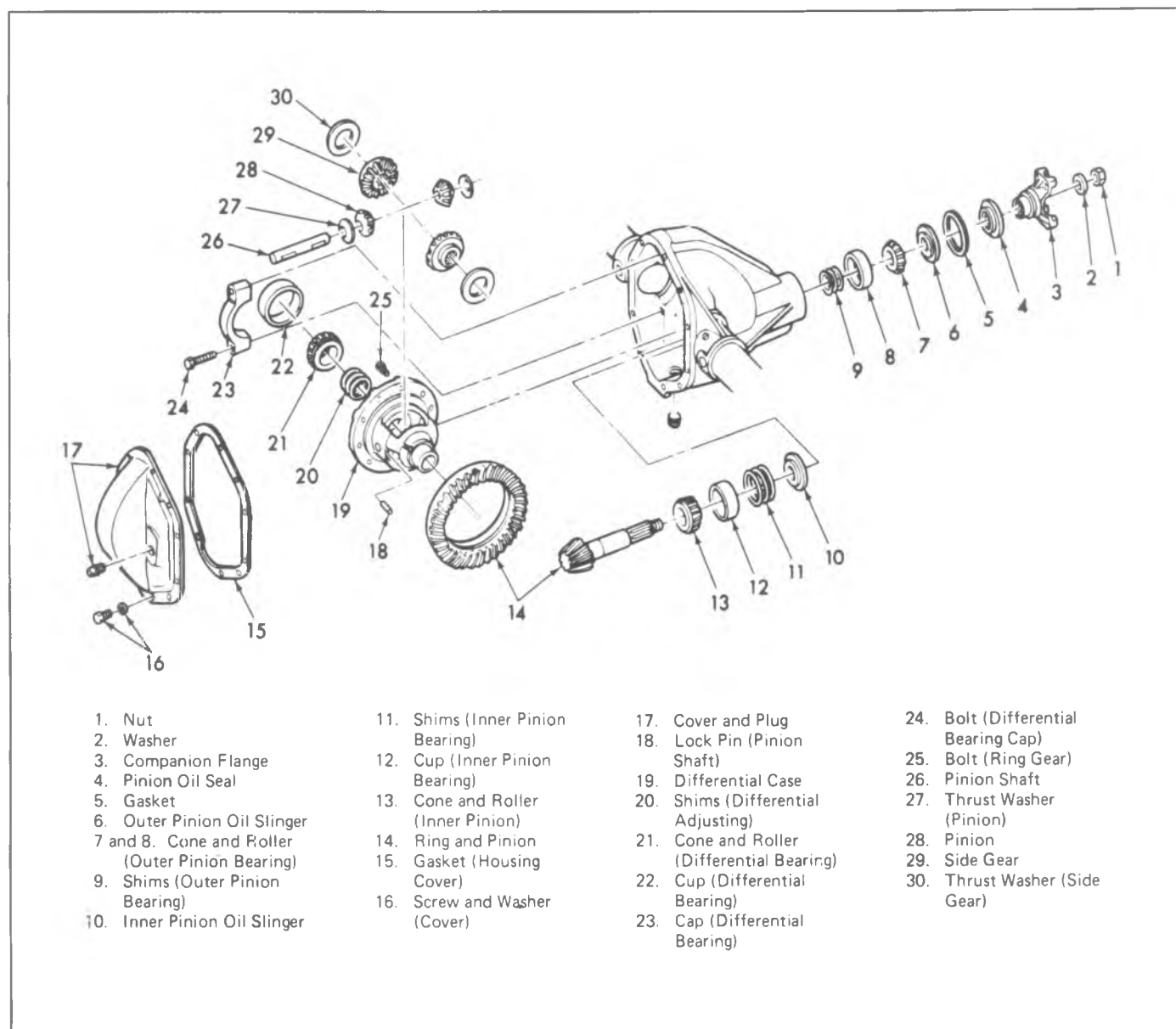


Fig. 4B-5--Dana 9-3/4" Ring Gear Axle Exploded View

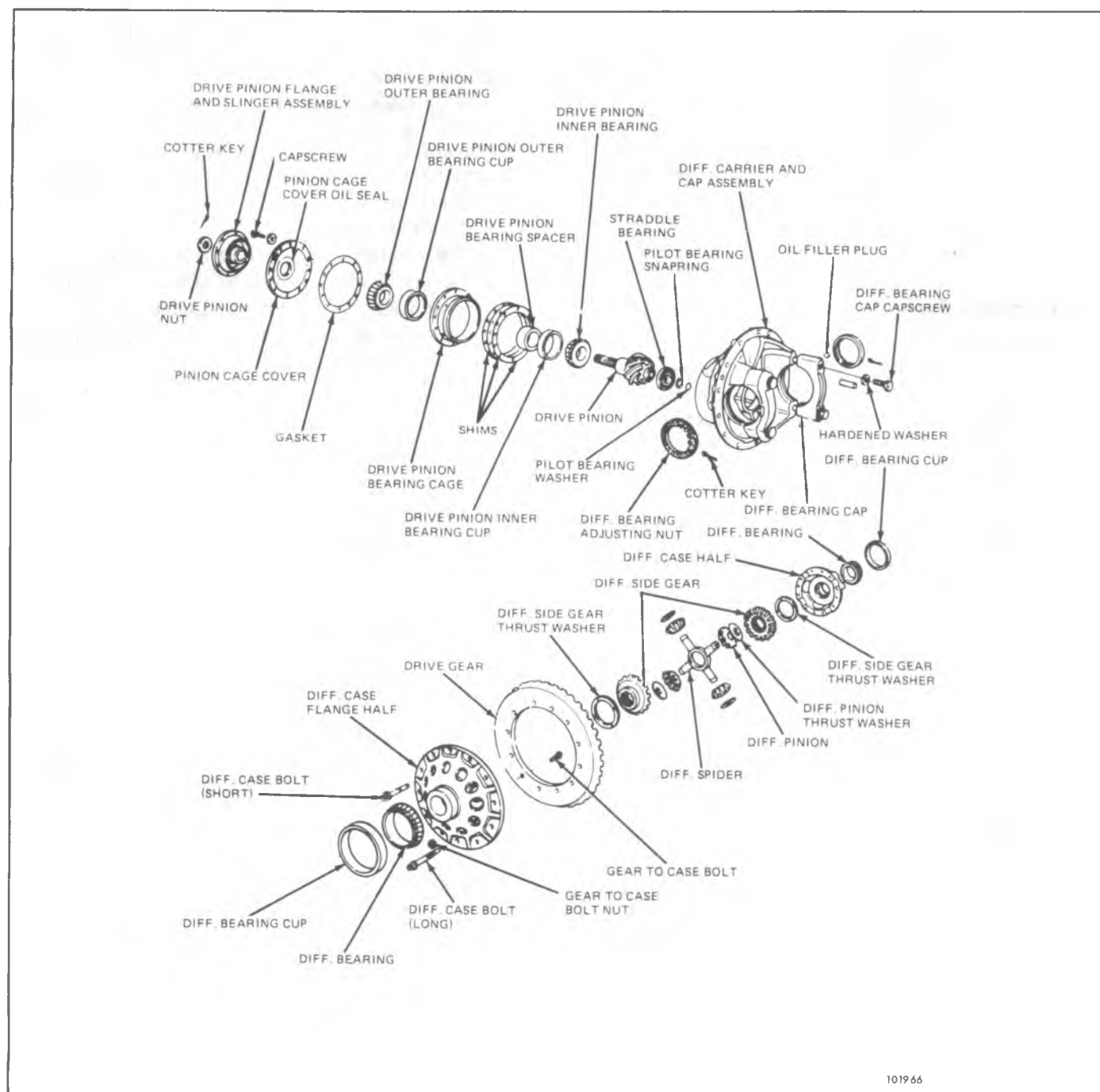


Fig. 4B-5a--Rockwell 12" Ring Gear Axle-11,000# Capacity

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 by 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.

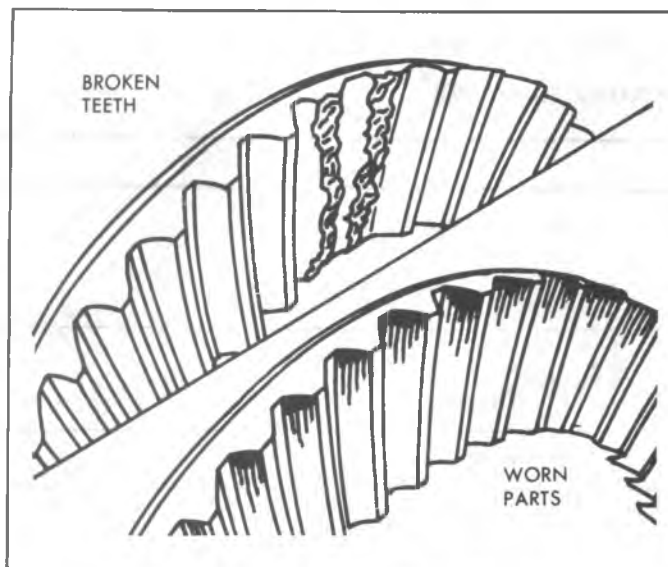


Fig. 4B-6--Two Causes of Gear Noise

For example, hypoid gear tooth scoring as seen in figure 4B-10 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 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.

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**.

**A GENERAL DIAGNOSTIC PROCEDURE FOR
ISOLATING REAR AXLE NOISE PROBLEMS**










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 car speed is lowered	3. Tire noise
4. Similar noise is produced with car 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	13. a) Wrong lube in differential 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.

 <p>ABRASIVE ROLLER WEAR</p> <p>PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p>GALLING</p> <p>METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD (WAGON'S)</p> <p>REPLACE BEARING - CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p>BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p>ABRASIVE STEP WEAR</p> <p>PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.</p>	 <p>ETCHING</p> <p>BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.</p> <p>REPLACE BEARINGS - CHECK SEALS AND CHECK FOR PROPER LUBRICATION.</p>	 <p>BENT CAGE</p> <p>CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.</p> <p>REPLACE BEARING.</p>
 <p>INDENTATIONS</p> <p>SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.</p> <p>CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.</p>	 <p>CAGE WEAR</p> <p>WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION.</p> <p>CLEAN RELATED PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS.</p>	 <p>MISALIGNMENT</p> <p>OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.</p> <p>CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.</p>

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

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

<u>EXAMPLE:</u>	<u>RAC</u>	<u>001</u>	<u>G</u>	<u>1</u>
<u>Axle & Vehicle Code</u>		<u>Day Code</u>	<u>Source Code</u>	<u>Shift Code</u>
		Jan. 1 = 001	C = Buffalo G = Gear & Axle K = GM of Canada W = Warren	1st Shift

Code is stamped on top of right axle tube outboard of carrier.

DANA AXLE

<u>EXAMPLE</u>	<u>603560-1</u>	<u>9</u>	<u>29</u>	<u>0</u>	<u>B</u>	<u>4</u>
<u>DANA P/N</u>	<u>MONTH CODE</u>	<u>DAY CODE</u>	<u>MODEL YEAR</u>	<u>SHIFT CODE</u>	<u>PRODUCTION LINE CODE</u>	

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.

101965

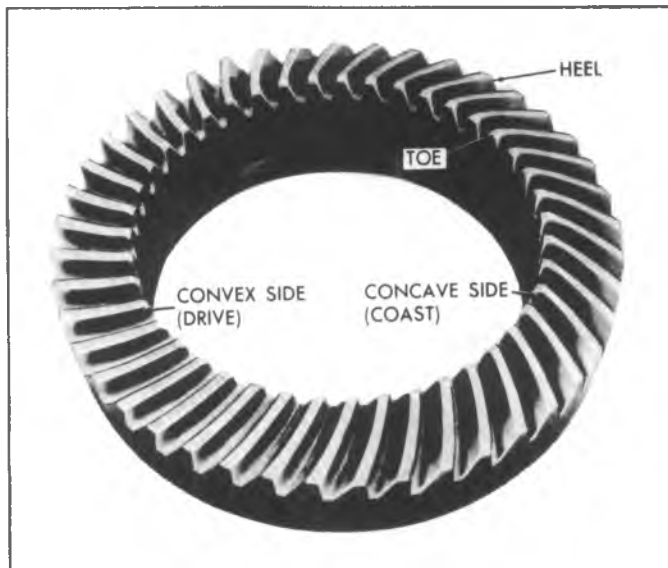


Fig. 4B-8--Gear Tooth Nomenclature

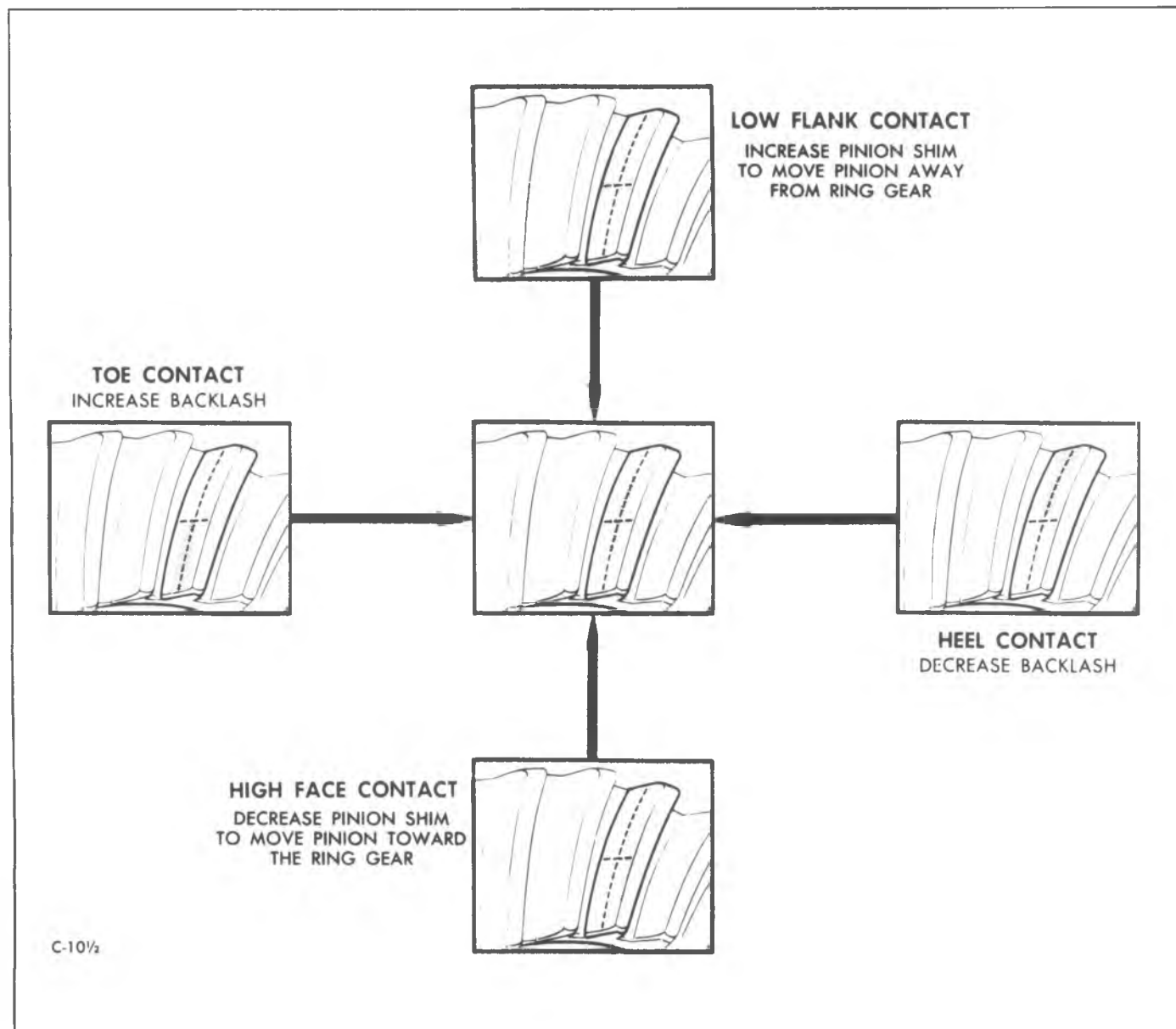


Fig. 4B-9--Gear Tooth Contact Pattern Check

SECTION 4B1

8-1/2" and 8-7/8" 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 Section 5.
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.

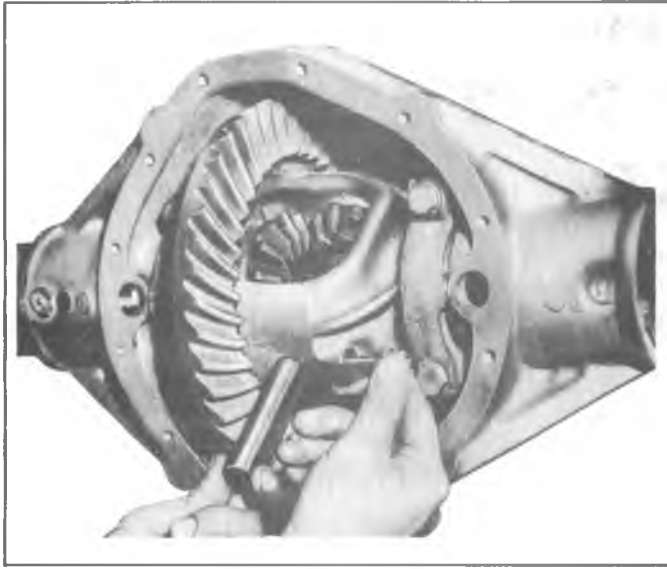


Fig. 4B1-1--Differential Pinion Shaft Removal

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.
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 8-7/8" ring gears and Eaton Locking differentials use a thrust block on the pinion shaft



Fig. 4B1-2--Removing Lock Screw

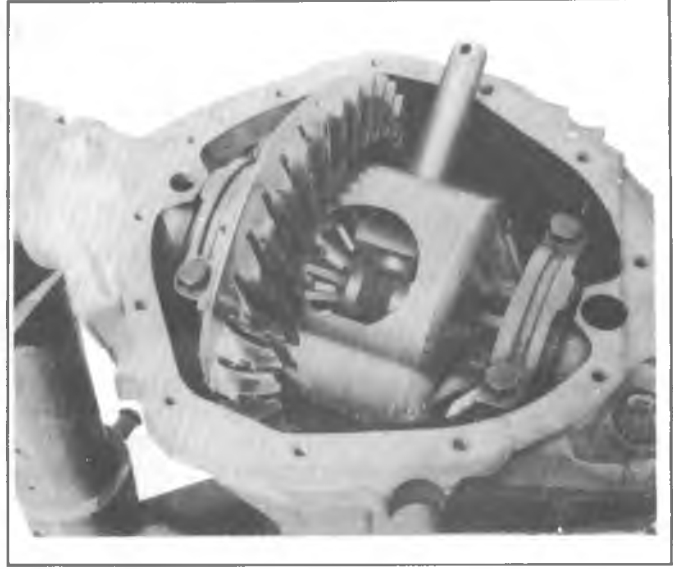


Fig. 4B1-3--Positioning Case For Best Clearance

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.
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.
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.

Do not force or hammer the axle shaft in an attempt to gain clearance.

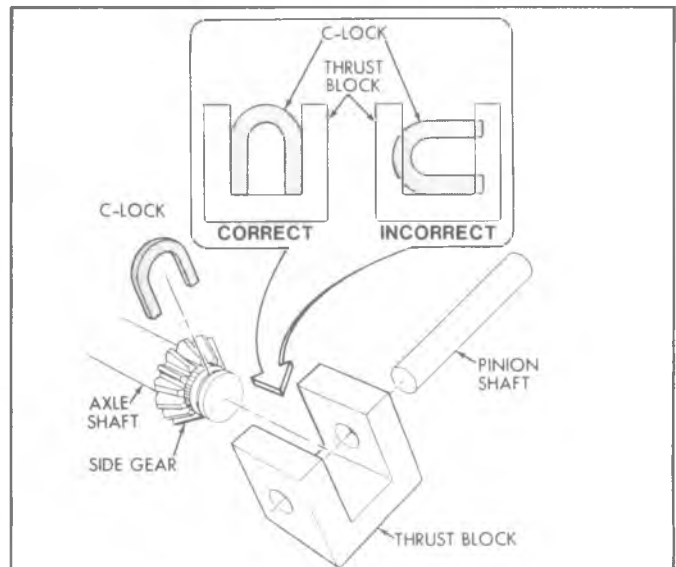


Fig. 4B1-4--Correct C-Lock Position

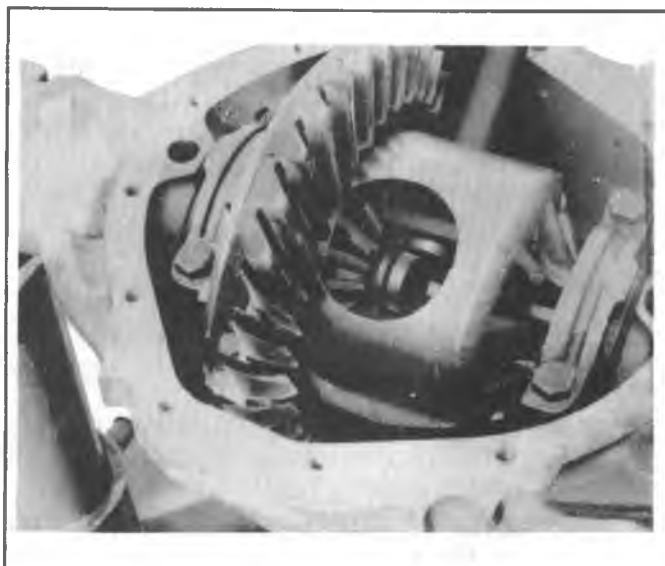


Fig. 4B1-5--Push Axle Shaft Inward

Remove the axle shaft and repeat steps 5 and 6 for the opposite axle shaft.

7. When installing C-locks keep the pinion shaft partially withdrawn. Place the C-lock in the same position shown in figure 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 and lock screw.

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 bearing 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

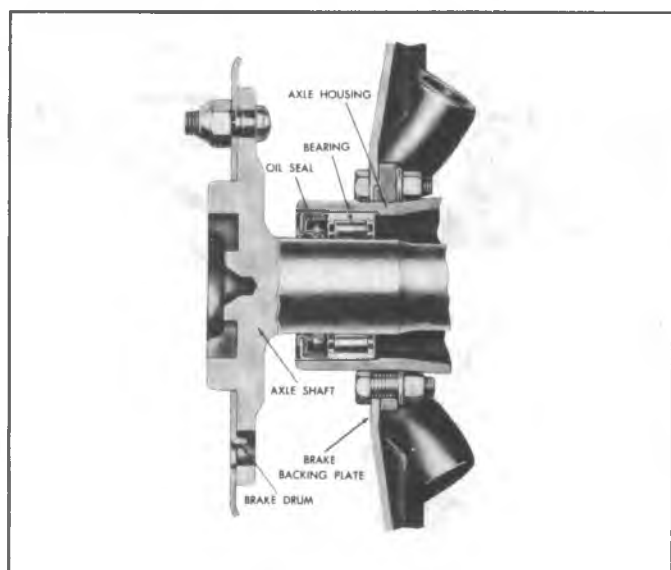


Fig. 4B1-6--Oil Seal and Wheel Bearing

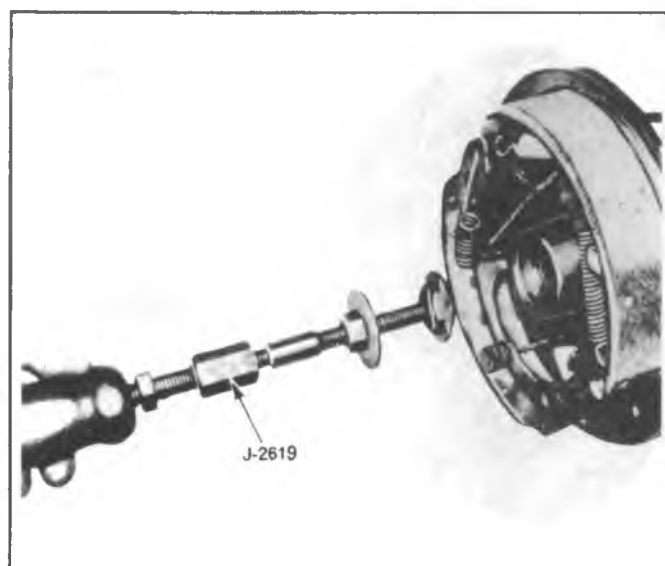


Fig. 4B1-7--Wheel Bearing Removal

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. See 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.

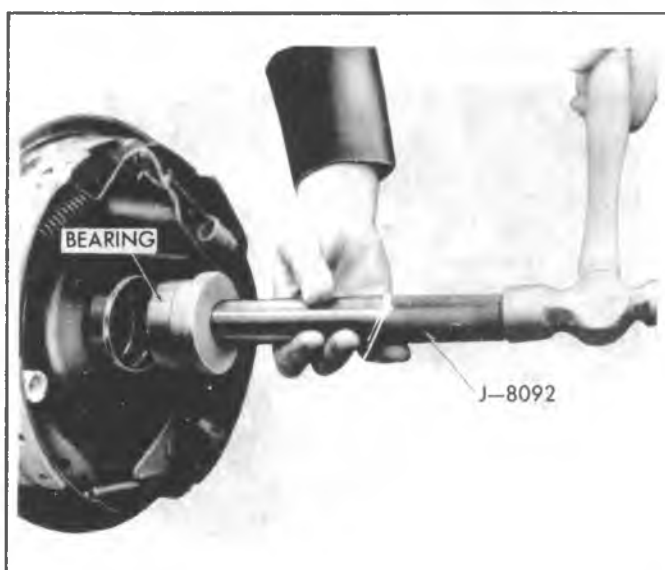


Fig. 4B1-8--Wheel Bearing Installation

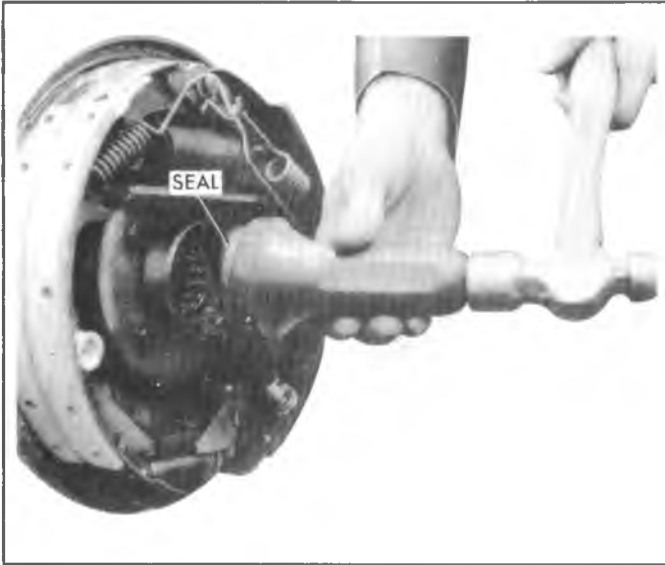


Fig. 4B1-9--Seal Installation

2. 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.
3. Position differential pinion shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw.
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 Section 0B 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 Section 5 for brake disassembly procedure.

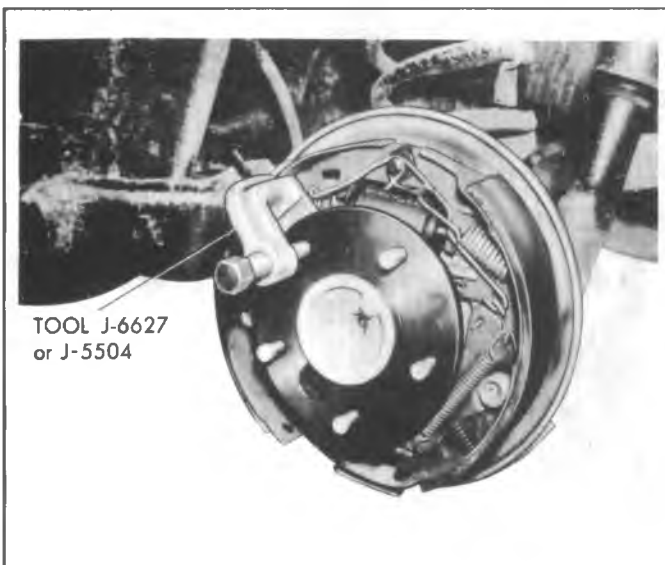


Fig. 4B1-10--Pressing Out Wheel Stud

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. See Section 5 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



Fig. 4B1-11--Measuring Pinion Rotating Torque

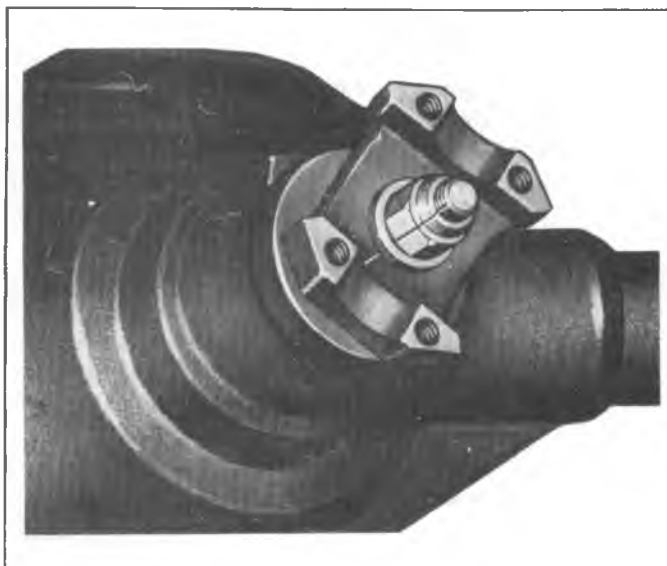


Fig. 4B1-12--Scribe Marks

for later reference. See figure 4B1-12.

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

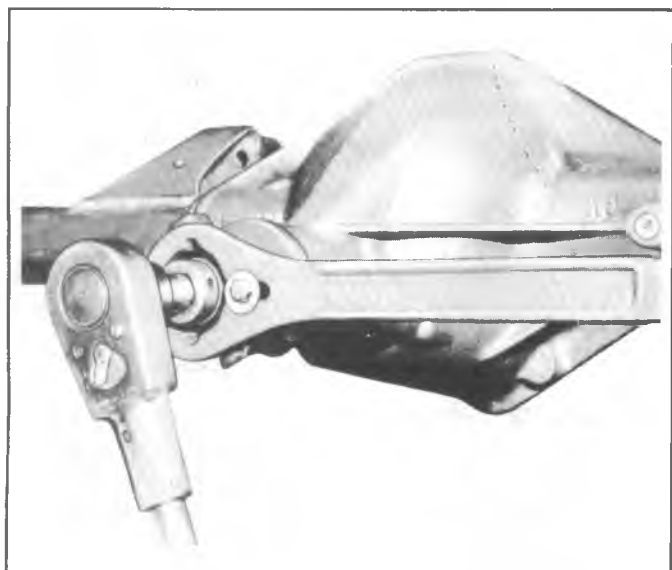


Fig. 4B1-13--Removing Nut from Drive Pinion

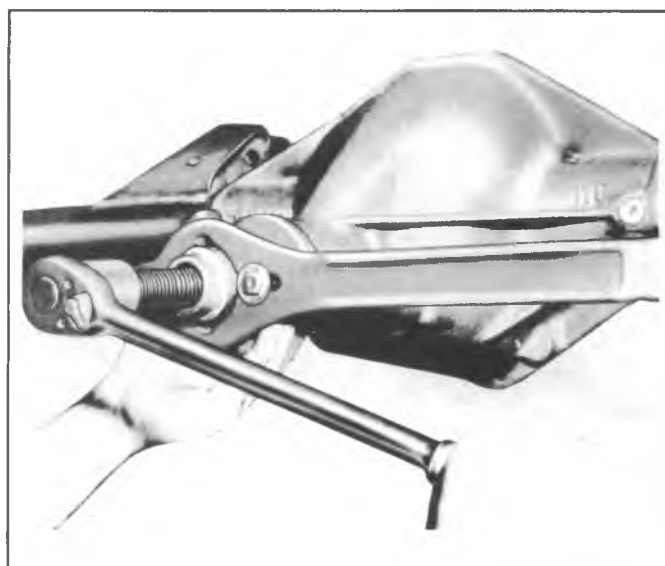


Fig. 4B1-14--Drive Pinion Flange Removal

new deflector, and stake deflector at three new equally spaced positions. 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

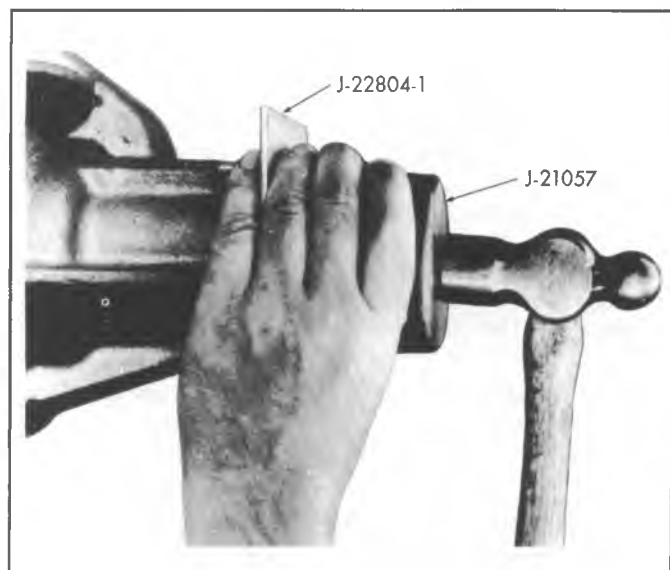


Fig. 4B1-15--Pinion Oil Seal Installation

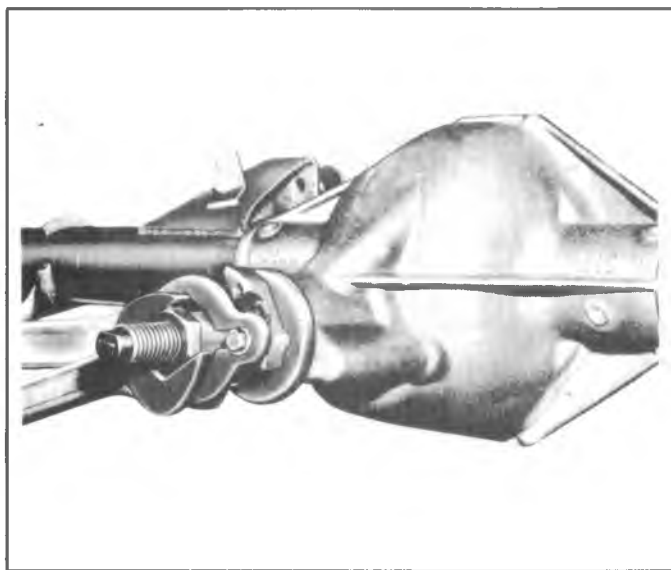


Fig. 4B1-16--Installing Pinion Flange

Permatex Type A or equivalent) prior to installing 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 (1-5 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

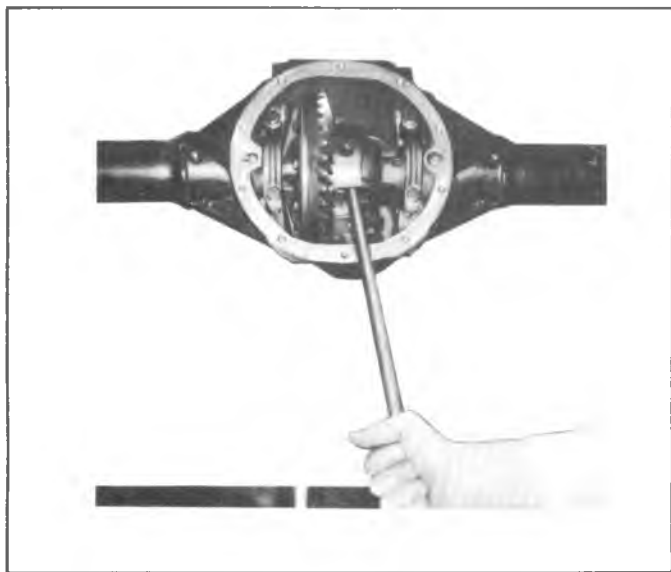


Fig. 4B1-17--Differential Case Removal

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 3B.
2. Tighten puller screw to remove bearing.

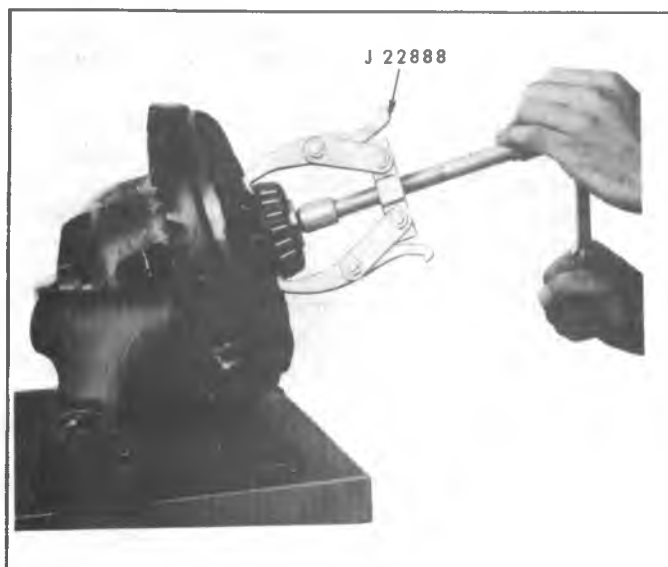


Fig. 4B1-18--Differential Bearing Removal

3. Place new bearing on hub with thick side of inner race toward case and drive into place, using J-22175 for 8-7/8" or 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

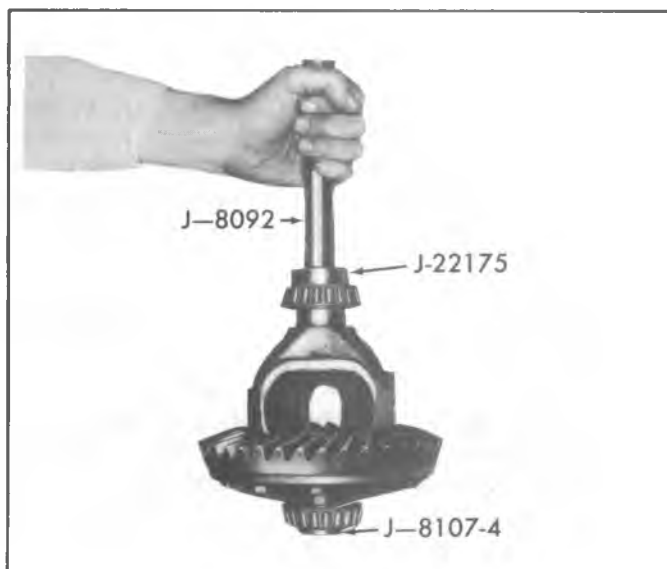


Fig. 4B1-19--Differential Bearing Installation

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 and 8 7/8" 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" and 8 7/8" 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

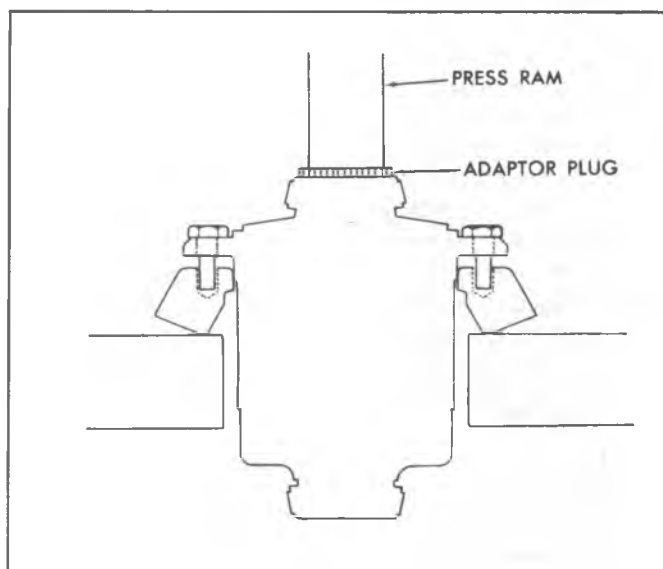


Fig. 4B1-20--Ring Gear-to-Case Installation

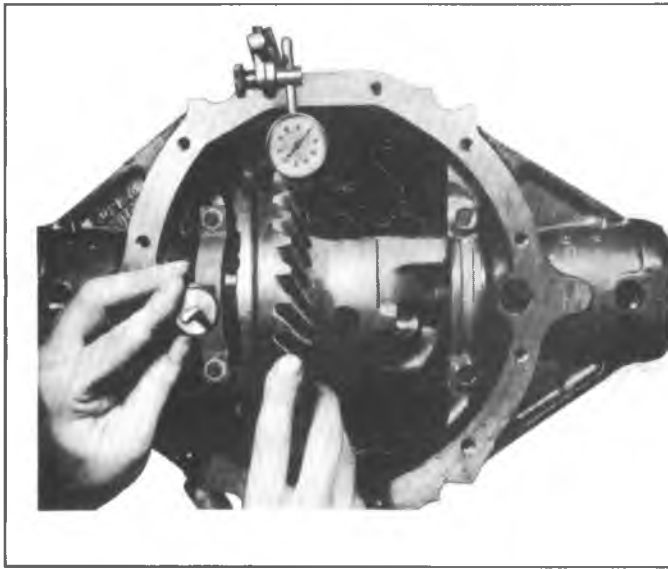


Fig. 4B1-21--Installing Gaging Tool

housing as shown in figure 4B1-21.

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.

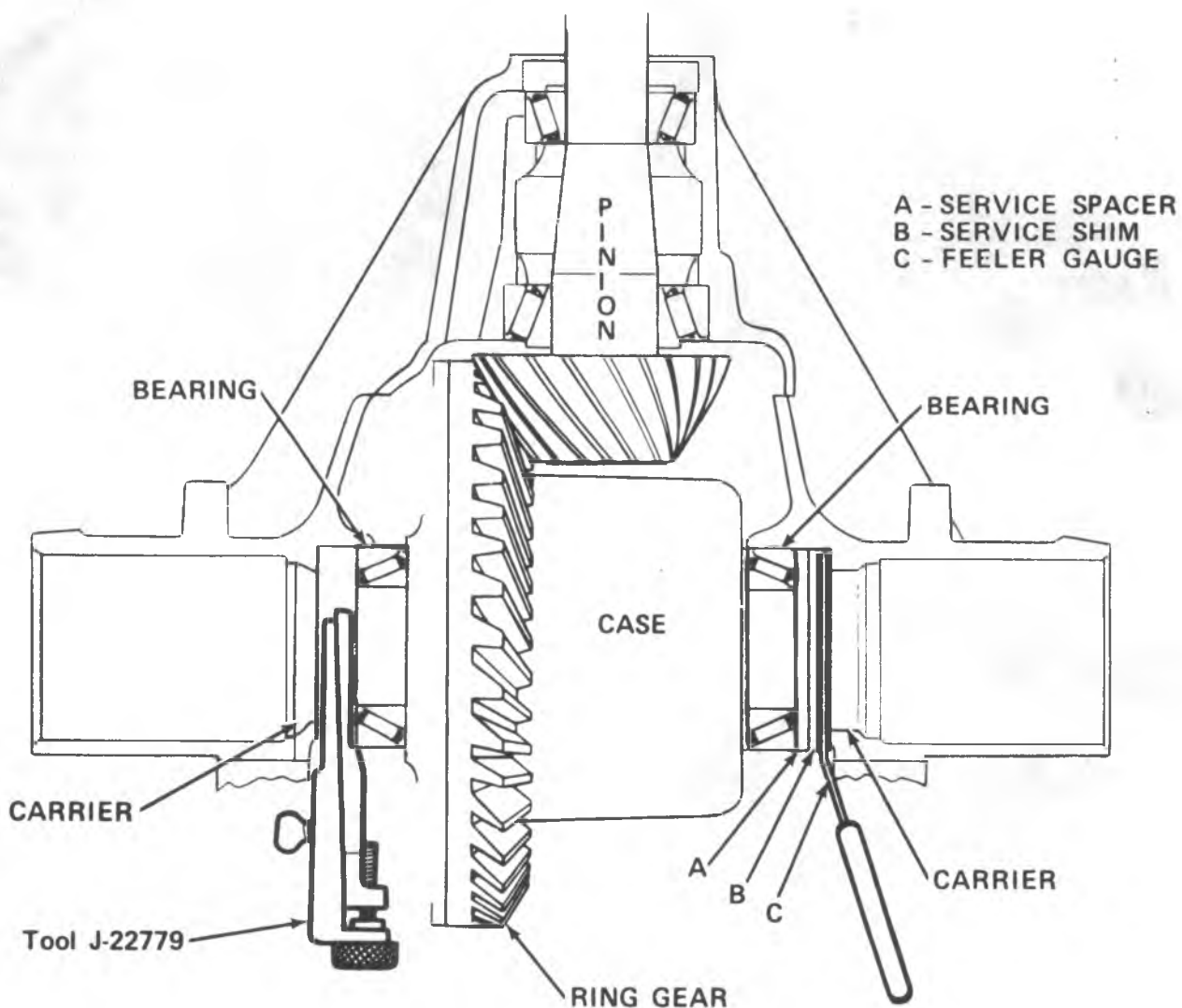
13. Mount a dial indicator on the carrier and check the backlash between the ring gear and pinion, as shown in figure 4B1-25. The backlash should be within the range of 0.005"-0.008". Check gear lash at four different equally spaced positions around the gear. Variation in readings should not exceed .001". 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 4.34 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

Thickness of Tool J-22779
required to force ring
gear into contact with
pinion

.250"

OPPOSITE SIDE

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

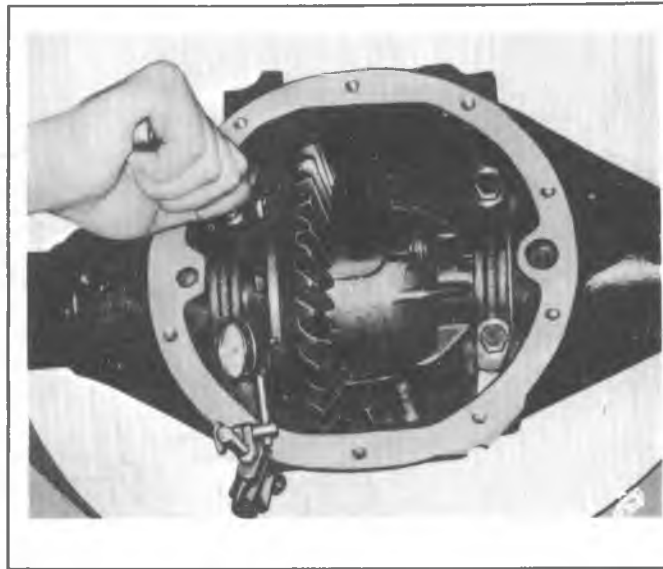


Fig. 4B1-26--Checking Ring Gear Runout

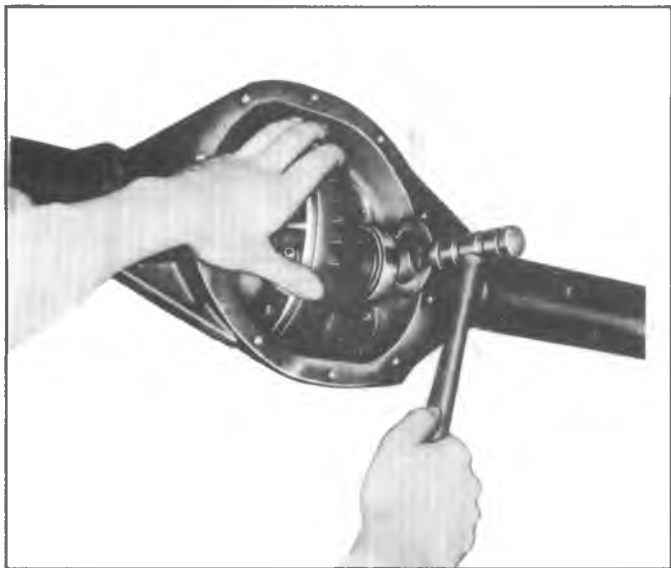


Fig. 4B1-24--Installing Differential Shim

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

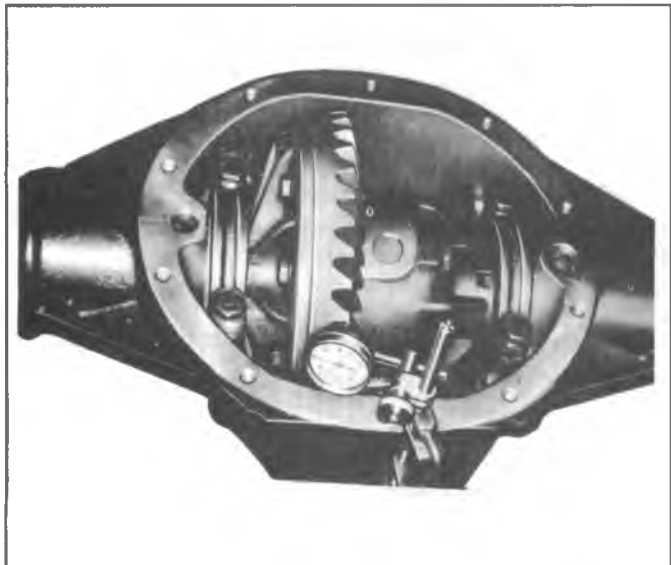


Fig. 4B1-25--Checking Ring Gear Backlash

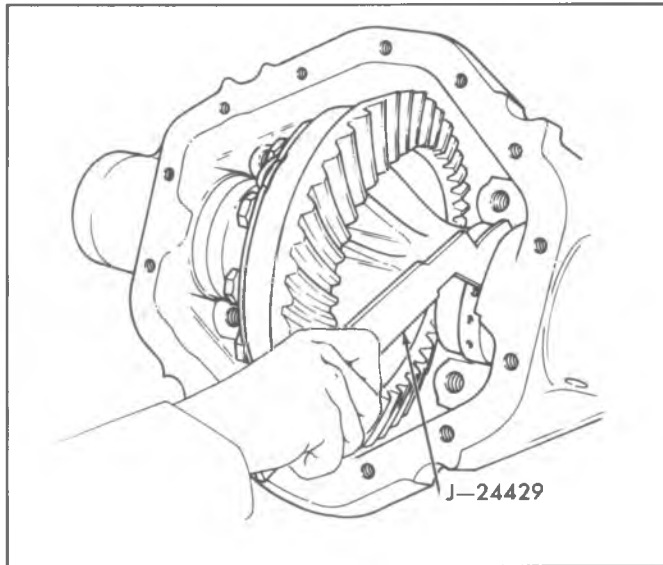


Fig. 4B1-27--Loosening Adjusting Nut

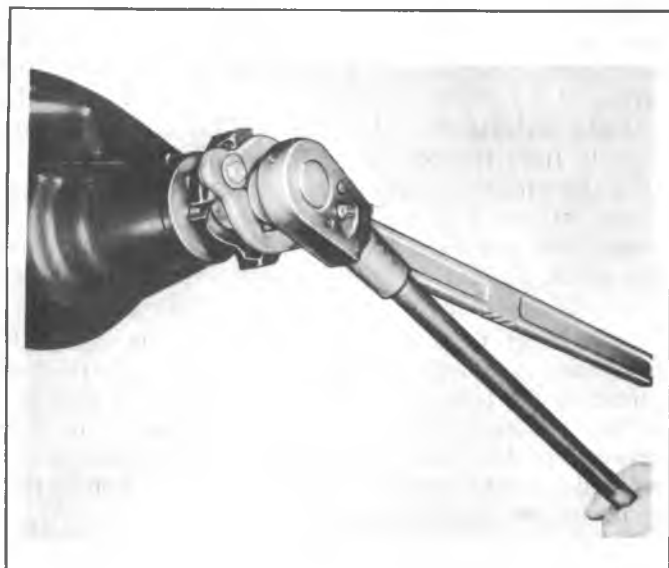


Fig. 4B1-28--Drive Pinion Nut Removal

J-8614-3 while holding J-8614-11 as shown in figure 4B1-29.

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.

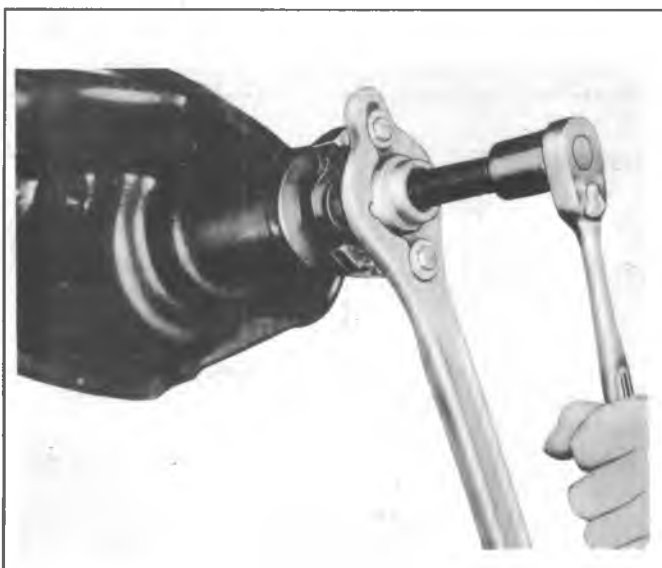


Fig. 4B1-29--Drive Pinion Flange Removal

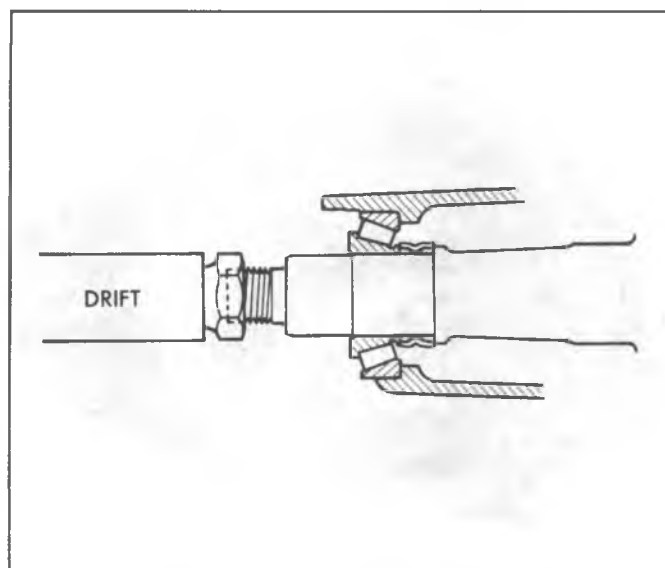


Fig. 4B1-30--Removing Drive Pinion

Bearing Removal and Cup Replacement

1. If front pinion bearing is to be replaced, drive outer race from carrier using a drift in slots 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 for 8-7/8" 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

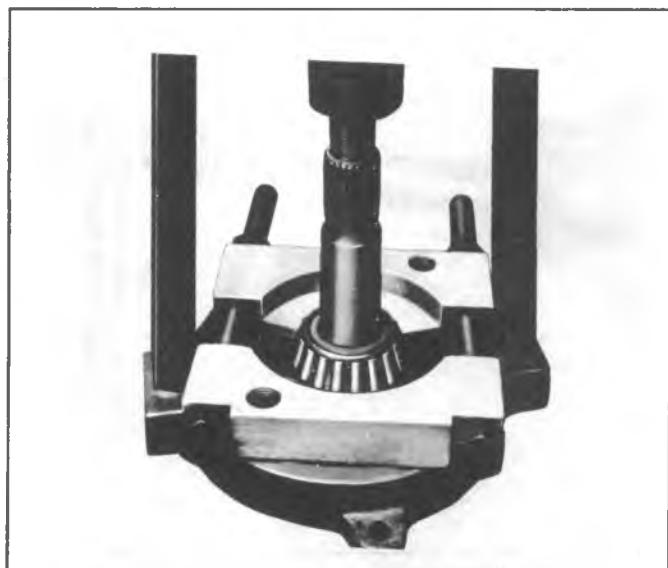


Fig. 4B1-31--Removing Drive Pinion Rear Bearing

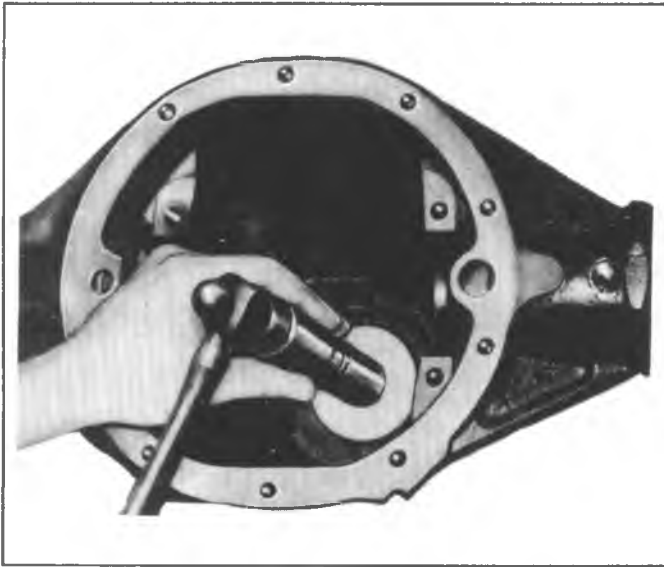


Fig. 4B1-32--Installing Pinion Rear Bearing Cup

for nicks. Remove as necessary. Clean the bores and the installation tools.

5. Lubricate both bearing cups with liberal amounts of 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-0270-14 for the 8-7/8" ring gear or 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 or J-7137 for the 8-7/8" ring gear or 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

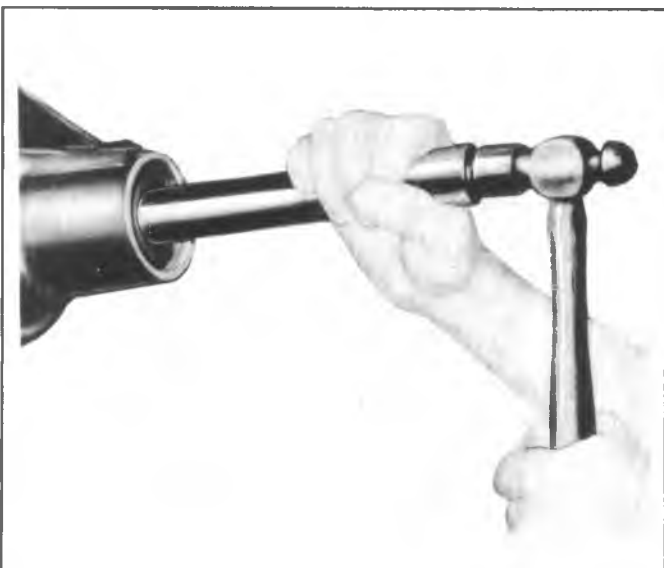


Fig. 4B1-33--Installing Pinion Front Bearing Cup

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 having 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 or J-21777-36 for 8-7/8" ring gear or 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 bearing 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.

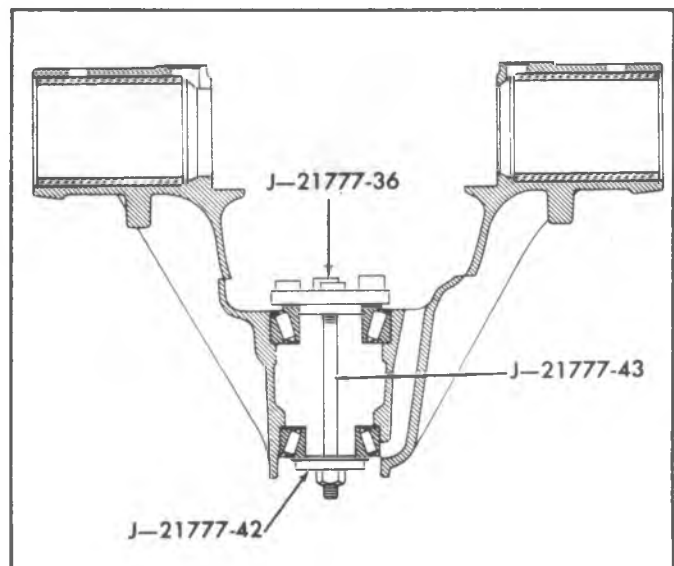


Fig. 4B1-34--Gage Plate Installed

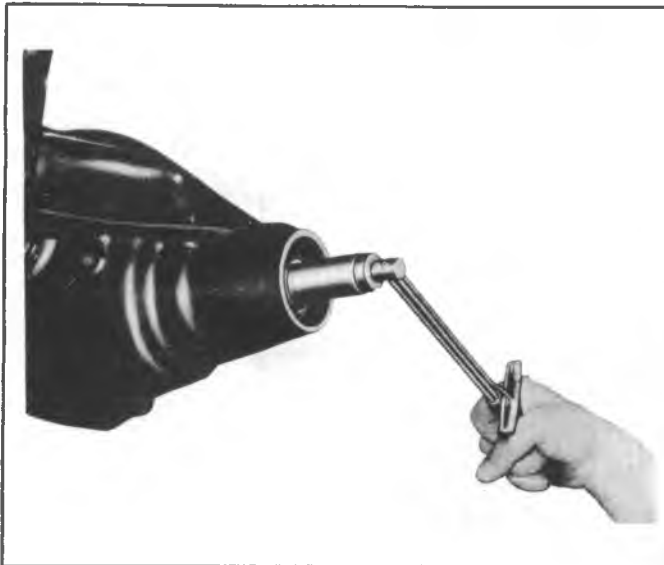


Fig. 4B1-35--Measuring Rotating Torque

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 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. See figure 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 or J-5590 for the 8-7/8" ring gear or 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 8-7/8" ring gear position seal in bore and place gage plate J-22804-2 over seal and against flange. Gage plate insures proper seating of seal in carrier bore. See figure 4B1-39. Use J-23911 to press seal into bore until gage plate is flush with the carrier shoulder and seal flange. Turn gage plate 180°; seal must be square in carrier to seal properly.

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.

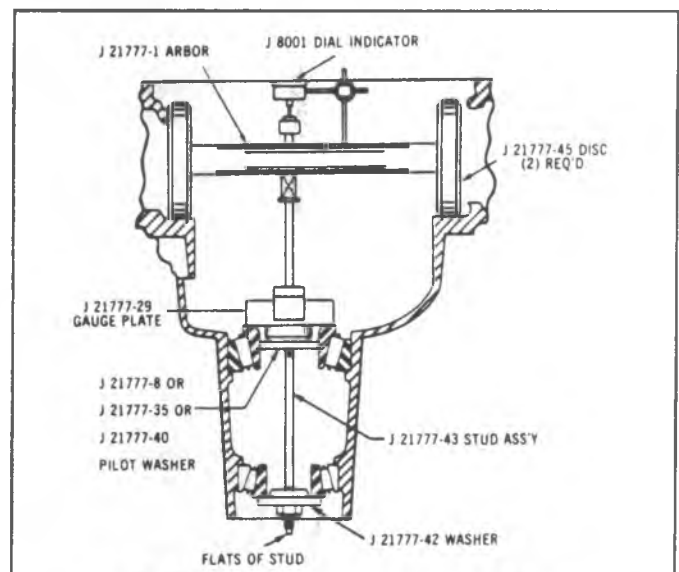


Fig. 4B1-36--Gaging Tools Installed in Carrier

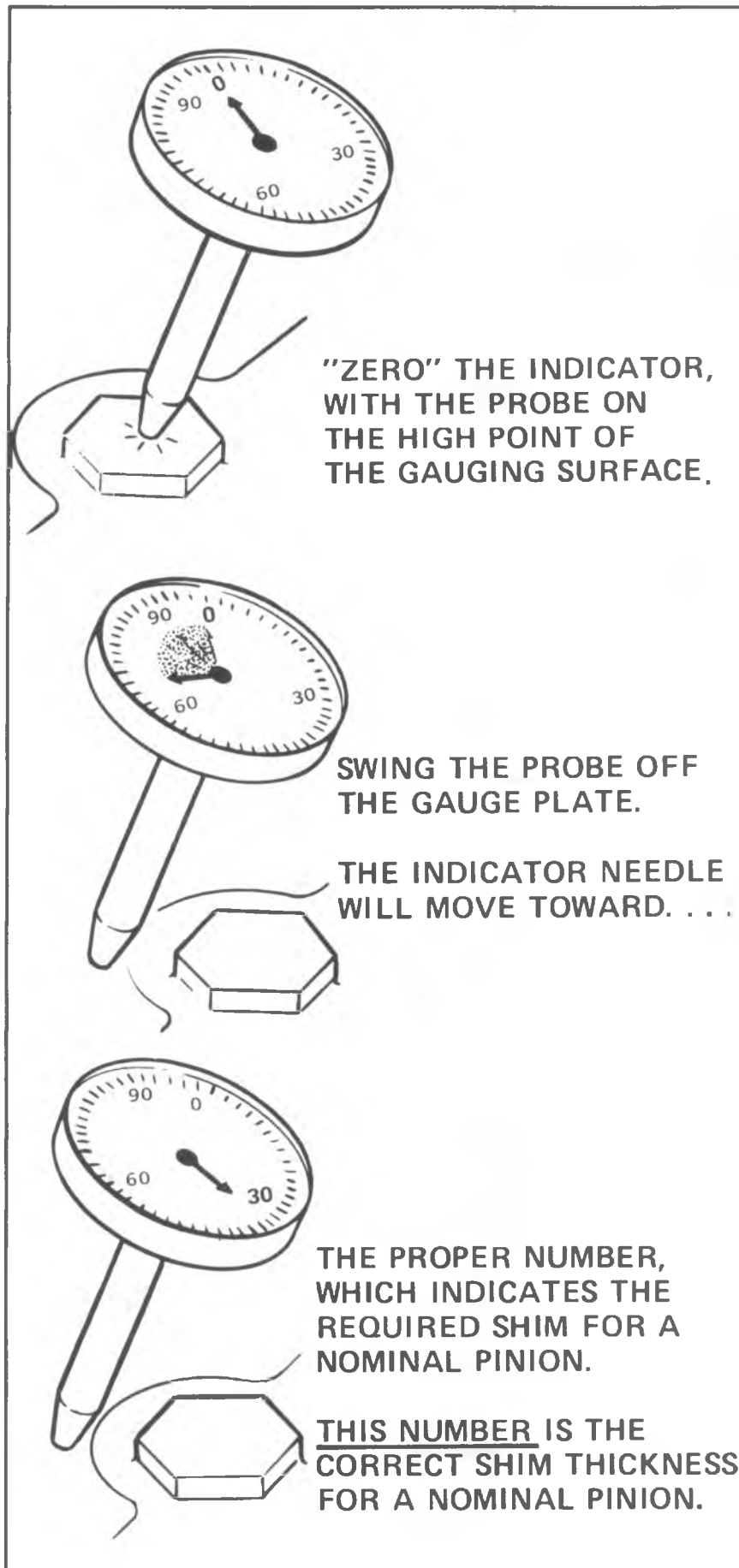


Fig. 4B1-37--Use of Dial Indicator



Fig. 4B1-38--Installing Rear Bearing

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.
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

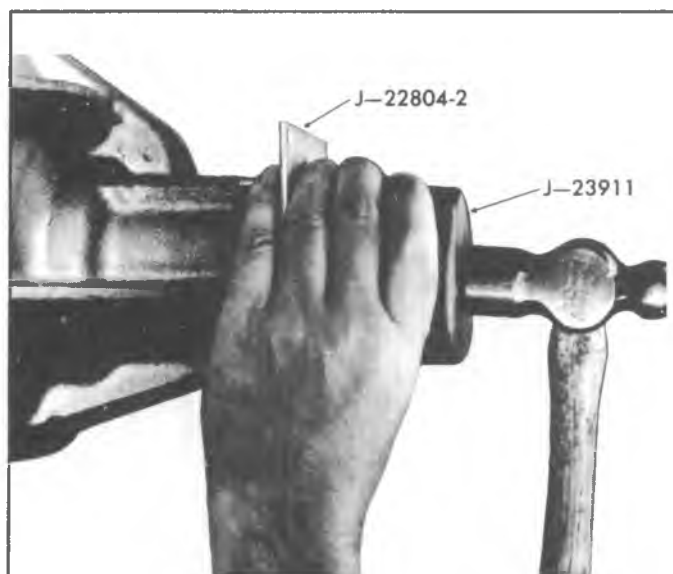


Fig. 4B1-39--Installing Pinion Oil Seal

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.

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) 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.

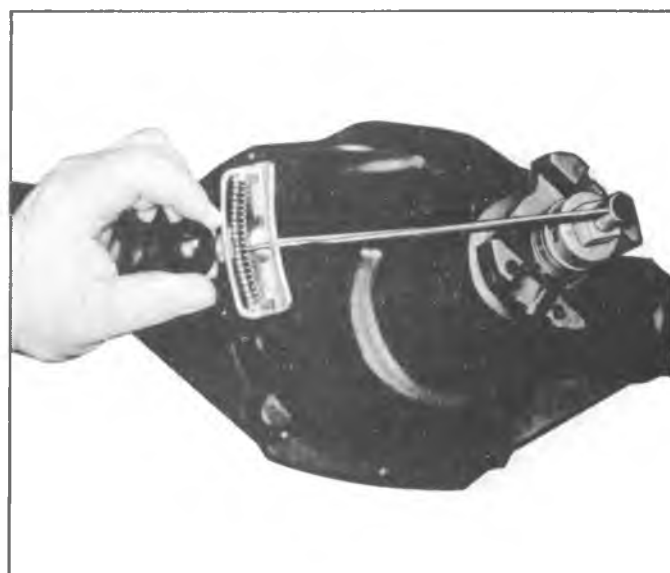
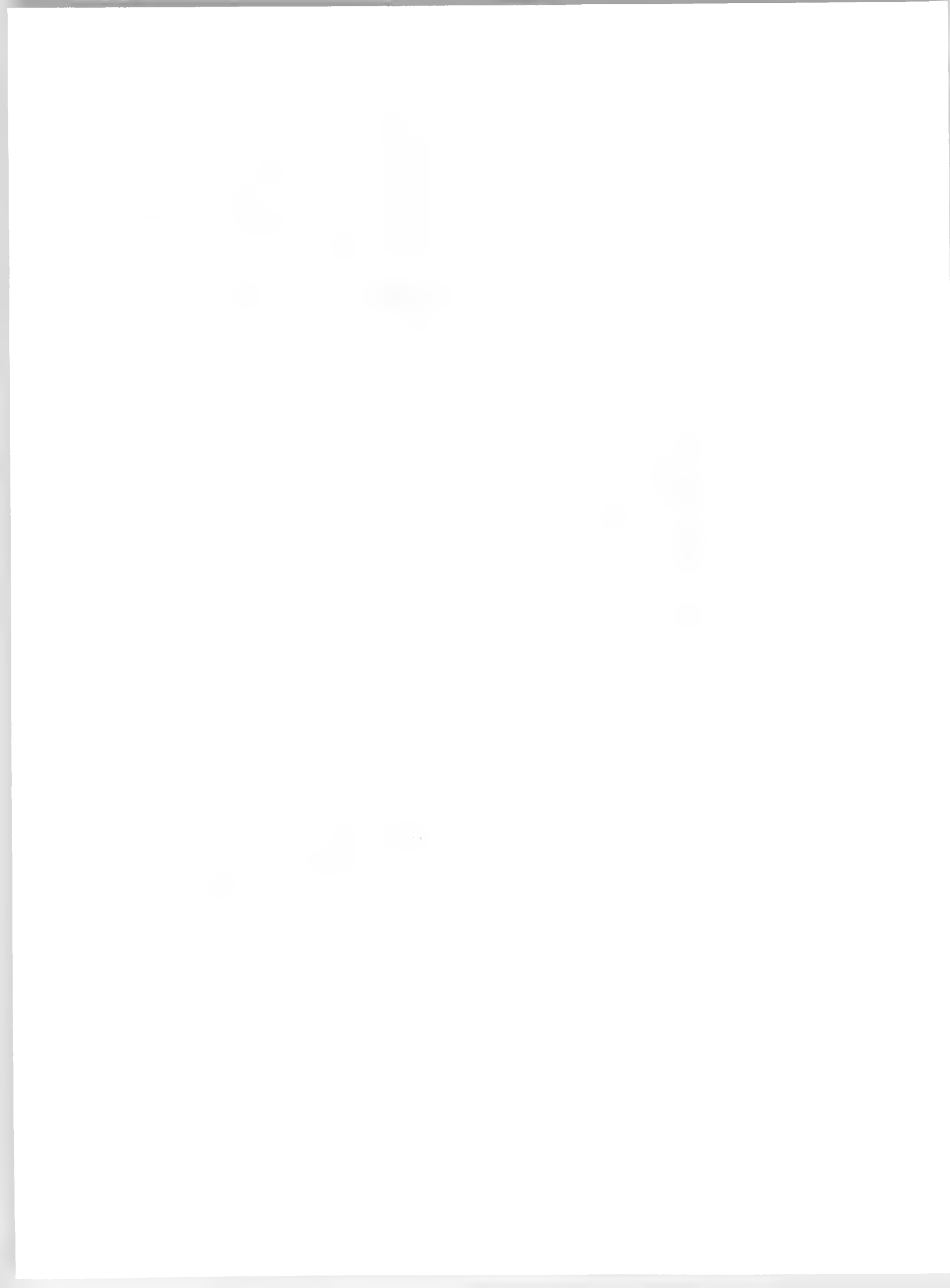


Fig. 4B1-40--Measuring Rotating Torque



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.

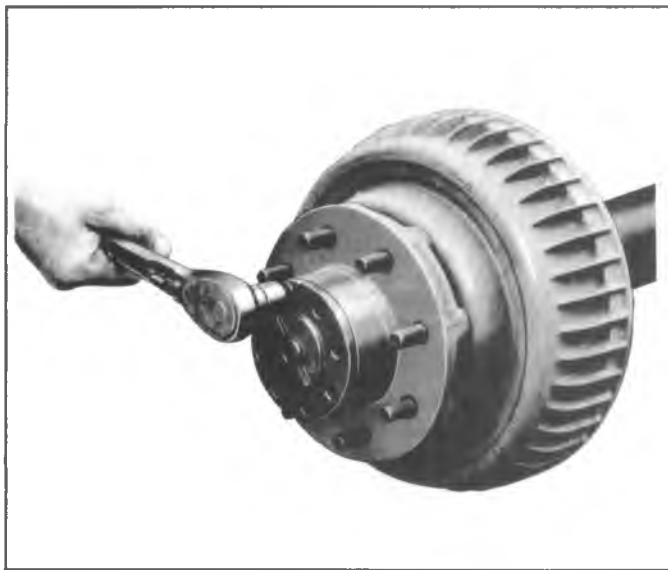
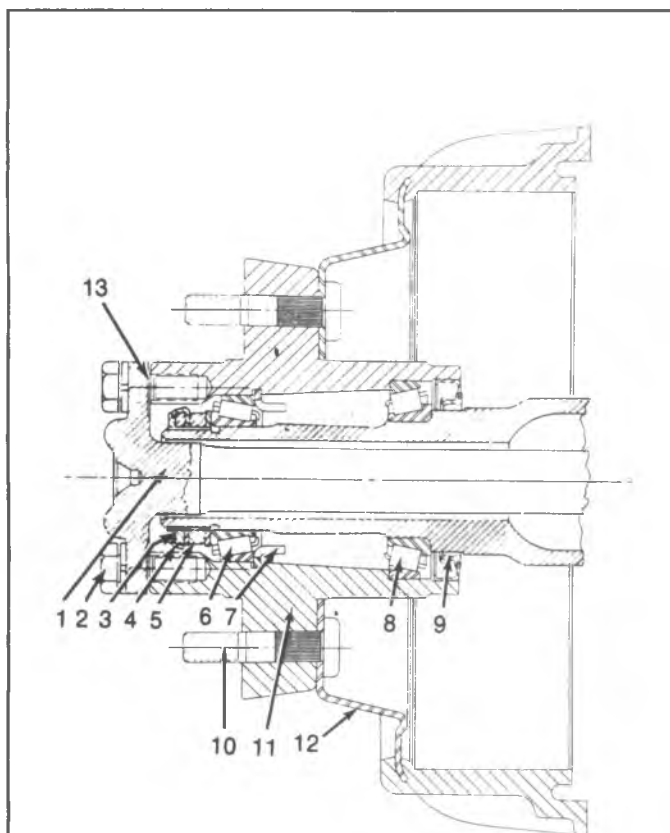


Fig. 4B2-1--Removing Flange-to-Hub Bolts



- | | |
|----------------------|----------------------|
| 1. Axle Shaft | 8. Hub Inner Bearing |
| 2. Shaft-to-Hub Bolt | 9. Oil Seal |
| 3. Retainer | 10. Wheel Bolt |
| 4. Key | 11. Hub Assembly |
| 5. Adjusting Nut | 12. Drum Assembly |
| 6. Hub Outer Bearing | 13. R.T.V. |
| 7. Snap Ring | |

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.

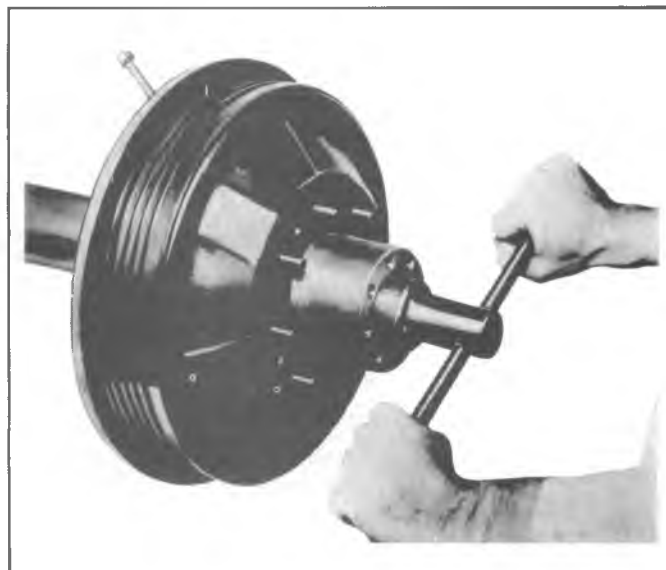


Fig. 4B2-3--Removing Lock Nut-Typical



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.

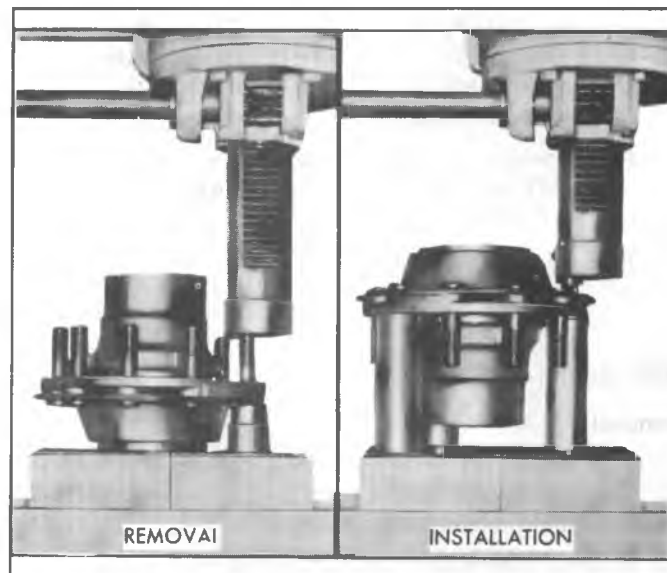


Fig. 4B2-5--Wheel Bolt Replacement

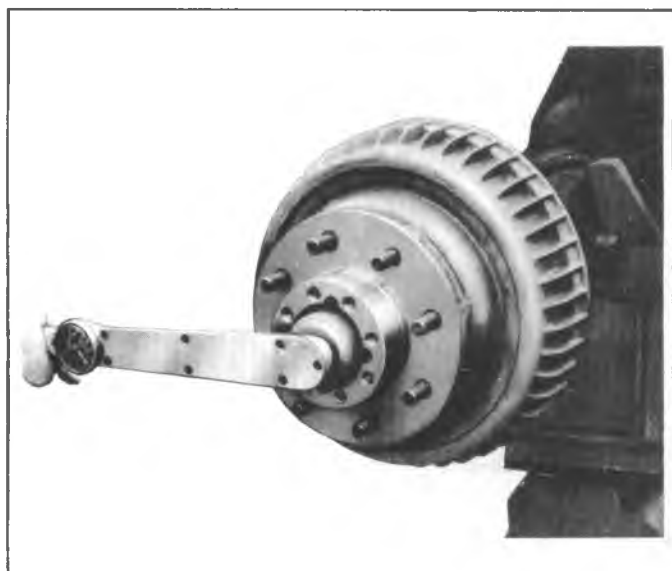


Fig. 4B2-6--Tightening Adjusting Nut-Typical

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.

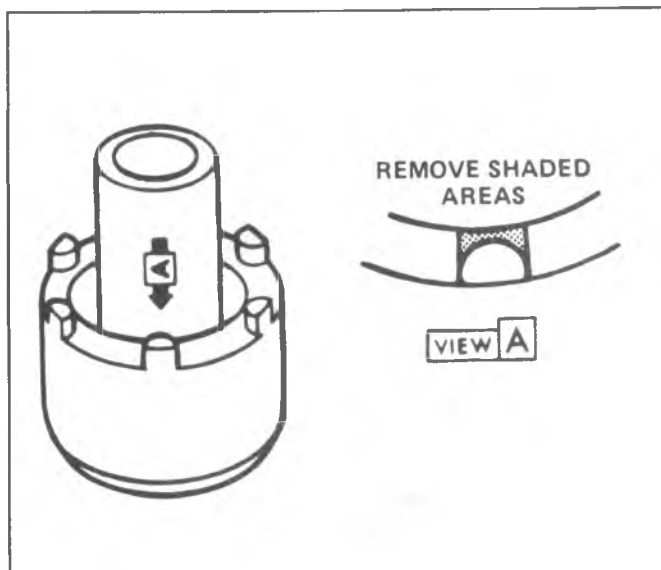


Fig. 4B2-7--Wheel Bearing Adjusting Tool

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

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.

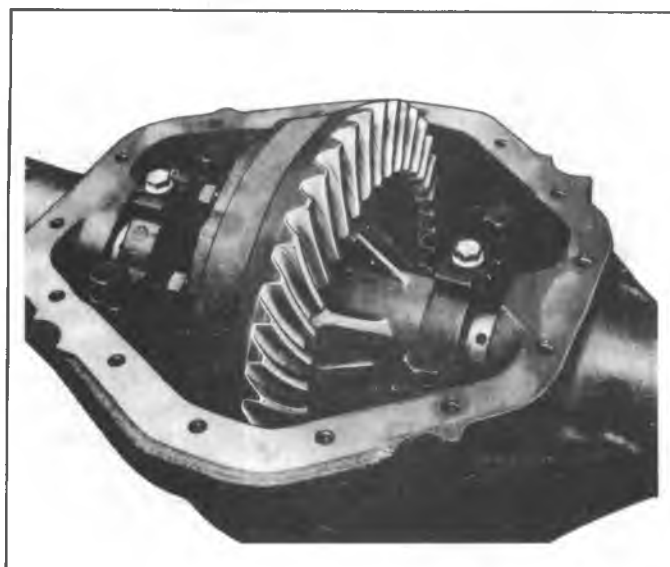


Fig. 4B2-8--Cover Removed from Carrier

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.

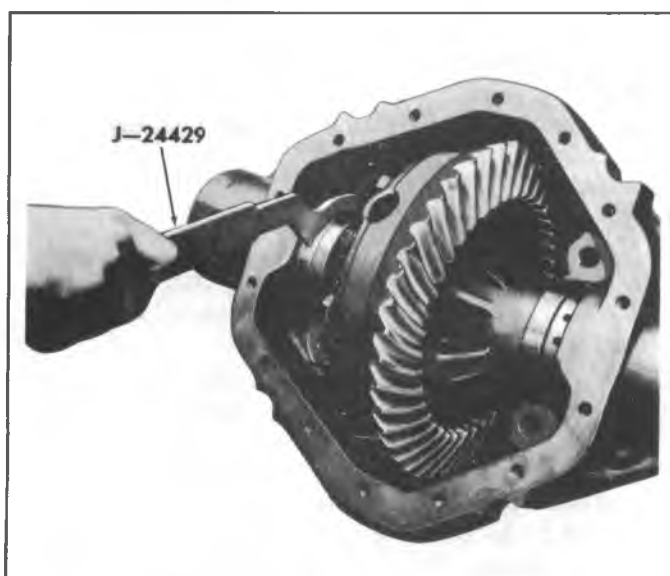


Fig. 4B2-9--Loosening Adjusting Nuts

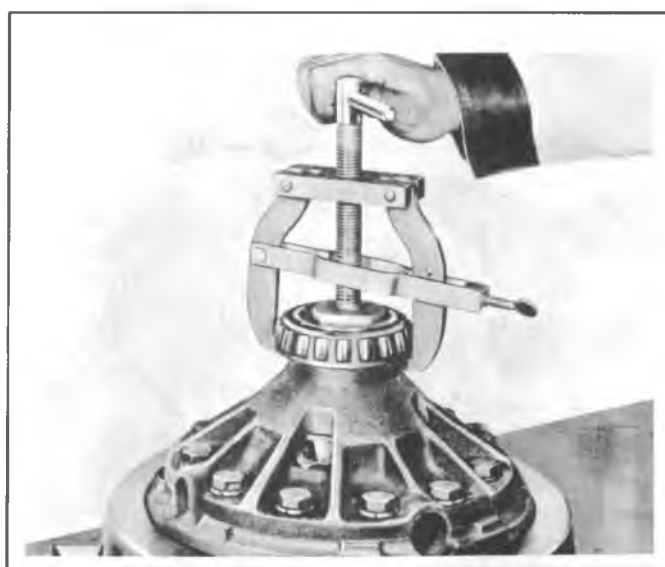


Fig. 4B2-10--Differential Bearing Removal

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

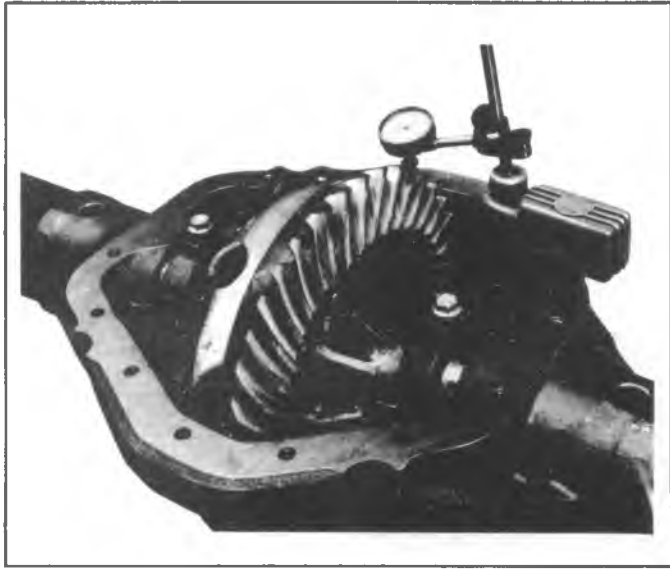


Fig. 4B2-12--Measuring Backlash

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

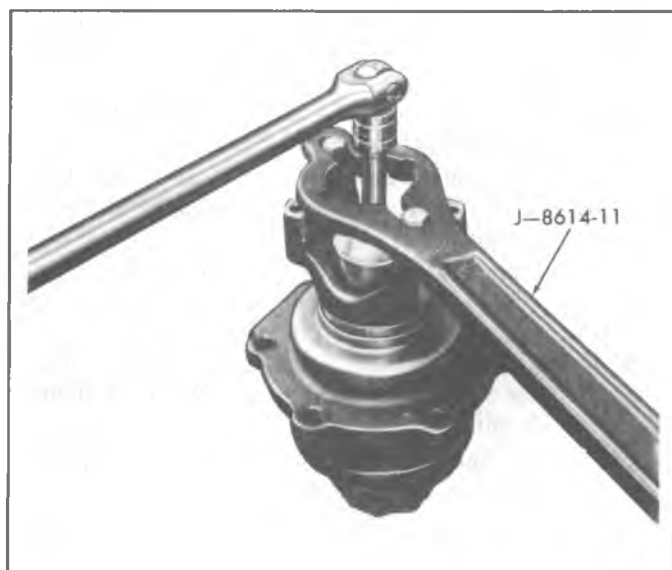


Fig. 4B2-14--Removing Pinion Nut

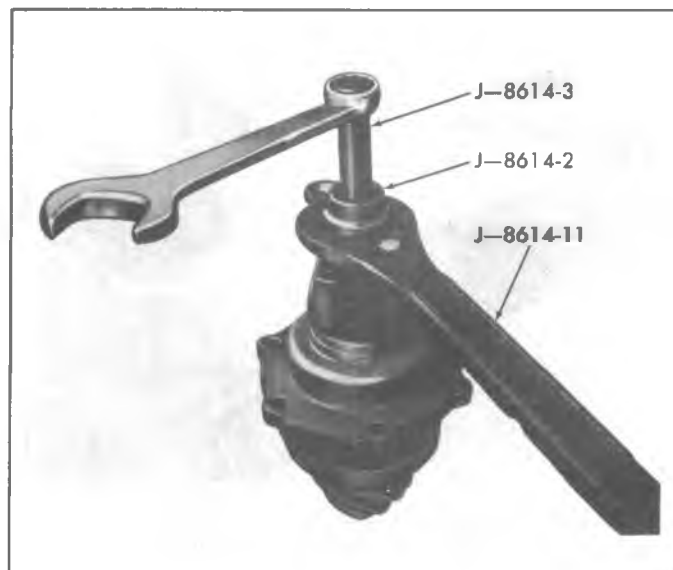


Fig. 4B2-15--Removing Flange



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 retainer 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.

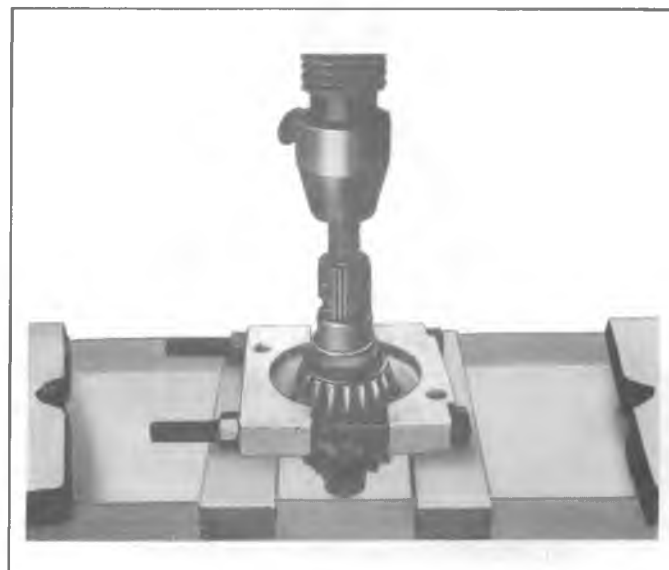


Fig. 4B2-17--Removing Pinion Rear Bearing

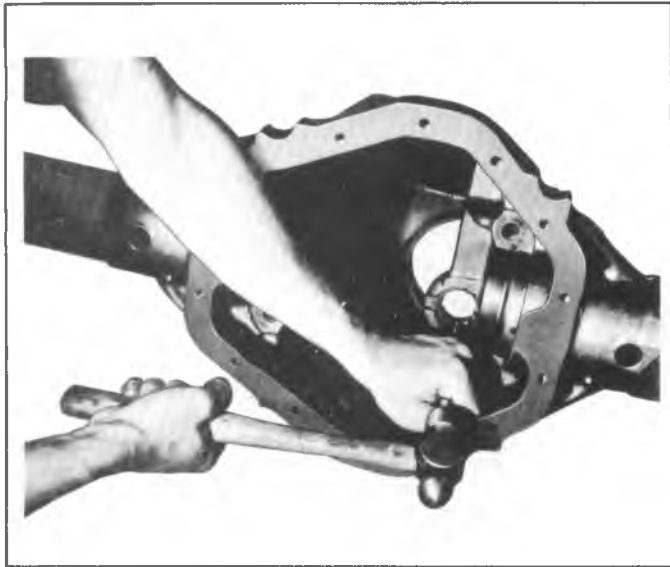


Fig. 4B2-18--Removing Straddle Bearing

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

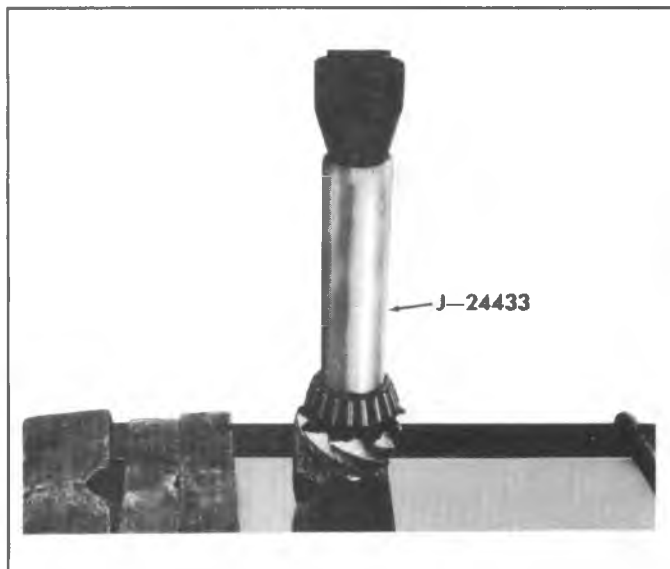


Fig. 4B2-19--Installing Pinion Rear Bearing

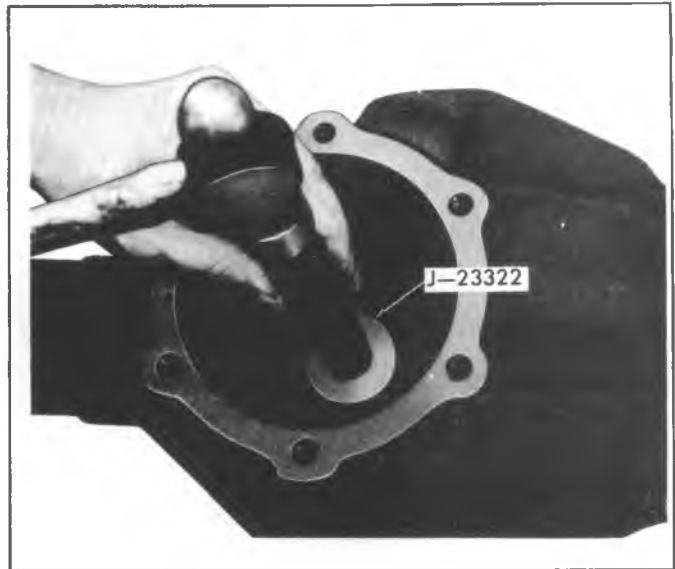


Fig. 4B2-20--Installing Straddle Bearing

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.

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.

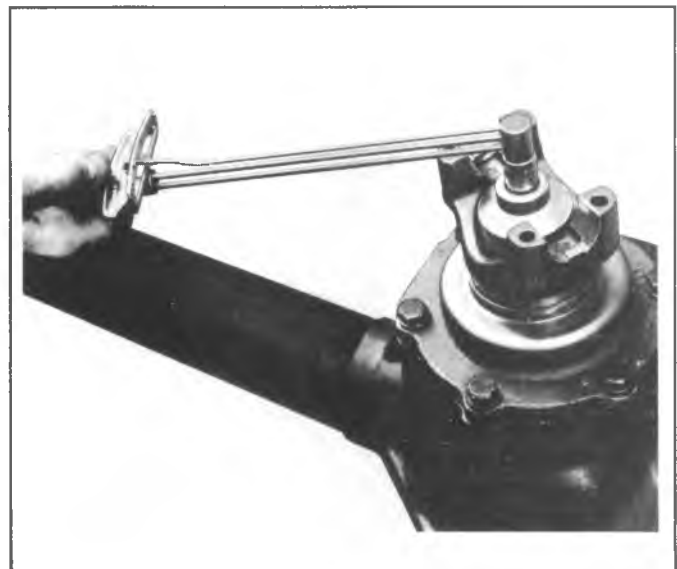


Fig. 4B2-21--Measuring Rotating Torque

		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.

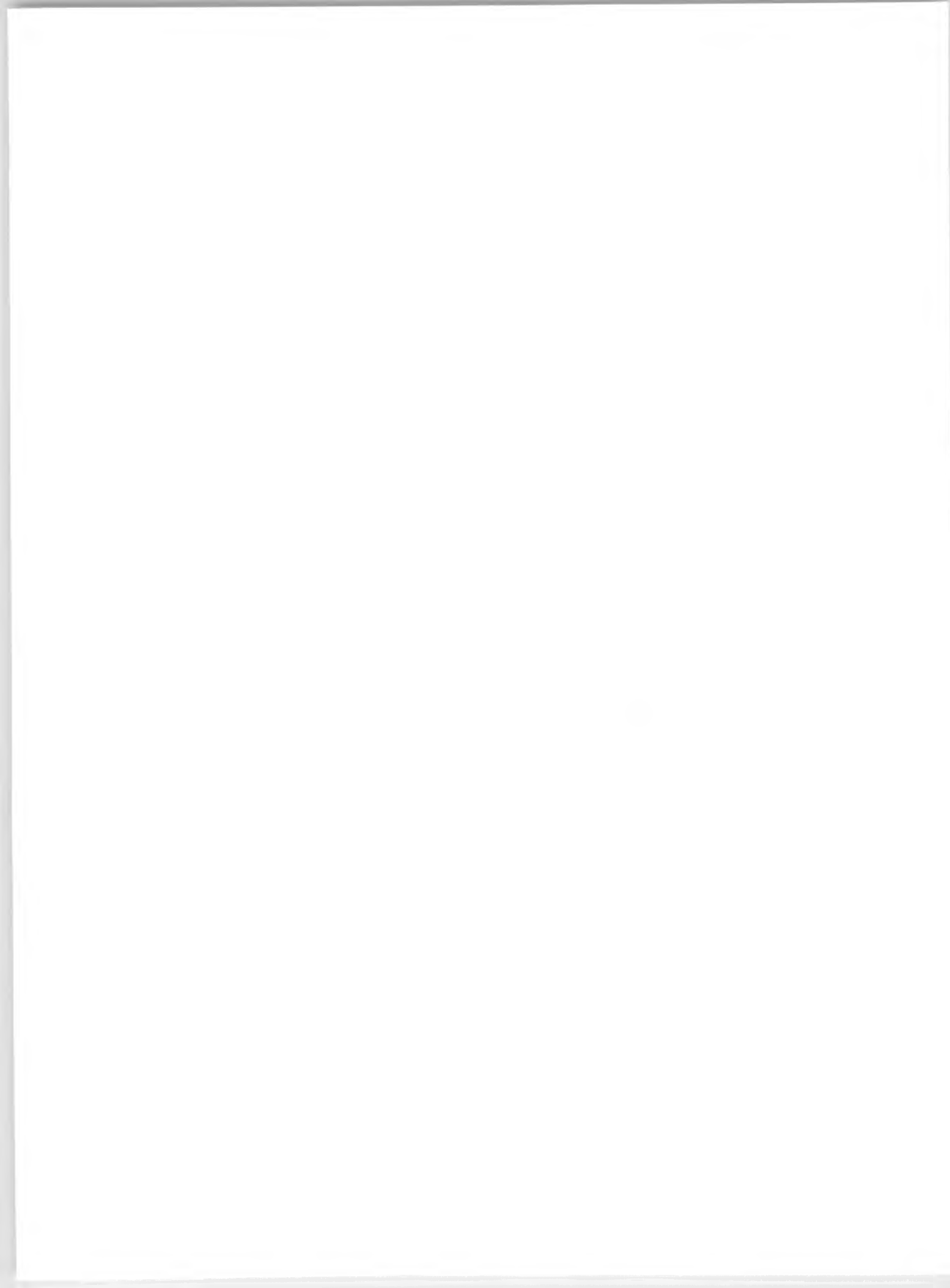
b. If original shim was .012 inch, original code +2, and new code is -2, the correct shim would be .012 minus .004 = .008 inch.

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 drive 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 placing J-22912 under bearings and supporting plates on a press bed. Apply force to pilot plug J-8107-3 to drive the case from the bearing.
Use care not to damage case hubs with tool J-22912.
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.

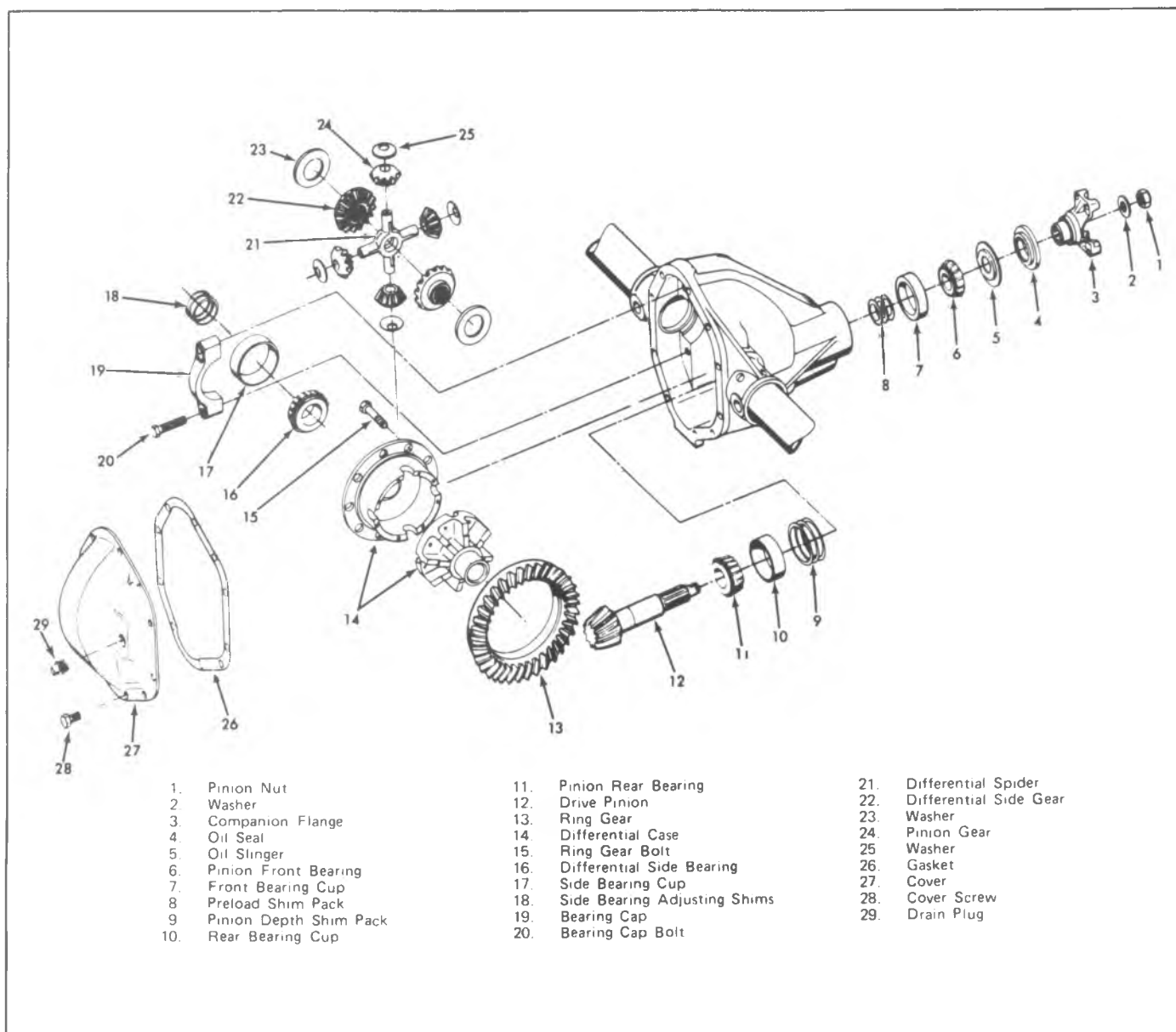


Fig. 4B3-1--Dana Differential with 10-1/2" Ring Rear - Exploded View L

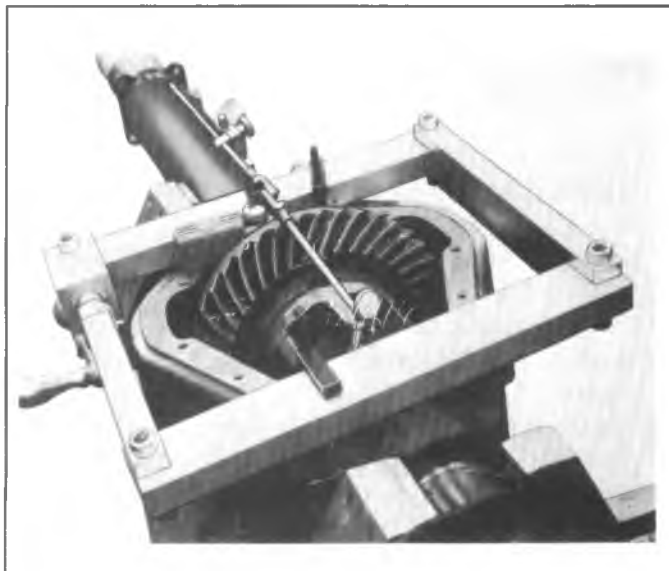


Fig. 4B3-2--Spreading the Carrier



Fig. 4B3-3--Separating Case Halves

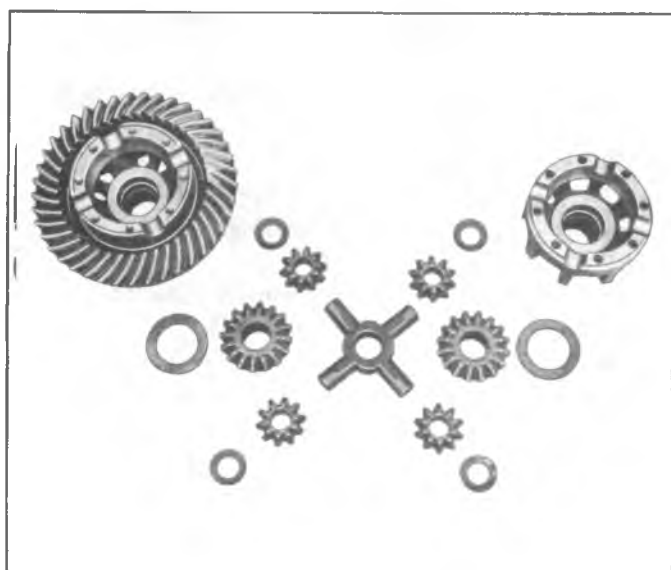


Fig. 4B3-4--Internal Parts Inspection

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.

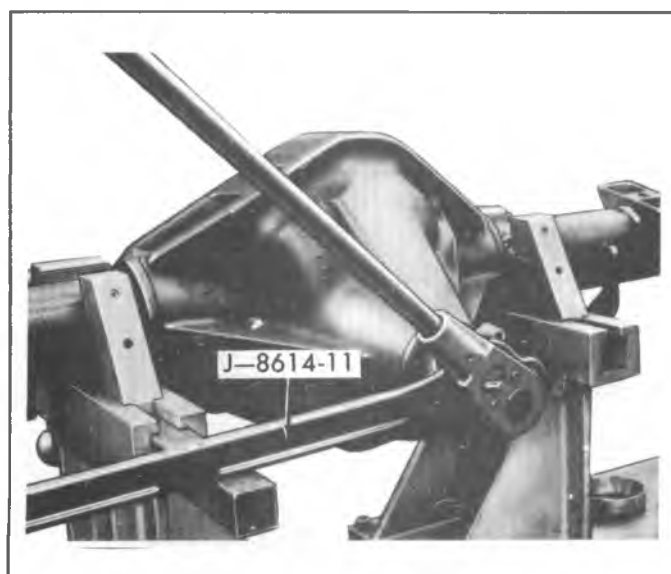


Fig. 4B3-5--Removing Pinion Nut

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.

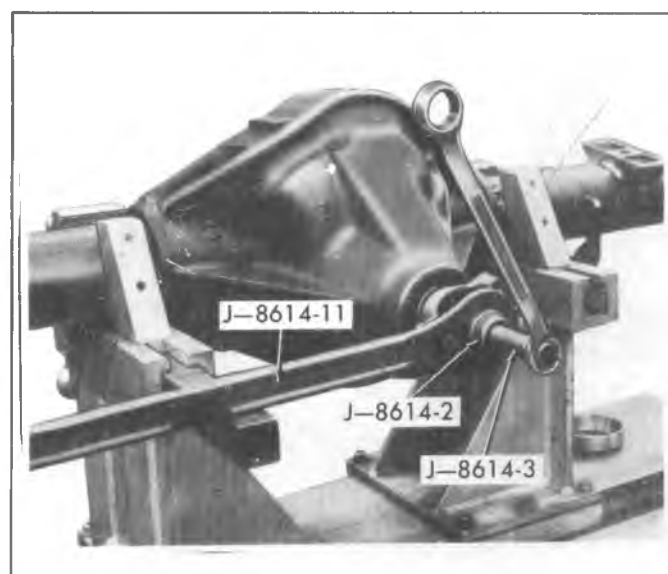


Fig. 4B3-6--Removing Companion Flange

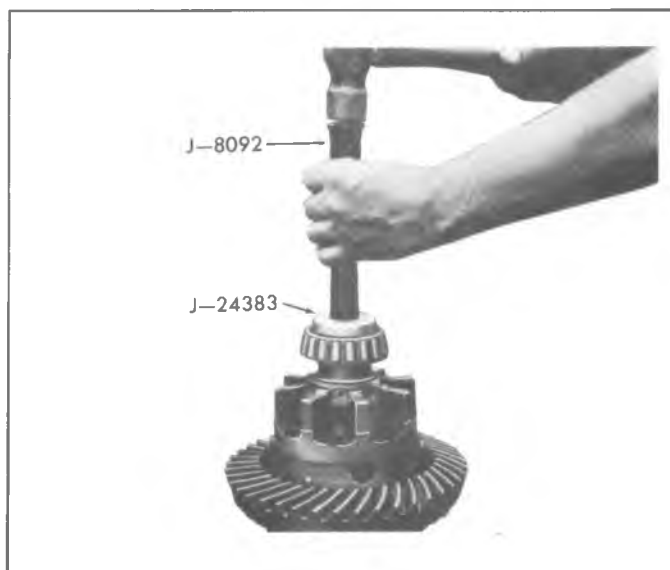


Fig. 4B3-7--Installing Side Bearing

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

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

used during determination of side bearing shim requirements.

Pinion Shims

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 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 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 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 thickness 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

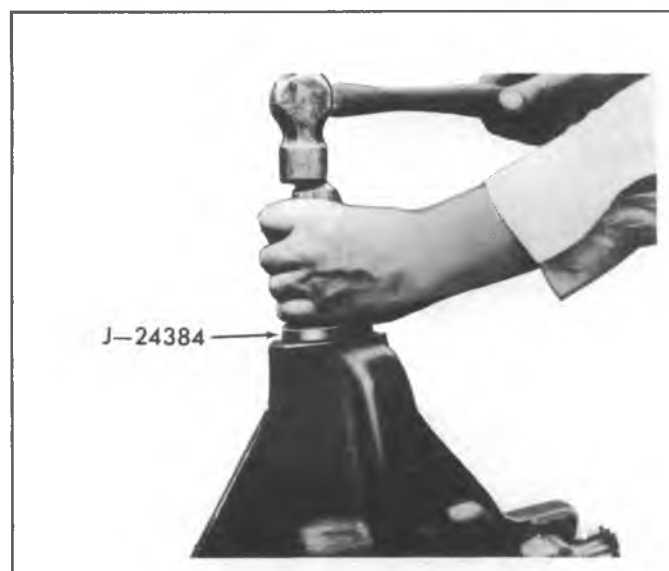


Fig. 4B3-11--Installing Pinion Oil Seal

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 operation 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'.
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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Drive Pinion-Removal and Disassembly	4B4-2	Operational Checks and Adjustments	4B4-6

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.

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 .020".
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.

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.

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-22888, with Plug J-8107-3, as in figure 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.

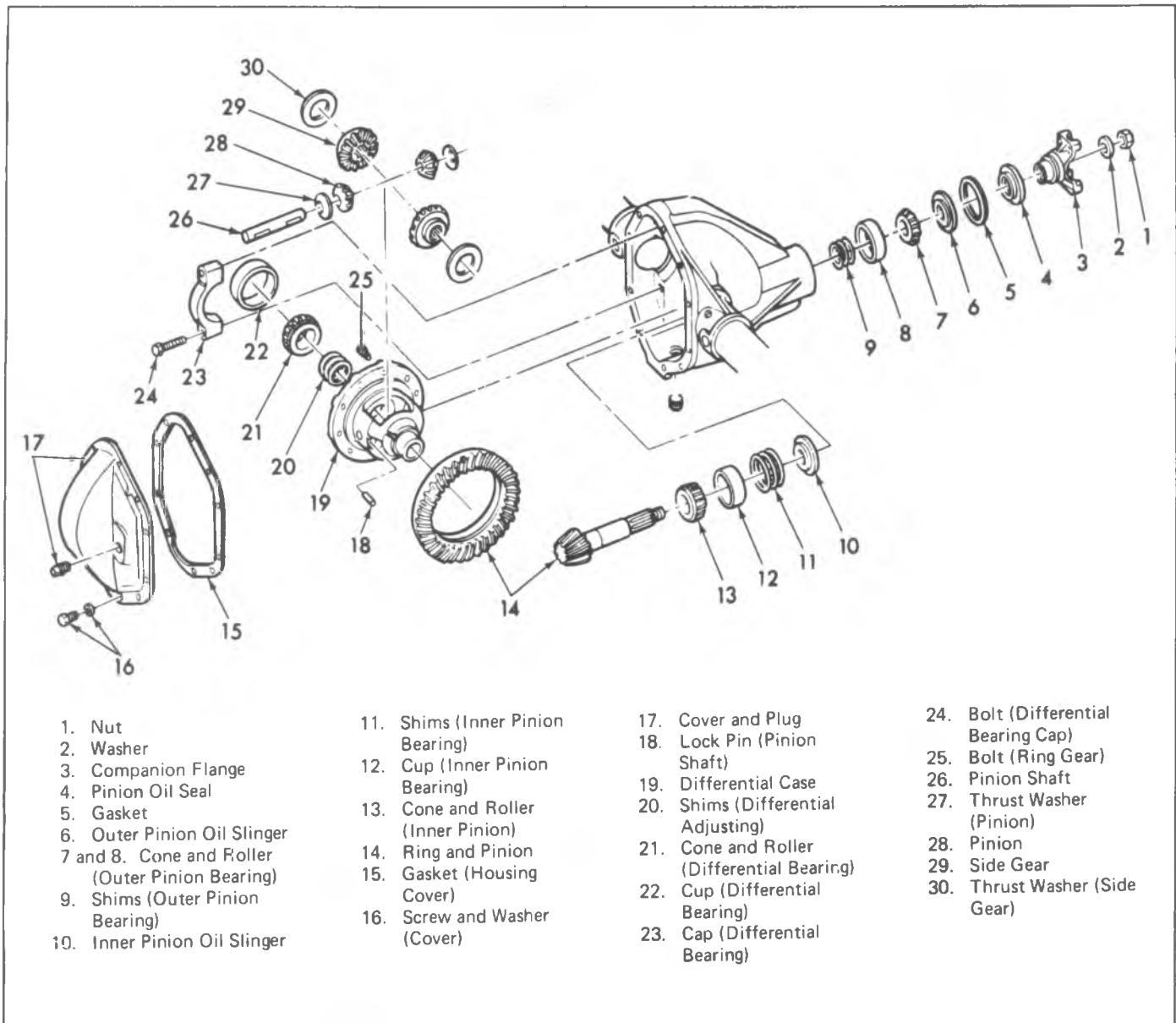


Fig. 4B4-1--Dana Differential With 9-3/4" Ring Gear - Exploded View

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, attached 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.

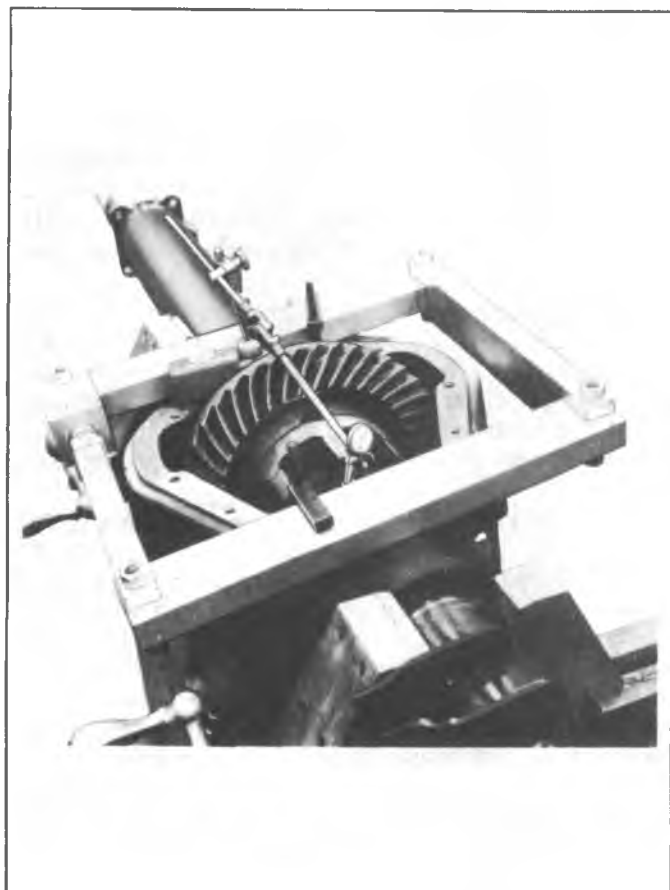


Fig. 4B4-2--Tool J-24385 Mounted on Carrier

4. Inspect differential case for cracks 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.

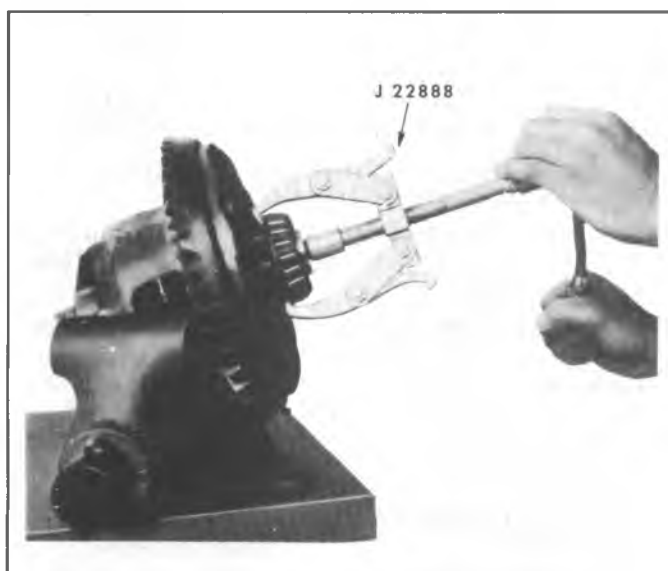


Fig. 4B4-3--Removing Differential Side Bearings

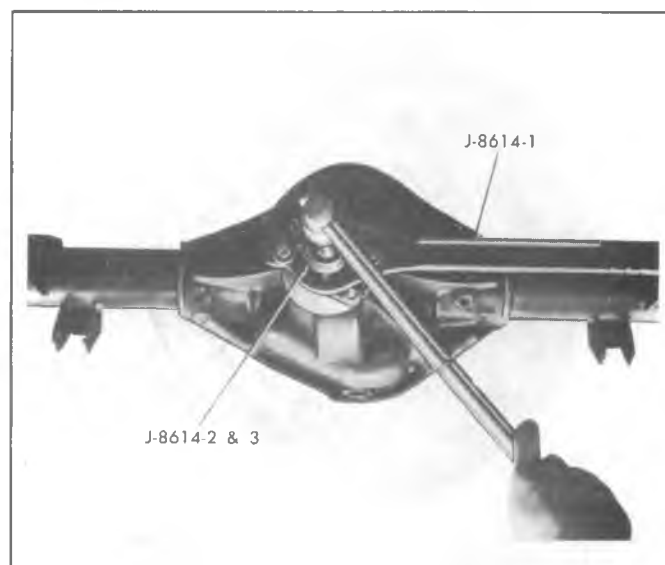


Fig. 4B4-4--Removing Pinion Flange

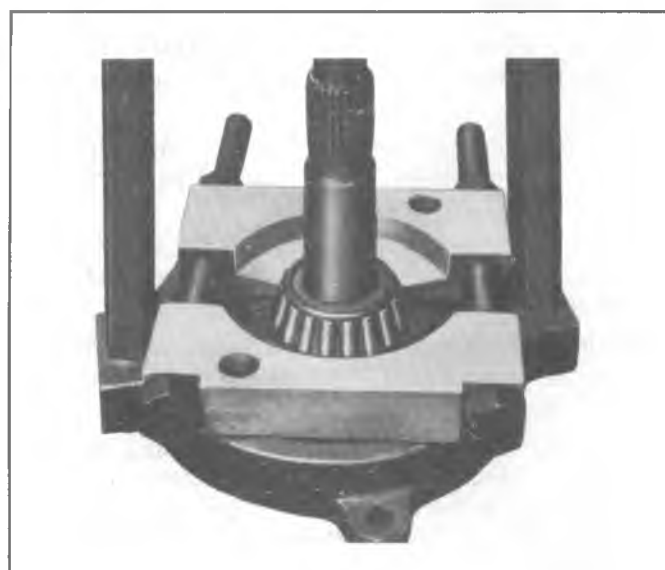


Fig. 4B4-5--Removing Inner Pinion Bearing Cone and Roller

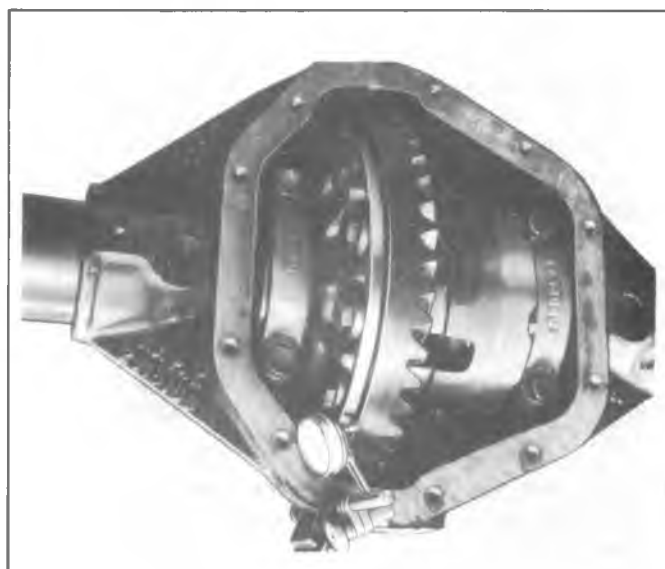


Fig. 4B4-6--Checking Runout



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

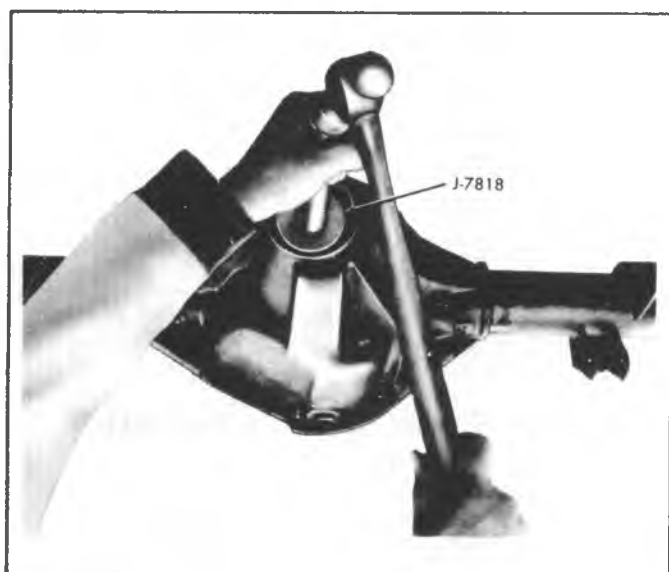


Fig. 4B4-9--Installing Outer Pinion Bearing Cup

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.

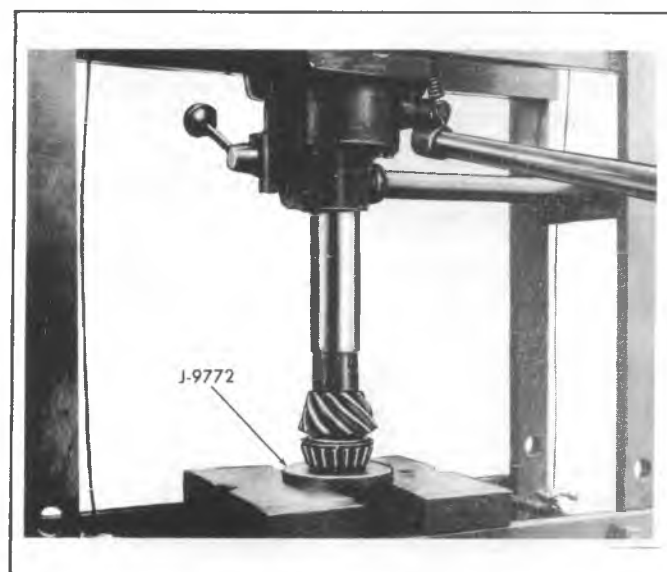


Fig. 4B4-10--Installing Inner Pinion Cone and Roller

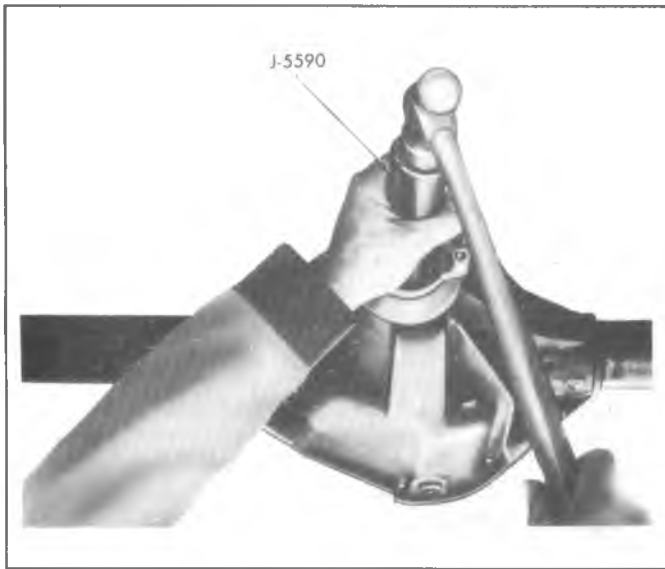


Fig. 4B4-11--Installing Pinion Flange

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

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 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

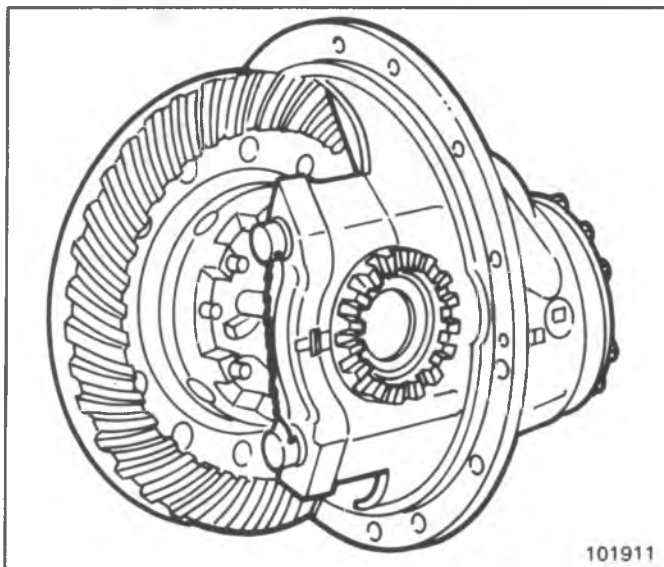
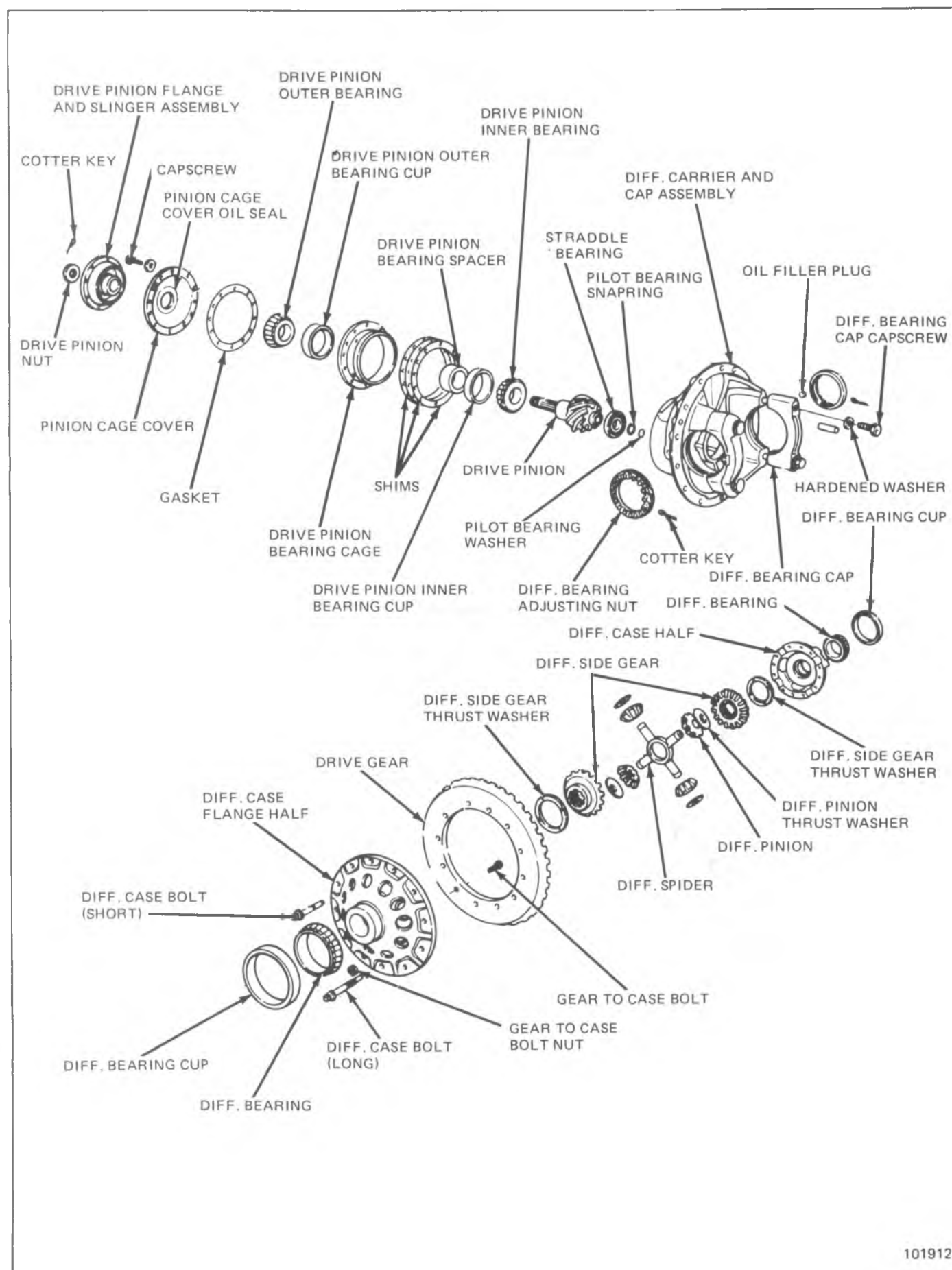


Fig. 4B5-1--Single-Reduction Carrier

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.



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Fig. 4B5-2--Rockwell Assembly

ON-VEHICLE SERVICE

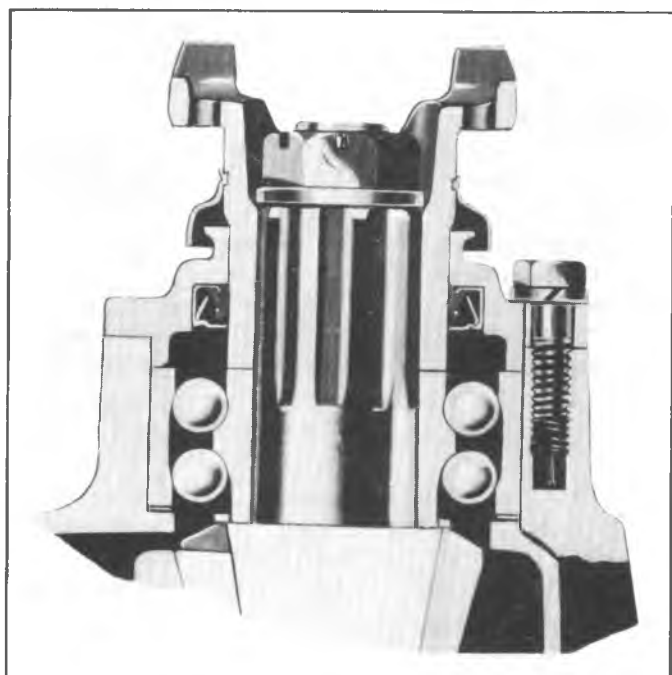


Fig. 4B5-2a -- Pinion Oil Seal

AXLE ASSEMBLY

The axle assembly removal and installation is identical to the procedure given earlier for "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.

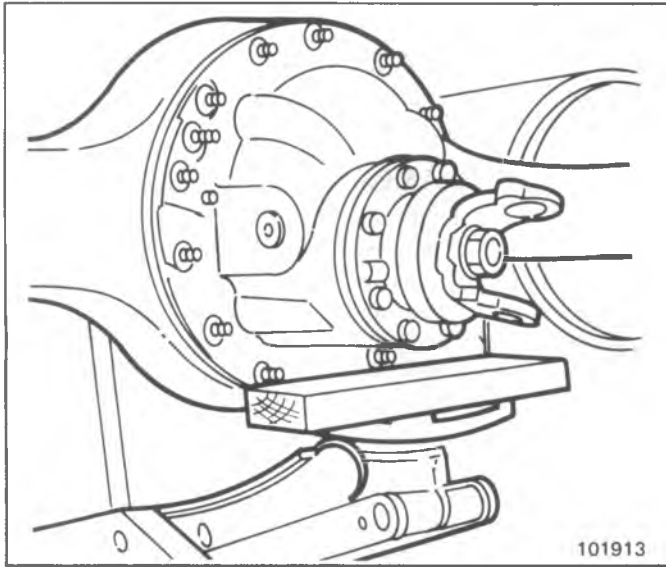


Fig. 4B5-3--Carrier Removal

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).

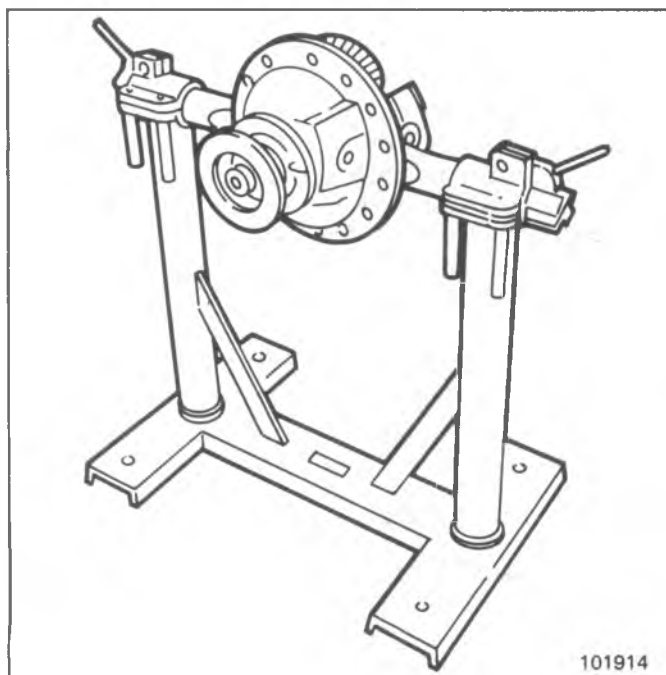


Fig. 4B5-4--Carrier In Repair Stand

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.

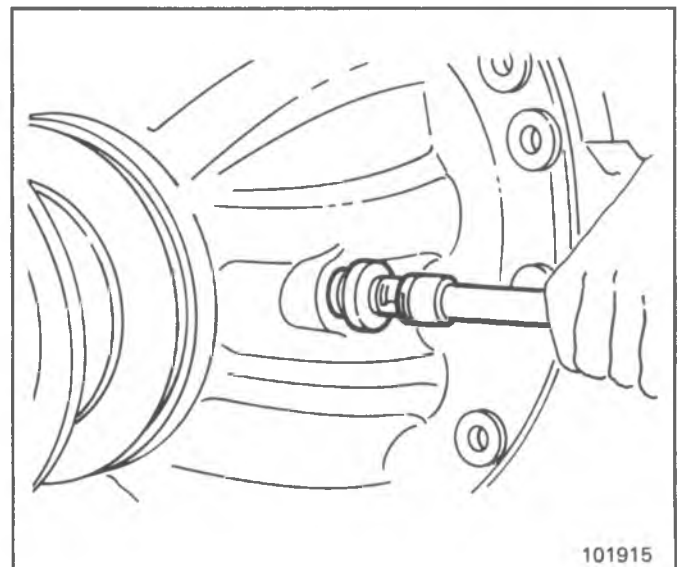


Fig. 4B5-5--Thrust Adjusting Screw

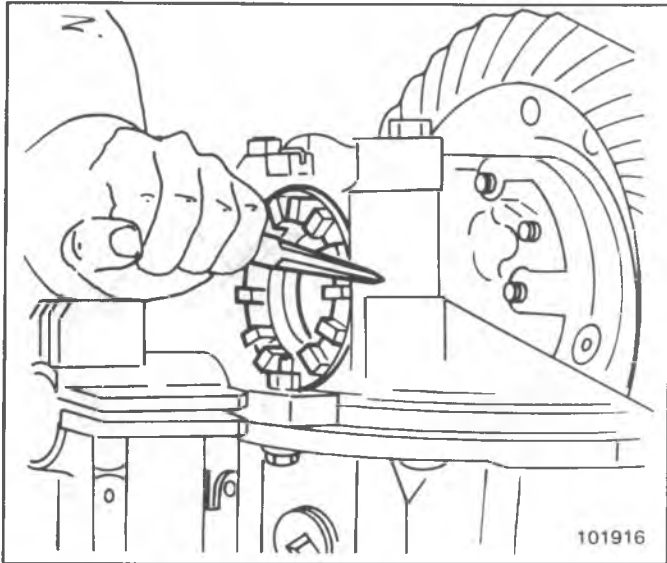


Fig. 4B5-6--Punching Carrier Leg

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

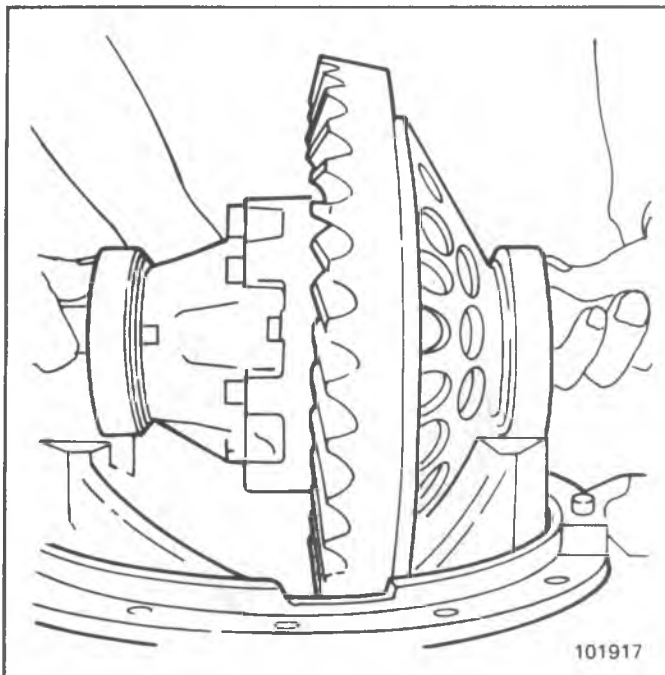


Fig. 4B5-7--Lifting Differential

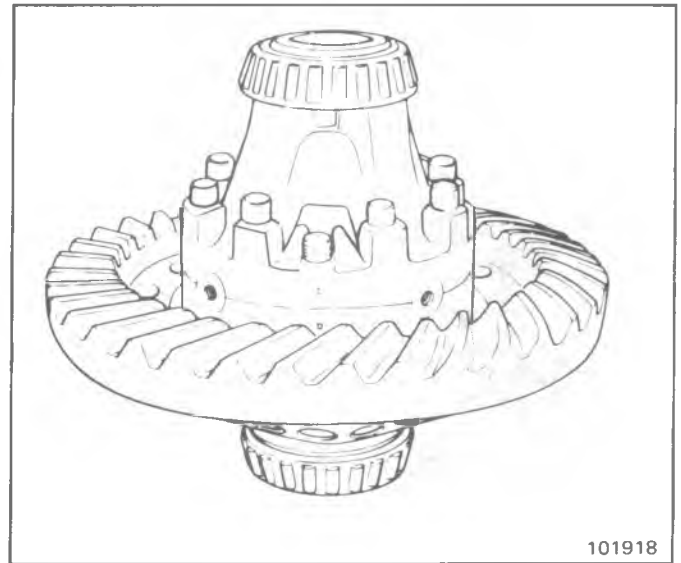


Fig. 4B5-8--Identification Mark

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).

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 seal 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.

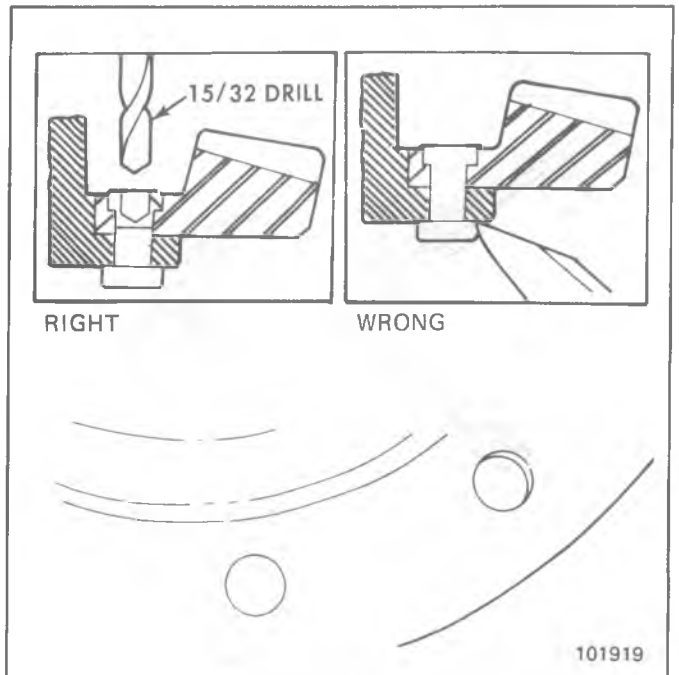


Fig. 4B5-9--Removing Rivets

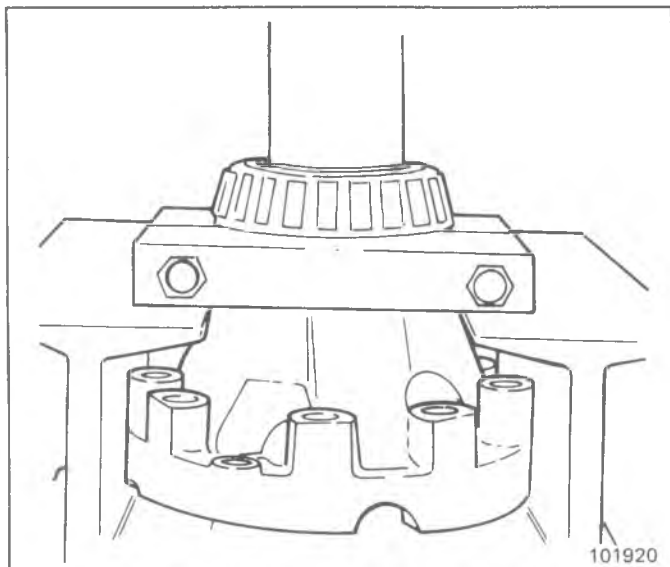


Fig. 4B5-10 -- Removing Differential Bearing

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.

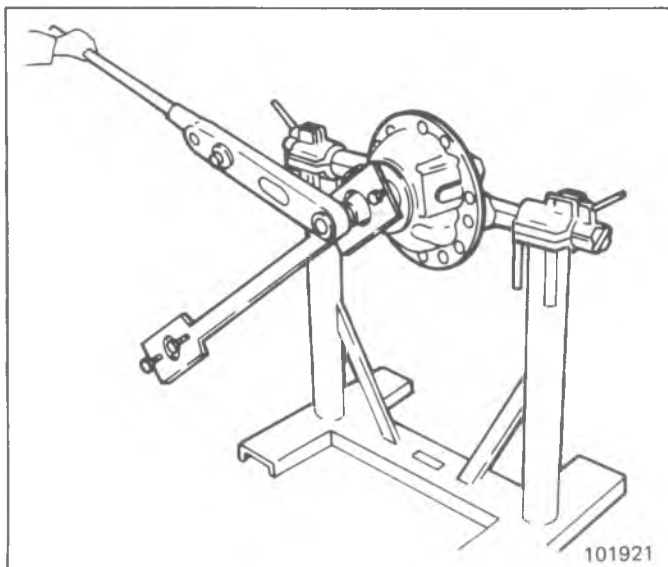


Fig. 4B5-11--Removing Pinion and Cage

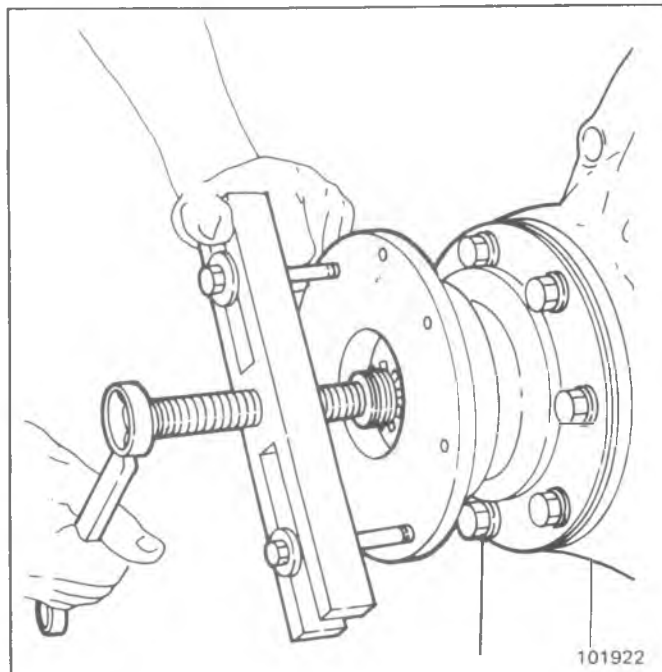


Fig. 4B5-12--Removing Flange

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 possibility 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

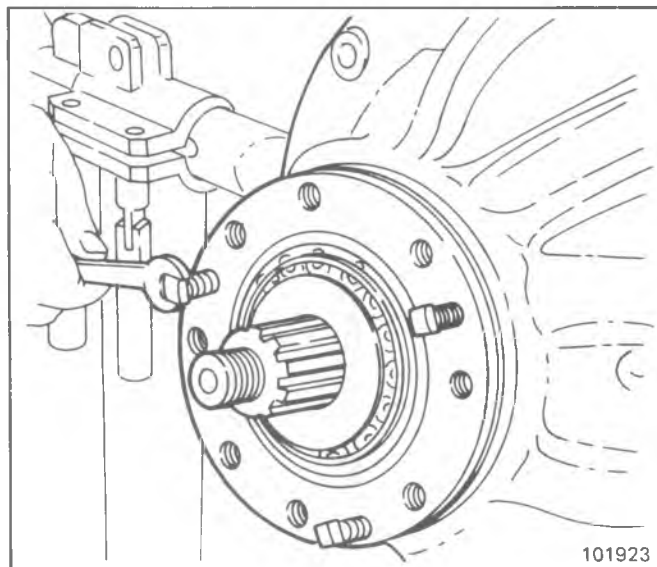


Fig. 4B5-13--Removing Bearing Cage

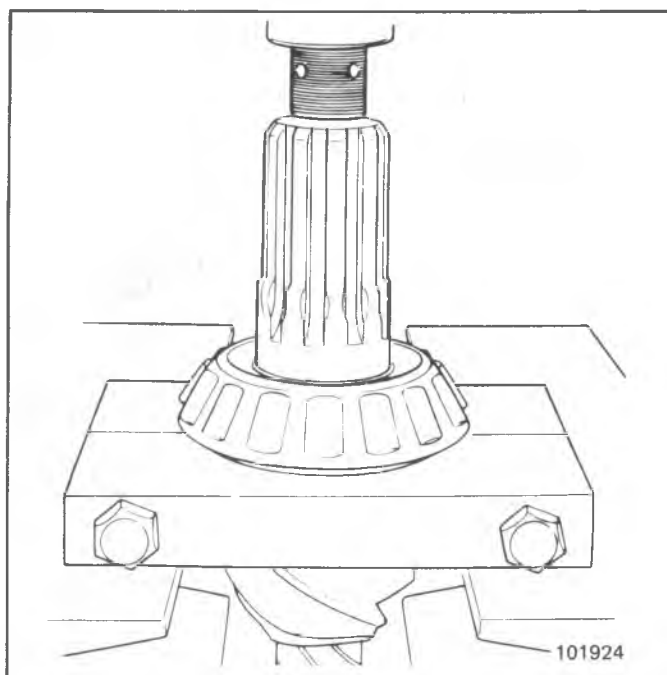


Fig. 4B5-14--Removing Inner Bearing

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 mutilate 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.

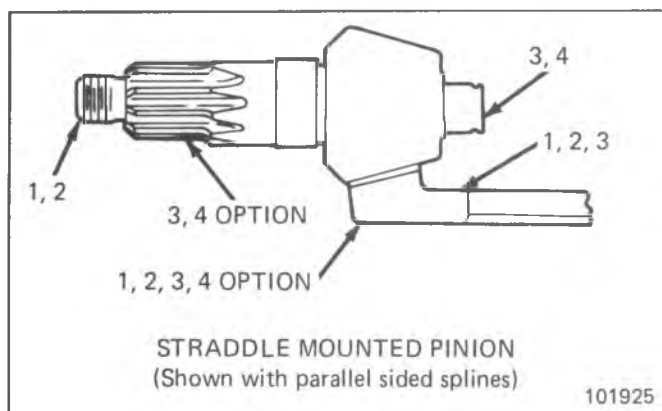


Fig. 4B5-15--Gear Set Identification

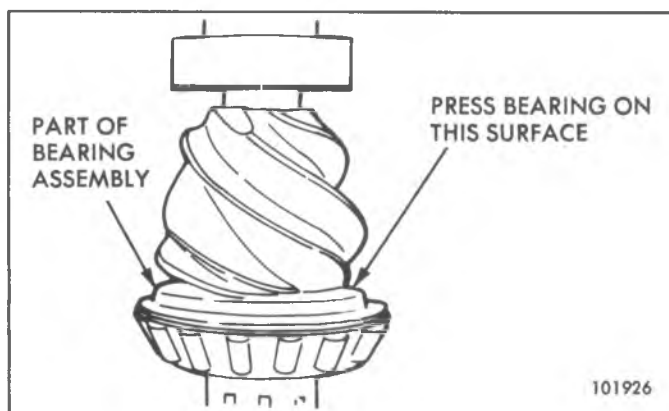


Fig. 4B5-16--Installing Bearings

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).

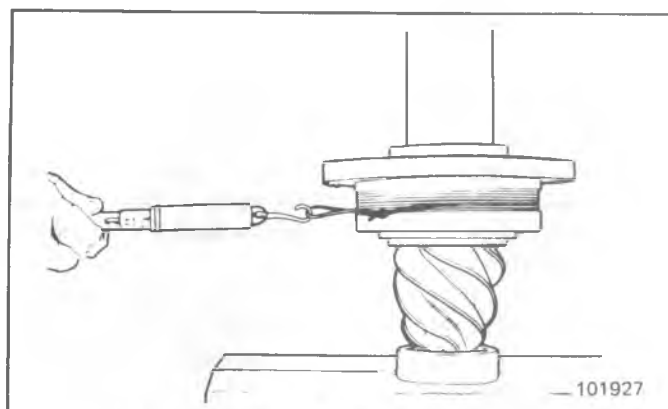


Fig. 4B5-17--Preload Torque

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.

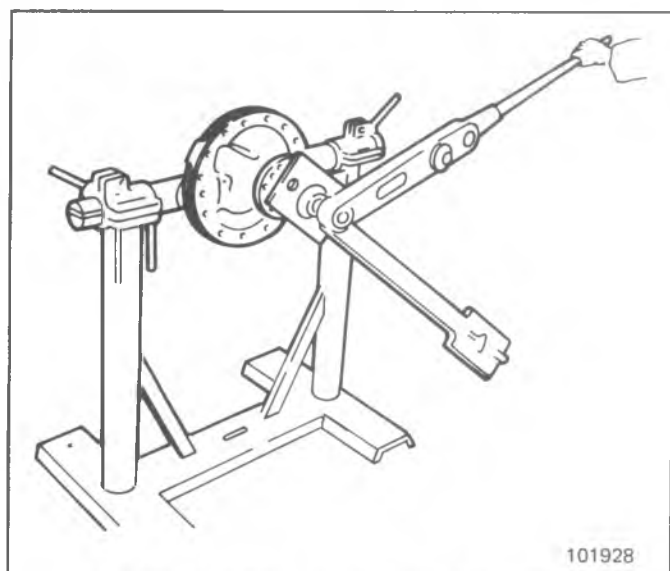


Fig. 4B5-18--Holding and Torquing Pinion Flange

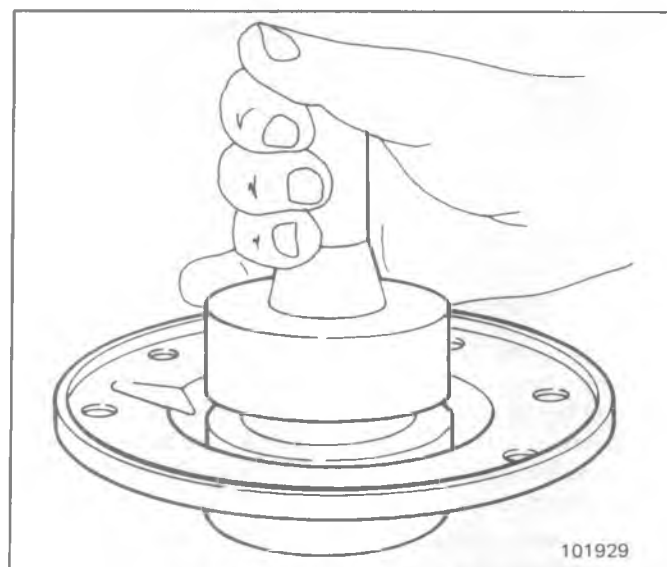


Fig. 4B5-19--Installing Seal

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 subtract this number as indicated by the variation sign (+ add or - subtract) 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 cap screws. Tighten cap screws 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.

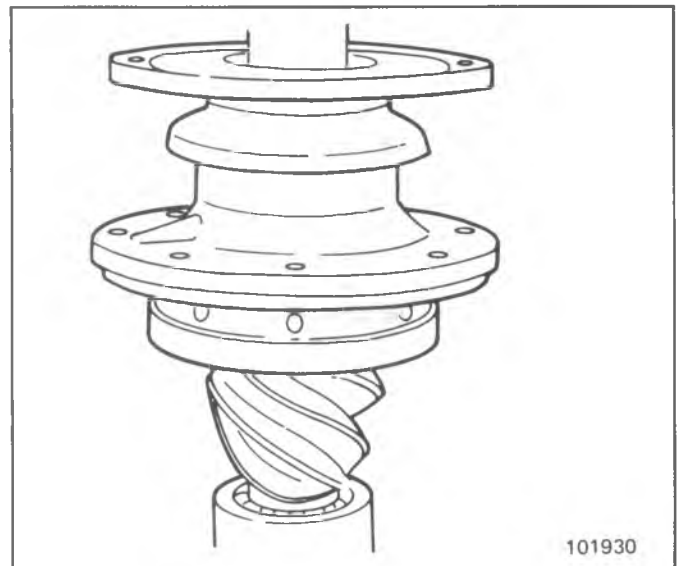


Fig. 4B5-20--Installing Flange

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 differential and ring gear assembly in a vise.
Use soft metal covers over vise jaw to protect ring gear.

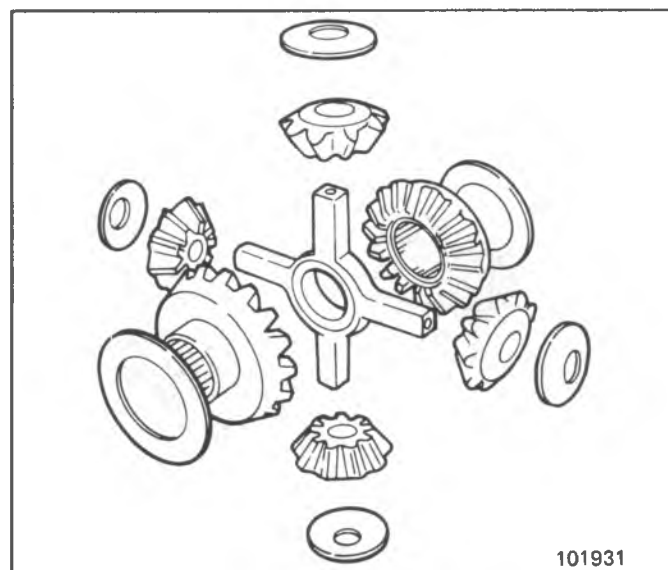


Fig. 4B5-21--Pinion and Side Gears

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"

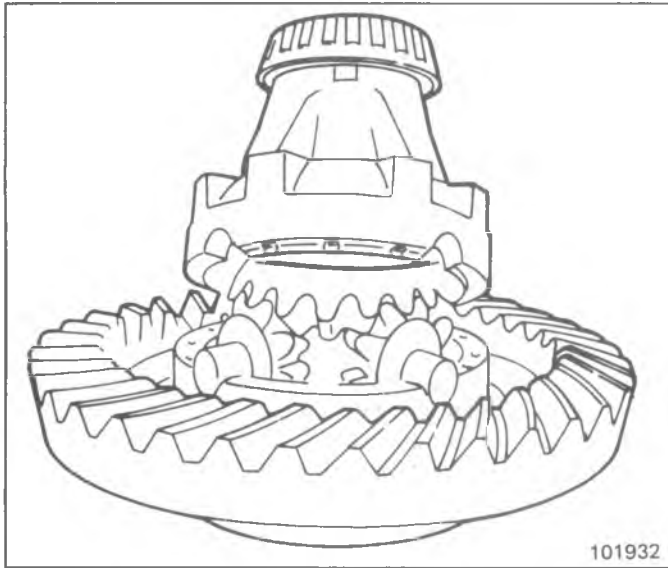


Fig. 4B5-22--Align Marks

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

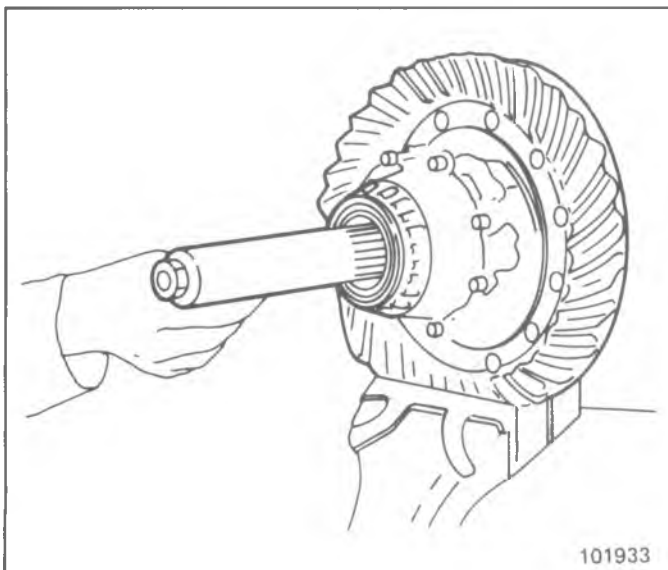


Fig. 4B5-23--Installing Tool

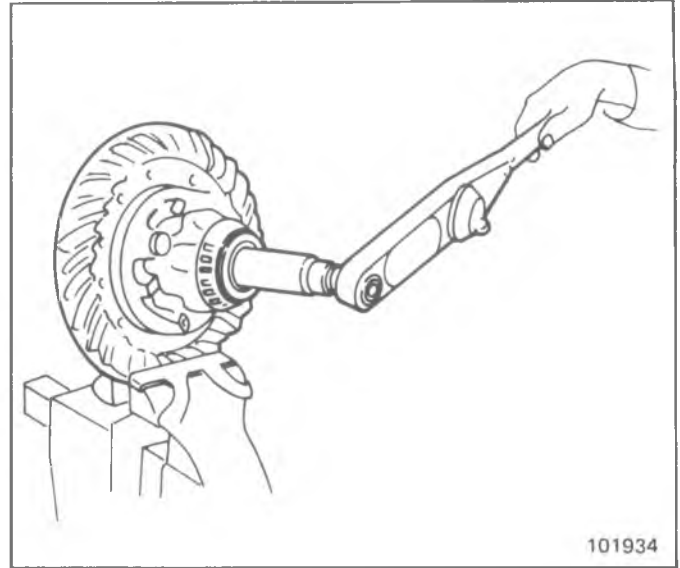


Fig. 4B5-24--Checking Torque

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).

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.

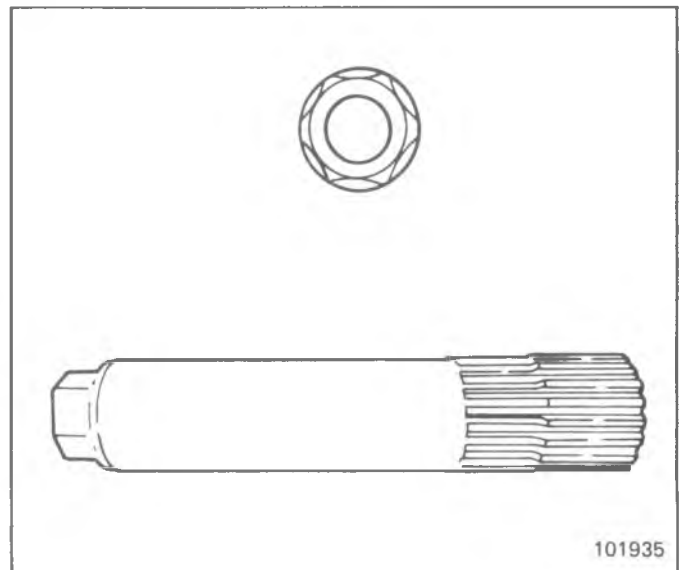


Fig. 4B5-25--Checking Tool

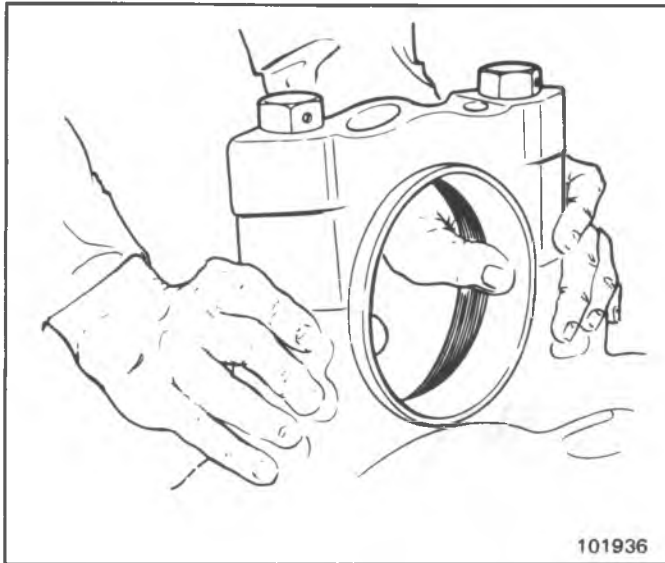


Fig. 4B5-26--Fitting Bearing Cups

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.

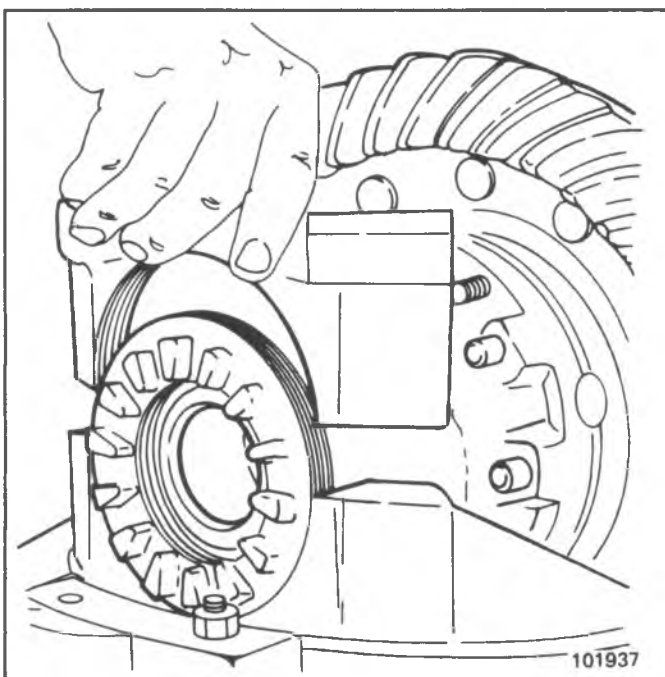


Fig. 4B5-27--Installing Bearing Caps

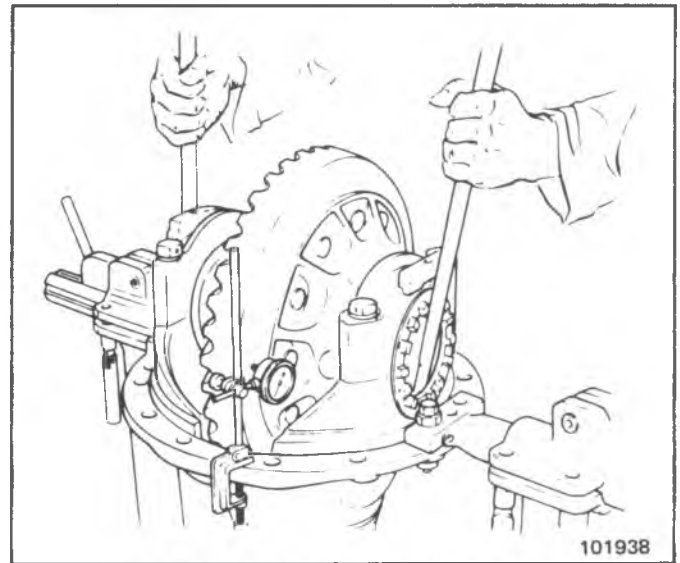


Fig. 4B5-28--Adjusting Bearing Preload

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.

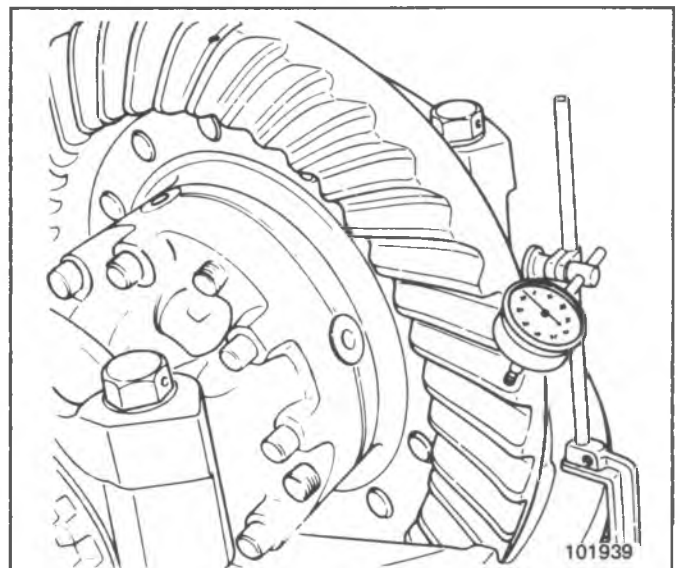


Fig. 4B5-29--Checking Backlash

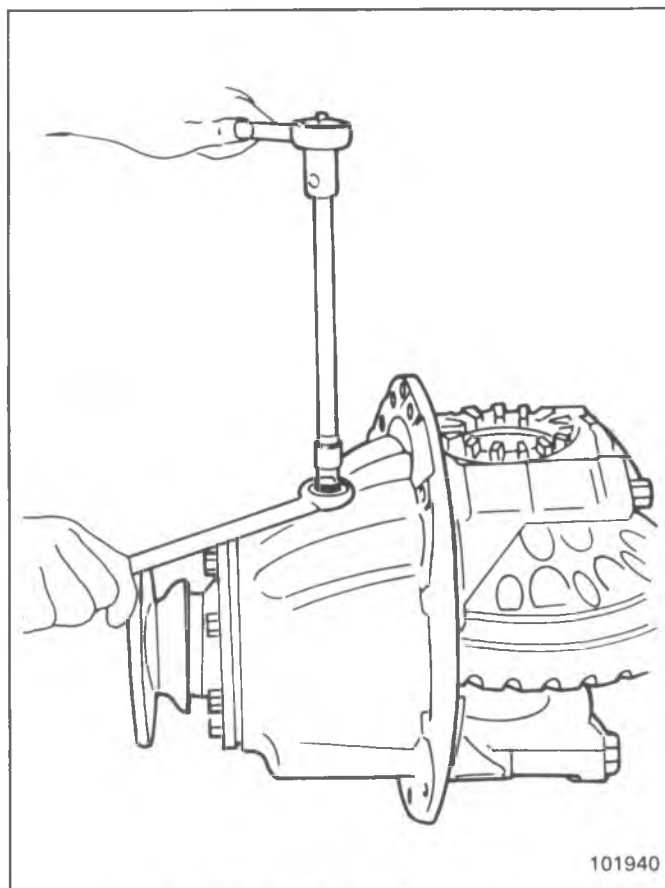
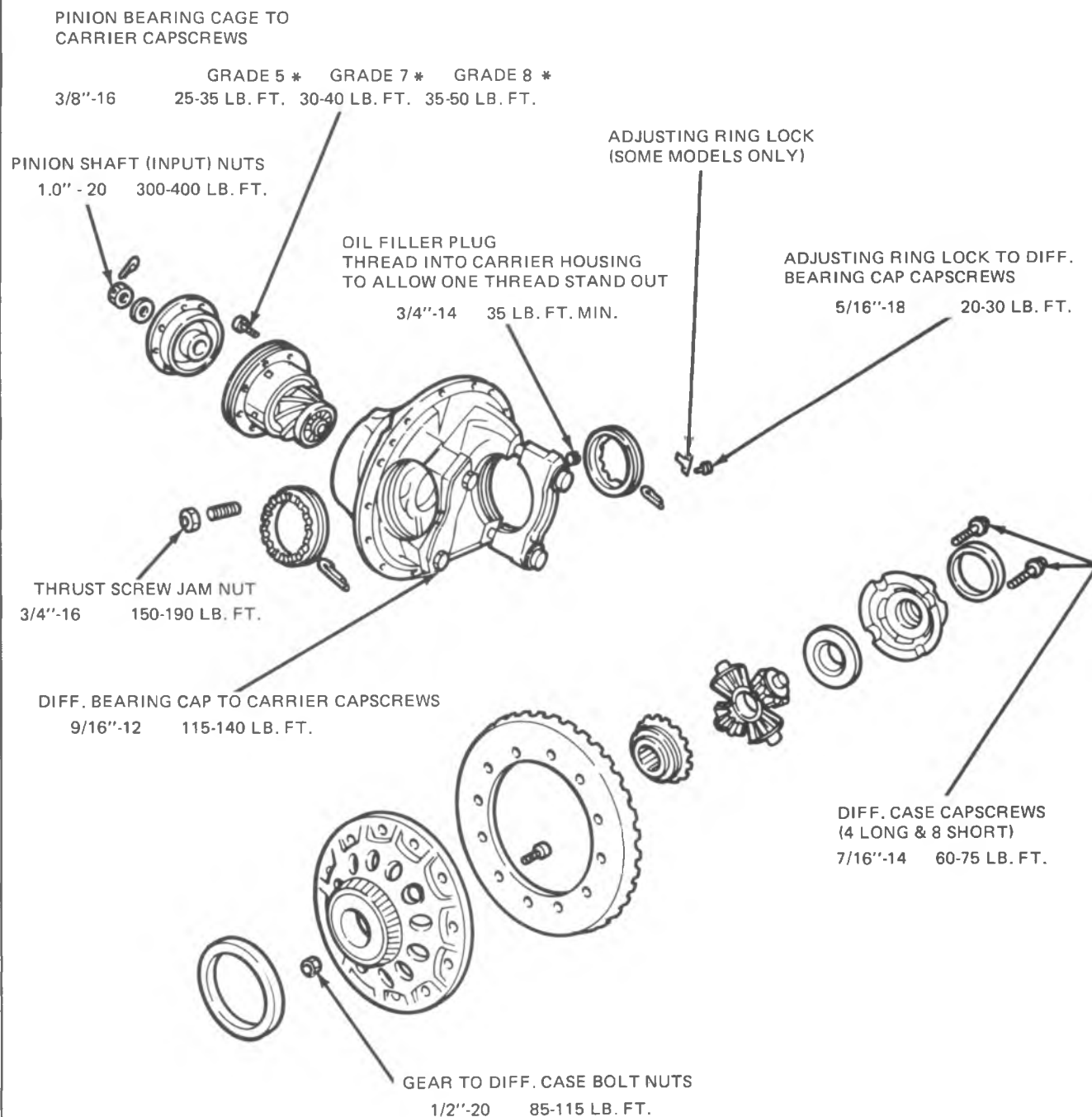


Fig. 4B5-30--Adjusting Thrust Screw

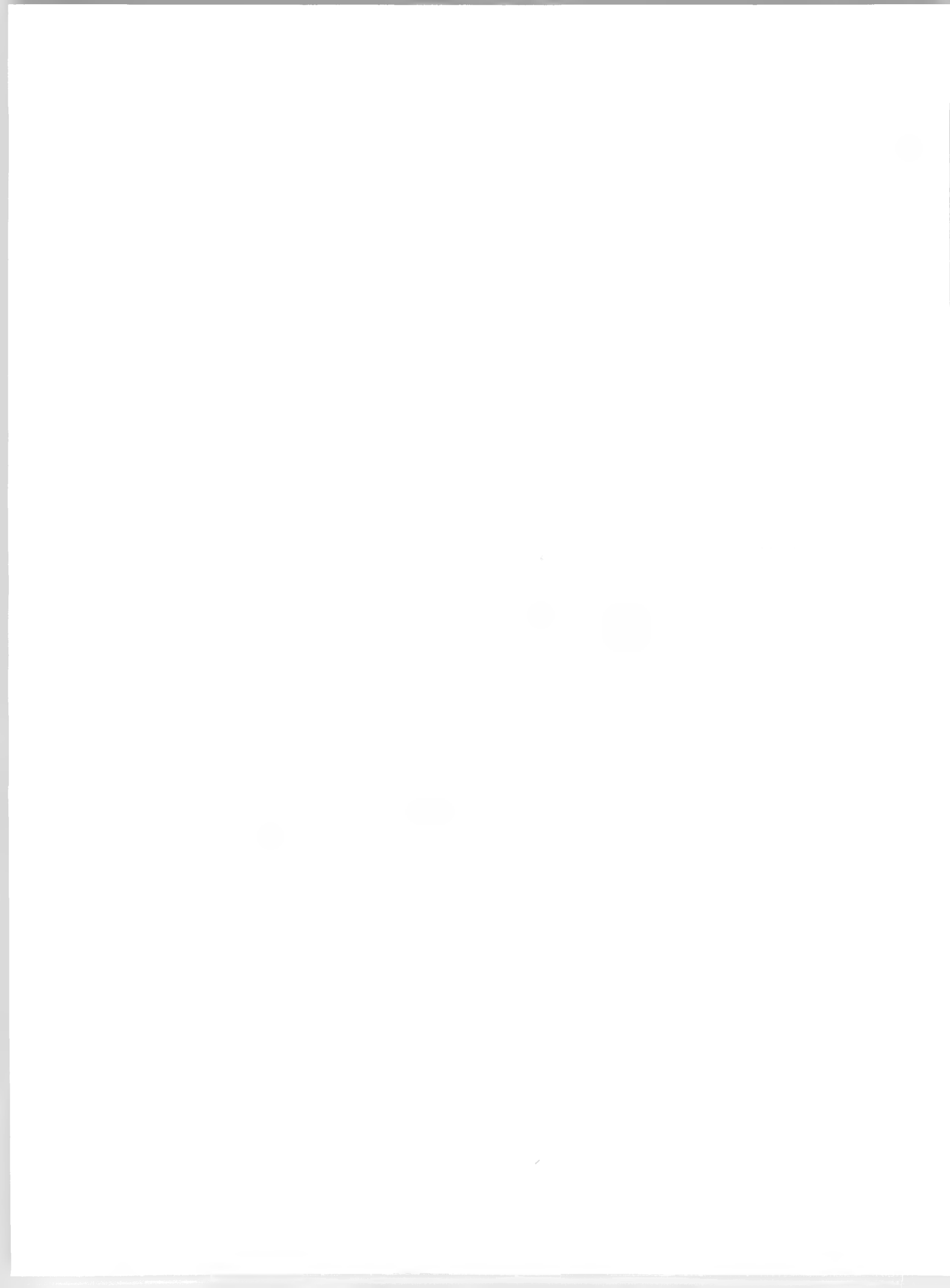


FOR ALL FASTENERS

- 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 



SECTION 4B6 LIMITED SLIP DIFFERENTIAL UNITS

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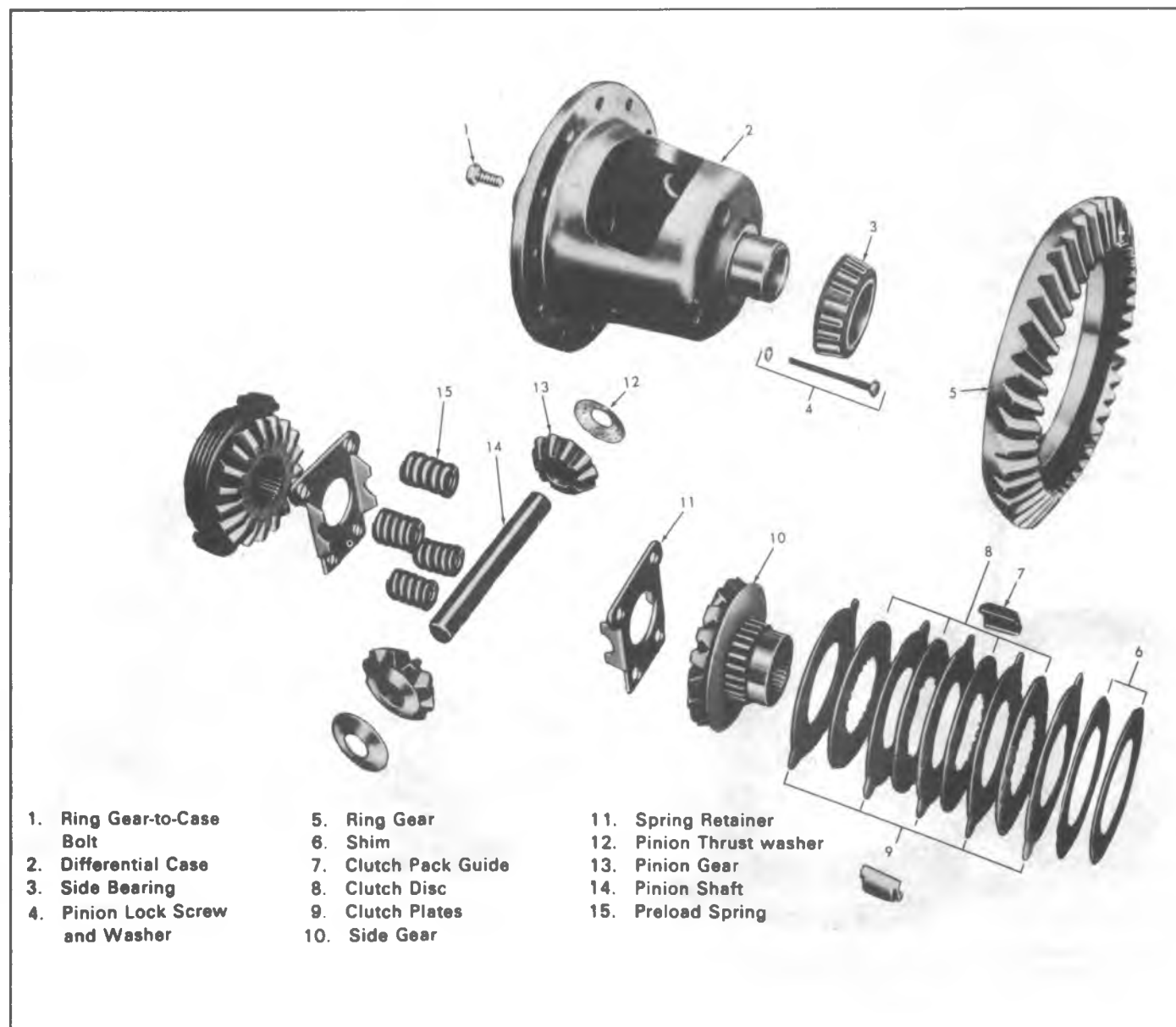


Fig. 4B6-1-Eaton Limited Slip Exploded View

EATON LIMITED SLIP - FIGURE 4B6-1

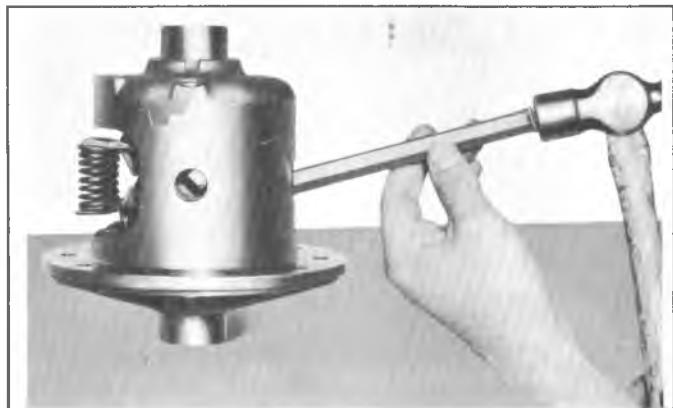


Fig. 4B6-2--Removing Preload Spring Pack (Typical)

Disassembly

1. Remove ring gear and side bearings following the procedures established for the conventional differential unit.
2. Remove the preload spring retainer and springs by tapping on the spring retainer through the observation hole in the case. See figure 4B6-2. Drive the spring retainer from the case sufficiently to allow insertion of a 1/4 inch bolt in each of the two front springs. Secure each bolt with a nut as in figure 4B6-3.
3. After installing the retaining bolts, continue to drive spring retainer from the case until enough of the retainer is exposed to permit installation of bar stock and "C" clamp as shown in figure 4B6-4. Center the bar stock over the axle shaft hole in the spring retainer, then compress "C" clamp sufficiently to permit withdrawal of spring pack.
4. Position spring pack in vise and remove 1/4 inch bolts. Alternately relieve "C" clamp pressure and vise pressure until spring compression is relieved. See figure 4B6-5.

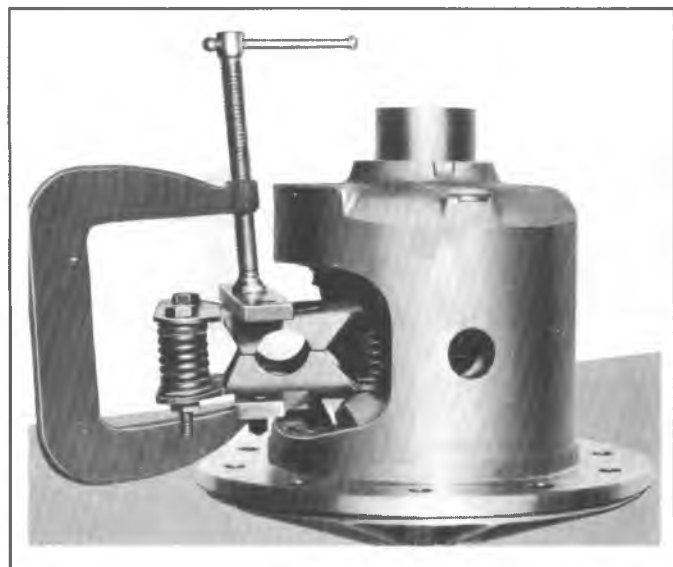


Fig. 4B6-4--C-Clamp and Bar Stock Installed for Spring Removal



Fig. 4B6-3--Installing Bolts to Retain Springs

5. Roll out the differential pinions and thrust washers.
6. Remove side gear, clutch pack, shims and guides from case. Tap the assembly from the case, using a brass drift as shown in figure 4B6-7. Repeat removal on opposite gear.
7. Separate clutch pack assembly from side gear. Retain clutch pack assembly with original side gear.

Inspection

1. Check clutch plates and discs for excessive wear and signs of overheating.
Clutch plates and discs are not serviced separately. If replacement is required, clutch pack must be replaced as an assembly.

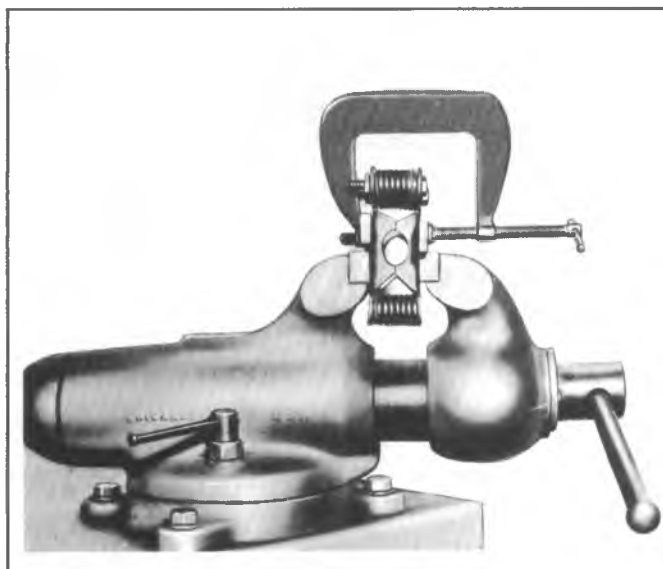


Fig. 4B6-5--Removing Preload Springs from Pack

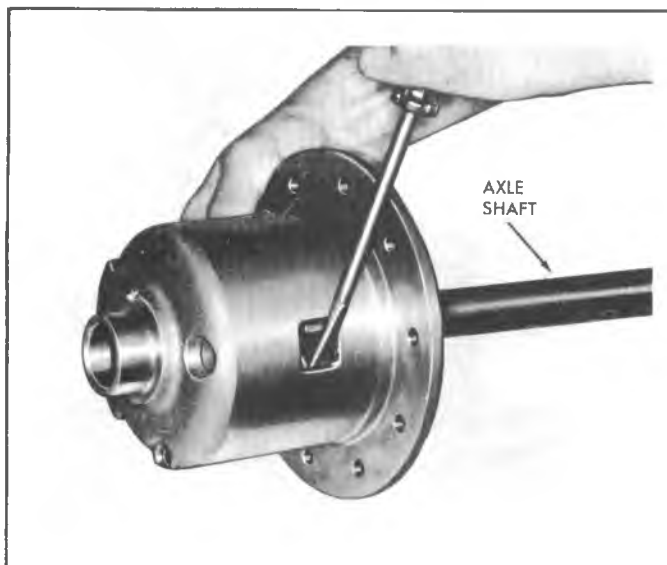


Fig. 4B6-6--Removing Differential Pinion Gears

2. Inspect preload springs for distortion and other defects.
3. Compress springs and determine if they are capable of properly preloading the clutch pack, replace springs that are weak or questionable.
4. Examine spring retainer for alignment between the retainer halves and for excessive wear at spring seats.

Reassembly

1. Lubricate clutch plates and discs with special limited slip lubricant.
2. Alternately position clutch plate and clutch disc on side gear, beginning and ending with clutch plate, until assembly of clutch pack is complete. See figure 4B6-8.
3. Install clutch pack guides on the clutch plate lugs. Make sure that the clutch disc lugs engage with side gear teeth.
4. Select shims of equal thickness as those removed from the case, or if old shims are suitable,



Fig. 4B6-7--Removing Side Gear



Fig. 4B6-8--Assembling Clutch Pack

reinstall them over the side gear hub.

5. Lubricate and assemble opposite side gear as above.
6. Install one side gear, clutch pack assembly and shim(s) in the differential case.
7. Position pinion gears and thrust washers on side gears. Install pinion shaft through case and gears.
8. Install dial indicator in case so that contact button rests against pinion gear as shown in figure 4B6-9.
9. Compress clutch pack, using a screwdriver as shown in figure 4B6-10. Move the pinion gear to obtain tooth clearance.
10. Tooth clearance should be .001" to .008". If required, change shims to obtain proper tooth clearance.
11. Remove side gear assembly and repeat tooth clearance procedure for other side gear on opposite side of case.
12. Remove pinion shaft, gears and thrust washers.
13. Install remaining side gear, clutch pack assembly and shims in case.
14. Install pinion gears and thrust washers. Installation of pinion gears can be performed by reversing the pinion gear removal procedure.
15. Assemble springs in spring retainer and clamp

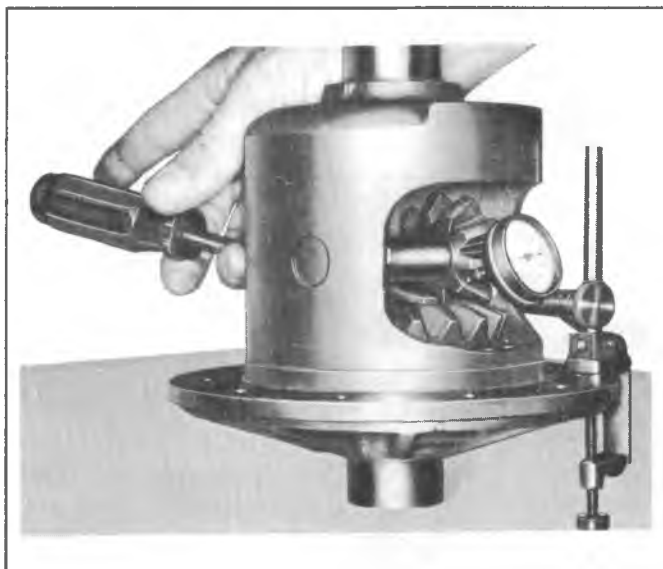


Fig. 4B6-9--Measuring Pinion Gear Tooth Clearance

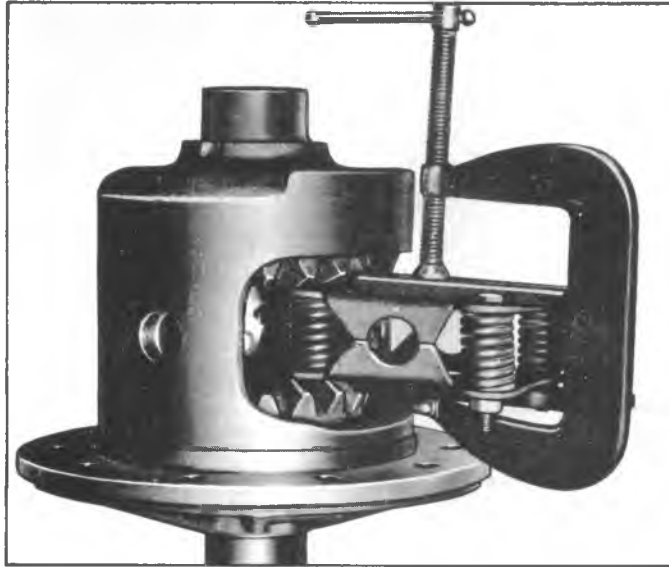


Fig. 4B6-10--Spring Pack Compressed for Installation

assembly in vise. Install "C" clamp and bar stock on spring retainer then install a 1/4 inch bolt and nut in each front spring. See figure 4B6-10.

16. Position spring pack between side gears and remove bar stock and "C" clamp.
17. Drive spring pack into side gears sufficiently to retain front springs, then remove 1/4 inch bolts from springs. Drive spring pack into position. See figure 4B6-12.
18. Install the pinion shaft and lock screw to retain side gears until axle shafts are installed.
19. Check alignment of spring retainer with side gears. Slight movement of the spring pack can be made if necessary.
20. Install side bearings and ring gear to case using procedure outlined for the conventional differential.
21. Place differential in carrier and adjust bearings and backlash as outlined for the conventional differential.
22. Check operation of unit as follows:
 - a. Raise rear of vehicle until rear wheels are off the ground, and remove one wheel and tire assembly.
 - b. Attach Adapter J-5748 to axle shaft flange and install a 1/2-13 bolt into adapter, shown in figure 4B6-13.



Fig. 4B6-11--Installing Spring Pack Compression Tool

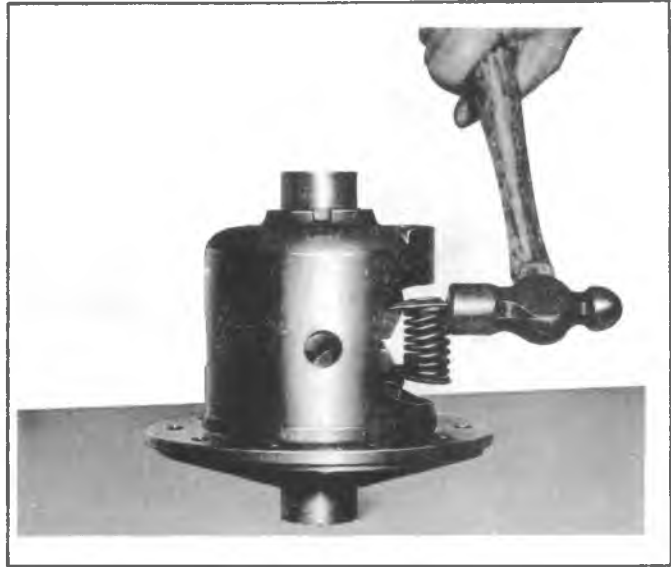


Fig. 4B6-12--Installing Spring Pack

- c. With wheel and tire assembly still on vehicle held firmly to prevent turning, measure torque required to rotate opposite axle shaft with a 0-150 lb. torque wrench attached to J-5748 Torque required to rotate axle shaft should be no less than 54 N·m (40 ft. lbs.).

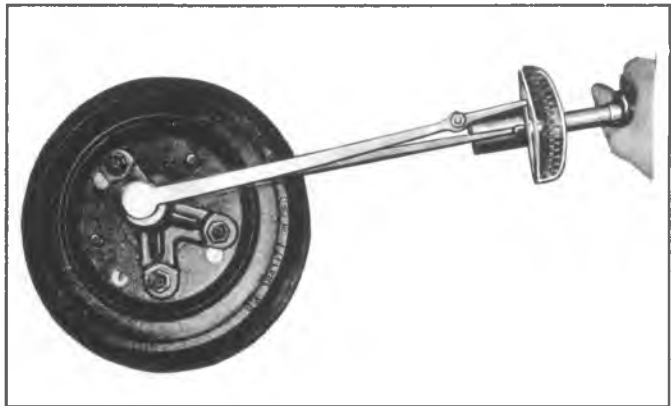


Fig. 4B6-13--Measuring Positraction Rotating Torque

CHEVROLET LIMITED SLIP - FIGURE 4B6-14

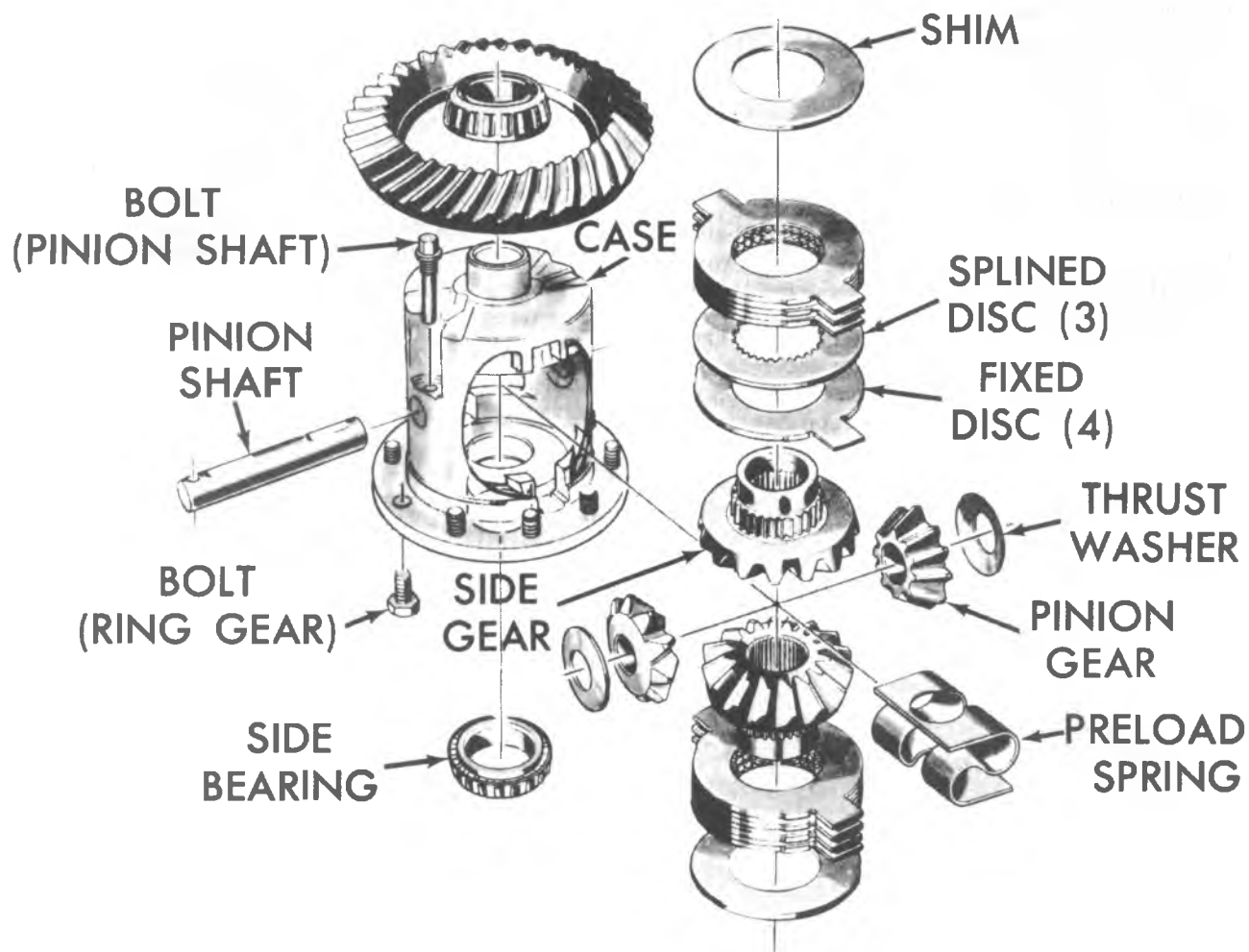


Fig. 4B6-14--Chevrolet Limited Slip - Exploded

Disassembly

1. Remove ring gear and side bearings following the procedures established for the conventional differential unit. Remove pinion shaft.
2. Using a wide, blunt instrument such as a drift or block of wood, drive the preload spring from the case.
3. Support an axle shaft in a vise, and slide the case into the shaft; then turn the case to remove both pinions and thrust washers.
4. Remove the case from the axle shaft and remove both side gears, clutch packs and shims. Mark the gears, clutch packs and shims for reinstallation in same positions.

Inspection

Check the clutch plates and discs for wear and signs of overheating. Check the condition of the preload spring.

Check the gear teeth for signs of wear. Replace parts as needed. Clean all parts to be used for assembly.

The force required to compress the preload spring to 1-5/16 inches should be 420 N·m \pm 40 N·m (300 ft. lbs. \pm 30 ft. lbs.).

Reassembly

1. Lubricate the clutch discs and plates with limited slip lubricant.
2. Alternately position clutch plates and discs on a side gear, beginning and ending with a clutch plate.
3. Position the side gear, clutch pack and original shim into the case.
4. Install both pinion gears and thrust washers into the case, and install pinion shaft.
5. Place the case onto an axle shaft supported in a vise.
6. Insert a screwdriver between the pinion shaft and

- the face of the side gear. Force the screwdriver in until the clutch pack is compressed.
7. Check the backlash between side gear and pinion gears. If backlash does not fall into the range of .005" to .008", adjust the shim dimension as required. Increasing shim thickness will decrease backlash; to increase backlash, decrease the thickness of the shim. Service shims are available from .070" to .122" in increments of .004".
 8. Remove the pinion shaft, pinion gears, side gear, clutch pack and shim from the case.
 9. Install the opposite gear, clutch pack and original shim into the opposite side of the case. Place both pinion gears, and thrust washers into position, and install the pinion shaft.
 10. Follow the procedure in steps 5, 6 and 7 to determine the proper shim dimension.
 11. When the proper shims have been determined to achieve .005" to .008" backlash between both pinion gears and both side gears, install shims, clutch packs and side gears into case.
 12. Mount the case onto the axle shaft locked in a vise. Place both pinions and thrust washers into position-180°-apart-and carefully "roll in" by turning the case on the shaft.
A large "C" clamp may be used to apply slight compression against pinion gears to aid the "rolling in" procedure.
 13. Tap the preload spring into place with a hammer.
 14. Install the pinion shaft and lock screw.
 15. Install the side bearings and ring gear using the procedure outlined for conventional units.
 16. Place the differential unit in the carrier and adjust ring gear and pinion backlash, and gear tooth pattern.

BORG WARNER (CONE TYPE)

MAINTENANCE AND LUBRICATION

Refer to Section 0B for maintenance and lubrication requirements.

SERVICE PROCEDURES

Rear axle service procedures are the same for the limited slip as for the conventional differential, except for servicing the case assembly.

If the case, clutch cone/side gears, or pinion gears are damaged, it is necessary to replace case assembly.

Never raise one wheel and run the engine with the transmission in gear. The driving force to the wheel on the floor will cause the vehicle to move. Do not use "on the vehicle" type wheel balancers on the rear wheels, unless both wheels are off the floor.

Differential Case

Disassemble

1. Before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.
2. Place one outer race onto its matched inner race and roller assembly and turn slowly, applying hand load.
3. If bearing outer race turns smoothly and no visible damage is found, bearing can be reused.

4. Repeat above operation with other race and matched bearing and check for smoothness.

Both side bearings and their outer races are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs.

If either bearing is loose on case, entire case must be replaced.

6. If bearing inspection indicates, bearings should be replaced.
7. If removing ring gear, clamp case in vise so jaws are 90° to pinion shaft holes and remove ten ring gear retaining bolts.
8. Partially install two bolts on opposite sides of ring gear.
9. Remove ring gear from case by alternately tapping on bolts. Do not pry between case and ring gear.
10. Remove differential case half attaching bolts.
11. Lift cap half of case from flange half. Remove clutch cone/side gears, spring blocks, preload springs, pinion gears and shaft.

Be certain that each clutch cone/side gear and pinion gear are marked so they can be installed in their original location.

Cleaning and Inspection

1. Make certain all parts are absolutely clean and dry.
2. Inspect pinion shaft, pinion and side gears, brake cone surfaces and corresponding cone seats in case. The cone seats in case should be smooth and free of any excessive scoring. Slight grooves or scratches, indicating passage of foreign material, are permissible and normal. The land surface on the heavy spirals of male cones will duplicate case surface condition. If case or clutch

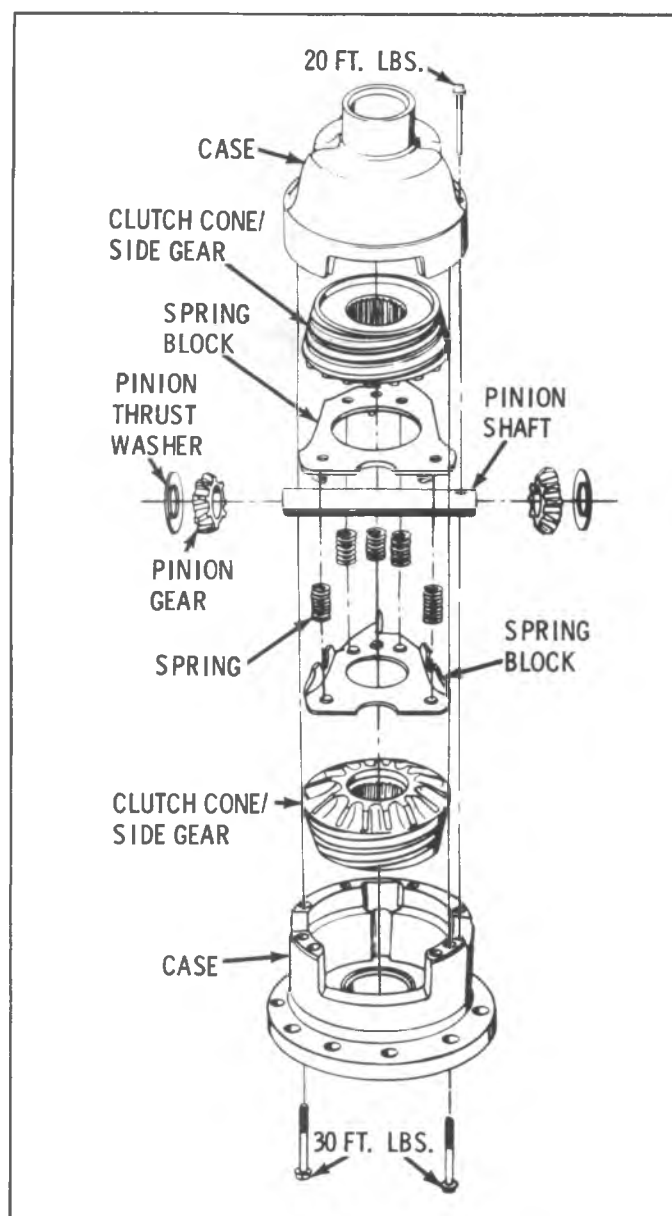


Fig. 4B6-15--Limited Slip (Cone Type)

DESCRIPTION

The limited slip differential can be identified by a tag attached to the lower right section of axle cover. It is designed to direct the major driving force to the wheel with greater traction, thereby reducing the possibility of the car becoming stuck while driving under adverse conditions.

All rear axle parts of vehicles equipped with the limited slip differential are interchangeable with those equipped with the conventional differential, except for the case assembly. It is similar in all respects to the conventional case assembly, with the addition of cone clutches splined to each side gear.

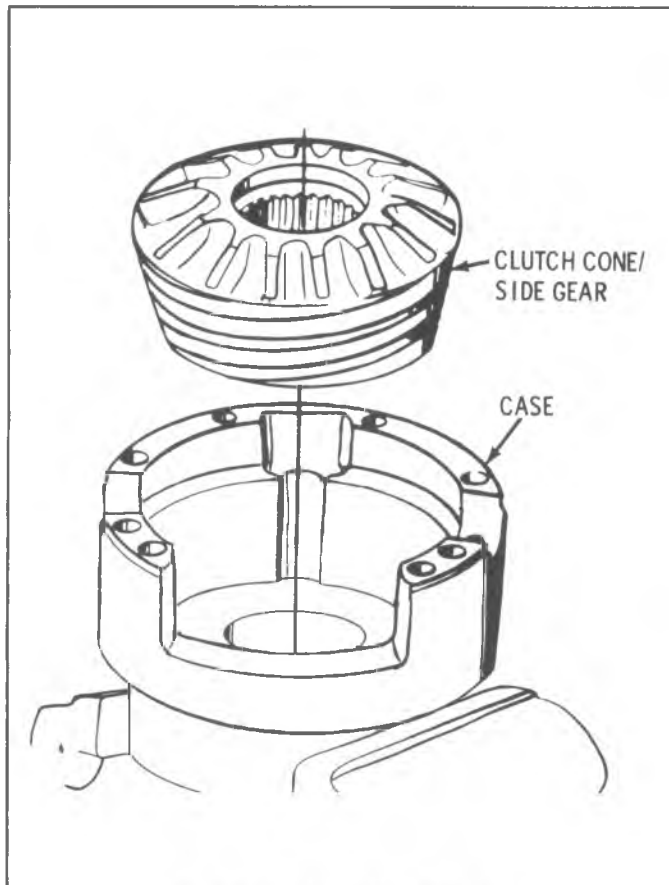


Fig. 4B6-16--Cone-Gear Position

cone/side gear are damaged, it is necessary to replace case assembly. All other parts are serviceable.

Assembly

1. Install proper cone/gear assembly, seating it into position in cap half of case (Fig. 4B6-16).

Be certain that each cone/gear is installed in proper case half, since tapers and surfaces become matched and their positions should not be changed.

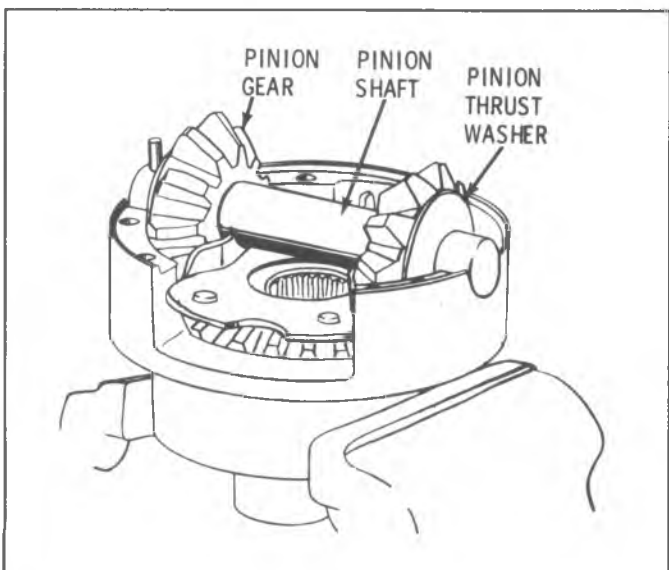


Fig. 4B6-17--Pinion Shaft Position

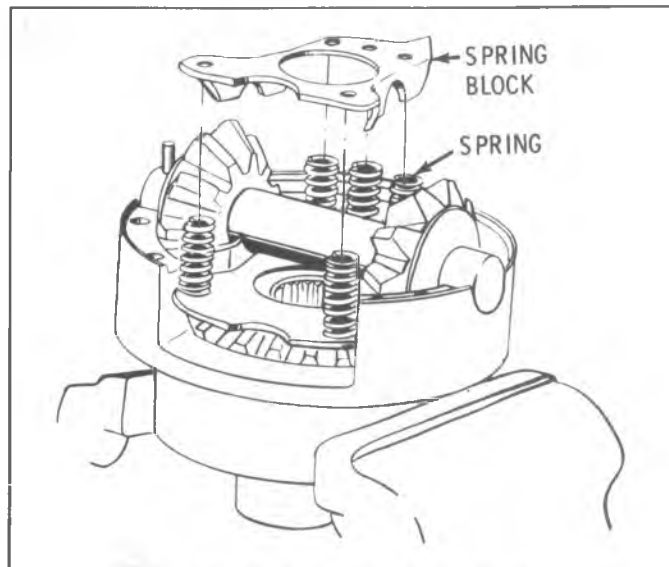


Fig. 4B6-18--Spring and Spring Block

2. Place one spring block in position over gear face, in alignment with pinion gear shaft grooves. Install pinion shaft, pinion gears and thrust washers into cap half or differential case in such a manner that pinion shaft retaining dowel can be inserted through pinion gear shaft into differential case. This prevents pinion shaft from sliding out and causing damage to carrier (Fig. 4B6-17).

Be certain that pinion gears are installed in their original locations.

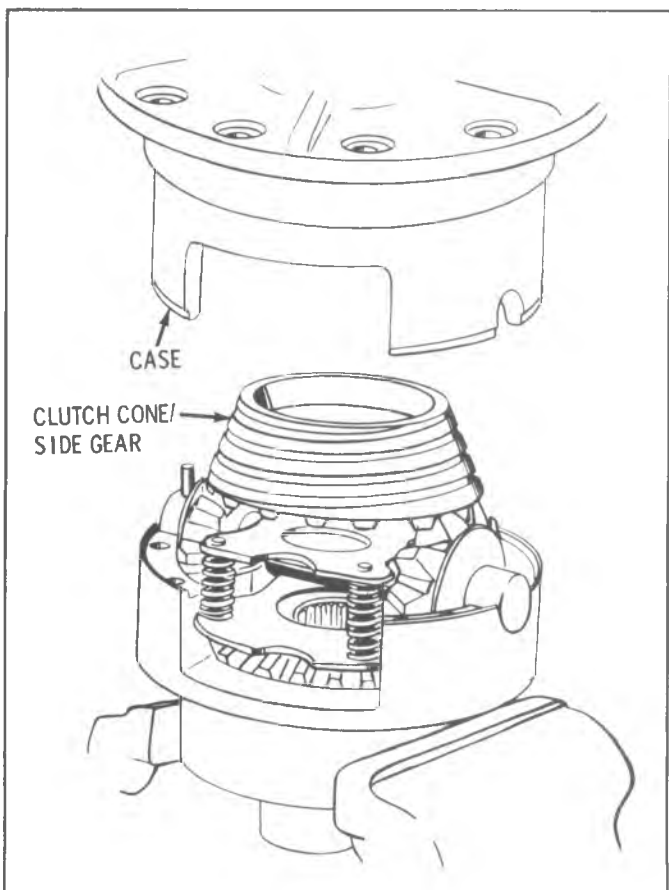


Fig. 4B6-19--Case-Cone Installation

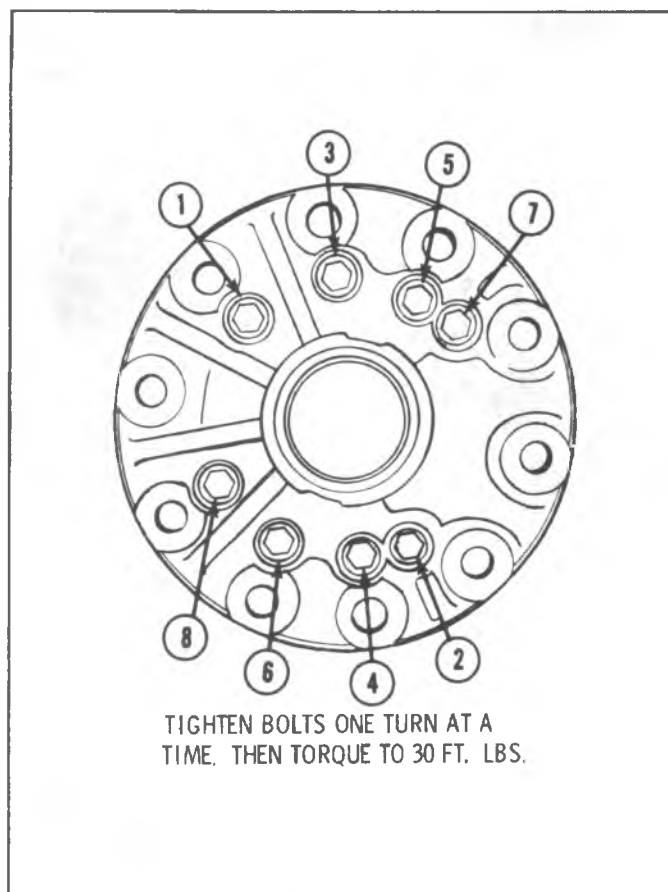


Fig. 4B6-20--Bolt Torque Sequence

3. Insert five springs into spring block that is already installed into case, then place second spring block over springs (Fig. 4B6-18).
4. Install second cone/gear assembly face down on spring block so that gear will mesh with pinion gears.
5. Install flange half of differential case over cone, insert case bolts finger tight (Fig. 4B6-9).
6. Tighten bolts one turn at a time in sequence shown in Fig. 4B6-20. Then torque case bolts to 40 N·m (30 ft. lbs.).
7. If side bearings were removed, lubricate outer bearing surfaces and press on bearings as shown in the Service Manual.
8. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.
9. Lubricate NEW attaching bolts with clean engine oil and install.
10. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 160 N·m (120 ft. lbs.) torque. Do not use hammer to force ring gear on case.
11. Install unit into axle carrier.

POWER-LOK DIFFERENTIAL

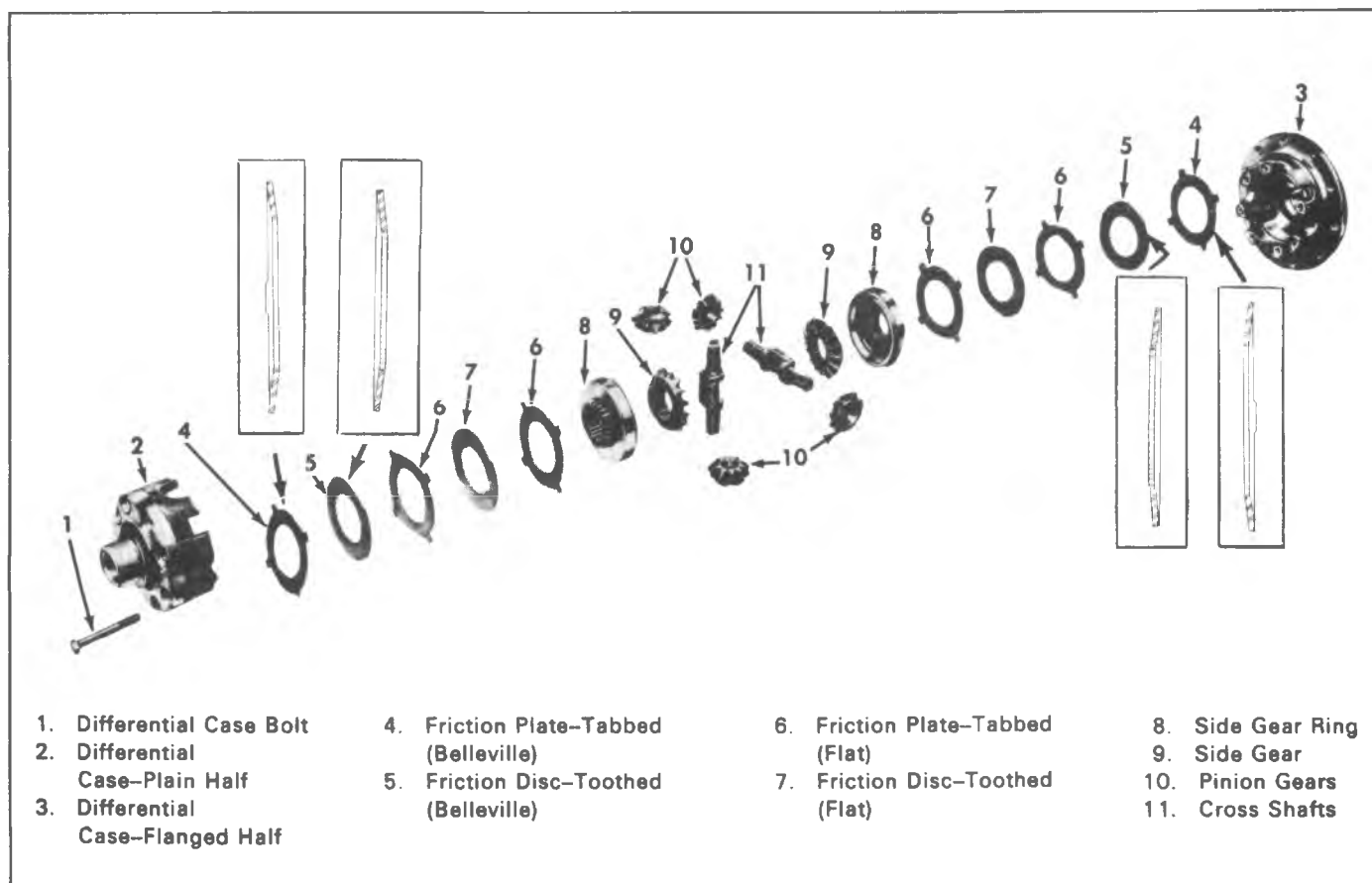


Fig. 4B6-21--Power-Lok Differential

The Power-Lok differential shown in figure 4B6-21 is a unit which is installed as optional equipment in place of the standard differential. The locking differential permits the major driving force to be transmitted to the wheel with better traction. This means that the vehicle can be operated on ice, snow, sand or under other adverse conditions with a minimum amount of slippage through one wheel.

Disassembly

1. Remove differential bearing cups and tag for reassembly reference.
2. Remove differential bearing cones, using Puller Tool J-22888.
3. Tag each bearing cone and shim for reassembly reference, as they should be replaced in their original locations.
4. Scribe mark on both halves of differential so they can be reassembled in their original locations.
5. Remove eight bolts attaching two halves of case together.
6. Separate plain half of differential case from flanged half.
7. Remove five plates and discs from side gear ring.

A series of clutch plates and dished (Belleville) friction plates on each side of differential side gears transmits drive from differential case to axle shafts. Carefully observe the order in which the plates are used, since they must be replaced in the same order. Refer to figure 4B6-21.

8. Remove side gear ring and side gear.
9. Remove two cross shafts and pinion gears.
10. Remove side gear, side gear ring, and five plates and discs from the opposite side. Observe the order in which the plates are used.

Inspection

1. Inspect cross shafts and pinions for scoring, wear, pitting, etc. If the center lands of either cross shaft show signs of wear, examine ends of axle shafts to determine if the axle shaft is rubbing against cross shaft. This rubbing condition may cause a whine or howl that is similar to a pinion bearing noise, at 40 to 50 MPH. This condition can be corrected by grinding 1/32" off the end of the axle shaft.
2. Inspect clutch discs and plates for wear, cracked, or distorted condition.
3. Inspect side gear rings, side gears, and differential cases for worn, cracked, or distorted condition that would render these parts unfit for further services.

Assembly

During assembly operations, all parts should be kept clean and free of dirt or other foreign material. As each part is assembled in its proper position, it is necessary that it be lightly coated with the correct lubricant.

1. Place tabbed Belleville friction plate (4) in flanged differential case, being extremely careful that convex (bulged) side is toward the side gear. See figure 4B6-21.

2. Assemble remaining plates and discs to splines of side gear ring, being sure they are assembled in the same order of removal. The convex (bulged) side of the Belleville friction disc (5) should be toward the side gear and it should nest into the Belleville friction plate (4).
3. Place assembled side gear ring with plates and discs in flanged half of differential case.
4. Install side gear and cross shafts with pinions.
5. In the order listed install the following: (1) side gear, (2) side gear ring, (3) flat plate with tabs, (4) flat disc with teeth, (5) flat plate with tabs, (6) Belleville disc with convex (bulged) side up, or toward side gear, (7) Belleville plate, with convex (bulged) side up, or side toward gear.
6. Position plain half of differential case over previously assembled parts with scribe markings on both halves of case in alignment.
7. Install differential case bolts, but do not tighten at this time.
8. Before tightening bolts, use axle shafts and align splines of the side gear and side gear ring, on each side. Tighten bolts evenly and alternately. Remove axle shafts.

9. Observe if Power-Lok components have been assembled properly. Each pinion cross shaft can be tight on its ramp or if there is clearance it should be only a few thousandths, and it should be equal at all four cross shaft ends.

Testing Procedure

The Power-Lok can be effectively tested for correct operation by placing one rear wheel on good dry pavement and the other on ice, snow mud, gravel, grease, etc.

It can easily be determined whether or not the non-slipping wheel is providing pulling power. The procedure should then be repeated with the opposite wheels on the dry and slippery surfaces.

The above testing procedure is a rough test that can be made by the owner of the vehicle. However, if it is suspected that the unit is not operating properly, it can be checked by the following procedure.

Be sure the transmission is in neutral. Raise one wheel off the floor and place a block in the front and rear of the opposite wheel. Remove the hub cap and install a special tool across two wheel studs. Apply a torque wrench to special tool. Disregard breakaway torque and observe only the torque required to continuously turn the wheel smoothly.

If the torque reading is less than 54 N·m (40 ft. lbs.) or more than 280 N·m (200 ft. lbs.), the unit should be disassembled and the necessary repairs made.

EATON POSITIVE LOCKING DIFFERENTIAL

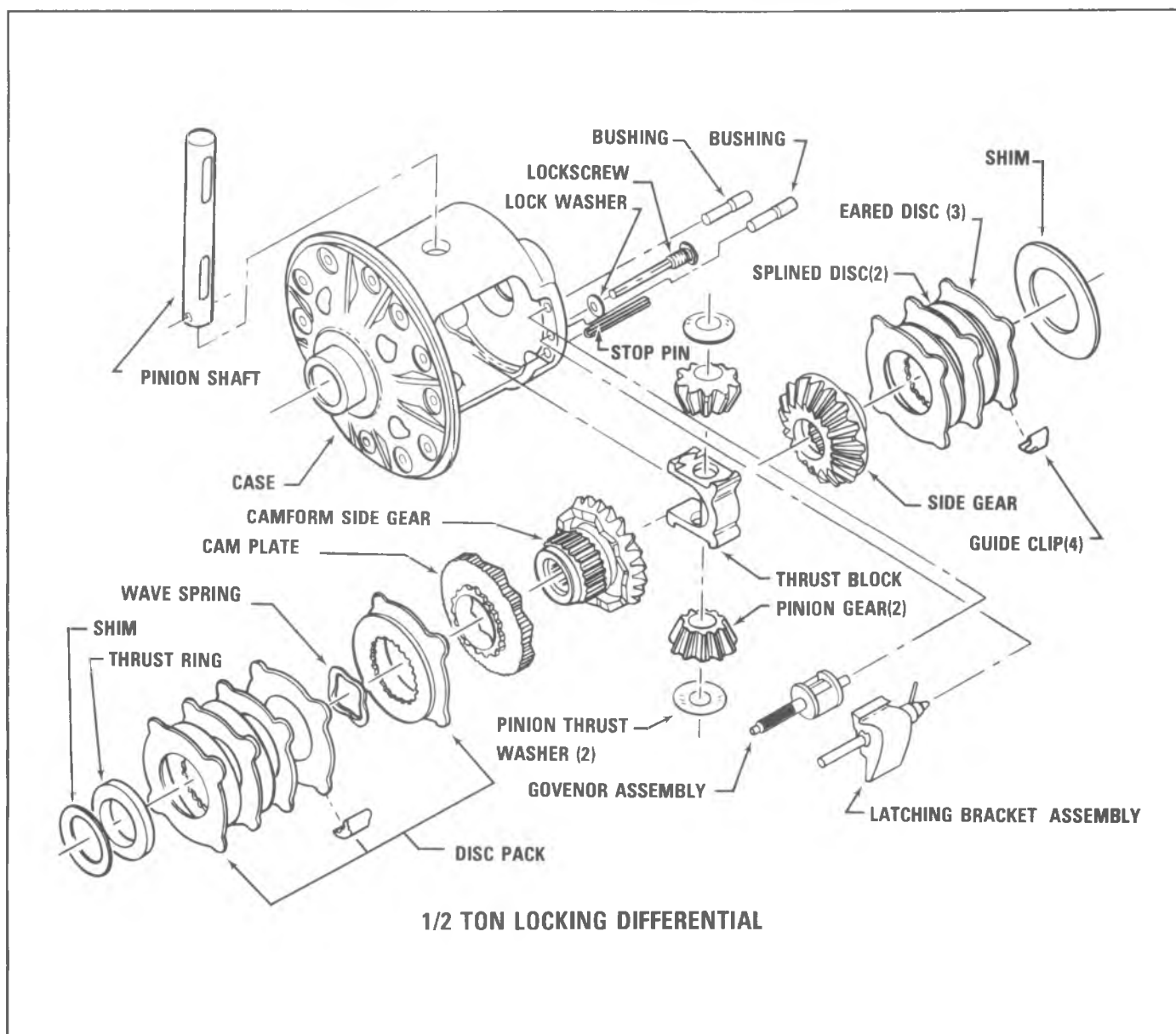


Fig. 4B6-1H--1/2 Ton Unit

GENERAL DESCRIPTION

Trucks equipped with locking differentials use one of the Eaton locking units in Figure 4B6-1H, 2H. These differentials provide true differential action and also incorporate a speed sensitive device which automatically and positively locks both rear wheels together if either wheel should spin excessively during slow vehicle operation.

Locking is accomplished through the use of a flyweight governor mechanism, cam system, and multi-disc clutch. 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 a multi-disc clutch locking one side gear to the case. At wheel-to-wheel differentials of less than approximately 100 rpm, the unit operates as a standard or open differential.

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 not necessary.

Service Test Procedure

1. Place the Truck 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. If both wheels attempt to turn together the differential is locking and is defective.

Rapid wheel rotation will cause a properly operating differential to lock and both wheels will rotate in the same direction.

3. Raise hoist to maximum height with one person in vehicle.

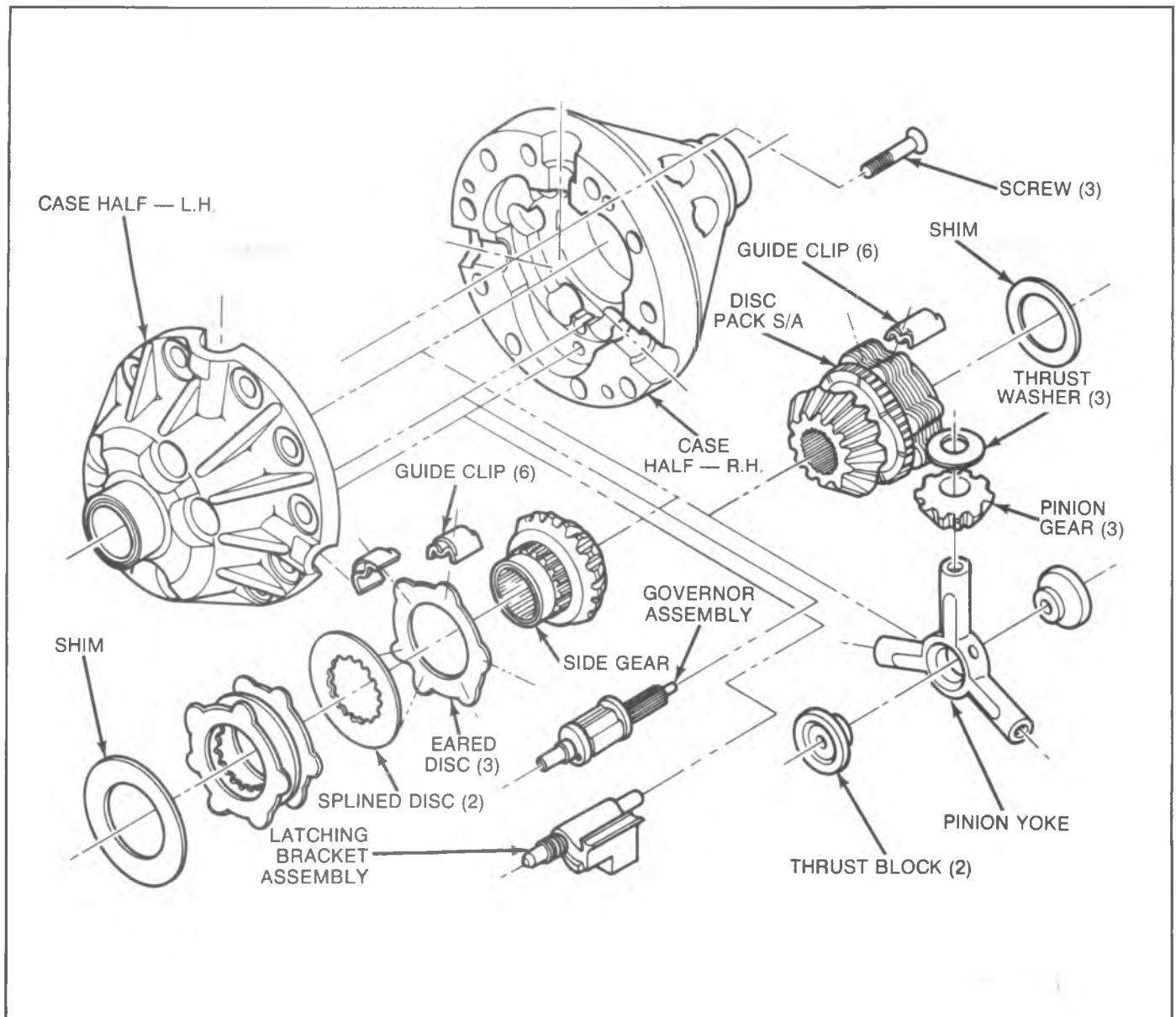


Fig. 4B6-2H--3/4 Ton Unit

4. Start engine making sure that carburetor is set to provide a low idle speed of 600-800 rpm.
5. Place transmission in drive range and apply brakes. With manual transmission, depress clutch and place transmission in first gear.
6. Lock one rear wheel by pulling one parking brake cable from under the vehicle.
7. With engine at low idle, slowly release brakes. With manual transmission, slowly engage clutch.
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 turn 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 (16 km/h) 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.

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.

UNIT REPAIR

Due to critical internal clearance dimensions, differential side gears and case cannot be serviced separately. If any side gear or case damage is found the entire differential must be replaced.

Internal clearances are such that shims, reaction block and thrust rings should not be replaced unnecessarily even if slight wear indications are present. If shims, reaction 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.

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 in cam gear assembly.	D. Replace clutch plates and wave spring.
Locks in turns:	A. Governor 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.
Noisy:		
NOTE:	In addition to normal axle noise (see section on standard differential), the locking differential exhibits some clutch noise upon engagement and disengagement.	
	A. Broken clutch plates.	A. Replace clutch plates and wave spring.
	B. Broken reaction block.	B. Replace reaction block.* Check closely for other damage. Replace entire unit if housing, side gear, or pinion gears are damaged.
	C. Broken differential gears.	C. Replace entire unit.

*Reaction blocks must be replaced with blocks of identical thickness.

Fig. 4B6-3H--Diagnosis Chart

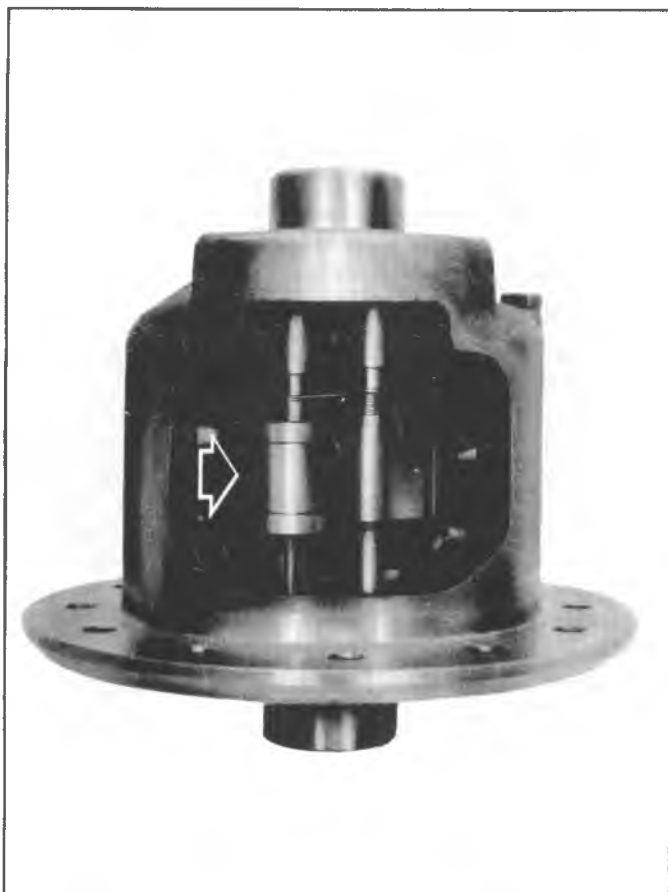


Fig. 4B6-4H--Governor and Latching Bracket

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.

Disassembly

1. Note position of governor and latching bracket assembly, Figure 4B6-4H. 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 4B6-5H. 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.
4. Remove thrust block and pinion thrust washers.
5. Remove cam gear, disc pack assembly and disc pack guide clips.
6. Remove plain side gear and shims.

Inspection

1. Clean all parts with solvent. 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 guides and guide clip.
- Pinion cross-shaft.
- Pinion gears.
- Pinion thrust washers.
- Reaction 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 reaction block or flange end shim 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

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 (front face of gear to back side of thrust ring, include shim). This dimension will be needed to

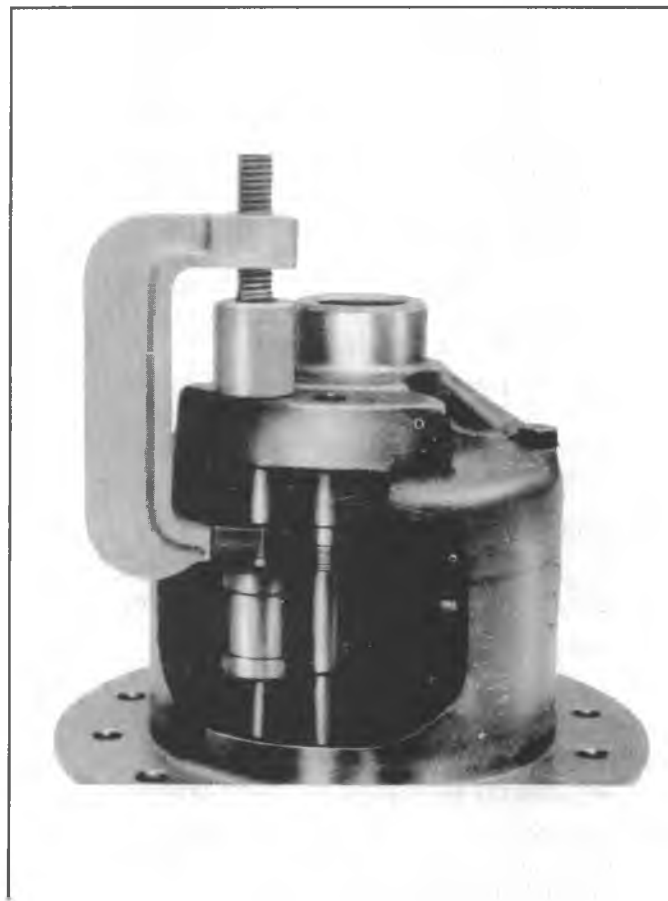


Fig. 4B6-5H--Bearing Puller J-26252

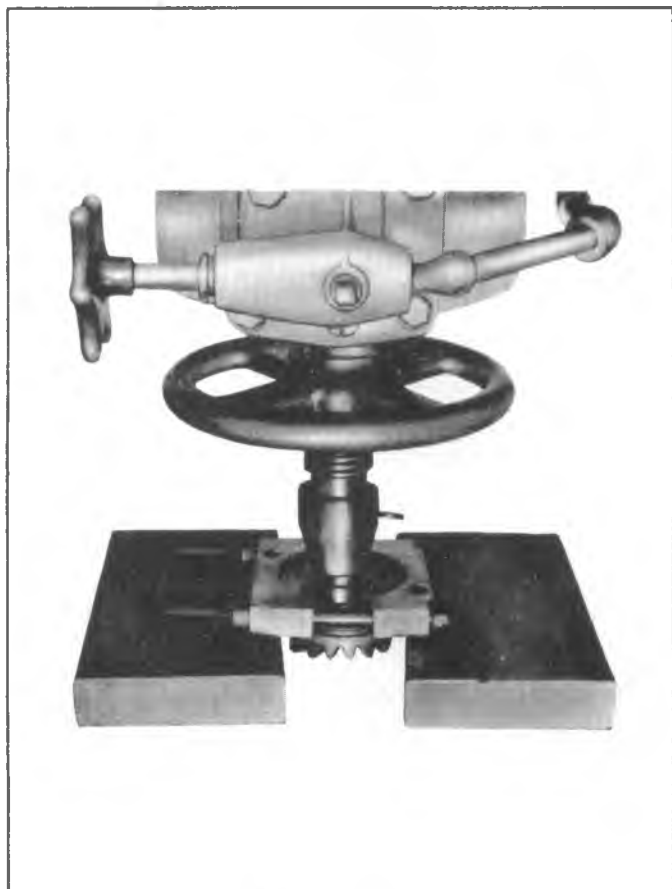


Fig. 4B6-6H-Bearing Remover J-22912

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 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.
4. Install a 1-1/2" to 1-3/4" 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 4B6-6H.

Reassembly

Replace cam plate and wave spring or clutch discs as necessary and reassemble as follows: See Fig. 4B6-1H.

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 (3) 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.

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 A 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.

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 the opposite end side gear 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 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: Reaction 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 4B6-4H. 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.



Fig. 4B6-7H--3/4 Ton Unit

7. Install ring gear and side bearings using the procedure outlined for conventional differentials.
8. Place differential unit in carrier and adjust ring gear and pinion backlash and gear tooth pattern as outlined in the conventional differential section.
9. Check operation as outlined in the Service Test Procedure.

NOTICE: Use standard differential lubricant. Do not use lubricant designed for "Limited Slip" differentials, or damage may result

10-1/2" RING GEAR AXLE 3/4 TON AND 1-TON TRUCKS

CAUTION: Due to critical internal clearance dimensions, differential side gears and case cannot be serviced separately. If any side gear or case damage is found, the entire differential must be replaced.

CAUTION: Internal clearances are such that shims, reaction blocks, and thrust ring should not be replaced unnecessarily even if slight wear indications are present. If shims, reaction blocks, 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.

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 locations Fig. 4B6-7H.
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.
 - Pinion yoke.
 - Pinion gears.
 - Pinion thrust washers.



Fig. 4B6-8H--3/4 Ton Assembly

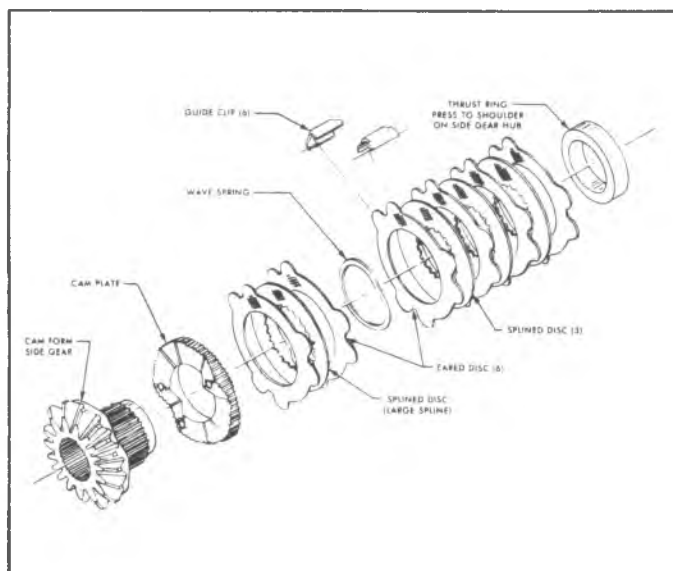


Fig. 4B6-9H—Cam Plate and Clutch Discs

- Reaction blocks (4 sizes).
- Thrust ring.
- Right side shim (4 sizes).
- Left side guide clips.

Attempts to service other components will disturb critical clearances and may result in differential failure. If reaction blocks or right side shim 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

If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows: Refer to Figure 4B6-9H.

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) 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.
4. Install a 1-1/2" to 1-3/4" diameter plug (J-8107-4) 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 reassemble 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. 4B6-9H.
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.

Reassembly

1. Install (6) 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 right side case half. 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 A 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.

3. Install right side reaction 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 disturb 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 button end of reaction block. A light tap on the yoke may be needed to seat it in the housing.
5. Install left side reaction block on the yoke with flange side 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: Right and left side reaction blocks may not be the same thickness. If blocks are broken or cannot be accurately measured for thickness, the entire differential must be replaced. Incorrect block thickness will disturb critical clearances and may result in differential failure.

6. Install governor assembly and latching barcket 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 original (3) eared and (2) splined clutch plates on the left side gear alternately, starting and ending with an eared disc.

NOTICE: Original discs must be used. Attempts to install other than original discs will disturb critical clearances and may result in differential failure.

8. Install (6) clutch pack guide clips on the left side disc pack assembly using grease for retention.
9. Install original shim in left side case half.

NOTICE: Original shim must be used. Attempts to install other than original shim will disturb critical clearances and may result in differential failure. Slight polishing or scuffing on discs and shims is normal.

10. Remove disc pack from side gear and carefully lower disc pack assembly into left side case half. Make sure car 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.

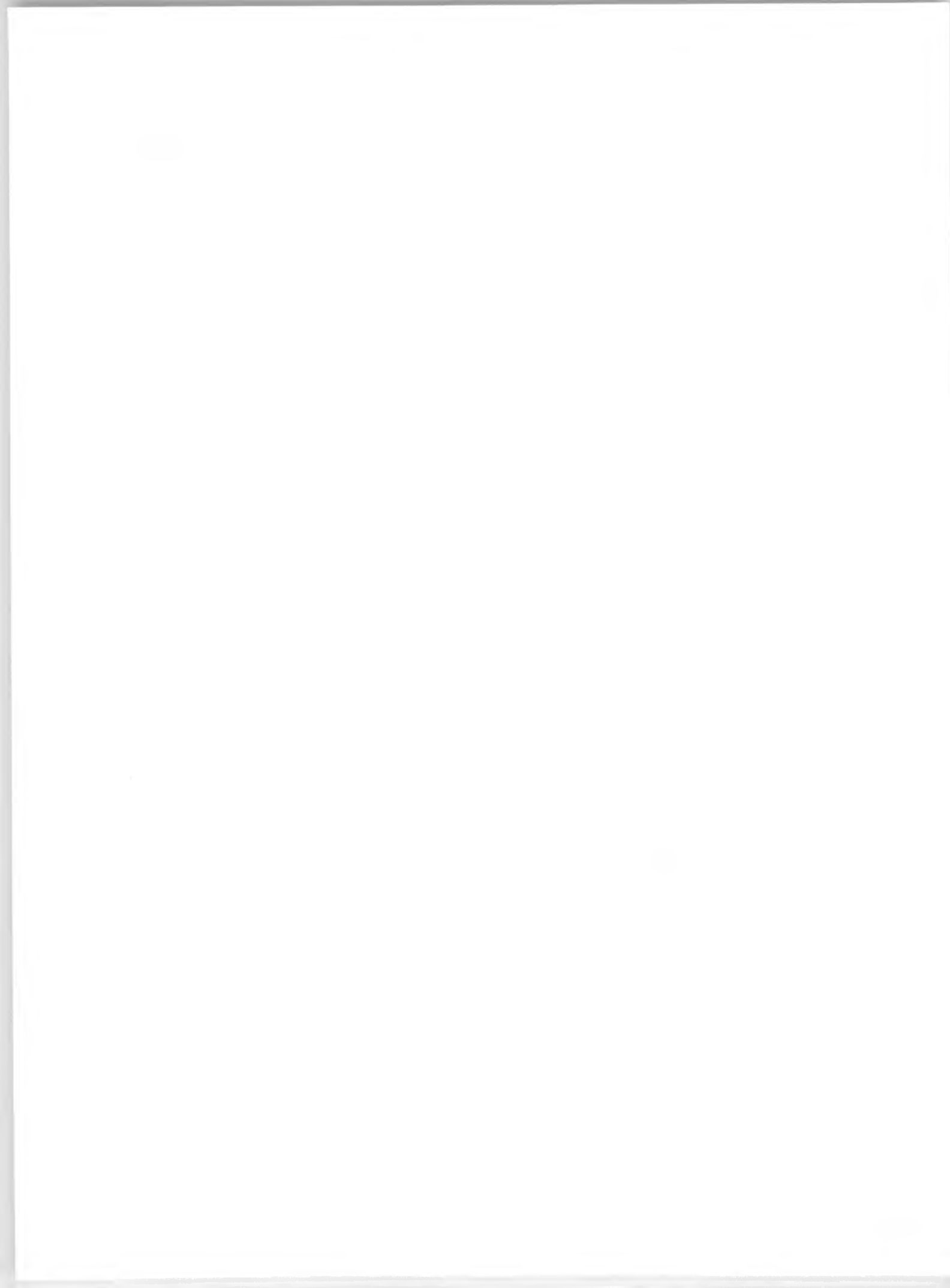
13. Turn entire unit over and install three (3) screws.

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 smoothly without binding or locking up.

NOTICE: Differential will lock if turned rapidly--50 rpm or greater.

15. Install ring gear and side bearings using the procedure outlined for conventional differentials.
16. Place differential unit in carrier and adjust ring gear to pinion backlash and gear tooth pattern as outlined in the conventional differential section.

NOTICE: Use standard differential lubricant. DO NOT use lubricants specifically designed for "limited slip differentials" or damage may result.



SECTION 4B10

SPECIFICATIONS AND SPECIAL TOOLS

DIFFERENTIAL SPECIFICATIONS

	8 1/2"	8 7/8"	9 1/2"	Dana 10 1/2" 9 3/4"	Chevrolet 10 1/2"	12# Rockwell
Gear Backlash Preferred	.005"-.008"	.005"-.008"	.005"-.008"	.004"-.009"	.005"-.008"	—
Min. and Max.	.003"-.010"	.003"-.010"	.003"-.010"	.004"-.009"	.003"-.012"	—
Pinion Bearing Preload (In.-Lbs.)						
— New	15-30	15-30	20-25	20-40	25-35	—
— Used	5-10	5-10	5-15	10-20	5-15	—

BOLT TORQUES (FT.-LBS.)▲

Carrier Cover	20	20	20	35	30	—
Ring Gear	80	60	110	110	120	—
Differential Bearing Caps	55	55	65	85	135	—

▲Except where noted otherwise.

BOLT TORQUES (FT.-LBS.)▲

Filler Plugs	25	18	18	10	18	10
Differential Pinion Lock	20" #	20" #	—	—	—	—
Drive Pinion Nut	—	—	*	*	*	—
Differential Carrier to Axle Housing	—	—	—	—	—	—
Differential Bearing Adjusting Lock	—	—	20	—	20	—
Pinion Bearing Cage To Carrier	—	—	—	—	65	—
Thrust Pad Lock Nut	—	—	—	—	—	—
Brake Backing Plate	35	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
8 1/2"	4.2 Pints
8 7/8"	3.5 Pints
Chevrolet 10 1/2"	5.4 Pints
Dana 10 1/2"	7.2 Pints
Dana 9 3/4"	6.0 Pints
Rockwell 12"	14.0 Pints
Chevrolet 9 1/2"	5.5 Pints

MODEL	SOURCE	TYPE/CAPACITY	RING GEAR SIZE
C10	Chevrolet	Salisbury/3750#	8-7/8"
C10	Chevrolet	Salisbury/3750#	8-1/2"
K10	Chevrolet	Salisbury/ 3750#	8-1/2"
K10	Chevrolet	Salisbury/3750#	8-7/8"
K10	Chevrolet	Salisbury/4000#	8-7/8"
P10	Chevrolet	Salisbury/3500#	8-7/8"
G10	Chevrolet	Salisbury/3500 #	8-7/8"
G10	Chevrolet	Salisbury/3500#	8-1/2"

C20 (Except Crew Cab)	Chevrolet	Salisbury/6000#	9-1/2"
C20 (Crew Cab)	Chevrolet	Salisbury/7500#	10-1/2"
K20	Chevrolet	Salisbury/6000#	9-1/2"
P20	Chevrolet	Salisbury/6000#	9-1/2"
G20	Chevrolet	Salisbury/3500#	8-7/8"
G20	Chevrolet	Salisbury/3500#	8-1/2"

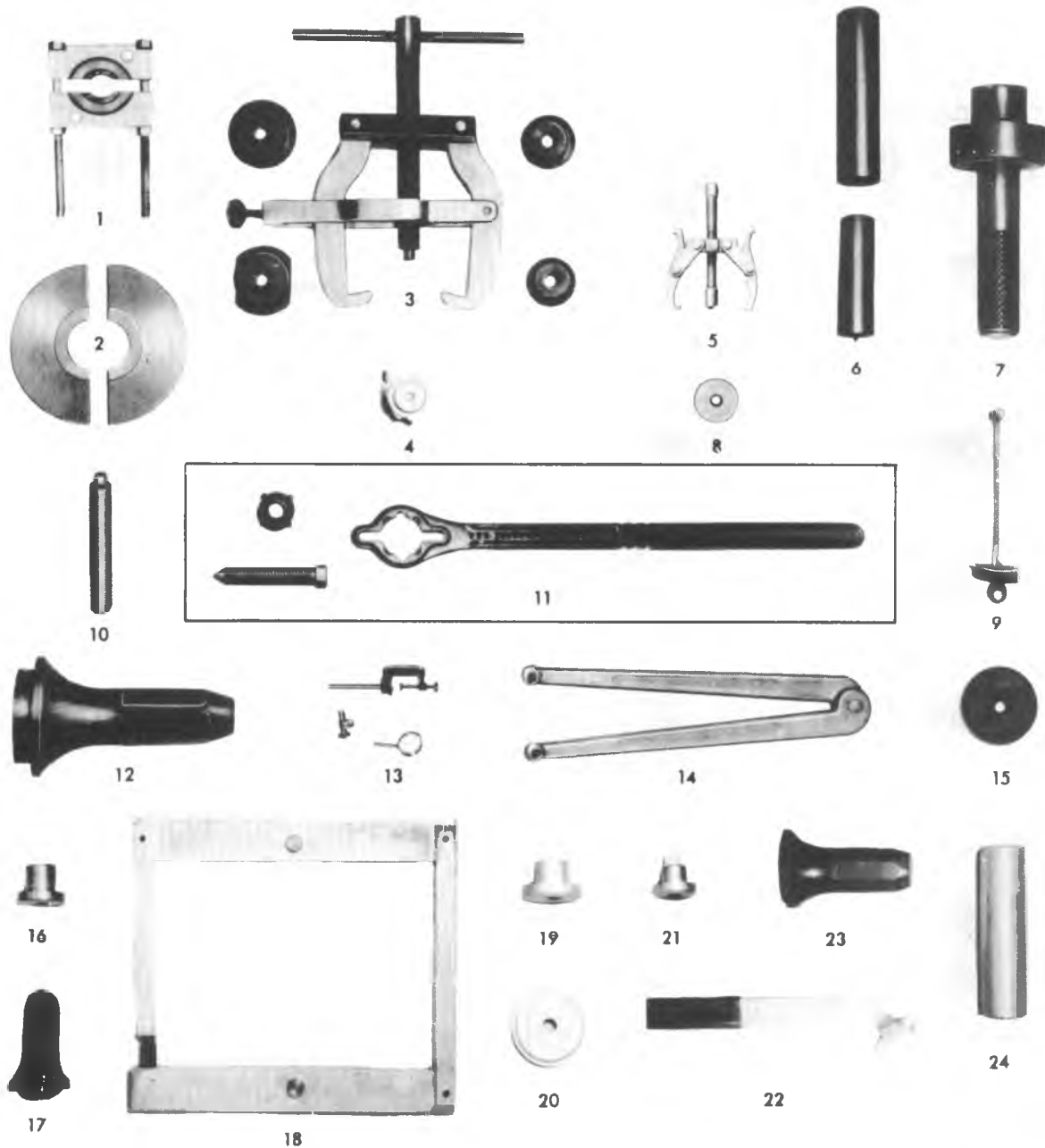
C30 (Except Dual Wheel Camper) K30	Chevrolet	Salisbury/7500#	10-1/2"
C30 (Dual Wheel Camper) K30	Dana	Salisbury/7500#	10-1/2"
P30	Chevrolet	Salisbury/7900#	10-1/2"
P30 (With H22/H23)	Rockwell	Banjo/11,000#	12"
G30	Chevrolet	Salisbury/5700#	10-1/2"
G30 (Dual Wheel)	Dana	Salisbury/6200#	9-3/4"
G30 (Dual Wheel)	Dana	Salisbury/7500#	10 1/2"

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	90 FT. LBS.	1/8 *	250 FT. LBS.	SLIGHT PRELOADED	BARREL ROLLER

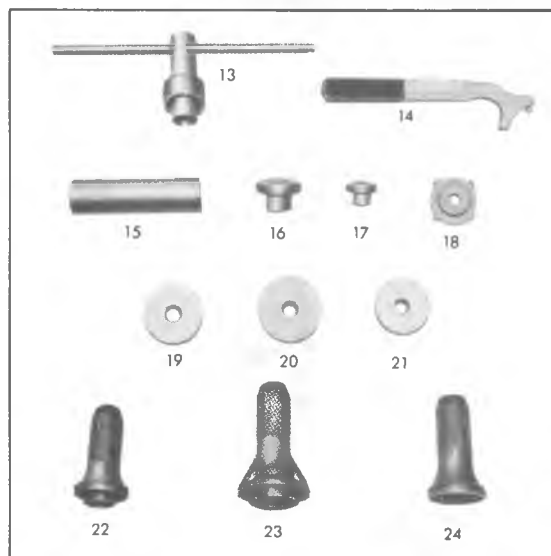
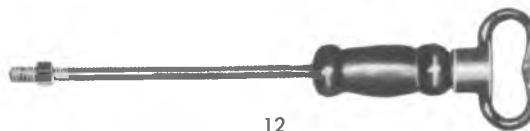
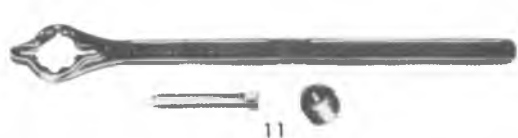
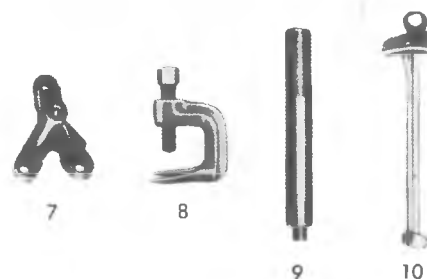
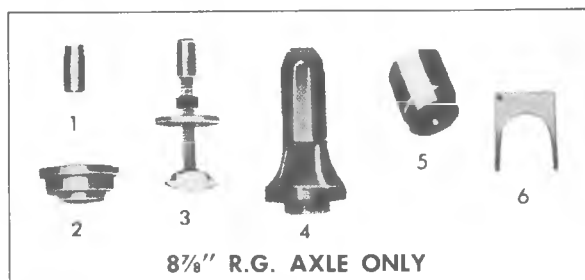
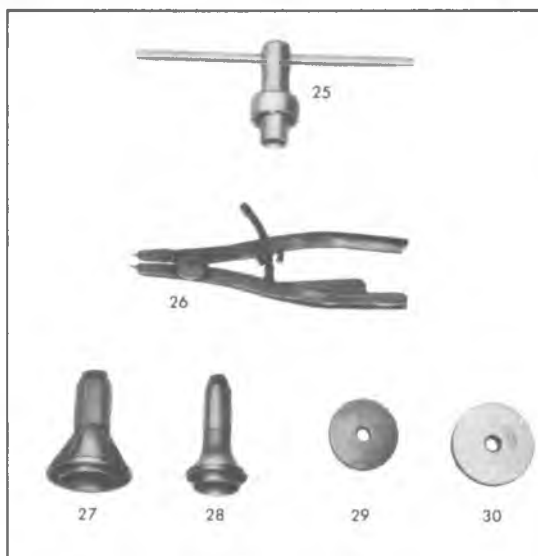
**Back-off nut and retighten to 35 Ft. Lbs. then, back-off nut 1/4 turn.

*With wheel rotating.



- | | | | |
|-------------|---|-------------|-----------------------------------|
| 1. J-22912 | Press Plate | 13. J-8001 | Dial Indicator Set |
| 2. J-1453 | Pinion Bearing Press Plate | 14. J-0972 | Differential Nut Wrench |
| 3. J-8107 | Differential Bearing Puller Set | 15. J-24381 | Pinion Rear Bearing Cup Installer |
| 4. J-8107-3 | Adapter Plug | 16. J-24383 | Side Bearing Installer |
| 5. J-22888 | Differential Side Bearing Remover | 17. J-24384 | Pinion Oil Seal Installer |
| 6. J-1364 | Pinion Bearing Ring Drive | 18. J-24385 | Case Spreader Tool |
| 7. J-1488 | Differential Side Bearing Replacer | 19. J-24430 | Side Bearing Installer |
| 8. J-8608 | Drive Pinion Rear Bearing Cup Installer
(Used with J-8092) | 20. J-24432 | Pinion Rear Cup Installer |
| 9. J-5853 | In.-Lbs. Torque Wrench | 21. J-23322 | Pinion Straddle Bearing Installer |
| 10. J-8092 | Drive Handle | 22. J-24429 | Adjusting Nut Wrench |
| 11. J-8614 | Companion Flange Holder and Remover | 23. J-24434 | Pinion Oil Seal Installer |
| 12. J-22281 | Pinion Flange Oil Seal Installer | 24. J-24433 | Pinion Rear Bearing Installer |

SPECIAL TOOLS

**10 1/2" R.G. AXLE ONLY****12 1/4" R.G. AXLE ONLY**

1. J-21548 Trunnion Seal Installer
2. J-23690 Axle Shaft Bearing Installer
3. J-23689 Axle Shaft Bearing Remover
4. J-21128 Axle Shaft Seal Installer
5. J-21057 Pinion Oil Seal Installer
6. J-22804-1 Pinion Seal Gauge Plate
7. J-5748 Positraction Torque Measuring Adapter
8. J-6627 Wheel Bolt Remover
9. J-8092 Driver Handle
10. J-5853 Torque Wrench - Inch/Pound
11. J-8614-II Companion Flange Holder
12. J-2619 Slide Hammer
13. J-2222 Wheel Bearing Nut Wrench
14. J-24429 Adjusting Nut Wrench
15. J-24433 Pinion Rear Bearing Installer

16. J-24430 Differential Side Bearing Installer
17. J-23322 Pinion Straddle Bearing Installer
18. J-24426 Outer Wheel Bearing Cup Tool
19. J-24432 Pinion Rear Bearing Cup Installer
20. J-24427 Inner Wheel Bearing Cup Installer
21. J-8608 Outer Wheel Bearing Cup Installer
22. J-24384 Pinion Oil Seal Installer - Dana
23. J-24428 Wheel Hub Oil Seal Installer
24. J-24434 Pinion Oil Seal Installer - Chevrolet
25. J-870 Wheel Bearing Nut Wrench
26. J-22380 Tru-Arc Pliers
27. J-22354 Wheel Oil Seal Installer
28. J-22281 Pinion Oil Seal Installer
29. J-8114 Wheel Bearing Outer Cup Installer
30. 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. The K-30 axle assembly is a Dana (60 Series) which incorporates a 9-3/4" ring gear and has a 4500 lb. capacity.

AXLE SHAFT

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 break hose.
4. Remove hub lock mechanism.
5. Remove gears and snap rings.

DIAGNOSIS

EXCESS NOISE COMPLAINT DIAGNOSTIC PROCEDURE	
Road Test	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 gears and snap rings.
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 break 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.

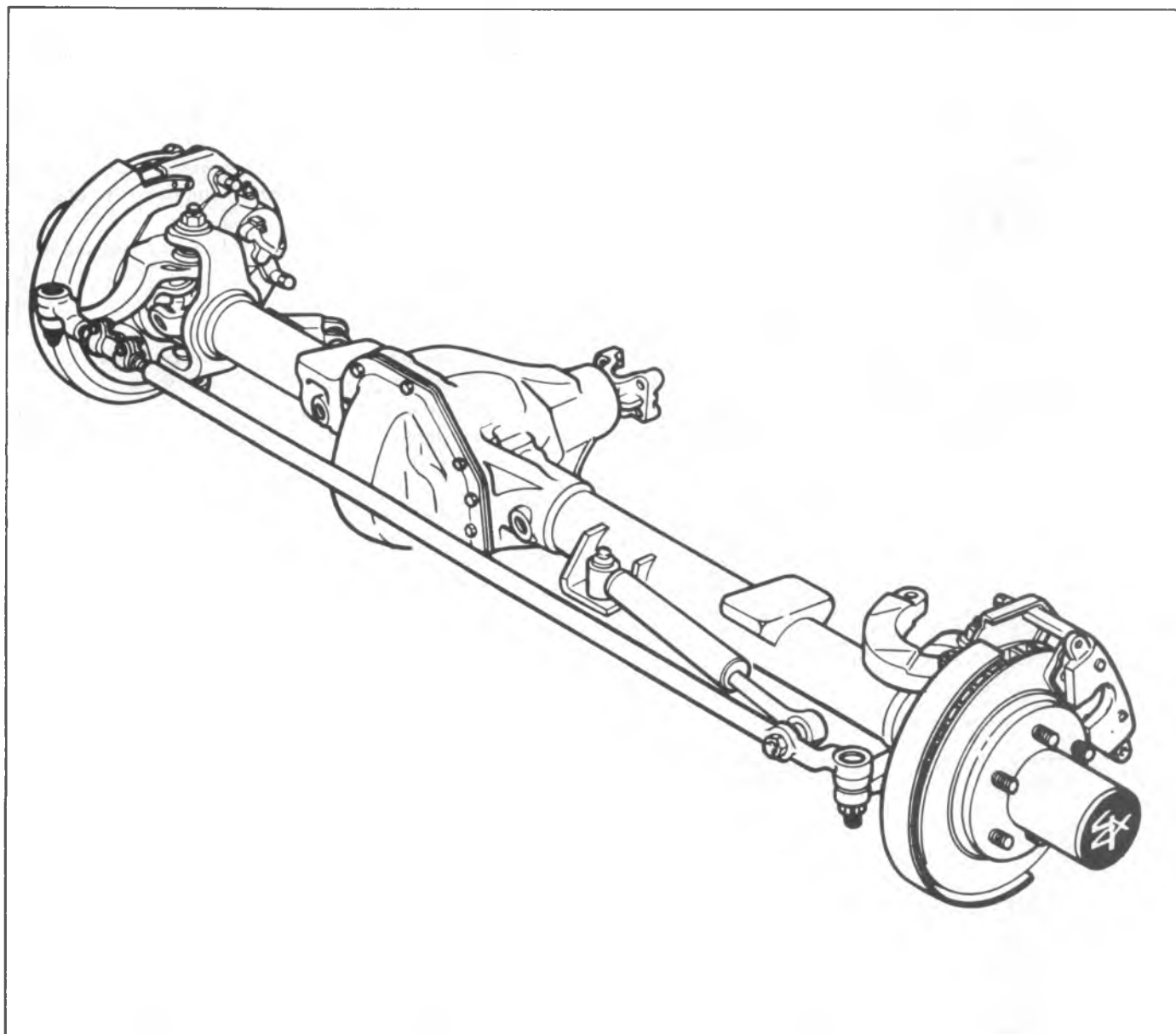


Fig. 4C-2--Front Drive Axle Typical

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.
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.

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 (see Section 5).

Disassembly

Refer to Section 3C 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 Section 3C).
3. Remove the wheel bearing outer lock nut, lock ring, and wheel bearing inner adjusting nut as outlined in Section 3C.
4. Remove the disc assembly outer wheel bearing and the spring retainer plate.

If the disc or other brake components require repairs or replacement, refer to Section 5.

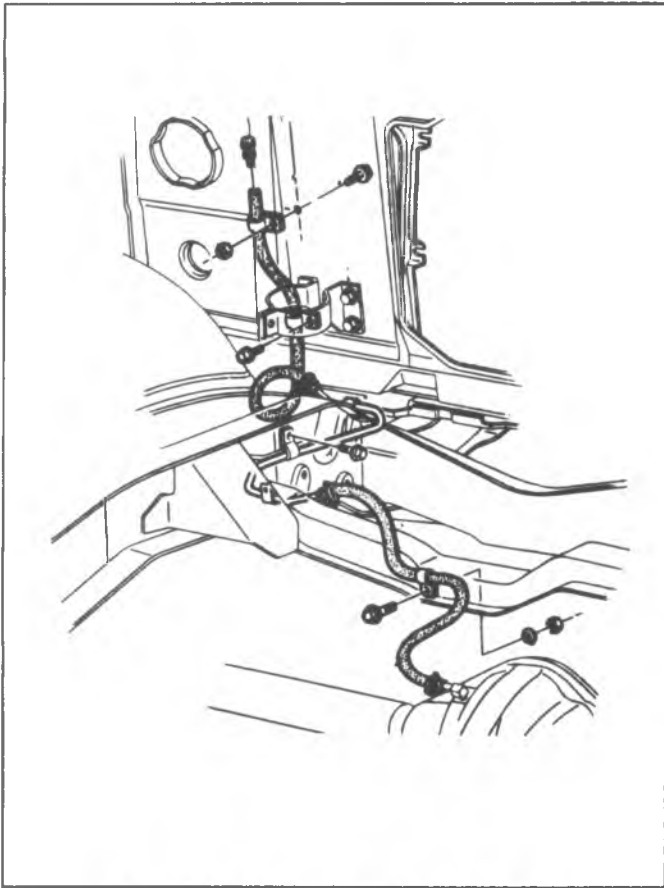


Fig. 4C-3--Axle Vent Hose Routing Typical

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 one 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 .020".

NOTICE: Do not attempt to remove differential without using the spreader tool. Do not expand carrier more than .020 in. or it may be damaged and take a permanent set.

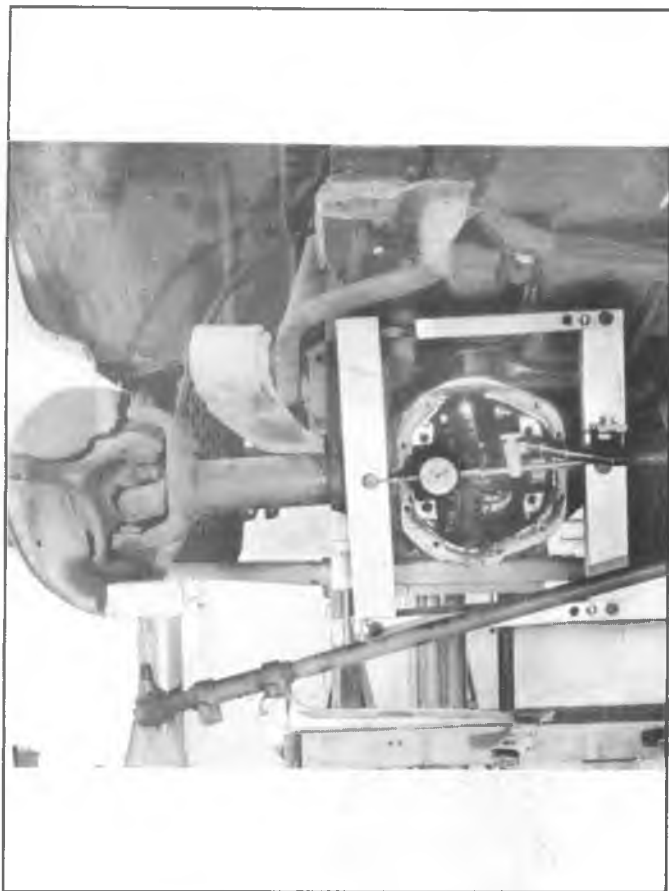


Fig. 4C-4--Removing Differential Case On Vehicle

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-22888 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

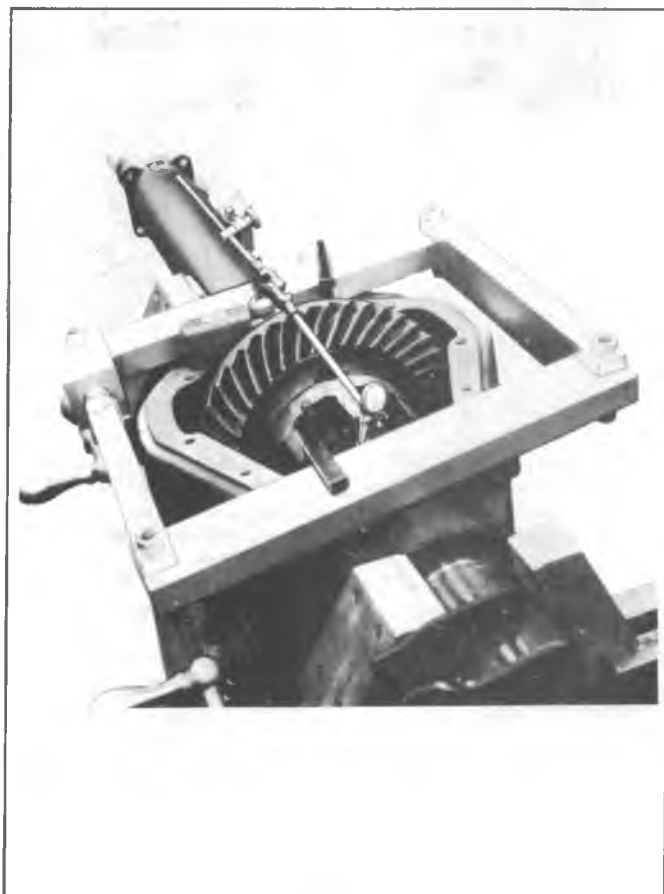
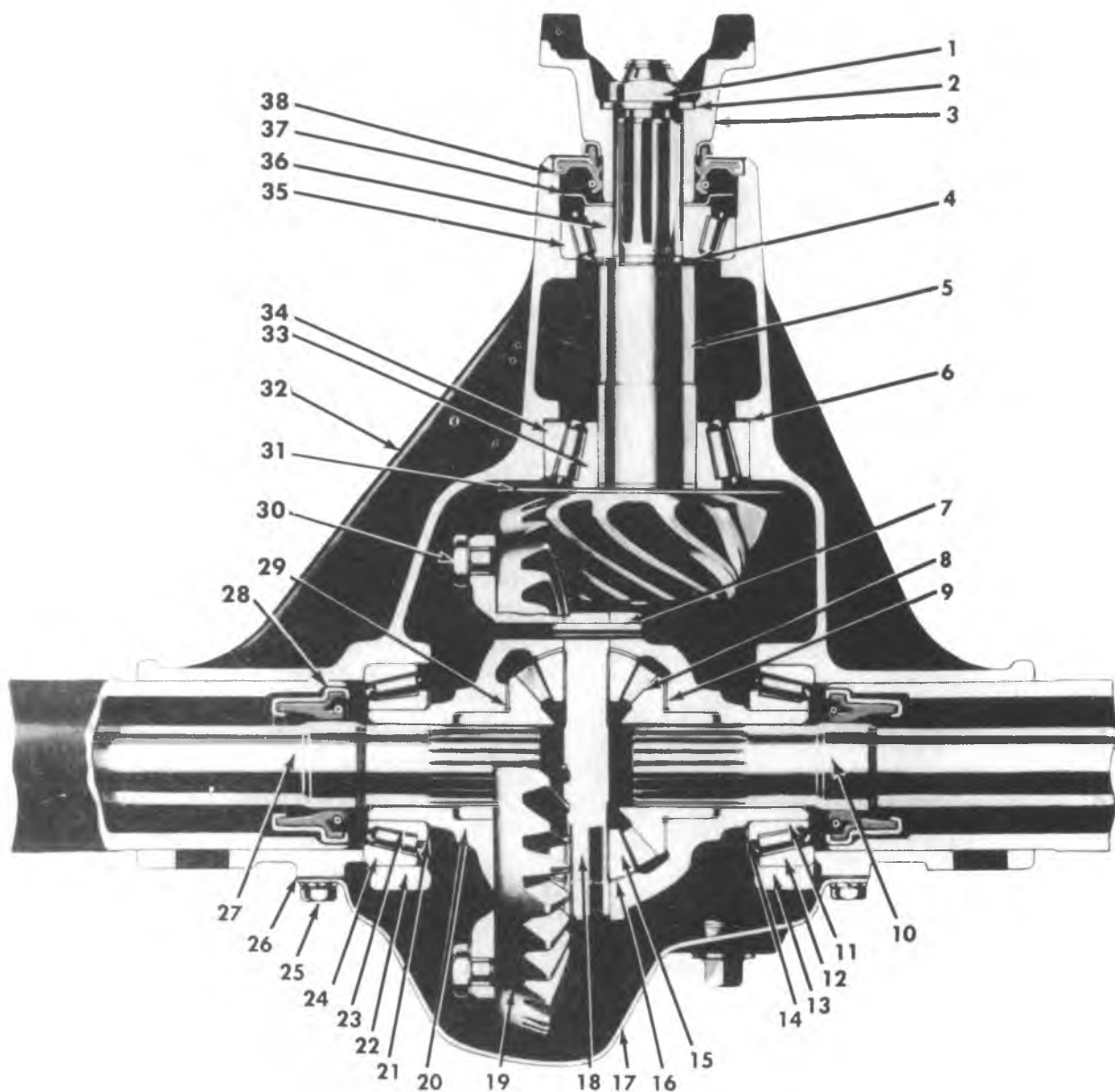


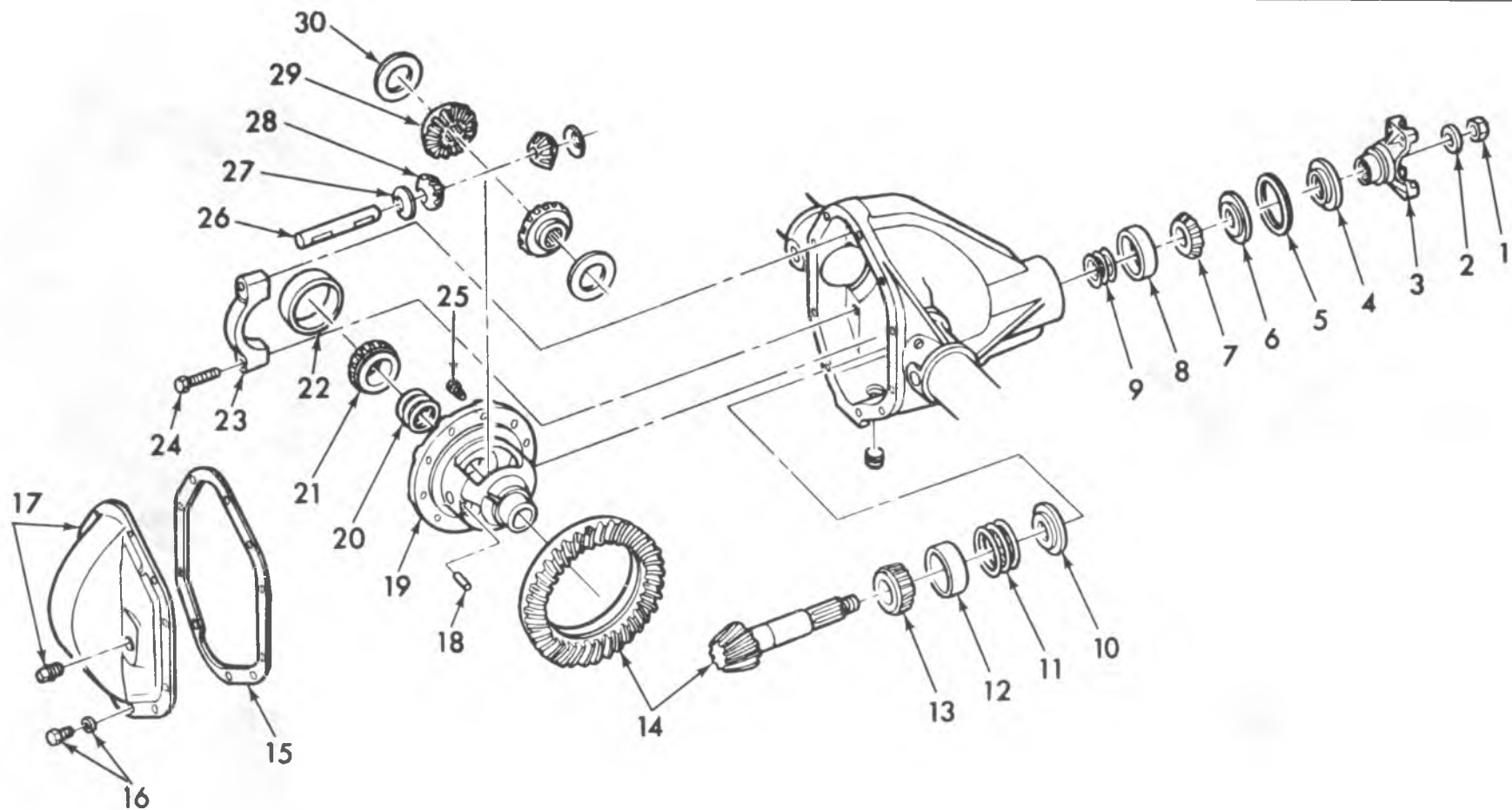
Fig. 4C-5--Spreading Case With J-24385



- | | | | |
|---------------------------|--|--|--------------------------|
| 1. Nut | 11. Differential Bearing Cone | 20. Differential Case | 29. Thrust Washer |
| 2. Washer | 12. Differential Bearing Cup | 21. Differential Bearing Adjusting Shims | 30. Ring Gear Bolt |
| 3. Pinion Flange | 13. Bearing Cap | 22. Differential Bearing Cap | 31. Oil Slinger |
| 4. Outer Bearing Shims | 14. Differential Bearing Adjusting Shims | 23. Differential Bearing Cone | 32. Differential Carrier |
| 5. Drive Pinion | 15. Differential Pinion | 24. Differential Bearing Cup | 33. Inner Bearing Cone |
| 6. Inner Bearing Shims | 16. Thrust Washer | 25. Cover Bolt | 34. Inner Bearing Cup |
| 7. Lock Pin | 17. Cover | 26. Gasket | 35. Outer Bearing Cup |
| 8. Differential Side Gear | 18. Pinion Cross Shaft | 27. Axle Shaft | 36. Outer Bearing Cone |
| 9. Thrust Washer | 19. Ring Gear | 28. Oil Seal | 37. Oil Slinger |
| 10. Axle Shaft | | | 38. Oil Seal |

Fig. 4C-6--Front Axle Differential Assembly

Fig. 4C-7--Differential - Exploded View



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)

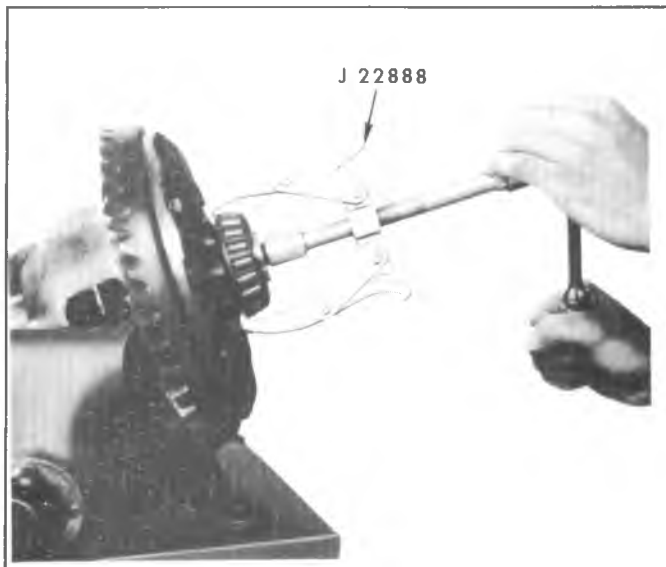


Fig. 4C-8--Removing Side Bearing

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

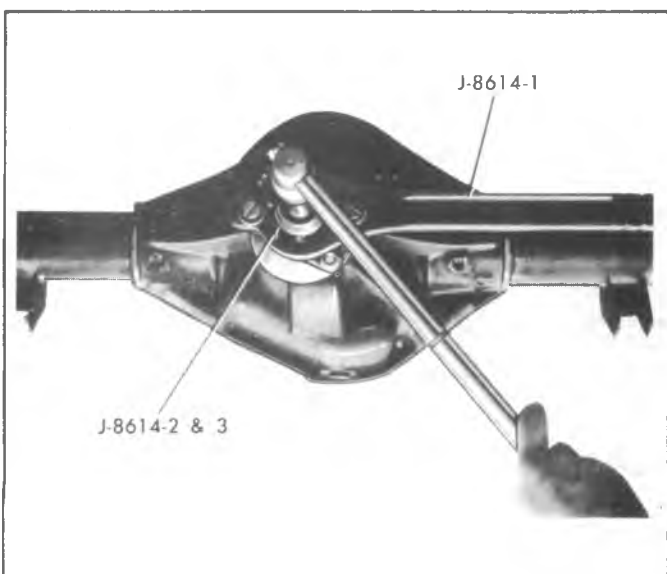


Fig. 4C-9--Removing Pinion Flange

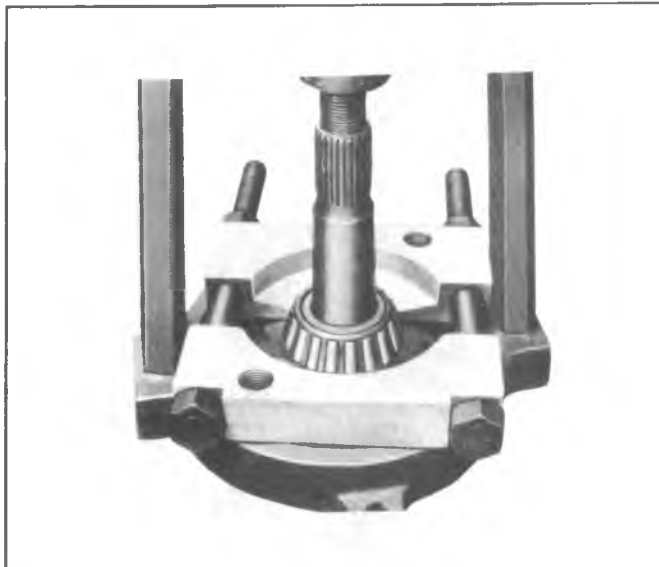


Fig. 4C-10--Removing Inner Pinion Bearing Cone and Roller

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 than .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

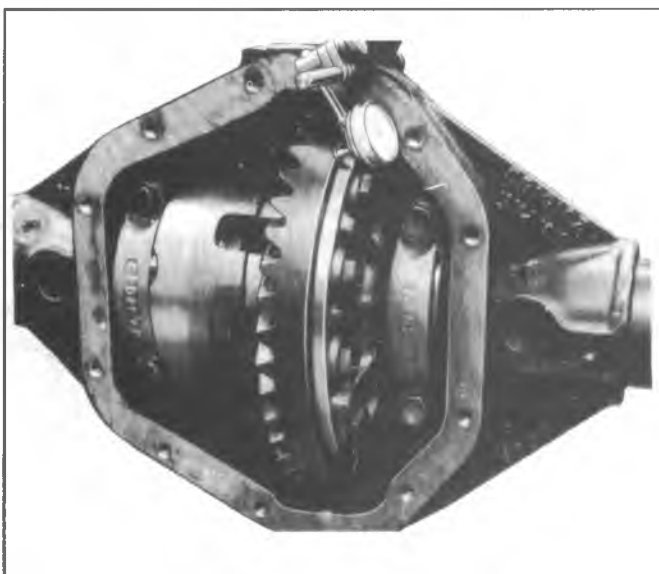


Fig. 4C-11--Checking Runout

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 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.

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

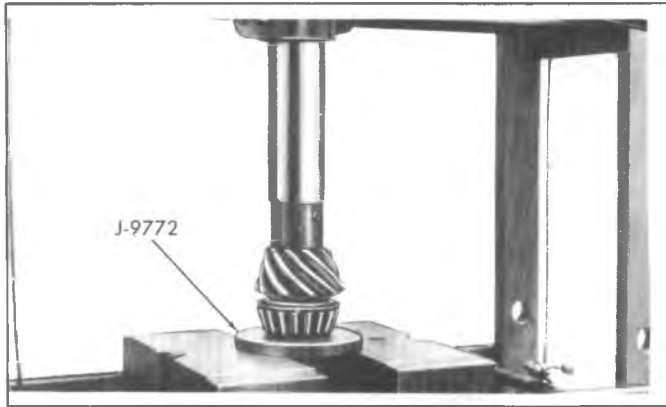


Fig. 4C-13--Installing Inner Pinion Core and Roller

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.

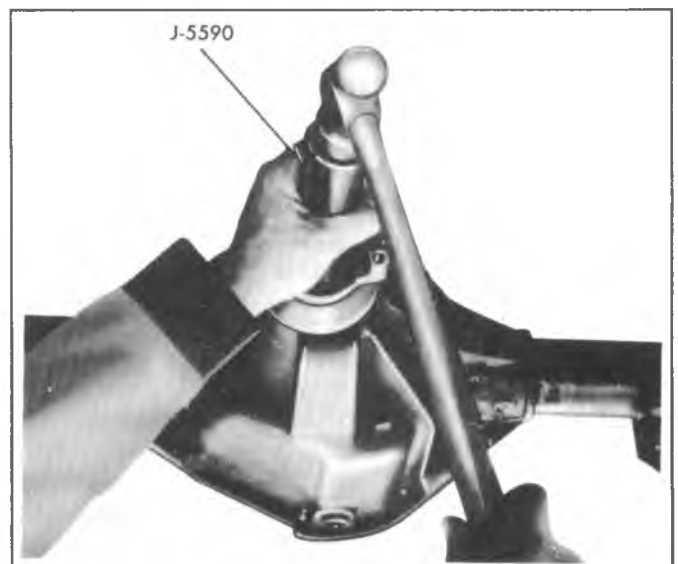


Fig. 4C-14--Installing Pinion Flange

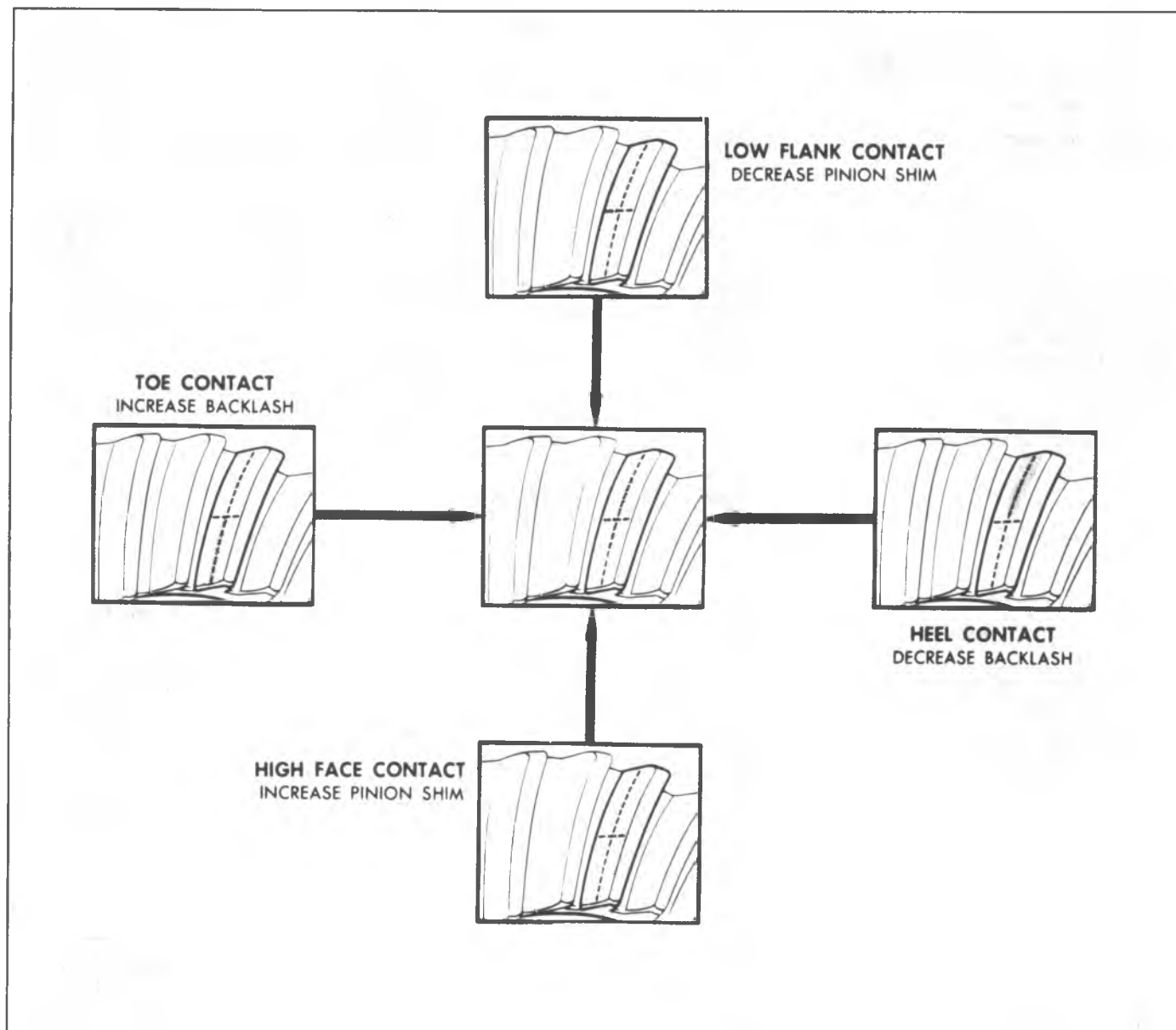


Fig. 4C-16--Gear Tooth Pattern Contact Pattern

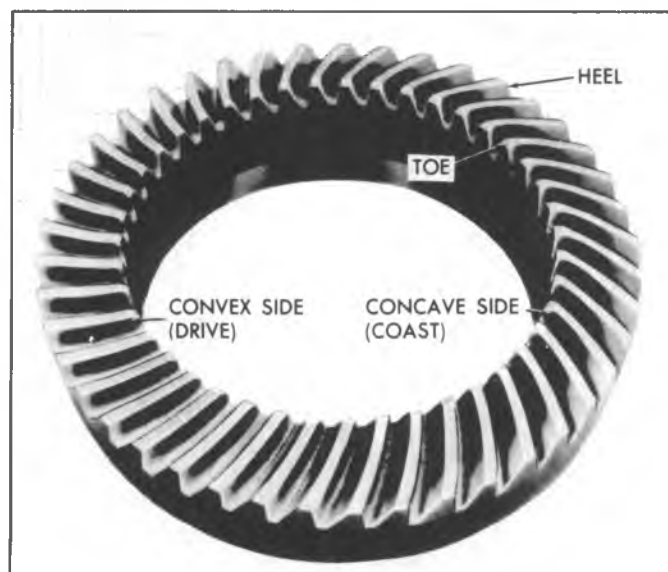


Fig. 4C-15--Gear Tooth Nomenclature

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 tolerances. 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

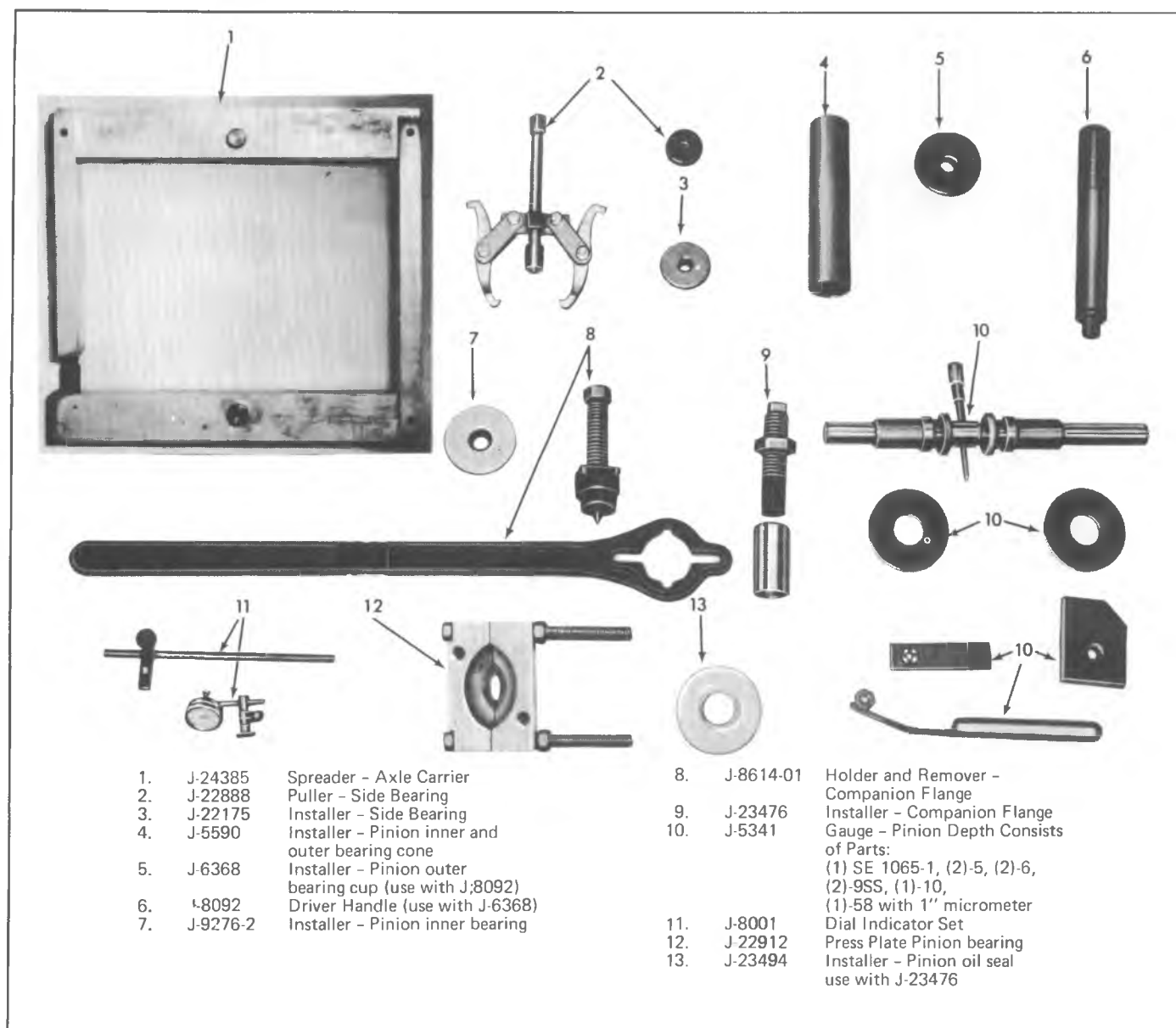
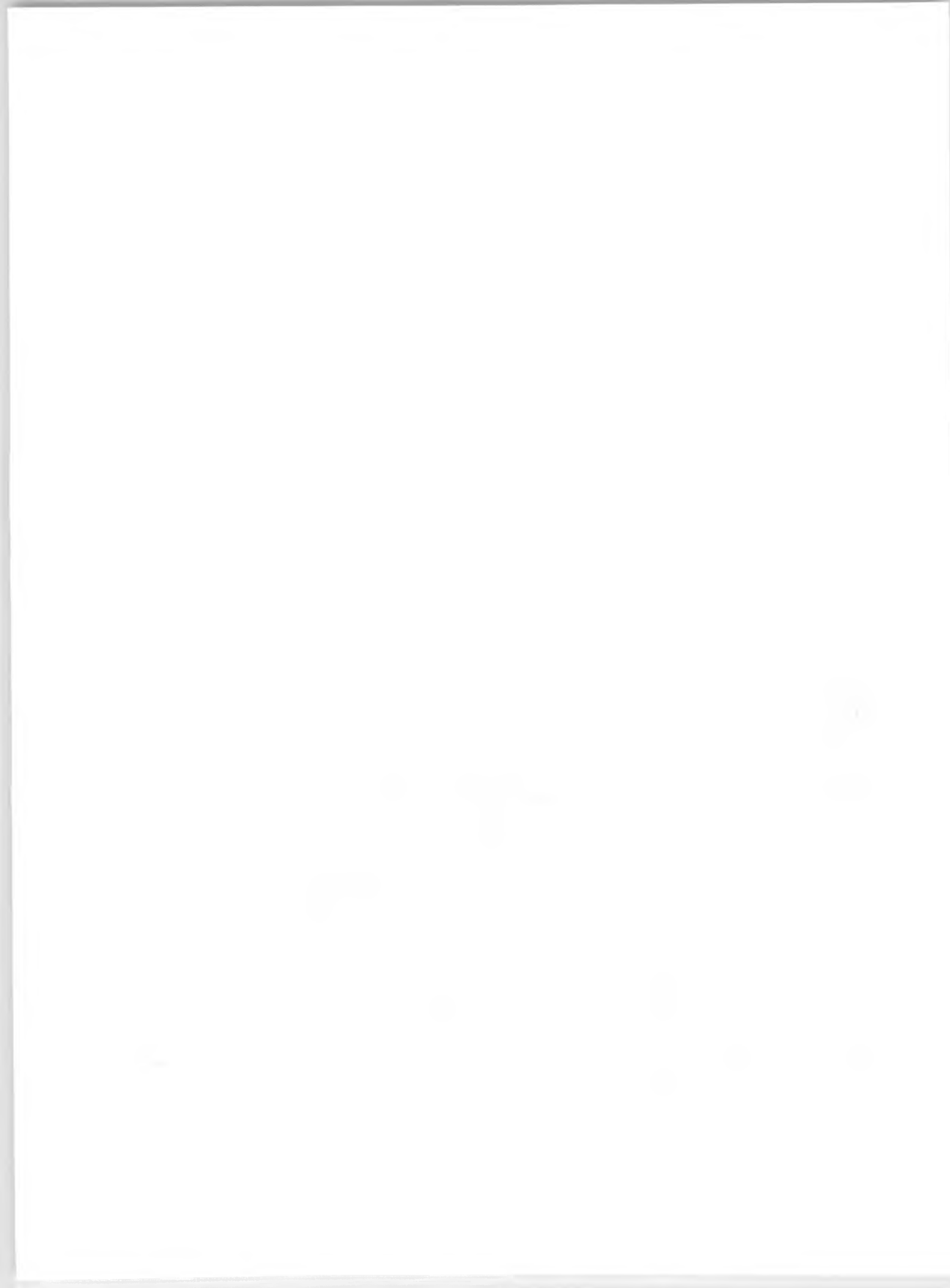


Fig. 4C-17--Special Tools



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 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.

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 DESCRIPTION

OPERATION OF MASTER CYLINDER

When the brake pedal is depressed, force is transferred through the push rod to the master cylinder primary piston, which moves forward. Under normal conditions, the combination of hydraulic pressure and the force of the primary piston spring move the secondary piston forward at the same time. When the pistons have moved forward so that their primary cups cover the bypass holes, hydraulic pressure is built up and transmitted to the front and rear brake assemblies. Hydraulic pressure behind the wheel cylinder cups forces the pistons outward, causing the brakes to be applied.

As brake pedal force is reduced, brake fluid pressure in the master cylinder is also reduced. This allows the drum brake retractor springs to retract the shoe and lining assemblies from contact with the drum which forces brake fluid out of the wheel cylinder assemblies and back into the master cylinder assembly. The reduction in fluid pressure also allows the caliper pistons to retract slightly by action of the piston seal.

Master cylinders 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.

OPERATION OF DISC BRAKE

Upon application of the brakes, fluid pressure behind the caliper piston increases. Pressure is exerted equally against the bottom of the piston and also against the bottom of the piston bore. The pressure applied to the piston is transmitted to the inner shoe and lining, forcing the lining against the inner rotor surface. The pressure applied to the bottom of the piston bore forces the caliper to slide or move on the mounting bolts toward the inner side, or toward the vehicle. Since the caliper is one piece, this movement toward the vehicle causes the outer section of the caliper to apply pressure against the back of the outer shoe and lining assembly, forcing the lining against the outer rotor surface. As line pressure builds up, the shoe and lining assemblies are pressed against the rotor surfaces with increased force, bringing the vehicle to a stop.

Lining wear is automatically compensated for by the outward movement of the caliper and piston. Brake fluid fills this void as lining wears.

OPERATION OF COMBINATION VALVE

The metering or hold off section of the combination valve limits pressure to the front disc brakes until a predetermined front input pressure is reached, approximating the pressure to overcome the rear shoe and lining retractor springs. There is no restriction at inlet pressures below 21 kPa (3 psi) to allow for pressure equalization during non apply periods.

The proportioning section of the combination valve proportions outlet pressure to the rear brakes after a predetermined rear input pressure has been reached. This is done to prevent rear wheel lock-up on vehicles with light rear wheel loads. Certain models having high rear wheel loads do not have the proportioning feature.

The valve is designed to have a "By-Pass" feature which assures full system pressure to the rear brakes in the event of a front brake system failure. Full front pressure is retained in the event of rear failure.

The pressure differential warning switch is designed to constantly compare front and rear brake pressure from the master cylinder and energize the warning light on the dash in the event of a front or rear system failure. The valve and switch are so designed that the switch will latch in the "warning" position once a failure has occurred. The only way the light can be turned off is to repair the failure and apply a pedal force as required to develop up to 3100 kPa (450 psi) line pressure.

DIAGNOSIS

INSPECTION AND TESTING BRAKES

Testing Brakes

New linings must be protected from severe use for several hundred miles.

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.

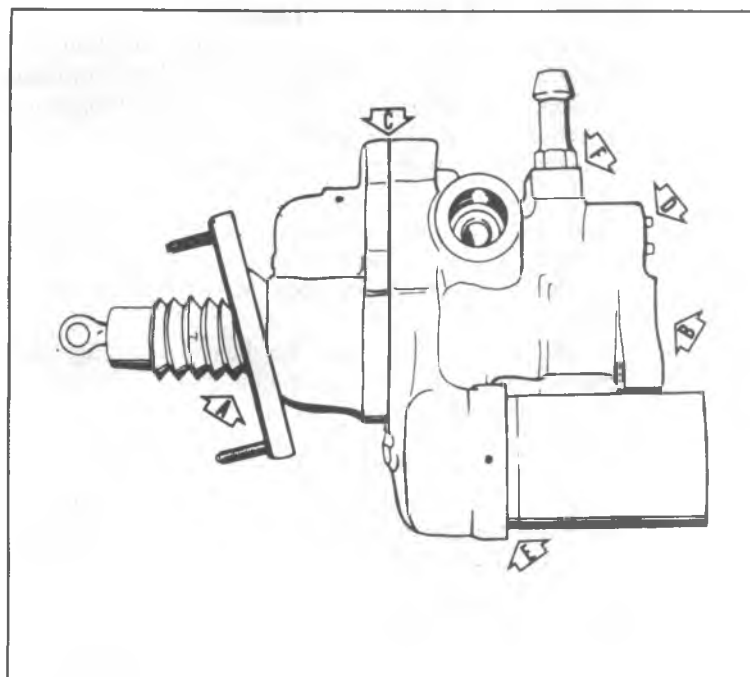
3. **Front Wheel Bearings**--A loose front wheel bearing permits the drum to tilt and have spotty contact with the brake shoe linings causing erratic action.
4. **Front End Alignment**--Misalignment of the front end, particularly in regard to limits on camber and theoretical king pin inclination, will cause the brakes to pull to one side.

HYDRO-BOOST

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 Section 3B.



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. 5-1--Seal Leakage Diagnosis

SEAL LEAK DIAGNOSIS (FIG. 5-1)

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 times to deplete accumulator pressure. Refer to "Pneumatic Accumulator On-Vehicle Service Procedure".

6. **EXTERNAL LEAKAGE AT THE RETURN PORT FITTING:** Tighten fitting to 7 lb. ft. (10 N·m). If it continues to leak, replace "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, replace tube seats.

TROUBLE SHOOTING AND TESTING (Fig. 5-2)

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 the 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 system.

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 mark. System must sit for 1 hour to remove the air. If the condition persists, this may be a sign of excessive pump wear and the pump should be checked; Refer to Section 3B.

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 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.
Slow Brake Pedal Return	Faulty booster spool plug seal.	Overhaul with spool plug seal kit.
	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.
Grabby Brakes	Damaged input rod end.	Replace input rod and piston assembly.
	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. 5-2--Hydro-Boost Diagnosis

CONDITION	POSSIBLE CAUSE	CORRECTION
Pulls	1. Incorrect tire pressures.	1. Inflate evenly on both sides to the recommended pressures.
	2. Front end out of line.	2. Check and align to manufacturer's specifications.
	3. Unmatched tires on same axle. For radial tire lead refer to Section 3E.	3. Tires with approximately the same amount of tread should be used on the same axle.
	4. Restricted brake pipes or hoses.	4. Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	5. Malfunctioning caliper assembly.	5. Check for stuck or sluggish pistons, proper lubrication. Remove and rebuild caliper.
	6. Defective or damaged shoe and lining (grease or brake fluid on lining or bent shoe).	6. Install new shoe and lining in complete axle sets.
	7. Malfunctioning rear brakes.	7. Check for inoperative auto adjusting mechanism, defective lining (grease or brake fluid on lining) or defective wheel cylinders. Repair as necessary.
	8. Loose suspension parts.	8. Check and torque all suspension mountings to specifications.
	9. Loose calipers.	9. Check and torque bolts to specifications.
Noise (high pitched squeak without brake applied).	1. Front linings worn out.	1. Replace linings.
Brake roughness or chatter (Pedal Pulsates)	1. Excessive lateral runout.	1. Check per instructions and replace or machine rotor, if not within specifications.
	2. Parallelism not within specifications.	2. Check per instructions and replace or machine the rotor, if not within specifications.
	3. Wheel Bearings not adjusted.	3. Adjust wheel bearings to correct specifications.
	4. Rear drums out of round.	4. Check runout and, if not within specifications, turn the drums (not over maximum of 0.060 on the diameter).

CONDITION	POSSIBLE CAUSE	CORRECTION
Brake roughness or chatter (Pedal Pulsates) — Continued	5. Shoe reversed (steel against iron).	5. Replace shoe and lining and machine rotor within specifications.
Excessive Pedal Effort	1. Malfunctioning power brake.	1. Check power brake and repair if necessary.
	2. Partial system failure.	2. Check front and rear brake system and repair, if necessary. Also, check and repair brake warning light circuit if a failed system is found and light did not function.
	3. Excessively worn shoe and lining.	3. Check and replace in axle sets.
	4. Piston in caliper stuck or sluggish.	4. Remove caliper and rebuild.
	5. Fading brakes due to incorrect lining.	5. Remove and replace with original equipment lining (or equivalent).
Excessive Pedal Travel	1. Partial brake system failure.	1. Check both front and rear system for a failure and repair. Also check and repair warning light circuit. It should have indicated a failure.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid. Check for leaks. Check warning light.
	3. Air trapped in system.	3. Bleed system.
	4. Rear brake not adjusting.	4. Adjust rear brakes and repair auto adjusters.
	5. Bent shoe and lining.	5. Replace axle set of shoe and lining.
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.)	1. Master cylinder pistons not returning correctly.	1. With reservoir cover off, check for fluid spurt at bypass holes as pedal is depressed. Adjust push rod, if necessary, or rebuild master cylinder.
	2. Restricted brake pipes or hoses.	2. Check for soft hoses or damaged pipes and replace with new hoses and new double-walled steel brake tubing.

CONDITION	POSSIBLE CAUSE	CORRECTION
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.) — Continued	3. Incorrect parking brake adjustment on rear brakes.	3. Check and readjust to correct specifications.
	4. Incorrect installation of inboard shoe and lining.	4. Refer to caliper installation in this section.
Grabbing or Uneven Braking Action	1. All conditions listed under "PULLS".	1. All corrections listed under "PULLS".
	2. Malfunction of combination valve.	2. Replace and bleed system.
	3. Malfunction of power brake unit.	3. Check operation and repair, if necessary.
	4. Binding brake pedal mechanism.	4. Check and lubricate, if necessary. Possibly replace pedal bushing and/or spacer.
Pulsation (roughness) Felt during normal brake application.	1. Uneven pad wear caused by caliper not sliding due to improper clearance or dirt.	1. Remove caliper and correct as necessary.
	2. Uneven rotor wear causing a thickness variation between the two braking surfaces.	2. Machine rotors as follows: <ol style="list-style-type: none"> Machine rotors to obtain a circumferential thickness variation no greater than .0005" in 360° and a lateral runout no greater than .004" (max. rate of change not exceed .001" in 30°). Check caliper freeness. With rotor removed, install caliper and mounting bolts (pins). Check for .005"-.012" clearance at both top and bottom of caliper. If less than .005" is found, file with a flat file until at least .005" is obtained. DO NOT EXCEED A MAXIMUM of .012" per end or .024" total clearance. Caliper clearance to inboard and outboard reaction pads must be equal within .004" both at the top and bottom of the caliper. This is to ensure correct alignment of caliper to knuckle during a brake application. Remove caliper after freeness check. Clean pins and sleeves, replace "O" rings, and apply a light coating of silicone grease or equivalent to all contact points and "O" rings.

CAUSE	SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Gradually Increases	Excessive Brake Pedal Effort	Brakes Slow to Respond	Brakes Slow to Release	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) During Stop	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
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 causes)

X - Indicates causes

ON-VEHICLE SERVICE

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 wheel cylinders 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, then that wheel cylinder only need be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then all wheel cylinders 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 as 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

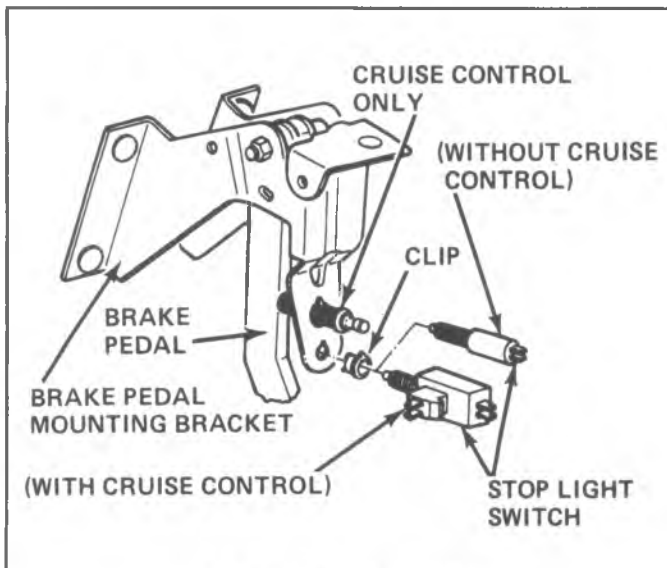


Fig. 5-3--Stop Light Switch

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" (115 mm)
- C-K-G Power 3.5" (90 mm)
- P (Except JF9) 3.5" (90 mm)
- P (JF9) 6.0" (150 mm)

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.

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 moved in tubular clip providing proper adjustment.
3. Release brake pedal, and 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.

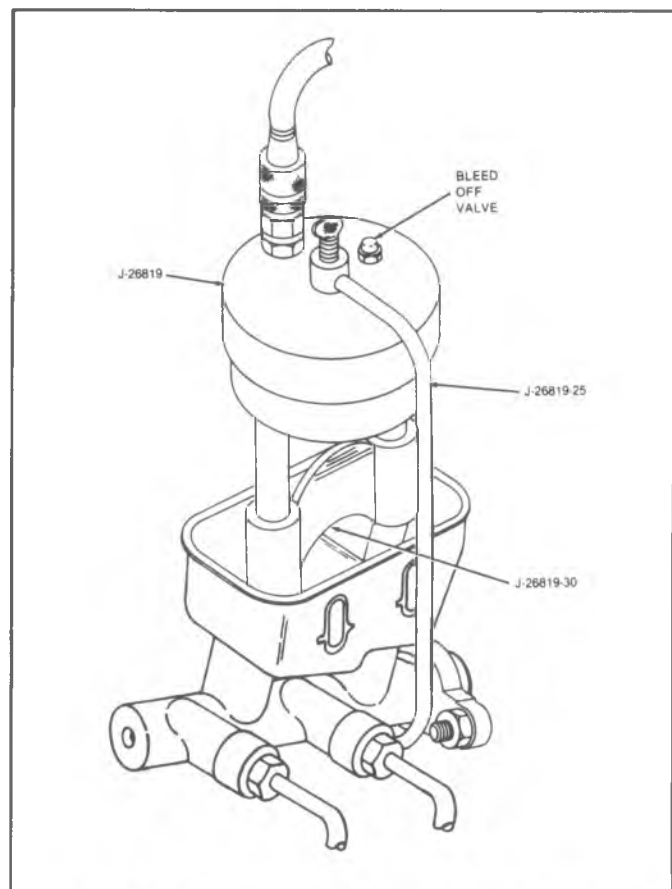


Fig. 5-4--Pressure Bleeding (CK Models JB1 thru JB6)

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 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 vehicles -- 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. If 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.

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 contaminants 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. 5-4, 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. 5-4).

2. Make sure the pressure tank is at least 1/3 full of Supreme #11 brake fluid or its equivalent. The bleeder ball 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 require a manual override of the front brake metering or combination valve to permit flow to the front wheels. Therefore, it will be necessary to hold the valve stem open manually 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 front, left rear 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 necessary.
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 mineral oil, all rubber parts that have been subjected to the contaminated fluid should be replaced.

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 engine off and repeat above procedure.
 - 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 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 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.

BRAKE PIPES

Replacement (Figs. 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" (3 mm) for each double flare.
3. Double flare tubing ends using a suitable flaring tool such as J-23530. Follow instructions included in tool set.

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 every 4 months or 6,000 miles (9 600 km) (heavy duty emission vehicles), every 12 months or 7,500 miles (12 000 km) (light duty emission vehicles). 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.

Front Hose

Removal (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 from female fitting at bracket and remove hose from bracket.
5. Remove bolt from caliper end of hose. Remove hose from caliper, and discard the two copper gaskets on either 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 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" clip to female fitting at frame bracket.
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.

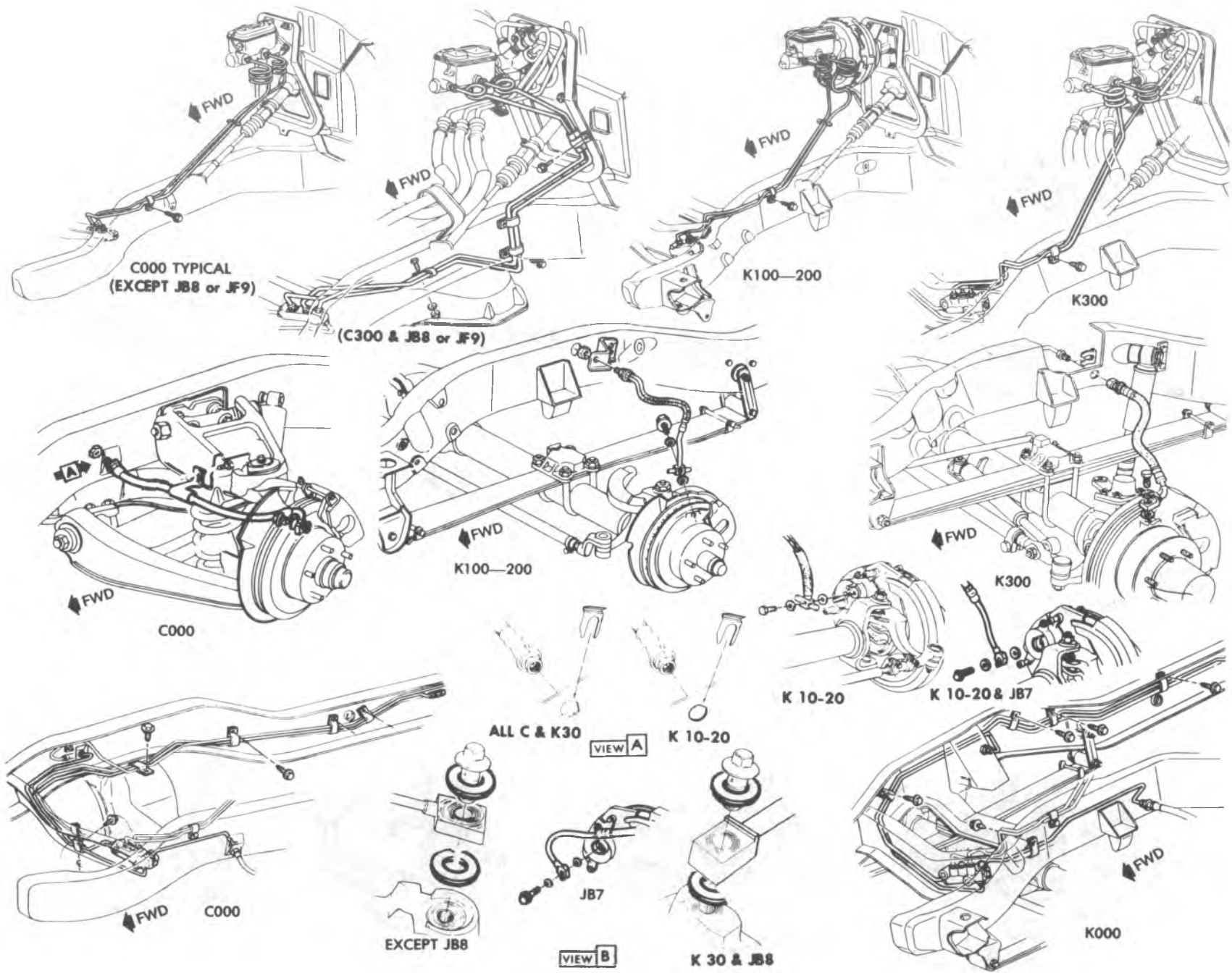


Fig. 5-5--Front Brake Pipes and Hoses--C-K Models

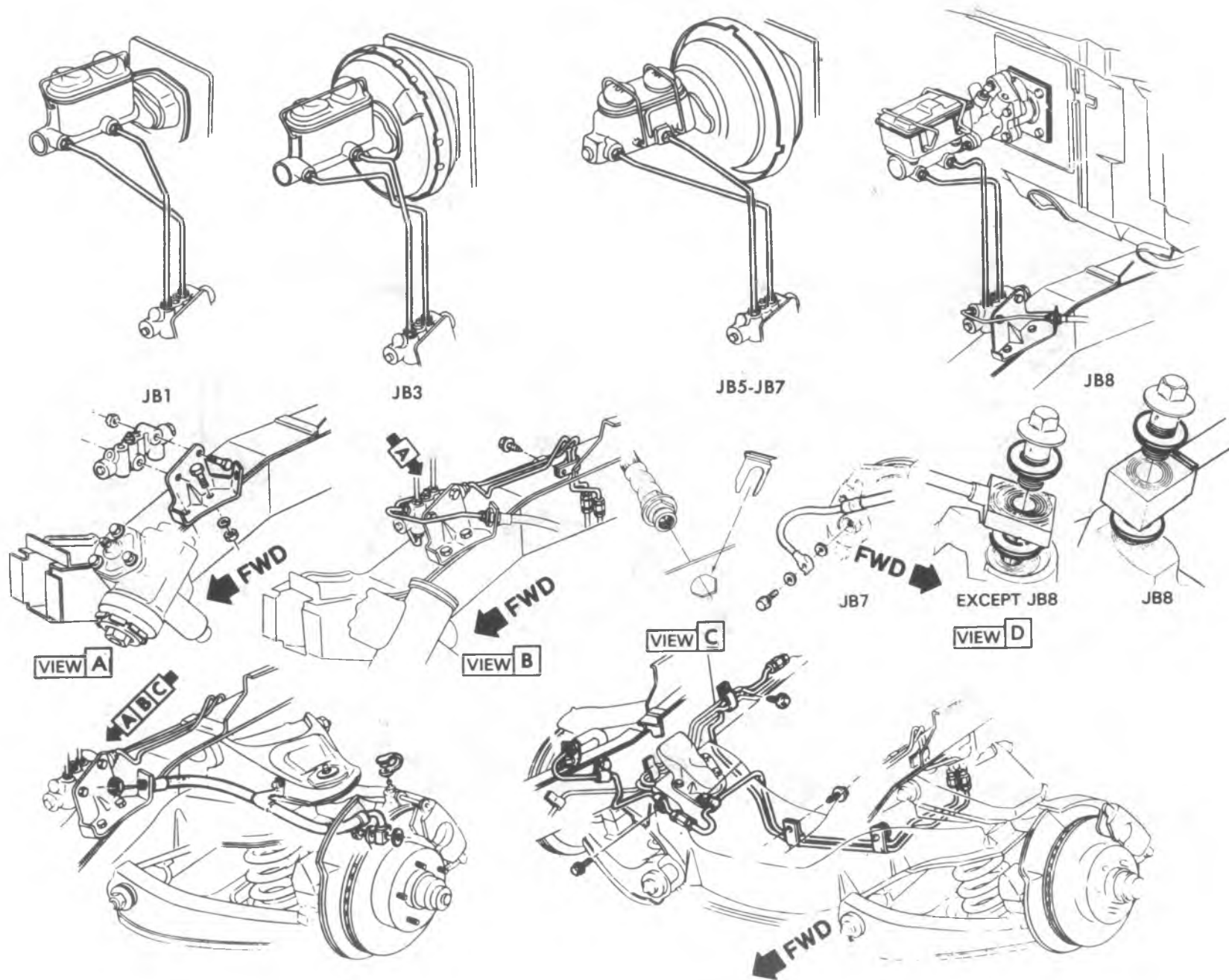
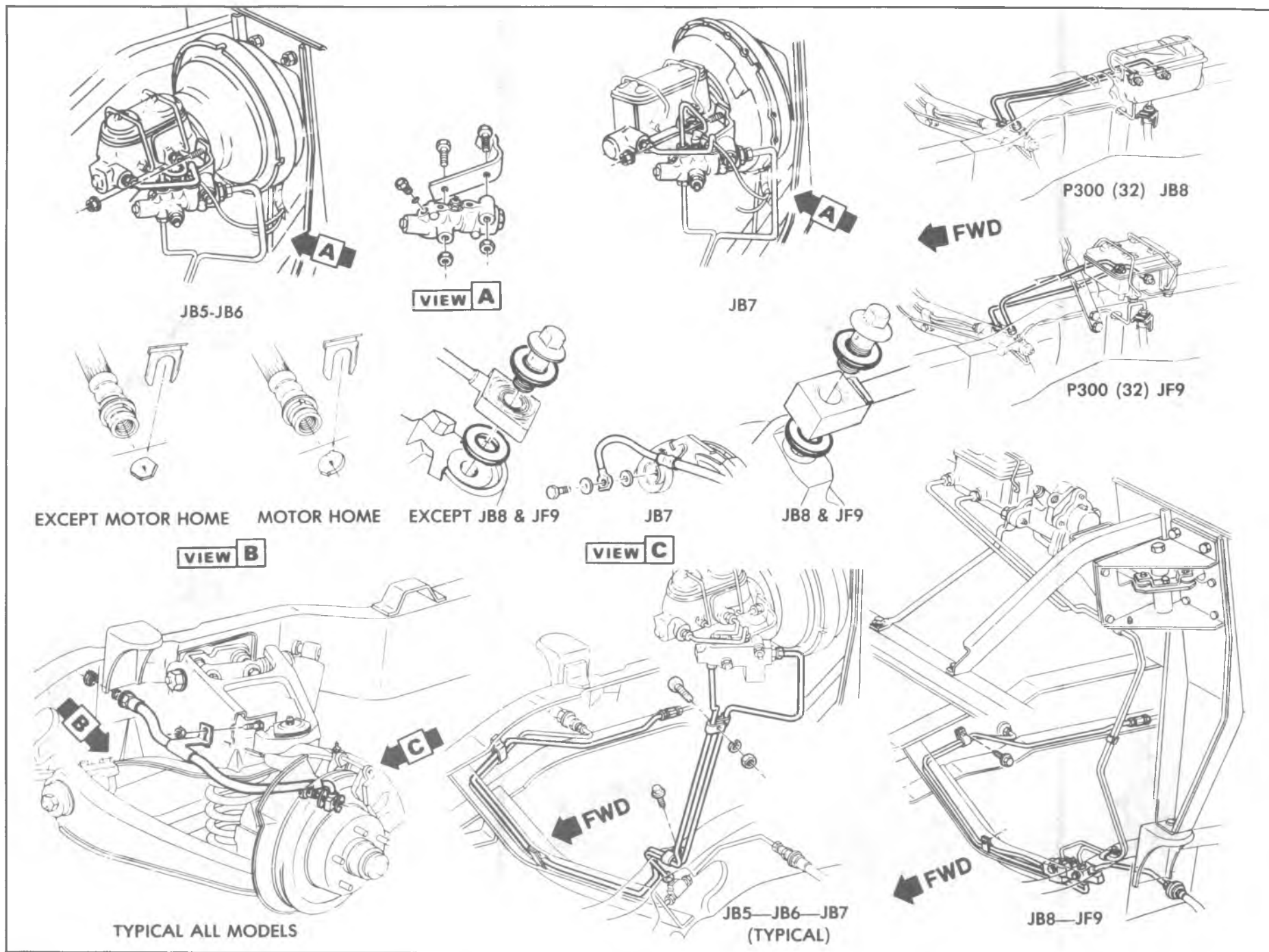


Fig. 5-6--Front Brake Pipes and Hoses--G Models

Fig. 5-7--Front Brake Pipes and Hoses--P Models



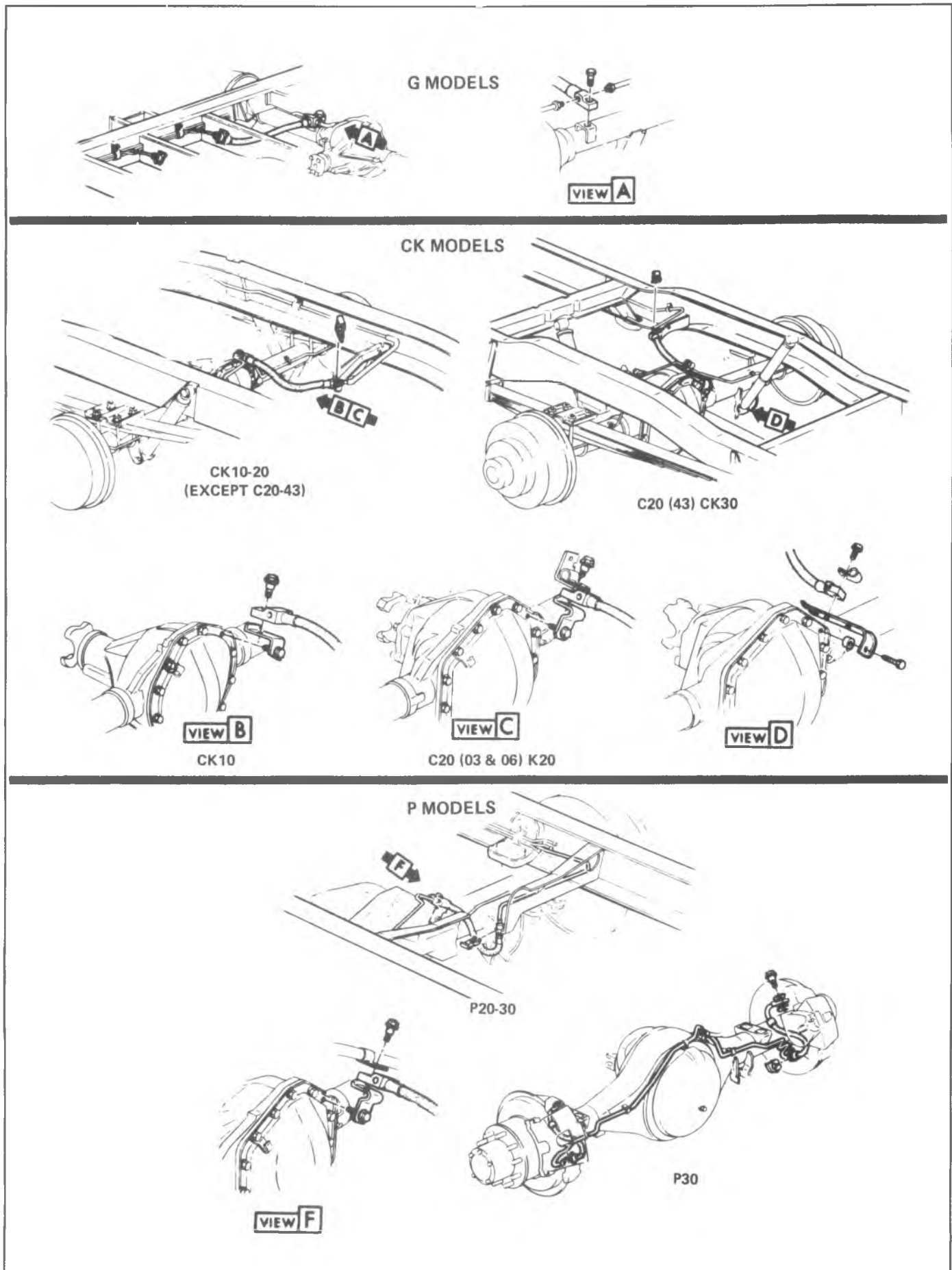


Fig. 5-8--Rear Brake Hoses

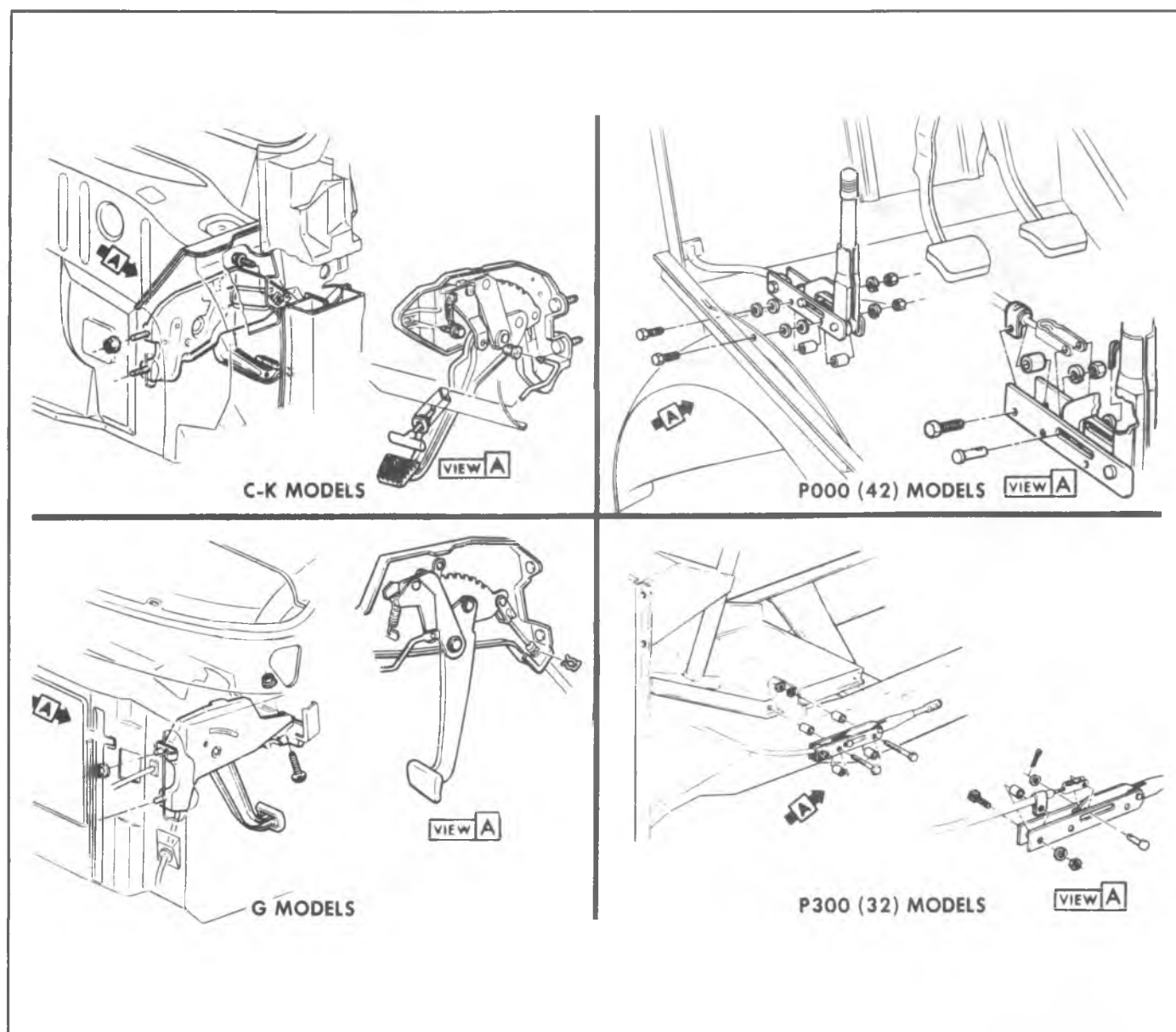


Fig. 5-9--Parking Brake Assembly--Typical

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 1 position (except G models), 2 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. re-torque bracket if necessary.

6. Bleed system.
7. Lower vehicle from hoist.

PARKING BRAKE PEDAL OR HANDLE

Removal (Fig. 5-9)

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.

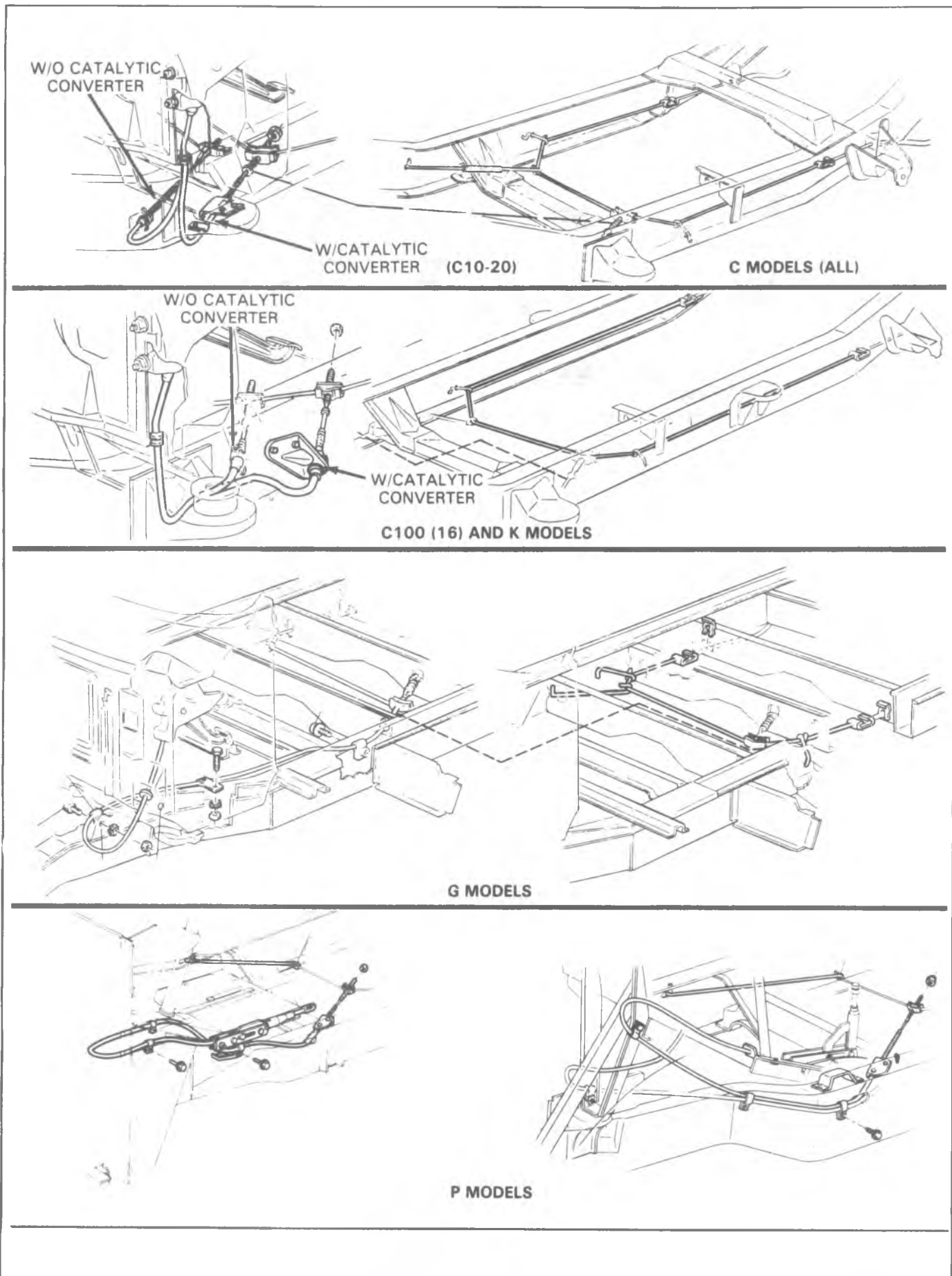


Fig. 5-10--Parking Brake System--Typical

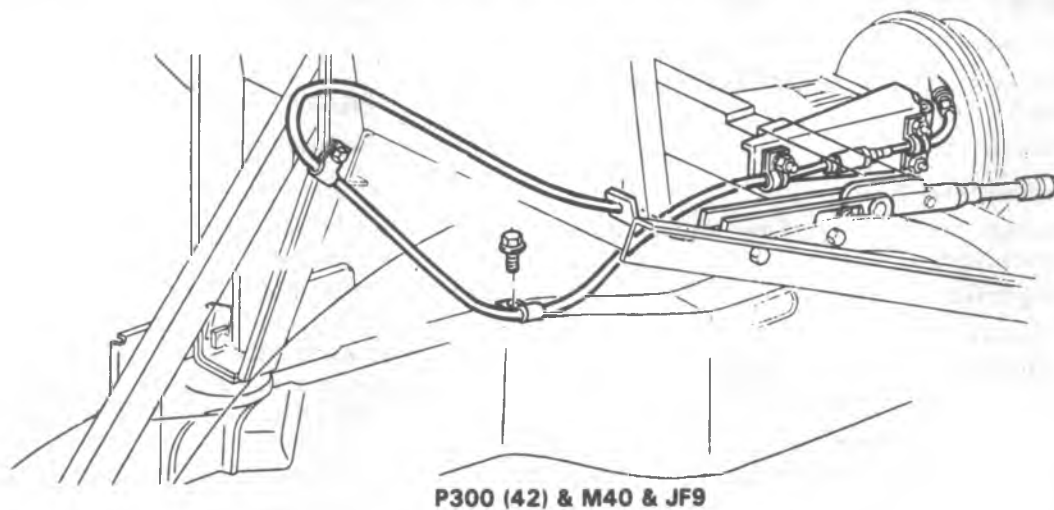
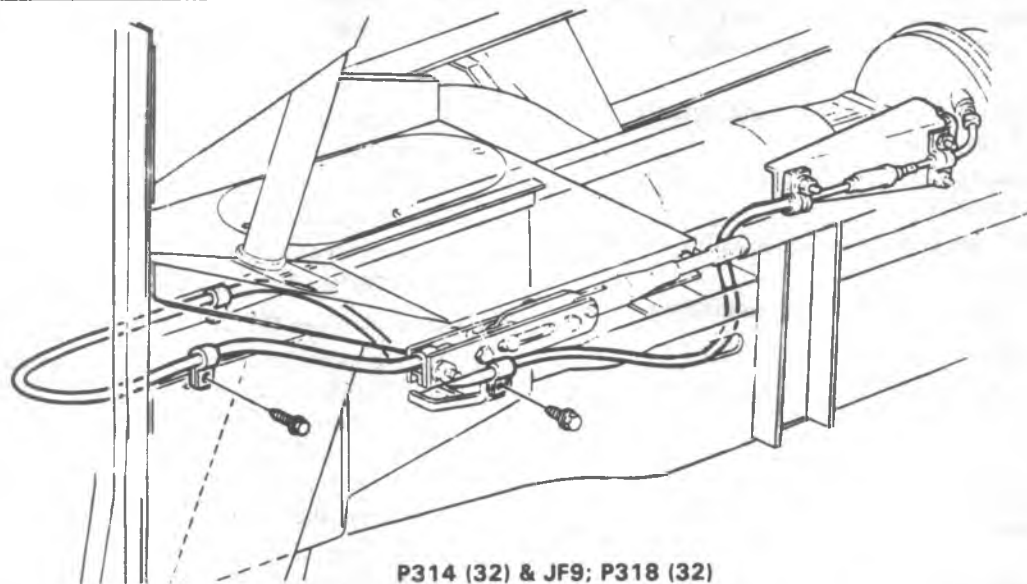
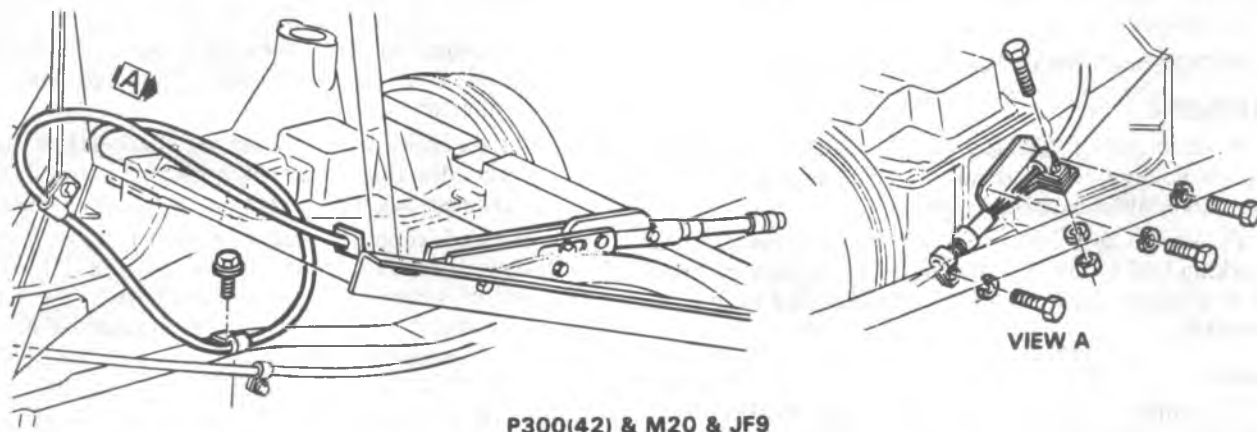


Fig. 5-11—Parking Brake System (Propshaft)

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.

ADJUSTMENT

Adjustment of parking brake cable is necessary whenever holding ability is not adequate or whenever the center brake cables have been disconnected.

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.

NOTICE: See "Notice" on Page 1 of this section.

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 equalizer 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)-**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 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 Gauge, 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 gauge just slides over the linings.
3. Rotate the gauge 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 (Fig. 5-10)**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.

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 2 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 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 dirt. 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 leaves, etc.), or making any 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.

Removal

1. Raise vehicle, axle must be allowed to hang free (no load condition).
2. Clean exterior of valve to prevent dirt from contaminating hydraulic system when brake pipes are disconnected.
3. Disconnect brake lines from valve.
If original valve is going to be reinstalled, mark relationship of the valve shaft to the lever assembly before removing lever.
4. Remove nut from shaft and remove lever.
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.
- 3a **New Valve.** Install lever assembly on valve shaft by pushing plastic bushing and clip assembly over serration on valve shaft.
- 3b **Old Valve.** If original valve is being reinstalled, align lever with mark made on valve at time of removal before installing bushing and clip assembly on shaft.
4. Install nut on shaft and tighten.
5. Connect brake lines to valve.
6. Bleed brake system
7. Lower vehicle and test brakes.

Lever Assembly

Replacement

1. Raise vehicle, axle must be allowed to hang free (no load condition).
2. Mark relationship of the height valve shaft to the lever assembly.

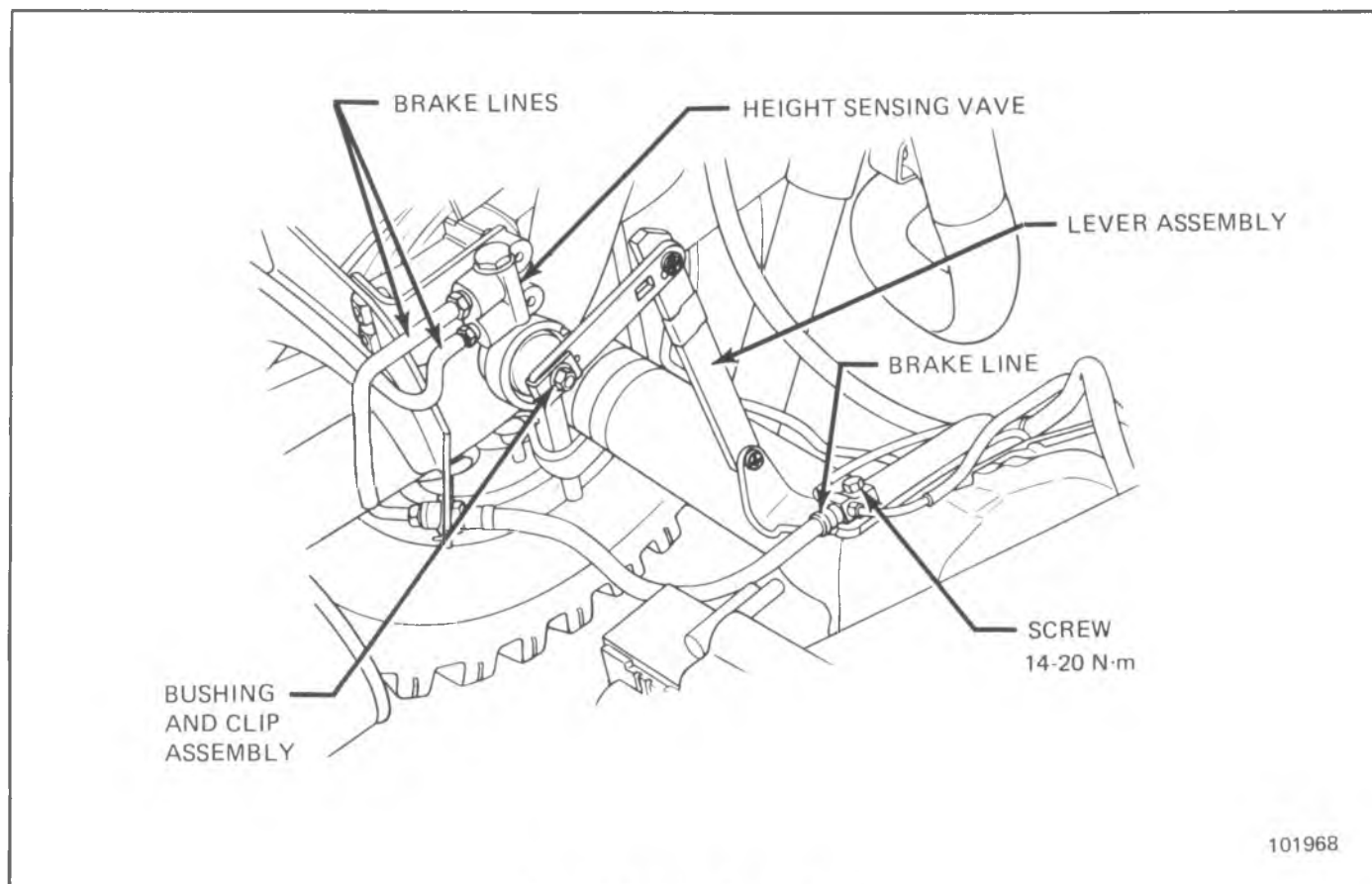


Fig. 5-11B—Height Sensing Valve

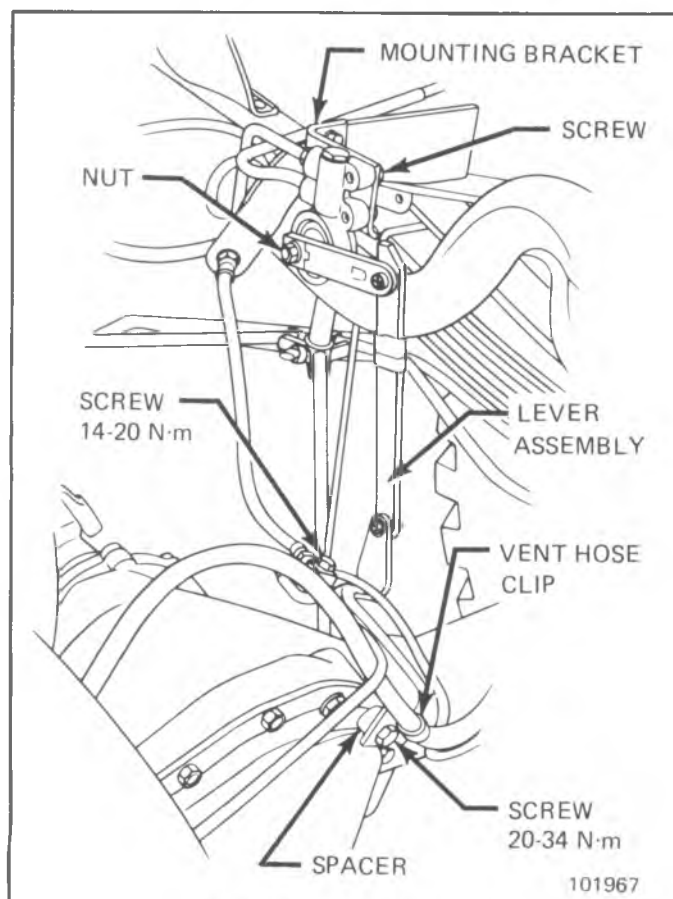


Fig. 5-11a—Lever Assembly

3. Remove nut from height sensing valve shaft.
4. Remove lever from valve.
5. Remove screw holding brake line to lever assembly.
6. Remove screw securing lever assembly to axle housing and remove spacer and vent hose clip (if used).
7. Remove lever assembly.
8. Install spacer (if used), lever assembly, vent hose clip (if used) and secure with screw to axle housing.
9. Align lever with mark made on valve at time of removal and install lever assembly on valve shaft by pushing plastic bushing and clip assembly over serration on valve shaft.
10. Install nut on shaft and tighten.
11. Install brake line to lever assembly and secure with screw.
12. Lower vehicle.

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. 5-12)

1. Remove the pull back spring from the body or brake pedal support bracket.
2. **Manual Transmission Vehicles--** Remove the clutch pedal as outlined under "Clutch Pedal" in Section 7C.

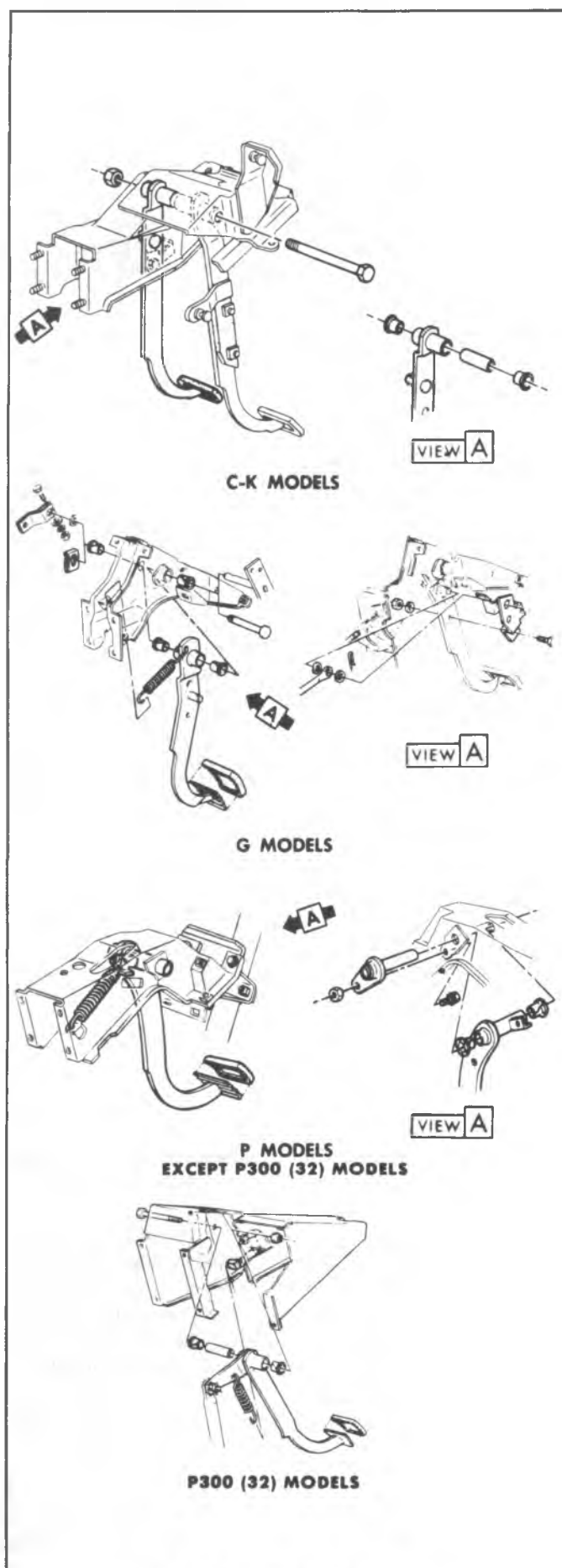


Fig. 5-12--Brake Pedal Installation

Automatic Transmission Vehicles-- Remove pedal pivot bolt nut or pivot pin retainer and remove bolts or pin and bushings.

3. **P Models--** Remove the sleeve assembly screw attachment and remove sleeve.
4. Disengage the push rod from the master cylinder and remove the pedal.

Inspection

Clean all parts and inspect for wear, cracks or any other damage that might impair operation; replace if required.

Installation

Reverse the above procedure and make certain the brake pedal is secure and adjusted properly before operating the vehicle. Lubricate pedal pivot bushings and pivot pin, bolt or sleeve with Delco Brake Lube (or equivalent). Adjust stoplamp switch.

NOTICE: See "Notice" on Page 1 of this section.

BRAKE PEDAL ROD

P30(32) Models

Replacement (Fig. 5-13)

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 upper attachment to center of lower attachment).
6. Lubricate the pedal rod bolts and special washers with Delco Brake Lube (or equivalent).

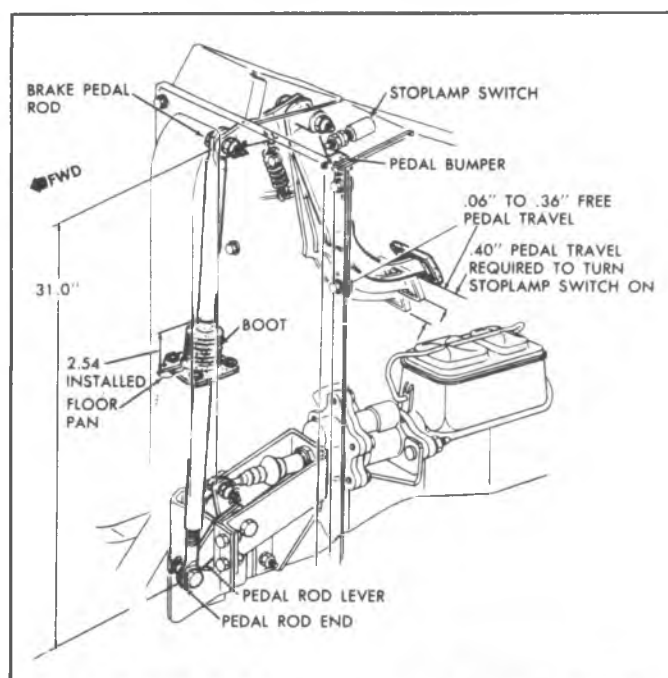


Fig. 5-13--Brake Pedal and Stop Lamp Adjustment P30(32) Model

7. Install the rod up through the floorpan 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). (Refer to Figure 5-13).
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.

MASTER CYLINDER

Filling Cylinder

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overfilled.

The brake fluid reservoir is on the master cylinder which is located under the hood on the left side of the dash.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and diaphragm. Add fluid as required to bring level to 1/4" (6 mm) (plus or minus 1/8"--3 mm) from the lowest portion of the top of each reservoir. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent.

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from water. Mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent water contamination.

Except Bendix Mini-Master Cylinder and Delco Quick Take-Up 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 (Figs. 5-14 and 5-15)

1. Clean outside of master cylinder thoroughly. Remove reservoir cover and diaphragm. Turn cylinder over and pump push rod by hand to drain all brake fluid. Always discard used fluid.
2. **Manual brake only--**Pull boot away from master cylinder to uncover push rod retainer. The retainer has a small, depressed tab in the side. This tab must be pried up to release retainer.
3. Depress piston and remove secondary piston stop bolt from bottom of front fluid reservoir (if so equipped).
4. Place master cylinder in a vise so that lock ring can be removed from groove in the inside diameter of bore. Remove lock ring and primary piston assembly. Remove secondary piston, secondary piston spring and retainer by blowing air through the outlet port.
5. Place master cylinder in vise, so that outlet holes are up. Enlarge hole in tube fitting insert using a 13/64" drill. Place a heavy washer over outlet on master cylinder and thread a 1/4-20 x 3/4" screw into the insert. Tighten screw until insert is unseated. Remove insert, screw, and washer.
6. Remove primary seal, and secondary seal from secondary piston.
7. Use clean brake fluid to clean all metal brake parts thoroughly. Air dry and place cleaned parts on clean paper or lint free clean cloth.

Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

Inspection

Inspect cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder. Corrosion can be identified as pits or excessive roughness.

Polish any discolored or stained area with crocus 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 kept 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. Place brass tube fitting insert (new parts) in outlet holes so that it is in a position to be pressed into outlet

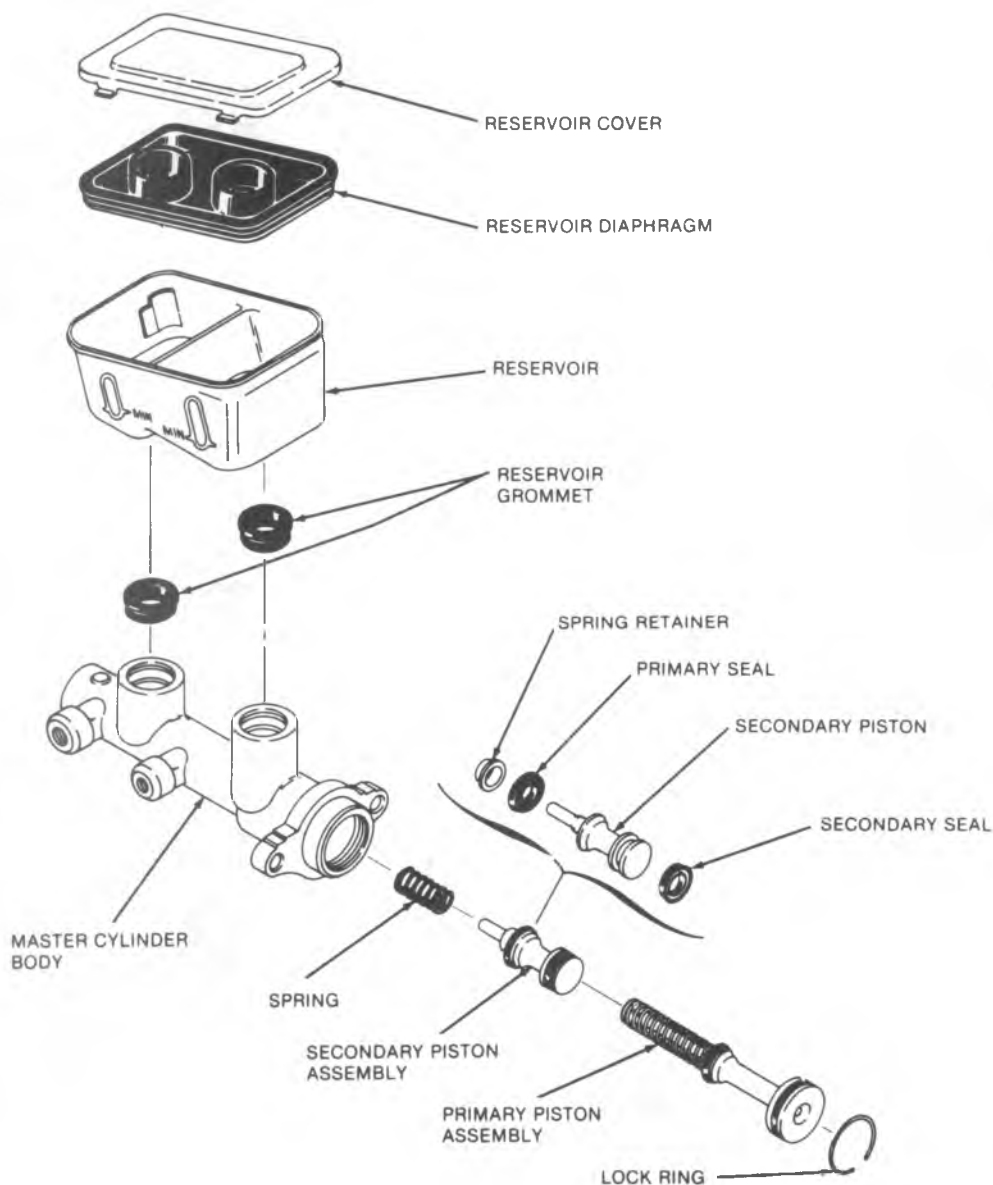
MASTER CYLINDER ASSEMBLY

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:

To prevent damage to brake parts, use all components included in repair kits. Lubricate parts with clean, fresh brake fluid. Do not use lubricated shop air on brake parts. Torque values specified are for dry, unlubricated fasteners.



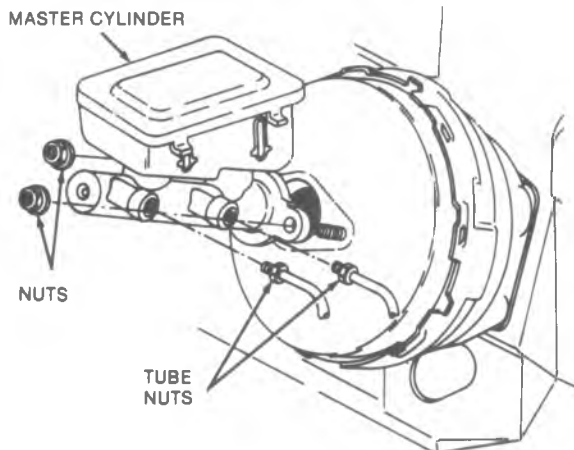
1. REMOVE AND INSTALL MASTER CYLINDER.**REMOVE**

1. Disconnect two hydraulic lines.
2. Remove two attaching nuts.
3. Remove master cylinder as shown.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Install master cylinder as shown and torque attaching nuts to 30-45 N·m (22-30 ft-lb).
2. Attach two hydraulic lines. Torque tube nuts to 13.6-20.3 N·m (120-180 in-lb).

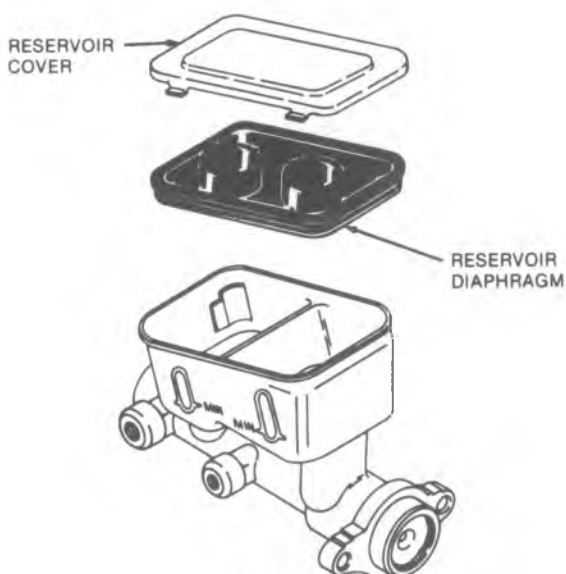
**2. REMOVE AND INSTALL RESERVOIR COVER AND DIAPHRAGM.****REMOVE**

1. Remove reservoir cover and diaphragm as shown.
2. Discard any brake fluid in reservoir.
3. Inspect reservoir cover and diaphragm for cuts, cracks or deformation. Replace damaged or defective parts.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION

1. Install reservoir diaphragm in reservoir cover.
2. Install assembly on reservoir.

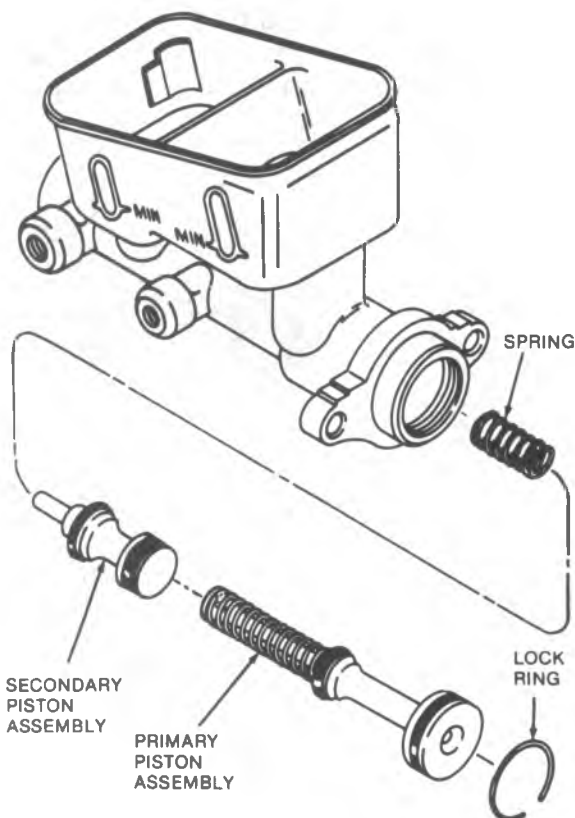
**3. REMOVE AND INSTALL PRIMARY AND SECONDARY PISTONS.****REMOVE**

1. Depress primary piston and remove lock ring.
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.
3. Disassemble secondary piston as shown in A, following.
4. Inspect master cylinder 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.

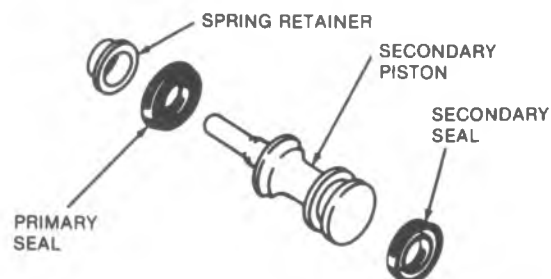
1. Assemble secondary piston as shown in A, following.
2. Install spring and secondary piston assembly in cylinder.
3. Install primary piston, depress, and install lock ring.

**A.****REMOVE**

1. Remove seals as shown.

INSTALL

1. Install new seals, positioning as shown.



4. REMOVE AND INSTALL RESERVOIR.**REMOVE**

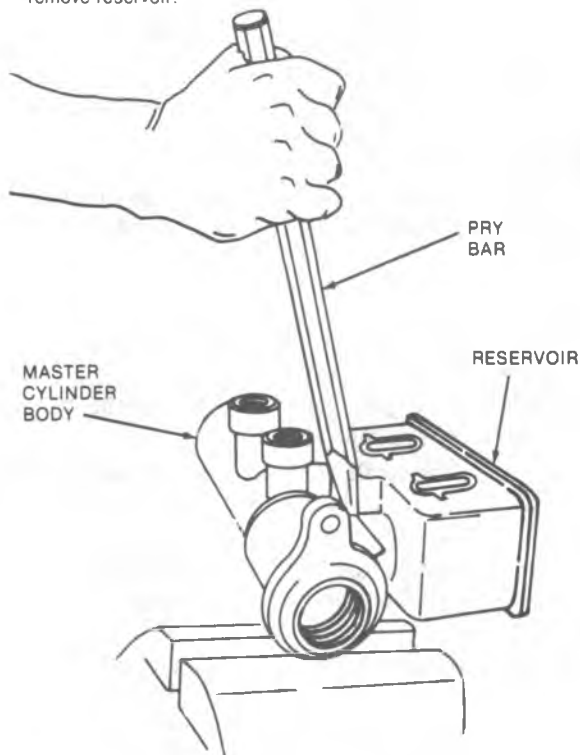
1. Remove reservoir as shown in A, following.

INSTALL

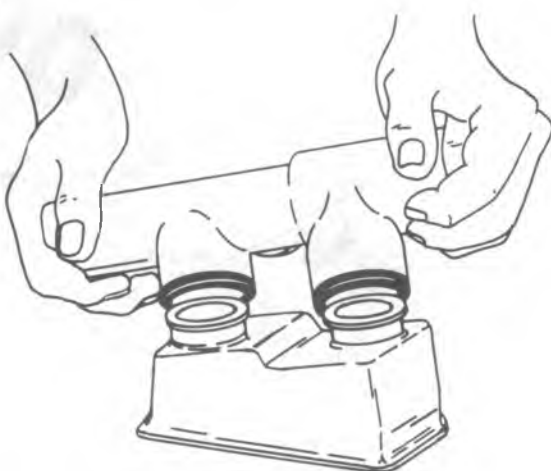
1. Install reservoir as shown in B, following.

A.**REMOVE**

1. Clamp master cylinder in vise as shown—do not clamp on master cylinder body—and use pry bar to remove reservoir.

**B.****INSTALL**

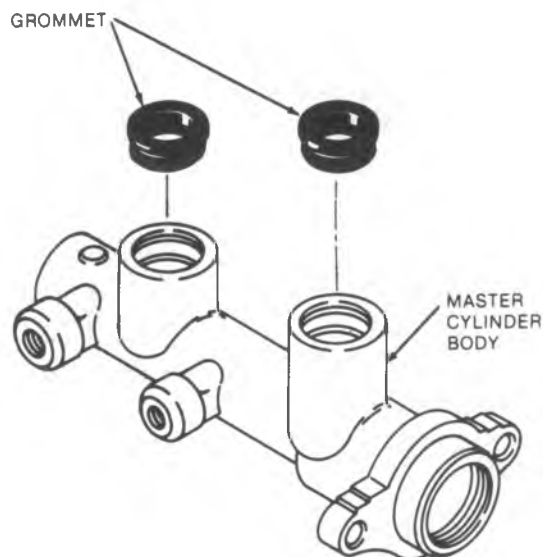
1. Lay reservoir on flat, hard surface as shown. Press on master cylinder body using rocking motion.

**5. REMOVE AND INSTALL RESERVOIR GROMMETS.****REMOVE**

1. Remove reservoir grommets.

INSTALL

1. Lubricate new reservoir grommets with silicone brake lube.
2. Press grommets into master cylinder body. Make sure grommets are properly seated.



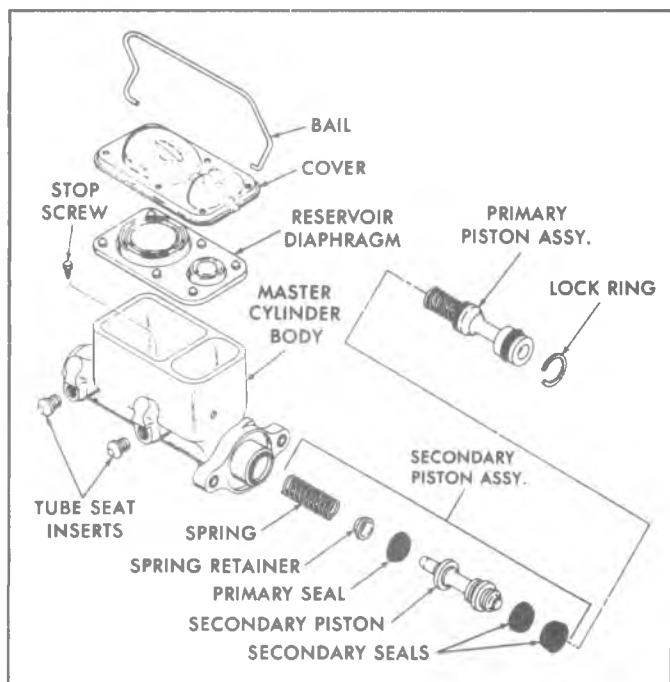


Fig. 5-14--Delco Master Cylinder--Exploded View

hole. The recommended method of inserting tube fitting insert is to thread a spare brake line tube nut into outlet hole and turn nut down until tube fitting insert bottoms. Remove tube nut and check outlet hose for loose burrs, which might have been turned up when tube fitting insert was pressed down.

2. Put new secondary seal in groove in end of secondary piston (fig. 5-15).
3. Assemble a new primary seal over end of secondary piston, so that flat side of the seal seats against flange of piston (fig. 5-15).
4. Assemble new secondary seal into groove on end of the secondary piston.
5. In order to insure correct assembly of the primary assembly, a complete primary piston assembly is included in the repair kits.
6. Coat bore of master cylinder with clean brake fluid. Coat primary and secondary seals on secondary piston with clean brake fluid. Insert the secondary piston spring retainer into secondary piston spring. Place retainer and spring over end of secondary piston, so that retainer locates inside lip of primary cup.
7. Hold master cylinder with open end of bore down, push secondary piston into bore, so that spring will seat against closed end of bore.
8. Place master cylinder in a vise with open end of bore up. Coat primary and secondary seal on primary piston with clean brake fluid. Push primary piston assembly, spring end first, into bore of master cylinder. Hold the piston down and snap lock ring into position in groove in inside diameter of bore.
9. Install a new reservoir diaphragm in reservoir cover where needed, and install cover on master cylinder. Beaded side faces master cylinder casting to insure positive sealing. The bail wire is now pushed into position to hold reservoir cover.

10. **Manual brake only**--Assemble push rod through push rod retainer, if it has been disassembled. Push retainer over end of master cylinder. Assemble new boot over push rod and press it down over the push rod retainer.

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 Mini-Master Cylinder

Removal, Inspection and Installation procedures are the same as described for "Except Bendix Mini-Master Cylinder".

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 inside 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

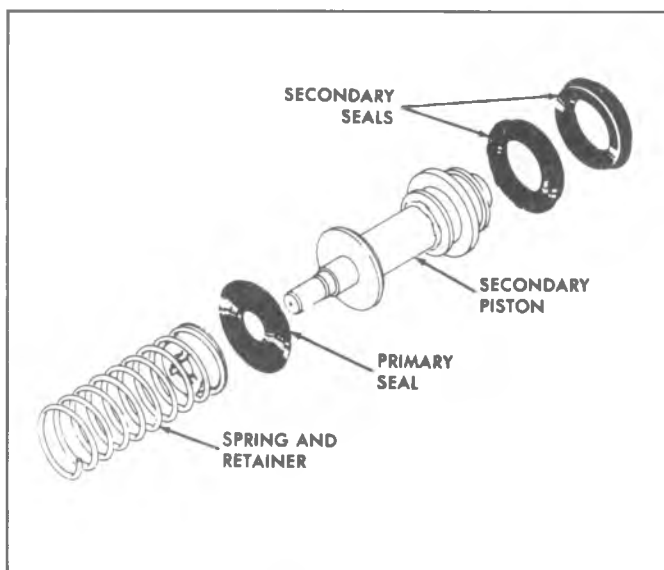


Fig. 5-15--Delco Secondary Piston - Exploded View

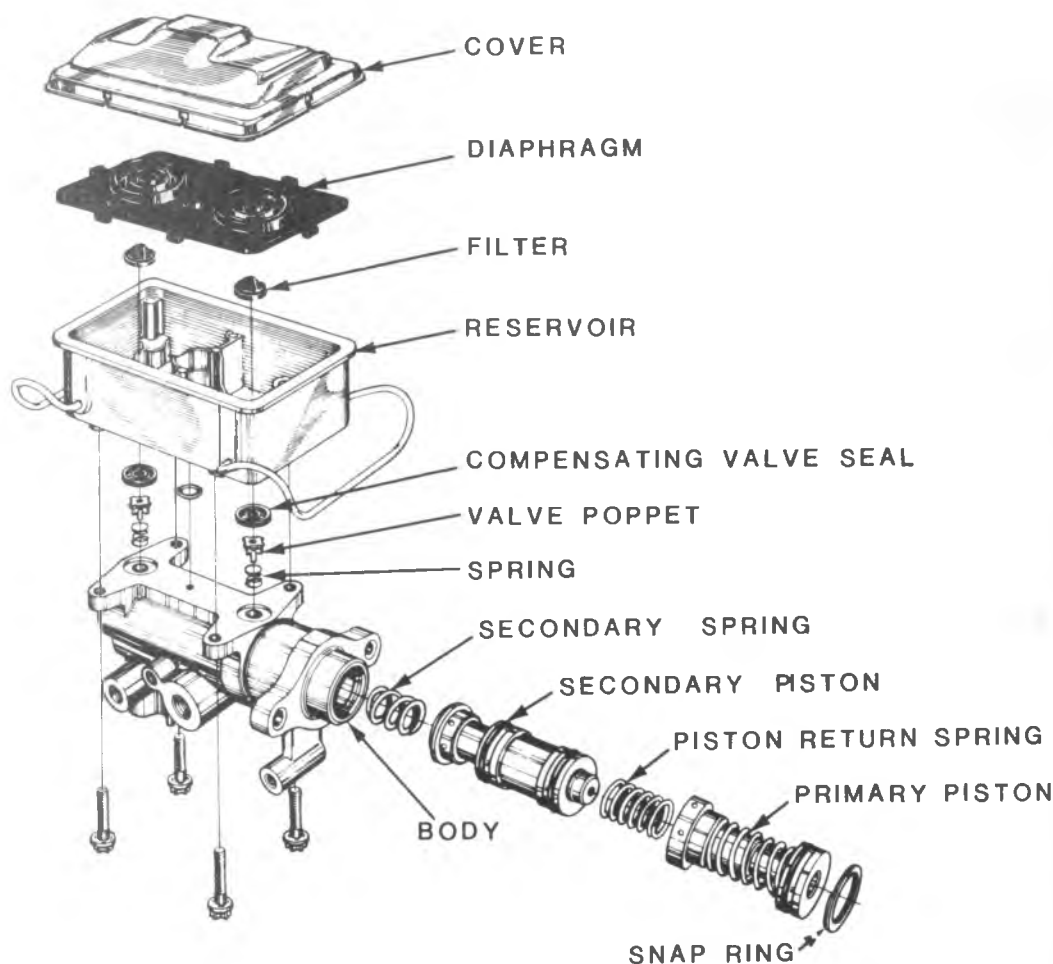


Fig. 5-16—Bendix Mini-Master Cylinder—Exploded View

piston and remove the primary and secondary piston assemblies from the cylinder bore. It may be necessary to plug the front outlet port and to apply low air pressure to the front compensating valve port to remove the secondary piston assembly.

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 bore, and press assembly to the bottom of the bore.
4. Lubricate the primary piston assembly with clean 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).

DELCO DISC BRAKE SHOE AND LINING

Lining Inspection

Inspect the brake linings per maintenance schedule and anytime that the wheels are removed (tire rotation, etc.) Check both ends of the outer shoe by looking in at each end

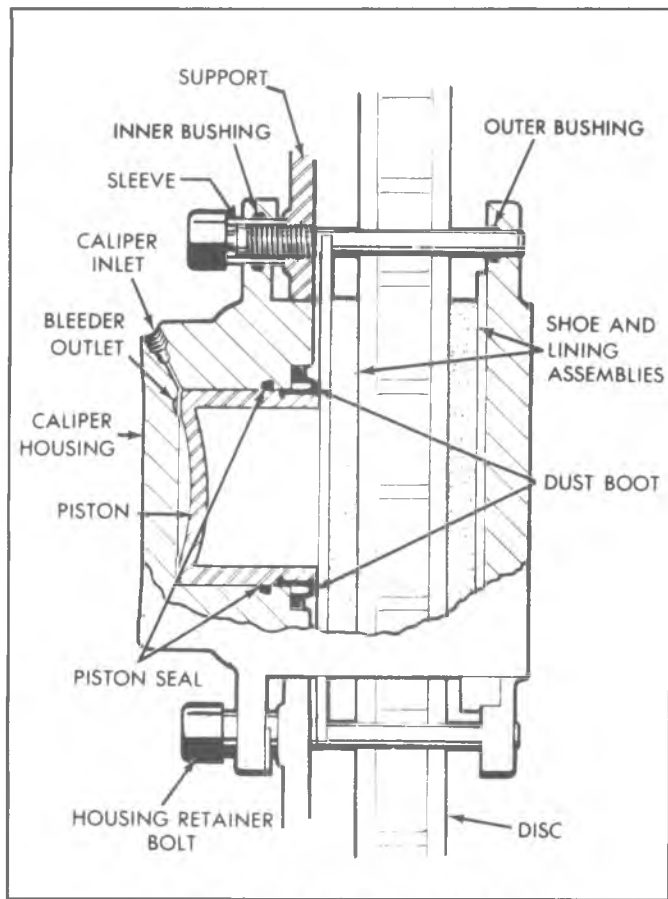


Fig. 5-17—Delco Single Piston Disc Brake

of the caliper (see figure 5-18). Check the lining thickness on the inner shoe by looking down through the inspection hole in the top of the caliper housing. Whenever the lining is worn to the approximate thickness of the shoe, the shoe and lining should be removed. After removal, measure the lining thickness. The shoe and lining should be replaced at any time when the lining is worn to within $1/32"$ (0.80 mm) of a

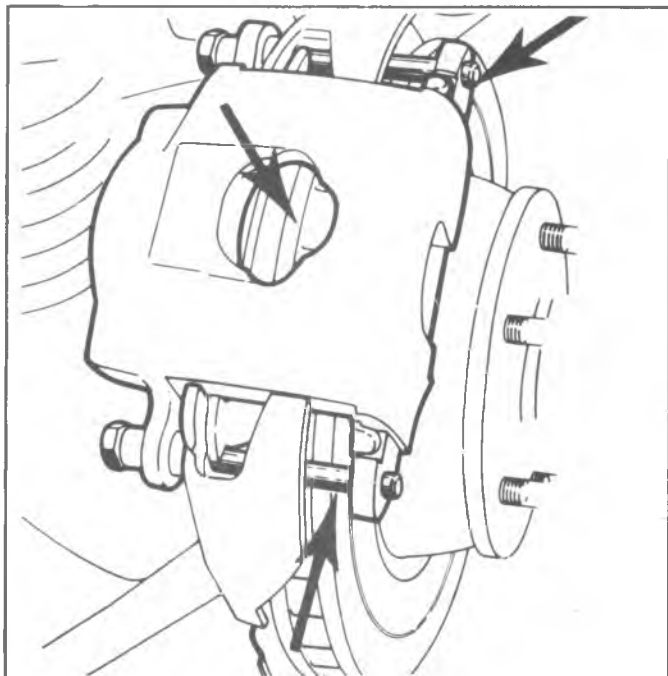


Fig. 5-18—Lining Inspection

rivet or $1/32"$ (0.80 mm) of the shoe at any point or when wear indicator contacts the rotor. Always replace linings in sets (both right and left front).

All front disc brakes have a wear indicator that makes a noise when the linings wear to a degree where replacement is required, (fig. 5-19). The spring clip is an integral part of the inboard shoe and lining. When the lining is worn, the clip contacts the rotor and produces a warning noise.

Check flatness of brake pads. Place inboard and outboard pad surfaces together and check for gap between pad surfaces. If more than 0.13mm (.005") gap is measured at middle of pad (midway between attaching lugs), pad must not be used. This applies to new or used brake pads. Whenever the front disc brakes are relined, the rear brakes should also be checked.

Caliper Removal

NOTICE: See "Notice" on Page 5-1 of this section.

1. Remove two thirds of the total fluid capacity from the front master cylinder reservoir. Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore to remove the caliper. This may be done by breaking the front line connection at the master cylinder and bleeding down the fluid level. Do not remove the brake line or completely empty the reservoir or it will be necessary to bleed the hydraulic system. Discard -- do not attempt to reuse -- the brake fluid removed.
2. Raise the vehicle on a hoist and remove the wheel covers and wheel assemblies. Position a 7 inch

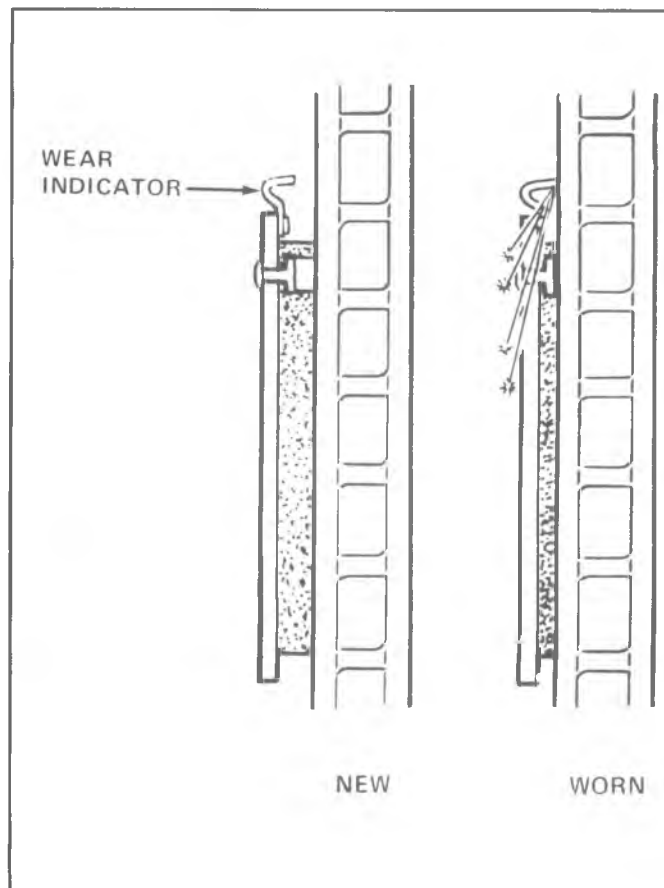


Fig. 5-19--Disc Brake Wear Indicators

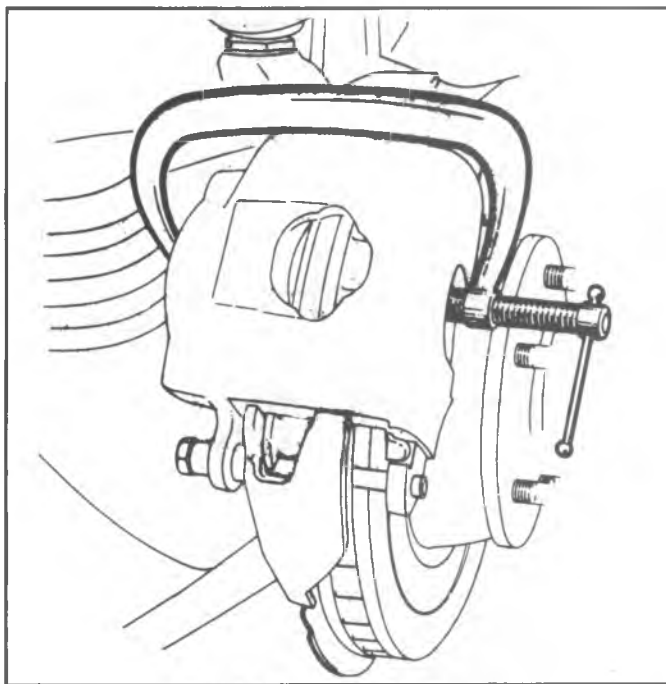


Fig. 5-20—Use of "C" Clamp

"C" clamp on the caliper so that solid side of the clamp rests against the metal part of the outboard shoe (fig. 5-20). Tighten the "C" clamp until the caliper moves away from the vehicle far enough to push the piston to the bottom of the piston bore. This will allow the shoes to back off from the rotor surfaces. Remove the "C" clamp.

3. It is not necessary to disconnect the brake hose for shoe and lining replacement. Remove the two mounting bolts which attach the caliper to the support bracket (fig. 5-21). Lift the caliper off the rotor and remove the inboard shoe. Dislodge the outboard shoe and position the caliper on the front suspension arm so that the brake hose will not support the weight of the caliper.

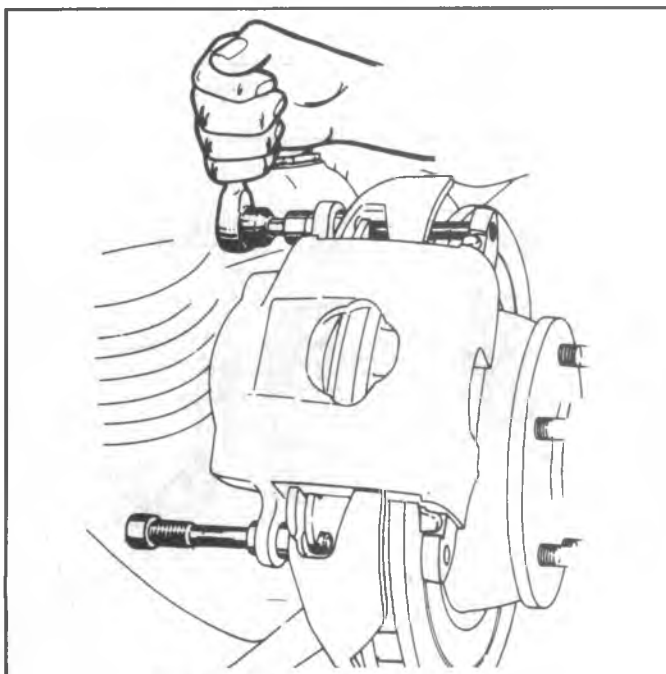


Fig. 5-21—Removing Mounting Bolts

Remove the shoe support spring from the cavity in the piston.

4. Using Tool J-22835, remove the sleeves from the inboard ears of the caliper (fig. 5-22). Next, remove the rubber bushings from the grooves in each of the four caliper ears.

Cleaning and Inspection

1. Thoroughly clean the holes and the bushing grooves in the caliper ears. Wipe all dirt from the mounting bolts. Do not use abrasives on the bolts since this will damage the plating. If the bolts are corroded, or damaged, they should be replaced.
2. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled. Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage. Make sure that the boot is properly engaged in the groove in the piston and also in the caliper counter-bore (fig. 5-24).

NOTICE: Do not use compressed air to clean the inside of the caliper since this may cause the dust boot to become unseated.

3. If the vehicle has a brake problem and diagnosis points to the rotor, it should be inspected and checked for runout at this time.

Caliper Installation

1. Install rubber bushings in all four caliper ears.

NOTICE: It is essential that the new sleeves and rubber bushings be used in order to insure the proper functioning of the sliding caliper design.

2. Use Tool, J-22835, to install the sleeves (fig. 5-25). Position the sleeves so that the end toward the shoe and lining assemblies is flush with the machined surface of the ear.
3. Install the shoe support spring by replacing the single tang end of the spring over the notch in the center of the edge of the shoe. Then press the two tangs at the spring end of the inboard shoe spring over the bottom edge of the shoe so that they engage the shoe securely, as

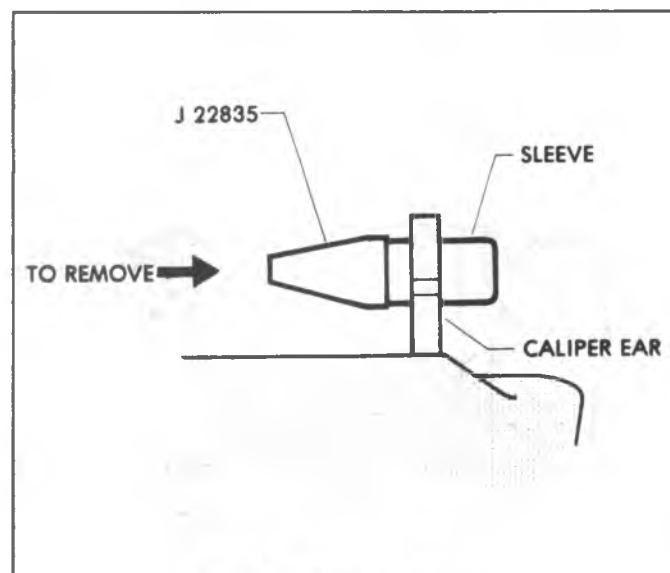


Fig. 5-22—Removing Sleeves

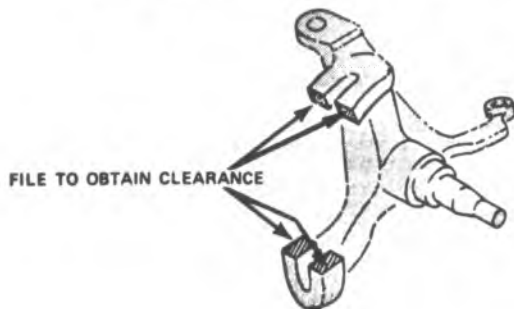


Fig. 5-23--Caliper to Stop Clearance

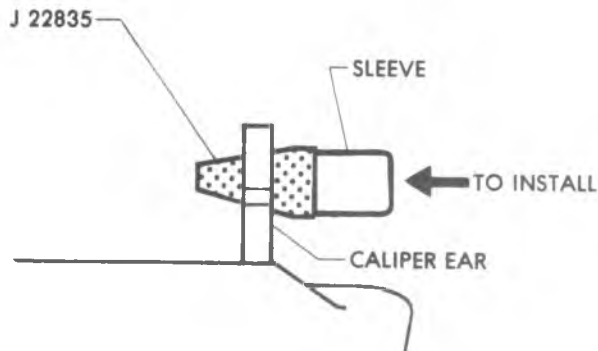


Fig. 5-25--Sleeve Installation

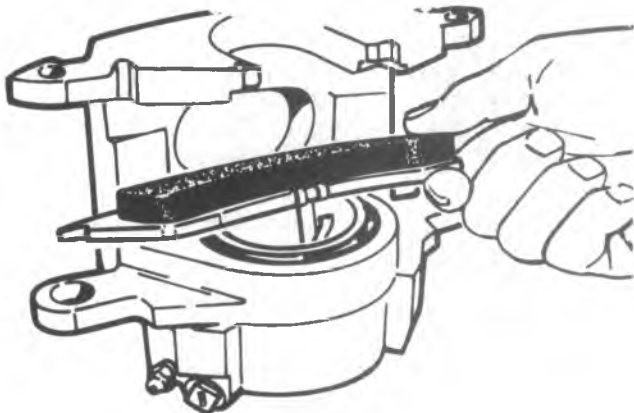


Fig. 5-26--Inserting Shoe Support Spring

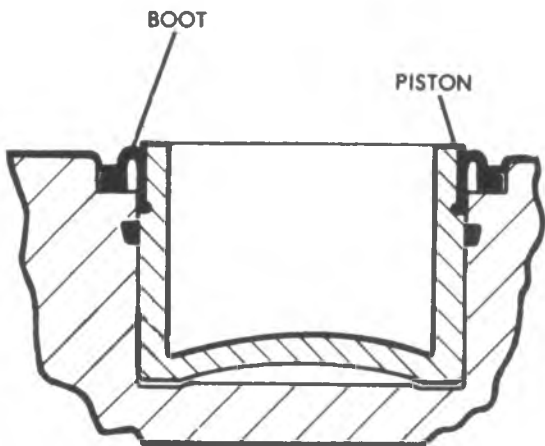


Fig. 5-24--Boot Installation

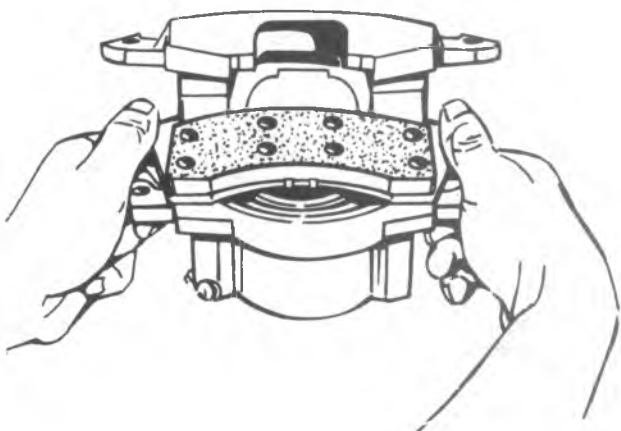


Fig.5-27--Installing Inboard Shoe

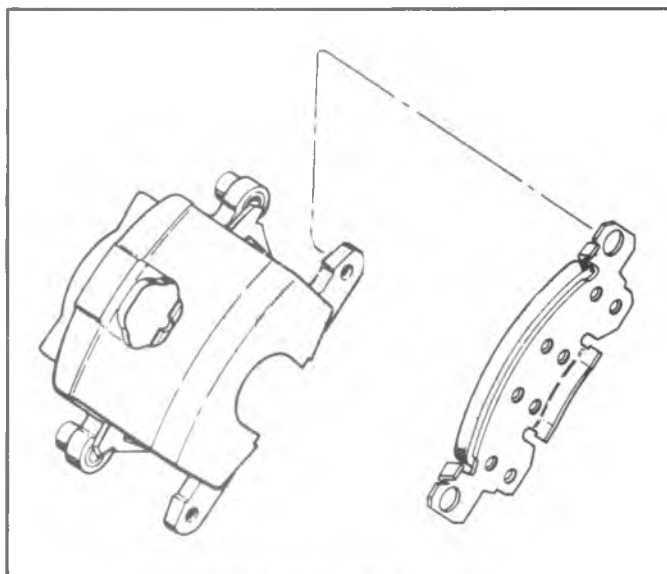


Fig. 5-28--Installing Outboard Shoe

shown in Figure 5-26.

4. Position the inboard shoe and lining assembly (with spring attached) in the caliper so that the ear end of the shoe and lining is down and the bottom end up at an angle with the spring resting on the piston I.D. (fig. 5-27). Press down on both ends of the shoe until the shoe is in a flat position, resting on the piston. The spring end of the inboard shoe support spring should be resting on the I.D. of the piston.

NOTICE: On inboard shoes there is a specific left hand and right hand shoe. When properly installed the wear sensor will be toward rear of caliper.

5. 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 cut-out (see fig. 5-28). Be sure to note right and left brake shoes.

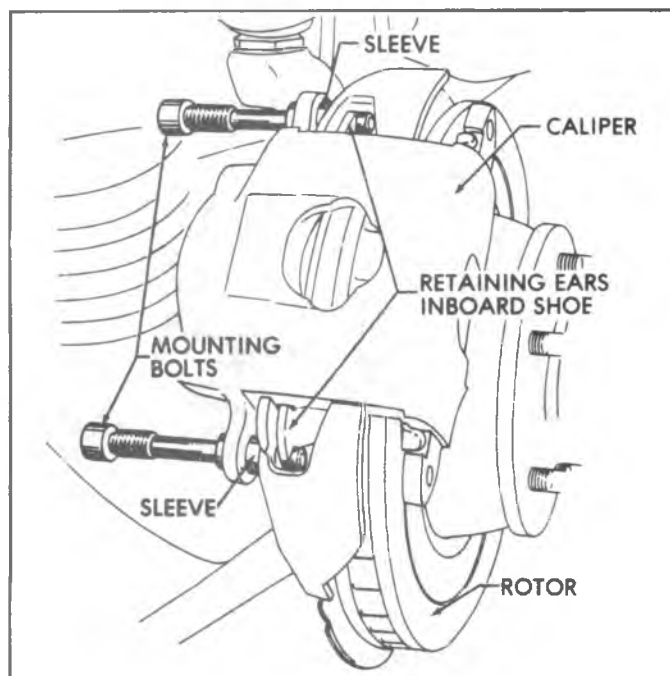


Fig. 5-29--Installing Mounting Bolts

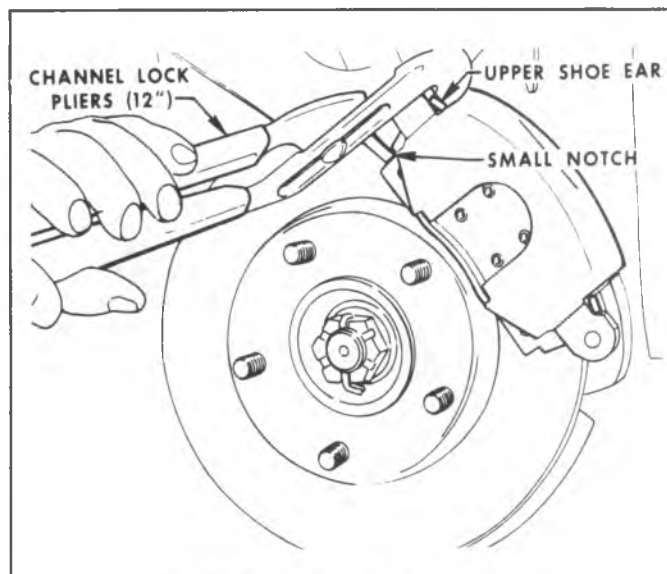


Fig. 5-30--Clinching Outboard Shoe

6. Position the caliper over the rotor, lining up the holes in the caliper ears with the holes in the mounting bracket.

NOTICE: When reinstalling caliper be sure you haven't turned it over, end over end. This would cause a severe twist in the brake hose. After positioning caliper on disc, observe brake hose being sure it is not twisted.

Start the bolts through the sleeves in the inboard caliper ears and through the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe (fig. 5-29). Push bolts on through to engage the holes in the outboard shoes and the outboard caliper ears at the same time, threading the bolts into the mounting bracket. Torque the bolts to 35 lb. ft. (50 N·m).

NOTICE: See "Notice" on Page 1 of this section.

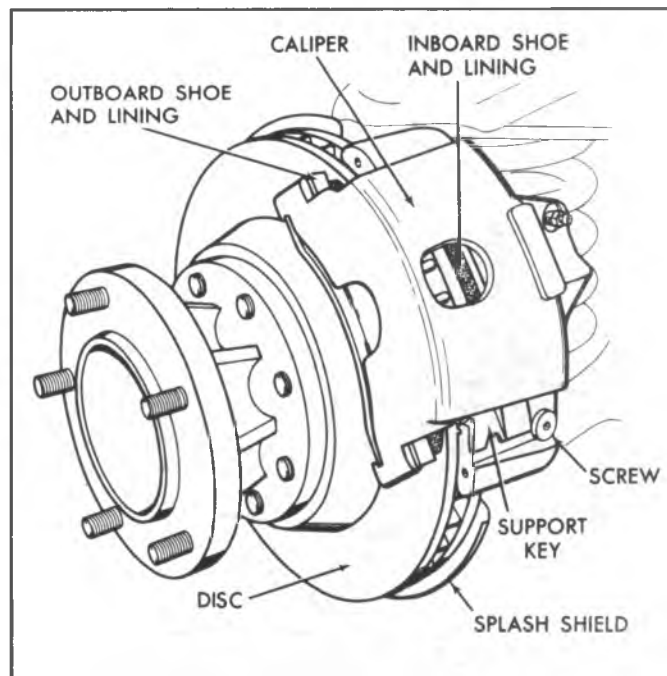


Fig. 5-31--Bendix Front Disc Brake Assembly

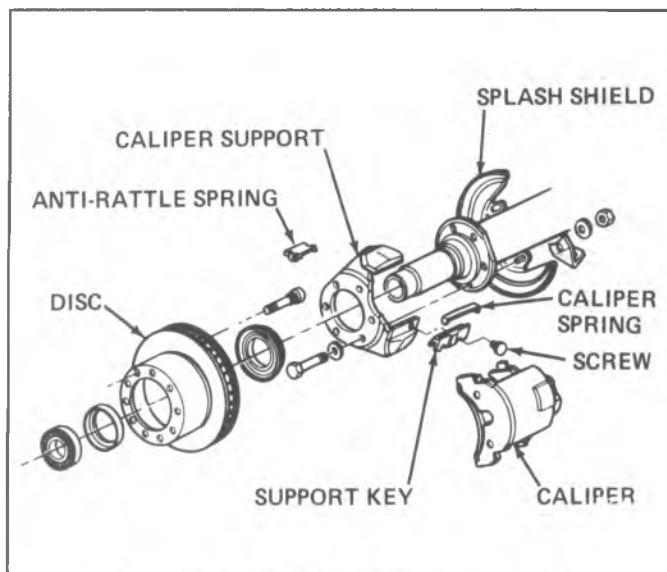


Fig. 5-32--Bendix Rear Disc Brake Assembly

7. Add fresh approved brake fluid to the master cylinder reservoirs to bring the level up to within 1/8" (3 mm) of the top.
8. Pump brake pedal to seat linings against rotor.
9. Clinch upper ears of outboard shoe by positioning channel lock pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe opposite upper ear (fig. 5-30).
10. After clinching, ears are to be flat against caliper housing with no radial clearance.
11. If radial clearance exists, repeat clinching procedure.

Completion

1. Replace the shoe and linings on the other front wheel disc brake in exactly the same manner as just described. Relining is to be done in full axle sets only. When completed, reinstall the wheel and tire assemblies. Torque wheel nuts to specifications. Install wheel covers and lower the vehicle to the floor.

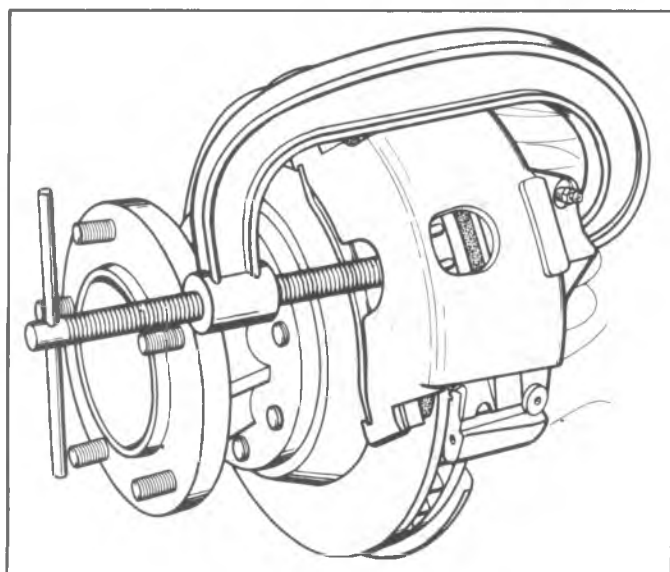


Fig. 5-33--Pushing Piston into Bore Using a "C" Clamp

NOTICE: See "Notice" on Page 1 of this section.

2. Whenever the front wheel disc brakes are relined, the rear drum brakes should be checked also.

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. 5-31). 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 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 its bore. This can be accomplished by using a "C" clamp as shown in Figure 5-33.
4. Remove the bolt at the caliper support key. Using a brass punch, remove the key and spring (fig. 5-34).
5. Lift the caliper off the disc and support in a raised position with a heavy wire (fig. 5-35).

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. 5-32). Remove and discard the inboard shoe clip. Remove the outboard shoe from the caliper. It may be necessary to tap the

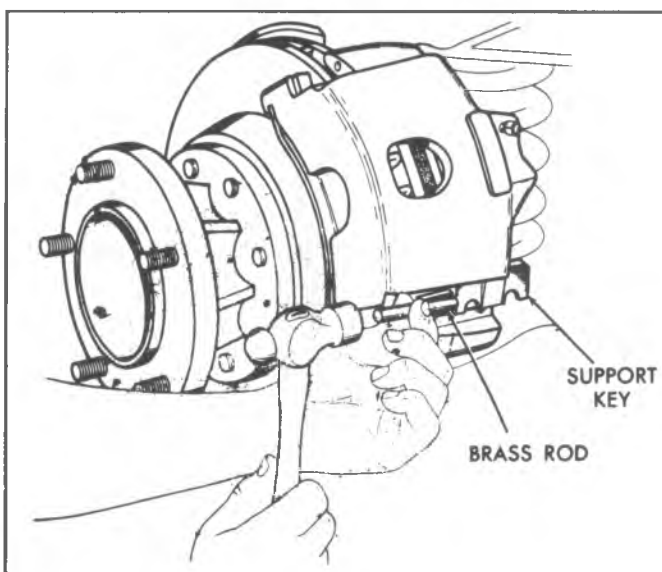


Fig. 5-34--Removing the Caliper Support Key

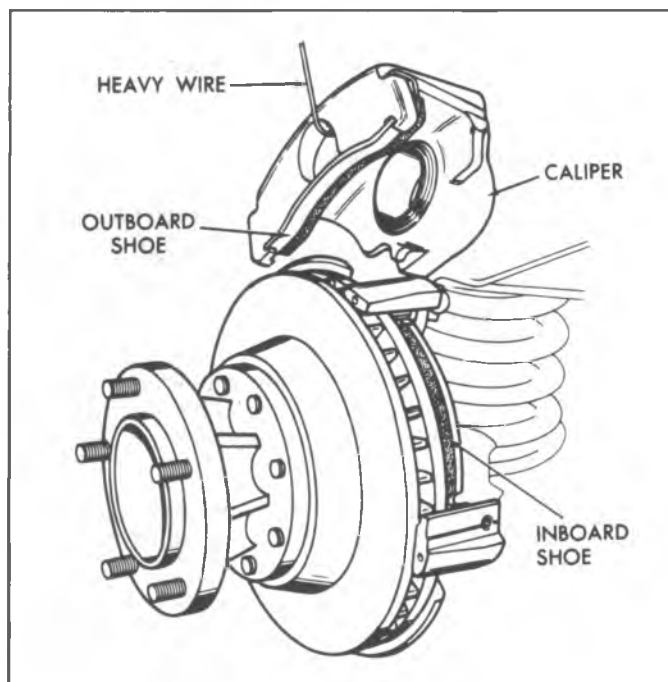


Fig. 5-35--Removing Caliper from the Disc

shoe to loosen it in the caliper housing.

Mark disc pad positions if pads are to be reinstalled.

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 in 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 knuckle or caliper support. Position the caliper to the lower steering knuckle (or support) sliding surface.

NOTICE: Make sure that the 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. 5-36).
7. Install the screw and torque to 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.

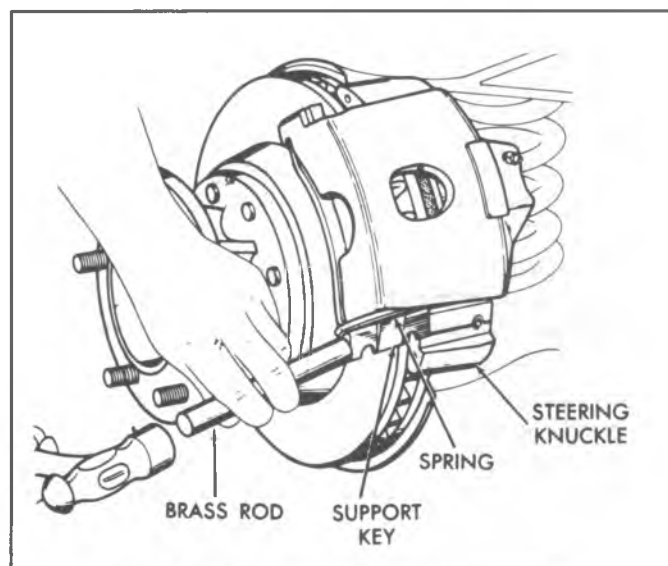


Fig. 5-36--Installing the Caliper Support Key

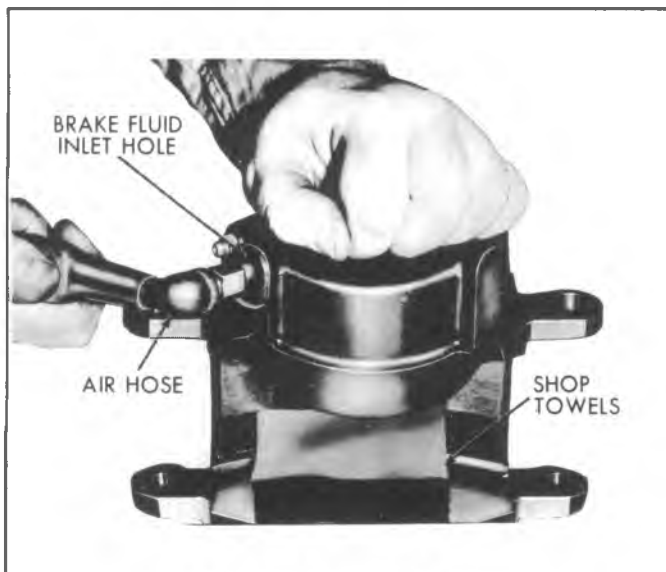


Fig. 5-37--Removing Piston

CALIPER OVERHAUL

Delco

Removal

1. Removal of the caliper for overhaul is the same as for shoe and lining replacement except that it will be necessary to disconnect the brake hose; (Refer to front brake hose replacement).
2. First, disconnect the hose from the steel brake pipe and cap the fittings to prevent dirt from entering the pipe or the hose. Then, remove the U-shaped retainer from the hose fitting. Withdraw the hose from the frame support bracket and remove the caliper -- with hose attached -- to a work bench for overhaul.

Disassembly

1. Before beginning disassembly, thoroughly clean the exterior of the caliper using brake cleaner. Place the caliper on a clean work surface.
2. Remove the brake hose from the caliper, discarding the copper gasket. Check the hose for worn spots, cracks or other signs of deterioration, discard the hose, if damaged, to be replaced with a new hose at reassembly. Drain brake fluid from the caliper.
3. Use clean shop towels to pad the interior of the caliper. Remove the piston by directing compressed air into the caliper inlet hole (fig. 5-37).

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 pressure to ease the piston out of the bore. If the piston is blown out, even with padding provided, it may become damaged.

4. Use a screwdriver to pry the boot out of the caliper. Extend the screwdriver across the caliper bore, under the boot, and pry up. Be careful not to scratch the caliper bore.
5. Use a piece of wood or plastic -- a plastic toothpick is ideal -- to remove the piston seal from its groove in the

caliper bore. **DO NOT USE A METAL TOOL OF ANY TYPE FOR THIS OPERATION.**

6. Remove the bleeder valve from the cliper.

Cleaning and Inspection

1. The boot, piston seal, rubber bushings and sleeves are to be replaced each time the caliper is overhauled. Discard, do not bother to clean and inspect, these parts.
2. Clean all other parts in clean denatured alcohol or brake cleaner. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper and bleeder valves.

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.

3. Check the mounting for corrosion, breaks in the plating or other damage. Do not use abrasives in an attempt to clean the pins -- replace them.
4. Carefully examine the piston outside diameter for scoring, nicks, corrosion and worn or damaged chrome plating. If any surface defects are detected, replace the piston.
5. Check the bore in the caliper for the same defects as the piston with the exception of plating damage. The piston bore is not plated and stains or minor corrosion can be polished with crocus cloth. Do not use emery cloth. Thoroughly clean the caliper after the use of crocus cloth. If the bore cannot be cleaned up in this manner, replace the caliper.

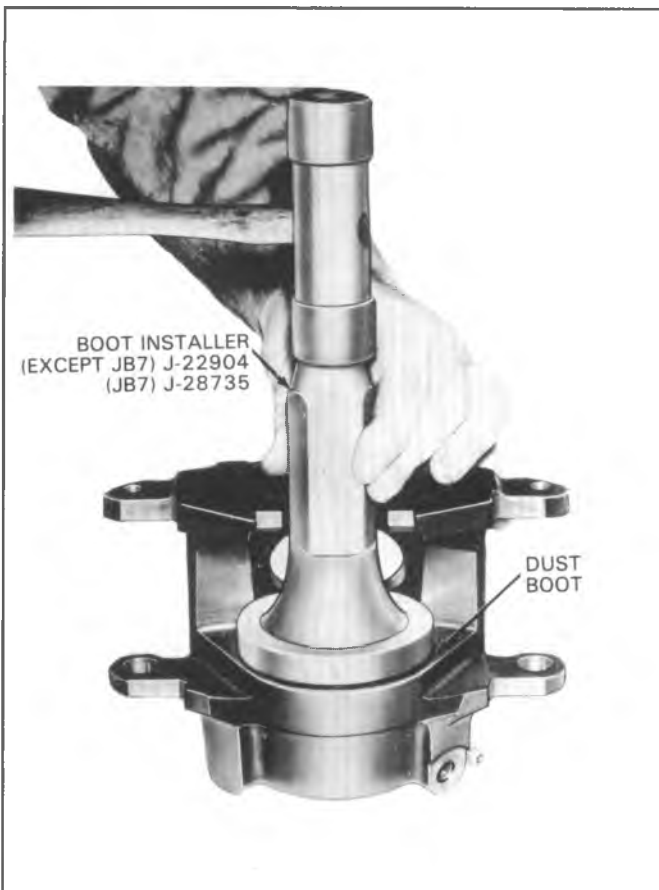


Fig. 5-38--Seating Boot

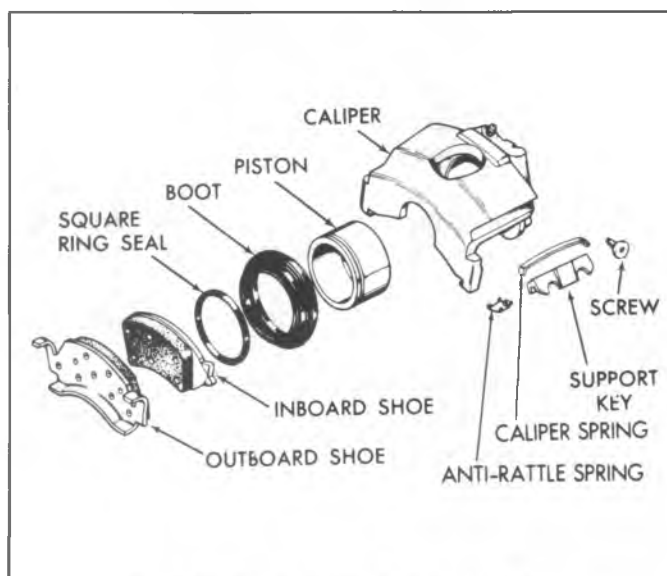


Fig. 5-39--Bendix Brake Caliper Assembly

Reassembly

1. Lubricate the bore in the caliper and the new piston seal with clean brake fluid. Position the seal in the caliper bore groove. Lubricate the piston with clean brake fluid and assemble a new boot into the groove in the piston so that the fold faces the open end of the piston. Insert the piston into the caliper bore, using care not to unseat the seal and force down to the bottom in the bore. This will require a force of 50 to 100 pounds (220 to 440 N). Position the outside diameter of the boot in the caliper counterbore and seat with Tool J-22904 (fig. 5-38).
2. Check the boot installation to make sure that the retaining ring molded into the boot is not bent and that the boot is installed fully, below the caliper face, and evenly all around. Otherwise dirt or moisture may enter the bore and cause damage or corrosion.
3. Install the brake hose in the caliper inlet using a new copper gasket.

Installation

1. Installation of the caliper and mounting parts (rubber bushing, sleeves, shoe and lining assemblies and pins) is the same as for lining replacement except for the following:
 - a. The brake hose must be connected to the brake pipe at the frame or frame bracket.
Use extreme care to orient the hose so that the keyed hose end fitting aligns with the slot in the bracket without twisting or kinking the hose.
 - b. After overhaul -- or any time that the brake hose or line is disconnected -- the calipers must be bled.

Bendix

Removal

Clean dirt from hose to caliper connection before proceeding with removal.

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 Linings-Removal".

Disassembly (Fig. 5-39)

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. 5-40).

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.

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.
6. Remove the bleeder valve from the caliper.

Cleaning and Inspection

The dust boot and piston seal are to 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

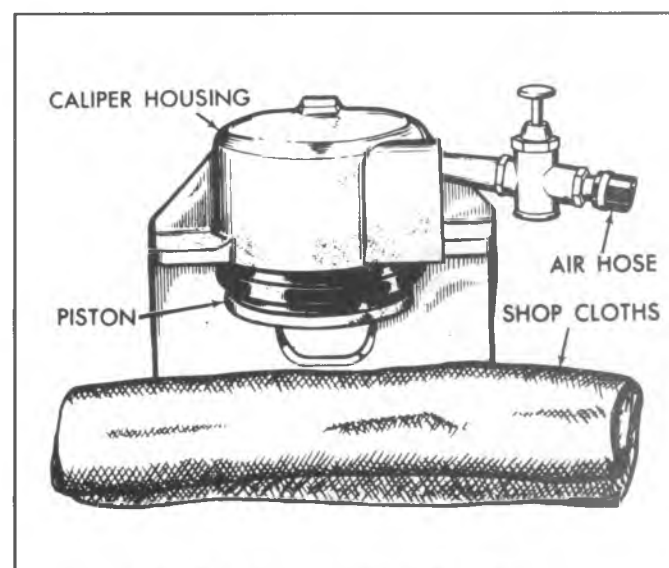


Fig. 5-40--Removing the Caliper Piston

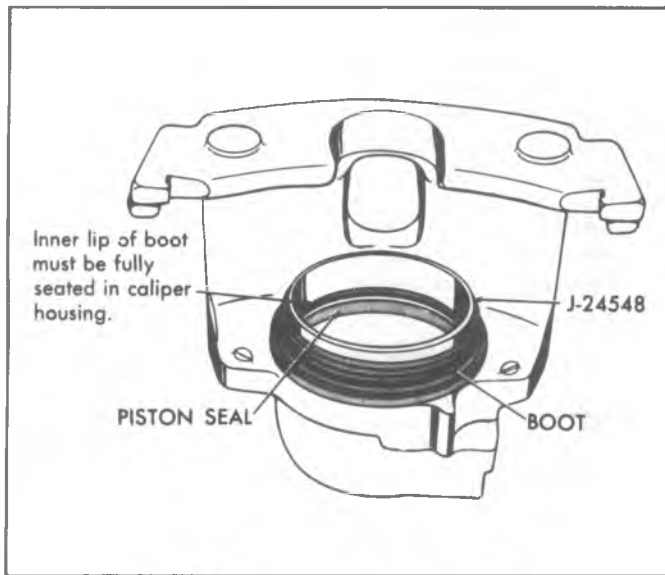


Fig. 5-41--Installing Caliper Piston Boot

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 crocus 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.

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. 5-41).

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. 5-42); 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.

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. 5-43). 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.

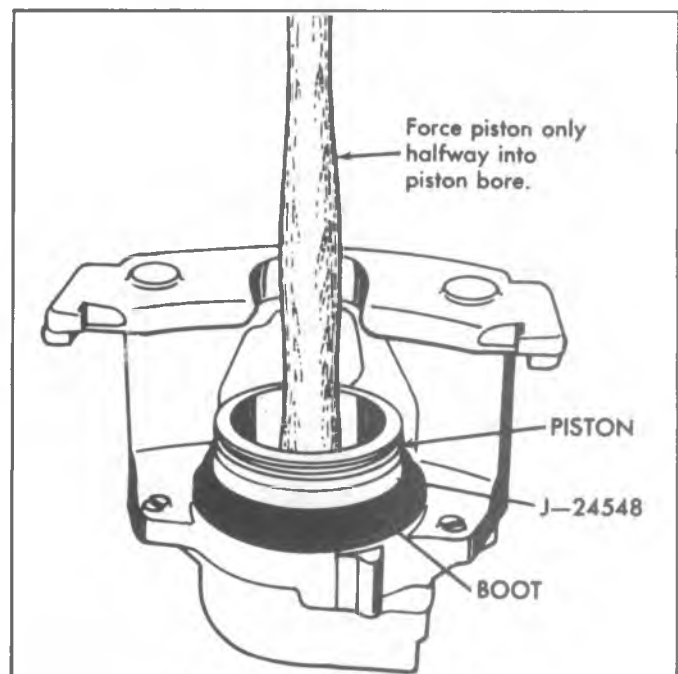


Fig. 5-42--Installing Piston in Caliper

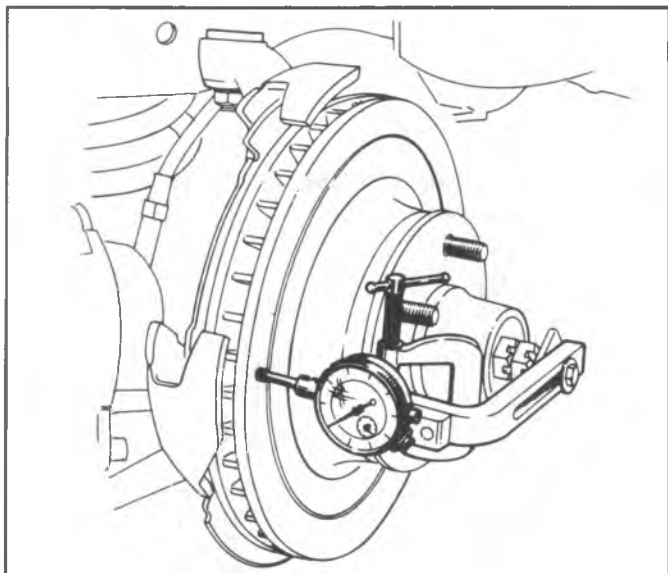


Fig. 5-43--Checking Rotor for Lateral Runout

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 manufacturing the brake rotor, tolerances of the rubbing surfaces for flatness, for parallelism and for lateral runout are held very closely. The maintenance 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.

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.

DRUM BRAKE SHOE AND LINING

Service Brake

Adjustment

1. Using a punch, knock out lanced area in brake drum. If this is done with the drum installed on the vehicle, the drum must be removed and all metal cleaned out of the brake compartment. Be sure to procure a new **metal** hole cover and install it in the drum after adjustment to prevent dirt and water from getting into the brakes. Use J-6166 to turn brake adjusting screw; expand brake shoes at each wheel until the wheel can just be turned by hand. The drag should be equal at all wheels.
2. Back off brake adjusting screw at each wheel 30 notches. If shoes still drag lightly on drum, back off adjusting screw one or two additional notches. Brakes should be free of drag when screw has been backed off approximately 12 notches. Heavy drag at this point indicates tight parking brake cables.
3. Install metal adjusting hole cover in brake drum.
4. Check parking brake adjustment.

Removal and Inspecting

NOTICE: See "Notice" on Page 1 of this section.

1. Raise vehicle on hoist. Remove wheel and brake drum. It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment, rotate shoe adjusting screw downward.
On JB6, JB7 and JB8 equipped vehicles, it is necessary to remove the axle shafts to remove the hub and drum assembly; refer to Section 4B of this manual.
2. Unhook the primary and secondary shoe return springs using large pliers.
3. Remove shoe hold down springs.
4. Lift up on actuator, unhook actuating link from anchor pin, then remove.
5. Spread shoes to clear wheel cylinder connecting

ROTOR THICKNESS	
MINIMUM AFTER REFINISHING	REPLACEMENT (DISCARD)
1.480	1.465
1.230	1.215
.980	.965

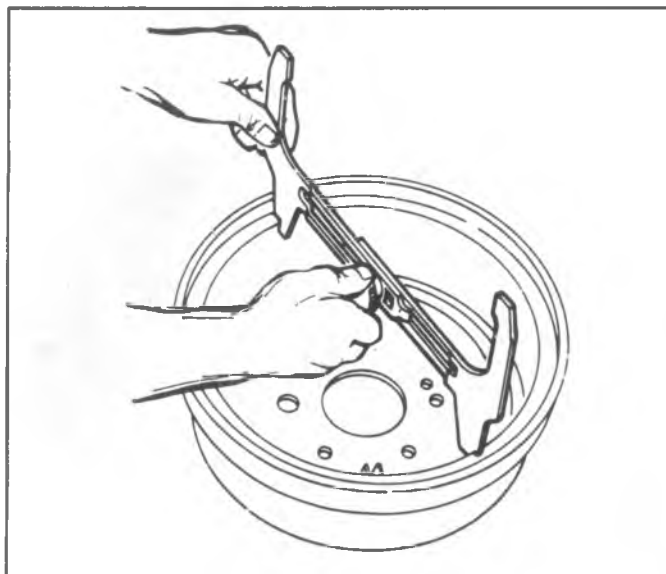


Fig. 5-45--Measuring Brake Drum I.D.

vehicle. Make certain starwheel lines up with adjusting hole in backing plate.

3. Lubricate shoe contact surfaces on backing plate with a thin coating of Delco Brake Lubricant or equivalent. Sparingly apply same lubricant where brake cable contacts backing plate.
4. Place brake shoes on backing plate, at the same time engaging shoes with wheel cylinder links. The primary shoe (short lining) goes toward front of vehicle. Connect cable to parking brake lever and install strut and spring between lever and primary shoe.
5. Install actuator, actuator return spring and actuating link. If old brake shoe return springs are nicked, distorted or of doubtful strength (discolored from heat), it is advisable to install new parts.
6. Install shoe hold down springs.
7. Install the primary and secondary shoe return springs using large pliers. Be careful not to distort springs.
8. Measure brake drum I.D. using inside caliper portion of Tool J-21177 (fig. 5-45). Adjust brake shoes to dimension obtained on outside caliper portion of Tool J-21177 (fig. 5-46).
9. Install brake drums and wheels.
10. If any hydraulic connections were disturbed, bleed hydraulic system.
11. Adjust parking brake.
12. Inspect all brake pipes, hoses and connections for evidence of fluid leakage. Tighten any leaking connection. Then apply heavy pedal pressure to brake pedal and recheck connections.
13. Check fluid level in master cylinder and add fluid if necessary.
14. Check brake pedal for proper feel and for proper return.
15. Remove vehicle from hoist and road test for proper brake action. Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently damage new linings and may score brake drums. When linings

are new, they must be given moderate use for several hundred miles of burnishing.

Repair Brake Lining

This procedure is to be used when brake action is unequal, severe, hard, noisy or otherwise unsatisfactory and when brake linings have had little wear.

1. Check fluid in master cylinder and add fluid if necessary.
2. Check brake pedal for proper feel and for proper return.
3. Raise vehicle on hoist and remove all wheels.
4. Remove all brake drums. **BRAKE PEDAL MUST NOT BE OPERATED WHILE DRUMS ARE REMOVED.**

NOTICE: See "Notice" on page 1 of this section.

5. Clean all dirt out of brake drums. Inspect drums and replace or recondition if required.
6. Clean all dirt from brake assemblies, then inspect brake linings for uneven wear, oil soaking, loose rivets or imbedded foreign particles. If linings are oil soaked, replacement is required.
7. If linings are otherwise serviceable, tighten or replace loose rivets and thoroughly clean all steel or other imbedded particles from surfaces and rivet counterbores of linings.
8. Check all backing plate bolts to make sure they are tight. (Refer to Section 4B for wheel stud replacement procedure.)
9. Measure brake drum I.D. using inside caliper portion of Tool J-21177. Adjust brake shoes to dimension obtained on outside caliper portion of Tool J-21177 (figs. 5-45 and 5-46).
10. Install drum and wheel and tire assemblies.
11. Remove vehicle from hoist and road test for proper brake action. Brakes must not be severely applied immediately after installation. Severe application may permanently damage new linings and may score brake drums. When linings are new, they must be given moderate use for several hundred miles of burnishing.

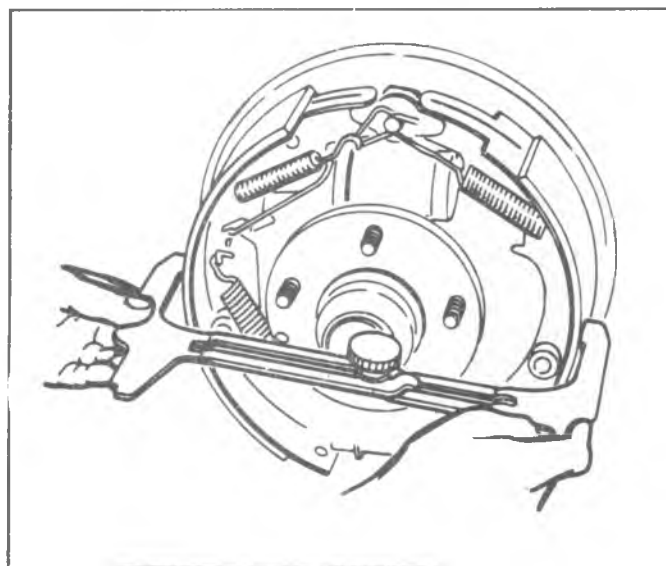


Fig. 5-46--Adjusting Brake Shoes

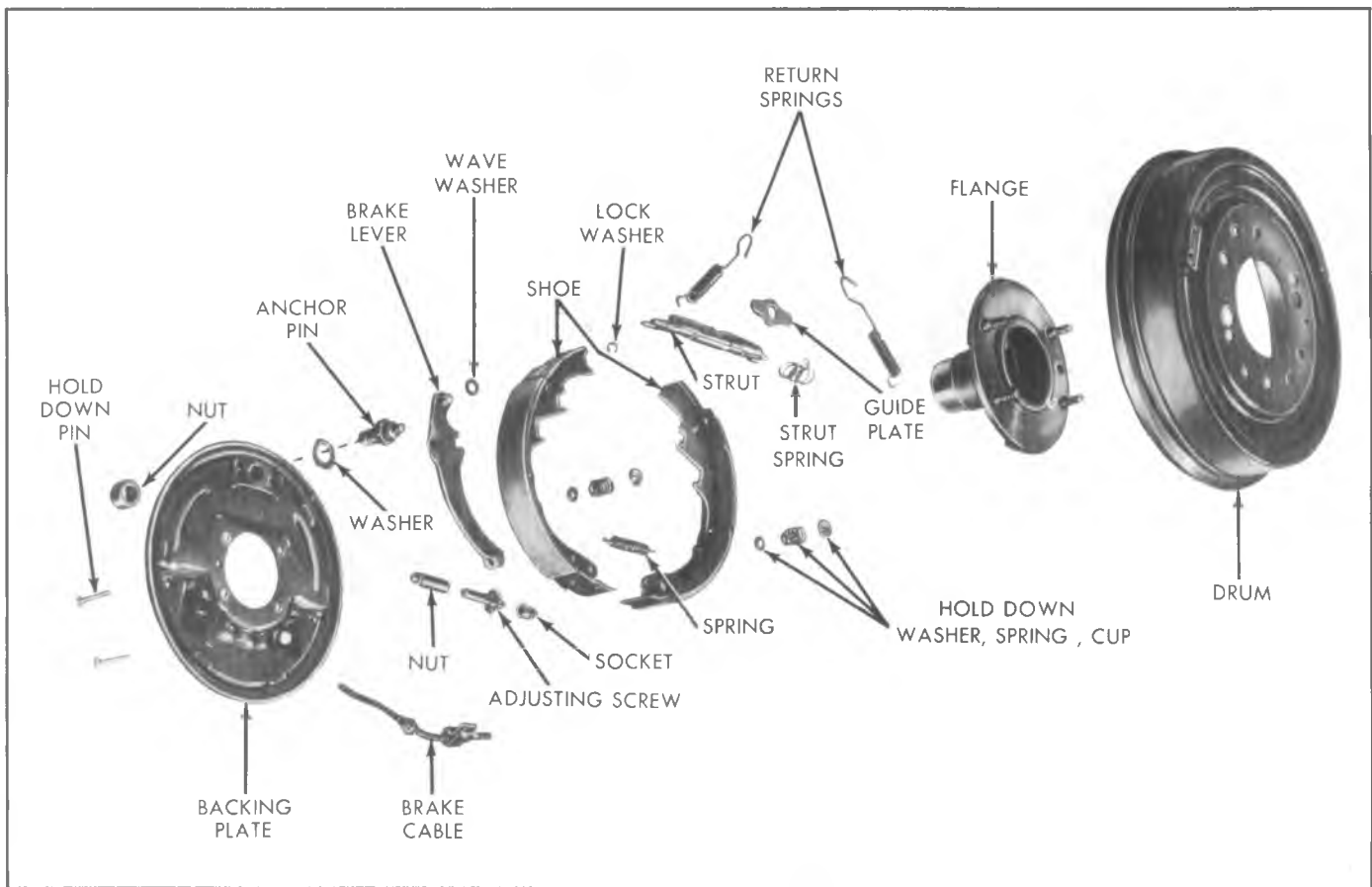


Fig. 5-47--Propshaft Parking Brake Components

Propeller Shaft Brake

Removal (Fig. 5-47)

1. Remove the propeller shaft; see Section 4A.
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.

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 nut 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

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

inserting cable in channel of lever. Release 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.

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 maximum diameter as shown in the general specification, it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion 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.

WHEEL CYLINDER

Removal

1. Remove wheel, drum and brake shoes. Be careful not to get grease or dirt on brake lining.
2. Remove wheel cylinder from backing plate.

Disassembly

1. Inspect cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder.
2. Polish any discolored or stained area with crocus cloth by revolving cylinder on cloth supported by a finger.
3. Rinse cylinder in clean brake fluid.
4. Shake excessive rinsing fluid from cylinder. Do not use a rag to dry cylinder, as lint from the rag cannot be kept from cylinder bore surfaces.

Assembly

1. Lubricate cylinder bore and counterbore with clean brake fluid and insert spring-expander assembly.
2. Install new cups. (Be sure cups are lint and dirt free.) Do not lubricate cups prior to assembly.
3. Install new pistons.
4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to assembly.

Installation

NOTICE: See "Notice" on page 1 of this section.

1. Install wheel cylinder on brake backing plate and connect brake pipe to hose. Torque rear wheel brake pipe to wheel cylinder to specifications.
2. Install brake shoes, drum and wheel; then flush and bleed hydraulic system.

POWER BRAKE VACUUM HOSE FILTER**Removal**

1. Use a pair of pliers to move the hose clamp approximately 2" (50 mm).
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 figure(s) 5-48 and 5-49.
2. Position hose clamp to retain filter.

POWER BRAKE UNIT**Vacuum Booster****Replacement (Fig. 5-50)**

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 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.

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 this 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" (1.6 mm) diameter hole through the end of the accumulator can opposite the "O" ring.

Removal

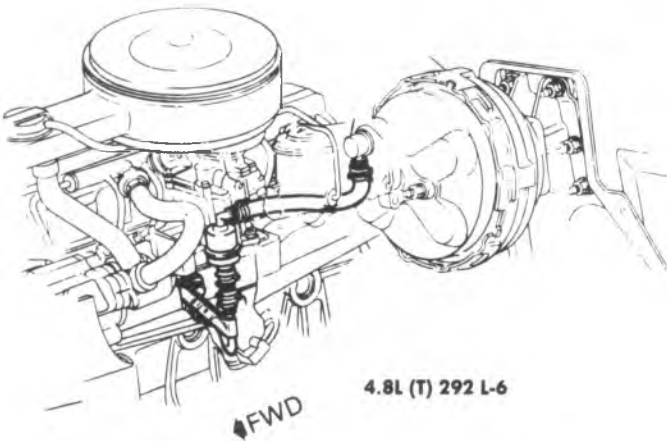
1. Turn engine off and pump brake pedal 4 or 5 times to deplete accumulator.
 2. Disconnect the high pressure hose.
 3. Remove two nuts from master cylinder, then move master cylinder away from booster with brake lines attached.
 4. Place the accumulator retaining cap Tool J-26889 over the master cylinder stud and install the nut as shown in Figure 5-51.
 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. 5-51).
- If the accumulator is not easily compressed approximately 1/8" (3 mm) 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. 5-52). 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. 5-51).
 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.

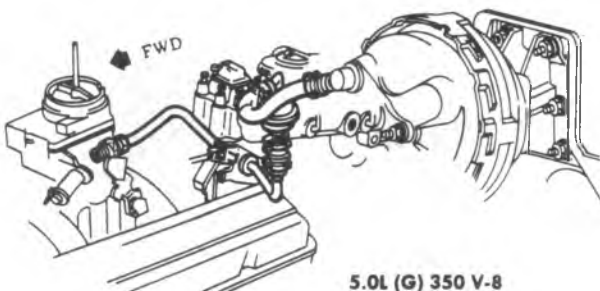
C-K MODELS



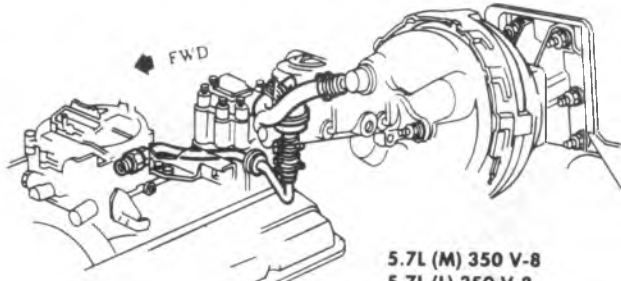
4.8L (T) 292 L-6



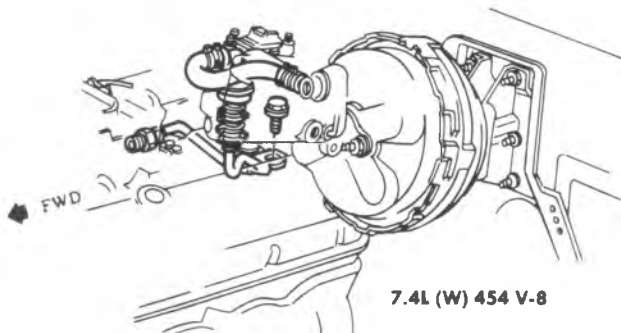
4.1L (D) 250 L-6



5.0L (G) 350 V-8

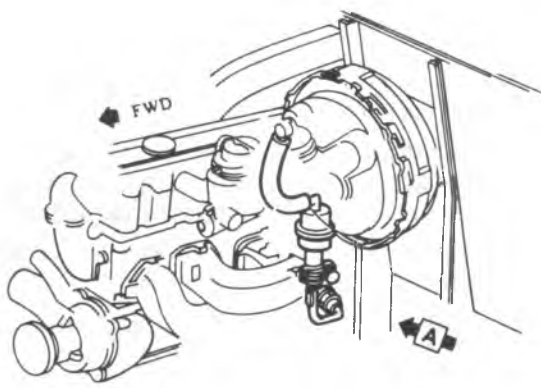


5.7L (M) 350 V-8
5.7L (L) 350 V-8
6.6L (R) 400 V-8
6.6L (X) 400 V-8

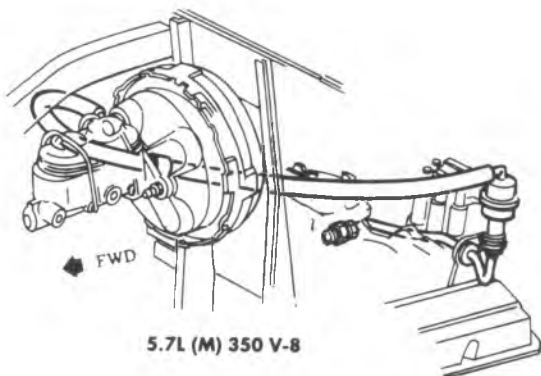


7.4L (W) 454 V-8

P MODELS



4.8L (T) 292 L-6



5.7L (M) 350 V-8

Fig. 5-48--Power Brake Vacuum Hose Filter Installation--C-K-P Trucks

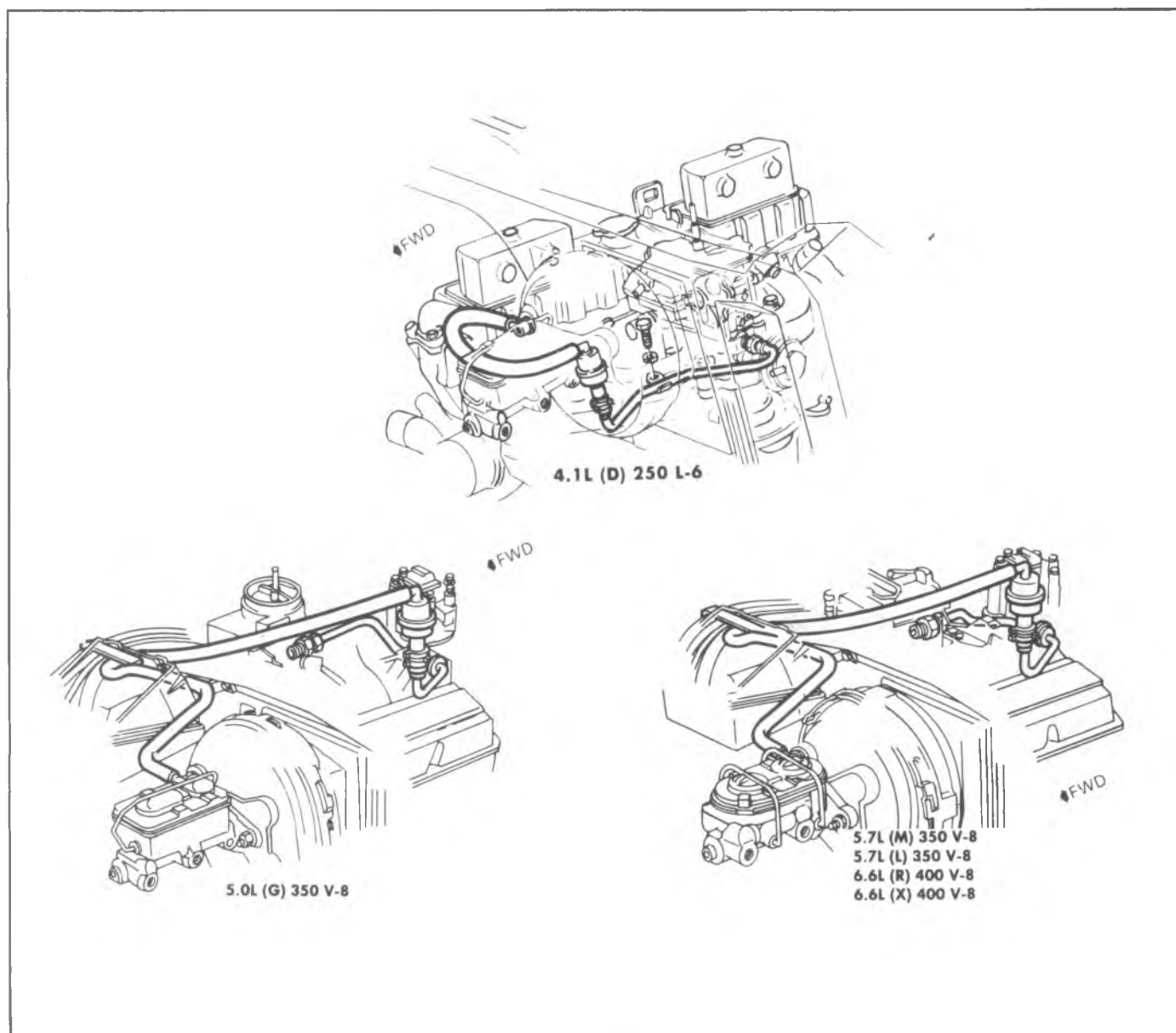


Fig. 5-49--Power Brake Vacuum Hose Filter Installation--G Models

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 booster with brake lines attached.
3. Push spool valve plug in and use a small screwdriver to remove retaining ring (fig. 5-53).
4. Remove spool valve plug and "O" ring.

Installation

1. Install "O" ring and spool valve plug (fig. 5-53).
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.
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 5-54.
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".

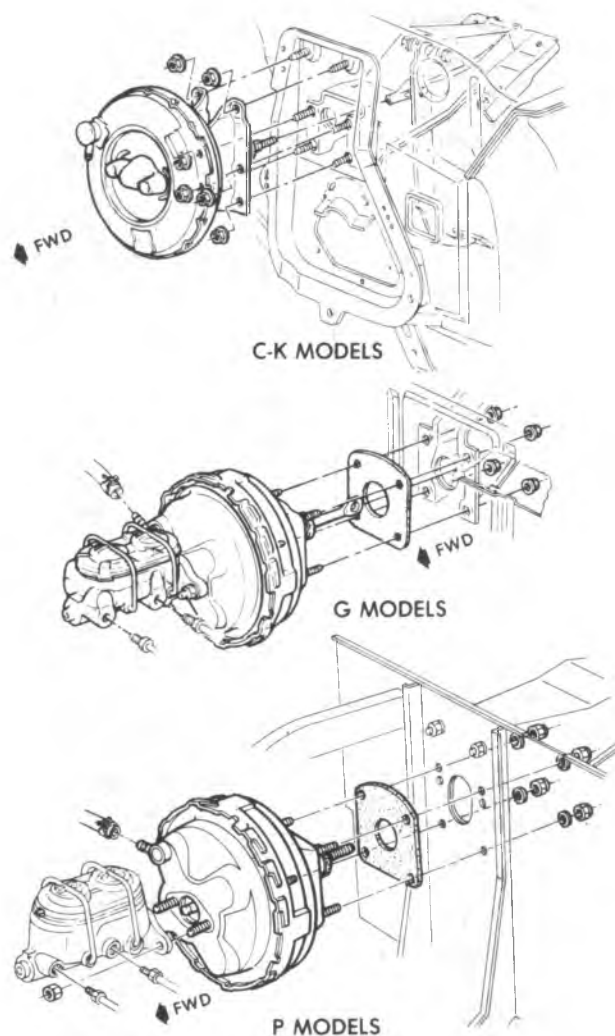


Fig. 5-50--Vacuum Booster Installation

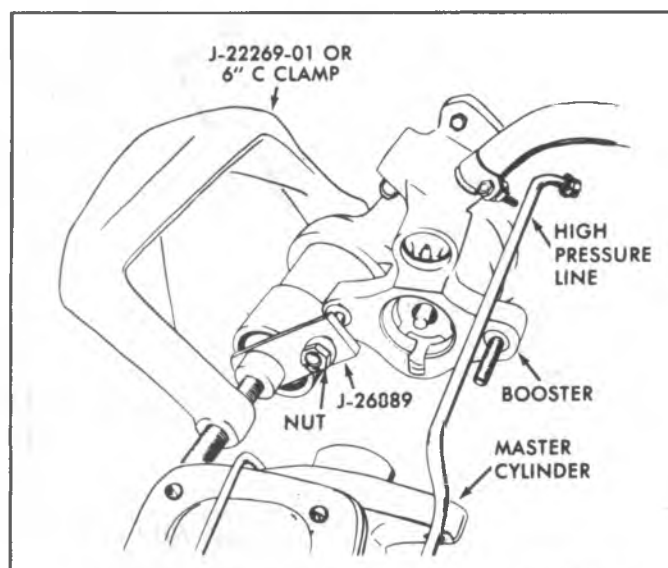


Fig. 5-51--Compressing Accumulator With J-26889

Hydro-Boost Unit

Replacement (fig. 5-56 thru 5-59)

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.
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 bending 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

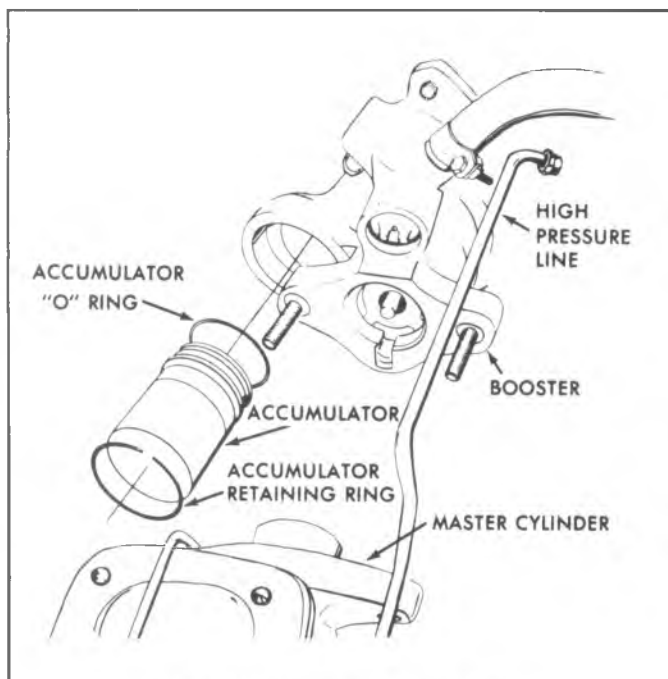


Fig. 5-52--Accumulator Installation

ports. Plug all lines and the booster ports to prevent loss of fluid and to keep out foreign material.

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 braces on P30 (42) models.
- c. Remove the booster bracket to dash panel or support bracket nuts and remove the booster assembly.

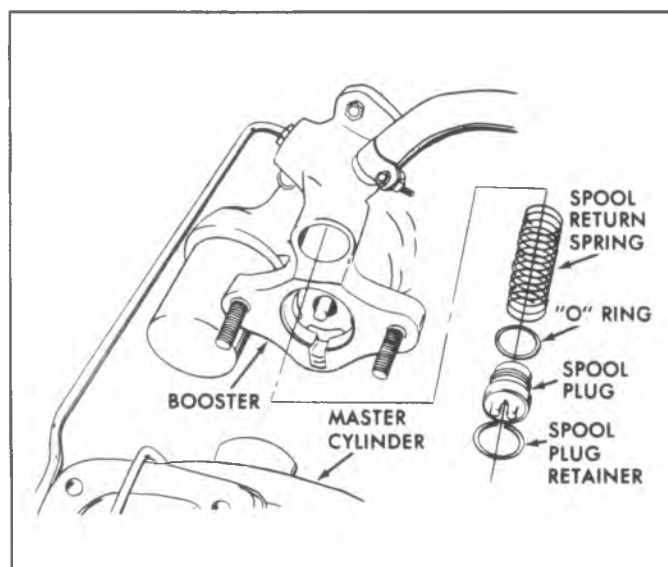


Fig. 5-53--Spool Valve Plug Removal

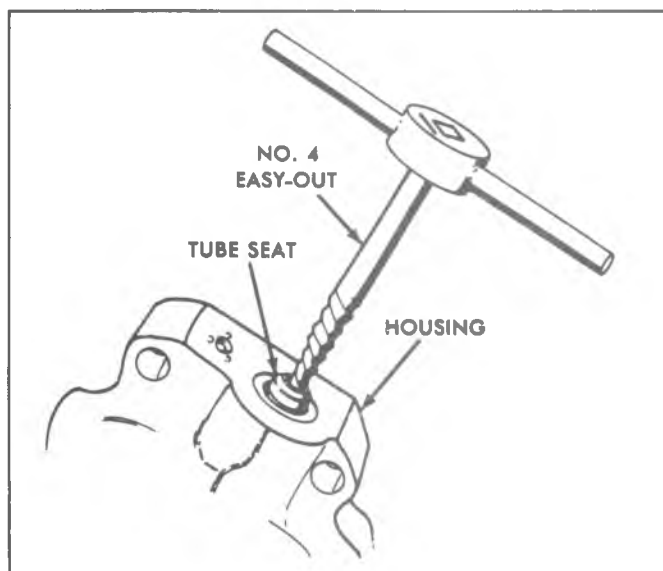


Fig. 5-54--Removing Tube Seat

7. P30(32) Models-

- a. Remove the cotter pin, nut, bolt and washers that secure the operating lever to the vertical brake rod.
- b. Remove 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 bushings.

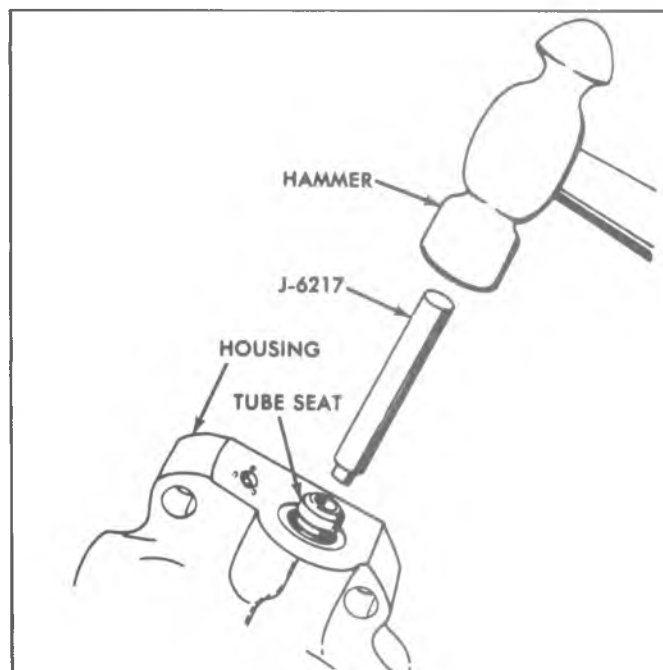


Fig. 5-55--Installing Tube Seat Using J-6217

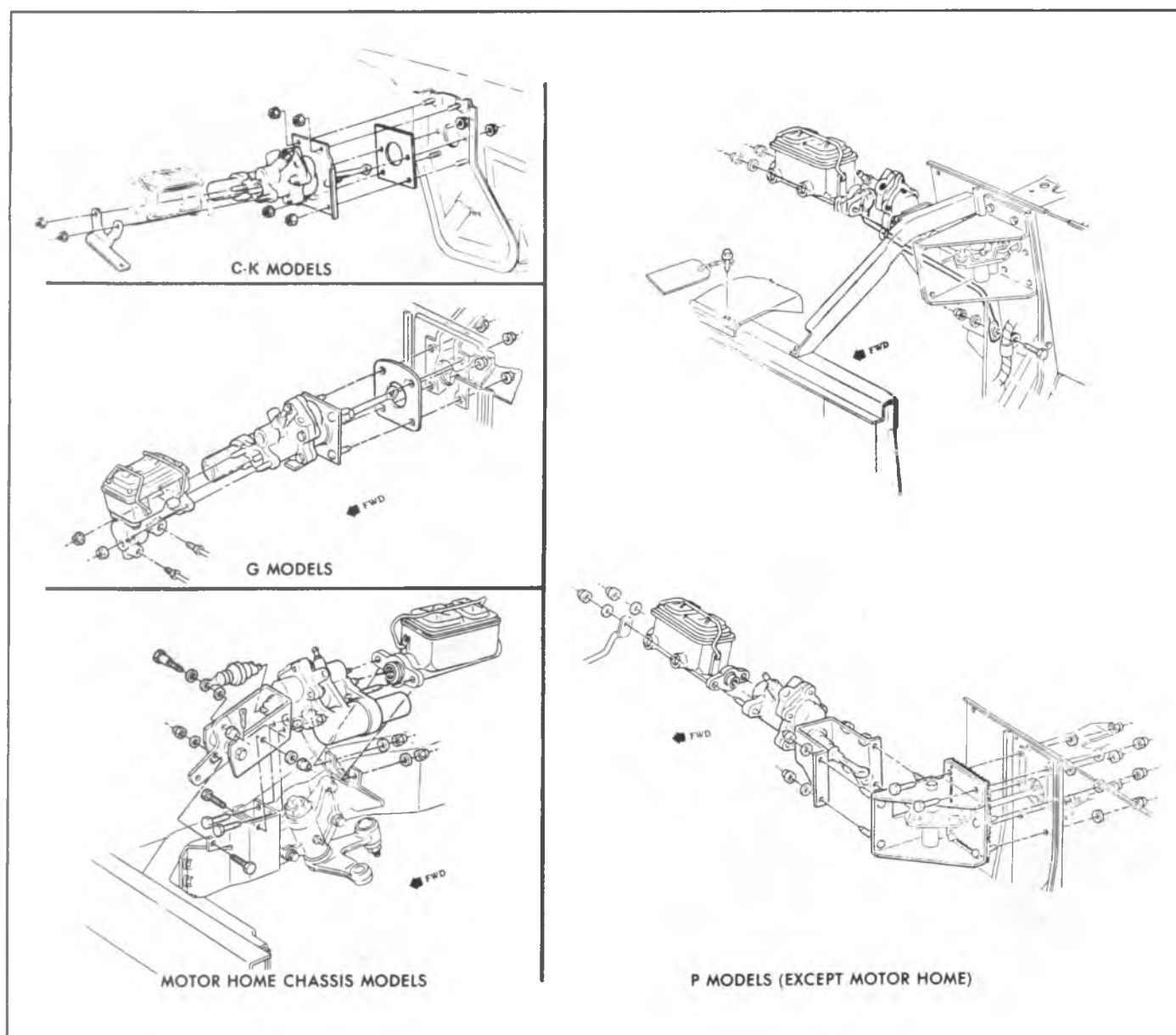


Fig. 5-56--Booster Installation (Hydro-Boost)

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.

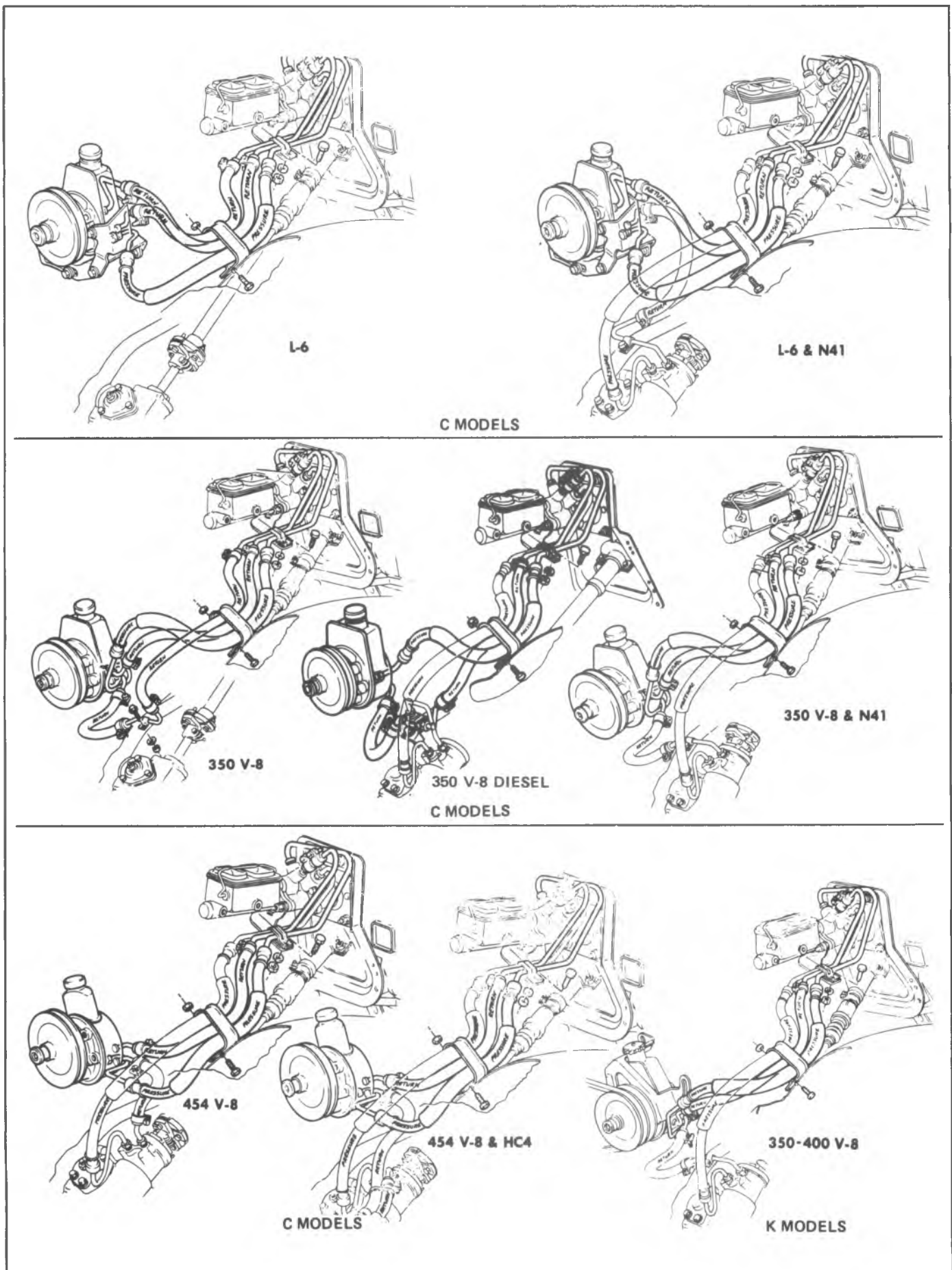


Fig. 5-57--Power Steering Hose Routing--C-K Models

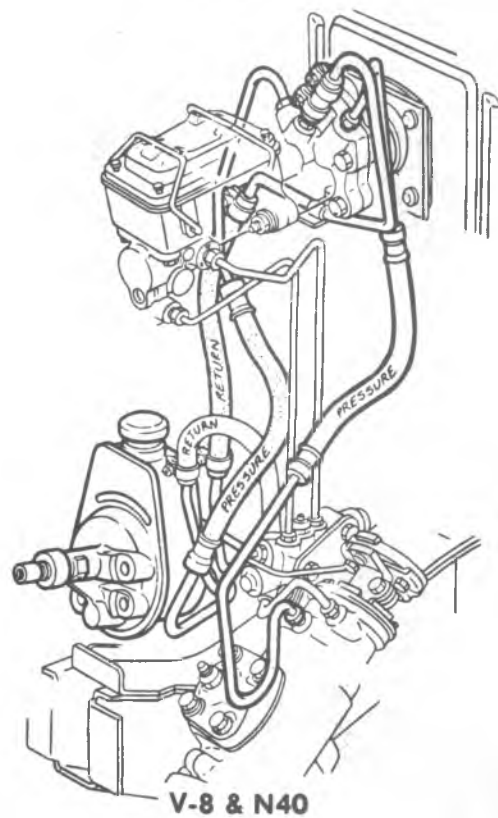
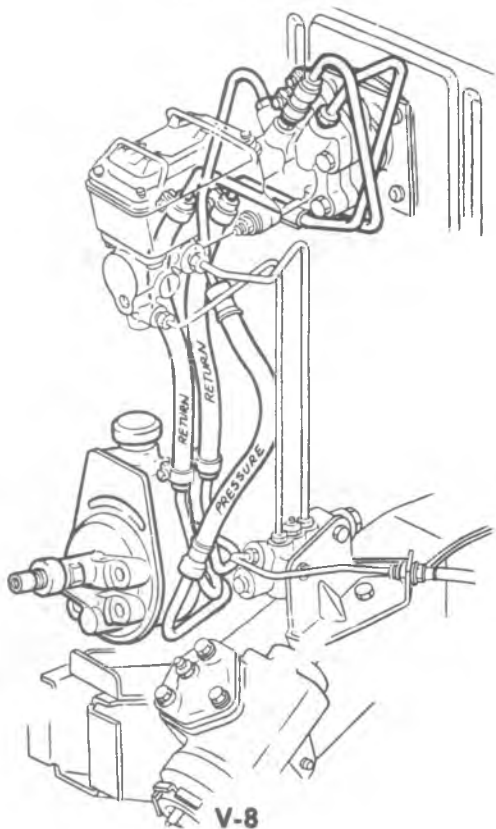
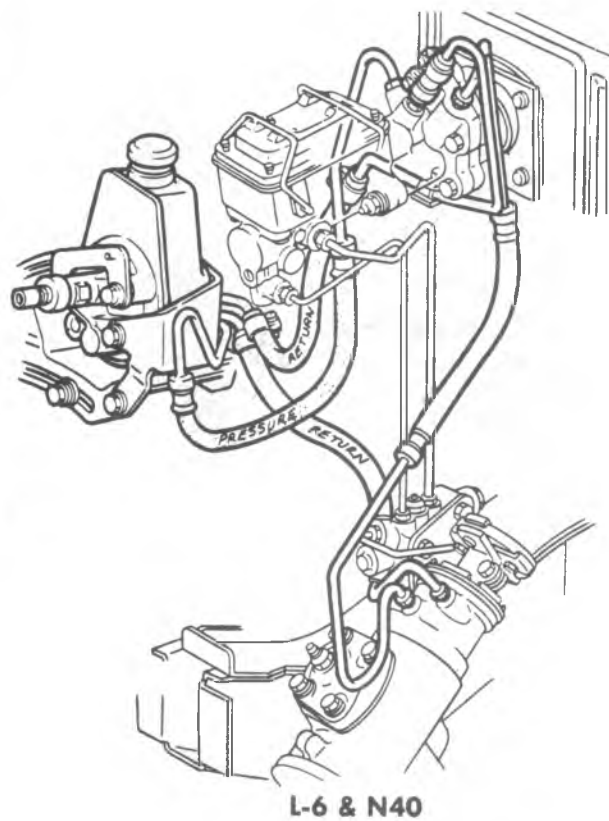
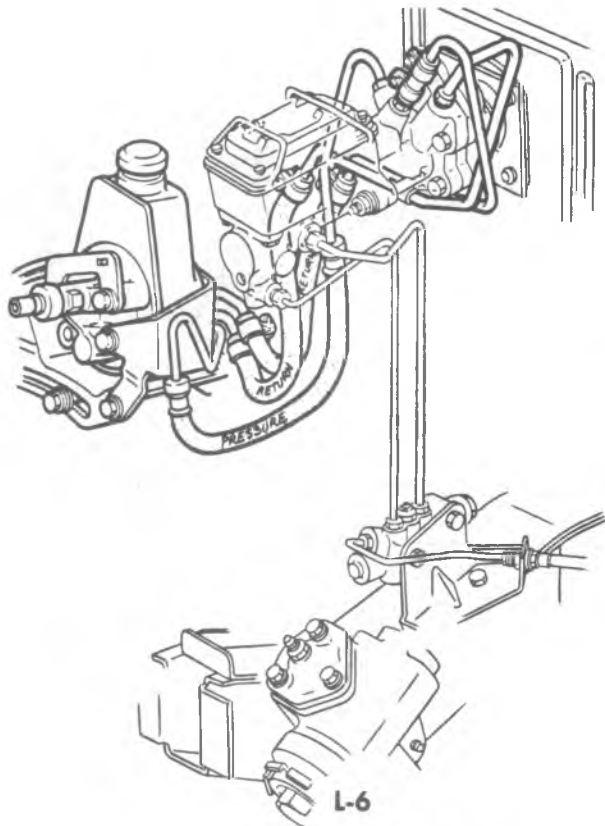


Fig. 5-58--Power Steering Hose Routing--G Models

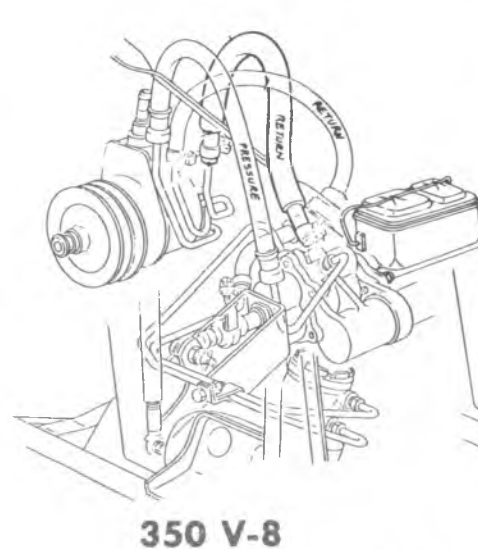
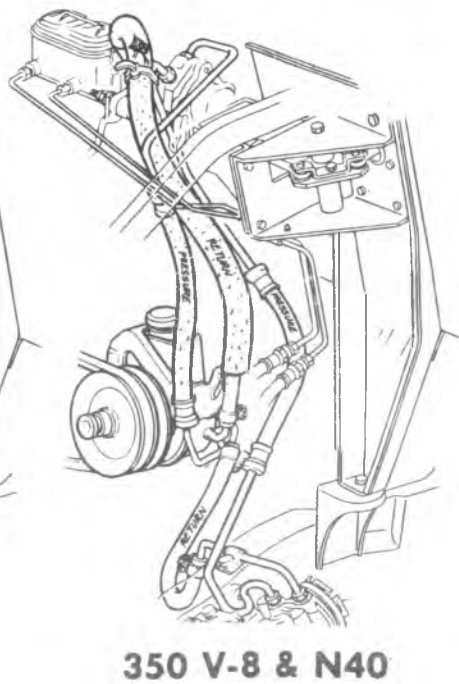
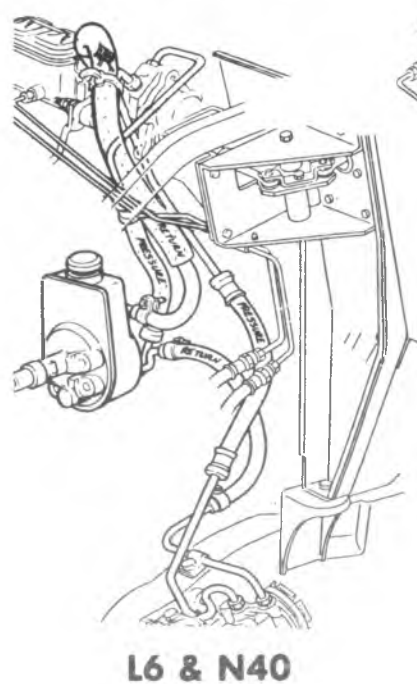
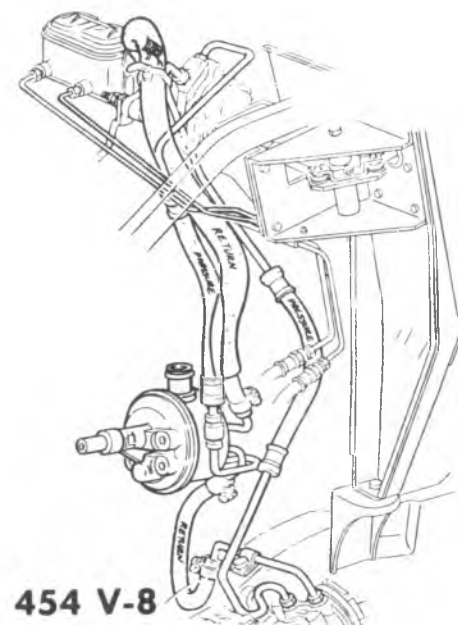
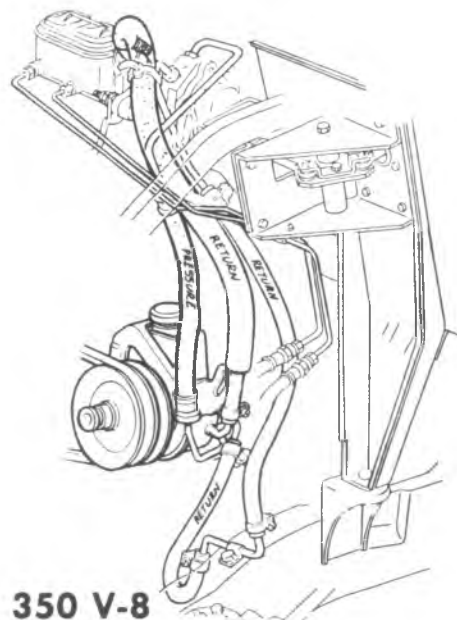
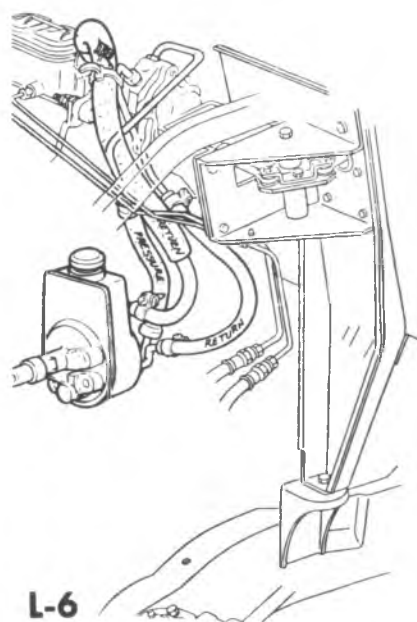


Fig. 5-59--Power Steering Hose Routing--P Models

UNIT REPAIR

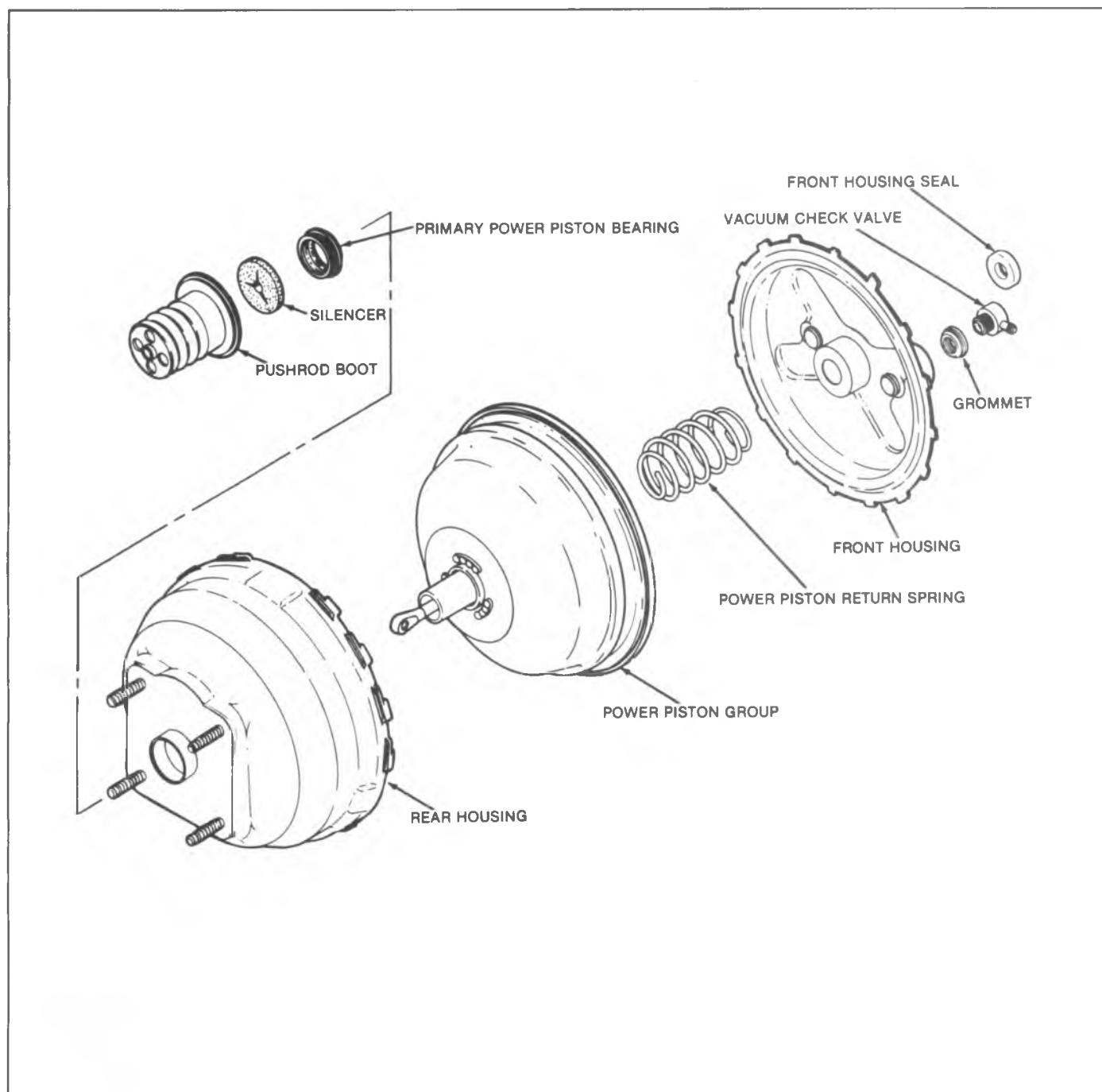


Fig. 5-1A--Booster Assembly Exploded

DELCO TANDEM POWER BRAKE UNIT

GENERAL DESCRIPTION

This booster is a tandem vacuum suspended unit. 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: To prevent damage to brake parts, use all components included in repair kits to service this booster. Lubricate rubber parts with silicone grease provided in kits. Torque values specified are for dry, unlubricated fasteners.

BENDIX TANDEM POWER BRAKE UNIT

Disassembly

1. Scribe a line across the front and rear housings to facilitate reassembly.
2. Carefully remove hydraulic push rod and seal and slide seal from rod.

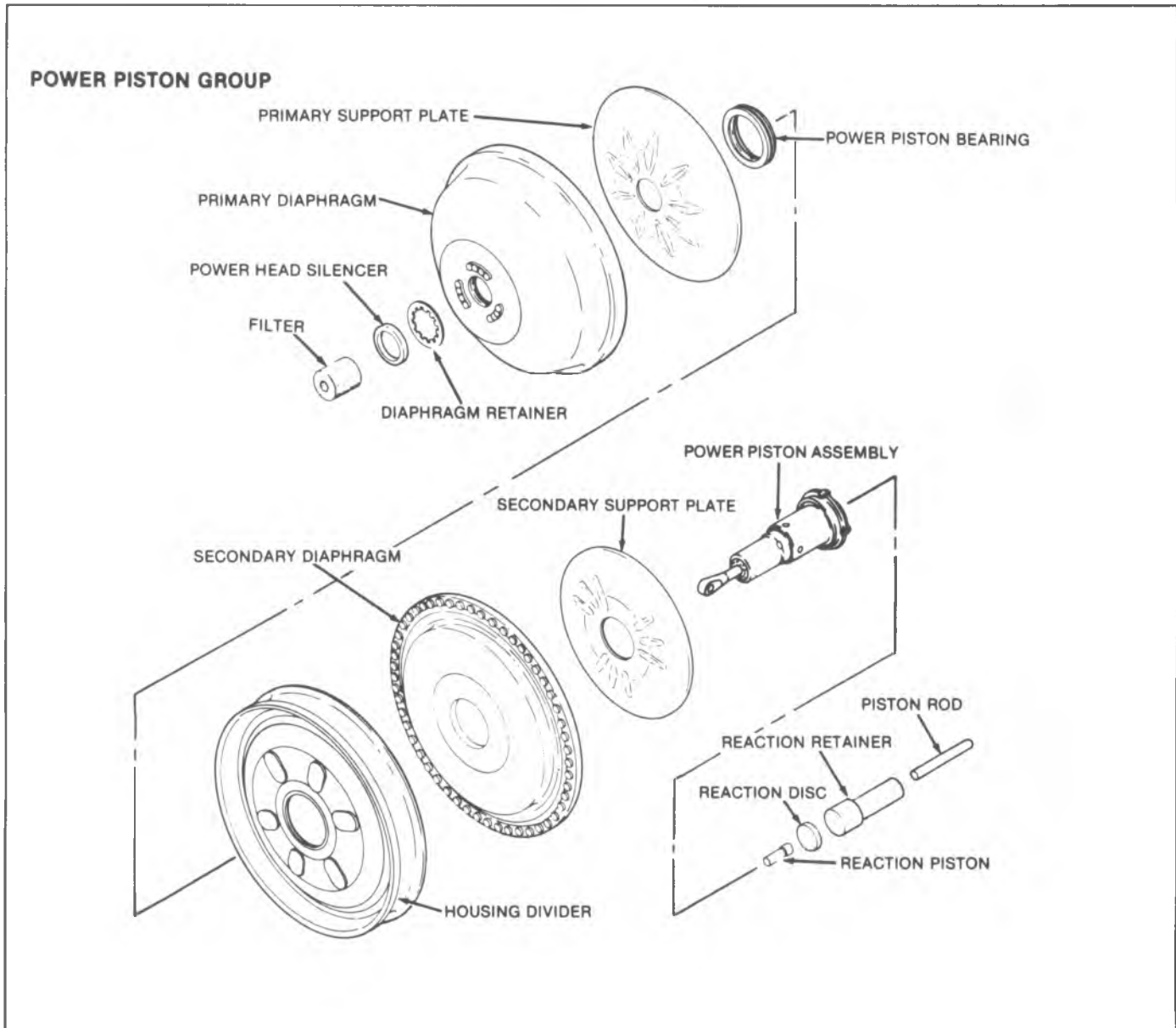


Fig. 5-2A--Power Piston Group

3. Remove vacuum check valve and grommet.
4. Remove dust boot and silencer from operating valve rod.
5. Remove dust guard retainer, dust guard and silencers from rear plate hub with an awl. Then reinstall steel retainer on hub.
6. Squirt denatured alcohol down the operating valve rod to lubricate rubber grommet in the valve plunger.
7. Position two small blocks of wood on either side of air valve rod and install end of air valve rod in vise, leaving just enough clearance to position two (2) open end wrenches between the vise and retainer on hub of rear plate.
8. Using the wrench nearest the vise as a pry, force the air valve off the ball end of the rod. DO NOT damage the plastic hub or allow vacuum cylinder to fall to the floor (fig. 5-1B and 5-2B).
9. The edge of the rear housing contains twelve (12) lances. Four (4) of these lances (one in each quadrant) are deeper than the other lances. The metal that forms the four (4) deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances break during straightening, the housing must be replaced (fig. 5-3B).
10. Remove the hydraulic push rod and vacuum seal from the front housing.
11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.
12. Place power unit with Holding Fixture J-22805 in an arbor press with rear housing up and secure to plate of press by a suitable means of holding Tool J-22805 (fig. 5-4B). By using a 1-1/2" open end wrench on Tool J-22805 and allowing unit to turn against back of arbor press, press will hold unit from turning.
13. Place Spanner Wrench J-9504 over studs on rear shell (fig. 5-4B). Use three washers and nuts to attach wrench to housing. Use a suitable piece of

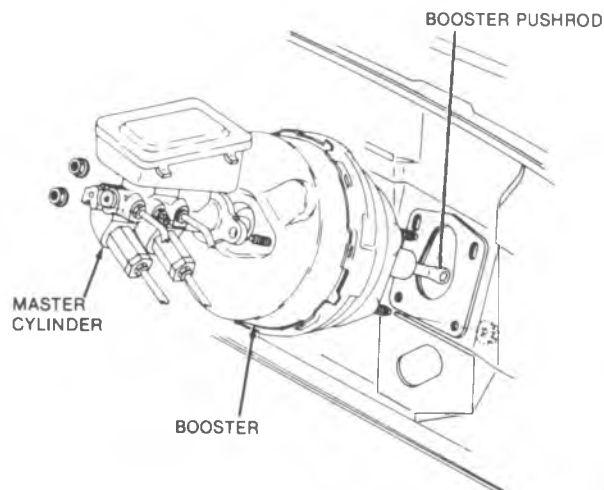
1. REMOVE AND INSTALL BOOSTER.**REMOVE**

1. Disconnect master cylinder from booster and disconnect booster pushrod as shown.
2. Remove attaching nuts and remove booster as shown.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

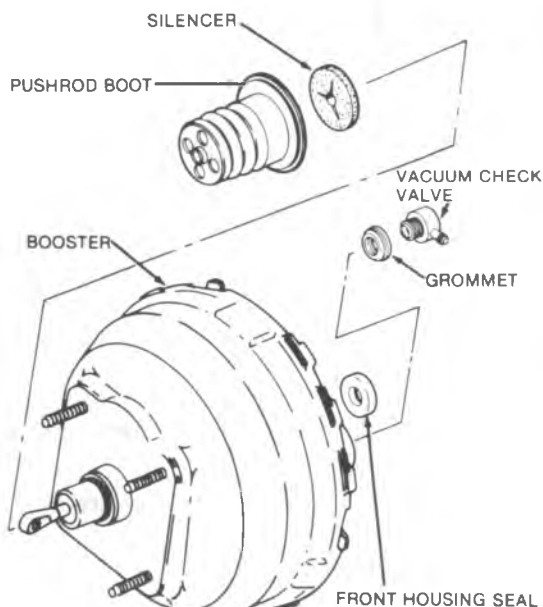
1. Install booster to cowl as shown. Torque attaching nuts to 30-45 N·m (22-33 ft·lb).
2. Connect booster pushrod.
3. Install master cylinder on booster and torque attaching nuts to 30-45 N·m (22-33 ft·lb).

**2. REMOVE AND INSTALL EXTERIOR COMPONENTS.****REMOVE**

1. Remove parts as shown.

INSTALL

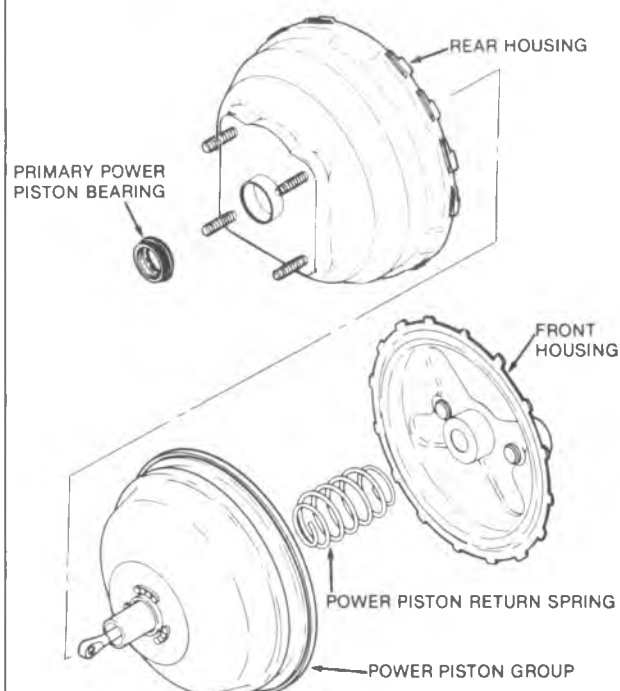
1. Lubricate inside and outside diameters of grommet and front housing seal.
2. Install parts as shown.

**3. UNLOCKING AND LOCKING BOOSTER****DISASSEMBLE**

1. Unlock booster as shown in A and disassemble booster as shown.

ASSEMBLE

1. Assemble parts as shown.
2. Lock housing as shown in A.
3. Stake housing as shown in B.

**A.****UNLOCKING BOOSTER**

1. Scribe a mark on front and rear housings to facilitate assembly.
2. Press down on tool J-9504 and turn counterclockwise to unlock housing.

LOCKING BOOSTER

1. Align scribe marks.
2. Press down on tool J-9504 and turn clockwise to lock front and rear housings. Assembly can be facilitated by connecting a vacuum source to the booster.

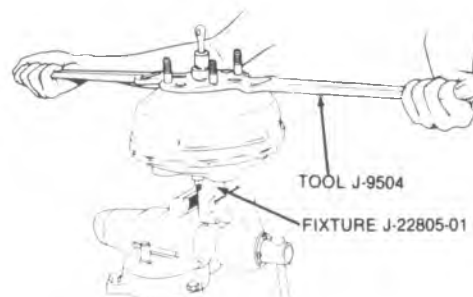
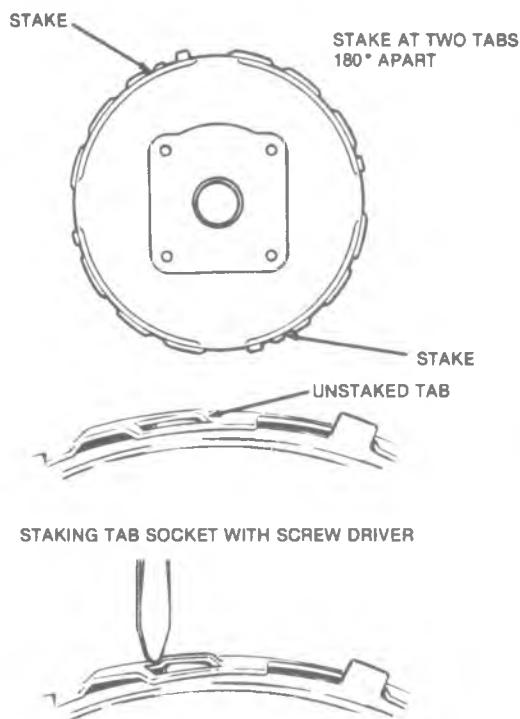


Fig. 5-3A--Service

3. (CONT)**B.****STAKING**

1. Stake housing as shown after locking.
2. Do not stake a tab that has been previously staked.

**4. DISASSEMBLY AND ASSEMBLY OF POWER PISTON GROUP.****DISASSEMBLE**

1. Remove piston rod, reaction retainer, and power head silencer.
2. Grasp assembly at outside edge of divider and diaphragms. Hold with pushrod down against a hard surface. Use a slight force or impact to dislodge diaphragm retainer.
3. Remove parts as shown.

ASSEMBLE

1. Lubricate inside diameter of secondary diaphragm lip and fit in secondary support plate.
2. Install secondary diaphragm and support plate as shown in A.
3. Lubricate inside diameter of secondary power piston bearing and install in housing divider as shown, flat surface of bearing on same side as 6 raised lugs on divider.
4. Install secondary power piston and divider as shown in B.
5. Lubricate inside diameter of primary diaphragm lip and fit in primary support plate.
6. Install primary diaphragm and support plate as shown in C.
7. Install diaphragm retainer and seat as shown in D.

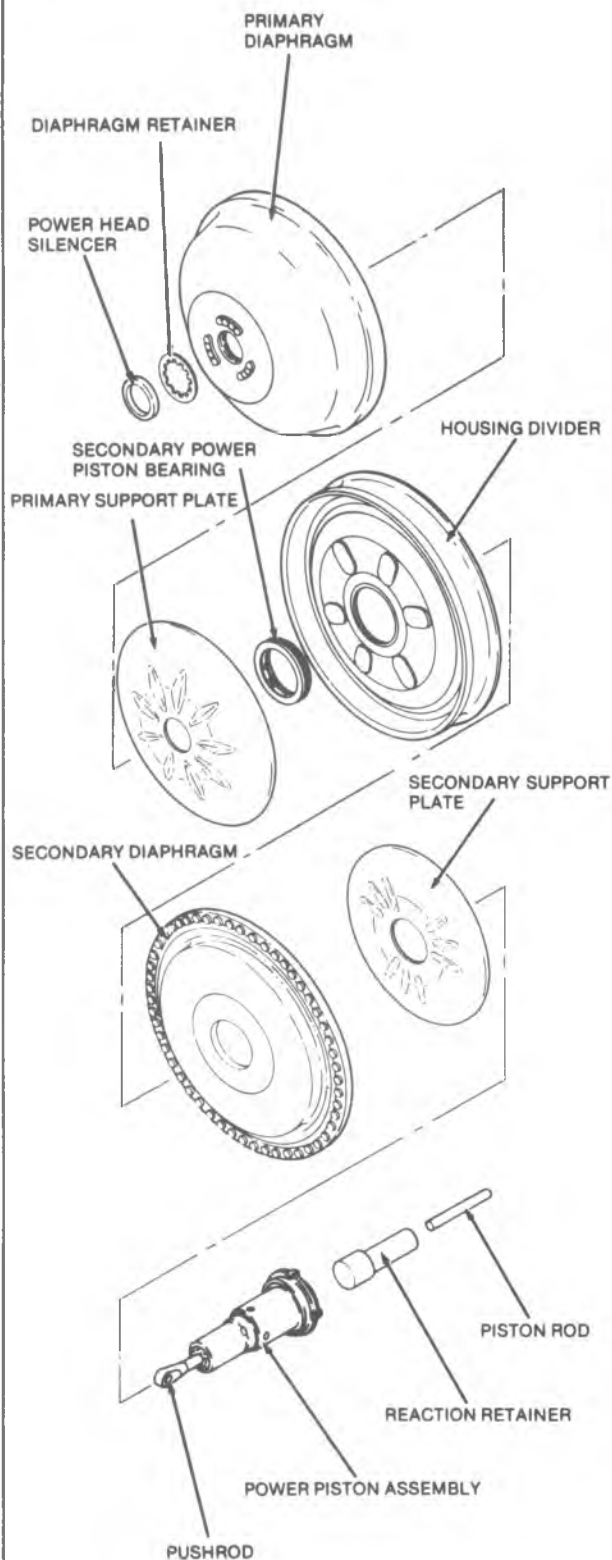
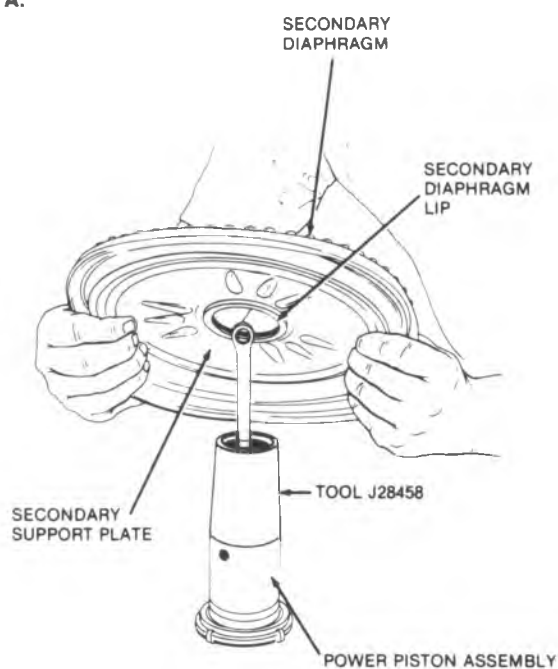
4. (CONT)

Fig. 5-4A--Service

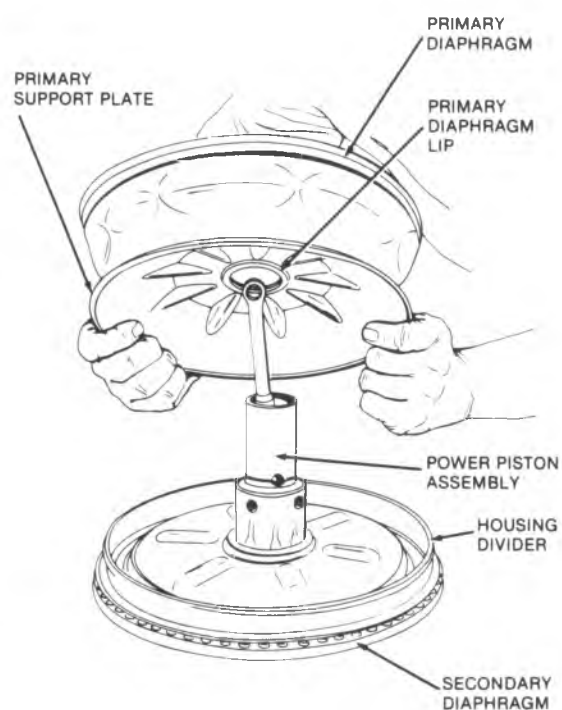
4. (CONT)

A.

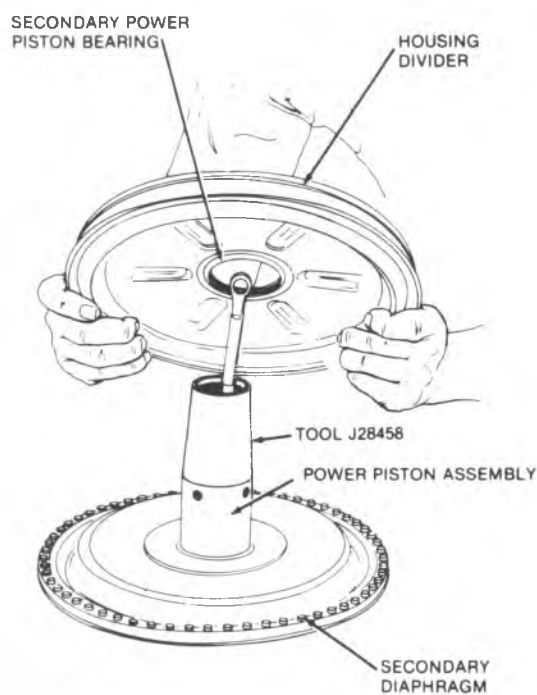


4. (CONT)

C.



B.



D.

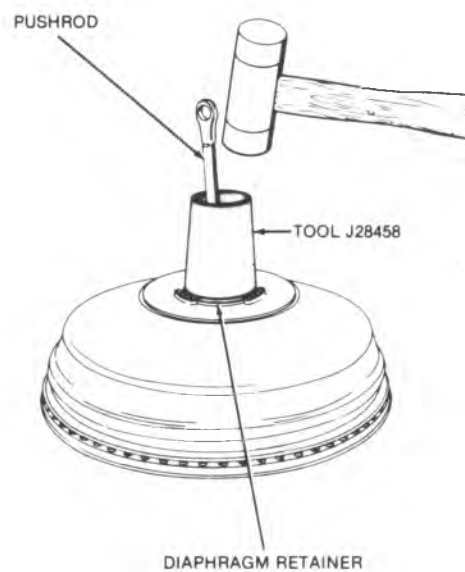


Fig. 5-5A--Service

5. GAGING PROCEDURE

GAGING

1. After assembly of booster, position gage over piston rod 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.

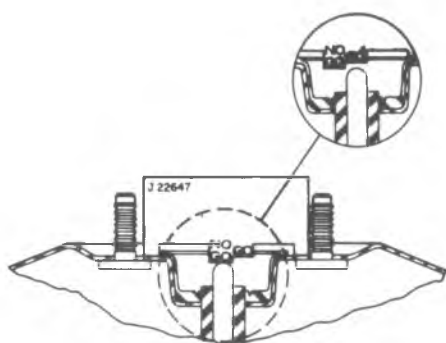


Fig. 5-6A--Gaging Procedure

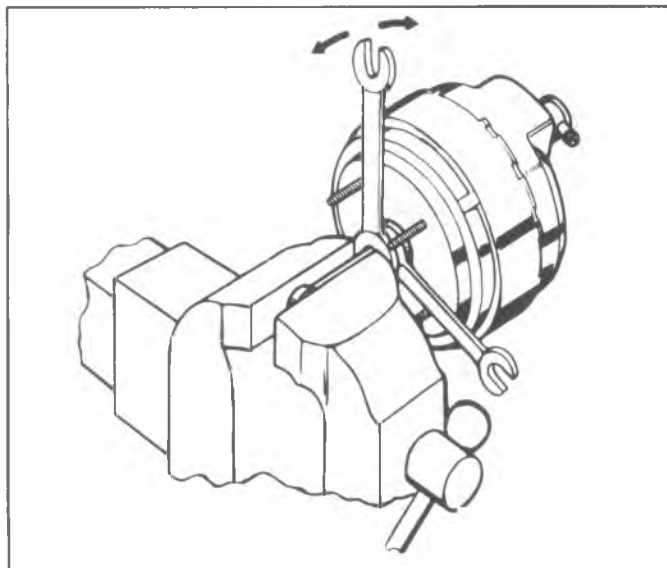


Fig. 5-1B--Removing Air Valve Rod

pipe of approximately two inches I.D. and approximately three inches in length. Place over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe and press rear housing down far enough to relieve tension of diaphragm rubber lip and spring.

14. Rotate spanner bar counterclockwise until the lances in the edge of the rear housing are aligned with the cut-outs in the front housing. Considerable effort may be required to rotate the front housing.

CAUTION: The diaphragm return spring is compressed in the power section and expands as the pressure on the housings is removed. If the housings do not separate when the screw has been turned slightly to reduce the pressure, tap the housings with a rubber hammer to break the bond.

15. Slowly release press to permit the two housings to separate.
16. Continue to release press until diaphragm spring tension has been removed.
17. Remove the front housing and return spring.
18. Remove three nuts and washers from Spanner Wrench and separate wrench and rear housing.
19. Remove Holding Fixture J-22805 from front housing.
20. Work edges of front diaphragm from under lances of rear housing and remove complete vacuum assembly from rear housing, using care not to damage rear housing seal. Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.
21. Wet the rear diaphragm retainer with denatured alcohol and remove the retainer using fingers only.
22. Clamp Tool J-22839 in a vise. Place the diaphragm and plate assembly on the tool with the tool seated in the hex opening in the front plate.
23. Twist the rear diaphragm plate counterclockwise, using hand leverage on the outer edge of the plate. It may be necessary to use a 1" x 1-3/16" x 8" wood strip as a lever in cover slot on outside circumference of rear plate.
24. After the two (2) plates have been loosened, remove the plates from Tool J-22839 and place on a

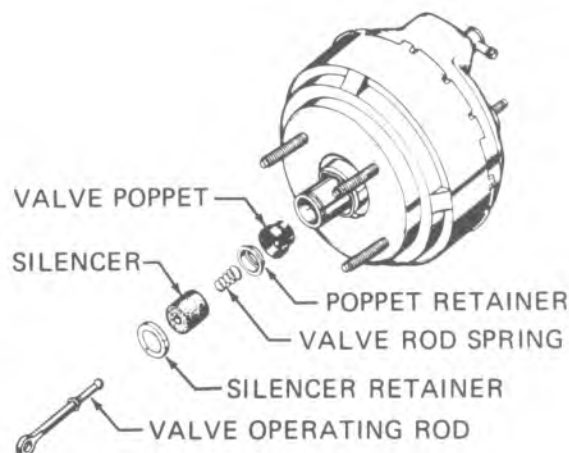


Fig. 5-2B--Air Valve Rod Assembly

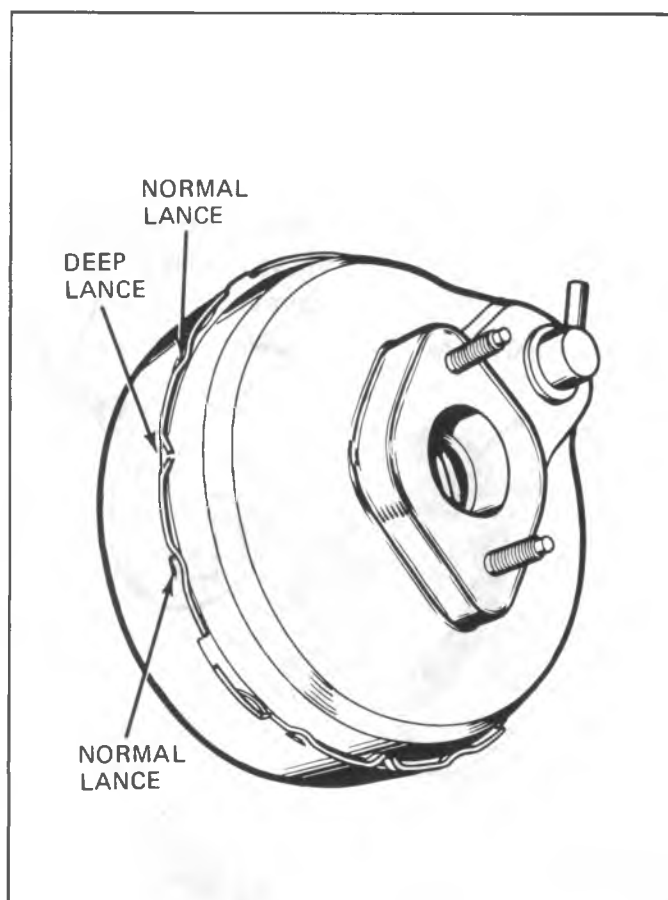


Fig. 5-3B--Lances in Rear Housing L

bench with the front plate down. Unscrew the rear plate completely and carefully lift it off the front plate hub, grasping the air valve plunger and valve return spring as the parts are separated (fig. 5-5B).

25. Remove the square ring seal from the shoulder of the front diaphragm plate hub.
26. Remove the reaction disc from inside the front diaphragm plate hub. Carefully slide the center plate off the hub of the front plate.
27. Remove the diaphragms from the plates.
28. Use a blunt punch or 1-1/4" socket to drive seal from rear housing (figs. 5-6B and 5-7B).

Cleaning

All parts to be reused should be washed in denatured alcohol or brake fluid. Dry the parts with compressed air and place them on clean paper or lint free cloth.

Small rust spots inside the shells may be removed with crocus cloth or fine emery cloth. Be sure to clean thoroughly after using any abrasive.

Inspect all parts and replace any that are damaged or show excessive wear.

Assembly

1. Press the new bearing and seal into the cavity in the rear housing using Tool J-22677 (fig. 5-8B). The flat rubber surface of the seal should be 5/16" below the flat, inside surface of the rear housing.
2. Install reaction disc in hub of front plate with small tip toward hole. Use rounded rod to seat disc.

3. Mount Tool J-22839 in vise.
4. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.
5. Install Tool J-22733 over threads on front plate hub (fig. 5-9B).
6. Apply a light film of silicone lubricant to front plate hub and to seal in center plate, then guide center plate, seal first, onto the front plate hub, being careful not to damage center plate seal. Remove Seal Protector J-22733.
7. Apply a light coat of silicone lubricant to bearing surfaces of air valve plunger, being careful not to apply lubricant to rubber grommet inside plunger. Install square ring seal on shoulder of front plate hub and install valve plunger return spring and plunger in base of front plate hub (fig. 5-10B).
8. Set rear plate over hub of front plate, and using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Hand torque plates to 150 in. lbs. Check travel of valve plunger with index finger.
9. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate (fig. 5-11B).
10. Apply talcum powder to inside wall of rear housing and silicone lubricant to the scalloped cutouts of front housing and to seal in rear housing. Assemble diaphragm and plate assembly into rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for reassembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.
11. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs.
12. Secure front housing and Holding Fixture J-22805 on arbor press plate by a suitable means (fig. 5-4B).
13. Place Spanner Wrench J-9504 over studs on rear

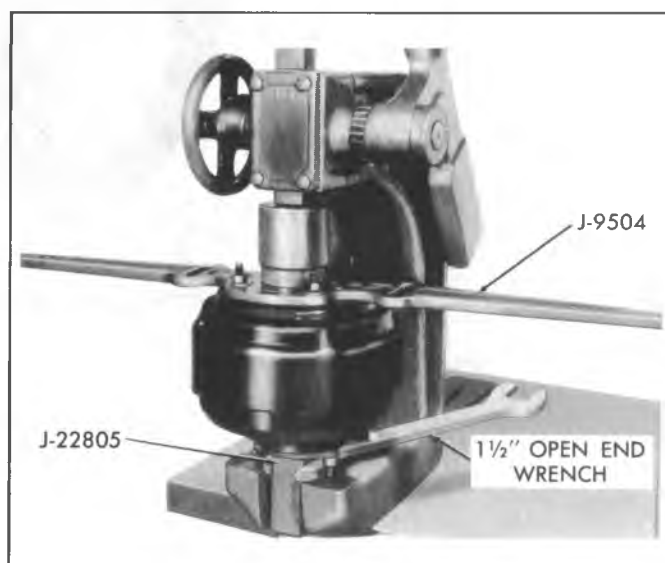


Fig. 5-4B--Holding and Separating Housings Using J-22805 and J-9504 in Arbor Press

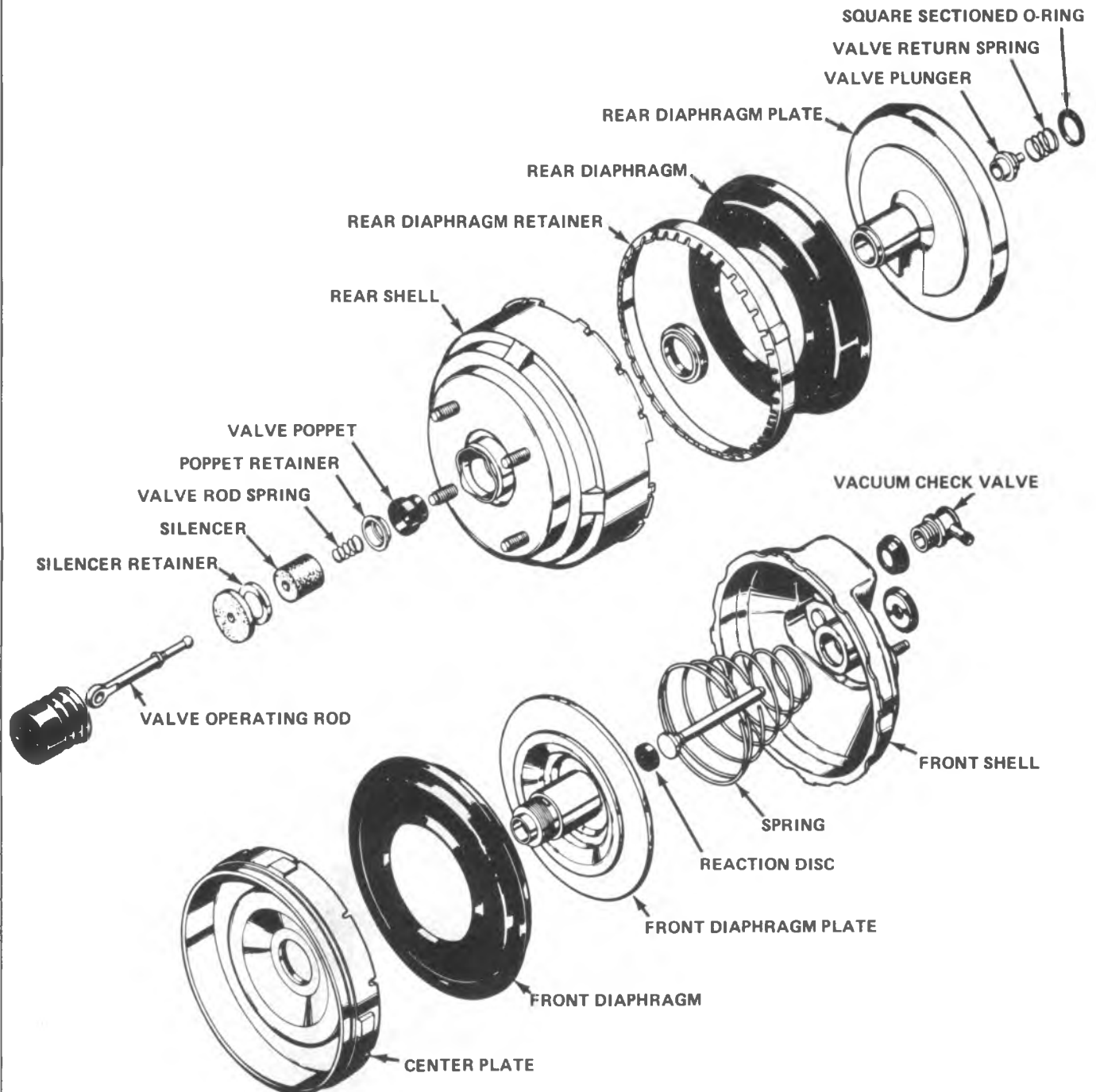


Fig. 5-5B--Diaphragm and Plates



Fig. 5-6B--Removing Rear Seal

housing. Use three washers and nuts to attach wrench to housing. Place a suitable piece of pipe (approximately two inch I.D. and approximately three inches in length) over plastic diaphragm plate hub. Place a piece of flat stock steel over end of pipe.

14. Install diaphragm return spring so that small end of spring is against front housing.
15. Place rear housing over front housing, and align scribe marks.
16. Rotate spanner wrench clockwise until housings are locked together. Bend tabs of the four deep lances back to their original position.
17. Remove three nuts and lock washers securing rear housing to spanner wrench.
18. Remove Holding Fixture J-22805 from front housing by removing two nuts and washers.
19. Wet poppet valve with denatured alcohol and assemble in rear plate hub, small end first. Wet poppet retainer with denatured alcohol and assemble with shoulder inside poppet. Assemble retainer, filters and silencer

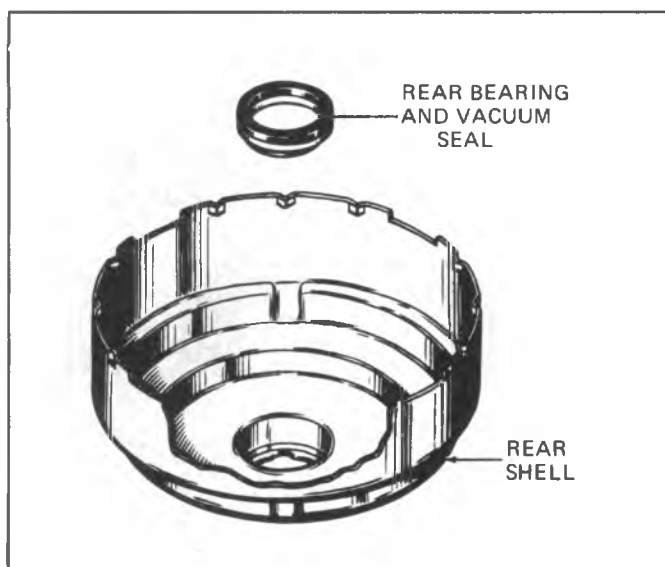


Fig. 5-7B--Rear Bearing and Rear Shell

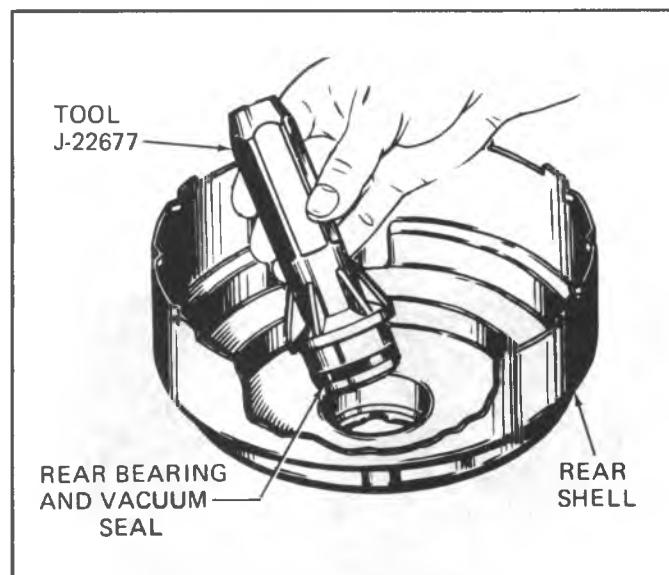


Fig. 5-8B--Installing Rear Bearing and Vacuum Seal

over ridge on rod and return spring over ball end of operating valve rod. Wet grommet in valve plunger with denatured alcohol and guide air valve rod into valve plunger. Tap end of operating valve rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.

20. Assemble silencer in dust boot, wet dust boot opening with denatured alcohol and assemble over operating valve rod and over flange of rear housing.
21. Install **new** check valve and grommet
22. Apply silicone lubricant to piston end of hydraulic push rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over push rod and press into recess in front housing.

Piston Rod Gauging

1. Place the power head assembly in a padded vise (front housing up); *Do not clamp tight.*
2. Remove the front housing seal to assure that no

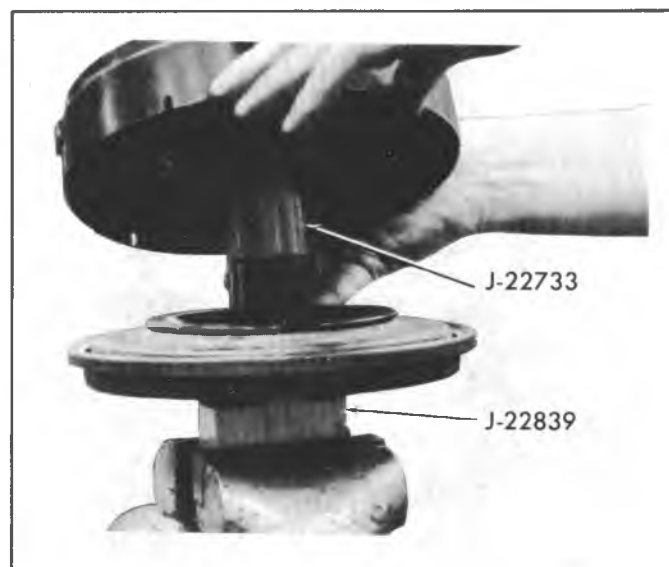


Fig. 5-9B--Seal Protector J-22733 Installed



Fig. 5-10B--Installing Air Valve Plunger

vacuum is in the power head while gaging.

3. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.
4. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.
5. Place Gage J-22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (fig. 5-12B).
6. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should **never** contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.
7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable



Fig. 5-11B--Installing Rear Diaphragm Retainer

piston rod and adjusting the self-locking screw to meet the gaging specifications.

8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

DELCO SINGLE DIAPHRAGM POWER BRAKE UNIT

GENERAL DESCRIPTION

This booster is a 240mm, single diaphragm vacuum suspended unit. 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: To prevent damage to brake parts, use all components included in repair kits to service this booster. Lubricate rubber parts with silicone grease provided in kits. Torque values specified are for dry, unlubricated fasteners.

BENDIX SINGLE DIAPHRAGM POWER BRAKE UNIT

Disassembly (Figs. 5-1D and 5-2D)

1. Scribe a line across front and rear housings to facilitate reassembly.
2. Remove the front housing seal (fig. 5-2D); pulling the piston rod from the front housing will also remove the seal assembly. Remove the piston rod.
3. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-1A).

NOTICE: Be sure to align tool so that the check valve in the front housing is not damaged.

4. Loosen locknut and remove push rod clevis and locknut, if so equipped.

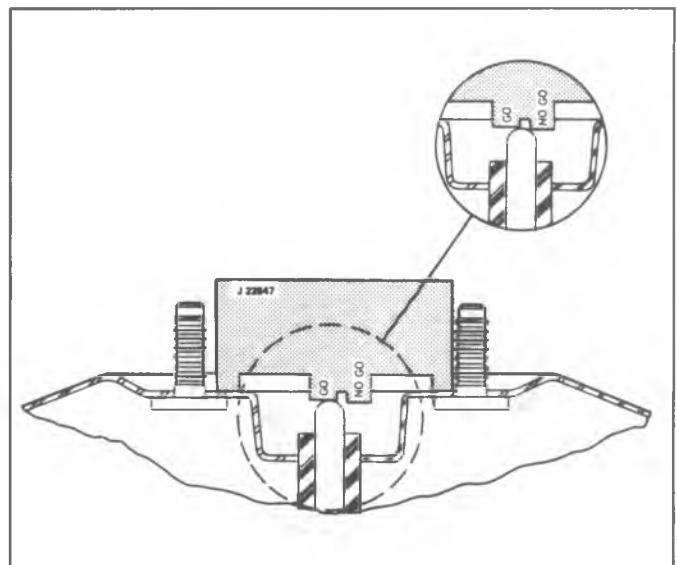


Fig. 5-12B Gaging Piston Rod

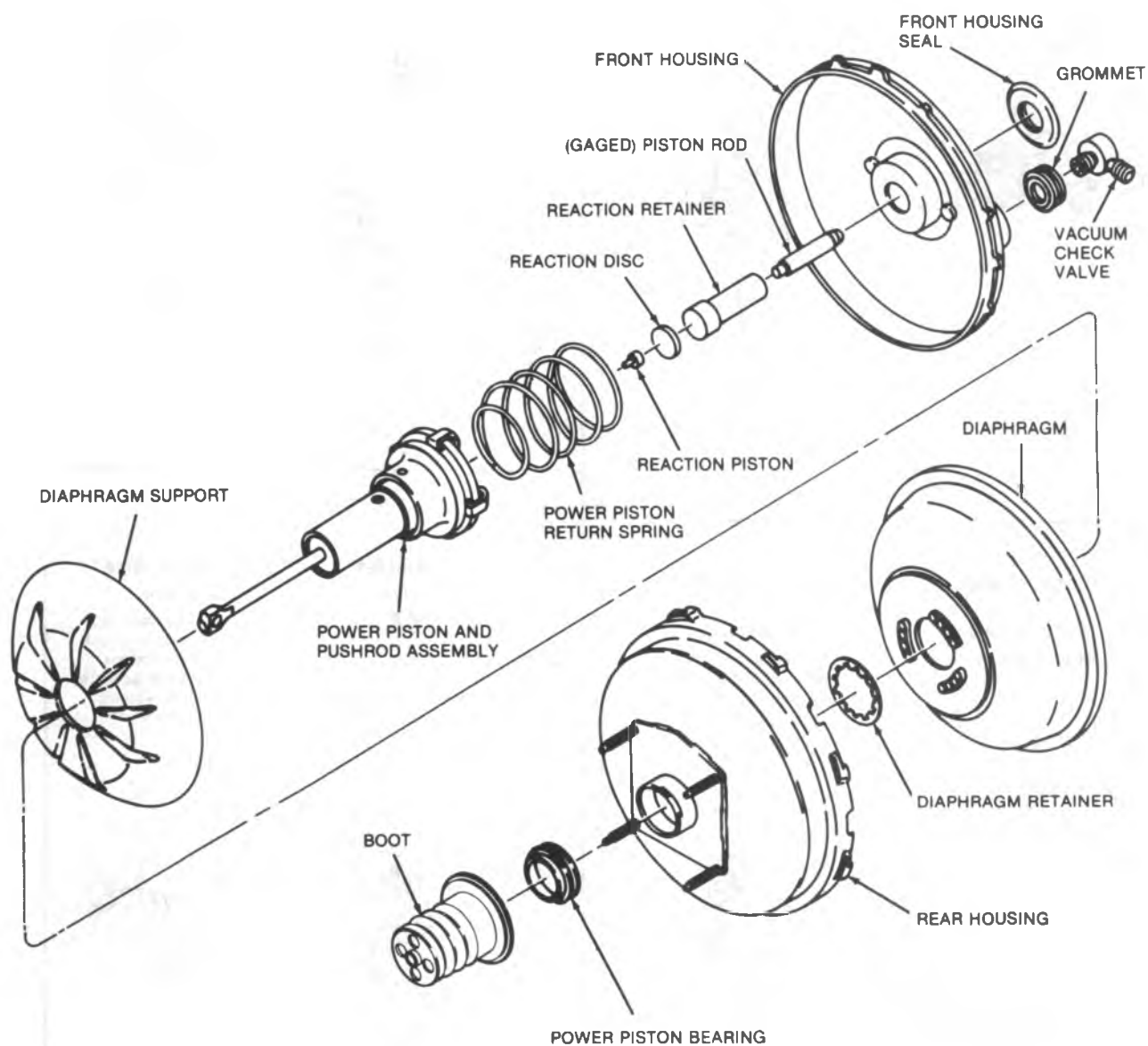


Fig. 5-1C--Booster Assembly Exploded

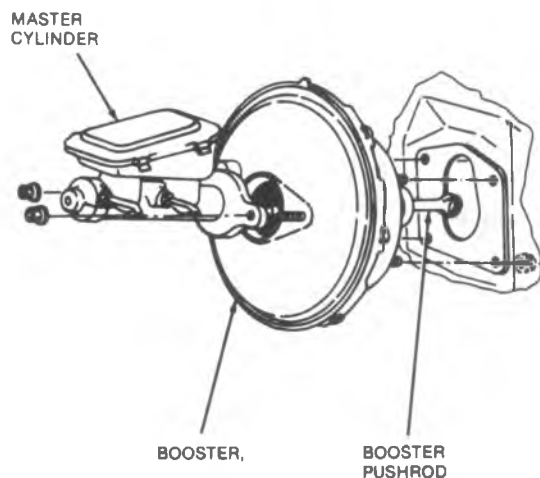
1. REMOVE AND INSTALL BOOSTER.**REMOVE**

1. Disconnect master cylinder from booster and disconnect booster pushrod as shown.
2. Remove attaching nuts and remove booster as shown.

INSTALL

SEE NOTICE ON PAGE 5-1 OF THIS SECTION.

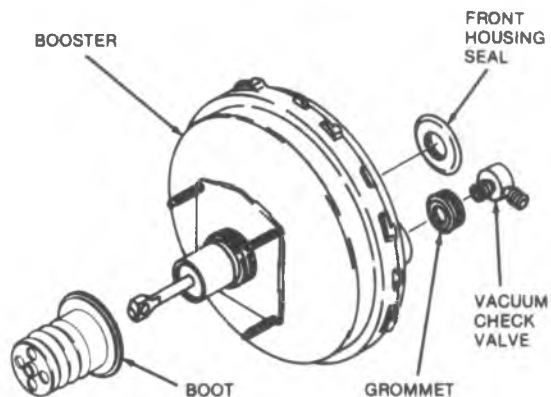
1. Install booster to cowl as shown. Torque attaching nuts to 30-45 N·m (22-33 ft·lb).
2. Connect booster pushrod.
3. Install master cylinder on booster and torque attaching nuts to 30-45 N·m (22-33 ft·lb).

**2. REMOVE AND INSTALL EXTERIOR COMPONENTS.****REMOVE**

1. Remove parts as shown.

INSTALL

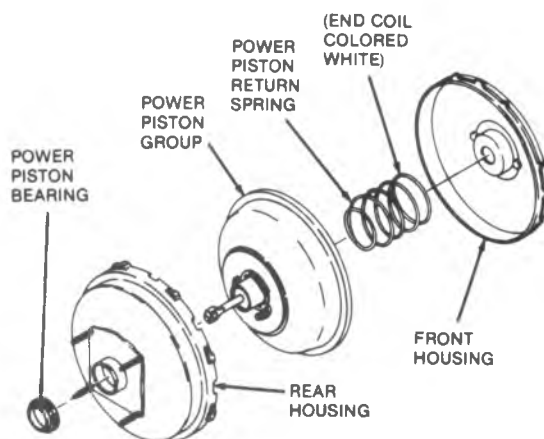
1. Lubricate inside and outside diameters of grommet and front housing seal.
2. Install parts as shown.

**3. UNLOCKING AND LOCKING BOOSTER****DISASSEMBLE**

1. Unlock booster as shown in A and disassemble booster as shown.

ASSEMBLE

1. Assemble parts as shown. Make sure white coil on return spring is flush against housing.
2. Lock housing as shown in A, following.
3. Stake housing as shown in B, following.

**A.****UNLOCKING BOOSTER**

1. Scribe a mark on front and rear housings to facilitate assembly.
2. Press down on tool J-9504 and turn counterclockwise to unlock housing.

LOCKING BOOSTER

1. Align scribe marks.
2. Press down on tool J-9504 and turn clockwise to lock front and rear housings. Assembly can be facilitated by connecting a vacuum source to the booster.

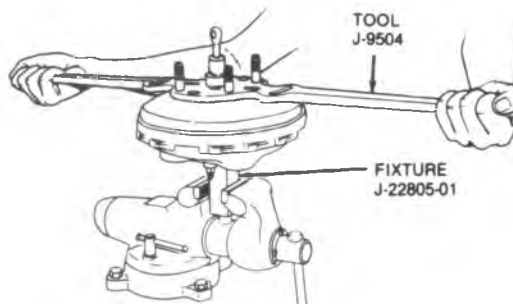
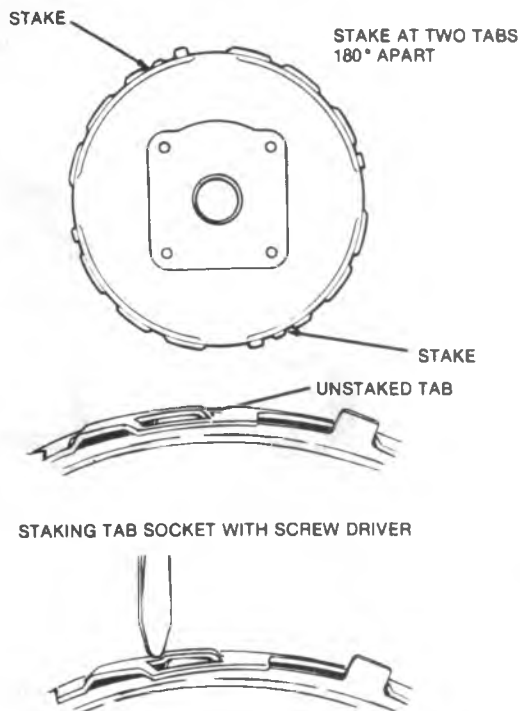


Fig. 5-2C--Service

3. (CONT)**B.****STAKING**

1. Stake housing as shown after locking.
2. Do not stake a tab that has been previously staked.

**4. DISASSEMBLY AND ASSEMBLY OF POWER PISTON GROUP.****DISASSEMBLE**

1. Remove piston rod and reaction retainer.
- CAUTION:** Use care not to damage power piston assembly when removing reaction disc as described in the following step. Reaction disc must be replaced.
2. Use an awl, ice pick or similar tool to remove reaction disc. Then, remove reaction piston.
 3. Grasp assembly at outside edge of diaphragm support and diaphragm. Hold with pushrod down against a hard surface. Use a slight force or impact to dislodge diaphragm retainer.
 4. Remove only parts shown. Do not disassemble power piston and pushrod assembly.

ASSEMBLE

1. Lubricate inside diameter of diaphragm lip and fit in diaphragm support.
2. Install diaphragm and support as shown in A, following.
3. Install new diaphragm retainer and seat as shown in B, following.
4. Install reaction piston, new reaction disc, reaction retainer and piston rod.

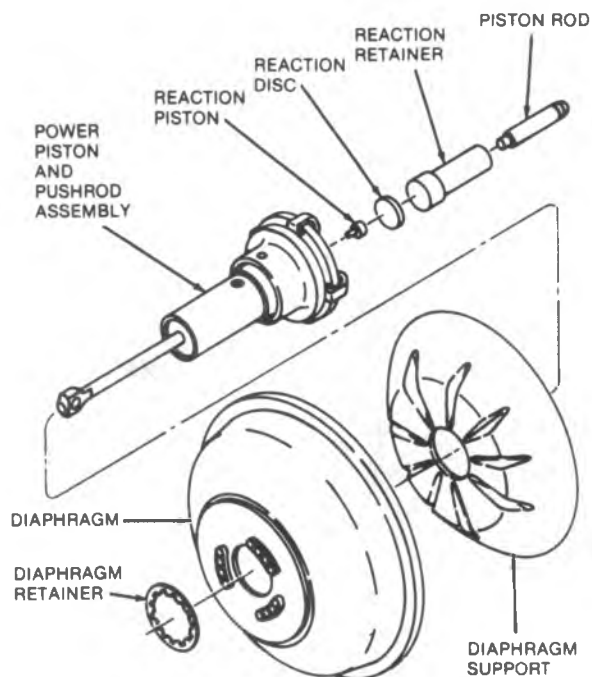
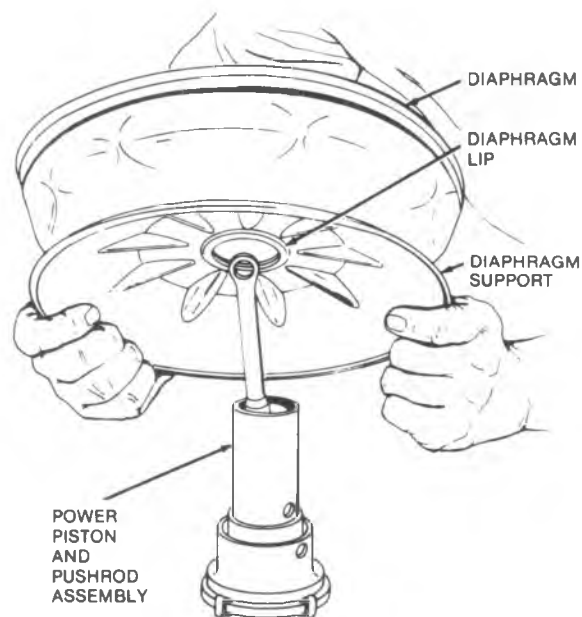
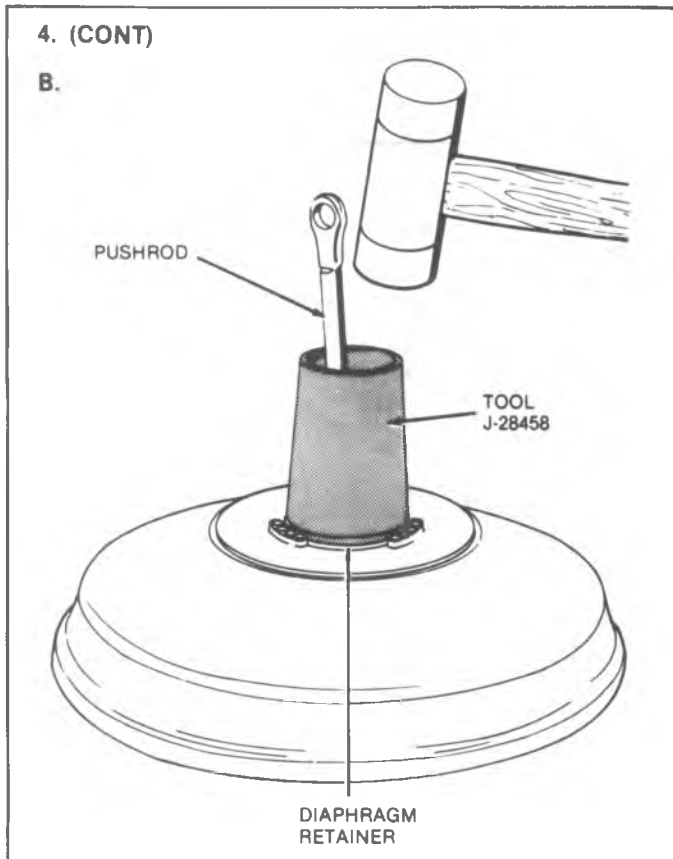
4. (CONT)**A.**

Fig. 5-3C--Service



5. GAGING PROCEDURE

GAGING

1. After assembly of booster, position gage over piston rod 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.

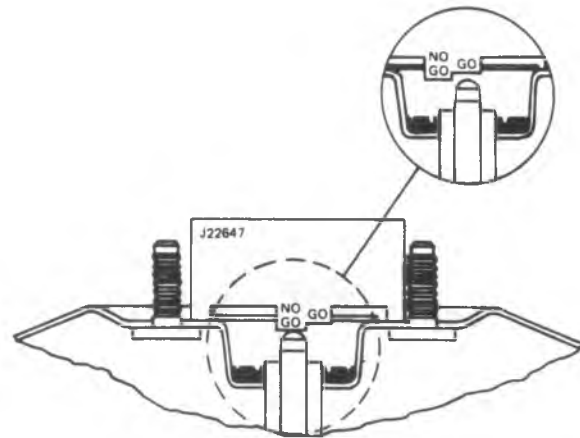


Fig. 5-4C--Service

5. Remove the mounting bracket from the rear housing, if so equipped.
6. Remove the dust boot retainer, dust boot and silencer from the diaphragm plate extension.
7. The edge of the rear housing contains twelve lances. Four of these lances (one in each quadrant) are deeper than the other lances (fig. 5-3D). The metal that forms the four deep lances must be partially straightened so that the lances will clear the cutouts in the front housing. If the metal tabs that form the deep lances crack or break during straightening, the housing must be replaced.
8. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs (fig. 5-2A).
9. Press down on Spanner Wrench J-9504 and rotate the rear housing clockwise to separate the two housings. If the rear housing cannot be readily loosened, tap the rear housing lightly with plastic hammer.
10. Remove Tool J-9504 from the rear housing.

NOTICE: Care must be exercised not to damage or loosen studs in the rear housing. Also, take care that no pressure is brought to bear on plastic diaphragm plate tension.

11. Lift the rear housing assembly from the unit.

Rear Housing Group

1. Remove the air filter element from location within the diaphragm plate extension.

NOTICE: To prevent chipping of the plastic diaphragm plate, exercise extreme caution when removing the air filter retainer. Use a small screwdriver or other suitable tool, and pry at several peripheral locations until the retainer is freed.

2. Separate the diaphragm plate assembly from the rear housing and lay the rear housing aside.
3. Disassemble diaphragm plate assembly (fig. 5-2D).
 - a. Remove rolling diaphragm from the groove in the diaphragm plate hub.

NOTICE: Care should be used in handling the diaphragm of the diaphragm plate assembly. The diaphragm should be protected from grease, oil, foreign matter and from nicks, scratches and gouges.

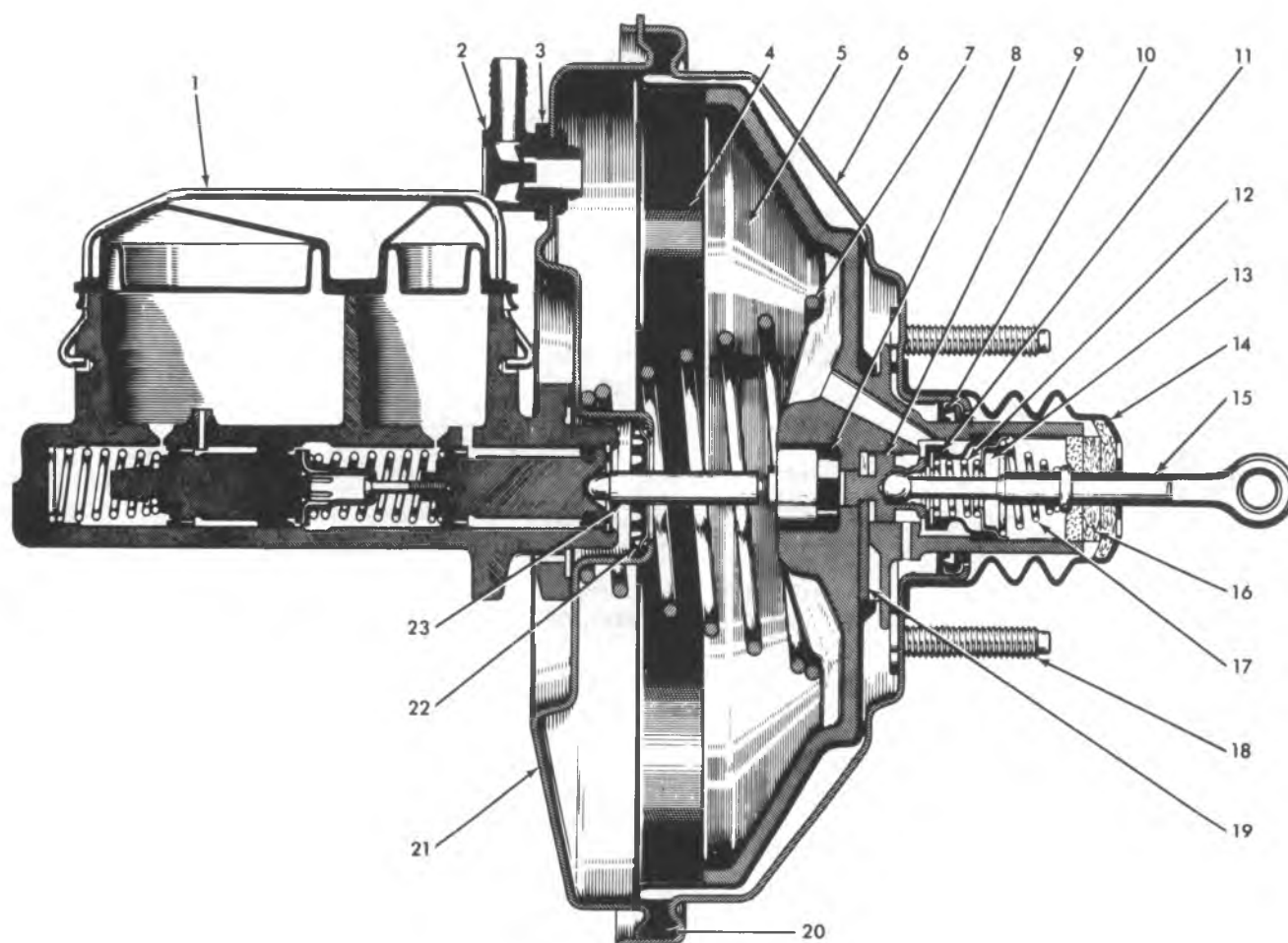
- b. Hold the diaphragm plate so that the push rod is in its normal (horizontal) installed position, depress the push rod slightly (approximately 1/16 inch), and rotate piston so the air valve lock will fall from its location in the diaphragm plate hub. Remove the air valve-push rod assembly from the diaphragm plate. Remove the reaction disc from its location in the diaphragm plate bore (insert the piston rod or other suitable tool through diaphragm plate extension and push disc from its seat). Exercise care so as not to chip surface of passages in the diaphragm plate.

Perform Step 4 only if seal is defective and a new seal is available. Do not reuse seal once it has been removed from the unit.

4. Support outer surface of rear housing on blocks of wood or other suitable material (stud side up) and drive out seal with a punch or a thin blade screwdriver. Discard seal.

INSPECTION CHART

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



- | | | |
|-----------------------|--------------------------|--------------------------|
| 1. Master Cylinder | 9. Air Valve | 17. Valve Return Spring |
| 2. Vacuum Check Valve | 10. Front Housing Seal | 18. Mounting Stud |
| 3. Grommet | 11. Poppet Valve | 19. Air Valve Lock Plate |
| 4. Diaphragm | 12. Poppet Valve Spring | 20. Diaphragm Lip |
| 5. Diaphragm Plate | 13. Poppet Retainer | 21. Front Housing |
| 6. Rear Housing | 14. Dust Boot | 22. Front Housing Seal |
| 7. Diaphragm Spring | 15. Valve Push Rod | 23. Piston Rod |
| 8. Reaction Disc | 16. Filter and Silencers | |

Fig. 5-1D--Bendix Single Diaphragm Unit (Typical)

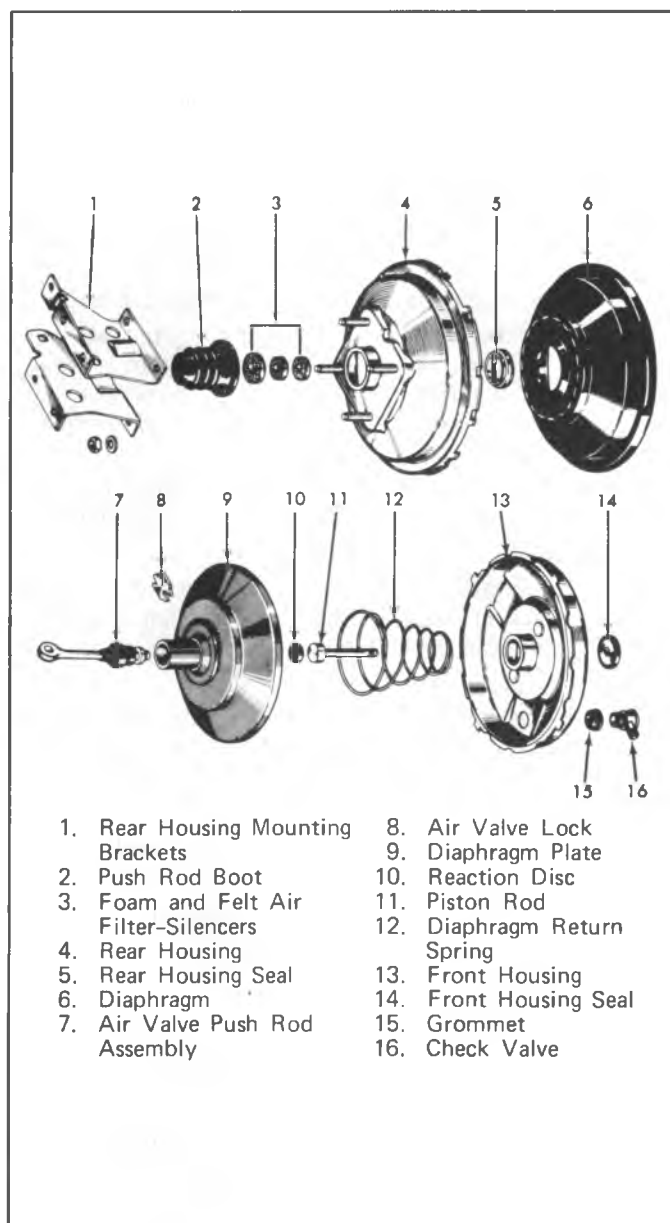


Fig. 5-2D--Bendix Power Booster Components (Typical)

Front Housing Group

1. Remove check valve from grommet and then remove grommet from front housing; discard valve and grommet.
2. Remove front housing and holding fixture from vise; then remove holding fixture from front housing.

Cleaning

Use clean brake fluid to thoroughly clean all reusable brake parts. Immerse in the cleaning fluid and brush metal parts with hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free clean cloth. If slight rust is found inside either the front or rear half housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards. Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until re-assembly

Re-wash at re-assembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

NOTICE: If there is any suspicion of contamination or any evidence of corrosion, completely flush the vehicle hydraulic brake system. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use of gasoline kerosene, anti-freeze, alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts.

Inspecting Rubber Parts

Wipe fluid from the rubber parts and carefully inspect each rubber part for cuts nicks or other damage. These parts are the key to the control of fluid or air flow, if the unit is in for overhaul, or if there is any question as to the serviceability of rubber parts, REPLACE them.

Inspecting Metal Parts

Badly damaged items, or those which would take extensive work or time To repair, should be replaced. In case of doubt, install new parts. Do not rely on the brake unit being overhauled at an early or proper interval. New parts will provide more satisfactory service, even if the brake unit is allowed to go beyond the desired overhaul period.

Assembly (Figs. 5-1D and 5-2D)

1. Be careful during the rebuild procedure that no grease or mineral oil comes in contact with the rubber parts of the power brake unit.
2. Lubricate power head parts, as outlined below, with silicone lubricant provided in the service repair kit.

Front Housing Group

1. Install new check valve grommet in front housing with beveled edge of grommet inside of housing. Dip new check valve in clean denatured alcohol and install in grommet--check valve stem is to be outside of housing.
2. Position and secure Holding Fixture J-22805 to mounting studs, and place tool and front housing in a vise. Be sure to align tool so that check valve is not damaged. If either or both of the housings are

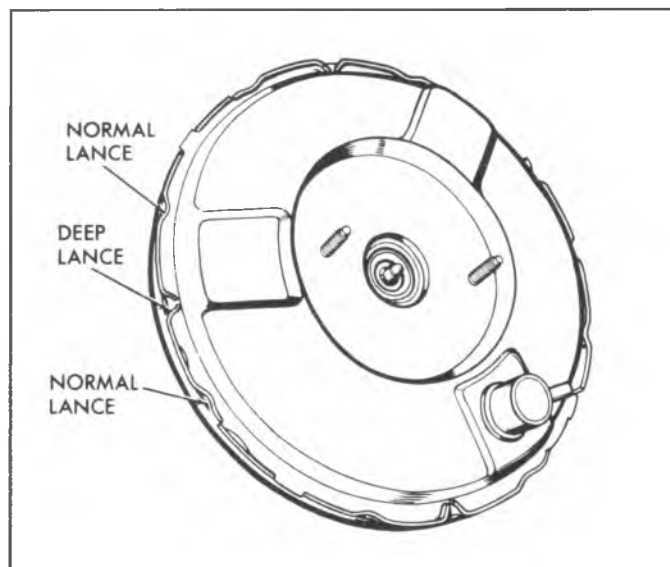


Fig. 5-3D--Lances in Rear Housing



Fig. 5-4D--Installing Rear Housing Seal

replaced, make sure alignment marks are transferred to the new housing.

Rear Housing Group

1. Place rear housing on a block of wood, stud side down, and position housing seal in center hole. Use Tool J-22677 (fig. 5-4D) to seat seal in recess of rear housing. Tool bottoms against housing when seal is in place.

2. Assemble diaphragm plate assembly (see fig. 5-2D).

- a. Apply silicone lubricant to outside diameter of diaphragm plate and extension, to bearing surfaces of air valve and to outer edge of valve poppet. Insert air valve and push rod assembly in extension of diaphragm plate.

The air valve, poppet valve and push rod are serviced as an assembly; a complete unit must be installed if there is damage to any of the component parts.

- b. Depress the push rod slightly and install the air valve lock. Make sure the lock indexes and retains the air valve.

- c. Install the rolling diaphragm in the groove of diaphragm plate.

- d. Apply silicone lubricant to surface of reaction disc and position disc in center bore of diaphragm plate. Use piston rod to seat disc in bore. Make sure disc is fully seated before removing piston rod. If reaction disc is not fully seated, it will result in an erroneous push rod height adjustment.

3. Apply silicone lubricant to I.D. of rear housing seal and diaphragm bead contact surface of rear housing. Install diaphragm plate assembly in rear housing.

4. Place air filter element over push rod and into diaphragm plate extension. Install filter retainer.

Final Assembly

1. Attach base of Holding Fixture J-22805 to front housing with nuts and washers and draw down tight to eliminate bending or damage to studs. Clamp base in bench vise with power section up (fig. 5-1A).

NOTICE: Be sure to align tool so that the check valve in the front housing is not damaged.

2. Place Spanner Wrench J-9504 over studs on rear housing and attach with nuts and washers. Draw nuts down tight to eliminate bending or damaging of studs.
3. Place diaphragm plate return spring in front housing and position rear housing assembly on front housing (small end of spring downward). Position rear housing so that when housings are locked, scribe marks on front and rear housings will be in alignment.
4. Press down on Spanner Wrench J-9504 and rotate the rear housing counterclockwise to assemble the two housings.

NOTICE: Bend lances in on the rear housing. If the tangs crack or break during this operation it will be necessary to replace that half of the housing.

5. Remove Tool J-9504 from the rear shell.
6. Install air silencers over push rod end and then install push rod boot. Install boot retainer.
7. **Clevis Type Push Rod** - Install locknut and push rod clevis.
8. Install mounting bracket to the rear shell, if so equipped.

NOTICE: See "Notice" on Page 1 of this section.

9. Remove power cylinder from vise and remove Holding Fixture J-22805.
10. Apply silicone lubricant sparingly to the piston rod, keeping lubricant away from rounded end of rod. Guide piston rod into center bore of the diaphragm plate until it is fully seated against reaction disc.
11. Install front housing seal. Press seal into front housing until seal is bottomed in recess of housing.

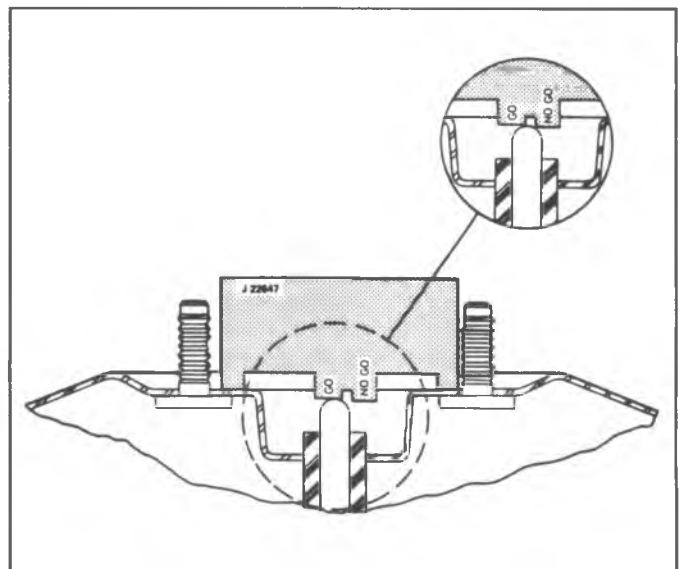


Fig. 5-5D--Gaging Piston Rod

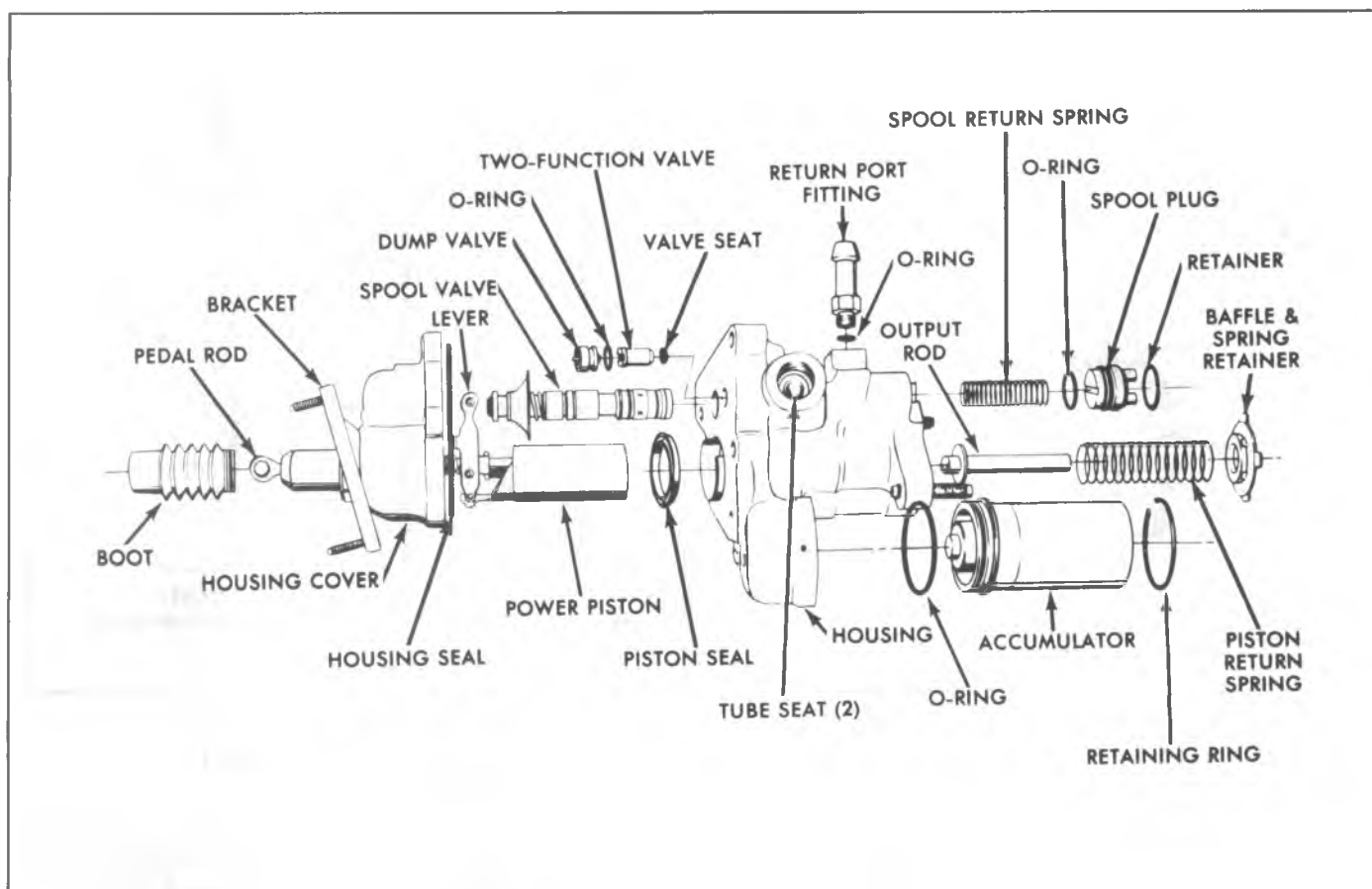


Fig. 5-1E--Bendix Hydro-Boost Explode--Typical

Gaging

1. Place the power head assembly in a padded vise (front housing up). 2. Remove the front housing seal to assure that no vacuum is in the power head while gaging.
3. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.
4. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.
5. Place Gage J-22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (fig. 5-5D).
6. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should *never* contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.
7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self-locking screw to meet the gaging specifications.
8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

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 accumulator, always replace with a new accumulator. Dispose of an inoperative accumulator by drilling a 1/16" diameter hole through the end of the accumulator can opposite the "O" ring.

The Bendix Hydraulic Brake Booster utilizes the hydraulic pressure supplied by the power 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 removal of the mounting bracket even though it is not necessary to remove the bracket for overhaul of the internal assembly.

Disassembly (Fig. 5-1E)

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 bracket 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

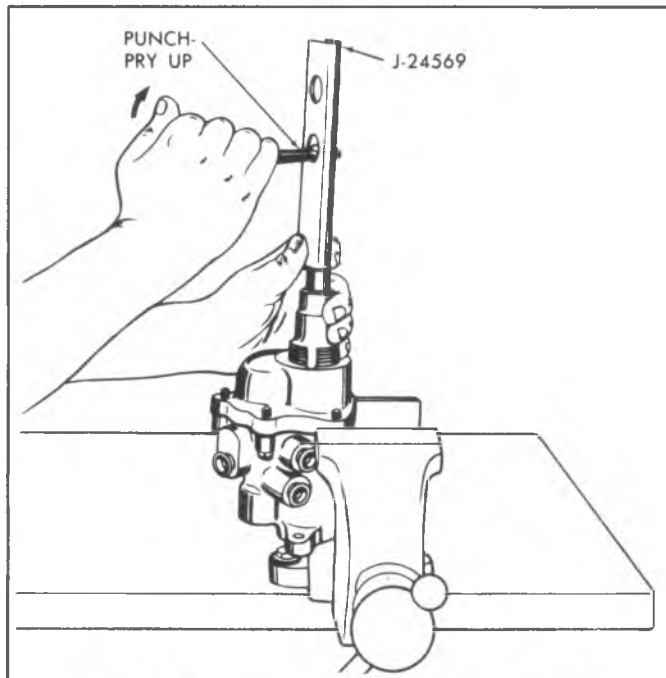


Fig. 5-2E--Removing Booster Pedal Rod (Typical)

- it off over the pedal rod eyelet.
- Place Tool J-24569 around the pedal rod and resting on the input rod end as shown in Figure 5-2E.
 - 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.
 - 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.
 - 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. 5-3E).
 - Place the booster cover in a vise equipped with soft jawed devices. Remove the five screws that secure the booster housing to the cover.
 - Remove the booster assembly from the vise and while holding the unit over a pan, separate the cover from

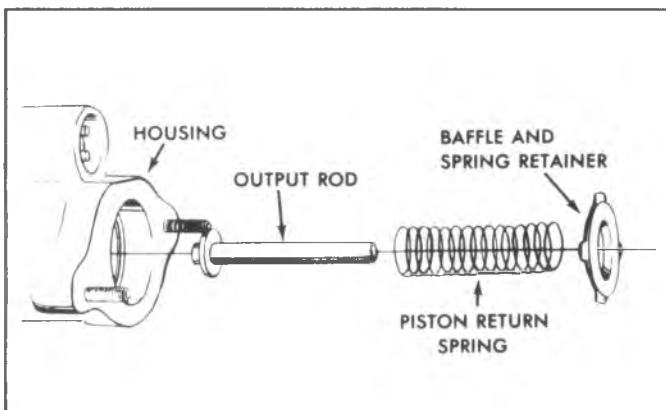


Fig. 5-3E--Output Rod, Spring and Retainer

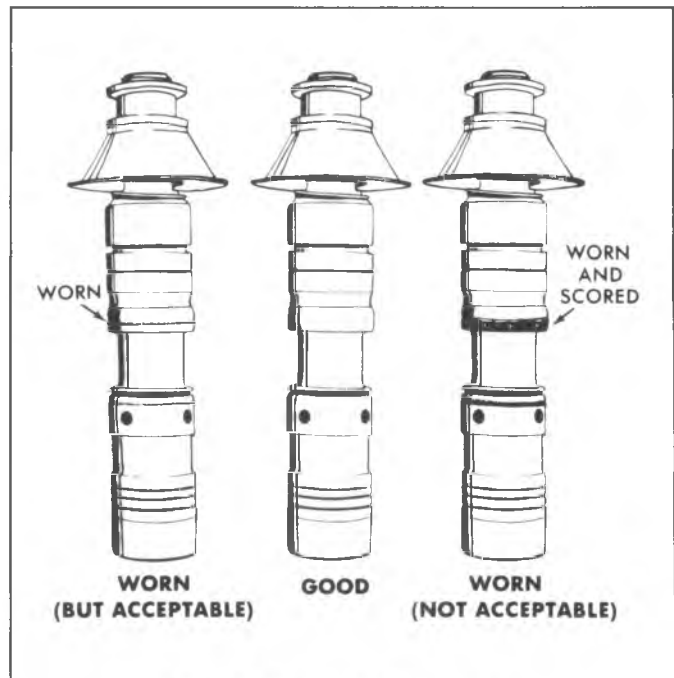


Fig. 5-4E--Spool Valve Inspection

- the housing. Remove the "figure eight" seal from the housing cover; discard the seal.
- Remove the input rod and piston assembly, the spool assembly and spool spring from the booster housing. Compare spool valve condition to Figure 5-4E. If spool valve is defective, the complete unit must be replaced.
- Inspect power piston. If scratches big enough to be felt with a fingernail are present, the input rod and piston must be replaced.
- Remove the input rod seals from the input rod end, and the piston seal from the piston bore in the housing; discard the seals.
- Place the accumulator retaining cap Tool J-26889 over the master cylinder stud and install the nut as shown in Figure 5-6E.
- Using Tool J-22269-01 or a large "C" clamp

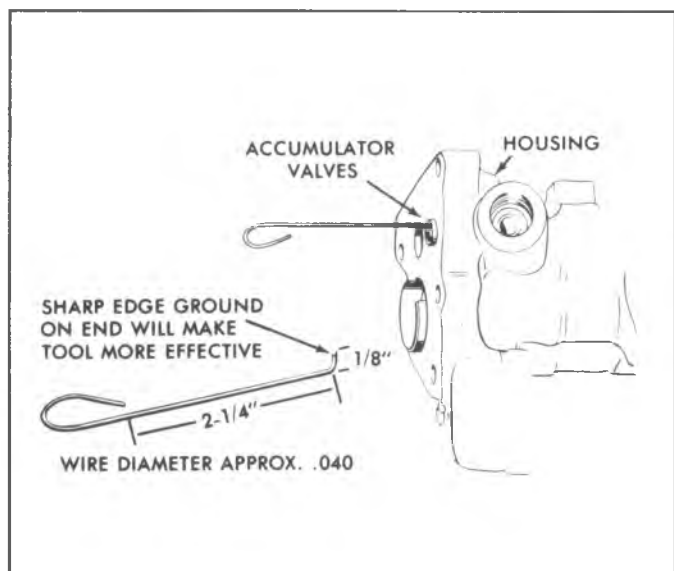


Fig. 5-5E--Removing Accumulator Valves

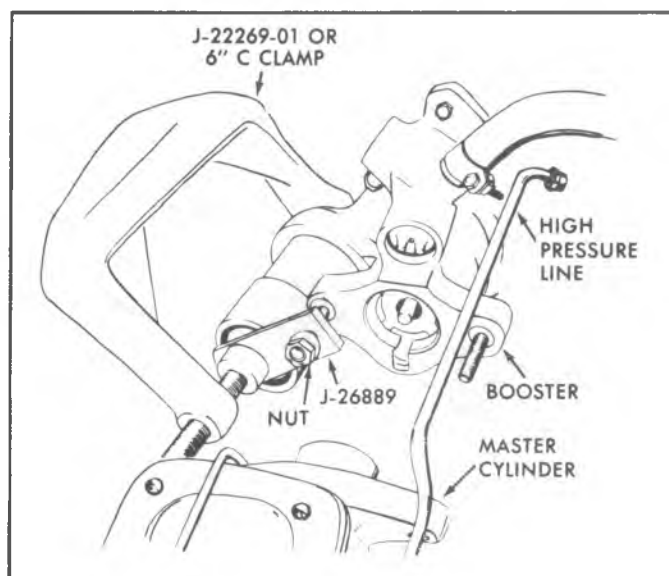


Fig. 5-6E--Compressing Accumulator With J-26889

(6" minimum), depress the accumulator. Insert a punch into the hole in the housing and remove retaining ring with a small screwdriver, (fig. 5-6E).

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. 5-5E). 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. 5-8E).
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. 5-9E).
18. Remove spool valve plug and "O" ring.
19. Remove the tube seats using No. 4 easy-out as

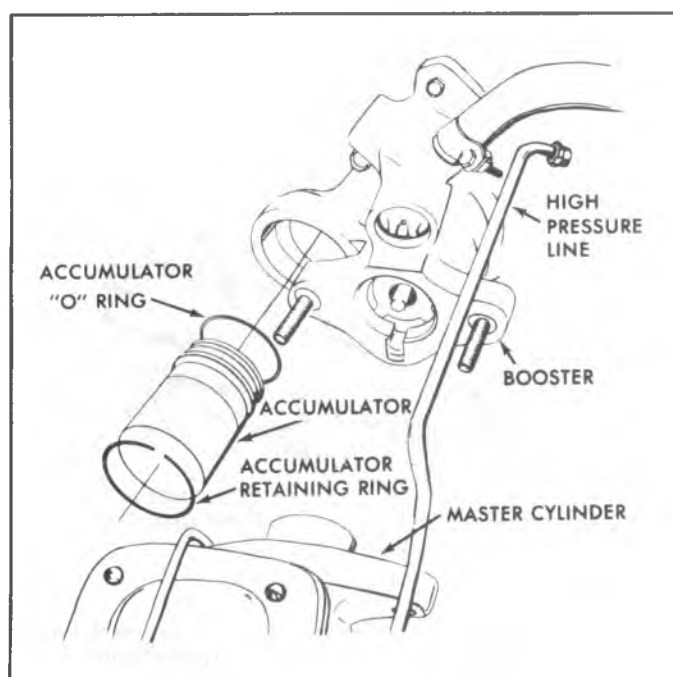


Fig. 5-7E--Accumulator Installation

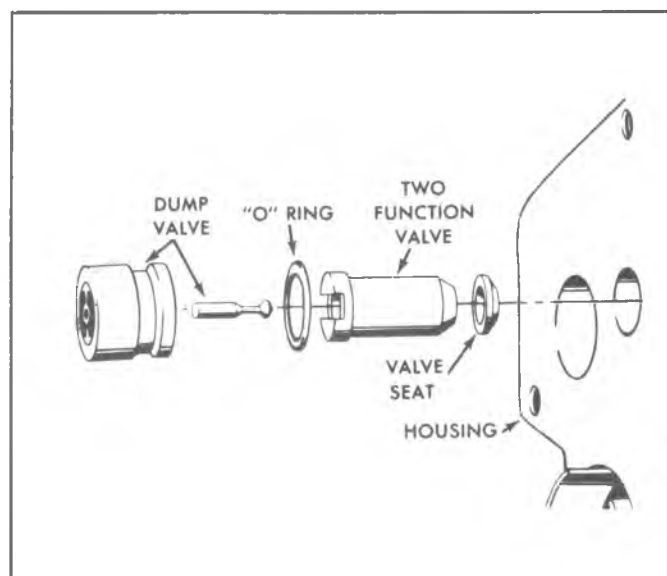


Fig. 5-8E--Accumulator Valves

shown in Figure 5-10E.

Cleaning and Inspection

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,

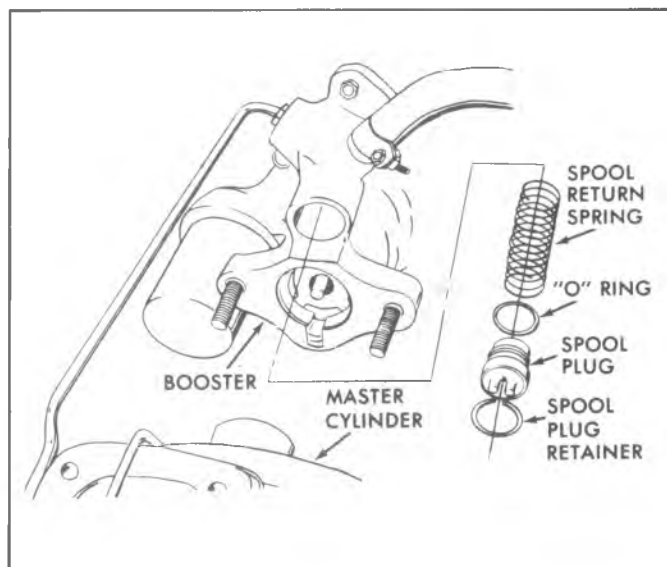


Fig. 5-9E--Spool Valve Plug Removal

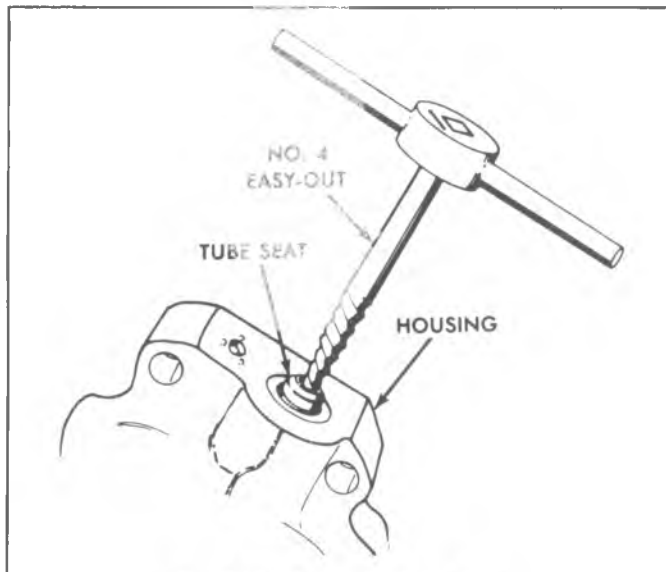


Fig. 5-10E--Removing Tube Seat

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 tube seat with Tool J-6217 as shown in Figure 5-11E.
2. Install "O" ring and spool valve plug (fig. 5-9E).

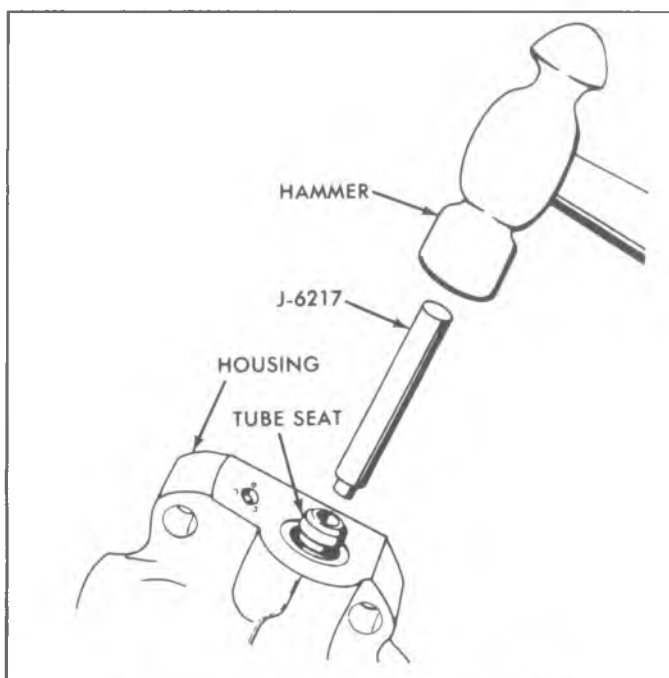


Fig. 5-11E--Installing Tube Seat Using J-6217

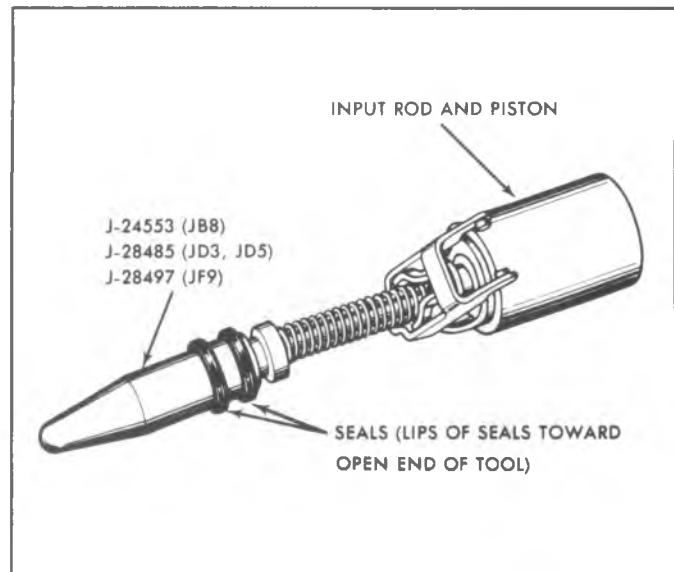


Fig. 5-12E--Installing Input Rod Seals

3. Push spool valve plug in and install retaining ring.
4. Coat the piston bore and the piston seal with clean power steering 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. 5-12E).
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. Assemble 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.

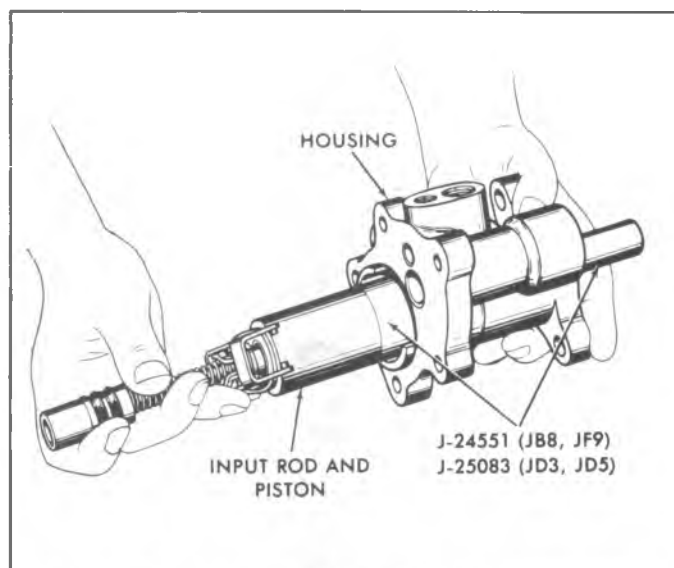


Fig. 5-13E--Installing Input Rod and Piston Assembly Into Booster (Typical)

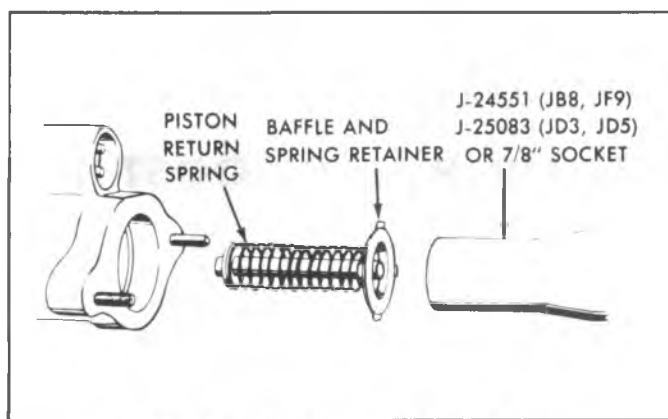


Fig. 5-14E--Installing Baffle and Spring Retainer

8. Lubricate the piston and Piston Installing Tool with clean power steering fluid. Hold the large end of the tool against the piston (fig. 5-13E), and slide the tool and piston into the piston bore and 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 seat into the valve bore. The seat can be forced to the bottom by installing the two function valve (fig. 5-8E). 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 spool 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.
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.

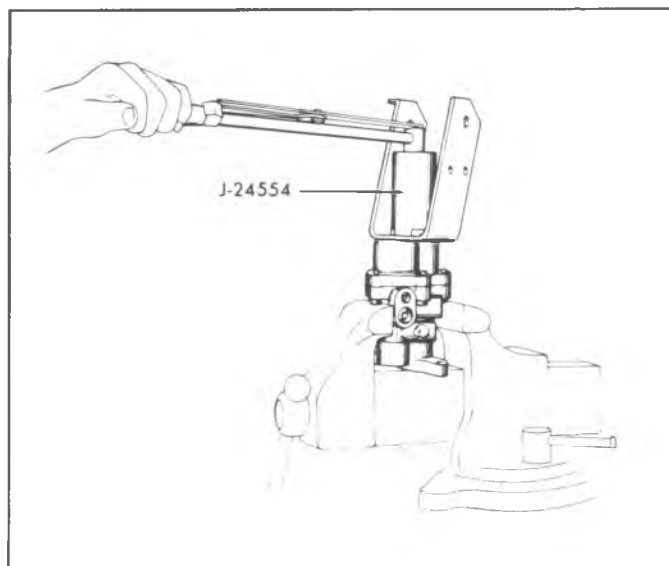


Fig. 5-15E--Installing Mounting Bracket Nut

- 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 5-14E.
 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. 5-7E). 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. 5-6E).
 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. 5-15E), 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. 5-16E), 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.

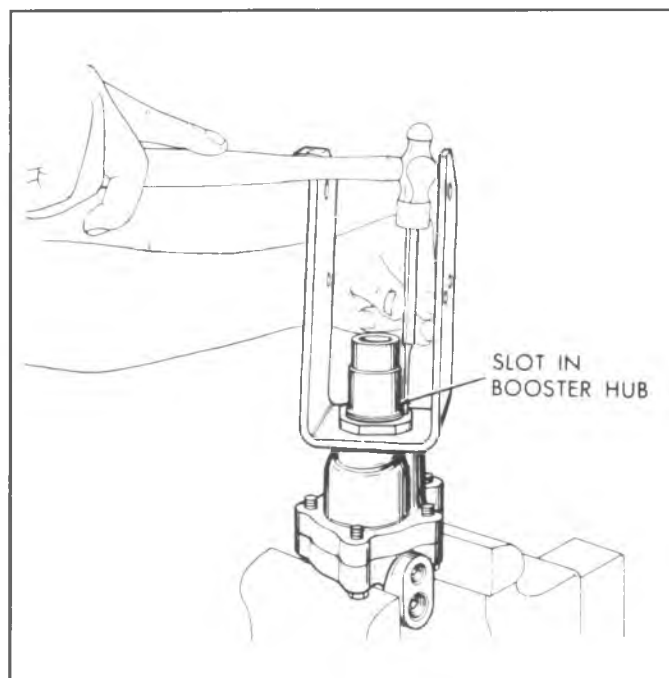


Fig. 5-16E--Staking Mounting Bracket Nut

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.

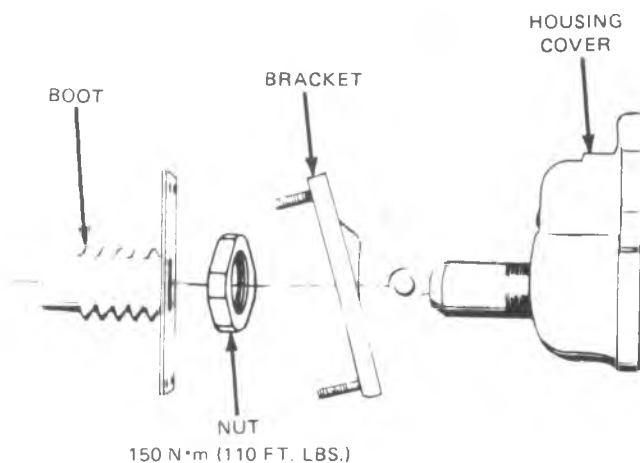
BENDIX HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST II)

UNIT REPAIR

3. Remove And Install Bracket.

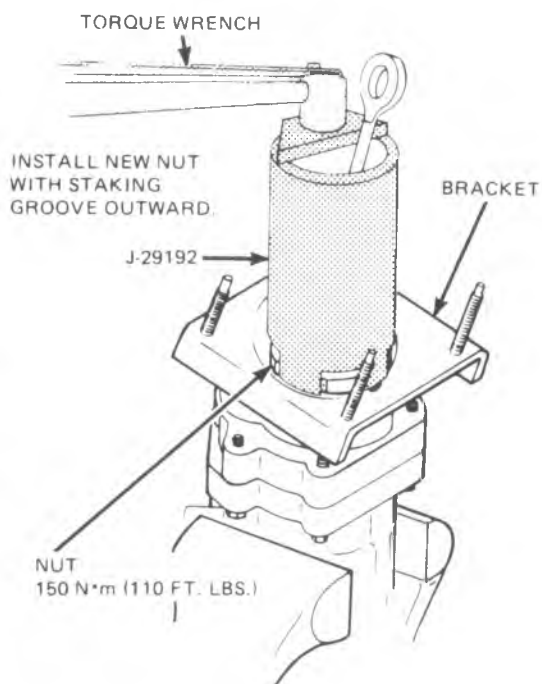
REMOVE

1. Cut nut with chisel.
2. Remove parts as shown.

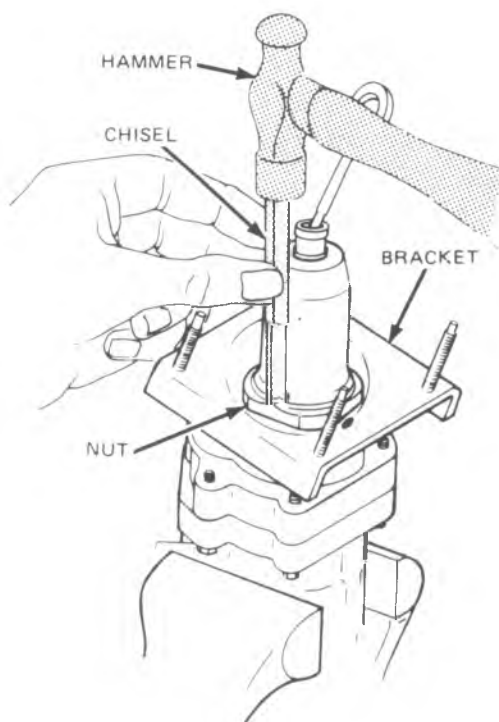


INSTALL

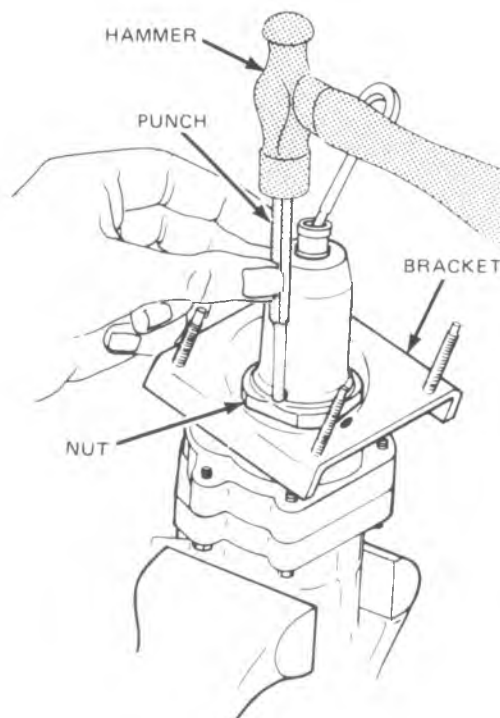
1. Install parts as shown.



TORQUE NUT WITH TOOL J-29192



CUTTING NUT TO REMOVE BRACKET

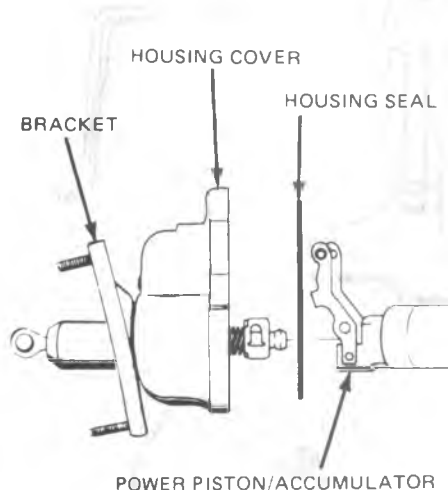


STAKING BRACKET NUT

4. Remove And Install Spool Valve, Power Piston/Accumulator And Seal.

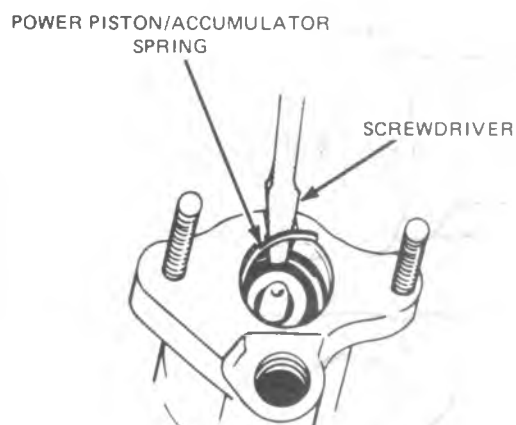
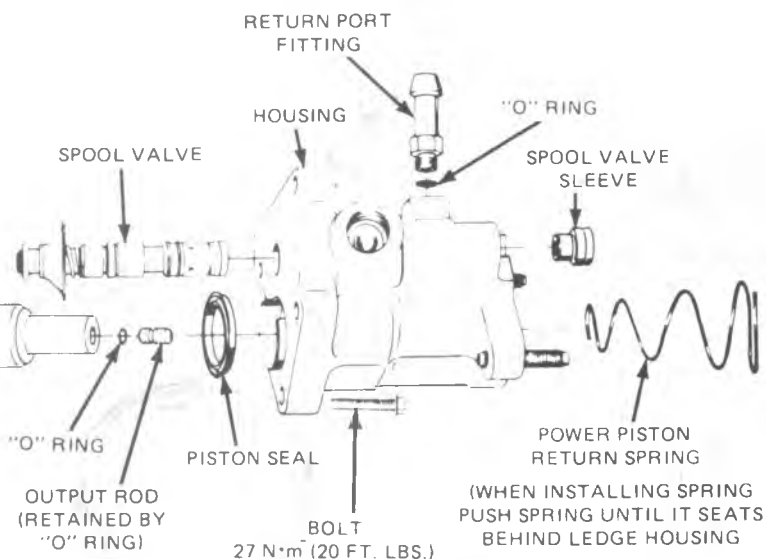
REMOVE

1. Remove parts as shown.
2. If removing spool valve plug refer to Remove and Install Spool Valve Plug In Car.

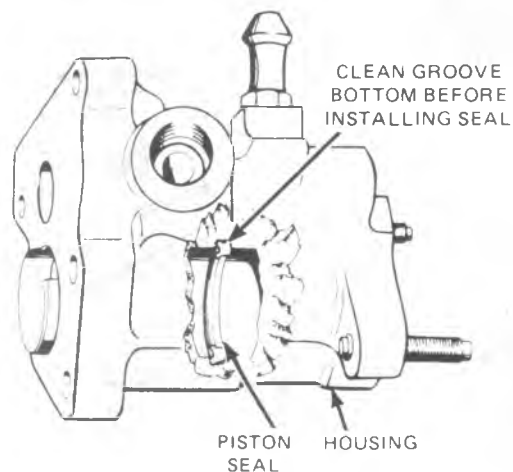


INSTALL

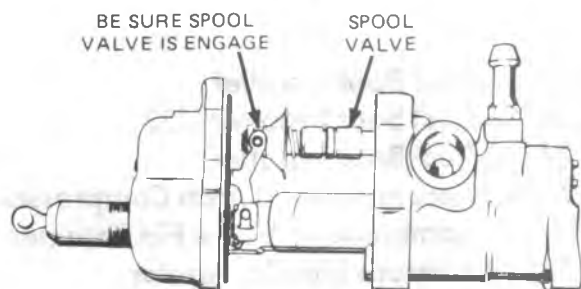
1. Install parts as shown.
2. If installing spool valve plug refer to Remove And Install Spool Valve Plug In Car.



REMOVE POWER PISTON/ACCUMULATOR SPRING

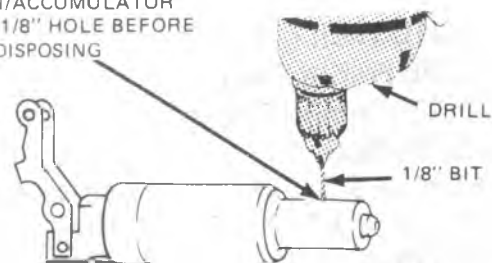


INSTALL POWER PISTON/ACCUMULATOR SEAL



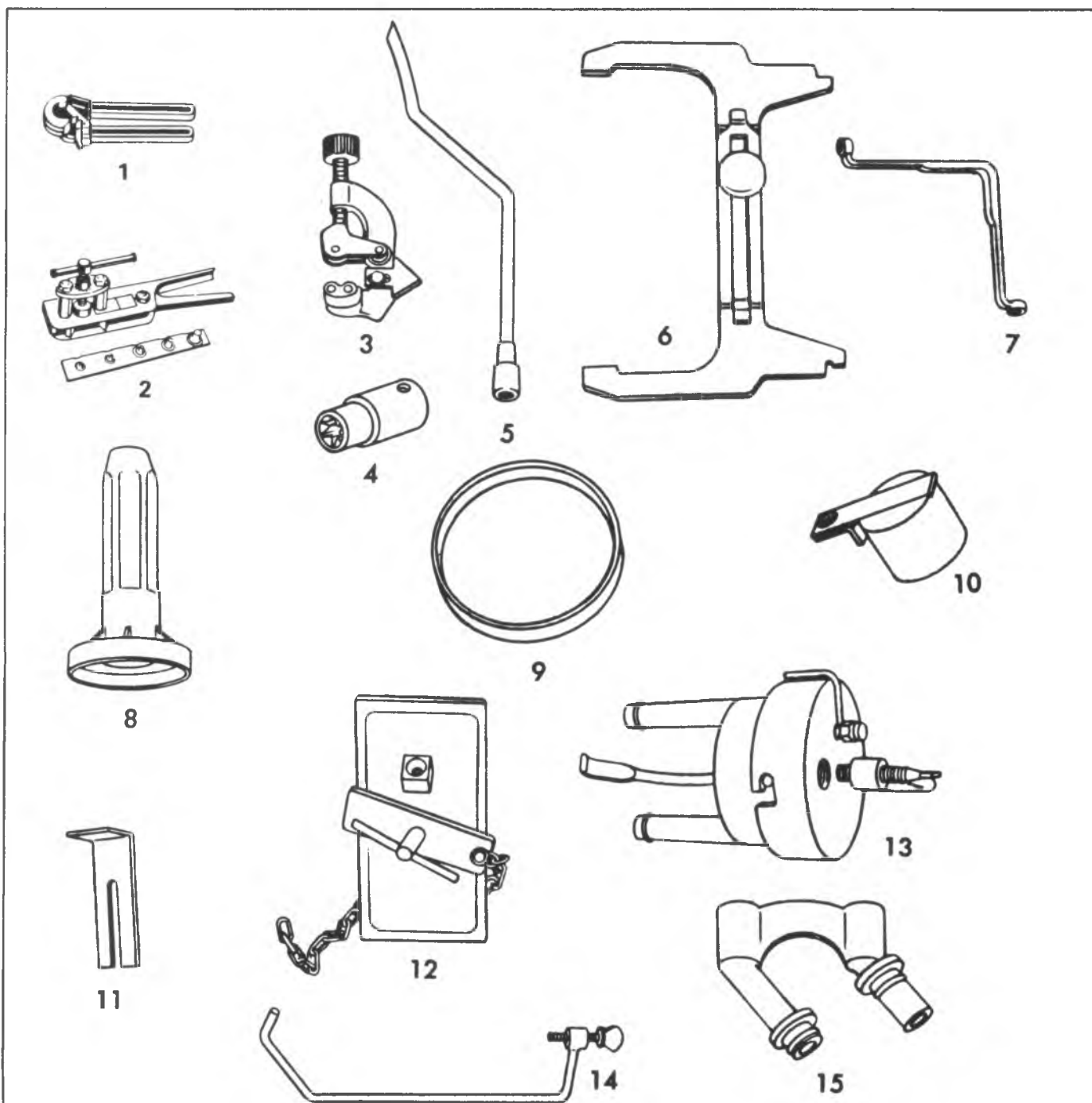
INSTALL SPOOL VALVE

WHEN REPLACING POWER PISTON/ACCUMULATOR DRILL A 1/8" HOLE BEFORE DISPOSING



DISPOSE POWER PISTON/ACCUMULATOR

SPECIAL TOOLS



1. J-25310 Tubing Bender
2. J-23530 Flaring Tool
3. J-23533 Tubing Cutter
4. J-25085 Socket
5. J-8049 or J-22348 Spring Remover
6. J-21177 or J-22364 Drum/Shoe Gauge
7. J-21472 or J-22364 Bleeder Wrench

8. J-22904 Dust Boot Installer
- J-28735 Dust Boot Installer (JB7)
9. J-24548 Dust Boot Installer
10. J-26889 Accumulation Piston Compressor
11. J-23709 Combination Valve Pin Retainer
12. J-23518 Pressure Bleeder Adapter
13. J-26819 Pressure Bleeder Adapter
14. J-26819-25 Bleeder Adapter Clamp (Long)
15. J-26819-30 Bleeder Adapter Extension

SPECIFICATIONS

BRAKE SYSTEM DESCRIPTION

<u>SYSTEM</u>	<u>FRONT BRAKES</u>	<u>REAR BRAKES</u>	<u>BRAKE ASSIST</u>
<u>GASOLINE ENGINE VEHICLES</u>			
<u>C-MODELS</u>			
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
<u>G-MODELS</u>			
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
<u>ALL MODELS</u>			
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
<u>DIESEL ENGINE VEHICLES</u>			
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

SPECIFICATIONS

	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.)

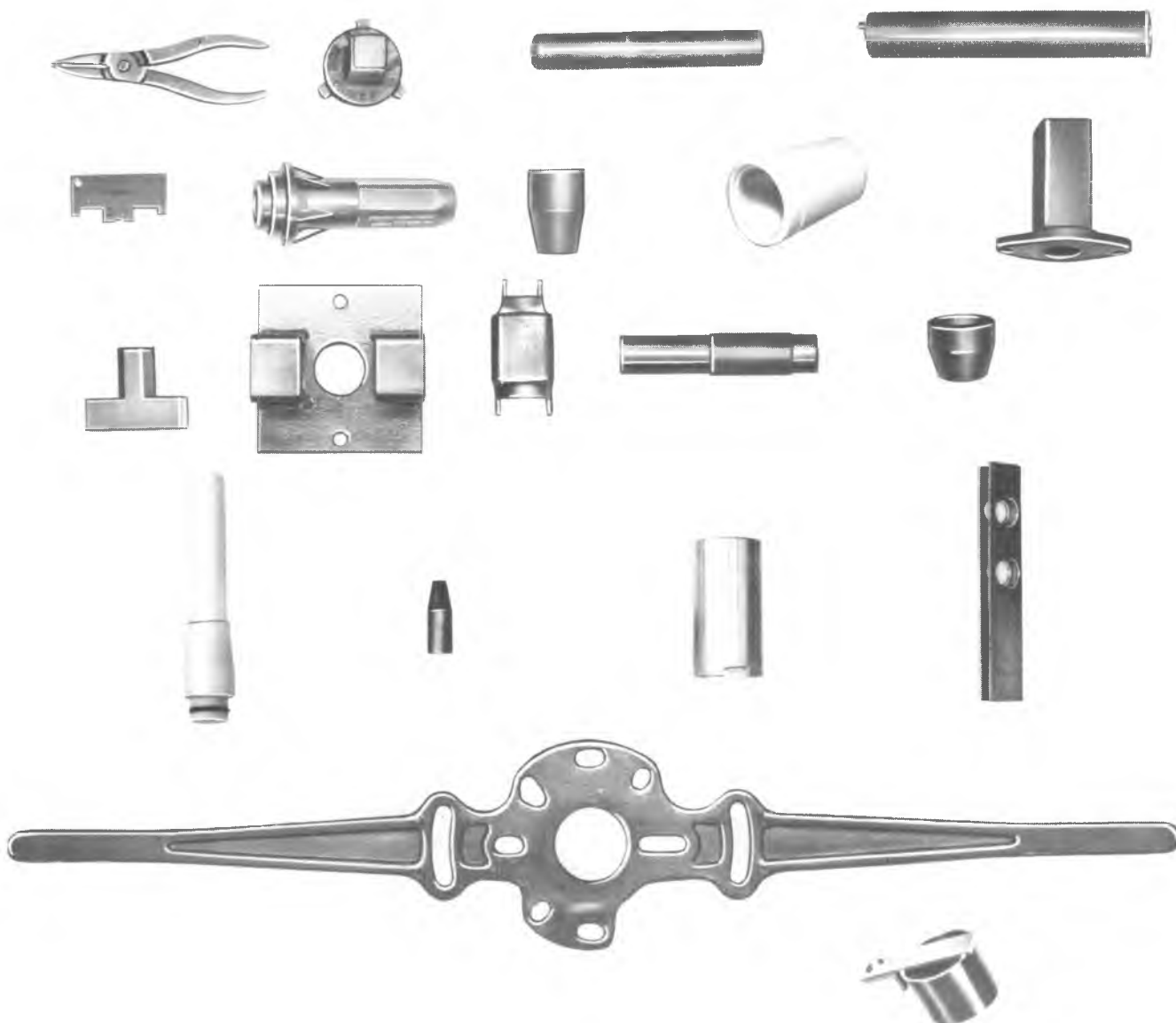
(*27 N•m (20 ft. lbs.)

**44 N•m (32 ft. lbs.) — Master Cylinder to Booster

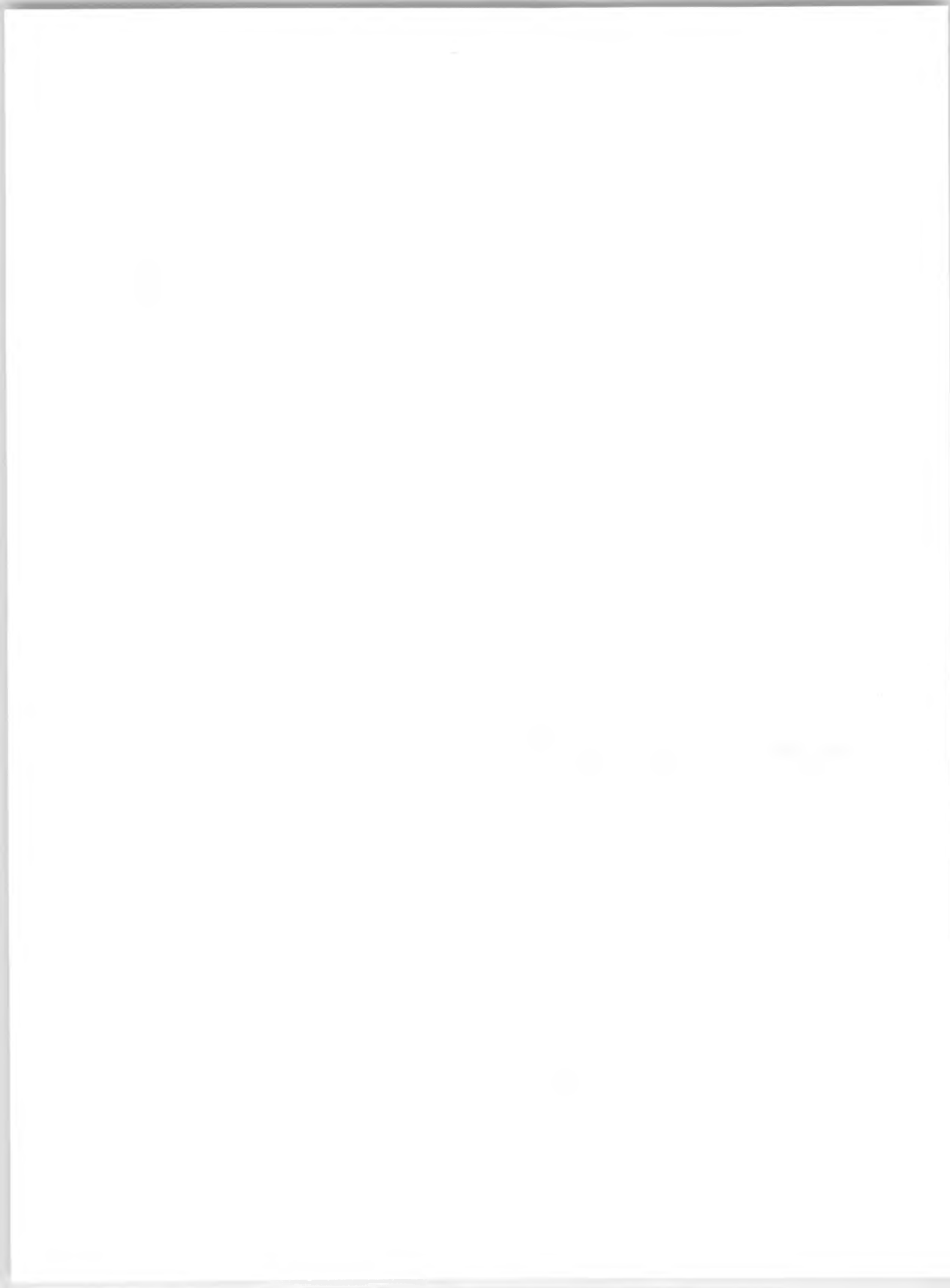
— Master Cylinder or Booster to Dash Reinforcement

(CKP20-30)

Special Tools



- | | |
|---|--|
| 1. J-4880 Snap Ring Pliers | 13. J-23175 Control Valve Installer |
| 2. J-21524 Power Piston Remover and Installer | 14. J-23188 Secondary Bearing Protector |
| 3. J-21601 Power Brake Retainer and Installer | 15. J-24551 Piston Installers |
| 4. J-22657 Bushing Retainer Socket | J-25083 |
| 5. J-22647 Height Gauge | 16. J-24553 Input Rod Seal Installers |
| 6. J-22677 Power Cylinder Seal Installer | J-28485 |
| 7. J-22733 Seal Installer and Protector | J-28497 |
| 8. J-28458 Power Piston Seal Protector | 17. J-24554 Socket |
| 9. J-22805 Power Cylinder Holding Fixture | 18. J-24569 Pedal Push Rod Remover |
| 10. J-22839 Front Plate Holding Fixture | 19. J-9504 Power Cylinder Spanner Wrench |
| 11. J-22893 Booster Separating Adapter | 20. J-26889 Accumulator Compressor |
| 12. J-23101 Power Piston Holding Tool | |



SECTION 6

ENGINE

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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.

GENERAL INFORMATION

STATEMENT ON CLEANLINESS AND CARE

A vehicle's 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 pick-up unit.

It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of violent and 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 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.

INTRODUCTION

Engine Performance Diagnosis procedures are guides that will lead to the most probable causes of engine performance complaints. They consider all of the components of the fuel, ignition, and mechanical systems that could cause a particular complaint, and then outline repairs in a logical sequence.

The procedures are based on Symptoms that are listed in the Table of Contents.

Each Symptom is defined, and it is vital that the correct one be selected based on the complaints reported or found.

Review the Symptoms and their definition to be sure that only the correct terms are used.

The words used may not be what you are used to in all cases, but because these terms have been used interchangeably for so long, it was necessary to decide on the most common usage and then define them. If the definition is not understood, and the exact Symptom is not used, the Diagnostic procedure will not work.

It is important to keep two facts in mind:

1. The procedures are written to diagnose problems on vehicles that have "run well at one time" and that time and wear have created the condition.

2. All possible causes cannot be covered, particularly with regard to emission controls. If doing the work prescribed does not correct the complaint, then either the wrong Symptom was used or a more detailed analysis will have to be made.

All of the Symptoms can be caused by worn out or defective parts. If time and/or mileage indicate that parts should be replaced, it is recommended that it be done.

SYMPTOM	DEFINITION
A. Dieseling	Engine continues to run after the switch is turned off. It runs unevenly and makes knocking noises.
B. Detonation	A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.
C. & D. Stalls, Cold or Hot	The engine quits running. It may be at idle or while driving.
C. & D. Rough Idle, Cold or Hot	The engine runs unevenly at idle. If bad enough, it may make the vehicle shake.
E. Miss	Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. Not normally felt above 1500 rpm or 30 mph. The exhaust has a steady spitting sound at idle or low speed.
F. Hesitates	Momentary lack of response as the accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.
G. Surges	Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.
H. Sluggish	Engine delivers limited power under load or at high speed. Won't accelerate as fast as normal; loses too much speed going up hills, or has less top speed than normal.
I. Spongy	Less than the anticipated response to increased throttle opening. Little or no increase in speed when the accelerator pedal is pushed down a little

to increase cruising speed. Continuing to push the pedal down will finally give an increase in speed.

J. Poor Gas Mileage	Self describing.
K. Cuts Out	The engine exhibits a significant or total temporary loss of power at sharp, irregular intervals. This may occur repeatedly or intermittently and is usually worse under heavy acceleration.
L. Hard Start - Cold	Self describing
M. Hard Start - Hot	Self describing

ENGINE PERFORMANCE DIAGNOSIS

A. Dieseling	<ol style="list-style-type: none"> 1. Make visual checks of the following for sticking. <ol style="list-style-type: none"> a. Carburetor, choke, and throttle linkage b. Fast idle cam <p>See cleaning, inspection, and adjustment of carburetor, Section 6C.</p> 2. Check and reset ignition timing and idle speed settings. Refer to emission control information label. 3. Remove carbon with top engine cleaner. Follow instructions on can. If condition still exists, suggest that owner try different gasoline.
B. Detonation	<ol style="list-style-type: none"> 1. Check for obvious overheating problems. <ol style="list-style-type: none"> a. Low coolant b. Loose fan belt c. Restricted air flow, etc. 2. Check ignition timing per emission control information label. 3. For "ESC" see diagnosis Section 6D. 4. Perform EGR functional check see Section 6E. 5. Remove carbon with top engine cleaner. Follow instructions on can. If condition still exists, suggest that owner try different gasoline.
C. Stalls or Rough Idle - Cold	<ol style="list-style-type: none"> 1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close it if engine is too warm. If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor. 2. Visually check the following: <ol style="list-style-type: none"> a. Hot air tube to air cleaner connection and condition of hot air stove. b. Vacuum hoses for splits, kinks and proper connections. See Hose Routing Schematic on Vehicle Emission Control Information Label. c. Air leaks at carburetor mounting and intake manifold. d. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.

3. Check the following for sticking:
 - a. Carburetor, choke, and throttle linkage.
 - b. Fast idle cam.
 - c. Carburetor flooding.
See cleaning, inspection and adjustment of carburetor, Section 6C.
4. With engine running, visually check vacuum break linkage for movement while removing and reinstalling vacuum hose. If the linkage does not move and vacuum is at hose, replace vacuum break assembly.
5. With engine off, check all choke adjustments. See Section 6C.
6. Check engine timing and idle speed. See Emission Control Information Label.
7. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold vacuum source to valve. If rpm doesn't drop, valve is leaking. See E.G.R. Section 6E for further functional tests, cleaning, and/or replacement.
8. Check E.F.E. valve.
Disconnect E.F.E. hose from tube and connect an extra vacuum hose from any manifold vacuum source to E.F.E. tube.
Observe actuator linkage for movement. If no movement, repair as necessary. Refer to Section 6E for further test and/or repair.

D. Stalls or Rough
Idle - Hot

1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be open. If closed and engine is hot, check temperature operation of sensor unit. See air cleaner temperature test, Section 6E.
2. Visually check the following:
 - a. Vacuum hoses for splits, kinks and proper connections. See hose routing Schematic, Vehicle Emission Control Information Label.
 - b. Air leaks at carburetor mounting and intake manifold.
 - c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.
 - d. Check idle solenoid - Replace as necessary - See idle solenoid Section 6E.
3. Check engine timing and idle speed. See emission control information label.
4. Check P.C.V. valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
5. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold source to valve. If rpm doesn't drop, valve is leaking. See E.G.R. Section 6E for further functional tests, cleaning and/or replacement.
6. Remove carbon with top engine cleaner. Follow instructions on can. If idle is still rough, run a cylinder compression check.

E. Miss

1. Visually check the following:
 - a. Vacuum hoses for splits, kinks and proper connections. See hose routing Schematic, Vehicle Emission Control Information Label.
 - b. Air leaks at carburetor mounting and intake manifold.
 - c. Ignition wires for cracking, hardness and proper connections. Repair or

replace as necessary.

2. Disconnect air cleaner and E.G.R. vacuum hoses and cap both vacuum sources.
3. Remove one spark plug wire at a time with insulated pliers. If there is an rpm drop on all cylinders, go to rough idle (hot) diagnosis charts.
4. If there is no rpm drop on one or more cylinders (See Section 6D Intermittent Operation or Miss), remove spark plug(s) and check for:
 - a. Cracks
 - b. Wear
 - c. Improper gap
 - d. Burned Electrodes
 - e. Heavy Deposits
 Repair or replace as necessary.
5. Check spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 50,000 ohms, replace wire(s).
6. Visually check distributor cap and rotor for moisture, dust, cracks, burns, etc. Clean and/or repair as necessary.
7. Perform compression check on questionable cylinder(s). If compression is low, repair as necessary.
8. Remove rocker covers. Check for bent push rods, worn rocker arms, broken valve springs, worn cam shaft lobes. Repair as necessary.

F. Hesitates

1. Visually check the following:
 - a. Vacuum hoses for splits, kinks and proper connections. See hose routing on the vehicle emission control information label.
 - b. Air leaks at carburetor mounting and intake manifold.
 - c. Check ignition wires for cracking, hardness and proper connections. Repair and replace as necessary.
2. Note: Cold Engine Only
Check the following for sticking or faulty operation:
 - a. Carburetor, choke, and throttle linkage.
 - b. Fast idle cam.
See cleaning, inspection and adjustment of carburetor, Section 6C.
3. Check carburetor accelerator pump operation. With air cleaner removed and engine off, hold choke valve open and look for gas squirt in carburetor bore while moving throttle.
4. If weak or no pump squirt, remove carburetor air horn and repair pump system as necessary. See air horn removal, cleaning and inspection, Section 6C for proper procedures. Check float level adjustment before replacing air horn and pump rod adjustment after assembly. See Float Adjustment, Section 6C.
5. Disconnect and plug vacuum advance hose, connect tachometer and timing light. Check ignition timing and idle speed against specs on emission label.
6. With engine running, remove air cleaner cover and filter. Damper door in

air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.

If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.

G. Surges

1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.
2. Visually check the following:
 - a. Vacuum hoses for splits, kinks and proper connections. See hose routing Schematic, Vehicle Emission Control Information Label.
 - b. Air leaks at carburetor mounting and intake manifold.
 - c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.
3. Check ignition timing per emission control information label.

To check mechanical advance, observe timing marks. It should advance as throttle is opened and return to mark as throttle is closed.
4. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.
5. Check carburetor fuel inlet filter. Replace if dirty or plugged.
6. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container. Start engine and let idle for 15 seconds.
 - a. Mechanical pump should supply 1/2 pint or more. If not, go to step 7. If OK, go to step 9.
7. To check mechanical fuel pump connect a vacuum gage. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If vacuum reading is 12 inches or more, go to step 8.
8. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connect vacuum gage. Crank or run engine until vacuum gage peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose.
9. If fuel lines and pump check OK, remove tank unit, replace strainer and clean fuel tank, if necessary.
10. Remove spark plugs, Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

H. Sluggish or Spongy

1. Remove air cleaner and check air filter for dirt or being plugged.
Replace as necessary.
2. With engine running, damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.
If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.
3. Check ignition timing per vehicle emission control information label.
Check mechanical advance as throttle is opened and closed.
4. Remove air cleaner and check for full throttle valve opening in carburetor by depressing accelerator pedal to floor; also check for full choke valve opening and free operating air valve (if equipped). Repair as necessary.
See carburetor cleaning and inspection, Section 6C.
5. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold vacuum source to valve. If rpm doesn't drop, valve is leaking.
See E.G.R. Section 6E for further functional tests, cleaning, and/or replacement.
6. With engine off, remove vacuum hose from distributor vacuum advance vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.
7. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
8. Remove carburetor air horn and check the following:
 - a. Power piston for freeness
 - b. Dirt in carburetor
 - c. Float adjustment
 - d. Metering rods
 - e. Power valve(s)
 Refer to carburetor cleaning and inspection, Section 6C.

I. Poor Gasoline Mileage

1. With engine running, remove air cleaner cover and filter. Check filter for dirt or being plugged. Replace as necessary. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close it if engine is too warm.
If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.
2. Visually check the following:
 - a. Vacuum hoses for splits, kinks and proper connections. See hose routing Schematic, Vehicle Emission Control Information Label.
 - b. Air leaks at carburetor mounting and intake manifold.
 - c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.
3. Check ignition timing per emission control information label.
To check mechanical advance, observe timing mark. It should advance throttle is opened and return to mark as throttle is closed.

4. Check carburetor choke linkage and settings. Clean and repair as necessary. See carburetor choke adjustments, cleaning and inspection, Section 6C.
5. With engine off, remove vacuum hose from distributor vacuum advance vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.
6. Remove spark plugs, check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
7. If in previous checks, adjustments have not been made that could improve mileage, remove carburetor air horn and check the following:
 - a. Power piston for freeness
 - b. Dirt in jets and metering passages
 - c. Metering rods
 - d. Power valve(s)
 - e. Float adjustmentSee carburetor cleaning, inspection, and adjustments, Section 6C.
8. Suggest owner fill tank and recheck mileage.

J. Cuts Out

1. Check ignition wires, boots, cap and coil for:
 - a. Damage
 - b. Deterioration
 - c. Loose connections
 - d. Carbon trackingClean, tighten and/or replace defective parts as necessary.
2. Check ignition system - See Section 6D.
Check distributor for:
 - a. Worn shaft
 - b. Bare or shorted wiresRepair or replace defective parts as necessary.
3. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
4. Check carburetor fuel inlet filter. Replace if dirty or plugged.
5. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container. Start engine and let idle for 15 seconds.
 - a. **Fuel** pump should supply 1/2 pint or more. If not, go to step 7.
6. To check mechanical fuel pump, disconnect inlet hose at pump and connect a vacuum gage. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If vacuum reading is 12 inches or more, go to step 8.

7. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connecting a vacuum gage. Crank or run engine until vacuum gage peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose as necessary.

8. If fuel pump and fuel lines check OK, remove tank unit, replace strainer and clean fuel tank, if necessary.

If carburetor is suspected, remove the air horn and check the following:

- a. Power Piston(s) or main fuel piston for freeness.
- b. Dirt in jets and metering passages.
- c. Metering rods.
- d. Power valve(s) or main fuel valve(s).
- e. Float adjustment.

See Carburetor Cleaning Inspection and Adjustment, Section 6C.

K. Hard Starting - Cold (Engine Cranks OK)

1. Visually check the following:

- a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E.
- b. Air leaks at carburetor mounting and intake manifold.
- c. Ignition wires for cracking, hardness, proper connections, and carbon tracking. Repair or replace as necessary.
- d. Check choke and vacuum break operation and adjustment.

2. Check ignition timing per emission control information label.

If timing is too early - speed up engine to see if timing mark moves

If not, check for stuck mechanical advance. Refer to Section 6D. Repair as necessary and recheck timing.

3. Check the following:

- a. Choke, throttle linkage and fast idle cam for sticking.
- b. Carburetor flooding.

Clean and repair as necessary. If repairs are necessary, see carburetor, cleaning and inspection, Section 6C.

4. Check ignition system - Section 6D.

Check distributor for:

- a. Worn shaft
- b. Bare and shorted wires
- c. Repair or replace as necessary.

5. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

6. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container.

Start engine and let idle for 15 seconds. Pump should supply 1/2 pint or more.

If more than 1/2 pint, check filter in carburetor. Replace if necessary.

If less than 1/2 pint, for mechanical pump go to step 7.

7. Disconnect inlet hose at pump and connect a vacuum gage. Crank or run engine

until maximum vacuum is reached. If less than 12 inches, replace pump. If more than 12 inches, go to step 8.

8. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connect vacuum gage. Crank or run engine until vacuum gage peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose.

9. If fuel lines and pump check OK, remove tank unit, replace strainer and clean fuel tank, if necessary.

**L. Hard Starting - Hot
(Engine cranks OK)**

1. Visually check the following:

- a. Vacuum hoses for splits, kinks and proper connections. See hose routing Schematic, Vehicle Emission Control Information Label.
- b. Air leaks at carburetor mounting and intake manifold.
- c. Ignition wires for cracking, hardness, proper connections, and carbon tracking. Repair or replace as necessary.

2. Check ignition timing per emission control information label.

If timing is too early - speed up engine to see if timing mark moves

If not, check for stuck mechanical advance. Refer to Section 6D. Repair as necessary and recheck timing.

3. Check the following:

- a. Choke, throttle linkage and fast idle cam for sticking.
- b. Carburetor flooding.

Clean and repair as necessary. If repairs are necessary, see carburetor, cleaning and inspection, Section 6C.

4. Check ignition system Section 6D.

Check distributor for:

- a. Worn shaft
- b. Bare and shorted wires
- c. Faulty pick up coil, module, ignition coil, and shorted condenser. Repair or replace as necessary.

5. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.

6. Also check steps 6, 7, 8, 9 - Hard Starting - Cold.

Emission Non-Compliance, See Section 6E.

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.	a. Tighten bolts and/or replace gaskets and seals as necessary.
	b. Improper reading of dipstick.	b. Check oil with car on a level surface and allow adequate drain down time.

- | | |
|---|---|
| <ul style="list-style-type: none"> c. Improper oil viscosity. d. Continuous high speed driving and/or severe usage such as trailer hauling. e. P.C.V. system malfunctioning. f. Valve guides and/or valve stem seals worn, or seals omitted. g. Piston rings not seated, broken or worn. h. Piston improperly installed or misfitted. | <ul style="list-style-type: none"> c. Use recommended S.A.E. viscosity for prevailing temperatures. d. Continuous high speed operation and/or severe usage will normally cause decreased oil mileage. e. Service as necessary. f. Ream guides and install oversize service valves and/or new valve stem seals. g. 1. Allow adequate time for rings to seat.
2. Replace broken or worn rings as necessary. 1. Replace piston or repair as necessary. |
|---|---|

Low Oil Pressure

- | | |
|---|--|
| <ul style="list-style-type: none"> a. Slow idle speed b. Incorrect or malfunctioning oil pressure switch. c. Incorrect or malfunctioning oil pressure gage. d. Improper oil viscosity or diluted oil. e. Oil pump worn or dirty. f. Plugged oil filter. g. Oil pickup screen loose or plugged. h. Hole in oil pickup tube. i. Excessive bearing clearance. j. Cracked, porous or plugged oil galleys. k. Galley plugs missing or misinstalled. | <ul style="list-style-type: none"> a. Set idle speed to specification b. Replace with proper switch. c. Replace with proper gage. d. 1. Install oil of proper viscosity for expected temperature.
2. Install new oil if diluted with moisture or unburned fuel mixtures. e. Clean pump and replace worn parts as necessary. f. Replace filter and oil. g. Clean or replace screen as necessary. h. Replace tube. i. Replace as necessary. j. Repair or replace block. k. Install plugs or repair as necessary |
|---|--|

Valve Train Noise	a. Low oil pressure.	a. Repair as necessary. (See diagnosis for low oil pressure.)
	b. Loose rocker arm attachments.	b. Inspect and repair as necessary.
	c. Worn rocker arm and/or pushrod.	c. Replace as necessary.
	d. Broken valve spring.	d. Replace spring.
	e. Sticking valves.	e. Free valves.
	f. Lifters worn, dirty or defective.	f. Clean, inspect, test and replace as necessary.
	g. Camshaft worn or poor machining.	g. Replace camshaft.
	h. Worn valve guides.	h. Repair as necessary.

ENGINE KNOCK DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
a. Engine knocks cold and continues for two to three minutes. Knock increases with torque.	<ol style="list-style-type: none"> 1. EFE equipped engines may have valve knock. 2. Flywheel contacting splash shield. 3. Loose or broken balancer or drive pulleys. 4. Excessive piston to bore clearance.¹ 	<ol style="list-style-type: none"> 1. Replace EFE valve. 2. Reposition splash shield. 3. Tighten or replace as necessary. 4. Replace piston.
b. Engine has heavy knock hot with torque applied.	<ol style="list-style-type: none"> 1. Broken balancer or pulley hub. 2. Loose torque converter bolts. 3. Accessory belts too tight or nicked. 4. Exhaust system grounded. 5. Flywheel cracked. 6. Excessive main bearing clearance. 7. Excessive rod bearing clearance. 	<ol style="list-style-type: none"> 1. Replace parts as necessary. 2. Tighten bolts. 3. Replace and/or tension to specs as necessary. 4. Reposition as necessary. 5. Replace flywheel. 6. Replace as necessary. 7. Replace as necessary.

c. Engine has light knock hot in light load conditions.	<ol style="list-style-type: none"> 1. Detonation or spark knock. 2. Loose torque converter bolts. 3. Exhaust leak at manifold. 4. Excessive rod bearing clearance. 	<ol style="list-style-type: none"> 1. EST or ESC (See Section 6D or 6E) Check engine timing and fuel quality. 2. Tighten bolts. 3. Tighten bolts and/or replace gasket. 4. Replace bearings as necessary.
d. Engine knocks on initial start up but only lasts a few seconds.	<ol style="list-style-type: none"> 1. Fuel pump. 2. Improper oil viscosity. 3. Hydraulic lifter bleed down.² 4. Excessive crankshaft end clearance. 	<ol style="list-style-type: none"> 1. Replace pump. 2. Install proper oil viscosity for expected temperatures. 3. Clean, test and replace as necessary. 4. Replace crankshaft thrust bearing.
e. Engine knocks at idle hot.	<ol style="list-style-type: none"> 1. Loose or worn drive belts. 2. Compressor or generator bearing. 3. Fuel pump. 4. Valve train. 5. Improper oil viscosity. 6. Excessive piston pin clearance. 7. Connecting rod alignment. 8. Insufficient piston to bore clearance. 	<ol style="list-style-type: none"> 1. Tension and/or replace as necessary. 2. Replace as necessary. 3. Replace pump. 4. Replace parts as necessary. 5. Install proper viscosity oil for expected temperature. 6. Ream and install oversize pins. 7. Check and replace rods as necessary. 8. Hone and fit new piston.

¹Cold 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.

²When 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	1. Loose or Corroded Battery Cables	Check connections at batteries, engine block and starter solenoid.
	2. Discharged Batteries	Check generator output and generator belt adjustment.
	3. Starter Inoperative	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 — 100 RPM COLD, 240 RPM HOT)	1. Battery Cable Connections Loose or Corroded	Check connections at batteries, engine block and starter.
	2. Batteries Undercharged	Check charging system.
	3. Wrong Engine Oil	Drain and refill with oil of recommended viscosity.
Engine Cranks Normally — Will Not Start	1. Incorrect Starting Procedure	Use recommended starting procedure.
	2. Glow Plugs Inoperative	Refer to ELECTRICAL DIAGNOSIS.
	3. Glow Plug Control System Inoperative	Refer to ELECTRICAL DIAGNOSIS.
	4. No Fuel Into Cylinders	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 5. 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. 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 11.
	5. No Fuel To Injection Pump	Loosen the line coming out of the filter. Crank the engine, the fuel should spray out of the fitting, use care to direct fuel away from sources of ignition. If fuel sprays from the fitting go to step 10.
	6. Restricted Fuel Filter	Loosen the line going to the filter, if fuel sprays from the fitting, the filter is plugged and should be replaced. Use care to direct the fuel away from sources of ignition.
	7. Fuel Pump Inoperative	Remove inlet hose to fuel pump. Connect a hose to the pump from a separate container that contains fuel. Loosen the line going to the filter. If fuel does not spray from the fitting, replace the pump. Use care to direct the fuel away from source of ignition.
	8. Restricted Fuel Tank Filter	Remove fuel tank and check filter. (Filter for diesel fuel is blue).

Engine Cranks Normally – Will Not Start (Contd)	9. Plugged Fuel Return System	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.
	10. No Voltage To Fuel Solenoid	Connect a volt meter 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.
	11. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	12. Pump Timing Incorrect	Make certain that pump timing mark is aligned with mark on front cover.
	13. Low Compression	Check compression to determine cause.
Engine Starts But Will Not Continue To Run At Idle	14. Injection Pump Malfunction	Remove injection pump for repair.
	1. Slow Idle Incorrectly Adjusted	Adjust idle screw to specification.
	2. Fast Idle Solenoid Inoperative	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.
	3. Restricted Fuel Return System	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 line. 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.
	4. Glow Plugs Turn Off Too Soon	Refer to ELECTRICAL DIAGNOSIS.
	5. Pump Timing Incorrect	Make certain that timing mark on injection pump is aligned with mark on front cover.
	6. Limited Fuel To Injection Pump	Test the engine fuel pump, check for plugged filters; check fuel lines. Replace or repair as necessary.
	7. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	8. Low Compression	Check compression to determine cause.
	9. Fuel Solenoid Closes In Run Position	Ignition switch out of adjustment. If OK, refer to ELECTRICAL DIAGNOSIS.
Engine Starts, Idles Rough, WITHOUT Abnormal Noise or Smoke	10. Injection Pump Malfunction	Remove injection pump for repair.
	1. Slow Idle Incorrectly Adjusted	Adjust slow idle screw to specification.
	2. Injection Line Leaks	Wipe off injection lines and connections. Run engine and check for leaks. Correct leaks.

Engine Cold Starts and Idles Rough WITH Excessive Noise and/or Smoke But Clears Up After Warmup	3. Restricted Fuel Return System	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.
	4. Air In System	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.
	5. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	6. Nozzle(s) Malfunction	Remove and replace.
Engine Misfires Above Idle But Idles Correctly	1. Injection Pump Timing Incorrect	Be sure timing mark on injection pump is aligned with mark on front cover.
	2. Insufficient Engine Break-in Time	Break-in engine 2000 or more miles.
	3. Air in System	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.
	4. Nozzle(S) Malfunction	Remove and replace.
Engine Will Not Return To Idle	1. Plugged Fuel Filters	Replace filters.
	2. Incorrect Injection Pump Timing	Be sure that timing mark on injection pump and front cover are aligned.
	3. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
Fuel Leaks On Ground — No Engine Malfunction	1. External Linkage Binding Or Misadjusted	Free up linkage. Adjust or replace as required.
	2. Fast Idle Malfunction	Check fast idle adjustment.
	3. Internal Injection Pump Malfunction	Remove injection pump for repair.
Noticeable Loss Of Power	1. Loose or Broken Fuel Line or Connection	Examine complete fuel system, including tank, and injection lines. Determine source and cause of leak and repair.
	2. Injection Pump Internal Seal Leak	Remove injection pump for repair.
	3. Restricted Air Intake	Check air cleaner element.
	4. EGR Malfunction	Refer to Section 6E.
	3. Restricted or Damaged Exhaust System	Check system and replace as necessary.
	4. Plugged Fuel Filter	Replace filter.

Noise – “Rap” From One or More Cylinders (Sounds Like Rod Bearing Knock)	5. Plugged Fuel Tank Vacuum Vent In Fuel Cap	Remove fuel cap. If loud “hissing” noise is heard, vacuum vent in fuel cap is plugged. Replace cap. (Slight hissing sound is normal).
	6. Restricted Fuel Supply From Fuel Tank To Injection Pump	Examine fuel supply system to determine cause of restriction. Repair as required.
	7. Restricted Fuel Tank Filter	Remove fuel tank and check filter. (Filter for diesel fuel is blue).
	8. Pinched or Otherwise Restricted Return System	Examine system for restriction and correct as required.
	9. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	10. External Compression Leaks	Check for compression leaks at all nozzles and glow plugs, using “Leak-Tec” or equivalent. If leak is found, tighten nozzle or glow plug.
	11. Plugged Nozzle(s)	Remove nozzles. Have them checked for plugging and repair or replace.
	12. Low Compression	Check compression to determine cause.
	1. Nozzle(s) Sticking Open or with very low Nozzle Opening Pressure	Remove nozzle for test and replace as necessary.
	2. Mechanical Problem	Refer to Mechanical Diagnosis Section 6
	1. Timing Not Set To Specification	Make certain that timing mark on injection pump is aligned with mark on front cover.
	2. EGR Malfunction	Refer to Emission Diagnosis. (Section 6E)
Excessive Black Smoke and/or Objectionable Overall Combustion Noise	3. Injection Pump Internal Problem	Remove injection pump for repair.
	1. Engine Fuel Pump, Generator, Water Pump, Valve Train, Vacuum Pump, Bearings, Etc.	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 Noise – Internal Or External	1. Coolant System Leak, Oil Cooler System Leak or Coolant Recovery System Not Operating	Check for leaks and correct as required. Check coolant recovery jar, hose and radiator cap.
	2. Belt Slipping or Damaged	Replace or adjust as required.
	3. Thermostat Stuck Closed	Check and replace if required.
	4. Head Gasket Leaking	Check and repair as required.
Engine Overheats		

Oil Warning Lamp
"ON" at Idle

1. Oil Cooler or Oil or
Cooler Line Restricted

Remove restriction in cooler or cooler line.

2. Oil Pump Pressure Low

Engine Will Not Shut
Off With Key

1. Injection Pump Fuel
Solenoid Does Not
Return Fuel Valve To
"OFF" Position

Refer to ELECTRICAL DIAGNOSIS.

NOTE With engine at
idle, pinch the fuel
return line at the
flexible hose to
shut off engine.

VACUUM PUMP DIAGNOSIS

Excessive noise or clattering
noise.

1. Loose screws between pump
assy. and drive assy.

1. A — Tighten screws to spec.
B—Replace "O" ring.
C—Replace pump assy.

2. Loose tube on pump assy.

2. Replace pump assy.

Hooting noise.

Valves not functioning properly.

Replace pump assy.

Pump assy. loose on drive assy.

Stripped threads.

Replace pump assy.

Oil around end plug.

Loose plug.

1. Seat Plug.
2. Replace drive assy.

Oil leaking out crimp.

Bad crimp.

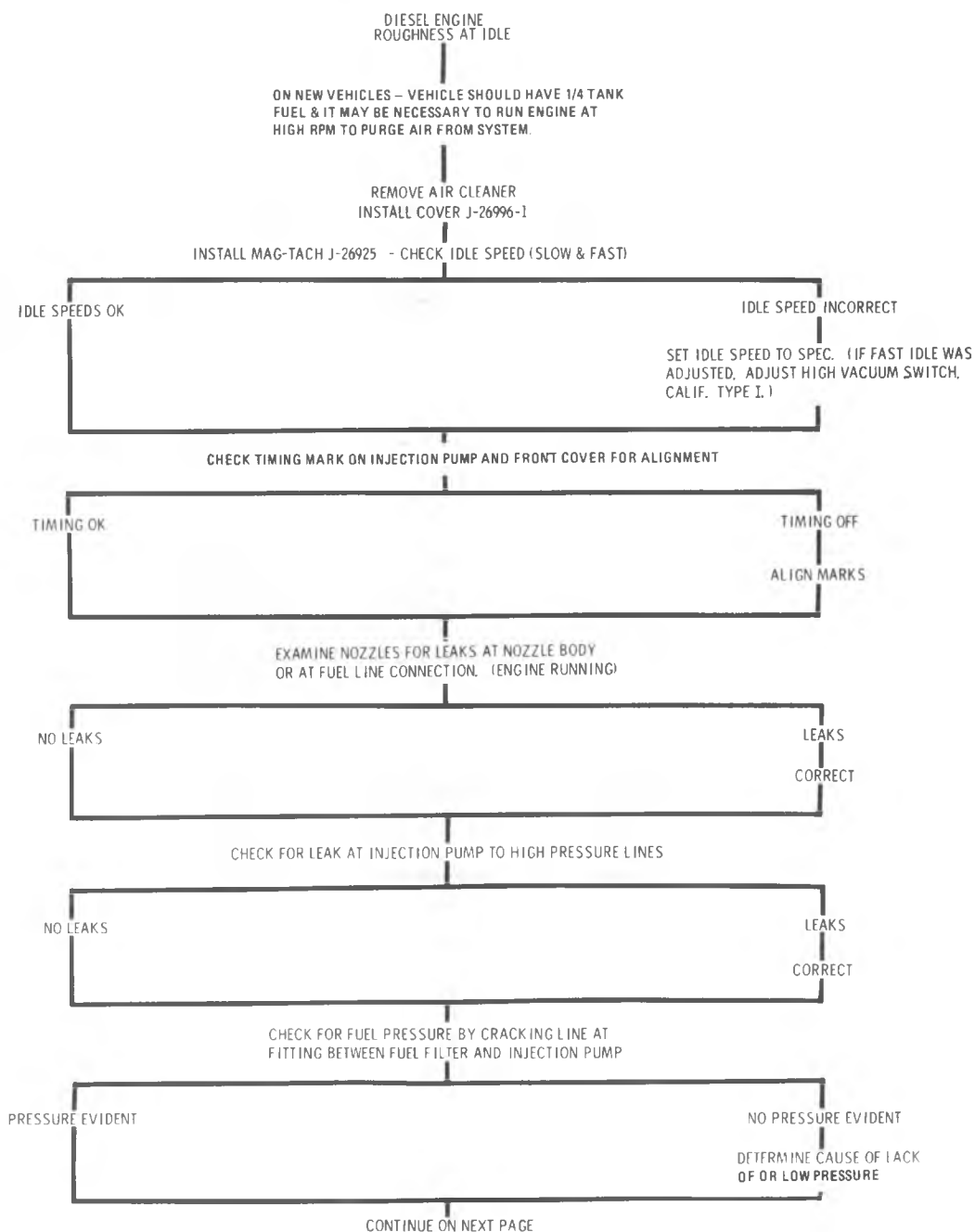
Replace pump assy.

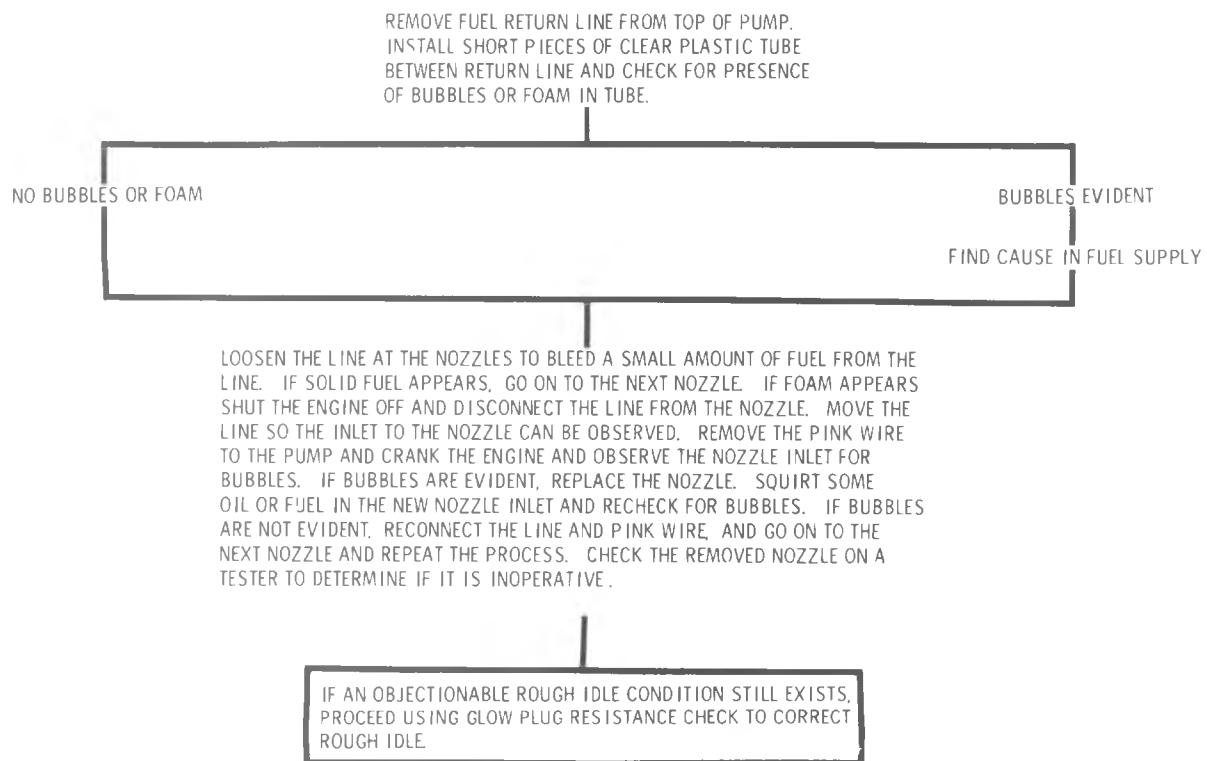
Install hose and vacuum gage
to pump, engine running, gage
should have reading of 20
inches vacuum minimum. With
engine off, vacuum level loss
should not drop from 20
inches to 19 inches in less than
1-1/2 seconds.

1. Defective valves.
2. Defective diaphragm.
3. Worn push rod seal.
4. Loose tube.

Replace pump assy.

DIESEL ENGINE IDLE ROUGHNESS DIAGNOSIS PROCEDURE





NOTES



Section 6A1

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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).

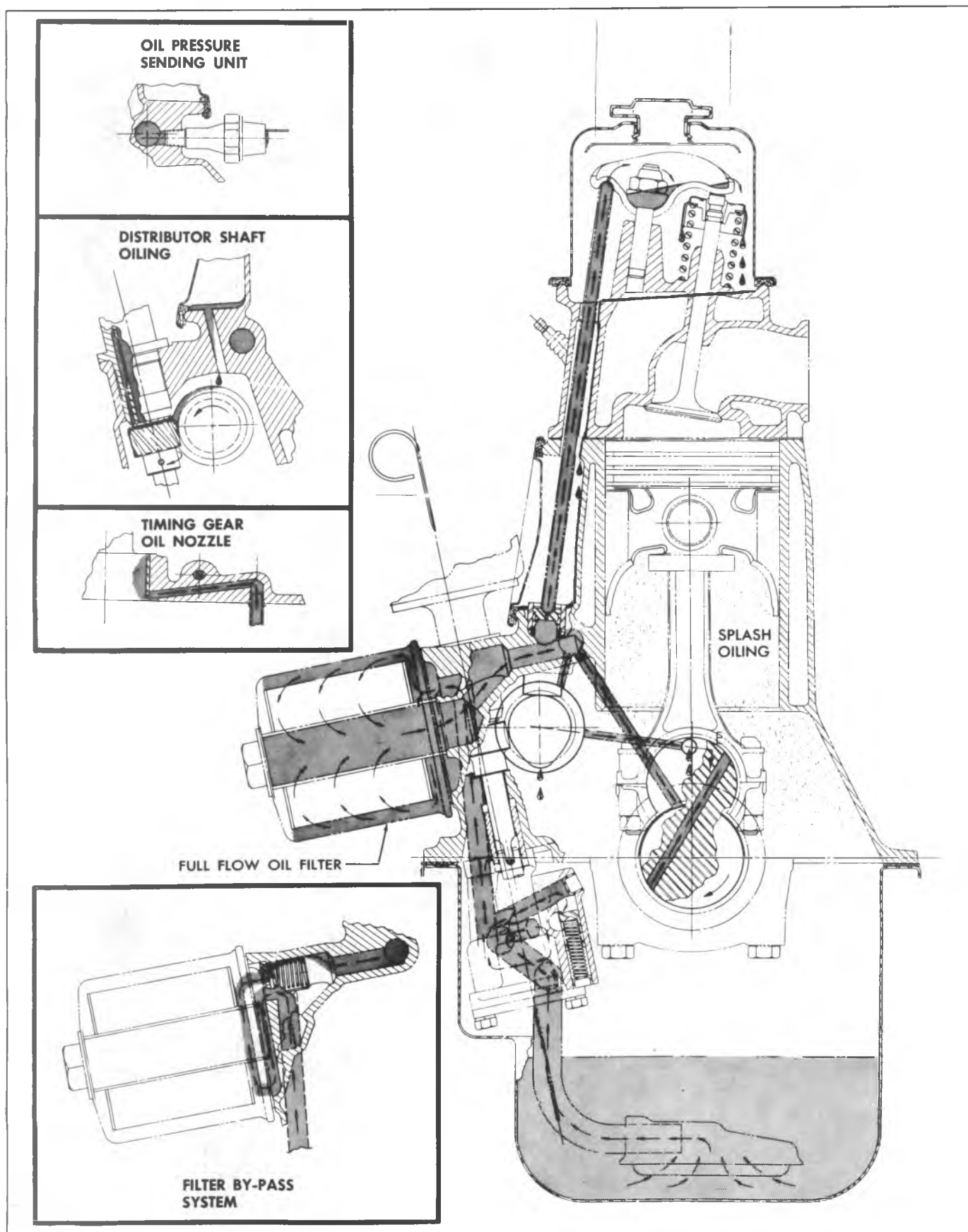


Fig. 6A1-1--In-Line Engine Lubrication

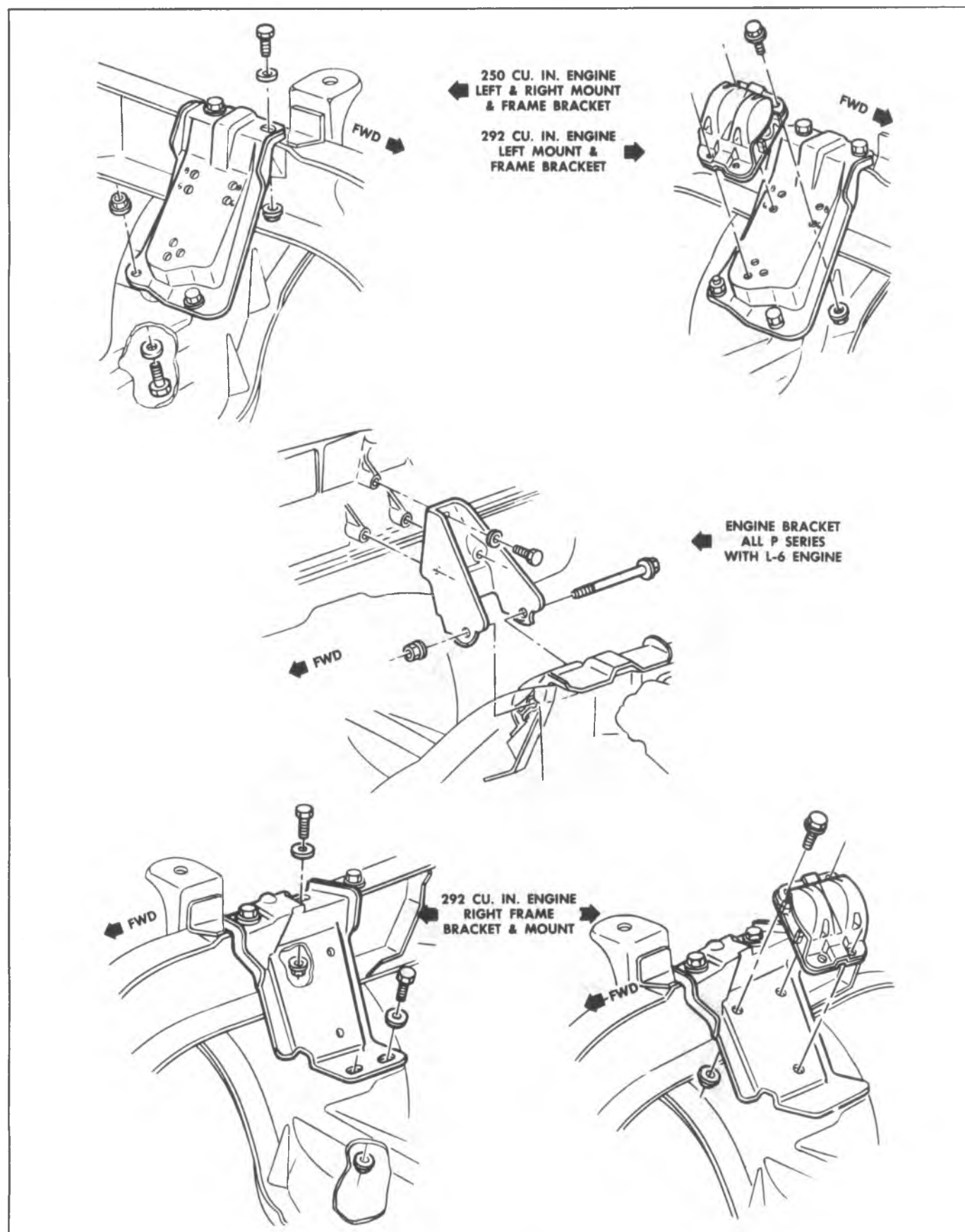


Fig. 6A1-2--"P" Series - Engine Front Mount

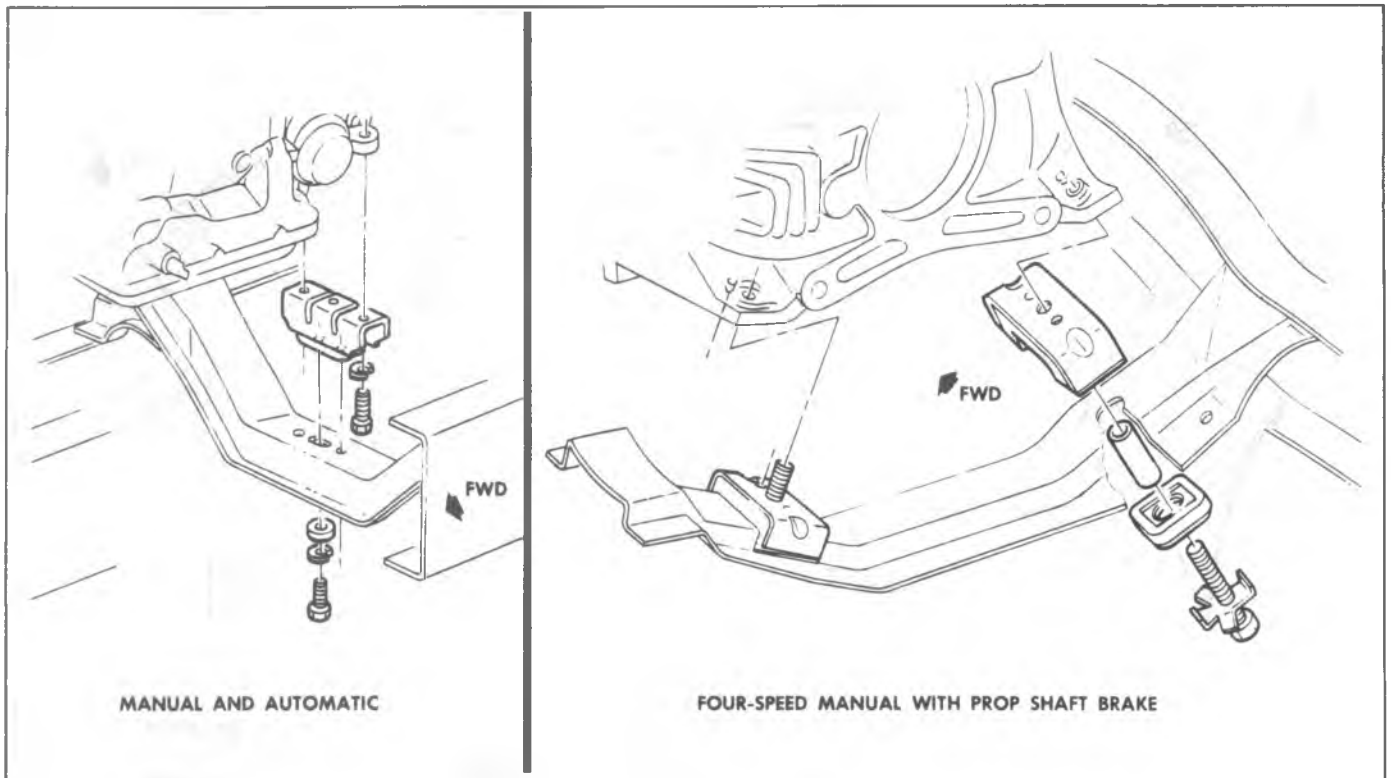


Fig. 6A1-3--"P" Series - Engine Rear Mount

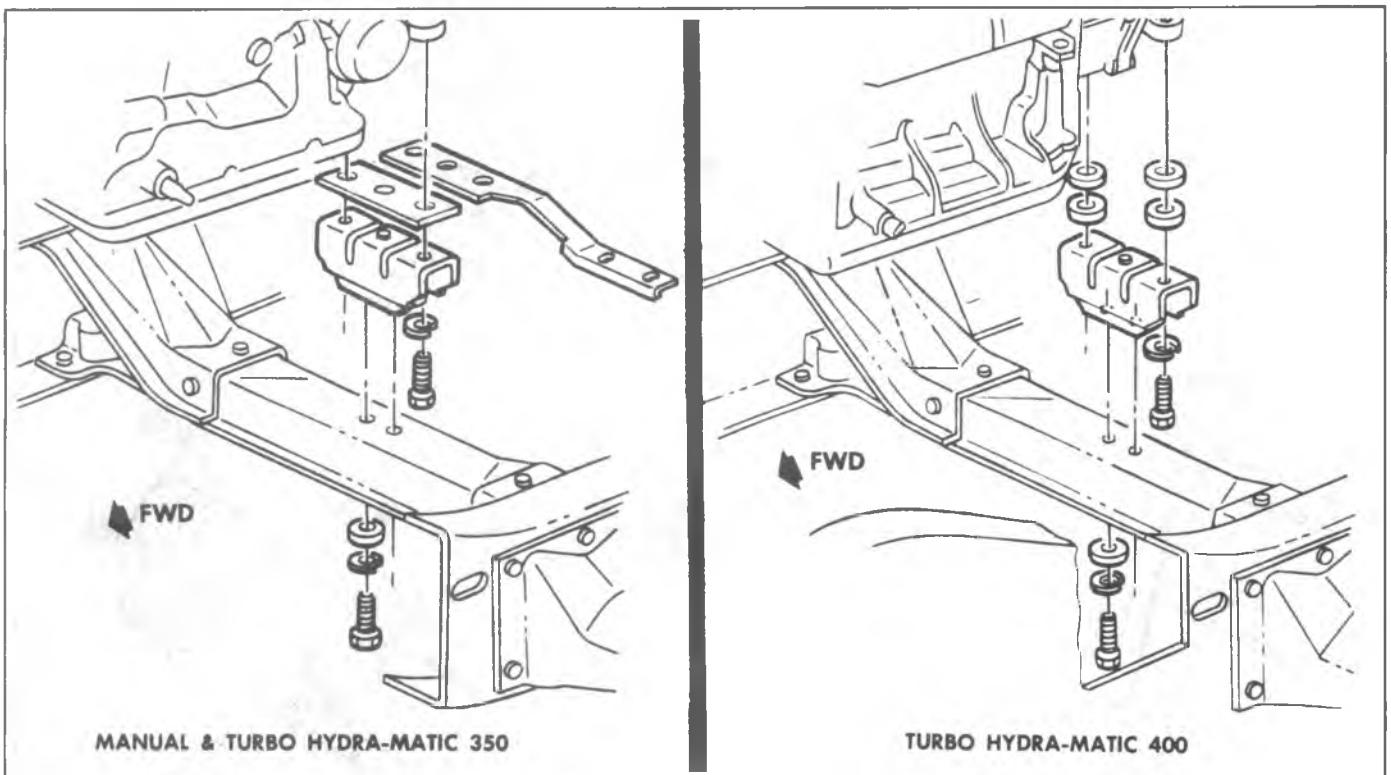


Fig. 6A1-4--"C" Series - Engine Rear Mounts

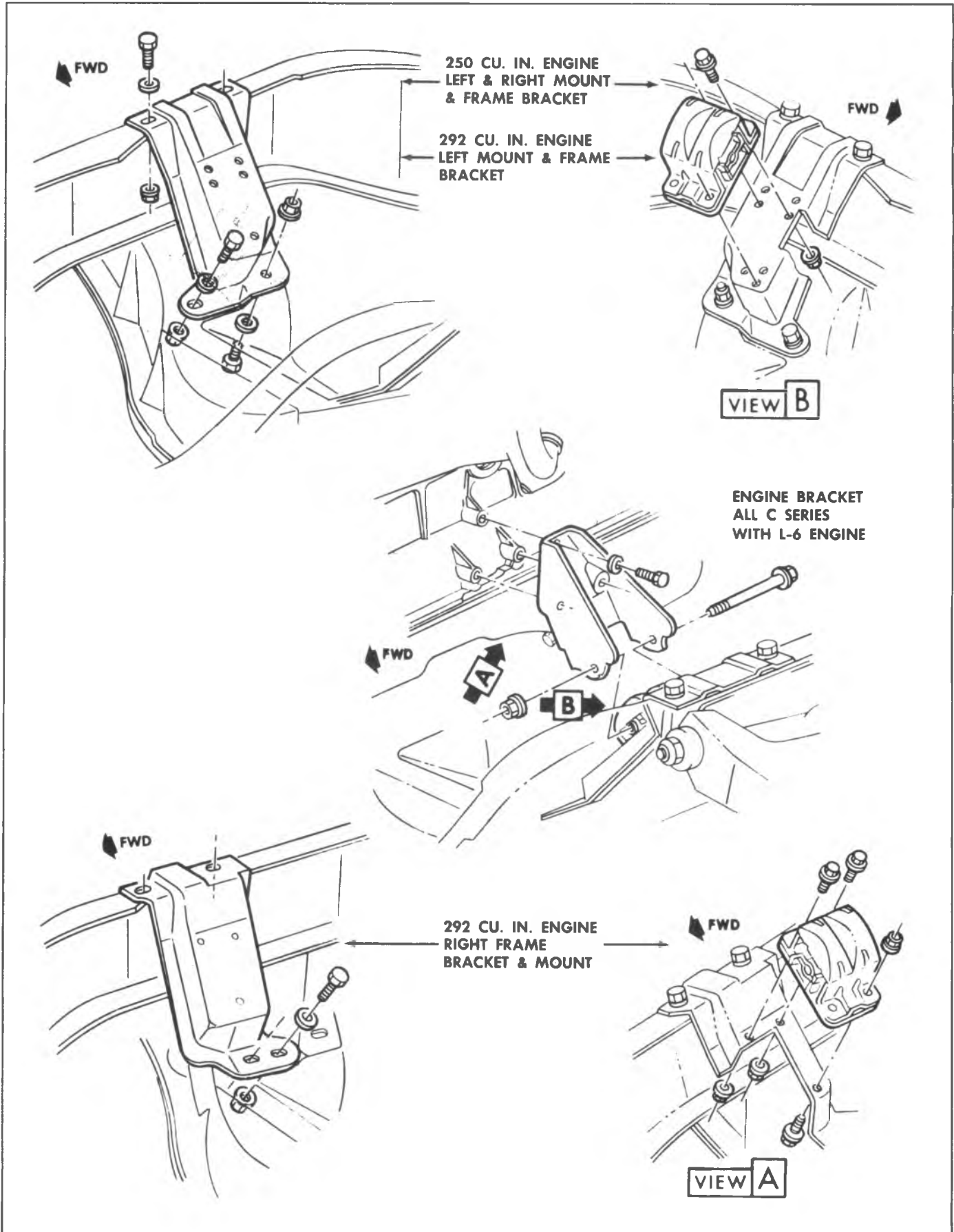
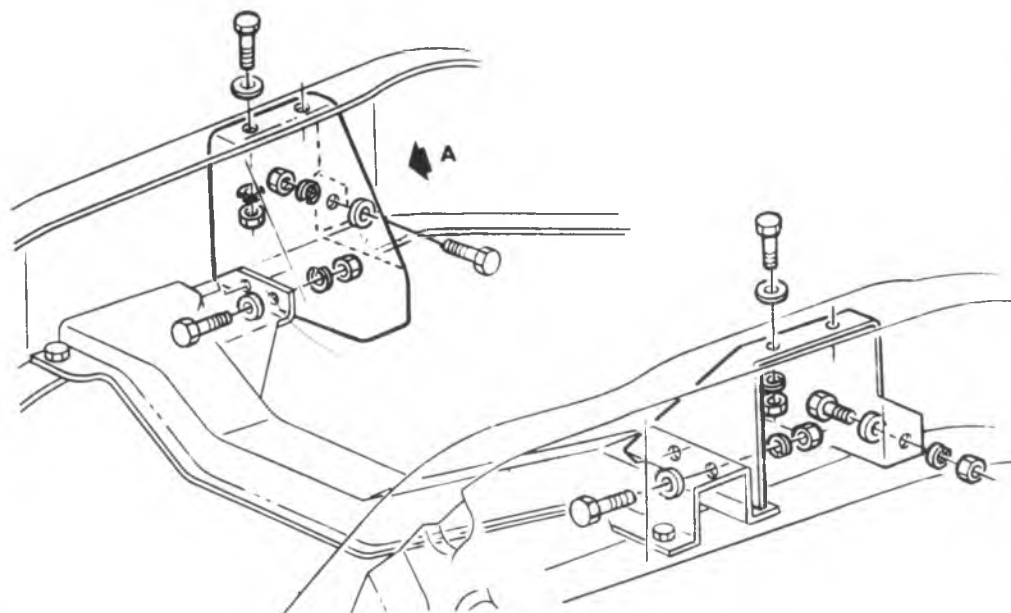
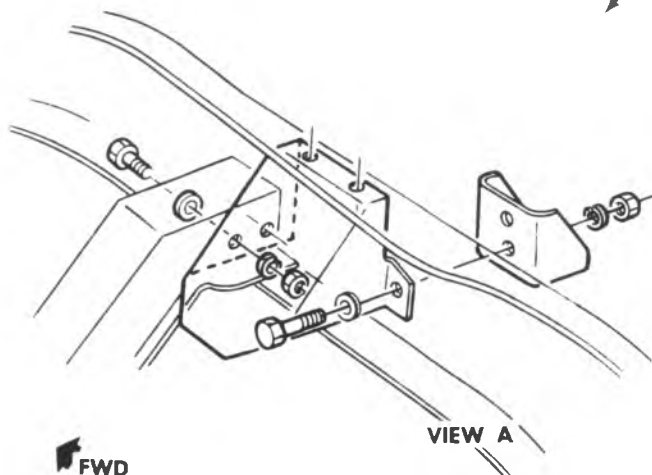


Fig. 6A1-5--"C" Series - Engine Front Mount

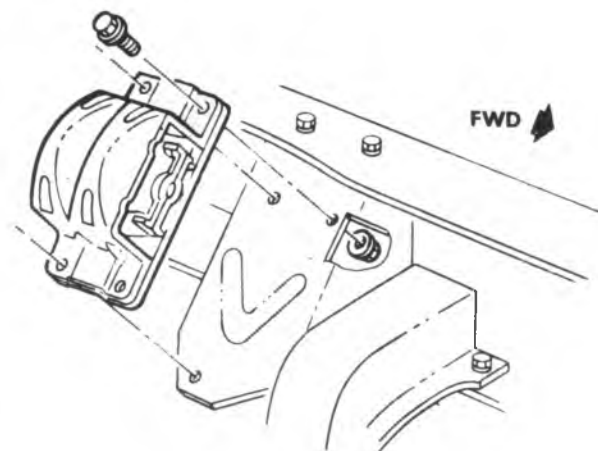
Fig. 6A1-6--"K" Series - Engine Front Mount



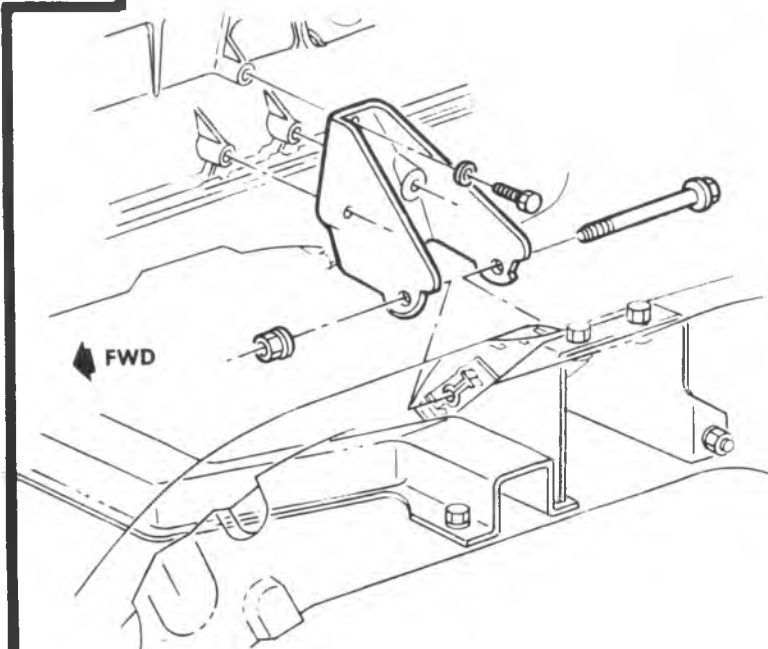
ENGINE MOUNT & BRACKET
ALL K SERIES WITH L-6 ENGINE



292 CU. IN. R. SIDE



ENGINE MOUNT FRAME BRACKET
ALL K SERIES WITH L-6 ENGINE



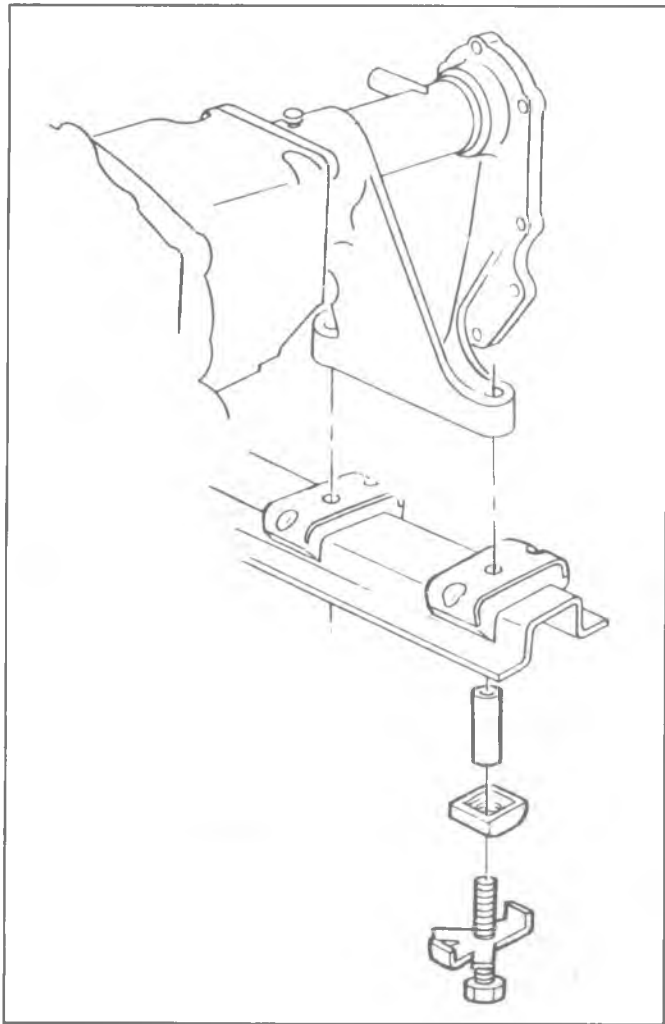


Fig. 6A1-7--"K" Series - Engine Rear Mount

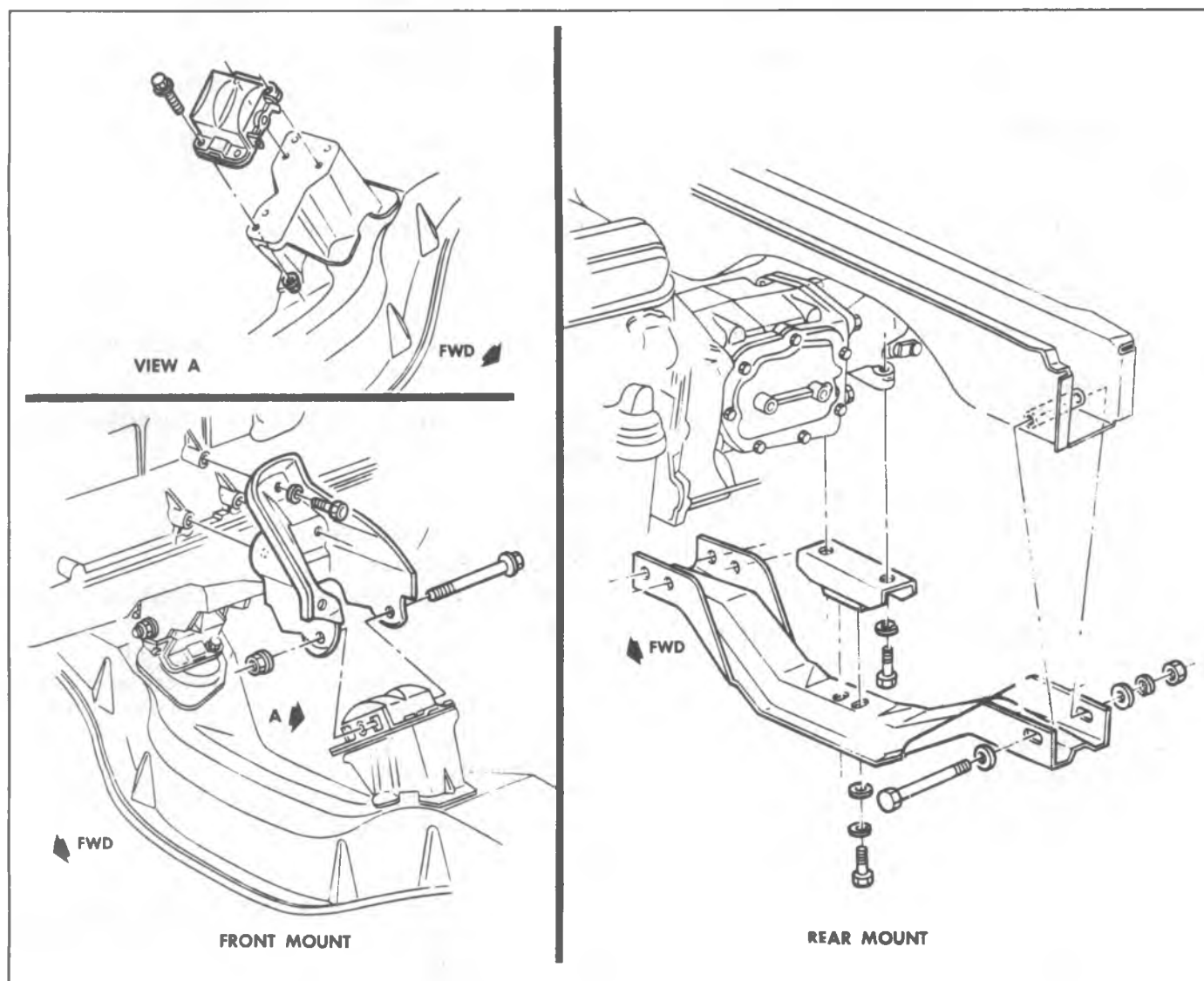


Fig. 6A1-8--"G" Series - Engine Mounts

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:

- Hard rubber surface covered with heat check cracks;
- Rubber separated from a metal plate of the mount;
- 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 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.

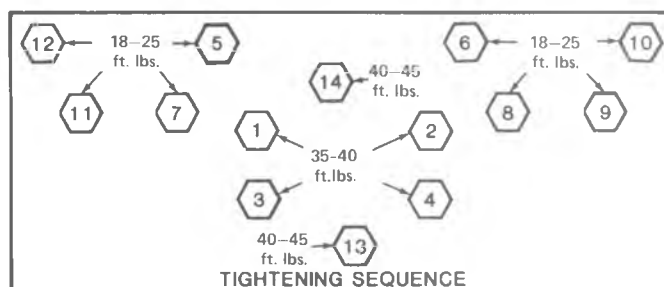


Fig. 6A1-9--Cylinder Head To Exhaust Manifold Tightening Sequence

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 distributor 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-Exhaust
- #5 cylinder-Intake
- #6 cylinder-Intake and Exhaust

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

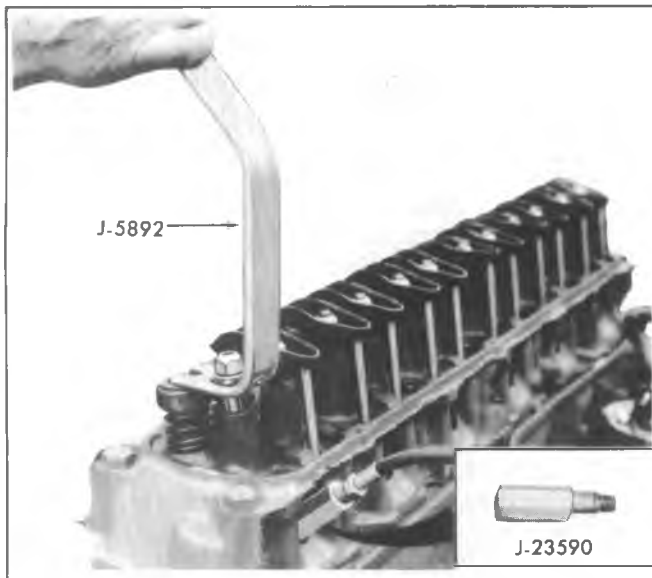


Fig. 6A1-11--Compressing Valve Spring

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).

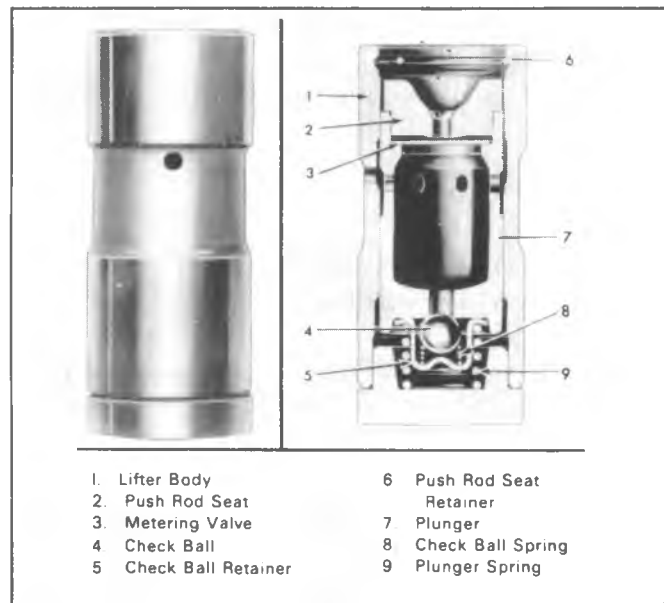


Fig. 6A1-12--Hydraulic Valve Lifter



Fig. 6A1-13--Removing Ball Check Valve

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. 6A1-14--Installing Ball Check Valve



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 previously 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 cylinder 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.

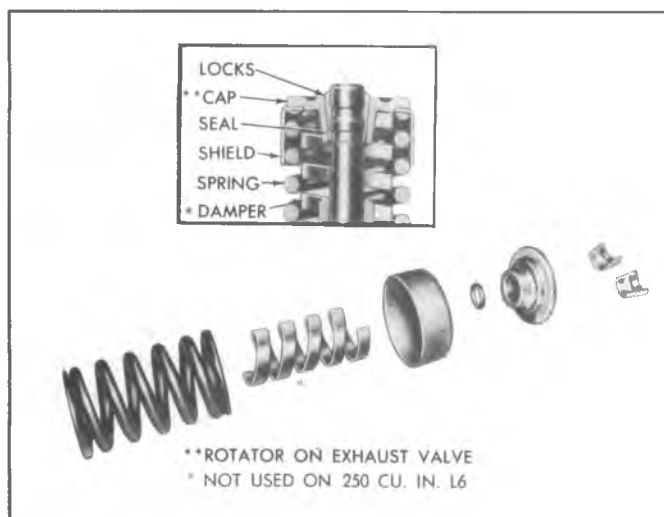


Fig. 6A1-17--Valve Spring Installation

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. (125 N·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:

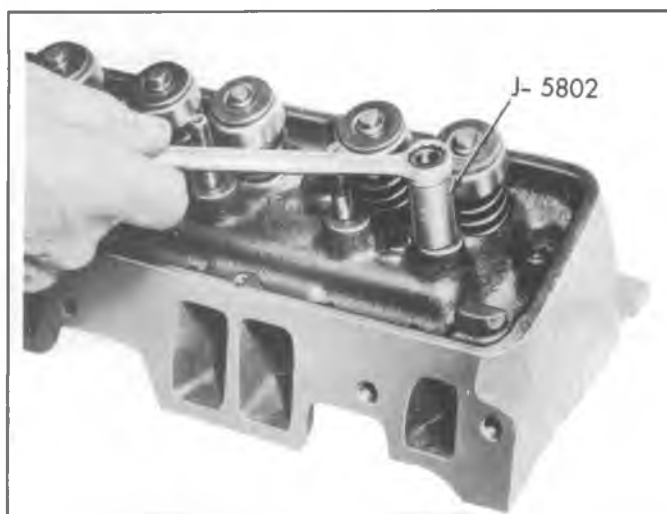


Fig. 6A1-18--Removing Rocker Arm Stud - Typical

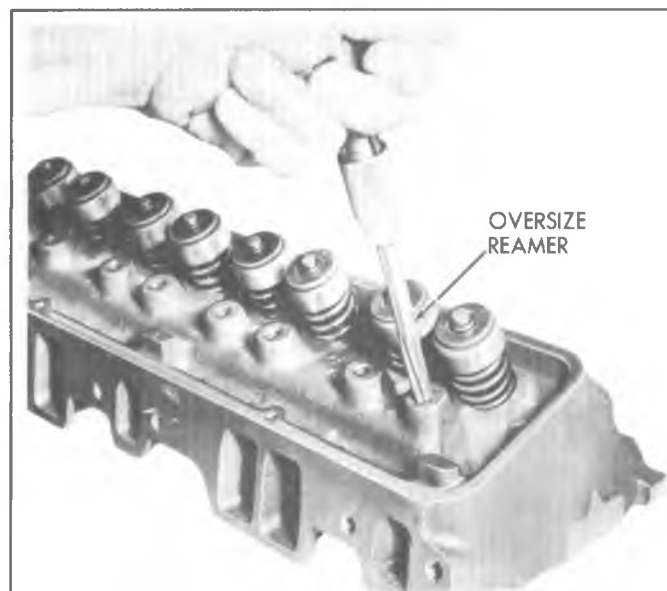


Fig. 6A1-19--Reaming Rocker Arm Stud Bore - Typical

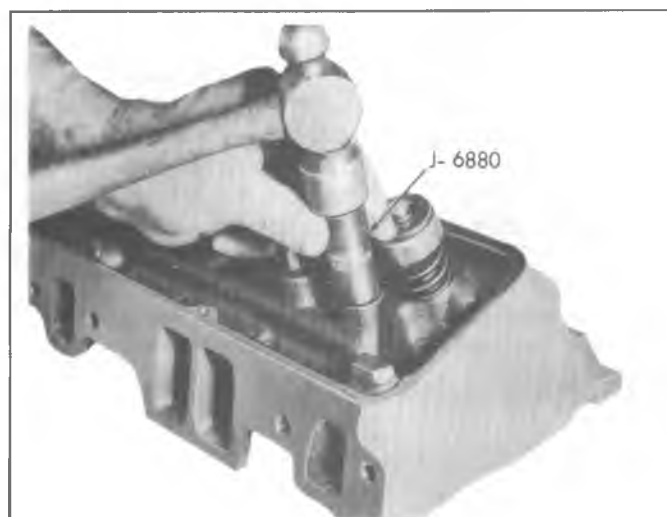


Fig. 6A1-20--Installing Rocker Arm Stud - Typical

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 valve 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).

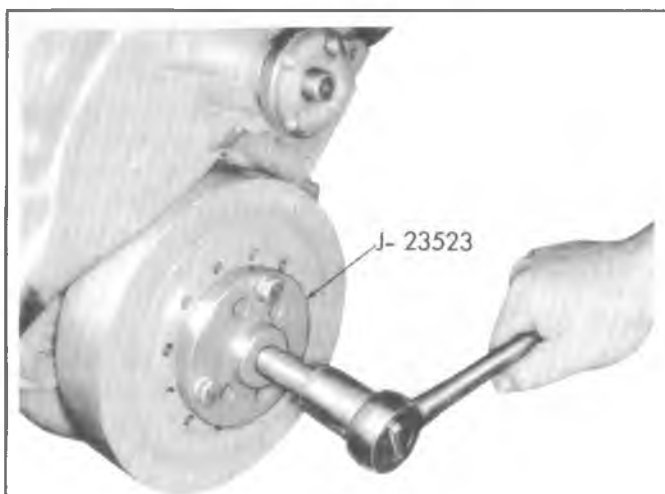


Fig. 6A1-21--Removing Torsional Damper

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).

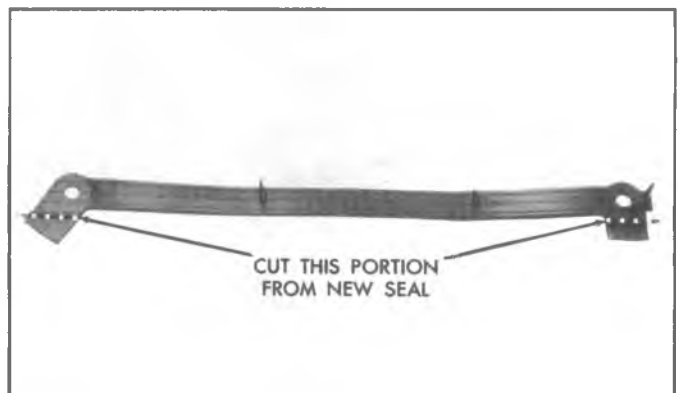


Fig. 6A1-22--Oil Pan Front Seal Modification - L25

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 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 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.

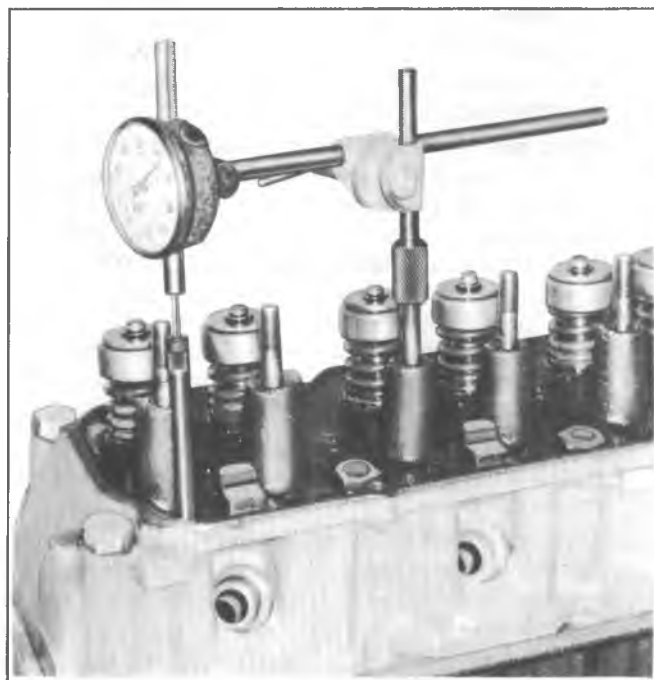


Fig. 6A1-23--Measuring Camshaft Lobe Lift

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.

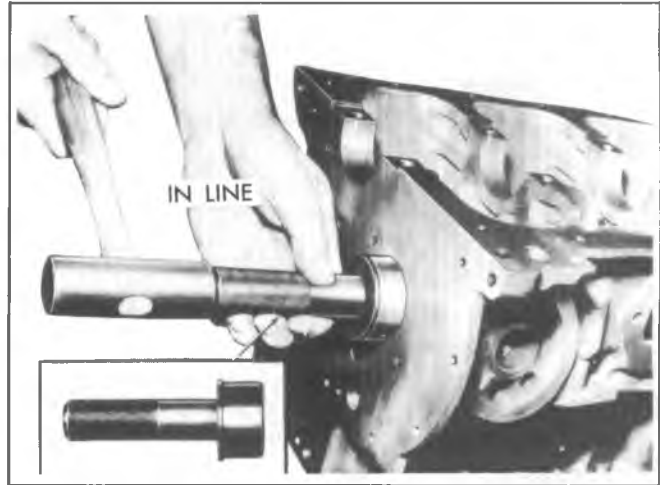


Fig. 6A1-25--Replacing Camshaft Front Bearing

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.

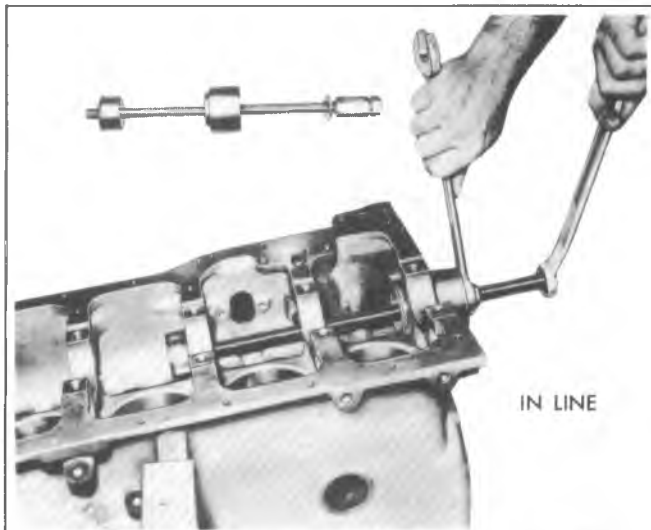


Fig. 6A1-24--Replacing Camshaft Intermediate Bearings

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.
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 bolts.
13. Remove oil pan and clean gasket surfaces.

Installation

1. Install new gasket on cleaned gasket surface.
2. Install oil pan and retaining bolts and torque to specifications.
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.

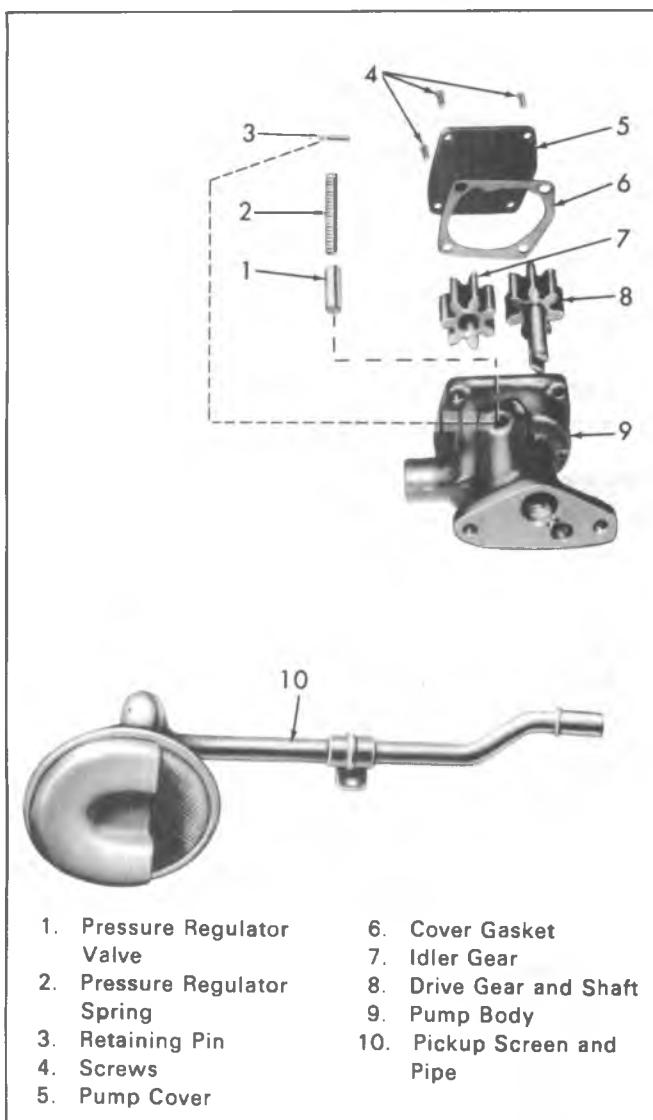


Fig. 6A1-26--Oil Pump

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 vise, 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" under-size for use with new and used standard size crankshafts, and in .010" and .020" under-size for use with reconditioned crankshafts.

On removing a connecting rod cap, it is possible to find a .009" under-size bearing. These are used in manufacturing for selective fitting.

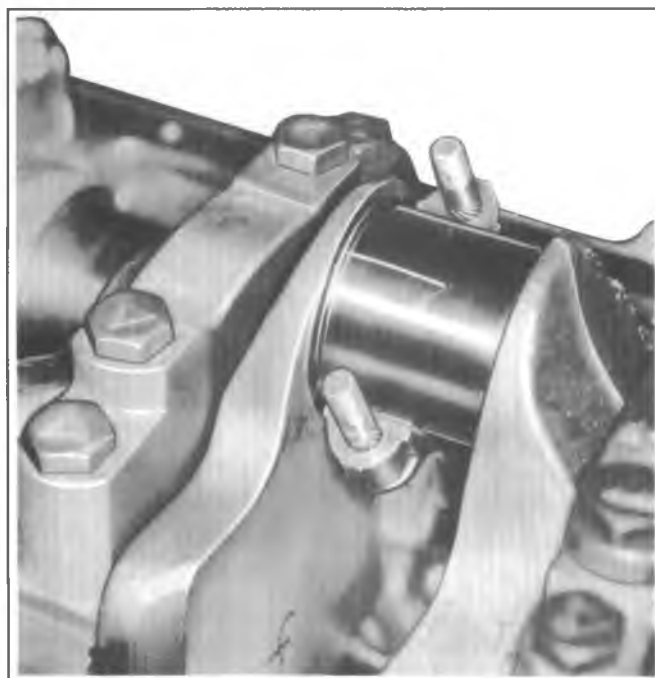


Fig. 6A1-27--Gaging Plastic on Crankpin



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 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.

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.**

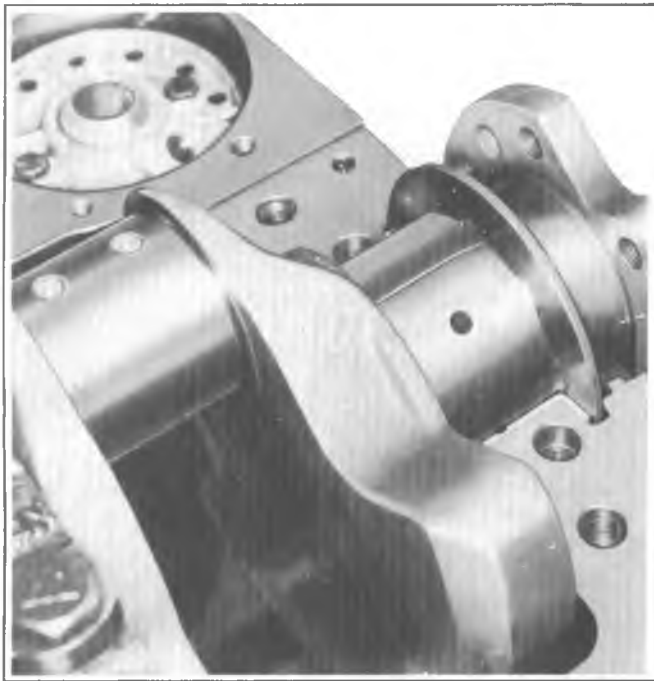


Fig. 6A1-30--Gaging Plastic on Journal - Typical

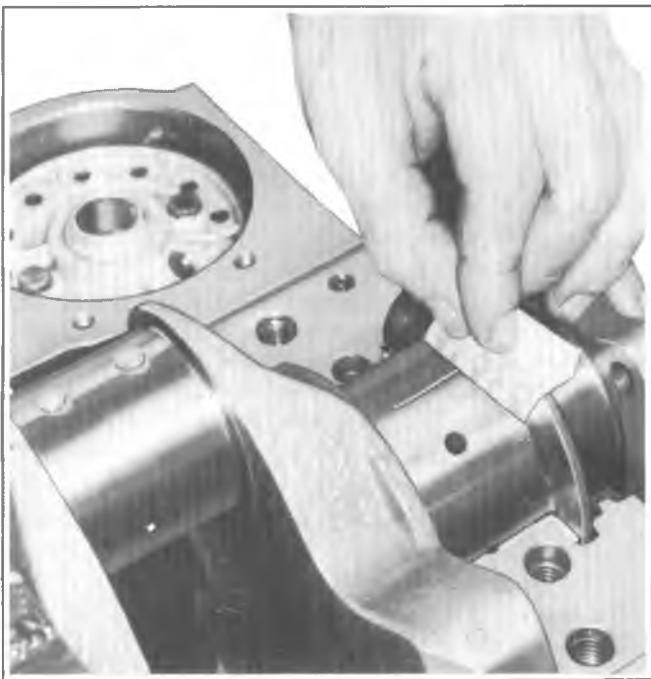


Fig. 6A1-31--Measuring Gaging Plastic - Typical

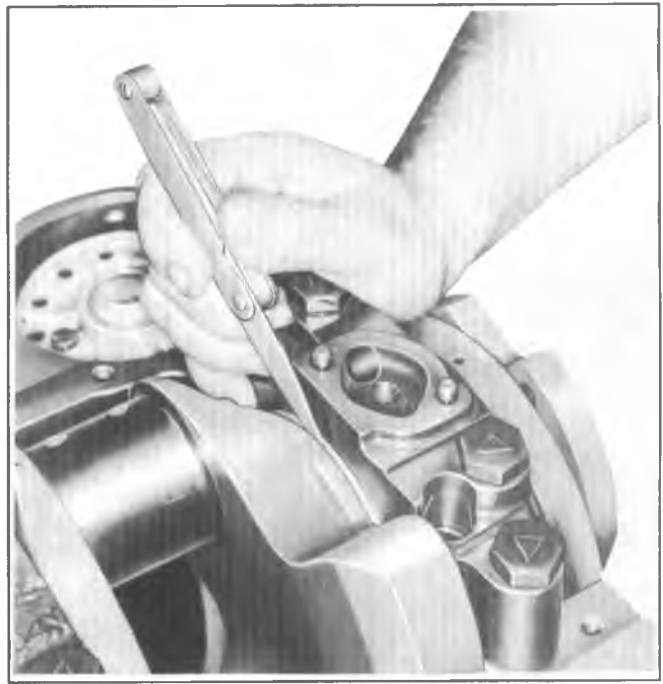


Fig. 6A1-32--Measuring Crankshaft End Play - Typical

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 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.
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.

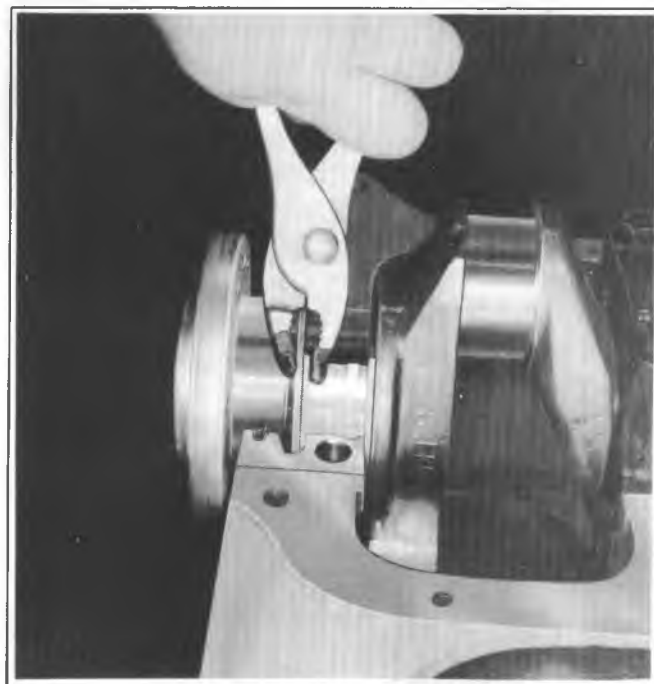


Fig. 6A1-33--Replacing Upper Main Bearing

- 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).

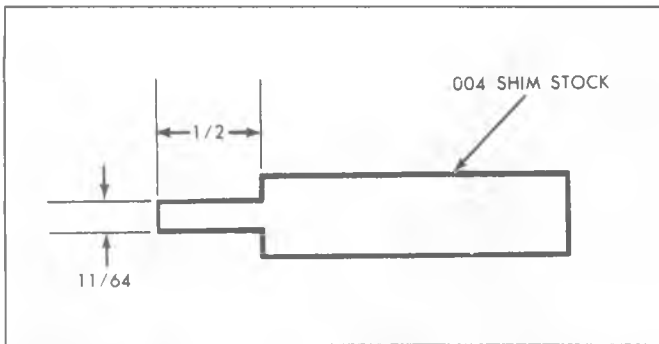


Fig. 6A1-34--Oil Seal Installation Tool

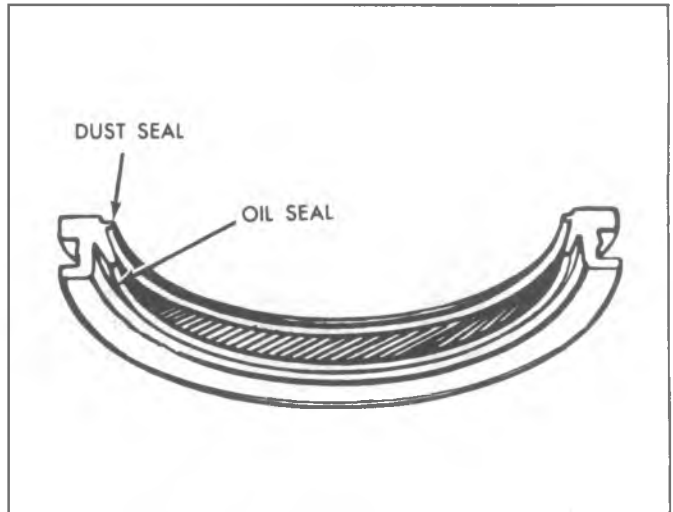


Fig. 6A1-37--Crankshaft Oil Seal - Rear Main



Fig. 6A1-35--Removing Oil Seal Lower Half - Typical

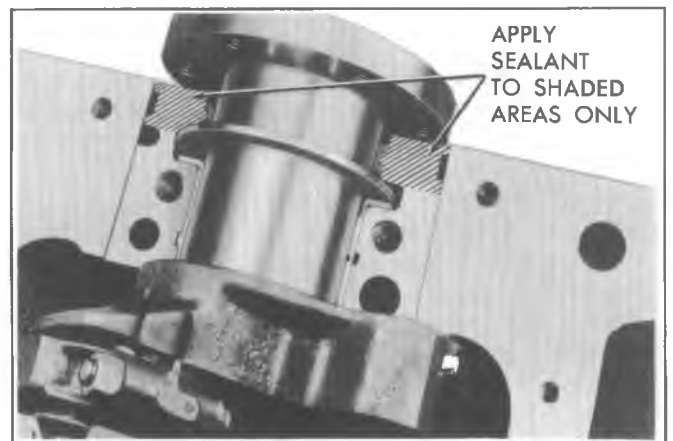


Fig. 6A1-38--Sealing Bearing Cap - Typical

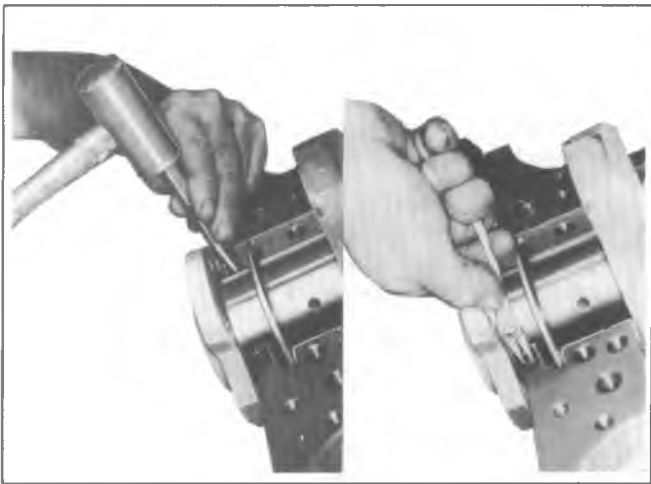


Fig. 6A1-36--Removing Oil Seal Upper Half - Typical

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:

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.

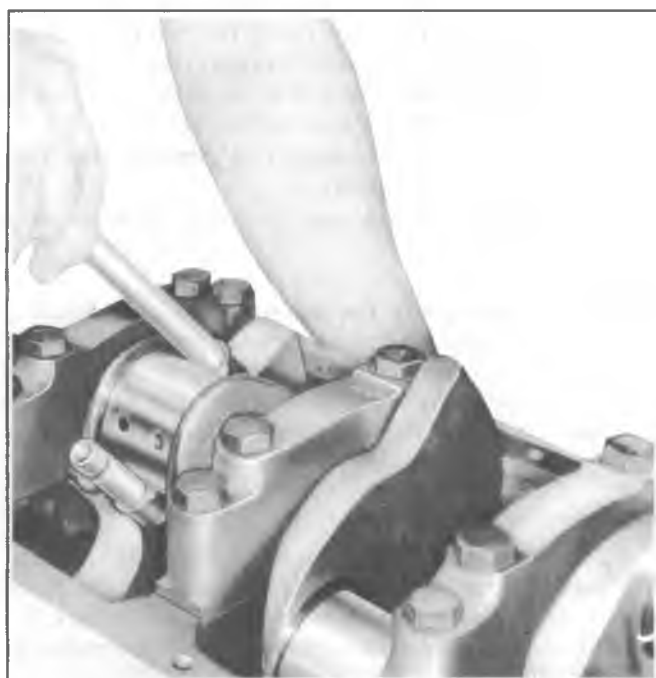


Fig. 6A1-39--Removing Connecting Rod & Piston Assembly

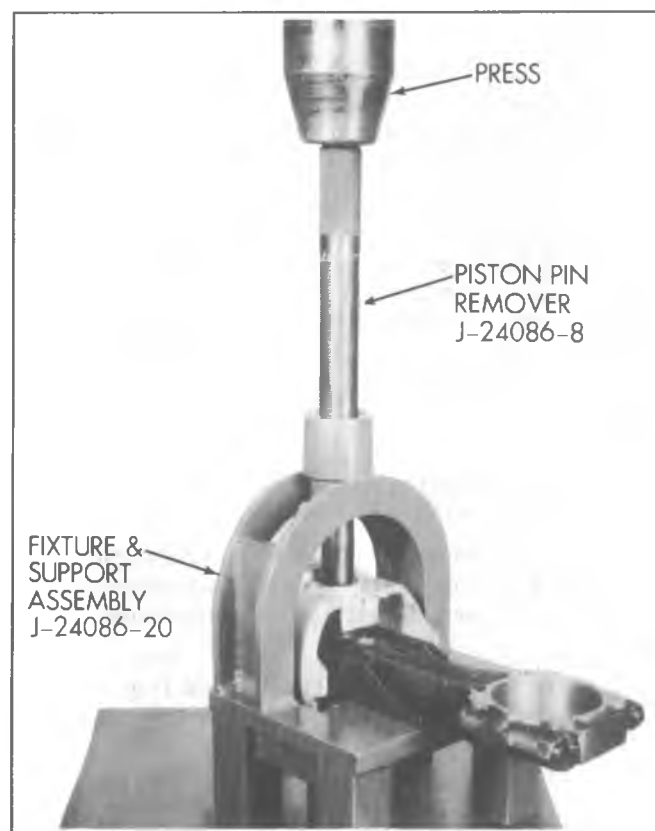


Fig. 6A1-40--Removing Piston Pin

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.

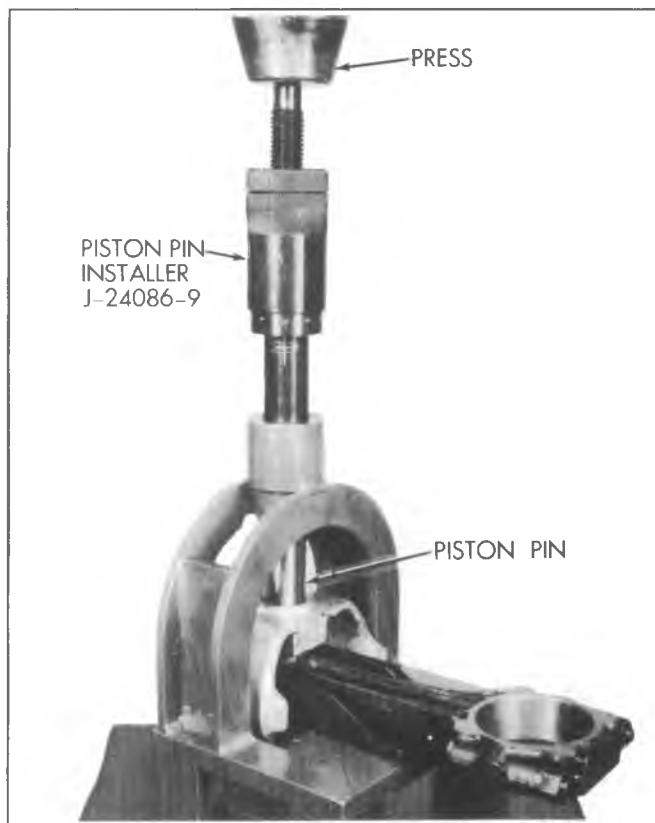


Fig. 6A1-41--Installing Piston Pin

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.

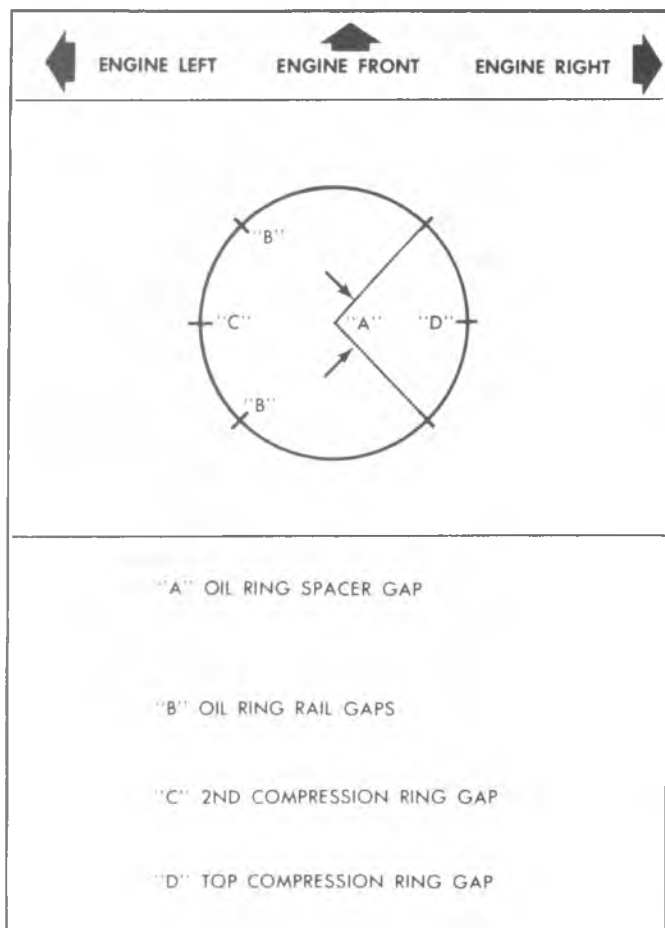


Fig. 6A1-42--Ring Gap Location



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.

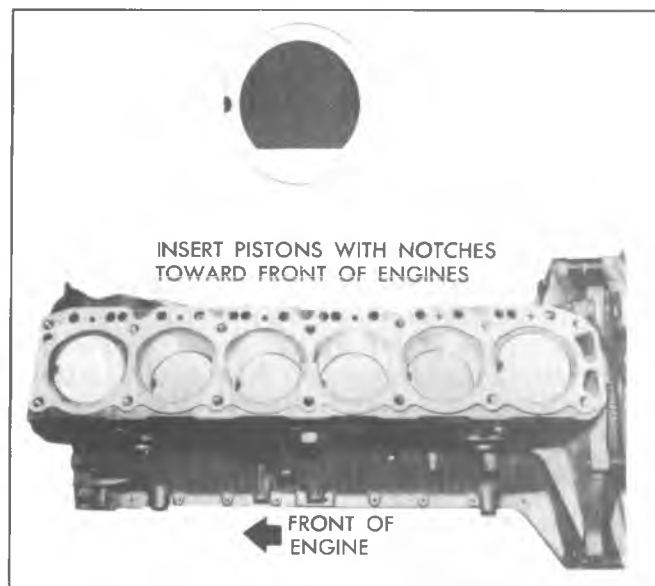


Fig. 6A1-44--Pistons-Installed Position



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 than .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 crankshaft 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

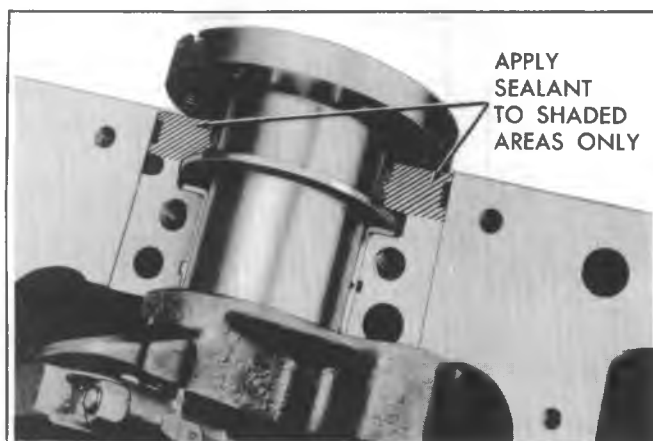


Fig. 6A1-46--Sealing Bearing Cap

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).

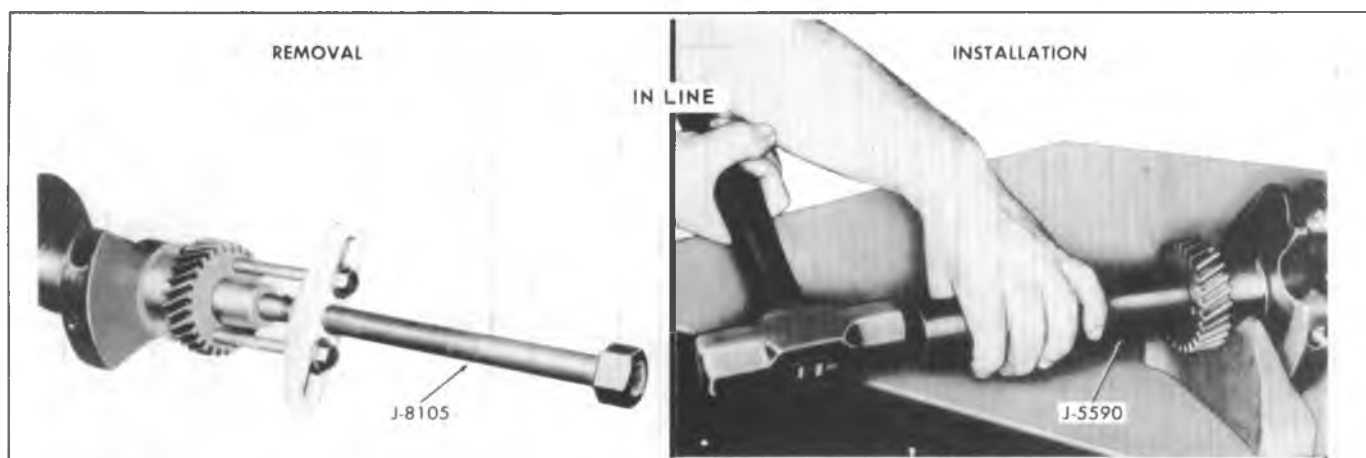


Fig. 6A1-47--Gear Replacement

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.	
	SERVICE	.002 MAX.	
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.
		RELIEF SIDE	.0005 MAX.
	SERVICE		.001 MAX.

PISTON:

CLEARANCE	PRODUCTION	.0010-.0020	.0026-.0036
	SERVICE	.0030 MAX.	.0045 MAX.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.0012-.0027	.0020-.0040
			2ND	.0012-.0032	.0020-.0040
		SERVICE		HI LIMIT + .001	
	GAP	PRODUCTION	TOP	.010-.020	
			2ND	.010-.020	
		SERVICE		HI LIMIT + .010	
OIL	GROOVE CLEARANCE	PRODUCTION		.005 MAX.	.005-.0055
		SERVICE		HI LIMIT + .001	
	GAP	PRODUCTION		.015-.055	
		SERVICE		HI LIMIT + .010	

* VIN Designation

PISTON PIN

LE3

L25

DIAMETER		.9270-.9273	
CLEARANCE	PRODUCTION	.00015-.00025	
	SERVICE	.001 MAX.	
FIT IN ROD		.0008-.0016 INTERFERENCE	

CRANKSHAFT

MAIN JOURNAL	DIAMETER		ALL 2.2979-2.2994	
	TAPER	PRODUCTION	.0002 MAX.	
		SERVICE	.001 MAX.	
	OUT OF ROUND	PRODUCTION	.0002 MAX.	
SERVICE		.001 MAX.		
MAIN BEARING CLEARANCE	PRODUCTION		#1-6 .0010-.0024 #7 .0016-.0035	
	SERVICE		#1-6 .0010-.0025	#7 .0015-.0035
CRANKSHAFT END PLAY			.002-.006	
CRANKPIN	DIAMETER		1.999-2.000	2.099-2.100
	TAPER	PRODUCTION	.0005	
		SERVICE	.001 MAX.	
	OUT OF ROUND	PRODUCTION	.0005	
SERVICE		.001 MAX.		
ROD BEARING CLEARANCE	PRODUCTION		.0010-.0026	
	SERVICE		.0030	
ROD SIDE CLEARANCE			.006-.017	

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2217		.2315
	EXHAUST	FED.	CALIF.	
			.2217	.2315
JOURNAL DIAMETER		1.8677-1.8697		
CAMSHAFT END PLAY		.003-.008		

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

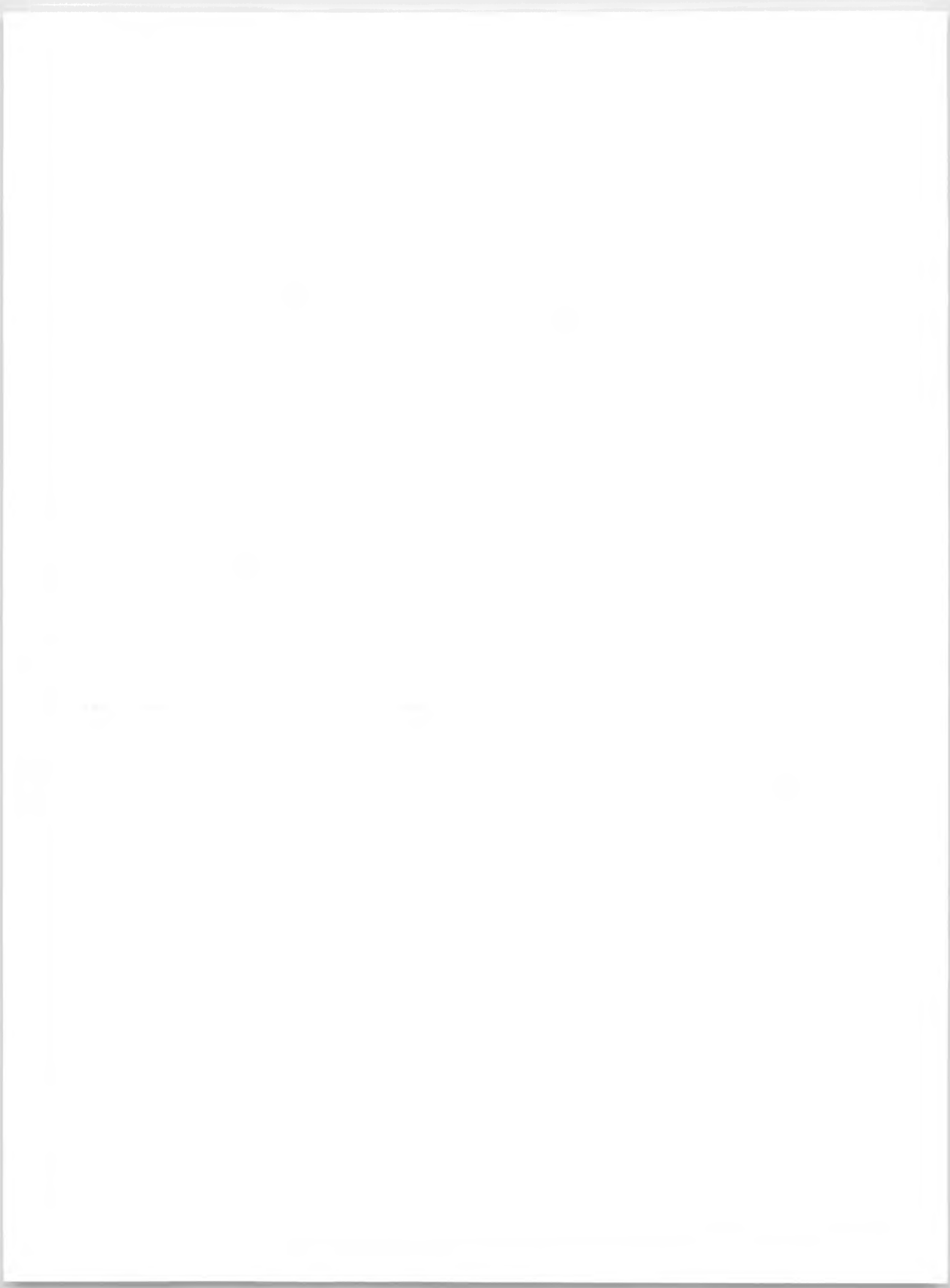
Camshaft Thrust Plate	.80 lb. in.
Crankshaft Front Cover	.80 lb. in.
Flywheel Housing Cover	.80 lb. in.
Oil Pan (To Crankcase) (1/4-20)	.80 lb. in.
Oil Pan (To Front Cover)	.50 lb. in.
Oil Pump Cover	.70 lb. in.
Rocker Arm Cover	.45 lb. in.
Connecting Rod Cap	.35 lb. ft.*
Clutch Pressure Plate	.20 lb. 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. ¹
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 6A4

5.0L (G) V-8 - RPO LG9

5.0L (F) V-8 - RPO LF3

5.0L (H) V-8 - RPO LE9

5.7L (L) V-8 - RPO LS9

5.7L (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

gallerys 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 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. 6A4-1 and 6A4-2).

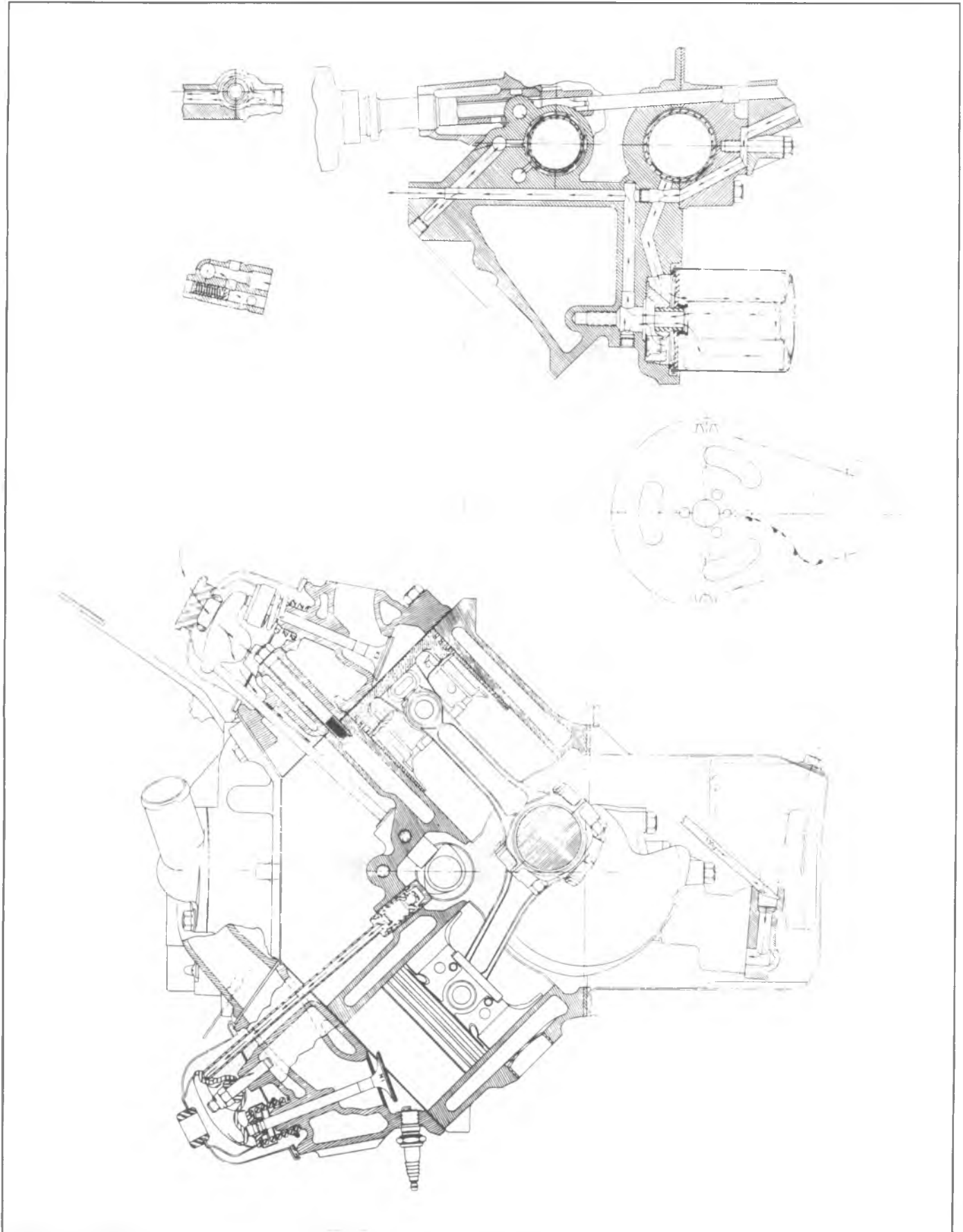


Fig. 6A4-1--Engine Lubrication

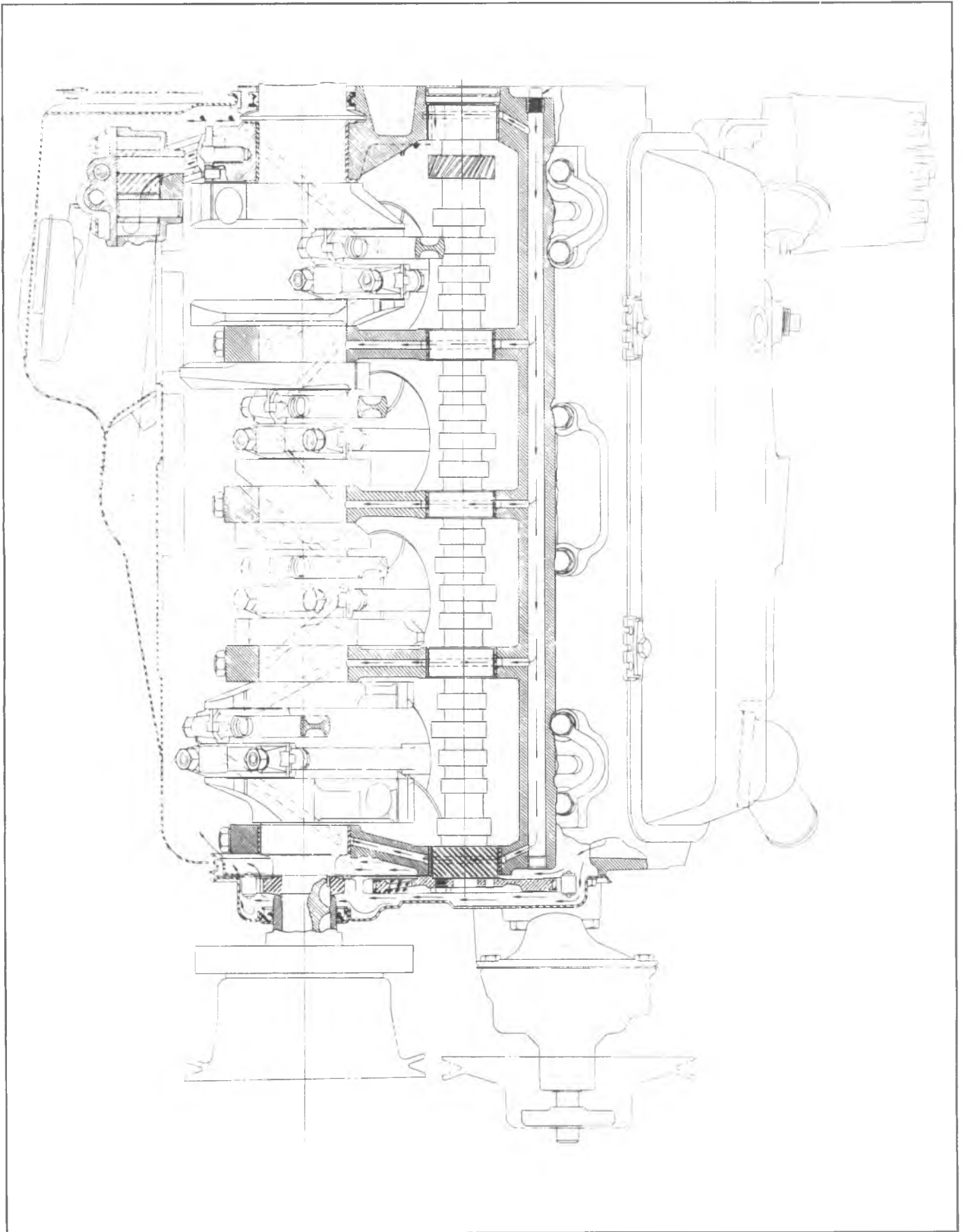


Fig. 6A4-2--Engine Lubrication

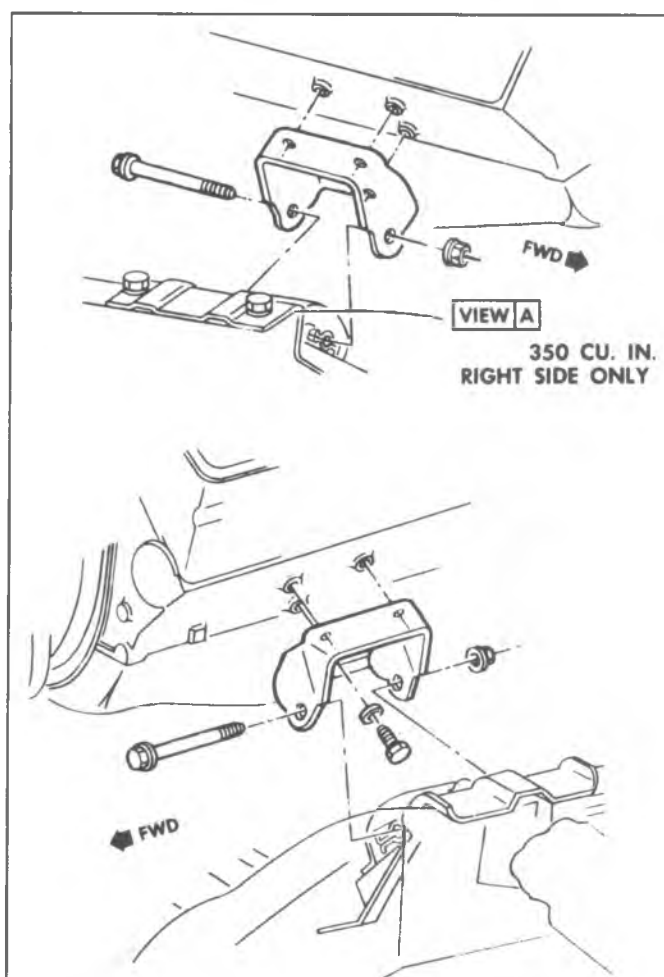
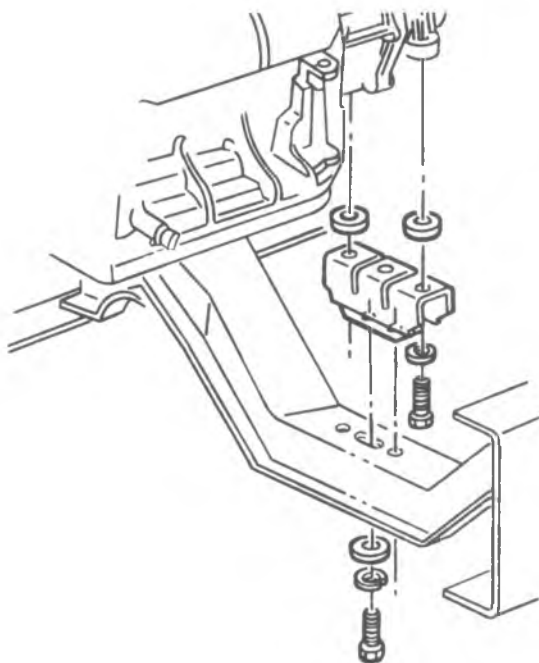
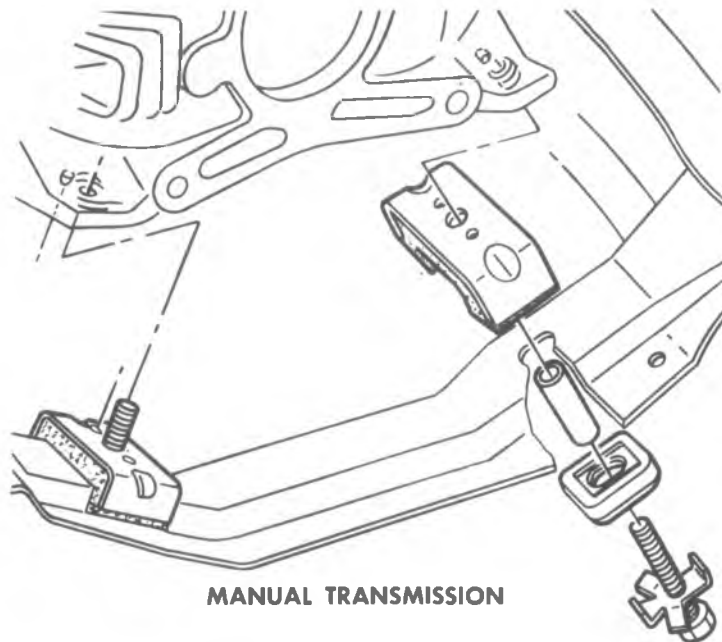


Fig. 6A4-3--"P" Series Engine Mount Bracket



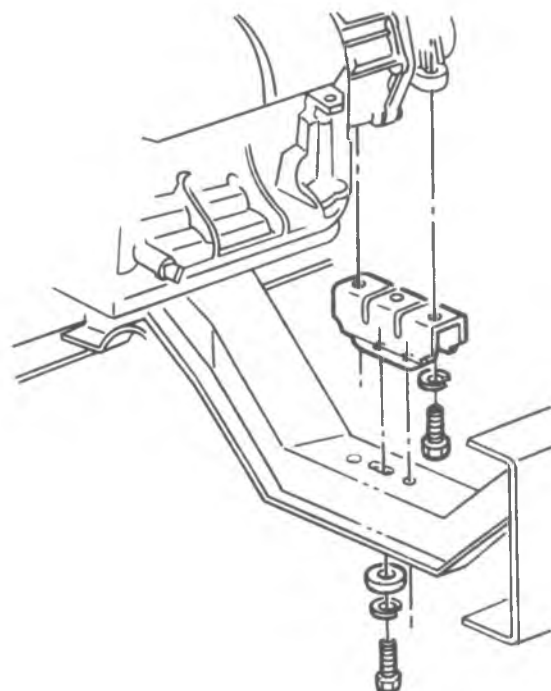
ALL TURBO HYDRA-MATIC 400
(EXCEPT MOBILE HOME CHASSIS)

WITHOUT PROPELLER SHAFT PARKING BRAKE



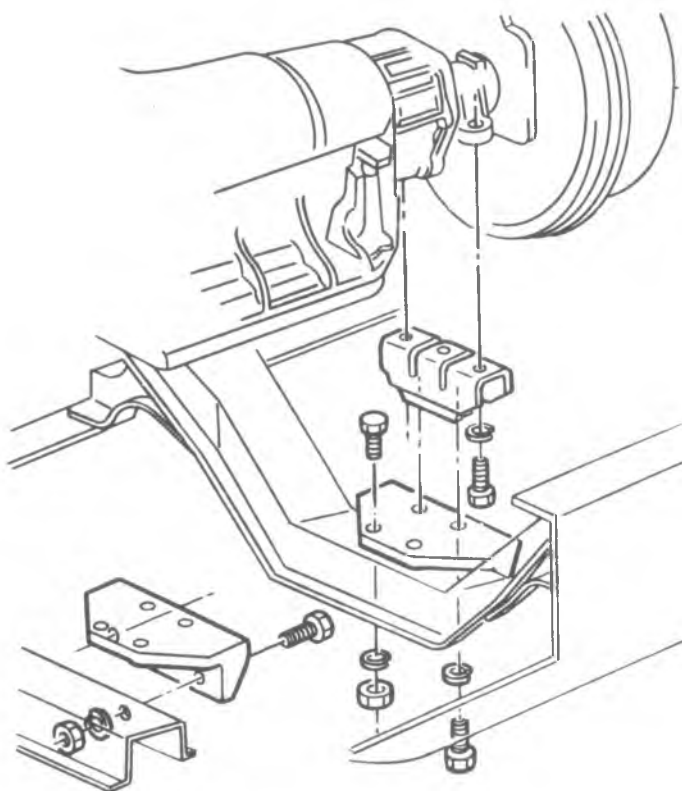
MANUAL TRANSMISSION

WITH PROPELLER SHAFT PARKING BRAKE



ALL MANUAL TRANSMISSION
ALL TURBO HYDRA-MATIC 350
ALL MOBILE HOME CHASSIS

WITHOUT PROPELLER SHAFT PARKING BRAKE



AUTOMATIC TRANSMISSION

WITH PROPELLER SHAFT PARKING BRAKE

Fig. 6A4-4--"P" Series Engine Rear Mount

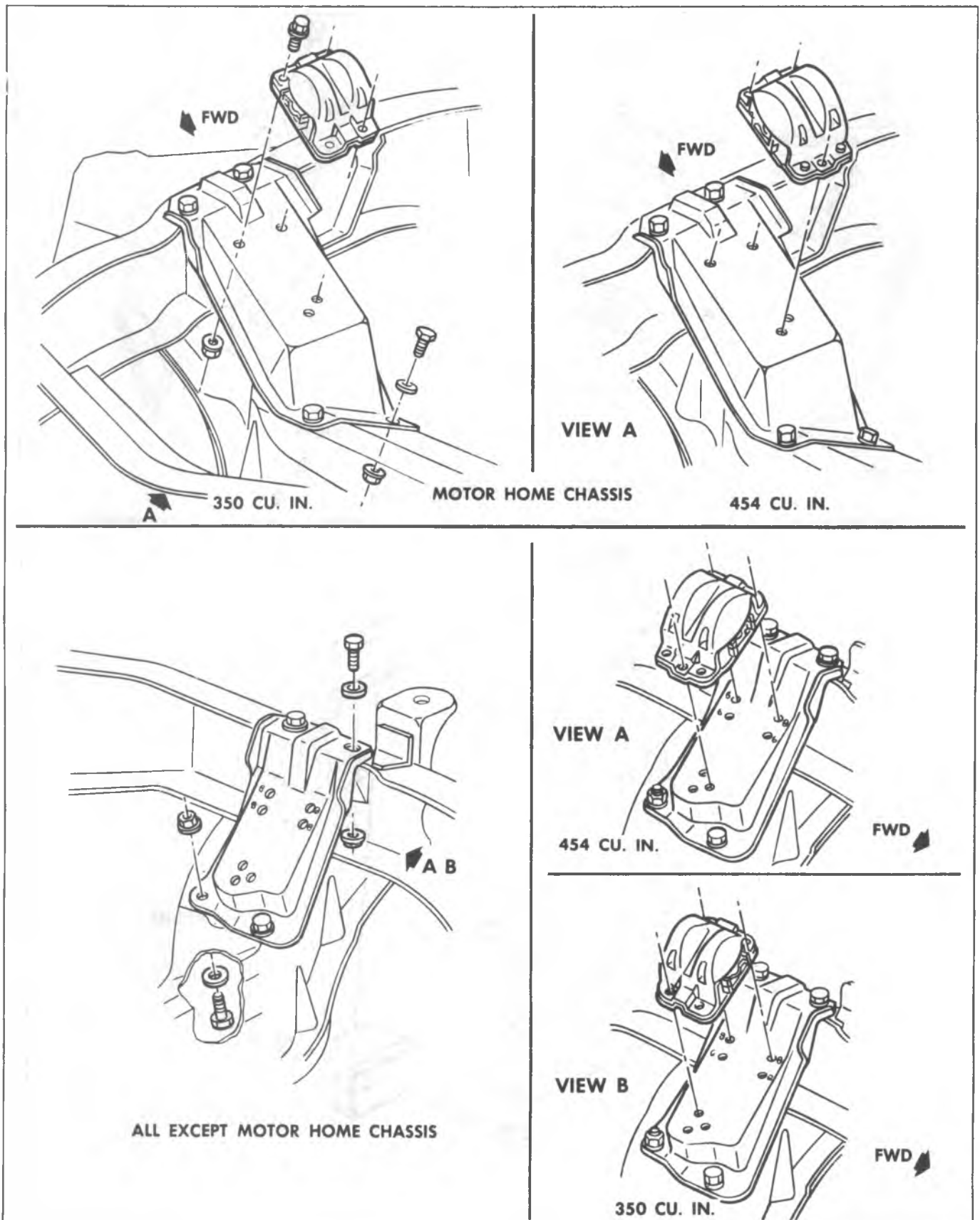


Fig. 6A4-5--"P" Series Engine Front Mount

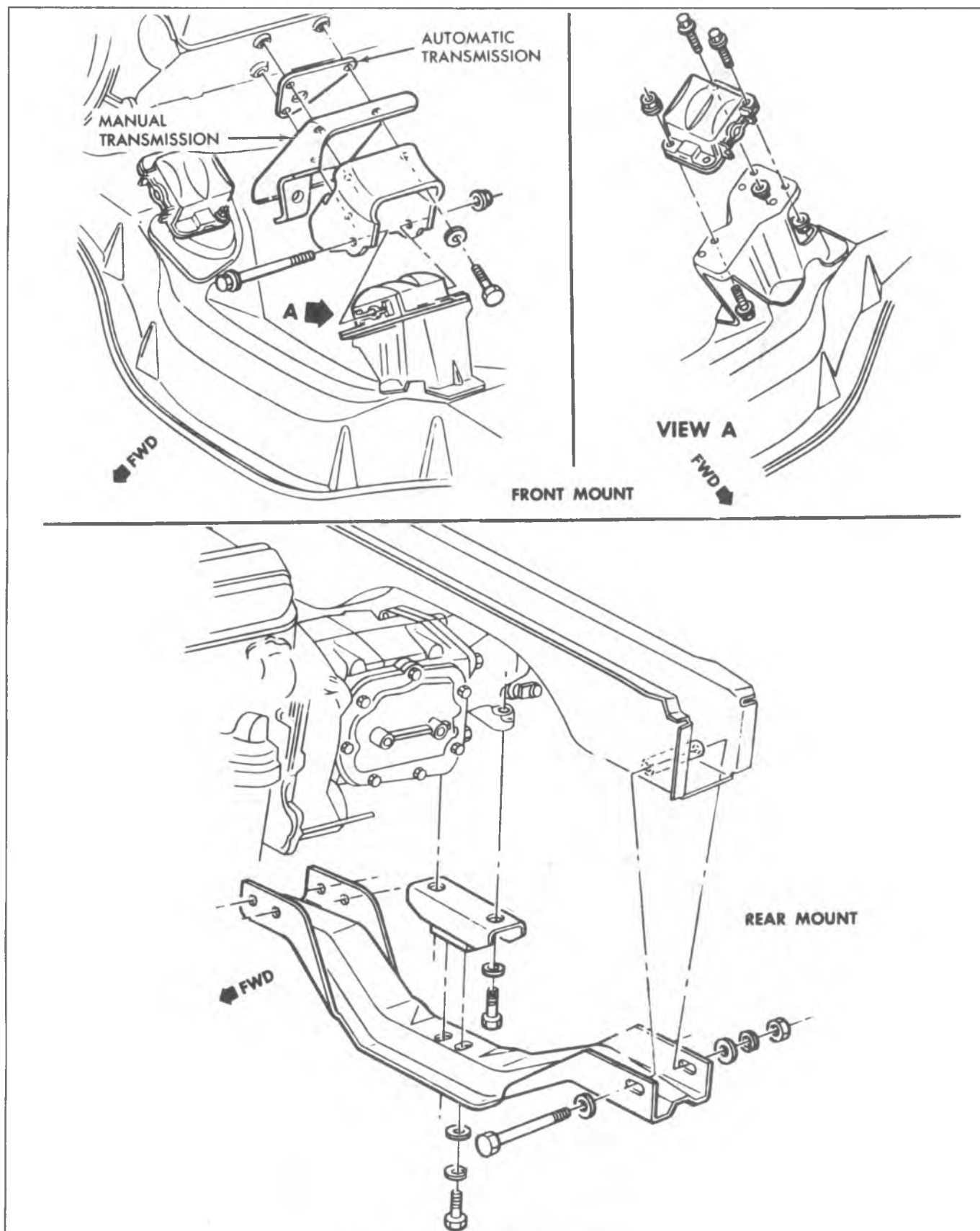


Fig. 6A4-6--"G" Series Engine Mounts

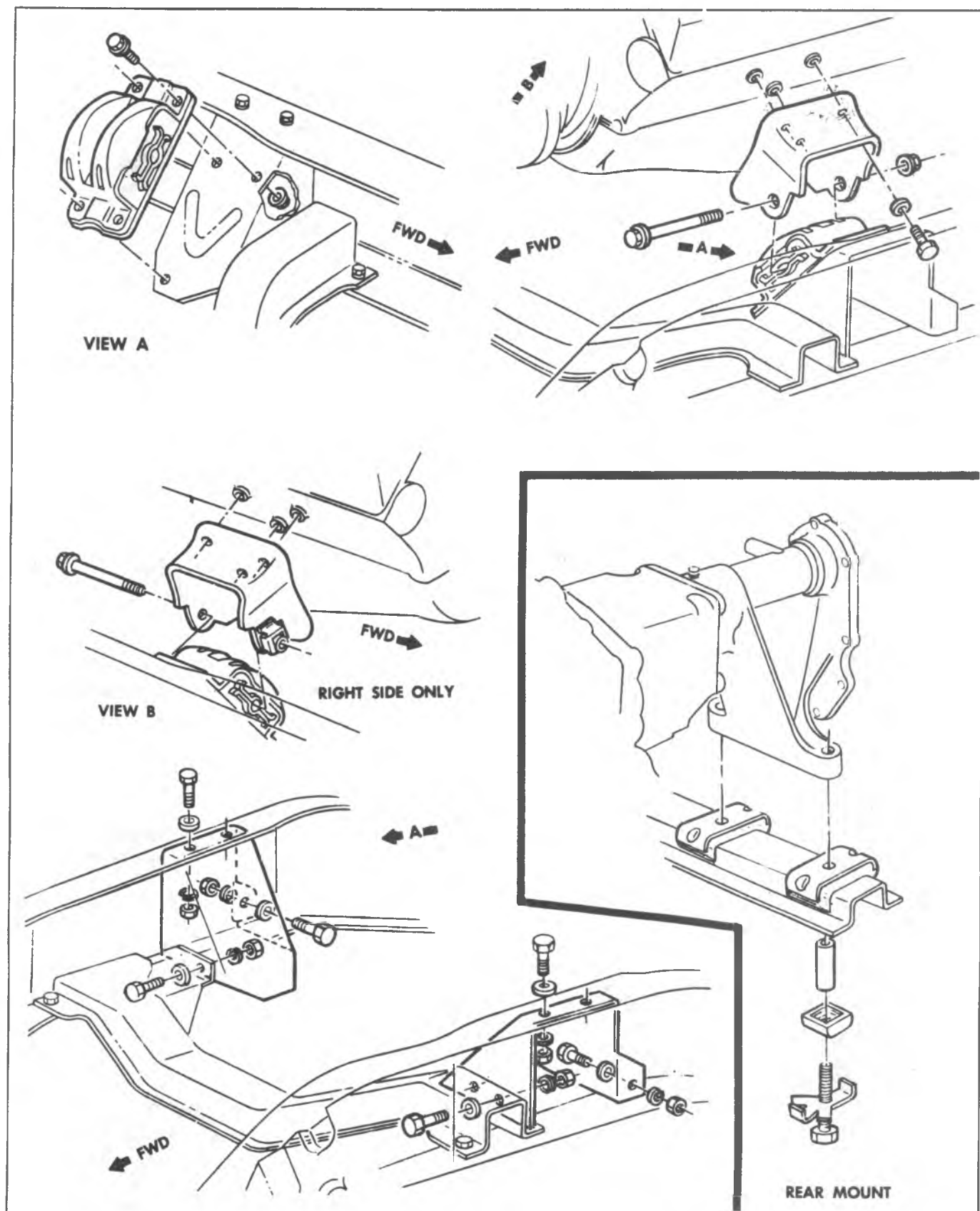


Fig. 6A4-7--"K" Series Engine Mounts

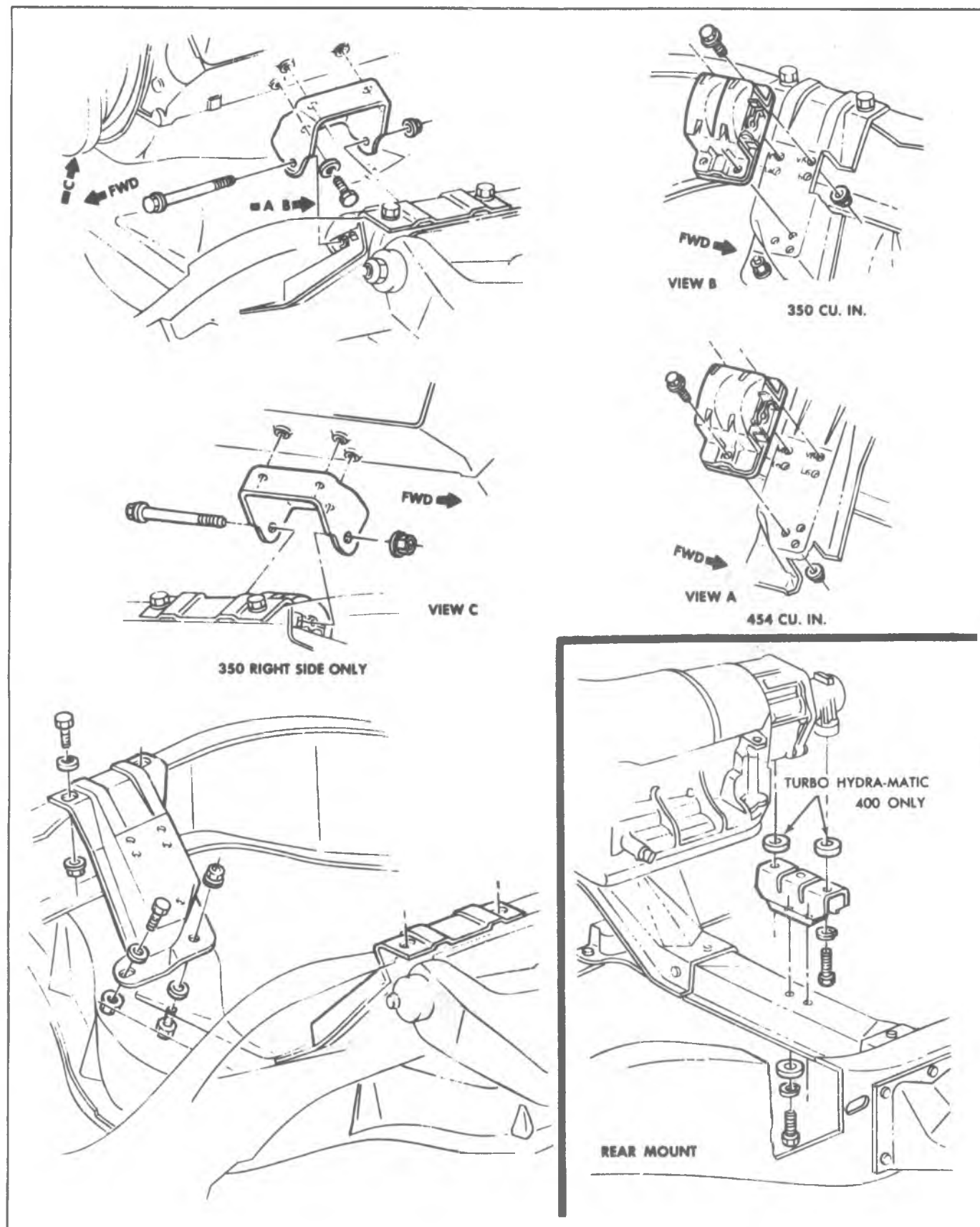


Fig. 6A4-8--"C" Series Engine Mounts

ON VEHICLE SERVICE

ENGINE MOUNTS

Engine mounts (fig. 6A4-3 - 6A4-8) 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:

- Hard rubber surface covered with heat check cracks;
- Rubber separated from a metal plate of the mount;
- 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

- Remove mount retaining bolt from below frame mounting bracket.
 - 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.
- Replace mount to engine and lower engine into place.
 - Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

- Support engine weight to relieve rear mounts.
- Remove crossmember-to-mount bolts.
- 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.
- Remove mount-to-transmission bolts, then remove mount.
- On "P" Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.
- Install new mount on transmission.
- While lowering transmission, align and start crossmember-to-mount bolts.
- Torque bolts to specifications then bend lock tabs to bolt head as applicable.

INTAKE MANIFOLD

Removal

- Drain radiator and remove air cleaner.
- Disconnect:
 - Battery negative cable at battery.
 - Radiator upper hose and heater hose at manifold.
 - Accelerator linkage at carburetor.
 - Fuel line at carburetor.
 - Crankcase ventilation lines.
 - Spark advance hose at distributor.
- Remove distributor cap and mark rotor position with chalk, then remove distributor.
- Remove air conditioning compressor and bracket (if equipped), accelerator return spring and bracket, and accelerator bellcrank.
- Remove generator upper mounting bracket.
- Remove manifold attaching bolts, then remove manifold and carburetor as an assembly. Discard gaskets.
- Remove A.I.R. crossover.
- If manifold is being replaced, transfer:
 - Carburetor and carburetor attaching bolts.
 - Temperature sending unit.
 - Thermostat with housing (use new gasket).
 - Heater hose adapter.
 - EGR Valve (use new gasket).
 - TVS switch.
 - Vacuum fitting(s).
 - Choke spring assembly (where applicable).

Installation

- Clean gasket and seal surfaces on manifold, block, and cylinder heads with degreaser. Remove all RTV that is loose or will cause installation interference.
- 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.
- Install manifold and torque bolts to specifications in the sequence outlined in fig. 6A4-9.
- Install (if removed) air compressor and bracket, accelerator bellcrank.
- Install distributor, positioning rotor at chalk mark, then install distributor cap.
- Connect:
 - Spark advance hose at distributor.
 - Crankcase ventilation lines.
 - Fuel line at carburetor.
 - Accelerator linkage at carburetor.
 - Battery negative cable at battery.
- Install air cleaner.
- Fill with coolant (refer to section 6B for proper procedure), start engine, adjust ignition timing and carburetor idle speed (if necessary) and check for leaks.

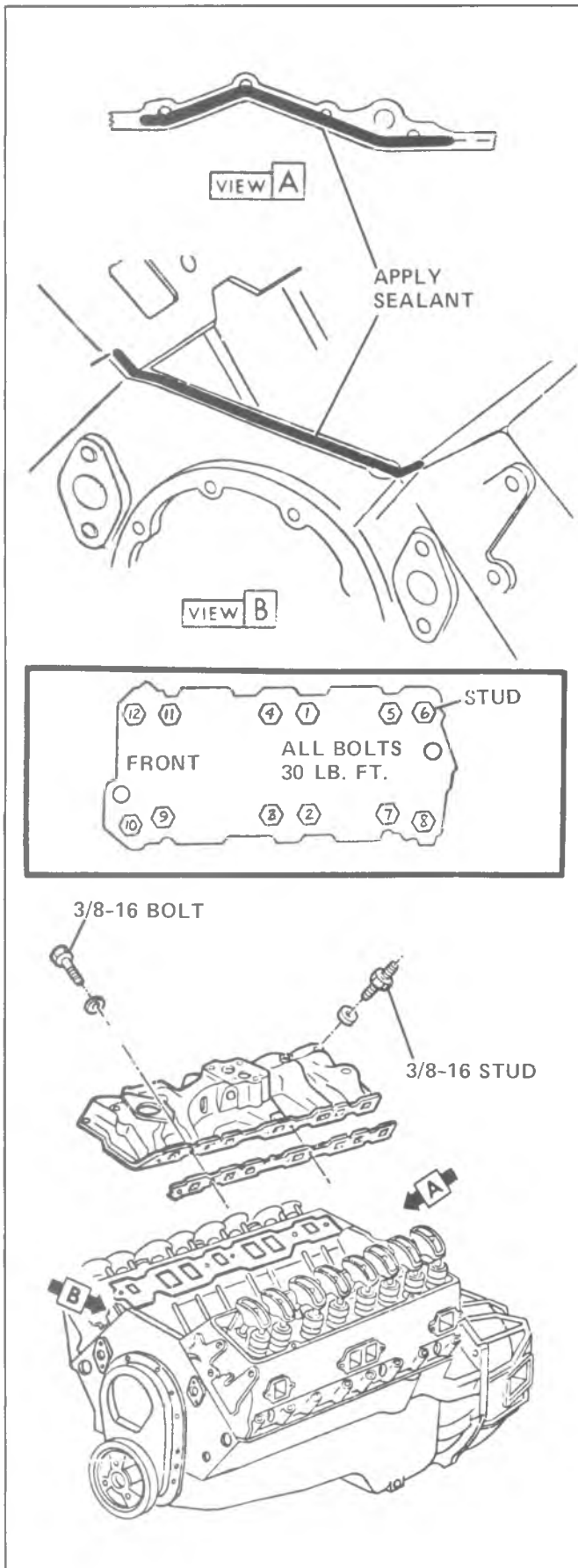


Fig. 6A4-9--Intake Manifold Torque Sequence

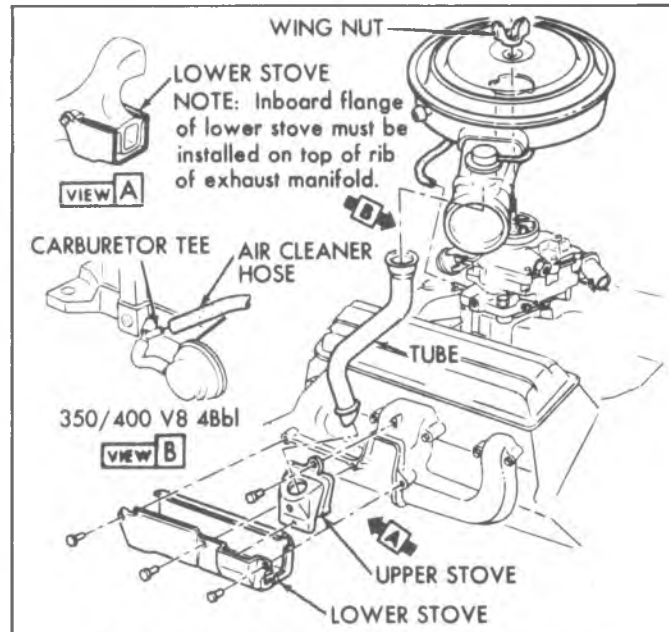


Fig. 6A4-10--Carburetor Heat Stove Assembly

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 remove manifold.

Installation

- If installing a new right side manifold, the carburetor heat stove must be transferred from the old unit (fig. 6A4-10).
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

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 conditioning, remove the A/C compressor rear brace (fig. 6A4-11).

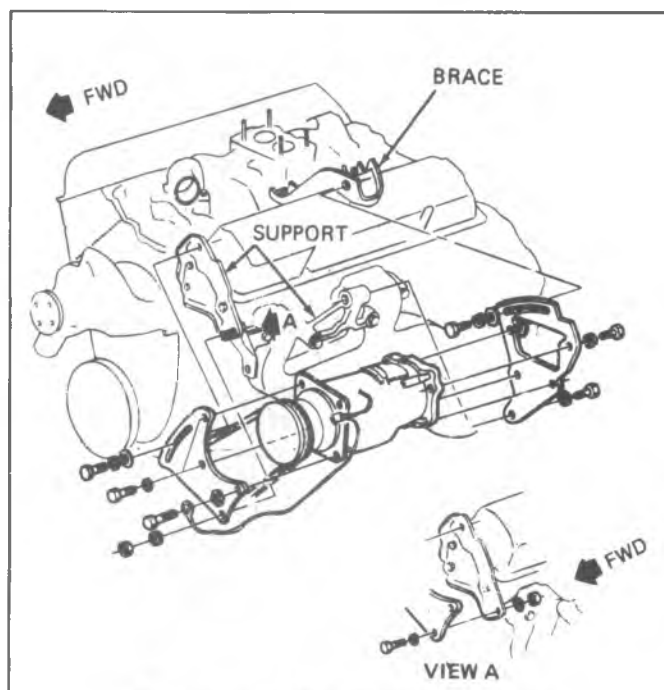


Fig. 6A4-11--A/C Compressor Mounting

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. 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 40 lb. in. (4.6 N·m). 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. Install cover and torque bolts while RTV is still wet (within 10 minutes).
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.
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:
 - 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. 6A4-12). 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.



Fig. 6A4-12-Valve Adjustment

- 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. 6A4-11A)

Removal

1. Remove rocker arm cover as previously outlined.

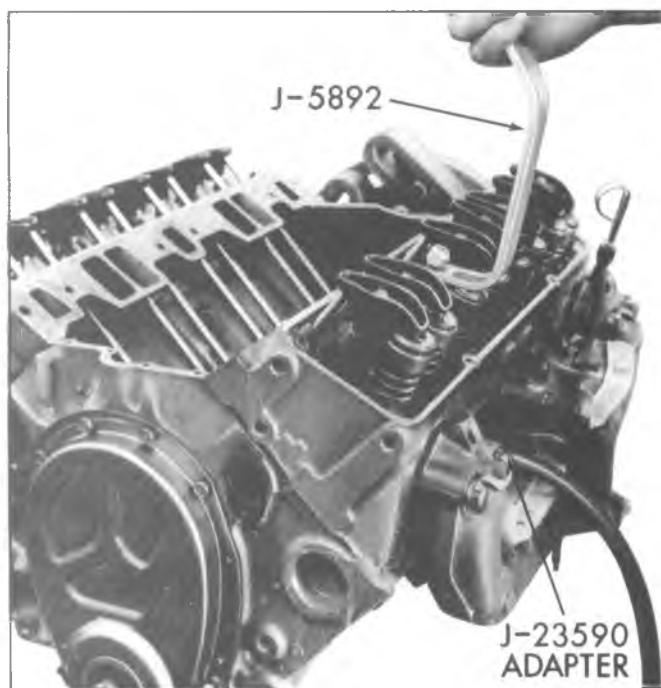


Fig. 6A4-13-Compressing Valve Spring

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, oil shedder and valve spring and damper (fig. 6A4-13).
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 install 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.
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. 6A4-14).
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. 6A4-15).

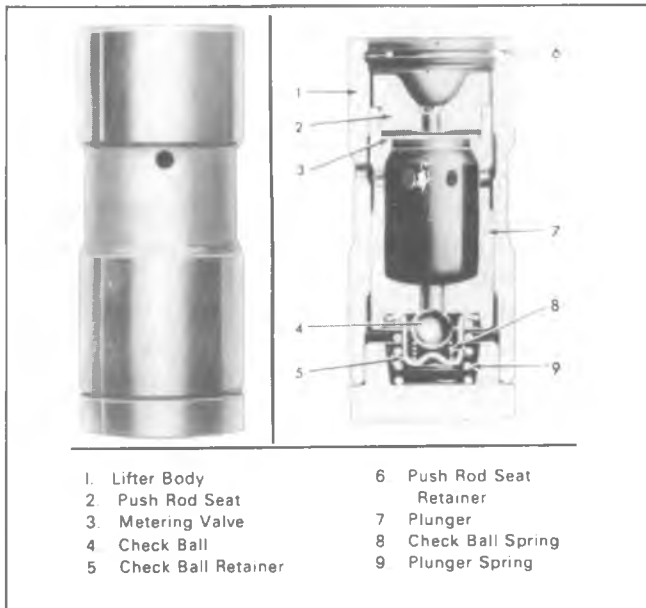


Fig. 6A4-14--Hydraulic Valve Lifter



Fig. 6A4-15--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.

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. 6A4-16).
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. 6A4-17).
5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 6A4-17).
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (fig. 6A4-14).
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.



Fig. 6A4-16--Installing Ball Check Valve



Fig. 6A4-17--Assembling Hydraulic Lifter

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. 6A4-18) 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.

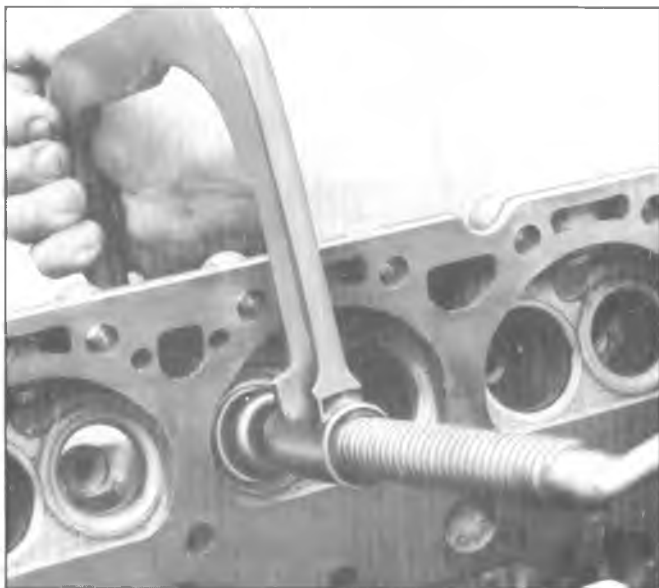


Fig. 6A4-18--Compressing Valve Spring

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. 6A4-19).
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 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. 6A4-20) 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. 6A4-21). Springs should be compressed to



Fig. 6A4-19--Cleaning Combustion Chambers



Fig. 6A4-20--Measuring Valve Stem Clearances



Fig. 6A4-21--Checking Valve Spring Tension

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 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. 6A4-22).

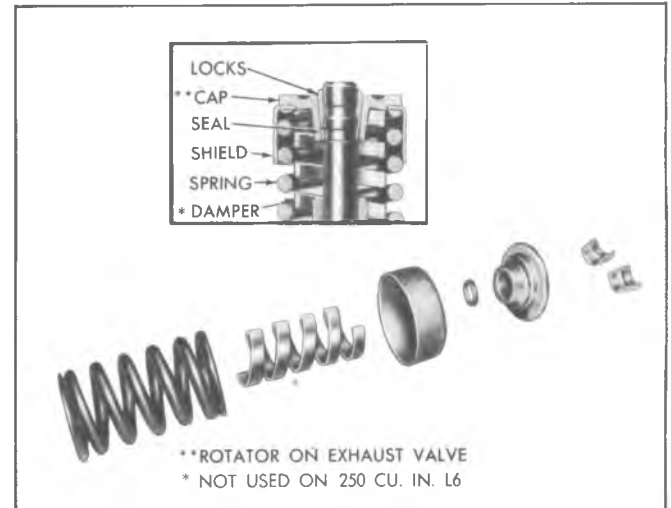


Fig. 6A4-22--Valve Spring Installation

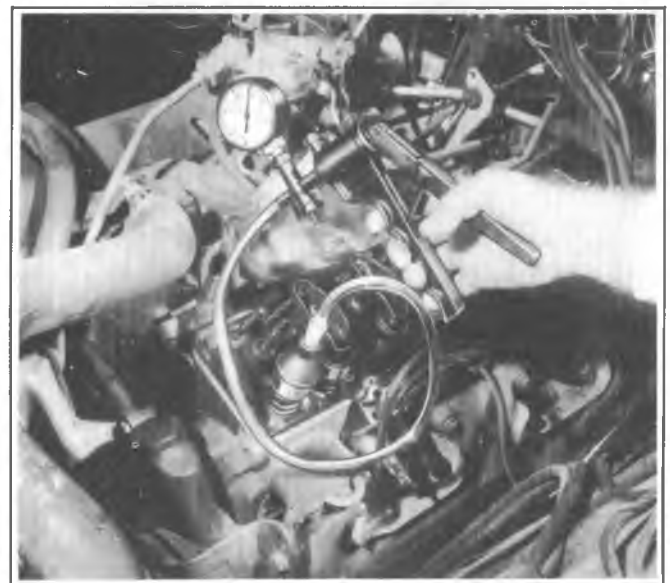


Fig. 6A4-23--Checking Valve Stem Oil Seals

- 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 valve stem and against the cap. Operate the vacuum pump and make sure no air leaks past the seal (fig. 6A4-23).
5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 6A4-24). Measure from the top of the shim or the spring seat to the top of the oil shedder (fig. 6A4-25). If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick.

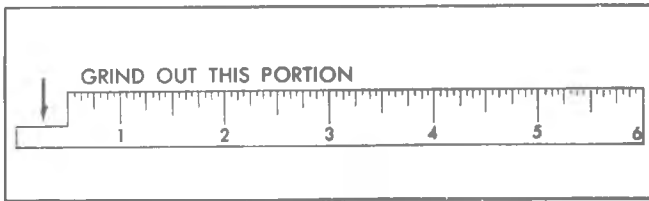


Fig. 6A4-24--Cutaway Scale

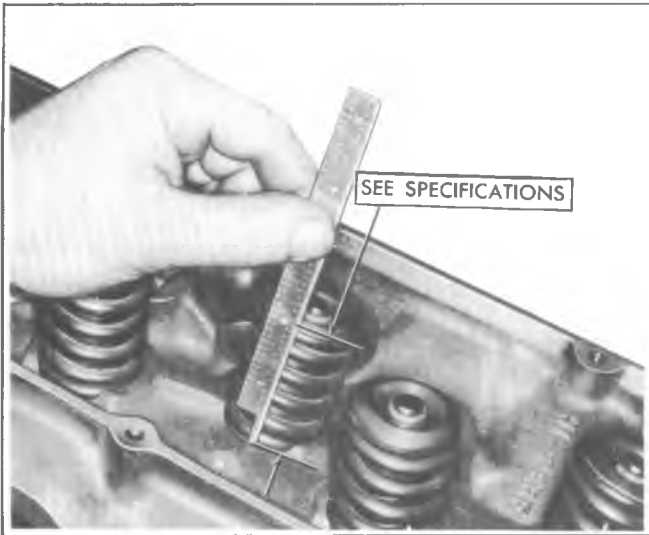


Fig. 6A4-25--Measuring Valve Spring Installed Height

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.
 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. 6A4-26).
2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 6A4-27).

NOTICE: Do not attempt to install an oversize stud without reaming stud hole as this could damage the head casting.

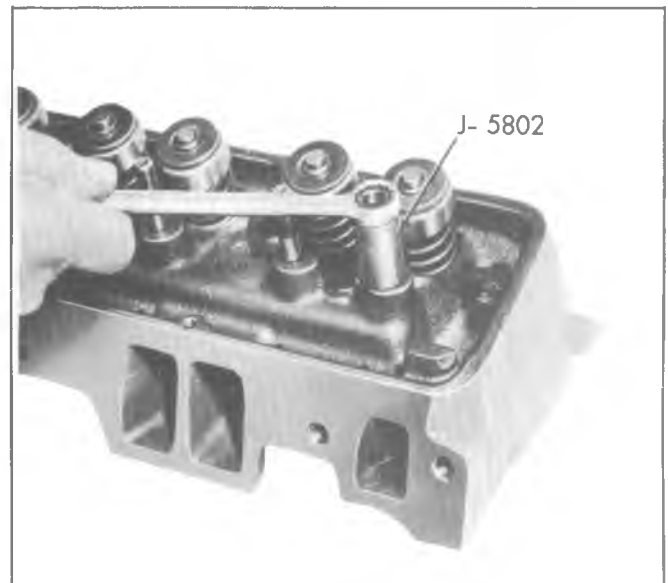


Fig. 6A4-26--Removing Rocker Arm Stud

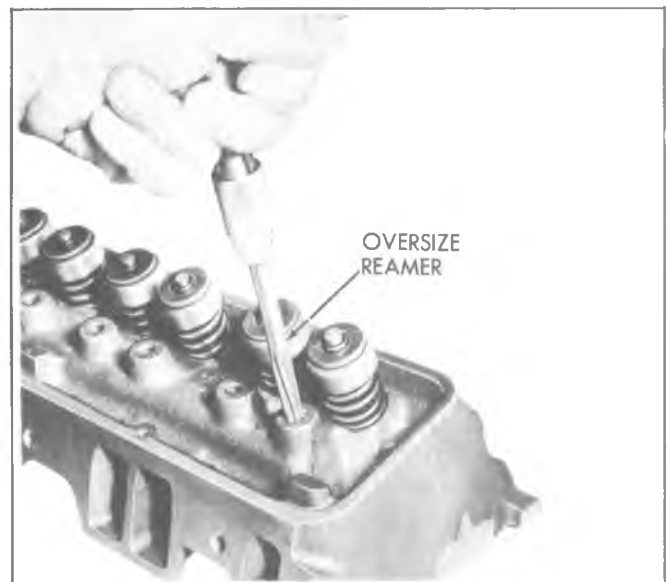


Fig. 6A4-27--Reaming Rocker Arm Stud Bore

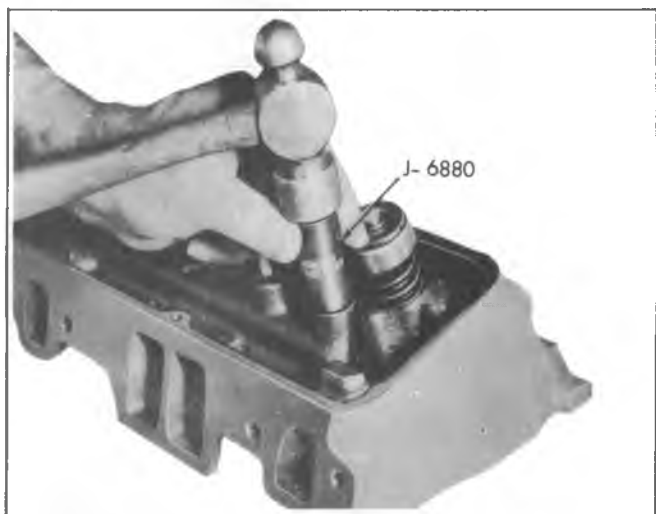


Fig. 6A4-28--Installing Rocker Arm Stud

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. 6A4-28).

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 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. 6A4-30).

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 6A4-31.
 - 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.

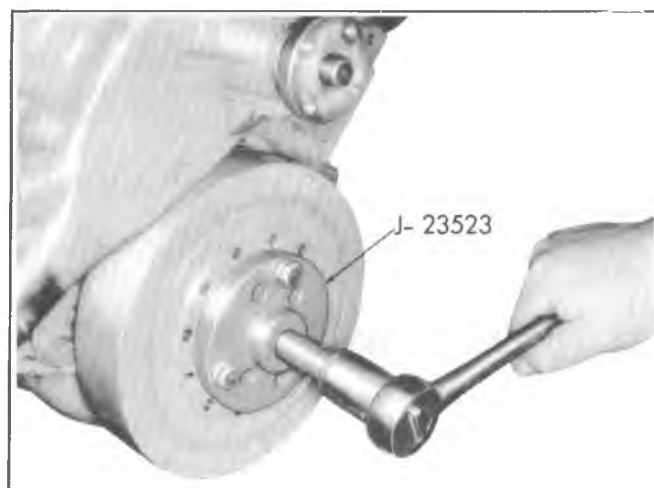


Fig. 6A4-30--Removing Torsional Damper - Typical

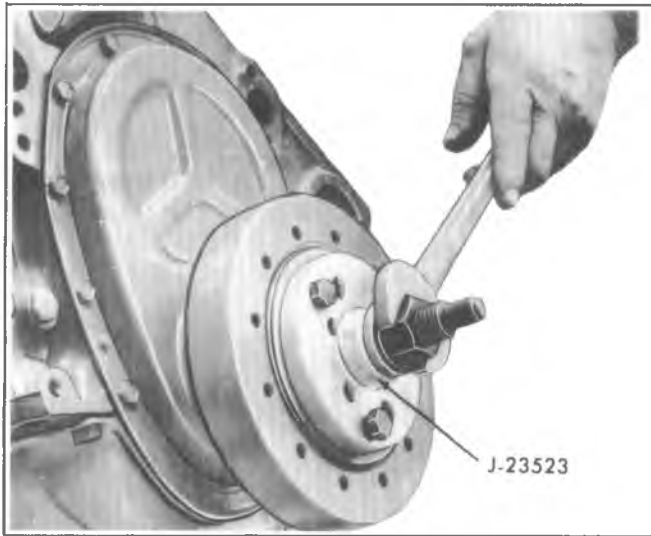


Fig. 6A4-31--Installing Torsional Damper

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.
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. 6A4-32).

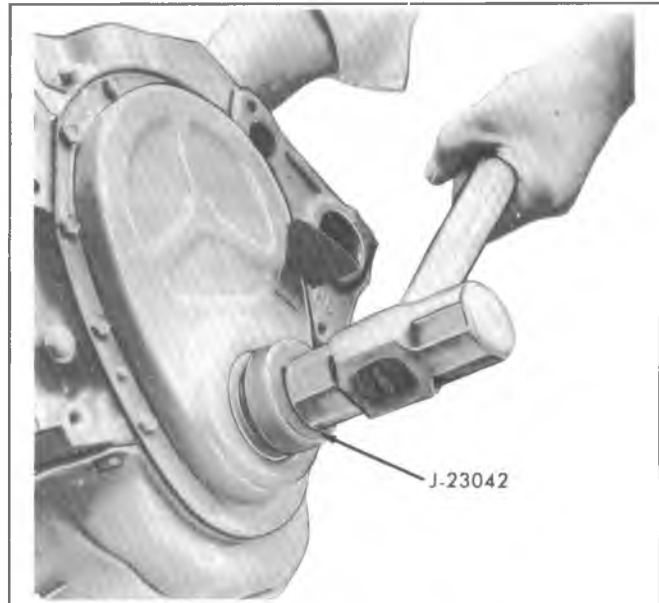


Fig. 6A4-32--Installing Oil Seal



Fig. 6A4-33--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. 6A4-33). 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 and push rod (see section 6C).
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. 6A4-34).

NOTICE: All camshaft journals are the same diameter and care must be used in removing camshaft to avoid damage to bearings.

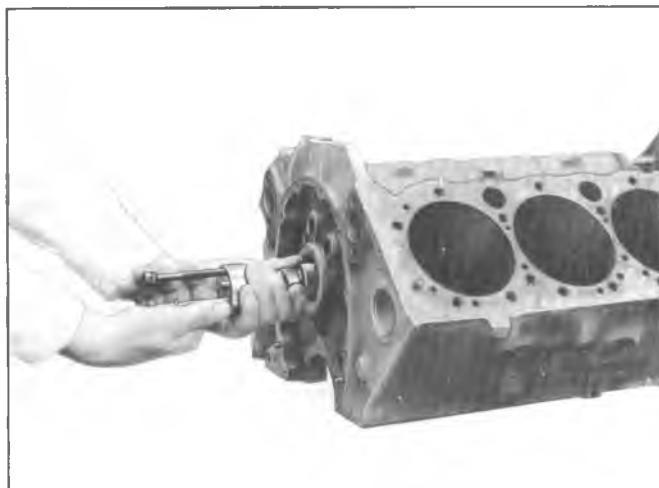


Fig. 6A4-34--Removing Camshaft

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. Install timing chain on camshaft sprocket (fig. 6A4-35). Hold the sprocket vertically with the chain hanging down and align marks on camshaft and crankshaft sprockets.
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 and fuel pump (see 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 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

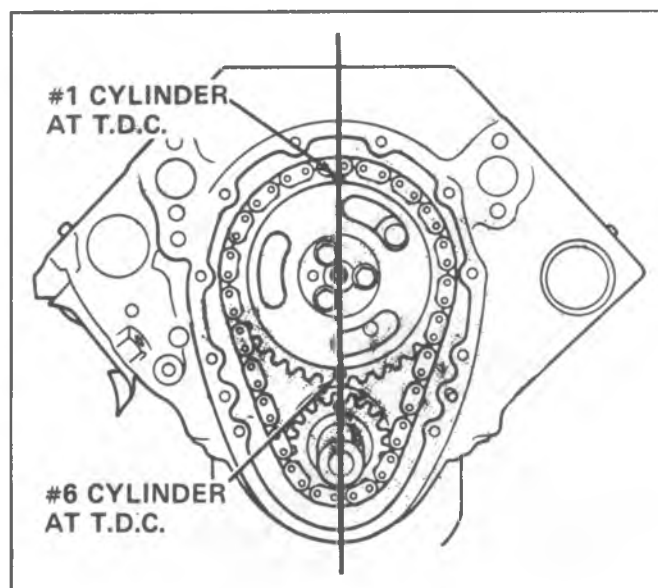


Fig. 6A4-35--Camshaft Sprocket Alignment Marks

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. 6A4-36).
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. 6A4-37).

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. 6A4-37).
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 positioned so that oil holes are equidistant from 6 o'clock position.

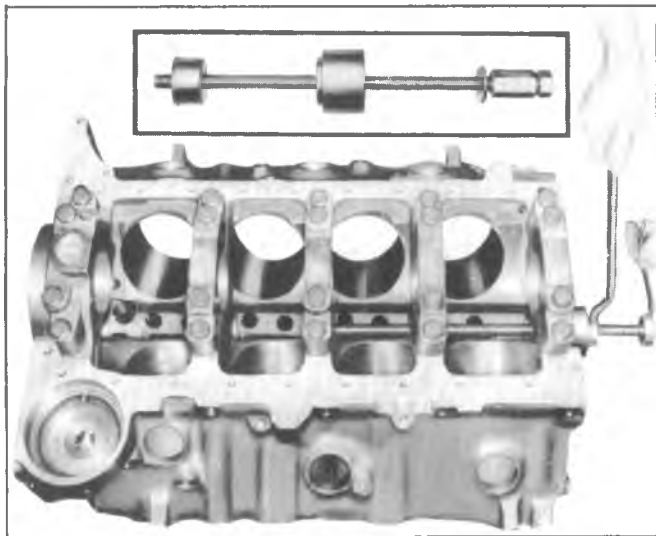


Fig. 6A4-36--Removing Camshaft Bearings

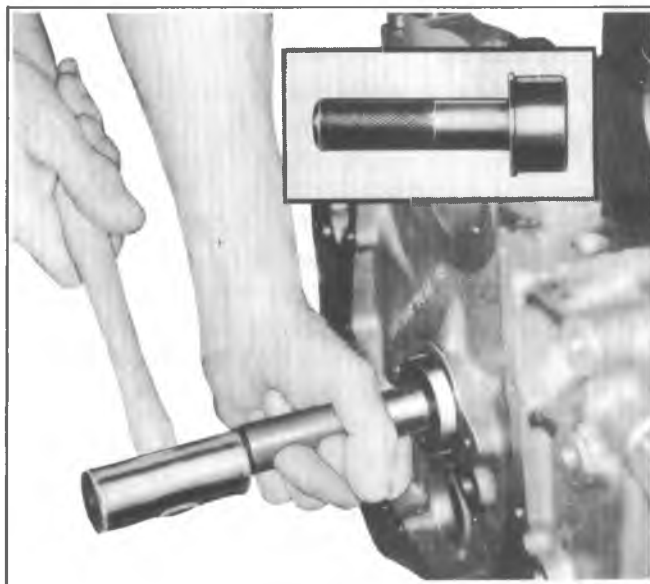


Fig. 6A4-37--Replacing Camshaft Front Bearing

- 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

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 6A4-38)

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.
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.

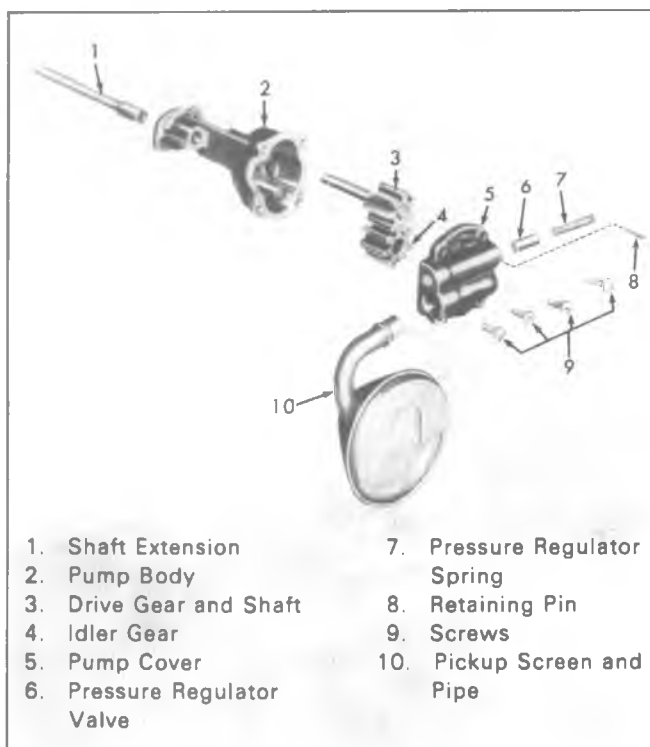


Fig. 6A4-38--Oil Pump

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 6A4-38)

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. 6A4-39) 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" under-size for use with new and used standard size crankshafts,



Fig. 6A4-39--Installing Screen

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.
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. 6A4-40). 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).



Fig. 6A4-40--Gaging Plastic On Crankpin

- 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. 6A4-41).

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. 6A4-42).

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.

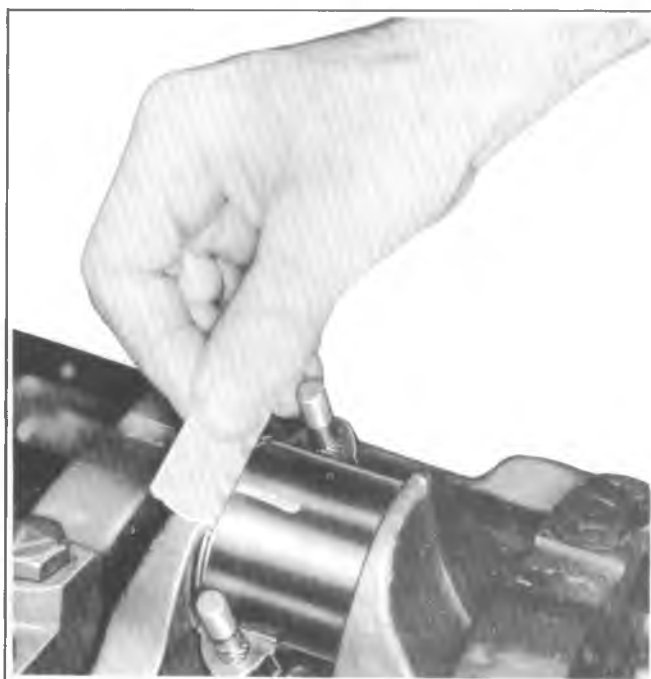


Fig. 6A4-41--Measuring Gaging Plastic



Fig. 6A4-42--Measuring Connecting Rod Side Clearance

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, 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. 6A4-43).
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. 6A4-44).

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



Fig. 6A4-43--Gaging Plastic on Journal

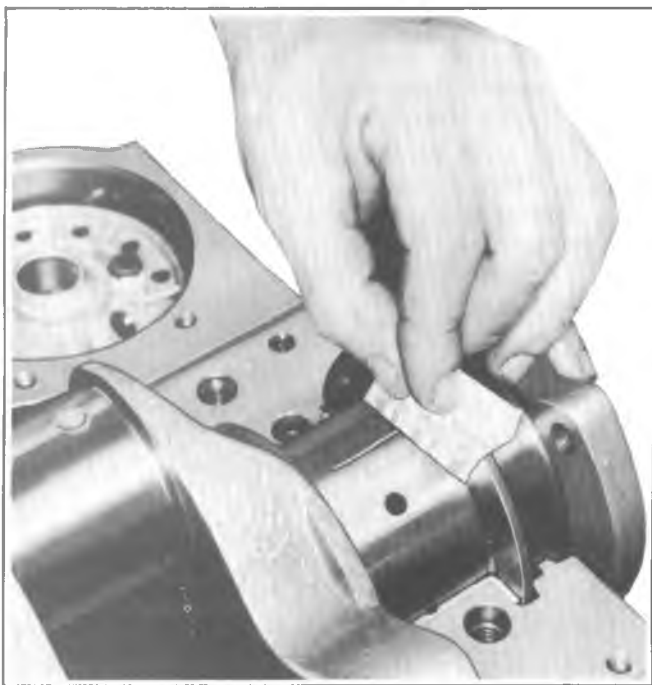


Fig. 6A4-44--Measuring Gaging Plastic

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.

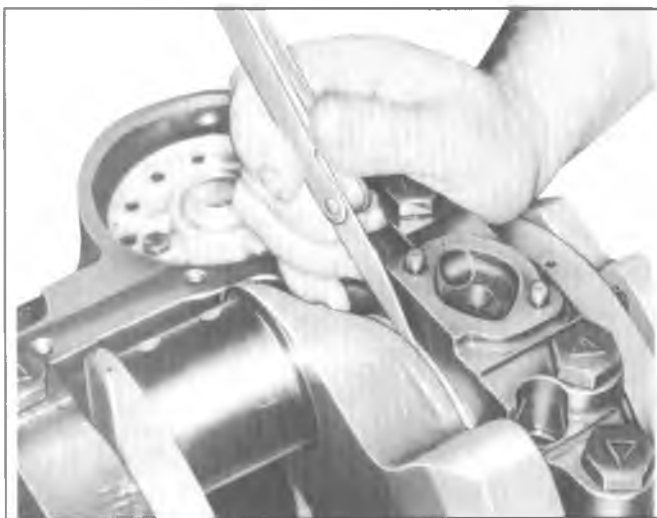


Fig. 6A4-45--Measuring Crankshaft End Play

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. 6A4-45).
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 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 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. (14-16 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)

Replacement

- ALWAYS REPLACE THE UPPER AND LOWER SEAL AS A UNIT.

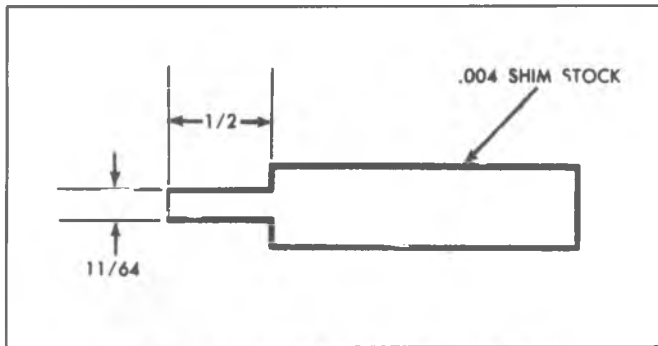


Fig. 6A4-46--Oil Seal Installation Tool



Fig. 6A4-47--Removing Oil Seal - Lower Half

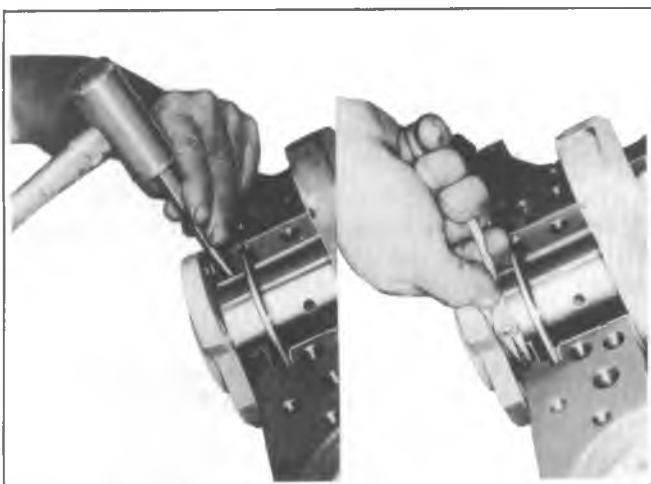


Fig. 6A4-48--Removing Oil Seal - Upper Half

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. 6A4-46) 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. 6A4-47).
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. 6A4-48).

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. 6A4-49).
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.

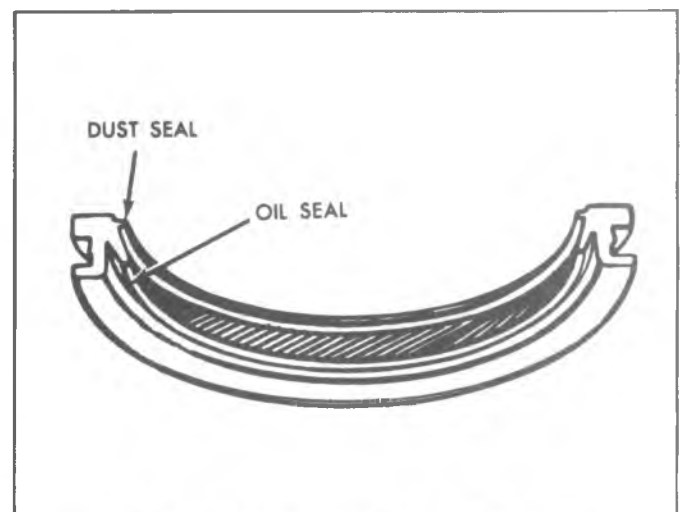


Fig. 6A4-49--Crankshaft Oil Seal - Rear Main

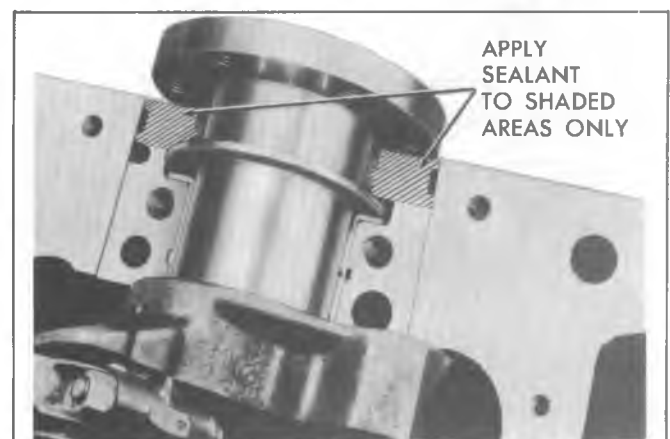


Fig. 6A4-50--Sealing Bearing Cap

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. 6A4-50).
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.

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. 6A4-51). 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.

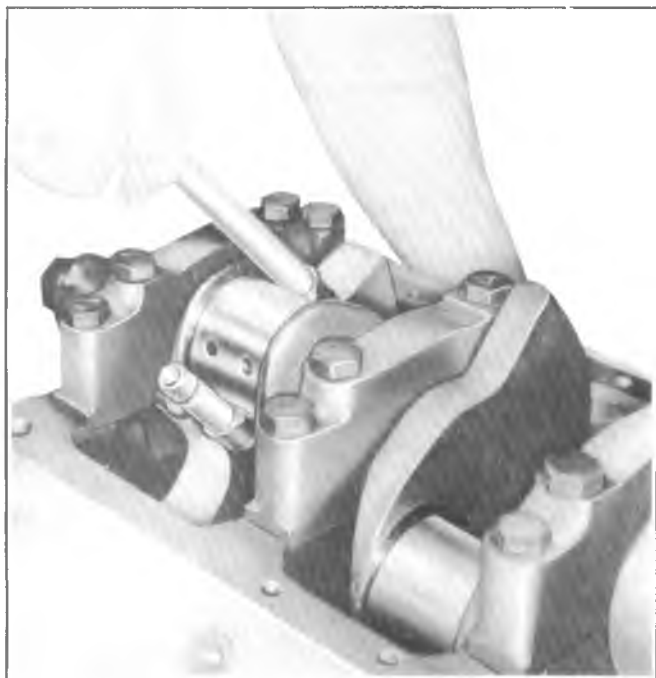


Fig. 6A4-51--Removing Connecting Rod & Piston Assembly

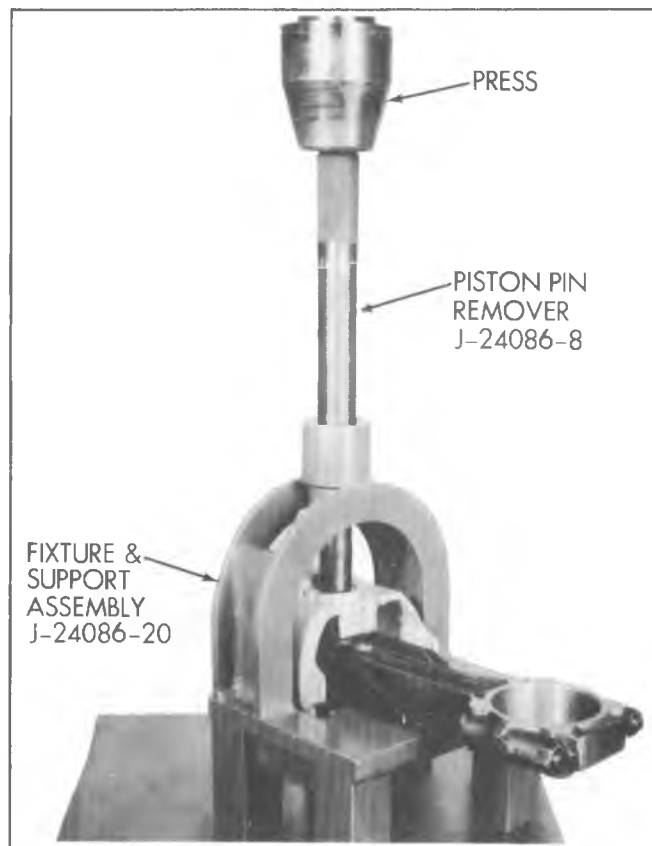


Fig. 6A4-52--Removing Piston Pin

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. 6A4-52).

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. 6A4-53).

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 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.
3. Measure the space or gap between the ends of the ring with a feeler gage (fig. 6A4-54).
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. 6A4-55) to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is



Fig. 6A4-53--Installing Piston Pin



Fig. 6A4-54--Measuring Ring Gap

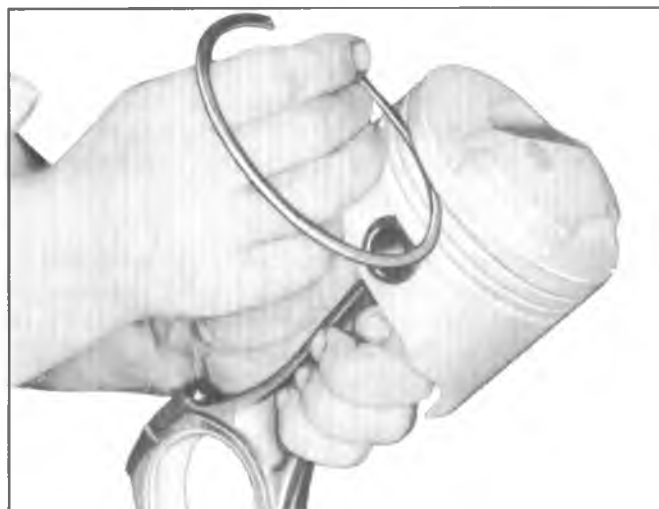


Fig. 6A4-55--Checking Ring in Groove

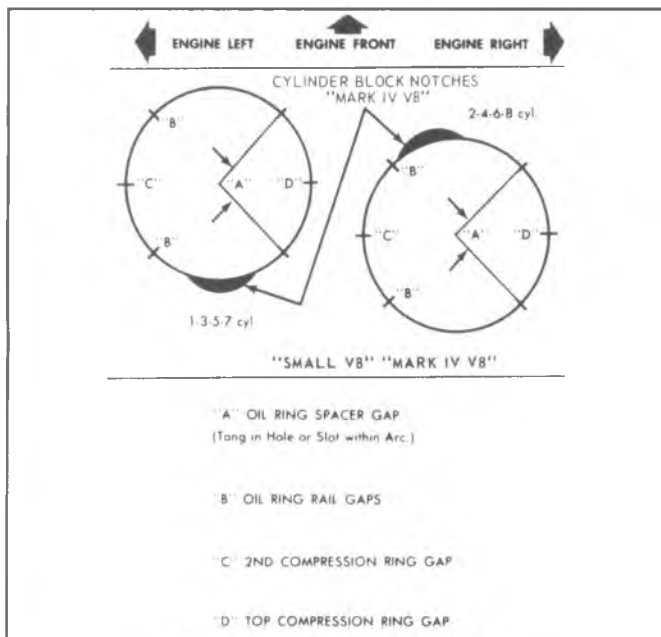


Fig. 6A4-56--Ring Gap Location

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. 6A4-56):
 - 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. 6A4-57). (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.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.

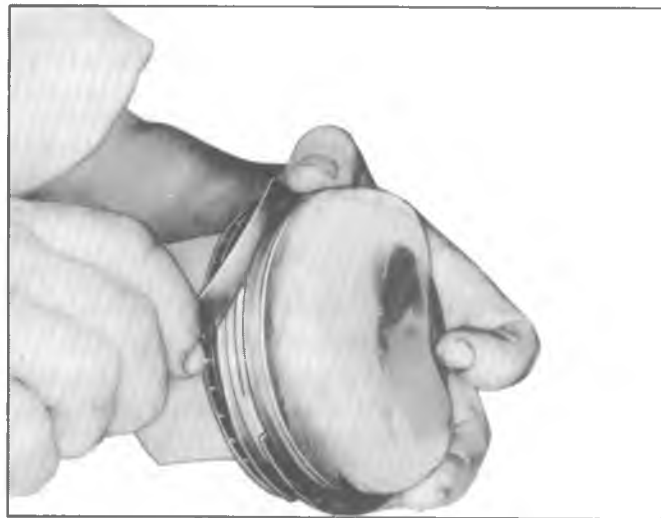


Fig. 6A4-57--Measuring Ring Groove Clearance



Fig. 6A4-58--Installing Connecting Rod Piston Assembly

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. 6A4-58). 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 than .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 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 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)

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)

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)

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)

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.

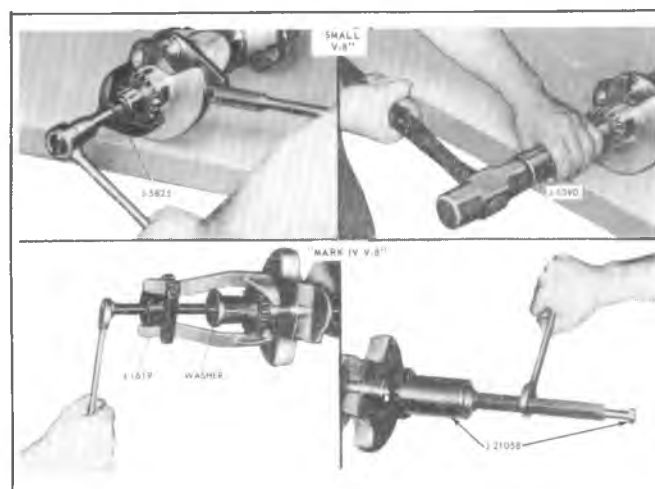


Fig. 6A4-59--Sprocket or Gear Replacement

SPROCKET OR GEAR REPLACEMENT (REFER TO FIG. 6A4-59)

- 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. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (fig. 6A4-60). 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.

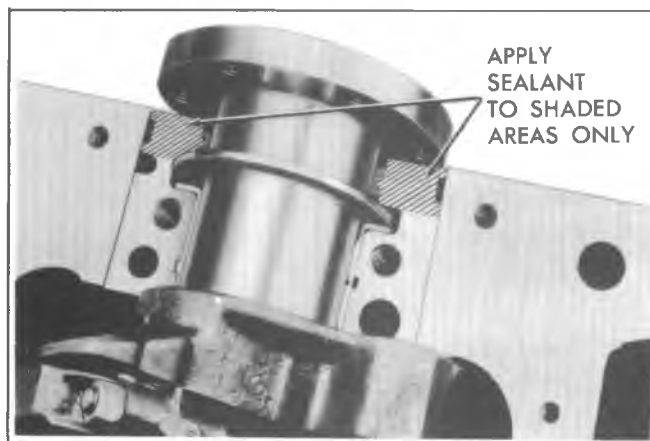


Fig. 6A4-60--Sealing Bearing Cap

GENERAL DATA:

TYPE		90° V-8 GASOLINE						
DISPLACEMENT	LITRE (*)	5.0 (F)			5.7 (L)			
		5.0 (G)			5.7 (M)			
		5.0 (H)						
RPO		LF3	LG9	LE9	LS9 /LT9			
BORE		3.736			4.000			
STROKE		3.480						
COMPRESSION RATIO		8.6:1	8.5:1	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.	
	SERVICE	.002 MAX.	
TAPER	PRODUCTION	THRUST SIDE	.0005 MAX.
		RELIEF SIDE	.001 MAX.
	SERVICE		.001 MAX.

PISTON:

CLEARANCE	PRODUCTION	.0007-.0017
	SERVICE	.0027 MAX.

PISTON RING:

COMPRESSION	GROOVE CLEARANCE	PRODUCTION	TOP	.0012-.0032
			2ND	.0012-.0032
		SERVICE HI LIMIT PRODUCTION + .001		
	GAP	PRODUCTION	TOP	.010-.020
			2ND	.010-.025
		SERVICE HI LIMIT PRODUCTION + .010		
OIL	GROOVE CLEARANCE	PRODUCTION		.002-.007
		SERVICE		HI LIMIT PRODUCTION + .001
	GAP	PRODUCTION		.015-.055
		SERVICE		HI LIMIT PRODUCTION + .010

* VIN Designation

PISTON PIN

LF3, LG9, LE9, LS9/LT9

DIAMETER		.9270-.9273
CLEARANCE	PRODUCTION	.00025-.00035
	SERVICE	.001 MAX.
FIT IN ROD		.0008-.0016 INTERFERENCE

CRANKSHAFT

MAIN JOURNAL	DIAMETER		#1 2.4484-2.4493
			#2-3-4 2.4481-2.4490
			#5 2.4479-2.4488
	TAPER	PRODUCTION	.0002 MAX.
		SERVICE	.001 MAX.
	OUT OF ROUND	PRODUCTION	.0002 MAX.
SERVICE		.001 MAX.	
MAIN BEARING CLEARANCE		PRODUCTION	#1 .008-.0020
			#2-3-4 .0011-.0023
			#5 .0017-.0032
		SERVICE	#1 .001-.0015 #2-4 .001-.0025 #5 .0025-.0035
CRANKSHAFT END PLAY			.002-.006
CRANKPIN	DIAMETER		2.0988-2.0998
	TAPER	PRODUCTION	.0005
		SERVICE	.001 MAX.
	OUT OF ROUND	PRODUCTION	.0005
		SERVICE	.001 MAX.
ROD BEARING CLEARANCE		PRODUCTION	.0013-.0035
		SERVICE	.0030
ROD SIDE CLEARANCE			.008-.014

CAMSHAFT

LOBE LIFT ± .002	INTAKE	.2484	.2600
	EXHAUST	.2667	.2733
JOURNAL DIAMETER		1.8682-1.8692	
CAMSHAFT END PLAY		.004-.012	

SPECIFICATIONS

VALVE SYSTEM		LF3,	LG9,	LE9	LS9/	LT9
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 + .001 INTAKE + .002 EXHAUST			
VALVE SPRING (OUTER)	FREE LENGTH		2.03			
	PRESSURE LBS. @ IN.	CLOSED	76-84 @ 1.70 INT. @ 1.61 EXH.			
		OPEN	194-206 @ 1.25 INT. @ 1.16 EXH.			
	INSTALLED HEIGHT ± 1/32"		1-23/32 INT. 1-19/32 EXH.			
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 CRANKCASE) (1/4-20)	80 LB. IN.
OIL PUMP COVER	80 LB. IN.
ROCKER ARM COVER	45 LB. IN.
CAMSHAFT SPROCKET	20 LB. FT.
OIL PAN TO CRANKCASE (5/16-18)	165 LB. IN.
CLUTCH PRESSURE PLATE	30 LB. FT.
DISTRIBUTOR CLAMP	25 LB. FT.
FLYWHEEL HOUSING	30 LB. FT.
MANIFOLD (EXHAUST)	20 LB. FT. ¹
MANIFOLD (INLET)	30 LB. FT.
WATER OUTLET	30 LB. FT.
WATER PUMP	30 LB. FT.
CONNECTING ROD CAP	45 LB. FT.
CYLINDER HEAD	65 LB. FT.
MAIN BEARING CAP	80 LB. FT. ²
OIL PUMP	65 LB. FT.
FLYWHEEL	60 LB. FT.
TORSIONAL DAMPER	60 LB. FT.
TEMPERATURE SENDING UNIT	20 LB. FT.
OIL FILTER	25 LB. FT.
OIL PAN DRAIN PLUG	20 LB. FT.
SPARK PLUG	17-27 LB. FT.

¹ Inside bolts on 5.7 (L) 30 LB. FT.

² Intermediate outer bolts are 70 LB. FT.

SECTION 6A5

7.4 L (W) V-8 - RPO 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 clearances. 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. A steel 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.

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.

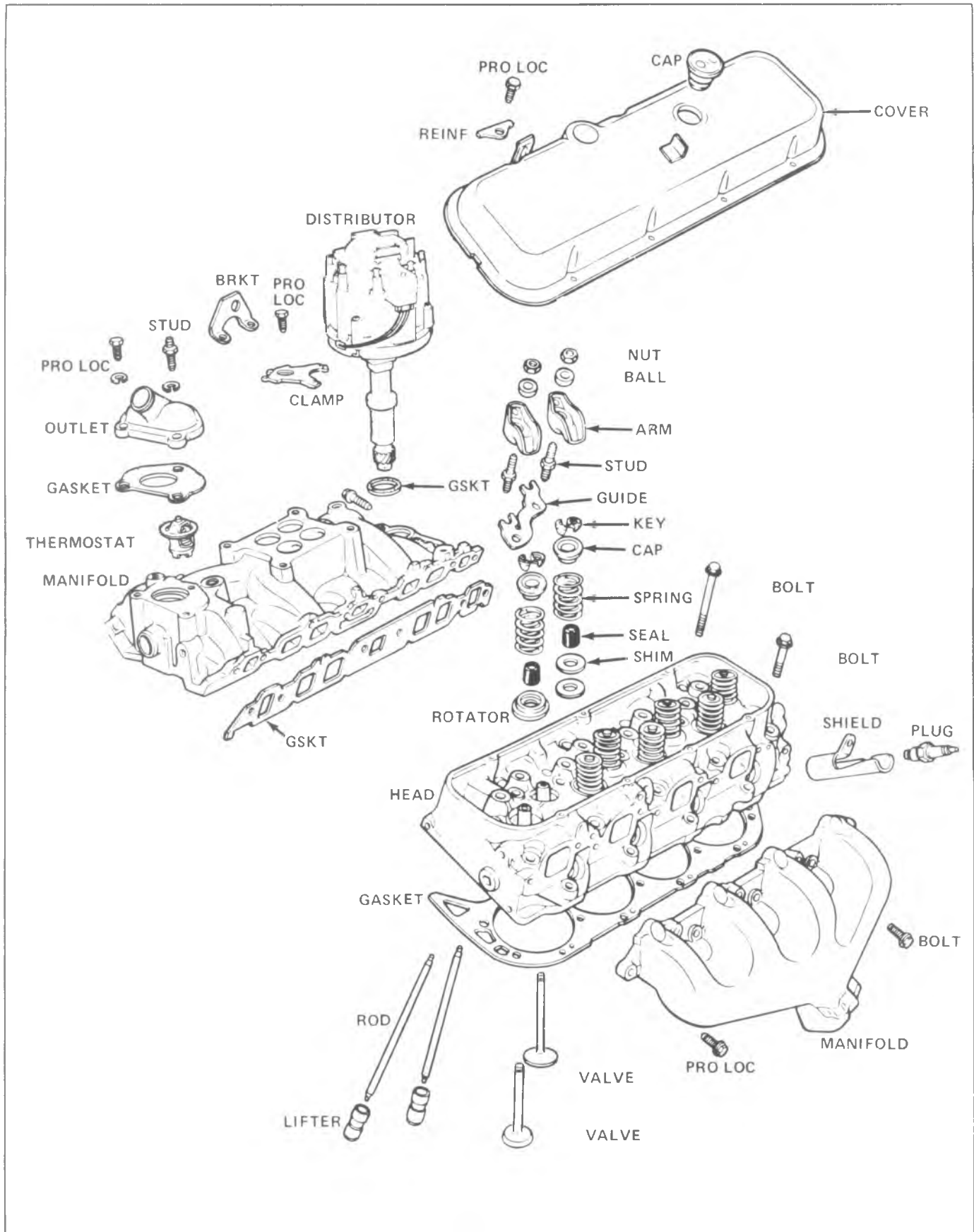


Fig. 6A5-1-Engine Upper End

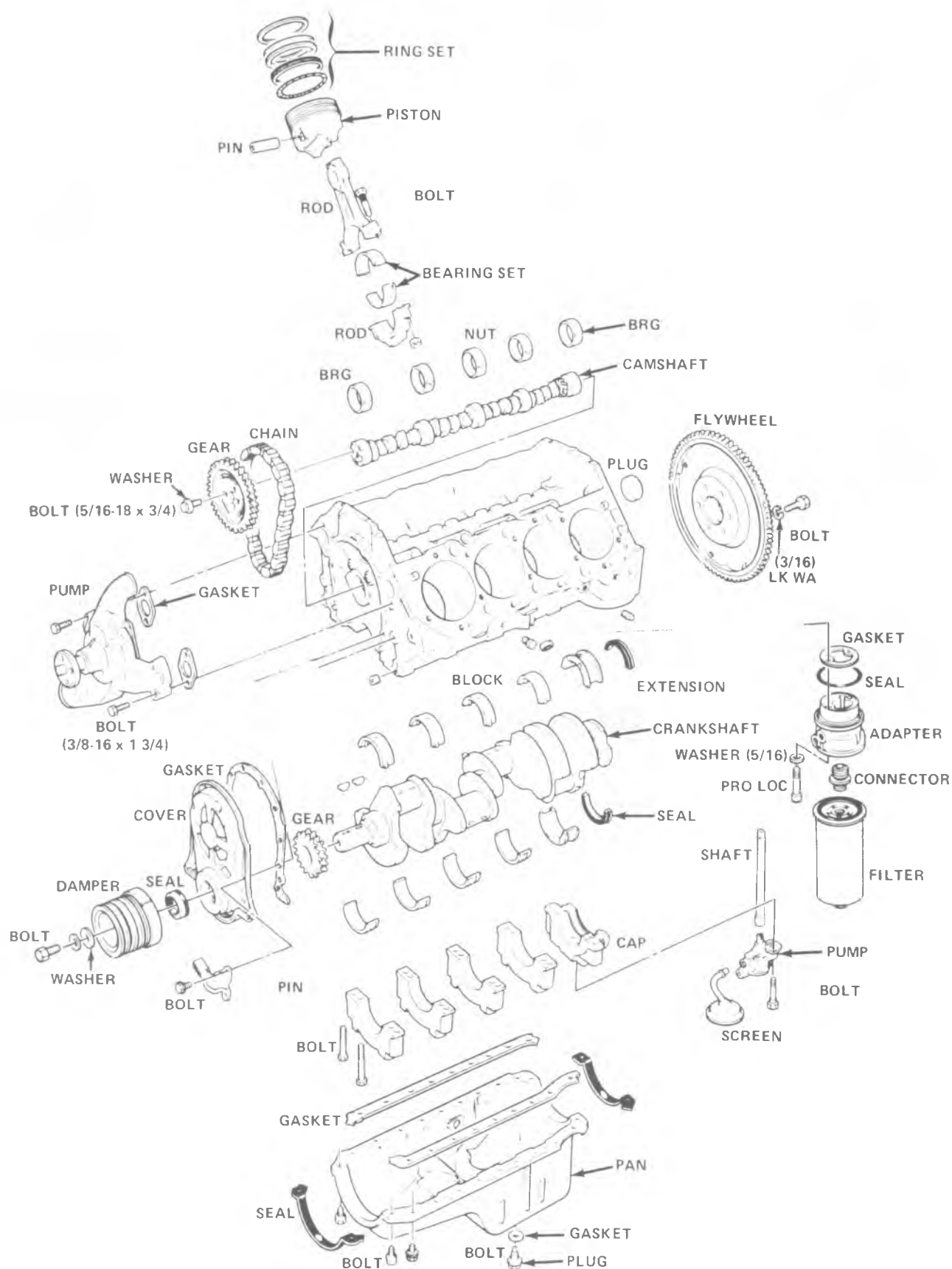


Fig. 6A5-2--Engine Lower End

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

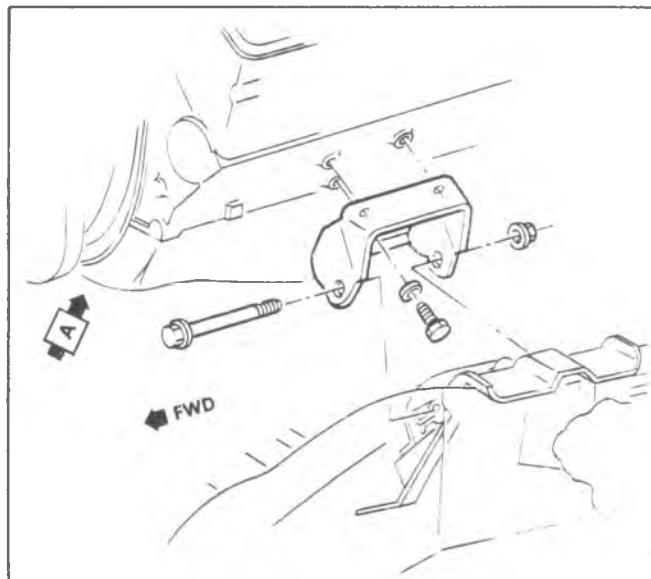


Fig. 6A5-4--"P" Series Engine Mount Bracket

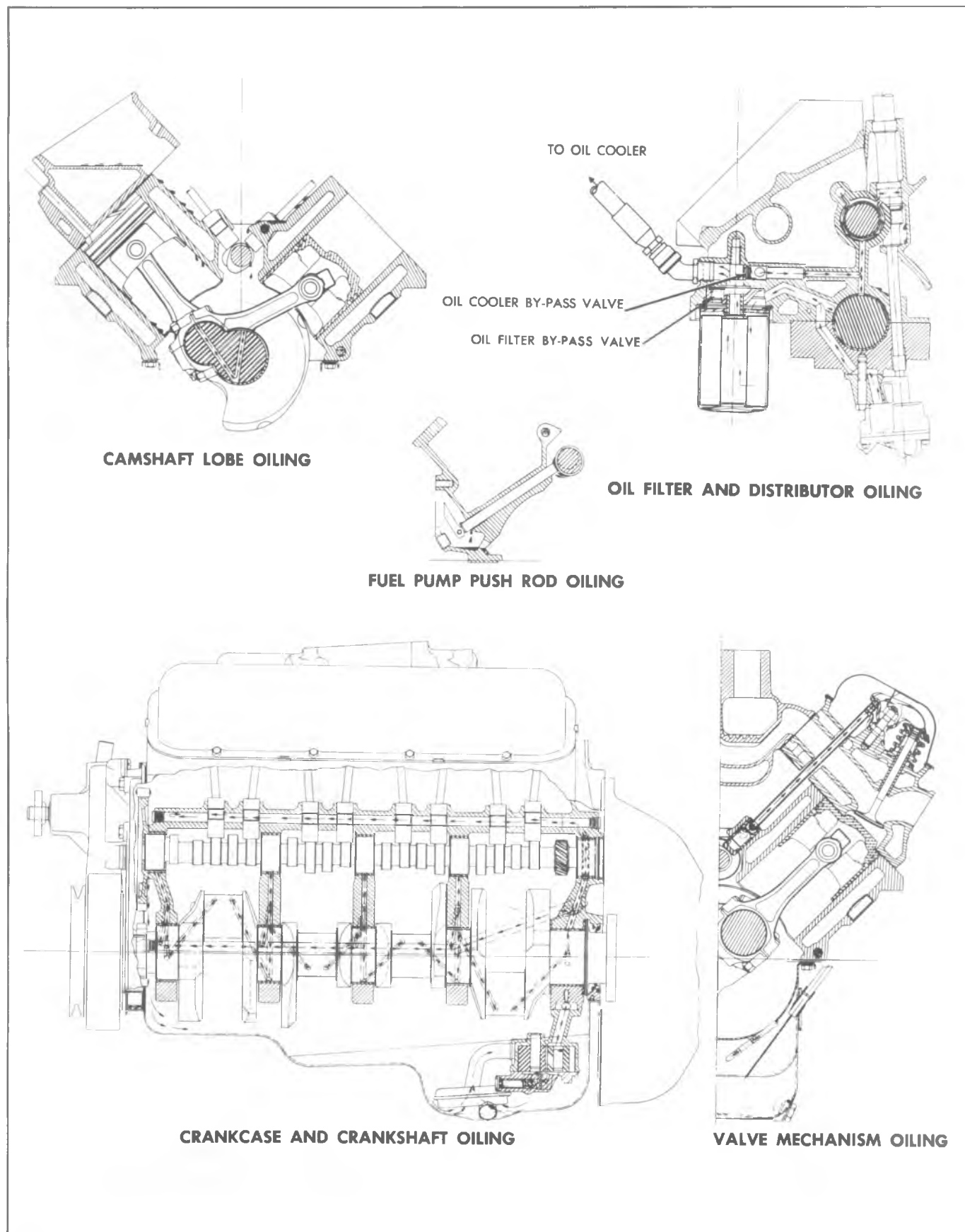
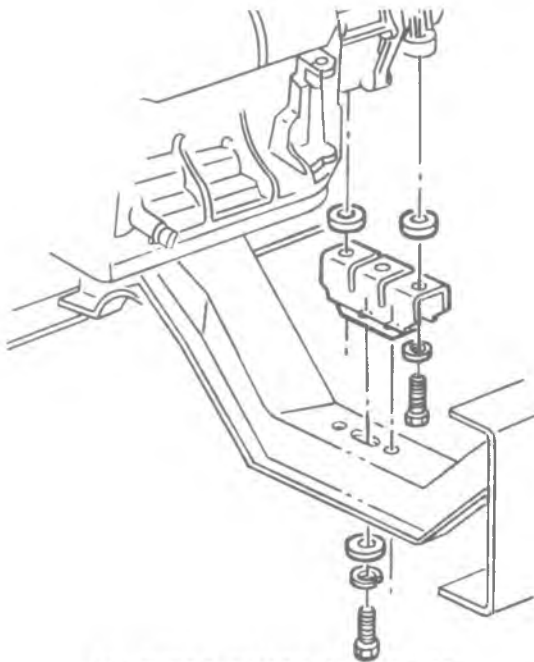
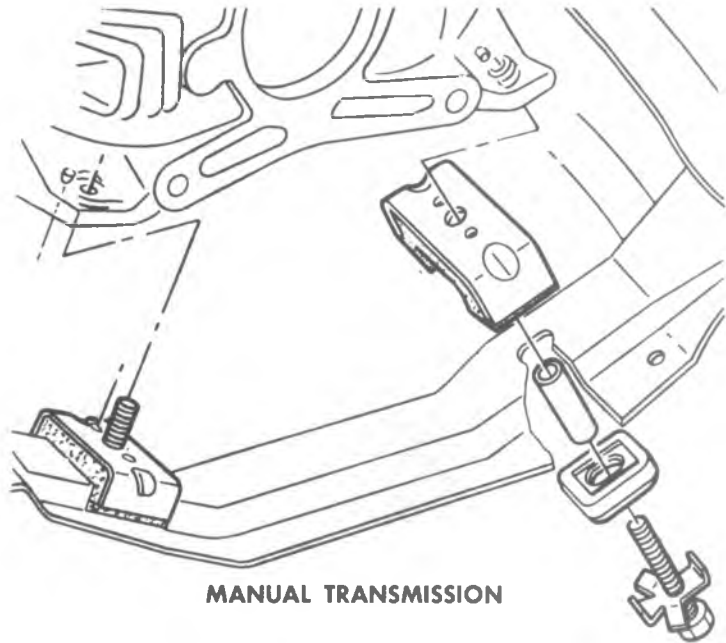


Fig. 6A5-3--"Mark IV" Engine Lubrication



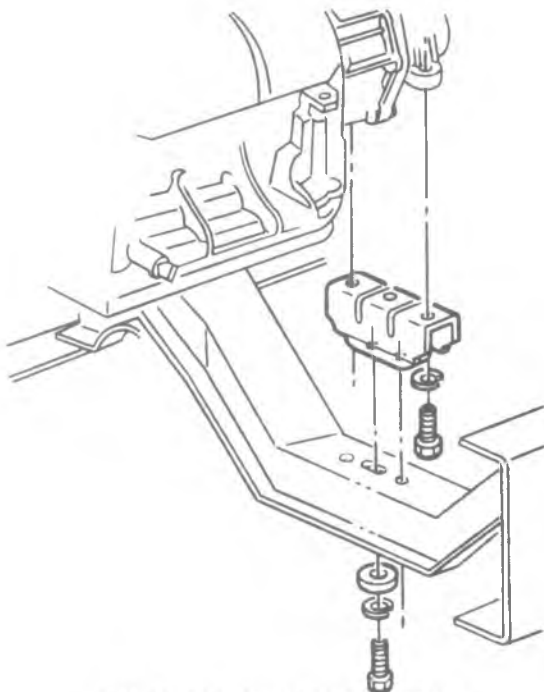
ALL TURBO HYDRA-MATIC 400
(EXCEPT MOBILE HOME CHASSIS)

WITHOUT PROPELLER SHAFT PARKING BRAKE



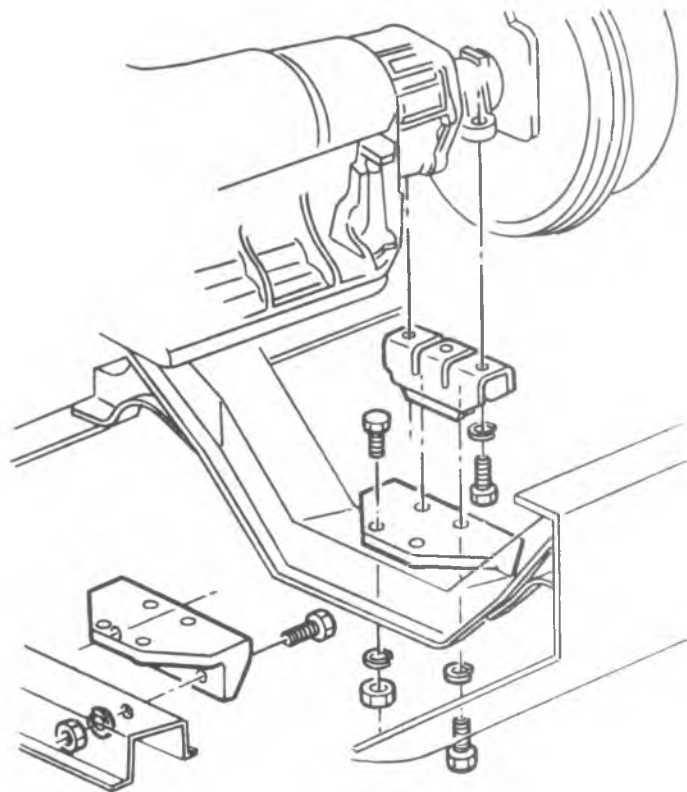
MANUAL TRANSMISSION

WITH PROPELLER SHAFT PARKING BRAKE



ALL MANUAL TRANSMISSION
ALL TURBO HYDRA-MATIC 350
ALL MOBILE HOME CHASSIS

WITHOUT PROPELLER SHAFT PARKING BRAKE



AUTOMATIC TRANSMISSION

WITH PROPELLER SHAFT PARKING BRAKE

Fig. 6A5-5--"P" Series Engine Rear Mount

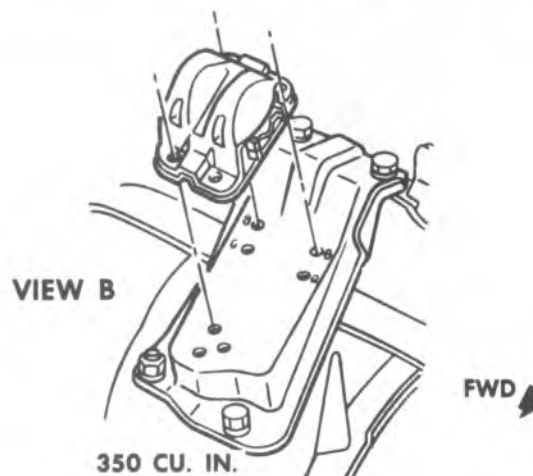
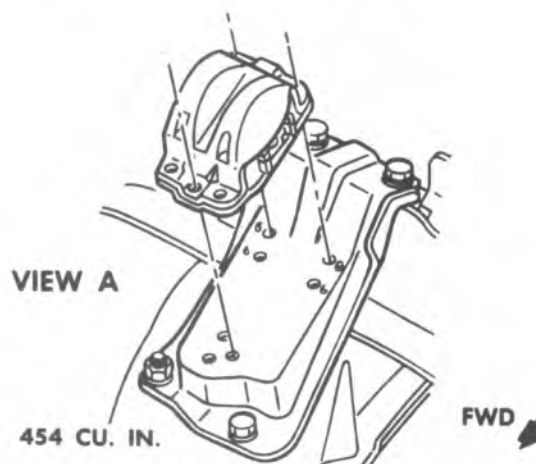
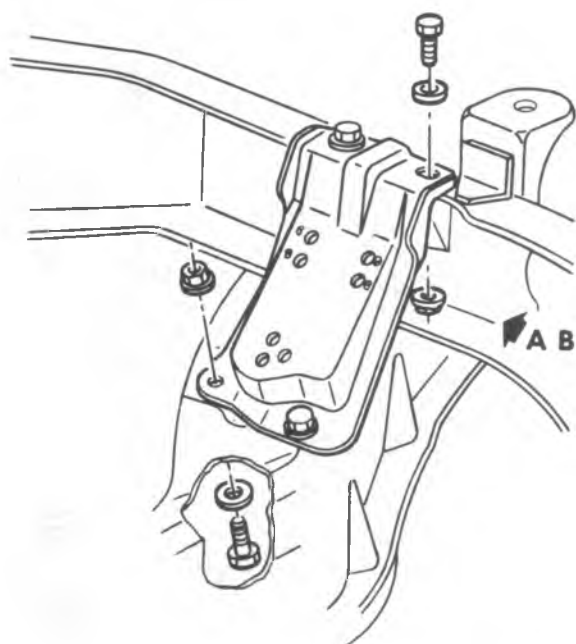
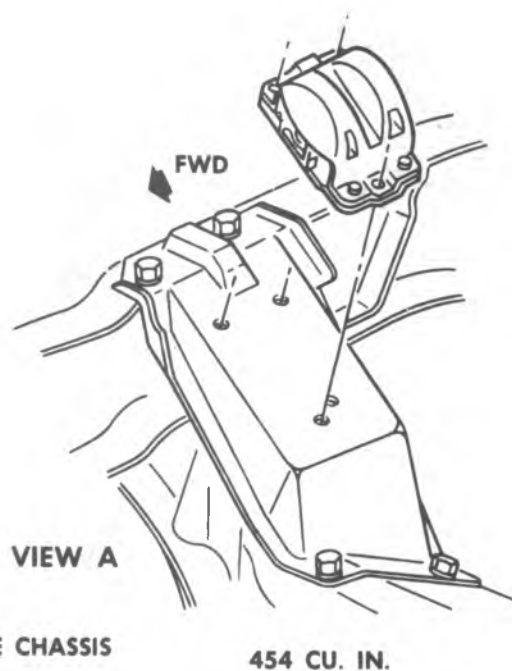
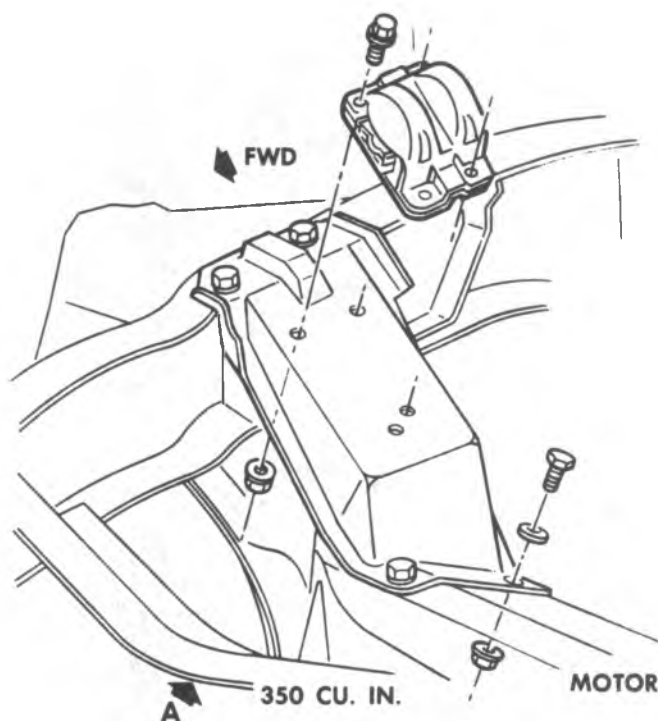


Fig. 6A5-6--"P" Series Engine Front Mount

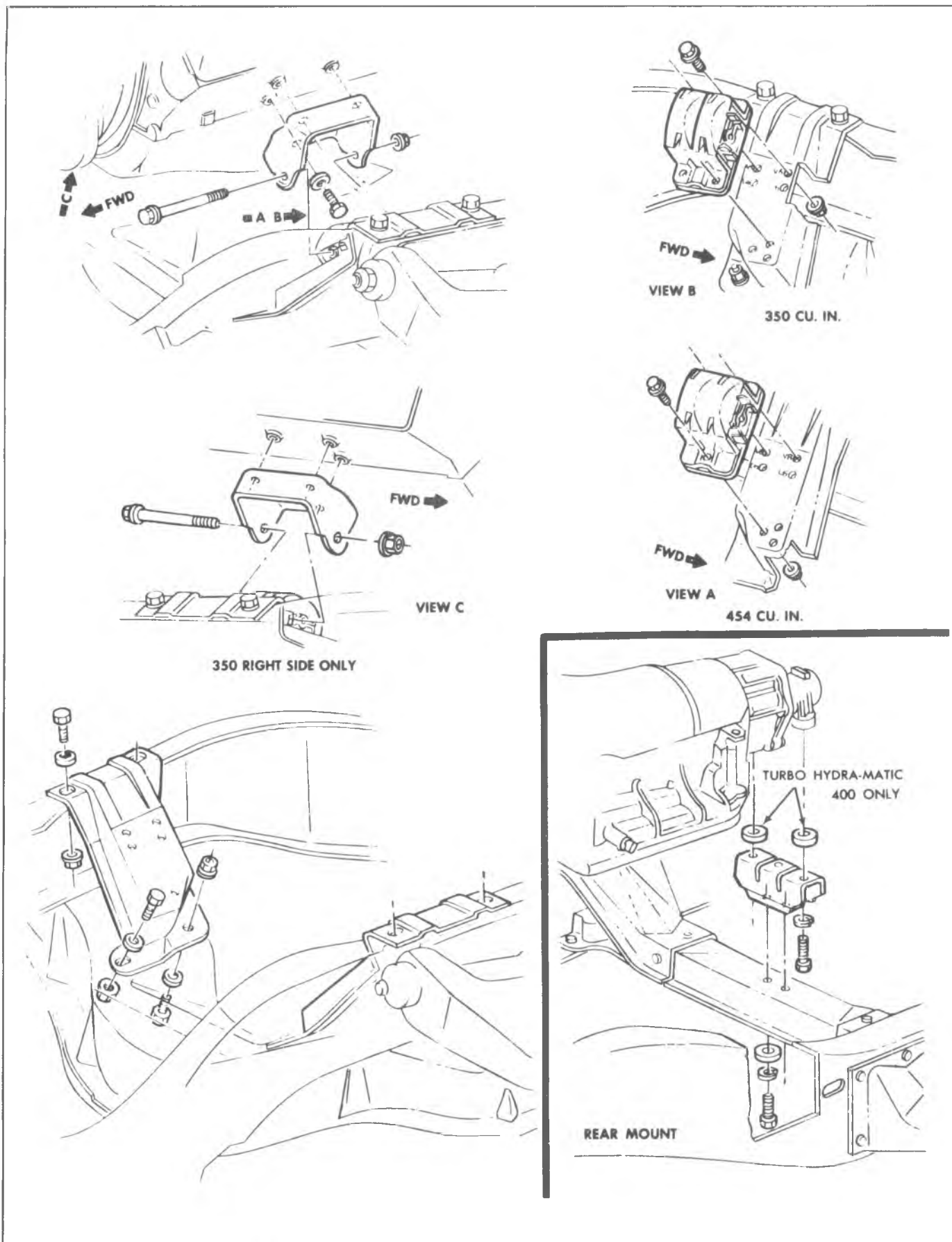


Fig. 6A5-7--"C" Series Engine Mounts

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:

- Hard rubber surface covered with heat check cracks;
- Rubber separated from a metal plate of the mount; or
- 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

- Remove mount retaining bolt from below frame mounting bracket.
- 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.
- Replace mount to engine and lower engine into place.
- Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

- Support engine weight to relieve rear mounts.
- Remove crossmember-to-mount bolts.
- 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.
- Remove mount-to-transmission bolts, then remove mount.
- On "P" Series with manual transmission and propeller shaft parking brake, install new mounting cushions and bolts.
- Install new mount on transmission.
- While lowering transmission, align and start crossmember-to-mount bolts.
- Torque bolts to specifications then bend lock tabs to bolt head as applicable.

INTAKE MANIFOLD

Removal

- Drain radiator and remove air cleaner.
- 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.
- Remove distributor cap and mark rotor position with chalk, then remove distributor.
- Remove (as required) air compressor and bracket, accelerator return spring and bracket, and accelerator bellcrank.
- Remove generator upper mounting bracket.
 - With A/C, remove rear compressor bracket.
- Remove manifold attaching bolts, then remove manifold and carburetor as an assembly. Discard gaskets and seals.
- 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

- Clean gasket and seal surfaces on manifold, block, and cylinder heads with degreaser.
- Install gaskets on cylinder heads and new end seals on block.
- Install manifold and torque bolts to specifications in the sequence outlined in fig. 6A5-8.
- Install (if removed) air compressor and bracket, accelerator bellcrank.

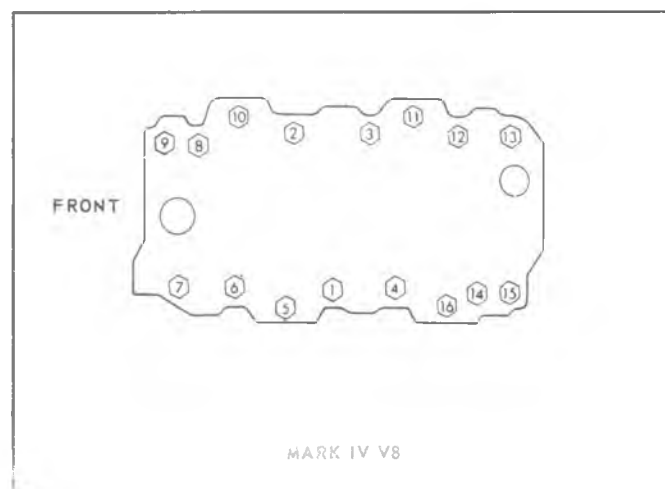


Fig. 6A5-8--Intake Manifold Torque Sequence

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.

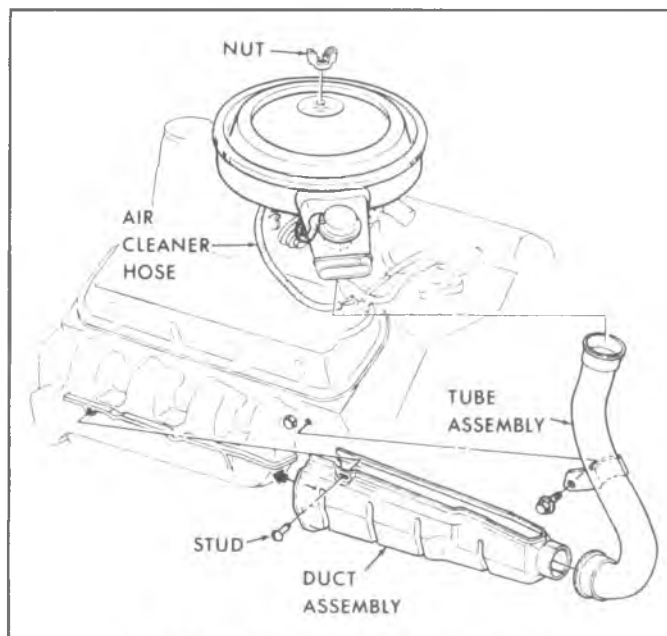


Fig. 6A5-9--Carburetor Heat Stove Assembly

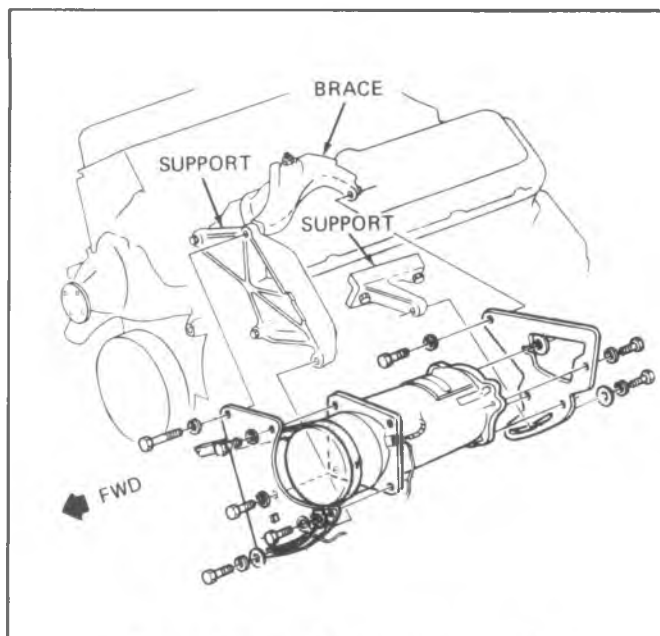


Fig. 6A5-10--A/C Compressor Mounting

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.

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.

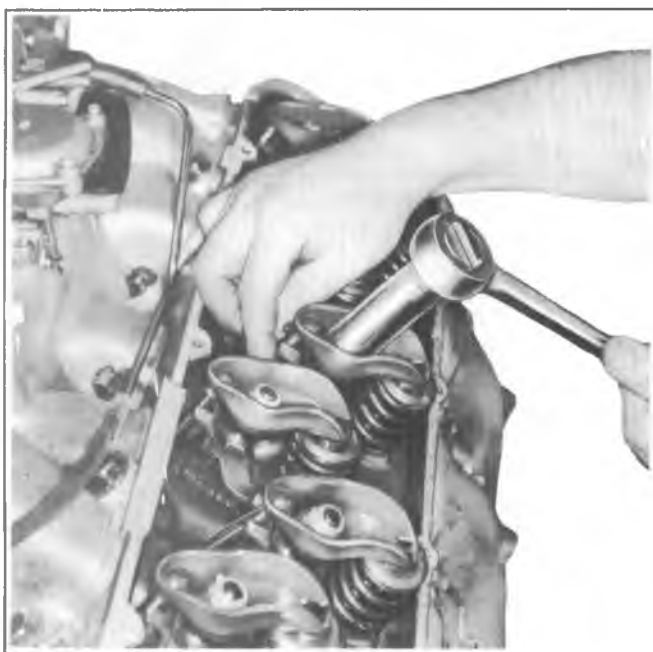


Fig. 6A5-11--Valve Adjustment



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).

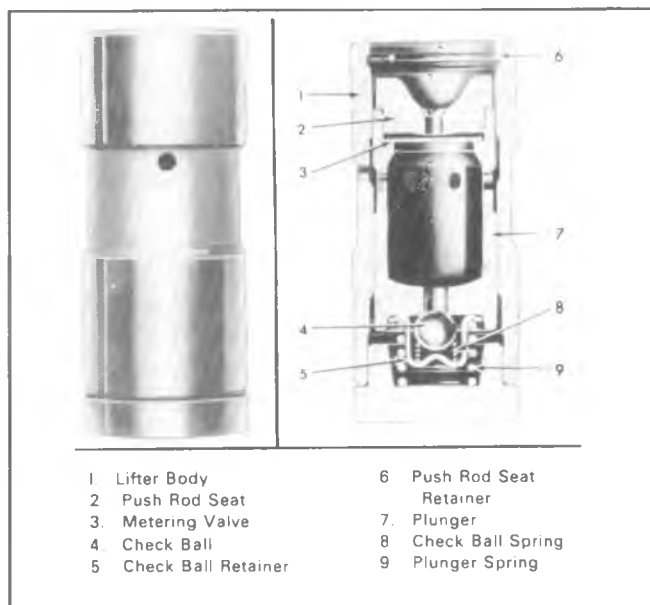


Fig. 6A5-14--Hydraulic Valve Lifter



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).

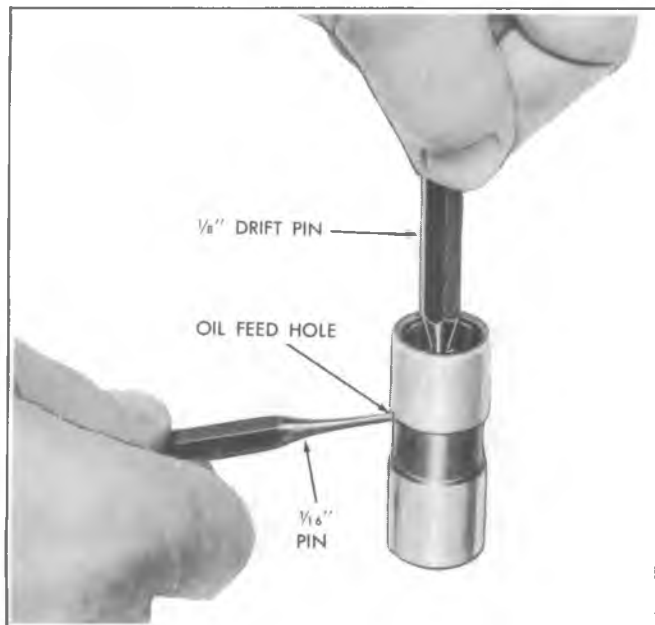


Fig. 6A5-17--Assembling Hydraulic Lifter

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.

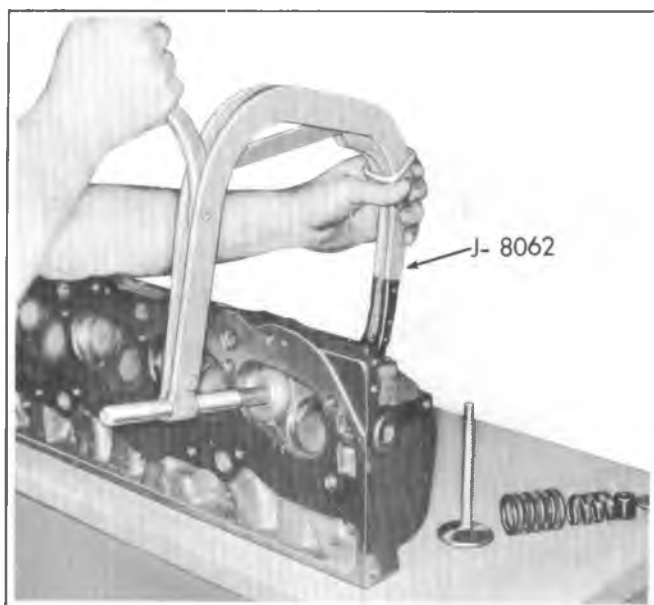


Fig. 6A5-18--Compressing Valve Spring

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.

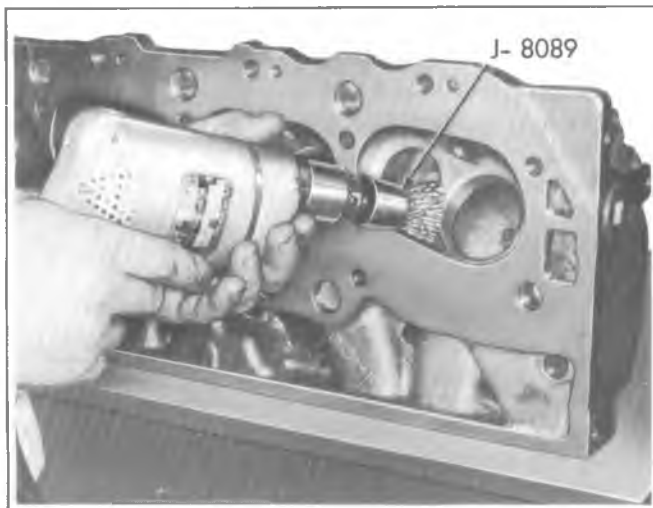


Fig. 6A5-19--Cleaning Combustion Chambers

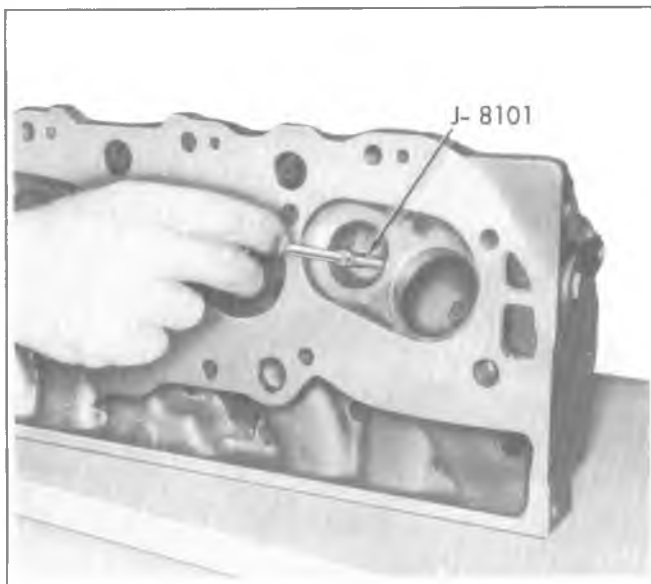


Fig. 6A5-20--Cleaning Valve Guides

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

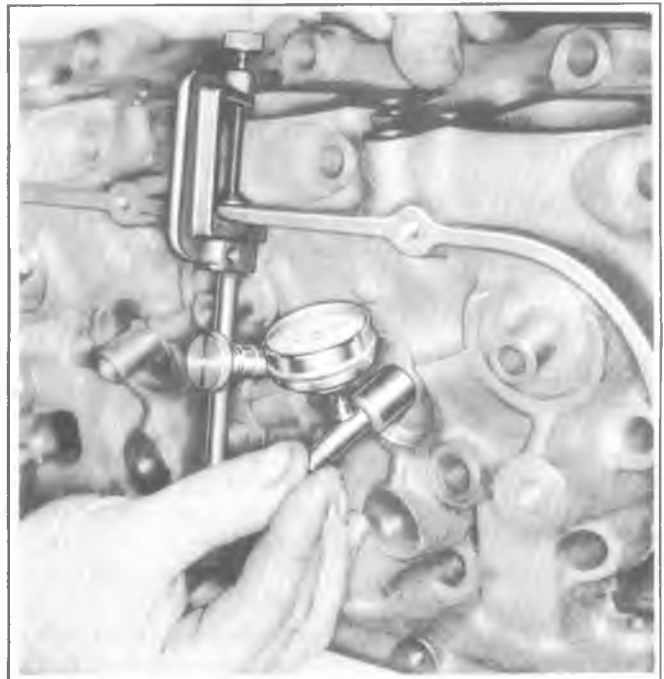


Fig. 6A5-21--Measuring Valve Stem Clearances



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 or 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.

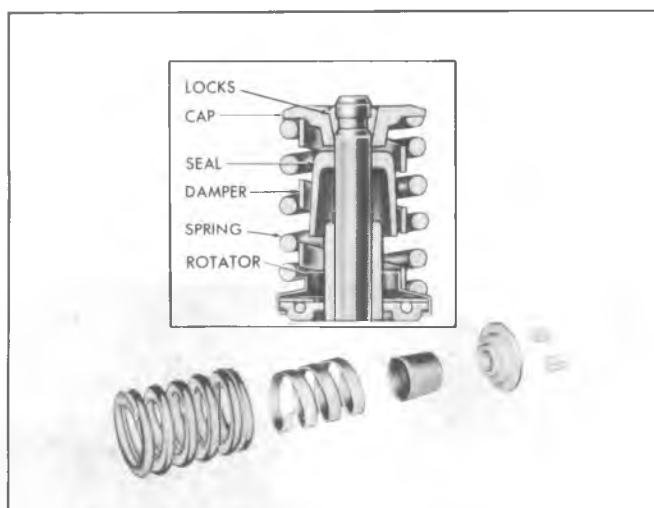


Fig. 6A5-23--Valve Spring Installation

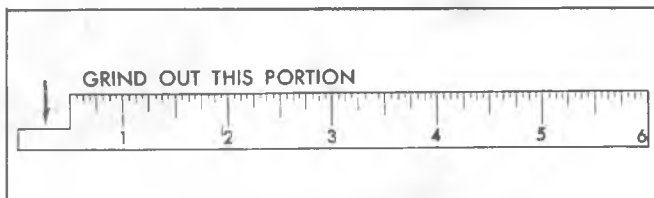


Fig. 6A5-24--Cutaway Scale

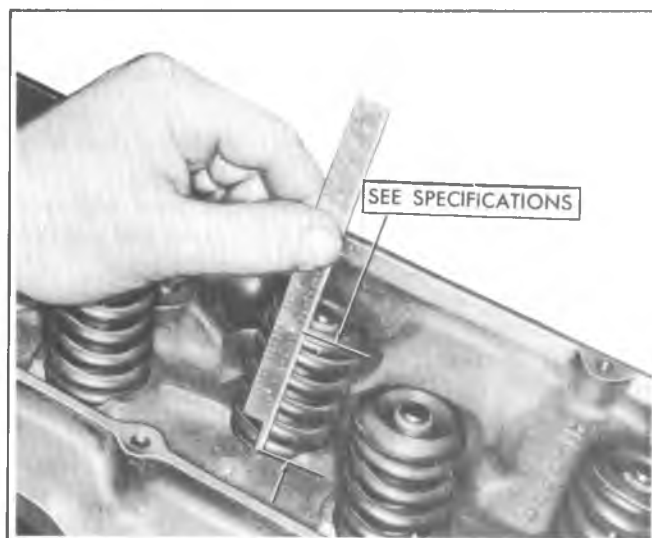


Fig. 6A5-25--Measuring Valve Spring Installed Height

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.

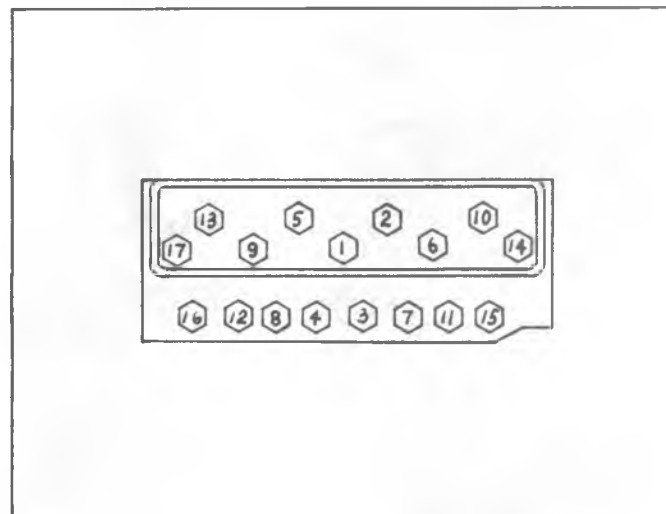


Fig. 6A5-26--Cylinder Head Torque Sequence

- 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

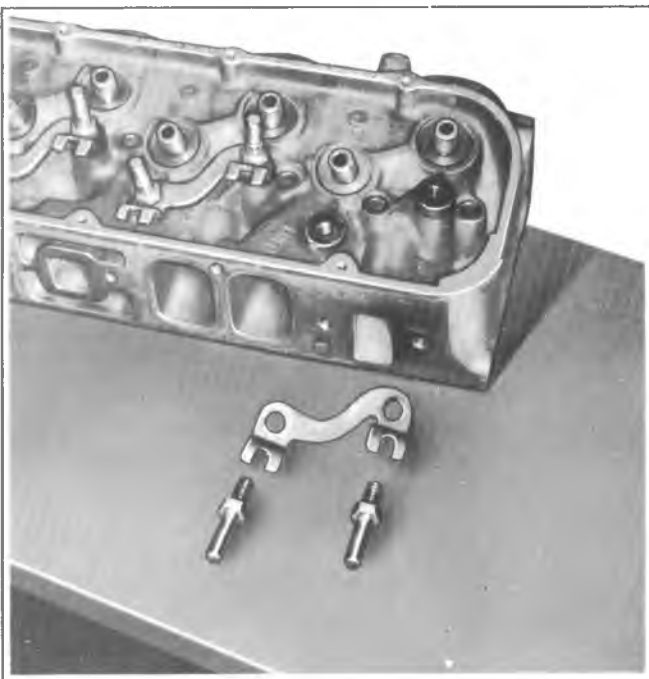


Fig. 6A5-27--Rocker Arm Stud & Push Rod Guide

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 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.

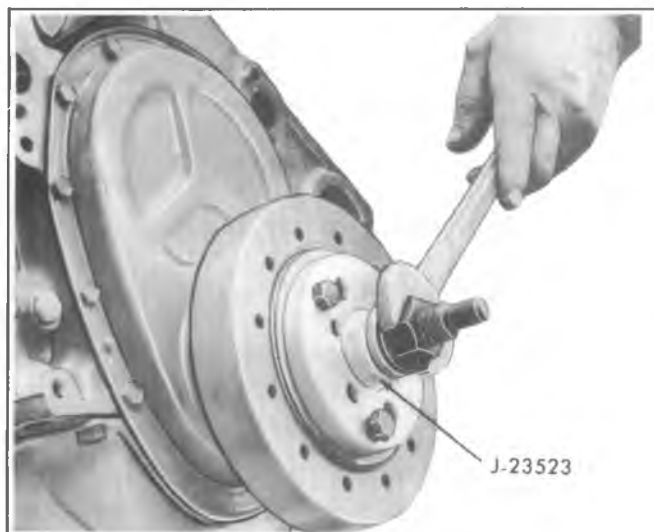


Fig. 6A5-30--Installing Torsional Damper

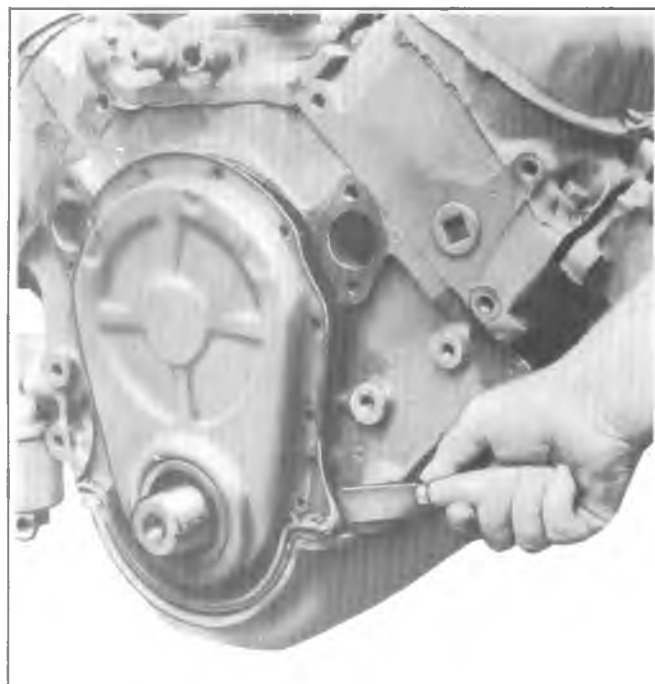


Fig. 6A5-31--Cutting Tabs on Oil Pan Front Seal

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.

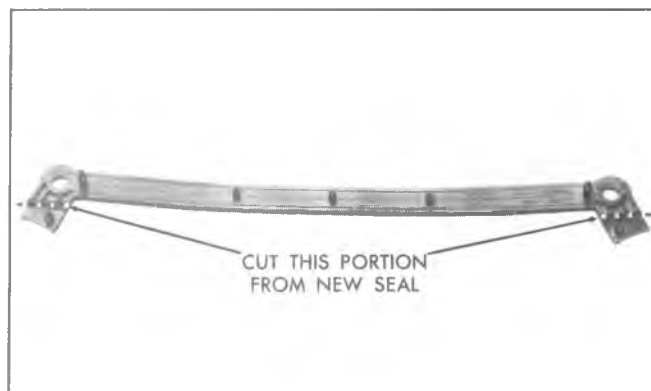


Fig. 6A5-32--Oil Pan Front Seal Modification

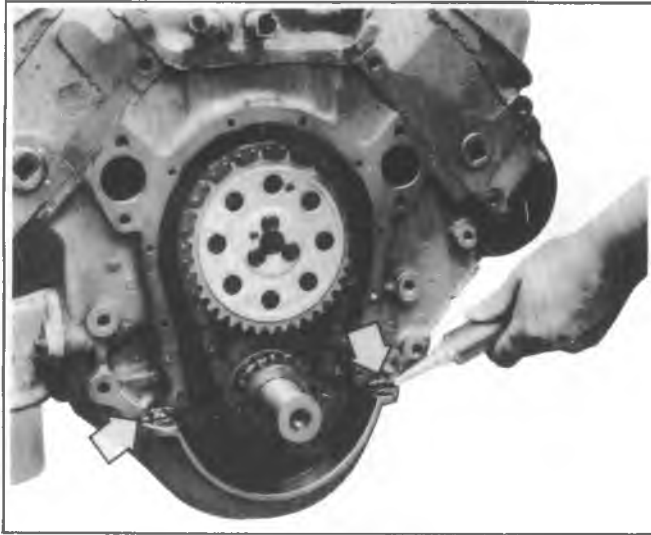


Fig. 6A5-33--Applying Front Cover Sealer

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).

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,

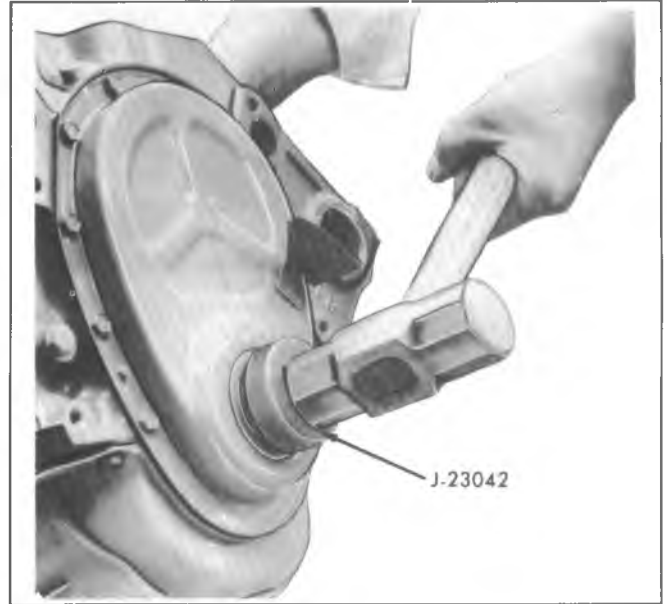


Fig. 6A5-34--Installing Oil Seal

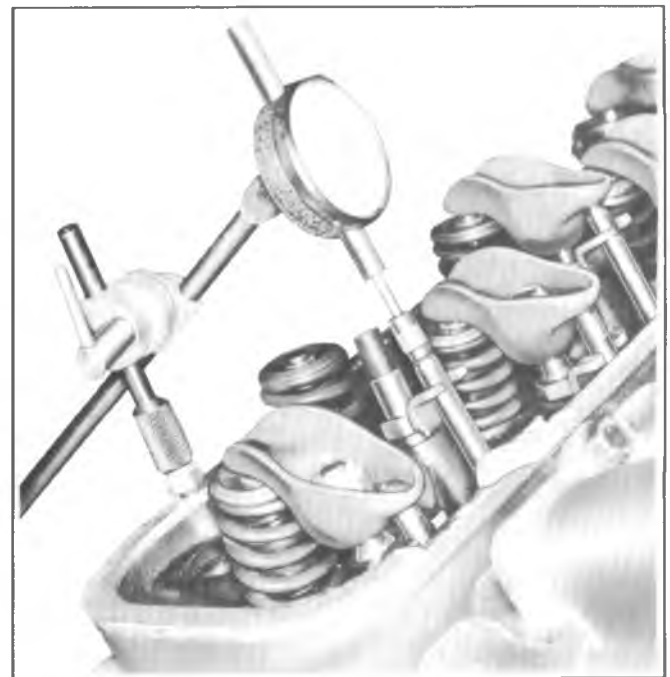


Fig. 6A5-35--Measuring Camshaft Lobe Lift

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.

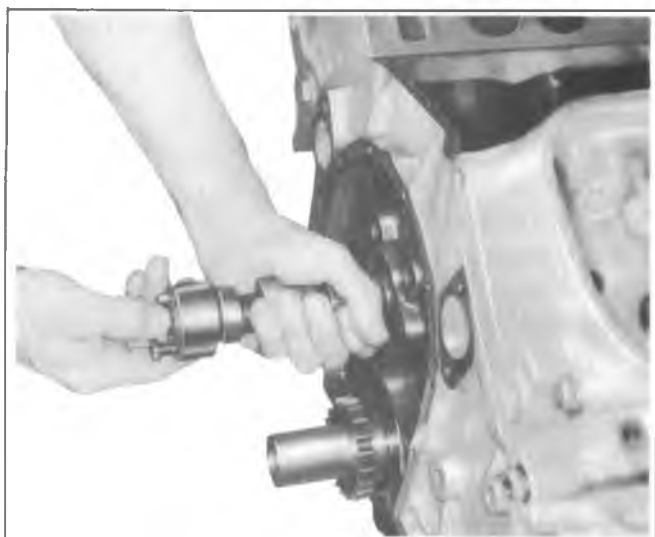


Fig. 6A5-36--Removing Camshaft

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.

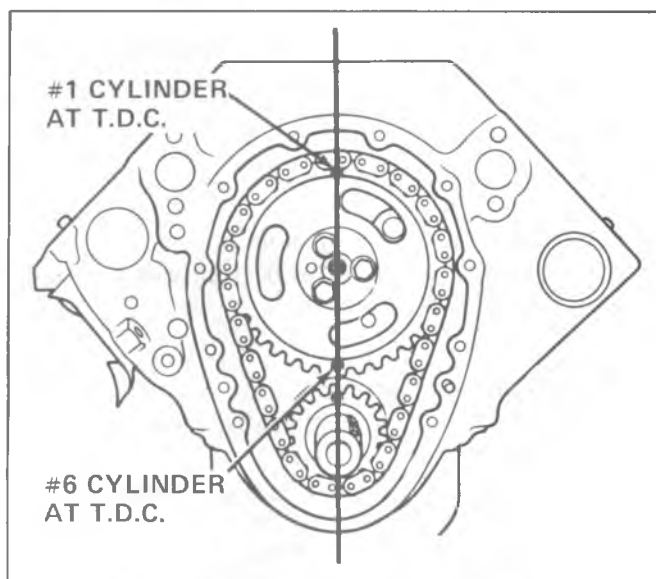


Fig. 6A5-37--Timing Sprocket Alignment Marks

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.

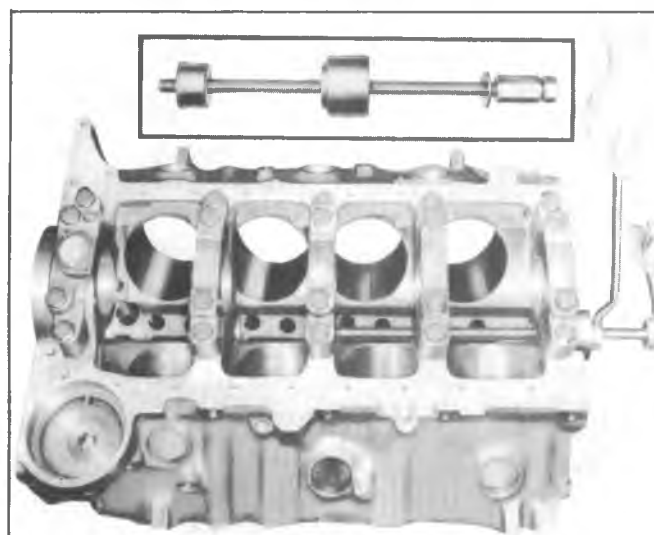


Fig. 6A5-38--Removing Camshaft Bearings

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.

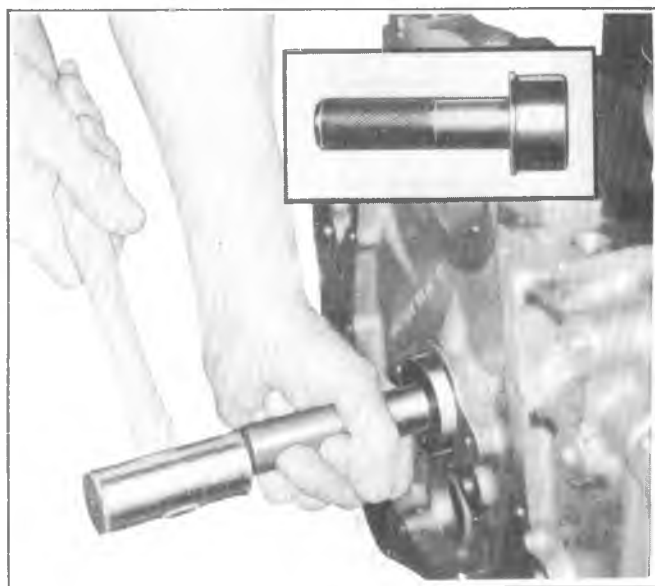


Fig. 6A5-39--Replacing Camshaft Front Bearing

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. (15 N·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.

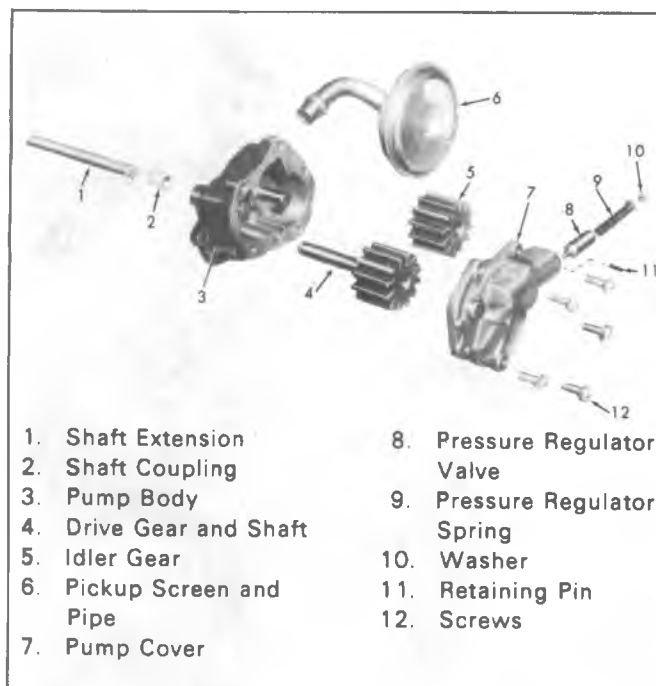


Fig. 6A5-40—Oil Pump

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, pipe or relief grommet.
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" under-size 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.

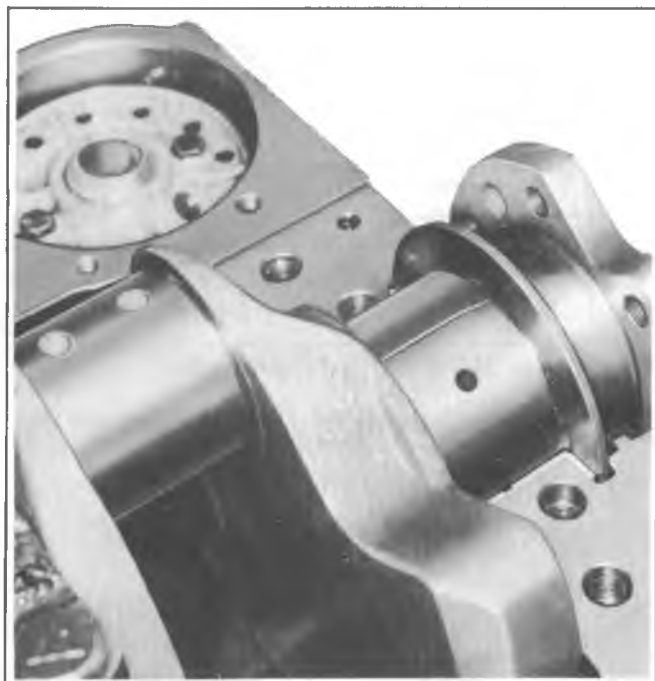


Fig. 6A5-44--Gaging Plastic on Journal

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.

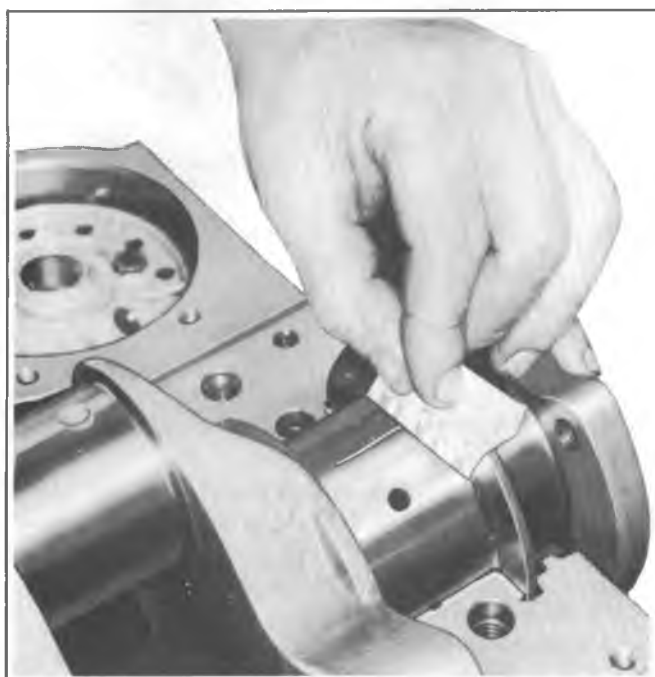


Fig. 6A5-45--Measuring Gaging Plastic

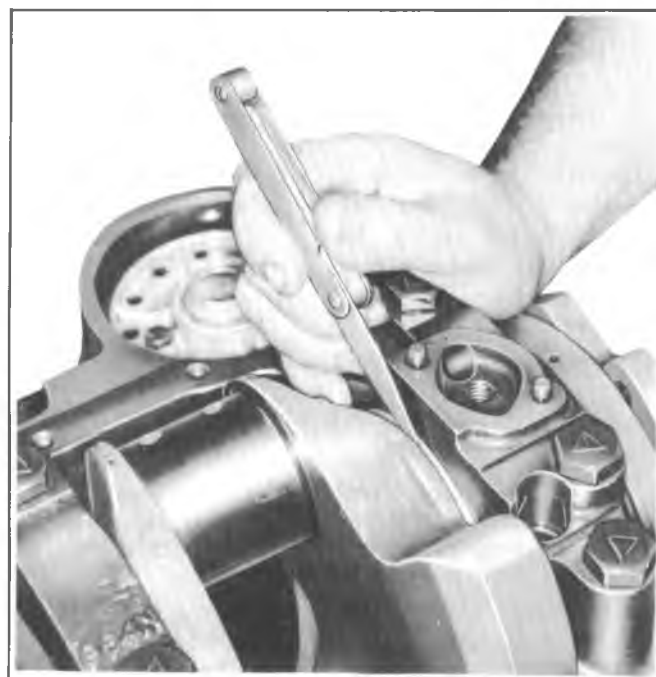


Fig. 6A5-46--Measuring Crankshaft End Play

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 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 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. (14-16 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)

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).

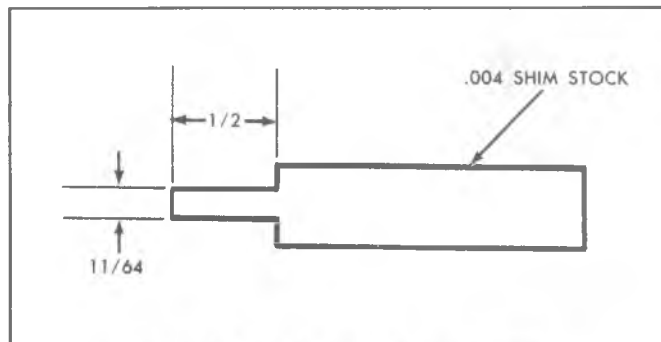


Fig. 6A5-47--Oil Seal Installation Tool



Fig. 6A5-48--Removing Oil Seal - Lower Half

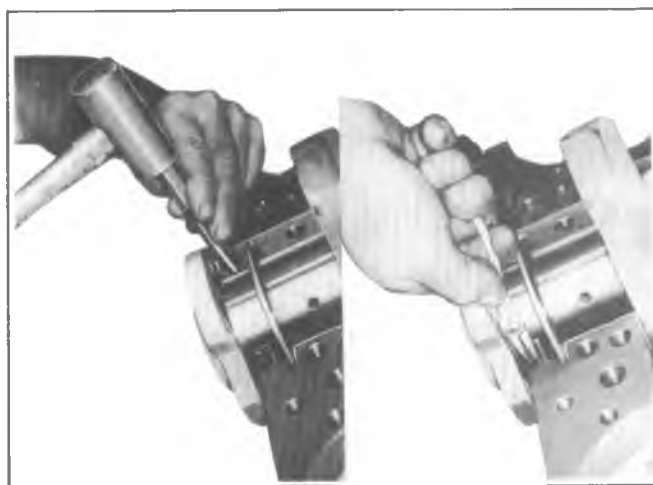


Fig. 6A5-49--Removing Oil Seal - Upper Half

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 crankshaft first rearward then forward with lead hammer. This will line up thrust surfaces. Retorque bearing cap to specifications.

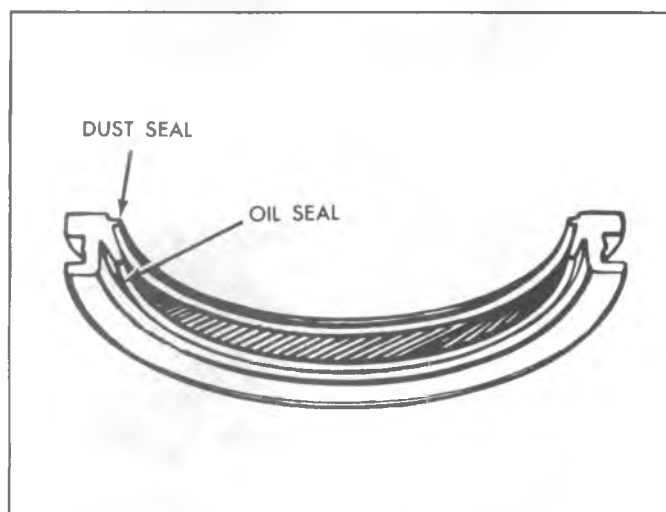


Fig. 6A5-50--Crankshaft Oil Seal - Rear Main

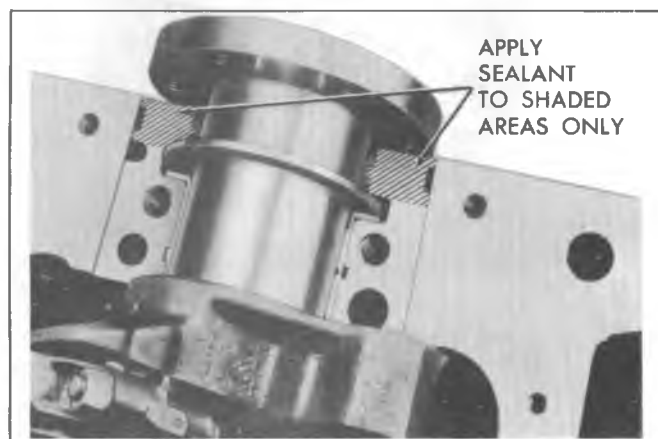


Fig. 6A5-51--Sealing Bearing Cap

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).

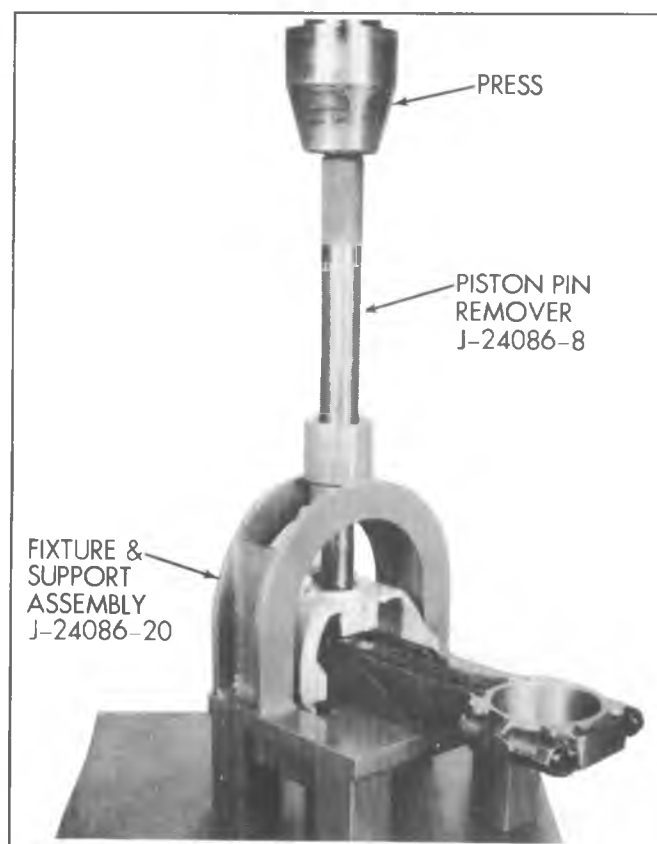


Fig. 6A5-52--Removing Piston Pin

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 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.

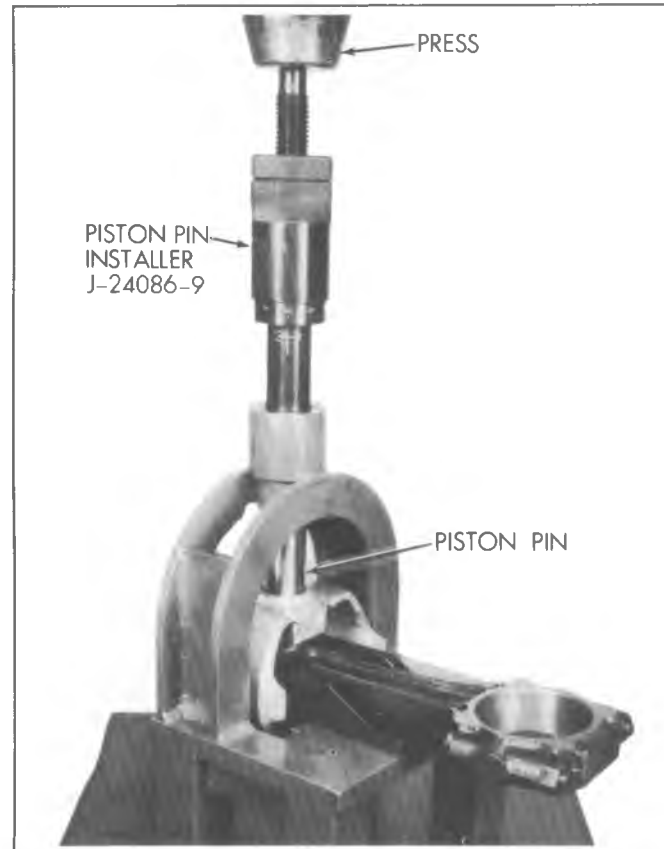


Fig. 6A5-53--Installing Piston Pin

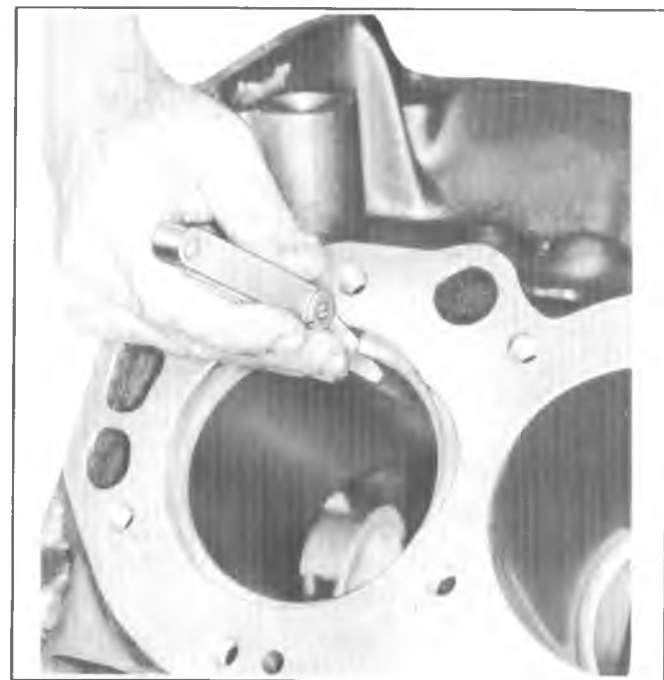


Fig. 6A5-54--Measuring Ring Gap

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

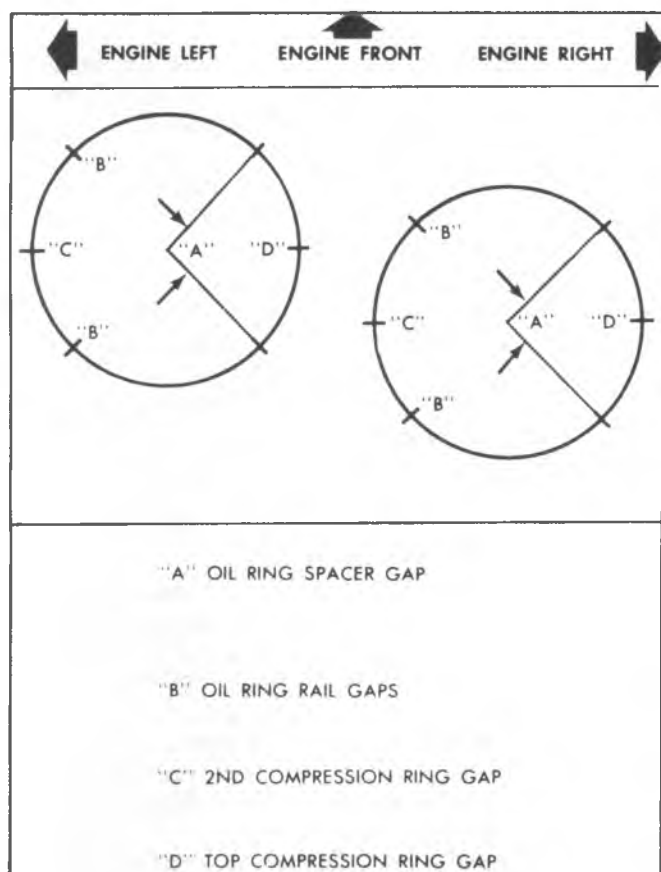


Fig. 6A5-56--Ring Gap Location

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 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 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 than .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 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

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
 - Distributor
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.

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

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

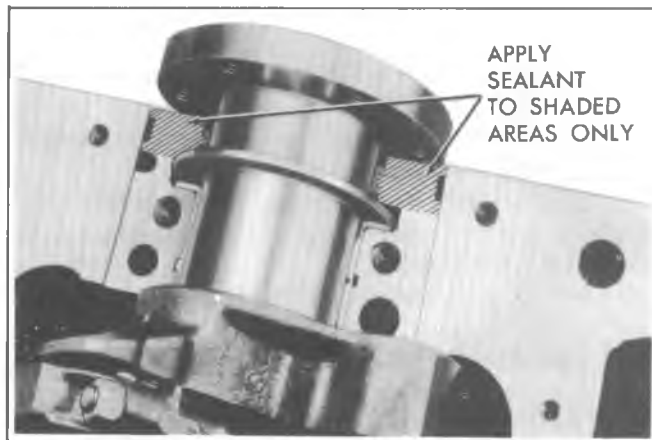


Fig. 6A5-58--Sealing Bearing Cap

- 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. 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		8.5:1
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	PRODUC-TION	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			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 p.s.i. of 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 burning.

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 tank which signals high water levels and a need for siphoning. Additional water separation, with a drain, is provided at the primary filter mounted on front of dash.

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.

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 fuel flow filter becomes clogged, the engine is equipped with a 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 also a second by-pass valve. This is the oil cooler by-pass valve. It works much the same as the oil filter by-pass valve and opens to allow an alternate route for the oil if the cooler should become clogged.

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 70 percent of the highest and no cylinder reading should be less than 275 p.s.i. (1900 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

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.

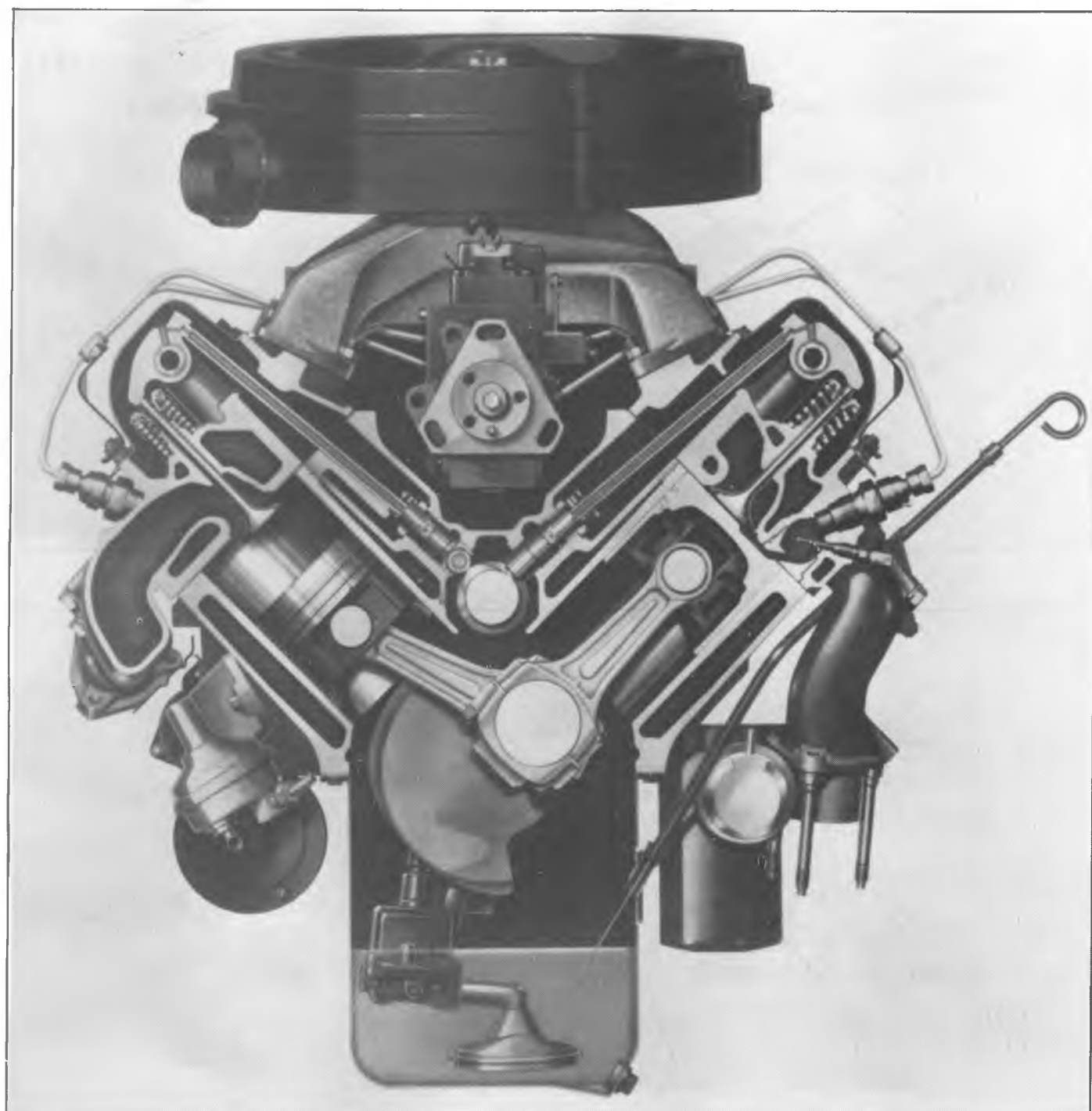
Replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

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.



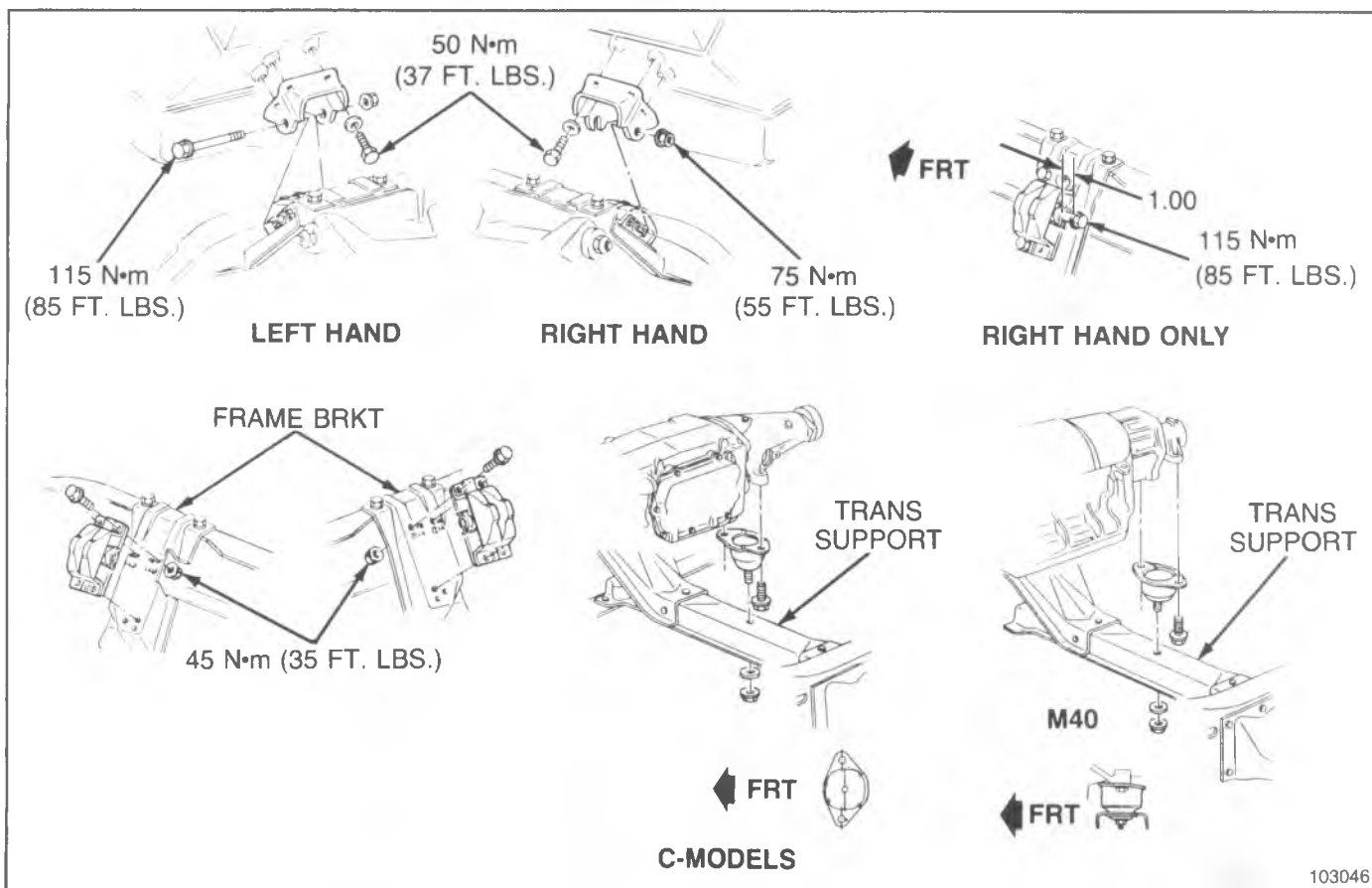


Fig. 6A7-1--Engine Mount C-Model

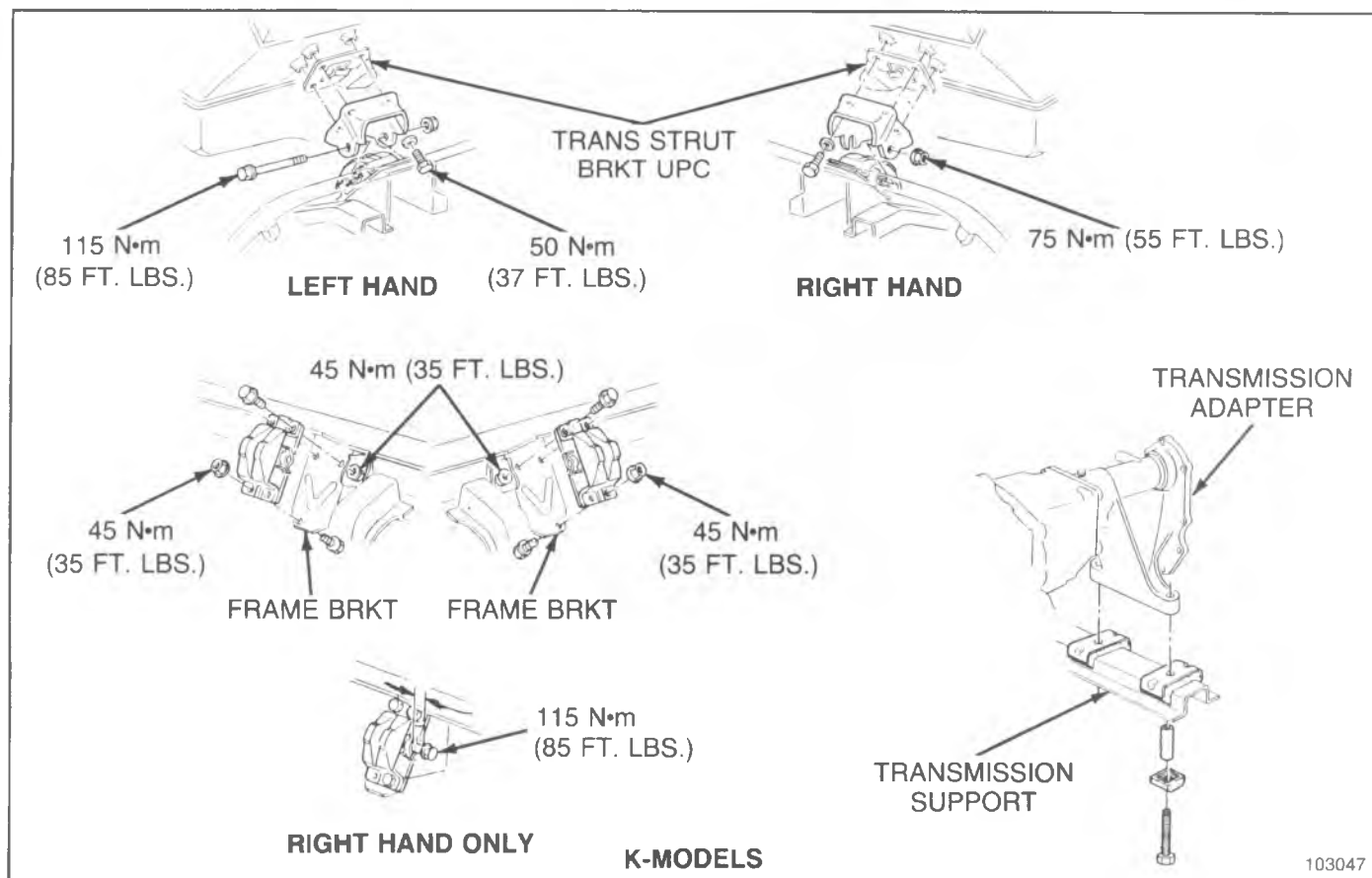


Fig. 6A7-2--Engine Mount K-Model

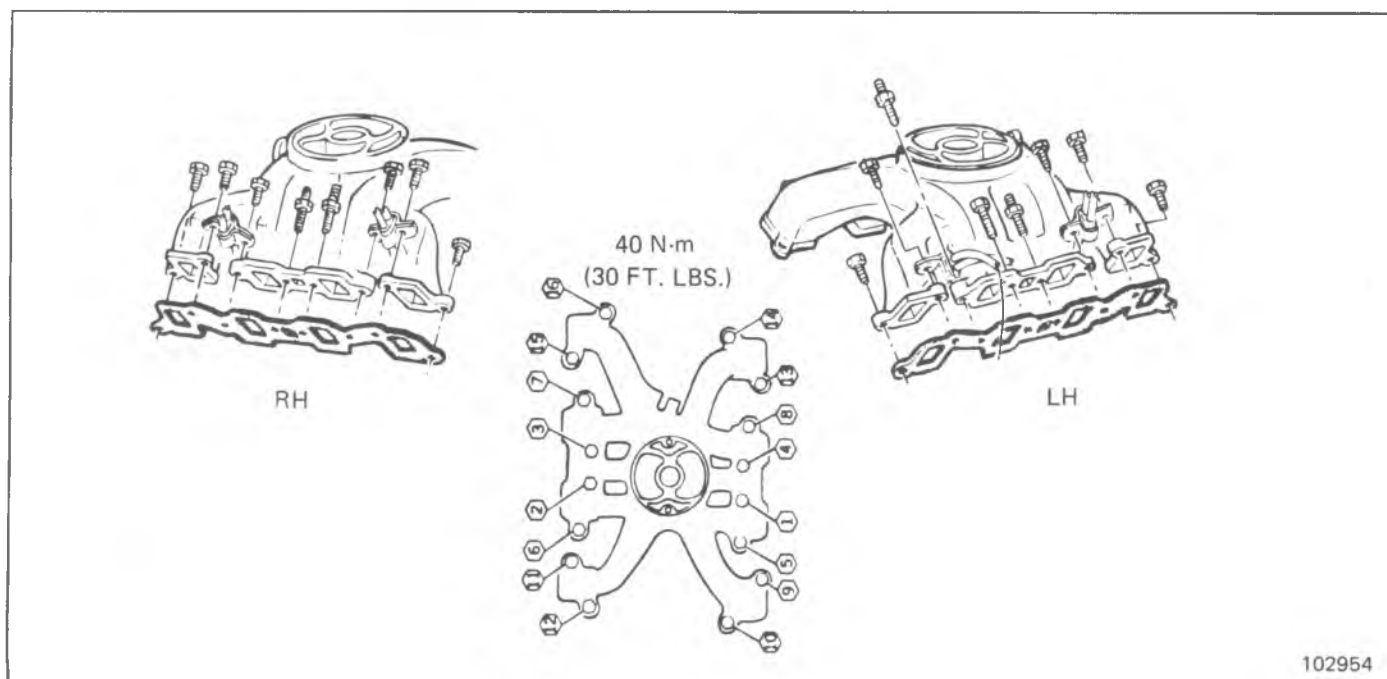


Fig. 6A7-4--Intake Manifold

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)

Removal and Installation (Right Side)

1. Disconnect battery.
2. Raise vehicle.

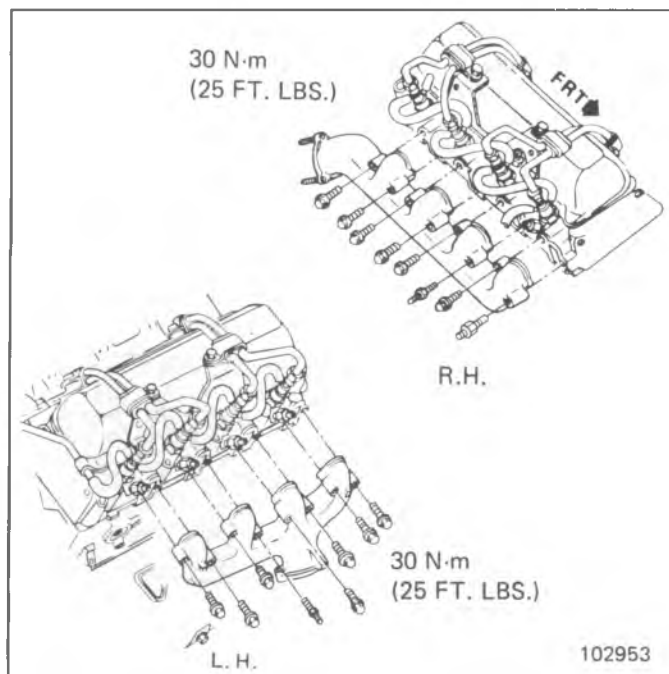


Fig. 6A7-3--Exhaust Manifold

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 6A7-4 for proper bolt torque.

Removal and Installation (Left Side)

1. Disconnect battery.
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 6A7-4 for proper bolt torque.

INTAKE MANIFOLD (Fig. 6A7-4)

Removal

1. Disconnect battery.
2. Remove air cleaner.
3. Remove crankcase ventilator tubes.
4. Disconnect secondary filter lines.
5. Remove secondary filter and adapter.
6. Loosen vacuum pump hold down clamp and rotate pump in order to gain access to manifold bolt.
7. Remove intake manifold bolts. Injection line clips are retained by the same bolts.
8. Remove intake manifold.

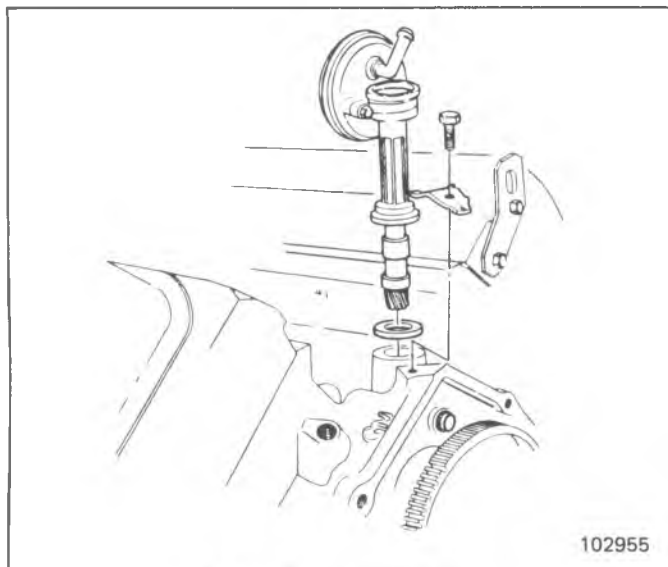


Fig. 6A7-5-Vacuum Pump

9. 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 as shown.
6. Fill secondary filter with clean diesel fuel prior to reinstallation.
7. Refer to Section 6C6 for fuel line installation.
8. For the remainder of the installation procedures reverse removal.

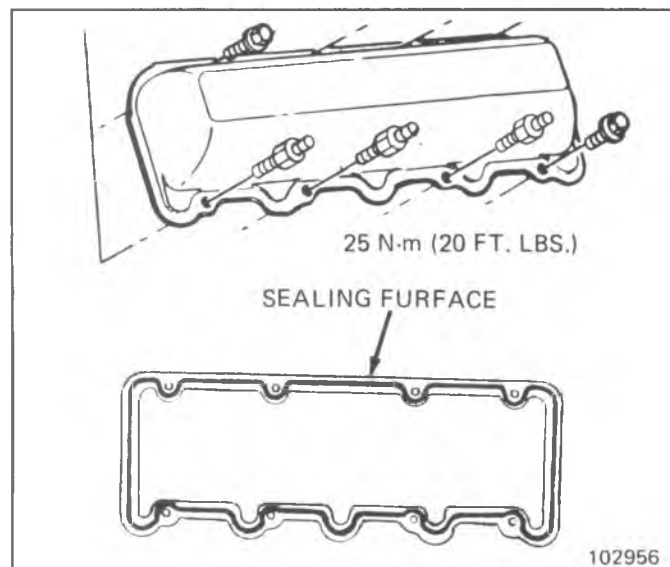


Fig. 6A7-6-Rocker Arm Cover

VACUUM PUMP (Fig. 6A7-5)

Removal

1. Disconnect battery.
2. Remove air cleaner. Cover intake manifold.
3. Remove vacuum pump clamp.
4. Remove pump.

Installation

1. Install new gasket
2. Install vacuum pump as shown.
3. For remainder of installation reverse removal procedures.

ROCKER ARM COVER (Fig. 6A7-6)

Removal

1. Remove intake manifold as previously outlined.
2. Remove injection lines as outlined in Section 6C6 (#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 4mm diameter (3/16") bead of RTV sealant #1052366 or equivalent all around the rocker cover 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 Section 6C6.
6. With protective covers J-29664-1 installed start engine and check for leaks at line fittings.

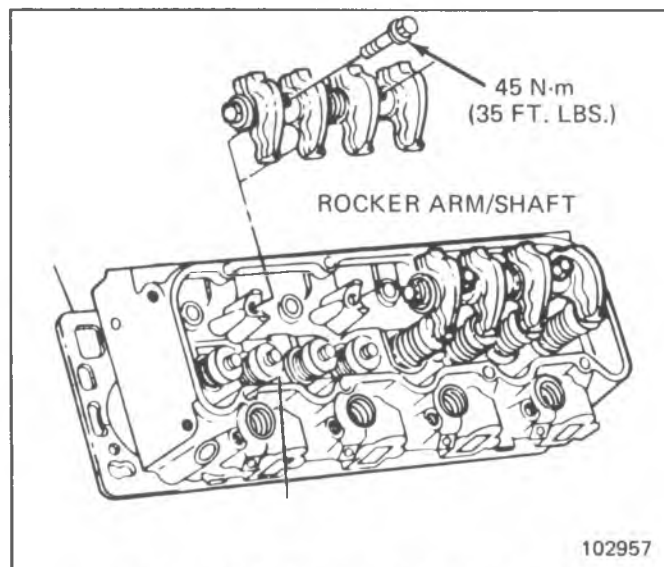


Fig. 6A7-7-Rocker Arm Shaft/Pushrods

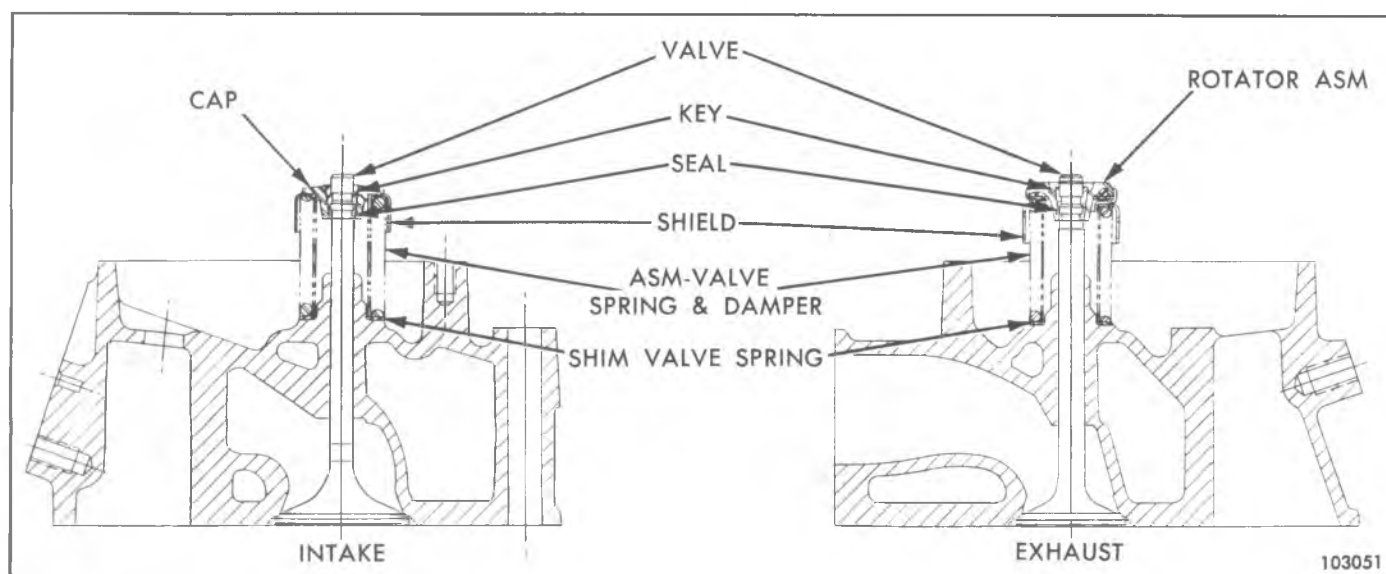


Fig. 6A7-8--Valve Assembly

7. Stop engine.
8. Install intake manifold as previously outlined.

ROCKER ARM AND SHAFT/PUSHRODS (Fig. 6A7-7)

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.

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 (35 ft. lbs.).

VALVE STEM OIL SEAL/OR VALVE SPRING

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 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)

Removal

1. Remove injection lines and intake manifold as previously outlined.
2. Remove rocker arm covers as previously outlined.
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

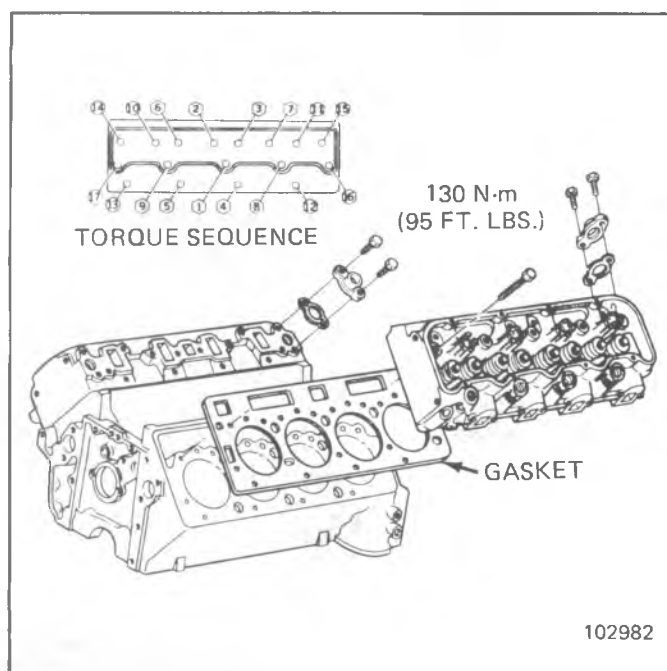


Fig. 6A7-9--Cylinder Head and Gasket

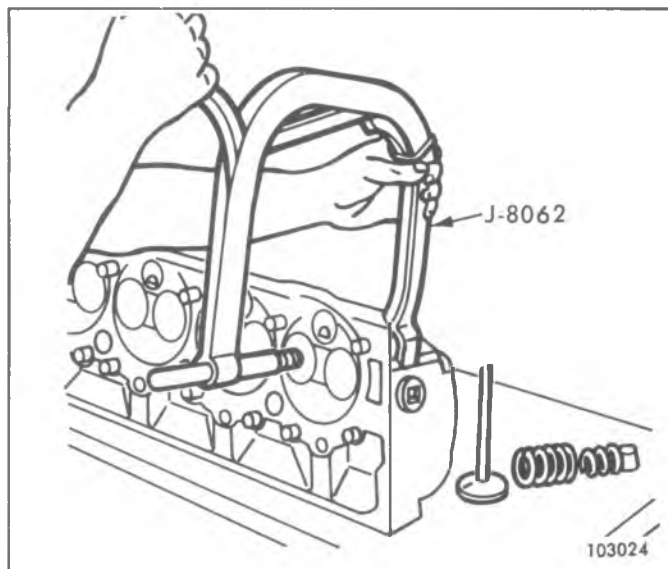


Fig. 6A7-10--Compressing Valve Spring

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.

Disassembly

1. With cylinder head removed using tool J-8062, compress the valve springs (figure 6A7-10) and remove

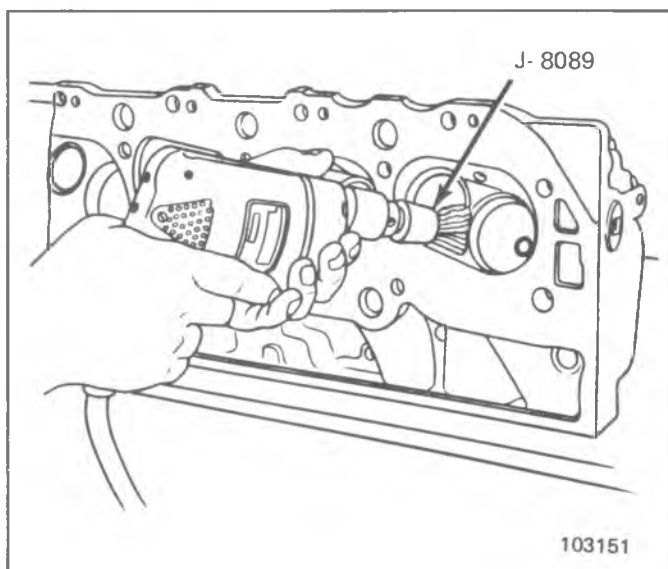


Fig. 6A7-11--Cleaning Combustion Chamber

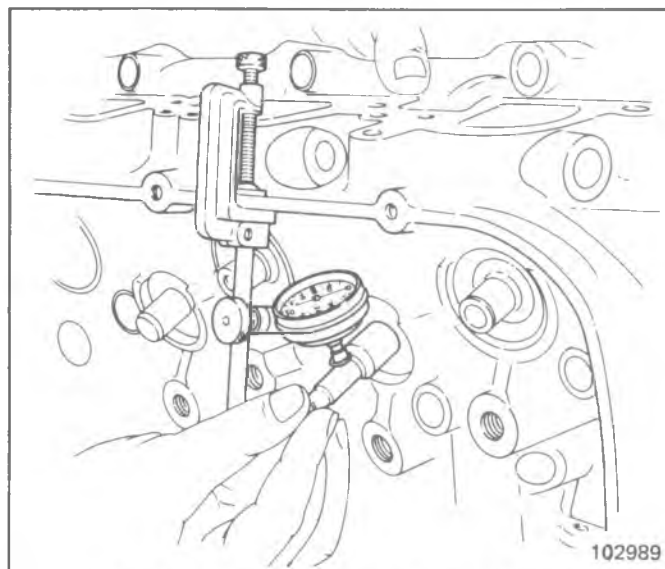


Fig. 6A7-12--Measuring Valve Stem Clearance

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.

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.
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.

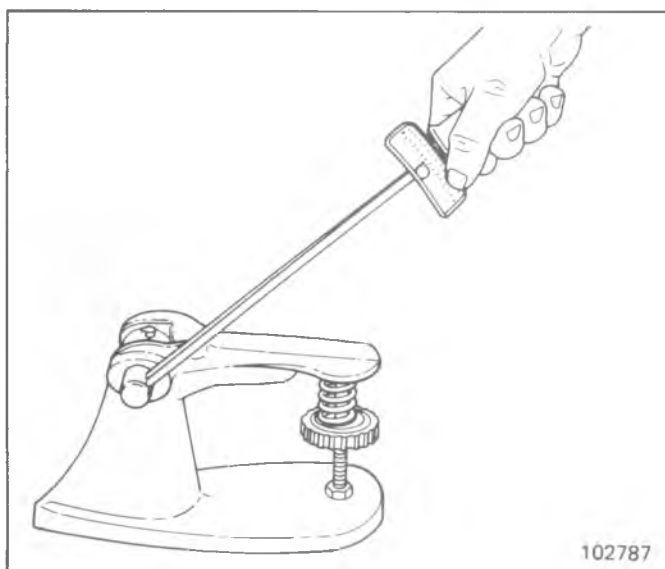


Fig. 6A7-13--Checking Valve Spring Tension

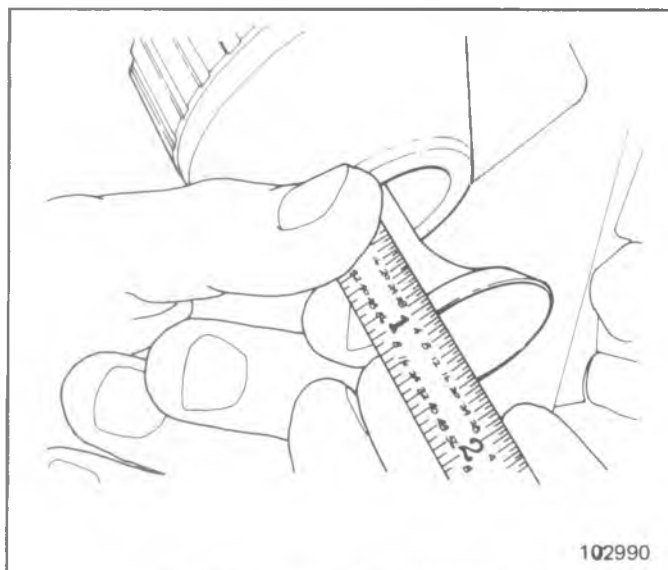


Fig. 6A7-14--Measuring Valve Head

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.
 - 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).

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.

NOTICE: Valve seats are induction hardened. Excessive stock removal could cause damage to the seat.

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.

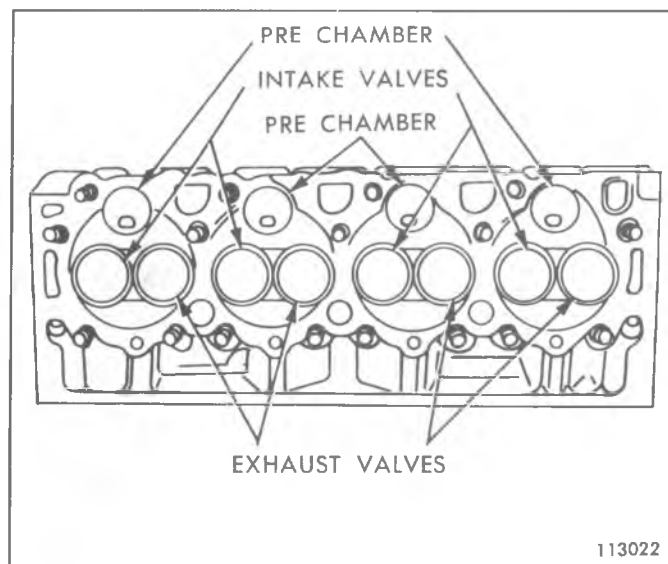


Fig. 6A7-15--Valve Location

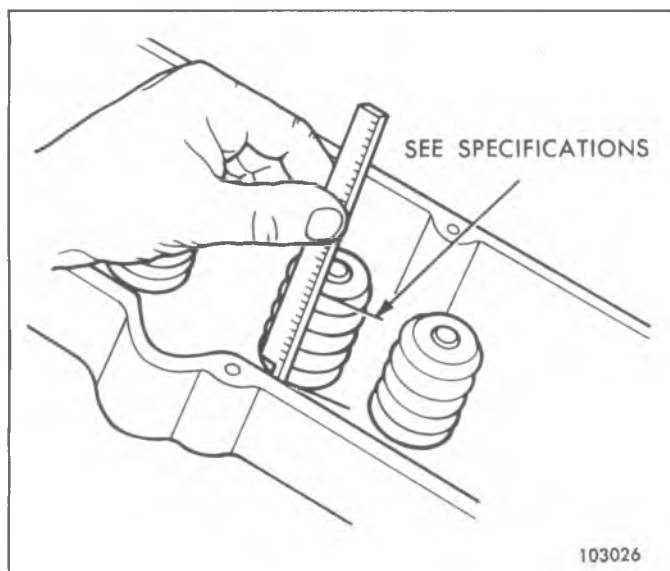


Fig. 6A7-16--Installed Height

- 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.
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"

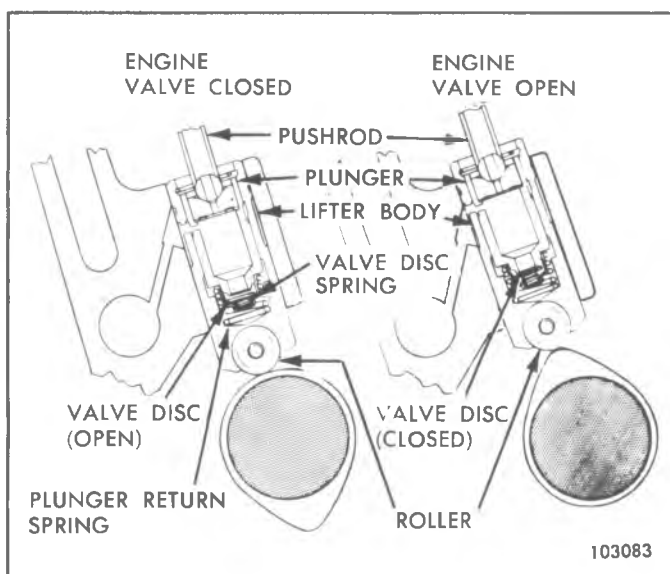


Fig. 6A7-17--Valve Lifter-Cutaway View

socket to reinstall pre-chamber and install in cylinder head. The pre-chamber should be flush to .002" above the face of the head.

INSTALLATION

All gasket surfaces (especially cylinder head gasket surfaces) to be entirely free of dirt, sand, and foreign matter directly before and during assembly.

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 of cylinder head bolts with sealing compound 1052080 or equivalent, and install bolts finger tight.
4. Tighten each cylinder bolt a little at a time in the sequence shown until the specified torque is met 130 N·m (95 ft. lbs.).
5. For remainder of installation reverse removal procedures.

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.

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.

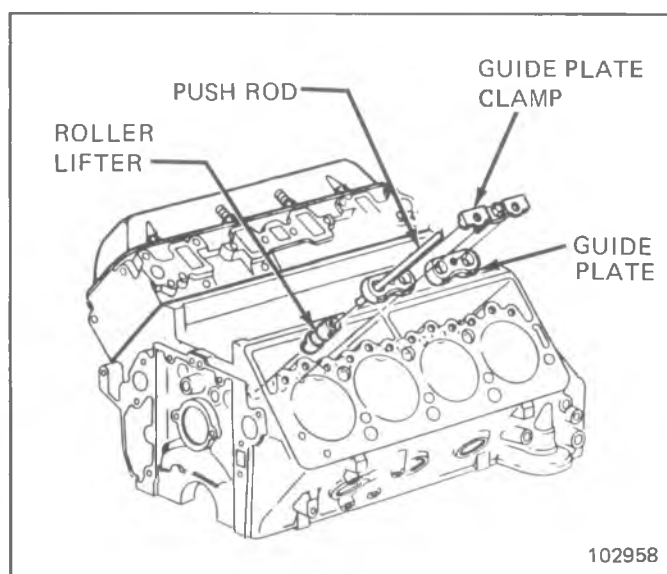


Fig. 6A7-18--Valve Lifter Removal

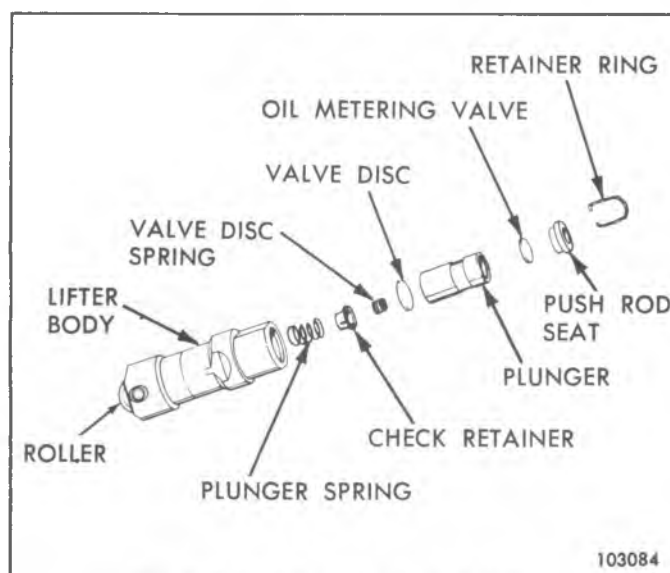


Fig. 6A7-19--Valve Lifter-Exploded View

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.

Removal (6A7-18)

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.

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 holes in cylinder head.

Disassembly (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.

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. Using 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.

CRANKSHAFT PULLEY

Removal

1. Disconnect battery.
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 Section 6B.

TORSIONAL DAMPER (Fig. 6A7-20)

Removal

1. Disconnect battery.
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

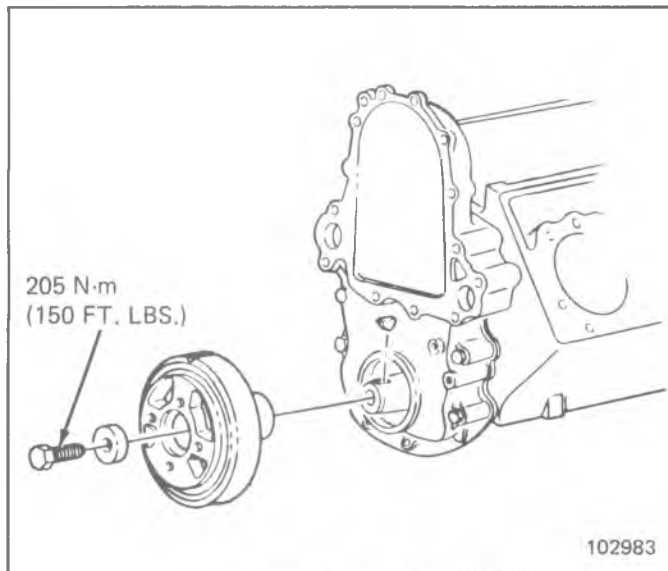


Fig. 6A7-20--Torsional Damper

attaching bolt can be installed. Torque bolt to specification.

2. Install crank pulley as outlined.
3. Install belt(s). Adjust belts. See Section 6B.

FRONT COVER (Fig. 6A7-21)

Removal

1. Drain engine block.
2. Remove water pump as outlined in Section 6B.
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).

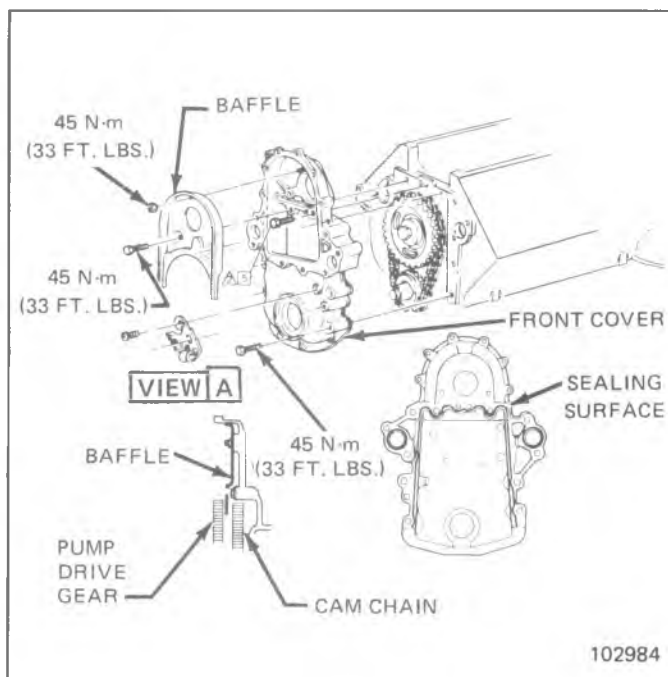


Fig. 6A7-21--Front Cover

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 #1052366 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.
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)

Removal

1. Remove front cover as previously outlined.
2. Remove bolt and washer attaching camshaft gear.
3. Remove injection pump gear.

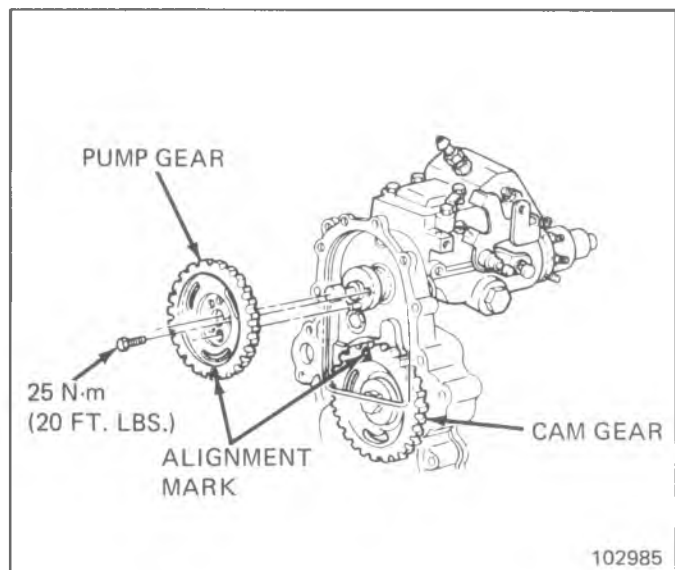


Fig. 6A7-22--Gear Alignment

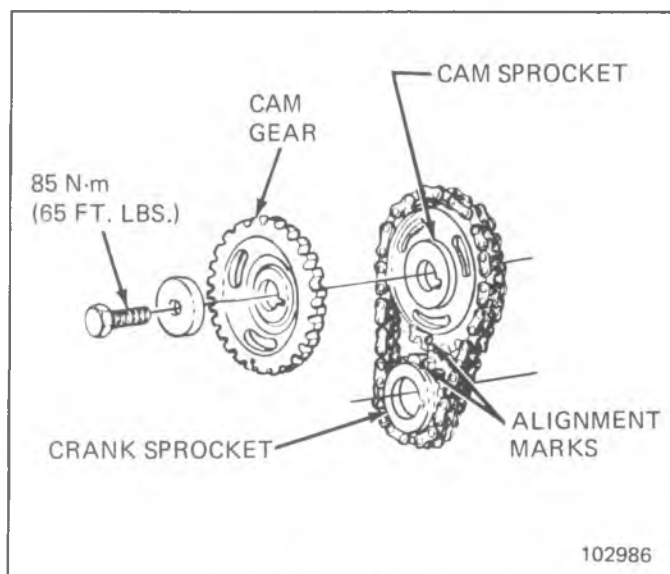


Fig. 6A7-23--Timing Chain

4. Remove cam sprocket, chain, and crank sprocket.

Installation

1. Install cam sprocket, and crank sprocket together and lubricate chain, 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 retune the engine. Refer to Section 6C6 for injection pump timing procedure.

CAMSHAFT (Fig. 6A7-24)

Removal

1. Disconnect battery.
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 Section 6B.
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 Section 6C6. Cap injection nozzles, to prevent dirt from entering fuel. (Tag injection lines for reinstallation). Refer to Section 6C6 or removal sequence.
13. Remove water pump as outlined in Section 6B.
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 condenser mounting bolts, and with the aid of an assistant, lift condenser.
29. Remove camshaft.

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

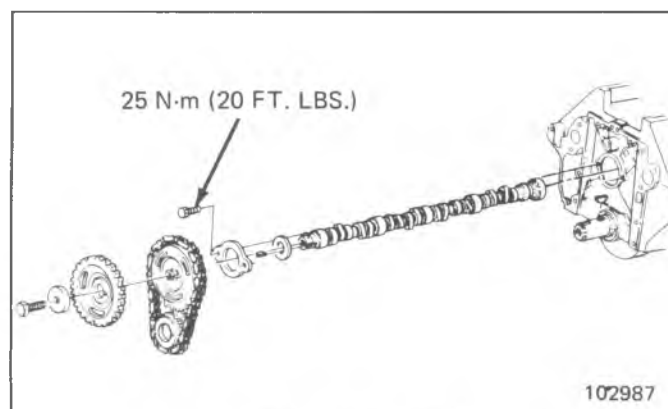


Fig. 6A7-24--Camshaft

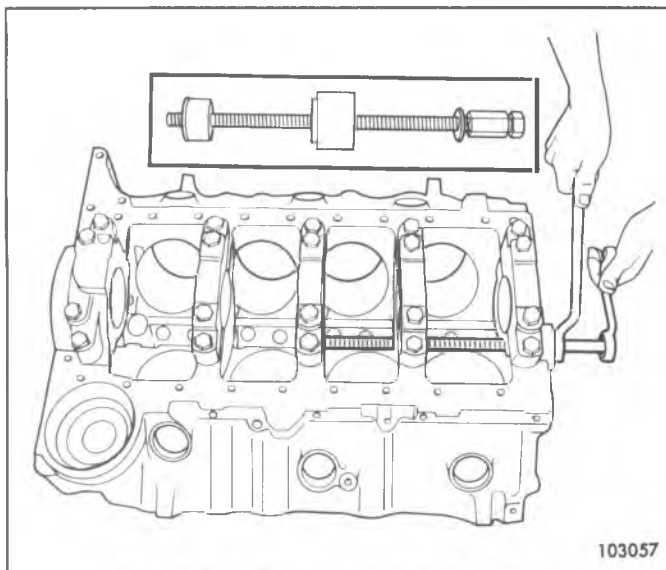


Fig. 6A7-25--Removing Camshaft Bearings

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 Section 6C6 for injection pump timing procedure).
12. Install water pump as outlined in Section 6B.
13. Install injection lines as outlined in Section 6C6.
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 Section 6B.
18. Install fan shroud.
19. Install radiator, and fill with coolant.
20. Connect necessary wires and hoses.
21. Raise vehicle.
22. Connect exhaust pipes to exhaust manifold.
23. Lower vehicle.
24. Install vacuum pump.
25. Connect secondary fuel filter lines (with adapter).
26. Install cylinder head covers J-29664-1.
27. Connect battery.
28. Start engine and check for leaks.
29. Stop engine.
30. Remove protective covers.
31. Loosen vacuum pump hold down and disconnect secondary filter (with adapter) from fuel lines.
32. Install intake manifold as previously outlined.

CAMSHAFT BEARINGS

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.

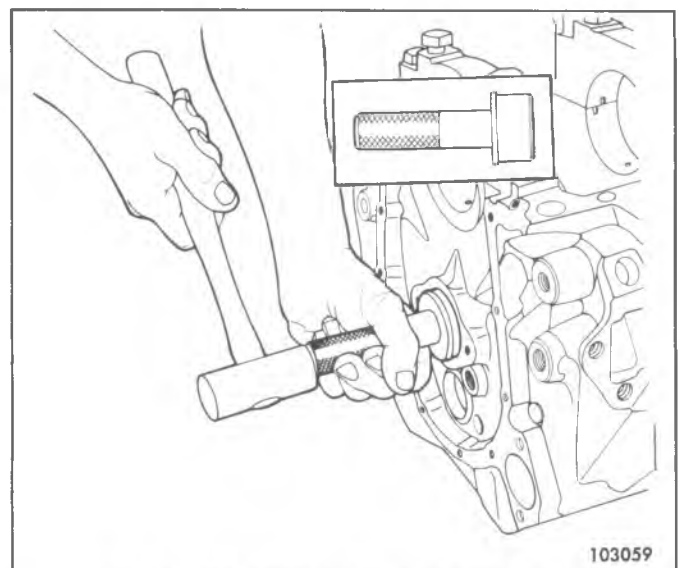


Fig. 6A7-26--Replacing Camshaft Front Bearing

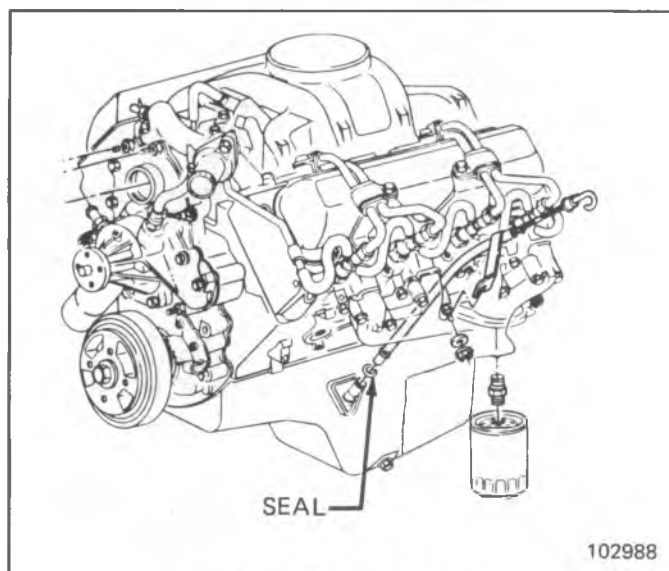


Fig. 6A7-27--Dipstick Tube

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.

DIPSTICK TUBE (Fig. 6A7-27)

Removal

1. Disconnect battery.
2. Remove attaching bolt at exhaust manifold.
3. Remove dipstick tube.
4. Remove O-ring seal. To install reverse removal procedures.

OIL PAN (Fig. 6A7-28)

Removal

1. Disconnect battery.
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 2.0mm bead of 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.

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

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.

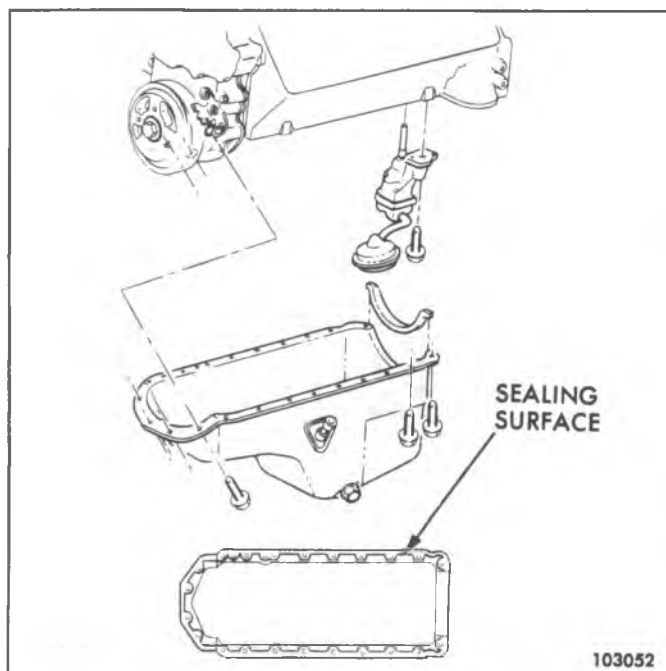


Fig. 6A7-28--Oil Pan

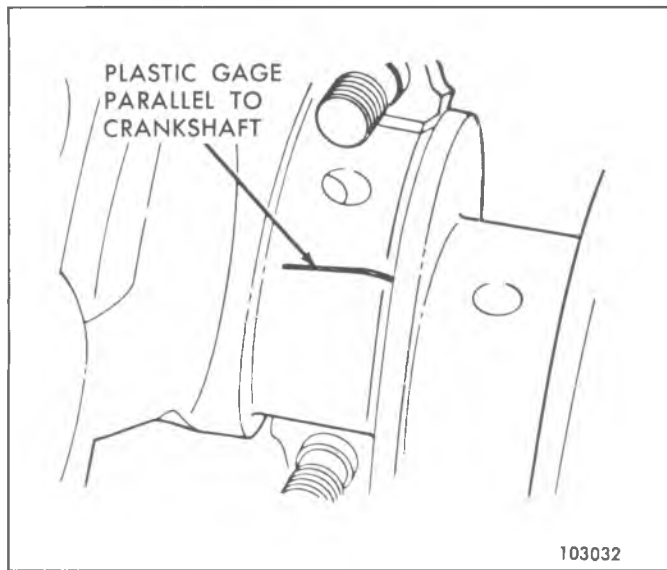


Fig. 6A7-29--Gaging Plastic on Crankpin

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.

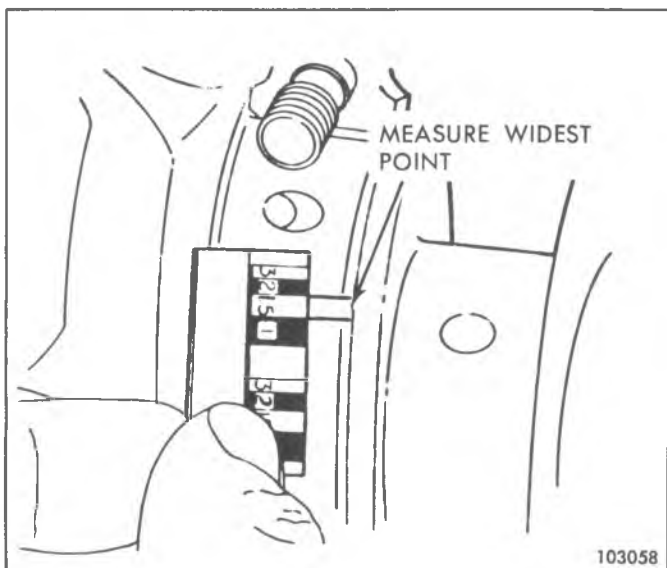


Fig. 6A7-30--Measuring Gaging Plastic

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" under size 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.
 - 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

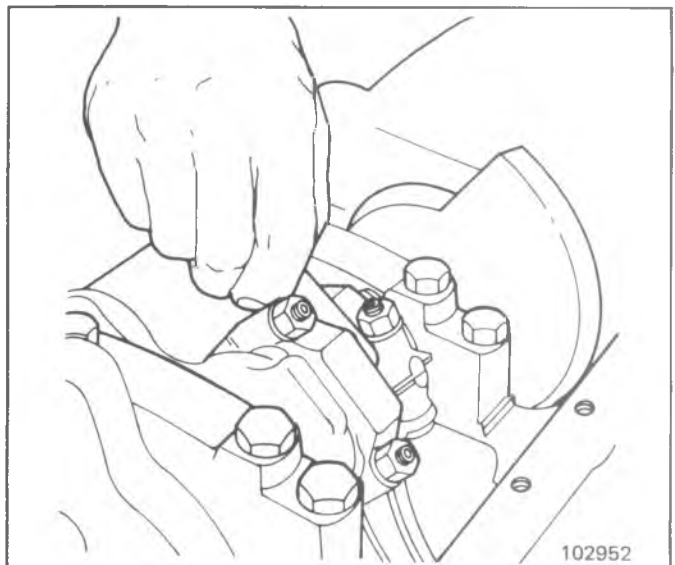


Fig. 6A7-31--Connecting Rod Side Clearance

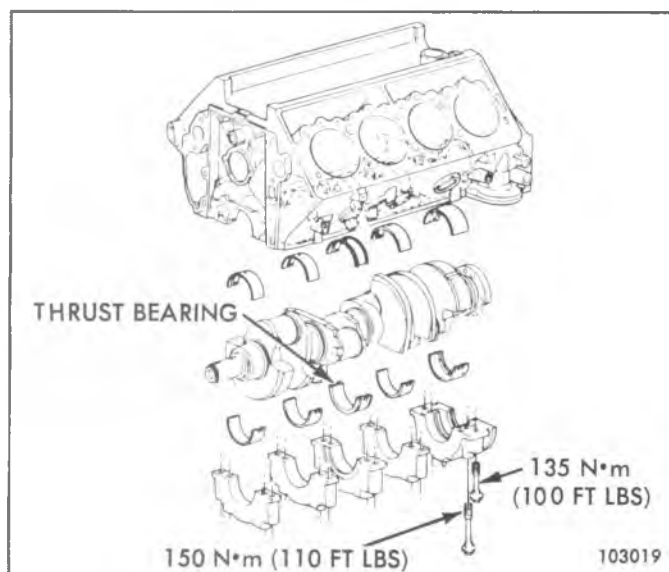


Fig. 6A7-32--Main Bearings

- cap.
- Install the bearing cap and evenly torque nuts to specifications. Do not turn the crankshaft with the gaging plastic installed.
 - 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).
- 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 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.
 - Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.
 - When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

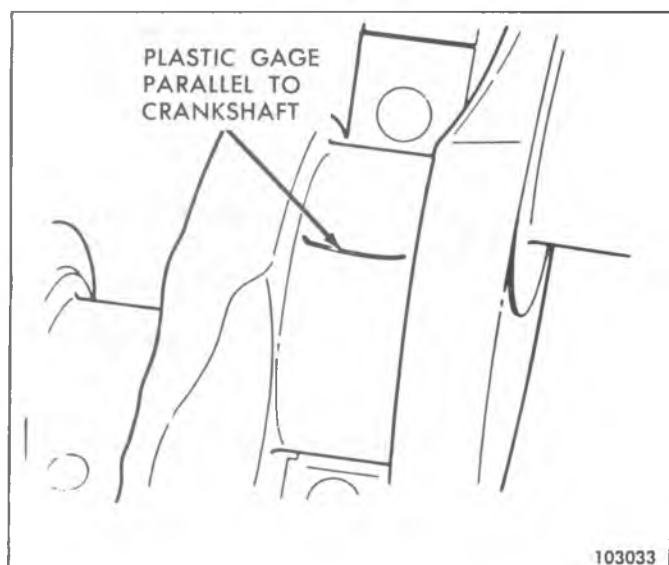


Fig. 6A7-33--Gaging Plastic On Journal

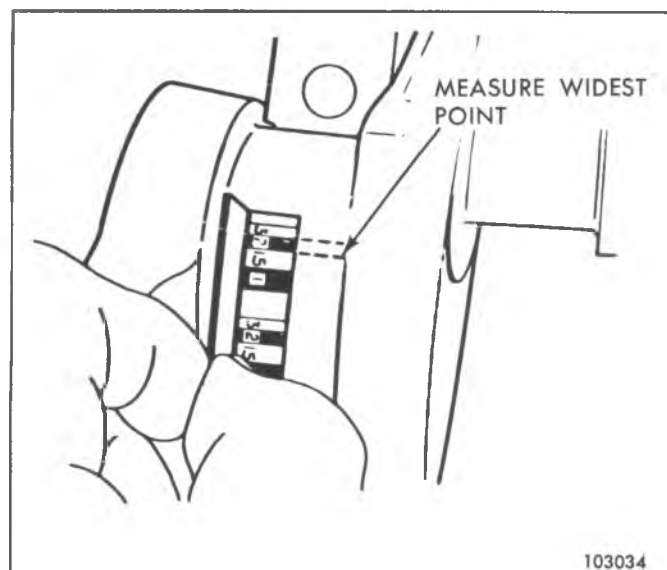


Fig. 6A7-34--Measuring Gaging Plastic

- Measure all connecting rod side clearances (see specifications) between connecting rod caps (Fig. 6A7-31).

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

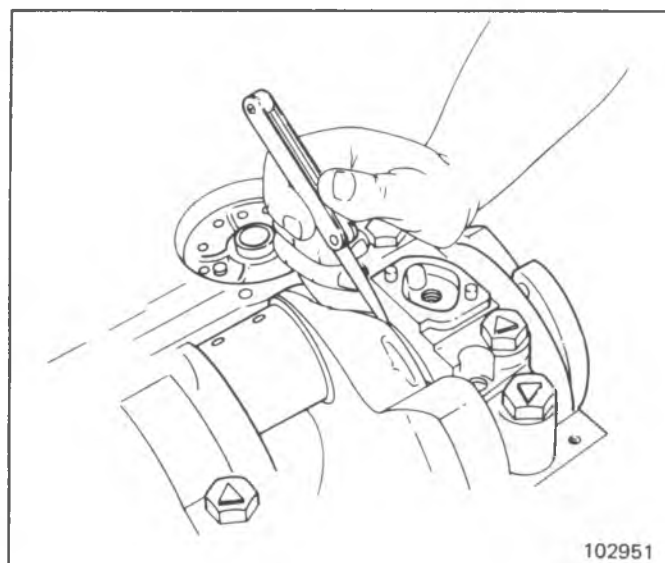


Fig. 6A7-35--Crankshaft End Play

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 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"-.0032") 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.

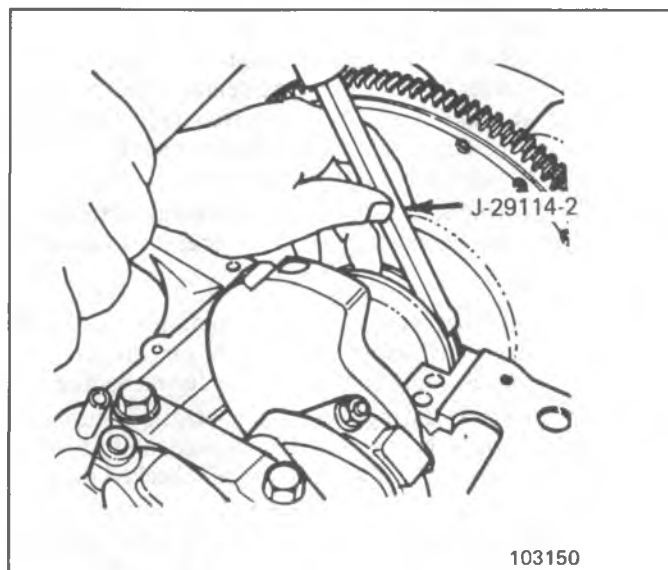


Fig. 6A7-36--Using Parking Tool Upper Half

3. Use packing tool J-33154-2 and gently drive upper 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.

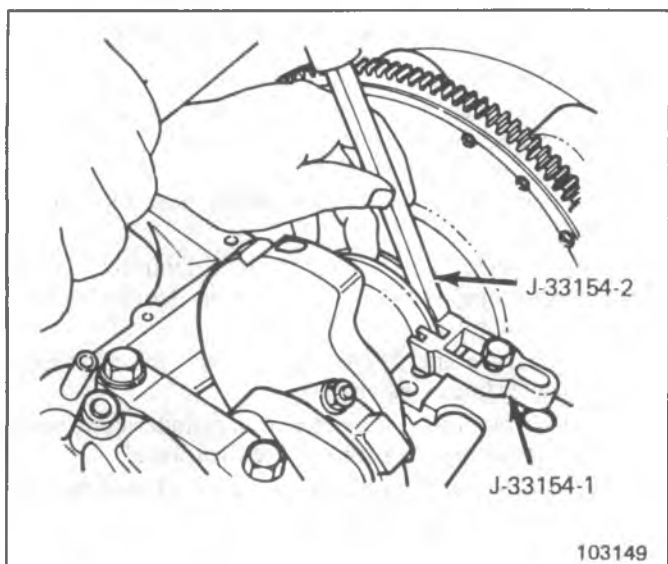


Fig. 6A7-37--Using Guide Tool

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 anacrobic 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.

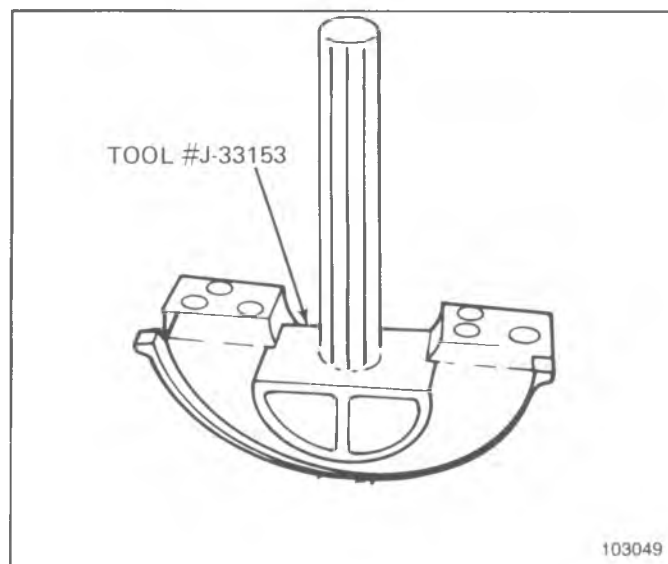


Fig. 6A7-38--Installing New Seal Lower Half

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 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

If boring is necessary, an oversize gasket will be required.

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 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

Each cylinder bore size is identified by a code A, B, C, D, E, F. This I.D. is stamped on the cylinder case pan rail and beside the proper cylinder.

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 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 diameter to determine "Piston to Bore Clearance".
 - d. Locate piston to bore clearance on Piston Selection Chart and determine if piston to bore

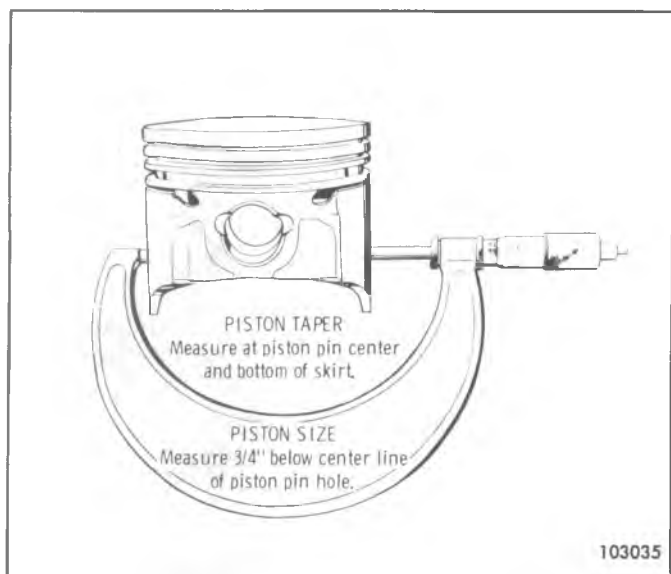


Fig. 6A7-39--Measuring Piston

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.

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 of oil when checking pin fit. The rod may be installed in the piston with either side facing up.

Whenever the replacement of a piston pin is necessary, remove the ring retaining the pin. Then remove pin. 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.

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.

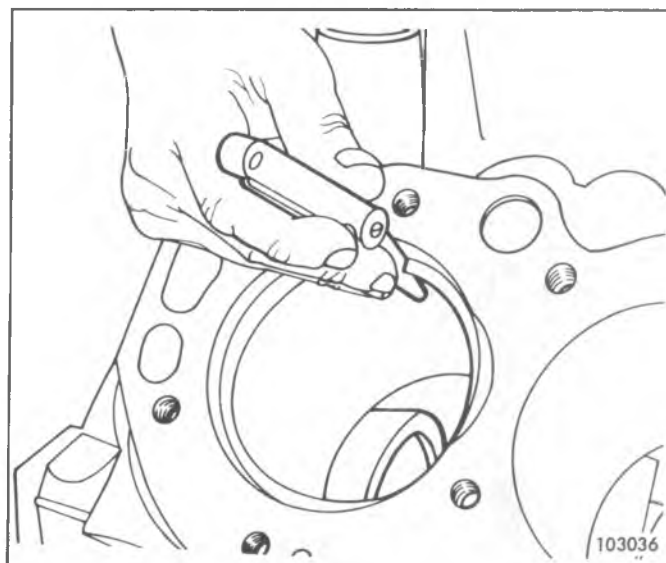
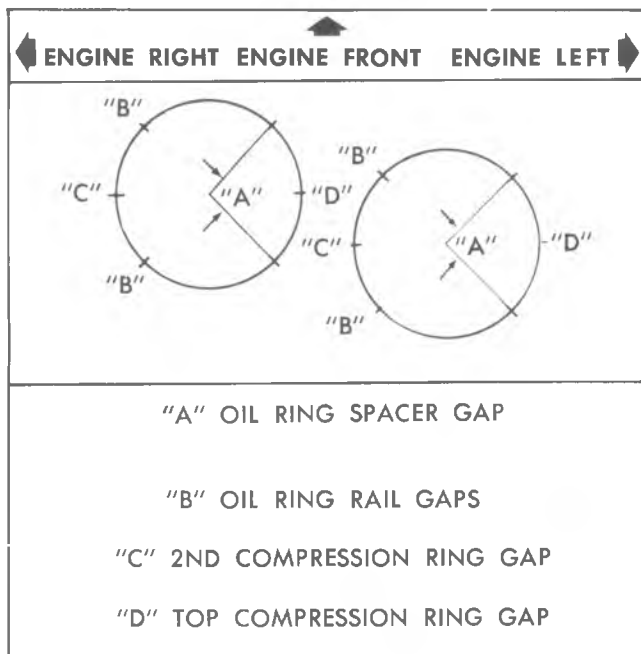


Fig. 6A7-40--Measuring Piston Ring Gap



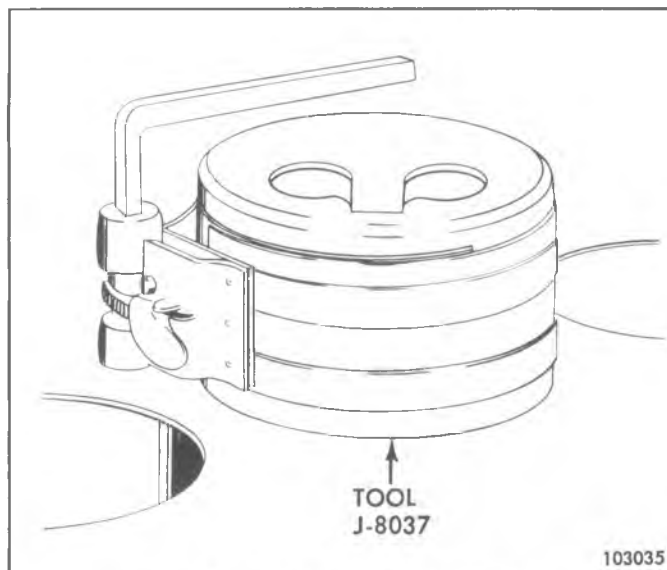
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Fig. 6A7-41--Ring Gap Location

ROD AND PISTON (Fig. 6A7-44)

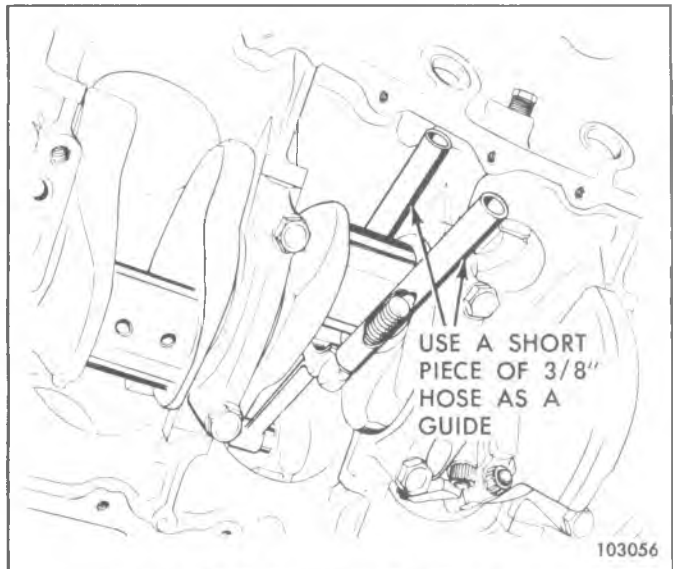
Installation

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 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.



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Fig. 6A7-42--Piston Ring Compressor



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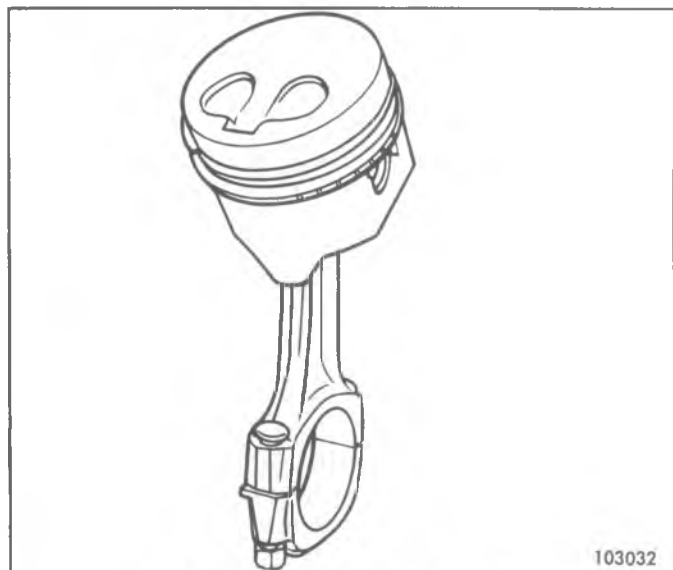
Fig. 6A7-43--Connecting Rod Bolt Guide

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.

CRANKSHAFT (Fig. 6A7-45)

Removal

1. Remove engine.
2. Remove flywheel
3. Mount engine in stand and clamp securely.



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Fig. 6A7-44--Piston Identification

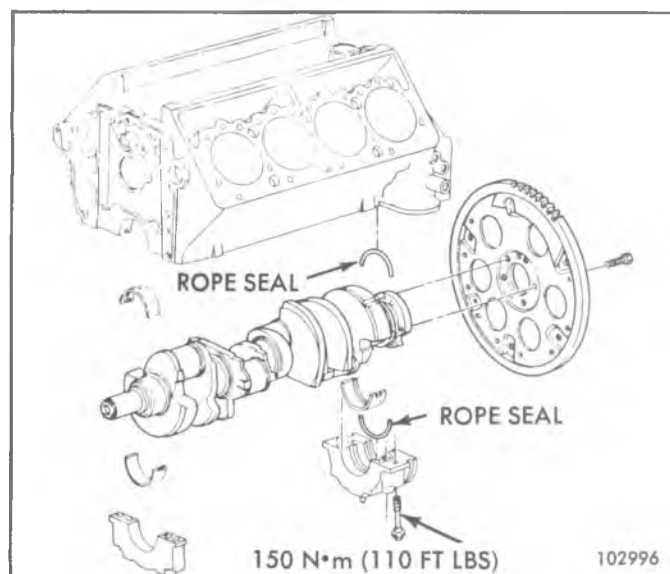


Fig. 6A7-45--Crankshaft

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.

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

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.

If fuel filters were removed, they must be filled with clean diesel fuel to avoid long cranking.

Installation

To install, reverse the removal procedures and include the following:

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:

Clearance		.102-.128
		.112-.138

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			0.05-0.18
Crank pin	Diameter		60.913-60.939
	Taper		.005 Max.
	Out Of Round		.005 Max.
	Rod Bearing Clearance		
	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	Closed 356 @ 46.0
	N @ mm	Open 1025 @ 35.3
Installed Height		46

NOTICE: All dimensions are in millimetres (mm) unless otherwise specified.

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
Main Bearing Cap Bolts		
Inner	105-117	143-158
Outer	94-105	128-143
Oil Pump to Bearing Cap Bolts	59-74	80-100
Rocker Arm Shaft Bolt to Head	30-37	40-50
Valve Cover Bolts and Studs	13-20	18-27
Oil Pan Bolts	4-7	6-10
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	18-25	25-35
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	88-103	120-140
Connecting Rod Nuts	44-52	60-70
Camshaft Sprocket Bolt	55-66	75-90

SECTION 6B

ENGINE COOLING

CONTENTS

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Coolant Level	6B-1	Thermostat	6B-12
Thermostat	6B-2	Radiator	6B-13
Drive Belts	6B-2	Fan Shroud	6B-14
Diagnosis	6B-7	Fan/Fan Clutch	6B-15
System Checks	6B-7	Coolant Recovery Bottle.....	6B-16
Fan Clutch	6B-8	Engine Oil Cooler	6B-18
On-Vehicle Service	6B-11		

GENERAL DESCRIPTION

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 -34°F (-37°C), to provide adequate corrosion protection and loss of coolant from boiling. With glycol content less than requirement for -34°F (-37°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 -34°F (-37°C) may occur, a sufficient amount of an ethylene glycol base anti-freeze that meets GM Specification 1899-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 before flushing the system.

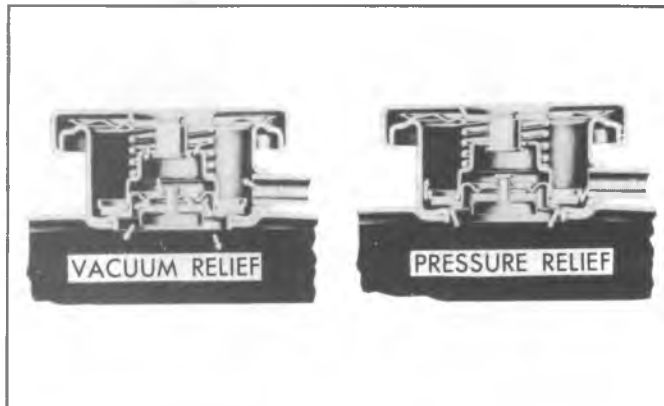


Fig. 6B-1--Radiator Pressure Cap

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.

ALL L6 ENGINES AND ALL V8 ENGINES EXCEPT DIESEL		
GENERATOR A.I.R. PUMP P/S PUMP	50 LB. (222 N) MIN.	ADJUST TO 75 ± 5 LBS. USED (334 ± 22 N) ADJUST TO 125 ± 5 LBS. NEW (556 ± 22 N)
A/C COMPRESSOR	65 LB. (289 N) MIN.	ADJUST TO 95 ± 5 LBS. USED (423 ± 22 N) ADJUST TO 140 ± 5 LBS. NEW (623 ± 22 N)
6.2L - V8 DIESEL		
GENERATOR P/S PUMP	70 LB. (311 N) MIN.	ADJUST TO 75 ± 5 LBS. USED (334 ± 22 N) ADJUST TO 110-140 LBS. NEW (480-623 N)
A/C COMPRESSOR	80 LB. (356 N) MIN.	ADJUST TO 90 ± 5 LBS. USED (400 ± 22 N) ADJUST TO 135-165 LBS. NEW (600-734 N)

100997

Fig. 6B-2--Drive Belt Tension Specifications

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,

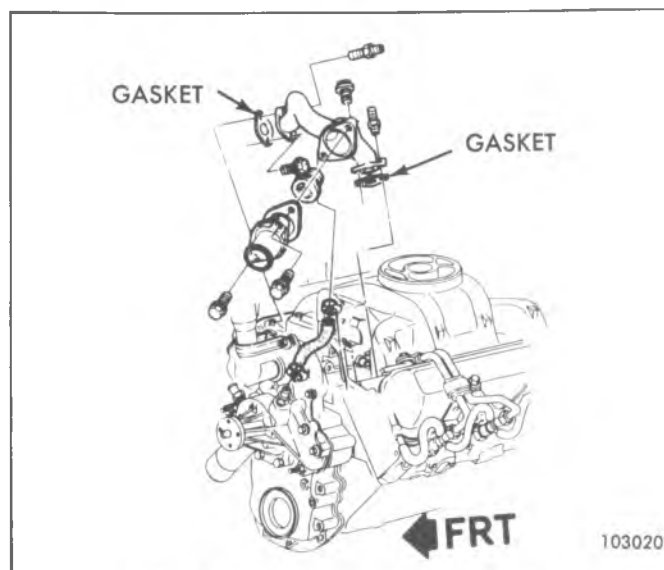


Fig. 6B-3--Thermostat Housing 6.2L Diesel

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.

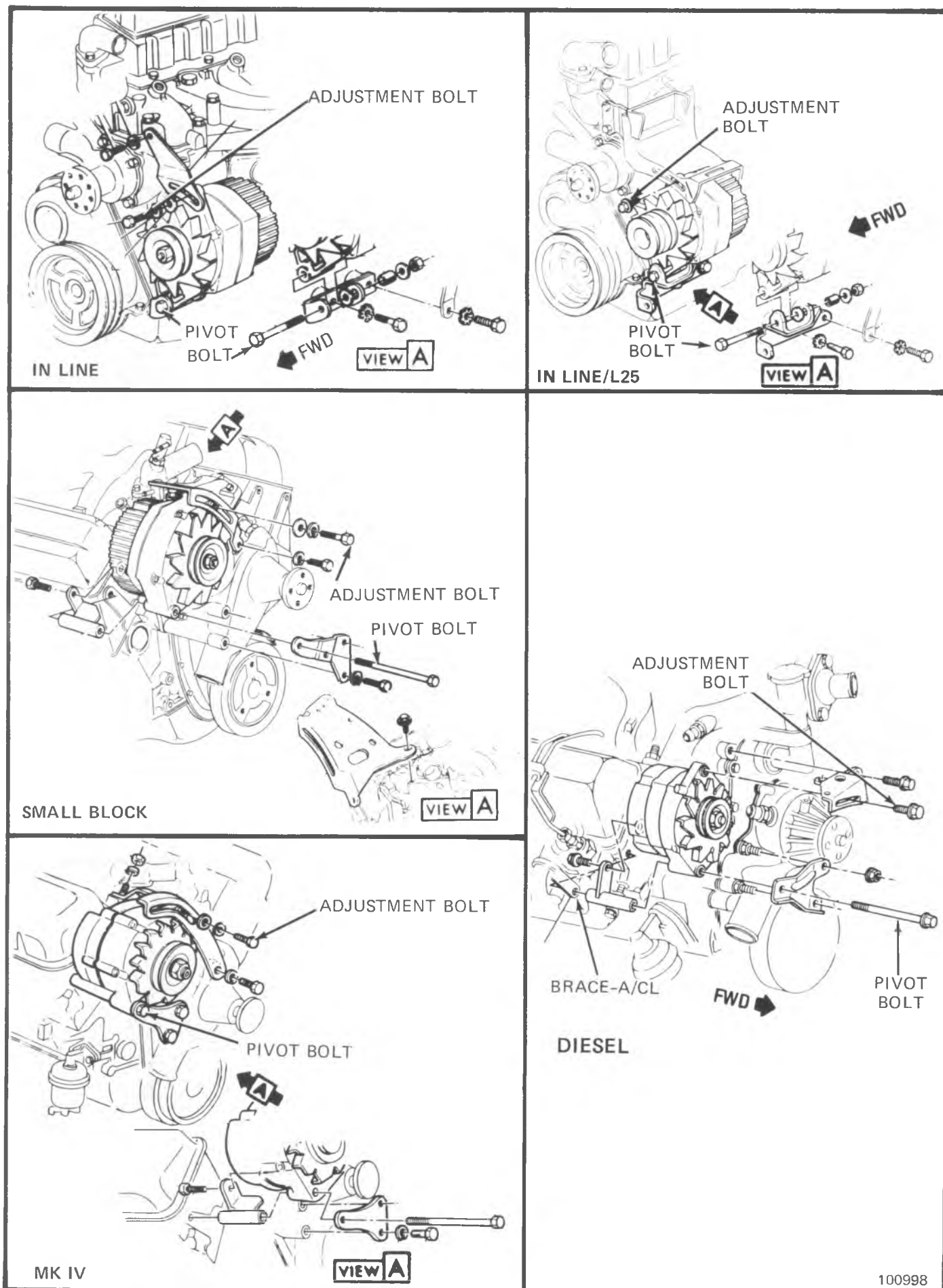


Fig. 6B-4--Generator Adjustment

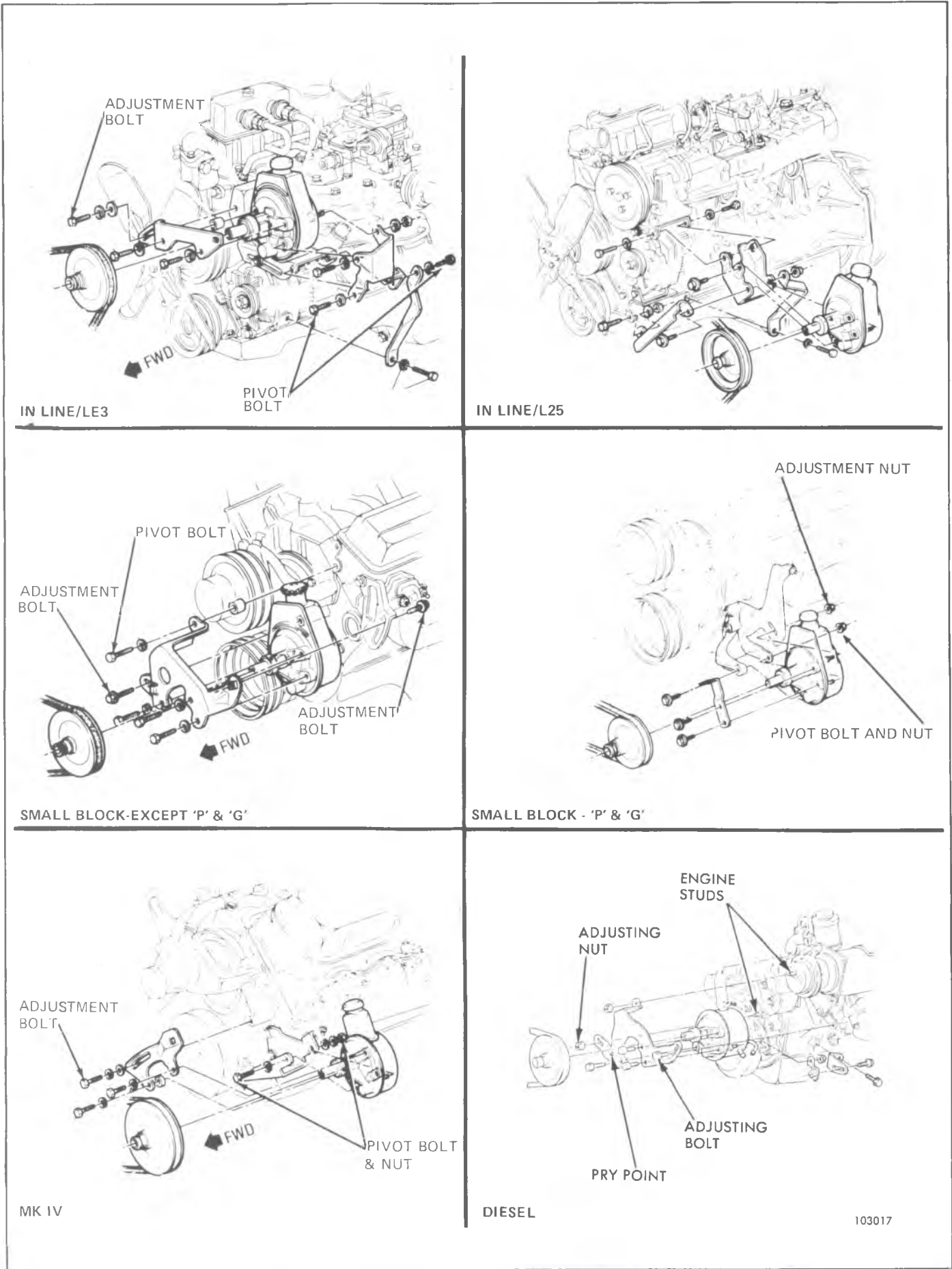
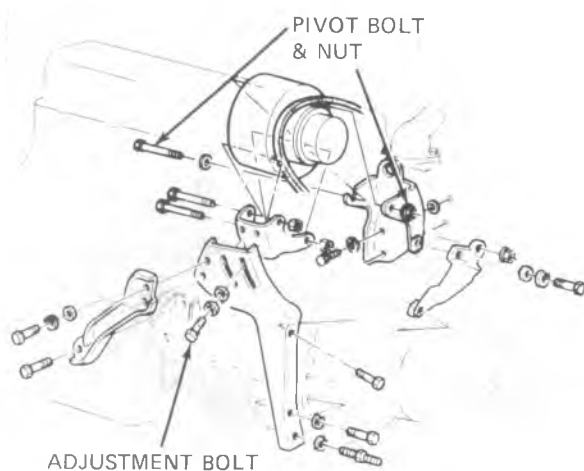
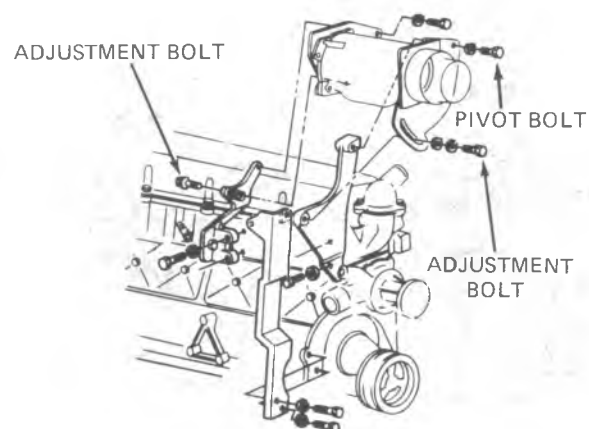


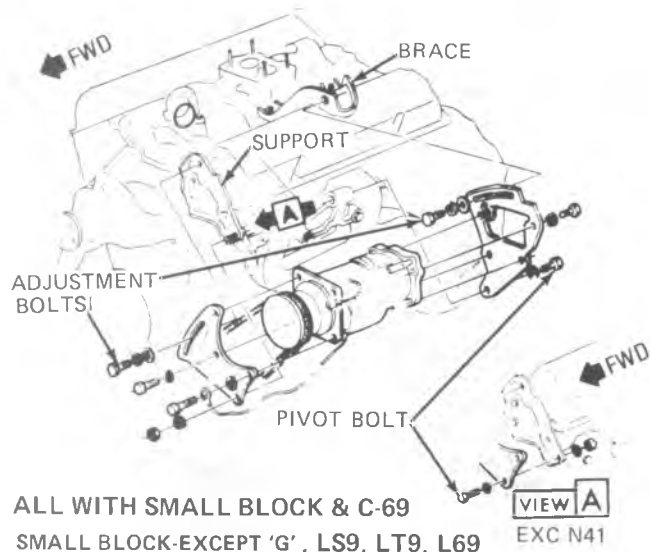
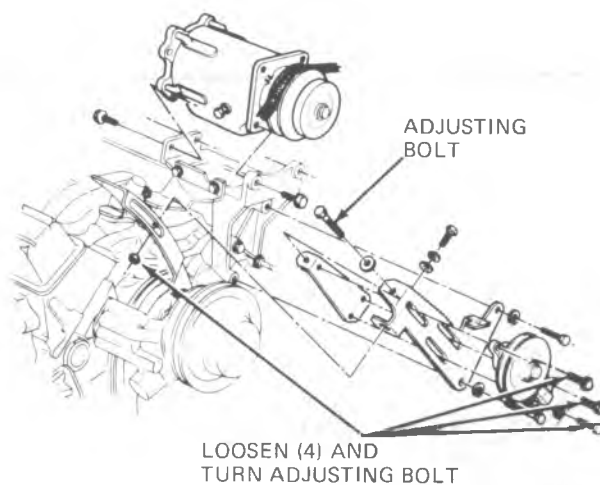
Fig. 6B-5--P/S Pump Adjustment



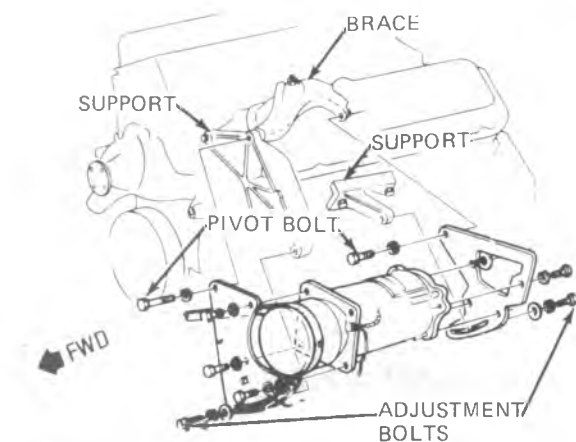
IN LINE-EXCEPT 'G'



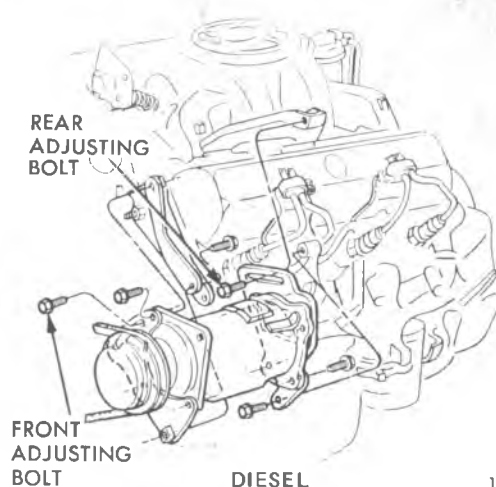
IN LINE-'G' MODEL

ALL WITH SMALL BLOCK & C-69
SMALL BLOCK-EXCEPT 'G', LS9, LT9, L69

SMALL BLOCK 'G' MODEL



MK IV



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Fig. 6B-6-A / C Compressor Adjustment

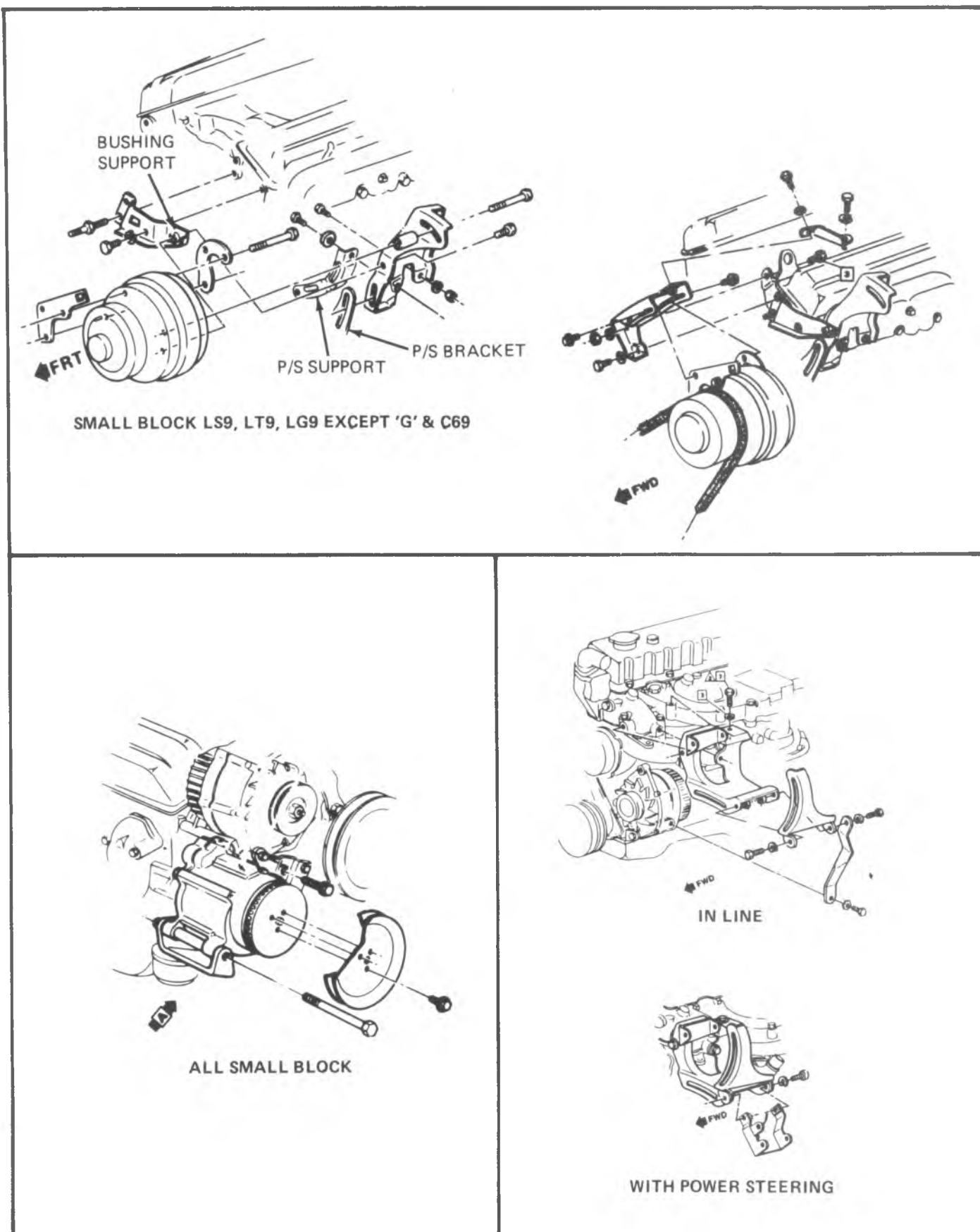


Fig. 6B-7--A/C and A.I.R. Adjustment

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 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 CHART3. IF COMPLAINT IS COOLANT LOSS –

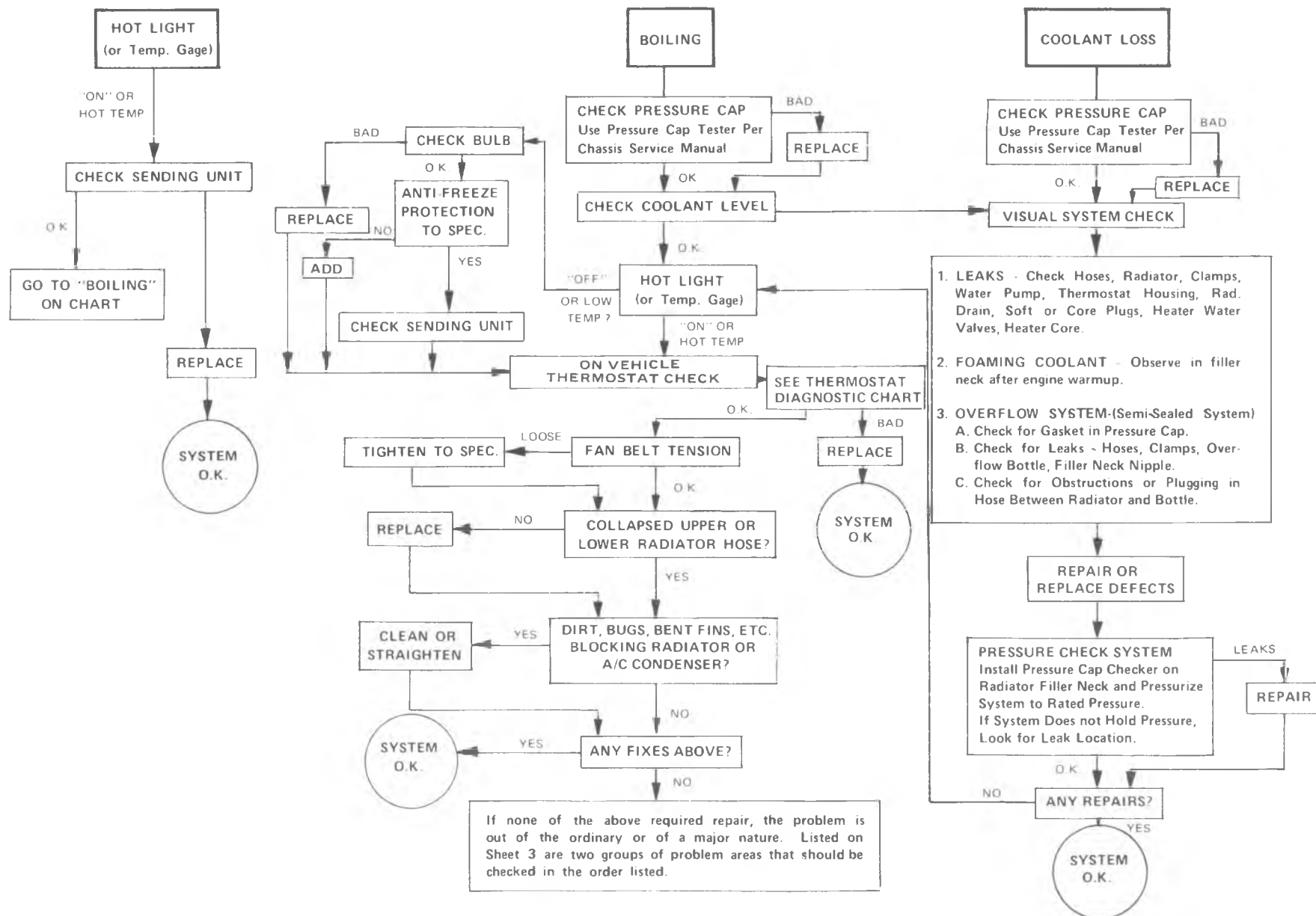
DETERMINE IF CUSTOMER IS OVERFILLING THE SYSTEM, THIS WOULD NORMALLY RESULT IN SMALL AMOUNTS OF COOLANT LOSS THROUGH THE OVERFLOW TUBE. IF THIS IS THE CASE, INSTRUCT THE CUSTOMER ON PROPER FILL LEVEL & NO FURTHER DIAGNOSTIC CHECKS SHOULD BE REQUIRED.

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.

DIAGNOSIS CHART



ON-VEHICLE SERVICE

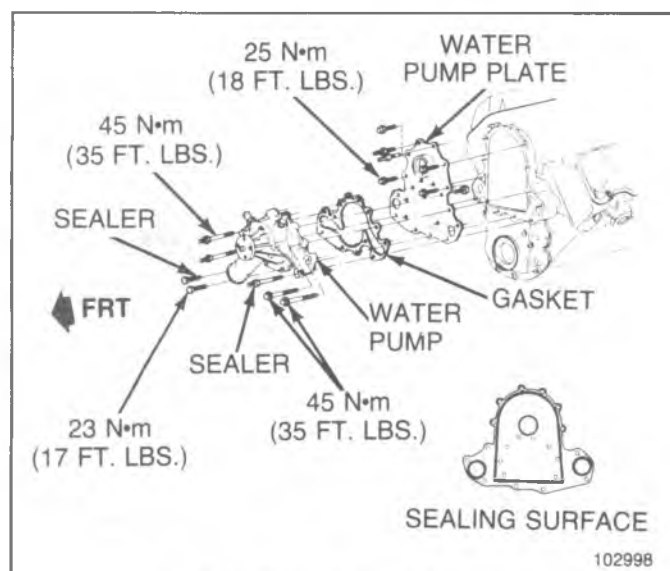


Fig. 6B-8--Water Pump 6.2L Diesel

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.
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 with an ethylene glycol anti-freeze and water mixture of 50/50%.

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 with an ethylene glycol anti-freeze and water mixture of 50/50%.
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-8)

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.

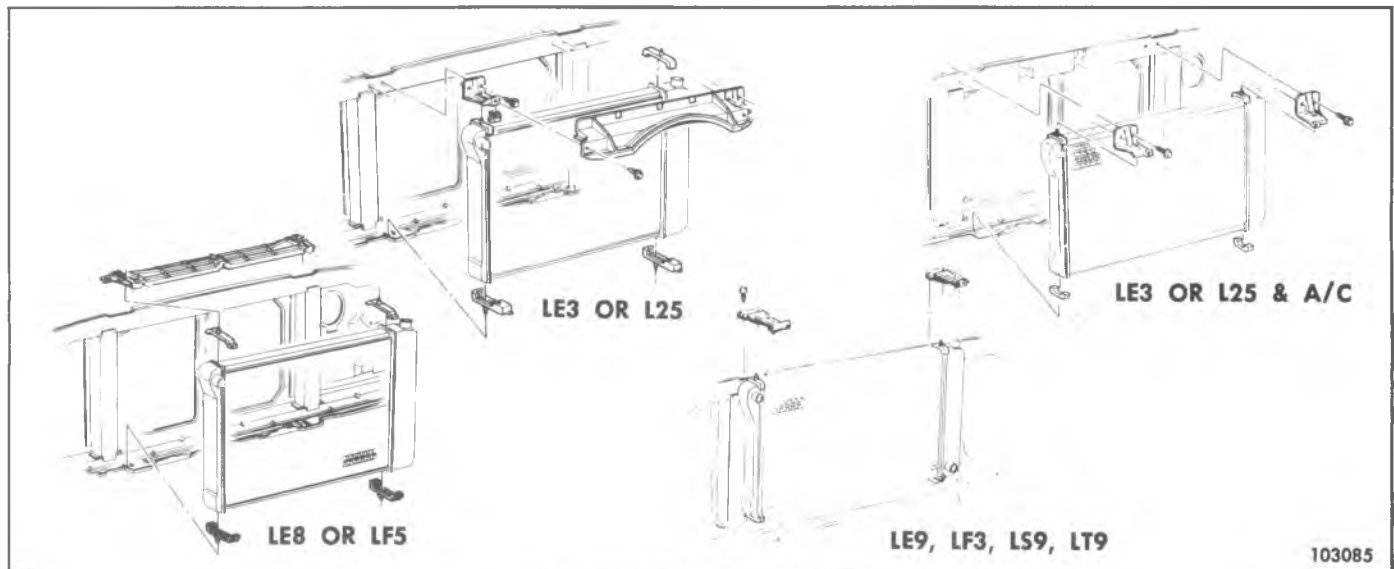


Fig. 6B-10--'CK' Radiator Mounting

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 anaerobic sealer 1052357 or equivalent as shown in Figure 6B-8. Sealer must be wet to the touch when bolts are torqued.

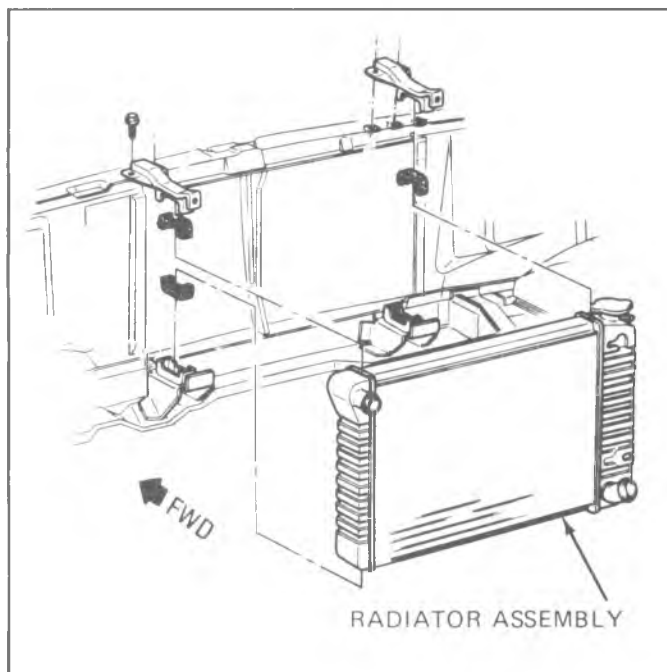


Fig. 6B-9--'G' Van Radiator Mounting

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.

THERMOSTAT

Removal (All Engines)

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 (All Engines)

Prior to installing thermostat, make sure thermostat housing and coolant outlet sealing surfaces are clean.

Refer to Figure 6B-3.

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 with an ethylene glycol anti-freeze and water mixture of 50/50%.
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.

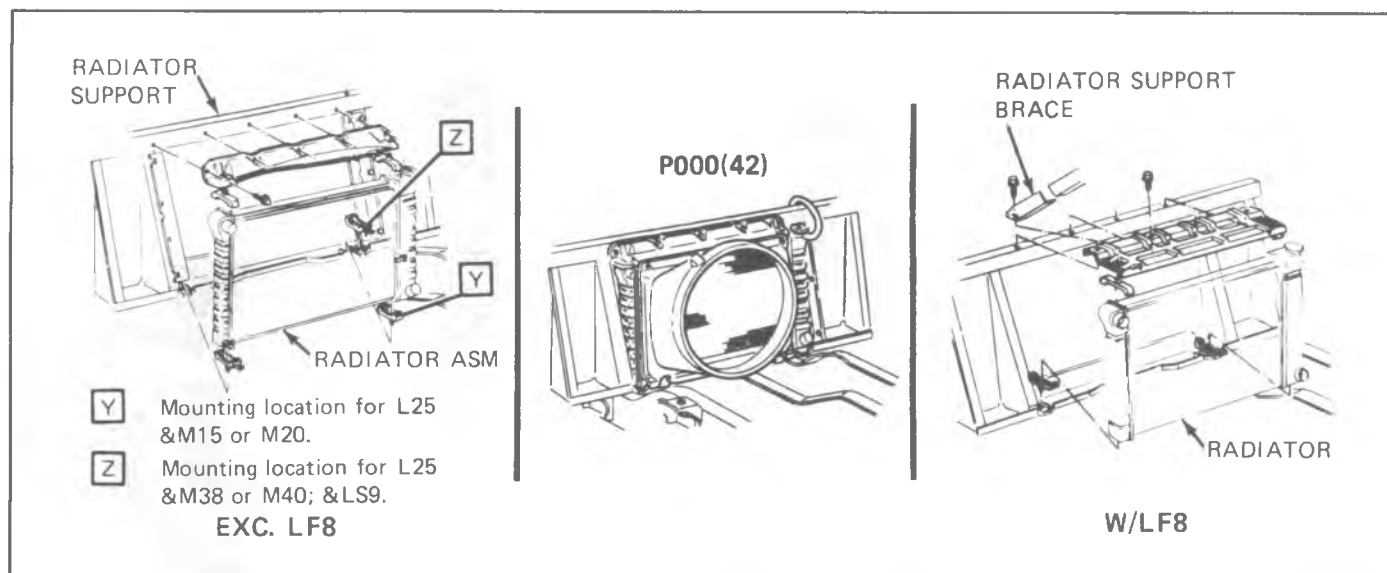


Fig. 6B-11--'P' (42) Radiator Mounting

RADIATOR (FIG. 6B-9 THRU 6B-13)**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.
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 with an ethylene glycol anti-freeze and water mixture of 50/50%.
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.

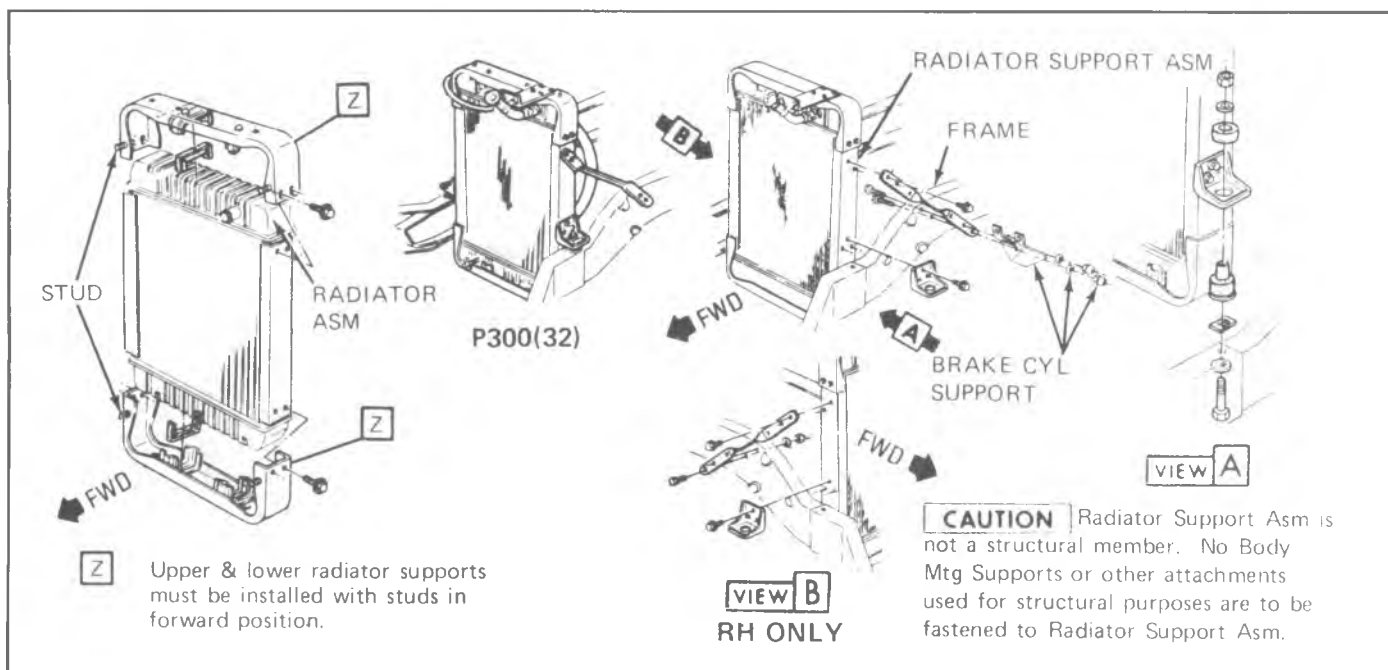


Fig. 6B-12--'P' (32) Radiator Mounting

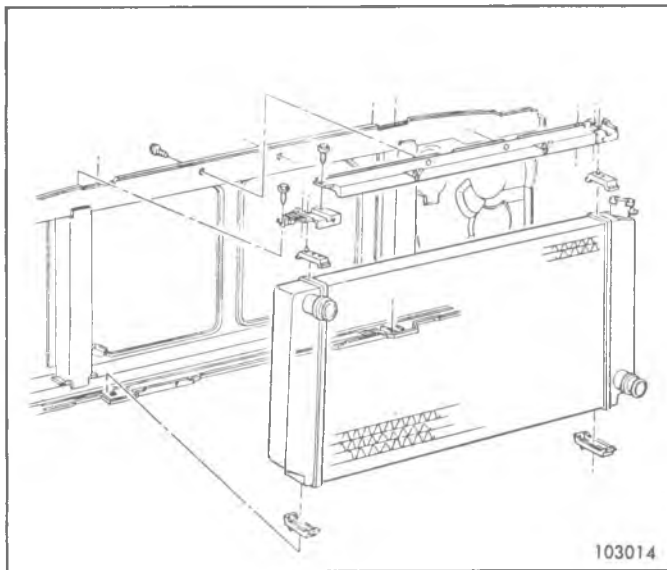


Fig. 6B-13--Radiator Mounting 6.2L Diesel

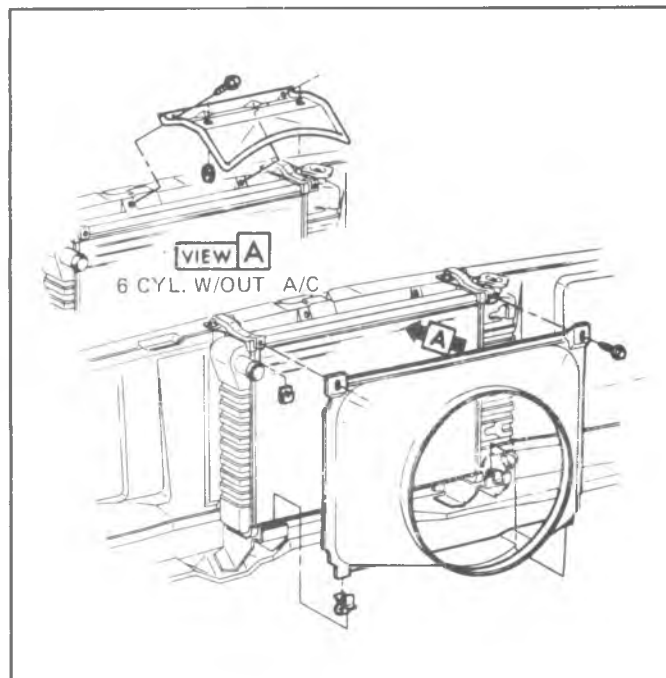


Fig. 6B-14--"G" Van Fan Shroud

RADIATOR 6.2L DIESEL

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.

FAN SHROUD (FIG. 6B-14 THRU 6B-17)

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.

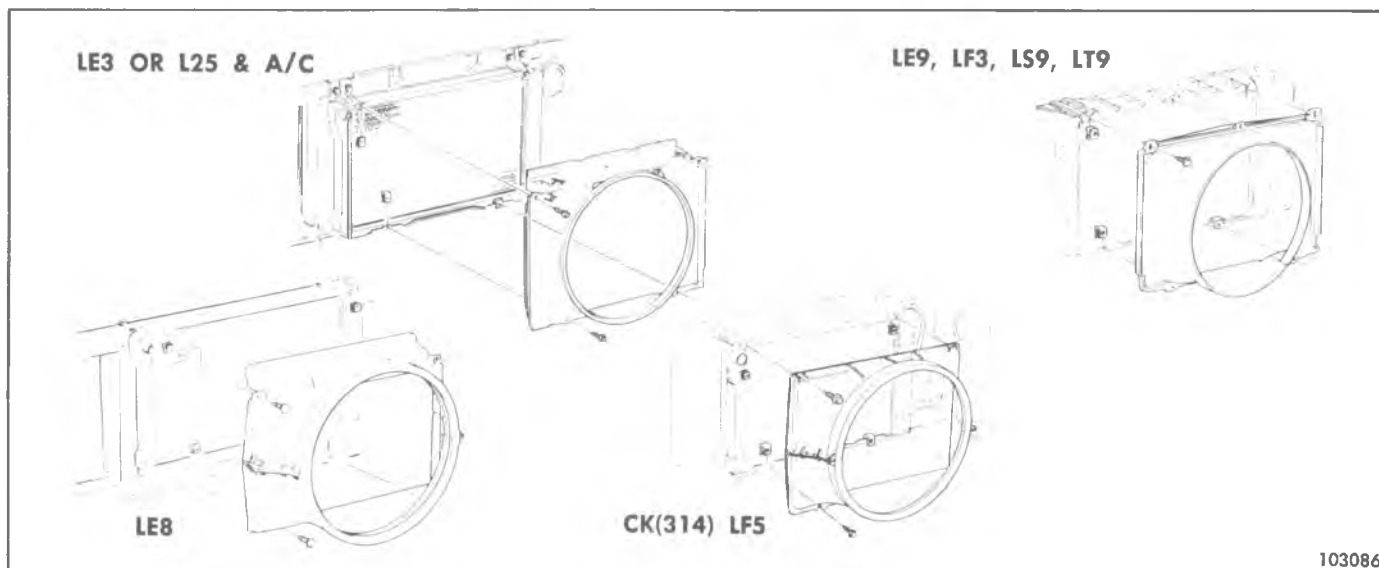


Fig. 6B-15--"CK" Series Fan Shroud

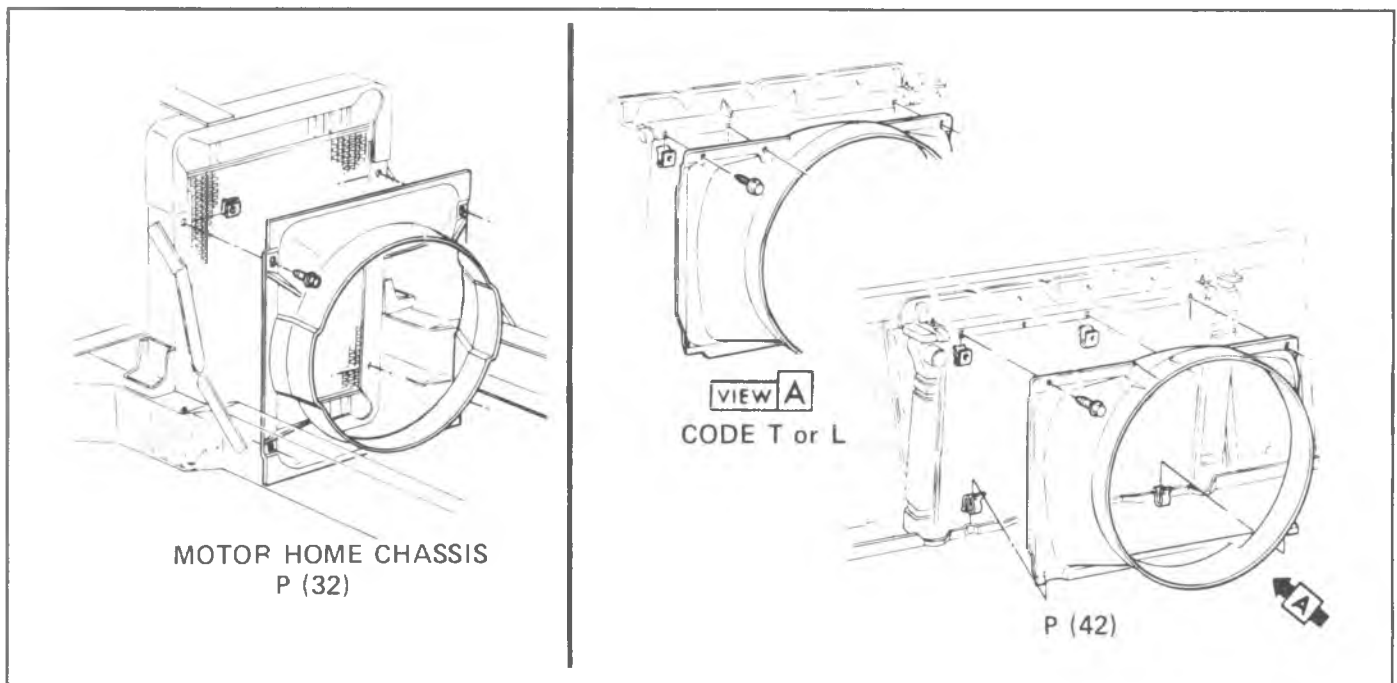


Fig. 6B-16--"P" Series Fan Shroud

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).
7. Remove radiator hose strap from shroud.
8. Remove fan shroud from water pump (leave pulley), then remove fan and shroud together.

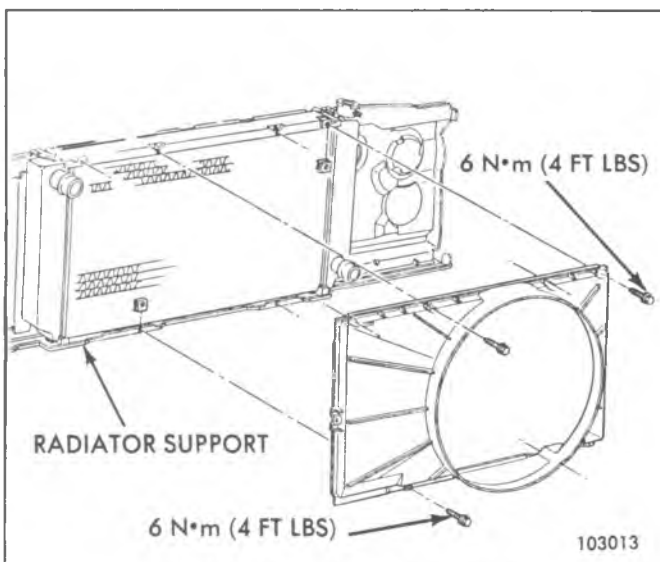


Fig. 6B-17--Fan Shroud 6.2L Diesel

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.

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.

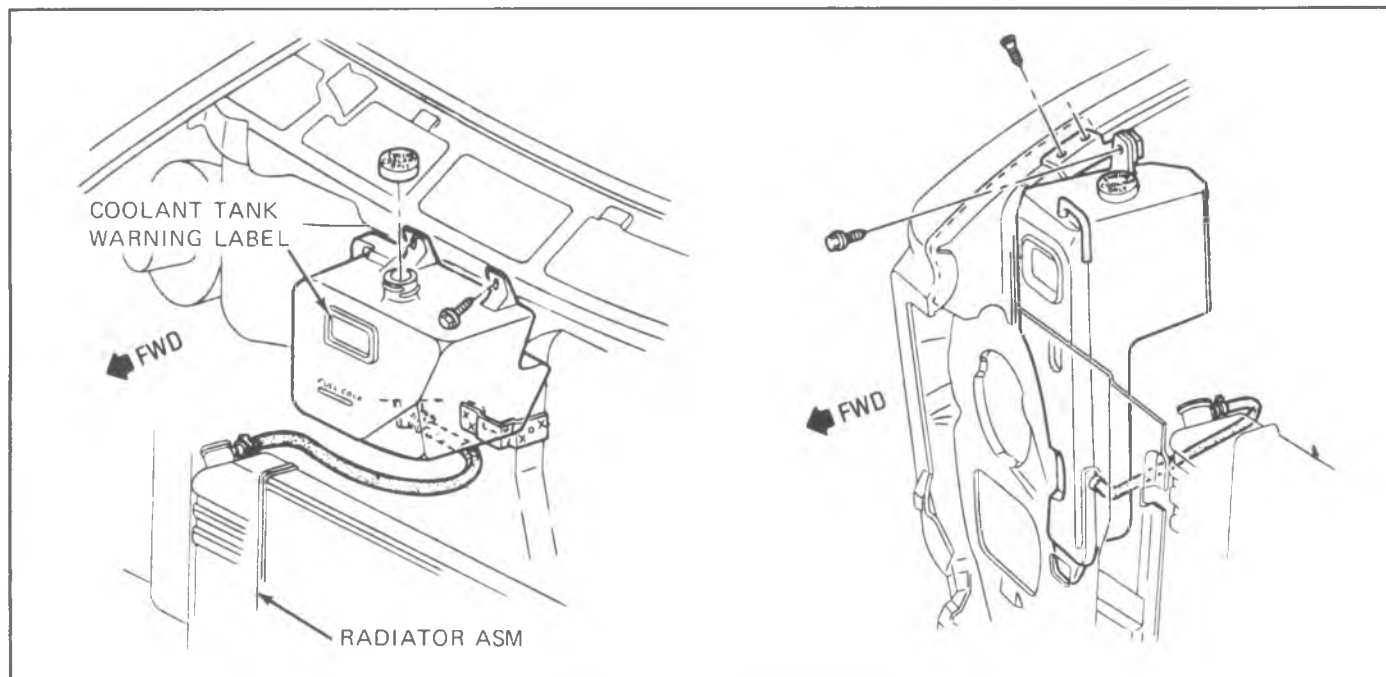


Fig. 6B-18--'G' Van Coolant Recovery Bottle

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.

COOLANT RECOVERY BOTTLE (FIG. 6B-18 & 6B-19)

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.

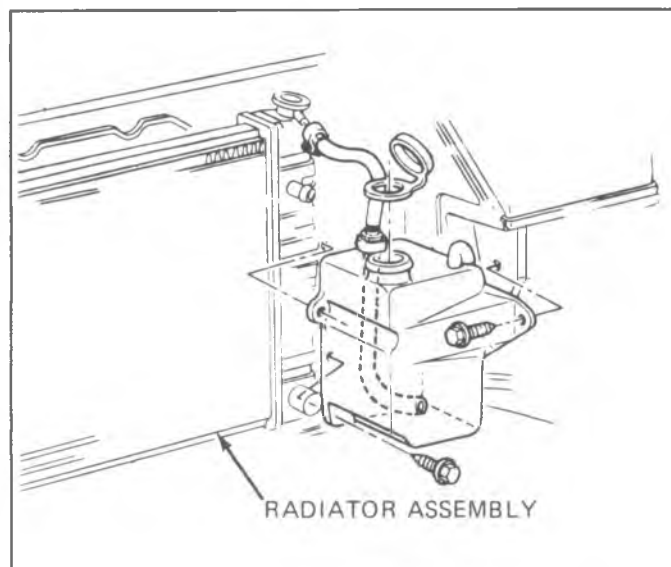


Fig. 6B-19--'CK' Series Coolant Recovery Bottle

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.
3. Fill recovery bottle to appropriate mark with a 50/50 solution of water and ethylene glycol base anti-freeze.
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-20 & 6B-21.

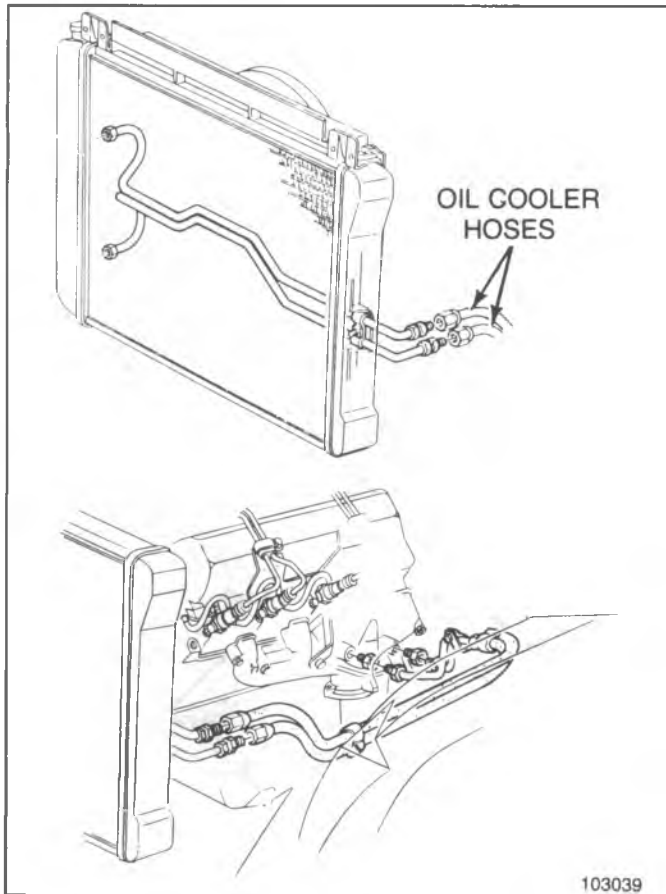


Fig. 6B-20--Engine Oil Cooler - 6.2L Diesel

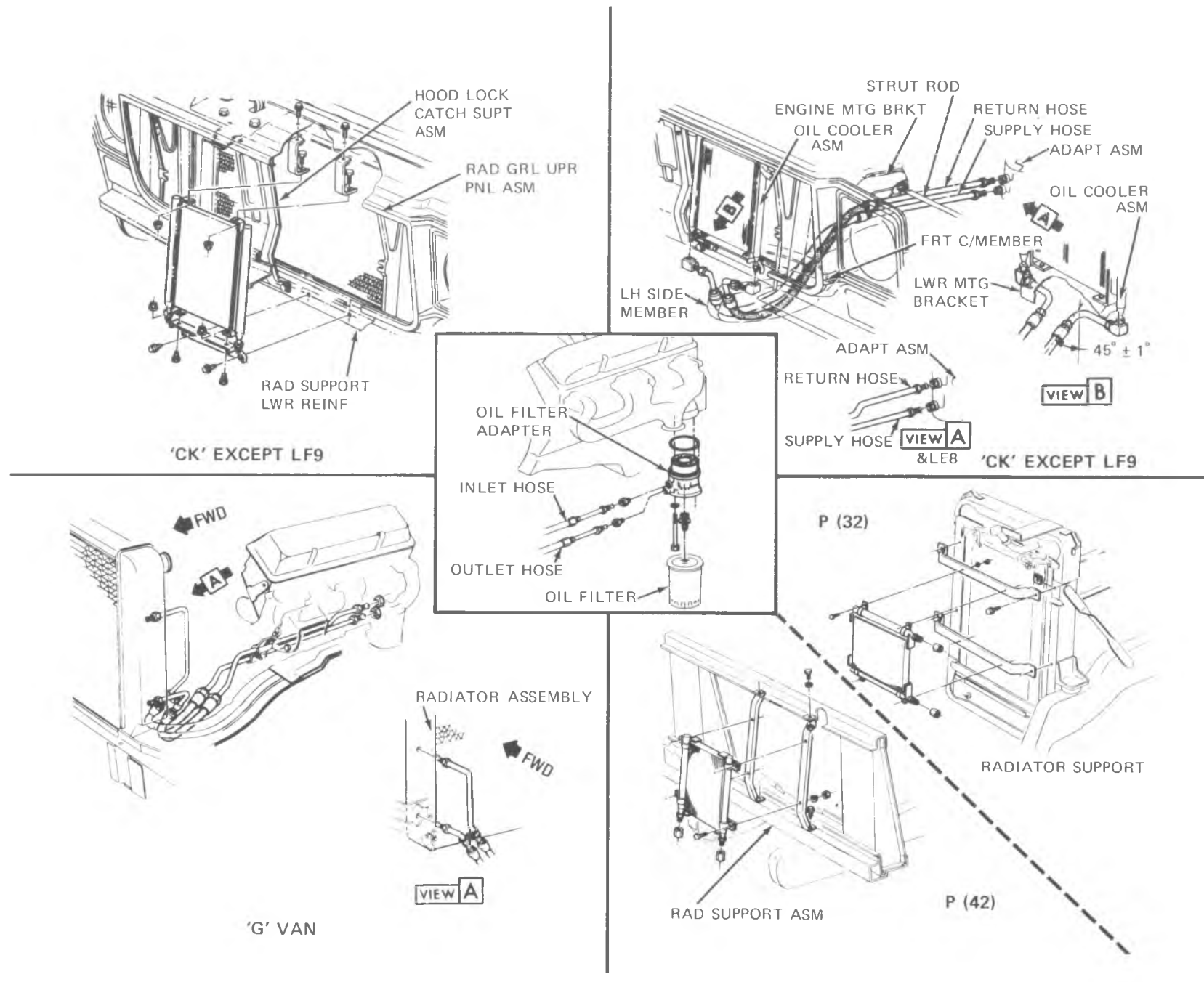


Fig. 6B-21—Engine Oil Coolers Except Diesel

SECTION 6C

ENGINE FUEL

CONTENTS

General.....	6C-1	Model M4ME/M4MC Carburetor	6C4-1
Diagnosis.....	6C-1	Fuel System-Gasoline.....	6C5-1
Model 1ME Carburetor	6C1-1	Fuel System-Diesel.....	6C6-1
Model 2SE Carburetor.....	6C2-1		

GENERAL

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.

GASOLINE ENGINE

This section, divided into sub-sections by carburetor model, covers the repair and adjustment procedure for gasoline fuel system components. 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.

DIESEL ENGINE

Refer to Section 6C6 for fuel system service on a diesel engine.

DIAGNOSIS

Refer to Figures 6C-1 through 6C-10 for diagnosis of:

- Gasoline Fuel System (Figs. 6C-1 through 6C-8).
- Evaporative Emission Control System (Fig. 6C-9).
- Fuel Tank (Fig. 6C-10).

CARBURETOR DIAGNOSIS

The following diagnostic procedures are for carburetor related problems and their effects on car performance. Other systems of the car 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.	<p>Improper starting procedure used.</p> <p>Choke valve not operating properly.</p> <p>No fuel in carburetor.</p> <p>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.</p>	<p>Check with the customer to determine if proper starting procedure is used, as outlined in the Owner's Manual.</p> <p>Adjust the choke thermostatic coil to specification. 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.</p> <p>NOTE: After any choke system work, check choke vacuum break settings and correct as necessary.</p> <p>Remove fuel line at carburetor. Connect hose to fuel line and run into metal container. Remove the wire from the "bat" terminal of the distributor. Crank over engine — if there is no fuel discharge from the fuel line, test fuel pump as outlined in Section 6. If fuel supply is okay, check the following:</p> <ol style="list-style-type: none"> a. Inspect fuel inlet filter. If plugged, replace. b. 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. <p>Remove the air horn.</p> <p>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.</p> <p>Check float for free movement, bent float hanger or binds in the float arm.</p> <p>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.</p>

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts — Will Not Keep Running	Fuel pump.	Check fuel pump pressure and volume, replace if necessary. See FUEL SYSTEM DIAGNOSIS, Section 6.
	Idle speed.	Adjust idle to specifications.
	Choke heater system malfunctioning (may cause loading).	Check vacuum supply at hot air inlet to choke housing. Should be not less than manifold vacuum minus 3" Hg. with engine running at idle. (Exc. IMV) Check wiring. Check for plugged, restricted, or broken heat tubes.
	Loose, broken or incorrect vacuum hose routing.	Check routing of all hot air parts. 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 adjusting vacuum break units.
	Choke valve sticking and/or binding.	Clean and align linkage or replace if necessary. Readjust all choke settings, see Section 6M, if part replacement or realignment is necessary.
Engine Starts Hard (Cranks Normally)	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.
	Loose, broken or incorrect vacuum hose routing.	Check condition and routing of all vacuum hoses — correct as necessary. See Section 6E.
	Incorrect starting procedure.	Check to be sure customer is using the starting procedure outlined in Owner's Manual.

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts Hard (Crankes 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.	Adjust choke thermostatic coil. Check choke valve and linkage for binds and alignment. Clean and repair or replace as necessary.
	Vacuum breaks misadjusted or malfunctioning.	Check for adjustment and function of vacuum breaks. Correct as necessary.
	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.
Engine Idles Abnormally (Too fast or too slow)	Slow engine cranking speed.	Refer to starting circuit diagnosis. Section 6D.
	Incorrect idle speed.	Reset idle speed per instructions on underhood 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 to 10 ft. lbs. 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 adjustments.
	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.

Fig. 6C-3--Gas Fuel System Diagnosis - 3 of 8

CARBURETOR 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 Section 6C1.
	Incorrect idle mixture adjustment.	Readjust per specified procedure. See Section 6C1.
Engine Diesels (After Run) upon Shut Off	Defective idle stop solenoid, idle speed-up solenoid or wiring.	Check solenoid and wiring.
	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.
	Loose, broken or improperly routed vacuum hoses.	Check condition and routing of all vacuum hoses. Correct as necessary.
	Incorrect idle speed.	Reset idle speed per instructions on label in engine compartment.
	Malfunction of idle stop solenoid, idle speed-up solenoid or dashpot.	Check for correct operation of idle solenoid. Check for sticky or binding solenoid.
Engine Hesitates On Acceleration	Fast idle cam not fully off.	Check fast idle cam for freedom of operation. Clean, repair, or adjust as required. Check choke heated air tubes for routing, fittings being tight or tubes plugged. Check choke linkage for binding. Clean and correct as necessary.
	Excessively lean condition caused by maladjusted carburetor idle mixture.	Adjust carburetor idle mixture as described in Section 6C1.
	Ignition timing retarded.	Set to specifications.
	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.

CARBURETOR 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 adjustment and operation of vacuum break diaphragm.
	Air valve malfunction.	Check operation of secondary air valve. Check spring tension adjustment.
	Power enrichment system not operating correctly.	Check for binding or stuck power piston(s) — correct as necessary.
	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 vacuum or mechanical advance malfunctioning.	Check for proper operation.
	Timing not to specifications.	Adjust to specifications.
	Choke coil misadjusted (cold operation.)	Adjust to specifications.
	EGR valve stuck open.	Inspect and clean EGR valve.
	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.
Engine Has Less Than Normal Power At Normal Accelerations.		Check connections and operation of choke hot air system.
	Clogged or inoperative power system.	Check jets and channels for plugging; clean and blow out passages. Remove air horn and check for free operation of power pistons.

CARBURETOR 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 H.E.I. diagnosis.
	Exhaust system.	Check for restrictions. Correct as required.
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.
		Check choke heated air system for proper and tight connections plus flow through system.
		Check adjustment of choke thermostatic coil.
		Make necessary corrections and adjustments.
	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. See FUEL SYSTEM DIAGNOSIS, Section 6.
	Power enrichment system not operating correctly.	Remove the air horn and check for free operation of both power piston(s), clean and correct as necessary.
	Choke closed or partially closed.	Free choke valve or linkage.
		Check for loose jets.
	Float level too low.	Check and reset float level to specification.

CARBURETOR DIAGNOSIS CONT'D.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Less Than Normal Power On Heavy Acceleration Or At High Speed (Continued)</p> <p>Engine Surges</p>	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. See FUEL SYSTEM DIAGNOSIS, Section 6.
	Exhaust system.	Check for restrictions. Correct as required.
	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 to 10 ft. lbs. 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.	Check 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.
	Power piston stuck or binding.	Check for free movement of power piston(s). Clean and correct as necessary.
	Fuel jets or passages plugged or restricted.	Clean and blow out with compressed air.
Poor Gas Mileage	Ignition system malfunction.	Check ignition system. See Section 6D.
	Exhaust system.	Check for restrictions. Correct as necessary.
	Customer driving habits.	Run mileage test with customer driving if possible. Make sure car has 2000-3000 miles for the "break-in" period.

CARBURETOR 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.
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.
	Power system in carburetor not functioning properly. Power piston(s) sticking or metering rods out of jets.	Remove air horn and check for free movement of power piston(s). Clean and correct as necessary.
	Choke system.	Check choke heated air tubes for routing and/or plugging which would restrict hot air flow to choke housing. Check choke linkage for binding. Clean or repair as required. Check adjustment of thermostatic coil. Readjust to specification as required. Check electric choke wiring. Replace element.
	Plugged air cleaner element.	Check for restrictions. Correct as required.
	Exhaust system.	Inflate tires to specifications and use correct size tires. See evaporative section (Diagnosis) Refer to transmission diagnosis.
	Low tire pressure or incorrect tire size.	
	Evaporative emission canister	
	Transmission malfunction or in wrong gear.	
	Plugged fuel filters.	Remove and replace filters.
Car feels like it is running out of gas — surging occurs in mid-speed range	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.

CONDITION	POSSIBLE CAUSE	CORRECTION
<p>Evidence of fuel loss or fuel vapor odor</p> <p>A) From area of fuel tank or fuel cap - Perform pressure check to determine possible causes</p>	<ol style="list-style-type: none"> 1. Leaking or plugged fuel or EVAP hoses 2. Leaking fuel cap 3. Leaking fuel filler neck 4. Fuel filler neck gasket surface nicked, burred, or dented 5. Leaking sending unit or gasket 6. Leaking tank switch unit (Dual tank system) 7. Inoperative tank switch unit (Dual tank system) 8. Plugged or inoperative tank pressure control valve 	<ol style="list-style-type: none"> 1. Repair or replace hoses as necessary 2. Repair or replace cap as necessary 3. Repair or replace as necessary 4. Repair or replace as necessary 5. Repair or replace as necessary 6. Replace unit 7. Replace unit 8. Repair or replace as necessary
<p>B) From under hood - Perform pressure check to determine possible causes</p>	<ol style="list-style-type: none"> 1. Liquid fuel leaking from fuel lines, fuel pump or carburetor 2. Cracked or damaged canisters 3. Inoperative bowl vent valve (see Bowl Vent Check Procedures) 4. Inoperative purge valve (see Purge Valve Check Procedures) 5. Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses or control hoses 6. Bowl vent hose misrouted 7. Air cleaner or air cleaner gasket improperly seated 8. Leaking or inoperative tank pressure control valve 	<ol style="list-style-type: none"> 1. Tighten fuel lines, repair or replace fuel pump or carburetor as necessary 2. Repair or replace canisters as necessary 3. Repair or replace hoses Replace canister 4. Repair or replace hoses Replace canister 5. Check for proper connections, and check routing as well as condition. Correct as necessary 6. Reroute hose without low spots 7. Reinstall air cleaner and/or replace gasket 8. Repair or replace as necessary
<p>Poor idle or driveability or driveability slugging</p>	<ol style="list-style-type: none"> 1. Inoperative purge valve (see Purge Valve Check Procedures) 2. Inoperative bowl vent valve (see Bowl Vent Check Procedures) 3. Vacuum leak at tank pressure control valve 	<ol style="list-style-type: none"> 1. Replace or repair hoses Replace canister 2. Repair or replace hoses Replace canister 3. Repair or replace hoses and/or valve
<p>Collapsed fuel tank (Loss of tank capacity)</p>	<ol style="list-style-type: none"> 1. Plugged or pinched vapor pipe or hoses and defective cap 2. Canister filter plugged and defective cap 3. Plugged or ruptured diaphragm in tank pressure control valve and defective cap 	<ol style="list-style-type: none"> 1. Check all lines from tank to canister and replace cap 2. Replace filter in canister and cap 3. Replace tank pressure control valve and cap

Fig. 6C-9--Evaporative Emission Control System

DIAGNOSIS

FUEL TANK

CONDITION	POSSIBLE CAUSE	CORRECTION
Gasoline Odor	<ol style="list-style-type: none"> 1. Tank overfilled. 2. Fuel feed line leaking. 3. Leak in fuel tank. 4. Disconnected fuel vapor pipe or hoses. 6. Faulty fill cap or tank neck. 	<p>Do not "pack" tank. Fill to automatic shut-off.</p> <p>Correct as required.</p> <p>Purge tank and repair or replace tank as required.</p> <p>Connect pipe or hoses as required.</p> <p>Install new cap or tank neck as required.</p>
Collapsed Fuel Tank	<ol style="list-style-type: none"> 1. Plugged or pinched vapor pipe or hoses, & defective cap. 2. Canister filter plugged & defective cap. 	<p>Check all lines from tank to canister and replace cap.</p> <p>Replace filter in canister & cap.</p>
Fuel Tank Rattles	<ol style="list-style-type: none"> 1. Mounting straps loose. 2. Baffle loose. 3. Foreign material in tank. 	<p>Tighten straps to specifications.</p> <p>Replace fuel tank.</p> <p>Remove tank and clean.</p>
Fuel Starvation	<ol style="list-style-type: none"> 1. Tank gage unit filter plugged. 2. Fuel line pinched, plugged or mis-routed. 	<p>Replace filter.</p> <p>Check open or re-route as required.</p>

Fig. 6C-10--Fuel Tank Diagnosis

SECTION 6C1

CARBURETOR MODEL 1ME

CONTENTS

General Description.....	6C1-1	Choke Coil Replacement.....	6C1-6
On-Vehicle Service.....	6C1-3	Throttle Lever Actuator.....	6C1-6
Adjustments.....	6C1-3	Unit Repair.....	6C1-6
Choke Checking Procedure.....	6C1-3	Disassembly.....	6C1-6
Idle Mixture Adjustment.....	6C1-4	Cleaning.....	6C1-9
Carburetor Mounting Torque.....	6C1-5	Assembly.....	6C1-9
Carburetor Replacement.....	6C1-5	Adjustment Specifications.....	6C1-14
Solenoid Replacement.....	6C1-5		

GENERAL DESCRIPTION

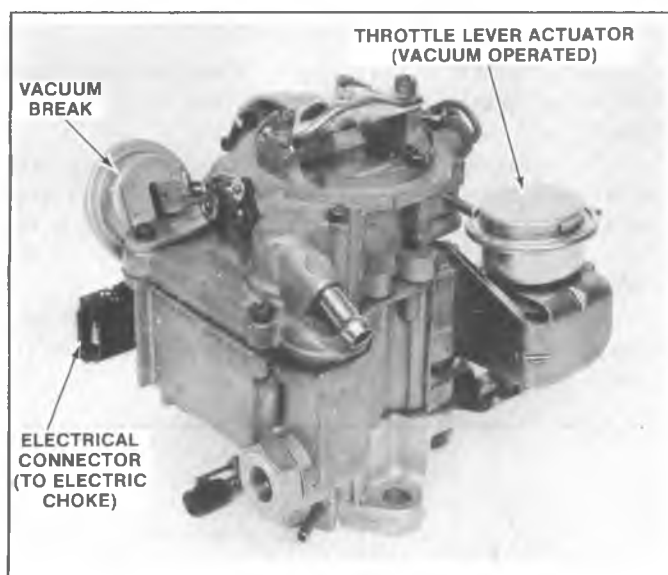


Fig. 6C1-1--Model 1ME Carburetor

The Model 1ME, carburetor (Fig. 6C1-1) is a single bore downdraft carburetor using a triple venture 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 filtration 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. 6C1-2).

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.

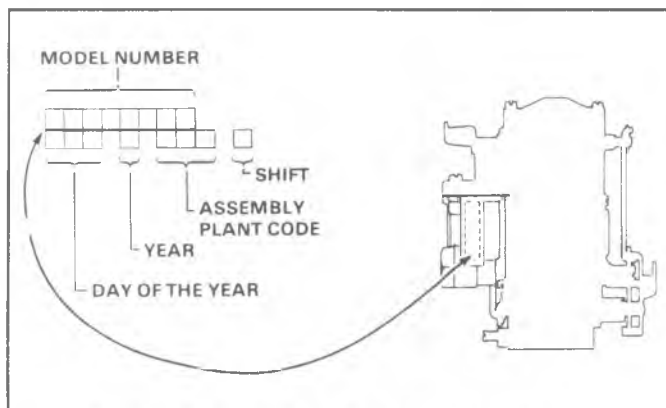


Fig. 6C1-2--Model 1ME Carburetor Identification

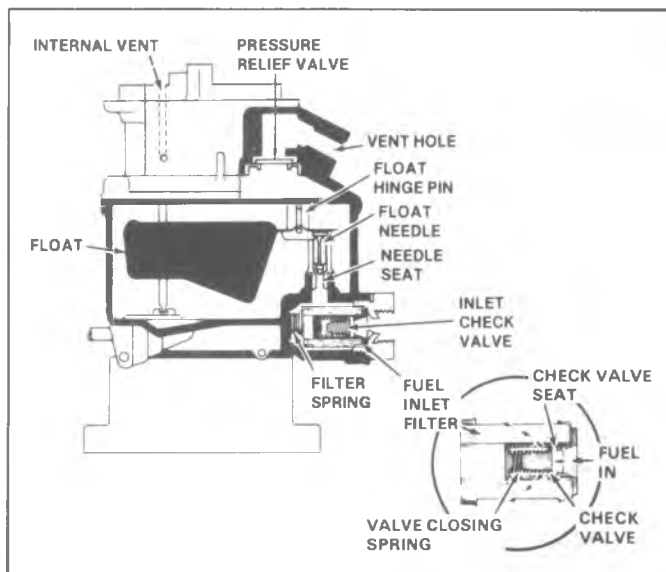


Fig. 6C1-3--Float System

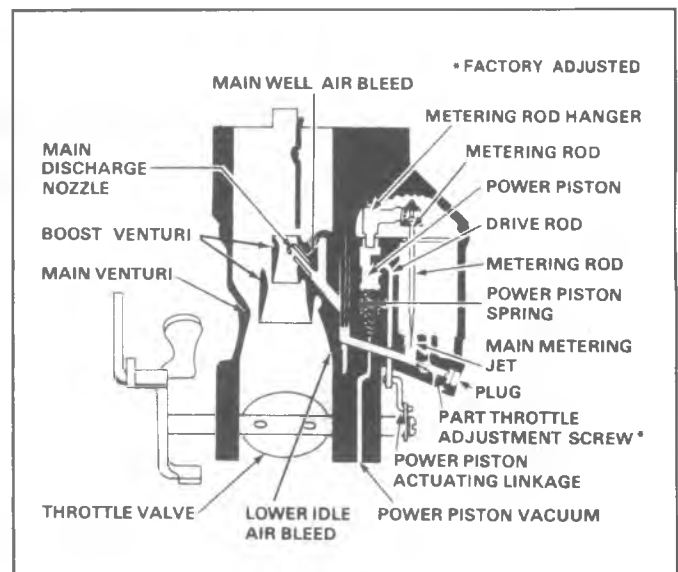


Fig. 6C1-6--Power Enrichment System

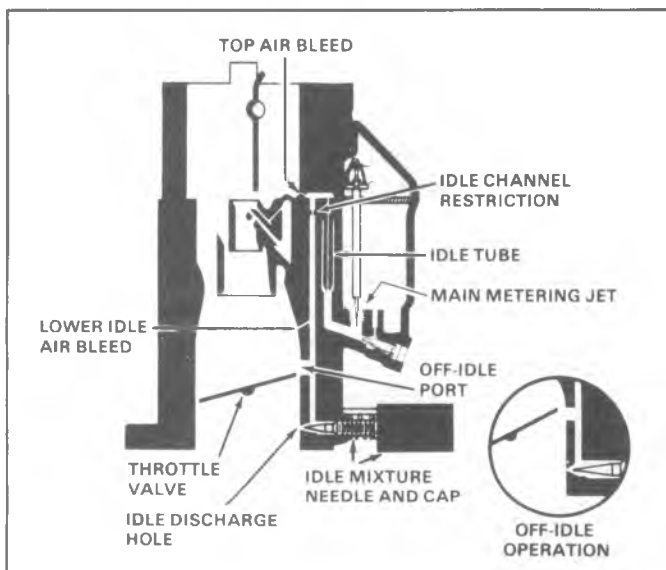


Fig. 6C1-4--Idle System

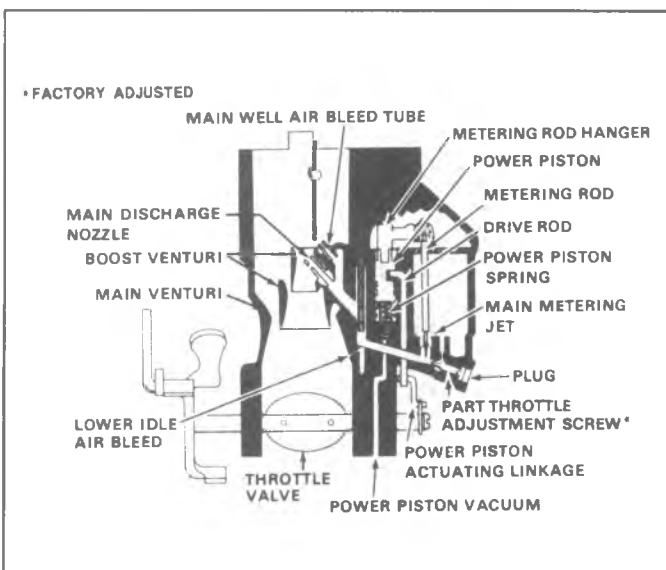


Fig. 6C1-5--Main Metering System Typical

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 (6C1-3 through 8).

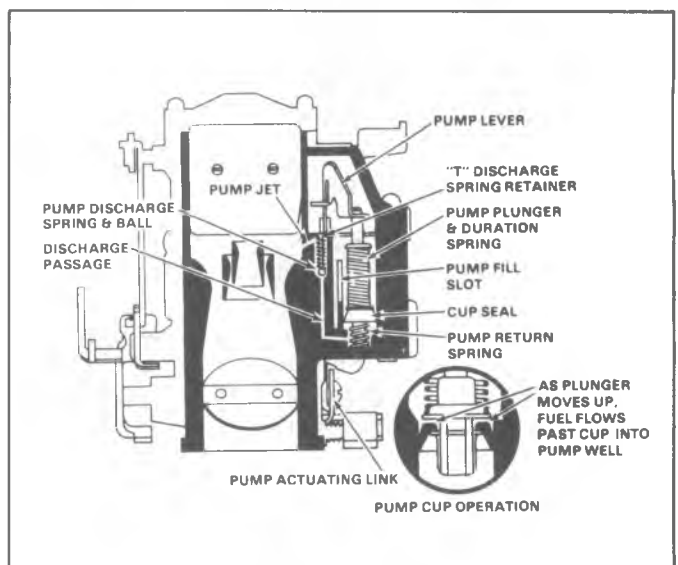


Fig. 6C1-7--Pump System

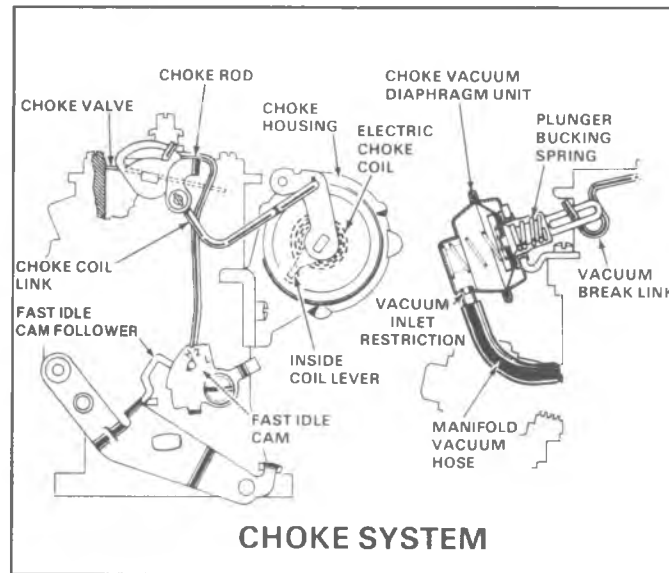


Fig. 6C1-8--Choke System

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

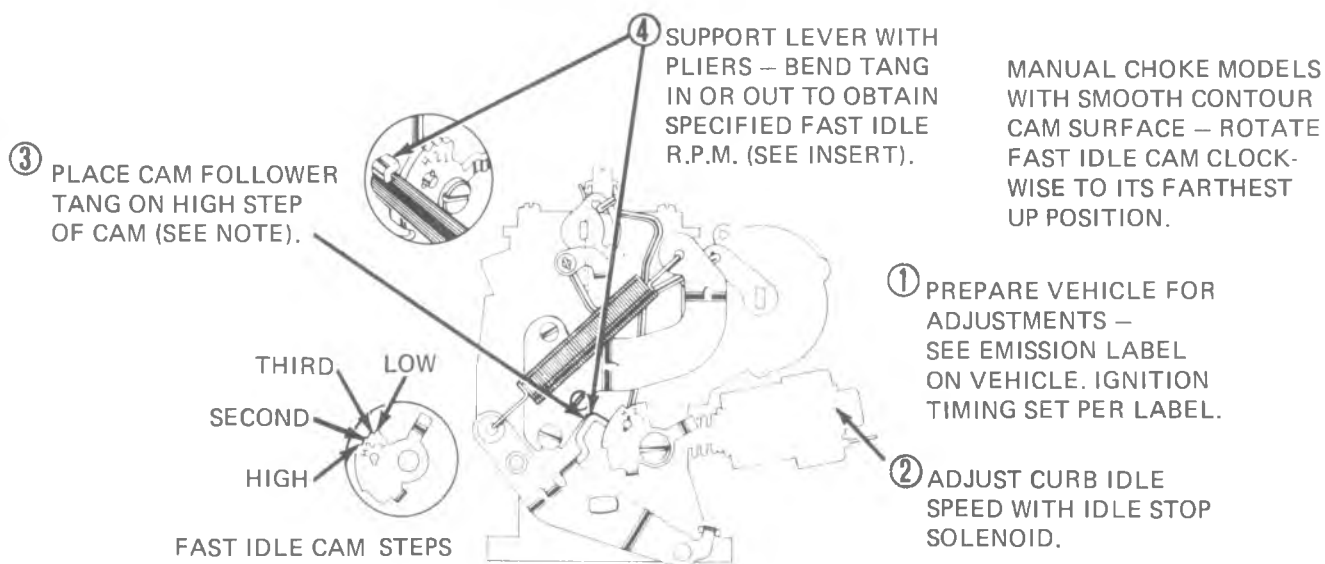
1. Turn on ignition, but do not start engine.
2. Open throttle to allow solenoid plunger to extend.
3. Hold throttle lever wide open, feel end of plunger and disconnect wire at solenoid.
4. Plunger should move. Some spring tension should be felt.
5. If plunger did not move, back out 1/8 hex screw (counterclockwise) 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

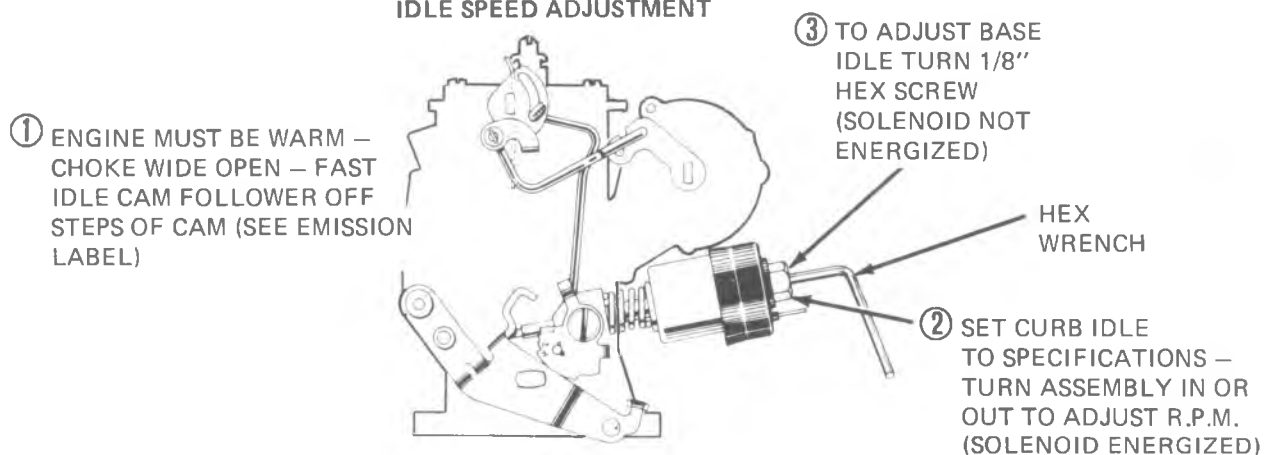
A carburetor is designed to meet the particular requirements of the engine, transmission and vehicle and although they may look alike, they are not usually interchangeable. Refer to carburetor part number and/or specifications when making adjustments.

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.

FAST IDLE ADJUSTMENT



IDLE SPEED ADJUSTMENT



101463

Fig. 6C1-9--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 6C1-9 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

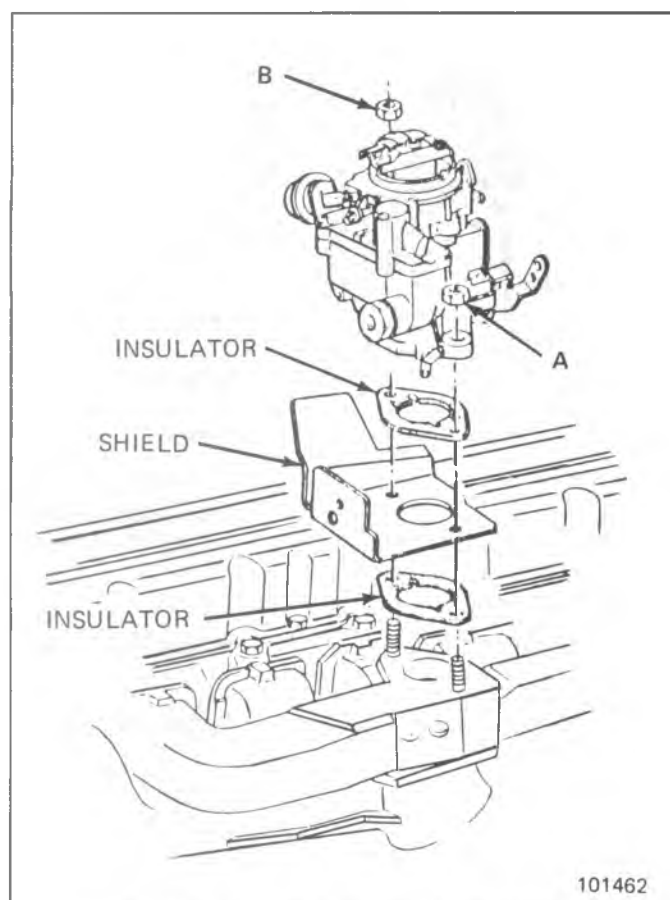


Fig. 6C1-10-1ME Carburetor Replacement

vehicle Emission Control Information label.

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 retorquing to 22 N·m (16 ft. lbs.).

CARBURETOR REPLACEMENT (FIG. 6C1-10)

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 retorquing 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. 6C1-11--Choke Coil

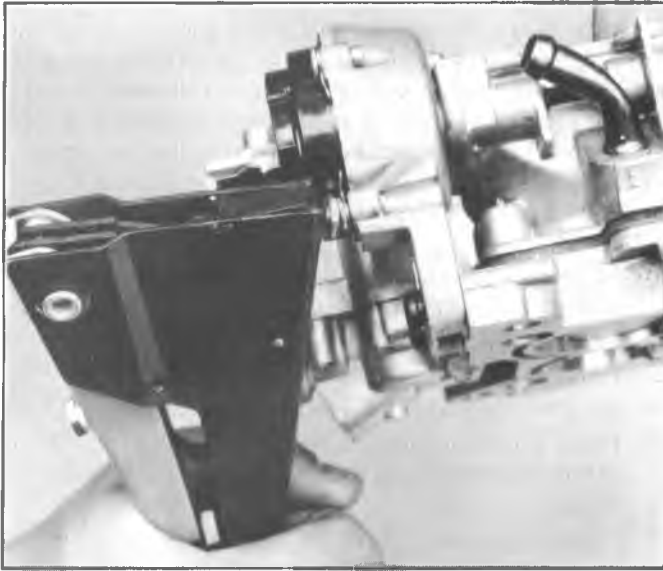


Fig. 6C1-12--Installing Choke

CHOKE COIL REPLACEMENT (Fig. 6C1-11a)

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:

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.

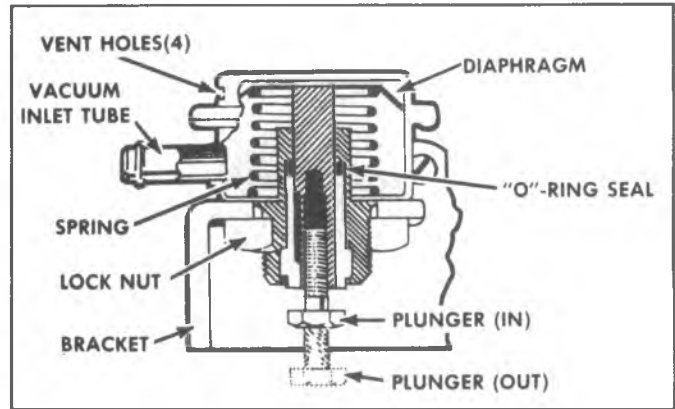


Fig. 6C1-13--Throttle Return Control

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. 6C1-12).

5. Connect choke electrical connector.
6. Start engine, check operation of choke and then install air cleaner.

THROTTLE LEVER ACTUATOR ADJUSTMENT (Fig. 6C1-13)

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 6C1-29 and 6C1-30 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. 6C1-14).

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. 6C1-16).
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

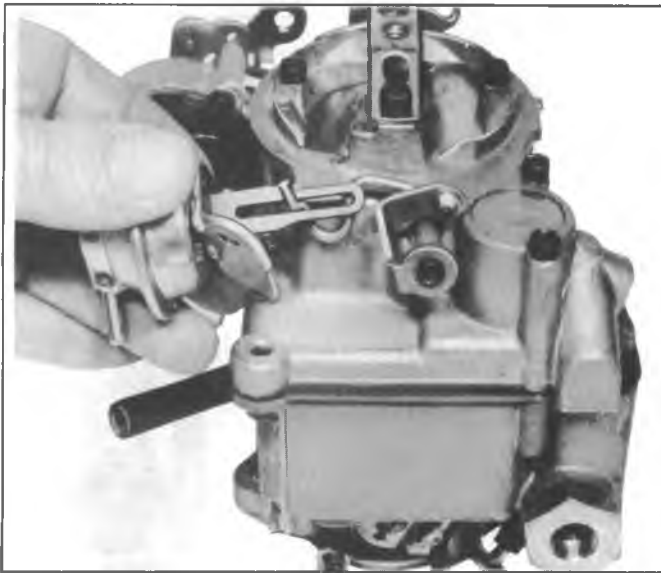


Fig. 6C1-14--Vacuum Break Diaphragm

enough to remove rivet head. Drill the two remaining 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. 6C1-16).



Fig. 6C1-16--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. 6C1-17).
2. Remove float assembly from float bowl by lifting



Fig. 6C1-15--Fast Idle Cam

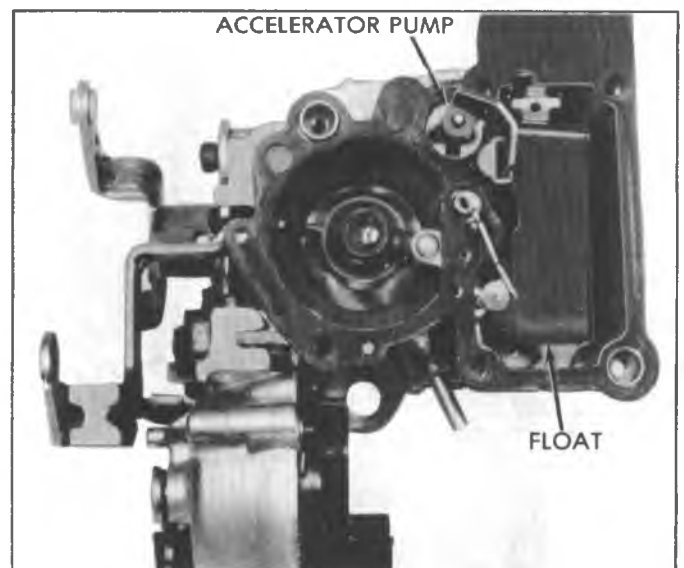


Fig. 6C1-17--Float Bowl Disassembly

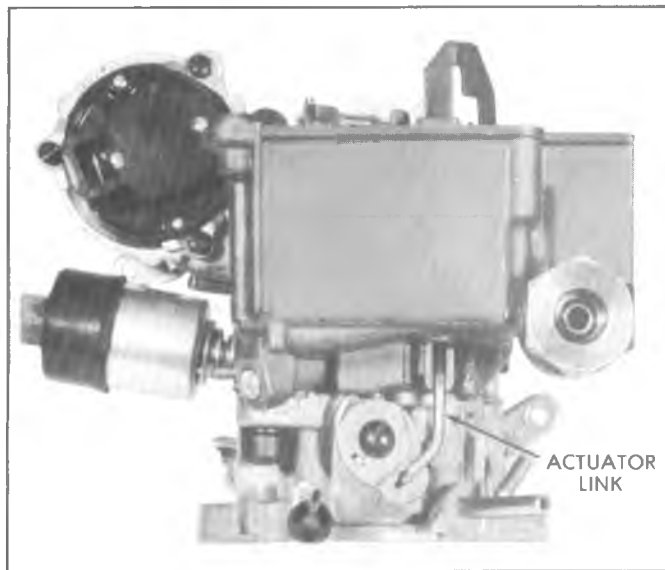


Fig. 6C1-18--Pump and Power Piston Actuator Lever

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. 6C1-18).
5. Hold down on power piston while removing lever. Power piston spring and metering rod assembly may now be removed from float bowl (Fig. 6C1-19).
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. 6C1-20).
10. Remove pump return spring and power piston spring from float bowl (Fig. 6C1-20).

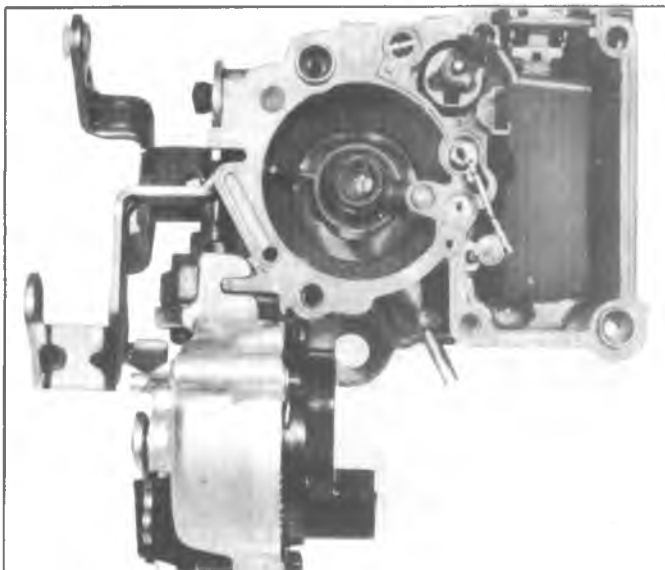


Fig. 6C1-19--Float Bowl Assembly

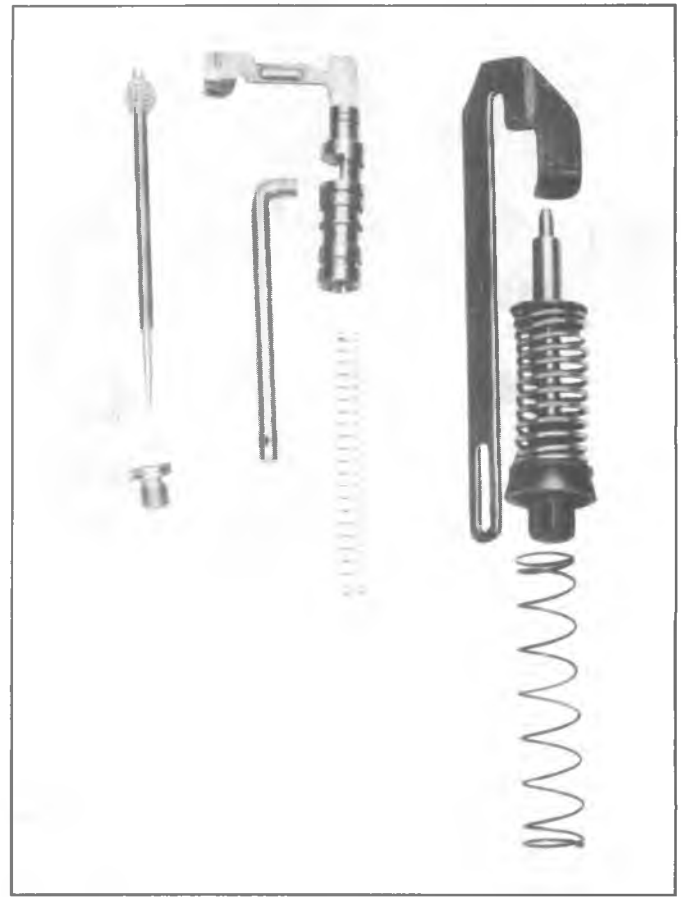


Fig. 6C1-20--Metering Rod and Accelerator Pump

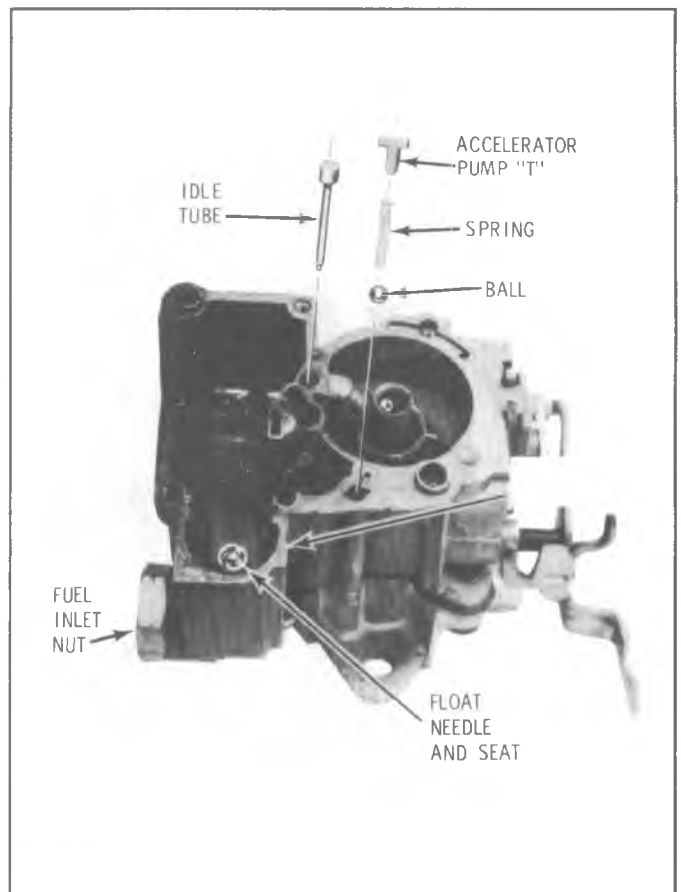


Fig. 6C1-21--Pump Discharge "T" Retainer

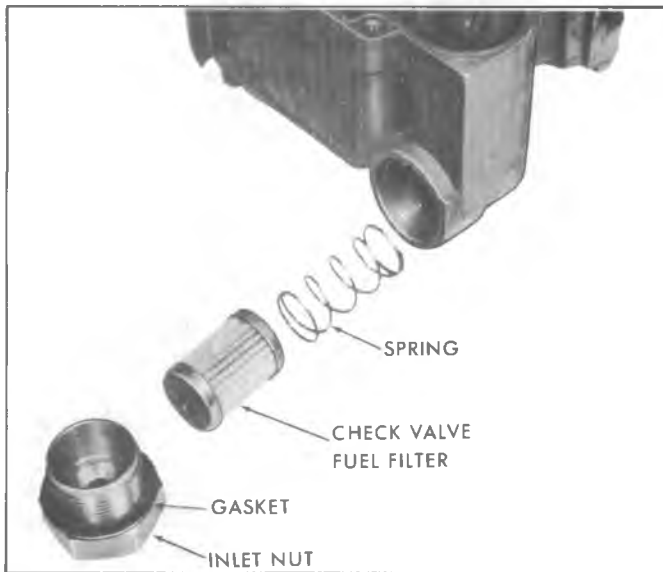


Fig. 6C1-22--Fuel Filter and Check Valve

11. Remove "T" guide and pump discharge spring using needle nose pliers (Fig. 6C1-21).
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. 6C1-22).
No further disassembly of the float bowl is required.

Throttle Body (Fig. 6C1-23)

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Throttle 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. 6C1-23)

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

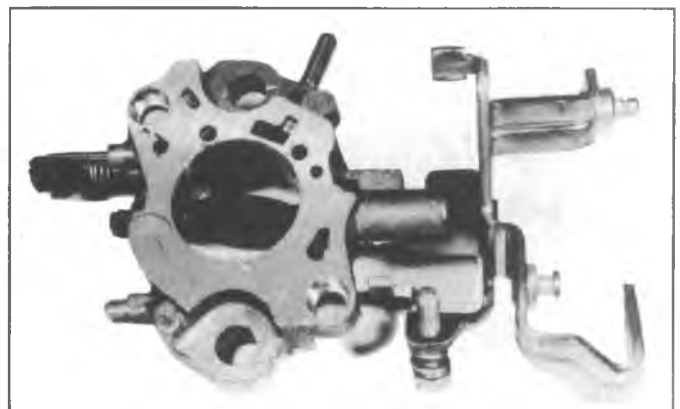


Fig. 6C1-23--Throttle Body

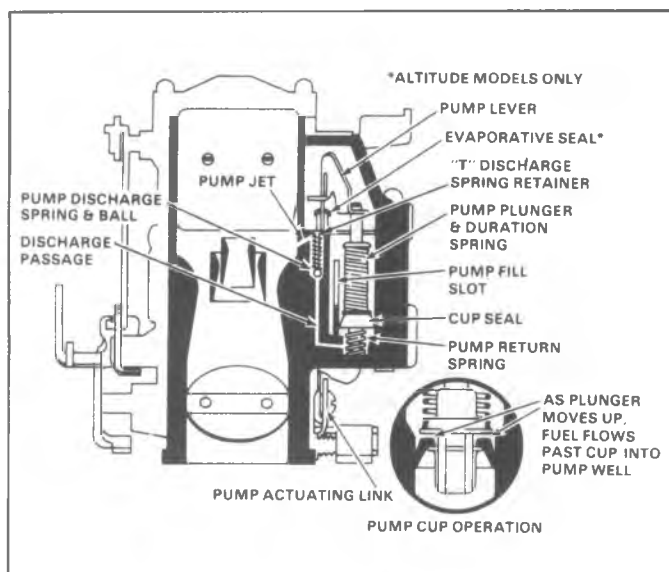


Fig. 6C1-24--Pump Drive Link

discharge hole (Fig. 6C1-21).

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. 6C1-24).
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 be in locating channels in float bowl.

Float Level Adjustment (Fig. 6C1-25)

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. 6C1-26)

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.

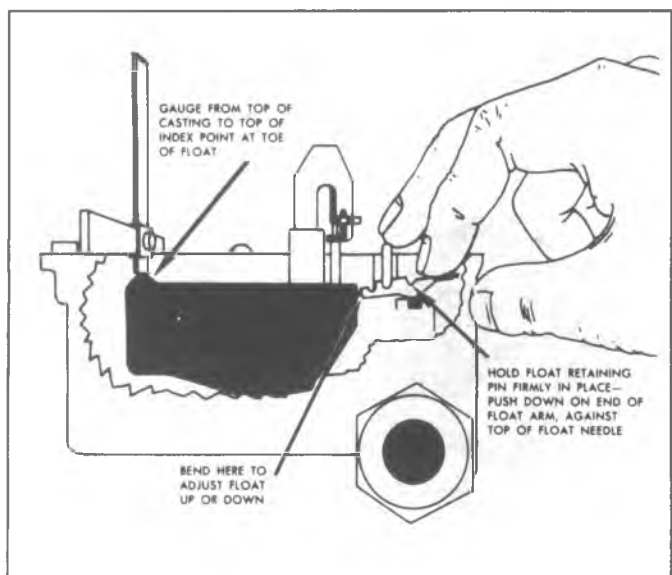


Fig. 6C1-25--Float Level Adjustment

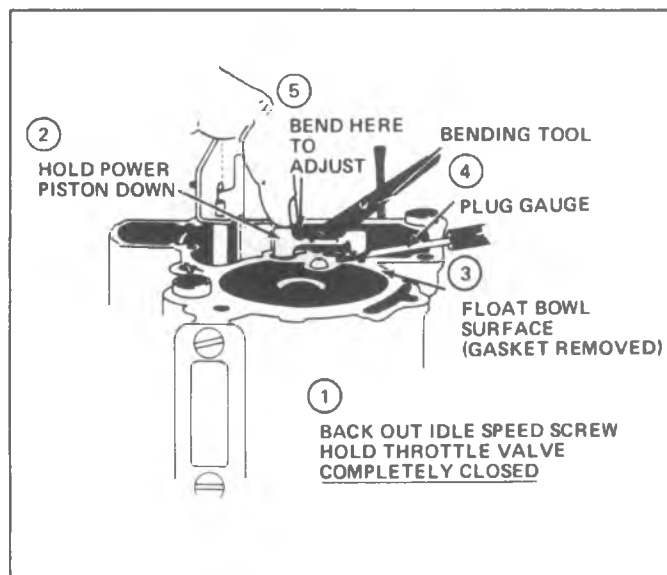


Fig. 6C1-26--Metering Rod Adjustment

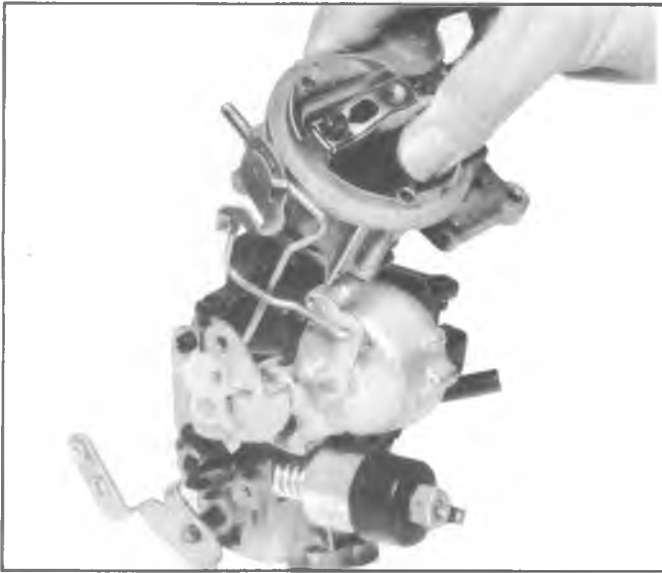


Fig. 6C1-27--Installing Air Horn

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. 6C1-27).
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. 6C1-28).

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.

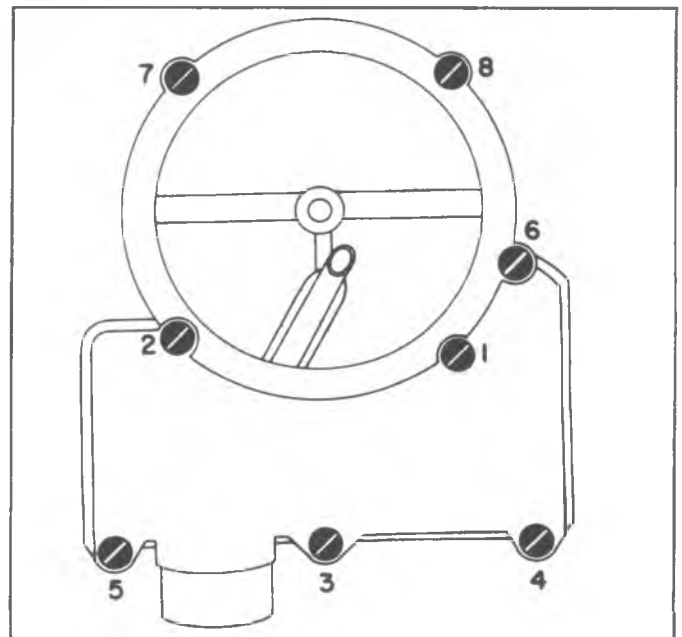
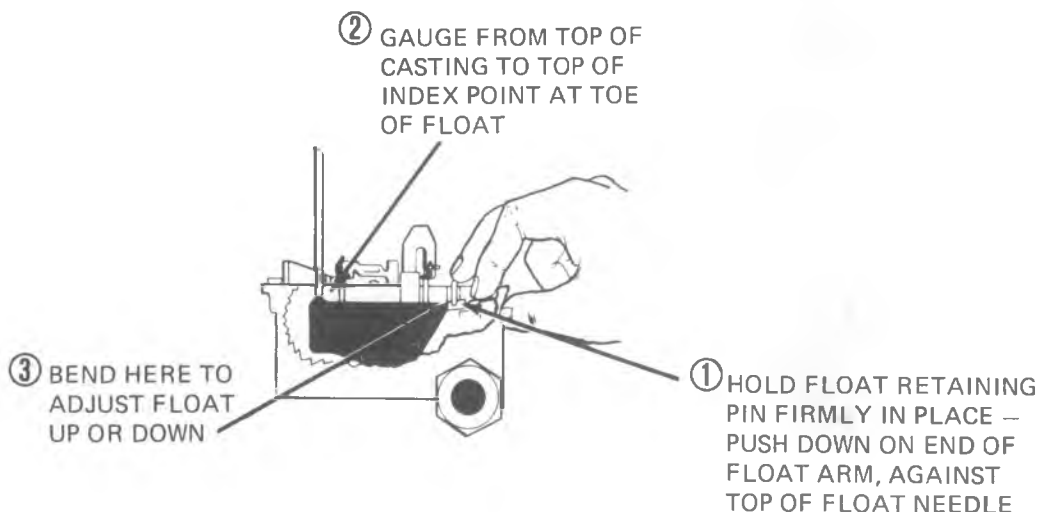
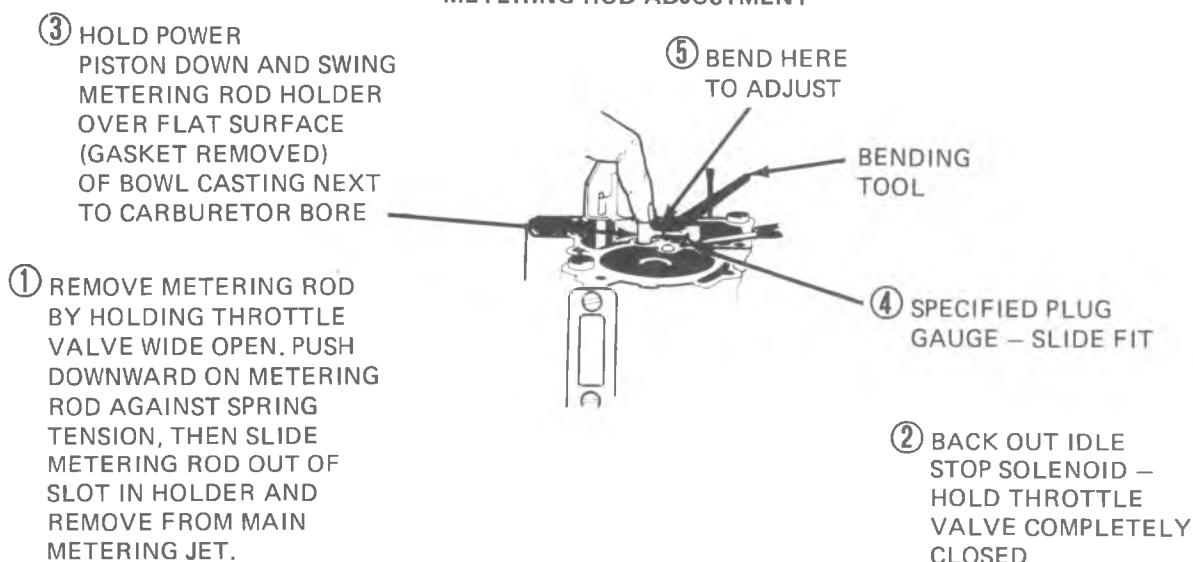


Fig. 6C1-28--Tightening Sequence

FLOAT LEVEL ADJUSTMENT



METERING ROD ADJUSTMENT



CHOKE COIL LEVER ADJUSTMENT – 1ME

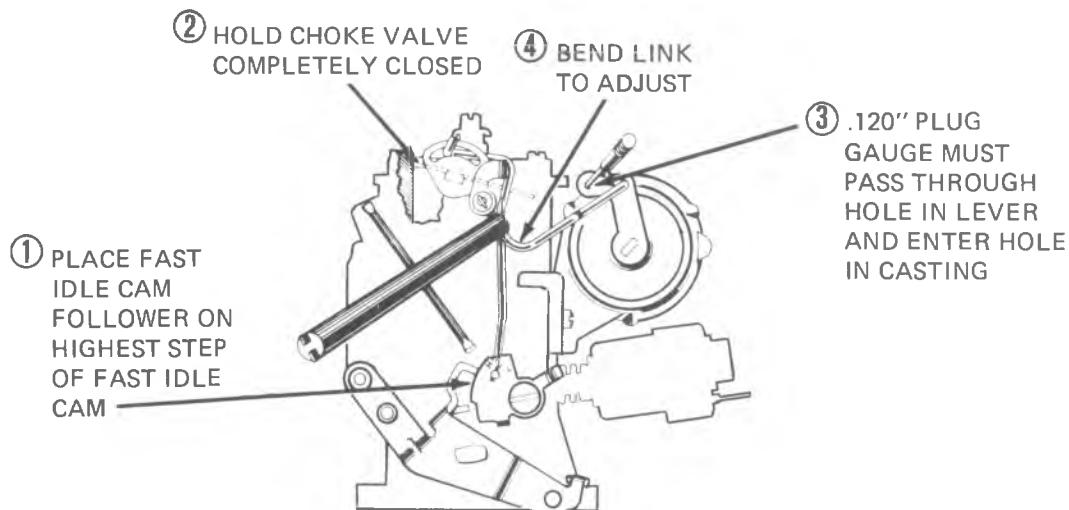
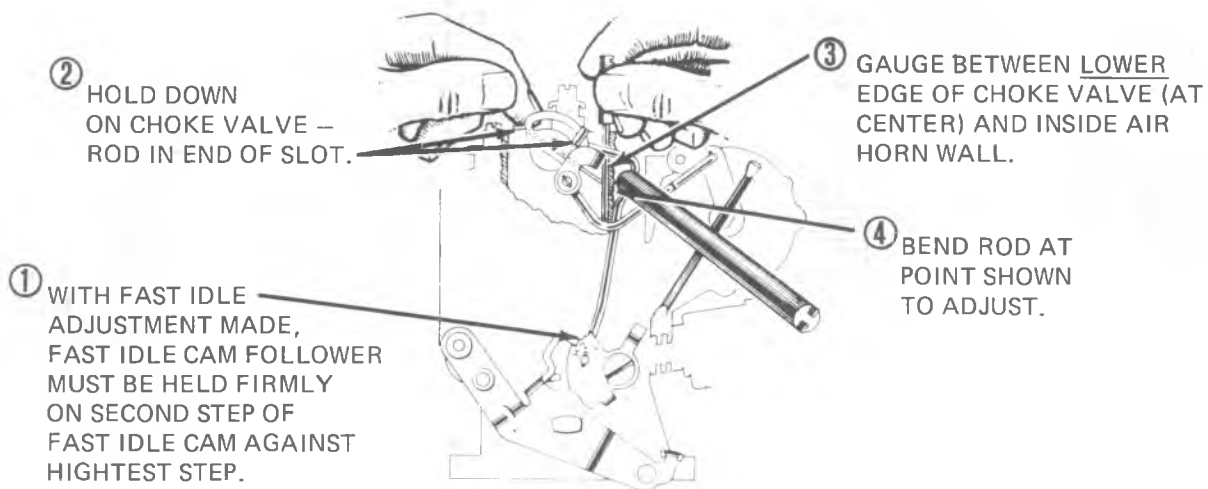
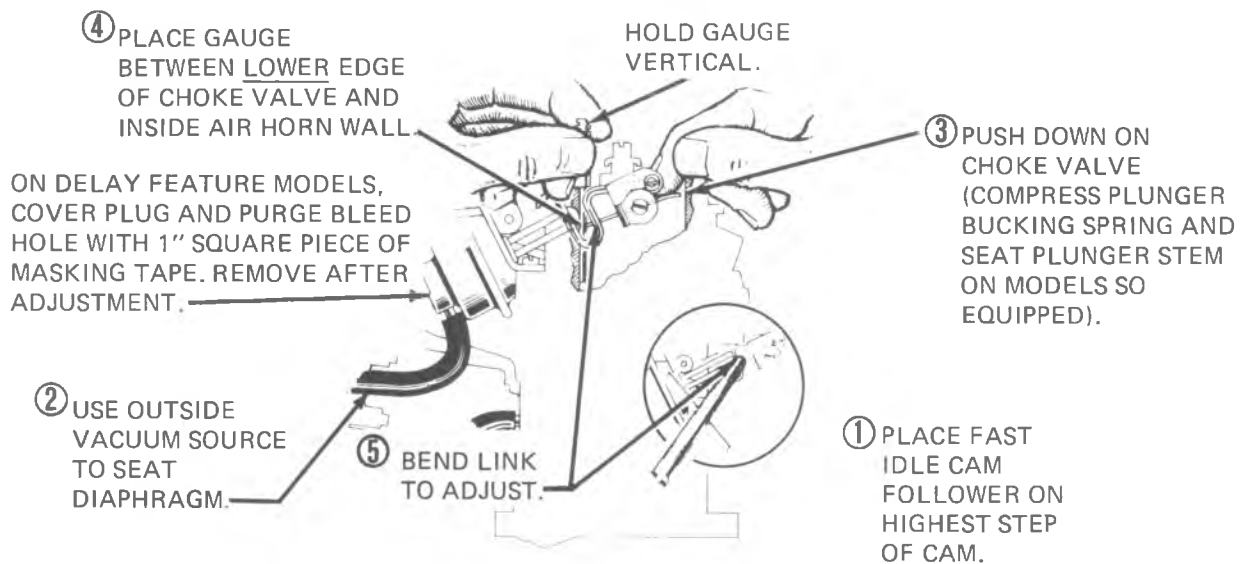


Fig. 6C1-29--1ME Adjustments (1 of 2)

CHOKE ROD (FAST IDLE CAM) ADJUSTMENT (2ND STEP)



VACUUM BREAK ADJUSTMENT — 1ME (BOWL SIDE)



UNLOADER ADJUSTMENT — 1ME (WIDE OPEN KICK)

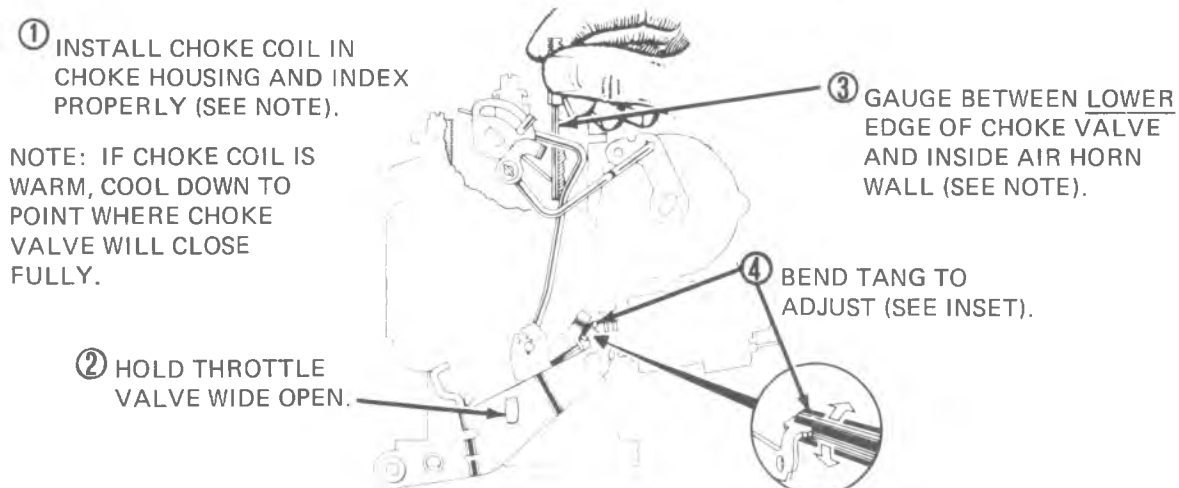


Fig. 6C1-30--1ME Adjustments (2 of 2)

CARBURETOR NUMBER	FLOAT LEVEL	METERING ROD	CHOKE ROD CAM ADJ	VACUUM BREAK	UNLOADER
	mm / (Inches)	mm / (Inches)	mm / (Inches)	mm / (Inches)	mm / (Inches)
17081009 ME	8.7 / (11/32)	2.3 / (.090)	7.0 / (.275)	10.0 / (.400)	13.2 / (.520)
17081309 ME	8.7 / (11/32)	2.3 / (.090)	7.0 / (.275)	10.0 / (.400)	13.2 / (.520)
17081329 ME	8.7 / (11/32)	2.3 / (.090)	7.0 / (.275)	10.0 / (.400)	13.2 / (.520)

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Fig. 6C1-31--1ME Adjustment Specifications

SECTION 6C2

CARBURETOR MODEL 2SE

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GENERAL DESCRIPTION

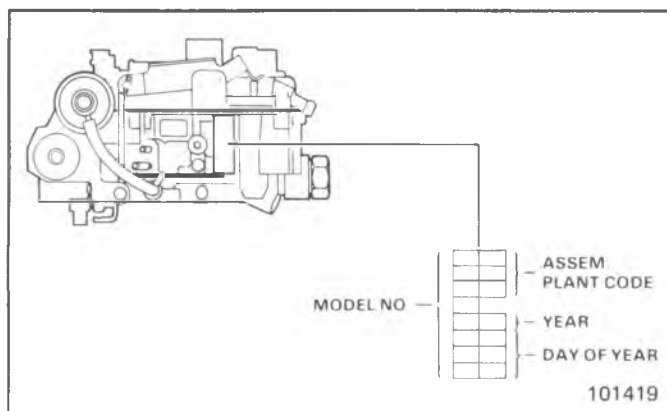


Fig. 6C2-1--Model 2SE Identification

The Model 2SE is a two barrel, two stage carburetor of down-draft design for use on the 4.1 liter engine.

The primary stage has a triple venturi, with a 30mm bore which gives good fuel control at idle and low speed operation.

The secondary stage has a larger 46mm bore that provides additional air capacity for engine power requirements. An air valve is used in the secondary stage which controls a tapered metering rod.

A pleated paper fuel filter with integral check valve is installed in the float bowl behind the fuel inlet nut. The check valve is used to shut off fuel flow to the carburetor and prevent fuel leaks if a vehicle roll-over should occur.

A single pontoon float, brass needle seat, and a rubber tipped float valve with pull clip are used to control fuel level in the float chamber.

The float chamber also is externally vented through a tube in the air horn. A hose connects this tube directly to a vacuum canister. When the engine is not running, a vapor vent valve is open allowing fuel vapors from the float

chamber to pass into the canister where they are stored until normally purged. An adjustable part throttle screw is used in the float bowl to aid in refinement of fuel mixtures for good emission control. This screw is pre-set at the factory and a plug is installed. **No attempt should be made to adjust this screw in the field.**

A hot idle compensator assembly (when used) is located in the air horn casting. The opening and closing of the hot idle compensator valve is controlled by a bi-metal strip that is calibrated to a specific temperature. When the valve opens, additional air is allowed to by-pass the throttle valves and enters the intake manifold to prevent rough idle during periods of hot engine operation.

The idle mixture needle is recessed in the throttle body casting and sealed with a hardened steel plug. The plug must not be removed and idle mixture screw re-adjusted unless required due to major carburetor overhaul or throttle body replacement in which case special service procedures must be carefully followed.

The choke system of the 2SE carburetor uses a dual vacuum break system arrangement. An electrically heated thermostatic choke coil is mounted in the choke housing located on the secondary side of the carburetor. To provide a tamper-resistant design to discourage field readjustment of factory settings, all models use a vacuum break link of a non-bendable design, a special cap over the vacuum break unit adjustment screws, a special choke cover which must be indexed with the cover housing, and special rivets to retain choke thermostatic cover and coil assembly in choke housing.

For ease of service, alphabetical code letters are cast into the air horn, float bowl, and throttle body castings at the external tube locations to identify air and vacuum hose connections. The carburetor model identification is stamped vertically on the float bowl in a flat area adjacent to the vacuum tube Location "B" (Figure 6C2-2).

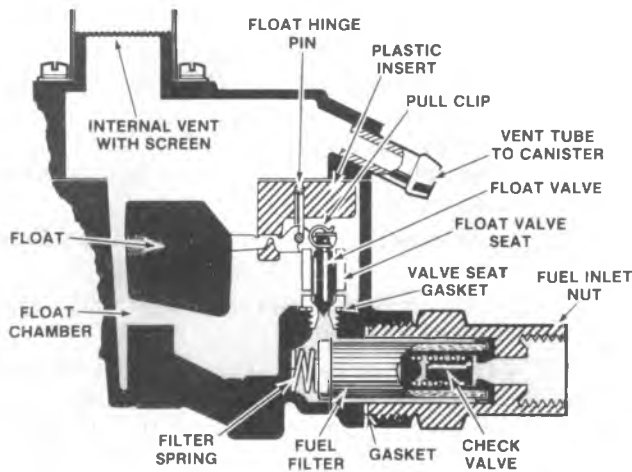
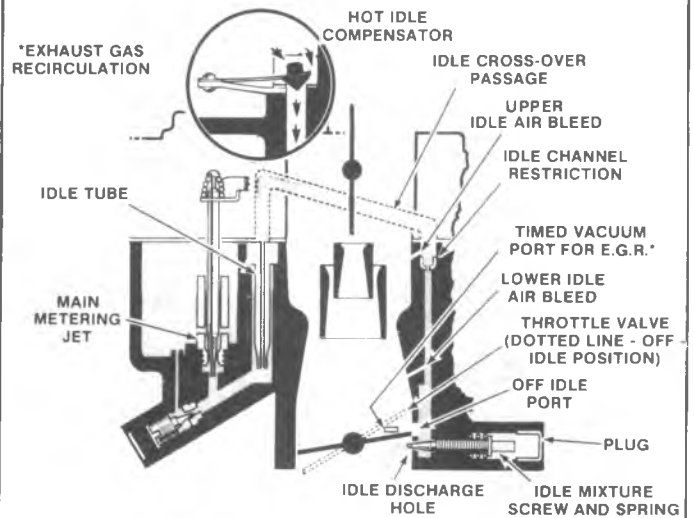
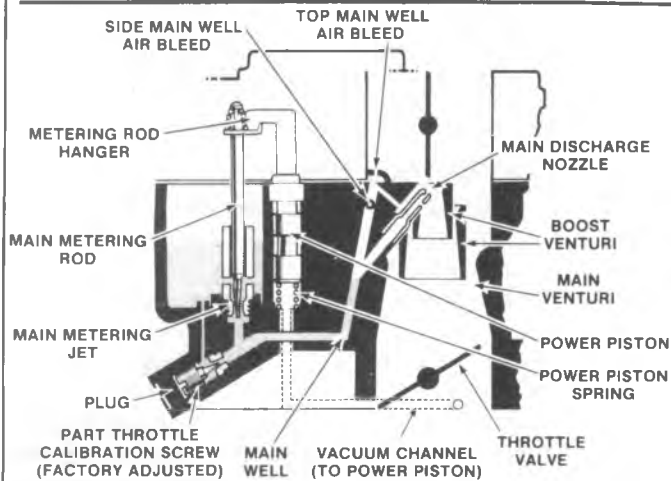
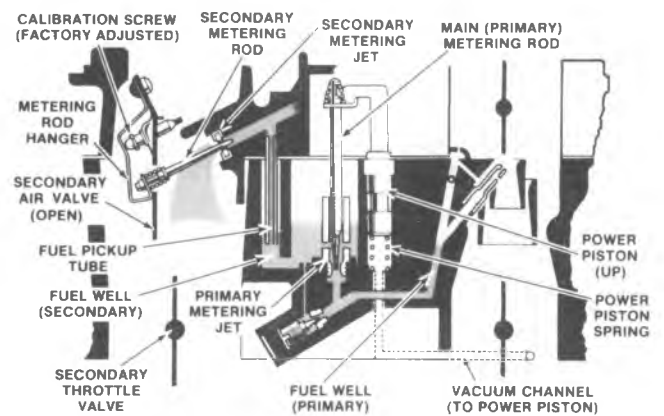
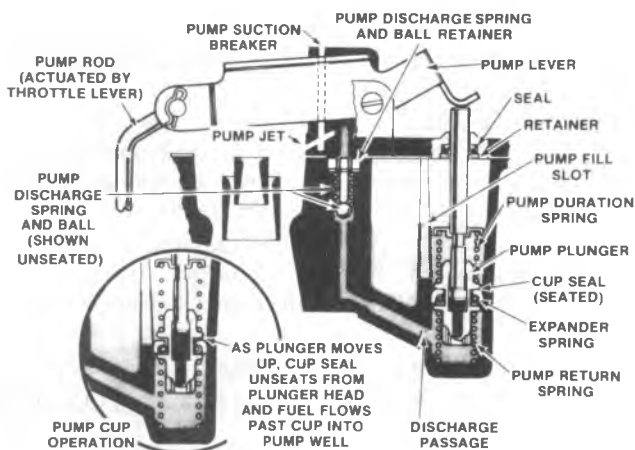
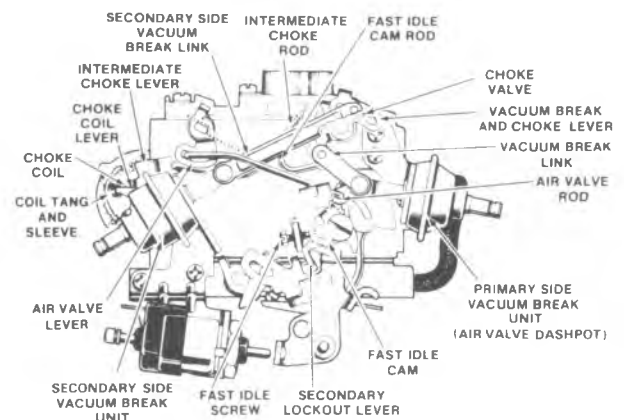
Refer to the part number when servicing the carburetor. An exhaust gas recirculation system (E.G.R.) is used on all applications. The vacuum port necessary to operate the EGR valve is located in the throttle body and connect through a channel to a tube in the float bowl. This tube is connected by a hose to the E.G.R. valve.

On the 2SE carburetor, the primary and secondary throttle shafts, the secondary actuating lever and lock-out lever are coated with a special coating to reduce friction and wear in these operating parts. Also, the secondary throttle bore and valve are coated with a special graphite compound for minimum air leakage past the valve for good idle air

control. Care should be taken during carburetor service to not disturb or damage these coatings. An idle speed solenoid is used to position the primary throttle valve to control engine idle speed requirements. A separate screw located in the primary throttle lever for fast idle speed adjustment. A second screw with a spring retainer is located in the throttle body. It is used to set curb idle speed.

Carburetor Operation

The model 2SE carburetor has six basic systems. They are float, idle, main metering, power, pump and choke (Fig. 6C2-3).

**FLOAT SYSTEM****IDLE SYSTEM
(TYPICAL)****MAIN METERING SYSTEM
(TYPICAL)****POWER SYSTEM
(INCLUDING SECONDARY STAGE)****PUMP SYSTEM****CHOKE SYSTEM**

ON-VEHICLE SERVICE

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 hose gaskets and connections for leaks and check torques of carburetor mounting bolts/nuts.

Refer to Figures 6C2-3 through 6C2-4 for on-vehicle carburetor adjustment procedures for fast idle, idle speed and external float check.

CHECKING IDLE SOLENOID

1. Turn on ignition, but do not start engine. On models with A/C idle solenoid, turn A/C on.
2. Open throttle to allow solenoid plunger to extend, close throttle.
3. Disconnect lead at solenoid. Solenoid plunger should drop away from throttle lever.
4. 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.
5. If plunger does not move in and out as lead is disconnected and connected, insert test lamp (1893 bulb or smaller) between the solenoid feed wire and ground.
6. If light lights, replace solenoid.
7. If light does not light, locate cause of open circuit in solenoid feed wire.

IDLE 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.

CHECKING ELECTRIC CHOKE

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 or binding.
2. If choke or linkage binds, sticks or works sluggishly due to petroleum gum formation, clean with choke cleaner or equivalent. Use cleaner as directed on can.
3. Allow choke to cool so that when throttle is opened slightly, choke blade fully closes. This check should be

made at an ambient temperature of 15° to 27°C (59° to 80°F).

4. Start engine and determine time for choke blade to reach full open position. (Start timer when engine starts.)
5. If choke blade fails to open fully within 3-1/2 minutes, open throttle about 1/3. If choke still fails to open fully, proceed with steps 6 and 7.
6. 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 the oil pressure switch is failed open, the oil pressure warning light will be on with engine running. Repair wires or connections as required.
7. If steps 4a and 4b do not correct problem, replace oil pressure switch.
No gasket is used between the choke cover and the choke housing due to grounding requirements.
8. Reinstall air cleaner.

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. After removing rivet heads and retainers, use a draft and small hammer to drive the remainder of the rivets out of 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 pick-up 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.

IDLE MIXTURE CHECK AND ADJUSTMENT

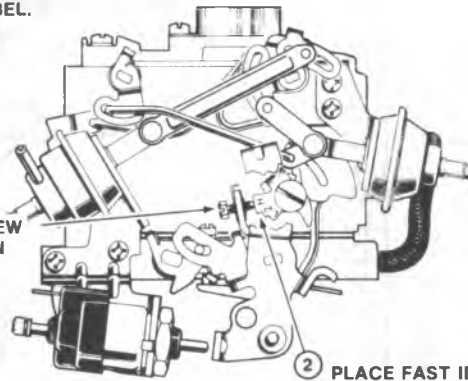
Propane Enrichment

Idle mixture screws have been present at the factory and sealed. Idle mixture should be adjusted only in the case of major carburetor overhaul, throttle body replacement

FAST IDLE ADJUSTMENT (ON VEHICLE)

- ① PREPARE VEHICLE FOR ADJUSTMENTS - SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.

- ③ TURN FAST IDLE SCREW IN OR OUT TO OBTAIN SPECIFIED FAST IDLE R.P.M. - (SEE LABEL)



- ② PLACE FAST IDLE SCREW ON HIGHEST STEP OF FAST IDLE CAM

IDLE SPEED ADJUSTMENT WITH A/C (ON VEHICLE)

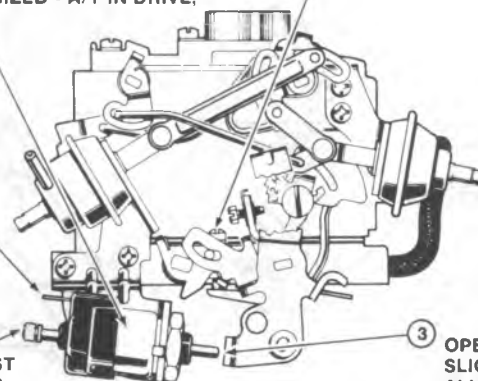
- ① PREPARE VEHICLE FOR ADJUSTMENTS - SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.

- ② SOLENOID ENERGIZED - A/T IN DRIVE, M/T IN NEUTRAL

- ⑤ TURN IDLE SPEED SCREW TO SET BASIC IDLE SPEED TO SPECIFICATIONS (SOLENOID DE-ENERGIZED)

- ⑥ RECONNECT SOLENOID ELECTRICAL LEAD AFTER ADJUSTMENT

- ④ TURN SOLENOID SCREW TO ADJUST CURB IDLE SPEED TO SPECIFIED RPM (SOLENOID ENERGIZED)

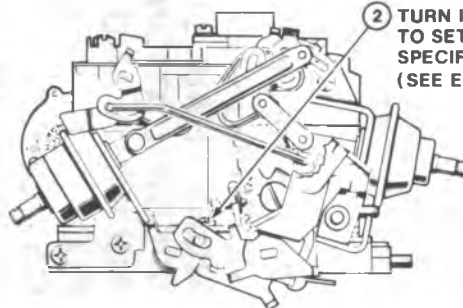


- ③ OPEN THROTTLE SLIGHTLY TO ALLOW SOLENOID PLUNGER TO FULLY EXTEND

IDLE SPEED ADJUSTMENT WITHOUT A/C (ON VEHICLE)

- ① PREPARE VEHICLE FOR ADJUSTMENTS - SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.

- ② TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS - (SEE EMISSION LABEL)



FUEL LEVEL MAY BE AFFECTED BY FUEL PUMP PRESSURE AS WELL AS BY FLOAT LEVEL ADJUSTMENT.

- ④ READING AT EYE LEVEL, OBSERVE MARK ON GAGE THAT LINES UP WITH TOP OF CASTING AT THE VENT HOLE. SETTING SHOULD BE WITHIN $\pm 1.5\text{mm}$ FROM SPECIFIED FLOAT LEVEL SETTING.

REMOVE FLOAT GAGE FROM AIR HORN

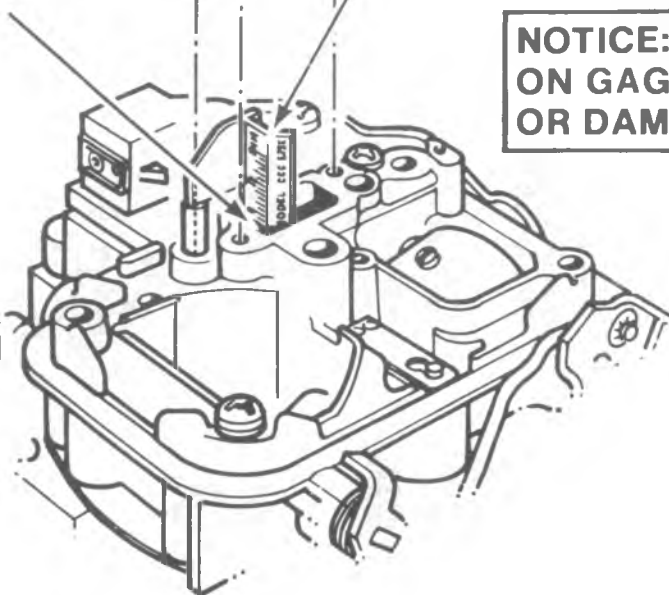
- ⑤ IF THE MECHANICAL SETTING (STEP 4) VARIES MORE THAN $\pm 1.5\text{mm}$ FROM SPECIFICATIONS, REMOVE AIR HORN AND ADJUST FLOAT LEVEL TO SPECIFICATIONS FOLLOWING NORMAL ADJUSTMENT PROCEDURES.

- ⑥ IF MECHANICAL SETTING IS FOUND TO BE WITHIN SPECIFIED TOLERANCE - REPLACE AIR HORN SCREW, VENT STACK AND VENT STACK SCREWS.

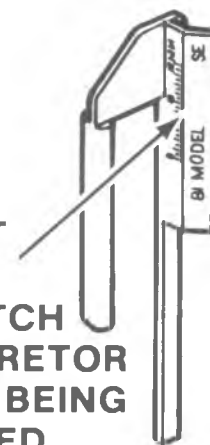
- ② REMOVE AIR HORN SCREW
- ① REMOVE VENT STACK SCREWS AND VENT STACK

- ③ WITH ENGINE RUNNING AT IDLE, CHOKE WIDE-OPEN, CAREFULLY INSERT GAGE IN AIR HORN SCREW HOLE WITH SCALE IN VENT HOLE. RELEASE GAGE AND ALLOW IT TO FLOAT FREELY.

NOTICE: DO NOT PRESS DOWN ON GAGE TO CAUSE FLOODING OR DAMAGE TO FLOAT.



SELECT GAGE TO MATCH CARBURETOR SERIES BEING CHECKED



BLUE - 1979-82 2SE

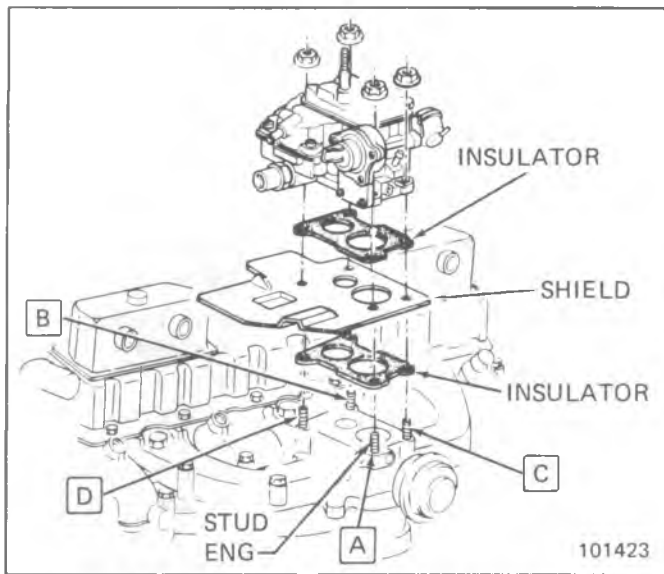


Fig. 6C2-5-2SE Carburetor Replacement

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 screws, the idle mixture checking procedure requires artificial enrichment by adding propane.

1. Set parking brake and block drive wheels. On cars equipped with vacuum parking brake release, disconnect and plug hose at brake. 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 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 must be vertical.
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 plug following procedures.
11. Lightly seat screw, then back out equally, just enough so engine will run.
12. Place transmission in Drive (automatic) or Neutral (manual).

13. Back 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 mixture screw in (clockwise) 1/8 turn at a time until idle speed reaches value given Vehicle Emission Control Information label.
15. Recheck enriched speed 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. Re-connect vacuum hoses.

CARBURETOR MOUNTING TORQUE

When torquing carburetor after removed, overhaul, replacement or when installing a new heat insulator, refer to Figure 6C2-5 and pre-torque mounting bolts in sequence to 4 N·m (38 in. lbs.) as follows:

1. Location B-Inboard Rear.
2. Location D-Inboard Front.
3. Location A-Outboard Front.
4. Location C-Outboard Rear. Final torque to be 17 N·m (150 in. lbs.) after initial pre-torque.

When retorquing carburetor at recommended maintenance intervals, retorque to 17 N·m (150 in. lbs.) maximum.

CARBURETOR REPLACEMENT (FIG. 6C2-5)

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 and transmission cable.
5. Disconnect solenoid electrical connector.
6. Remove carburetor attaching nuts and remove carburetor and solenoid assembly attachment.
7. Remove insulator.

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 insulator.

3. Install carburetor over manifold studs.
4. Install vacuum and fuel lines at carburetor.
5. Install attaching nuts and tighten referring to carburetor mounting torque.
6. Tighten fuel line.

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 previous "On Vehicle Service" information serve as an example.

The information that follows is relative to a complete overhaul. The carburetor must first be removed from the engine. A complete overhaul includes: disassembly, thorough cleaning; inspection and replacement of all gaskets, seals; worn or damaged parts and adjustment of individual systems. Refer to Figure 6C2-6 for individual part identification and for disassembly and assembly of carburetor components.

NOTICE: Before performing any service on the carburetor, it is essential that the carburetor be placed on a holding fixture such as Tool J-9789-118 or BT-30-15. Without the use of the holding fixture, it is possible to damage throttle valves.

Idle Speed Solenoid

Removal

1. Bend back retaining tabs on lockwasher; then remove large solenoid retaining nut using suitable wrench. Use care in removing nut with wrench to avoid bending or damaging choke linkage, solenoid bracket, vacuum break unit or throttle lever.
2. Remove lockwasher and solenoid unit from bracket.

NOTICE: The solenoid should not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul. Immersion in cleaner will damage solenoid.

Air Horn

1. Remove clip from hole in pump lever. Do not remove pump lever retaining screw or pump lever from air horn assembly.
2. Remove hose from primary side vacuum break assembly.
3. Remove screws securing primary side vacuum break bracket to air horn and throttle body, then, rotate vacuum break and bracket assembly to disengage vacuum break link from slot in vacuum break and choke lever and air valve rod from slot in air valve lever.

NOTICE: Do not place vacuum break assembly in carburetor cleaner. Immersion in cleaner will damage vacuum break diaphragm.

4. If necessary to remove air valve rod from vacuum break, remove and discard retaining clips from end of air valve rod. New retaining clip is required for reassembly. Remove plastic bushing used on rods and retain for later re-use.
5. Remove secondary side idle speed solenoid-vacuum break bracket attaching screws from throttle body.

7. Connect accelerator linkage and transmission cable.
8. Connect choke and solenoid electrical connectors.
9. Install air cleaner.
10. Check and adjust idle speed.

UNIT REPAIR

Then, rotate bracket to remove secondary side vacuum break link from slot in break and choke lever.

NOTICE: Do not place vacuum break assembly and solenoid in carburetor cleaner. Immersion in cleaner will damage vacuum break diaphragm.

6. Remove and discard retaining clip from intermediate choke rod at choke lever. A new retaining clip is required for reassembly. Remove choke rod and plastic bushing from choke lever, and save the bushing for later re-use.
7. Remove small screws that retain the hot idle compensator valve (if used). Remove valve and seal from air horn. Discard seal. Hot idle compensator valve must be removed to gain access to short air horn to bowl attaching screw.
8. Remove the air horn to bowl attaching screws and lockwashers (Fig. 6C2-6). Remove vent and screen assembly.
9. Rotate fast idle cam to the full UP position and remove air horn assembly by tilting to disengage fast idle cam and pump rod from hole in pump lever. If pump plunger remain with air horn, remove. The air horn gasket should remain on the float bowl for removal later.
Do not remove fast idle cam screw and cam from float bowl. These parts are not serviced separately and are to remain permanently in place. The new service replacement float bowl will include the secondary lockout lever, fast idle cam and screw installed as required.
10. Remove fast idle cam rod from choke lever by rotating rod to align squirt on rod with small slot in lever.

Air Horn Disassembly

1. Remove pump plunger stem seal by inverting air horn and use a small screwdriver to remove staking holding the seal retainer in place. Remove and discard retainer and seal (Fig. 6C2-7).

NOTICE: Use care in removing the pump plunger stem seal retainer to prevent damage to air horn casting. A new seal and retainer are required at time of reassembly.

2. Further disassembly of the air horn is not required for cleaning purposes or air horn replacement. The new service air horn assembly includes the secondary metering rod-air valve assembly and is pre-set at the factory. No attempt should be made to change this adjustment in the field. The air valve and choke valve screws are staked in place and should not be removed.

Float Bowl Disassembly

1. Remove air horn gasket. Gasket is pre-cut for easy removal around metering rod and hanger assembly.
2. Remove pump plunger from pump well (if not removed with air horn).

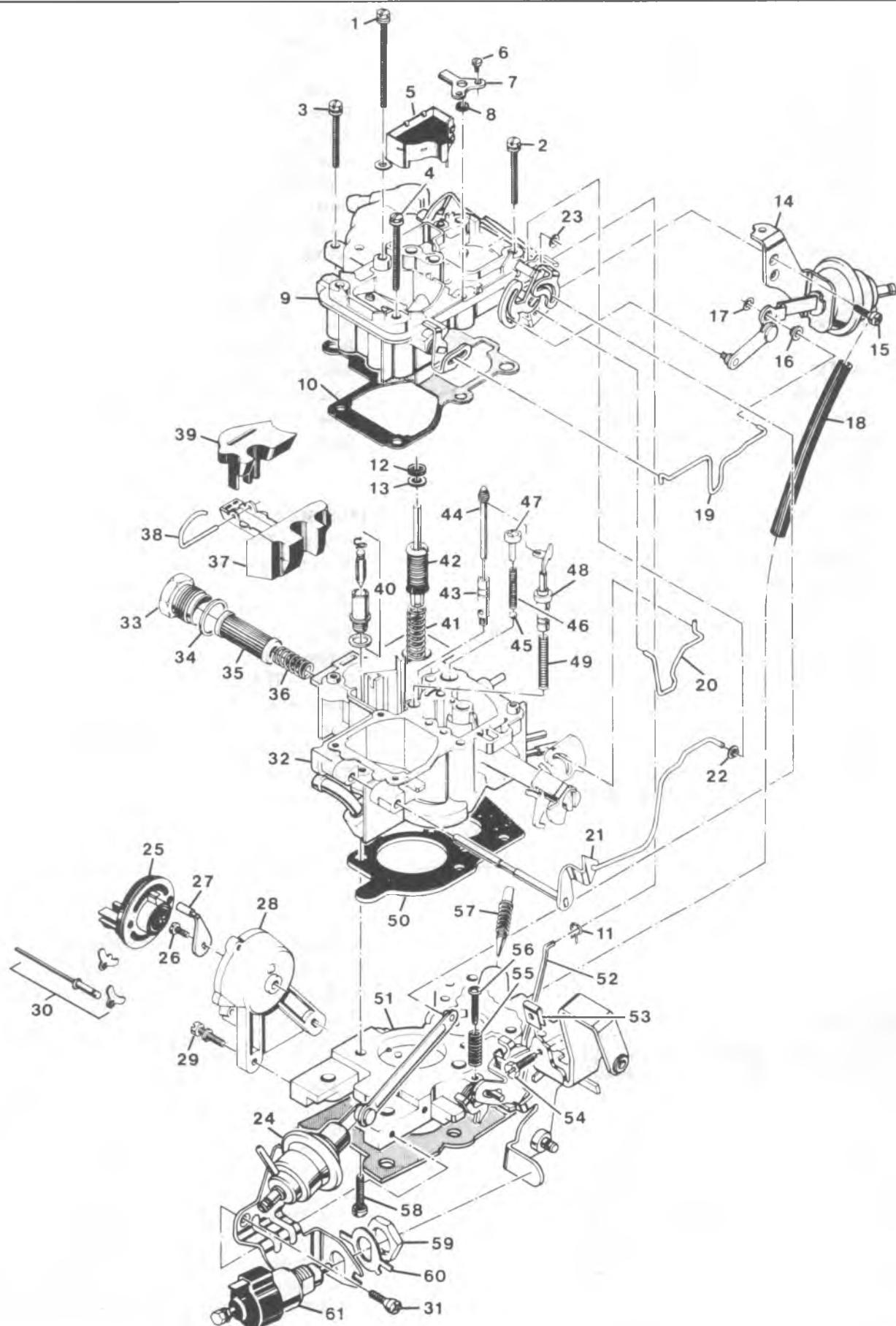


Fig. 6C2-6--Typical 2SE Carburetor Assembly

AIR HORN PARTS

- 1 — Screw — Air Horn (Long) (2)
- 2 — Screw — Air Horn (Large)
- 3 — Screw — Air Horn (Short) (3)
- 4 — Screw — Air Horn (Medium)
- 5 — Vent Stack Assembly
- 6 — Screw — Hot Idle Compensator (2)
- 7 — Hot Idle Compensator
- 8 — Gasket — Hot Idle Compensator
- 9 — Air Horn Assembly
- 10 — Gasket — Air Horn
- 11 — Retainer — Pump Link
- 12 — Seal — Pump Stem
- 13 — Retainer — Stem Seal

CHOKE PARTS

- 14 — Vacuum Break and Bracket Assembly — Primary
- 15 — Screw — Vacuum Break Attaching
- 16 — Bushing — Air Valve — Link
- 17 — Retainer — Air Valve Link
- 18 — Hose — Vacuum Break — Primary
- 19 — Link — Air Valve
- 20 — Link — Fast Idle Cam
- 21 — Intermediate Choke Shaft/Lever/Link Assembly
- 22 — Bushing — Intermediate Choke Shaft Link
- 23 — Retainer — Intermediate Choke Shaft Link
- 24 — Vacuum Break and Bracket Assembly — Secondary
- 25 — Choke Cover and Coil Assembly
- 26 — Screw — Choke Lever
- 27 — Choke Lever and Contact Assembly
- 28 — Choke Housing
- 29 — Screw — Choke Housing (2)
- 30 — Stat Cover Retainer Kit
- 31 — Screw — Vacuum Break Attaching (2)

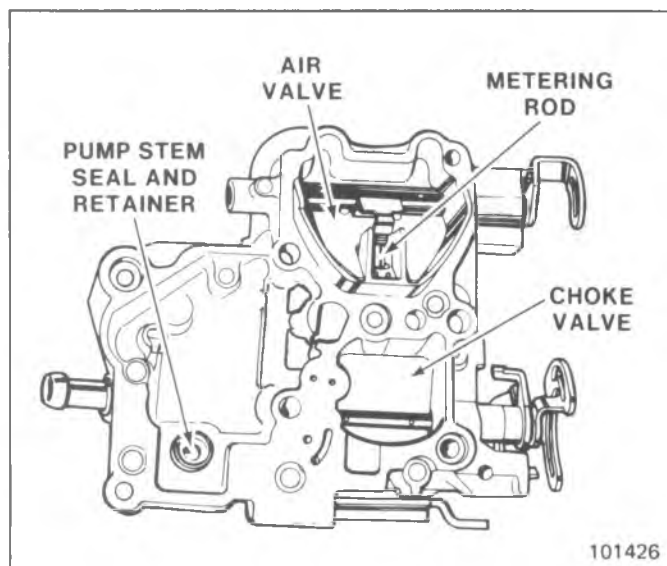
FLOAT BOWL PARTS

- 32 — Float Bowl Assembly
- 33 — Nut — Fuel Inlet
- 34 — Gasket — Fuel Inlet Nut
- 35 — Filter — Fuel Inlet
- 36 — Spring — Fuel Filter
- 37 — Float Assembly
- 38 — Hinge Pin — Float
- 39 — Insert — Float Bowl
- 40 — Needle and Seat Assembly
- 41 — Spring — Pump Return
- 42 — Pump — Assembly
- 43 — Jet — Main Metering
- 44 — Rod — Main Metering Assembly
- 45 — Ball — Pump Discharge
- 46 — Spring — Pump Discharge
- 47 — Retainer — Pump Discharge Spring
- 48 — Power Piston Assembly
- 49 — Spring — Power Piston

THROTTLE BODY PARTS

- 50 — Gasket — Throttle Body
- 51 — Throttle Body Assembly
- 52 — Pump Rod
- 53 — Clip — Cam Screw
- 54 — Screw — Cam
- 55 — Spring — Throttle Stop Screw
- 56 — Screw — Throttle Stop
- 57 — Idle Needle and Spring
- 58 — Screw — Throttle Body Attaching (4)
- 59 — Nut — Idle Solenoid
- 60 — Retainer — Idle Solenoid
- 61 — Idle Solenoid

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Fig. 6C2-7--Air Horn Assembly

- 3. Remove pump return spring from pump well.
- 4. Remove plastic filler block over float valve.
- 5. Remove float assembly and float valve by pulling up on retaining pin.
- 6. Remove float valve seat and gasket using a wide-blade screwdriver (Fig. 6C2-8).
- 7. Remove power piston and metering rod assembly 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 spring to snap the piston up against the plastic retainer. This procedure may have to be repeated several times (Fig. 6C2-9). Do not remove power piston by using pliers on metering rod holder.
- 8. Remove the power piston spring from the piston bore. If necessary, metering rod may be removed from power piston hanger by compressing spring on top of metering rod and aligning groove on rod with slot in

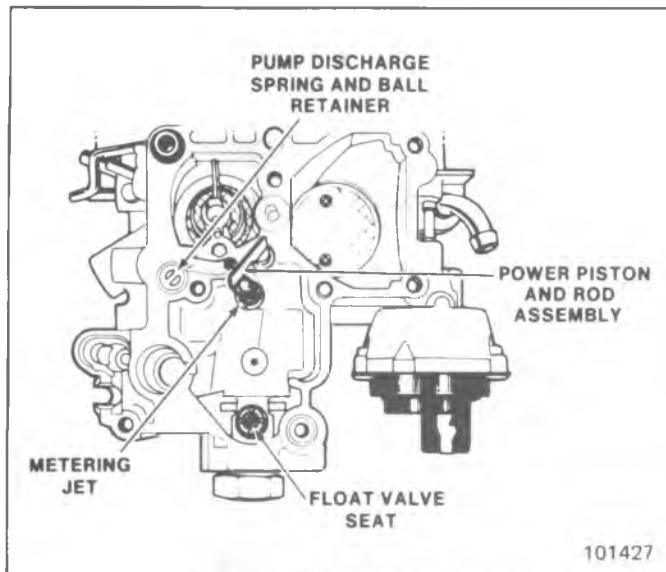


Fig. 6C2-8--Float Bowl Assembly

holder (Fig. 6C2-10). Use extreme care in handling the metering rod to prevent damage to metering rod tip.

9. Remove the main metering jet using a wide blade screwdriver.
10. Using a small slide hammer or equivalent, remove plastic retainer holding pump discharge spring and check ball in place. Discard plastic retainer (a new retainer is required for reassembly). Turn bowl upside down catching spring and check ball in palm of hand.

NOTICE: Do not attempt to remove plastic retainer by prying out with a tool such as a punch or screwdriver - this will damage the sealing beads on the bowl casting surface requiring complete float bowl replacement.

Choke Disassembly

NOTICE: The tamper resistant choke cover design is used to discourage readjustment of 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 using the procedures that follows.

Choke Cover Removal

1. Support float bowl and throttle body as an assembly on a suitable holding fixture such as Tool J-9789-118. Carefully align a #21 drill (.159") on rivet head and drill only enough to remove rivet head (Fig. 6C2-11). 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.
2. Remove the choke cover assembly from choke housing.
3. Remove screw from end of intermediate choke shaft inside choke housing.
4. Remove choke coil lever from shaft.
5. Remove intermediate choke shaft and lever assembly from float bowl by sliding rearward out throttle lever side.
6. Remove choke housing by removing two (2) attaching screws in throttle body.

Disassembly of Remaining Float Bowl Parts

Remove/fuel inlet nut, gasket, check valve/filter assembly, and spring. Discard gasket and filter.

Throttle Body

Disassembly

1. Remove throttle body to bowl attaching screws and lockwashers and remove throttle body assembly.
2. Remove throttle body to bowl insulator gasket.
3. Place throttle body assembly on carburetor holding fixture to avoid damaging throttle valves.
4. Hold primary throttle lever wide-open and disengage pump rod from throttle lever by rotating rod until squirt on rod aligns with slot in lever.
5. Further disassembly of the throttle body is not required for cleaning purposes.

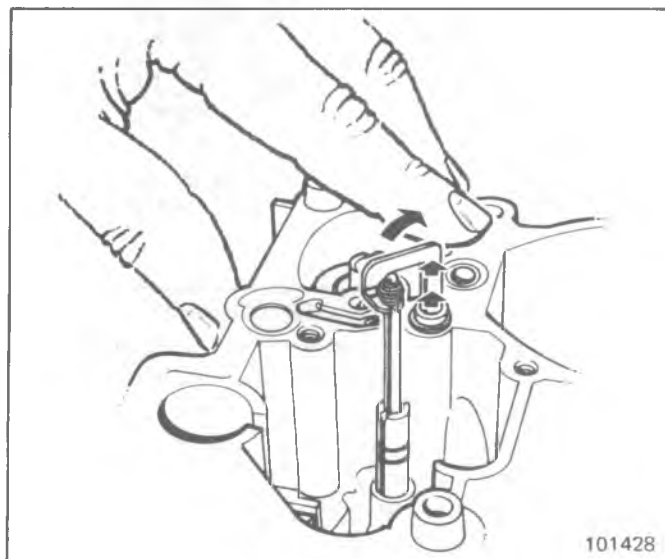


Fig. 6C2-9--Power Piston/Metering Rod Removal

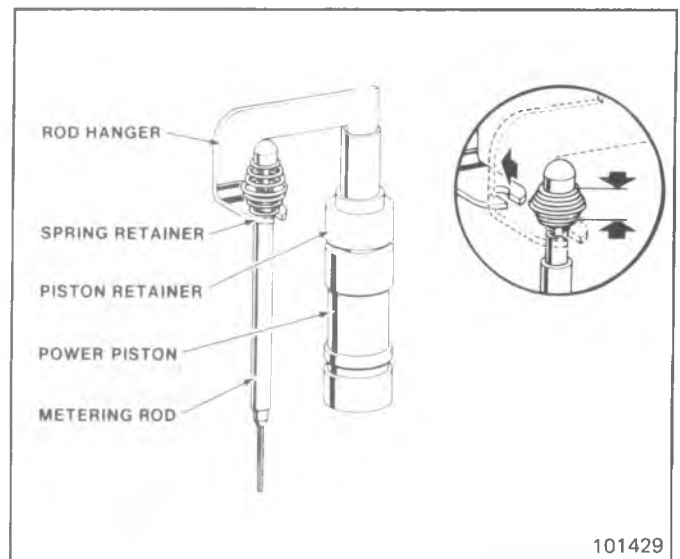


Fig. 6C2-10--Power Piston/Metering Rod Assembly

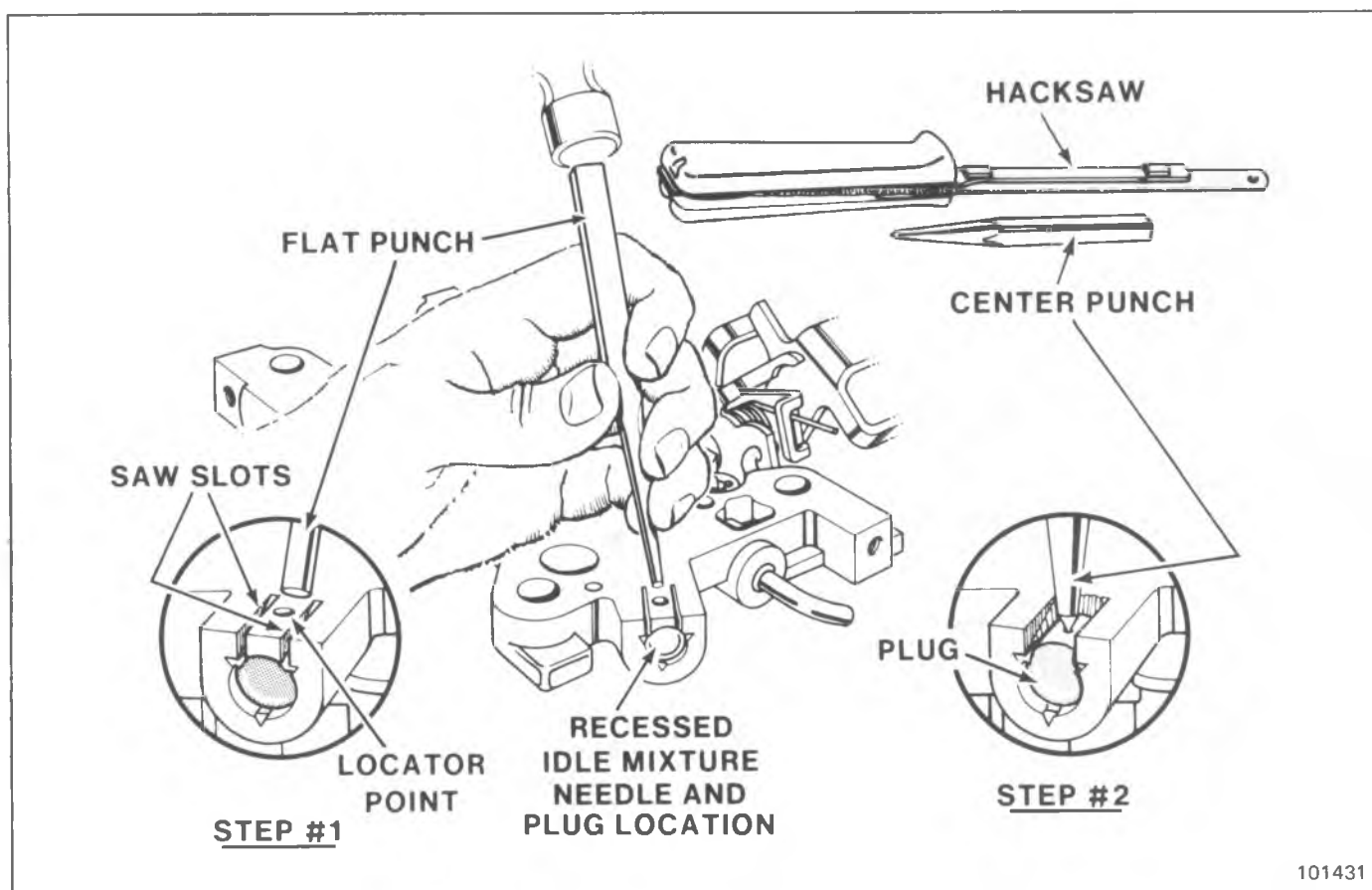


Fig. 6C2-12--Idle Needle Plug Removal

The primary and secondary throttle valve screws are permanently staked in place and should not be removed. The throttle body is serviced as a complete assembly.

DO NOT REMOVE plugs covering idle mixture needle unless it is necessary to replace the mixture needle or normal soaking and air pressure fails to clean the idle mixture passages.

Idle mixture should be adjusted only if required at time of major carburetor overhaul, throttle body replacement, or high emissions as determined by official inspections.

If necessary, remove idle mixture needle and plug as follows (Fig. 6C2-12):

- a. Invert throttle body and place on carburetor holding fixture-manifold side up.
- b. Make two parallel cuts in throttle body on either side of the locator points beneath the idle mixture needle plug (manifold side) with a hack saw. 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.
- c. Place a flat punch at a point near the ends of the saw marks in the throttle body. Holding the punch at a 45 degree angle, drive it into the throttle body until the casting breaks away, exposing the steel plug.
- d. Holding a center punch vertical, drive it into the steel plug. Then, holding the punch at a 45 degree angle, drive the plug out of the casting.

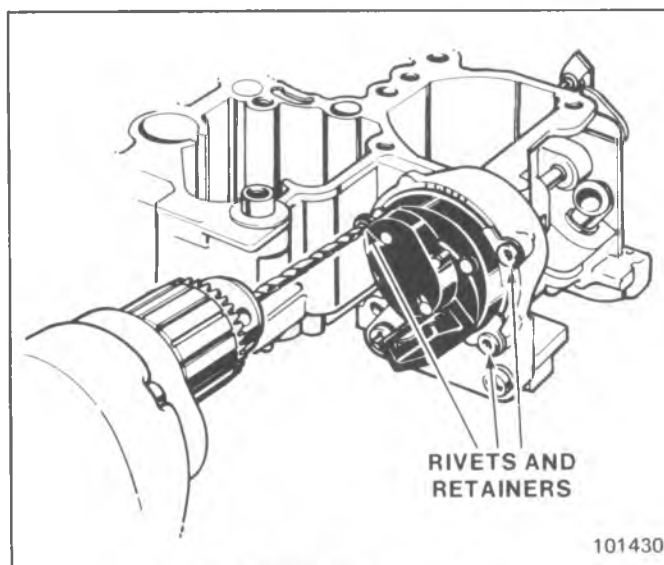


Fig. 6C2-11--Choke Cover Removal

Hardened plug will shatter rather than remaining intact. It is not necessary to remove the plug completely; remove loose pieces.

- e. Using Tool J-29030, remove idle mixture needle and spring from throttle body.
- f. Using Tool J-29030-B, remove idle mixture needle, and spring from throttle body.

CLEANING AND INSPECTION

The carburetor parts should be cleaned in a cold immersion-type cleaner such as Carbon X (X-55) or its equivalent.

NOTICE: The solenoid, electric choke, rubber parts, plastic parts, diaphragms, pump plunger, plastic filler block should NOT be immersed in carburetor cleaner as they will swell, harden or distort.

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 wires through jets and passages.
2. Inspect upper and lower surface of carburetor castings for damage.
3. Inspect holes in levers for excessive wear or out of round conditions. If worn, levers should be replaced. Inspect plastic bushings for damage and excessive wear. Replace as required.
4. Check, repair, or replace parts if the following problems are encountered:

A. Flooding

1. Inspect float valve and seat for dirt, deep wear grooves, scores, and proper seating.
2. Inspect float valve pull clip for proper installation. Be careful not to bend pull clip.
3. Inspect float, float arms 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 and check valve assembly.

B. Hesitation

1. Inspect pump plunger and cup for cracks, scores, or cup excessive wear. A used pump cup will shrink when dry. If dried out, soak in fuel for 8 hours before testing.
2. Inspect pump duration and return springs for being weak or distorted.
3. Check all pump passages and jet for dirt, improper seating of discharge check ball and scores in pump well. Check condition of pump discharge check ball spring.
4. Check pump linkage for excessive wear; repair or replace as necessary.

C. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.
2. Inspect choke vacuum diaphragms for leaks.
3. Replace carburetor fuel filter.
4. Inspect float valve for sticking, dirt, etc.
5. 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 rod, and jet for dirt, sticking, binding, damaged parts or excessive wear.
4. Check air valve and secondary metering rod for binding conditions.

If air valve or metering rod is damaged, the air horn assembly must be replaced. Also, check air valve spring for proper installation (tension against air valve lever).

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 needle for ridges, burrs, or being bent.
4. Check throttle lever and valves for bind, nicks and other damage.
5. Check all diaphragms for possible ruptures or leaks.
6. Clean plastic parts only in low volatile cleaning solvent - never in gasoline.

CARBURETOR ASSEMBLY

Throttle Body

1. Holding primary throttle lever wide open, install lower end of pump rod in throttle lever by aligning squirt on rod with slot in lever. End of rod should point outward toward throttle lever.
2. If removed, install idle mixture needle and spring using tool J-29030-B. Lightly seat needle and then back out 3 turns as a preliminary idle mixture adjustment. Final idle mixture adjustment must be made on-vehicle using the procedure described under Idle Mixture Adjustment.

Float Bowl

Assembly

If a new float bowl assembly is used, stamp or engrave the model number on the new float bowl (See Fig. 6C2-1).

1. Install new throttle body to bowl insulator gasket over two locating dowels on bowl.
2. Holding fast idle cam so that cam steps face fast idle screw on throttle lever when properly installed, install throttle body making certain throttle body is properly located over dowels on float bowl; then install throttle body to bowl screws and lockwashers and tighten evenly and securely.

Inspect linkage to insure lockout tang is located properly to engage slot in secondary lockout lever and that linkage moves freely and does not bind.

3. Place carburetor on proper holding fixture such as J-9789-118 or equivalent.
4. Install fuel inlet filter spring, new filter assembly, new gasket and inlet nut and tighten nut to 24 N·m (18 ft. lbs.).

When installing a service replacement filter, make sure the filter is the type that includes the check valve to meet U.S. Motor Vehicle Safety Standards (M.V.S.S.). 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 nylon gasket and cause fuel leak.

5. Install choke housing on throttle body, making sure raised boss and locating lug on rear of housing fit into recesses in float bowl casting. Install choke housing attaching screws and lockwashers in throttle body and tighten screws evenly and securely.

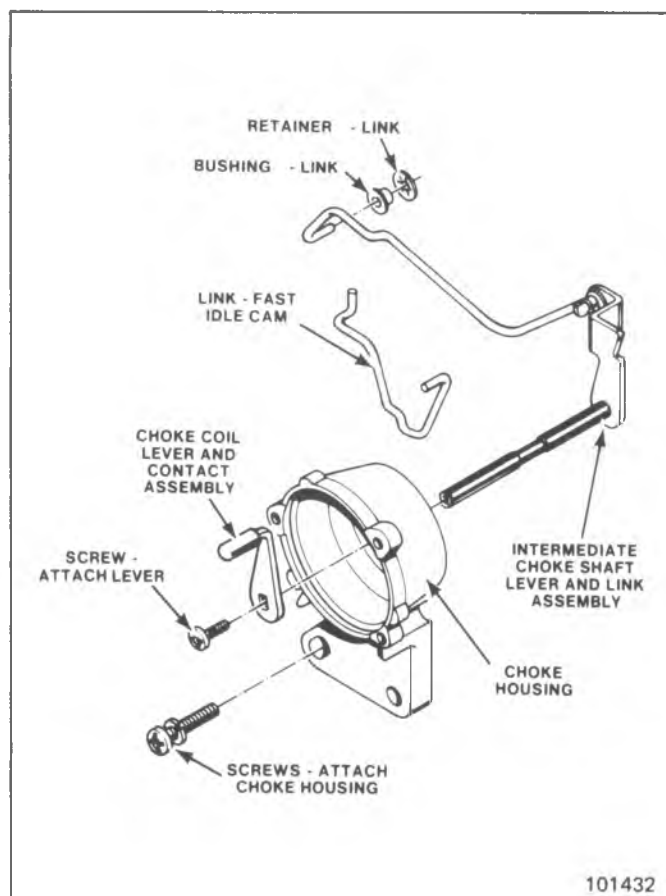


Fig. 6C2-13--Typical Choke Assembly

6. Install intermediate choke shaft and lever assembly in float bowl by pushing through from throttle lever side (Fig. 6C2-13).
7. With intermediate choke lever in the UP (12 o'clock) position, install thermostatic coil lever inside choke housing onto flats on intermediate choke shaft. Coil is properly aligned when the coil pick-up tang is at the top (12 o'clock) position. Install retaining screw into end of intermediate choke shaft and tighten securely.
8. Install pump discharge steel check ball and spring in passage next to float chamber. Insert end of new plastic retainer into end of spring and install retainer in float bowl, tapping lightly in place until top of retainer is flush with bowl casting surface.
9. Using a wide-blade screwdriver, install main metering jet and the float valve seat (with gasket) into bottom of float bowl. Tighten jet and seat securely.
10. To make adjustment easier, carefully bend float arm upward at notch in arm before assembly.
11. Install float valve onto float arm by sliding float lever under pull clip. Correct installation of the pull clip is to hook the clip over the edge of the float on the float arm (Fig. 6C2-16).
12. Install float retaining pin into float arm with end of loop of pin facing pump well. Then, install float assembly by aligning valve in the seat and float retaining pin into locating channels in float bowl.

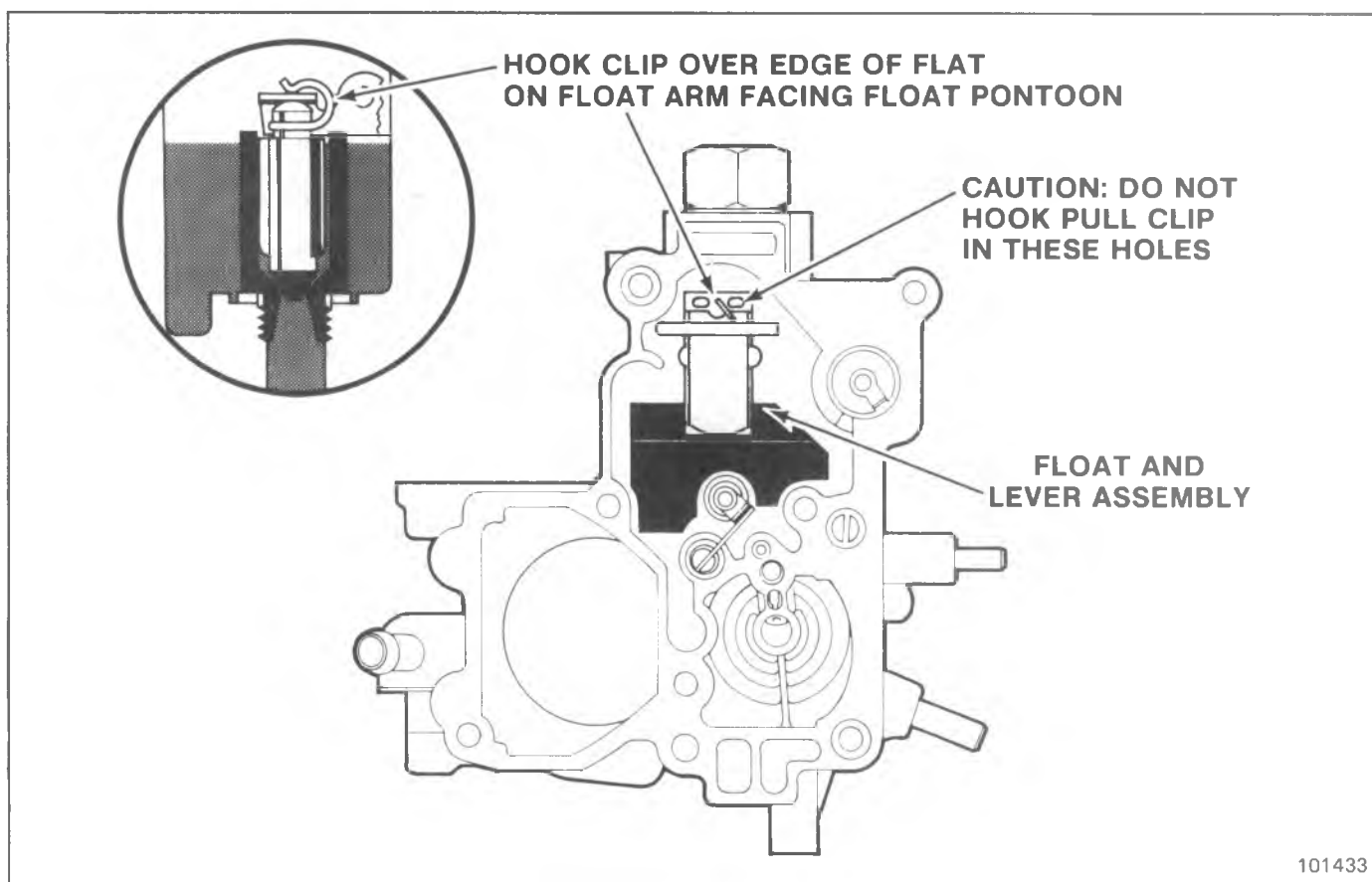


Fig. 6C2-14--Float Pull Clip Location

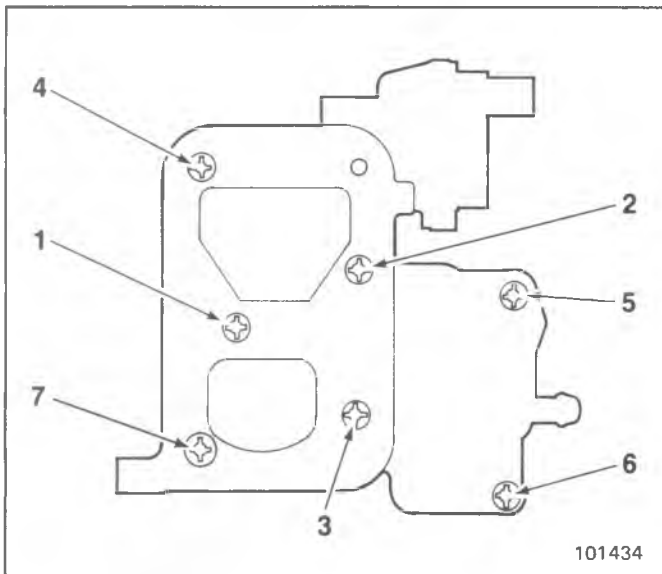


Fig. 6C2-15--Air Horn Screw Tightening Sequence

13. Float Level Adjustment

- Hold float retaining pin firmly in place and push down lightly on float arm at outer end against top of float valve.
 - Using adjustable "T" scale, measure from top of float bowl casting surface (air horn gasket removed) to top of float at toe (See inset, Float Adjustment Fig. 6C2-18).
 - Bend float arm as necessary for proper adjustment by pushing on pontoon (see adjustment chart for specifications).
 - Visually check float alignment after adjustment.
- Install power piston spring into piston bore.
 - If removed, assemble metering rod to holder on power piston. Spring must be on top of arm when assembled correctly.
 - Install power piston and metering rod assembly into the float bowl and main metering jet. Use care installing the metering rod into the jet to prevent damaging the metering rod tip. 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, tap retainer lightly in place using a drift and small hammer.
 - Install plastic filler block over float valve, pressing downward until properly seated (flush with bowl casting surface).
 - Install air horn gasket on float bowl by carefully sliding slit portion of gasket over power piston, locating gasket over two dowel locating pins on bowl.
 - Install pump return spring in pump well.
 - Install pump plunger assembly in pump well.

Air Horn

Assembly

- Install new pump plunger stem seal and retainer in air horn casting. Lightly stake seal retainer in three places, choosing locations different from the original stakings.

- Install fast idle cam rod in lower hole of vacuum break and choke lever, aligning squirt on rod with small slot in lever (squirt end of rod points inward toward air horn).

Air Horn To Bowl

Installation

- Rotate fast idle cam to the full UP position and tilt the air horn assembly to engage lower end of fast idle cam rod in slot in fast idle cam and install pump rod end into hole in pump lever. Then, holding down on the pump plunger assembly, carefully lower air horn assembly onto float bowl, guiding pump plunger stem through hole in air horn casting. Do not force air horn assembly onto bowl, but rather lightly lower in place.
- Install vent and screen assembly over vent stack in air horn. Then, install air horn to bowl attaching screws and lockwashers -- tighten evenly and securely (Fig. 6C2-15).
- Install new retainer clip through hole in end of pump rod.
- Install new seal in recess of air horn, then install hot idle compensator valve and retain with (2) small attaching screws. Tighten screws securely.
- Install plastic bushing in upper hole in vacuum break and choke lever, making sure small end of bushing faces retaining clip when installed. With inner coil lever and intermediate choke lever at the 12 o'clock position, install intermediate choke rod in bushing. Retain rod with new clip, pressing clip securely in place with needlenose pliers. Make sure clip has full contact on rod but is not seated tightly against bushing. Rod to bushing clearance should be .8mm (.030") (Fig. 6C2-16).
- Install idle speed solenoid, lockwasher and retaining nut on secondary side vacuum break. Tighten nut securely. Then, bend back two (2) retaining tabs on lockwasher to fit slots in bracket.
- Rotate secondary side vacuum break and bracket assembly and insert end ("T" pin) of vacuum break

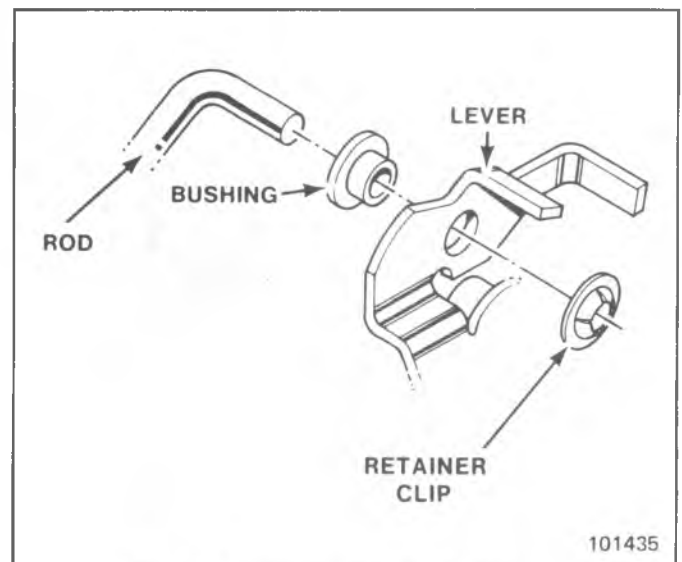


Fig. 6C2-16--Intermediate Choke Linkage

link into upper slot of vacuum break and choke lever. Install bracket on throttle body and install countersunk screws. Tighten screws securely.

8. If air valve rod has been removed from primary side vacuum break plunger, install plastic bushings in hole in primary side vacuum break plunger, making sure small end of bushing faces retaining clip when installed. Then, insert end of air valve rod through bushing. Retain with new clip, pressing clip in place using needlenose pliers. Make sure clip has

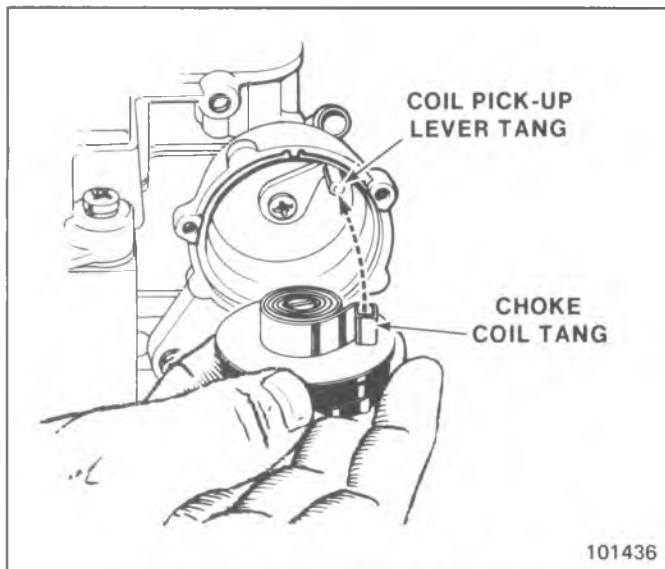


Fig. 6C2-17--"Trapped Stat" Choke Design

full contact on rod but is not sealed tightly against the bushing. Rod to bushing clearance should be .8mm (.030").

9. Rotate primary side vacuum break assembly and bracket and insert end of air valve rod into slot of air valve lever and end of ("T" pin) of vacuum break link into lower slot of vacuum break and choke lever. Position bracket over locating lug on air horn and install (2) countersunk screws and tighten securely.
10. Reinstall hose to primary side vacuum break assembly and throttle body tube.
11. Perform choke coil lever adjustment procedure as specified in carburetor adjustment section (Fig. 6C2-20).
12. 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 choke coil lever is located inside the "trapped stat" coil tang when installing the choke cover and coil assembly (Fig. 6C2-17).

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.

A choke cover retainer kit is required to attach choke cover to choke housing. Install proper retainers and rivets contained in kit, using a suitable blind rivet installing tool.

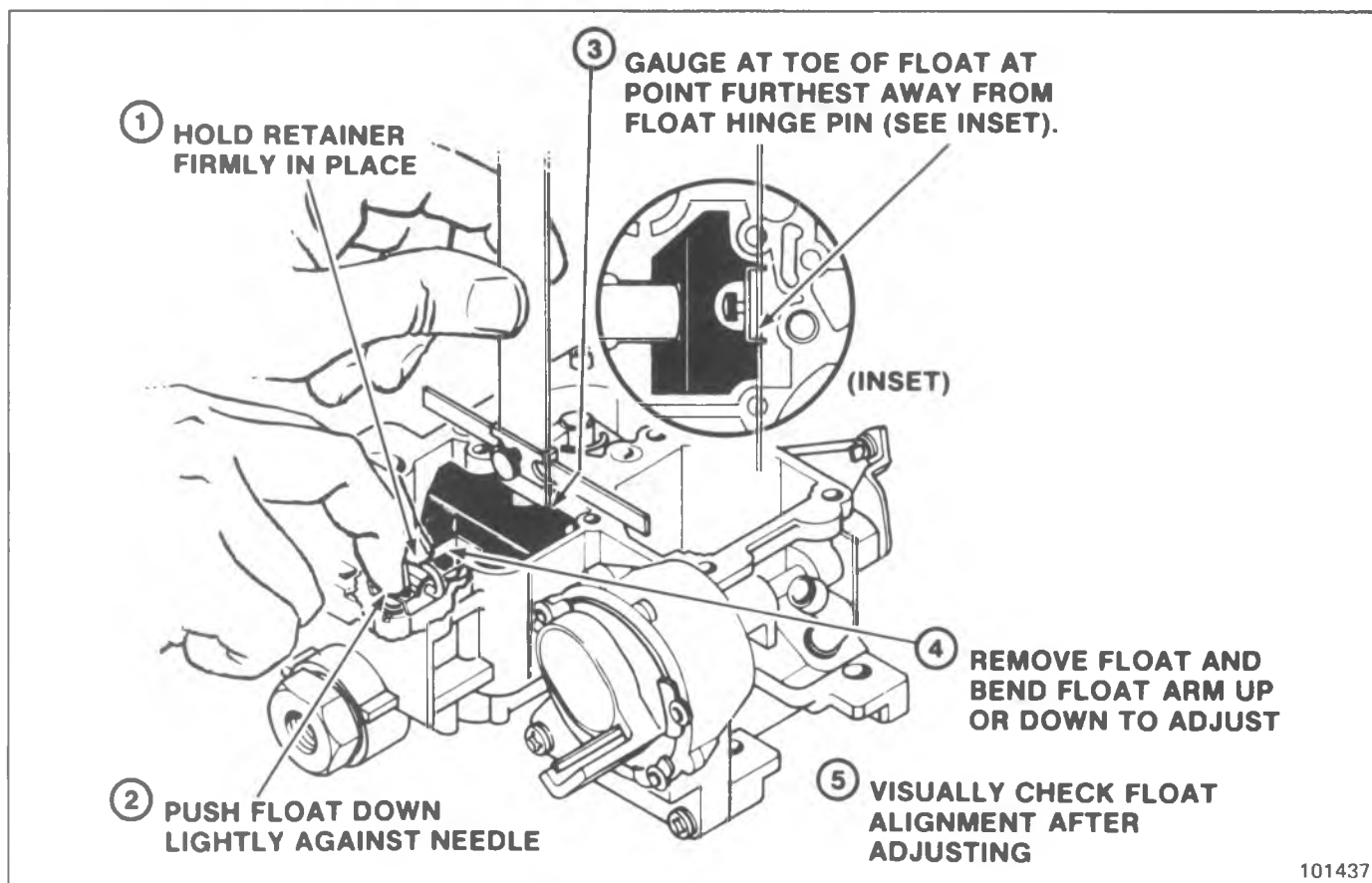
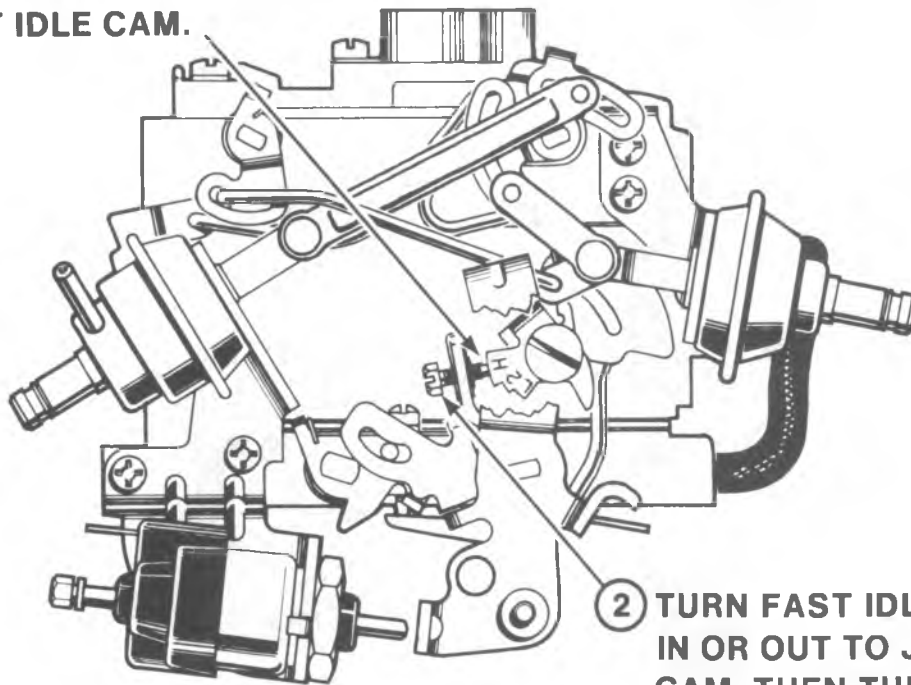


Fig. 6C2-18--Float Adjustment

- ① PLACE FAST IDLE SCREW ON HIGHEST STEP OF FAST IDLE CAM.



- ② TURN FAST IDLE SCREW IN OR OUT TO JUST CONTACT CAM, THEN TURN SCREW IN SPECIFIED NUMBER OF TURNS.

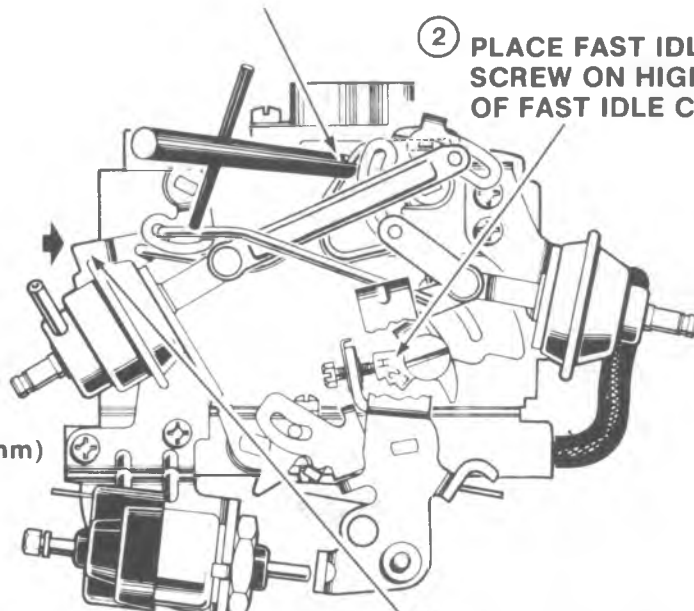
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Fig. 6C2-19--Fast Idle Cam Adjustment

- ① REMOVE RIVETS AND CHOKE COVER AND COIL ASSEMBLY FOLLOWING INSTRUCTIONS IN CHOKE STAT COVER RETAINER KIT (SEE NOTE). NOTE: DO NOT REMOVE RIVETS AND RETAINERS HOLDING CHOKE COVER AND COIL ASSEMBLY IN PLACE UNLESS NECESSARY TO CHECK THE CHOKE COIL LEVER ADJUSTMENT. IF RIVETS AND COVER ARE REMOVED, A CHOKE STAT COVER RETAINER KIT IS REQUIRED FOR REASSEMBLY.

- ⑥ BEND INTERMEDIATE CHOKE ROD TO ADJUST

- ② PLACE FAST IDLE SCREW ON HIGH STEP OF FAST IDLE CAM



- ⑤ EDGE OF LEVER SHOULD JUST CONTACT SIDE OF PLUG GAUGE AS SHOWN

- ④ INSERT SPECIFIED PLUG GAUGE INTO HOLE PROVIDED

- ③ PUSH ON INTERMEDIATE CHOKE LEVER UNTIL CHOKE VALVE IS CLOSED

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Fig. 6C2-20--Choke Coil Lever Adjustment

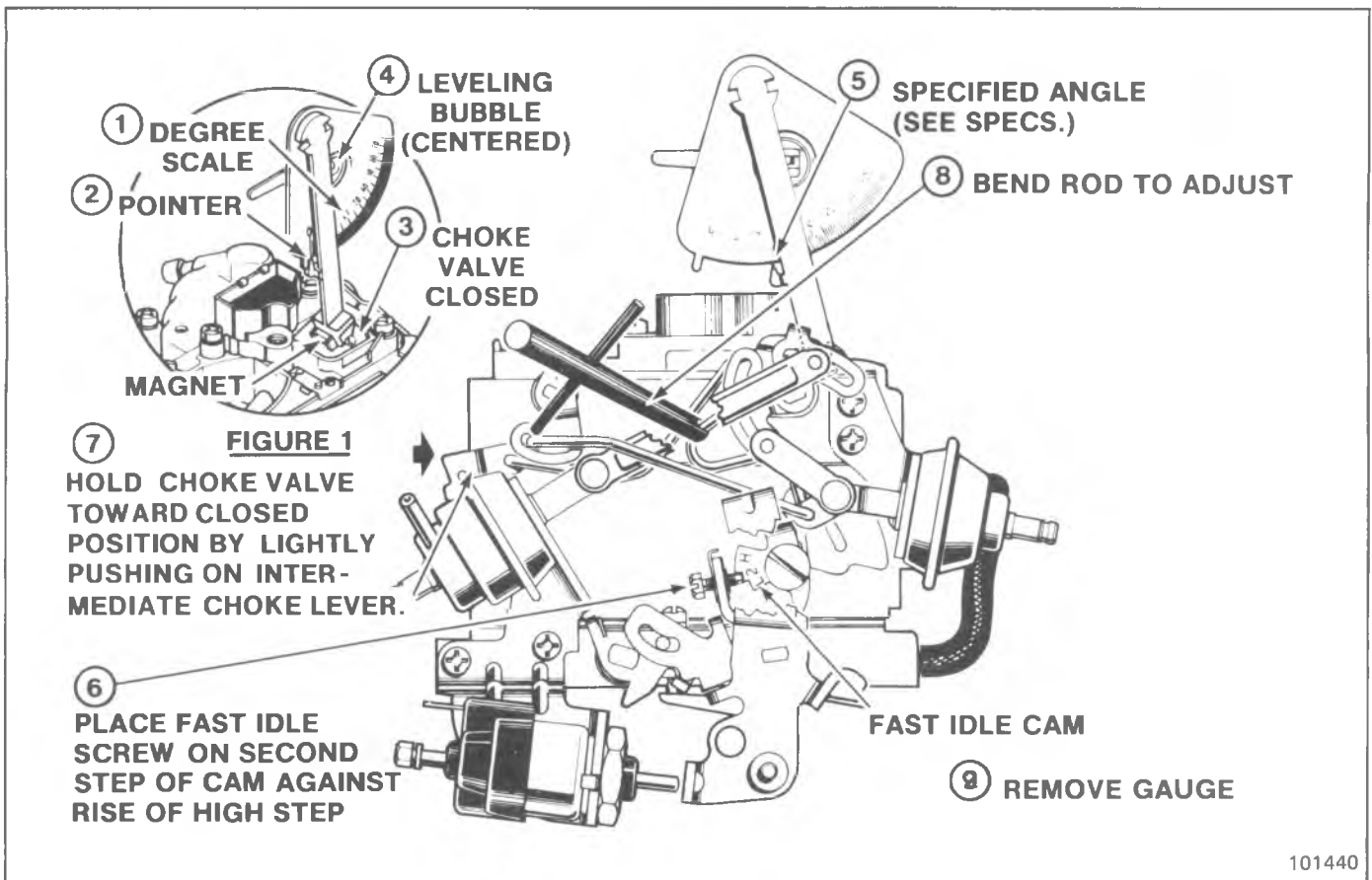


Fig. 6C2-21--Fast Idle Cam (Choke Rod) Adjustment

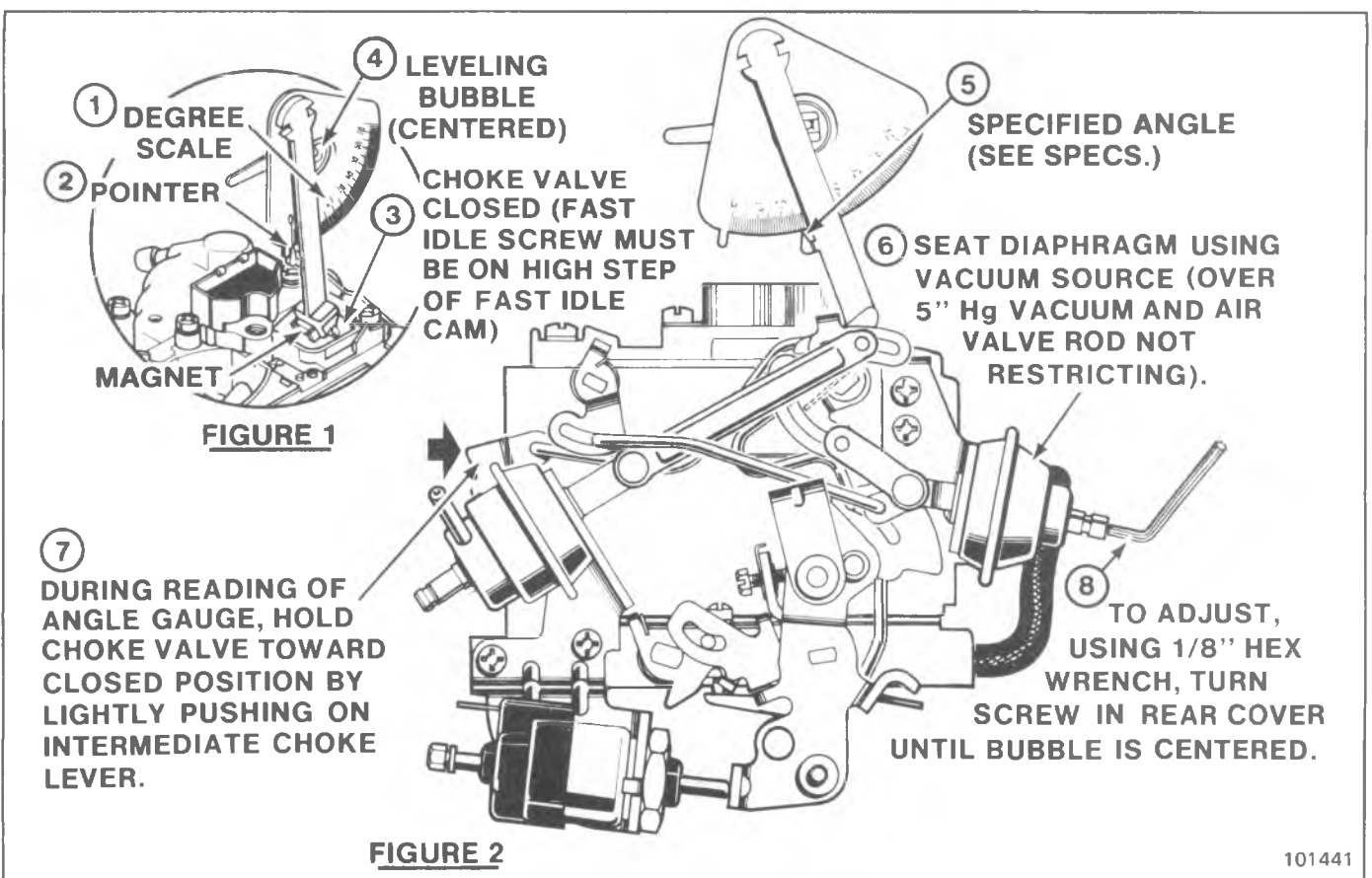
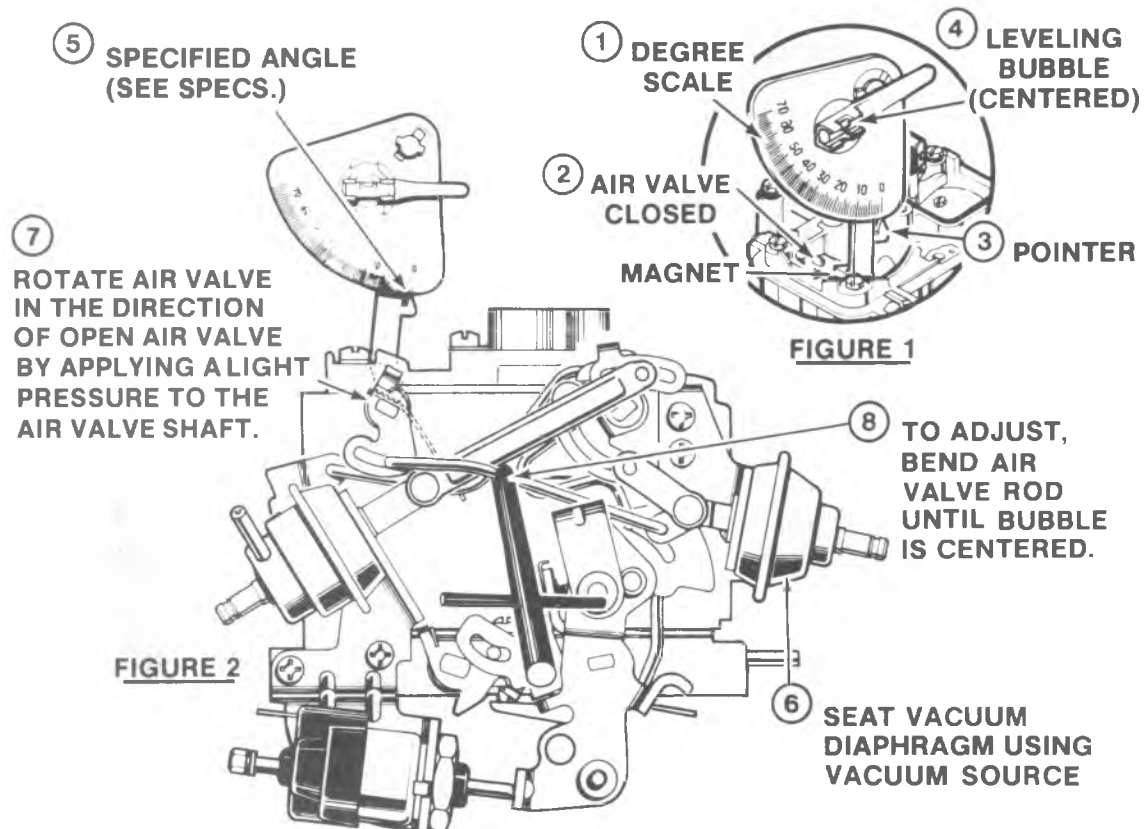
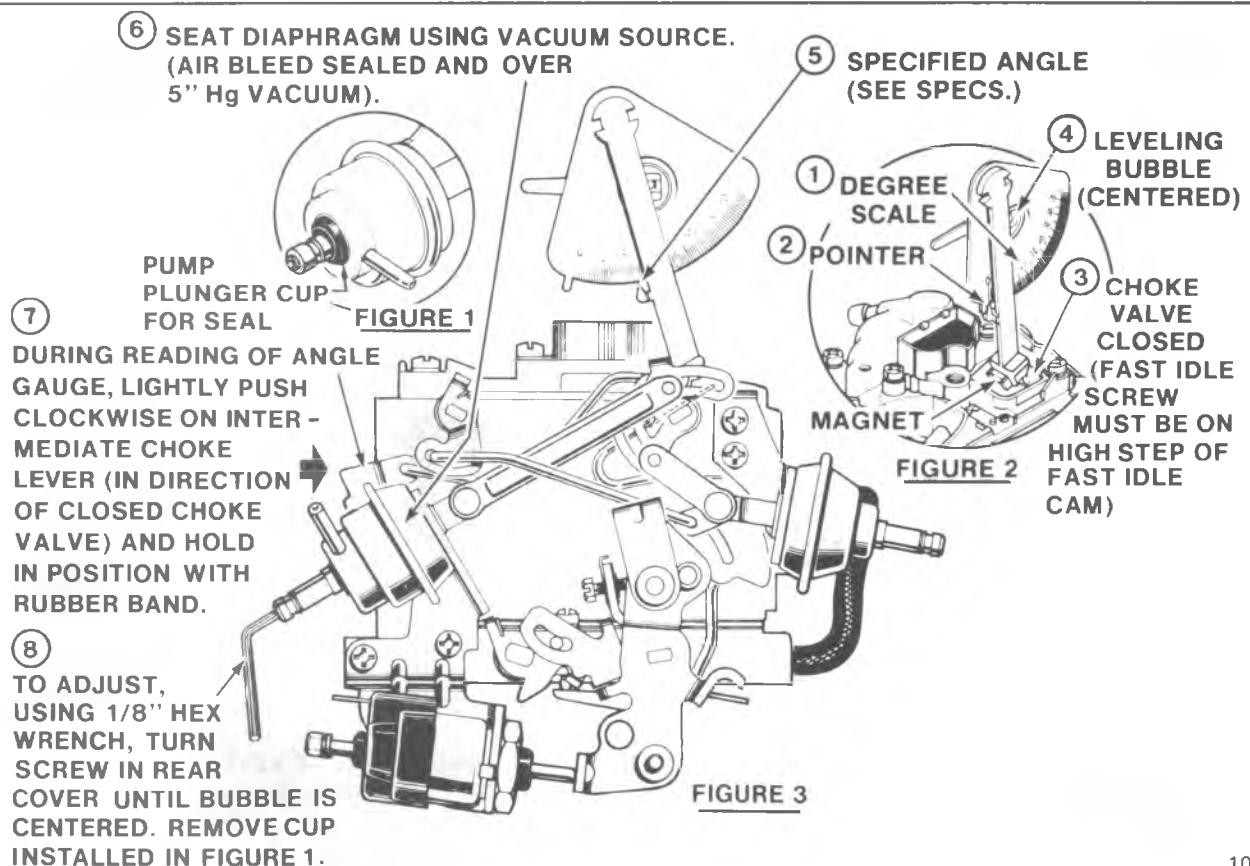


Fig. 6C2-22--Primary Vacuum Break Adjustment



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Fig. 6C2-23--Air Valve Rod Adjustment



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Fig. 6C2-24--Secondary Vacuum Break Adjustment

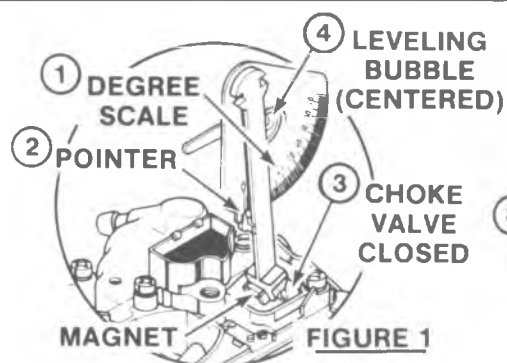


FIGURE 1

5 SPECIFIED ANGLE (SEE SPECS.)

8 BEND TANG TO ADJUST UNTIL BUBBLE IS CENTERED.

FIGURE 2

7 DURING READING OF ANGLE GAUGE, LIGHTLY PUSH CLOCKWISE ON INTERMEDIATE CHOKE LEVER (IN DIRECTION OF CLOSED CHOKE VALVE) AND HOLD IN POSITION WITH RUBBER BAND.

6 HOLD PRIMARY THROTTLE VALVE WIDE OPEN

Fig. 6C2-25--Unloader Adjustment

101444

1 HOLD CHOKE VALVE WIDE OPEN BY PUSHING COUNTER-CLOCKWISE ON INTERMEDIATE CHOKE LEVER.

4 IF NECESSARY TO ADJUST, BEND LOCKOUT LEVER TANG CONTACTING FAST IDLE CAM.

3 GAUGE CLEARANCE - DIMENSION SHOULD BE AS SPECIFIED.

2 OPEN THROTTLE LEVER UNTIL END OF SECONDARY ACTUATING LEVER IS OPPOSITE TOE OF LOCKOUT LEVER.

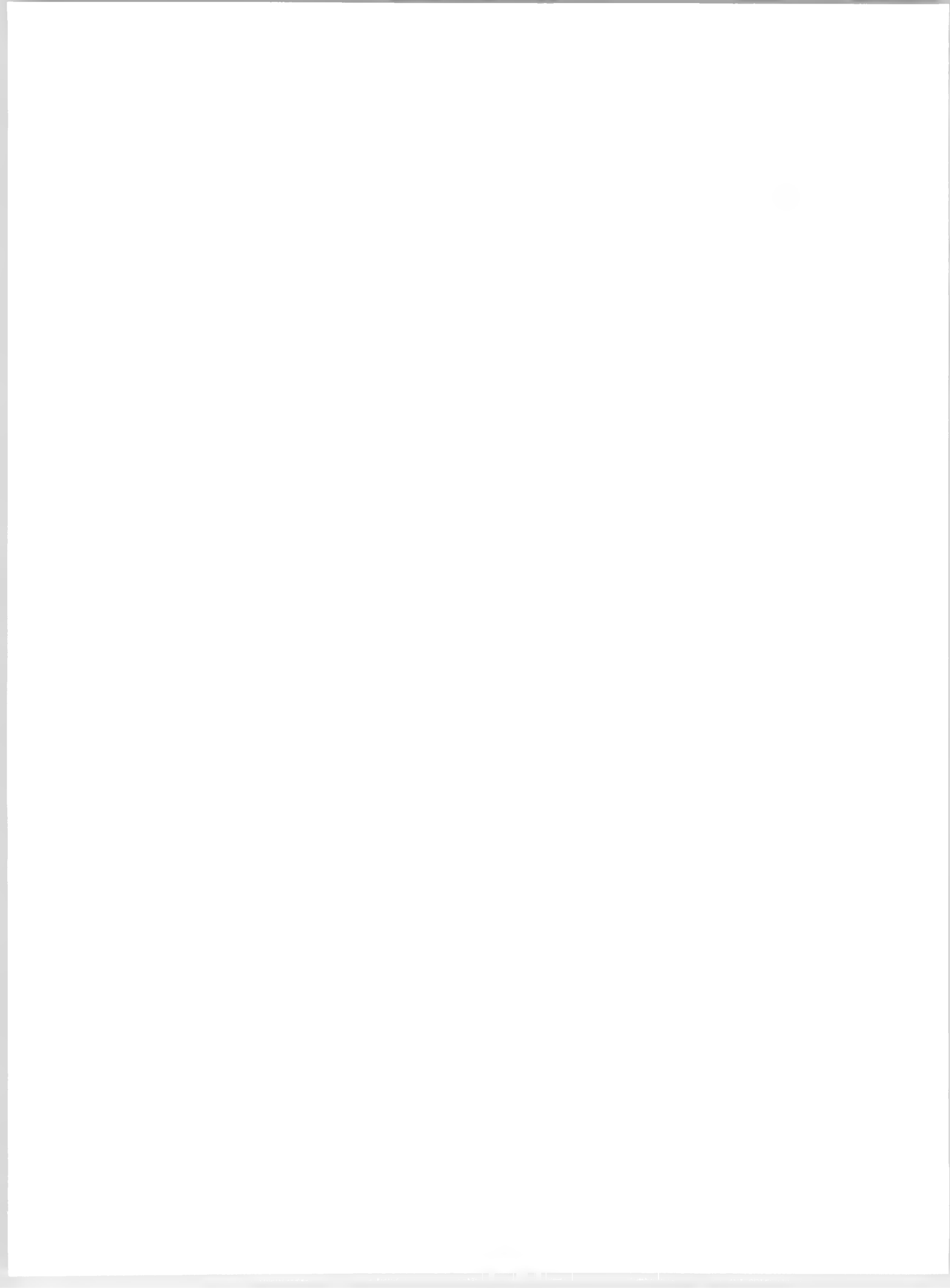
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Fig. 6C2-26--Secondary Lockout Adjustment

CARBURETOR MODEL 2SE ADJUSTMENT SPECIFICATIONS

CARBURETOR NUMBER	FLOAT LEVEL mm/Inch	AIR VALVE ROD	FAST IDLE CAM (CHOKE ROD)	VAC. BREAK PRIMARY	VAC. BREAK SECONDARY	UNLOADER	PROPANE ENRICHMENT (RPM)
17082334	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	50
17082335	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	60
17082336	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	20
17082337	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	60
17082338	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	10
17082339	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	40
17082341	4.5 ($\frac{3}{16}$)	1°	15°	30°	37°	42°	100
17082342	4.5 ($\frac{3}{16}$)	1°	15°	30°	37°	42°	30
17082344	4.5 ($\frac{3}{16}$)	1°	15°	30°	37°	42°	30
17082345	4.5 ($\frac{3}{16}$)	1°	15°	30°	37°	42°	100
17082431	4.5 ($\frac{3}{16}$)	1°	15°	24°	38°	42°	70
17082433	4.5 ($\frac{3}{16}$)	1°	15°	24°	38°	42°	70
17082480	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	50
17082481	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	60
17082482	4.5 ($\frac{3}{16}$)	1°	15°	23°	38°	42°	20
17082483	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	60
17082484	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	10
17082485	4.5 ($\frac{3}{16}$)	1°	15°	26°	38°	42°	40
17082486	4.5 ($\frac{3}{16}$)	1°	15°	28°	38°	42°	20
17082487	4.5 ($\frac{3}{16}$)	1°	15°	28°	38°	42°	100
17082488	4.5 ($\frac{3}{16}$)	1°	15°	28°	38°	42°	20
17082489	4.5 ($\frac{3}{16}$)	1°	15°	28°	38°	42°	100

Fig. 6C2-27--2SE Carburetor Specifications



SECTION 6C4

CARBURETOR MODEL M4ME/M4MC

CONTENTS

General Description.....	6C4-1	Carburetor Mounting Torque.....	6C4-8
Carburetor Operation.....	6C4-1	Carburetor Replacement.....	6C4-8
On-Vehicle Service.....	6C4-4	Unit Repair.....	6C4-9
General Information.....	6C4-4	Disassembly.....	6C4-9
External Float Check.....	6C4-4	Cleaning.....	6C4-14
Carburetor Choke Check.....	6C4-4	Assembly.....	6C4-15
Speed Adjustments.....	6C4-5	Unit Repair Adjustments.....	6C4-17
Mixture Control Adjustments.....	6C4-8	Adjustment Specifications.....	6C4-26

GENERAL DESCRIPTION

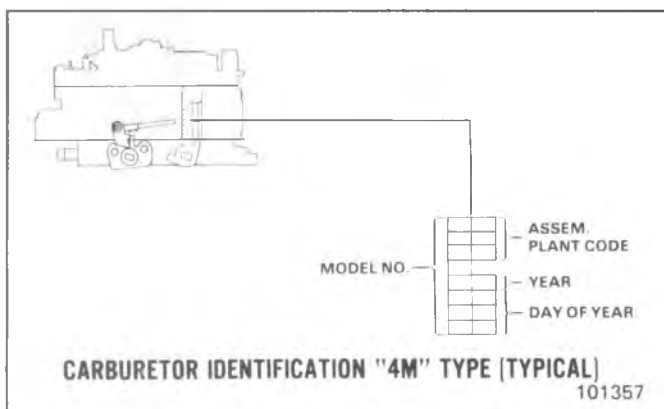


Fig. 6C4-1—Carburetor Identification

A hot air choke model M4MC carburetor is used on a Heavy Duty Emissions vehicle. A electric choke model M4ME carburetor is used on a Light Duty Emissions vehicle.

Each of these carburetors is a 4-barrel, two-stage design. A triple venturi with plain tube nozzle is used in each primary bore resulting in precise fuel metering control during the off-idle and part throttle ranges of engine operation. The secondary side has two large bores which, added to the primary, gives sufficient air capacity to meet most engine requirements. An air valve is used on the secondary side for fuel metering control.

The main metering system has separate main fuel wells which feed each fuel nozzle for good fuel flow through the venturi.

During off-idle and part throttle operation, fuel metering is accomplished by two tapered primary metering

rods, operating in metering jets, positioned by a conventional spring-loaded power piston that is responsive to manifold vacuum.

Adjustable Part Throttle

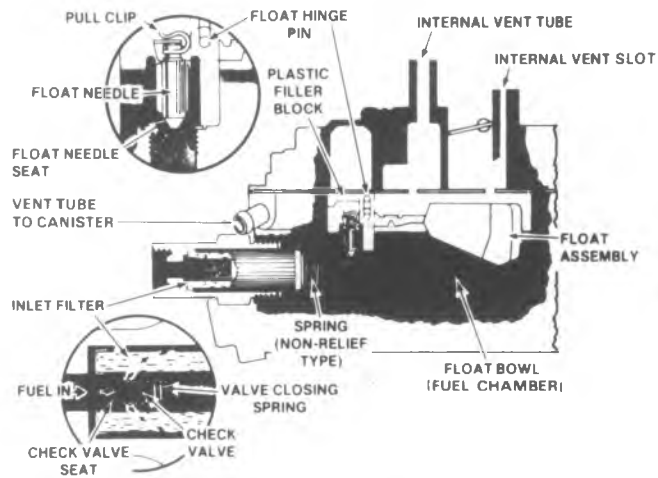
An adjustable part throttle (APT) feature is used to provide a close tolerance adjustment in the main metering system. The APT adjustment very accurately sets the depth of the metering rods in the primary metering jets.

The adjustment feature consists of a pin pressed in the side of the power piston which extends through a slot in the side of the piston well. When the power piston is down (economy position), the side of the pin stops on top of a flat surface on the adjustment screw located in the cavity next to the power piston. The adjustment screw is held from turning by a tension spring beneath the head of the adjustment screw. During production flow test, this adjustment screw is turned up or down which, in turn, raises or lowers the power piston and metering rod assembly. This very accurately controls the fuel flow between the rods and jets to meet emission requirements.

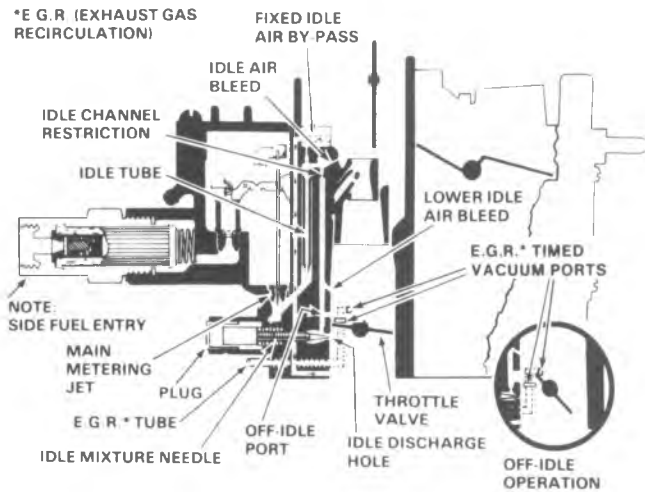
No attempt should be made to change the APT adjustment. If float bowl replacement is required, the new bowl assembly will include an adjustment screw pre-set by the factory.

Carburetor Operation

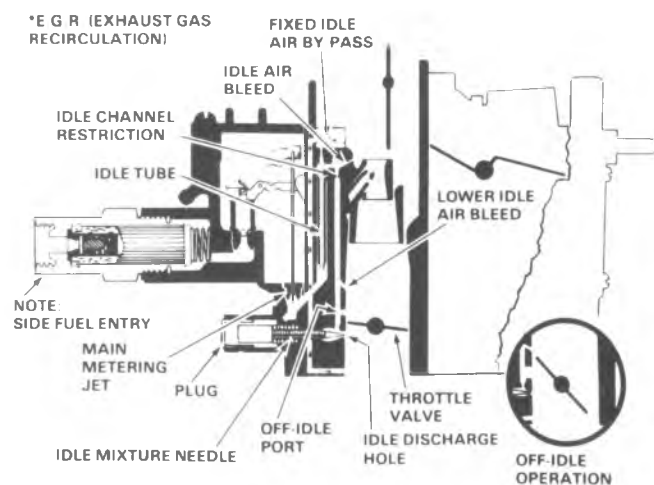
The carburetors M4ME/M4MC have six basic systems. They are float, idle, main metering, power, pump, and choke (Figs. 6C4-2 and 6C4-3).



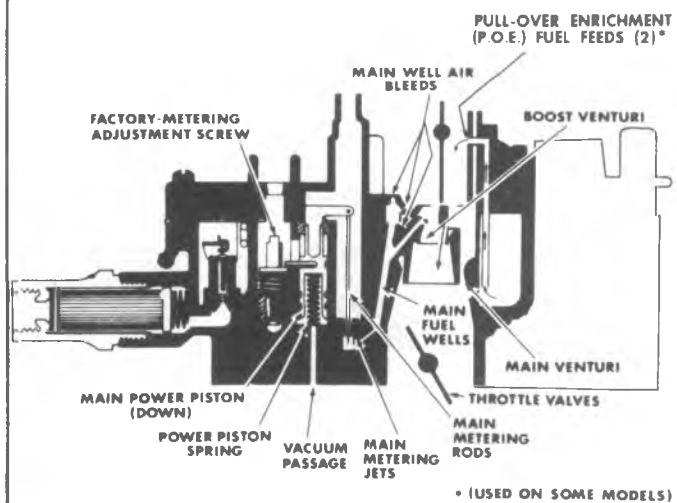
**FLOAT SYSTEM
(M4M MODELS)**



**IDLE SYSTEM
W/LD EMISSION**



**IDLE SYSTEM
W/HD EMISSION**



MAIN METERING SYSTEM

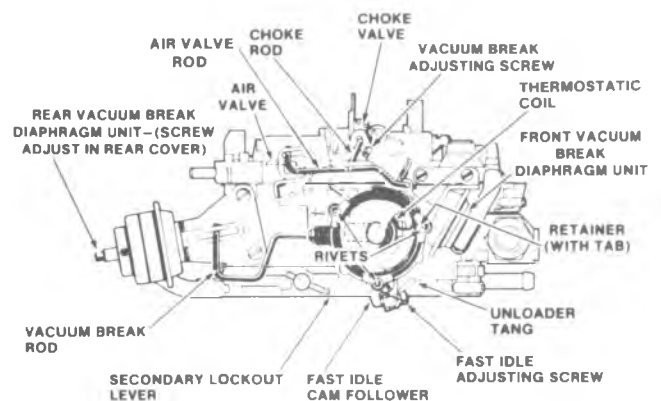
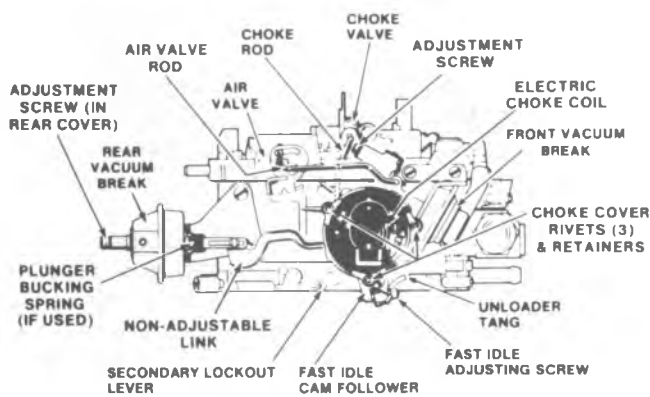
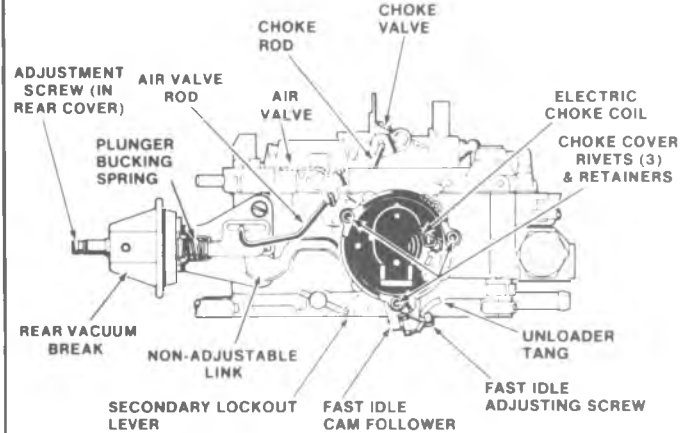
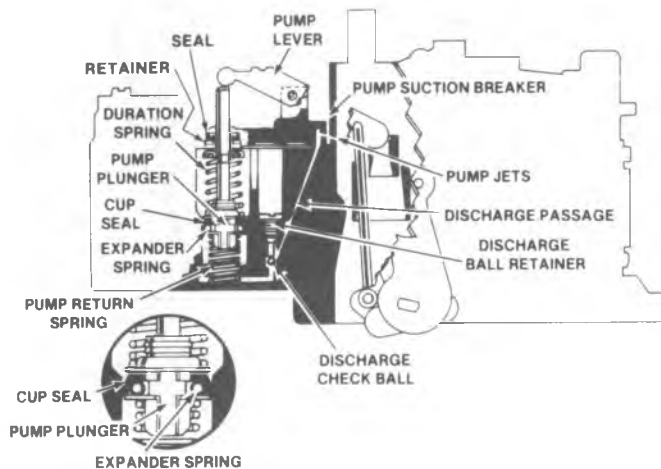
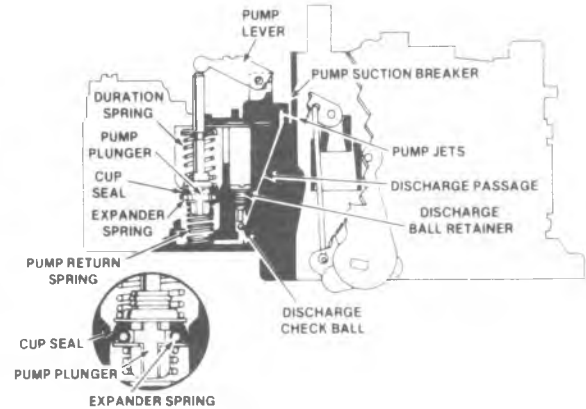
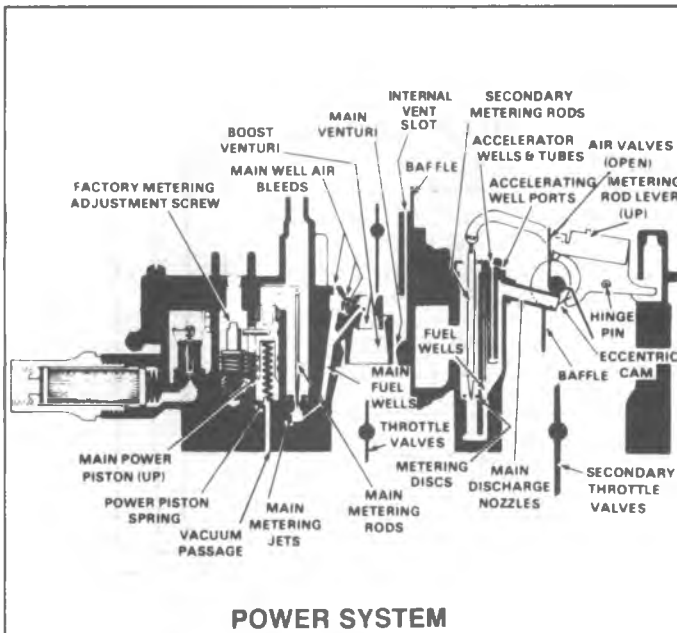


Fig. 6C4-3--Carburetor Systems (2 of 2)

ON-VEHICLE SERVICE

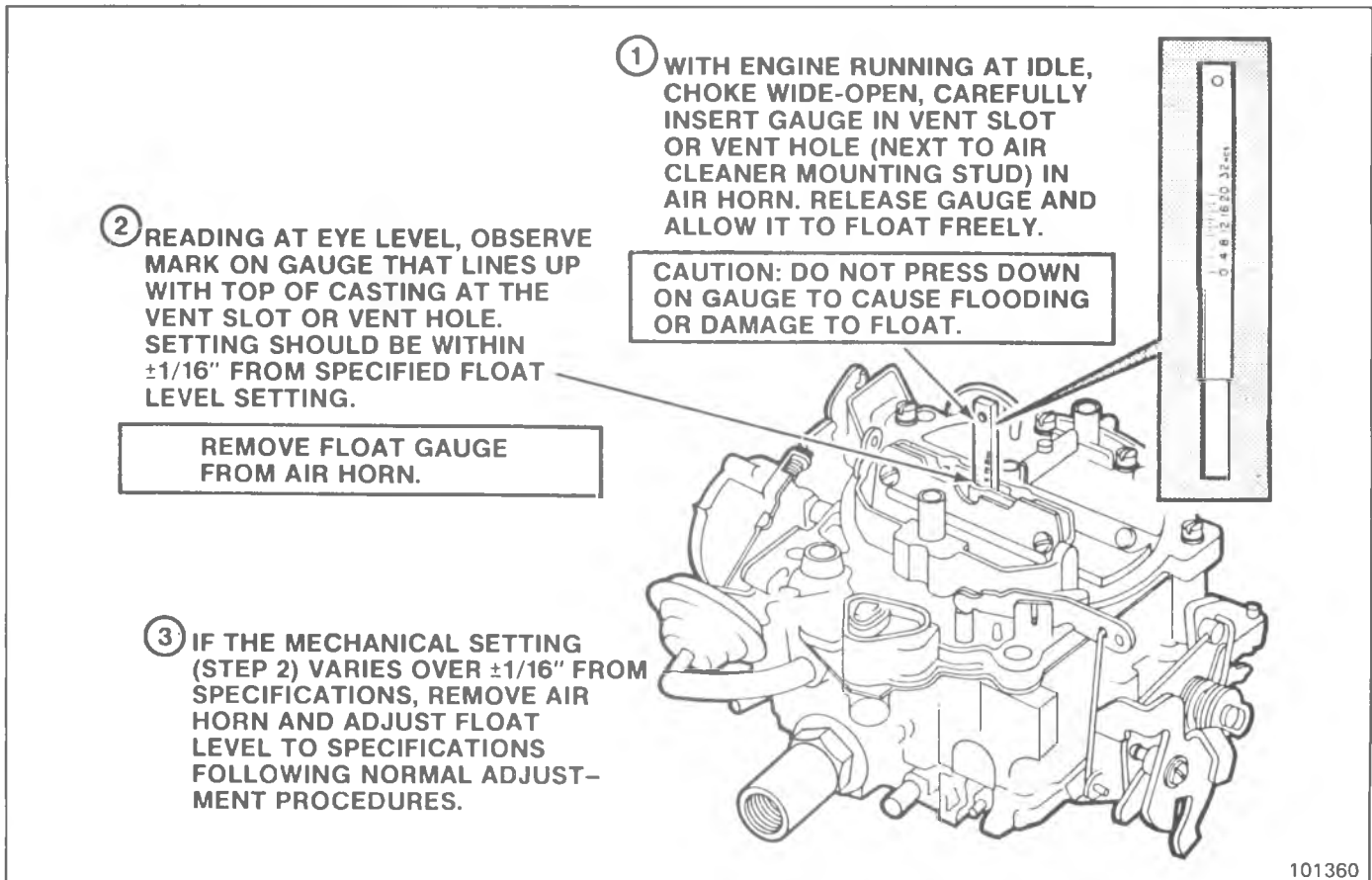


Fig. 6C4-4--External Float Level Check

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.

EXTERNAL FLOAT 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 6C4-4.

CARBURETOR CHOKE CHECK

General Procedure

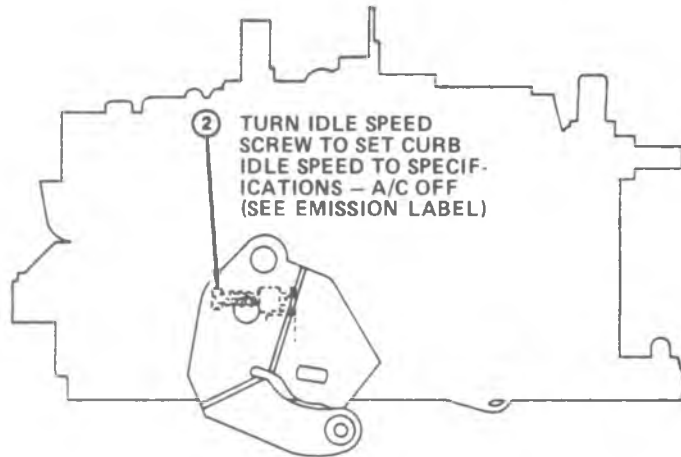
1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.
2. If choke or linkage binds, sticks or works sluggish, clean with choke cleaner X-20-A or equivalent. Use cleaner 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.

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

- ① PREPARE VEHICLE FOR ADJUSTMENTS — SEE EMISSION LABEL ON VEHICLE.
NOTE: IGNITION TIMING SET PER LABEL.



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Fig. 6C4-5--Idle Speed Adjustment Without A/C

- 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.

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.

SPEED ADJUSTMENTS

Refer to Figure 6C4-5 for idle speed adjustment without air conditioning.

Refer to Figure 6C4-6 for idle speed adjustment with air conditioning.

Refer to Figure 6C4-7 for fast idle adjustment.

Refer to Figure 6C4-8 for 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 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 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 Emission Control Information label. Re-connect vacuum advance.
5. Set carburetor idle speed to specification as shown on Emission Control Information label.

- ③ SOLENOID ENERGIZED - A/C COMPRESSOR LEAD DISCONNECTED AT A/C COMPRESSOR, A/C ON, A/T TRANSMISSION IN DRIVE, M/T IN NEUTRAL
- ① PREPARE VEHICLE FOR ADJUSTMENTS - SEE EMISSION LABEL ON VEHICLE.
NOTE: IGNITION TIMING SET PER LABEL.
- ⑤ TURN SOLENOID SCREW TO ADJUST TO SPECIFIED RPM. (RECONNECT A/C COMPRESSOR LEAD AFTER ADJUSTMENT)
- ④ OPEN THROTTLE SLIGHTLY TO ALLOW SOLENOID PLUNGER TO FULLY EXTEND
- ② TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS - A/C OFF (SEE EMISSION LABEL)

ELECTRICAL CONNECTION

A/C IDLE SPEED ADJUSTMENT (ON VEHICLE)

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Fig. 6C4-6--Idle Speed Adjustment With A/C

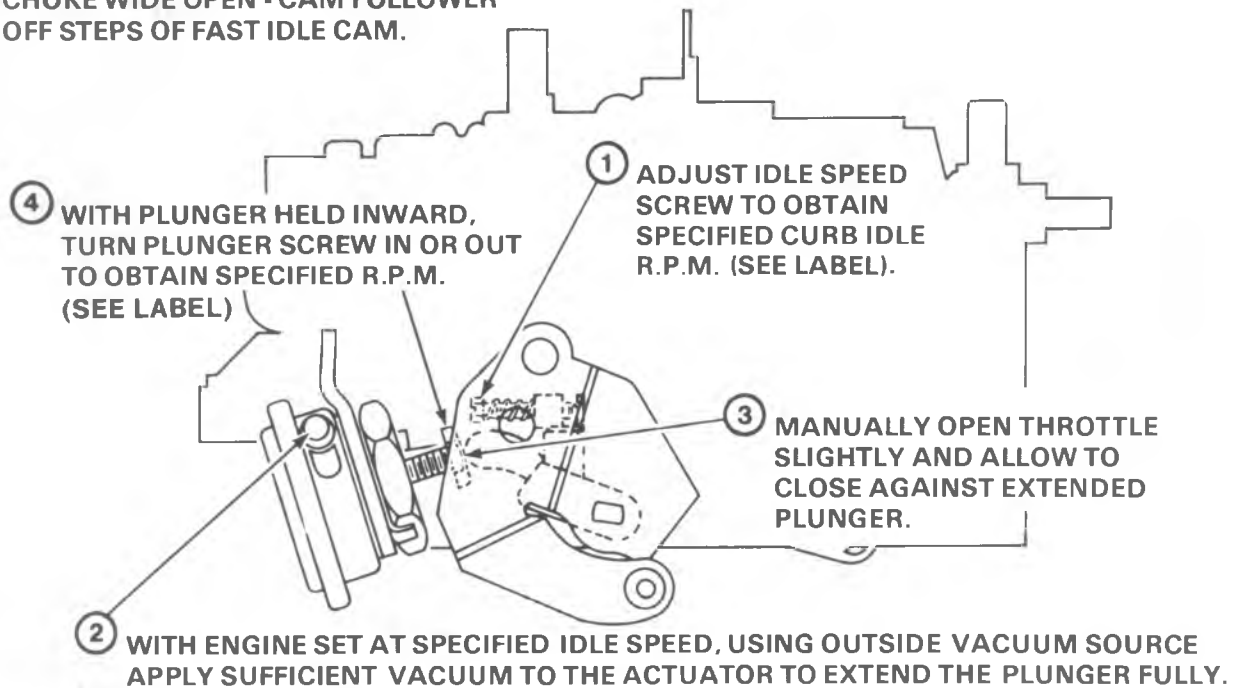
- ① PREPARE VEHICLE FOR ADJUSTMENTS - SEE EMISSION LABEL ON VEHICLE.
NOTE: IGNITION TIMING SET PER LABEL.
- ② POSITION TRANSMISSION IN PARK OR NEUTRAL
- ③ HOLD CAM FOLLOWER ON PROPER STEP OF FAST IDLE CAM PER EMISSION LABEL
- ④ IF SPECIFIED ON EMISSION LABEL, DISCONNECT AND PLUG VACUUM HOSE AT EGR VALVE.
- ⑤ TURN FAST IDLE SCREW TO OBTAIN SPECIFIED RPM

FAST IDLE ADJUSTMENT (ON VEHICLE)

101363

Fig. 6C4-7--Fast Idle Adjustment

**NOTE: ENGINE MUST BE WARM -
CHOKE WIDE OPEN - CAM FOLLOWER
OFF STEPS OF FAST IDLE CAM.**



THROTTLE LEVER ACTUATOR ADJUSTMENT (ON VEHICLE)

101364

Fig. 6C4-8--Throttle Lever Actuator Adjustment

on 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 must be vertical (Fig. 6C4-9).
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.

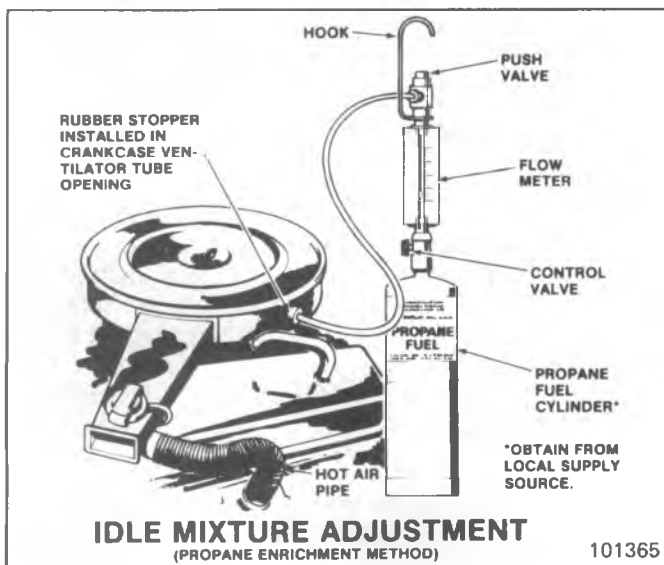
b. Invert carburetor and drain fuel in container.

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. 6C4-10). 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.



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Fig. 6C4-9--Idle Mixture Choke-Propane Enrichment

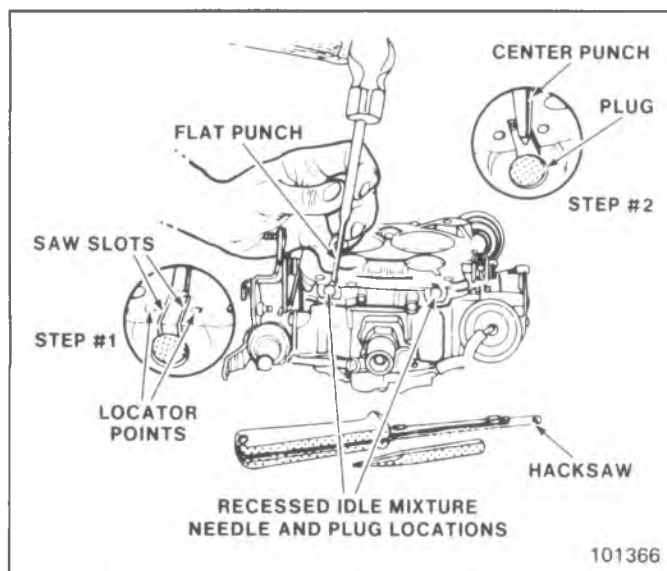


Fig. 6C4-10--Removing Idle Needle Plug-Typical

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 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 replacement, 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.
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.

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

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. 6C4-11).
5. Disconnect accelerator linkage.

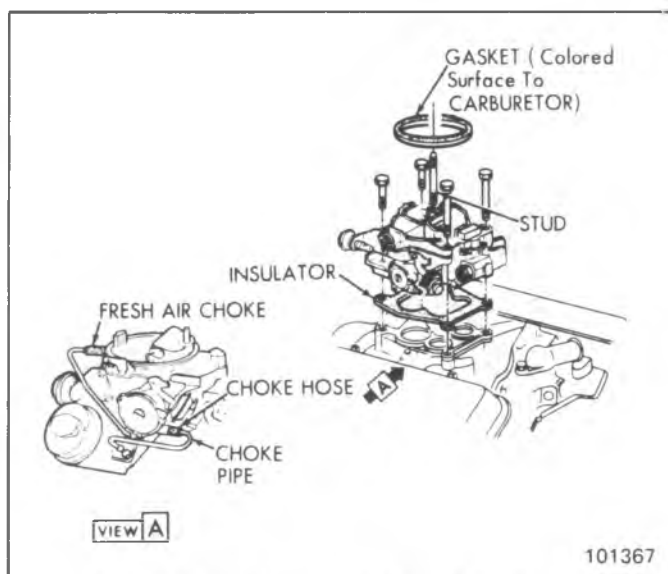


Fig. 6C4-11--Carburetor and Choke Pipes-M4MC

The procedures that follow apply to a complete carburetor overhaul with the carburetor removed from the engine. Refer to Figure 6C4-12 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 or equivalent to prevent damage to throttle valves.

Idle Speed Solenoid (ISS) (If Equipped)

Remove two attaching screws and remove idle speed solenoid 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

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 (Fig. 6C4-13). Lift upward on metering rod hanger until the secondary metering rods

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.

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

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. Then remove pump lever from pump rod (Fig. 6C4-14). 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 noting tube location for reassembly.
6. Remove thirteen air horn to bowl attaching screws; the two counter-sunk screws (Number 1 and 2) are located next to the venturi (Fig. 6C4-15). 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.**

Air Horn Disassembly

1. Remove front vacuum break bracket two attaching screws. The vacuum break assembly may now be removed from the air valve rod and the rod from the air valve lever. Do not place vacuum break assembly in carburetor cleaner.
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. 6C4-16). 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

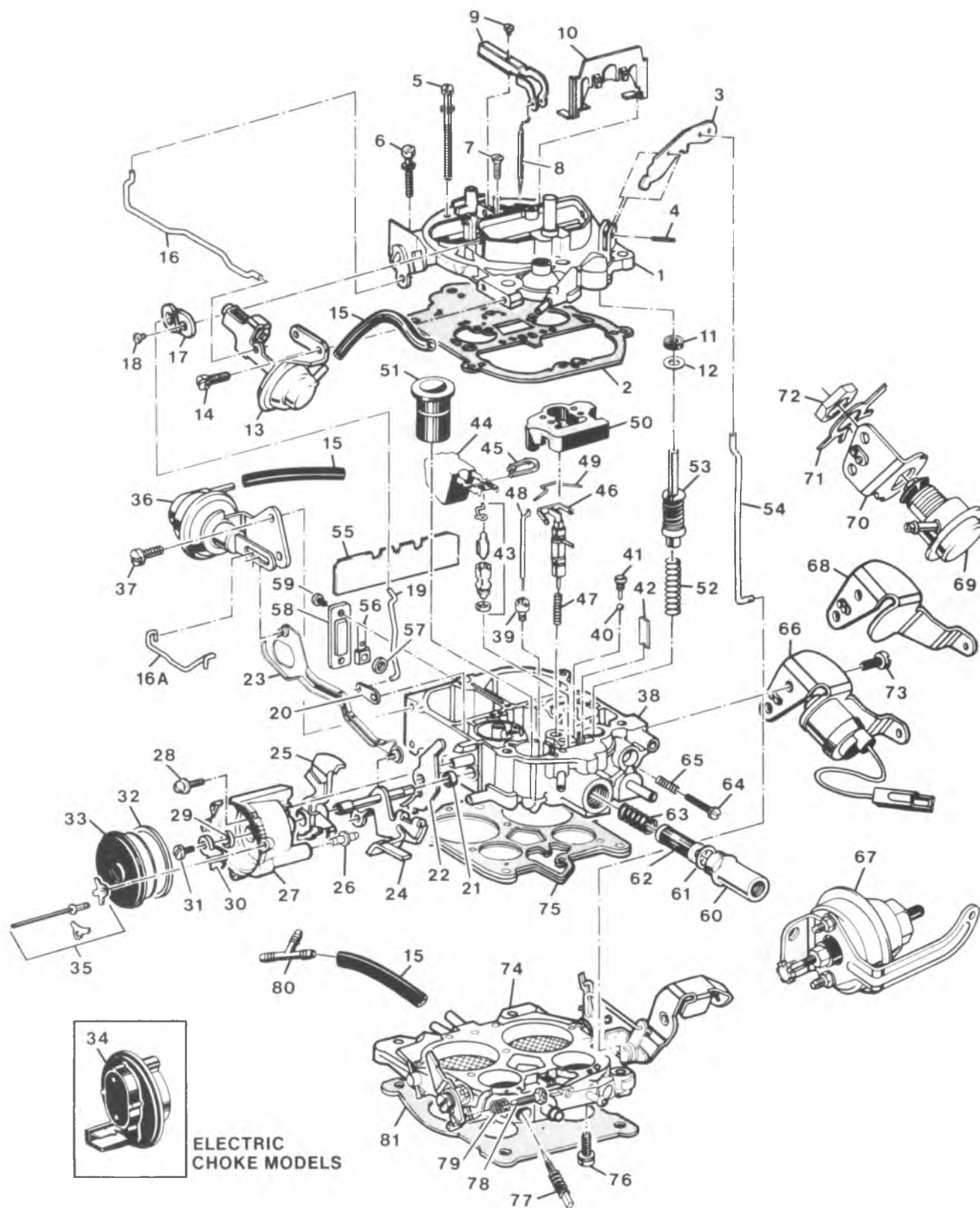


Fig. 6C4-12--M4MC/M4ME Carburetor Exploded View

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)

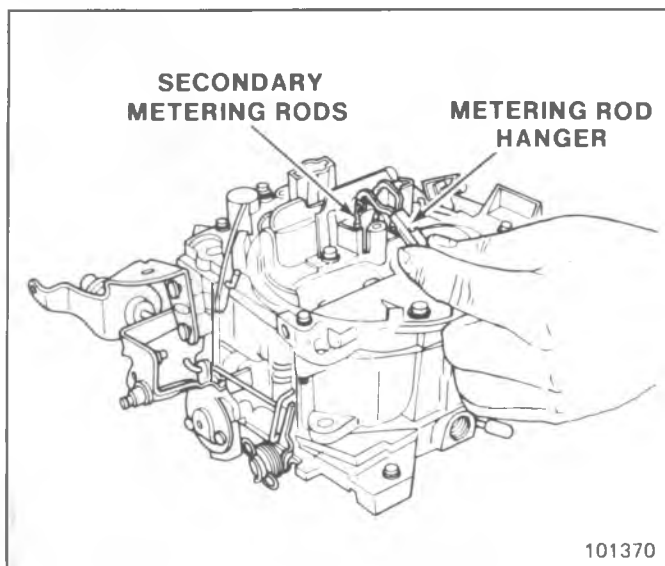
FLOAT BOWL PARTS (Continued)

- 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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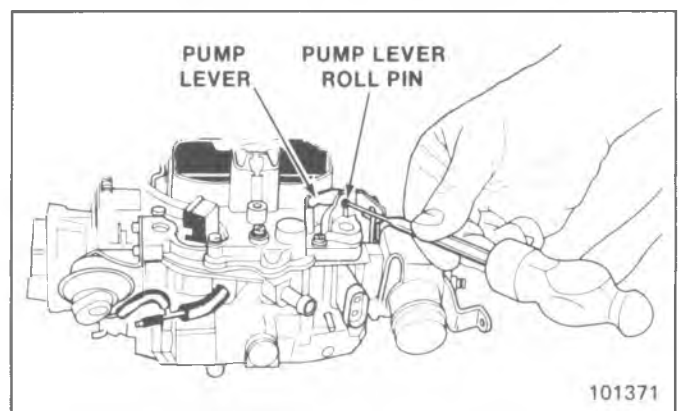


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Fig. 6C4-13--Removing Secondary Metering Rods

and retainer are required for reassembly.

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. If it is necessary to replace the air valve closing spring or



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Fig. 6C4-14--Removing Pump Lever

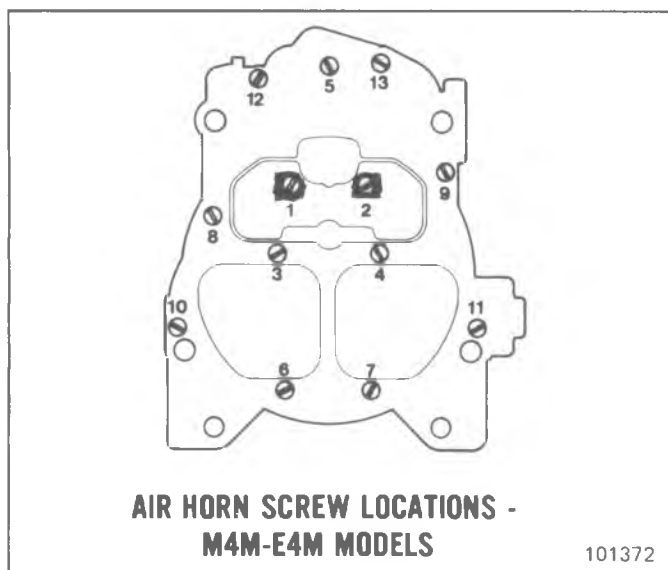


Fig. 6C4-15--Removing Air Horn Screws

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 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 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.

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. 6C4-17) pre-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 bowl assembly will be

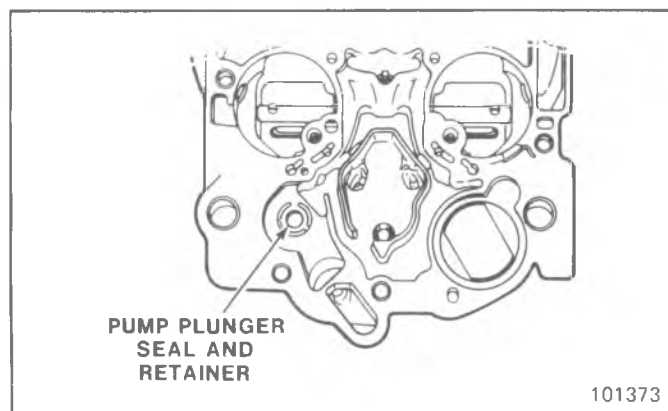


Fig. 6C4-16--Pump Plunger Stem Seal

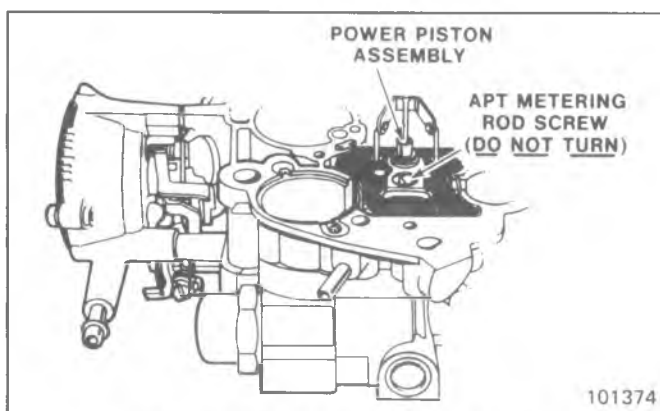


Fig. 6C4-17--APT Metering Rod Screw

supplied with an A.P.T. metering rod screw pre-set as required.

5. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C4-18).
- Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly.
6. Remove plastic filler block over float chamber.
 7. Remove float assembly and float needle by pulling up on retaining pin. Remove float needle seat and gasket using seat remover J 22769 or equivalent.
 8. If used, remove plastic insert cavity in float bowl.
 9. 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, bowl replacement is required.

10. Remove pump discharge check ball retainer and turn bowl upside down, catching discharge ball in palm of hand.
11. Remove secondary air baffle, if replacement is required.
12. Remove pump well fill slot baffle only if necessary.

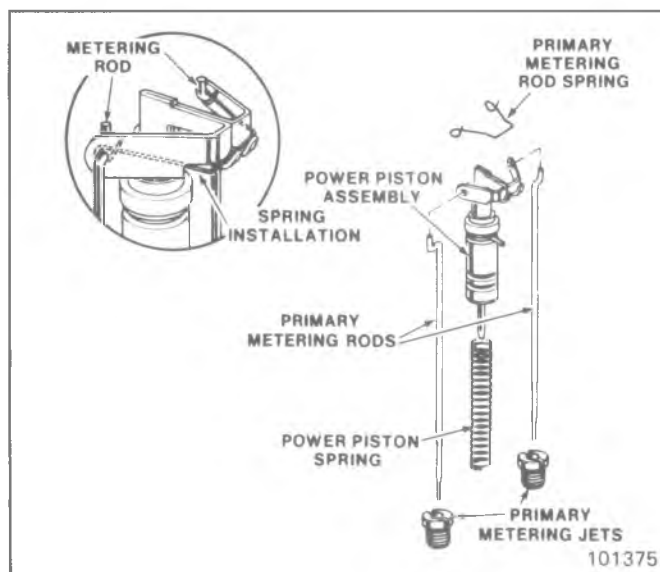


Fig. 6C4-18--Power Piston and Metering Rods

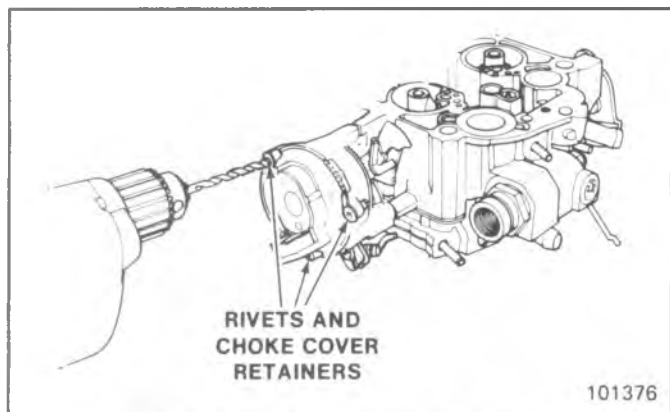


Fig. 6C4-19--Removing Choke Cover

13. Remove rear vacuum break assembly, where used. Then remove (2) screws and rotate the assembly to remove vacuum break link from slot in plunger head and, if used, air valve rod. On M4ME, the non-adjustable vacuum break link, riveted to the intermediate choke lever, is not removed at this time, but is removed after removal of the choke assembly from the float bowl.

NOTICE: Do not place vacuum break assembly in carburetor cleaner because it will damage internal parts.

Choke

Disassembly

The tamper-resistant choke cover design is used to discourage 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 using procedures described below.

Removal of Choke Cover

1. Support float bowl and throttle body as an assembly on a suitable holding fixture such as Tool J 9789-118 or equivalent.
2. Carefully align a #21 drill (.159") on rivet head and drill only enough to remove rivet head (Fig. 6C4-19). 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 two conventional retainers, retainer with tab, choke cover gasket, 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. 6C4-20). 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.

Plastic tube seal should not be increased in carburetor cleaner.

6. If used, remove rear vacuum break link from intermediate choke lever.
7. Remove secondary throttle valve lock-out lever from float bowl (6C4-20).
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 choke shaft and remove lever (Fig. 6C4-20.). 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.**

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 (Fig. 6C4-21).
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.

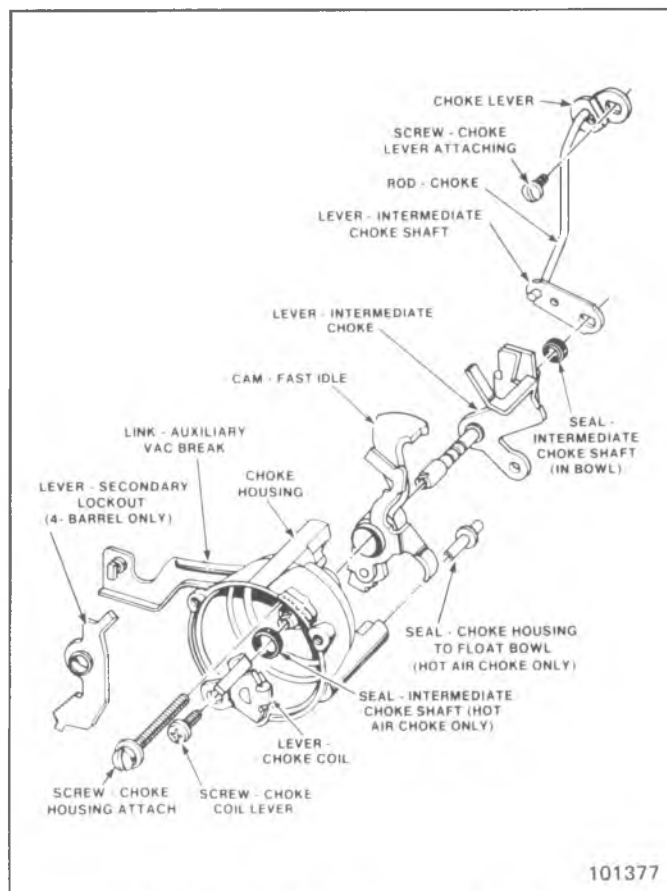


Fig. 6C4-20--Choke Assembly - Typical

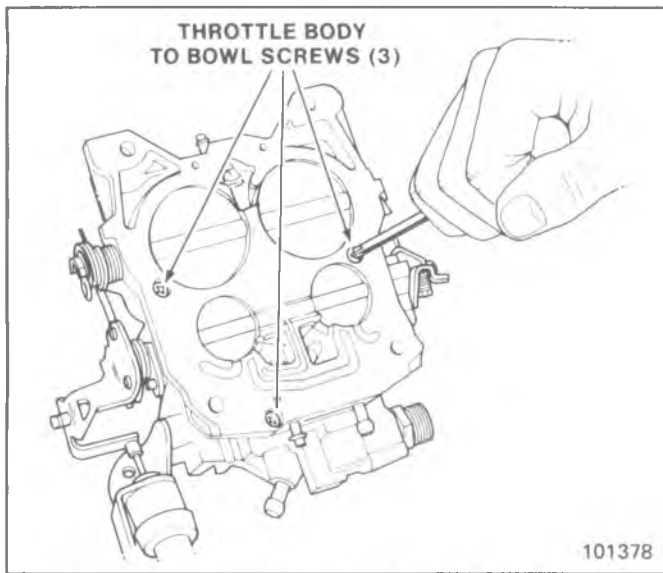


Fig. 6C4-21--Removing Throttle Body to Bowl Screws

2. **Do not remove** plugs covering idle mixture needles during normal carburetor cleaning and servicing, unless 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 factory recommended procedures. (See On-Vehicle Service).

If necessary to remove the idle mixture needles, see Idle Mixture Needle Plug Removal (Fig. 6C4-10).

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

The carburetor parts should be cleaned in cold immersion type cleaner.

NOTICE: The electric solenoid, rubber parts, plastic parts, diaphragms, pump plungers, 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.
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 as 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 proper seating.
2. Inspect float needle pull clip for proper installation (Fig. 6C4-22). 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.
5. Check power piston for sticking, binding, damaged or missing metering rods.

b. Hesitation

1. Inspect pump plunger for cracks, scores or cup excessive wear and replace plunger if necessary.
2. Inspect pump duration and return spring for being weak or distorted.
3. Check all pump passages and jets for dirt, improper seating of discharge ball and scores in pump well. Check condition of pump discharge check ball.
4. Check pump linkage for excessive wear,; repair or replace as 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.

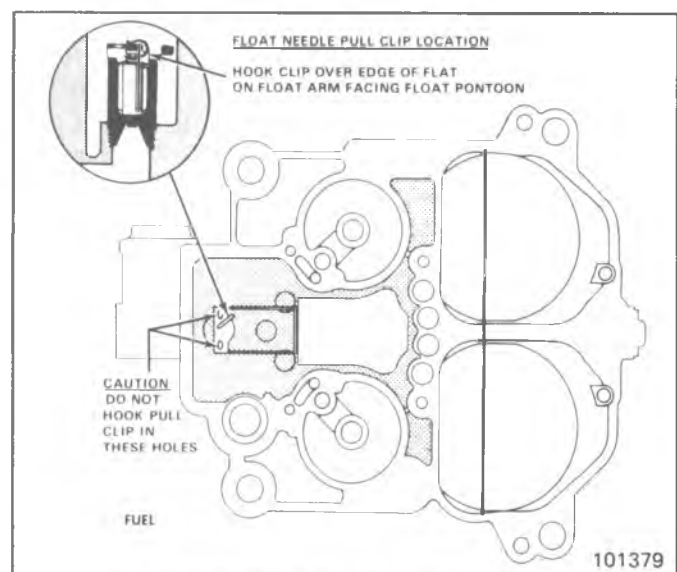


Fig. 6C4-22--Float Needle Pull Clip Location

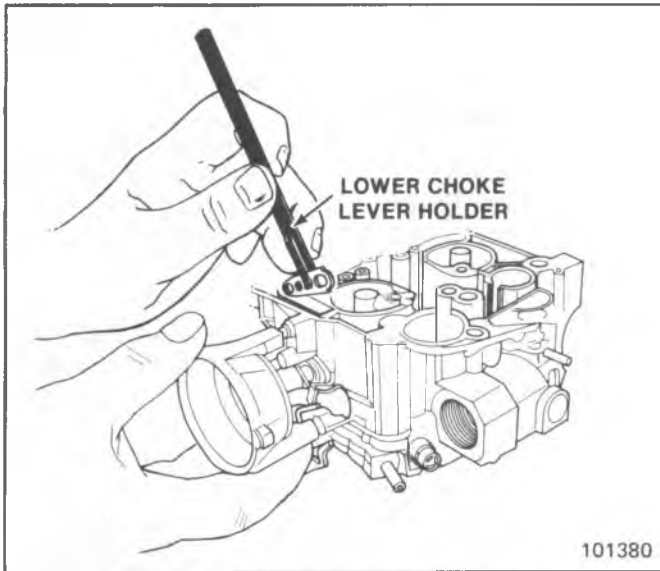


Fig. 6C4-23--Installing Lower Choke Lever

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 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

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 mixture needle, washer, and spring using Tool J-29030. Lightly seat needle and then back out 4-1/2 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. 6C4-1).

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, then install throttle body to bowl screws and tighten evenly and securely (Fig. 6C4-21).
3. Place carburetor on proper holding fixture J9789-118 or equivalent. 4. Install fuel inlet filter spring, filter, new gasket and inlet nut and tighten nut to 24 N·m (18 ft. lbs.).

When installing a service replacement filter, make sure the filter is the type that includes the check valve to meet safety standards for vehicle roll-over. 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

1. Install new cup seal into insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward (Fig. 6C4-20).
2. Install secondary throttle valve lock-out lever on boss on float bowl with recess in hole in lever facing inward (Fig. 6C4-20).
3. Install new cup seal into choke shaft hole (hot air choke model) Lips on seal face inward toward float bowl.
4. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward) and install intermediate choke shaft in choke housing pushing shaft through seal in housing.
5. Install choke coil lever on flats on intermediate choke shaft, install retaining screw, and tighten securely (Fig. 6C4-20). Lever is properly aligned when both inside and outside levers face toward fuel inlet.
6. If used, install rear vacuum break link in hole in intermediate choke shaft lever. End of link faces toward choke housing when installed properly.
7. On hot air choke models, insert plastic tube seal (to float bowl) in vacuum inlet hole on choke housing (Fig. 6C4-20).
8. Install lower (inner) choke lever in cavity in float bowl using Tool J-23417 or equivalent (Fig. 6C4-23). 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. 6C4-20) and tighten securely. Check linkage for freedom of movement.

Do not install the choke cover and coil assembly on housing until completion of adjustments (starting at Figure 6C4-29).

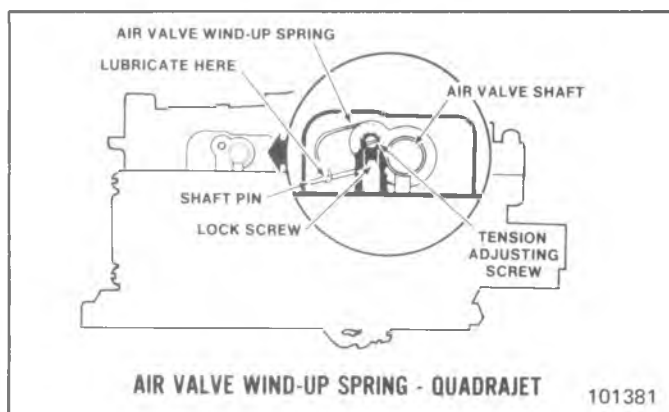


Fig. 6C4-24--Lubrication of Air Valve Shaft Pin

Float Bowl

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. Then, install vacuum break and bracket assembly on float bowl using two large countersunk attaching screws. Tighten securely. If vacuum break adjustment is necessary, see Adjustments.
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, 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 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-correct 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. 6C4-22).
10. Install float hinge pin into float arm with end of loop of pin facing pump well. Then, 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 6C4-22 for correct needle pull clip location.
11. **Float Level Adjustment** See Figure 6C4-28 at end of this section.
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. 6C4-18). Install power piston assembly in well (aligning pin on piston with slot in well) 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 lightly in place.
15. Install pump return spring in pump well.
16. Install air horn gasket by carefully sliding tab of gasket 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 6C4-24), 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. 6C4-16). Lip on seal faces outward (away from air horn mounting surface). Lightly stake seal retainer in three places, choosing locations different 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 making 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.
Do not force the air horn assembly onto the bowl but rather lightly lower in place.
2. Install eleven 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. 6C4-25).**
3. On models using a single rear vacuum break, install air valve rod in air valve lever; then, install end of air valve rod and vacuum break link in slots in vacuum break plunger. Then, install vacuum break and bracket assembly on float bowl using too large countersunk attaching screws. Tighten securely. If vacuum break adjustment is necessary, see Adjustments.
4. On models using a front vacuum break, install air valve rod into slot in air valve lever; then, install the other end of rod in hole in front vacuum break

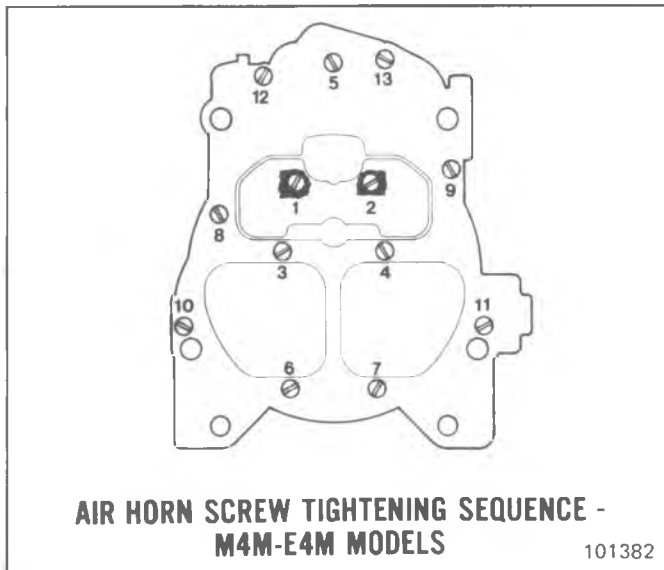


Fig. 6C4-25--Air Horn Screw Tightening Sequence

diaphragm plunger. Install vacuum break on air horn using two attaching screws. Tighten screws securely. If vacuum break adjustment is necessary, see Adjustments.

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 (Fig. 6C4-26).

Use care installing the small roll pin to prevent damage to pump lever 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 end tighten securely. Work air valves up and down several times to make sure they are free in all positions (Fig. 6C4-13).
7. Connect check rod into lower choke lever inside

bowl cavity; then, 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. **Completion of Choke Assembly** After the inside choke coil lever, fast idle cam (choke rod), and front and rear vacuum break adjustments have been checked, install the thermostatic choke cover, and gasket (if used), on the choke housing, making sure coil tang engages choke coil lever.

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.

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. It may be necessary to use an adapter (tube) if installing tool interferes with electrical connector tower on choke cover (Fig. 6C4-27).

9. Install vacuum break hoses on front and rear (if used) vacuum control units.
10. Install idle speed solenoid-bracket assembly on float bowl, retaining with two large countersunk screws. Tighten screws securely.
11. Install carburetor, using new mounting gasket. (See "Carburetor Replacement", this section, for procedure).
12. Refer to "On Vehicle Service" and perform carburetor adjustment listed.

Unit Repair Adjustments

Refer to Figures 6C4-28 through 6C4-35 for carburetor adjustments.

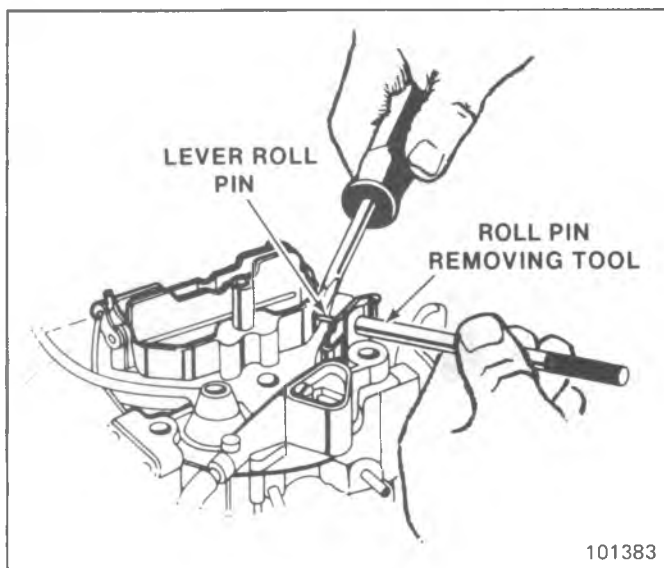


Fig. 6C4-26--Installing Pump Lever

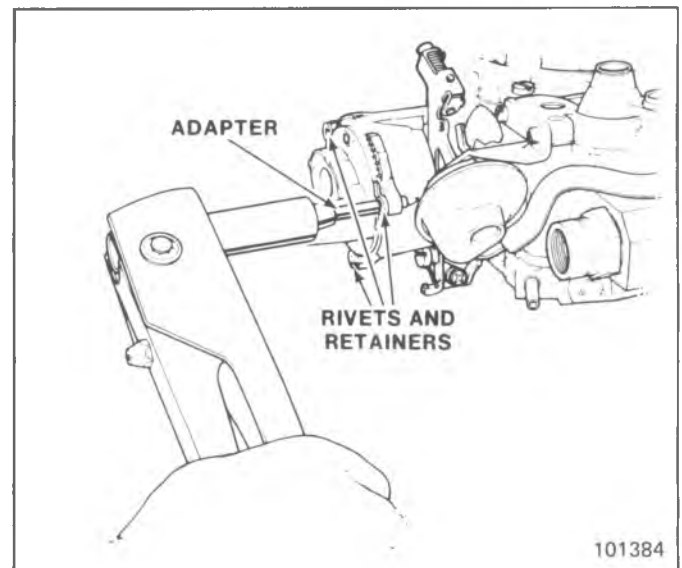
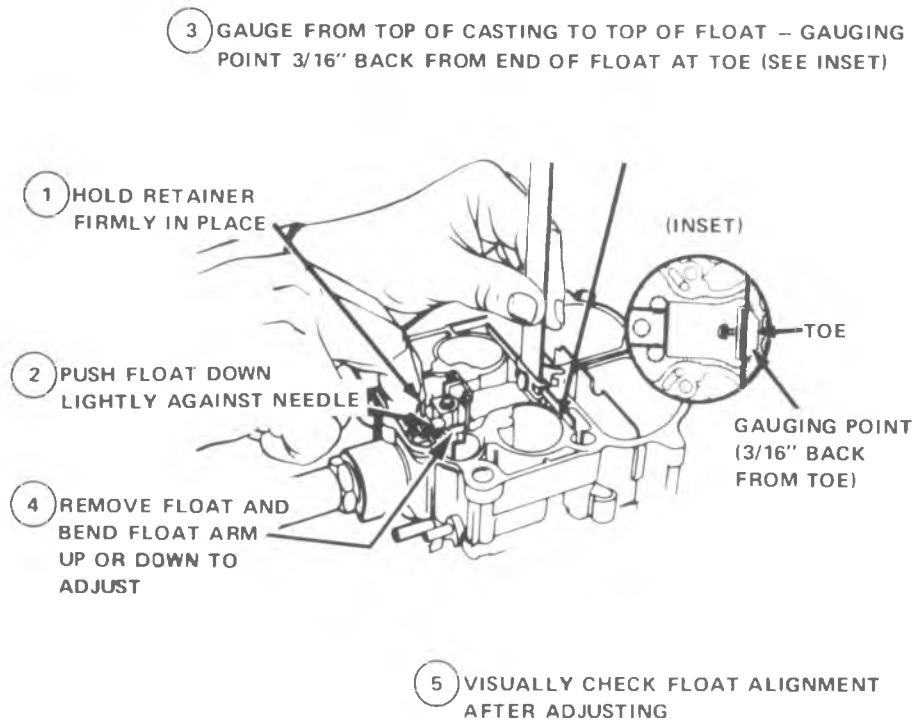


Fig. 6C4-27--Installing Choke Cover

FLOAT LEVEL ADJUSTMENT (MECHANICAL SETTING)



PUMP ADJUSTMENT

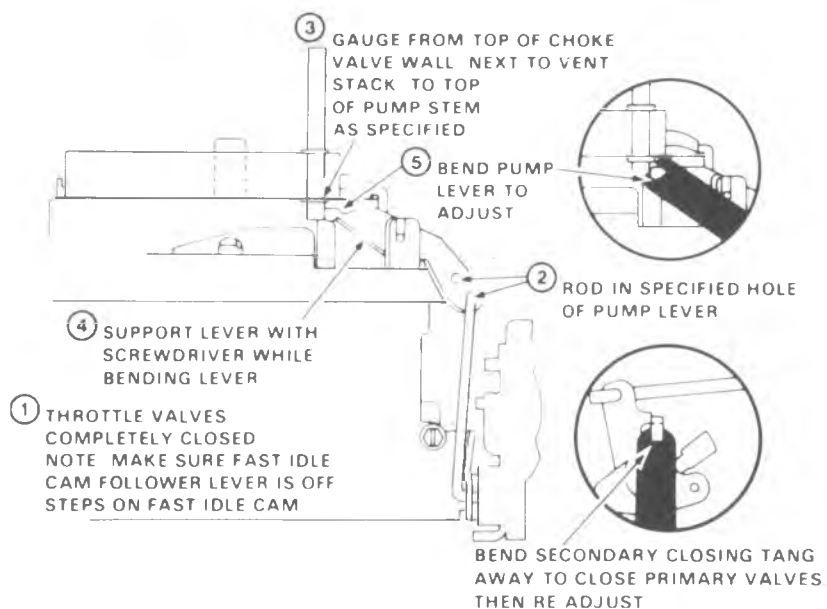
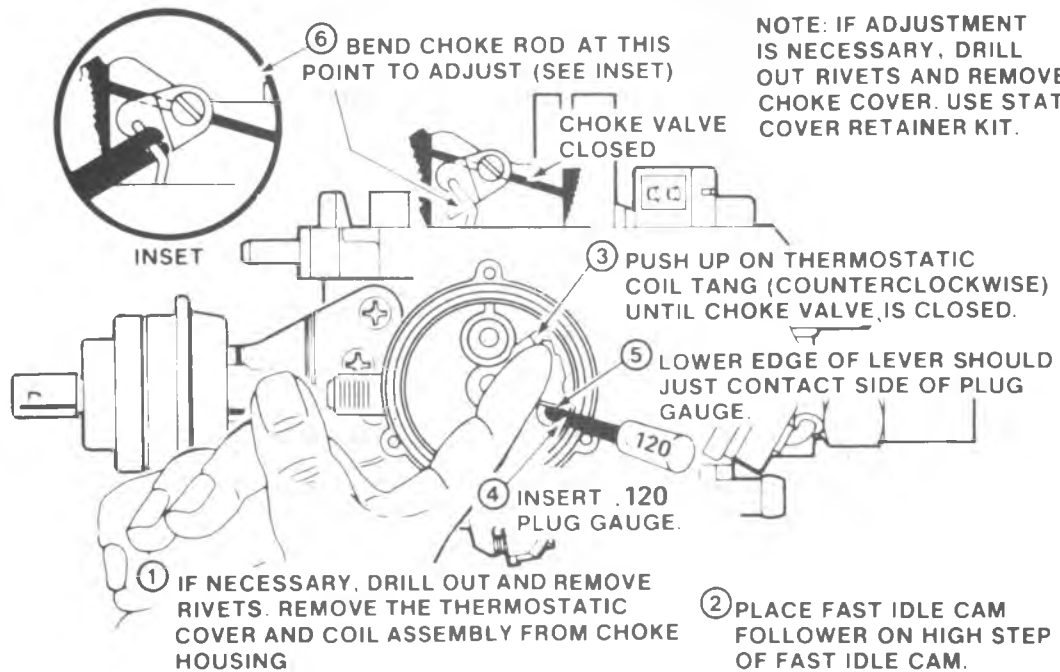


Fig. 6C4-28--M4MC/M4ME Adjustment (1 of 8)

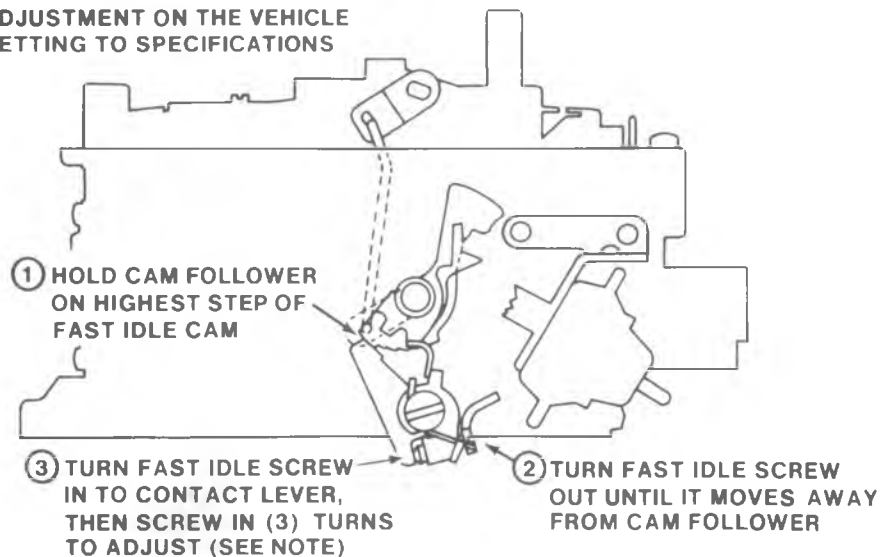
CHOKE COIL LEVER ADJUSTMENT

(SEE NOTE)



FAST IDLE ADJUSTMENT (BENCH SETTING)

NOTE: RECHECK FAST IDLE ADJUSTMENT ON THE VEHICLE SETTING TO SPECIFICATIONS



FAST IDLE CAM (CHOKE ROD) RELATION ADJUSTMENT

FIGURE 1

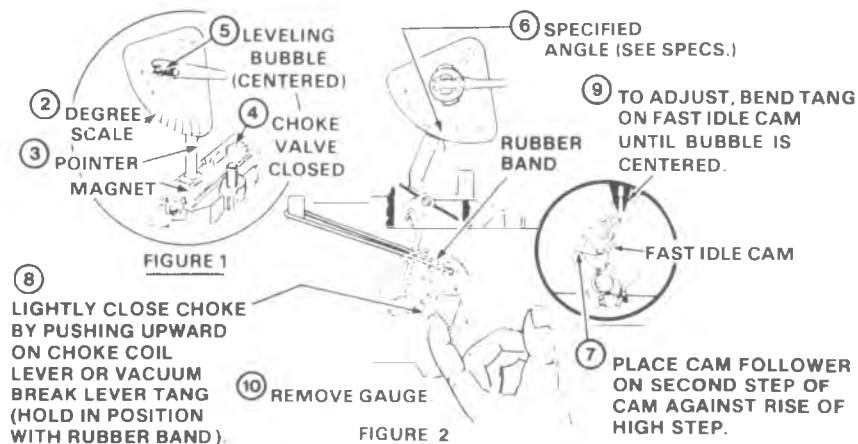
1. CHOKE COIL LEVER ADJUSTMENT MUST BE CORRECT AND FAST IDLE ADJUSTMENT MUST BE MADE BEFORE PROCEEDING.
2. USE CHOKE VALVE MEASURING GAUGE J 26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
3. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
4. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
5. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

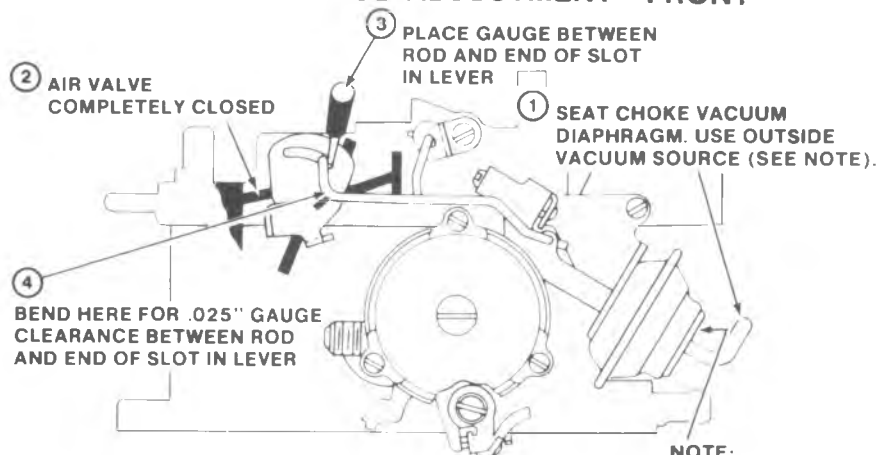
6. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER
7. PLACE CAM FOLLOWER ON SECOND STEP OF CAM AGAINST RISE OF HIGH STEP.
8. CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER OR VACUUM BREAK LEVER TANG (HOLD IN POSITION WITH RUBBER BAND).
9. TO ADJUST, BEND TANG ON FAST IDLE CAM UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE

- ① MAKE CHOKE COIL LEVER AND FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING).

NOTE: DO NOT REMOVE RIVETS AND CHOKE COVER TO PERFORM THIS ADJUSTMENT. USE RUBBER BAND ON VACUUM BREAK LEVER TANG TO HOLD CHOKE VALVE CLOSED, (STEP 8).



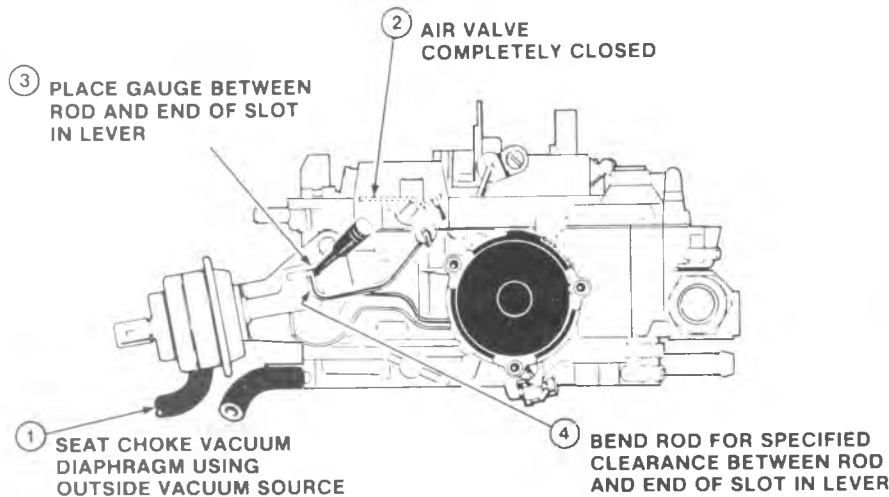
AIR VALVE ROD ADJUSTMENT - FRONT



NOTE:
PLUG END COVER
WITH TAPE IF
PURGE BLEED HOLE
IS USED. REMOVE
TAPE AFTER
ADJUSTMENT.

AIR VALVE ROD ADJUSTMENT - REAR

(LIGHT DUTY TRUCK ONLY — NON-CALIFORNIA APPLICATIONS)



FRONT VACUUM BREAK ADJUSTMENT - ANGLE GAUGE METHOD

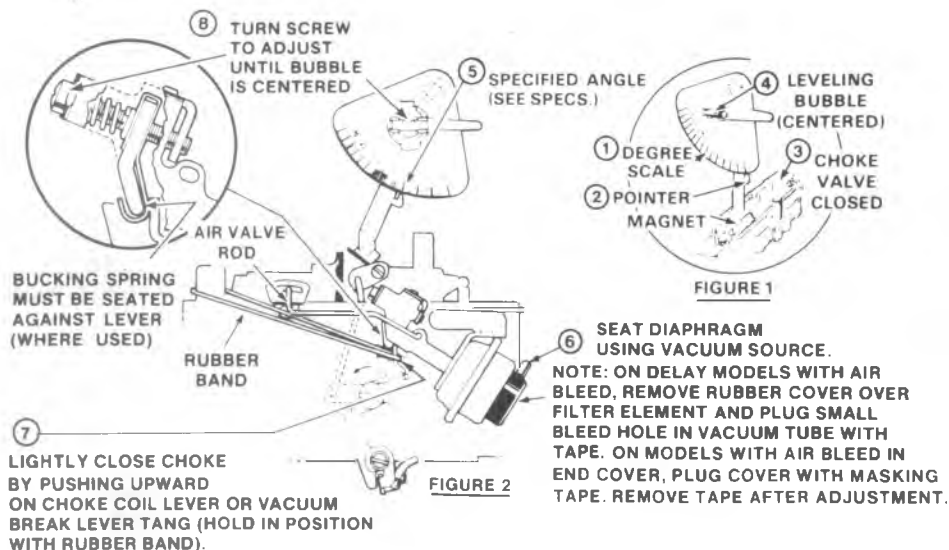
NOTE: CHOKE COIL LEVER ADJUSTMENT MUST BE CORRECT BEFORE PROCEEDING.

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE GAUGE MAGNET SQUARELY ON TOP OF CHOKE VALVE — FIGURE 1.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. SEAT CHOKE VACUUM DIAPHRAGM USING VACUUM SOURCE. (ANY AIR BLEEDS IN DIAPHRAGM COVER MUST BE SEALED. ALSO ON FOUR BARREL CARBURETORS, THE AIR VALVE ROD MUST NOT RESTRICT VACUUM UNIT FROM FULLY RETRACTING. IF NECESSARY, BEND AIR VALVE ROD AT AIR VALVE LEVER TO PROVIDE CLEARANCE FOR PROPER ADJUSTMENT. FINAL ROD CLEARANCE CAN BE SET AFTER VACUUM BREAK SETTING HAS BEEN MADE.)
7. LIGHTLY CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER OR VACUUM BREAK LEVER TANG (HOLD IN POSITION WITH RUBBER BAND). UNITS WITH BUCKING SPRING MUST HAVE THE PLUNGER EXTENDED FULLY (BUCKING SPRING COMPRESSED) WITH DIAPHRAGM SEATED.
8. TO ADJUST, TURN SCREW IN OR OUT UNTIL BUBBLE IS CENTERED.
9. REMOVE GAUGE.



REAR VACUUM BREAK ADJUSTMENT - TYPICAL

(SCREW ADJUSTMENT TYPE)

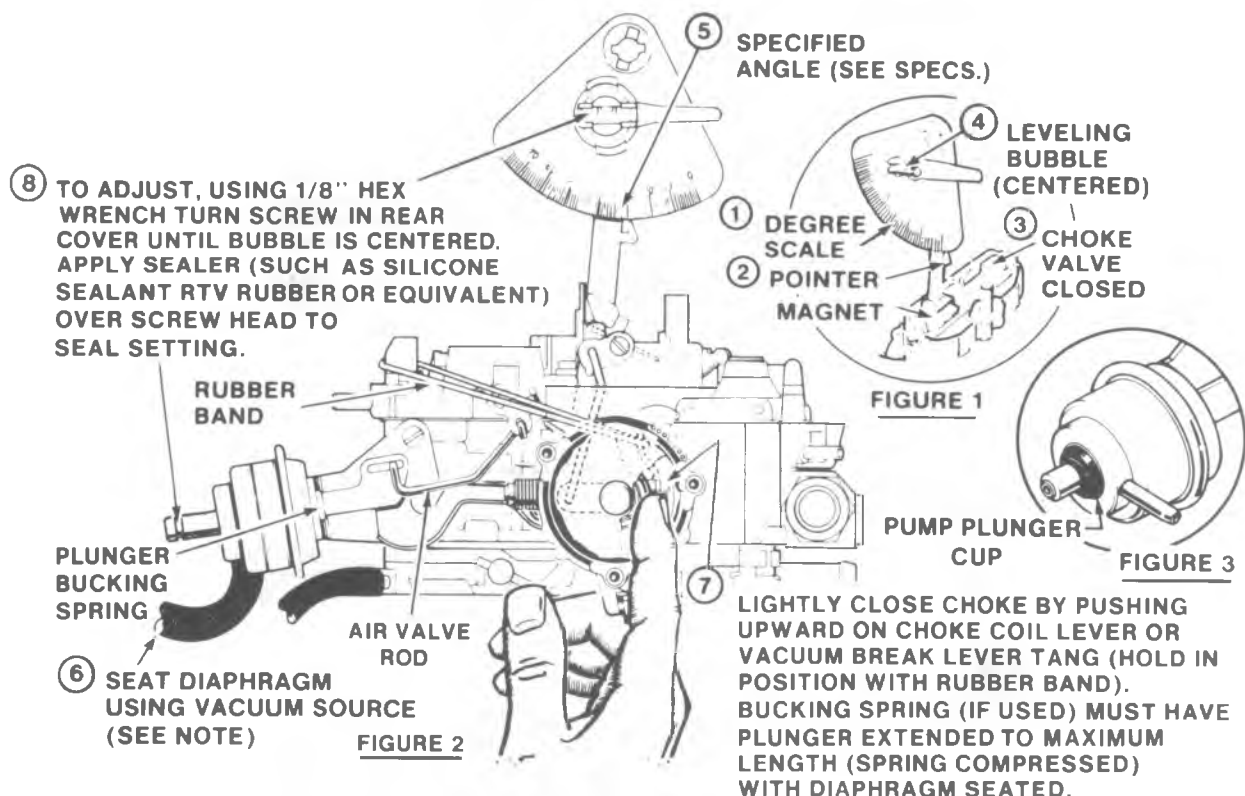
NOTE: CHOKE COIL LEVER ADJUSTMENT MUST BE CORRECT BEFORE PROCEEDING.

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE GAUGE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. SEAT CHOKE VACUUM DIAPHRAGM USING VACUUM SOURCE. (ANY AIR BLEEDS IN DIAPHRAGM COVER MUST BE SEALED — SEE NOTE BELOW. ALSO ON FOUR BARREL CARBURETORS, THE AIR VALVE ROD MUST NOT RESTRICT VACUUM UNIT FROM FULLY RETRACTING. IF NECESSARY, BEND AIR VALVE ROD AT PLUNGER SLOT TO PROVIDE ADEQUATE CLEARANCE FOR PROPER ADJUSTMENT. PROCEED TO AIR VALVE ROD ADJUSTMENT AFTER VACUUM BREAK ADJUSTMENT HAS BEEN COMPLETED).
7. LIGHTLY CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER OR VACUUM BREAK LEVER TANG (HOLD IN POSITION WITH RUBBER BAND). UNITS WITH BUCKING SPRING MUST HAVE THE PLUNGER EXTENDED TO MAXIMUM LENGTH (BUCKING SPRING COMPRESSED) WITH DIAPHRAGM SEATED.
8. TO ADJUST, TURN SCREW IN OR OUT UNTIL BUBBLE IS CENTERED.
9. REMOVE GAUGE.



NOTE: ON DELAY MODELS, PLUG END COVER USING AN ACCELERATOR PUMP PLUNGER CUP - 2G TYPE (FIGURE 3) OR EQUIVALENT. SEAT VACUUM DIAPHRAGM MAKING SURE VACUUM IS ABOVE 5" Hg WHEN READING GAUGE (STEP 8). REMOVE CUP AFTER ADJUSTMENT.

UNLOADER ADJUSTMENT - TYPICAL

1. USE CHOKE VALVE MEASURING GAUGE J-26701. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.

FIGURE 1

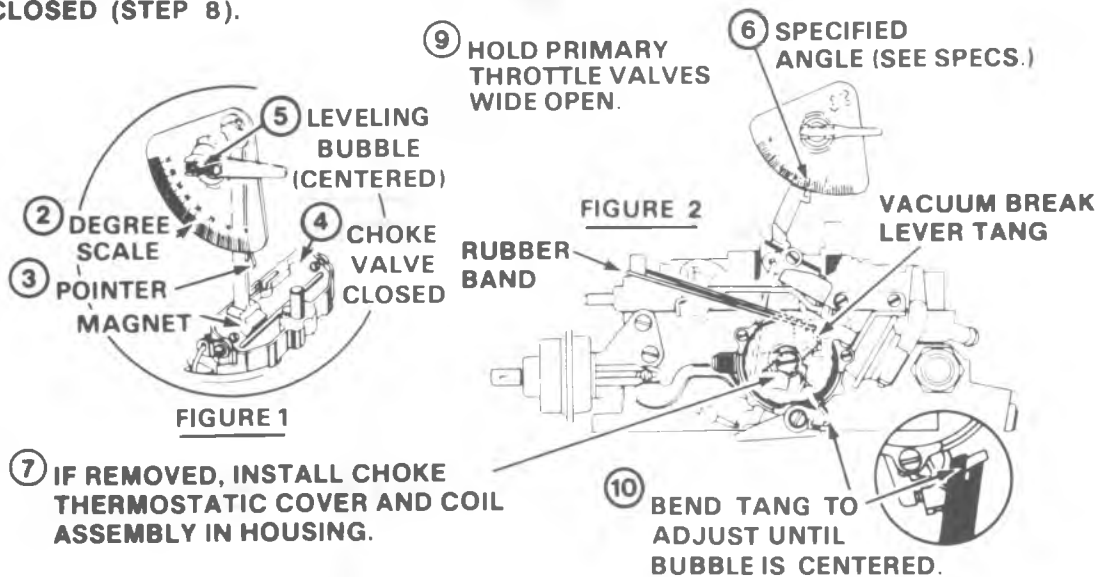
2. CHOKE COIL LEVER ADJUSTMENT MUST BE CORRECT AND FAST IDLE ADJUSTMENT MUST BE MADE BEFORE PROCEEDING.
3. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
4. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
5. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

6. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
7. IF REMOVED, INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING.
8. CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).
9. HOLD PRIMARY THROTTLE VALVES WIDE OPEN.
10. TO ADJUST, BEND TANG ON FAST IDLE LEVER UNTIL BUBBLE IS CENTERED.
11. REMOVE GAUGE.

① MAKE CHOKE COIL LEVER AND FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING).

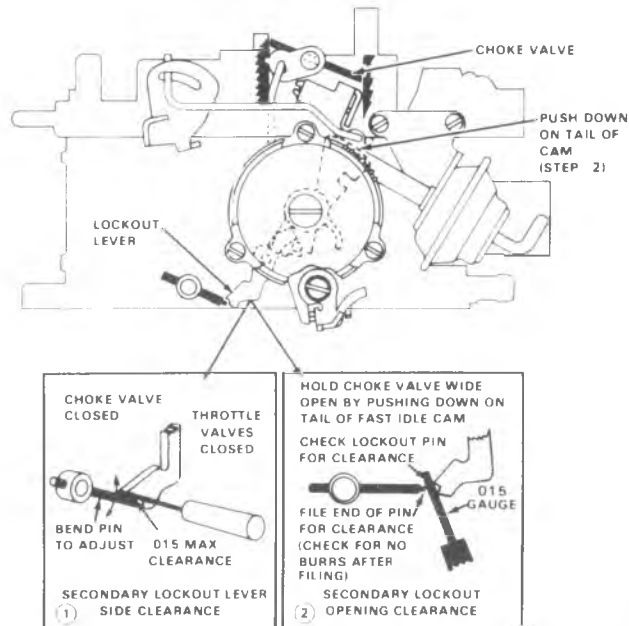
NOTE: DO NOT REMOVE RIVETS AND CHOKE COVER TO PERFORM THIS ADJUSTMENT. USE RUBBER BAND ON VACUUM BREAK LEVER TANG TO HOLD CHOKE VALVE CLOSED (STEP 8).



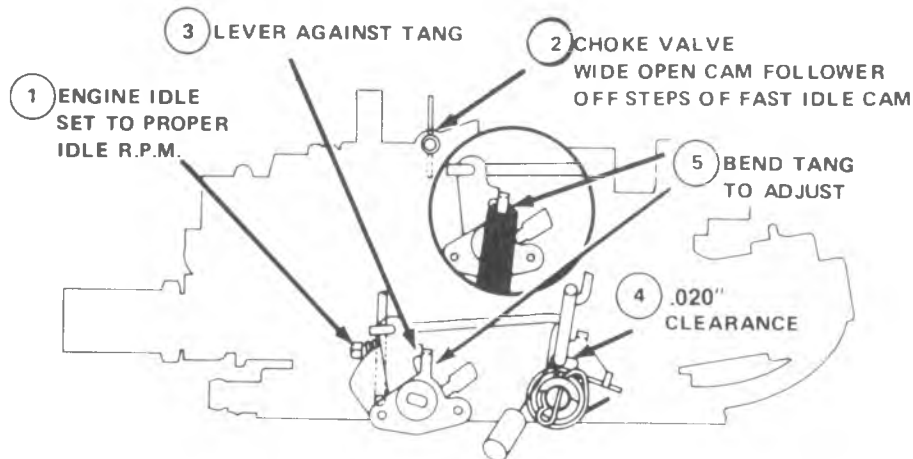
⑦ IF REMOVED, INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING.

⑧ CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).

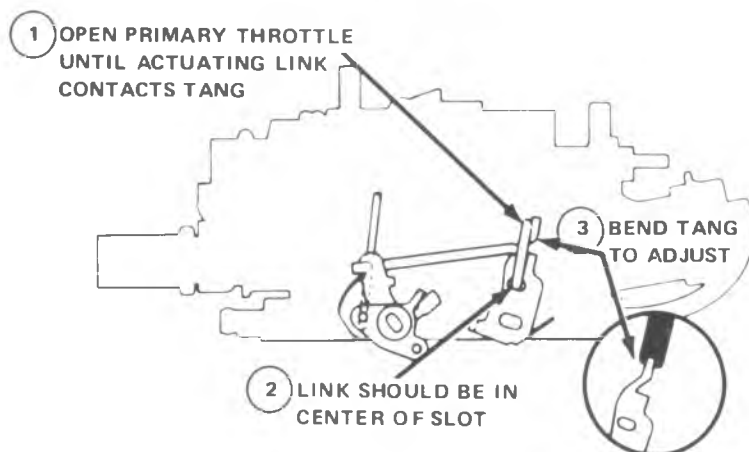
SECONDARY LOCKOUT ADJUSTMENT



SECONDARY CLOSING ADJUSTMENT



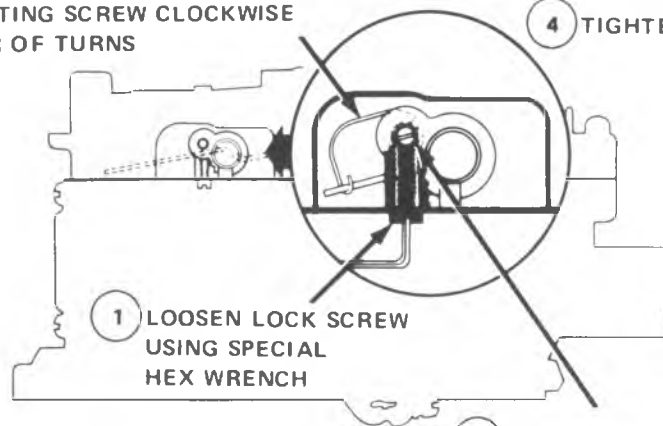
SECONDARY OPENING ADJUSTMENT



AIR VALVE SPRING ADJUSTMENT

- 3 TURN TENSION ADJUSTING SCREW
CLOCKWISE UNTIL AIR VALVE JUST CLOSES.
THEN TURN ADJUSTING SCREW CLOCKWISE
SPECIFIED NUMBER OF TURNS

- 4 TIGHTEN LOCK SCREW



- 1 LOOSEN LOCK SCREW
USING SPECIAL
HEX WRENCH

- 2 TURN TENSION ADJUSTING
SCREW COUNTERCLOCKWISE
UNTIL AIR VALVE
OPENS PART WAY

101392

Fig. 6C4-35--M4MC/M4ME Adjustment (8 of 8)

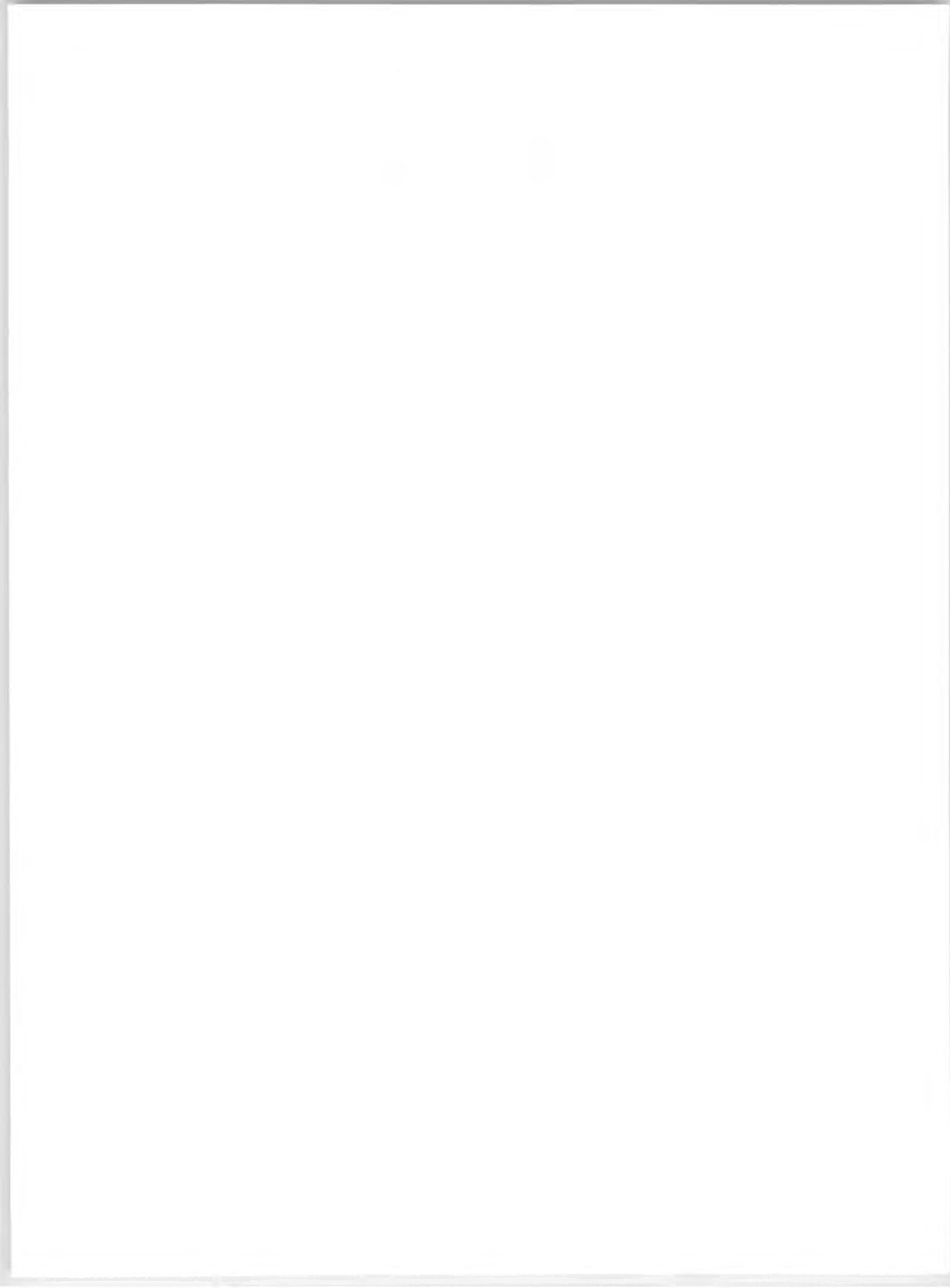
CARBURETOR ADJUSTMENTS – MODEL M4MC/M4ME

CARBURETOR PART NO.	FLOAT LEVEL mm (Inches)	PUMP ROD LOCATION	PUMP ROD SETTING mm (Inches)	FAST IDLE CAM (CHOKE ROD)	AIR VALVE ROD mm (Inches)	VACUUM BREAK FRONT	VACUUM BREAK REAR	AIR VALVE WINDUP mm (Inches)	UNLOADER
17080212	9.5 (3/8)	INNER	7 (9/32)	46°	0.6 (.025)	24°	30°	19 (3/4)	40°
17080213	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	25.4 (1)	40°
17080215	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	25.4 (1)	40°
17080298	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	25.4 (1)	40°
17080507	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	25.4 (1)	40°
17080512	9.5 (3/8)	INNER	7 (9/32)	46°	0.6 (.025)	24°	30°	19 (3/4)	40°
17080513	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	19 (3/4)	40°
17082213	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	25.4 (1)	40°
17082220	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082221	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082222	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082223	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082224	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082225	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082226	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082227	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082230	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	26°	36°	22 (7/8)	39°
17082231	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	26°	36°	22 (7/8)	39°
17082234	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	26°	36°	22 (7/8)	39°
17082235	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	26°	36°	22 (7/8)	39°
17082290	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082291	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082292	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082293	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	24°	34°	22 (7/8)	39°
17082506	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	23°	36°	22 (7/8)	39°
17082508	10 (13/32)	INNER	7 (9/32)	46°	0.6 (.025)	23°	36°	22 (7/8)	39°
17082513	9.5 (3/8)	INNER	7 (9/32)	37°	0.6 (.025)	23°	30°	19 (3/4)	40°
17082524	10 (13/32)	OUTER	8 (5/16)	46°	0.6 (.025)	25°	36°	22 (7/8)	39°
17082526	10 (13/32)	OUTER	8 (5/16)	46°	0.6 (.025)	25°	36°	22 (7/8)	39°

Fig. 6C4-36--Adjustment Specifications

CARBURETOR MODEL M4MC/M4ME ENRICHED IDLE SPEED

CARBURETOR PART NO.	PROPANE ENRICHMENT SPEED	CARBURETOR PART NO.	PROPANE ENRICHMENT SPEED	CARBURETOR PART NO.	PROPANE ENRICHMENT SPEED
17082221	150 RPM	17082230	20 RPM	17082293	100 RPM
17082222	50 RPM	17082231	100 RPM	17082506	50 RPM
17082223	100 RPM	17082234	20 RPM	17082508	50 RPM
17082224	50 RPM	17082235	100 RPM	17082513	
17082225	150 RPM	17082290	40 RPM	17082524	20 RPM
17082226	50 RPM	17082291	100 RPM	17082526	20 RPM
17082227	50 RPM	17082292	40 RPM		



SECTION 6C5

FUEL SYSTEM

GASOLINE

CONTENTS

Fuel Filter	6C5-1	Evaporative Control System.....	6C5-8
Fuel Pump.....	6C5-1	Accelerator Controls	6C5-10
Fuel Tank.....	6C5-3	Specifications	6C5-13
Cleaning Fuel System	6C5-5	Angle to Decimal Conversion	6C5-14
Fuel Feed and Vapor Pipes	6C5-7	Special Tools.....	6C5-14

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. 6C5-1 through 6C5-5) 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.

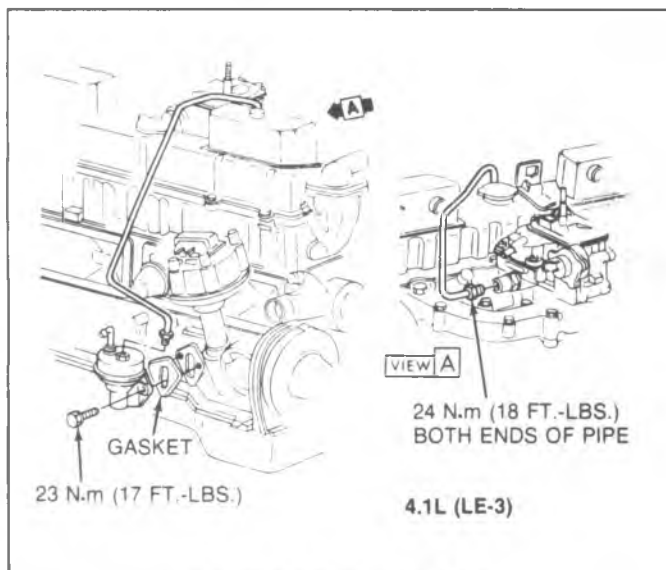


Fig. 6C5-1--Fuel Pump--4.1 L

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.

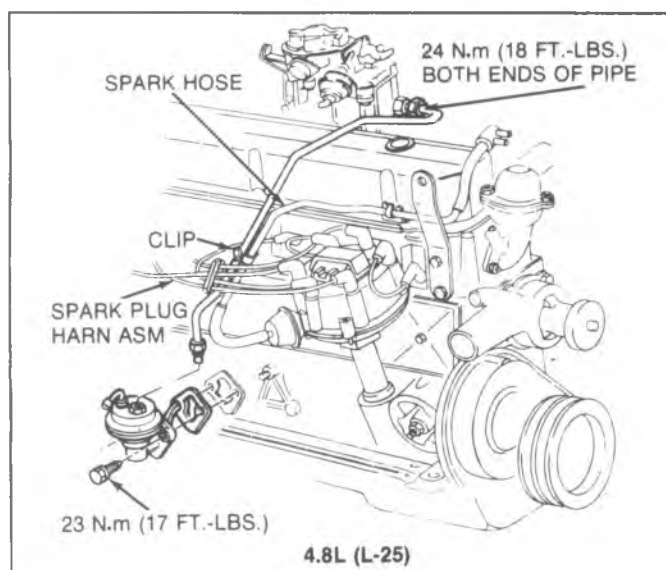


Fig. 6C5-2--Fuel Pump--4.3 L

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 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.
2. Disconnect fuel outlet pipe.
3. Remove two bolts holding fuel pump.
4. Remove fuel pump, push rod, gasket and mounting plate (if used).

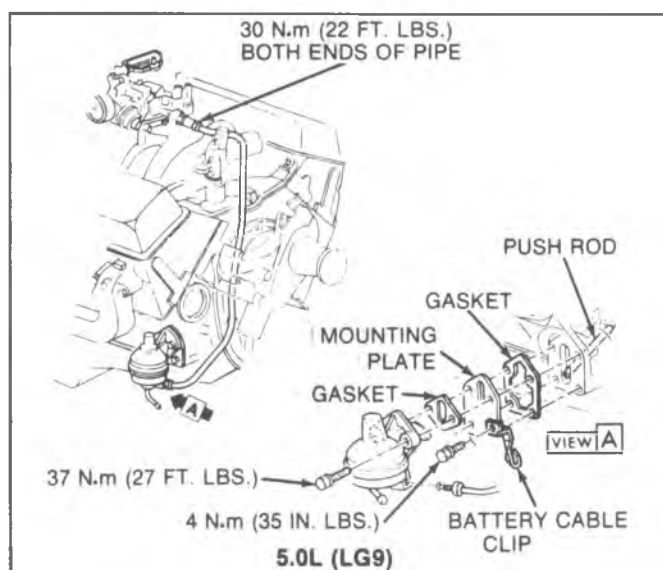


Fig. 6C5-3--Fuel Pump--5.0 L

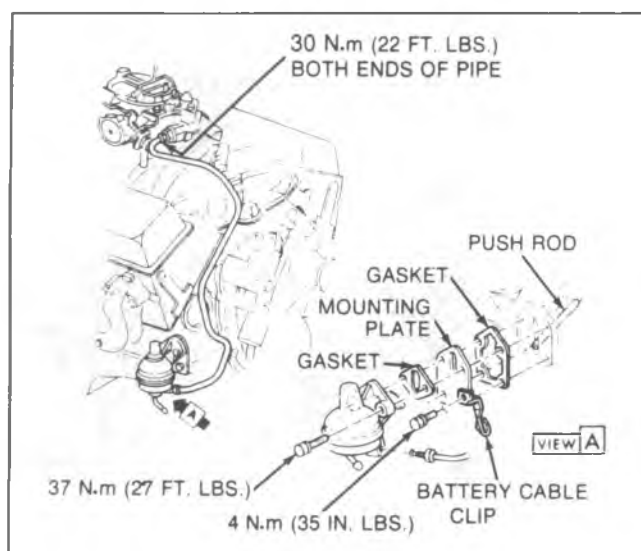


Fig. 6C5-4--Fuel Pump--5.7 L

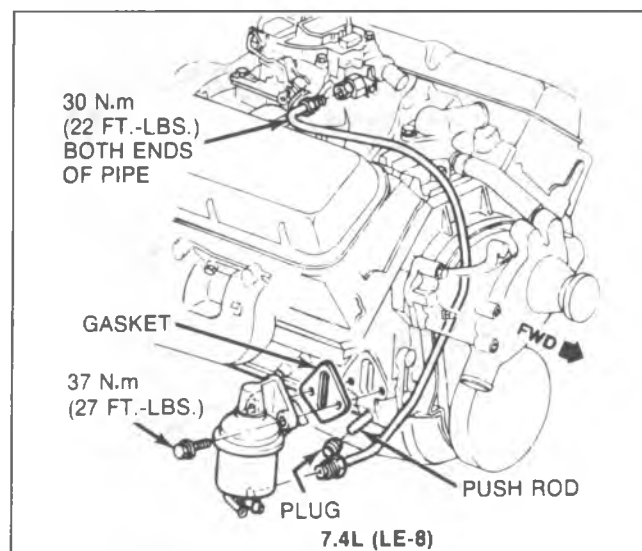


Fig. 6C5-5--Fuel Pump--7.4 L

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

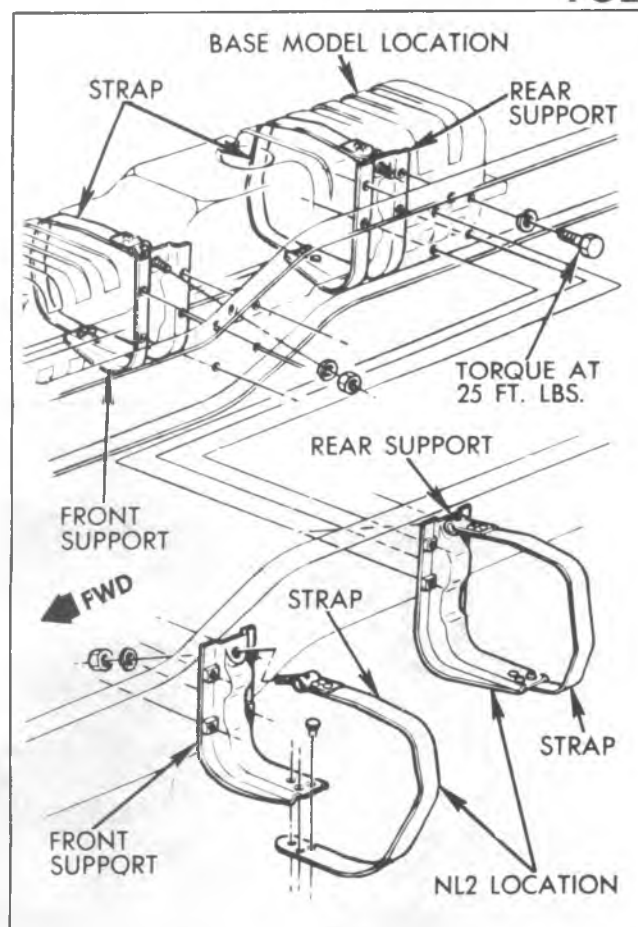


Fig. 6C5-6--Fuel Tank Mounting--Cab and Crewcab

ON-VEHICLE SERVICE

Outside Frame Rail Fuel Tank-

Cab and Crewcab (Figs. 6C5-6 and 8)

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. 6C5-8 and 6C5-9).
7. Remove meter assembly from fuel tank using Tool J-24187 (Fig. 6C5-10).
8. Reverse removal procedure to install fuel tank.

Center and Auxiliary Fuel Tank

CK 10 and 20 (06, 16) (Figs. 6C5-11, 12) G Van (Fig. 6C5-13).

1. Drain tank.
2. Raise vehicle on hoist.
3. Unclamp upper filler neck and vent tube hose (Fig. 6C5-8 and 9).
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.

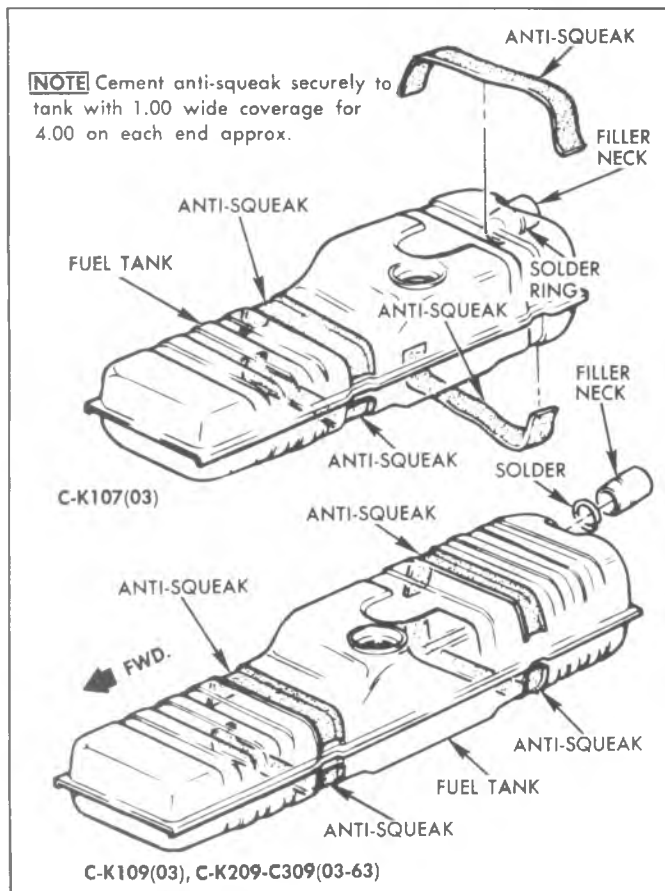


Fig. 6C5-7--Fuel Tank-Cab and Crewcab

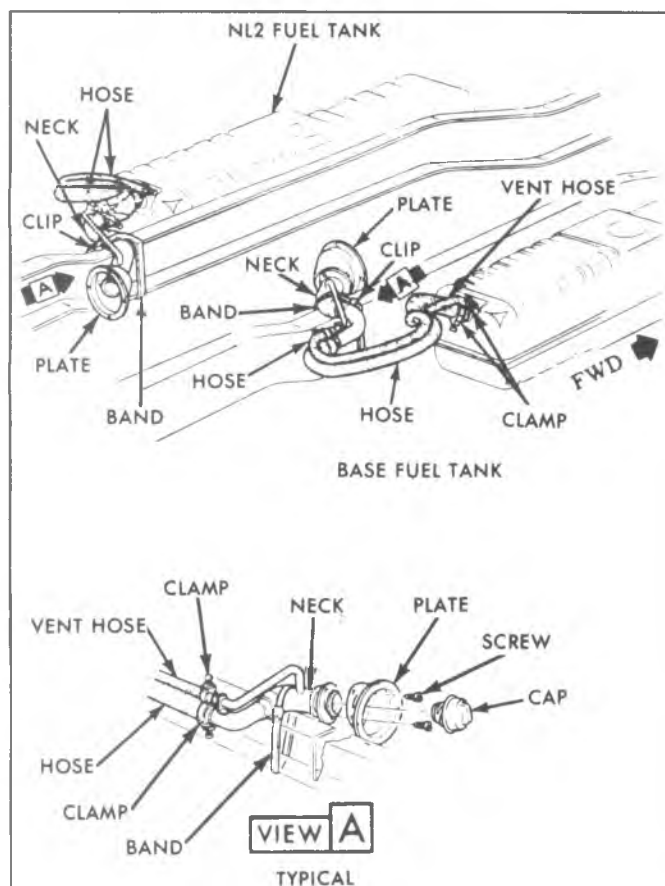


Fig. 6C5-8--Fuel Tank Filler Neck (03 & 43)

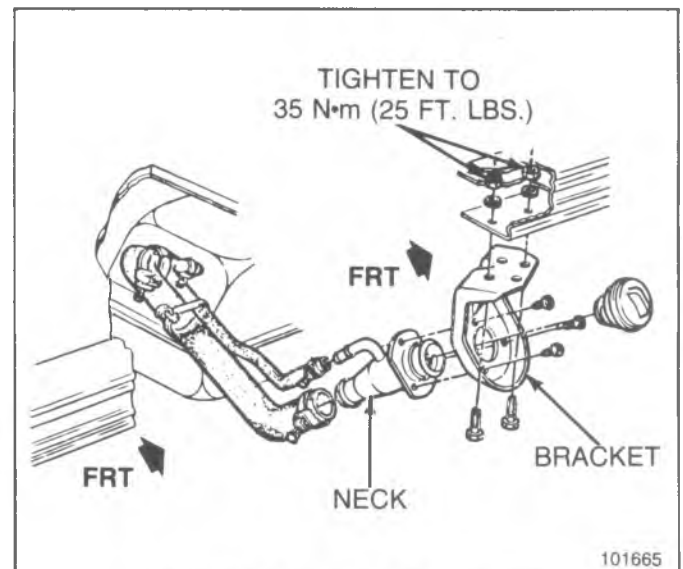


Fig. 6C5-9--Filler Neck-Cab Stake Body

8. Install in the reverse order, using new antisqueak material.
9. Lower vehicle and remove from hoist.

Frame Mounted Fuel Tank - P Model (Figs. 6C5-15 and 16)

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.
7. Install in reverse order and replace antisqueak material.



Fig. 6C5-10--Removing Meter Assembly

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.
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.

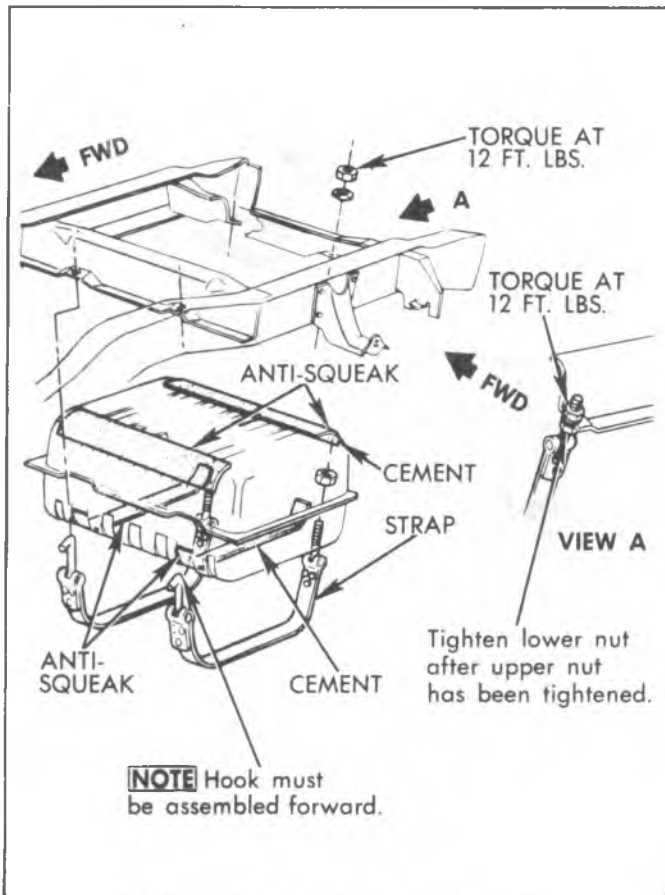


Fig. 6C5-11--Fuel Tank, CK 10-20 (06, 16)

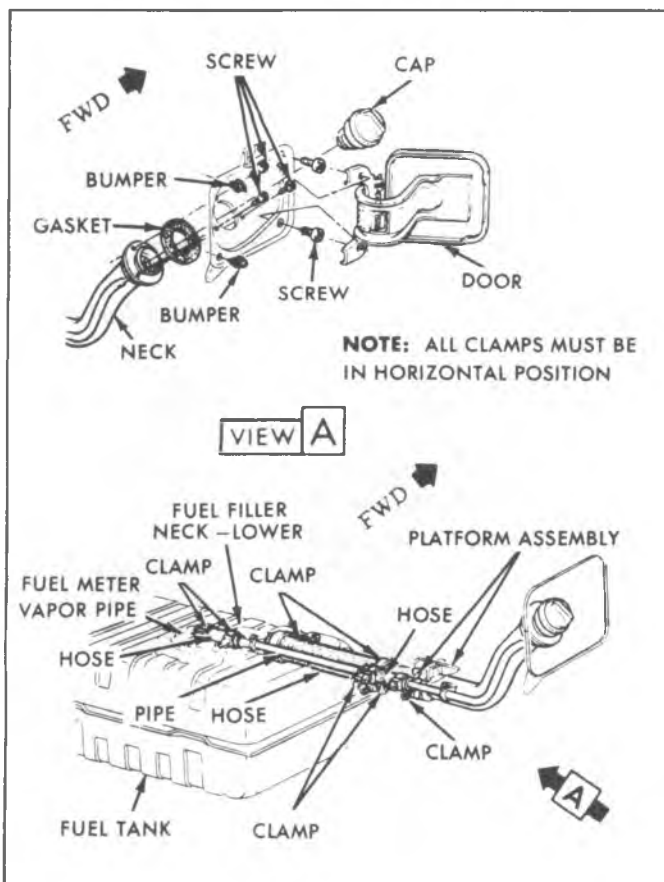


Fig. 6C5-12--Fuel Tank, CK 10-20 (06, 16)

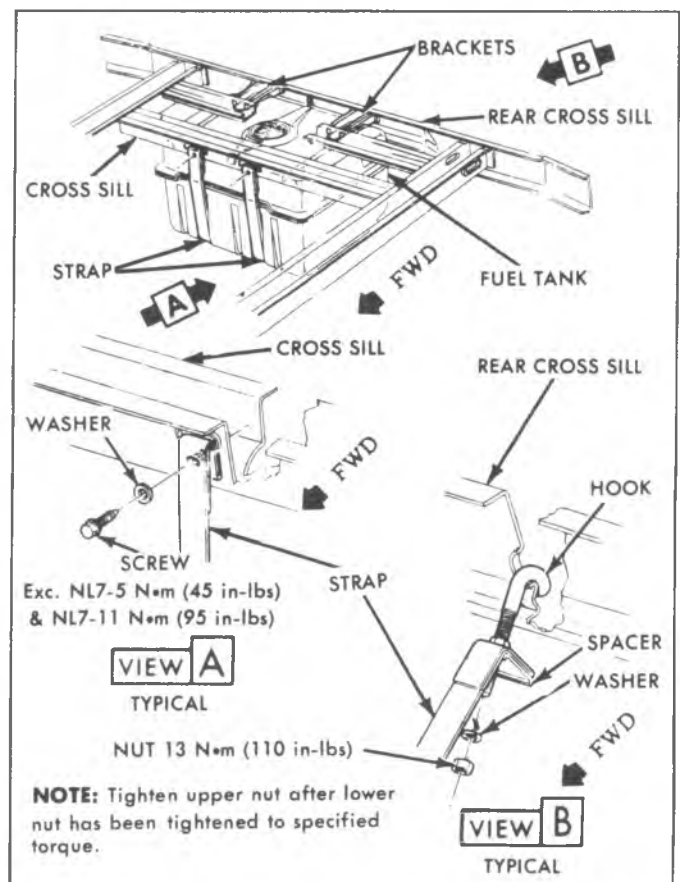


Fig. 6C5-13--Fuel Tank Installation G Van

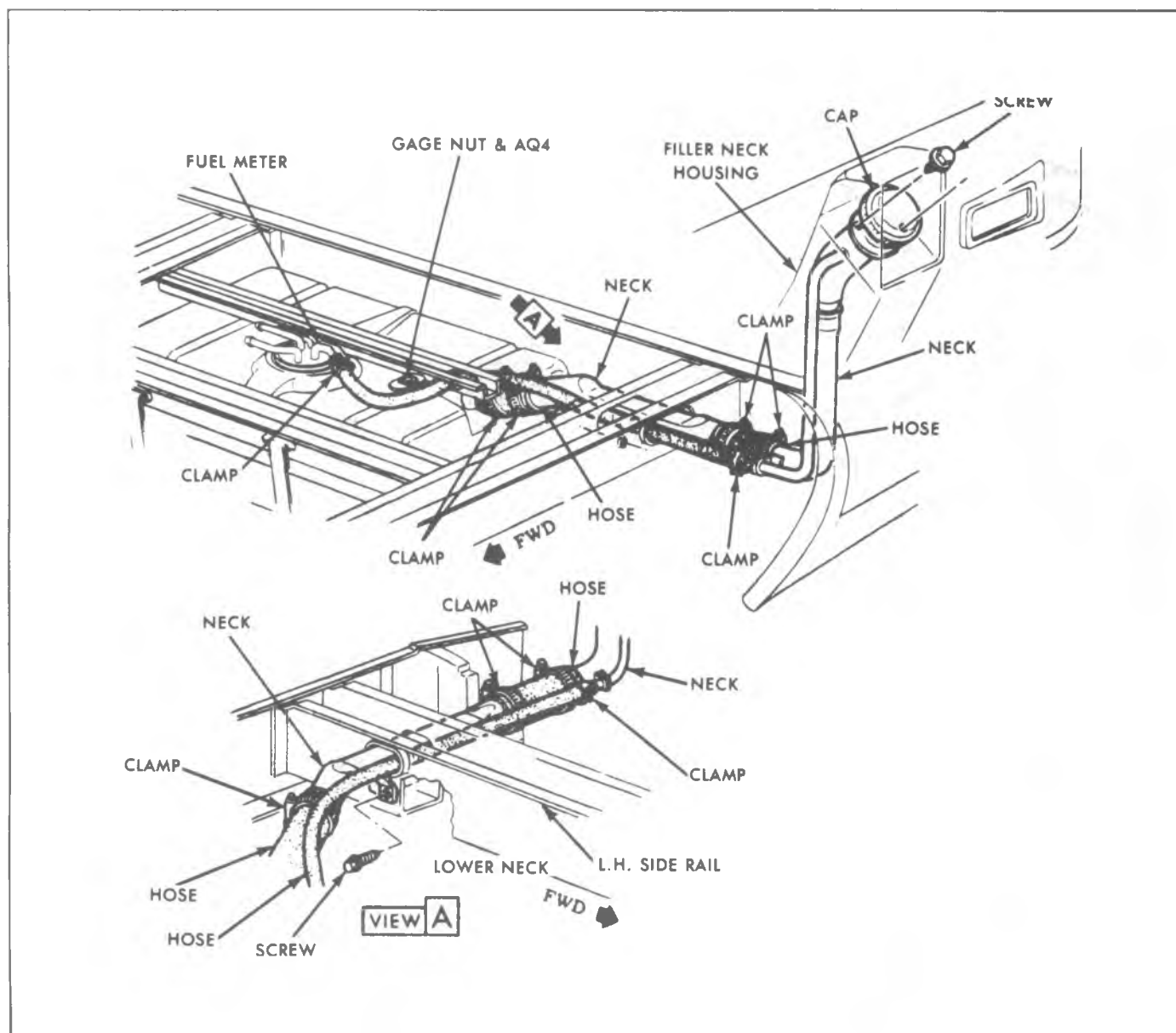


Fig. 6C5-14--Fuel Tank and Filler Neck G Van

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.

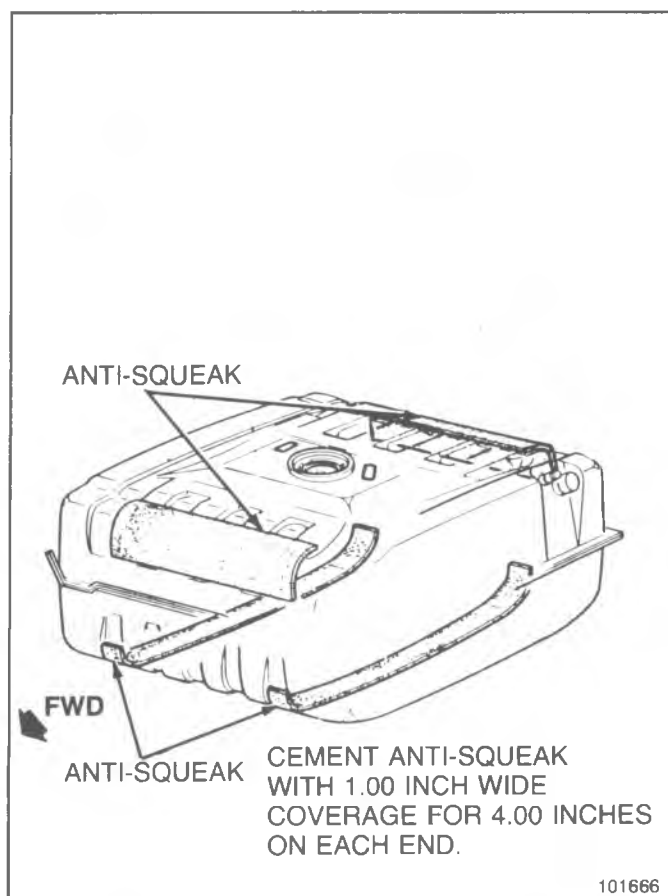


Fig. 6C5-15--Fuel Tank - P Model

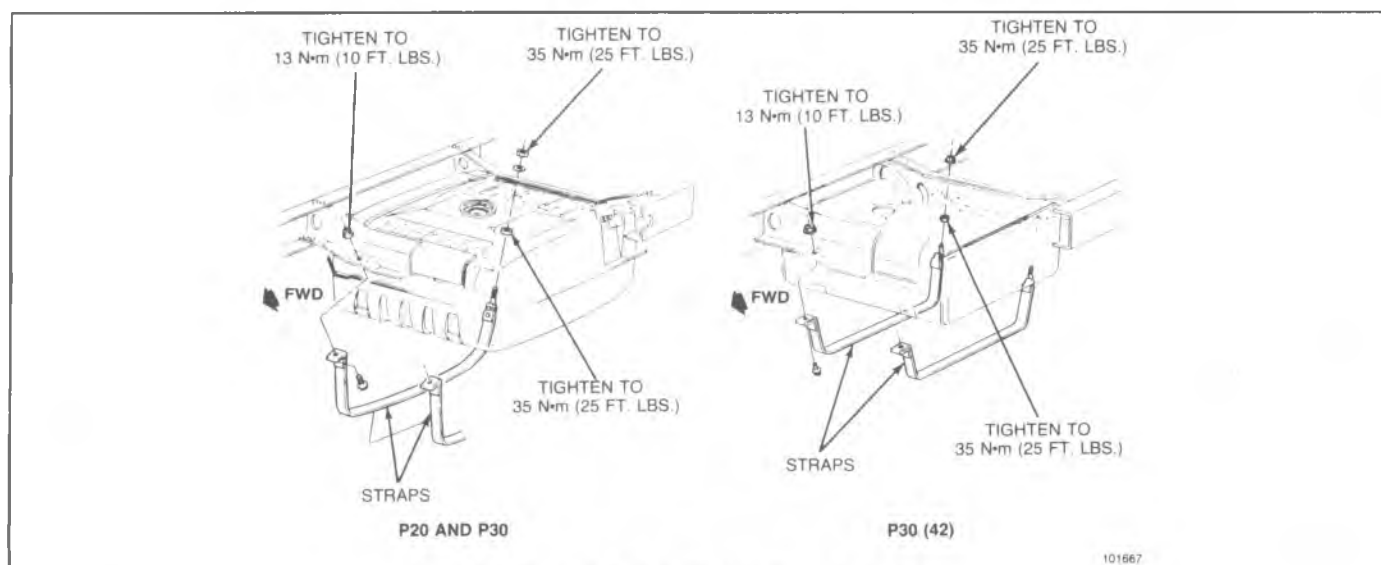


Fig. 6C5-16--Fuel Tank Mounting - P Model

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

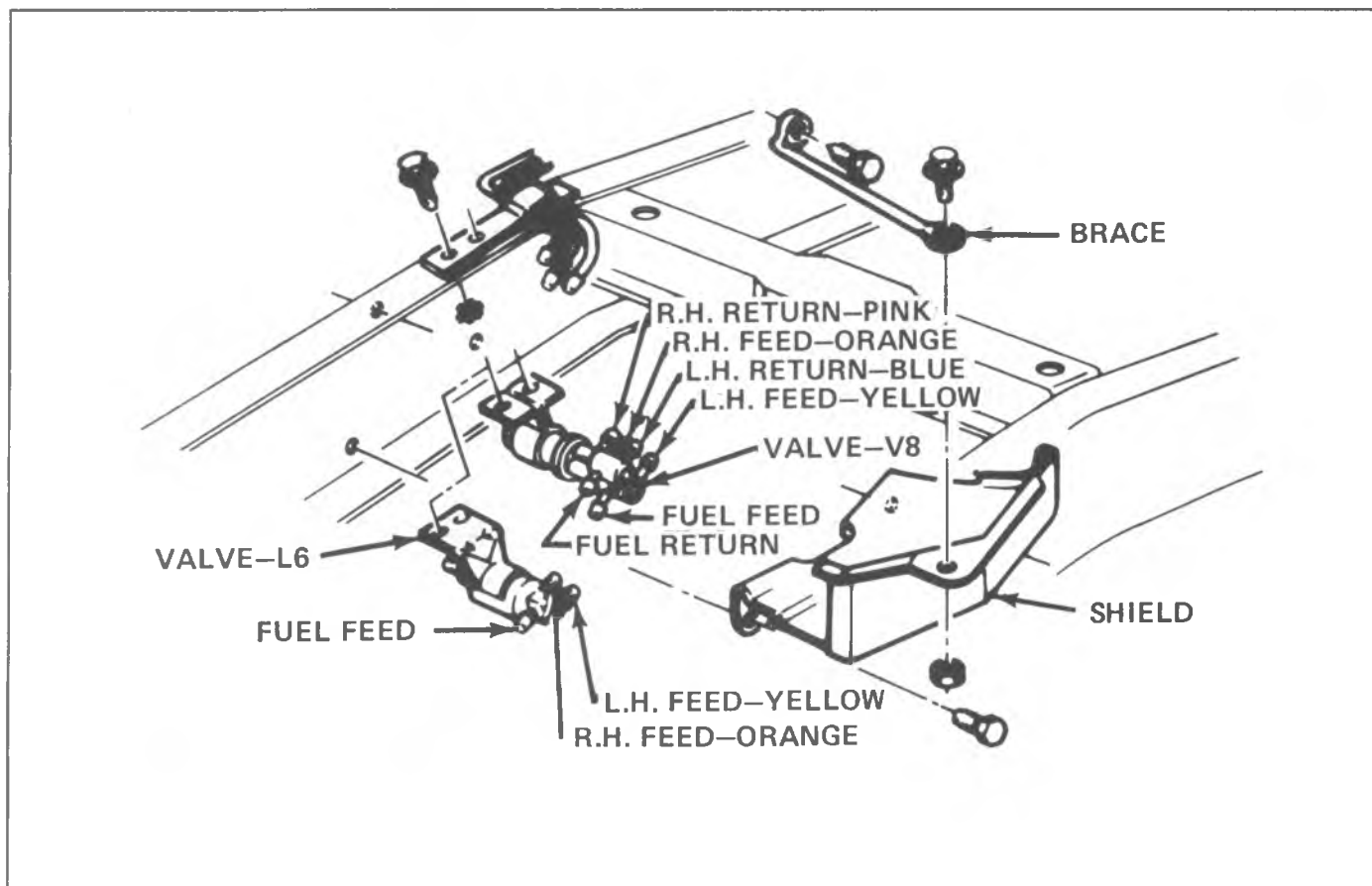


Fig. 6C5-17--Selector Valve

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 or 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" H₂O 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 dual tank units) and blow on vent line to check for obstructions. (Install LH cap on dual tank units and remove RH cap. Repeat above.)

Fuel Tank Selector Valve

Replacement (Fig. 6C5-17)

1. Disconnect battery.
2. Remove hose shield and brace.
3. Remove fuel and vapor hoses noting their position for later installation.
4. Remove two screws holding valve to frame and remove valve.
5. Install valve and tighten screws.
6. Install fuel and vapor hoses in same positions noted at removal.
7. Install brace and hose shield.
8. Connect battery.

ACCELERATOR CONTROLS

GENERAL

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.

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 6C5-18 through 6C5-21 for removal and installation of accelerator control cable.

ACCELERATOR PEDAL

Refer to figures 6C5-22 through 25 for removal and installation of accelerator pedal.

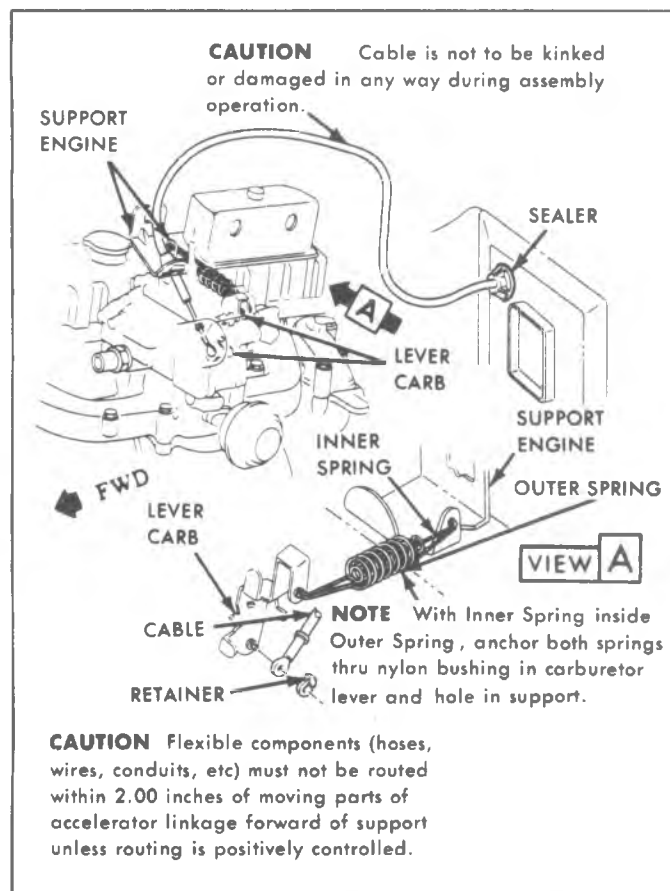


Fig. 6C5-18--Accelerator Controls L6-Light Duty Emissions

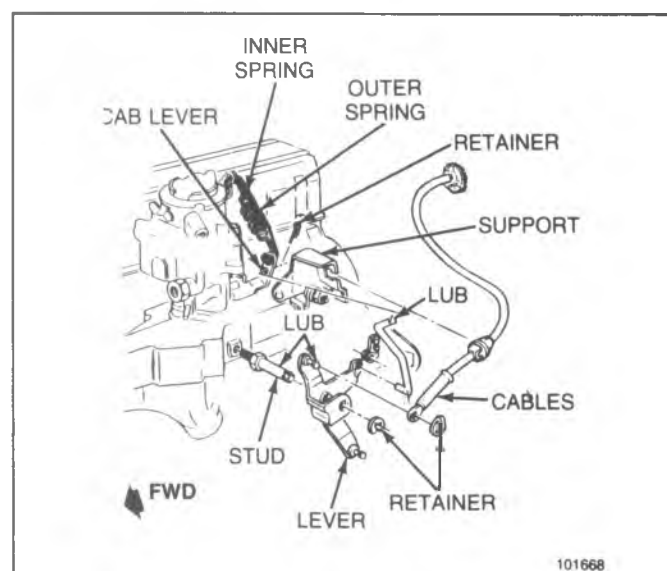


Fig. 6C5-19--Accelerator Controls L6-Heavy Duty Emissions.

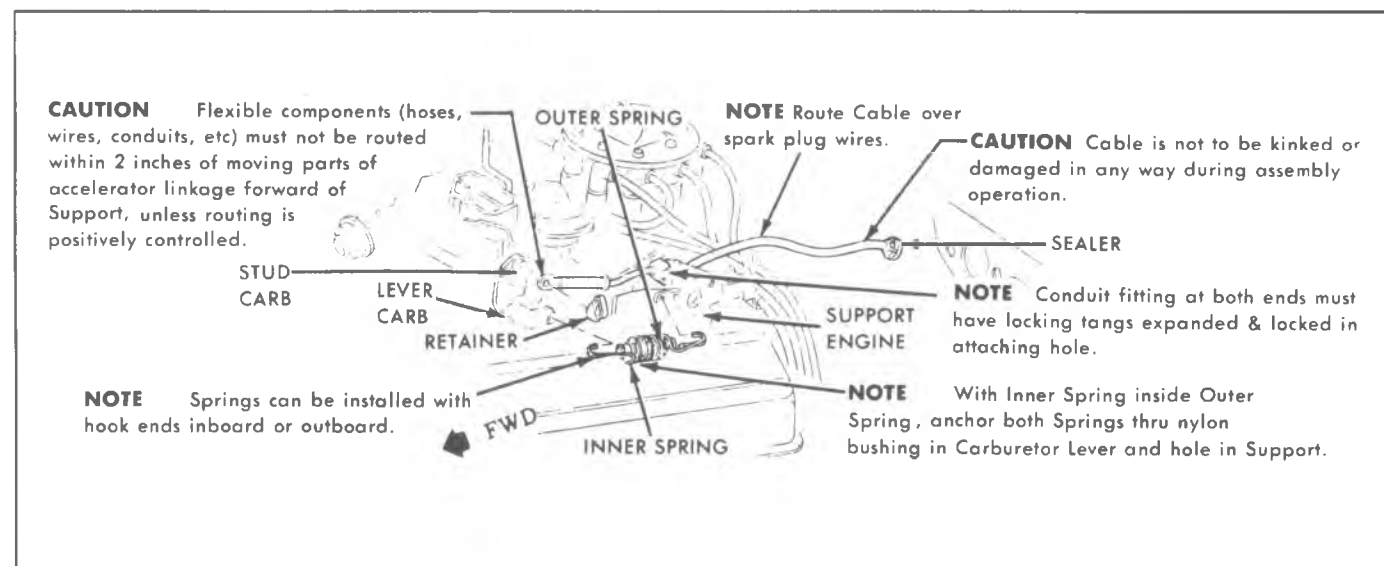


Fig. 6C5-20--Accelerator Controls V8-2Bbl.

CAUTION Flexible components (hoses, wires, conduits, etc.), must not be routed within 2 inches of moving parts of accelerator linkage forward of Support unless routing is positively controlled.

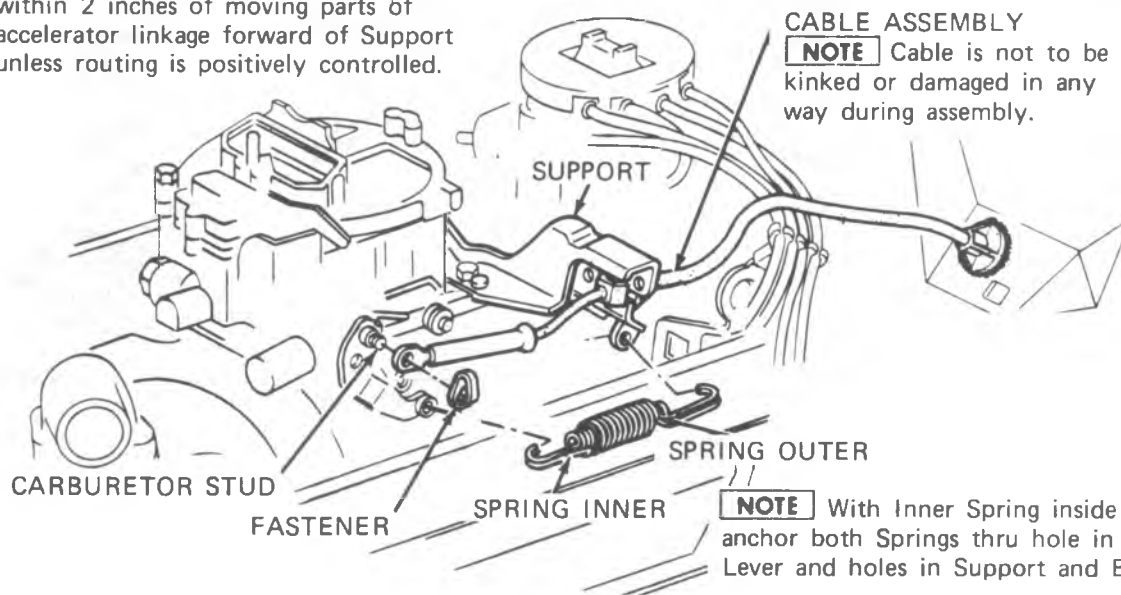
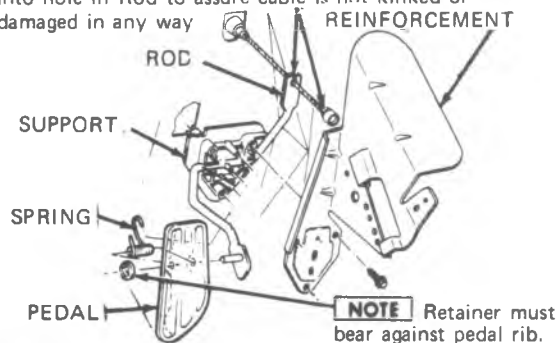


Fig. 6C5-21--Accelerator Controls V8-4Bbl.

NOTE Slip accelerator control cable thru slot in Rod. Install retainer, being sure it is seated.

CAUTION Care must be used in pressing the retainer into hole in Rod to assure cable is not kinked or damaged in any way



NOTE Having secured all components of the accelerator linkage as specified, linkage must operate freely without bind between full closed throttle and full wide open throttle.

Fig. 6C5-22--Accelerator Pedal-CK

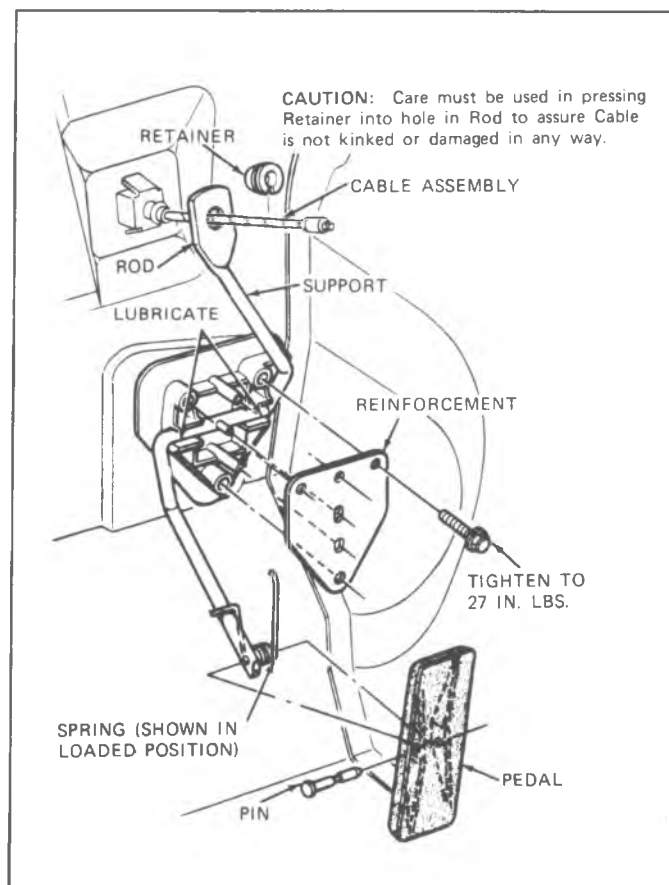


Fig. 6C5-23--Accelerator Pedal-G

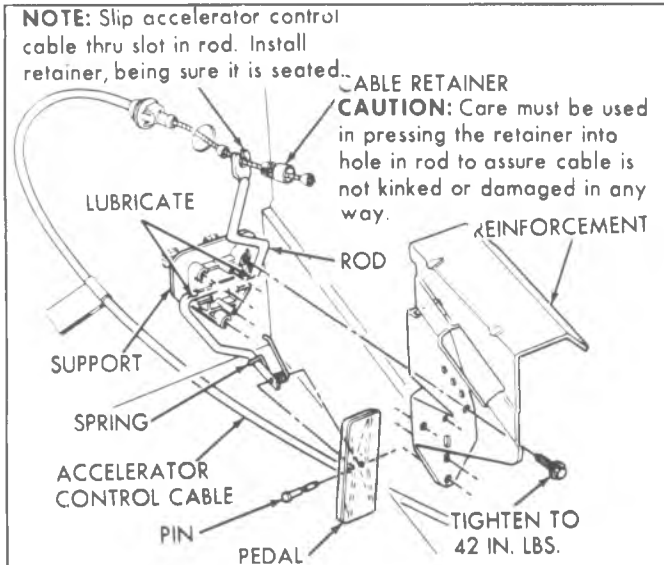


Fig. 6C5-24--Accelerator Pedal-P42

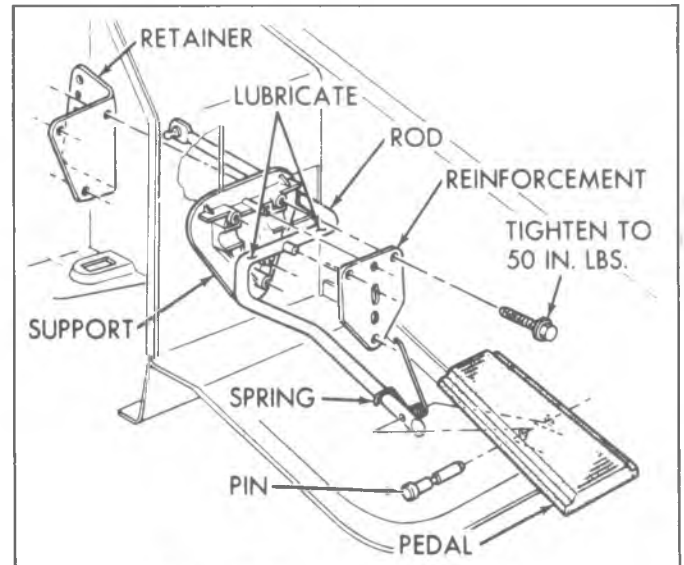


Fig. 6C5-25--Accelerator Pedal-P32

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 CHOKE HOUSING ATTACHING CHOKE HOUSING COVER	14 46 26
AIR HORN AIR HORN TO BOWL 10-32 AIR HORN TO BOWL 8-32 AIR HORN TO THROTTLE BODY CHOKE LEVER VACUUM BREAK UNIT FUEL INLET NUT NEEDLE SEAT METERING JET SOLENOID BRACKET	46 26 46 14 26 400 45 40 71

Fig. 6C5-26--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. 6C5-27--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
Hand Vacuum Device.....	J-23738
Thermac Thermometer.....	J-22973
Carburetor Gage Set.....	J-9789-C
Fuel Tank Sending Unit Remover.....	J-24187

SECTION 6C6

DIESEL FUEL INJECTION

CONTENTS

General Description	6C6-1	Injection Pump Fuel Lines.....	6C6-4
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Primary Fuel Filter Drain.....	6C6-2	Injection Pump	6C6-5
Idle Speed Setting	6C6-2	Checking Or Adjusting Timing	6C6-7
T.P.S. Adjustment.....	6C6-2	Injection Nozzle	6C6-7
Vacuum Regulator Valve Adjustment	6C6-2	Injection Pump On Car Service.....	6C6-8
Secondary Fuel Filter.....	6C6-4	Injection Pump Off Car Service	6C6-12
Housing Pressure Cold Advance.....	6C6-4	Pressure Test.....	6C6-13

GENERAL DESCRIPTION

FUEL SYSTEM

The 6.2 liter diesel engine fuel system is composed of:

- Fuel tank with water sensor and screen filter.
- Primary Fuel Filter.
- Mechanical fuel pump.
- Secondary Fuel filter.
- Fuel line heater.
- Injection distributor pump.
- High pressure lines.
- Fuel injection nozzles.

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 pulled through the primary filter, by the Mechanical pump. Fuel is then pumped through the secondary filter mounted on the inlet manifold. Both filters remove 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.

The fuel tank is equipped with a filter which screens out the water and lets it lay in the bottom of the tank below the fuel pickup. When the water level reaches a point

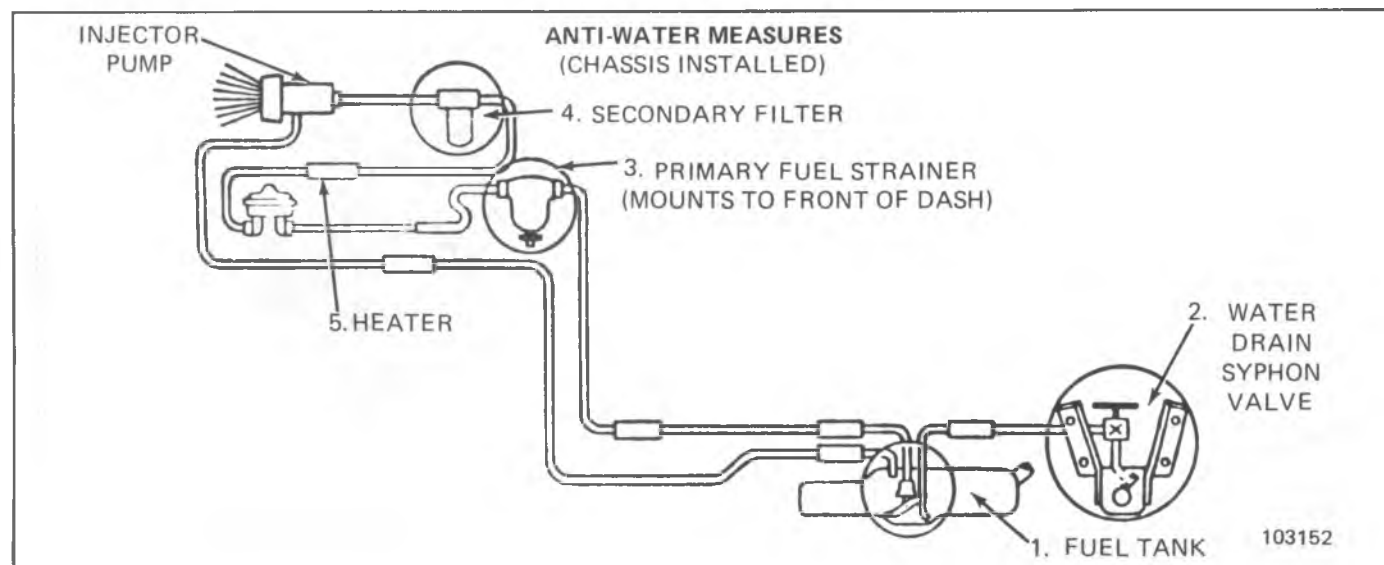


Fig. 6C6-1--Water In Fuel

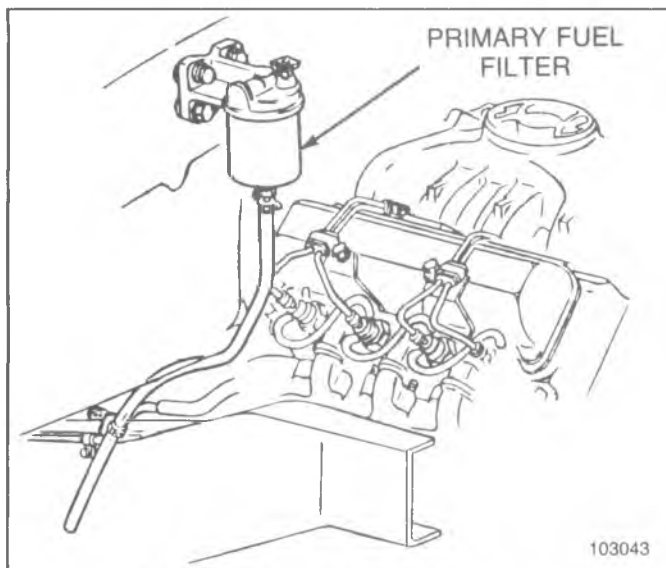


Fig. 6C6-2--Primary Filter Water Drain

where it could be drawn into the system, a warning light flashes in the cab. A siphoning system starting at the tank and going to the rear spring hanger on some models and at the midway point of the right frame rail on other models permits the user to attach a hose at the shut-off and siphon out the water.

A primary filter is located on the front of dash and it also has water draining provisions.

A secondary in line fuel filter is the final filter before fuel enters the injection pump.

PRIMARY FUEL FILTER-WATER DRAIN (Fig. 6C6-2)

If it should become necessary to drain water from the fuel tank, also check the primary fuel filter for water. This can be done as follows:

1. Open the petcock on the top of the primary filter housing.
2. Place a drain pan below the filter and open the petcock on the bottom of the drain assembly. (A length of hose is attached to the petcock to direct drained fluid below the frame.)
3. When all water is drained from the filter, close the petcock lightly.

NOTICE: If filter is completely drained, remove filter and refill with clean diesel fuel to prevent engine stalling.

4. Close upper petcock tightly.
5. Start the engine and let it run briefly. The engine may run roughly for a short time until the air is purged from the system.
6. If engine continues to run roughly, check that both petcocks at the primary filter are closed tightly.

IDLE SPEED SETTING PROCEDURE (Fig. 6C6-3)

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. 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 550 RPM in drive for automatic transmission and 575 RPM in neutral 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 700 RPM in neutral.
 - d. Remove jumper wire and reinstall connector to fast idle solenoid.
7. Remove tachometer.

THROTTLE POSITION SWITCH ADJUSTMENT (Fig. 6C6-4)

TRANSMISSION VACUUM REGULATOR VALVE ADJUSTMENT

1. Attach the vacuum regulator valve snugly, but loosely to the fuel injection pump. The switch body must be free to rotate on the pump.
2. Attach vacuum source of 67 ± 5 kpa ($9.7 \pm .7$ psi) to inboard vacuum nipple. Attach vacuum gage to outboard vacuum nipple.
3. Insert vacuum regulator valve gage bar between the gage boss on the injection pump and the wide open stop screw on the throttle lever.
4. Rotate and hold the throttle shaft against the gage bar.
5. Slowly rotate the vacuum regulator valve body clockwise (facing valve) until vacuum gage reads 39 ± 2 kpa ($5.6 \pm .3$ psi). Hold valve body at this

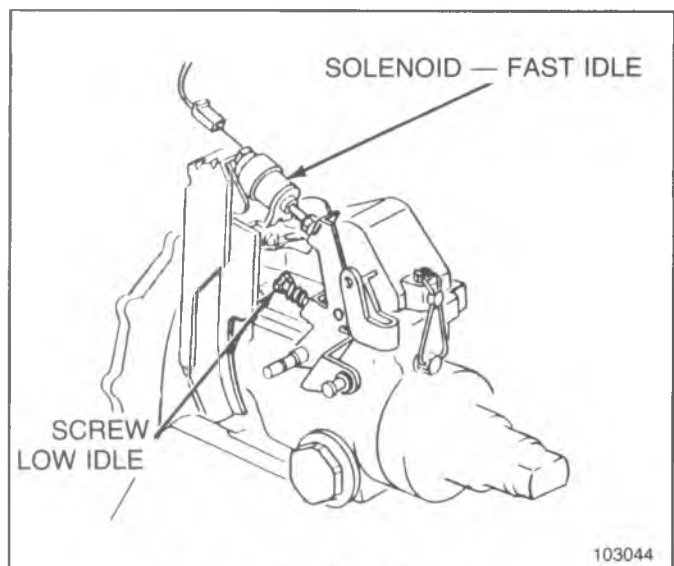
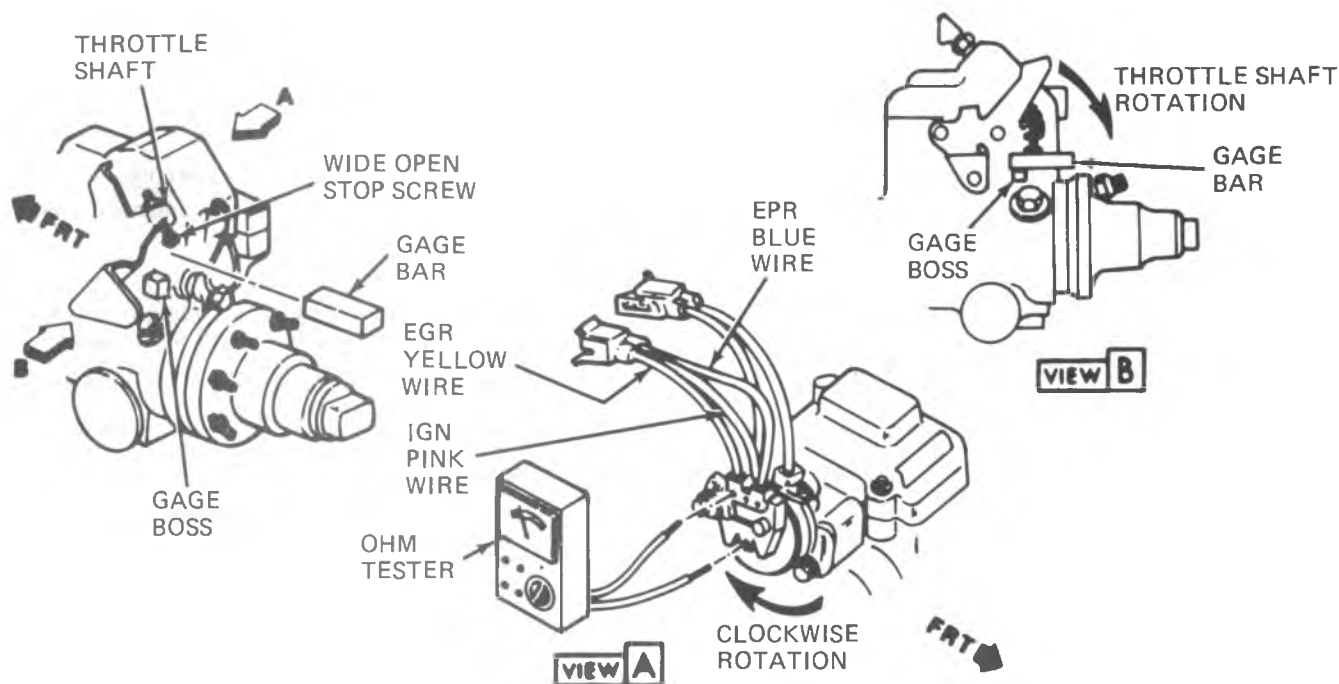


Fig. 6C6-3--Idle Speed Adjustments



1. Loosen 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 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 just occurs (high meter reading) across the IGN and EGR terminals or wires. Hold switch body at this position and tighten mounting screws to specified torque.

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 0) 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. 6C6-4--Throttle Position Switch Adjustment

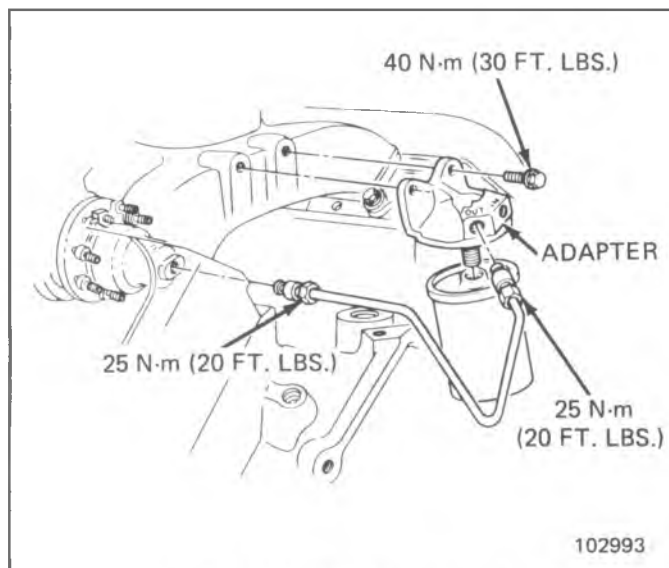


Fig. 6C6-5--Secondary Fuel Filter

position and tighten mounting screws.

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 against the gage bar to determine if vacuum gage reads within 39 ± 2 kpa ($5.6 \pm .3$ psi). If vacuum is outside limits, reset valve.

SECONDARY FUEL FILTER (Fig. 6C6-5)

Removal

1. Remove fuel filter lines from adapter.
2. Remove fuel filter adapter from intake.
3. Remove filter.

Installation

Anytime either of the fuel filters are removed or replaced, refill with clean diesel fuel to prevent engine stalling after start up, and to avoid very long engine cranking time.

1. Install filter to adapter.
2. Install adapter to intake manifold.
3. Install fuel filter lines.

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 115°F . Below the switching point, housing pressure is decreased from 10 psi to zero which advances the timing 4° . Above 115°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 95°F .

Purpose:

1. Emission Control device.
2. Better cold starts.
3. Improves idle and noise when cold.

When changing the fuel filter or when the car 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. 6C6-6 and 6C6-7)

When lines are to be removed, clean all line fittings thoroughly before loosening. Immediately cap the lines, nozzles and pump fittings to maintain cleanliness.

Removal

1. Disconnect battery.
2. Disconnect air cleaner bracket at valve cover.
3. Remove crankcase ventilator bracket and move aside.
4. Disconnect secondary filter lines.
5. Remove secondary filter adapter.
6. Loosen vacuum pump hold-down clamp and rotate pump in order to gain access to intake manifold bolt.
7. Remove intake manifold bolts. Injection line clips are retained by the same bolts.
8. Remove intake manifold.
9. Install protective covers J-29664-1.
10. Remove injection line clips at loom brackets.
11. Remove injection lines at nozzles and cover nozzles with protective caps.
12. Remove injection lines at pump and tag lines for reinstallation.
13. Remove fuel line from injection pump.

Installation

1. Install injection lines as shown in Figures 6C6-6 and 6C6-7.
2. Remove protective covers.
3. Install intake manifold.
4. Install secondary filter and lines.
5. Tighten vacuum pump holddown clamp.
6. Install crankcase ventilator.
7. Connect air cleaner.
8. Connect battery.

FUEL LINE HEATER/FUEL LINE TO PRIMARY FILTER (Fig. 6C6-8)

Removal

1. Disconnect battery.
2. Remove air cleaner.
3. Remove crankcase ventilator bracket from intake and move aside.
4. Disconnect secondary filter fuel lines.
5. Remove secondary filter adapter.
6. Loosen vacuum pump hold-down clamp and rotate pump in order to gain access to manifold bolts.
7. Remove intake manifold bolts.
8. Remove intake manifold.
9. Install protective covers J-29664-1.
10. Remove injection lines (except #5 and #7).
11. Cap injection lines, nozzles and pump fittings to maintain cleanliness.
12. Disconnect fuel line at fuel pump.

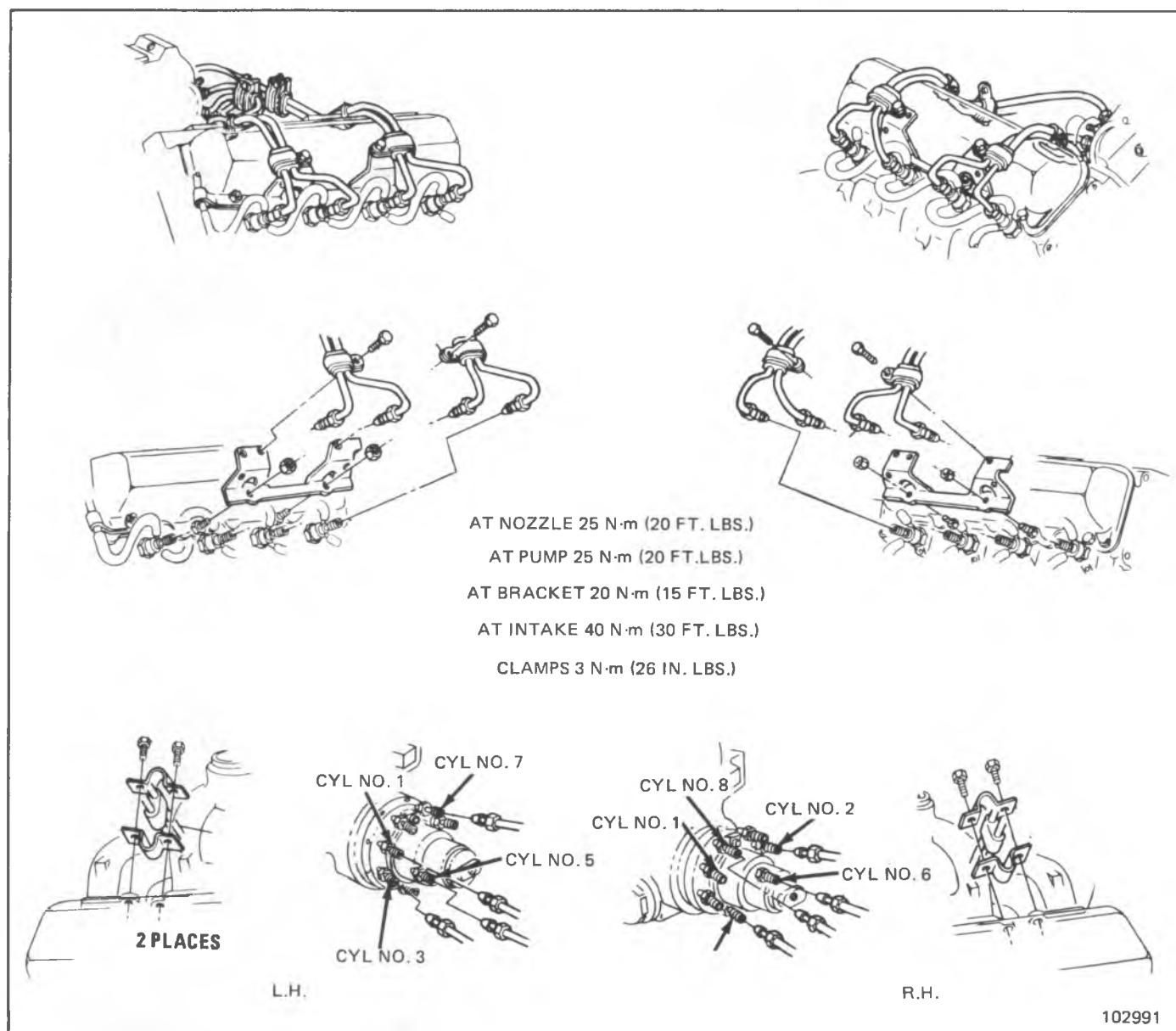


Fig. 6C6-6--Fuel Injection Lines

13. Disconnect fuel line clip.
 14. Disconnect wire connector.
 15. Remove fuel line heater/fuel line to primary filter.
- For installation procedures, reverse removal.

INJECTION PUMP

Removal

1. Disconnect battery.
2. Remove fan.
3. Remove fan shroud.
4. Remove intake manifold as described in Section 6A7.
5. Remove fuel lines as previously outlined.
6. Disconnect accelerator cable at injection pump, and detent cable where applicable (Fig. 6C6-10).
7. Disconnect necessary wires and hoses at injection pump.
8. Disconnect fuel return line.
9. Disconnect fuel line at pump.
10. Remove A/C hose retainer bracket if equipped with A/C.
11. Remove oil fill tube, includes PCV vent hose assembly.
12. Scribe or paint a mark on front cover and align, alignment mark on pump and front cover.
13. It will be necessary to rotate engine in order to gain access to injection pump retaining bolts through the oil filler neck hole.
14. Remove injection pump to front cover attaching nuts.
15. 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 gear (Figure 6C6-9 and 6C6-11). At the same time, align timing marks.
3. Attach injection pump to front cover, torque nuts to 40 N·m (30 ft. lbs.).

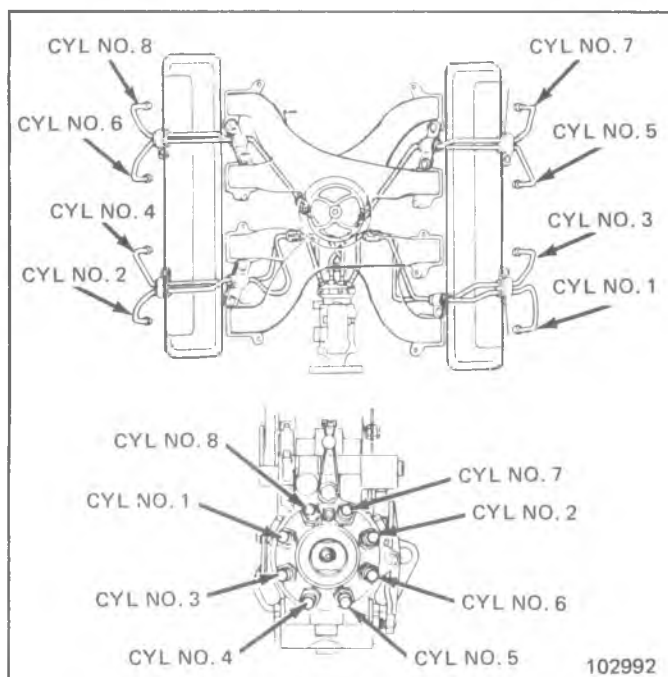


Fig. 6C6-7--Fuel Line Routing

4. Attach pump to drive gear, torque bolts to 25 N·m (20 ft. lbs.).
5. Install oil fill tube, includes PCV vent hose assembly.
6. Install A/C hose retainer bracket if equipped.
7. Install fuel line at pump, torque to 25 N·m (20 ft. lbs.).
8. Install fuel return line.
9. Connect necessary wires and hoses.
10. Connect accelerator cable.
11. Connect injection lines.
12. Install intake manifold.
13. Install fan shroud.
14. Install fan.
15. Connect battery.

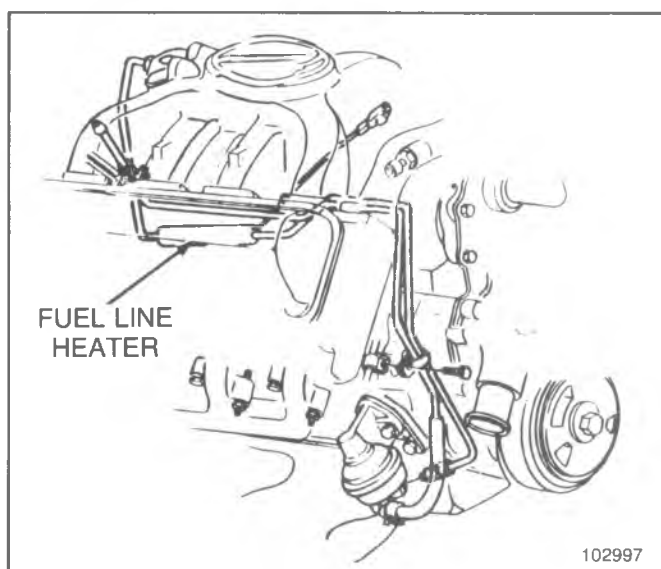


Fig. 6C6-8--Fuel Line Heater / Fuel Line

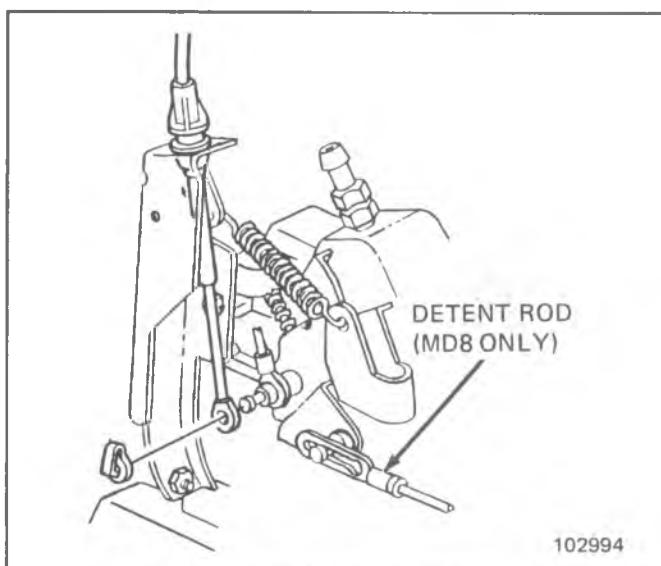


Fig. 6C6-10--Accelerator Linkage

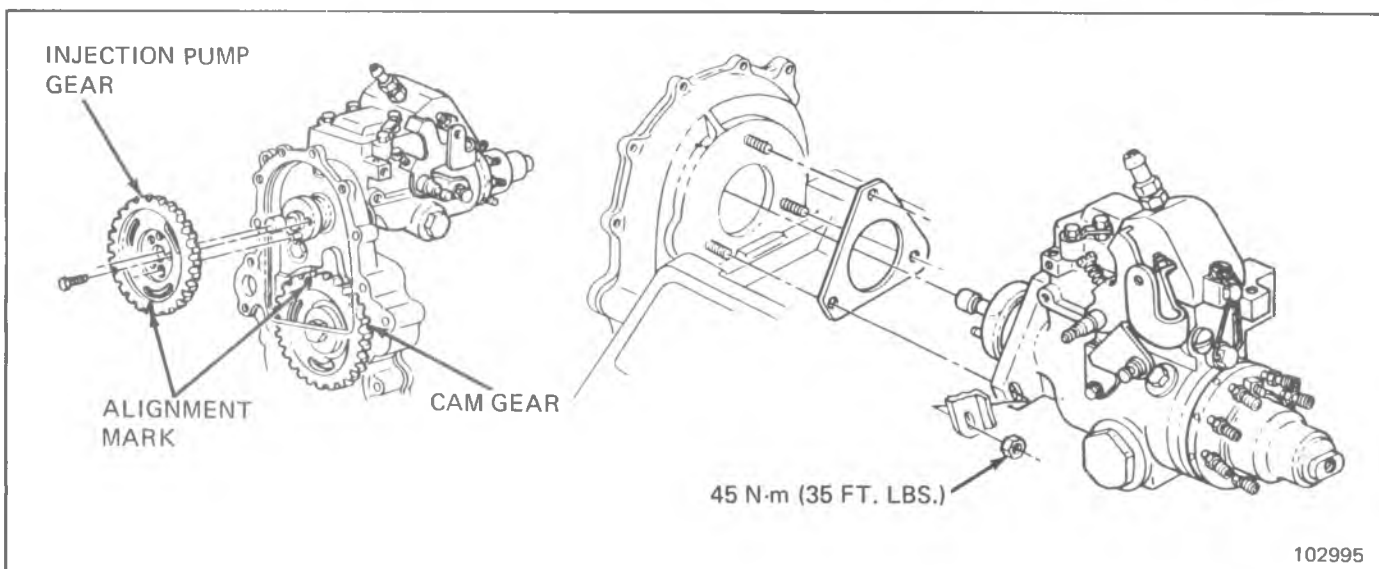


Fig. 6C6-9--Injection Pump Installation

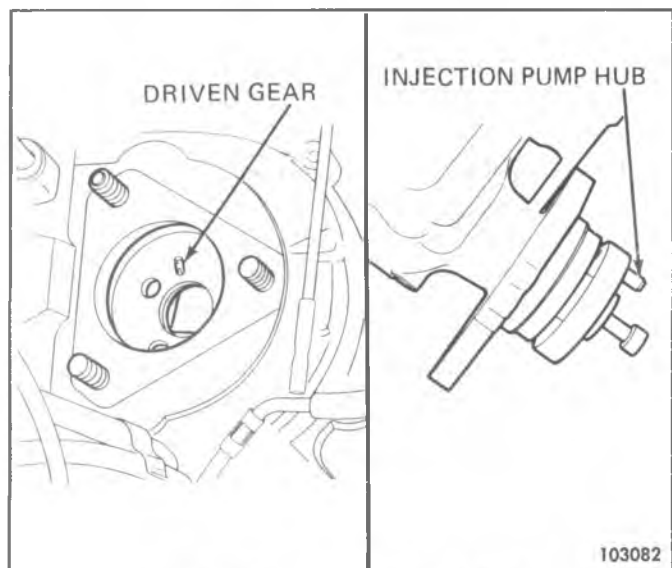


Fig. 6C6-11--Injection Pump Locating Pin

CHECKING OR ADJUSTING TIMING

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.

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.). Use tool J-29872 to aid in rotating the pump to align the marks.
3. Adjust throttle rod.

MARKING TDC ON FRONT HOUSING

1. Set engine to TDC #1 cylinder (firing).
2. Install timing fixture J-33042 in F.I. pump

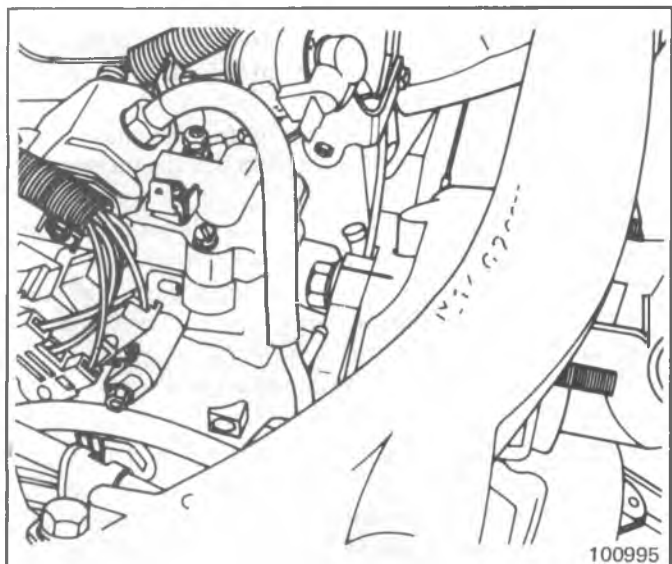


Fig. 6C6-12--Alignment Marks

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 a 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 scribe 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. 6C6-13)

Removal

1. Disconnect battery.
2. Disconnect fuel line clip.
3. Remove fuel return hose.
4. Remove fuel injection line.
5. Remove injection nozzle using tool J-29873 whenever possible.

NOTICE: When removing an injection nozzle, use tool J-29873. Be sure to remove the nozzle using the 30mm hex (Fig. 6C6-13). Failure to do so will result in damage to the injection nozzle. Always cap the nozzle and lines to prevent damage and contamination.

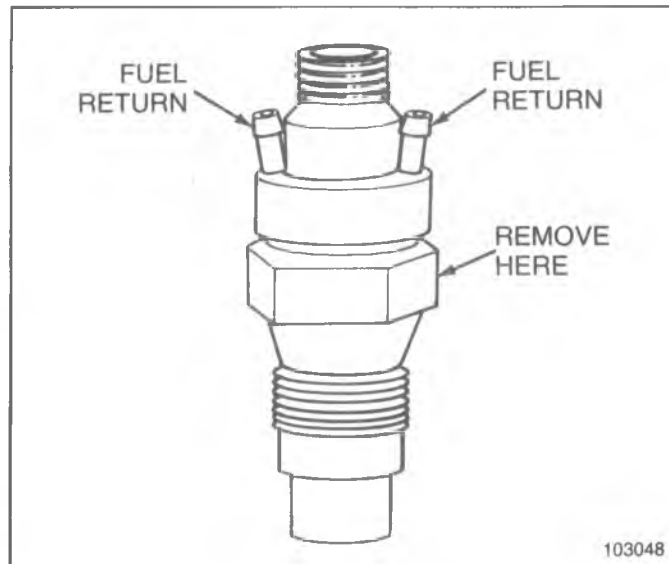


Fig. 6C6-13--Injection Nozzle

Testing

Test is comprised of the following checks:

Nozzle Opening Pressure

Chatter

Leakage

Spray Pattern

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...2.75 mm²/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. Close the shutoff valve to the pressure gage.
3. 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, indicating an increase in pressure (nozzle does not chatter) or at which pressure the pressure dropped substantially (nozzle chatters). The maximum observed pressure is the opening pressure.
3. The opening pressure should not fall below the lower limit of 110 bar (1600 psi).
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. Install two clear plastic lines (approximately 1-1 1/2") over leak-off connections.
4. Depress lever of manual test stand slowly until gage reads a pressure of 95 bar (1380 psi). Observe tip of

nozzle. A drop may form but not drop off within a period of 10 seconds.

5. Replace the nozzle holder assembly if a droplet drops off the nozzle bottom within the 10 seconds.

Chatter Test

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.
4. The chatter indicates 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

1. Close shutoff valve at pressure gage.
2. Depress lever of manual test stand downward abruptly and quickly. The spray should have a tight, evenly shaped conical pattern which is well atomized. This pattern should be concentric to the nozzle axis. Stream-like injections indicate a defect.

Installation (Fig. 6C6-14)

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 CAR 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.

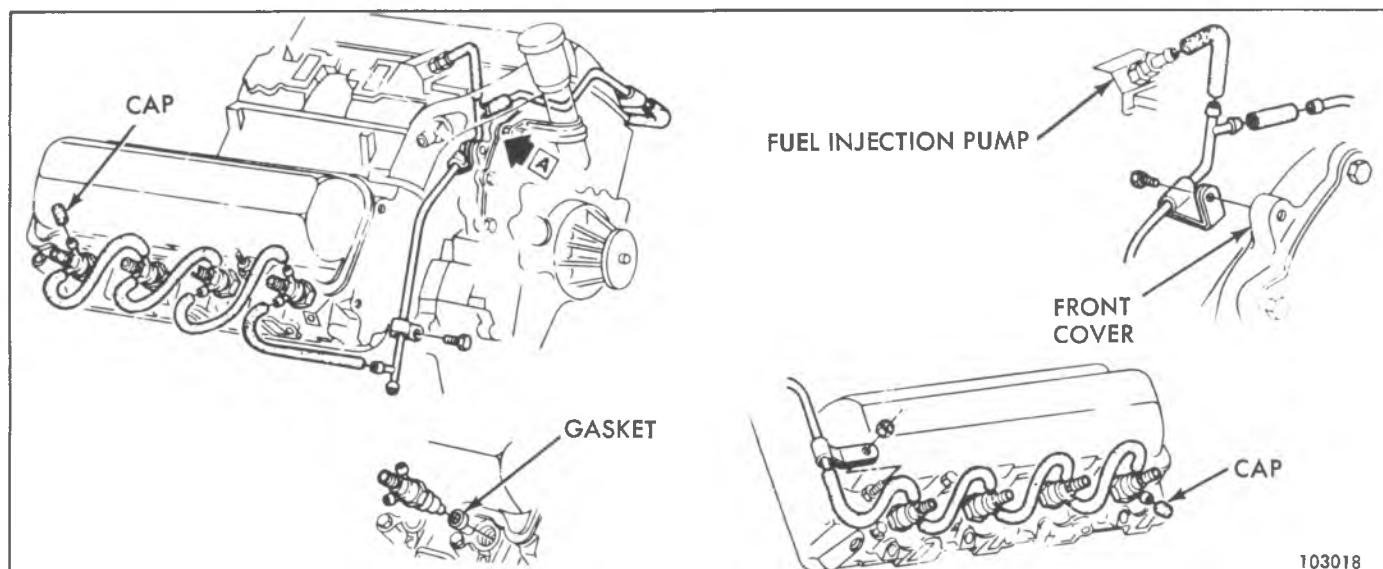


Fig. 6C6-14--Nozzle Installation

7. Observe position of metering valve spring over the top of the guide stud. This position must be exactly duplicated during reassembly (Fig. 6C6-15).
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. 6C6-16).
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 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.
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.

THROTTLE SHAFT SEAL REPLACEMENT

1. Disconnect the negative cables from both batteries.
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 (Fig. 6C-16).
4. Remove the T.P.S. switch or vacuum regulator valve, 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. 6C6-17).
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.

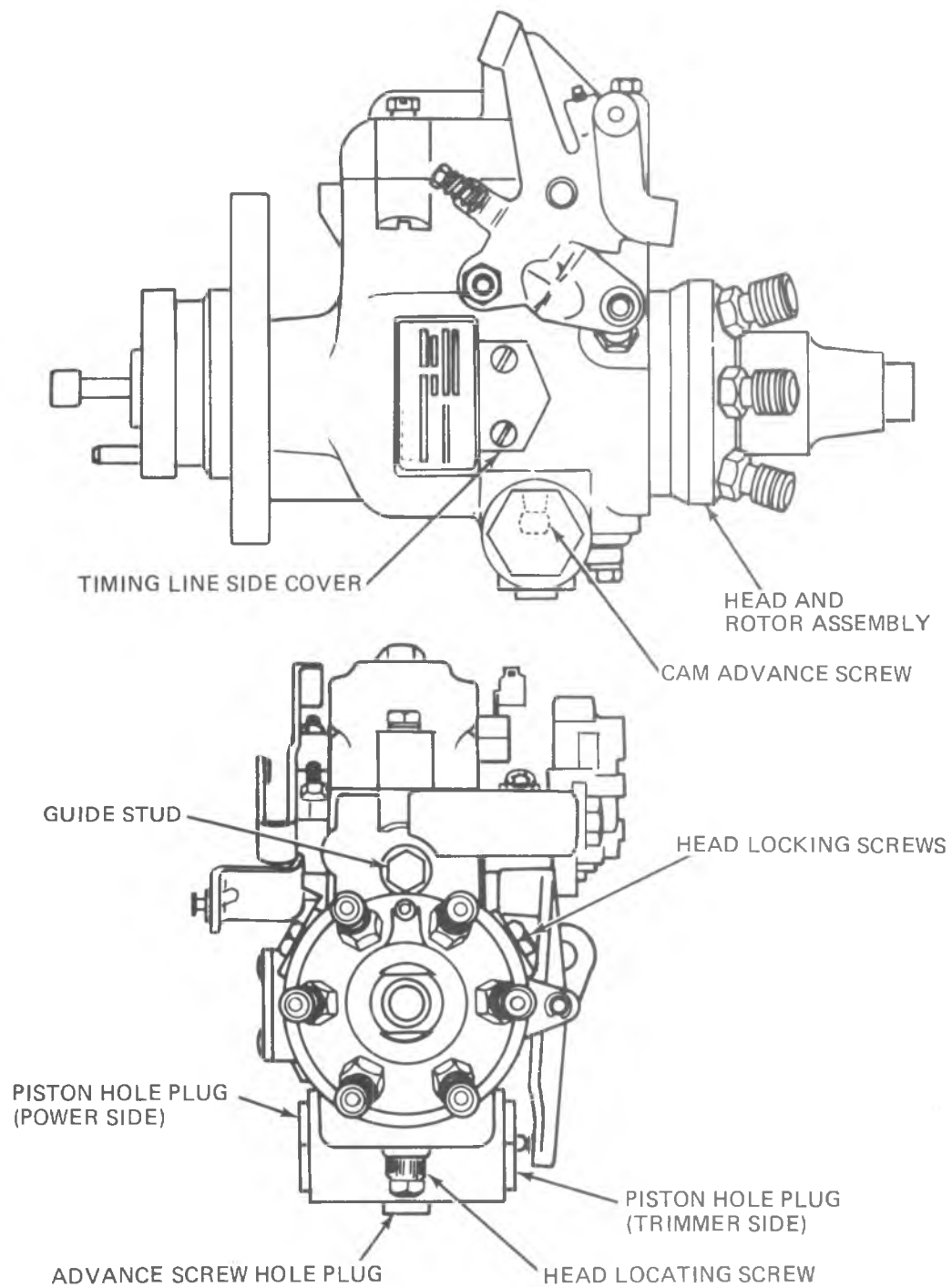


Fig. 6C6-14a--Injection Pump Components Location

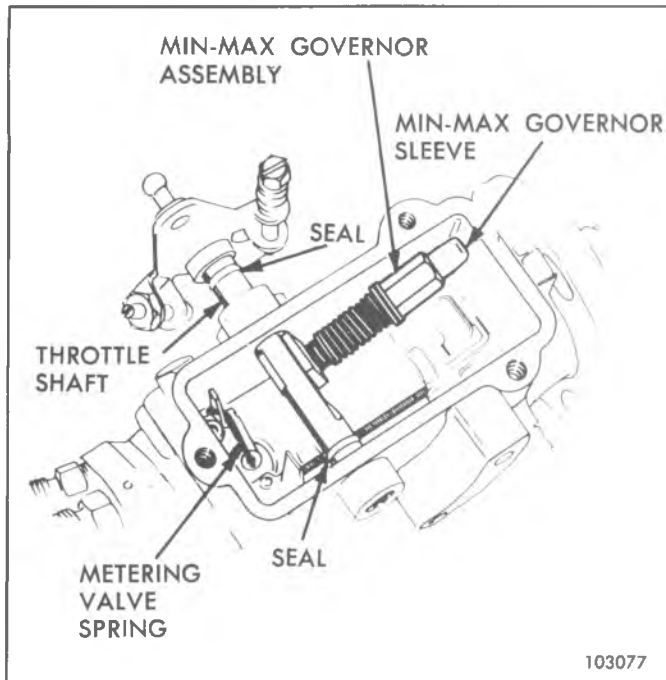


Fig. 6C6-15--Injection Pump Cover Removed

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.
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. 6C6-15). 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

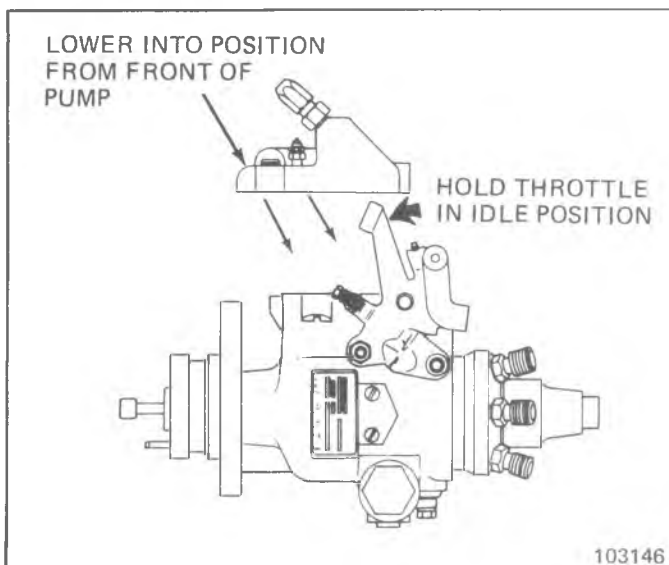


Fig. 6C6-16--Installing Injection Pump Cover

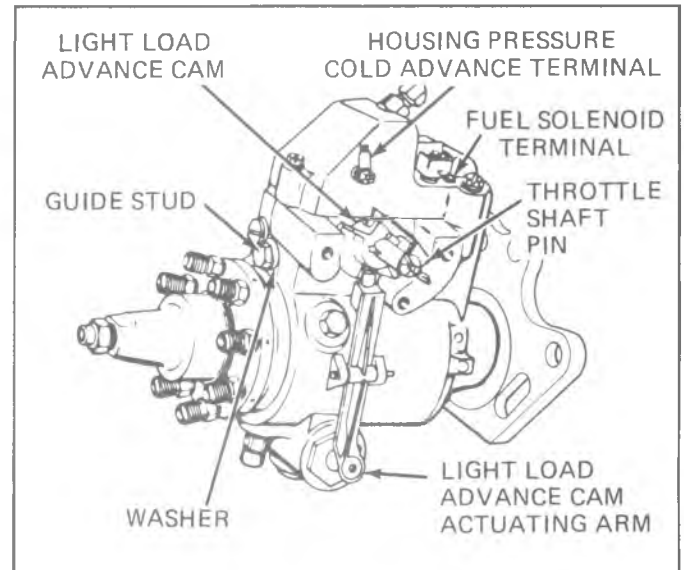


Fig. 6C6-17--Injection Pump Housing Right Side View Typical

housing for any evidence of damage or unusual wear and leaks. Remove the pump and send to the local Roosa Master 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 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. 6C6-15).
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. 6C6-17).

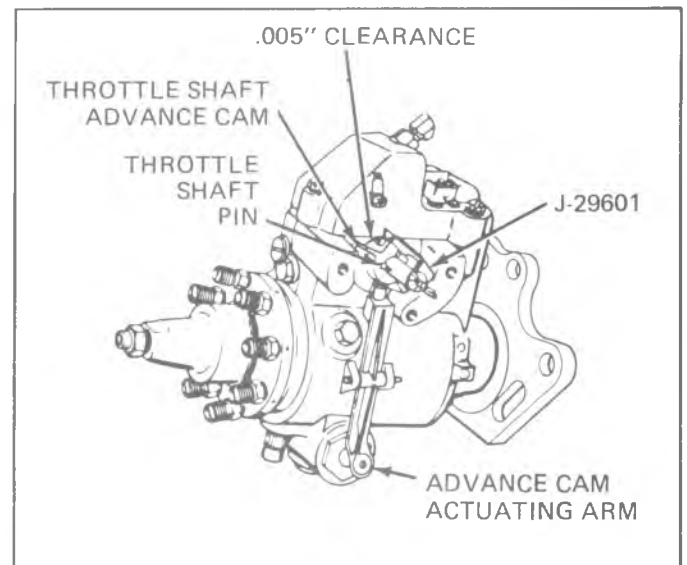


Fig. 6C6-18--Injection Pump With Tool J29601 Installed

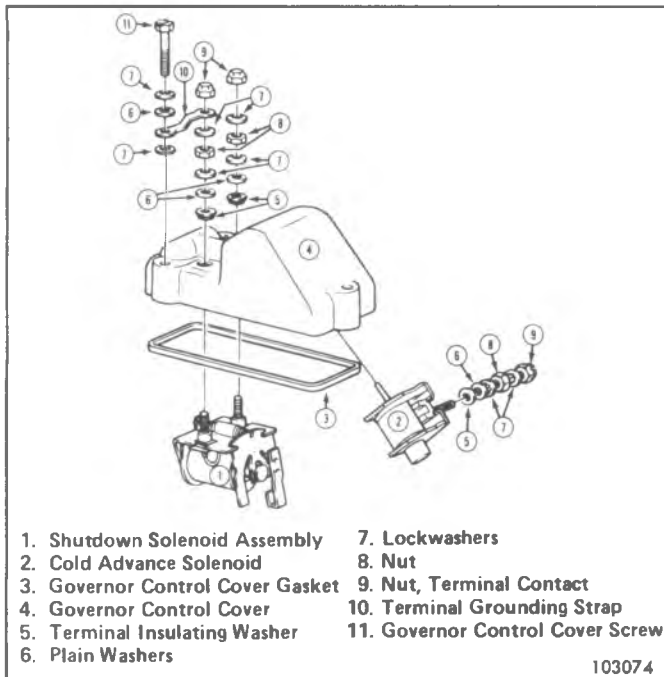


Fig. 6C-19--Solenoids

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. Put a .005" feeler gage between the cam and the mylar washer. Tighten the cam screw and remove tool J-29601.
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. 6C6-17).
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. 6C6-16).
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. 6C6-17), 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. Adjust vacuum regulator valve. See "VACUUM REGULATOR VALVE ADJUSTMENT" or "T.P.S. ADJUSTMENT".
35. Remove the head screens, then reinstall the intake and air cleaner.

SOLENOIDS (Fig. 6C6-19)

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 1.13-1.69 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.

SIDE COVER GASKET (Fig. 6C6-20)

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-CAR SERVICE

Refer to Injection Pump removal. Off-car service operations require a leak test after repair. See Pressure Testing.



Fig. 6C6-20--Side Housing and Drive Group

ADVANCE PIN HOLE PLUG SEAL (Fig. 6C6-21)**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. 6C6-21)**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 shown in Fig. 6C6-21.
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. 6C6-15).
3. Remove the housing vent screw assembly (Fig. 6C6-20).

4. Remove the advance pin hole plug, see "ADVANCE PIN HOLE PLUG".
5. Remove the Advance Pin (Fig. 6C6-21).
6. Locate the pump assembly and holding fixture so that the rear of pump is sloping 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. 6C6-21).
4. Torque the head locking screws to 20-25 N·m (15-18 ft. lbs.) (Fig. 6C6-20).
5. Install the advance pin (Fig. 6C6-21).
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".

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.

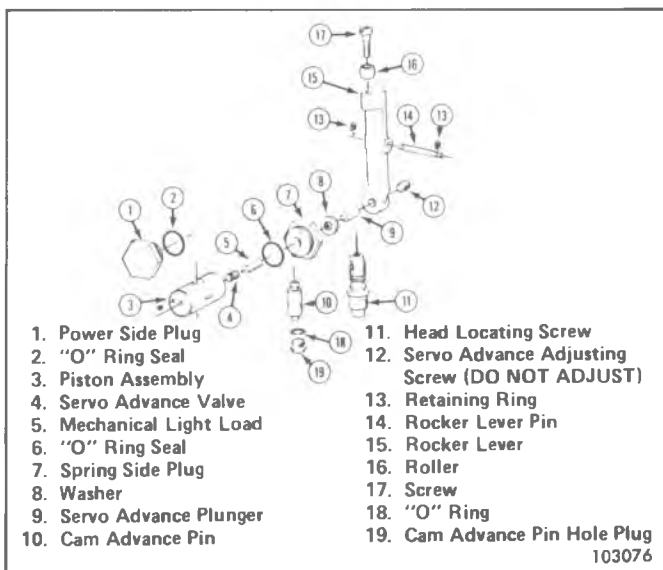


Fig. 6C6-21--Automatic Advance Group

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

Electric Choke Heater.....	6D-1	Diesel Engine.....	6D-15
General Electrical System Diagnosis.....	6D-1	Ignition System	6D-31
Battery	6D-4	Conventional Engine	6D-31
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		Specifications	6D-66

ELECTRIC CHOKE HEATER-OIL PRESSURE SWITCH

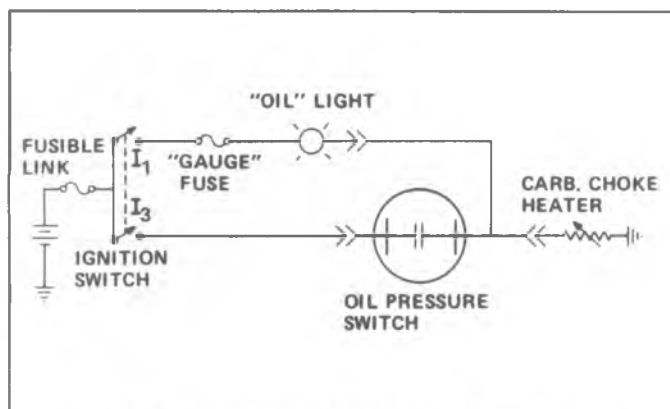


Fig. 6D-1A--Electric Choke Heater Diagram

All gasoline engines have a two-terminal oil pressure switch (sending unit) for controlling current to the electric choke heater. This switch and its associated circuitry provide for the illumination of the "Oil" tell tale lamp in the event of loss of oil pressure or loss of voltage at the choke heater.

The diagram in Figure 6D-1A shows how the dual function is accomplished. The "Bulb Check" feature is same as present system. That is, with ignition switch in "Run" position with engine off. This circuit will also indicate continuity in the choke heater and its connector.

If "Oil" tell tale lamp illuminates with engine running, it could indicate one or more of the following:

1. Loss of oil pressure.
2. Loss of choke heater voltage.
3. Blown GAGE fuse.

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).
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. 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. No gasket is used between the choke cover and the choke housing because of grounding requirements.

GENERAL ELECTRICAL SYSTEM DIAGNOSIS

The diagnosis in figures 6D-2A and 6D-3A can be used to find electrical system - faults. Once a fault has been

traced to a particular component, refer to that components section of the service manual.

POOR CRANKING, OR SOLENOID CLICKS OR CHATTERS

Test	Voltage	Action
1. 1 to G	9 volts or more	Move voltmeter from G to engine block, key in "Start" 9 volts or more - Faulty starter. Under 9 volts - Faulty ground, battery cable to engine block.
	Under 9 volts	Go to test 2.
2. Bat (+) to Bat (-) at battery	9.6 volts or more	Go to test 3.
3. Bat (+) at Battery to term. #1	Under 9.6 volts	Make battery load test. If OK, starter is faulty.
	0.7 volt or more	Faulty positive cable, connections, or fusible link.
	Under 0.7 volt	Faulty ground cable or connections.

SOLENOID MAKES NO SOUND - NO CRANKING

Test	Voltage	Action
1. 8 to G	7 volts or more	If there are 7 volts or more at the starter solenoid terminal the starter is faulty. If not, the wire from connector terminal #8 to the solenoid is faulty.
	Under 7 volts	Go to test 2.
2. 1 to G	9 volts or more	Go to test 5.
	Under 9 volts	Go to test 3.
3. Bat (+) to Bat (-) at battery	9.6 volts or more	Go to test 4.
	Under 9.6 volts	Make battery load test. If OK, Starter is faulty.
4. Bat (+) at battery to term. #1	0.7 volt or more	Faulty positive cable connections, or fusible link.
	Under 0.7 volt	Faulty ground cable or connections.
5. 9 to G	7 volts or more	Faulty purple wire from ignition switch to starter solenoid, or bulkhead connector.
	Under 7 volts	Go to test 6.
6. 2 to G	7 volts or more	Faulty ignition switch.
	Under 7 volts	Faulty battery lead to ignition switch.

Fig. 6D-2A--Electrical System Diagnosis

SLOW CRANKING, SOLENOID CLICKS OR CHATTERS

CHECK: BATTERY FOR GREEN INDICATOR.

VISUAL CONDITION OF BATTERY CABLES AND CONNECTIONS.

IF BATTERY NEEDS CHARGING, MAKE GENERATOR AND BATTERY DRAIN CHECK, CHARGE BATTERY AND RECHECK CRANKING. IF TROUBLE HAS NOT BEEN FOUND, PROCEED.

REMOVE BATTERY LEAD FROM DISTRIBUTOR ON HEI. MAKE ALL VOLTMETER READINGS WITH KEY IN START POSITION.

MEASURE CRANKING VOLTAGE AT BATTERY TERMINAL POSTS.

9.6 VOLTS OR MORE

LESS THAN 9.6 VOLTS

MEASURE VOLTAGE FROM BATTERY
NEGATIVE TERMINAL TO ENGINE
BLOCK. (POS. LEAD ON BLOCK.)

CHECK BATTERY
CONDITION AND CAPACITY

.5 VOLT OR MORE

LESS THAN .5 VOLT

REPAIR GROUND
CABLE AND
CONNECTIONS

MEASURE VOLTAGE
AT SOLENOID "B"
TERMINAL, CLEAN
AND TIGHTEN
CONNECTIONS AT
STARTER.

OK

DEFECTIVE

REPAIR
STARTER

REPLACE
BATTERY

9 VOLTS OR MORE

LESS THAN 9 VOLTS

REPAIR
STARTER

CLEAN AND TIGHTEN POSITIVE CABLE CONNECTIONS.
IF OK, REPLACE CABLE.

NOTE: THIS PROCEDURE IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE DEFECTS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

Fig. 6D-3A--Electrical System Diagnosis

BATTERY

General Description	6D-4	Built In Hydrometer	6D-5
General Information.....	6D-4	Diagnosis.....	6D-5
Common Causes of Failure.....	6D-4	On-Vehicle Service	6D-6
Electrolyte Freezing	6D-4	Charging Procedure	6D-6
Carrier and Hold Down	6D-4	Jump Starting.....	6D-6
Cleaning.....	6D-5	Remove and Replace.....	6D-7
Ratings.....	6D-5		

GENERAL DESCRIPTION

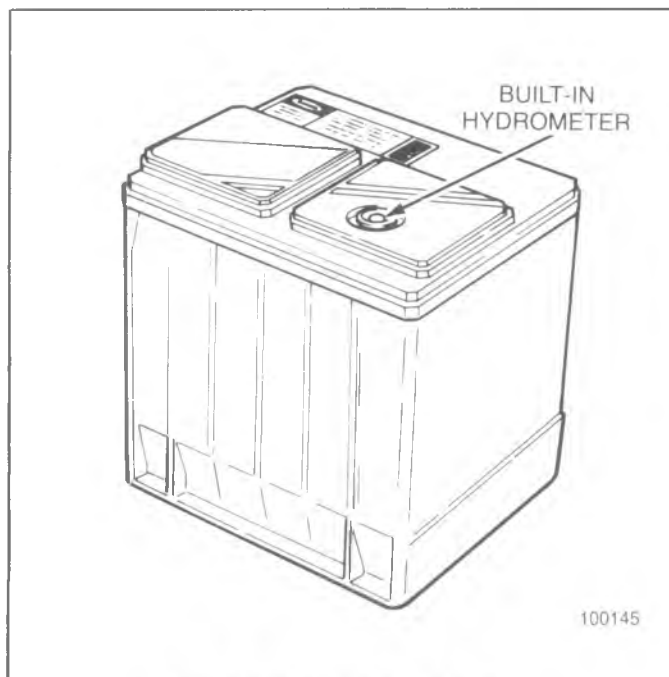


Fig. 6D-1B--Sealed Top Battery

The sealed battery (see Fig. 6D-1B) is standard on all vehicles (see Specifications for specific applications). Diesel equipped vehicles have two batteries connected in parallel to supply the required starter motor and glow plug current. 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. This improvement makes the sealed battery possible.
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, the excess voltage will cause gassing, which leads to liquid loss.
3. Reduced self-discharge compared to a conventional battery. This is important when a battery is left standing for long periods of time.
4. Comparable 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 exceeds the output of the generator.

GENERAL INFORMATION

COMMON CAUSES OF FAILURE

A 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, the following are some of the more important factors that may point to the cause of the trouble.

1. Car accessories left on overnight.
2. Slow average driving speeds for short periods.
3. The vehicle's electrical load is more than the generator output particularly with the addition of after market equipment such as radio equipment, air conditioning, window defoggers or light systems.
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 Car Service for torque specifications.

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 a fully charged condition.

Carrier and Hold-Down

The battery carrier and hold-down should be clean and free from rust before installing the battery. The carrier should be in good 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. See On Car Service for torque specifications.

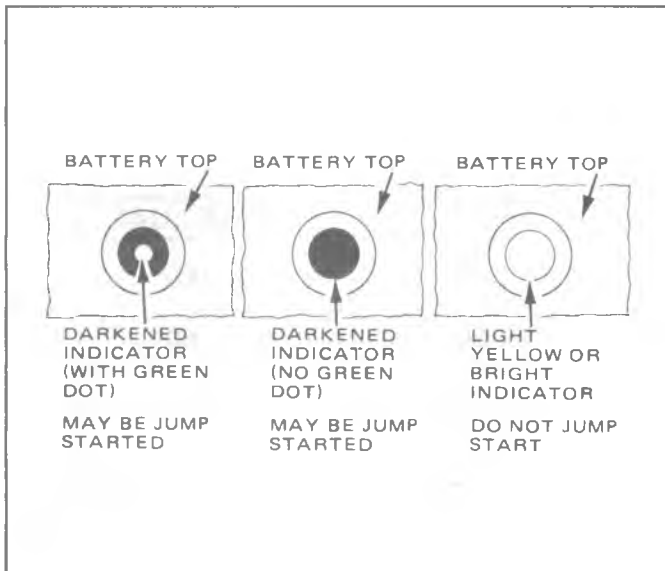


Fig. 6D-2B--Built-In Hydrometer

Visual Inspection

The external condition of the battery should be checked periodically for damage such as cracked cover or case.

RATINGS

A battery has two ratings: (1) a reserve capacity rating at 80°F (27°C) which is the time a fully charged battery will operate the vehicle with no generator operation, (2) a cold crank rating at 0°F (18°C) which indicates the cranking load capacity. (See Specifications for specific battery ratings). The Ampere/Hour rating formerly found on batteries was based on the reserve capacity rating and is no longer used.

DIAGNOSIS

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, go to step 2.

2. HYDROMETER CHECK (Fig. 6D-2B)

- GREEN DOT VISIBLE
- go to step 3.
- 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-3B). On

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 observed (see Figure 6D-2B):

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.

Replace battery. Do not charge, test or jump-start.

CAUTION: Do not charge, test or jump start battery when the hydrometer is clear or light yellow. Not following this caution could result in serious personal injury (particularly to eyes) or property damage from battery explosion or battery acid.

diesel engine vehicles, disconnect and test each battery separately.

- Connect a voltmeter and a battery load tester across the battery terminals.
- Apply 300 ampere load for 15 seconds to remove surface charge. Remove load.
- Wait 15 seconds to let battery recover and apply specified load from load test chart. Read voltage after 15 seconds, then remove load.
- If voltage does not drop below the minimum listed in Fig. 6D-5B, the battery is good. Temperature of the battery will change the minimum voltage to pass the load test. See Temperature vs. voltage drop Chart, and estimate the temperature the battery has been exposed to for the last several hours.

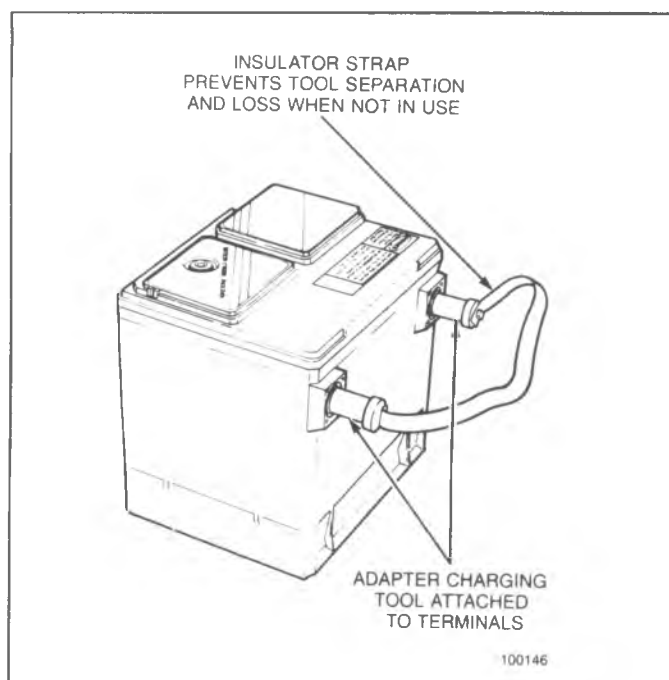


Fig. 6D-3B--Side Terminal Battery Adapters

BATTERY	TEST LOAD
692, 83-50	150
693, 83-60	180
695, 87A-60	230
696, 89A-60	270

210094

Fig. 6D-4B--Load Test Values

ON-VEHICLE SERVICE

CHARGING PROCEDURES

When it is necessary to charge the battery, the following basic rules 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. Charge the battery until the green ball appears. Tipping or shaking the battery may be necessary to make the green ball appear.

Temperature of the battery will effect the charging rate, and most charging equipment will not charge at a constant rate. For example, if the charger starts at 30

amperes and drops off to 10 amperes after 1 hour, the average current for that hour was 20 amperes. The actual boost charge was 20 ampere-hours. The sealed battery can be fast charged or slow charged with ordinary chargers in the same manner as conventional batteries. Either method will restore the battery to full charge.

Many chargers have special settings for sealed batteries. These settings reduce the charge voltage and limit the current. It is not necessary to use these settings with this sealed battery.

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.

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: Departures 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. Never expose battery to open flame or electric spark - batteries generate a gas which is flammable and explosive. Remove

MINIMUM VOLTAGE	TEMPERATURE	
	"F	"C
9.6	70	21
9.5	60	16
9.4	50	10
9.3	40	4
9.1	30	- 1
8.9	20	- 7
8.7	10	-12
8.5	0	-18

Fig. 6D-5B--Minimum Voltage Drop

rings, watches, and other jewelry. Wear approved eye protection. Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - it 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 vehicle, 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, do not attempt to jump start.
3. Only 12 volt batteries can be used to start the engine.

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.

4. 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.

5. 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 450 mm (18 inches) from the battery of the vehicle being started (DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY).
6. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the vehicle with the discharged battery.
7. 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 REPLACE

When handling a battery, the following safety precautions should be observed:

1. Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.
2. Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately. To remove or replace a battery, always disconnect the negative cable first, then the positive cable. Torque battery cables at battery to 12 N·m (9 lb. ft.).

CHARGING SYSTEM

General Description.....	6D-7	Rotor Field Winding Checks.....	6D-13
Diagnosis.....	6D-9	Diode Trio Check.....	6D-13
Faulty Indicator Lamp Operation.....	6D-9	Rectifier Bridge Check.....	6D-14
Undercharged Battery.....	6D-9	Stator Checks.....	6D-14
Overcharged Battery.....	6D-11	Brush Holder and Regulator Replacement.....	6D-14
On-Vehicle Service.....	6D-11	Slip Ring Servicing.....	6D-15
Unit Repair.....	6D-13	Bearing Replacement and Lubrication.....	6D-15
Disassembly.....	6D-13	Reassembly.....	6D-15

GENERAL DESCRIPTION

The basic charging system is the SI integral regulator charging system (Fig. 6D-1C and 6D-2C). The internal components are connected electrically as shown in Fig. 6D-3C. The 15-SI generator is similar to the 10-SI except that:

1. It is slightly larger physically.
2. It produces 70 amps output at full speed and approximately 40 amps at idle speed.
3. It uses different drive end and slip ring end bearings.
4. The stator uses delta windings. The windings cannot be checked for opens.

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 or the choke heater relay with optional voltmeter, is needed to protect the diode trio.

Although several models of generators are available with different outputs at idle and different maximum outputs, their basic operating principles are the same.

The generator uses 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 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

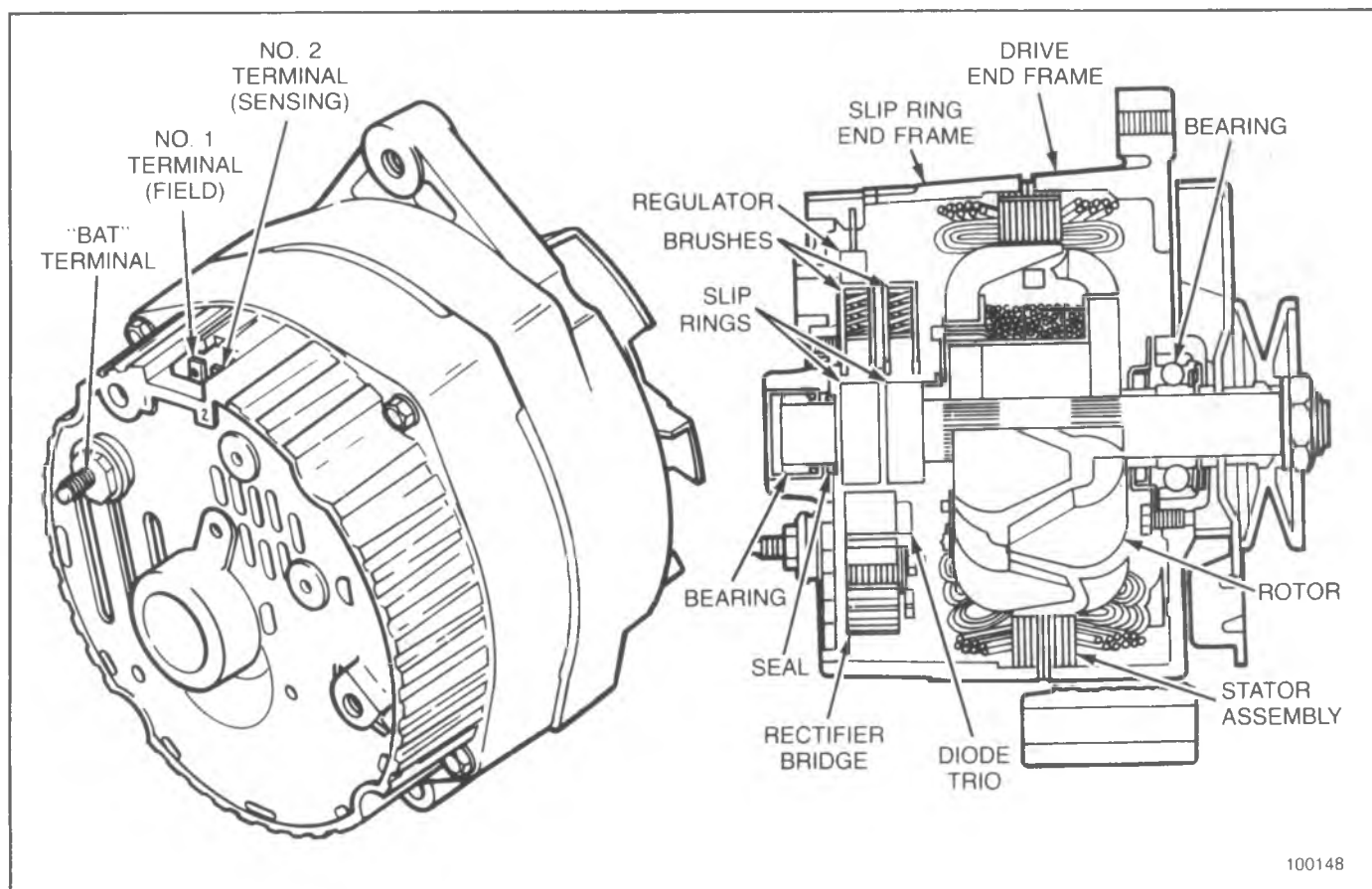


Fig. 6D-1C--10SI Generator

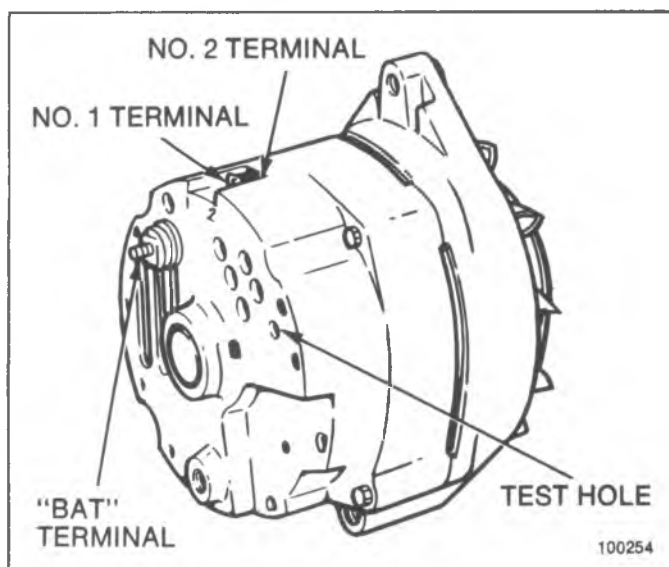


Fig. 6D-2C--15 SI Generator

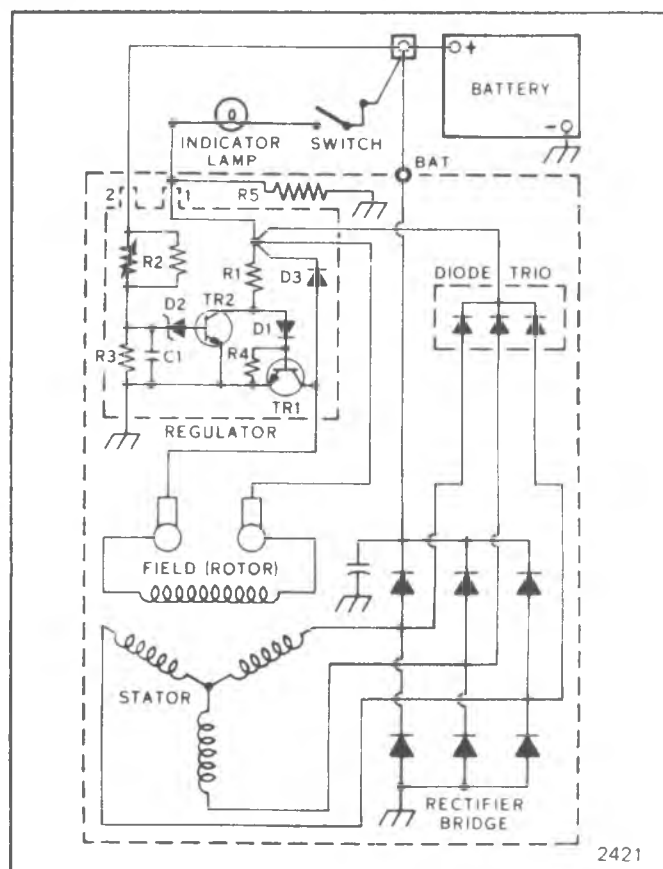


Fig. 6D-3C--Regulator in Charging Circuit

laminated core that forms part of the generator frame. A rectifier 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.

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

Most charging system troubles show up as a faulty indicator lamp, an undercharged or an overcharged battery. Since the battery itself may be defective, it should be checked first to determine its condition. Also, in the case of an undercharged battery, check for battery drain caused by grounds or by accessories being left on.

A basic wiring diagram showing lead connections is shown in Figure 6D-3C. To avoid damage to the electrical equipment, always observe the following 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 vehicles, 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. Choke light stays on after engine is running (Gage Cars).
- C. An undercharged battery as evidenced by slow cranking or hydrometer dark.
- D. 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-4C.

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 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 blown fuse (where used) between indicator lamp and

switch, and also in A/C circuit. The 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, 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-Car Service and Unit Repair.

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. This procedure also applies to vehicles with a voltmeter.

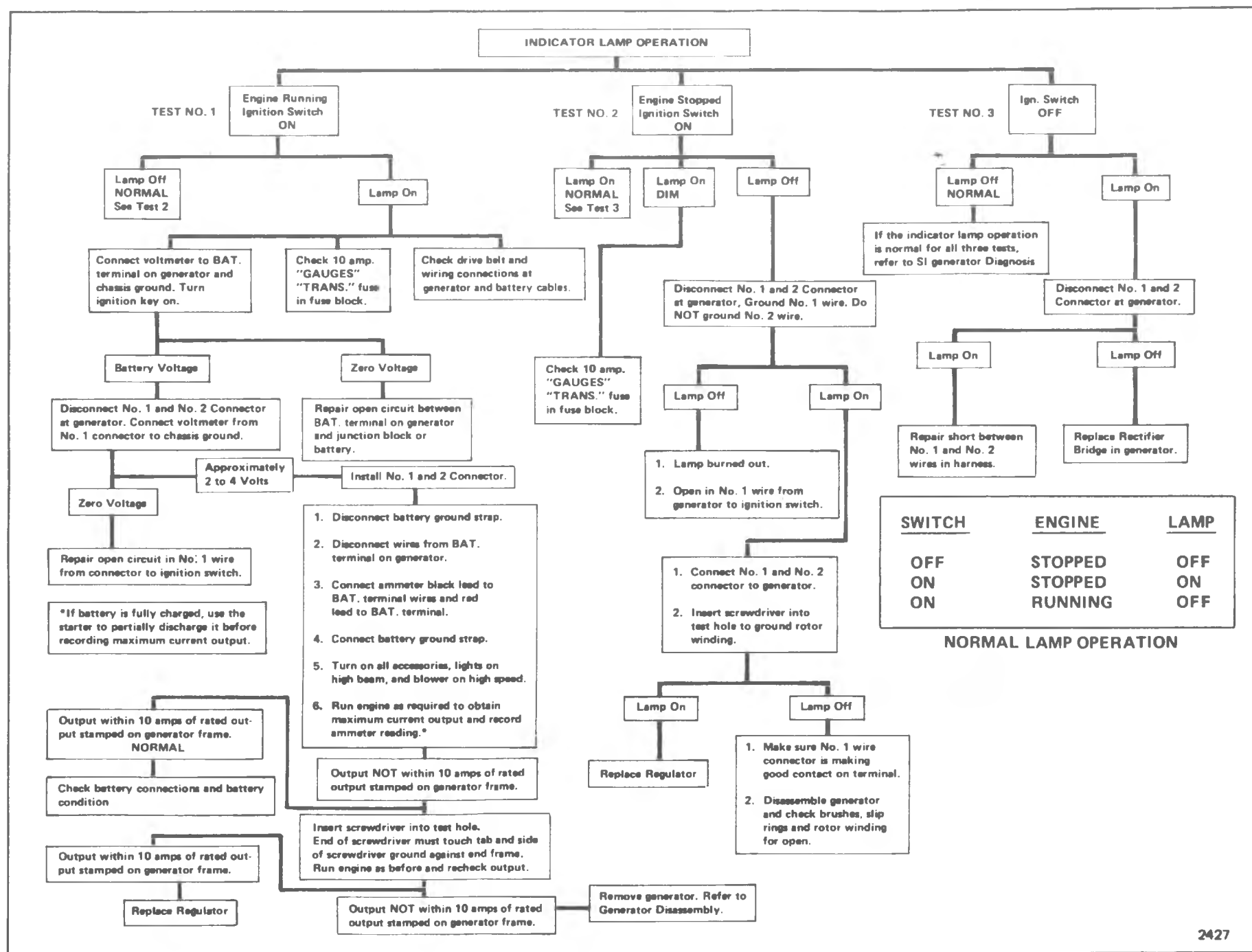
1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension (see Section 6B).
3. If a battery defect is suspected, refer to Battery Section.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and cowl and the battery cable connections at the battery, the starter and the engine 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 previous Steps 1 through 5 check satisfactorily, check generator as follows:
 - a. Disconnect battery ground cable.
 - b. Connect an ammeter or generator tester in the circuit at the "BAT" terminal of the generator.
 - c. Reconnect negative battery cable.

Fig. 6D-4C--Charging System Diagnosis



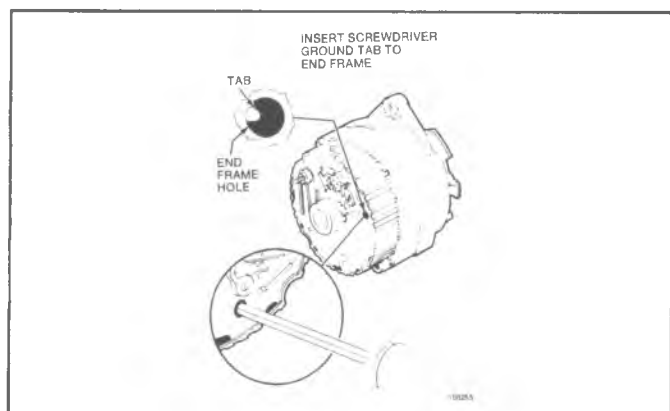


Fig. 6D-5C--Generator Test Hole

- d. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the battery or use generator tester.
- e. Operate engine at 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-6C). 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-5C). Make sure tab is within 19mm (3/4 inch) of casting surface. Do not force screwdriver deeper than one inch (25mm) into end frame.

- i. Operate engine at about 2000 RPM, and adjust carbon pile as required to obtain maximum current output.
- j. If output is within 10 amperes of rated output, check field winding 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 Generator Repair Section.
7. If test hole is not accessible, disassemble generator and make tests listed in "UNIT REPAIR" section.

D. OVERCHARGED BATTERY

1. To determine battery condition refer to Battery section of Section 6D.
2. If an obvious overcharge condition exists as evidenced by excessive spewing of electrolyte, proceed to "Disassembly" section of Generator Overhaul and check field windings for grounds and shorts. If 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-vehicle test, and can save time over conventional diagnostic methods. Consult manufacturer's instructions for usage.

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.

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-6C and 6D-7C 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.

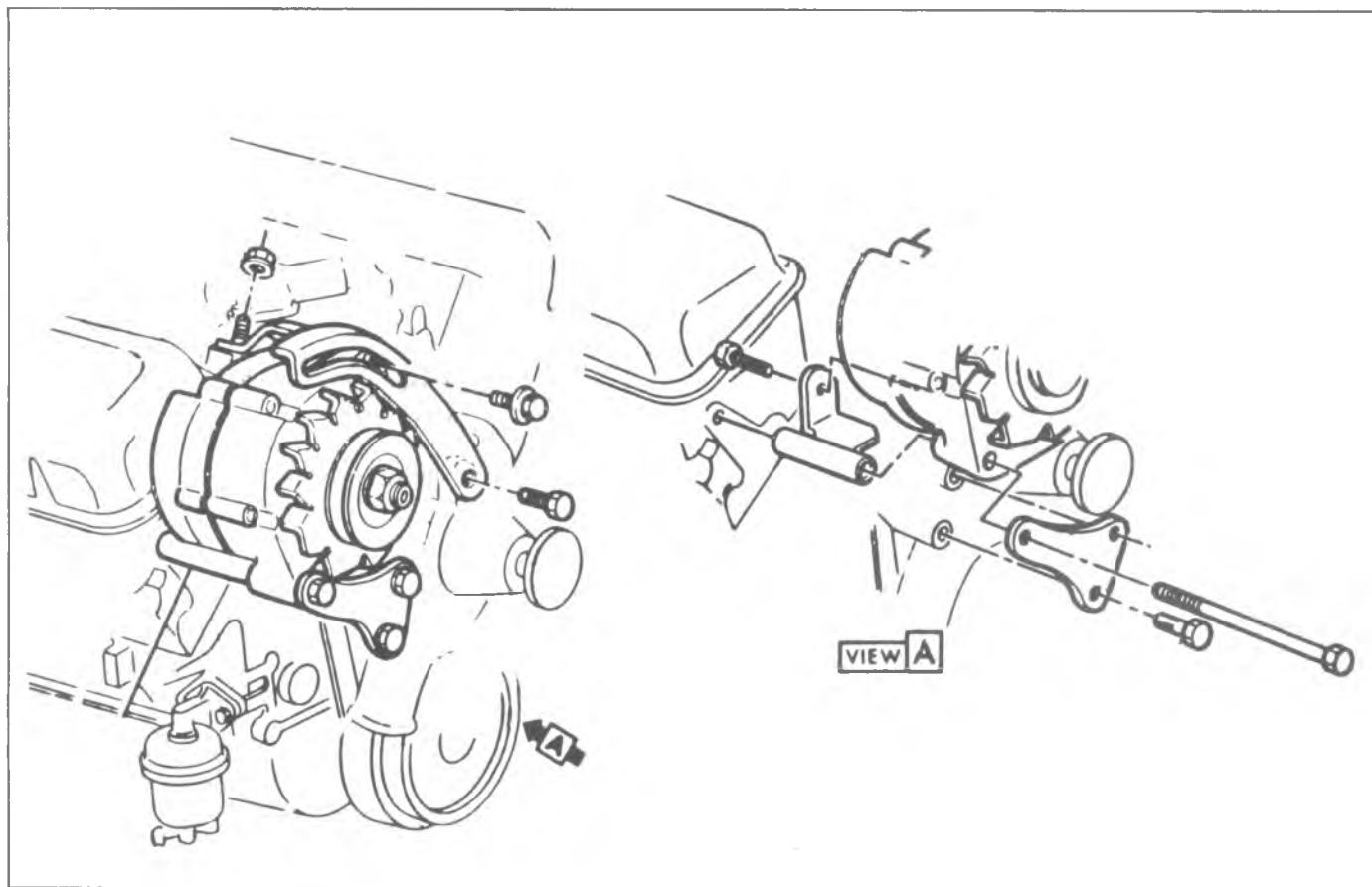


Fig. 6D-6C--Generator Mounting

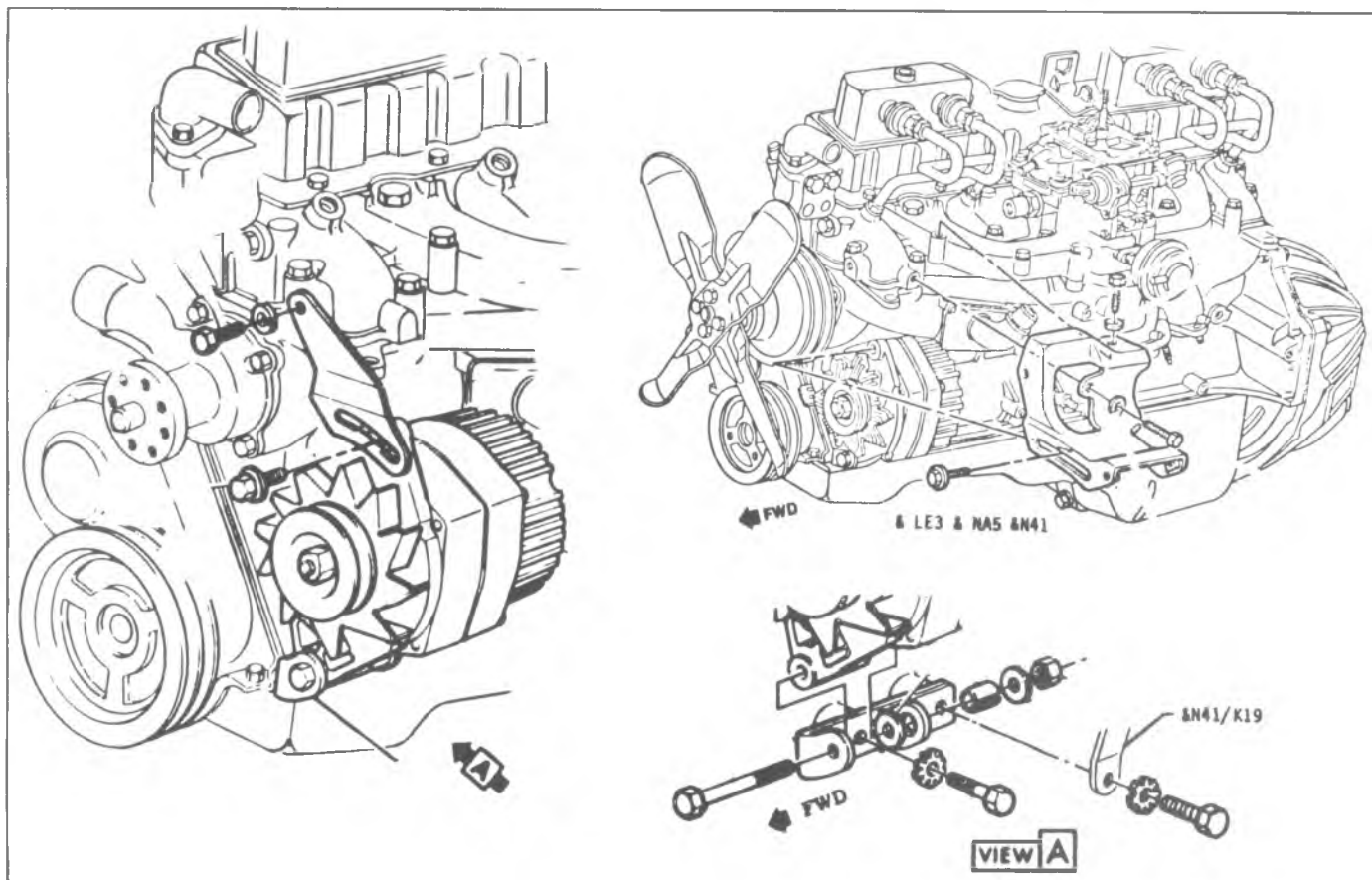


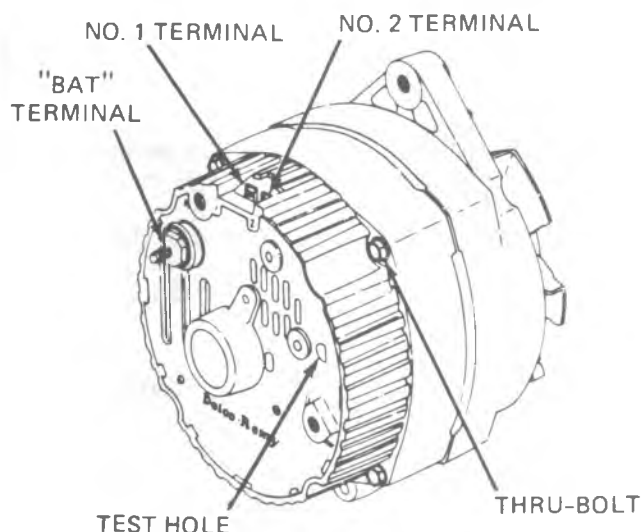
Fig. 6D-7C--Generator Mounting

UNIT REPAIR

To repair the generator, observe the illustrated procedures which follow:

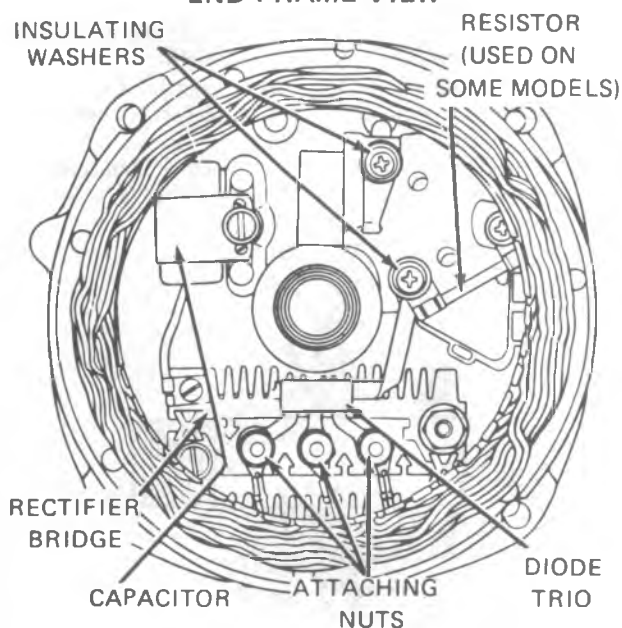
10SI, 15SI AND 27SI GENERATORS DISASSEMBLY, TEST AND REASSEMBLY (GENERATOR REMOVED FROM ENGINE)

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

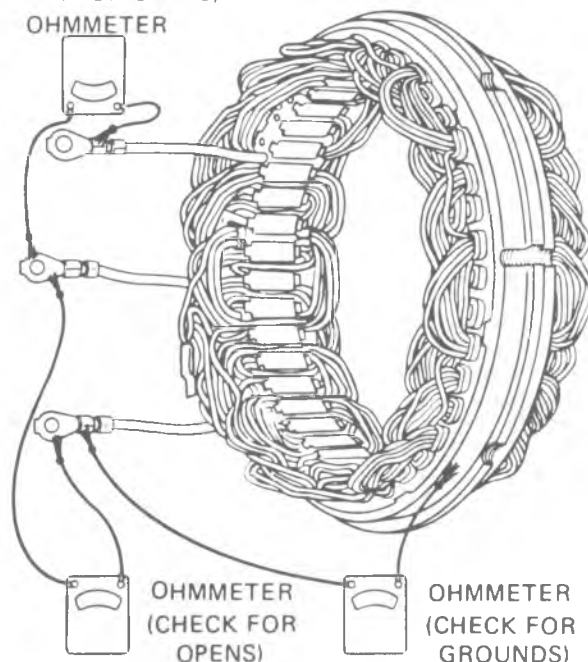


3. Remove three attaching nuts and regulator attaching screws.
4. Separate stator, diode trio and regulator from end frame. NOTE: The regulator cannot be tested on the work bench except with a regulator tester.

TESTING STATOR

(CHECK FOR OPENS)

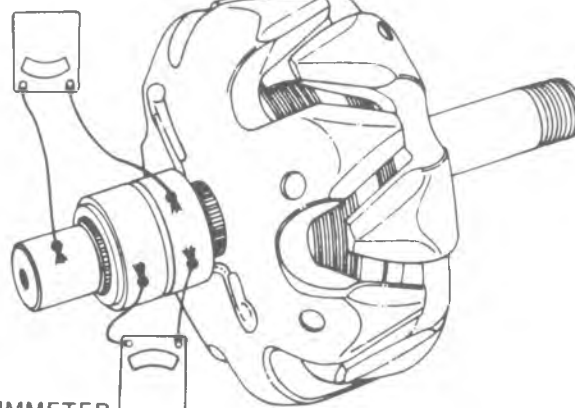
OHMMETER



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

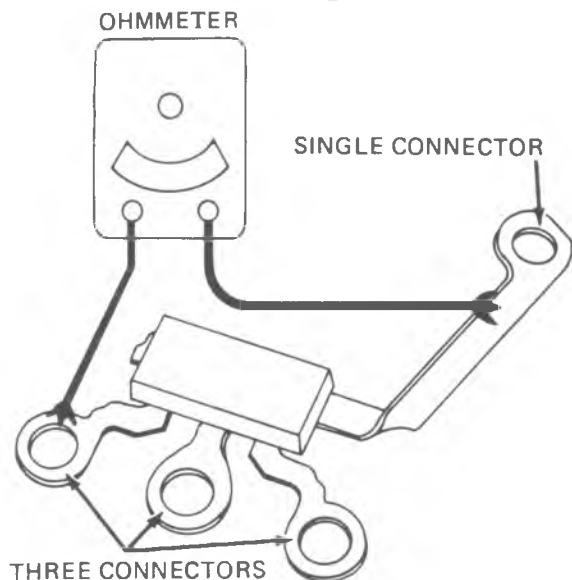
(CHECK FOR GROUNDS)(OHMMETER)



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.

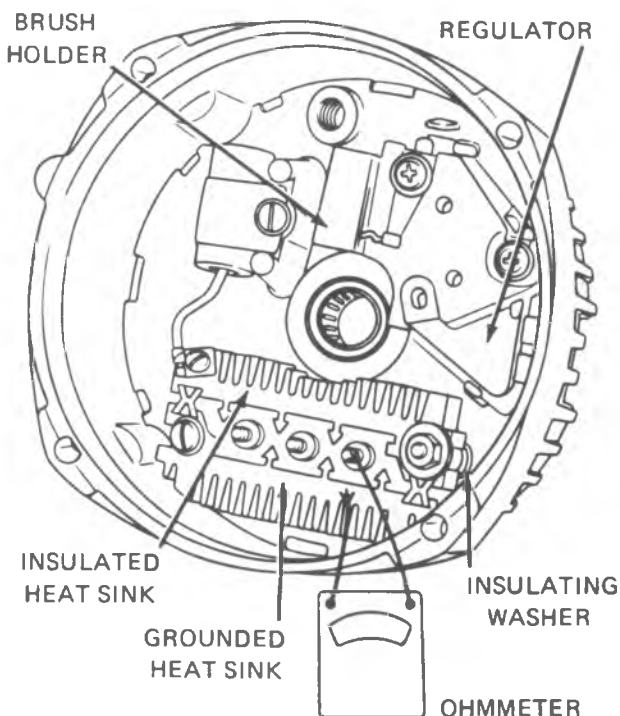
Fig. 6D-8C--Generator Disassembly, Test and Reassembly 1 of 3

TESTING TRIO



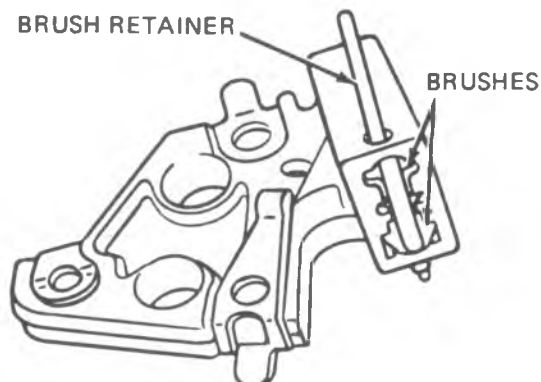
9. To check diode trio, connect ohmmeter as shown, then reverse lead connections. Should read high and low. If not, replace diode trio.
10. Repeat same test between single connector and each of other connectors.

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

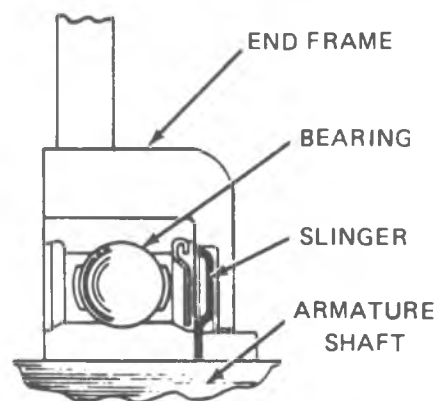


14. Clean brushes with soft, dry cloth.
15. Put brushes in holder and hold with brush retainer wire.

DRIVE END BEARING

(Some models use flat washer instead of slinger)

10SI AND 27SI SERIES



16. 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 Part No. 1948791 lubricant. 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).

15SI SERIES

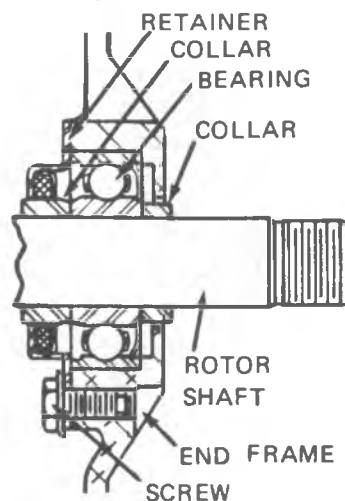


Fig. 6D-9C--Generator Disassembly, Test and Reassembly 2 of 3

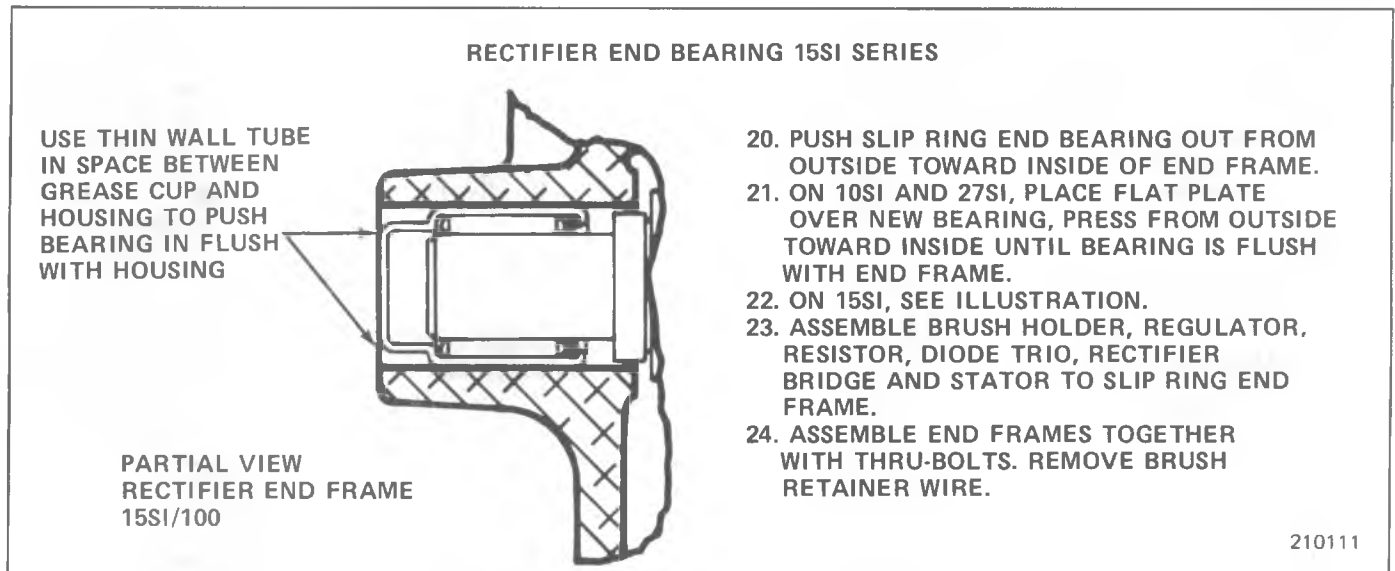


Fig. 6D-10C--Generator Disassembly, Test and Reassembly 3 of 3

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.

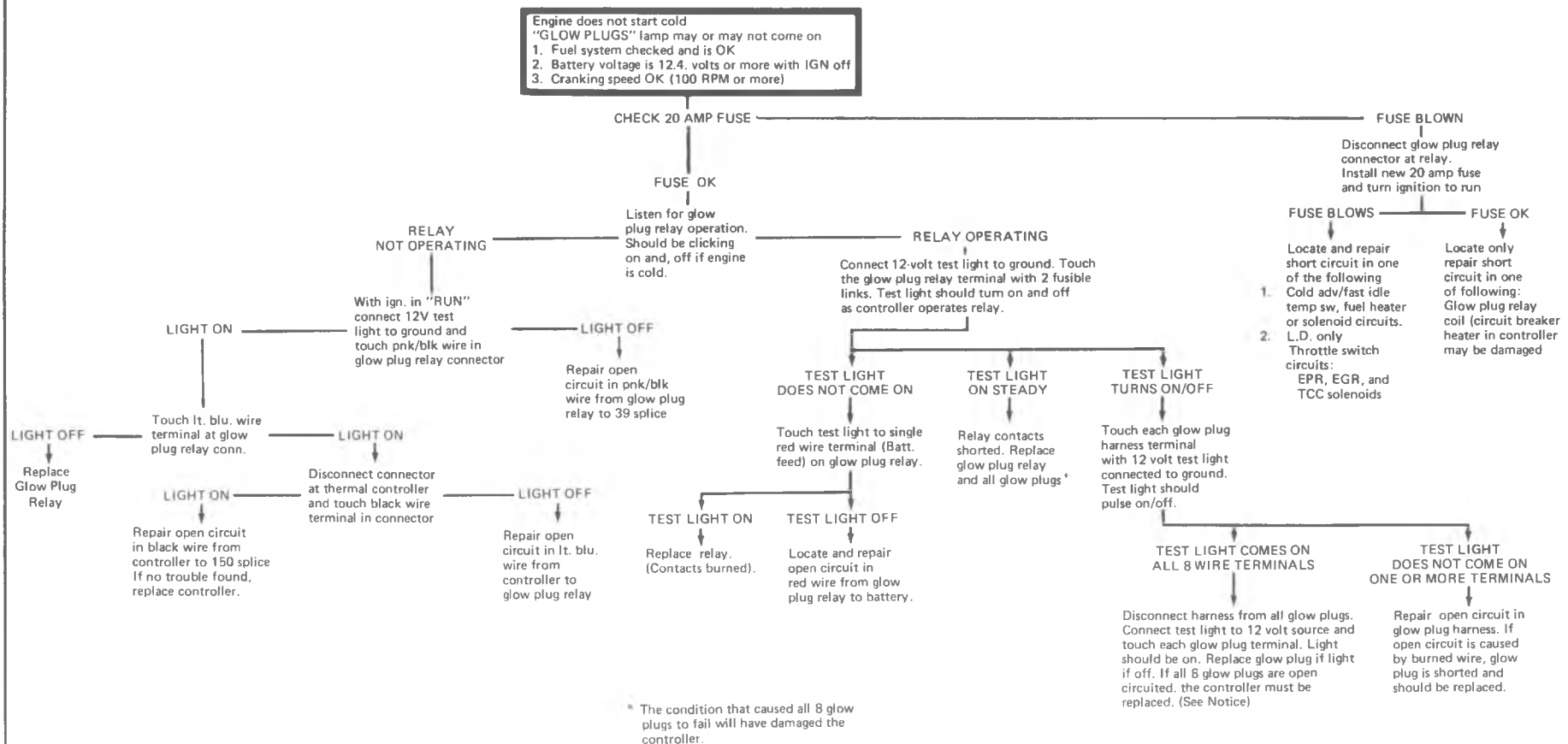
Diesel Glow Plug Electrical System Diagnosis

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-3D through 6D-5D.

6.2L DIESEL ELECTRICAL SYSTEM DIAGNOSIS



101078

THERMAL CONTROLLER CHECK

With connector removed from controller the controller heater circuits may be checked using a high impedance ohmmeter. However, this check will not determine shorted switches within the controller.

Pin 3 – Pin 2 $.40 \text{ to } .75 \Omega$

Pin 5 – Pin 1 $130 \Omega \pm 10\%$

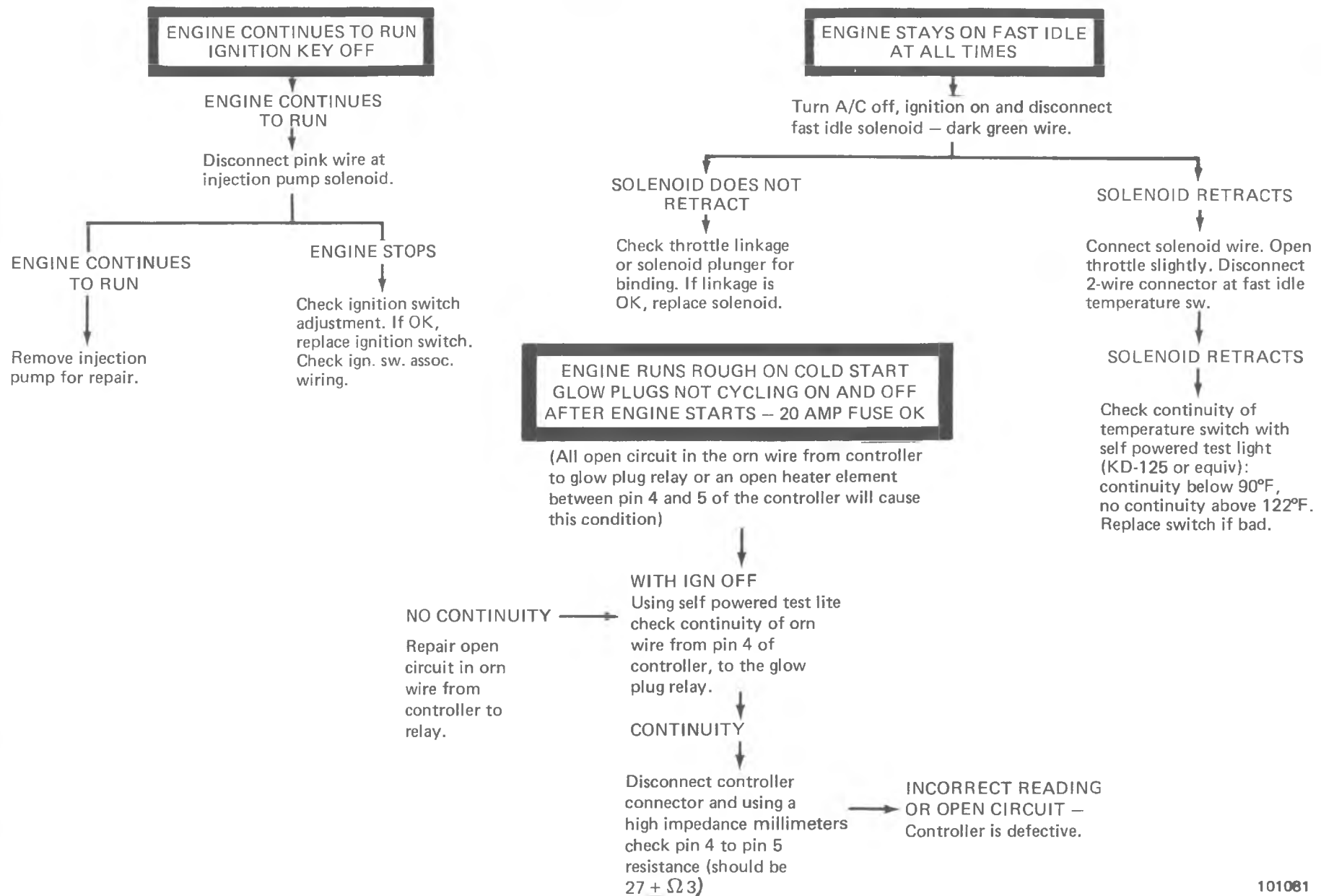
Pin 4 – Pin 5 $27 \Omega \pm 3 \Omega$

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.

6.2 LITER DIESEL ELECTRICAL SYSTEM DIAGNOSIS



101081

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

Not clicking

With ignition switch OFF
Check continuity of BLK wire circuit 150A,
from bulb socket to fuse block bus bar grd.

go to
"Engine does not
start cold" chart
(relay not operating).

Continuity

No Continuity

Check continuity of ORN/BLK wire
circuit 503 from bulb socket to
splice 503

Repair as necessary

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.

**NO FAST IDLE WITH COLD ENGINE (20 AMP FUSE OK)
TEMPERATURE BELOW 90°F**

Turn ignition switch to run position and disconnect and connect fast idle solenoid. Check for solenoid operation.

SOLENOID OPERATES

Re-adjust for correct fast idle. See engine fuel section.

SOLENOID DOES NOT OPERATE

Use a 12-volt test light connected to ground and touch the disconnected light green wire at the solenoid connector.

TEST LIGHT OFF

Touch test light to lt. green wire in connector on cold advance/fast idle temp. sw.

TEST LIGHT ON

Repair open lt. grn. wire from fast idle solenoid to cold advance solenoid or lt. grn. wire cold advance solenoid to temperature switch.

TEST LIGHT OFF

Touch test light to pnk/blk. wire on cold advance switch

TEST LIGHT ON

Replace cold advance temp. sw.

TEST LIGHT OFF

Locate and repair open circuit in pnk/blk wire

TEST LIGHT ON

Check solenoid connector and ground. If OK, replace solenoid.

NO COLD ADVANCE COLD ENGINE

Turn ignition switch to run position and disconnect and connect cold advance solenoid connector. Check for solenoid operation.

SOLENOID OPERATES

Problem is in fuel injection pump system refer to engine fuel section.

SOLENOID DOES NOT OPERATE

Use a 12-volt test light connected to ground and touch the disconnected light green wire at the solenoid connector.

TEST LIGHT OFF

Touch test light to lt. green wire in connector on cold advance/fast idle temp. sw.

TEST LIGHT ON

Repair open lt. grn. wire from fast idle solenoid to cold advance solenoid or pnk/blk. wire cold advance solenoid to temperature switch.

TEST LIGHT ON

Check solenoid connector and ground. If OK, replace solenoid.

TEST LIGHT OFF

Touch test light to lt. grn. wire on cold advance switch

TEST LIGHT ON

Replace cold advance temp. sw.

TEST LIGHT OFF

Locate and repair open circuit in pnk/blk wire

GLOW PLUG RESISTANCE PROCEDURE

1. Use the Kent-Moore High Impedence Digital Multimeter (Essential Tool J-29125) for resistance measurements.
2. Select scales as follows: LH Switch to "OHMS", RH Switch to full counterclockwise, "200 Ω ," Slide Center Switch to the left "DC.LO."
3. Start engine, turn on heater and allow engine to warm up. REMOVE all the feed wires from the glow plugs.
4. Using Mag-Tach J-26925, adjust engine speed by turning the idle speed screw on the side of the injection pump to the worst engine idle roughness, but do not exceed 900 RPM (860 is the most likely speed to get roughest idle).
5. Allow engine to run at worst idle speed for at least one minute. The thermostat must be open and the upper radiator hose hot.
6. Attach an alligator clip to the black test lead of the multimeter. This clip must be grounded to the engine lift strap on the left-hand side of the intake manifold. It must remain grounded to this point until all tests are completed.
7. On a separate sheet of plain writing paper write down the engine firing order – 1-8-3-26-5-7-3;
8. With engine still idling, probe each glow plug terminal and record the resistance values on each cylinder in firing sequence. Most readings will be between 1.8 and 3.4 OHMS. If these readings are not obtained, turn engine "OFF" for several minutes and recheck the glow plugs. The resistance should be .7 or .8 OHMS. If this reading is not obtained check meter for correct settings, check for low or incorrect battery in meter and check the meter ground wire to the engine.
9. The resistance values are dependent on the temperature in each cylinder, and therefore indicate the output of each cylinder.
10. If ohm reading on any cylinder is about 1.2 or 1.3 ohms, check to see if there is an engine mechanical problem. Make a compression check of the low reading cylinder and the cylinders which fire before and after the low cylinder reading. Correct the cause of the low compression before proceeding to the fuel system.
11. Examine the results of all cylinder glow plug resistance readings, looking for differences between cylinders. Normally, rough engines will have a difference of .3 ohms or more between cylinders in firing order. It will be necessary to raise or lower the reading on one or more of these cylinders by selection of nozzles.

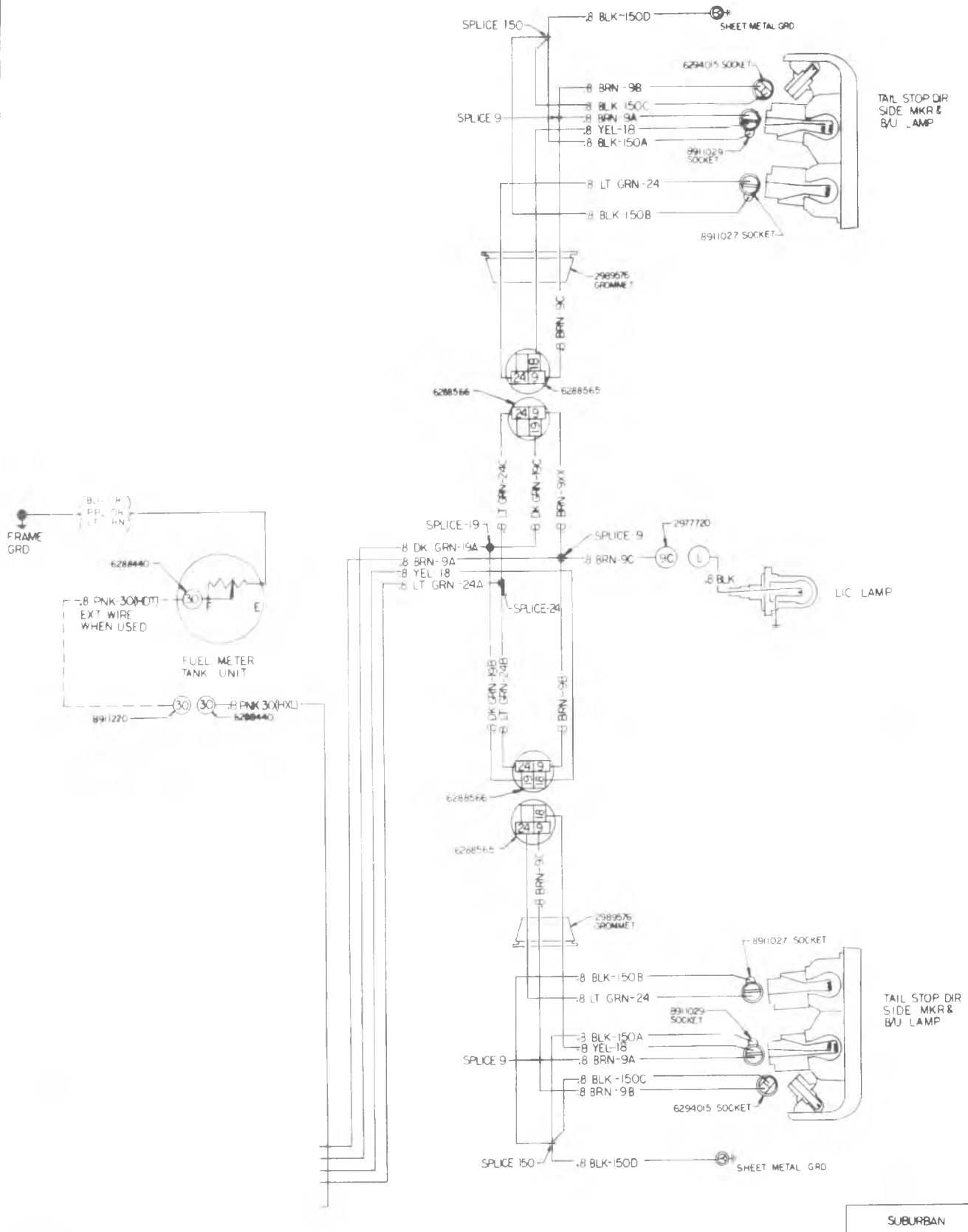
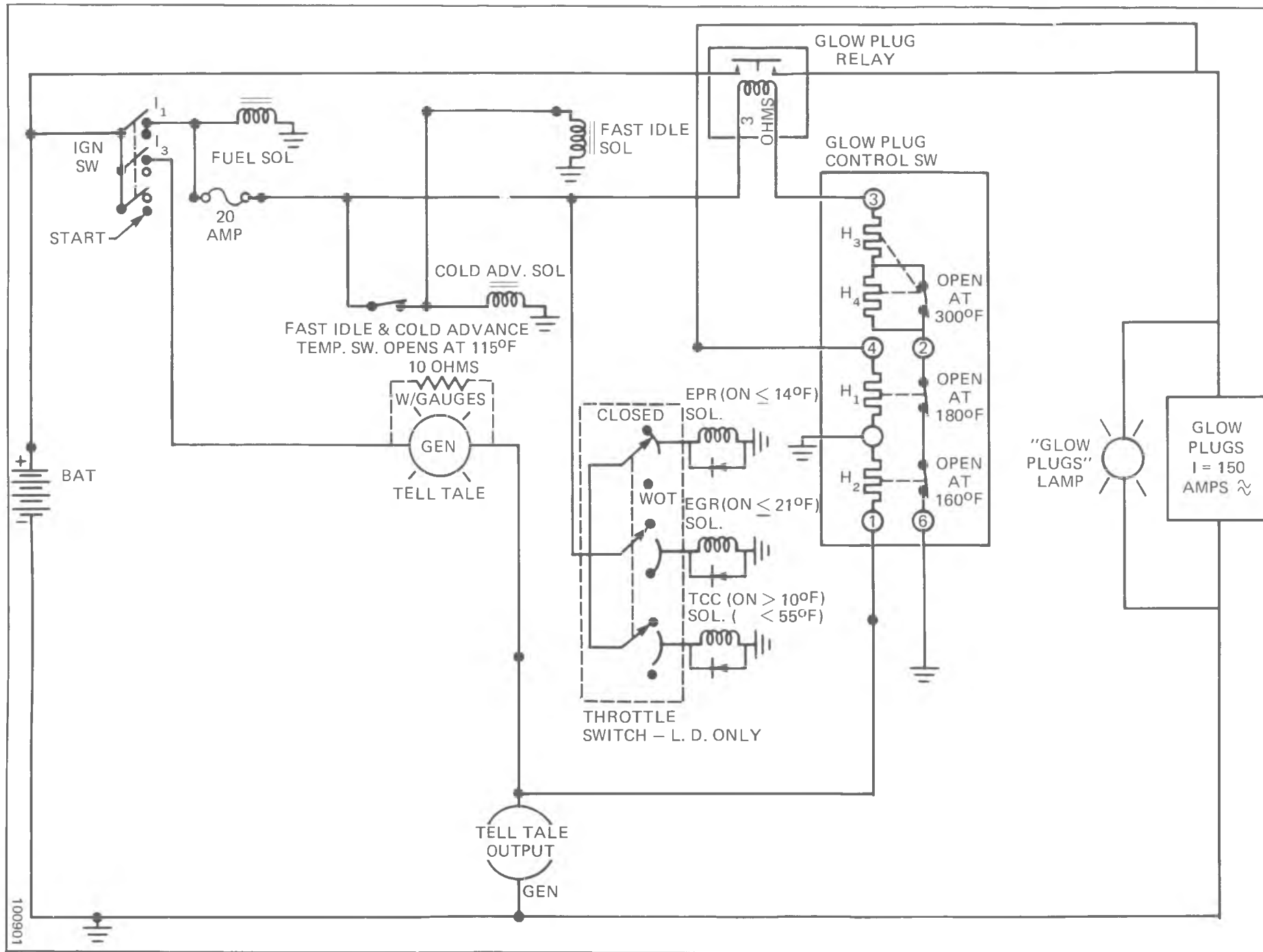


Fig. 6D-1D--Diesel Glow Plug Wiring Schematic



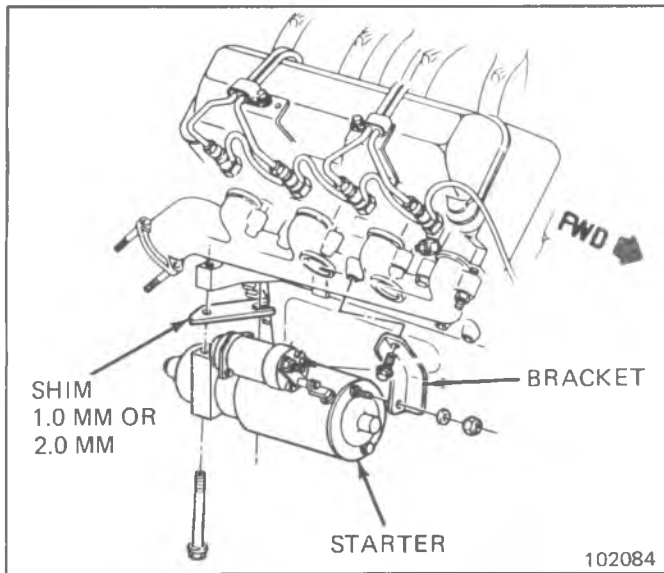


Fig. 6D-3D--Diesel Starter Mounting

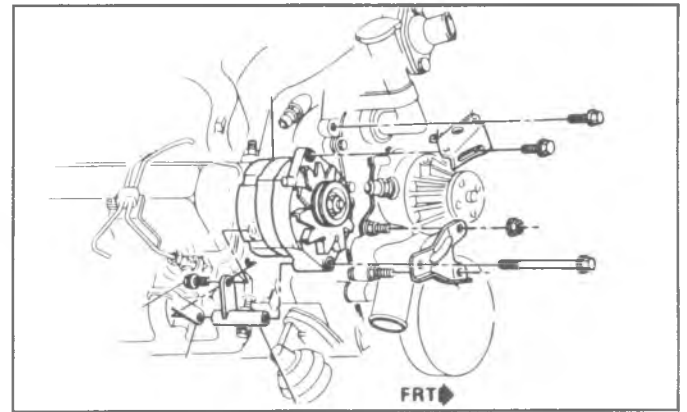


Fig. 6D-4D--Generator Mounting

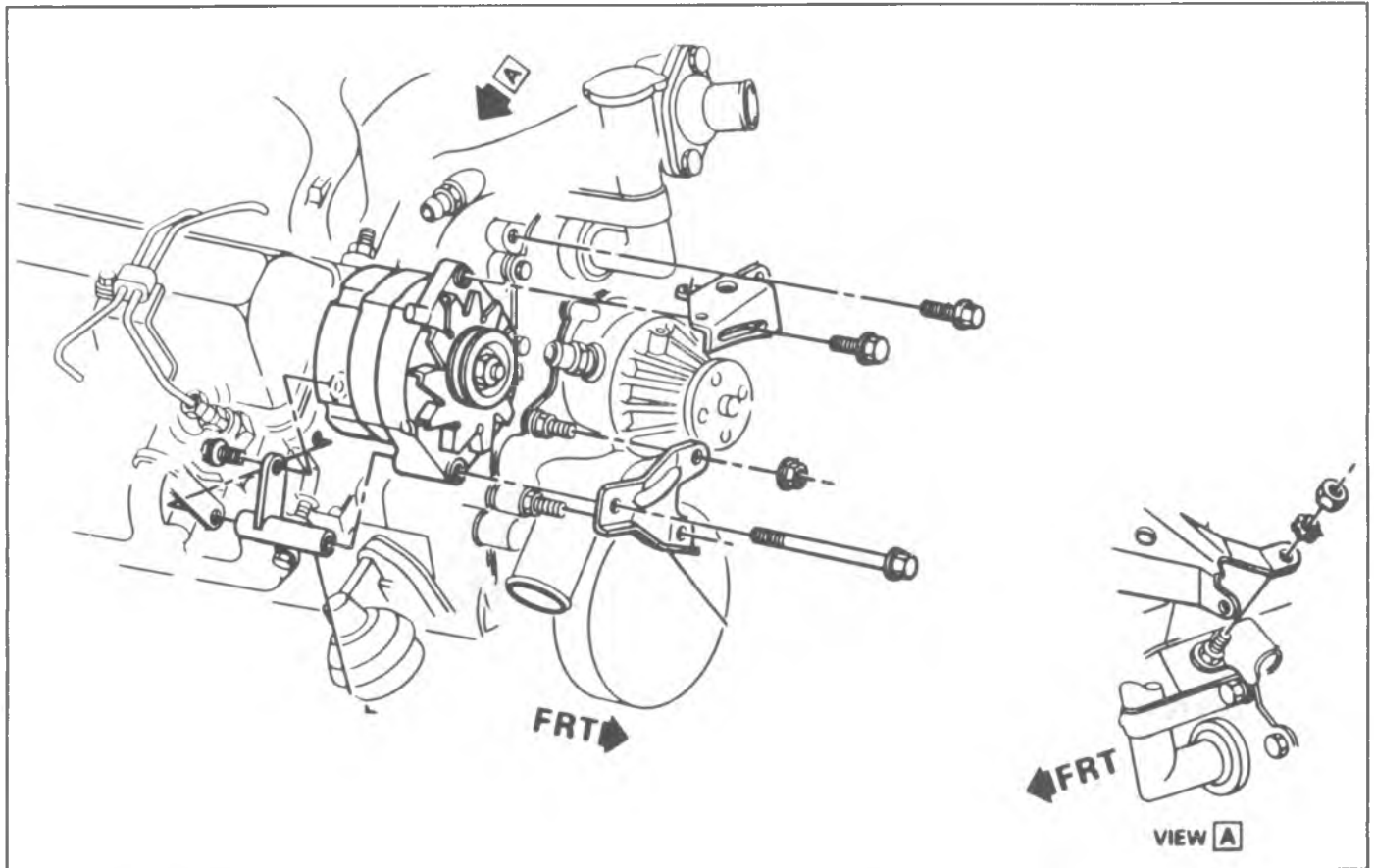


Fig. 6D-5D--Generator Mounting - with A/C

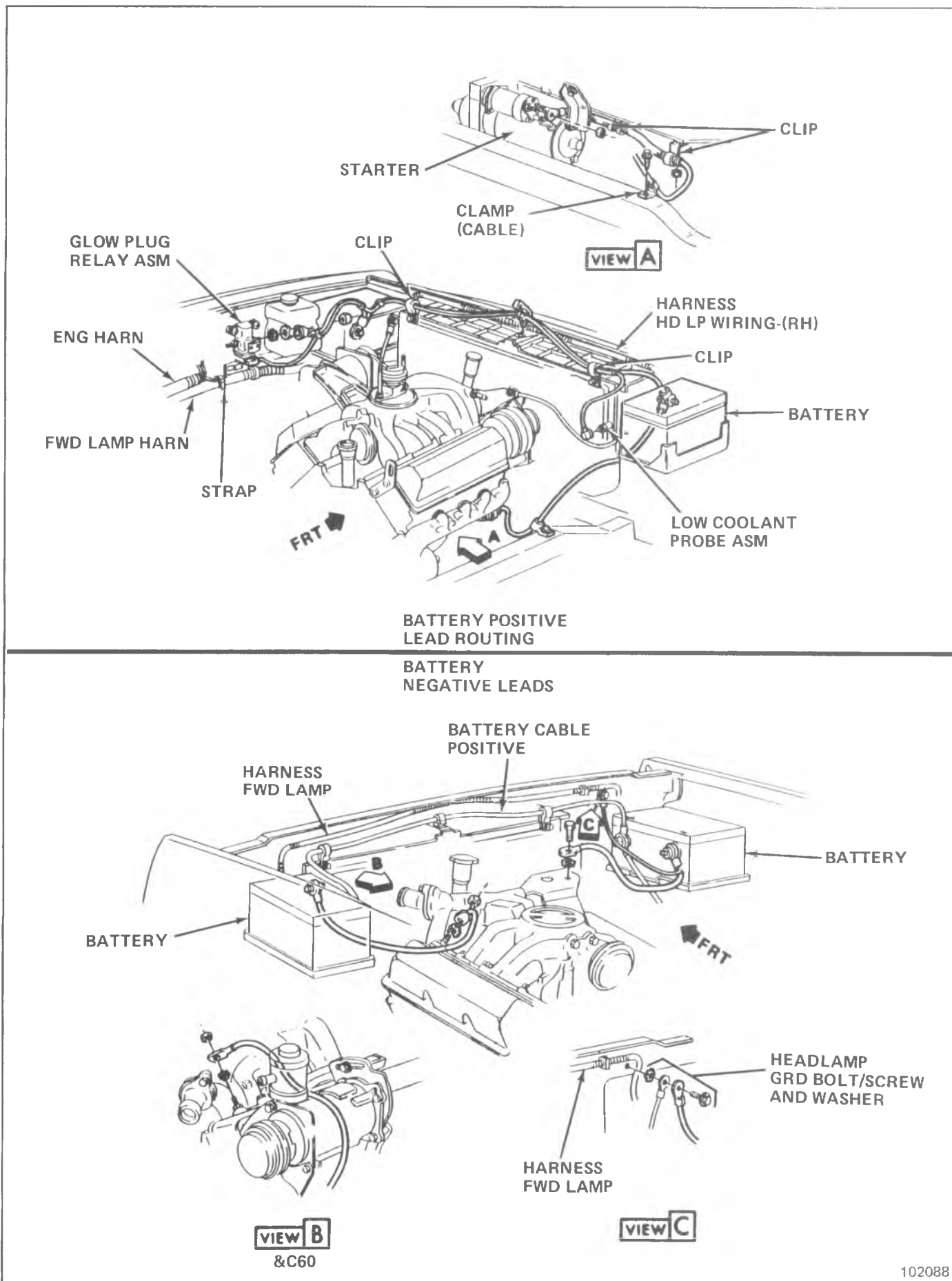
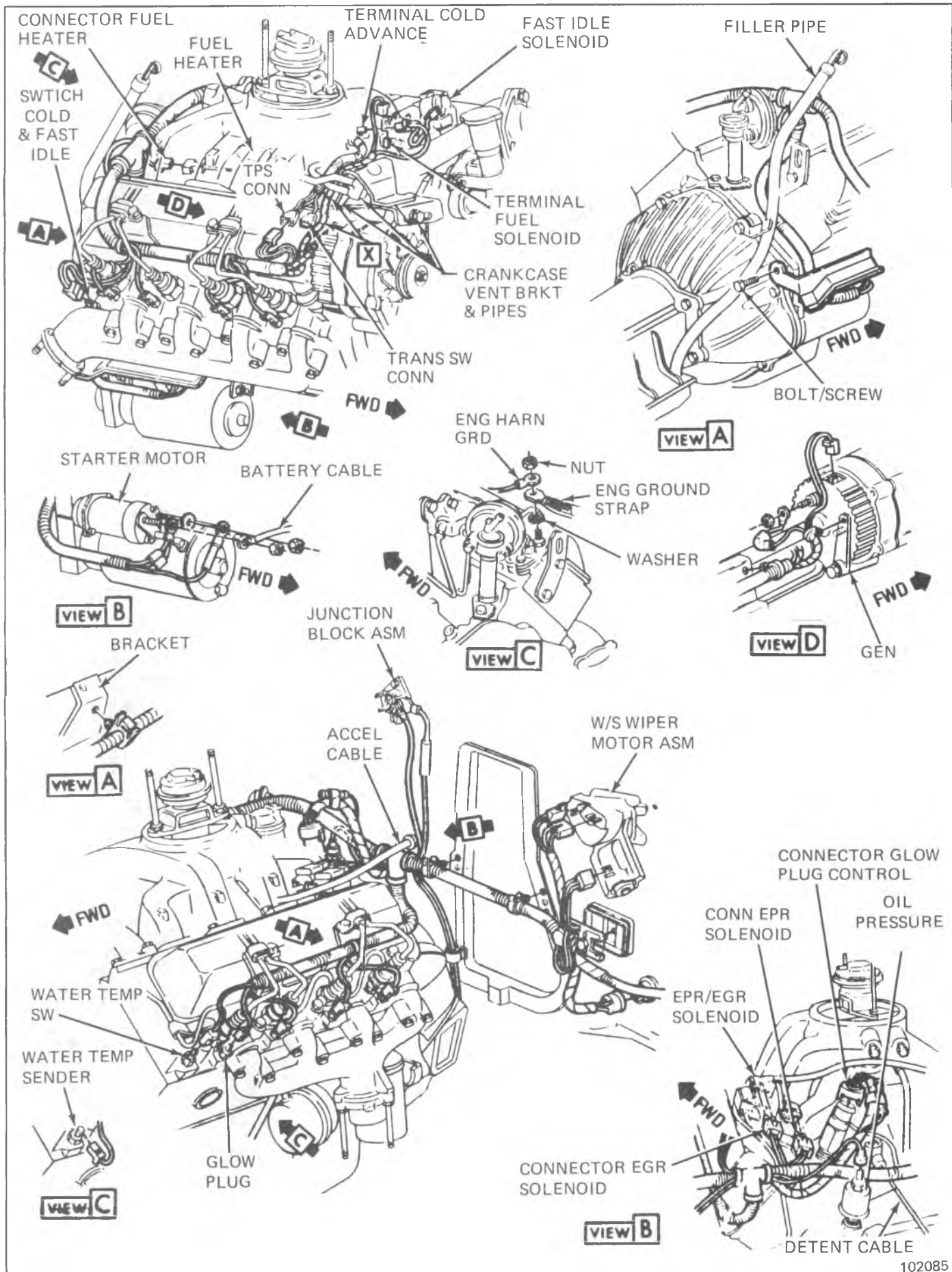


Fig. 6D-6D--Battery and Leads



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Fig. 6D-7D--Engine Compartment Wiring-LH6

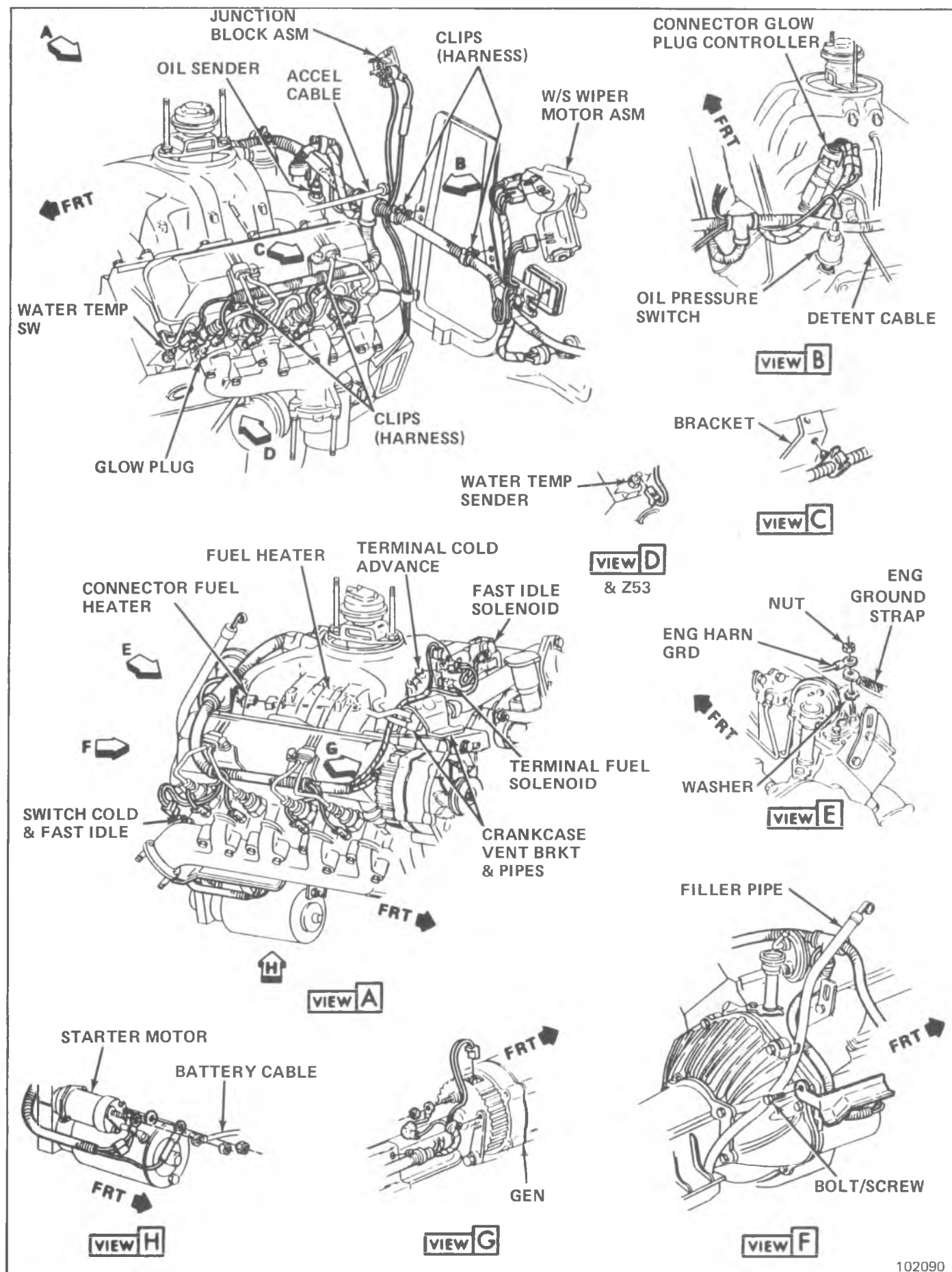


Fig. 6D-8D--Engine Compartment Wiring-LL4

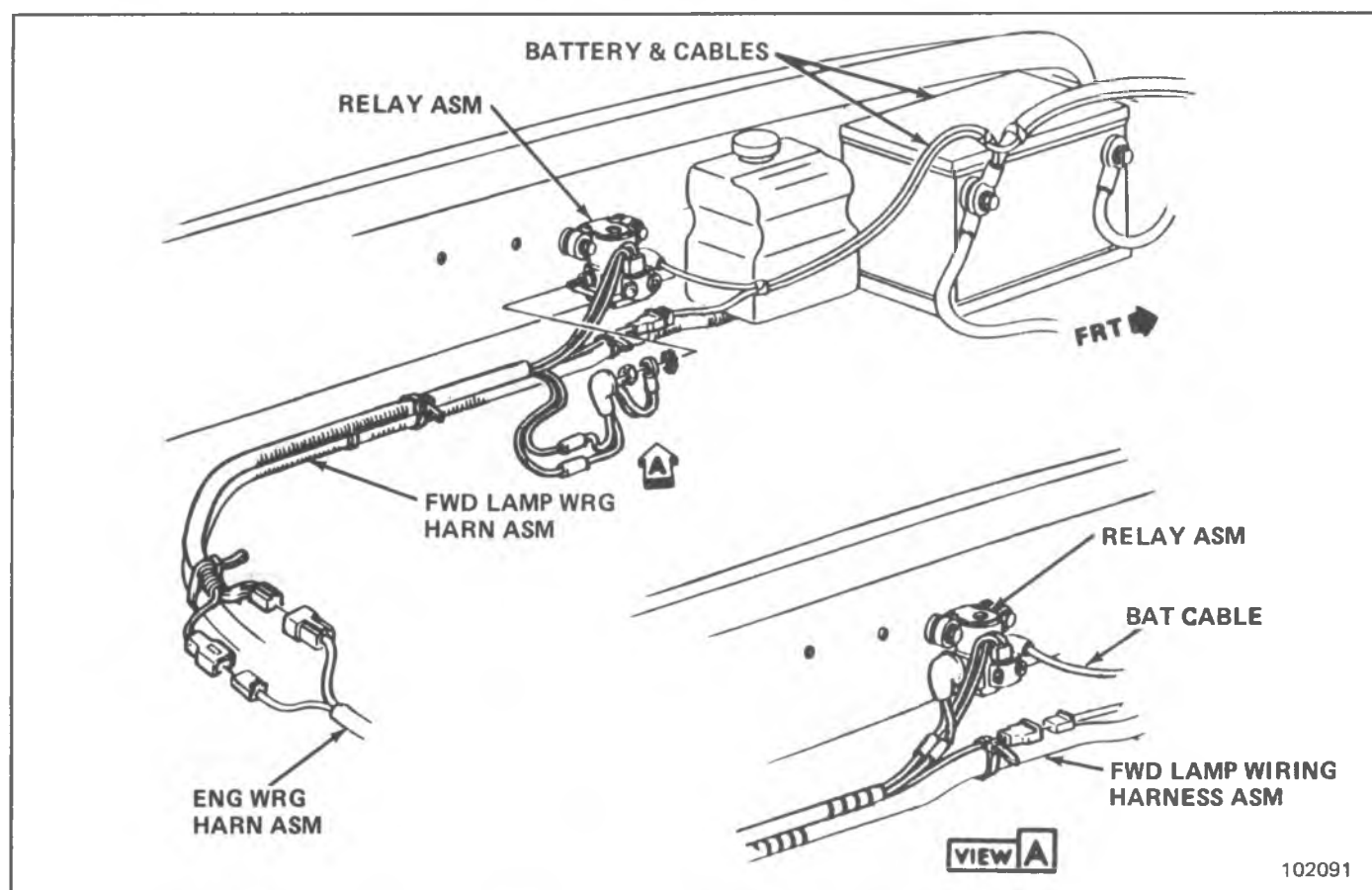


Fig. 6D-9D--Diesel Engine Wiring-Relay

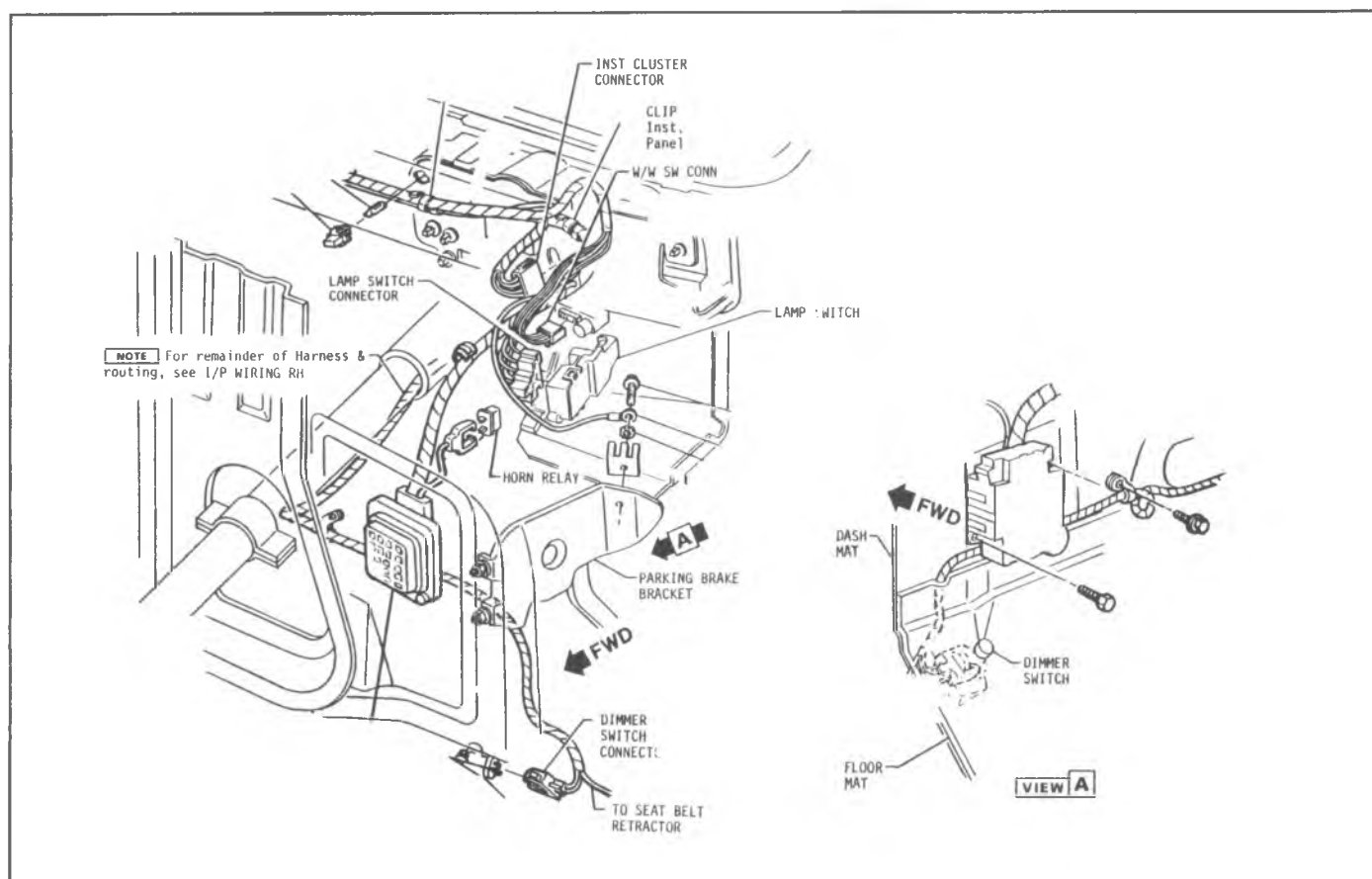


Fig. 6D-10D--I.P. Wiring-Left Side and Bus Bar Grd

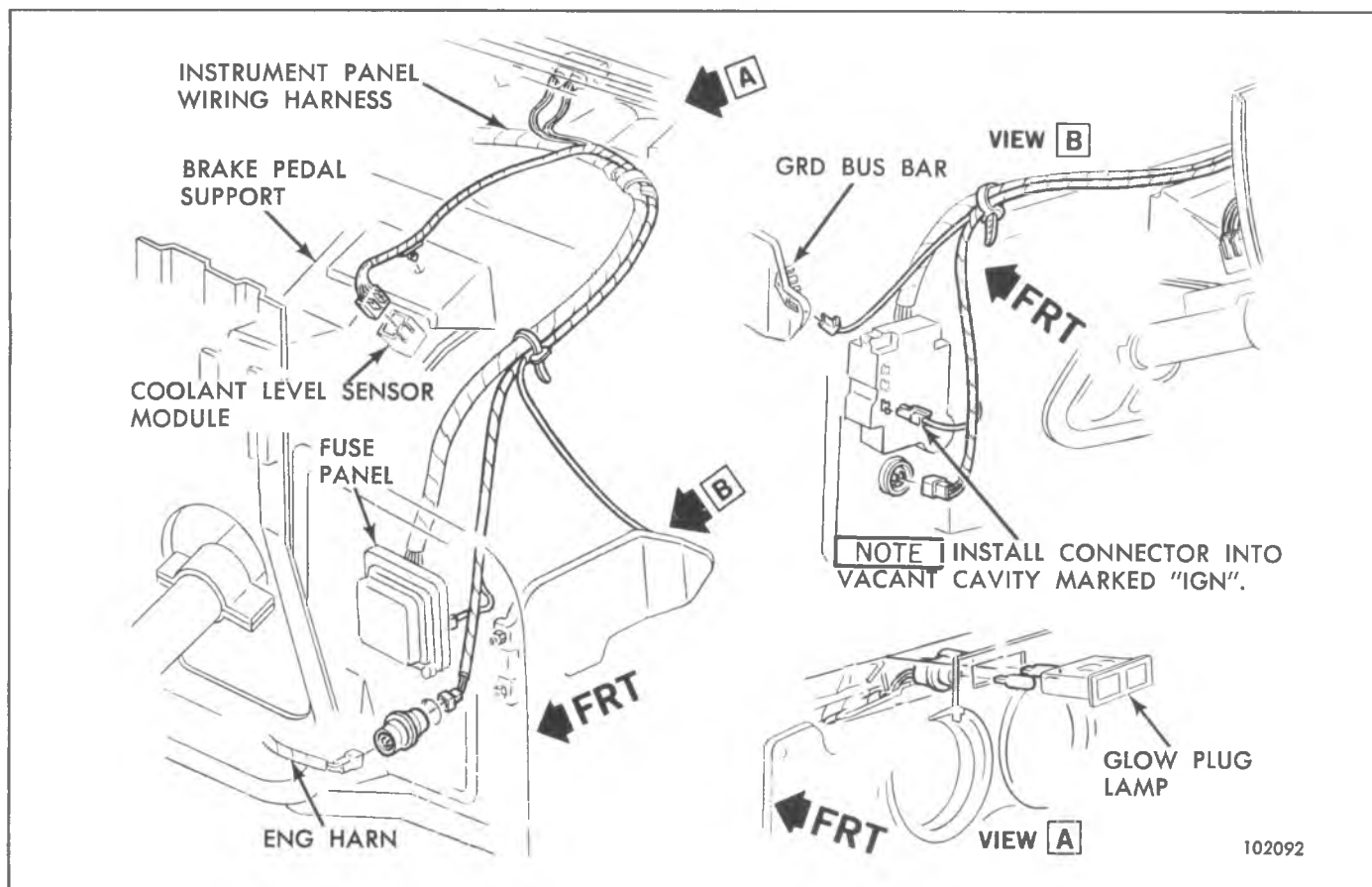


Fig. 6D-11D--Glow Plug Lamp Wiring

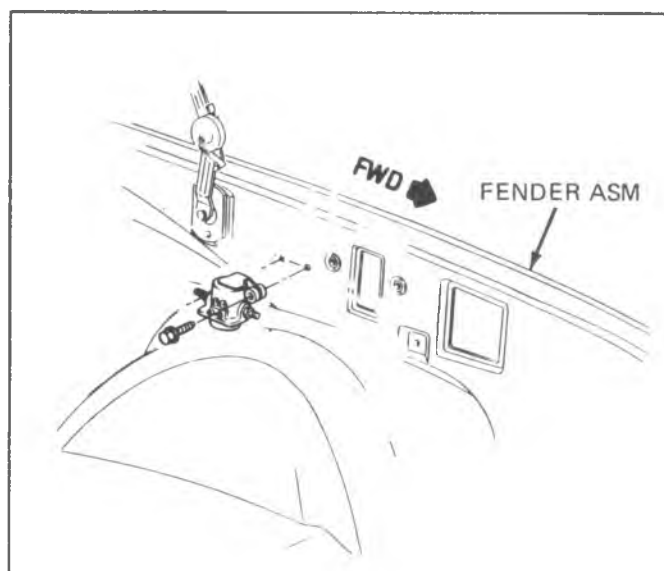


Fig. 6D-12D--Glow Plug Relay Mounting

IGNITION SYSTEM - CONVENTIONAL ENGINES

GENERAL DESCRIPTION

CONTENTS

General Description.....	6D-31	Remove and Replace.....	6D-38
H.E.I. Distributor.....	6D-31	Distributor	6D-38
Ignition Timing	6D-32	Module.....	6D-39
Secondary Wiring.....	6D-32	Pick-up Coil.....	6D-39
Spark Plugs.....	6D-32	Rotor.....	6D-39
Ignition Switch	6D-34	Vacuum Advance Unit.....	6D-39
Diagnosis.....	6D-34	Integral Ignition Coil	6D-39
H.E.I. Distributor.....	6D-34	Capacitor	6D-39
On-Vehicle Service.....	6D-38	Set Ignition Timing	6D-39
H.E.I. Distributor.....	6D-38	Spark Plug Wires	6D-39
		Unit Repair	6D-40

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-13D and 6D-14D). 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 suppression.

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.

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 adjusting spark timing. 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-15D)

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-15D)

The (ESC) sensor is a magnetostrictive device, mounted in the engine block that detects the presence (or absence) 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-16D)

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.

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.

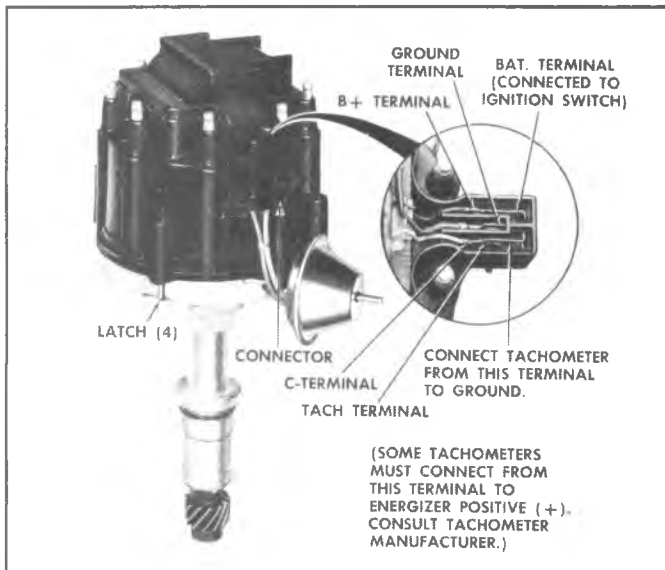


Fig. 6D-13D--HEI Distributor Assembly

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-17D)

Resistor type, tapered seat spark plugs are used on all gasoline engines. No gasket is used on these tapered seat plugs. See Fig. 6D-18D 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 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

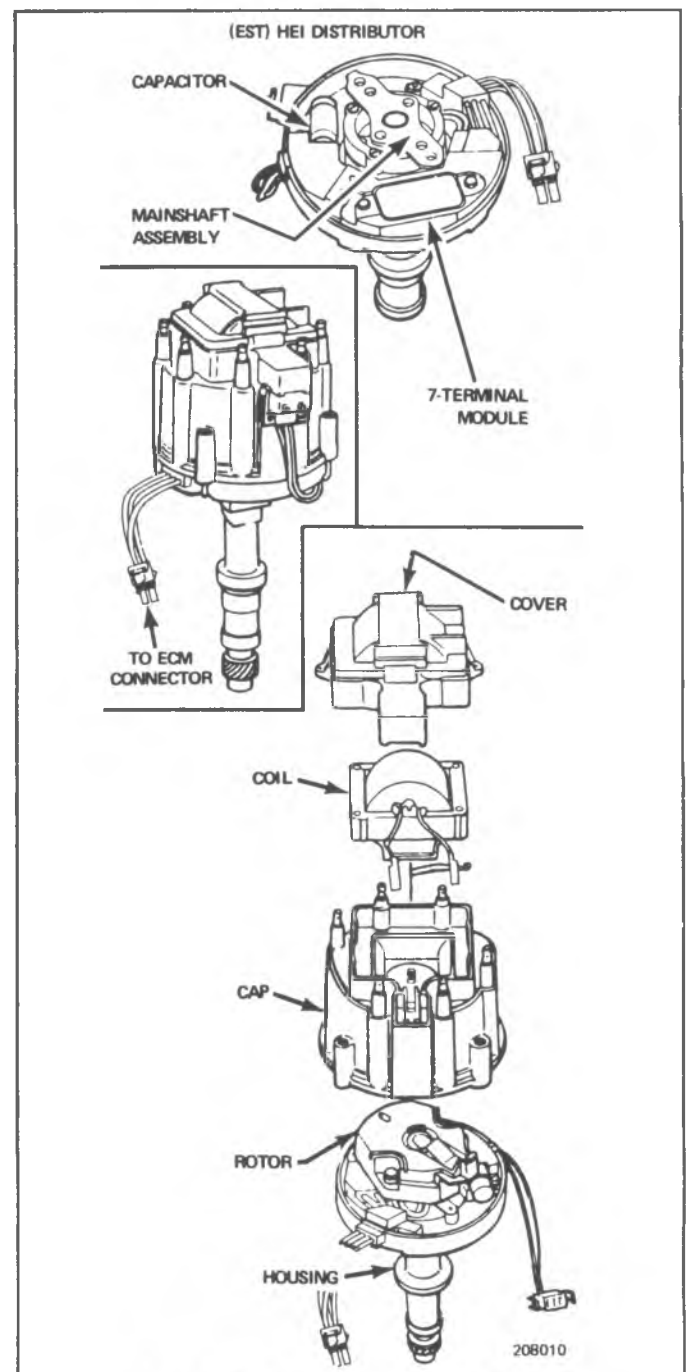


Fig. 6D-14D--HEI Distributor - Exploded View

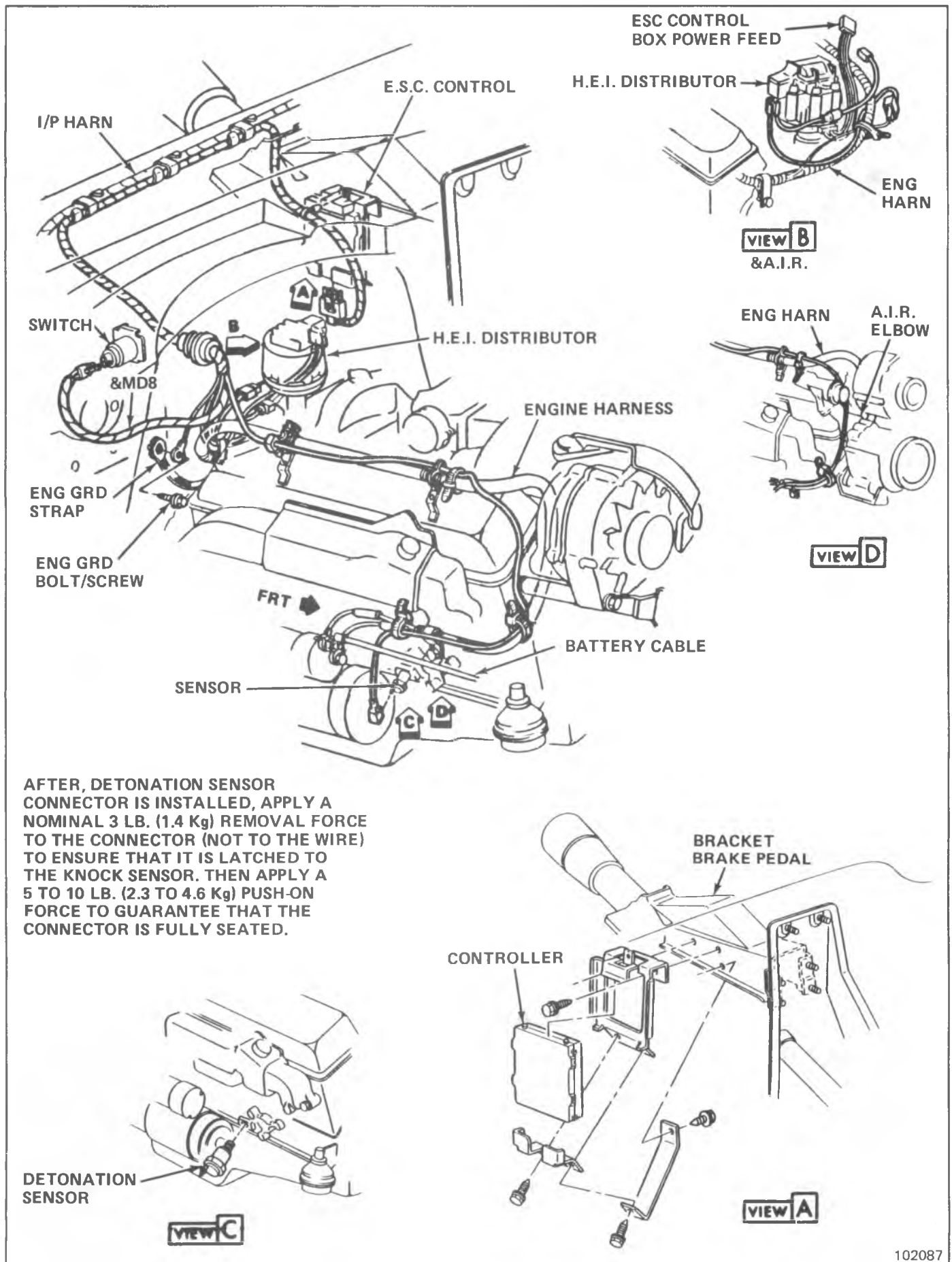


Fig. 6D-15D--ESC Controller, Sensor and Wiring

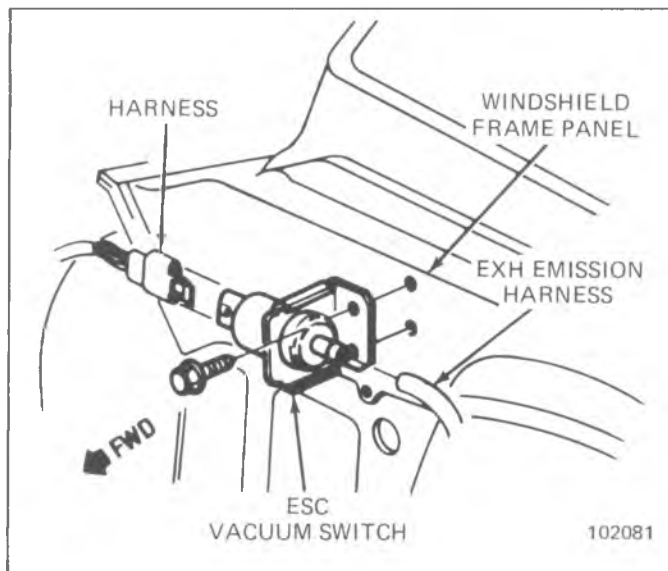


Fig. 6D-16D--ESC Vacuum Switch Mounting

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 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

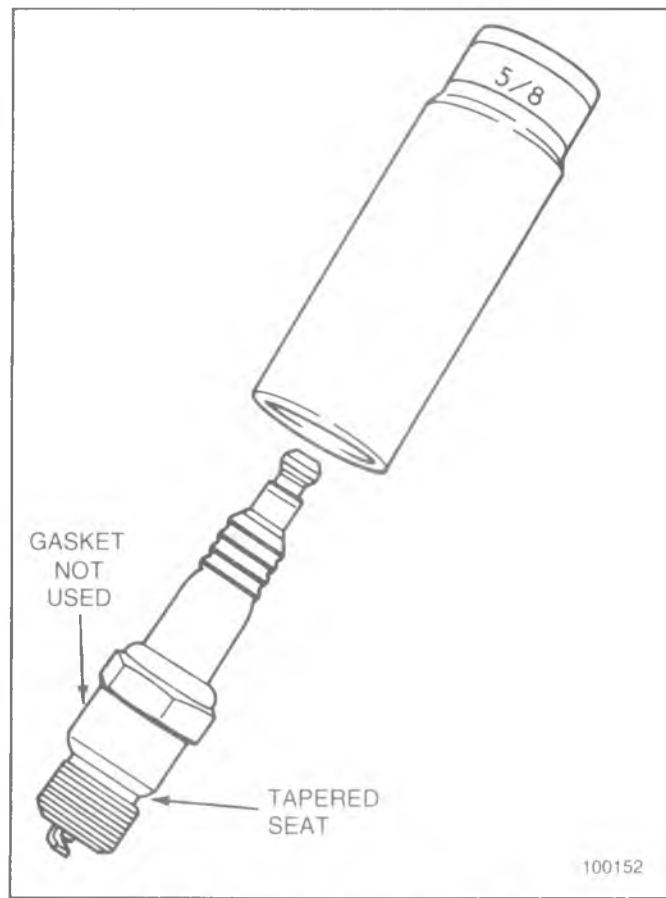


Fig. 6D-17D--Spark Plug - Tapered Seat

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.

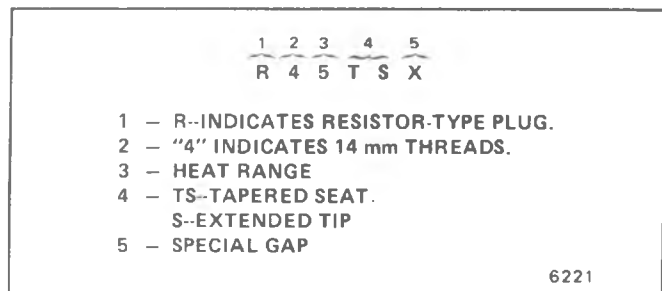


Fig. 6D-18D--Spark Plug Coding

DIAGNOSIS

H.E.I. DISTRIBUTOR

Use Figure 6D-19D and 20D 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

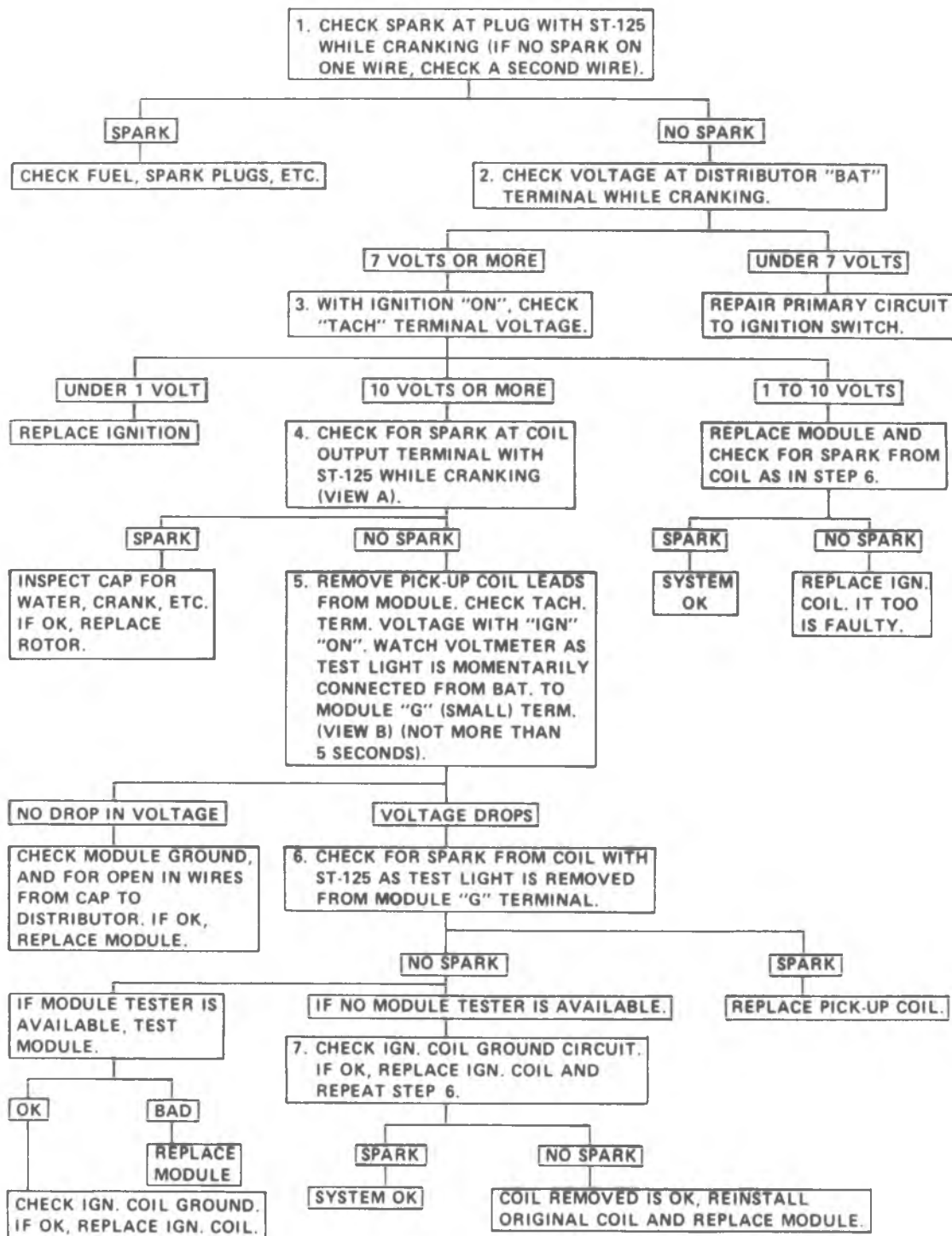
of the spark plug. Excessively lean carburetion will also result in excessive electrode wear.

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 START

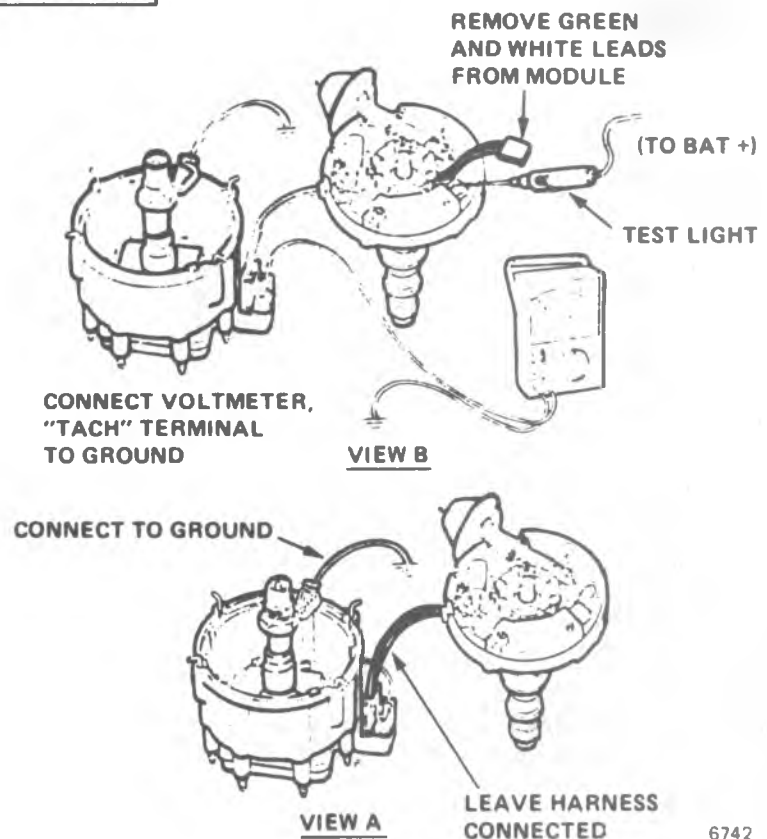
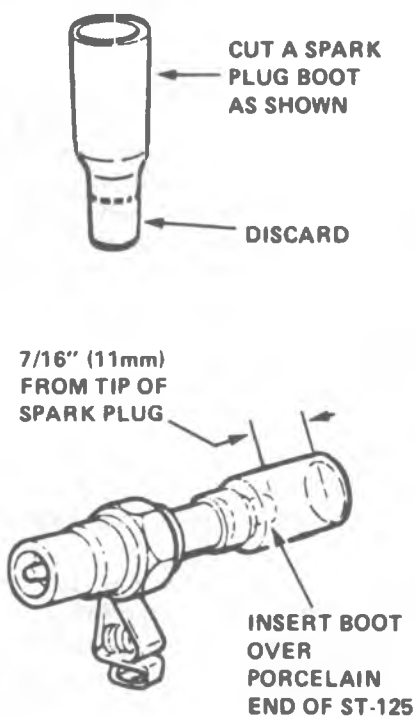
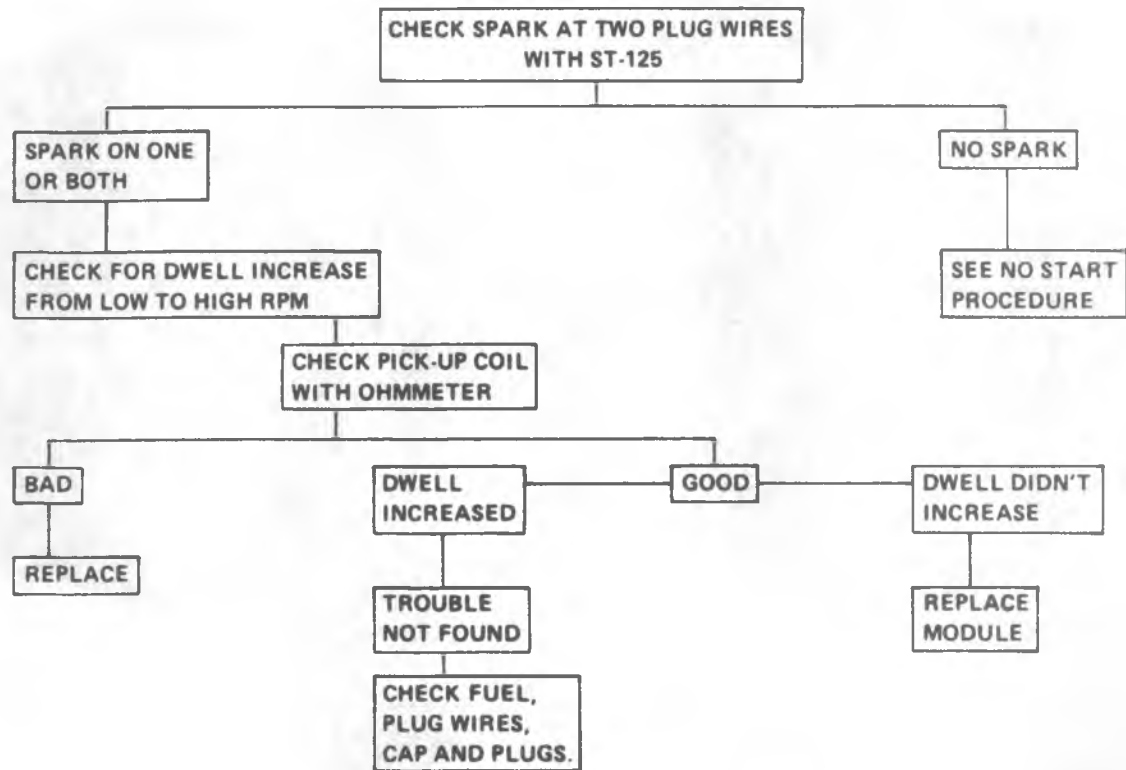
NOTE: IF A TACHOMETER IS CONNECTED TO THE TACHOMETER TERMINAL, DISCONNECT IT BEFORE PROCEEDING WITH THE TEST.



NOTE: VIEWS ARE IN PART 2.

6741

Fig. 6D-19D--HEI Diagnosis

INTERMITTENT OPERATION OR MISS

6742

Fig. 6D-20D--HEI Diagnosis

ON-VEHICLE SERVICE

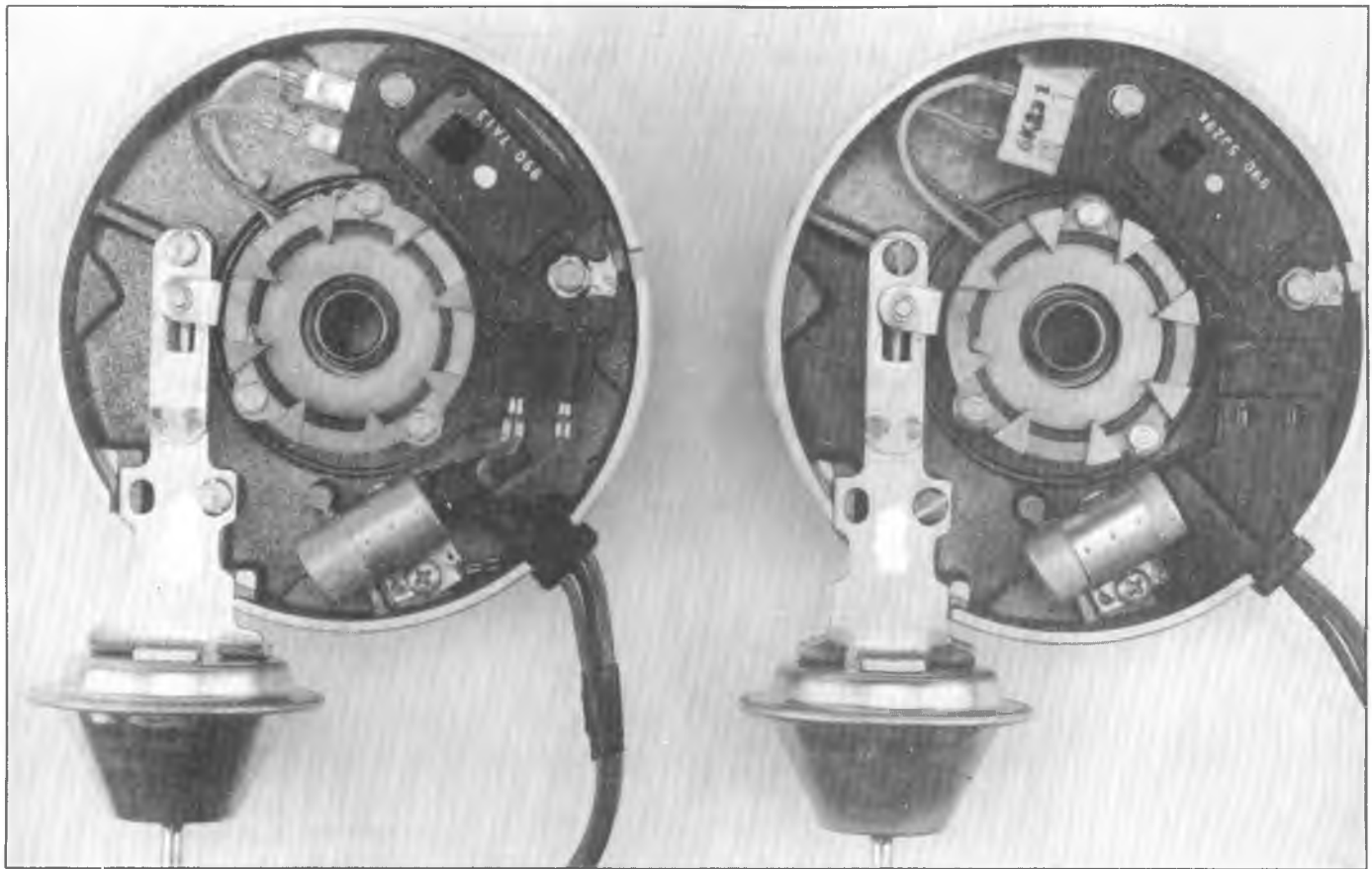


Fig. 6D-21D--Distributor Base and Components

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.

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 one position.

Integral Ignition Coil (Refer to Fig. 6D-21D)

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.

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-25D). 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

g. Check engine timing (see Set Ignition Timing below).

Vacuum Advance Unit (Refer to Fig. 6D-21D)

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.

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.

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.

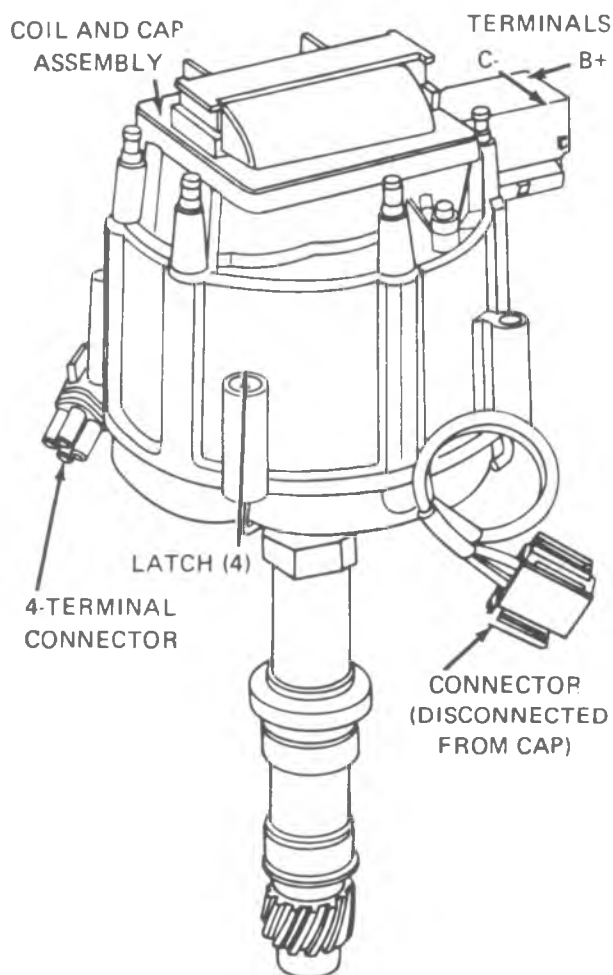
It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

Refer to Figure 6D-26D for proper spark plug wire routing.

Unit Repair

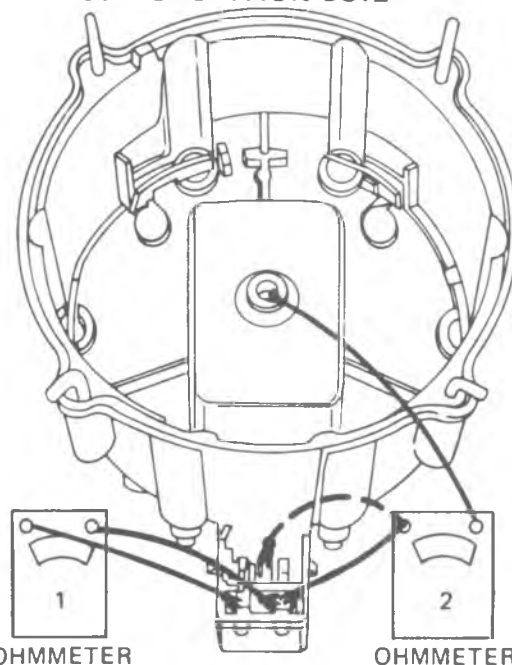
DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (COIL IN CAP)

"COIL IN CAP" DISTRIBUTOR



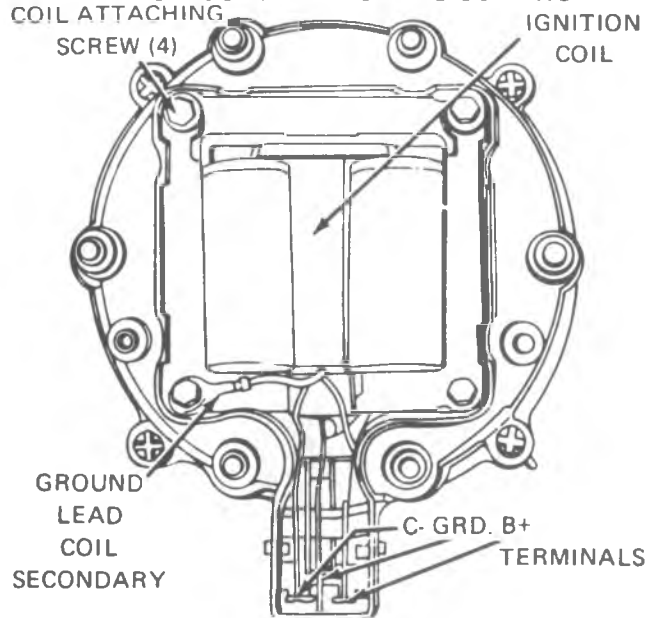
1. A 6-cyl. EST distributor with coil-in-cap is illustrated.
2. Detach wiring connector from cap, as shown.
3. Turn four latches and remove cap and coil assembly from lower housing.

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.

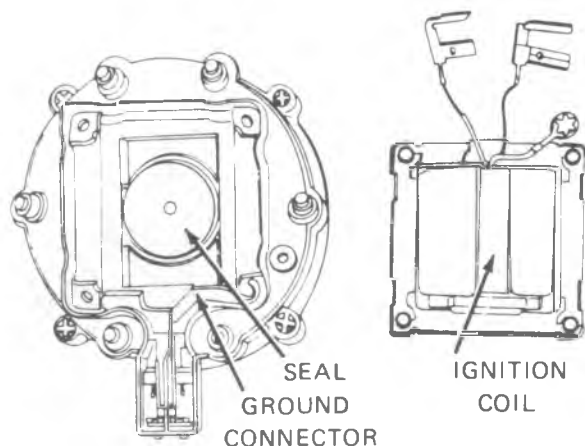
IGNITION COIL ATTACHING SCREWS



8. Remove coil-cover attaching screws and lift off cover.

Fig. 6D-22D--Distributor Unit Repair

IGNITION COIL REMOVED FROM CAP



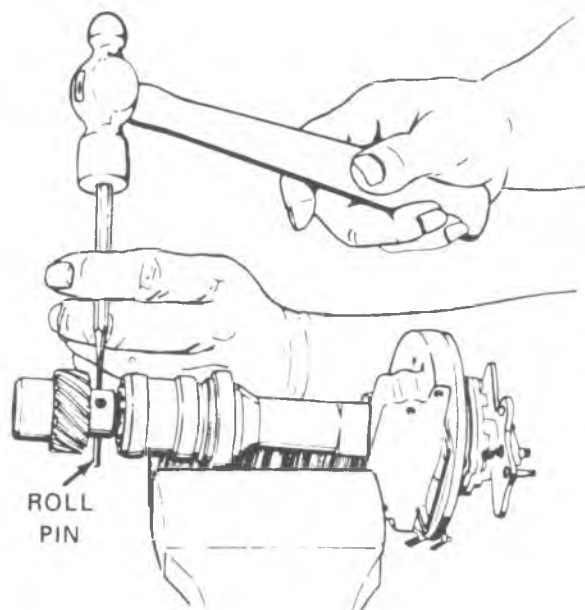
9. Remove ignition coil attaching screws and lift coil with leads from cap.

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.

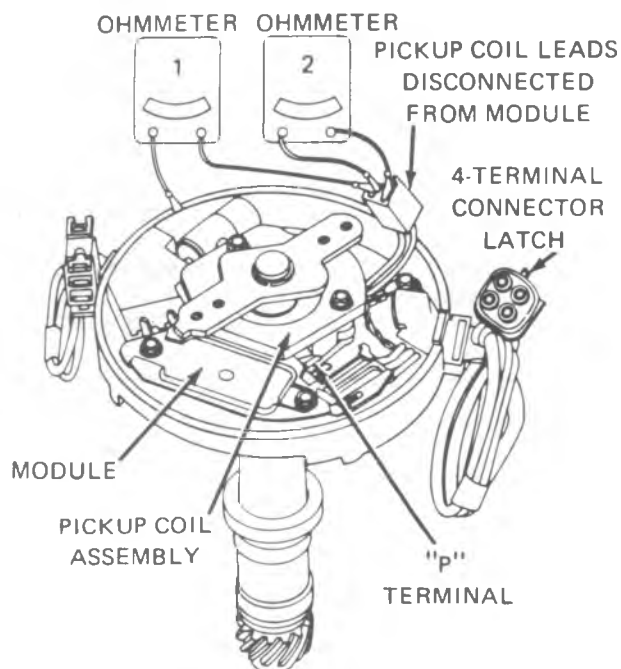
DRIVING PIN FROM SHAFT



18. Mark distributor shaft and gear so they can be reassembled in same position.

19. Drive out roll pin.

TESTING PICKUP COIL



13. On all distributors, 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.

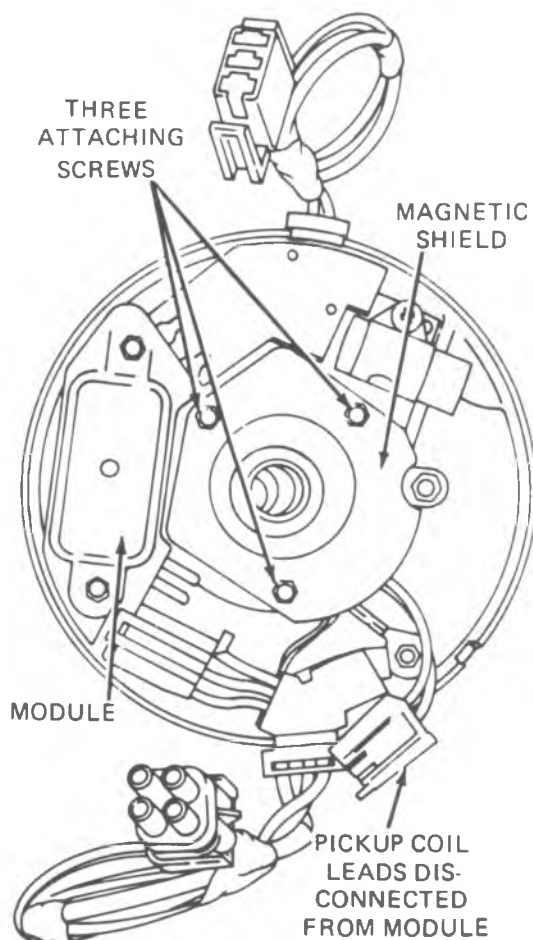
16. Test 1 — should read infinite at all times.

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.

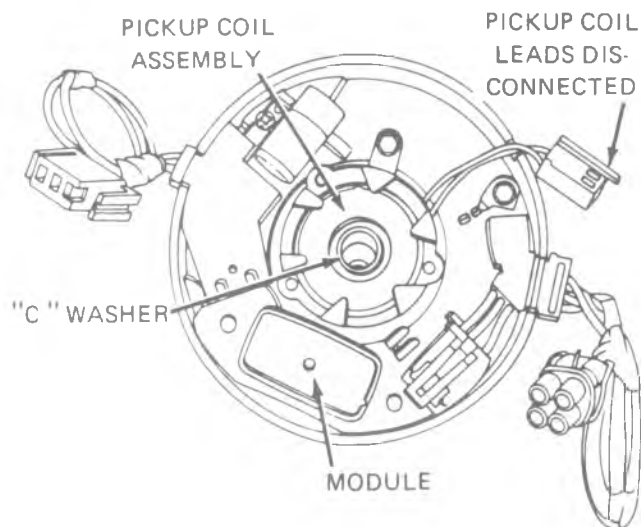
SHAFT ASSEMBLY REMOVED



20. Remove gear and pull shaft assembly from distributor.

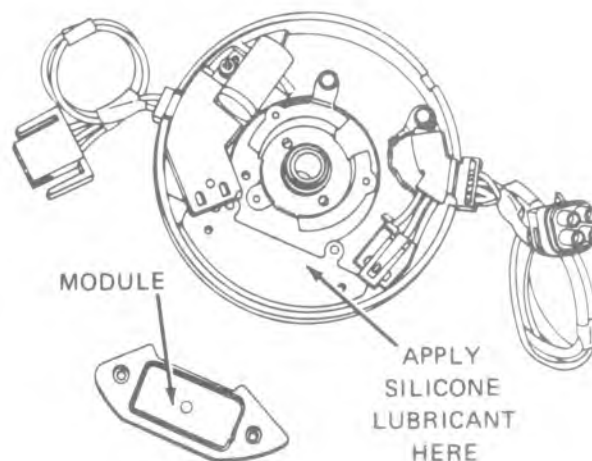
Fig. 6D-23D--Distributor Unit Repair

ALUMINUM NON-MAGNETIC SHIELD REMOVED



21. Remove three attaching screws and remove magnetic shield.

MODULE REMOVED



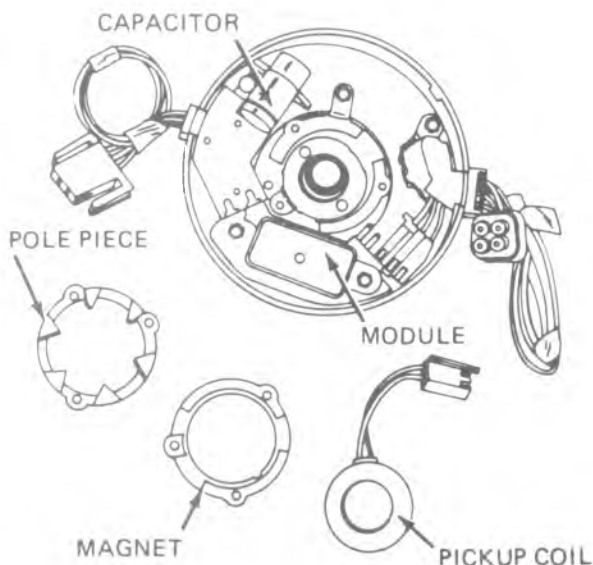
23. Remove two module attaching screws, and capacitor attaching screw. Lift module, capacitor and harness assembly from base.

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.

INSTALL PICKUP COIL, SHAFT ASSEMBLY AND CAP

27. Install pickup coil assembly, shaft and gear.

28. Spin shaft and if used, operate the vacuum unit to insure that teeth do not touch.

To eliminate contact, loosen three pickup screws, then re-tighten and check for contact.

29. Assemble rotor, cap assembly and attach wiring harness to cap.

Fig. 6D-24D-Distributor Unit Repair



Fig. 6D-25D--Timing Mark - Typical

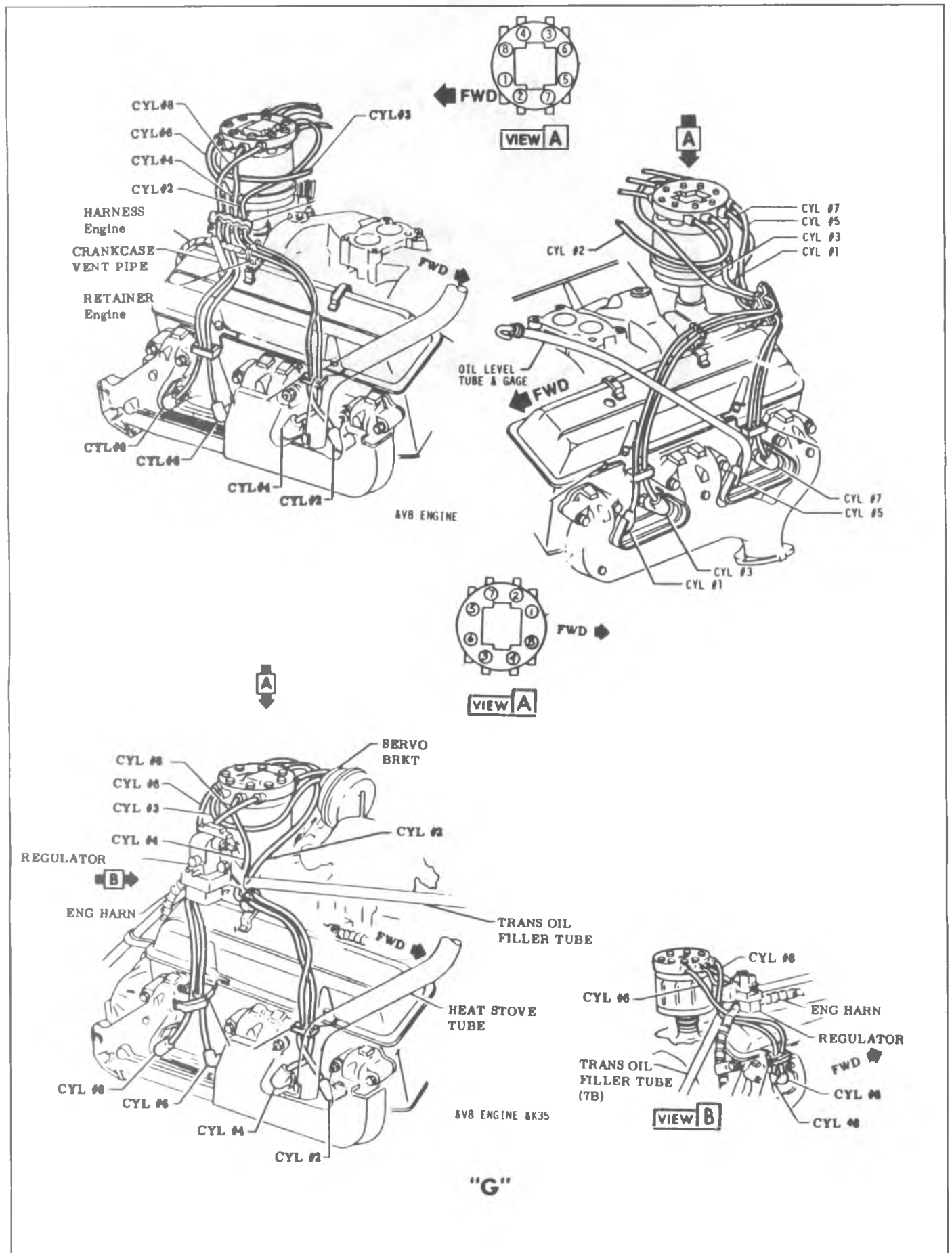


Fig. 6D-26D--Spark Plug Wire Routing

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-28D through 6D-33D.

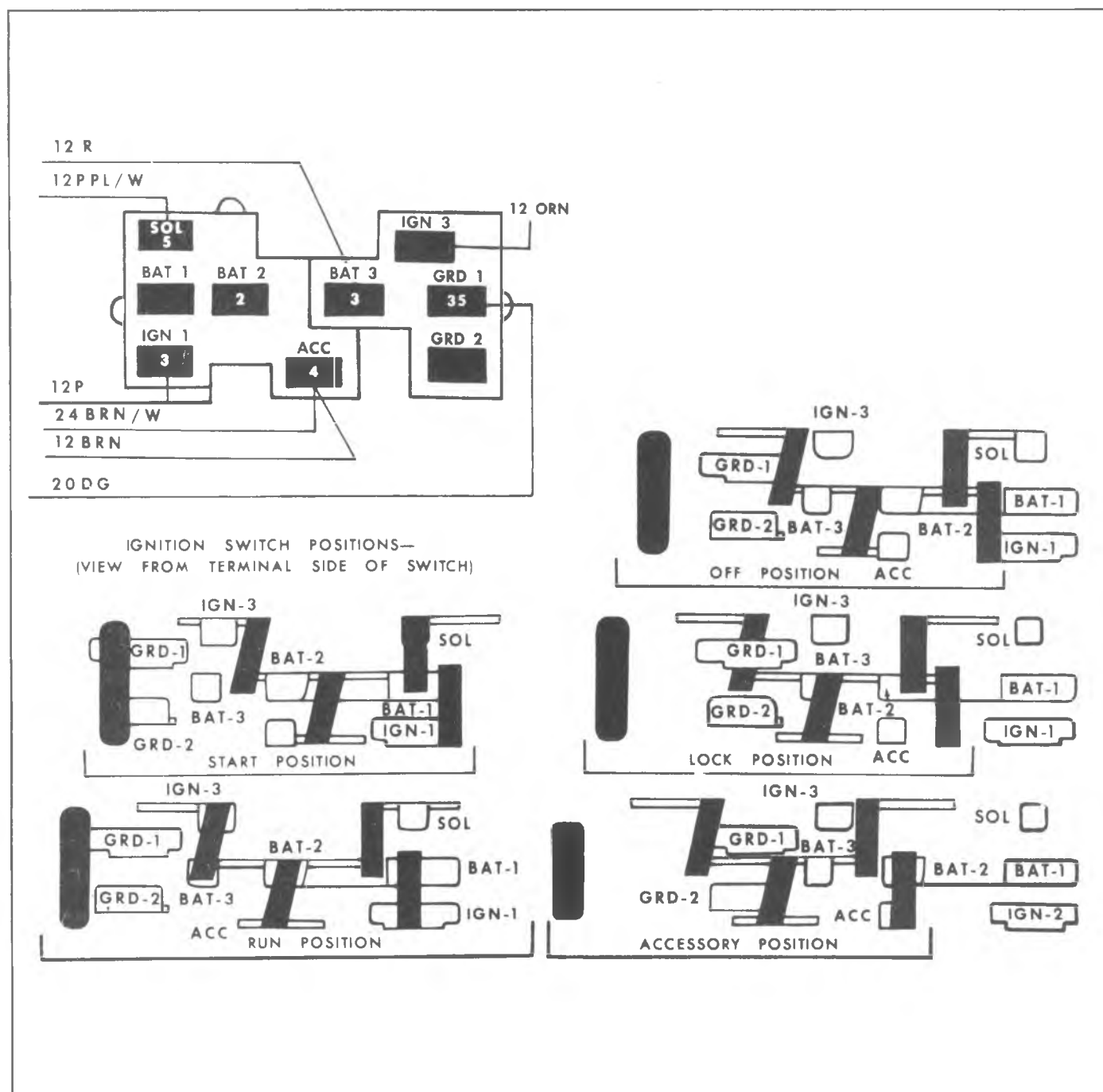
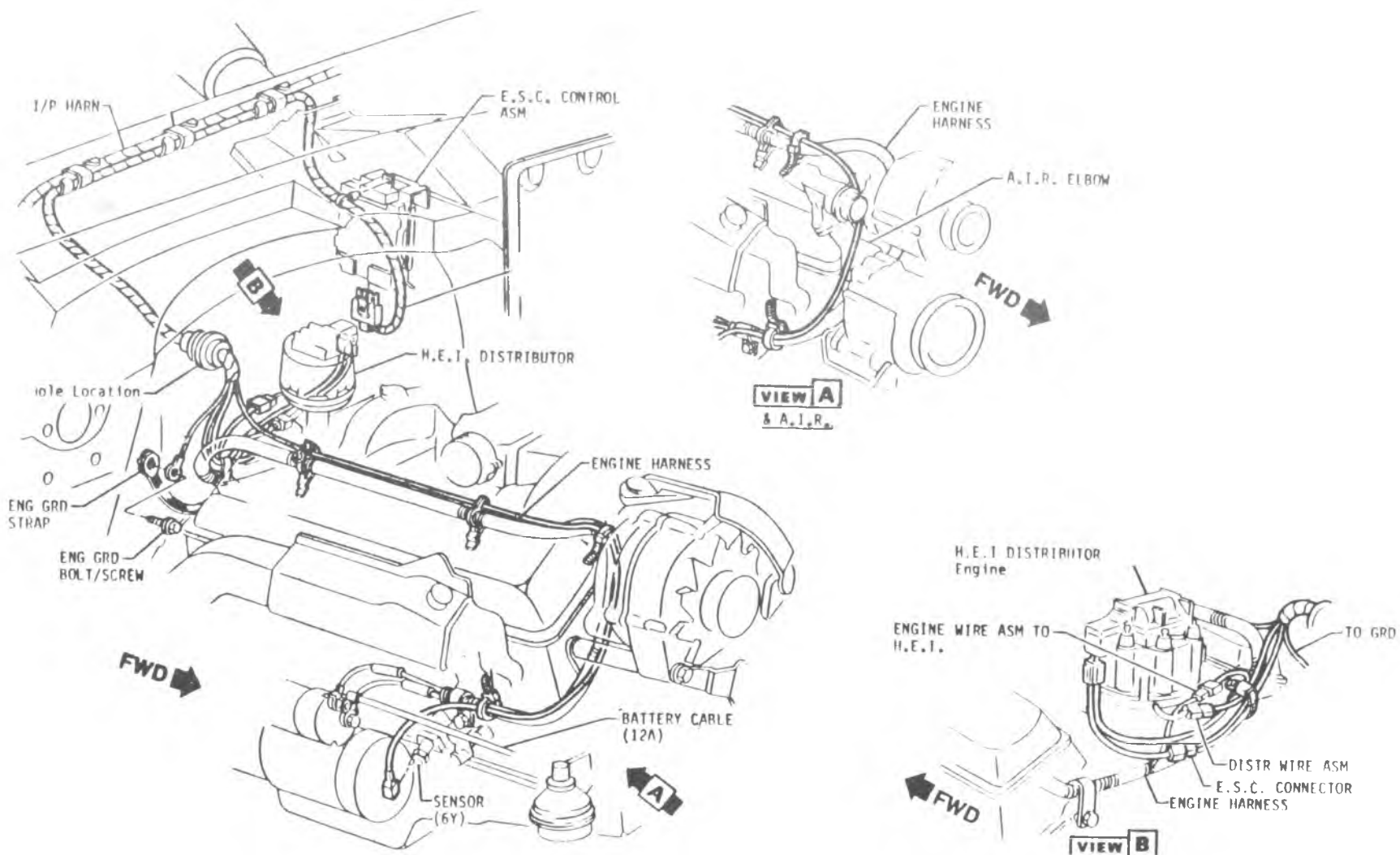


Fig. 6D-27D--Ignition Switch Circuit

Fig. 6D-28D--Engine Wiring LE9, LF3, LG9, LS9



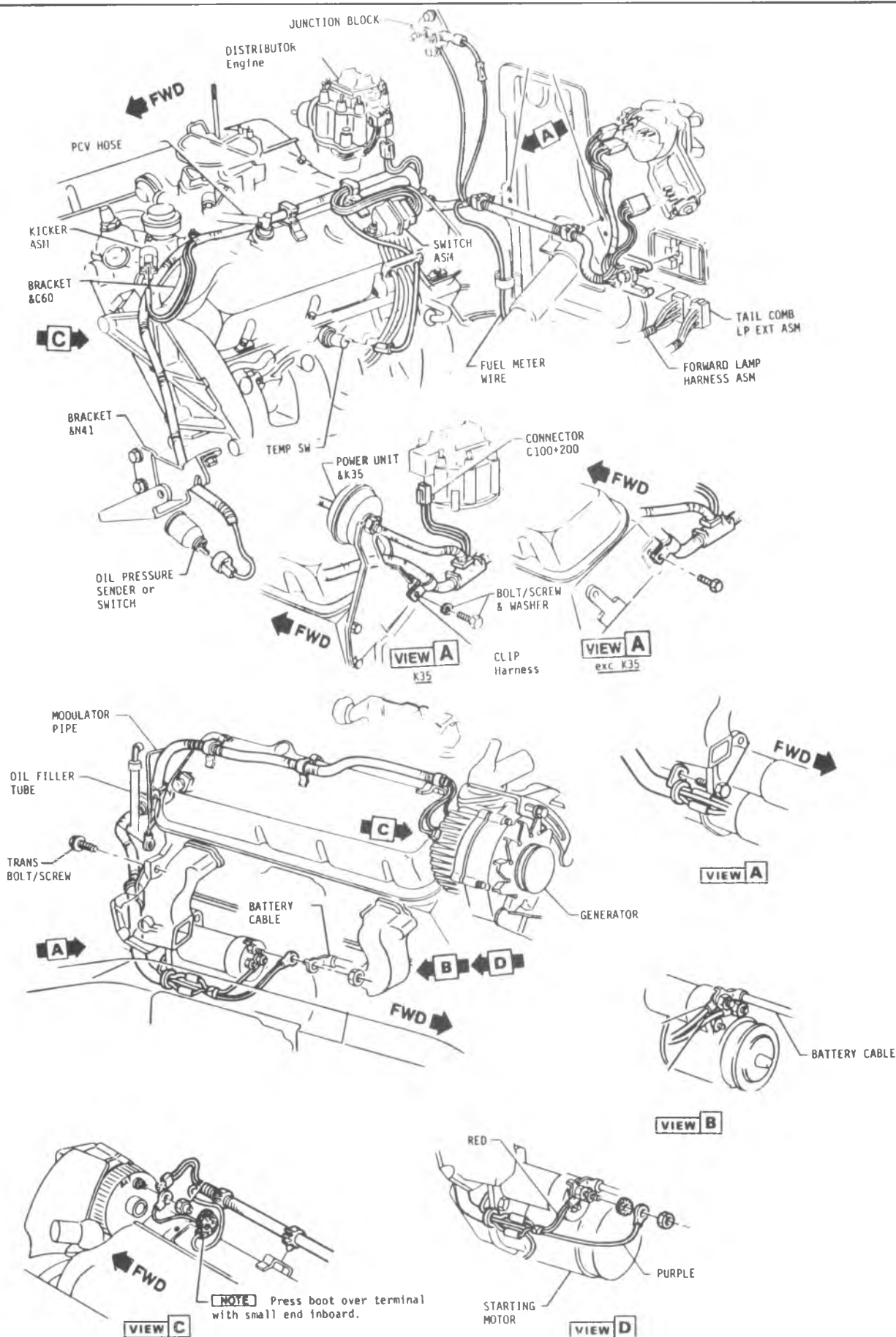


Fig. 6D-29D--Engine Wiring CK-20, 30 - LE8

ENGINE DETONATION ① ②**CHEVROLET LIGHT TRUCK
ESC SYSTEM DIAGNOSIS**

BEFORE ATTEMPTING ANY
DIAGNOSIS, CHECK CONNECTION
AT DETONATION SENSOR AND
INSURE THAT ALL CONNECTIONS
ARE CLEAN AND TIGHT.

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 CON-
TROLLER. MEASURE RESISTANCE FROM PIN B TO
PIN K IN CONNECTOR. SHOULD BE 175-375 OHMS.

HIGH
OR
LOW

DISCONNECT SENSOR WIRE FROM SENSOR. MEA-
SURE RESISTANCE FROM SENSOR TERMINAL TO
GROUND. SHOULD BE 175-375 OHMS.

OK

TRY TO START ENGINE (WITH 10-PIN CONNECTOR
DISCONNECTED).

HIGH
OR LOW

REPLACE SENSOR.

NO START

START

REPLACE DISTRIBUTOR
MODULE.

CHECK WIRES FROM PINS
A, B, & K (IN 10-PIN
CONNECTOR) FOR OPEN
& SHORT CIRCUITS.

OK

REPAIR SENSOR
CONNECTOR.

NOT OK

REPAIR HARNESS.

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 THIS DIAGNOSIS SHOULD BE INSERTED WITH OR IMMEDIATELY AFTER ITEM a. (FAULTY IGNITION SYSTEM) OF THE "ENGINE DETONATION" SECTION ON PAGE 6A-7 OF THE 1980 LIGHT DUTY TRUCK SERVICE MANUAL
- ② SOME OCCASIONAL TRACE-TO-LIGHT DETONATION IS ACCEPTABLE.

CHEVROLET LIGHT TRUCK ESC SYSTEM DIAGNOSIS

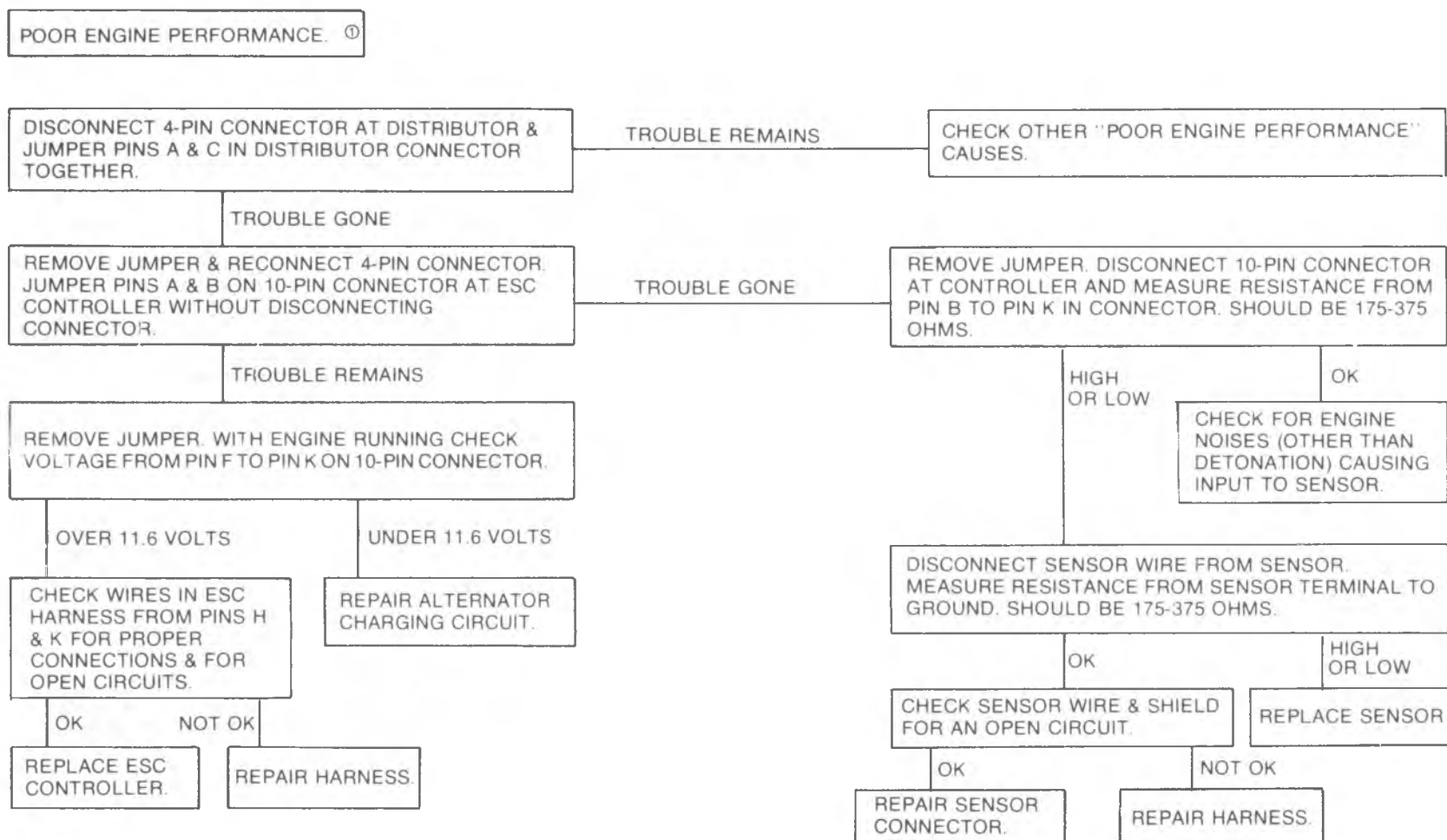
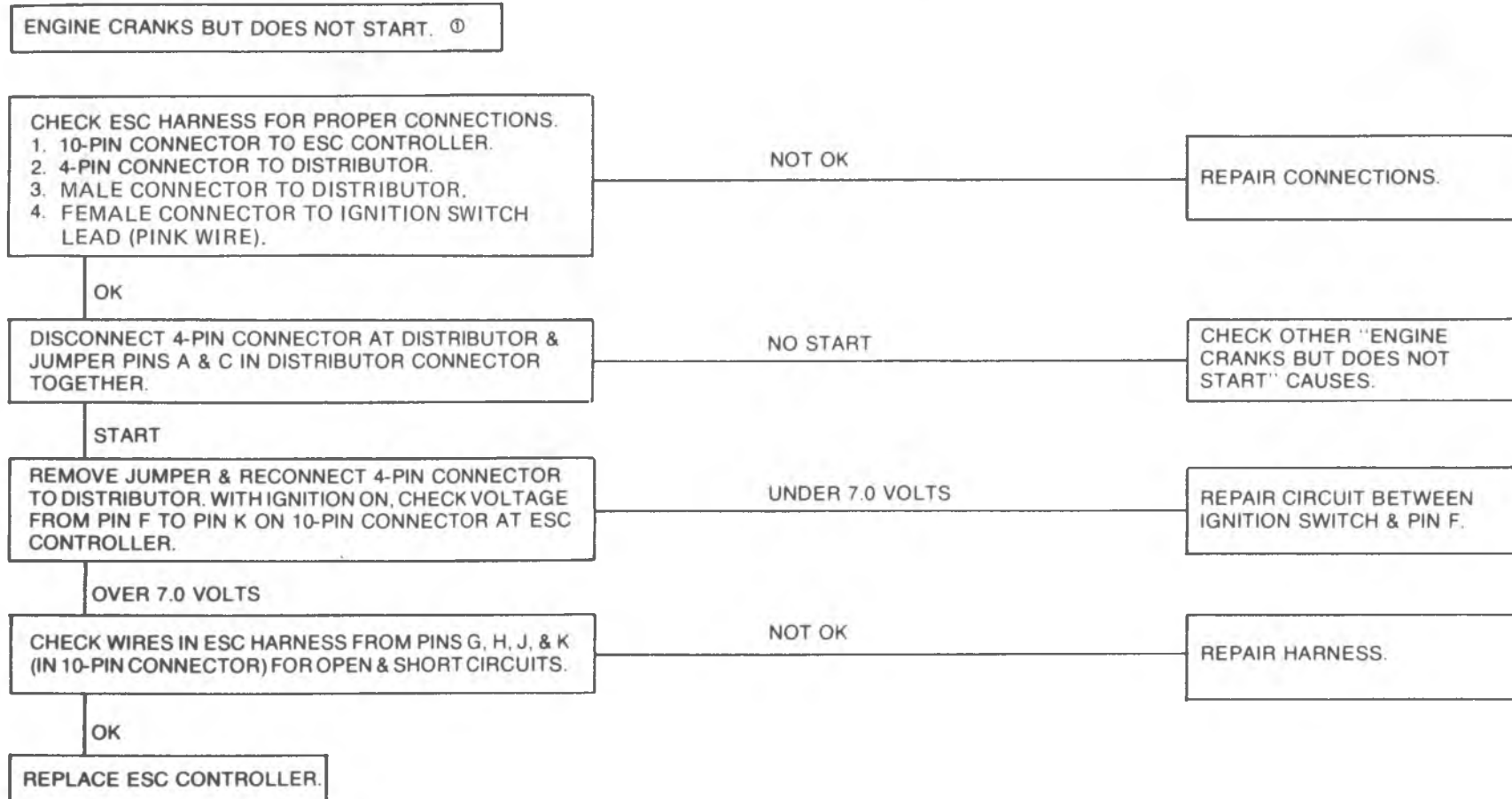


Fig. 6D-31D--Engine Wiring G Series IEC3

CHEVROLET LIGHT TRUCK ESC SYSTEM DIAGNOSIS



① THIS DIAGNOSIS SHOULD BE INSERTED WITH OR IMMEDIATELY AFTER ITEM g. (IGNITION PROBLEMS) OF THE "ENGINE FAILS TO START" SECTION ON PAGE 6A-2 OF THE 1980 LIGHT DUTY TRUCK SERVICE MANUAL.

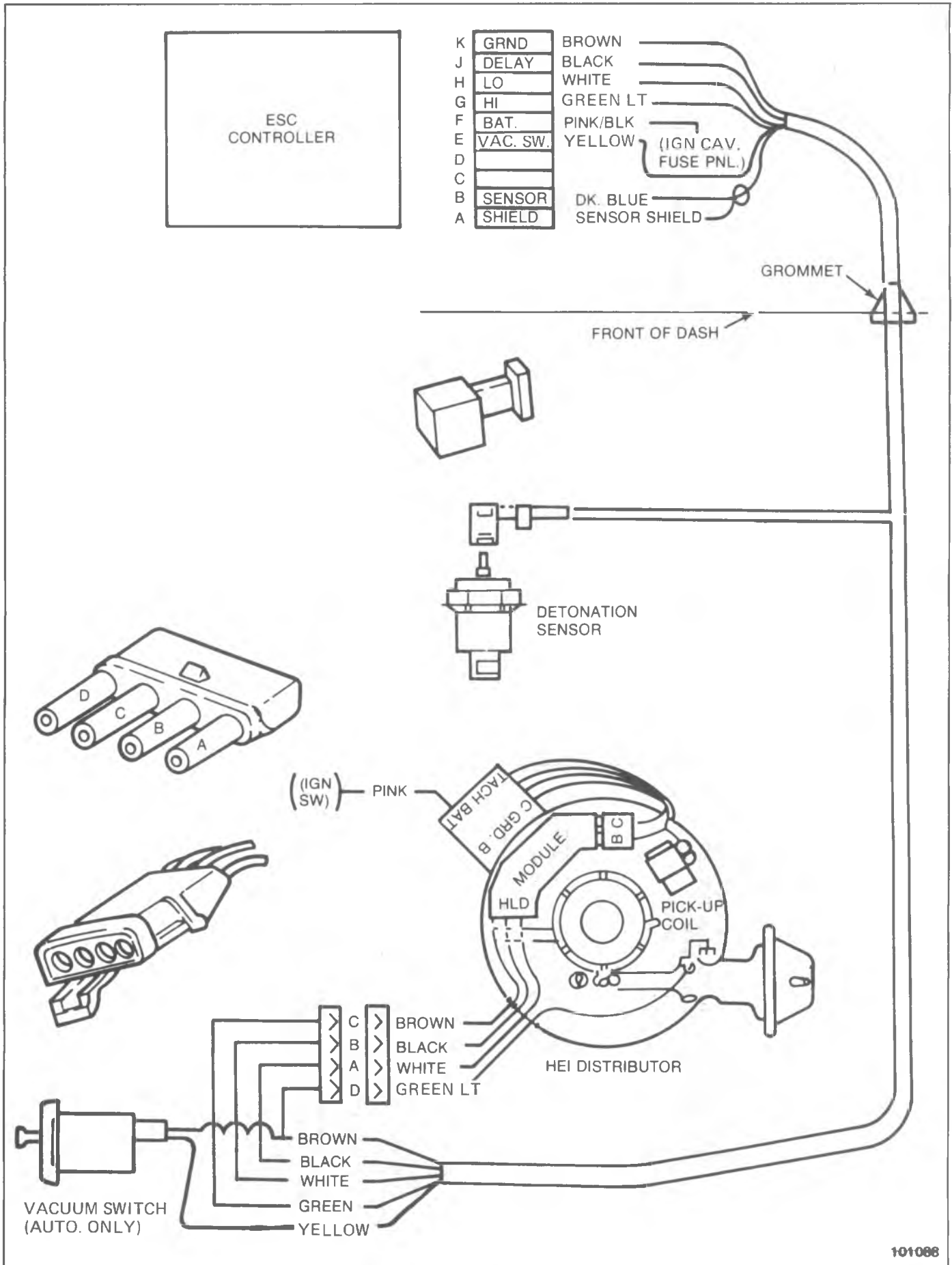


Fig. 6D-33D-Engine Wiring CK Series - LE9

CRANKING SYSTEM

General Description.....	6D-53	Solenoid	6D-59
Cranking Circuit	6D-53	Overhaul	6D-60
Starter Motor	6D-53	Disassembly	6D-61
Diagnosis.....	6D-55	Component Inspection.....	6D-62
On-Vehicle Service.....	6D-59	Reassembly	6D-64
Remove and Replace.....	6D-59	Specifications	6D-66
Starter	6D-59		

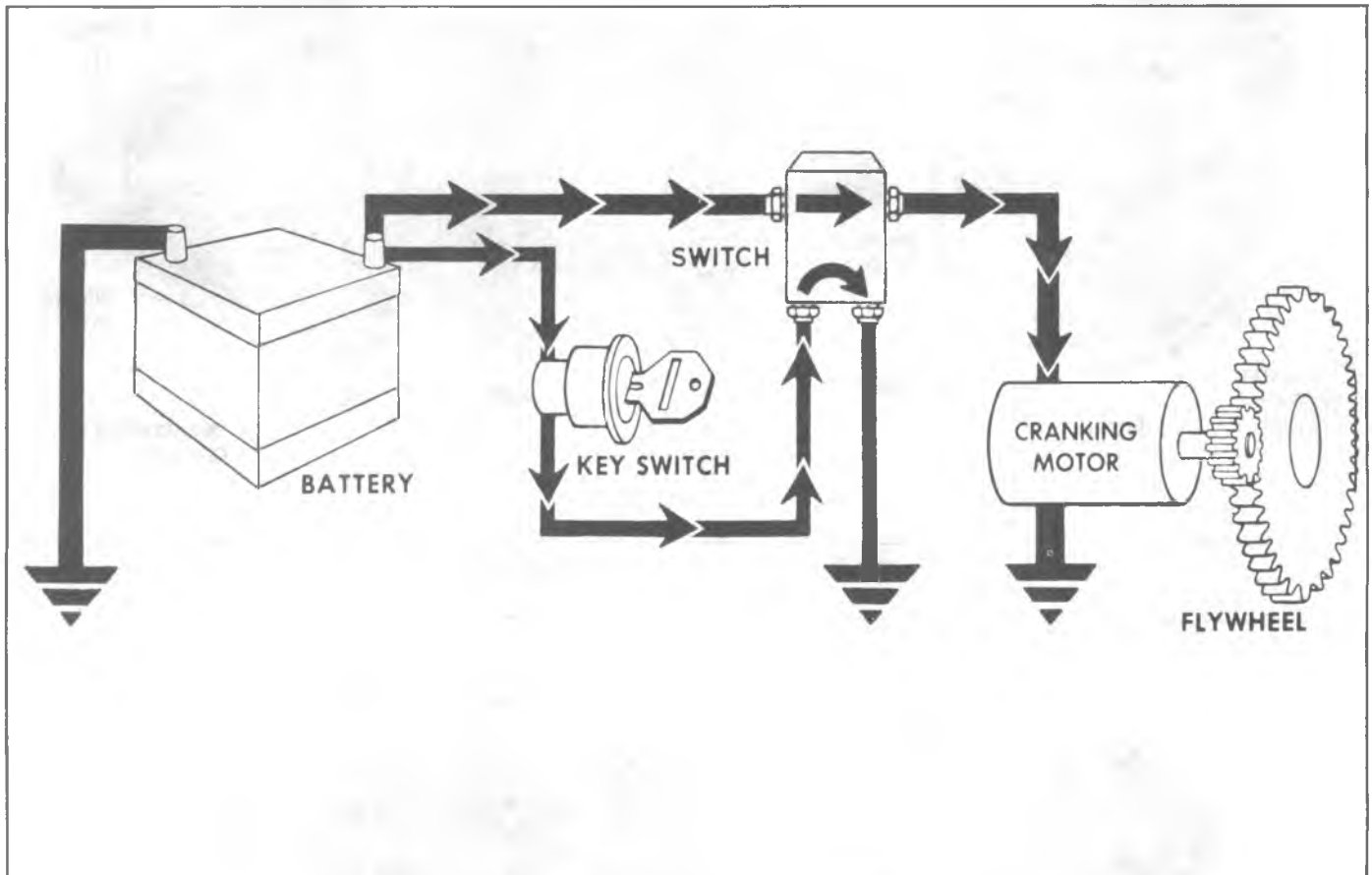


Fig. 6D-1E--Cranking Circuit - All

GENERAL DESCRIPTION

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-1E. Only the starting motor will be covered in this portion.

STARTING MOTOR

Two types of starter motors are used. The first, referred to as the 10MT series, is shown in Fig. 6D-2E. The second type, referred to as the 27MT series used on diesel equipped engines, is shown in Fig. 6D-3E. The main difference is that the 27MT has a center bearing. Fig. 6D-4E shows an exploded view of the 27MT series. 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.

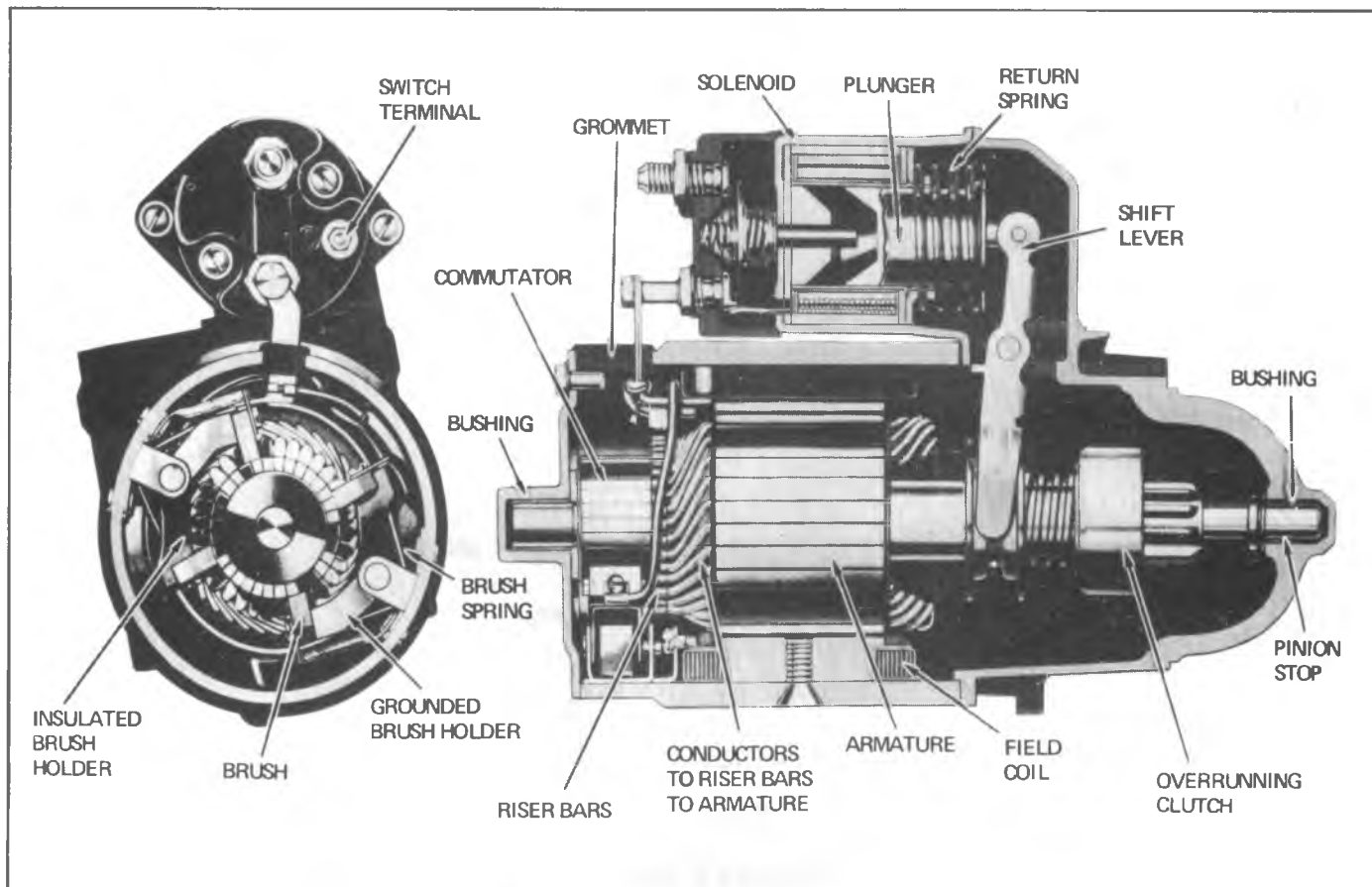


Fig. 6D-2E--Cross Section of 10MT Starting Motor

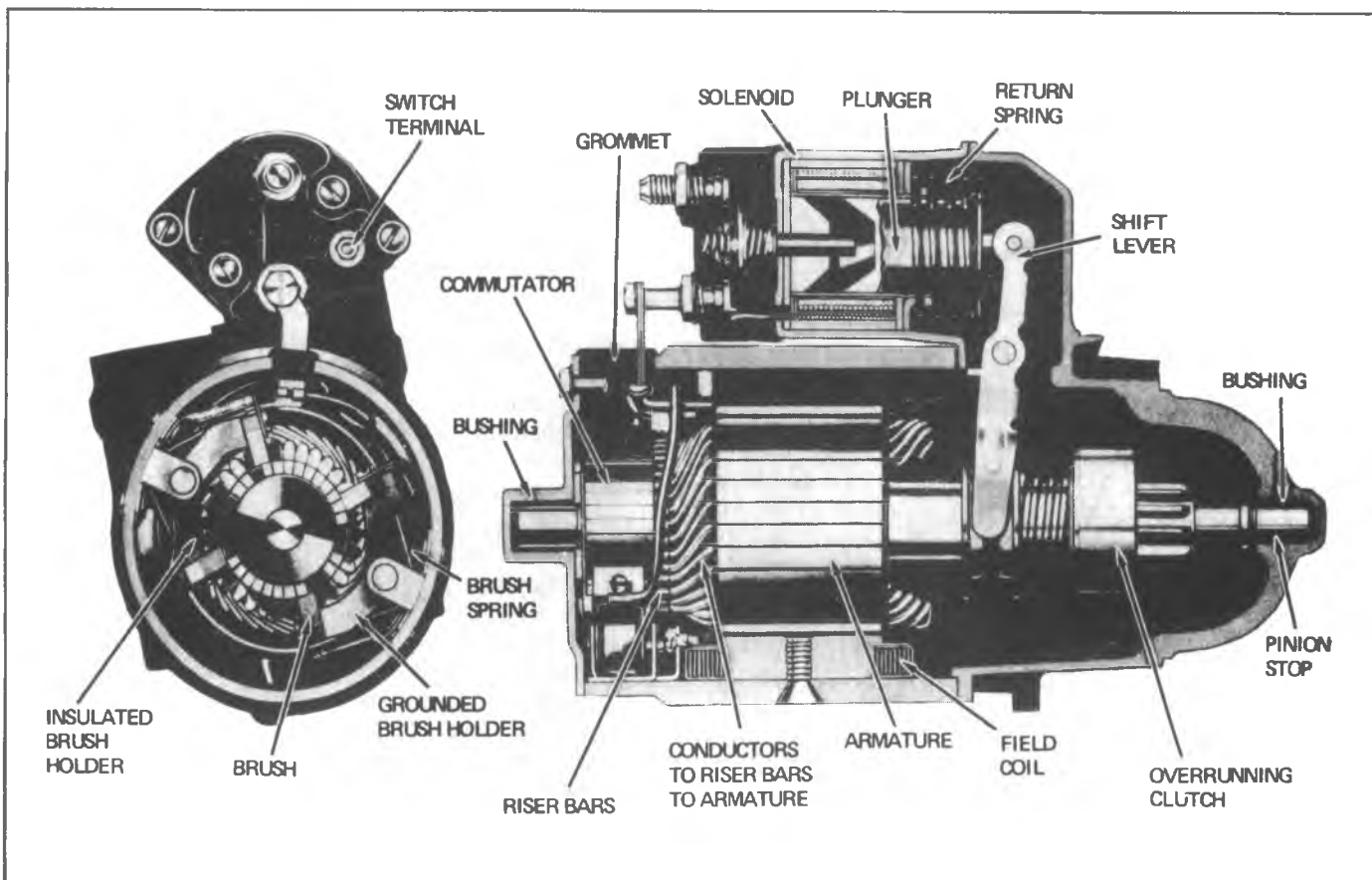


Fig. 6D-3E--Cross Section of 27MT Starting Motor

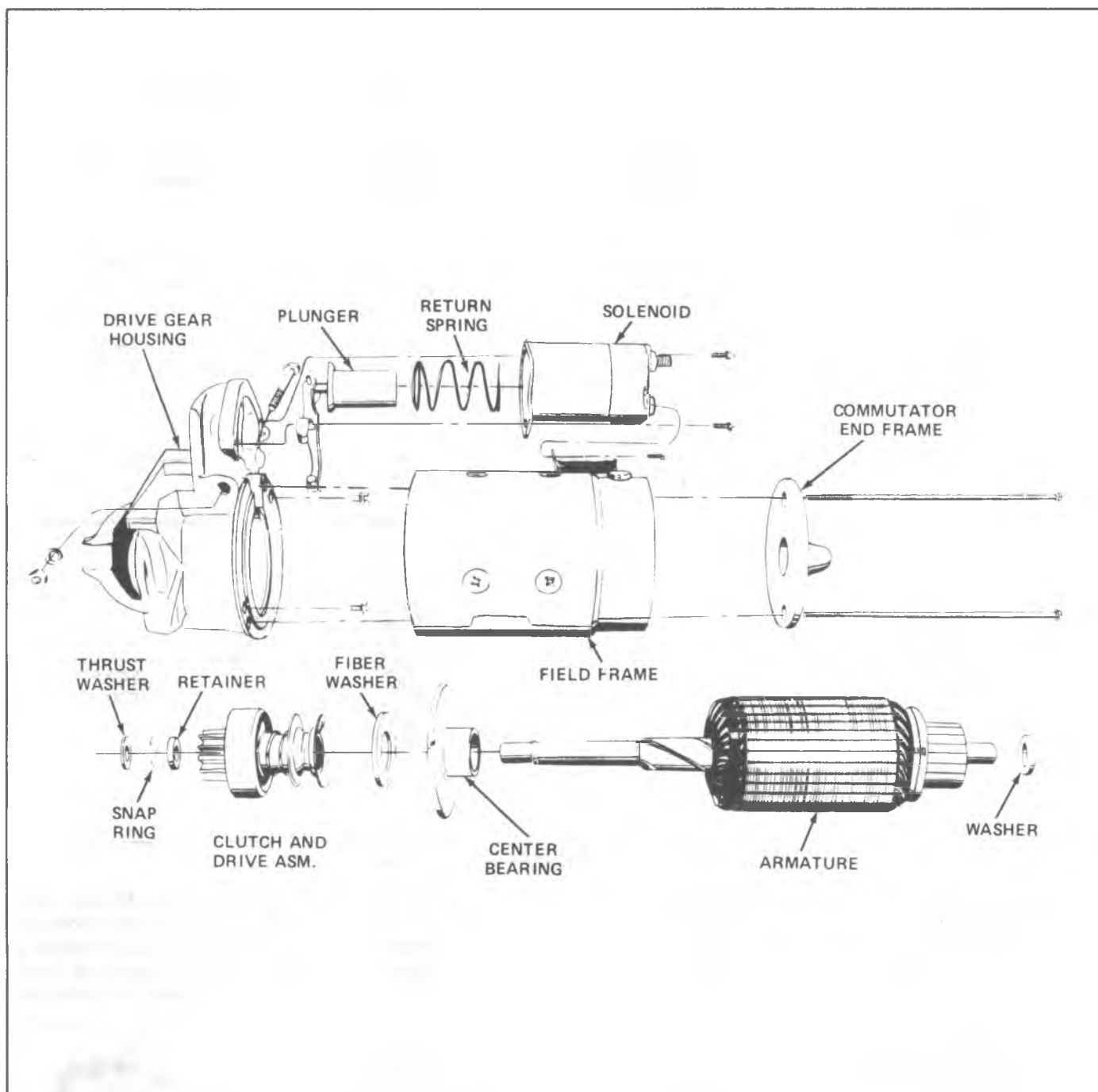


Fig. 6D-4E--Exploded View of 27MT Starting Motor

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-5E to determine the problem.
2. If the complaint is similar to problem categories 1 or 2 above, correction can be achieved by proper "shimming" as follows:
 - a. Remove lower flywheel housing cover and examine for visual problems - bent flywheel, unusual wear, etc.

PROBLEM

1. HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.
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."
3. A LOUD "WHOOOP" 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.
4. A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.

CAUSE

DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL.

DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.

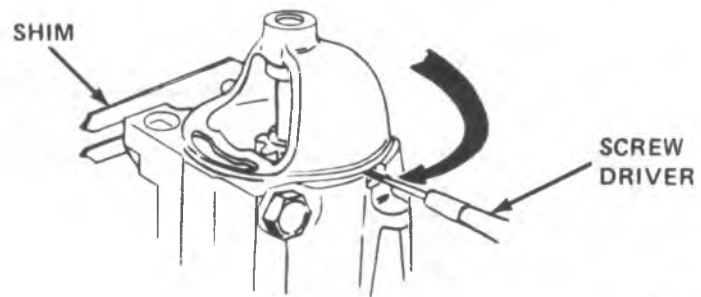
MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.

MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

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Fig. 6D-5E--Starter Motor Noise Diagnosis

A .015" SHIM WILL INCREASE THE CLEARANCE APPROXIMATELY .005". MORE THAN ONE SHIM MAY BE REQUIRED.



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Fig. 6D-6E--Meshing Starter and Flywheel Teeth

- 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.

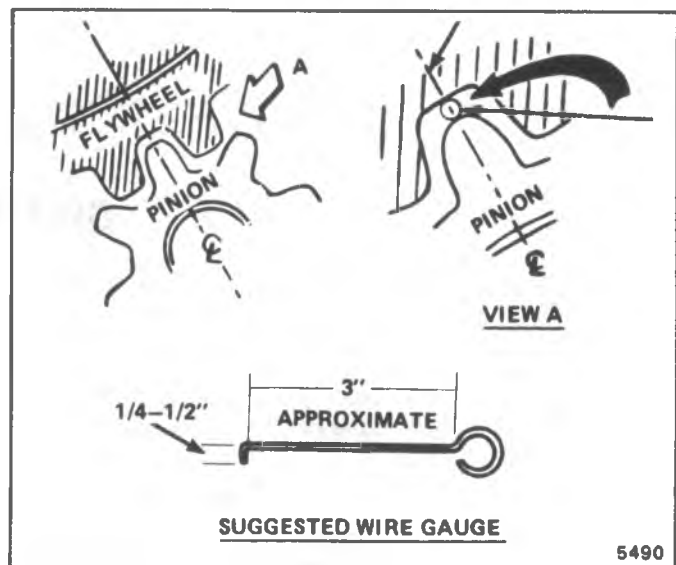
- c. Disconnect negative battery cable to prevent inadvertent cranking of engine.

Insert screwdriver in small hole in bottom of starter shown by arrow in Fig. 6D-6E and move starter pinion and clutch assembly so that pinion teeth and flywheel teeth are meshed. If necessary, rotate the flywheel so that a pinion tooth is directly in the center of two flywheel teeth and on the centerline of the two gears, as shown in Fig. 6D-7E.

- d. Check pinion to flywheel clearance, as shown in Fig. 6D-7E, by using a wire gage of .5mm (.020") minimum thickness (or diameter). Center the pinion tooth between the flywheel teeth and gage, as shown in Fig. 6D-7E, and not in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required.

- 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.) 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



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Fig. 6D-7E--Flywheel to Pinion Clearance

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-2A and 6D-3A. 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.

No-Load Test (Fig. 6D-9E)

Connect a voltmeter from the motor terminal to the motor frame, and use an RPM indicator to measure armature speed. Connect the motor and an ammeter in series with a fully charged battery of the specified voltage, and a switch in the open position from the solenoid battery terminal to the solenoid switch terminal. Close the switch and compare the RPM, current, and voltage readings with the specifications at the end of this section. It is not necessary to obtain the exact voltage specified in the figure, as an accurate interpretation can be made by recognizing that if the voltage is slightly higher the RPM will be

proportionately higher, with the current remaining essentially unchanged. However, if the exact voltage is desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. 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. Interpret the test results as follows:

1. Rated current draw and no-load speed indicates normal condition of the cranking motor.
2. Low free speed and high current draw indicates:
 - a. Too much friction - tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.
 - b. Shorted armature. This can be further checked on a growler after disassembly.
 - c. Grounded armature or fields. Check further after disassembly.
3. Failure to operate with high current draw indicates:
 - a. A direct ground in the terminal or fields.
 - b. "Frozen" bearings (this should have been determined by turning the armature by hand).
4. Failure to operate with no current draw indicates:
 - a. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.
 - b. Open armature coils. Inspect the commutator for badly burned bars after disassembly.
 - c. 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:
 - a. 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 and check for improved performance. In some instances, the armature could also be shorted. Check on a growler.

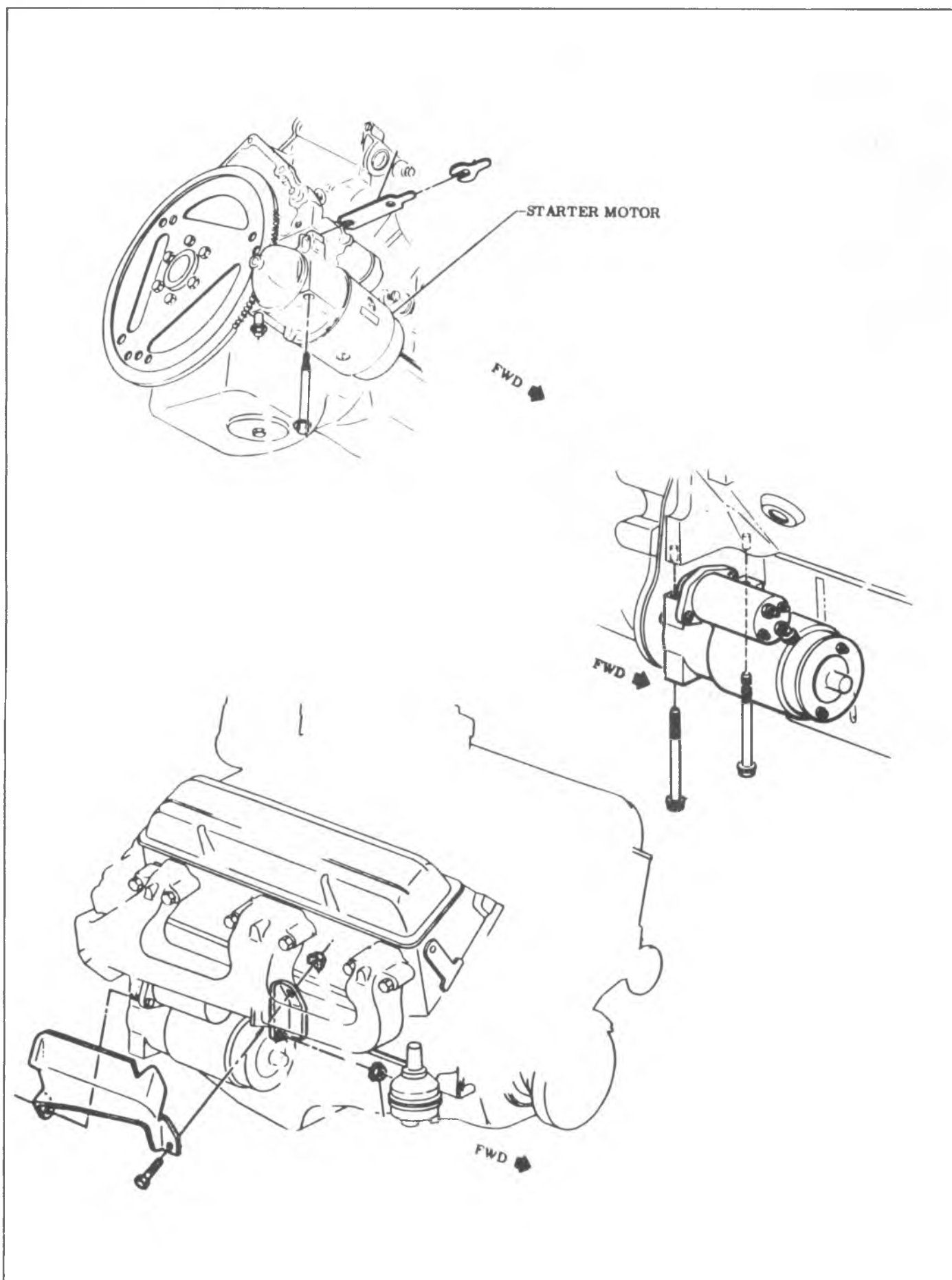


Fig. 6D-8E--Starter Motor Mounting

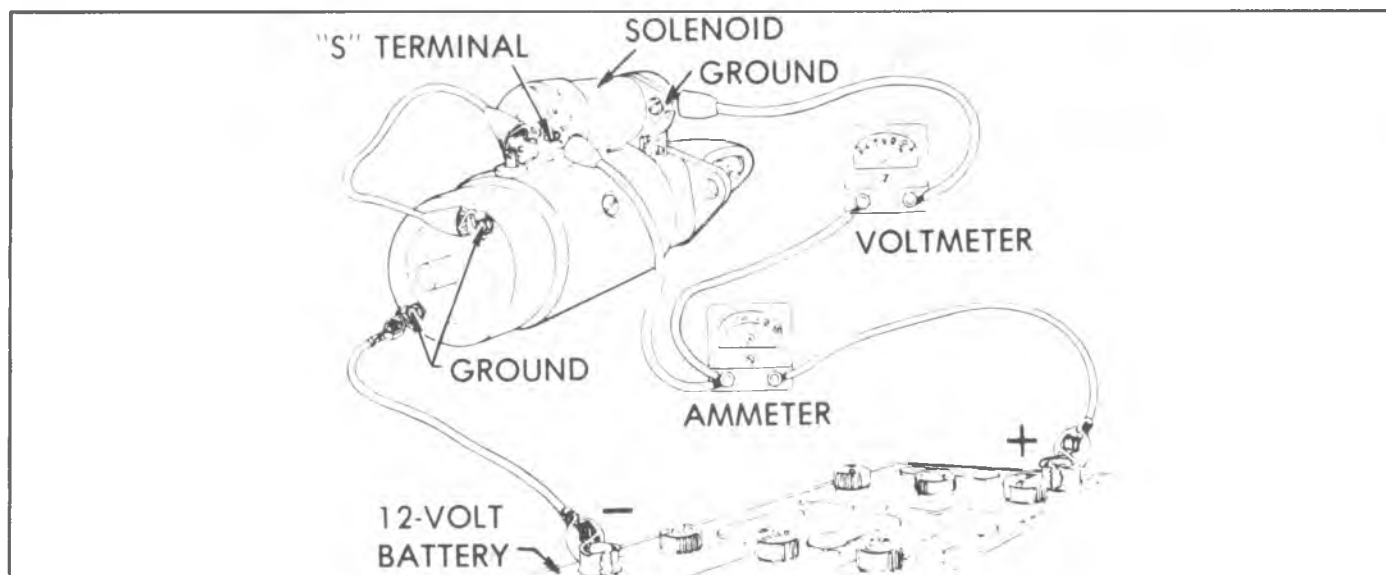


Fig. 6D-9E--No Load Test Hook Up

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-8E)

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.

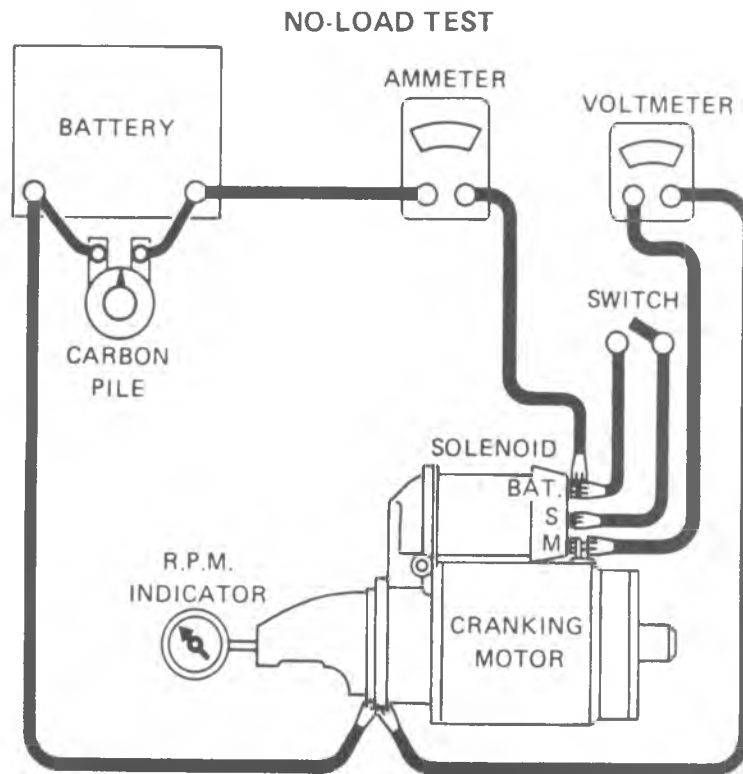
Solenoid

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)



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.

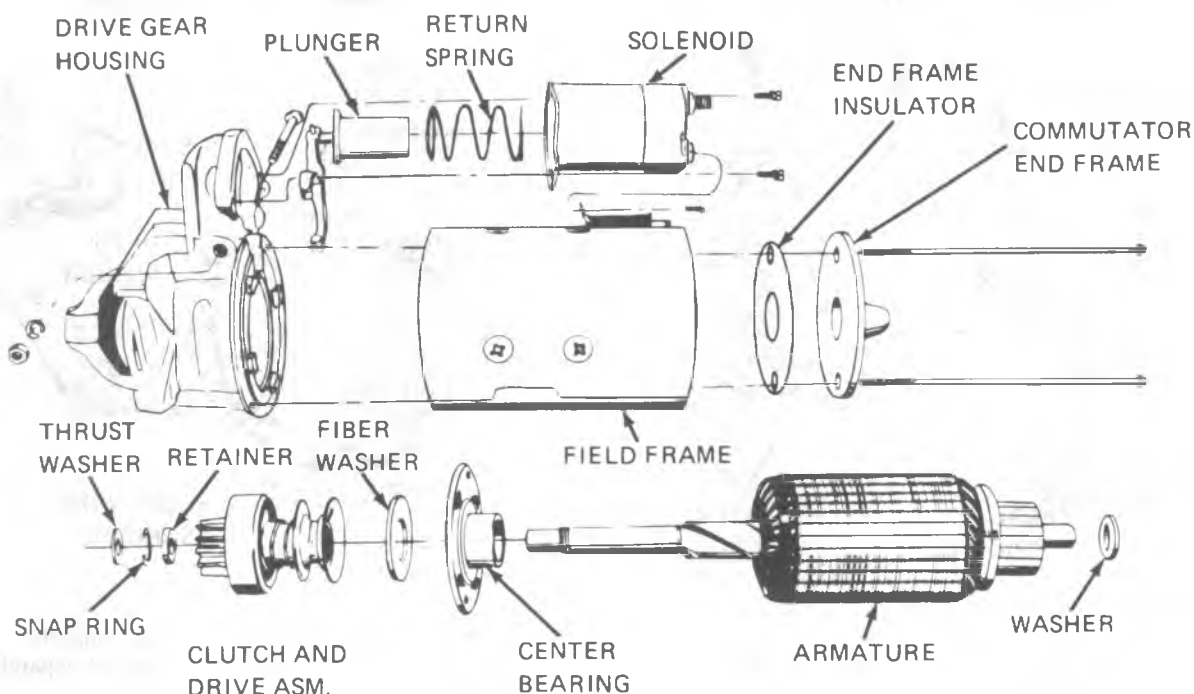
- Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

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.

STARTER DISASSEMBLY

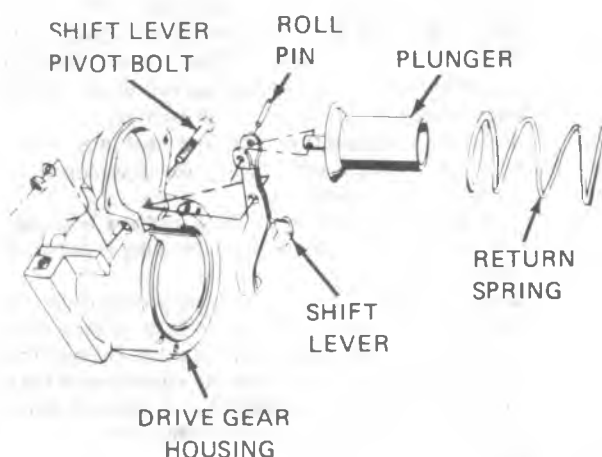


7. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring. Solenoid may now be serviced without further starter disassembly at this time.

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

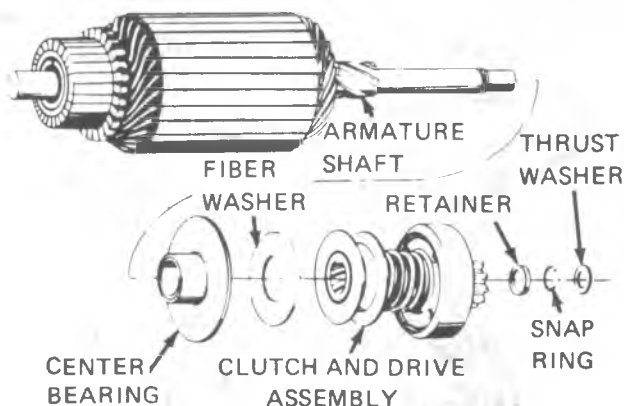


Steps 10 and 11 are required only on diesel starters.

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.

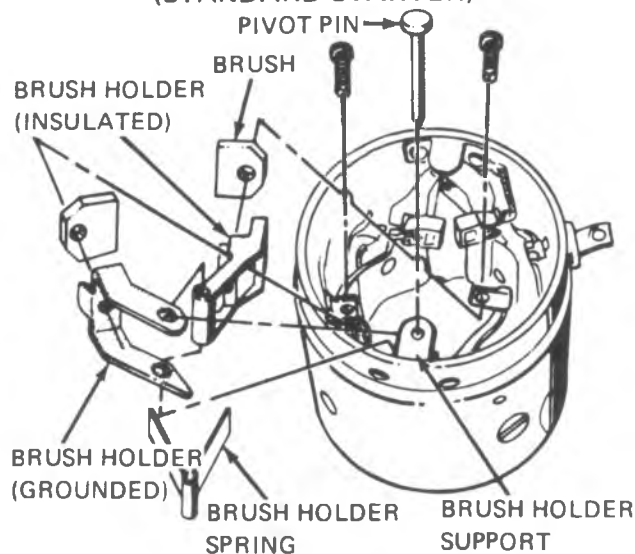
d. Remove retainer, clutch assembly (also fiber washer and center bearing on diesel) from armature shaft.

13. The shift lever and plunger may be disassembled at this time by removing the roll pin.

Fig. 6D-11E--Starter Unit Repair 2 of 6

REPLACE BRUSH HOLDER

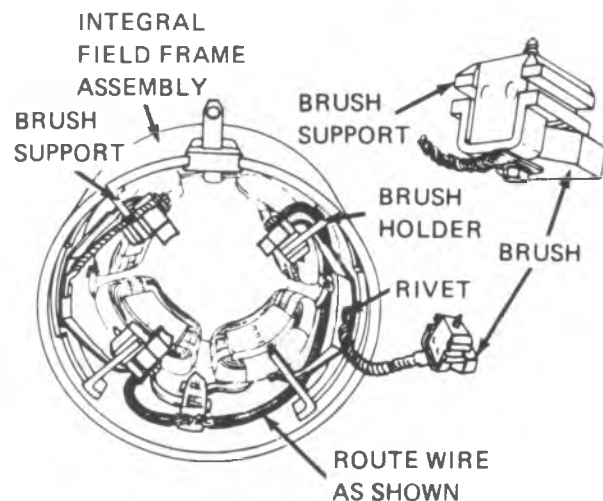
(STANDARD STARTER)



14. If necessary to replace brush holder parts, proceed as follows:

- Remove brush holder pivot pin which positions one insulated and one grounded brush.
- Remove brush spring.
- Replace brushes as necessary.

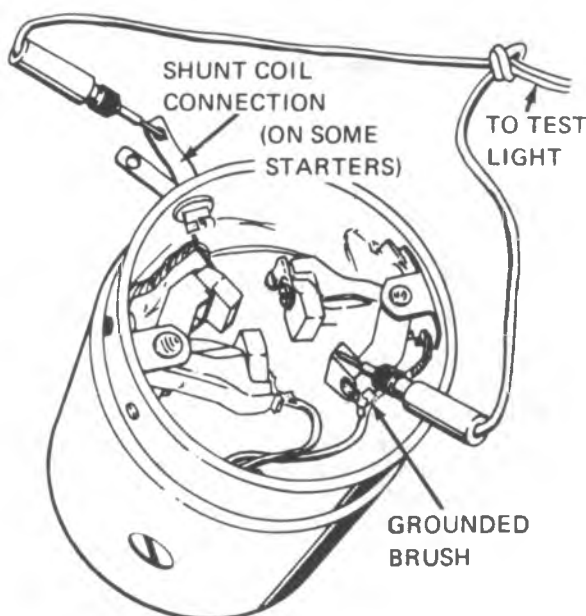
(SMALL 5MT STARTER)



- Remove brush holder from brush support.
- Remove screw from brush holder and separate brush and holder.
- Inspect brush holder for wear or damage.
- 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.

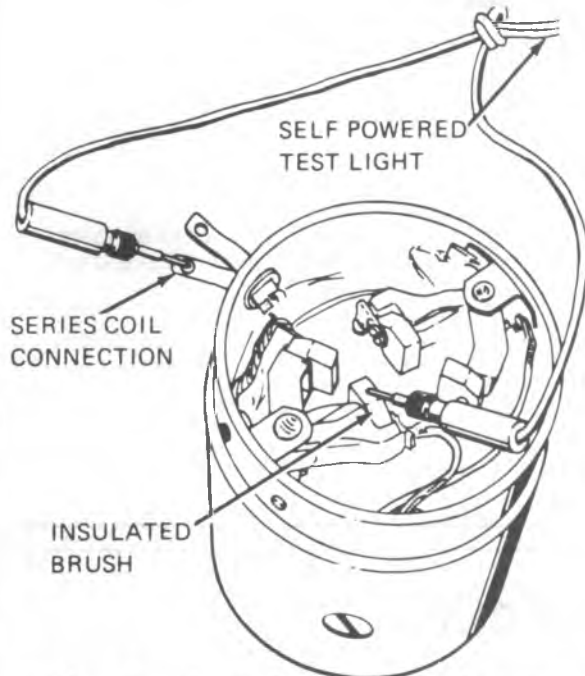
19. If test equipment is available:

- 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.

- 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-12E--Starter Unit Repair 3 of 6

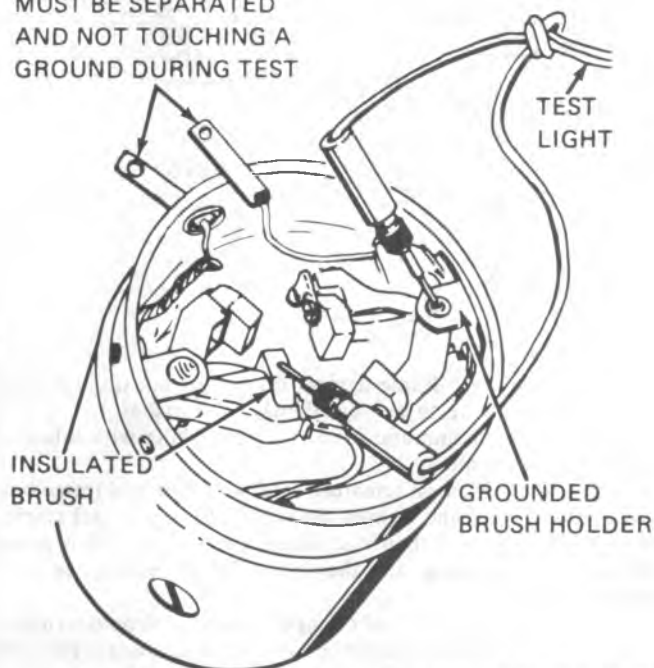
TESTING SERIES COIL FOR OPEN



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.

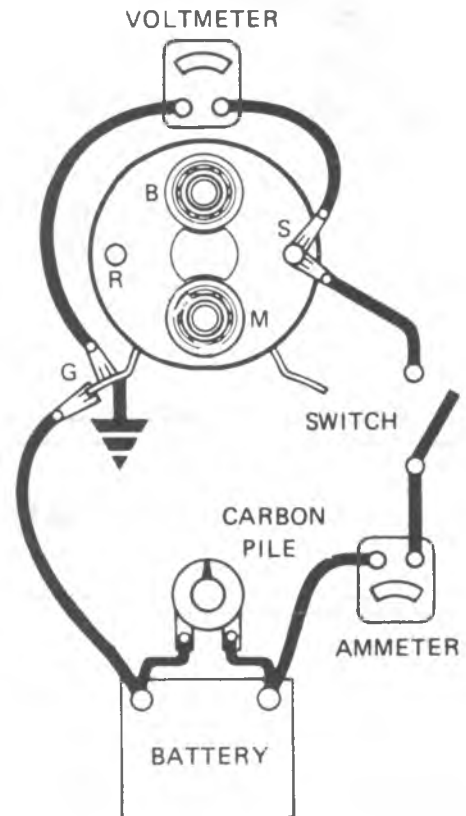
TESTING SERIES COIL FOR GROUND

THESE TWO TERMINALS MUST BE SEPARATED AND NOT TOUCHING A GROUND DURING TEST



d. On starters with shunt coil, separate 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.

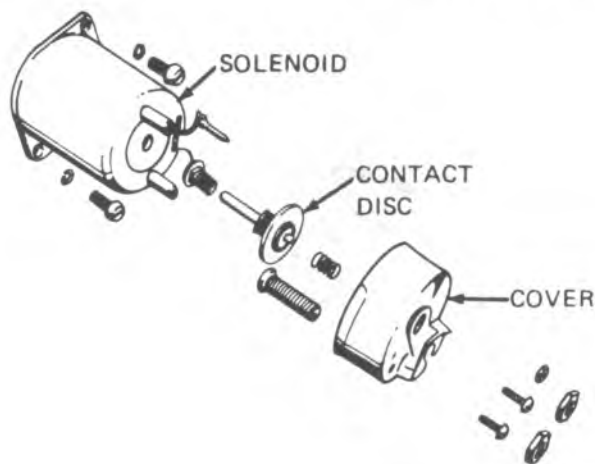
To check hold-in winding, connect an ammeter in series with 12-volt battery and the "switch" terminal on the solenoid. Connect a voltmeter to the "switch" terminal and to ground. Connect carbon pile across battery. Adjust the voltage to 10 volts and note the ammeter reading. It should be 14.5 to 16.5 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.

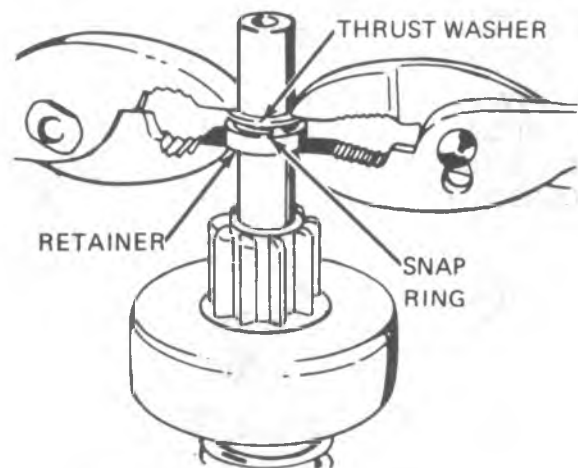
SOLENOID SWITCH DISASSEMBLY



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

INSTALLING RETAINER, WASHER AND RING



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.

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.

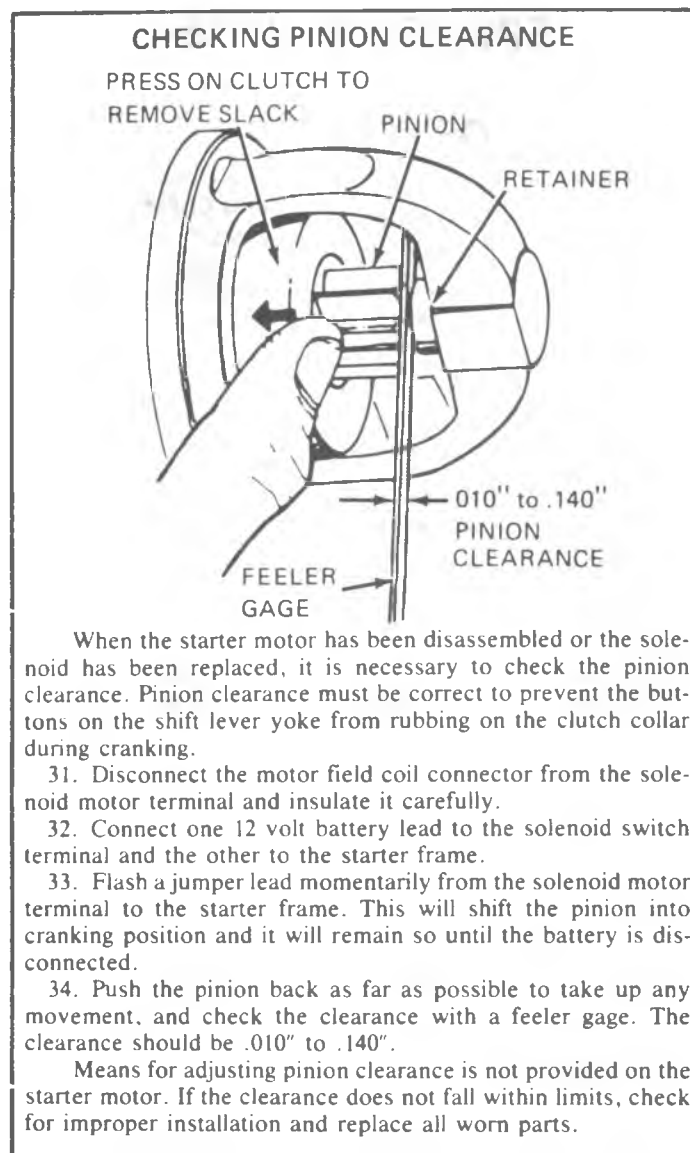


Fig. 6d-14E--Starter Unit Repair 6 of 6

SPECIFICATIONS

GENERATOR

MODEL NO.	APPLICATION	DELCO REMY SPEC. NO.	FIELD CURRENT AMPS 27°C (80°F) @ 12 VOLTS	COLD OUTPUT* AMPS @ 5000 RMP	RATED HOT OUTPUT** AMPS
1102394 1102491 1102889	All L-6 (Base) (Except G-20, 30 & P-Truck) All C-K-G Truck Base V-8 (Except K31303 & G30003)	4519	4-4.5	33	37
1102485 1102841 1102887	292 L-6 (L25) (Base) (G-20, 30 & P-Truck) All P-Truck Base V-8 (Except P31832)	4521	4-4.5	38	42
1102480 1102486 1102886 1102888	P31832 Truck (Base) All L-6 or V-8 with RPO K76 454 V-8 (FL8) (Base) K31303 & G30003 Truck Base V-8	4522	4-4.5	57	61
1101016 1101028	Optional (COPO)	4525	4-4.5	76	80

*Generator temperature approximately 27°C. (80°F.).

**Ambient temperature 27°C. (80°F.).

Note: The only difference between generators within each group above is the position end frame is rotated.

SPECIFICATIONS

DISTRIBUTOR & SPARK PLUGS

Distributor and spark plug specifications are shown in the Emission Control Chart in Section 6E Specifications.

BATTERY

MODEL NO.	APPLICATION	COLD CRANK RATE @ 0°F (-18°C)	AMPS FOR LOAD TEST	25 AMP. RESERVE CAPACITY (MINUTES)
85-4	250 L-6 (LD4)	275 Amps	130	60
85-5	292 L-6 (L25) 305 V-8 (LG9) 350 V-8 (LS9) 400 V-8 (LF4)	350 Amps	170	80
89-5	454 V-8 (LF8) RPO UA1	465 Amps	230	125
87-5	RPO TP2	430 Amps	210	100

STARTING MOTOR

MODEL NO.	APPLICATION	SPEC. NO.	VOLTS	FREE SPEED AMPERES	RPM
1108778	250 L-6 (LD4) (C & K-10)	3573	9	50-80*	5500-10500
1108779	250 L-6 (LD4) (G-Van)	3573	9	50-80*	5500-10500
1108780	292 L-6 (L25)	2438	9	50-80*	3500-6000
1109056	305 V-8 (LG9) (C & K)	3573	9	50-80*	5500-10500
1109798	305 V-8 (LG9) (G-Van)	3573	9	50-80*	5500-10500
1109052	350 V-8 (LS9)	3563	9	65-95*	7500-10500
1108776	400 V-8 (LF4) 454 V-8 (LF8)	3563 Insert Chart 6D-52	9	65-95*	7500-10500

*Includes Solenoid

SECTION 6E

ENGINE EMISSION CONTROLS

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General Description.....	6E-1	EGR System.....	6E-5
Positive Crankcase Ventilation-(PCV).....	6E-1	Belt Driver Air Pump.....	6E-6
Exhaust Gas Recirculation-(EGR).....	6E-1	Emission Failure.....	6E-8
Early Fuel Evaporation(EFE).....	6E-2	On-Vehicle Service.....	6E-9
Air Management System.....	6E-2	Positive Crankcase Ventilation.....	6E-9
Thermostatic Air Cleaner-TAC.....	6E-2	Exhaust Gas Recirculation.....	6E-10
Throttle Return Control-(TRC).....	6E-2	Early Fuel Evaporation.....	6E-15
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PCV System.....	6E-4	Vehicle Emission Control	
		Information Label.....	6E-29

GENERAL DESCRIPTION

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

Gasoline Engine

All engines have closed Positive Crankcase Ventilation System to provide more complete scavenging of crankcase vapors (Fig. 6E-1).

Ventilation air is drawn from the dirty air side of the air cleaner, through a hose, down into the crankcase, up through the ventilator valve, through a hose and into the intake manifold. Intake manifold vacuum draws any fumes from the crankcase to be burned in the engine.

Diagnosis and service procedures for the PCV system can be found in this section.

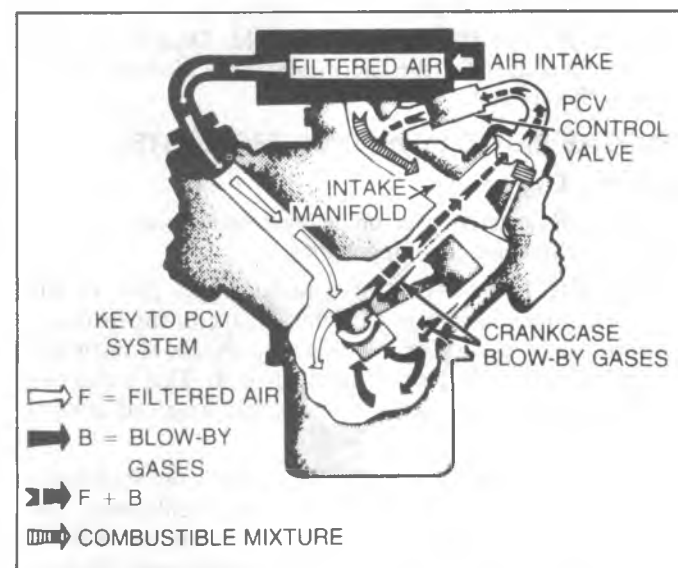


Fig. 6E-1--PCV System-Typical

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Gasoline Engine

The Exhaust Gas Recirculation (Fig. 6E-2) is used on all engines except those equipped with H.D. Emissions. It meters exhaust gas into induction system for recirculation through the combustion cycle to reduce oxides of nitrogen emissions.

The EGR valve remains closed during periods of engine idle and deceleration to prevent rough idle from excessive exhaust gas dilution in the idle air/fuel mixtures. It also remains closed at wide open throttle to prevent power loss.

Diagnosis and service procedures for the EGR system can be found in this section.

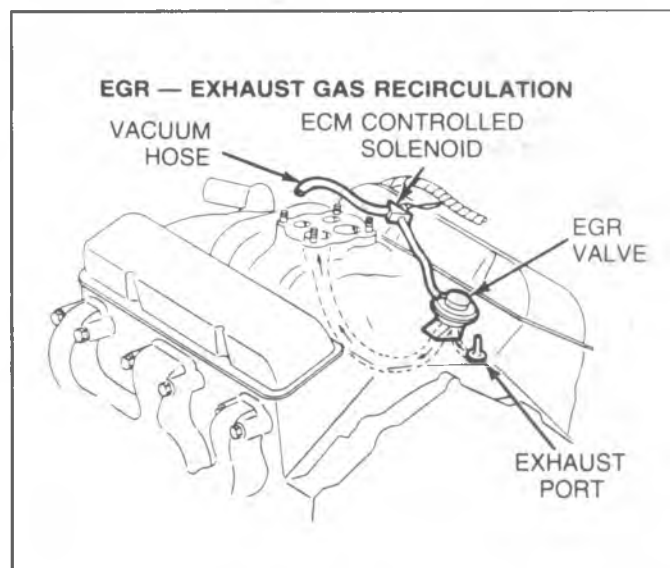


Fig. 6E-2--EGR System-Typical

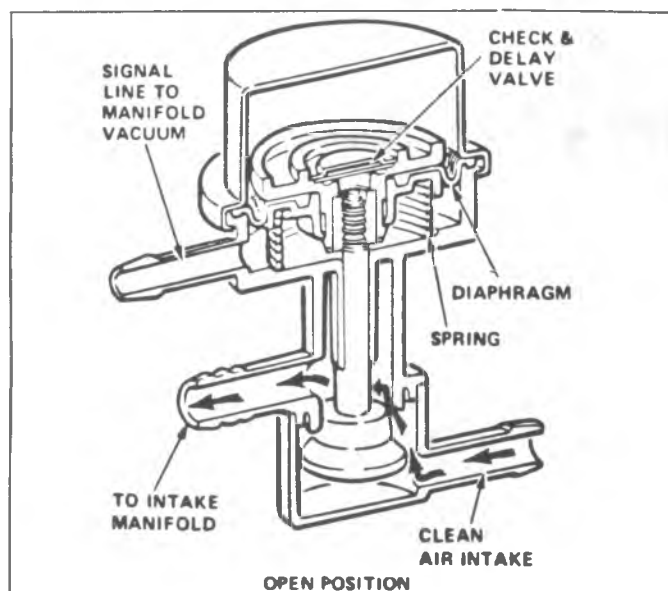


Fig. 6E-3--Deceleration Valve

Diesel Engine

Refer to On-Vehicle Service for Exhaust Gas Recirculation System general description and service information on a diesel engine.

EARLY FUEL EVAPORATION (EFE) SYSTEM

Gasoline Engine

The EFE system is used to provide a source of rapid heat to the engine induction system during cold driveway. Rapid heating is desirable because it provides for quick fuel evaporation and more uniform fuel distribution to aid cold driveability. It also reduces the length of time carburetor choking is required making reductions in exhaust emission levels possible.

EFE systems may use a valve which increases the exhaust gas flow under the intake manifold during cold engine operation. The valve is vacuum operated and is controlled by a thermal vacuum switch (TVS) which applies vacuum when the coolant temperature is below the calibration value.

Diagnosis and service procedures of the EFE system can be found in this section.

AIR MANAGEMENT SYSTEM

Gasoline Engine

Two different types of air management systems are used on light duty trucks.

An air injection reactor (AIR) (Fig. 6E-4) is used on some engines to provide 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.

Diagnosis and service procedures for air injection reactor systems are in this section.

The Pulse Air Injection Reactor System consists of four pulse air check valves. The check valves are connected by tubes to the exhaust ports. The firing of the engine creates a pulsating flow of exhaust gases which are positive or negative pressure. A negative pressure at the pulse air valves results in the flow of fresh air into the exhaust system. If pressure is positive the check valve is forced closed and no exhaust gas will flow past the valve into the fresh air supply line.

A deceleration valve is used on all L6 and automatic V8 models to prevent backfiring in the exhaust system during deceleration. When deceleration causes a sudden vacuum increase in the vacuum signal line, the pressure differential on the diaphragm will overcome the closing force of the spring, opening the valve and bleeding air into the intake manifold.

Air trapped in the chamber above the vacuum diaphragm will bleed at a calibrated rate through the delay valve portion of the integral "Check and Delay Valve," reducing the vacuum acting on the diaphragm. When the vacuum load on the diaphragm and the spring load become equal, the valve assembly will close, shutting off the air flow into the intake manifold.

The check valve portion of the "Check and Delay Valve" provides quick balancing of chamber pressure when a sudden decrease in vacuum is caused by acceleration rather than deceleration.

THERMOSTATIC AIR CLEANER (THERMAC)

Gasoline Engine

The Thermostatic Air Cleaner (THERMAC) is on all engines. The TAC uses a damper door in the air cleaner inlet, controlled by a vacuum diaphragm motor to mix pre-heated and non pre-heated air entering the air cleaner to maintain a controlled air temperature into the carburetor. The vacuum motor is modulated by a temperature sensor in the air cleaner. The pre-heating of the air cleaner inlet air allows leaner carburetor and choke calibrations resulting in lower emission levels, while maintaining good driveability. The pre-heated air is obtained by drawing inlet air through stove attached to the exhaust manifold. Diagnostics and service procedures for the thermostatic air cleaner can be found in this section.

THROTTLE RETURN CONTROL (TRC) SYSTEM

Gasoline Engine

The TRC system used on heavy duty emission vehicles consists of three major components:

1. Throttle Lever Actuator - Mounted as part of the carburetor assembly, this device opens the primary throttle blades a preset amount in excess of curb idle when engine vacuum is applied to it. This actuating vacuum is controlled by a separate solenoid control valve.
2. 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 electronic 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.
3. Electronic Speed Sensor - Mounted separately from the solenoid vacuum control valve, this switching

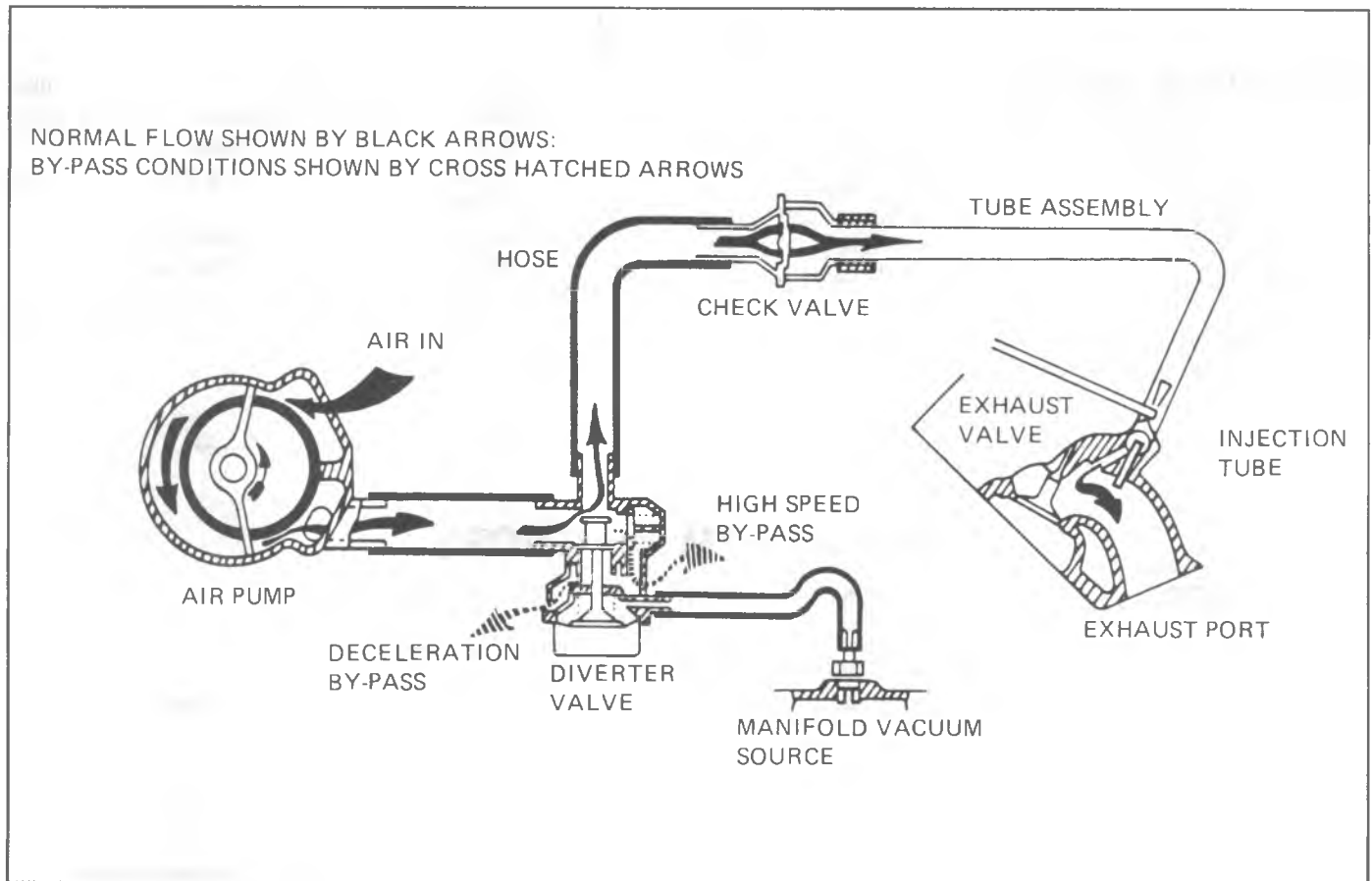


Fig. 6E-4--AIR System

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.

CARBURETOR CALIBRATION

While the carburetor's main function is to provide the engine with a combustible air/fuel mixture, the carburetor calibration is critical to maintaining proper emission levels.

The carburetor's idle, off-idle, main metering, power enrichment, and accelerating pump systems are calibrated to provide the best possible combination of engine performance, fuel economy and exhaust emission control. Carburetor adjustments and service must be performed using the recommended procedures to insure engine exhaust emission levels remain within official limits.

See Section 6C, Engine Fuel, for carburetor adjustment specifications and recommended service procedures.

DISTRIBUTOR CALIBRATION

The distributor is an integral part of the engine ignition system and the distributor calibration is an important part of exhaust emission control.

The distributor is calibrated to provide the best engine performance and fuel economy at varying speeds and loads while remaining within exhaust emission limits. Distributor diagnostics and service procedures are in Section 6D, Engine Electrical.

CATALYTIC CONVERTER

The catalytic converter is an emission control device added to the exhaust system of gasoline light duty emission vehicles to reduce hydrocarbon and carbon monoxide from the exhaust gas stream.

Refer to Section 6F, Engine Exhaust System, for catalytic converter service procedures and diagnostics.

DIAGNOSIS

P.A.I.R. FAILURE DIAGNOSIS

1. A hissing noise may indicate a defective pulse air valve or improper torque at manifold. Inspect pulse air valve.
2. If one or more check valves have failed, exhaust gas will enter the carburetor through the air cleaner and cause poor driveability indicated by a surge or poor performance. Check pulse air valves. Be sure pulse air pipe extension tubes are installed in exhaust manifold.
 - a. If exhaust gases pass through the pulse air valve, excessive heat is transmitted to the rocker cover

plenum, indicated by burned off paint. Also, rubber grommets and hose will deteriorate. Failure could also be indicated by a hissing noise. Repair rocker cover plenum seals and replace grommets and hose as required.

- b. If rubber hose to air cleaner deteriorates, particles may enter carburetor causing poor driveability. It will be necessary to clean carburetor, and remove particles from pulse air plenums and connecting pipe.

PCV SYSTEM DIAGNOSIS

CONDITION

Slow, unstable idle, frequent stalling.

Oil in air cleaner.

POSSIBLE CAUSE

Valve completely plugged or stuck.

Restricted filter

PCV system plugged.

Leak in closed ventilation system.

CORRECTION

Replace valve.

Replace filter, clean system.

Replace valve.

Clean system as required.

Inspect for leaks to atmosphere and correct as necessary.

Fig. 6E-5--PCV System Diagnosis

EGR DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine idles abnormally rough and/or stalls.	EGR valve vacuum hoses misrouted. Leaking EGR valve. EGR valve gasket failed or loose EGR attaching bolts. EGR-TVS. Improper vacuum to EGR valve at idle.	Check EGR valve vacuum hose routing. Correct as required. Check EGR valve for correct operation. Check EGR attaching bolts for tightness. Tighten as required. If not loose, remove EGR valve and inspect gasket. Replace as required. Perform EGR-TVS functional check. Check vacuum from carburetor EGR port with engine at stabilized operating temperature and at curb idle speed. (See checking EGR valve.)
Engine runs rough on light throttle acceleration and has poor part load performance.	EGR valve vacuum hose misrouted. Check for loose valve. Failed EGR-TVS (TVS open below 130°F.) Sticky or binding EGR valve. Wrong or no EGR gasket(s) and/or Spacer.	Check EGR valve vacuum hose routing. Correct as required. Torque valve. Same as listing in "Engine Idles Abnormally Rough and/or Stalls" condition. Clean EGR passage deposits. Perform EGR System check. Install new gasket(s), install spacer (if used), torque attaching parts.
Engine stalls on decelerations.	Transducer control valve blocked or air flow restricted. Restriction in EGR vacuum line or vacuum signal tube. Sticking or binding EGR valve.	Check transducer control valve operation (See Checking Back Pressure EGR Valve). Check EGR vacuum lines for kinks, bends, etc. Remove or replace hoses as required. (See Checking EGR Valve). Check EGR valve for excessive deposits causing sticky or binding operation. Perform EGR System Check.
Part throttle engine detonation. (NOTICE: Non-Functioning EGR valve could contribute to part throttle detonation. Detonation can also be caused by several other engine variables. Perform ignition and carburetor related diagnosis.)	Transducer control valve blocked or air flow restricted. Insufficient exhaust gas recirculation flow during part throttle accelerations. Control valve blocked or flow restricted.	Check internal control valve operation (See Checking EGR Valve). Check EGR valve hose routing. Check EGR valve operation. Repair or replace as required. Check EGR-TVS as listed in "Engine Idles Abnormally Rough and/or Stalls" section. Replace valve as required. Check EGR passages and valve for excessive deposit. Clean as required. Check EGR per service procedure.
Engine starts but immediately stalls when cold. (NOTICE: Stalls after start can also be caused by carburetor problems.)	EGR valve hoses misrouted. EGR-TVS system malfunctioning when engine is cold.	Check EGR valve hose routings. Perform EGR-TVS functional check.

Fig. 6E-6-EGR Diagnosis

A.I.R. Trouble Diagnosis

NOTE: The A.I.R. 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

system, disconnect the drive belt and operate the engine. If noise does not exist, proceed with diagnosis.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive belt noise.	<ol style="list-style-type: none"> 1. Loose belt. 2. Seized pump. 3. Excessively tight belt. 	<ol style="list-style-type: none"> 1. Tighten to spec. 2. Replace pump.
Excessive pump noise. Chirping.	Insufficient break-in.	Run vehicle 10-15 miles (16-24 kilometers) at turnpike speeds — recheck.
Excessive pump noise, chirping, rumbling, or knocking.	<ol style="list-style-type: none"> 1. Leak in hose. 2. Loose hose. 3. Hose touching other engine parts. 4. Diverter valve inoperative. 5. Check valve inoperative. 6. Pump mounting fasteners loose. 7. Pump failure. 	<ol style="list-style-type: none"> 1. Locate source of leak using soap solution and correct. 2. Reassemble and replace or tighten hose clamp. 3. Adjust hose position. 4. Replace diverter valve. 5. Replace check valve. 6. Tighten mounting screws as specified. 7. Replace pump.

Fig. 6E-7--A.I.R. Diagnosis

A.I.R. Trouble Diagnosis (Cont'd.)

CONDITION	POSSIBLE CAUSE	CORRECTION
No air supply (accelerate engine to 1500 rpm and observe air flow from hoses. If the flow increases as the rpm's increase, the pump is functioning normally.) If not, check possible cause.	<ol style="list-style-type: none"> 1. Loose drive belt. 2. Leaks in supply hose. 3. Leak at fitting(s). 4. Diverter valve leaking. 5. Diverter valve inoperative. (Usually accompanied by backfire during deceleration.) 6. Check valve inoperative. 	<ol style="list-style-type: none"> 1. Tighten to specs. 2. Locate leak and repair or replace as required. 3. Tighten or replace clamps. 4. If air is expelled through diverter muffler with vehicle at idle, replace diverter valve. 5. Replace diverter valve. 6. Blow air through hose toward air manifold. If air passes, function is normal. If air can be sucked from manifold, replace check valve.
	7. Pump pressure relief plug leaking or damaged.	7. Replace pressure relief plug.
Centrifugal filter fan damaged or broken.	Mechanical damage.	Replace centrifugal filter fan.
Exhaust tube bent or damaged.	Mechanical damage.	Replace exhaust tube.
Poor idle or driveability.	A defective A.I.R. pump cannot cause poor idle or driveability.	Do <i>not</i> replace A.I.R. pump.

Fig. 6E-8--A.I.R. Diagnosis

POSSIBLE CAUSES OF EMISSIONS TEST FAILURES

EXCESSIVE EMISSIONS	EXPLANATION	POSSIBLE CAUSES
Hydrocarbons (HC) *	Excessive hydrocarbons are caused by an air fuel mixture that is not burning completely.	<ul style="list-style-type: none"> ● Engine not at normal operating temperature. ● Disconnected, obstructed, leaking, or mis-routed vacuum hoses. ● Vacuum leaks. ● Maladjusted idle speed. ● Maladjusted idle mixture - if plugs are removed. ● Maladjusted initial spark timing. ● Spark plugs, wires or distributor cap. ● Improper operation of AIR or Pulsair system. ● Lead contamination of catalytic converter (check for absence of filler neck restrictor).
Carbon monoxide (CO) *	Excessive carbon monoxide emissions are due to a mixture that is rich.	<ul style="list-style-type: none"> ● Engine not at normal operating temperature. ● Maladjusted idle mixture if plugs are removed. ● Improperly adjusted/sticking choke. ● Stuck PCV valve or obstructed PCV hose. ● Lead contamination of catalytic converter (check for absence of filler neck restrictor). ● Improper operation of AIR or Pulsair system. ● Leaking carburetor fuel passages or gaskets. ● Carburetor float level. ● Stuck carburetor power piston. ● Restricted air cleaner element.
Oxides of nitrogen (NO _x)	Excessive oxides of nitrogen are generally due to high temperatures in the combustion chamber.	<ul style="list-style-type: none"> ● Obstructed/leaking/misrouted vacuum lines. ● Faulty EGR temperature sensor controls. ● Improper operation of the EGR system. ● Incorrect EGR valve for engine type. ● Plugged EGR passages. ● Inoperative Thermoac. ● Maladjusted initial spark timing. ● Improper operation of distributor centrifugal or vacuum spark advance.

* Excessive emissions of both hydrocarbons and carbon monoxide are related to an extremely rich air/fuel mixture. A rich air/fuel mixture increases CO emissions, but if the mixture is too rich, it will not burn completely. This unburned fuel contributes to high hydrocarbon emissions. Check for possible causes as stated in the HC and CO section. Check co-related causes first.

Fig. 6E-9--Emission Test Failure

ON-VEHICLE SERVICE

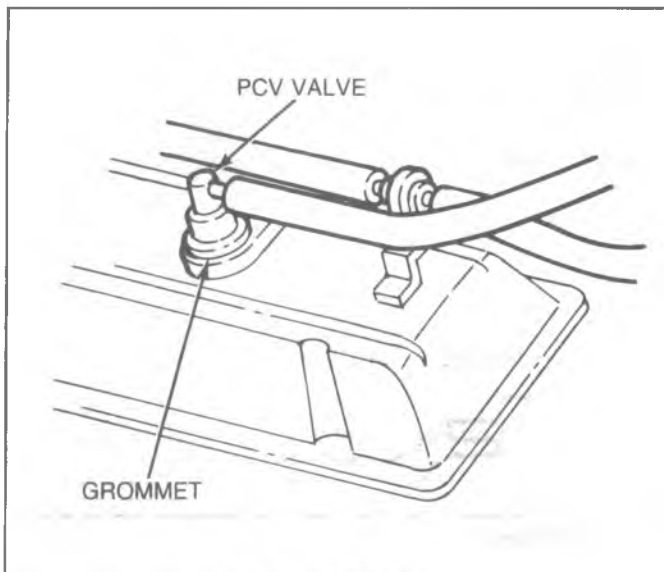


Fig. 6E-10-PCV Valve

POSITIVE CRANKCASE VENTILATION

Gasoline Engine

An engine which is operated without any crankcase ventilation can be damaged seriously. Therefore, it is important to replace the PCV valve at intervals shown in Section OB.

NOTICE: If an engine is idling too slow or rough, this may be caused by a clogged ventilator valve or plugged hose; therefore, never adjust the carburetor idle without first checking the PCV valve and hose.

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 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.

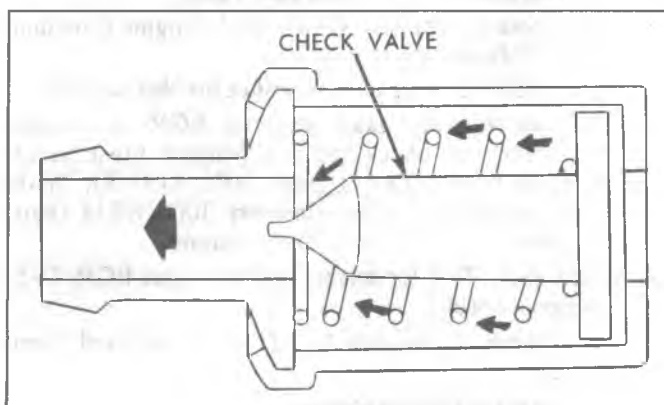


Fig. 6E-11-PCV Cross Section

Removal

1. Remove PCV valve from intake manifold or rocker arm shaft 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 valve. Replace plugged and/or deteriorated hoses.
4. Shut off the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve (Fig. 6E-11). If valve does not rattle, replace valve (Fig. 6E-10).
5. After installing a new PCV valve, readjust engine idle if necessary.

CRANKCASE VENTILATION

Diesel Engine

A Crankcase Depression Regulator Valve (Fig. 6E-12) is used to regulate (meter) the flow of crankcase gases back into the engine. The Crankcase Depression Regulator Valve (C.D.R.V.) is designed to limit vacuum in the crankcase as the gases are drawn from the valve cover through the C.D.R.V. and into the intake manifold (air crossover).

Fresh air enters the engine through the combination filter, check valve and oil fill cap. The fresh air mixes with blow-by gases and enters right cover. The gases pass through a filter on the valve cover and are drawn into connecting tubing.

The intake manifold vacuum acts against a spring loaded diaphragm to control the flow of crankcase gases. 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 maintenance requirements.

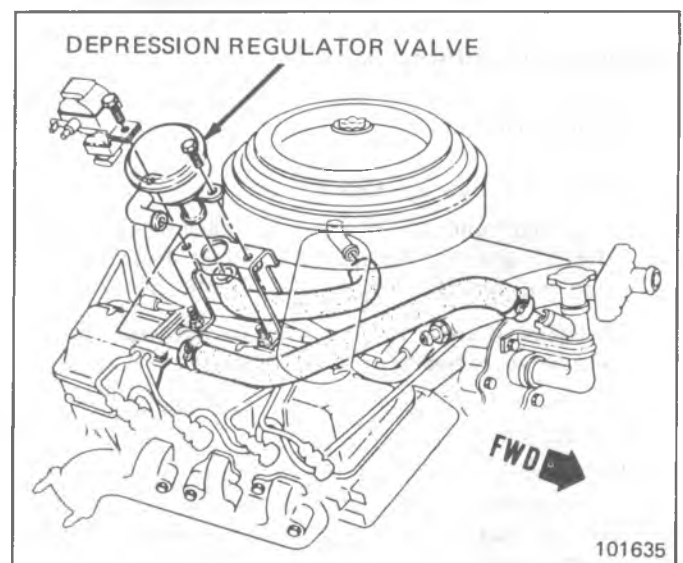


Fig. 6E-12-Crankcase Ventilation

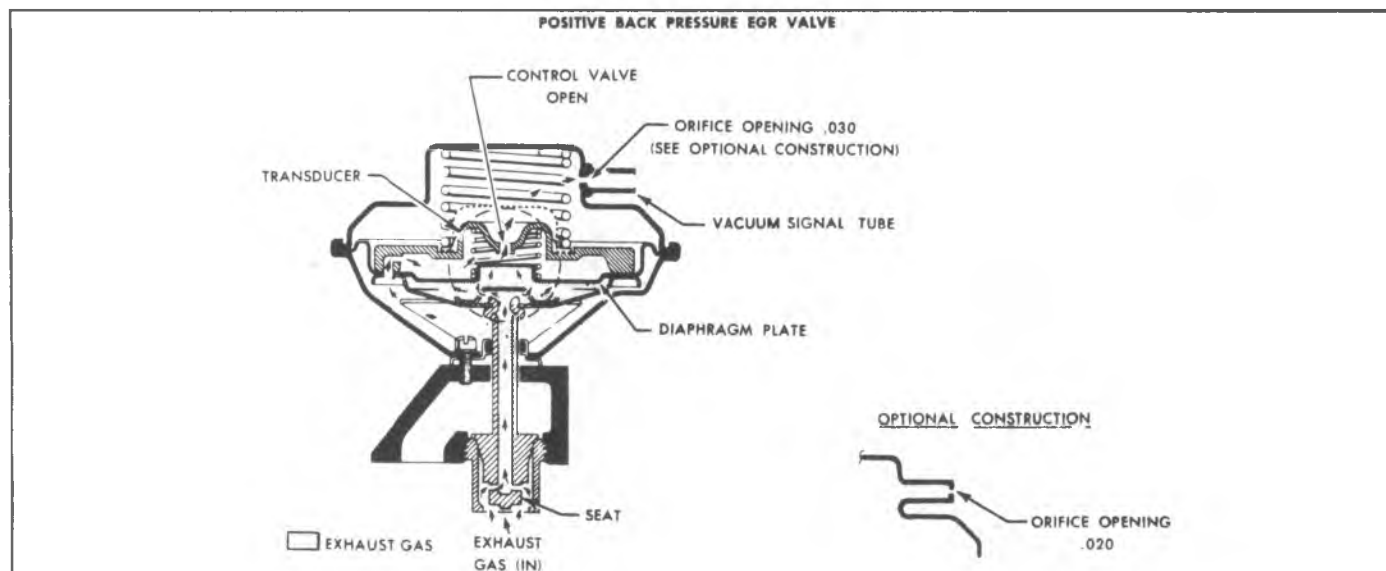


Fig. 6E-13—Positive Backpressure EGR Valve

NOTICE: Do not allow any solvent to come in contact with the diaphragm of the Crankcase Depression Regulator Valve because the diaphragm will fail.

EXHAUST GAS RECIRCULATION (EGR)

Gasoline Engine

A backpressure EGR valve is used on Light Duty Emission class engines. The valve opening is determined by the amount of vacuum received from a ported source on the carburetor and the amount of backpressure in the exhaust system.

Two different types of backpressure EGR valves are used. A positive transducer valve (Fig. 6E-13) and a negative transducer valve (Fig. 6E-14). The negative transduced backpressure valve is used on engines with a relatively low backpressure to provide the desired opening point and flow rate.

The EGR system requires the use of unleaded fuel.

EGR Valve Identification

Refer to figures 6E-15 and 6E-16 for identification of the different EGR valves.

Checking EGR System Operation

1. Place finger under EGR valve and push on diaphragm plate. Diaphragm should move freely from open to closed position. If it does not move freely replace valve.

CAUTION: If valve is hot it may be necessary to wear gloves to avoid burning fingers.

2. Hook up vacuum gage between EGR signal tube and vacuum hose.
3. With vehicle in "Park" or "Neutral" and engine running open throttle to obtain at least 5" of vacuum at EGR be careful not to overspeed engine neutral. Engine must be at coolant operating temperature (90°C (approx. 195°F)).
4. Remove vacuum hose from EGR signal tube and check for diaphragm plate to move downward (valve closed).

5. Replace vacuum hose and check for diaphragm plate to move upward (valve open). Engine speed should decrease.

A vibration of the diaphragm plate may be noticed on back pressure EGR valves. This does not indicate a bad valve or require correction.

Diaphragm doesn't move:

1. Check engine vacuum, it should be at least 5" at EGR valve with engine running and throttle open. If no vacuum is present, find the cause (hose routing not correct, plugged or leaking hose or carburetor port).
2. Make sure engine is at operating temperature.
3. On back pressure EGR valves, check transducer control valve operation (See Checking Negative or Positive EGR Valve).

Diaphragm moves with no change in engine speed:

Check EGR manifold passages for blockage (clean if blocked).

If cause is not found, check EGR valve (See Checking Negative or Positive EGR Valve).

Functional Checks

Checking Negative Backpressure EGR Valve

1. Check hose routing (Refer to Vehicle Engine Emission Control Information Label).
2. Check EGR valve signal tube orifice for obstructions.
3. Hook up vacuum gage between EGR valve and carburetor and check vacuum (engine must be at operating temperature approx. 90°C (195°F). With engine running at approximately 3000 RPM there should be at least 17 kPa (5") of vacuum.
4. Check EGR-TVS for correct operation (see EGR-TVS functional check).
5. Valve check: (valve can be left on or removed from engine).
 - a. Depress the valve diaphragm.
 - b. With diaphragm still depressed hold a finger over source tube and release diaphragm.
 - c. Check diaphragm and seat for movement. Valve is

NEGATIVE BACKPRESSURE EGR VALVE

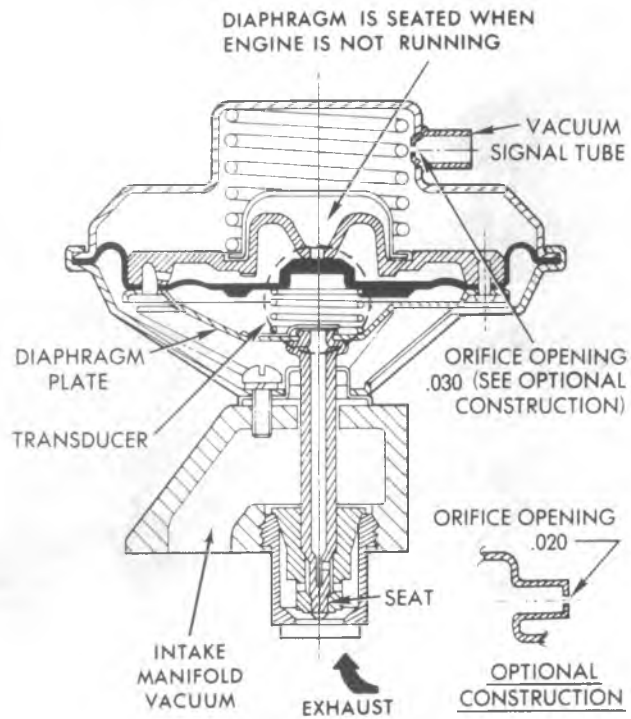


Fig. 6E-14--Negative Backpressure EGR Valve

POSITIVE BACK PRESSURE EGR VALVE

NOTE: IDENTIFY POSITIVE EGR VALVE BY DIAPHRAGM PLATE DESIGN

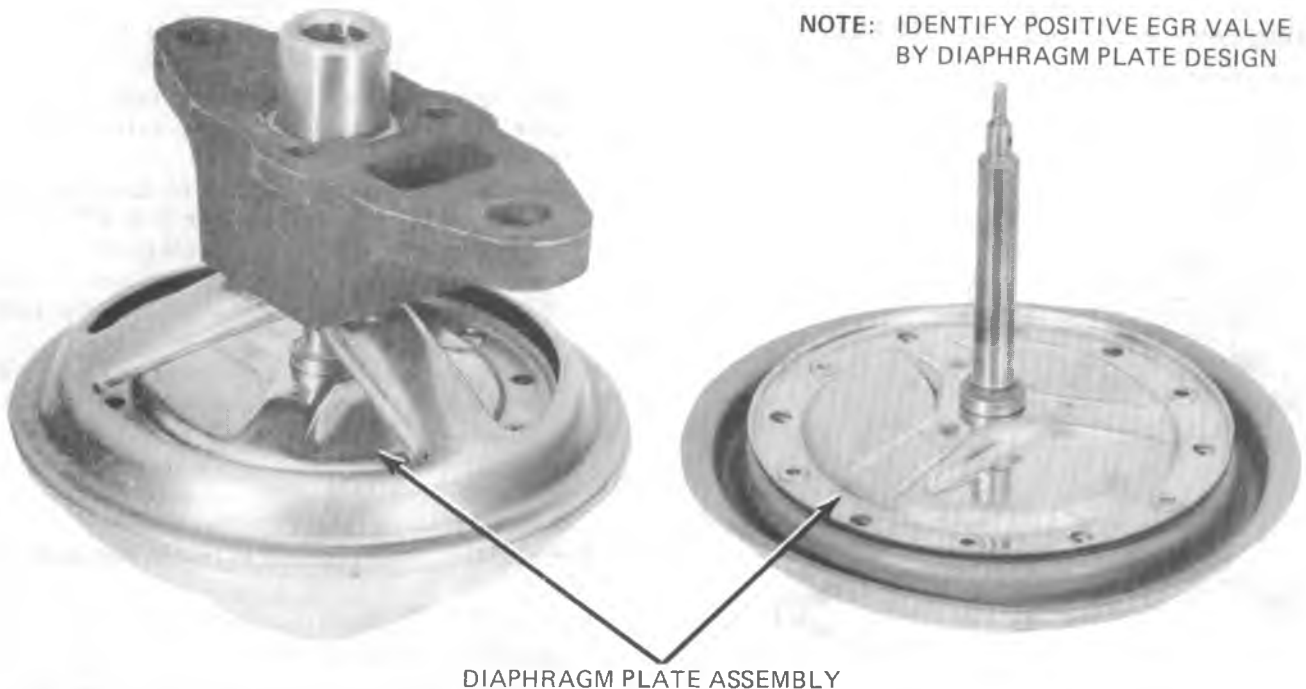


Fig. 6E-15--Positive EGR Identification

NEGATIVE BACK PRESSURE EGR VALVE

NOTE: IDENTIFY NEGATIVE EGR VALVE
BY DIAPHRAGM PLATE DESIGN

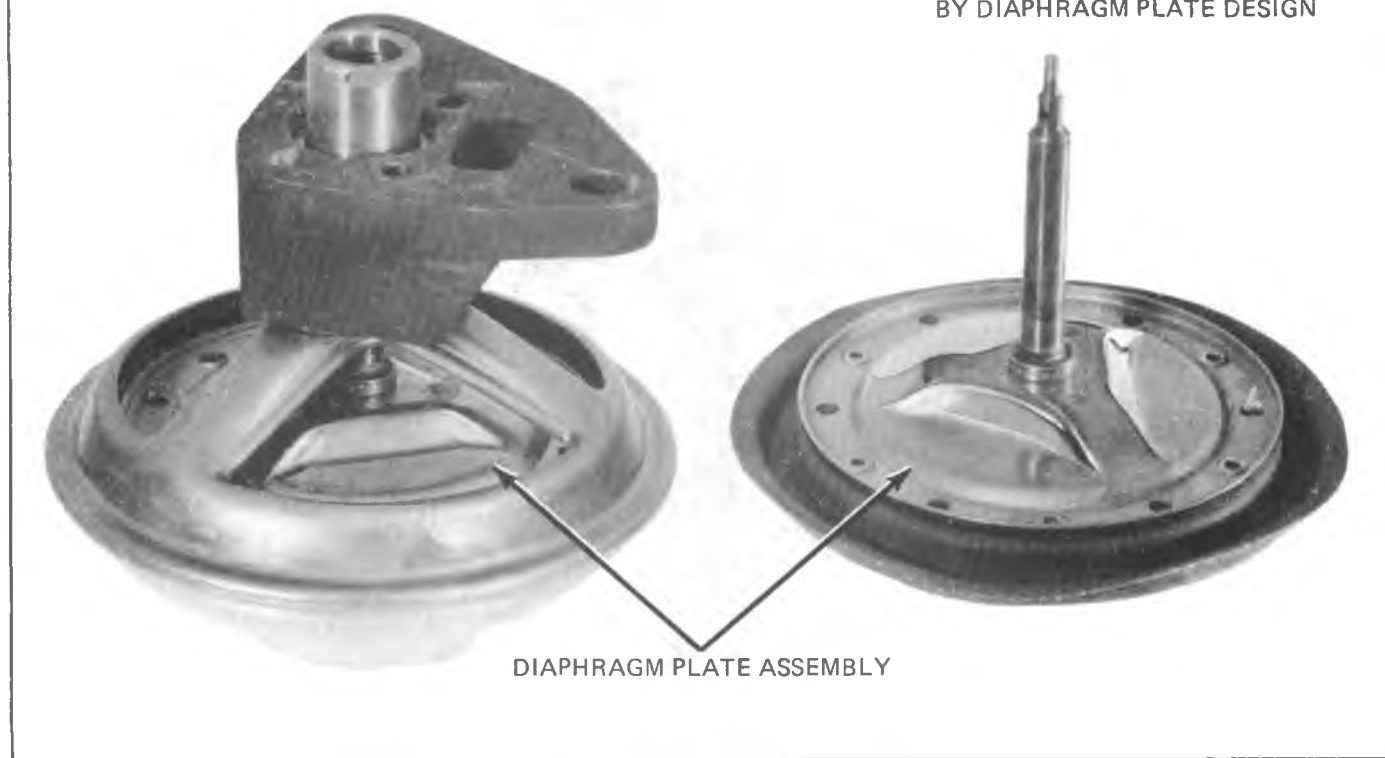


Fig. 6E-16--Negative EGR Identification

good if it takes over 20 seconds for the diaphragm to move to the seated position (valve closed).

- d. Replace EGR valve if it takes less than 20 seconds to move to the seated position.

Checking Positive Backpressure EGR Valve

1. Check hose routing (Refer to Vehicle Emission Control Information Label).
2. Check EGR valve signal tube orifice for

obstructions.

3. Check EGR-TVS for correct operation. (See EGR-TVS functional check).
4. Valve check.
 - a. Remove EGR valve from vehicle.
 - b. Apply a constant external vacuum 34 kPa (10") or more supply to EGR vacuum signal tube.
 - c. Valve should not open. If it does transducer control valve is stuck closed and EGR valve must be replaced.
 - d. With the vacuum supply still applied, direct a stream of air from a low pressure source (103 kPa 15 psi maximum) into the valve exhaust gas intake.
 - e. Valve should open completely. If it does not open at all transducer control valve is stuck open and EGR valve must be replaced.
 - f. If EGR valve and transducer control valve are both operating clean the EGR mounting surfaces and install valve.

EGR Valve Replacement

1. Disconnect EGR valve vacuum hose at valve.
2. Remove bolts or nuts holding EGR valve on manifold (Fig. 6E-17).
3. Remove EGR valve from manifold.
4. Clean EGR mounting surfaces.
5. Reassemble replacement EGR valve on intake manifold using new gasket(s). Install spacer (if used). Torque attachments to correct torque.
6. Connect vacuum hose to valve.

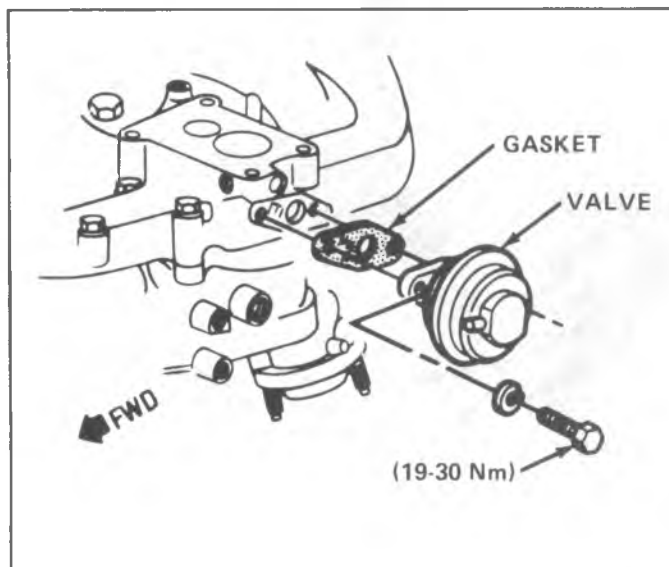


Fig. 6E-17--EGR Valve 4.1L

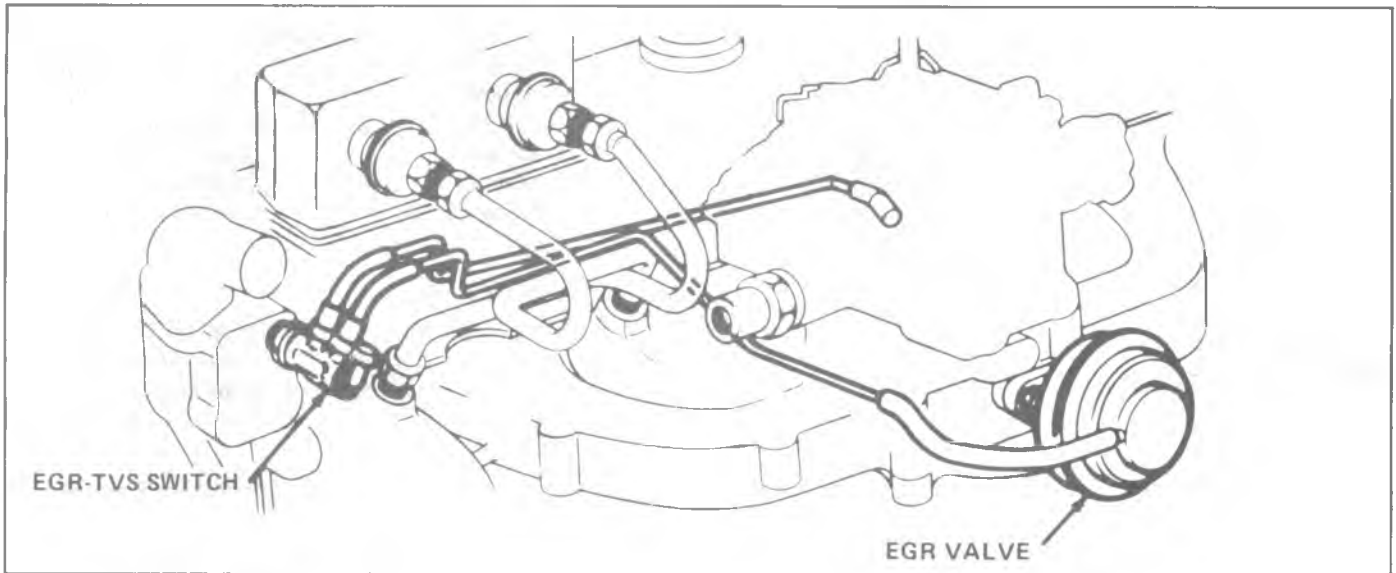


Fig. 6E-18--EGR-TVS 4.1L (1 of 3)

EGR Manifold Passage

If inspection of EGR passages in the inlet manifold indicates 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.

EGR Thermal Vacuum Switch (EGR - TVS)

Replacement

1. Drain engine coolant.
2. Disconnect vacuum lines from the thermal vacuum switch.
3. Remove switch.
4. Apply an approved sealer to threaded portion of switch.
5. Install switch and torque to 20 N·m (15 lbs. ft.).
6. Rotate switch head as required to align for proper hose routing.
7. Install vacuum hoses to switch.
8. Replace engine coolant and check level.

EGR-TVS Functional Check - Hot

The EGR Thermal Vacuum Delay Switch opens as coolant temperature increases, permitting the ported vacuum signal to reach the EGR valve. Check as follows:

1. Remove EGR valve vacuum hose at EGR valve and connect hose to a vacuum gage.
2. Start engine. With transmission selector lever in Neutral or Park open throttle partially. (Do not overspeed engine.) as throttle is opened, the vacuum gage should respond with an increase in vacuum reading.
3. If operation is satisfactory, remove gage and reconnect hose to EGR valve.

If gage does not respond to throttle opening, proceed to Step 4.

4. Remove Carb-to-switch hose from switch and connect hose to vacuum gage. Repeat Step 2.
 5. If vacuum gage responds to throttle opening, then switch is defective. Remove switch and replace with new part.
- If gage does not respond to throttle opening, then check for plugged hose or defective carburetor.

EGR-TVS Functional Check - Cold

This check can be used to diagnosis a stall after cold start or poor driveability immediately after cold start.

The EGR thermal vacuum delay switch should be closed below a coolant temperature of 85°F (29°C) thereby blocking the ported vacuum signal from reaching the EGR valve below that temperature. Check as follows:

1. Drain coolant to below level of switch.
2. Disconnect vacuum lines and remove switch.
3. Inspect switch to make sure it is in good condition.
4. Connect a vacuum hose to lower nipple of switch, marked "C" or "CARB". Connect a vacuum gage to upper nipple, marked "E" or "EGR".
5. Place switch in water at 75°F (24°C) and submerge completely for 2 minutes while agitating water thoroughly.
6. Apply 12 in. hg. (-41 kPa) vacuum to hose on lower nipple of switch. Under this condition, the switch should be closed.

NOTICE: Leakage of up to 2 in. hg. (-7 kPa) of vacuum in 2 minutes is allowable and does not mean a defective switch.

7. If operation is satisfactory, reinstall switch. If switch is defective, replace with a new part.
8. Replace coolant and check level.

EXHAUST GAS RECIRCULATION (EGR)

Diesel Engine

To lower the formation of nitrogen oxides (NO_x), it is necessary to reduce combustion temperatures. This is done by introducing exhaust gases into the cylinders.

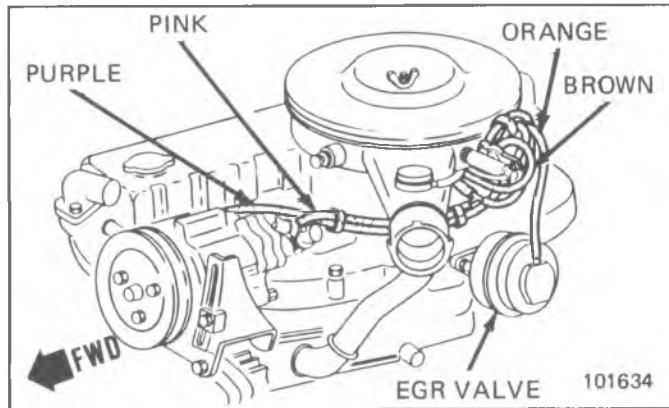


Fig. 6E-19-EGR-TV5 4.1L (2 of 3)

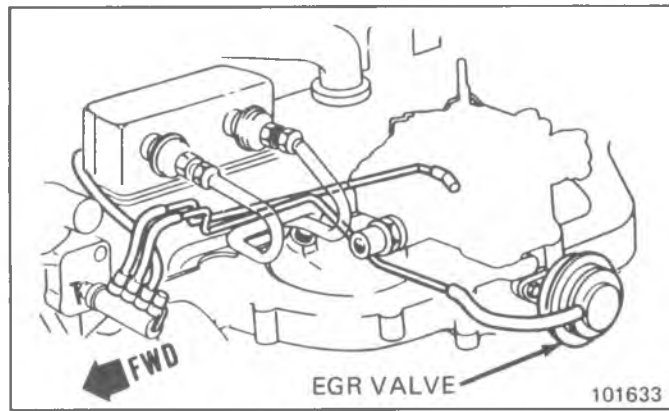


Fig. 6E-20-EGR-TV5 4.1L (3 of 3)

Vacuum Regulator Valve (RPO LL4)

Vacuum from the vacuum pump is modulated by the Vacuum Regulator Valve mounted on the injection pump. Vacuum is highest at idle and decreases to zero at wide open throttle. The EGR valve is therefore fully opened at idle and closed at wide open throttle. A Response Vacuum Reducer Valve is used between the VRV and the EGR valve to allow the EGR valve to change position quickly as throttle position is changed.

EPR Valve (Fig. 6E-24)

The Exhaust Pressure Regulator (EPR) valve is normally open. The valve is closed at idle to increase exhaust pressure which increases EGR flow to the engine. The EPR valve opens above idle to achieve normal EGR level for typical driving.

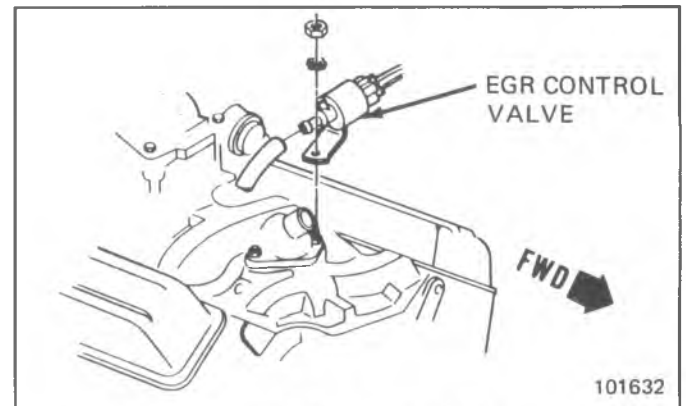


Fig. 6E-21-EGR Control Valve

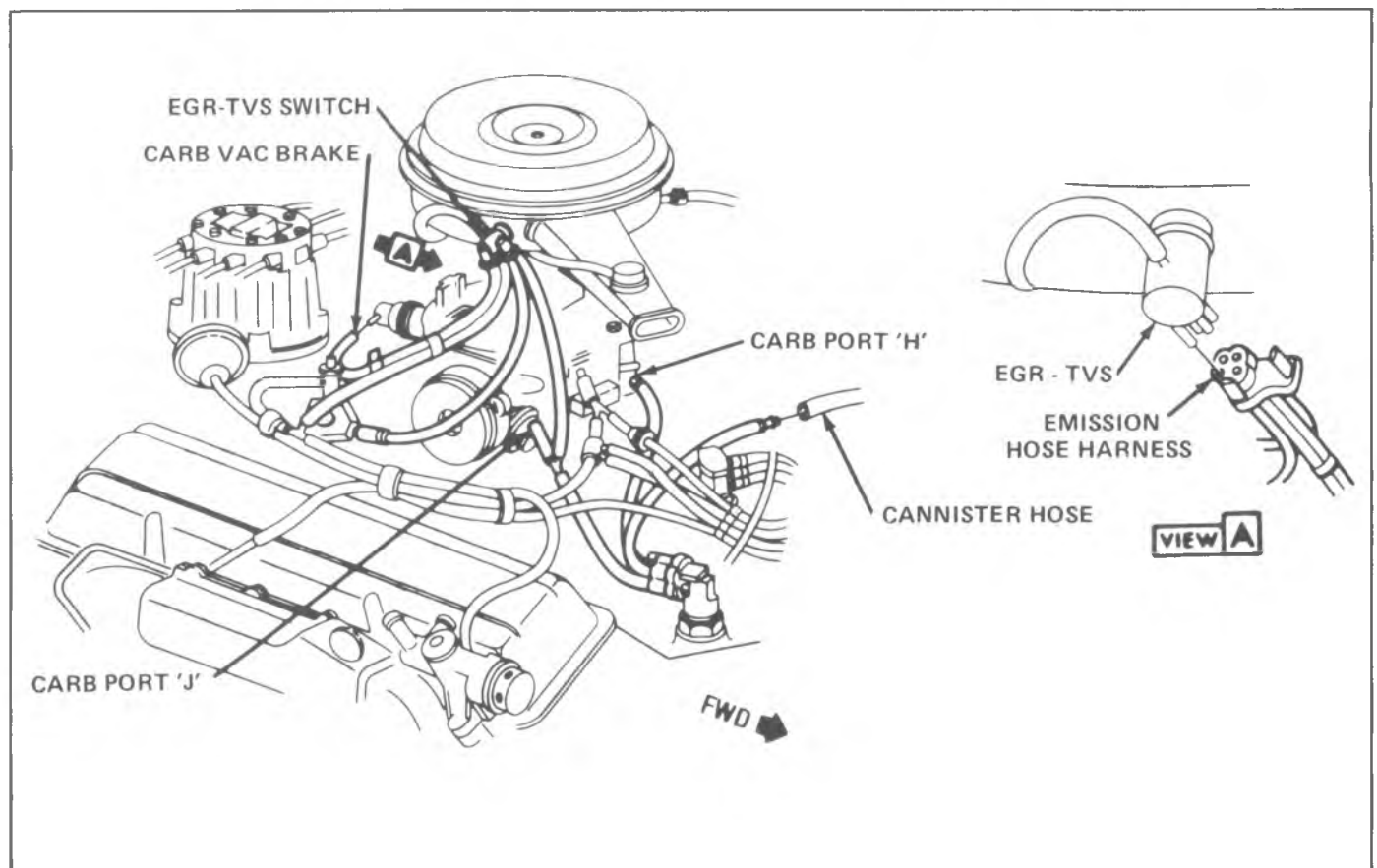


Fig. 6E-22-EGR-TV5 5.0L and 5.7L California

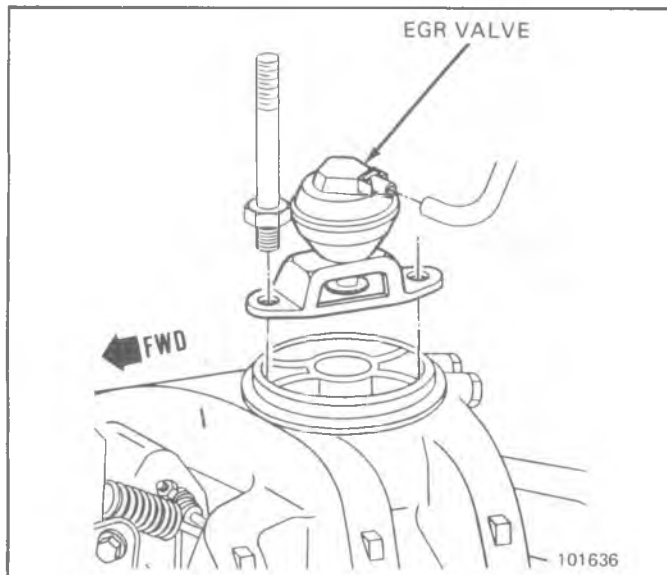


Fig. 6E-23--EGR Valve

COMPONENTS TESTS

Vacuum Regulator Valve (RPO LL4)

1. Attach the vacuum regulator valve snugly, but loosely to the fuel injection pump. The switch body must be free to rotate on the pump.
2. Attach vacuum source of 67.5 kPa to inboard vacuum nipple. Attach vacuum gage to outboard vacuum nipple.
3. Insert vacuum regulator valve gage bar between the gage boss on the injection pump and the wide open stop screw on the throttle lever.
4. Rotate and hold the throttle shaft against the gage bar.
5. Slowly rotate the vacuum regulator valve body clockwise (facing valve) until vacuum gage reads 39.0 ± 2 kpa. Hold valve body at this position and tighten mounting screws.

NOTICE: 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 39.0 ± 2 kpa. If vacuum is outside limits, reset valve.

Throttle Position Switch (RPO LH6)

1. Attach the throttle position switch snugly, but loosely, to the fuel injection pump. The switch body must be free to rotate on the pump.
2. Plug the three-wire Pack-Con II connector into an instrument that can check for continuity across the pink and yellow wires.
3. Insert the proper gage bar (Federal, California, manual or automatic transmission) between the gage boss on the injection pump and the wide open stop screw on the throttle shaft.
4. Rotate and hold the throttle shaft against the gage bar.
5. Slowly rotate the throttle switch body clockwise (facing throttle switch) until continuity just occurs across the

pink and yellow wires. Hold switch body at this position and tighten mounting screws.

NOTICE: Switch point has built in hysteresis and must be set only while rotating switch body in clockwise direction.

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 and check for continuity across the pink and yellow wires. If continuity does not occur, reset switch body.

Exhaust Gas Recirculation (EGR) Valve

Apply vacuum to vacuum port. The valve should be fully open at 10.5 inches (35.46 kPa) and closed below 6 inches (20.26 kPa).

MANIFOLD HEAT VALVE

4.8L (292 CID)

Inspection

- Visually inspect manifold heat valve for damage or binding.
- Move valve by hand. If binding or stuck, free with manifold heat valve lubricant, GM Part No. 1050422 or equivalent. If valve cannot be freed, replace valve.

Replacement

1. Remove exhaust pipe to manifold nuts and lower exhaust pipe.
2. Remove heat valve and packings.
3. Reverse above steps to install.

EARLY FUEL EVAPORATION (EFE)

Except 4.8L (292 CID)

Inspection

- Visually inspect exhaust heat valve for damage or binding linkage.
- Check that linkage is connected and vacuum hoses are properly routed and connected.

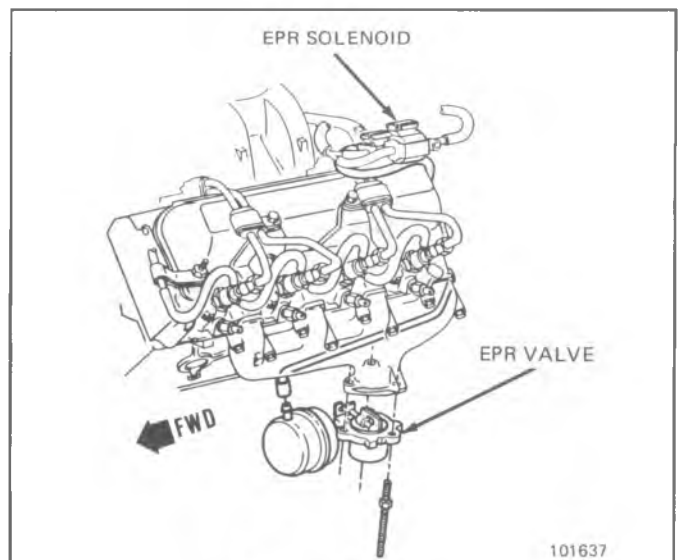


Fig. 6E-24--EPR Valve

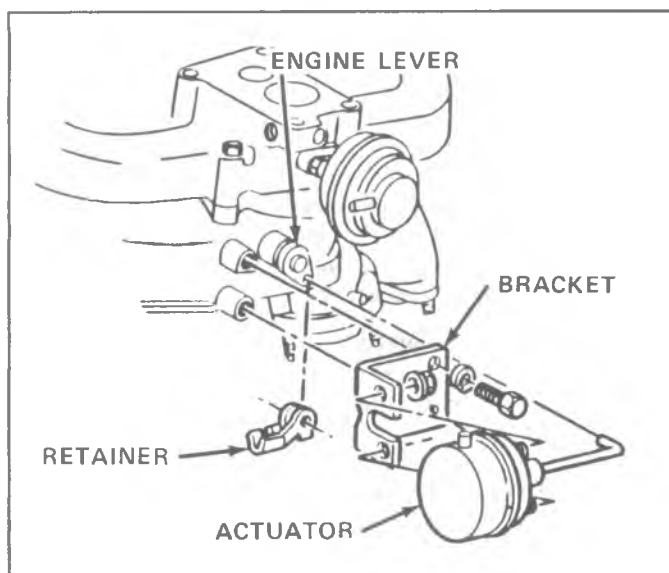


Fig. 6E-25--EFE System-4.1L

- Move exhaust heat valve by hand. If binding or stuck, free with manifold heat valve lubricant, GM Part No. 1050422 or equivalent. If valve cannot be freed, replace valve.

Checking EFE System

1. With engine cold, position transmission in neutral or park and apply parking brake.
2. Start engine and observe movement of actuator rod and exhaust heat valve. Valve should move to its closed position.
3. If valve does not close, disconnect hose at actuator and check for vacuum.
 - If there is vacuum, replace actuator.
 - If there is no vacuum, disconnect hose at TVS-to-vacuum source.
 - If there is vacuum at hose, replace TVS.
 - If there is no vacuum, check for deteriorated hose and vacuum source to determine lack of vacuum.

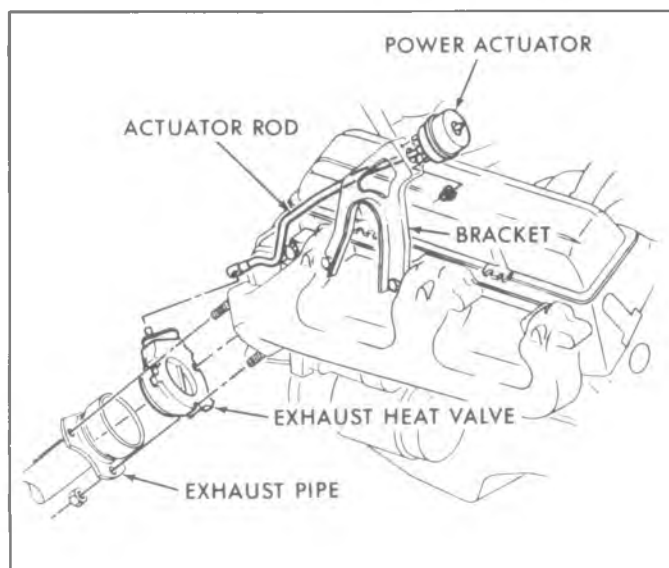


Fig. 6E-26--Actuator and Rod-5.7L-G/ CK

4. When coolant reaches 180°F (82°C) (V8), or oil reaches 150°F (66°C) (six cylinder), the exhaust heat valve should move to its open position.
5. If valve does not move, disconnect hose at actuator and check for vacuum.
 - If there is vacuum, replace TVS.
 - If there is no vacuum, replace actuator.

Coolant Temperature Thermal Vacuum Switch (TVS) - V8

Replacement

1. Drain coolant below level of engine coolant outlet housing.
2. Disconnect hoses at TVS ports.
3. Remove TVS.
4. Apply a soft setting sealant uniformly on replacement TVS male threads. No sealant should be applied to sensor end of TVS.
5. Install TVS, tighten to 14N·m (120 pound inches) and then hand torque clockwise as required to align TVS to accommodate hoses.
6. Connect hoses to TVS ports.
7. Add coolant as required.

Oil Temperature Thermal Vacuum Switch (TVS) - L6

Replacement

1. Disconnect hoses at TVS ports.
2. Remove TVS switch.
3. Install TVS switch.
4. Connect hoses to TVS ports.

Actuator Assembly (Fig. 6E-25 thru 29)

The actuator assembly is located on a bracket attached to right exhaust manifold or mounted directly to the right or left exhaust manifold. Actuators which are remotely located on bracket are connected to the heat valve by a rod.

Replacement

1. Disconnect vacuum hose from actuator.
2. Remove fasteners holding actuator to manifold or bracket.
3. If used, disconnect rod from actuator and remove.
4. Remove actuator.

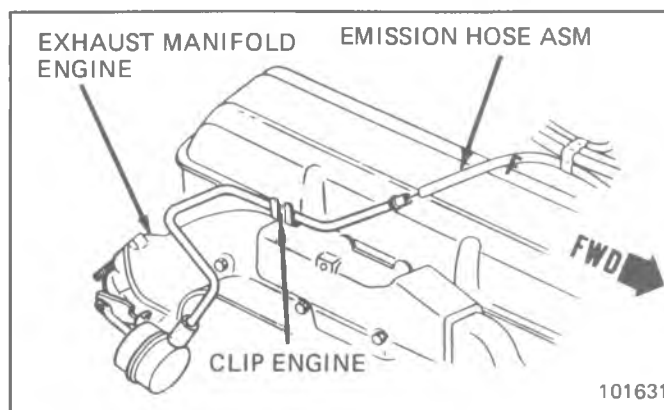


Fig. 6E-27--Exhaust Heat Valve-5.0L-CK

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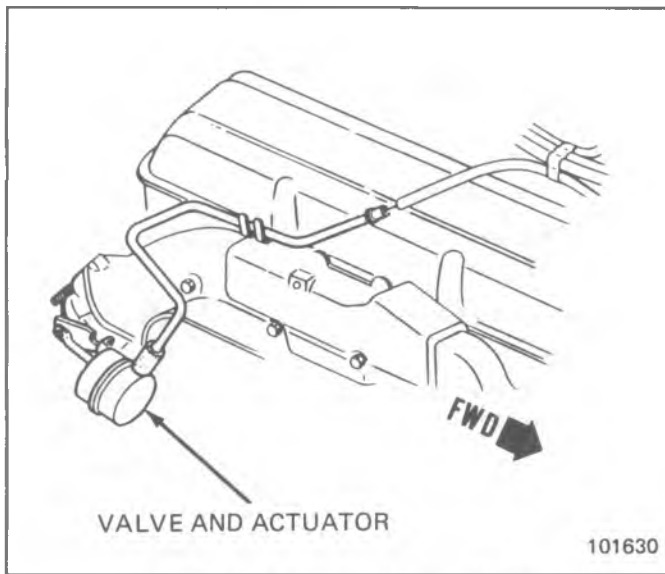


Fig. 6E-28--Exhaust Heat Valve-5.7L-P

5. Install actuator and rod (if used) reversing steps 1 through 4. Tighten nuts to 3 N·m (25 in. lbs.).

Exhaust Heat Valve - V8

Replacement

1. Remove crossover exhaust pipe.
2. Disconnect rod from valve.
3. Remove valve.
4. Install valve and connect rod.
5. Install crossover exhaust pipe.

Exhaust Heat Valve - 4.1L

Replacement

1. Remove 2 nuts attaching actuator bracket-to-valve and exhaust manifold.
2. Remove bracket and disconnect rod from valve.
3. Remove 2 additional nuts from valve and remove valve.
4. Install valve reversing Steps 1 through 3.

AIR INJECTION REACTOR (AIR) SYSTEM

Gasoline Engine

The Air Injection Reactor (A.I.R.) System consists of: an air injection pump (with necessary brackets and drive attachments), an air diverter valve, a check valve, an air pipe assembly, and connection hoses.

Inspection

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:

1. Check for proper drive belt tension.

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 system, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed, proceed as follows:

2. Check for a seized Air Injection Pump Do not oil pump.
3. Check hoses, pipes and all connections for leaks and proper routing.
4. Check diverter valve attaching screws for tightness.
5. Check injection pump for proper mounting and bolt torque.
6. Repair irregularities in these components as necessary.
7. If no irregularities exist and the air injection pump noise is still excessive, remove and replace pump.

Air Pump Drive Belt Adjustment and Replacement

1. Inspect drive belt for wear, cracks or deterioration.
2. Loosen generator adjustment bolt on V8 models or pump bolt on L6 models.
3. Replace belt if required.
4. Move generator or pump until drive belt is at proper tension as specified in Section 6B, then retighten bolts.
5. Check belt tension using a belt tension gage.

Air Pump Pulley

Replacement

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts (Fig. 6E-30 and 31).
2. Loosen pump through bolt and adjusting bolt.
3. Remove drive belt, pump pulley and pulley spacer.
4. Install pump, pulley and spacer with retaining bolts hand tight.
5. Install drive belt and adjust to proper tension as specified in Section 6B.
6. Hold pump pulley from turning by compressing drive belt, then torque pump pulley bolts to 32 N·m (24 ft. lbs.).
7. Recheck belt tension and adjust if required.

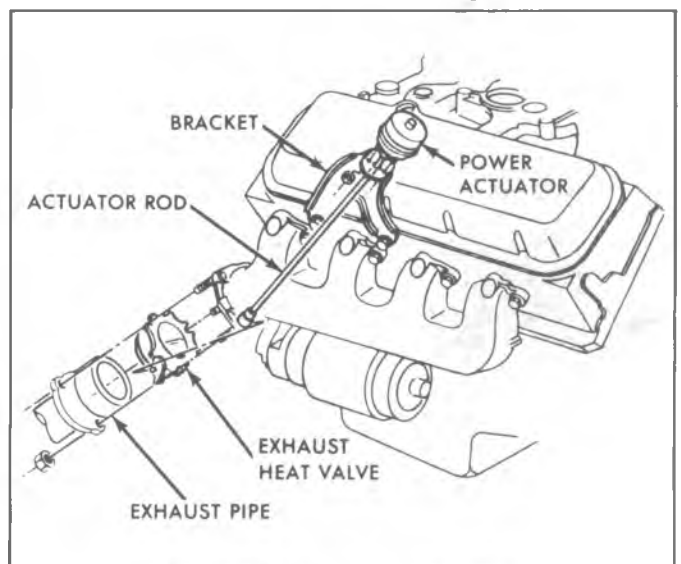


Fig. 6E-29--Actuator and Rod 7.4L

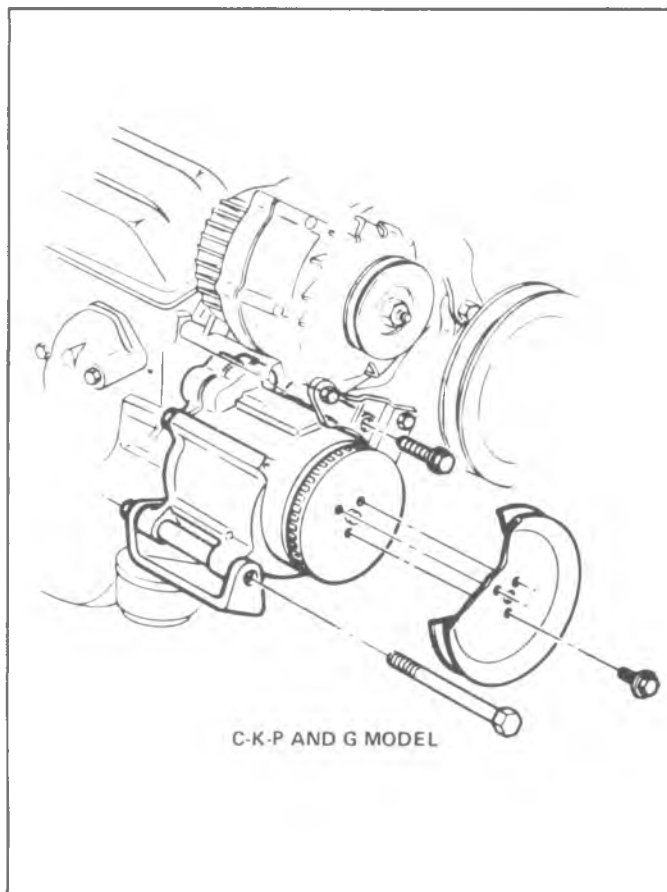


Fig. 6E-30--Air Pump and Pulley

Air Injection Pump

Removal

1. Disconnect battery cable.
2. Mark front of pump pulley so it can be installed in the same direction.
3. Remove air pump pulley as outlined under air pump pulley replacement.
4. Disconnect hoses, vacuum and electrical connections from diverter valve.
5. Remove air pump mounting bolts and remove pump assembly.
6. If pump is being replaced, transfer diverter valve to new pump.

Install

1. Install air pump assembly and tighten mounting bolts.
2. Reconnect hoses, vacuum and electrical connections to diverter valve.
3. Install air pump pulley.
4. Install pump belt and adjust to correct tension.
5. Reconnect battery cable.
6. Check system for proper operation.

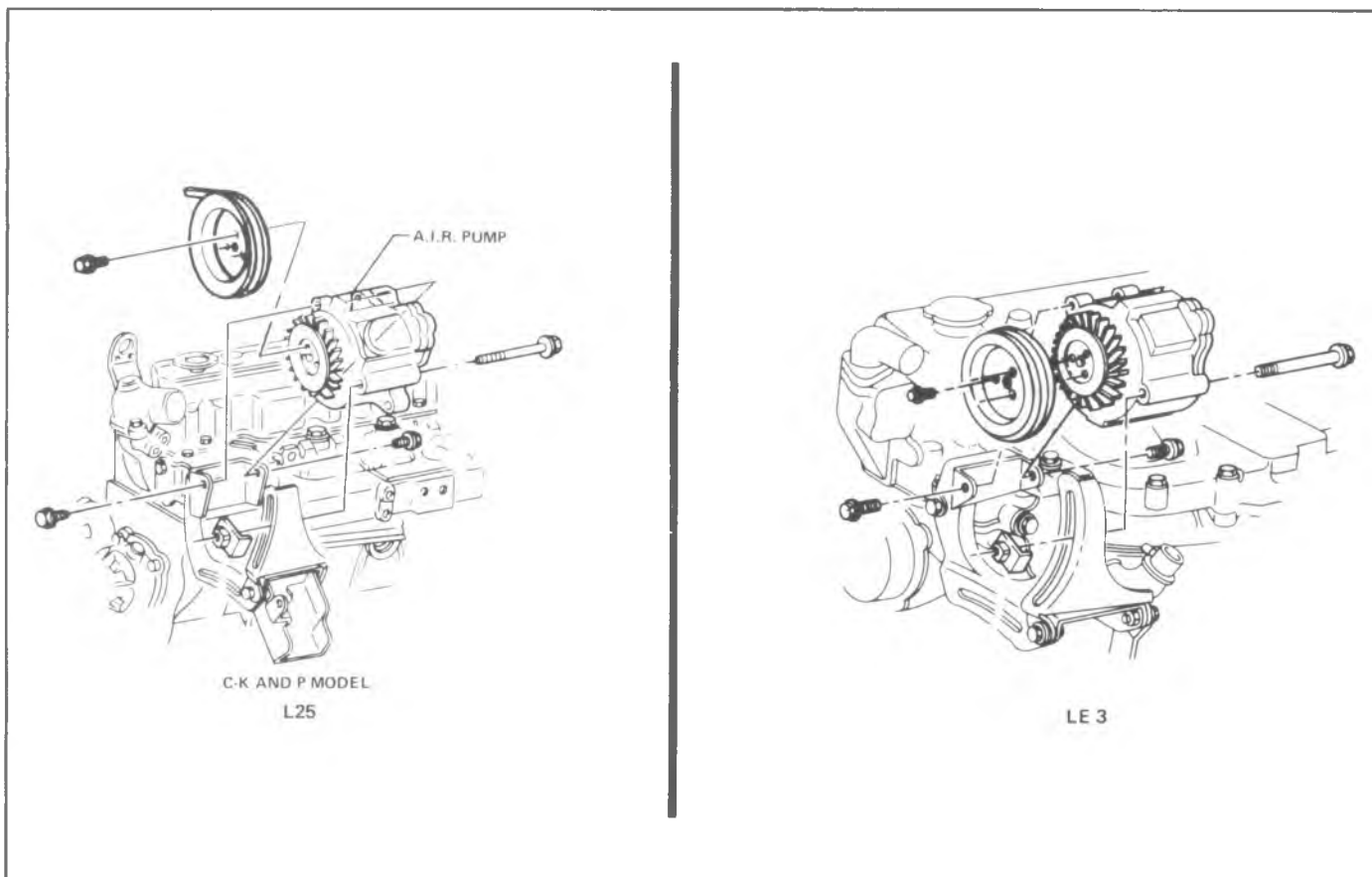


Fig. 6E-31--Air Pump and Pulley-L6

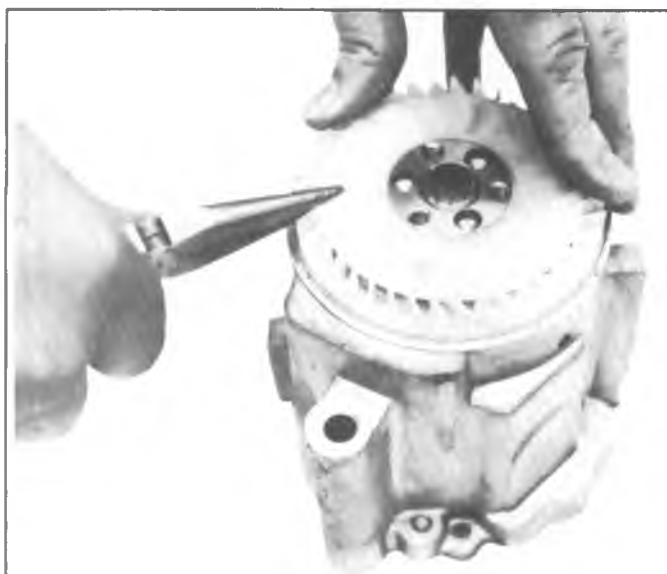


Fig. 6E-32--Filter Fan-Removal

Air Pump Filter Fan

Replacement

Before starting this operation note the following:

- Do not allow any 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 on pump will result.
- Do not remove motor drive hub from filter fan.
- It is seldom possible to remove the filter fan without destroying it.

1. Remove drive belt, pulley and spacer.
2. Insert needle nose pliers and pull filter fan from hub (Fig. 6E-32).
3. Position new filter fan on pump hub.
4. Position spacer and pump pulley against centrifugal filter fan.
5. Install pump pulley bolts and tighten equally to 9 N·m (30 in. lbs.). This will compress the centrifugal filter fan onto the pump hub (Fig. 6E-33). 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. Install pump drive belt and adjust to specifications shown in Section 6B.

Air Hoses and Injection Pipes

Inspection and Replacement (Fig. 6E-34 and 35)

1. Inspect all hoses for deterioration or holes.
2. Inspect all air injection pipes for cracks or holes.
3. Check all hose and pipe connections.
4. Check pipe and hose routing. Interference may cause wear.

5. If a leak is suspected on the pressure side of the system or any pipe and/or hose has been disconnected on the pressure side, the connection should be checked for leaks with a soapy water solution.
6. If hose and/or pipe replacement is required, note routing, then remove hose and/or those as required.
7. Install new hose and/or pipe, routing them as when removed.
8. Tighten hose and pipe connections. Use an anti-seize compound on threads of the air pipe fitting when re-assembling.

Check Valve

Inspection

1. The check valve should be inspected whenever the hose is disconnected from the 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 check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not function this way.

Replacement (Fig. 6E-34 and 35)

1. Release clamp and disconnect air hoses from check valve.
2. Unscrew check valve from air injection pipe.
3. Screw check valve onto air injection pipe.
4. Position air hose on check valve and secure with clamp

Air Diverter Valve

Removal (Fig. 6E-36, 37 and 38)

1. Disconnect battery ground cable.
2. Disconnect vacuum hose at valve.
3. Disconnect air outlet hoses from valve.
4. Bend tab on locks and remove bolts holding elbow to control valve.



Fig. 6E-33--Filter Fan-Installation

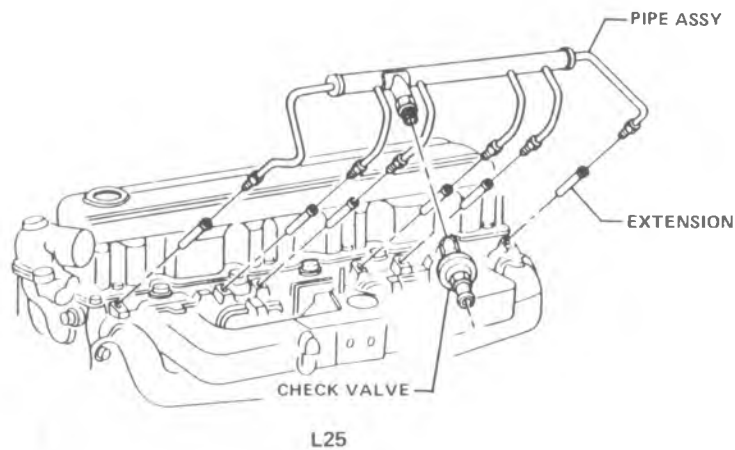
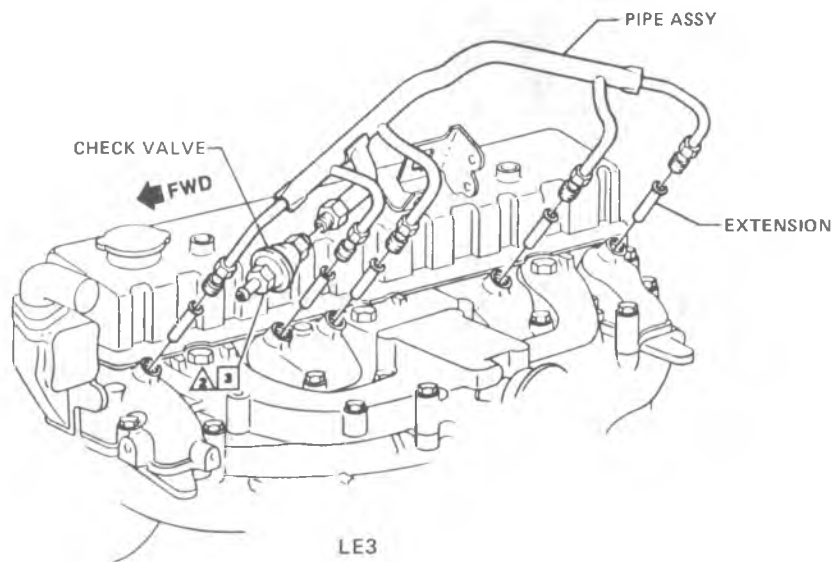


Fig. 6E-34--Air Injection Pipes-L-6

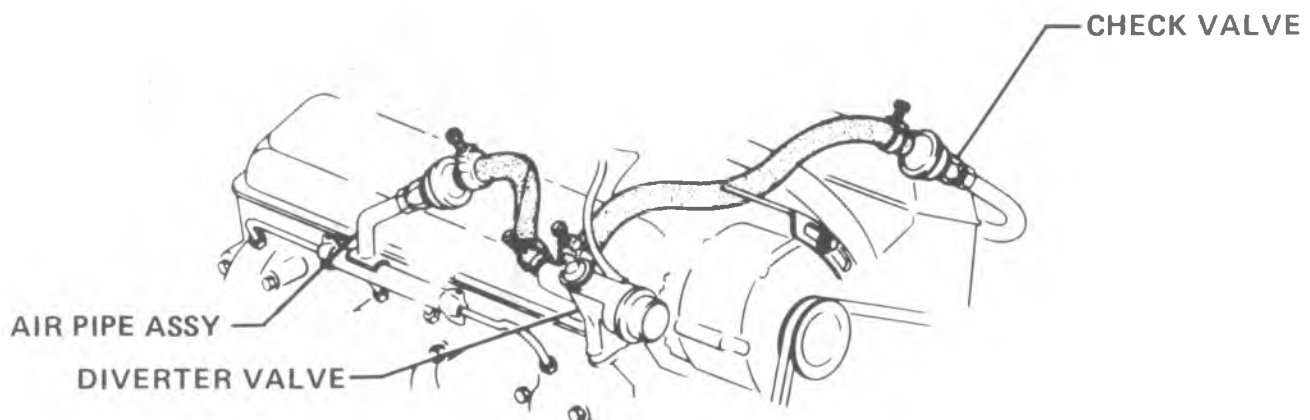


Fig. 6E-35--Air Injection Pipes V8

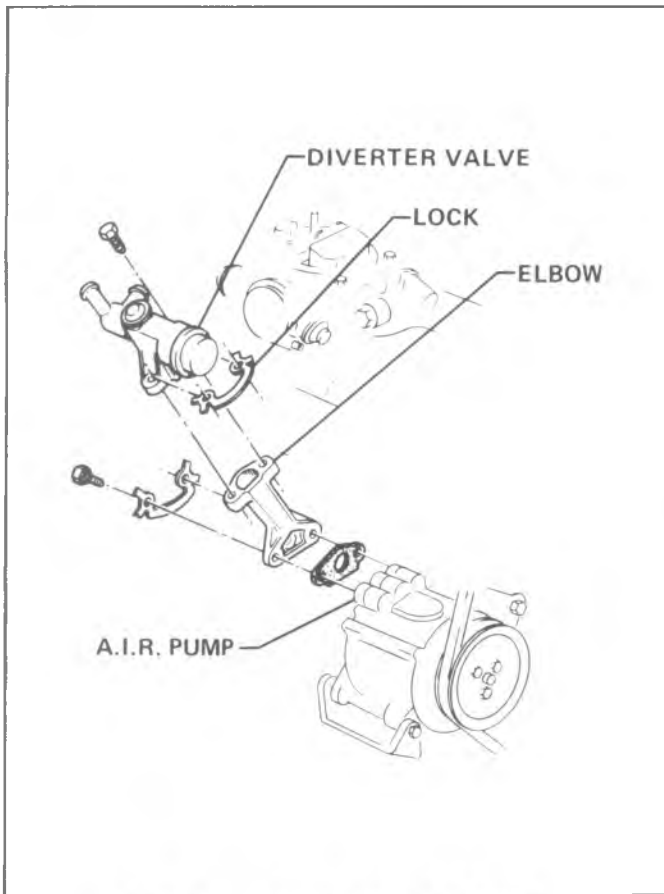


Fig. 6E-36--Diverter Valve-V8 C/K Series

5. Remove control valve and gasket from elbow.

Installation

1. Install control valve and gasket to elbow.
2. Install bolts and locks to elbow.
3. Tighten bolts to elbow and control valve.
4. Bend tab nearest to hex flat against the bolt and screw heads.
5. Connect vacuum and air outlet hoses to valve.
6. Reconnect battery ground cable.

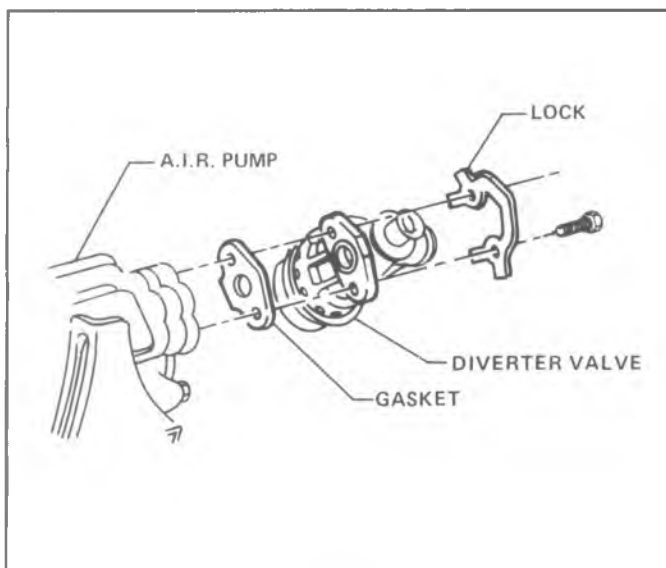


Fig. 6E-37--Diverter Valve-L25

7. Check system operation.

PULSE AIR INJECTION REACTOR SYSTEM - PAIR

Inspection and Checking Pulse Air Valve

Inspect pulse air valves, pipes, grommets and hose for leaks and cracks and replace as required.

Check operation of pulse air valves by creating a vacuum at grommet end of valve by adapting tool J-23738, with a tight fitting length of 3/4" hose. With vacuum of 5 kPa (17" Hg.) there will be an allowable drop to 1.7 kPa (6" Hg.) in 2 seconds. Replace valve and/or hose if vacuum drops in less than two seconds.

NOTICE: Vacuum drop must be a result of a leaking valve not a leaking hose or connection.

Replacement of Pulse Air Valve (Fig. 6E-39)

1. Remove air cleaner and disconnect rubber hose from plenum connecting pipe.
2. Disconnect four pipe check valve fittings at cylinder head and remove check valve pipes from plenum grommets.
3. Disconnect check valve from check valve pipe.
4. Bench assemble check valves to check valve pipe.
5. Install pipe check valve assemblies to cylinder head as shown in fig. 6E-39 and finger tighten the fittings.
6. Using a 1" open end wrench or similar tool as a lever, align check valve on pipe "A" (fig. 6E-40) to the plenum grommet. Then using palm of your left hand install check valve into the grommet. Use rubber lubricant on grommets to ease assembly.
7. Repeat procedure in step 6 on pipe "B" (fig. 6E-41) but use your left hand on the tool for alignment of check valve and install valve with the palm of your right hand.
8. Tighten fittings to specified torque and reinstall air cleaner and hose.

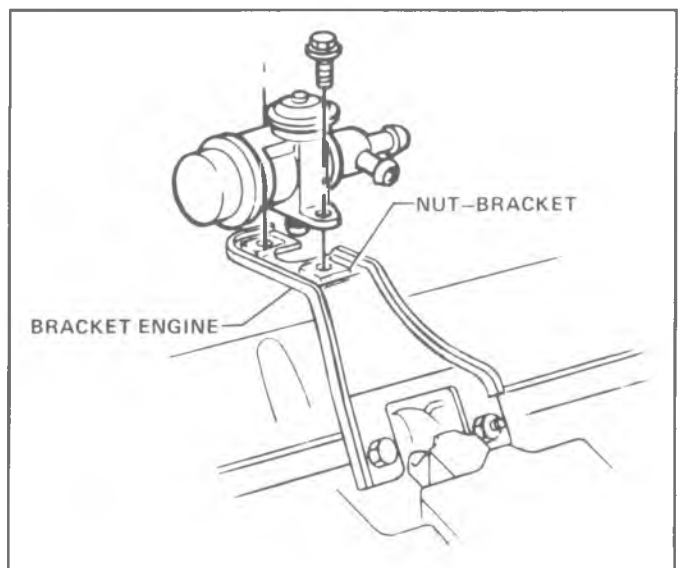


Fig. 6E-38--Diverter Valve G Series-V8

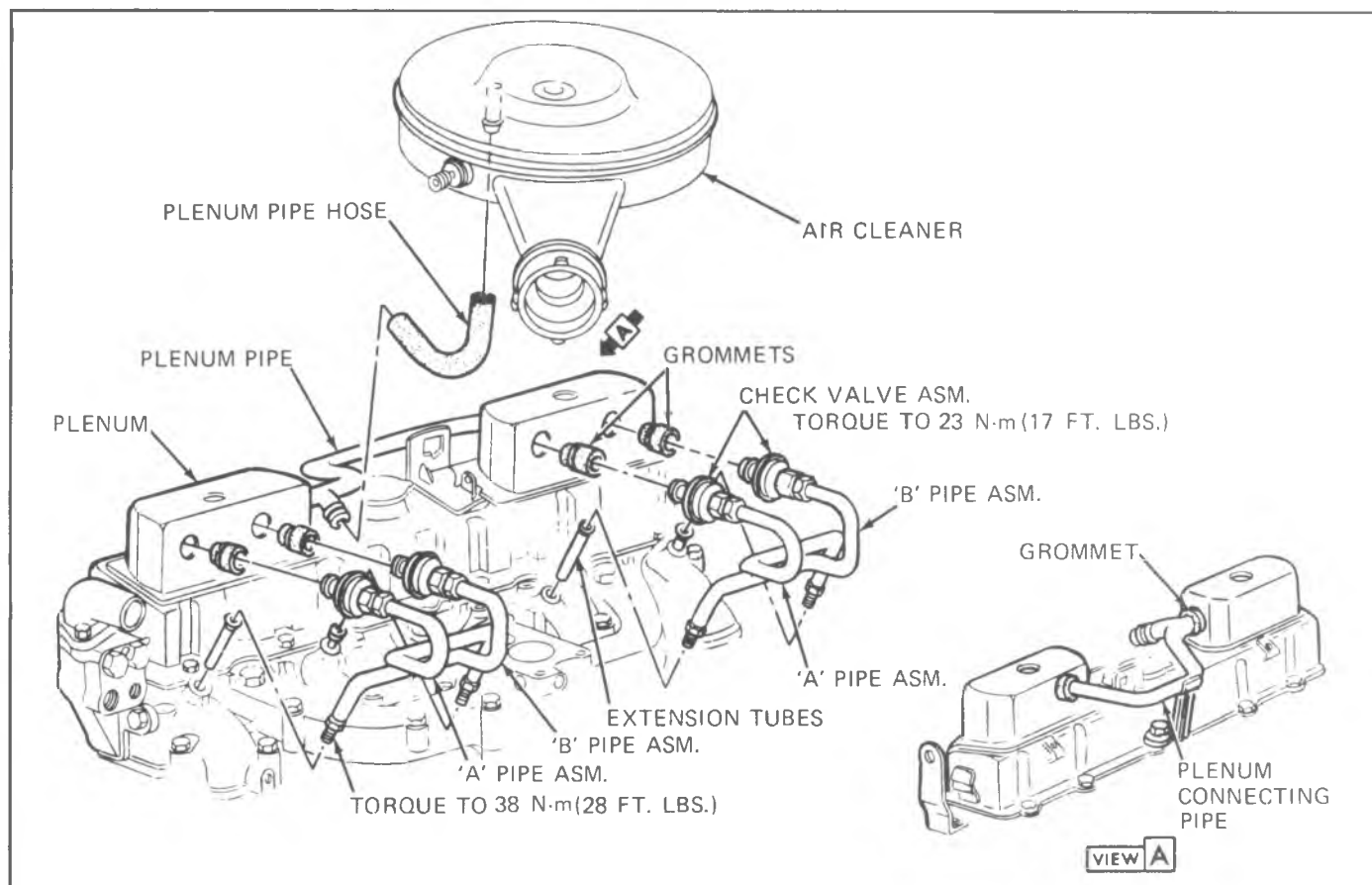


Fig. 6E-39--PAIR System

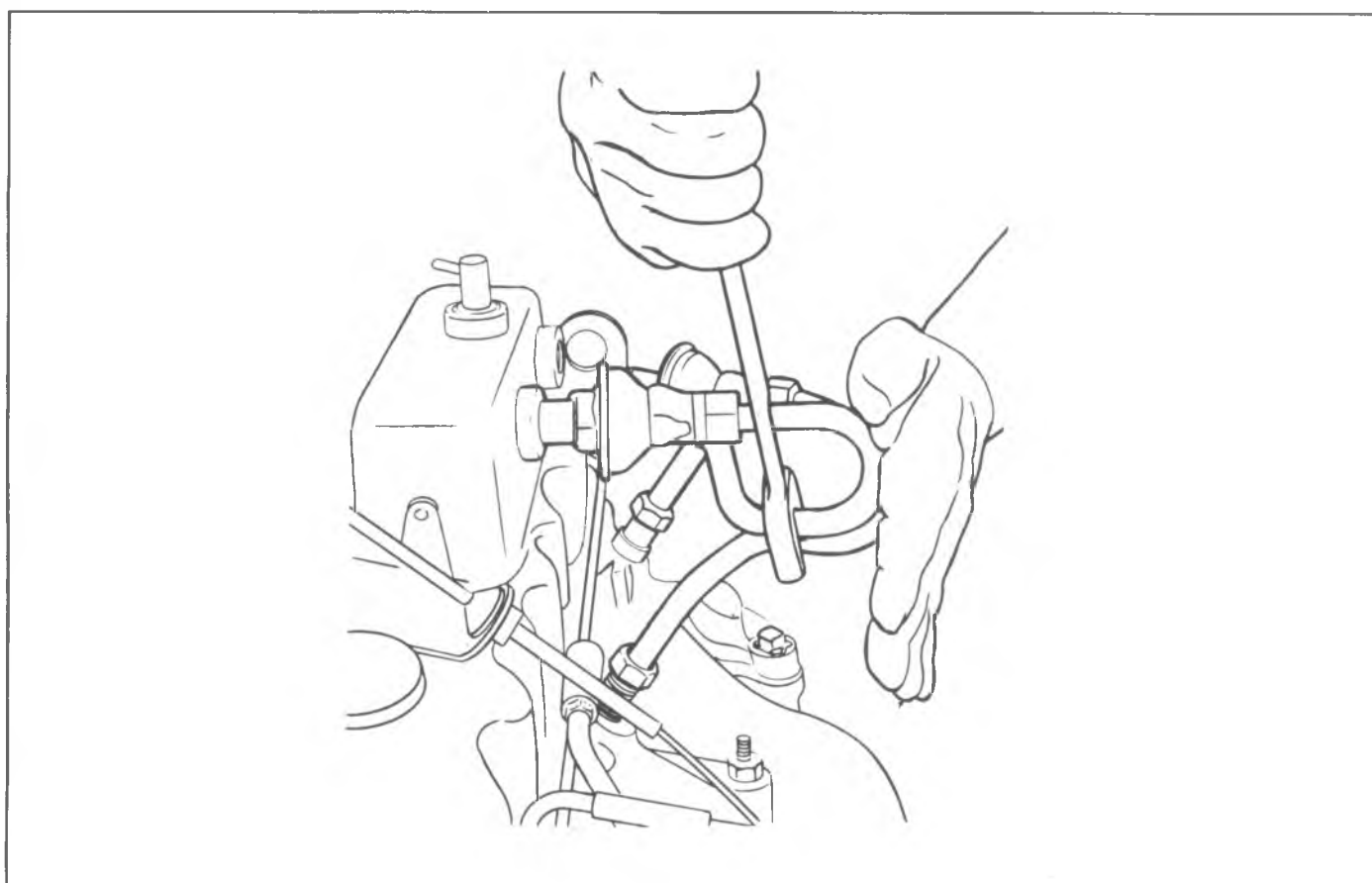


Fig. 6E-40--PAIR (Pipe A)

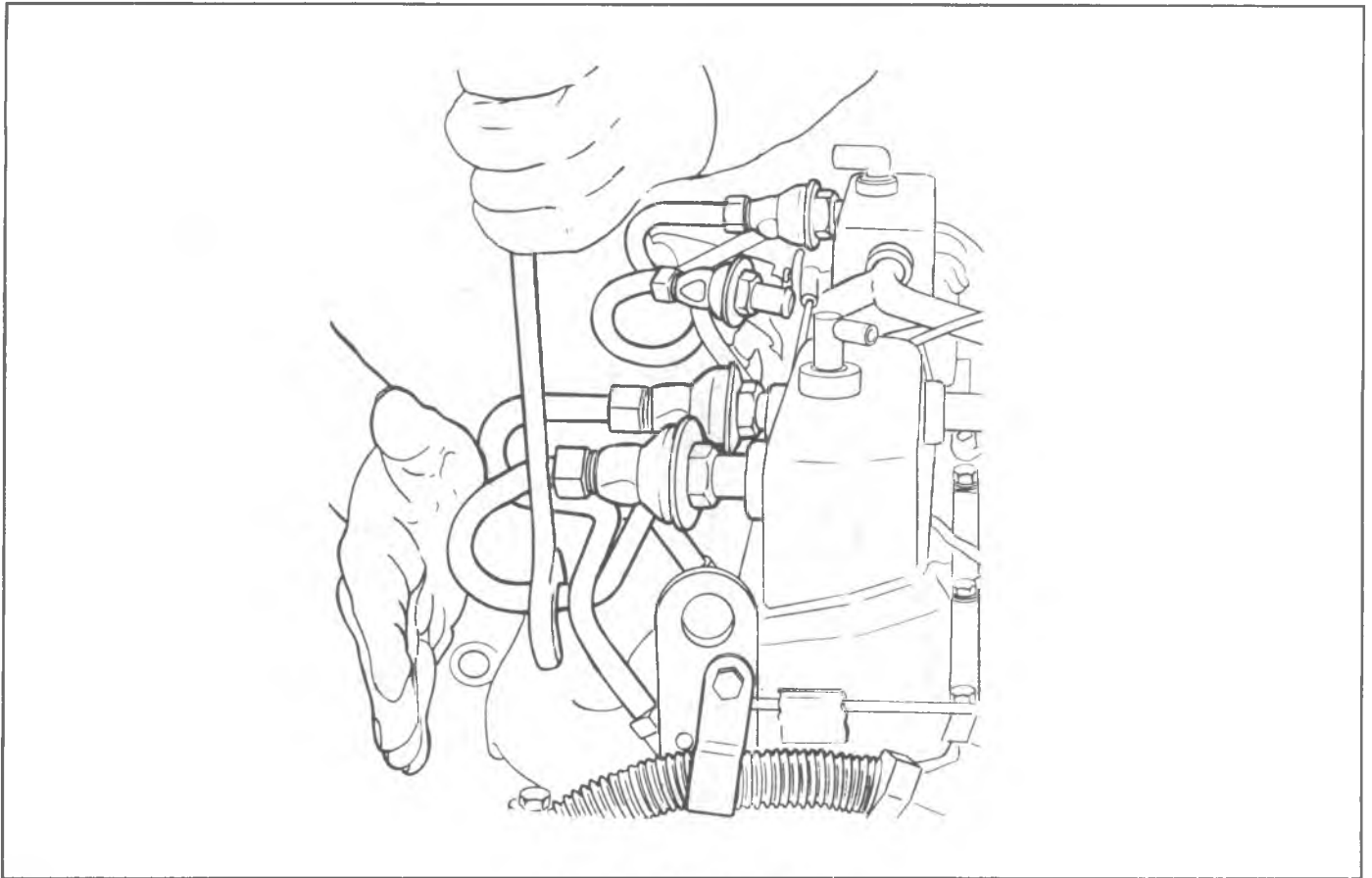


Fig. 6E-41--PAIR (Pipe B)

Deceleration Valve 4.1L (LE-3)

Replacement

1. Remove vacuum hoses from valve (Fig. 6E-42).
2. Remove two screws securing valve to engine bracket and remove valve.
3. Install valve, tighten screws to engine bracket.
4. Install vacuum hoses.

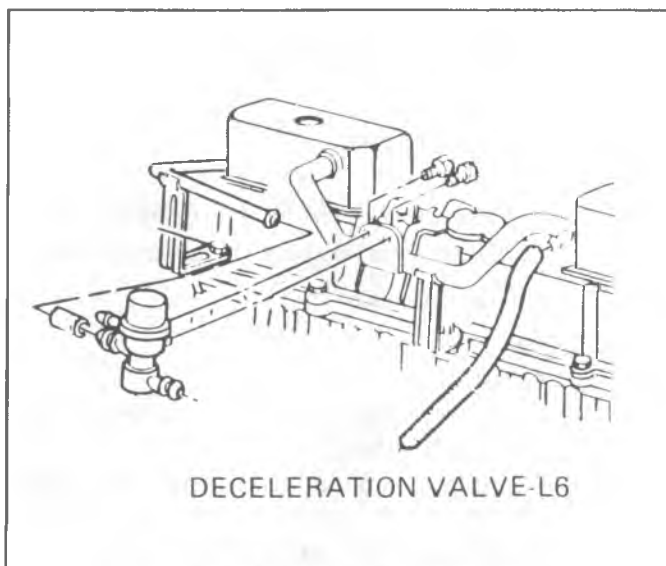


Fig. 6E-42--Deceleration Valve - L6

THERMOSTATIC AIR CLEANER

Checking Thermac Air Cleaner

1. Inspect system to be sure all hoses and tubes are connected (Fig. 6E-43 and 44). Check for kinked, plugged or deteriorated hoses.
2. If engine is warm above 27°C (80°F), remove air cleaner. Allow it to cool to room temperature, below 27°C (80°F). Placing a cool wet rag on the temperature sensor will aid in cooling.
3. Install cooled air cleaner with cold air intake disconnected from snorkel (if equipped).
4. Observe damper door before starting the engine. It should be in the open snorkel position (hot air duct covered).
5. Start engine. Watch damper door in air cleaner snorkel. When engine is first started, damper door should close. As air cleaner warms up, damper door should open slowly.
6. If damper door does not close when the engine is started, remove air cleaner.
7. Apply at least 23 kPa (7 in. Hg.) of vacuum to the vacuum diaphragm motor through hose disconnected at the temperature sensor. Damper door should completely block off snorkel passage when vacuum is applied. If not check to see if linkage is hooked up correctly.
8. With vacuum still applied, trap vacuum in vacuum diaphragm motor by bending hose. Damper door should remain closed; if not, replace vacuum diaphragm motor.

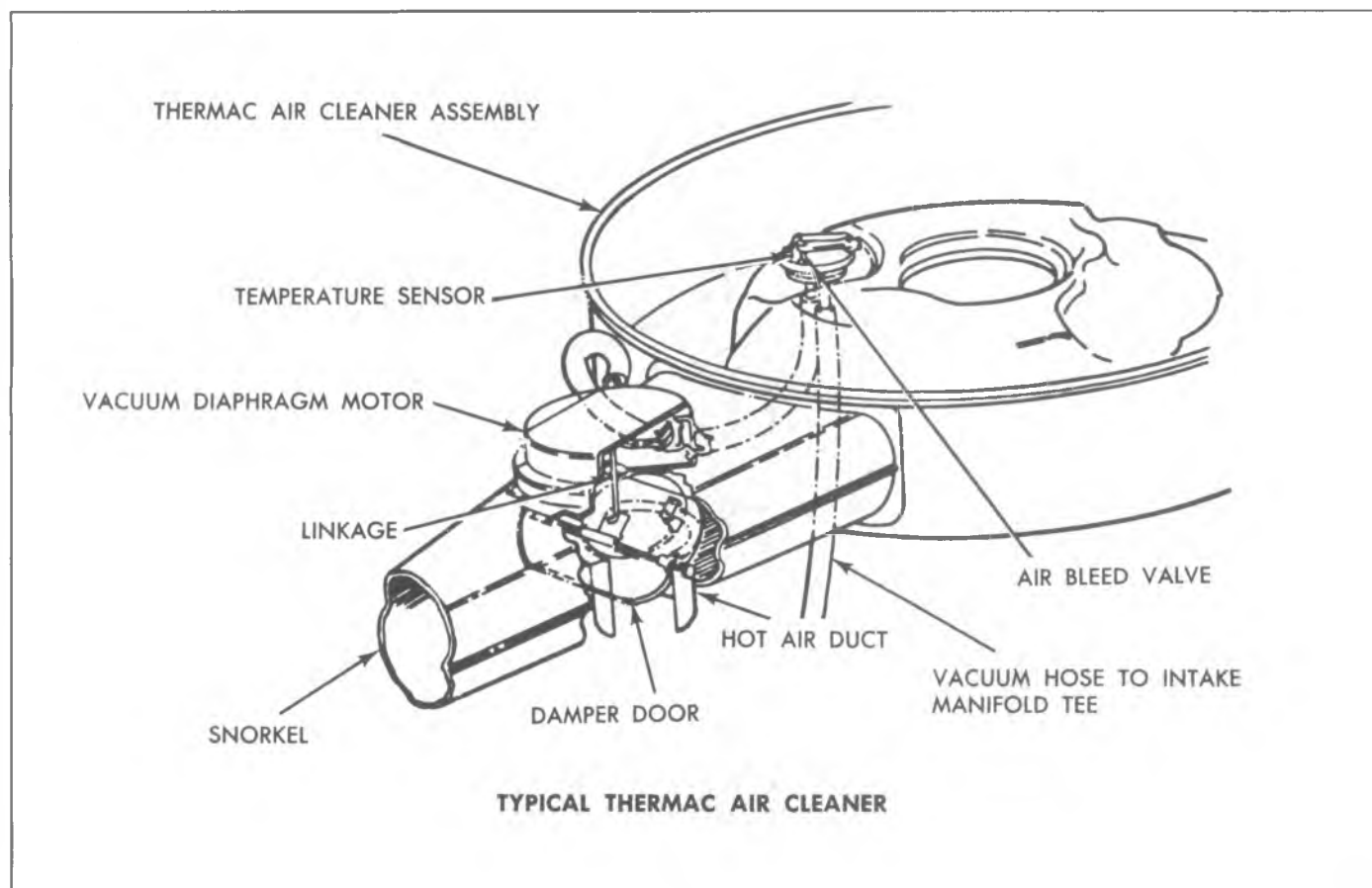


Fig. 6E-43—Thermac Air Cleaner-Typical

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.)

9. Reinstall air cleaner. As the engine warms up, the damper door should start to allow outside air and heated air to enter the carburetor.
10. If the air cleaner fails to operate as described above or if correct operation of the air cleaner is still in doubt, perform thermometer check of sensor.

Thermometer Check of Sensor

1. Start test with air cleaner temperature below 80°F (27°C). If engine has been run recently, remove air cleaner and place a cool wet rag on sensor. Remove air cleaner cover and place thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 79°F (26°C) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to step 2 below.
2. Start and idle engine. Damper door should move to close the snorkel passage 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 100°F ± 20°F (38°C ± 7°C).
3. If the damper door does not start to open up the snorkel passage at temperature indicated, temperature sensor is malfunctioning and must be replaced.

AIR CLEANER TVS

Remove

1. Remove air cleaner cover and element.
2. Disconnect vacuum hoses.
3. Pry clip from TVS and remove.
4. Install new TVS and replace clip.
5. Reconnect vacuum hoses (refer to Vehicle Emission Control Information Label).
6. Install air cleaner element and cover.

Air Cleaner Element Replacement

Paper Element

1. Remove air cleaner cover.
2. Remove element.
3. Install new element in air cleaner with either end up.
4. Install air cleaner cover. Do not over tighten wing nut.

Polywrap Element (P Models)

1. Remove air cleaner cover.
2. Remove element.
3. Remove polywrap band from paper element and discard element (Fig. 6E-45).
4. Clean bottom section of air cleaner and inspect cover seal for tears or cracks. Replace seal if damaged.
5. Inspect band for tears and replace if damaged.

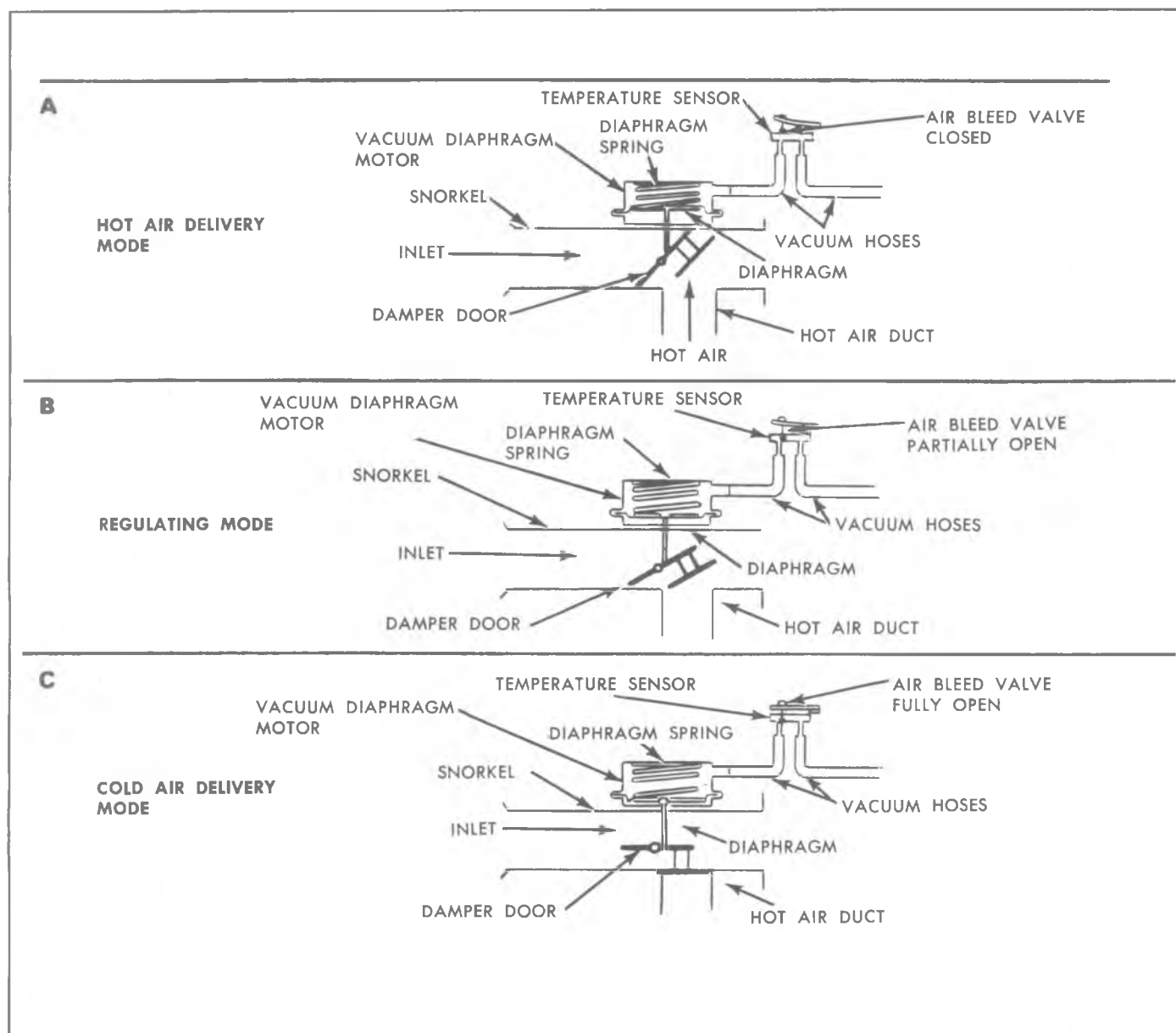


Fig. 6E-44--Preheated Air System Operation

6. If band is serviceable, wash in kerosene or mineral spirits and squeeze out excess solvent.
- NOTICE:** Never use a hot degreaser or any solvent containing acetone or similar solvent; also, never shake, swing or wring the element to remove excess solvent as this may tear the polyurethane material. Instead, "squeeze" the excess solvent from the element.
7. Dip band into light engine oil and squeeze out excess oil.
8. Install band around outer surface of new paper element.
9. Install element in bottom section of air cleaner with either end up.
10. Install air cleaner cover. Do not over-torque wing nut(s).
2. Disconnect vacuum hose from motor.
3. Drill out the two spot welds initially with a 1/16" hole, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.
4. Remove motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Installation

1. Drill a 7/64" hole in snorkel tube at center of vacuum motor retaining strap.
2. Insert 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 the retaining strap and motor to the snorkel tube.

Vacuum Diaphragm Motor

Removal (Fig. 6E-46)

1. Remove air cleaner.

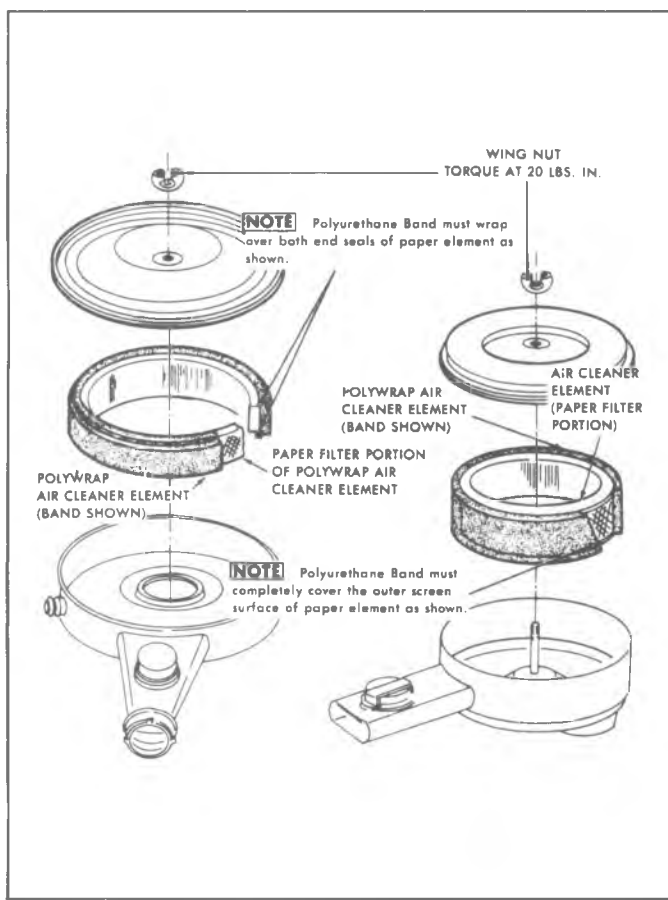


Fig. 6E-45--Polywrap Air Cleaner

4. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
5. Connect vacuum hose to motor and install air cleaner.

Temperature Sensor

Removal

1. Remove air cleaner.
2. Detach hoses at sensor.
3. Pry up tabs on sensor retaining clip; remove clip and sensor from air cleaner. Note position of sensor for installation.

Installation

1. Install sensor and gasket assembly in original position.
2. Press retainer clip on hose connectors.
3. Connect vacuum hoses and install air cleaner on engine.

THROTTLE RETURN CONTROL (TRC) SYSTEM

Checking And Adjusting TRC System

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 vacuum solenoid. 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 vacuum solenoid 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 solenoid 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 solenoid-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.

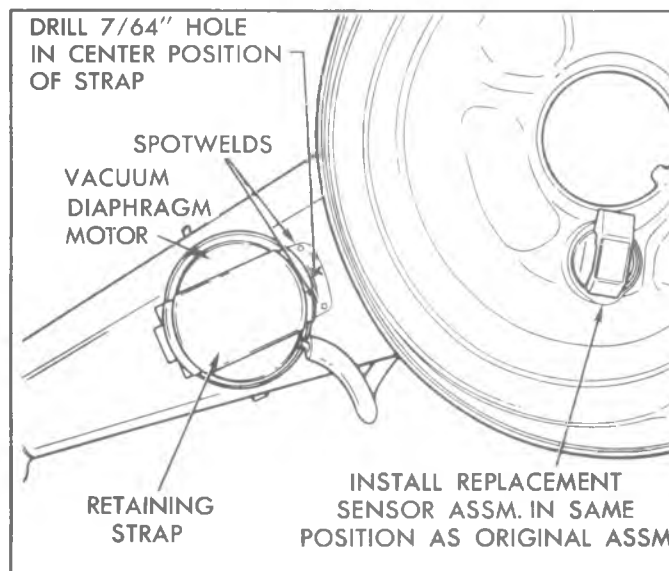


Fig. 6E-46--Vacuum Motor

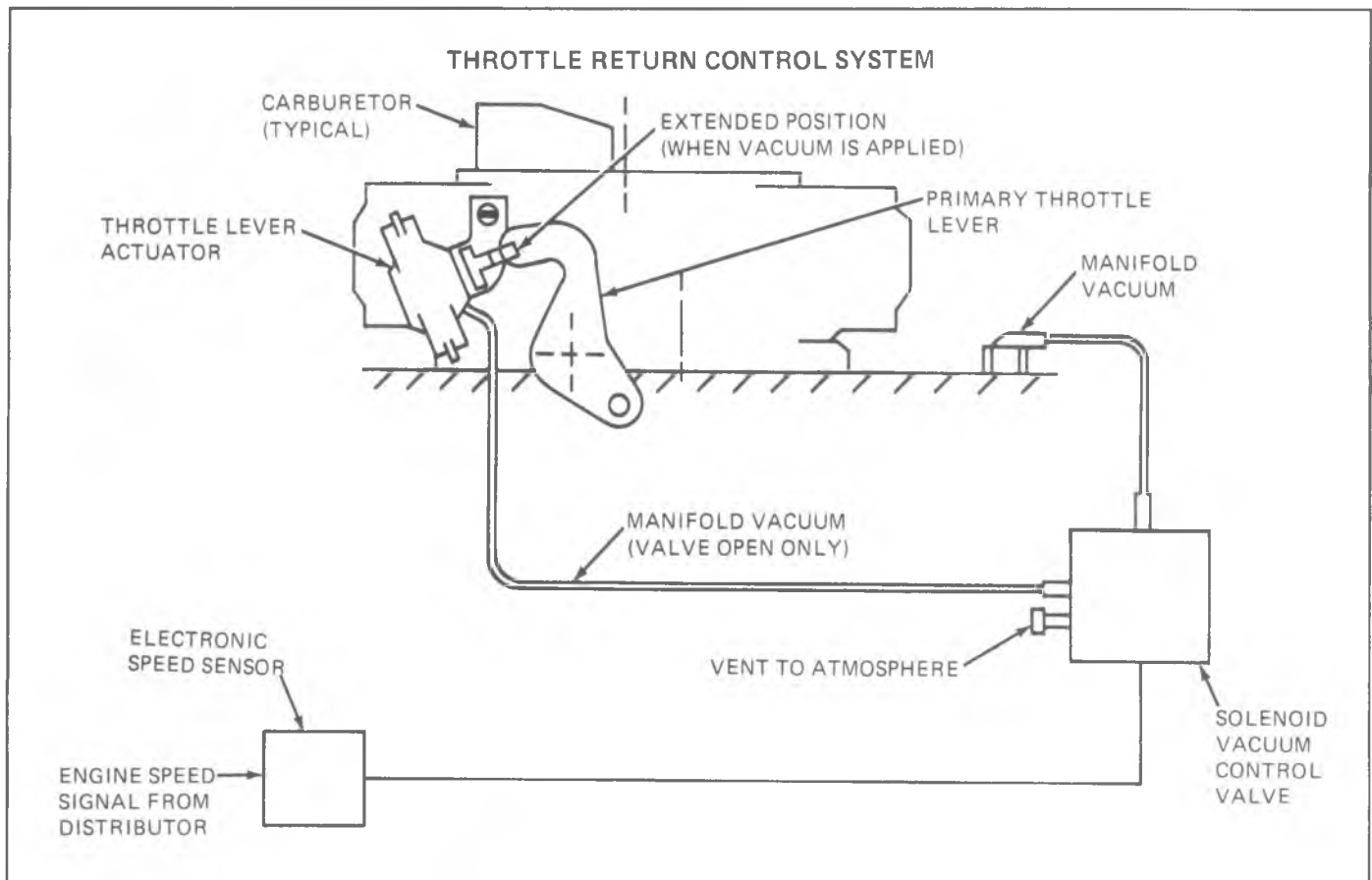


Fig. 6E-47--Throttle Return Control System

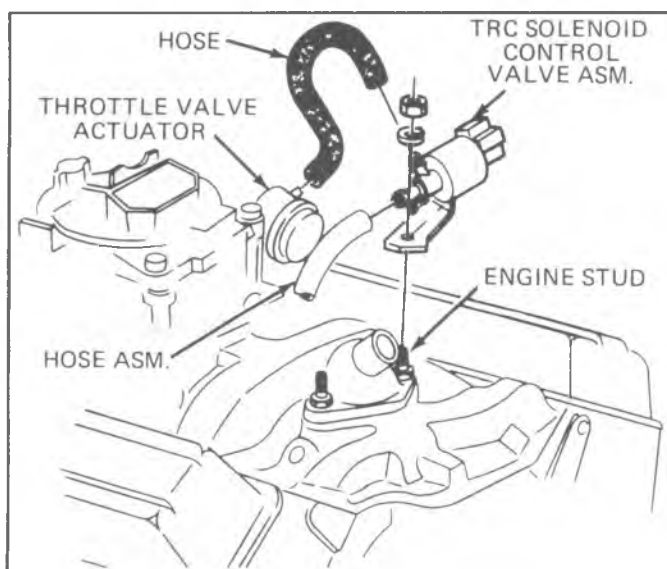


Fig. 6E-48--TRC System-V8

- f. If the actuator extends in Step D, ground the solenoid-to-switch wire terminal at the speed switch. If it does not extend, repair the wire connecting the speed switch and solenoid. 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 con-

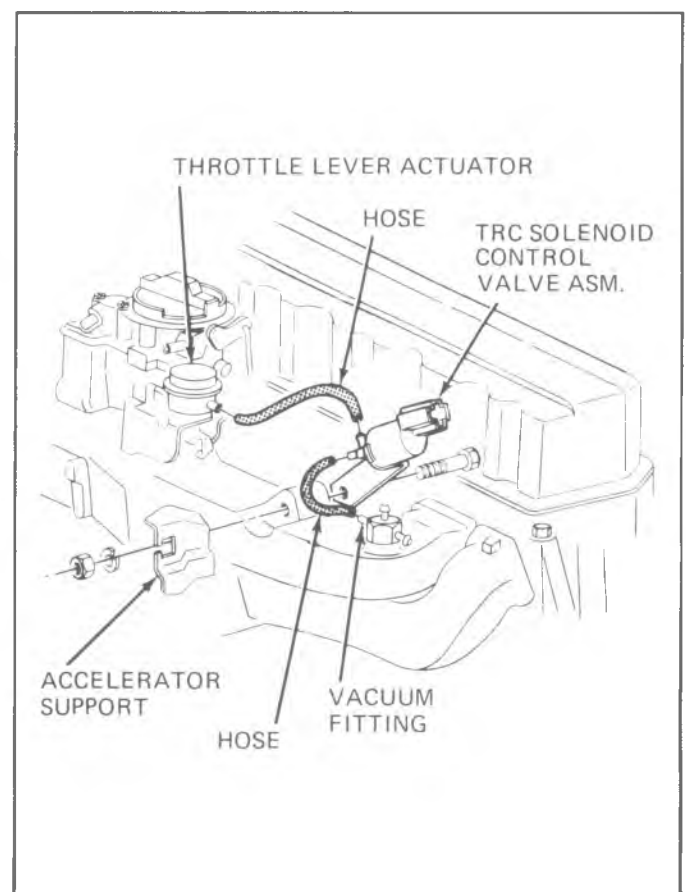


Fig. 6E-49--TRC System-L6

nected 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 following steps.
 - a. Remove connector from vacuum solenoid.
 - b. If actuator remains extended, check the orifice in the solenoid side port for plugging. If plugged, clear and reconnect system and recheck. If the actuator again remains extended, remove the solenoid connector. If the actuator does not retract, replace the vacuum solenoid.
 - c. If the actuator retracts with the solenoid 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 solenoid-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 20 in. Hg 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.
 - b. Start engine and run until warmed up and idle is stable. Note idle rpm.
 - c. Apply 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.
 - d. Release and reapply 20 in. Hg vacuum to the actuator and note the rpm to which the engine speed increases (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 in section 6C.

VACUUM ADVANCE CONTROL

Trapped Vacuum Spark

Trapped vacuum spark is on all engines. A thermal vacuum switch (TVS) is used to sense engine coolant temperature. A check valve is between manifold vacuum, distributor and thermal vacuum switch.

When engine temperature is below specified value, the manifold vacuum signal is routed through the check valve to the distributor. Ports on TVS are blocked. The check valve will keep the vacuum to the distributor at vacuum levels higher than manifold depression during vehicle acceleration. A small sintered iron bleed orifice is provided in the check valve to allow for a leak-down to enable restarts in case of engine stalls.

When engine temperature is above specified value, the ports on TVS will be open to allow manifold vacuum to the distributor. The check valve in this mode of operation acts as a connector.

SPARK VACUUM DELAY

General Description

On heavy duty emission engines a check valve with an internal bleed is installed between the Trapped Vacuum Spark check valve and the distributor. When manifold vacuum increases it opens the check valve which allows the distributor vacuum to increase to the same level. Decreasing manifold vacuum, as during vehicle acceleration; closes the check valve and the distributor vacuum will decrease at a rate controlled by the internal bleed.

DETONATION SENSOR

Replacement

The Detonation Sensor is an integral part of the Electronic Spark Control system. It mounts on the right hand side of engine in block drain hole.

Upon replacement, avoid the use of impact type tools and excessive torque.

- Minimum torque 16.3 N·m (12.02 ft. lbs.)
- Maximum torque 21.7 N·m (16.01 ft. lbs.)

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information Label (Fig. 6E-50) is located in the engine compartment (fan shroud, radiator support, 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.

LABEL CODE
ENGINE SIZE
EXHAUST EMISSION FAMILY
EVAPORATIVE EMISSION FAMILY

**ADJUSTMENT
 PROCEDURE**

**ENGINE ADJUSTMENT
 SPECIFICATIONS**

CDJ
 5.0 LITER
 * C1G5.714MAC5
 2D4D-8

VEHICLE EMISSION CONTROL INFORMATION

GENERAL MOTORS CORPORATION



SET PARKING BRAKE AND BLOCK DRIVE WHEELS.
 MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE, CHOKE FULL OPEN
 CLEANER INSTALLED, AND AIR CONDITIONING (A/C) OFF, EXCEPT WHERE NOTED.

1. DISTRIBUTOR: DISCONNECT AND PLUG VACUUM HOSE AT DISTRIBUTOR. ADJUST TIMING AT SPECIFIED ENGINE SPEED. UNPLUG AND RECONNECT VACUUM HOSE.
2. IDLE SPEED SCREW: DISCONNECT ELECTRICAL WIRE FROM IDLE SPEED SOLENOID. ADJUST CARBURETOR IDLE SPEED SCREW TO SPECIFIED RPM.
3. IDLE SPEED SOLENOID: DISCONNECT ELECTRICAL WIRE FROM IDLE SPEED SOLENOID. ADJUST IDLE SPEED SOLENOID TO SPECIFIED RPM.
4. FAST IDLE: ADJUST FAST IDLE SCREW TO SPECIFIED RPM. START ENGINE WITHOUT TOUCHING THROTTLE. ADJUST FAST IDLE SCREW TO SPECIFIED RPM. UNPLUG AND RECONNECT VACUUM HOSE TO EGR VALVE, CANISTER PURGE SIGNAL HOSE TO CANISTER.

CATALYST

EGR/DC

LOW ALTITUDE SPECIFICATIONS	MANUAL
4° @ 600 (N)	0.045
600 (N)	
750 (N)	
FAST IDLE SPEED SCREW (RPM)	1300 (N)

NOTE IDLE MIXTURE SCREWS ARE PRESET AND SEALED AT FACTORY. PROVISION FOR ADJUSTMENT DURING TUNE UP IS NOT PROVIDED.

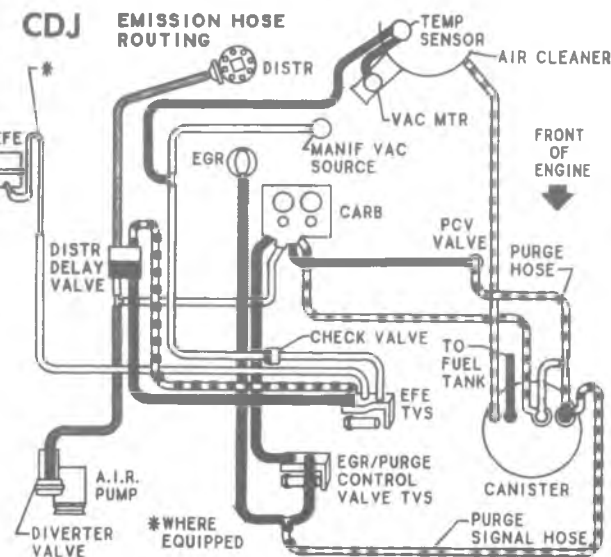
SEE SERVICE MANUAL, MAINTENANCE SCHEDULE AND EMISSION HOSE ROUTING DIAGRAM FOR ADDITIONAL INFORMATION.

THIS VEHICLE HAS BEEN DESIGNED FOR PRINCIPAL USE AT LOW ALTITUDE. SEE SERVICE PUBLICATION FOR FURTHER INFORMATION.

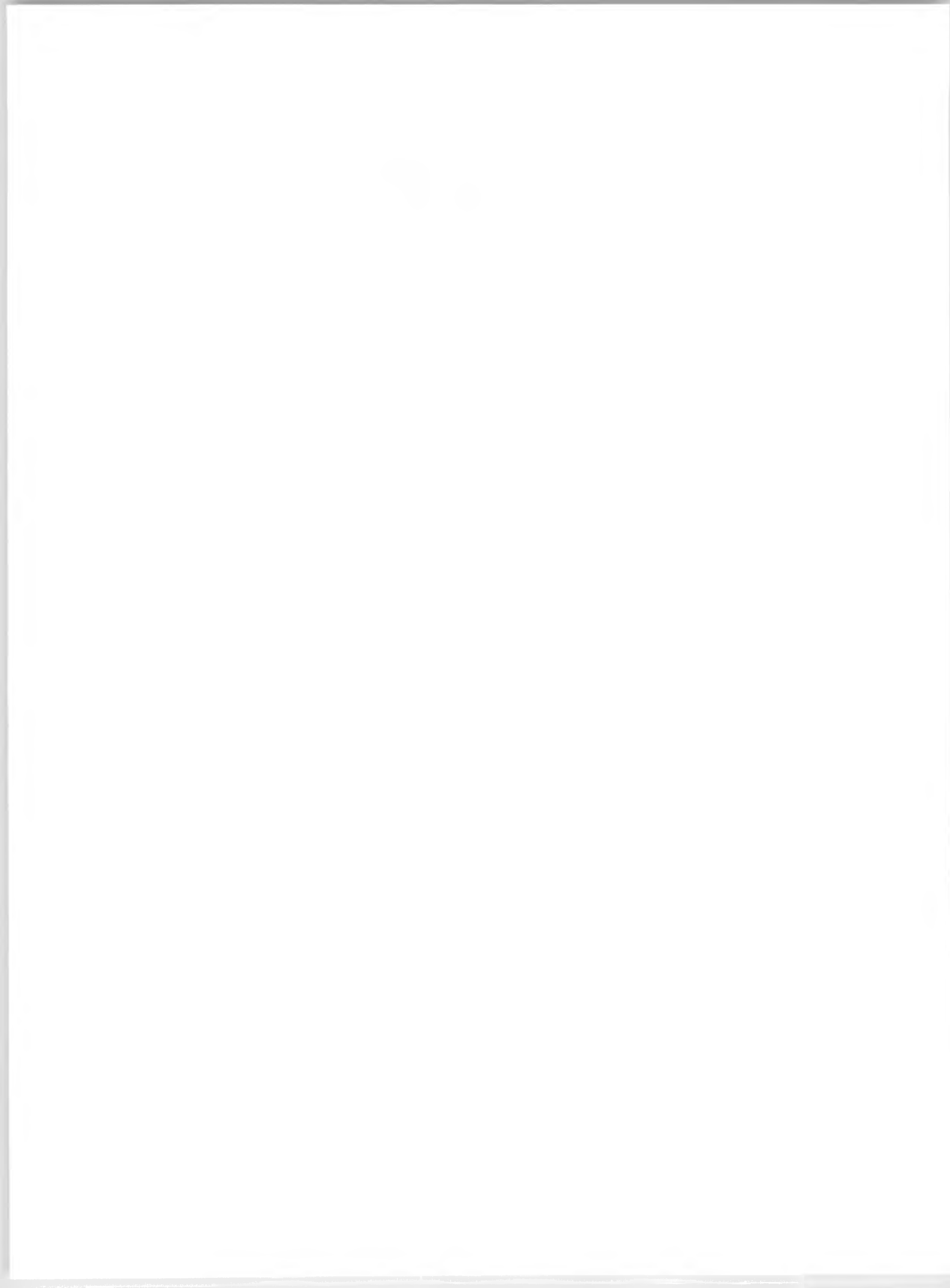
THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1982 MODEL YEAR NEW LIGHT-DUTY TRUCKS.

PT. NO. 14045807
 PRINTED IN U.S.A.

**LABEL PART
 NUMBER**



**EMISSION COMPONENT
 AND VACUUM HOSE SCHEMATIC**



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).

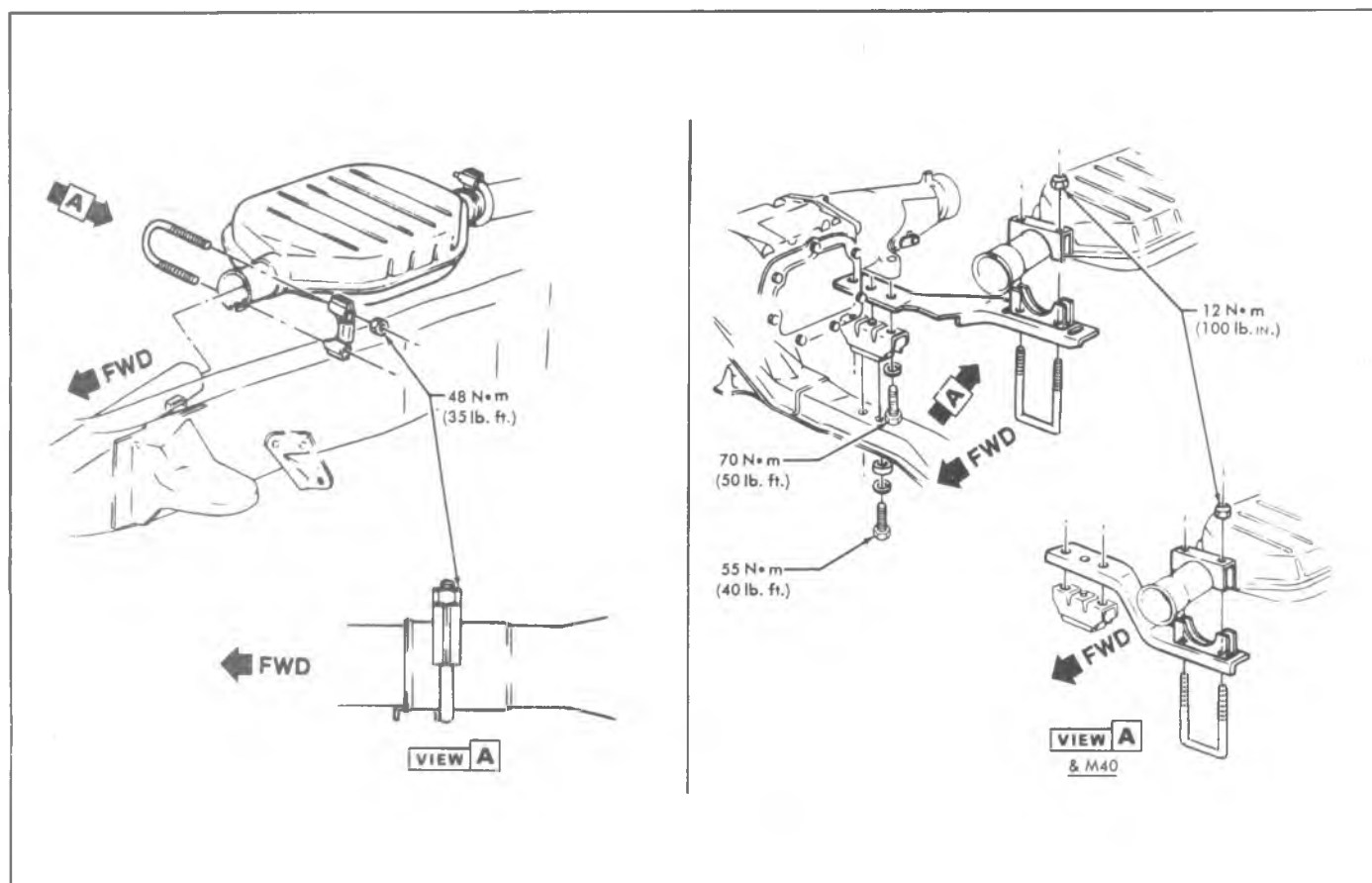


Fig. 6F-1--Catalytic Converter-CK Series

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.

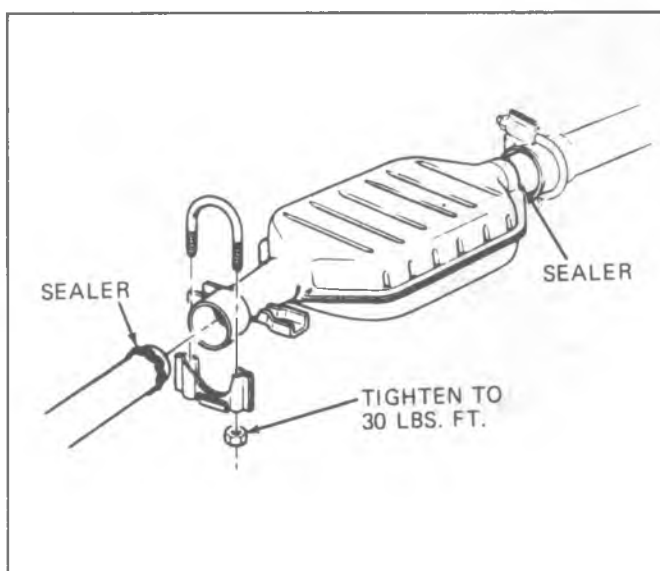


Fig. 6F-2--Catalytic Converter-G Series

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

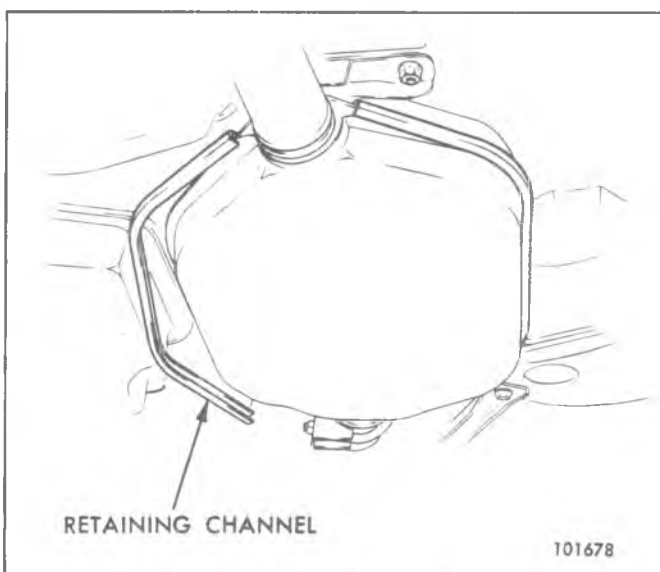


Fig. 6F-7--Installing Bottom Cover Retaining Channels

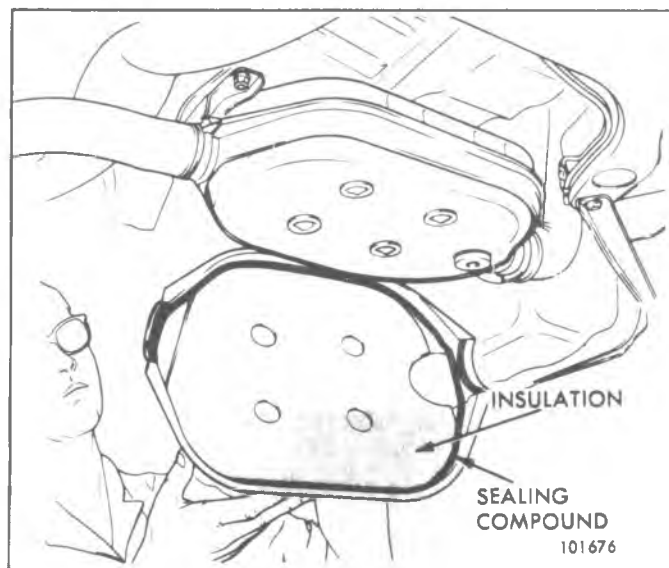


Fig. 6F-6--Installing Bottom Cover Replacement

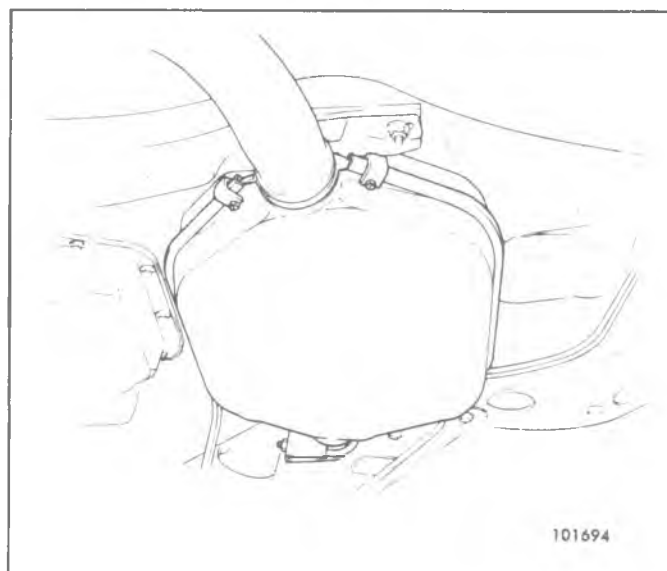


Fig. 6F-8--Installing Bottom Cover Clamps

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.

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

MODEL				
Application	125 125C	200 200C	200-4R	400
Oil Pan	X	X	X	X
Side Cover	X			

102903

Fig. 7A-1 -- R.T.V. Usage Chart

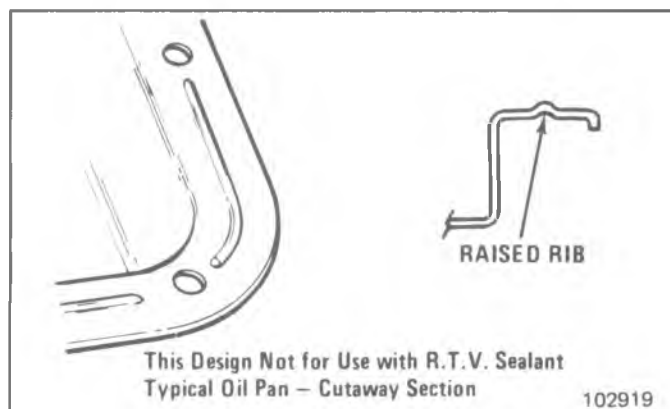


Fig. 7A-2 -- Raised Rib Oil Pan Design

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.
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).

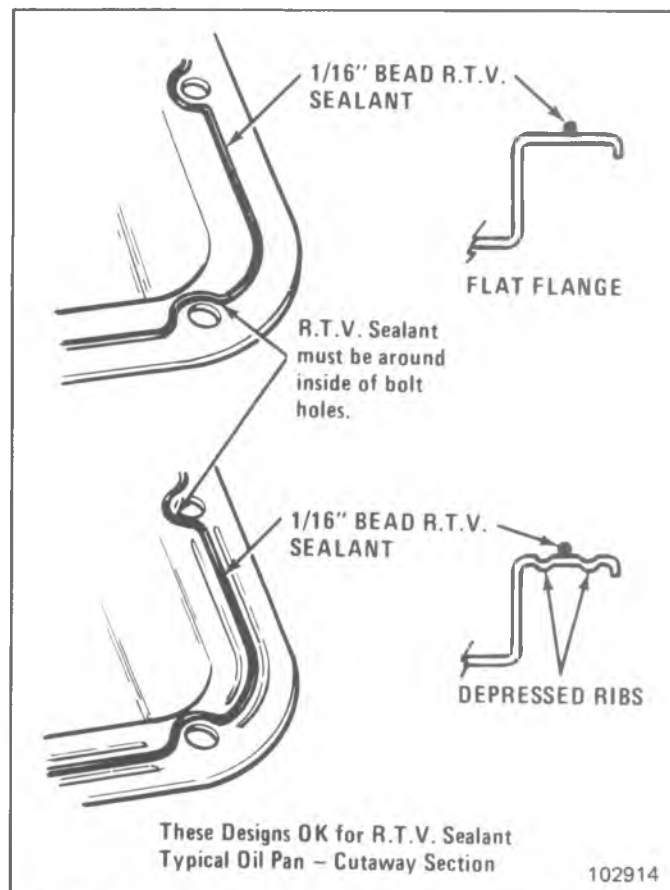


Fig. 7A-3 -- Depressed Ribs and Flat Flange Oil Pan Design

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

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. 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.
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.

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

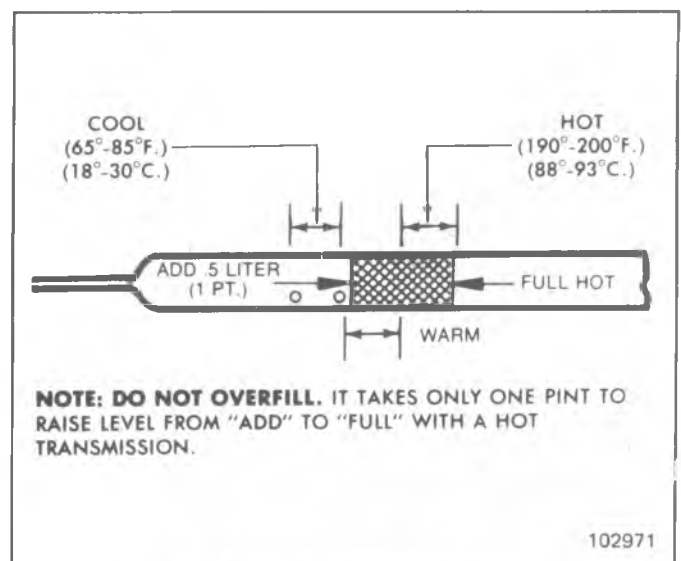


Fig. 7A-5 -- Transmission Dipstick

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. Thoroughly 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. The primary function of this assembly is to transfer the carburetor throttle plate movement to the T.V. plunger 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.

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.

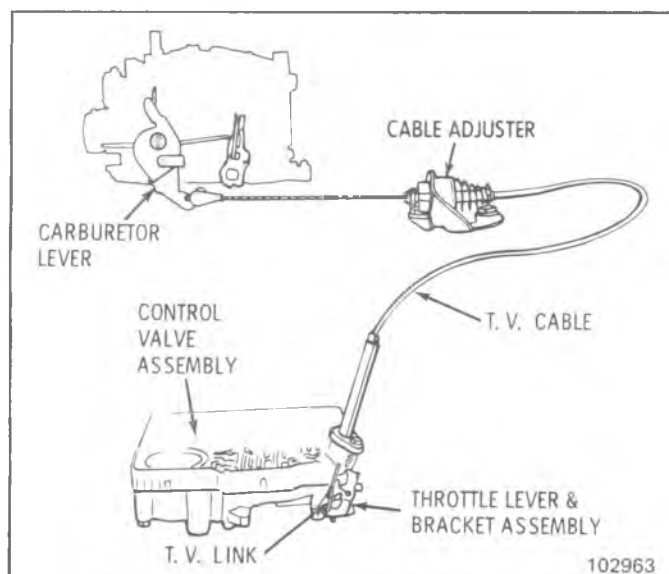


Fig. 7A-6--Throttle Valve (T.V.) Cable and Linkage.

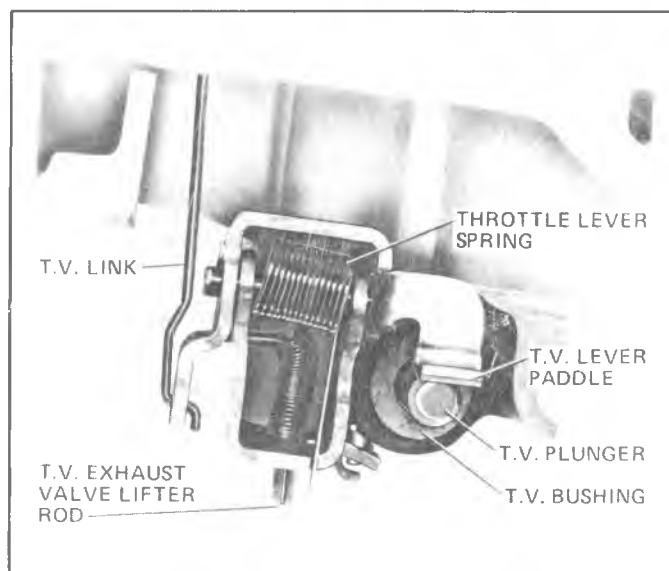


Fig. 7A-7--Throttle Lever and Bracket Assembly

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

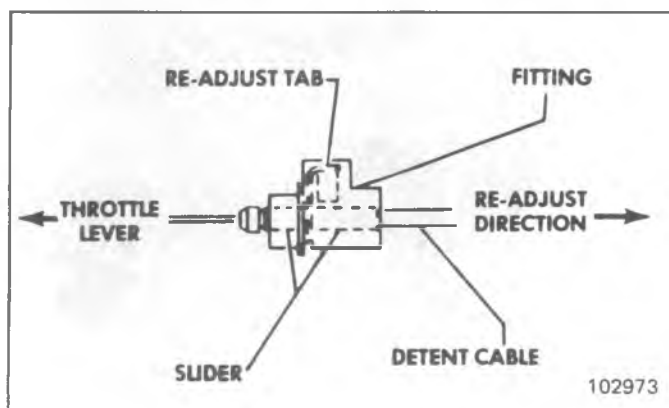


Fig. 7A-8--T.V. Cable (Self Adjusting)

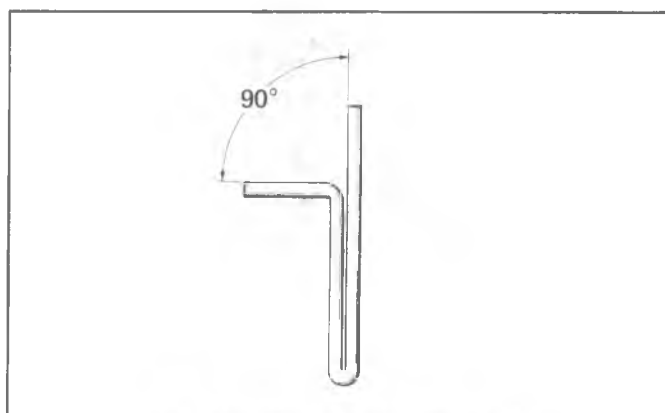


Fig. 7A-9--Throttle Valve Lifter Rod

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:

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:

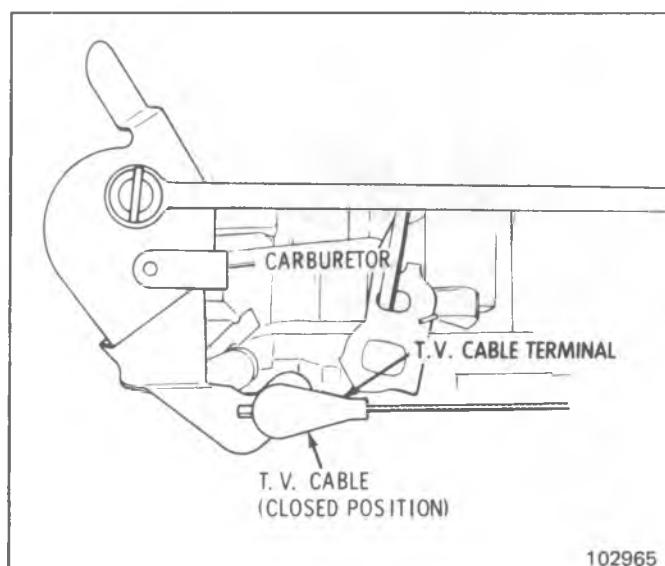


Fig. 7A-10--T.V. Cable at Carburetor Lever (Typical)

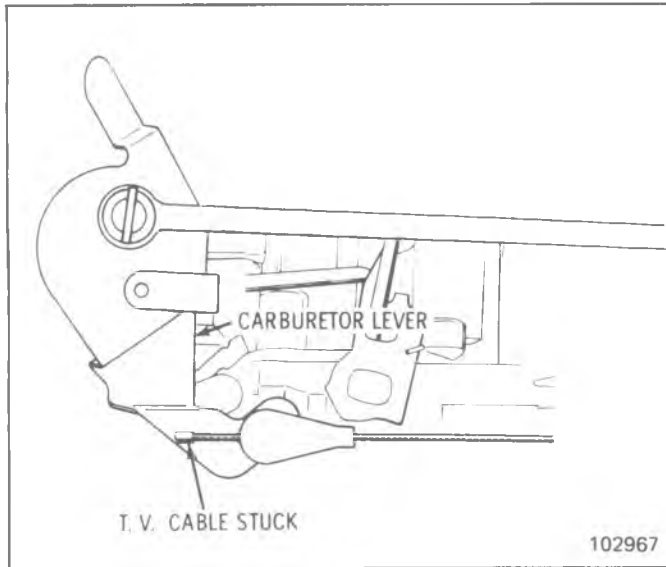


Fig. 7A-11--Sticking T.V. Cable

- 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 described as no upshifts, delayed or sharp upshifts.

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.

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.

Adjustment Procedure for 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 that 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 the 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 the 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 closest to the bellcrank, but 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

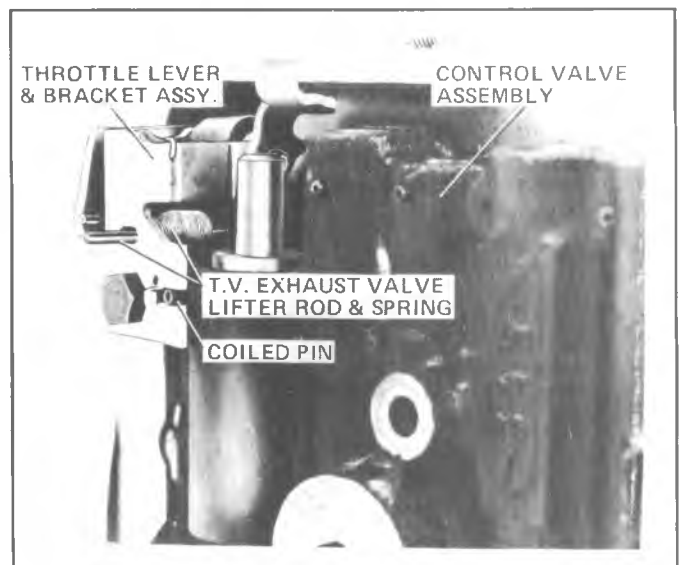


Fig. 7A-12--Alignment of Throttle Lever and Bracket Assembly

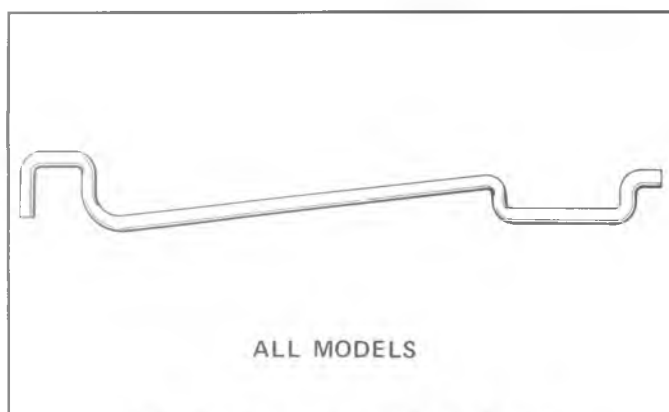


Fig. 7A-13--Throttle Lever to Cable Link

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).

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 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

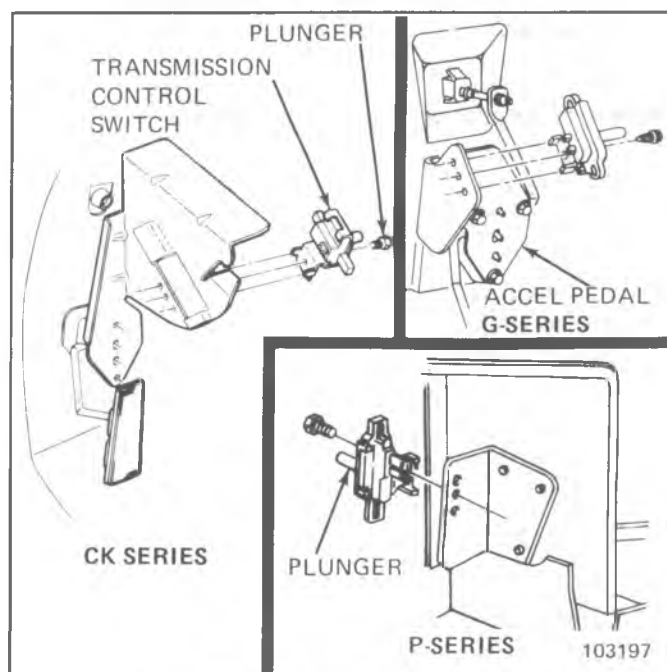


Fig. 7A-14--Detent Downshift Switch

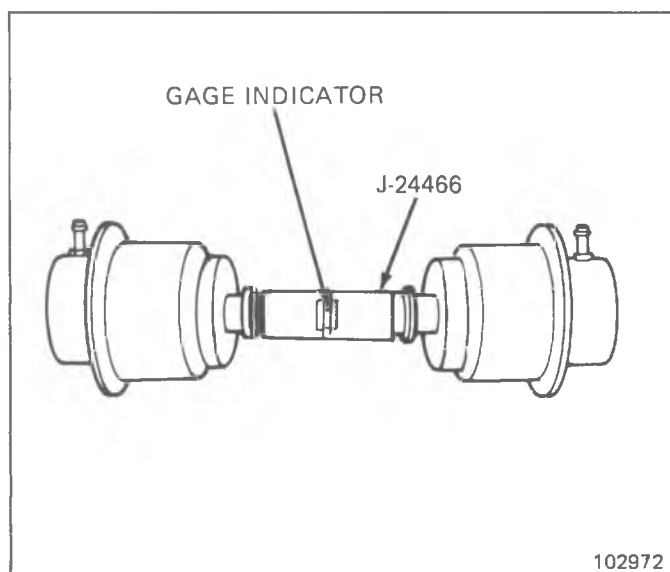


Fig. 7A-15--Checking Modulator

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 Aignment 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.

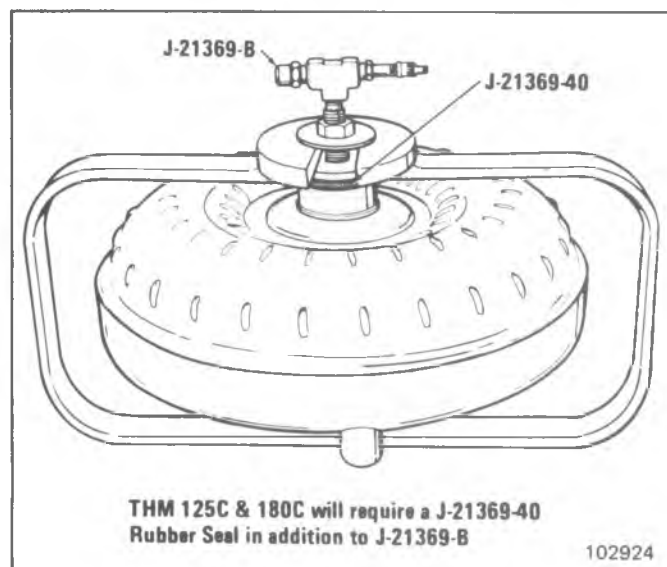
DIAGNOSIS

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.



THM 125C & 180C will require a J-21369-40 Rubber Seal in addition to J-21369-B

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Fig. 7A-16--Installing Tool J-21369

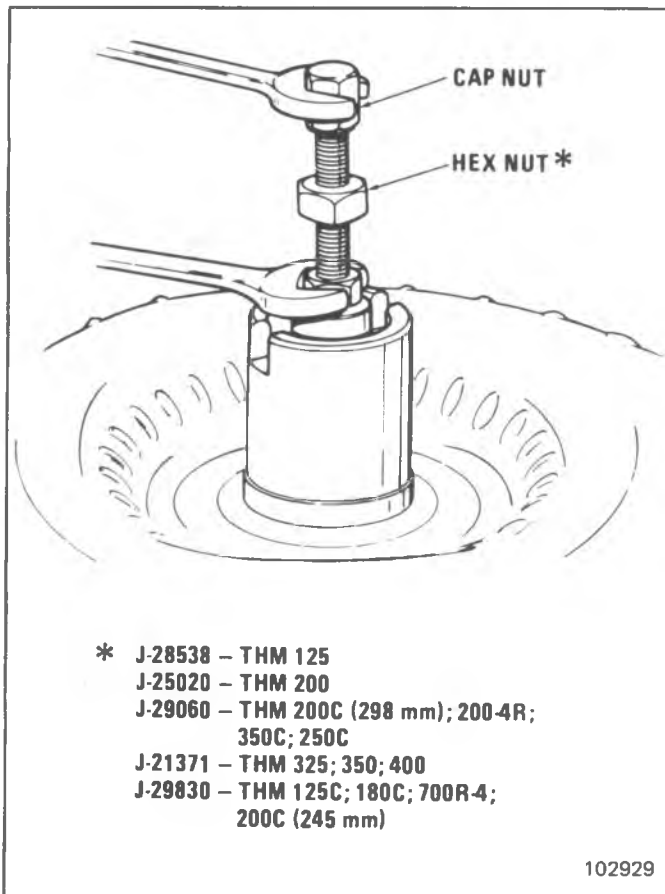


Fig. 7A-17--Installing Tools

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 350, 400 converters

- a. Install tool J-21371-3 and tighten hex nut to 4.0

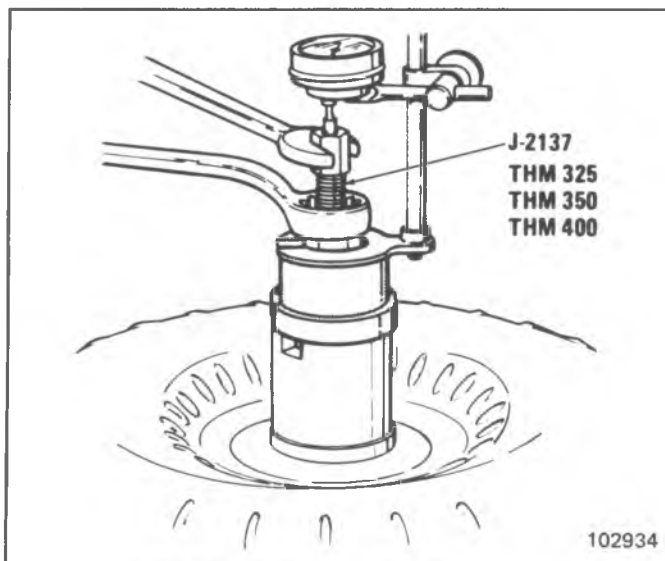


Fig. 7A-18--Checking End Clearance

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 0.127 mm (0.0050"). 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

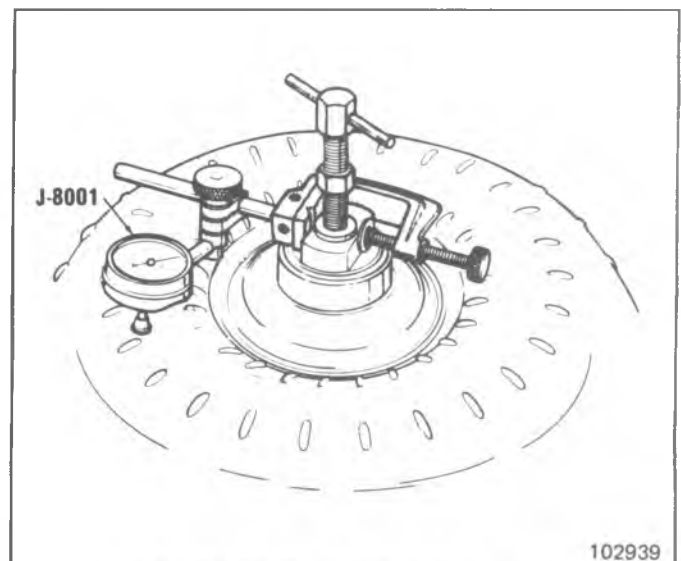


Fig. 7A-19--Checking End Clearance

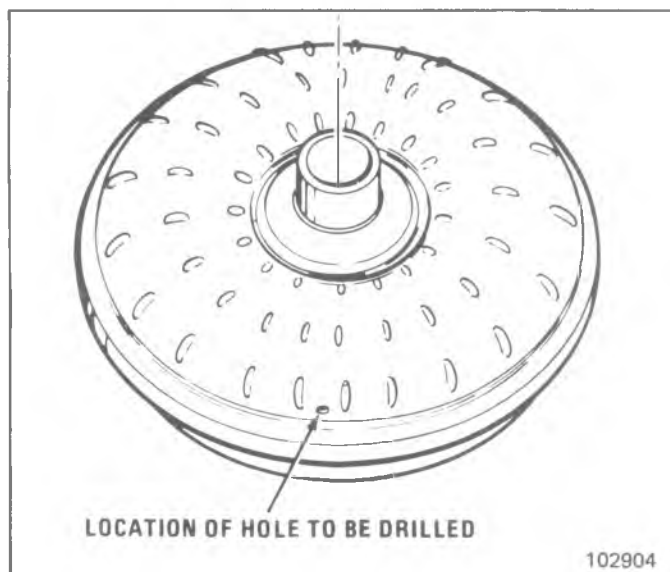


Fig. 7A-20--Location of Hole to be Drilled

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 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

1. Drill a 1/8" hole in the converter along the row of vane extrusions near converter's edge (weld seam). This hole must be centered between two vane extrusions (Fig. 7A-20).
 - a. Drill the hole to approximate completion.
 - b. Remove the drill bit from the hole and coat with grease to hold metal chips. Use care as the drill bit may be hot.
 - c. Complete the hole.
2. Remove any burrs on the edge of the drilled hole with a flat file.
3. Drain fluid by propping converter in a drain pan with the drilled hole at the bottom (Fig. 7A-21). 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. Apply gasket sealer such as Loctite No. 271, Permatex No. 1 or equivalent on a 1/8" closed end pop rivet (Fig. 7A-22). Install rivet in the drilled hole. (Fig. 7A-23). Brush sealer over head of rivet.

NOTICE: A special closed-end pop rivet **MUST** be used in this repair. Use of any other type of rivet may result in converter leaks and transmission failure.

6. Pressure test the converter for leaks at 551 kPa (80 psi) air pressure using Tool J-21369 (Fig. 7A-24). Put liquid soap or leak-detecting solution on the pop rivet and watch for bubbles. If the pop rivet leaks, the converter must be replaced. The rivet cannot be drilled out, as part of it would remain inside and damage the converter.

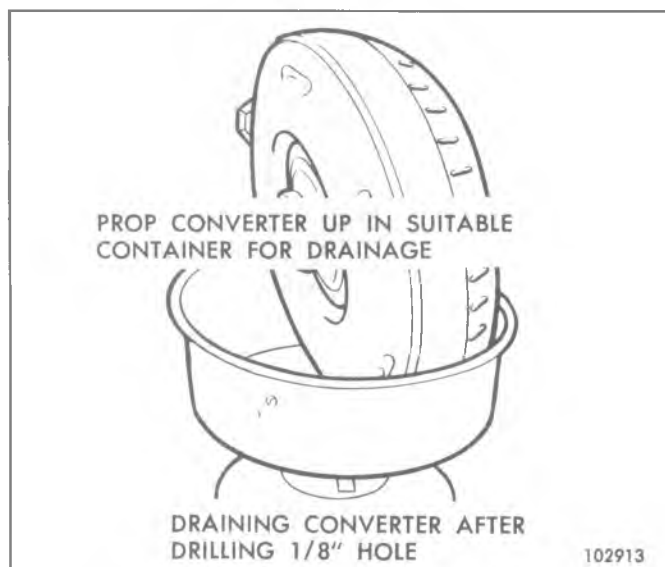


Fig. 7A-21--Draining Converter

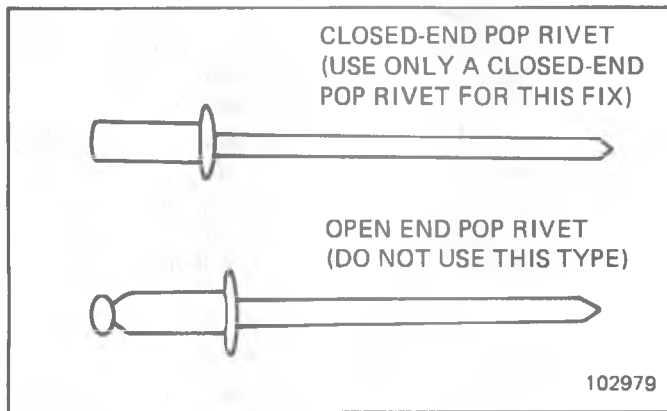


Fig. 7A-22--Pop Rivets

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 "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

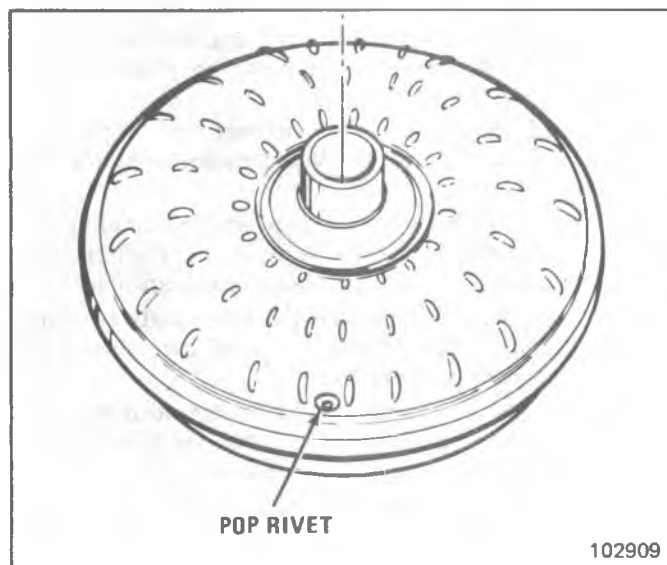


Fig. 7A-23--Pop Rivet Installed

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.)

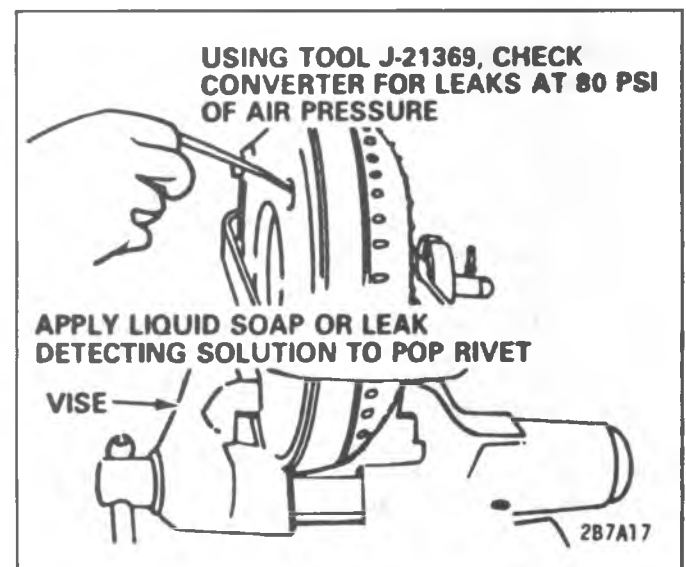


Fig. 7A-24--Pressure Testing Converter

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 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 usage of clutch plates. Also, engine coolant in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

On 350C, an inoperative Exhaust Gas Recirculation System will raise engine vacuum, causing lower transmission oil pressure which will result in burned clutch plates.

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.

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-R4

1. Remove two oil pan bolts, install J-29714 on oil pan flange to depress servo cover.
2. Using small screwdriver, remove servo cover retaining ring.
3. Remove tool J-29714.
4. Remove cover and seal ring. Seal ring may be in case.
5. Remove servo piston and bore apply pin assembly.
6. Refer to Overhaul Section for inspection procedure.
7. To install, reverse removal procedure.

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.

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 (350C and 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.
Remove "O" ring seal from governor cover, and replace.
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 carrier 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.

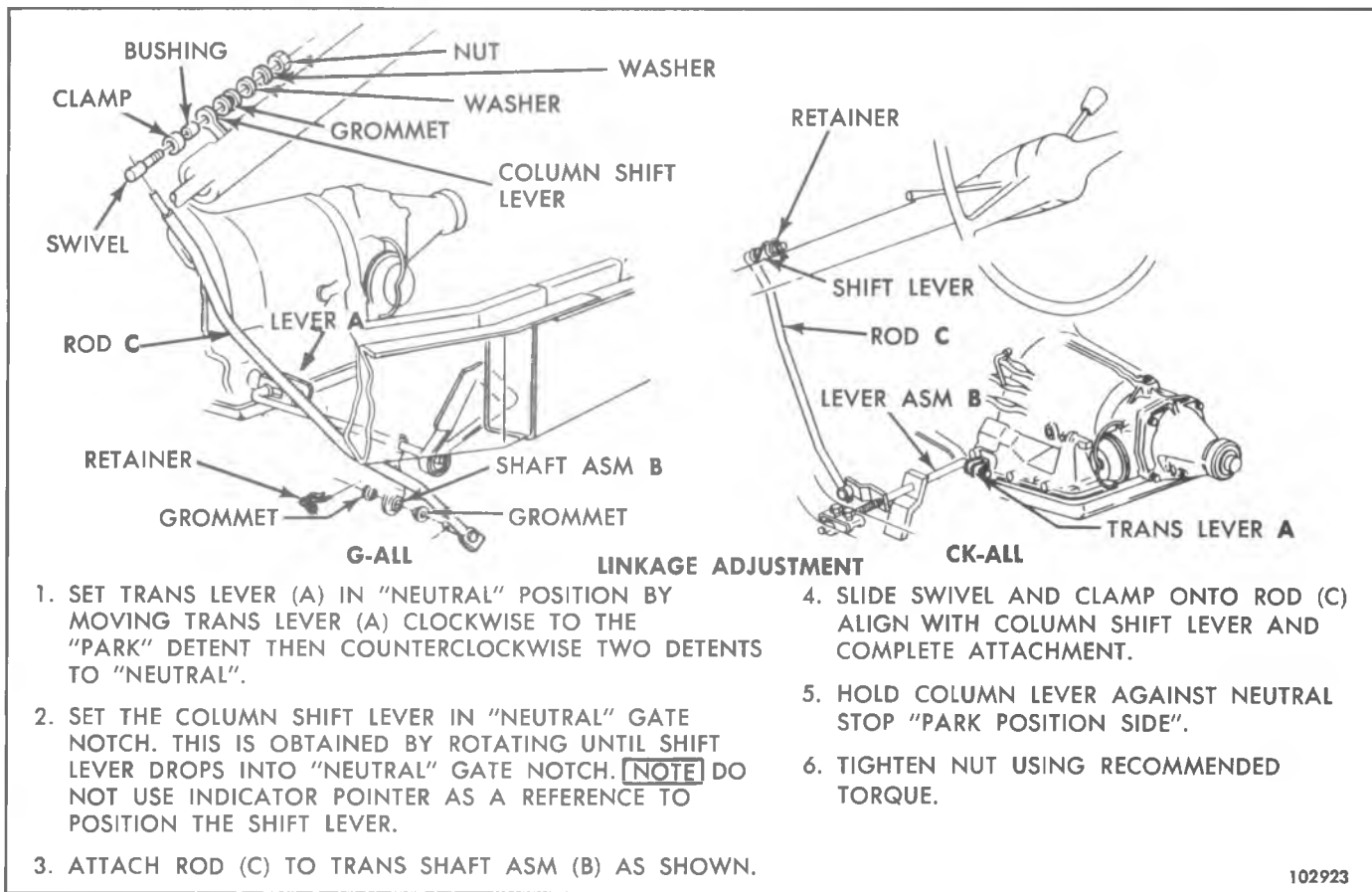


Fig. 7A-25--Column Shift Linkage Adj.

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-27).
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

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
25. Manual Valve Link		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	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			
43. Converter Clutch Solenoid	X		X
44. Solenoid Wire Clips	X		X
45. Electrical 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-26--On-Vehicle Service Items

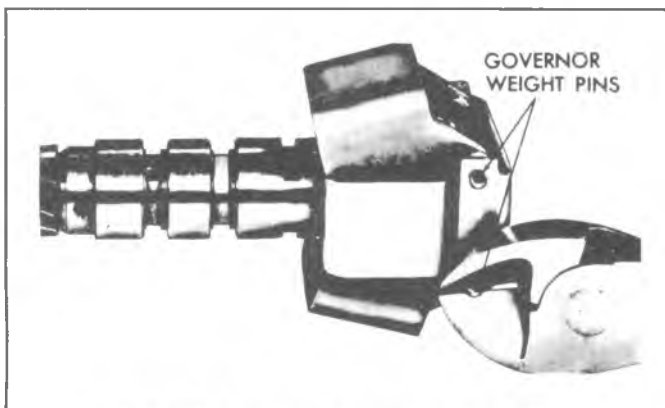


Fig. 7A-27--Removing Governor Weight Pins

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-28).
11. Check valve opening at exhaust 5.1 mm (.020") minimum with a feeler gage, holding governor as shown with governor weights completely inward (Fig. 7A-29). 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

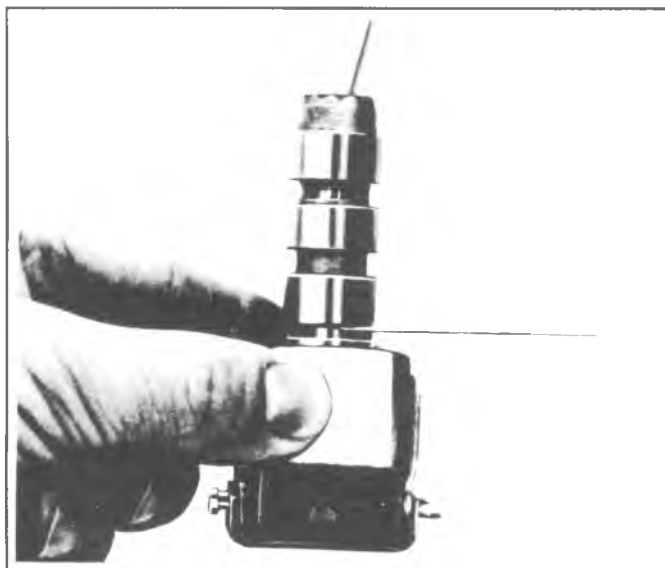


Fig. 7A-28--Check Valve Opening (Entry)

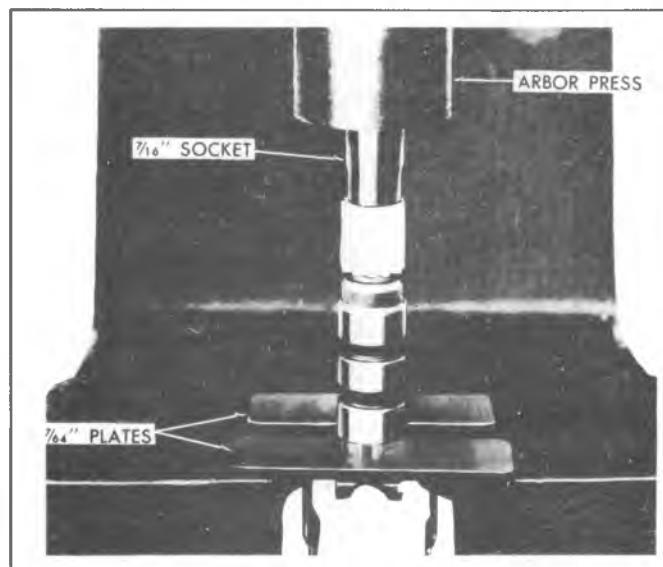


Fig. 7A-29--Check Valve Opening (Exhaust)

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-30).
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-31).
6. Install retaining pin, making sure each end is slightly below top of hole.
7. Stake both ends of pin hole, two places.

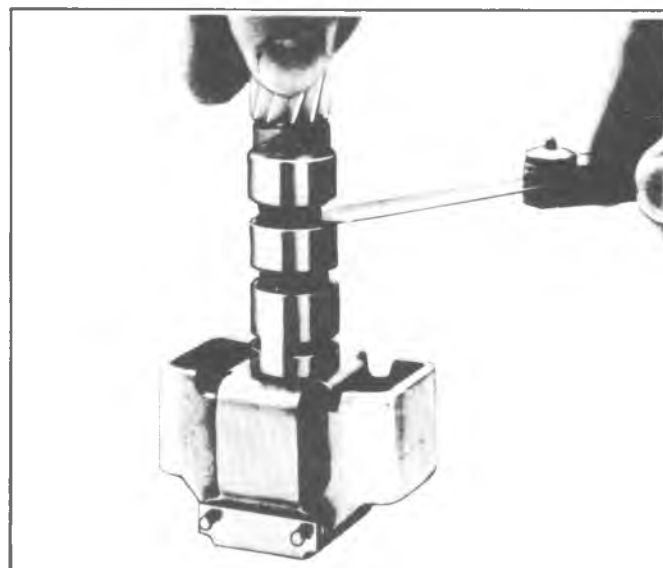


Fig. 7A-30--Installing Driven Gear

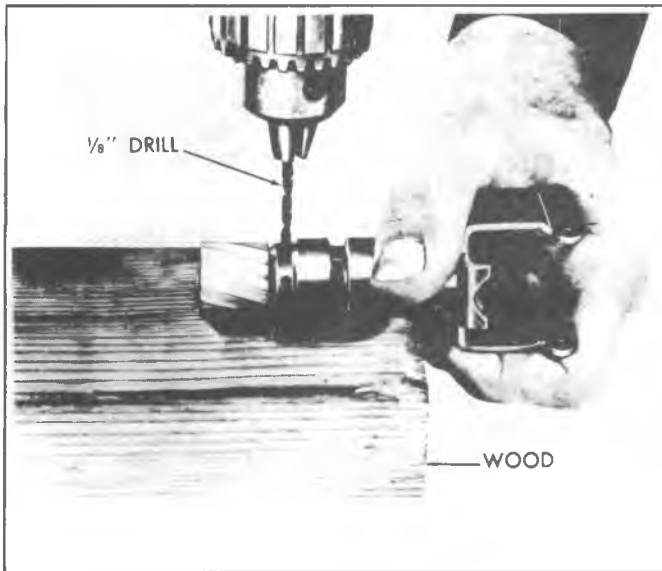


Fig. 7A-31--Drilling Hole in Driven Gear

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.
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

350C

1. Refer to draining procedures, drain transmission fluid from oil pan.
2. Remove oil pan, gasket 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.

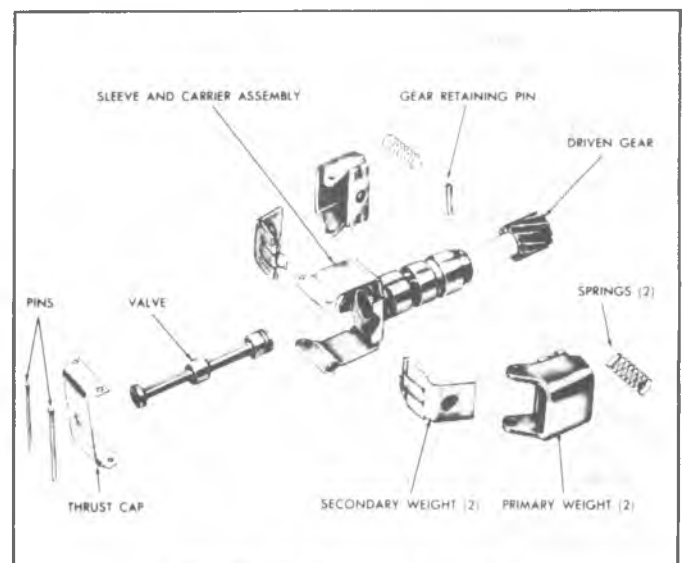
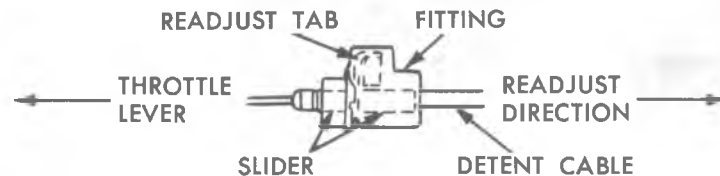


Fig. 7A-32--Governor Assembly

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 RE-ADJUSTMENT 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 IN-ADVERTANT 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.

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Fig. 7A-33--T.V./Detent Cable Adj. Diesel Engine

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.

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-33, 34 and 35.
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

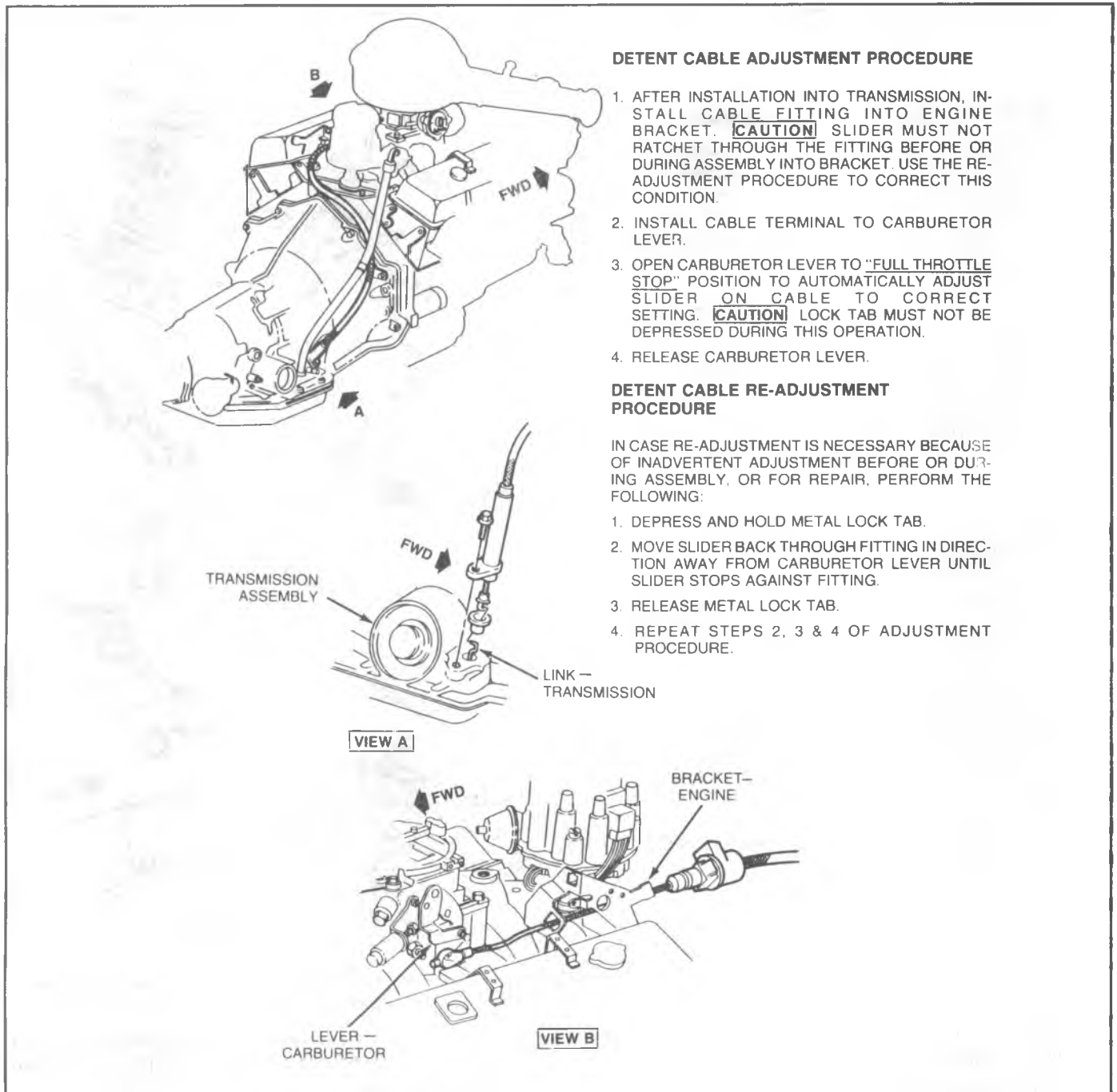


Fig. 7A-34--T.V./Detent Cable Adj. Gasoline Engine

- dipstick tube if accessible.)
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.
 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.

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.

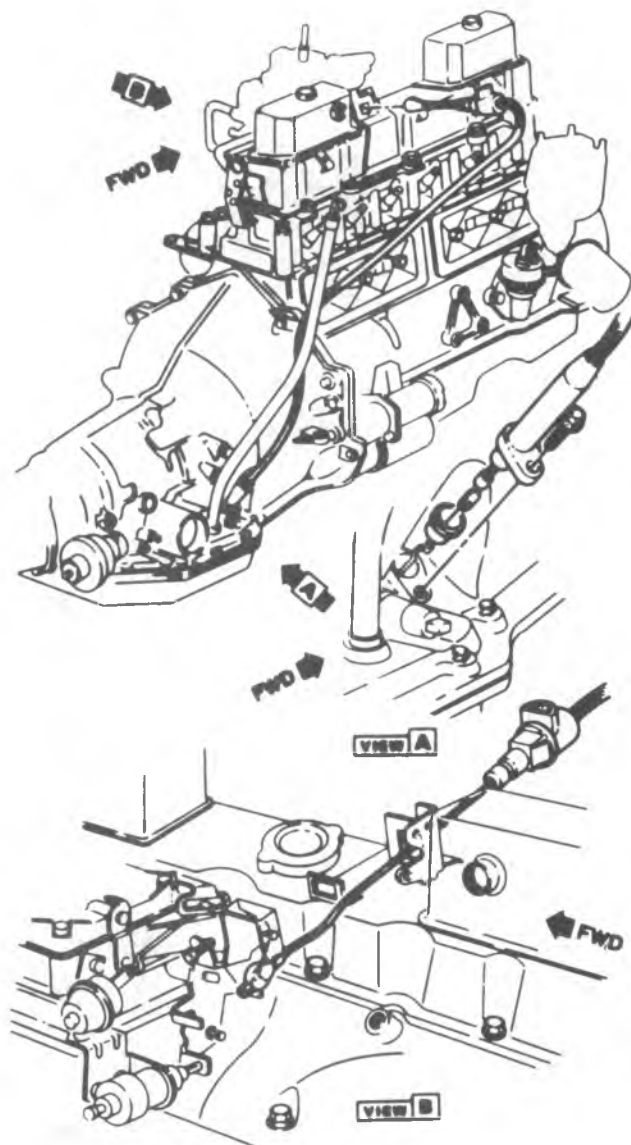


Fig. 7A-35--T.V./Detent Cable Adj. Gasoline Engine

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.
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 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.)

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Fig. 7A-SP Specifications

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS

MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC.,
SHOULD BE PERFORMED PRIOR TO USING THIS CHART.

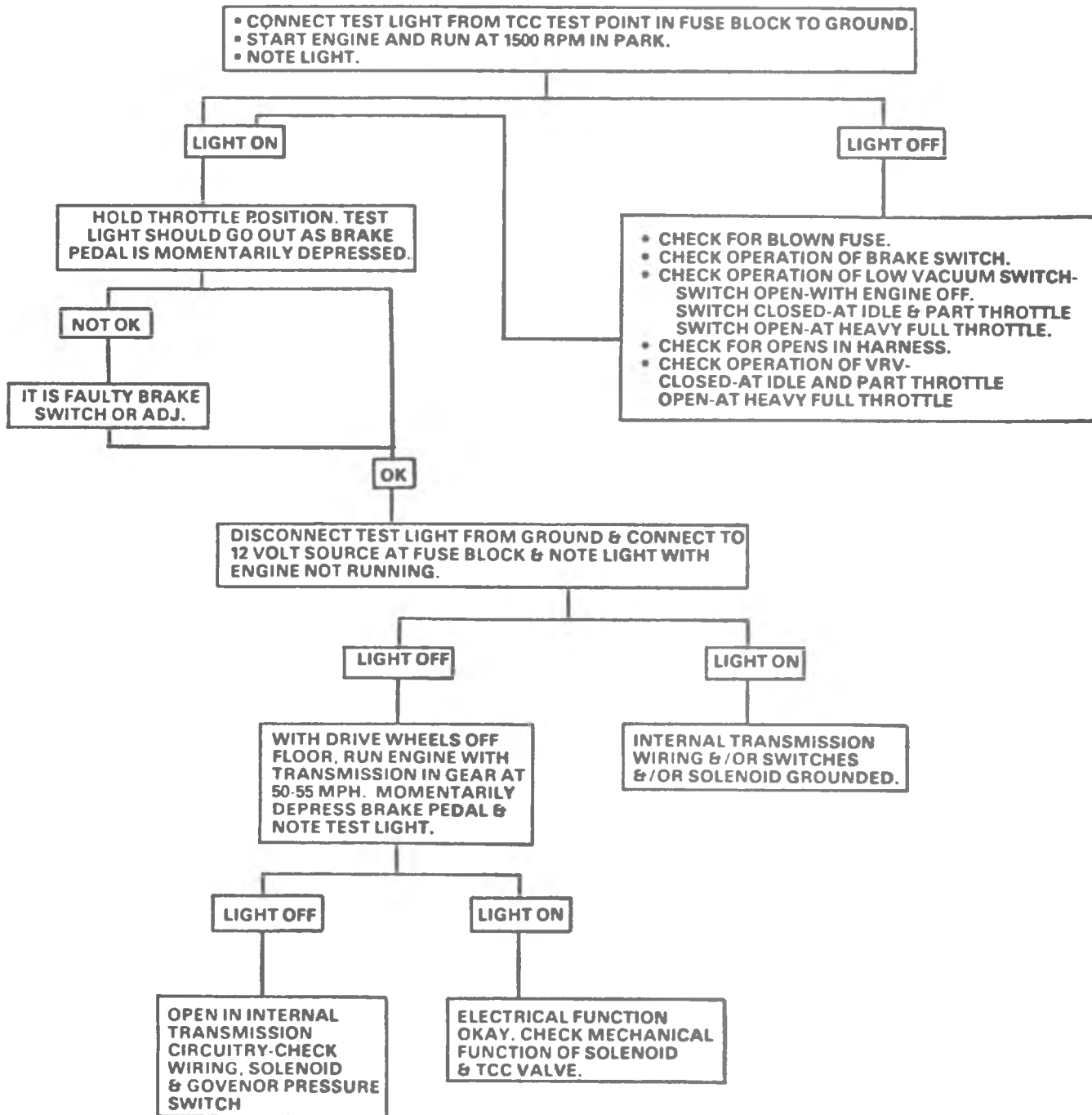


Fig. 7A-36--T.C.C. Diagnosis

SECTION 350C

AUTOMATIC 350C TRANSMISSION

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GENERAL DESCRIPTION

The 350 automatic transmission, is a fully automatic unit consisting primarily of 3-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. Cable Control - To operate the detent valve.

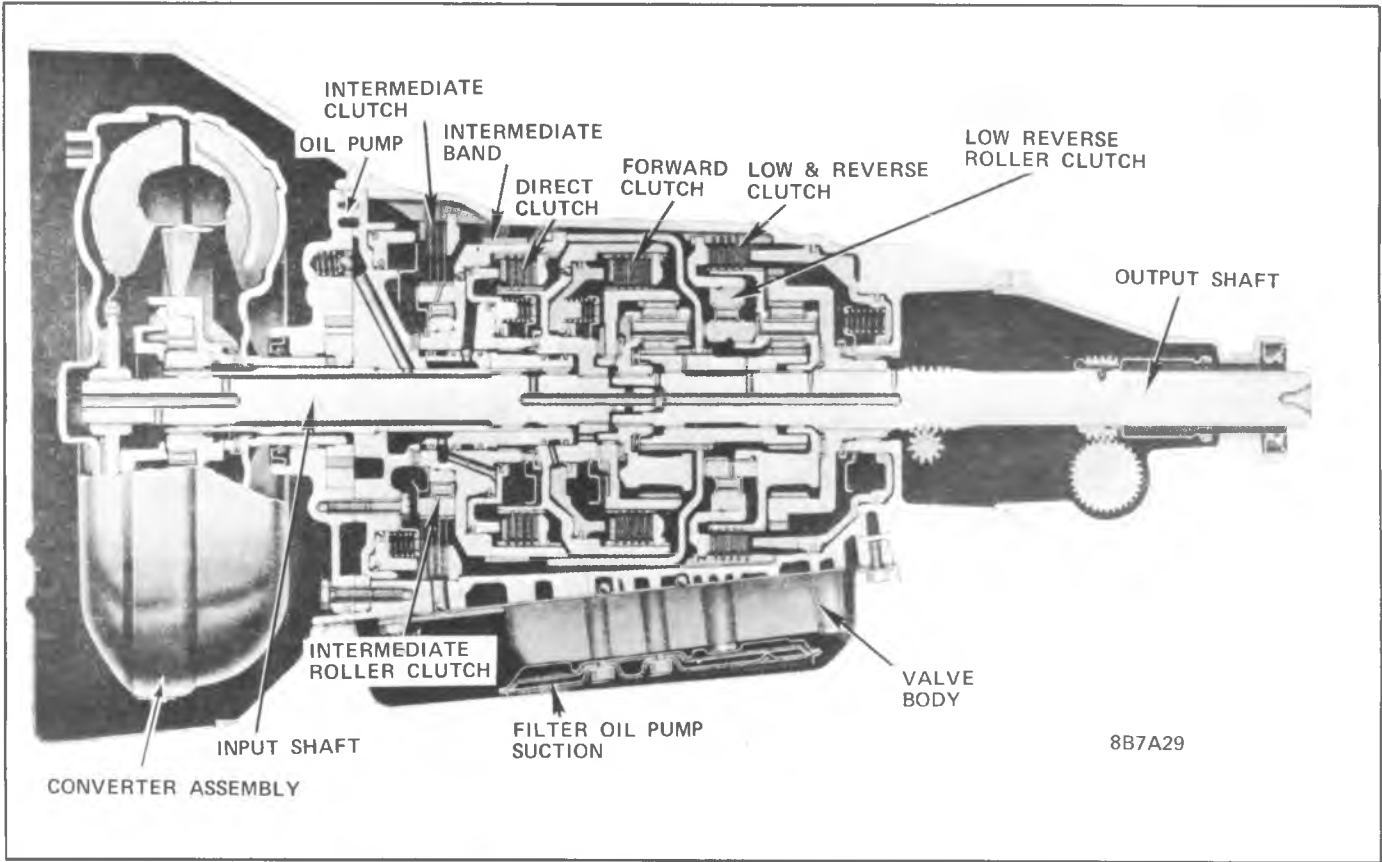


Figure 350C-1 350 Automatic Transmission

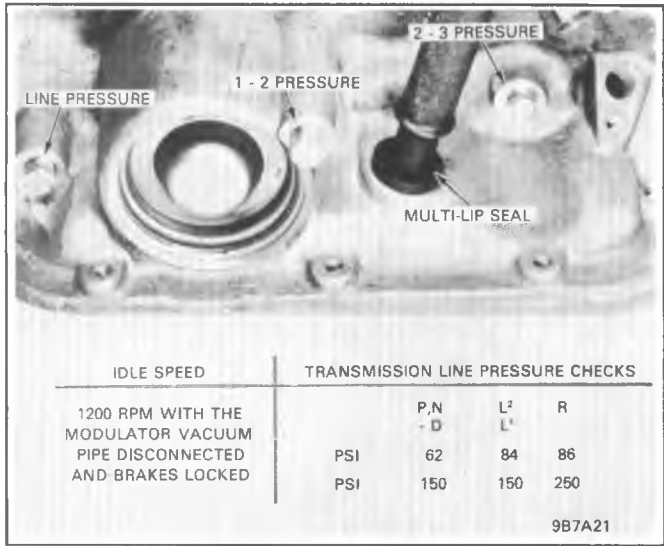


Figure 350C-2 Line Pressure Chart

350 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.

	<p>3. Low oil pressure.</p> <p>4. Control valve assembly.</p> <p>5. Forward clutch.</p> <p>6. Roller clutch assembly.</p>	<p>3a. Filter assembly - blocked.</p> <p>b. Pump assembly - pressure regulator, pump drive gear - tangs damaged by converter.</p> <p>c. Case - porosity in intake bore.</p> <p>4. Manual valve disconnected from inner lever.</p> <p>5a. Forward clutch does not apply - piston cracked; seals missing, damaged; clutch plates burned.</p> <p>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.</p> <p>6. Broken spring or damaged cage.</p>
Oil pressure high low	<p>1. High oil pressure.</p> <p>2. Low oil pressure.</p>	<p>1a. Vacuum line or fittings leaking.</p> <p>b. Vacuum modulator.</p> <p>c. Modulator valve.</p> <p>d. Pressure regulator.</p> <p>e. Oil pump.</p> <p>2a. Vacuum line or fittings obstructed.</p> <p>b. Vacuum modulator.</p> <p>c. Modulator valve.</p> <p>d. Pressure regulator.</p> <p>e. Governor.</p> <p>f. Oil pump.</p>
1-2 shift - full throttle only.	<p>1. Detent valve misadjusted.</p> <p>2. Vacuum leak.</p> <p>3. Control valve assembly.</p> <p>4. Case assembly.</p>	<p>1. Sticking or linkage</p> <p>2. Vacuum line or fittings leaking.</p> <p>3a. Valve body gaskets - leaking, damaged, incorrectly installed.</p> <p>b. Detent valve train stuck.</p> <p>c. 1-2 valve stuck.</p> <p>4. Porosity.</p>
First speed only - no 1-2 shift.	<p>1. Governor assembly.</p> <p>2. Control valve assembly.</p>	<p>1a. Governor valve sticking.</p> <p>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..</p> <p>2a. 1-2 shift valve train stuck closed.</p> <p>b. Governor feed channels blocked.</p> <p>c. Valve body gaskets -</p>

	3. Case	leaking, damaged, incorrectly installed. 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.	1a. 2-3 shift train stuck. b. Valve body gaskets - leaking, damaged, incorrectly installed.
	2. Direct clutch.	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.	1. Add oil. 2. Misadjusted. Refer to adjustment. 3a. Modulator valve stuck. b. Modulator and reverse boost valve stuck. c. Pump hub - direct clutch oil seal rings broken, missing. d. Direct clutch piston seal cut or missing. e. Low and reverse clutch piston seal cut or missing. f. No. 1 check ball missing.
	4. Control valve assembly.	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.
	5. Intermediate servo.	5a. Piston or pin stuck so intermediate overrun band

	<p>6. Low and reverse clutch.</p> <p>7. Direct clutch.</p> <p>8. Forward clutch.</p>	<p>is applied.</p> <p>6. Piston out or seal damaged or missing.</p> <p>7a. Outer seal damaged or missing.</p> <p>b. Clutch plates burned - may be caused by stuck ball check in piston.</p> <p>8. Clutch does not release (will also cause "Drive" in "Neutral").</p>
Slips in all ranges, slips on take-off - (install pressure gage).	<p>1. Oil level low.</p> <p>2. Oil pressure.</p> <p>3. Case</p> <p>4. Forward clutch slipping.</p>	<p>1. Add oil.</p> <p>2a. Vacuum modulator inoperative.</p> <p>b. Vacuum modulator valve sticking.</p> <p>c. Filter assembly - plugged or leaks.</p> <p>3a. Pressure regulator valve stuck.</p> <p>b. Pump to case gasket damaged or incorrectly installed.</p> <p>4. Cross leaks, porosity.</p>
Slips 1-2 shift - (install pressure gage).	<p>1. Oil level low.</p> <p>2. Oil pressure.</p> <p>3. 2-3 accumulator.</p> <p>4. 1-2 accumulator.</p> <p>5. Pump to case gasket.</p> <p>6. Case</p> <p>7. Intermediate clutch.</p>	<p>1. Add oil.</p> <p>2a. Vacuum modulator assembly inoperative.</p> <p>b. Modulator valve sticking.</p> <p>c. Pump pressure regulator valve.</p> <p>3. Oil ring damaged or missing.</p> <p>4. Oil ring missing or damaged, case bore damaged.</p> <p>5. Mispositioned</p> <p>6. Porosity between channels.</p> <p>7. Piston seals missing or damaged; clutch plates burned.</p>
Rough 1-2 shift - (install pressure gage).	<p>1. Oil pressure. for loose fittings, restrictions in line.</p> <p>2. Case</p> <p>3. 1-2 accumulator assembly.</p>	<p>1a. Vacuum modulator - check</p> <p>b. Modulator valve stuck.</p> <p>c. Valve body - regulator or boost valve stuck.</p> <p>d. Pump to case gasket - off location or damaged.</p> <p>2. Porosity between channels.</p> <p>3a. Oil rings damaged.</p> <p>b. Piston stuck.</p> <p>c. Broken or missing spring.</p> <p>d. Bore damaged.</p> <p>e. Check accumulator feed hole in valve body plate.</p>

350C-6 AUTOMATIC TRANSMISSION

Slips 2-3 shift - (install pressure gage).	<ol style="list-style-type: none">1. Oil level low.2. Oil pressure low.3. Case4. Direct clutch.	<ol style="list-style-type: none">1. Add oil.2a. Modulator assembly.b. Modulator valve.c. Pump pressure regulator valve or boost valve; pump to case gasket off location.3. Porosity4. Piston seals leaking, or ball check leak.
Rough 2-3 shift - (install pressure gage).	<ol style="list-style-type: none">1. Oil pressure high2. 2-3 accumulator assembly.	<ol style="list-style-type: none">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.	<ol style="list-style-type: none">1. Intermediate servo and 2-3 accumulator.2. Intermediate overrun band.3. Oil pressure low.	<ol style="list-style-type: none">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.	<ol style="list-style-type: none">1. Manual low control valve assembly.2. Oil pressure low.3. Low and reverse clutch.	<ol style="list-style-type: none">1. Stuck2. Pressure regulator and/or boost valve stuck.3. Piston inner seal damaged or missing.
No part throttle down- shift - (install pres- sure gage).	<ol style="list-style-type: none">1. Oil pressure.2. Detent valve and linkage.3. 2-3 shift valve.	<ol style="list-style-type: none">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.	<ol style="list-style-type: none">1. Control valve assembly.2. Detent valve and linkage.	<ol style="list-style-type: none">1. 2-3 valve stuck.2. Sticks or disconnected or broken.
Low or high shift points - (install pressure gage).	<ol style="list-style-type: none">1. Oil pressure.2. Governor	<ol style="list-style-type: none">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.2a. Valve sticking.b. Feed holes restricted or leaking, pipes damaged or mispositioned.c. Feed line plugged.

	3. Detent valve and linkage. 4. Control valve assembly. 5. Case	3. Stuck open. (Will cause late shifts). 4a. 2-3 valve train sticking. b. 1-2 shift valve train sticking. 5. Porosity
Won't hold in "Park".	1. Manual linkage. 2. Internal linkage.	1. Misadjusted 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. 2. Direct clutch. 3. Lo and Reverse Clutch.	1. Check stator shaft position. 2a. Direct clutch bore undersize or piston oversize. b. Direct clutch feed hole shy small chamber. 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. 2. Direct clutch.	1. Bore undersize or piston oversize. 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 sided.	1. Governor sizing in bore.	1. Repair or replace as necessary.

350C-8 AUTOMATIC TRANSMISSION

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.

REMOVAL OF CONVERTER HOLDING TOOL J-21366, CONVERTER, VACUUM MODULATOR

Removal of Converter

1. Place transmission in Fixture J-8763. Do not overtighten. See Figure 350C-27.
2. Remove converter Holding Tool J-21366. See Figure 350C-28.
3. With transmission in Holding Fixture J-8763, remove torque converter assembly. See Figure 350C-29. It may be necessary to pry the converter with a screwdriver due to a suction condition caused by the input shaft "O" ring.

Removal of Vacuum Modulator

1. Remove modulator assembly attaching bolt and retainer. See Figure 350C-30.
2. Remove vacuum modulator assembly "O" ring seal and modulator valve from case. See Figure 350C-31.

REMOVAL OF EXTENSION HOUSING AND LIP SEAL

Removal of Extension Housing

1. Remove bolt retainer and speedometer driven gear from side of extension housing and remove four (4) extension housing to case attaching bolts. See Figure 350C-32.
2. Remove speedometer drive gear and retaining clip.

Removal of Extension Housing Seal

1. Remove extension housing to case oil seal. See Figure 350C-33.

Removal of Extension Housing Lip Seal

1. Remove extension housing lip seal using screwdriver. See Figure 350C-34.

Installation of Extension Housing Lip Seal

1. Install extension housing lip seal using Installer J-21426. See Figure 350C-35.

REMOVAL OF VALVE BODY, GOVERNOR, SCREEN, AND CHECK BALLS

1. Remove oil pan and pan gasket.

2. Remove filter assembly and filter gasket.

Removal of Valve Body

1. Remove detent roller and spring assembly from valve body. See Figure 350C-35A.
2. Remove actuator pin from detent control link and remove control wire.
3. Disconnect solenoid wires. Remove pressure switch only if replacement is necessary.

Refer to Figure 350C-36 for specific wiring diagrams for the various 350C Transmission models. The model code stamped is on the right side of the bell housing.

4. Remove solenoid attaching bolts and solenoid. Inspect solenoid wires for loose connections and cut or worn insulator.

The spacer plate to valve body has a gasket with a yellow ink stripe. The yellow ink stripe is necessary for identification purposes. The gasket is almost identical to the spacer plate to case gasket.

5. Remove manual shaft retaining clip with (Figure 350C-42) screwdriver and slide manual shaft outward. This will allow the manual valve "S" link to be removed.
6. Remove valve body attaching bolts and valve body.
7. Remove auxiliary valve body attaching bolts and auxiliary valve body. (Figure 350C-37A)
8. Remove support plate attaching bolts and support plate.
9. Remove spacer plate and gaskets.
10. Remove 5 check balls. Note locations of check balls.
11. Remove park lock bracket and special bolts. Figure 350C-35A.

Removal of Pressure Screen

1. Remove oil pump pressure screen from oil pump pressure hole in case, and clean. See Figure 350C-40.
2. Remove governor screen from case and clean. See Figure 350C-41.

Removal of Case Electrical Connector

1. Remove case electrical connector and "O" ring by depressing tabs.

350 AUTOMATIC TRANSMISSION
DIAGNOSIS CHART

PROBLEM		DIAGNOSIS CHART																														
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	2-3 INTERM. 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	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	
	VACUUM LEAK				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							
	PRES. REG. & / OR BOOST VALVE	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							
	PUMP-GEARS	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	X	
	POROUS/CROSS LEAK	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			
	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	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							
	GEAR SET & BEARINGS																									X	X					

9B7A22

Figure 7A3-25S

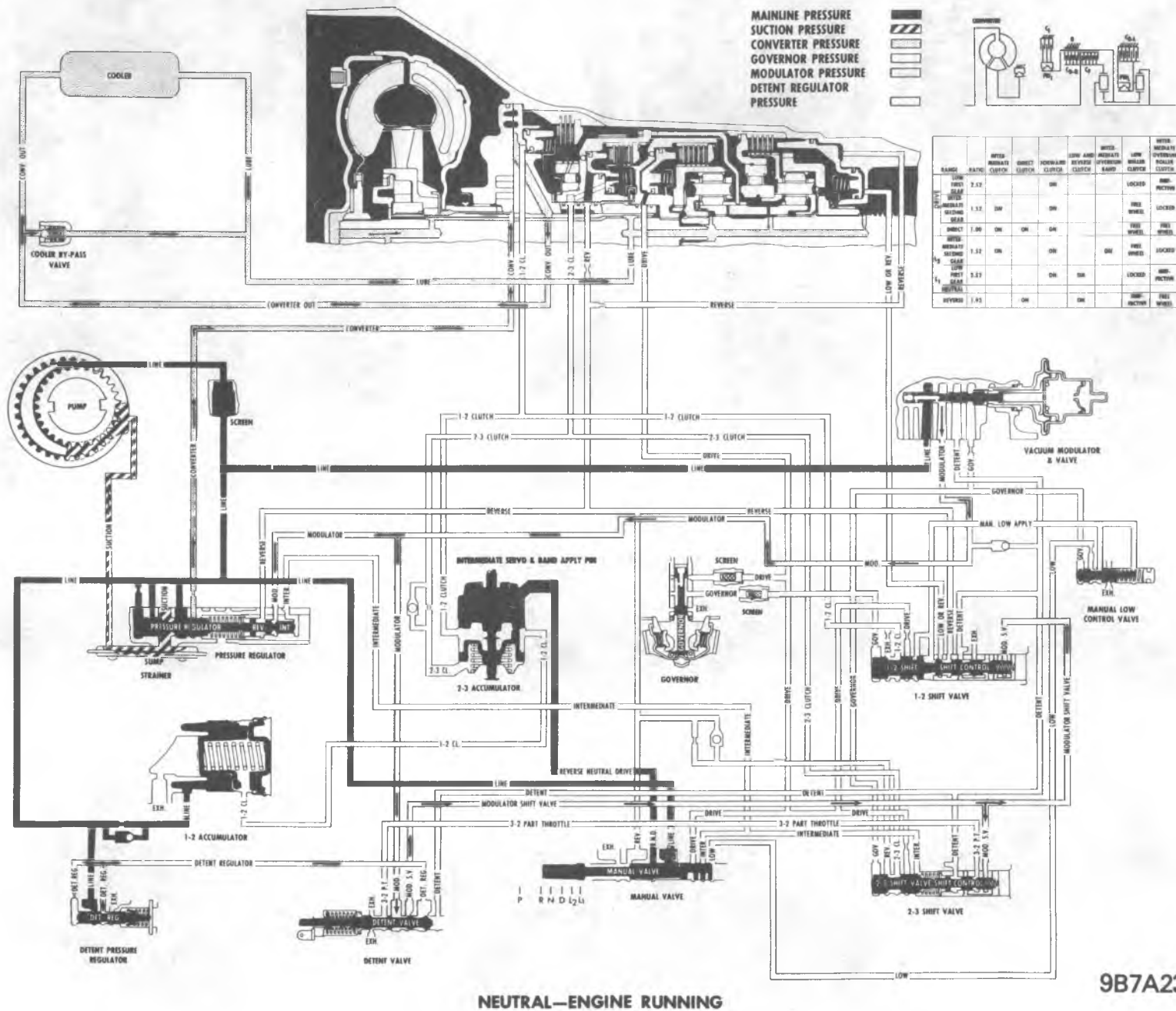


Figure 350C-25A Neutral - Engine Running

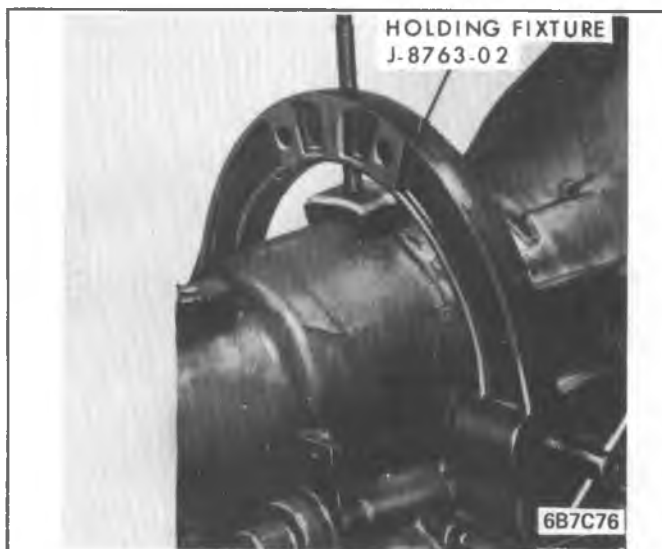


Figure 350C-27 Transmission Holding Fixture

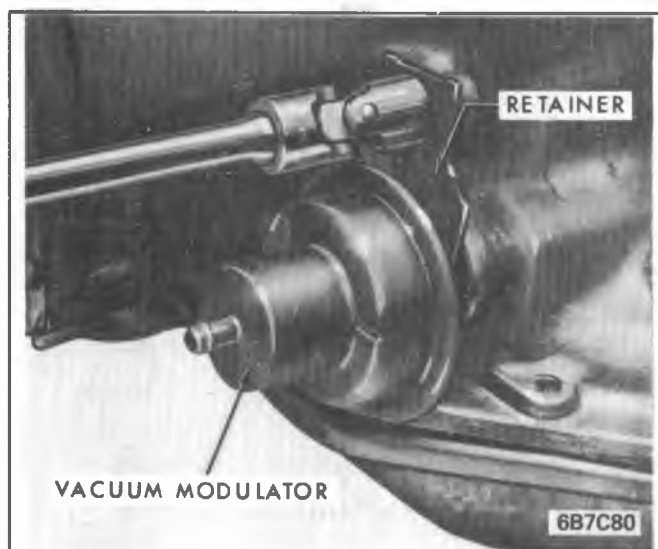


Figure 350C-30 Removal of Modulator Retainer

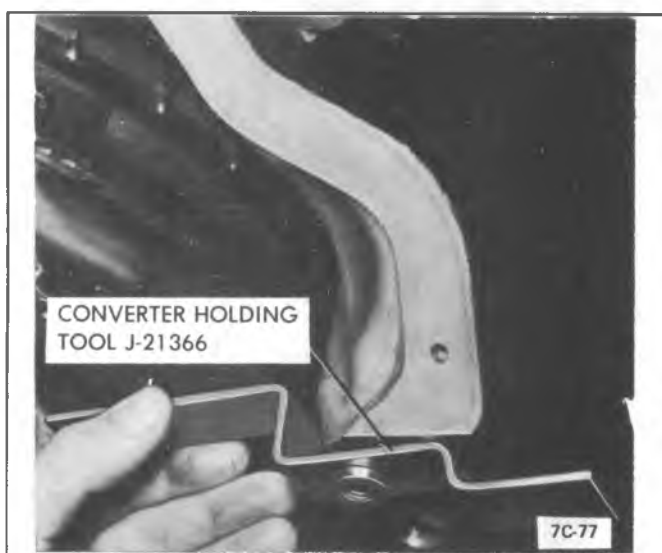


Figure 350C-28 Converter Holding Fixture

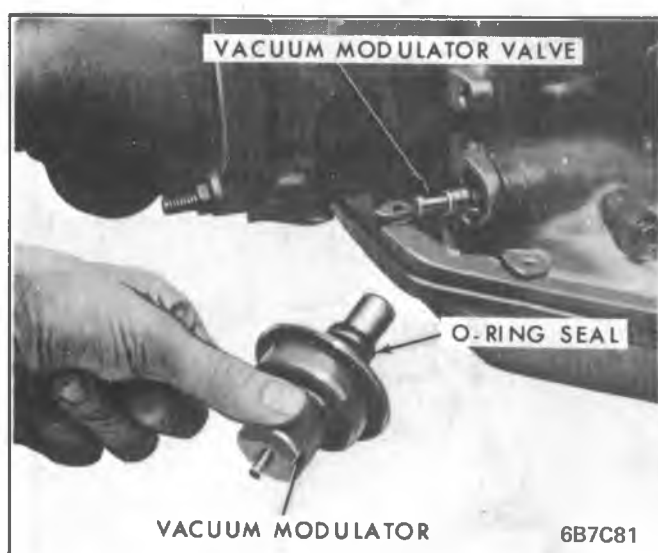


Figure 350C-31 Vacuum Modulator



Figure 350C-29 Torque Converter Removal



Figure 350C-32 Extension Housing Removal



Figure 350C-33 Extension Housing Square Cut Oil Seal



Figure 350C-34 Removing Extension Housing Lip Seal Removal

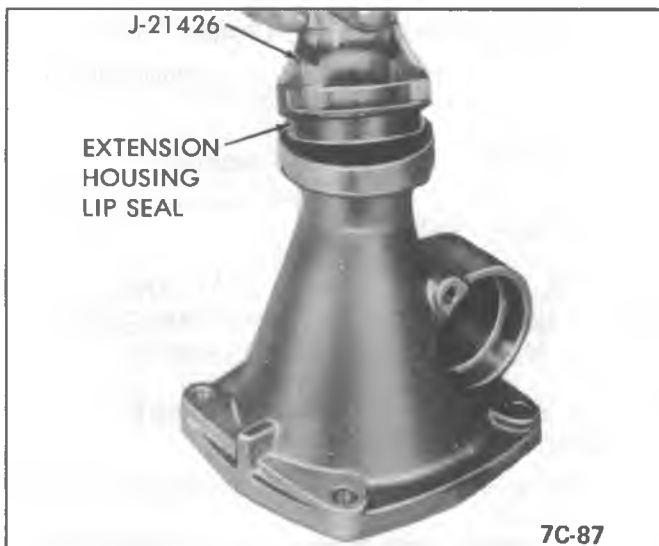


Figure 350C-35 Installing Extension Housing Lip Seal Installation

REMOVAL OF MANUAL SHAFT, INNER, LEVER, PARKING PAWL, AND INTERMEDIATE SERVO PISTON

Removal of Range Selector Inner Lever

If removal of internal manual linkage is required proceed as follows:

1. Remove manual control valve link retainer from range selector inner lever.
2. Remove jam nut holding range selector inner lever to manual shaft.
3. Remove manual shaft from case. Remove range selector inner lever and parking pawl actuating rod.
4. Remove manual shaft to case lip seal, if necessary. See Figure 350C-43.
5. Remove parking pawl shaft retaining plug stake marks. Remove retaining plug, parking pawl shaft, parking pawl, disengaging spring. See Figure 350C-45.

Removal of Intermediate Servo Piston

1. Remove intermediate servo piston, washer, spring seat, and apply pin. See Figure 350C-46.
2. If the piston seal needs replacing, the piston assembly will have to be replaced. This is due to a plastic grooved piston that is not serviceable. (Piston and Seal are one assembly).

REMOVAL OF PUMP ASSEMBLY

Removal of 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-47.
3. Remove pump assembly to case gasket.

Removal of 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 and the steel separator plates. See Figure 350C-48 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 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-49.

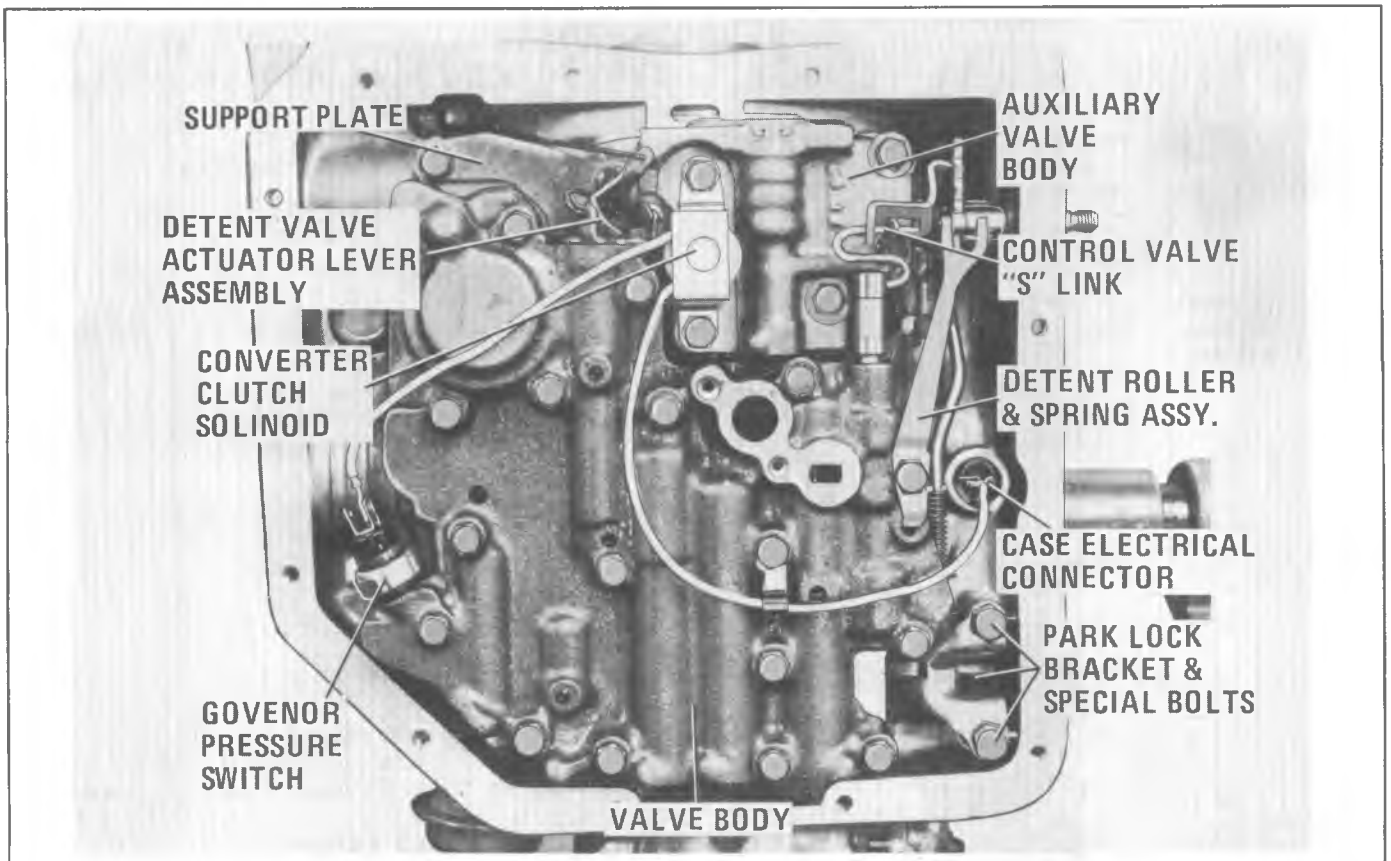


Figure 350C-35A Valve Body and Related Components

REMOVAL OF DIRECT AND FORWARD CLUTCH ASSEMBLIES, INPUT RING GEAR, AND OUTPUT CARRIER

Removal of Direct and Forward Clutch Assemblies

1. Remove direct and forward clutch assemblies from case. See Figure 350C-50.

Removal of 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-51.

Removal of 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-52.
3. Remove output carrier assembly.

REMOVAL OF SUN GEAR DRIVE SHELL, LOW AND REVERSE CLUTCH SUPPORT ASSEMBLY, LOW AND REVERSE CLUTCH PLATES AND REACTION CARRIER

Removal of Sun Gear Drive Shell Assembly

1. Remove sun gear drive shell assembly. See Figure 350C-53.

Removal of Low and Reverse Clutch Support Assembly

1. Remove low and reverse roller clutch support to case retaining ring. See Figure 350C-54.
2. Grasp output shaft and pull up until low and reverse roller clutch and support assembly clear low and reverse clutch support retainer spring and remove support assembly.
3. Remove low and reverse clutch support retainer spring. See Figure 350C-54.

Removal of Low and Reverse Clutch Plates

1. Remove the low and reverse clutch composition plates and the steel separator plates. See Figure 350C-55.

Removal of Reaction Carrier Assembly

1. Remove reaction carrier assembly from output ring gear and shaft assembly. See Figure 350C-56.

REMOVAL OF OUTPUT RING GEAR AND SHAFT ASSEMBLY, AND OUTPUT RING GEAR TO CASE NEEDLE BEARING ASSEMBLY

Removal of Output Ring Gear and Shaft Assembly

1. Remove output ring gear and shaft assembly from case. See Figure 350C-57.
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. See Figure 350C-58.
4. Remove output ring gear to case needle bearing. See Figure 350C-59.

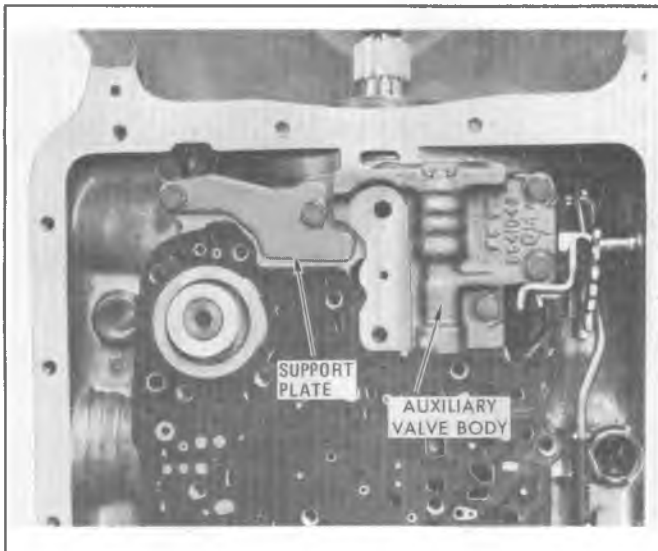


Figure 350C-37A Auxiliary Valve Body and Support Plate

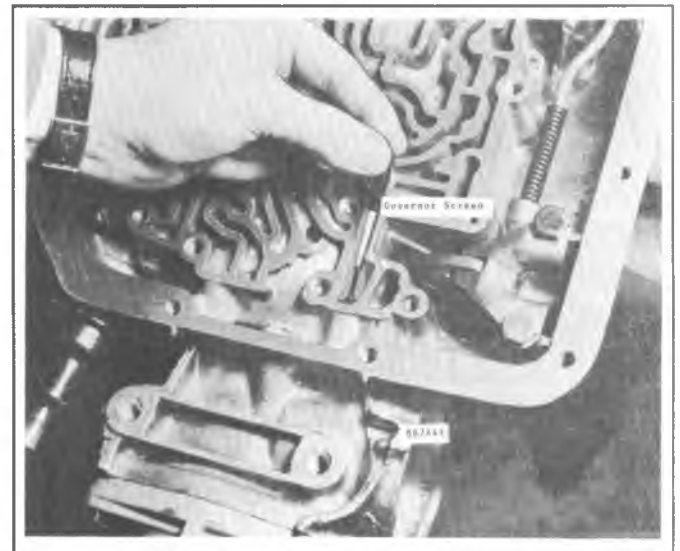


Figure 350C-41 Removing Governor Feed Screen

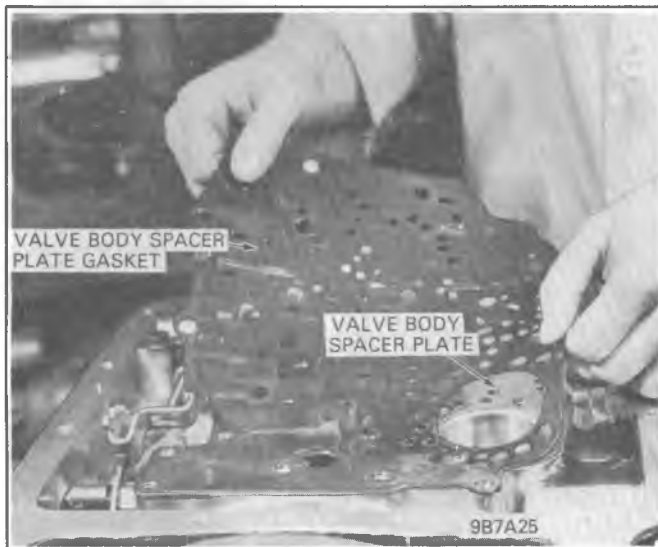


Figure 350C-38 Valve Body and Spacer Plate Gasket

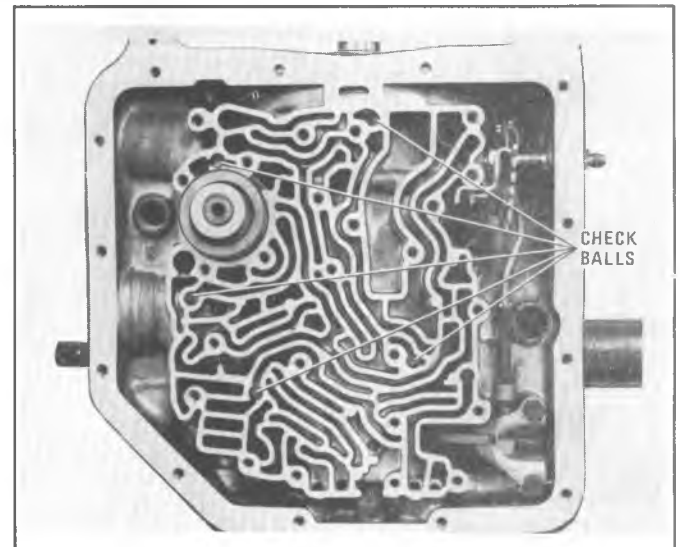


Figure 350C-41A Check Ball Locations

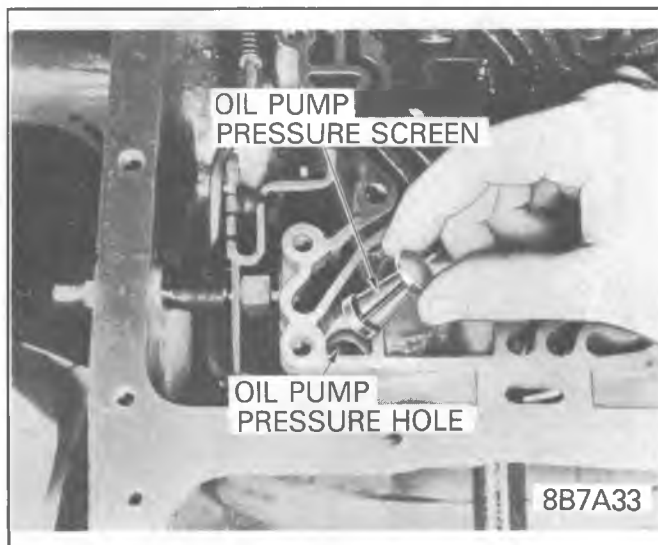


Figure 350C-40 Pump Screen Removal

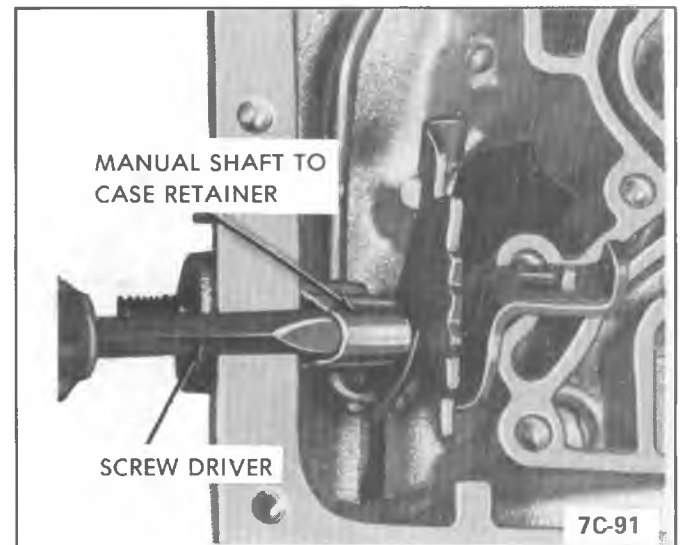


Figure 350C-42 Removing Manual Shaft Retainer

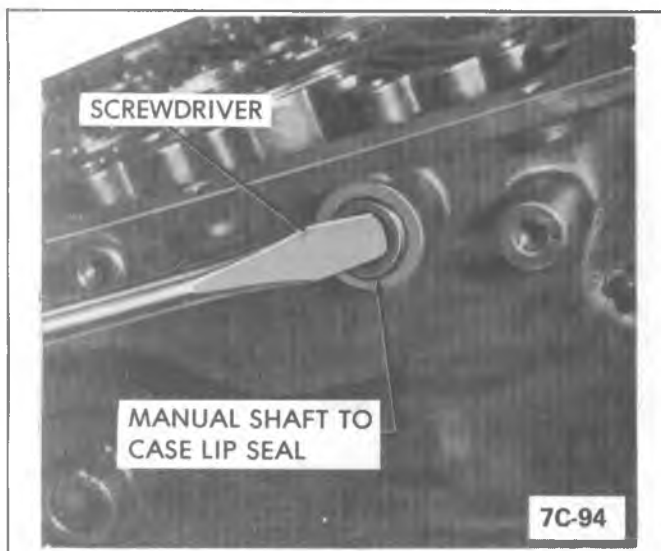


Figure 350C-43 Removing Manual Shaft Lip Seal



Figure 350C-47 Pump Removal



Figure 350C-45 Park Pawl

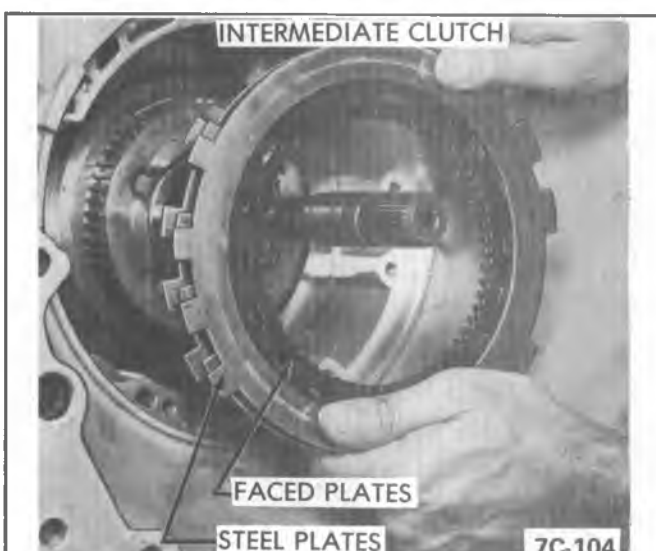


Figure 350C-48 Intermediate Clutch Plate Removal

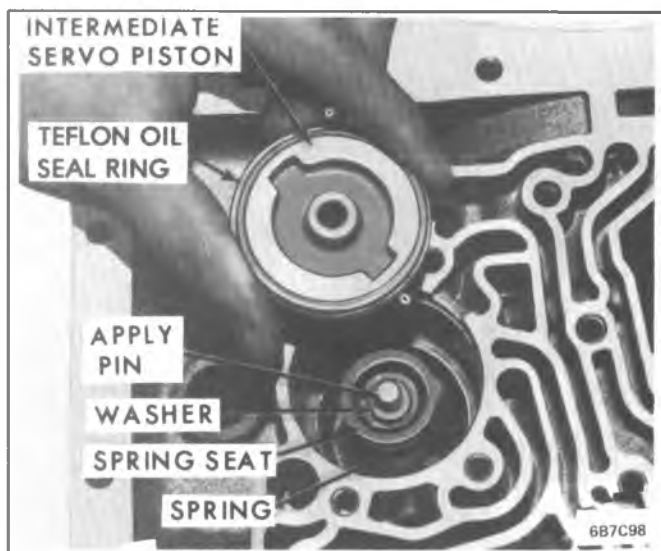


Figure 350C-46 Intermediate Servo Assembly

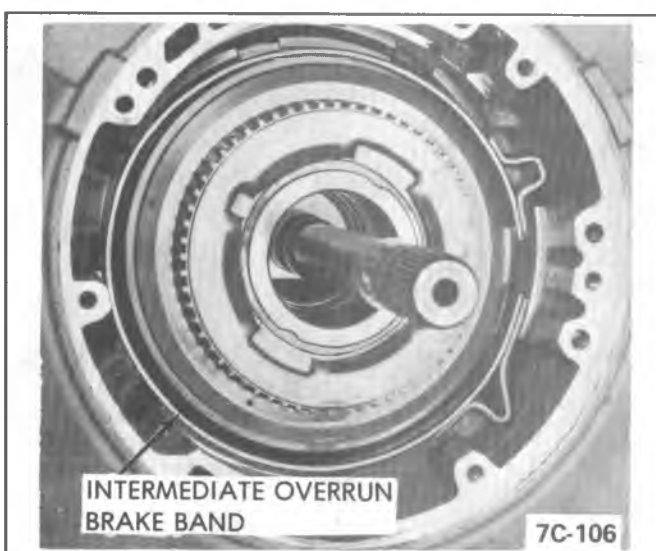


Figure 350C-49 Intermediate Overrun Brake Band

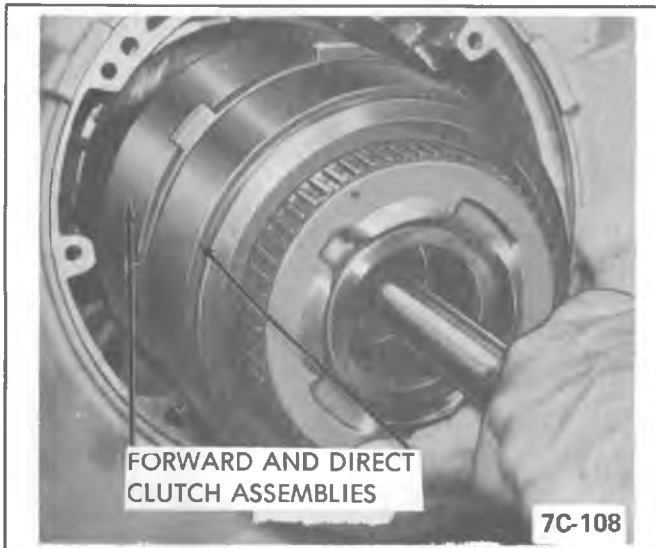


Figure 350C-50 Removing Forward and Direct Clutch Assemblies



Figure 350C-53 Removing Drive Shell Assembly

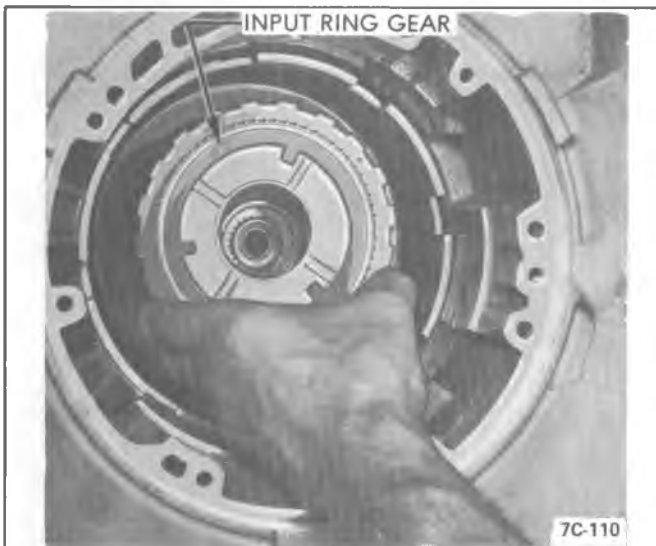


Figure 350C-51 Removing Input Ring Gear

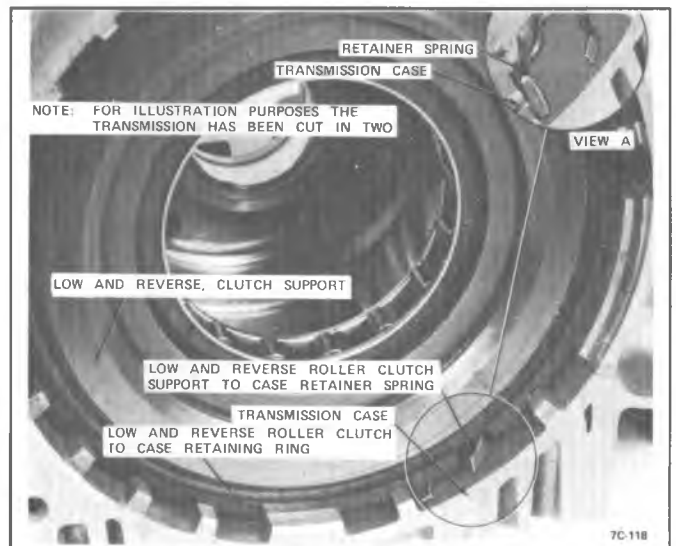


Figure 350C-54 Retainer Position

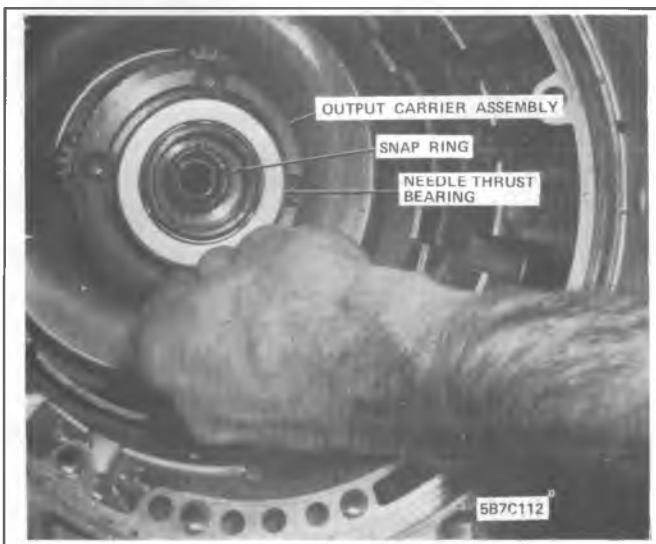


Figure 350C-52 Removing Input Carrier

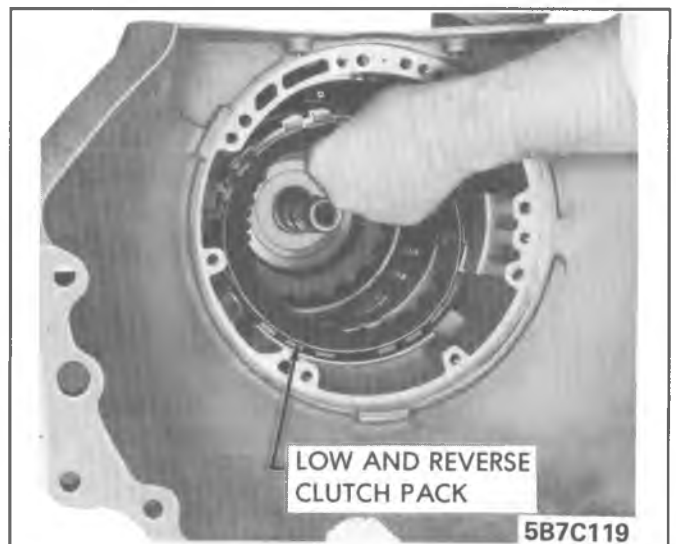


Figure 350C-55 Lo and Reverse Clutch Removal

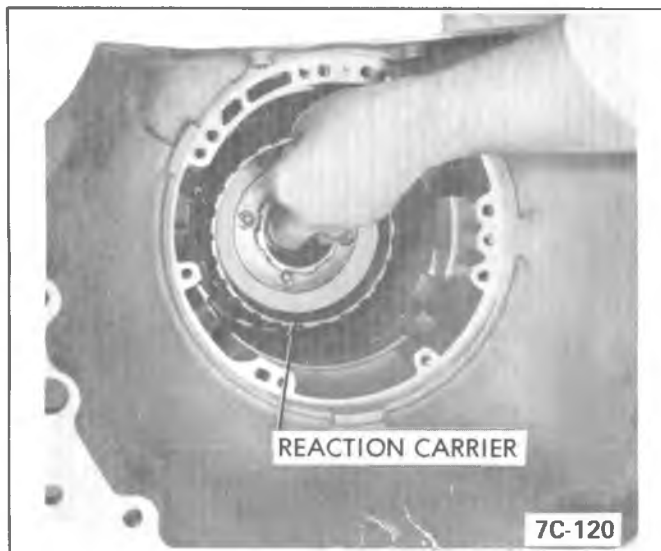


Figure 350C-56 Reaction Carrier Removal

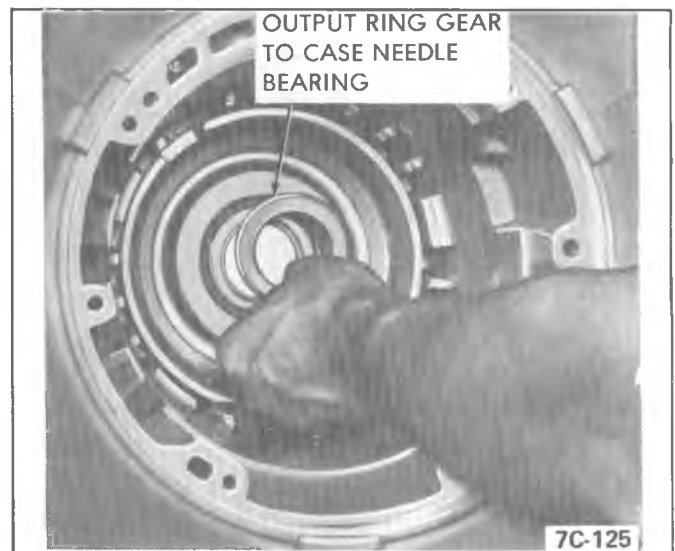


Figure 350C-59 Removal of Needle Bearing

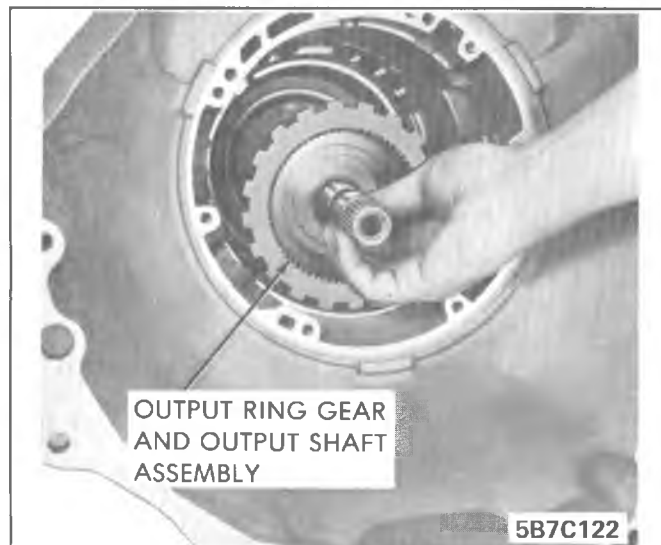


Figure 350C-57 Output Ring Gear and Shaft Assembly Removal

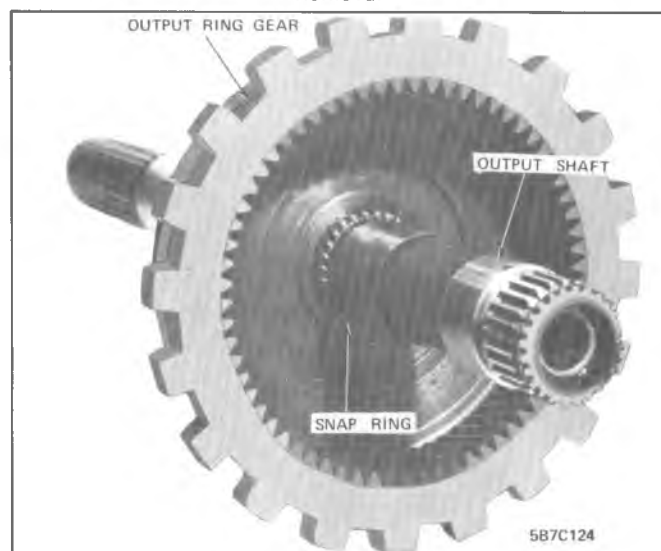


Figure 350C-58 Output Ring Gear Snap Ring

Removal of 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-60.

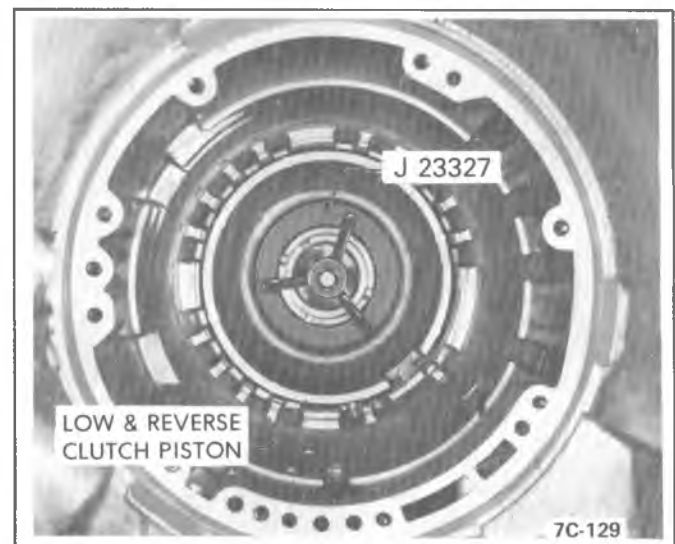


Figure 350C-60 Remove Low and Reverse Piston Snap Ring

2. Remove low and reverse clutch piston assembly. Aid removal with the use of compressed air in passage shown. See Figure 350C-61.

Removal of 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-62.

REMOVAL AND INSTALLATION OF INTERMEDIATE CLUTCH 1 - 2 ACCUMULATOR

Removal and installation of intermediate clutch 1 - 2 accumulator can be done without removal of transmission from car. See On Car Service.

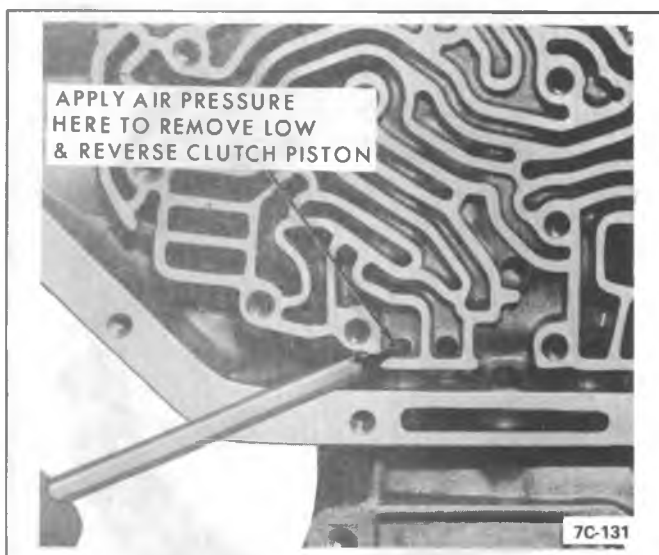


Figure 350C-61 Location for Air Pressure

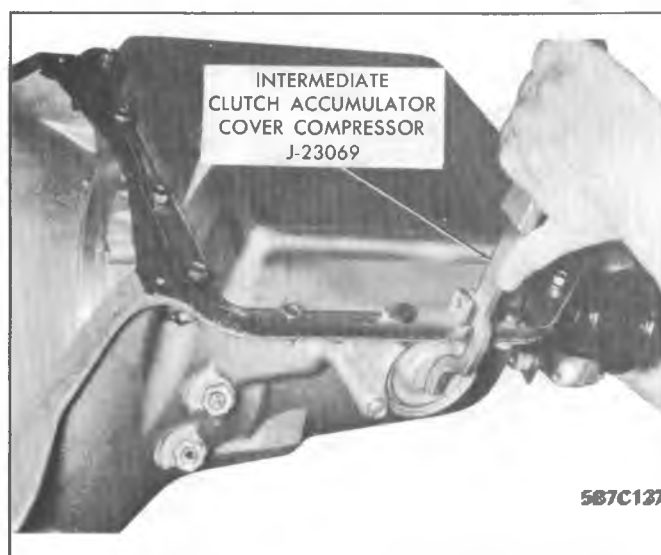


Figure 350C-63 Removal of 1-2 Accumulator Cover



Figure 350C-62 Piston Seal Removal

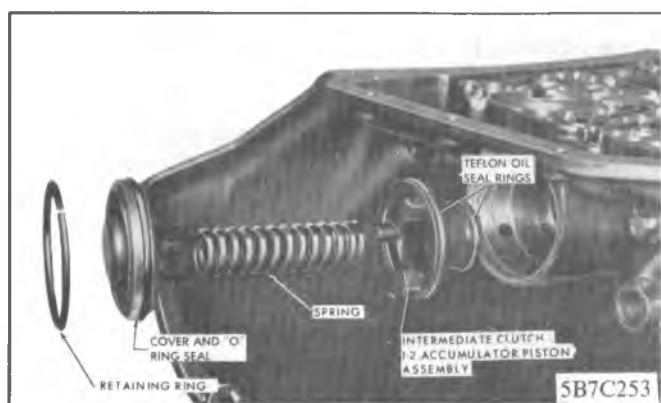


Figure 350C-64 Intermediate Clutch 1-2 Accumulator

3. Install J-23069 tool and compress intermediate clutch 1-2 accumulator cover and install retaining ring. See Figure 350C-63.

Removal of Intermediate Clutch 1-2 Accumulator Piston

1. Install Tool J-23069 to compress intermediate clutch 1-2 accumulator cover and remove retaining ring. See Figure 350C-63.
2. Remove intermediate clutch 1-2 accumulator piston cover and "O" ring seal from case. See Figure 350C-64.
3. Remove intermediate clutch 1-2 accumulator piston spring. See Figure 350C-64.
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-64. (Piston and Seal are one assembly).

Installation of Intermediate Clutch 1-2 Accumulator Piston

1. Install intermediate clutch 1-2 accumulator piston assembly and spring. See Figure 350C-64.
2. Place new "O" ring seal on intermediate clutch 1-2 accumulator piston cover, and install cover into case. See Figure 350C-64.

DISASSEMBLY AND REASSEMBLY OF OIL PUMP ASSEMBLY

Disassembly of Oil Pump Assembly

1. Place assembly through hole in bench. Remove five (5) pump cover to body attaching bolts. See Figure 350C-65.
2. Remove intermediate clutch return spring seat retainer with springs and the intermediate clutch piston assembly. See Figure 350C-66.
3. Remove intermediate clutch piston inner and outer seals. See Figure 350C-67.
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-66.
5. Check steady rest ring, if cut or frozen in bore remove and replace with the same color ring.
If the steady rest rings are colored (yellow, green, white or purple), always replace this ring 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-68.

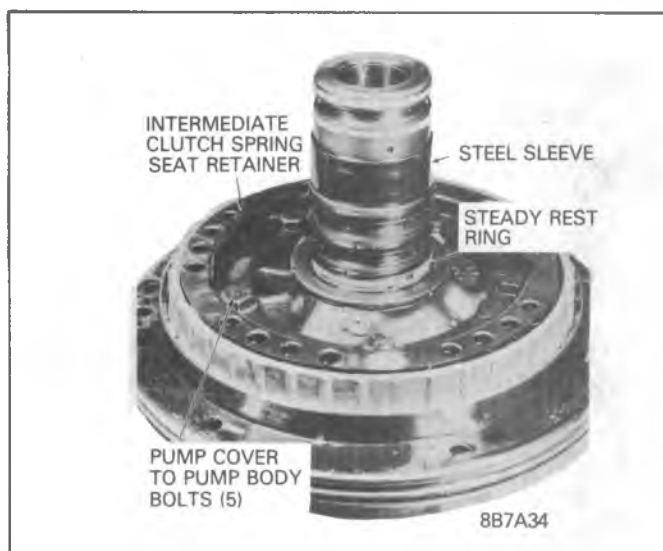


Figure 350C-65 Intermediate Clutch Piston Removal

6. Remove pump drive gear and driven gear from pump body. Inspect pump gears and cover for wear or scoring. See Figure 350C-69.

The pump body assembly should be replaced only if the drive and/or driven gears are broken or galled, pump body galled, uneven machined surfaces or pump body to case seal ring groove damaged, or the pump seal drain back hole is undrilled.

7. Fill cooler by-pass passage with grease and insert Tool J-23134 and force by-pass valve seat, check ball, and spring from pump body. See Figure 350C-70.
8. Remove pump outside diameter to case square cut "O" ring seal. See Figure 350C-71.

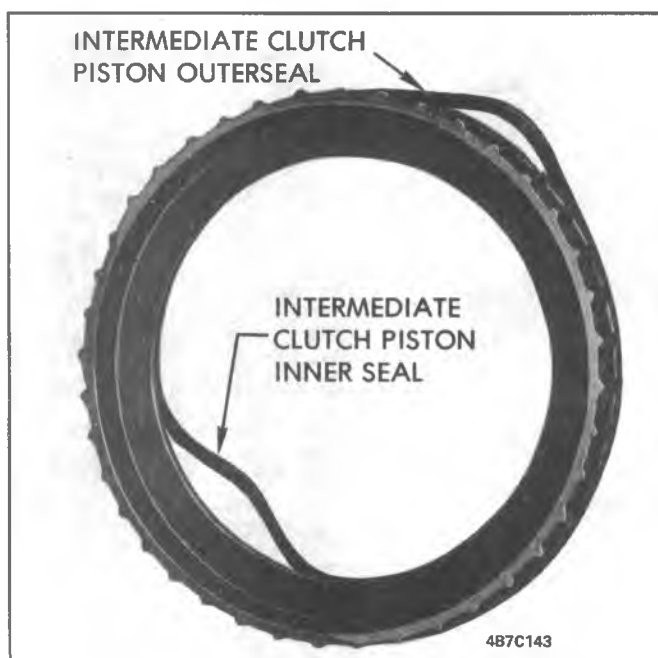


Figure 350C-67 Intermediate Clutch Piston Seals

9. Remove pump body to converter hub lip seal, if necessary. See Figure 350C-72.
 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-73.
- Make certain lip seal is not turned or nicked.

Reassembly of Oil Pump Assembly

1. Install pump drive gear and driven gear. Drive gear has off-set tangs, assemble with tang face up to prevent damage to converter. See Figure 350C-69.

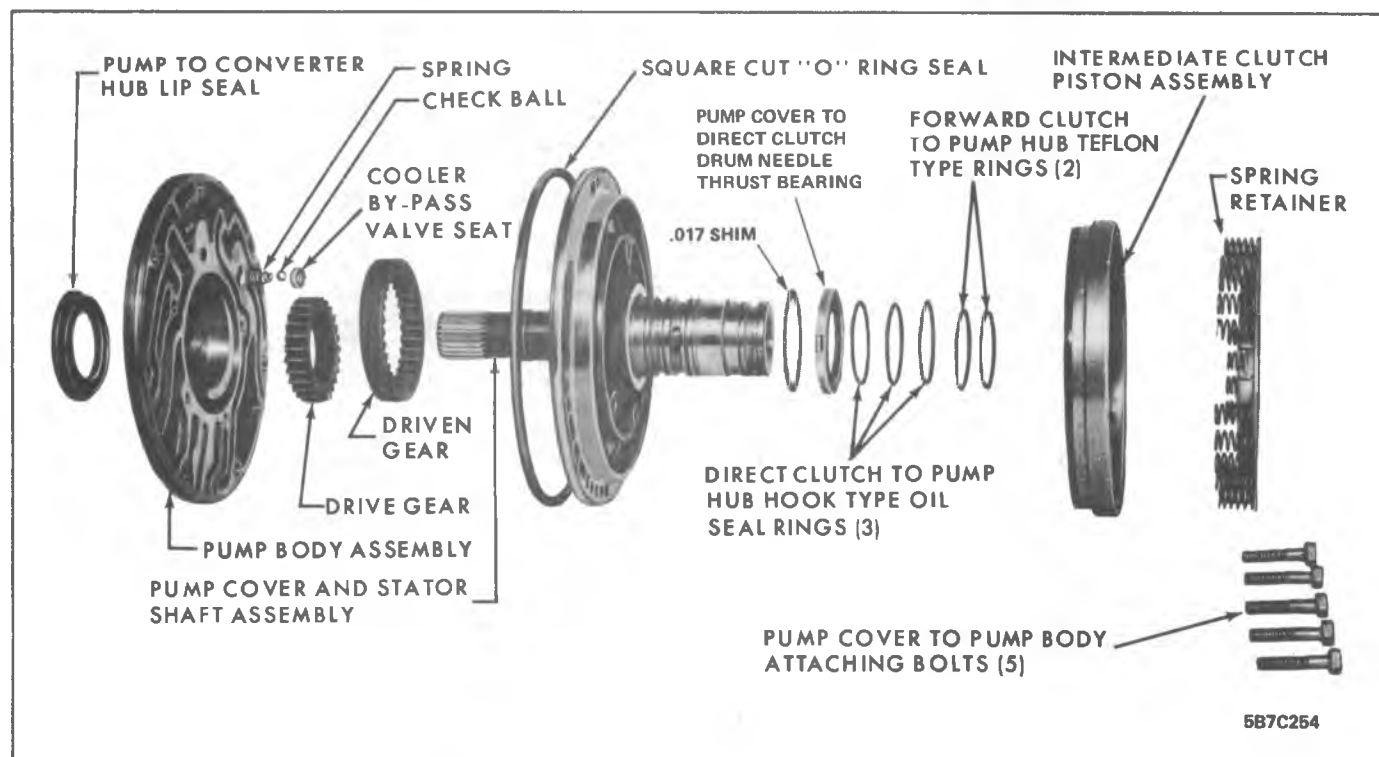


Figure 350C-66 Oil Pump Assembly - Exploded View

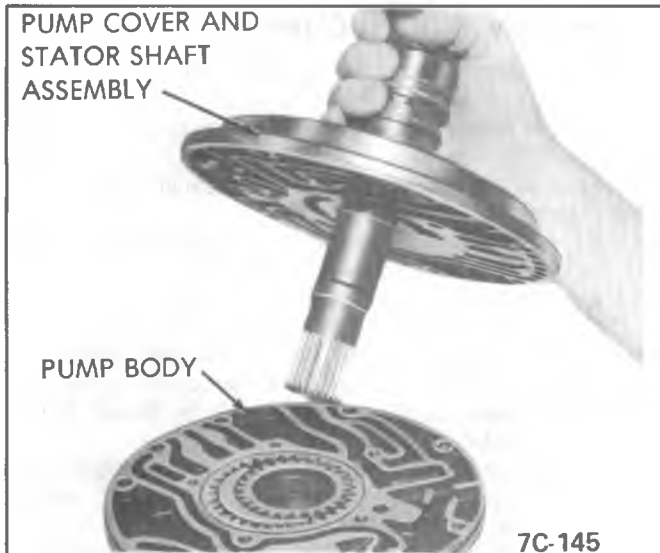


Figure 350C-68 Pump Cover Removal

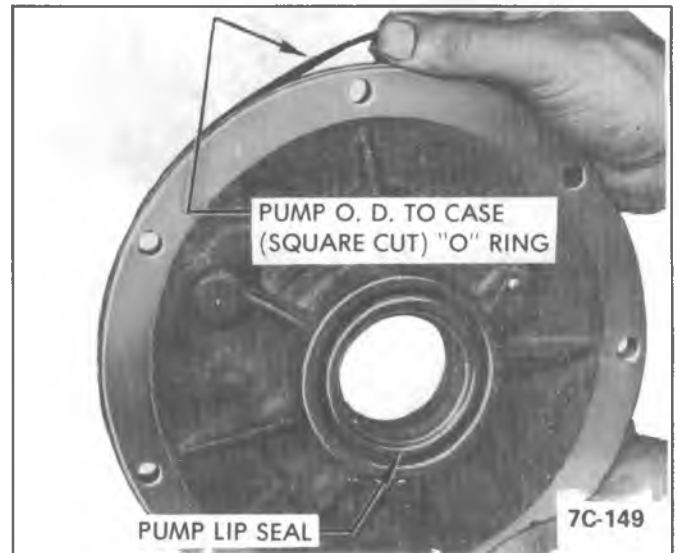


Figure 350C-71 Square Cut Pump Seal

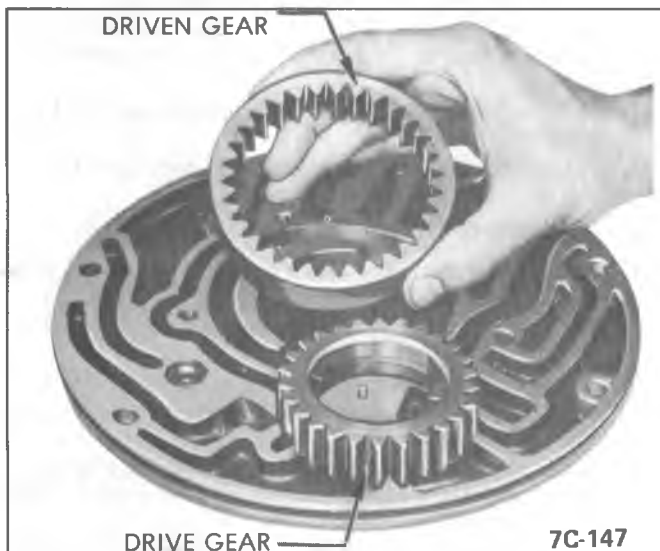


Figure 350C-69 Oil Pump Gears

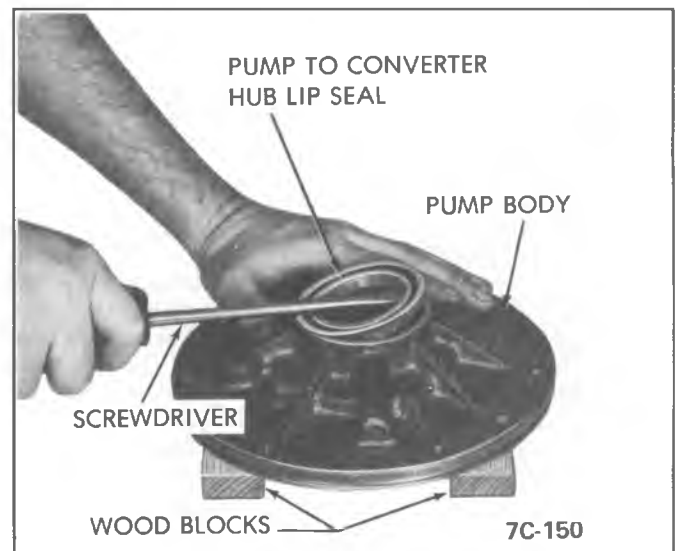


Figure 350C-72 Converter Seal Removal

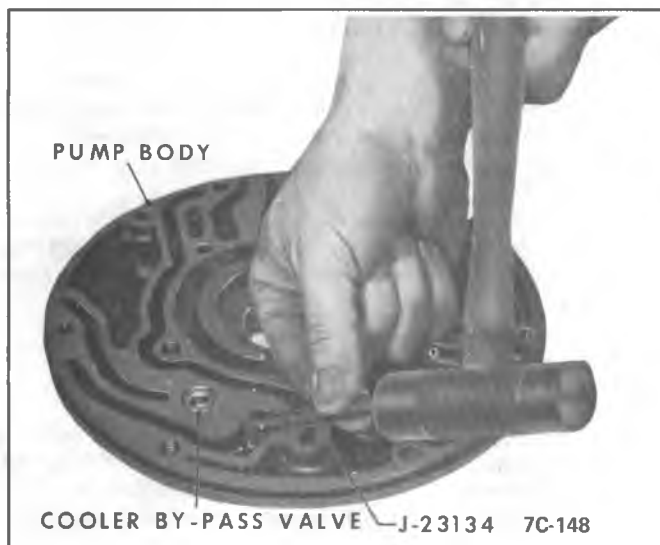


Figure 350C-70 Cooler By-Pass Valve

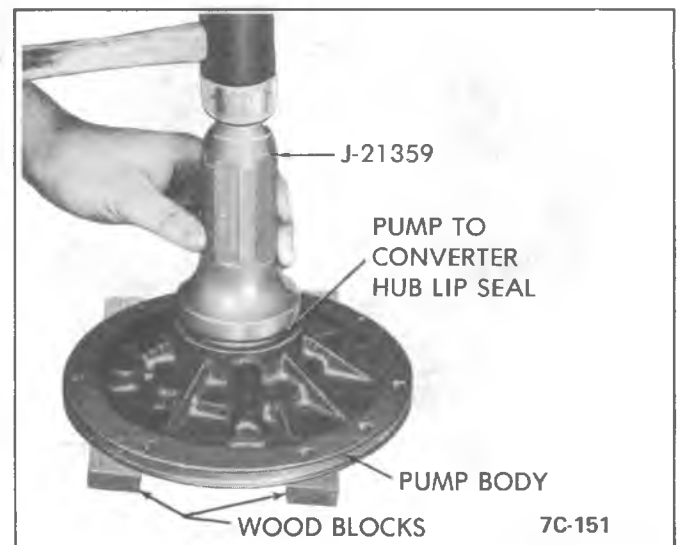


Figure 350C-73 Converter Seal Installation

2. Install cooler by-pass spring, check ball and seat. Using Tool J-23112, press seat into bore until top of seat is flush with face of pump body. See Figure 350C-74.
3. Assemble pump cover to pump body. See Figure 350C-68.
4. Install intermediate clutch piston new inner and outer seals. See Figure 350C-67.

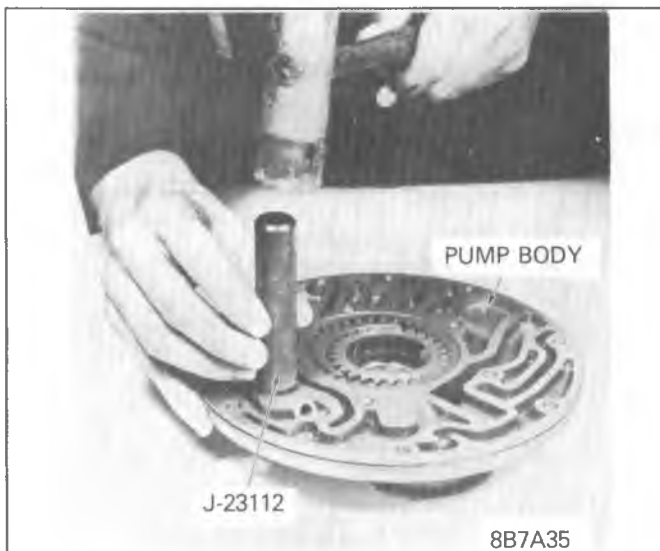


Figure 350C-74 Installing Cooler By-Pass

5. Install intermediate clutch piston assembly into pump cover with J-26744-A.
6. Install spring retainer and install five (5) attaching bolts, finger tight. See Figures 350C-66 and 350C-65.
7. Place pump aligning strap, J-21368 over pump body and cover and tighten.
8. Tighten attaching bolts. Torque to 18 ft.lbs. (24 N·m).
9. Install pump outside diameter to case (square cut) "O" ring seal. See Figure 350C-71. Use new square cut "O" ring seal.
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 350
11. Check three (3) pump cover hub lube holes. Make certain they are not restricted. See Figure 350C-75.



Figure 350C-75 Lube Hole Location

DISASSEMBLY AND REASSEMBLY OF DIRECT CLUTCH

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.

Disassembly of Direct Clutch

1. Remove intermediate overrun clutch front retainer ring and retainer. See Figure 350C-76.
2. Remove intermediate clutch overrun outer race. See Figure 350C-77.
3. Remove intermediate overrun roller clutch assembly. See Figure 350C-78.
4. Remove direct clutch drum to forward clutch housing needle roller bearing. See Figure 350C-79.
5. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate. See Figure 350C-80.
6. Remove composition and steel plates from direct clutch housing. See Figure 350C-81 and one cushion spring.
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-82.
9. Remove spring retainer, springs and piston. See Figure 350C-83.
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. See Figure 350C-84.
12. Remove direct clutch piston center seal. See Figure 350C-85.

Reassembly of Direct Clutch

1. Install new direct clutch piston outer seal and inner seal. See Figure 350C-84.
2. Install new direct clutch piston center seal. See Figure 350C-85.
3. Install the direct clutch piston into housing with the aid of a piece of .020" music wire crimped into copper tubing. See Figure 350C-86.
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-82.
5. Lubricate with transmission fluid and install composition plates and steel plates starting with a steel plate and alternating steel and composition. See Figure 350C-87.
6. Install direct clutch pressure plate and retaining ring. See Figure 350C-80.
7. Install intermediate overrun roller clutch assembly. See Figure 350C-89. 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-89.
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-89.

DISASSEMBLY AND REASSEMBLY OF FORWARD CLUTCH ASSEMBLY

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.

Disassembly of Forward Clutch

1. Remove forward clutch drum to pressure plate retaining ring. Remove forward clutch pressure plate. See Figure 350C-90.
2. Remove forward clutch housing faced plates, steel plates, and cushion spring. See Figure 350C-91.

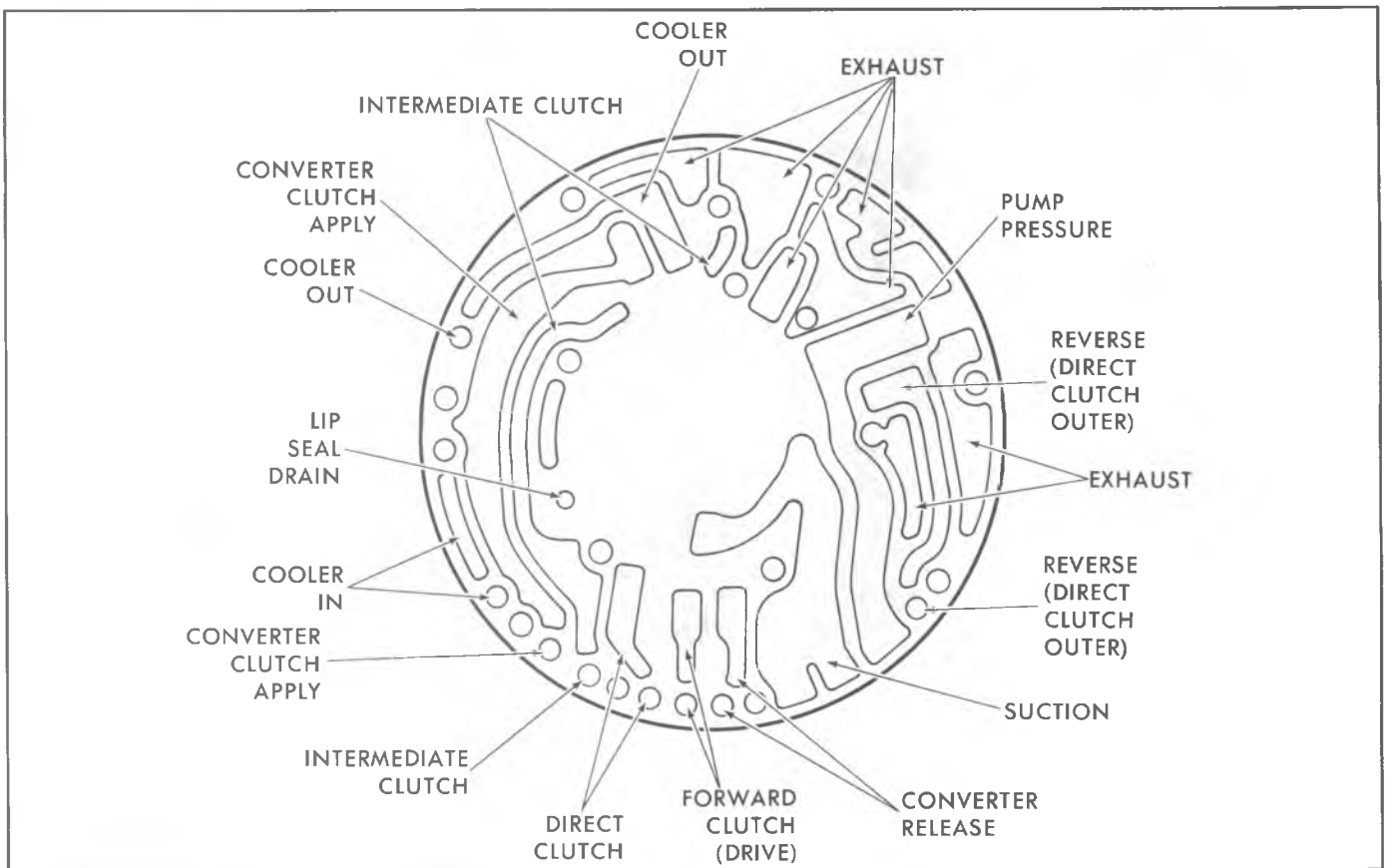


Figure 350C-75A Identification of Oil Channels in Pump Cover

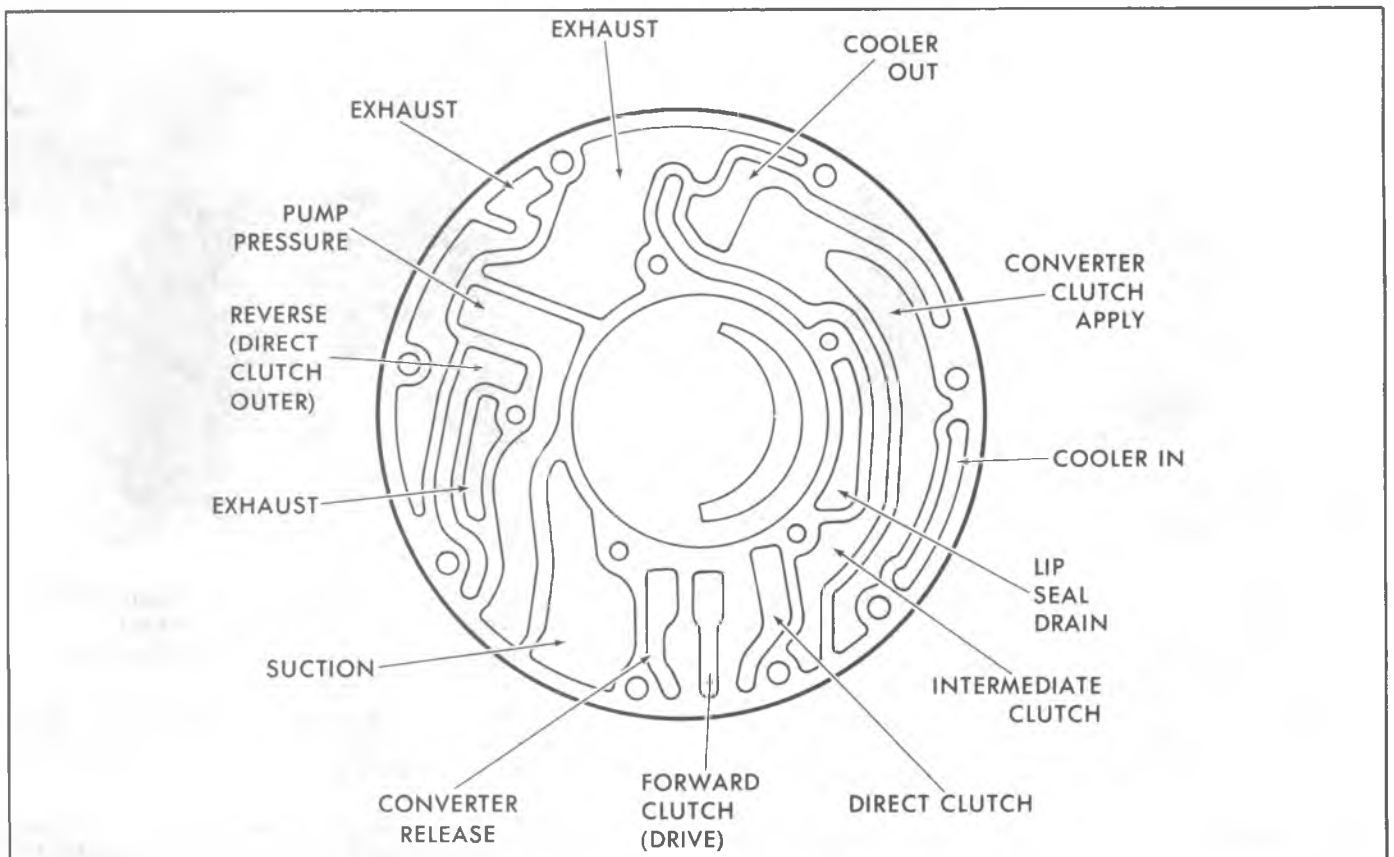


Figure 350C-75B Identification of Oil Channels in Pump Body Front Face

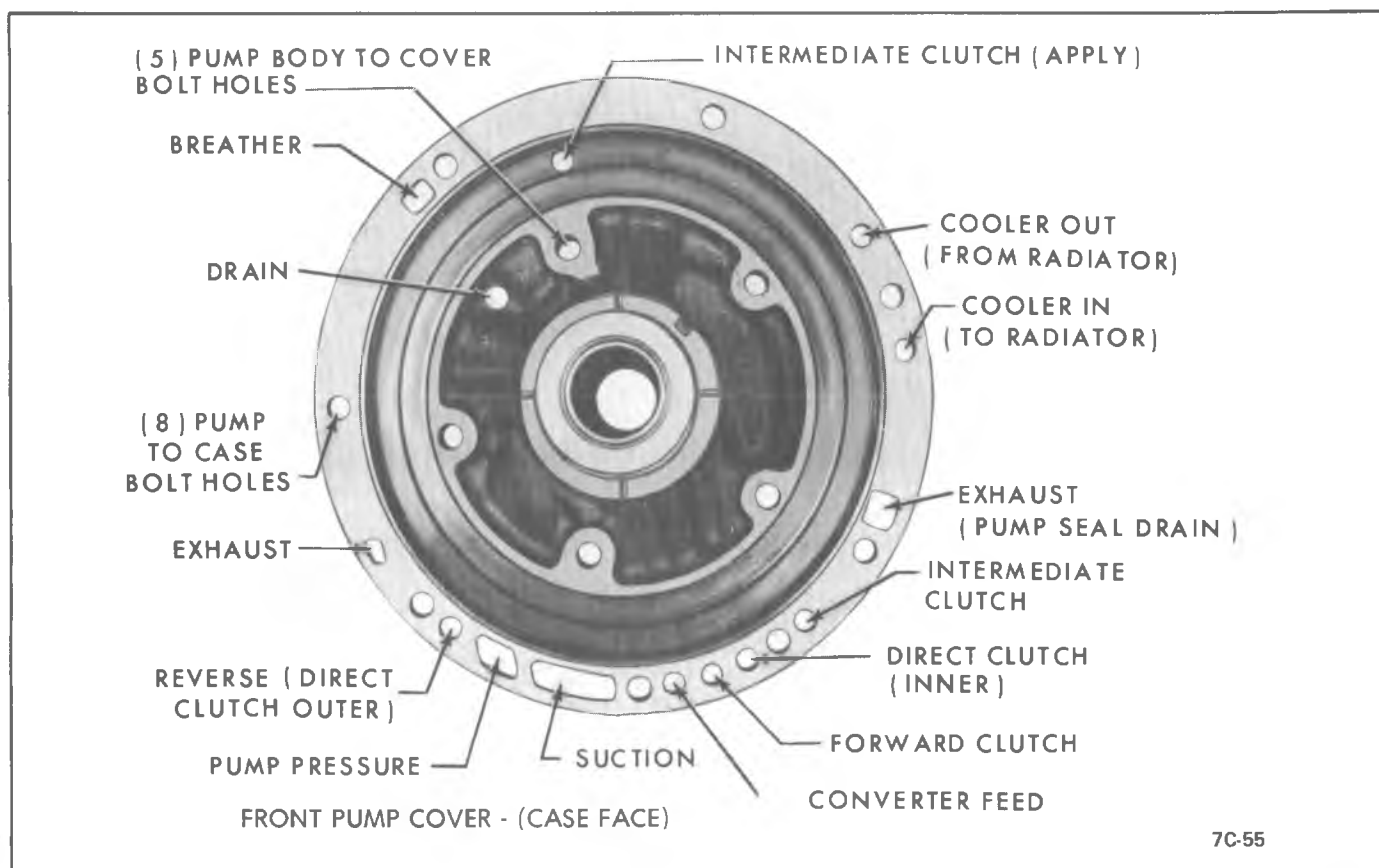


Figure 350C-75C Identification of Oil Channels in Pump Cover Rear Face

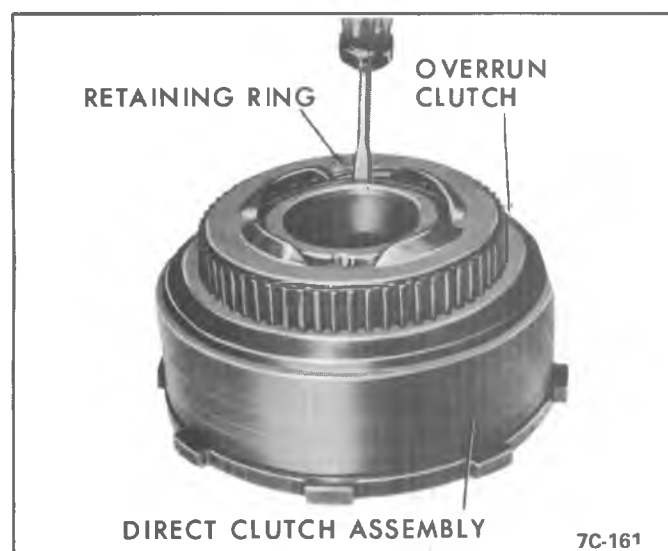


Figure 350C-76 Overrun Clutch Retaining Ring



Figure 350C-77 Roller Clutch Outer Race

3. Inspect condition of lined and steel plates. *Do not diagnose a drive plate by color.*
4. Remove spring retainer and springs by compressing with a ram press. See Figure 350C-92.
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. See Figure 350C-94.
7. Remove forward clutch piston inner and outer seals. See Figure 350C-95.
8. Make certain forward clutch ball check exhaust is free of dirt, etc. See Figure 350C-96.
9. If the input shaft is scored excessively (Figure 350C-97) it may be replaced using the following procedure.
 - a. Using wood blocks for support press input shaft out of forward clutch housing.
 - b. Taking care support forward clutch housing on rear thrust washer surface and press input shaft into housing until it is properly seated.

NOTICE: 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.

- c. Runout at rear thrust washer surface should be no more than .005.

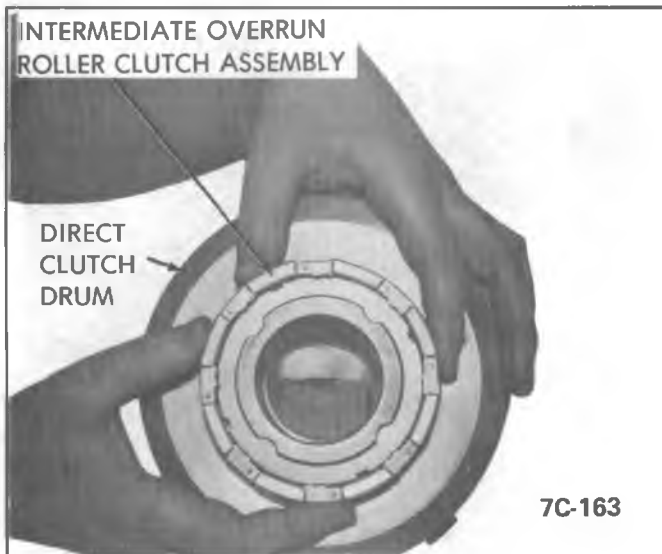


Figure 350C-78 Removing Roller Clutch Outer Race

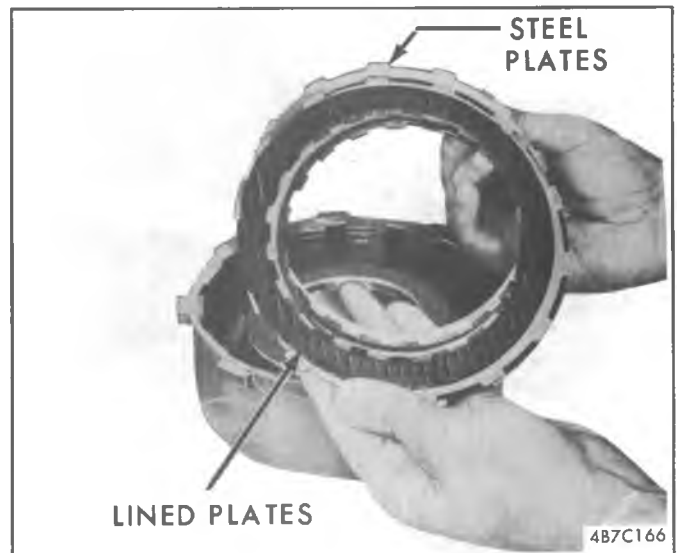


Figure 350C-81 Clutch Plates



Figure 350C-79 Needle Bearing Assembly

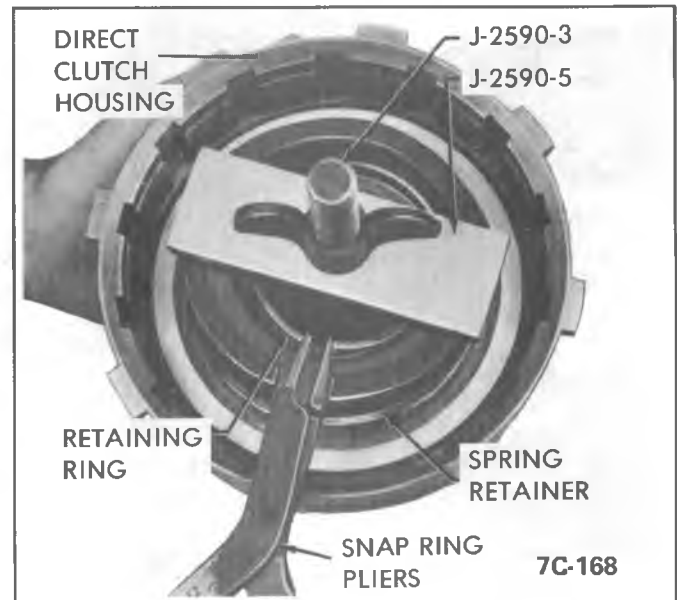


Figure 350C-82 Piston Snap Ring Removal



Figure 350C-80 Disassembly of Direct Clutch

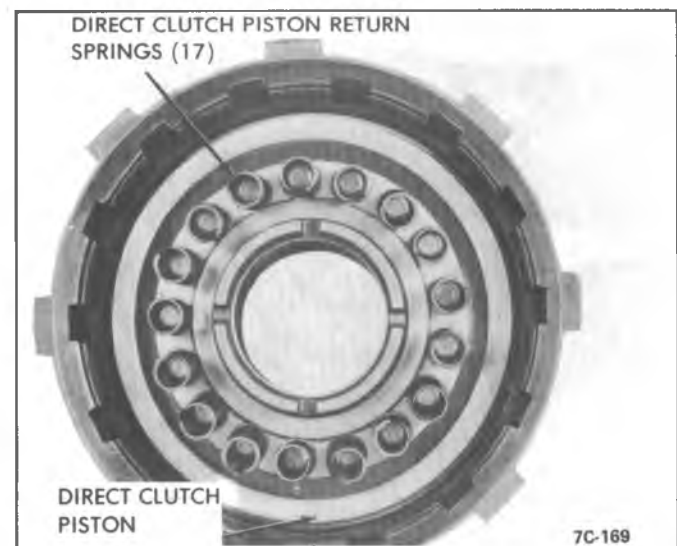


Figure 350C-83 Install Piston Return Springs

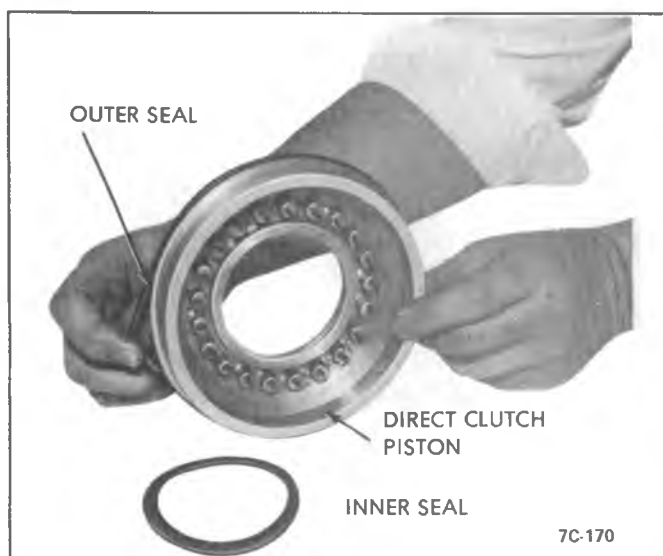


Figure 350C-84 Install Piston Seals

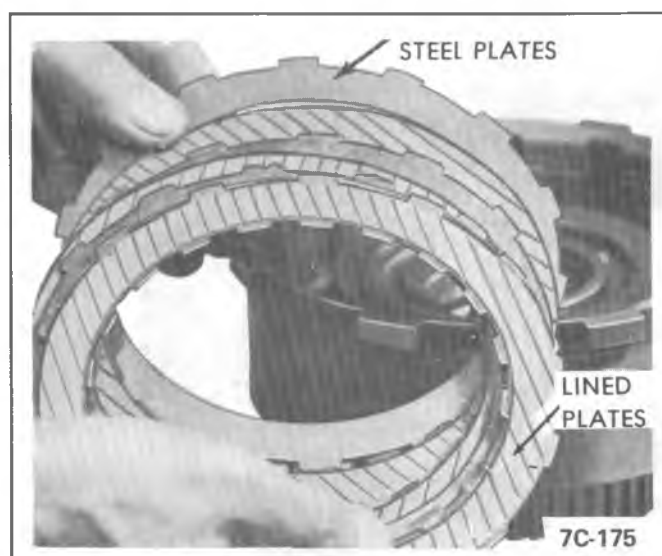


Figure 350C-87 Install Clutch Plates

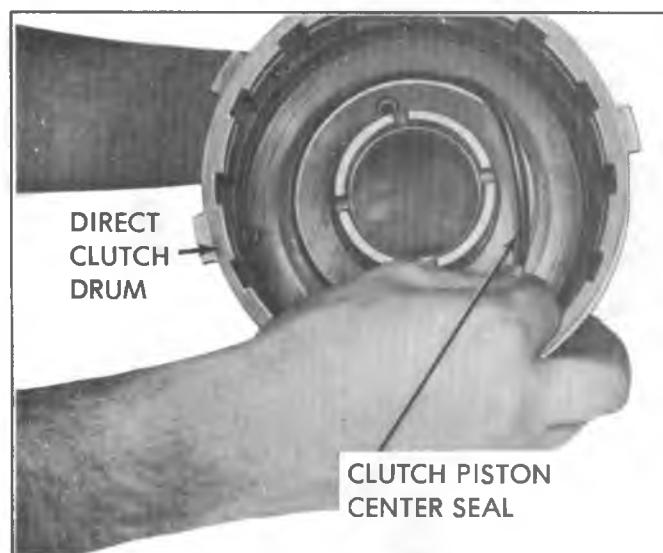


Figure 350C-85 Install Center Seal

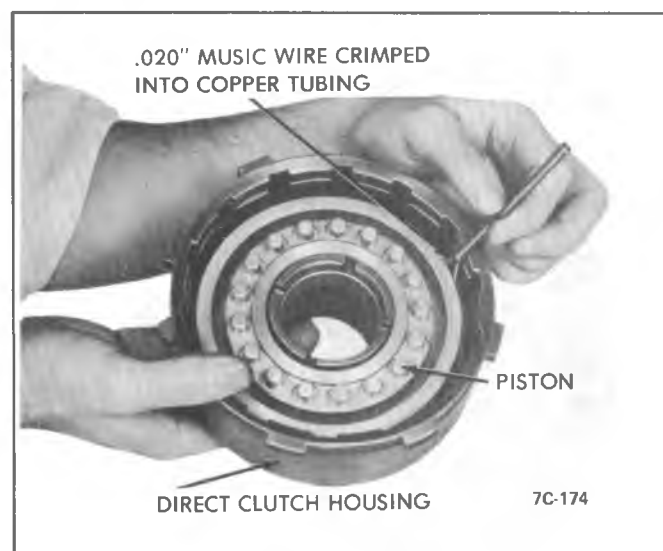


Figure 350C-86 Install Piston

INPUT SHAFT SEAL REMOVAL AND INSTALLATION

1. Inspect the input shaft seal ring for damage. If the seal is cut or otherwise damaged, it must be replaced. Some scoring and/or scuffing of the shaft is normal. Figure 350C-97.
2. Remove seal with a sharp pointed knife by inserting under the seal and cutting, making sure not to damage the seal land area.
3. Install new seal using Tool J-28553 and a 9/16" box end wrench.
4. Position J-28553 with dowel peg inserted in end of shaft until taper fits down onto shaft.
5. Slide seal partially down taper of tool by hand.
6. Position 9/16" box end wrench over end of J-28553 and quickly push seal down taper and onto shaft and into groove. See Figure 350C-98.
Do not leave seal on untapered or middle of tool as this will stretch the seal excessively.
7. The seal must now be sized. Dip end of input shaft into automatic transmission fluid to lubricate seal and shaft, slowly insert end of shaft with seal into output shaft three times before final assembly.
8. Check that the seal has not been cut and is free in the groove.

NOTICE: All service input shafts will be provided with the seal design incorporated, therefore when replacing an input shaft with a bronze bushing between input and output shaft, the bronze bushing must be removed from the output shaft and the inside diameter of the shaft polished to accept the new seal.

Reassembly of Forward Clutch Assembly

1. Install the forward clutch inner piston seal and outer piston seal. See Figure 350C-91.
2. Install the forward clutch piston assembly using a thin feeler gage. See Figure 350C-99.
3. Install spring retainer and springs. Compress spring retainer with an arbor press or ram press. See Figure 350C-92.
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-93.
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-100.

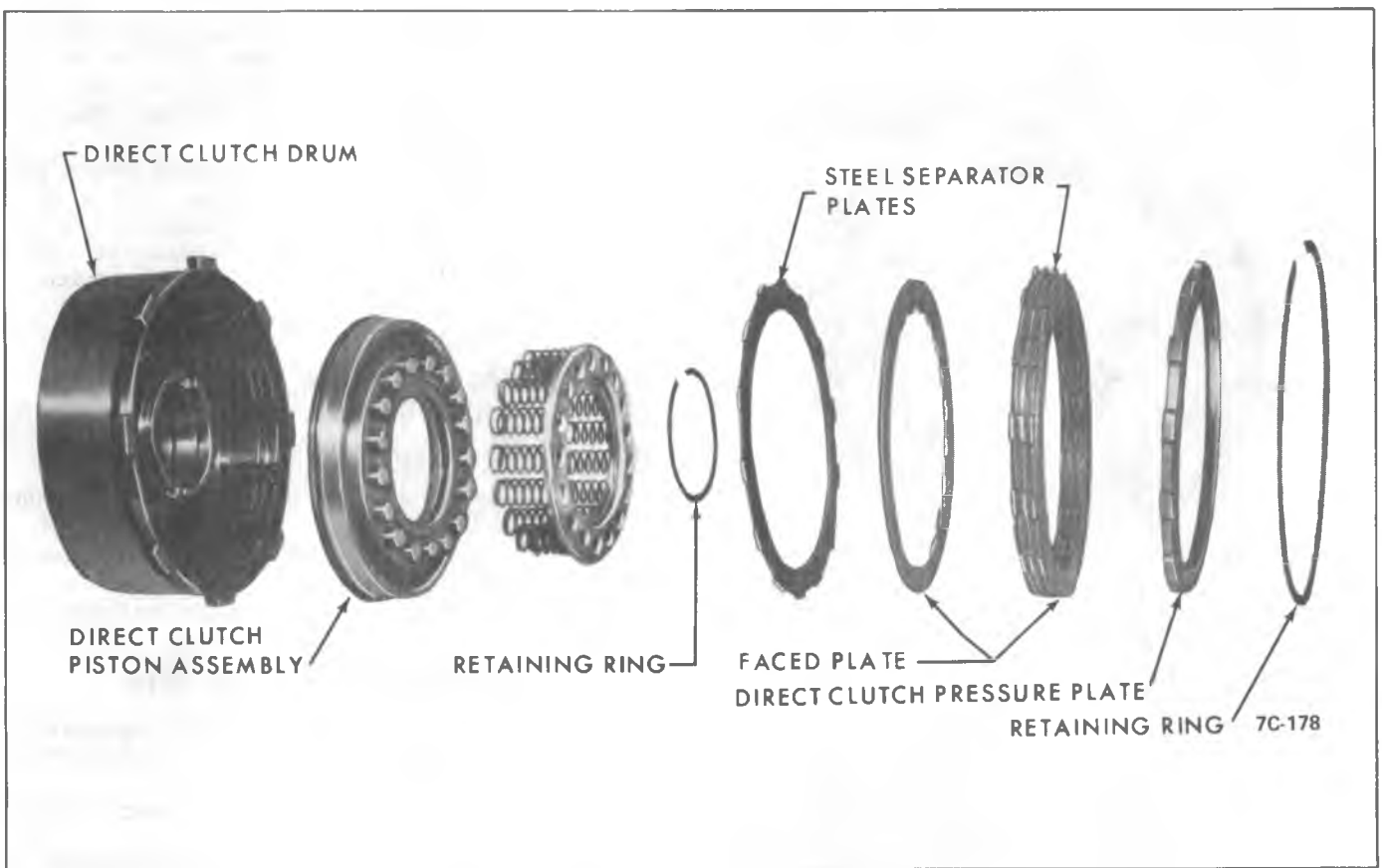


Figure 350C-88 Direct Clutch Assembly - Exploded View

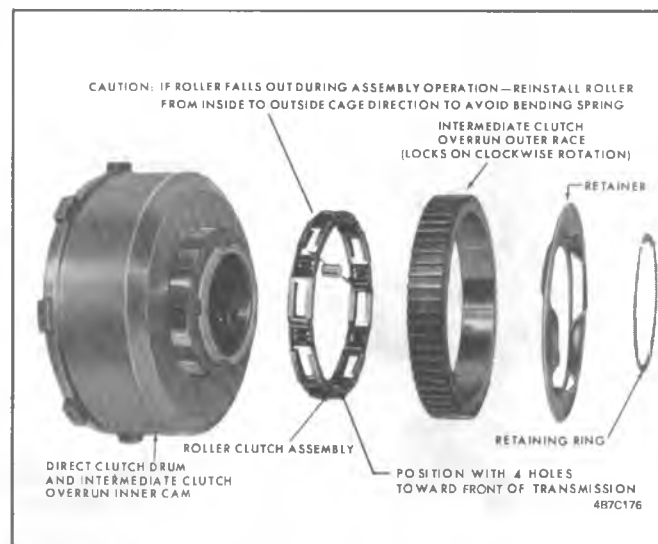


Figure 350C-89 Intermediate Overrun Roller Clutch Assembly

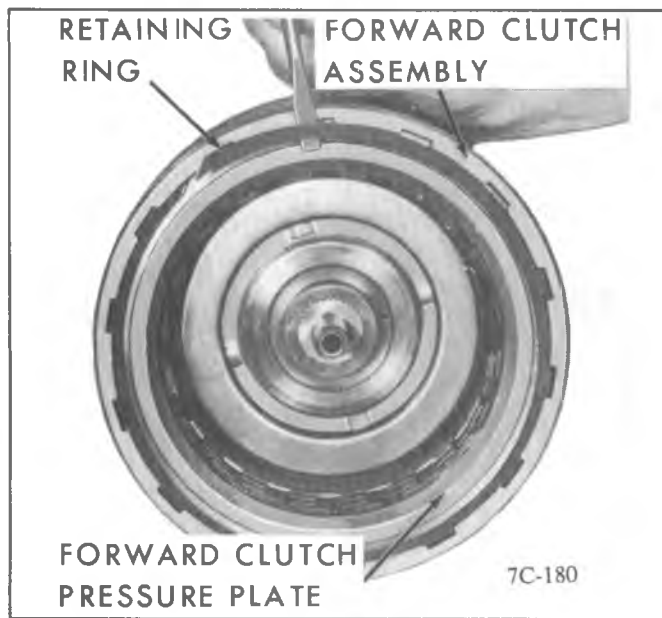


Figure 350C-90 Forward Clutch Retaining Ring

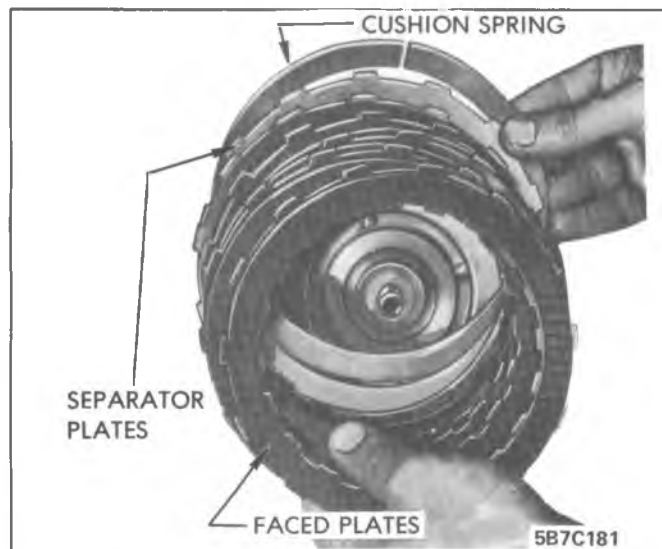


Figure 350C-91 Forward Clutch Plates

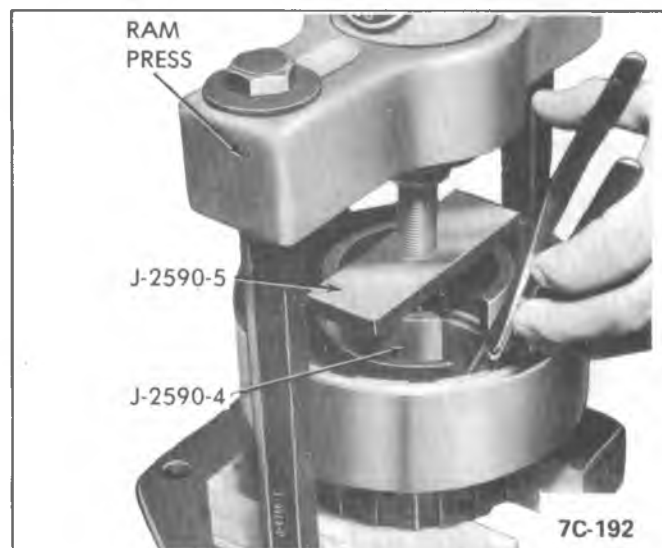


Figure 350C-92 Forward Clutch Piston Snap Ring Removal

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-101. 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.

DISASSEMBLY AND REASSEMBLY OF SUN GEAR TO DRIVE SHELL

Disassembly of Sun Gear to Drive Shell

1. Remove sun gear to sun gear drive shell rear retaining ring. See Figure 350C-102.
2. Remove sun gear to drive shell flat rear thrust washer. See Figure 350C-103.
3. Remove front retaining ring from sun gear. See Figure 350C-104.

Reassembly of Sun Gear to Drive Shell

1. Install sun gear to drive shell front retaining ring, and install into drive shell. See Figure 350C-104. Use a new ring and do not overstress when installing.
2. Install sun gear to drive shell flat thrust washer. See Figure 350C-103.
3. Install sun gear to sun gear drive shell rear retaining ring. See Figure 350C-102. Use a new ring and do not overstress when installing.

DISASSEMBLY AND REASSEMBLY OF LOW AND REVERSE ROLLER CLUTCH ASSEMBLY

Disassembly of Low and Reverse Roller Clutch Assembly (Refer to Figure 350C-105)

1. Remove low and reverse clutch to sun gear shell thrust washer.
2. Remove low and reverse overrun clutch inner race.
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 of Low and Reverse Roller Clutch Assembly

1. Install low and reverse roller clutch assembly to inner race. See Figure 350C-106. The inner race should free wheel in the clockwise direction only.
2. Install low and reverse overrun roller clutch assembly and inner race into the low and reverse clutch support. See Figure 350C-107. Assemble with four (4) holes down or to rear of transmission.
3. Install low and reverse clutch to cam retaining ring. See Figure 350C-108.
4. Install low and reverse clutch to sun gear drive shell thrust washer. See Figure 350C-105.

VALVE BODY DISASSEMBLY, INSPECTION AND REASSEMBLY

Disassembly of Valve Body (Refer to Figure 350C-110)

Transmission need not be removed from car to perform the following operations.

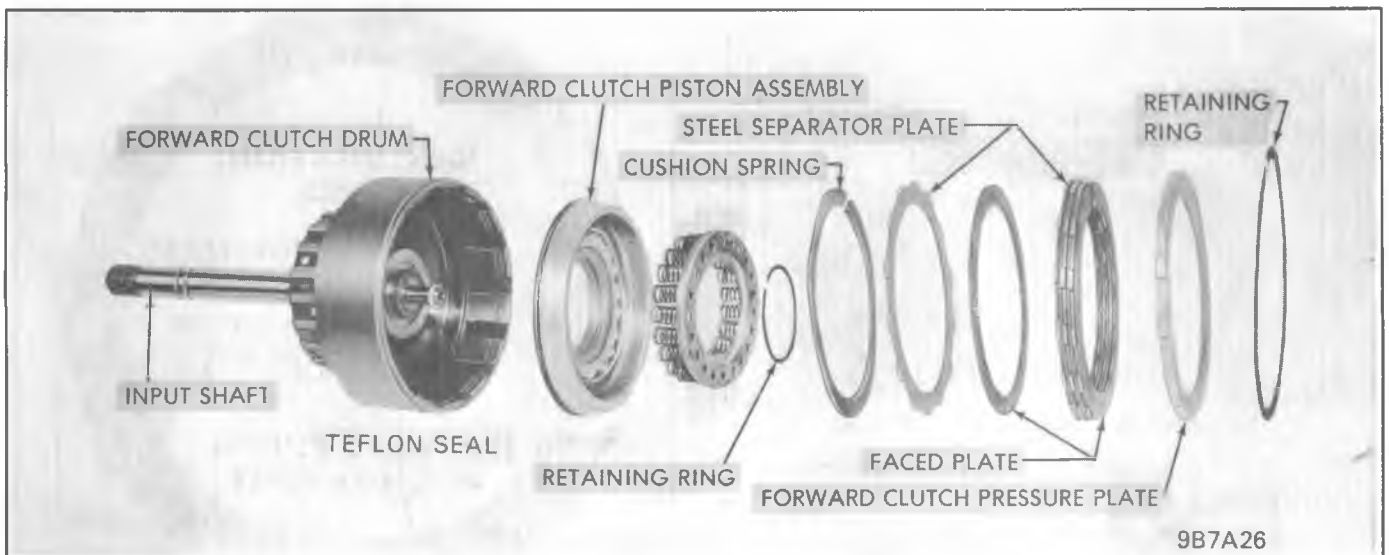


Figure 350C-93 Forward Clutch Assembly Exploded View

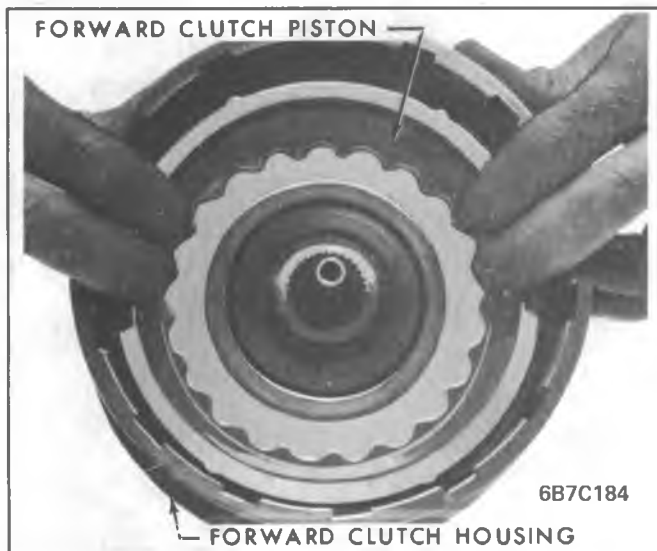


Figure 350C-94 Forward Clutch Piston Removal

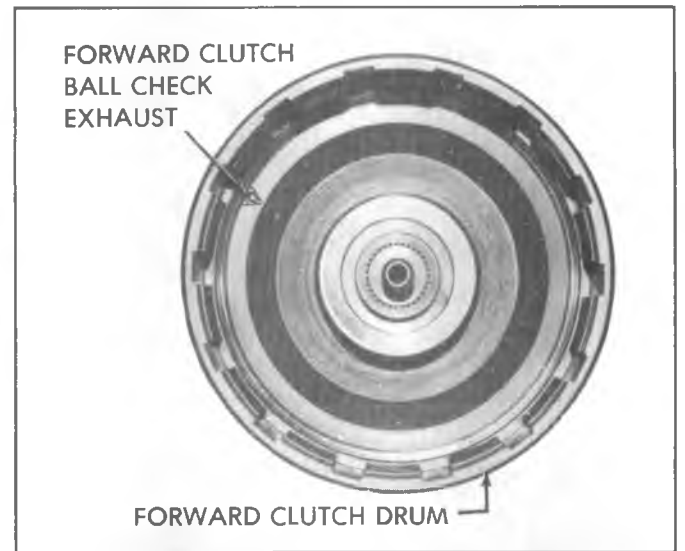


Figure 350C-96 Ball Exhaust Location

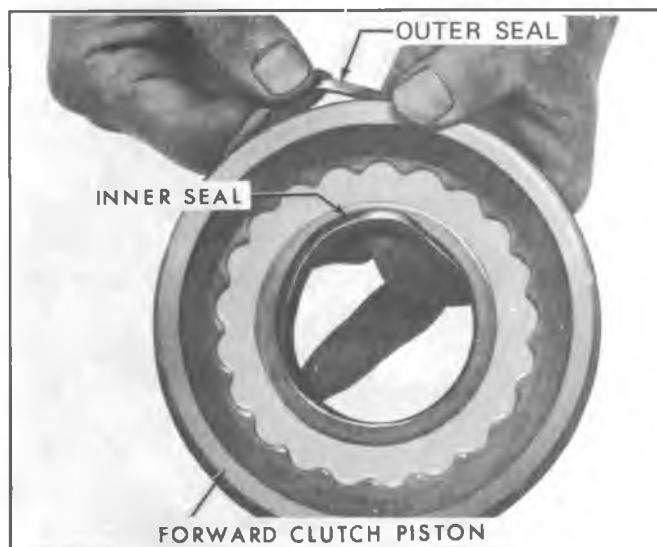


Figure 350C-95 Piston Seal Removal

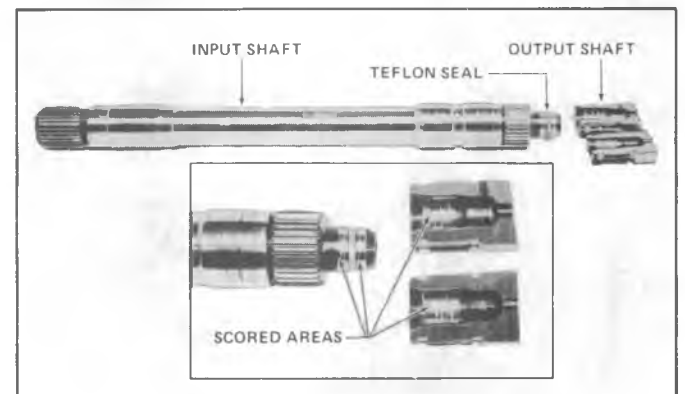


Figure 350C-97 Normal Scuffing and Scoring

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.

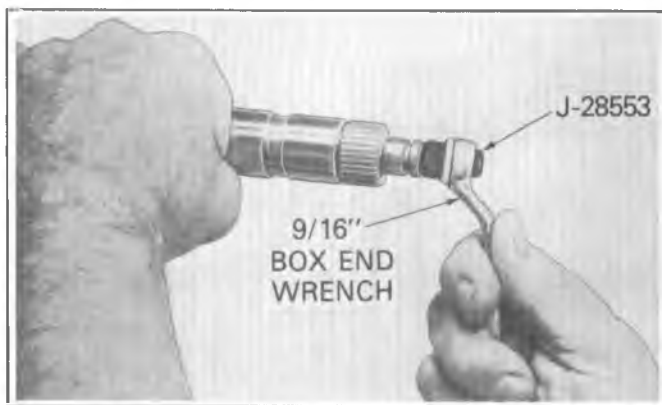


Figure 350C-98 Installing Input Shaft Seal

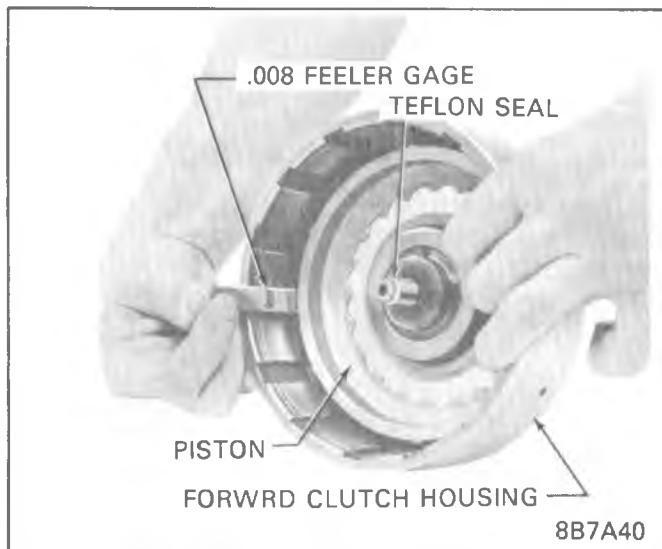


Figure 350C-99 Installing Clutch Piston

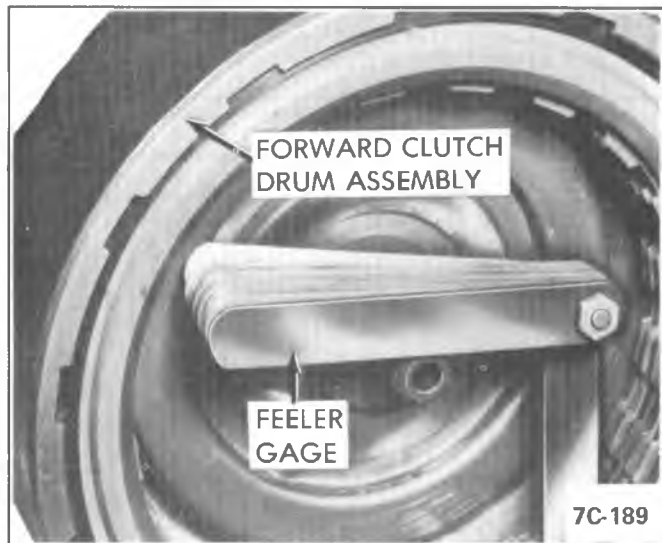


Figure 350C-100 Checking Pressure Plate Clearance

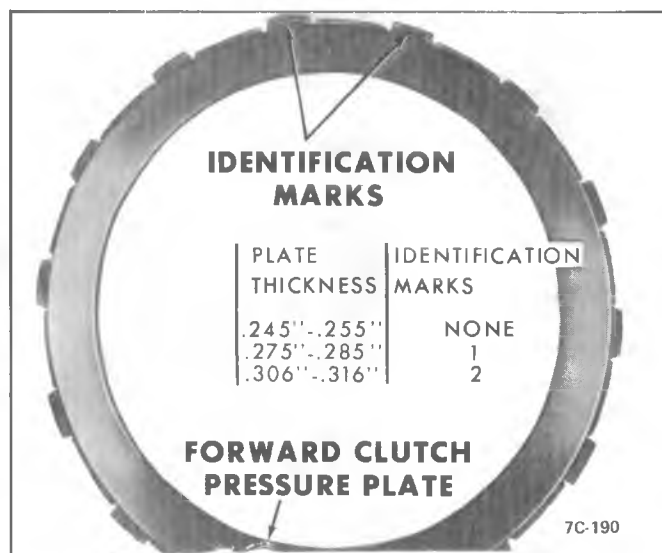


Figure 350C-101 Pressure Plate Selection



Figure 350C-102 Sun Gear Retaining Ring Removal

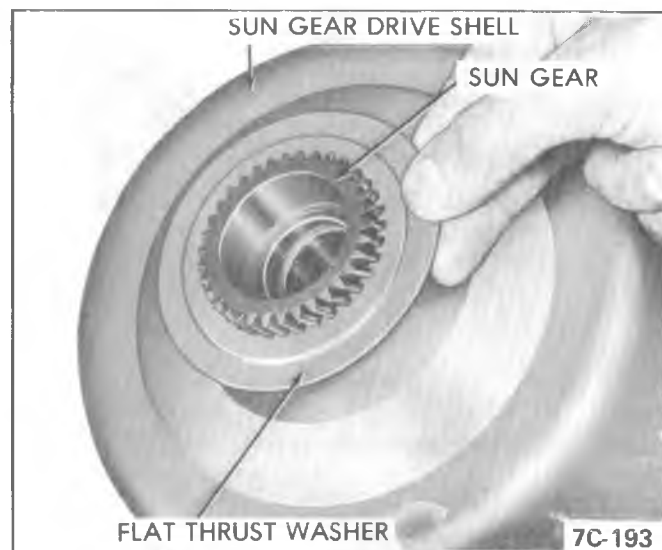


Figure 350C-103 Sun Gear Drive Shell Flat Washer

- 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.
- From the next bore (E), remove retaining pin, plug, manual low control valve spring, and the manual low control valve.
- From the next bore (F), remove the retaining pin, spring, seat, and the detent regulator valve.
- Install Tool J-22269, on direct clutch 2-3 accumulator piston and remove retaining "E" ring. (G) See Figure 350C-111.

- 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).

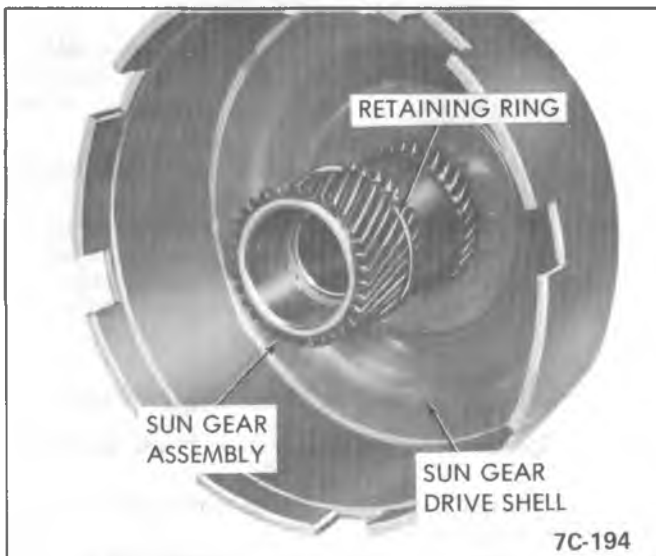


Figure 350C-104 Front Retaining Ring Removal

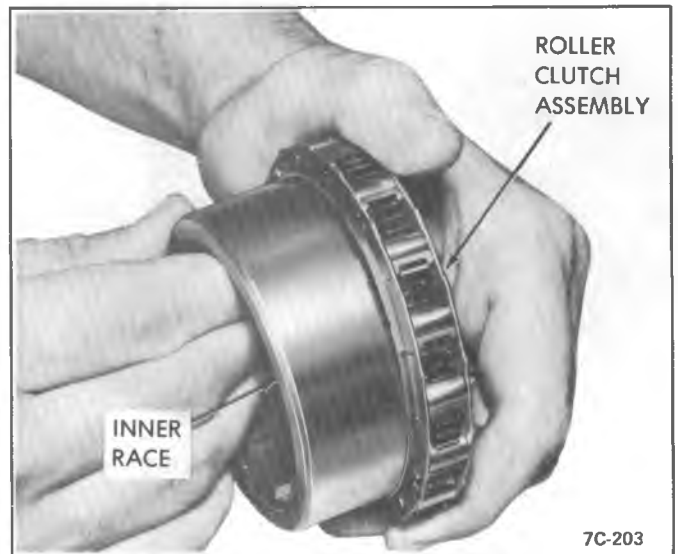


Figure 350C-106 Checking Roller Clutch

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.

Valve Body 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 of Valve Body

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-111. 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

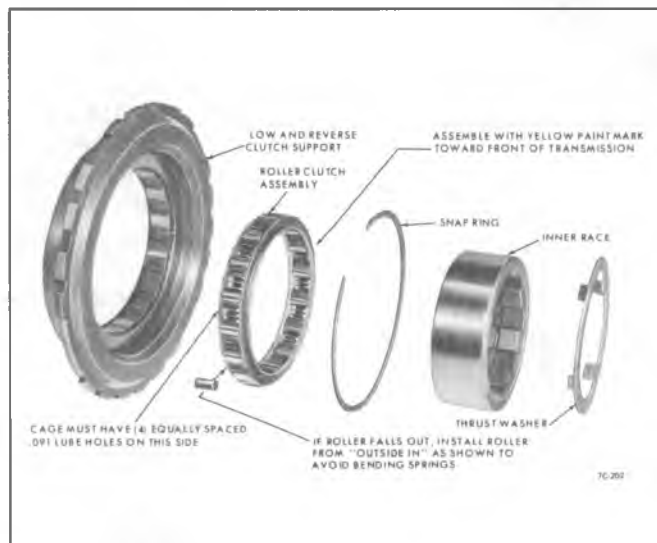


Figure 350C-105 Low and Reverse Clutch Support and Overrun Roller Clutch Assembly

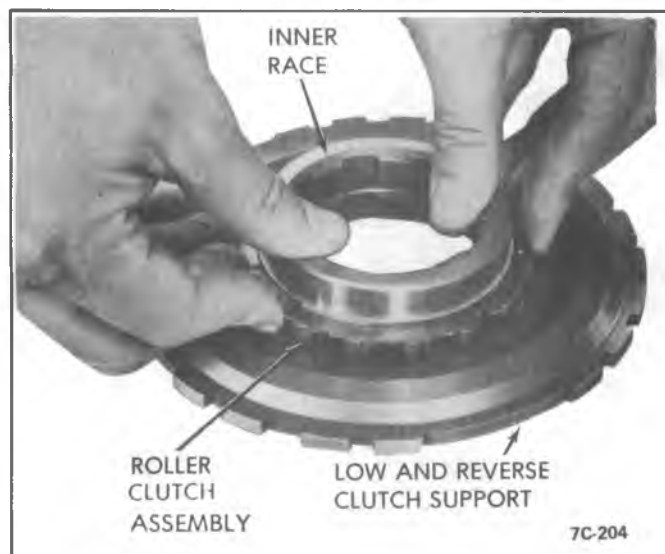


Figure 350C-107 Install Roller Clutch Inner Race

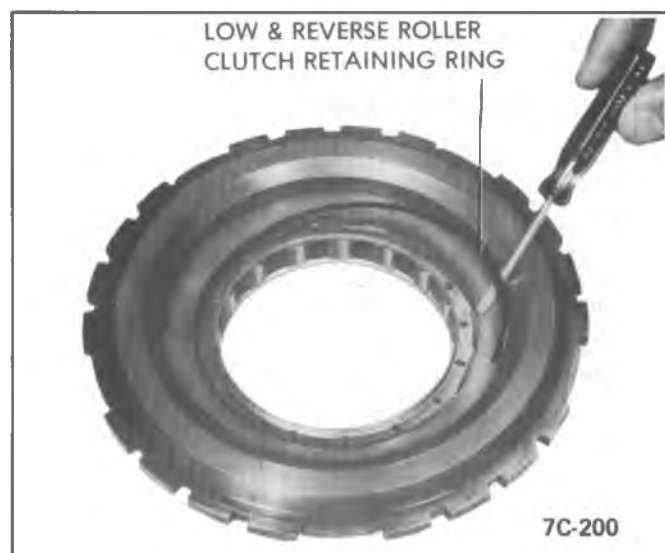


Figure 350C-108 Install Roller Clutch Retaining Ring

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.

REASSEMBLY OF TRANSMISSION

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.*

Installation of Low and Reverse Clutch Piston

1. Install low and reverse clutch piston outer seal. See Figure 350C-112.
2. Install low and reverse clutch piston center and inner seal. See Figure 350C-113.
3. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl. See Figure 350C-114.
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-115.

As spring retainer is compressed make certain inner edge of retainer does not hang up on snap ring groove.

Installing 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-116.
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-117.
3. Install output ring gear to case needle bearing assembly. See Figure 350C-118. 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-119.
5. Install output shaft and reaction carrier assembly into case.

Installing Low and Reverse Clutch Plates

NOTICE: 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.

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-120.
2. Install low and reverse clutch support retainer spring. See Figure 350C-121.
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-122.

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-121.

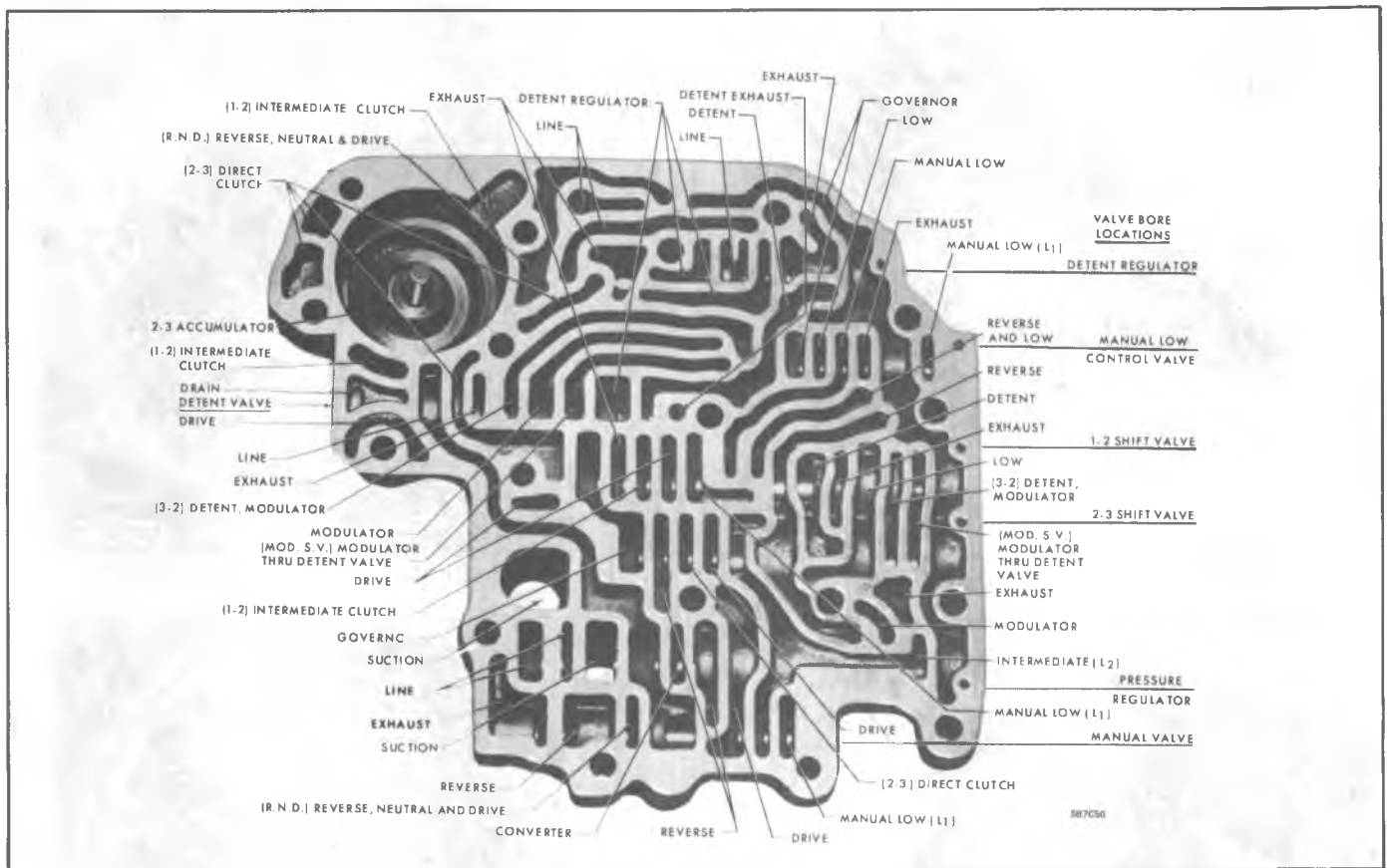


Figure 350C-109 Identification of Oil Channels in Valve Body

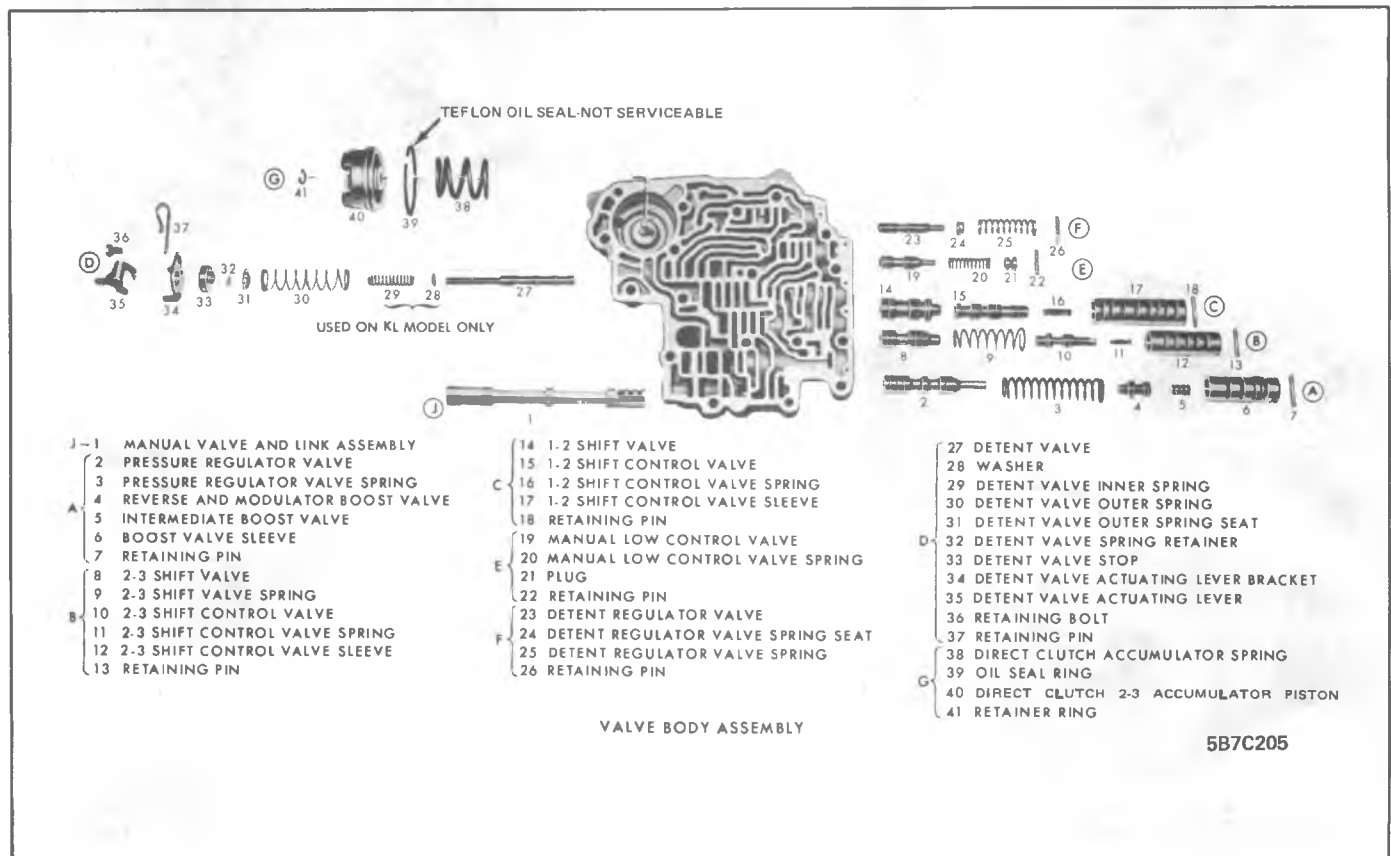


Figure 350C-110 Valve Body - Exploded

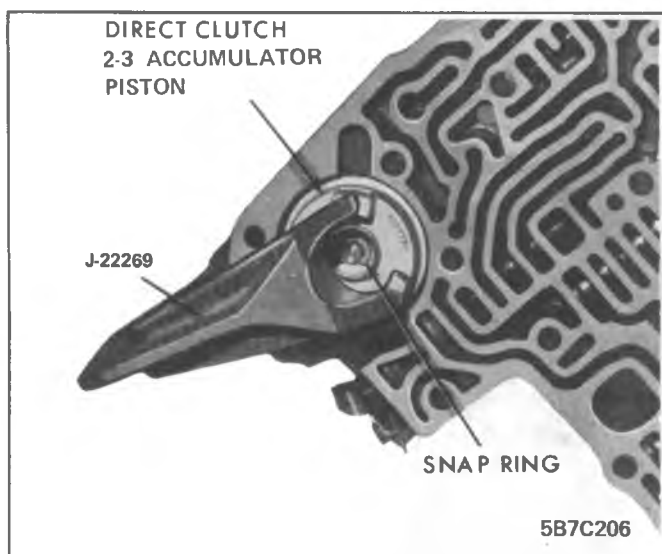


Figure 350C-111 Removing 2-3 Accumulator

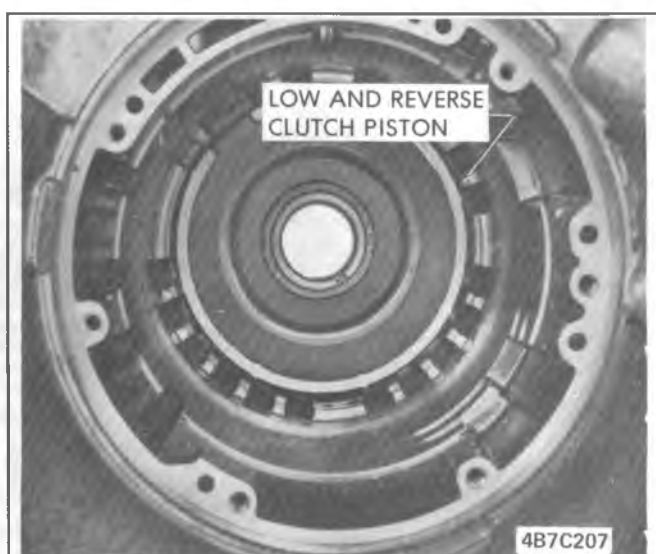


Figure 350C-114 Installation of Low and Reverse Piston

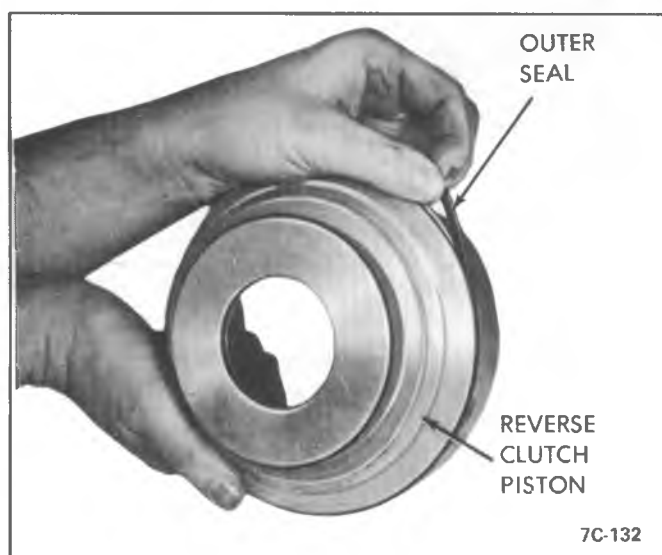


Figure 350C-112 Installation of Outer Seal

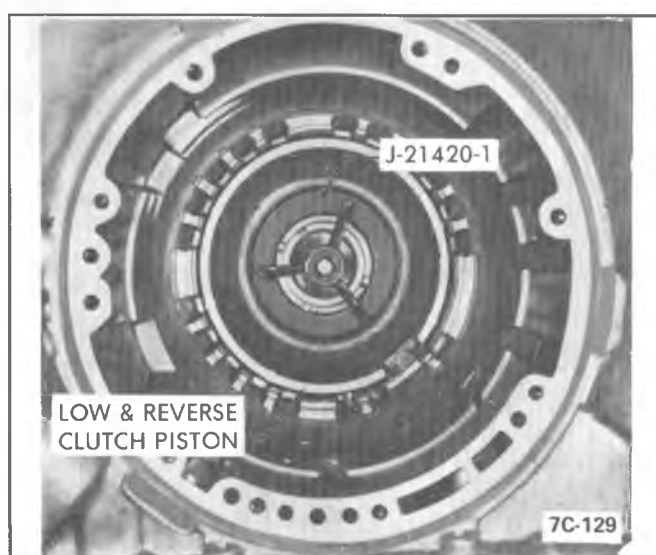


Figure 350C-115 Low and Reverse Piston Snap Ring

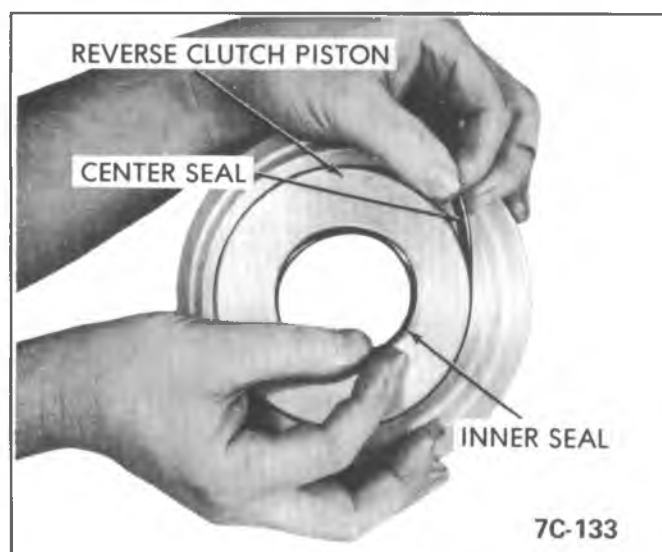


Figure 350C-113 Installation of Inner and Center Seal

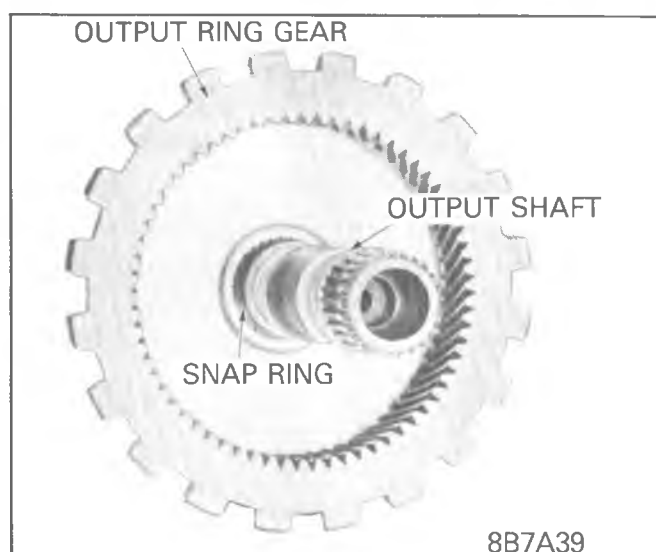


Figure 350C-116 Output Ring Gear and Shaft Assembly

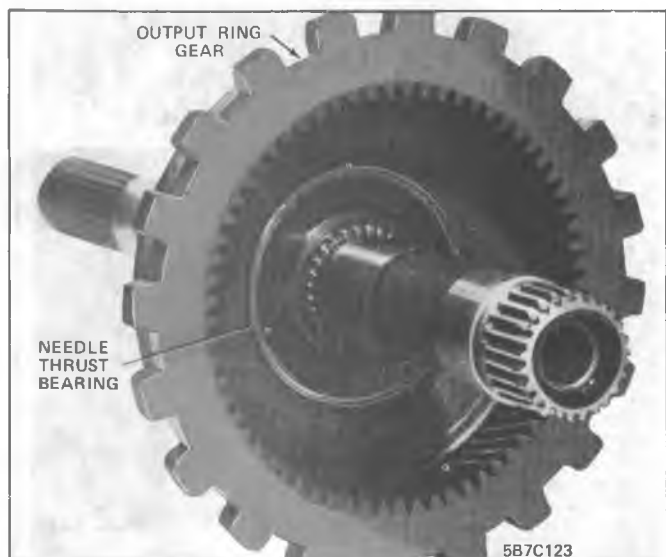


Figure 350C-117 Needle Bearing Assembly

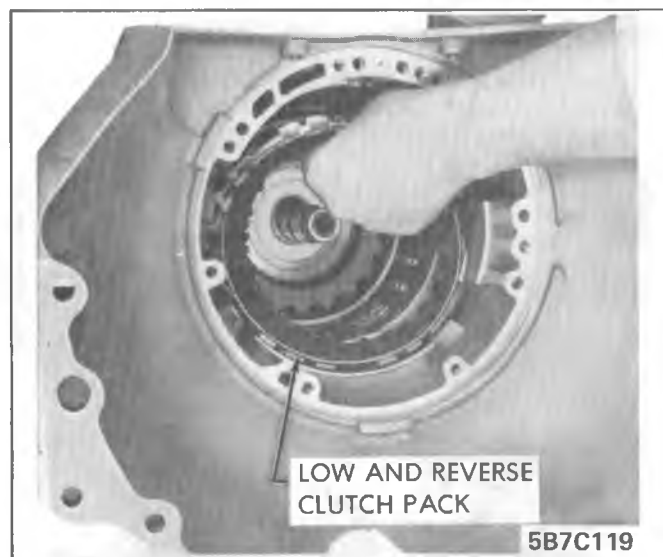


Figure 350C-120 Installing Low and Reverse Clutch Plates

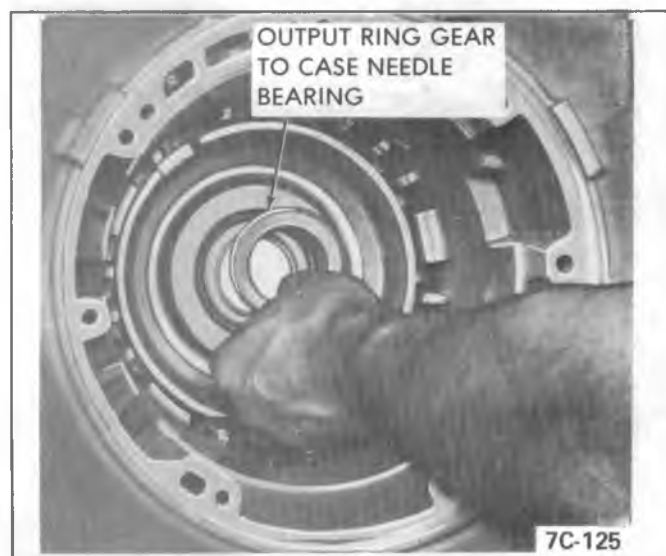


Figure 350C-118 Needle Bearing Assembly

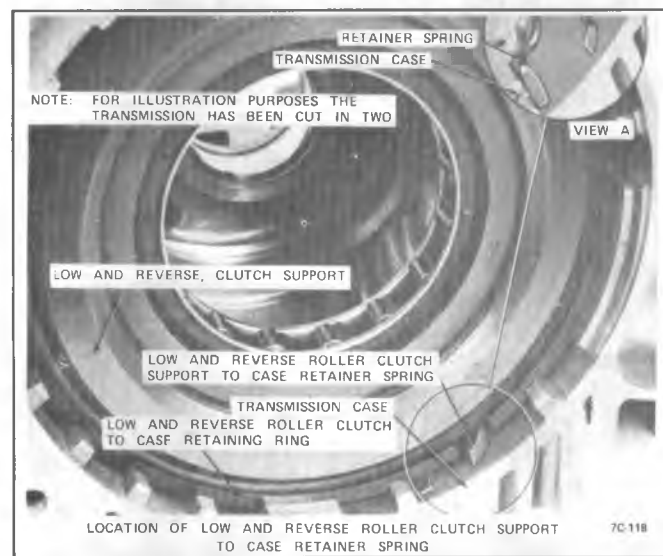


Figure 350C-121 Retainer Location

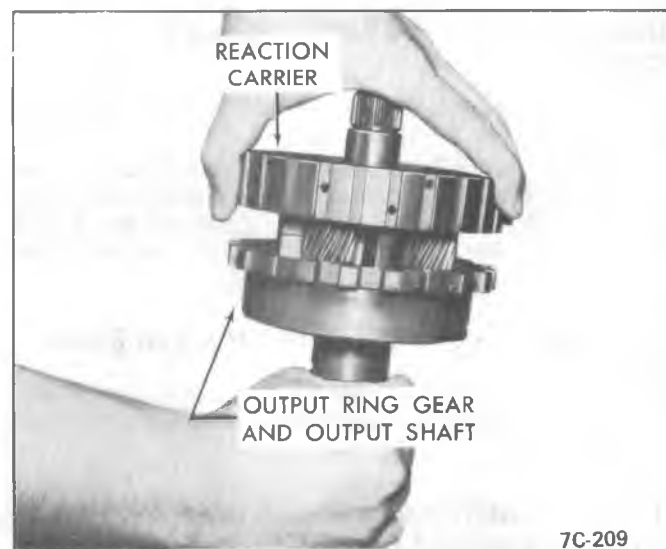


Figure 350C-119 Installing Reaction Carrier

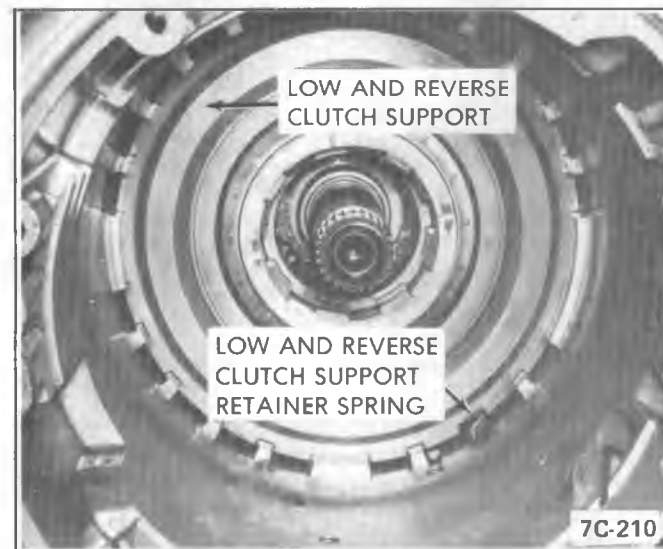


Figure 350C-122 Low and Reverse Clutch Support

Installing 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-123.

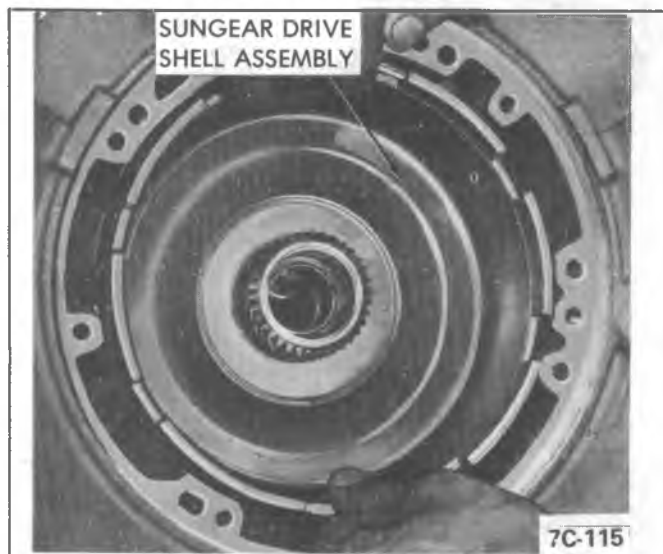


Figure 350C-123 Sun Gear Drive Shell Assembly

Installing Output Carrier Assembly

1. Install output carrier assembly. See Figure 350C-124.

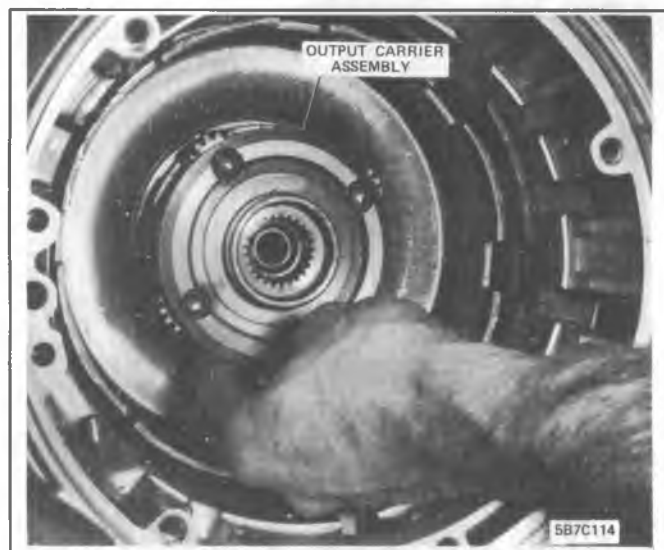


Figure 350C-124 Install Output Carrier

2. Install input ring gear to output carrier needle thrust bearing lip side face down. See Figure 350C-125.
3. Install output carrier to output shaft snap ring.

Use new snap ring and do not over stress on installing. See Figure 350C-125.

Installing Input Ring Gear

1. Install input ring gear. See Figure 350C-126.
2. Install forward clutch housing to input ring gear front thrust washer. See Figure 350C-120. Washer has three (3) tangs.

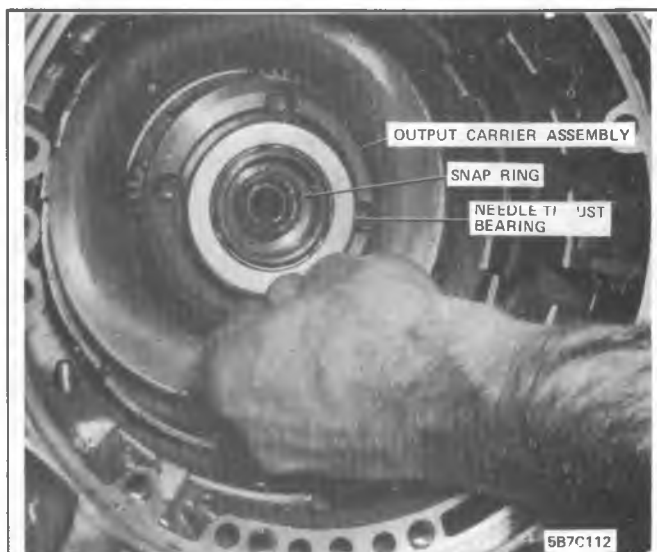


Figure 350C-125 Output Carrier Needle Bearing

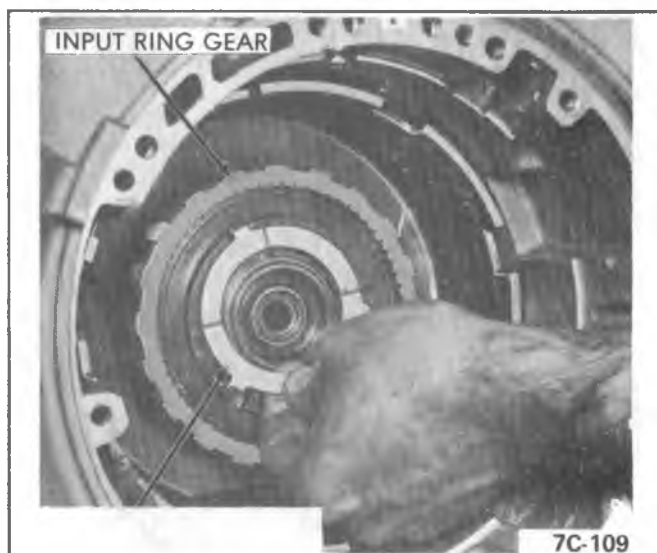


Figure 350C-126 Input Ring Gear Thrust Washer

Installing Direct and Forward Clutch Assemblies

1. Install direct clutch drum to forward clutch housing needle roller bearing. See Figure 350C-127.
2. Install direct clutch assembly to forward clutch assembly. Install assemblies into case making 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-128.

Installing Intermediate Clutch Overrun Brake Band

1. Install intermediate clutch overrun brake band. See Figure 350C-129.

Installing Intermediate Clutch Pressure Plate, Clutch Plates, and Cushion Spring

NOTICE: 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.

**DIRECT CLUTCH DRUM TO
FORWARD CLUTCH HOUSING
NEEDLE ROLLER BEARING**



Figure 350C-127 Forward Clutch Needle Bearing

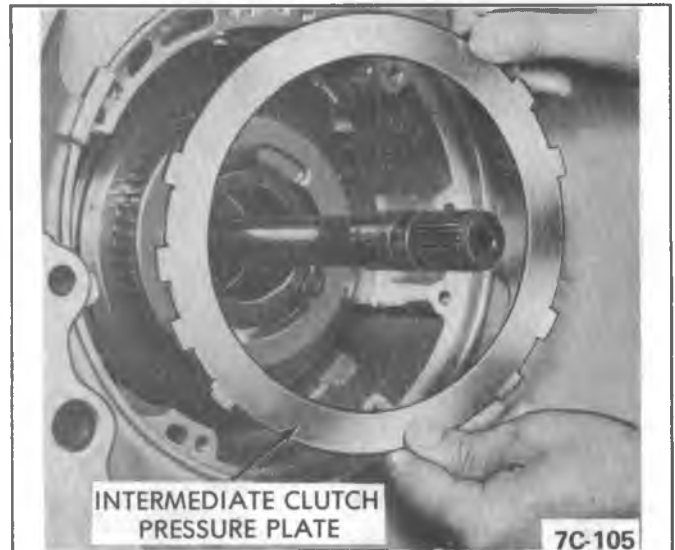


Figure 350C-130 Intermediate Clutch Pressure Plate

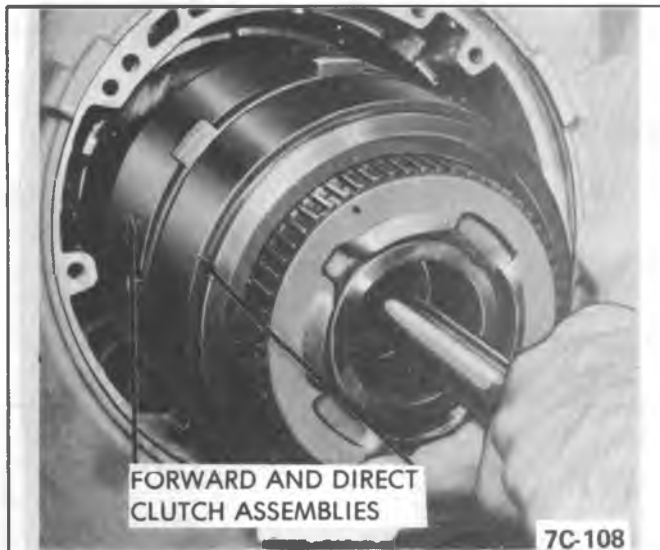


Figure 350C-128 Install Forward and Direct Clutch Assembly

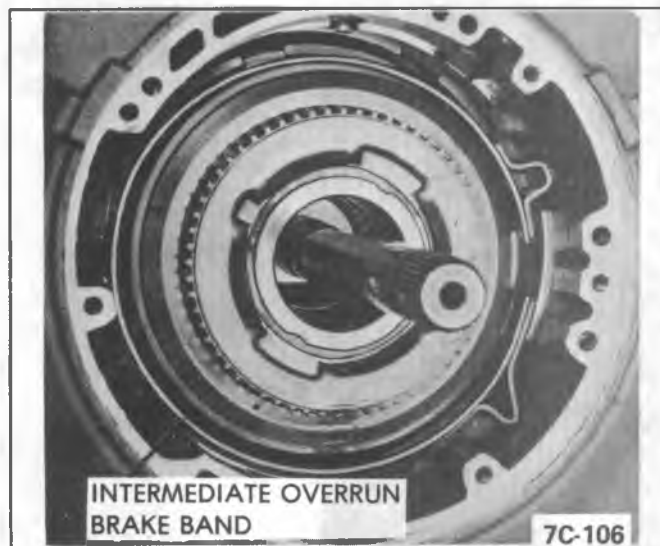


Figure 350C-129 Install Intermediate Band

1. Install intermediate clutch pressure plate. See Figure 350C-130.

2. Oil and install composition and steel intermediate clutch plates, starting with a lined plate and alternating steel and lined. See Figure 350C-131.

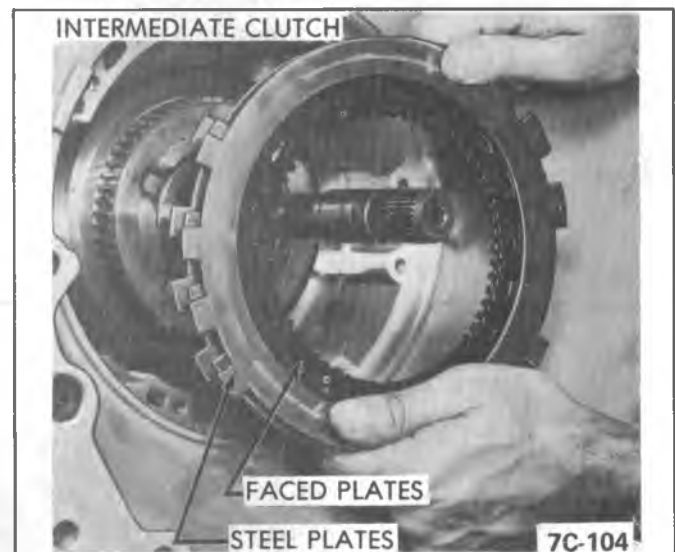


Figure 350C-131 Intermediate Clutch Plates

3. Install intermediate clutch cushion spring. See Figure 350C-132.

Installing 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-133.
2. Install new pump assembly to case gasket. See Figure 350C-134. 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-135.
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-

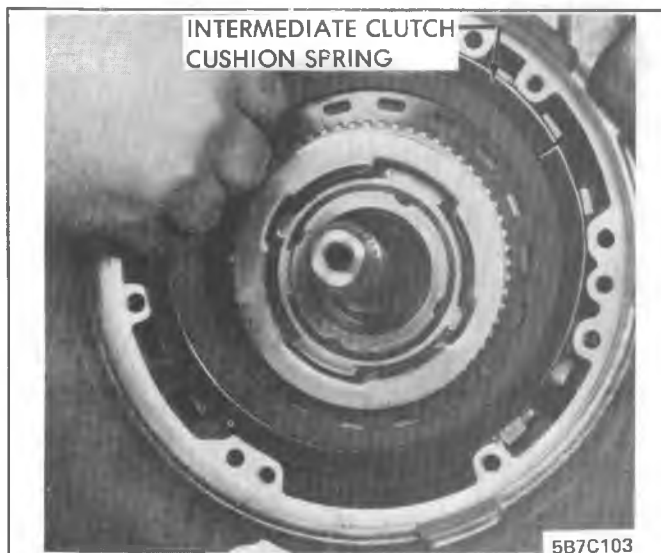


Figure 350C-132 Intermediate Clutch Cushion Spring

136. With flat of hand on 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 zero, one, or two .017 shims to obtain correct reading. See Figure 350C-133.

Installing Speedometer Drive Gear

1. Place speedometer drive gear retaining clip into hole in output shaft. See Figure 350C-137.

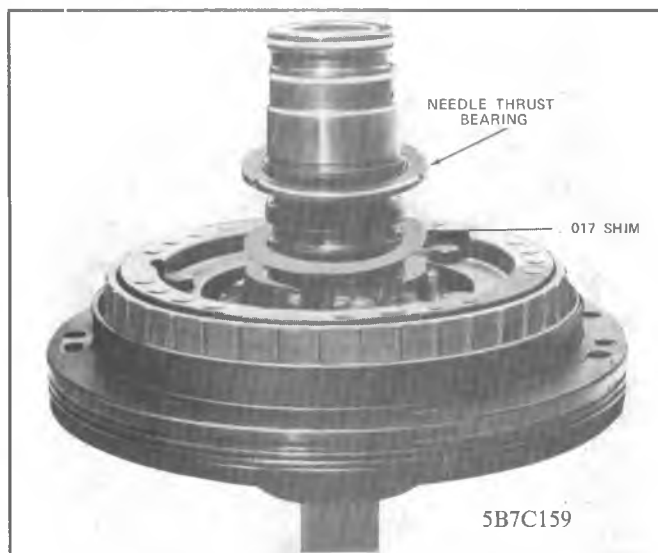


Figure 350C-133 Pump Shim and Needle Bearing

2. Align slot in speedometer drive gear with retaining clip and install. See Figure 350C-137.

Installing Extension Housing

1. Install extension housing to case square cut "O" - ring seal. See Figure 350C-138.
2. Attach extension housing to case using attaching bolts. Torque to 35 ft.lbs. (47 N·m).
3. Install speedometer driven gear, retainer and bolt. Torque bolt to 12 ft.lbs. (16 N·m).

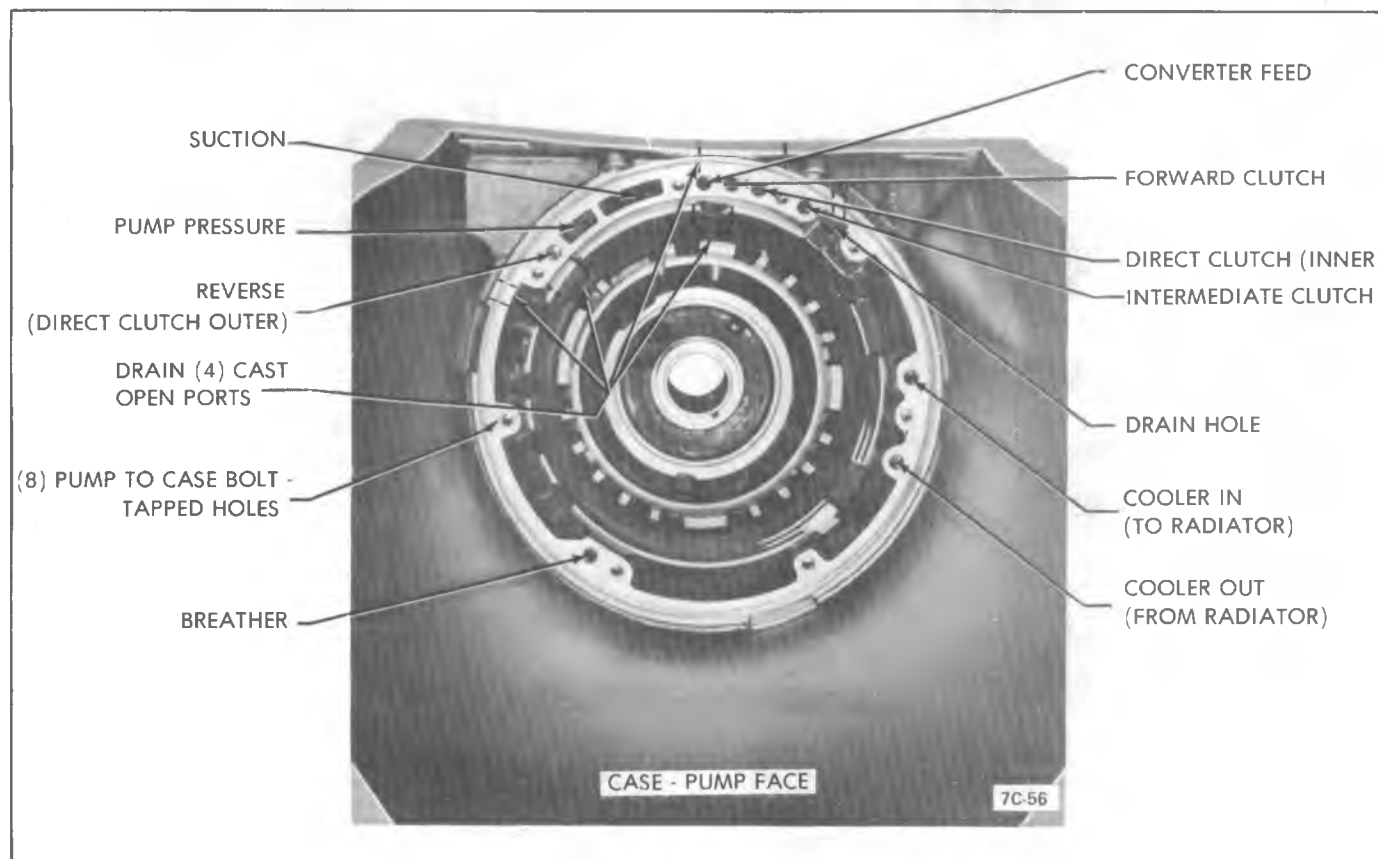


Figure 350C-132A Case - Pump Identification of Oil Channels

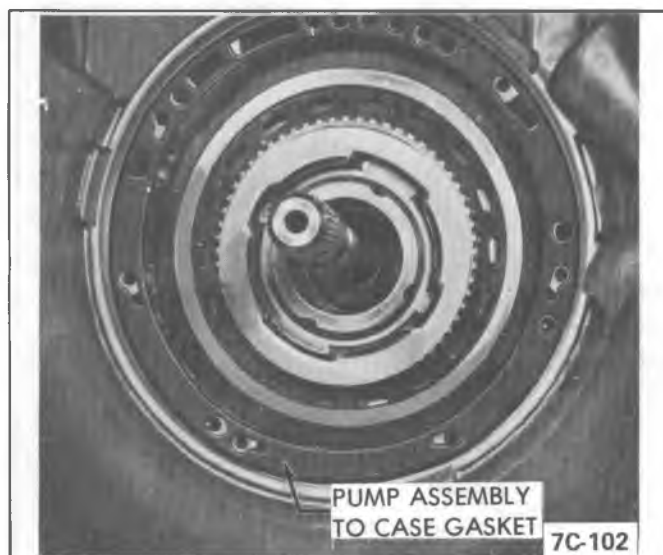


Figure 350C-134 Pump Gasket

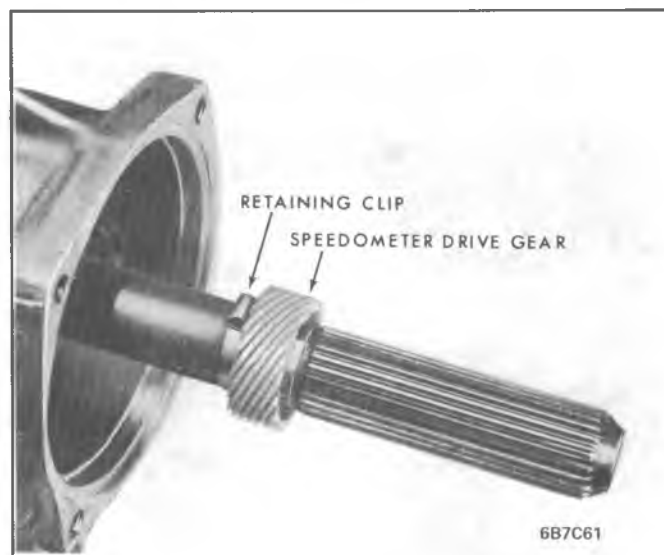


Figure 350C-137 Speedo Gear and Clip

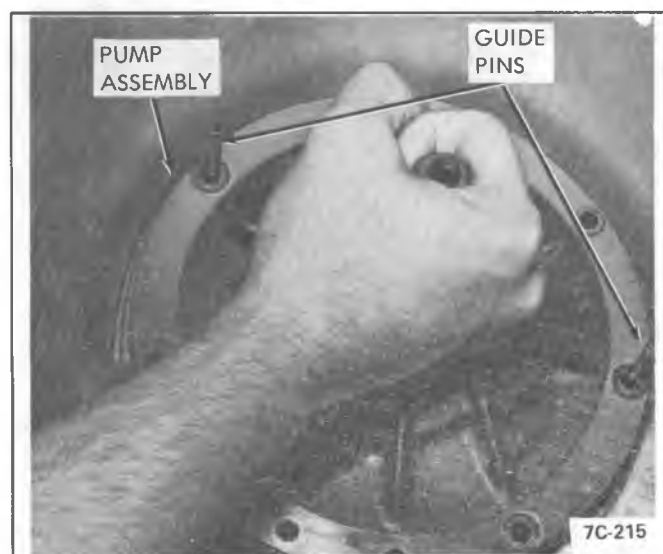


Figure 350C-135 Installing Pump

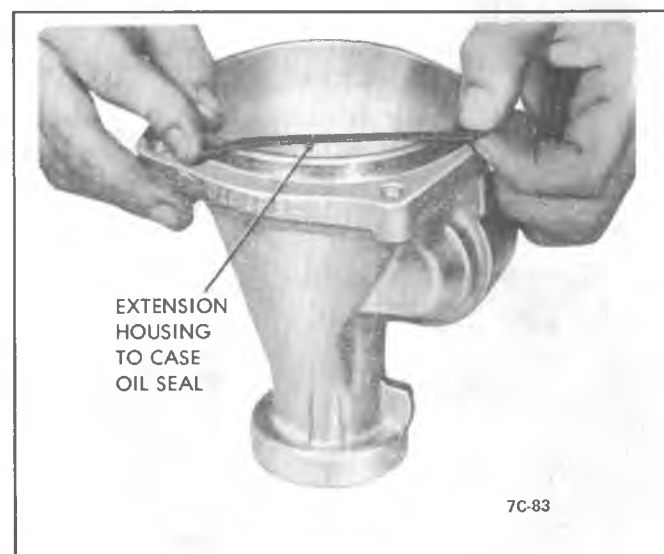


Figure 350C-138 Extension Oil Seal

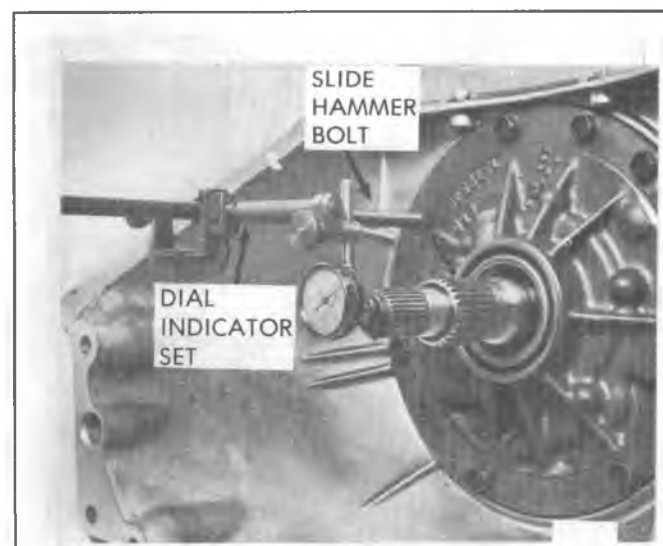


Figure 350C-136 Checking End-Play Output Shaft Sleeve & O Ring

Installing 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-139.



Figure 350C-139 Install Parking Pawl

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-140.

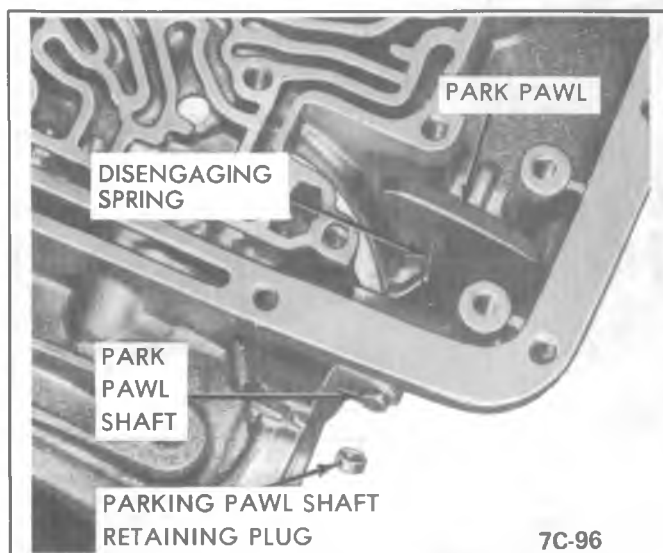


Figure 350C-140 Parking Pawl Shaft and Retaining Plug

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-141.

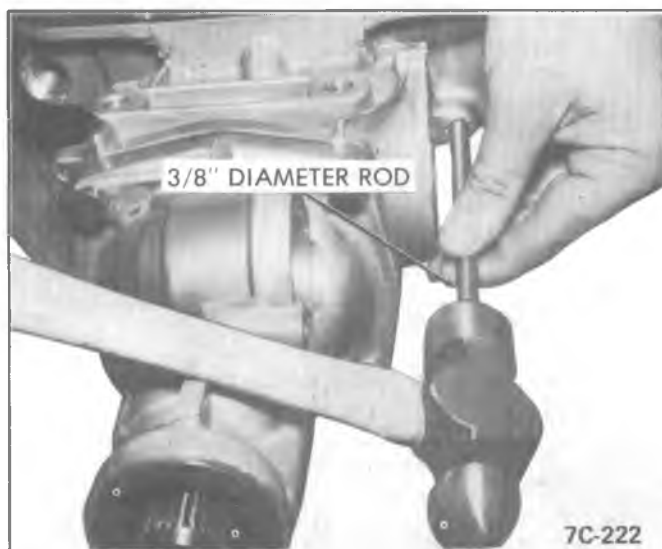


Figure 350C-141 Install Retaining Plug

4. Install park lock bracket, torque bolts to 29 ft.lbs. (39 N·m). See Figure 350C-142.
5. Install actuating rod under the park lock bracket, and parking pawl. See Figure 350C-143.

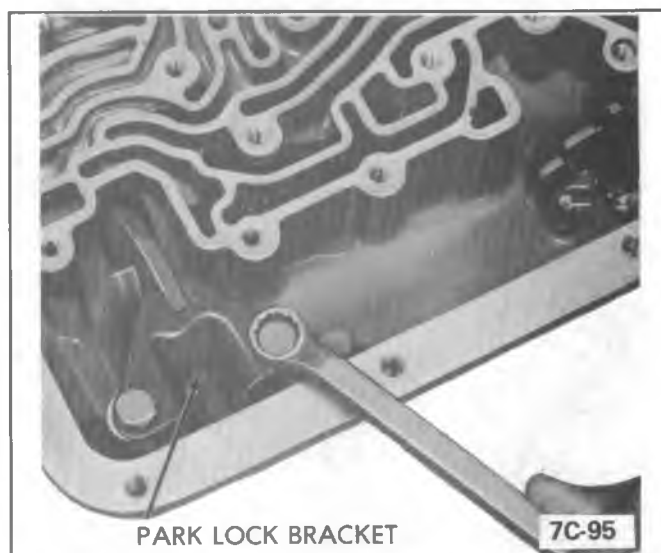


Figure 350C-142 Install Park Lock Bracket



Figure 350C-143 Actuating Rod



Figure 350C-144 Seal Installation

Installing 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-144.
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-145. Install manual shaft to case retainer.

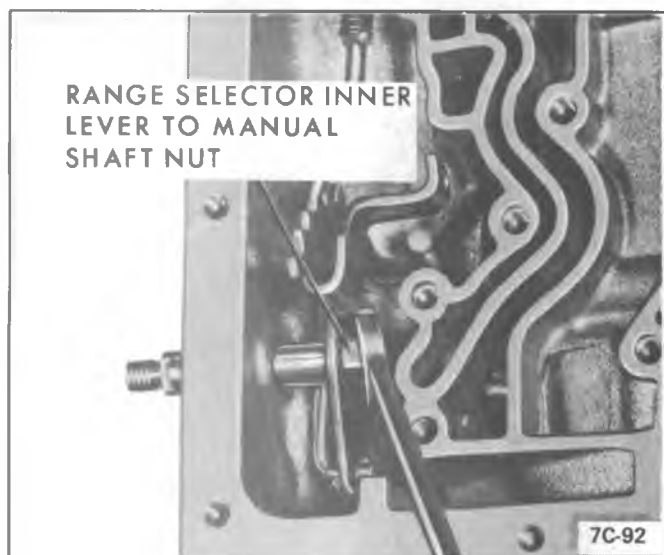


Figure 350C-145 Manual Shaft Nut

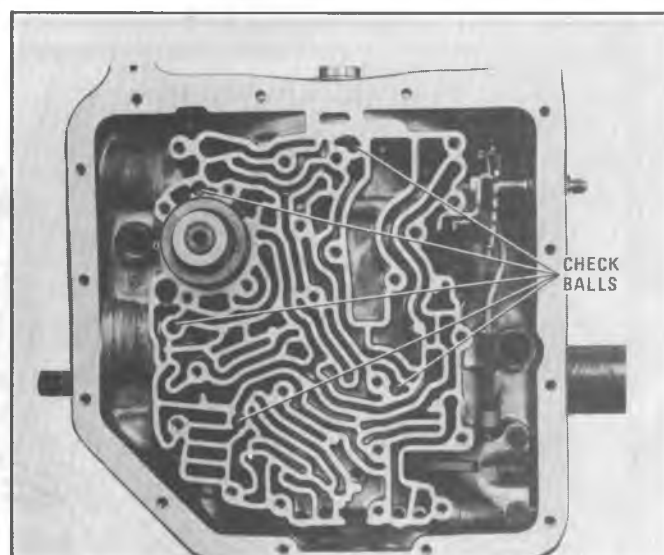


Figure 350C-146A Check Ball Locations

Installing 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-146.

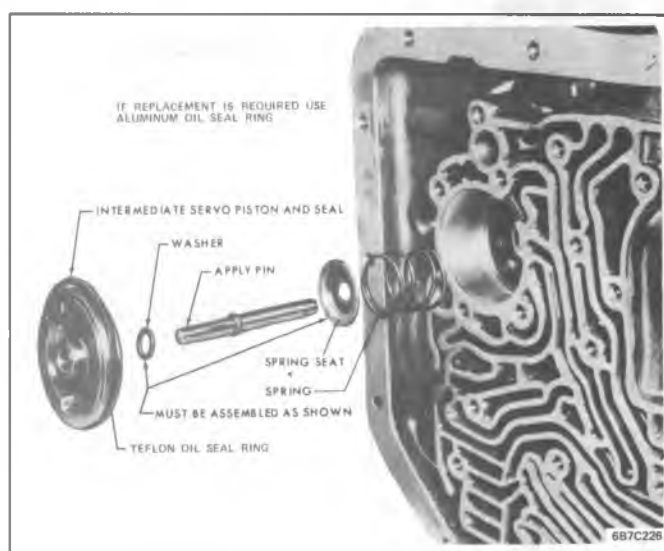


Figure 350C-146 Intermediate Servo Assembly - Exploded View

3. Install 5 check balls into correct transmission case pockets. See Figure 350C-146A. If number one (1) check ball is omitted or incorrectly placed, transmission failure will result due to minimum line pressure.
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-149. (*Clean before installing*).
5. Install governor screen in the case. See Figure 350C-150. (*Clean before installing*).
6. TCC Models - If removed, install case electrical connector with new "O" ring seal.

Installing 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-152.

2. Install spacer support plate. Torque bolts to 13 ft.lbs. (18 N·m). See Figure 350C-153.
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 sequence to 13 ft.lbs. leaving bolt loose for detent roller and spring assembly. See Figure 350C-155. 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-156.
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. See Figure 350C-157. Install filter and gasket exactly as shown. Always replace filter when foreign material is found to be present.

Installing Oil Pan, Governor, and Modulator Valve

1. Install new bottom pan gasket and bottom pan. See Figure 350C-158.
2. Install governor assembly, 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. Figure 350C-159. If cover is damaged it must be replaced.
3. Install vacuum modulator valve and modulator. See Figure 350C-160. Lubricate "O" ring seal to prevent damage, install retaining clip, and torque bolt to 12 ft. lbs. (16 N·m).

Install Converter

1. Install converter, making sure that the converter hub engages the drive lugs inside the pump gear. If they are not correctly engaged, a low mileage pump failure will occur.
2. Make sure that the converter has not bound up the pump gear inside the transmission.
3. Check the converter to be sure that it turns freely and is able to move forward to meet the flywheel. See Figure 350C-161.

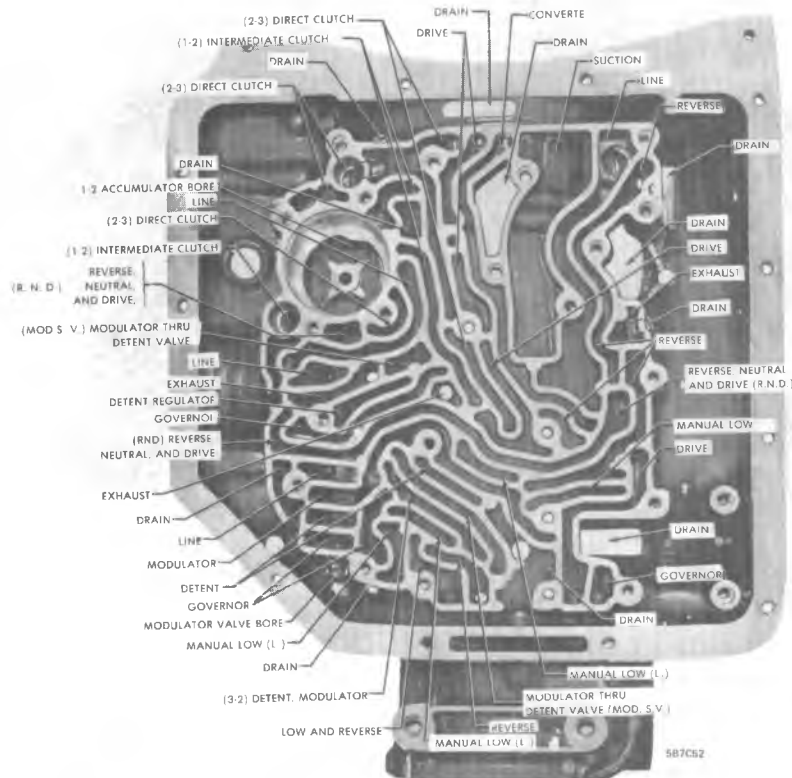


Figure 350C-147 Identification of Oil Channels in Case Face

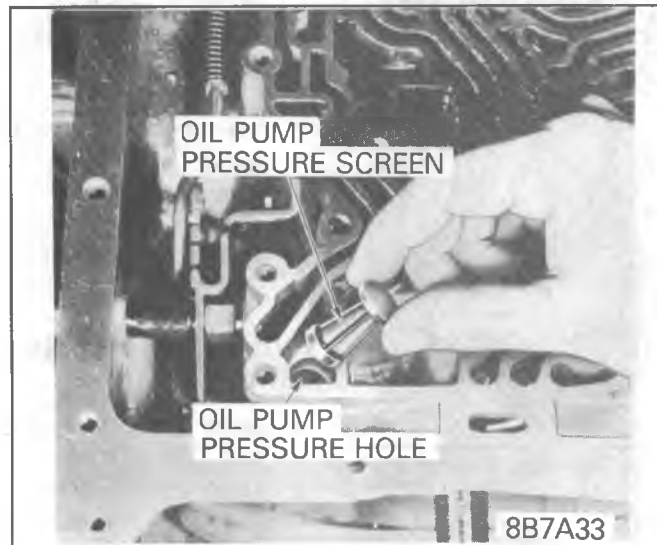


Figure 350C-149 Pump Screen

INSTALLATION OF BUSHINGS

GOVERNOR BUSHING

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. See Figure 350C-162.
4. Clean off excess stock from the governor o-ring seal to case mating surface. See Figure 350C-163.
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-164.
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 ratchet, *hand* ream the governor bore using the following procedure: (*Hand Ream Only*)
 - a. Oil the reamer, drill bushing, and governor bore.

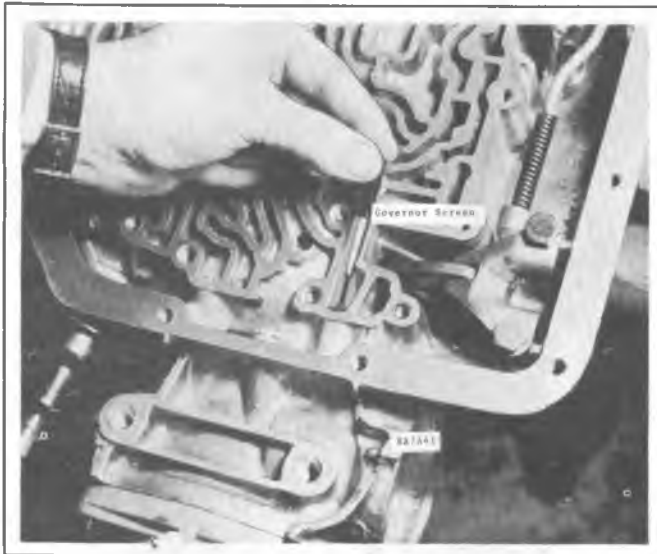


Figure 350C-150 Installing Governor Feed Screen

- b. Use 7 lbs. of feeding force on the reamer. See Figure 350C-165.
- 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-166.
- 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.

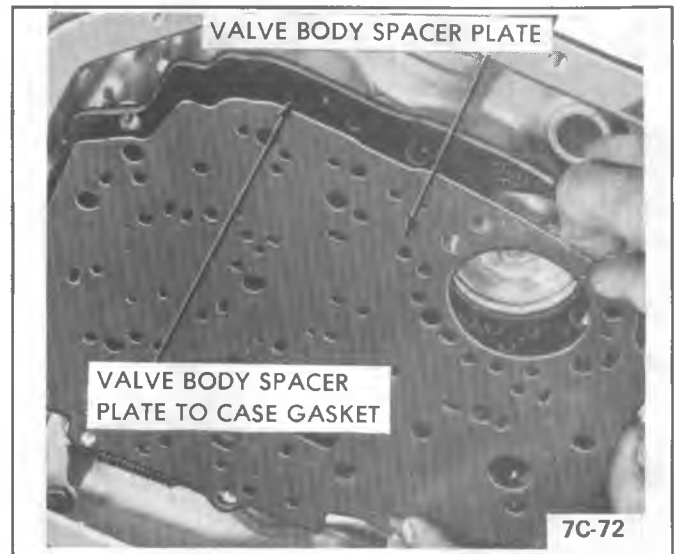


Figure 350C-152 Spacer Plate and Gaskets

- 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.
 12. 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-167.
 - c. Use J- 22976-13 alignment arbor and bushing installer to drive the bushing into the case. See Figure 350C-168.

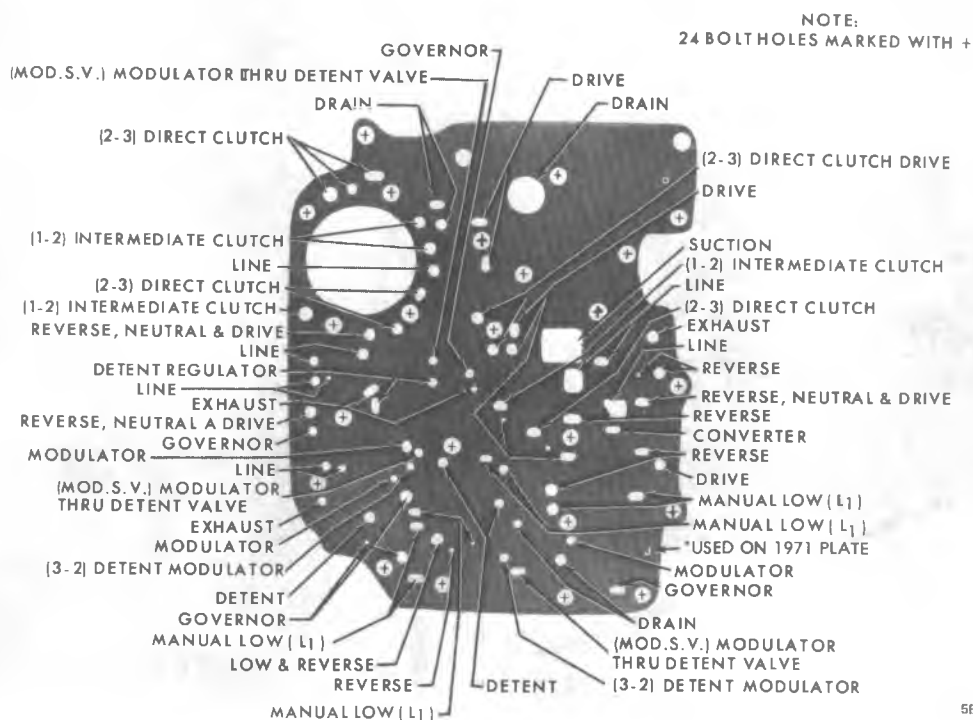


Figure 350C-151 Valve Body Spacer Plate - (Typical)

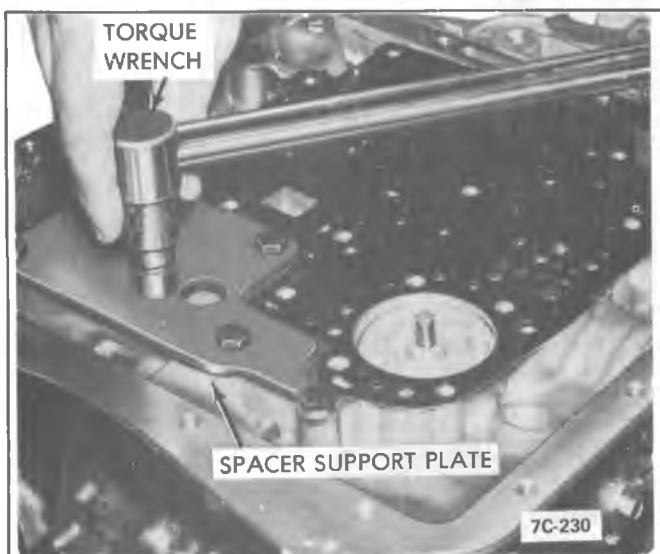


Figure 350C-153 Support Plate

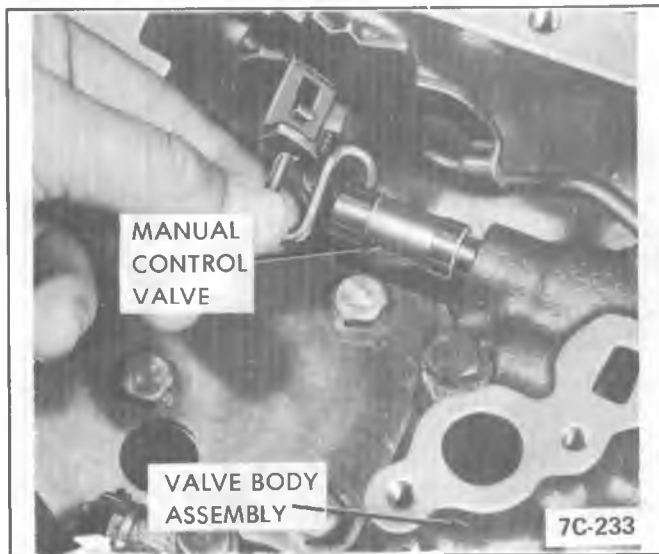


Figure 350C-155 Manual Valve Link

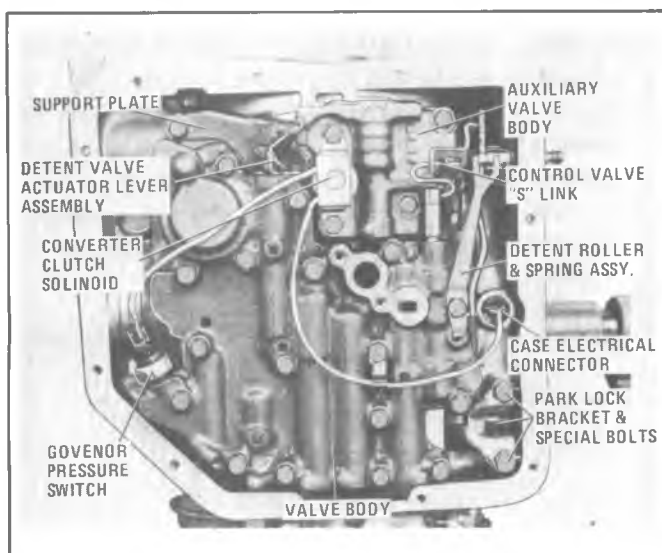


Figure 350C-153A

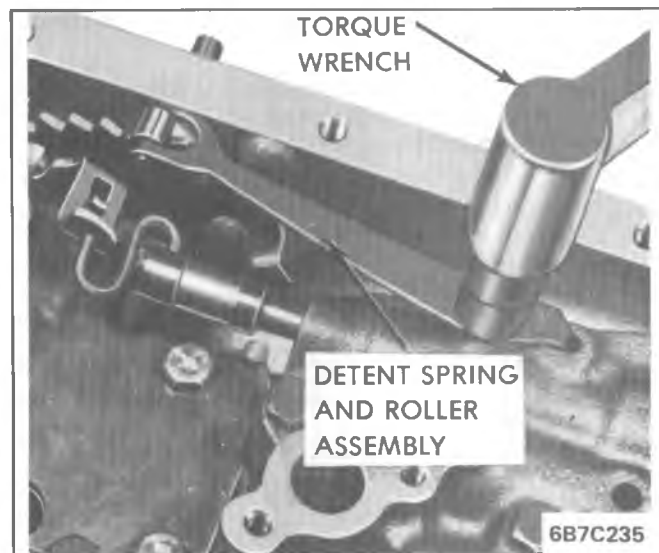


Figure 350C-156 Detent Spring and Roller

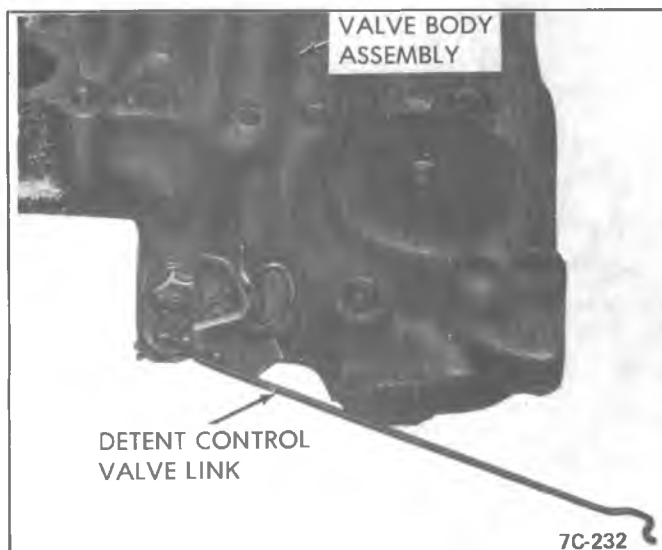


Figure 350C-154 Detent Link

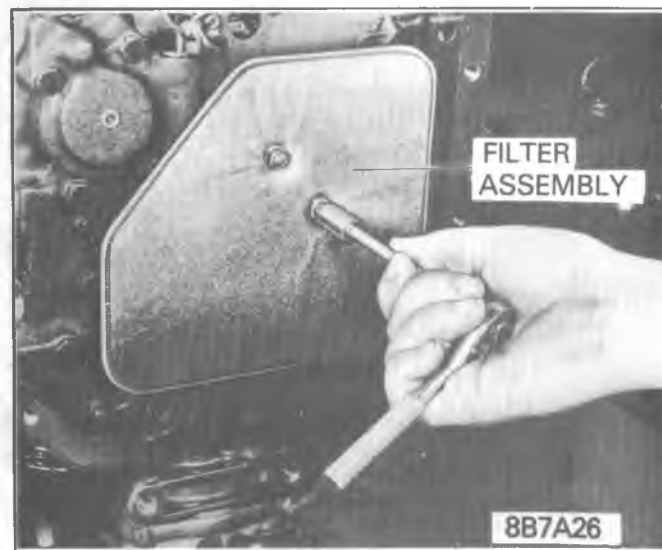


Figure 350C-157 Oil Filter

A brass hammer should be used to strike the hardened steel bushing installer tool.

- d. Drive the bushing until it is flush with the top of the bore and seated properly in the case. See Figure 350C-169.

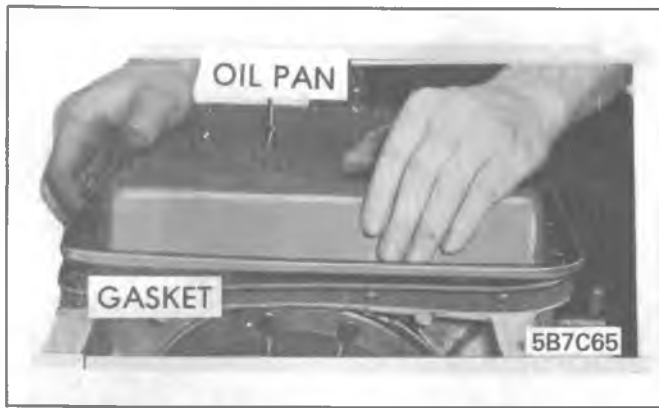


Figure 350C-158 Install Oil Pan

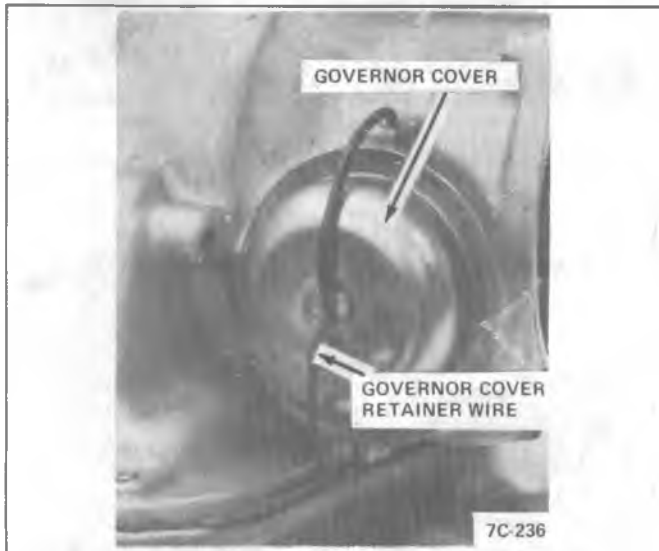


Figure 350C-159 Governor Cover

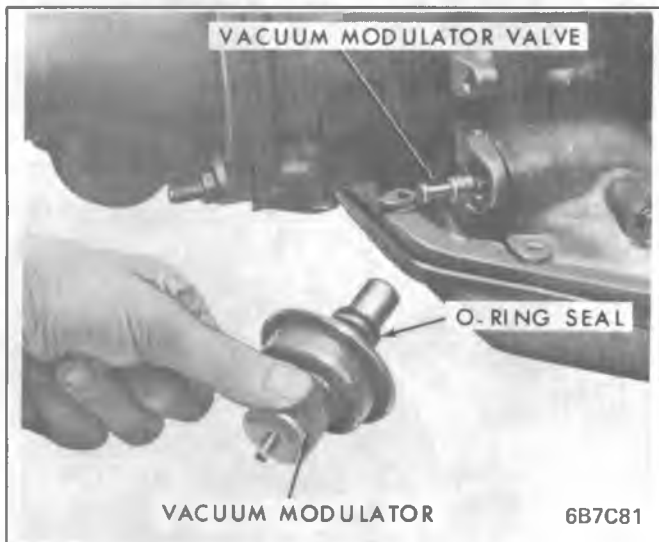


Figure 350C-160 Install Modulator

13. 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.

Removal of Extension Housing Bushing

1. Remove extension housing bushing using screwdriver to collapse bushing. See Figure 350C-170.

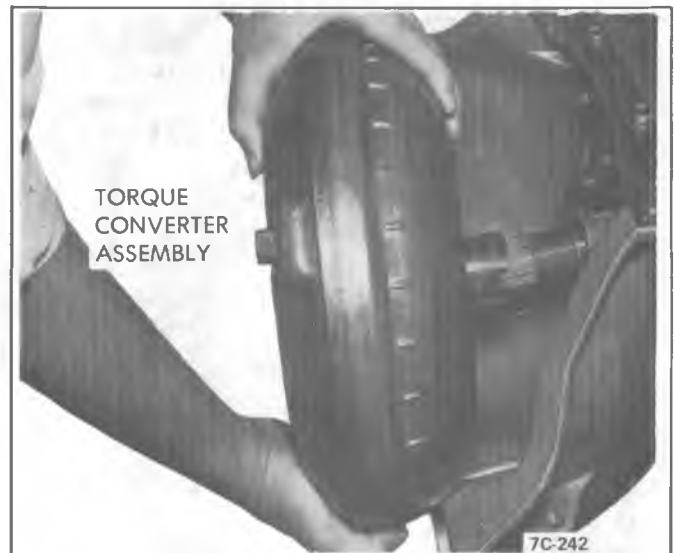


Figure 350C-161 Install Torque Converter

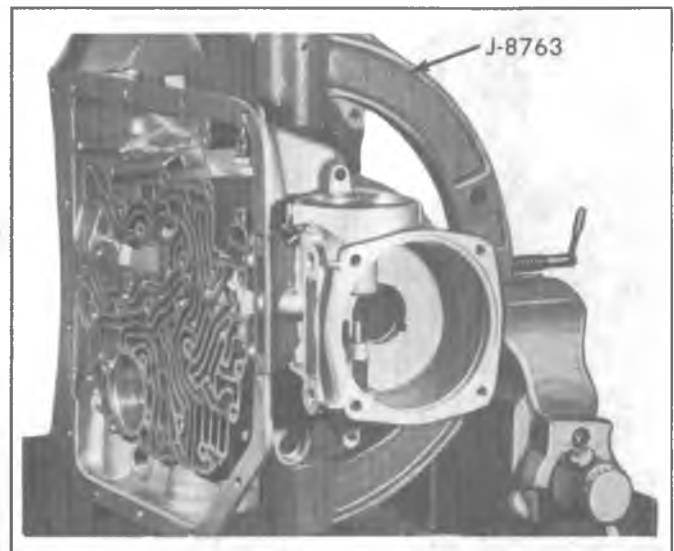


Figure 350C-162 Case in Holding Fixture

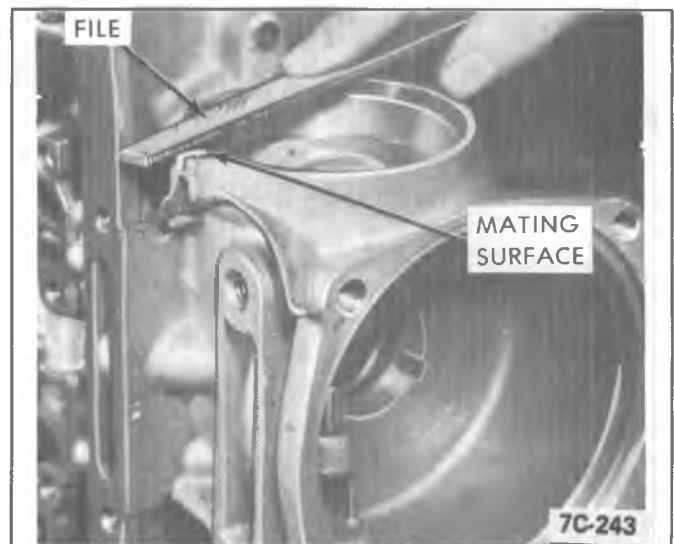


Figure 350C-163 Removing Excess Material From Governor Surface

Installation of Extension Housing Bushing

1. Install extension housing bushing using drive handle J-8092 and Bushing Tool J- 21424-9. See Figure 350C-171.

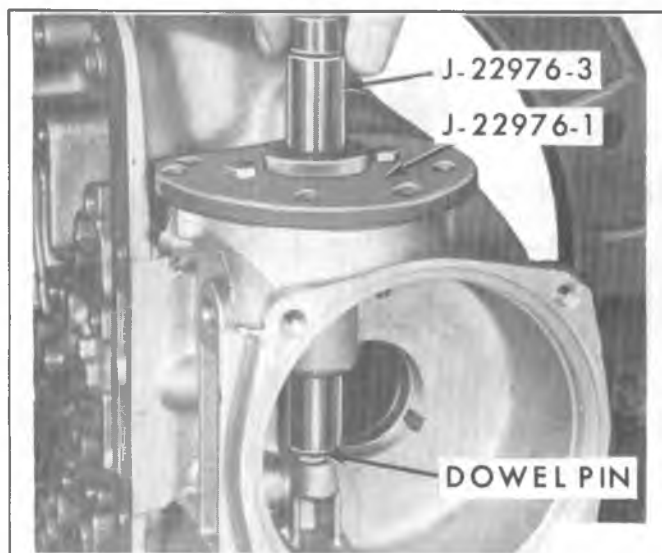


Figure 350C-164

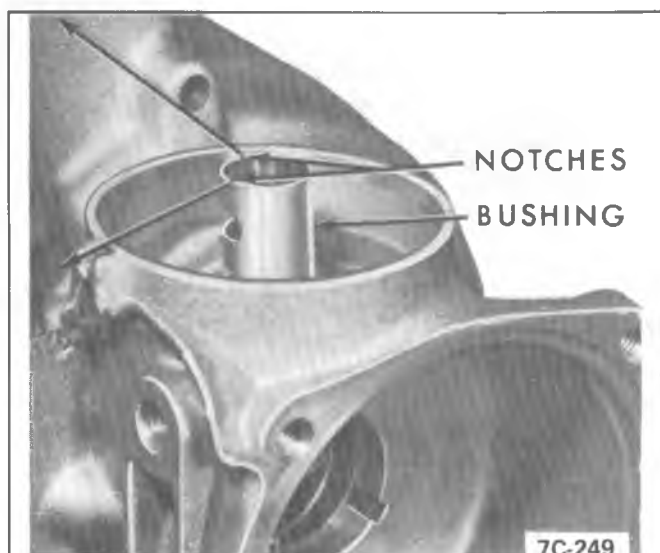


Figure 350C-167 Position Notches

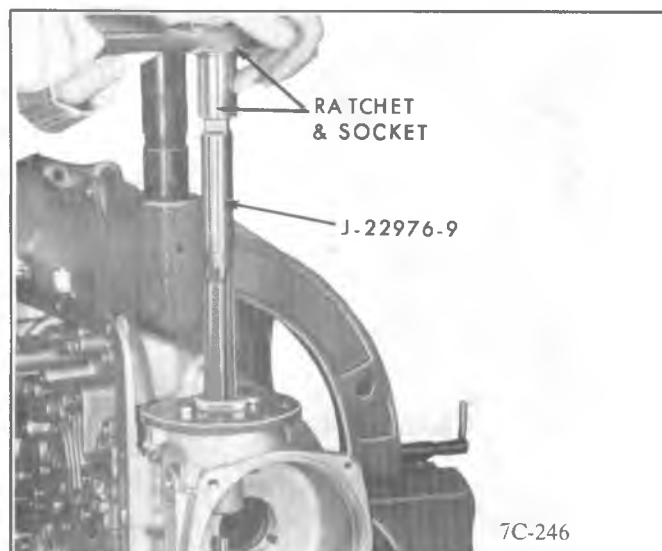


Figure 350C-165 Reamer

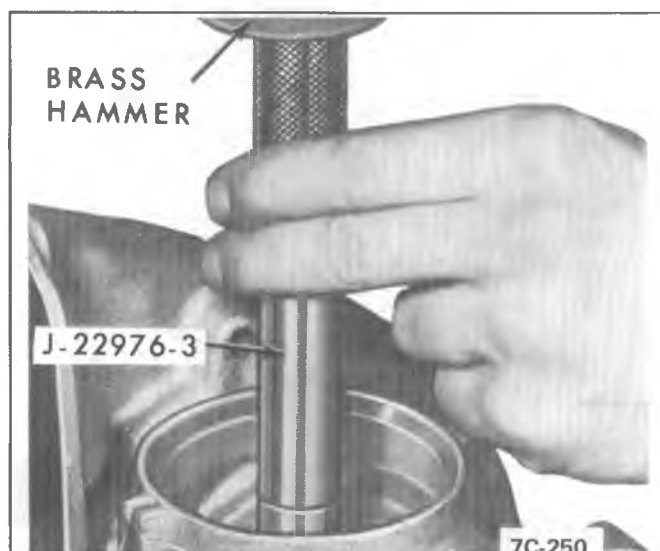


Figure 350C-168 Bushing Installer

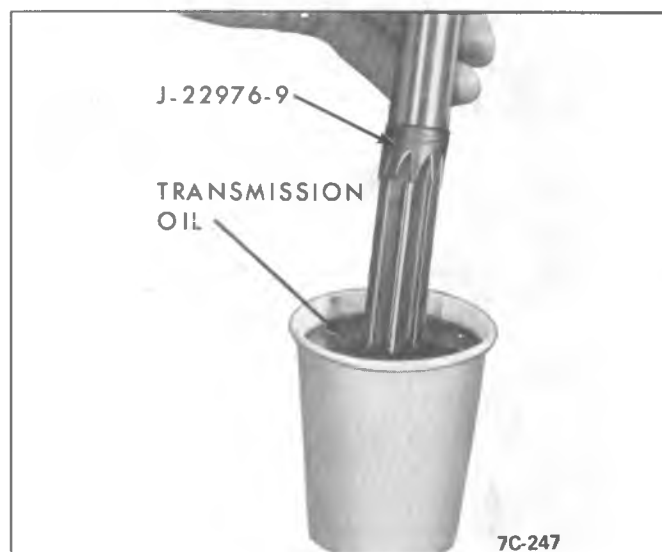


Figure 350C-166

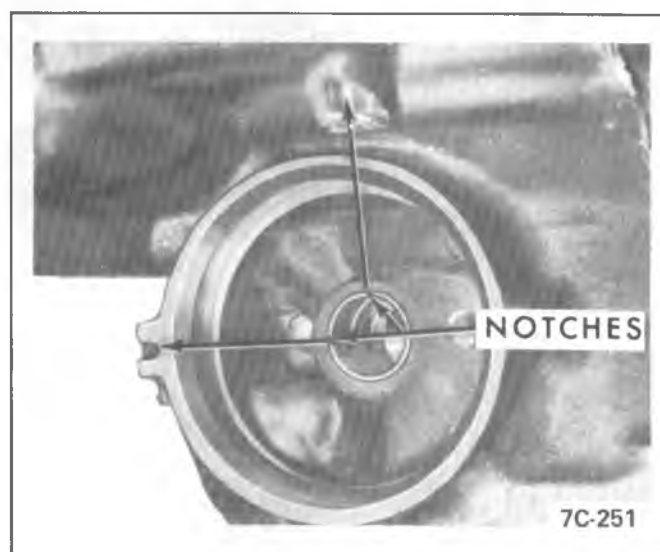


Figure 350C-169 Bushing Properly Seated

Replacing Input Ring Gear Bushing

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-172.



Figure 350C-170 Collapsing Bushing

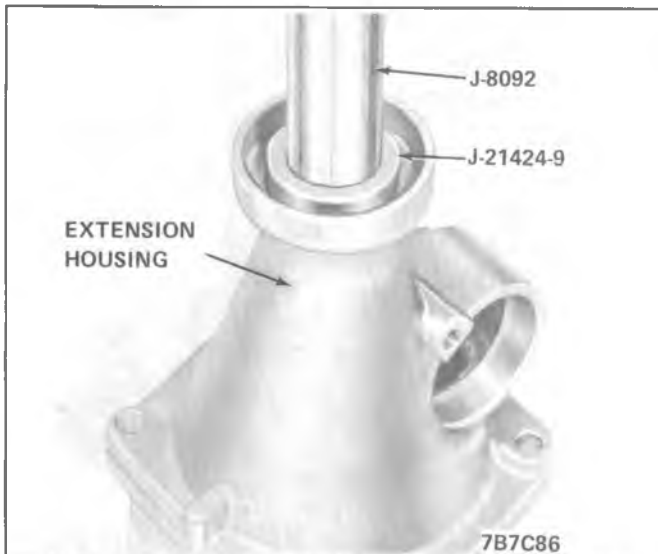


Figure 350C-171 Installing Extension Housing Bushing

b. Using Tool J- 23062-15, press in new bushing .050" to .060" from inner surface of hub. See Figure 350C-172.

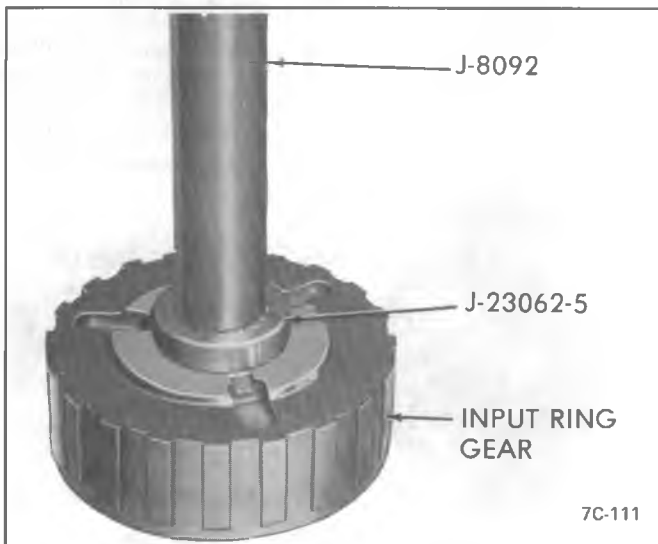


Figure 350C-172 Reaction Carrier Bushing Removal

Replacing Reaction Carrier Bushing

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-173.
 - b. Using Tool J- 23062-13, press in new bushing flush to .010" from inner surface of hub. See Figure 350C-173.

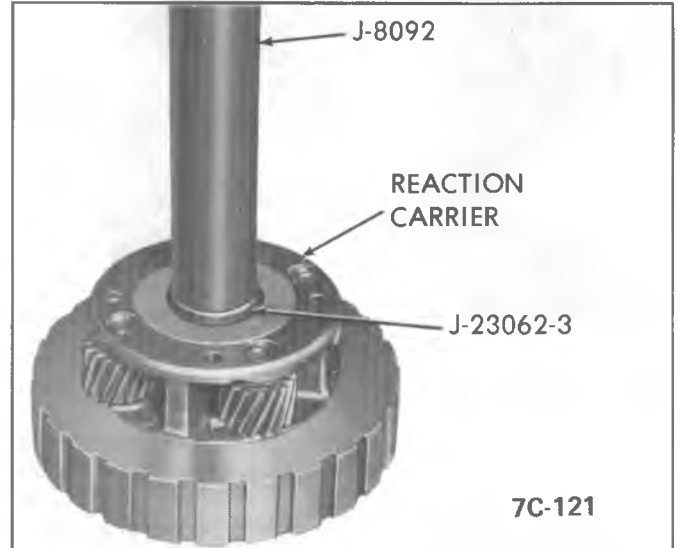


Figure 350C-173 Reaction Carrier Bushing Installation

Replacing Case Bushing

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-174.

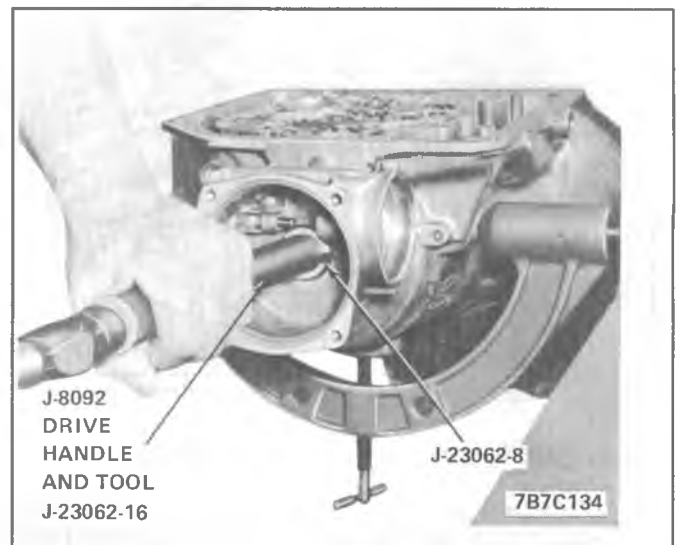


Figure 350C-174 Removing Case Bushing

2. 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-175.

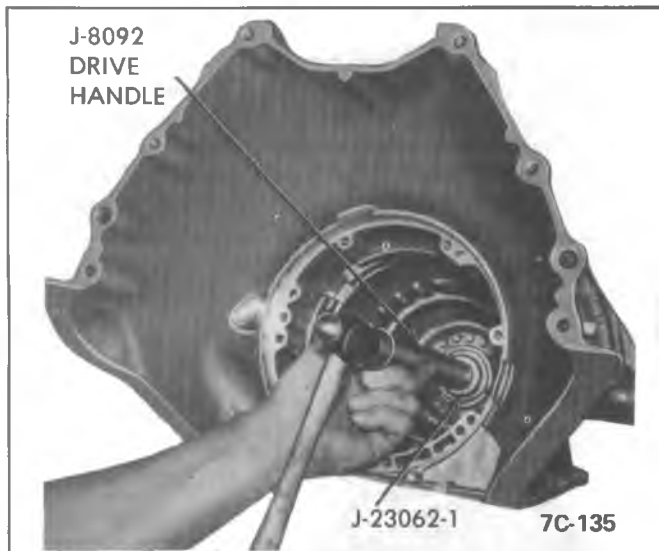


Figure 350C-175 Installing Case Bushing

Replacing Pump Body Bushing

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-176.

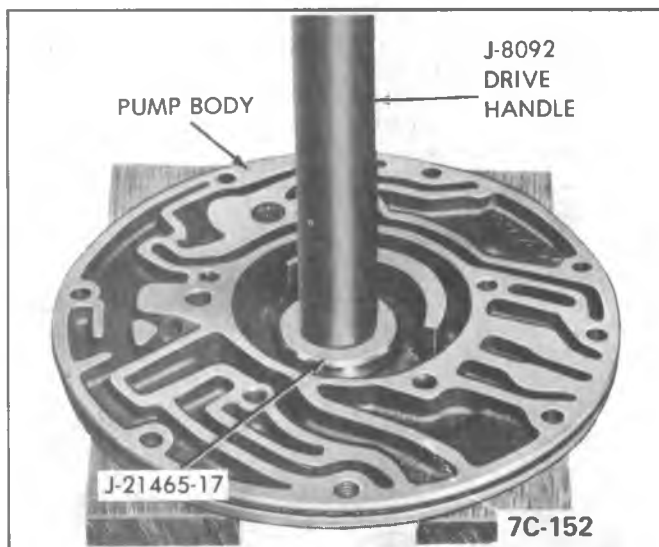


Figure 350C-176 Pump Bushing Removal

Replacing Front Stator Shaft Bushing

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-177.
2. 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-178. Extreme care must be taken so bushing is not driven past shoulder.

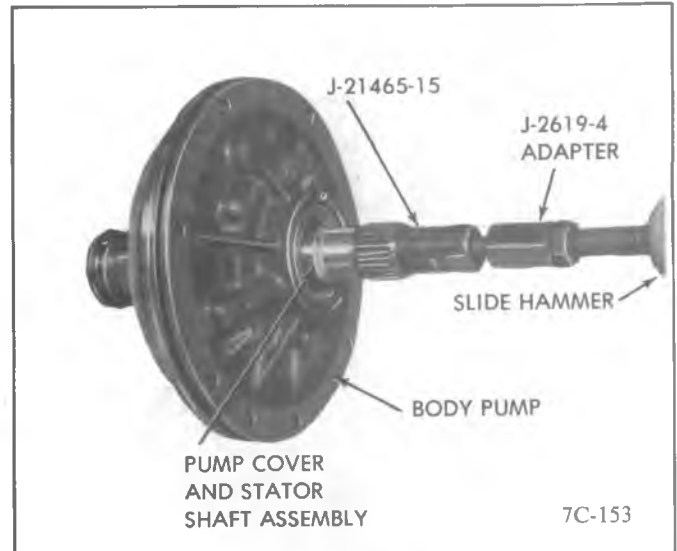


Figure 350C-177 Remove Front Stator Bushing

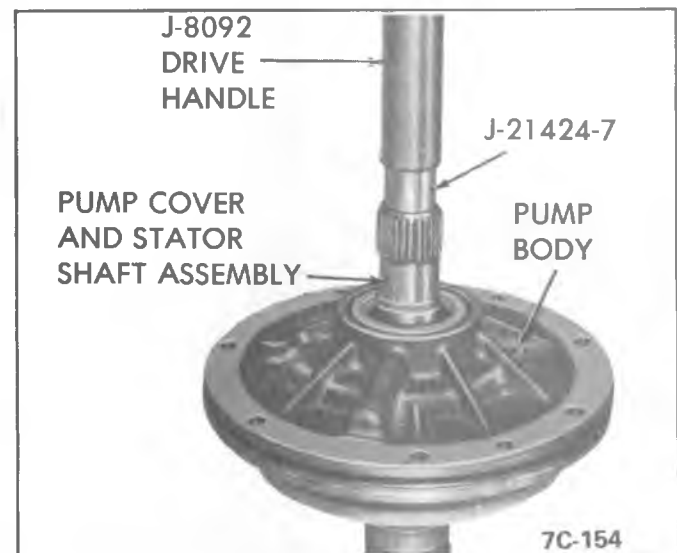


Figure 350C-178 Install Front Stator Shaft Bushing

Replacing Rear Stator Shaft Bushings

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-179. If upper rear stator shaft bushing is required, repeat above procedure.

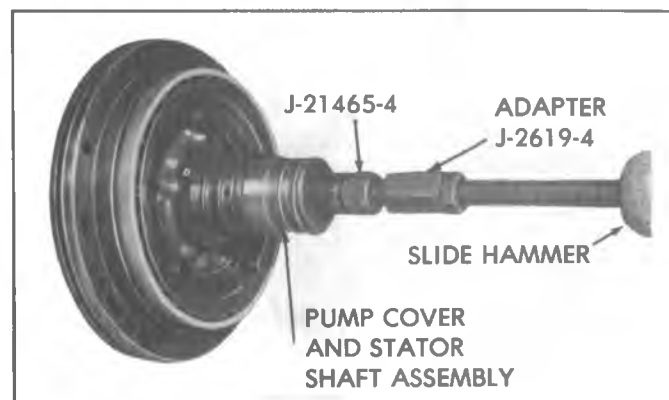


Figure 350C-179 Remove Rear Stator Bushing

- 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-180.

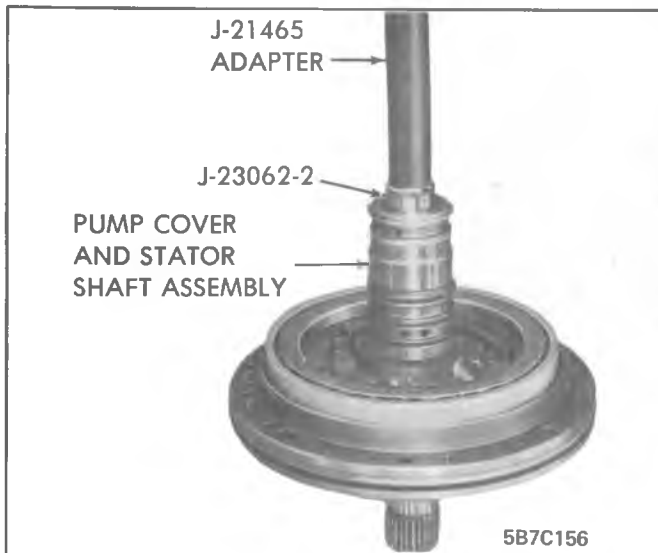


Figure 350C-180 Install Rear Stator Bushing

- Using Tool J- 23062-12, press lower rear stator shaft bushing flush to .010" below chamfer on oil pump delivery sleeve.

Replacing Direct Clutch Bushing

- If bushing replacement is necessary, use Tool J- 23062-110 and Drive Handle J-18092 and remove the bushing. See Figure 350C-181.

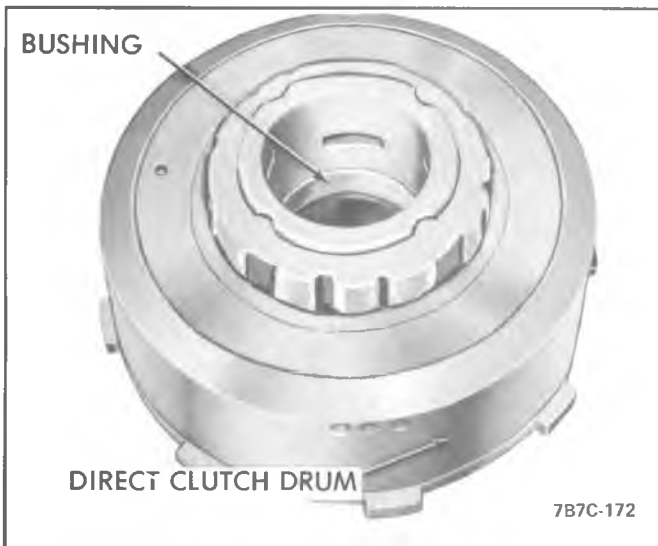


Figure 350C-181 Removing Direct Clutch Bushing

- Install direct clutch bushing using Tool J- 23062-14, Drive Handle J- 8092, and install .010" below slot in retainer hub. See Figure 350C-182.

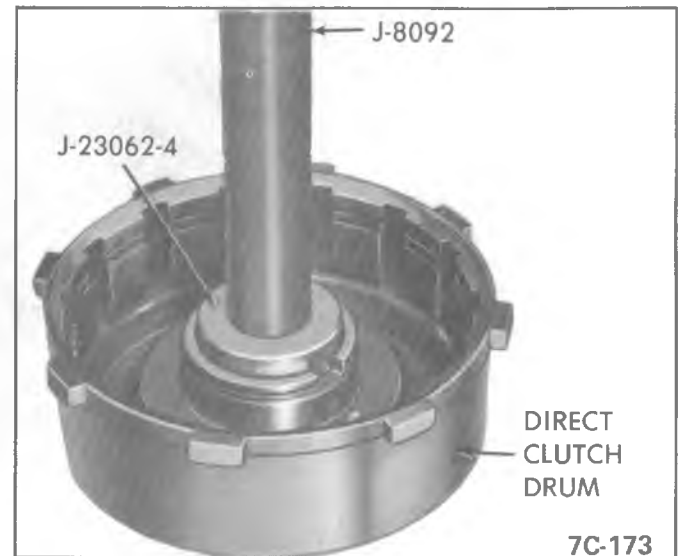


Figure 350C-182 Install Direct Clutch Bushing

Replacing Sun Gear Bushing

- 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-183.

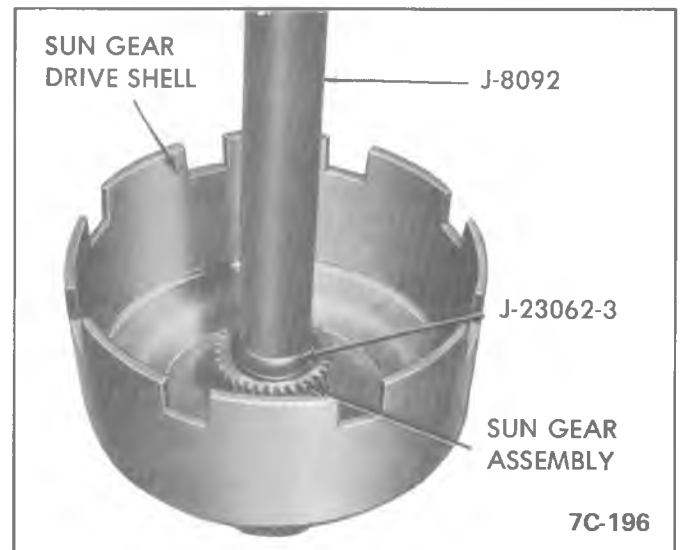


Figure 350C-183 Install Sun Gear Bushing

- 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-183.

Transmission Identification Number

A production day and shift built number, transmission model and model year are stamped on the governor cover. See Figure 350C-184. Since the production day built number and model number furnishes the key to construction and interchangeability of parts in each transmission, they should be used when selecting replacement parts as listed in the master parts list. The model number and day built number should always be furnished on product reports, warranty document forms, and all correspondence with factory concerning a particular transmission.

NOTICE: The direct clutch housing with the aluminum bushing can be used only with the cast iron pump cover. The housing with the bronze bushing can be used either with the steel sleeve pump cover or the cast iron pump cover.



Figure 350C-184 Production Code

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.)

AUTOMATIC 350C TRANSMISSION CLUTCH PLATE USAGE

TRANS MISSION I.D. CODE	SPEEDOMETER DRIVE GEAR		INTERMEDIATE CLUTCH			DIRECT CLUTCH			FORWARD CLUTCH			LOW AND REVERSE CLUTCH		
	NUMBER OF TEETH	GEAR COLOR	NO. OF FACED PLATES	NO. OF STEEL PLATES	CLUTCH PISTON THICKNESS	NO. OF FACED PLATES	NO. OF STEEL PLATES	CLUTCH PISTON THICKNESS	NO. OF FACED PLATES	NO. OF STEEL PLATES	CLUTCH PISTON THICKNESS	NO. OF FACED PLATES	NO. OF STEEL PLATES	CLUTCH PISTON THICKNESS
9WD, 9WA 9WH, 9WC 9WP, 9TX 9VN, 9VL 9TS, 9VJ 9VC	10	PURPLE	3	3	.992	4	4	.833	4	4	1.405	4	4	3.106
9WT, 9WX 9VW	10	PURPLE	3	3	.992	4	4	.833	5	5	1.223	5	5	2.921
9WE, 9WJ 9VP, 9VK 9VO, 9VS 9VE, 9VH 9V4, 977 9T3	9	GREEN	3	3	.992	4	4	.833	5	5	1.223	5	5	2.921
9KA, 9KC 9KE, 9KH 9KK, 9KN	17	RED	2	2	1.184	3	3	1.014	4	4	1.391	4	4	3.106
9KJ	18	BLUE	3	3	.992	4	4	.833	5	5	1.223	5	5	2.921
9LA	19	YELLOW	2	2	1.184	3	3	1.014	4	4	1.391	4	4	3.106
9LD, 9LB	19	YELLOW	3	3	.992	4	4	.833	5	5	1.223	5	5	2.921
9LC	19	YELLOW	3	3	.992	4	4	.833	4	4	1.391	4	4	3.106

Figure 350C-185

ESSENTIAL TOOLS — THM350C & THM250C


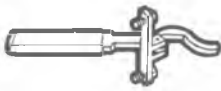
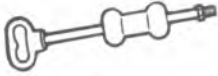

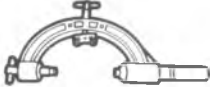









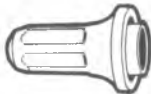







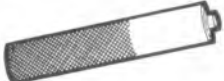




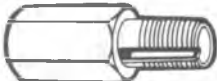
	J 2590-02 Clutch Spring Compressor		J 23069 Accumulator Cover Remover & Installer
	J 2619-A Slide Hammer (5/8" x 18" with 1/2" x 13 Adapter)		J 26744 Piston Seal Installer
	J 8763-02 Holding Fixture (Use with J3289-20)		J 22974 Seal Protector
	J 3289-20 Holding Fixture Base (Use with J 8763-02)		J 23327 Clutch Spring Compressor
	J 7004-1 Slide Hammers-Pair (3/8" 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-185 Special Tools

SECTION 7A

400 AUTOMATIC TRANSMISSION

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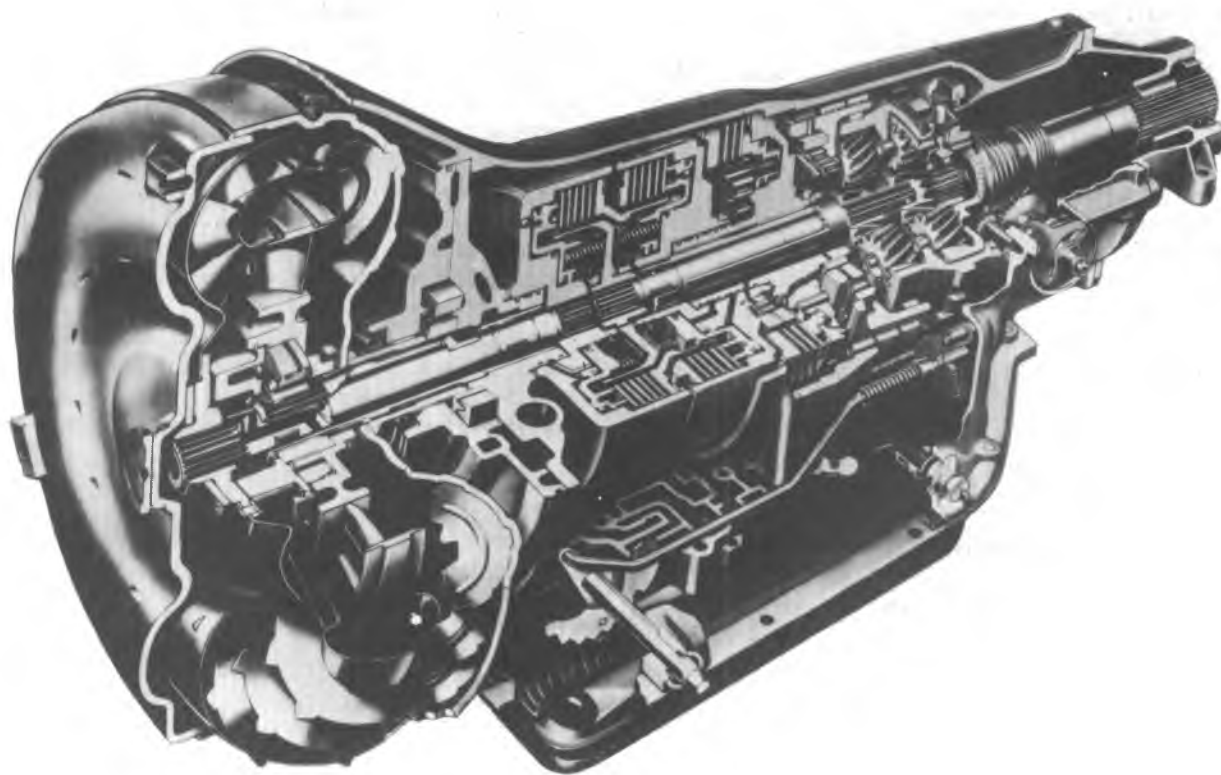


Fig. 7A-1C-400 Automatic Transmission, Side Cross Section--Typical



Fig. 7A-2C--Transmission in Holding Fixture

DISASSEMBLY OF MAJOR UNITS

1. With transmission in cradle on portable jack, remove converter assembly by pulling straight out. Converter contains a large amount of oil.
2. Install holding Fixture J-8763-01 on transmission so that modulator assembly will be located on side of holding fixture nearest bench (Fig 7A-2C). Do not over-torque holding screw. This will bind center support.
3. Install fixture and transmission into holding Tool Base J-3289-14 with bottom pan facing up (Fig. 7A-2C).

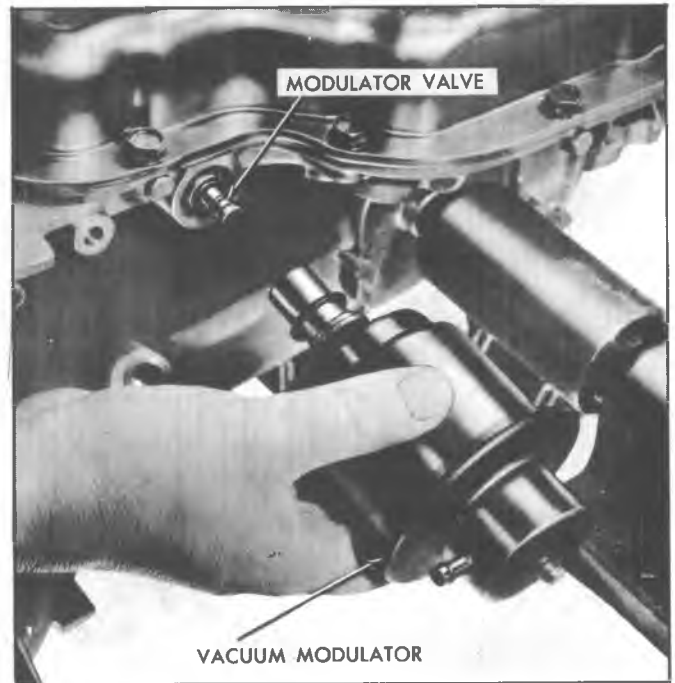


Fig. 7A-4C--Removing Vacuum Modulator and Valve

4. Remove modulator assembly attaching screw and retainer (Fig. 7A-3C).
5. Remove vacuum modulator assembly and "O" ring seal from case (Fig. 7A-4C). Discard "O" ring.
6. Remove modulator valve from transmission case (Fig. 7A-4C).

Removal of Governor,

Speedometer Driven Gear,

Pan, Filter and Intake Pipe

1. Remove attaching screws, governor cover and gasket (Fig. 7A-5C). Discard gasket.
2. Withdraw governor assembly from case.



Fig. 7A-3C--Removing Modulator Retainer

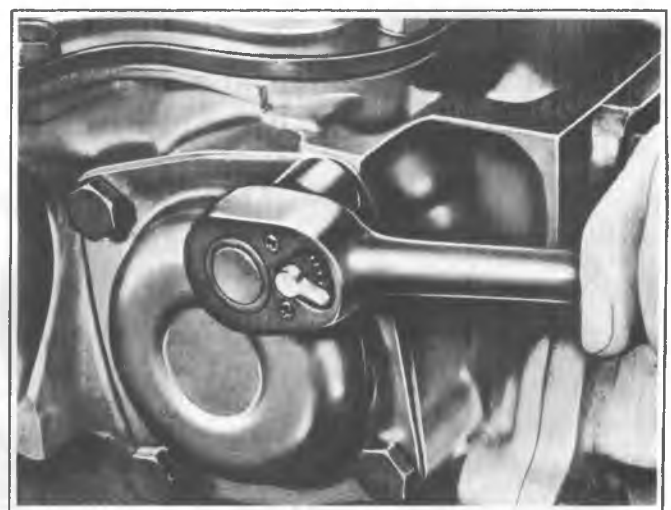


Fig. 7A-5C--Removing Governor Cover Attaching Screws

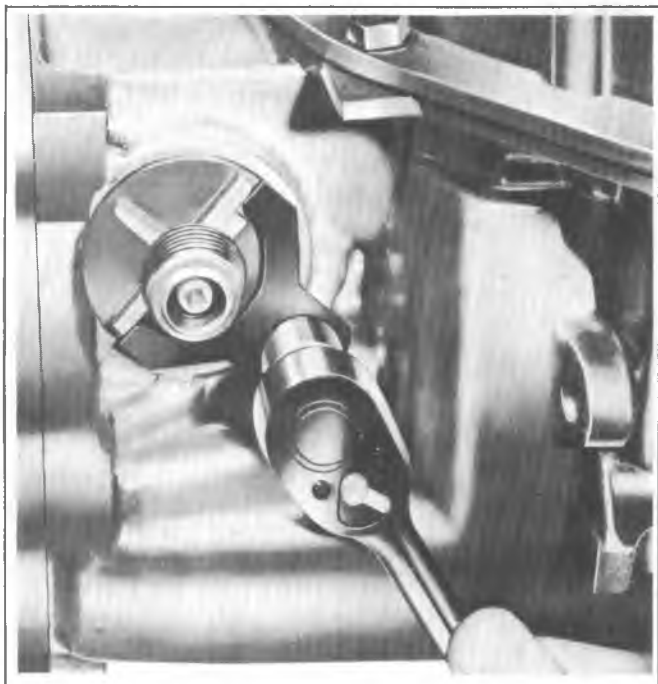


Fig. 7A-6C--Removing Speedometer Driven Gear Retainer

3. Remove speedometer driven gear attaching screw and retainer (Fig. 7A-6C).

4. Withdraw speedometer driven gear assembly from case.

5. Remove bottom pan attaching screws, bottom pan and bottom pan gasket. Discard gasket.

6. Remove the filter retainer bolt (Fig. 7A-7C).

7. Remove filter and intake pipe assembly from case (Fig. 7A-8C) and discard filter.

8. Remove intake pipe to case "O" ring seal from intake pipe or case and discard.

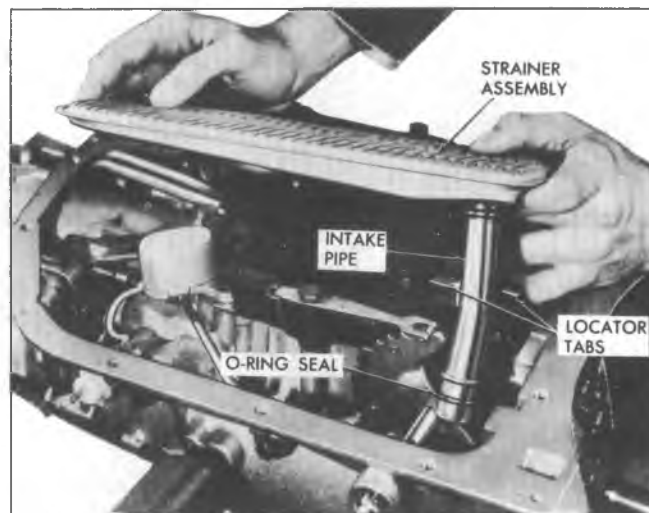


Fig. 7A-8C--Removing Filter Assembly and "O" Ring

Removal of Control Valve Assembly,

Solenoid Connector, Governor Pipes, Governor Screen Assembly, and Detent Spring Assembly

1. Remove control valve body attaching screws and detent roller and spring assembly (Fig. 7A-9C). Do not remove solenoid attaching screws.

NOTICE: If transmission is in the vehicle, the front servo parts may drop out as the control valve assembly is removed.

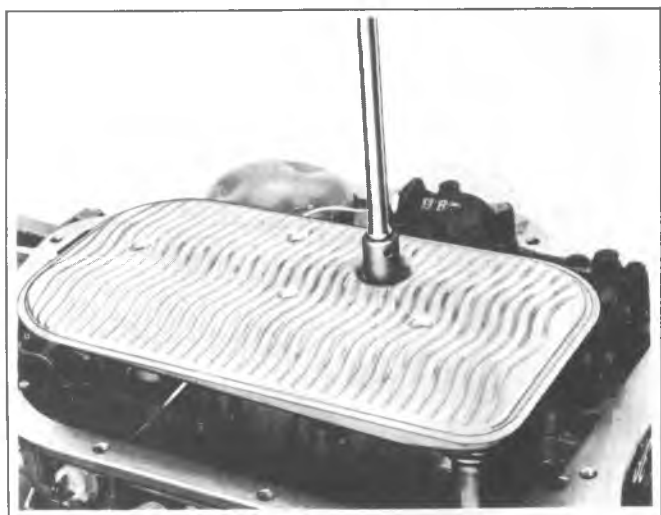


Fig. 7A-7C--Removing Filter Retainer Bolt

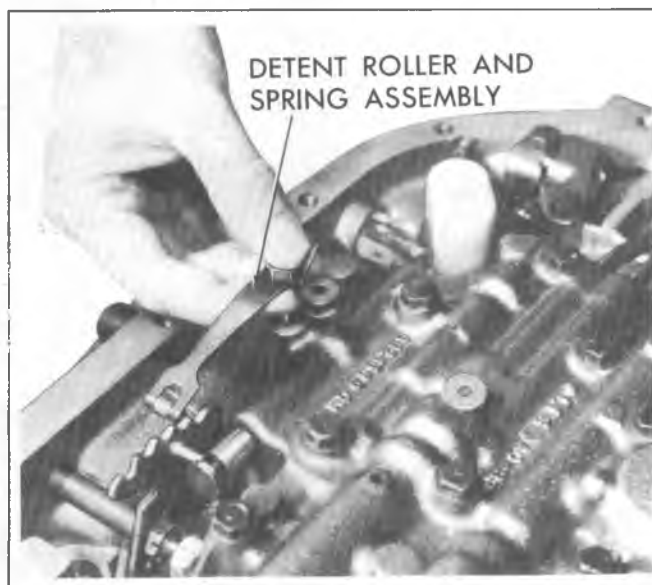


Fig. 7A-9C--Removing Detent Roller and Spring Assembly

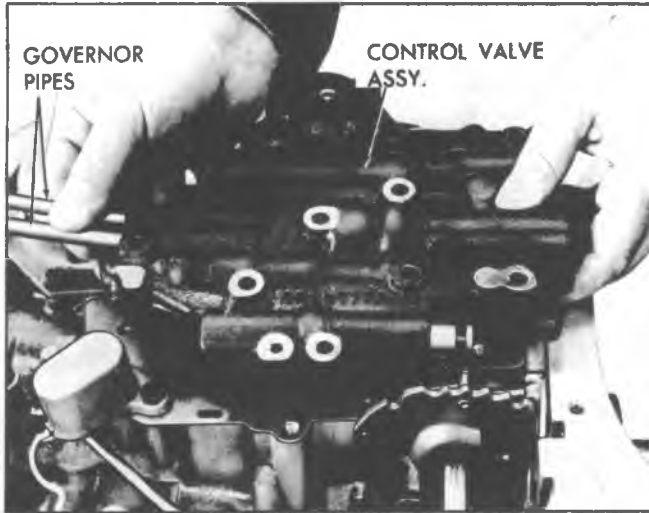


Fig. 7A-10C—Removing Control Valve Assembly and Governor Pipes from Case

2. Remove control valve assembly and governor pipes (Fig. 7A-10C). Do not drop manual valve.
3. Remove governor screen assembly from governor feed pipe hole in the case or from end of governor feed pipe (Fig. 7A-11C). Clean governor screen in clean solvent and air dry.
4. Remove governor pipes from control valve assembly.
5. Disconnect solenoid lead wire from connector terminal (Fig. 7A-12C).

Removal of Rear Servo, Valve Body Spacer, Gasket and Front Servo

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket (Fig. 7A-13C).
2. Remove rear servo assembly from case (Fig. 7A-14C).
3. Remove rear servo accumulator spring.
4. Make band apply pin selection check to determine possible cause of malfunction (Fig. 7A-15C).

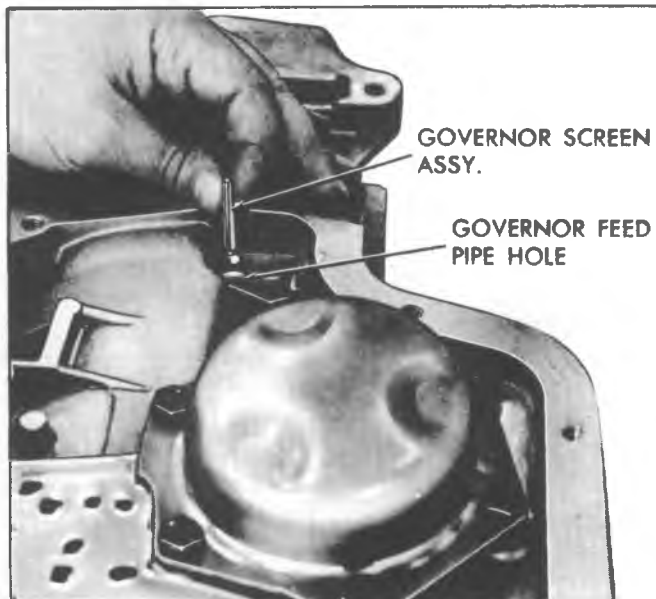


Fig. 7A-11C—Removing Governor Screen Assembly

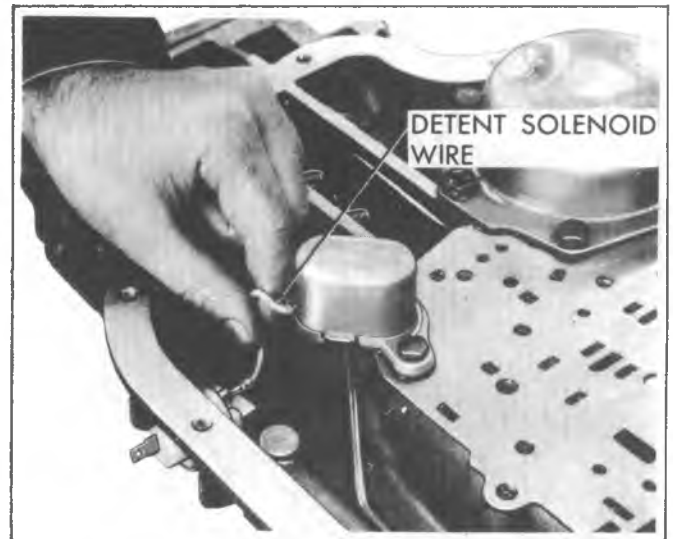


Fig. 7A-12C—Disconnecting Detent Solenoid Wire

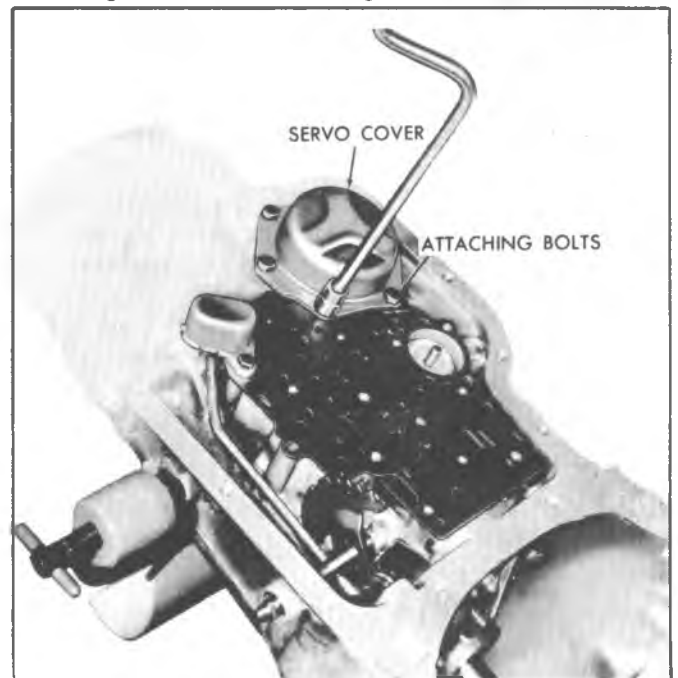


Fig. 7A-13C—Removing Rear Servo Cover Attaching Bolts

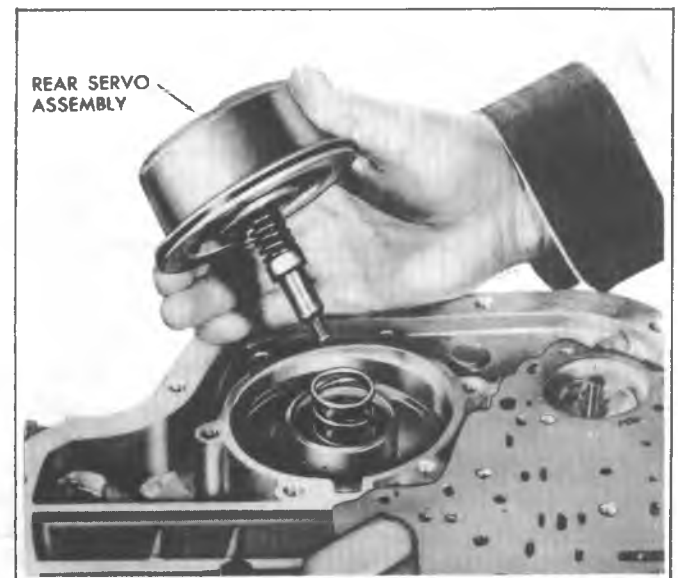


Fig. 7A-14C—Removing Rear Servo Assembly

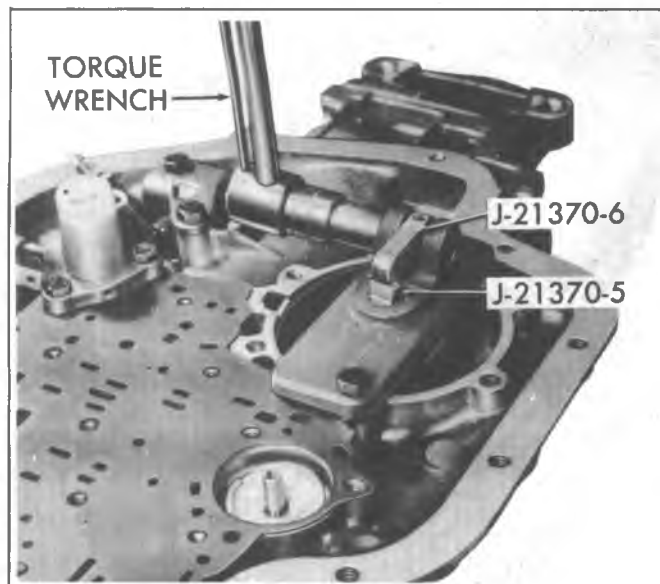


Fig. 7A-15C--Checking Rear Band Apply Pin, Except Models CD and CL

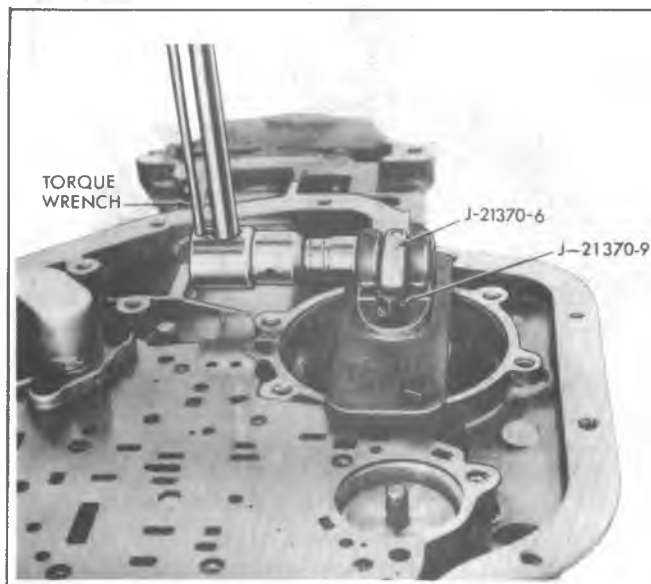


Fig. 7A-16C--Checking Rear Band Apply Pin, Models CD and CL

Rear Band Apply Pin Selection (All Models Except CD and CL)

a. Attach band apply pin selection Gage J-21370-5 and J-21370-6 to transmission case with attaching screws checking to make certain the gage pin does not bind in servo pin hole (Fig. 7A-15C).

b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission. Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two or three rings.

c. If both steps of J-21370-5 are below the gage surface, the long pin, identified by 3 rings, should be used.

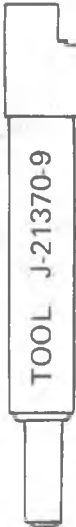

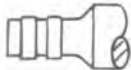







d. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

e. If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

Rear Band Apply Pin Selection (Models FL and FS)

There are six selective pins identified as shown in Figure 7A-17C. Selecting proper pin is equivalent to adjusting band.

a. Attach band apply pin selection gage (J-21370-9 and J-21370-6), to transmission case (lever pivot pin to rear) with rear servo cover attaching screws.

GAGING STEPS LOCATED ON THREE SIDES OF TOOL J-21370-9		PART NO.	PIN IDENTIFICATION	
	 C	LONGEST PIN	THIS STEP: USE PIN NO. 8627195	
			THIS STEP: SIDES B TO C USE PIN NO. 8627194	
	 B		THIS STEP: USE PIN NO. 8624141	
			THIS STEP: SIDES A TO B USE PIN NO. 8627193	
	 A		THIS STEP: USE PIN NO. 8624140	
		LOWER STEP SHORTEST PIN	LOWER STEP: USE PIN NO. 8627192	

Note: The Identification Rings are .030" and .100" wide.

Note: The Identification Rings are .030" and .100" wide.

Fig. 7A-17C--Rear Band Apply Pin Identification



Fig. 7A-18C--Removing Detent Solenoid and Gasket

b. Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 foot-pounds and recheck pin to make certain it does not bind.

c. Apply 25 foot-pounds torque to the lever on Tool J-21370-6 (Fig. 7A-16C). Selection of the proper rear band apply pin is determined by the relation of the flat on Tool J-21370-9 to the flat machined area around the hole on Tool J-21370-6.

d. Before removing gaging tool make note of the proper band apply pin to be used during assembly of the transmission as determined by the six selective pins identified as shown in Fig. 7A-17C. If the transmission is in the vehicle, be careful when the detent solenoid is removed as it prevents the spacer plate and gasket and check balls from dropping down.

5. Remove detent solenoid attaching screws, detent solenoid and gasket (Fig. 7A-18C).



Fig. 7A-20C--Removing Front Servo Piston, Retainer Ring, and Pin

6. Withdraw electrical connector and "O" ring seal (Fig. 7A-19C).

7. Remove control valve assembly spacer plate and gasket.

8. Remove six (6) check balls from cored passages in transmission case. Mark location of balls for aid in reassembly.

9. Remove front servo piston, retainer ring, washer, pin, spring retainer and spring from transmission case (Fig. 7A-20C).

Remove Manual Linkage

1. Unthread jam nut holding detent lever to manual shaft.

2. Remove manual shaft retaining pin from case (Fig. 7A-21C).

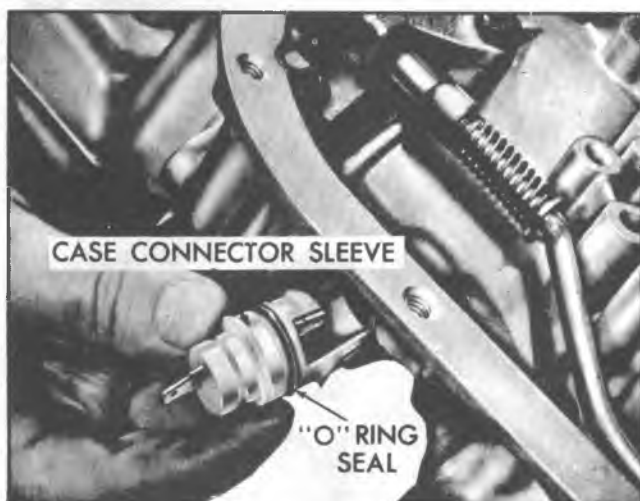


Fig. 7A-19C--Removing Electrical Connector and "O" Ring Seal

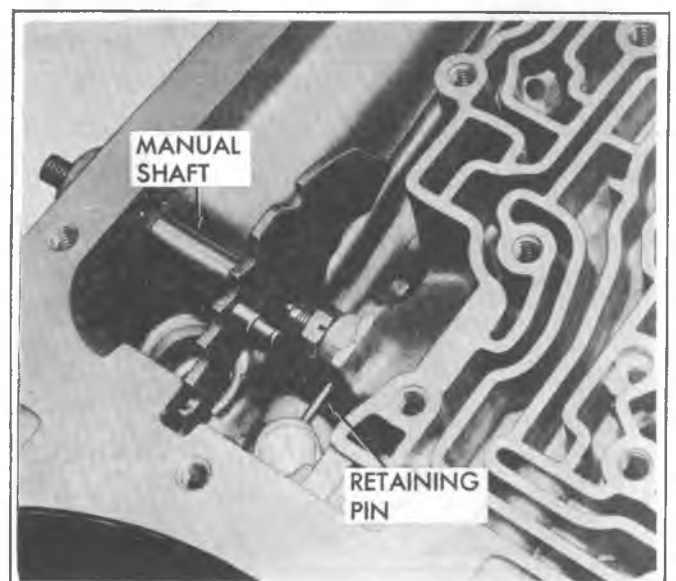


Fig. 7A-21C--Removing Manual Shaft Retaining Pin from Case

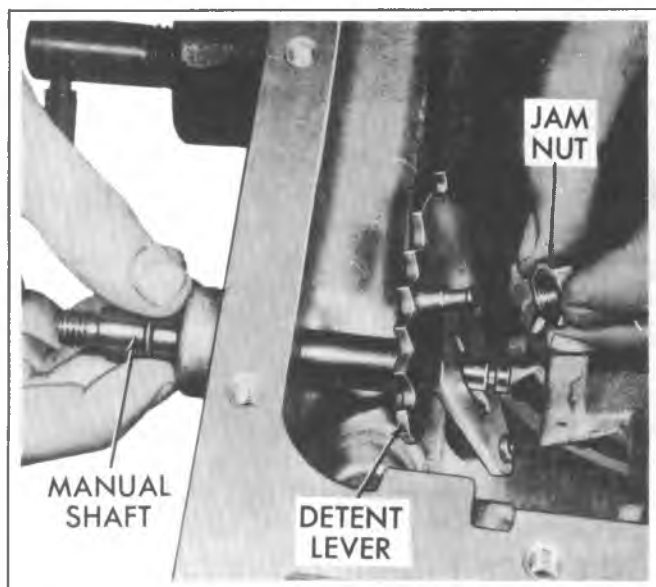


Fig. 7A-22C--Removing Detent Lever and Jam Nut from Manual Shaft

3. Remove manual shaft and jam nut from case (Fig. 7A-22C). Do not lose jam nut as it becomes free from manual shaft.

4. Remove parking actuator rod and detent lever assembly.



Fig. 7A-24C--Removing Parking Pawl Return Spring

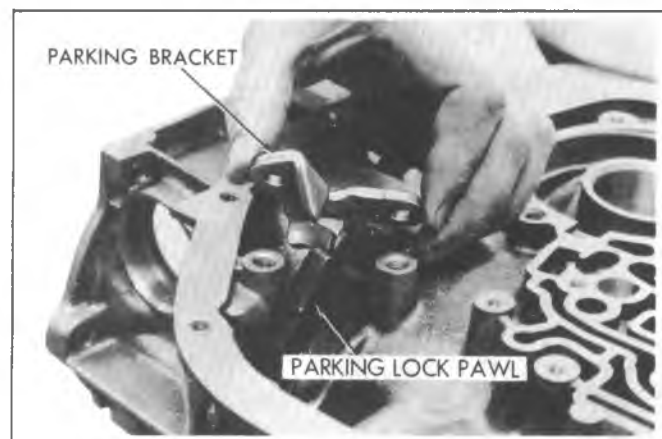


Fig. 7A-23C--Removing Parking Bracket

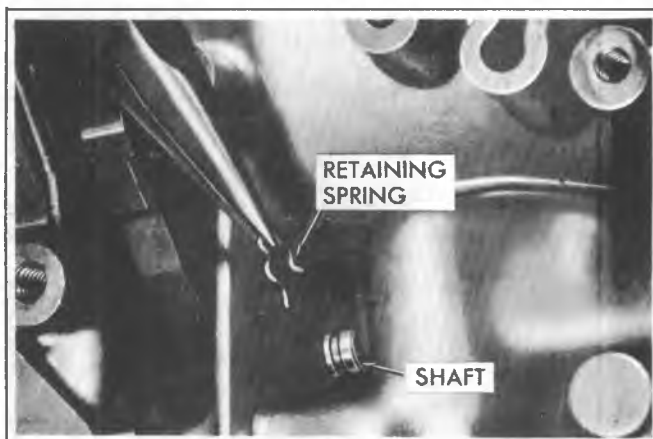


Fig. 7A-25C--Removing Parking Shaft Retaining Spring

5. Remove attaching screws and parking bracket (Fig. 7A-23C).

6. Remove parking pawl return spring (Fig. 7A-24C).

The following steps are to be completed only if 1 or more of the parts involved require replacement.

7. Remove parking pawl shaft retainer (Fig. 7A-25C).

8. Remove parking pawl shaft cup plug by inserting a screwdriver, between the parking pawl shaft and the case rib, and prying outwards (Fig. 7A-26C).

9. Remove parking pawl shaft and parking pawl (Fig. 7A-26C).

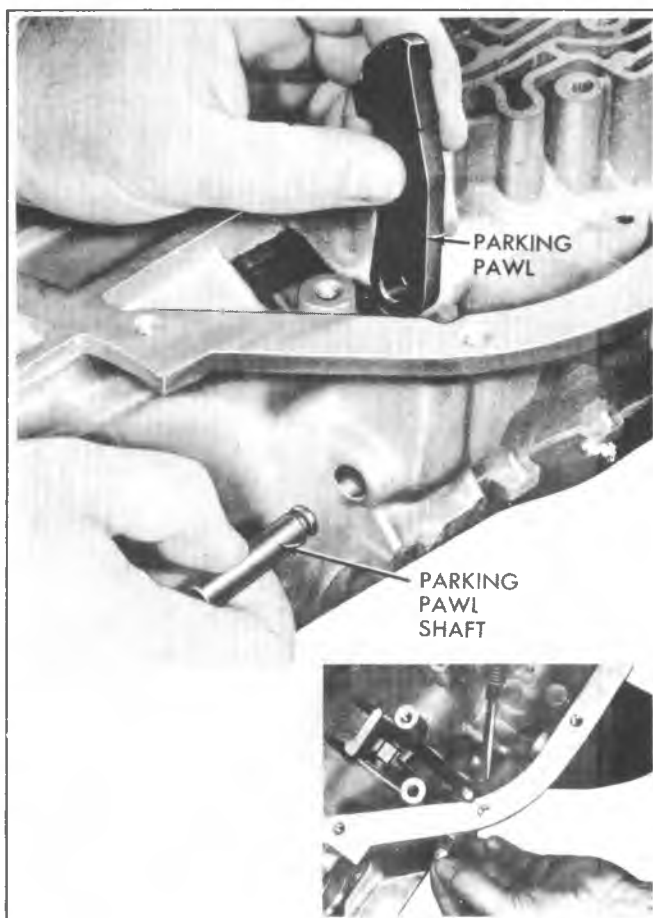


Fig. 7A-26C--Removing Parking Pawl, Shaft and Cup Plug

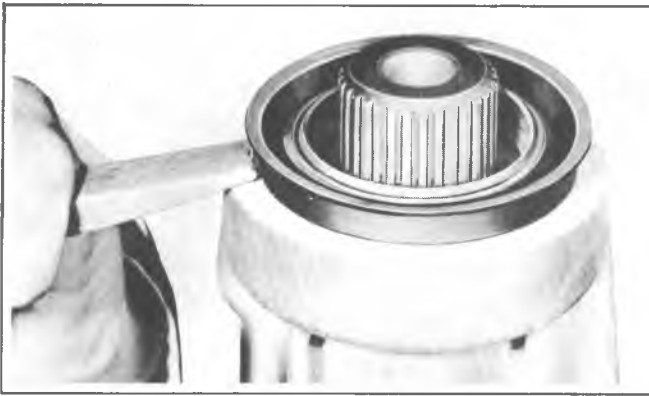


Fig. 7A-27C--Removing Rear Oil Seal from Case Extension

Removal of Rear Oil Seal and Case Extension and Front Unit End Play Check

1. If necessary to replace, pry rear oil seal from case extension (Fig. 7A-27C).
2. Remove case extension to case attaching bolts.
3. Remove case extension to case gasket (Fig. 7A-28C).
4. Make front unit end play check as follows (Fig. 7A-29C):
 - a. Remove one front pump attaching bolt, and bolt washer. (See Fig. 7A-29C for location).
 - b. Install a 3/8"-16 threaded slide hammer bolt or J-9539, into bolt hole.
 - c. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

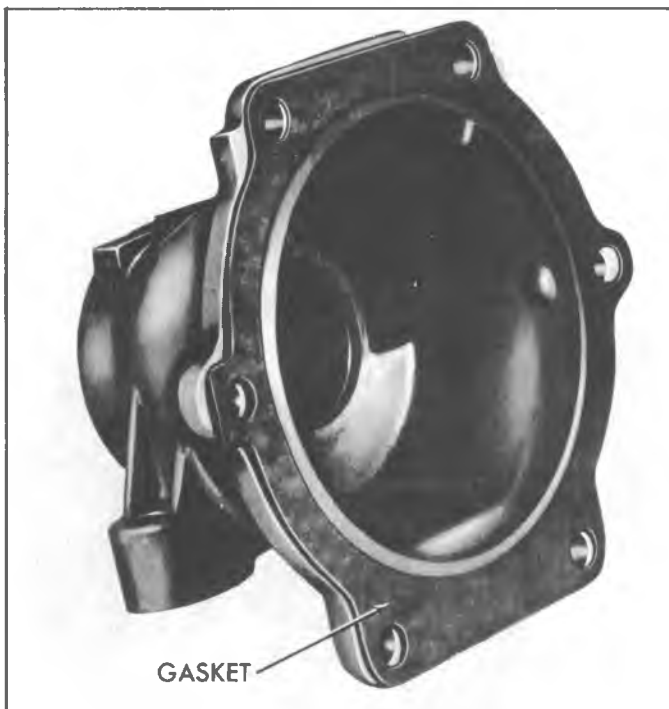


Fig. 7A-28C--Case Extension and Gasket



Fig. 7A-29C--Checking Front Unit End Play

- d. Push on turbine shaft rearward.
- e. Push output shaft forward.
- f. Set dial indicator to Zero.
- g. Pull turbine shaft forward.

Read resulting travel or end play. Should be .003"-.024".

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 the chart shown in Fig. 7A-30C. An oil soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.

FRONT END WASHER THICKNESS

Thickness	Number	Color
.060 - .064	- 0 -	Yellow
.071 - .075	- 1 -	Blue
.082 - .086	- 2 -	Red
.093 - .097	- 3 -	Brown
.104 - .108	- 4 -	Green
.115 - .119	- 5 -	Black
.126 - .130	- 6 -	Purple

Fig. 7A-30C--Front End Washer Selection Chart

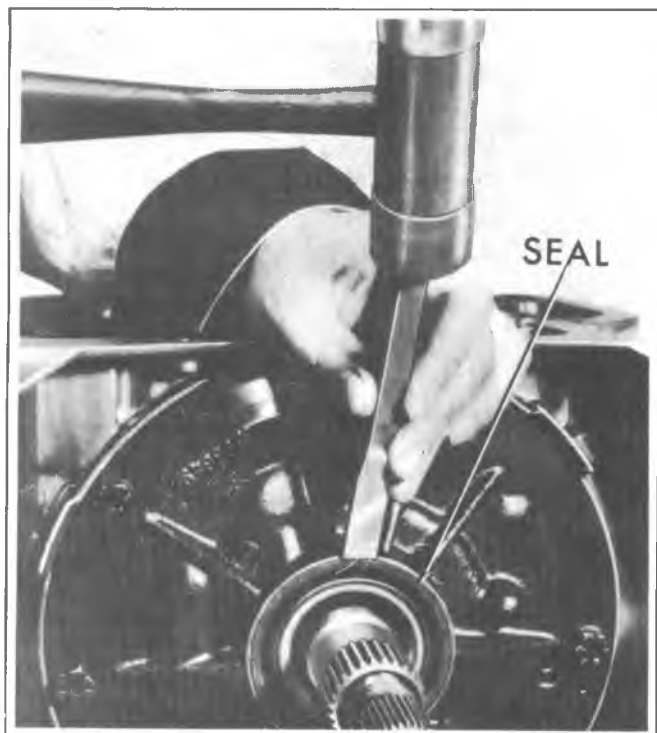


Fig. 7A-31C--Removing Front Seal

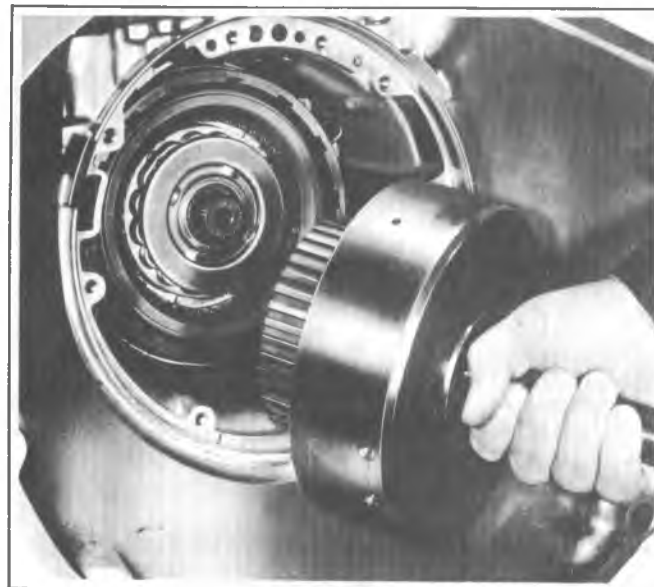


Fig. 7A-33C--Removing Forward Clutch Assembly and Turbine Shaft

Oil Pump and Internal Case Components Removal

1. If necessary to replace, pry front seal from pump (Fig. 7A-31C).
2. Remove pump attaching bolts.



Fig. 7A-32C--Removing Pump Assembly

3. Install two 3/8"-16 threaded slide hammer bolts, J-9539 with weights J-6585-01, into bolt holes in pump body and remove pump assembly from case (Fig. 7A-32C). (See illustration for location of threaded holes.)

4. Remove and discard pump to case seal and gasket.
5. Remove forward clutch assembly and turbine shaft from transmission (Fig. 7A-33C).
6. Remove forward clutch hub to direct clutch housing thrust washer, if it did not come out with forward clutch housing assembly.
7. Remove direct clutch assembly (Fig. 7A-34C).



Fig. 7A-34C--Removing Direct Clutch Assembly

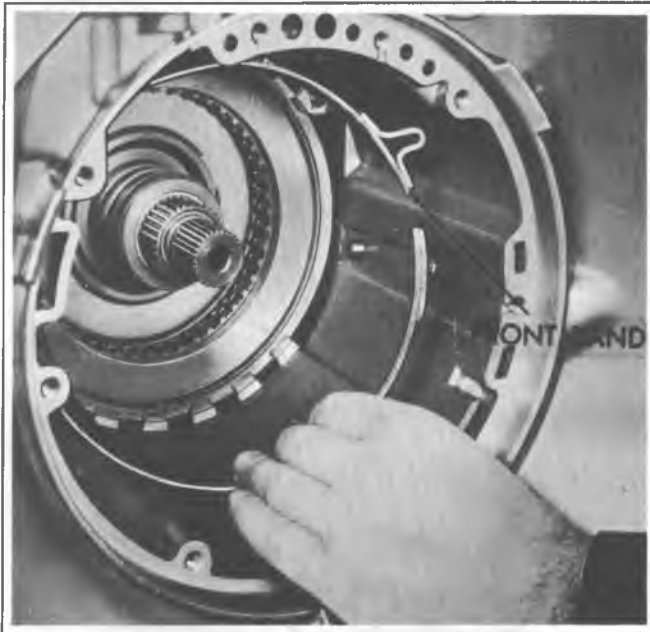


Fig. 7A-35C—Removing Front Band

8. Remove front band assembly (Fig. 7A-35C).
9. Remove sun gear shaft (Fig. 7A-36C).

Check Rear End Play as Follows (Fig. 7A-37C)

- a. Install J-9539 or a 3/8"-16 threaded bolt into an extension housing attaching bolt hole (Fig. 7A-37C).
- b. Mount a dial indicator on bolt and index with end of output shaft.
- c. Move output shaft in and out to read end play. End play should be from .007"-.019". Selective washer controlling this end play is a steel washer having 3 lugs that is located between output shaft thrust washer and rear face of transmission case.



Fig. 7A-36C—Removing Sun Gear Shaft

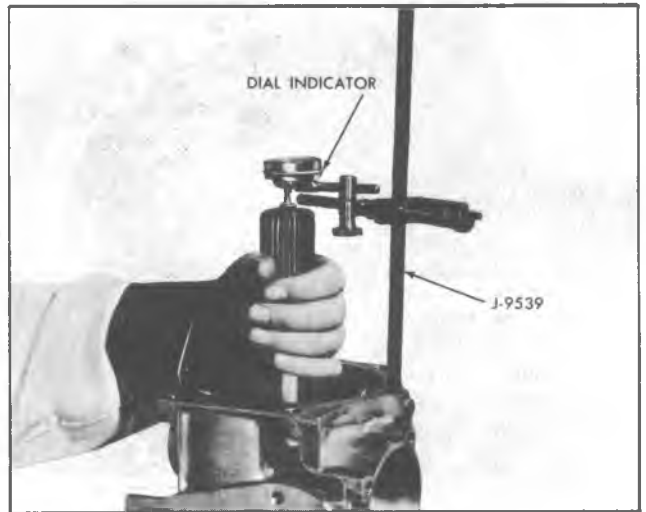


Fig. 7A-37C—Checking Rear Unit End Play

REAR END WASHER THICKNESS

Thickness	Identification
.074 - .078	None 1
.082 - .086	1 Tab Side 2
.090 - .094	2 Tab Side 3
.098 - .102	1 Tab O.D. 4
.106 - .110	2 Tabs O.D. 5
.114 - .118	3 Tabs O.D. 6

Fig. 7A-38C—Rear End Washer Thickness Chart

If a different washer thickness is required to bring end play within specification, it can be selected from the chart shown in Fig. 7A-38C.

10. Remove center support to case bolt (Fig. 7A-39C), using a 3/8" 12-point thin wall deep socket.

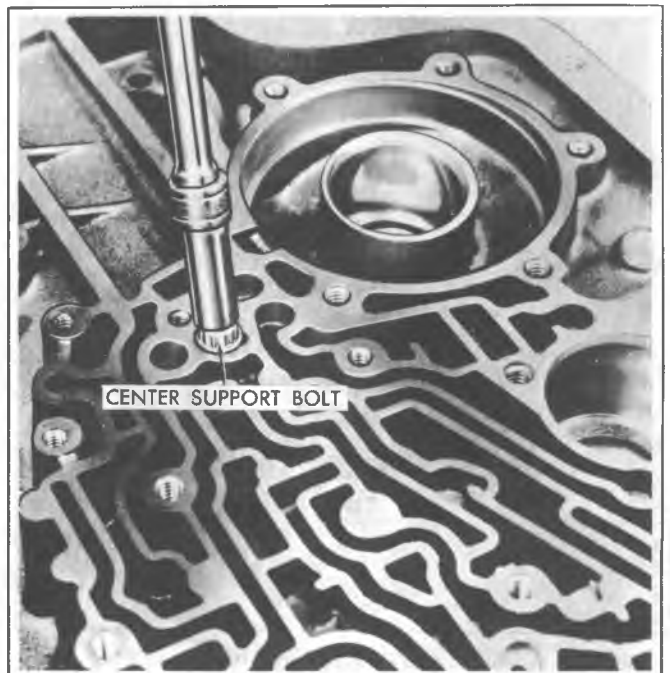


Fig. 7A-39C—Removing Center Support Bolt

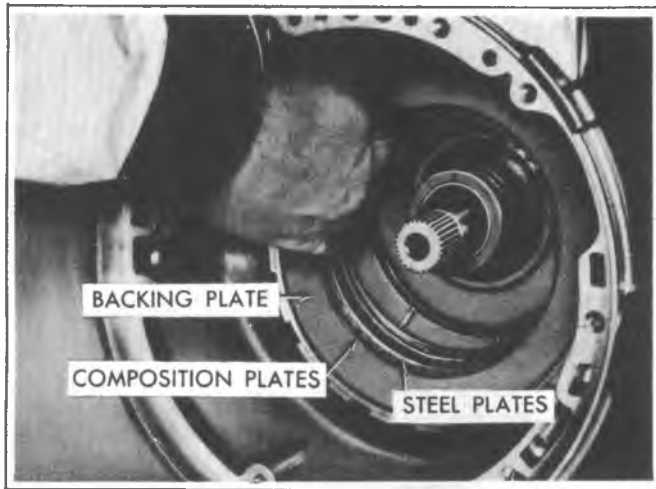


Fig. 7A-40C--Removing Intermediate Backing Plate and Clutch Plates

11. Remove intermediate clutch backing plate to case snap ring.

12. Remove intermediate clutch backing plate, as shown in Fig. 7A-40C.

13. Remove intermediate clutch plates.

a. (All except CB, CL and CD models) Remove three (3) composition, two (2) steel clutch plates and one waved steel plate.

b. (CB, CL and CD models) Remove three (3) composition, and three (3) steel clutch plates.

14. Remove center support to case retaining snap ring (Fig. 7A-41C).

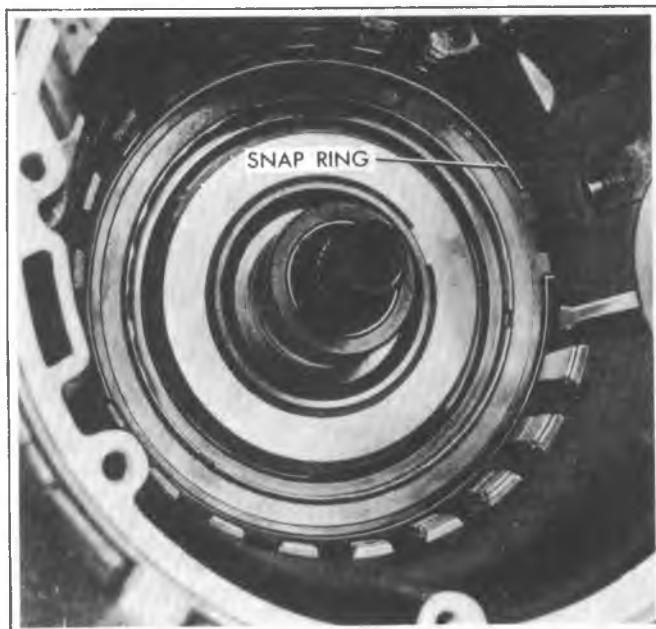


Fig. 7A-41C--Removing Center Support to Case Retaining Snap Ring

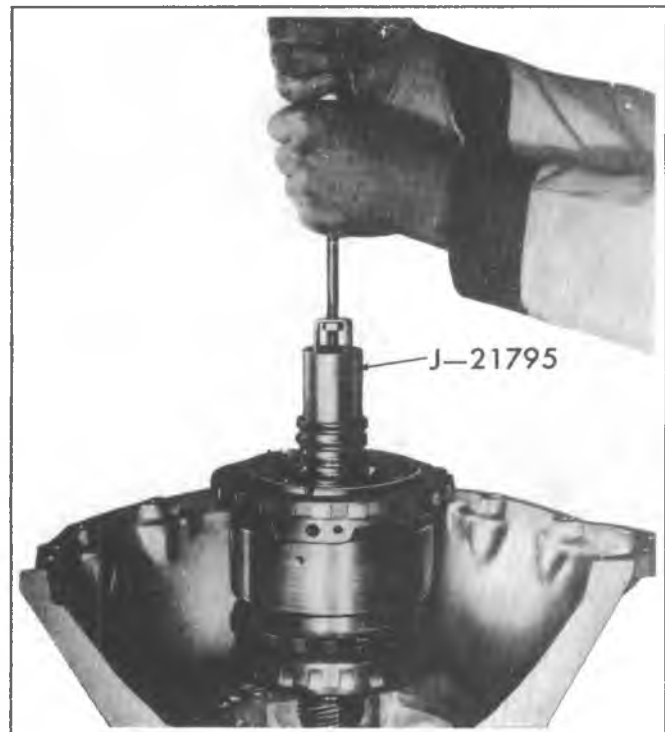


Fig. 7A-42C--Removing Center Support and Gear Unit from Case

15. Remove entire gear unit assembly by lifting with gear assembly installing and removing Holding Tool J-21795 with J-9539 slide hammer (Fig. 7A-42C).

16. Remove shaft to case thrust washer from rear of output shaft or inside case.

17. Place gear unit assembly, with output shaft facing down through hole in work bench.

18. Remove rear unit selective washer from transmission case (Fig. 7A-43C).



Fig. 7A-43C--Removing Selective Washer

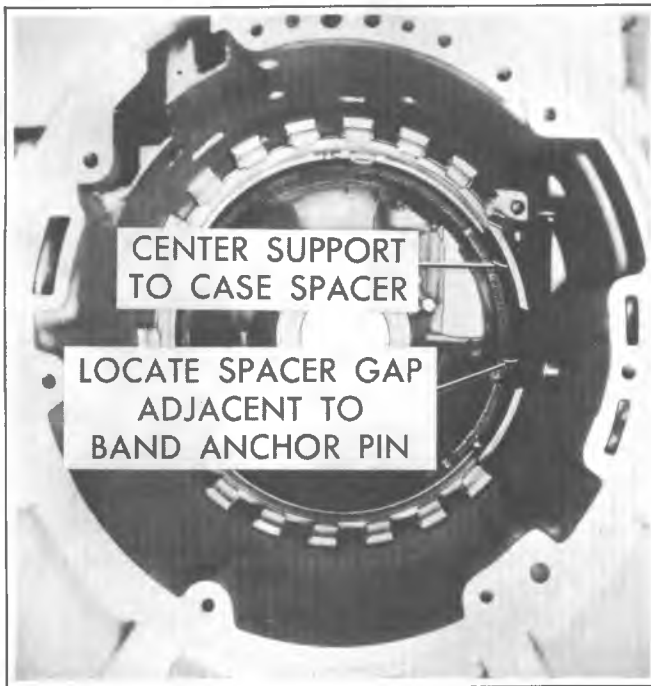


Fig. 7A-44C--Removing Center Support to Case Spacer



Fig. 7A-46C--Removing Center Support Assembly

19. Remove center support to case spacer (Fig. 7A-44C).

20. Remove rear band assembly (Fig. 7A-45C).

Disassembly of Gear Unit Assembly

CL Model (spur gears) disassembly procedure is identical as illustrated.

1. Remove center support assembly (Fig. 7A-46C).

2. Remove center support to reaction carrier thrust washer (Fig. 7A-47C).

3. Remove center support to sun gear races and thrust bearing. One race may have been removed with center support.

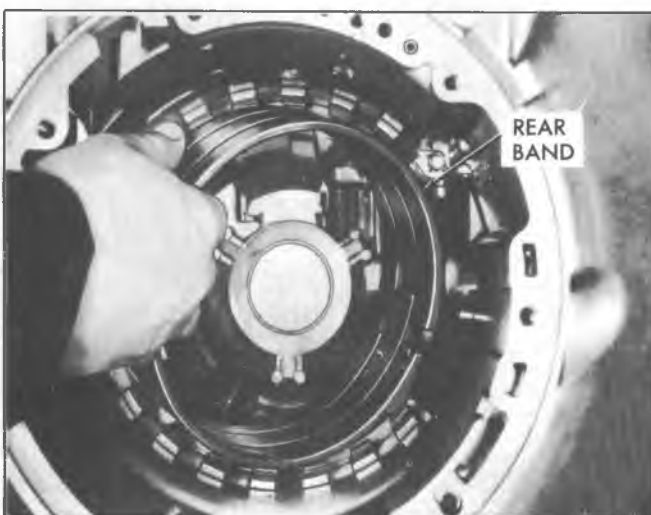


Fig. 7A-45C--Removing Rear Band

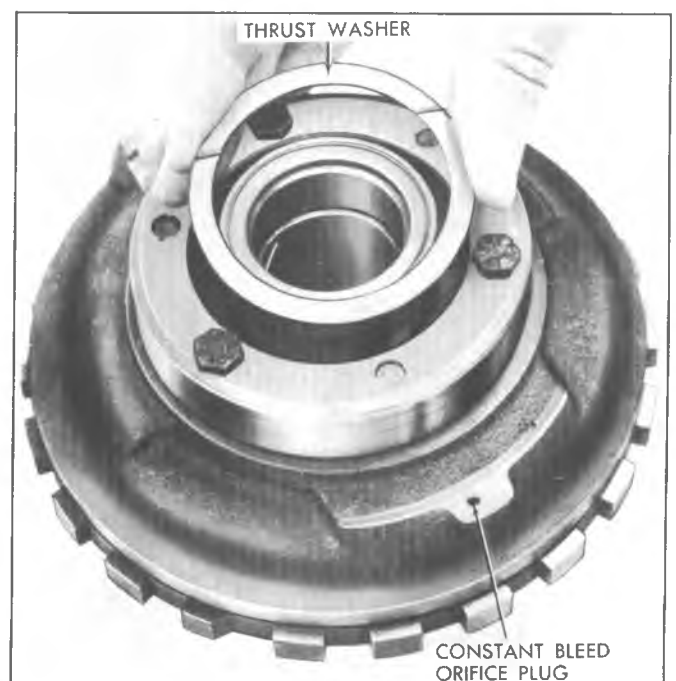


Fig. 7A-47C--Removing Center Support Thrust Washer

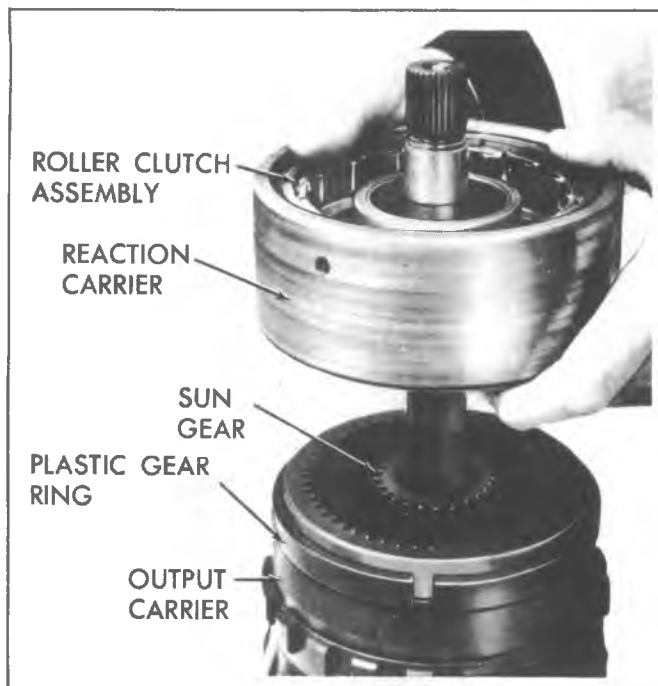


Fig. 7A-48C--Removing Reaction Carrier and Roller Clutch from Output Carrier

4. Remove reaction carrier and roller clutch assembly (Fig. 7A-48C). Lift roller clutch assembly out of carrier.

5. Remove front internal gear ring from output carrier assembly.

6. Remove sun gear (Fig. 7A-49C).

7. Remove reaction carrier to output carrier thrust washer.

8. Turn assembly over and place main shaft through hole in work bench.



Fig. 7A-49C--Removing Sun Gear

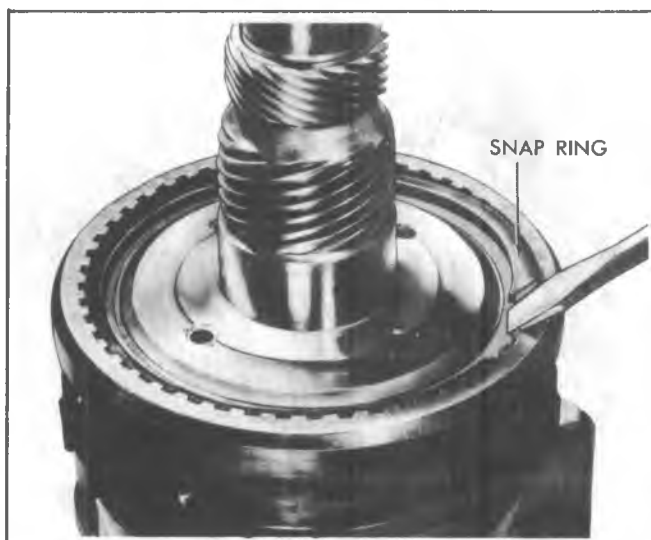


Fig. 7A-50C--Removing Output Shaft to Carrier Snap Ring

9. Remove "O" ring from output shaft of models that use an "O" ring.

10. Remove output shaft to output carrier snap ring (Fig. 7A-50C).

11. Remove output shaft.

12. Remove output shaft to rear internal gear thrust bearing and two (2) races.

13. Remove rear internal gear and mainshaft (Fig. 7A-51C). Do not drop bearings.



Fig. 7A-51C--Removing Rear Internal Gear and Mainshaft

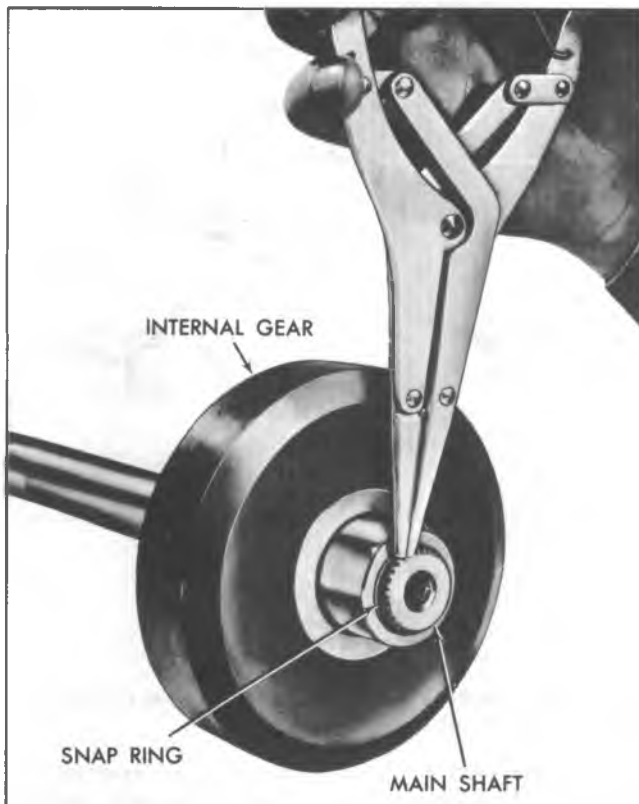


Fig. 7A-52C--Removing Rear Internal Gear to Main Shaft Snap Ring

14. Remove rear internal gear to sun gear thrust bearing and two (2) races.

15. If necessary, remove rear internal gear to mainshaft snap ring, to remove mainshaft (Fig. 7A-52C).

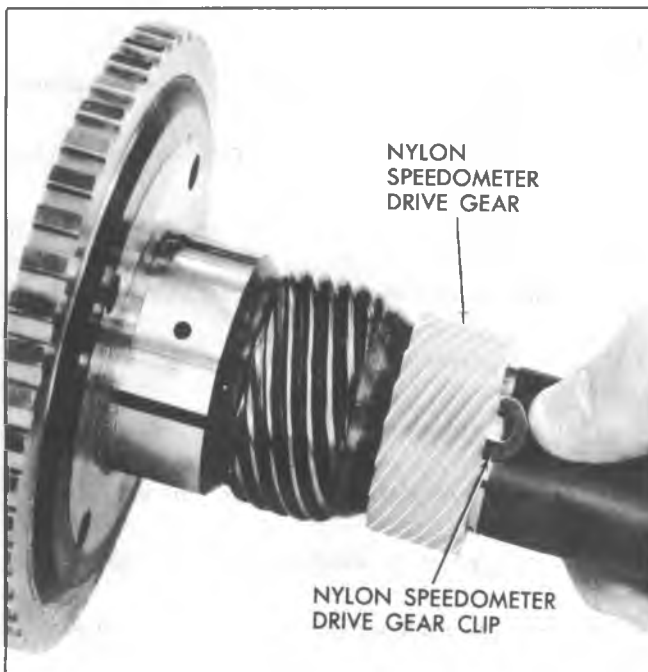


Fig. 7A-53C--Removing Nylon Speedometer Drive Gear

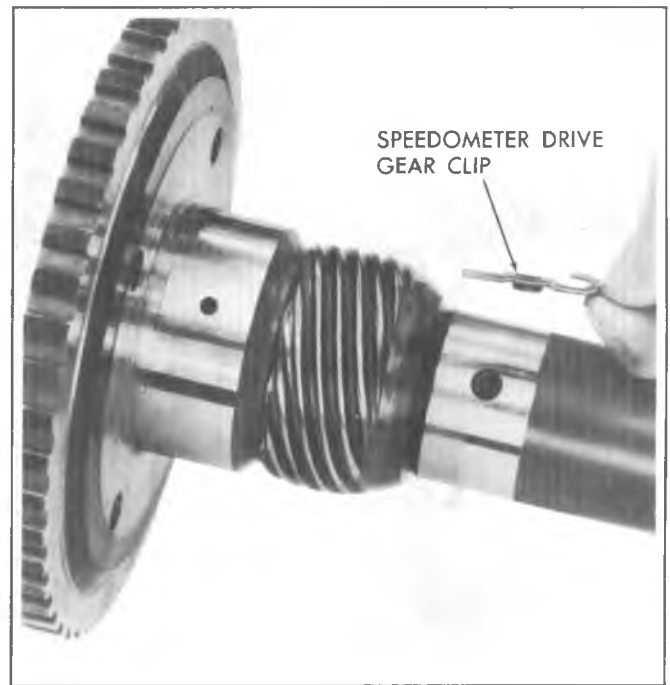


Fig. 7A-54C--Installing Speedometer Drive Gear Clip

Speedometer Drive Gear Replacement

If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

Nylon Speedometer Drive Gear

1. Depress clip and slide speedometer drive gear off output shaft (Fig. 7A-53C).

2. To install, place clip (square end toward flange of shaft) into hole in output shaft (Fig. 7A-54C). Align slot in speedometer drive gear with clip and install gear.

The nylon speedometer drive gear is installed at the factory only. ALL service replacement speedometer drive gears are STEEL. When replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and refer to Step "2" of steel speedometer drive gear installation. Models CA, CF and CG do not have a speedometer drive gear.

Steel Speedometer Drive Gear

1. Install speedometer drive gear remover Tool J-21427-01 and J-9539 bolts with J-8105 or suitable puller on



Fig. 7A-55C--Removing Steel Speedometer Drive Gear

output shaft, and remove speedometer drive gear (fig. 7A-55C).

2. Install new steel speedometer drive gear and drive to location 5-21/32" below end of output shaft for all models. (Fig. 7A-56C).

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is

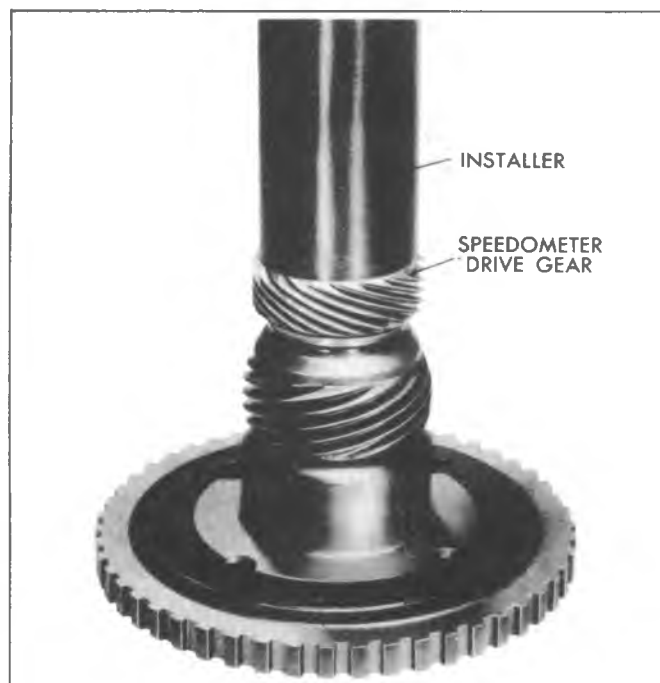


Fig. 7A-56C--Installing Steel Speedometer Drive Gear

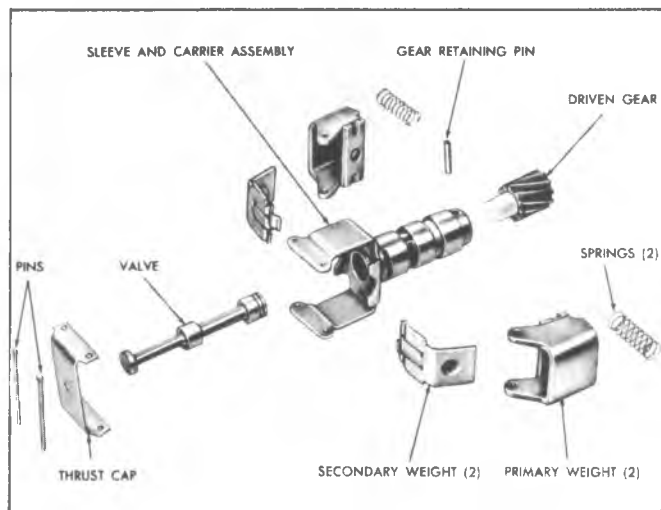


Fig. 7A-57C--Governor--Exploded

serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace 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. (Fig. 7A-57C).

2. Remove governor valve from governor sleeve. Be careful not to damage valve.

3. Perform 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.

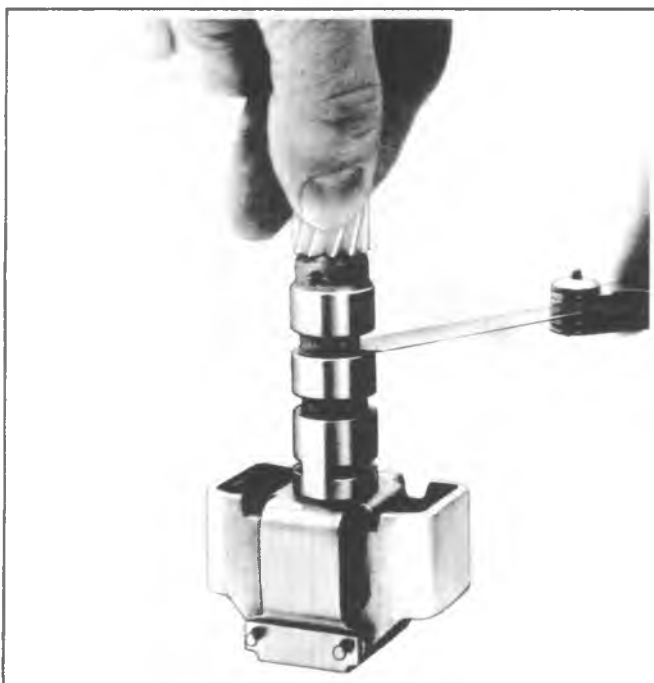


Fig. 7A-58C--Checking Valve Opening With Weights Outward

10. Check valve operating at entry (.020" minimum) with a feeler gage, holding governor as shown with governor weights extended completely outward (Fig. 7A-58C).

11. Check valve opening at exhaust (.020" minimum) with a feeler gage, holding governor as shown with governor weights completely inward (Fig. 7A-59C).

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



Fig. 7A-59C--Checking Valve Opening With Weight Inward

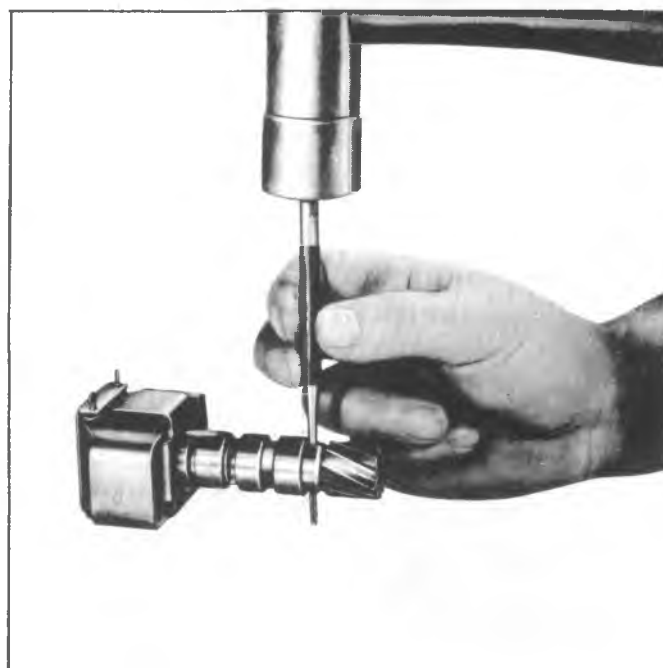


Fig. 7A-60C--Removing Governor Gear Retaining Pin

with care in the following manner:

1. Drive out governor gear retaining split pin using small punch (Fig. 7A-60C).

2. Support governor on 7/64 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 7/64 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 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.

6. Install split retaining pin.

7. Wash governor assembly thoroughly to remove any chips that may have collected.

Assembly

1. Install governor valve in bore of governor sleeve, large end first.

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.

4. Check governor weight assemblies for free operation on pins.

5. Check governor valve for free movement in governor sleeve.

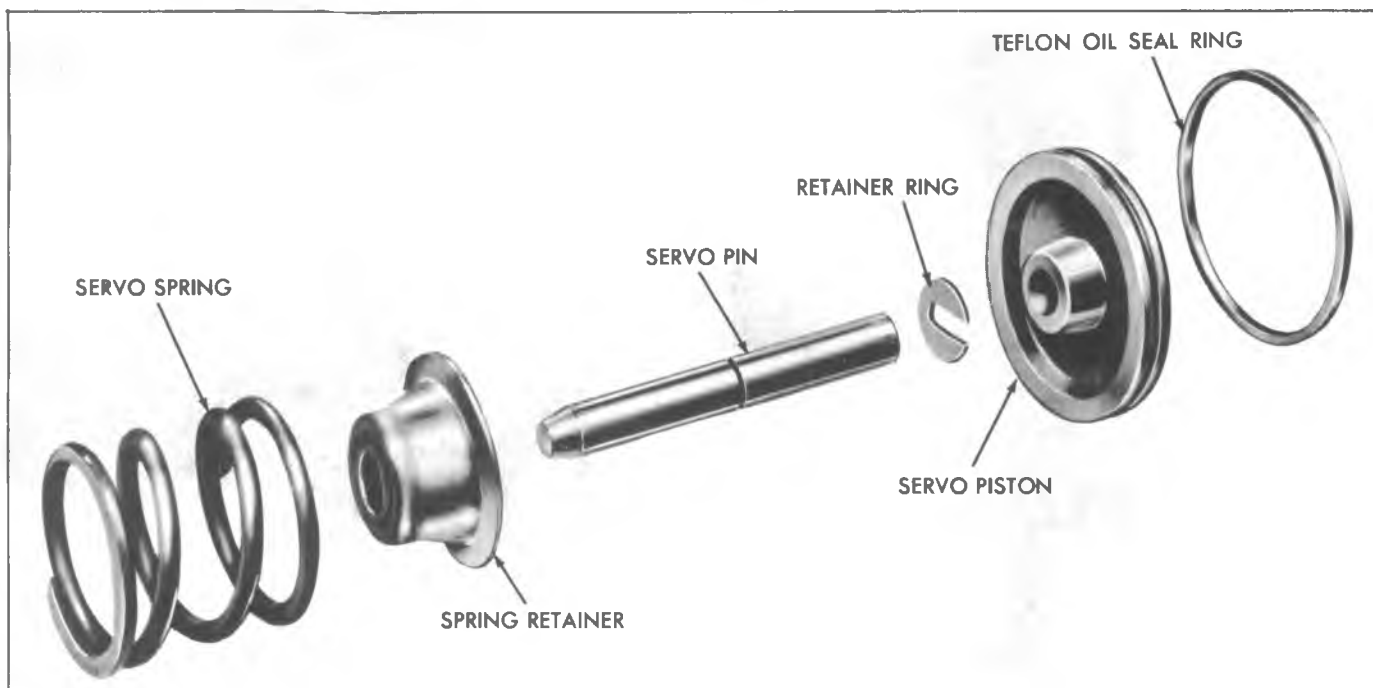


Fig. 7A-61C--Front Servo Assembly--Exploded View

Front Servo Parts Inspection

See Fig. 7A-61C. Do not remove the teflon oil seal ring from the front servo piston unless the oil seal ring requires replacement. For service, the oil seal ring is aluminum.

1. Inspect servo pin for damage.
2. Inspect piston and oil ring for damage.
3. Check fit of servo pin in piston and case bore.

Rear Servo Assembly

Disassembly

1. Remove rear accumulator piston from rear servo piston (Fig. 7A-62C-A).
2. Remove "E" ring retaining rear servo piston to servo pin (Fig. 7A-63C).



Fig. 7A-62C--Removing Rear Accumulator Piston from Rear Servo Piston

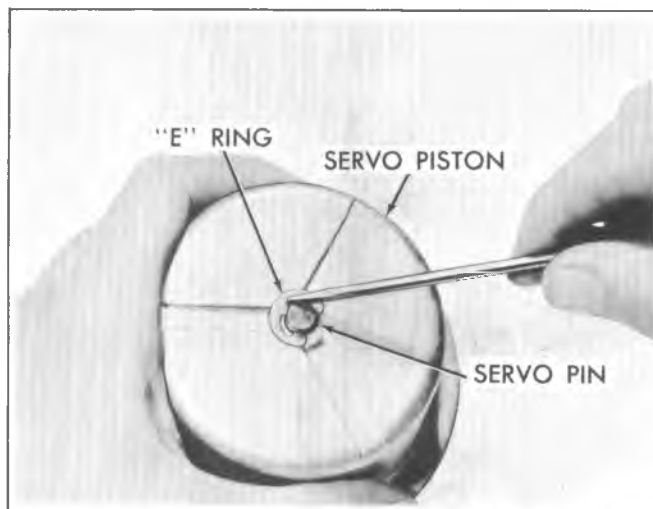


Fig. 7A-63C--Removing Retaining "E" Ring from Rear Servo Pin

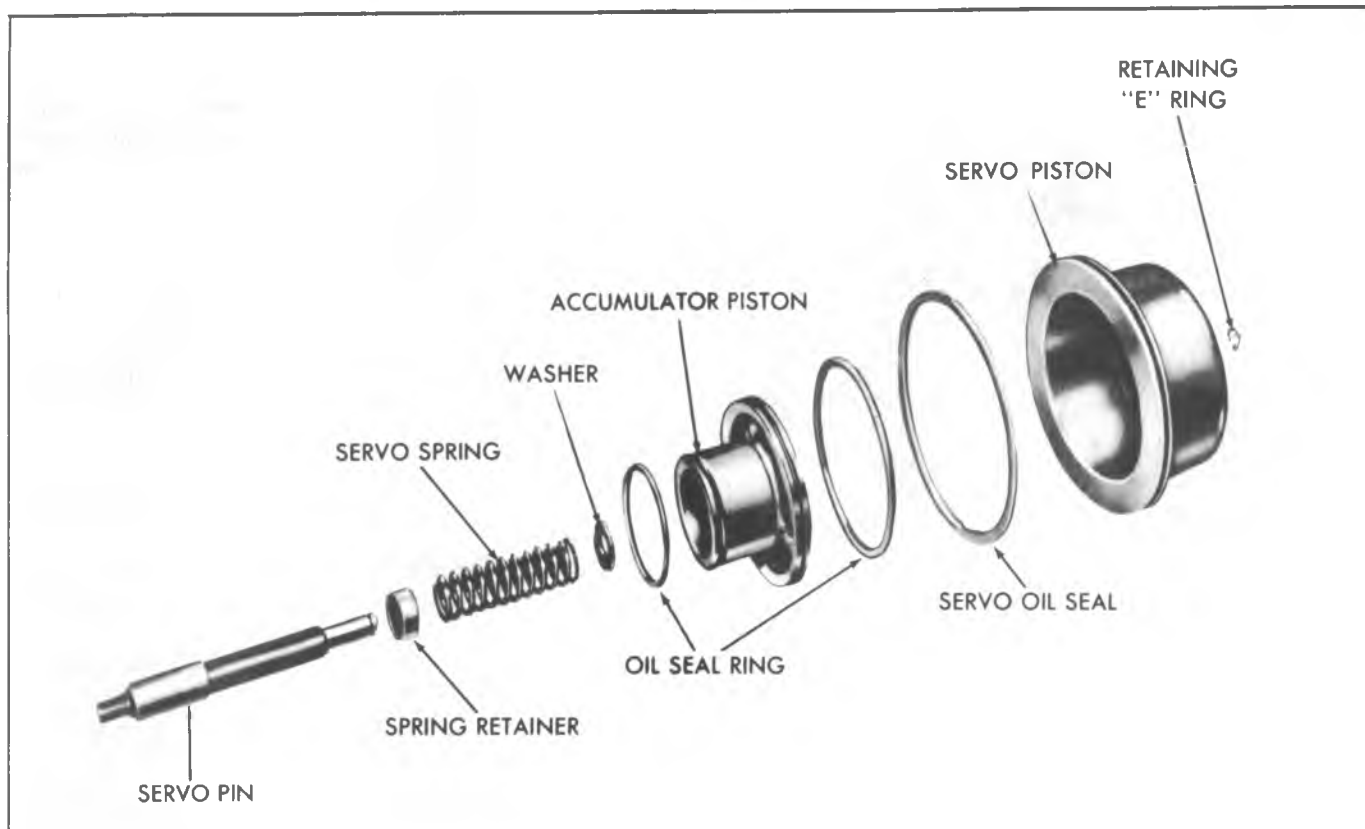


Fig. 7A-64C--Rear Servo and Accumulator Assembly--Exploded View

3. Remove rear servo piston and seal from servo pin (Fig. 7A-64C). (Exploded view.)

4. Remove washer, spring, and spring retainer.

Inspection

NOTICE: See Fig. 7A-64C. 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.

The rear accumulator piston, large diameter ring groove depth, is machined shallower to take the large teflon oil seal ring. If this ring requires replacement use only the teflon oil seal ring.

1. Inspect freedom of accumulator rings in piston grooves.
2. Inspect fit of servo pin in servo piston in case bore.
3. Inspect servo pin for scores or cracks.
4. Inspect accumulator and servo pistons for scoring, cracks or porosity.

Assembly

1. Install spring retainer cup side down, spring and washer on servo pin.
2. Install servo pin, retainer, spring and washer, into bore of servo piston and secure with "E" ring.
3. Install oil seal ring on servo piston, if removed.
4. Install outer and inner oil rings on accumulator piston, if removed, and assemble into bore of servo piston.

CONTROL VALVE, DISASSEMBLY, INSPECTION AND RE-ASSEMBLY (Fig. 7A-67C)

Disassembly

1. Position control valve assembly with cored face up and accumulator pocket nearest operator.
2. Remove manual valve from upper bore.
3. Install Special Tools J-22269 and J-24675, on accumulator piston and remove retaining ring (Fig. 7A-65C).



Fig. 7A-65C--Installing Compressor Tool to Front Accumulator Piston



Fig. 7A-66C--Front Accumulator Assembly - Exploded View

4. Remove front accumulator piston and spring (Fig. 7A-66C).

5. On the right side adjacent to the manual valve, remove the 1-2 valve train as follows:

a. (Models FP, FN, FK, FB AND FJ) Remove retaining pin, 1-2 modulator bushing, 1-2 valve spring, 1-2 modulator valve, and 1-2 shift valve.

b. (All other models) Remove retaining pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve and 1-2 shift valve.

6. From next bore down, remove retaining pin, 2-3 shift valve spring, 2-3 modulator valve bushing, 2-3 modulator valve, 3-2 intermediate spring, and 2-3 shift valve.

7. From next bore down remove retaining pin, bore plug, spring, spacer, and 3-2 valve.

8. At other end of assembly, top bore, remove retaining pin and bore plug, detent valve, detent regulator valve, spring and spacer.

9. From the next bore down, remove the 1-2 accumulator valve train as follows:

a. Remove the grooved retaining pin, bore plug, 1-2 accumulator valve and spring.

b. (Models FW, FH, FZ, FQ, FA, FT and FM) Remove the grooved retaining pin, bore plug, 1-2 accumulator secondary spring and 1-2 accumulator valve.

Inspection

NOTICE: See Fig. 7A-66C. Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. For service, the oil seal ring is cast iron.

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect bushings for cracks, scratches or distortion.
3. Inspect body for cracks, or scored bores.
4. Check all springs for distortion or collapsed coils.
5. Inspect accumulator piston and oil seal ring for damage.

Reassembly

1. Install front accumulator spring and piston into valve body.

2. Install Special Tools J-22269 and J-24675 and compress spring and piston and secure with retaining "E" ring.

3. Install the 1-2 accumulator valve train into the lower left hand bore as follows:

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. (Models FW, FH, FZ, FQ, FA, FT and FM) 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 inserted from the cast surface side 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.

4. In next bore up, install detent spring and spacer. Compress spring and secure with small screwdriver (Fig. 7A-68C).

5. Install detent regulator valve, wide land first.

6. Install detent valve, narrow land first.

7. Install bore plug (hole out), depress spring by pressing in on plug, install retaining pin, and remove screwdriver.

8. In lower right hand bore, install 3-2 valve.

9. Install 3-2 spring, spacer, bore plug (hole out) and retaining pin.

10. In next bore up, install the 2-3 shift valve, open end out, into the bore and install 3-2 intermediate spring.

11. Install 2-3 modulator valve into bushing and install both parts into valve body bore.

12. Install 2-3 valve spring and retaining pin.

13. In next bore up, install 1-2 valve, stem end out.

14. Install parts as follows:

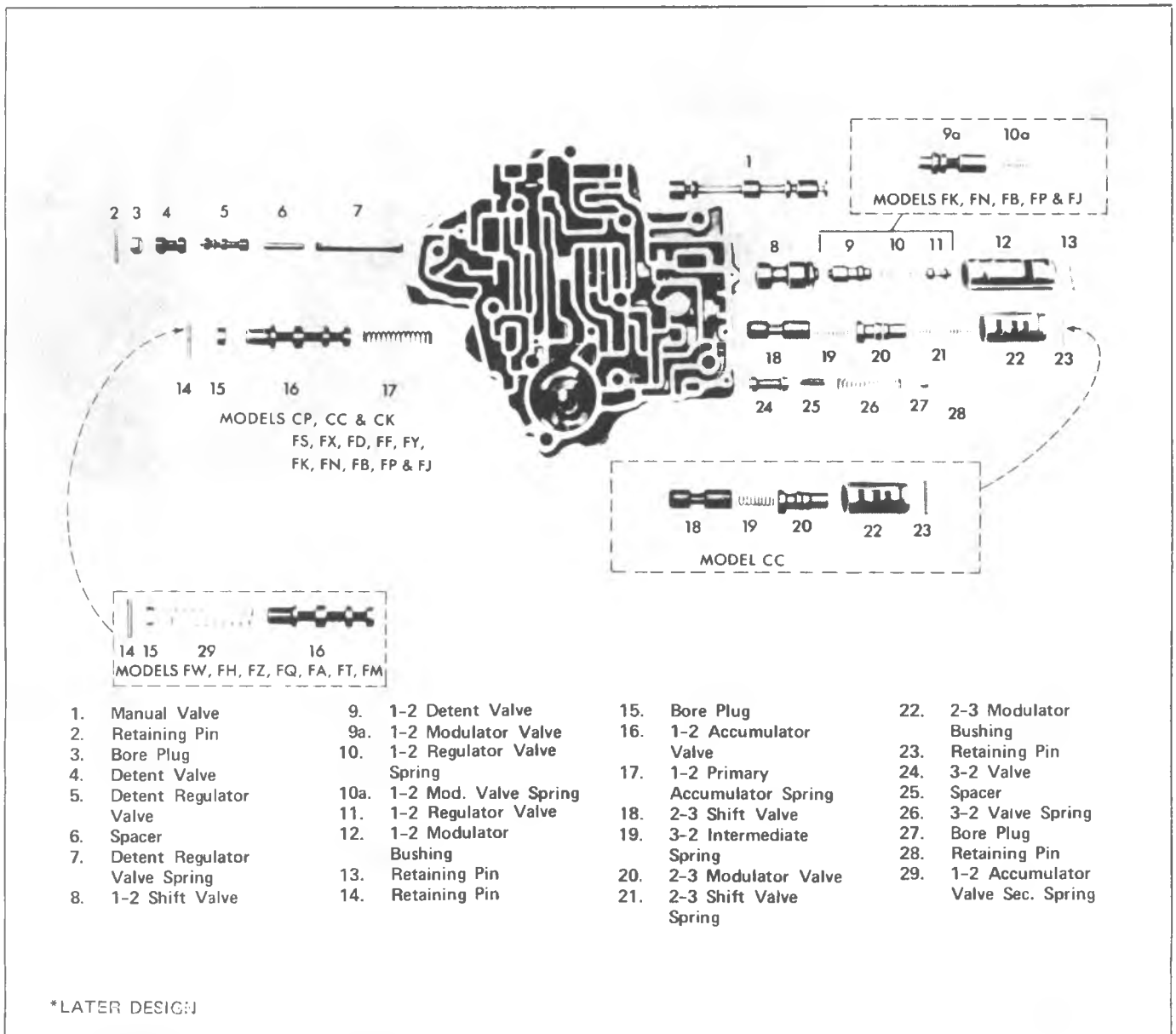


Fig. 7A-67C--Control Valve Assembly--Exploded View

a. (Models FK, FN, FB, FJ and FP) Install the 1-2 valve spring and 1-2 modulator valve into the 1-2 modulator bushing, aligning the spring in the bore of the modulator valve. Install parts into the valve body bore.

and 1-2 modulator valve into the 1-2 modulator bushing, aligning the spring in the bore of the modulator valve. Install parts into the valve body bore.

b. (All other models) Install the 1-2 regulator valve, regulator spring and 1-2 detent valve open hole first into the 1-2 modulator bushing, aligning the spring in the bore of the detent valve.

15. Compress bushing against spring and install retaining pin.

16. Install manual valve with detent pin groove to the right.

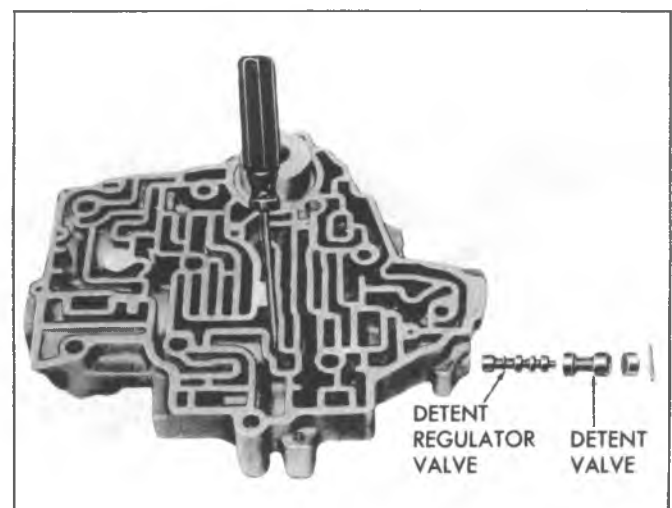


Fig. 7A-68C--Installing Detent Regulator Valve and Detent Valve

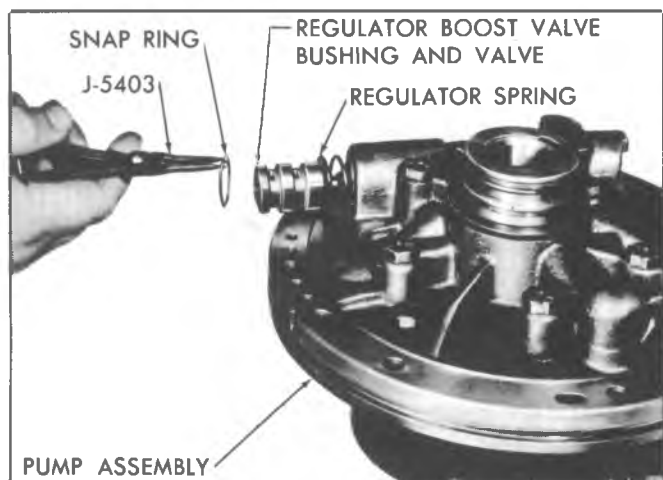


Fig. 7A-69C--Removing Pump Regulator Valve Snap Ring

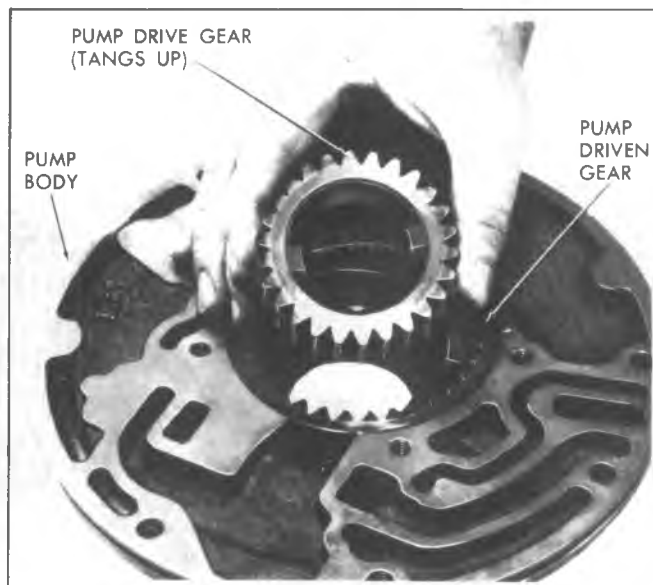


Fig. 7A-71C--Installing Pressure Regulator Retaining Pin and Bore Plug

Oil Pump Disassembly, Inspection and Assembly

Disassembly

1. Place oil pump assembly in hole in bench or holding fixture, J-6116 with J-21364 adapter.
2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using J-5403 pliers (Fig. 7A-69C).
3. Remove regulator boost valve bushing and valve.
4. Remove pressure regulator spring.
5. Remove regulator valve, spring retainer and spacer(s), if present (Fig. 7A-70C).
6. Remove pump cover to body attaching bolts.

7. Remove pump cover from body.
8. Remove retaining pin and bore plug from pressure regulator bore (Fig. 7A-71C).
9. Remove hook type oil rings from pump cover.
10. Remove pump to forward clutch housing selective washer.
11. Mark drive and driven gears for reassembly in same position and remove from the pump body. See Fig. 7A-72C.

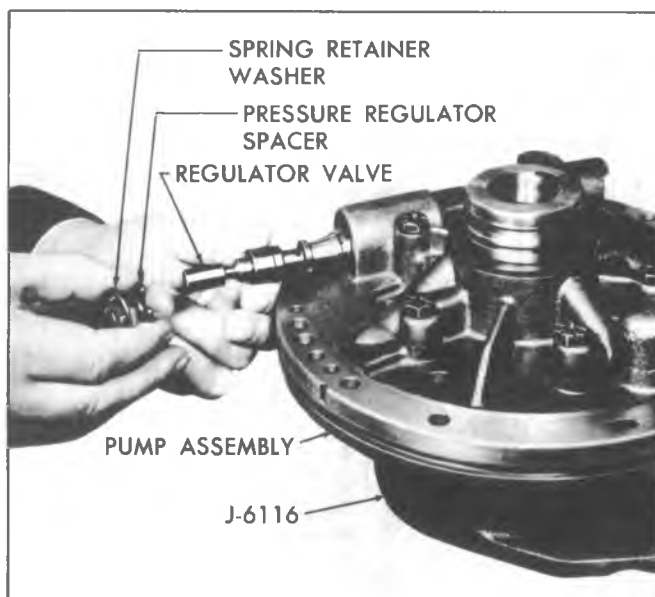


Fig. 7A-70C--Removing Pressure Regulator Valve

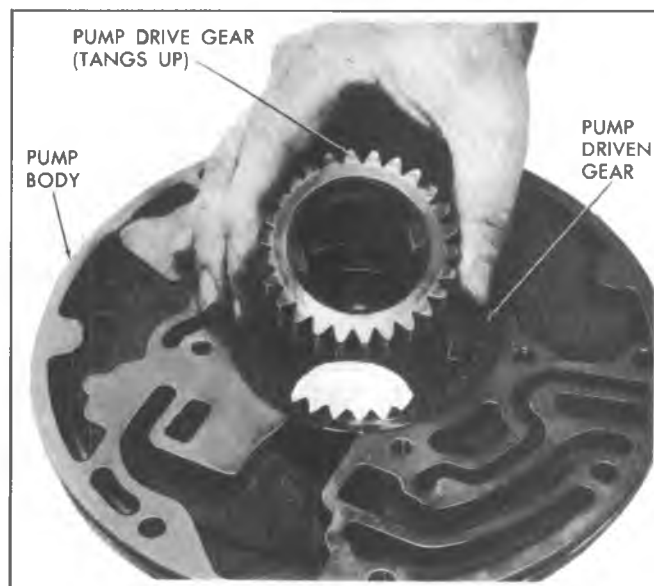


Fig. 7A-72C--Installing Pump Drive Gear

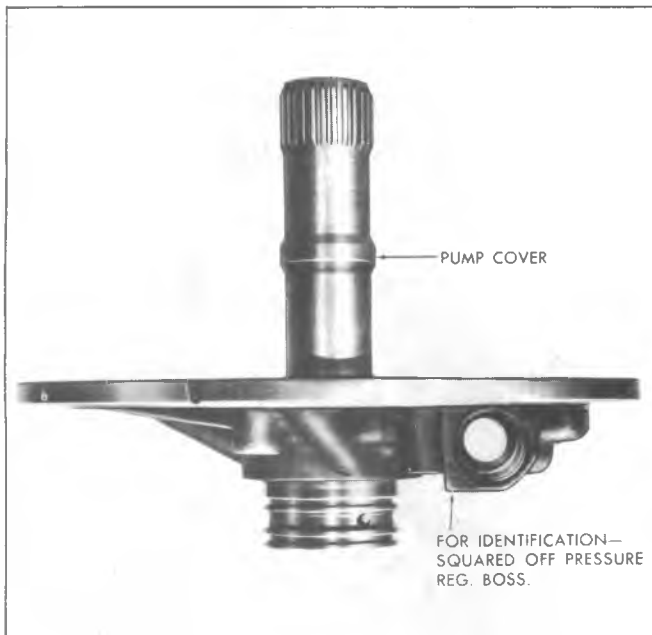


Fig. 7A-73C--Pressure Regulator Valve Identification

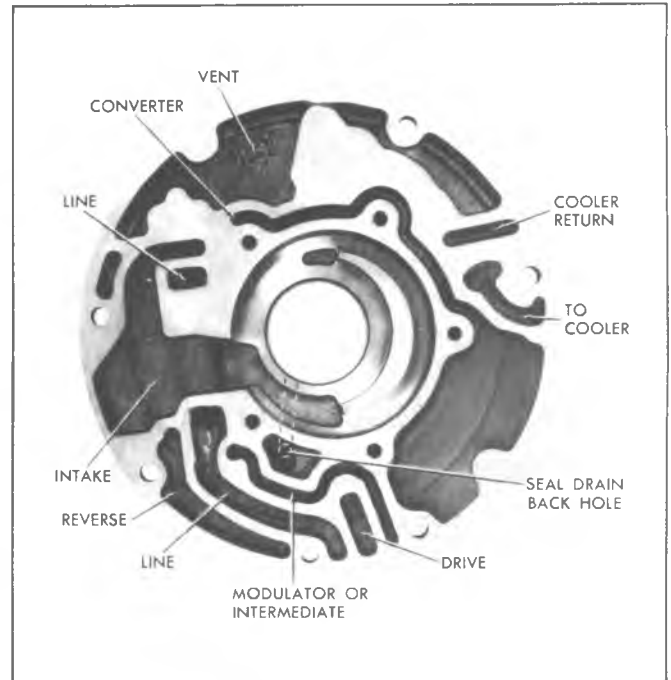


Fig. 7A-75C--Pump Body Oil Passages

Inspection of Pump Body and Pump Cover

NOTICE: A solid type pressure regulator valve must only be used in a pump cover with a squared off pressure regulator boss. See Fig. 7A-73C. A pressure regulator valve with oil holes and orifice cup plug may be used to service either type pump cover.

1. Inspect drive and driven gear pocket and crescent for scoring, galling or other damage.
2. Place pump gears in pump body and check pump body face to gear face clearance (should be .0008" - .0035") (Fig. 7A-74C).
3. Check face of pump body for scores or nicks.
4. Check oil passages (Fig. 7A-75C).
5. Check for damaged cover bolt attaching threads.
6. Check for overall flatness of pump body face.



Fig. 7A-74C--Checking Pump Body Face to Gear Face Clearance

7. Check bushing for scores or nicks. If replacement is necessary, proceed as follows:

- a. Using Tool J-21465-17 and driver Handle J-8092 remove bushing.
- b. From front side of pump, using J-21465-17 and driver Handle J-8092 install new bushing flush to .010" below gear pocket face.
8. Inspect pump attaching bolt seals for damage, replace if necessary.
9. Inspect pump cover face for overall flatness.
10. Check for scores or chips in pressure regulator bore.
11. Check that all passages are open and not interconnected (Fig. 7A-76C).

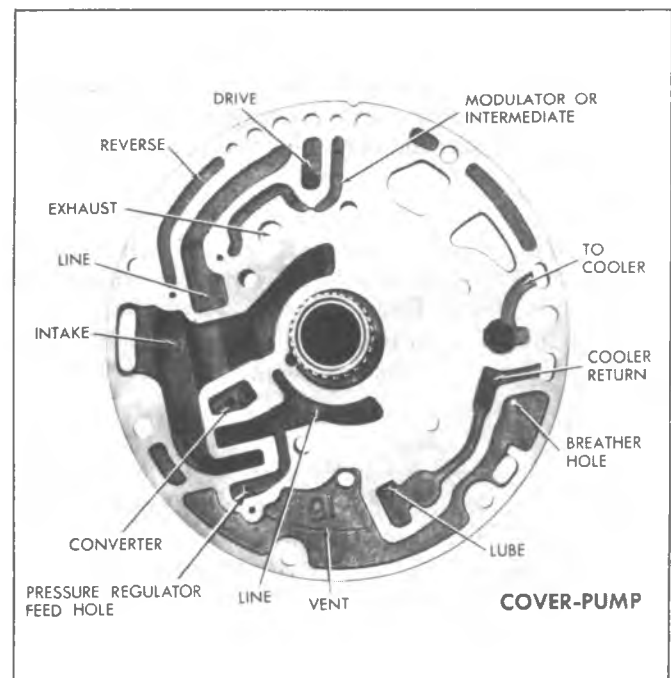


Fig. 7A-76C--Pump Cover Oil Passages

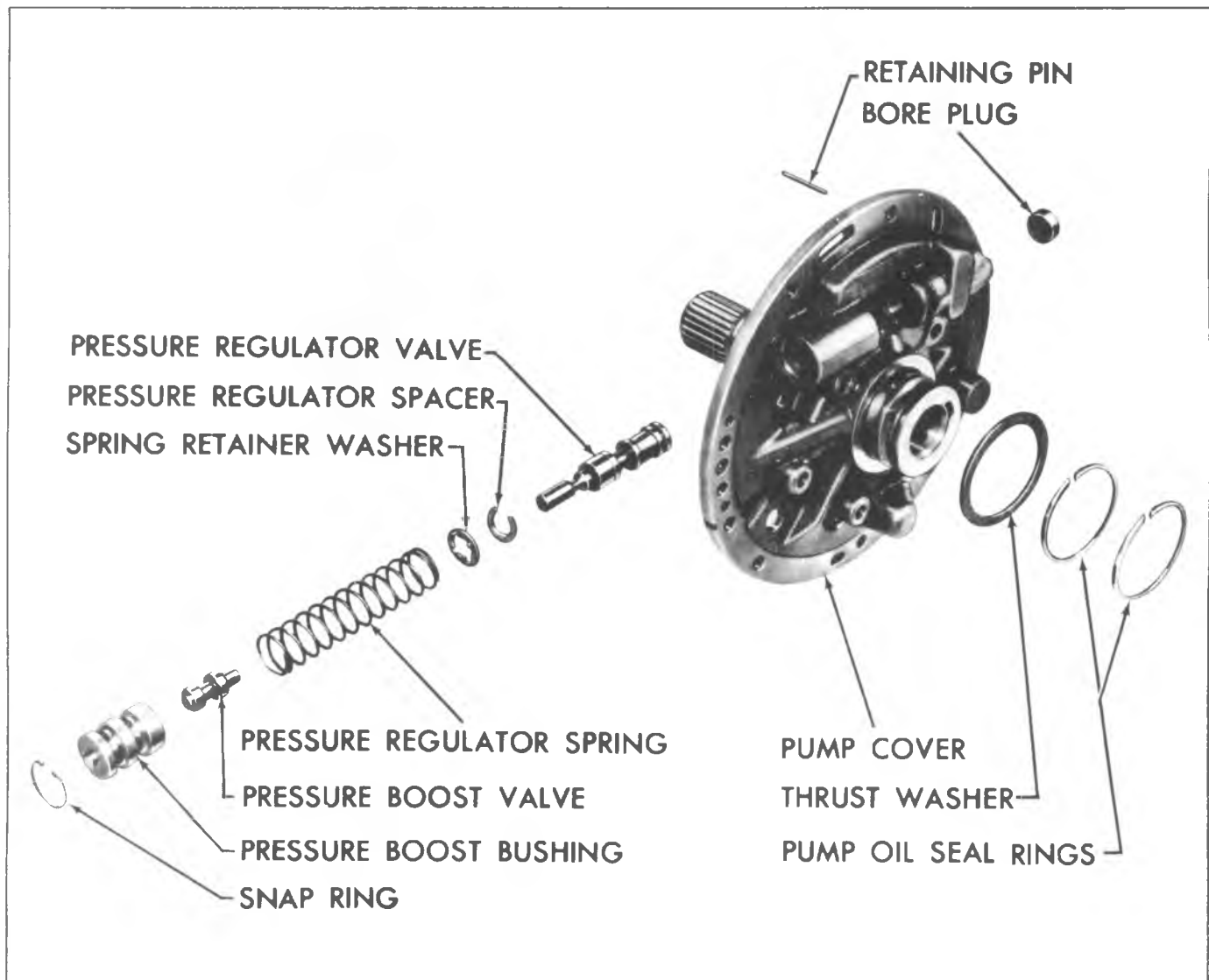


Fig. 7A-77C--Pump Cover--Exploded View

12. Check for scoring or damage at pump gear face.

13. Inspect stator shaft for damaged splines, or scored bushings. If replacement of bushing is necessary proceed as follows:

Front

a. With pump cover and stator shaft properly supported, using Tool J-21465-15, with slide hammer tool J-2619, and adapter Tool J-2619-4 remove bushing.

b. Using Tool J-21465-3 with Driver Handle J-8092 press or drive replacement bushing into place until tool bottoms.

Rear

c. With pump and stator shaft properly supported, using Tool J-21465-15, with slide hammer Tool J-2619 and adapter tool J-2619-4, remove bushing.

d. Using Tool J-21465-2 with Driver Handle J-8092, pressor drive replacement bushing into place until tool bottoms.

14. Inspect oil ring grooves for damage or wear.

15. Inspect selective washer thrust face for wear or damage.

16. Inspect pressure regulator and boost valve for free operation in their respective bores.

17. Inspect pump cover for open 1/8" breather hole (Fig. 7A-76C).

Assembly

1. Install drive and driven pump gears with alignment marks up into pump body (Fig. 7A-72C) drive gear tangs up.

2. Protect stator shaft and install pump cover in vise.

3. Install spacer(s) if used, retainer and spring, into pressure regulator bore (Fig. 7A-77C).

4. Install pressure regulator valve from opposite end of bore, stem end first.

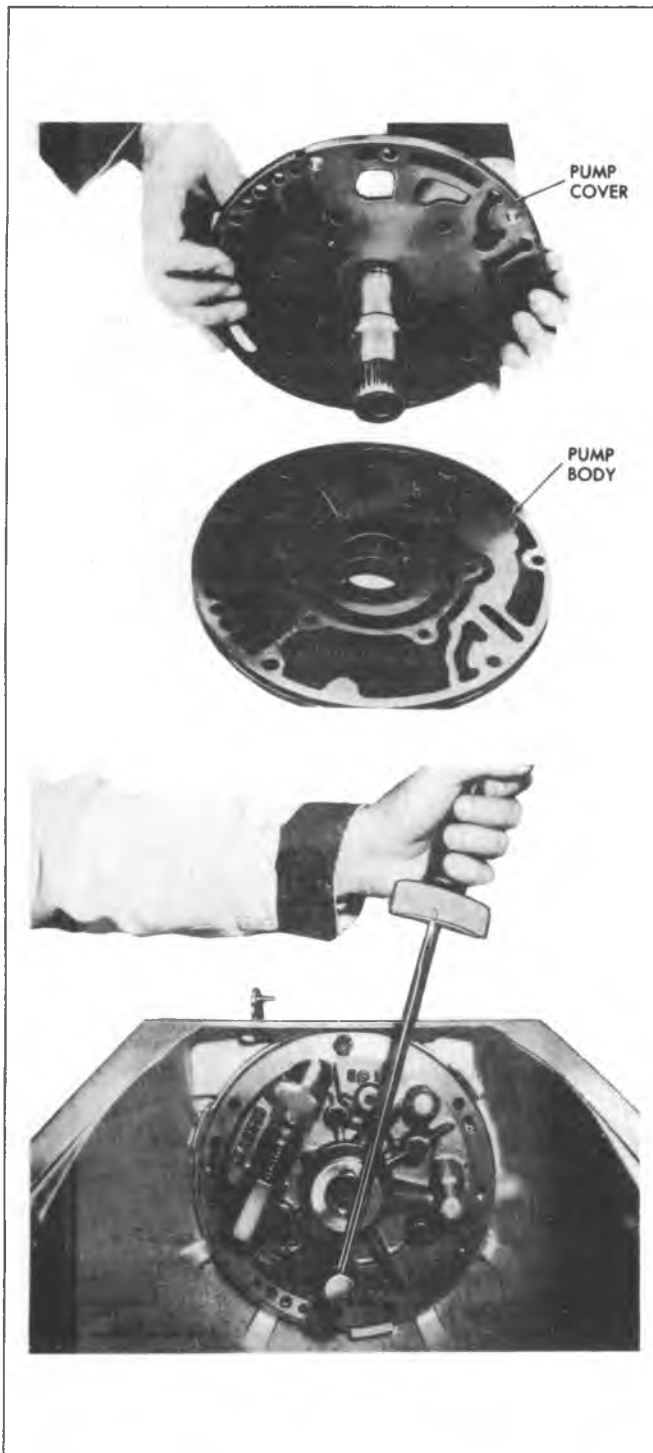


Fig. 7A-78C--Aligning and Installing Pump Cover to Pump Body

5. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

6. Install retaining snap ring.

7. Install pressure regulator valve bore plug and retaining pin into opposite end of bore.

8. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

9. Install two (2) hook type oil seal rings.

10. Assemble pump cover to pump body with attaching bolts (Fig. 7A-78C). Leave bolts one turn loose at this time.

11. To align the pump body and cover, place the pump assembly, less rubber seal ring, upside down into the pump bore of the case (Fig. 7A-78C).

12. Tighten pump cover bolts to 18 foot pounds. Remove pump assembly from case bore.

13. Install pump to case "O" ring seal.

FORWARD CLUTCH DISASSEMBLY, INSPECTION AND ASSEMBLY

See Clutch Chart, Fig. 7A-79C, for details of clutch components by specific model designations.

CLUTCH APPLICATION CHART
THM 400

MODEL	FORWARD CLUTCH				DIRECT CLUTCH			INTERMEDIATE CLUTCH		
	FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF COMPOSI- TION PLATES	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSI- TION PLATES	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSI- TION PLATES
	NO.	THICKNESS								
FM, FA, FJ, FP, FN, FH, FY, FF, FW, FB, FD, FX, FZ, FK, FT	4	.0775"	1	4	5	0	5	2	1	3
FL, FS	5	.0915"	0	5	6	0	*6	3	0	*3
FQ, FT, FR	4	.0775"	1	5	4	1	5	2	1	3

* MODELS FL & FS HAVE CLUTCH PLATES WHICH ARE DIFFERENT THAN OTHER MODELS. REFER TO THE PARTS CATALOG FOR CORRECT USAGE.

Fig. 7A-79C--Clutch Chart, Component Details

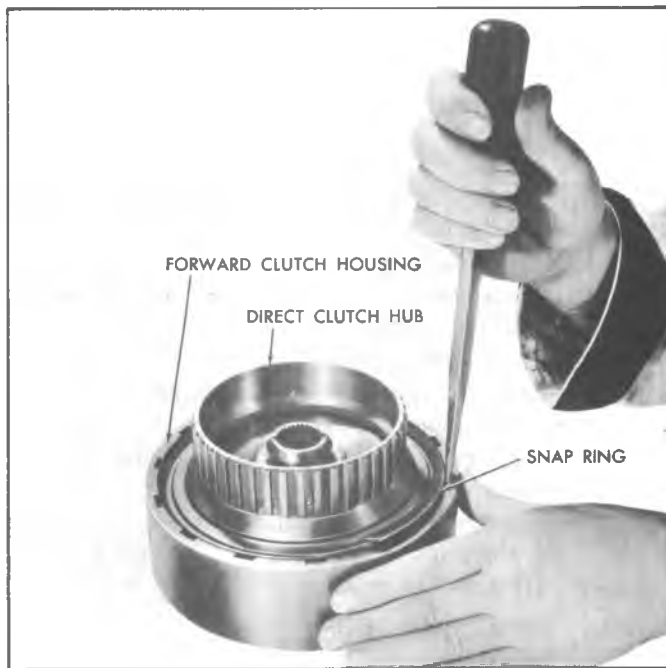


Fig. 7A-80C--Removing Forward Clutch Housing to Direct Clutch Hub Snap Ring

Disassembly

1. Place forward clutch assembly with turbine shaft through hole in bench or Holding Fixture J-6116, and remove forward clutch housing to direct clutch hub snap ring (Fig. 7A-80C).
2. Remove direct clutch hub.
3. Remove forward clutch hub and thrust washers (Fig. 7A-81C).
4. Remove composition, steel clutch plates, and waved steel plate. Models FL and FS do not use a waved steel plate.

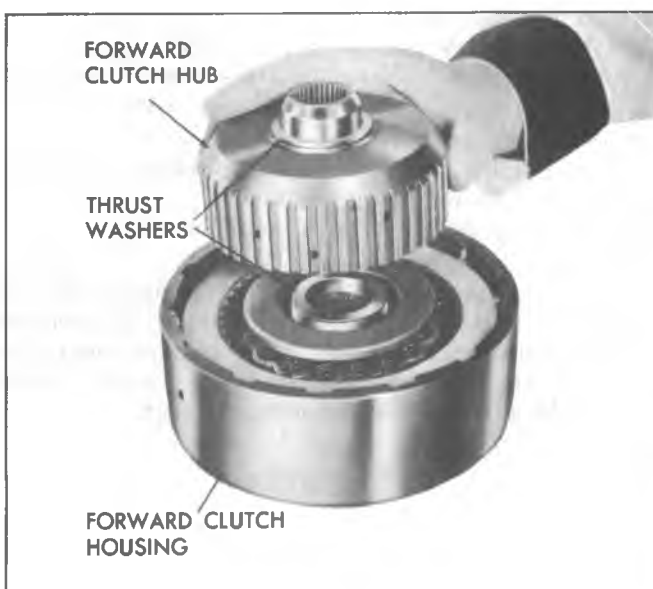


Fig. 7A-81C--Removing Forward Clutch Hub and Thrust Washers

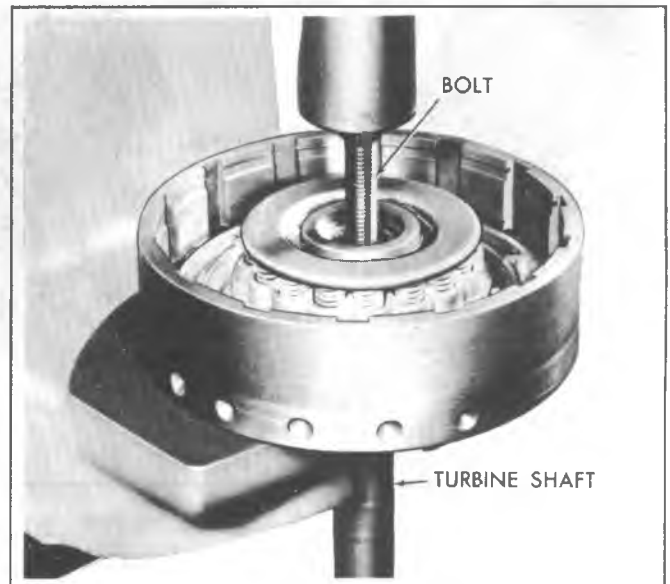


Fig. 7A-82C--Removing Turbine Shaft from Forward Clutch Housing

5. If necessary place forward clutch and turbine shaft in arbor press and remove turbine shaft (Fig. 7A-82C).

6. Using J-4670 clutch spring compressor in arbor press with Adapter J-21664, compress spring retainer and remove snap ring (Fig. 7A-83C).

7. Remove spring retainer and sixteen (16) clutch release springs. Keep springs separate from direct clutch release springs.

8. Remove forward clutch piston.



Fig. 7A-83C--Removing Forward Clutch Spring Retaining Snap Ring



Fig 7A-84C--Removing Forward Clutch Piston Outer Seal

9. Remove inner and outer clutch piston seals (Fig. 7A-84C).

10. Remove center piston seal from forward clutch housing (Fig. 7A-85C).

Inspection

1. Inspect composition-faced and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen (16) springs for collapsed coils or signs of distortion.



Fig. 7A-85C--Removing Forward Clutch Center Seal

3. Inspect clutch hubs for worn splines, proper lubrication holes or scored thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.

6. Inspect turbine shaft.

a. Inspect for open lubrication passages at each end.

b. Inspect splines for damage.

c. Inspect ground bushing journals for damage.

d. Inspect shaft for cracks or distortion.

Turbine shaft and clutch housing are serviced separately. Shaft may be removed from housing by using a suitable size socket in an arbor press (Fig. 7A-82C).

Assembly (Fig. 7A-86C)

NOTICE: The forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore, care should be exercised to make certain the proper piston be installed in the clutch assemblies, as shown in Figure 7A-102C.

1. Place new inner and outer oil seals on clutch piston, lips face away from spring pockets (Fig. 7A-84C).

2. Place a new center seal on clutch housing, as shown in Fig. 7A-85C. Apply automatic transmission oil to all seals and clutch plates.

3. Place seal protector Tool J-21362, over clutch hub and install outer clutch piston seal Protector J-21409, into clutch drum and install piston, rotating piston on drum until seated (Fig. 7A-87C).

4. Install sixteen (16) clutch release springs into pockets in piston.

5. Place spring retainer and snap ring on springs.

6. Compress springs in arbor press, using clutch compressor Tools J-4670 and J-21664, install snap ring.

7. If removed, install turbine shaft in forward clutch housing, using arbor press.

8. Install forward clutch hub washers on forward clutch hub. Retain with petrolatum.

9. Place forward clutch hub into forward clutch housing.

10. Oil and install the composition plates, flat steel plates and waved steel clutch plate (with "U" notches), starting with waved steel and then alternating composition and steel clutch plates, as shown in Fig. 7A-88C. Models FL and FS do not use a waved steel clutch plate.

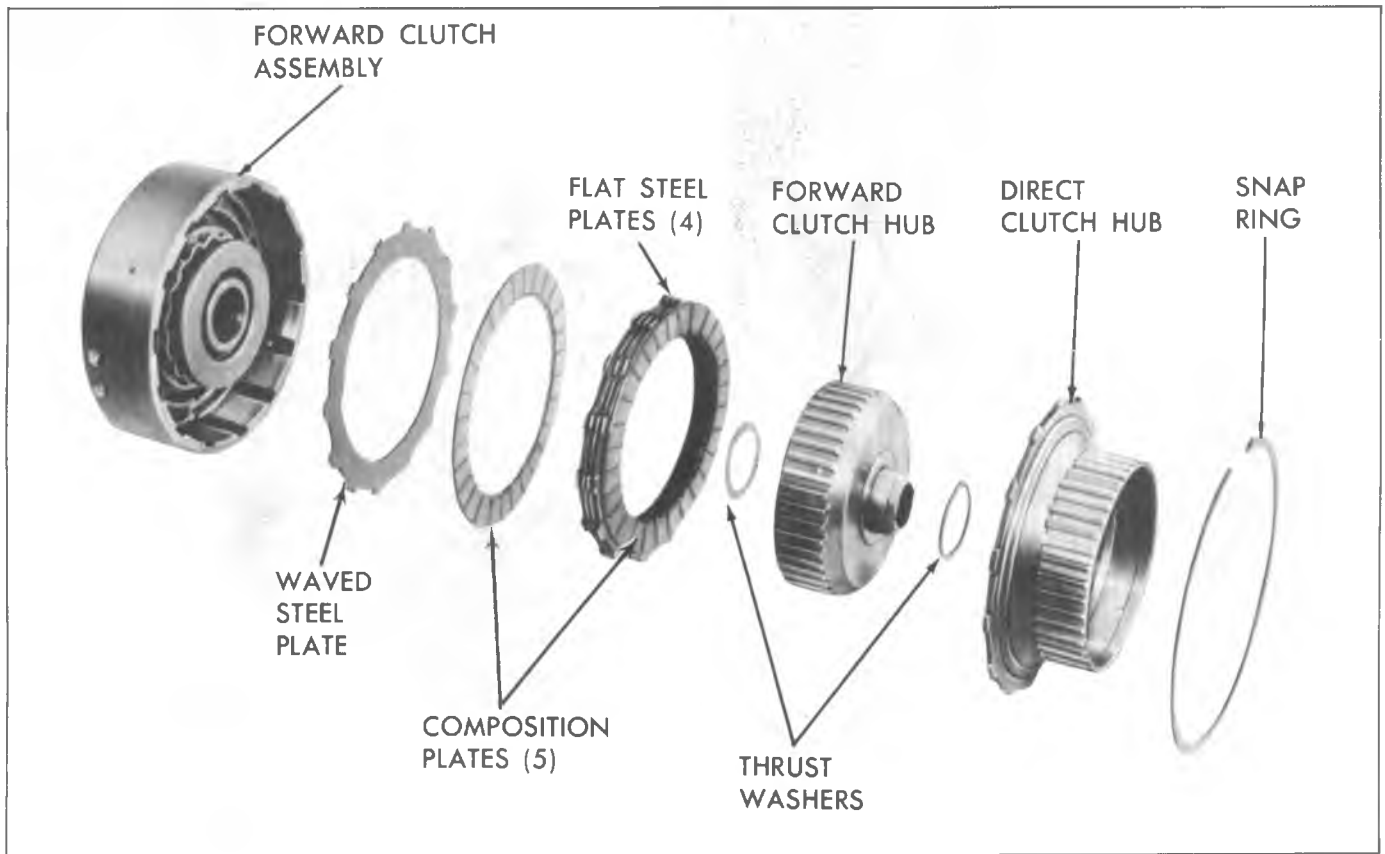


Fig. 7A-86C--Forward Clutch Assembly--Exploded View

NOTICE: Do not confuse the flat steel clutch plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch), or damage may occur.

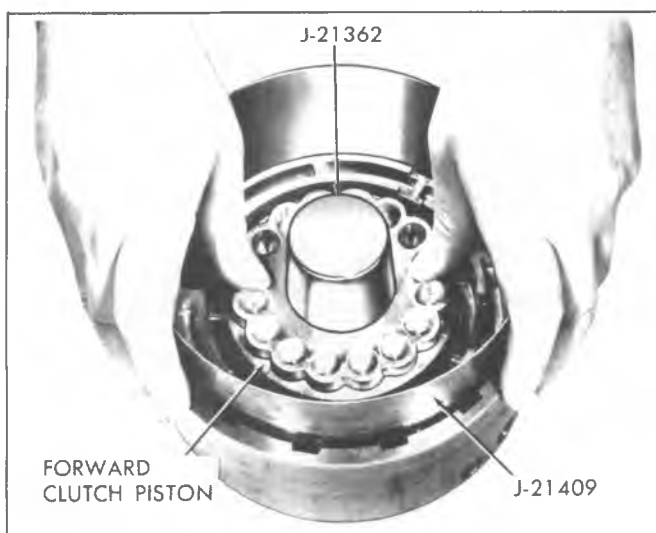


Fig. 7A-87C--Installing Forward Clutch Piston

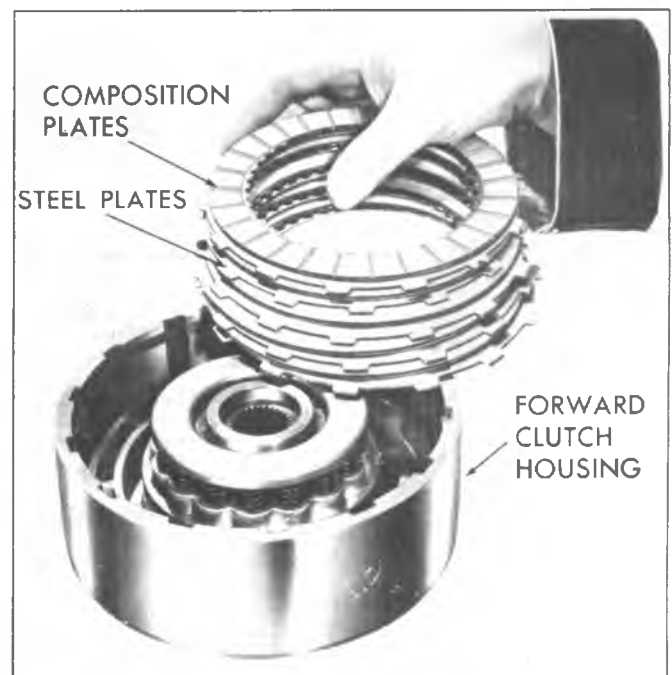


Fig. 7A-88C--Installing Forward Clutch Composition and Steel Plates



Fig. 7A-89C--Installing Forward Clutch Housing to Direct Clutch Hub Snap Ring



Fig. 7A-90C--Air Checking Forward Clutch Assembly

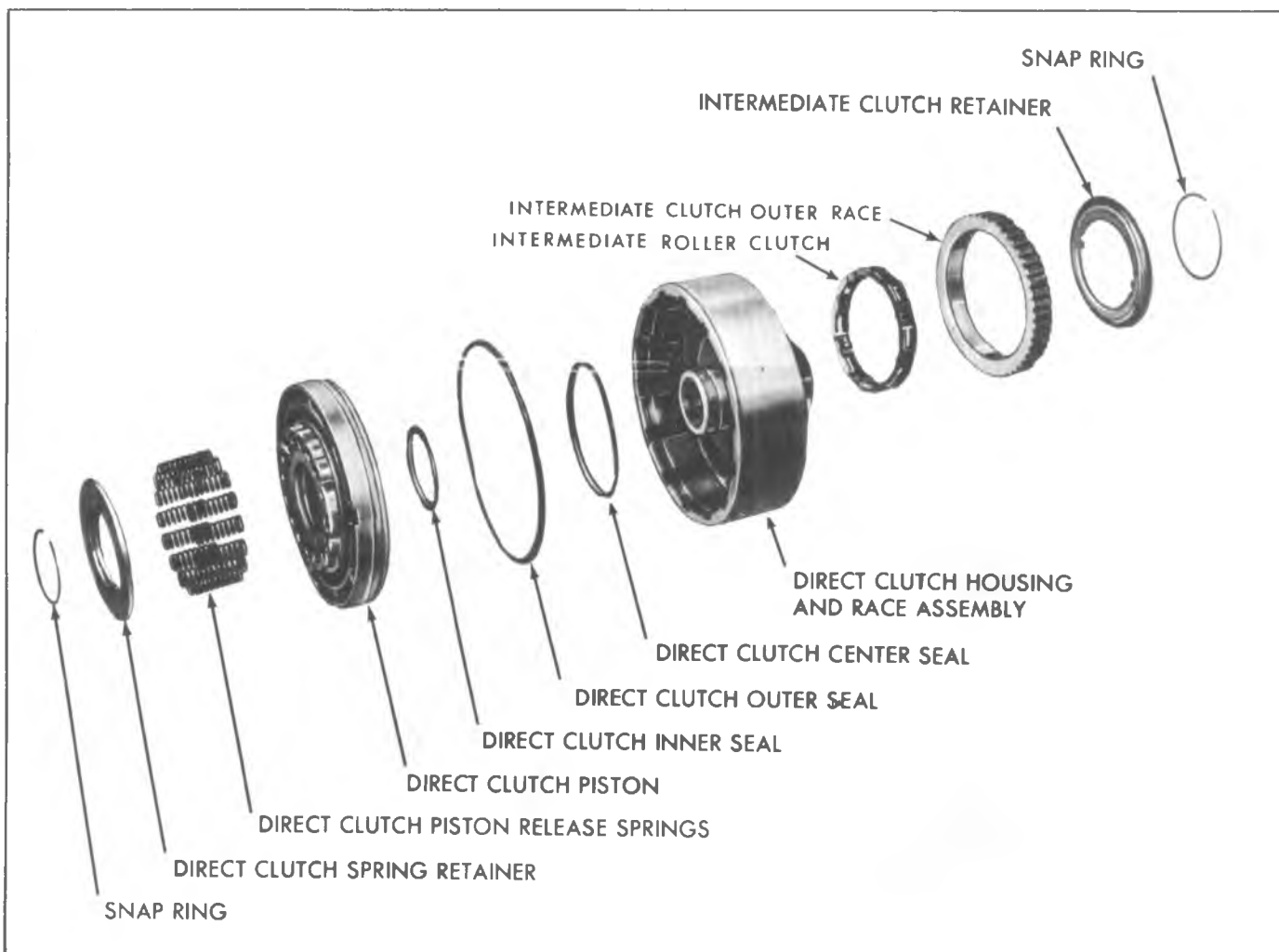


Fig. 7A-91C--Direct Clutch and Intermediate Roller Assembly

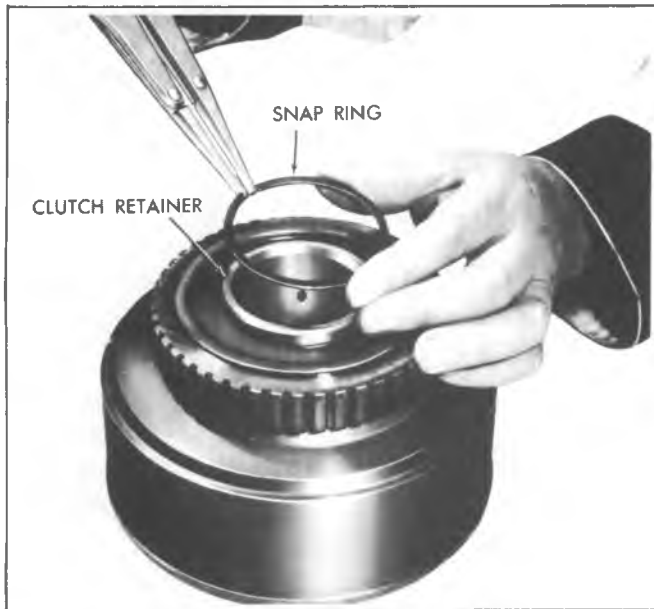


Fig. 7A-92C--Removing Intermediate Clutch Retainer Snap Ring

11. Install direct clutch hub and retaining snap ring (Fig. 7A-89C).

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (7A-90C).

DIRECT CLUTCH AND INTERMEDIATE ROLLER DISASSEMBLY, INSPECTION AND ASSEMBLY

Refer to Fig. 7A-79C.

Disassembly (Fig. 7A-91C)

1. Remove intermediate roller assembly retainer snap ring and retainer (Fig. 7A-92C).

2. Remove roller outer race and roller assembly.

3. Turn unit over and remove backing plate to direct clutch housing snap ring (Fig. 7A-93C).

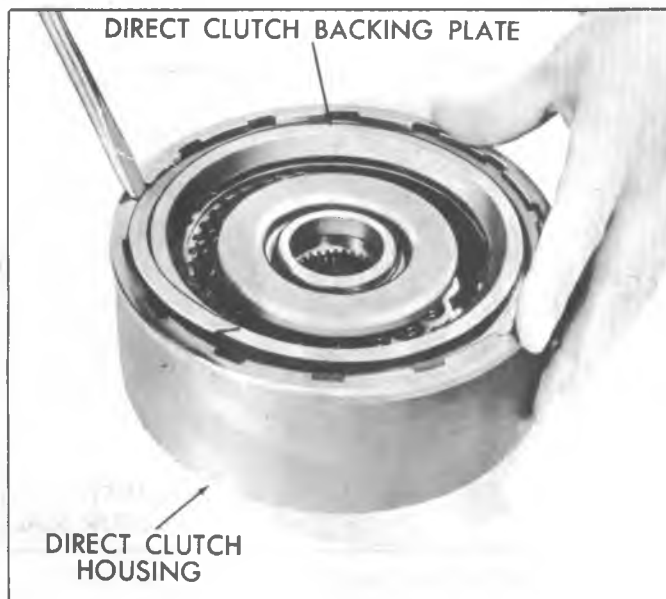


Fig. 7A-93C--Removing Direct Clutch Backing Plate Snap Ring



Fig. 7A-94C--Removing or Installing Direct Clutch Snap Ring

4. Remove direct clutch backing plate, composition plates, and steel clutch plates.

5. Using clutch compressor Tool J-4670 and J-21664, compress spring retainer in arbor press and remove snap ring (Fig. 7A-94C).

6. Remove retainer and fourteen (14) piston release springs. Keep springs separate from forward clutch release springs.

7. Remove direct clutch piston (Fig. 7A-95C).

8. Remove outer seal from piston.

9. Remove inner seal from piston.

10. Remove center piston seal from direct clutch housing.

Inspection

1. Inspect roller assembly for popped or loose rollers.

2. Inspect inner cam and outer race for scratches or wear.

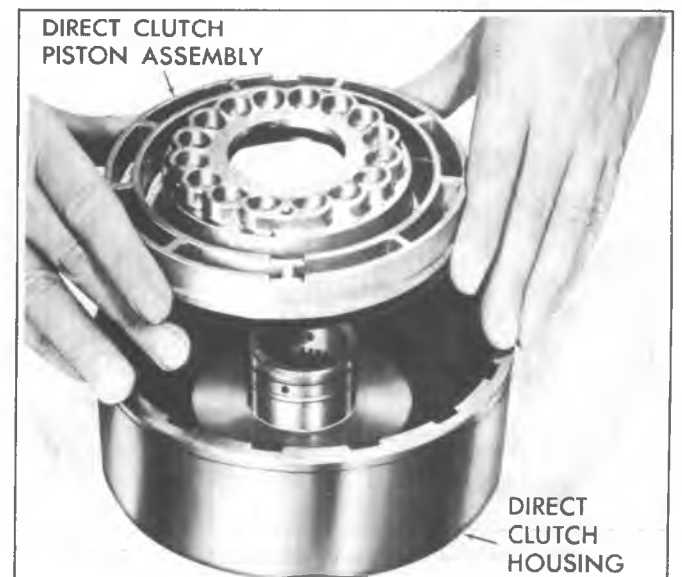


Fig. 7A-95C--Removing Direct Clutch Piston Assembly

3. Inspect clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.
4. Inspect composition-faces and steel clutch plates for sign of wear or burning.
5. Inspect backing plate for scratches or other damage.
6. Inspect clutch piston for cracks.
7. Inspect fourteen (14) release springs for collapsed coils or signs of distortion. The 14 direct clutch release springs are not serviced. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.
8. Inspect housing for free operation of check ball.

Assembly

The forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore, care should be exercised to make certain the proper piston be installed in the clutch assemblies, as shown in Figure 7A-102C.

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets (Fig. 7A-96C).
2. Install a new outer clutch piston seal with lip facing away from spring pockets (Fig. 7A-97C).
3. Install a new center seal on clutch housing with lip of seal facing up (Fig. 7A-98C). Apply automatic transmission oil to all seals and clutch plates before installation.

NOTICE: The direct clutch housing for models FL and FS use the 6 plate clutch assembly. This housing can be identified by the elimination of the inside diameter chamfer on the clutch plate end and/or a groove in the

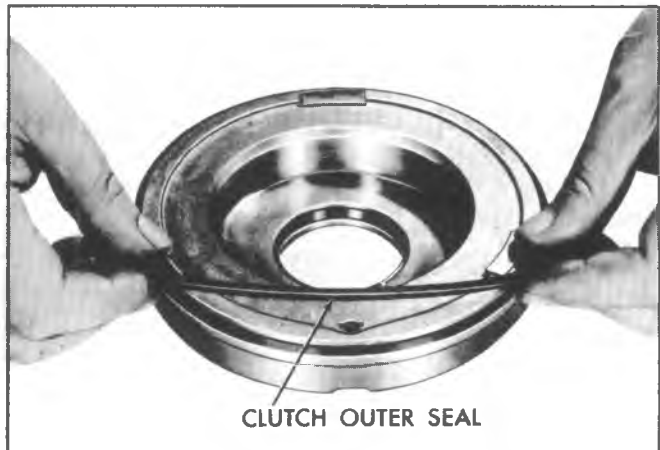


Fig. 7A-97C--Installing Direct Clutch Outer Seal

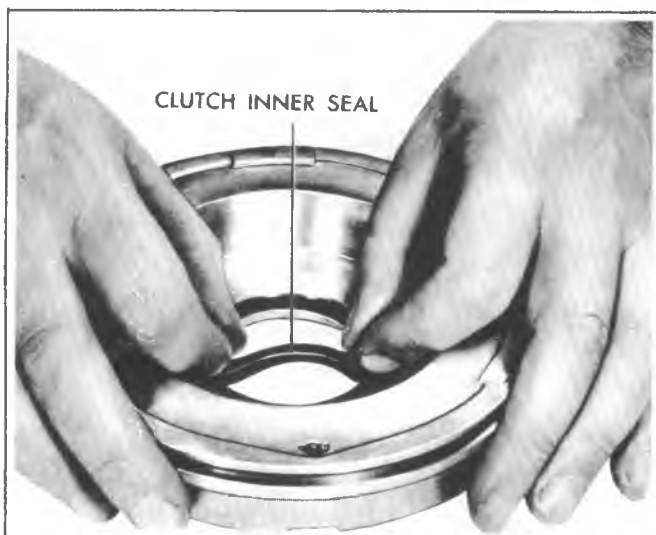


Fig. 7A-96C--Installing Direct Clutch Inner Seal



Fig. 7A-98C--Installing Direct Clutch Center Seal

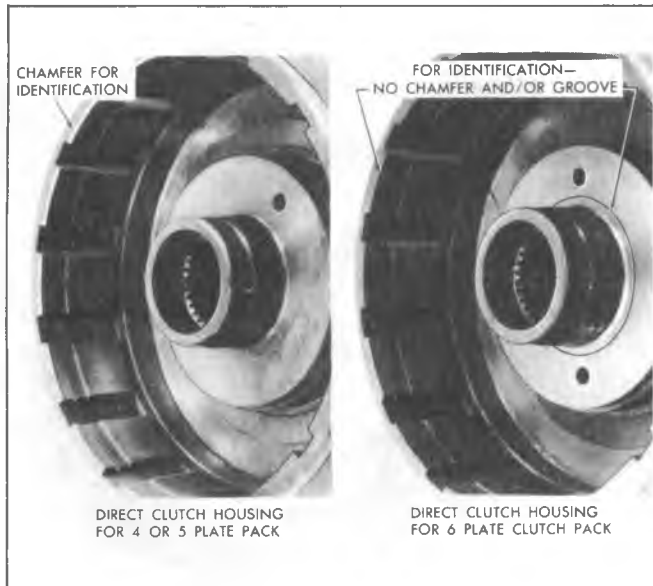


Fig. 7A-99C--Direct Clutch Housing Identification

face at the base of the tower (Fig. 7A-99C). Should replacement of the direct clutch housing become necessary, extreme care must be taken in obtaining the correct part for the model involved.

Production built transmissions use a direct clutch housing with a check ball (See Fig. 7A-100C). If the housing requires replacement and the replacement housing does not contain a check ball, replace the direct clutch piston with the service piston which has a check ball. **EITHER THE DIRECT CLUTCH HOUSING AND/OR THE PISTON MUST CONTAIN A CHECK BALL(S).**

4. Place seal protectors, Tools J-21362 Inner, J-21409 Outer, over hub and clutch housing and install clutch piston, with a rotating motion (Fig. 7A-101C).

5. Install fourteen (14) springs into piston leaving two pockets diagonally opposite with no springs.

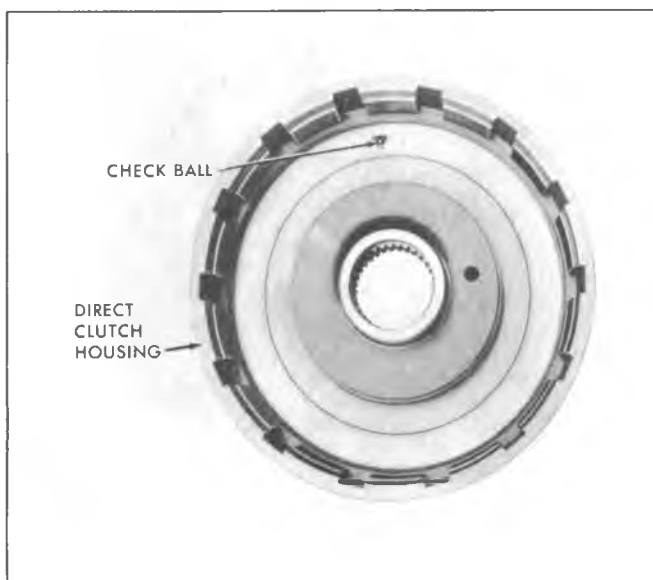


Fig. 7A-100C--Direct Clutch Housing with Check Ball

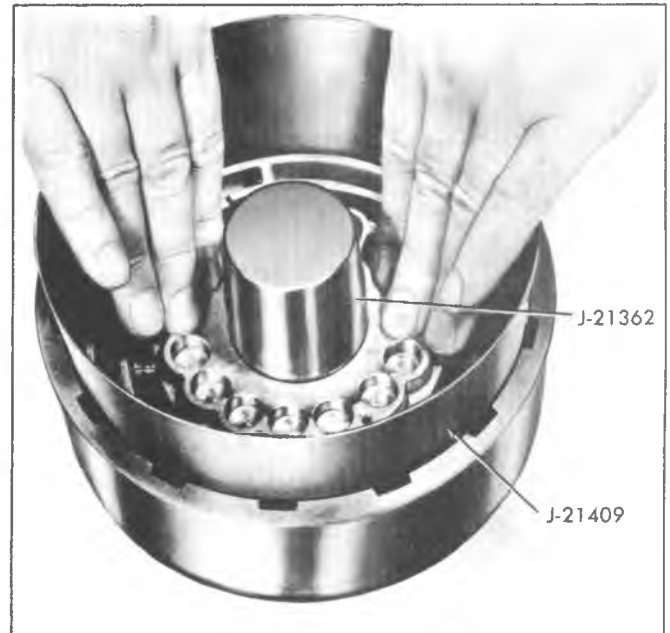


Fig. 7A-101C--Installing Direct Clutch Piston

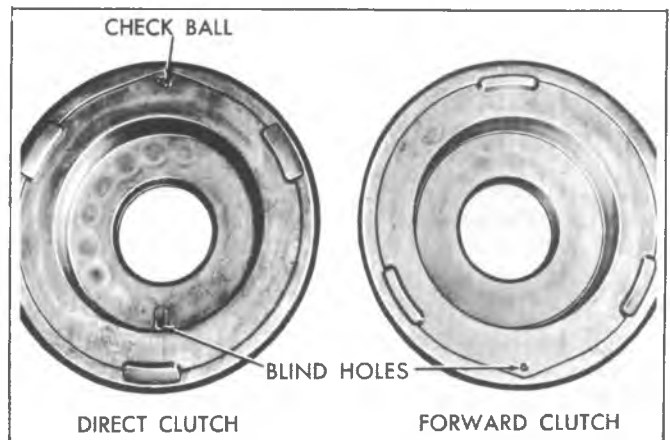


Fig. 7A-102C--Forward and Direct Clutch Piston Identification

6. Place spring retainer and snap ring on retainer.

7. Using an arbor press and Tool J-4670, with J-21664, compress springs and install snap ring (Fig. 7A-94C):

8. Install direct clutch plates. See Fig. 7A-103C.

a. For model FQ, start with one (1) waved steel plate.

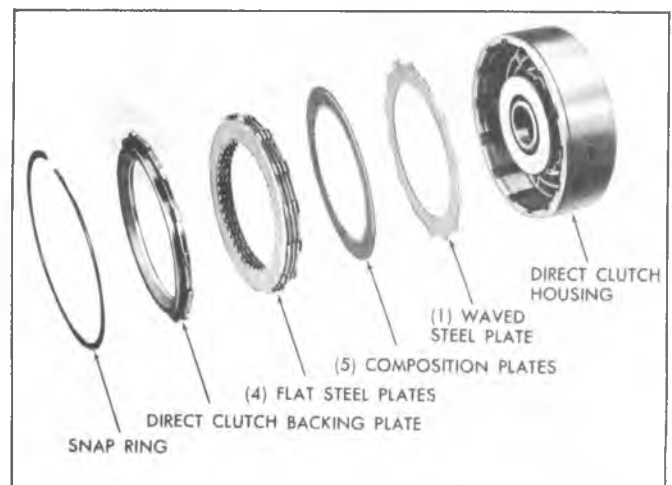


Fig. 7A-103C--Direct Clutch Assembly Exploded

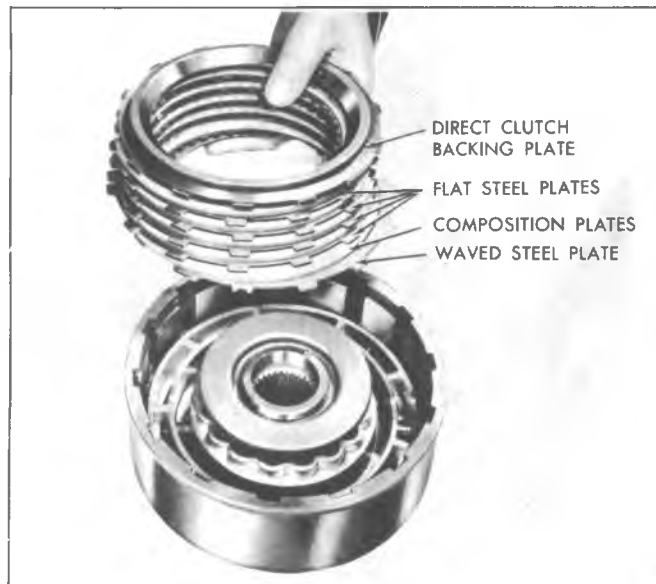


Fig. 7A-104C--Install Direct Clutch Backing Plate, Composition Plates, and Steel Plates

followed alternately by five (5) composition plates and four (4) flat steel plates. (Fig. 7A-104C).

b. (Models FL and FS) Oil and install six (6) composition and six (6) flat steel plates, starting with a flat steel plate and alternating composition and flat steel clutch plates.

9. Install clutch backing plate.

10. Install backing plate retaining snap ring (Fig. 7A-105C). 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.

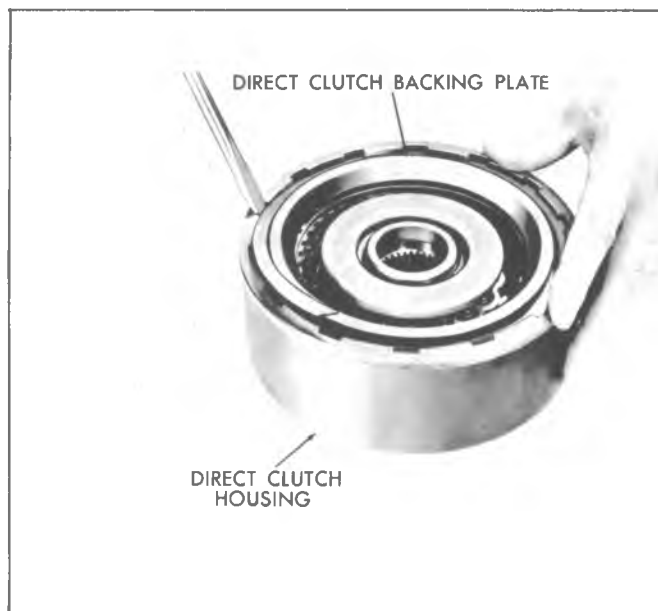


Fig. 7A-105C--Installing Direct Clutch Housing to Backing Plate Snap Ring

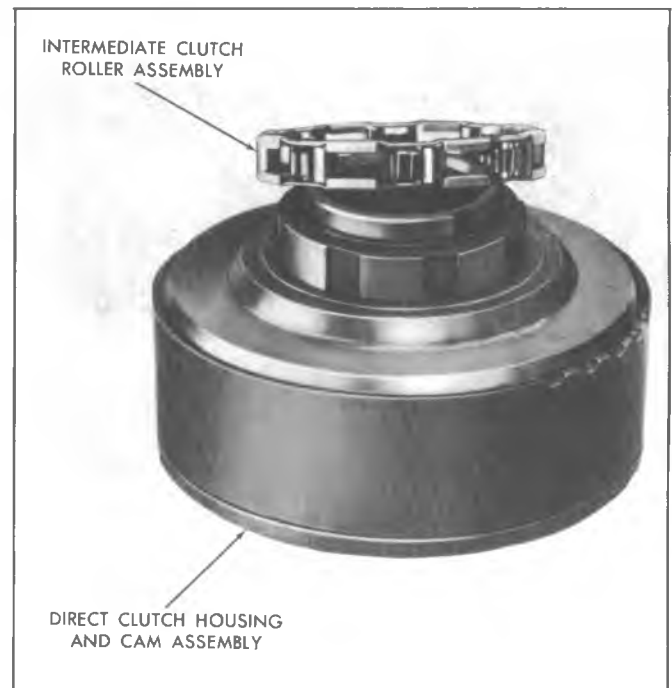


Fig. 7A-106C--Installing Intermediate Clutch Roller Assembly

11. Turn unit over and install the intermediate clutch roller assembly onto the intermediate clutch inner cam (fig. 7A-106C).

12. Install the intermediate clutch outer race with a clockwise turning motion (fig. 7A-107C).

Intermediate roller clutch is not released for the FL and FS models. The sprag assembly is released for these models. Outer race should not turn counter-clockwise after installation. (See Figure 7A-108C).



Fig. 7A-107C--Installing Intermediate Clutch Outer Race to Direct Clutch

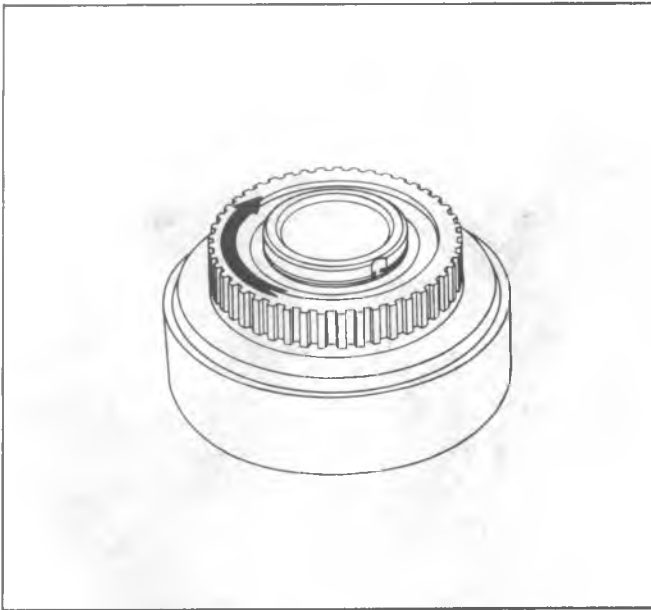


Fig. 7A-108C--Intermediate Roller Clutch Rotation

13. Install intermediate clutch retainer and snap ring (Fig. 7A-109C and 7A-110C).

14. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7A-111C).

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.

DISASSEMBLY, INSPECTION AND RE-ASSEMBLY OF CENTER SUPPORT

Disassembly

1. Remove four (4) oil seal rings from the center support (Fig. 7A-112C).



Fig. 7A-109C--Installing Intermediate Clutch Retainer

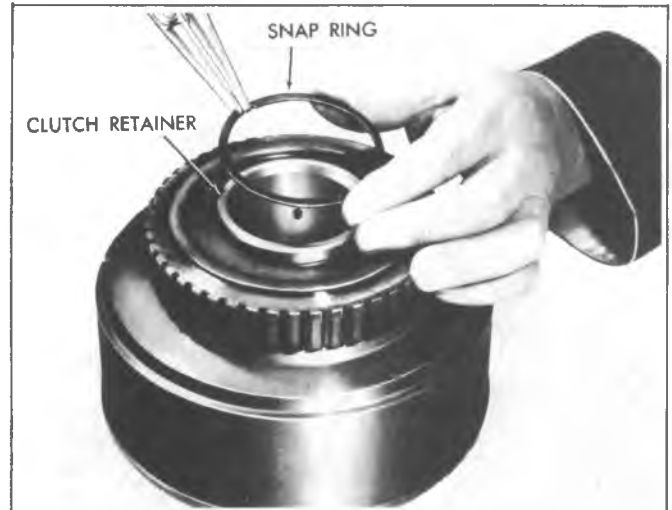


Fig. 7A-110C--Installing Intermediate Clutch Retainer Snap Ring

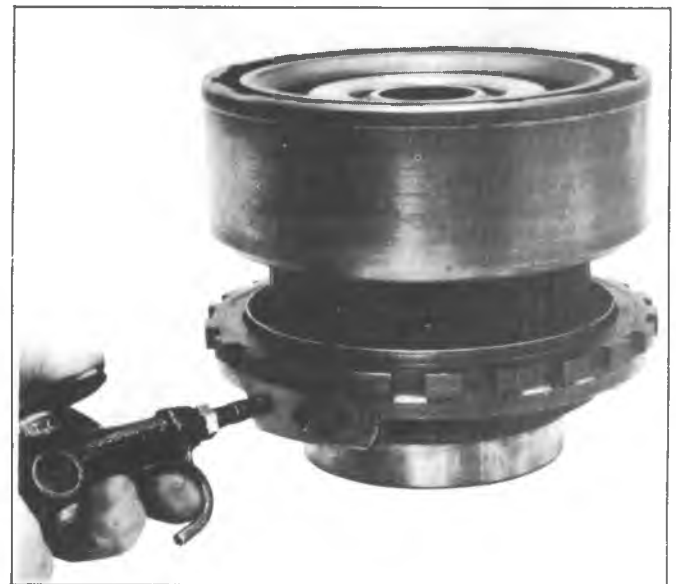


Fig. 7A-111C--Air Checking Direct Clutch Assembly

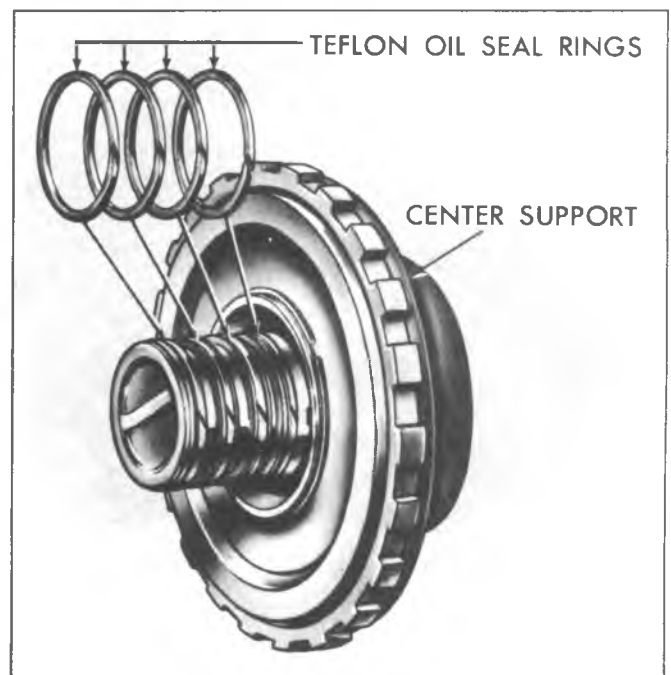


Fig. 7A-112C--Center Support and Oil Seal Rings



Fig. 7A-113C--Removing Intermediate Clutch Piston Snap Ring



Fig. 7A-115C--Removing Clutch Release Springs

2. Compress spring retainer and remove snap ring (7A-113C).

3. Remove spring retainer (Fig. 7A-114C) and three (3) clutch release springs (Fig. 7A-115C).

4. Remove intermediate clutch spring guide (Fig. 7A-116C).

5. Remove intermediate clutch piston (Fig. 7A-117C).

6. Remove inner and outer piston seal. Do not remove three (3) screws retaining roller clutch inner race to center support.

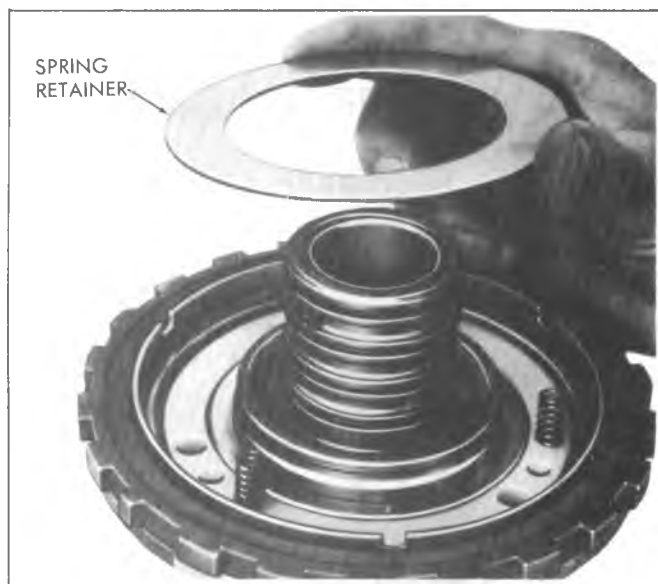


Fig. 7A-114C--Removing Spring Retainer

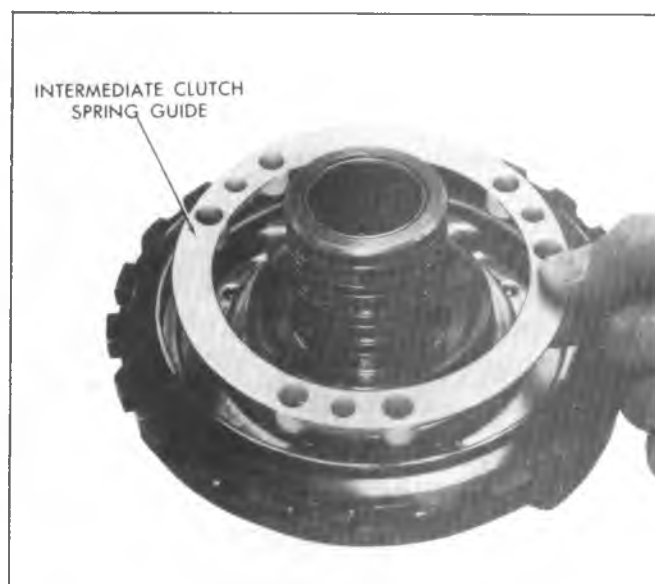


Fig. 7A-116C--Removing Intermediate Clutch Spring Guide



Fig. 7A-117C--Removing Intermediate Clutch Piston

Inspection (Fig. 7A-118C)

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open. Be sure constant bleed plug orifice, (approx. .020 dia.), is open (Fig. 7A-47C).
2. Inspect bushing for scoring, wear or galling. If replacement is necessary, proceed as follows:
 - a. Using Tool J-21465-6 with Driver Handle J-8092 remove bushing.
 - b. From front side of center support, align elongated slot in the bushing with drilled hole in the oil delivery sleeve closest to the piston. Using Tool J-21465-6 and Driver Handle J-8092, drive bushing squarely into the bore until the bushing is flush to .010" below top of oil delivery sleeve.
3. Check oil ring grooves and oil rings for damage.
4. Air check oil passages to be sure they are not interconnected.
5. Inspect piston sealing surfaces for scratches.
6. Inspect piston seal grooves for nicks or other damage.
7. Inspect piston for cracks.
8. Inspect release springs for distortion.
9. Inspect support to case for burrs or raised edges. If present, remove with a stone or fine sandpaper.

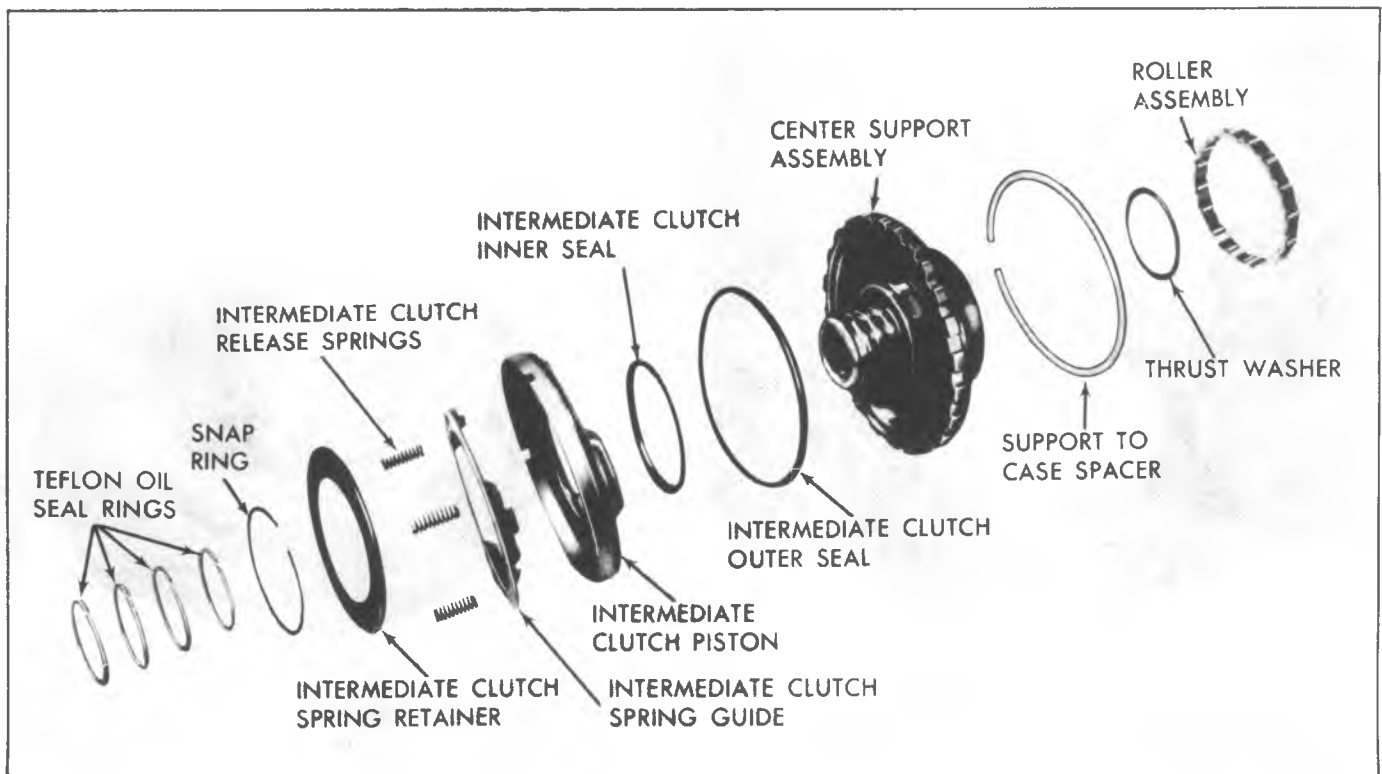


Fig. 7A-118C--Center Support Assembly--Exploded View

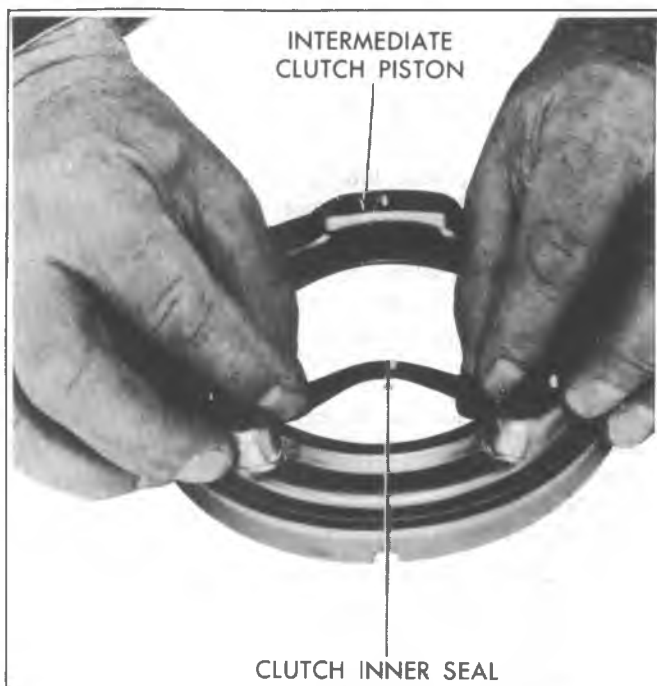


Fig. 7A-119C--Installing Intermediate Clutch Inner Seal

Assembly

1. Lubricate and install new inner and outer seals on piston with lip of seal facing away from spring pocket (Fig. 7A-119C and 7A-120C).



Fig. 7A-120C--Installing Intermediate Clutch Outer Seal

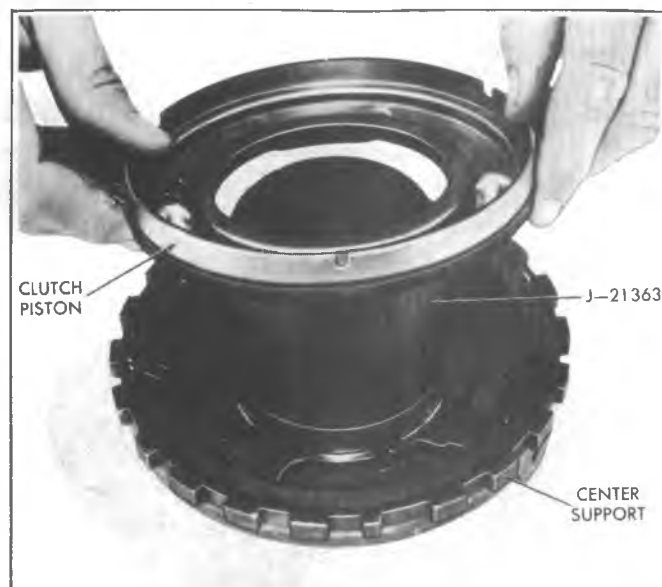


Fig. 7A-121C--Installing Intermediate Clutch Piston

2. Install inner seal protector, Tool J-21363, on center support hub, install piston, indexing spring pockets of piston into cored areas of the center support (Fig. 7A-121C).

3. Install intermediate clutch spring guide (Fig. 7A-122C).

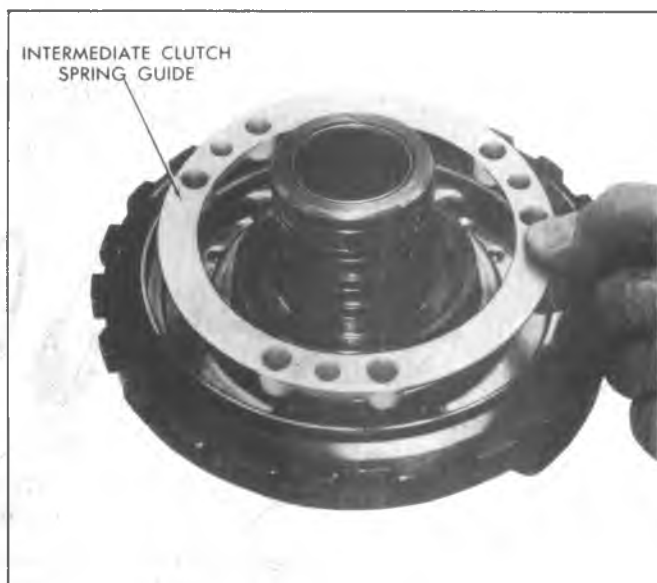


Fig. 7A-122C--Installing Intermediate Clutch Spring Guide



Fig. 7A-123C--Installing Intermediate Clutch Release Springs

4. Install three (3) release springs into holes of spring guide. Space equally during assembly (Fig. 7A-123C).
5. Place spring retainer and snap ring over springs.

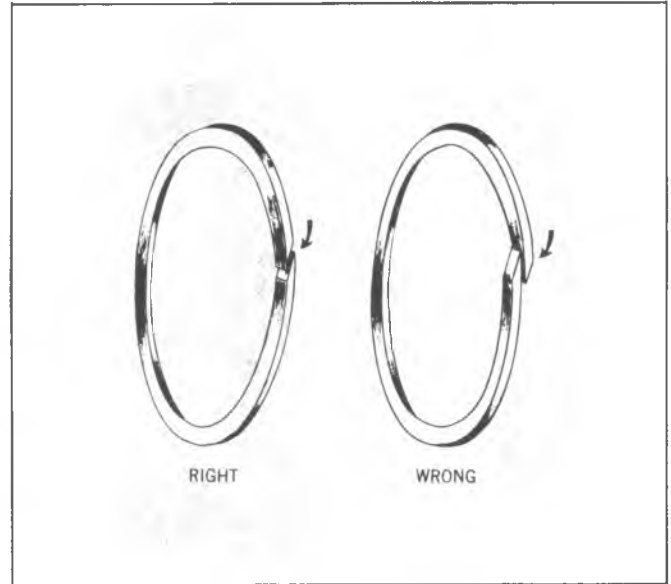


Fig. 7A-125C--Teflon Rings

6. Compress springs and install snap ring (Fig. 7A-124C).

7. Install four (4) oil seal rings on the center support. When installing teflon oil seal rings, make sure slit ends are assembled in same relation as cut (Fig. 7A-125C). Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during re-assembly of mating parts over rings. Retain with petrolatum.

8. Air check operation of intermediate clutch piston (Fig. 7A-126C).



Fig. 7A-124C--Installing Intermediate Clutch Piston Snap Ring



Fig. 7A-126C--Air Checking Intermediate Clutch Piston

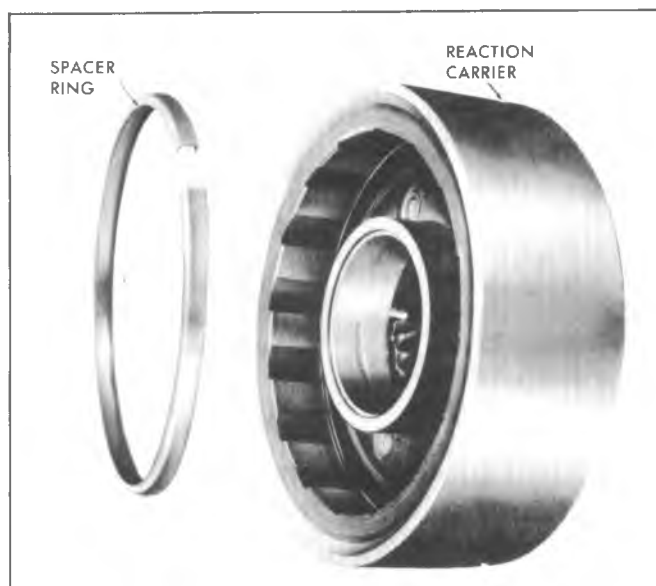


Fig. 7A-127C--Inspecting Spacer Ring

Inspection of Reaction Carrier, Roller Clutch, and Output Carrier Assembly

1. If the reaction carrier has a spacer ring in an undercut at the bottom of the roller cam ramps, inspect it for damage (Fig. 7A-127C).



Fig. 7A-128C--Checking Pinions End Play

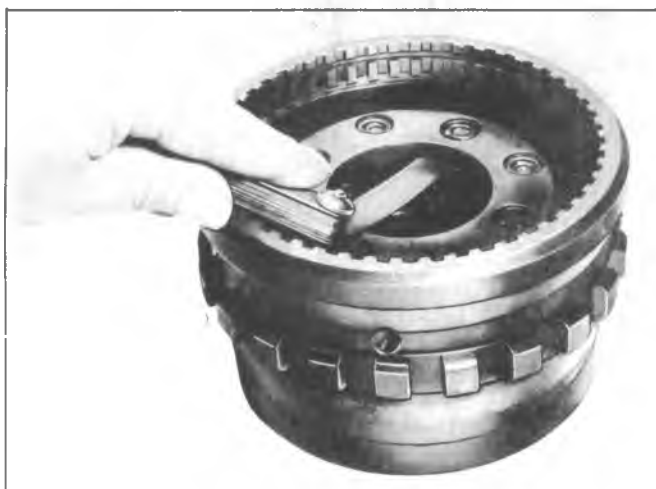


Fig. 7A-129C--Checking Output Carrier Pinion End Play

The reaction carrier with the undercut and spacer ring is used optionally and interchangeably with the reaction carrier which does not have an undercut and spacer ring.

2. Inspect band surface on reaction carrier for signs of burning or scoring.

3. Inspect roller clutch outer race for scoring or wear.

4. Inspect thrust washer surfaces for signs of scoring or wear.

5. Inspect bushing for damage. If bushing is damaged, reaction carrier must be replaced.

6. Inspect reaction carrier pinions for damage, rough bearings, or excessive tilt.

7. Check pinion end play. Pinion end play should be .009"-.024" (Fig. 7A-128C).

8. Inspect roller clutch for damaged rollers.

9. Inspect roller clutch cage and springs for damage.

10. Inspect front internal gear (output carrier) for damaged teeth.

11. Inspect output carrier pinions for damage, rough bearings or excessive tilt.

12. Check pinion end play. Pinion end play should be .009"-.024" (Fig. 7A-129C).

13. Inspect parking pawl lugs for cracks or damage.

14. Inspect output locating splines for damage.

15. Inspect front internal gear ring for flaking (Fig. 7A-49C).

Pinion Replacement Procedure

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 probability of cracking the carrier when pinion pins are pressed out. Do not allow drill to remove any stock from the carrier.

3. Using a tapered punch, drive or press pinion pins out of carrier (Fig. 7A-130C).

4. Remove pinions, thrust washers and roller needle bearing.

5. Inspect pinion pocket thrust faces for burrs and remove if present.

6. Install eighteen (18) needle bearings into each pinion



Fig. 7A-130C--Removing Planet Pinion Pin

using petrolatum to hold bearings in place. Use pinion pin as guide (Fig. 7A-131C).

7. Place a bronze and steel washer on each side of pinion so steel washer is against pinion, hold them in place with petrolatum.

8. Place pinion 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 while rotating pinion from front, being sure that headed end is flush or below face of carrier (Fig. 7A-132C).

10. Place a large punch in a bench vise to be used as an anvil while staking opposite end of pinion pin in three places. Both ends of pinion pins must lie below face of carrier or interference may occur.

OUTPUT SHAFT, REAR INTERNAL GEAR, SUN GEAR AND SHAFT

Output Shaft

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:

- Thread Tool J-21465-16 into bushing and using Slide Hammer J-2619, remove bushing.
- Using Tool J-21465-1 with drive handle J-8092, install bushing into place until tool bottoms.

2. Inspect bearing and thrust washer surfaces for damage.

3. Inspect governor drive gear for rough or damaged teeth.

- Inspect splines for damage.
- Inspect drive lugs for damage.
- Inspect speedometer drive gear.

Inspection of Rear Internal Gear

- Inspect gear teeth for damage or wear.
- Inspect splines for damage.
- Inspect gear for cracks.

Inspection of Sun Gear

- Inspect gear teeth for damage or wear.
- Inspect splines for damage.
- Be sure oil lubrication hole is open.

Inspection of Sun Gear Shaft

- Inspect shaft for cracks or splits.
- Inspect splines for damage.
- Inspect bushings for scoring or galling. If necessary to replace, proceed as follows:

SUN GEAR SHAFT BUSHING-FRONT AND REAR

Remove

With sun gear shaft properly supported, using Tool J-21465-15, with slide hammer and Adapter J-2619, remove bushing.

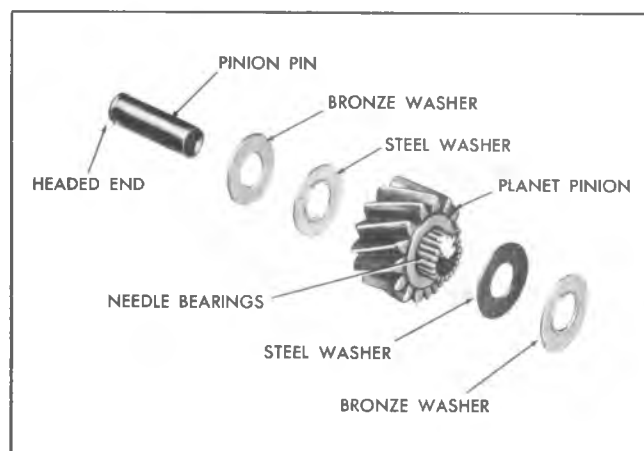


Fig. 7A-131C--Planet Pinion Assembly--Exploded View

Replace

Using Tool J-21465-5 with Driver Handle J-8092 press or drive replacement bushing into place until tool bottoms.

INSPECTION OF MAIN SHAFT

- Inspect shaft for cracks or distortion.
- Inspect splines for damage.
- Inspect ground bushing journals for damage.
- Inspect snap ring groove for damage.
- Make sure that lubrication holes are open.

NOTICE: If replacement of mainshaft is required, make sure that the orifice cup plug in the service mainshaft is removed.

INSPECTION OF FRONT AND REAR BANDS, SUPPORT TO CASE SPACER

- Inspect lining for cracks, flaking, burning, or looseness.
- Inspect bands for cracks or distortion.
- Inspect end for damage at anchor lugs or apply lugs.
- Inspect support to case spacer for burrs or raised edges, if present remove with stone or fine abrasive.

INSPECTION OF CASE EXTENSION - ALL EXCEPT CL MODEL

- Inspect bushing for excessive wear or damage. If replacement is necessary, remove rear seal and with



Fig. 7A-132C--Installing Planet Pinion Pin

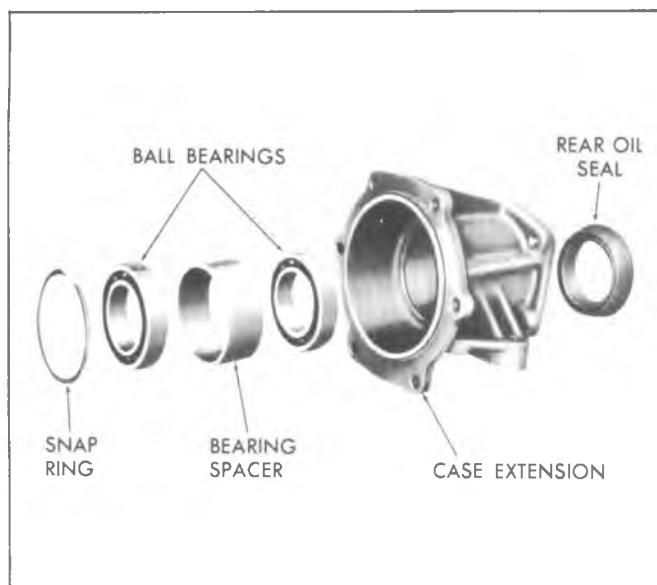


Fig. 7A-133C--Model CL Case Extension

extension housing properly supported, remove bushing as follows:

a. With rear seal removed, position case extension on bench, with seal end up. Assemble remover J-21465-17 on handle J-8092, and drive out bushing with lead or brass hammer.

b. Using tool J-21465-17, with Driver Handle J-8092, drive or press replacement bushing into place, flush to .010 below oil seal counter bore area. Stake bushing, using tool J-21465-10. Stake marks to be in bushing lubrication grooves.

2. Inspect gasket mounting face for damage.
3. Inspect housing for cracks or porosity.
4. Be sure rear seal drain back port is not obstructed.

INSPECTION OF CASE EXTENSION-

CL MODEL (FIG. 7A-133C)

1. Inspect seal (case extension to case) groove for damage.
2. Inspect for cracks, or porosity.
3. Inspect dowel pin in rear face for damage.

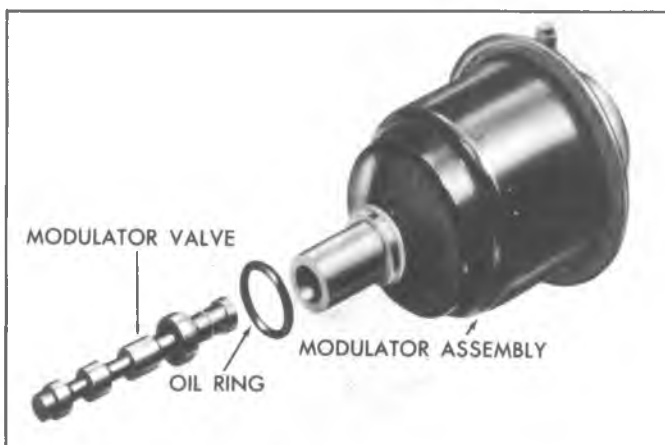


Fig. 7A-134C--Modulator Assembly and Valve

4. Inspect oil seal for damage. If replacement is required, proceed as follows:

- a. Pry oil seal from extension.
- b. Apply non-hardening sealer to outside of new oil seal, and install oil seal into case extension using tool (J-24057) (see Fig. 7A-171C).

5. Inspect ball bearing assemblies. If they are damaged, or if they require cleaning, proceed as follows:

- a. Remove rear seal.
- b. Remove snap ring.
- c. Remove ball bearings and bearing spacer, using a brass rod on the outside race of bearing. An arbor press can be used if tool to press bearing out is located on outer race of bearing. **DO NOT** locate against inner race or balls.
- d. Install ball bearing assembly and spacer, bearing first.
- e. Install ball bearing assembly and snap ring.
- f. Install new rear oil seal.

INSPECTION OF MODULATOR AND VALVE

1. Inspect modulator assembly for any signs of bending or distortion (Fig. 7A-134C).
2. Inspect "O" ring seal seat for damage.
3. Apply suction to vacuum tube and check for diaphragm leaks.
4. Check modulator bellows as outlined in Section 7 of Service Manual (modulator plunger is under pressure - 16 lbs.). If bellows is damaged plunger will have very little pressure.
5. Inspect modulator valve for nicks or damage.
6. Check freeness of valve operation in case bore.

INSPECTION OF MANUAL AND PARKING LINKAGE

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs (Fig. 7A-135C).
2. Inspect actuator spring for damage.
3. Inspect actuator for free fit on actuator rod.
4. Inspect parking pawl for cracks or wear.
5. Inspect manual shaft for damaged threads, rough oil surface or loose lever.
6. Inspect inside detent lever for cracks or a loose pin.
7. Inspect parking pawl shaft if removed for damaged retainer groove.
8. Inspect parking pawl return spring for deformed coils or end.
9. Inspect parking bracket for cracks or wear.
10. Inspect detent roller and spring assembly.

INSPECTION OF CASE ASSEMBLY (FIGS. 7A-136C AND 7A-137C)

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.

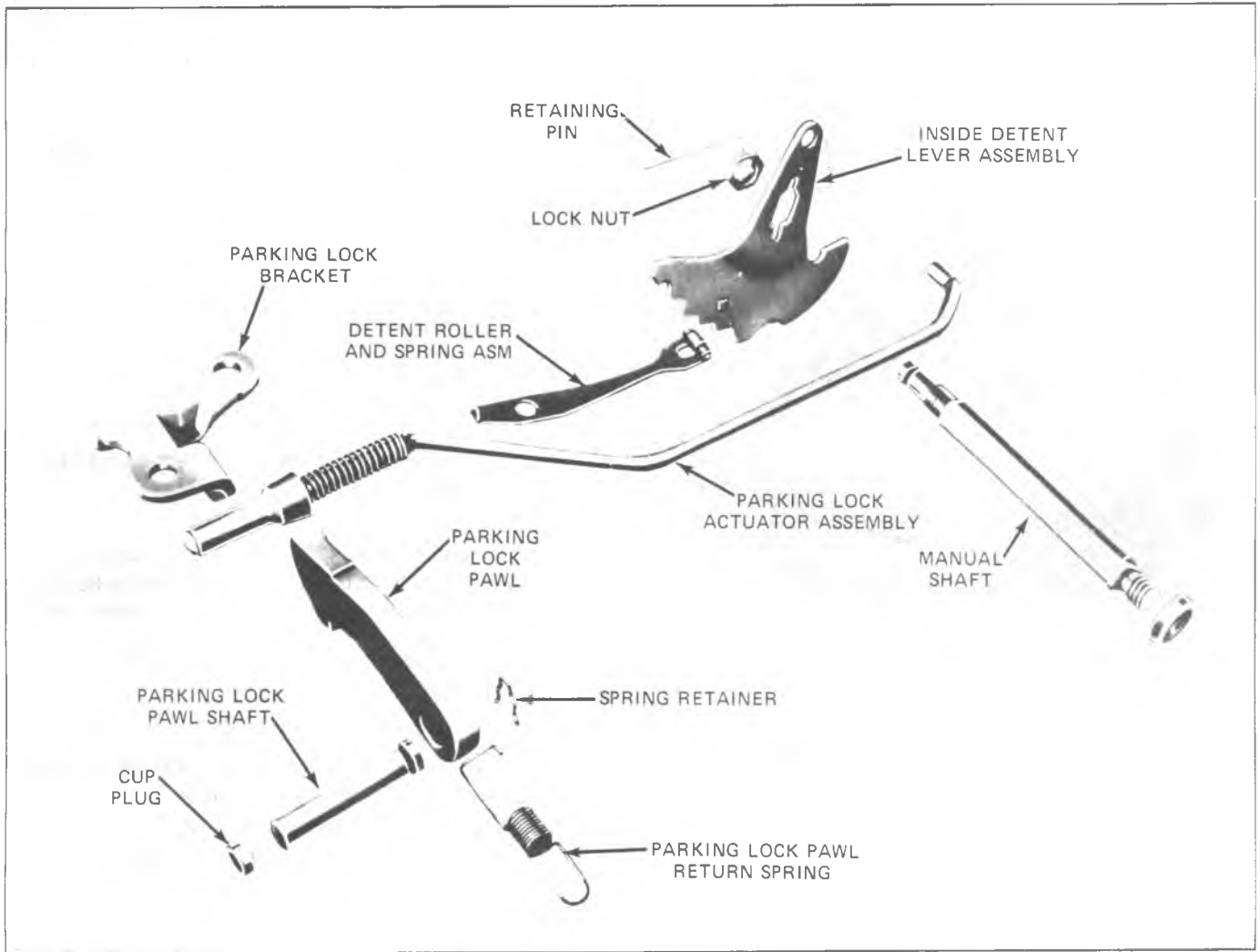


Fig. 7A-135C--Manual and Parking Linkage--Exploded View

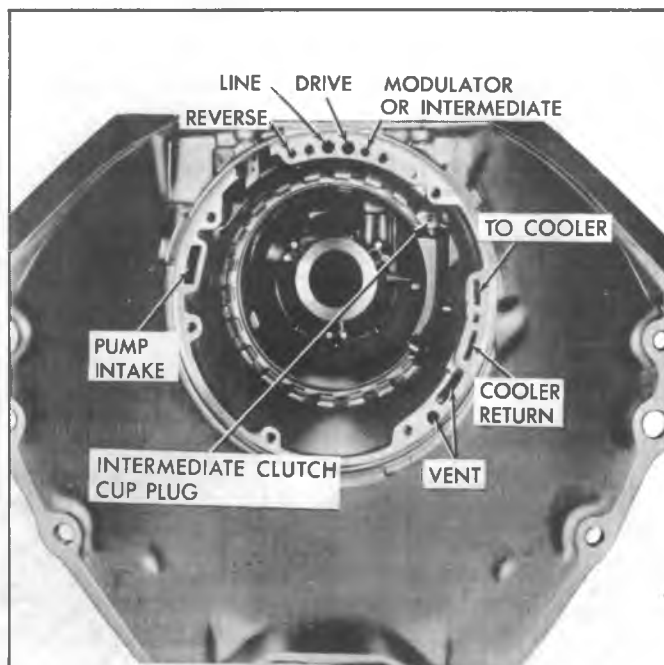


Fig. 7A-136C--Case-Front View Passage Identification

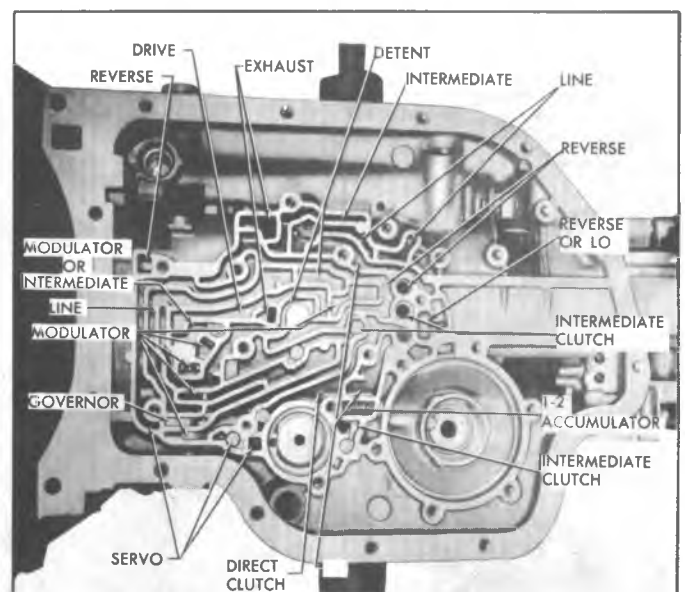


Fig. 7A-137C--Inspect Transmission Case



Fig. 7A-138C--Air Checking Converter

1. Inspect case assembly for cracks, porosity or inter-connected passages.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. On model FL and FS inspect studs for thread damage, and make sure they are tight.

The two (2) studs at 9 o'clock and 11 o'clock (when viewed from the rear of case and transmission in vehicle) are approximately 1/4" longer than the other four (4) studs. These two longer studs are required to accommodate the parking brake actuating cable bracket.

5. Inspect intermediate clutch driven plate lugs for damage or brinelling.

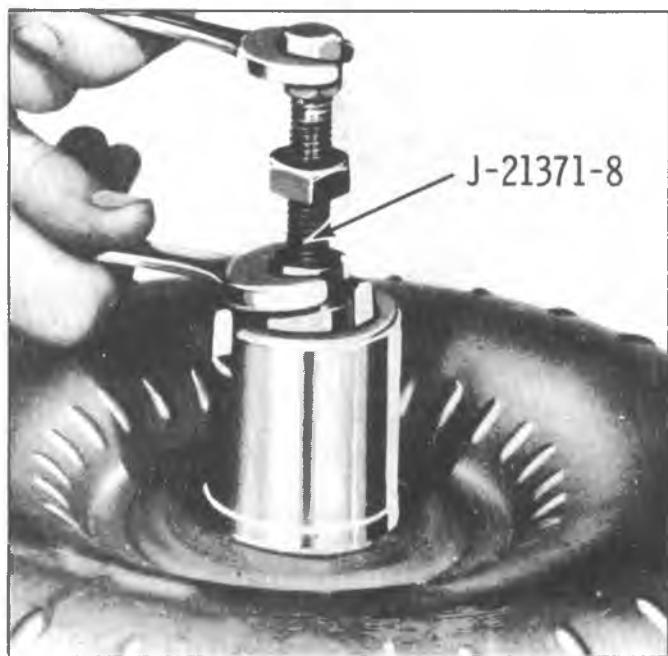


Fig. 7A-139C--Loosening Collet on Tool J-21571-8

If the case assembly requires replacement, remove the nameplate from the old case and re-install it on the new case, using the truss head nameplate attaching screw that is serviced with the case.

6. Inspect snap ring grooves for damage.
7. Inspect bore for governor assembly for scratches or scoring.
8. Inspect modulator valve bore for scoring or damage.
9. Inspect cup plug inside case for good staking and sealing.
10. Inspect case bushing. If necessary to replace, proceed as follows:

Case Bushing

Remove

With case properly supported, using tool J-21465-8, with Driver Handle J-8092, remove bushing.

Replace

Using tool J-21465-8 adaptor ring J-21465-9, Driver Handle J-8092, and extension J-21465-13, with lube passage facing front of transmission case, drive replacement bushing into case until .040 to .055 above selective washer face. Stake bushing with tool J-21465-10. Stake marks to be in bushing lubrication grooves.

INSPECTION OF CONVERTER

1. Check converter for leaks as follows (Fig. 7A-138C):
 - a. Install Tool J-21369 and tighten.
 - b. Apply 80 psi air pressure to tool.
 - c. Submerge in water and check for leaks.
2. Check converter hub surfaces for signs of scoring or wear.

Converter End Clearance Check (Figs. 7A-139C and 7A-140C)

1. Fully release collet end of Tool J-21371-8.
2. Install collet end of Tool J-21371-8 into converter

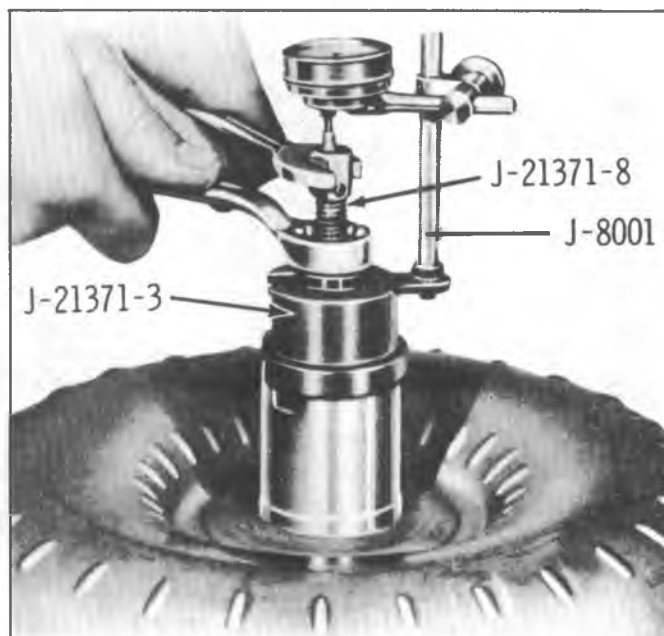


Fig. 7A-140C--Checking Converter End Clearance

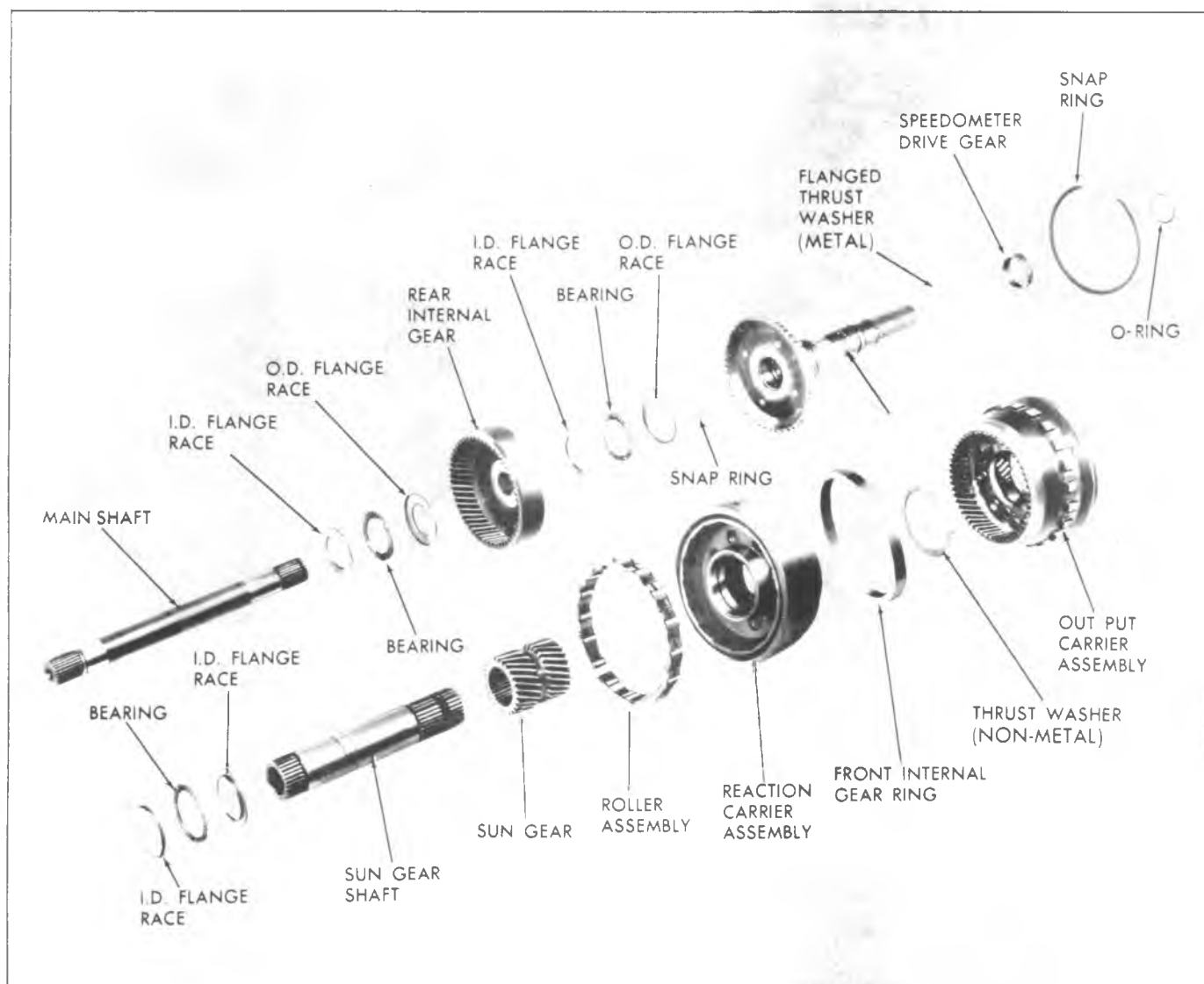


Fig. 7A-141C--Gear Unit Assembly--Exploded View

hub until it bottoms; then tighten cap nut to 5 lb. ft. (Fig. 7A-139C).

3. Install Tool J-21371-3 and tighten hex nut to 3 lb. ft. (Fig. 7A-140C).

4. Install Dial Indicator J-8001 and set it at "zero", while its plunger rests on the cap nut of Tool J-21371-8.

5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened 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 .050". If the end clearance is .050" or greater, the converter must be replaced.

ASSEMBLY OF REAR UNIT (FIG 7A-141C)

1. Install rear internal gear on end of main shaft.

2. Install rear internal gear retaining snap ring (Fig. 7A-142C).

3. Install sun gear to internal gear thrust races and bearings against inner face of rear internal gear as follows, and retain with petrolatum.

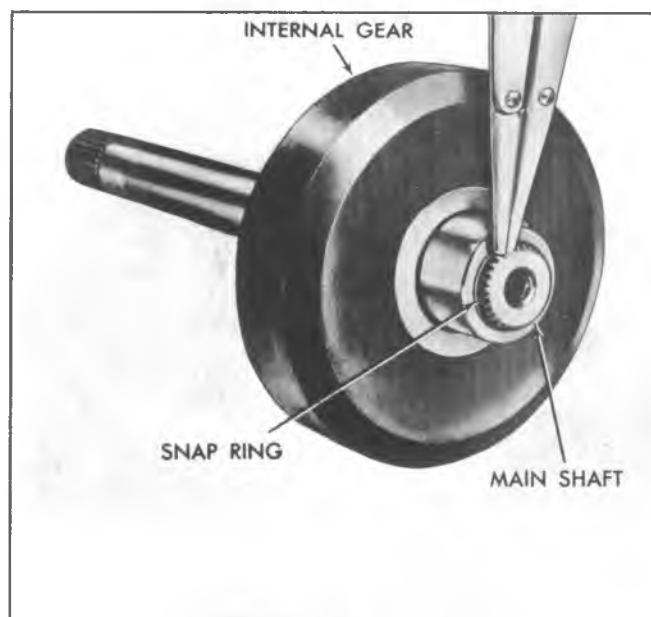


Fig. 7A-142C--Installing Rear Internal Gear Snap Ring

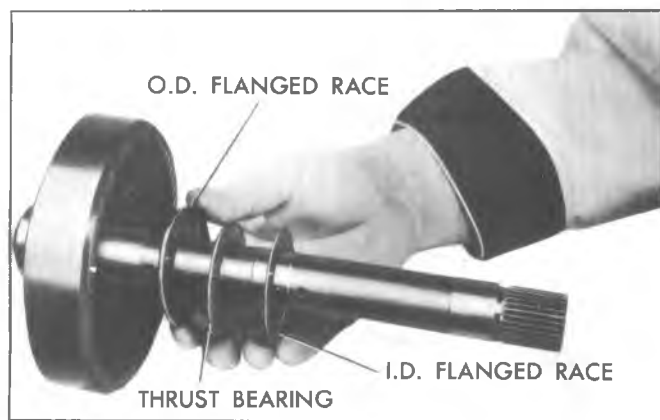


Fig. 7A-143C--Installing Rear Internal Gear to Sun Gear Bearing and Races

- a. Place large race against internal gear with outer flange facing forward or up (Fig. 7A-153C).
- b. Place thrust bearing against race.
- c. Place small race against bearing with inner flange facing into bearing or down.
4. Install output carrier over mainshaft so that pinions mesh with rear internal gear.
5. Place above portion of "build-up" through hole in bench so that mainshaft hangs downward.
6. Install rear internal gear to output shaft thrust races and bearings as follows and retain with petrolatum (Fig. 7A-144C).



Fig. 7A-144C--Installing Rear Internal Gear to Output Shaft Bearing and Races



Fig. 7A-145C--Installing Output Shaft

- a. Place small diameter race against internal gear with center flange facing up.
- b. Place bearing on race.
- c. Place second race on bearing with outer flange cupped over bearing.
7. Install output shaft into output carrier assembly (Fig. 7A-145C).
8. Install output shaft to output carrier snap ring.
9. Install "O" ring on output shaft of models that use an "O" ring.
- Models CB, CD, CF, CG and CH do not use an output shaft "O" ring.
10. Turn assembly over and support so that output shaft hangs downward.
11. Install reaction carrier to output carrier metal or non-metal thrust washer with tabs facing down in pockets of output carrier and retain with petrolatum. The production built transmissions use a non-metal washer here. However, the service replacement washer is made of metal.
12. Install sun gear I.D. splines with chamfer down.

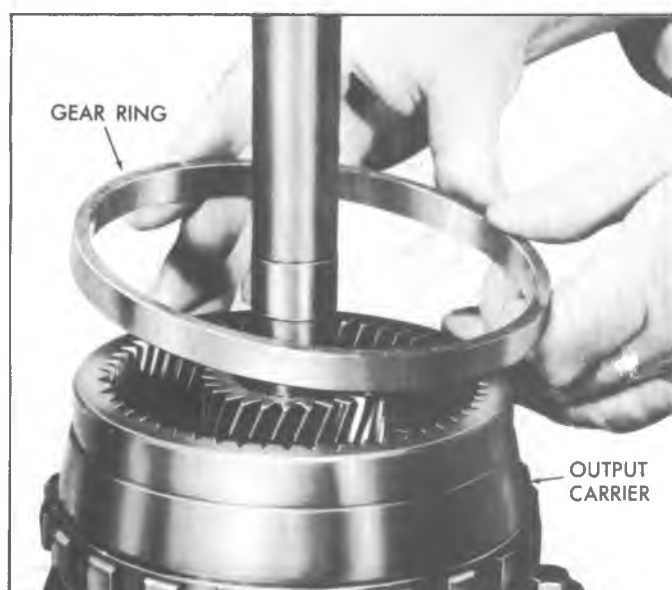


Fig. 7A-146C--Installing Front Internal Gear Ring to Output Carrier

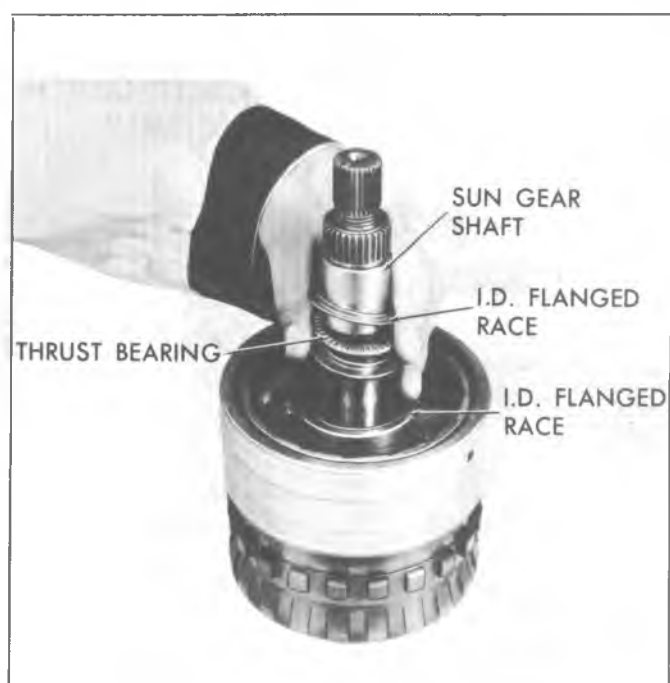


Fig. 7A-148C--Installing Center Support to Sun Gear Thrust Bearing and Races

13. Install front internal gear ring over output carrier (Fig. 7A-146C).

14. Install sun gear shaft with long splined end down.

15. Install reaction carrier (Fig. 7A-147C).

NOTICE: 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.

16. Install center support to sun gear thrust races and bearings as follows: (Retain with petrolatum).

a. Install large race, center flange up over sun gear shaft.

b. Install thrust bearing against race.

c. Install second race, center flange up (Fig. 7A-148C).

17. Install rollers that may have come out of the roller clutch cage, by compressing the energizing spring with forefinger and inserting roller from the outer edge (Fig. 7A-149C).



Fig. 7A-147C--Installing Reaction Carrier



Fig. 7A-149C--Installing Roller into Roller Clutch Cage



Fig. 7A-150C--Installing Roller Clutch to Reaction Carrier

18. Install roller clutch assembly (Fig. 7A-150C) into reaction carrier.

19. Install center support to reaction carrier thrust washer into recess in center support. Retain with petrolatum (Fig. 7A-47C).

20. Install center support into roller clutch in reaction carrier (Fig. 7A-151C). With reaction carrier held, center support should only turn counter-clockwise after installation. See Fig. 7A-152C for check of roller clutch.

21. Install J-21795 on gear unit assembly to hold units in place.

22. Install output shaft to case thrust washer tabs in pockets (Fig. 7A-152C), and retain with petrolatum. This must be a metal washer.

ASSEMBLY OF UNITS TO TRANSMISSION CASE

The first three steps can be omitted if the parts involved were not removed on disassembly.

1. Install parking pawl tooth toward inside of case, and parking pawl shaft (Fig. 7A-154C).

2. Install parking pawl shaft retainer clip (Fig. 7A-155C).



Fig. 7A-151C--Installing Center Support to Reaction Carrier

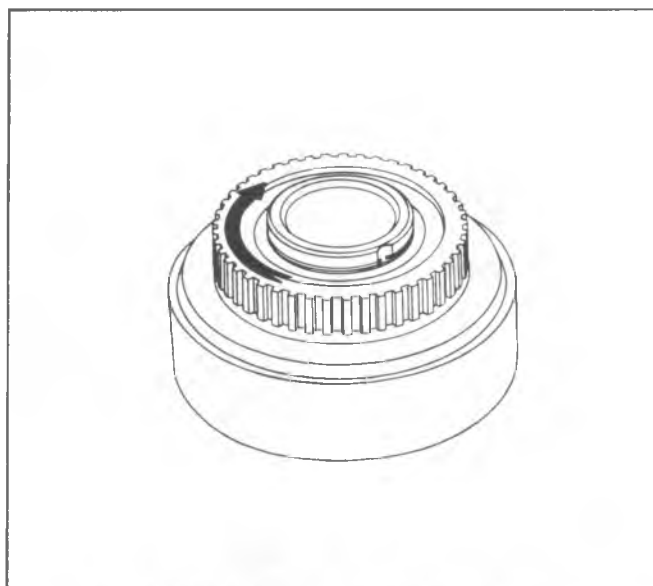


Fig. 7A-152C--Checking Roller Clutch Rotation



Fig. 7A-153C--Installing Case to Output Shaft Thrust Washer



Fig. 7A-154C--Installing Parking Pawl Shaft Cup Plug

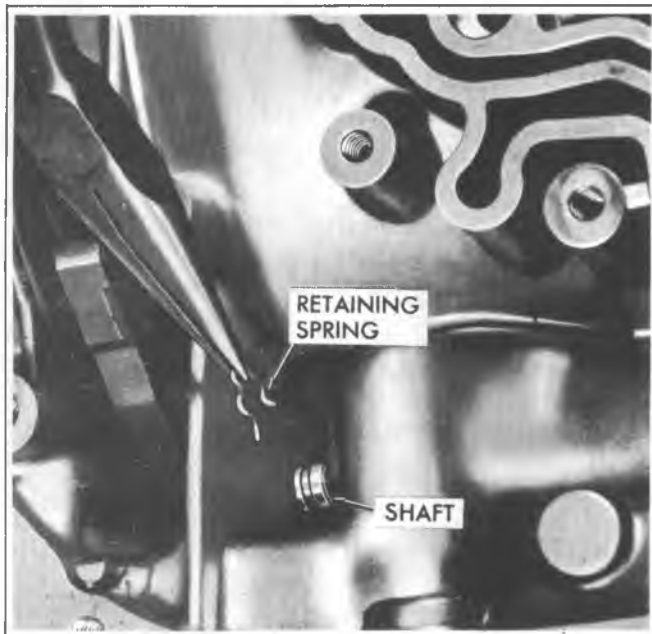


Fig. 7A-155C--Installing Parking Shaft Retaining Spring

3. Install parking pawl shaft cup plug and drive into the case, using a 3/8 dia. rod, until the parking pawl shaft bottoms on the case rib (Fig. 7A-154C).

4. Install parking pawl return spring, square end hooked on pawl and other end on case.

5. Install parking bracket with guides over parking pawl using two attaching bolts, torque to 18 ft. lbs.

6. Install rear band assembly so that two lugs index with two anchor pins. Check to make sure band is seated on lugs (Fig. 7A-156C).

7. Install the center support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin (Fig. 7A-157C).

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 intermediate clutch backing plate to case snap ring (.093" thick and both sides flat).



Fig. 7A-156C--Installing Rear Band

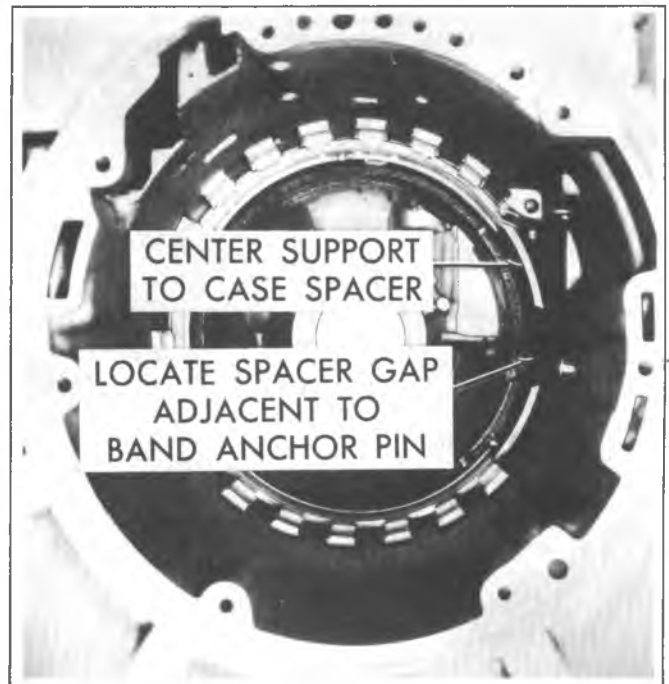


Fig. 7A-157C--Installing Center Support to Case Spacer

8. Install proper rear selective washer (proper washer determined by previous end play check) into slots provided inside rear of transmission case.

9. Install complete gear unit assembly into case, using Tool J-21795 (Fig. 7A-158C).

10. Install center support to case retaining snap ring with bevel side up (flat surface against the center support)

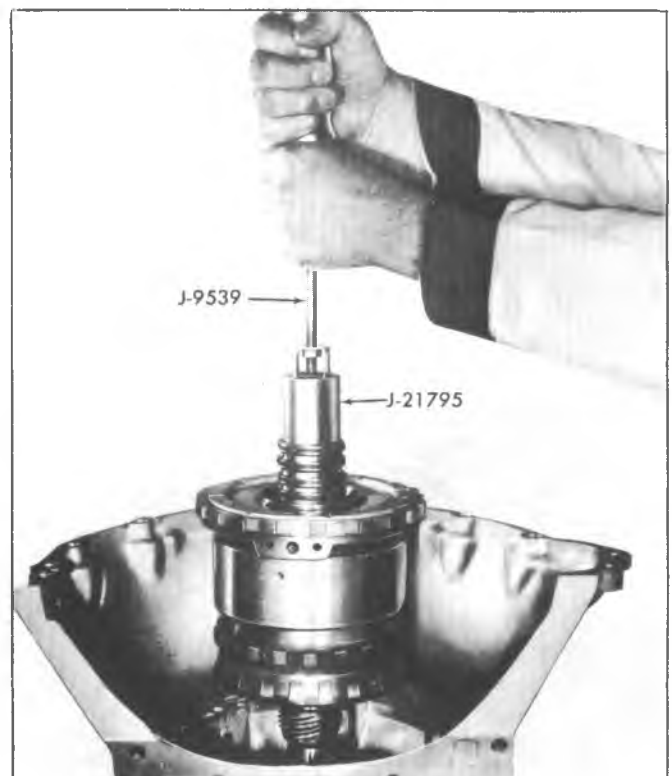


Fig. 7A-158C--Installing Center Support and Gear Unit

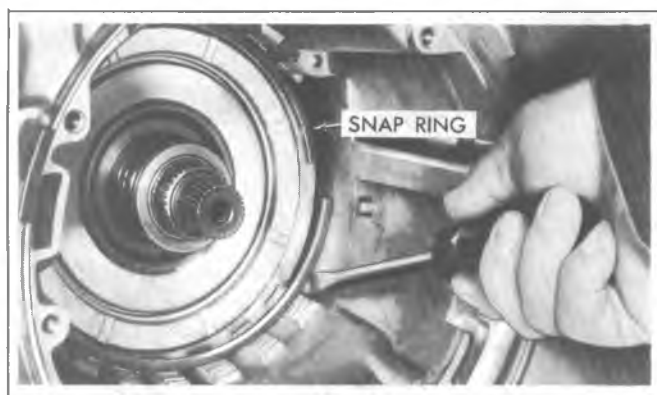


Fig. 7A-159C--Installing Center Support to Case Snap Ring

and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case (Fig. 7A-159C).

11. Install case to center support bolt by placing the center support locating tool into the case direct clutch passage, 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 20-25 ft. lbs., using a 3/8" 12-point thin wall deep socket (Fig. 7A-160C).

NOTICE: When using the locating tool, care should be taken not to raise burrs on the case valve body mounting face.

12. Install intermediate clutch plates.

a. (All models except FL and FS) Lubricate with transmission oil two (2) flat steel and one (1) waved steel plates and three (3) composition-faced intermediate clutch plates and install, starting with waved steel plate and alternating composition-faced and flat steel plates (Fig. 7A-161C).

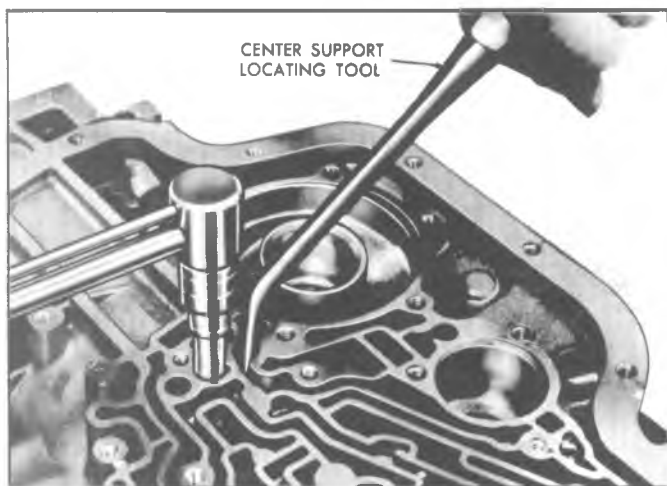


Fig. 7A-160C--Installing Center Support Bolt

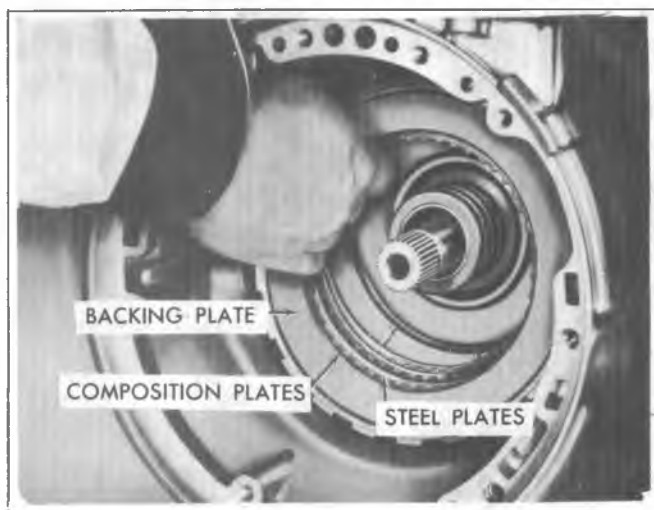


Fig. 7A-161C--Installing Intermediate Backing Plate and Clutch Plates

b. (Models FL and FS) Lubricate with transmission oil three (3) flat steel and three (3) composition-faced intermediate clutch plates and install, starting with flat steel and alternating composition-faced and flat steel plates (Fig. 7A-161C).

The models FL and FS intermediate composition-faced plates are different from the other models. Refer to parts catalog for correct usage.

13. Install intermediate clutch backing plate, ridge up (Fig. 7A-161C).

14. Install intermediate clutch backing plate to case snap ring, locating gap opposite band anchor pin. Both sides of this snap ring are flat, and it is .093" thick.

15. Check rear end play as follows:

a. Install a 3/8"-16 bolt or J-9539, into an extension housing attaching bolt hole (Fig. 7A-37C).

b. Mount a dial indicator on a rod and index with end of output shaft.

c. Move output shaft in and out to read end play. End play should be from .007"-.019". The selective washer controlling this end play is a steel washer having 3 lugs that is located between thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end play within specifications, it can be selected from the chart shown in Fig. 7A-162C.

REAR END WASHER THICKNESS

Thickness	Identification	
	Notches and/or Numeral	
.074 - .078	None	1
.082 - .086	1 Tab Side	2
.090 - .094	2 Tab Side	3
.098 - .102	1 Tab O.D.	4
.106 - .110	2 Tabs O.D.	5
.114 - .118	3 Tabs O.D.	6

Fig. 7A-162C--Rear End Washer Selection Chart

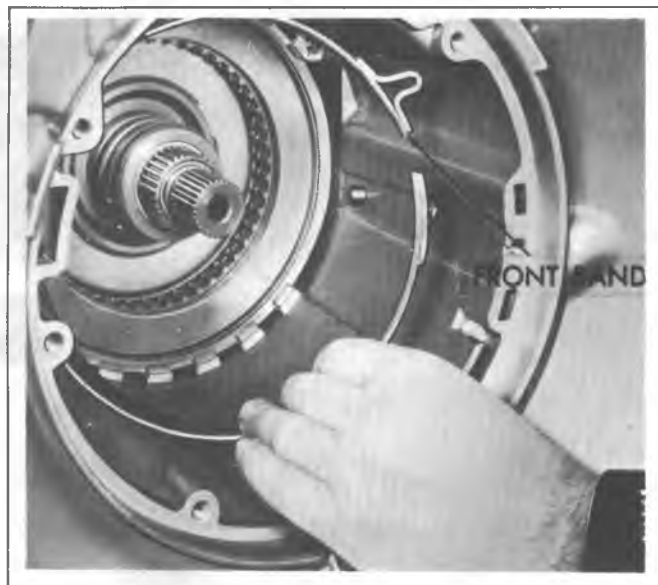


Fig. 7A-163C--Installing Front Band

16. Install front band with anchor hole placed over band anchor pin and apply lug facing servo hole (Fig. 7A-163C).

Install Manual Linkage

a. Install a new manual shaft seal into transmission case using a 3/4 diameter rod to seat seal.

b. If removed, insert actuator rod into manual detent lever from side opposite pin.

c. Install actuator rod plunger under parking bracket over parking pawl.

d. Install manual shaft through case and detent lever (Fig. 7A-164C).

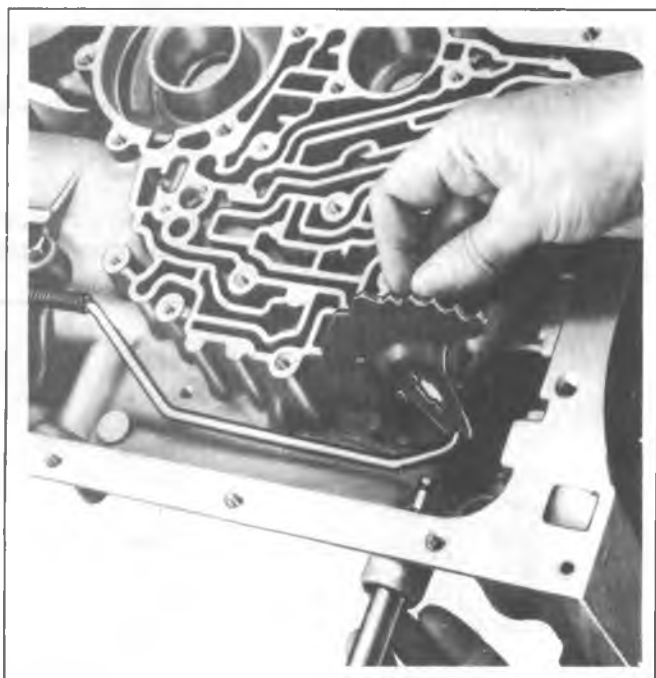


Fig. 7A-164C--Installing Manual Shaft to Case

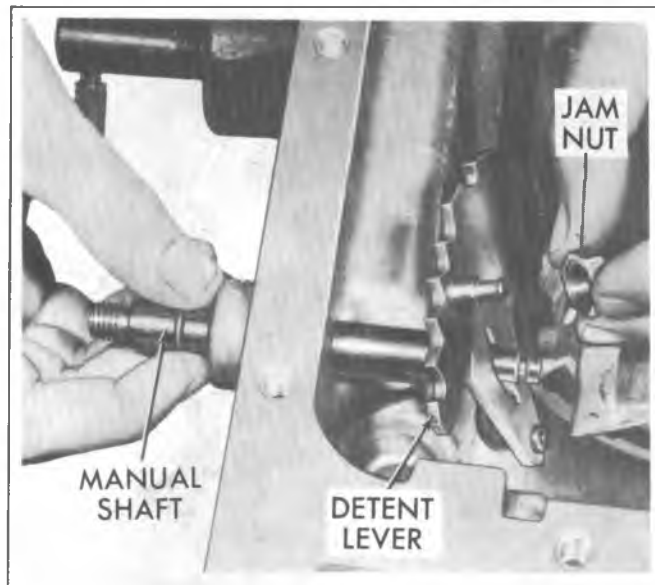


Fig. 7A-165C--Installing Detent Lever and Jam Nut to Manual Shaft

e. Install detent jam nut on manual shaft, and tighten to 18 ft. lbs. (Fig. 7A-165C).

f. Install retaining pin indexing with groove in manual shaft. Rotate transmission to vertical position and remove J-21795.

17. With converter end of transmission up, carefully install direct clutch and intermediate roller assembly. It will be necessary to shake and slightly twist housing to allow roller outer race to index with composition plates. Housing hub will bottom on sun gear shaft (Fig. 7A-166C).

First visually line up the intermediate clutch drive lugs, one above the other to help engagement of housing hub splines. It also may be helpful to remove the direct clutch plates while installing housing.

18. Install forward clutch hub to direct clutch housing thrust washer on forward clutch hub, if not already installed. Retain with petrolatum.

19. Install forward clutch assembly and turbine shaft; indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is

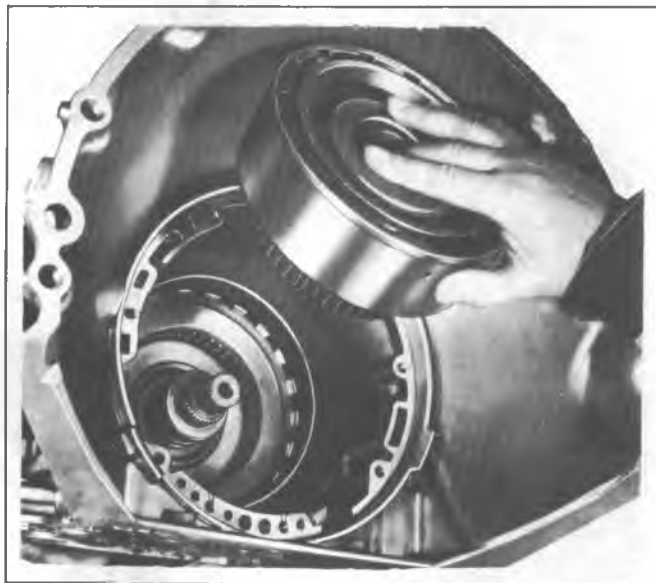


Fig. 7A-166C--Installing Direct Clutch Assembly

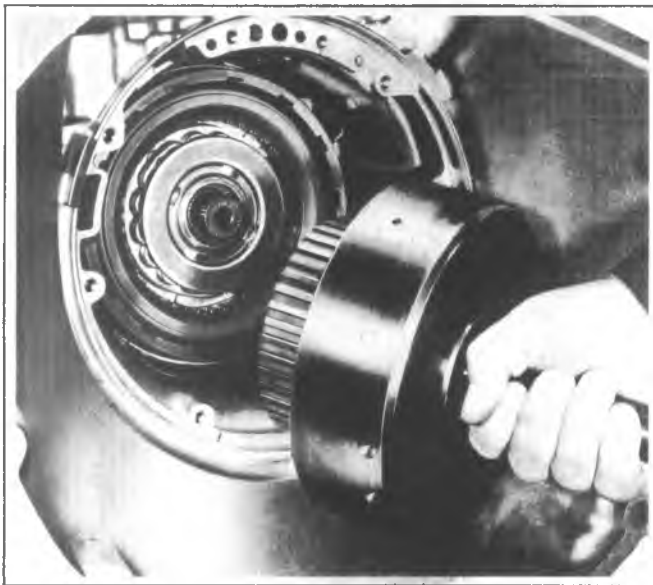


Fig. 7A-167C--Installing Forward Clutch Assembly and Turbine Shaft

seated it will be approximately 1-1/4" from pump face in case (Fig. 7A-167C).

20. Install pump assembly and gasket.

NOTICE: If turbine shaft cannot be rotated as pump is being pulled into place, forward or direct clutch housing have not been properly installed to index with all clutch plates. This condition must be corrected before pump is pulled fully into place.

21. Install all but one pump attaching bolts and seals. Torque to 18 ft. lbs. (See Figure 7A-169C for location of omitted bolt.)

22. If necessary to install a new front seal, use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (Fig. 7A-168C).



Fig. 7A-168C--Installing Pump Seal

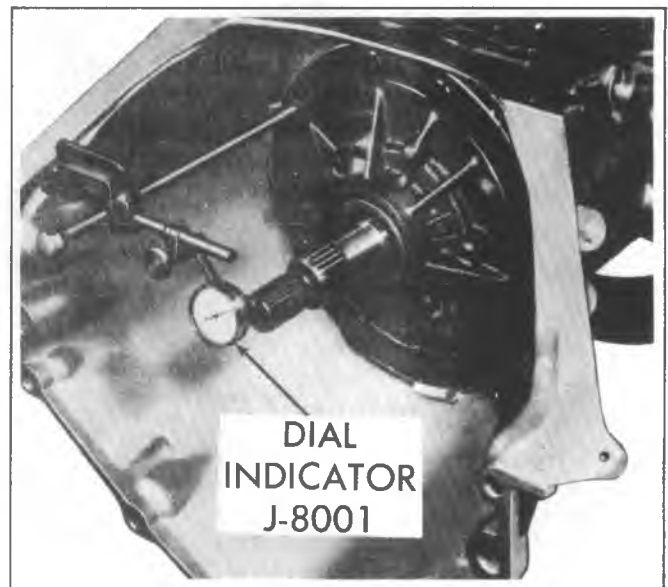


Fig. 7A-169C--Checking Front Unit End Play

23. Check front unit end play as follows (Fig. 7A-169C).

a. Install a 3/8"-16 threaded bolt or a Slide Hammer Bolt J-9539 into bolt hole in pump.

b. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

c. Push turbine shaft rearward.

d. Push output shaft forward.

e. Set dial indicator to zero.

f. Pull turbine shaft forward.

Read resulting travel or end play which should be .003"-.024". Selective washer controlling this end play is 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 the chart in Fig. 7A-170C.

An oil soaked washer may tend to discolor. It will be necessary to measure washer for its actual thickness.

24. Install remaining front pump attaching bolt and seal. Torque 18 ft. lbs.

CASE EXTENSION ASSEMBLY

1. Install new case extension housing to case gasket on extension housing. Model CL uses a seal between the extension housing and case extension.

FRONT END WASHER THICKNESS

Thickness	Number	Color
.060 - .064	- 0 -	Yellow
.071 - .075	- 1 -	Blue
.082 - .086	- 2 -	Red
.093 - .097	- 3 -	Brown
.104 - .108	- 4 -	Green
.115 - .119	- 5 -	Black
.126 - .130	- 6 -	Purple

Fig. 7A-170C--Front End Washer Selection Chart

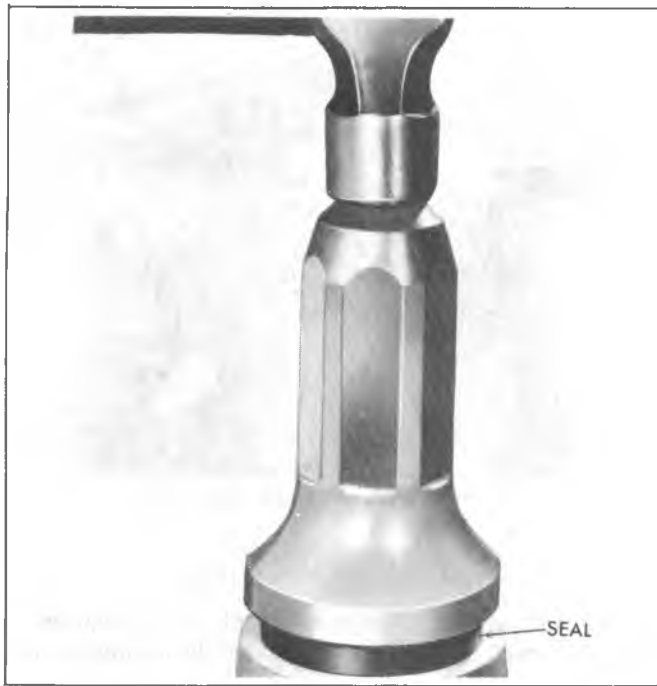


Fig. 7A-171C--Installing Extension Oil Seal (Typical)

2. Attach extension housing to case using attaching bolts and/or studs. Torque bolts to 20-25 ft. lbs.

3. If necessary, install a new seal as follows:

a. (All except FL and FS Models) use a non-hardening sealer on outside of seal body; and using Tool J-21359, drive seal in place (Fig. 7A-171C).

b. (Models FL and FS) use a non-hardening sealer on outside of seal body; and using Tool J-24057 drive seal in place (Fig. 7A-171C).

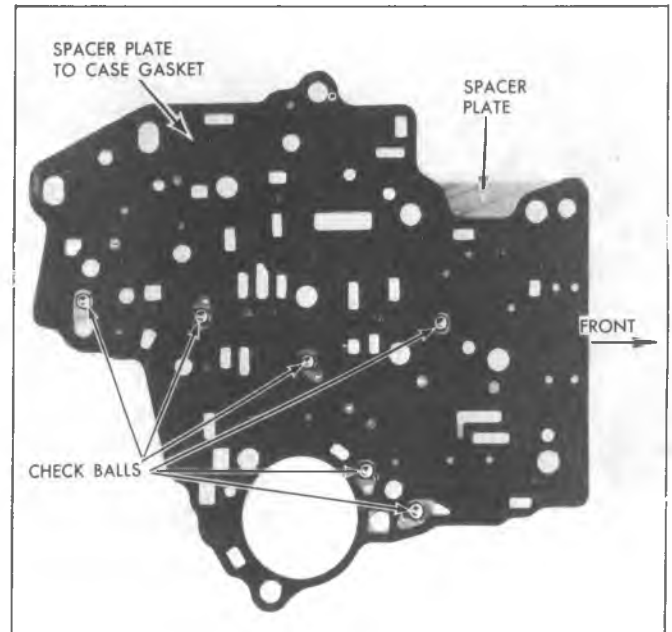


Fig. 7A-173C--Location of Check Balls--In Vehicle Installation

Installation of Check Balls, Control Valve Spacer Plate and Gasket,

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 7A-183C.

2. Install six (6) check balls into ball seat pockets in transmission case. Figure 7A-172C. If transmission is in the vehicle, install check balls into ball seat pockets on spacer plate (Fig. 7A-173C).

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid and a "C" near front servo location) (Fig. 7A-174C).

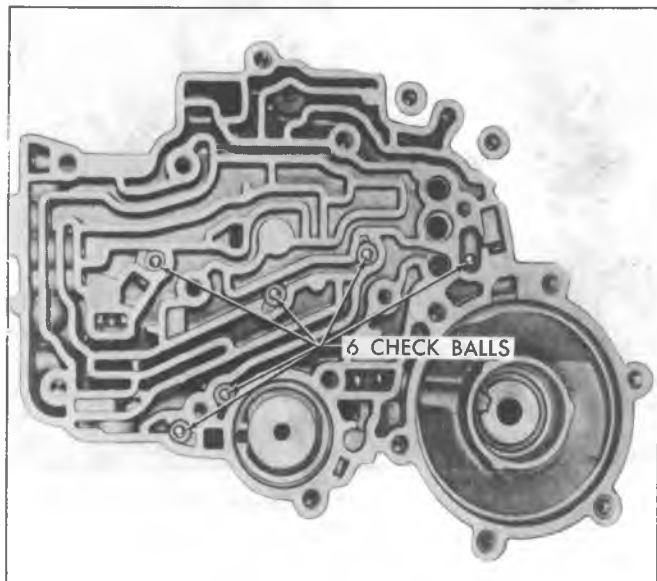


Fig. 7A-172C--Location of Check Balls

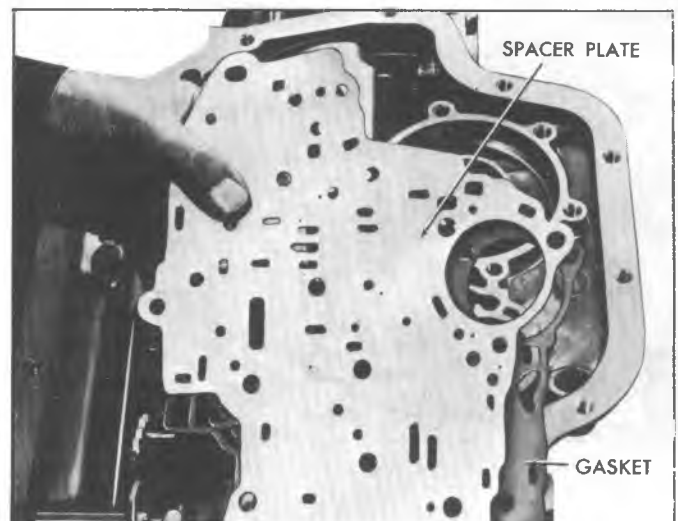


Fig. 7A-174C--Installing Control Valve Assembly Spacer Plate and Gasket

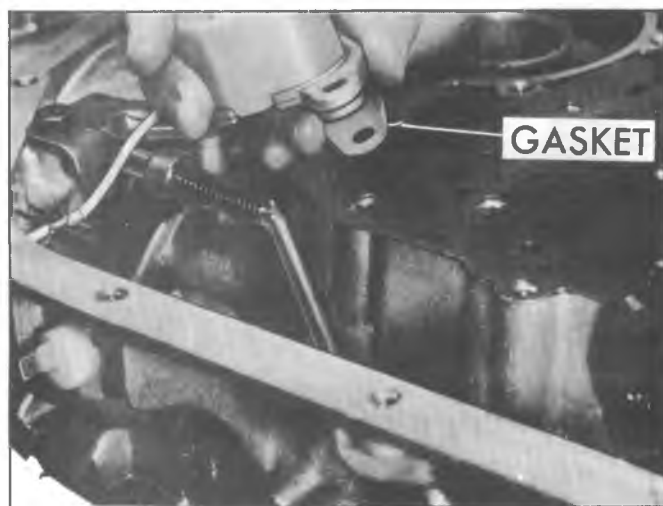


Fig. 7A-175C--Installing Detent Solenoid and Gasket

4. Install control valve spacer plate and control valve to spacer plate gasket (gasket identified with a "VB" near front servo).

5. Install detent solenoid gasket.

6. Install detent solenoid assembly with connector facing outer edge of case (Fig. 7A-175C). Do not tighten bolts at this time.

7. Install front servo spring and spring retainer into transmission case.

8. Install retainer pins 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. (Figure 7A-176C).

The teflon 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

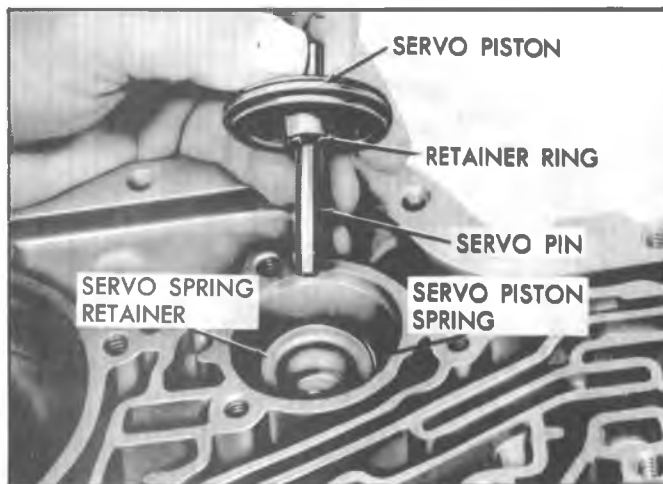


Fig. 7A-176C--Installing Front Servo Piston, Washer, and Pin

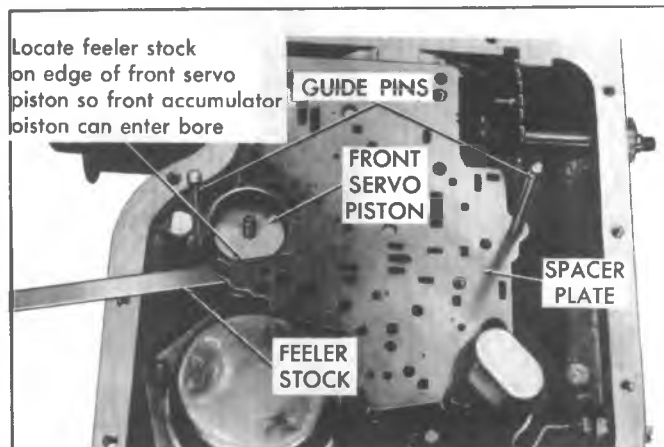


Fig. 7A-177C--Front Servo Group--In Vehicle Installation

during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.

If transmission is in the vehicle, assemble front servo group as shown in Figure 7A-61C 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. Figure 7A-177C.

10. Install "O" ring seal on electrical connector.

11. Lubricate and install electrical connector with lock tabs facing into case, positioning locator tab in notch on side of case (Fig. 7A-178C).

12. Install detent wire to electrical connector (Fig. 7A-12C).



Fig. 7A-178C--Installing Electrical Connector and "O" Ring Seal

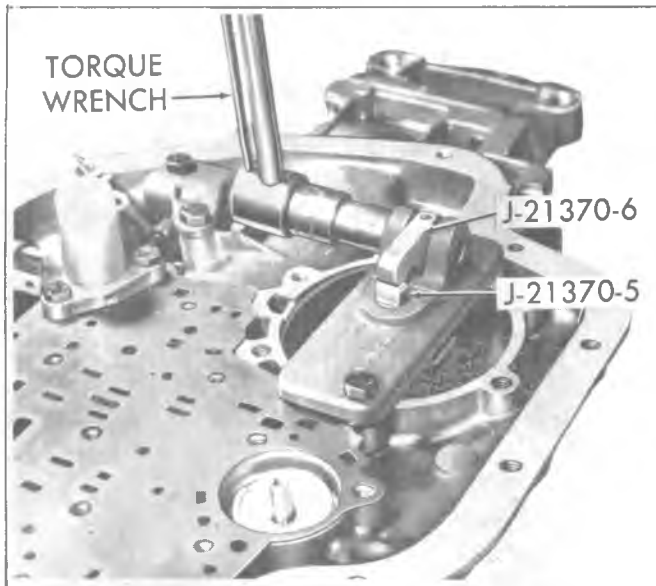


Fig. 7A-179C--Checking Rear Band Pin

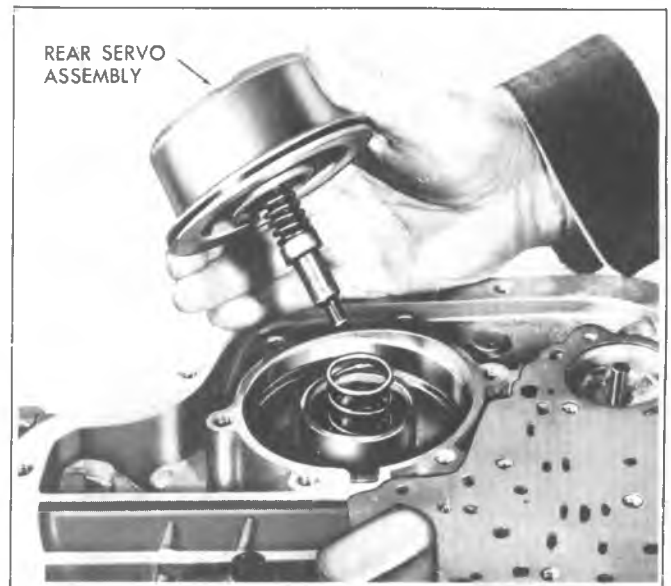


Fig. 7A-181C--Installing Rear Servo Assembly

Installation of Rear Servo Assembly

1. Check rear servo band apply pin. (Fig. 7A-179C).
 - a. Attach band apply pin selection Gage J-21370-6 and J-21370-5 to transmission case (lever pivot pin to rear) with attaching screws.

Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.

- b. Apply 25 ft. lb. torque and select proper servo pin to be used from scale on tool.

Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two, or three rings.

There are three selective pins identified as follows:

1. If both steps are below the gage surface, the long pin, identified by 3 rings, should be used.

2. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

- If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

3. Install rear accumulator spring into case (Fig. 7A-180C).

4. Lubricate and install rear servo assembly into case (Fig. 7A-181C).

5. Install rear servo gasket and cover (Fig. 7A-182C).

6. Install attaching screws. Torque bolts to 15-20 ft. lbs.



Fig. 7A-180C--Installing Rear Accumulator Spring

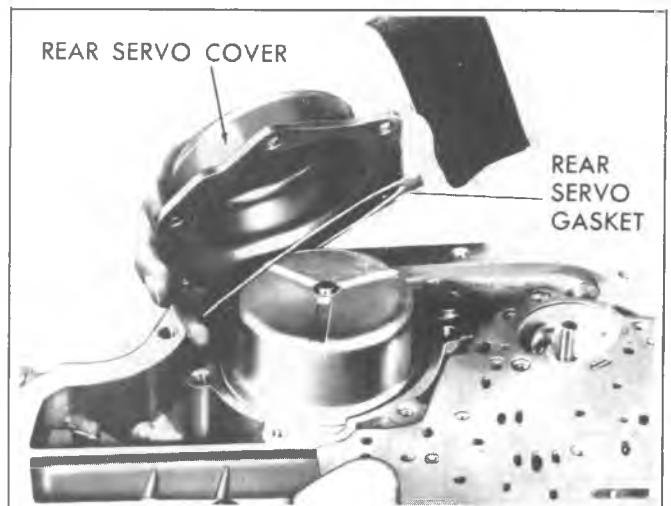


Fig. 7A-182C--Installing Rear Servo Cover and Gasket

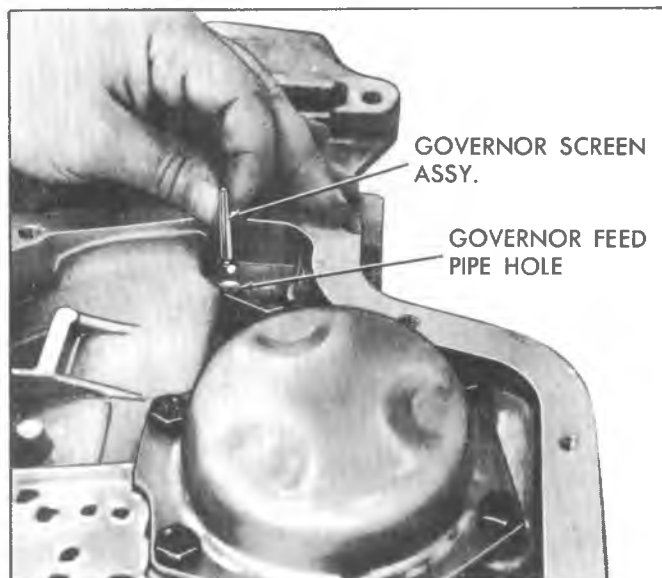


Fig. 7A-183C--Installing Governor Screen Assembly

INSTALLATION OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND GOVERNOR SCREEN ASSEMBLY

1. Install governor pipes on control valve assembly. Governor pipes are interchangeable.

2. Install governor screen assembly, open end first, into governor feed pipe hole in case (hole nearest the center of the transmission) (Fig. 7A-183C).

If transmission is in vehicle, before installing the control valve assembly and governor pipes as outlined in Step 3 below, insert the governor screen, closed end first, into governor feed pipe. (This pipe locates in the governor feed pipe hole in the case nearest the center of the transmission). See Figure 7A-183C).

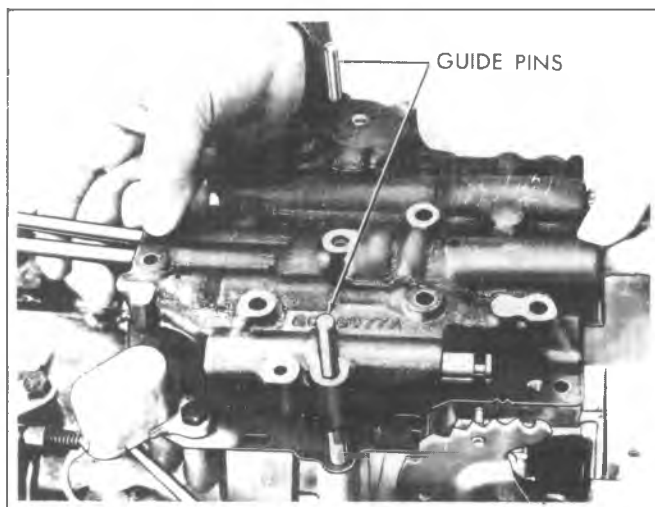


Fig. 7A-184C--Installing Control Valve Assembly and Governor Pipes

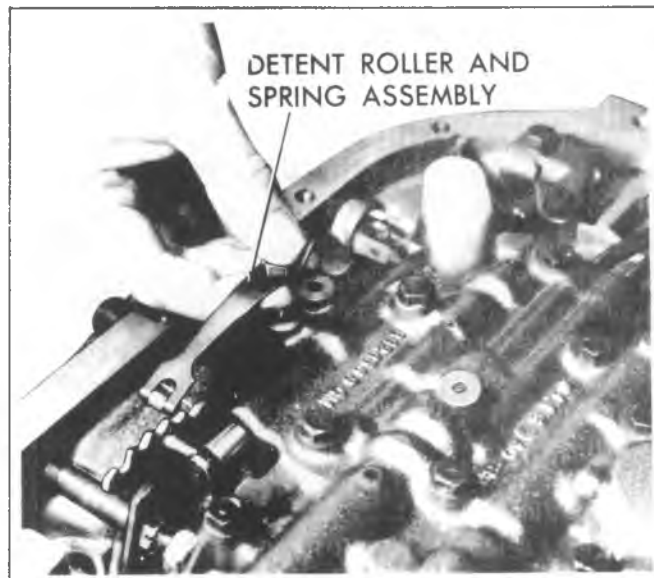


Fig. 7A-185C--Installing Detent Roller and Spring Assembly

3. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen (Fig. 7A-184C). Make certain gasket and spacer do not become mispositioned.

Check manual valve to make sure it is indexed properly with pin on detent lever and check governor pipes to make certain they are properly seated in case holes.

4. Start control valve assembly attaching bolts. If transmission is in the vehicle, remove feeler stock before tightening any control valve bolts.

5. Remove guide pins and install detent roller and spring assembly and remaining bolts (Fig. 7A-185C).

INSTALLATION OF FILTER AND INTAKE PIPE

1. Install case to intake pipe "O" ring seal on intake pipe and assemble into filter assembly.

2. Install filter and intake pipe assembly (Fig. 7A-8C). It is recommended that the filter be replaced, rather than cleaned, whenever the transmission is disassembled.

3. Install filter retainer bolt (Fig. 7A-7C).

4. Install new bottom pan gasket and bottom pan, with attaching screws. Torque to 12 ft. lbs.



Fig. 7A-186C--Installing Vacuum Modulator and Valve

INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into case, stem end out (Fig. 7A-186C).
2. Install "O" ring seal on vacuum modulator.
3. Install vacuum modulator into case.

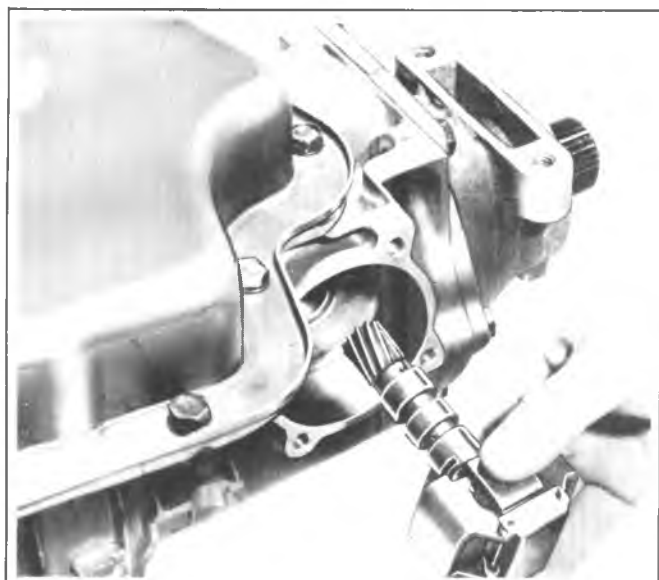


Fig. 7A-187C--Installing Governor Assembly

4. Install modulator retainer and attaching bolt. Torque bolt 18 ft. lbs.

INSTALLATION OF GOVERNOR ASSEMBLY

1. Install governor assembly into case (Fig. 7A-187C).
2. Attach governor cover and gasket with four (4) attaching bolts. Torque bolts to 18 ft. lbs.

INSTALLATION OF SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Install speedometer driven gear assembly (Fig. 7A-188C).
2. Install speedometer driven gear retainer and attaching bolt.

INSTALL CONVERTER ASSEMBLY

With the transmission in cradle or portable jack, install the converter assembly into the pump assembly making certain 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 used in the FA, FL AND FM models has six (6) mounting lugs.

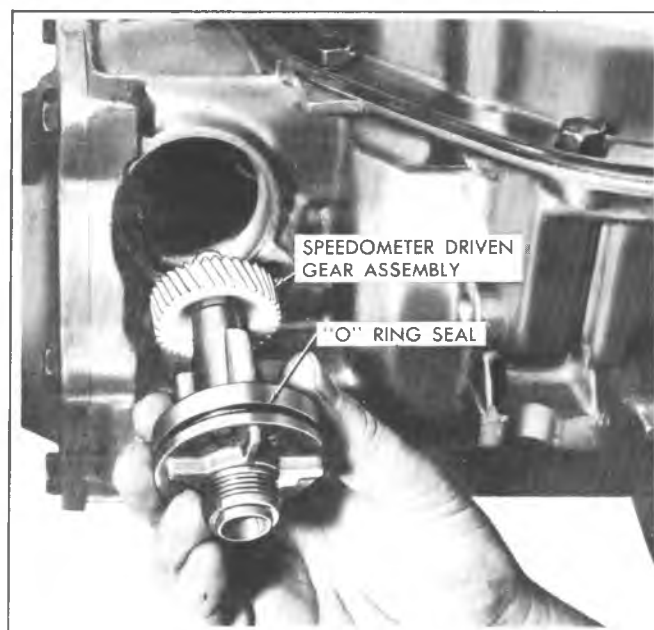


Fig. 7A-188C--Installing Speedometer Driven Gear and Sleeve

SPECIFICATIONS

TORQUE SPECIFICATIONS

Pump Cover Bolts	18 ft. lbs.
Parking Pawl Bracket Bolts	18 ft. lbs.
Center Support Bolt	23 ft. lbs.
Pump to Case Attaching Bolts	18 ft. lbs.
Extension Housing to Case Attaching Bolts	23 ft. lbs.
Rear Servo Cover Bolts	18 ft. lbs.
Detent Solenoid Bolts	7 ft. lbs.
Control Valve Body Bolts	8 ft. lbs.
Bottom Pan Attaching Screws	12 ft. lbs.
Modulator Retainer Bolt	18 ft. lbs.
Governor Cover Bolts	18 ft. lbs.
Manual Lever to Manual Shaft Nut	8 ft. lbs.
Manual Shaft to Inside Detent Lever	18 ft. lbs.
Linkage Swivel Clamp Nut	43 ft. lbs.
Converter Dust Shield Screws	93 ft. lbs.
Transmission to Engine Mounting Bolts	35 ft. lbs.
Converter to Flywheel Bolts	32 ft. lbs.
Rear Mount to Transmission Bolts	40 ft. lbs.
Rear Mount to Crossmember Bolt	40 ft. lbs.
Crossmember Mounting Bolts	25 ft. lbs.
Line Pressure Take-Off Plug	13 ft. lbs.
Strainer Retainer Bolt	10 ft. lbs.
Oil Cooler Pipe Connectors to Transmission	
Case	28 ft. lbs.
Oil Cooler Pipe to Connector	10 ft. lbs.
Gearshift Bracket to Frame	15 ft. lbs.
Gearshift Shaft to Swivel	20 ft. lbs.
Manual Shaft to Bracket	20 ft. lbs.
Downshift Switch to Bracket	30 in. lbs.

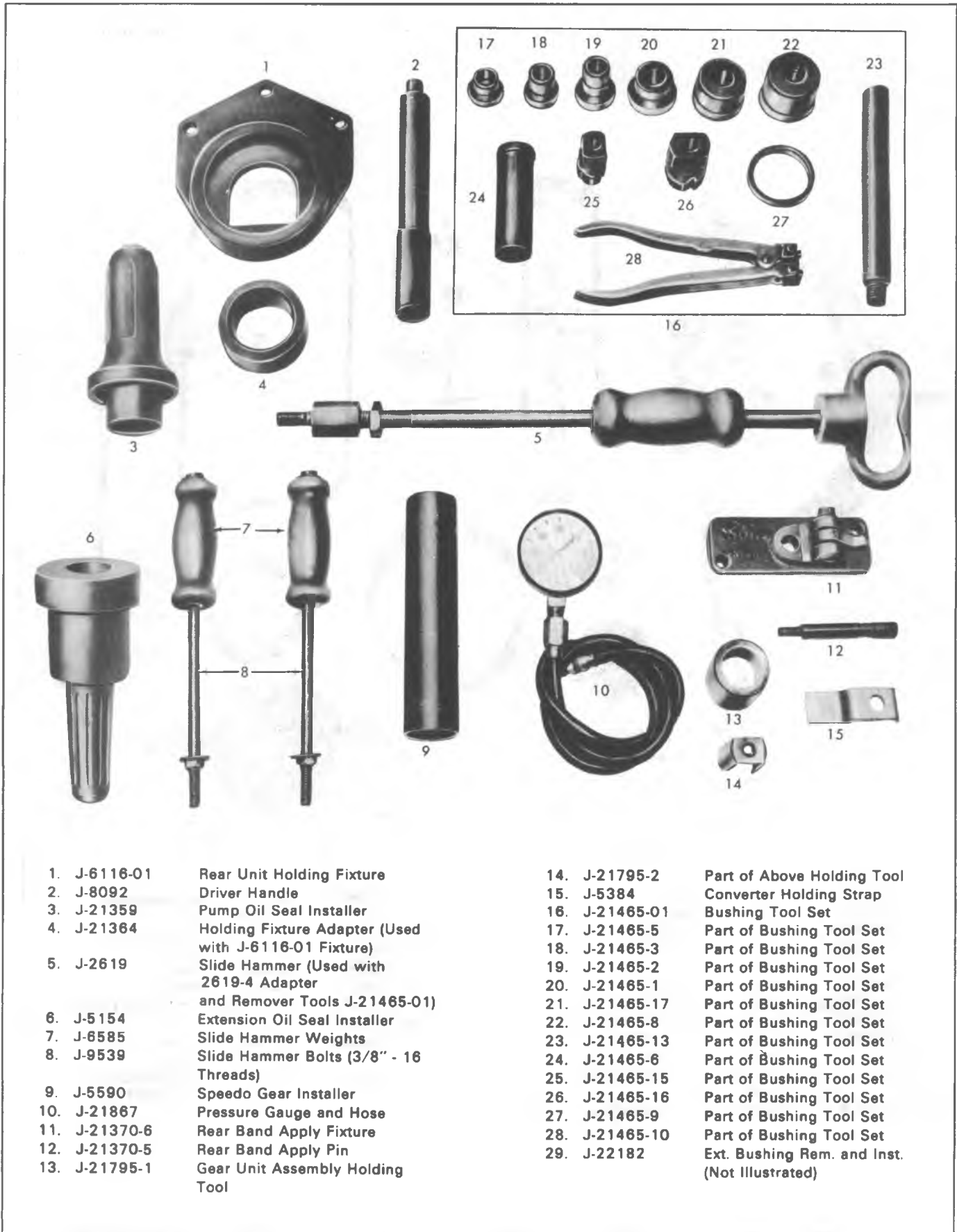
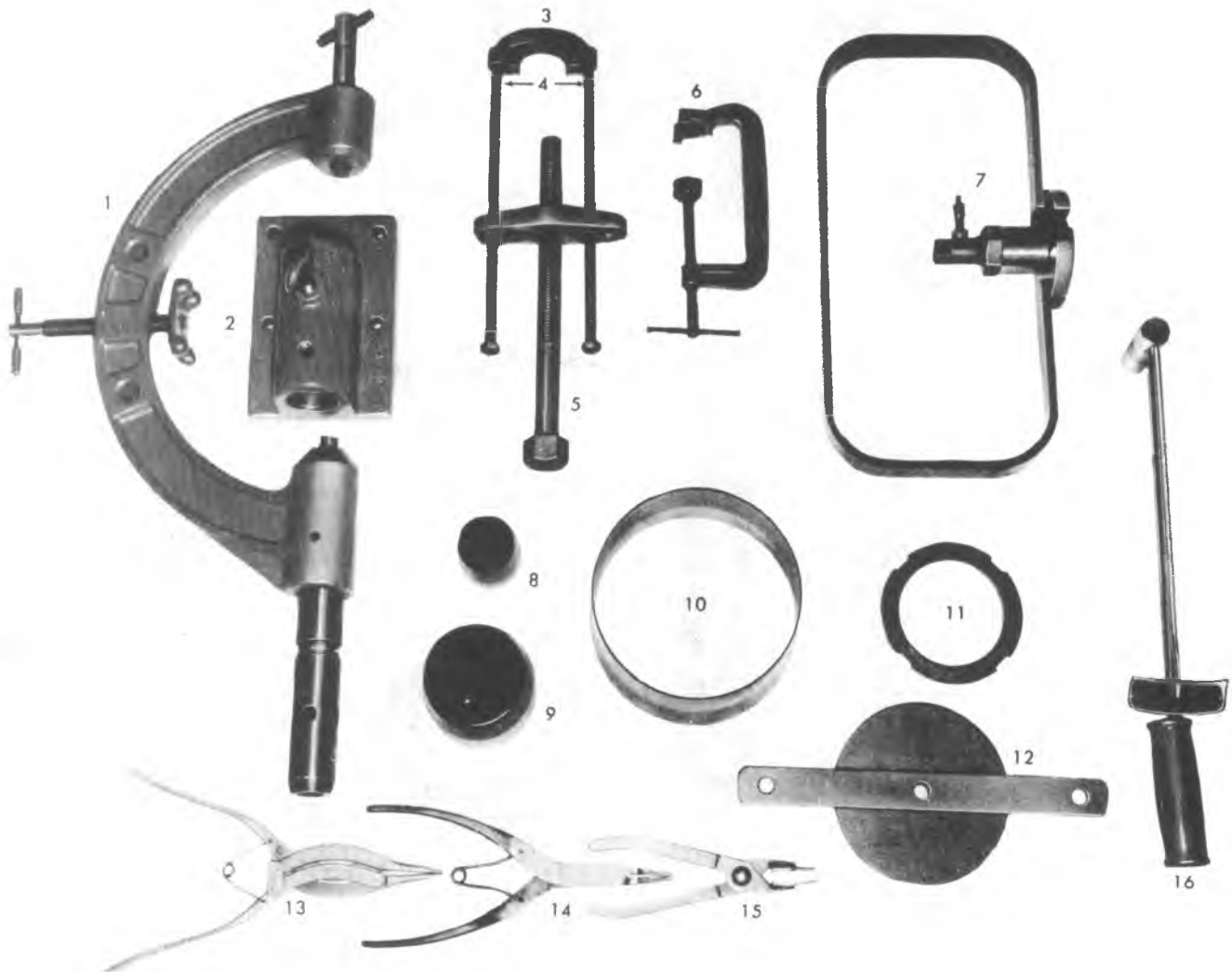


Fig. 7A-15T- 400 Special Tools



- | | |
|---------------|--|
| 1. J-8763 | Transmission Holding Fixture |
| 2. J-3289-14 | Holding Fixture Base |
| 3. J-21427-1 | Speedo Gear Remover |
| 4. J-9539 | Side Hammer Bolts (3/8" - 16 Threads) |
| 5. J-8105 | Speedo Gear Remover Puller |
| 6. J-22269-01 | Accumulator Piston Remover and Installer |
| 7. J-21369 | Converter Pressure Check Fixture |
| 8. J-21362 | Seal Protector - Forward and Direct Clutch - Inner |
| 9. J-21363 | Seal Protector - Intermediate Clutch - Inner |
| 10. J-21409 | Seal Protector - Forward Clutch - Outer |

- | | |
|-----------------|---|
| 11. J-21664 | Clutch Spring Compressor Adapter Ring |
| 12. J-4670 | Clutch Spring Compressor |
| 13. J-8059 | Snap Ring Pliers |
| 14. J-5586 | Snap Ring Pliers |
| 15. J-5403 | Snap Ring Pliers |
| 16. J-1313 | Torque Wrench 0-140 Ft. Lbs. |
| Not Illustrated | |
| J-24684 | Pressure Regulator |
| J-24675 | Valve Compressor |
| | Accumulator Piston Adapter (Used with J-22269-01) |

Fig. 7A-2ST-400 Special Tools

SECTION 700-R4

700-R4 AUTOMATIC TRANSMISSION

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General Description.....	7A1-2
Diagnosis.....	7A1-4
Transmission Repair.....	7A1-7

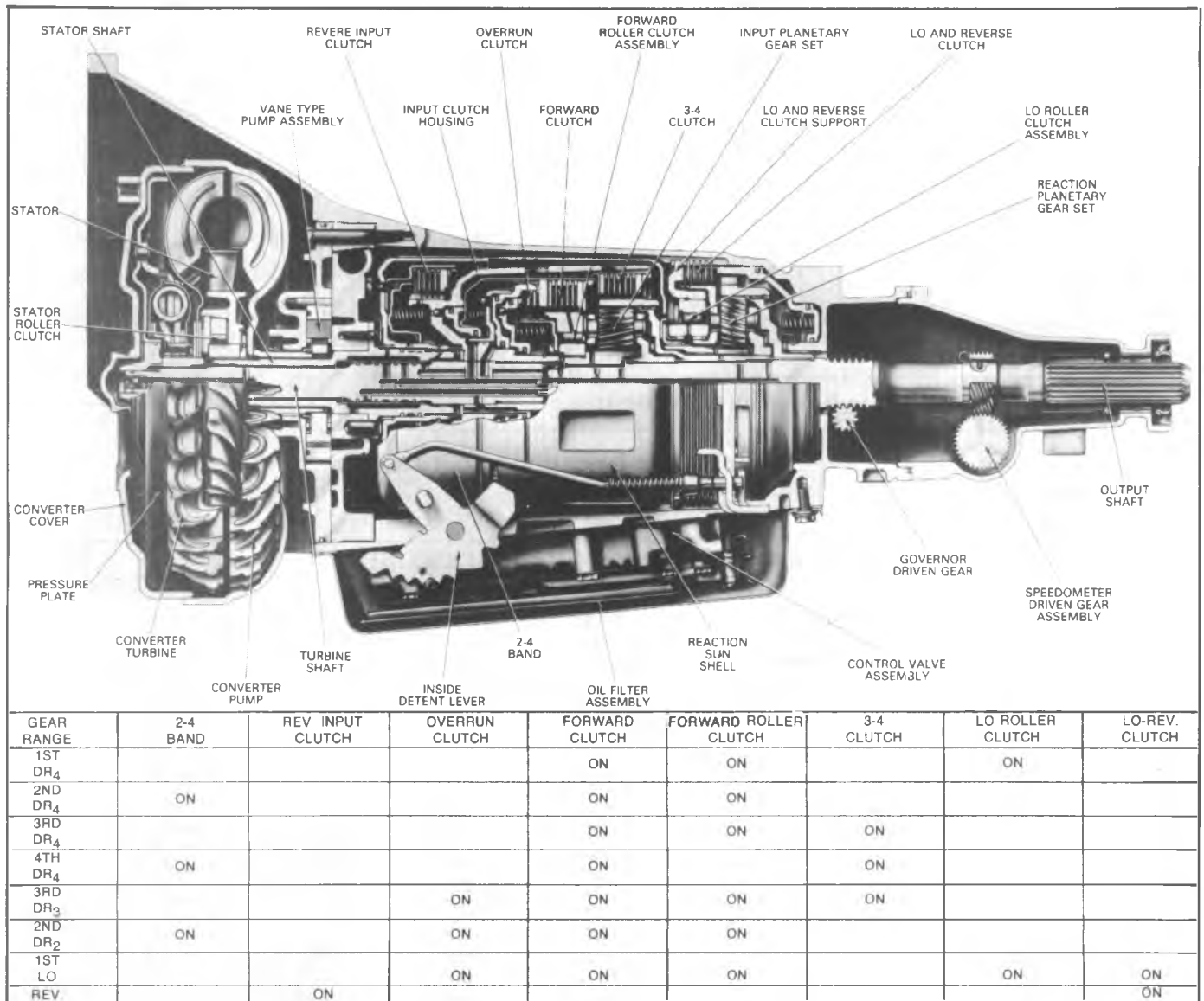


Figure 700-R4-1A Transmission Cross Section & Band & Clutch Chart

GENERAL DESCRIPTION

The model 700-R4 is a fully automatic transmission consisting of a 3-element hydraulic torque converter with the addition of a converter clutch.

Also two planetary gear sets, five multiple-disc type clutches, two roller or one-way clutches and a band are used which provide the friction elements to produce four forward speeds, the last of which is overdrive.

The torque converter, through oil, couples the engine power to the gear sets and hydraulically provides additional torque multiplication when required. Also, through the converter clutch, the converter drive and driven members operate as one unit when applied providing mechanical drive from the engine through the transmission.

The gear ratio changes are fully automatic in relation to vehicle speed and engine torque. Vehicle speed and engine torque are directed to the transmission providing the proper gear ratios for maximum efficiency and performance at all throttle openings.

A hydraulic system pressurized by a variable capacity vane type pump provides the operating pressure required for the operation of the friction elements and automatic controls.

700 - GEAR RATIOS

FIRST	3.06	FOURTH	.70
SECOND	1.62	REVERSE	2.29
THIRD	1.00		

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 typing 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

MODEL	RANGE	NORMAL OIL PRESSURE AT MINIMUM T.V.		NORMAL OIL PRESSURE AT FULL T.V.	
		KPA	PSI	KPA	PSI
TE, TH, TJ, TK, T5 TW, TC TN, TP YA	PARK & NEUTRAL AT 1000 RPM	385-445	55-65	880-1,190	130-170
		385-445	55-65	880-1,190	130-170
		450-515	65-75	890-1,180	130-170
		385-445	55-65	880-1,190	130-170
TE, TH, TJ, TK, T5 TW, TC TN, TP YA	REVERSE AT 1000 RPM	630-730	90-105	1,445-1,955	210-285
		630-730	90-105	1,445-1,955	210-285
		740-845	110-120	1,455-1,940	210-280
		630-730	90-105	1,445-1,955	210-285
TE, TH, TJ, TK, T5 TW, TC TN, TP YA	DRIVE & MANUAL THIRD AT 1000 RPM	385-445	55-65	880-1,190	130-170
		385-445	55-65	880-1,190	130-170
		450-515	65-75	890-1,180	130-170
		385-445	55-65	880-1,190	130-170
TE, TH, TJ, TK, T5 TW, TC TN, TP YA	MANUAL SECOND & LO AT 1000 RPM	705-815	100-120	705-815	100-120
		705-815	100-120	705-815	100-120
		710-810	105-115	710-810	105-115
		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.

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Figure 700-R4-1-B General Description & Oil Pressure Chart

Figure 700-R4-1-C Transmission Oil Circuit Chart - Park Position

DIAGNOSIS GUIDE

OIL PRESSURE - HIGH OR LOW

1. **Pump Assembly**
 - A. Pressure Regulator Valve Binding, Dirt, Damaged Spring.
 - B. T.V. and Reverse Boost Plugs and Bushings, Dirty, Sticking Damaged or Incorrect Assembly.
 - C. Pressure Relief Ball Not Seated or Damaged.
 - D. Slide Sticking
 - E. Not Regulating
 - F. Excess Rotor Clearance.
2. **Manual Valve**
 - A. Not Engaged, Damaged.
3. **T.V. Exhaust Valve**
 - A. Binding, Damaged
4. **Throttle Lever and Bracket Assembly**
 - A. Misassembled, Binding, Damaged or Missing Check Valve
5. **Valve Body**
 - A. Throttle Valve or Plunger Sticking
 - B. T.V. Limit Valve Sticking
7. **Throttle Link**
 - A. Not Engaged - Damaged - Incorrect - Burr on Upper End - Hanging on T.V. Sleeve
8. **Filter**
 - A. Restricted
 - B. Missing 'O' Ring
 - C. Hole in Intake Pipe.

Check: Oil Level

T.V. Cable

Oil Pressure

HIGH OR LOW SHIFT POINTS

1. **T.V. CABLE**
 - A. Binding or Not Set
2. **External Linkage**
 - A. Improper External Linkage Travel
3. **Valve Body**
 - A. Binding Throttle Valve or Plunger
 - B. T.V. Modulator Up or Down Valve Sticking
 - C. Gaskets, Spacer Plate Mispositioned or Damaged
 - D. T.V. Limit Valve Sticking
4. **Pump Assembly**
 - A. Sticking Pressure Regulator Valve, or T.V. Boost Valve
 - B. Pump Slide Sticking

Check: Oil Level

T.V. Cable

Oil Pressure

FIRST SPEED ONLY - NO UPSHIFT

1. **Governor Assembly**
 - A. Sticking Governor Valve
 - B. Governor Driven Gear
 1. Damaged
 2. Missing Retaining Pin

CHECK: OIL LEVEL

T.V. CABLE

OIL PRESSURE

3. Nicks or Burrs on Output Shaft
4. Correct Governor Retaining Pin in Case. (Long or Short)
5. Governor Sleeve - Burrs
6. Case - Burrs
7. Governor Weights - and Springs
2. **Valve Body**
 - A. 1-2 Shift Valve - Sticking
 - B. Gaskets, Spacer Plate Mispositioned
3. **Case**
 - A. Valve Body Pad - Porosity and or Damaged Lands
 - B. Governor Screen - Restricted, Damaged
 - C. 2-4 Servo
 1. Apply Passages, Servo Pin and Pin Hole in Case.
 2. Damaged or Missing Servo Piston Seals, Apply Pin Damaged
 - D. 2-4 Band Assembly
 1. Burned, Band Anchor Pin Not Engaged. Apply End Broken.

Check: Oil Level

T.V. Cable

Oil Pressure

SLIPS IN 1ST GEAR

1. **Forward Clutch Plates Burned**
2. **Forward Clutch**
 - A. Porosity - Forward Clutch Piston
 - B. Cut or Damaged Seals
 - C. Damaged Forward Clutch Housing
 - D. Internal Leak
 - E. Forward Clutch Housing Check Ball Damaged
 - F. Low Oil or Oil Pressure
3. **Valve Body**
 - A. Accumulator Valve Sticking
 - B. Damaged Lands - Interconnected Passages
 - C. Valve Body Gaskets, Spacer Plate, Damaged Mispositioned
4. **Binding Internal T.V. Linkage**
5. **1-2 Accumulator Piston Assembly**
 - A. Porous Piston or Bore
 - B. Cut or Damaged Seals
 - C. Leak Between Piston and Pin
 - D. Missing or Broken Accumulator Spring

Check: Oil Level

T.V. Cable

Oil Pressure

1-2 FULL THROTTLE SHIFTS ONLY

1. **T.V. Cable**
 - A. Not Connected
 - B. Long or Short
2. **Throttle Lever and Bracket Assembly**
 - A. Misassembled
 - B. Binding

C. Missing Exhaust Check Valve

3. Throttle Link

- A. Not Connected
- B. Burr on Upper End
- C. Hanging on Sleeve

4. Throttle Valve or Plunger

- A. Hanging or Sticking in Full Open Position

5. Inter Connected Passages

- A. Pump - Case - Valve Body

Check: Oil Level

T.V. Cable

Oil Pressure

1-2 SLIP OR ROUGH

1. Throttle Lever and Bracket Assembly

- A. Damaged
- B. Incorrectly Installed

2. Valve Body

- A. Throttle Valve or Bushing, Sticking
- B. Sticking 1-2 Shift Valve Train
- C. Gaskets or Spacer Plate Mispositioned
- D. Sticking Line Bias Valve
- E. Sticking Accumulator Valve
- F. Sticking T.V. Limit Valve

3. 2-4 Servo

- A. Incorrect Servo Apply Pin
- B. Damaged Oil Seal Rings or Seals
- C. Damaged Bores
- D. Restricted or Missing Oil Passages

4. 2nd Accumulator

- A. Damaged Piston Seal
- B. Missing Accumulator Spring
- C. Damaged Bores
- D. Porous Piston
- E. Restricted or Missing Oil Passage

5. Burned 2-4 Band

Check: Oil Level

T.V. Cable

Oil Pressure

2-3 SLIP OR ROUGH

1. Valve Body

- A. 2-3 Shift Valve Train Sticking
- B. Accumulator Valve Sticking
- C. Gaskets or Spacer Plate Mispositioned
- D. Throttle Valve Sticking
- E. T.V. Limit Valve Sticking

2. 3-4 Clutch

- A. Burned Clutch Plates
- B. Excessive Clutch Plate Travel
- C. Cut or Damaged Piston Seals
- D. 3-4 Piston Porosity
- E. 3-4 Piston Exhaust Ball Open
- F. Restricted Apply Passages
- G. Check Ball (#7) Capsule Damaged or Misassembled

Check: Oil Level

T.V. Cable

Oil Pressure

3-4 SLIP OR ROUGH

1. 3-4 Accumulator

- A. Missing Accumulator Spring
- B. Piston Porosity
- C. Restricted Feed Passage
- D. Broken Oil Seal Ring
- E. Damaged Case Bore

2. Servo

- A. Incorrect Band Apply Pin
- B. Damaged or Missing Piston Seals
- C. Damaged Piston Bores
- D. Piston Porosity

3. 3-4 Clutch

- A. Burned - Refer to 2-3 Slip

4. 2-4 Band

- A. Burned

5. Valve Body

- A. 2-3 Shift Valve Train Sticking
- B. Accumulator Valve Sticking
- C. Gaskets or Spacer Plate Mispositioned
- D. Throttle Valve Sticking
- E. T.V. Limit Valve Sticking

Check: Oil Level

T.V. Cable

Oil Pressure

NO REVERSE - OR SLIPS IN REVERSE

1. Forward Clutch

- A. Will Not Release

2. Manual Linkage

- A. Improperly Adjusted

3. Pump Assembly

- A. Reverse Boost Plug - Sticking

4. Valve Body

- A. Valve Body Gaskets, Spacer Plate

5. Lo Reverse Clutch

- A. Cut or Damaged Piston Seals
- B. Restricted or Missing Apply Passage
- C. Burned Clutch Plates
- D. Cover Plate Loose or Damaged Gasket

6. Reverse Input Clutch

- A. Burned Clutch Plates
- B. Cut or Damaged Piston Seals
- C. Restricted or Missing Apply Passage
- D. Housing Exhaust Ball & Capsule Damaged

Check: Oil Level

T.V. Cable

Oil Pressure

NO PART THROTTLE DOWNSHIFTS

1. Binding External or Internal Linkage

2. Valve Body

- A. T.V. Modulator Downshift Valve Binding
- B. Throttle Valve Binding
- C. Throttle Valve Bushing - Feed Hole Restricted or Missing

- D. Check Ball #3 Mispositioned

Check: Oil Level

T.V. Cable

Oil Pressure

NO OVERRUN BRAKING - MANUAL 3 - 2 - 1

1. External Manual Linkage Not Properly Adjusted
2. Overrun Clutch
 - A. Burned Clutch Plates
 - B. Damaged Inner or Outer Piston Seals
 - C. Piston Exhaust Ball Sticking or Missing
 - D. Piston Porosity
3. Valve Body
 - A. Gaskets or Spacer Plate Mispositioned or Orifice Holes Plugged
 - B. 4-3 Sequence Valve Sticking
 - C. Check Balls 3, 9 or 10 Mispositioned
4. Turbine Shaft
 - A. Restricted or Missing Oil Feed Passage
 - B. Damaged Teflon Oil Seal Rings
 - C. Plug Missing

NO CONVERTER CLUTCH APPLY

1. Electrical
 - A. 12 Volts Not Being Supplied to the Transmission (Refer to the 7A Section)
 - B. Defective Transmission Outside Electrical Connector
 - C. Defective Inside Electrical Connector, Wiring Harness, Solenoid
 - D. Electrical Ground Inside Transmission
 - E. Defective Pressure Switch or Improper Connection
 - F. Solenoid Not Grounded
2. Valve Body
 - A. Sticking Converter Clutch Shift or Throttle Valve
 - B. Valve Body Casting or Spacer Plate in Converter Clutch Valve Area
3. Pump Assembly
 - A. Converter Clutch Apply Valve, Stuck or Installed Backwards
 - B. Signal Oil Orifice, Restricted or Not Present
 - C. "O" Ring on Solenoid Damaged, Not Installed - Signal Oil Leak
 - D. Pump to Case Gasket Damaged or Mispositioned
 - E. Cup Plug Missing from Apply Passage
 - F. Orifice Plug Missing from the Cooler Input Passage

- G. High or Uneven Bolt Torque on Cover to Body
H. Converter Clutch Stop Valve or Retainer Ring Not Installed Properly

CONVERTER SHUDDER

1. Converter Clutch Pressure Plate Damaged.
2. Check Ball on End of Turbine Shaft Damaged.
3. Sticking Converter Clutch Shift Valve in Valve Body.
4. Sticking Converter Clutch Apply Valve in Pump.
5. Restricted Converter Clutch Apply Passage.
6. Low Oil or Oil Pressure.
7. Engine Not Tuned Properly.

NO CONVERTER RELEASE

1. Converter Clutch Apply Valve Stuck in the Open Position.
2. "O" Ring or Check Ball in the End of the Turbine Shaft Damaged.
3. Internal Converter Damage.

DRIVES IN NEUTRAL

1. Forward Clutch
 - A. Burned - Not Releasing
2. Manual Linkage or Manual Valve
 - A. Incorrectly Set
 - B. Disconnected
 - C. Internal Linkage
3. Case
 - A. Interconnected Passages

2ND SPEED START (DR. RANGE)

1. Governor Assembly
2. T.V. Cable

NO PARK OR WILL NOT HOLD IN PARK

1. Actuator Rod Assembly Bent or Damaged.
2. Actuator Rod Spring Binding or Improper Crimp.
3. Parking Lock Pawl Return Spring Damaged or Not Assembled Properly.
4. Actuator Rod Not Attached to Inside Detent Lever.
5. Parking Brake Bracket Damaged or Bolts Not Torqued.
6. Inside Detent Lever Nut Not Torqued.
7. Detent Roller Improperly Installed or Damaged.
8. Parking Lock Pawl Binding or Damaged.
9. Parking Lock Pawl Interference with the Lo Reverse Piston.

GENERAL

Thoroughly clean the exterior of the transmission to prevent the possibility of dirt entering and effecting its operation. Clean and air dry all parts. Do not use cloths or rags to dry. Do not use solvents on neoprene seals or composition clutch plates.

SEALS

If any seal rings are damaged distorted, cut, scored etc or do not rotate freely in their groove, and replacement is required, the following procedures are recommended.

TEFLON OIL SEAL RINGS

1. Remove the old angle cut seal rings.
2. Inspect the seal ring groove for burrs or damage.
3. When installing angle cut seal rings do not over stretch. Make sure the ends are in the same relationship as those removed.

Also, make sure rings are seated in the grooves to prevent damage during reassembly of the mating part. Retain rings with petrolatum.

4. Angle oil seal rings may appear to be distorted after being installed and exposed to normal transmission oil

temperatures, the new seal rings will return to their normal shape and fit freely in their bores.

5. **THRUST WASHER SURFACES** The thrust washers and thrust bearings will polish the surfaces this is not to be considered a damaged part due to this condition.
6. **CLUTCH PLATES**

COMPOSITION

Some composition clutch plates will be very dark in color and will be reusable. This will be due to the type of material used. If the plates are thin, flaked, burned etc. They should be replaced.

STEEL

Steel clutch plates are considered usable if they do not indicate excessive heat. Distortion, or other form of damage.

TRANSMISSION DISASSEMBLY

VALVE BODY AND WIRING HARNESS PARTS

(Fig. 1)

Removal

1. With the converter removed, install the transmission in the holding fixture and position the transmission with the oil pan upwards and the servo positioned away from the bench.
2. Remove the transmission oil pan and attaching bolts.
3. Remove the transmission oil pan gasket and discard.
4. Remove the oil filter and "O" Ring, which can be retained in the case bore.
5. Disconnect the inner harness connector at the outside connector located in the transmission case, by bending the locking tab outward and pulling the connector upwards.
6. Remove the outside electrical connector and "O" Ring seal from the transmission case by bending the inner tab inward with a small screwdriver and pushing downward.
7. Remove the solenoid and attaching bolts, and "O" Ring from the case and pump. If the solenoid is not free, gently pry up with a small screwdriver.
8. Disconnect all wire leads at the pressure switches and remove the complete wiring harness and solenoid assembly.
9. Remove the 3-4 accumulator housing, attaching bolts, 3-4 accumulator spring, and piston, gasket and plate. (Fig. 2)
10. Remove the oil passage cover, and attaching bolts from the transmission case.
11. Removal of the valve body assembly.
 - a. Remove the manual detent roller assembly and attaching bolt.
 - b. Remove the harness wire retaining clips and attaching bolts.
 - c. Remove the throttle lever bracket assembly and T.V. link.
 - d. Remove all remaining valve body attaching bolts.
 - e. Unhook the manual valve, retaining clip - at the inside detent lever, and remove the valve body assembly, spacer plate, and gaskets.

3 check balls and 1 check valve are located in the valve body can will fall free.
12. Remove the 1-2 accumulator spring, piston and pin from the transmission case.
13. Remove the 5 check balls and check valve from the case passages.
14. Remove the converter clutch and governor screens from the transmission case.

GOVERNOR AND EXTERNAL PARTS

Removal

1. Remove the governor and governor cover.

Do Not Damage Governor Cover.
2. If the rear seal requires replacement, replace at this time by removing with a screwdriver and installing with J-21426. (Fig. 3)
3. Remove the case extension and attaching bolts.
4. Remove the sleeve and "O" Ring from the output shaft, and with a screwdriver remove the speedo gear and clip.
5. **2nd & 4th Servo**
 - a. Install tool J-29714 and remove the 2-4 servo cover retaining ring with a small screwdriver. (Fig. 4)
 - b. Remove the servo cover and "O" Ring by applying air pressure in servo apply hole in the case or by using vise grip pliers.
 - c. Remove the 4th gear apply piston and "O" Ring.
 - d. Remove the 2nd servo piston assembly.
 - e. Remove the inner servo piston assembly and oil seal ring, and release spring.
5. **2-4 Servo Pin Selection Procedure**

The 2-4 servo apply pin checking gage J-33037 is used with the production servo apply pin used in the transmission. Use the gage to check the transmission pin. If it is not correct, select the proper pin from one supplied with the tool, which are service replacement parts. (Fig. 5)

When one of the pins is used, a replacement should be ordered so that a complete set is available.

2-4 Servo Pin Checking Procedure

- a. Install J-33037 into the servo bore and secure with the snap ring, locating the gap in the case slot.
- b. Disassemble the 2-4 servo assembly using tool J-22269-01 and insert the servo pin into the tool, locating the end of the pin on the band anchor lug.
- c. Install a torque wrench and apply 11.2 N·M (100 ft. lbs.)
- d. If any part of the white line appears in the window, the pin is the correct length. If the white line cannot be found, select another pin until the correct one is obtained. (Fig. 6)
- e. Remove all tools, servo cover and snap ring and assemble the 2nd servo.

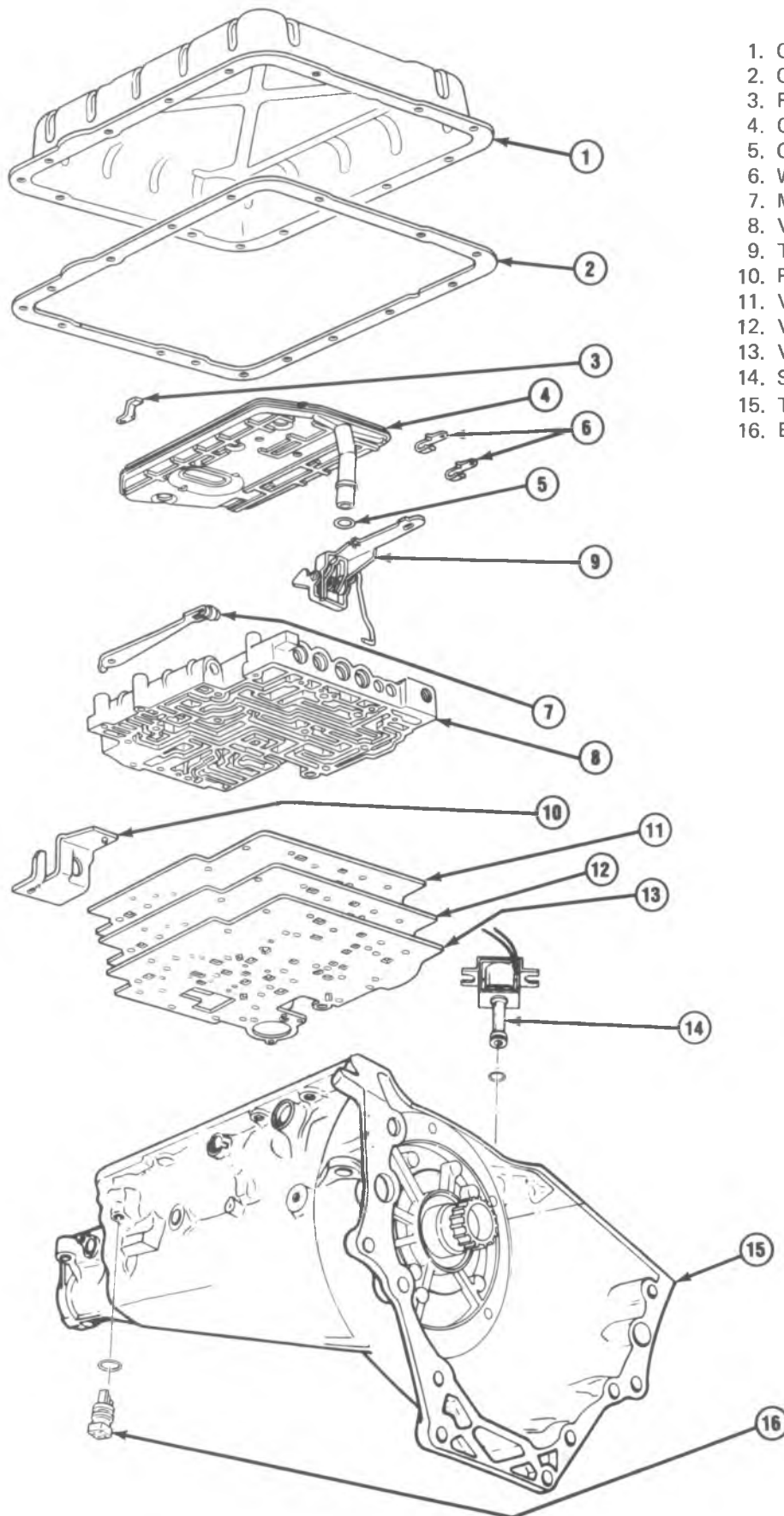
TRANSMISSION END PLAY CHECK

1. Position the transmission in a vertical position with the pump side up.
2. Remove a pump to case bolt and washer and install a 278 mm (11") bolt and locking nut.
3. Install J-24773-A and J-25022 securing on the end of the turbine shaft.
4. Mount a dial indicator and clamp on the bolt positioning the indicator point cap nut on the top of J-24773-A. (Fig. 7)
5. With the dial indicator set at zero, pull upwards. The end play should be 0.13 - 0.92 mm (.005 - .036). The selective washer controlling transmission end play is located between the input housing and the thrust washer on the pump hub. If more or less end clearance is required to bring the transmission within specifications, select the proper washer from the washer selection chart. (Fig. 8)
6. Remove the dial indicator and all tools.

THE PUMP, REVERSE AND INPUT CLUTCHES

Removal

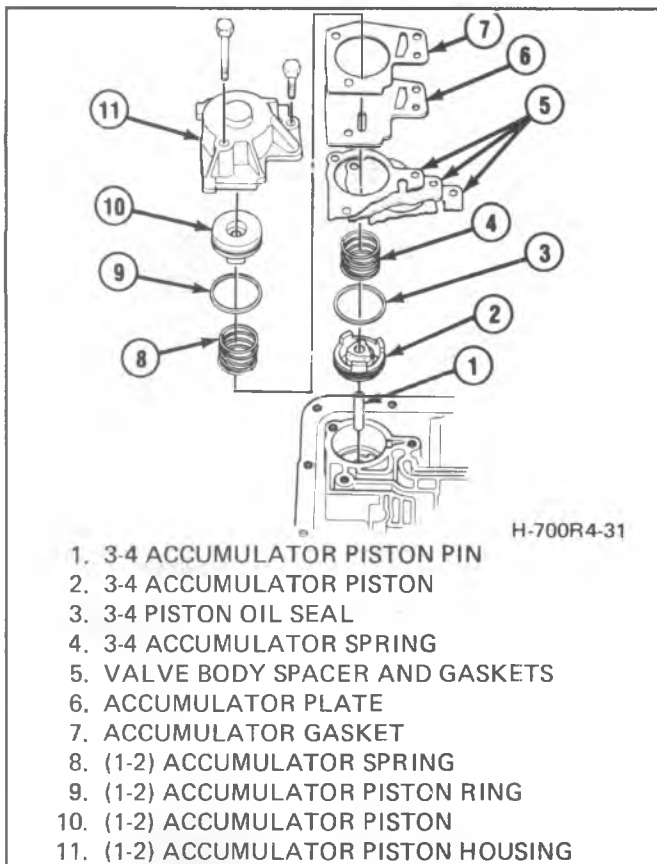
1. **Pump Assembly**
 - a. If required replace the pump seal by removing with a screwdriver and replacing with tool J25016. (Fig. 9)



1. OIL PAN
2. OIL PAN GASKET
3. FILTER RETAINING CLIP
4. OIL FILTER
5. OIL FILTER 'O' RING
6. WIRING HARNESS CLIP
7. MANUAL DETENT ROLLER
8. VALVE BODY
9. T.V. LEVER AND BRACKET
10. PARKING LOCK BRACKET
11. VALVE BODY SPACER GASKET
12. VALVE BODY SPACER
13. VALVE BODY CASE GASKET
14. SOLENOID AND 'O' RING
15. TRANSMISSION
16. ELECTRICAL CONNECTOR

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Figure 700-R4-1 Case Attaching Parts



1. 3-4 ACCUMULATOR PISTON PIN
 2. 3-4 ACCUMULATOR PISTON
 3. 3-4 PISTON OIL SEAL
 4. 3-4 ACCUMULATOR SPRING
 5. VALVE BODY SPACER AND GASKETS
 6. ACCUMULATOR PLATE
 7. ACCUMULATOR GASKET
 8. (1-2) ACCUMULATOR SPRING
 9. (1-2) ACCUMULATOR PISTON RING
 10. (1-2) ACCUMULATOR PISTON
 11. (1-2) ACCUMULATOR PISTON HOUSING

Figure 700-R4-2 1-2 and 3-4 Accumulator Assembly

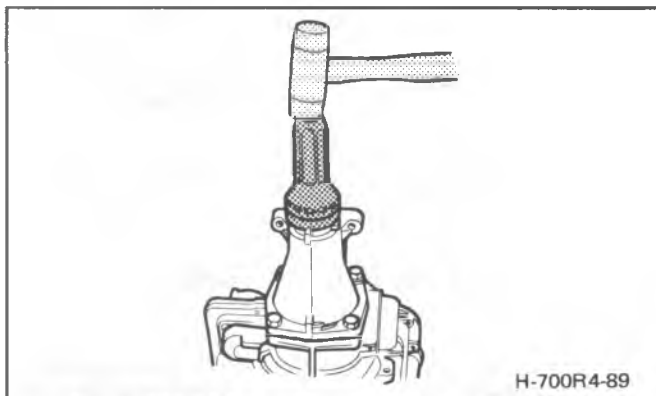


Figure 700-R4-3 Installing Rear Seal with J-21426

- b. Remove the remaining pump to case bolts and washers.
- c. Using J-24773-A tool remove the pump assembly and pump to case gasket. (Fig. 10)

The filter and solenoid must be removed before the pump can be removed.

2. Remove the reverse input drum to pump washer from the pump.
3. Remove the reverse and input clutch assemblies by lifting out with the turbine shaft.

Do not remove the teflon oil seal rings on turbine shaft unless required.

2-4 BAND AND INPUT GEAR SET

Removal

1. Remove the 2-4 band assembly from the case.
2. Remove the band anchor pin from the case.
3. Remove the input sun gear.

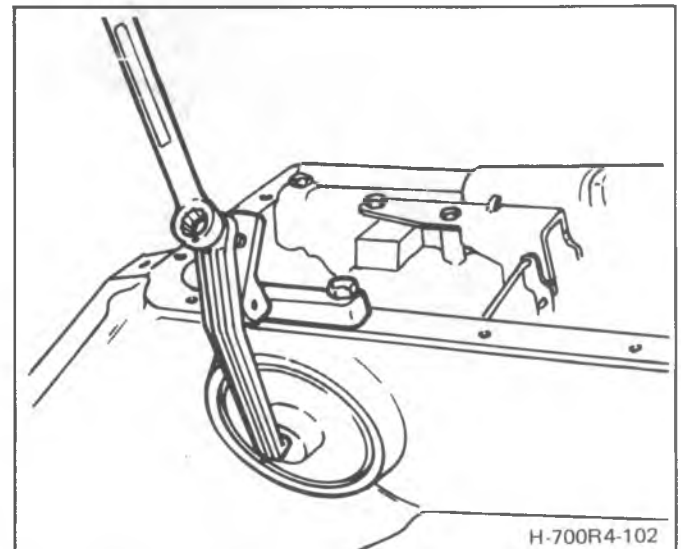


Figure 700-R4-4 Installing or Removing Servo Cover with J-29714

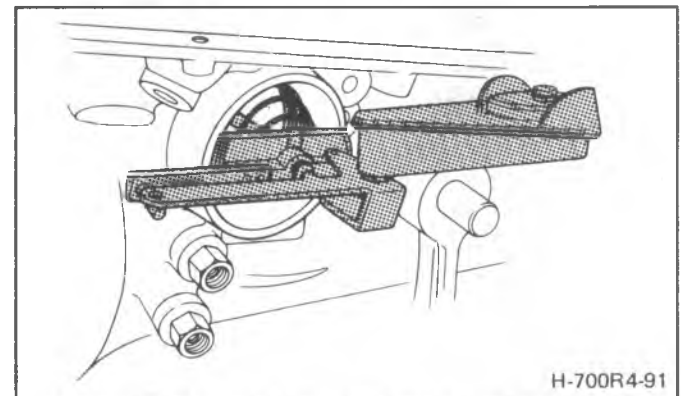


Figure 700-R4-5 2-4 Servo Pin Selection Using J-33037

2-4 SERVO PIN SELECTION			H-700R4-48
DIAL INDICATOR READING		PIN I.D.	
mm	INCH		
0 TO 1.37 mm	(0" - .053")	1 RING	
1.37 - 2.74 mm	(.053" - .106")	2 RINGS	
2.74 - 4.11 mm	(.106" - .159")	3 RINGS	
4.11 - 5.48 mm	(.159" - .212")	WIDE BAND	

Figure 700-R4-6 2-4 Servo Pin Selection Chart

The output shaft and reaction internal gear assy. are assembled using Loctite to hold the parts as one unit for ease of assembly. During transmission operation, these parts can become separated.

To prevent the possibility of the output shaft falling free, install output shaft support tool J-29837 on the case holding the output shaft in place. (Fig. 11)

4. Remove the input carrier to output shaft snap ring with narrow snap ring pliers.
5. If free, remove the output shaft and tool
6. Remove the input carrier and thrust washer.
7. Remove the reaction shaft thrust bearing from the input internal gear.

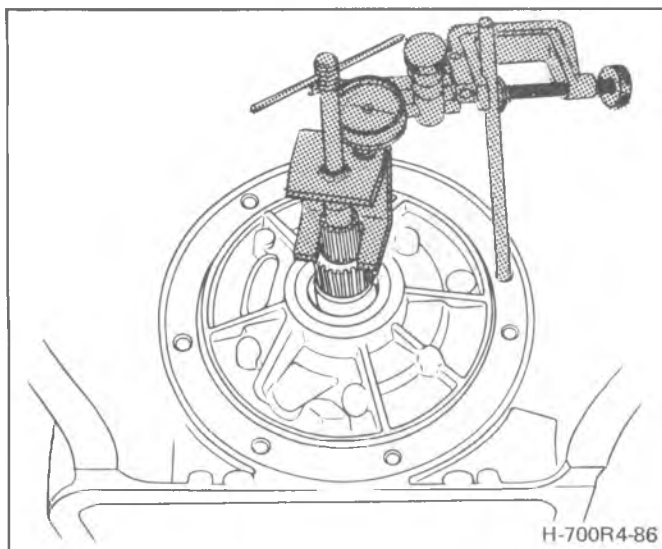


Figure 700-R4-7 End Play Check Using Dial Indicator Set and J-25032 and J-24773A

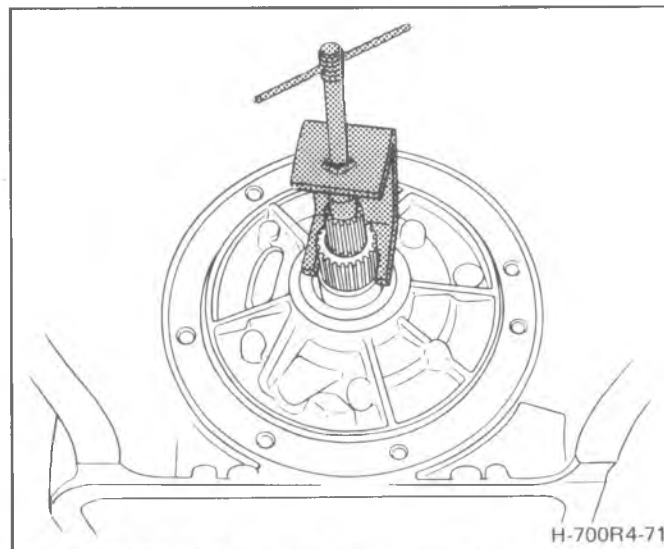


Figure 700-R4-10 Removing Pump Assembly with J-24773-A

TRANSMISSION END PLAY WASHER SELECTION CHART		H-700R4-47
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 700-R4-8 Transmission Selective Washer Chart

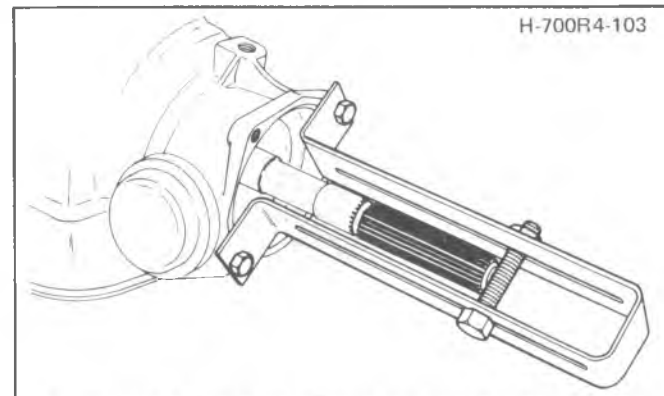


Figure 700-R4-11 Positioning Output Shaft with J-29837

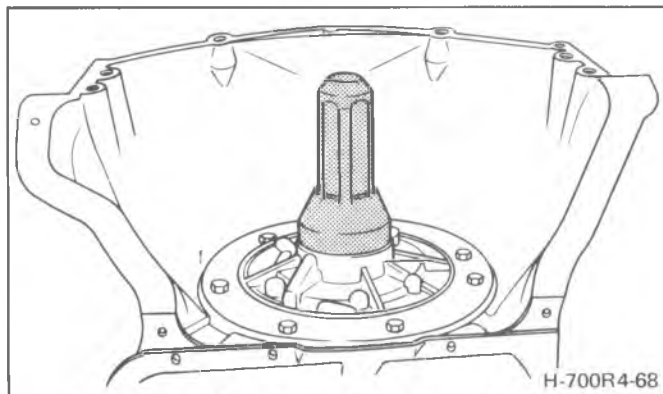


Figure 700-R4-9 Installing Pump Seal with J-25016

7. Remove the reaction internal gear, output shaft if not removed and bearing assembly.
8. Remove the support bearing assembly from the case hub.

LO AND REVERSE CLUTCH PARTS

Removal

1. Remove the parking lock bracket and (2) two attaching bolts. If not removed. Position the parking lock pawl inboards.
2. Using tool J-23327, compress the low and reverse clutch spring retainer and remove the spring retaining ring and low and reverse spring assembly.
3. Remove tools.
4. Remove the low and reverse clutch piston by applying air pressure in the case apply passage.

REACTION GEAR SET

Removal

1. Remove the reaction shaft to reaction sun gear washer and the reaction shell.
2. Remove the reaction shell to inner race washer.
3. Remove the low and reverse support to case retaining ring and support spring.
4. Remove the reaction sun gear.
5. Remove the low and reverse inner race, roller assembly, and support assembly and reaction carrier assembly.
6. Remove the (5) low and reverse clutch plate assemblies (composition) and (5) low and reverse clutch plates (steel).

INNER MANUAL LINKAGE

Removal

If necessary remove the inner manual linkage as follows:

1. Rotate the transmission to the horizontal position and loosen the manual shaft retaining nut and move inboard on the manual shaft.
2. Move the inner detent lever and connected actuator rod assembly and manual shaft retainer inboard.
3. Gently tap the manual shaft outboard until the retaining nut is free. If necessary install a retaining nut on the outside end of the manual shaft. With a screwdriver remove the manual shaft retainer and connect inner detent lever and actuator rod.

4. Remove the manual shaft and nut.
5. If necessary remove the inside detent lever from the actuator rod assembly by rotating the rod and indexing notches in the rod with the hole in the lever.
6. Inspect the manual shaft seal in the case for damage, and proper location and if necessary replace as follows:
 - a. Using a small screwdriver remove by driving outwards.
 - b. Install a new seal by locating a socket on the outside of the new seal and drive inwards. Make sure the seal is bottomed square against bottom of the case bore and with the open or sealing surface facing inboard. (Fig. 12)

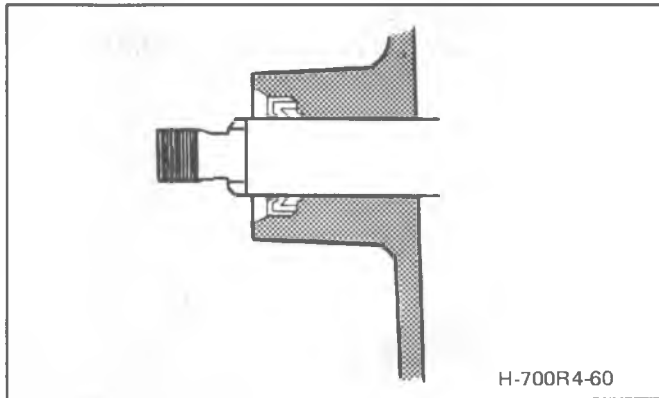


Figure 700-R4-12 Manual Shaft Seal Location

Inspection

1. Inspect the actuator rod assembly for damage, correctness of shape (not bent).
2. Inspect the actuator rod spring for freeness of action, distortion.
3. Inspect the inside detent lever for damage or cracks.
4. Inspect the manual shaft for damage and burrs.

Assembly

(Fig. 13)

1. If removed, connect the parking lock actuator assembly to the inside detent lever by indexing the notches on the actuator rod with the slot on lever.
2. Install the outer manual shaft part way into the case with the long pin end first.
3. On the outer manual shaft loosely install the manual shaft retainer the inside detent lever with the small ear inboard and the attached actuator rod assembly. Position the end of the actuator rod on the outside side of the parking lock pawl and on the inside of the bracket.
4. Install the manual shaft retaining nut on the manual shaft, do not engage threads.
5. Gently tap the outer manual shaft into the case.
6. Indexing the slot in the outside detent lever and the manual the shaft engaging threads and torque to 31 N·m (23 ft. lbs.).

Check for proper operation of assembly by rotating the inside manual lever and observing the operation of the parking lock parts.

PARKING PAWL AND RETURN SPRING

Removal

If necessary, the parking pawl and return spring can be removed as follows:

1. With an "easy out" remove parking lock shaft retaining plug from the outside of the case.
2. Remove the parking lock shaft, pawl and return spring.

Inspection

1. Inspect the parking lock pawl for hairline cracks, burrs, or other damage.
2. Inspect the parking lock return spring for distortion, or damage.
3. Inspect the parking lock shaft for damage and freeness of fit with the pawl.

Assembly

1. Position the return spring on the parking lock pawl so the long end of the spring is inboard pushing the pawl outward.
2. Locate the pawl and spring in the case and install the parking lock shaft.

Check for proper operation.

3. Install the retaining plug with loctite sealer in the case with a punch.

CASE AND ATTACHING PARTS

Inspection

1. Inspect the case for damage, cracks, porosity or interconnected oil passages. (Fig. 14)
2. Inspect the valve body case pad for flatness or land damage. The oil passage lands are considered acceptable if a void exists and is not in excess of 50% of the land. The condition of the valve body pad can also be checked by inspecting the mating face of the spacer plate to case gasket for a proper case land impression.
3. Air check the case passages for restrictions or blockage.
4. Inspect the case internal clutch plate lugs for damage, or wear.
5. Inspect the speedo, servo and accumulator bores for damage and clearance relative to the mating parts.
6. Inspect all bolt holes for damaged threads. Helo-coils can be used for repair.
7. Inspect the cooler line connectors for damage and proper torque.
8. Inspect all snap ring grooves for damage.
9. Inspect the governor locating pin for proper length. A incorrect length results in a damaged governor gear. (Fig. 15)

3RD ACCUMULATOR CHECK VALVE

Inspect the 3rd accumulator check valve for the following conditions: Missing ball check, ball binding or stuck in the sleeve, the oil feed slot in sleeve missing or restricted, improperly assembled, loose fitting or not fully seated in the case or damaged. (Fig. 16)

If the 3rd accumulator check valve assembly requires replacement, perform the following:

1. Using a 6.3 (#4) easy out, remove the check valve assembly from the case by turning and pulling straight out. (Fig. 17)
2. Install a new check valve assembly, small end first, into the case. Positioning the oil feed slot in the sleeve so that it faces the servo cover.
3. Using a 9.5mm (3/8) dia. metal rod and hammer, drive the check valve assembly until it is seated in the case.

GOVERNOR ASSEMBLY

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out passages.
2. Inspect the governor body and valve for free operation, nicks, burrs, scoring or galling.
3. Inspect the driven gear for nicks, damage or excessive looseness.

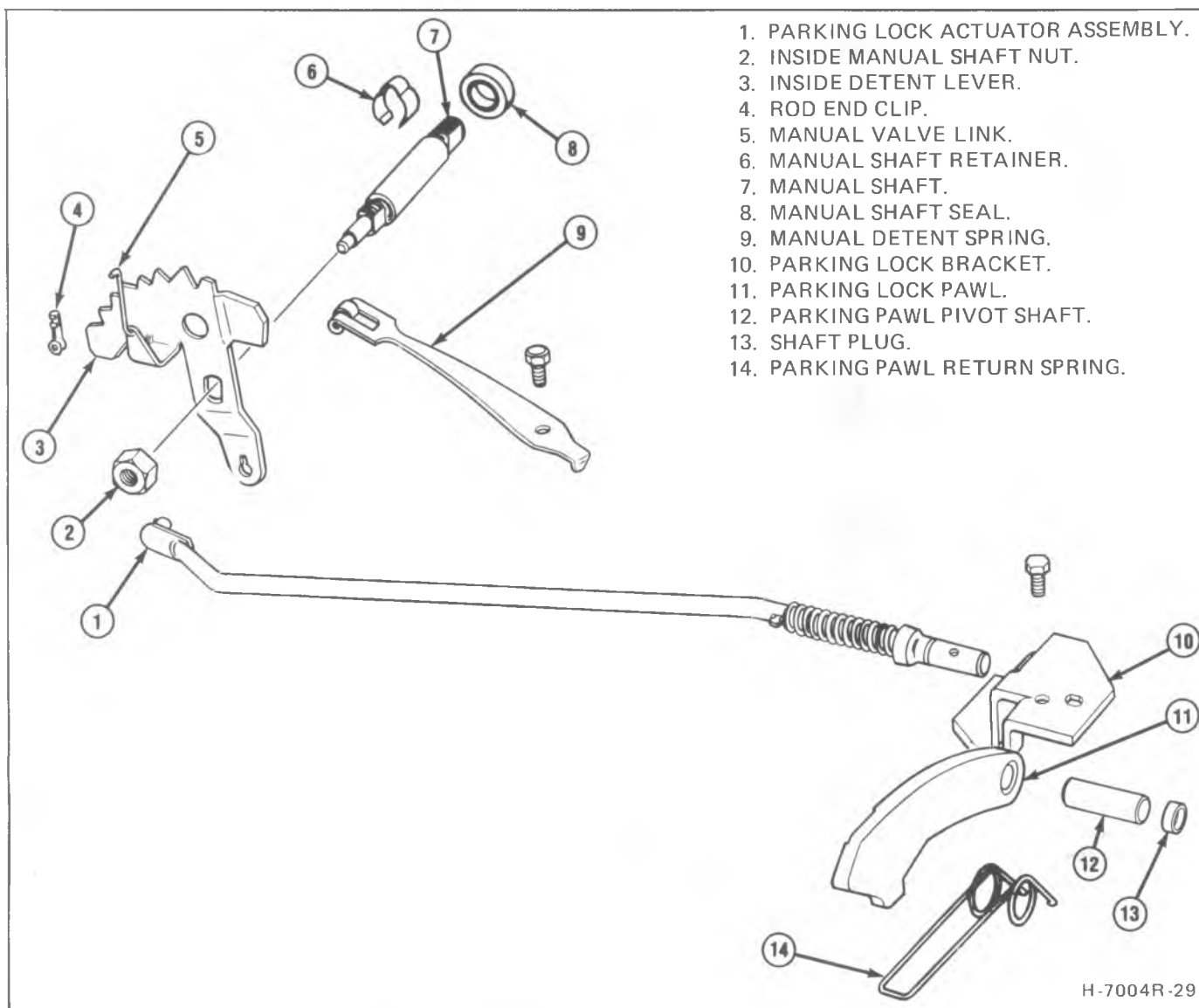


Figure 700-R4-13 Parking Lock Linkage

4. Inspect the governor weight springs for distortion.

Disassembly

(Fig. 18)

The governor assembly should be disassembled when the governor drive gear requires replacement or if the valve is sticking and requires cleaning.

1. Cut off one end of each governor weight pin and remove the pins, outer and secondary weights.
2. Remove the governor valve from the governor sleeve.
3. Inspect and replace the governor drive gear if required.
 - (a) Drive out the governor gear retaining pin, using a small punch.
 - (b) Support the governor assembly on plates installed in the exhaust slots of the governor sleeve. Place in a arbor press and with a long punch, press the gear out of the sleeve.
 - (c) Clean the governor sleeve of any chips that might be present.

Assembly

- (a) Support the governor on plates, installed in the exhaust slots of the sleeve. Position a new gear on the sleeve and press the gear into the sleeve until it is seated against the shoulder.

- (b) A new pin hole must be drilled through the sleeve and gear. Locate the new hole position 90 degrees from the existing hole. While supporting the governor in press, center punch and drill a new hole through the sleeve and gear using a standard 1/8 inch drill.
- (c) Install the retaining pin and stake in two locations and thoroughly wash.

CASE ATTACHING PARTS

Inspection

1. Inspect the 1-2 and 3-4 accumulator parts for the following:
 - a. Porosity or damage in the pistons, housing or oil seal rings.
 - b. Damaged or distorted oil seal rings and pins.
 - c. Clearance or freeness of the pistons to the pins.
 - d. Flatness and condition of the accumulator and oil passage plate and gasket.
2. Wiring Harness
 - a. Inspect the wire leads and connectors for damage or exposed wires.
 - b. Inspect the "O" Ring for damage.
 - c. Inspect the coil and all connections for damage.
3. Speedo gear and clip

H-7004R-29

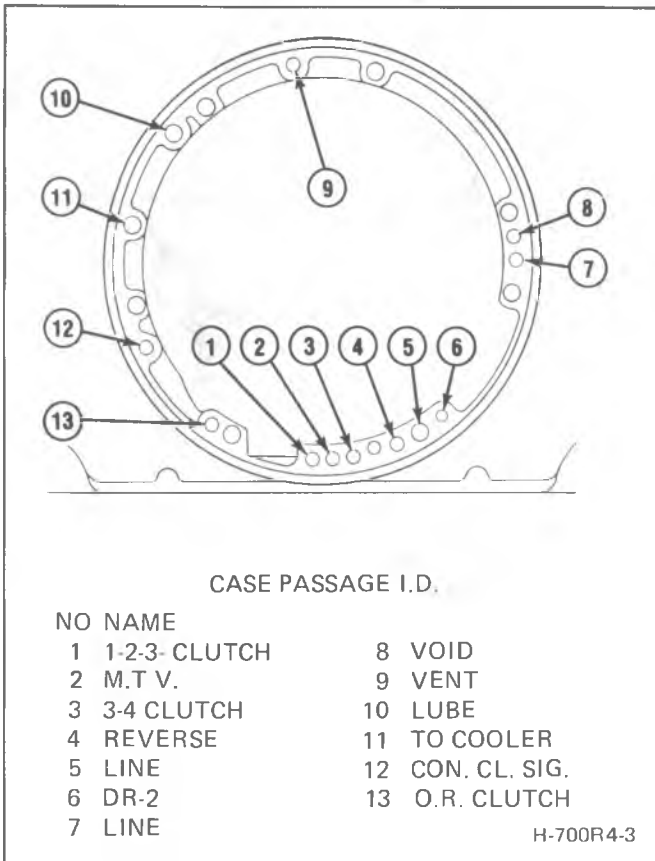


Figure 700-R4-14 Pump to Case Oil Passages

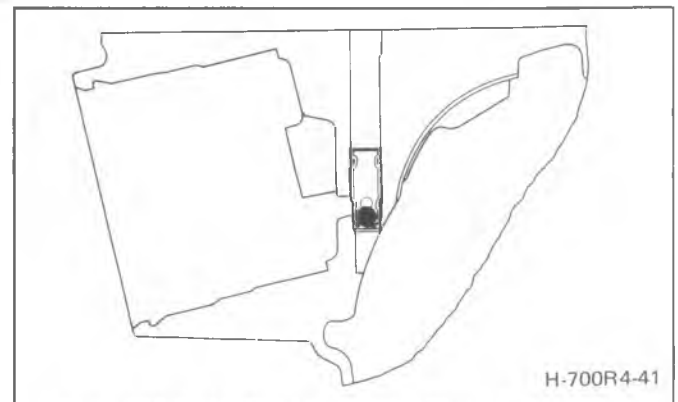


Figure 700-R4-16 3rd Accumulator Check Ball Location

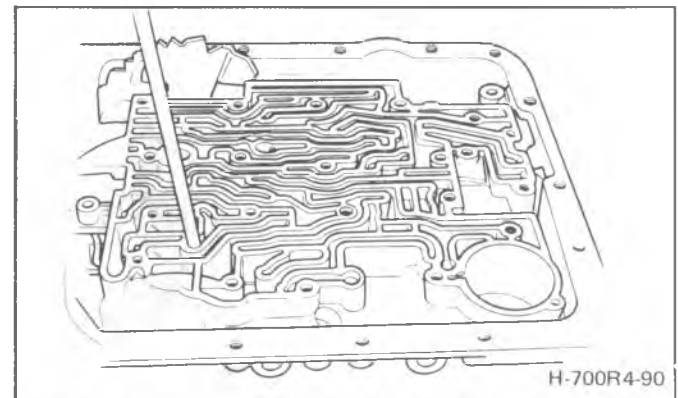


Figure 700-R4-17 Installing the 3rd Accumulator Check Ball Assembly

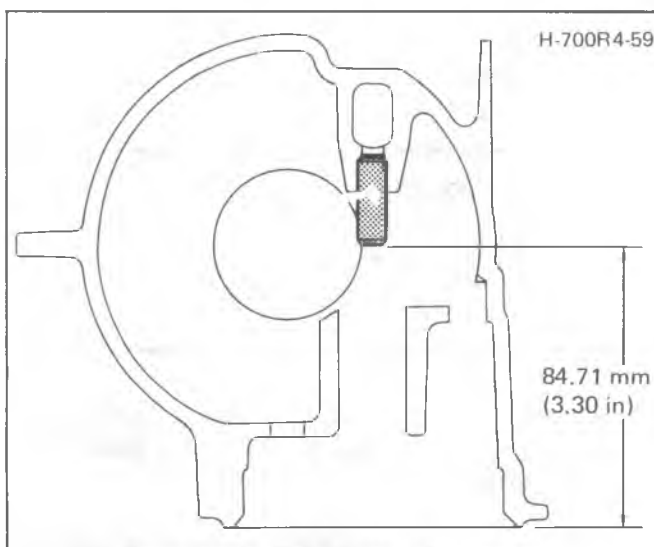


Figure 700-R4-15 Governor Pin Location

a. Inspect the speedo gear and clip for tooth damage or distortion.

4. Throttle lever and bracket assy. (Fig. 19)

REACTION AND INPUT GEAR SETS AND LOW REVERSE CLUTCH AND SUPPORT

Inspection

1. Inspect the reaction and input carriers for pinion gear damage, excessive wear, incorrect number of pinion pin washers and proper staking of the pinion pins.
2. Inspect the captive bearings of the carrier for excessive heat damage, flatness, and roller condition by rotating the top thrust washer.

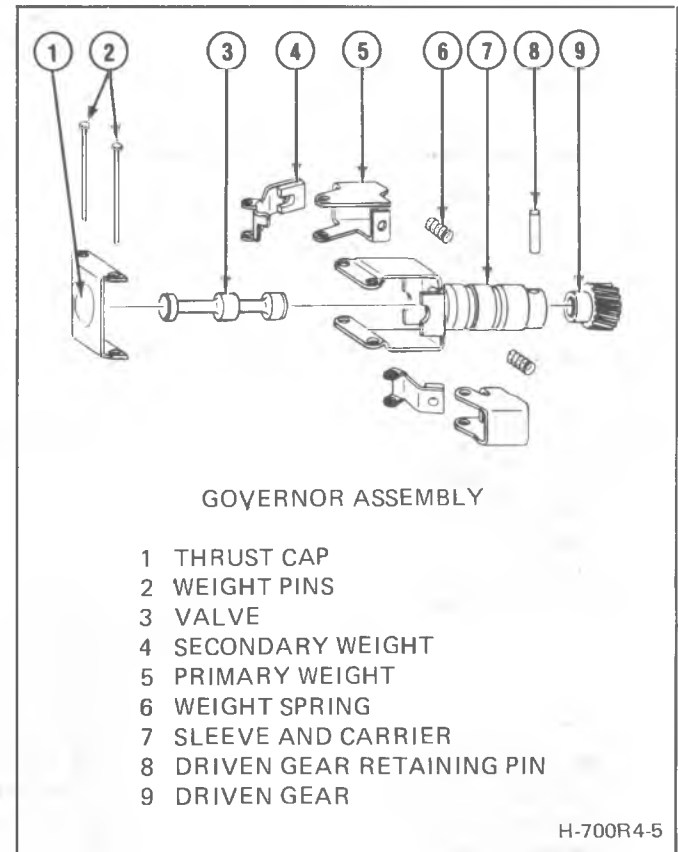
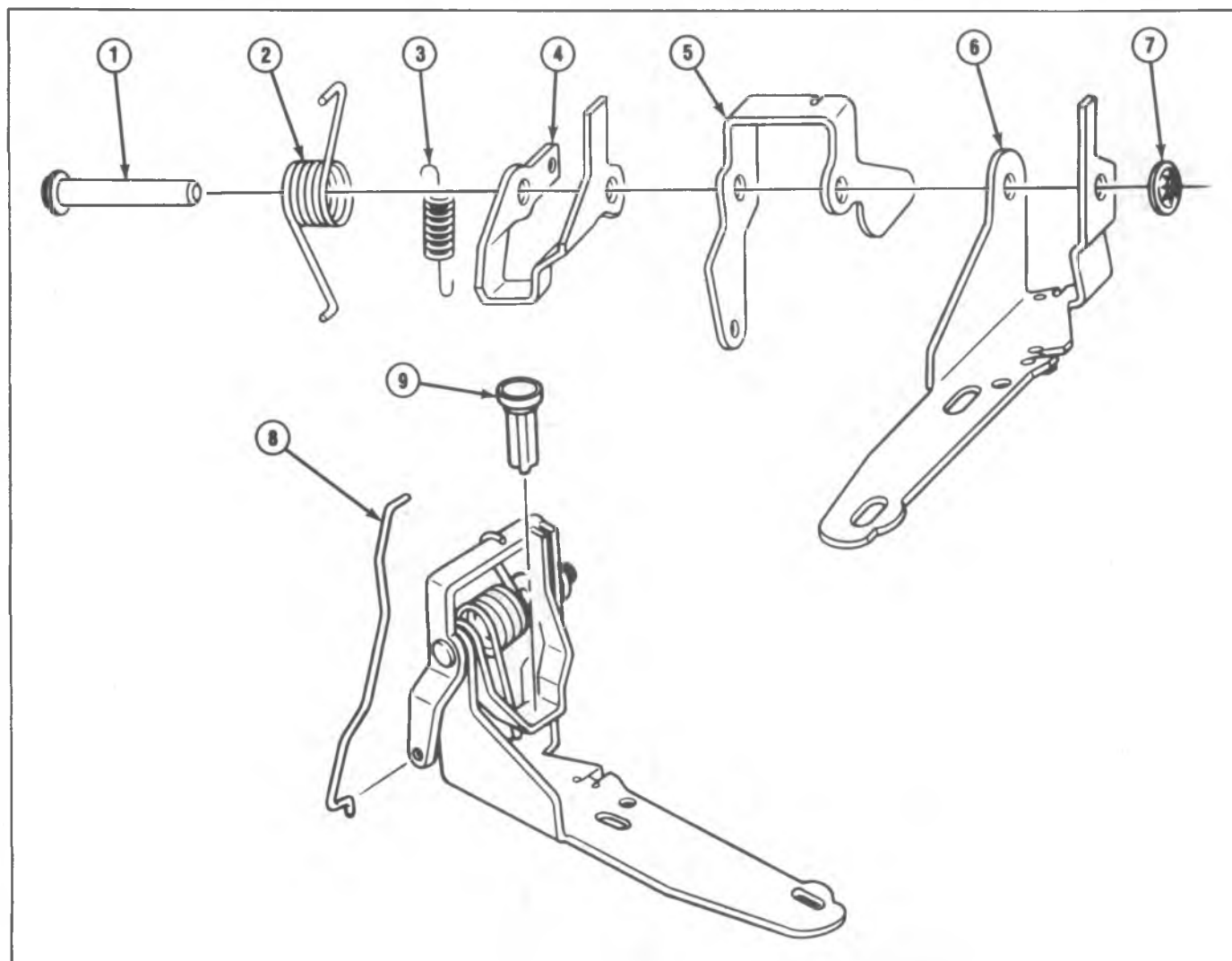


Figure 700-R4-18 Governor Assembly (Exploded View)

3. Inspect the sun and internal gears and supports for tooth condition and bushing wear. If necessary, remove the retaining rings of the internal gears.



1. PIN
2. LINE BOOST SPRING
3. TORSION LEVER SPRING
4. LINE BOOST LEVER
5. THROTTLE LEVER

6. THROTTLE BRACKET
7. RETAINING NUT
8. THROTTLE LINK
9. EXHAUST VALVE

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

H-700R4-26

Figure 700-R4-19 Throttle Lever and Bracket Assembly

4. Inspect all snap rings for damage or distortion.
5. Inspect the low reverse clutch plates for damage or burning. The steel plates can indicate some discoloration. The composition plates can be dark in color and be satisfactory. Inspect for flaking, scoring or wear (thickness).
6. Remove the seals from the low reverse piston and inspect for damage and condition. Reinstall the seals or replace as required.
7. Inspect the low reverse piston for damage or porosity.
8. Inspect the low reverse spring retainer and springs for flatness or distortion.
9. Inspect all thrust washers for surface finish or damage.

LOW REVERSE SUPPORT ASSEMBLY

Disassembly

1. Remove the low reverse inner race if not removed.
2. Remove one snap ring retaining the roller assembly to the support.
3. Remove the roller assembly.

Inspection

1. Inspect the inner and outer races for damage and surface finish.
2. Inspect the roller and springs for damage or distortion.

Assembly

(Fig. 20)

1. Position the low reverse support on the bench so that the chamfered side is up.
2. Install the low reverse roller assembly into the support with the oil lube hole down or rearward.

Care should be taken to insure that the rollers and spring are not damaged and that the rollers do not become dislodged.

3. Install the low reverse inner race into the roller assembly by rotating clockwise.

When installed, the inner race should rotate in the clockwise direction and lock up in the counterclockwise direction.

TRANSMISSION ASSEMBLY

LOW REVERSE CLUTCH

(Fig. 21)

Assembly

1. Position the transmission in a vertical position.
2. Lubricate and install the inner, center, and outer seals on the low reverse clutch piston if removed. (Large aluminum).
3. Install the low reverse clutch piston in the transmission case indexing the piston with the notch at the bottom of the case with the hub facing downward, making certain the piston is fully seated in the downward position and the parking pawl will index into the opening in the piston wall.
4. Install the low reverse clutch spring retainer assembly into the case with the flat side of the retainer upwards.
5. Install tool J-23327 and compress the springs, indexing the tool retaining plate so that the tool is free to slide over the case hub.
6. Install the low reverse clutch snap ring and remove all tools.
7. Install the reaction internal gear support bearing on the case hub so that the longer inside "L" race is positioned downward. (Fig. 22)
8. Install the reaction internal gear and output shaft on the bearing assembly in the case. When the gear is properly seated it will be centered with the long open slot in the case and the parking lock pawl can be engaged with the external teeth of the internal gear.

If the reaction internal gear and output shaft were removed as one unit, install into the case at this time, otherwise assemble only the reaction internal gear.

9. Install the reaction carrier to support thrust bearing on the internal gear support so that the longer outside "L" race is positioned downwards.
10. Install the reaction carrier (with large outside hub) locating the reverse hub upwards.
11. Install the low and reverse clutch plates, starting with steel and alternating with composition (5 steel and 5 composition) indexing with the splines of the reaction carrier and ease, aligning the steel plates. (Figs. 23 & 25)
12. Remove the low reverse inner race and install the low reverse support and roller assembly with the chamfered side up in the case, indexing with the case splines. (Fig. 24)

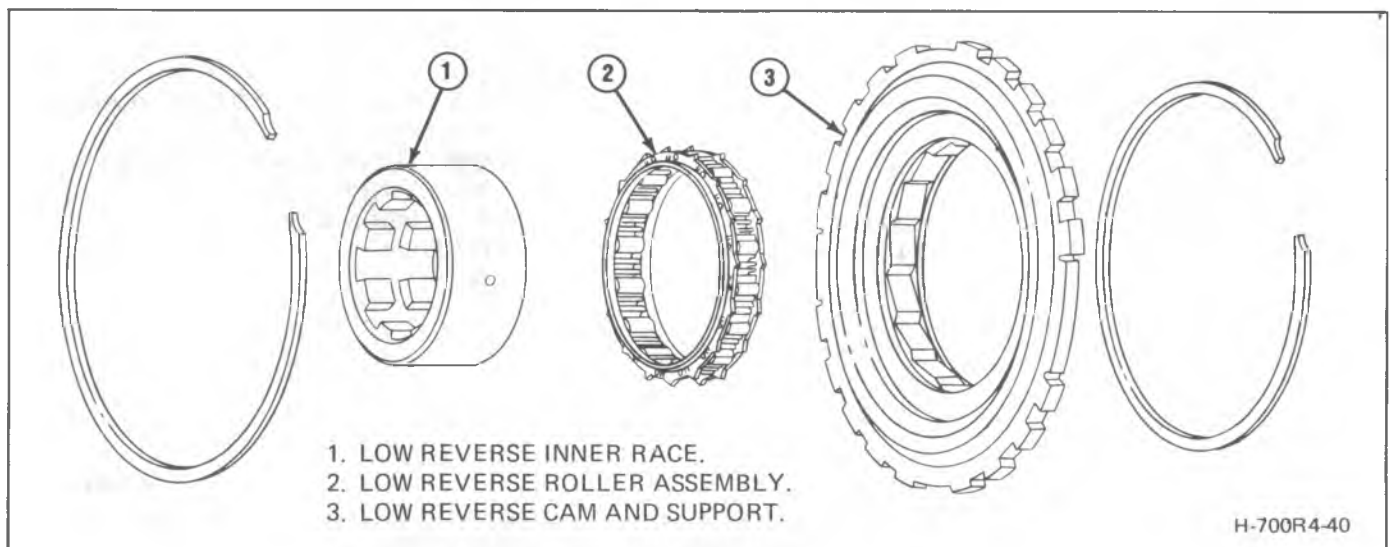
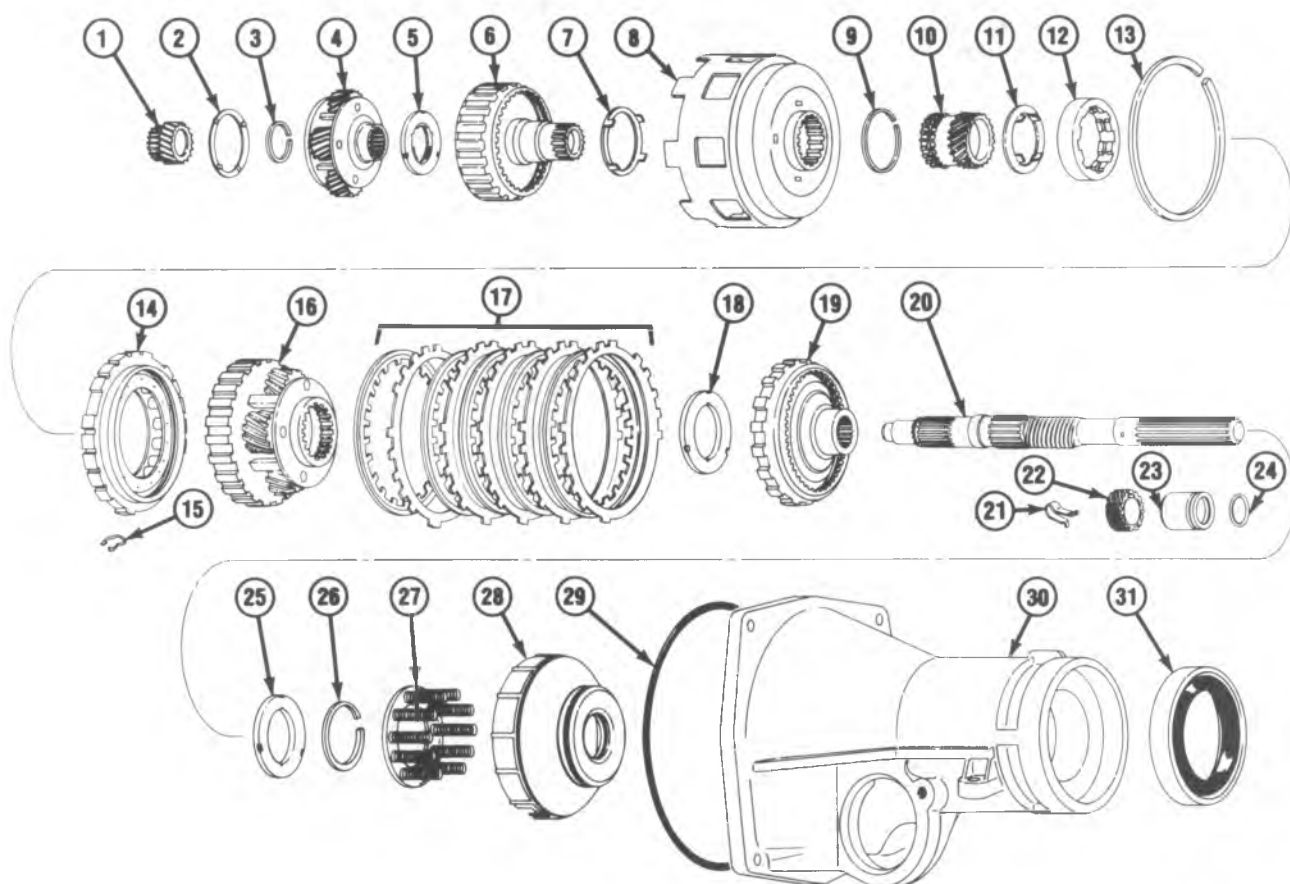


Figure 700-R4-20 Low Reverse Clutch Support Assembly



1. INPUT SUN GEAR.
2. INPUT CARRIER THRUST WASHER
3. OUTPUT SHAFT TO INPUT CARRIER SNAP RING
4. INPUT CARRIER ASSEMBLY
5. INPUT CARRIER TO REACTION SHAFT BEARING
6. INPUT INTERNAL GEAR AND SUPPORT ASSEMBLY
7. REACTION SHAFT SHELL THRUST WASHER
8. REACTION SUN GEAR SHELL
9. REACTION SUN GEAR SNAP RING
10. REACTION SUN GEAR
11. RACE TO SHELL THRUST WASHER
12. LO REVERSE INNER RACE
13. LO REVERSE CLUTCH SUPPORT SNAP RING
14. LO REVERSE SUPPORT AND ROLLER ASSEMBLY
15. CLUTCH SUPPORT RETAINER

16. REACTION CARRIER
17. LO REVERSE CLUTCH PLATES
18. REACTION GEAR SUPPORT BEARING
19. REACTION INTERNAL GEAR AND SUPPORT
20. OUTPUT SHAFT
21. SPEEDO GEAR RETAINER
22. SPEEDO DRIVE GEAR
23. OUTPUT SHAFT SLEEVE
24. OUTPUT SHAFT SEAL
25. REACTION GEAR SUPPORT TO CASE BEARING
26. LO REVERSE SPRING RETAINER
27. LO REVERSE CLUTCH SPRING ASSEMBLY
28. LO REVERSE CLUTCH PISTON
29. CASE TO EXTENSION SEAL
30. CASE EXTENSION
31. REAR SEAL

Figure 700-R4-21 Input - Reaction and Case Extension Parts

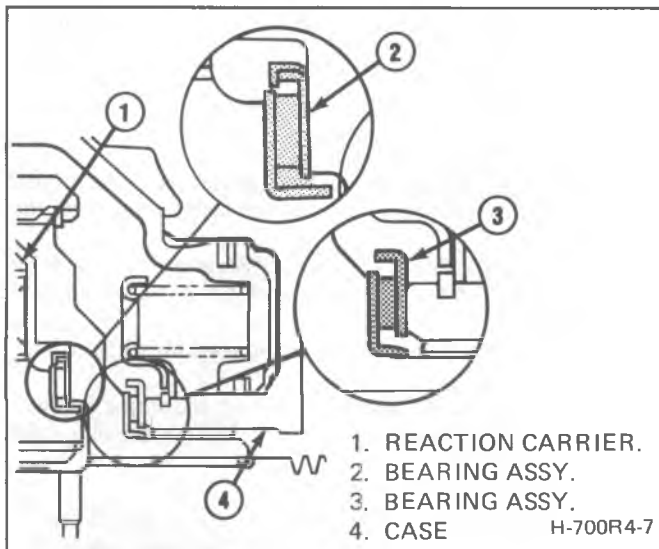


Figure 700-R4-22 Reaction Internal Gear and Carrier Bearing Locations

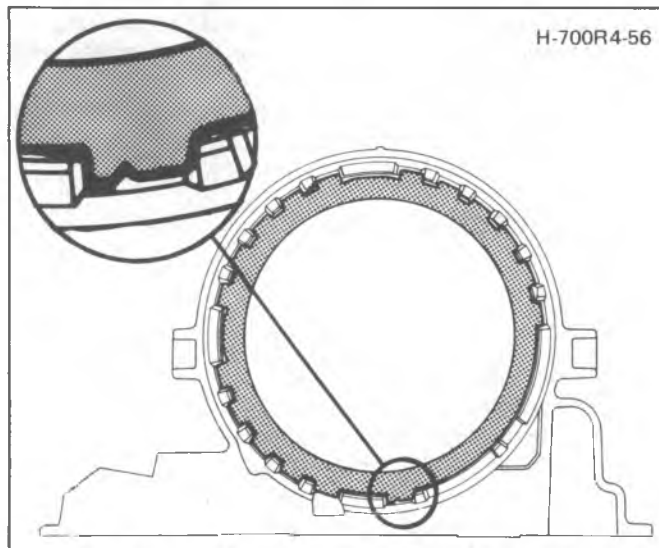


Figure 700-R4-23 Installing Low Reverse Clutch Plates

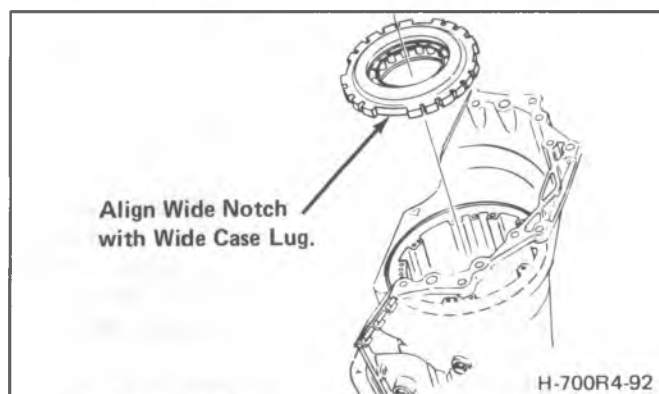


Figure 700-R4-24 Installing the Low Reverse Support and Roller Assembly

13. Install the low reverse inner race into the roller assembly and rotate until the internal splines are engaged, then push downward for full engagement. The bottom tanges will be flush with the reaction hub when seated.
14. Install the low reverse snap ring and support spring into the transmission case.

H-700R4-46				
LOW REV. CLUTCH				
MODEL	FLAT STEEL		COMPOSITION FACED	
	NO.	THICK-NESS	NO.	THICK-NESS
TW TC	4	1.77 mm (.069")	4	2.25 mm (.088")
ALL OTHERS	5	1.77 mm (.069")	5	2.25 mm (.088")

Figure 700-R4-25 Low Reverse Clutch Plate Chart

THE REACTION AND INPUT GEAR SETS

Assembly

1. Install the snap ring on the reaction sun gear if removed, and install into the reaction carrier indexing the pinions.
2. Install the nylon low reverse thrust washer with 4 locating ears on the low, reverse inner race. (Fig. 26)

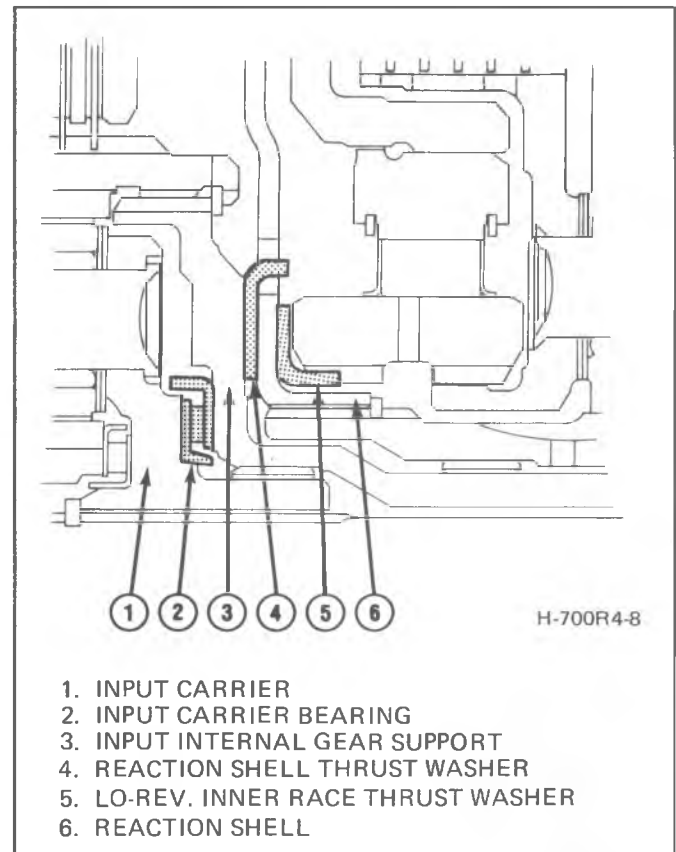


Figure 700-R4-26 Input Carrier and Reaction Shell Bearing and Thrust Washer Locations

3. Install the reaction sun gear shell (large housing with end slots and holes) engaging the splines of the shell shaft and the sun gear.
4. Install the reaction shaft to shell thrust washer indexing the tangs in the shell. (Bronze thrust washer with wide thrust face).
5. Install the input internal gear and shaft positioning the shaft end first.

If the output shaft and reaction gear were removed as separate parts during disassembly, the following procedures must be used.

- a) Position the output shaft into the transmission, indexing with all parts.
- b) Install the output shaft support tool J-29837 and adjust so that the output shaft is positioned upwards as far as possible. (Fig. 27)

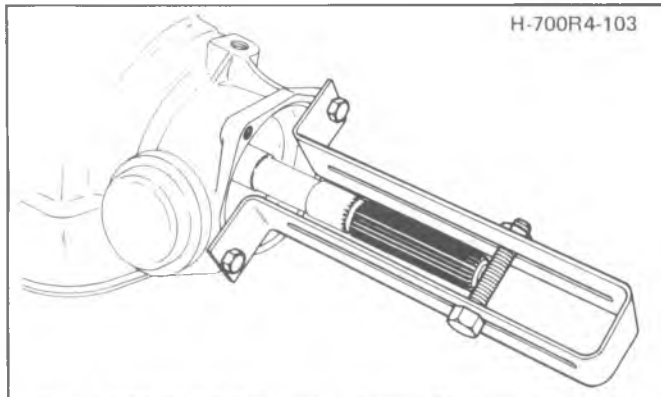


Figure 700-R4-27 Positioning Output Shaft with J-29837

6. Install the input carrier to reaction shaft thrust bearing with the long "L" race on the outside. (Fig. 26)
7. Install the input carrier assembly, with the hub end down.
8. Install a new snap ring on the output shaft.
9. Install the input sun gear, indexing the gear end with the input carrier pinions.
10. Install the input carrier thrust washer on the input carrier.

REVERSE INPUT AND INPUT CLUTCH ASSEMBLIES

Disassembly

(Fig. 28)

1. Remove the reverse input clutch from the input clutch assembly by lifting upwards.
2. Remove the stator bearing and selective washer from the input housing.

REVERSE INPUT CLUTCH

Disassembly

1. Remove the snap ring from the reverse input housing.
2. Remove the reverse input clutch backing plate.
3. Remove the reverse input steel and composition clutch plates.
4. Using tool J-23327 compress the reverse input spring assembly and remove the snap ring. (Fig. 29)
5. Remove all tools.
6. Remove the reverse input clutch release spring assembly.
7. Remove the reverse input clutch piston and remove the inner and outer seals.

Inspection

1. Inspect the reverse input clutch backing plate for damage, distortion, flatness and burred edges on the clutch plate face.
2. Inspect the reverse plates (steel) for distortion, damage, heavy burned spots or pitting.
3. Inspect the reverse input composition plates for burning, flaking and tooth damage. A dark color will not necessarily indicate a burned plate as some clutch plate materials will darken with age and heat.
4. Inspect the release spring retainer for distortion or damage.
5. Inspect the reverse input clutch piston and seals for damage, or distortion.
6. Inspect the reverse input housing and drum for cracks, surface finish on the hub, worn or damaged bushings, freeness

and condition of the ball check. The ball must move freely with applied air pressure.

Assembly

(Fig. 30)

1. Lubricate and install the inner and outer seals on the reverse input clutch piston with the seal lips facing away from the hub.
2. Install the reverse clutch piston into the reverse input housing with the hub upwards using an 8mm feeler gage to position the seal.
3. Install the reverse input clutch spring assembly with the large opening first.
4. Install tools J-23327 and J-25018-A on the spring retainer. Compress the spring retainer and install the retaining snap ring.
5. Remove all tools.
6. Install the (1) waved steel reverse plate. The waved plate is thinner and will show some high burnished spots. No indexing or alignment is required.
7. Install a composition plate, then install the balance of the plates, alternating composition faced and flat steel. (Fig. 31) **The reverse clutch plates are the largest plates with equally spaced tangs.**
8. Install the reverse input backing plate with the chamfered side up.
9. Install the backing plate snap ring.

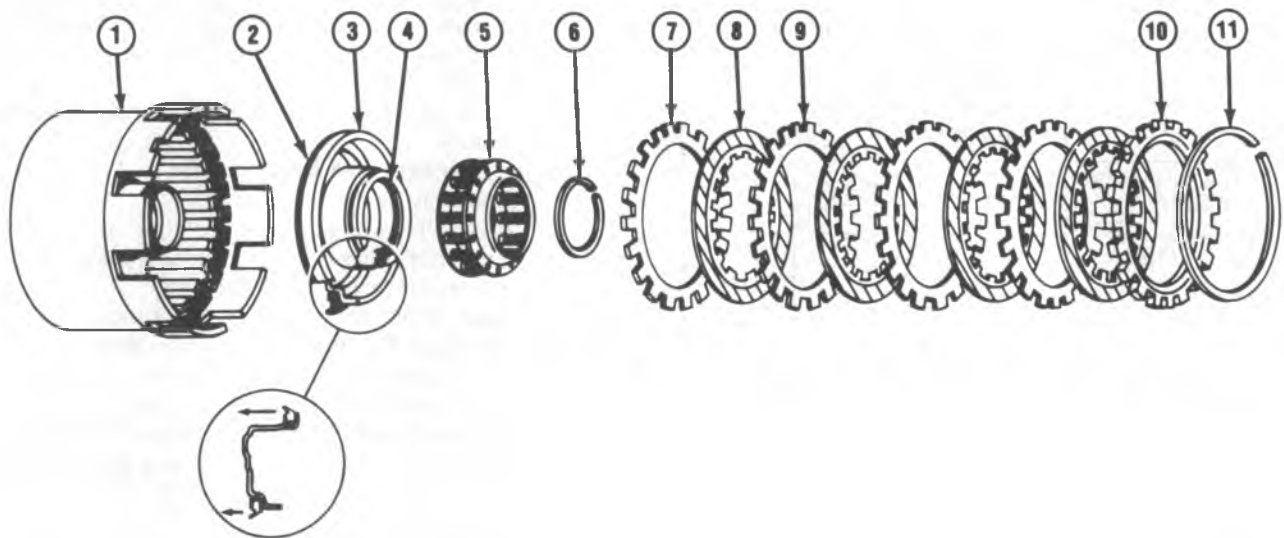
INPUT CLUTCH ASSEMBLY

(Fig. 32)

Disassembly

1. Position the input clutch assembly on the bench with the turbine shaft located in a bench hole and resting on the turbine shaft housing.
2. Remove the snap ring retaining the 3-4 clutch backing plate.
3. Remove the 3-4 clutch backing plate.
4. Remove the 3-4 clutch plates (composition and steel).
5. Remove the 3-4 clutch apply plate.
6. Remove the 3-4 clutch retaining apply ring. (Fig. 33)
7. Remove the forward clutch backing plate snap ring.
8. Remove the forward clutch backing plate.
9. Remove the forward clutch cam assembly and outer race by pulling up. The complete assembly will consist of the forward clutch roller cam, overrun clutch hub and snap ring, and the forward clutch outer race and roller assembly.
10. Remove the input sun gear bearing (it can be located on the back side of the input inner race).
11. Remove the input housing to output shaft nylon seal.
12. Remove the forward clutch plates (steel and composition).
13. Remove the forward clutch apply plate and spacer if used.
14. Remove the overrun clutch plates (2 steel and 2 composition).
15. Install tools J-23456 and J-25018 and compress the overrun clutch spring retainer.
16. Remove the overrun clutch retaining snap ring.
17. Remove all tools.
18. Remove the overrun clutch spring assembly.
19. Remove the overrun clutch piston assembly.
20. Remove the inner and outer seals from the overrun clutch piston.
21. Remove the forward clutch piston assembly.
22. Remove the inner and outer seals from the forward clutch piston assembly.

Apply air pressure to the 3-4 feed hole in the turbine shaft - 3rd hole from the shaft end. If unable to remove parts strike housing on a soft surface squarely on the open end.

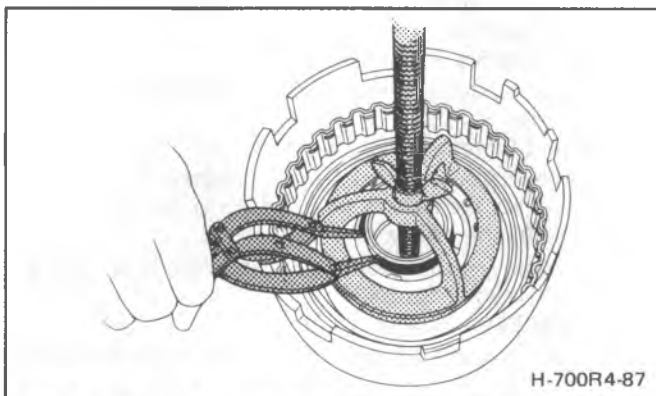


1. REVERSE INPUT HOUSING
2. REVERSE INPUT OUTER SEAL
3. REVERSE INPUT PISTON
4. REVERSE INPUT INNER SEAL
5. REVERSE INPUT SPRING ASSY.
6. REVERSE INPUT SPRING SNAP RING

7. REVERSE INPUT PLATE (WAVED)
8. REVERSE INPUT PLATE (COMPOSITION)
9. REVERSE INPUT PLATE (STEEL)
10. REVERSE INPUT BACKING PLATE
11. REVERSE INPUT SNAP RING

H-700R4-37

Figure 700-4R-28 Reverse Input Clutch Assembly - Exploded View



H-700R4-87

Figure 700-R4-29 Removing and Installing Reverse Input Snap Ring Using J-23327

23. Remove the forward clutch housing assembly.
24. Remove the 3-4 clutch spring assembly.
25. Remove the 3-4 apply ring and piston.
26. Remove the "O" Ring from the input housing assembly.
27. Inspect the (4) four teflon oil seal rings on the turbine shaft for damage or distortion.
Remove and Replace only if necessary.

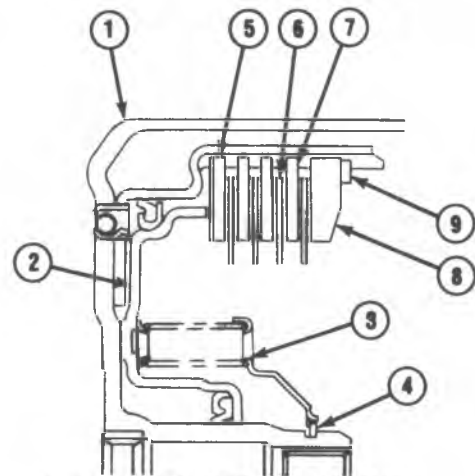
FORWARD CLUTCH CAM ASSEMBLY

(Fig. 35)

Disassembly

1. Remove the overrun clutch hub snap ring.
2. Remove the overrun clutch hub.
3. Remove the forward clutch cam (inner race).
4. Remove the forward clutch roller assembly from the forward clutch cam.

Care should be taken to prevent any parts of the roller clutch, from becoming dislodged from the roller cage.



1. REVERSE INPUT HOUSING
2. REVERSE INPUT PISTON
3. REVERSE INPUT SPRING ASSEMBLY
4. REVERSE INPUT SPRING SNAP RING
5. REVERSE INPUT PLATE (WAVED)
6. REVERSE INPUT PLATE (COMPOSITION)
7. REVERSE INPUT PLATE (STEEL)
8. REVERSE INPUT BACKING PLATE
9. REVERSE INPUT SNAP RING

H-700R4-100

Figure 700-R4-30 Reverse Input Clutch Assembly

Inspection

1. Forward Clutch Roller Assembly

REV. INPUT CLUTCH						
H-700R4-74						
MODEL	FLAT STEEL		COMP. FACED		WAVED STEEL	
	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS
TW TC	2	1.97 mm (.077")	3	1.97 mm (.077")	1	2.03 mm (.079")
ALL OTHERS	3	1.97 mm (.077")	4	1.97 mm (.077")	1	2.03 mm (.079")

Figure 700-R4-31 Reverse Input Clutch Plate Chart

Inspect the locating ears on top of the cage for damage or distortion. Inspect rollers for wear or damage.

Do not remove the rollers from the cage.

2. Overrun Clutch Hub

Inspect the overrun clutch hub for spline damage, excessive wear or distress and that all lubrication passages are open.

3. Forward Clutch Cam

Inspect the forward clutch cam for damage to splines, tangs and roller cam surface.

4. Forward Clutch Outer Race

Inspect for surface finish and damage.

Assembly

1. Position the forward clutch cam with the tangs facing upward.
2. Install the forward clutch roller assembly over the cam indexing the roller cage to engage the tangs in the ramps of the forward clutch cam.

When properly seated, the square ears will be flush with the inner race.

3. Position the overrun clutch hub on the assembled cam and roller assembly and install the snap ring.
4. Install the assembled hub, cam and roller assembly into the forward clutch outer race by rotating clockwise. When assembled, the forward clutch hub must rotate freely in the clockwise direction and lock-up in the counterclockwise direction.

INPUT CLUTCH ASSEMBLY

Inspection

1. Input Housing Assembly

- a. Inspect all splines for damage or wear.
- b. Air check all clutch feed passages for obstructions.
- c. Inspect the rear end of the turbine shaft for the presence of (3) three sealing balls.

One hole is an open feed hole and will not be sealed.

- d. Inspect the (4) four turbine shaft teflon seals for damage and correct installation. (Fig. 36)

Do not remove unless damaged or replacement is required.

- e. Inspect the converter check ball on the front end of the turbine shaft for restrictions and free operation. Ball must move with air pressure. If damaged, replace as follows: (Fig. 37)

- (1) Straighten the tangs of the retainer and check valve assembly capsule and remove the check ball.
- (2) Using a #4 easy out, remove the check valve retainer from the turbine shaft by turning and pulling straight out.
- (3) Install the new check valve assembly, check valve seat first, into the turbine shaft.

- (4) Using a 9.5mm (3/8) diameter metal rod and hammer drive retainer and check valve assembly until it is 3mm (1/8) below the top surface of the turbine shaft.

- f. Inspect the 3-4 check ball in the input housing for free operation.

2. Overrun - Forward - 3-4 Gear Pistons

Inspect the 3 pistons for the following:

- a. Inspect all inner and outer seals for damage, cuts, softness or hardness if any are to be replaced, lubricate the new ones before installation.
- b. Inspect all pistons for damage or porosity.

3. 3-4 and Overrun Spring Retainer Assemblies

- a. Inspect the release springs for damage, distortion, and the spring retainer for flatness or damage.

4. Clutch Plates (Steel) - Overrun - Forward - 3rd & 4th

- a. Inspect all steel clutch plates for damaged tang ends, high or burned spots, excessive wear, or distortion caused by heat.

5. Clutch Plate Assemblies (Composition Faced) - Overrun - Forward - 3-4

- a. Inspect the composition faced clutch plates for damaged tangs, burning, flaking or excessive wear (thickness). A dark color does not necessarily indicate burning. Some clutch plate material will darken with age and heat which is normal.

6. Snap Rings - Overrun Clutch Hub Retaining and Overrun Clutch

- (a) Inspect for distortion damage and flatness.

7. Backing Plates - 3-4 Clutch - Forward Clutch Spacer and 3-4 Apply Plate

- a. Inspect for flatness, distortion and sharpness or burrs on inside edge.

8. Apply Ring 3rd & 4th Clutch

- a. Inspect the apply ring for distortion and damaged apply tangs.

9. Forward Clutch Housing (Small Steel)

- a. Inspect the ball check for proper operation and damage. Inspect the housing for distortion or damage.

10. Needle Bearing Assy. (Stator Shaft)

- a. Inspect needle bearings for excessive wear, flatness, damages or flat rollers.

11. Oil Seal Ring - Turbine Shaft

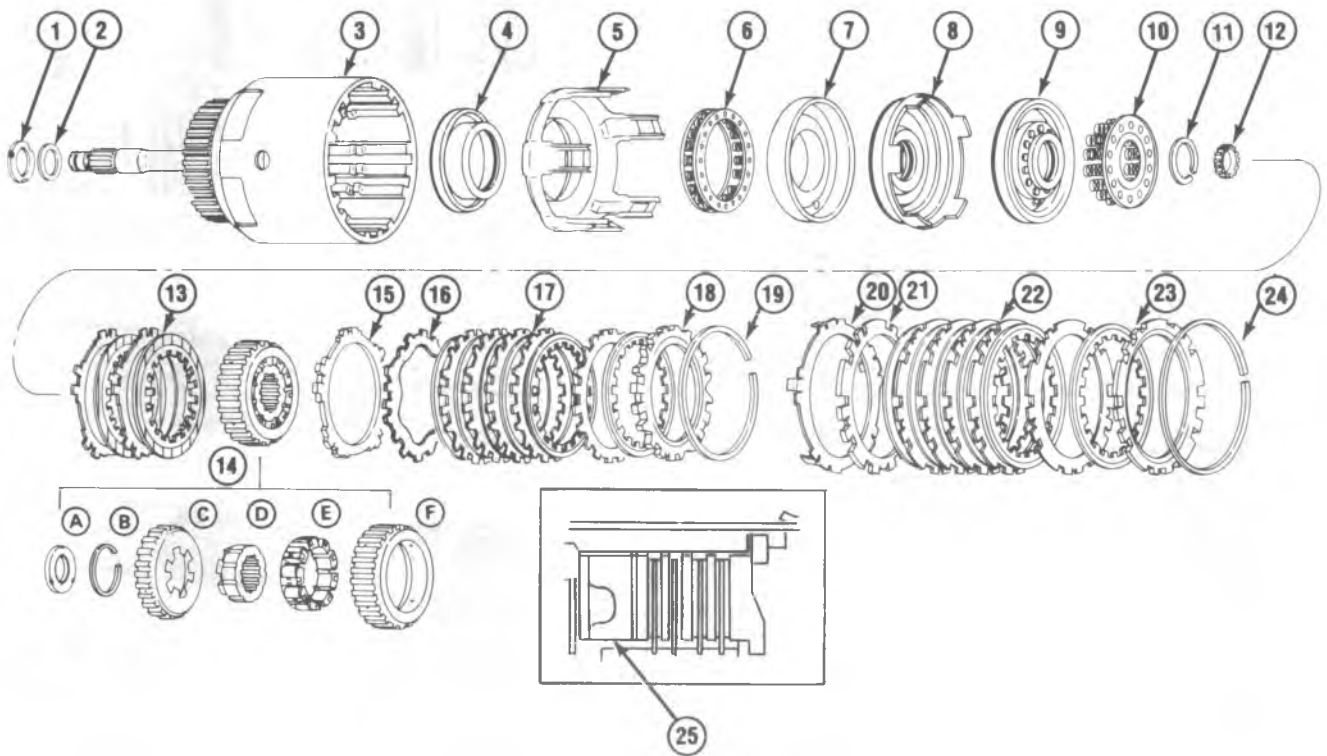
- a. Remove and inspect for damage and replace if required.

INPUT CLUTCH ASSEMBLY

(Fig. 38)

Assembly

1. If removed install the (4) four teflon oil seal rings on the turbine shaft. Assemble with a long edge to a long edge and the large "O" ring on the inside of the housing.
2. If removed, install the small "O" Ring on the end of the turbine shaft.
3. Position the input clutch housing over the bench hole with the turbine shaft in a hole pointing downwards.
4. Install the inner and outer seals on the 3-4 piston (smallest aluminum piston) with the lips facing away from the hub.
5. Install the 3-4 piston in the input housing, rotate and gently push downward making certain the piston is properly seated.
6. Install the inner and outer seals on the forward clutch piston (largest aluminum) with the lips facing away from the tangs.
7. Lubricate and install the forward clutch piston (largest remaining aluminum) into the forward clutch housing (large steel).
8. Install the 3-4 spring retainer into the 3-4 clutch apply ring.



INPUT CLUTCH ASSY. (EXPLODED VIEW)

- | | |
|---------------------------------------|--|
| 1. STATOR SHAFT WASHER | C. OVERRUN CLUTCH HUB |
| 2. SELECTIVE WASHER | D. FORWARD CLUTCH ROLLER CAM |
| 3. INPUT HOUSING ASSEMBLY | E. FORWARD CLUTCH ROLLER ASSY. |
| 4. 3-4 CLUTCH PISTON | F. FORWARD CLUTCH OUTER RACE |
| 5. 3-4 CLUTCH APPLY RING | 15. FORWARD CLUTCH APPLY PLATE |
| 6. 3-4 CLUTCH SPRING ASSEMBLY | 16. FORWARD CLUTCH WAVED PLATE |
| 7. FORWARD CLUTCH HOUSING | 17. FORWARD CLUTCH PLATES |
| 8. FORWARD CLUTCH PISTON | 18. FORWARD CLUTCH BACKING PLATE |
| 9. OVERRUN CLUTCH PISTON | 19. FORWARD CLUTCH BACKING PLATE SNAP RING |
| 10. OVERRUN CLUTCH SPRING ASSEMBLY | 20. 3-4 CLUTCH RETAINER RING |
| 11. OVERRUN CLUTCH RETAINER SNAP RING | 21. 3-4 APPLY PLATE |
| 12. INPUT HOUSING SEAL | 22. 3-4 CLUTCH PLATES |
| 13. OVERRUN CLUTCH PLATES | 23. 3-4 CLUTCH BACKING PLATE |
| 14. FORWARD CLUTCH CAM ASSEMBLY | 24. 3-4 CLUTCH RETAINING RING |
| A. INPUT CLUTCH SUN GEAR BEARING | 25. FORWARD CLUTCH SPACER |
| B. OVERRUN CLUTCH HUB SNAP RING | 4 CLUTCH PACK |

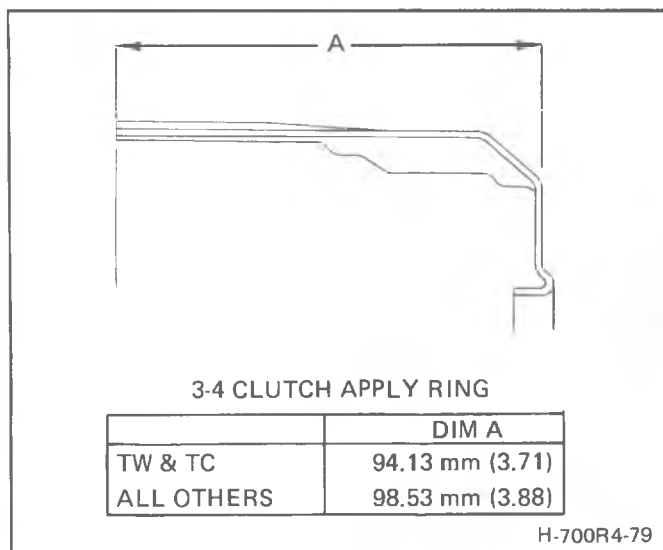


Figure 700-R4-33 3-4 Clutch Apply Ring Chart

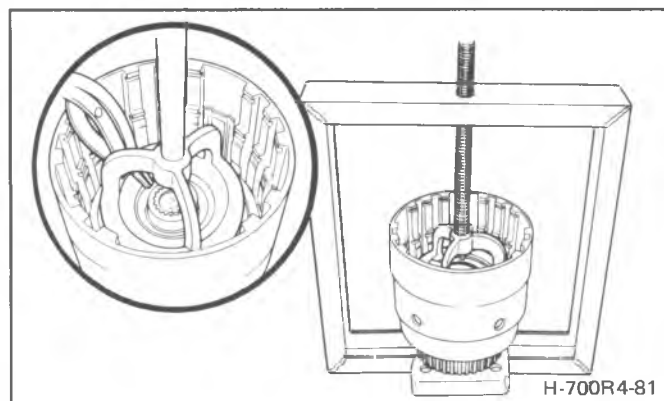


Figure 700-R4-34 Removing Overrun Clutch Snap Ring

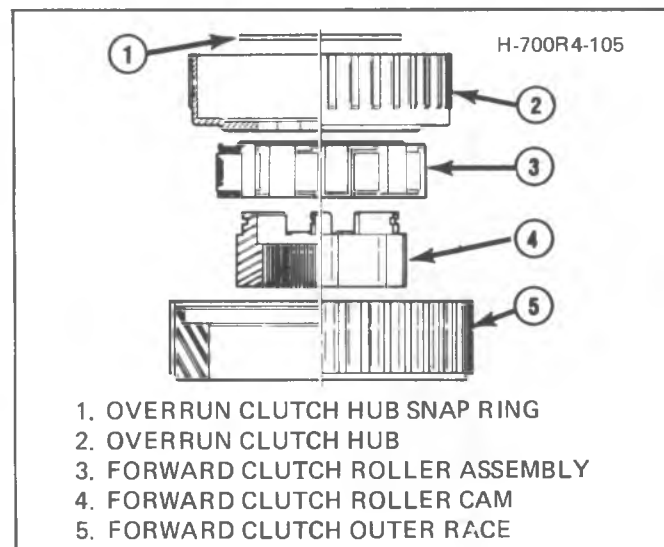


Figure 700-R4-35 Forward Clutch Cam Assembly

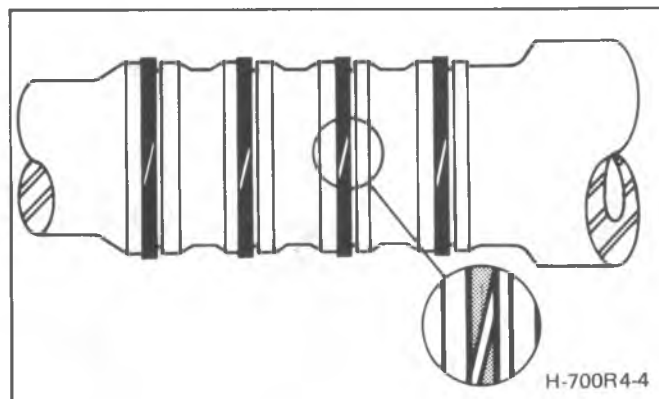


Figure 700-R4-36 Installing Turbine Shaft Oil Seal Rings

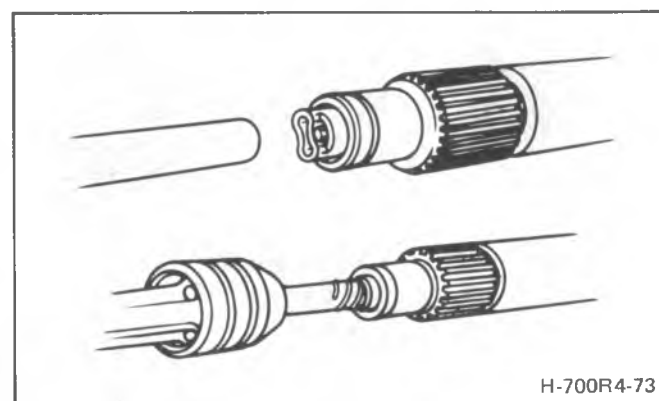


Figure 700-R4-37 Turbine Shaft Check Ball Replacement

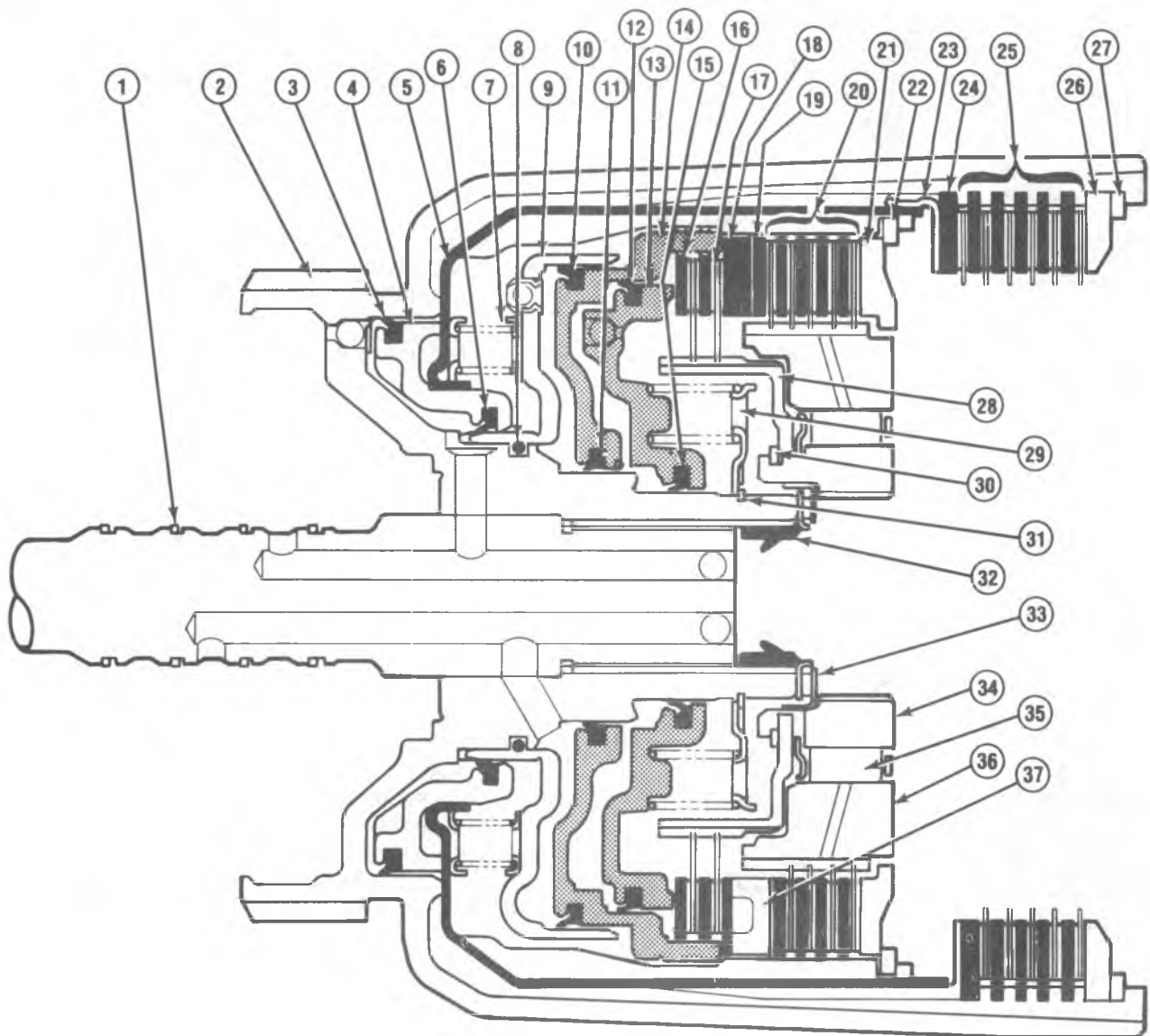
Use care to insure the pistons do not separate.

12. Install overrun clutch seal protector J-29882 on the input housing shaft and install the overrun clutch piston with the hub facing upward and remove tool.

When properly positioned the overrun piston will be approx. 3/16 inch below the snap ring groove on the input housing hub if not seated install J-23327 clutch spring compressor and gently tap until all parts are fully seated.

13. Install the overrun clutch spring retainer on the overrun clutch piston locating the release springs on the piston tabs.
14. Position tools J-23456 and J-25018 overrun on the overrun spring assembly and compress the spring retainer. (Fig. 40)
Do not over compress springs as distortion to the retainer can occur.
15. With the springs compressed, install the retaining snap ring and remove all tools.
16. Install the splined nylon output shaft seal, with the seal lip facing up. (Fig. 41)
17. On the forward clutch piston in the input housing, install the (4) four overrun clutch plates. Starting with a steel plate and positioning so that the long recessed slot is indexed with a wide notch in the housing, install the remaining clutch plates alternating steel and composition. The overrun plates will be the smallest of the (3) three clutch plate sets in the input clutch assembly. (Figs. 42 & 44)
18. Install the input sun gear bearing assembly on the input clutch hub on top of the nylon seal positioning the outside "L" race in the downward position. (Fig. 43)
Make certain the bearing is properly centered.
19. With a screwdriver, align and center the inside drive tangs of the (2) two overrun clutch plates (composition).
20. Install the assembled forward clutch cam assembly and outer race clutch hub indexing the overrun clutch plates.

9. Install the assembled forward clutch housing and piston on the spring retainer in the 3-4 apply ring.
The notches of the forward clutch piston must be indexed with the long apply tangs of the 3-4 apply ring.
10. Install seal protector J-29883 on the input housing shaft. (Fig. 39)
11. Hold the 3-4 apply ring and assembled parts by the tangs and install into the input clutch housing and firmly seat the forward clutch piston. Remove tools.



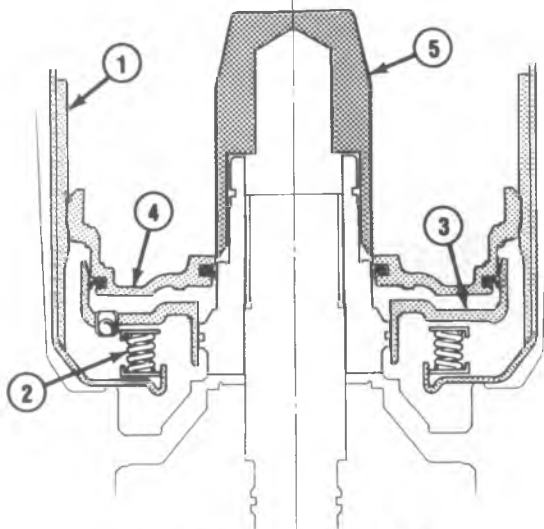
- | | |
|----------------------------------|-------------------------------------|
| 1. TEFLON TURBINE SHAFT SEALS | 20. FORWARD CLUTCH PLATES |
| 2. INPUT HOUSING ASSEMBLY | 21. FORWARD CLUTCH BACKING PLATE |
| 3. 3-4 CLUTCH OUTER SEAL | 22. FORWARD CLUTCH SNAP RING |
| 4. 3-4 CLUTCH PISTON | 23. 3-4 CLUTCH RETAINING RING |
| 5. 3-4 CLUTCH APPLY RING | 24. 3-4 APPLY PLATE |
| 6. 3-4 CLUTCH INNER SEAL | 25. 3-4 CLUTCH PLATES |
| 7. 3-4 CLUTCH SPRING ASSEMBLY | 26. 3-4 CLUTCH BACKING PLATE |
| 8. INPUT FORWARD CLUTCH "O" RING | 27. 3-4 CLUTCH RETAINING RING |
| 9. FORWARD CLUTCH HOUSING | 28. OVERRUN CLUTCH HUB |
| 10. FORWARD CLUTCH OUTER SEAL | 29. OVERRUN CLUTCH SPRING ASSY. |
| 11. FORWARD CLUTCH INNER SEAL | 30. OVERRUN CLUTCH HUB SNAP RING |
| 12. OVERRUN CLUTCH OUTER SEAL | 31. OVERRUN CLUTCH SPRING SNAP RING |
| 13. OVERRUN CLUTCH PISTON | 32. INPUT HOUSING SEAL |
| 14. FORWARD CLUTCH PISTON | 33. INPUT CLUTCH SUN GEAR BEARING |
| 15. OVERRUN CLUTCH INNER SEAL | 34. FORWARD CLUTCH ROLLER CAM |
| 16. FORWARD CLUTCH PISTON | 35. FORWARD CLUTCH ROLLER ASSY. |
| 17. OVERRUN CLUTCH PLATES | 36. FORWARD CLUTCH OUTER RACE |
| 18. FORWARD CLUTCH WAVED PLATE | 37. FORWARD CLUTCH SPACER |
| 19. FORWARD CLUTCH APPLY PLATE | |

H-700R4-99

Figure 700-R4-38 Input Clutch Assembly Cross Section

INSTALLING INPUT CLUTCH PISTONS

FIGURE A



1. 3-4 APPLY RING
2. 3-4 SPRING ASSEMBLY
3. FORWARD CLUTCH HOUSING
4. FORWARD CLUTCH PISTON
5. FORWARD CLUTCH PISTON INSTALLER J-29883

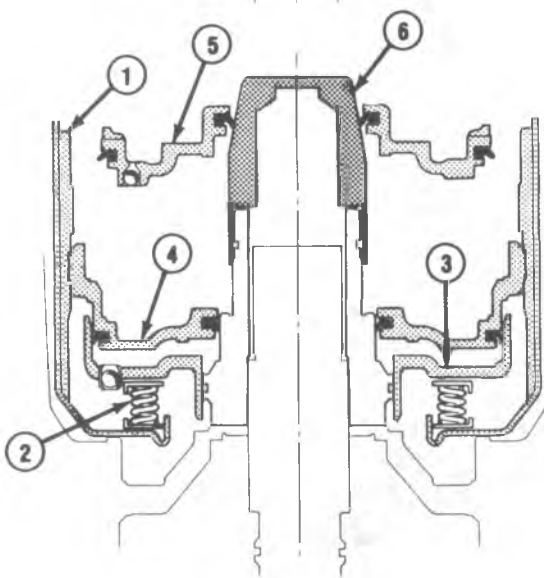


FIGURE B

1. 3-4 APPLY RING
2. 3-4 SPRING ASSEMBLY
3. FORWARD CLUTCH HOUSING
4. FORWARD CLUTCH PISTON
5. OVERRUN CLUTCH PISTON
6. OVERRUN CLUTCH PISTON INSTALLER J-29882

H-700R4-101

Figure 700-R4-39 Installing Input Clutch Pistons

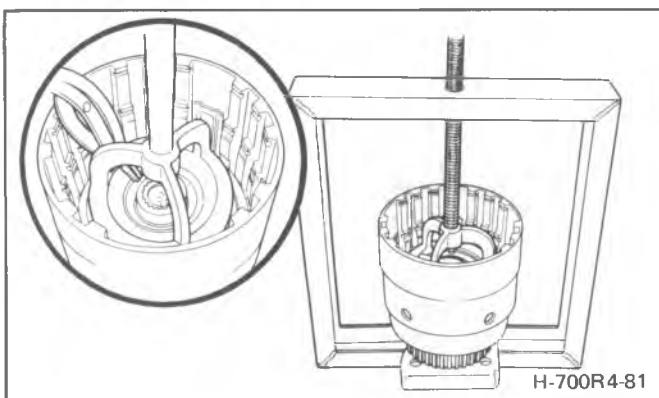


Figure 700-R4-40 Installing Overrun Clutch Snap Ring

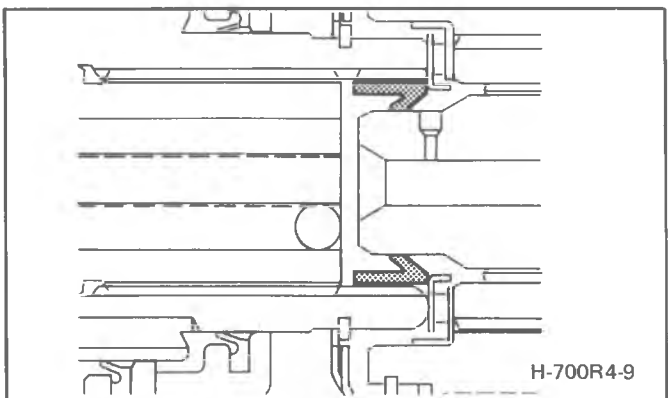


Figure 700-R4-41 Input Housing to Output Shaft Seal Location

21. Install the forward clutch spacer (thick steel) into the input clutch housing, indexing the lug on the spacer with the large slot in the input housing.

A five clutch plate forward clutch will use a single thick apply plate. A four clutch forward clutch will use a thick spacer and a thin apply plate, and must be assembled with the thin apply plate first and the spacer with the holes facing the thin apply plate.

22. Install the "Waved" steel forward clutch plate into the input housing, indexing the wide slot with (2) two small ears with the wide notch in the housing.

The waved steel plate will show high burnish marks.

23. Install a forward clutch plate assembly (composition) on the forward clutch hub. In the same manner, install the remaining forward clutch plates alternating composition and steel. The last plate installed will be composition. (Fig. 45)

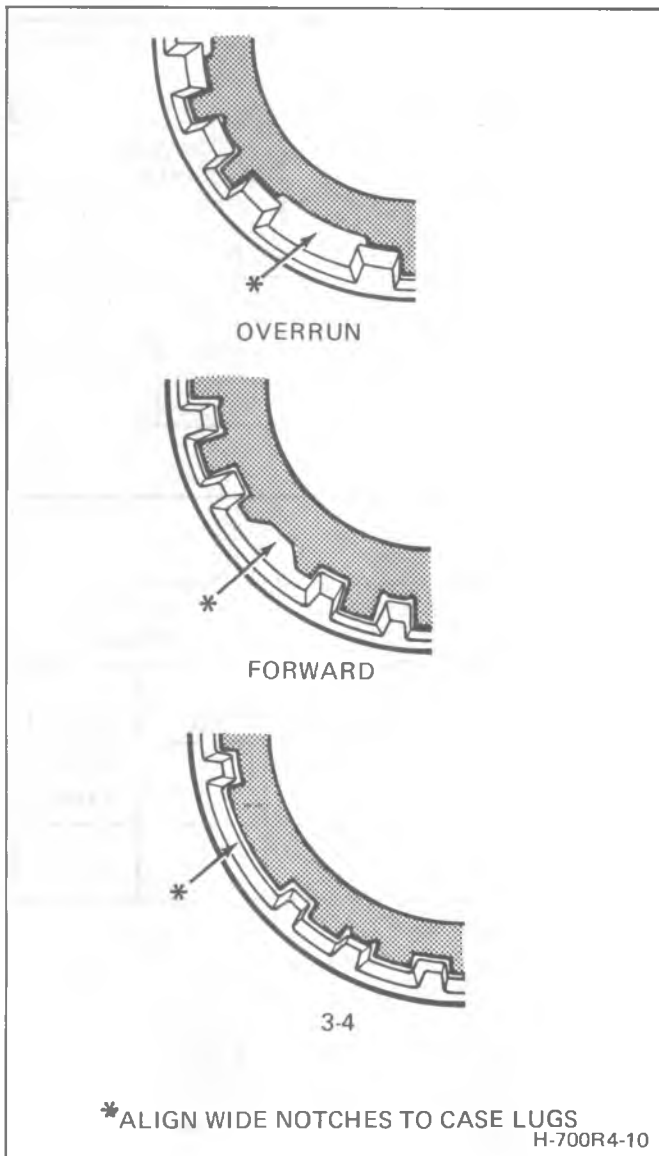


Figure 700-R4-42 Installing Input Clutch Plates

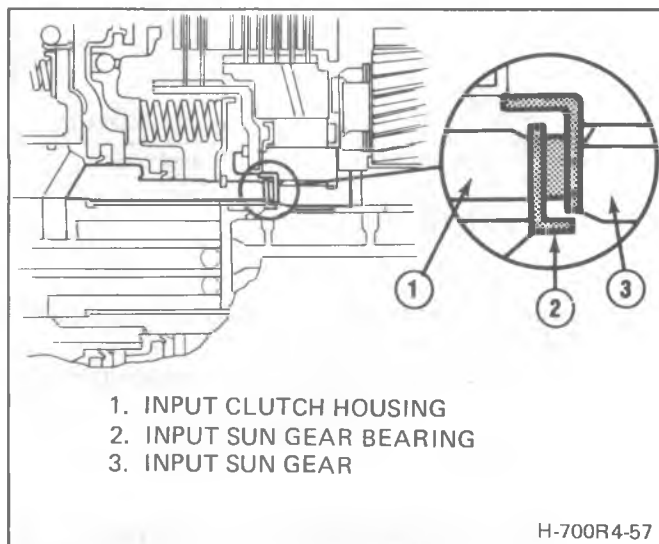


Figure 700-R4-43 Input Sun Gear Bearing Location

24. Install the forward clutch backing plate into the input housing, with the chamfered side up.

H-700R4-43				
OVERRUN CLUTCH				
MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICK- NESS	NO.	THICK- NESS
ALL MODELS	2	2.34 mm (.091")	2	2.03 mm (.079")

Figure 700-R4-44 Overrun Clutch Plate Chart

25. Install the forward clutch backing plate snap ring into the input clutch housing (smaller ring with the larger gap).
26. Install the 3-4 gear ring retaining plate (flat plate with legs) into the clutch housing indexing each apply lug with the ends of the 3-4 gear apply ring.
27. Install the 3-4 gear apply plate (thick steel) into the input housing indexing the long wide gear of the plate with the wide slot in the housing.
28. Install a 3-4 plate assembly (composition) then install the remaining plates alternating steel and composition indexing the long wide ear of the plate with the wide slot in the housing. The last plate installed will be composition. (Figs. 46 & 47)
29. Install the 3-4 gear backing plate with the chamfered side up.
30. Install the 3-4 gear retaining ring into the input housing assembly.

3-4 Clutch Piston Travel Check

(Fig. 48)

Using feeler gages, measure the end clearance between the backing plate and the first composition plate. If the end clearance is not within specifications, select the proper backing plate from the chart.

Clutch Air Check

Air check all clutches by applying air pressure at the feed holes in the turbine shaft. (Fig. 49)

REVERSE INPUT AND INPUT CLUTCH

Installation

1. Install the selective washer on the turbine housing.
2. Install pump hub bearing on the selective washer. With the black finish side up. (Fig. 50)
3. Position the reverse input assembly on the bench hole with the clutch plates facing upward. Align and center the clutch plates with a screwdriver and install the input clutch assembly with turbine shaft downward indexing the reverse clutch plates with the hub of the input housing.

Make certain all clutch plates are fully engaged.

THE REVERSE AND INPUT CLUTCHES

Assembly

1. Install the reverse and input clutch assemblies as a complete unit into the transmission case indexing the 3-4 clutch plates of the input assembly with the input internal gear. The complete assembly will be properly seated when the reverse housing is located just below the pump face of the case.
- Make certain all clutch plates are fully engaged.**

FORWARD CLUTCH										H-700R4-45
MODEL	FLAT STEEL		COMP. FACED		APPLY PLATE		SPACER		WAVED STEEL	
	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS
TW TC	3	1.97 mm (.077")	4	2.03 mm (.079")	1	6.44 mm (.251")	1	8.45 mm (.330")	1	2.03 mm (.079")
ALL OTHERS	4	1.97 mm (.077")	5	2.03 mm (.079")	1	6.44 mm (.251")	NONE		1	2.03 mm (.079")

Figure 700-R4-45 Forward Clutch Plate Chart

3-4 CLUTCH										H-700R4-44
MODEL	FLAT STEEL		COMP. FACED		APPLY PLATE		BACKING PLATE		APPLY RING	
	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS	NO.	THICK-NESS	NO.	LENGTH
TW TC	4	1.97 mm (.077")	5	2.03 mm (.079")	1	3.30 mm (.128")	1	SELECT-IVE	1	98.53 (3.88)
ALL OTHERS	5	1.97 mm (.077")	6	2.03 mm (.079")	1	3.30 mm (.128")	1	SELECT-IVE	1	94.13 (3.71)

Figure 700-R4-46 3-4 Clutch Plate Chart

3-4 BACKING PLATE SELECTION				H-700R4-55
MODEL	BACKING PLATE TRAVEL	BACKING PLATE		
		DIM	I.D.	
T.W. T.C.	.75 - 1.90 mm (.029" - .074")	7.125 mm (.278")	1	
		6.125 mm (.239")	2	
		5.125 mm (.200")	3	
		4.125 mm (.161")	4	
ALL OTHERS	.86 - 2.11 mm (.034" - .083")	7.125 mm (.278")	1	
		6.125 mm (.239")	2	
		5.125 mm (.200")	3	

Figure 700-R4-47 3-4 Backing Plate Selection Chart

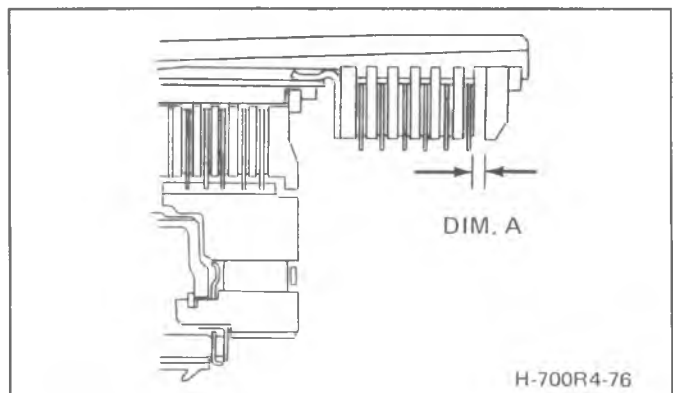


Figure 700-R4-48 3-4 Clutch Piston Travel Check

INTERNAL PARTS

Installation

1. Install the 2-4 band into the case indexing the band anchor pin end with the case pin hole. (Fig. 51)
2. Install the band anchor pin in the case, indexing with the 2-4 band end.
2-4 Servo Assembly.

(Figs. 52 and 53)

1. Install the complete 2-4 servo assembly into the case indexing the servo apply pin on the 2-4 band end and check for proper engagement.

Recheck for the correct apply pin length if any of the servo parts, the 2-4 band or the input housing have been replaced.

2. Install the servo cover and "O" Ring into the case.

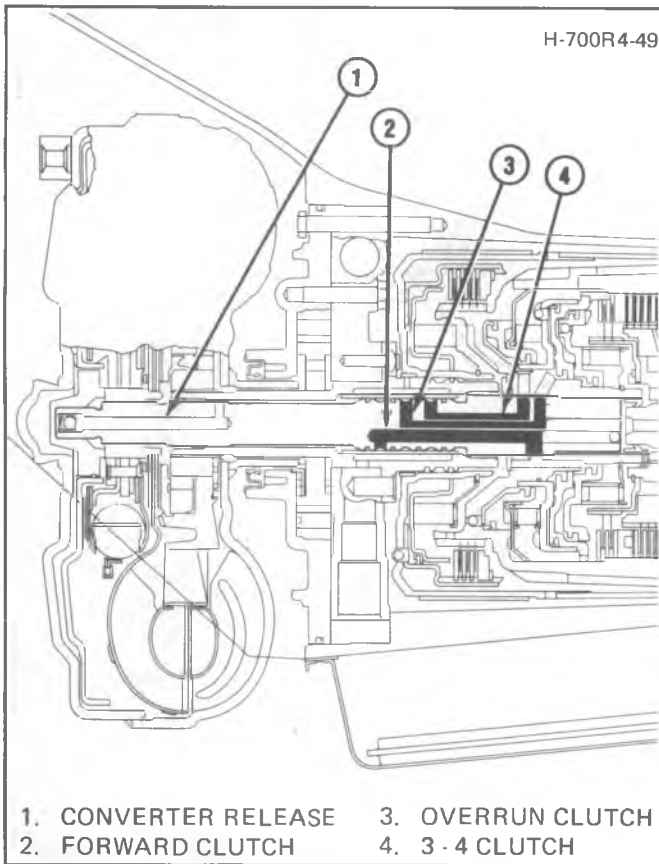


Figure 700-R4-49 Turbine Shaft Oil Passage I.D.

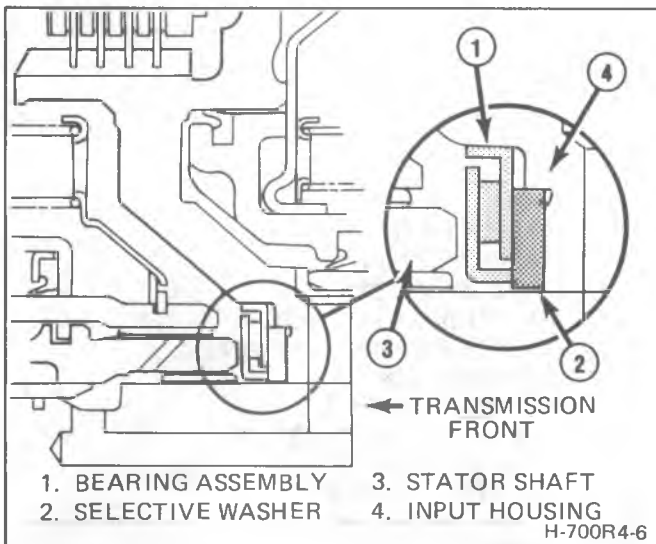


Figure 700-R4-50 Stator Shaft Bearing and Selective Washer Locations

3. Install the servo compressing tool J-29714 and compress the servo cover. (Fig. 54)
4. Install the servo retaining ring, indexing the ring ends with the slot in the case.

OIL PUMP ASSEMBLY

Disassembly

1. Remove the drum to pump washer from the pump assembly.
2. Remove the pump cover to case gasket from the pump cover.
3. Remove the pump to case oil seal ring from the pump assembly.

Do not remove the (2) two teflon oil seal rings from the pump hub unless they require replacement.

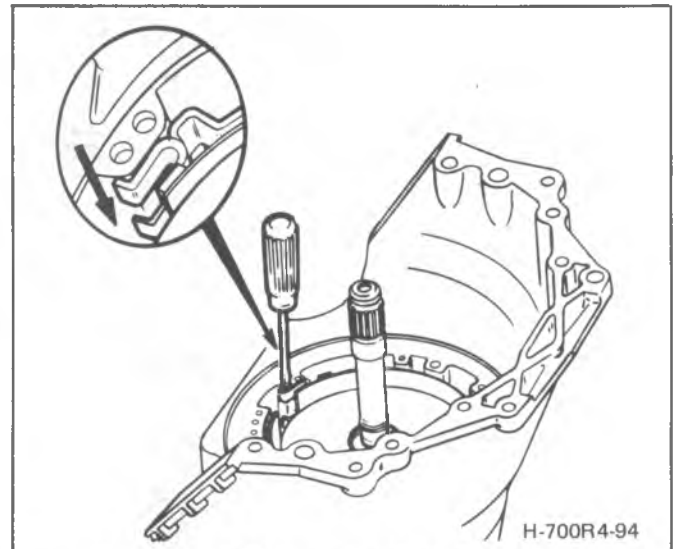


Figure 700-R4-51 Installing The 2-4 Band Assy.

4. Remove the pump cover from the pump body.

Pump Body

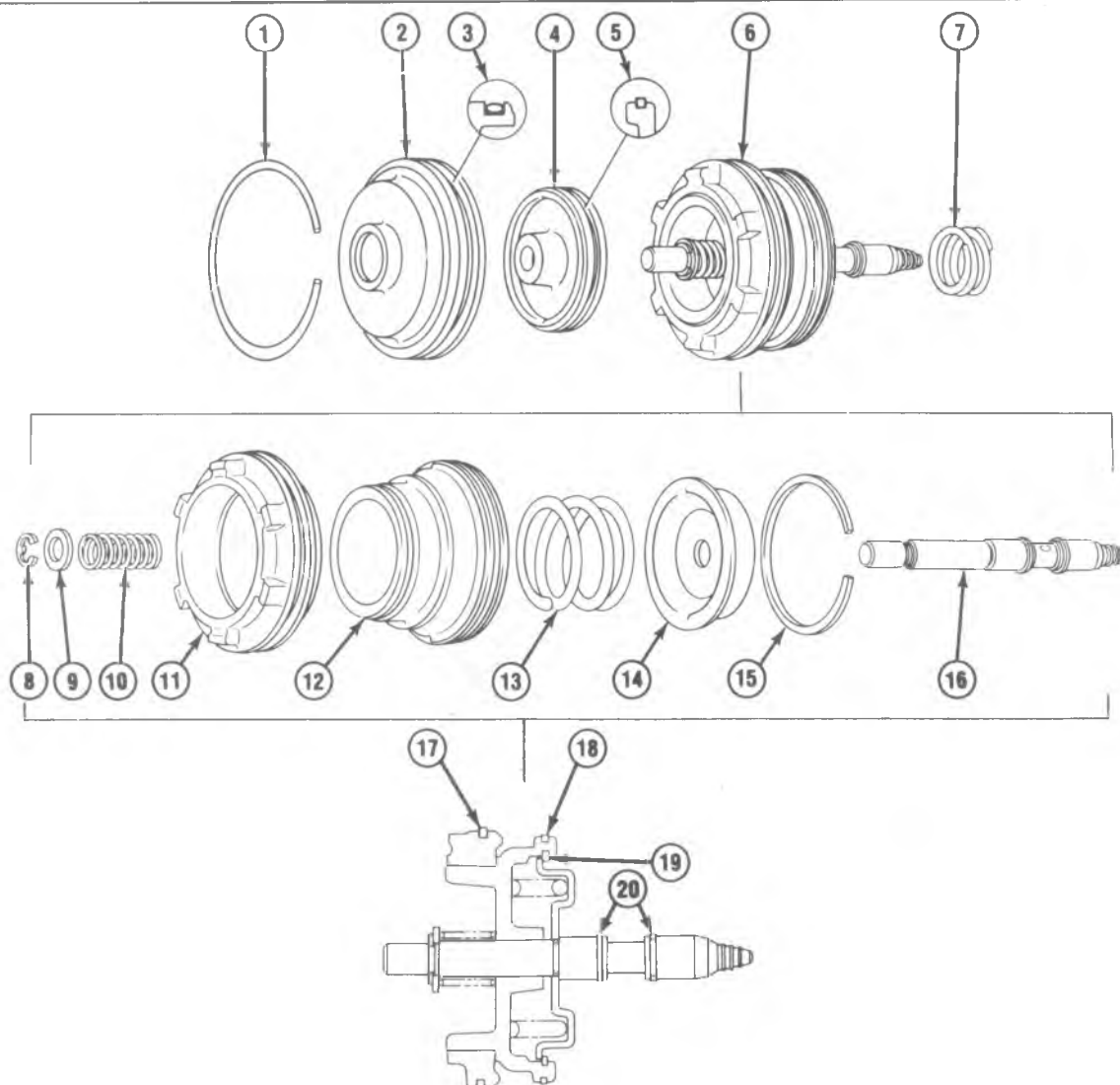
Disassembly

1. Remove the pump slide spring by compressing the spring with the needle nose pliers and pulling straight out or with a large bent end screwdriver.
CAUTION: Spring is under very high pressure: Place covering over spring to prevent possible injury.
2. From the pump pocket, remove the following:
 - a. Pump Guide Rings
 - b. Pump Vanes
 - c. Pump Rotor
 - d. Rotor Guide
3. Remove the slide from the pump pocket.
4. Remove the slide seal and support seal from the pump body pocket or slide.
5. Remove the pivot slide pin and spring from the pocket.
6. Remove the slide seal ring and slide backup seal from the slide pump pocket.

Front Pump Cover

Disassembly

1. Converter Clutch Apply Valve
 - a. Using a small screwdriver, push on the retainer to compress the converter clutch apply valve spring and remove the snap ring.
 - b. Slowly release the valve spring tension and remove the retainer and converter clutch apply valve and spring.
2. Pressure Relief Ball
 - a. Remove the pressure relief spring retaining rivet with a small punch.
Rivet is under very strong spring pressure.
 - b. Remove the pressure relief spring and ball. If the ball is not free remove by applying air pressure to the oil passage located in the pump cover.
3. Oil Pump Screen
 - a. Using small pliers remove the oil screen and "O" Ring from the pump cover.
4. Pressure Regulator Assembly
 - a. Locate the pump with the stator shaft down through a hole in the bench and secure with a holding bolt.
 - b. With a small screwdriver compress the T.V. boost valve bushing and remove the snap ring.



1. SERVO COVER RETAINING RING.
2. 2-4 SERVO COVER.
3. 2-4 SERVO COVER SEAL.
4. 4TH APPLY PISTON.
5. 4TH APPLY PISTON RING.
6. 2ND SERVO ASSEMBLY.
7. SERVO RETURN SPRING.
8. RETAINING RING.
9. SERVO APPLY PIN WASHER.
10. SERVO APPLY PIN SPRING.

11. 4TH APPLY PISTON ASSEMBLY.
12. 2ND APPLY PISTON.
13. SERVO CUSHION SPRING.
14. SERVO SPRING RETAINER.
15. 2ND APPLY PISTON OUTER SEAL.
16. SERVO APPLY PIN.
17. SERVO HOUSING SEAL.
18. 2ND APPLY PISTON OUTER SEAL.
19. RETAINING RING.
20. SERVO APPLY PIN SEAL.

DISASSEMBLY

1. Remove the 4th apply piston and housing from the 2nd apply piston assembly.
2. Remove the servo release spring from the servo apply pin.
3. Disassemble the 2nd servo apply piston assy. using J-22269-01 and separate the 2nd apply piston, spring and retainer.
4. Remove the retaining 'E' ring, washer and spring from the servo apply pin, and remove the pin.
5. Remove all oil seal rings.

INSPECTION

1. Inspect all pistons for porosity or damage.
2. Inspect all springs and oil seal rings for distortion or damage.

ASSEMBLY

Assemble all parts in the reverse order.

Assemble all flat edged seals with the flat edge to flat edge and coat with petrolatum.

H-700R4-32

Figure 700-R4-52 2-4 Servo Assembly - Exploded View

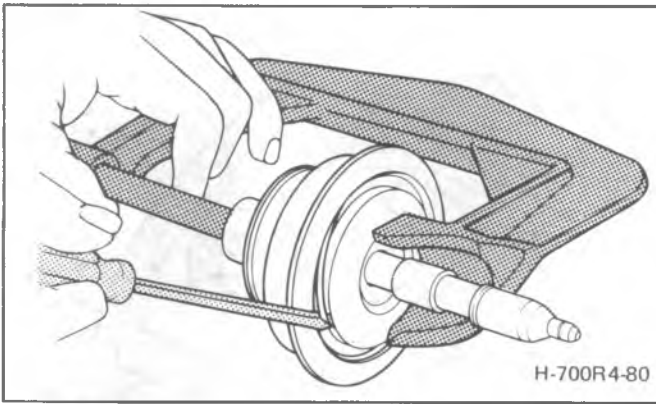


Figure 700-R4-53 Removing or Installing the 2nd Servo Snap Ring with J-22269-01

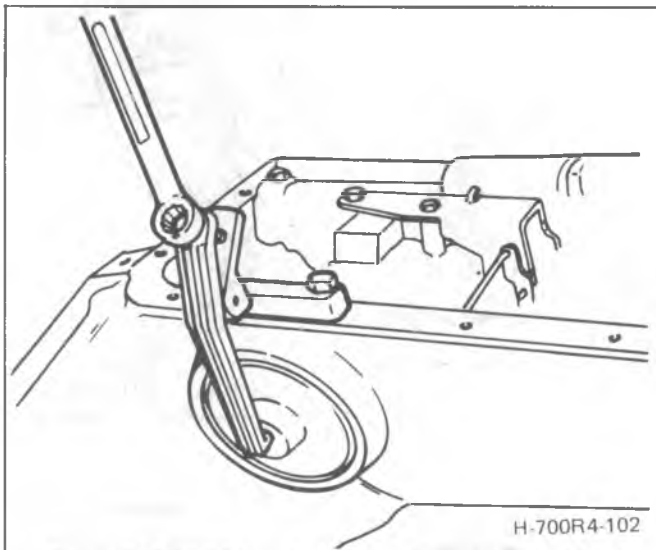


Figure 700-R4-54 Installing Servo Cover with J-29714

- c. Remove the T.V. boost valve bushing and valve with a small magnet.
- d. In the same manner remove the reverse boost valve bushing and valve and the pressure regulator valve and spring.

Inspection

1. Pressure Regulator Assembly
 - a. Inspect all valves, springs and bushings for chips, burrs, distortion and freeness of bore fits.
2. Converter Clutch Apply Valve Assembly
 - a. Inspect the converter clutch apply valve and spring for distortion or damage, and freeness in the pump bore.
3. Pressure Relief Assembly
 - a. Inspect the pressure relief ball and spring for damage, or distortion.
4. Pump Screen
 - a. Inspect the oil pump cover screen and "O" Ring for damage or distortion. Clean or replace as required.
5. Pump Cover and Body
 - a. Clean the cover and body and inspect all bores for foreign material.
 - b. Inspect the mating sides of the cover and body for scoring, flatness, porosity or voids between channels.
 - c. Inspect all channels for dirt, interconnected passages or damage.
 - d. Inspect the pump rotor and slide for scoring, cracks or damage.
 - e. Inspect all springs for distortion or damage.

- f. Inspect the rotor guide and pump vane rings for excessive wear or damage.
- g. Inspect all seals for damage.
- h. Inspect the front seal for damage or excess wear and the seal retaining spring for proper location and damage.

Pump Body

(Figs. 57 and 58)

Assembly

1. Install the pump slide "O" Ring and flat steel ring into the groove on the back side of the slide. Retain the petrolatum.
2. Install the small pivot pin and spring into the small hole located in the pump pocket.
3. Install the pump slide into the pump, positioning so that the notch in the slide is indexed with the pivot pin hole and the flat oil seal ring facing downward into the pocket.
4. Install the pump slide seal and support into the slide adjacent to the rotor.

The pump slide seal (composition) must be positioned against the other diameter of the pump pocket.

5. Install a vane ring into the pump pocket centering on the stator hole.
6. Install the composition rotor guide into the deep pocket of the rotor indexing the notches, and retain with petrolatum.
7. Install the rotor and guide into the pump pocket with the guide positioned downward.
8. Install the vanes into the rotor positioning so they are flush with the rotor and with the full wear pattern against the slide.
9. Install the vane guide ring into the rotor.

NOTICE: All components must be flush with pump body face.

10. Compress the pump slide spring and install into pump pocket.

Oil Pump Cover

Assembly

1. Oil Pump Screen
 - a. Assemble the "O" Ring on the oil pump screen and install in the bore of the pump with the seal end last.
2. Pressure Relief Ball
 - a. Install the pressure relief ball and spring, ball first.
 - b. Install the retaining rivot.
3. Converter Clutch Apply Valve
 - a. Install the converter clutch apply valve spring on the long end of the converter clutch apply valve and retain with petrolatum. (Fig. 59)
 - b. Install the converter clutch apply valve and spring into the bore of the pump.
 - c. Install the retainer and snap ring.
4. Pressure Regulator Assembly
 - a. Position the pump cover so that the pressure regulator bore is located in the vertical position.
 - b. Install the pressure regulator valve into the bore of the pump cover with the large land and the orifice hole first, positioning with a magnet into the bottom of the bore.
 - c. Install the pressure regulator valve spring into the bore.
 - d. Install the T.V. boost valve into the T.V. bushing. Long land of valve into the large hole of the bushing - retain the valve with petrolatum.
 - e. Install the reverse boost valve into the reverse sleeve, small end of valve first. Retain with petrolatum.
 - f. Using a small magnet install the T.V. boost valve and bushing into the cover with the small hole in the bushing rearward.

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

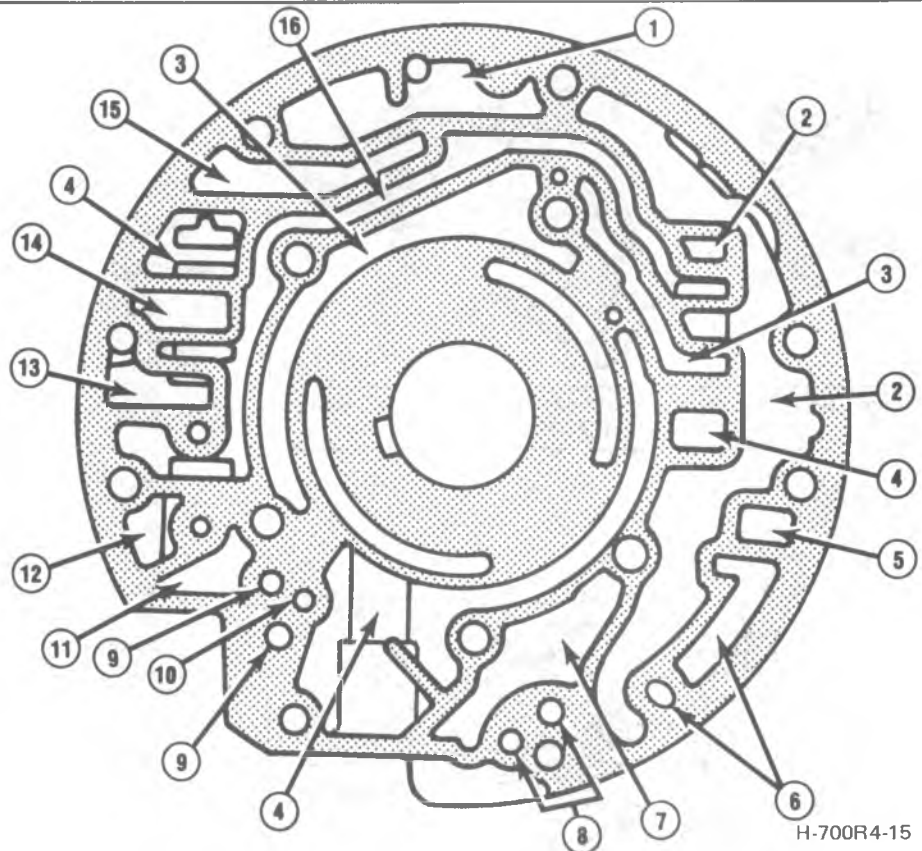


Figure 700-R4-55 Pump Cover Passage I.D.

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.

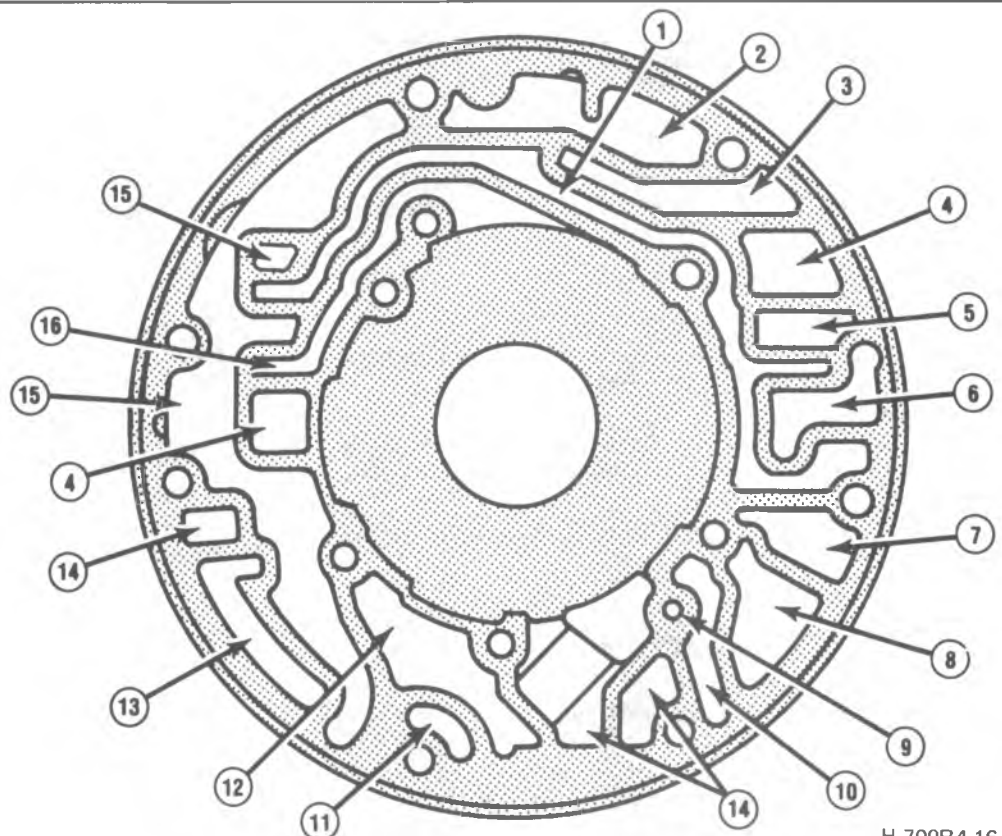


Figure 700-R4-56 Pump Body Passage I.D.

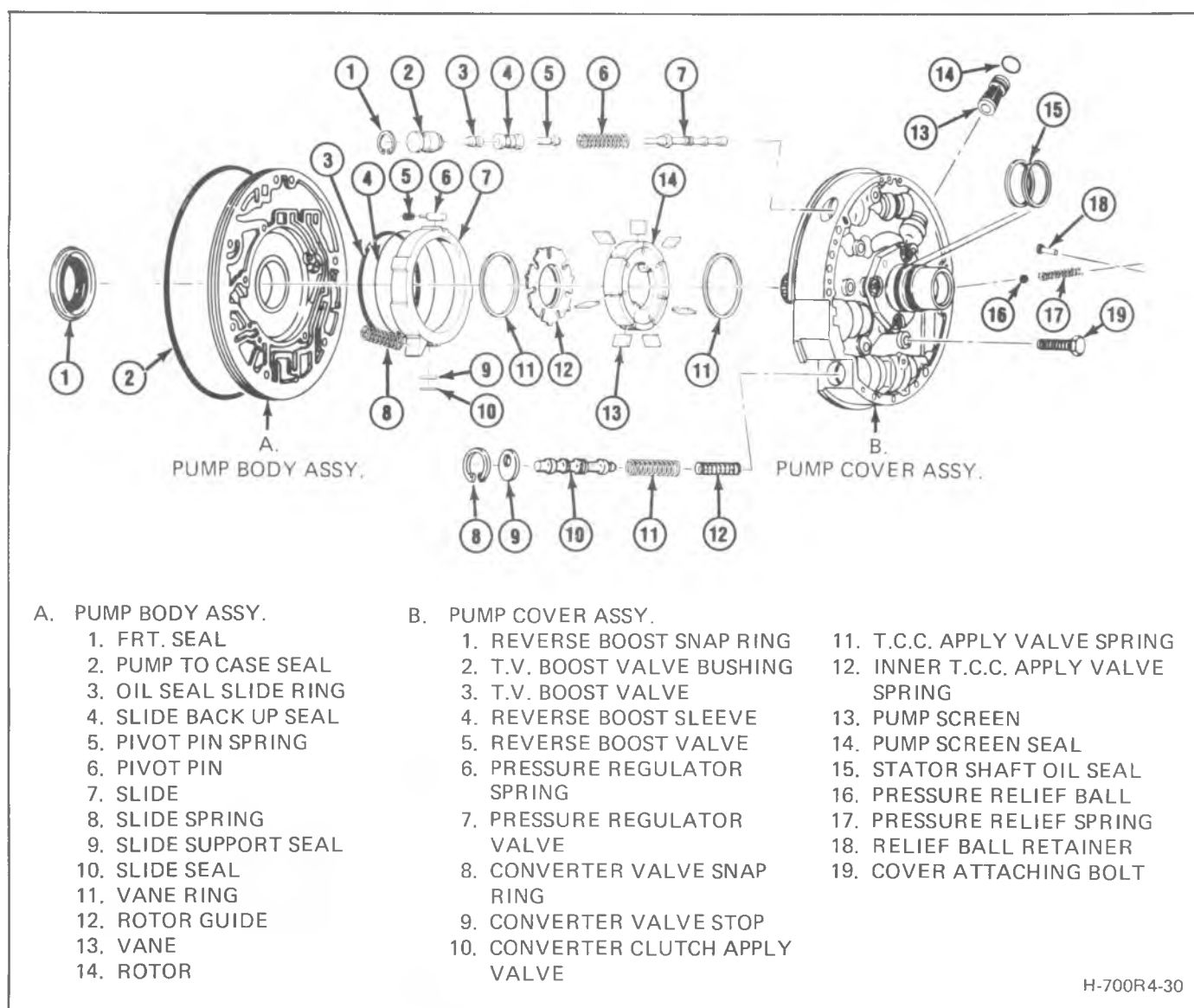


Figure 700-R4-57 Pump Assembly

- g. With the T.V. boost valve and bushing compressed and with the snap ring groove visible, install the snap ring.

9. Install pump to drum thrust washer. (Fig. 62)

Pump Cover and Body Assembly

Assembly

1. Place the pump body assembly over a hole in the bench with the stator shaft downward.
2. Assemble the pump cover to pump body with the attaching bolts finger tight.
3. Position the pump cover and pump body using J-25015 and place a holding bolt or screwdriver through a pump to case bolt hole and bench hole. (Fig. 60)
4. Remove tool and torque the pump cover attaching bolts to 22 N·m (18 ft. lbs.).
5. Install a new pump to case gasket on pump and retain with petrolatum.
6. If removed install (2) two teflon oil seal rings on the stator hub. (Fig. 61)
7. Install the pump to case oil seal on the cover - do not twist and make certain seal is properly located. Apply petrolatum.
8. Install a pump cover to case gasket aligning holes. Retain with petrolatum.

Pump Installation

1. Install the aligning pins into the case and install the pump, aligning the filter and pressure regulator holes with the case holes and attach with bolts and washers, torquing to 22 N·m (18 ft. lbs.). (Fig. 63)

Rotate the transmission to a horizontal position and rotate the turbine or output shaft by hand. If it will not rotate, loosen the pump attaching bolts and attempt to rotate again. If the turbine shaft will now turn, the reverse and input assemblies have not been indexed properly or some other assembly problem has occurred, such as a mispositioned washer. Rotate the transmission to a vertical position.

TRANSMISSION END PLAY CHECK

1. Remove a pump to case bolt and washer and install a 278 mm (11") bolt and locking nut.
2. Install tool J-25022 on J-24773-A and secure on the end of the turbine shaft.
3. Mount a dial indicator and clamp on the bolt positioning the indicator point cap nut on top of J-24773-5. (Fig. 64)

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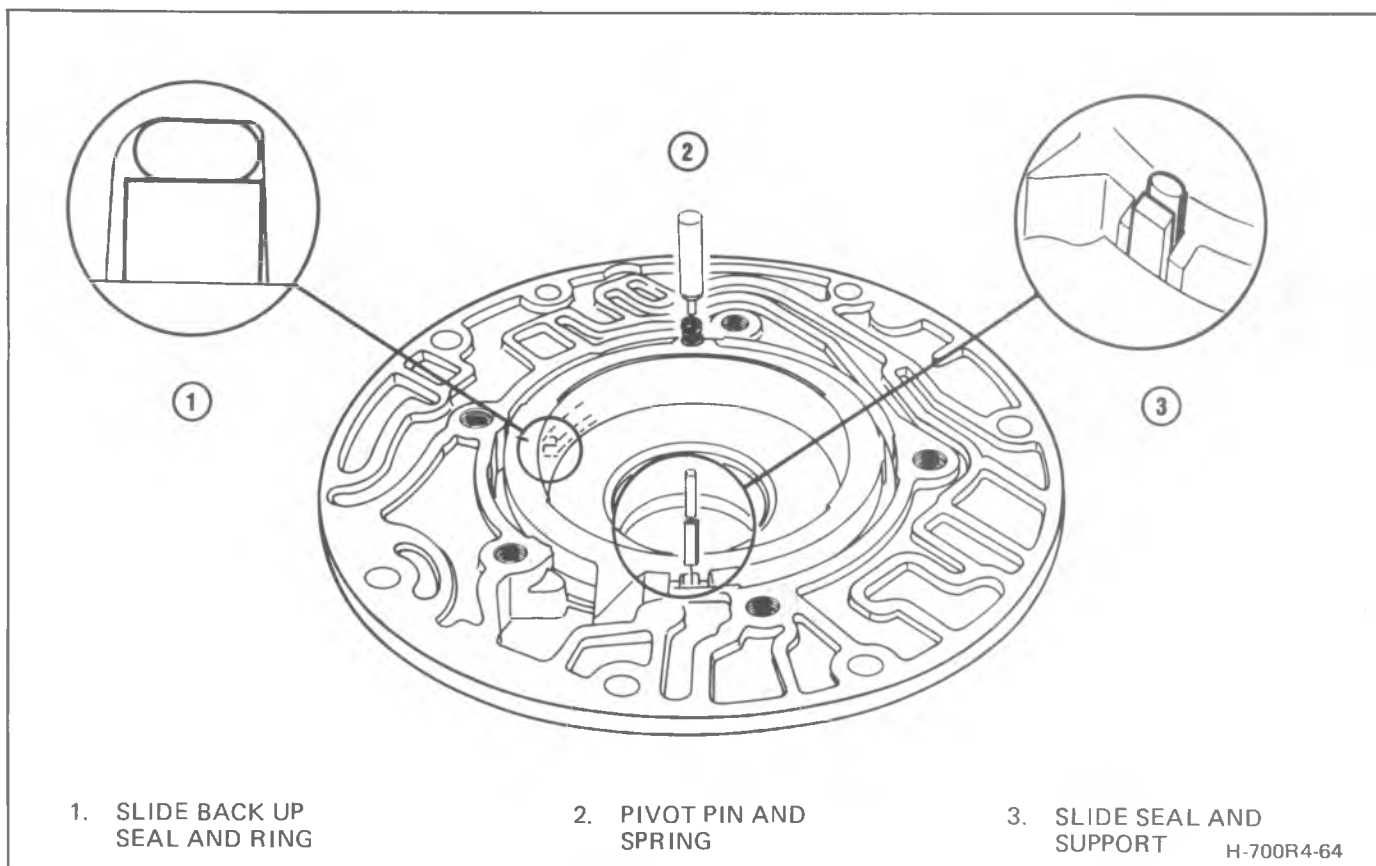


Figure 700-R4-58 Pump Body Assembly

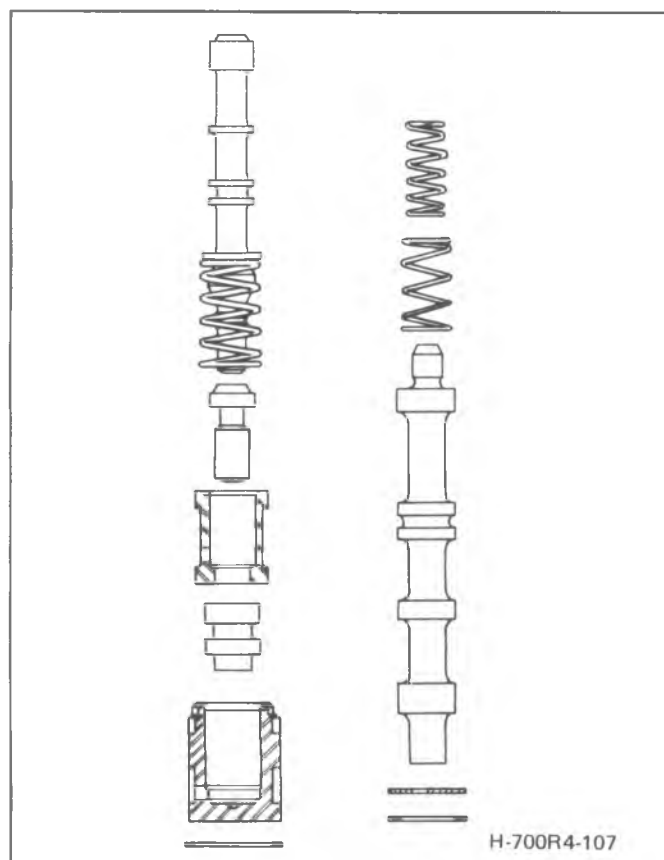


Figure 700-R4-59 Pressure Regulator and Converter Valves

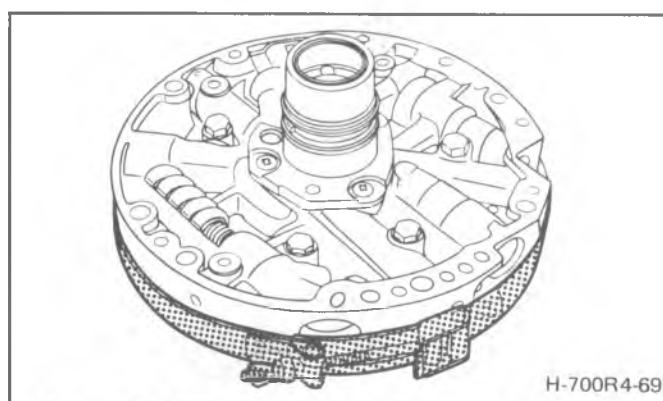


Figure 700-R4-60 Aligning Pump Cover and Body With J-25015

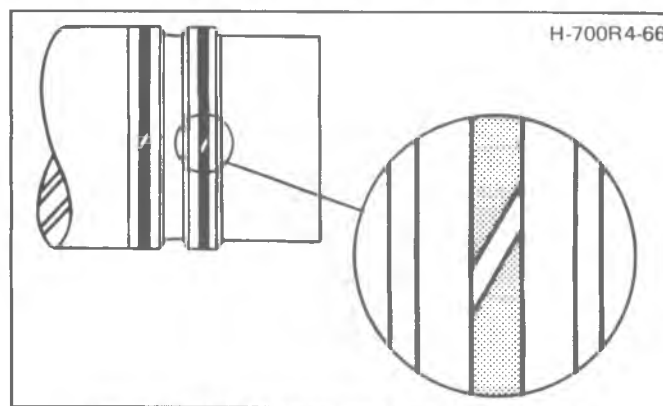


Figure 700-R4-61 Installing Pump Oil Seal Rings

4. With the dial indicator set at zero, pull upwards. The end play should be 0.13 - 0.92 mm (.005 - .036). The selective washer controlling the transmission end play is located between the

input housing and the thrust washer on the pump hub. If more or less end clearance is required to bring the

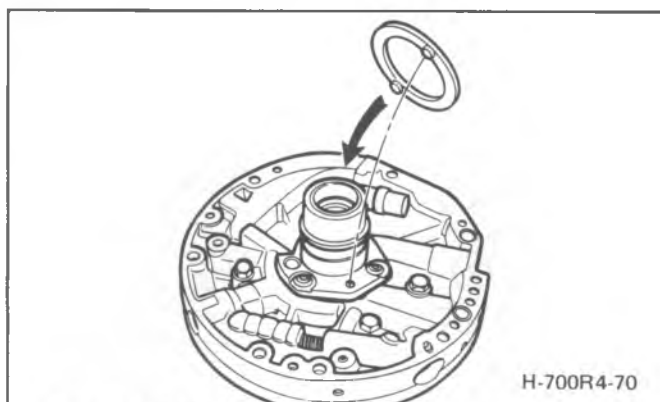


Figure 700-R4-62 Installing Pump to Reverse Input Drum Thrust Washer

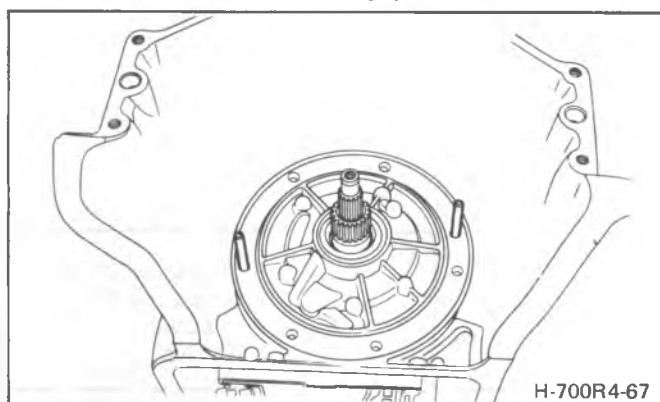


Figure 700-R4-63 Installing Pump With Alignment Pins

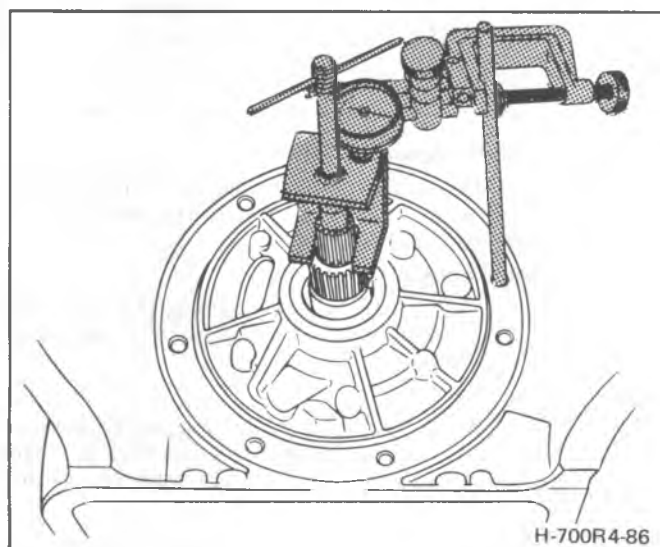


Figure 700-R4-64 Transmission End Play Check

transmission end play within specifications, select the proper washer from the following chart. (Fig. 65)

5. Remove the dial indicator and all tools.
6. Rotate the transmission to a horizontal position.

VALVE BODY AND WIRING HARNESS

1. **1-2 Accumulator Assembly**
 - a. Install the 1-2 accumulator pin into the case.
 - b. Install the 1-2 accumulator piston and seal over the pin with the lug end up.
 - c. Install the 1-2 accumulator spring on the piston.
2. **Control Valve Assembly**

TRANSMISSION END PLAY WASHER SELECTION CHART		H-700R4-47
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 700-R4-65 Transmission End Play Washer Selection Chart

(Figs. 66 and 67)

- a. Install the governor and converter clutch oil screens into the case.
- b. Install the (5) five check balls in the transmission case. (Fig. 68)
- c. Install the valve body alignment pins.
- d. Install the spacer plate to case gasket identified with a small "C," on the case.
- e. Install the valve body spacer on the guide pins, aligning holes. (Fig. 69)
- f. Install the valve body to spacer gasket identified with a "V" on the spacer plate.
- g. Install the 3 exhaust balls and check valve into the valve body and retain with petrolatum. (Fig. 70)
- h. Install the valve body, and connect the link to the inside detent lever.
- i. Remove the aligning pins and install the valve body to case attaching bolts and torque to 11 N·m (8 ft. lbs.).
- j. Attach the retaining clip to the link and inside detent lever. (Fig. 72)
3. Install the throttle lever and bracket, and T.V. link locating the slot in the bracket with the roll pin on the valve body top face, aligning the link through the T.V. linkage case bore. Attach with (2) two valve body to case bolts and torque to 11 N·m (8 ft. lbs.). (Fig. 73)
4. Install the valve body attaching bolt and harness clip and torque to 11 N·m (8 ft. lbs.).
5. Install the parking pawl bracket and torque to 22 N·m (18 ft. lbs.).
6. Install the manual detent spring and roller assembly with an attaching bolt and torque to 11 N·m (8 ft. lbs.).
7. Install the "O" Ring on the solenoid assembly and install into the pump, locating the attaching wire harness toward the transmission, attaching with (2) two bolts and torque to 22 N·m (18 ft. lbs.).
8. Install the wiring harness and connect to all pressure switches.

EACH PRESSURE SWITCH WILL BE COLOR CODED FOR SWITCH AND WIRE CONNECTOR IDENTIFICATION. WHEN CONNECTING THE WIRE CONNECTORS TO THE PRESSURE SWITCHES, ALWAYS CONNECT THE SAME COLORS. IT IS NOT NECESSARY TO CONNECT THE SAME WIRE CONNECTOR TO THE SAME PRESSURE SWITCH TERMINALS AS THEY ARE REVERSIBLE.

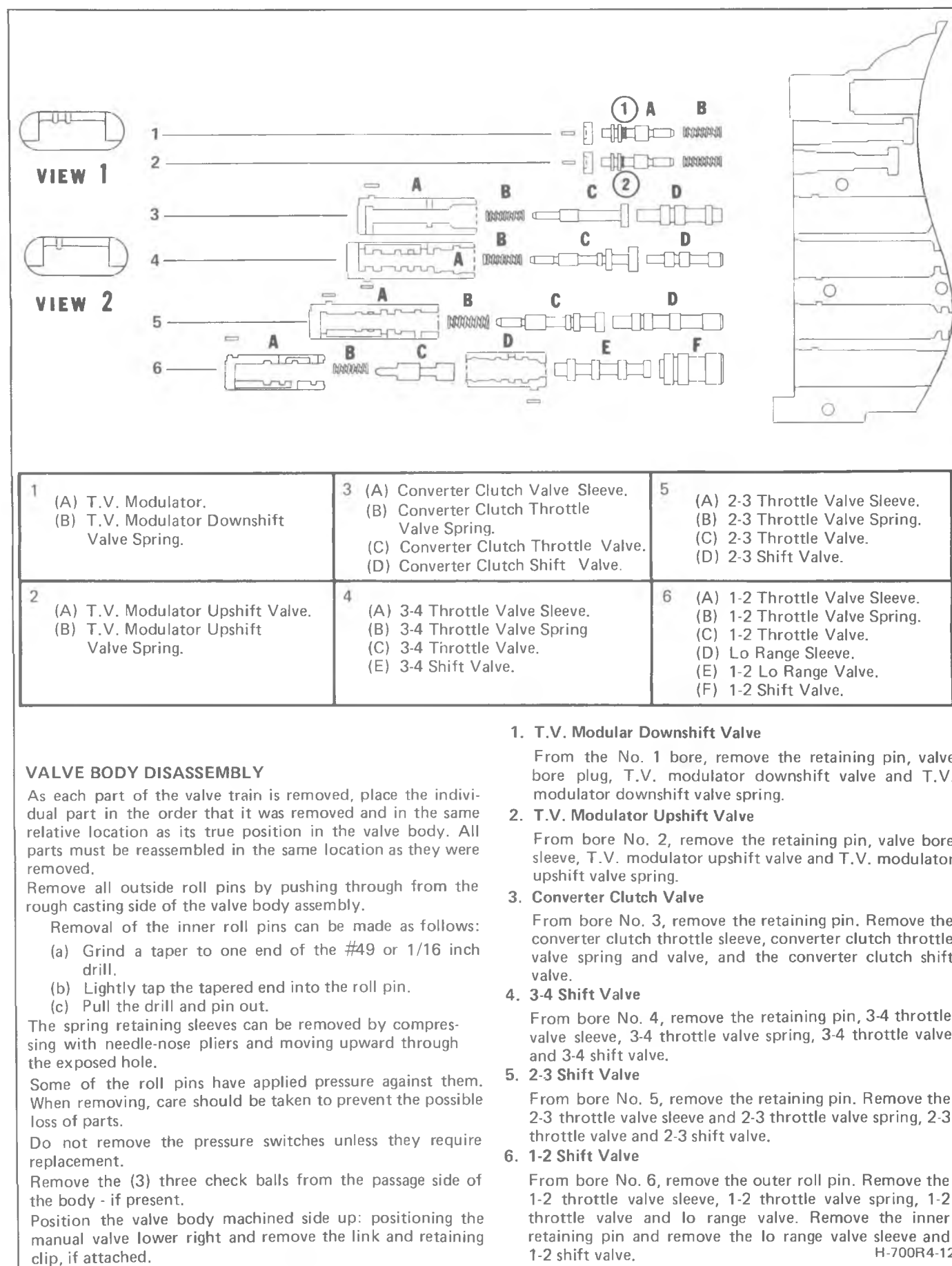
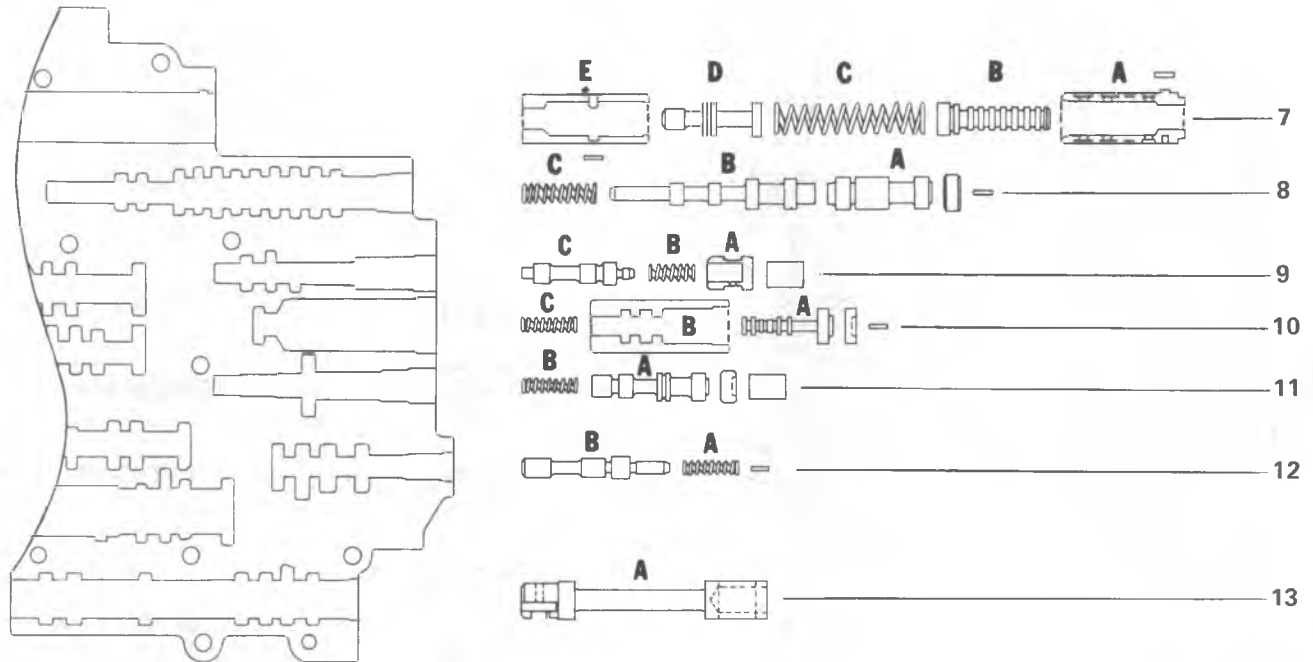


Figure 700-R4-66 Typical Valve Body Assembly



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.

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Figure 700-R4-67 Typical Valve Body Assembly

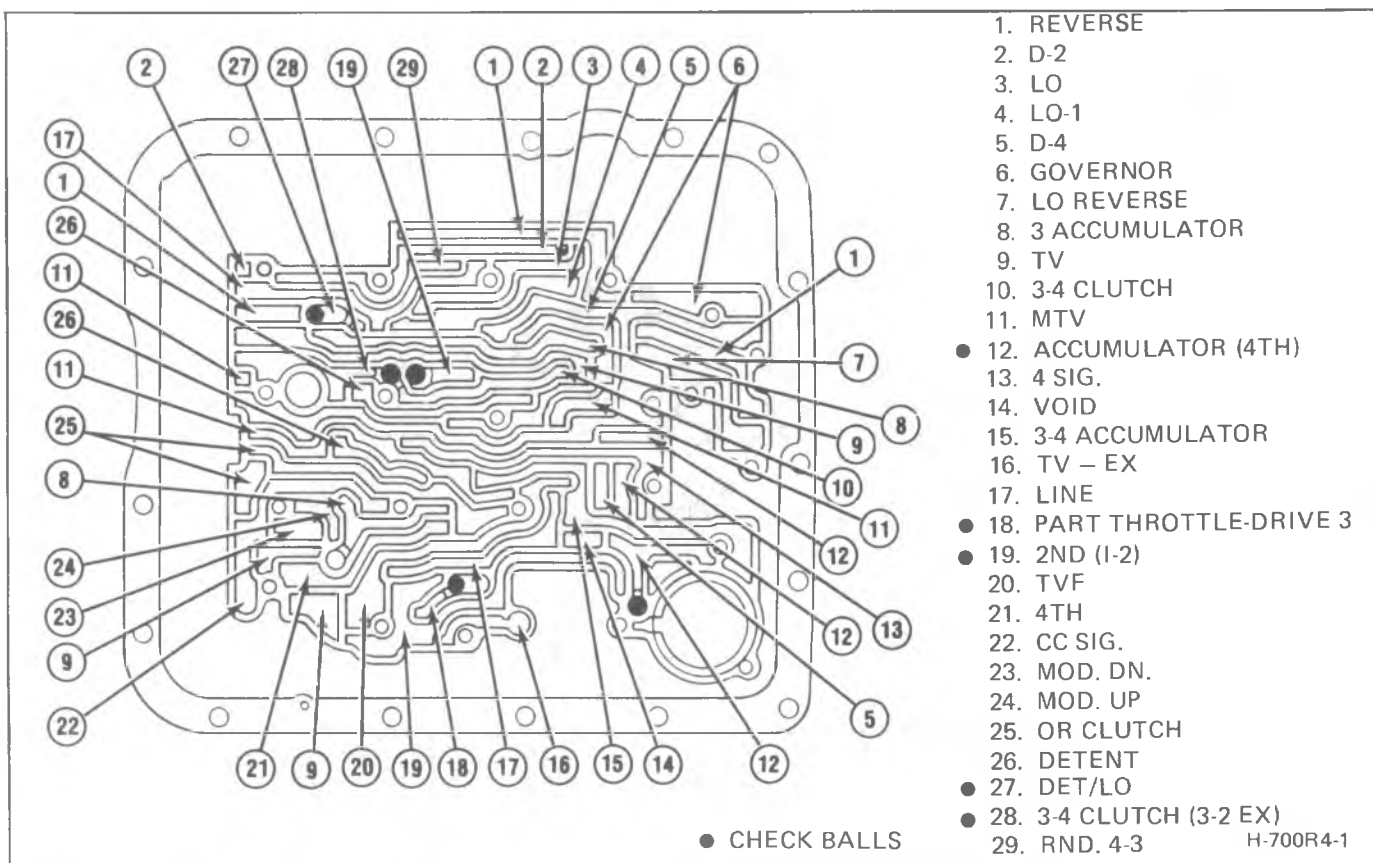


Figure 700-R4-68 Case Check Balls and Oil Passages

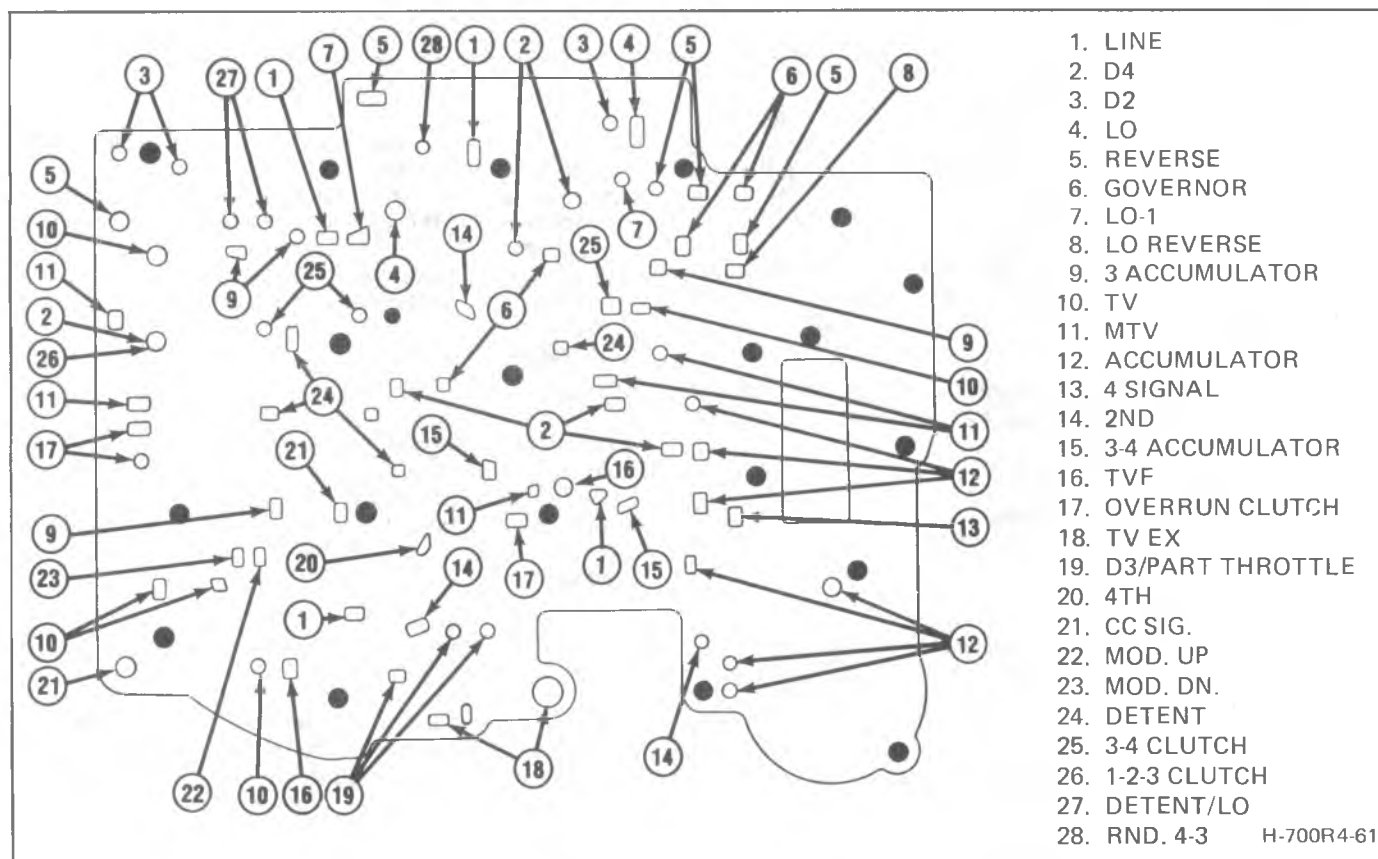


Figure 700-R4-69 Spacer Plate I.D.

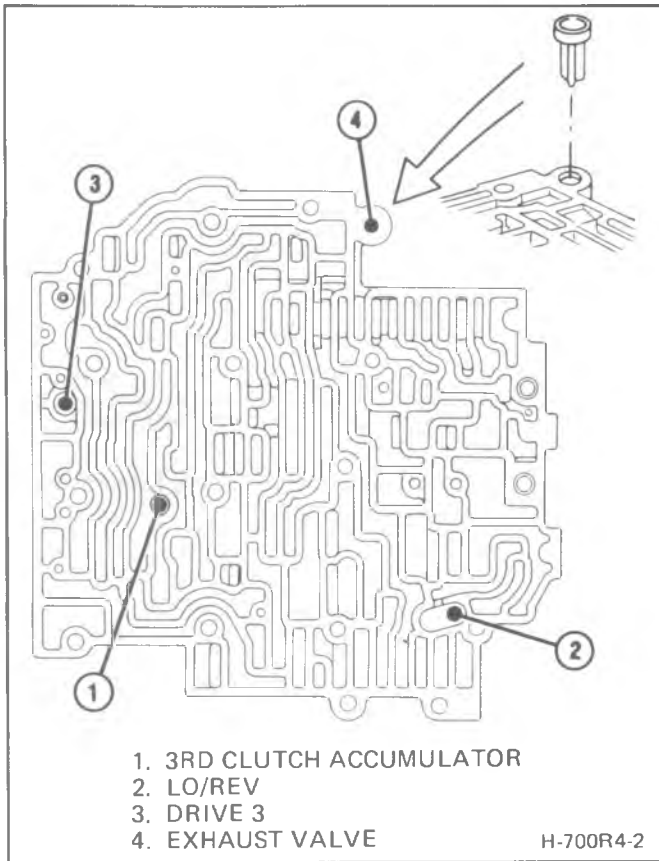


Figure 700-R4-70 Valve Body Check Ball Locations

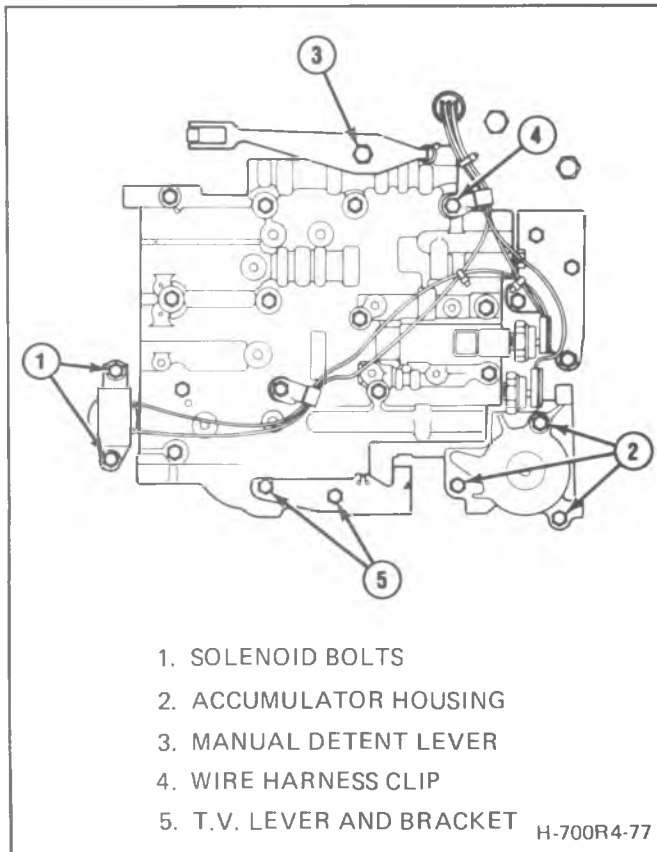


Figure 700-R4-71 Valve Body Bolt Locations

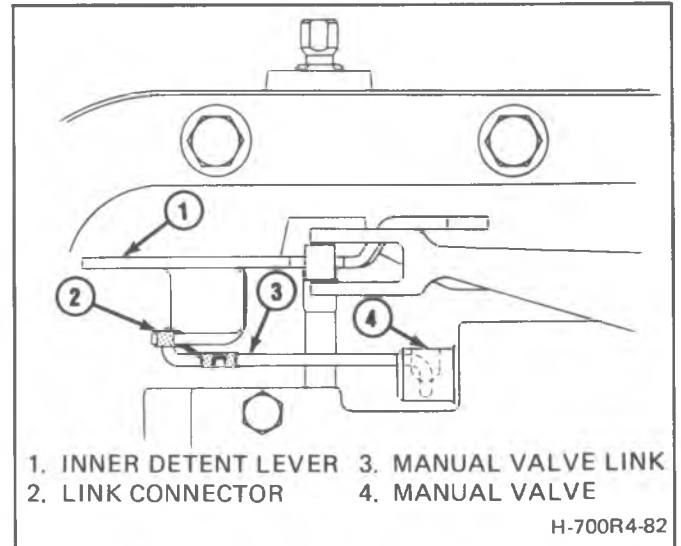


Figure 700-R4-72 Manual Valve Link and Clips

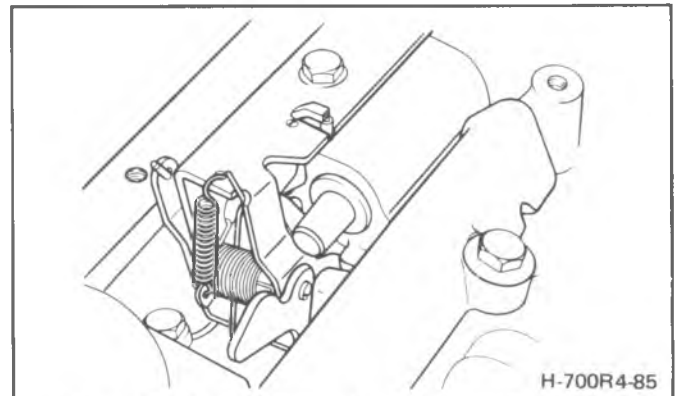


Figure 700-R4-73 Installing the T.V. Bracket and Lever Assembly

10. Attach the inside electrical connector terminal to the outside electrical connector.
 11. Install the oil passage cover on the transmission with (3) three attaching bolts and torque to 11 N·m (8 ft. lbs.).
 12. 3-4 Accumulator Assembly
 - A. Install the 3-4 accumulator piston into the accumulator housing with the lug end up.
 - B. Install the 3-4 accumulator piston spring into the housing on the piston.
 - C. Position the 3-4 accumulator plate and gasket on the transmission positioning the gasket on top.
 - D. Install the housing, spring and piston on the transmission case and secure with (3) three attaching bolts, torquing to 11 N·m (8 ft. lbs.).
 13. Install the speedo gear and retaining clip on the output shaft, positioning the large notch on the speedo gear rearward. (Fig. 74)
 14. Install the output shaft seal in the output shaft sleeve and install on the output shaft with J25016. (Fig. 75)
 15. Install the oil seal ring on the case extension and install on case. Positioning so the speedo hole is located on the same side as the governor. Torque bolts to 31 N·m (23 ft. lbs.).
 16. Install the governor assembly.
 17. Apply a sealant, such as loctite cup plug sealant No. 11 or equivalent to the edge of the cover, then install cover.
Use care to prevent damage.
 18. Install the "O" Ring on the filter and install in the transmission.
 19. Install a new oil pan gasket on the transmission case and install the attaching bolts and torque to 11 N·m (8 ft. lbs.).
9. Install the "O" Ring on the outside electrical connector and install into the case by compressing the inside tang or gently taping in board, locating the tab with the case notch.

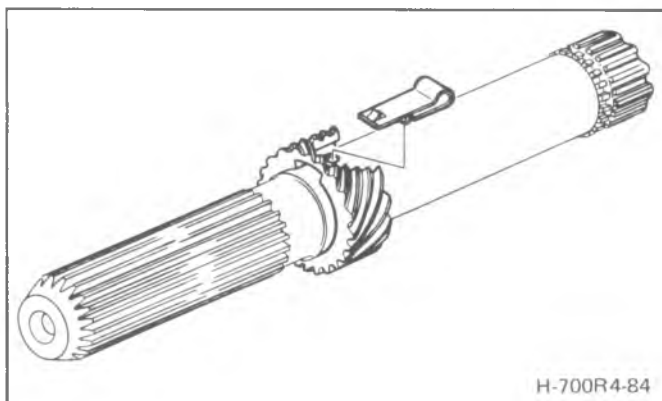


Figure 700-R4-74 Installing Speedo Gear and Clip

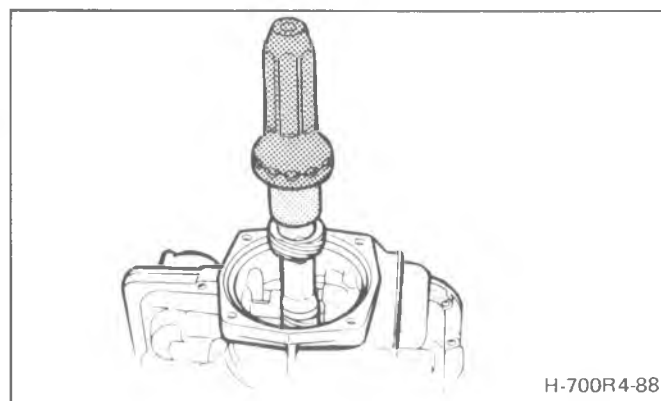
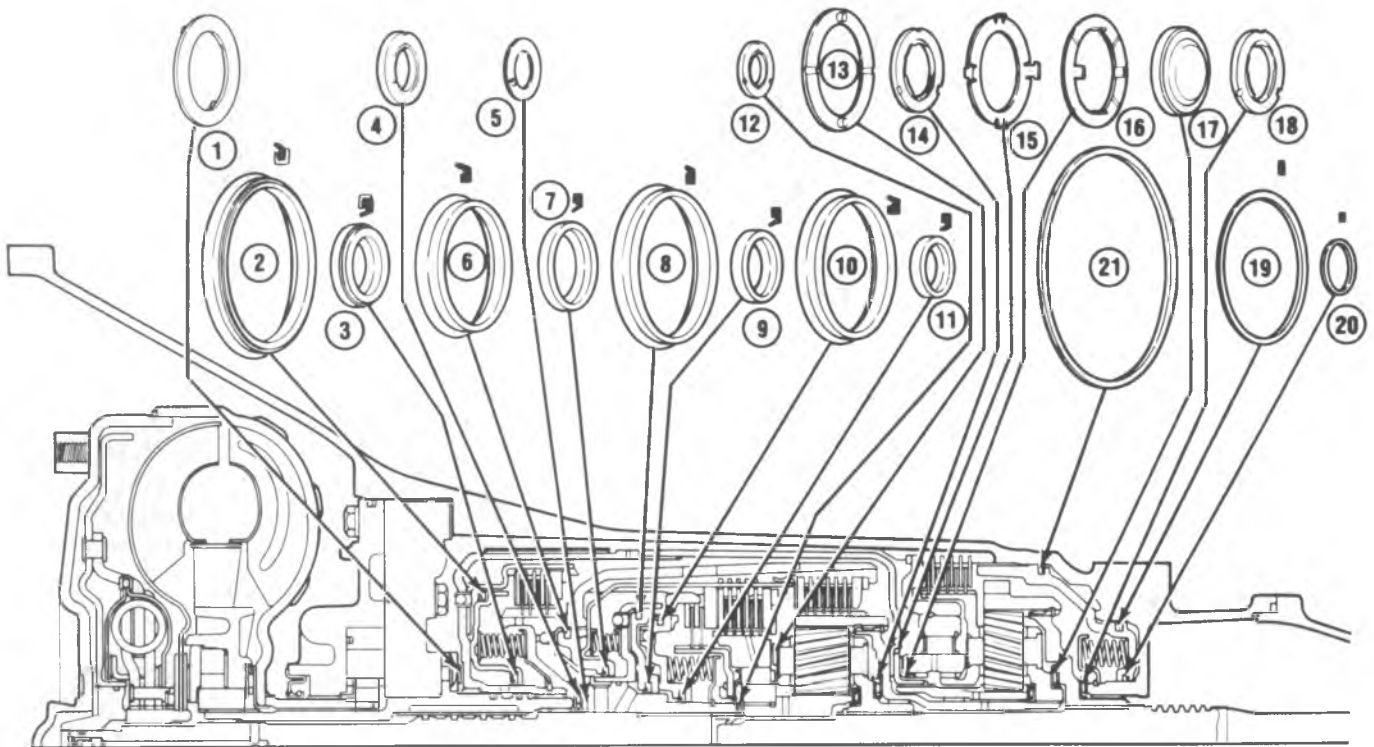


Figure 700-R4-75 Installing Output Shaft Sleeve

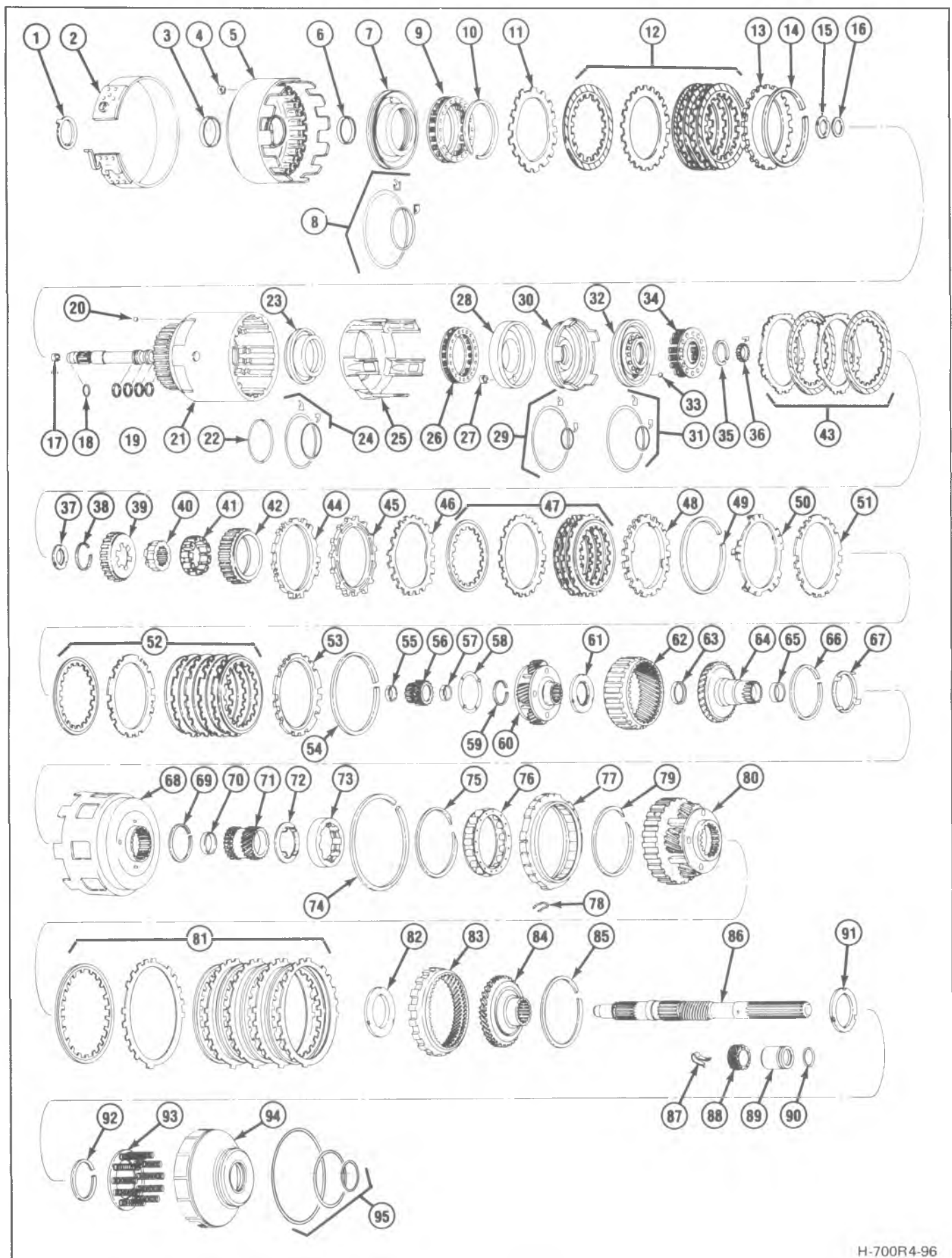
20. Install all remaining outside connectors such as driven speedo gear and adaptor, outside manual lever and nut.
21. Remove the transmission from the holding fixture and install the torque converter.



- | | |
|------------------------------------|--|
| 1 PUMP TO DRUM THRUST WASHER. | 14 REACTION SHAFT BEARING |
| 2 OUTER REVERSE INPUT CLUTCH SEAL. | 15 REACTION SHAFT TO SHELL THRUST WASHER |
| 3 INNER REVERSE INPUT CLUTCH SEAL. | 16 REACTION RACE TO SHELL THRUST WASHER |
| 4 STATOR SHAFT BEARING. | 17 REACTION CARRIER TO SUPPORT BEARING |
| 5 SELECTIVE WASHER | 18 REACTION GEAR SUPPORT TO CASE BEARING |
| 6 3-4 CLUTCH OUTER SEAL | 19 LOW REVERSE CLUTCH CENTER SEAL |
| 7 3-4 CLUTCH INNER SEAL | 20 LOW REVERSE CLUTCH INNER SEAL |
| 8 FORWARD CLUTCH OUTER SEAL | 21 LOW REVERSE CLUTCH OUTER SEAL |
| 9 FORWARD CLUTCH INNER SEAL | |
| 10 OVERRUN CLUTCH OUTER SEAL | |
| 11 OVERRUN CLUTCH INNER SEAL | |
| 12 INPUT SUN GEAR BEARING | |
| 13 INPUT CARRIER THRUST WASHER | |

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	41 N·m (31 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	31 N·m (23 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	3	1/8 - 27	11 N·m (8 FT. LB.)
TRANSMISSION OIL PAN TO CASE	16	1.25 X 16	24 N·m (18 FT. LB.)	CONNECTOR COOLER PIPE	2	1/4 - 18	38 N·m (28 FT. LB.)
PRESSURE SWITCHES	1-3	1/8 - 27	11 N·m (8 FT. LB.)				H-700R4-58

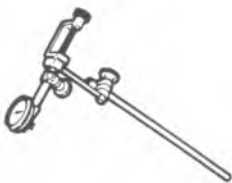
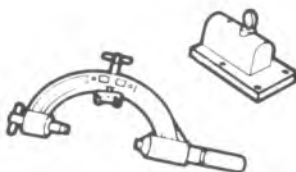





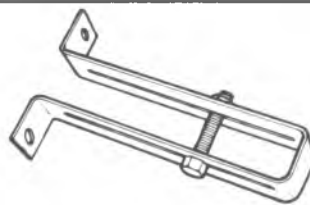


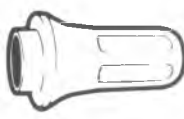


Figure 700-R4-78 Seals and Bearing Locations and Torque Specifications



H-700R4-96

Figure 700-R4-76 Transmission Assembly - Exploded View

- | | |
|--------------------------------------|--|
| 1. PUMP THRUST WASHER | 49. FORWARD CLUTCH SNAP RING |
| 2. 2-4 BAND ASSY. | 50. 3-4 CLUTCH RETAINER PLATE |
| 3. REVERSE INPUT CLUTCH BUSHING | 51. 3-4 CLUTCH APPLY PLATE |
| 4. CHECK VALVE ASSY. | 52. 3-4 PLATE ASSY |
| 5. REVERSE INPUT CLUTCH HOUSING | 53. 3-4 CLUTCH BACKING PLATE |
| 6. REVERSE INPUT CLUTCH BUSHING | 54. 3-4 CLUTCH SNAP RING |
| 7. REVERSE INPUT CLUTCH PISTON | 55. INPUT SUN GEAR BUSHING |
| 8. REVERSE INPUT CLUTCH SEALS | 56. INPUT SUN GEAR |
| 9. REVERSE INPUT CLUTCH SPRING ASSY. | 57. INPUT SUN GEAR BUSHING |
| 10. REVERSE INPUT SNAP RING | 58. INPUT CARRIER THRUST WASHER |
| 11. REVERSE INPUT WAVED PLATE | 59. OUTPUT SHAFT SNAP RING |
| 12. REVERSE INPUT CLUTCH PLATE ASSY | 60. INPUT CARRIER ASSY |
| 13. REVERSE INPUT BACKING PLATE | 61. INPUT CARRIER BEARING ASSY |
| 14. REVERSE INPUT SNAP RING | 62. INPUT INTERNAL GEAR |
| 15. STATOR SHAFT BEARING | 63. REACTION CARRIER BUSHING |
| 16. SELECTIVE WASHER | 64. REACTION CARRIER SHAFT |
| 17. CHECK VALVE ASSY | 65. CARRIER SHAFT BUSHING |
| 18. TURBINE SHAFT "O" RING | 66. REACTION SHAFT SNAP RING |
| 19. TURBINE SHAFT OIL SEALS | 67. REACTION SHAFT THRUST WASHER |
| 20. CHECK BALL | 68. REACTION SHELL |
| 21. INPUT HOUSING | 69. REACTION SUN GEAR RETAINER |
| 22. INPUT HOUSING "O" RING | 70. REACTION SUN GEAR BUSHING |
| 23. 3-4 CLUTCH PISTON | 71. REACTION SUN GEAR |
| 24. 3-4 CLUTCH SEALS | 72. REACTION SHELL THRUST WASHER |
| 25. 3-4 CLUTCH APPLY RING | 73. LO-REVERSE ROLLER RACE |
| 26. 3-4 CLUTCH SPRING ASSY | 74. LO-REVERSE SUPPORT SNAP RING |
| 27. FORWARD CLUTCH CHECK BALL | 75. LO-REVERSE ROLLER RETAINER |
| 28. FORWARD CLUTCH HOUSING | 76. LO-REVERSE ROLLER CLUTCH |
| 29. FORWARD CLUTCH SEALS | 77. LO-REVERSE SUPPORT ASSY |
| 30. FORWARD CLUTCH PISTON | 78. LO-REVERSE CLUTCH SUPPORT RETAINER |
| 31. OVERRUN CLUTCH SEALS | 79. LO-REVERSE ROLLER RETAINER |
| 32. OVERRUN CLUTCH PISTON | 80. REACTION CARRIER ASSY |
| 33. OVERRUN CLUTCH BALL | 81. LO-REVERSE CLUTCH PLATE ASSY |
| 34. OVERRUN CLUTCH SPRING ASSY | 82. REACTION CARRIER BEARING |
| 35. OVERRUN CLUTCH SNAP RING | 83. REACTION INTERNAL GEAR |
| 36. INPUT HOUSING SEAL | 84. REACTION INTERNAL GEAR SUPPORT |
| 37. INPUT SUN GEAR BEARING | 85. REACTION GEAR SNAP RING |
| 38. OVERRUN CLUTCH SNAP RING | 86. OUTPUT SHAFT |
| 39. OVERRUN CLUTCH HUB | 87. SPEEDO DRIVE GEAR CLIP |
| 40. FORWARD ROLLER CAM | 88. SPEEDO DRIVE GEAR |
| 41. FORWARD ROLLER ASSY | 89. OUTPUT SHAFT SLEEVE |
| 42. FORWARD CLUTCH OUTER RACE | 90. OUTPUT SHAFT SEAL |
| 43. OVERRUN CLUTCH PLATE ASSY | 91. REACTION GEAR SUPPORT BEARING |
| 44. FORWARD CLUTCH APPLY PLATE | 92. LO-REVERSE CLUTCH SNAP RING |
| 45. FORWARD CLUTCH SPACER (4-PLT) | 93. LO-REVERSE SPRING ASSY |
| 46. FORWARD CLUTCH PLATE (WAVED) | 94. LO-REVERSE CLUTCH PISTON |
| 47. FORWARD CLUTCH PLATE ASSY | 95. LO-REVERSE CLUTCH SEALS |
| 48. FORWARD CLUTCH BACKING PLATE | |

	J-8001 DIAL INDICATOR SET		J-8763-02 HOLDING FIXTURE AND BASE
	J-23327 CLUTCH SPRING COMPRESSOR		J-22269-01 PISTON COMPRESSOR
	J-25018-A CLUTCH SPRING COMPRESSOR ADAPTOR		J-24773-A OIL PUMP REMOVER AND END PLAY CHECKING FIXTURE
	J-29714 SERVO COVER COMPRESSOR		J-25022 END PLAY CHECKING FIXTURE ADAPTOR
	J-29837 OUTPUT SHAFT SUPPORT FIXTURE		J-29882 INNER OVERRUN CLUTCH SEAL PROTECTOR
	J-25016 PUMP OIL SEAL INSTALLER		J-29883 INNER FORWARD CLUTCH SEAL PROTECTOR
	J-21426 REAR SEAL INSTALLER		J-33037 2-4 BAND APPLY PIN TOOLS
	J-23456 CLUTCH SPRING COMPRESSOR PRESS		J-25015 OIL PUMP BODY AND COVER ALIGNMENT BAND

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Figure 700-R4-79 Special Tools

MANUAL TRANSMISSION

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89MM (4 Speed)	7B3-1
117MM (4 Speed)	7B4-1

GENERAL DESCRIPTION

THREE-SPEED TRANSMISSIONS

3-Speed 76mm (7B1-4)

3-Speed 77mm (7B2-3)

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. In the 77mm unit, the mainshaft is carried at the rear by a ball bearing mounted in the rear of the case.

Helical gears are incorporated throughout, except for reverse gear in the 77mm 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 transmissions are 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. In the 77mm transmission, only the driven gear, second speed gear and first speed gear are rigidly connected to the countergear. The engine 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

Preliminary Inspection

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 blackout. 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 procedure for the steering column lower bearing in Section 3B.
4. Lubricate all rod and swivel connections and recheck shift effort after 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

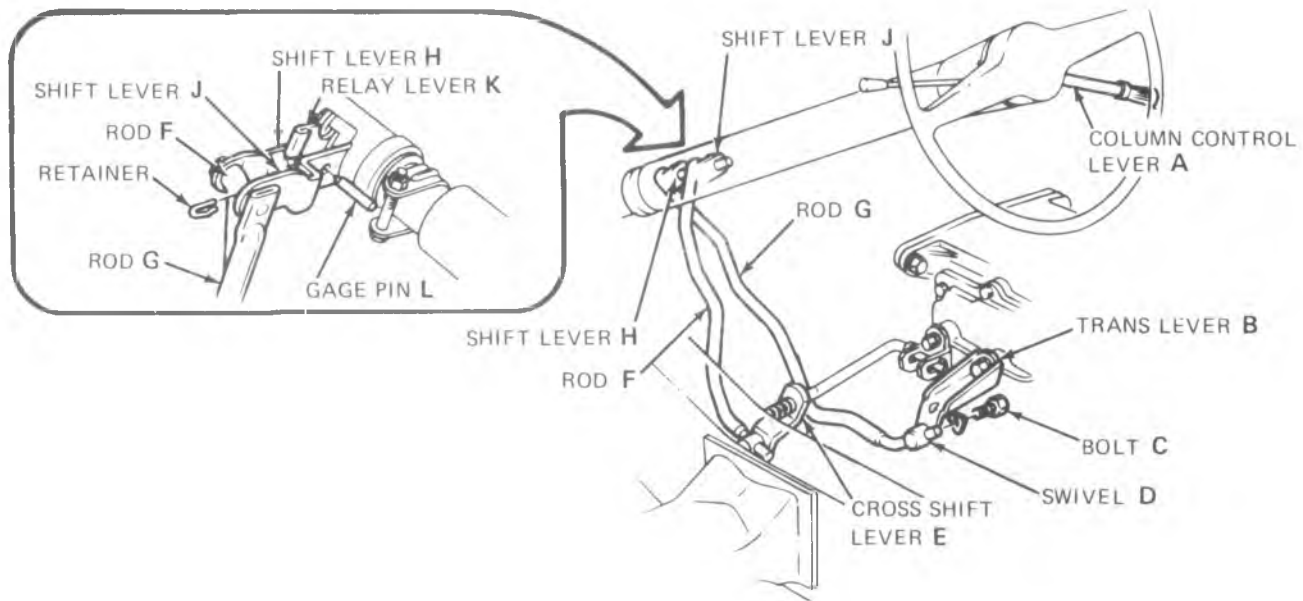
All swivels, rods and mountings should be checked for lost motion and repaired or replaced as necessary. Transmission control levers should be checked for wear and repaired or replaced as necessary.

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 blackout 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 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".

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Fig. 7B-2--C Truck Column Shift Linkage

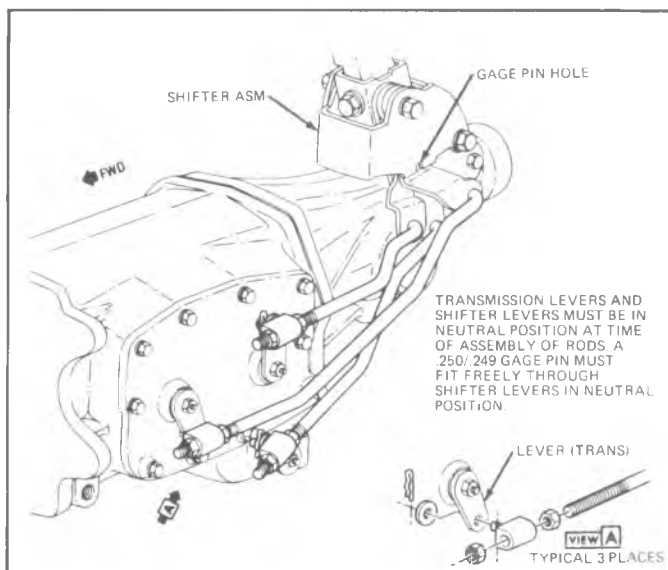


Fig. 7B-3--4-Speed (89mm) Shift Linkage

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. Set 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	<ul style="list-style-type: none"> 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 clutch housing g. Misalignment of transmission h. Stiff shift lever seal i. Pilot bearing loose in crankshaft j. Worn or improperly adjusted linkage 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> a. Damaged main drive gear bearing b. Damaged mainshaft bearing c. Damaged high speed gear synchronizer 	<ul style="list-style-type: none"> a. Replace damaged bearing b. Replace damaged bearing c. Replace synchronizer
Noisy in Neutral with Engine Running	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> a. Insufficient lubricant b. Worn or damaged main drive gear or countergear 	<ul style="list-style-type: none"> a. Fill to correct level b. Replace faulty or damaged gears
Noisy in Second Only	<ul style="list-style-type: none"> a. Damaged or worn second-speed constant mesh gears b. Worn or damaged countergear rear bearings c. Damaged or worn second-speed synchronizer 	<ul style="list-style-type: none"> a. Replace damaged gears b. Replace countergear bearings and shaft c. Replace synchronizer
Noisy in Third Only (Four Speed)	<ul style="list-style-type: none"> a. Damaged or worn third-speed constant mesh gears b. Worn or damaged countergear bearings 	<ul style="list-style-type: none"> a. Replace damaged gears b. Replace damaged countergear bearings and shaft

MANUAL TRANSMISSION DIAGNOSIS (CONT'D.)

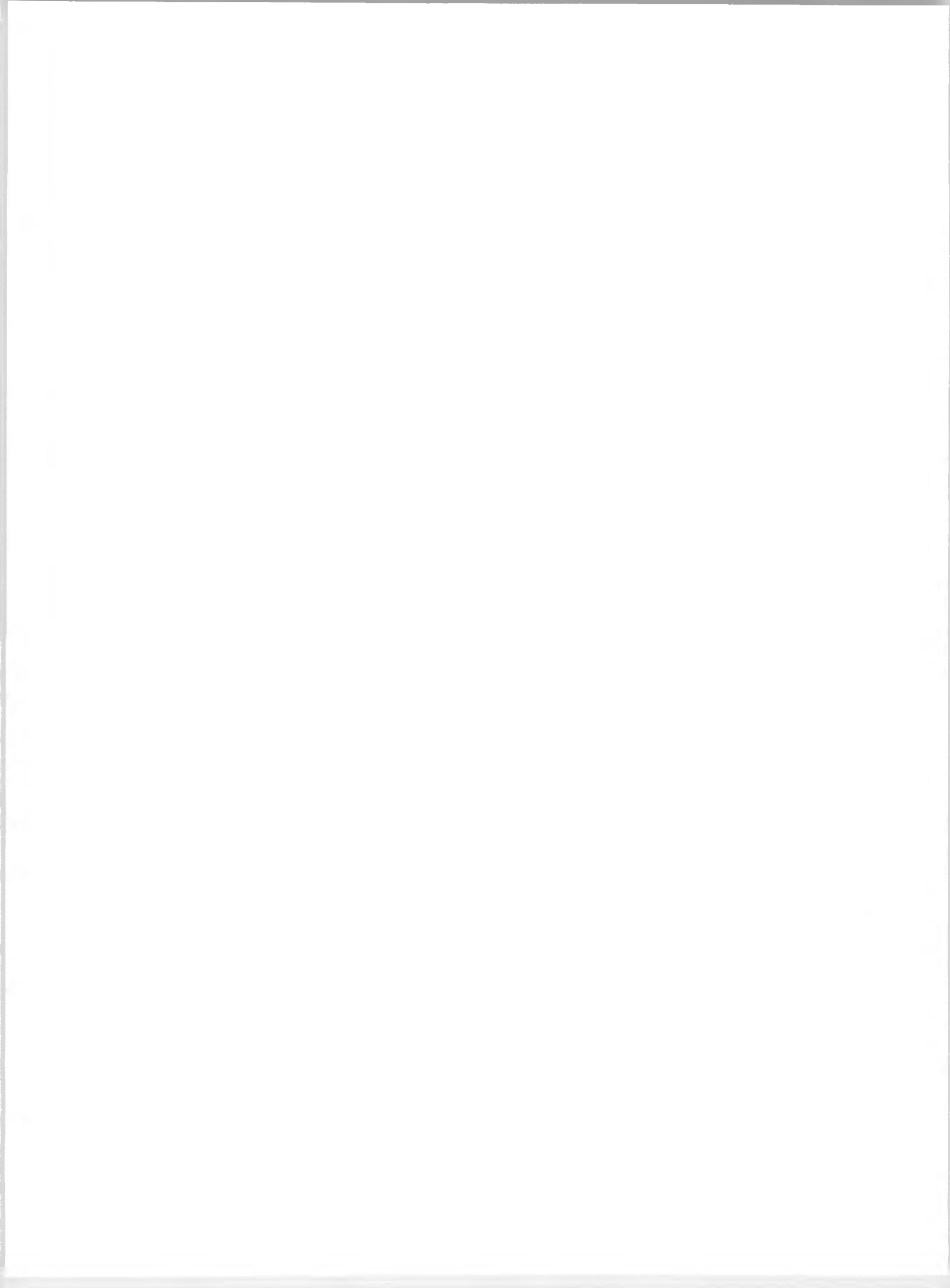
CONDITION	PROBABLE CAUSE	CORRECTION
Noisy in Reverse Only	a. Worn or damaged reverse idler gear or idler bushing b. Worn or damaged reverse gear on mainshaft c. Damaged or worn reverse countergear d. Damaged Shift mechanism	a. Replace reverse idler gear assembly b. Replace reverse gear c. Replace countergear 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. See Section 6 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 mechanism per Section 3B Steering of the Chassis Service Manual
		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



3 SPEED 76MM TRANSMISSION

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ON VEHICLE SERVICE

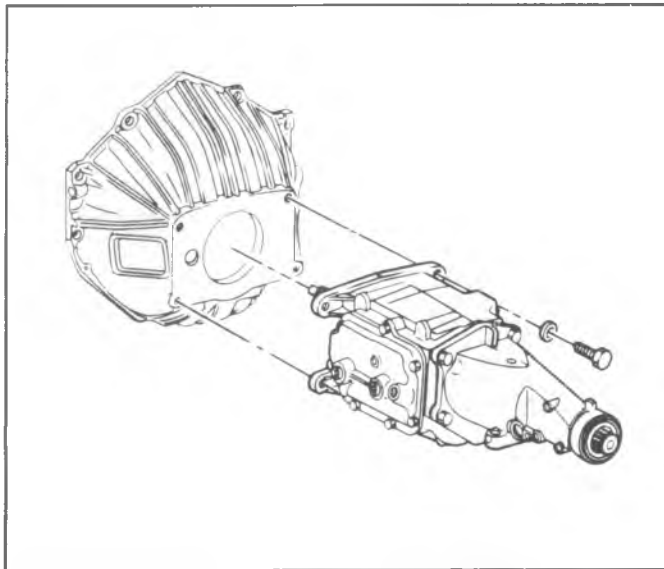


Fig. 7B1-1--Transmission To Engine Attachment

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

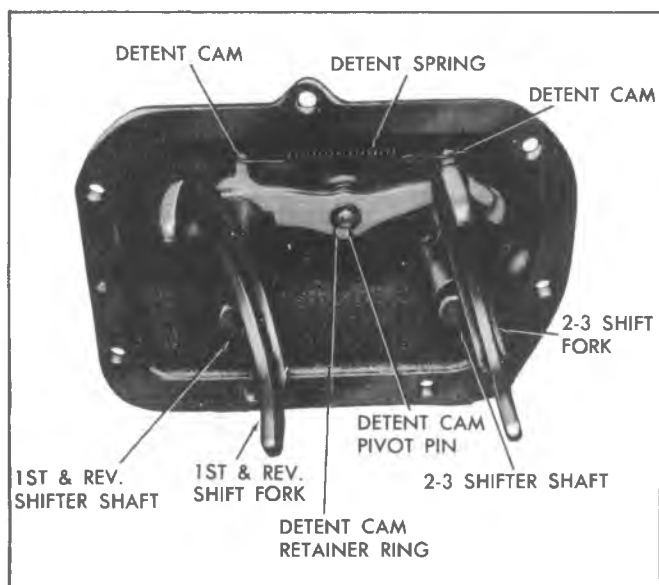


Fig. 7B1-2--Transmission Side Cover Assembly

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 (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.

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.

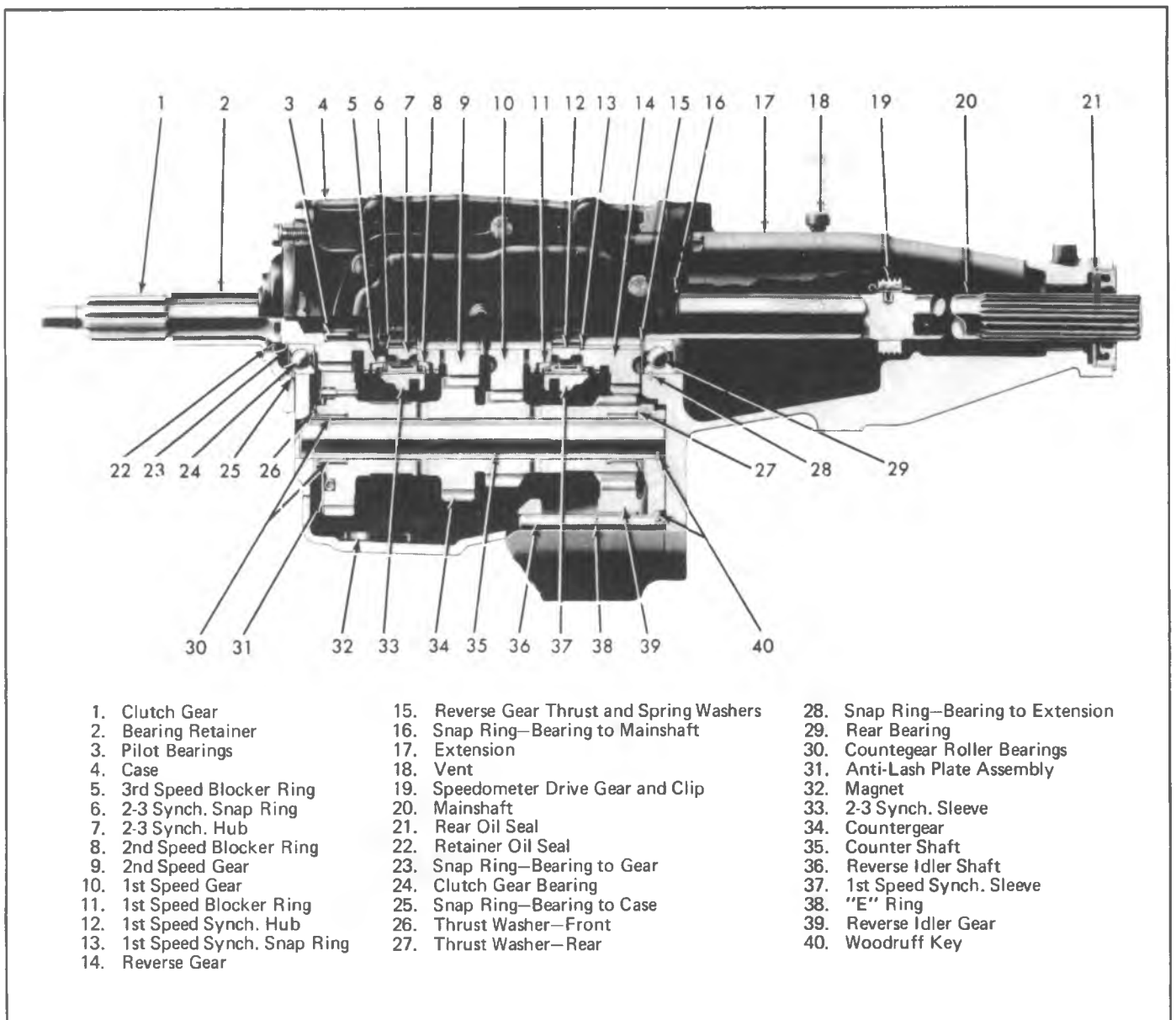
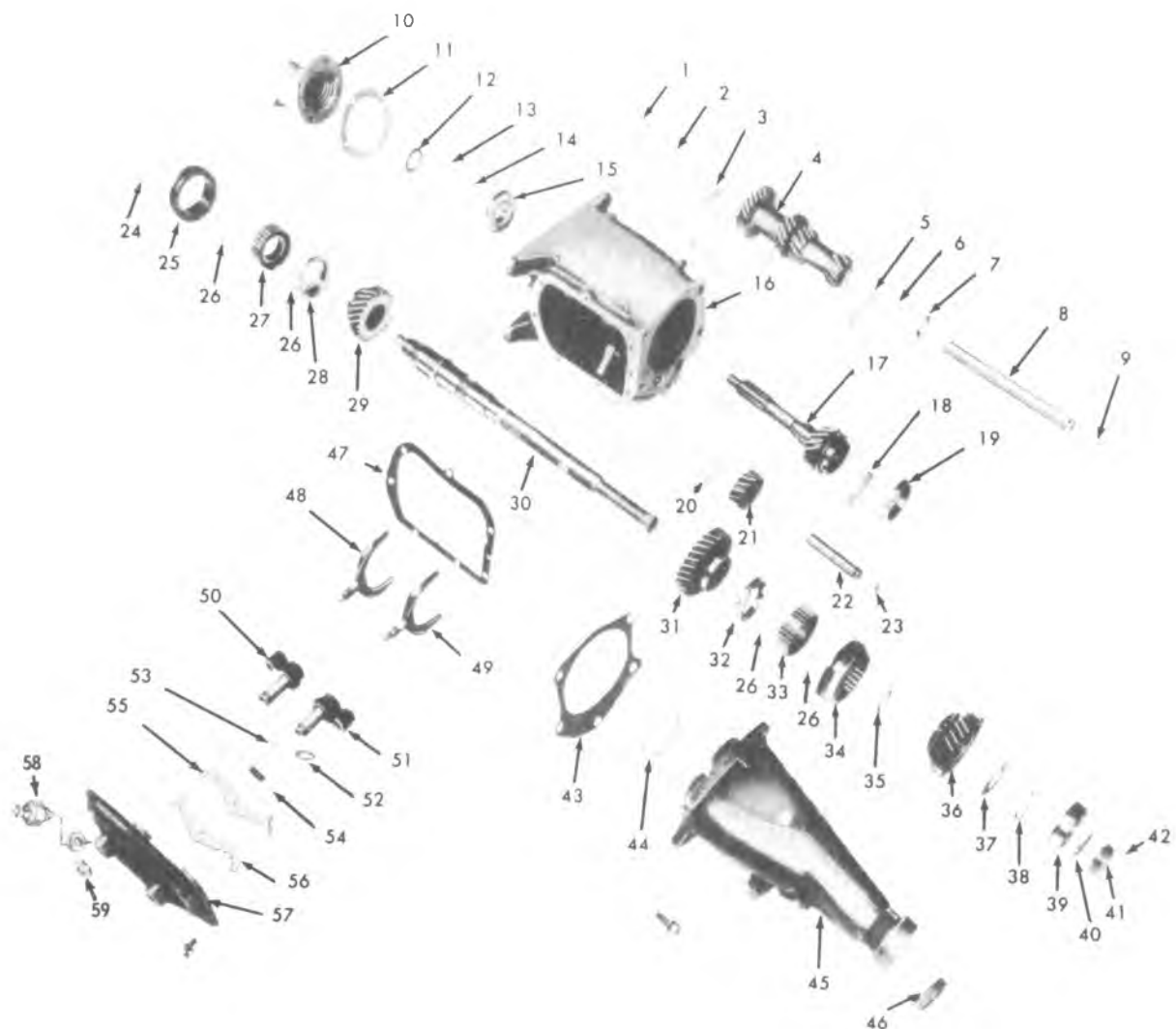


Fig. 7B1-3--3 Speed 76mm Cross Section



- | | | | |
|---------------------------------|-----------------------------------|---|--|
| 1. Thrust Washer - Front | 19. 3rd Speed Blocker Ring | 33. 1-2 Synchronizer Hub Assembly | 47. Gasket |
| 2. Bearing Washer | 20. "E" Ring | 34. 1-2 Synchronizer Sleeve | 48. 2-3 Shift Fork |
| 3. Needle Bearings | 21. Reverse Idler Gear | 35. Snap Ring - Hub to Shaft | 49. 1st and Reverse Shift Fork |
| 4. Countergear | 22. Reverse Idler Shaft | 36. Reverse Gear | 50. 2-3 Shifter Shaft Assembly |
| 5. Needle Bearings | 23. Woodruff Key | 37. Thrust Washer | 51. 1st and Reverse Shifter Shaft Assembly |
| 6. Bearing Washer | 24. Snap Ring - Hub to Shaft | 38. Spring Washer | 52. "O" Ring Seal |
| 7. Thrust Washer - Rear | 25. 2-3 Synchronizer Sleeve | 39. Rear Bearing | 53. "E" Ring |
| 8. Counter Shaft | 26. Synchronizer Key Spring | 40. Snap Ring - Bearing to Shaft | 54. Spring |
| 9. Woodruff Key | 27. 2-3 Synchronizer Hub Assembly | 41. Speedometer Drive Gear | 55. 2nd and 3rd Detent Cam |
| 10. Bearing Retainer | 28. 2nd Speed Blocker Ring | 42. Retaining Clip | 56. 1st and Reverse Detent Cam |
| 11. Gasket | 29. 2nd Speed Gear | 43. Gasket | 57. Side Cover |
| 12. Oil Seal | 30. Mainshaft | 44. Snap Ring - Rear Bearing to Extension | 58. TCS Switch and Gasket |
| 13. Snap Ring - Bearing to Case | 31. 1st Speed Gear | 45. Extension | 59. Lip Seal |
| 14. Snap Ring - Bearing to Gear | 32. 1st Speed Blocker Ring | 46. Oil Seal | |

Fig. 7B1-4--3-Speed 76mm Exploded View

UNIT REPAIR

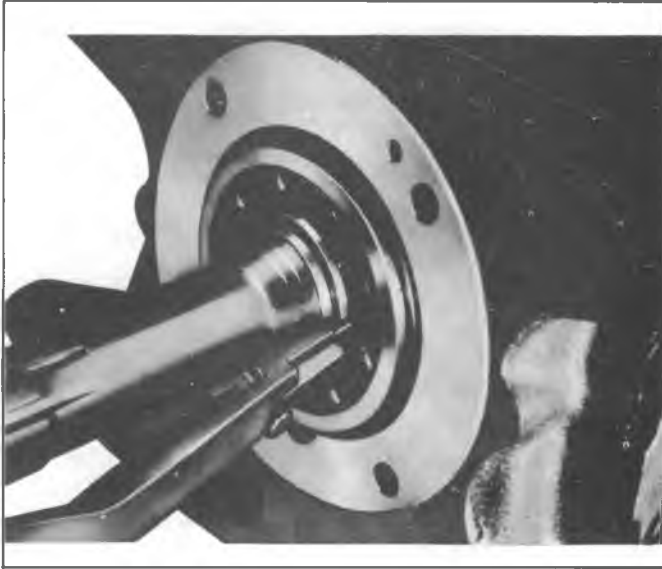


Fig. 7B-5--Clutch Gear Bearing Retaining Ring



Fig. 7B1-8--Counter Gear Shaft

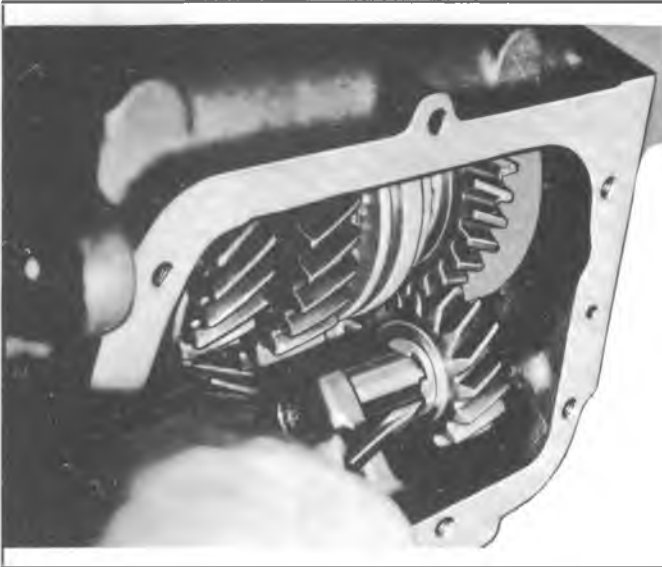


Fig. 7B1-6--Reverse Idler Shaft "E" Ring

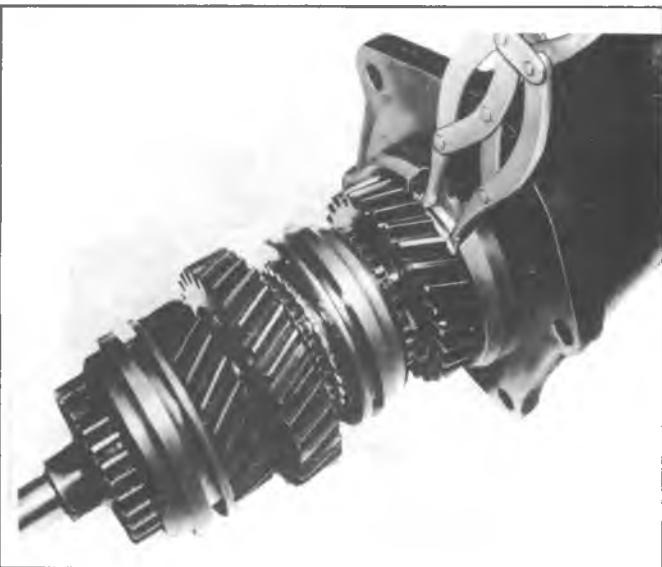


Fig. 7B1-7--Rear Extension From Main Shaft

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.

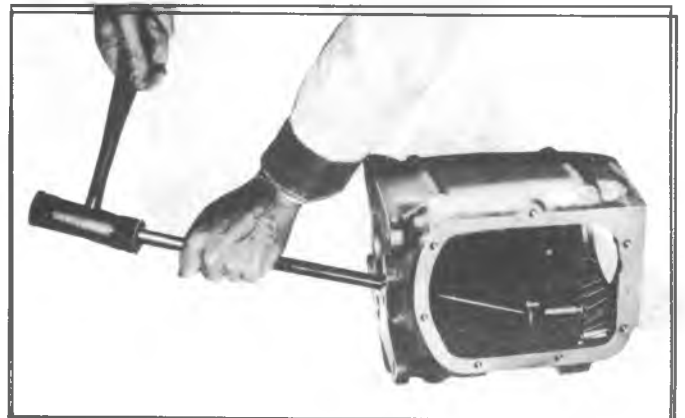


Fig. 7B1-9--Reverse Idler Shaft

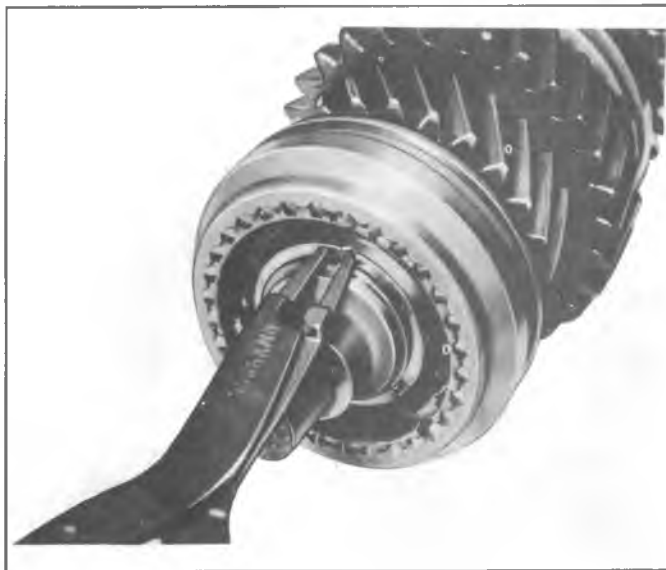


Fig. 7B1-10--2nd-3rd Clutch Hub Retaining Ring

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



Fig. 7B1-11--Rear Bearing Retaining Ring

second speed gear from front of mainshaft. See Fig. 7B1-10.

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.

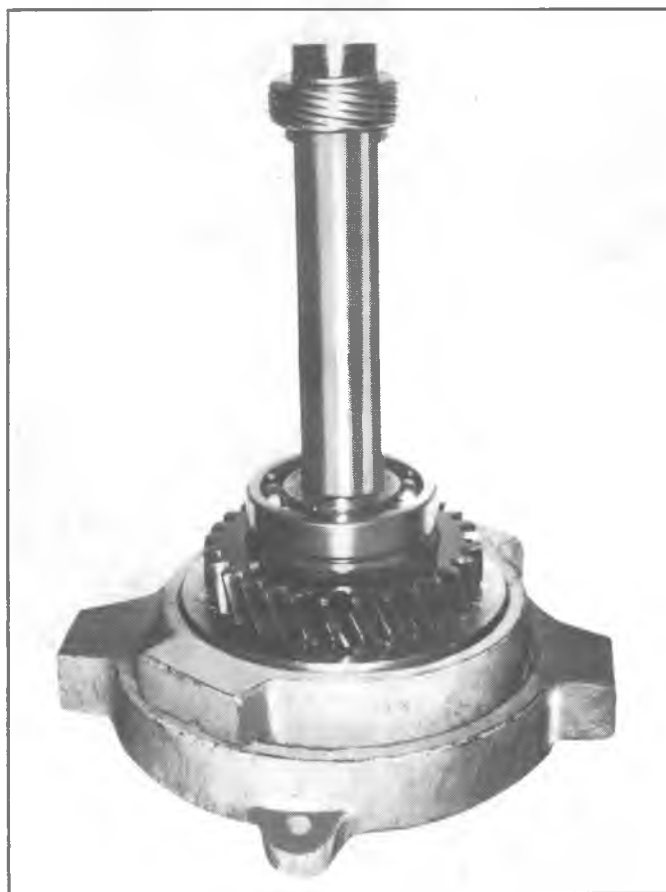


Fig. 7B1-12--Rear Bearing From Mainshaft

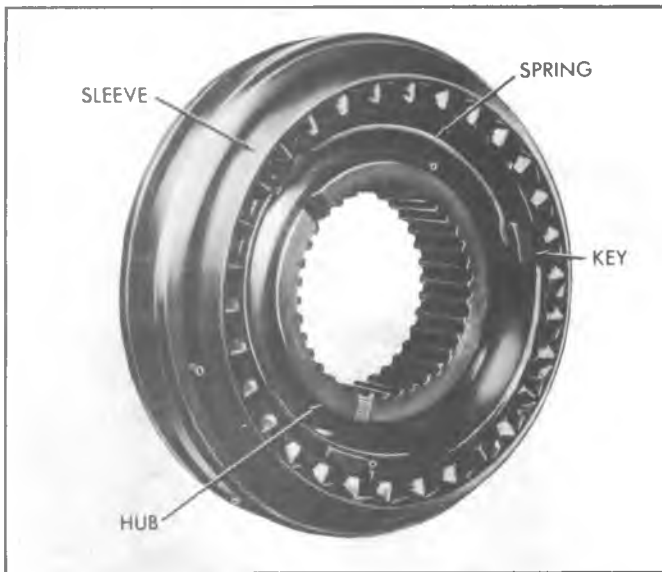


Fig. 7B1-13--Synchronizer Assembly

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 originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so that 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).

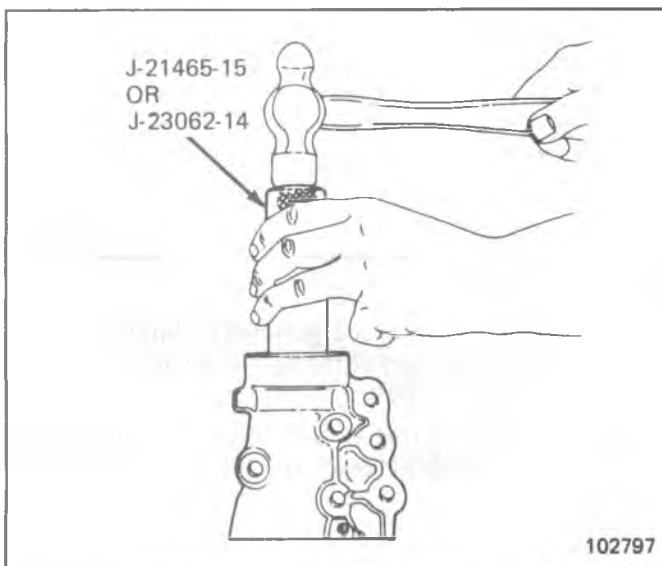


Fig. 7B1-14--Removing/Installing Rear Extension Bushing

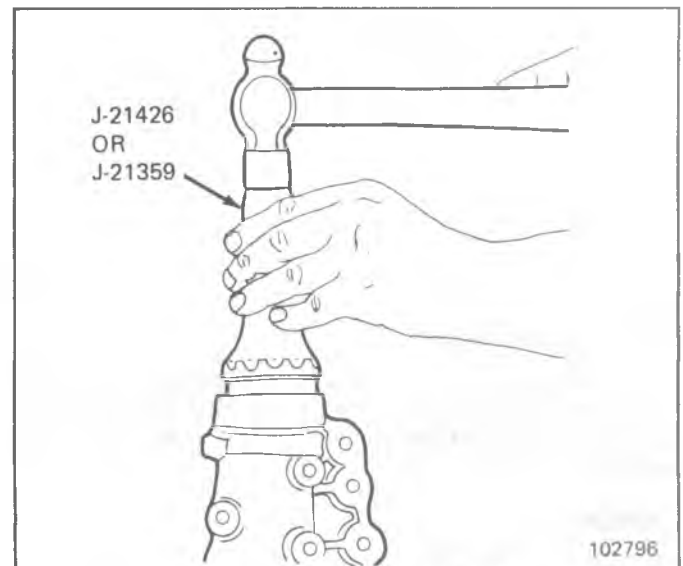


Fig. 7B1-15--Rear Extension Seal



Fig. 7B1-16--Drive Gear Bearing Retainer Seal

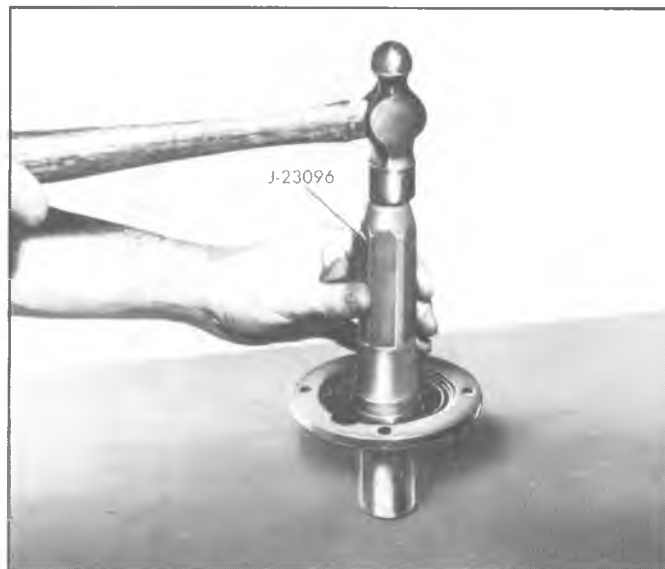


Fig. 7B1-17--Drive Gear Bearing Retainer Seal

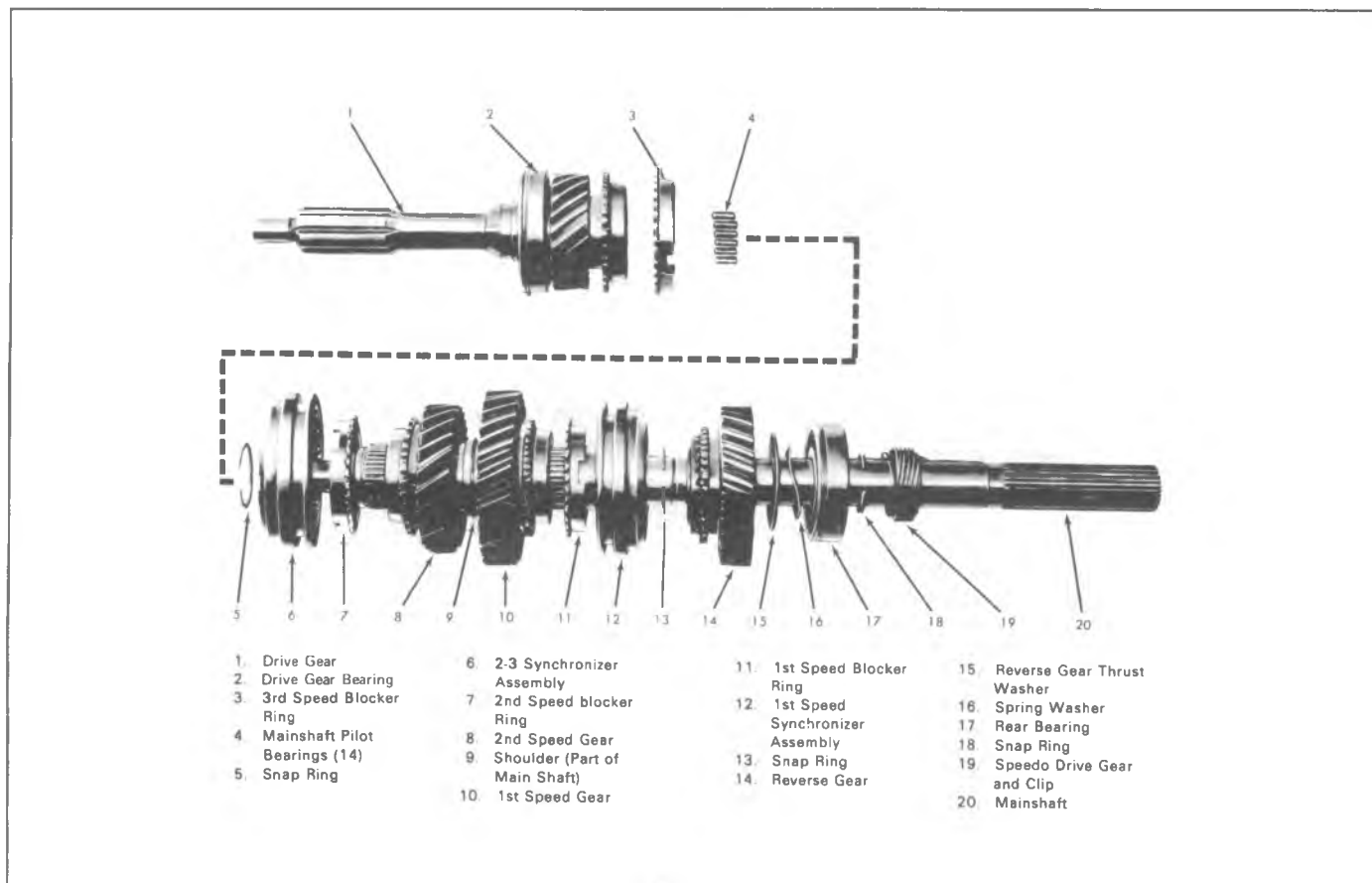


Fig. 7B1-18--Drive Gear And Mainshaft Assembly

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

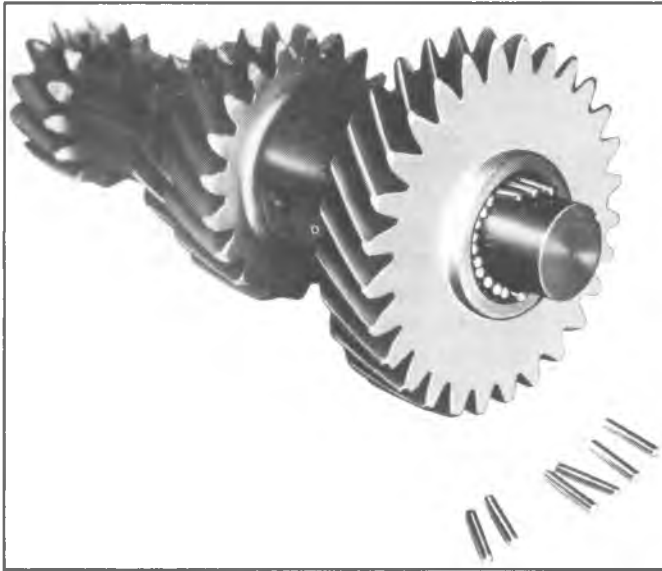


Fig. 7B1-19--Loading Countergear

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.
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.

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).

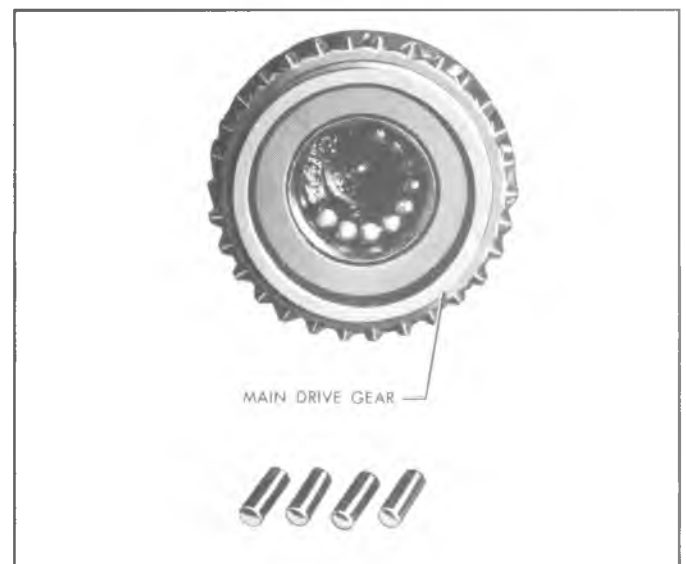


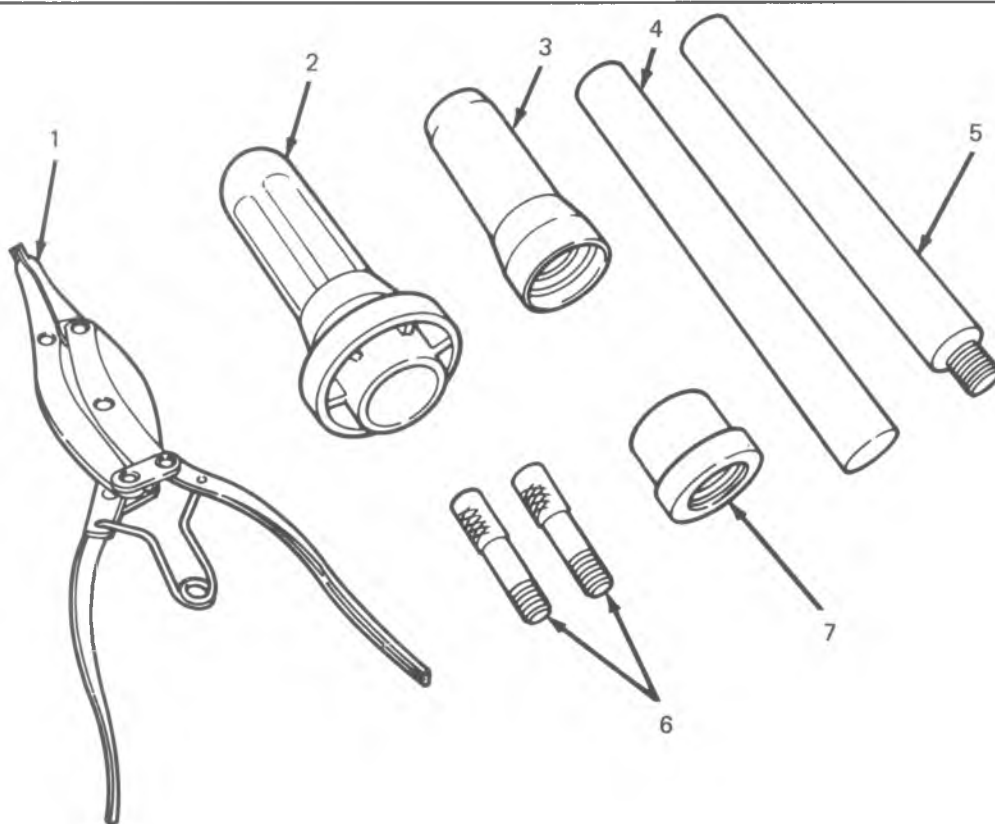
Fig. 7B1-20--Loading Pilot Bearings

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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3 SPEED 77MM TRANSMISSION

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ON VEHICLE SERVICE

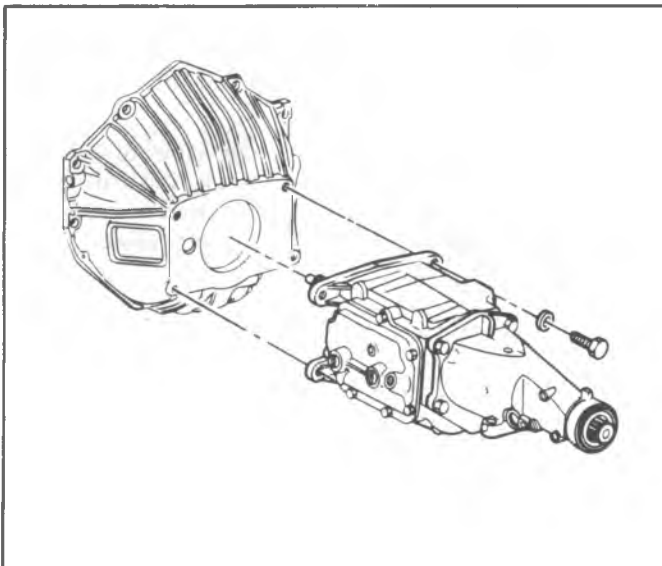


Fig. 7B2-1--Transmission To Engine Attachment

TRANSMISSION

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 edquipment, 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. 7B2-1.
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 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.
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 to 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.

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 oil seal using extension housing oil seal install 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.

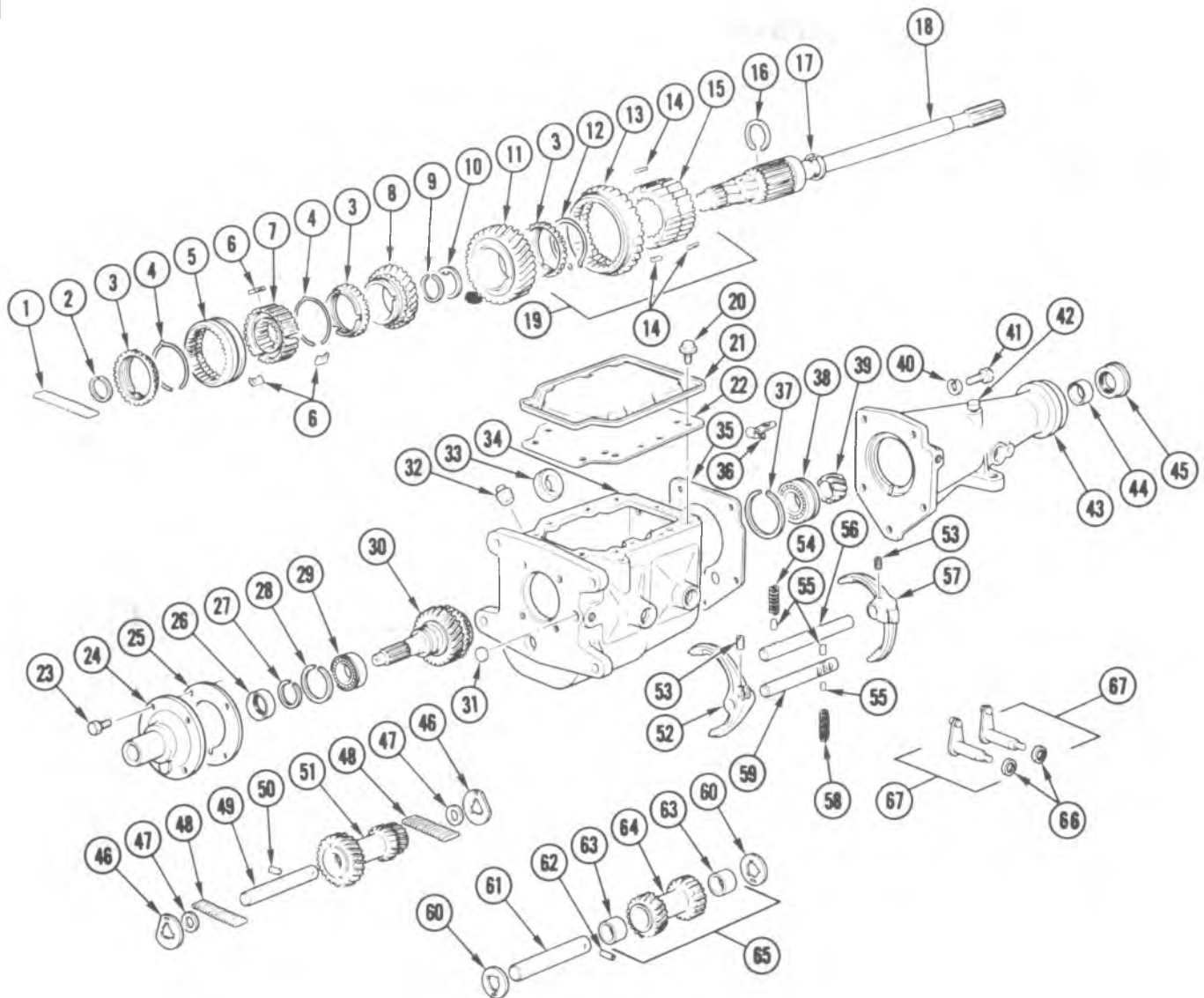
SPEEDOMETER DRIVEN GEAR

Removal

1. Raise vehicle.
2. Disconnect speedometer cable, then remove lock plate to housing bolt, washer and 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. Installation 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. Install speedometer cable.
3. Lower vehicle.



- | | |
|--|---|
| 1. MAINSHAFT ROLLER BEARINGS | 35. EXTENSION HOUSING TO CASE GASKET |
| 2. 2ND & 3RD SYNCHRONIZER RETAINING RING | 36. SPEEDOMETER DRIVER GEAR RETAINING CLIP |
| 3. SYNCHRONIZER BLOCKER RINGS | 37. TRANSMISSION REAR BEARING LOCK RING |
| 4. 2ND & 3RD SYNCHRONIZER SPRING | 38. MAINSHAFT BEARING ASSEMBLY |
| 5. 2ND & 3RD SYNCHRONIZER SLEEVE | 39. SPEEDOMETER DRIVE GEAR |
| 6. 2ND & 3RD SYNCHRONIZER KEYS | 40. EXTENSION TO CASE WASHER |
| 7. 2ND & 3RD SYNCHRONIZER HUB | 41. EXTENSION TO CASE BOLT |
| 8. SECOND SPEED GEAR | 42. TRANSMISSION EXTENSION VENTILATOR ASSEMBLY |
| 9. 1ST SPEED GEAR RETAINING RING | 43. EXTENSION HOUSING ASSEMBLY |
| 10. 1ST SPEED GEAR TABBED WASHER | 44. EXTENSION HOUSING BUSHING |
| 11. 1ST SPEED GEAR | 45. EXTENSION HOUSING OIL SEAL ASSEMBLY |
| 12. REVERSE SYNCHRONIZER SPRING | 46. COUNTERGEAR THRUST WASHER |
| 13. 1ST & REVERSE SYNCHRONIZER SLEEVE & GEAR | 47. COUNTERGEAR SPACER |
| 14. REVERSE SYNCHRONIZER KEYS | 48. COUNTERGEAR ROLLER BEARINGS |
| 15. 1ST & REVERSE SYNCHRONIZER HUB | 49. COUNTERGEAR SHAFT |
| 16. 1ST & REVERSE SYNCHRONIZER RETAINING RING | 50. COUNTERGEAR SPRING PIN |
| 17. REAR BEARING RETAINING RING | 51. COUNTERGEAR |
| 18. TRANSMISSION MAINSHAFT | 52. 2ND & 3RD SHIFTER FORK |
| 19. REVERSE SYNCHRONIZER ASSEMBLY | 53. SHIFTER FORK LOCKING SCREW |
| 20. ACCESS COVER BOLTS | 54. 1ST & 2ND SHIFTER INTERLOCK SPRING |
| 21. ACCESS COVER | 55. SHIFTER INTERLOCK PIN |
| 22. ACCESS COVER GASKET | 56. 1ST & REVERSE SHIFTER RAIL |
| 23. BEARING RETAINER - TO CASE BOLTS | 57. 1ST & REVERSE SHIFTER FORK |
| 24. BEARING RETAINER - CLUTCH GEAR | 58. 2ND & 3RD SHIFTER INTERLOCK SPRING |
| 25. GASKET - CLUTCH GEAR BEARING RETAINER | 59. 2ND & 3RD SHIFTER RAIL |
| 26. SEAL ASSEMBLY - CLUTCH GEAR BEARING RETAINER | 60. REVERSE IDLER GEAR THRUST WASHER |
| 27. CLUTCH GEAR BEARING RETAINING RING | 61. REVERSE IDLER GEAR SHAFT |
| 28. CLUTCH GEAR BEARING LOCK RING | 62. SPRING PIN IDLER GEAR SHAFT |
| 29. CLUTCH GEAR BEARING ASSEMBLY | 63. REVERSE IDLER GEAR BUSHING |
| 30. CLUTCH GEAR | 64. REVERSE IDLER GEAR |
| 31. EXPANSION PLUG | 65. REVERSE IDLER GEAR ASSEMBLY |
| 32. FILLER PLUG | 66. SEAL TRANSMISSION SHIFTER |
| 33. TRANSMISSION CASE MAGNET | 67. TRANSMISSION SHIFTER SHAFT & LEVER ASSEMBLY |
| 34. CASE | |

Fig. 7B2-2--Exploded View - 3 Speed 77mm Transmission

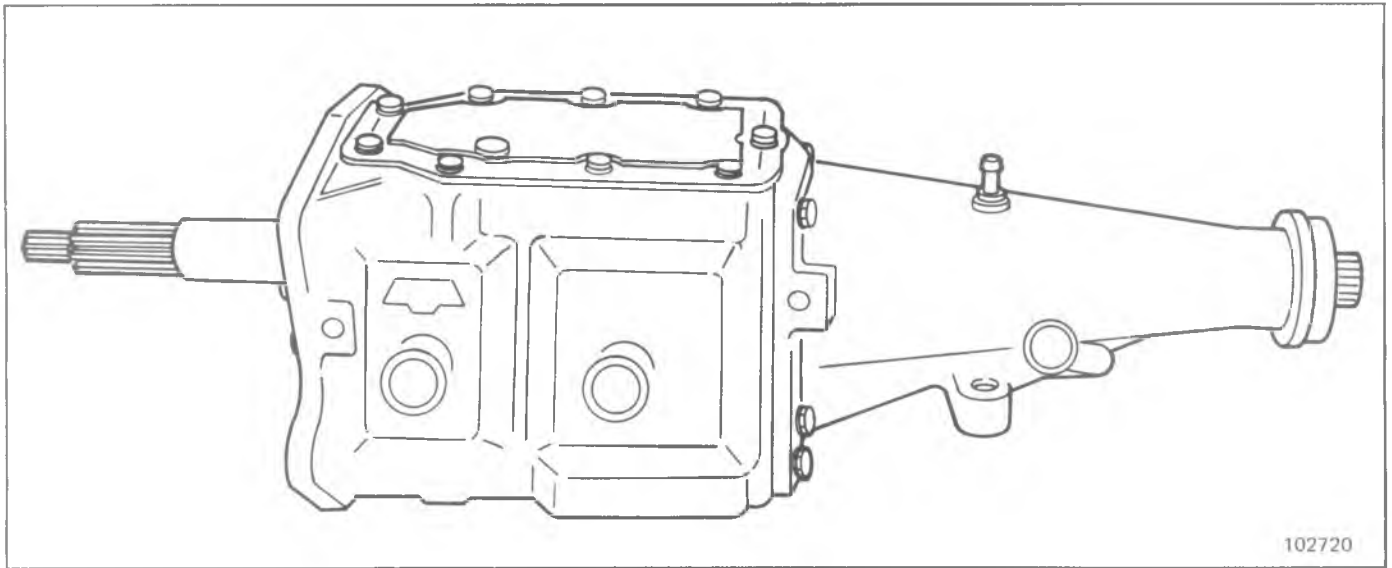


Fig. 7B2-3--3-Speed 77mm Transmission

UNIT REPAIR

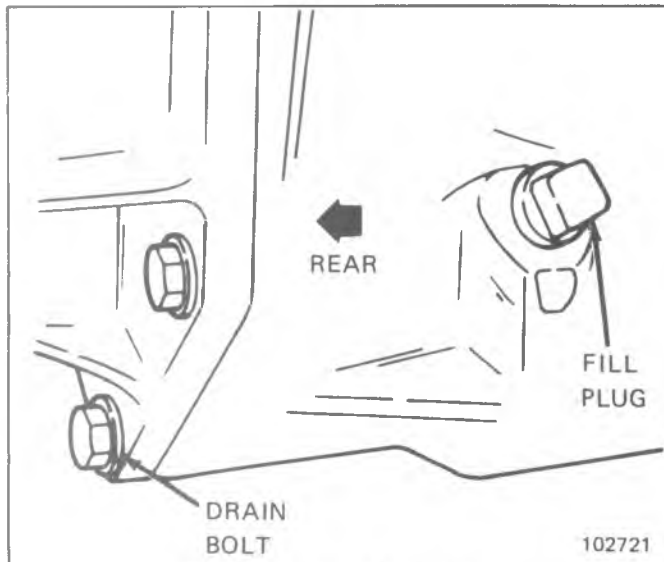


Fig. 7B2-4--Drain Transmission

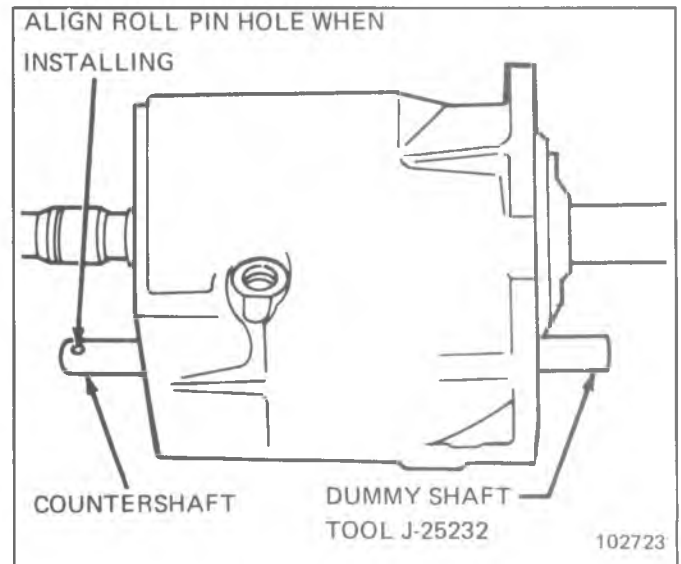


Fig. 7B2-6--Removing Countershaft

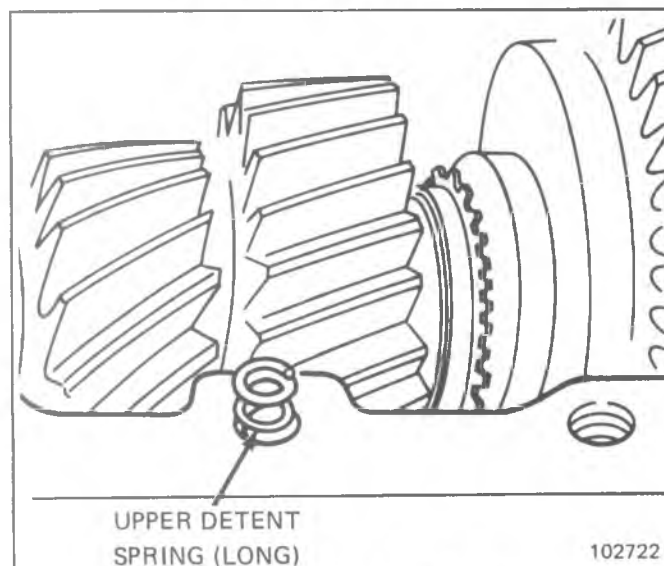


Fig. 7B2-5--Upper Detent Spring

TRANSMISSION

Disassembly

1. Remove lower extension housing bolt and drain transmission (Fig. 7B2-4).
2. Remove top cover and gasket from case.
3. Remove long spring that retains the detent plug in the case (Fig. 7B2-5). Remove the detent plug with a small magnet.
4. Remove extension housing and gasket.
5. Press down on speedometer gear retainer and remove speedometer drive gear retainer from output shaft.
6. Remove fill plug from right side of case (Fig. 7B2-4). Working through the plug opening drive out countergear roll pin with a 3/16 inch pin punch that has been chamfered slightly.

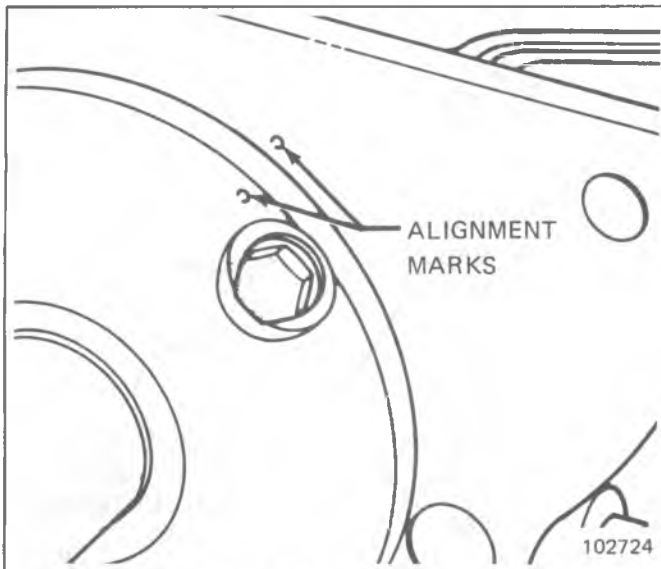


Fig. 7B2-7--Front Bearing Retainer

Do not attempt to retrieve pin at this time. Pin can easily be retrieved after output shaft assembly is removed.

7. Insert dummy shaft tool J-25232 into bore at front of case, tap lightly on tool to push countershaft out rear of case (Fig. 7B2-6). With countershaft removed, allow countergear to lie at bottom of case.
8. Punch alignment mark in front bearing retainer and transmission case to ensure correct assembly and remove front bearing retainer and gasket (Fig. 7B2-7).
9. Remove large locating snap ring from front bearing and smaller snap ring from clutch gear shaft.
10. Remove clutch shaft front bearing using tool J-6654-01 and tool J-8433-1 (Fig. 7B2-8).

It may be necessary to alternate the tightening of the bolts between tools J-6654-01 and J-8433-1 to remove the front bearing.

11. Remove large locating snap ring from rear bearing and smaller retaining snap ring from output shaft.

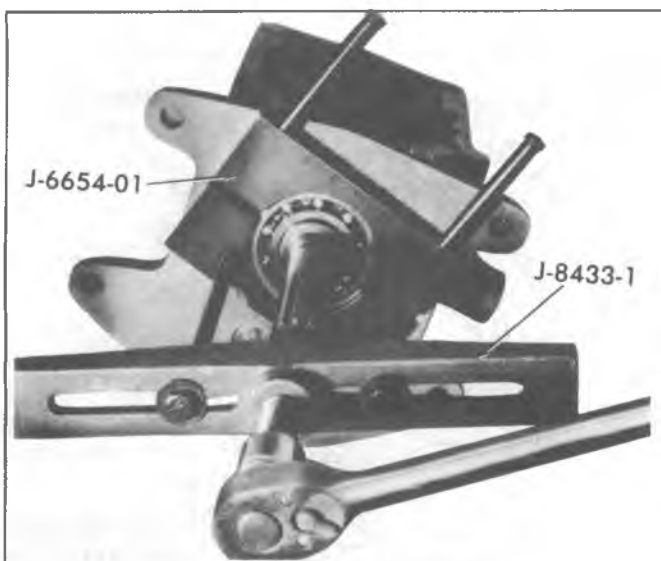


Fig. 7B2-8--Removing Front Bearing

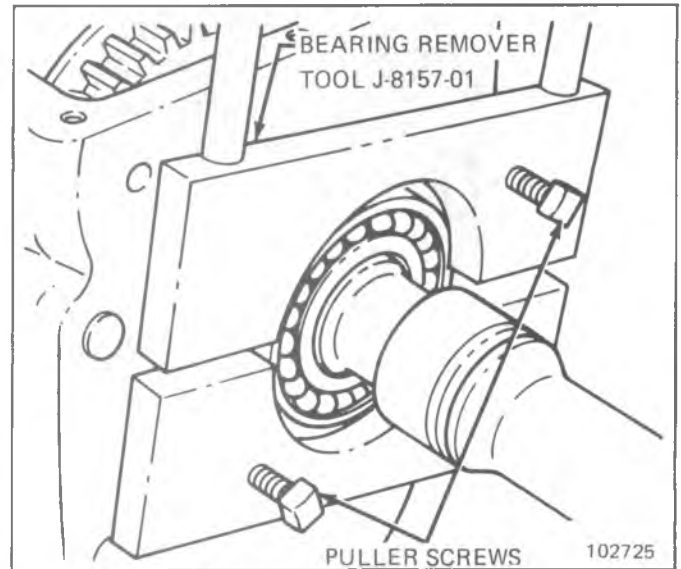


Fig. 7B2-9--Removing Rear Bearing

It may be necessary to place a screwdriver or a piece of bar stock between the case and the first-reverse sleeve and gear assembly. This will hold the output shaft assembly in place while removing the rear bearing.

12. Remove rear bearing from output shaft using tool J-8157-01 (Fig. 7B2-9).
13. Remove set screw from First-Reverse shifter fork and slide shift rail out rear of case.
14. Shift First-Reverse sleeve and gear all the way forward and rotate First-Reverse shifter fork upward and out of case. Remove First-Reverse Detent plug from case.
15. Shift Second-Third Shifter fork rearward to gain access to setscrew, remove setscrew, rotate shift rail 90° with pliers to clear bottom detent plug and remove interlock plug with magnet (Fig. 7B2-10.)
16. Using a long thin punch (1/4 inch diameter or less) insert through access hole in rear case to drive out shift rail and expansion plug located in shift rail bore at

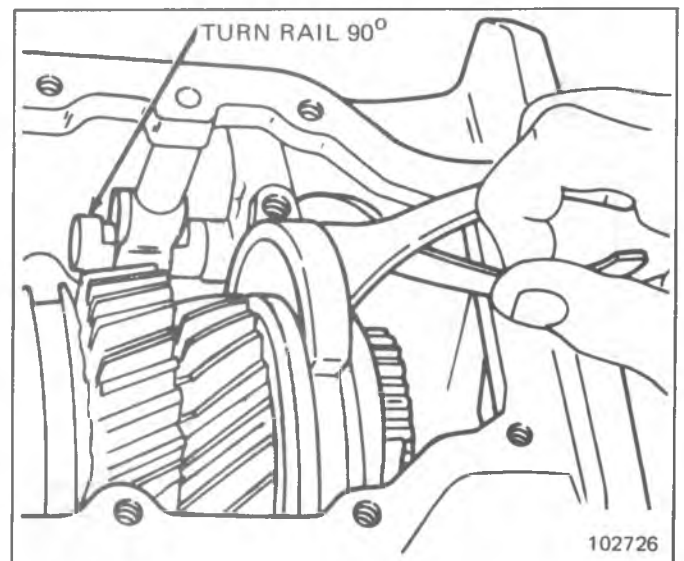


Fig. 7B2-10--Rotating Shift Rail

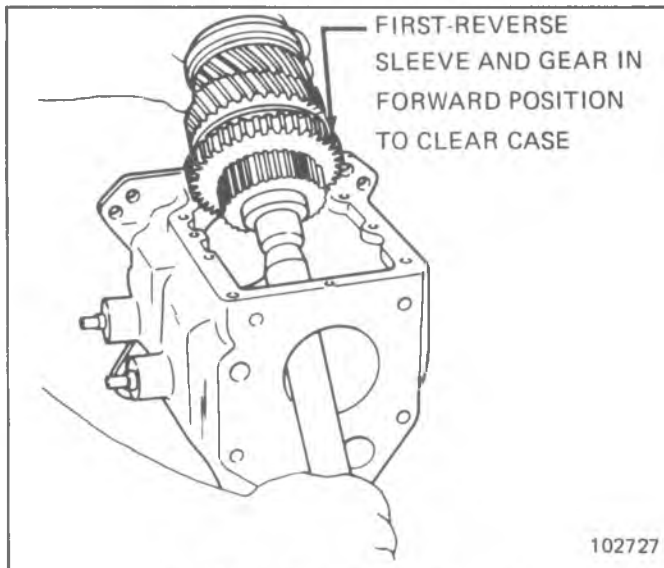


Fig. 7B2-11--Output Shaft Assembly

front of case.

17. Rotate second-third shifter fork upward and out of case.
18. Remove the bottom detent plug and short detent spring from case.
19. Separate clutch gear from output shaft and remove output shaft assembly (Fig. 7B2-11); tilt spline end of shaft downward and lift gear end upward and out of case.
First and reverse sleeve and gear must pass through notch at right rear end of case.
20. Remove clutch gear through top of case.
21. Remove both shifter fork shafts (Fig. 7B2-12).
22. Remove countergear (with tool in place), thrust washers and roll pin.
23. Remove reverse idler gear and thrust washers by tapping shaft with hammer until end of idler gear shaft (end with roll pin) clears counterbore in rear of case and remove shaft (Fig. 7B2-13).
24. From the bottom of the case retrieve, clutch shaft

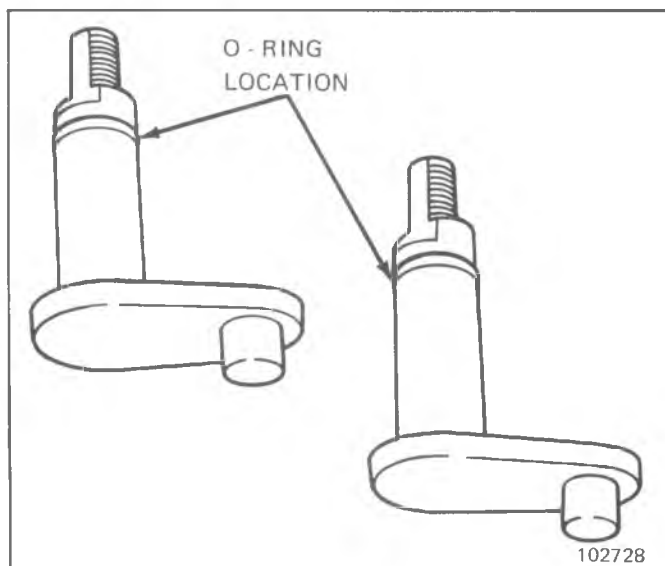


Fig. 7B2-12--Shift Fork Shafts

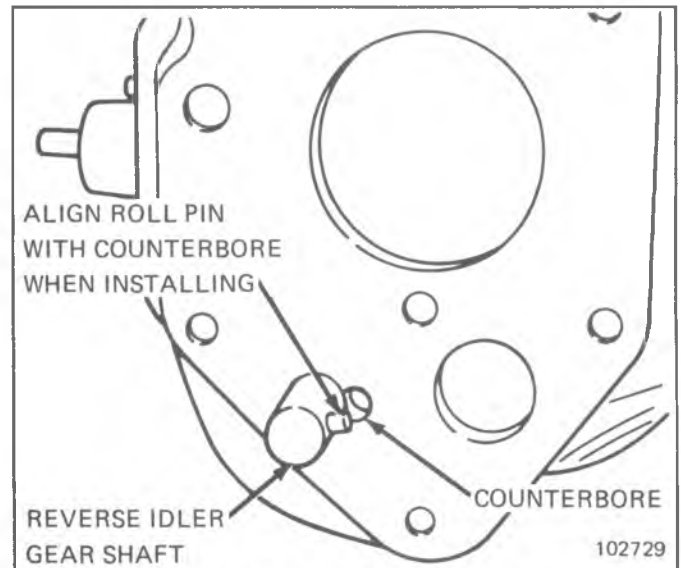


Fig. 7B2-13--Reverse Idler Gear Shaft

roller bearing or countergear needle bearing that may have fallen into case during disassembly.

MAINSHAFT

Disassembly

1. Remove snap ring from front of output shaft and remove Second-Third synchronizer assembly and second gear. Mark hub and sleeve for correct assembly.
2. Remove snap ring and tabbed thrust washer from shaft and remove first gear and blocking ring.
3. Remove First-Reverse hub retaining snap ring. Observe position of spring and keys before removal, also, mark hub and sleeve for correct assembly.
4. Remove sleeve and gear, spring and three keys from hub (Fig. 7B2-14).
5. Using an arbor press, remove hub from output shaft.

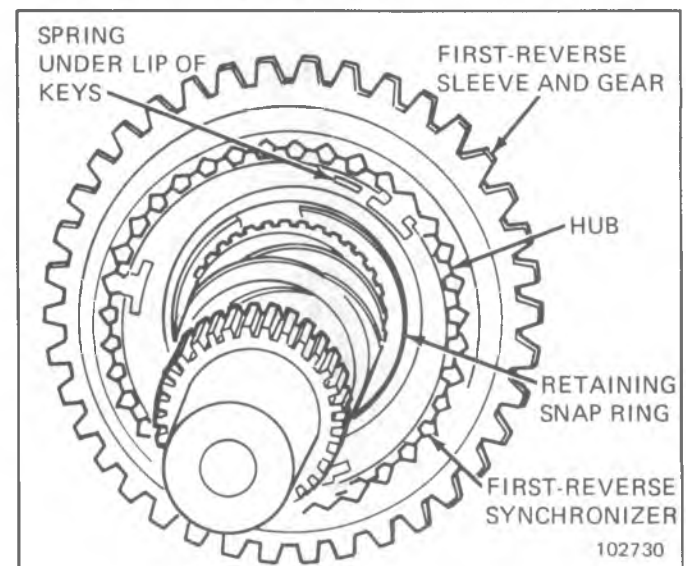


Fig. 7B2-14--First Reverse Synchronizer Hub

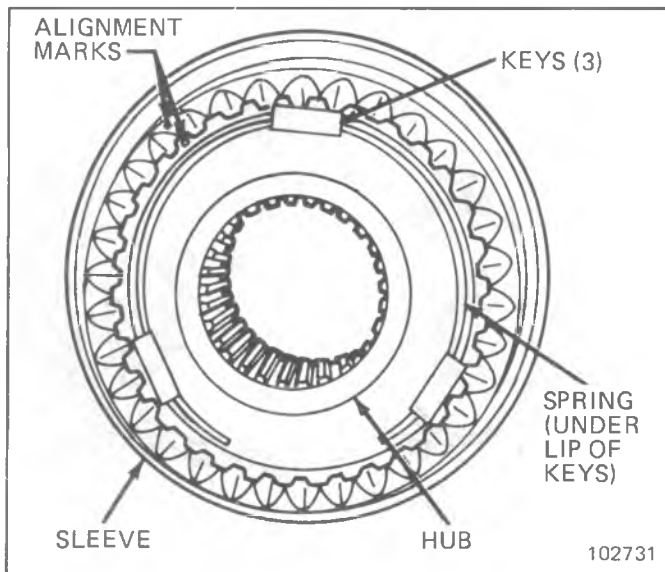


Fig. 7B2-15--Second-Third Synchronizer Assembly

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.

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.

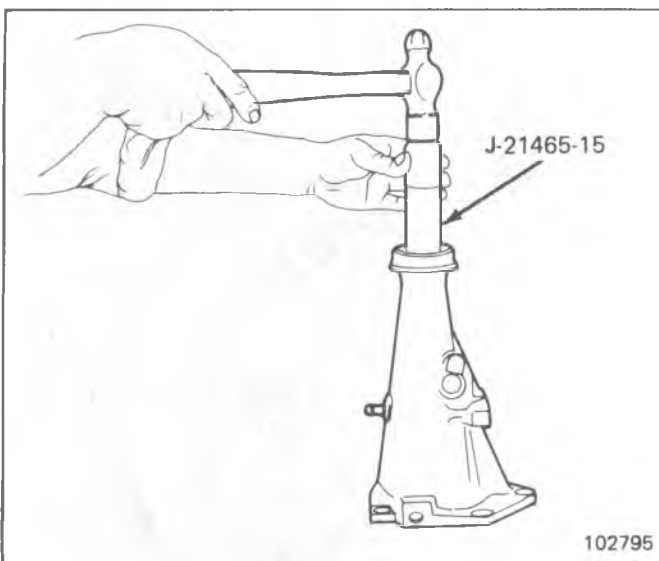


Fig. 7B2-16--Extension Housing Bushing

Bearing Rollers

All clutch 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 washers.

Gears

1. Inspect all gears for excessive wear, chips, or cracks and replace any that are worn or damaged.
2. Check both clutch sleeves to see that they slide freely on their hubs.

REPAIRS

Synchronizer Keys and Spring

Replacement

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Install one spring into second-third hub. Be sure spring covers all three key slots in hub. Align second-third sleeve to hub using marks made during disassembly, and start sleeve onto hub.
4. Place the three keys into hub slots and on top of spring, then push sleeve fully onto hub to engage keys in sleeve (Fig. 7B2-15).
5. Install remaining spring in exact same position as first spring. Ends of both spring must cover same slots in hub and not be staggered. Keys have small lip on each end. When correctly installed, this lip will fit over spring (Fig. 7B2-15).

Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J-21465-15 to drive bushing into extension housing (Fig. 6B2-16). 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-21359 (Fig. 7B2-17).

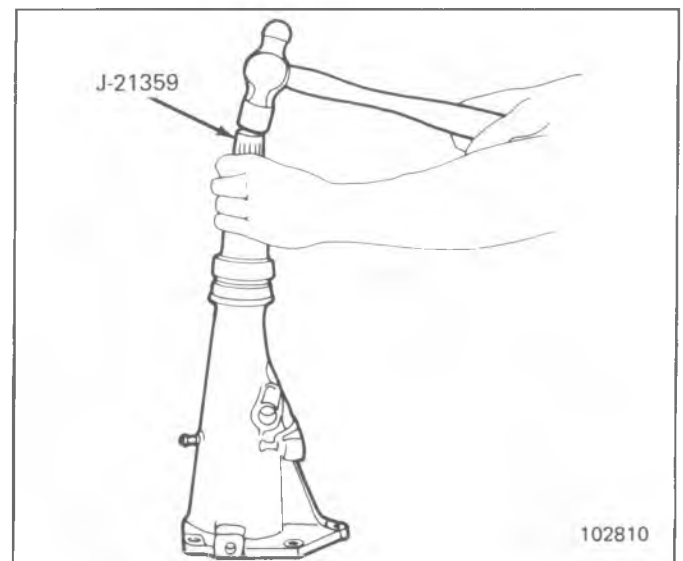


Fig. 7B2-17--Extension Housing Seal

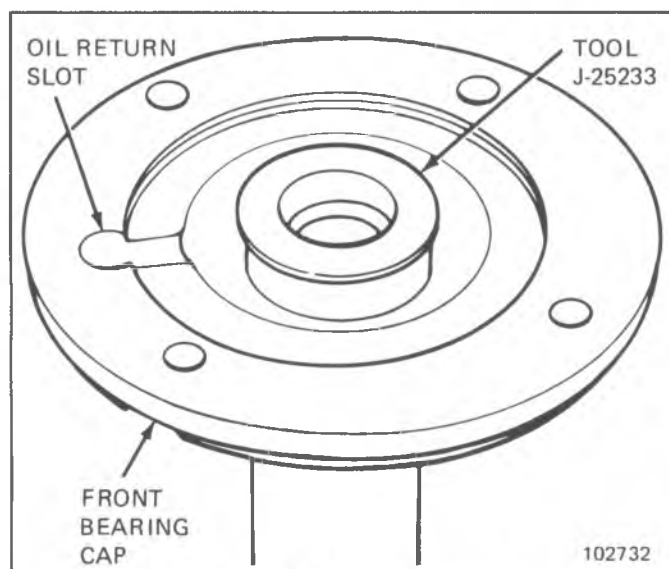


Fig. 7B2-18--Clutch Bearing Retainer Seal

Clutch Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement, pry the old seal out and replace with a new seal using Installer Tool J-25233, or similar tool, until seal seats in its bore (Fig. 7B2-18).

MAINSHAFT

Assembly

1. Install First-Reverse synchronizer hub on output shaft splines by hand. Slotted end of hub should face front of shaft. Use an arbor press to complete hub installation on shaft and install retaining snap ring (in most rearward groove).

NOTICE: DO NOT attempt to drive hub onto shaft with hammer. Hammer blows could damage hub and splines.

2. Install First-Reverse sleeve and gear half-way onto hub with gear end of sleeve facing rear of shaft. Index sleeve to hub with marks made during disassembly.

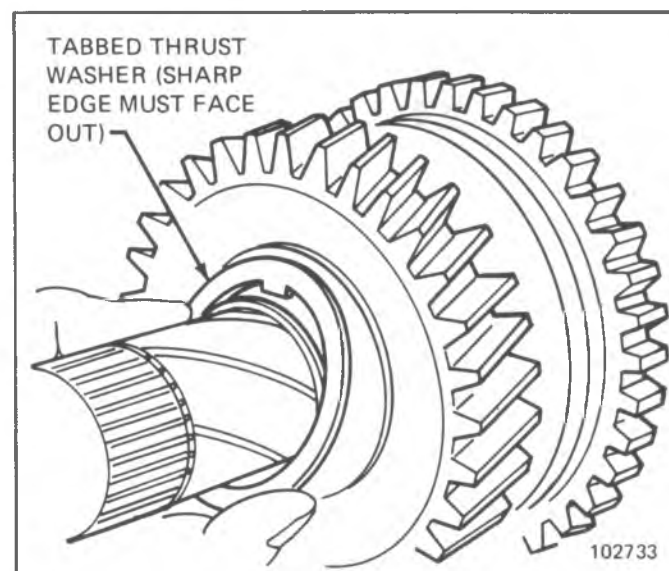


Fig. 7B2-19--Tabbed Thrust Washer

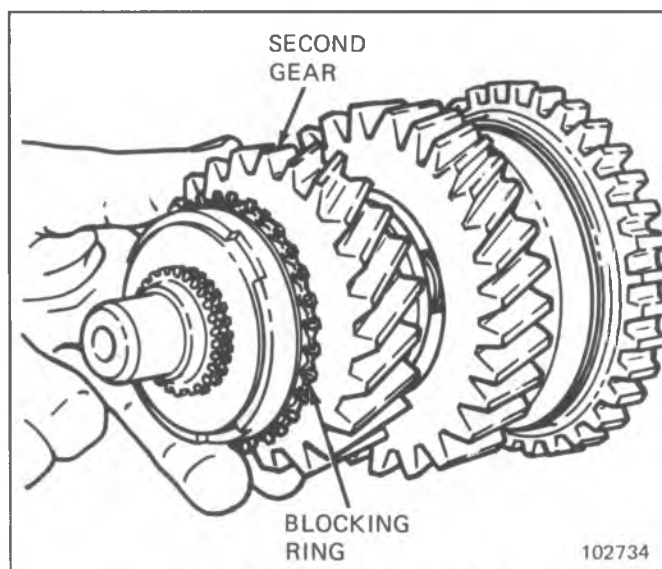


Fig. 7B2-20--Installing Second Gear

3. Install spring in First-Reverse hub. (Make sure spring is bottomed in hub and covers all three key slots.) Position three synchronizer keys in hub, with small ends in hub slots and large ends inside hub. Push keys fully into hub so they seat on spring. Then slide First-Reverse sleeve and gear over keys until the keys engage in the synchronizer sleeve (Fig. 7B2-14).
4. Place first gear blocking ring on tapered surface of gear. Install First gear on output shaft. Rotate gear until notches in blocking ring engages keys in First-Reverse hub.
5. Install tabbed thrust washer (sharp edge facing out) and retaining snap ring on output shaft (Fig. 7B2-19).
6. Place second gear blocking ring on tapered surface of gear and install second gear on output shaft with tapered surface of gear facing front of output shaft (Fig. 7B2-20).
7. Install Second-Third synchronizer assembly with

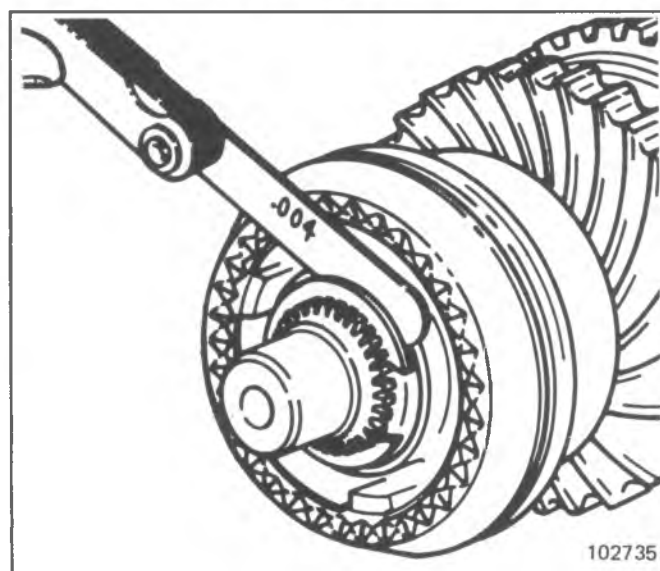


Fig. 7B2-21--Measuring Output Shaft End Play

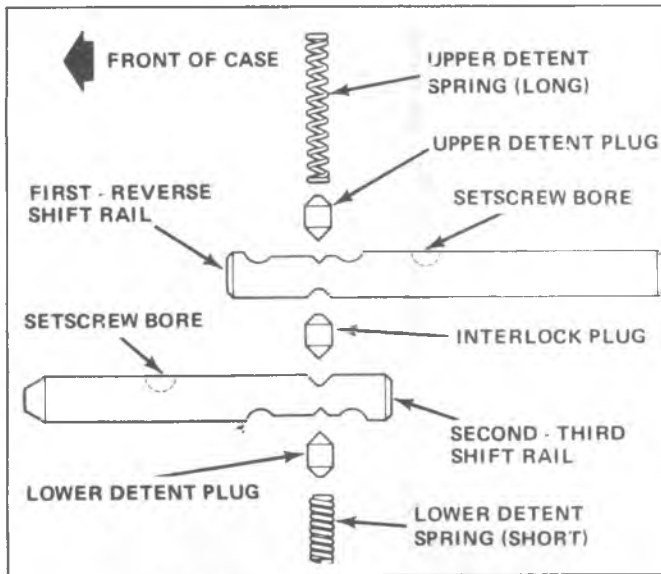


Fig. 7B2-22--Installation Sequence

flat portion of synchronizer hub facing rearward on output shaft. Rotate Second gear until notches in blocking ring engages keys in Second-Third synchronizer assembly. It may be necessary to tap synchronizer with a plastic hammer to ease assembly.

8. Install retaining snap ring on output shaft and measure end play between snap ring and Second-Third synchronizer hub with feeler gage (Fig. 7B2-20). End play should be (.10 to .04mm). If end play exceeds 0.014 inch, replace thrust washer and all snap rings on output shaft assembly.

TRANSMISSION

Assembly

1. Coat transmission case reverse idler gear thrust washer surfaces with vaseline (or equivalent) and position thrust washer in case. Be sure to engage locating tabs on thrust washers in locating slots in case.
2. Install reverse idler gear with helical cut gear towards front of case. Align gear bore, thrust washers, case bores, and install reverse idler gear shaft from rear of case. Be sure to align and seat roll pin in shaft into counterbore in rear of case.
3. Measure reverse idler gear end play by inserting feeler gage between thrust washer and gear. End play should be (.10 to .46mm). If end play exceeds .46mm (0.018 in.), remove idler gear and replace thrust washer.
4. Install shaft J-25232 in bore of countergear and load a row of needle bearing (25) in each end of gear. Use heavy grease or equivalent to hold them in place. Install one needle bearing retainer on each end of gear.
5. Position countergear thrust washer in case, used vaseline or equivalent to hold washers in place. Be sure to engage locating tabs on thrust washer in locating slots in case.
6. Insert countershaft into bore at rear of case just far enough to hold rear thrust washer from being displaced when the countergear is installed.
7. Align bore in countergear with countershaft and front thrust washer, then start countershaft into countergear. Before countershaft is completely installed, make sure that roll pin in countershaft is aligned with hole in case. When holes are aligned, tap countershaft into place, remove tool J-25232 (Fig. 7B2-6).
8. Measure countershaft end play by inserting feeler gage between thrust washer and countergear. End play should be .10 to .46mm. If end play exceeds .46mm (0.018 in.), remove gear and replace thrust washers.
9. After correct end play has been obtained, install roll pin in case.
10. Lower shorter detent spring in detent bore in case (7B2-22). Allow spring to drop into place at bottom of Second-Third shift rail bore. Insert lower detent plug in detent bore on top of spring.
11. Install shifter fork shafts in their case bores with the pivot lug facing up. Shifter fork shafts are interchangeable.
12. Install (15) roller bearings in clutch shaft bore. Use vaseline (or equivalent) to hold bearings in place.

NOTICE: Do not use chassis grease or a similar "heavy" grease in clutch shaft bore. Heavy grease could plug the lubricant holes in the shaft and prevent proper lubrication of the roller bearing.

13. Install blocking ring on clutch gear and place clutch gear through top of case and position in front case bore.
14. Install output shaft assembly in case. Be sure First-Reverse sleeve and gear is in Neutral (centered) position on hub so gear end of sleeve will clear notch in top of case when output shaft assembly is installed.
15. Assemble the clutch gear to the output shaft.
16. Move Second-Third sleeve rearward to Second gear position and position Second-Third shifter fork in groove of sleeve. Be sure setscrew hole in shifter fork is facing up. Second-Third fork is the smaller of the two shifter forks.

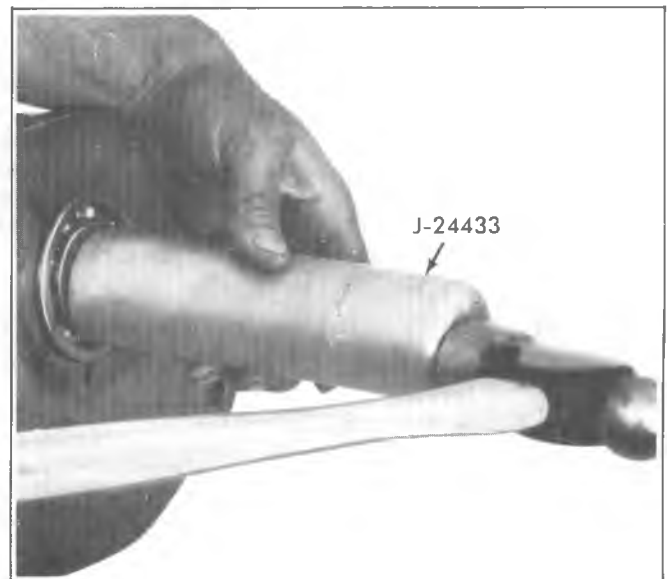


Fig. 7B2-23--Installing Front Bearing

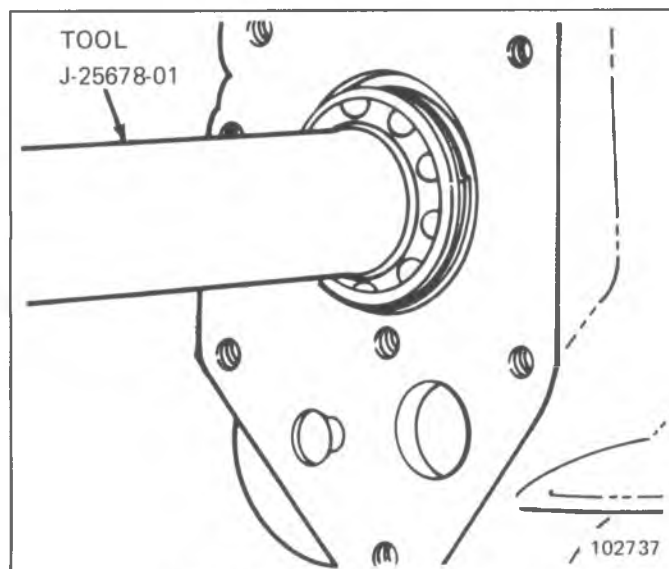


Fig. 7B2-24--Installing Rear Bearing

17. Engage Second-Third shifter fork in shifter fork shaft and insert Second-Third shift rail through front case bore and into shifter fork. Tapered end of rail faces front of case.
18. Turn shift rail until detent notches in rail face bottom of case. Insert a phillips screwdriver in detent bore to depress lower detent plug and push shift rail into rear bore. Move rail inward until detent plug engages forward notch in shift rail (second gear position).
19. Secure fork to rail with setscrew and move second-third synchronizer to Neutral (centered) position.
20. Install interlock plug in detent bore. With Second-Third synchronizer in Neutral position, top of plug will be slightly below surface of First-Reverse shift rail bore.
21. Move first reverse synchronizer forward to first gear position. Place First-Reverse shifter fork in groove of sleeve. Be sure setscrew hole in fork is facing up. Rotate fork into position in case, engage fork in shifter fork shaft, and insert First-Reverse shift rail through rear case bore and shifter fork.
22. Turn shift rail until detent notches in rail face upward. Move rail inward until setscrew hole in fork and setscrew bore in shift rail are aligned. Secure fork to rail with setscrew and place First-Reverse sleeve and gear into Neutral (centered) position (Fig. 7B2-21).
23. Install large snap ring on front bearing.
24. Install front bearing on clutch gear shaft by hand, drive bearing on clutch gear shaft using tool J-24433 (Fig. 7B2-23).
25. Install smaller snap ring on clutch gear shaft.



Fig. 7B2-25--Installing Speedometer Retainer and Gear

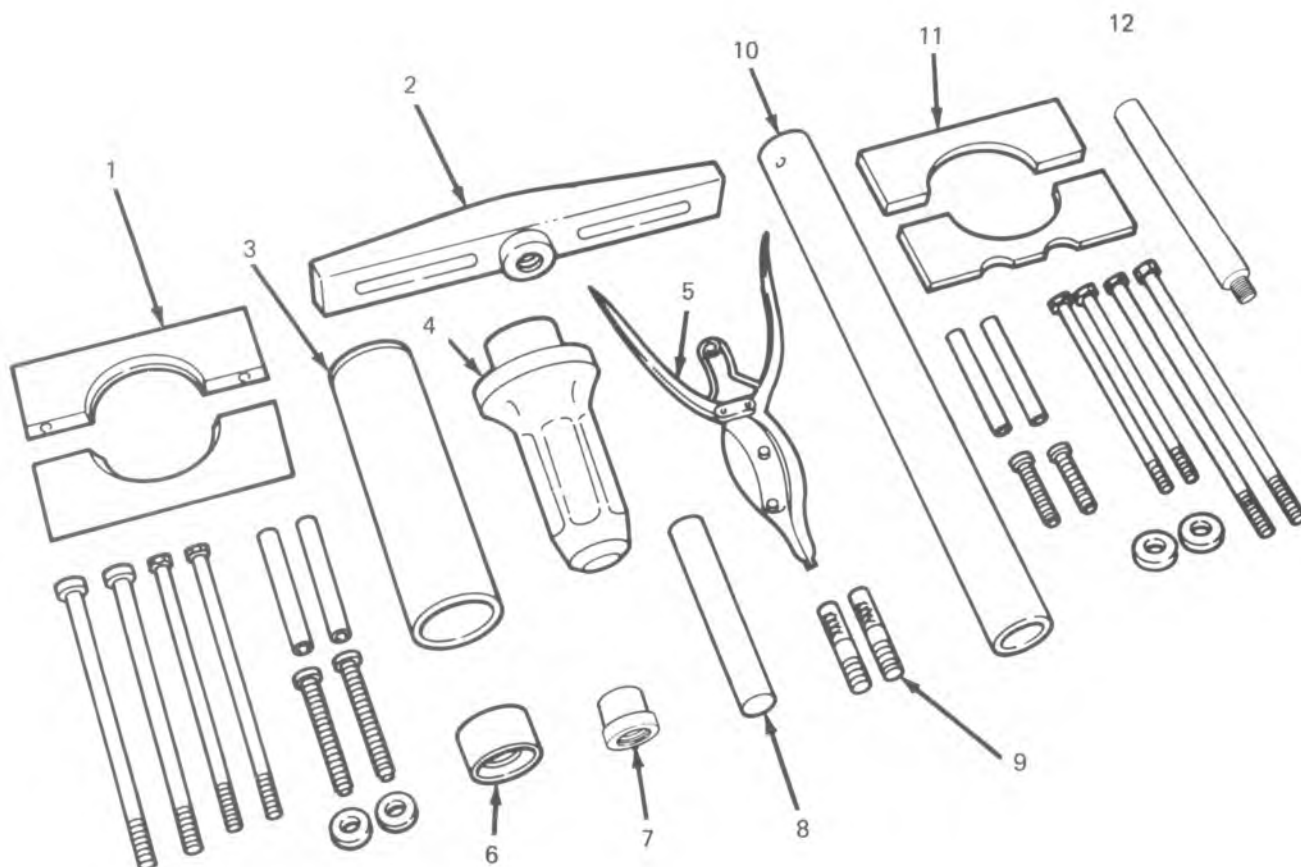
26. Position bearing retainer gasket on case. Be sure cut-out in gasket is aligned with oil return hole in case.
27. Install front bearing retainer and tighten attaching bolts to 40-48 N·m (30 to 36 ft. lbs.) of torque. Be sure to index cap to case with alignment marks, and that oil return slot in cap is aligned with oil return hole in case.
28. Install large snap ring on rear bearing.
29. Install rear bearing on output shaft by hand. Drive bearing onto shaft and into case with tool J-25678-01, make sure snap ring groove is facing rear of shaft (Fig. 7B2-24).
30. Install smaller snap ring on output shaft to hold rear bearing in place.
31. Engage speedometer gear retainer in hole provided in output shaft, with retainer loop forward, slide speedometer gear over output shaft and into position (Fig. 7B2-25).
32. Position extension housing gasket on case and install extension housing to case. Tighten bolts to 57-68 N·m (42-50 ft. lbs.) torque.
33. Install expansion plug in Second-Third shift rail bore in front of case. Be sure plug is fully seated in bore and is approximately 1.6mm (1/16 inch) below front face of case.
34. Install upper detent plug in detent bore, then install long detent spring on top of plug. Install transmission fill plug and tighten 14-27 N·m (10-20 ft. lbs.).
35. Install top cover and gasket on case and secure with attaching bolts. Tighten bolts 27-34 N·m (20-25 ft. lbs.).

SPECIFICATIONS

Drive Gear Retainer to Case Bolts	47 N·m	35 ft. lb.
Cover to Case Bolts	40 N·m	30 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	20 N·m	15 ft. lb.
Transmission to Clutch Housing Bolts	101 N·m	75 ft. lb.
Crossmember to Frame Nuts	85 N·m	65 ft. lb.
Crossmember to Mount Bolts	60 N·m	45 ft. lb.
2-3 Cross Over Shaft Bracket Retaining Nut	24 N·m	18 ft. lb.
1-Rev. Swivel Attaching Bolt	27 N·m	20 ft. lb.
Mount to Transmission Bolt	50 N·m	35 ft. lb.

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SPECIAL TOOLS



1. J-8157-01 Rear Bearing Remover
2. J-8433-1 Bearing Puller
3. J-24433 Front Bearing Installer
4. J-21359 Rear Extension Seal Installer
5. J-8059 Snap Ring Pliers
6. J-25233 Drive Gear Brg. Retainer Seal Installer
7. J-21465-15 Extension Bushing Remover and Installer
8. J-25232 Countershaft Loading Tool
9. J-1126 Transmission Guide Pins
10. J-25678-01 Rear Bearing Installer
11. J-6654-01 Front Bearing Remover
12. J-8092 Driver Handle

4-SPEED 89MM TRANSMISSION

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ON VEHICLE SERVICE

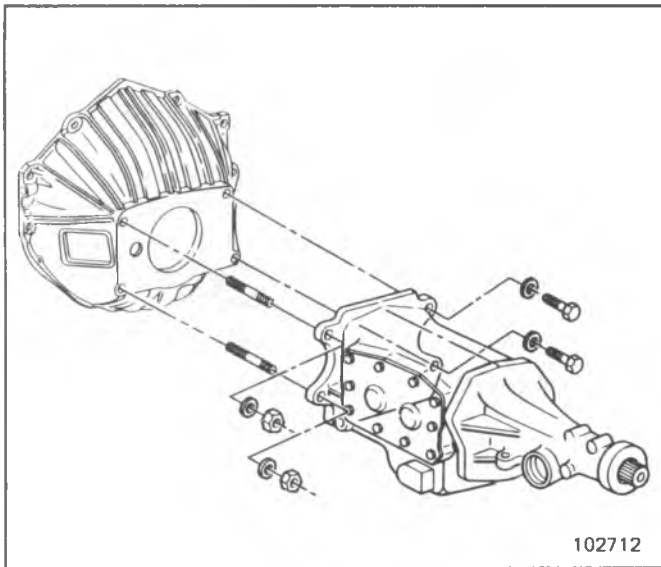


Fig. 7B3-1—Transmission To Engine Attachment

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 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. 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

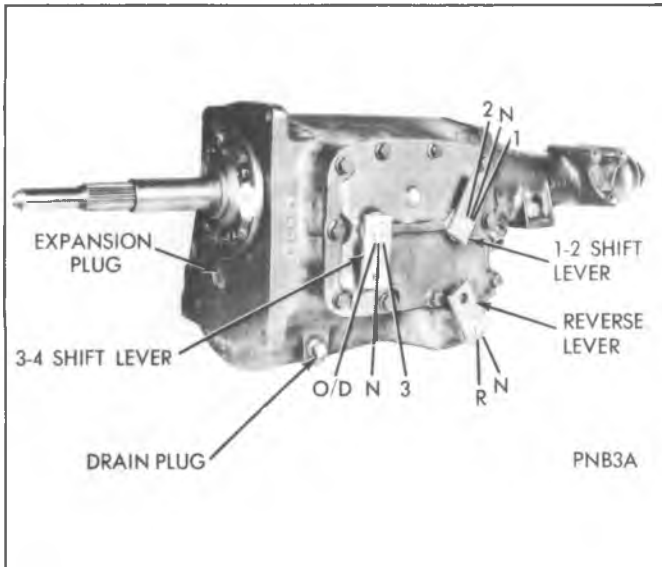


Fig. 7B3-2--Transmission Side Cover Assembly

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

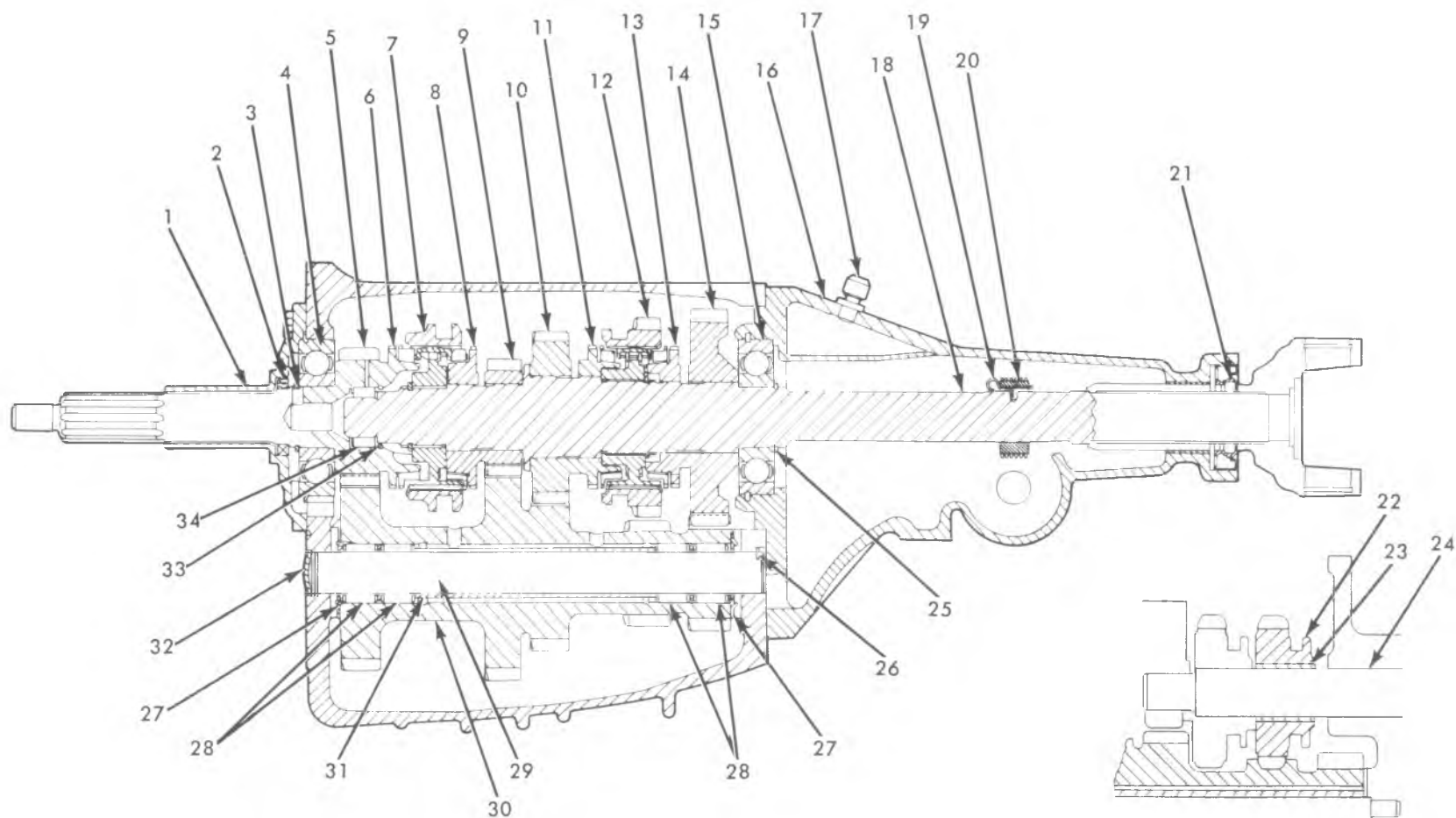
1. Raise vehicle.
2. Disconnect control rods from levers and shift the transmission levers into neutral position.
3. Remove reverse shift lever, side cover bolts, side cover and shift forks. Remove cover assembly from

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 filler plug.
9. Lower vehicle.



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. 7B3-3-4-Speed, 89mm, Cross-Section

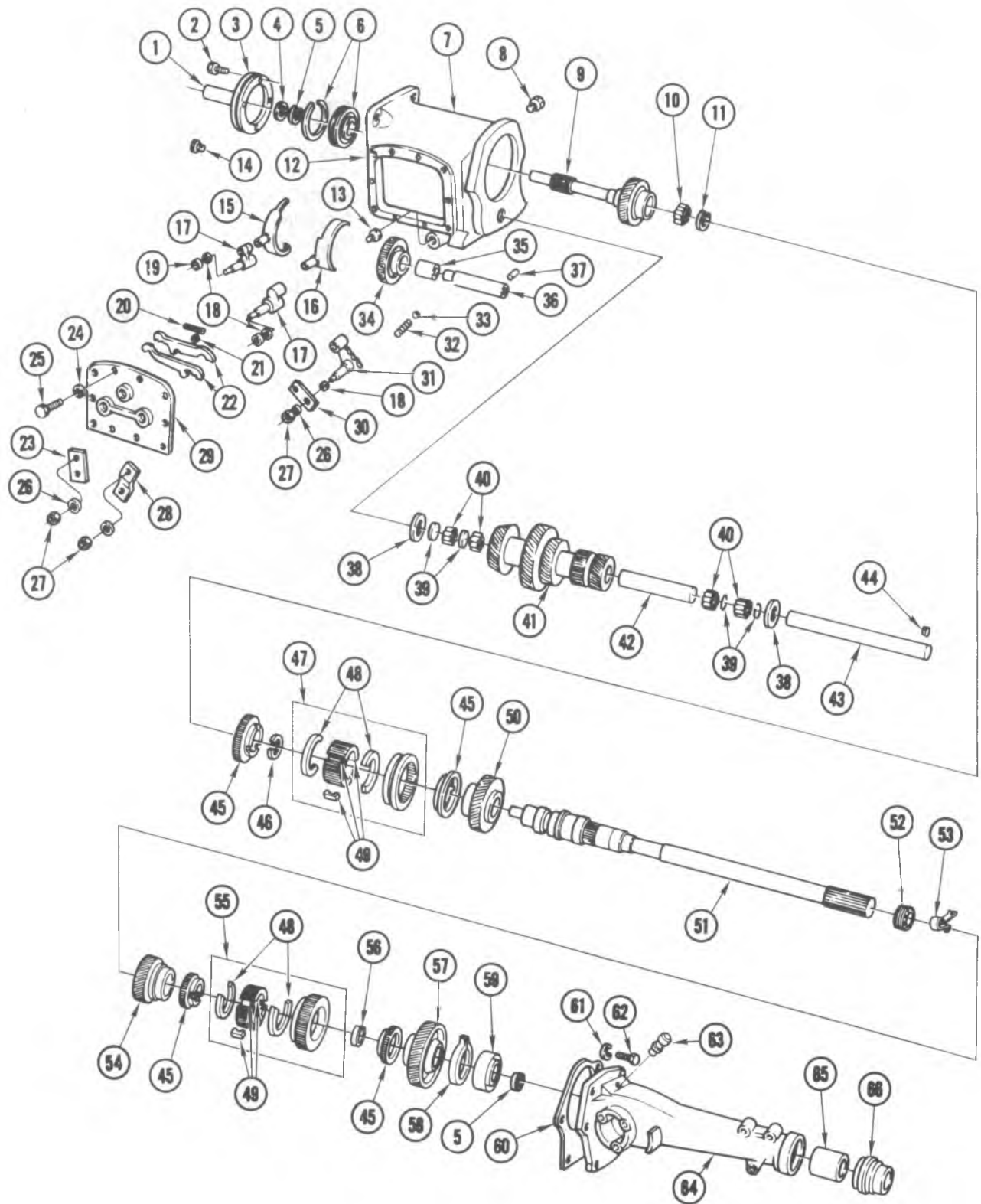


Fig. 7B3-4--4-Speed, 89mm, Exploded View

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

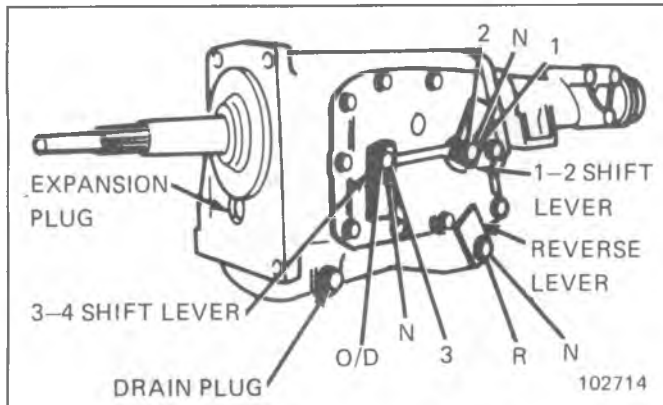


Fig. 7B3-6--Transmission Shift Levers

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.
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.

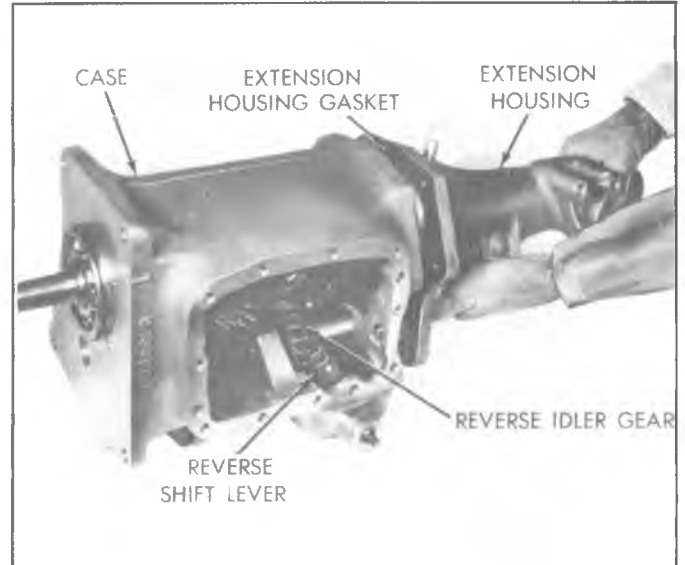


Fig. 7B3-8--Extension Housing and Mainshaft Assembly

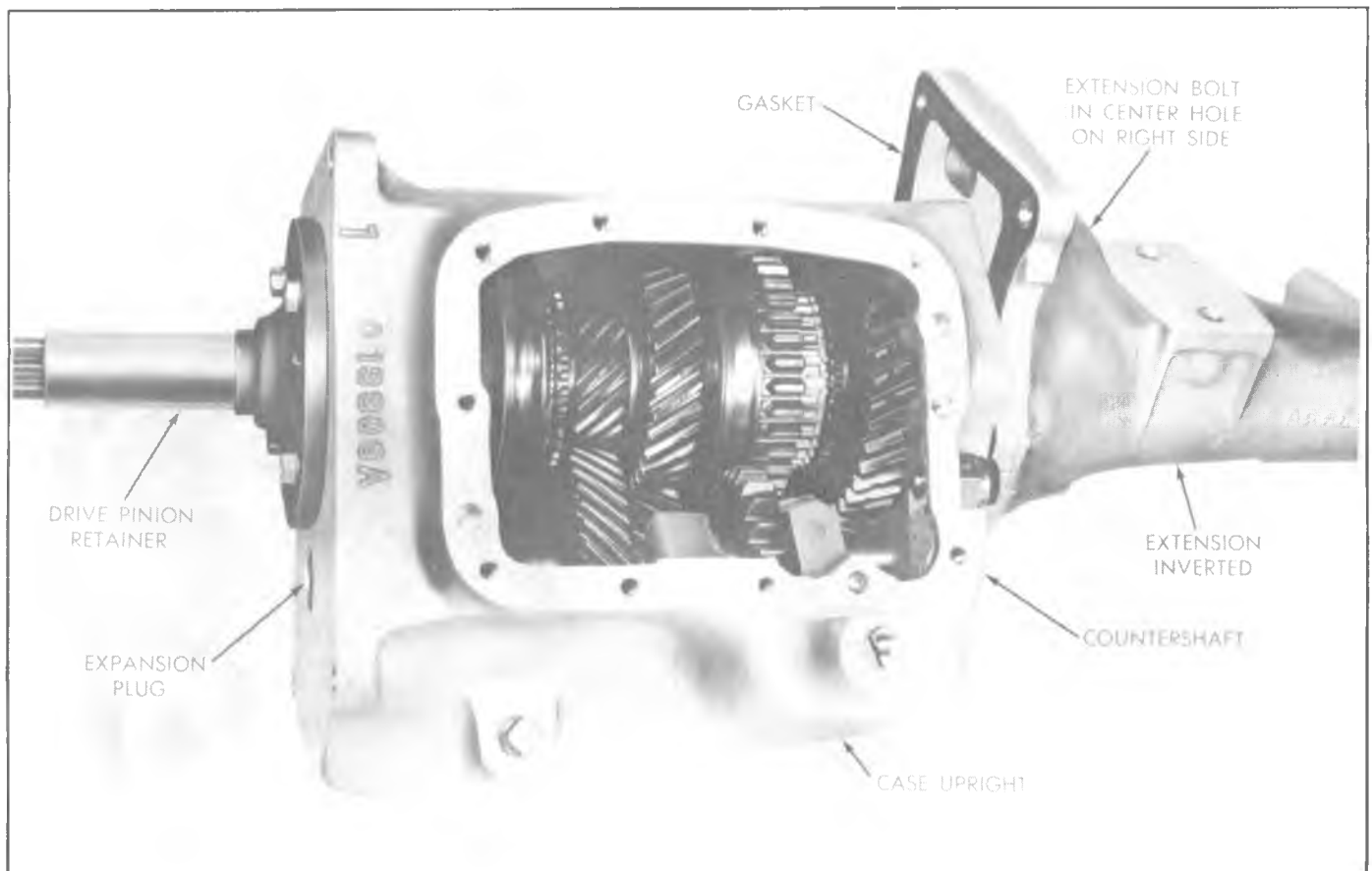


Fig. 7B3-7--Rotating Extension Housing

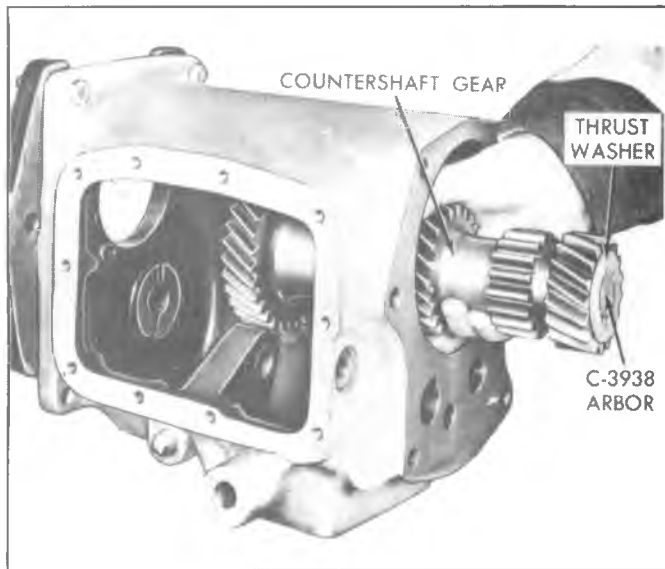


Fig. 7B3-9--Countershaft Gear and Arbor

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



Fig. 7B3-10--Reverse Idler Shaft

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

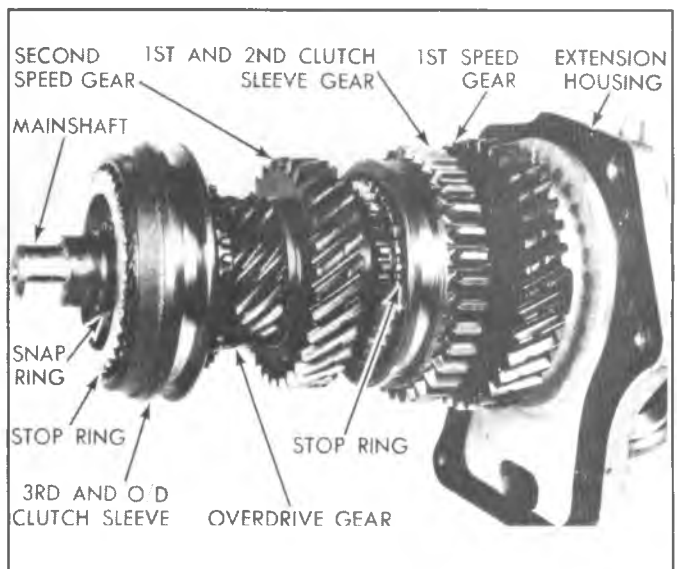


Fig. 7B3-11--Mainshaft Gear Identification

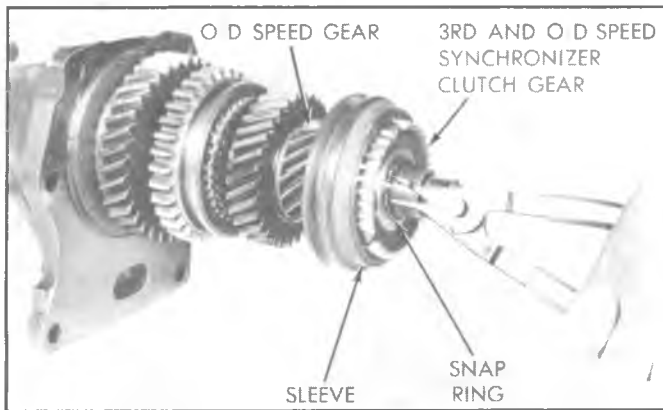


Fig. 7B3-12--Disassembling Mainshaft

mainshaft by inserting steel plate on the front side of 1st gear, then press mainshaft through bearing. (Be carefully 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

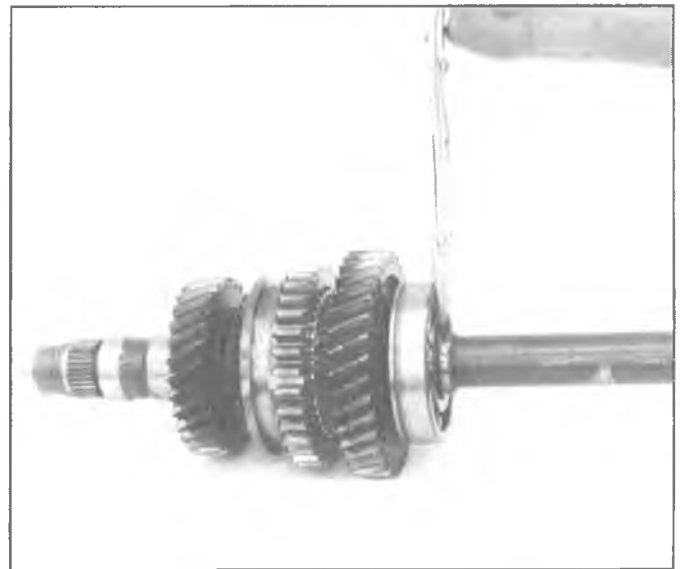


Fig. 7B3-14--Mainshaft Bearing Snap Ring

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

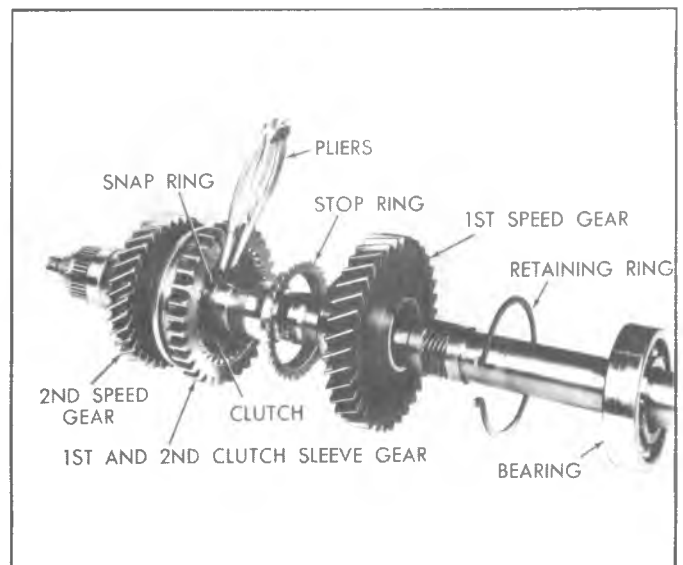


Fig. 7B3-15--Clutch Gear Snap Ring

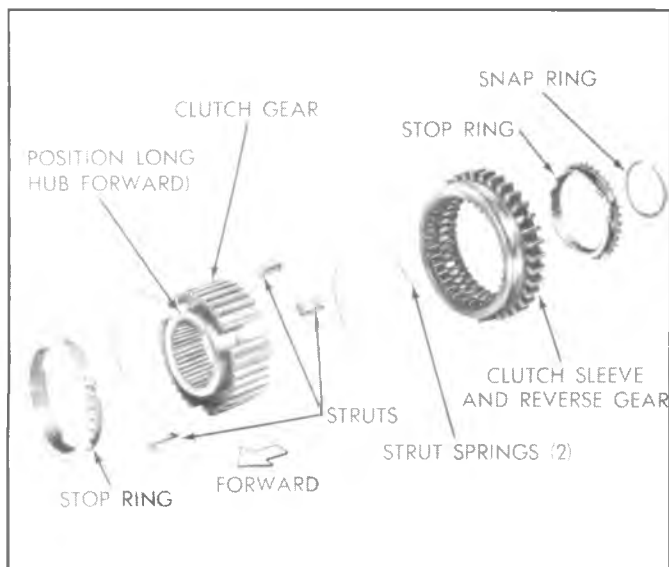


Fig. 7B3-16--1st-2nd Synchronizer Disassembled

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



Fig. 7B3-18--Installing Rear Extension Bushing

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.

Extension Oil Seal and/or Bushing

Replacement

1. Pry oil seal out of extension housing, using a screwdriver or small chisel.
2. Drive the bushing out of housing, using tool J-8092 with J-21424-9.

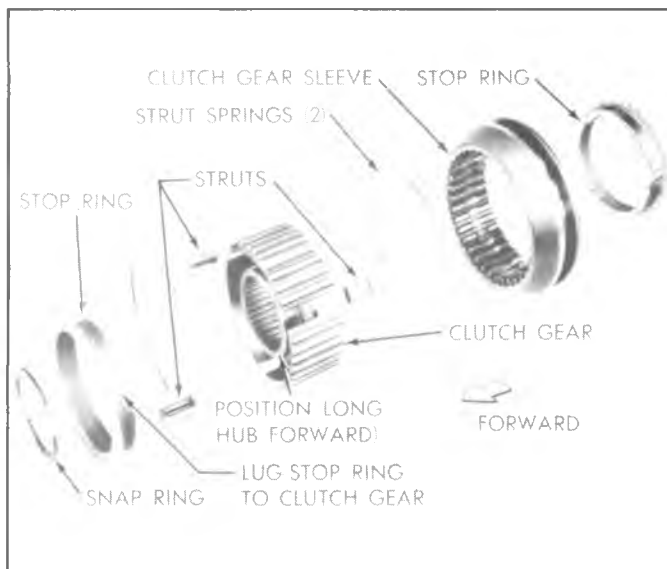


Fig. 7B3-17--3rd-O/D Synchronizer Disassembled



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

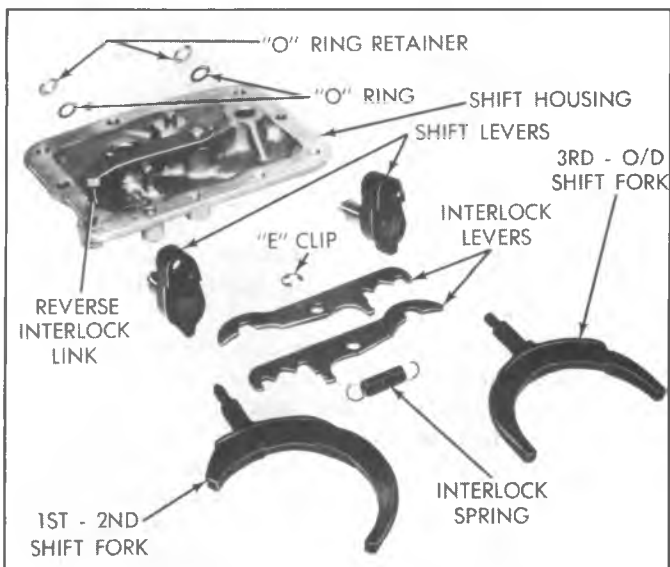


Fig. 7B3-21--Side Cover Exploded View

and remove. Make sure 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 assembly 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.

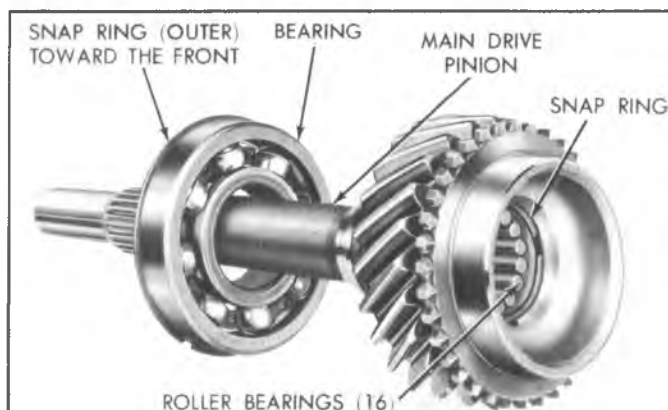


Fig. 7B3-22--Drive Pinion and Bearing Assembly

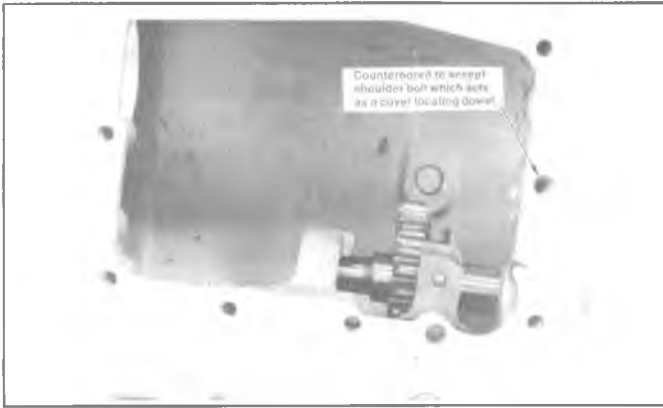


Fig. 7B3-23--Side Cover Bolt Identification

MAINSHAFT

Assembly

- Slide second gear over mainshaft (synchronizer cone toward rear) and down against shoulder on shaft. Refer to Fig. 7B3-15.
- 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.
- Slide first gear (synchronizer cone toward clutch sleeve gear just installed) over mainshaft into position against clutch sleeve gear.
- 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.
- 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.
- Slide overdrive gear over mainshaft (with synchronizer cone toward front) followed by O/D gear stop ring.
- 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.
- Using grease, position front stop ring over clutch gear, again indexing ring lugs with struts.

TRANSMISSION

Assembly

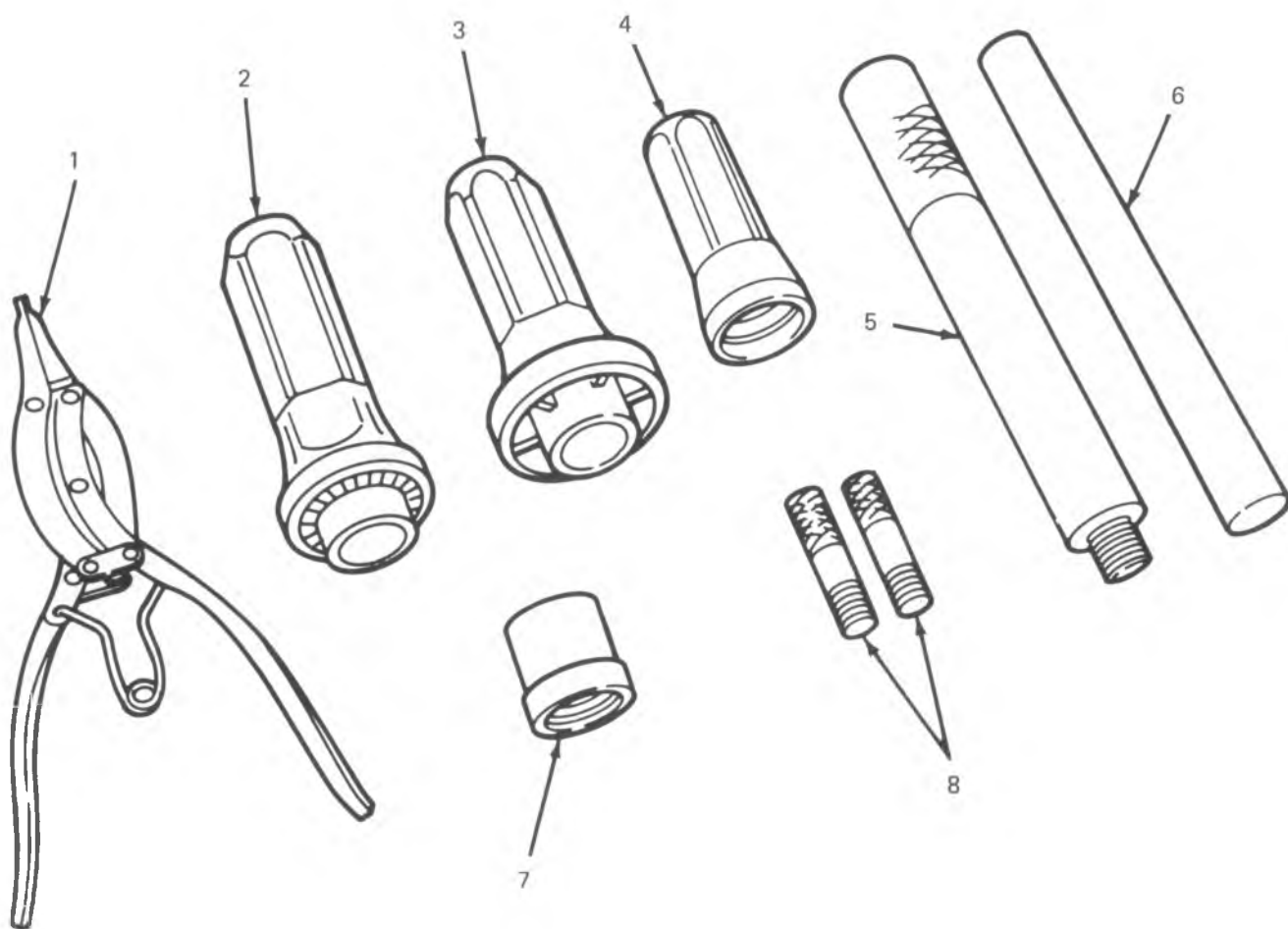
- Place the transmission case on its side with the shift cover opening toward the assembler.
- Install countergear assembly into the case aligning the tangs on the front washer with the slots in the case. Next install the rear washer aligning the tangs with the slot at the rear of the case and then let the countergear rest in the bottom of the case. (Be sure thrust washers stay in position). Refer to Fig. 7B3-9).
- Coat a new extension gasket with grease, then place it in position on the extension.
- Insert mainshaft assembly into the case tilting it as required to clear the countershaft gear.
- 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.
- 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.
- 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.
- 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.
- Install reverse shift lever shaft in case bore followed by greased "O" ring and retainer.
- Remove extension housing bolt and rotate extension to provide clearance for installation of the reverse idler gear in end of case.
- 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.
- Install woodruff key on shaft and drive shaft in flush with end of case.
- Align extension housing to case and install bolts. Torque housing bolts to specifications.
- Install drive gear bearing retainer and gasket. Coat threads with sealing compound, then install bolts and torque to specifications.
- Install new expansion plug coated with sealing compound in countershaft bore at front of case.
- 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.
- Rotate each shift lever to neutral position (straight up) and install 3rd/overdrive shift fork into its bore and under both interlock levers.
- 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.
- 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

4-SPEED 117MM TRANSMISSION

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ON VEHICLE SERVICE

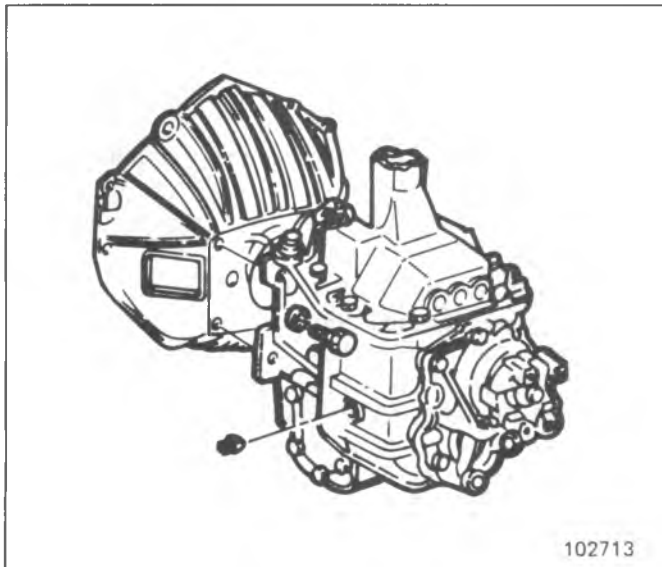


Fig. 7B4-1--Transmission To Engine Attachment

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.
2. If equipped with a center console, remove console and then remove floor mat or carpeting from compartment.
3. Remove transmission floor cover attaching screws and cover.
4. Raise vehicle and support engine with a suitable floor stand.
5. Drain transmission and disconnect the speedometer cable from transmission.
6. Disconnect propeller shaft front U-joint at transmission yoke, and tie up out of way.
7. Open lock tabs and remove transmission mount-to-crossmember bolts.

8. Support transmission with a suitable floor stand. Remove frame to crossmember bolts and remove crossmember 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 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. Fill transmission with lubricant specified in Section 0B.
7. Remove supports and lower vehicle.
8. Install transmission floor cover and attaching screws. Torque to specifications.

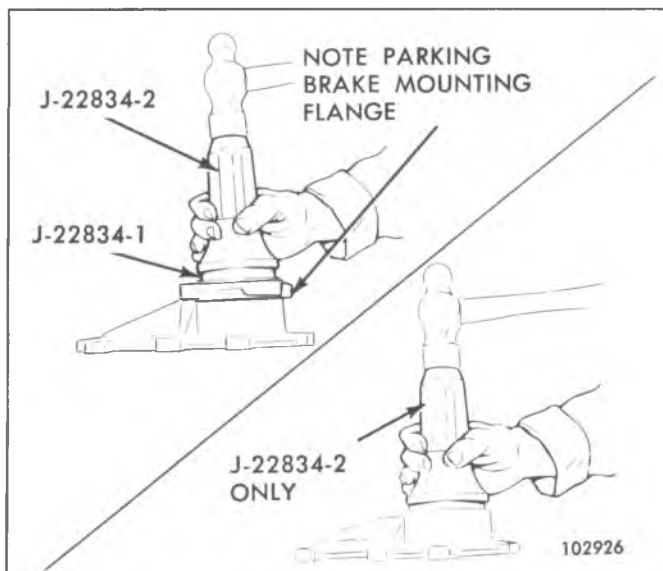


Fig. 7B4-2--Rear Bearing Retainer Oil Seal

9. Install floor mat or carpeting. Install center console if equipped.
10. Install transmission shift lever, boot, retainer and attaching screws.

Remove (K-Series)

1. Remove attaching screws from transmission shift lever boot retainer. Slide boot and retainer up lever and remove transmission shift lever.
2. If equipped with a 208 transfer case, raise vehicle and disconnect control rod from transfer case shift lever and then lower vehicle. If equipped with a 205 transfer case, remove attaching screws from transfer case shift lever boot retainer and remove retainer.
3. If equipped with a center console, remove console and then remove floor mat or carpeting from compartment.
4. Remove transmission floor cover attaching screws. On 208 Model, leave transfer case shifter attached to cover and remove cover. On 205 Model rotate cover approximately 90° to clear transfer case shift lever while lifting cover.
5. On 205 Model, disconnect shift lever rod assembly from shift rail connecting link and remove shift lever attaching bolt from adapter.
6. Raise vehicle and support engine with a suitable floor stand. Drain transfer case and transmission.
7. Disconnect speedometer cable.
8. Disconnect propeller shafts at transfer case and tie up, away from work area.
9. Support transfer case in a suitable cradle. Remove bolts attaching transfer case to adapter, and remove transfer case.
10. Open lock tabs and remove transmission mount-to-crossmember bolts.
11. Support transmission and remove frame to crossmember bolts. Rotate crossmember to clear frame rails and remove from vehicle.
12. 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.

13. Slide transmission rearward until main drive gear clears the clutch assembly and lower assembly from vehicle.
14. 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. Fill transmission and transfer case with lubricant recommended in Section OB of this manual.
8. On 205 Model, position shift lever and install attaching bolt and torque to specifications. Connect shift lever rod to shift rail connecting link. Lower vehicle and install transmission floor cover and attaching screws. Torque to specifications.
On 208 Model, lower vehicle and install transmission floor cover. Install attaching screws and torque to specifications. Raise vehicle and connect control rod to transfer case shift lever and adjust as outlined in Section 7E. Lower vehicle.
9. Install floor mat or carpeting. Install center console if equipped.
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.

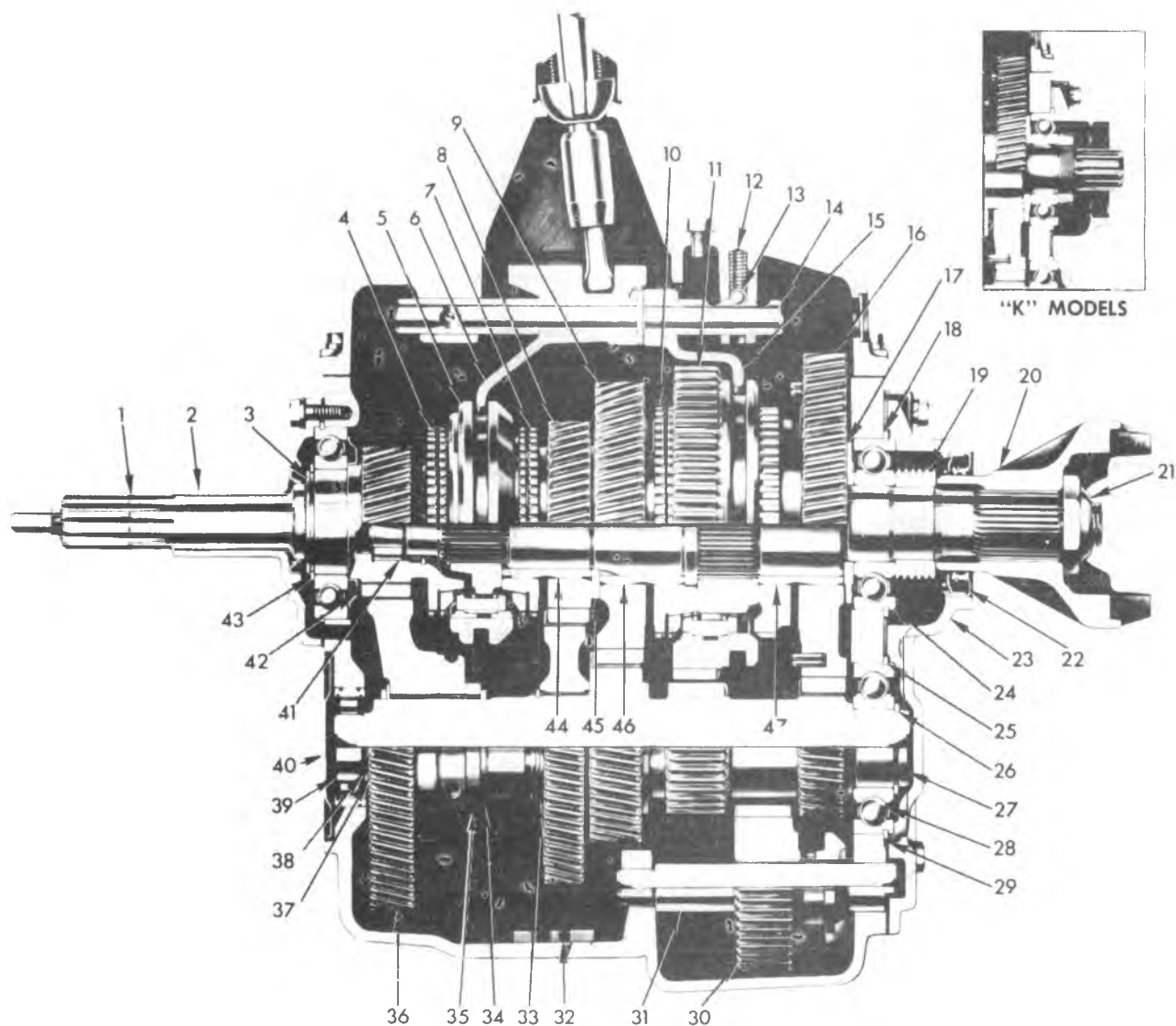
FLOOR SHIFT CONTROL LEVER

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

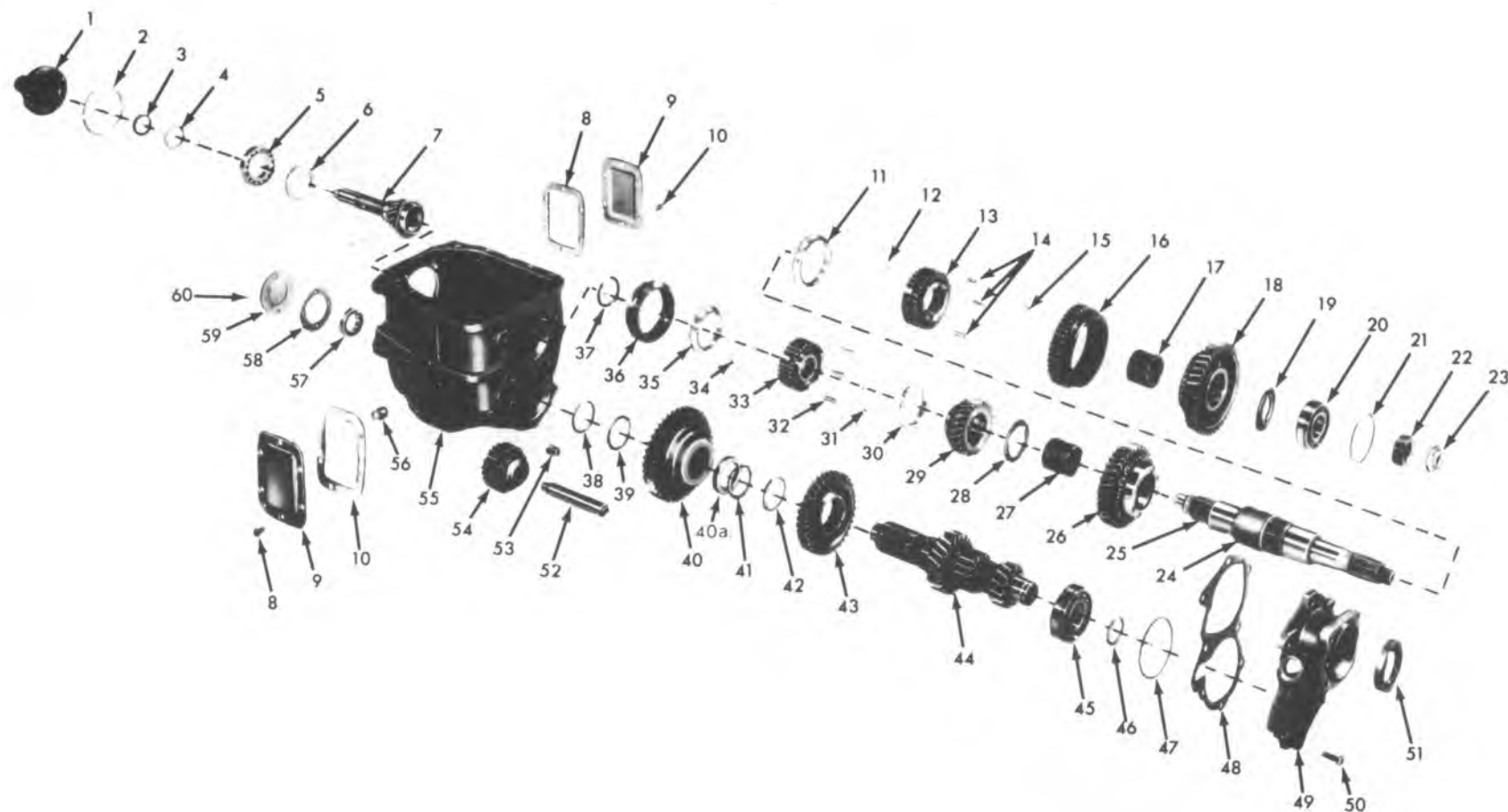
1. Install transmission shift lever. Slide boot and retainer down shift lever and install attaching screws.
2. On K-Series models, install transfer case shift lever boot, retainer and attaching screws.



- | | | | |
|--|------------------------------------|-------------------------------|--------------------------------|
| 1. Main Drive Gear | 11. Reverse Driven Gear | 24. Mainshaft Rear Bearing | 37. Thrust Washer |
| 2. Drive Gear Bearing Retainer | 12. Poppet Spring | 25. Rear Bearing Snap Ring | 38. Snap Ring |
| 3. Snap Ring-Outer | 13. Poppet Ball | 26. Snap Ring | 39. Front Countershaft Bearing |
| 4. 3rd and 4th Synchronizer Ring | 14. Shift Rail | 27. Countershaft | 40. Countergear Front Cover |
| 5. 3rd and 4th Synchronizer Collar | 15. 1st and 2nd Shift Fork | 28. Countershaft Rear Bearing | 41. Pilot Bearing Rollers |
| 6. 3rd and 4th Shift Fork | 16. 1st Speed Gear | 29. Bearing Snap Ring | 42. Clutch Gear Oil Slinger |
| 7. 3rd and 4th Speed Synchronizer Ring | 17. Thrust Washer | 30. Reverse Idler Gear | 43. Snap Ring |
| 8. 3rd Speed Gear | 18. Bearing Snap Ring | 31. Reverse Idler Shaft | 44. 3rd Speed Gear Bushing |
| 9. 2nd Speed Gear | 19. Speedometer Drive Gear | 32. Case Magnet | 45. Thrust Washer |
| 10. 1st and 2nd Synchronizer Assembly | 20. Output Yoke | 33. Snap Ring | 46. 2nd Speed Gear Bushing |
| | 21. Flange Nut | 34. Snap Ring | 47. 1st Speed Gear Bushing |
| | 22. Rear Bearing Retainer Oil Seal | 35. Spacer | |
| | 23. Rear Bearing Retainer | 36. Countergear | |

Fig. 7B4-3--4-Speed 117mm Transmission-Cross Section

Fig. 7B4-4--4-Speed 117mm Transmission-Exploded View



- | | | | | |
|----------------------------------|------------------------------------|---------------------------------------|------------------------------|-------------------------------|
| 1. Drive Gear Bearing Retainer | 13. 1st-2nd Speed Synchronizer Hub | 26. 2nd Speed Gear | 37. Snap Ring | 48. Rear Retainer Gasket |
| 2. Retainer Gasket | 14. Synchronizer Keys | 27. 3rd Gear Bushing | 38. Snap Ring | 49. Rear Retainer |
| 3. Lip Seal | 15. Synchronizer Spring | 28. Thrust Washer | 39. Thrust Washer | 50. Retainer Bolts |
| 4. Snap Ring | 16. Reverse Driven Gear | 29. 3rd Speed Gear | 40. Clutch Countergear | 51. Retainer Lip Seal |
| 5. Drive Gear Bearing | 17. 1st Gear Bushing | 30. 3rd Speed Blocker Ring | 40a. Spacer | 52. Reverse Idler Shaft |
| 6. Oil Slinger | 18. 1st Gear | 31. Synchronizer Spring | 41. Snap Ring | 53. Drain Plug |
| 7. Drive Gear and Pilot Bearings | 19. Thrust Washer | 32. Synchronizer Keys | 42. Snap Ring | 54. Reverse Idler Gear |
| 8. Power Take-Off Cover Gasket | 20. Rear Main Bearing | 33. 3rd-4th Synchronizer Hub | 43. 3rd Speed Countergear | 55. Case |
| 9. Power Take-Off Cover | 21. Bearing Snap Ring | 34. Synchronizer Spring | 44. Countergear Shaft | 56. Fill Plug |
| 10. Retaining Screws | 22. Speedometer Gear Nut | 35. 3rd-4th Speed Blocker Ring | 45. Countergear Rear Bearing | 57. Countergear Front Bearing |
| 11. 1st-2nd Speed Blocker Ring | 23. Rear Mainshaft Lock Nut | 36. 3rd-4th Speed Synchronizer Sleeve | 46. Snap Ring | 58. Gasket |
| 12. Synchronizer Spring | 24. 2nd Speed Bushing (On Shaft) | | 47. Bearing Outer Snap Ring | 59. Front Cover |
| | 25. Mainshaft | | | 60. Cover Screws |

UNIT REPAIR

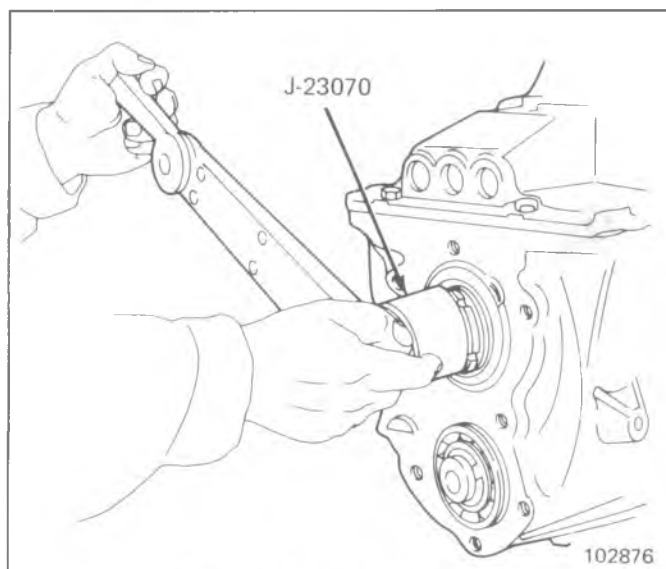


Fig. 7B4-5--Four Wheel Drive

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 through 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

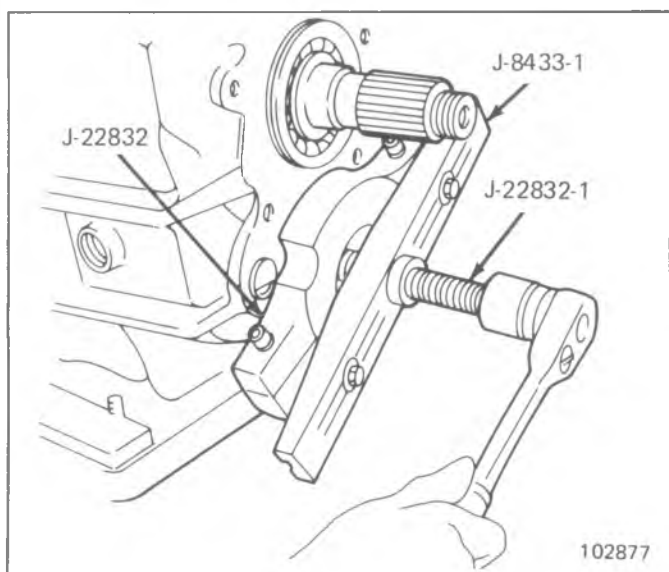


Fig. 7B4-6--Countergear Rear Bearing

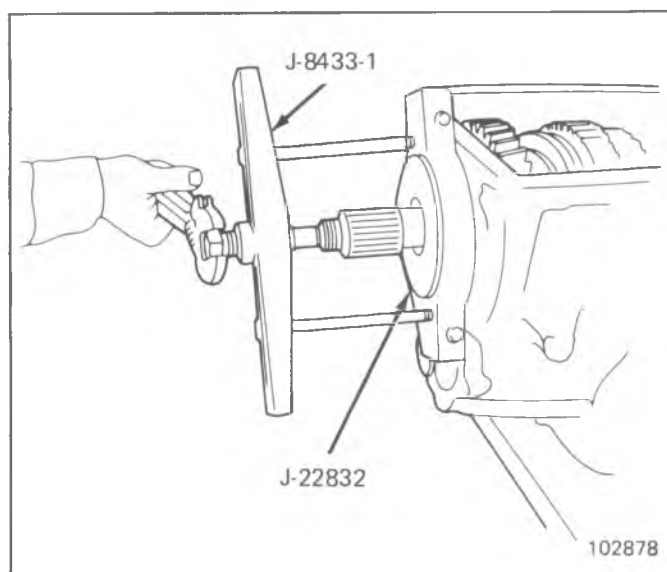


Fig. 7B4-7--Mainshaft Rear Bearing

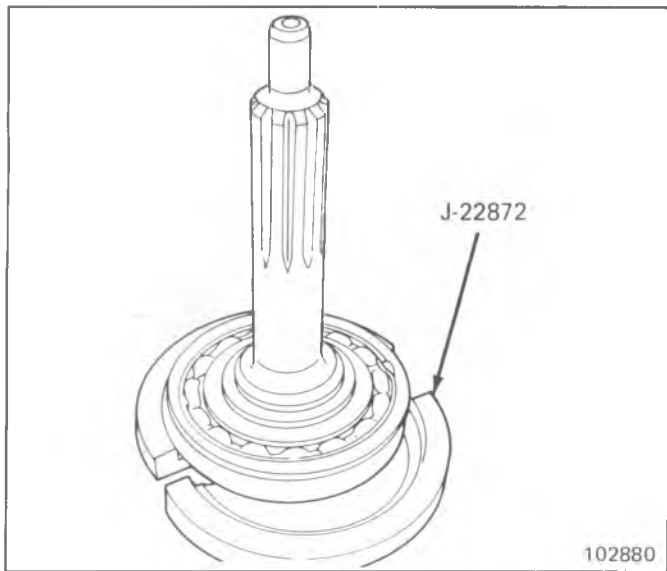


Fig. 7B4-8--Tool J-22872

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 retaining 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.

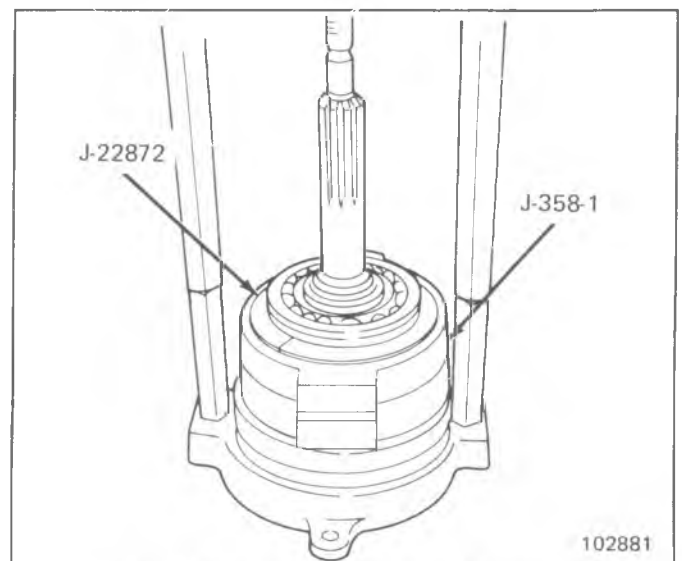


Fig. 7B4-9--Removing Drive Gear Bearing

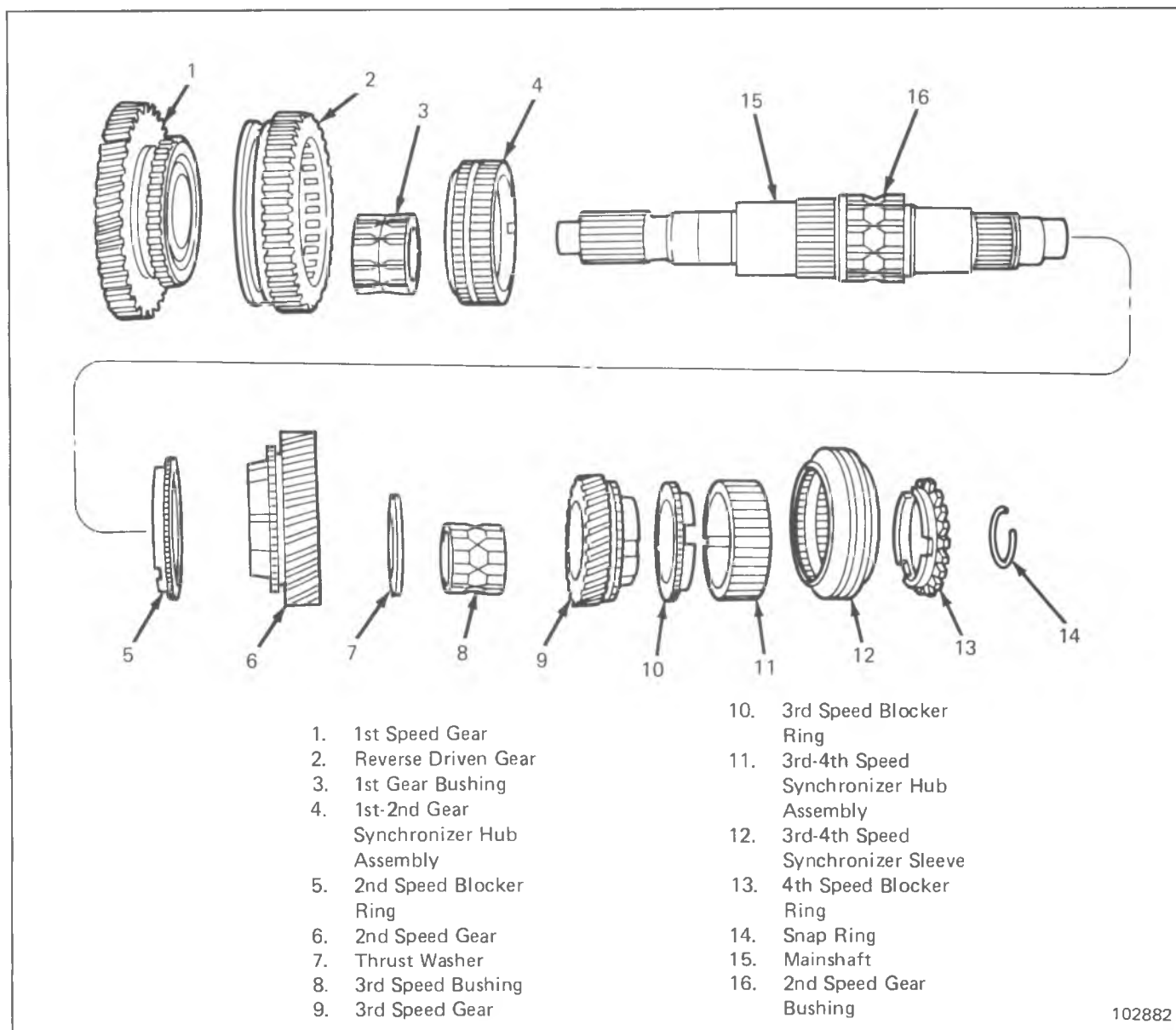


Fig. 7B4-10--Mainshaft Assembly

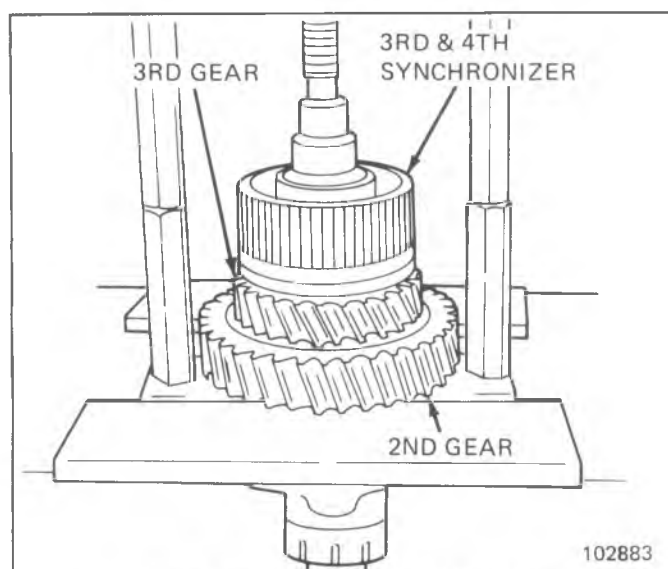


Fig. 7B4-11--Disassembly of Mainshaft

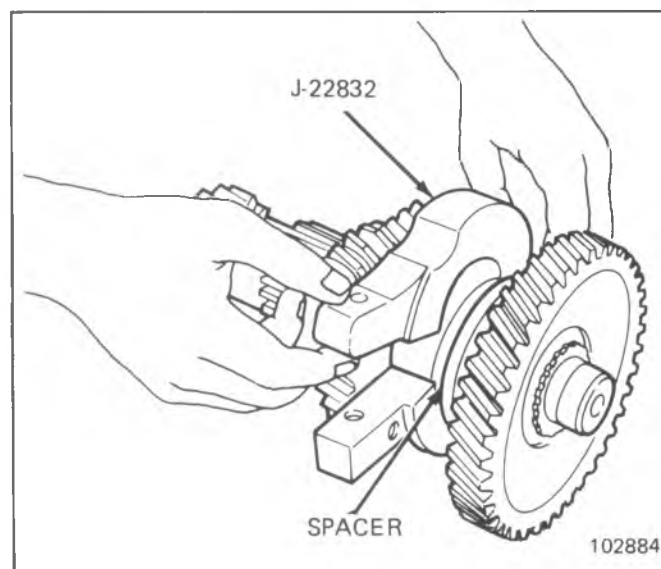


Fig. 7B4-12--Positioning Tool J-22832

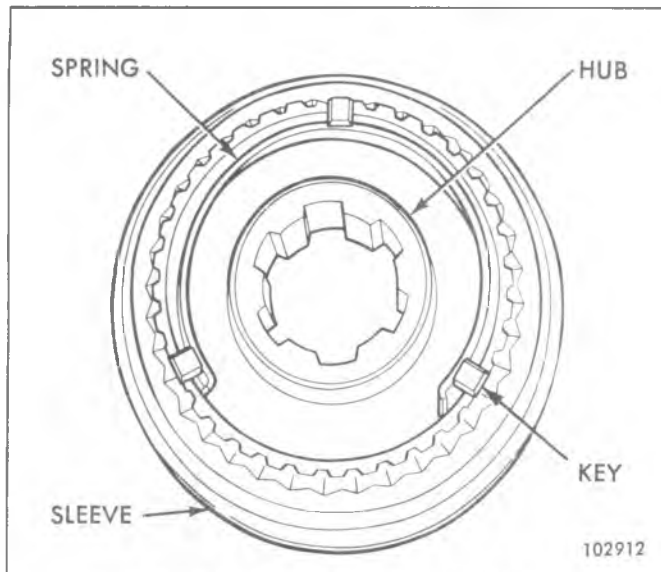


Fig. 7B4-13--Synchronizer Assembly

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.

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.

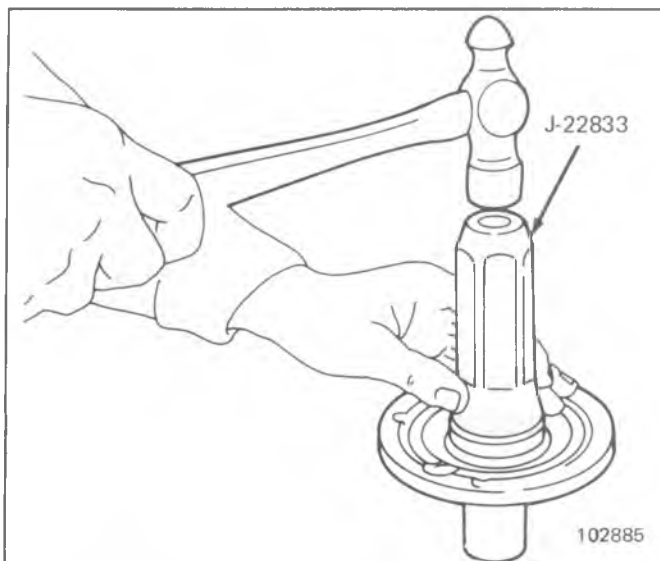


Fig. 7B4-14--Installing Bearing Retainer Oil Seal

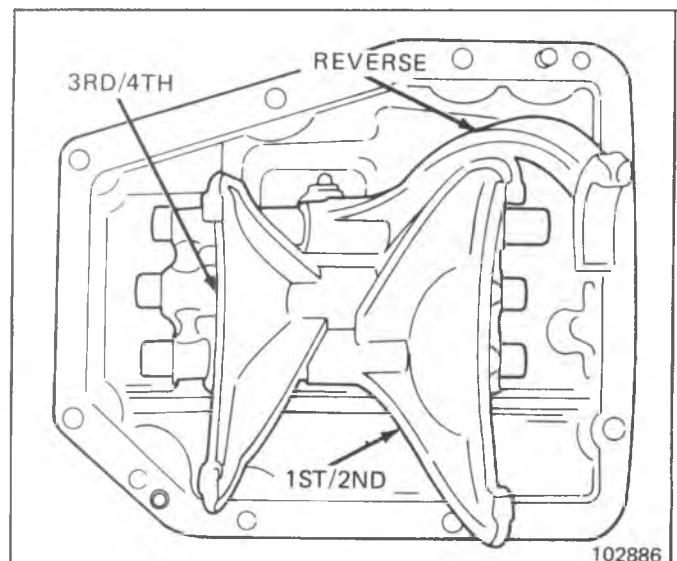
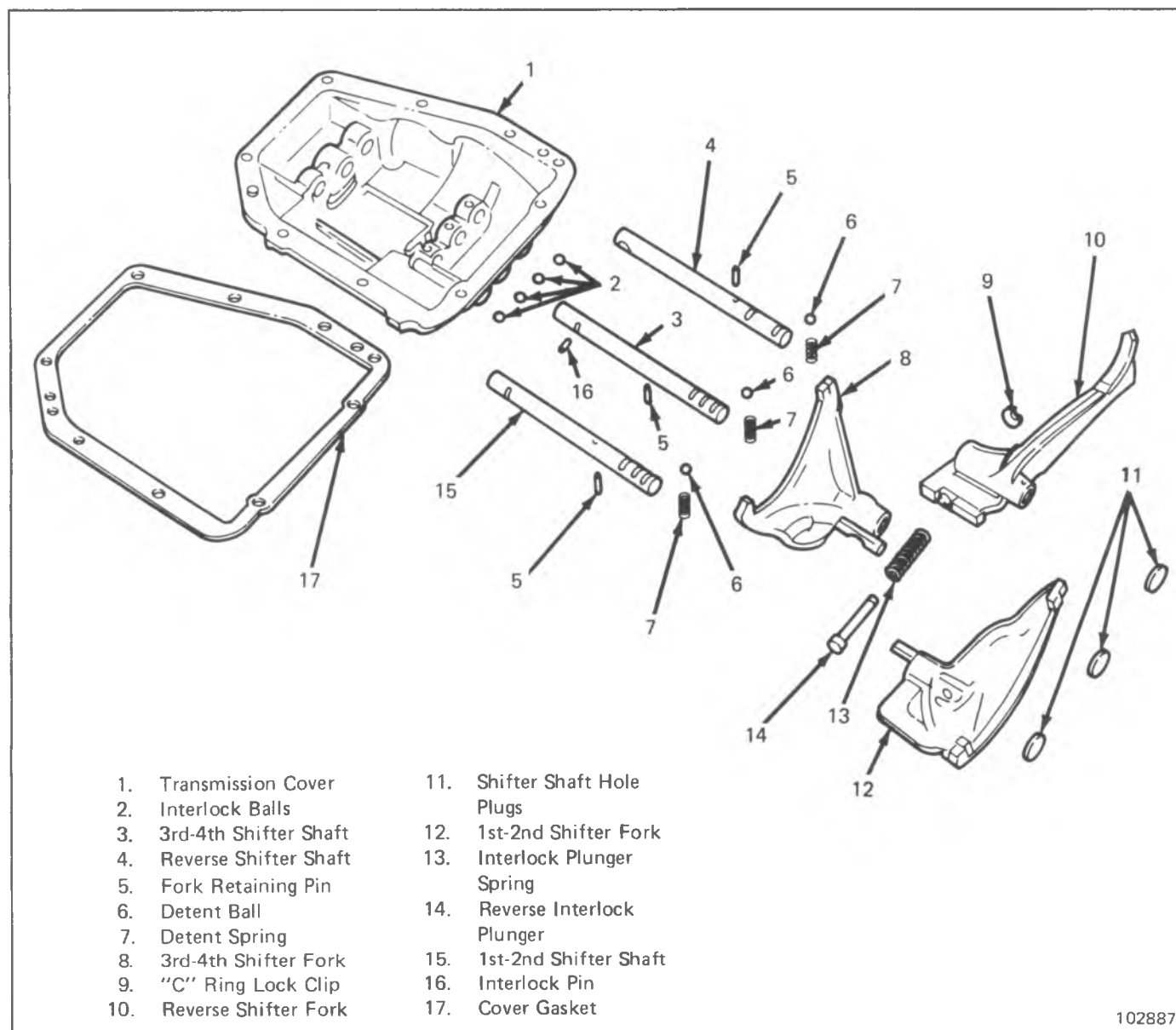


Fig. 7B4-15--Cover Assembly



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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 counter gear 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

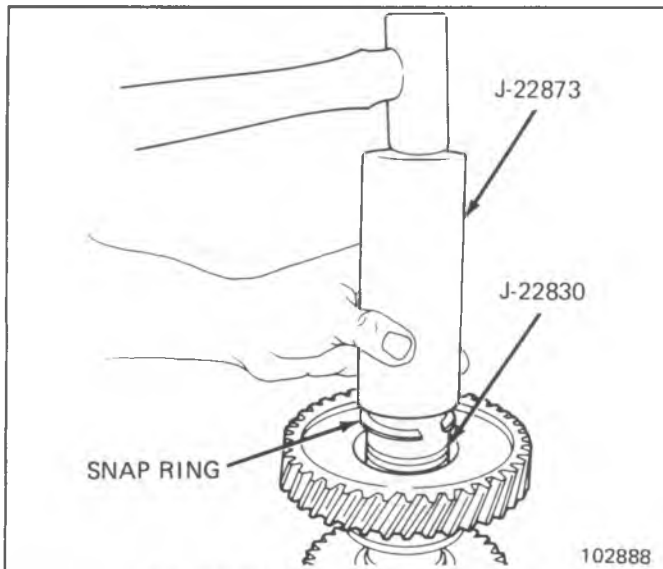


Fig. 7B4-17--Shifter Shaft Installation

the gear requires less than 1500 lb., 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

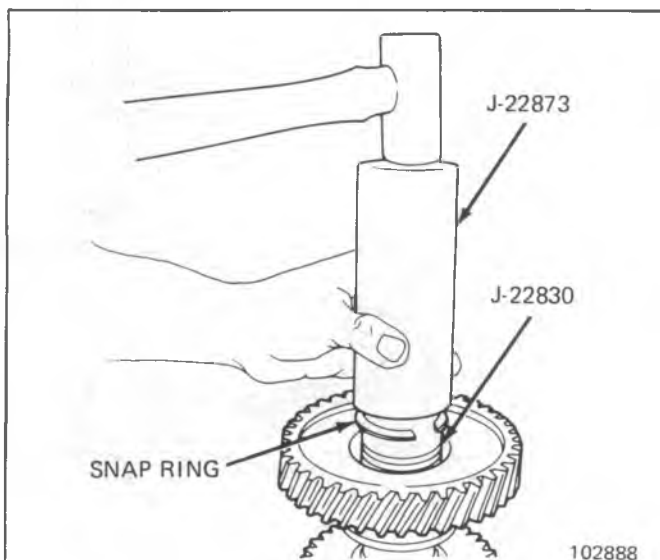


Fig. 7B4-18--Counter Gear Snap Ring

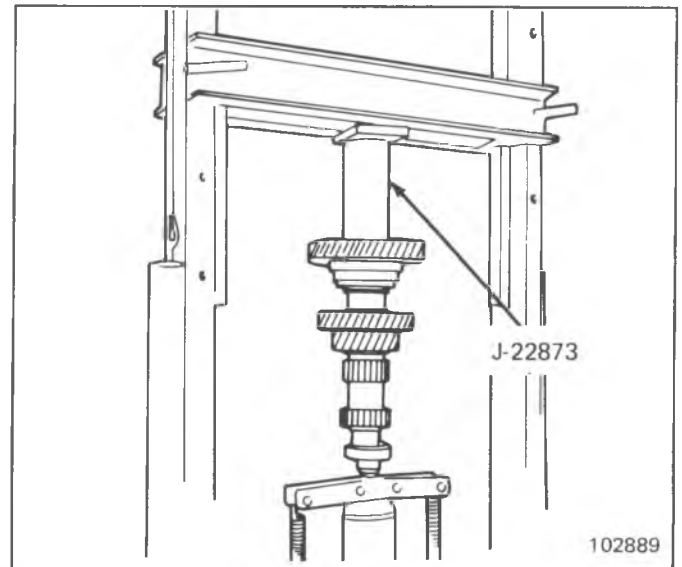


Fig. 7B4-19--Clutch Countergear

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.

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.

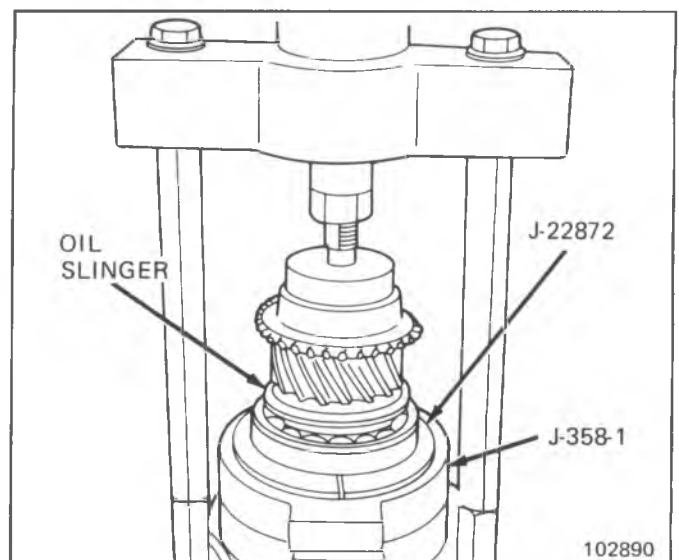


Fig. 7B4-20--Drive Gear Bearing

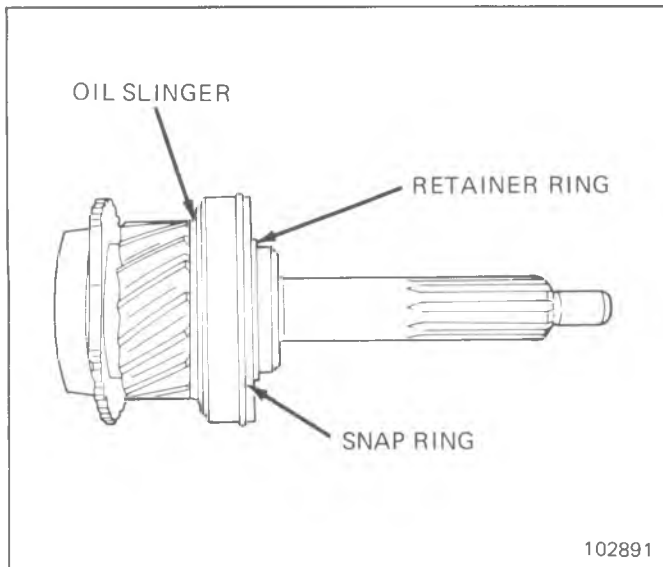


Fig. 7B4-21--Drive Gear Assembly

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

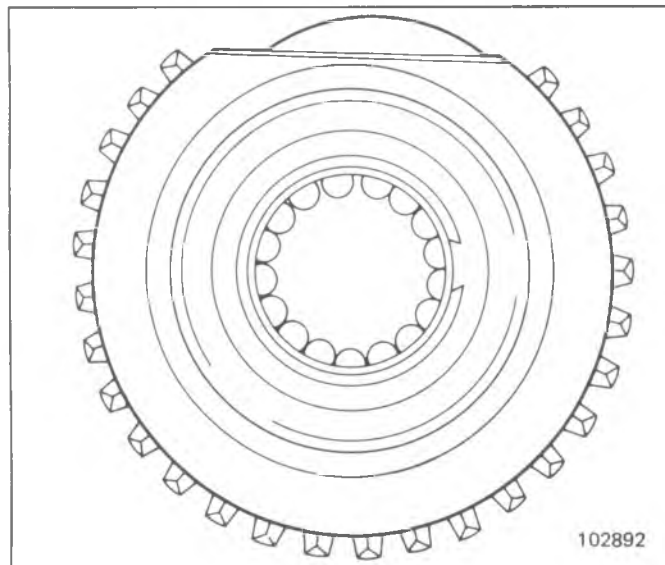


Fig. 7B4-22--Pilot Roller Bearing

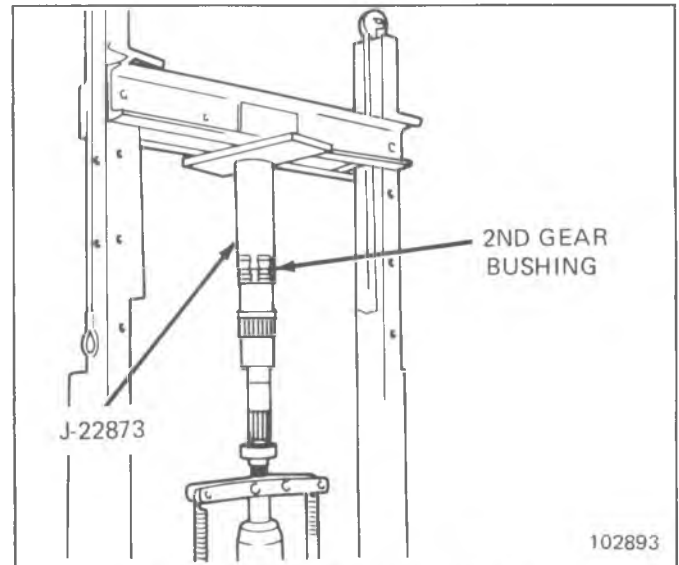


Fig. 7B4-23--2nd Speed Gear Bushing

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

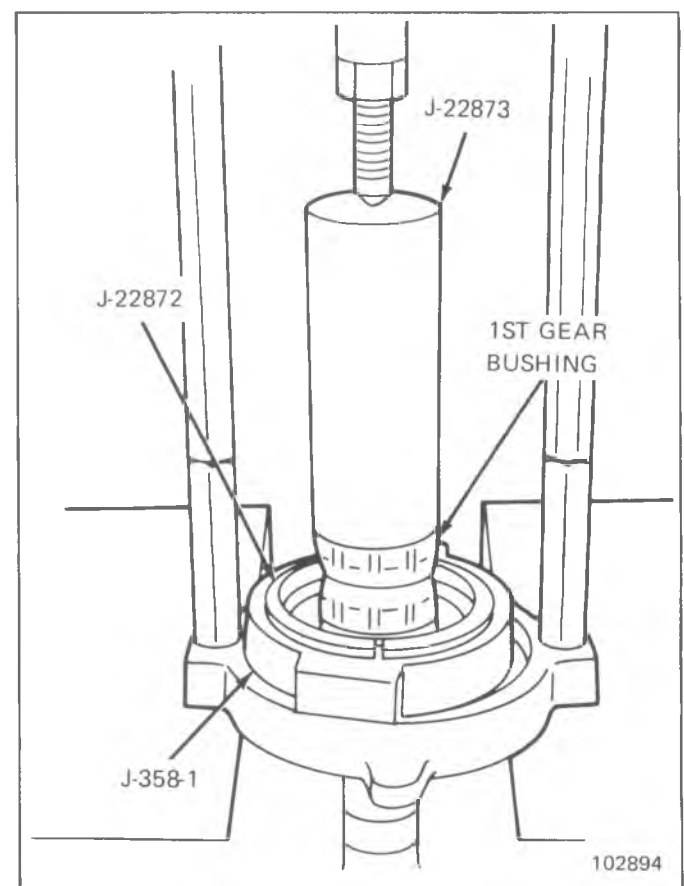


Fig. 7B4-24--1st Speed Gear Bushing

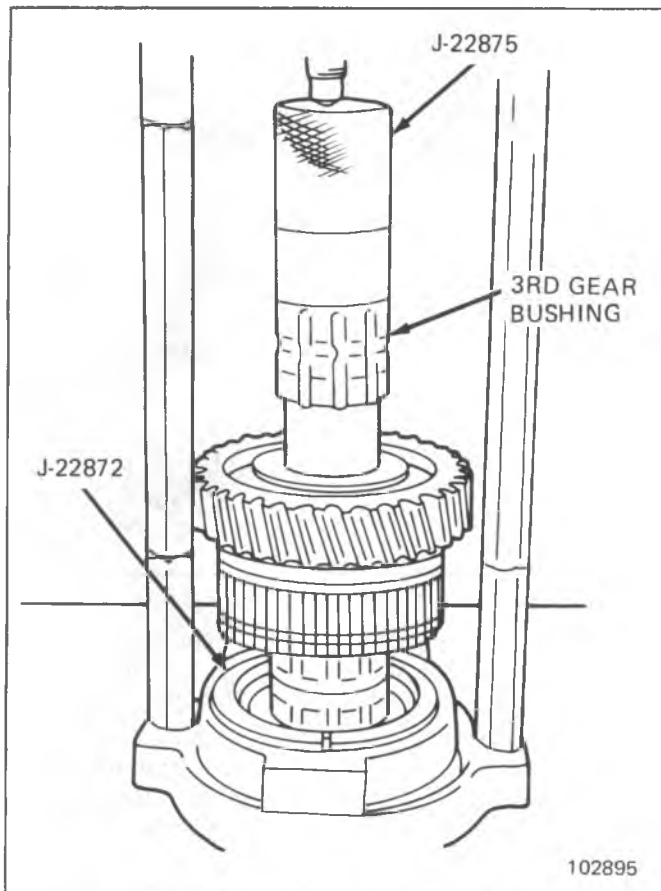


Fig. 7B4-25--3rd Speed Gear Bushing

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).

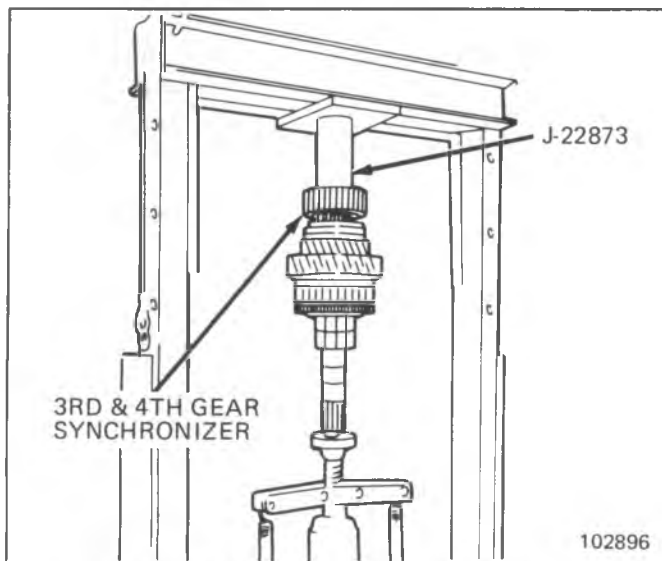


Fig. 7B4-26--3rd and 4th Gear Synchronizer

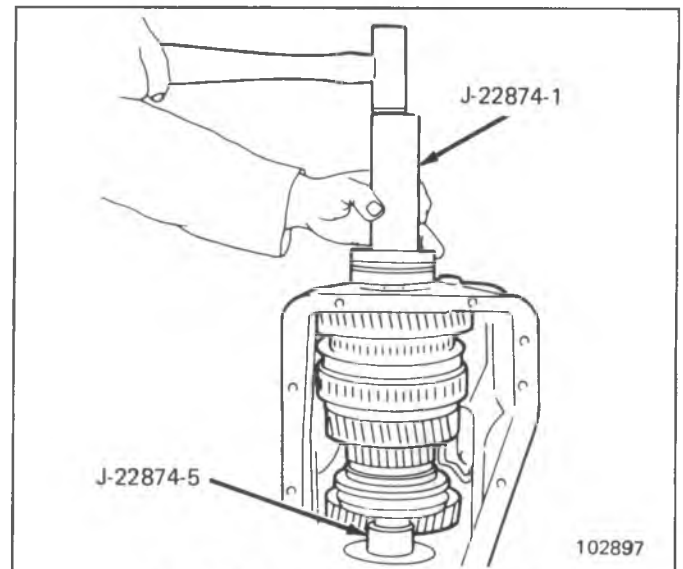


Fig. 7B4-27--Mainshaft Rear Bearing

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

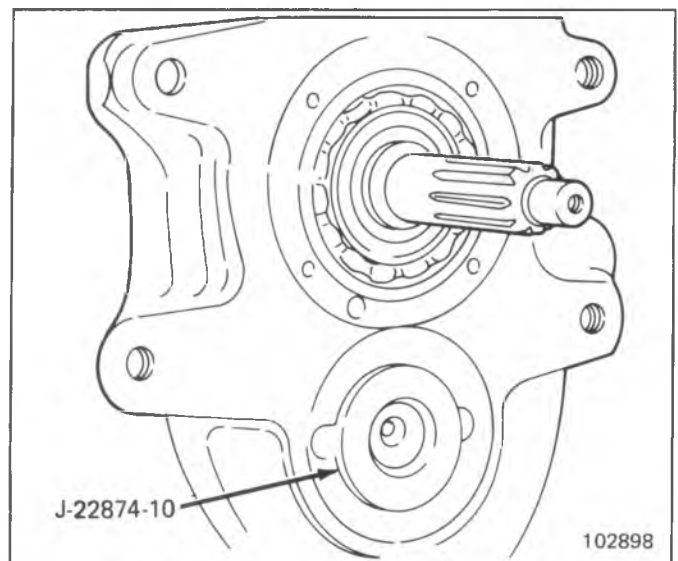


Fig. 7B4-28--Countergear Front Support Tool

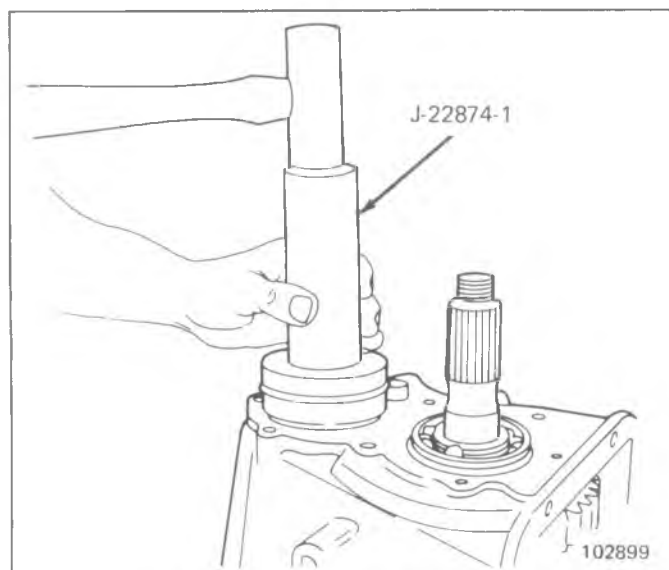


Fig. 7B4-29--Countergear Rear Bearing

gear teeth toward the front. Install idler gear shaft from rear to front, being carefully 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.

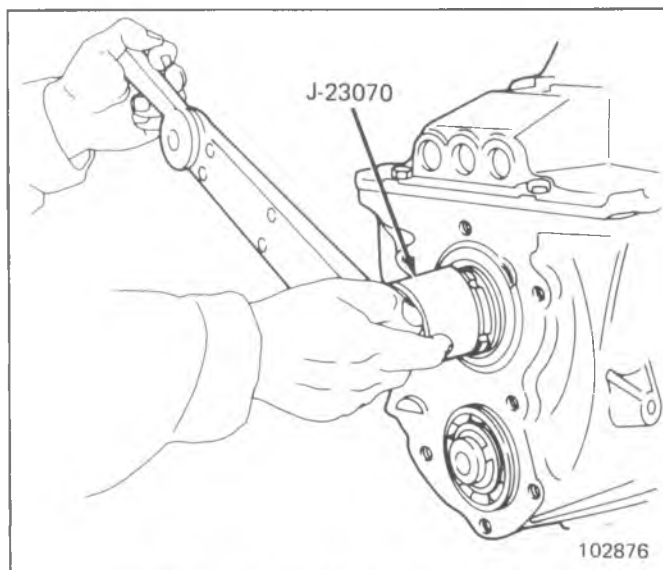


Fig. 7B4-30--Mainshaft Rear Bearing Lock Nut

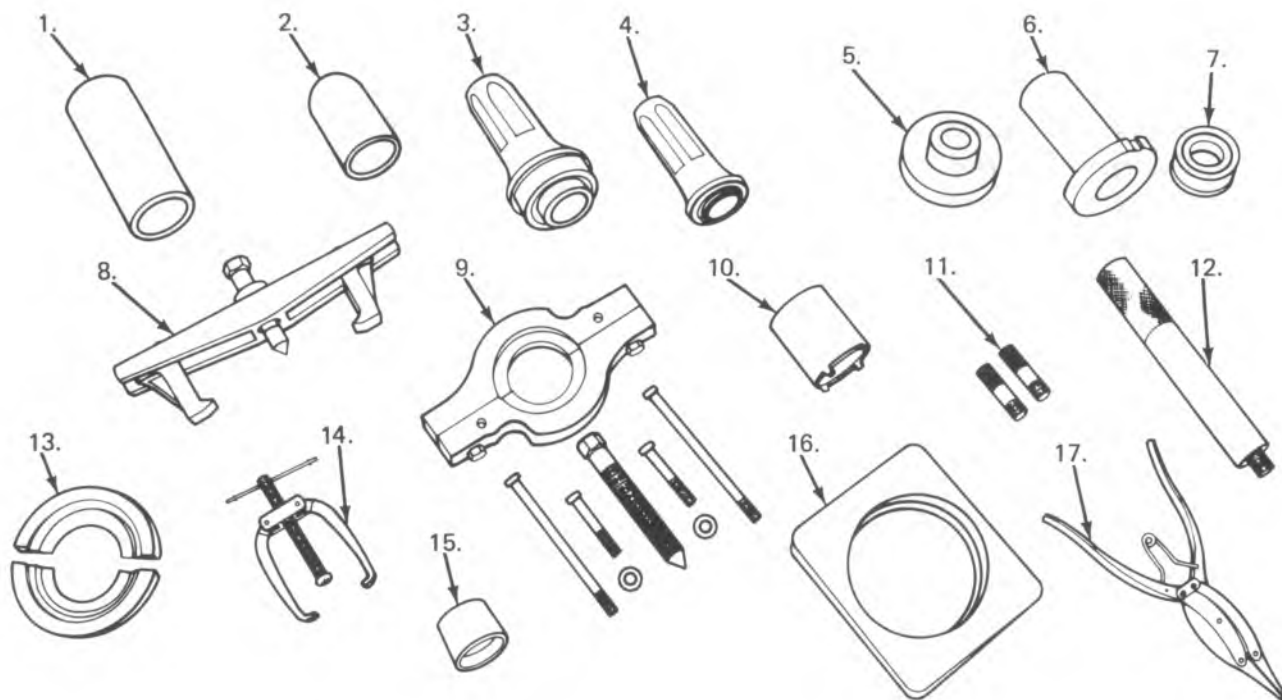
8. Install appropriate tool in countergear front bearing opening in case to support countergear and rotate case onto front end. (Fig. 7B4-28).
9. Install snap ring on countergear rear bearing O.D. position, bearing on countergear and using Tool J-22874-1, drive bearing into place (Fig. 7B4-29). Rotate 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

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Coil Spring Type	7C-11	Special Tools.....	7C-18

GENERAL DESCRIPTION

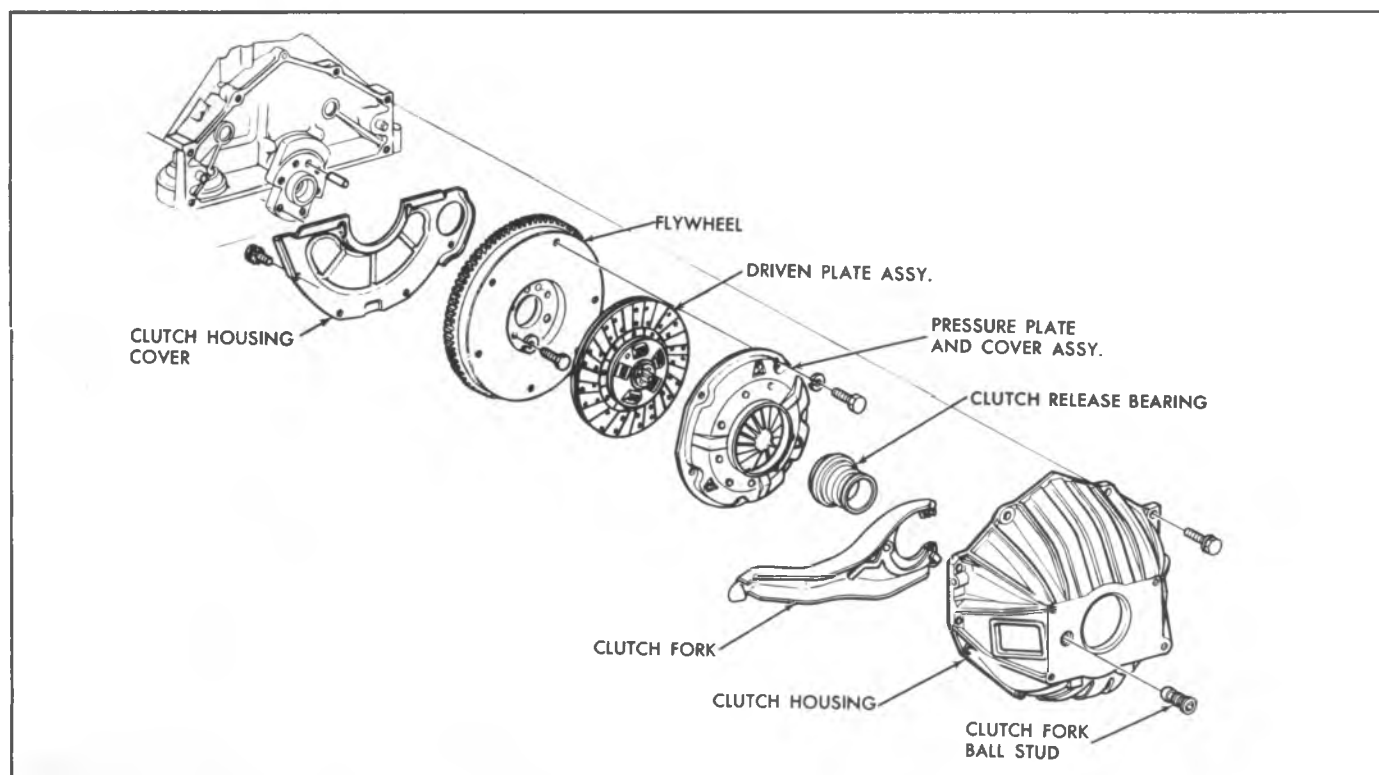


Fig. 7C-1--Clutch System Components

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.

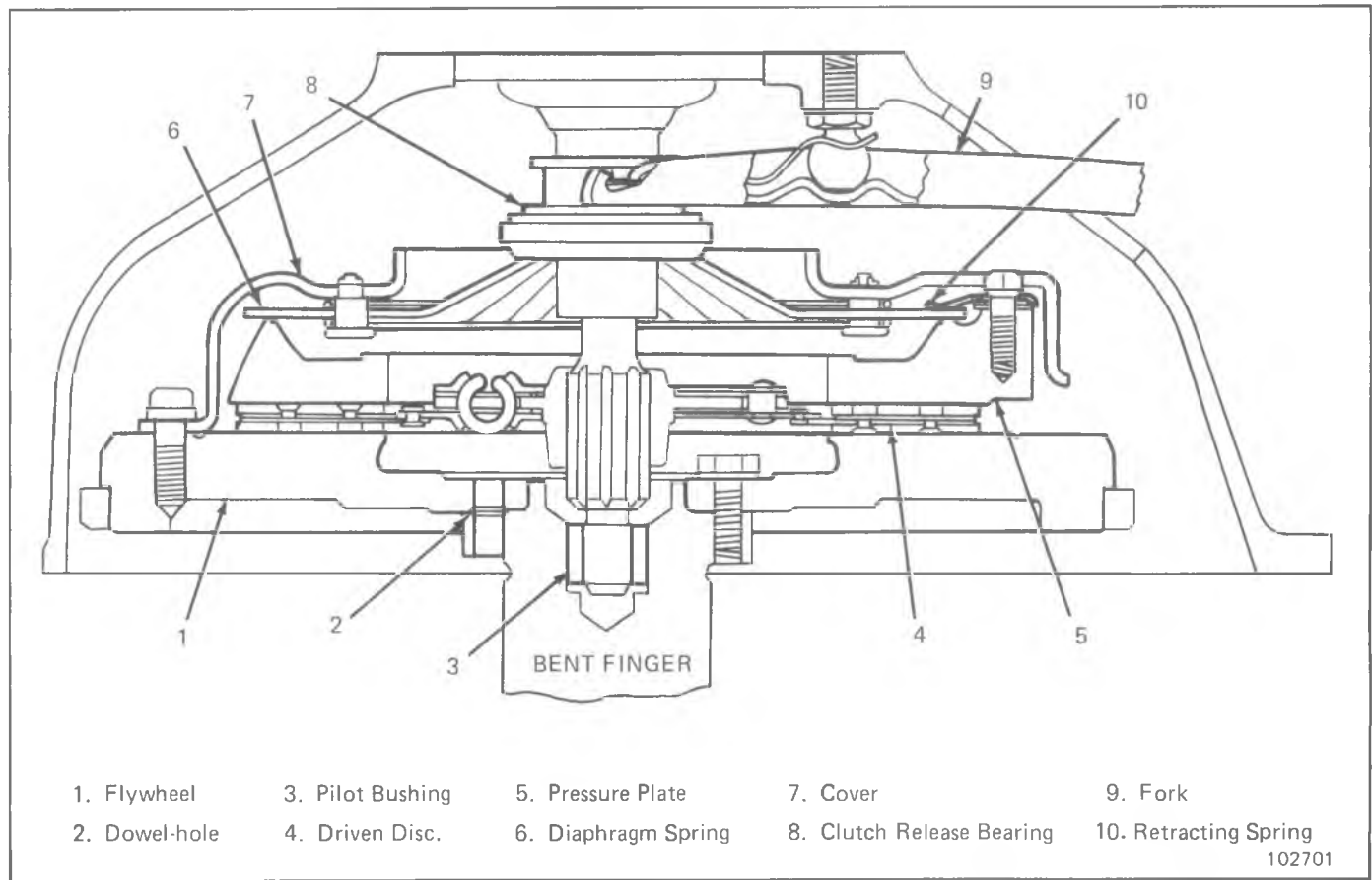


Fig. 7C-2--Cross-Section View of Diaphragm-Type

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 clutch pedal is release bearing lash.

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

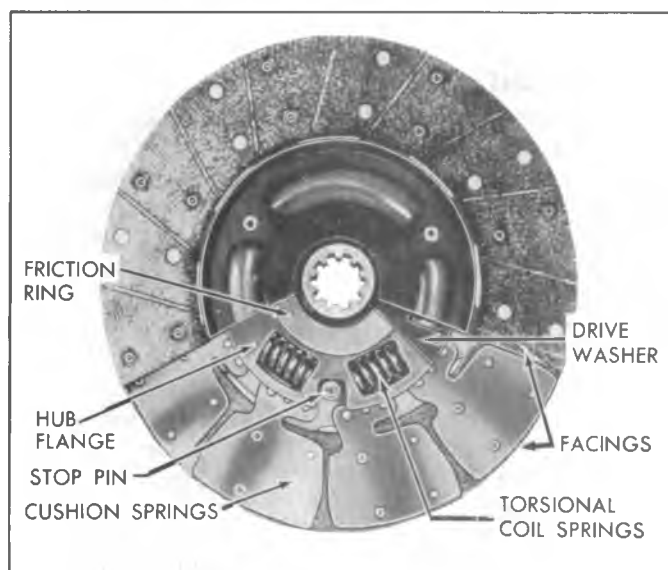


Fig. 7C-3--Clutch Disc

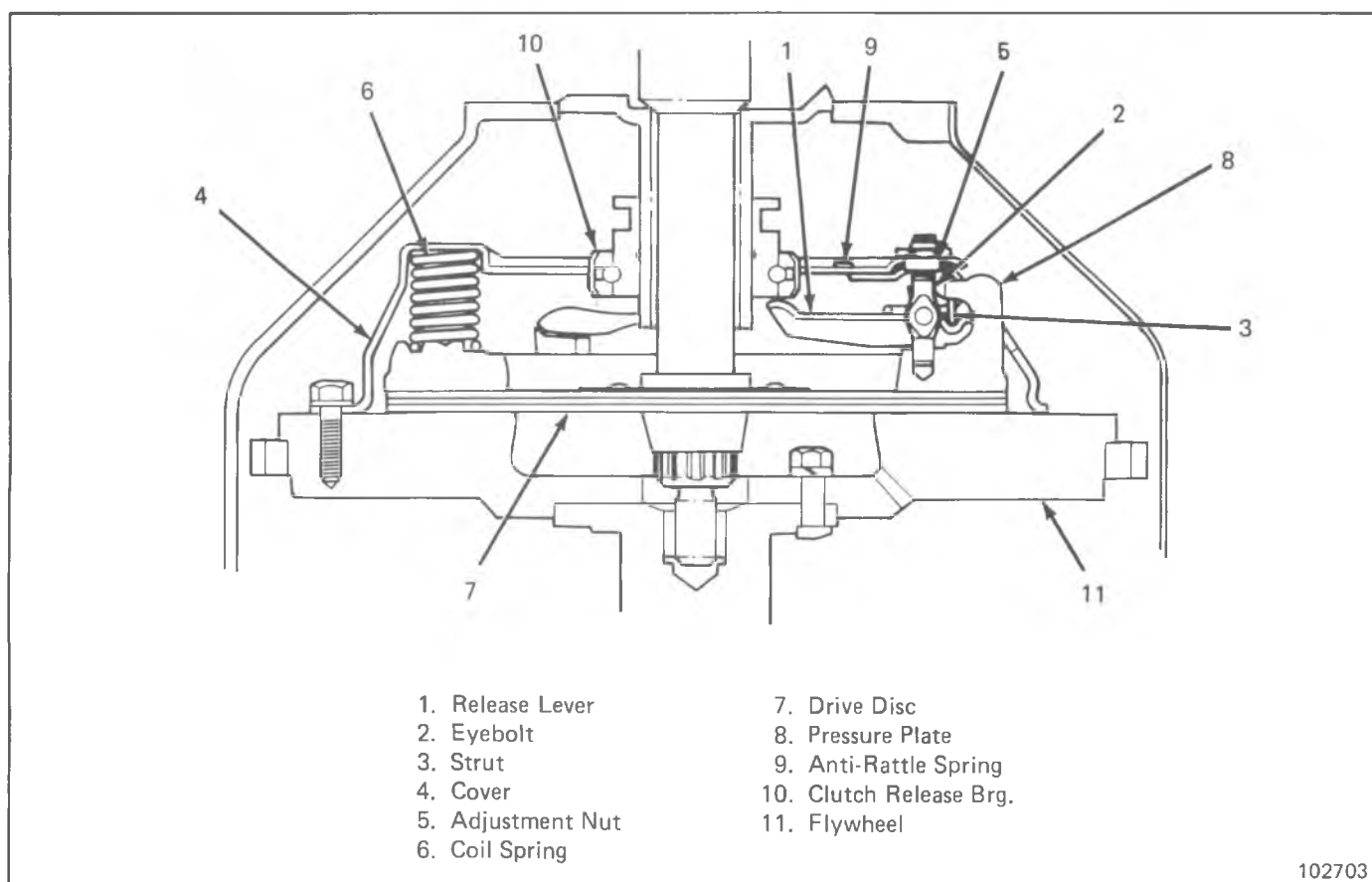


Fig. 7C-4--Cross-Section View of Coil Spring Type

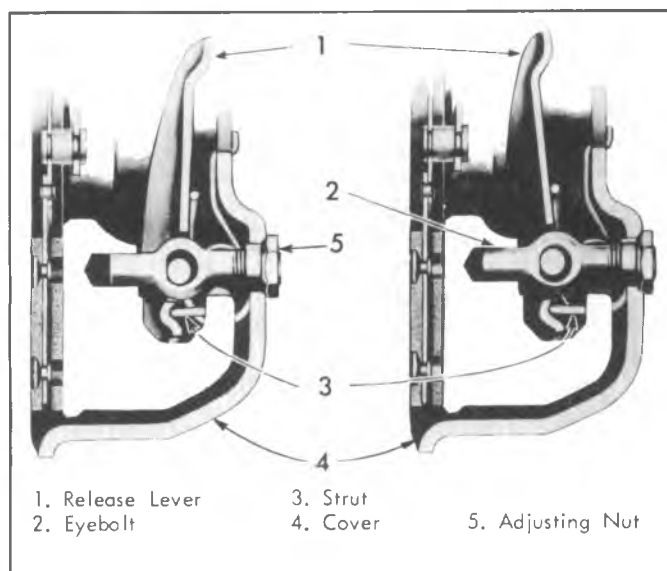


Fig. 7C-5--Release Lever, Coil Spring Type

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.

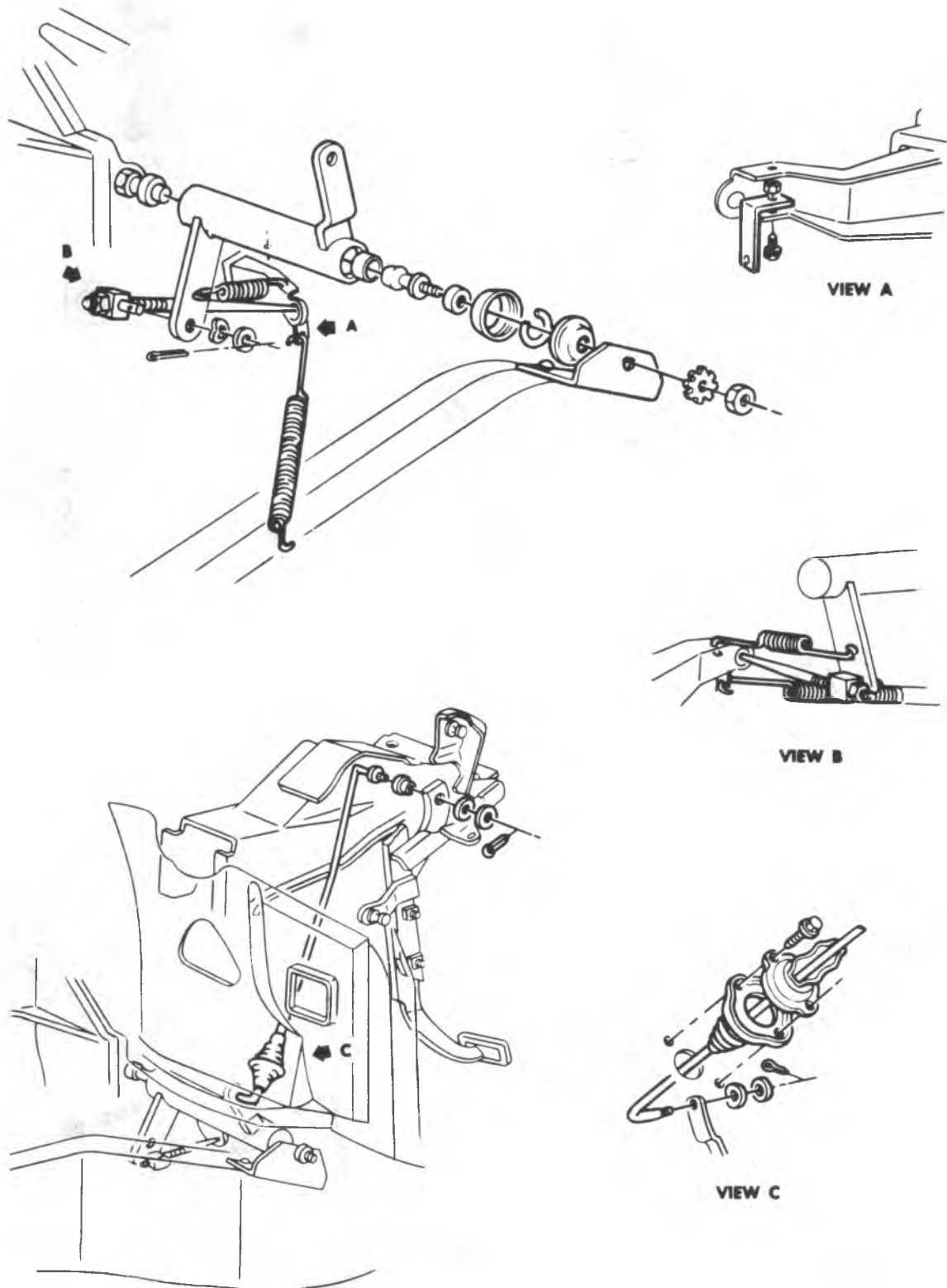


Fig. 7C-6--C-K Truck Clutch Controls

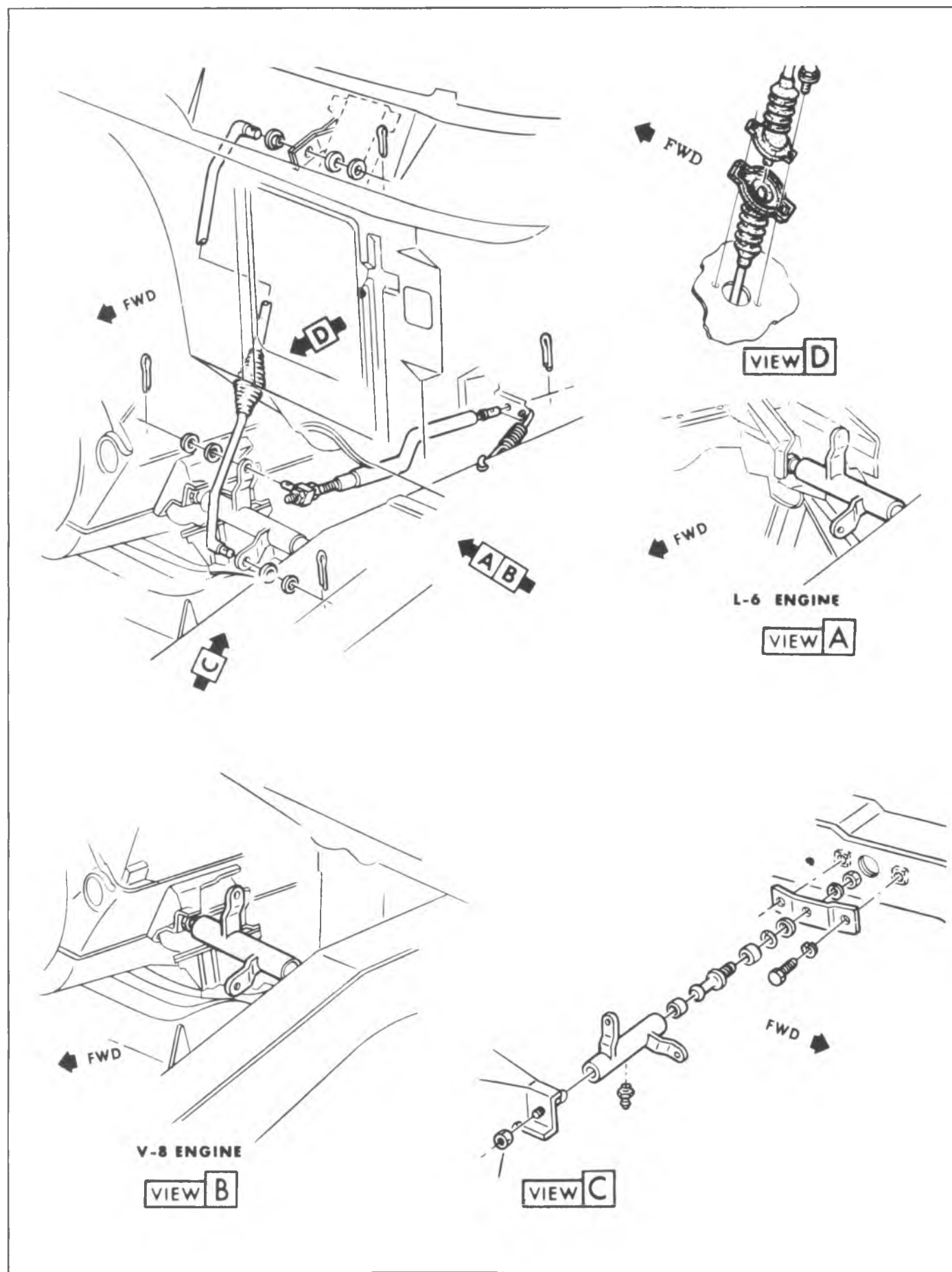


Fig. 7C-7--G-Truck Clutch Controls

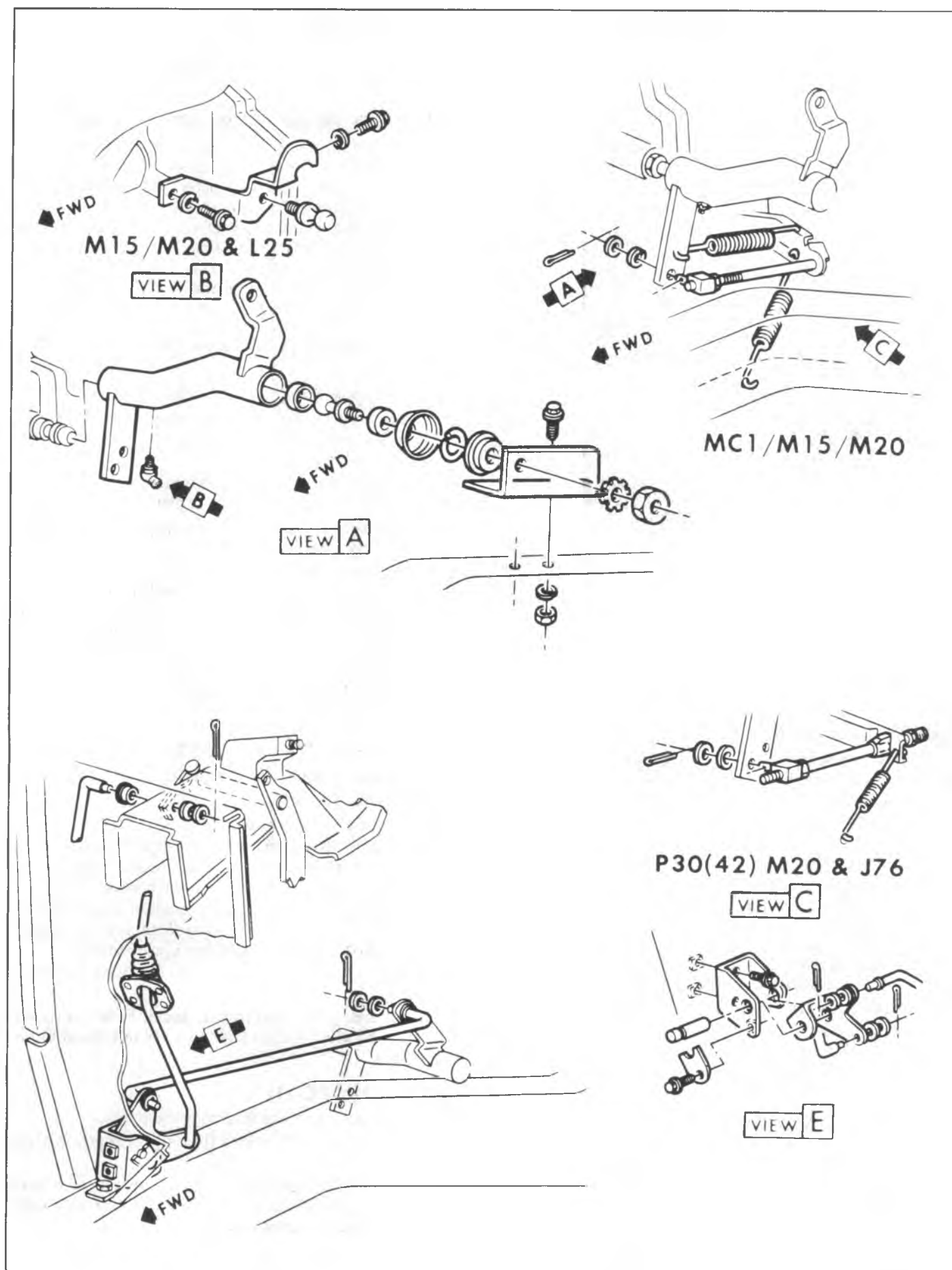


Fig. 7C-8--P-Truck Clutch Controls

MAINTENANCE AND ADJUSTMENTS

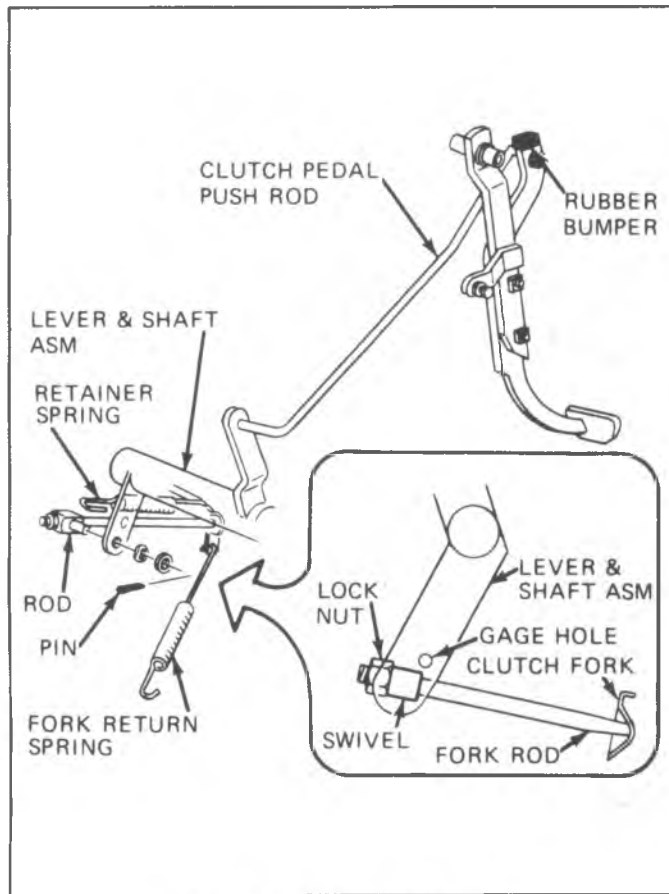


Fig. 7C-9--CK-Free Pedal Travel

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/J76) (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/J76 (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).

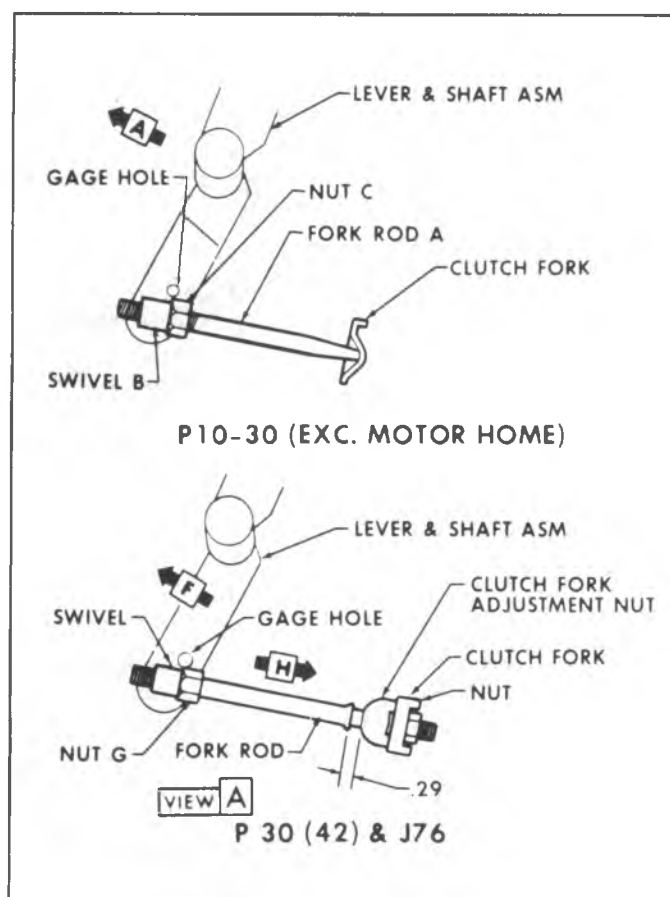


Fig. 7C-10--P-Truck Free Pedal Travel

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

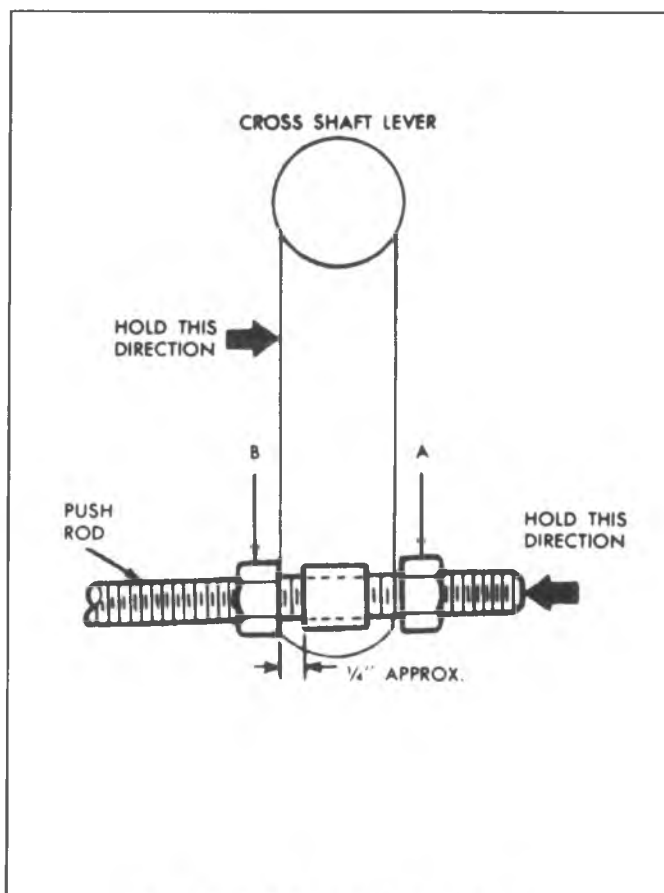


Fig. 7C-11--G-Truck Free Pedal Travel

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

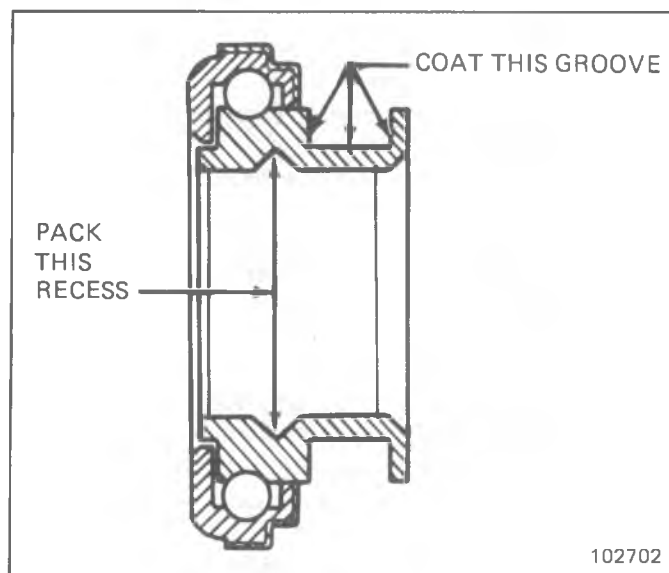


Fig. 7C-13--Lubrication Points on Clutch Release Bearing

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 if 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.

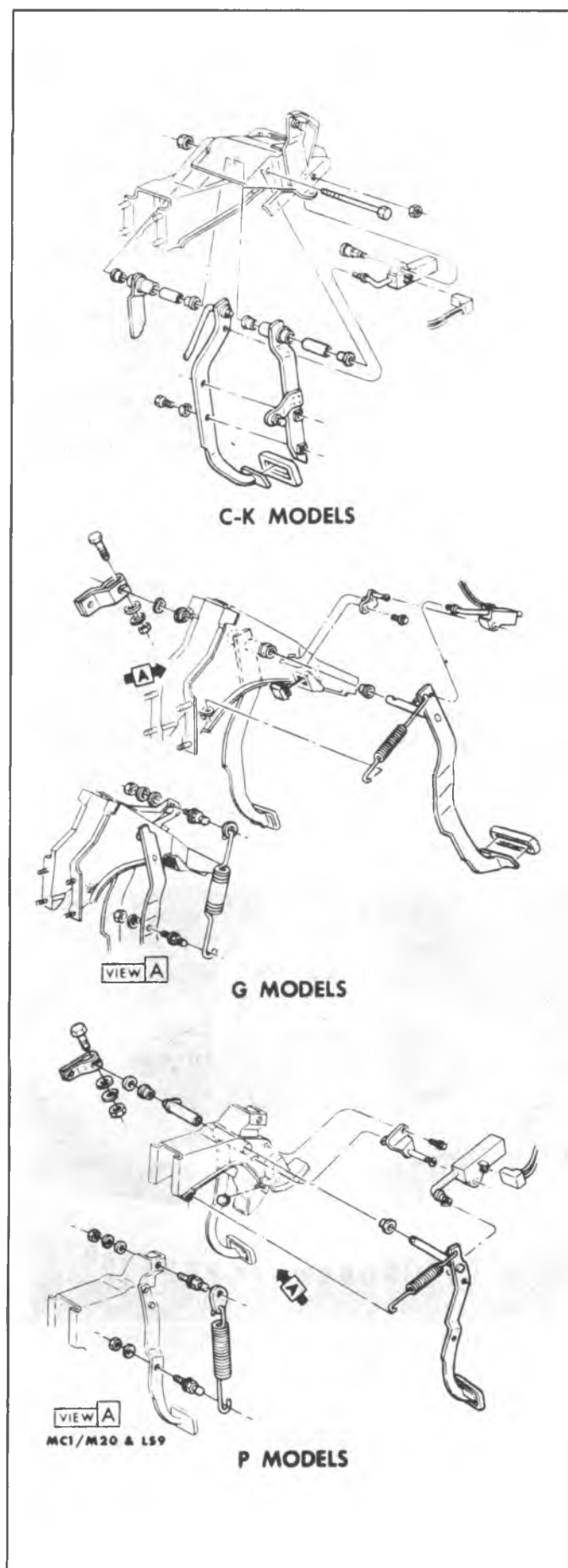
Installation

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.



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.

Fig. 7C-14--Clutch Pedal Mounting Attachment

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

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.

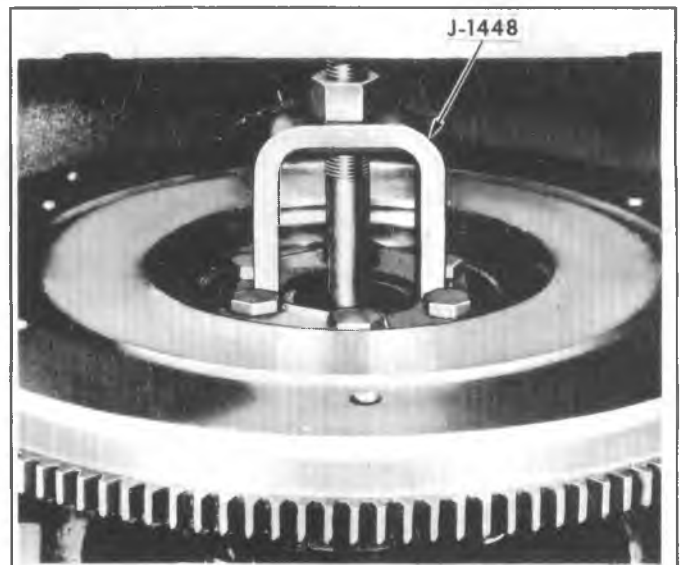


Fig. 7C-16--Clutch Pilot Bearing Removal (Typical)



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

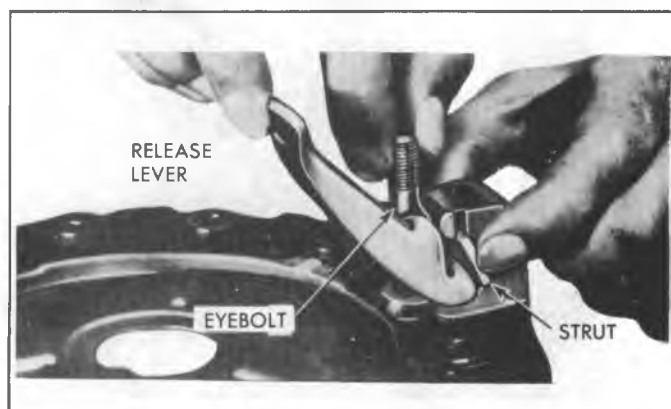


Fig. 7C-19--Grasping Lever and Strut



Fig. 7C-20--Removing or Installing Lever

inner end of lever and upper end of eyebolt are close together, keeping eyebolt pin seated in its socket in 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.

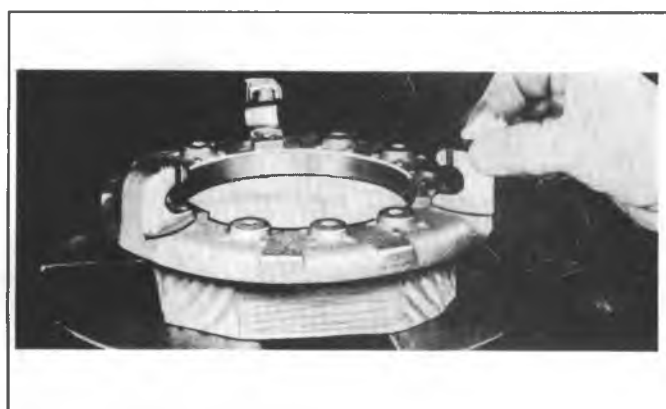


Fig. 7C-21--Greasing Lug

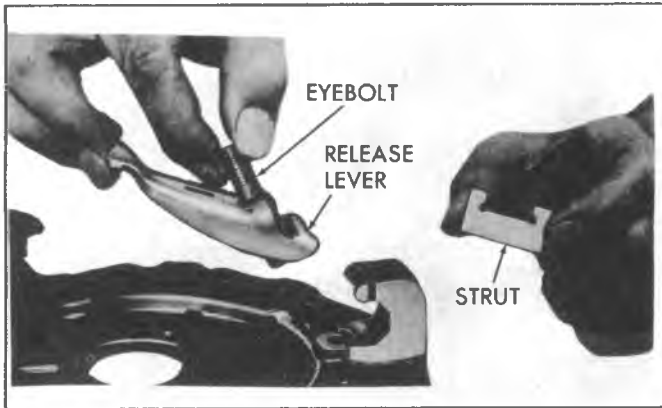


Fig. 7C-22--Installing Lever

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

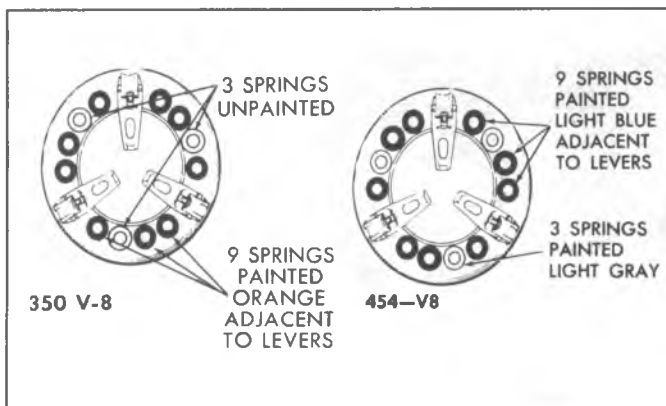


Fig. 7C-23--Spring Arrangement Diagram

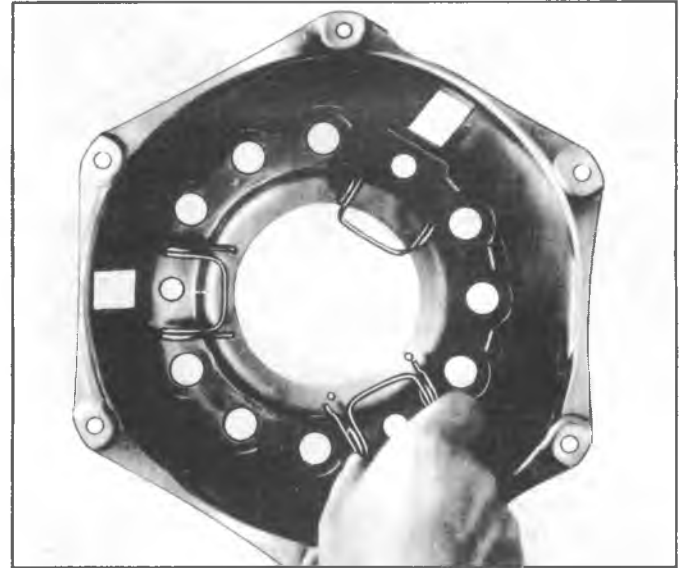


Fig. 7C-24--Installing Anti-Rattle Spring

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.

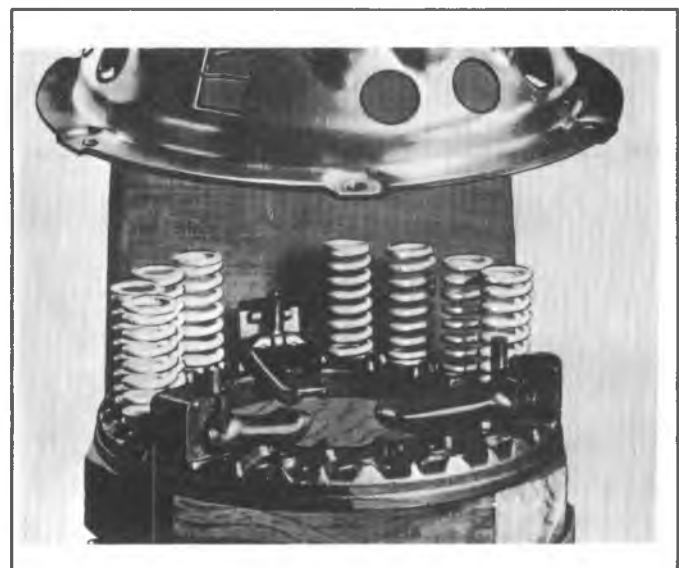


Fig. 7C-25--Assembling Cover and Pressure Plate



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

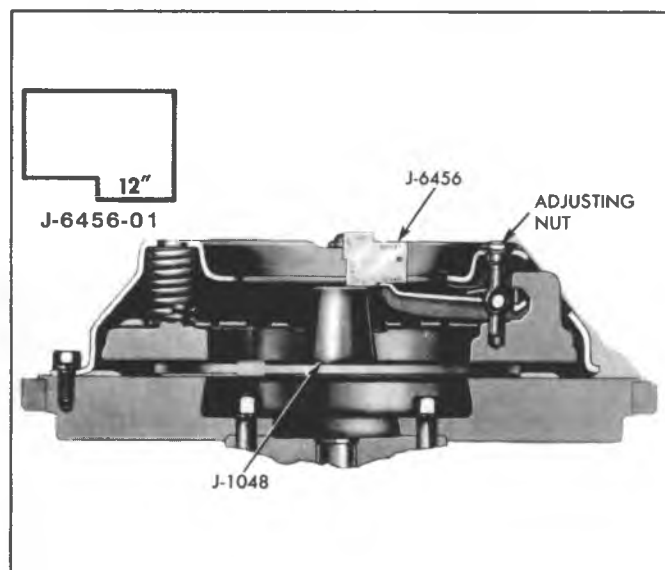


Fig. 7C-28--Coil Spring Clutch Adjustment



Fig. 7C-29--Staking Nut

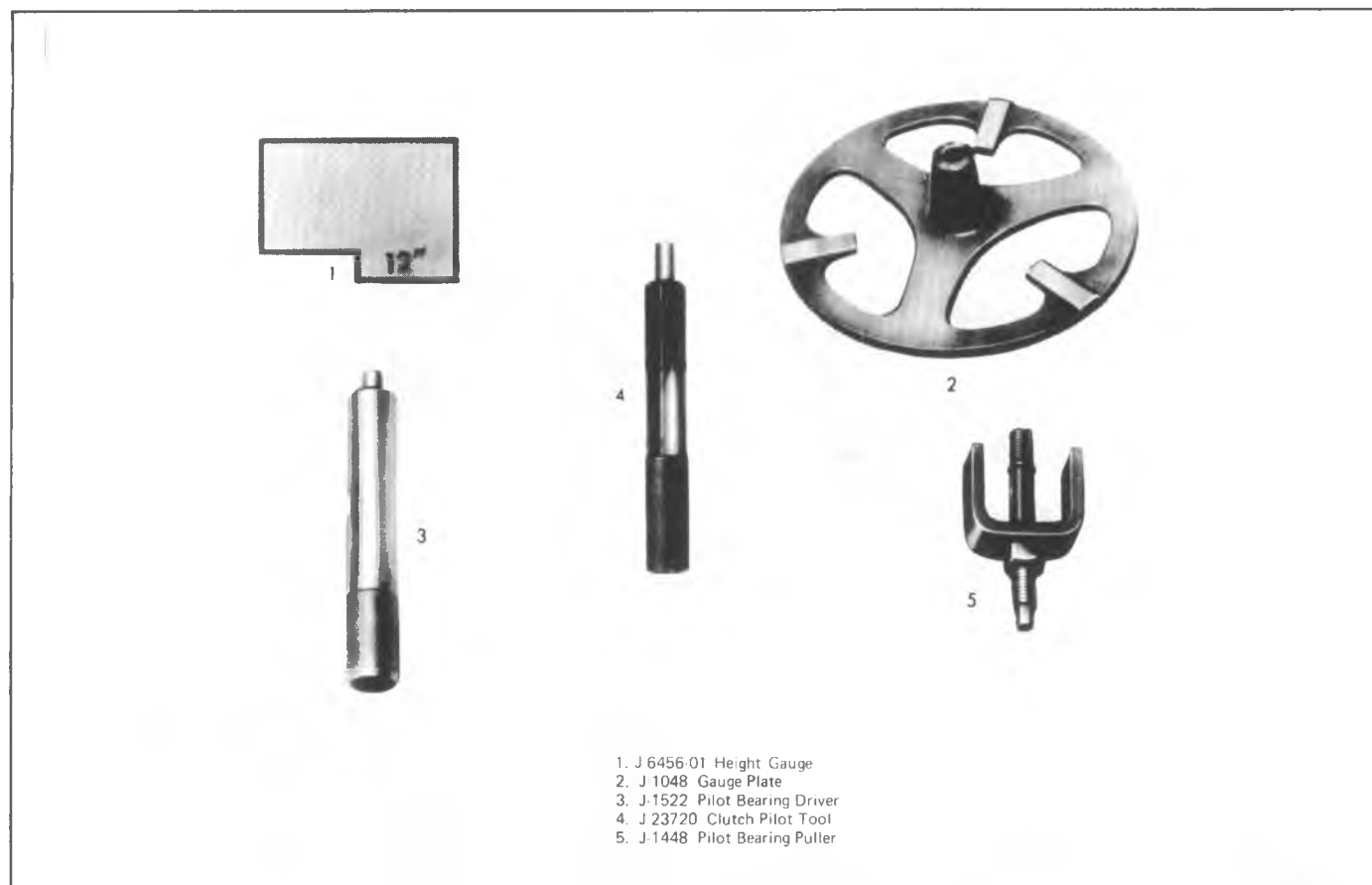


Fig. 7C-ST--Clutch Special Tools

SECTION 7E

TRANSFER CASE

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MODEL 208 TRANSFER CASE

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 connected 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

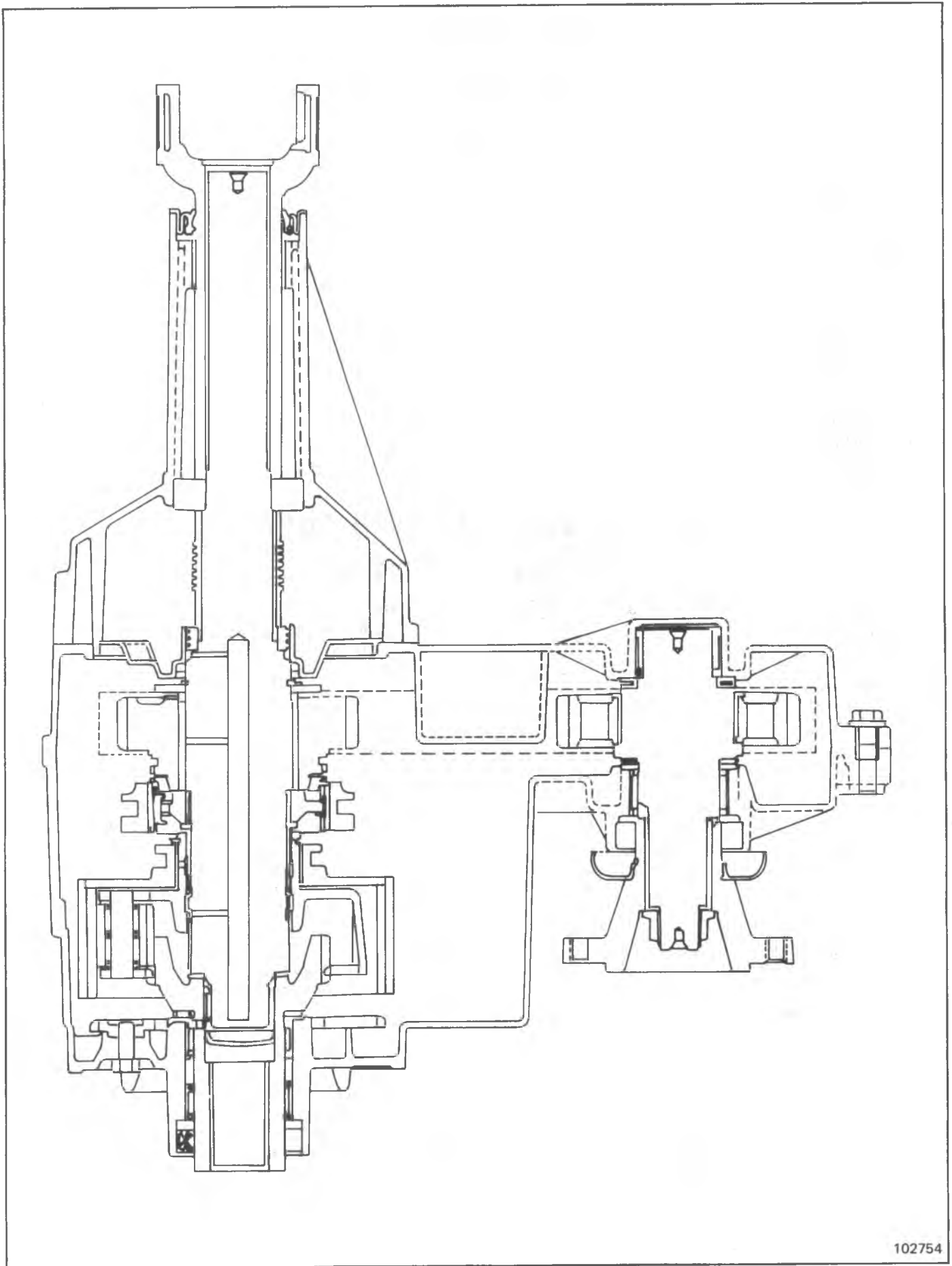
The Model 208 transfer case lubricant should be changed at the intervals specified in the Maintenance Schedule. When adding lubricant to or refilling the transfer case after service, use Dexron® II. Refer to the maintenance and adjustments section for lubricant change procedures and fill level.

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



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Fig. 7E-1 Model 208 Transfer Case (Cross Section)

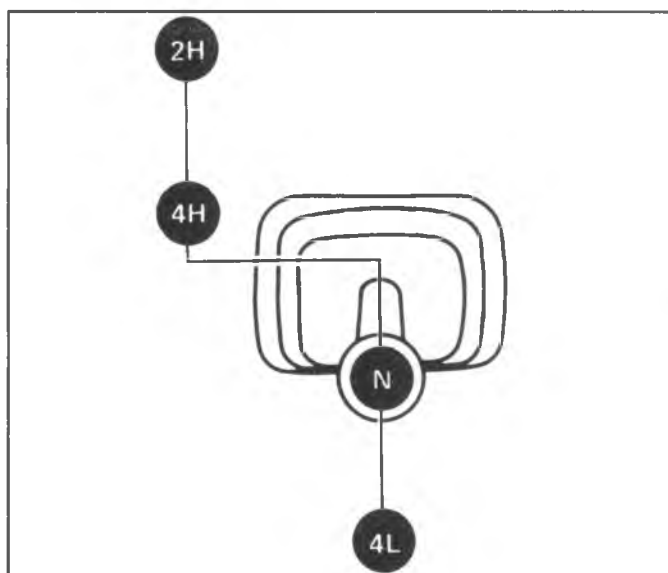


Fig. 7E-2 Model 208 Shift Pattern

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 driven 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

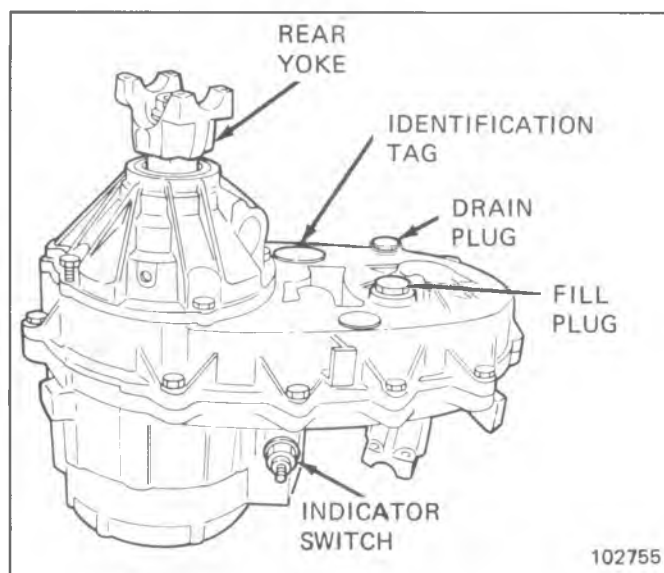


Fig. 7E-3 Model 208 Indicator Switch, Identification Tag, and Drain and Fill Plug Location

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.

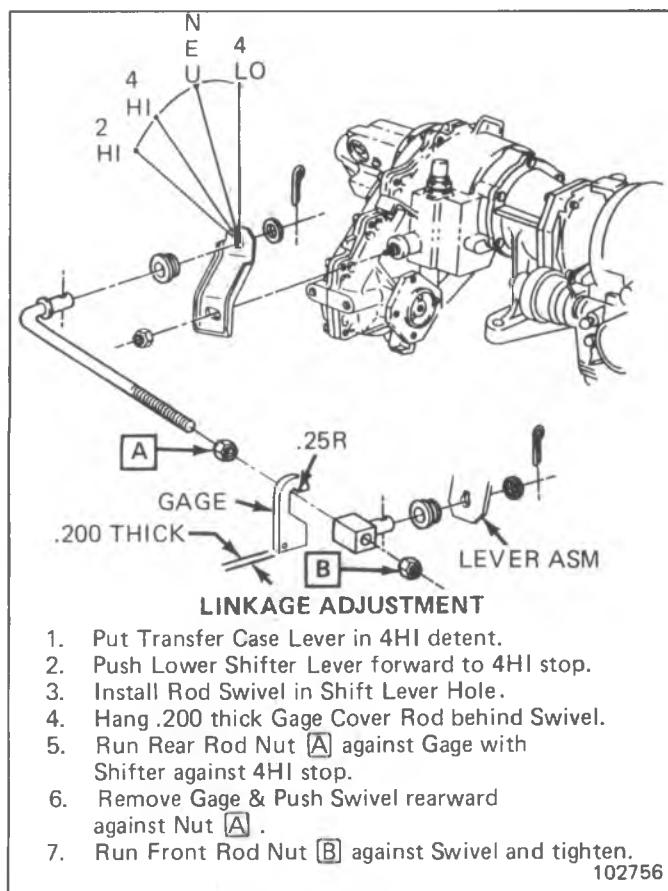


Fig. 7E-4--Linkage Adjustment

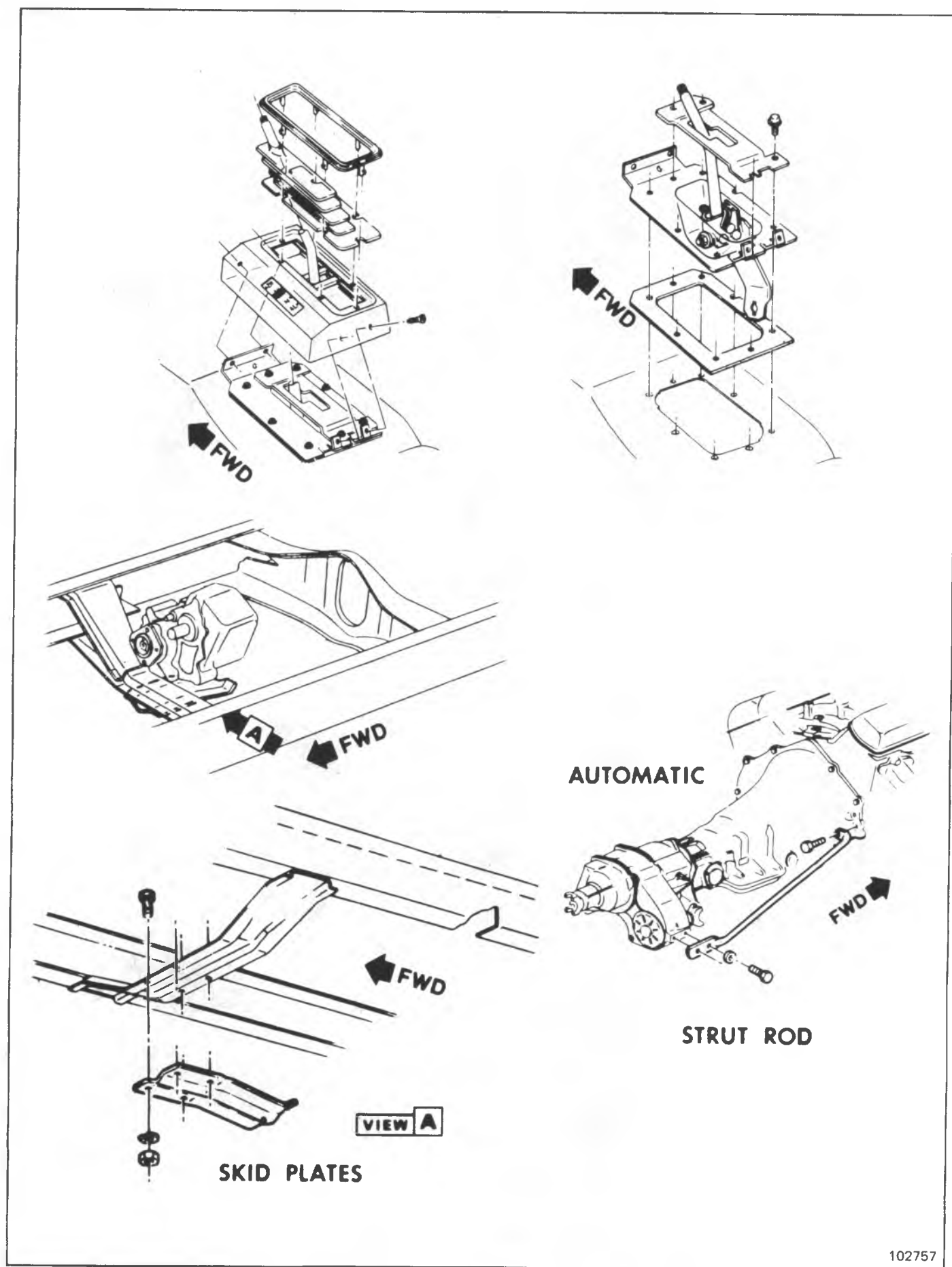
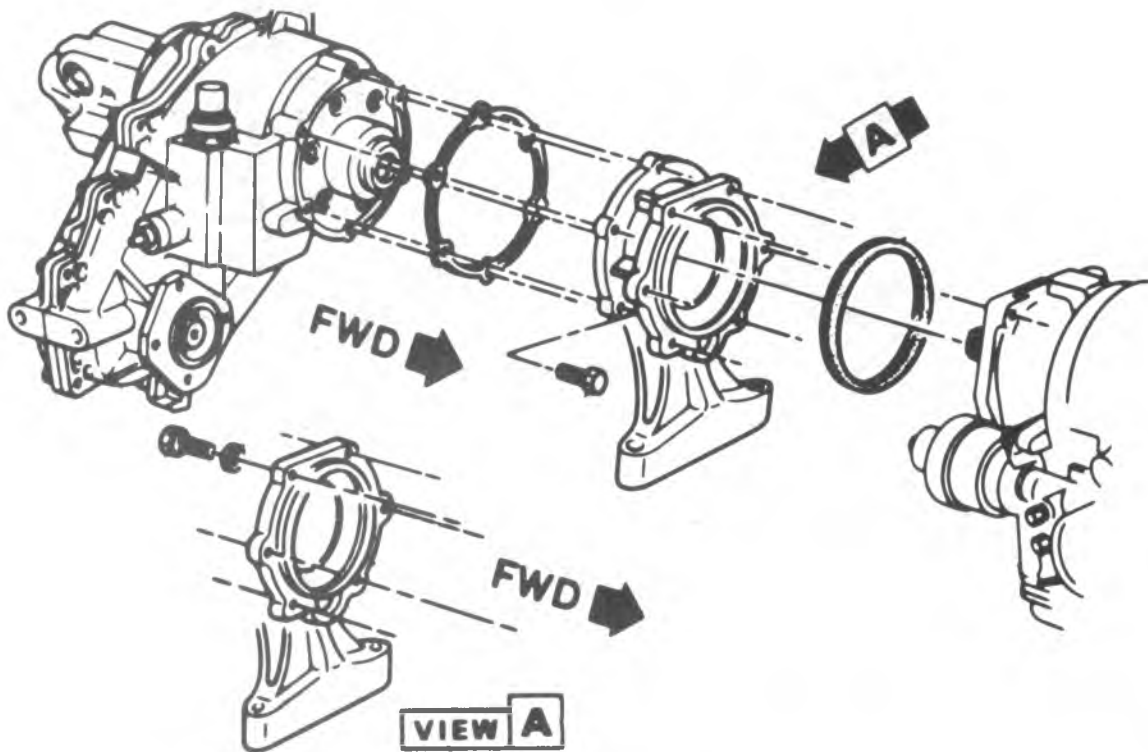
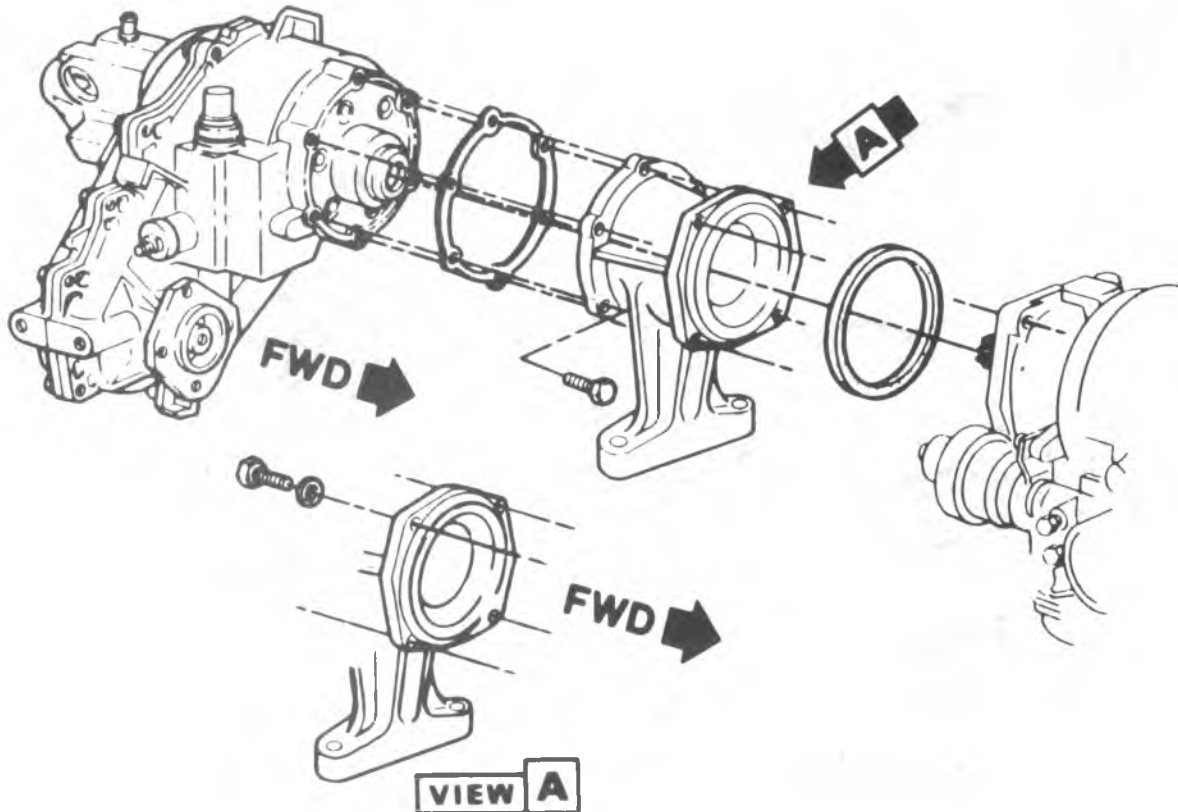


Fig. 7E-5 Transfer Case Shifter, Skid Plates and Strut Rods



WITH AUTOMATIC TRANSMISSION



WITH MANUAL TRANSMISSION

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. (2) If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficult shifting. (3) Transfer case external shift linkage binding. (4) Insufficient or incorrect lubricant. (5) Internal components binding, worn, or damaged.	(1) Stop vehicle and shift into desired range. Or reduce speed to 2-3 mph (3-4 km/h) before attempting to shift. (2) Stop vehicle, shift transmission to neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces. (3) Lubricate or repair or replace linkage, or tighten loose components as necessary. (4) Drain and refill to edge of fill hole with DEXRON®-II only. (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. (2) Shift linkage loose or binding. (3) Range fork cracked, inserts worn, or fork is binding on shift rail. (4) Annulus gear or lockplate worn or damaged.	(1) Stop vehicle, shift transfer case in Neutral, then shift back into 4L position. (2) Tighten, lubricate, or repair linkage as necessary. (3) Disassemble unit and repair as necessary. (4) Disassemble unit and repair as necessary.
LUBRICANT LEAKING FROM OUTPUT SHAFT SEALS OR FROM VENT	(1) Transfer case overfilled. (2) Vent closed or restricted. (3) Output shaft seals damaged or installed incorrectly.	(1) Drain to correct level. (2) Clear or replace vent if necessary. (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

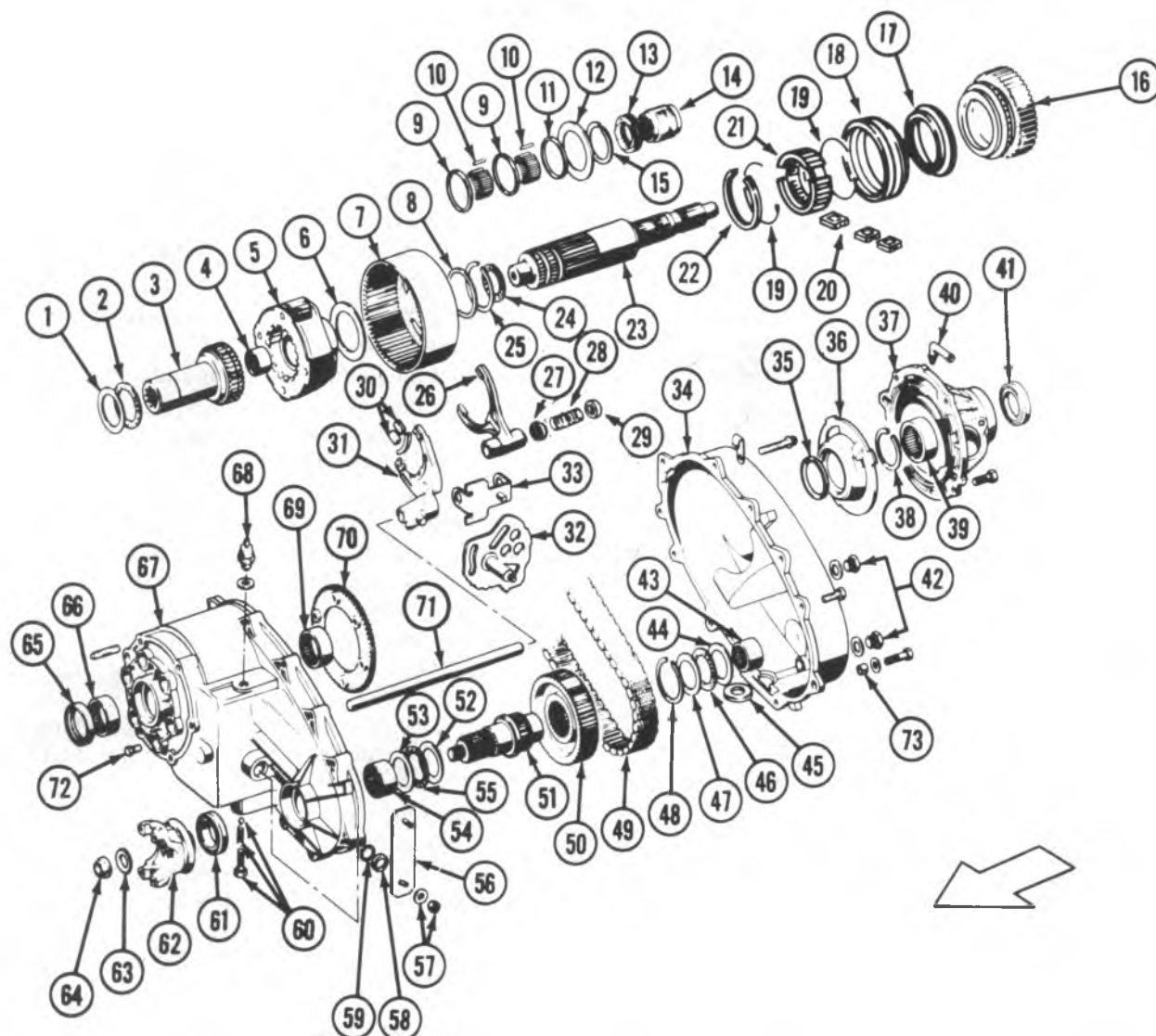
TRANSFER CASE

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 | 33. MODE FORK BRACKET | 57. WASHER AND LOCKNUT |
| 2. INPUT GEAR THRUST BEARING | 34. REAR CASE | 58. RANGE SECTOR SHAFT SEAL |
| 3. INPUT GEAR | 35. SEAL | RETAINER |
| 4. MAINSHAFT PILOT BEARING | 36. PUMP HOUSING | 59. RANGE SECTOR SHAFT SEAL |
| 5. PLANETARY ASSEMBLY | 37. REAR RETAINER | 60. DETENT BALL, SPRING AND |
| 6. PLANETARY THRUST WASHER | 38. BEARING SNAP RING | RETAINER BOLT |
| 7. ANNULUS GEAR | 39. REAR OUTPUT BEARING | 61. FRONT SEAL |
| 8. ANNULUS GEAR THRUST WASHER | 40. VENT TUBE | 62. FRONT YOKE |
| 9. NEEDLE BEARING SPACERS | 41. REAR SEAL | 63. YOKE SEAL WASHER |
| 10. MAINSHAFT NEEDLE BEARINGS (120) | 42. DRAIN AND FILL PLUGS | 64. YOKE NUT |
| 11. NEEDLE BEARING SPACER | 43. FRONT OUTPUT SHAFT REAR | 65. INPUT GEAR OIL SEAL |
| 12. SPACER WASHER | BEARING | 66. INPUT GEAR FRONT BEARING |
| 13. OIL PUMP GEAR | 44. FRONT OUTPUT SHAFT REAR THRUST | 67. FRONT CASE |
| 14. SPEEDOMETER GEAR | BEARING RACE (THICK) | 68. LOCK MODE INDICATOR SWITCH |
| 15. DRIVE SPROCKET SNAP RING | 45. CASE MAGNET | AND WASHER |
| 16. DRIVE SPROCKET | 46. FRONT OUTPUT SHAFT REAR THRUST | 69. INPUT GEAR REAR BEARING |
| 17. BLOCKER RING | BEARING | 70. LOCKPLATE |
| 18. SYNCHRONIZER SLEEVE | 47. FRONT OUTPUT SHAFT REAR THRUST | 71. SHIFTER FORK SHAFT |
| 19. SYNCHRONIZER SPRING | BEARING RACE (THIN) | 72. LOCKPLATE BOLTS |
| 20. SYNCHRONIZER KEY | 48. DRIVEN SPROCKET RETAINING RING | 73. CASE ALIGNMENT DOWELS |
| 21. SYNCHRONIZER HUB | 49. DRIVE CHAIN | |
| 22. SYNCHRONIZER HUB SNAP RING | 50. DRIVEN SPROCKET | |
| 23. MAINSHAFT | 51. FRONT OUTPUT SHAFT | |
| 24. MAINSHAFT THRUST BEARING | 52. FRONT OUTPUT SHAFT FRONT | |
| 25. INTERNAL GEAR SNAP RING | THRUST BEARING RACE (THIN) | |
| 26. MODE FORK | 53. FRONT OUTPUT SHAFT FRONT | |
| 27. BUSHING, SHIFT ROD | THRUST BEARING RACE (THICK) | |
| 28. SPRING | 54. FRONT OUTPUT SHAFT FRONT | |
| 29. SPRING RETAINER | BEARING | |
| 30. RANGE FORK PADS | 55. FRONT OUTPUT SHAFT FRONT | |
| 31. RANGE FORK | THRUST BEARING | |
| 32. RANGE SECTOR | 56. OPERATING LEVER | |

Fig. 7E-8-208 Transfer Case (Exploded View)

UNIT REPAIR

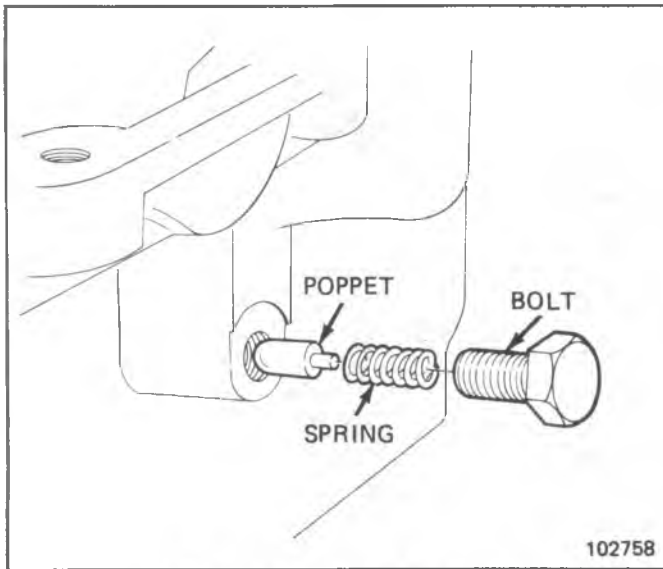


Fig. 7E-9-Poppet, Spring and Bolt

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 bushing, 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

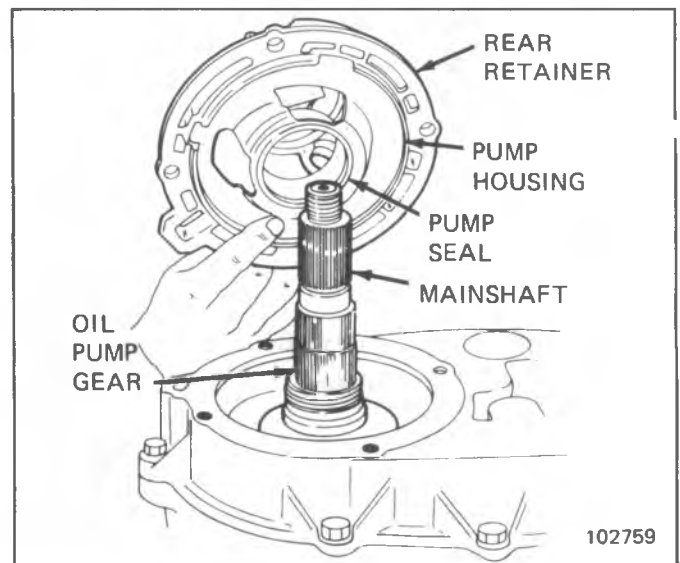


Fig. 7E-10-Rear Retainer

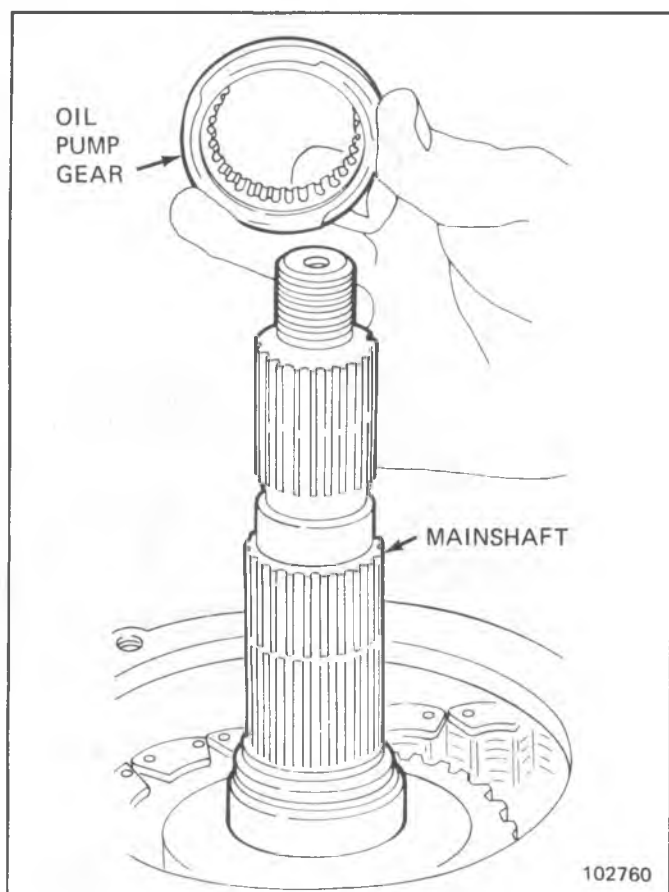


Fig. 7E-11-Oil Pump

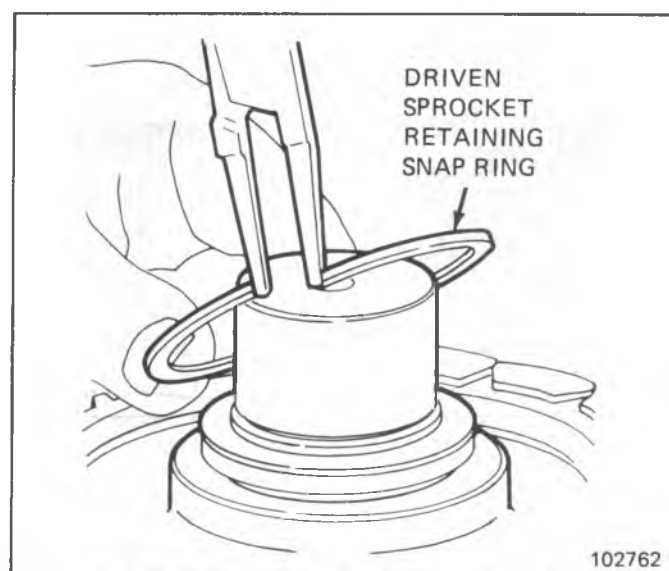


Fig. 7E-13-Driven Sprocket Retaining Snap Ring

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

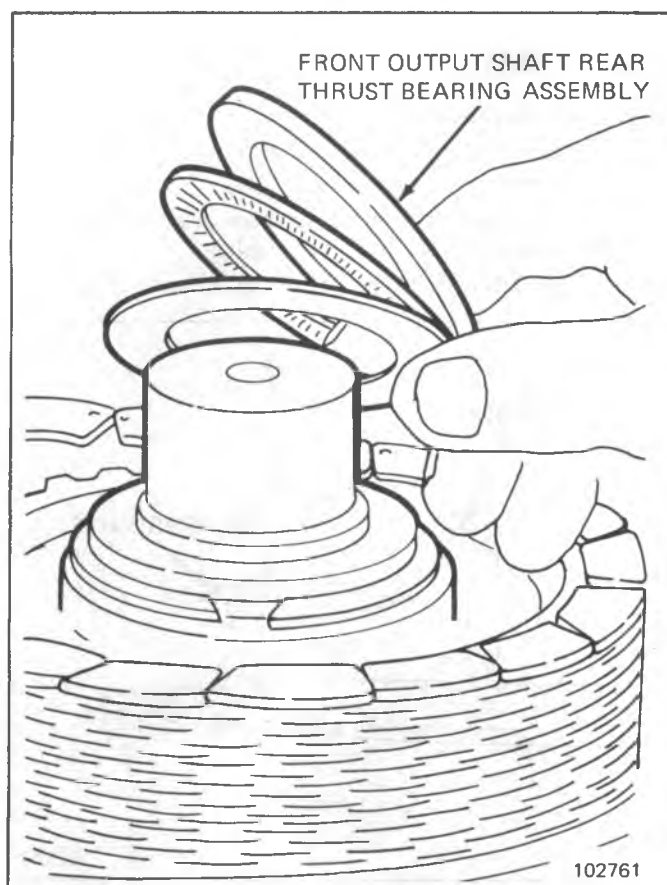


Fig. 7E-12-Front Output Shaft Rear Thrust Bearing

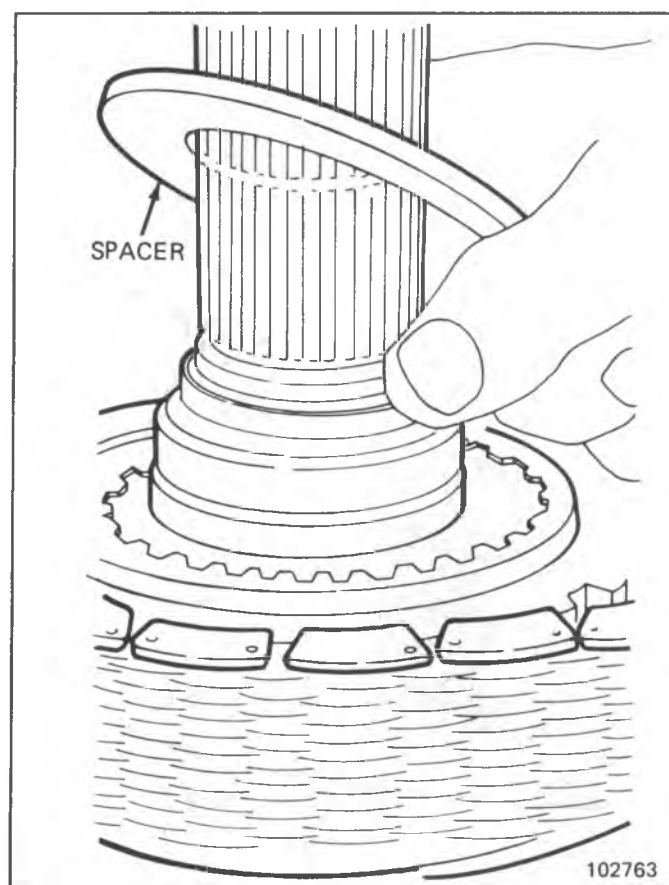


Fig. 7E-14-Drive Sprocket Thrust Washer

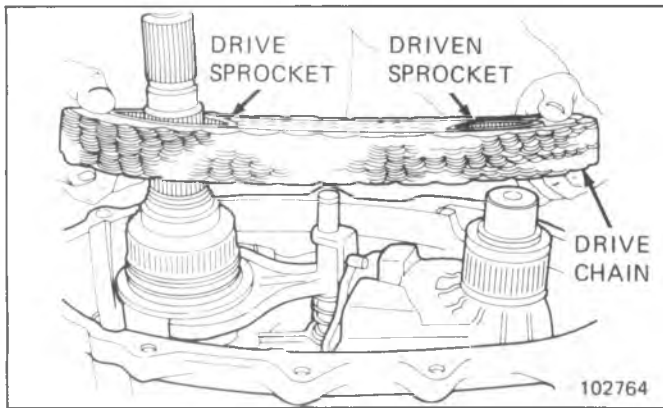


Fig. 7E-15-Sprocket and Chain

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.

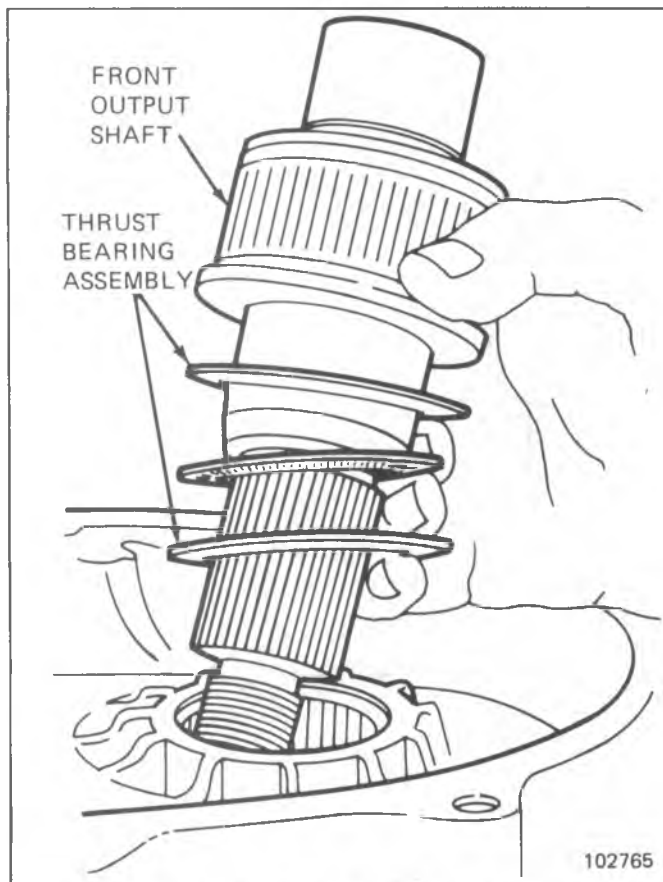


Fig. 7E-16-Front Output Shaft and Front Thrust Bearing Assembly

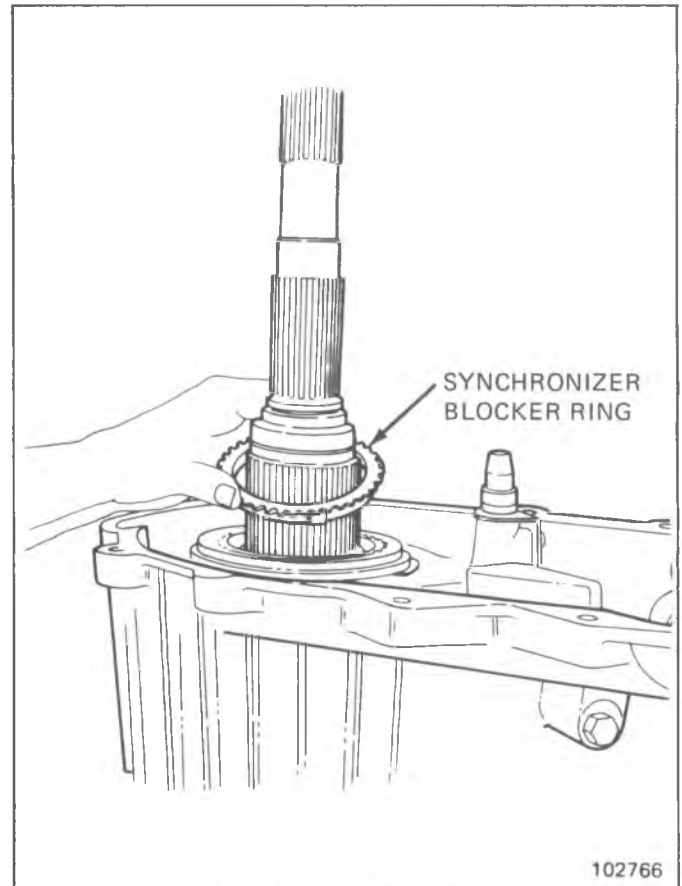


Fig. 7E-17-Synchronizer Blocker Ring

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

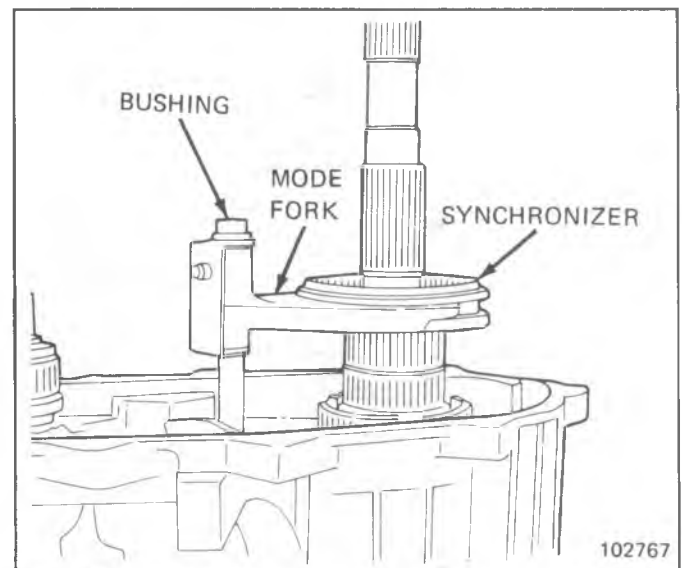


Fig. 7E-18-Synchronizer, Mode Fork Bushing, Mode Fork and Bracket

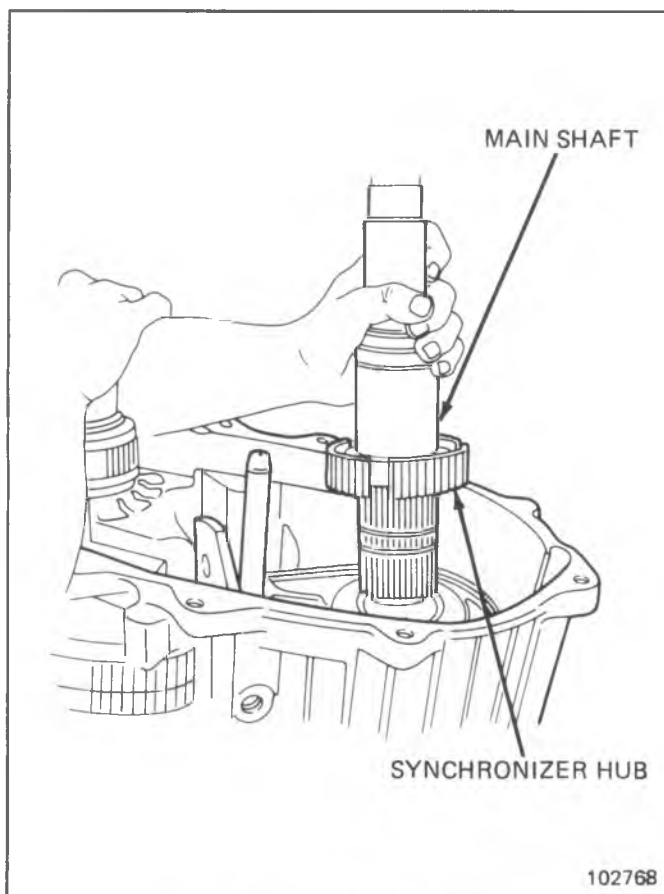


Fig. 7E-19-Mainshaft

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

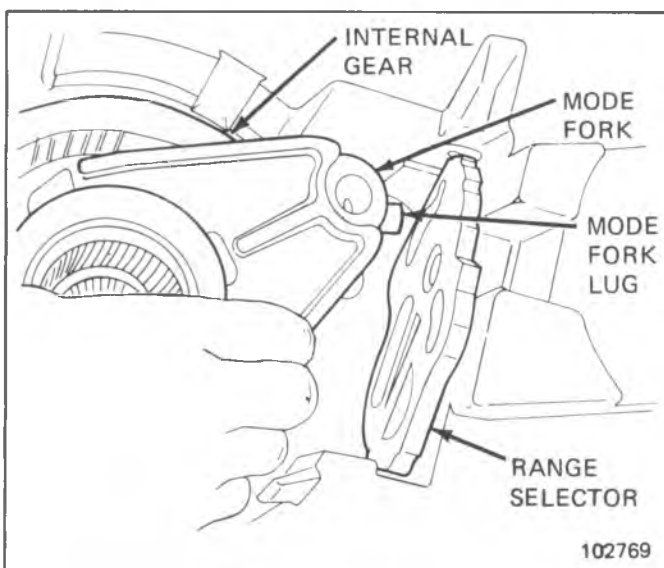


Fig. 7E-20-Annulus Gear and Mode Fork

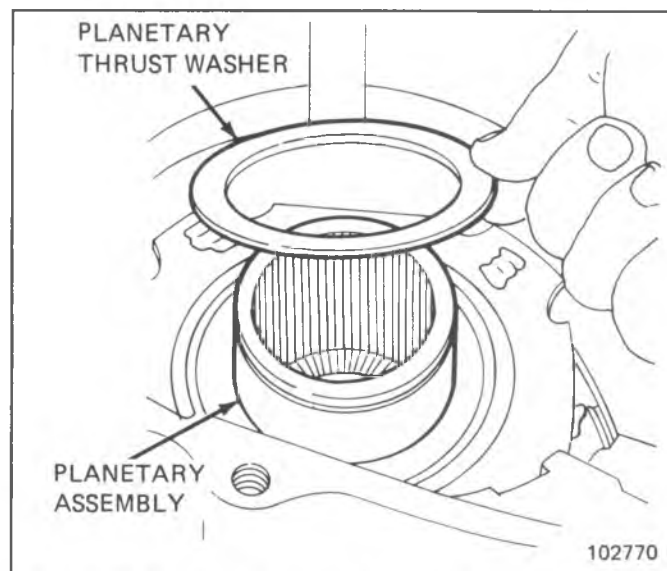


Fig. 7E-21-Planetary Thrust Washer and Planetary Assembly

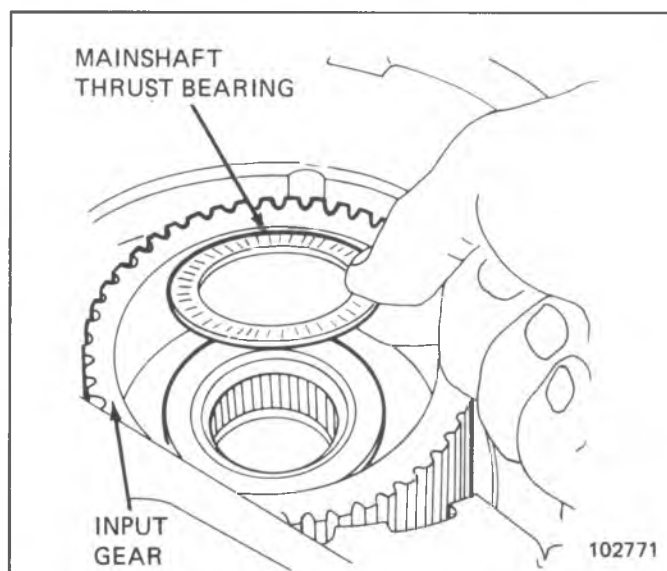


Fig. 7E-22-Mainshaft Thrust Bearing and Input Gear

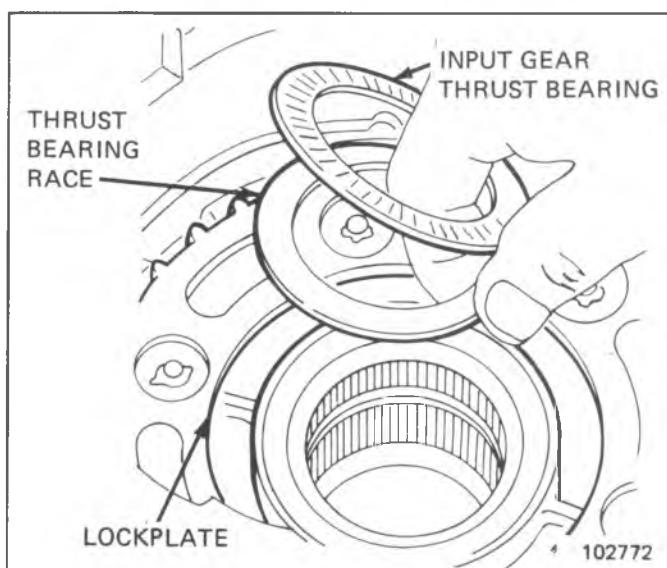


Fig. 7E-23-Input Gear Thrust Bearing and Race

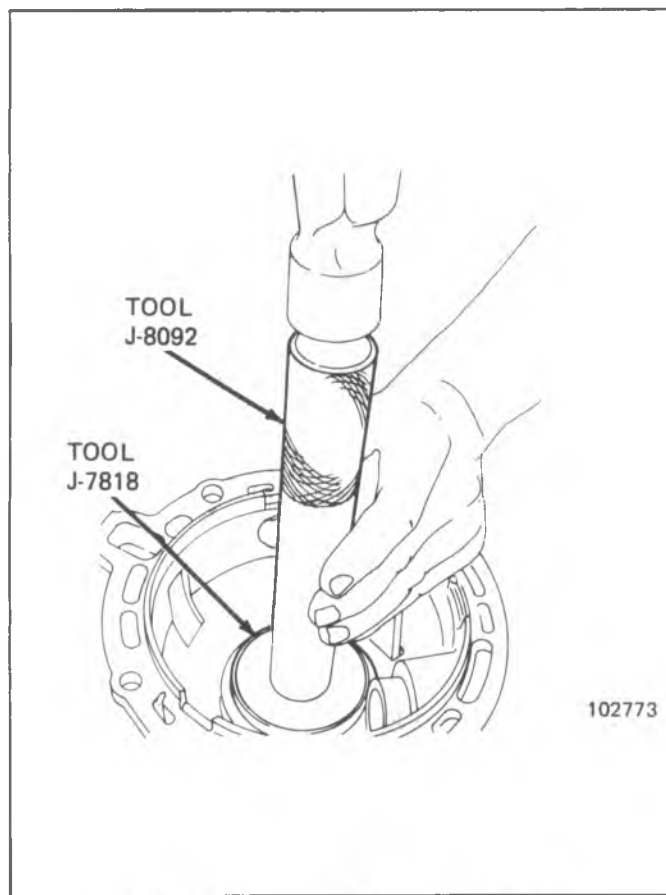


Fig. 7E-24-Rear Output Bearing Installation

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.

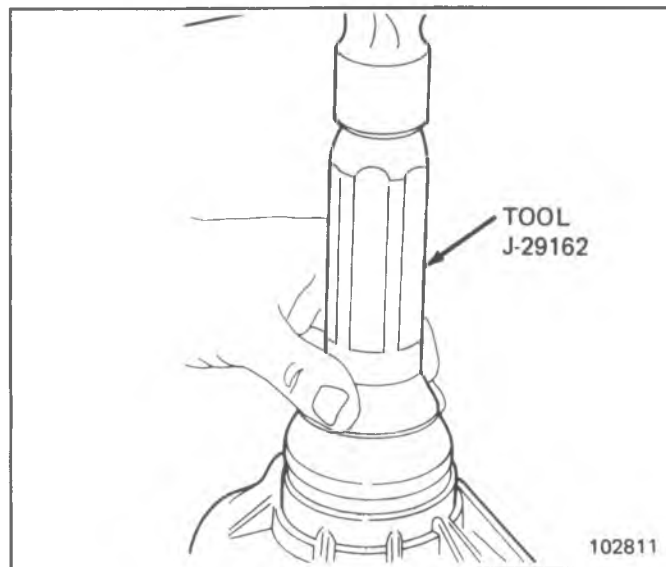


Fig. 7E-25-Rear Seal Installation

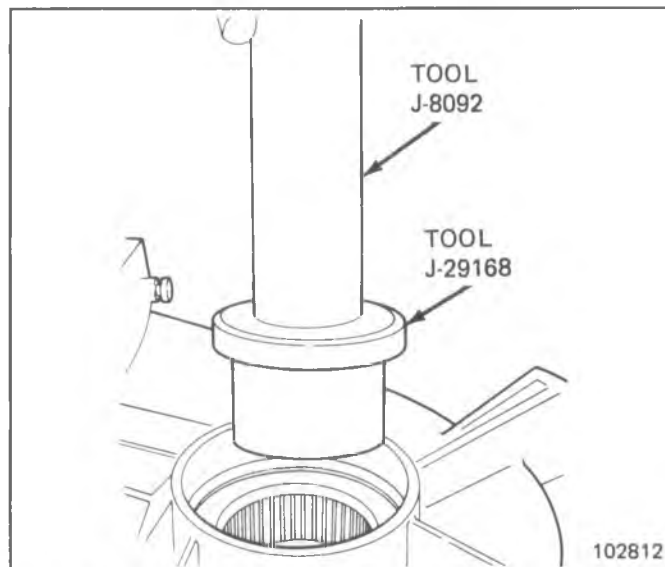


Fig. 7E-26-Front Output Shaft Front Bearing Removal

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.

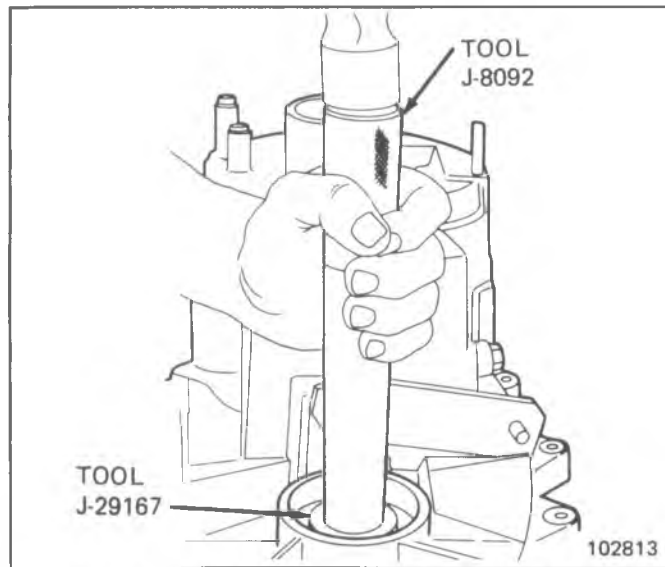


Fig. 7E-27-Front Output Shaft Front Bearing Installation

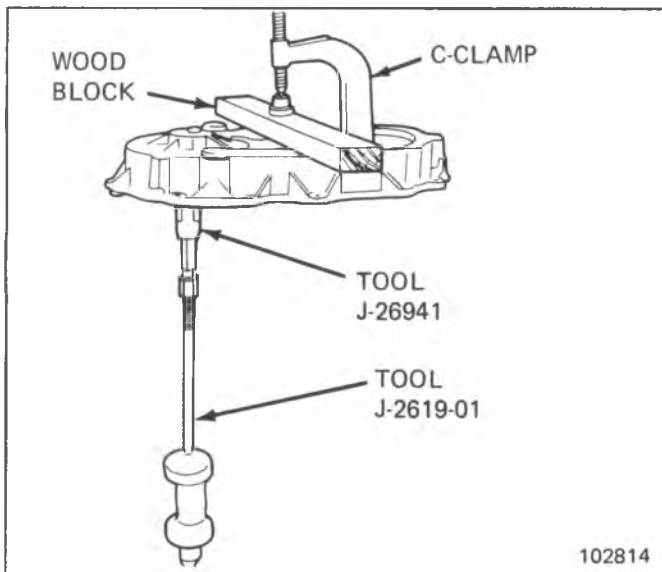


Fig. 7E-28-Front Output Shaft Rear Bearing Removal

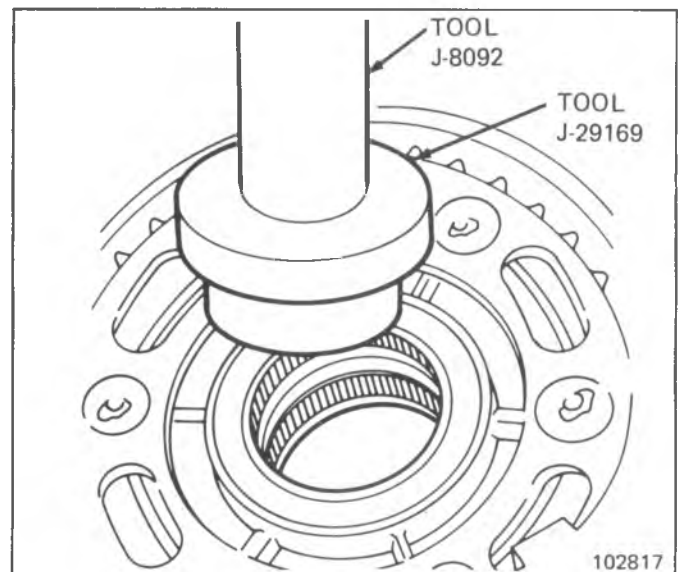


Fig. 7E-31-Input Gear Bearing Installation

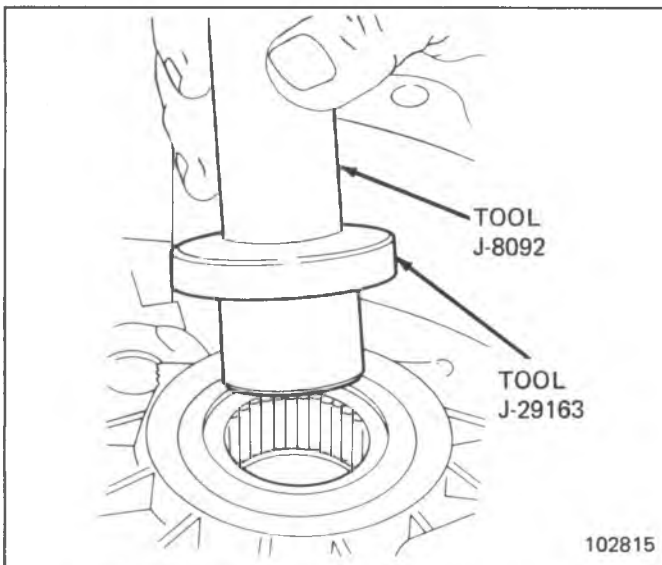


Fig. 7E-29-Front Output Shaft Rear Bearing Installation

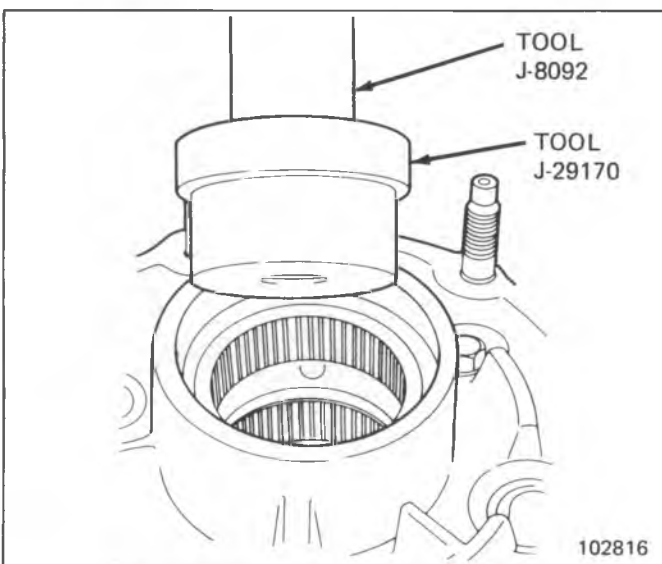


Fig. 7E-30-Input Gear Bearing Removal

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.

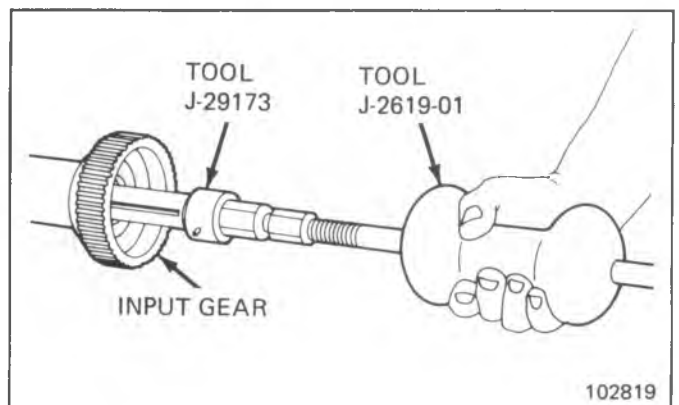


Fig. 7E-32 Mainshaft Pilot Bearing Removal

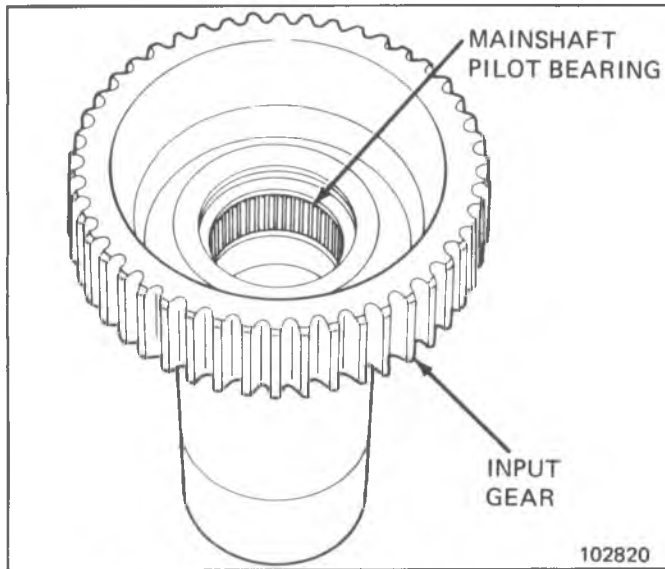


Fig. 7E-33-Mainshaft Pilot Bearing Installation

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).

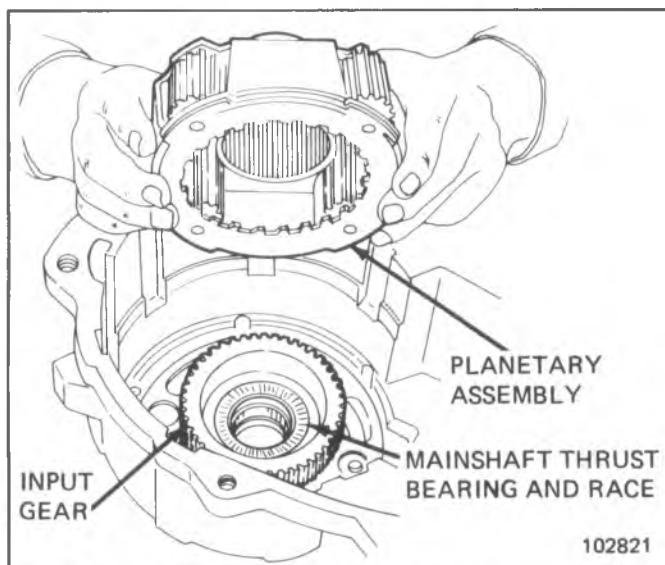


Fig. 7E-34-Input Gear, Mainshaft Thrust Bearing and Planetary Installation

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 bushing, spring and retainer on shift rail.
27. Apply Loctite 515 sealant, or equivalent, to mating

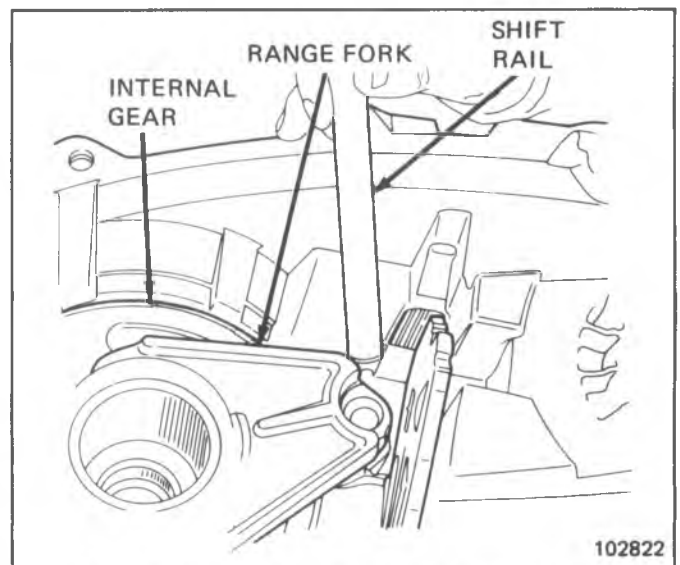


Fig. 7E-35-Annulus Gear and Shift Rail Installation

- 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.). Be sure 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 6 pints (3 liters) of Dexron® II into transfer case through fill plug hole and install and tighten fill plug to 24 N·m (18 ft. lb.).

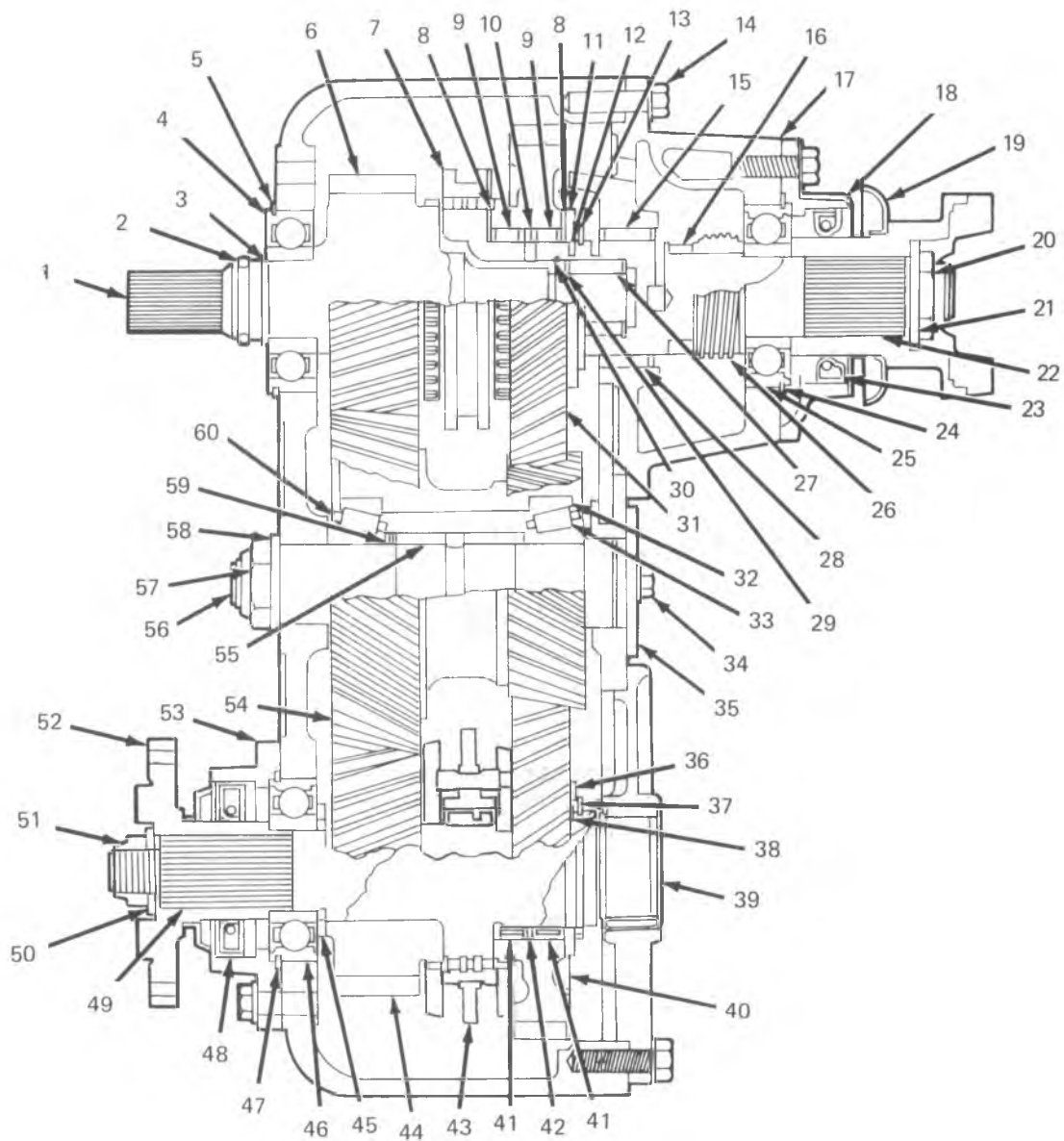
MODEL 205 TRANSFER CASE (30 SERIES)

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 | 18. Rear Bearing Retainer | 32. Idler Gear Shaft Bearing Cup | 42. Spacer |
| 2. "O" Ring | 19. Rear Yoke Assembly | 33. Idler Shaft Bearing Cone | 43. Synchronizer |
| 3. Snap Ring | 20. Locknut | 34. Idler Shaft Cover | 44. Front Wheel Hi-Gear |
| 4. Bearing | 21. Washer | 35. Idler Shaft Gear Cover and Gasket | 45. Spacer |
| 5. Snap Ring | 22. Rear Output Shaft Bearing Retainer Seal | 36. Thrust Washer | 46. Bearing |
| 6. Input Shaft Gear | 23. Bearing Retainer Seal | 37. Snap Ring | 47. Snap Ring |
| 7. Sliding Clutch | 24. Snap Ring | 38. Thrust Washer Pin | 48. Seal |
| 8. Tanged Bronze Thrust Washer | 25. Bearing | 39. Rear Bearing Retainer and Output Shaft Cover | 49. Front Output Shaft |
| 9. Roller Bearings | 26. Speedometer Gear | 40. Front Wheel Drive Low Gear | 50. Washer |
| 10. Spacer | 27. Pilot Bearings | 41. Roller Bearings | 51. Locknut |
| 11. Thrust Washer | 28. Rear Output Shaft Front Bearing | | 52. Output Yoke |
| 12. Thrust Washer Pin | 29. Washer | | 53. Bearing Retainer |
| 13. Snap Ring | 30. Bearing Retainer | | 54. Idler Gear |
| 14. Bolt and Lockwasher | 31. Rear Wheel Drive Low Gear | | 55. Idler Gear Spacer |
| 15. Needle Bearings | | | 56. Idler Shaft |
| 16. Spacer | | | 57. Locknut |
| 17. Rear Output Shaft Housing | | | 58. Washer |
| | | | 59. Bearing Cone |
| | | | 60. Bearing Cup |

102818

Fig. 7E-36--Model 205 Transfer Case (Cross Section)

MAINTENANCE AND ADJUSTMENTS

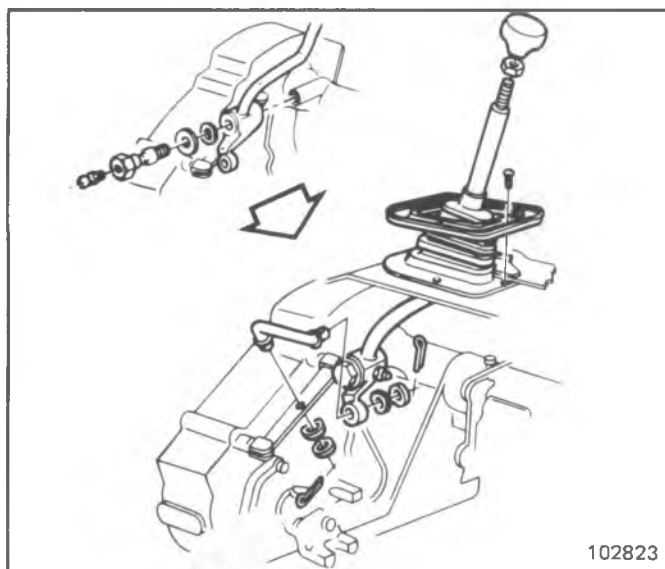


Fig. 7E-37--Model 205 Linkage

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	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 1. Fill as required 2. Replace 3. Align 4. Torque to specs. 5. Torque to specs.
Shifter Lever Difficult to Move	<ol style="list-style-type: none"> 1. Binding inside transfer case 	<ol style="list-style-type: none"> 1. Repair as required
Shifter Lever Disengages from Position	<ol style="list-style-type: none"> 1. Gears worn or damaged 2. Shift rod bent 3. Missing detent ball or spring 	<ol style="list-style-type: none"> 1. Replace 2. Replace 3. Replace
Lubricant Leaking	<ol style="list-style-type: none"> 1. Excessive lubricant in case 2. Leaking seals or gaskets 3. Loose bolts 4. Scored yoke in seal contact area 	<ol style="list-style-type: none"> 1. Adjust level 2. Replace 3. Tighten 4. Refinish or replace

Fig. 7E-38--Transfer Case Diagnosis

ON VEHICLE SERVICE

TRANSFER CASE

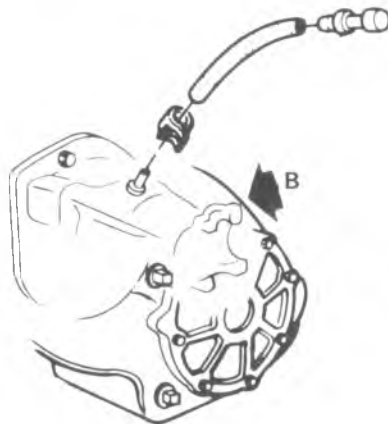
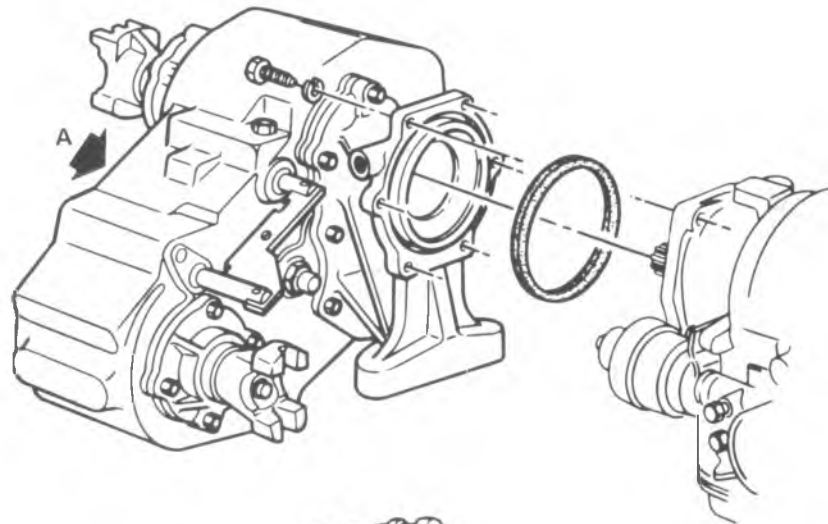
Removal (Fig. 7E-39)

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.

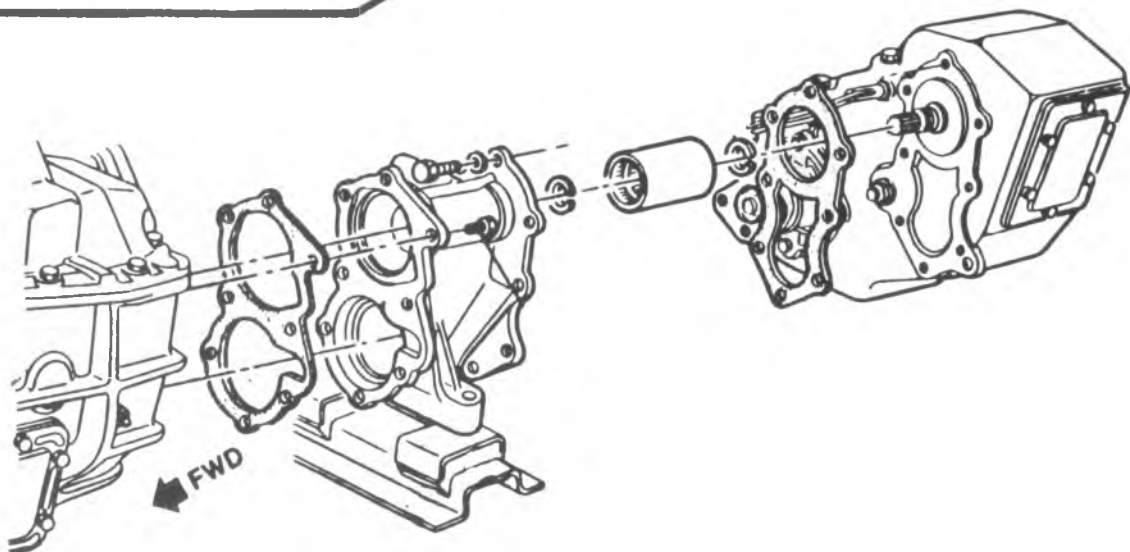
Installation

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



WITH "AUTOMATIC"
TRANSMISSION

VIEW A



WITH "MANUAL"
TRANSMISSION

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.

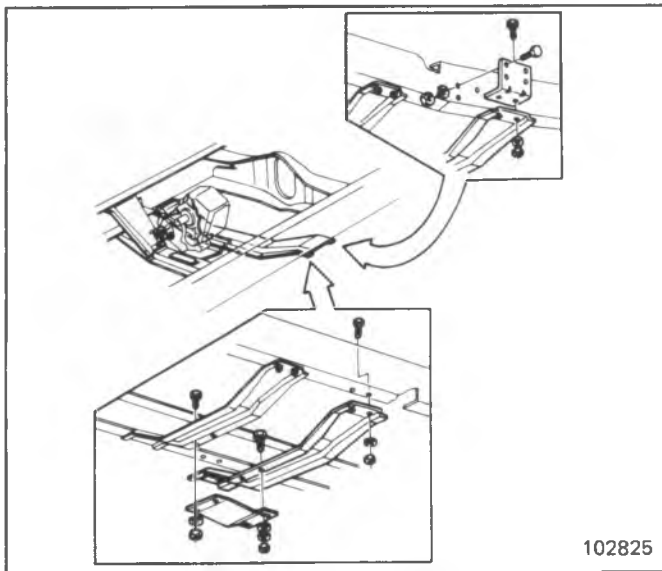


Fig. 7E-40--Skid Plates

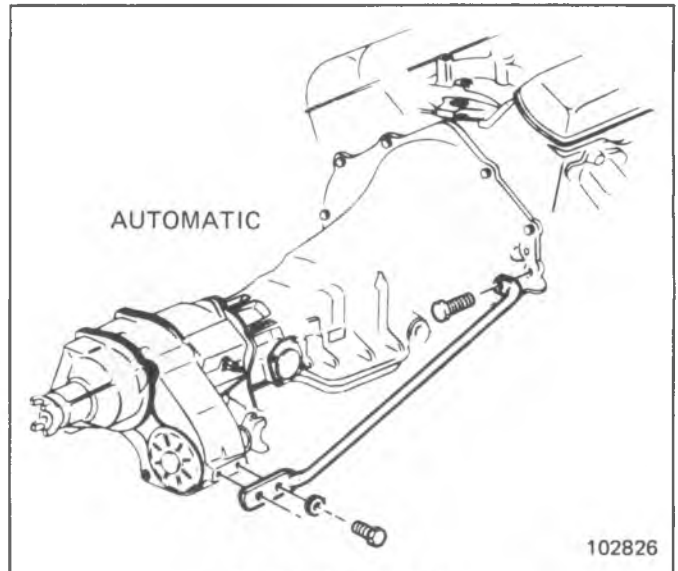


Fig. 7E-41--Strut Rods

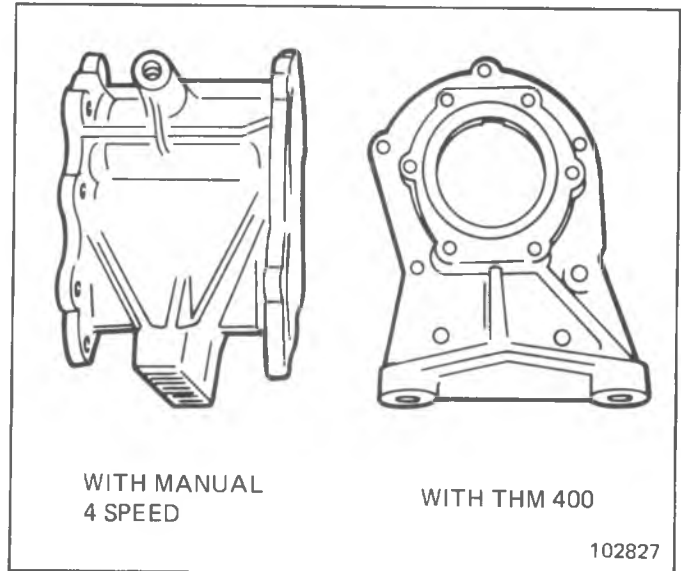


Fig. 7E-42--Adapter Assemblies

UNIT REPAIR

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.

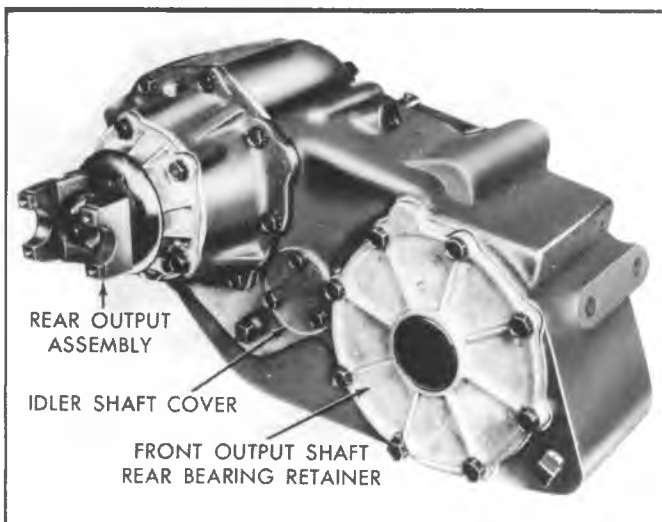


Fig. 7E-43--Rear View of Transfer Case

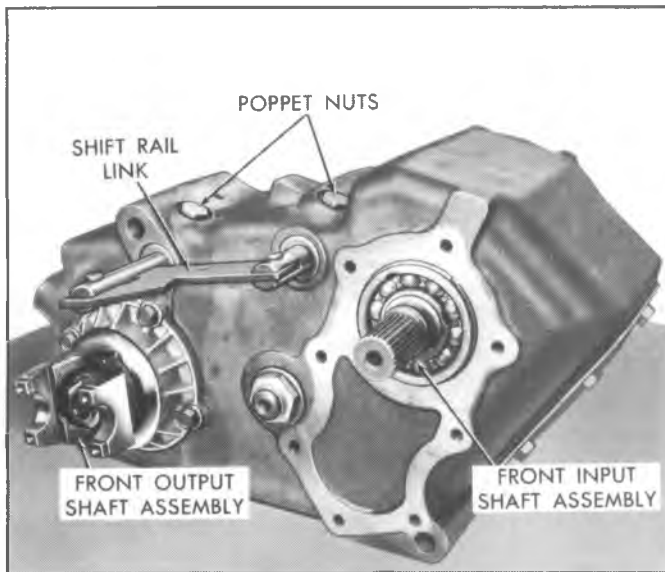


Fig. 7E-44--Front View of Transfer Case

7. Remove tapered 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.

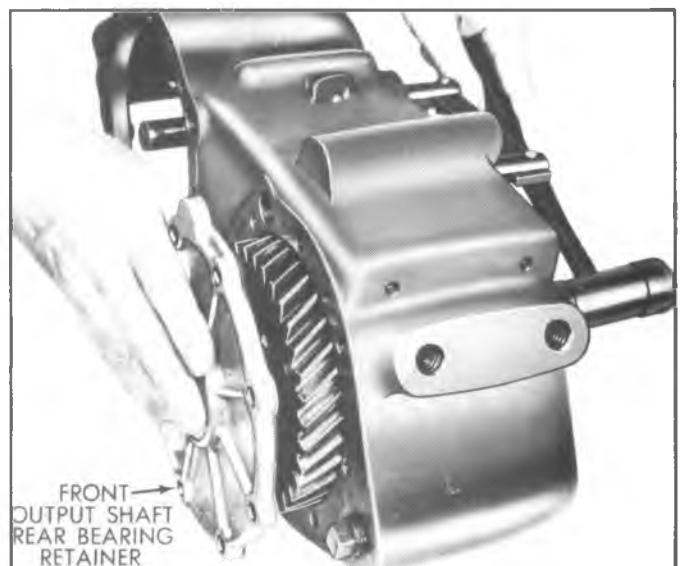
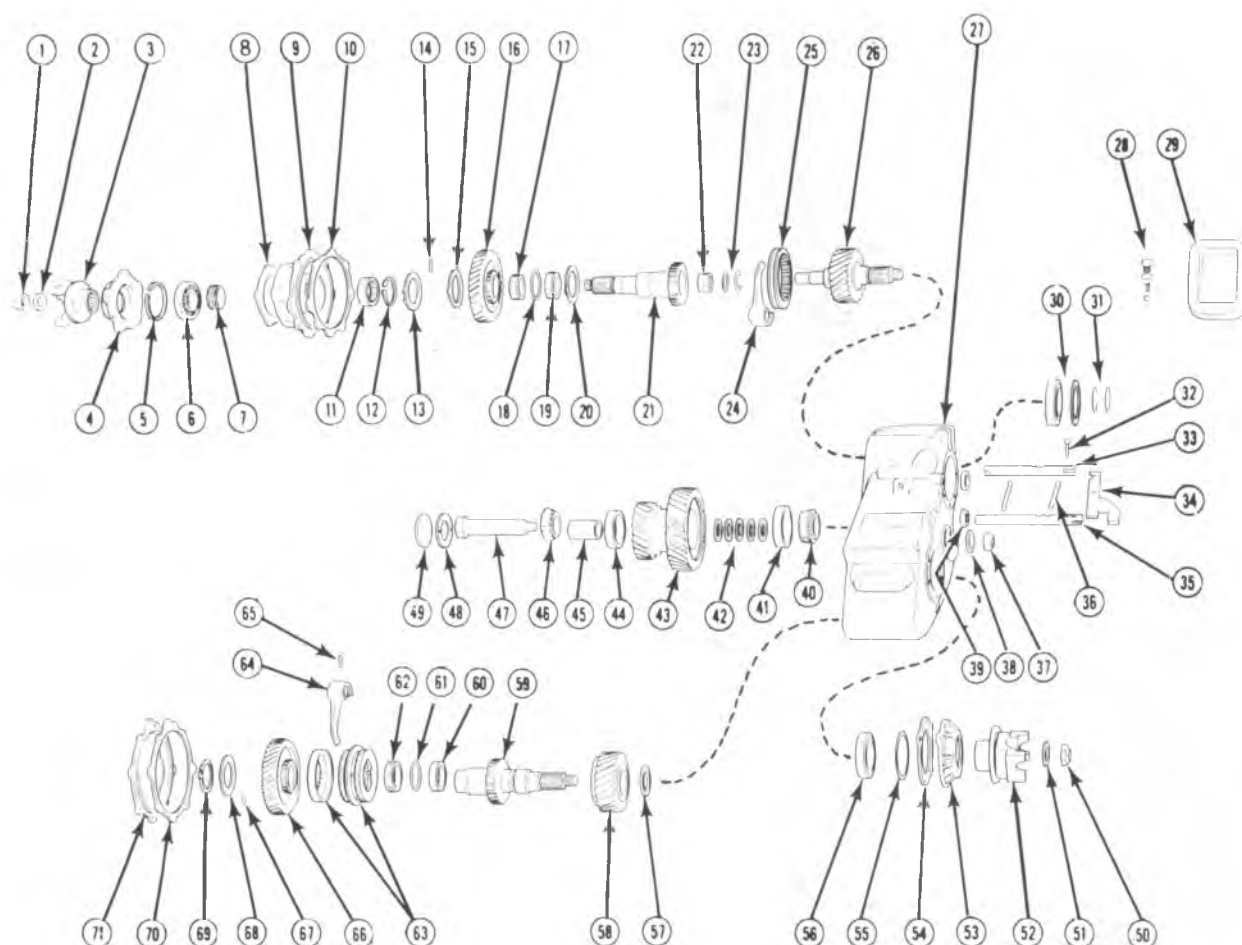


Fig. 7E-45--Removing Front Output Shaft Rear Bearing Retainer



- | | | |
|--------------------------------------|---------------------------------------|-------------------------------------|
| 1 Rear Output Shaft Locknut | 26 Input Shaft | 49 Rear Cover |
| 2 Washer | 27 Transfer Case | 50 Front Output Shaft Locknut |
| 3 Yoke | 28 Poppet Spring & Ball, Light Switch | 51 Washer |
| 4 Bearing Retainer and Seal Assembly | 29 P.T.O. Gasket and Cover | 52 Yoke |
| 5 Snap Ring | 30 Input Shaft Bearing and Snap Ring | 53 Bearing Retainer and Seat Gasket |
| 6 Bearing | 31 Snap Ring and Rubber O Ring | 54 Snap Ring |
| 7 Speedometer Gear | 32 Shift Link Clevis Pin | 55 Front Bearing |
| 8 Gasket | 33 Range Shift Rail | 56 Thrust Washer |
| 9 Housing | 34 Shift Rail Connector Link | 57 Front Wheel High Gear |
| 10 Gasket | 35 Front Wheel Drive Shift Rail | 58 Front Output Shaft |
| 11 Bearing | 36 Interlock Pins | 59 Needle Bearings |
| 12 Snap Ring | 37 Rear Idler Lock Nut | 60 Spacer |
| 13 Thrust Washer | 38 Washer | 61 Needle Bearing |
| 14 Thrust Washer Lock Pin | 39 Shift Rail Seals | 62 Synchronizer |
| 15 Thrust Washer (Tanged) | 40 Idler Shaft Bearing | 63 Shift Fork |
| 16 Low Speed Gear | 41 Bearing Cup | 64 Roll Pin |
| 17 Needle Bearings | 42 Shims | 65 Front Output Low Gear |
| 18 Spacer | 43 Idler Gear | 66 Thrust Washer Lock Pin |
| 19 Needle Bearings | 44 Bearing Cup | 67 Thrust Washer |
| 20 Tanged Washer | 45 Spacer | 68 Snap Ring |
| 21 Rear Output Shaft | 46 Idler Shaft Bearing | 69 Rear Cover Gasket |
| 22 Needle Bearings | 47 Idler Shaft | 70 Rear Cover and Bearing |
| 23 Washer and Retainer | 48 Cover Gasket | |
| 24 Shift Fork | | |
| 25 Sliding Clutch | | |

102828

Fig. 7E-46--Model 205 Transfer Case-Exploded View

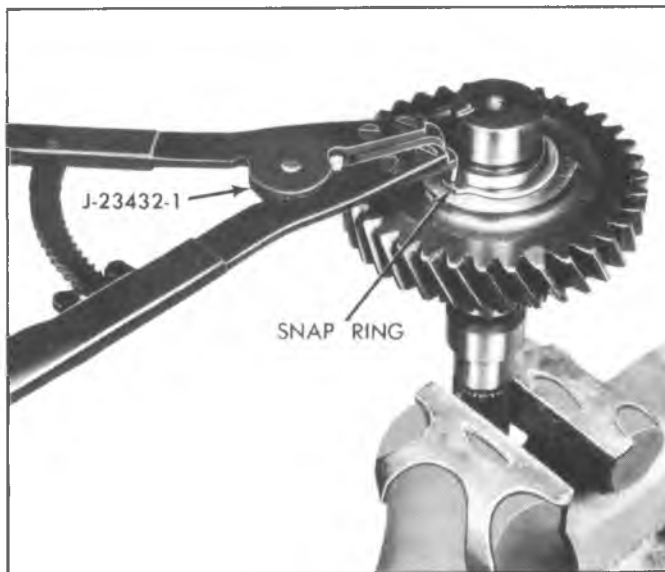


Fig. 7E-47--Removing Gear Retaining Ring

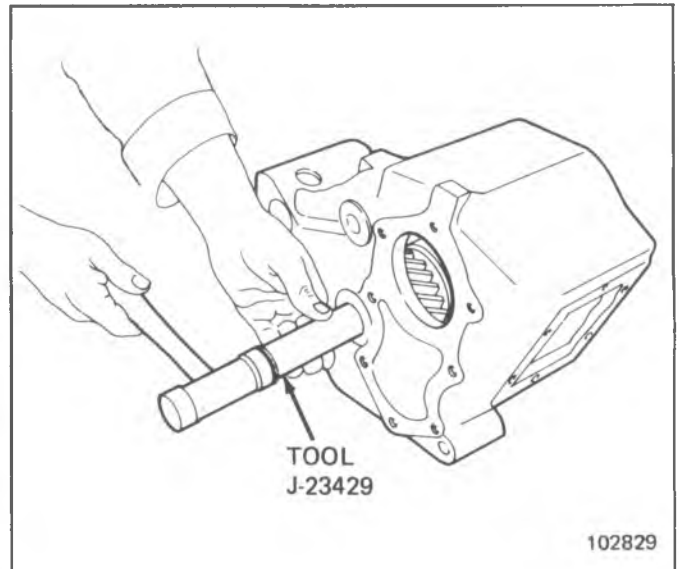


Fig. 7E-50--Removing Idler Gear Shaft

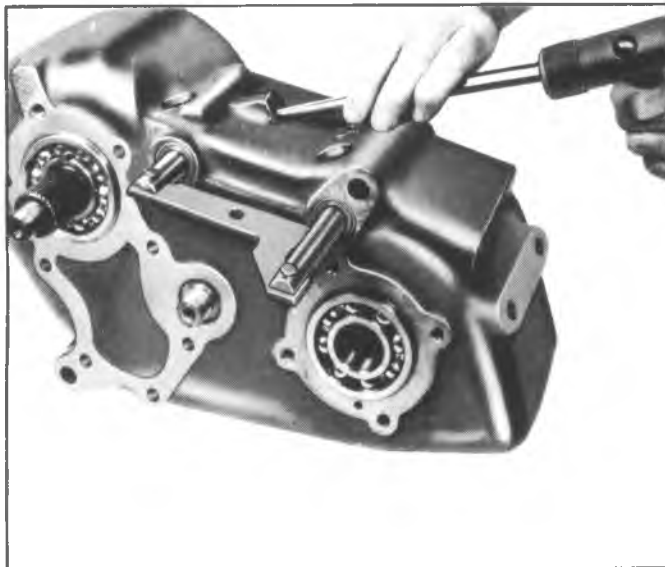


Fig. 7E-48--Removing Shift Fork Pins

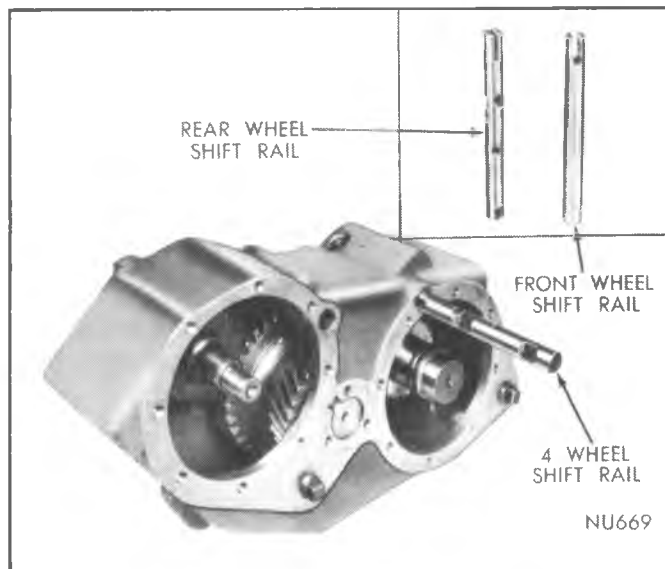


Fig. 7E-49--Shift Rail Removal

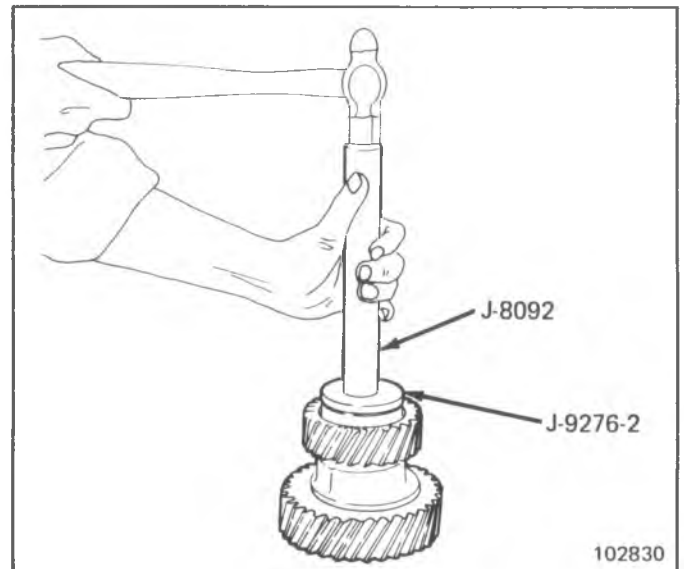


Fig. 7E-51--Installing New Bearing Cups

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

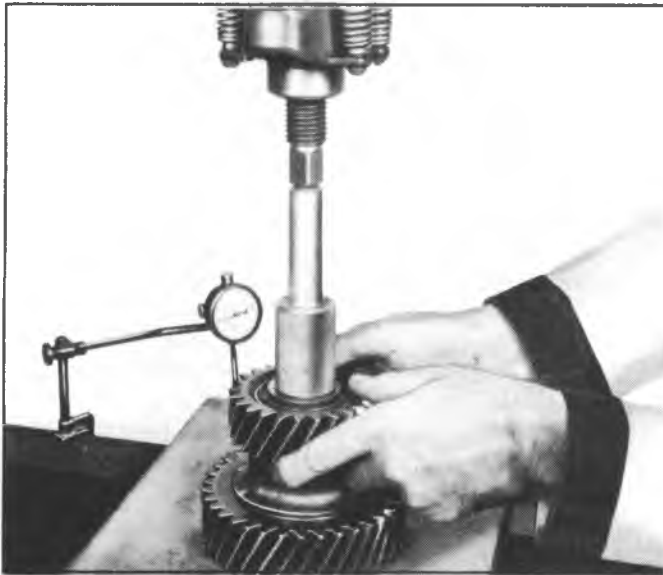


Fig. 7E-52--Checking Idler Gear End Play

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.

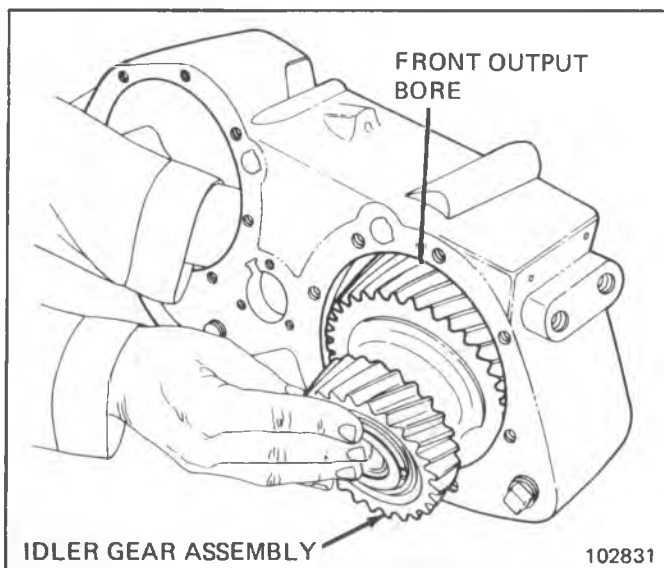


Fig. 7E-53--Installing Idler Gear

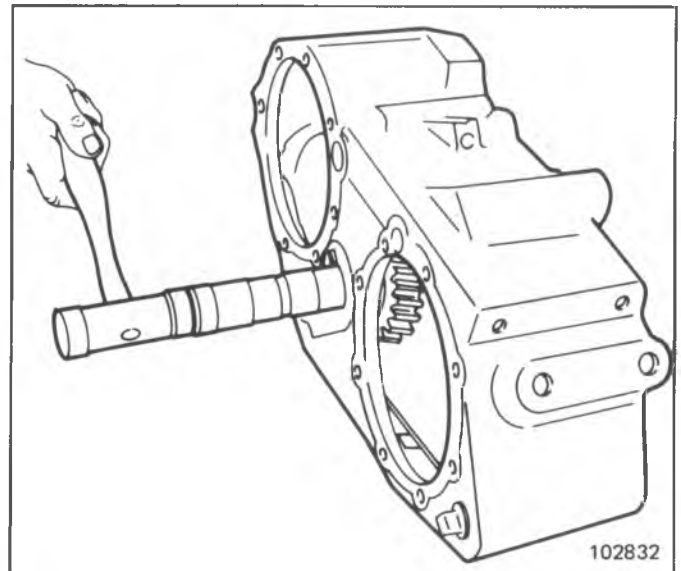


Fig. 7E-54--Installing Idler Shaft

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

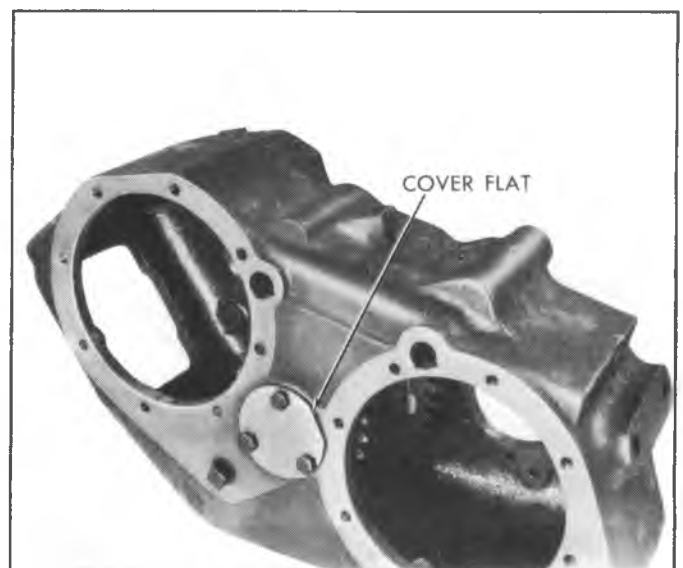


Fig. 7E-55--Installing Idler Shaft Rear Cover

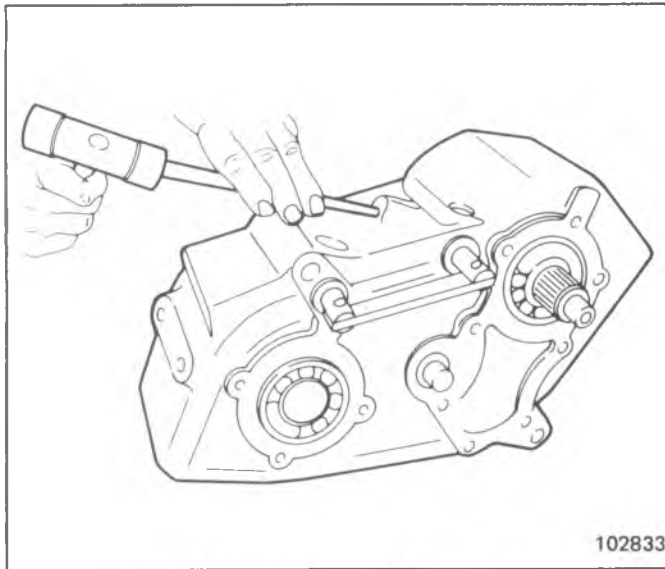


Fig. 7E-56--Installing Shift Rail Lock Pins

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.).

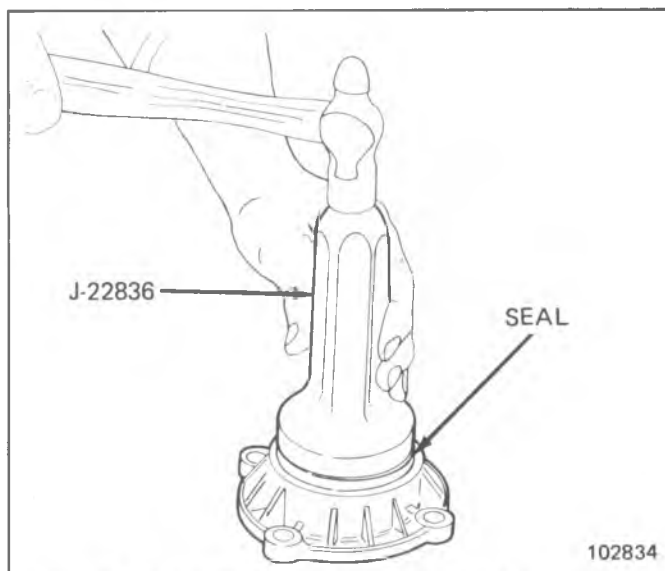


Fig. 7E-57--Installing Front Output Bearing Retainer Seal

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 to 20 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.

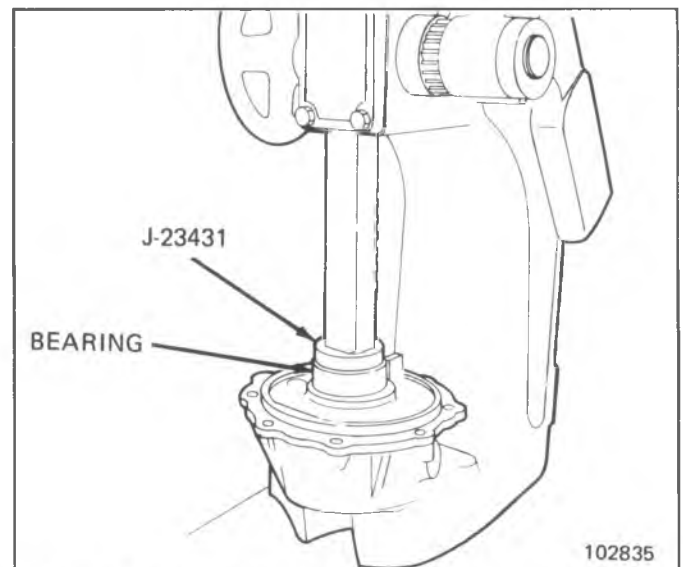


Fig. 7E-58--Installing Rear Output Shaft Housing Bearing

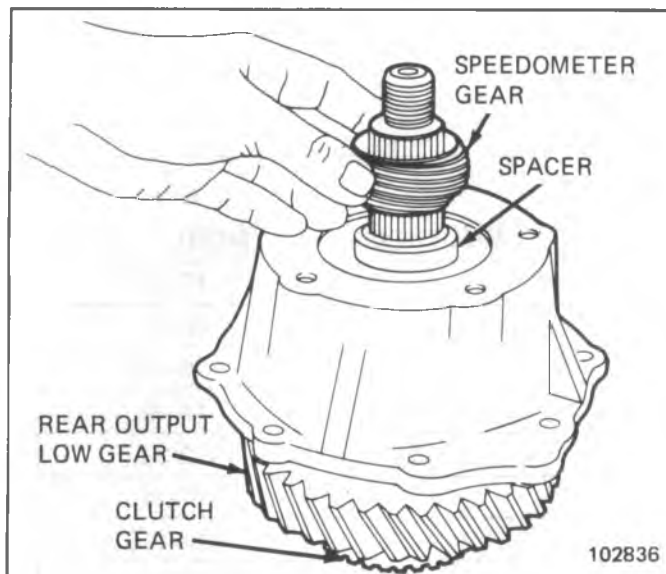


Fig. 7E-59--Installing Rear Output Shaft Spacer and Speedometer Gear

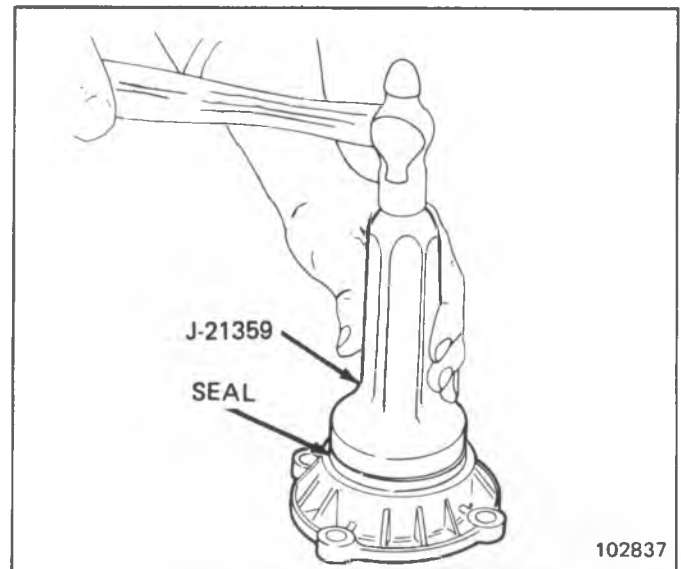


Fig. 7E-60--Installing Rear Bearing Retainer Seal

	N·m MODEL 205	N·m MODEL 208
NUT, SHIFT LEVER-TO-SHIFTER ASSEMBLY	—	19-27
NUT, KNOB ASSEMBLY-TO-SHIFT LEVER	26-40	26-40
BOLT, SHIFTER ASSEMBLY-TO-TRANSFER CASE	120-150	120-140
NUT, SHIFT ARMS-TO-CASE	14-20	14-20
SCREW, SHIFT LEVER BOOT RETAINER	2.2-3.2	2.2-3.2
BOLT, DETENT RETAINER	—	27-34
SWITCH, INDICATOR	—	122-176
BOLT, ADAPTER-TO-TRANSMISSION	26-40	26-40
BOLT, ADAPTER-TO-TRANSFER CASE	26-40	26-40
FILLER PLUG	40-48	40-54
BOLTS P.T.O. COVER	20-24	—
NUT, SKID PLATE-TO-CROSSMEMBER	55-70	55-70
BOLT, SUPPORT STRUT ROD		
— TRANSMISSION END	40-54	40-54
— TRANSFER CASE END	150-200	150-200

MODEL NO.	205 (PART TIME)	208 (PART TIME)
AVAILABILITY	ALL K30 SERIES	ALL K10-20 SERIES
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
POWER TAKE-OFF DATA: OPENING AND LOCATION	SAE 6-BOLT; LEFT SIDE	
LUBRICANTS: OIL CAPACITY	5.2 PINTS*	8 PINTS*
TYPE, GRADE	SEE OWNER'S MANUAL	SEE OWNER'S MANUAL

*TO BE FILLED WITHIN ONE INCH OF FILL PLUG.

Fig. 7E-SP Specifications

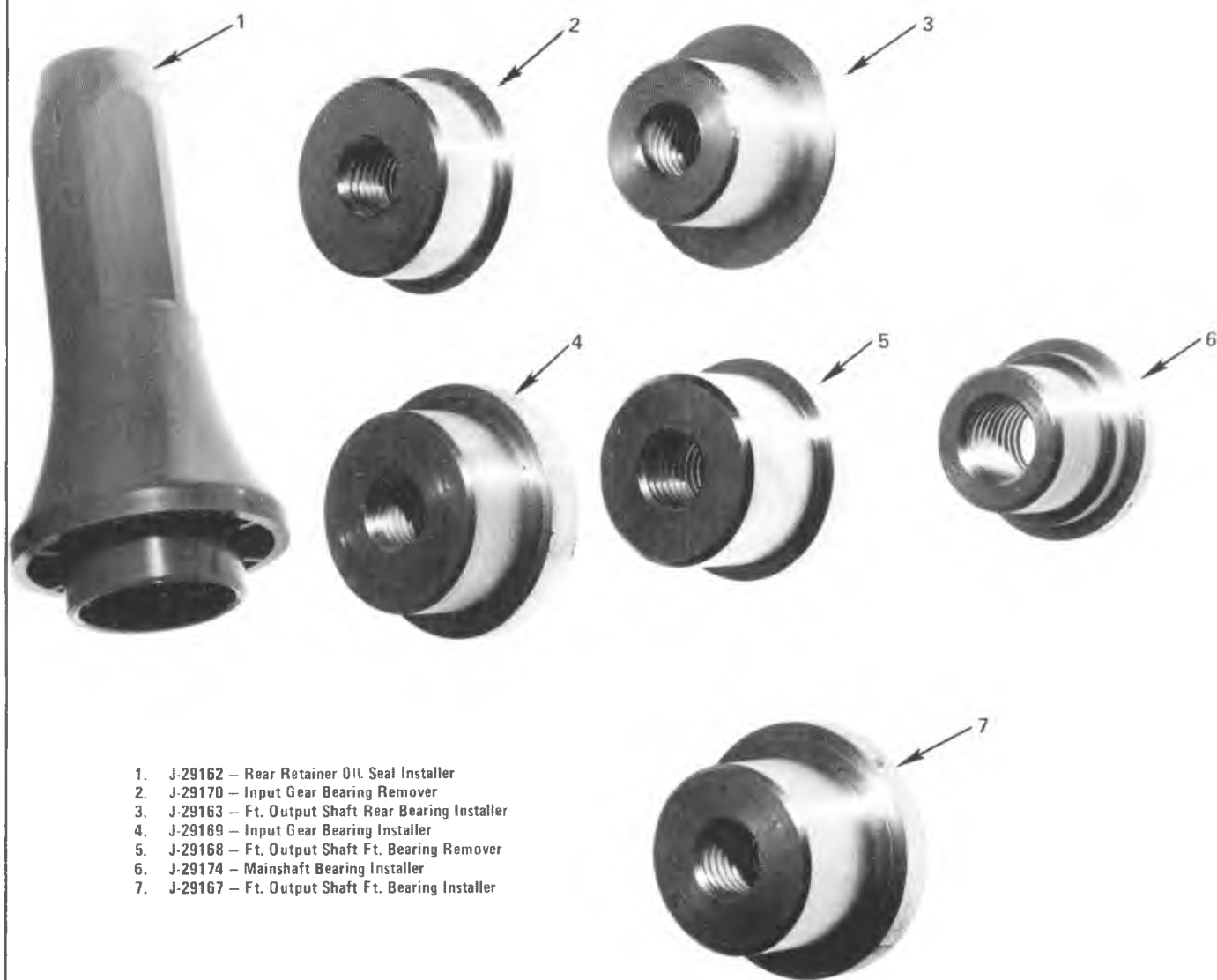
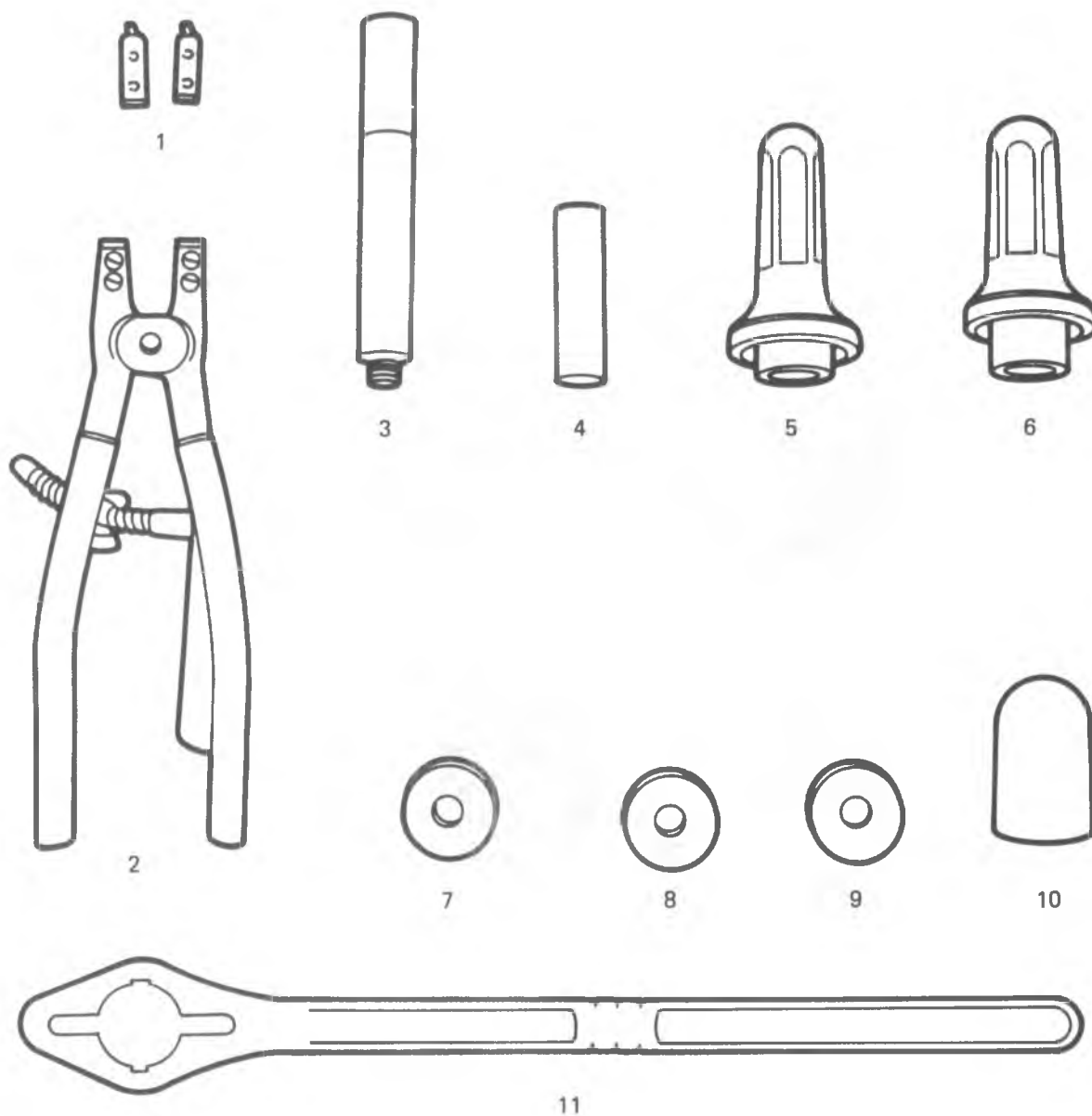


Fig. 7E-ST1--208--Special Tools



- | | | |
|-----|-----------|--|
| 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. |

Fig. 7E-ST2--205--Special Tools

SECTION 8A

ELECTRICAL - BODY AND CHASSIS

LIGHTING SYSTEM

CONTENTS

Lighting System	8A-1	Front Side Marker	8A-12
General Description.....	8A-1	Rear Side Marker	8A-12
Diagnosis.....	8A-3	Tail, Stop and Backup Lamps	8A-12
On-Vehicle Service.....	8A-9	Directional Signal Lamps	8A-12
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Sealed Beam Unit	8A-9	Headlamp Beam Selector Switch	8A-14
Parking Lamp Bulb.....	8A-9	Stoplamp Switch	8A-14
Parking Lamp Housing.....	8A-11	Specifications	8A-20

LIGHTING SYSTEM

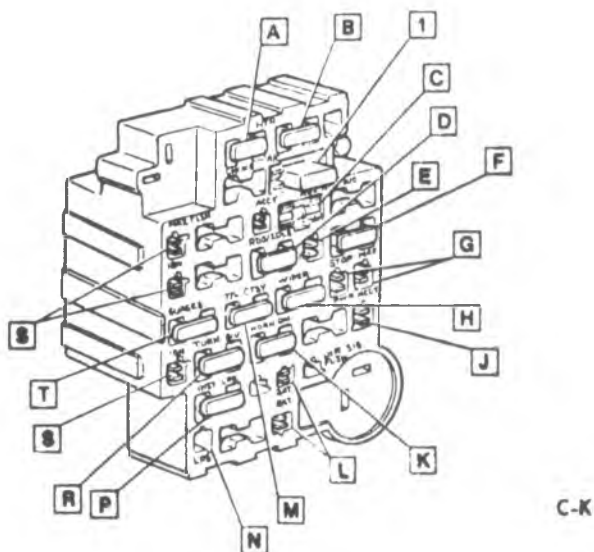
GENERAL DESCRIPTION

The lighting system includes the main light switch; stop light, dimmer and backing lamp switches; head and parking lamps; stop, tail, side marker, clearance and identification lamps; instrument illumination, directional signal and indicator lamps and the necessary wiring to complete the various circuits.

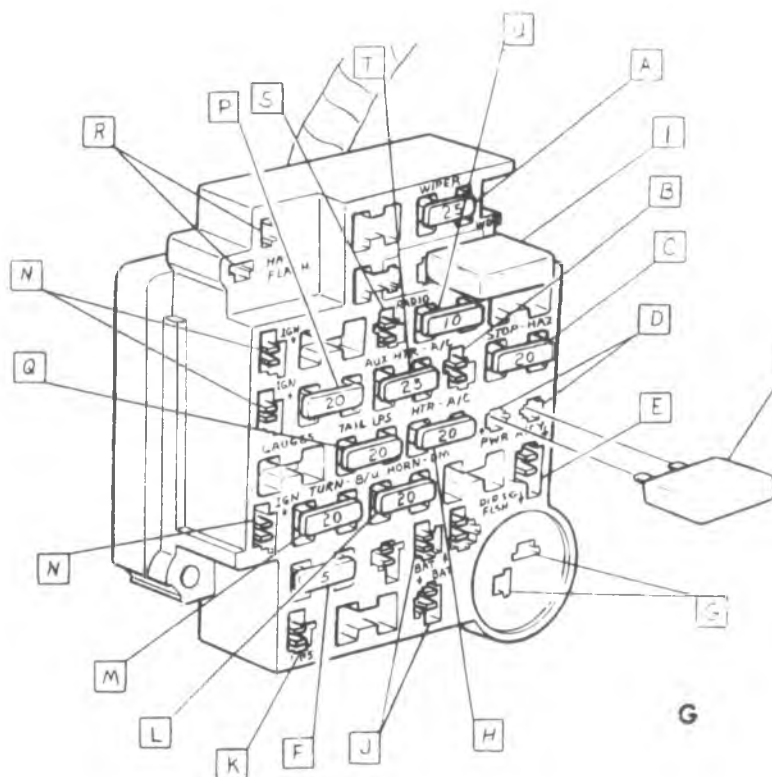
A bulkhead fuse panel (fig. 8A-1) provides convenient power taps and fuse clips for the appropriate circuits. The engine wiring harness and forward lamp harness connectors are bolted to the fuse panel.

All wiring systems not protected by a fuse or circuit breaker incorporate a fusible link which provides increased overload protection. The starting motor circuit is the exception.

Composite wiring diagrams are available in Section 8C. The standardized color code is common to all wiring harnesses. The wire covering color designates a particular circuit usage. Wire size designations are metric, conversions to AWG sizes are provided.



- 1 CIRCUIT BREAKER
- A FUSE-CHOKE
- B FUSE-HEATER OR AIR COND
- C FUSE-AUX HEATER OR AIR COND
- D FUSE-RADIO
- E RECEPTACLE 8C69
- F FUSE-STOP, HAZARD LAMPS
- G RECEPTACLE-POWER ACCESSORY
- H FUSE-WINDSHIELD WIPER
- I RECEPTACLE 8AU3/A33
- J FUSE-HORN, DOME LAMP
- K RECEPTACLE 8T63/UF2/U35
- L FUSE-TAIL, CTSY LAMP
- M RECEPTACLE-8T63
- N FUSE-INSTRUMENT PANEL LAMPS
- P FUSE-TURN, BACK UP LAMPS
- S RECEPTACLE 8K30/LF9/NL2/MX1/M38/M40/U16
- T RECEPTACLE 8TP2



- 1 CIRCUIT BREAKER
- A FUSE-WINDSHIELD WIPER
- B RECEPTACLE-IGN ACC-RADIO & AUX BAT.
- C FUSE-STOP & TRAF HAZARD LPS
- D POWER ACCESSORY
- E RECEPTACLE-POWER DOOR LOCKS
- F FUSE-INST PANEL LAMPS
- G RECEPTACLE-DIR SIG L/P FLASHER
- H FUSE-HEATER & A/C
- J RECEPTACLE-BAT, LTR, RDO CAPAC. CLOCK, H/L WARNING
- K RECEPTACLE-PNL LPS, RAD DIAL, TRANS IND LP & TILT WHEEL.
- L FUSE-HORN DM
- M FUSE-DIR SIG & BACK-UP LAMPS
- N RECEPTACLE-IGN-AUTO TRANS. CRUISE CONTROL, PULSE WIPER, TRANS IND LP
- P FUSE-GAUGES
- Q FUSE-TAIL LAMPS
- R RECEPTACLE-TRAFFIC HAZARD FLASHER
- S RECEPTACLE-IGN/ACC REAR AIR COND AUX HEATER
- T FUSE-AUX HEATER & A/C
- U FUSE-RADIO

Fig. 8A-1--Fuse Panel

DIAGNOSIS

HEADLAMP DIAGNOSIS

Condition	Possible Cause	Correction
One headlamp inoperative or intermittent	1. Loose connection	1. Secure connections to sealed beam including ground. (Black Wire)
	2. Defective Sealed Beam	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 headlight connector (type 2 sealed beam)	2. Relocate black wire in connector
One or more headlights short life	1. Voltage regulator misadjusted	1. Readjust regulator to specifications.
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 lamp. If test lamp bulb lights only at light blue wire terminal, replace dimmer switch.
	3. Open wiring - light switch to dimmer switch	3. Check light blue wire with test lamp. If bulb lights at light switch light blue 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 lamp. If lamp 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 white wire terminals at light switch with test lamp. If bulb lights at read wire terminal but not at light blue terminal, replace light switch.

Upper or lower beam
will not light or
intermittent

1. Open connection or defective dimmer switch
2. Short circuit to ground

1. Check dimmer switch terminals with test lamp. If bulb lights at light blue or tan wire terminals, repair open wiring between dimmer switch and headlights. If bulb will not light at one of these terminals, replace dimmer switch.
2. Follow diagnosis above (All headlights inoperative or intermittent)

SIDE MARKER LAMP DIAGNOSIS

Condition	Possible Cause	Correction
One lamp inoperative	1. Turn signal bulb burnt out (Front lamp)	1. Switch turn signals on. If signal bulb does not light, replace bulb. (Bulb filament provides ground path for marker lamp bulb through the light blue or dark blue/white strip wires).
	2. Side marker bulb burnt out	2. Replace bulb.
	3. Loose connection or open in wiring	3. Using test lamp, check brown wire terminal at bulb socket. If test lamp lights, repair open ground circuit. If lamp does not light, repair open brown wire circuit.
Front or rear lamps inoperative	1. Loose connection or open ground connection	1. If associated tail or park lamps do not operate, secure all connectors in brown wire circuit. If park and turn lamps operate, repair open ground connections.
	2. Multiple bulbs burnt out	2. Replace burnt out bulbs.
All lamps inoperative	1. Blown fuse	1. If park and tail lamps do not operate, replace blown fuse. If new fuse blows, check for short to ground between fuse panel and lamps.
	2. Loose connection	2. Secure connector to light switch.
	3. Open in wiring	3. Check tail light fuse with test lamp. If test lamp 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 lamp. If test lamp lights at terminal No. 5 but not at terminal No. 4, replace light switch.

TAIL, PARK AND LICENSE LAMP DIAGNOSIS

Condition	Possible Cause	Correction
One side inoperative	1. Bulb burnt out	1. Replace bulb
	2. Open ground connection at bulb socket or ground wire terminal	2. Jumper bulb base socket connection to ground. If lamp lights, repair open ground circuit.
Both sides inoperative	1. Tail lamp fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through light switch to lamps.
	2. Loose connection	2. Secure connector at light switch.
	3. Open wiring	3. Using test light, check circuit on both sides of fuse. If lamp does not light on either side, repair open circuit between fuse panel and battery. (possible open fusible link). If test lamp lights at light switch brown wire terminal, repair open wiring between light switch and lamps.
	4. Multiple bulb burnout	4. If test lamp lights at lamp socket brown wire terminal, replace bulbs.
	5. Defective light switch	5. If test lamp lights at light switch terminal No. 4 (Brown/white wire) but not at terminal No. 5 (Brown wire), replace defective light switch.

TURN SIGNAL AND HAZARD WARNING LAMP

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 necessary bulbs.
	2. Open wiring or ground connection	2. Turn Hazard warning system on. If one or more bulbs are inoperative, use test lamp and check circuit at lamp socket. If test lamp 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 lamps operate, check for improper bulb (1034 instead of 1157). 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 lamps operate, replace blown fuse. If new fuse blows, repair short to ground between fuse and lamps.
	2. Defective flasher (Located behind instrument panel near steering column)	2. If turn signal fuse is OK and hazard warning system will operate lamps, replace defective turn signal flasher.
	3. Loose connection	3. Secure steering column connector. If necessary, check purple wire terminals in connector with test lamp. If test lamp lights only on one side of connector, clean or tighten connector contacts.

Hazard warning lamps inoperative

1. Blown stop-hazard fuse

1. Switch turn signals on. If lamps 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 on fuse panel).

2. If stop-hazard fuse is OK, switch turn signals on. If lamps operate, replace defective hazard flasher.

3. Open in wiring or defective turn signal switch.

3. Using test lamp, check brown wire in turn signal steering column connector. If lamp does not light on either side of connector, repair open circuit between flasher and connector. If lamp lights only on feed side of connector, clean connector contacts. If lamp lights on both sides of connector, replace defective turn signal switch assembly.

BACK-UP LAMP

Condition	Possible Cause	Correction
One lamp inoperative or intermittent	1. Loose or burnt out bulb	1. Secure or replace bulb.
	2. Loose connection	2. Tighten connectors.
	3. Open ground connections	3. Repair bulb ground circuit.
Both lamps inoperative or intermittent.	1. Neutral start switch misadjusted (Open when shift lever is in reverse position)	1. Readjust neutral start switch.
	2. Loose connection or open circuit	2. Secure all connectors. If OK, check continuity of circuit from fuse to lamps with test lamp. If lamp does not 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 neutral start switch to back-up lamps.
	4. Defective neutral start switch	4. With ignition on, check switch terminals in back-up position with test lamp. If lamp lights at pink wire terminal but not at light green wire terminal, replace neutral start switch.
	5. Defective ignition switch	5. If test lamp lights at ignition switch battery terminal but not at output terminal, replace ignition switch.

Lamp will not turn off	1. Neutral start switch misadjusted (closed when shift lever is not in reverse position)	1. Readjust neutral start switch
STOP LIGHTS		
Condition	Possible Cause	Correction
One bulb inoperative	1. Bulb burnt out.	1. Replace bulb.
One side inoperative	1. Loose connection, open wiring or defective bulbs	1. Turn on directional signal. If lamp does not operate, check bulbs. If bulbs are OK, secure all connections. If lamp still does not operate, use test lamp and check for open wiring.
	2. Defective directional signal switch or cancelling cam	2. If lamp 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 inoperative	1. Stop-hazard fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in circuit between fuse and lamps.
	2. Stop-switch misadjusted or defective	2. With brake pedal depressed, check white wire terminal in steering column connector with test lamp. If lamp does not light, check stop switch for proper adjustment. If adjustment is OK, replace stop switch.
Will not turn off	1. Stop switch misadjusted or defective.	1. Readjust switch. If switch still malfunctions, replace.

ON-VEHICLE SERVICE

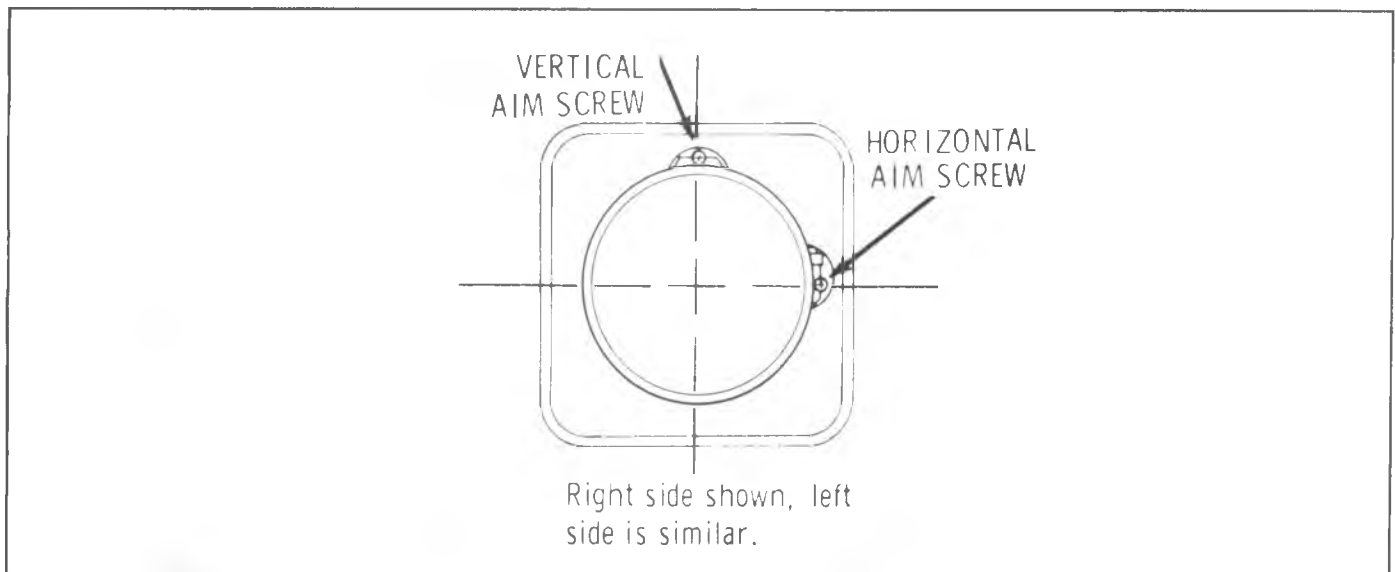


Fig. 8A-2--Headlamp Adjustments (Typical)

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 securely mounted to provide good ground and that the headlamps are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to the generator. Wire harnesses must be replaced if insulation becomes burned, cracked, or deteriorated. Whenever it is necessary to splice a wire or repair one that is broken, always use solder to bond the splice. Always use rosin flux solder on electrical connections. Use insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct size be used. Never replace a wire with one of a smaller size. Fusible links in the wiring are four gage sizes smaller than the cable it is designed to protect. The links are marked on the insulation with wire gage size because of the heavy insulation which makes the link appear a heavier gage than it actually is.

Each harness and wire must be held securely in place by clips or other holding devices to prevent chafing or wearing away the insulation due to vibration.

By referring to the wiring diagram manual, circuits may be tested for continuous circuit or shorts with a conventional test lamp or low reading voltmeter. These wiring diagrams use metric wire size designations, a chart showing metric to AWG size conversions is provided in the manual.

HEADLAMP ADJUSTMENT (Fig. 8A-2)

The headlamps must be properly aimed to obtain maximum road illumination. When using mechanical headlamp aimers, follow manufacturers instructions.

The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after repairs of the front end sheet metal assembly.

Regardless of the method used for checking headlamp aim, the truck must be at normal weight, that is with gas, oil, water and spare tire. Tires must be inflated to specified pressures.

Some states have special requirements for headlamp aiming adjustment and these requirements must be known and followed.

Horizontal and vertical aiming of each sealed beam is provided by two adjusting screws visible through the bezel which move the mounting ring against the tension of the coil spring (fig. 8A-2).

There is no adjustment for focus since the sealed beam unit is set for focus during manufacturing assembly.

ON-VEHICLE SERVICE

SEALED BEAM UNIT

Replacement (Figs. 8A-3 and 8A-4)

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. 8A-3 and 8A-4)

1. Remove lens retaining screws and remove lens from the housing.
2. Replace bulb and check lamp operation.
3. Install lens and retaining screws.

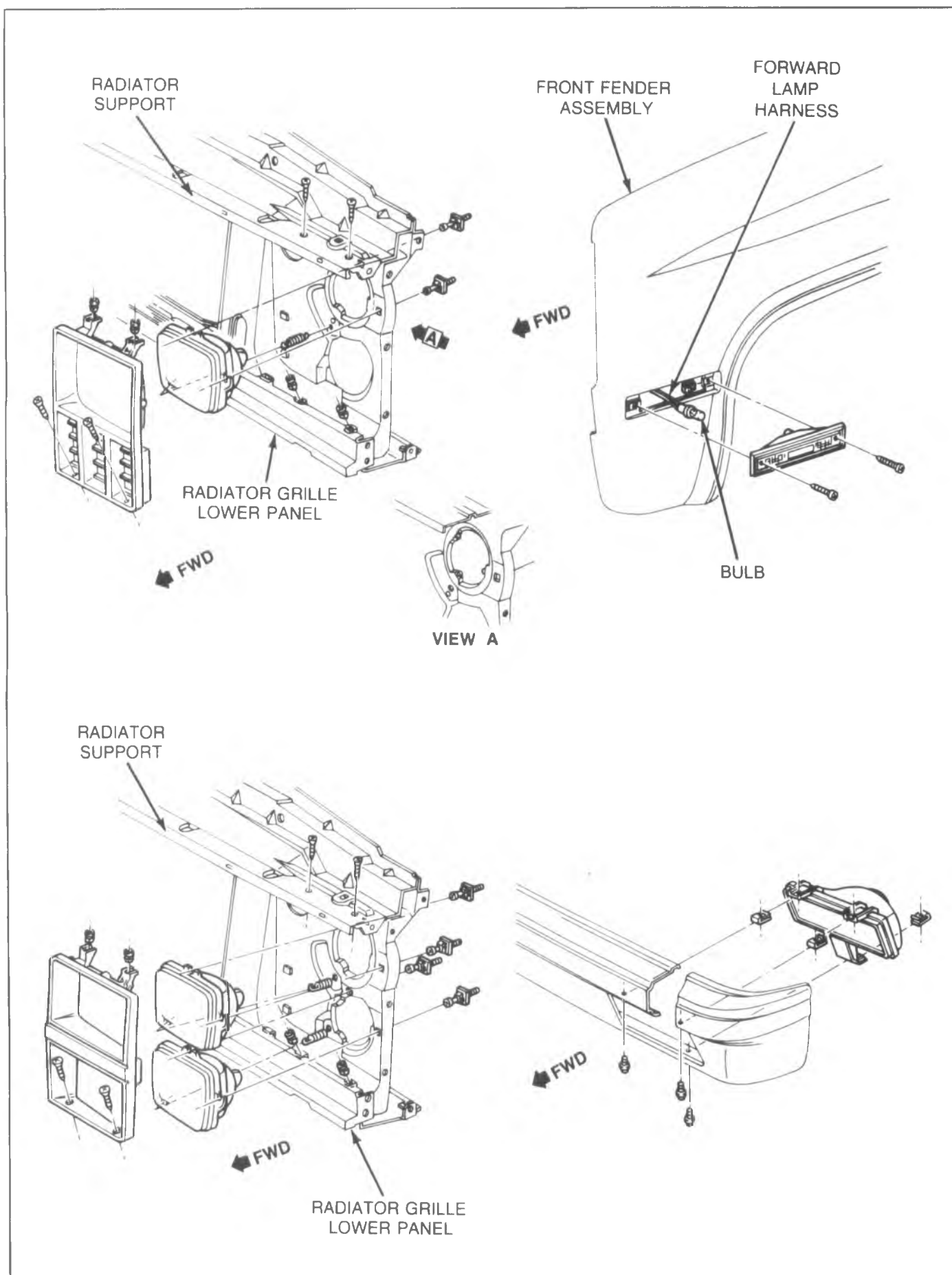


Fig. 8A-3--Front Lighting (C-K Models)

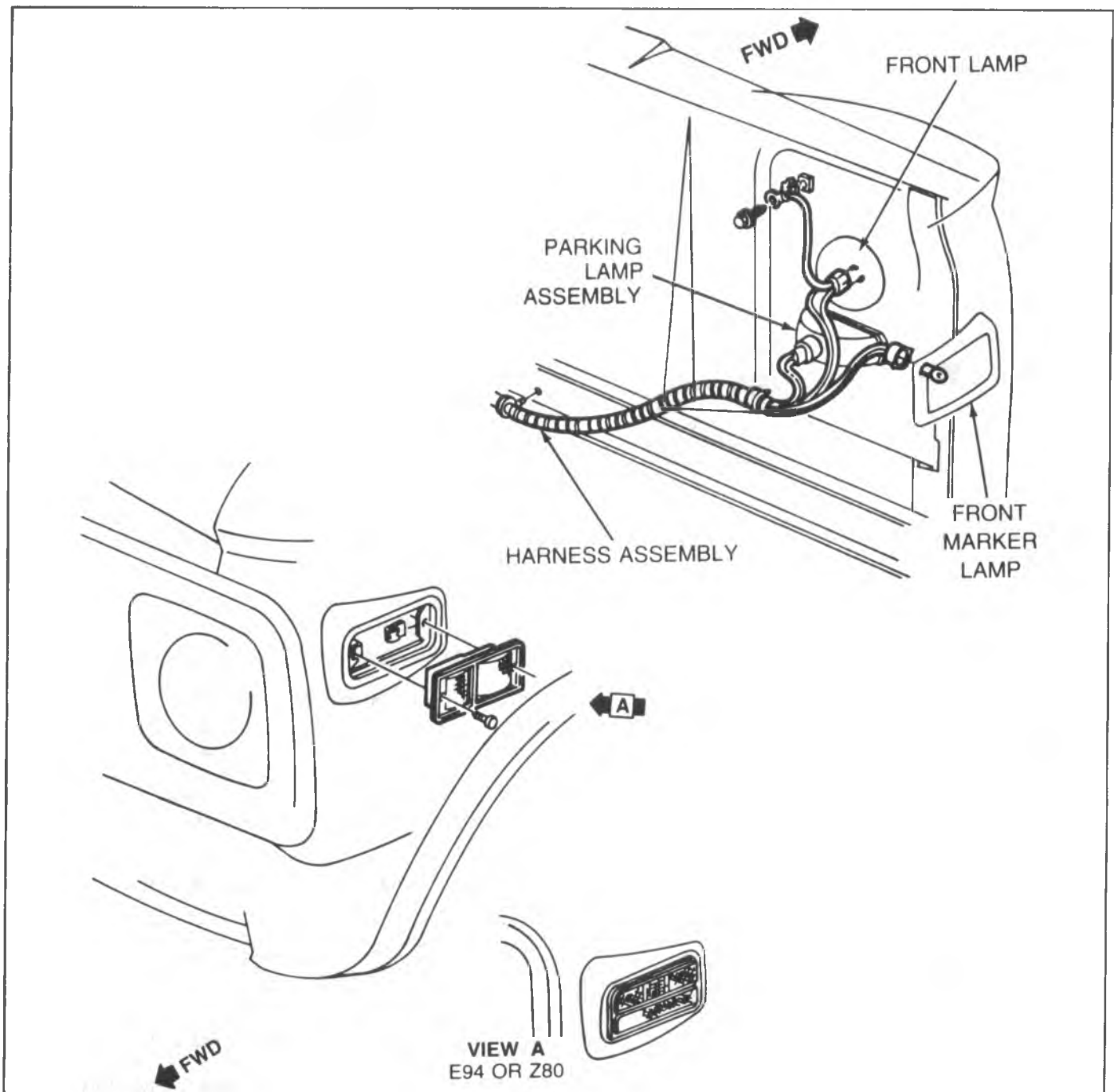


Fig. 8A-4--Front Lighting (G Models)

PARKING LAMP HOUSING

C-K Models

Replacement (Fig. 8A-3)

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. 8A-4)

Right Side

1. Remove both headlamp bezels.
2. Remove both parking lamp lens.
3. Remove grille.
4. Remove battery and battery box.
5. Disconnect wiring harness at connector.
6. Remove housing stud nuts and remove housing with pigtail.
7. To install, reverse removal steps.

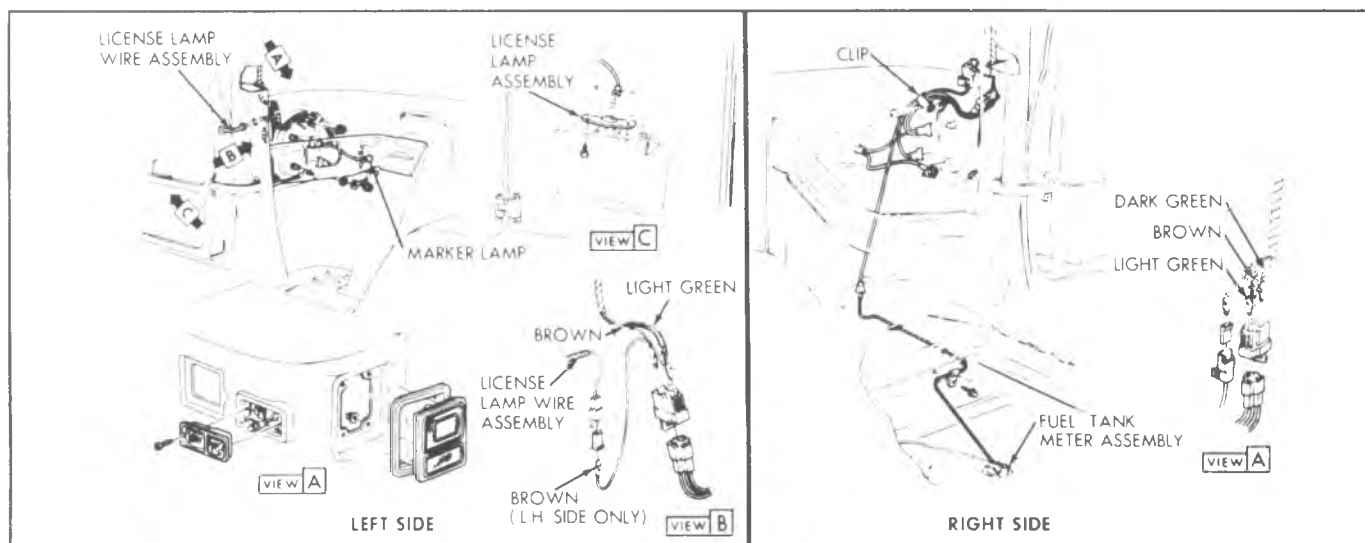


Fig. 8A-5--Rear Lighting (G Models)

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.
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.

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 8A-7 and 8A-8. 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.

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.

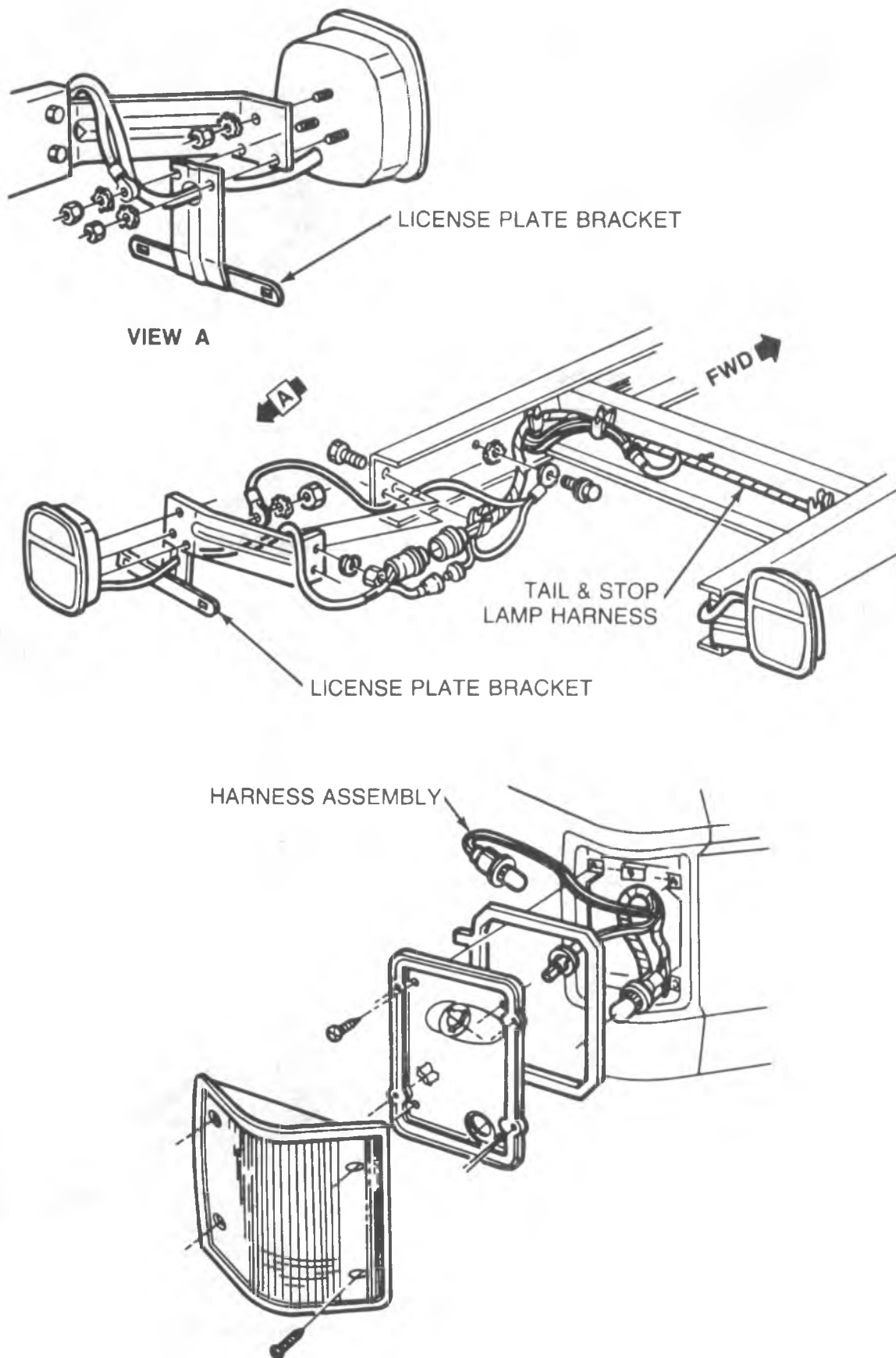


Fig. 8A-6--Rear Lighting (C-K Models Except with E56 or E62)

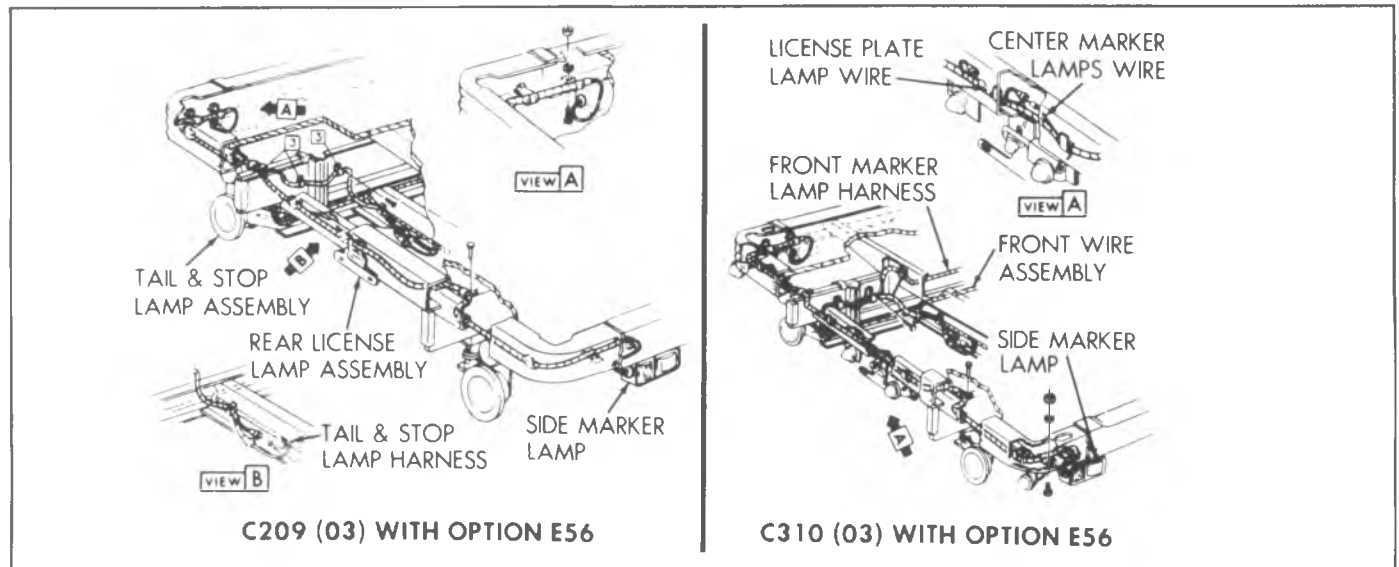


Fig. 8A-7--Rear Lighting (C-K Platform and Stake Rack Models)

CLEARANCE, LICENSE PLATE AND IDENTIFICATION LAMPS

Refer to Figures 8A-10 and 8A-11 for clearance, license plate and identification lamp installations.

LIGHT SWITCH

C-K Series (Fig. 8A-12)

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. 8A-12)

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.

STOPLAMP SWITCH

See Section 5 (Brakes) of this manual for adjustment and replacement procedures.

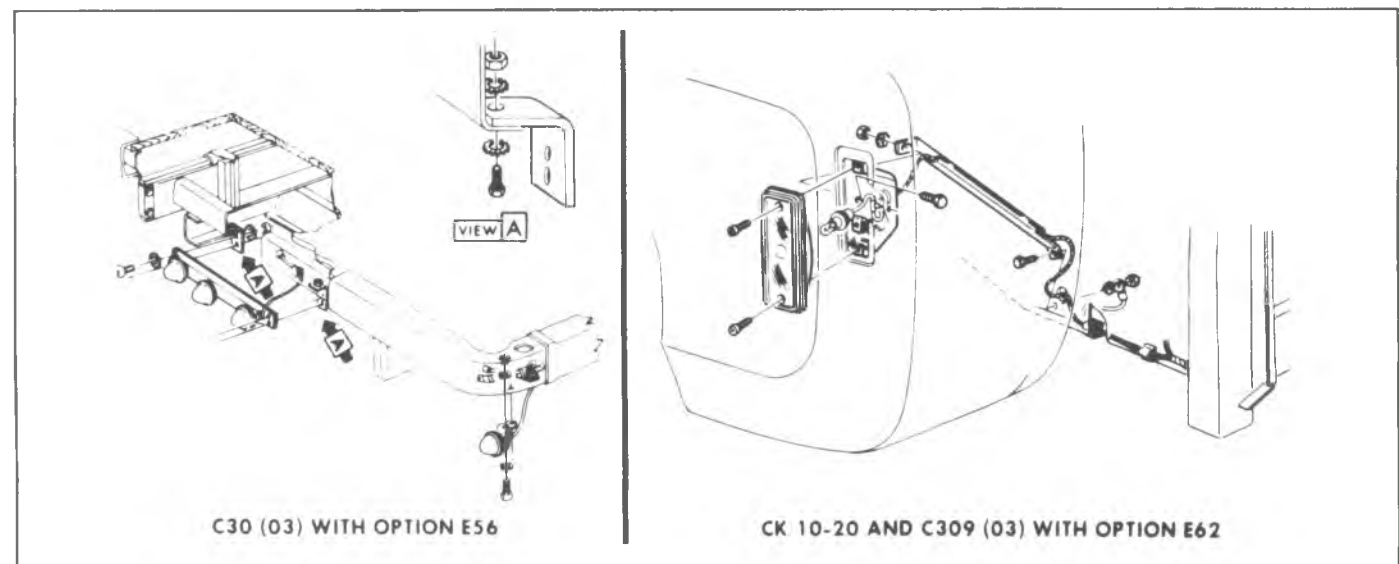


Fig. 8A-8--Rear Lighting (C30 03 Models with E56 and C-K Models with E62)

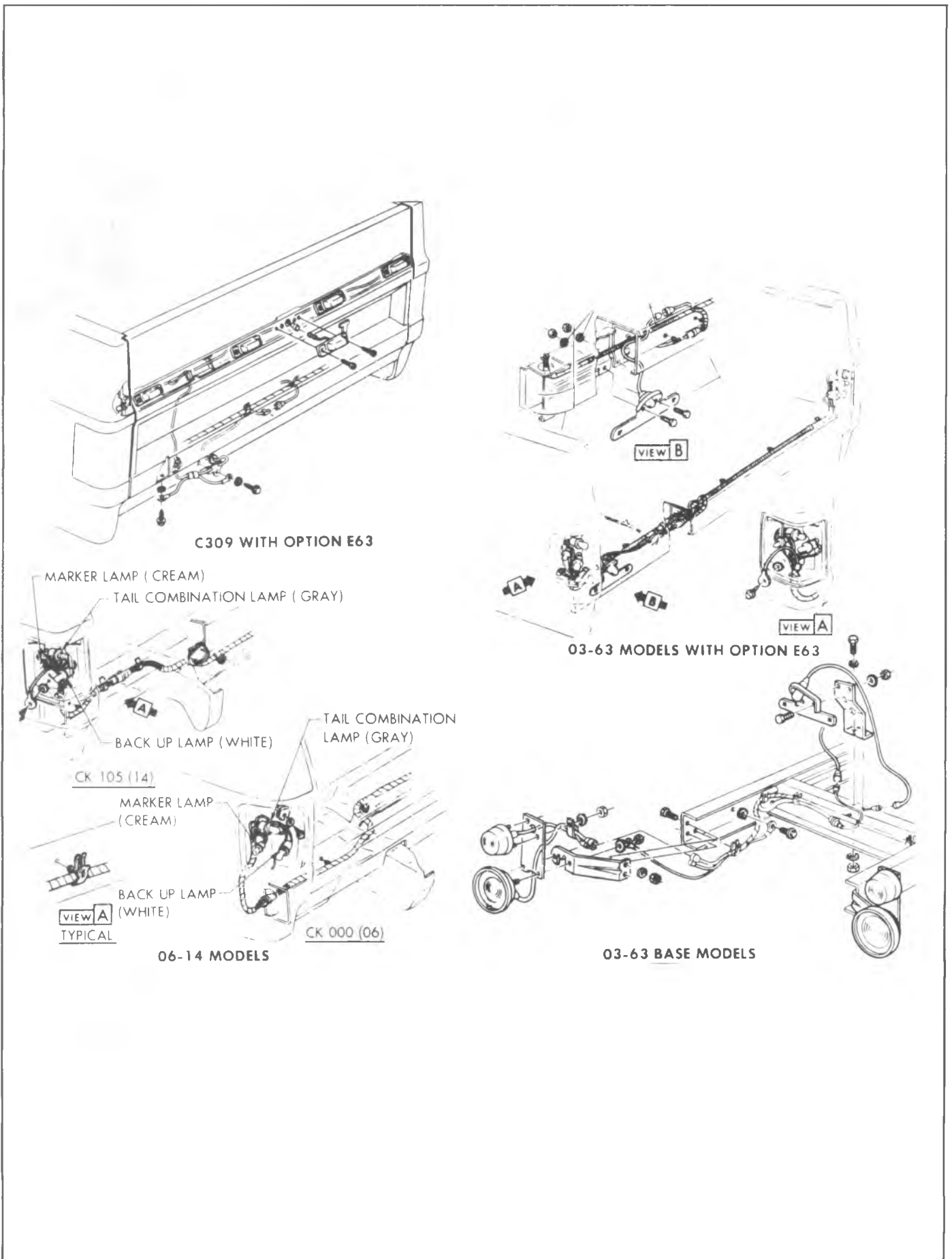


Fig. 8A-9--Rear Lighting CK 03 and 43 Models exc E62 or E6E

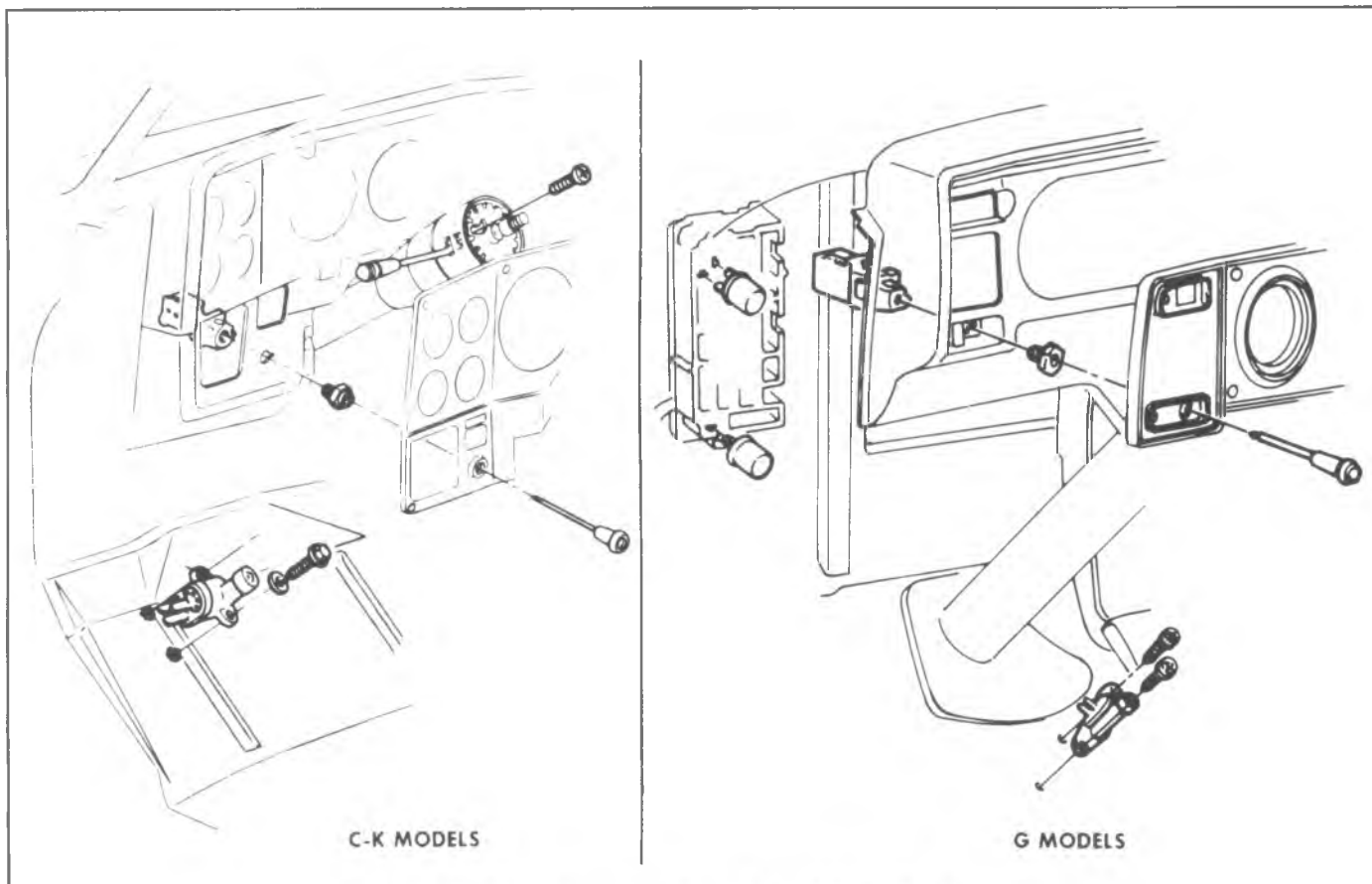


Fig. 8A-12--Light and Headlamp Beam Selector Switches

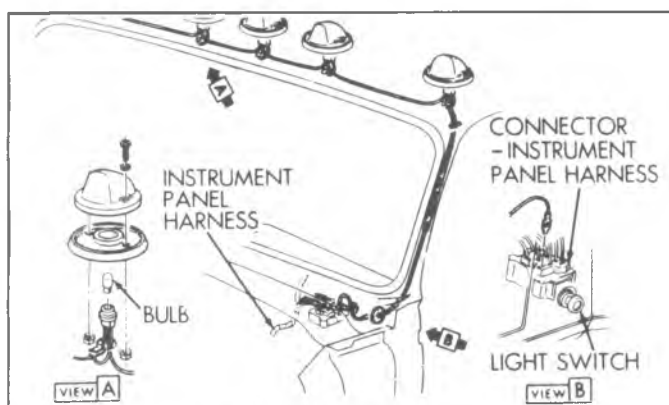


Fig. 8A-10--Clearance Lamps

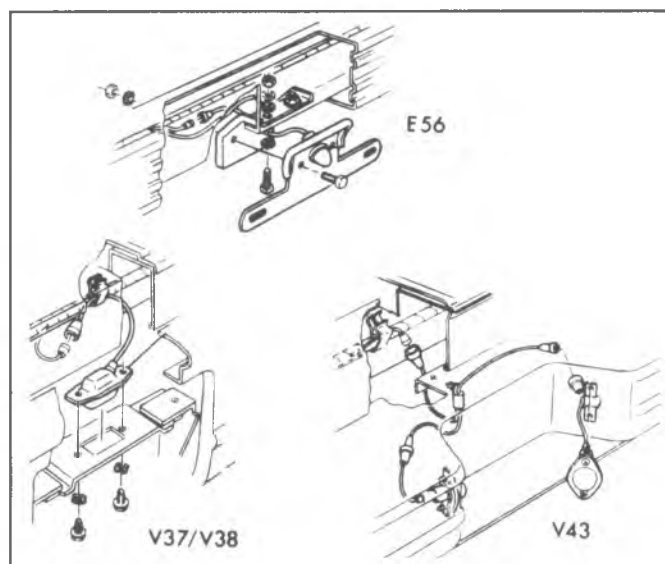


Fig. 8A-11--License Plate Lamps (C-K Series)

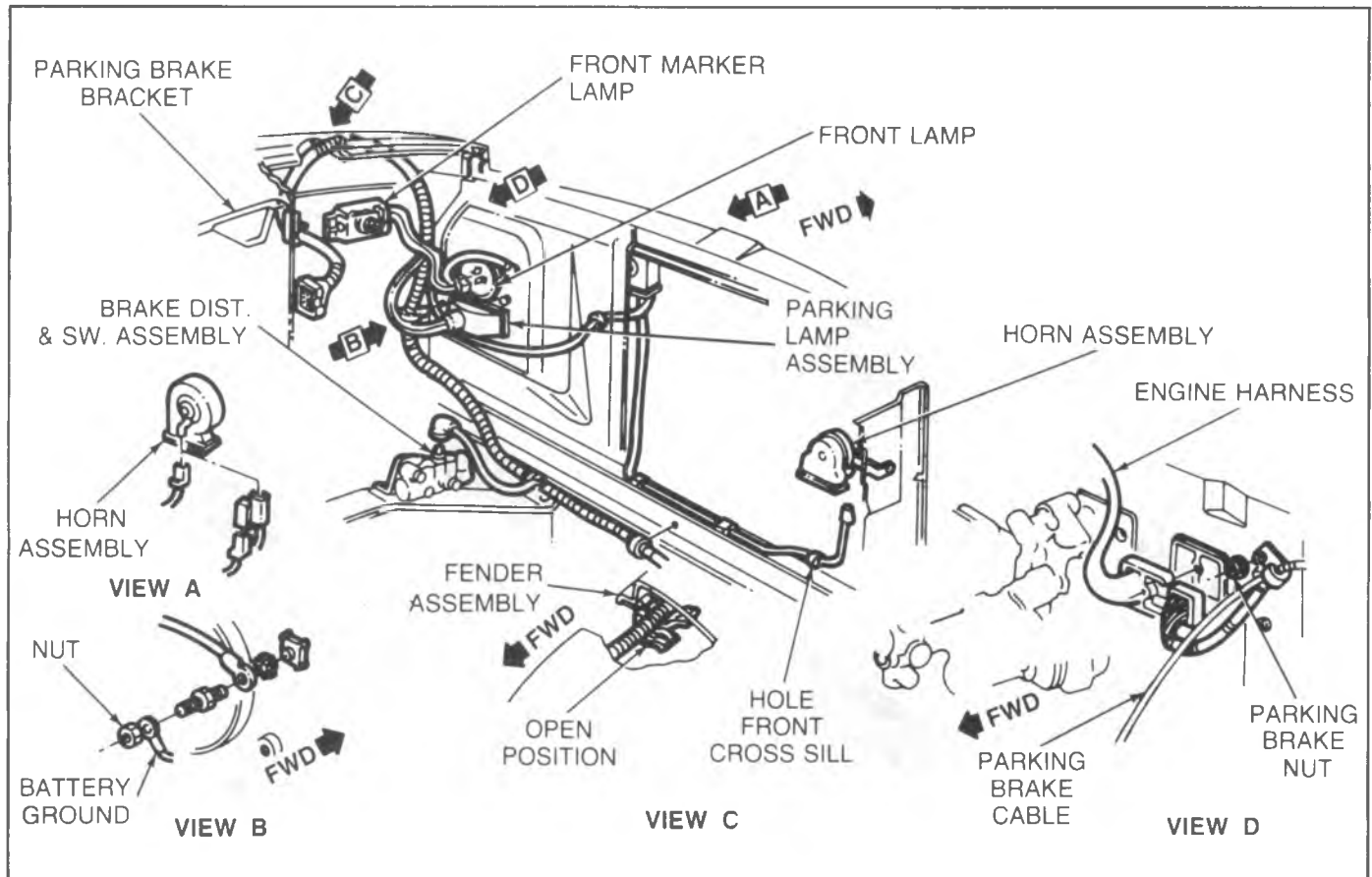


Fig. 8A-13--G Series Forward Lamp Wiring

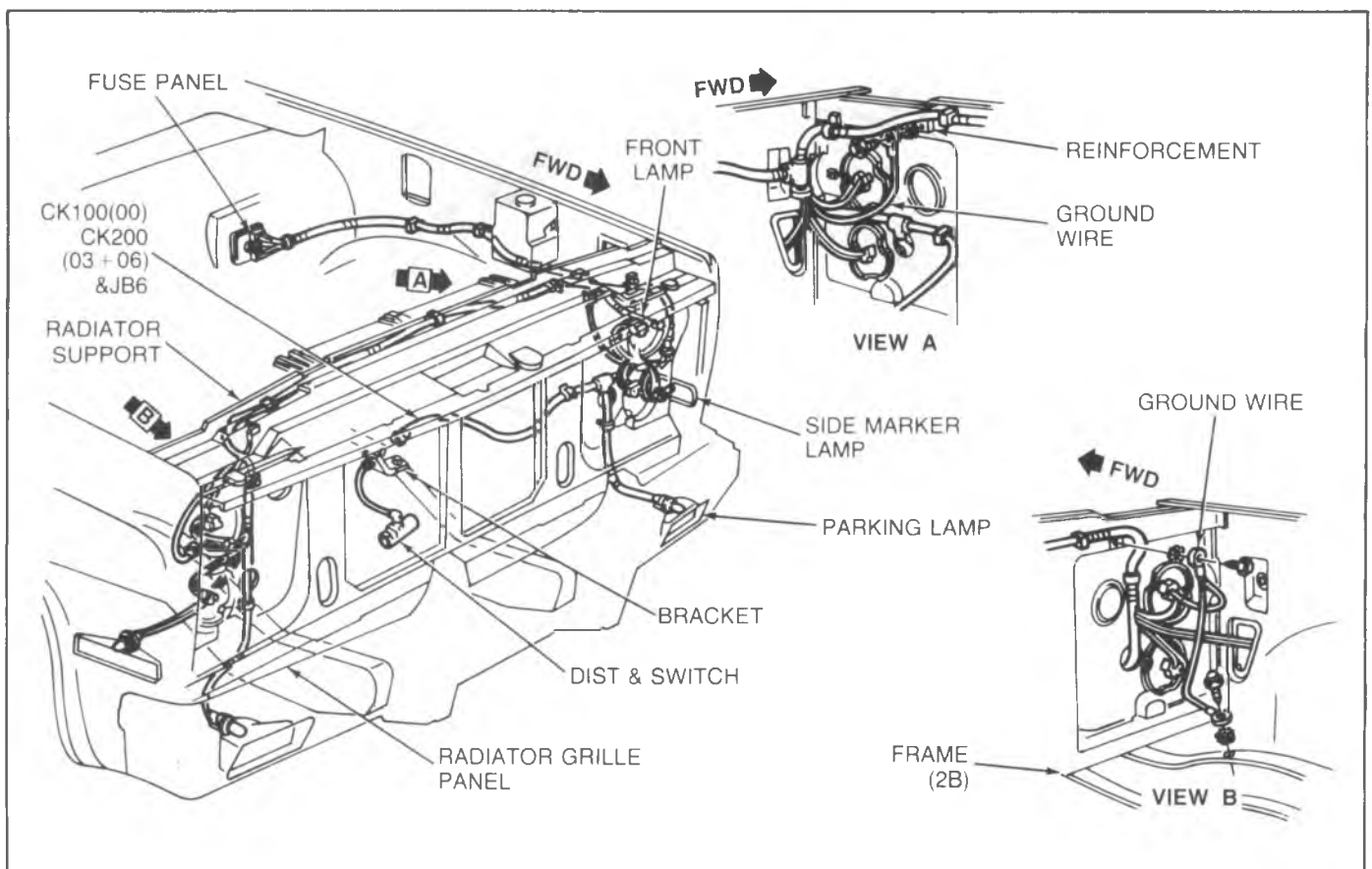


Fig. 8A-14--CK Series Forward Lamp Wiring

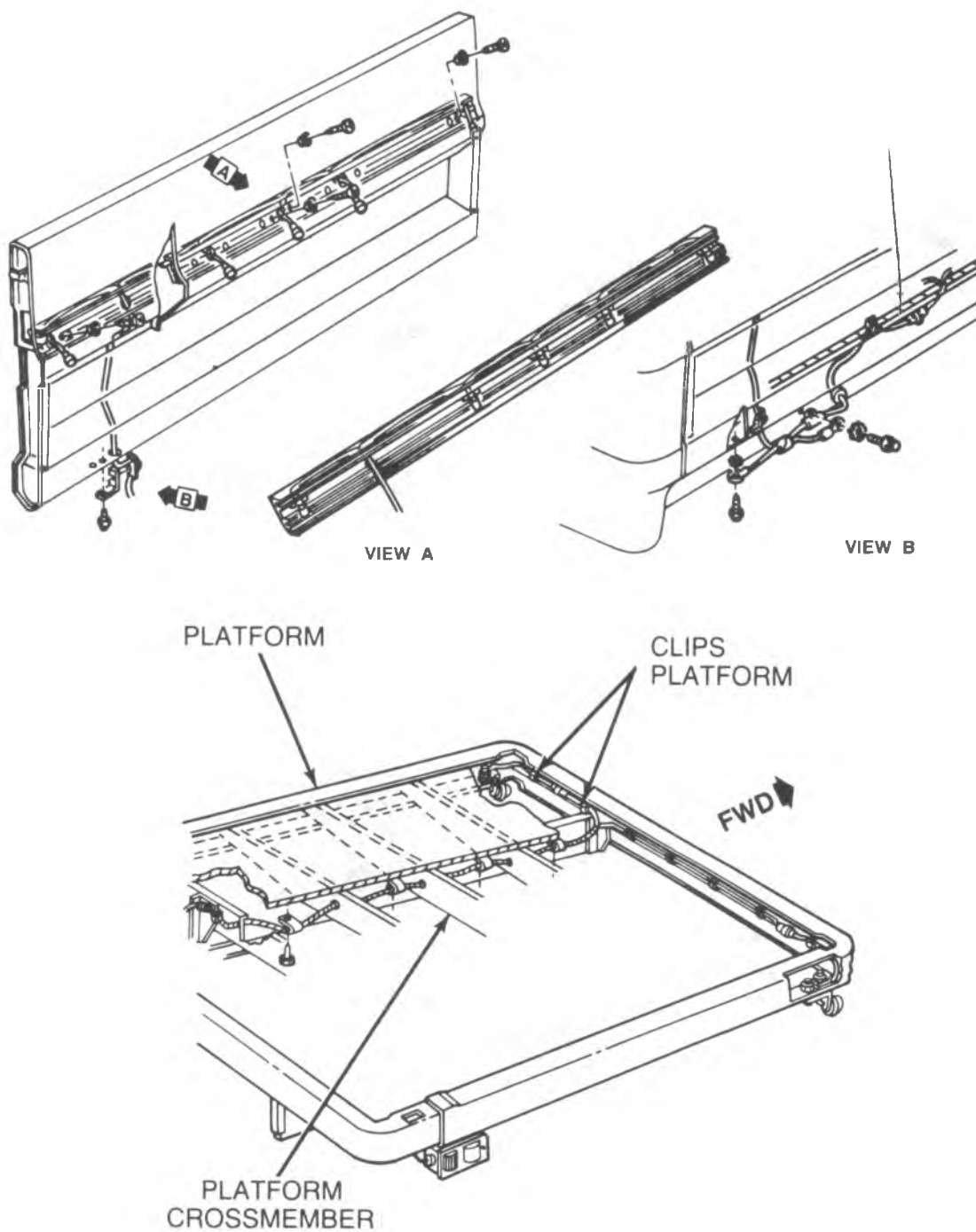


Fig. 8A-15--CK Series Rear Lamp Wiring

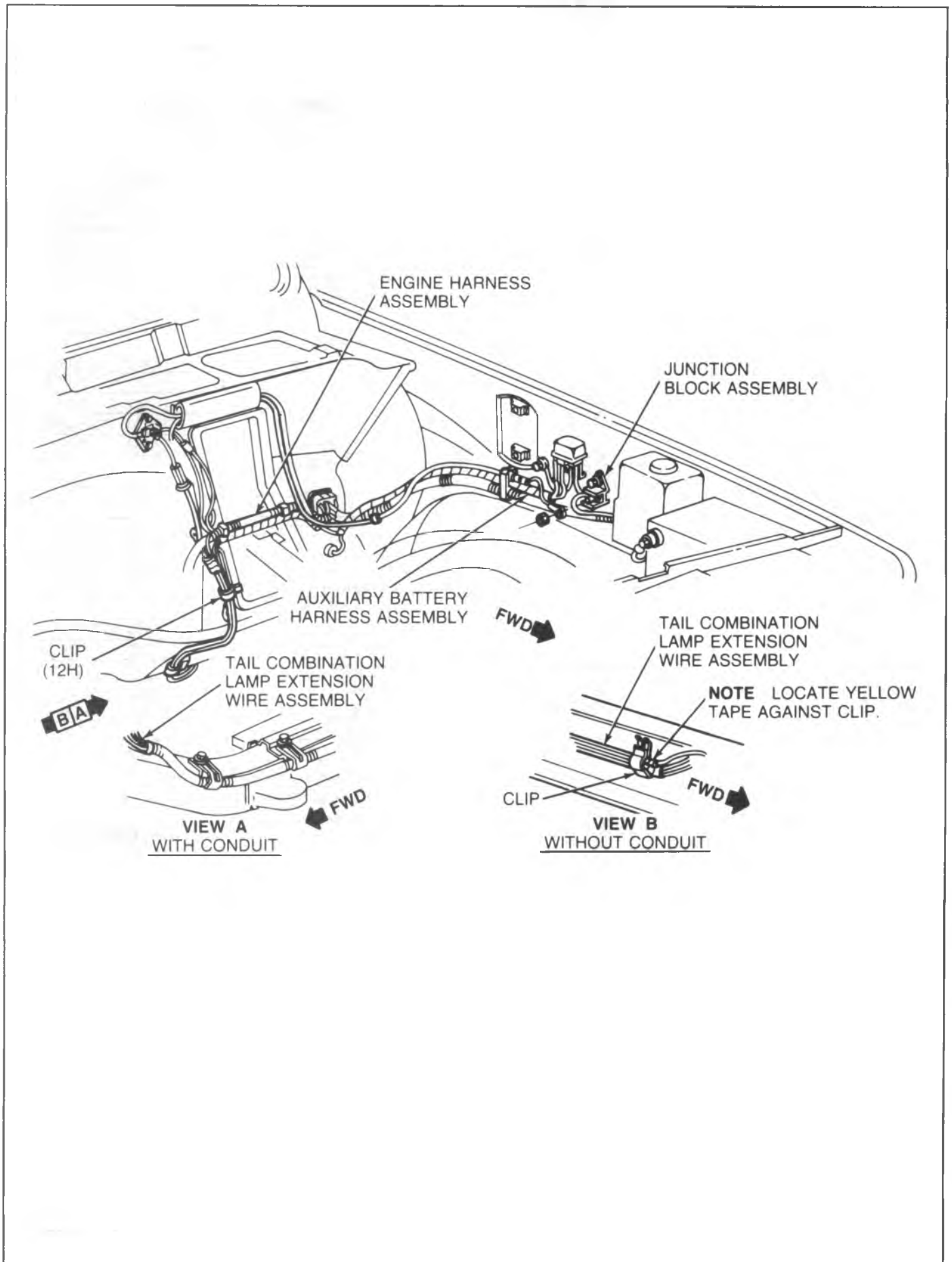


Fig. 8A-16--CK Series Auxiliary Wiring

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 8B

ELECTRICAL AND WIRING

CONTENTS

Radio Receiver		Fusible Link	8B-5
Speakers	8B-1	Diagnosis	8B-5
Circuit Protection	8B-4	On-Vehicle Service	8B-5
General Description	8B-4	Headlamp Warning Buzzer	8B-6
Circuit Breaker	8B-4	Seat Belt Warning System	8B-6
Fuse	8B-4	Specifications	8B-8

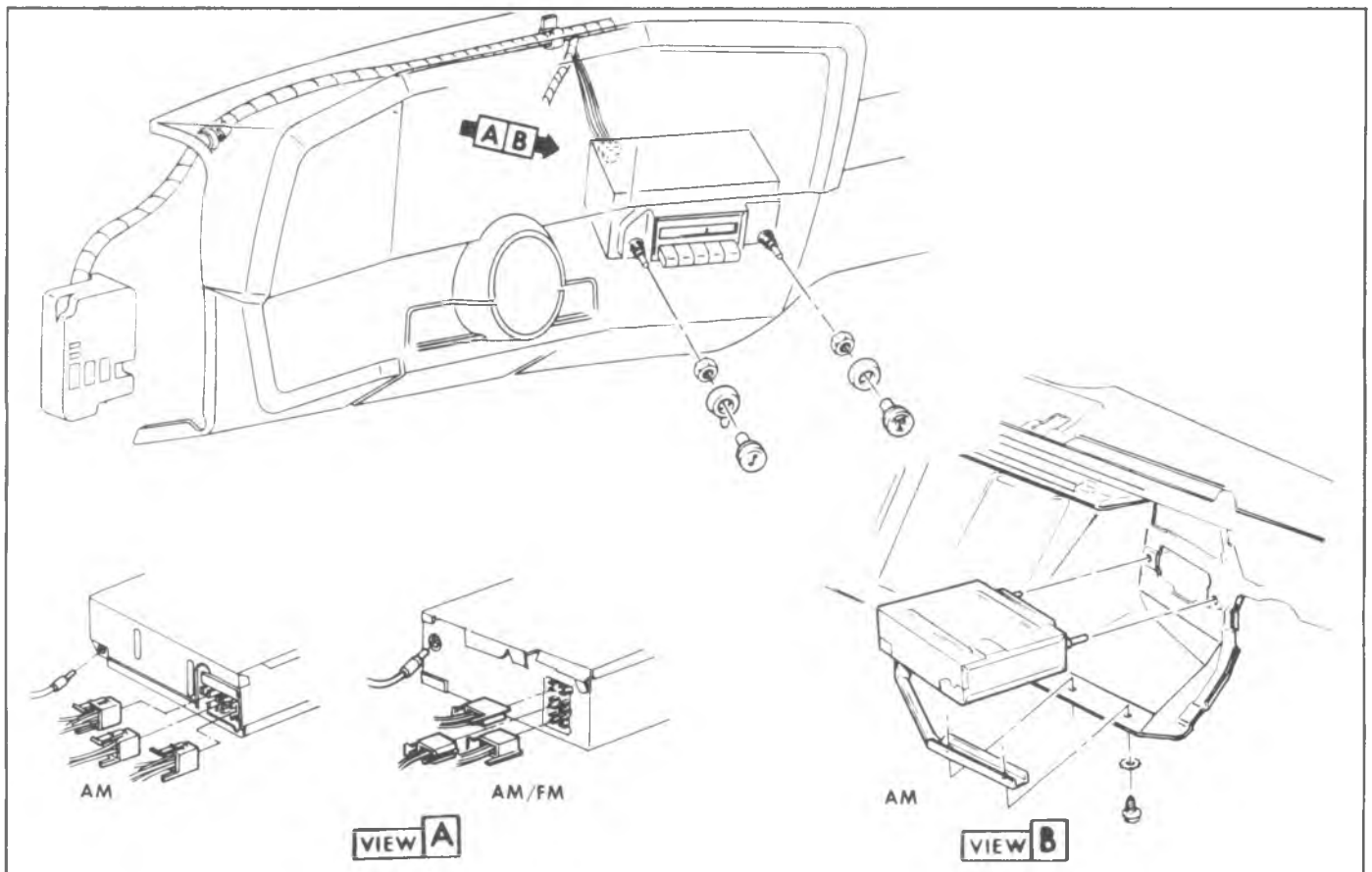


Fig. 8B-1--Radio Receiver (C-K Series)

RADIO RECEIVER

REMOVAL AND INSTALLATION

C-K Series

Replacement (Fig. 8B-1)

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. 8B-2)

1. Disconnect battery ground cable.
2. Remove engine cover.

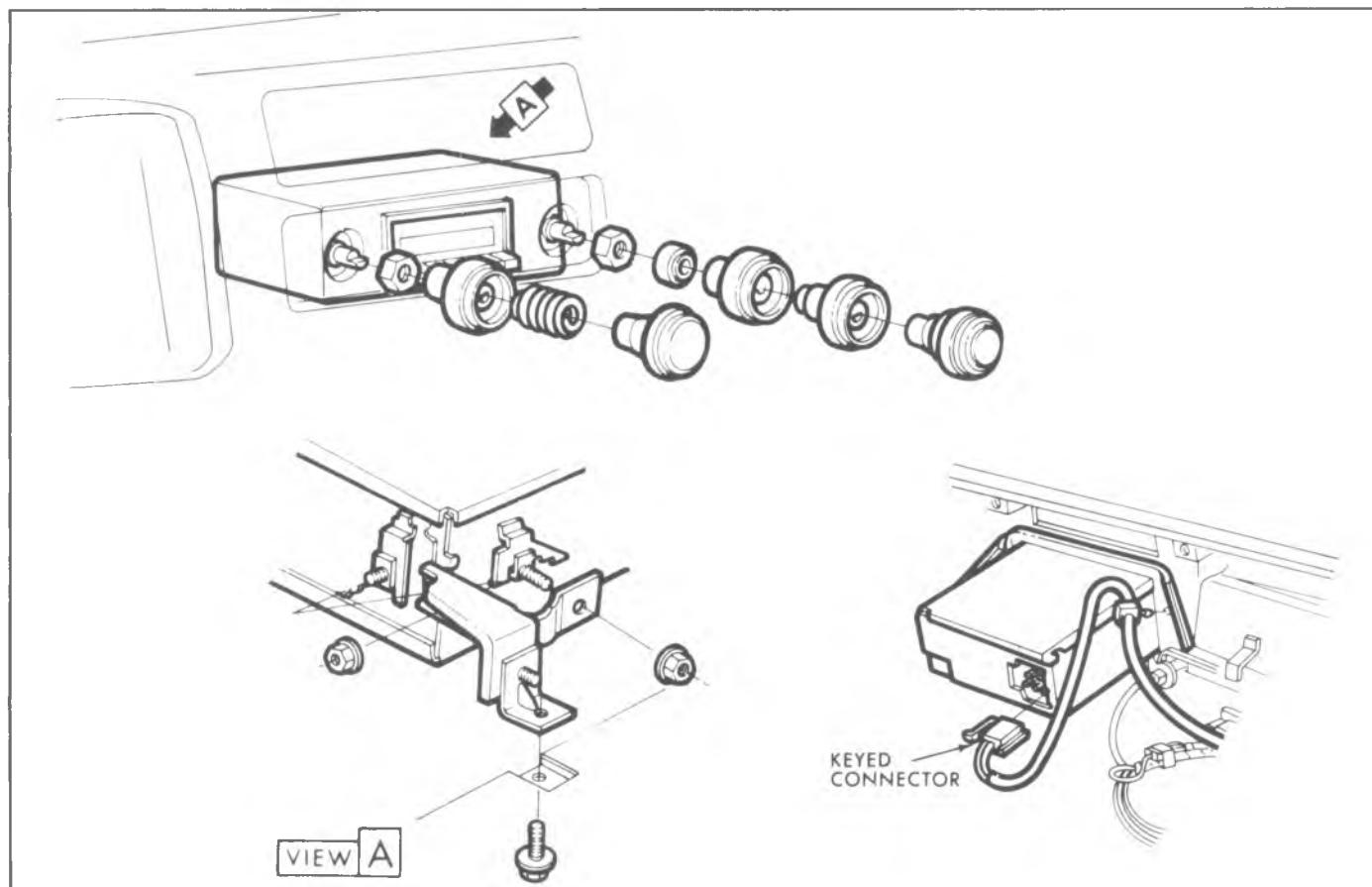


Fig. 8B-2--Radio Receiver Installation--G Models

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.

CAUTION: 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.

AM-FM And Stereo 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.
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. 8B-3)

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.

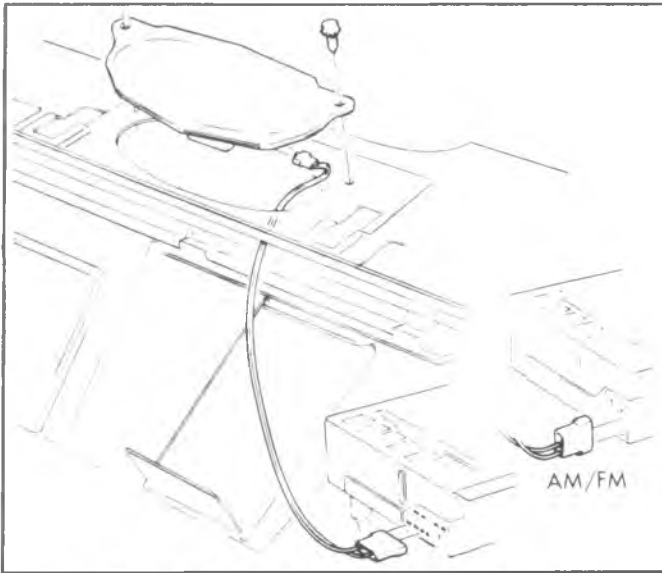


Fig. 8B-3--Radio Front Speaker (C-K Series)

G Models

Replacement (Fig. 8B-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.

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

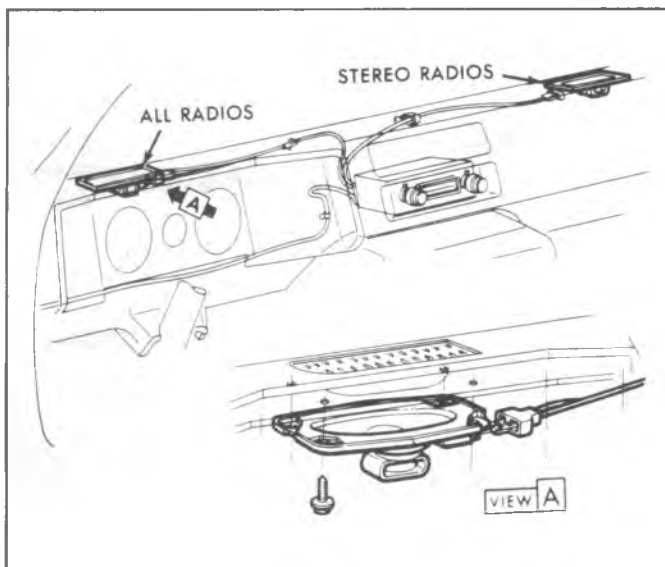


Fig. 8B-4--Speaker Installation--G Series

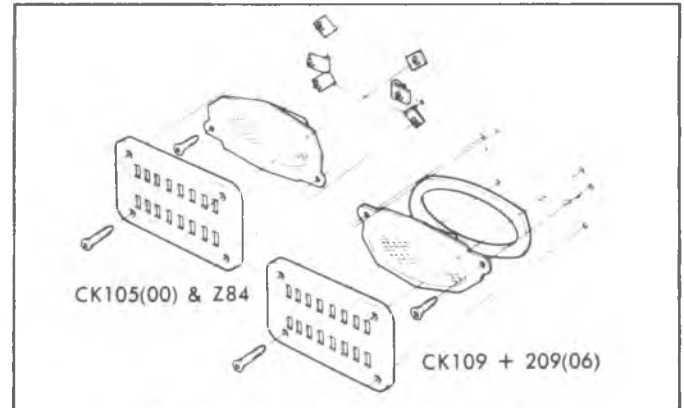


Fig. 8B-5--Rear Speaker (C-K Models)

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. 8B-5)

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. 8B-6 and 8B-7)

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.

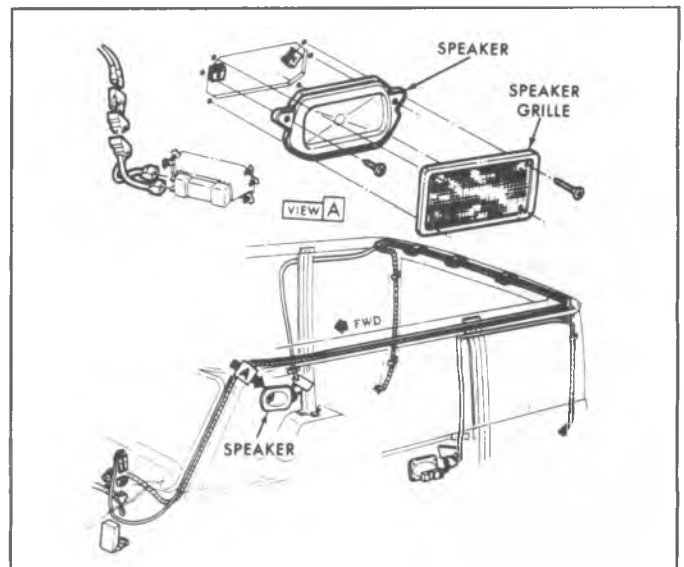


Fig. 8B-6--Rear Speaker (G (05) Truck)

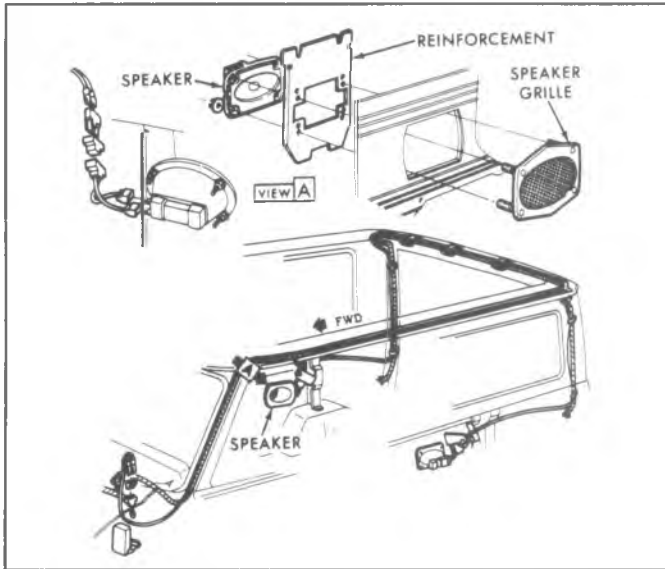


Fig. 8B-7--Rear Speaker (G (06) Truck)

3. Remove four nuts securing speaker to grille studs and remove speaker.
4. Install replacement speaker in reverse order of removal.

CIRCUIT PROTECTION

GENERAL DESCRIPTION

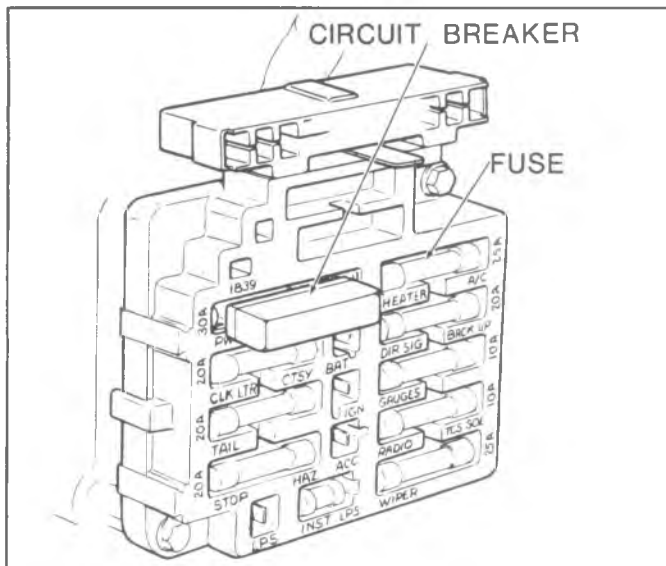


Fig. 8B-8--Fuse and Circuit Breaker

All electrical circuits are protected against excessive loads which might occur due to shorts or overloads in the wiring system. Such protection is provided by either a circuit breaker, fuse or fusible link. Each of these protective devices are explained below.

CIRCUIT BREAKER (Fig. 8B-8)

A circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excess current will open the circuit breaker and cause it to cycle if it automatically resets, thus, indicating there is something wrong in the system. The circuit breaker will continue to cycle until the

trouble is found and corrected. Excessive cycling of the breaker will eventually damage the breaker contacts to the point that replacement of the breaker is necessary.

FUSE (Fig. 8B-8)

A common method of protection is to use a fuse in the circuit. Whenever there is an excessive current through the circuit, the fusible element will melt and open the circuit. The disadvantage of using a fuse instead of a circuit breaker is the fuse in a one-time protection and replacement is required.

FUSIBLE LINK (FIG. 8B-9)

In addition to circuit breakers and fuses, the wiring harness incorporates fusible links to protect the wiring.

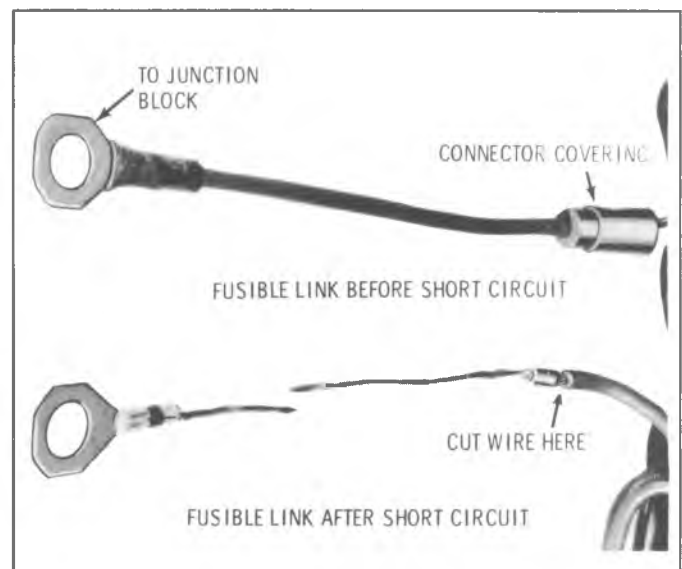


Fig. 8B-9--Fusible Link

Links are used rather than a fuse in wiring circuits that are not normally fused, such as the ignition circuit. Fusible links are color coded red in the charging and load circuits to match color coding of the circuit they protect. Each link is four gage sizes smaller than the cable it is designed to protect and are marked on the insulation with wire gage size because the heavy insulation makes the link appear a heavier gage than it actually is.

Engine compartment wiring harnesses incorporate several fusible links. The same size wire with special hypalon insulation must be used when replacing a fusible link.

The links are:

1. A molded splice at the starter solenoid "Bat" terminal, 14 gage red wire. Servicing requires splicing in a new link.
2. A 16 gage red fusible link is located at junction block to protect all unfused wiring of 12 gage or larger. The link is molded into the bulkhead connector.
3. The generator warning light and field circuitry (16 gage wire) is protected by a fusible link (20 gage red wire) used in the "battery feed to voltage regulator #3 terminal". The link is installed as a molded splice in the circuit at the junction block. Service by splicing in a new 20 gage wire.

DIAGNOSIS

Failures in a circuit are usually caused by short or open circuits. Open circuits are usually caused by breaks in the

wiring, faulty connections or mechanical failure in a component such as a switch or circuit breaker. Short circuits are usually caused by wires from different components of the circuit contacting one another or by a wire or component grounding to the metal of the body due to a screw driven through the wires, insulation cut through by a sharp metal edge, etc.

The following information may aid in locating and correcting a failure in the body wiring electrical system.

1. If a major portion of the electrical circuit becomes inoperative simultaneously, the failure may be due to improper connections between the front and rear harness, or between the front harness and the chassis wiring connector on top of fuse block.
2. If only one of the circuits is inoperative, the failure is due to an open circuit or short in the affected circuit. Short circuits usually result in blown fuses or in the case of power equipment circuits, in the circuit breaker opening the circuit. If the fuse is not blown and the circuit affected is a lamp circuit, check the bulb before proceeding with any checking procedures.
3. The dome lamp and courtesy lamp circuits are designed so that the switches are in the "ground" side of the circuit. If a condition is encountered where the lamps remain "on" even though the jamb or courtesy lamp switches are not actuated, the failure is probably due to defective switches, or to the wire leading to the switches being grounded to the metal body.

ON-VEHICLE SERVICE

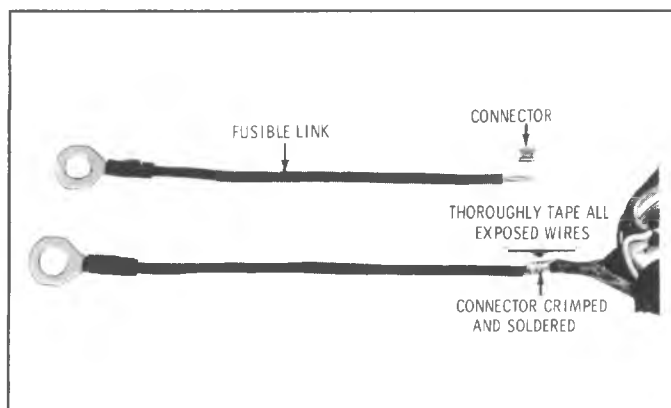


Fig. 8B-10--Fusible Link Replacement

Fusible Link Replacement (Fig. 8B-10)

A new fusible link can be installed, after the short circuit is located and repaired, as follows:

1. Disconnect battery ground cable.
2. Disconnect fusible link from junction block or starter solenoid.
3. Cut harness directly behind connector to remove damaged fusible link (fig. 8B-9).
4. Strip harness wire approximately 1/2".
5. Position clip around new fusible link and harness wire, crimp so that all wires are securely fastened.

6. Solder connection using rosin core solder. Use sufficient heat to obtain a good solder joint.
7. Tape all exposed wires with plastic electrical tape to prevent corrosion and shorting.
8. Connect fusible link to junction block or starter solenoid.
9. Connect battery ground cable.

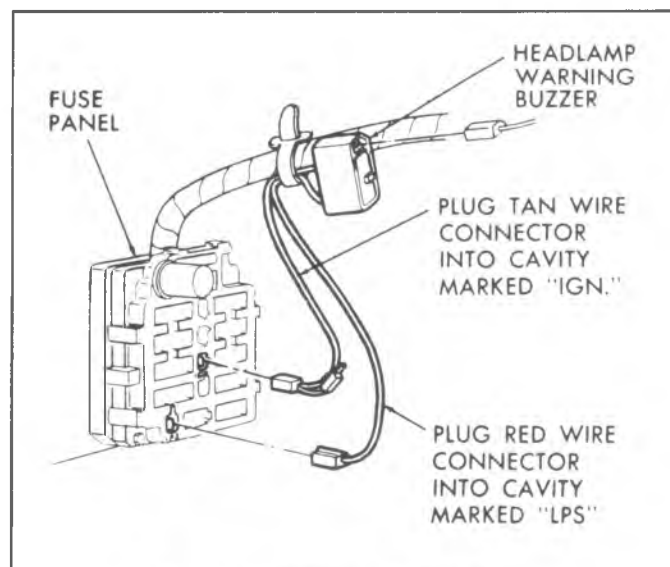


Fig. 8B-11--Headlamp Warning Buzzer

HEADLAMPS WARNING BUZZER

Replacement (Fig. 8B-11)

1. Disconnect electrical connector from LPS (Lamps) socket of fuse panel.
2. Disconnect electrical connector from IGN (Ignition) socket of fuse panel.
3. Disconnect electrical connector to instrument panel harness.
4. Remove strap securing buzzer to instrument panel harness.
5. Install replacement headlamp warning buzzer in reverse wequence of removal.

SEAT BELT WARNING SYSTEM

All C-K type light duty trucks have a non-sequential timer controlled seat belt warning system. This system has an instrument panel warning light that will illuminate every time the ignition switch is turned on, whether or not the driver's seat belt is buckled, but will automatically go off after 4-8 seconds. The buzzer is also controlled by the 4-8 second timer, but will operate only if the driver has not buckled-up prior to turning on the ignition. If no attempt is made to buckle-up after turning on the ignition, the buzzer will also shut-off automatically after 4-8 seconds.

A trouble shooting diagnostic chart and wiring schematic are shown in Figures 8B-12 and 8B-13.

SEAT BELT REMINDER LIGHT/BUZZER DIAGNOSIS

NOTE: WHEN DIAGNOSING A WARNING SYSTEM FAILURE AND THE SYSTEM AUTOMATICALLY SHUTS OFF BECAUSE OF THE 4-8 SECOND TIMER, A MINIMUM OF 3 MINUTES MUST BE ALLOWED BETWEEN THE DIAGNOSTIC STEPS TO ALLOW THE TIMER TO RESET (KEY IN OFF POSITION DURING THIS PERIOD)

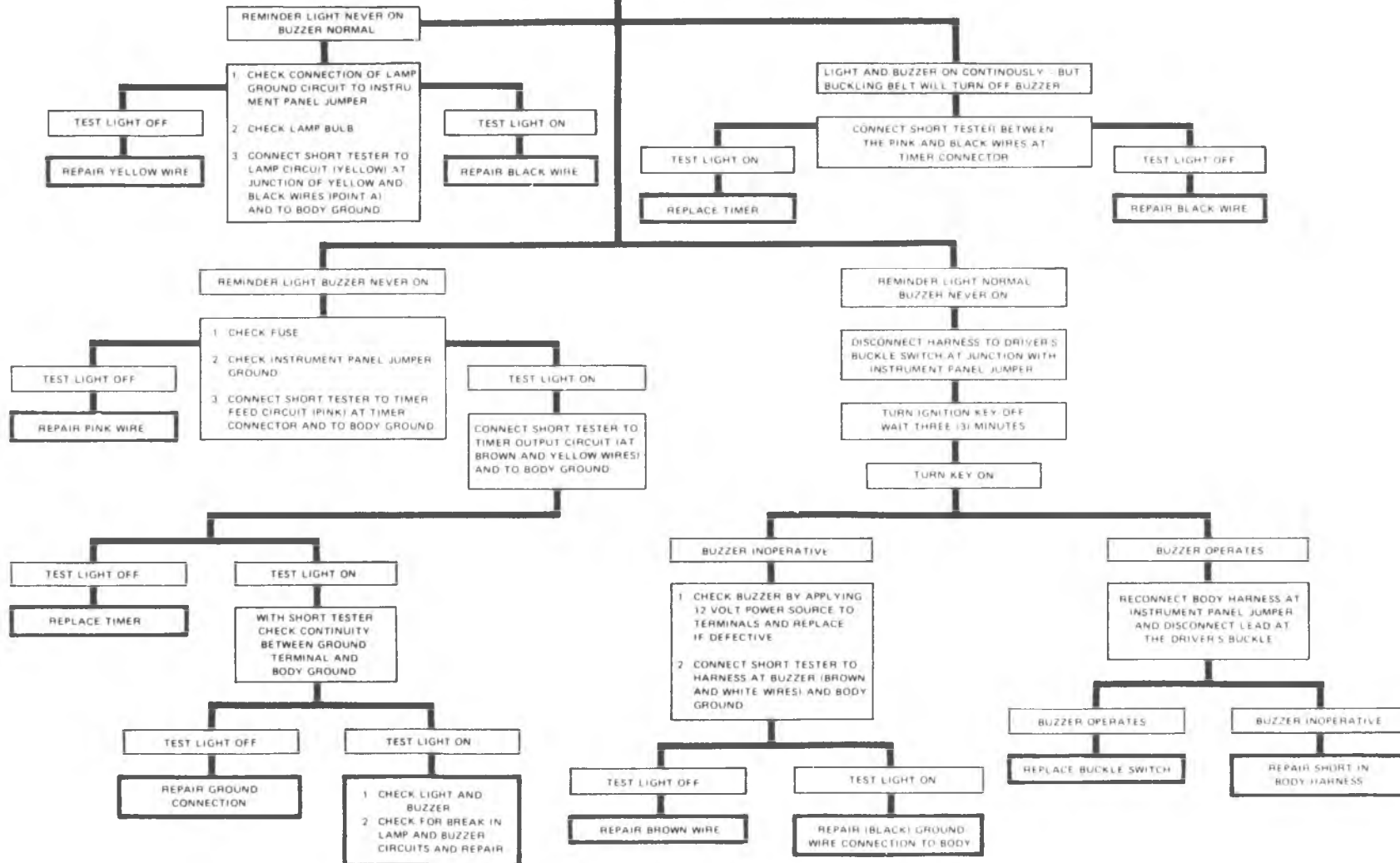


Fig. 8B-12--Seat Belt Reminder System Diagnosis

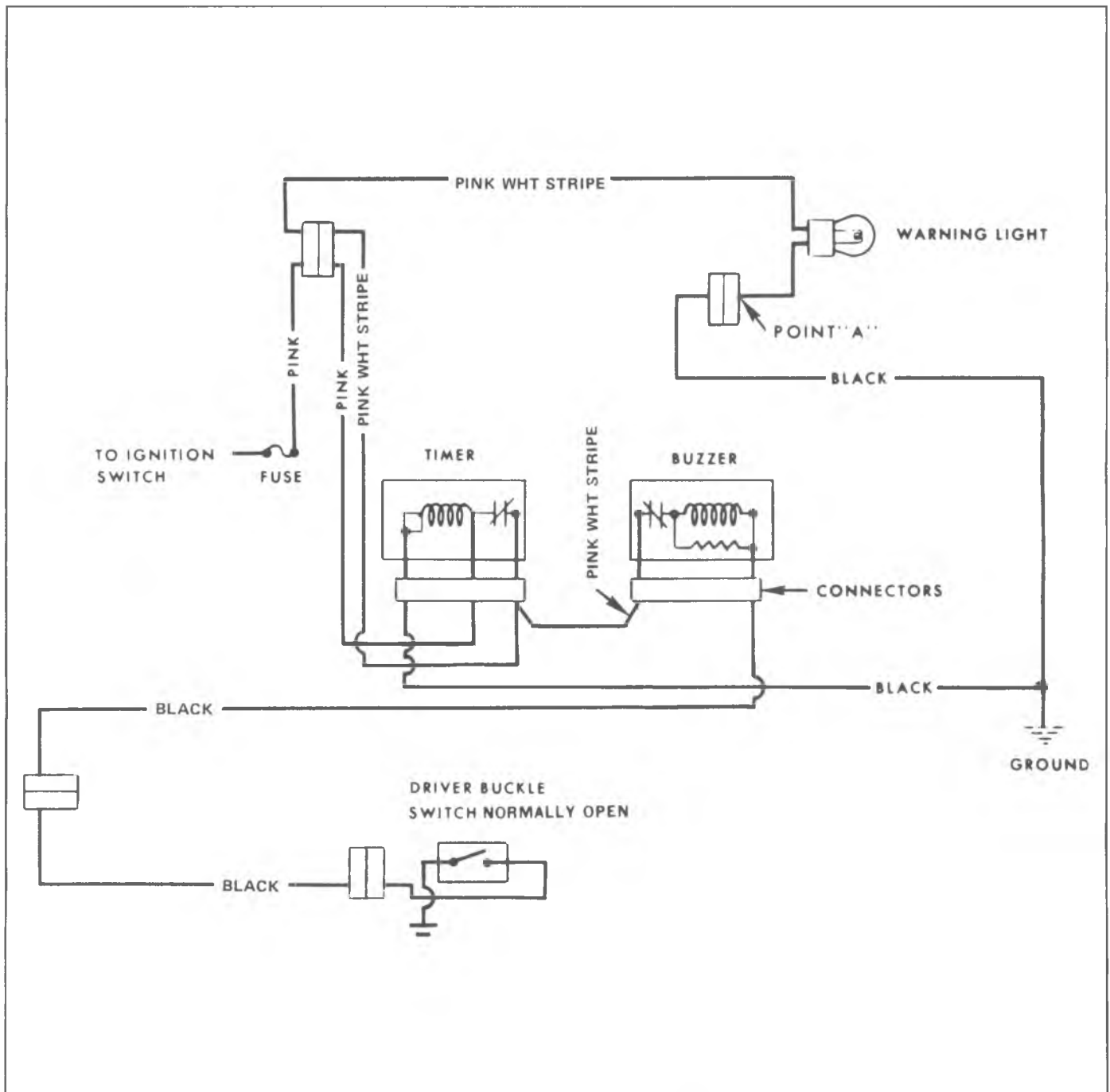


Fig. 8B-13--Seat Belt Reminder System Schematic

SPECIFICATIONS

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

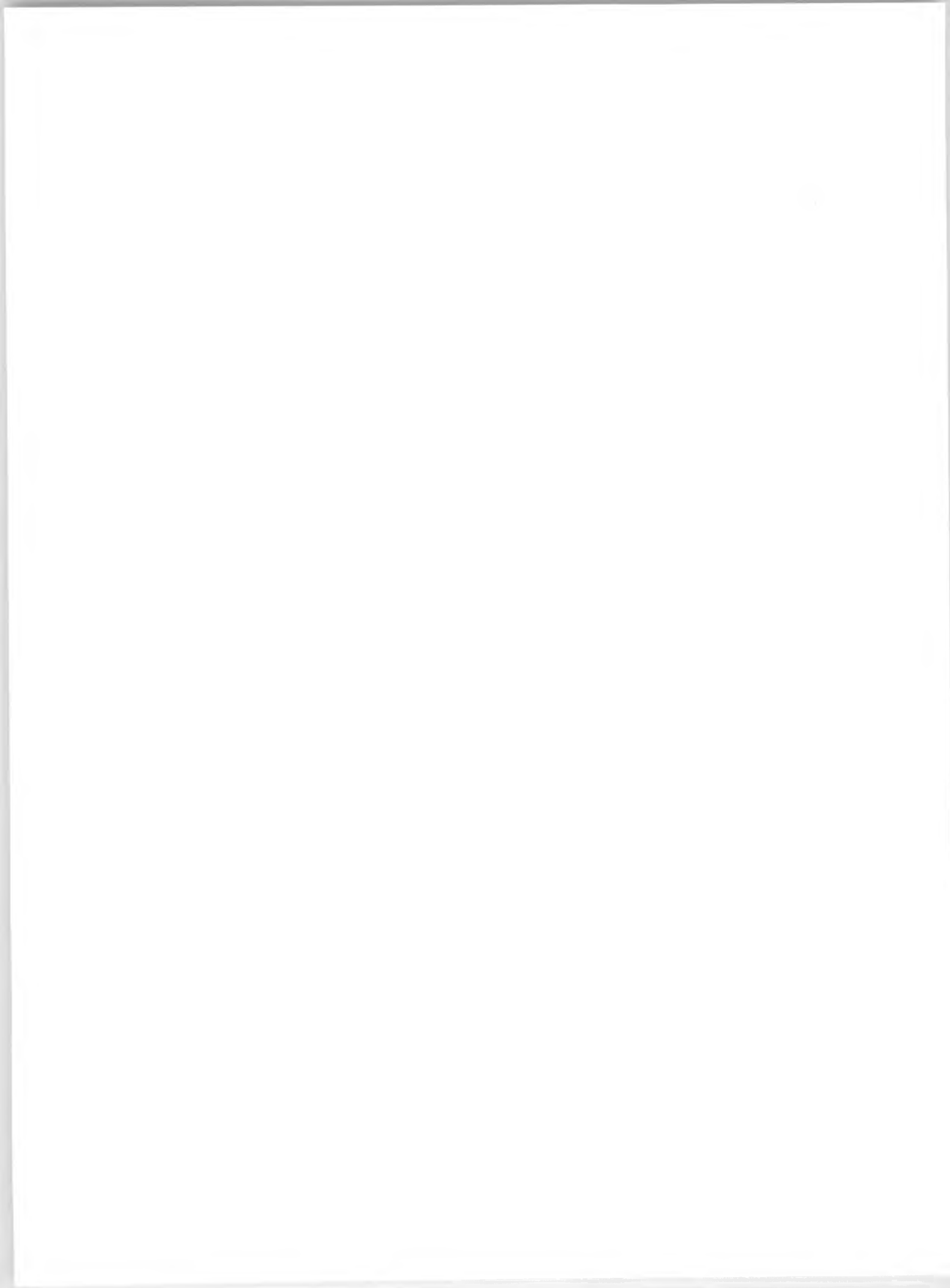
An in-line fuse is located in the Ammeter and the auxiliary heater circuits.

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)



SECTION 8C

INSTRUMENT PANEL AND GAGES

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GENERAL DESCRIPTION

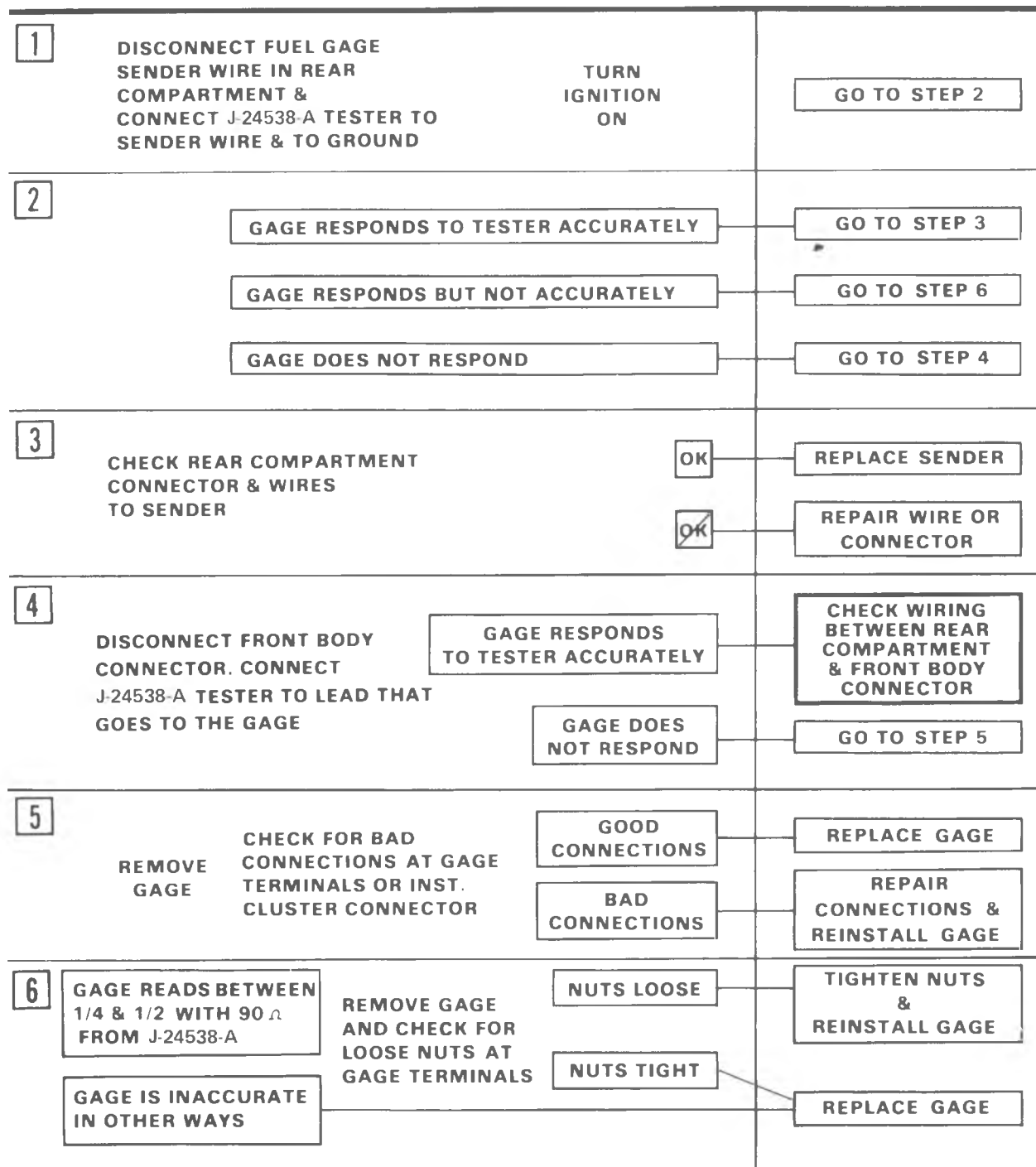
All instruments and gages are installed in the instrument cluster. Instruments and gages can be serviced in the vehicle (C-K Series); however, the entire cluster must be removed from the vehicle for servicing of the instruments and gages (G Series). Illuminating and indicator lamps may be replaced without 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

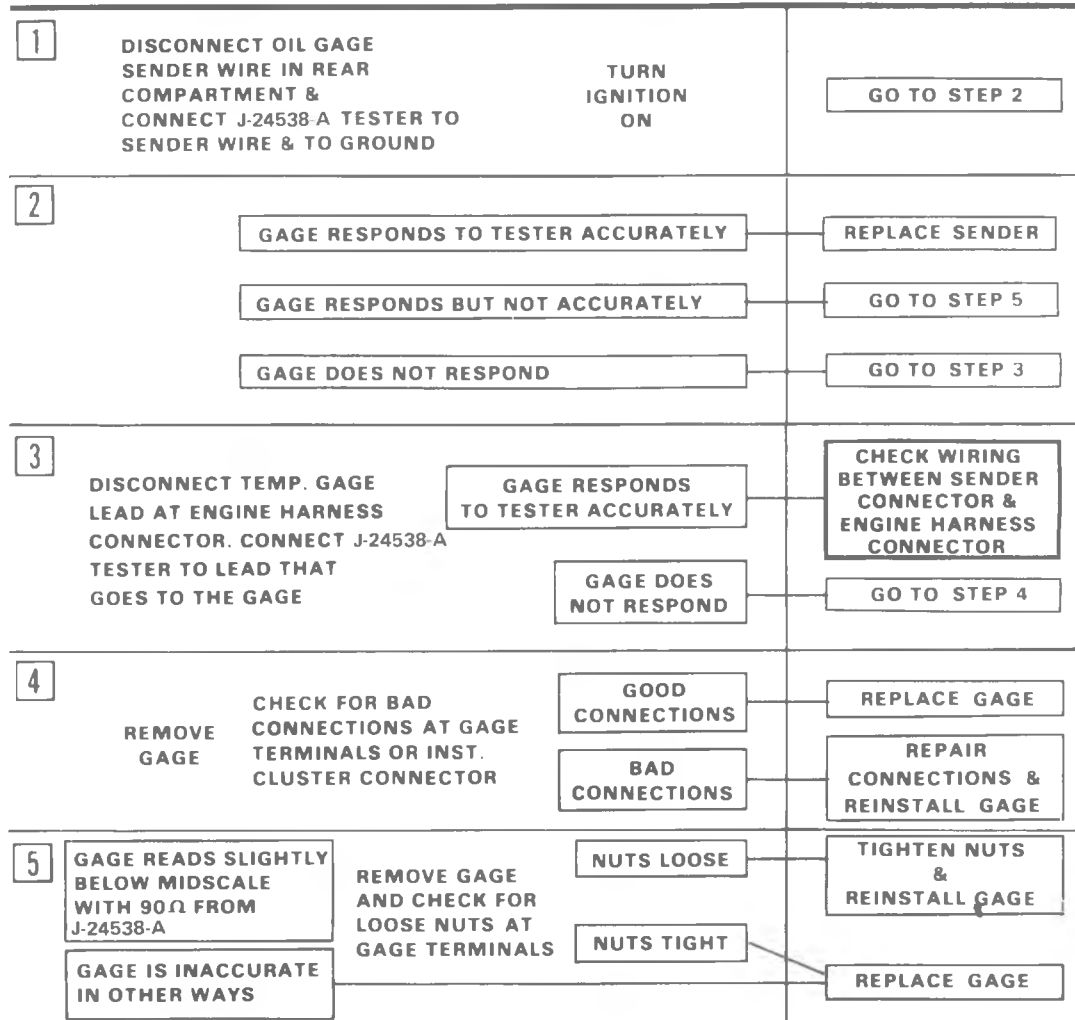
FUEL GAGE DIAGNOSIS



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.

OIL PRESSURE GAGE DIAGNOSIS



HORNS WILL NOT OPERATE

Cause	Correction
Loose connections in circuit.	Check and tighten connections. Be sure to check ground straps.
Defective horn switch.	Replace defective parts.
Defective horn relay.	Replace relay.
Defects within horn.	Replace horn.

HORNS HAVE POOR TONE

Cause	Correction
Low available voltage at horn.	Check battery and charging circuit.
Defects within horn.	Although horn should blow at any voltage above 7.0 volts, a weak or poor tone may occur at operating voltages below 11.0 volts. If horn has weak or poor tone at operating voltage of 11.0 volts or higher, remove horn and replace.

HORNS OPERATE INTERMITTENTLY

Cause	Correction
Loose or intermittent connections in horn relay or horn circuit.	Check and tighten connections.
Defective horn switch.	Replace switch.
Defective relay.	Replace relay.
Defects within horn.	Replace horn.

HORNS BLOW CONSTANTLY

Cause	Correction
Sticking horn relay.	Replace relay.
Horn relay energized by grounded or shorted wiring.	Check and adjust wiring.
Horn button can be grounded by sticking closed.	Adjust or replace damaged parts.

SPEEDOMETER

Cause	Correction
Noisy speedometer cable.	1. Loosen over-tightened casing nuts and snap-on at speedometer head.
Pointer and odometer inoperative.	2. Replace housing and core.
Inaccurate reading.	Replace broken cable.
Kinked cable.	1. Check tire size.
Defective speedometer head.	2. Check for correct speedometer driven gear.
	Replace cable. Reroute casing so that bends have no less than 6" radius.
	Replace or have repaired at authorized service station.

TEMPERATURE GAGE DIAGNOSIS

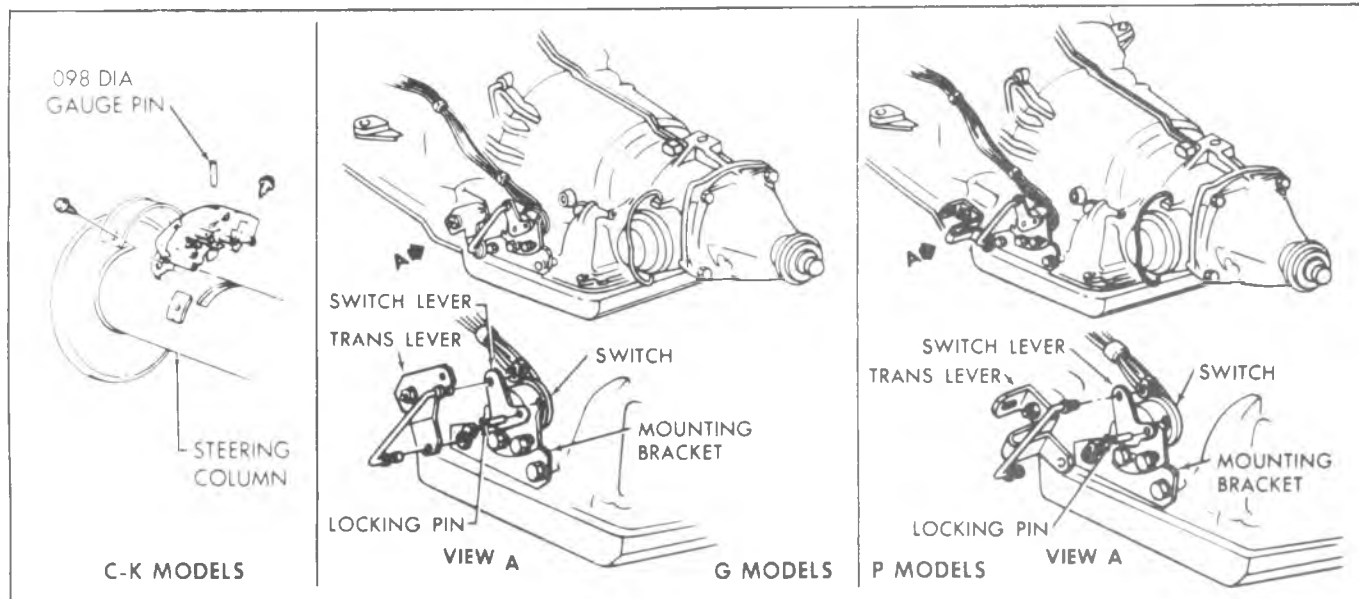
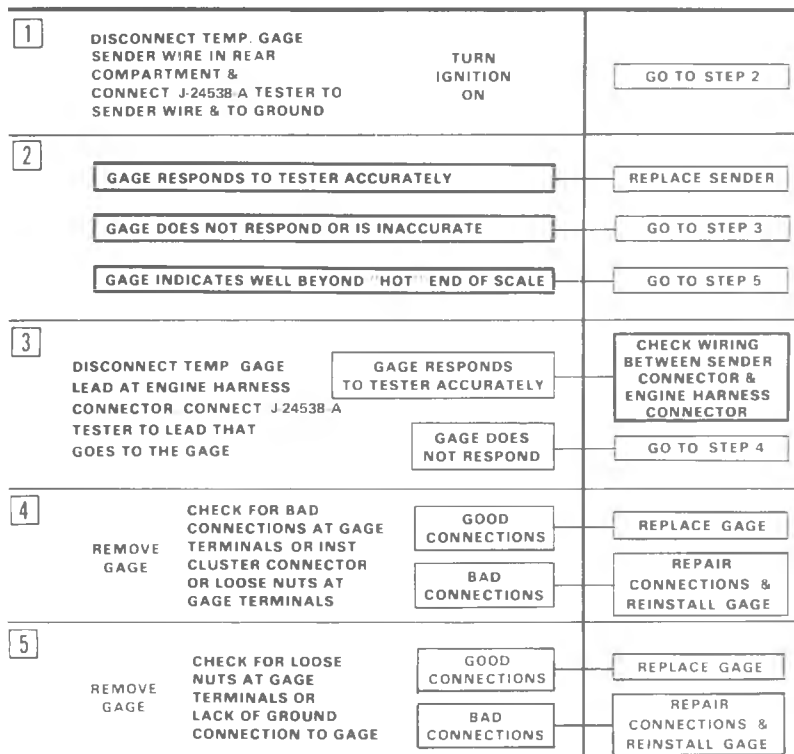


Fig. 8C-1--Neutral Start Switch Replacement - Typical

ON-VEHICLE SERVICE

NEUTRAL START SWITCH

C-K Models (Fig. 8C-1)

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.

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-1)

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.

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.

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.

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

C-K Series

See Section 3B - Steering, for ignition switch replacement procedure.

G Series

Replacement

1. Disconnect battery ground cable.
2. Remove lock cylinder by positioning switch in "ACC" position and inserting stiff wire in small hole in cylinder face. Push in on wire to depress plunger and continue to turn key counterclockwise until lock cylinder can be

removed.

3. Remove metallic ignition switch nut.
4. Pull ignition switch out from behind instrument panel and remove "theft resistant" connector. Use a screwdriver to unsnap locking tangs on connector from their position on switch.
5. Snap connector into place on new ignition switch.
6. Place switch into position from behind instrument panel, first adding grounding ring then install ignition switch nut.
7. Install lock cylinder, key inserted.
8. Install battery ground cable.

INSTRUMENT CLUSTER

C-K Series

Replacement (Fig. 8C-3)

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-4)

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.
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-3 and 8C-4)

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.

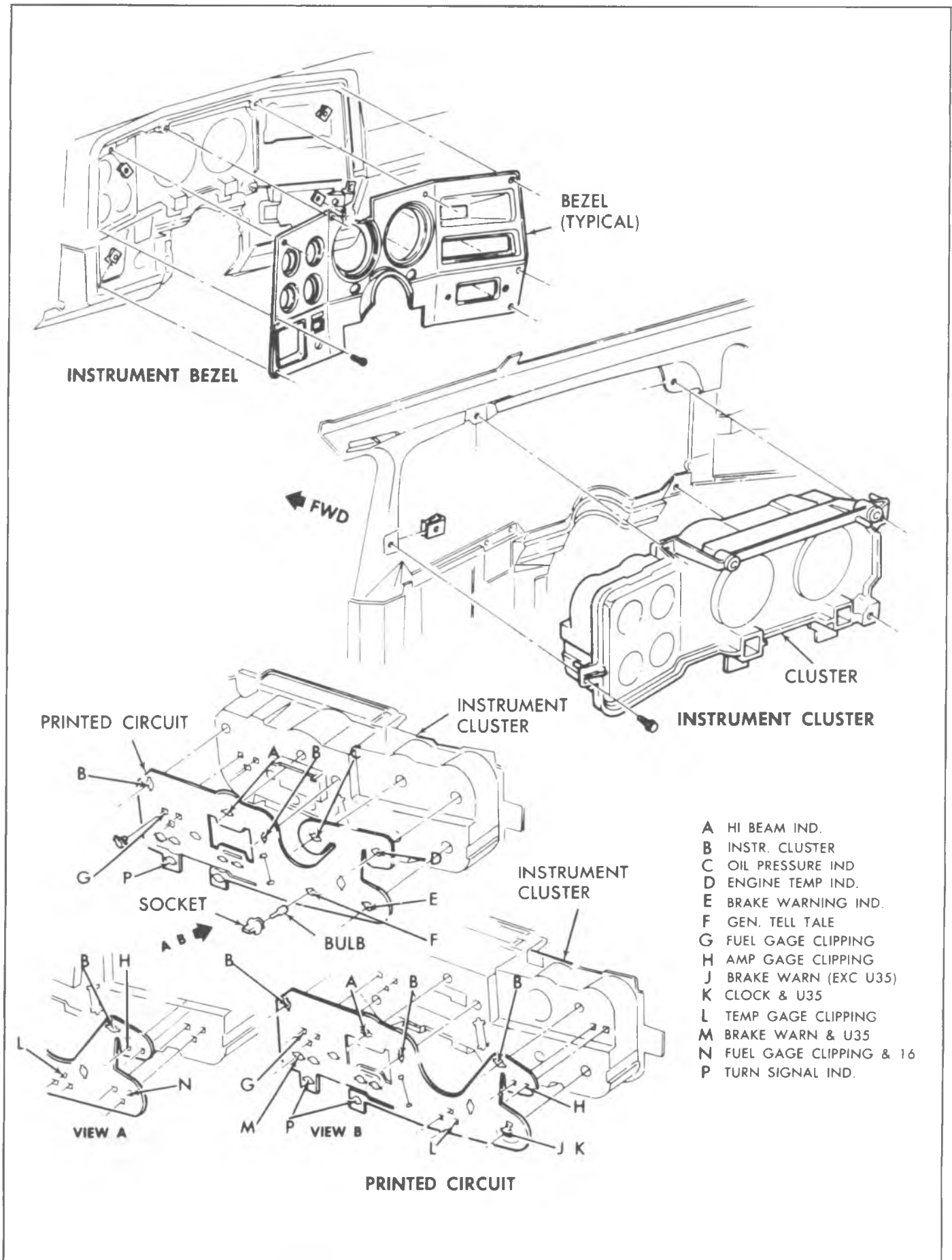


Fig. 8C-3--Instrument Cluster Assembly (C-K Series)

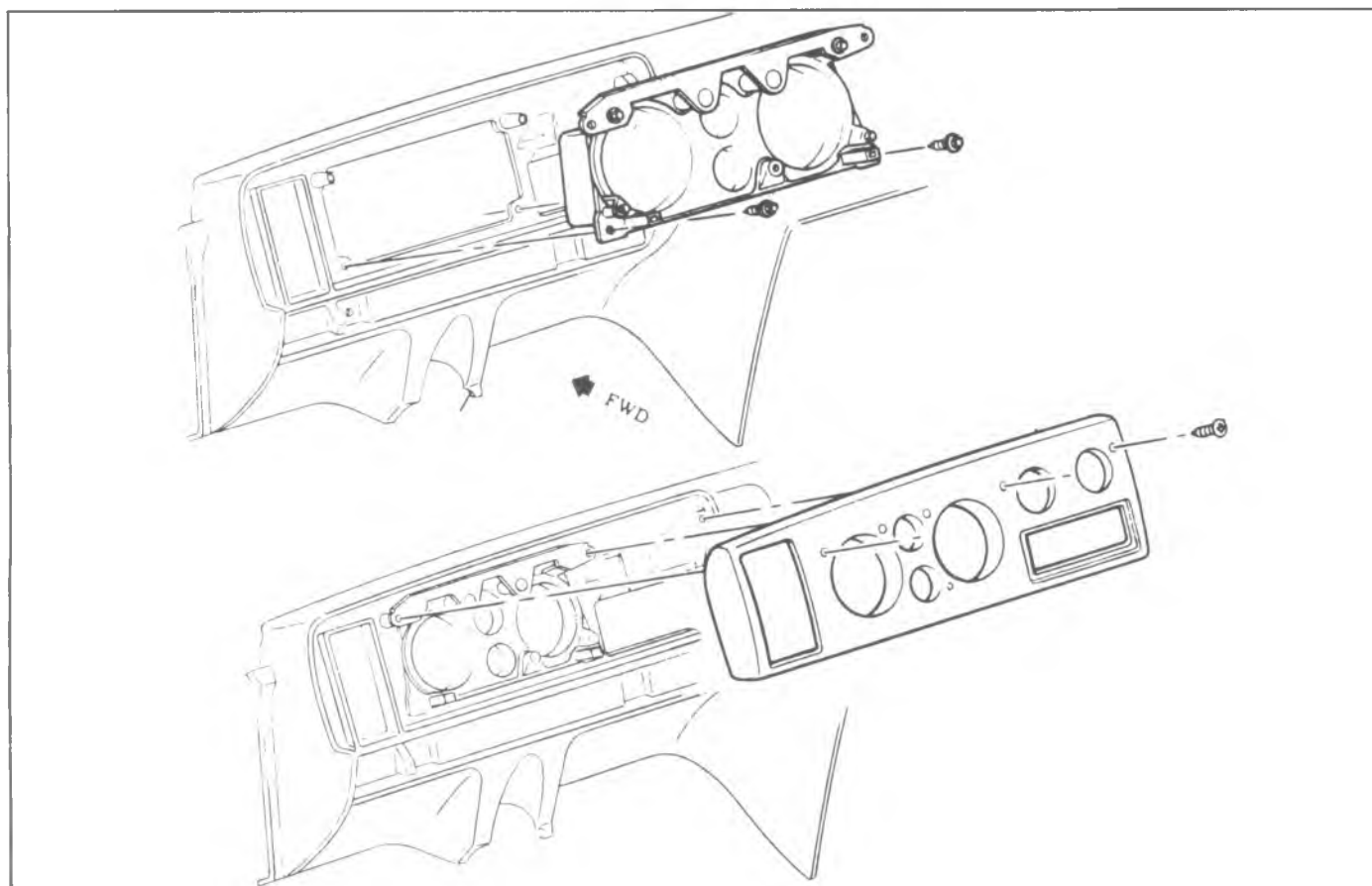


Fig. 8C-4--Instrument Cluster Assembly (G Series)

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 operation 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.

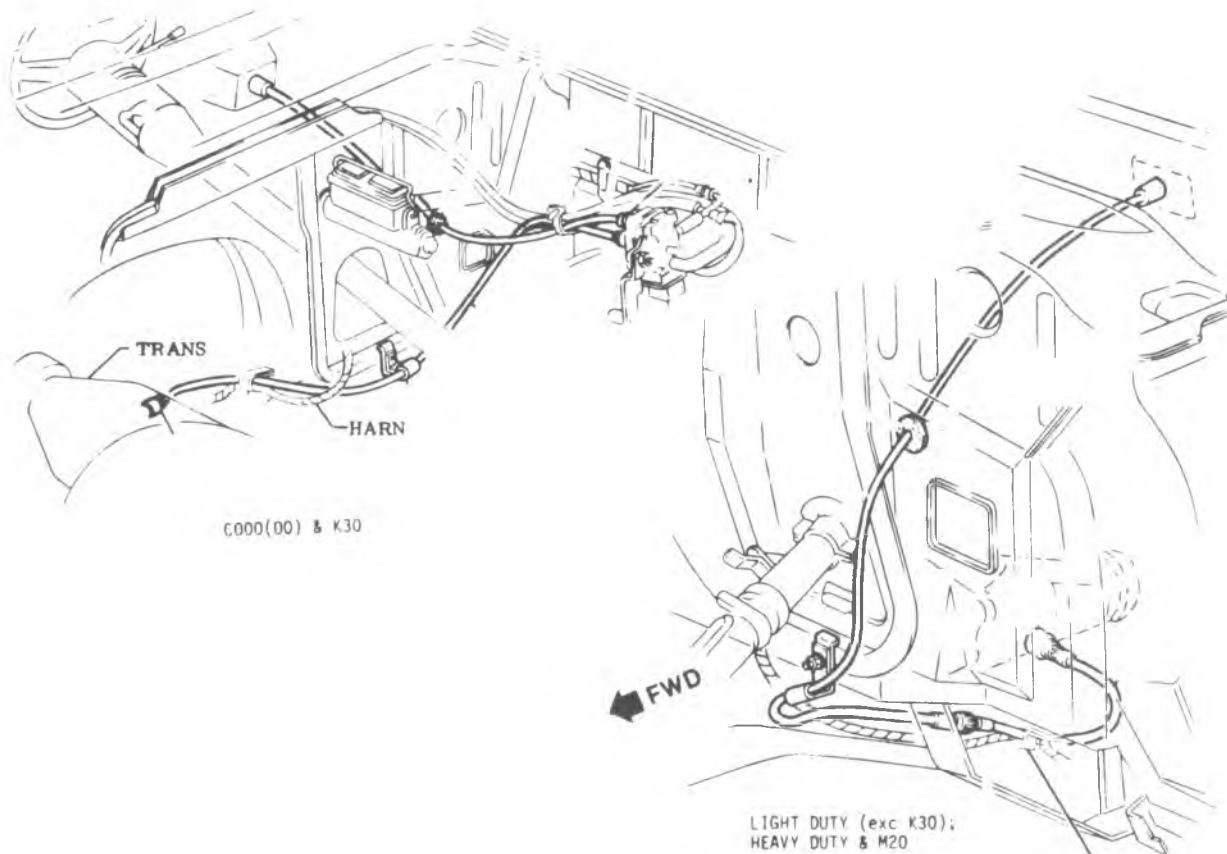
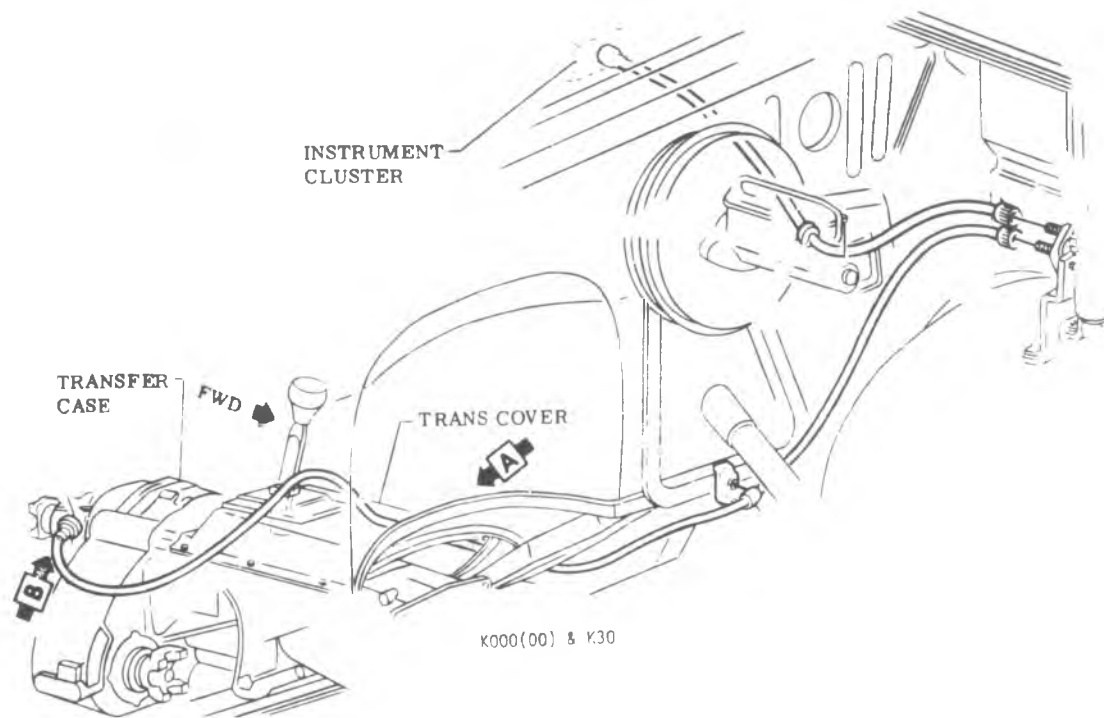


Chart 8C-F2--Speedometer Cable Routing

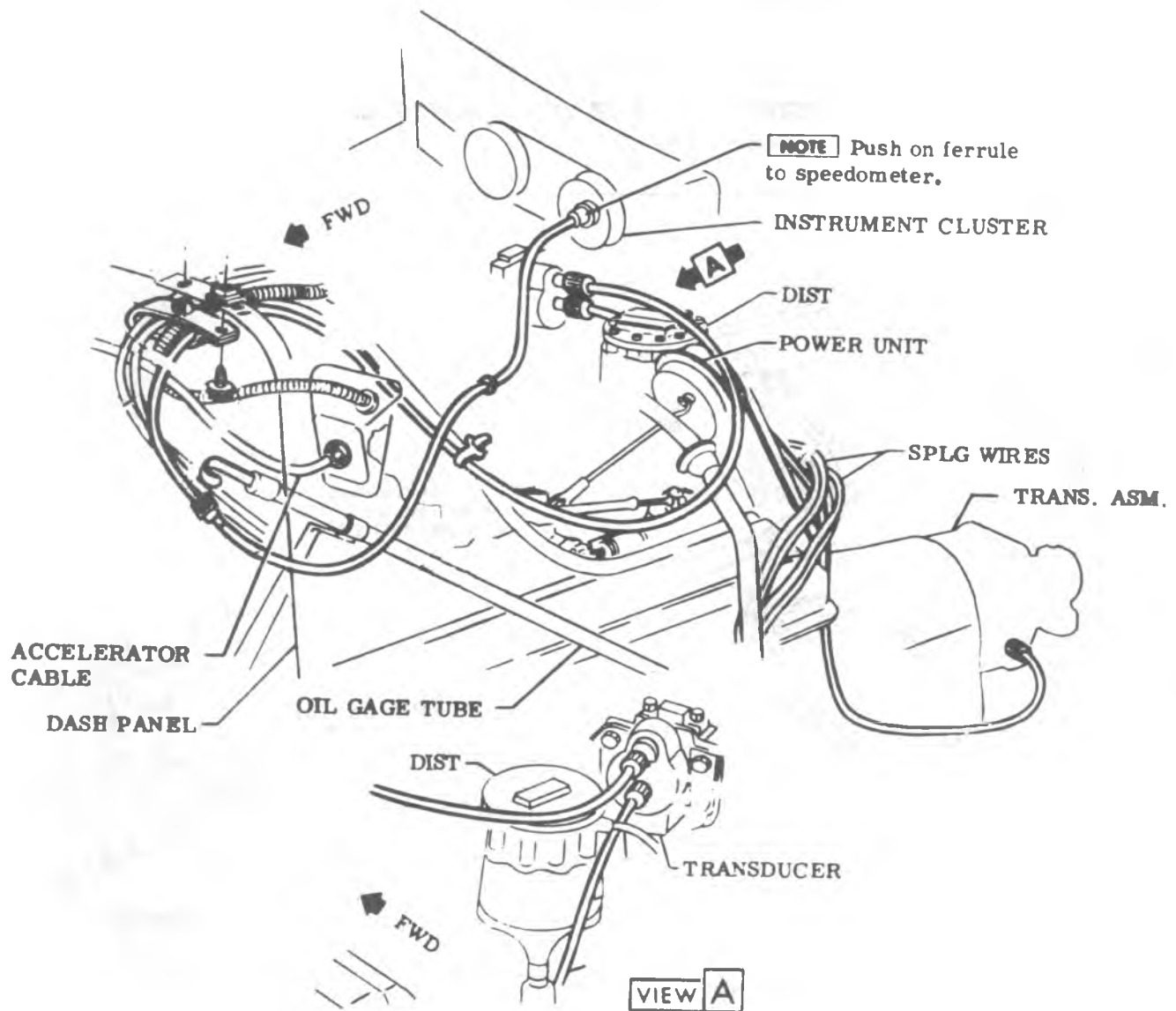


Chart 8C-G2--Speedometer Cable Routing

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 HARNESSSES

Refer to Figs. 8C-5 thru 8C-8.

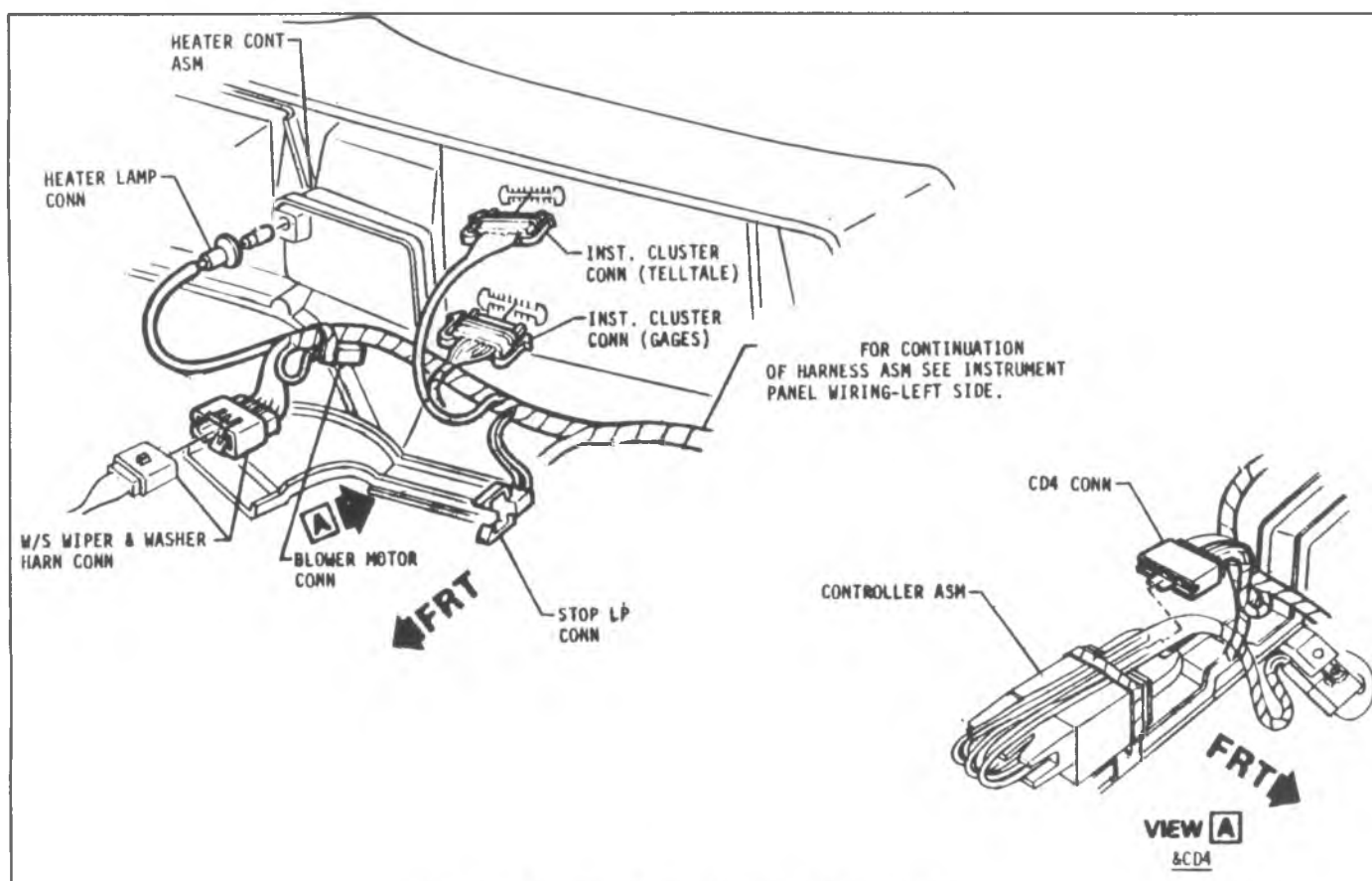


Fig. 8C-5--Instrument Panel Wiring - R.H. - G Models

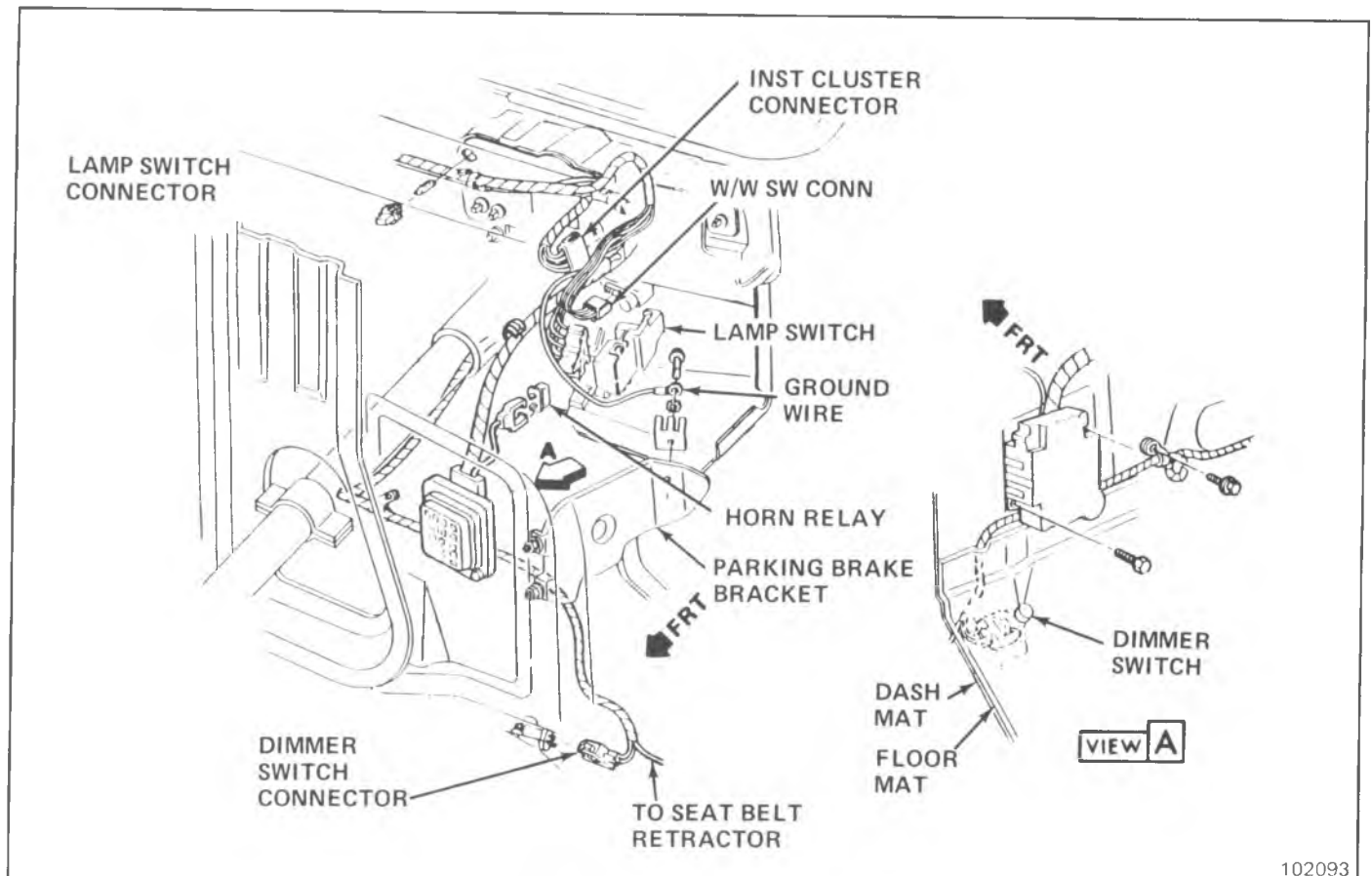


Fig. 8C-6--Instrument Panel Wiring - L.H. - G Models

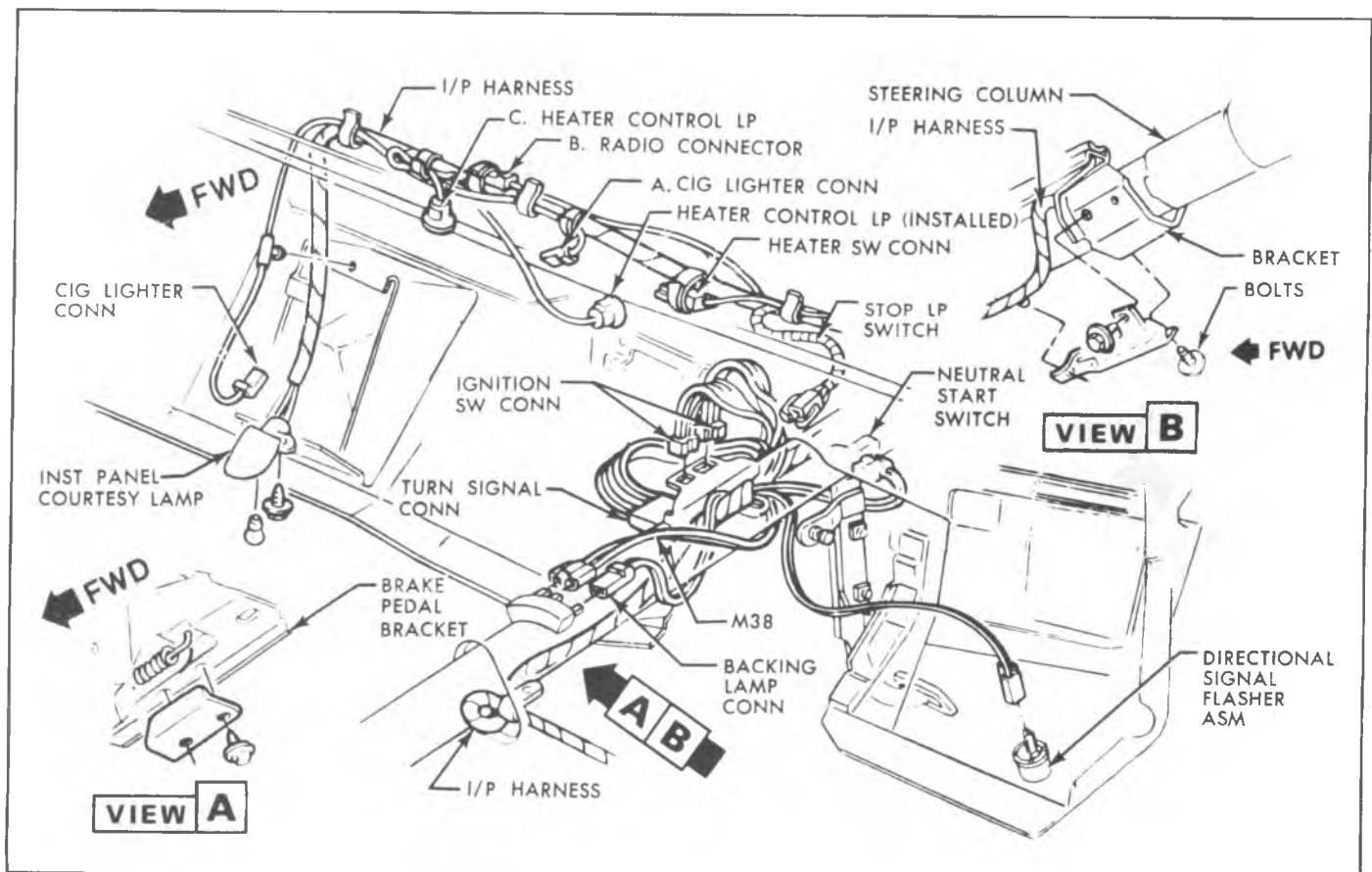


Fig. 8C-7--Instrument Panel Wiring R.H. - CK Models

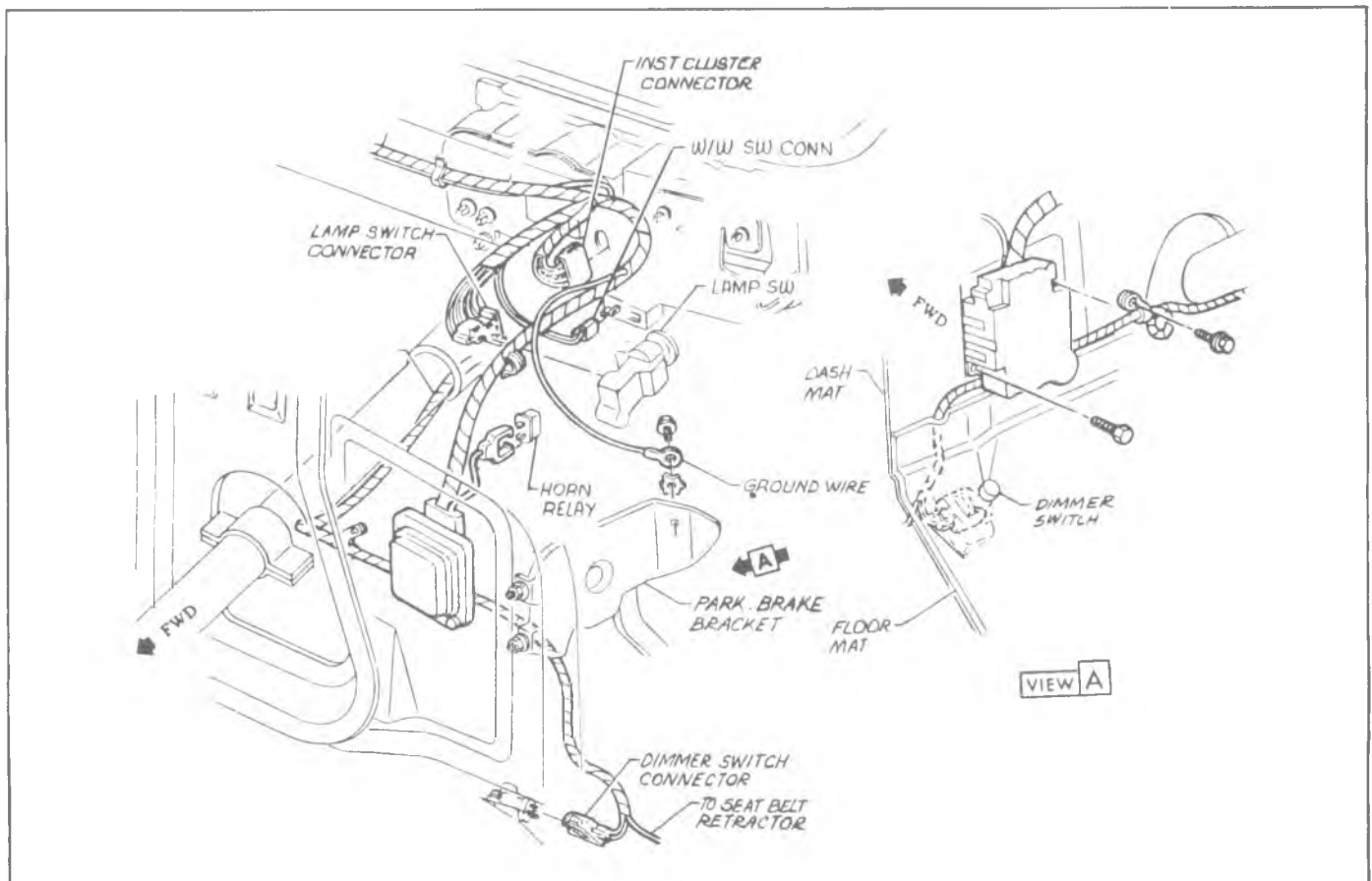


Fig. 8C-8--Instrument Panel Wiring - L.H. - CK Models

WINDSHIELD WIPER AND WASHER

C-K-G Series

GENERAL DESCRIPTION

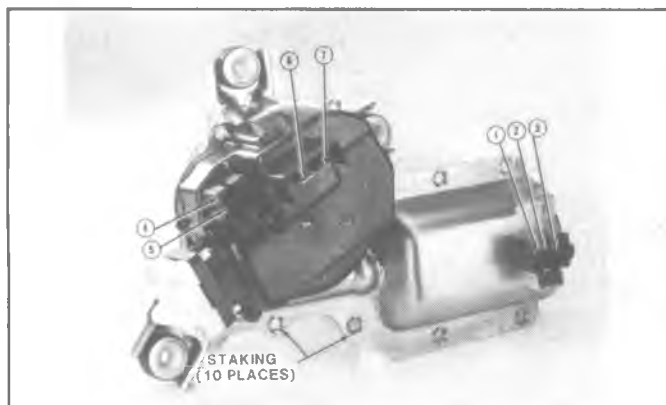


Fig. 8C-9--Wiper Motor Housing

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-9.

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-10 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-10, 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.

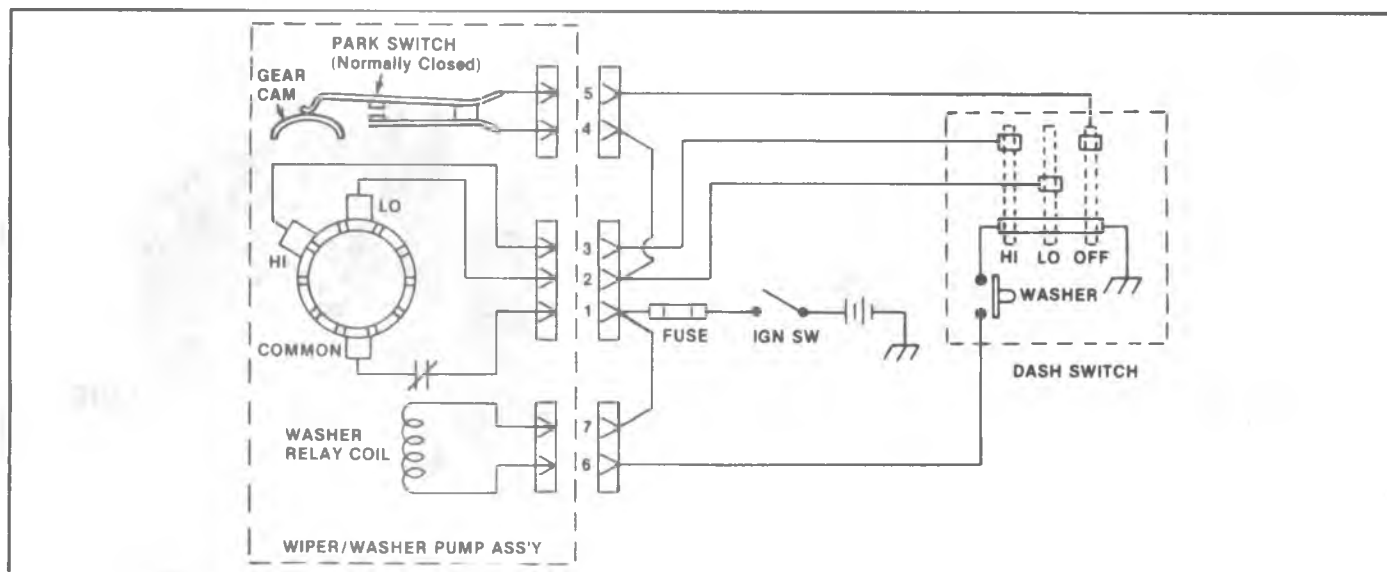


Fig. 8C-10--Wiper Motor Schematic

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 park 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-11.

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-12 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-12), 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-13), permitting the

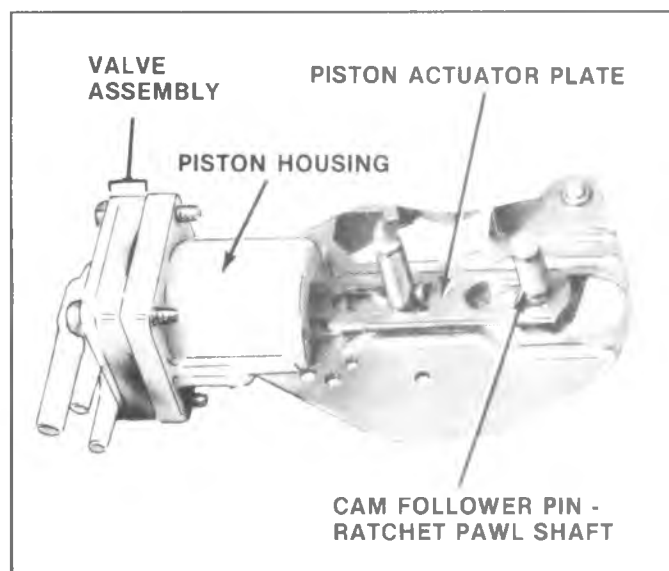


Fig. 8C-11--Washer Valve Assembly

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-14, 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-14).

Exhaust Stroke

As the 4-lobe cam continues to rotate, the cam follower moves in the opposite direction described in the intake

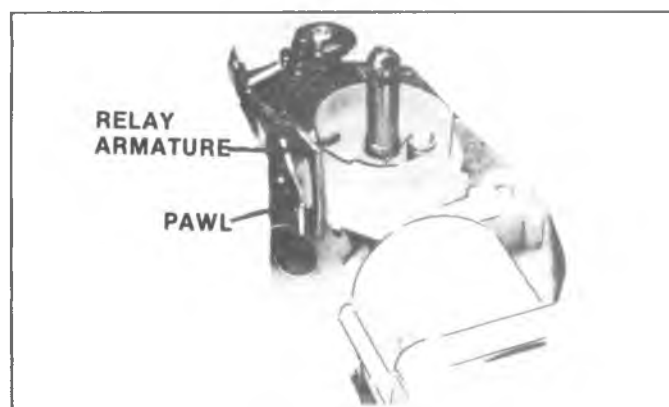


Fig. 8C-13--Relay Armature

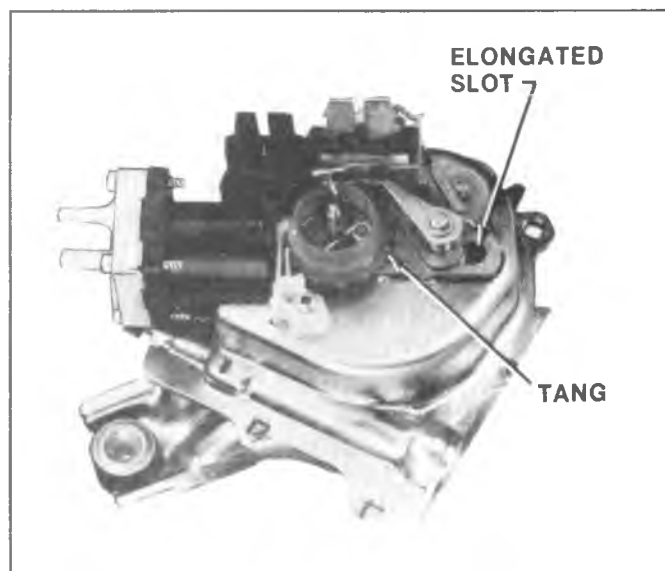


Fig. 8C-12--Ratchet Gear Pawl

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-14.

For purposes of explanation, only one exhaust valve opening is shown in Fig. 8C-14.

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-14 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-11).

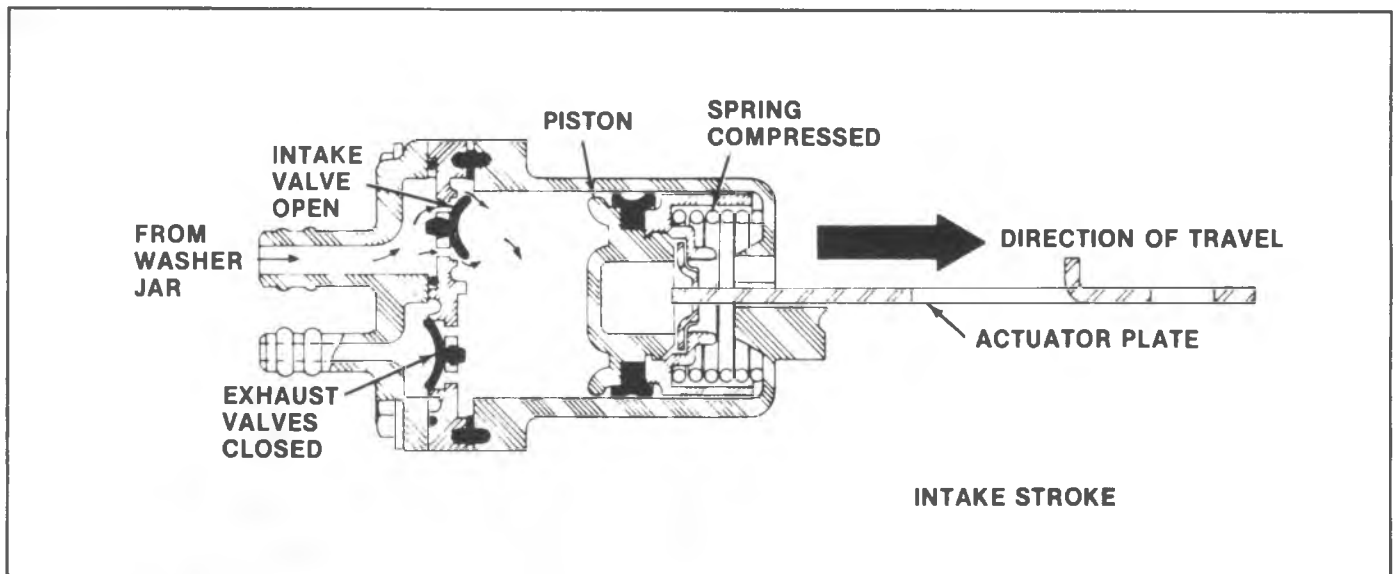


Fig. 8C-14--Pump Operation



Fig. 8C-15--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.

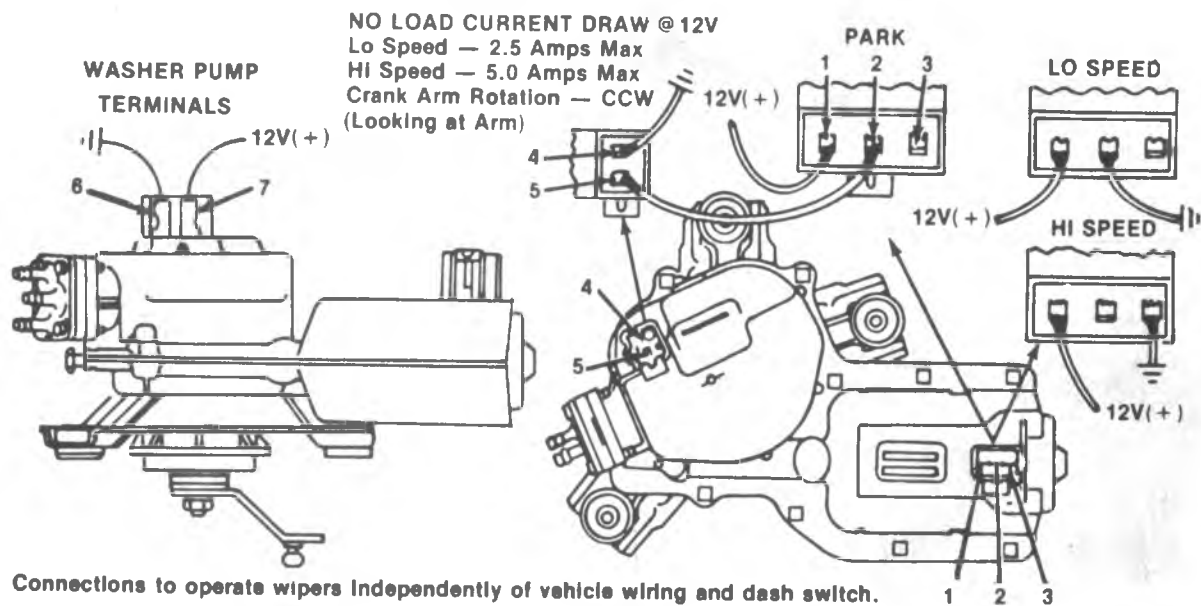


Fig. 8C-16--Wiper Motor Diagnosis Diagram

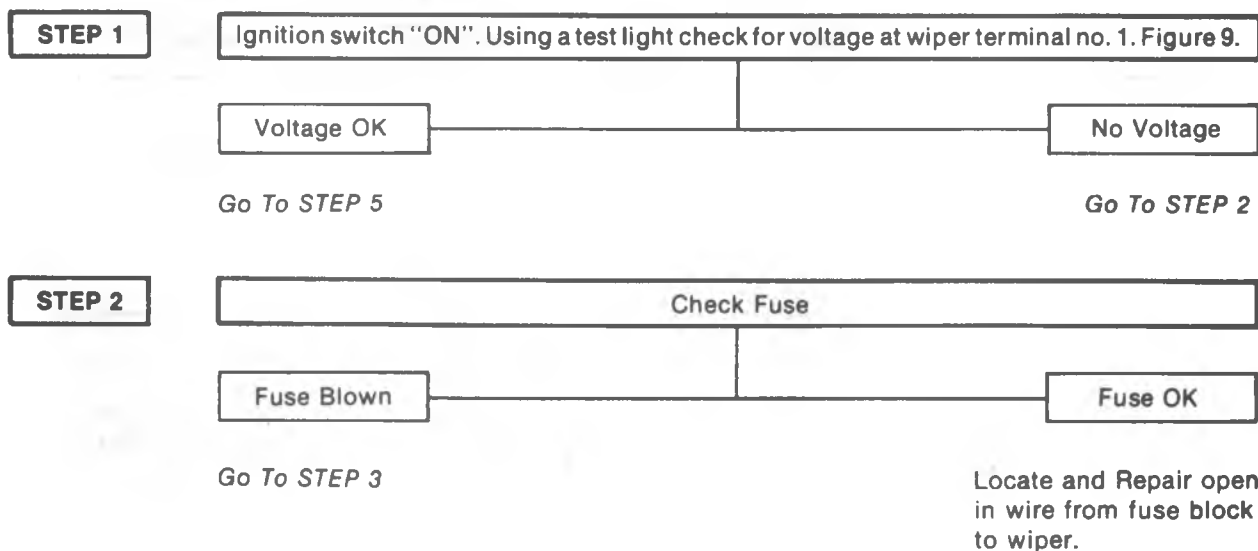
WIPER MOTOR/WASHER PUMP DIAGNOSIS

NOTE: Detached wiper/washer assemblies may be operated as shown in Figure 9 to determine possible problems.

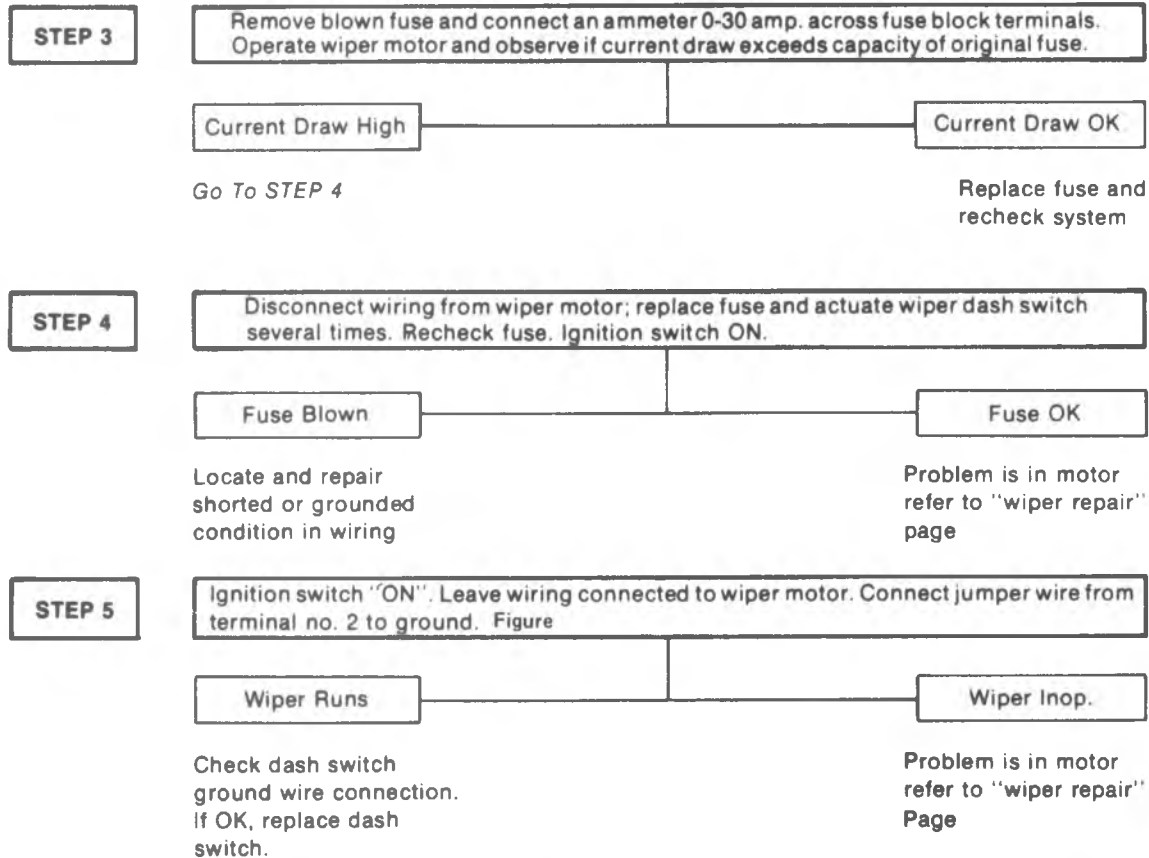
DIAGNOSIS CHART

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

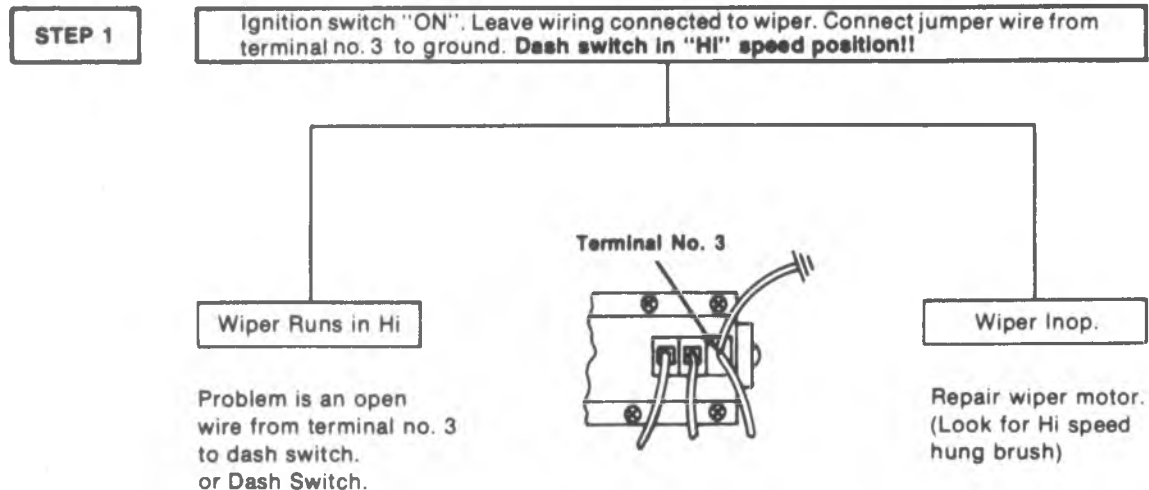
PROCEDURE I (Wiper Inoperative)



Procedure 1 (cont.)



PROCEDURE 2 (Lo Speed Only) (Inop in Hi)



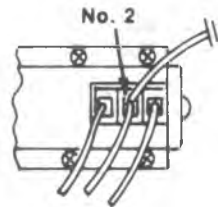
PROCEDURE 3 ("Hi" Speed Only) (Inop in Lo)

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)

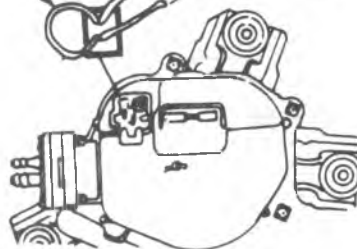
STEP 1

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.

Jumper Wire Existing Wires



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.

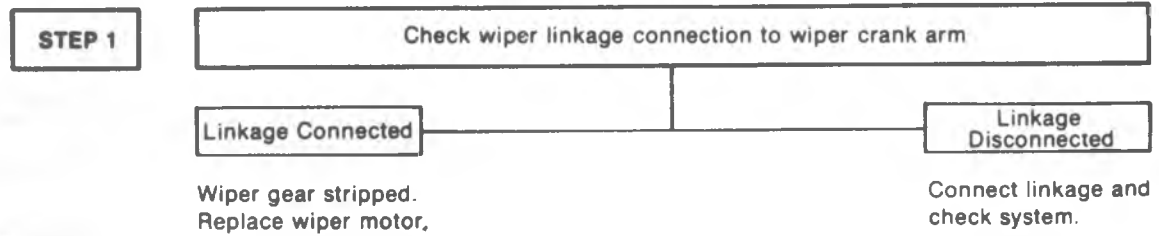
Current Draw OK

Check wiper linkage
for a binding condition
and repair or replace
as req'd.

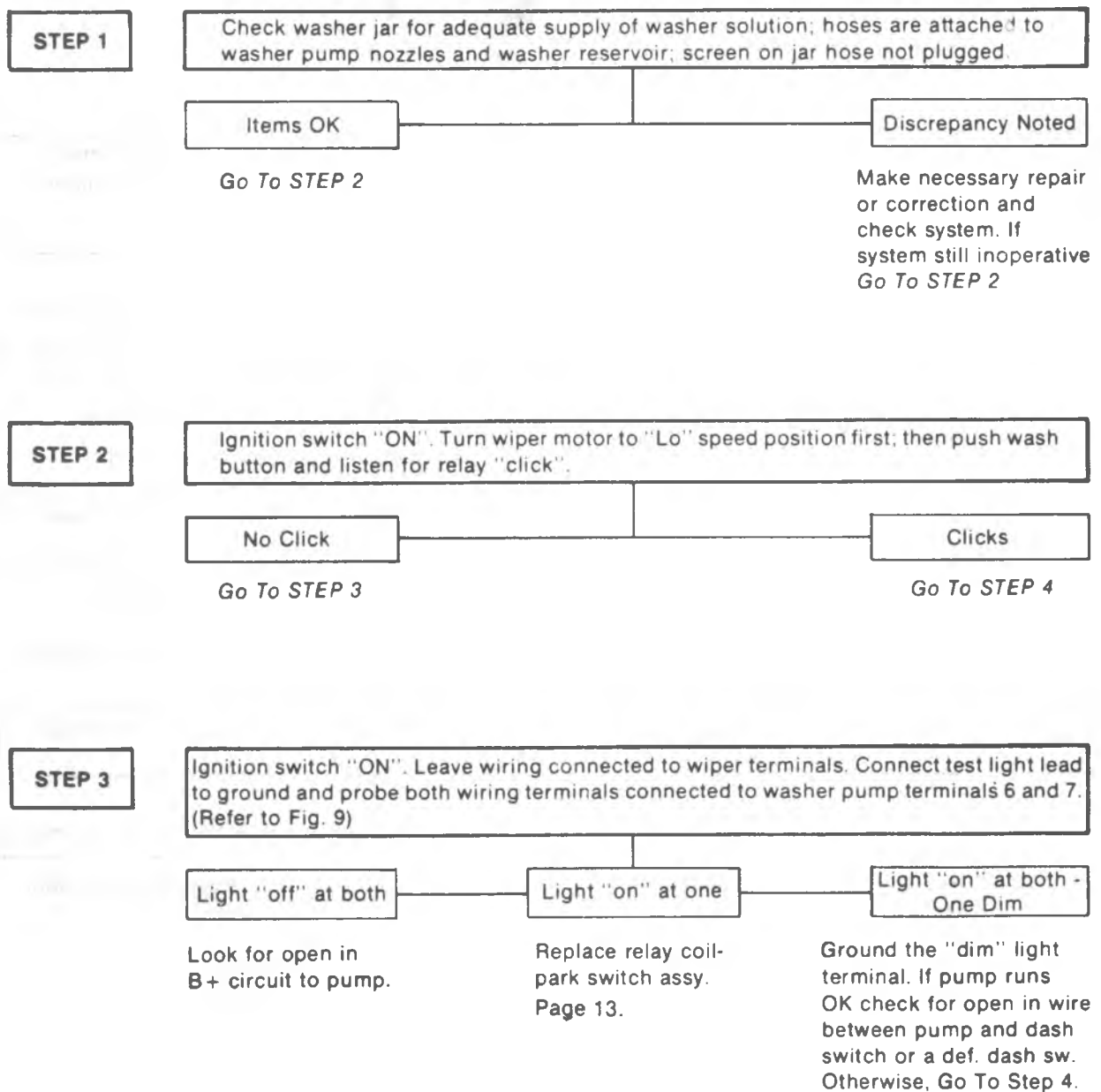
Current Draw Hi

Problem is in wiper
motor. Check for
armature end play,
shorted or grounded
armature.

PROCEDURE 8 (Wiper Runs But Blades Don't Move)



PROCEDURE 9 (Washer Pump Inoperative)

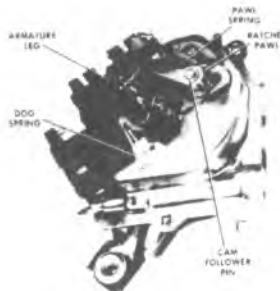


STEP 4

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 if 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

Pump keeps
running

Check for grounded wire
between pump terminal
and dash switch or
a defective dash sw.

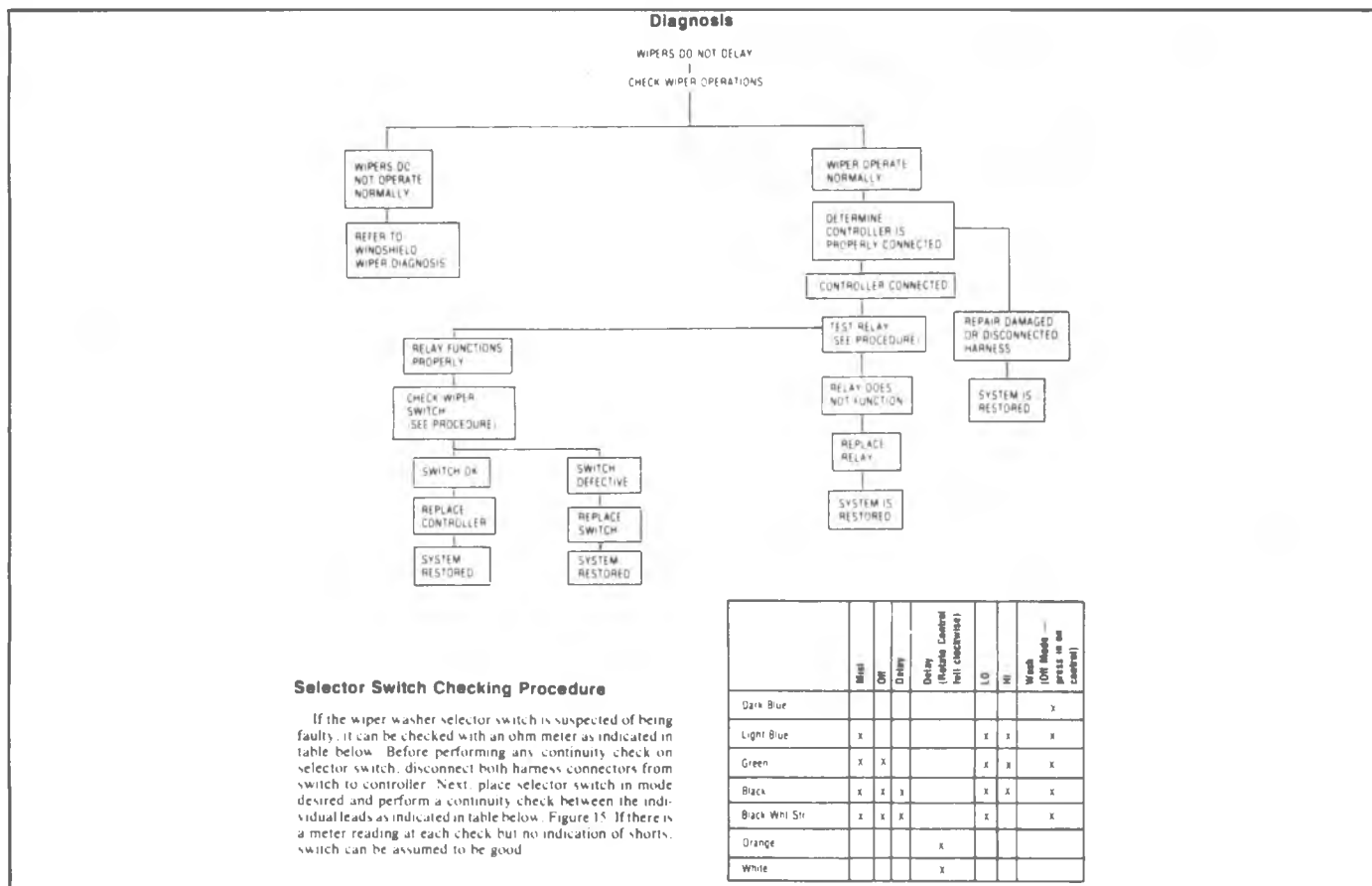
Go To STEP 2

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 ohmmeter 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

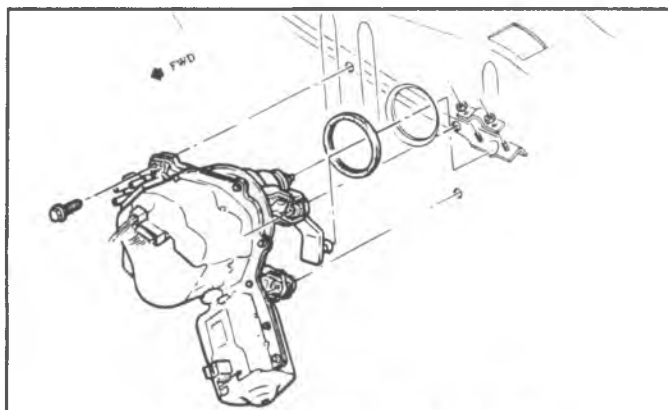


Fig. 8C-17--Wiper Motor (C-K Series)

WIPER MOTOR

C-K Models

Replacement (Fig. 8C-17)

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-18)

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-19.

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-20.
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-21 and slide brushes back in their respective brush holders.
2. Assemble armature in end cap assembly and reposition brush spring legs behind their respective tabs, figure 8C-22.
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-23.
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 8-11.

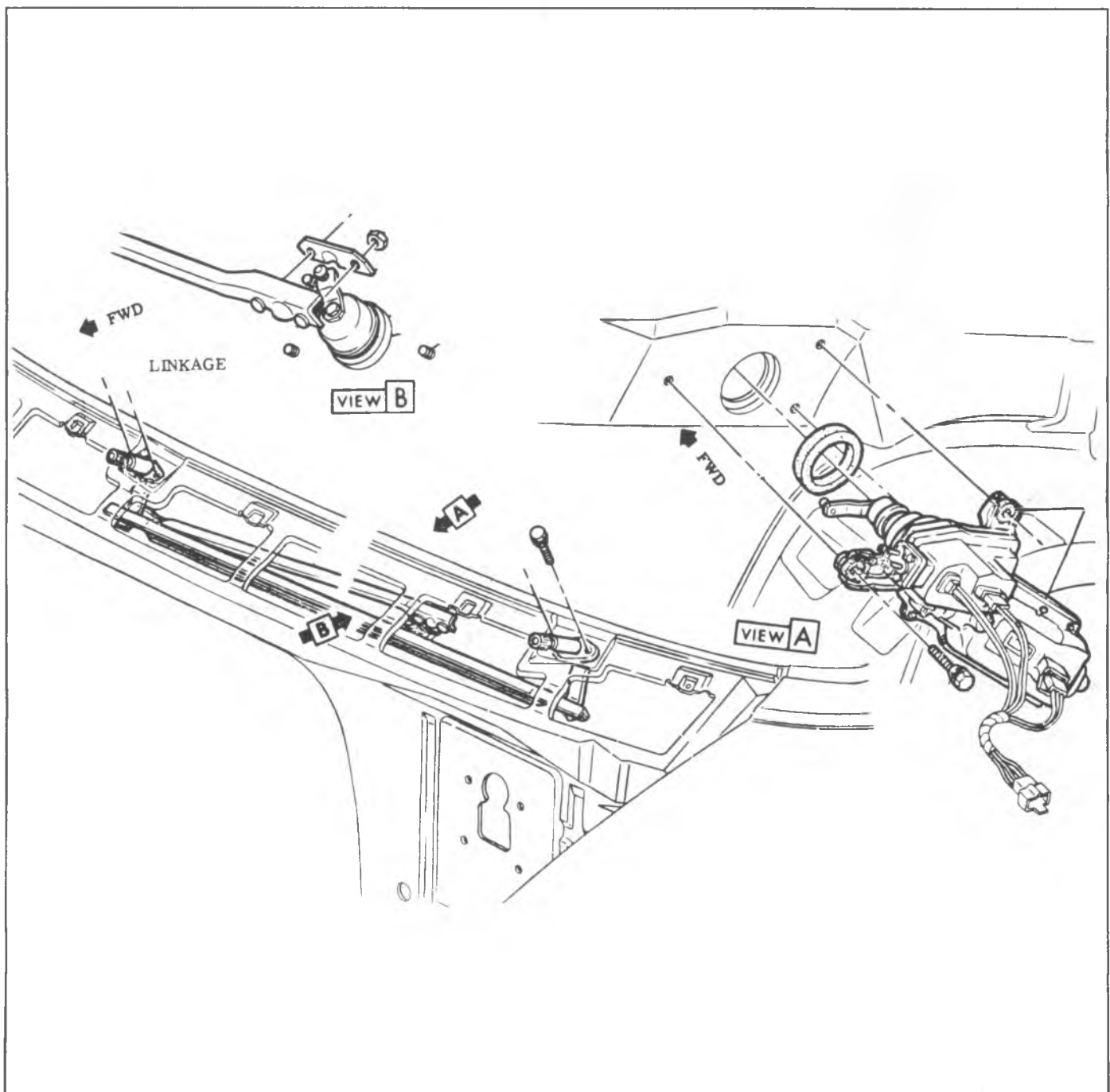


Fig. 8C-18--Wiper Motor (G Series)

9. Check wiper operation.

CRANK ARM, SPACER, SEAL Refer to Figure 8C-24

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-25), and assemble crank arm on shaft in position shown in Figure 8C-25.

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-26.

1. Disconnect pawl spring.
2. Remove "e" type retainer ring and slip pawl off of shaft.

Dog Spring: Refer to Figure 8C-26

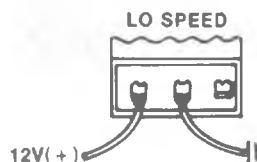
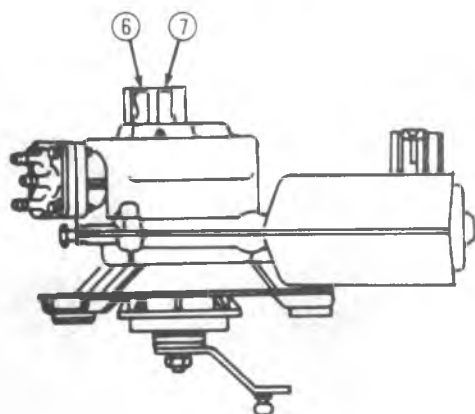
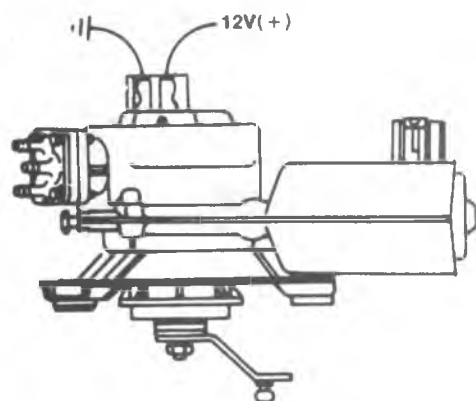
1. Remove screw that attaches dog spring to washer frame.

CONNECTIONS TO OPERATE WIPERS INDEPENDENTLY OF VEHICLE WIRING AND DASH SWITCH.

NO LOAD CURRENT DRAW @ 12V

Lo Speed — 2.5 Amps Max

HI Speed — 5.0 Amps Max

Crank Arm Rotation — CCW
(Looking at Arm)

PARK

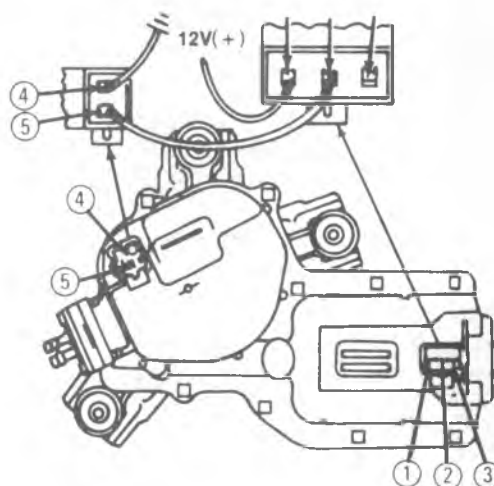


Fig. 8C-19--Checking Motor Operation

Ratchet Gear: Refer to Figure 8C-26

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-12).

Piston and Housing Assy:

Refer to Figure 8C-27.

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-26.

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.

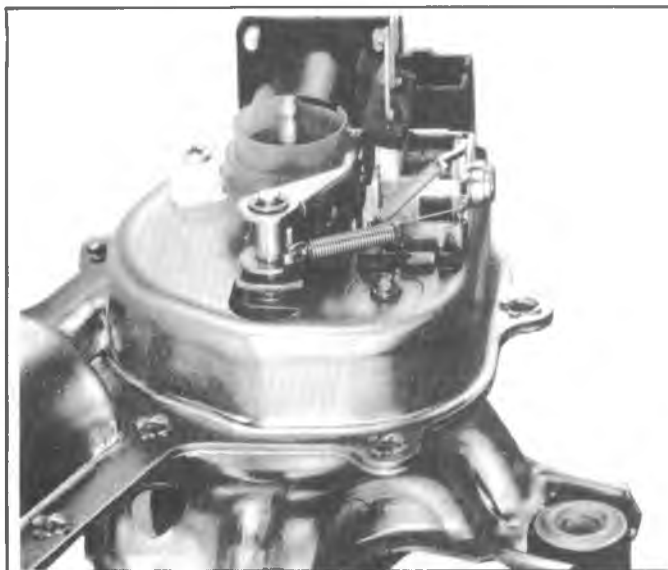


Fig. 8C-20--Relay Coil Assembly

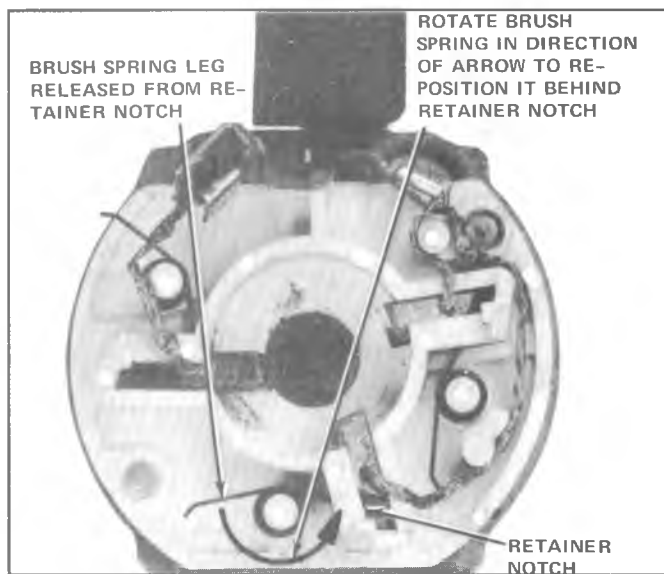


Fig. 8C-21--Releasing Brush Spring Tension

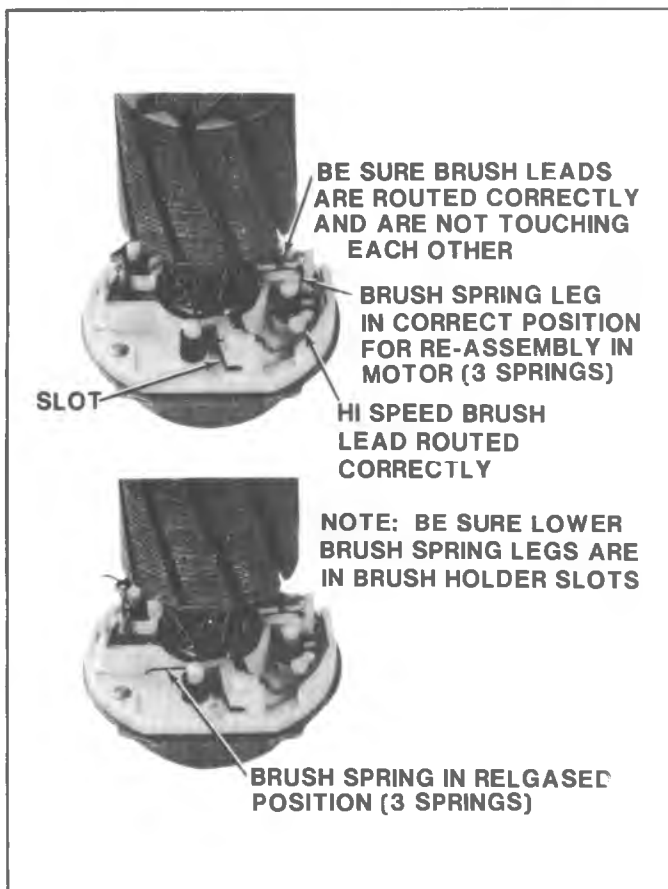


Fig. 8C-22--Brush Spring--Brush Spring-Released Position

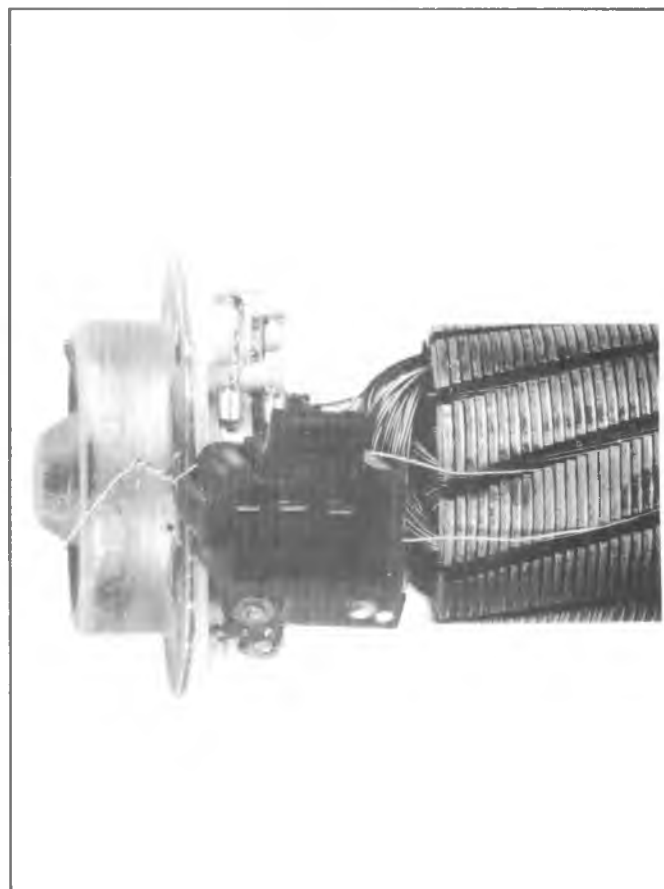


Fig. 8C-23--End Cap Assembly

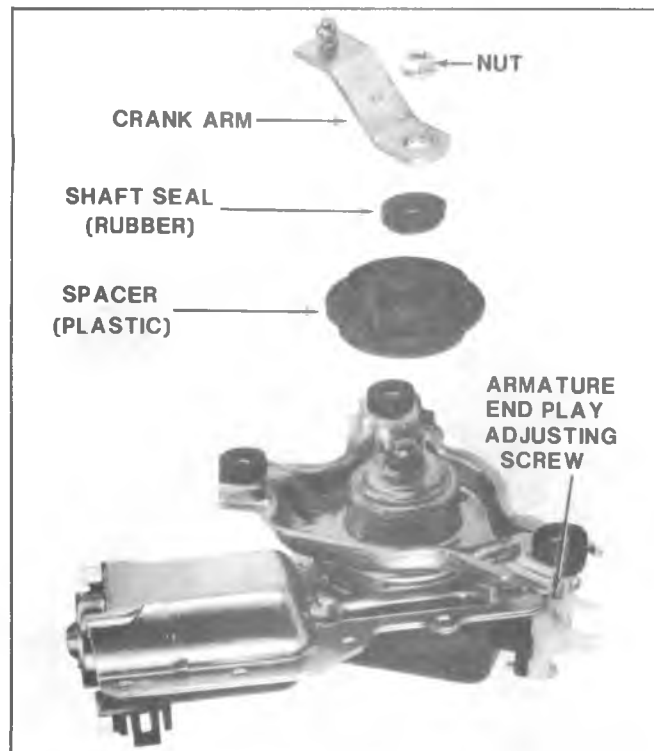


Fig. 8C-24--Crank Arm Spacer Seal

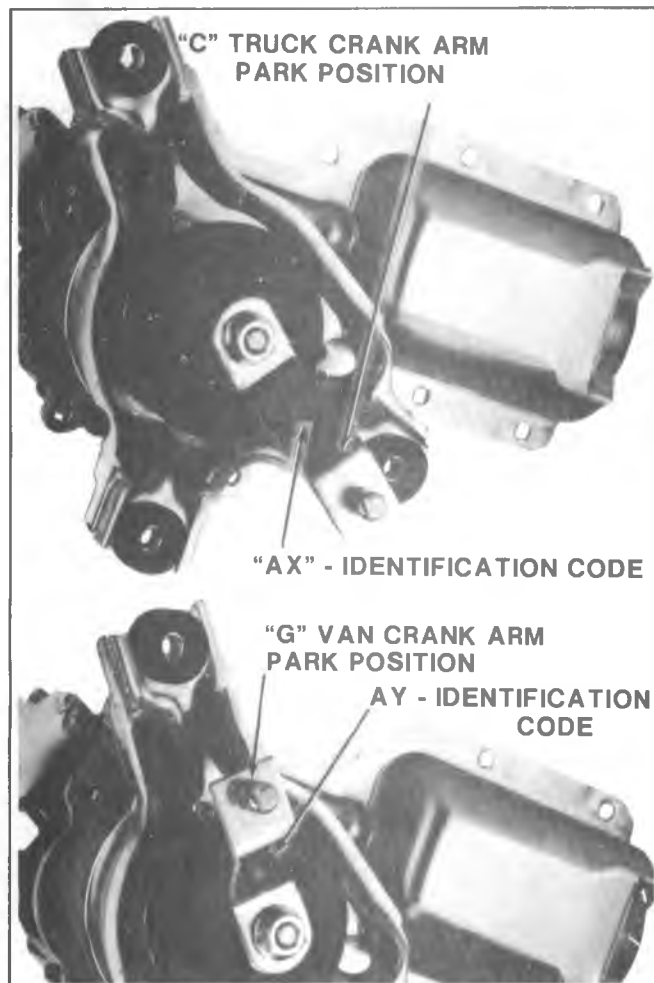


Fig. 8C-25--Crank Arm Park Position

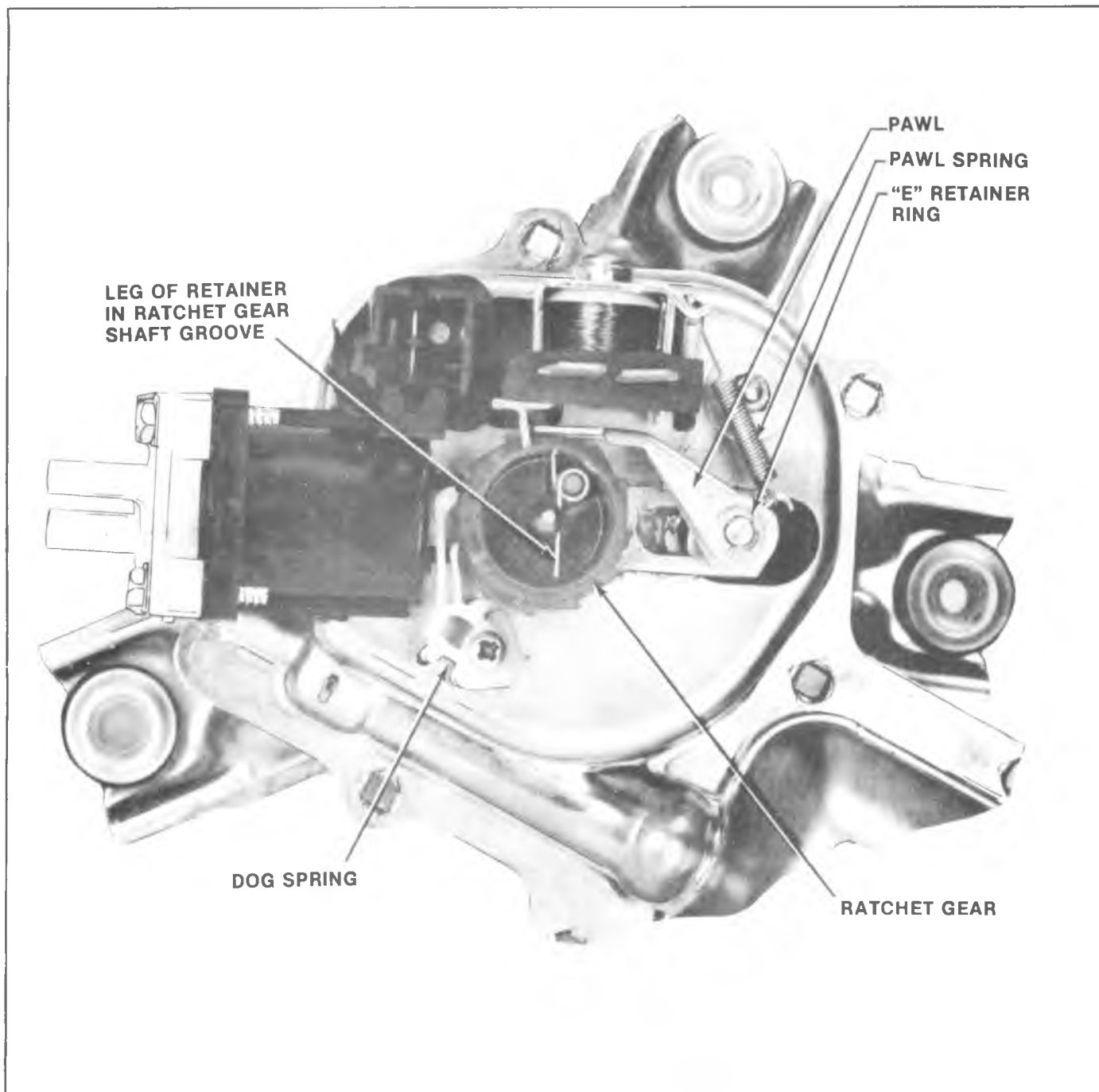


Fig. 8C-26--Washer Pump Assembly

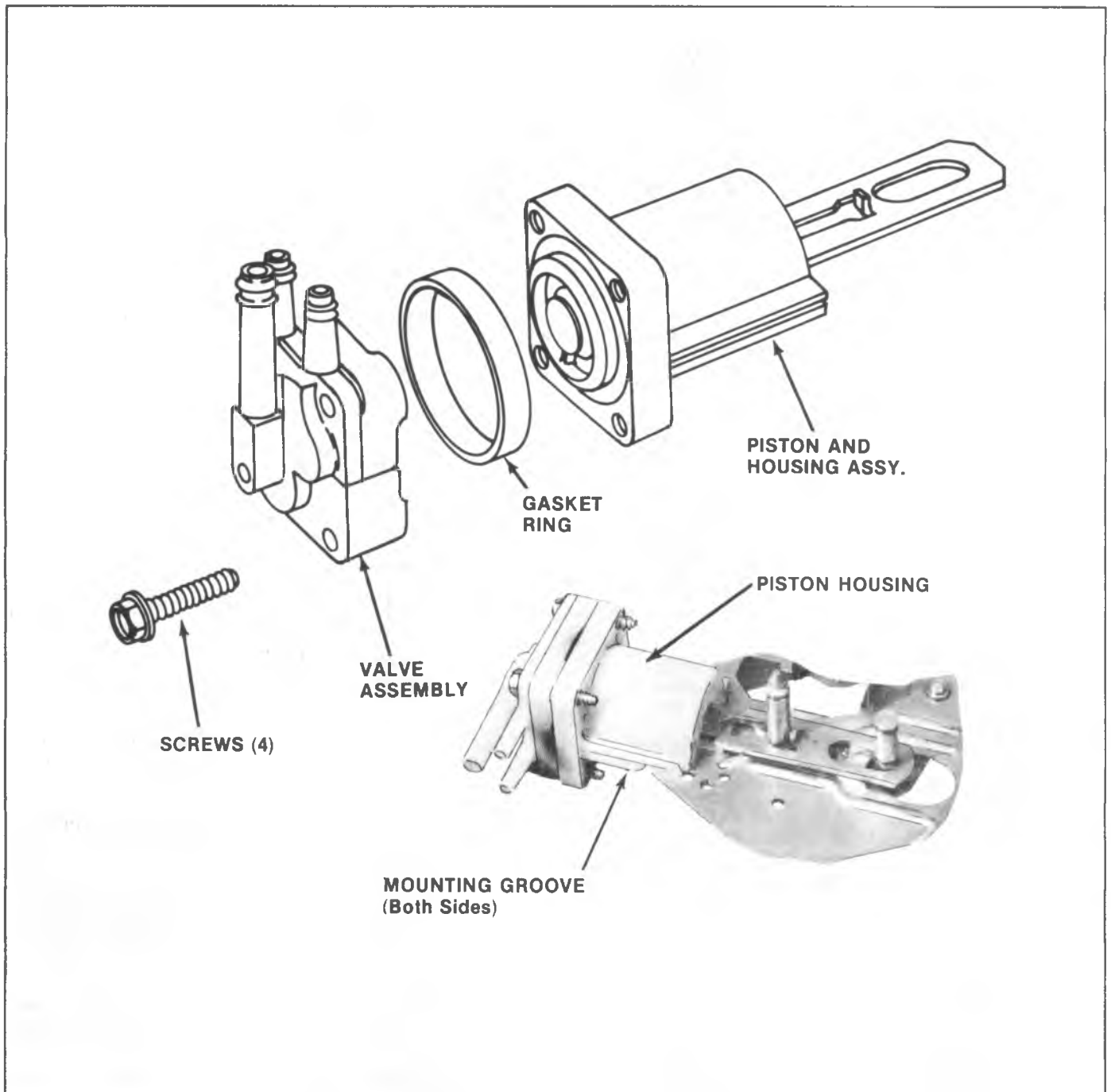


Fig. 8C-27--Washer Pump Exploded View

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-28).

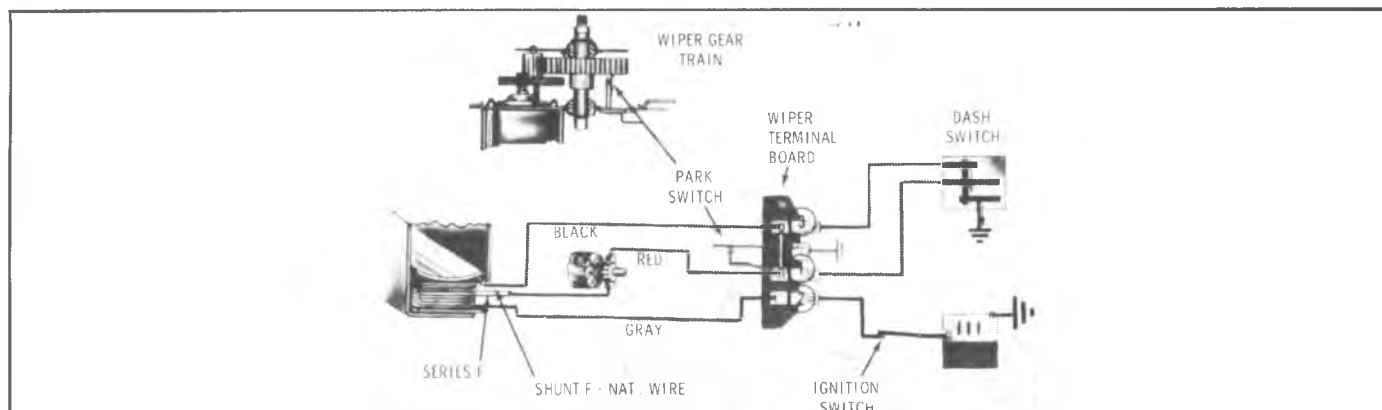


Fig. 8C-28--LO Speed Circuit

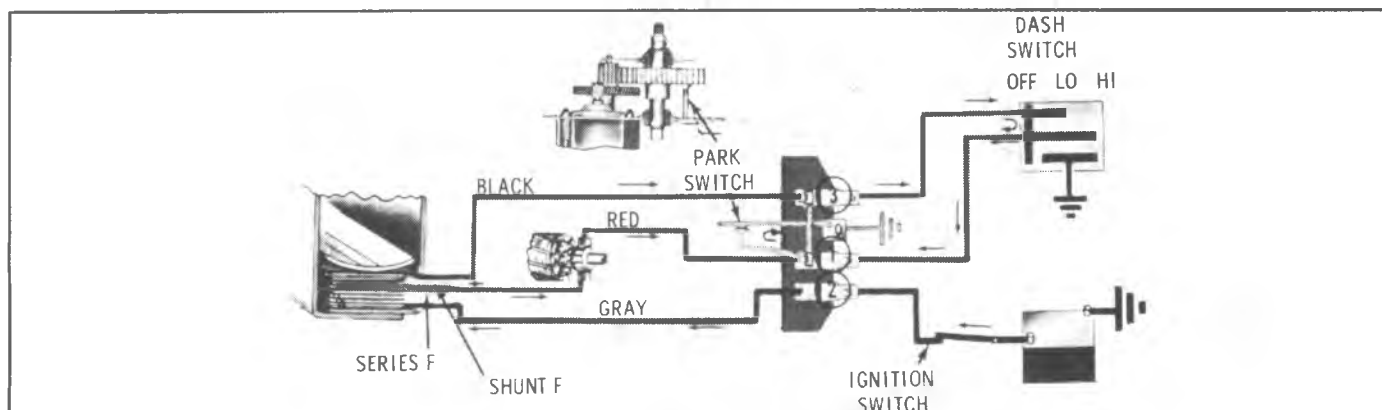


Fig. 8C-30--PARKING Circuit

NOTICE: 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-29).

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-30, 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, bypassing 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.

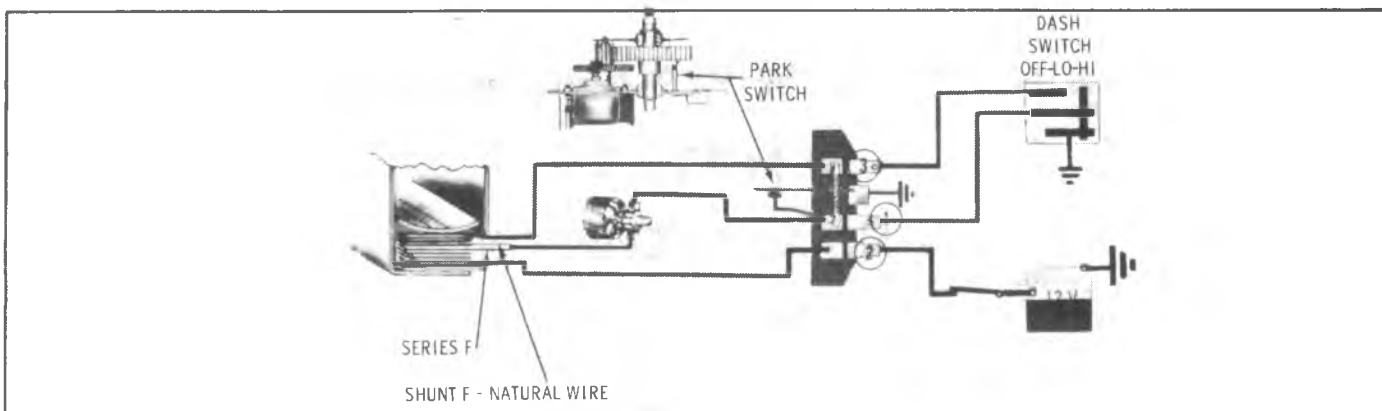


Fig. 8C-29--HI Speed Circuit

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 operates 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 DIAGNOSIS CHART-WIPER OFF VEHICLE.

DIAGNOSIS - WIPER ON VEHICLE**NOTE:** Ignition switch must be "on" for all electrical tests.

CONDITION	APPARENT CAUSE	CORRECTION
1. Wiper Inoperative or intermittent	<p>A. Blown fuse</p> <p>B. Open circuit in feed wire (No. 2 terminal on wiper motor)</p> <p>C. Loose mounting of wiper switch</p> <p>D. Defective wiper switch</p> <p>E. Open circuit in wire to wiper switch (No. 1 terminal on wiper motor)</p>	<p>A. Locate short circuit and repair. Replace fuse.</p> <p>B. Locate broken wire and repair</p> <p>C. Tighten switch mounting</p> <p>D. Replace switch</p> <p>E. Locate broken wire and repair</p>
<p>2. Wiper will not shut off:</p> <p>A. Wiper has both "Lo" and "Hi" speeds</p> <p>B. Wiper has "Lo" speed only</p> <p>C. Wiper has "Hi" speed only</p>	<p>A. Grounded Wire (No. 1 terminal on wiper motor) to wiper switch</p> <p>A. Defective wiper switch</p> <p>B. Grounded wire (No. 3 terminal on wiper motor) to wiper switch</p> <p>A. Defective wiper switch</p> <p>B. Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch</p>	<p>A. Locate short circuit and repair</p> <p>A. Replace wiper switch</p> <p>B. Locate and repair short circuit</p> <p>A. Replace wiper switch</p> <p>B. Locate and repair broken wire</p>
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	<p>A. Grounded wire (No. 3 terminal on wiper motor) to wiper switch</p> <p>B. Defective wiper switch</p>	<p>A. Locate short circuit and repair</p> <p>B. Replace wiper switch</p>
5. Blades do not return to full park position	A. Loose wiper ground strap connection	A. Tighten strap connection

DIAGNOSIS - WIPER OFF VEHICLE

CONDITION	APPARENT CAUSE	CORRECTION
1. Wiper Inoperative or Intermittent	<p>A. Broken or damaged gear train (only if inoperative)</p> <p>B. Poor solder connections at terminal board</p> <p>C. Loose splice joints at brush plate</p> <p>D. Brushes binding in brush holder</p> <p>E. Open circuit in armature</p>	<p>A. Replace gears as required</p> <p>B. Resolder wires at terminals</p> <p>C. Recrimp or solder splice joints</p> <p>D. Clean holder or replace brush, spring or brush plate assembly.</p> <p>E. Replace armature</p>
<p>2. Wiper will not shut-off:</p> <p>A. Wiper has normal "Hi" and "Lo" speed</p> <p>B. Wiper has "Lo" speed only</p> <p>C. Wiper has "Hi" speed only</p>	<p>A. Defective park switch</p> <p>B. Grounded red lead wire</p> <p>A. Grounded shunt field coil</p> <p>B. Grounded black wire</p> <p>A. Open circuit in shunt field coil</p> <p>B. Open circuit in black wire</p>	<p>A. Replace terminal board assembly</p> <p>B. Repair short circuit in red wire</p> <p>A. Replace frame and field assembly</p> <p>B. Repair short circuit in black wire</p> <p>A. Replace frame and field assembly</p> <p>B. Repair broken wire or poor solder connection</p>
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

LO SPEED - AS SHOWN

HI SPEED - DISCONNECT JUMPER WIRE FROM
TERMINAL NO. 3.

OFF - LEAVE JUMPER CONNECTED TO NOS. 1 & 3 BUT
DISCONNECT IT FROM GRD. STRAP. WIPER SHOULD
STOP WITH GEAR SHAFT FLATS AS SHOWN.

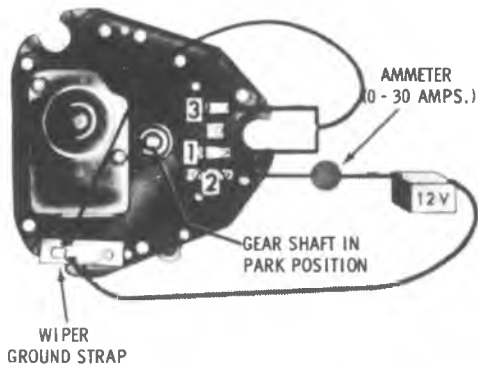
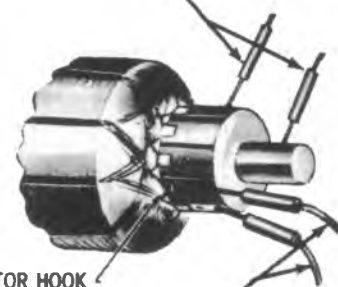


Fig. 8C-31--Jumper Wire Connections

TEST LIGHT PROBES FOR
GROUND CHECK. IF LAMP
LIGHTS, ARMATURE IS
GROUNDED



TEST LIGHT PROBES,
BAR TO BAR CHECK
FOR OPENS - LAMP
SHOULD LIGHT BETWEEN
ADJACENT BARS

Fig. 8C-32--Checking Armature

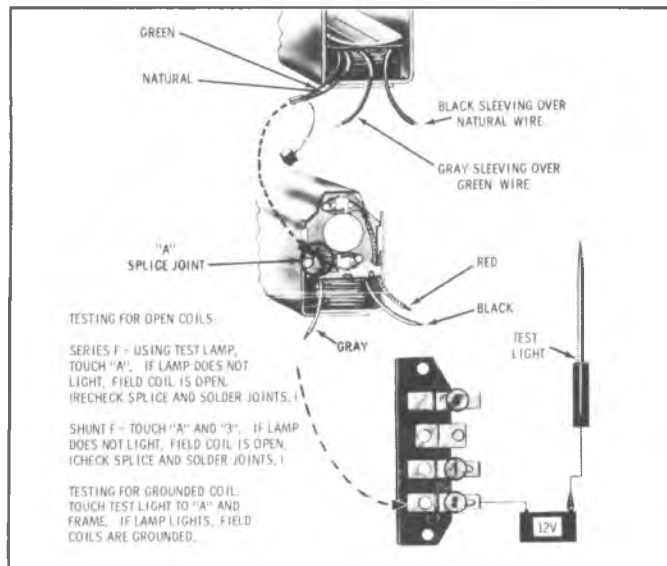


Fig. 8C-33--Testing Field Coils

DIAGNOSIS - WASHER SYSTEM

CONDITION	APPARENT CAUSE	CORRECTION
1. Washers inoperative	<p>A. Inadequate quantity of washer solution</p> <p>B. Hoses damaged or loose</p> <p>C. Plugged screen at end of jar cover hose</p> <p>D. Loose electrical connection to washer pump or wiper switch</p> <p>E. Open circuit in feed wire to ratchet relay coil</p> <p>F. Wiper switch defective</p> <p>G. Ratchet relay coil defective</p> <p>H. Washer nozzles plugged</p> <p>I. Ratchet wheel tooth missing</p> <p>J. Ratchet pawl spring missing</p> <p>K. Defective pump valve assembly</p>	<p>A. Add washer solution</p> <p>B. Cut short length off end of hose to insure air tight connection or replace hose</p> <p>C. Clean screen</p> <p>D. Check electrical connections and repair if necessary</p> <p>E. Locate open circuit and repair</p> <p>F. Replace wiper switch</p> <p>G. Replace ratchet relay</p> <p>H. Clean washer nozzles</p> <p>I. Replace ratchet wheel</p> <p>J. Replace ratchet pawl spring</p> <p>K. Replace pump valve assembly</p>
2. Washer pumps continuously when wipers are operating	<p>A. Grounded wire from ratchet relay to switch</p> <p>B. Wiper switch defective</p> <p>C. Ratchet wheel tooth missing</p> <p>D. Ratchet wheel dog broken or not contacting ratchet wheel teeth</p> <p>E. Lock-out tang broken or bent on piston actuating plate</p>	<p>A. Locate grounded wire and repair</p> <p>B. Replace wiper switch</p> <p>C. Replace ratchet wheel</p> <p>D. Replace or repair ratchet wheel dog</p> <p>E. Replace piston actuating plate</p>

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

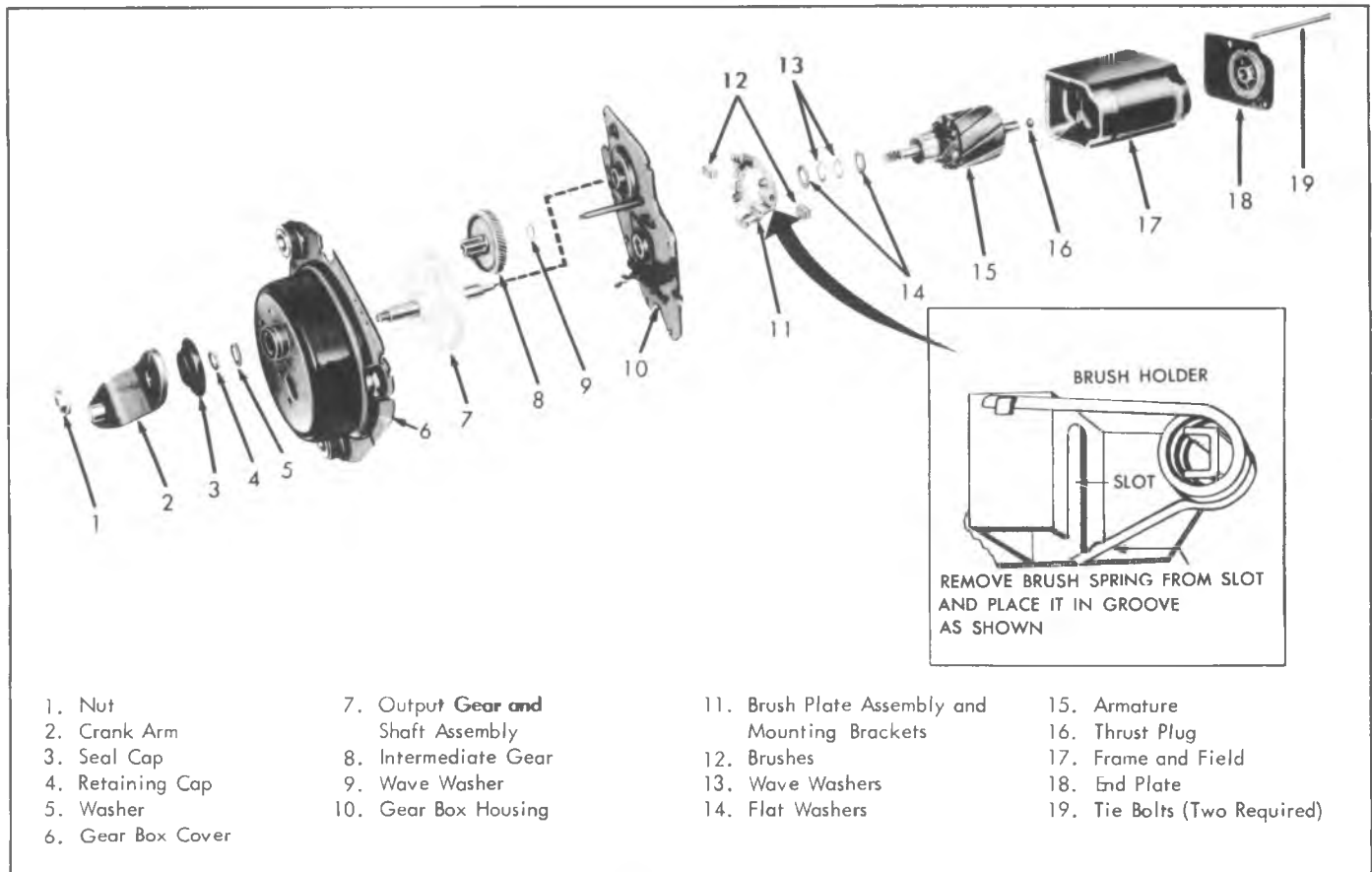


Fig. 8C-34--Wiper Motor and Gear Box Assembly

WIPER MOTOR

Disassembly (Fig. 8C-34)

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-33 and 8C-34). 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-34), slide armature and end plate from motor frame. Pull end plate from armature.

Thrust plug located between armature shaft and end

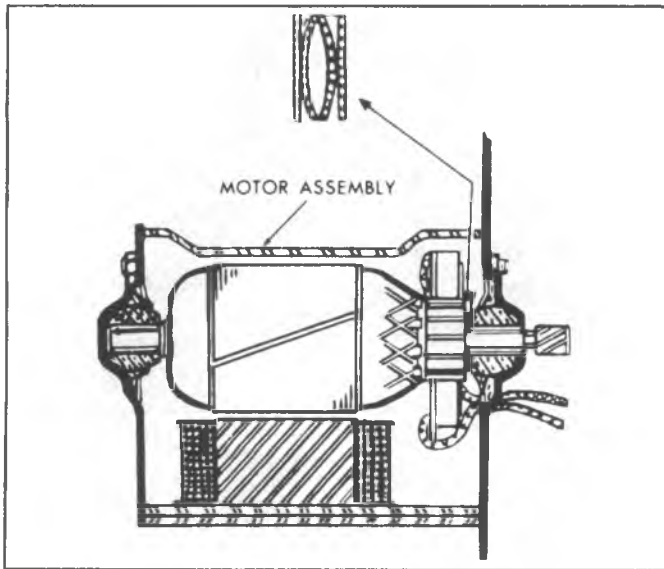


Fig. 8C-35--End Play Wave Washer Installation

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-34 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-35 for proper assembly of end play washers. Lubricate armature shaft bushings with light machine oil.

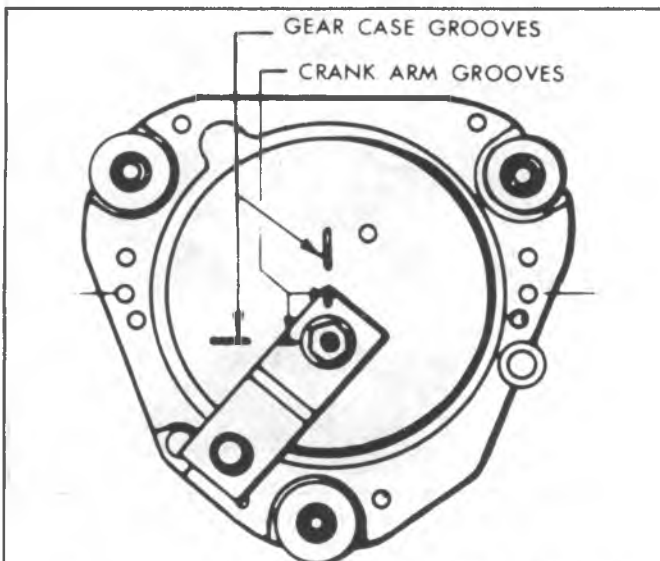


Fig. 8C-36--Wiper Motor Crank Arm in Park Position

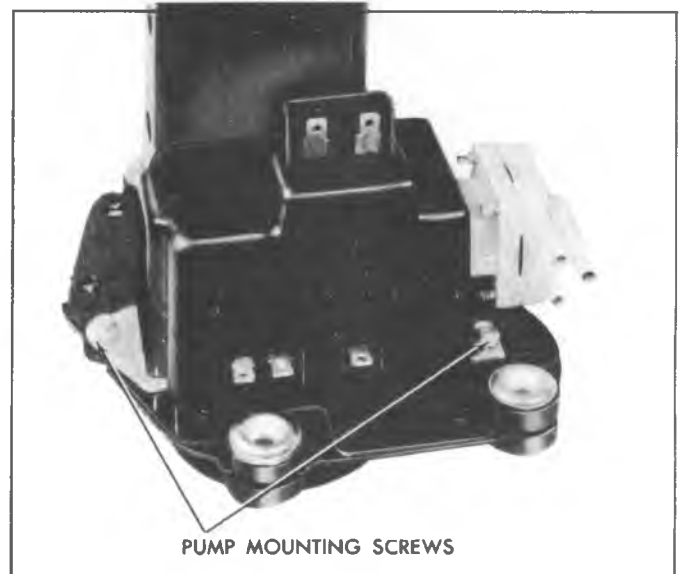


Fig. 8C-37--Washer Pump Attaching Screws

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-36).
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-37) use a pump mechanism consisting of a piston, piston spring and valve arrangement driven by a (4) lobe cam, and follower assembly (fig. 8C-39). The cam is attached to one shaft of the wiper motor output gear (fig. 8-49). Programming is accomplished

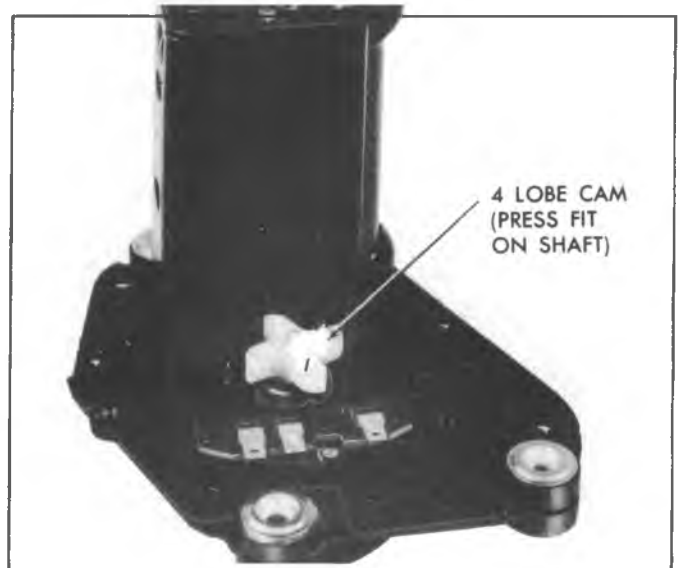


Fig. 8C-38--Washer Pump Drive Cam

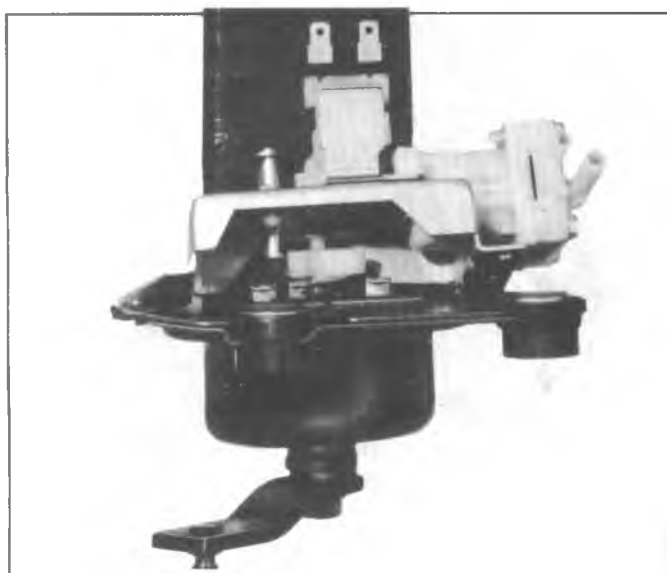


Fig. 8C-39--Washer Pump Drive Cam and Actuator

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-37). Incorrect installation of connector will result in direct ground and destroy wiper motor fuse.

Disassembly-Assembly (Figures 8C-40 thru 8C-43)

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.

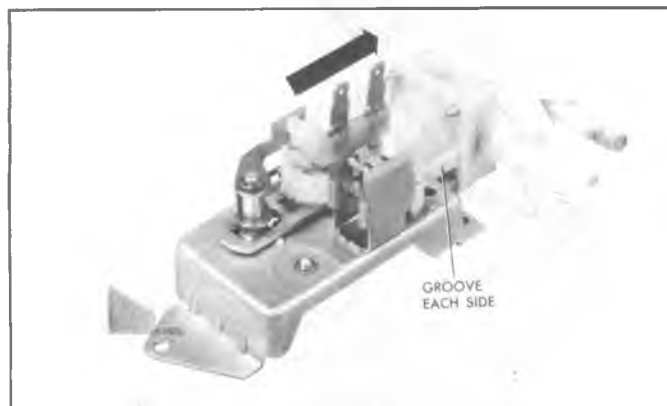


Fig. 8C-42--Releasing Pump From Lockout Position

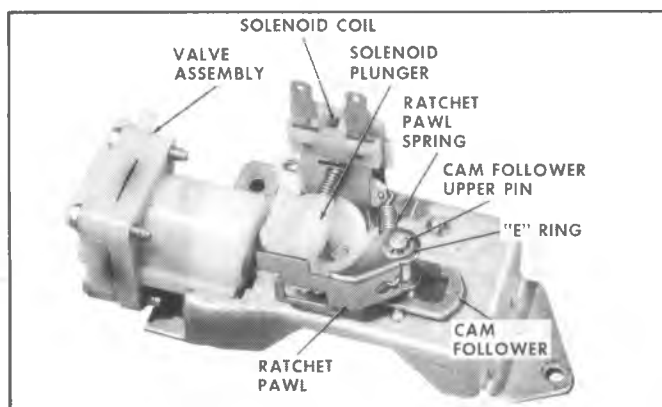


Fig. 8C-40--Washer Pump Mechanism

- 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 separate 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.

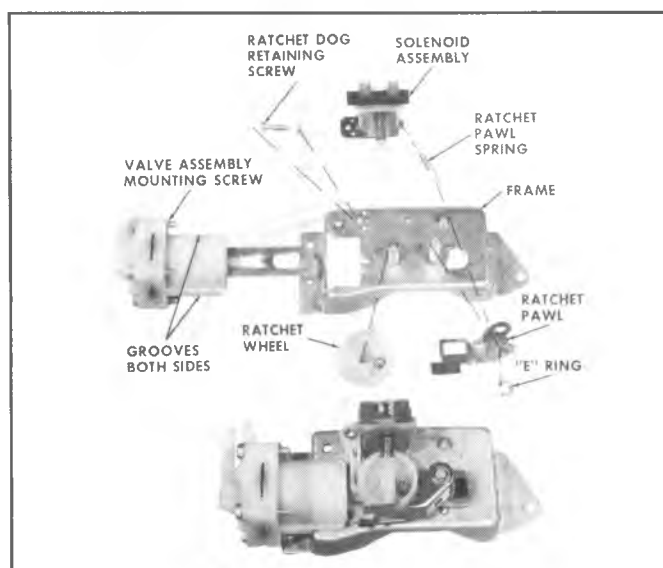


Fig. 8C-41--Washer Pump-Exploded View

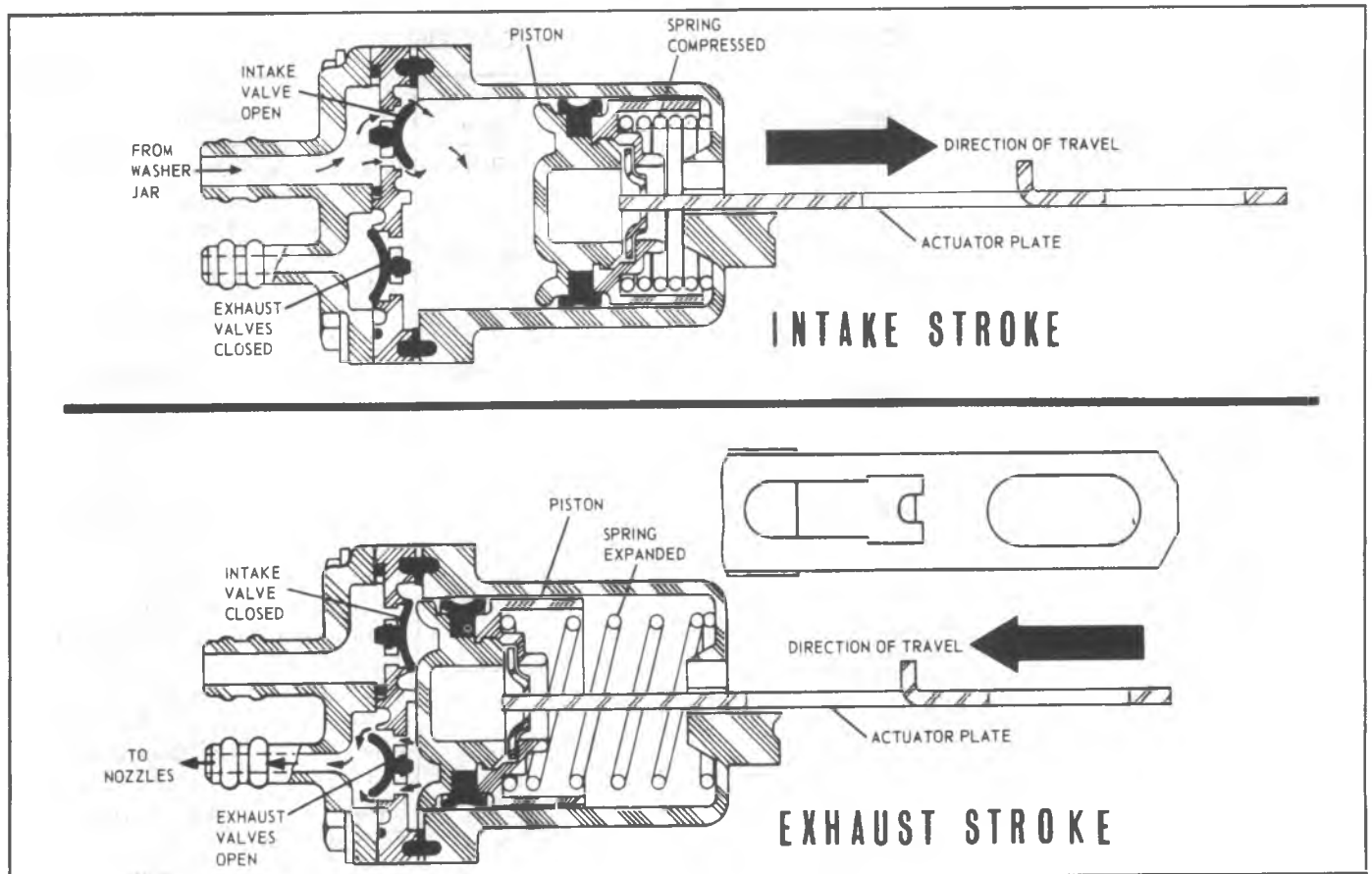


Fig. 8C-43--Cross Section of Windshield Washer Pump Valve

WIRING DIAGRAMS

Body and Chassis Wiring Diagrams and circuit identification charts are shown on the pages which follow.

WIRE SIZE CONVERSION TABLE	
METRIC SIZE (mm) ²	AWG SIZE
.22	24
.5	20
.8	18
1	16
2	14
3	12
5	10
8	8
13	6
19	4
32	2

ELECTRICAL CIRCUIT IDENTIFICATION

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

Circuit Number	Circuit Color	Circuit Name
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 Controlled
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
68	Yellow-Black	Ground, Resistive, Low Coolant Probe Controlled
69	Gray	Ground Low Coolant Module Controlled
70	Pink	Feed, Relay Controlled, Ign. Sw. Controlled

ELECTRICAL CIRCUIT IDENTIFICATION (Cont'd)

Circuit Number	Circuit Color	Circuit Name	Circuit Number	Circuit Color	Circuit Name
71	Black	Ground, A/C Selector Sw. "Def" Controlled	131	Black-Pink	Generator (Alternator) Ext. Resist. 1 Ohm/Foot
72	Light Blue	Feed, Blower Sw. "Medium 2" Controlled	132	White	Ground, Fuel Economy Sw. Controlled, Amber Telltale
73	Purple-White	Feed, Blower Sw. "Medium 3" Controlled	133	Yellow	Ground, Fuel Economy Sw. Controlled, Grn. Telltale
74	Light Green	Feed to Throttle Switch	135	Dark Green	
75	Dark Blue	Feed, Ign. Sw. "On and Crank" Controlled - Fused		White	Ground, Resistive, Temp. Gauge Sensor Controlled
76	Pink	Feed, Ign. Sw. Controlled	139	Pink-Black	Feed, Ign. Sw. "On and Crank" Controlled - Fused
78	Light Blue	Electric Choke Feed	140	Orange	Feed, Battery - Fused
80	Light Green	Ground Key Warning Buzzer	141	Brown-White	Feed, Ign. Sw., "Accsy and On" Controlled
81	Nat. White	Electric Remote Mirror, Right	142	Black	Rr Compartment Lid Lock Release
82	Light Blue	Electric Remote Mirror, Left	143	Pink	Feed Radio Sw. "On" Controlled
83	Dark Green	Feed, Cruise Engage Sw. "Retard" Controlled	144	Yellow	Feed to Pwr Ant Sw.
84	Dark Blue	Feed, Cruise Engage Sw. "Engage" Controlled	145	Dark Green	Feed, Pwr Ant Up, Relay Controlled
85	White	Ground, Cruise Indicator Regulator Controlled	146	Dark Green	Ground, Trunk Release Tell-Tale
86	Brown	Feed, Cruise Brake Release Sw. Controlled	150	Black	Ground Circuit - Direct
88	Yellow	Electric Remote Mirror, Up	151	Black	Ground Circuit - Direct
89	Light Green	Electric Remote Mirror, Down	152	Black	Ground Circuit - Direct
90	Pink	Feed, Cutout Sw. Controlled, Cir. Brkr. Protected	153	Black	Ground Circuit - Direct
91	Gray	Windshield Wiper - Low	154	Black	Ground Circuit - Direct
92	Purple	Windshield Wiper - Hi	155	Black	Ground Circuit - Direct
93	White	Windshield Wiper Motor Feed	156	White	Ground Circuit - Sw. Controlled
94	Pink	Windshield Washer Sw. to Washer			Body Interior Lamps - such as Dome, Courtesy, Map, Warning, etc.
95	Dark Green	Ground, Pulse Wiper Sw. Controlled	157	Gray	Ground Circuit - Sw. Controlled - Body Interior Lamps - such as Dome, Courtesy, Map, Warning etc.
96	Brown	Feed, Pulse Wiper Rheostat Sw. Controlled	158	Black-Orange	Ground Circuit - Sw. Controlled - Body Interior Lamps - such as Dome, Courtesy, Map, Warning etc.
99	Black-White	Windshield Washer Low Fluid	159	Tan	Ground, Key Warning Buzzer
101	Dark Blue	Resistor Output to Blower Relay	160	White	Power Antenna Down
102	White	SL Alternator - Regulator Sensing Circuit	161	Black	Power Antenna Up
105	Black	Ammeter - Generator	162	Gray	Power Top - Up
106	Gray	Ammeter - Battery	163	Purple	Power Top - Down
107	Dark Blue	Over Speed Warning Light	164	Dark Blue	Window Control LF Up
111	Black	Ground, Anti-Ski Low Air Sw. Controlled	165	Brown	Window Control LF Down
112	Dark Green	Telltale Temperature Gauge (Hot)	166	Dark Blue-White	Window Control RF Up
115	Light Blue	Speaker Return, RT rr Stereo	167	Tan	Window Control RF Down
116	Yellow	Speaker Return, LF rr Stereo	168	Dark Green	Window Control LR Up
117	Dark Green	Speaker Return, RT Frt. Stereo	169	Purple	Window Control LR Down
118	Gray	Speaker Return, LF Frt. Stereo	170	Light Green	Window Control RR Up
119	White	Generator (Alternator) to Regulator	171	Purple-White	Window Control RR Down
120	Purple	Electric Fuel Pump Feed	172	Light Green	Vent Control LF Close
121	White	Tachometer to Coil	173	Yellow	Vent Control LF Open
125	Yellow	Door Jamb Switch	174	Dark Green	Vent Control RF Close
126	Black	Seat Back Lock Feed			
130	Brown-White	Generator (Alternator) Ext. Resist. 2 Ohms/Foot			

ELECTRICAL CIRCUIT IDENTIFICATION (Cont'd)

Circuit Number	Circuit Color	Circuit Name
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
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

Circuit Number	Circuit Color	Circuit Name
213	Dark Blue	Center Seat Sensor
214	Gray	RH Seat Sensor
215	Tan-Black	LH Sw.
216	Dark Blue-White	
217	Gray-White	Center Buckle Sw. (Feed) 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
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

ELECTRICAL CIRCUIT IDENTIFICATION (Cont'd)

Circuit Number	Circuit Color	Circuit Name	Circuit Number	Circuit Color	Circuit Name
248	Dark Blue	Feed, to A/C Compressor Harn Relay Controlled	283	Light Blue	Power Seat, Rear Vert Down - Motor
249	Dark Green	Feed, From A/C Harn	284	Light Green	Power Seat, Aft Motor
250	Brown	Feed, Ign. Sw. on Controlled, Fused	285	Tan	Power Seat, Fore Motor
251	Orange	Passenger Initiator Feed	286	Dark Green	Power Seat, Front Vert Up - Motor
252	Yellow	Ground, ADL Module Unlock Output Controlled	287	Dark Blue	Power Seat, Front Vert Down - Motor
253	Dark Brown	Ground, ADL Module Lock Output Controlled	288	Yellow-Black	Power Seat, Rear Vert Up Relay
254	Light Green	Ground, ADL LT Unlock Relay Coil	289	Light Blue-Black	Power Seat, Rear Vert Down Relay
255	Yellow	Ground, ADL RT Unlock Relay Coil	290	Light Green-Black	Power Seat, Aft Relay
256	Dark Blue	Ground, Module Controlled, Lamp Out Indicator	291	Dark Blue	Ground, Heated Glass Timer, On-Off Sw. Controlled
257	Brown	Ground, A/C Press, Sw. Controlled	292	Light Blue	Feed, Heated Glass Timer, On-Off Sw. Controlled
258	White	Passenger Initiator Return Hi Level, IR	293	Purple-White	Feed, Heated Glass Timer Controlled
259	Purple	IR Crank Start Signal - Fused 6 Cir.	294	Tan	Door Lock Motor - Unlock
260	Black	Theft Deterrent - Hood Sw.	295	Gray	Door Lock Motor - Lock
261	Yellow	Theft Deterrent - Alarm Arm	296	Brown	Power Seat, Fore Relay
262	Light Green	Theft Deterrent - Key - Door Unlock and Alarm Disarm	297	Gray	Power Seat, Front Vert Up Relay
263	Light Blue	Theft Deterrent - Alarm	298	Purple	Power Seat, Front Vert Down Relay
264	Dark Green	Theft Deterrent - Arm Indication	300	Orange	Feed, Ign. Sw., "On" Controlled - Unfused
265	Black-White	Theft Deterrent - Alarm Output	318	Yellow-Black Stripe	Relay Activated Left Directional Lamp
266	Pink	Theft Deterrent - Alarm Arm Abort	319	Dark Green-White	Relay Activated Right Directional Lamp
267	Dark Green	Pwr Seat - Fore and Up Recliner	339	Pink-Black	Feed, Ign. Sw. On and Crank Controlled Fused
268	Yellow	Pwr Seat - Aft and Down Recliner	340	Orange	Feed, Battery - Fused
269	Light Green	Pwr Seat - Sol Up and Down Recliner	350	Pink-White	Feed, Ign. Sw. "On" Controlled - Fused
270	Black-Yellow	Feed, Amplifier to Potentiometer	351	Dark Blue	Feed, Inverter to Opera Lamp
271	Purple	Ground, Potentiometer Controlled	352	White	Opera Lamp to Inverter Return
272	Light Green	Feed, Potentiometer Rheostat Controlled	370	Pink	Feed, Avl
273	Orange	Feed, HdIp Sw. to Amplifier, HdIp Sw. Controlled	383	Light Blue	Convert Clutch Release Sw. to Vac. Sw.
274	Dark Green-White	Feed, HdIp Sw. to Amplifier	384	Light Green	Vac. Sw. to Transmission Sw. Sol
275	Light Green	Feed, Neut Saf Start Sw. "Park" Controlled	385	Purple	Hi Vac Sw. to Transmission Sw. Sol
276	Light Green	Recl. Mtr. Feed, Power St. Fwd.	390	Tan	Feed to Side Marker and License Lamp - Export Only
277	Light Blue	Recl. Mtr. Feed, Power St. Recliner	394	Light Green	Ground, LT F/D Remote Handle Sw. Controlled
278	White	Amplifier to Photocell	395	Light Blue	Ground, RT F/D Remote Handle Sw. Controlled
279	Black	Headlamp Sw. to Photocell	402	Light Green	Feed, Electronic Cruise Control Valve
280	Pink	Feed, P.M. Motor Up Cycle (Deck Lid Pull Down)	403	Dark Blue	Feed, Electronic Cruise Shut-Off Valve
281	White	Ground, Relay Coil Down Cycle (Deck Lid Pull Down)	404	Light Green	EST Pickup Coil to HEI Module, High
282	Yellow	Power Seat, Rear Vert Up - Motor			

ELECTRICAL CIRCUIT IDENTIFICATION (Cont'd)

Circuit Number	Circuit Color	Circuit Name
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-White	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 ISC-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	Dark Blue-Gray	ECM to Map Sig
433	Gray-Black	ECM to Baro Sig
434	Orange-Black	ECM to Neutral Park Sw
436	Brown	ECM to Air Switch Solenoid
437	Brown	ECM to Vehicle Speed Sensor
438	Red-White	ECM to High Gear Switch
439	Pink-Black	Feed Ign. Sw. "On & Crank" Controlled - Fused
440	Orange	Feed, Battery - Fused
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

Circuit Number	Circuit Color	Circuit Name
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
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	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.

ELECTRICAL CIRCUIT IDENTIFICATION (Cont'd)

Circuit Number	Circuit Color	Circuit Name	Circuit Number	Circuit Color	Circuit Name
669	Brown	Wdo Control Lr Down - Lr Sw.	815	Black	Feed, EFI Module Distributor Trigger Output Controlled, Fused
670	Dark Blue	Wdo Control RR Up - RR Sw.	816	Pink	Accelerator Enrichment Input #2
671	Brown	Wdo Control RR Down - RR Sw.	817	Tan	Accelerator Enrichment Input #1
756	Dark Green-White	Feed, Vac Sol Controlled (For Electronic Distributor)	818	Light Green	Accelerator Enrichment Sw. Supply Voltage
801	Brown	Feed, EFI Battery Controlled, Fusible Link Protected	819	Black-White	Closed Throttle Sw.
804	Purple	Feed, EFI, Ign. Sw. "Crank" Controlled, Fusible Link Protected	820	Orange	Wide Open Throttle Switch
807	Purple	Feed, EFI Battery Controlled, Fused	821	Dark Green	Ground, EFI Module Coolant Temp. Sensor Output Controlled
808	Dark Blue	Feed, EFI Module Fast Idle Valve Output and 3 Circuit Controlled - Fused	822	Dark Blue	Ground Resistive, Coolant Temp. Sensor Controlled
810	Tan	Feed, Distributor Electronics Controlled	823	Gray	Ground, EFI Module Air Temp. Sensor Output Controlled
811	White	Feed, EFI Module Group Two Injector Output Controlled Fusible Link Protected	824	Orange	Ground, Resistive Air Temp. Sensor Controlled
812	Pink	Feed, EFI Module Group One Injector Output Controlled Fusible Link Protected	827	Dark Green	Feed, EFI Module Elec Fuel Pump Output Controlled - Fused
813	White	Feed, EFI Distributor Trigger and 815 Circuit Controlled, Fused	828	Gray	Feed, EFI, Ign. Sw. "On & Crank" Controlled Fused
814	Yellow	Feed, EFI Distributor Trigger and 815 Circuit Controlled, Fused	831	Brown	Feed, EFI Module EGR Solenoid Output Controlled, Fused

THE CIRCUITS LISTED BELOW HAVE REVISED COLORS:

CIRCUIT	ORIGINAL COLOR	REVISED COLOR
422	TAN-WHITE	TAN-BLACK
432	DARK BLUE -GRAY	LIGHT GREEN
438	RED-WHITE	DARK GREEN-WHITE
508	YELLOW	YELLOW-BLACK

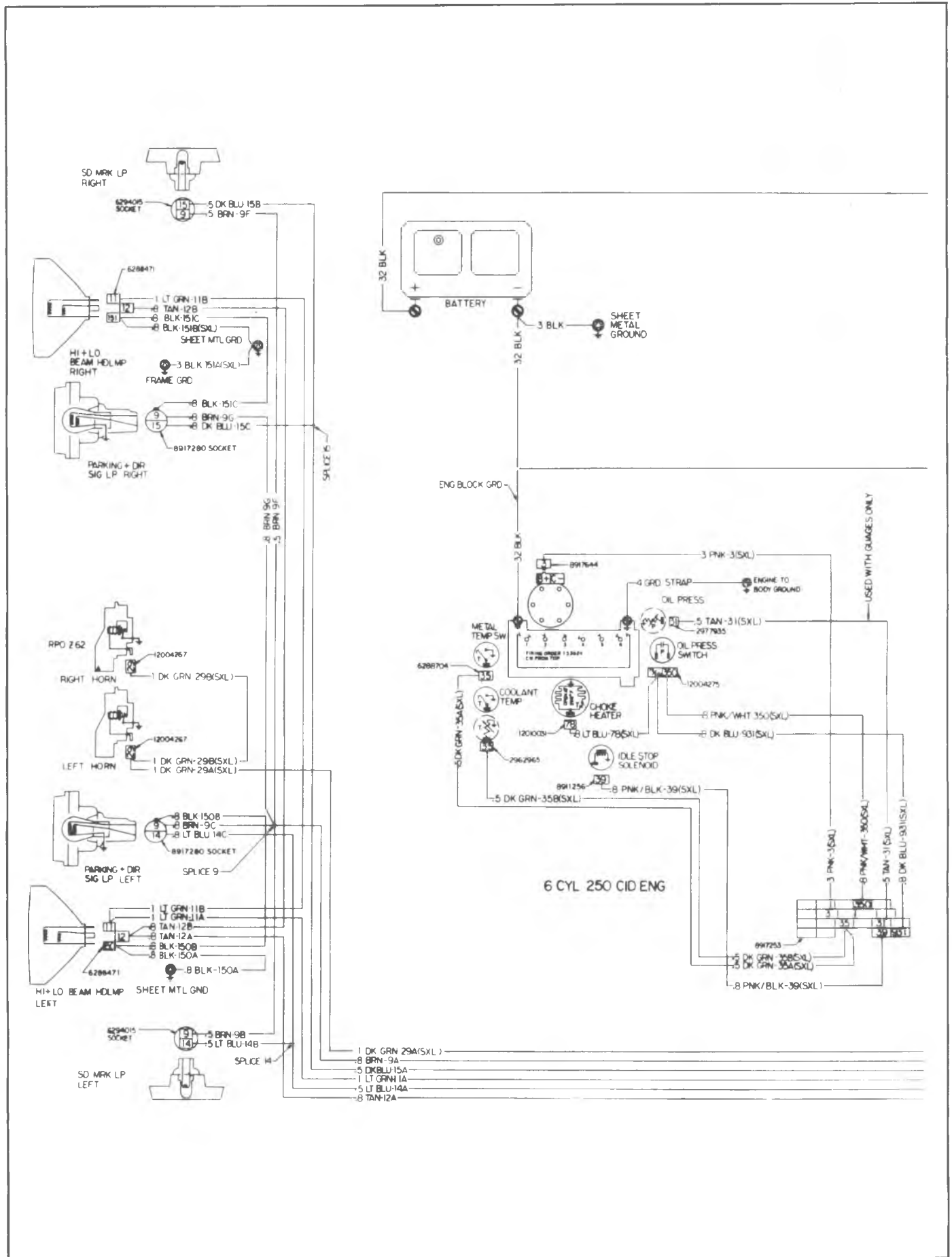


Fig. 8C-44--CK Series Wiring 1 of 29

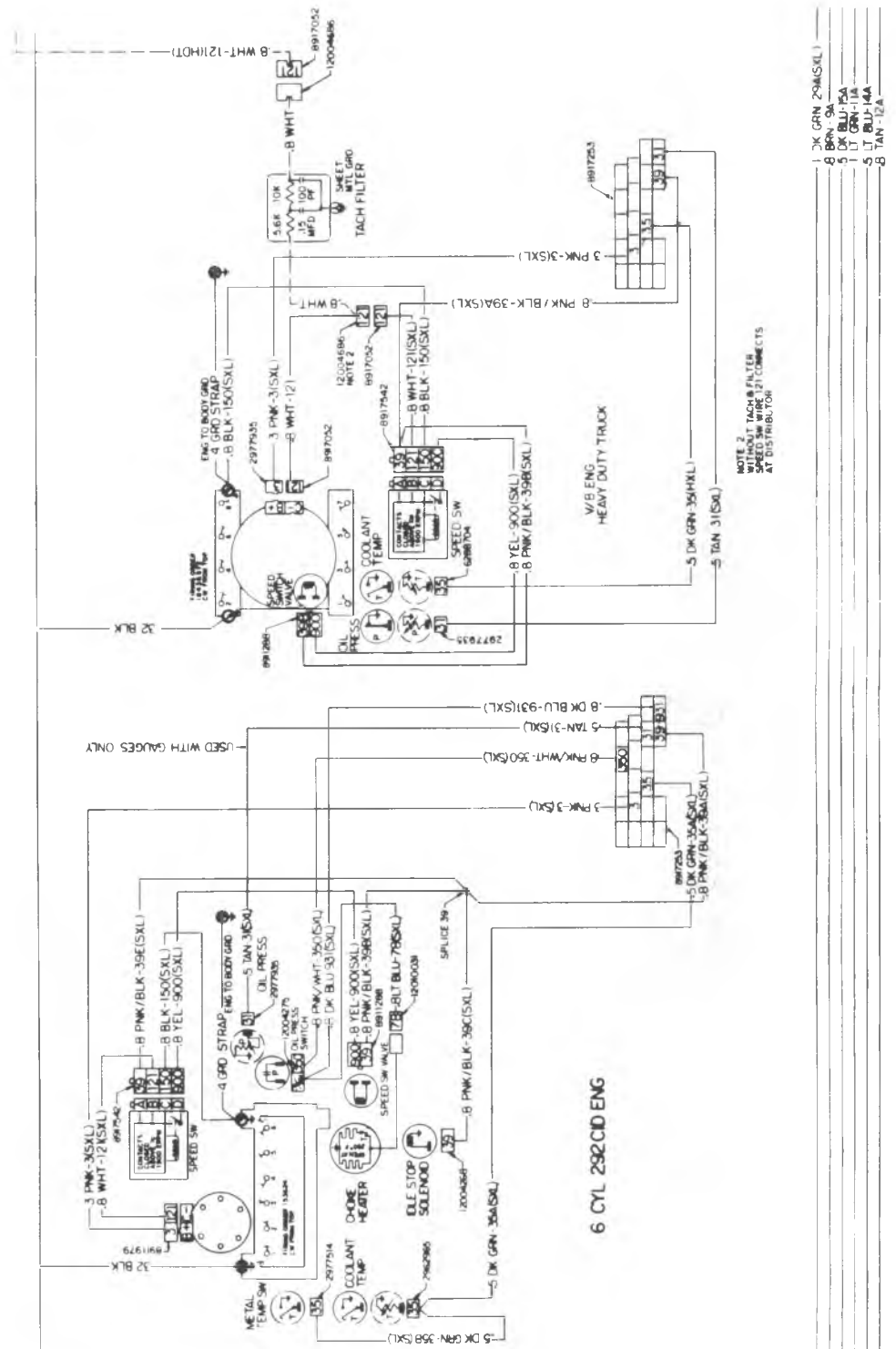


Fig. 8C-45--CK Series Wiring 2 of 29

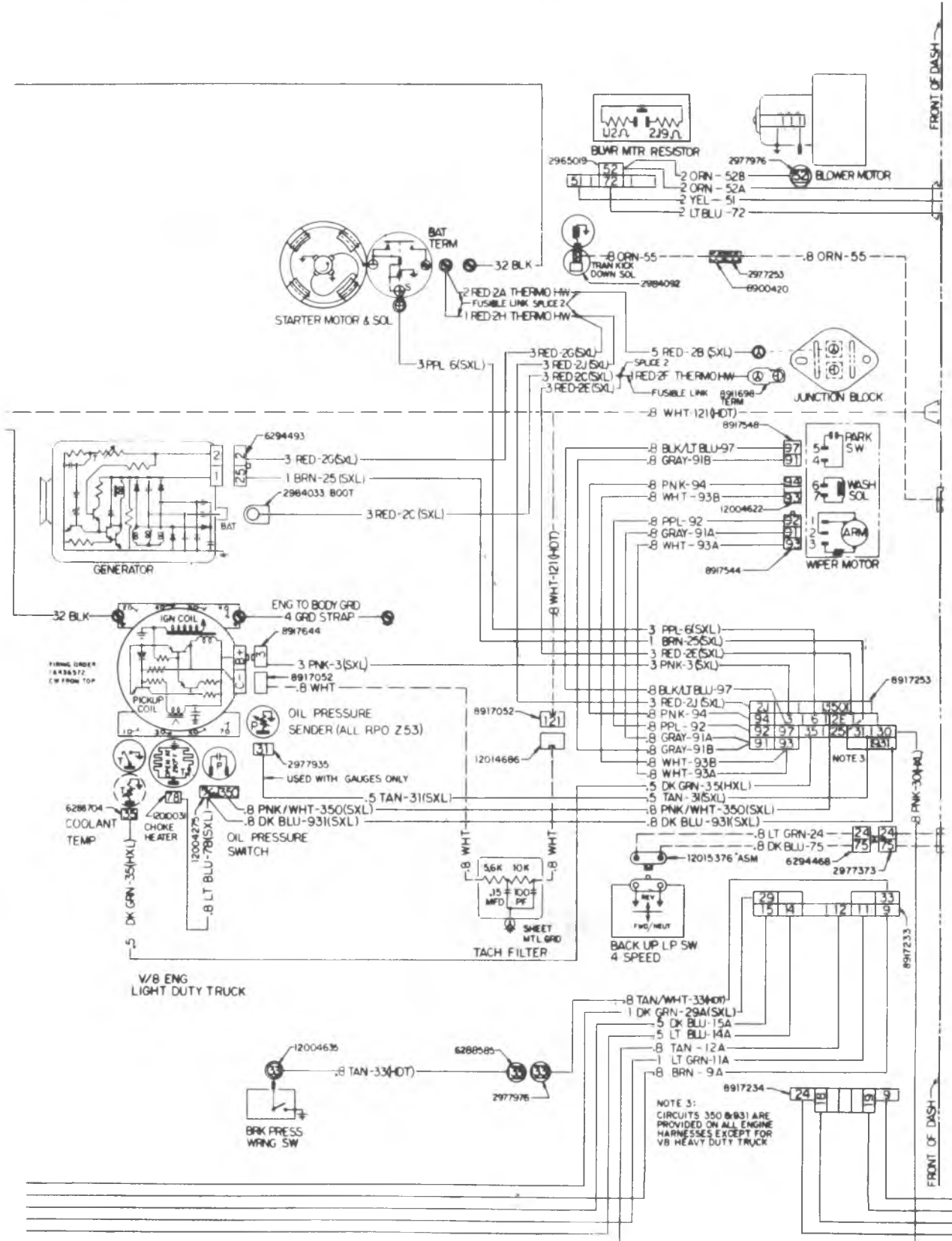


Fig. 8C-46-CK Series Wiring 3 of 29

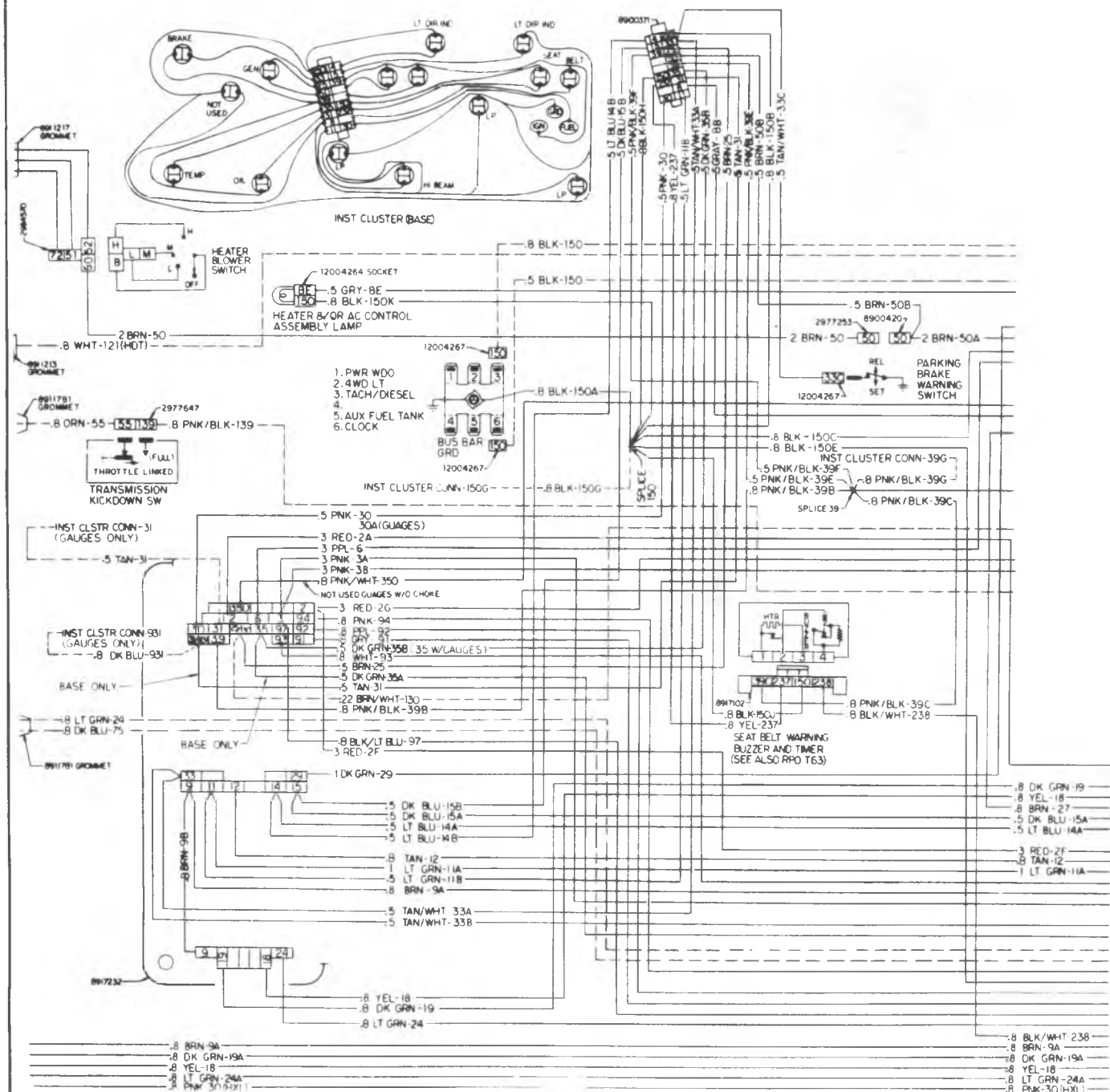


Fig. 8C-47--CK Series Wiring 4 of 29

Fig. 8C-48--CK Series Wiring 5 of 29

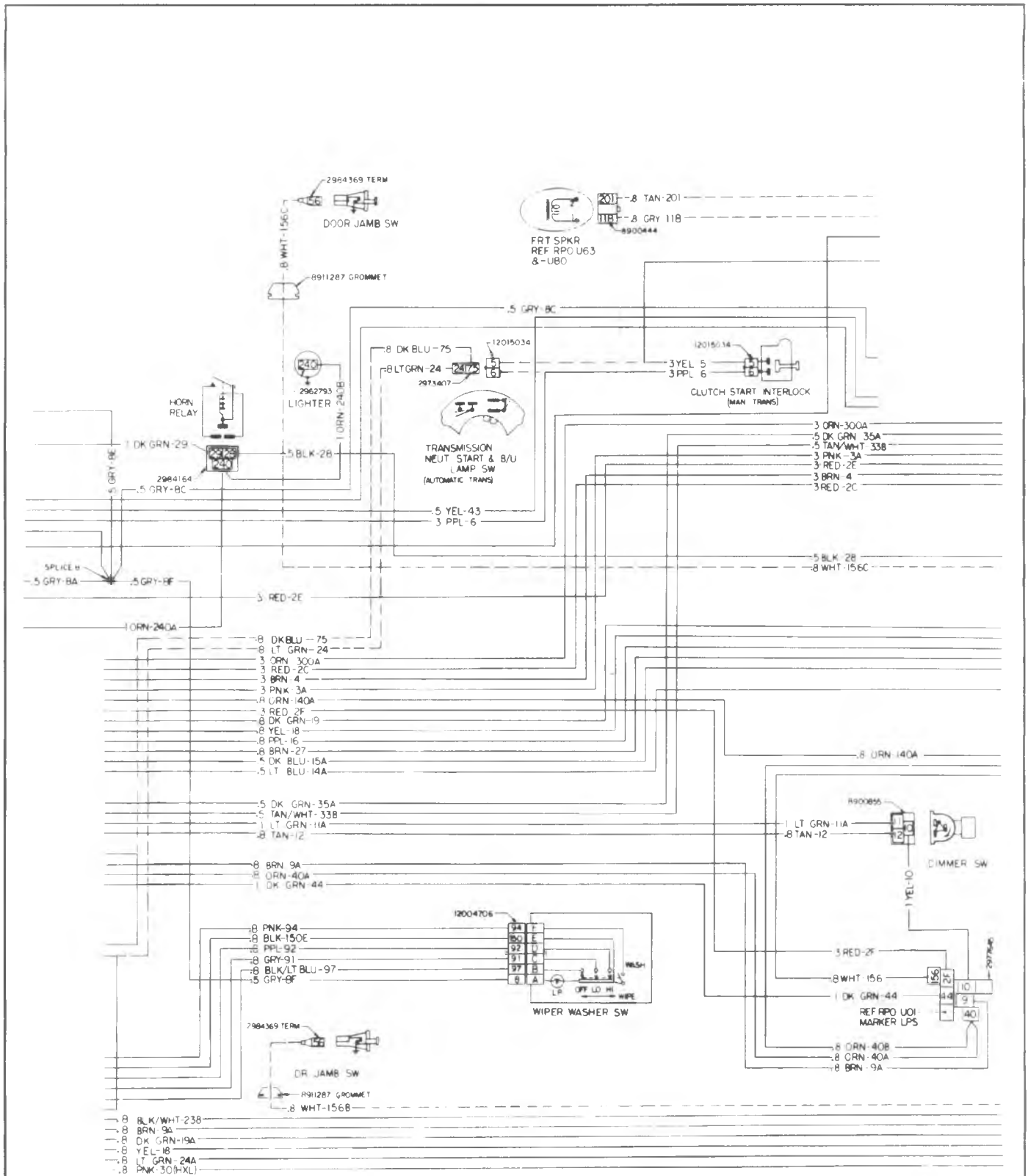
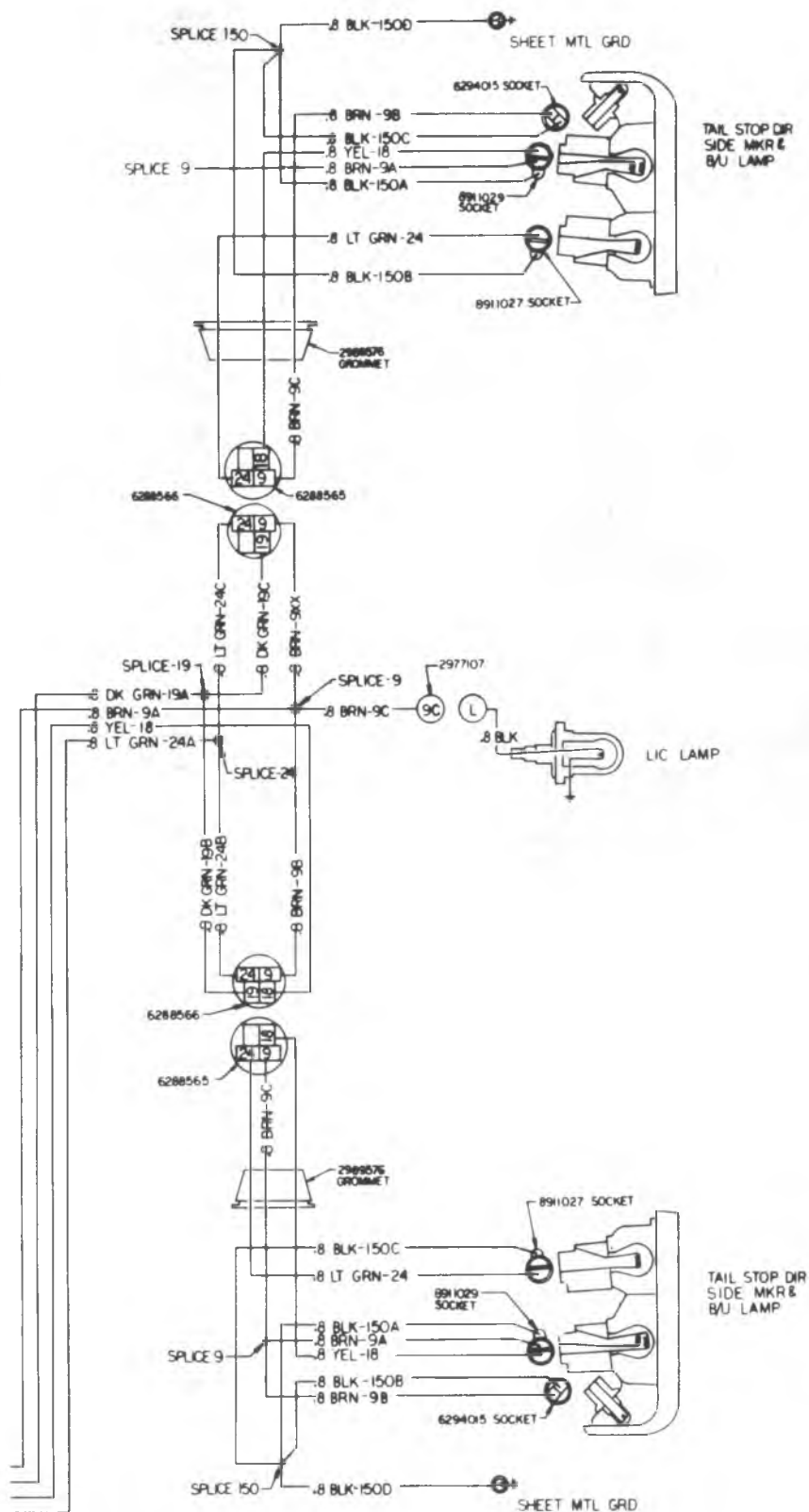


Fig. 8C-49--CK Series Wiring 6 of 29

Fig. 8C-50--CK Series Wiring 7 of 29



SUBURBAN

Fig. 8C-51--CK Series Wiring 8 of 29

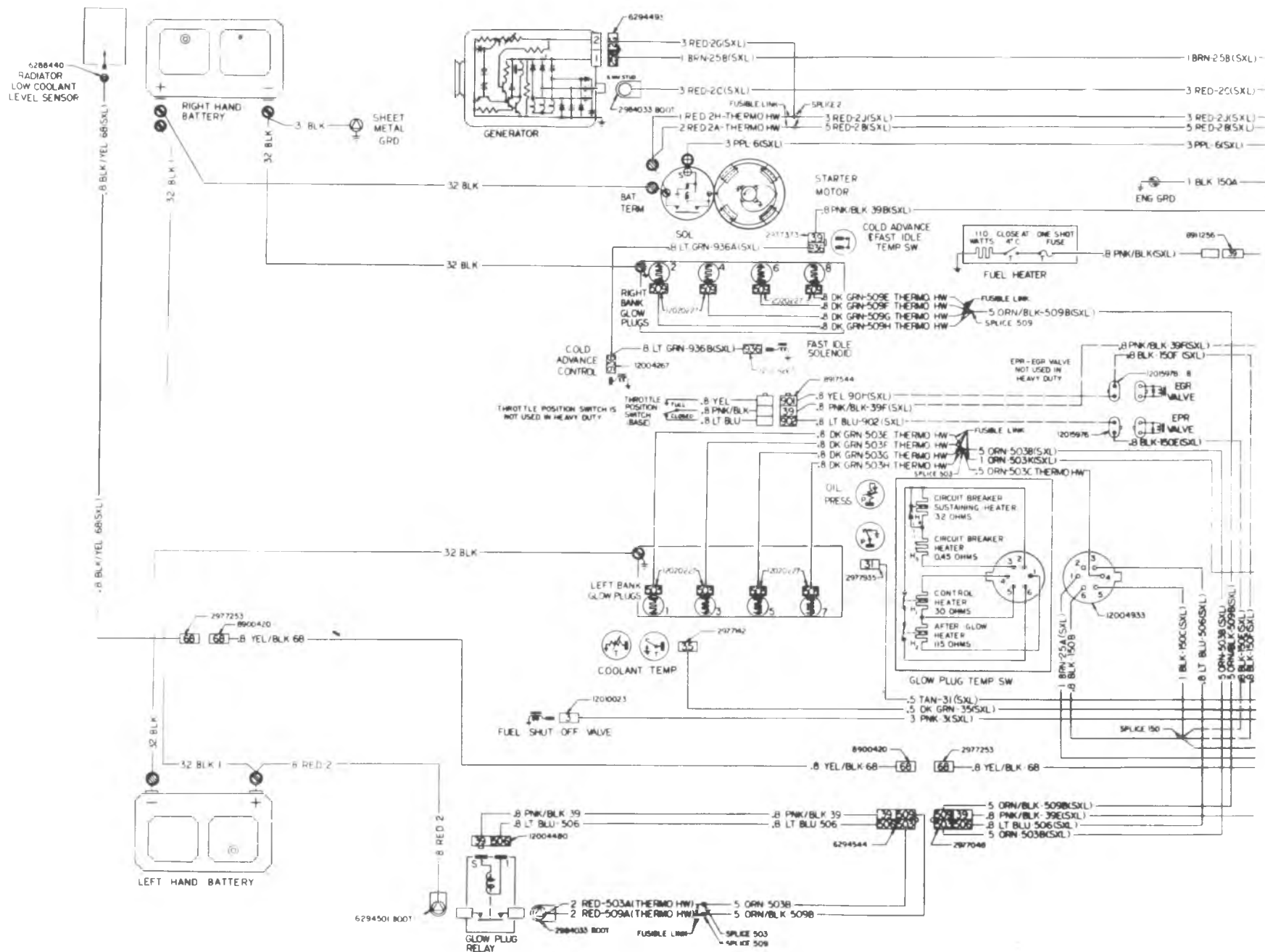


Fig. 8C-53--CK Series Wiring 10 of 29

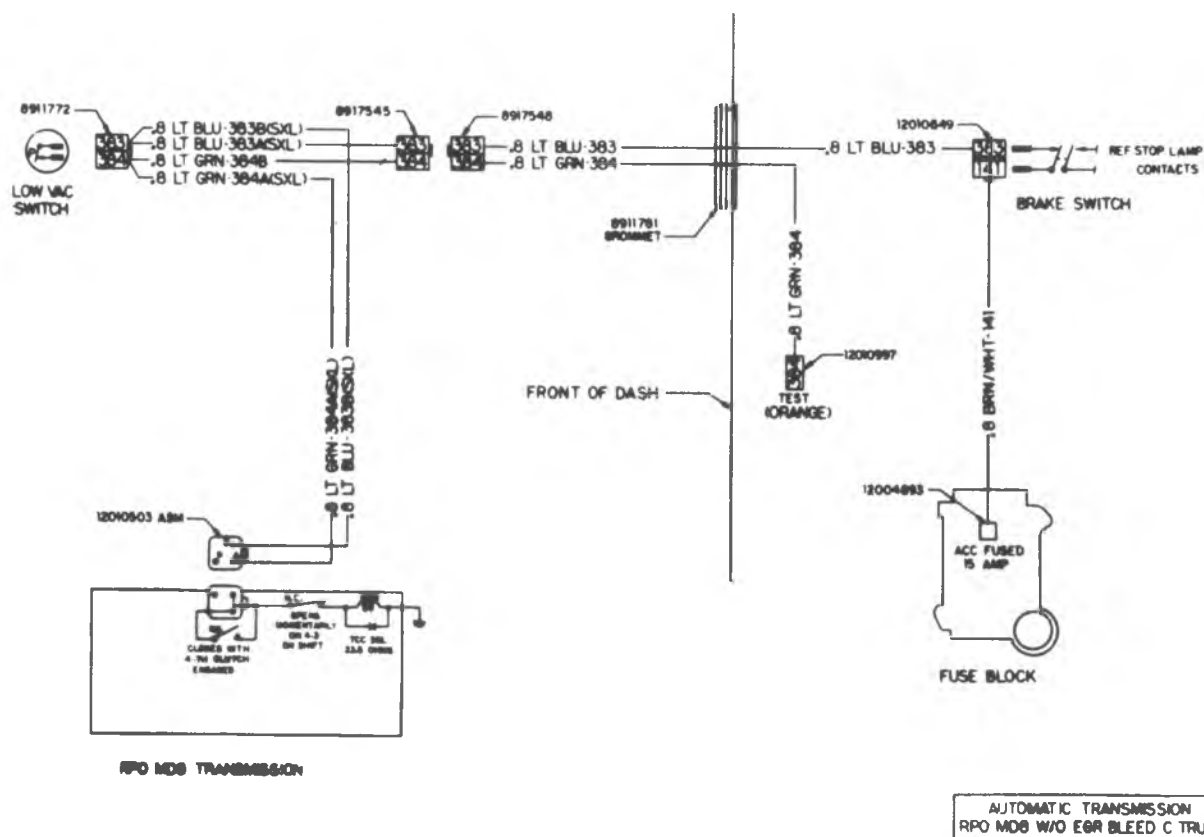
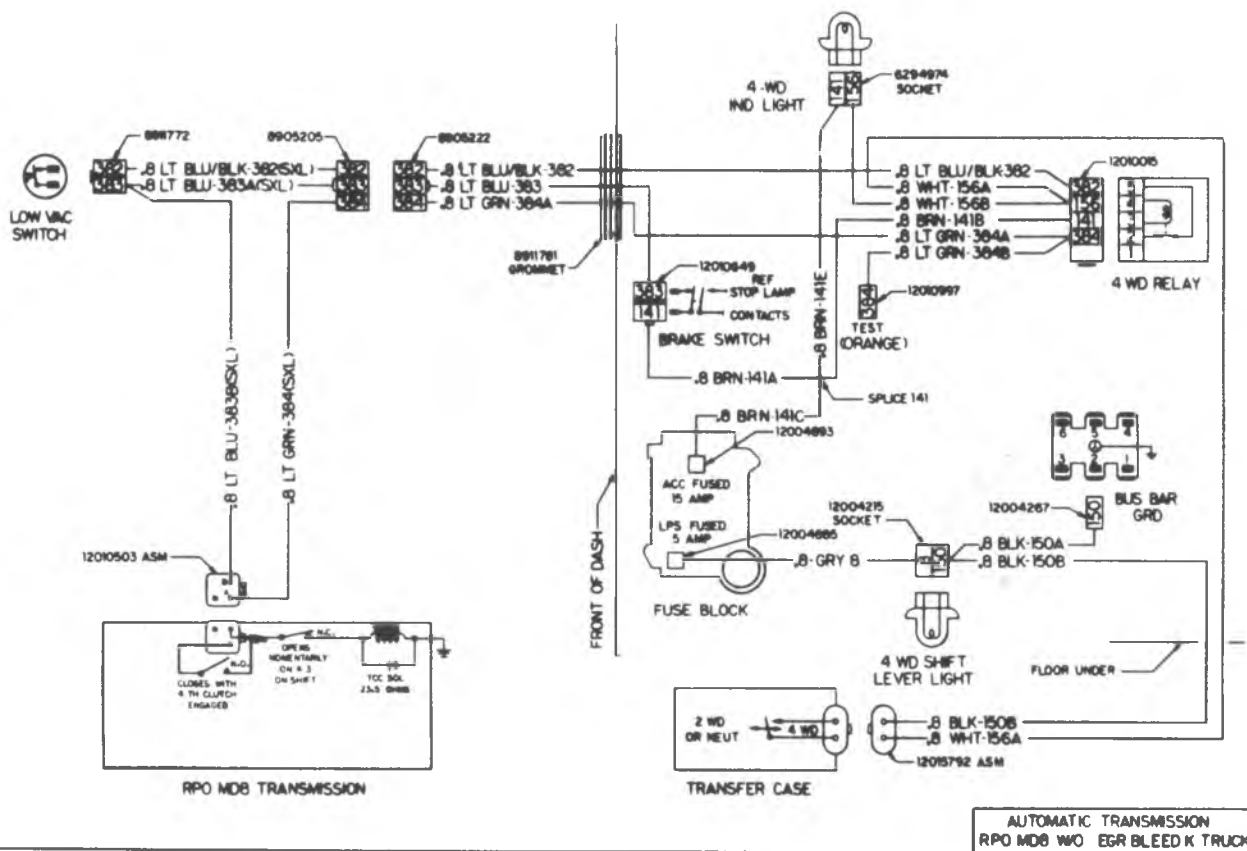


Fig. 8C-54--CK Series Wiring 11 of 29

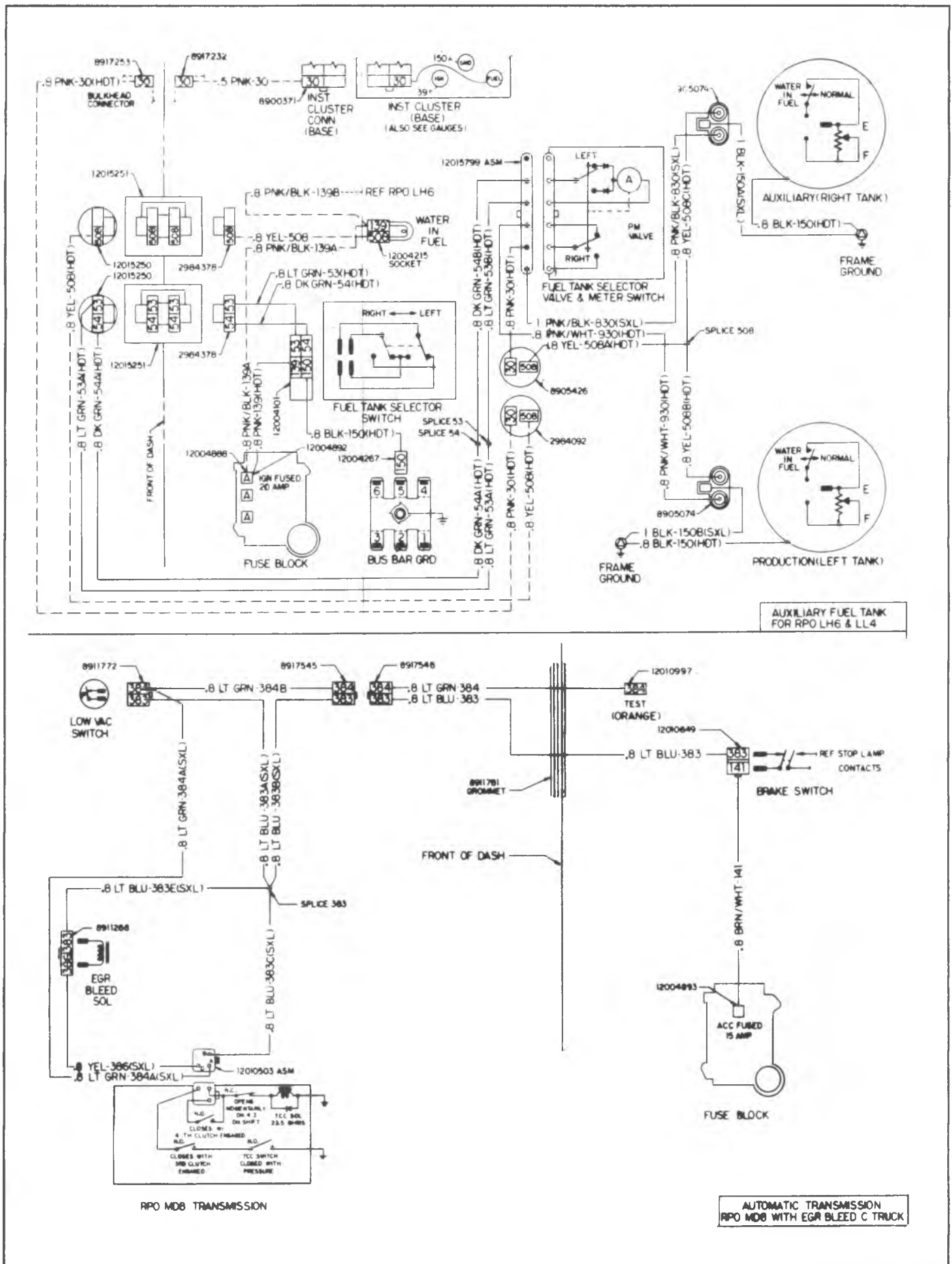


Fig. 8C-55--CK Series Wiring 12 of 29

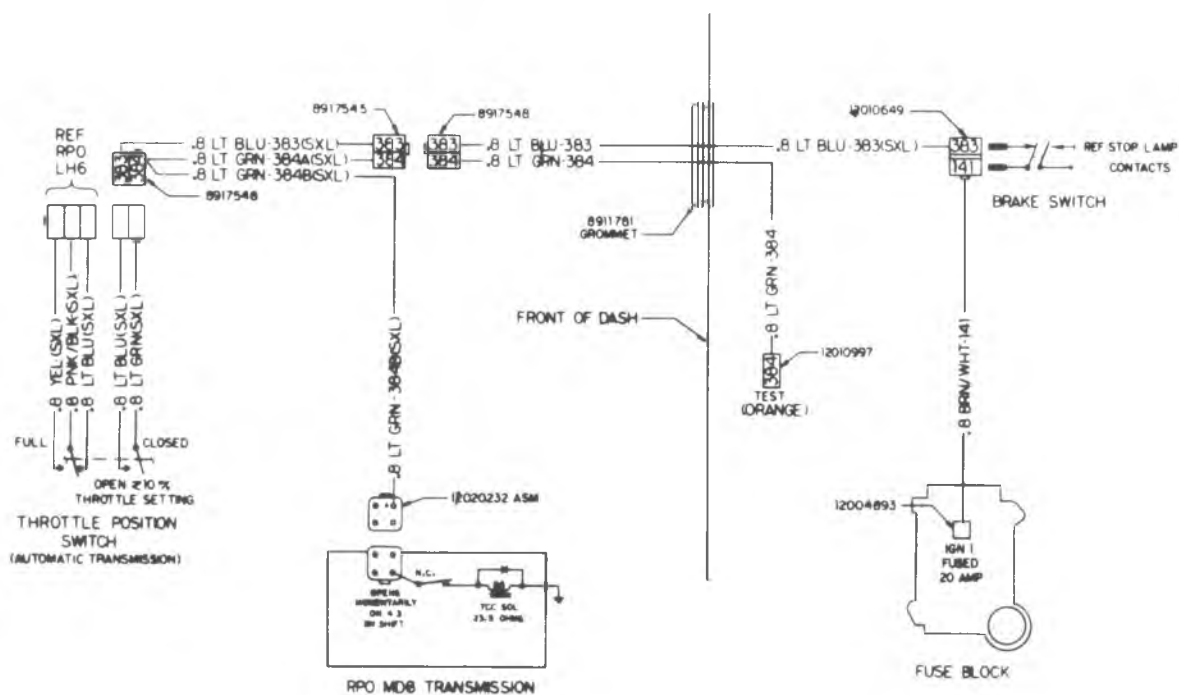
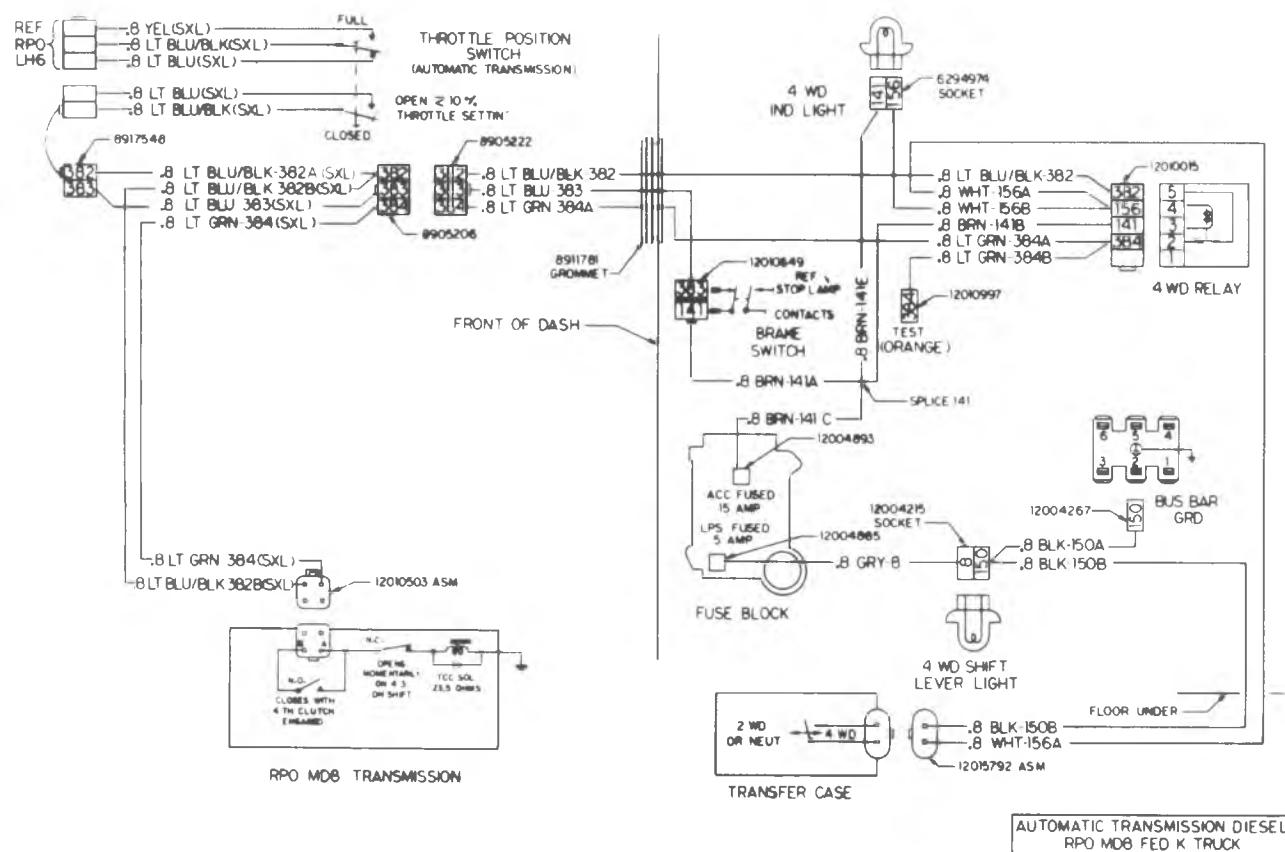


Fig. 8C-56--CK Series Wiring 13 of 29

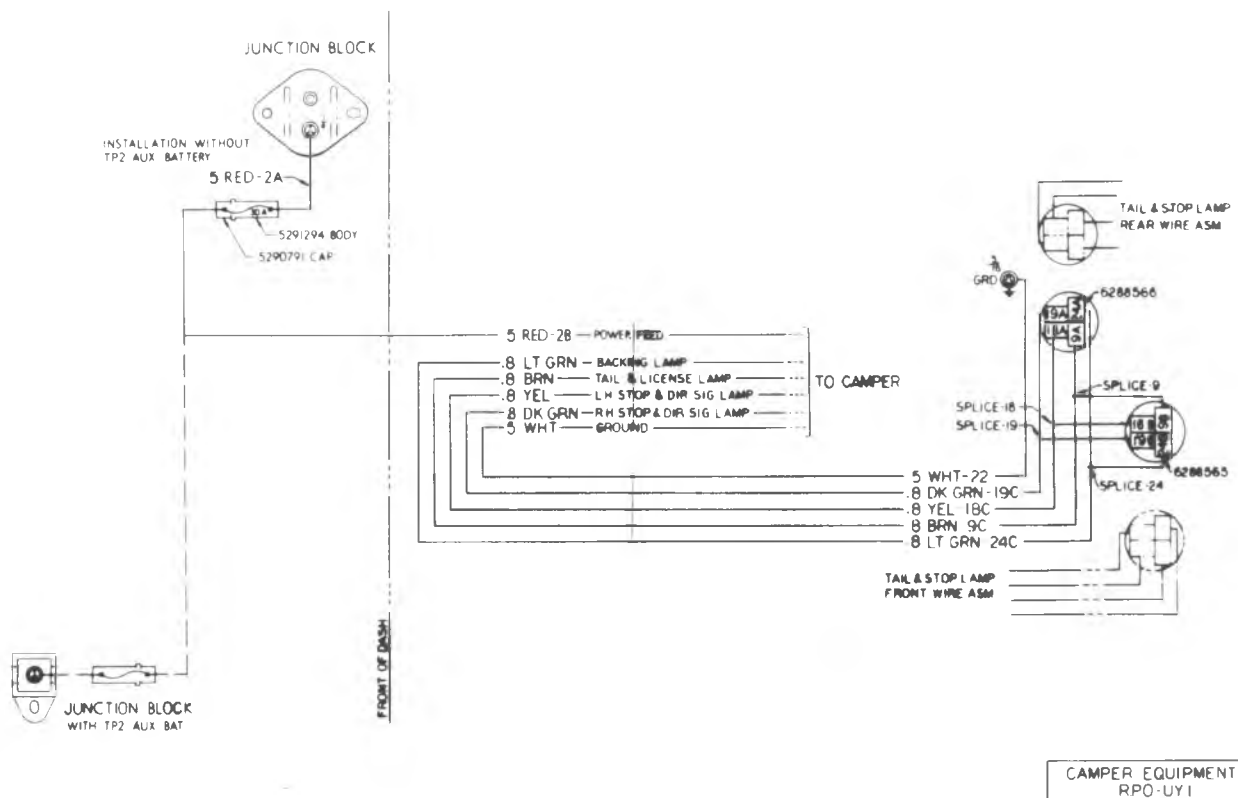
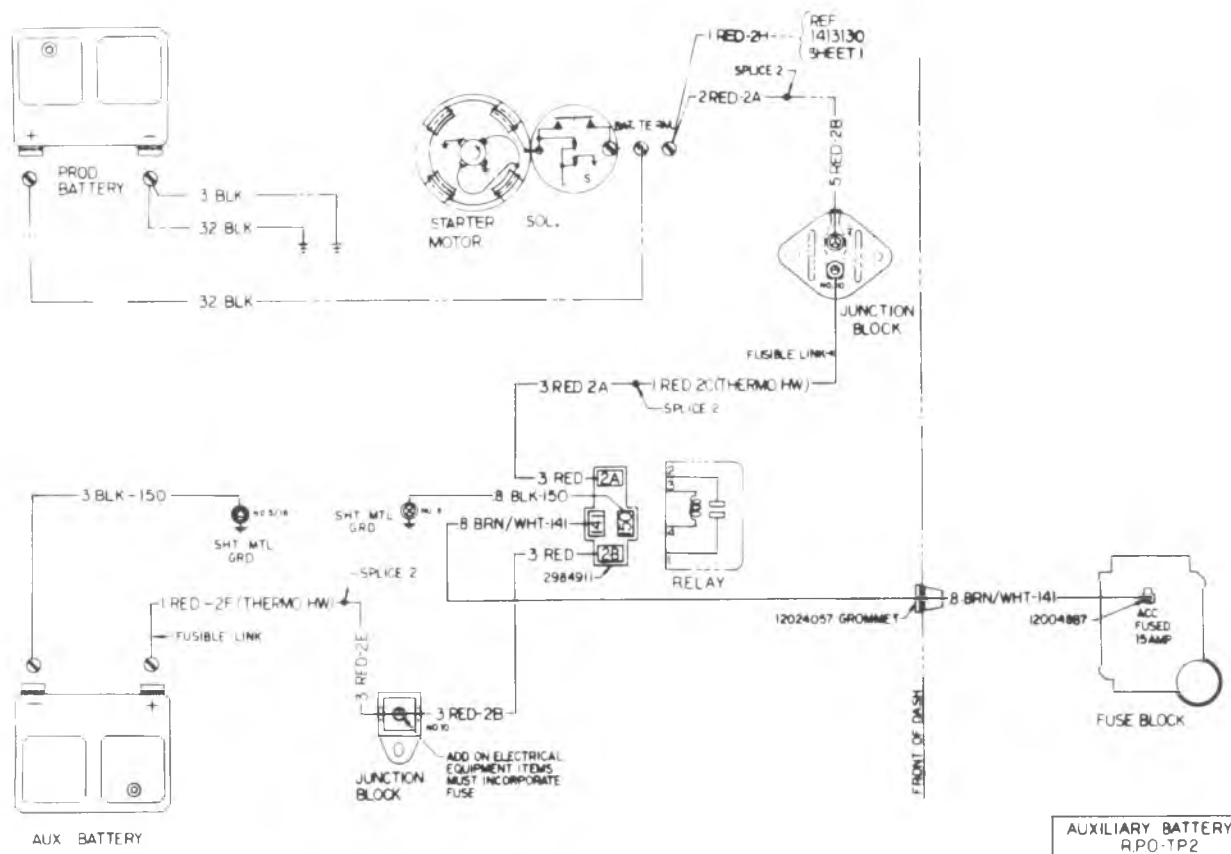


Fig. 8C-57--CK Series Wiring 14 of 29

Fig. 8C-58--CK Series Wiring 15 of 29

Fig. 8C-59--CK Series Wiring 16 of 29

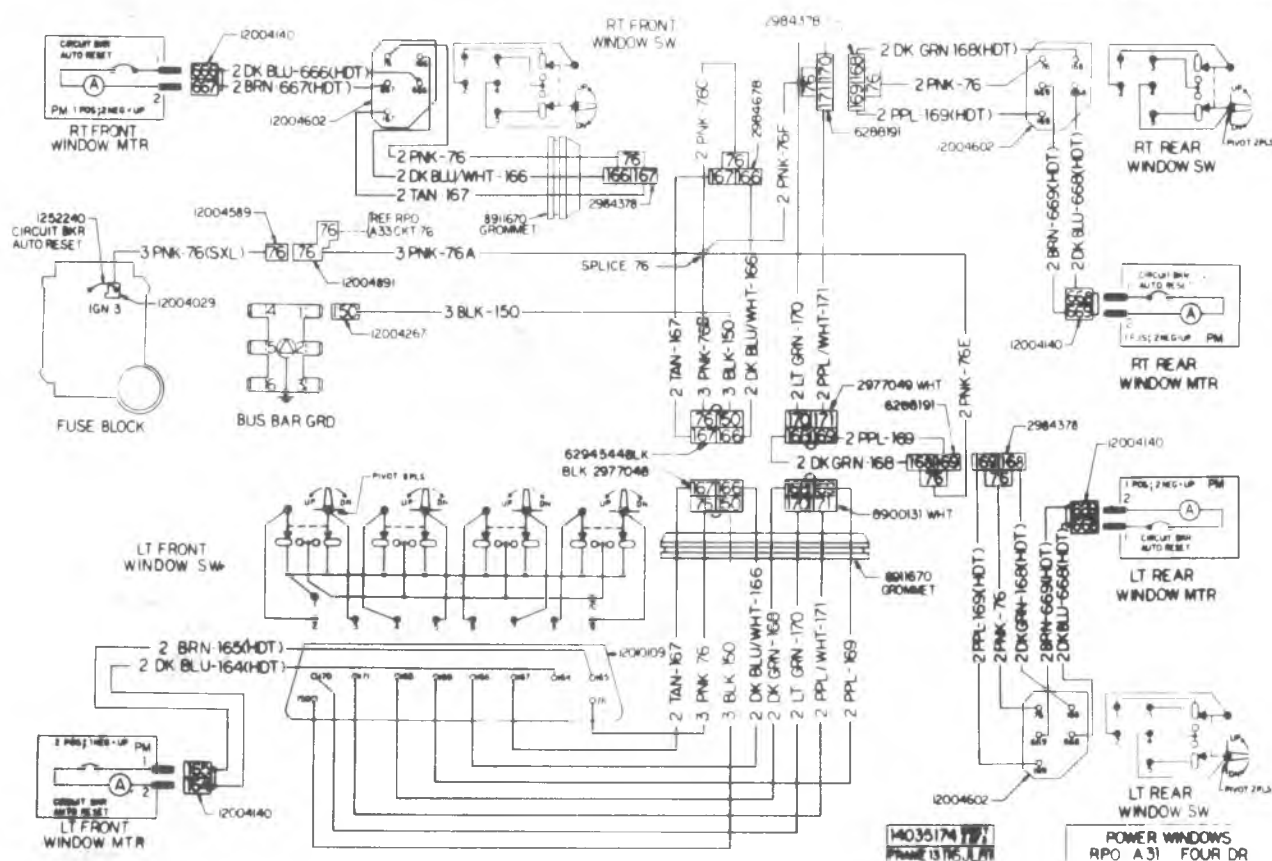
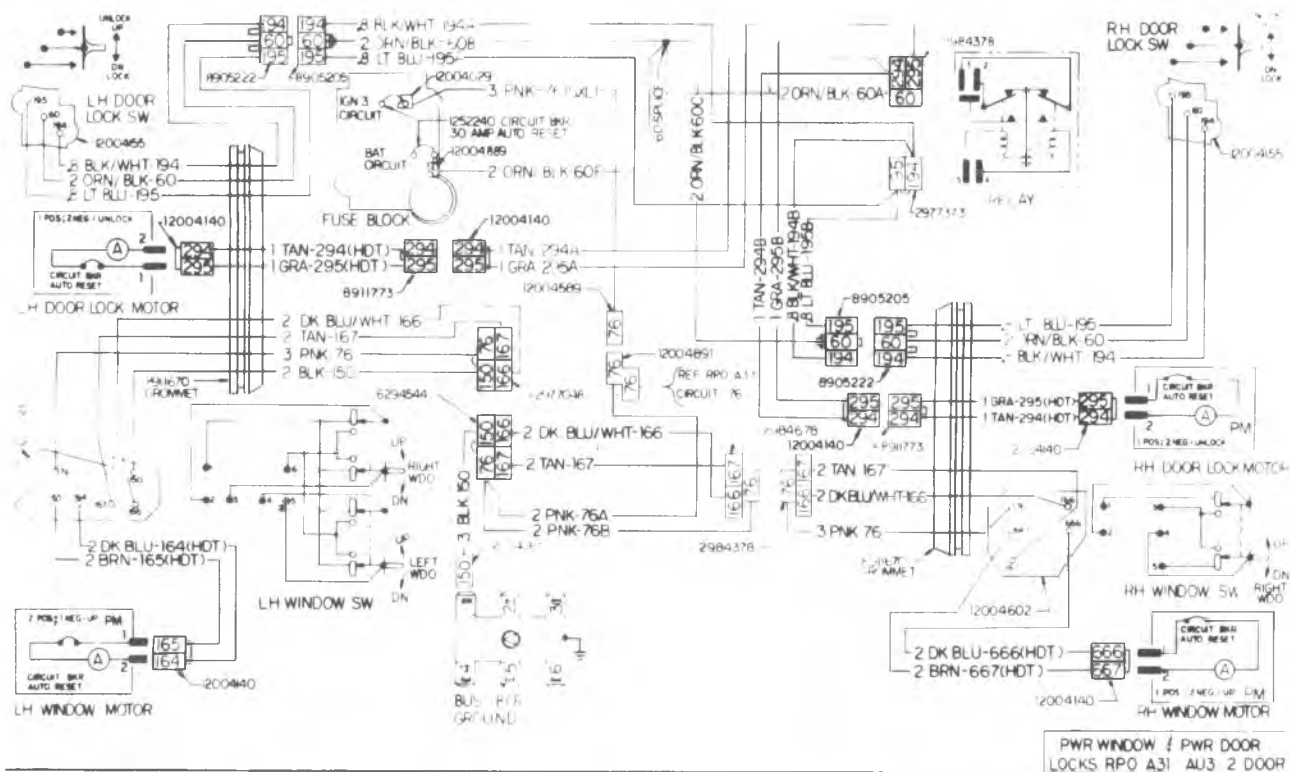


Fig. 8C-60-CK Series Wiring 17 of 29

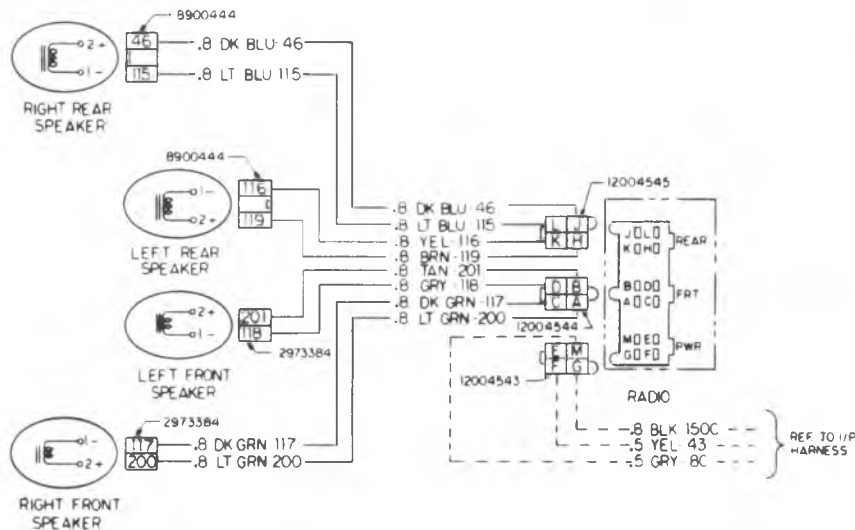
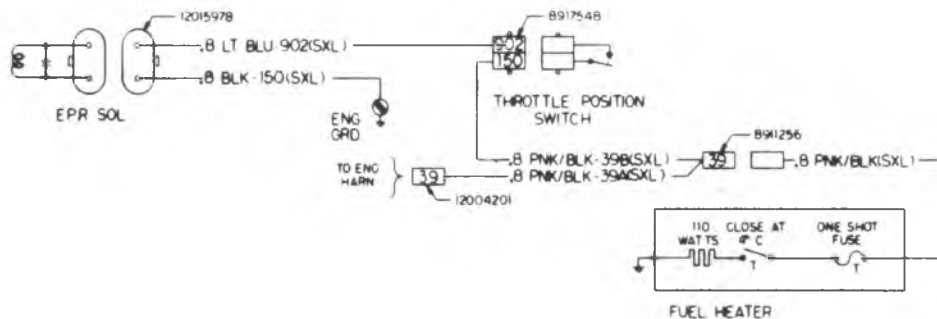
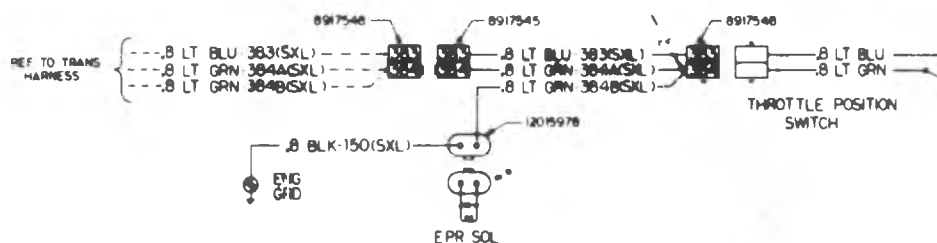
RADIO EQUIPMENT
RPO UPB SUBURBANTHROTTLE POSITION SWITCH
JUMPER RPO B5Q MANUALTHROTTLE POSITION SWITCH
JUMPER RPO B5Q AUTO.

Fig. 8C-61-CK Series Wiring 18 of 29

Fig. 8C-62--CK Series Wiring 19 of 29

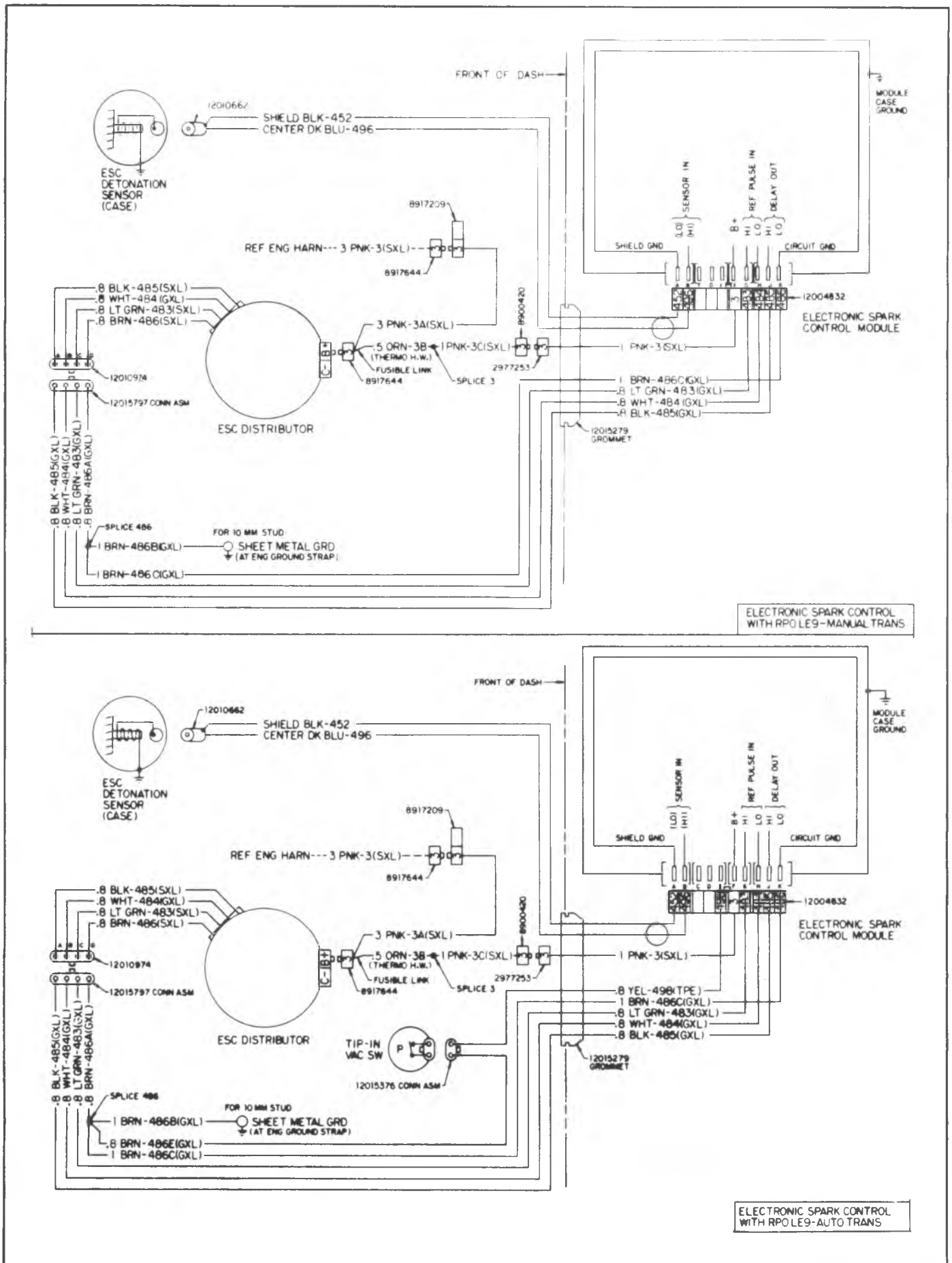


Fig. 8C-63--CK Series Wiring 20 of 29

Fig. 8C-64--CK Series Wiring 21 of 29

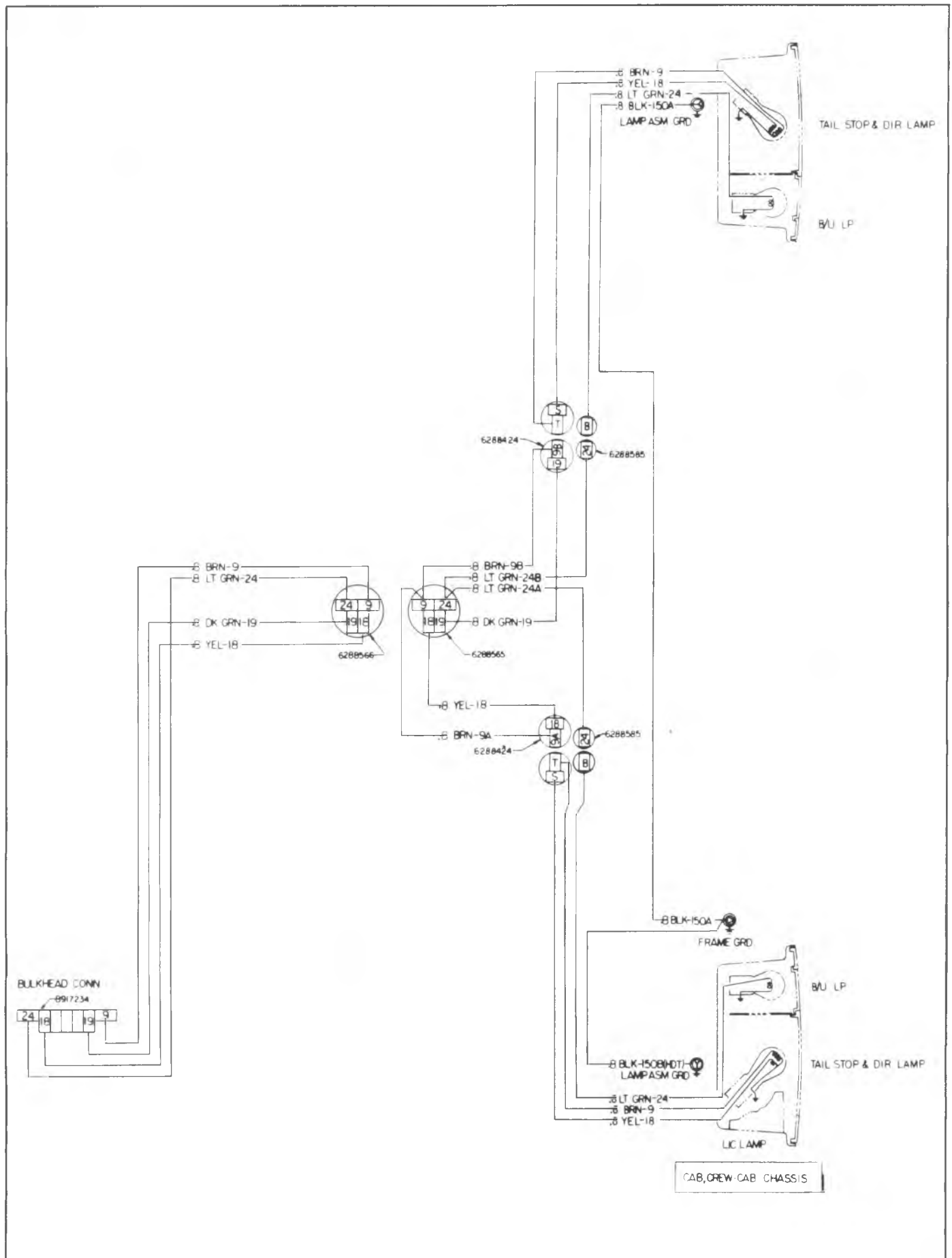


Fig. 8C-65--CK Series Wiring 22 of 29

Fig. 8C-66--CK Series Wiring 23 of 29

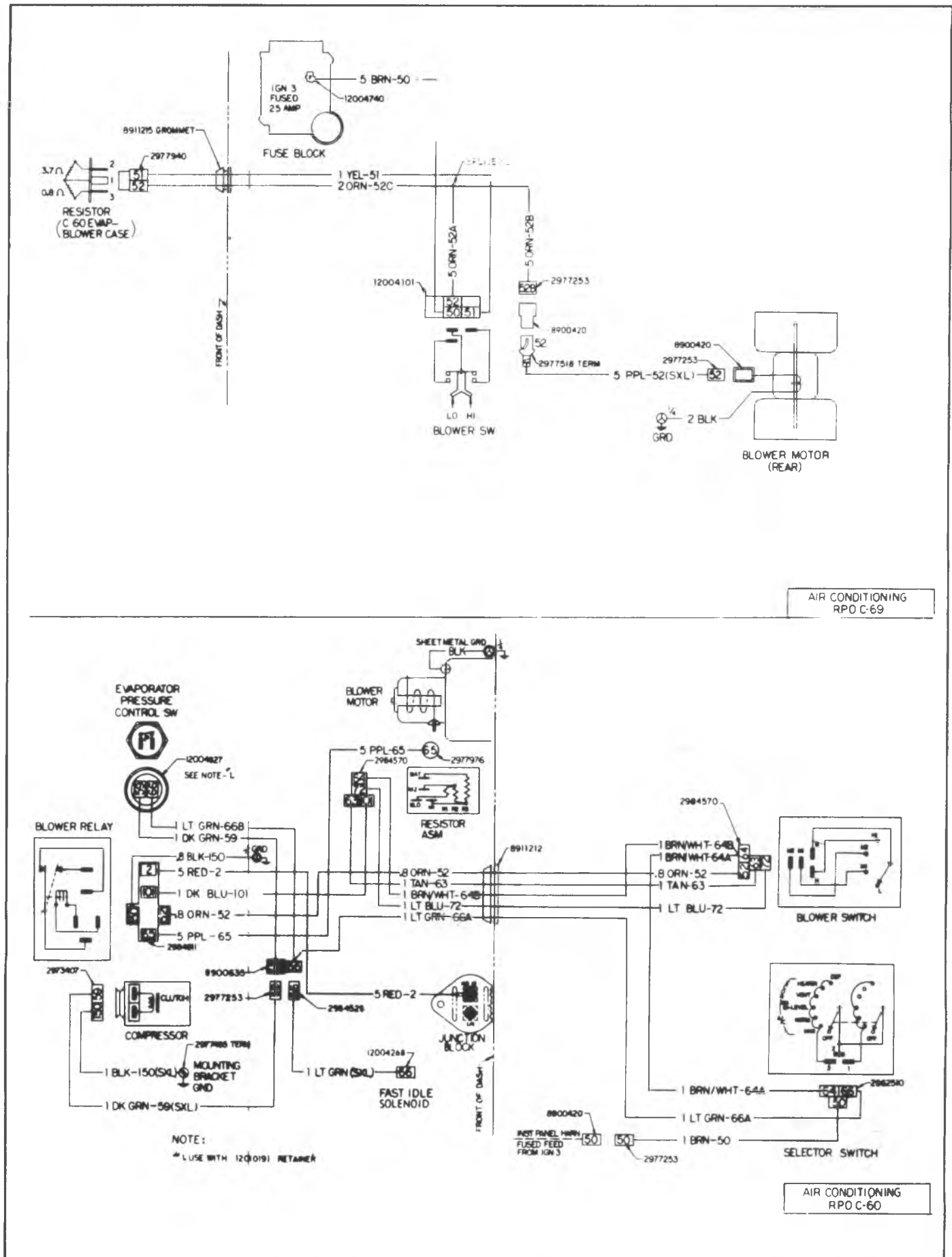
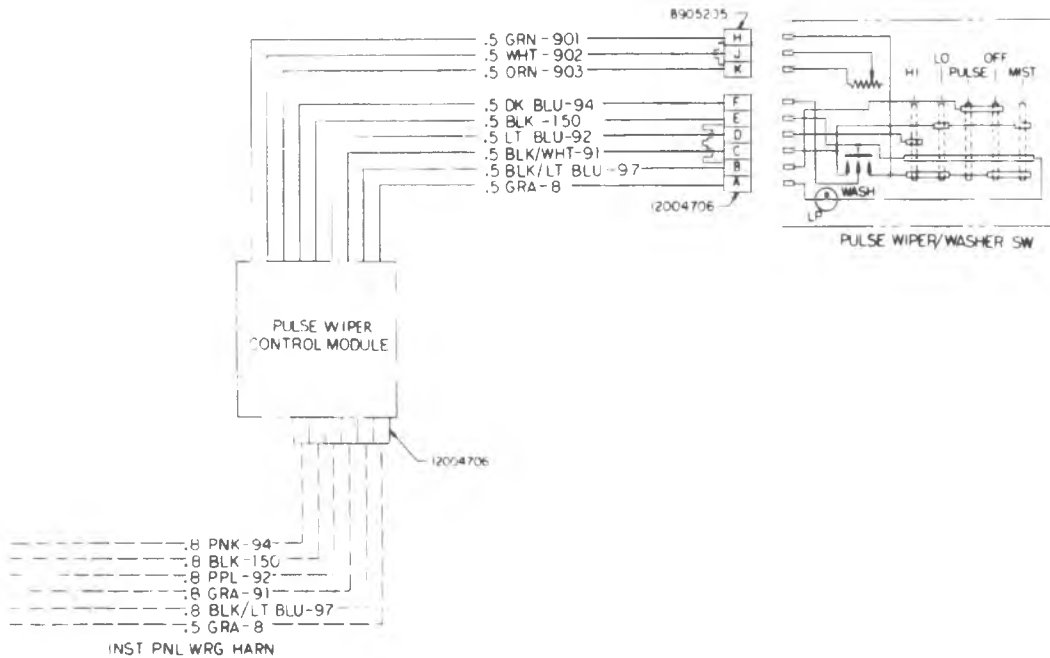
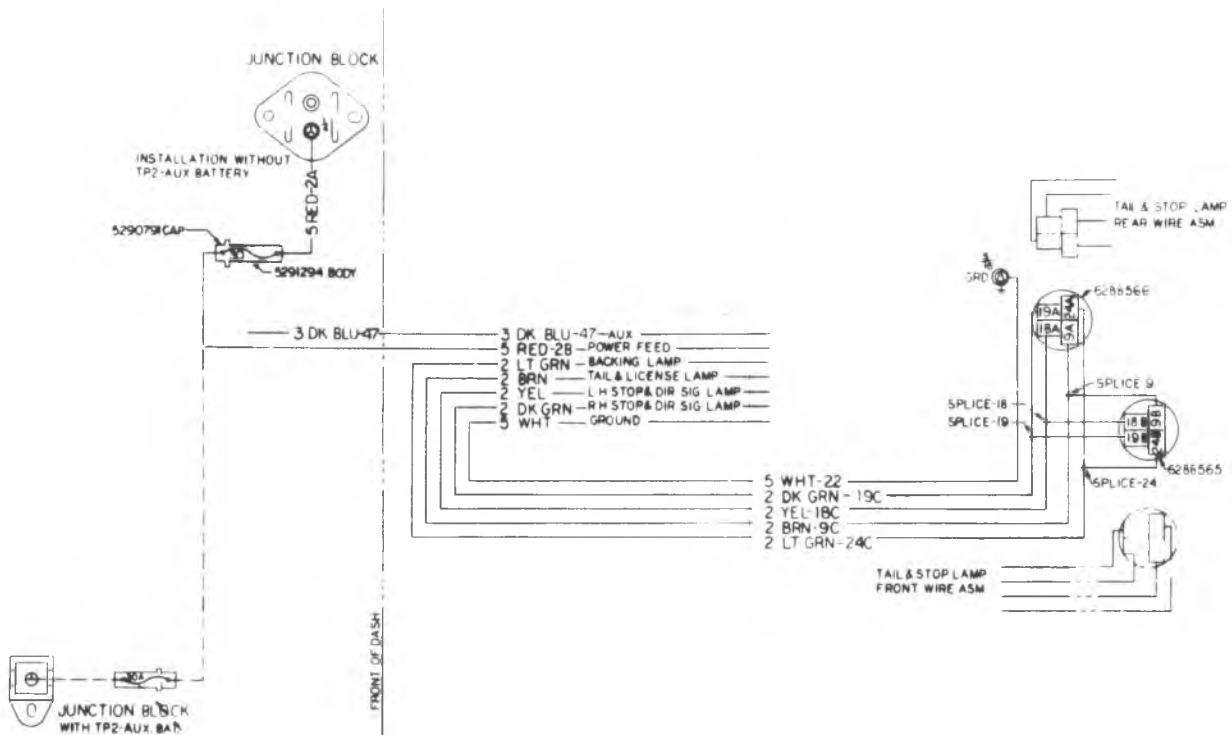


Fig. 8C-67-CK Series Wiring 24 of 29



PULSE WIPER SYSTEM
RPO CD4



HEAVYDUTY TRAILER
RPO UY7

Fig. 8C-69--CK Series Wiring 26 of 29

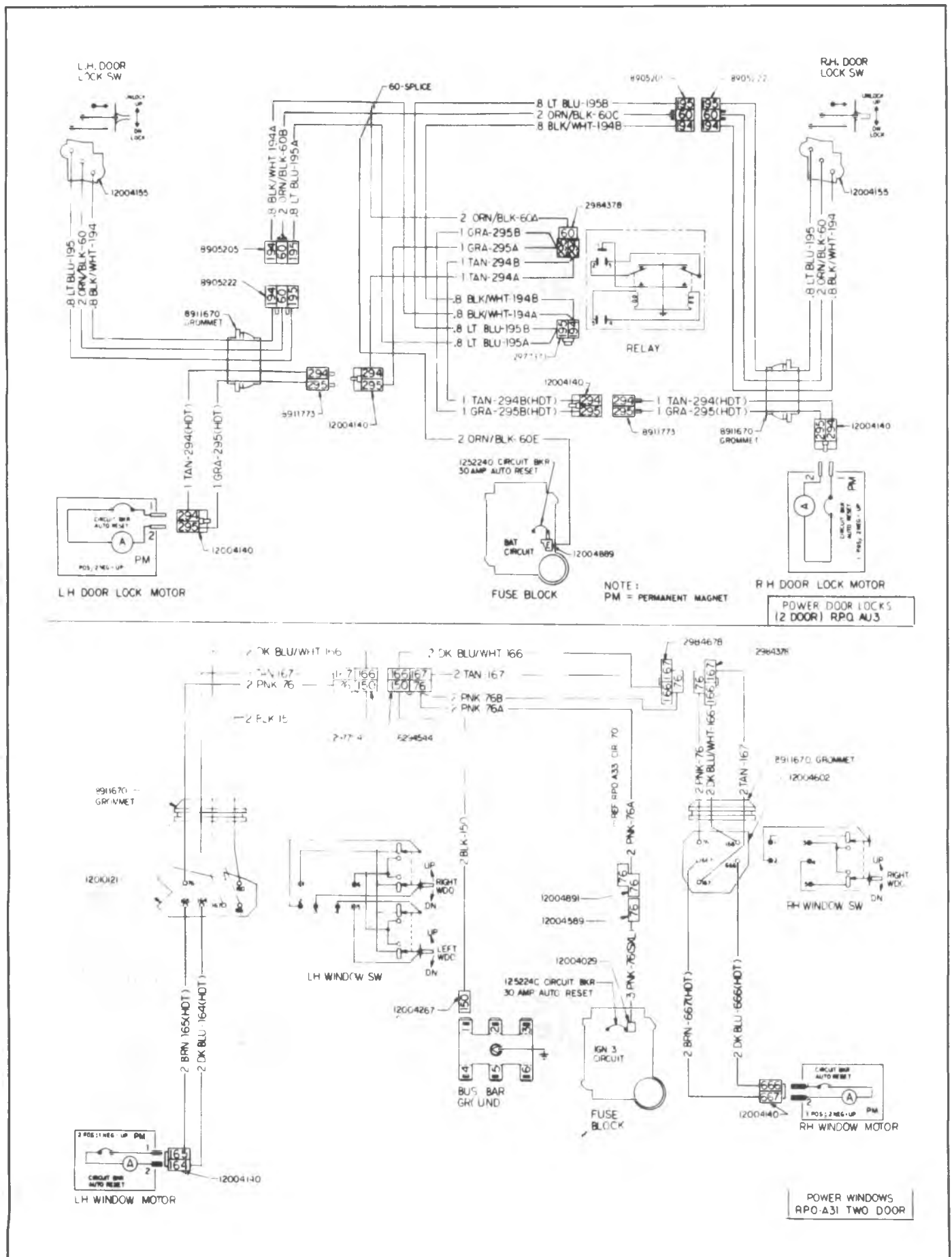


Fig. 8C-70-CK Series Wiring 27 of 29

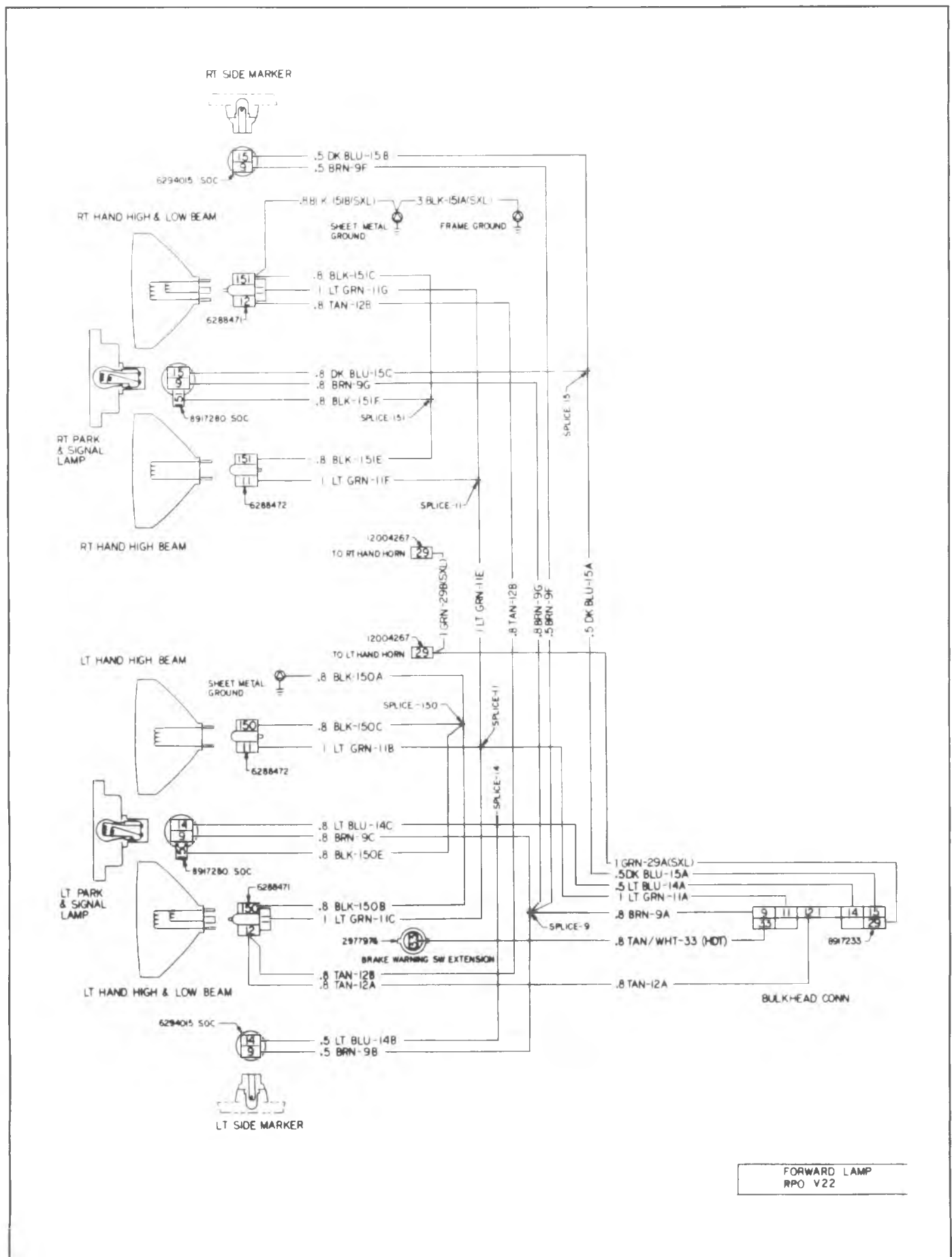


Fig. 8C-72--CK Series Wiring 29 of 29

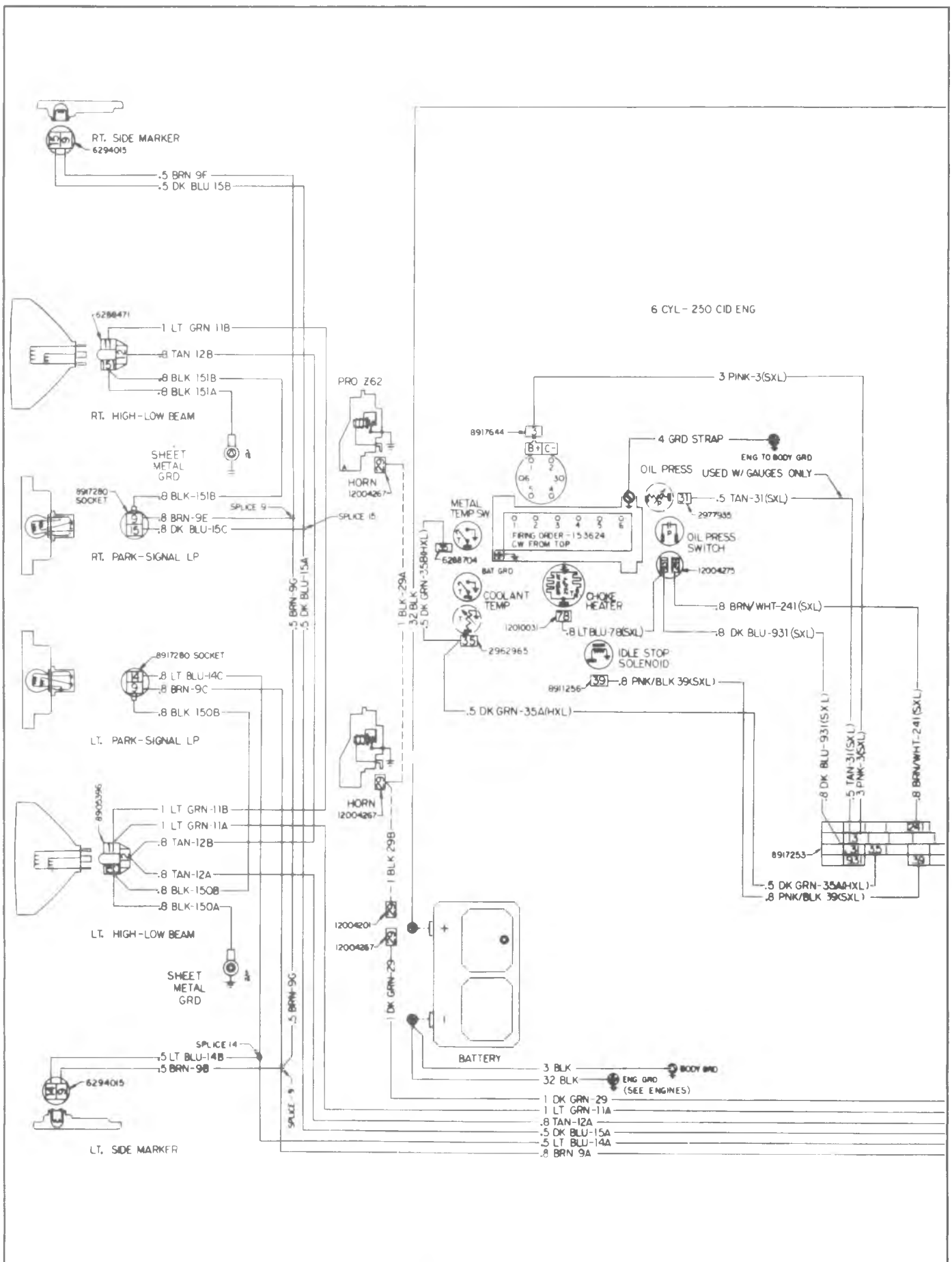


Fig. 8C-74--G Series Wiring 2 of 19

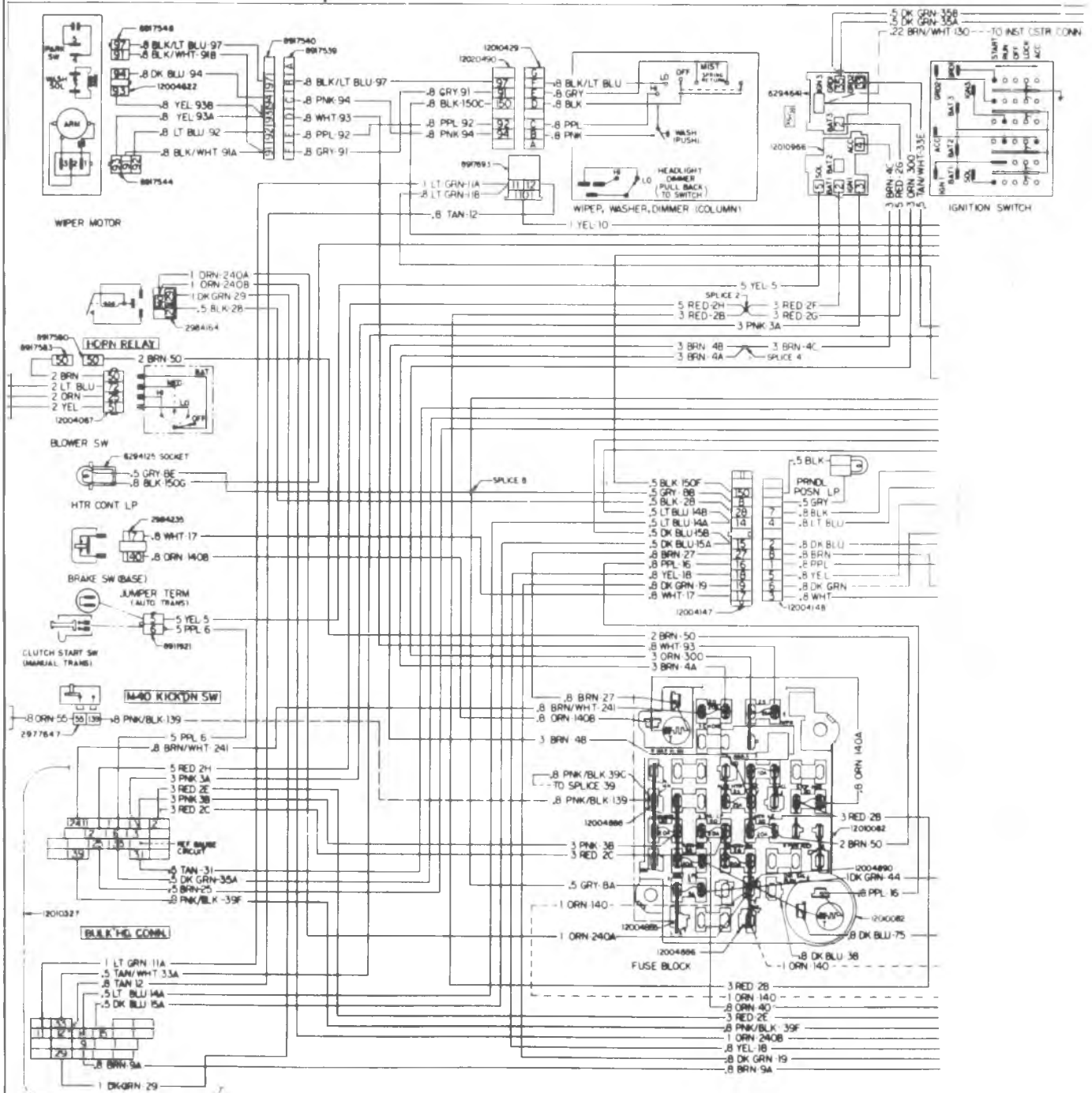


Fig. 8C-75--G Series Wiring 3 of 19

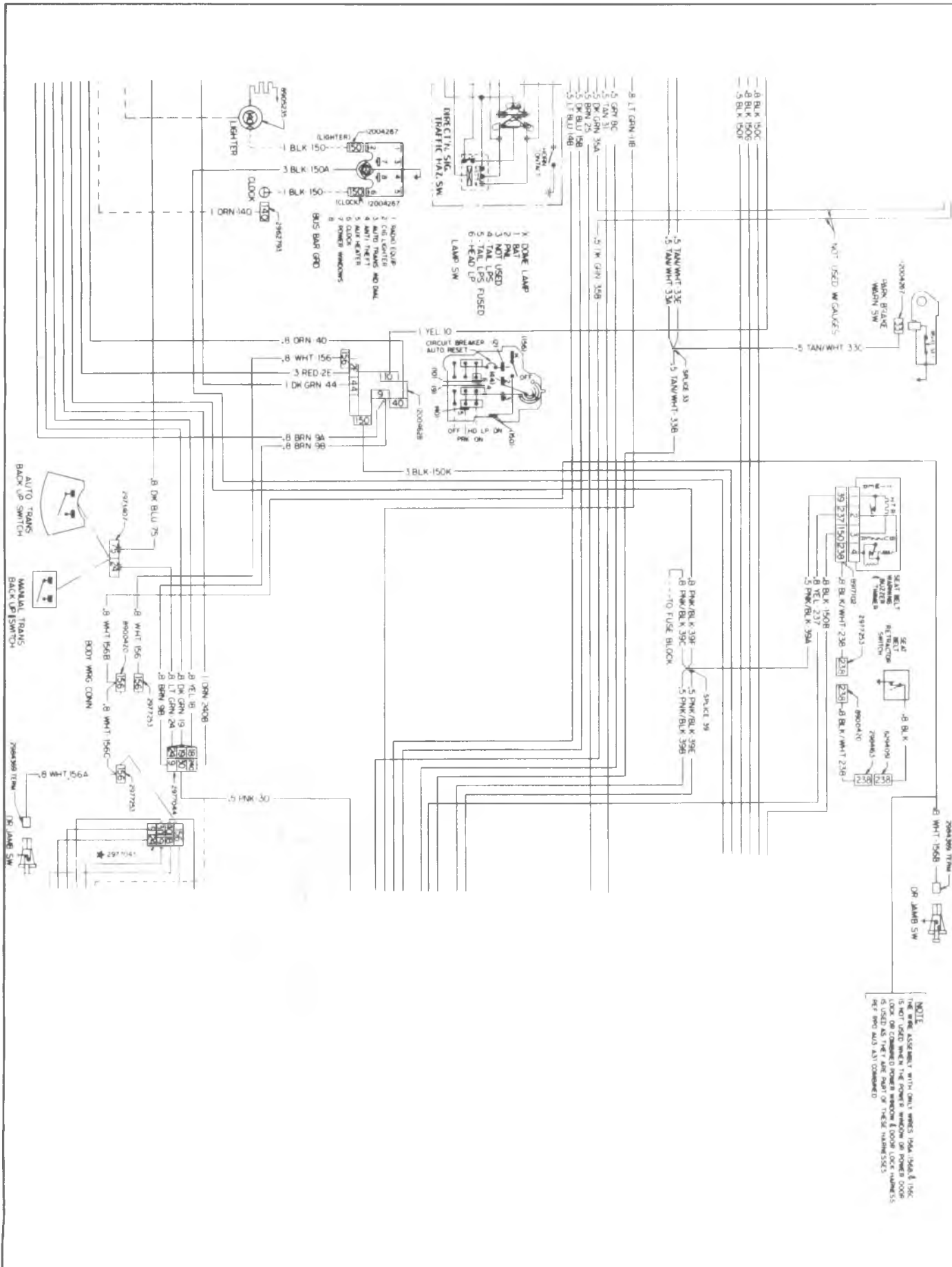
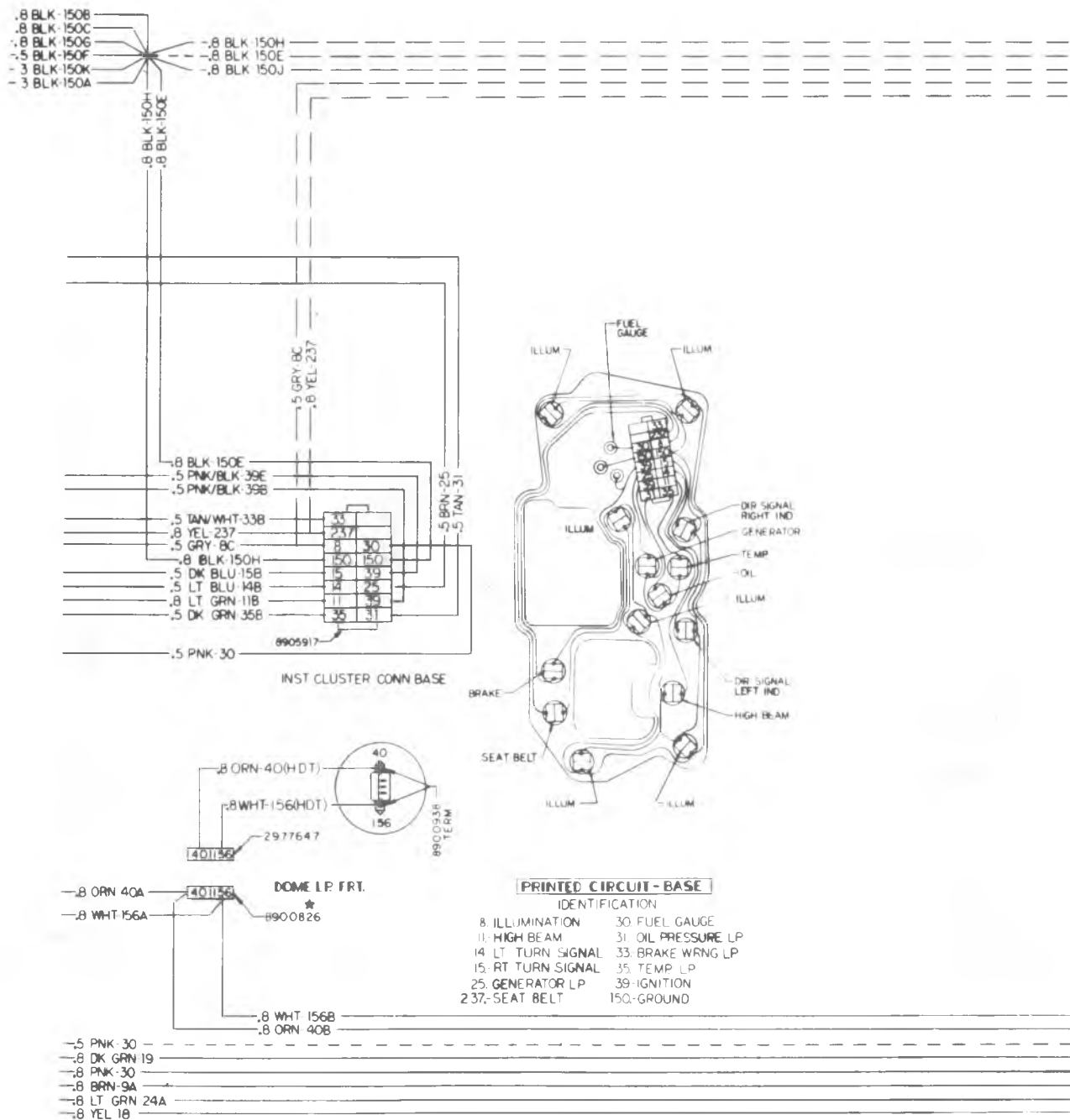


Fig. 8C-76--G Series Wiring 4 of 19



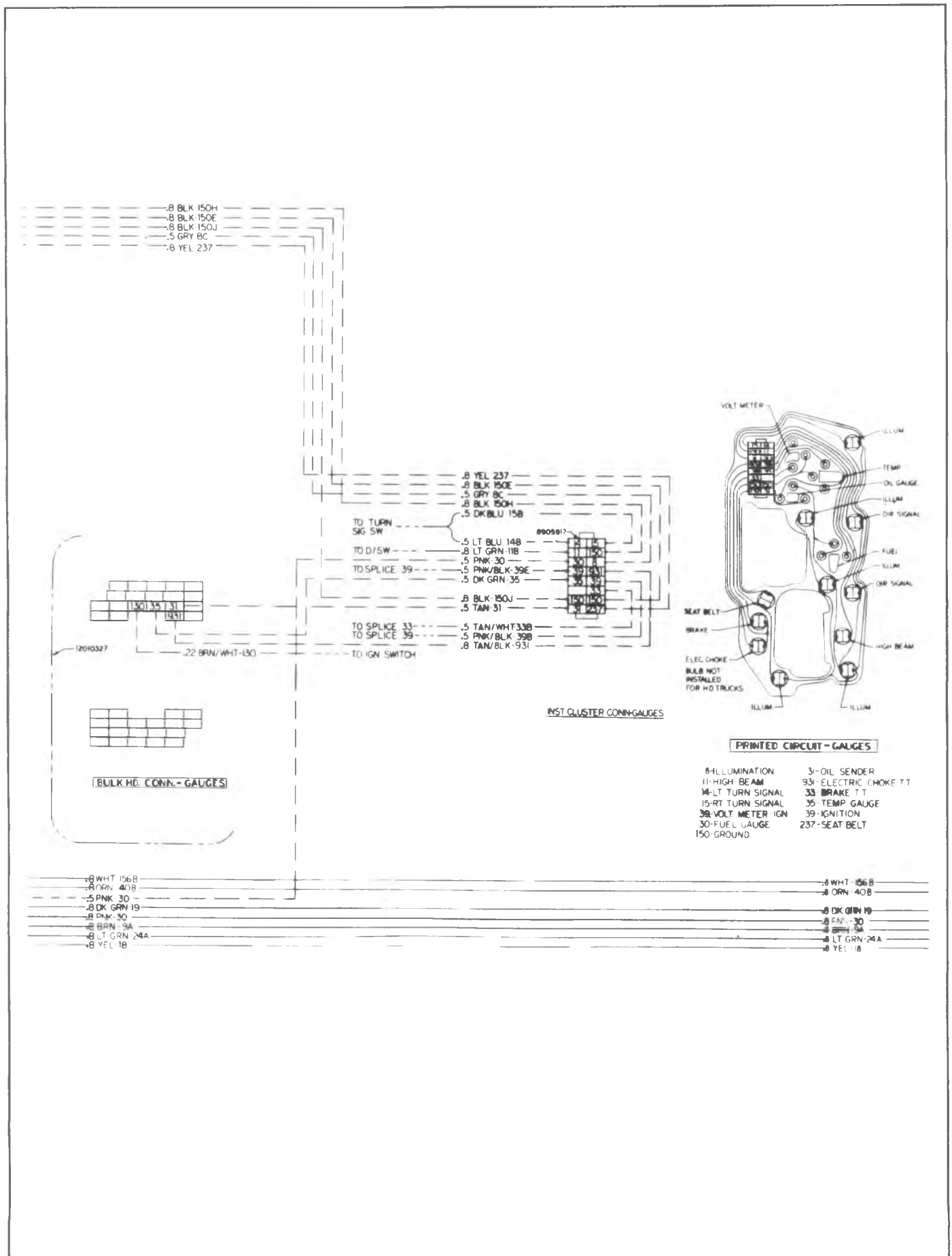
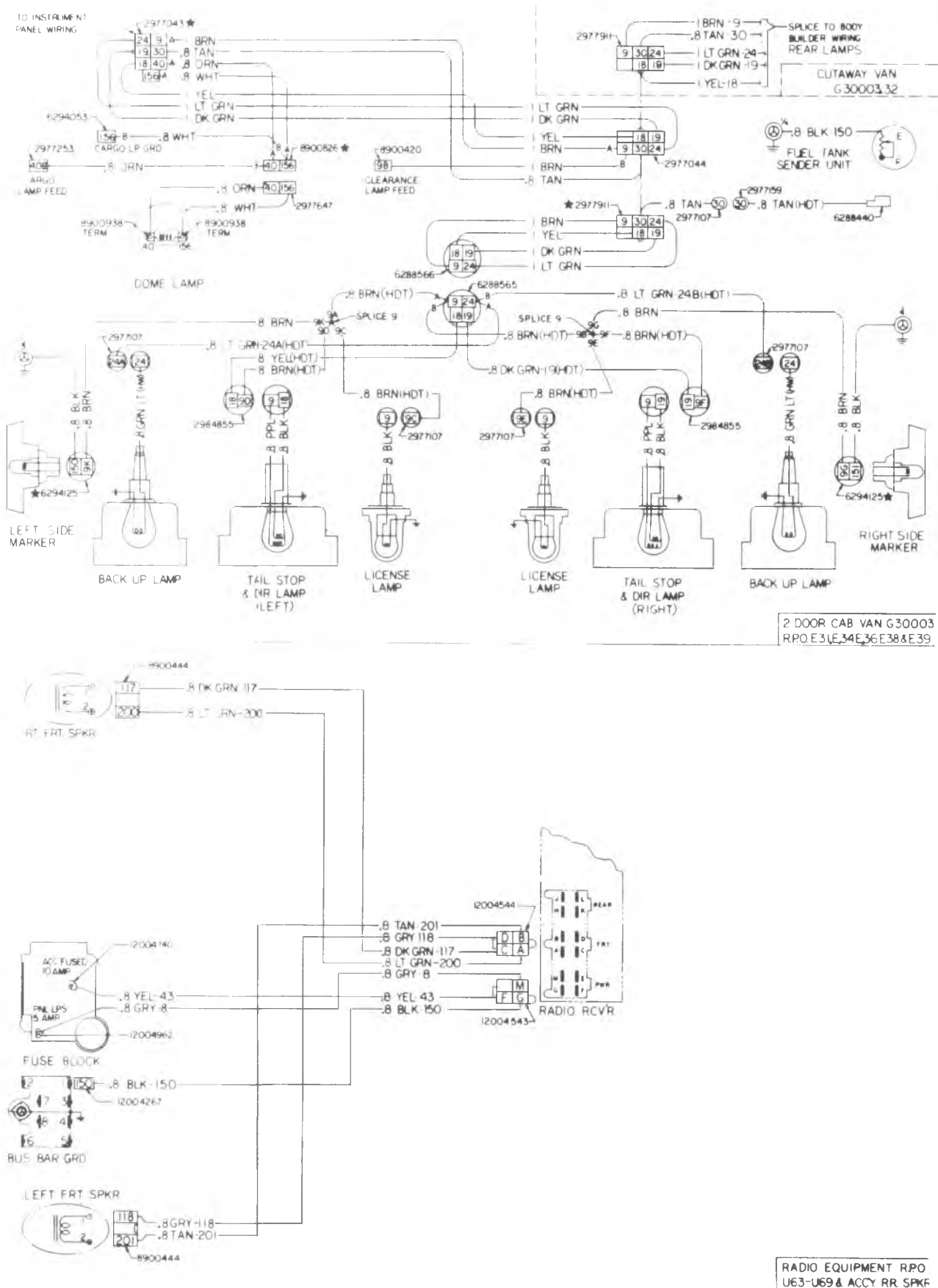


Fig. 8C-78--G Series Wiring 6 of 19

Fig. 8C-80--G Series Wiring 8 of 19



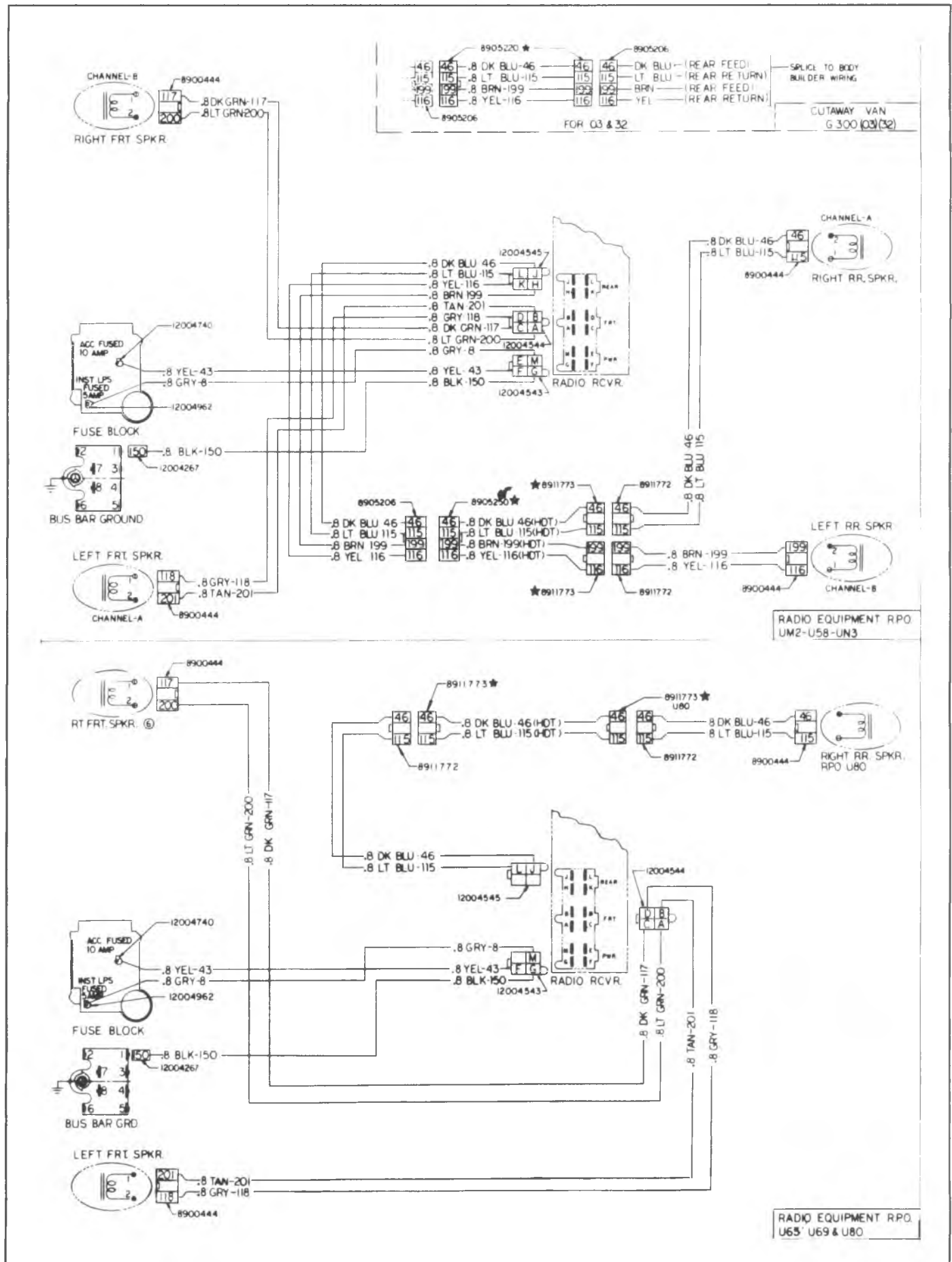


Fig. 8C-83-G Series Wiring 11 of 19

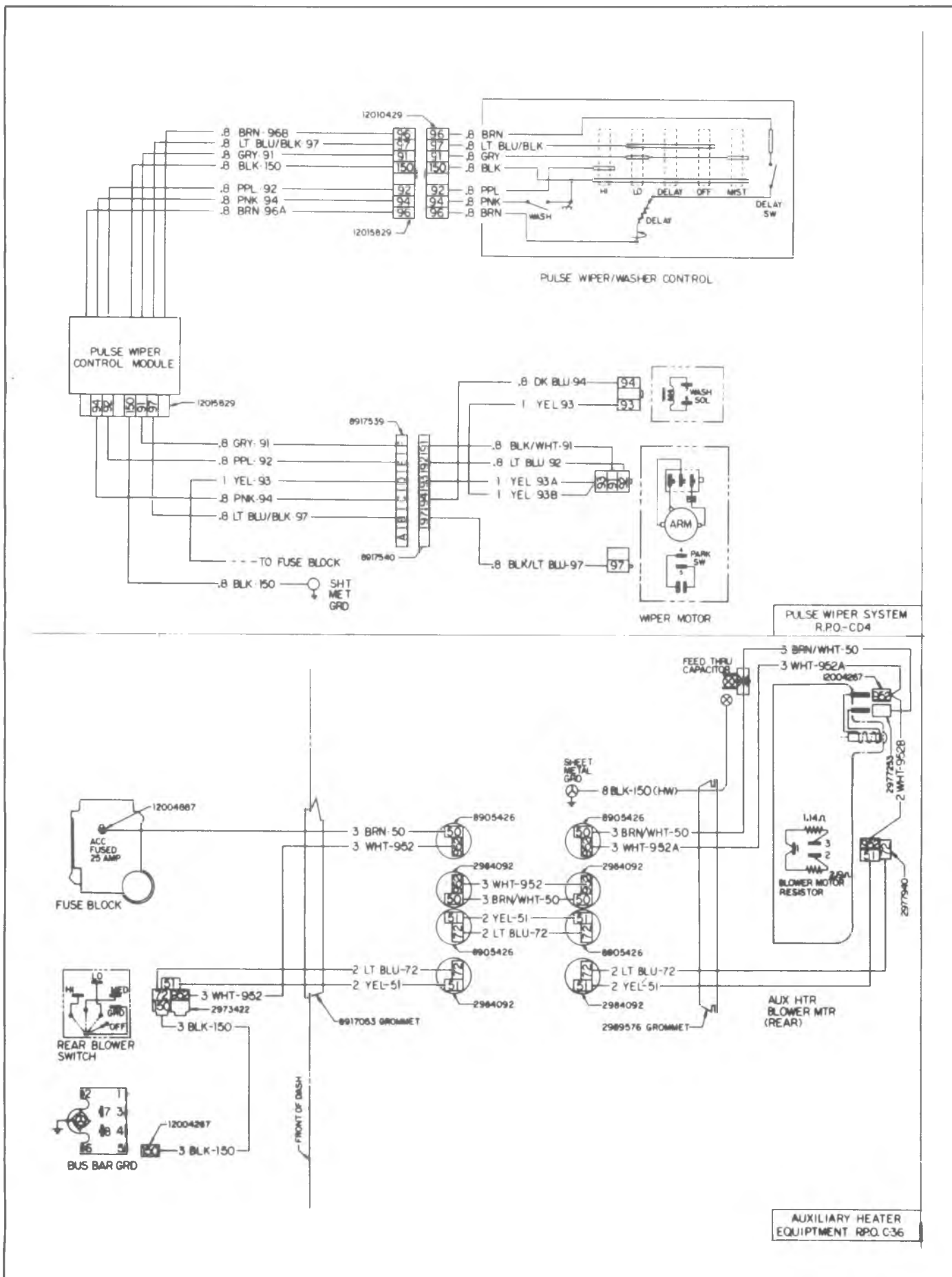


Fig. 8C-84-G Series Wiring 12 of 19

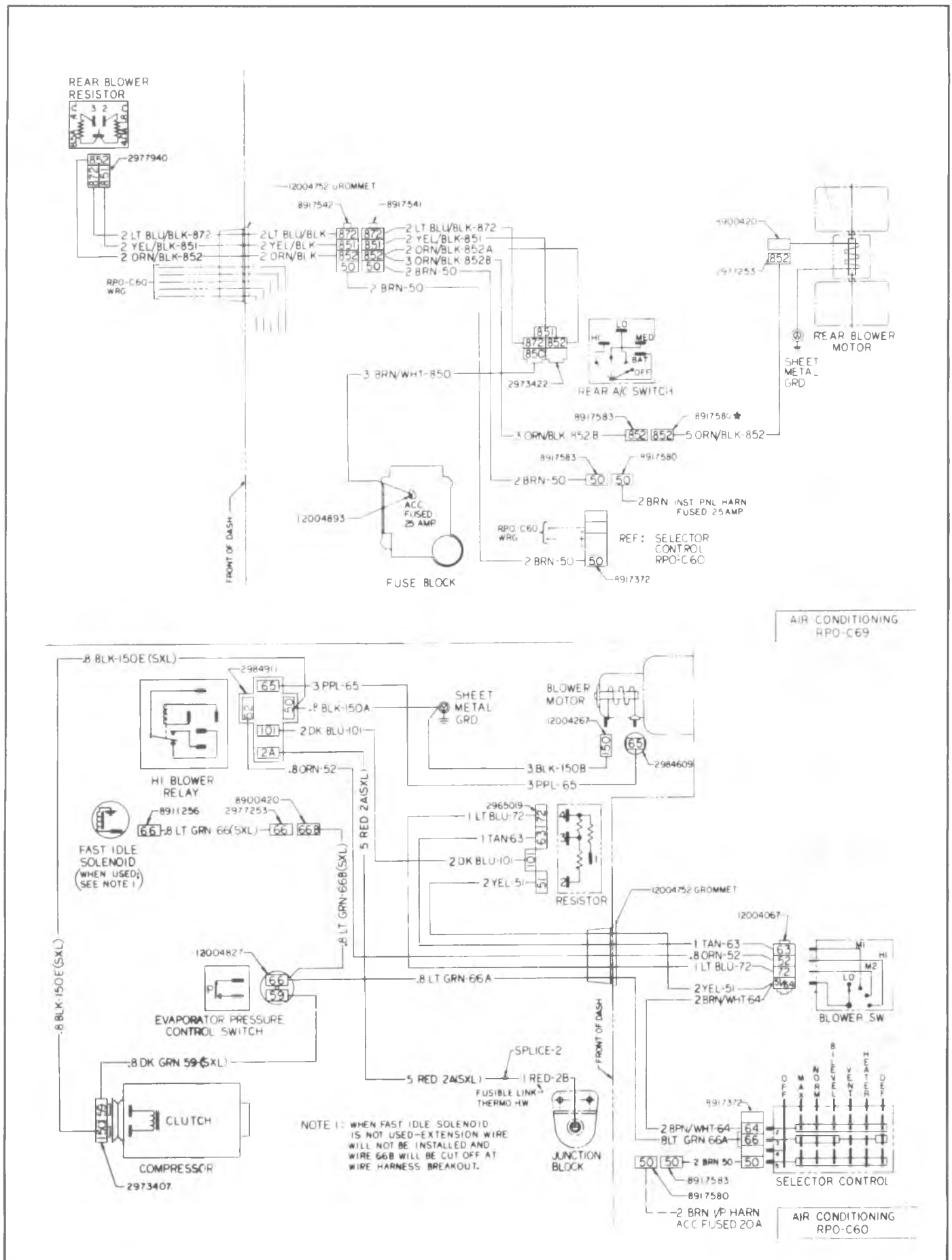


Fig. 8C-85--G Series Wiring 13 of 19

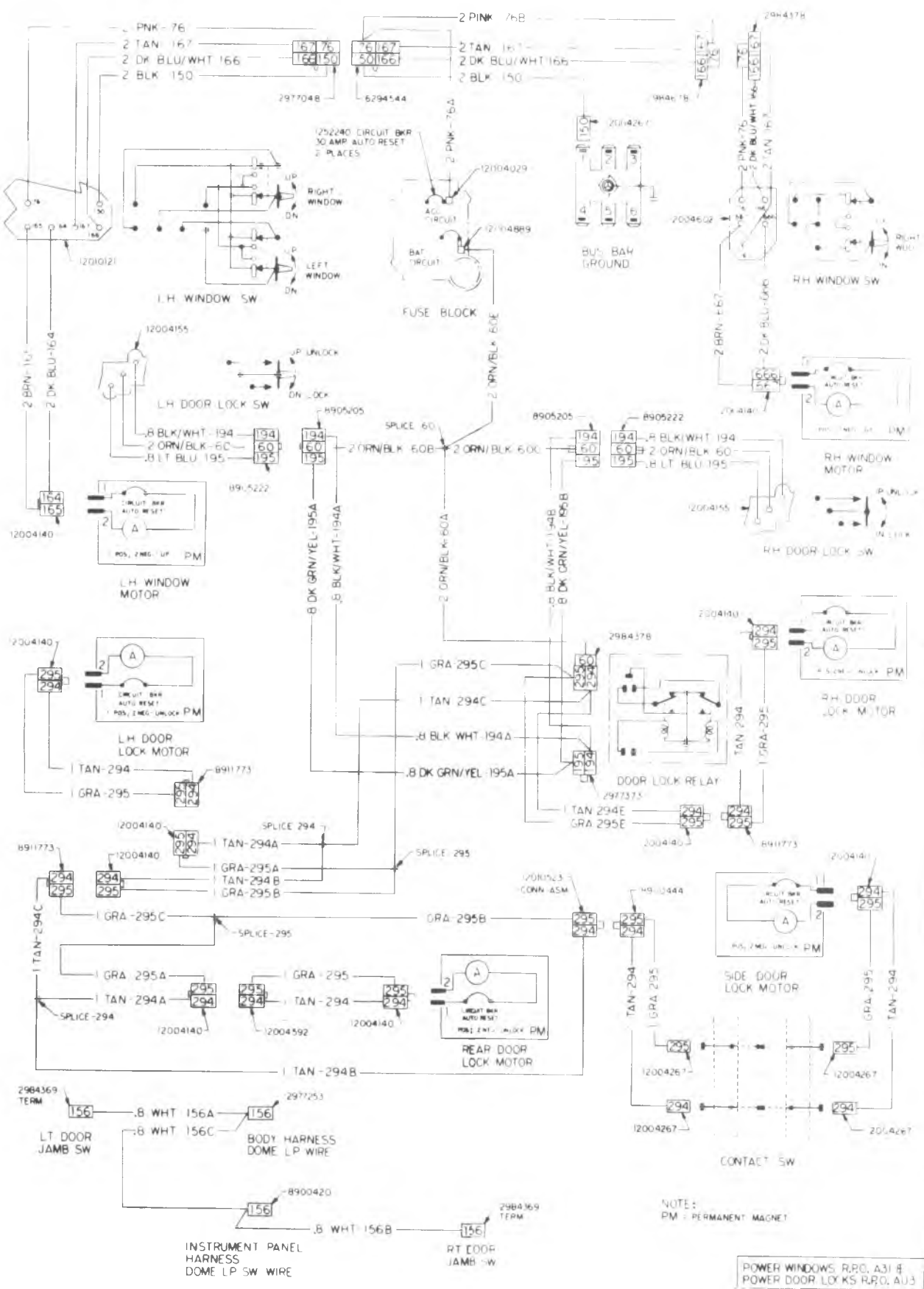


Fig. 8C-86--G Series Wiring 14 of 19

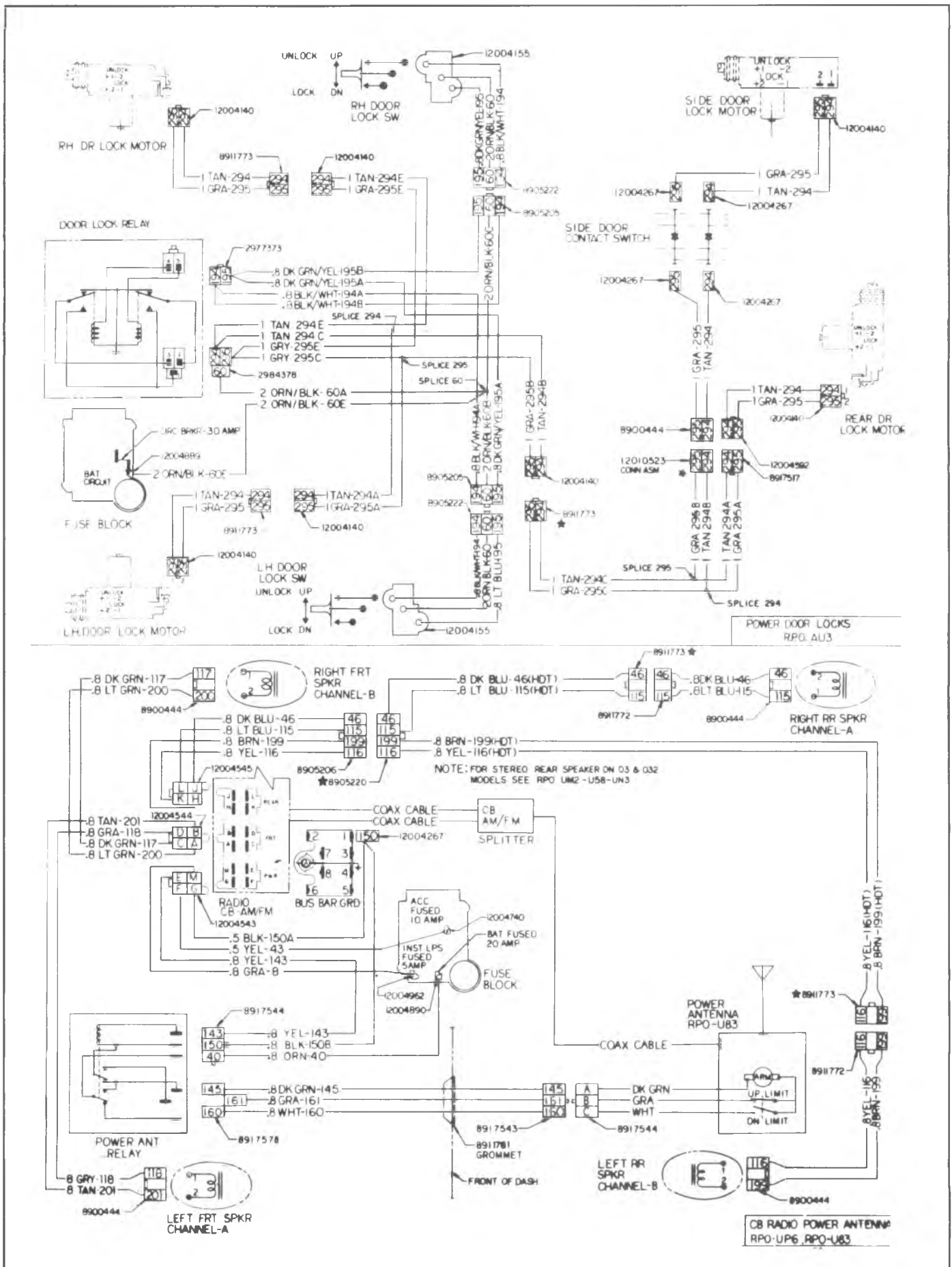
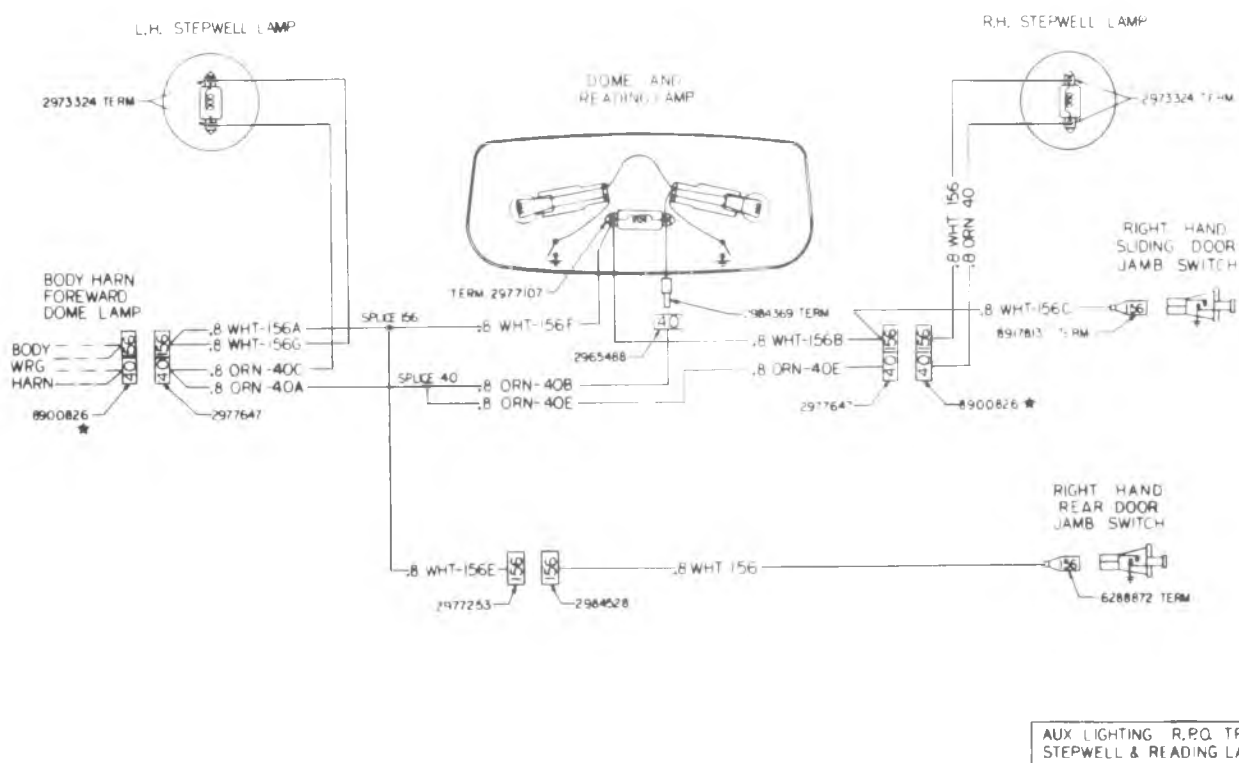


Fig. 8C-87--G Series Wiring 15 of 19

Fig. 8C-88--G Series Wiring 16 of 19



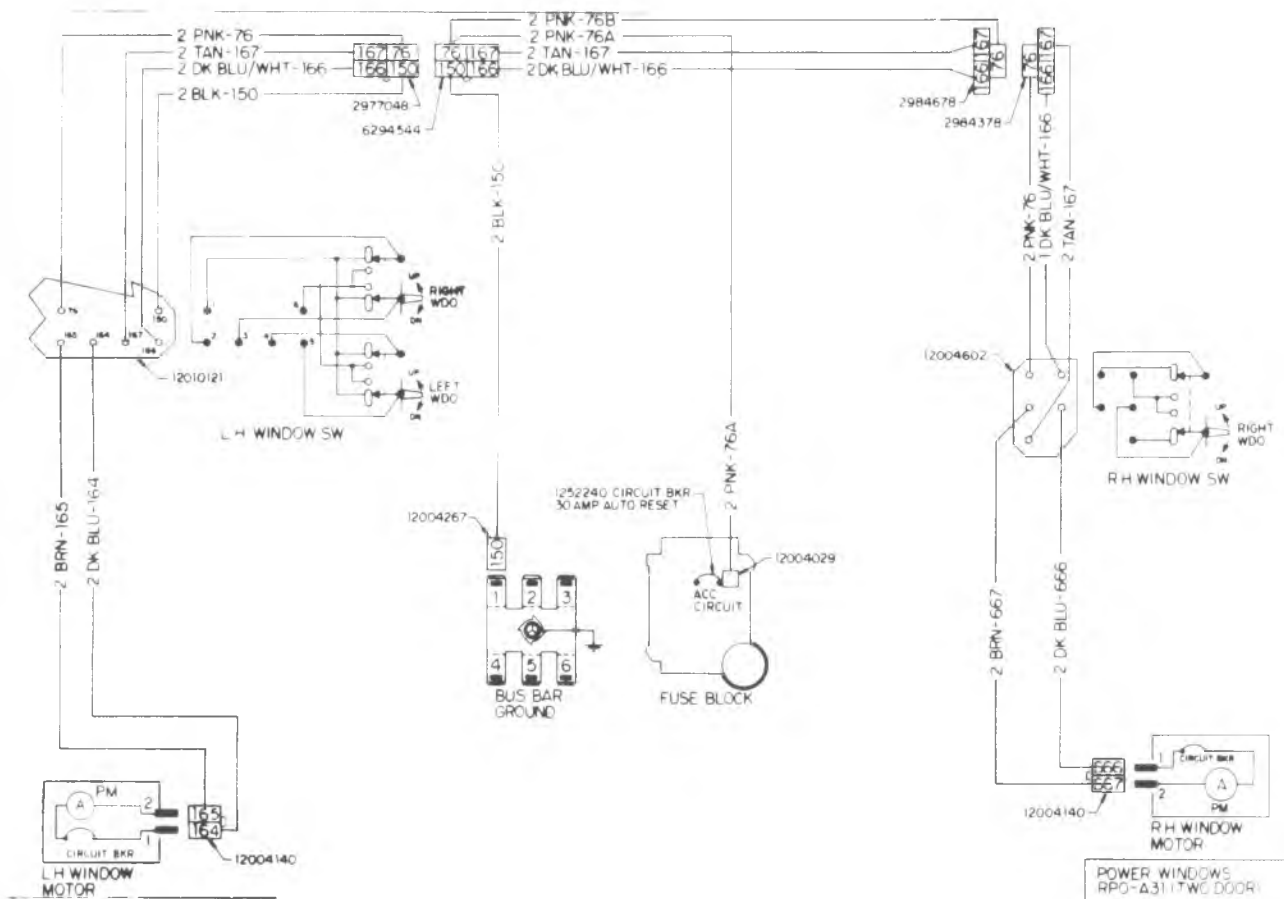


Fig. 8C-90--G Series Wiring 18 of 19

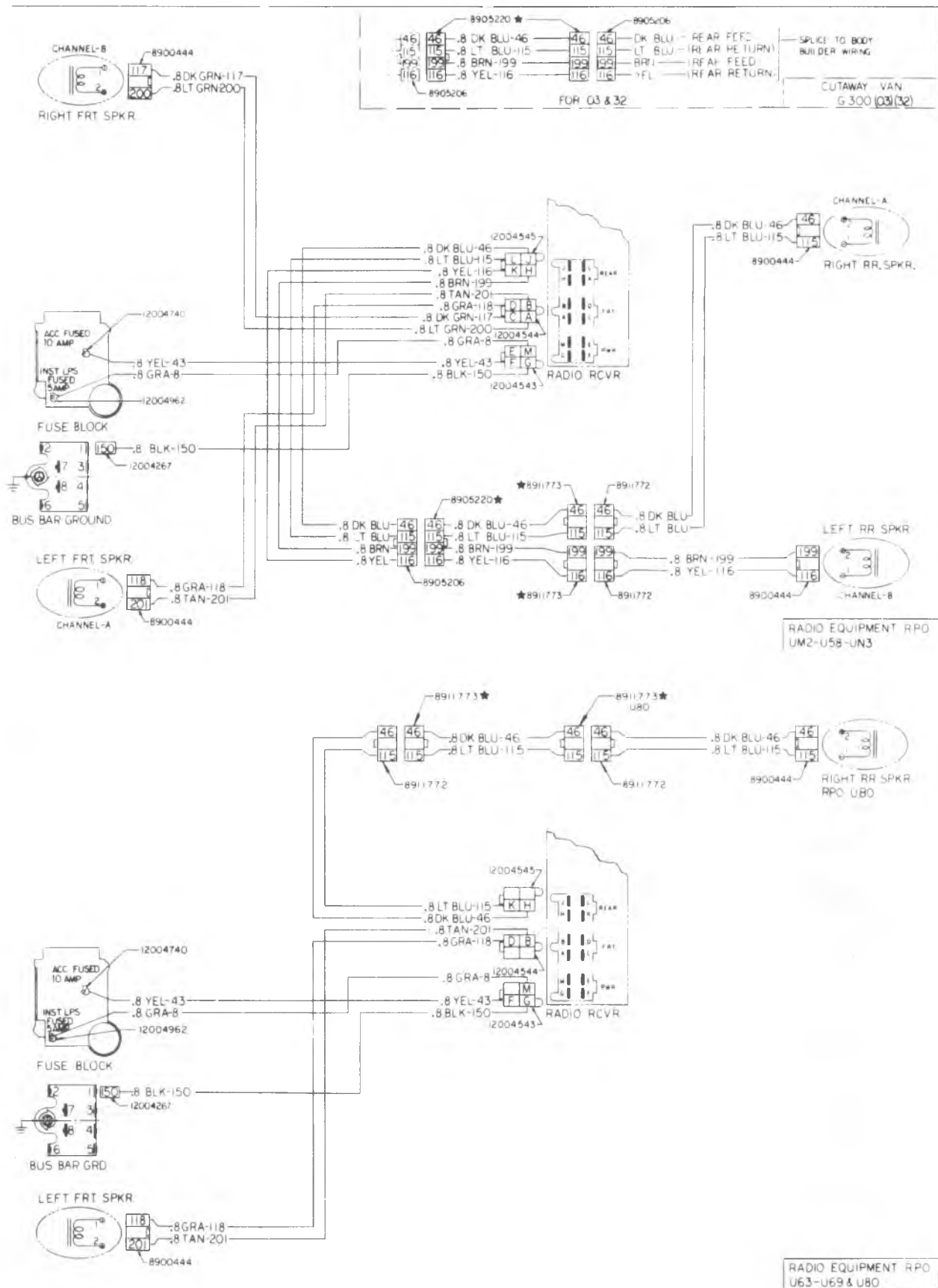


Fig. 8C-91--G Series Wiring 19 of 19

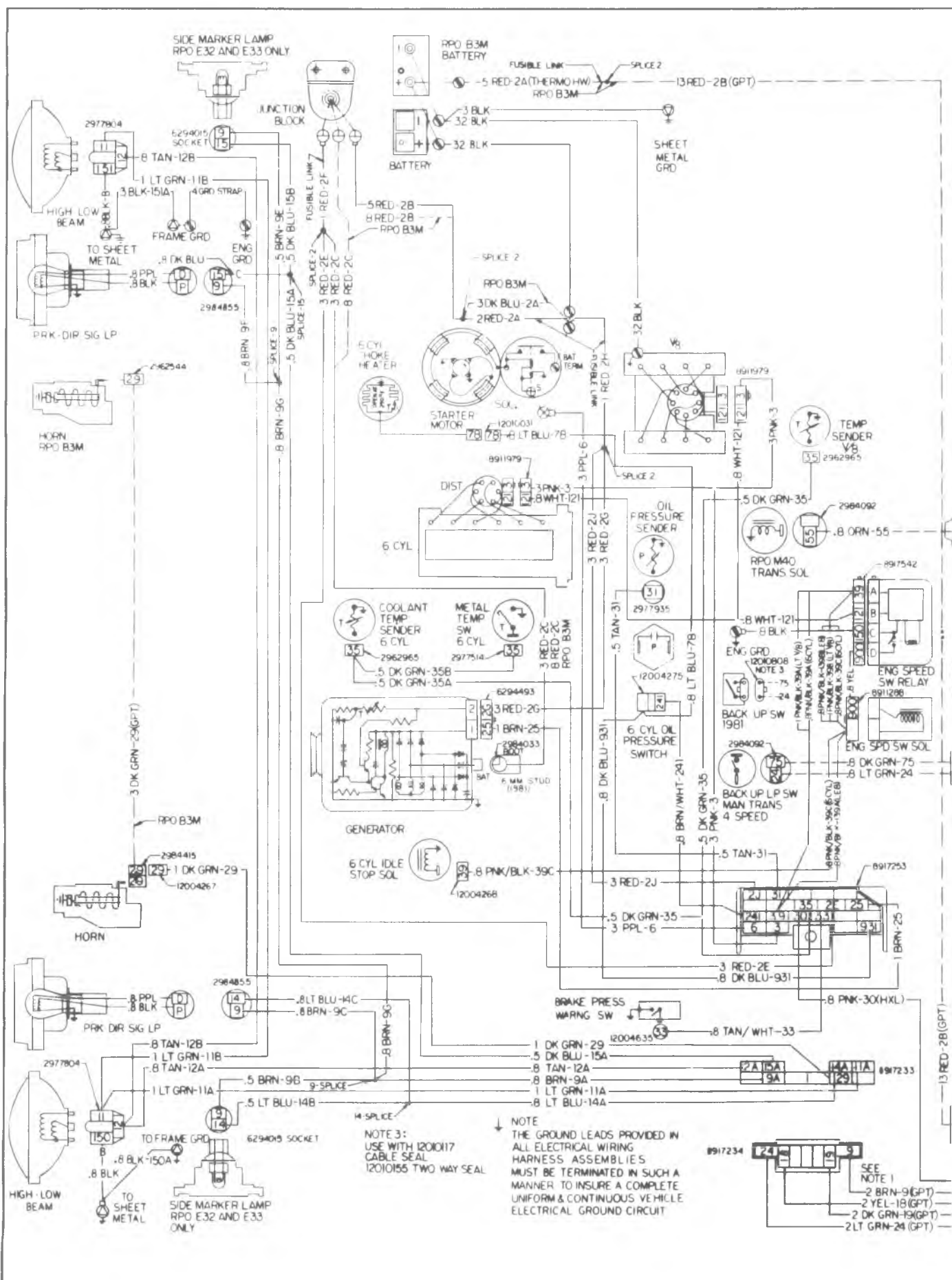


Fig. 8C-92--P Series Wiring 1 of 11

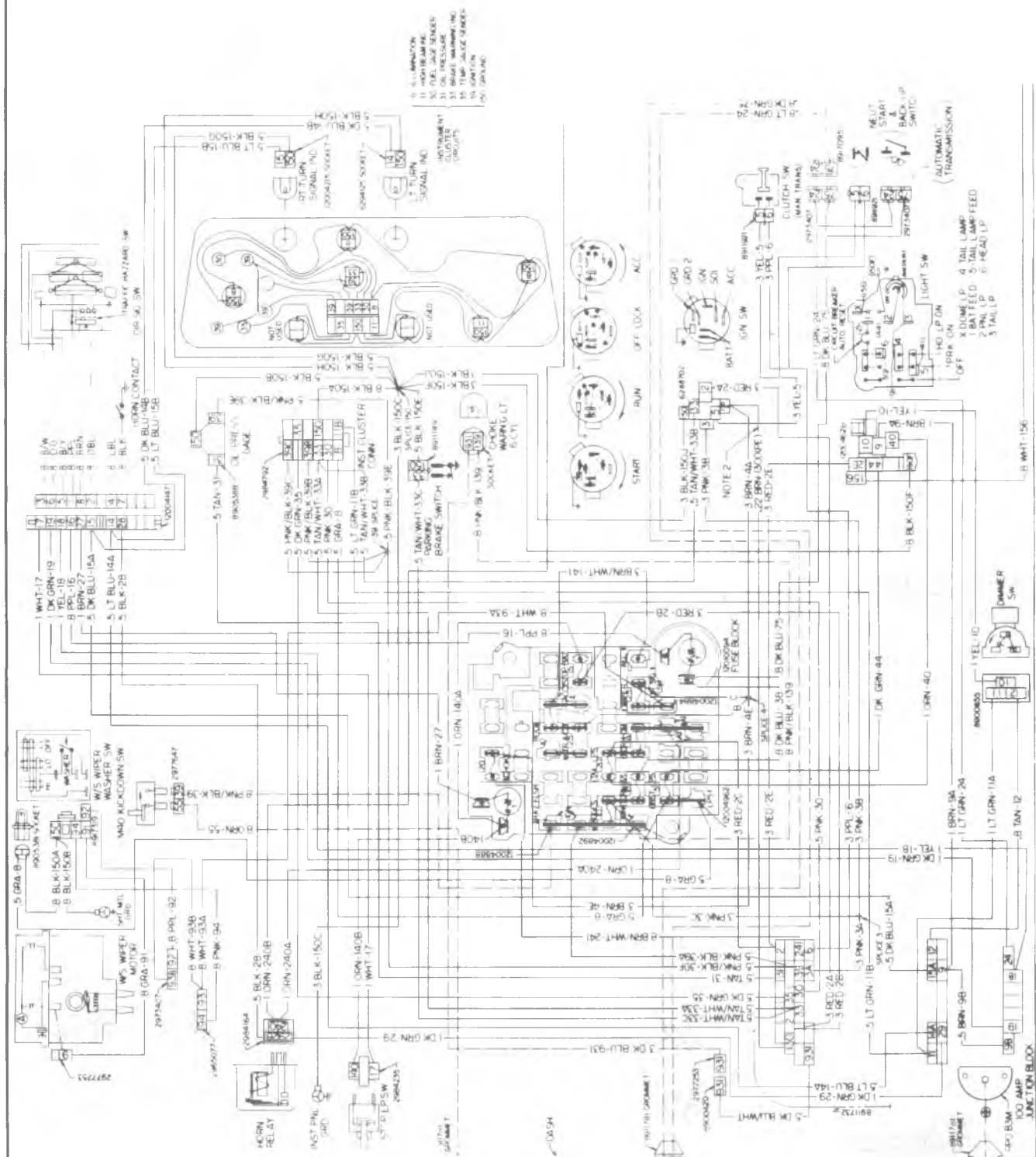


Fig. 8C-93--P Series Wiring 2 of 11

Fig. 8C-94--P Series Wiring 3 of 11

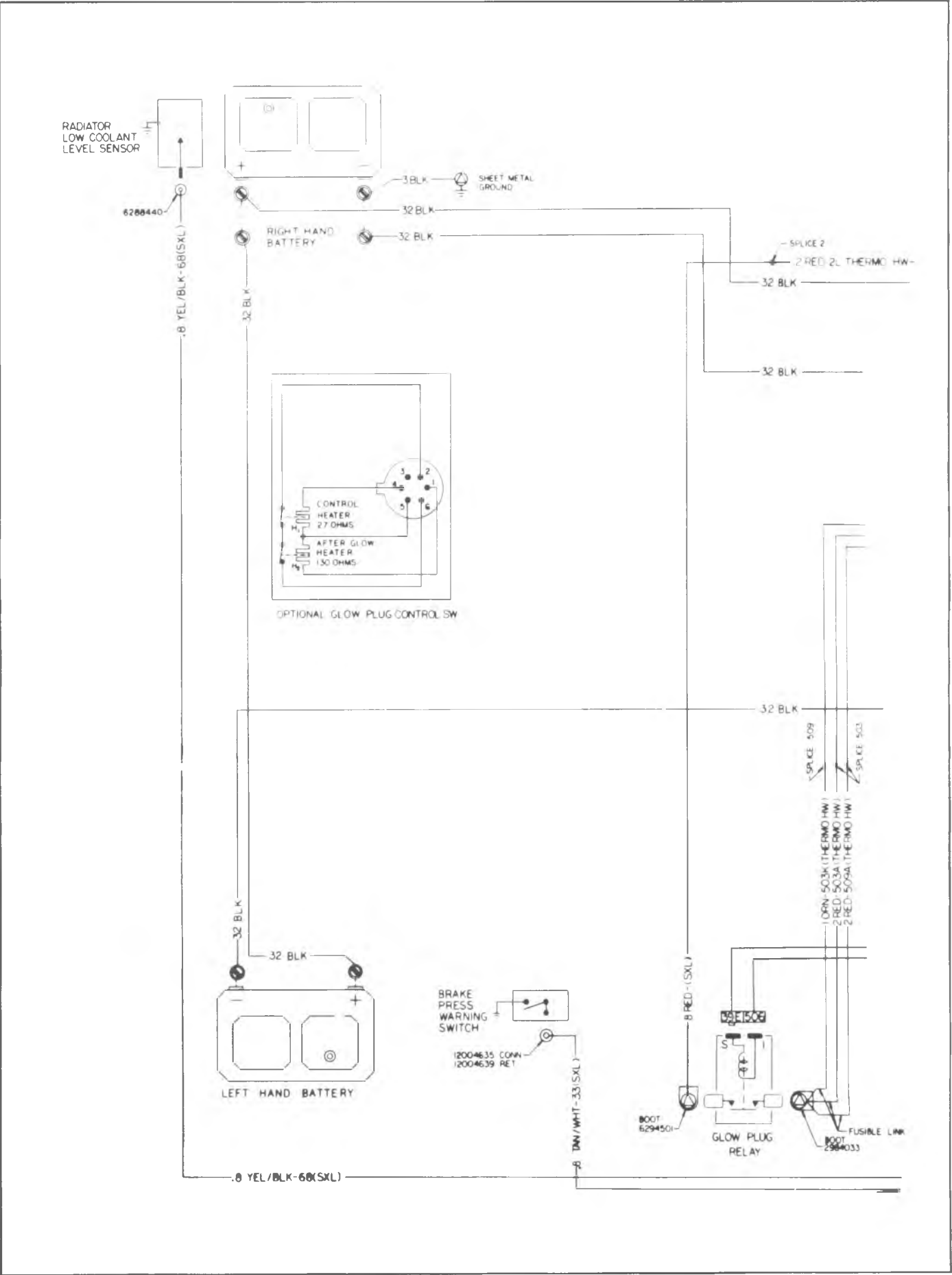
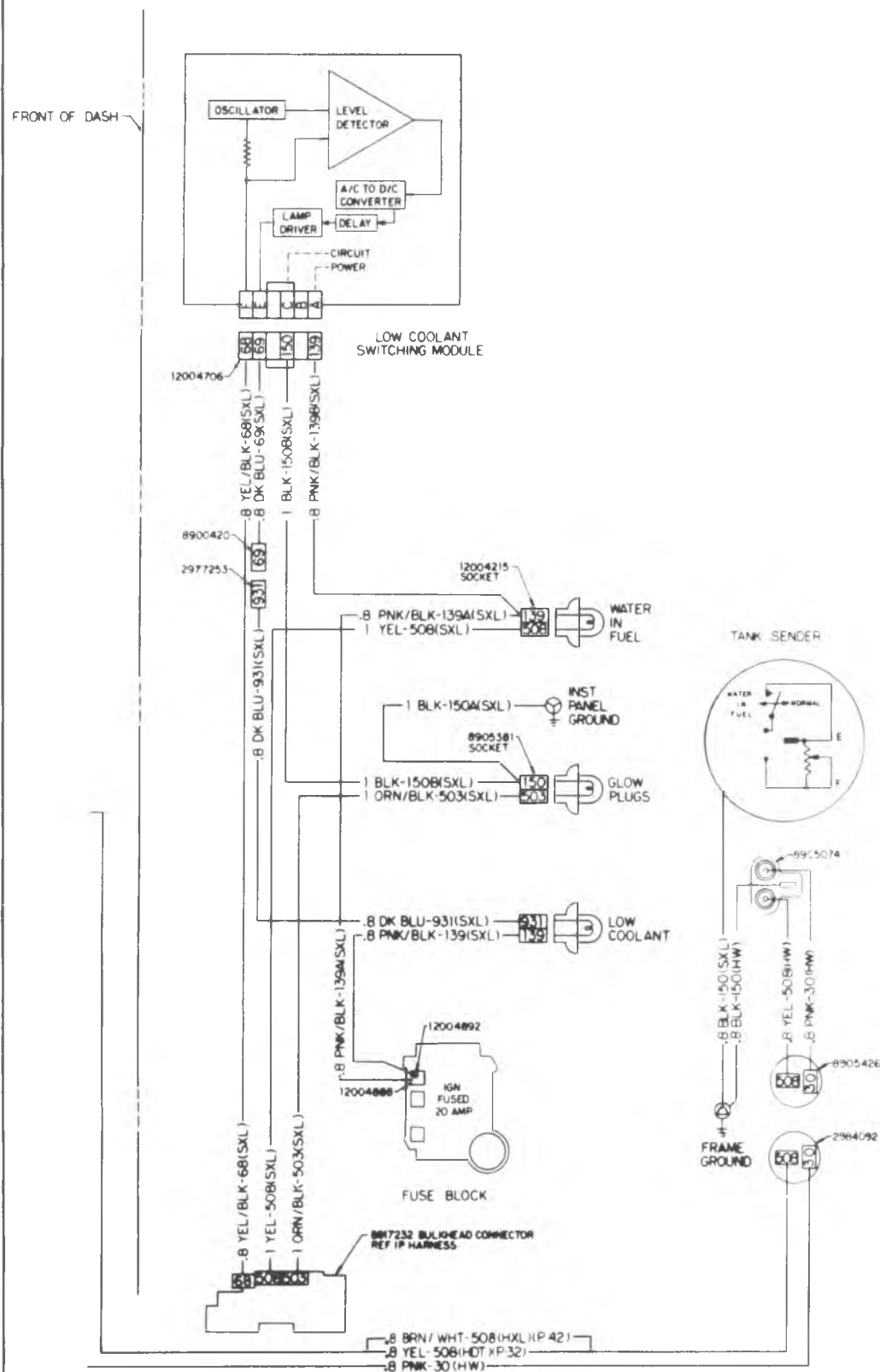


Fig. 8C-95--P Series Wiring 4 of 11

Fig. 8C-96--P Series Wiring 5 of 11



NOTE
THE GROUND LEADS PROVIDED IN ALL
ELECTRICAL WIRING MUST BE
TERMINATED IN A MANNER TO
INSURE A COMPLETE UNIFORM &
CONTINUOUS VEHICLE ELECTRICAL
GROUND CIRCUIT.

DIESEL ENGINE
RPO. HEAVY DUTY TRUCK LL4

Fig. 8C-97--P Series Wiring 6 of 11

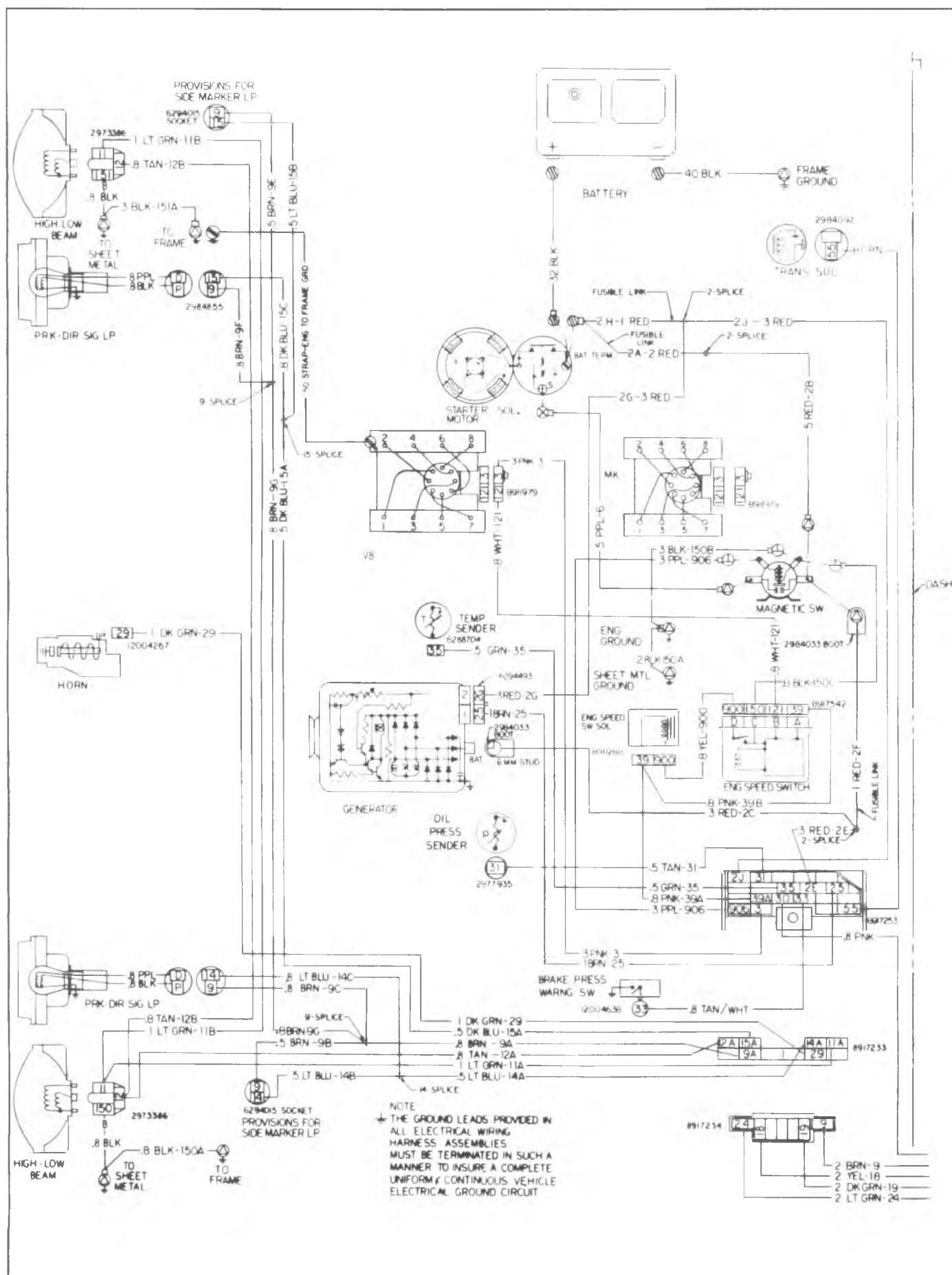


Fig. 8C-98--P Series Wiring 7 of 11

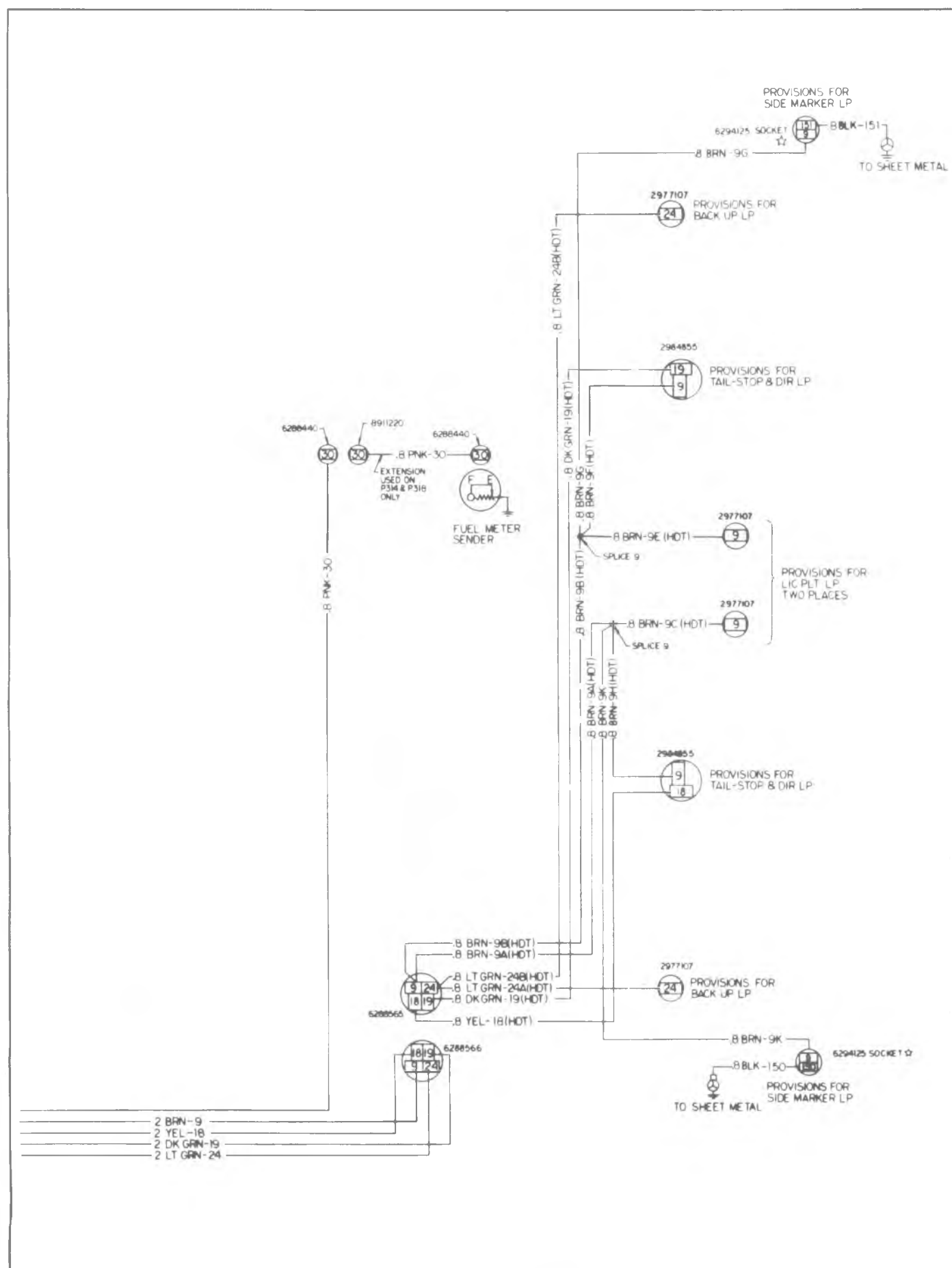
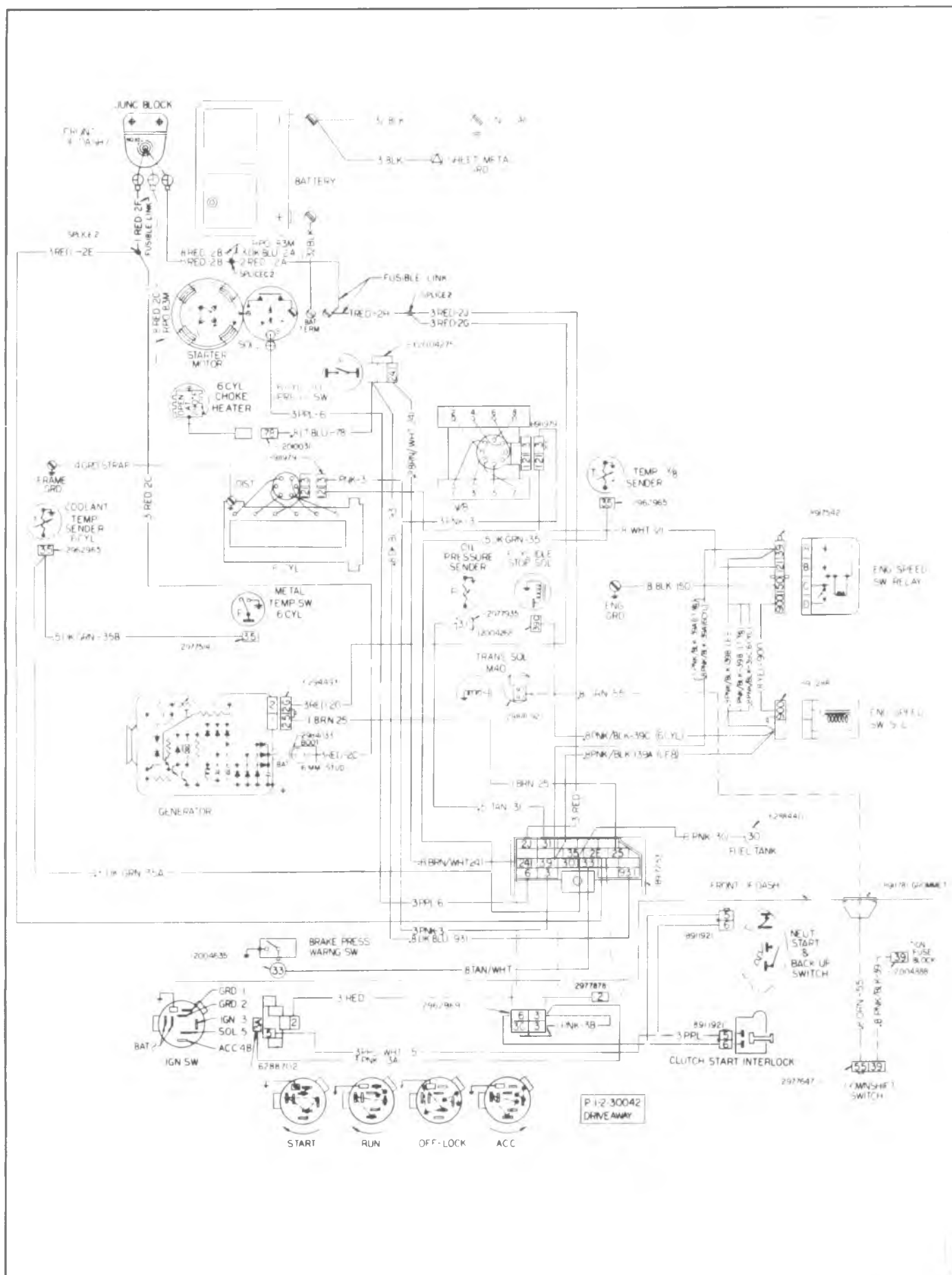


Fig. 8C-100--P Series Wiring 9 of 11



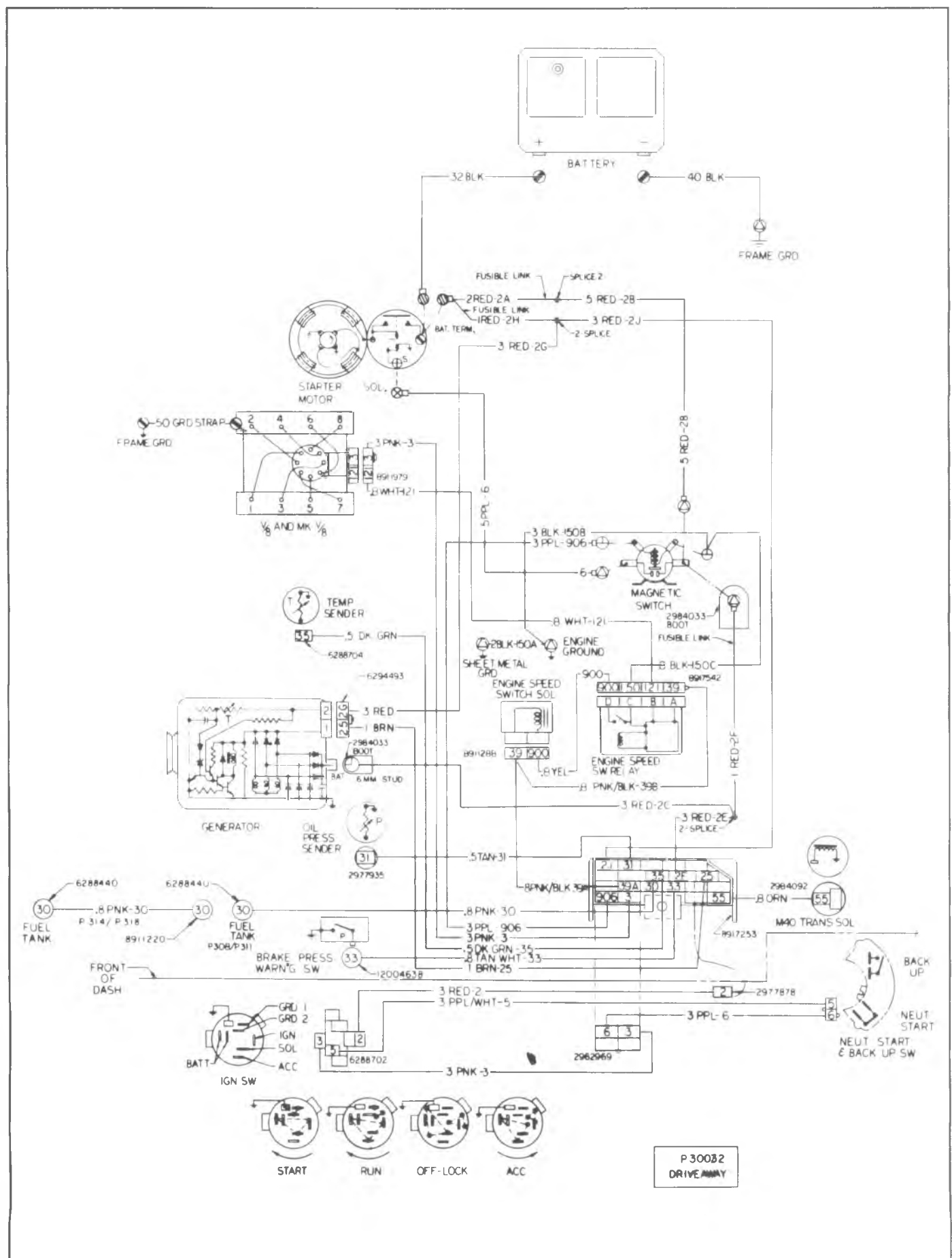


Fig. 8C-102--P Series Wiring 11 of 11

SECTION 9

ACCESSORIES

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CRUISE MASTER

GENERAL DESCRIPTION

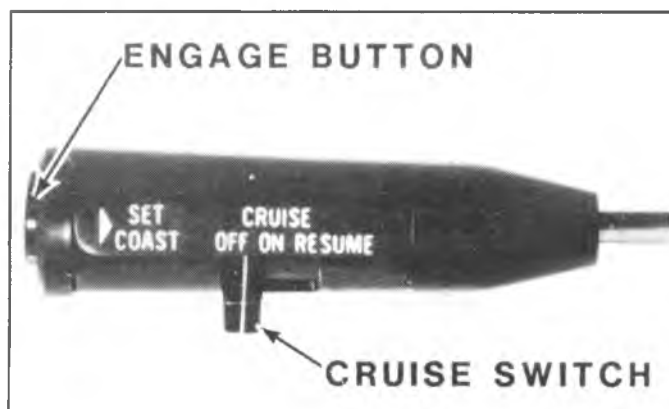


Fig. 9-1C--Resume Cruise Control Lever

The Cruise Master is a speed control system which employs vacuum to control the throttle power unit. The power unit moves the throttle, when speed adjustment is necessary, by receiving a varying amount of controlled vacuum from the transducer. The speedometer cable (from the transmission) drives the transducer, and a cable (from the transducer) drives the instrument panel speedometer. The engagement of the transducer unit is controlled by an engagement switch located at the end of the turn signal or multi-function lever. Two brake release switches are provided: an electric switch disengages the transducer and a vacuum valve decreases the vacuum in the power unit to quickly return the throttle to idle position.

The purpose of the Cruise Master system is to allow the driver to maintain a constant highway speed without the necessity of continually applying foot pressure to the accelerator pedal. Speed changes are easily made and override features allow the vehicle to be stopped, slowed or accelerated as described below.

SWITCH FUNCTIONS

The switch functions of the cruise control lever (Fig. 9-1C) are as follows:

ON - The cruise switch must be in the ON position and the vehicle speed above 30 mph (50 km/h) before the system can be engaged.

SET-COAST - This is a dual function switch that operates in the following manner.

- **SET** - Depress the "SET" button completely when vehicle reaches desired speed, and release the button slowly to engage system. Use of the brakes or clutch will disengage the system but pre-set speed will be retained in memory.
- **COAST** - Cruise speed may be reduced by depressing "COAST" button until desired speed is reached, then releasing slowly to re-engage. Higher speeds are set by accelerating vehicle to desired speed and depressing "SET-COAST" button.

RESUME - Slide cruise switch to "RESUME" and release, vehicle will accelerate to previously set cruise speed. It is advisable not to use "RESUME" in city traffic or in situations where the previously set speed is faster than the immediate traffic flow. Do not use "RESUME" or cruise control features on slippery conditions.

DISENGAGEMENT - The system is disengaged by applying the brakes or clutch. Under normal operation, it is not necessary to use the "OFF" position. Sliding the cruise switch to "OFF" or turning off the ignition will erase the memory and disengage the system. System can be momentarily disengaged by holding in the "SET-COAST" button.

DRIVER OPERATION

Engaging the Cruise System

The driver accelerates to the desired cruise speed above 30 mph (50 km/h) and moves the "on/off" resume slider to the "on" position located on directional signal handle. The operator then fully depresses and slowly releases the cruise "set coast" button. A speed switch built into the transducer assembly prevents engaging the system below approximately 30 mph (50 km/h). The cruise system takes over speed control, and within engine limitation, maintains this speed regardless of changes in terrain.

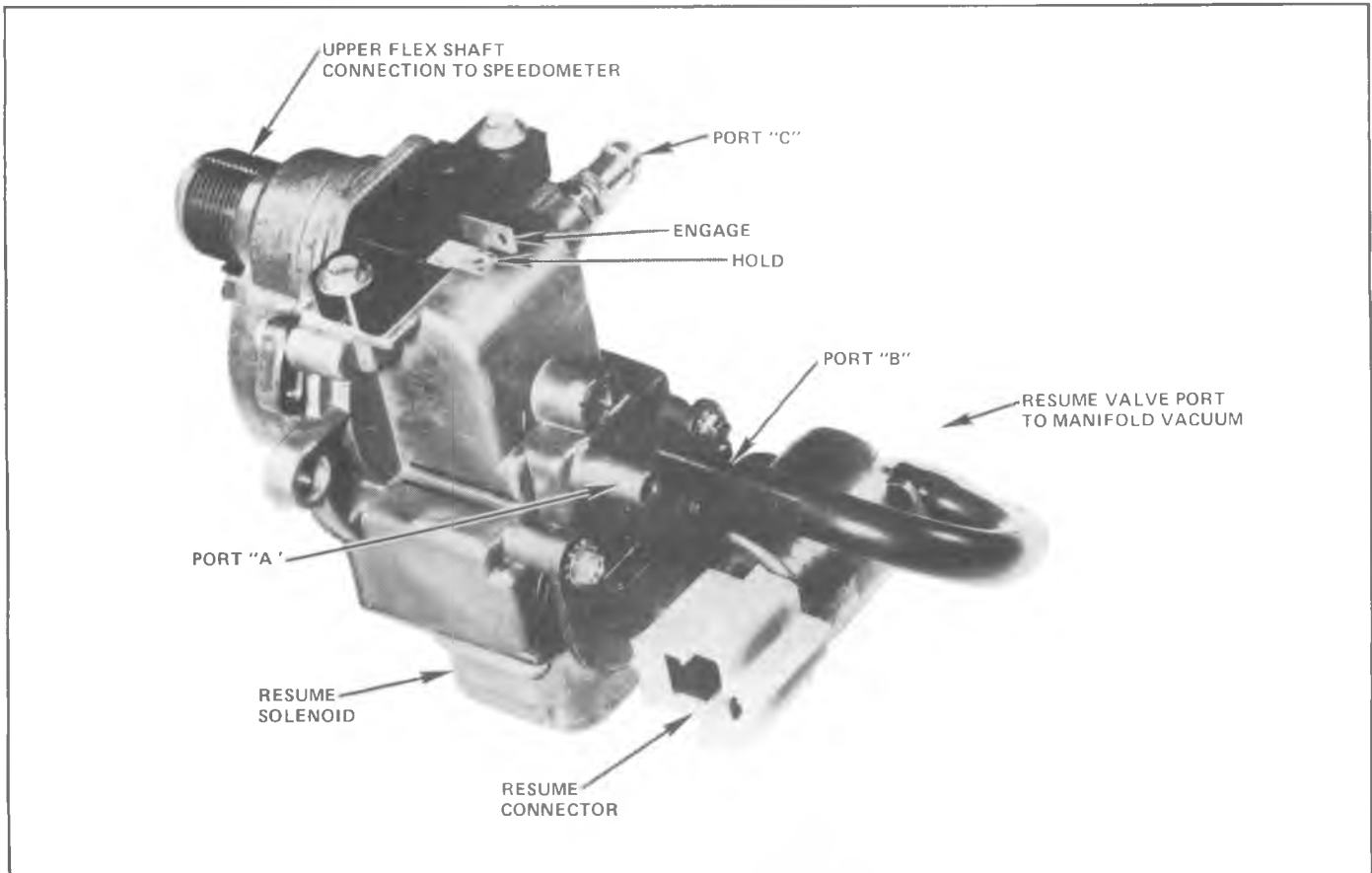


Fig. 9-2C--Resume Cruise Control Transducer

Disengaging the Cruise System

Disengagement occurs when the brake or clutch pedal is depressed. This maintains previous set speed in the systems memory. Disengagement can also be accomplished by moving the "off"- "on"- "resume" slider to the "off" position. This slider should be left in the "off" position when system usage is not intended. This removes any previous set speed from the memory.

Resume Re-engagement of the Cruise System

To re-engage the system after disengagement with the brake or clutch pedal, move the "off"- "on"- "resume" slider to the Resume position. The vehicle will return to that cruise speed existing at the time the brake pedal was depressed.

Re-engagement at New Set Speed

The system may also be reset to any speed desired above 30 mph (50 km/h) by depressing the Set-Coast button all the way down and then releasing it slowly.

To Cruise at a Higher Speed

Depress the accelerator pedal to reach the new desired speed. Then depress and release the cruise control Set-Coast button. The system re-engages at the higher speed when the button is released.

To Cruise at a Lower Speed

Disengage the system by depressing the Set-Coast button fully and holding it there until the vehicle has

decelerated to the new desired speed; then release the button slowly. The system re-engages at the lower speed when the button is slowly released.

Lower speed can also be obtained by depressing the brake pedal which disengages the system. When the vehicle has slowed down to the desired lower speed, it may be re-engaged by depressing the Set-Coast button and releasing it slowly.

Cruise Master Components

The cruise control switch is used to control the cruise system in the set, coast, or resume and off modes of operation.

The Transducer (Fig.. 9-2C and 9-3C) is mounted in the speedometer cable line. It is a combination speed sensing device and control unit. When engaged, it senses vehicle speed and positions the servo unit to maintain the selected speed. It also incorporates internal design features which perform the "resume" function in conjunction with the external resume vacuum control valve.

- **THE SERVO Unit** is bracket mounted to the engine. It opens or closes the throttle as dictated by the Transducer.
- **The Cruise Brake Release Switch**, which is mounted on the brake pedal bracket, disengages the system electrically when the brake pedal is depressed. On manual transmission models, a Cruise Clutch Release Switch is mounted on the clutch pedal bracket and disengages the system electrically when the clutch pedal is depressed.
- **The Cruise Brake Release Valve**, which is mounted

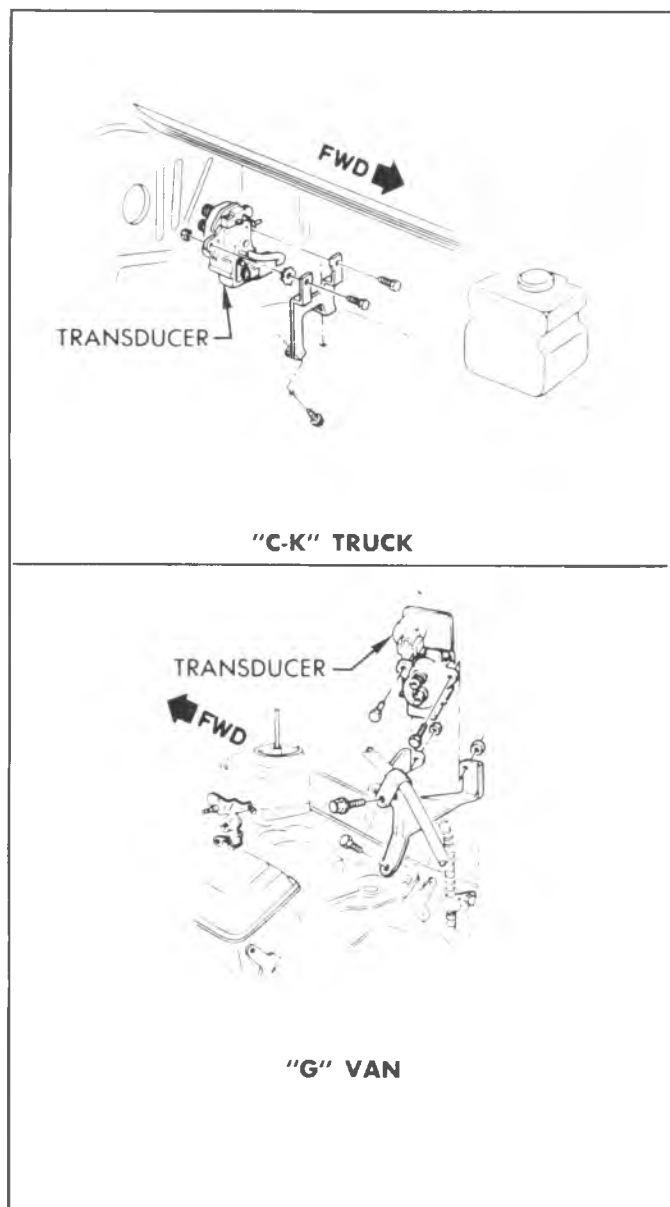


Fig. 9-3C--Resume Cruise Control Transducer Mounting

on the brake pedal bracket, disengages the system pneumatically when the brake pedal is depressed. On manual transmission models, the Cruise Clutch Release Valve is mounted on the clutch pedal bracket and disengages the system pneumatically when the clutch pedal is depressed.

- The Cable and Casing Assemblies drive the transducer and speedometer.

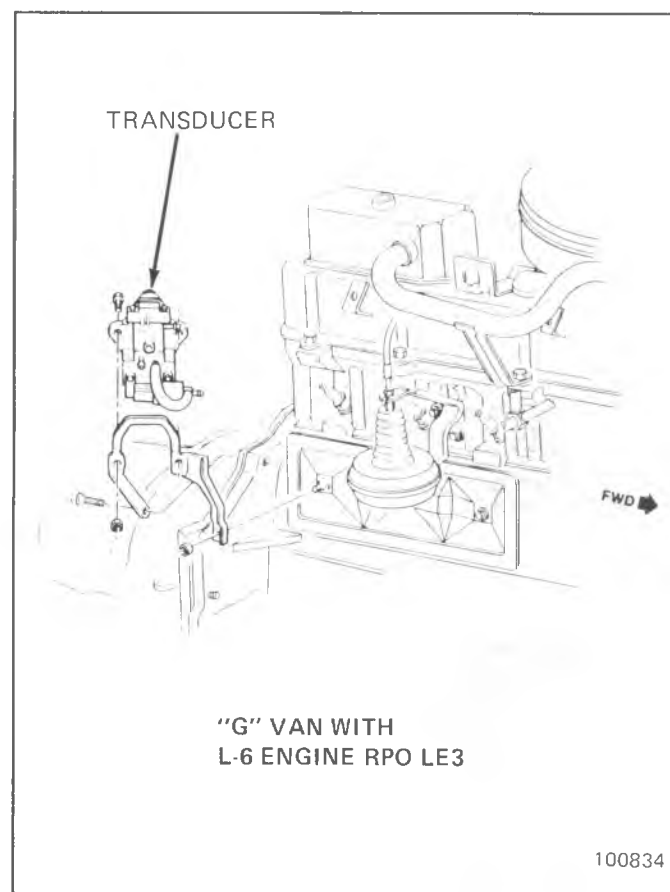


Fig. 9-4C--Resume Cruise Control Transducer Mounting-G Van L-6 Engine

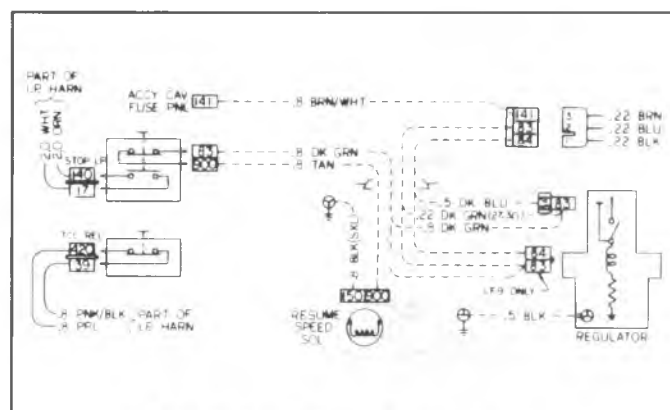


Fig. 9-5C--Cruise Control Wiring Diagram

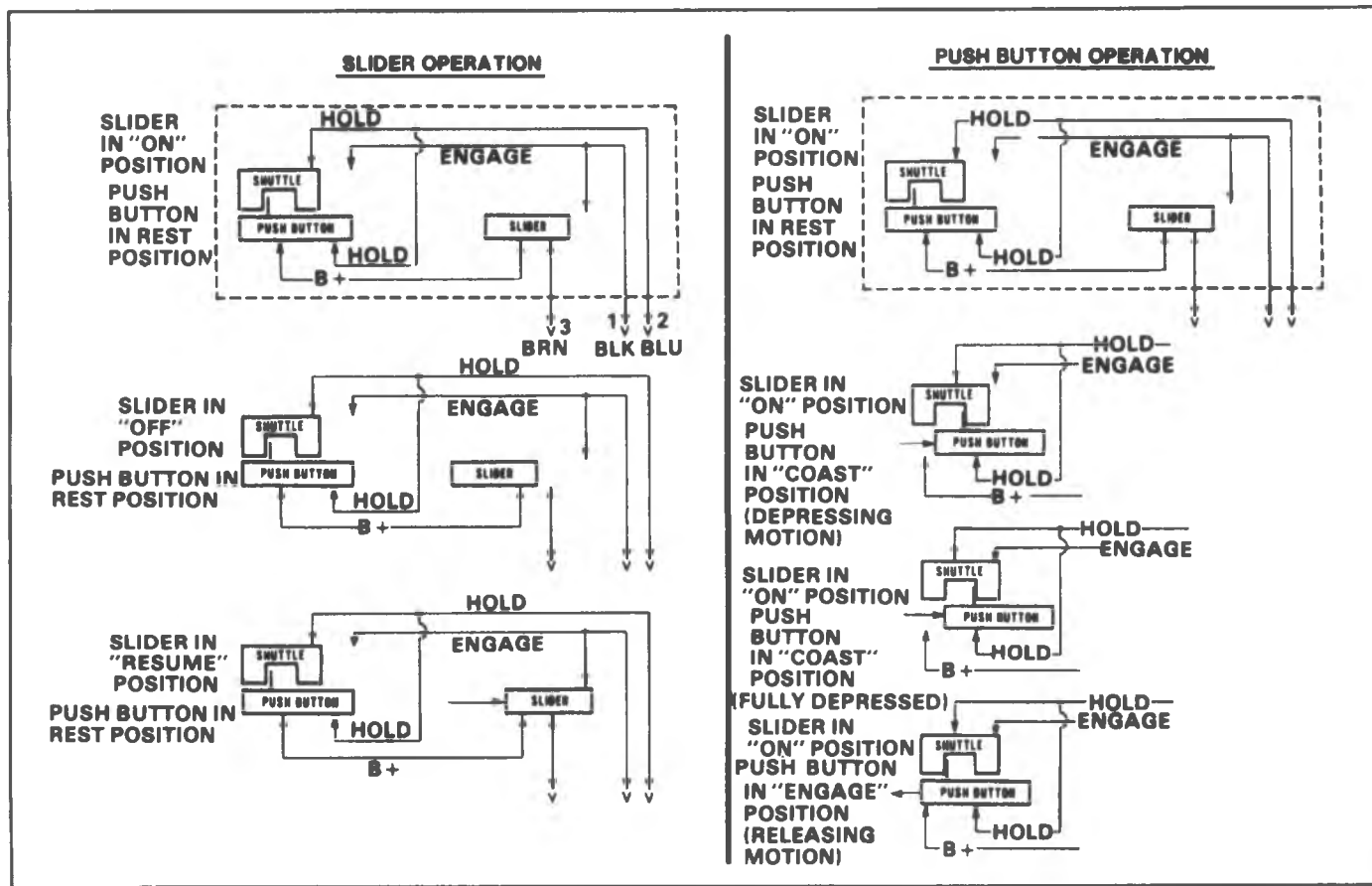


Fig. 9-6C--Cruise Control Switch Operation

SWITCH FUNCTION TABLE						
Test Order	Function	Switch Condition		Terminal Connections		
		End Button	xx Slider	3 to 2	1 to 3	2 to 1
1	Off	Released	Off	O	O	O
	Resume	Released	Resume	C	C	C
	Cruise	Released	On	C	O	O
	Coast	Half Depressed	On	O	O	O
2	Coast	Fully Depressed	On	O	O	C
3	Set	Releasing	On	C	C	C

O = Open C = Continuity

x These test are continuity tests between the terminals shown in figures of resume cruise control lever and lever electrical operation.

xx The slider must have a detent in the "on" and "off" positions and must return to the "on" detent when released from the resume position.

Fig. 9-7C--Cruise Control Switch Function Table

RESUME CRUISE CONTROL QUICK CHECKS

VEHICLE SURGES

- PERFORM GENERAL PRELIMINARY DIAGNOSTIC SYSTEM CHECK
- CHECK FOR BENT SPEEDO CABLE TIP
- CHECK FOR TOO LONG SPEEDO CABLE ASSEMBLY
- CHECK FOR BENT, KINKED, OR MISROUTED CABLE & CASING ASSEMBLY
- CHECK FOR BINDING THROTTLE LINKAGE OR CRUISE CONTROL BEAD CHAIN OR BOWDEN CABLE
- CHECK VEHICLE FOR CORRECT TRANSDUCER P/N

OK

NOT OK

REPLACE
TRANSDUCERREPLACE WITH PROPER
P/N TRANSDUCER

ROAD TEST

VEHICLE CRUISES OVER SET SPEED

- PERFORM GENERAL PRELIMINARY DIAGNOSTIC SYSTEM CHECK
- IF OK, ADJUST ORIFICE TUBE INWARD 1/4 OF A TURN AT A TIME.
- RECHECK AT 55 MPH.

NOTE: 1/4 OF A TURN EQUALS APPROXIMATELY 1 MPH.

EXCESSIVE SPEED DOWNHILL

- PERFORM GENERAL PRELIMINARY DIAGNOSTIC SYSTEM CHECK
- CHECK FOR PLUGGED TRANSDUCER FILTER
- CHECK FOR WEAK THROTTLE RETURN SPRING
- CHECK FOR BINDING THROTTLE LINKAGE OR CRUISE CONTROL BEAD CHAIN ON BOWDEN CABLE
- REPAIR AS REQUIRED AND ROAD TEST

VEHICLE CRUISES UNDER SET SPEED

- PERFORM GENERAL PRELIMINARY DIAGNOSTIC SYSTEM CHECK
- CHECK FOR VACUUM LEAKS AT ALL HOSES, POWER UNIT, BRAKE RELEASE VALVE
- CHECK FOR TOO MUCH PLAY IN THROTTLE LINKAGE OR CRUISE CONTROL BEAD CHAIN OR BOWDEN CABLE
- IF OK ADJUST ORIFICE TUBE OUTWARD 1/4 OF A TURN AT A TIME
- RECHECK AT 55 MPH

NOTE: 1/4 OF A TURN EQUALS APPROXIMATELY 1 MPH.

GENERAL PRELIMINARY DIAGNOSTIC SYSTEM CHECK

1. CHECK SERVO CABLE OR ROD ADJUSTMENT FOR MINIMUM SLACK.
2. CHECK VACUUM HOSES FOR CRACKS, KINKS, SHARP BENDS, OR MISSING HOSES.
3. CHECK SPEEDOMETER AND DRIVE CABLES ROUTING FOR KINKS OR SHARP BENDS AND LOOSE CONNECTION.
4. CHECK ADJUSTMENT OF VACUUM VALVE AND ELECTRICAL SWITCH VALVE AND ELECTRICAL SWITCH AT BRAKE OR CLUTCH RELEASE SWITCH AND CONNECTIONS.
5. CHECK ENGAGE LEVER FOR ELECTRICAL CONNECTIONS AND SMOOTH CONTROL FUNCTION.
6. CHECK FOR DAMAGED SYSTEM COMPONENTS.
7. CHECK FOR WORKING SPEEDOMETER.

100835

Fig. 9-8C--Resume Cruise Control Quick Checks

DIAGNOSIS

ELECTRICAL SYSTEM TROUBLESHOOTING

1. Check fuse and connector.
2. Check brake electric switch as follows:
 - a. Unplug connector at switch.
 - b. Connect ohmmeter across cruise master contacts on brake switch. The ohmmeter must indicate no continuity when the pedal is depressed and continuity when pedal is released. The cruise release brake switch (electric) is adjusted as is the standard stop light brake switch.
 - c. Replace brake electric switch if needed.

Electrical Test

Refer to wiring diagram in Figure 9-6C to perform any electrical test.

Engagement Switch Test

Refer to Figures 9-7C and 9-8C to perform engagement switch test.

Resume Cruise Control Quick Checks

Refer to Figure 9-8C for cruise control quick checks.

Servo and Vacuum System Test

To determine the condition of the Servo diaphragm, remove hose from the Power Unit and apply 15 inches of vacuum to the tube opening and hold in for one minute. The vacuum shall not leak down more than 5 inches of vacuum in one minute. If leakage is detected, replace the Power Unit.

The cruise release brake valve (vacuum), resume valve and connecting hoses can be checked by applying 15" of vacuum to each component, then sealing them off. The vacuum leakage from 15" Hg should not exceed 5 inches, in a one second interval.

The cruise vacuum switch can be tested in the same manner. Leakage from 15" Hg should not exceed one inch in one minute.

Harness Test

1. Disconnect engage switch wire harness connector from the main harness connector (red, brown/white, and white wires).
2. Connect ohmmeter between point C (brown/white stripe wire in main wire harness) and ground. Make sure the Transducer is well grounded to the chassis. The ohmmeter should read between 42 and 49 ohms. If a resistance either above or below the value indicated is shown, then disconnect the connector from the Transducer and measure the resistance of the brown/white stripe wire from point C to D. It should measure 40 ohms \pm 2 ohms.

3. If a resistance either above or below the value indicated is shown, the main wiring harness should be replaced.

NOTICE: When disconnecting or reconnecting the main wiring harness connector from the Transducer, care should be exercised so as not to damage the blade connectors or the wiring harness. The disconnect may be facilitated by prying carefully on the plastic connector with a small screwdriver.

4. Measuring the solenoid coil circuit resistance between point E (Hold Terminal) and ground, the ideal resistance should be between 5 and 6 ohms. A reading of less than 4 ohms indicates shorting in the coil circuit. A reading of more than 7 ohms indicates excessive resistance in the coil circuit. Either extremity indicates replacement of the Transducer assembly. The main harness wiring from point F to G (white wire) should also be checked for continuity.

CRUISE CONTROL DIAGNOSIS (ALL SERIES)

PRELIMINARY CHECKS

1. Check Servo Chain or rod adjustment. Must have minimum slack.
2. Check vacuum hoses. Must be in good condition - no restrictions or leaks.
3. Check drive cable routings. No kinks or sharp bends.
4. Check throttle linkage or cable for binding.
5. Check adjustment of brake release and clutch switch and vacuum release valve.
6. Check engagement switch operation.
7. If steps 1 through 6 do not solve the problem, continue with diagnosis.

CRUISE CONTROL INOPERATIVE

1. Check gages fuse. If blown check wiring for short circuit.
2. If fuse and preliminary checks ok, turn ignition to run position and cruise control switch on.
3. Disconnect 2 wire connector at transducer.
4. Connect 12 volt test light to ground and to engage wire in connector. Push engagement button in part way.
5. Repeat test on hold wire in connector.

TEST LIGHT OFF AT
ONE WIRE ONLY

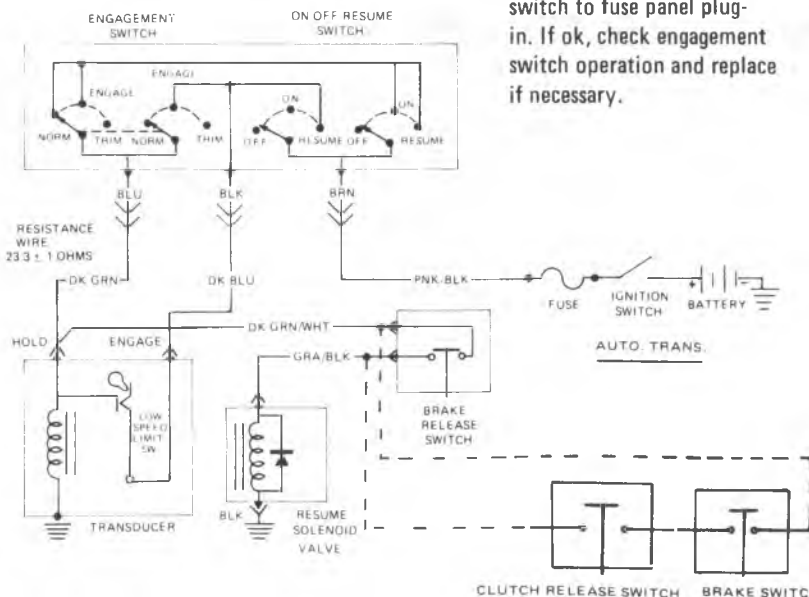
Test engagement switch.
(See test procedure)
Check for open circuit
in wire if test light
did not light.
Repair or replace part
that checks bad.

TEST LIGHT ON
AT BOTH WIRES
(MAY BE DIM ON
HOLD WIRE)

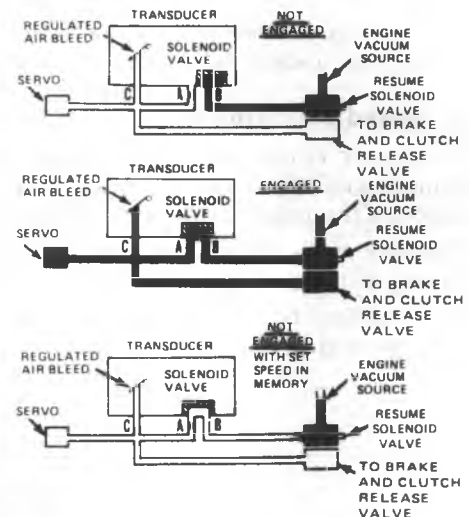
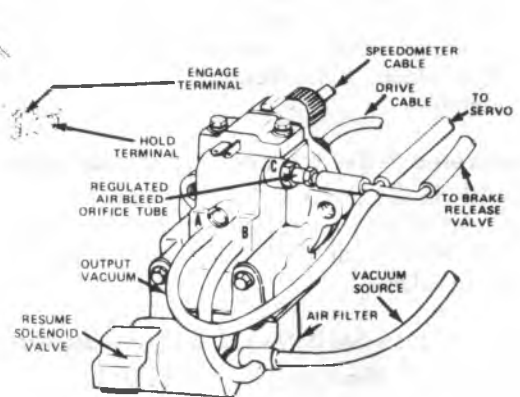
Check for poor ground
at transducer. If ok,
remove transducer
for repair.

TEST LIGHT OFF AT
BOTH WIRES

1. Check for open circuit in brn wire from engagement switch connector to brake or clutch switch.
2. Check brake and clutch switch (should have voltage on both terminals when ignition key is in run position and on/off switch on).
3. Check for open in wire from brake or clutch release switch to on/off switch to fuse panel plug-in. If ok, check engagement switch operation and replace if necessary.



CLUTCH RELEASE SWITCH BRAKE SWITCH
REFER TO SECTION 8 FOR WIRING FOR ALL SERIES



ENGAGEMENT SWITCH TEST PROCEDURE

USE AS SELF POWERED TEST LIGHT. LIGHT WILL BE ON FOR EACH TEST IF SWITCH IS GOOD. CONNECTOR TERMINALS AND COLOR 1 - BROWN, 2 - BLUE, 3 - BLACK

SWITCH POSITIONS		TERMINALS		
ENGAGE BUTTON	RESUME SWITCH	1 to 2	1 to 3	2 to 3
Released	on	closed	open	open
Fully Depressed	on	open	open	closed
Partially Released	on	closed	closed	closed
Released	resume	closed	closed	closed
Released	off	open	open	open

MANUAL
TRANSMISSION

Fig. 9-9C--Resume Cruise Control Diagnosis Chart

ON VEHICLE SERVICE

Power Unit Bead Chain Adjustment

1. With air conditioning off, adjust engine curb hot idle speed, with the idle stop solenoid disconnected (if equipped), to 500 rpm, then shut off engine.
2. Check bead chain slack by unsnapping swivel from ball stud and holding chain taut at ball stud; center of swivel should extend 1/8 inch beyond center of ball stud.
3. Adjust bead chain slack if necessary, by removing the retainer from the swivel and chain assembly. Place chain into swivel cavities which permits chain to have slight slack. Place retainer over swivel and chain assembly.

Brake Release Switch and Valve Adjustment

With brake pedal fully depressed, push switch and valve forward until they stop against bracket or arm, pull pedal rearward with 15-20 lbs. force to properly adjust switch and valve.

Clutch Release Switch and Valve Adjustment (Models with Manual Transmission)

With clutch at rest, push switch and valve forward until they stop against bracket, pull pedal rearward with 15-20 pounds force to adjust switch and valve assembly.

Cruise Speed Adjustment

If the car cruises at a speed above or below the engagement speed, this error can be corrected with a simple adjustment of the orifice tube in the transducer.

1. To check cruise speed error, engage Cruise Control at exactly 50 mph.
2. If car cruises below engagement speed, screw orifice tube outward.

3. If car cruises above engagement speed, screw orifice tube inward. Each 1/4 turn of the orifice tube will change cruise speed approximately one mph. Snug-up lock nut after each adjustment before testing.

Removal of Cruise Control Actuating Engagement Switch

1. Place shift lever in low and remove horn actuator and steering wheel.
2. Remove cover plate (three screws).
3. Remove turn signal lever and conduit from wire assembly.
4. Attach fine pliable wire through hole in connector. Tape end of wire and connector.
5. Pull switch and wire assembly through column. (Threading pliable wire).
6. Attach and tape wire to new connector.
7. Pull connector and wire through column.
8. Replace conduit on wire assembly.
9. Install turn signal lever screw.
10. Install cover plate.
11. Install steering wheel and horn actuator.

TRANSDUCER

Replacement

1. Disconnect battery ground cable.
2. Disconnect speedometer cables at transducer.
3. Disconnect vacuum and wiring harness at transducer body.
4. Remove transducer to bracket screws and remove transducer.
5. To install, reverse Steps 1-4 above.

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 volume 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 together 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

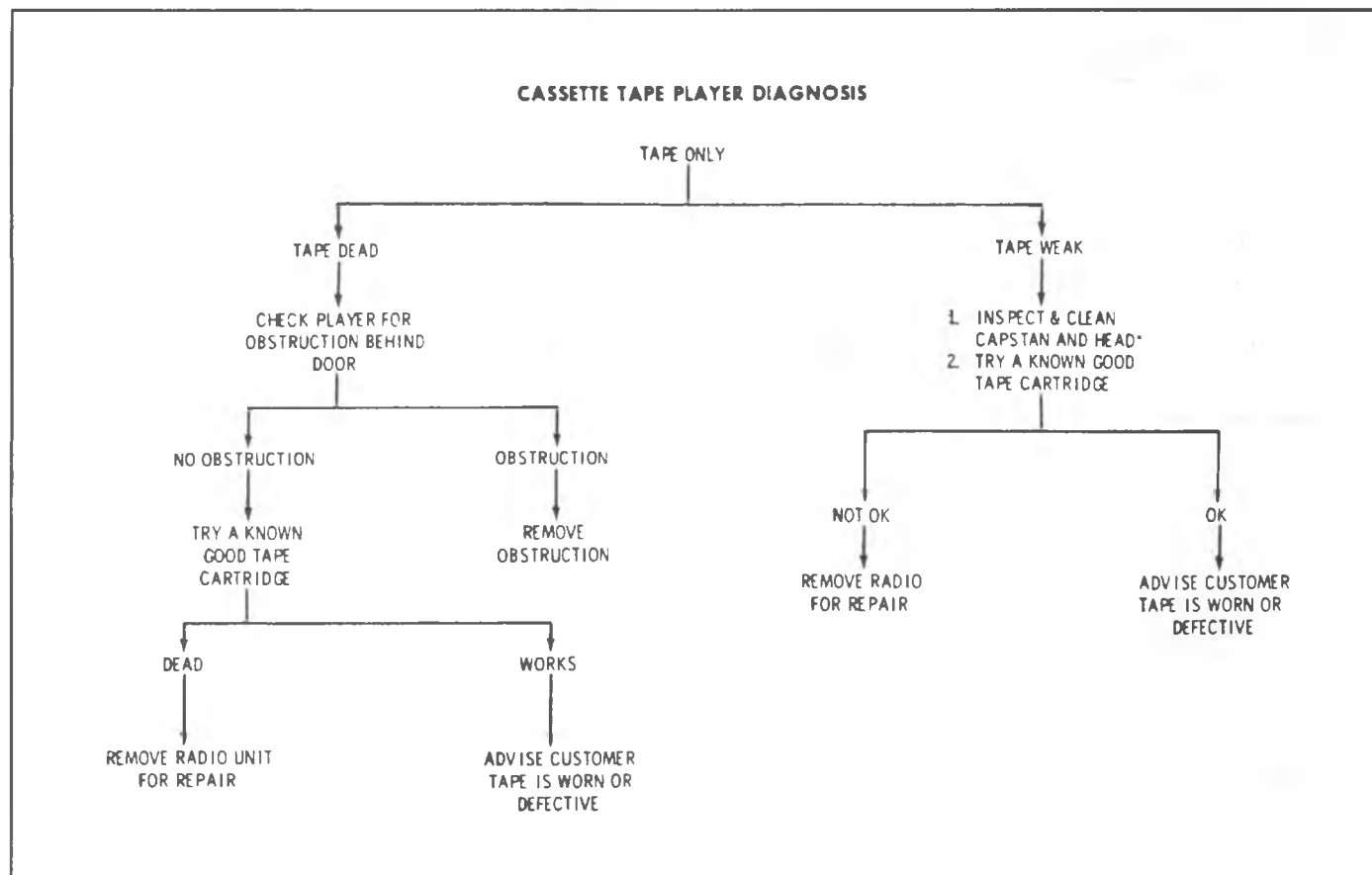


Fig. 9-1R--Cassette Tape Player Diagnosis

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 by 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.

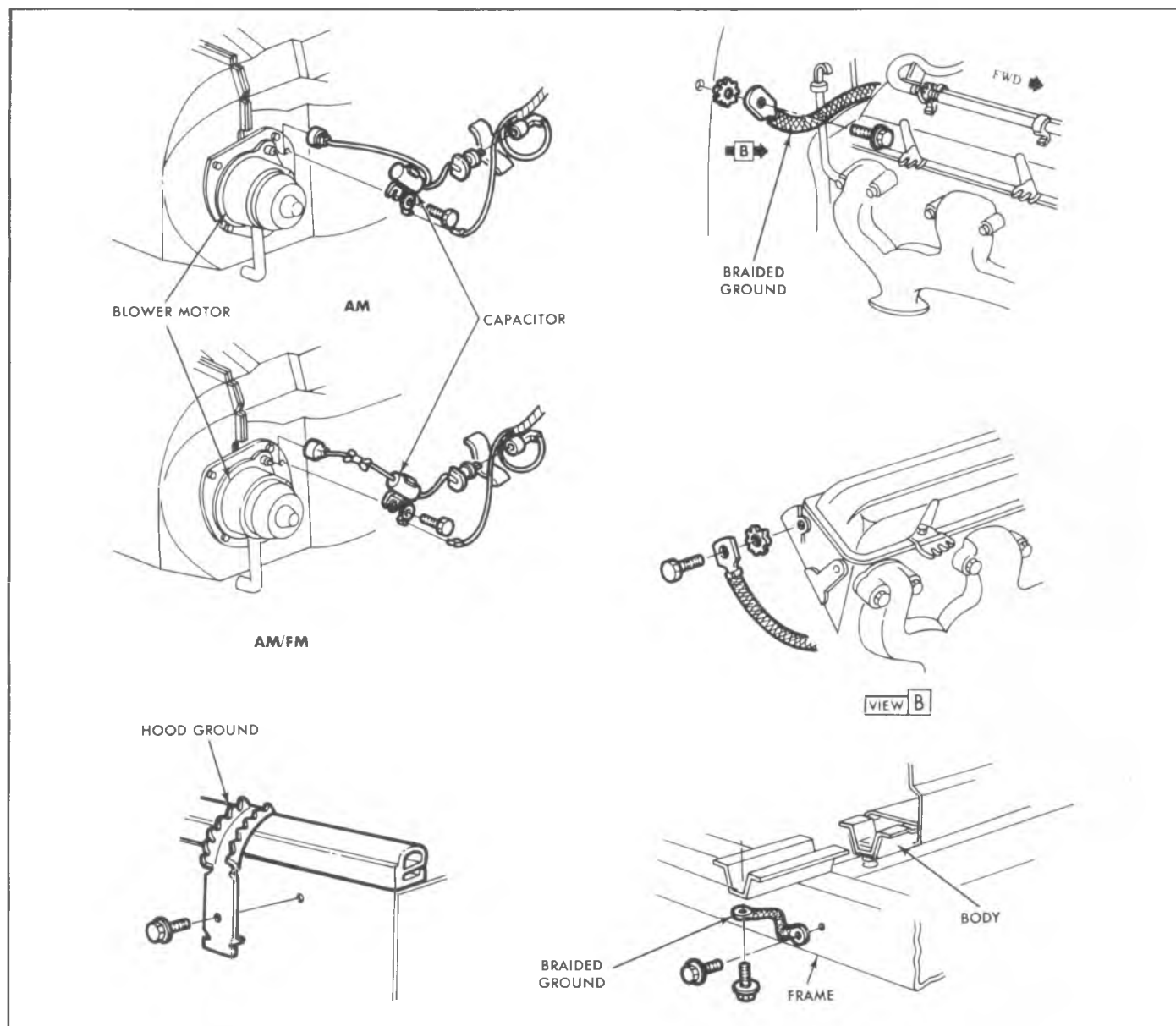


Fig. 9-3R--Radio Static Suppression--Typical

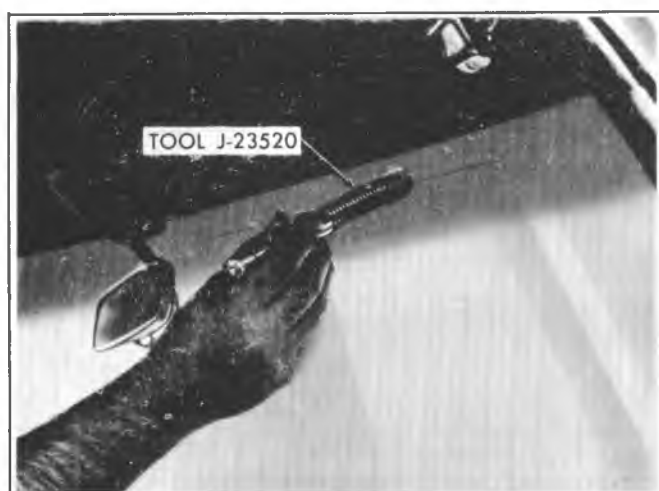
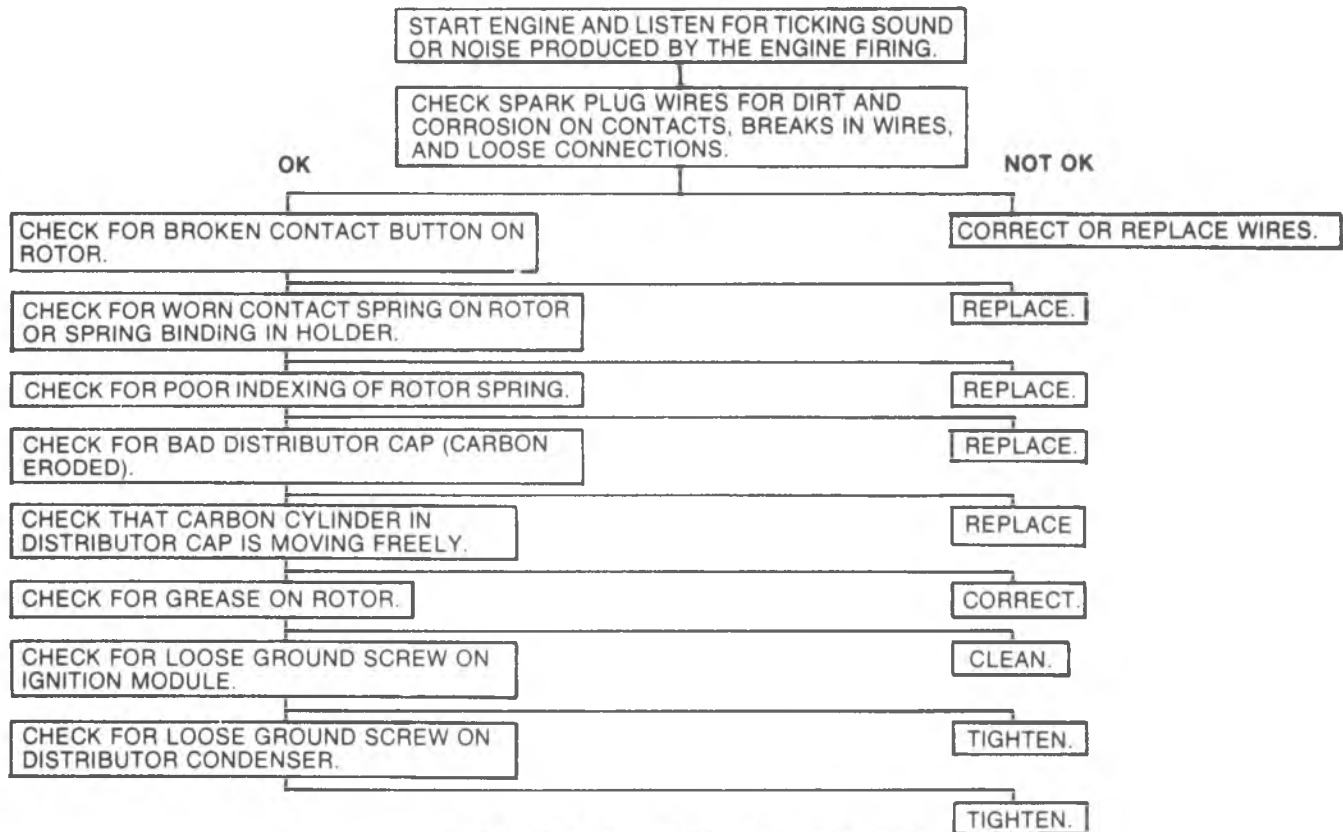


Fig. 9-4R--Testing Windshield Antenna (Typical)

RADIO NOISE DIAGNOSIS IMPROPERLY OPERATING IGNITION SYSTEM (HEI)



LACK OF SHIELDING/GROUNDING

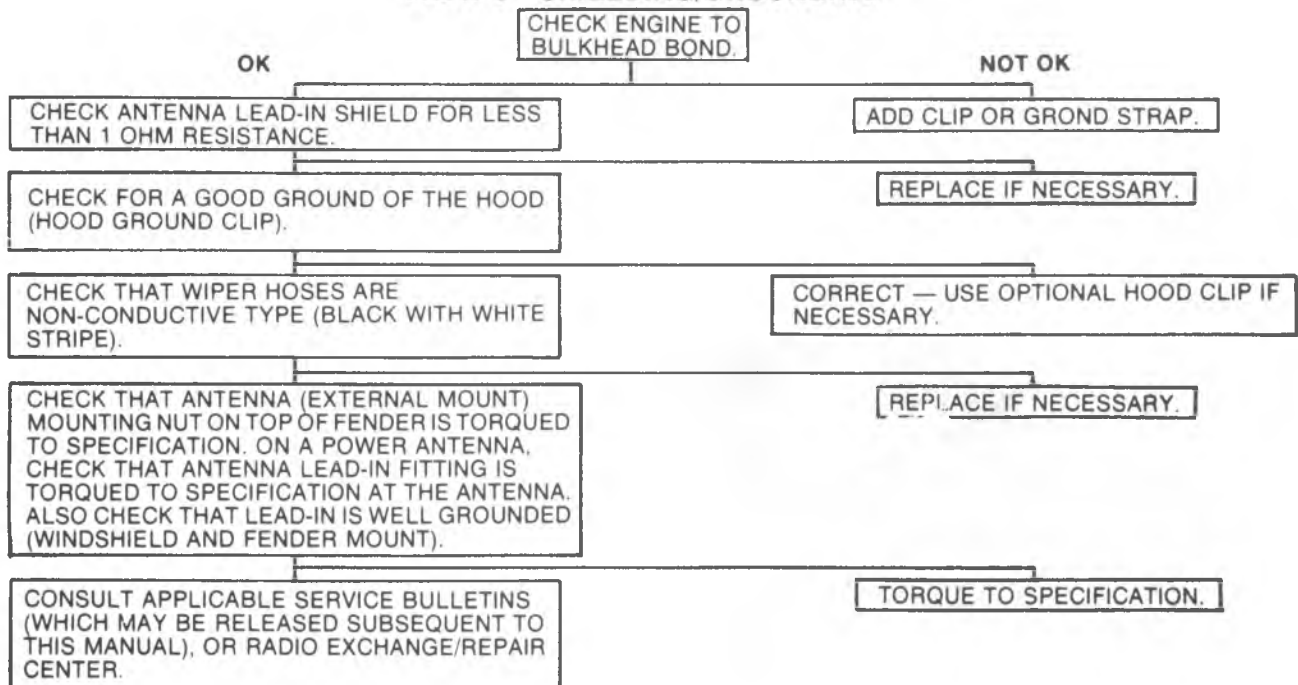


Fig. 9-5R--Radio Diagnosis, Chart A

RADIO NOISE — BLOWER MOTOR

TURN ON BLOWER MOTOR. NOISE APPEARS AS STATIC WHICH FOLLOWS BLOWER MOTOR SPEED (USUALLY ON FM).

CHECK IF A .25 MFD COAXIAL FEED-THROUGH CAPACITOR IS INSTALLED ON THE BLOWER MOTOR LEAD.

INSTALLED**NOT INSTALLED**

SUBSTITUTE A .25 MFD COAXIAL CAPACITOR. (REFER TO "MAINTENANCE AND ADJUSTMENTS")

INSTALL A .25 MFD COAXIAL CAPACITOR. (REFER TO "MAINTENANCE AND ADJUSTMENTS")

NO NOISE**NOISE****NO NOISE**

REPLACE CAPACITOR.

REPLACE BLOWER MOTOR.

STOP.

TAPE ONLY**TAPE DEAD****TAPE WEAK**

CHECK PLAYER FOR OBSTRUCTION THROUGH DOOR.

INSPECT & CLEAN, MOVING PARTS AND HEAD*

NO OBSTRUCTION**OBSTRUCTION****TAPE NOT OK****TAPE OK**

SUBSTITUTE KNOWN GOOD TAPE CARTRIDGE

REMOVE OBSTRUCTION

SUBSTITUTE WITH KNOWN GOOD TAPE CARTRIDGE.

STOP

DEAD**WORKS****SUBSTITUTE TAPE NOT OK****SUBSTITUTE TAPE OK**

REMOVE PLAYER

INFORM CUSTOMER TO USE GOOD QUALITY TAPES

REMOVE UNIT

INFORM CUSTOMER TO USE GOOD QUALITY TAPE

Fig. 9-6R—Radio Diagnosis, Chart B

DEAD RADIO — AM RADIO

CHECK FUSE.

FUSE OK**FUSE BLOWN**CHECK THAT ANTENNA IS
PLUGGED INTO RADIO. MAKE
SURE PLUG ISN'T COCKED OR
CORRODED.CHECK AT THE RADIO FOR
FAULTY POWER CONNECTION
OR SPEAKER CONNECTIONS.UNPLUG RADIO POWER LEAD.
REPLACE FUSE.**FUSE BLOWS AGAIN****FUSE DOESN'T BLOW**CHECK ALL ACCESSORIES ON
FUSE FOR PROBLEM. (SEE
SERVICE MANUAL/TEST DRIVE IF
NECESSARY.)

CORRECT PROBLEM.

PLUG RADIO
POWER LEAD
BACK IN.**GOOD CONNECTION****BAD CONNECTION**CHECK ANTENNA AND LEAD-IN
WITH A SUBSTITUTE ANTENNA.
TRIM. (SEE PROCEDURE)REPAIR
CONNECTION.**FAULTY
CONNECTION**REPAIR
CONNECTION.SUBSTITUTE SPEAKER.
(USE FADER IF SO EQUIPPED.)**RADIO
WORKS** **FUSE
BLOWS**

STOP.

REMOVE RADIO.

NO RECEPTION**RADIO WORKS**

REMOVE RADIO.

REPLACE MALFUNCTIONING
ANTENNA OR LEAD-IN. RE-TRIM.**NO RECEPTION****RADIO WORKS**

REMOVE RADIO.

REPLACE MALFUNCTIONING
SPEAKER/WIRING ASSEMBLY.

Fig. 9-7R--Radio Diagnosis, Chart C

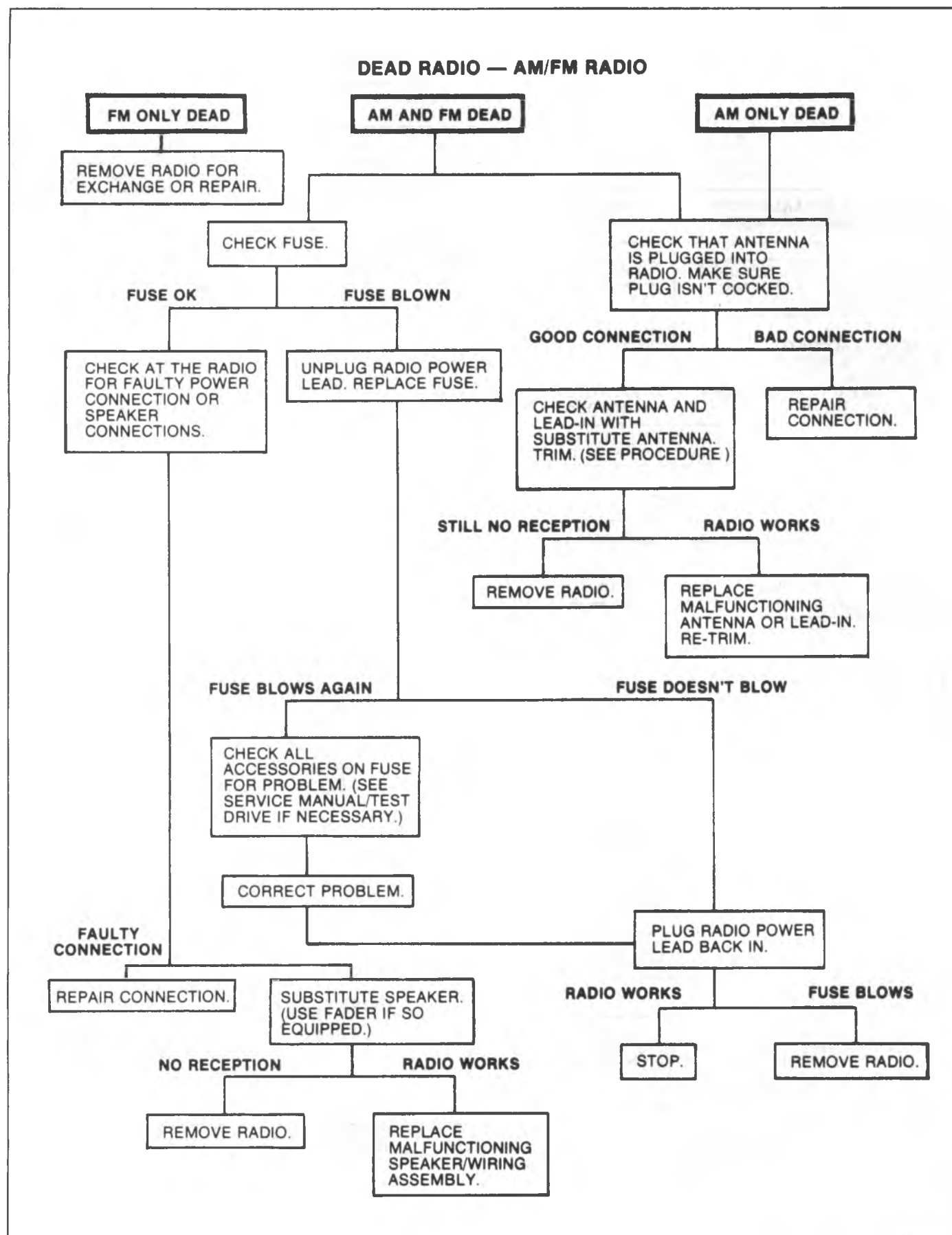


Fig. 9-8R--Radio Diagnosis, Chart D

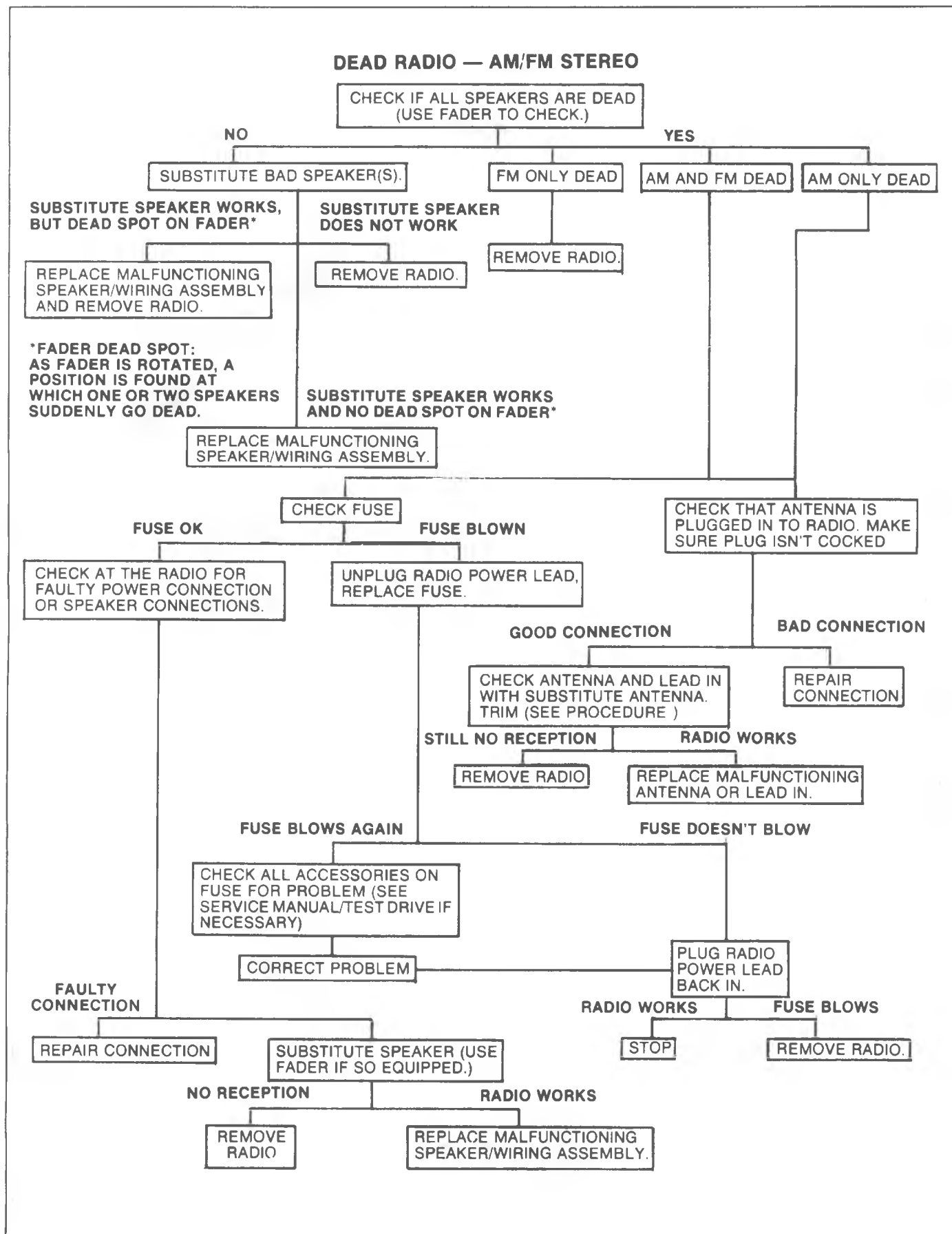


Fig. 9-9R--Radio Diagnosis, Chart E

SLIMLINE POWER ANTENNA DIAGNOSIS

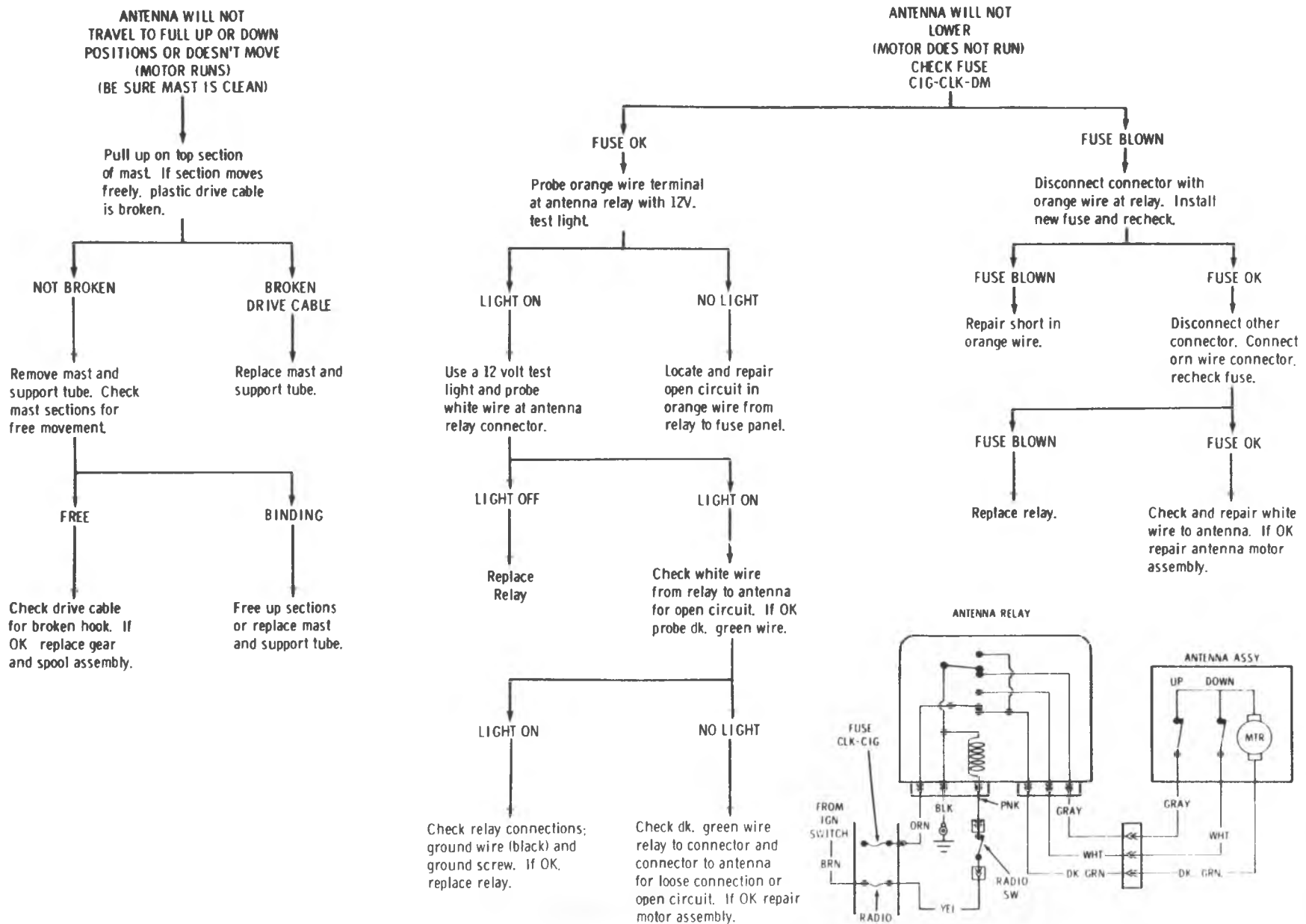


Fig. 9-10R--Slimline Power Antenna Diagnosis, Chart F

SLIMLINE POWER ANTENNA DIAGNOSIS (CONT'D)

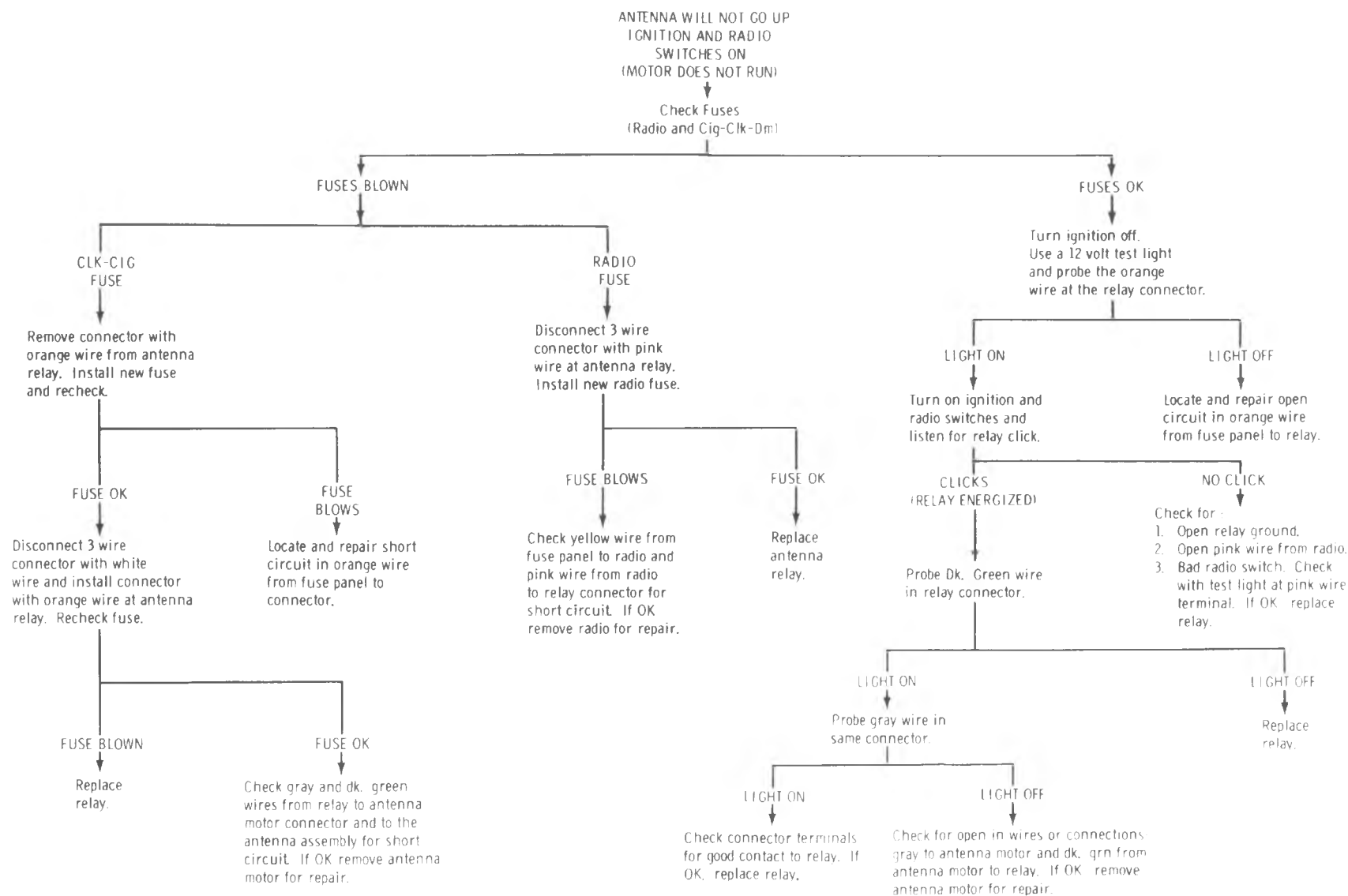


Fig. 9-11R--Slimline Power Antenna Diagnosis, Chart G

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.

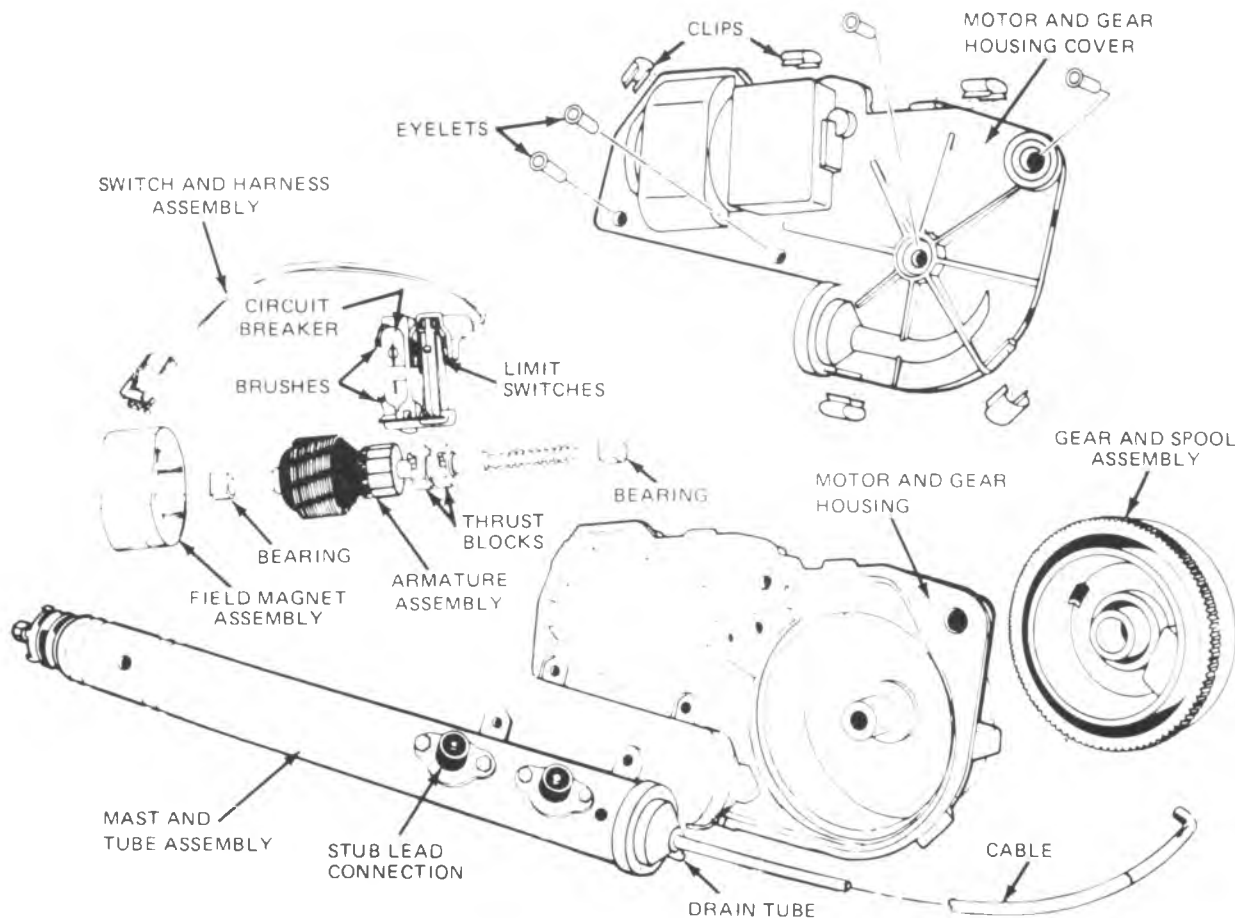


Fig. 9-12R--Slimline Power Antenna Diagnosis, Chart H

SWR (STANDING WAVE RATIO) CHECK

1. With Ignition and Radio off install an SWR meter as shown following meter manufacturers instructions.

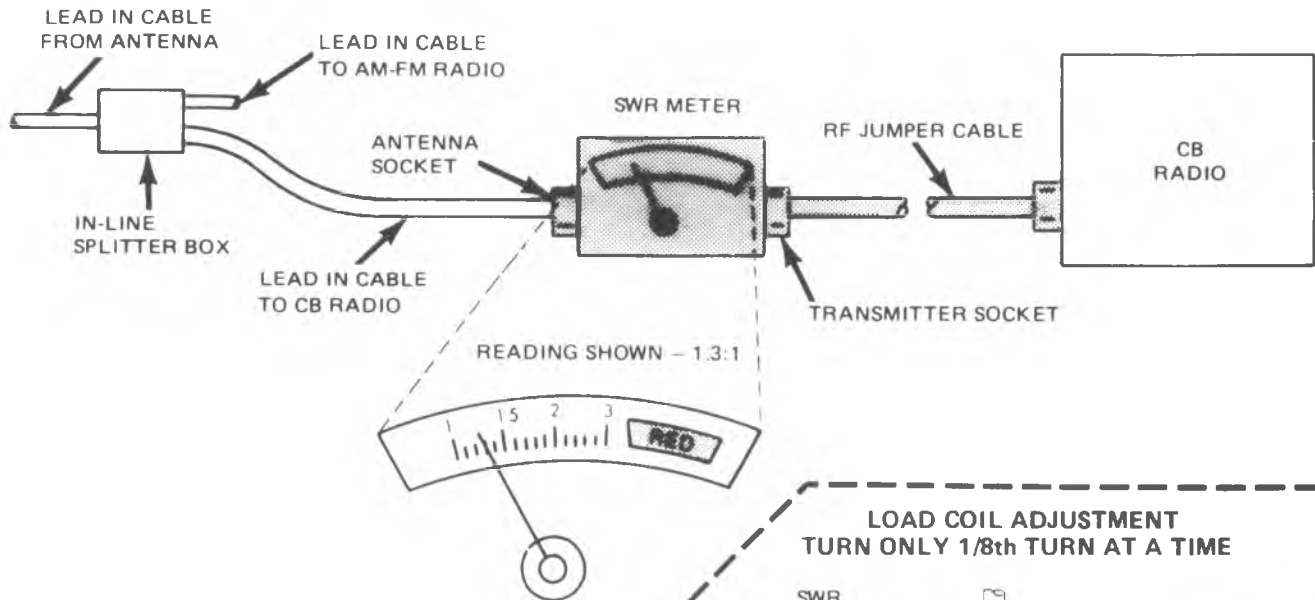
NOTICE: Operation of transmitter requires FCC CB Operators License.

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.

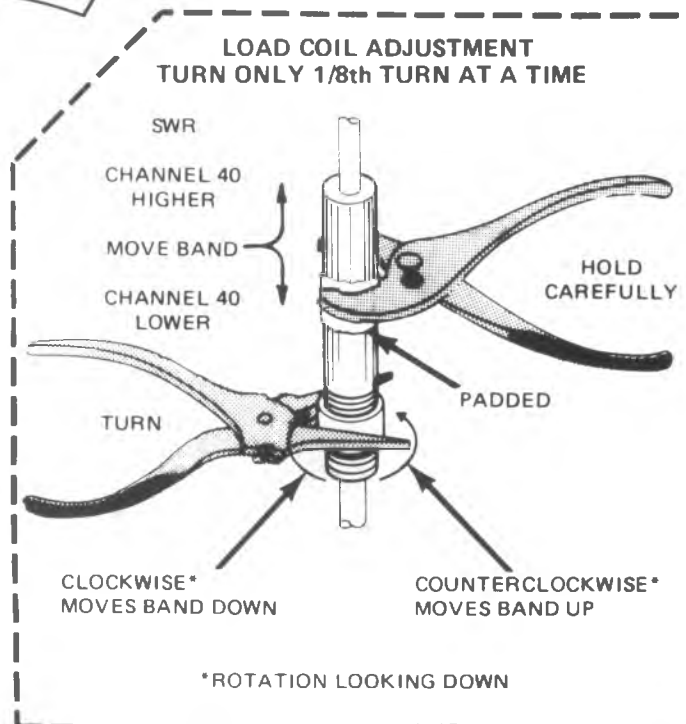
3. Check Antenna height – Must be fully extended.
914 mm (36") from fender to tip
286 mm (11-1/4") top of load coil to tip.

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
- Lead in cable connections to radio, splitter and antenna are tight.
- between antenna mounting surface and car sheet metal.
- Lead in cables not pinched and cutting the insulation.

Fig. 9-13R--Slimline SWR Check

ON VEHICLE SERVICE

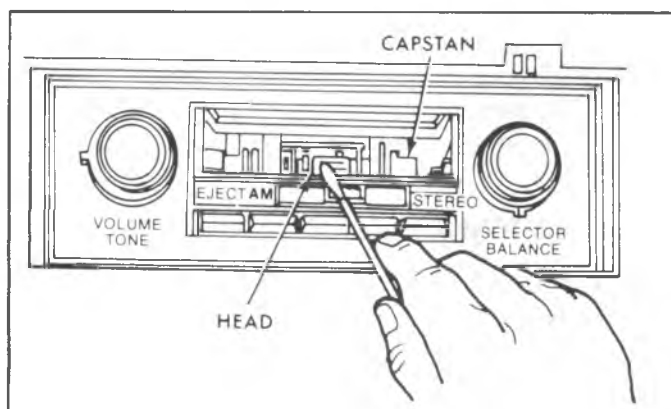


Fig. 9-14R--Cleaning Tape Player Head

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.

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).

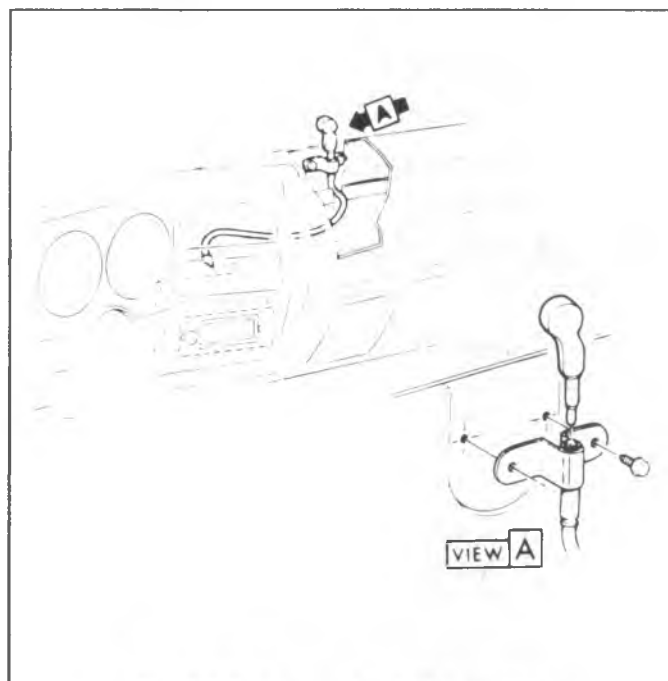


Fig. 9-16R--Antenna Lead (C-K Models)

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

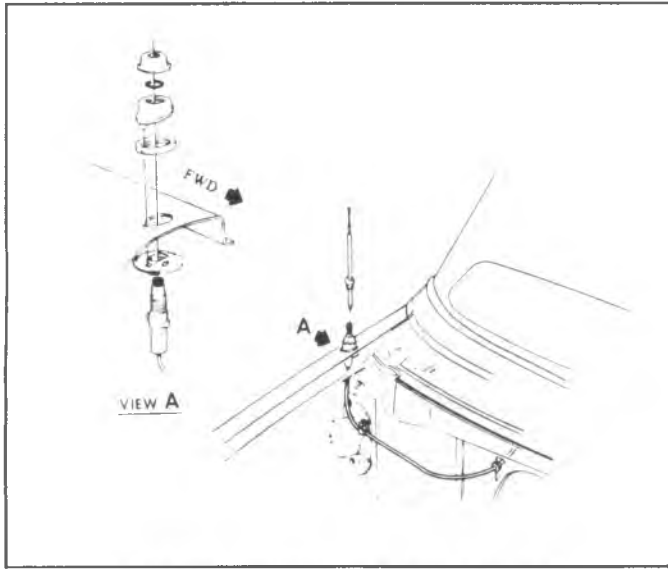


Fig. 9-17R--Antenna Installation (G Models)

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.

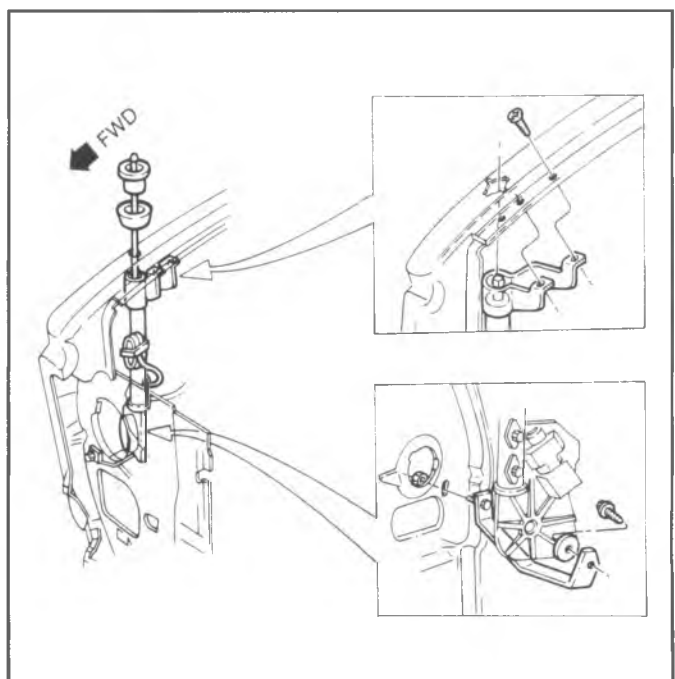


Fig. 9-18R--G Model Power Antenna

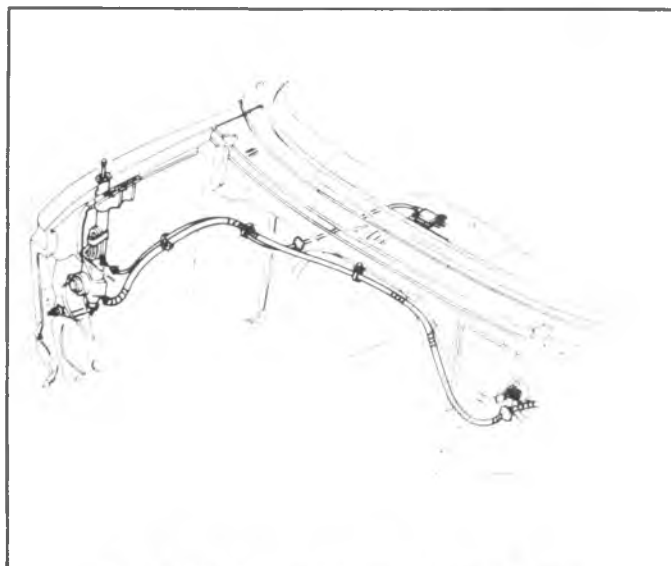


Fig. 9-19R--G Model Power Antenna Wiring

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.

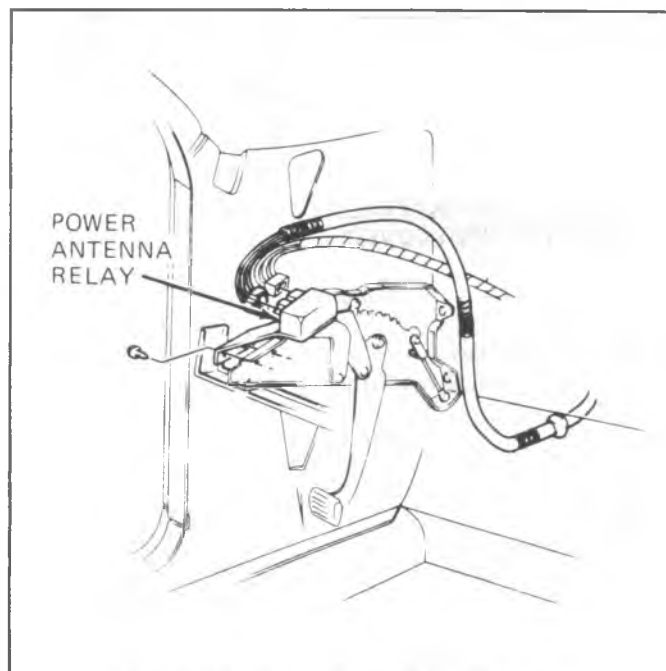


Fig. 9-20R--G Model Power Antenna Relay

POWER ANTENNA DISASSEMBLY-SLIMLINE

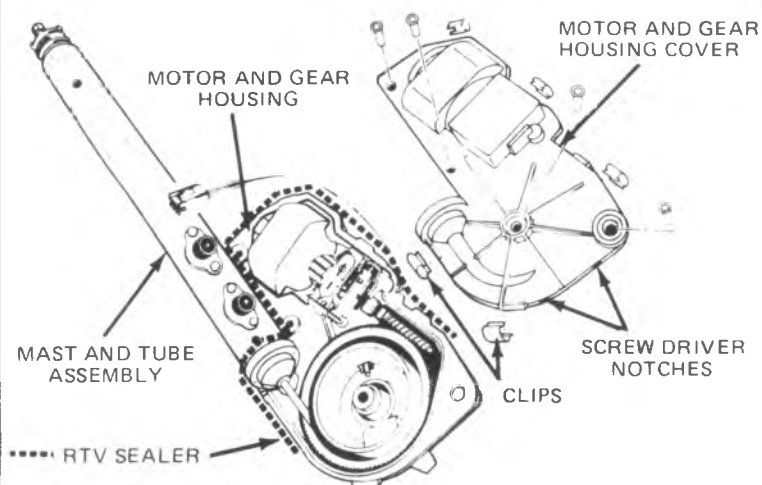
NOTICE: With the exception of load coil on the tri-band antenna, all service operations require opening the motor and gear housing. All disassembly will require a bolt and clip package.

1. REMOVE AND INSTALL MOTOR AND GEAR HOUSING COVER.

REMOVAL

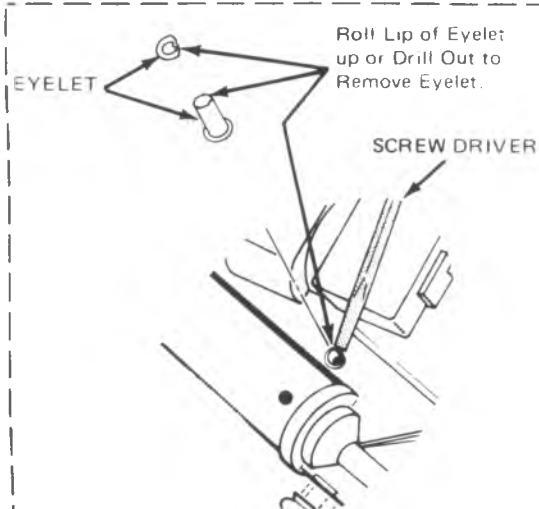
1. Remove parts shown.
2. Separate housing and cover as shown.

EYELETS



INSTALL

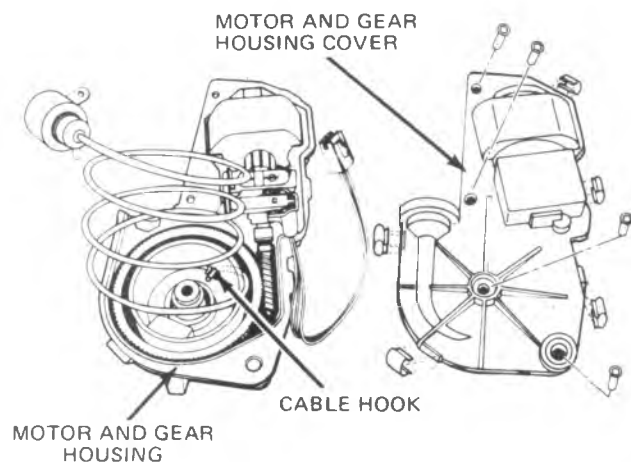
1. Remove loose or excess sealer and reassemble using 3 bolts and nuts, from service package and the 5 clips.
2. Apply RTV sealer around support tube and along seam on top half of housing.



2. REMOVE AND INSTALL MAST AND TUBE ASSEMBLY.

REMOVAL

1. Remove parts as shown.



Disengage cable from gear by rotating cable 90°

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.

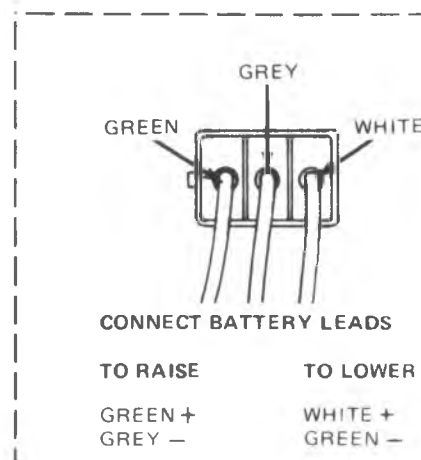


Fig. 9-21R-Slimline Disassembly I

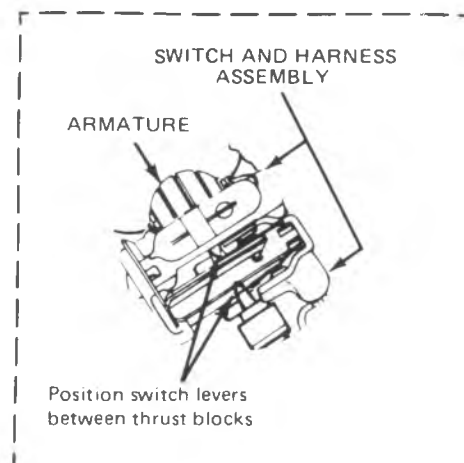
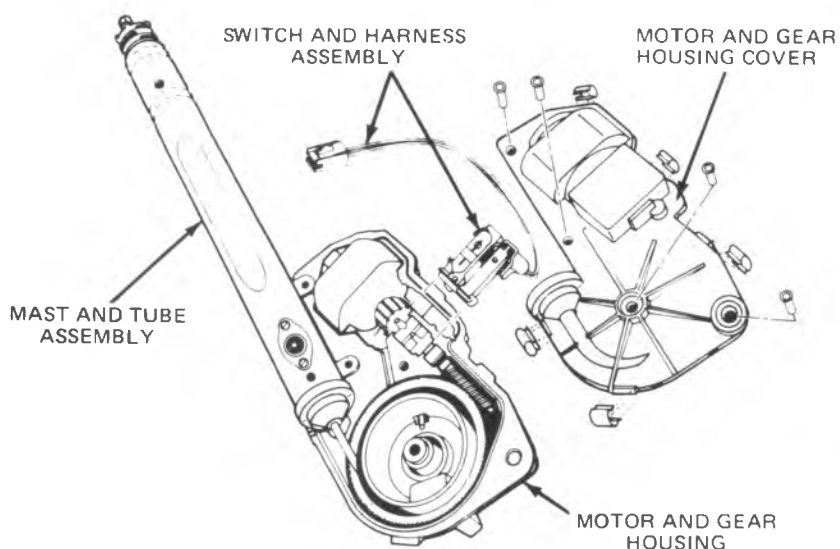
3. REMOVE AND INSTALL SWITCH AND HARNESS ASSEMBLY.

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.

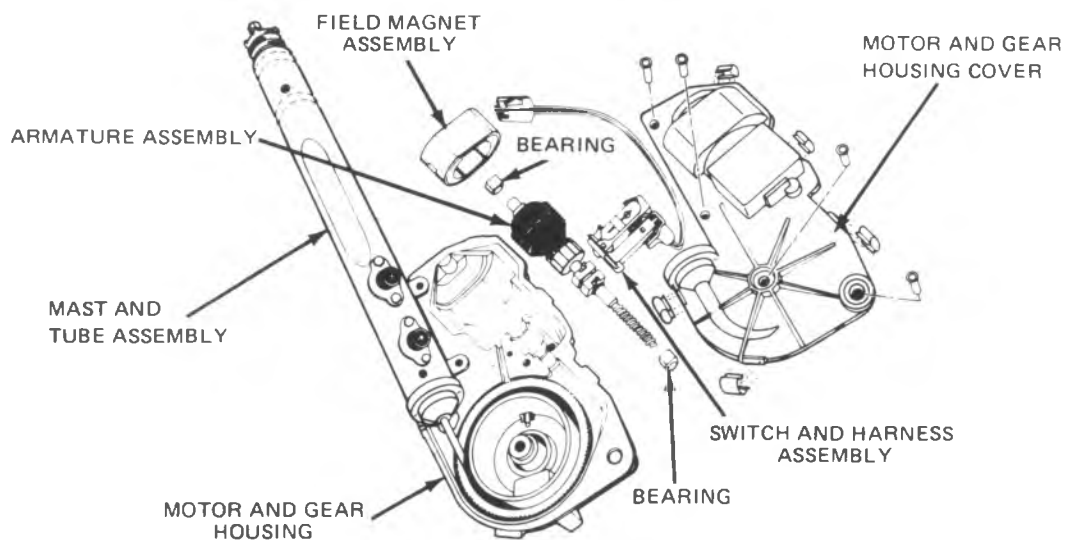


Fig. 9-22R--Slimline Disassembly II

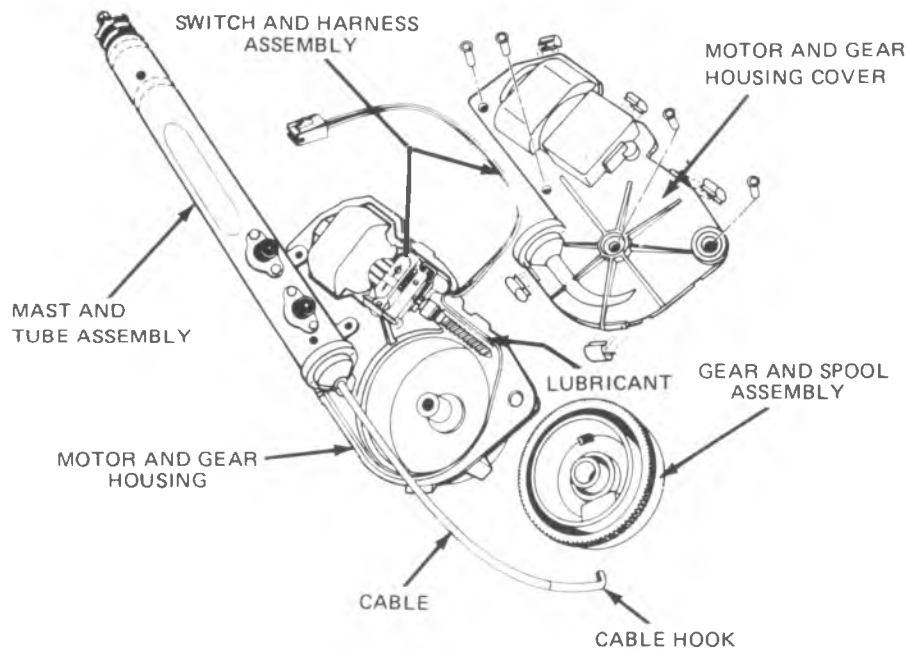
5. REMOVE AND INSTALL GEAR ASSEMBLY.

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)

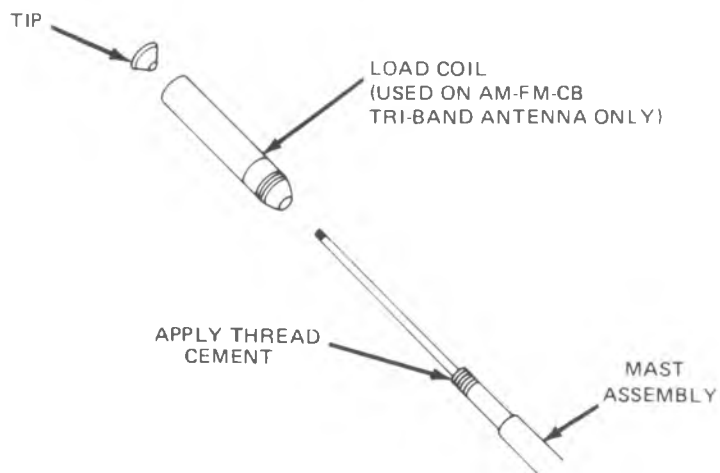


Fig. 9-23R--Slimline Disassembly III

SECTION 10

METRIC & FASTENER INFORMATION

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 (Système 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

1/4

Thread Major
Diameter
in Inches

20

Number of
Threads
per Inch

METRIC

M6.3

Thread Major
Diameter
in Millimeters

1

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.

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

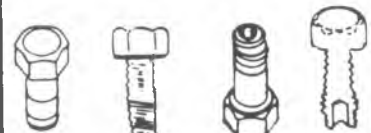


NYLON WASHER INSERT

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:

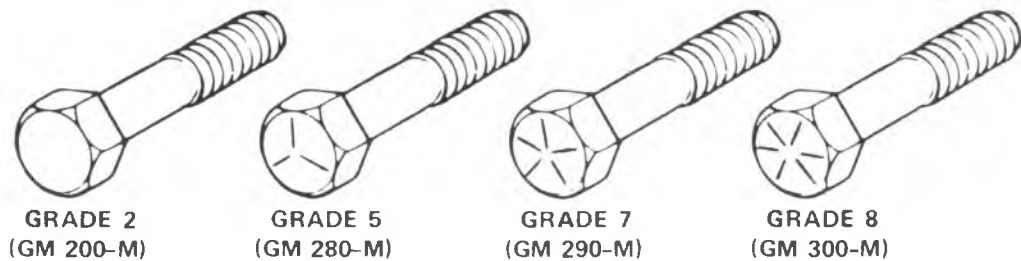
1. CLEAN DIRT AND OTHER FOREIGN MATERIAL OFF NUT AND BOLT.
2. INSPECT BOLT AND NUT TO ASSURE THERE ARE NO CRACKS, ELONGATION OR OTHER SIGNS OF ABUSE OR OVERTIGHTENING. LIGHTLY LUBRICATE THREADS. (IF ANY DOUBT, REPLACE WITH NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH.)
3. ASSEMBLE PARTS 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.

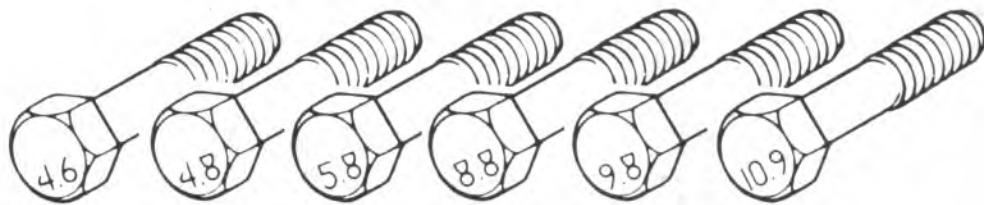
METRIC SIZES								
		6 & 6.3	8	10	12	14	16	20
NUTS AND ALL METAL BOLTS	N•m	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	In. Lbs.	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	N•m	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	In. Lbs.	4.0	5.0	10	14	20	28	46
INCH SIZES								
		.250	.312	.375	.437	.500	.562	.625
NUTS AND ALL METAL BOLTS	N•m	0.4	0.6	1.4	1.8	2.4	3.2	4.2
	In. Lbs.	4.0	5.0	12	15	20	27	35
ADHESIVE OR NYLON COATED BOLTS	N•m	0.4	0.6	1.0	1.4	1.8	2.6	3.4
	In. Lbs.	4.0	5.0	9.0	12	15	22	28

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.

MANUFACTURERS
IDENTIFICATION



NUT STRENGTH
IDENTIFICATION



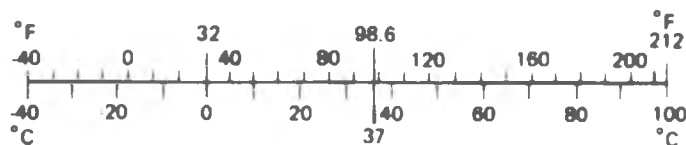
POSIDRIV
SCREW HEAD



IDENTIFICATION MARKS (4)

SI METRIC-CUSTOMARY CONVERSION TABLE

Multiply	by	to get equivalent number of:	Multiply	by	to get equivalent number of:
LENGTH			ACCELERATION		
Inch	25.4	millimeters (mm)	Foot/sec ²	0.304 8	meter/sec ² (m/s ²)
Foot	0.304 8	meters (m)	Inch/sec ²	0.025 4	meter/sec ²
Yard	0.914 4	meters	TORQUE		
Mile	1.609	kilometers (km)	Pound-inch	0.112 98	newton-meters (N·m)
AREA			Pound-foot	1.355 8	newton-meters
Inch ²	645.2	millimeters ² (mm ²)	POWER		
Foot ²	6.45	centimeters ² (cm ²)	Horsepower	0.746	kilowatts (kW)
Yard ²	0.092 9	meters ² (m ²)	PRESSURE OR STRESS		
	0.836 1	meters	Inches of mercury	3.377	kilopascals (kPa)
VOLUME			Pounds/sq. in	6.895	kilopascals
Inch ³	16 387	mm ³	ENERGY OR WORK		
	16 387	cm ³	BTU	1 055	joules (J)
Quart	0.016 4	liters (l)	Foot-pound	1.355 8	joules
Gallon	0.946 4	liters	Kilowatt-hour	3 600 000	joules (J = one W's)
Yard ³	3.785 4	liters		or 3.6x10 ⁶	
	0.764 6	meters ³ (m ³)	LIGHT		
MASS			Foot candle	10.764	lumens/meter ² (lm/m ²)
Pound	0.453 6	kilograms (kg)	FUEL PERFORMANCE		
Ton	907.18	kilograms (kg)	Miles/gal	0.425 1	kilometers/liter (km/l)
Ton	0.907	tonne (t)	Gal/mile	2.352 7	liters/kilometer (l/km)
FORCE			VELOCITY		
Kilogram	9.807	newtons (N)	Miles/hour	1.609 3	kilometers/hr. (km/h)
Ounce	0.278 0	newtons			
Pound	4.448	newtons			
TEMPERATURE					
Degree Fahrenheit	(°F-32) ÷ 1.8	degree Celsius (°C)			



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

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

<p>Amp. - 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</p> <p>BARO - Barometric Absolute Pressure Sensor Bat. - Battery Bat. + - Positive Terminal Bbl. - Barrel BHP - Brake Horsepower BP - Back Pressure BTDC - Before Top Dead Center</p> <p>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 CL - 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)</p> <p>DBB - Dual Bed Bead DBM - Dual Bed Monolith DEFI - Digital Electronic Fuel Injection DFI - Digital Fuel Injection Diff. - Differential Dist. - Distributor</p> <p>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</p>	<p>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</p> <p>FMVSS - Federal Motor Vehicle Safety Standards Ft. Lb. - Foot Pounds (Torque) FWD - Front Wheel Drive - Four Wheel Drive 4 x 4 - Four Wheel Drive</p> <p>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</p> <p>IAC - Idle Air Control IC - Integrated Circuit ID - Identification - Inside Diameter ILC - Idle Load Compensator IP - Instrument Panel ISC - Idle Speed Control</p> <p>km - Kilometers km/h - Kilometers Per Hour KV - Kilovolts (Thousands of Volts) km/L - Kilometers/Liter (mpg) kPa - Kilopascals</p> <p>L - Litre L-4 - Four Cylinder In-Line (Engine) L-6 - Six Cylinder In-Line (Engine) LF - Left Front LR - Left Rear</p> <p>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</p> <p>N m - Newton Metres (Torque)</p> <p>OD - Outside Diameter</p>	<p>OHC - Overhead Cam OL - Open Loop O₂ - Oxygen</p> <p>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</p> <p>Qt. - Quart</p> <p>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</p> <p>SAE - Society of Automotive Engineers SI - System International Sol. - Solenoid</p> <p>T - Turbocharger 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 Turbo - Turbocharger TV - Throttle Valve TVBV - Turbocharger Vacuum Bleed Valve TVRS - Television & Radio Suppression TVS - Thermal Vacuum Switch</p> <p>U-Joint - Universal Joint</p> <p>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</p> <p>W/ - With W/B - Wheel Base W/O - Without WOT - Wide Open Throttle</p> <p>X-Valve - Expansion Valve</p>
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