X-7525

1975 AND 1976 MAINTENANCE MANUAL MOTOR HOME

ZEO 6581

AND

TRANS MODES

ZEO 6083

ZEO 6583

GMC

TRUCK & COACH DIVISION
GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

Printed in U.S.A.
X-7525, 5M

SECTION INDEX

SECTION 7
TRANSMISSION

Contents of this section are listed below:

GENERAL INFORMATION

DESCRIPTION

The Turbo Hydra-Matic transmission, Figure 1, is a fully automatic transmission used for front wheel drive applications.

The Turbo Hydra-matic transmission consists primarily of a three-element hydraulic torque converter, a dual sprocket and link assembly and a compound planetary gear set. Three multiple-disc clutches, a sprag unit, a roller clutch unit, and two bands provide the friction elements required to obtain the desired functions of the compound planetary gear set.

The torque converter, the dual sprocket and link, the clutches, the sprag and roller clutch, couple the engine to the planetary gears, providing three forward speeds and one reverse. The torque converter when required will supplement the gears by multiplying engine torque.

The torque converter is of welded construction and is serviced as an assembly. The unit is made up of two vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is, in effect, connected to the transmission.

The torque converter couples the engine to the planetary gear set through the use of a drive sprocket, a link assembly, and a driven sprocket. Clockwise engine torque turns the drive sprocket clockwise, which, in turn, drives the driven sprocket in a clockwise direction. This in effect is a reverse in the direction of engine torque due to the side mounting of the gear unit.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels the oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

Manual Linkage—To select the desired operating range.

Engine Vacuum—To operate a vacuum modulator unit.

12 Volt Electrical Signal—To operate an electrical detent solenoid.

Gear or Torque ratios of the transmission are as follows:

First = 2.48:1 gear ratio

Second = 1.48:1 gear ratio

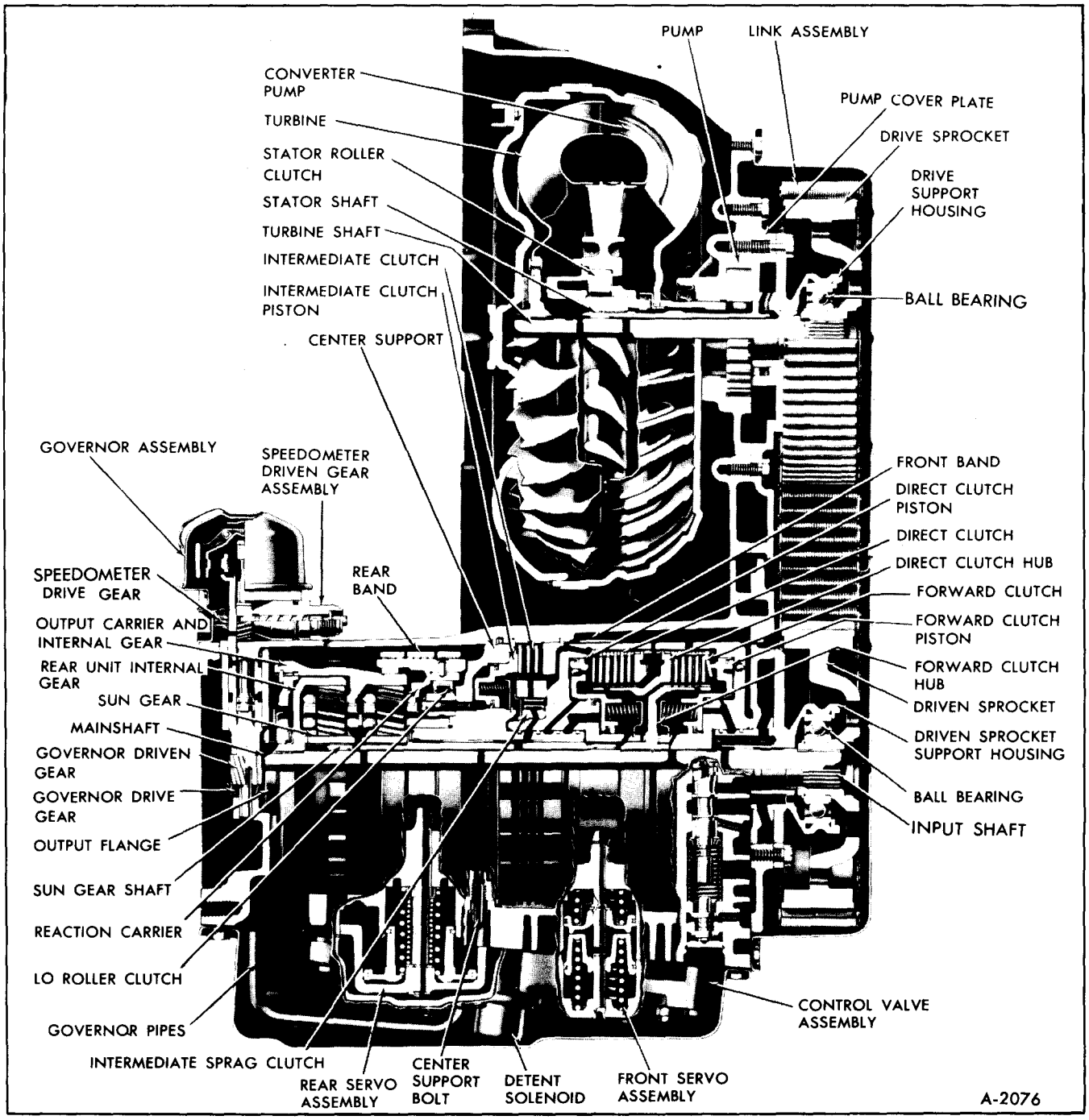


Figure 1—Turbo Hydra-matic Transmission

Third = 1.0:1 gear ratio

Reverse = 2.08:1 gear ratio

First and reverse gears can be multiplied by as much as 2.2:1, depending upon the slip speed of the converter pump and turbine.

A vacuum modulator is used to sense engine torque input to the transmission automatically. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and proper shift spacing is obtained at all throttle openings.

The downshift solenoid is activated by an adjustable switch at the accelerator pedal. When the throttle is opened sufficiently to close this switch, the solenoid in the transmission is activated, causing a

downshift at speeds below approximately 70 miles per hour. At lower speeds, downshifts will occur at lesser throttle openings without use of the switch.

The oil cooler is located in the right hand tank of the radiator. The transmission is cooled by directing oil from the converter to the radiator. Oil returning from the radiator feeds the transmission lubrication system.

The oil system incorporates an intake pipe and filter assembly. The transmission fluid and filter assembly should be replaced after each 12,000 miles or 12 months. In addition, in the event of a transmission malfunction that resulted in metal shavings or clutch plate material, the filter and fluid should be changed; and the oil cooler and cooler lines should be flushed.

The transmission quadrant has six selector positions that enable the driver to control the operation of the transmission under various driving conditions. The six selector positions appear on the quadrant in the following sequence, from left to right; PARK-park, R-reverse, N-neutral, D-drive, S-super, L-lo.

PARK—Park position positively locks the output flange to the transmission case by means of a locking pawl and prevents the vehicle from rolling either forward or backward. For this reason, it is recommended that the engine be started with transmission selector lever in Park position. If it is necessary to re-start the engine with vehicle rolling, place selector lever in Neutral and start the engine.

R—Reverse enables the vehicle to be operated in a reverse direction.

N—Neutral position enables the engine to be started and run without driving the vehicle. It is recommended that Neutral be used to start the engine only if it is necessary to re-start the engine with the vehicle rolling. At all other times use Park.

D—Drive is used for all normal driving conditions and maximum economy. Drive has three gear ratios from starting to direct drive. Downshifts are available for safe passing by depressing the accelerator pedal.

S—Super adds performance for congested traffic or engine braking in hilly terrain. The Super range has the same starting gear ratio as Drive, but prevents the transmission from shifting above second speed to retain acceleration when extra performance is desired.

L—Lo range permits operation at a lower gear ratio, and should be used where maximum engine braking is desired, such as in descending a steep grade. When selector lever is moved from Drive to Lo range at normal highway speeds, the transmission will shift to second gear and remain in second gear until vehicle speed is reduced to approximately 45 mph. The transmission will then shift to first gear and remain in first gear regardless of vehicle or engine speed, until selector lever is moved back into either Super or Drive position.

HYDRAULIC SYSTEM

PRESSURE CONTROL

The transmission is controlled automatically by a hydraulic system, Figure 2. Hydraulic pressure is supplied by the transmission oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the transmission case and by the vacuum modulator which is connected to engine vacuum. The pressure regulator controls line pressure automatically, in response to a pressure signal from a modulator valve in such a way that the torque requirements of the transmission clutches are met and proper shift spacing is obtained at all throttle openings and vehicle speeds.

To control line pressure properly, modulator pressure is used which varies in the same manner as torque input to the transmission. Since the torque input to the clutches is the product of engine torque and converter ratio, modulator pressure must compensate for changes in either or both of these.

To meet these requirements, modulator pressure is regulated by engine vacuum, which is an indicator of engine torque, (Governor pressure also controls modulator pressure). It will decrease with an increase in vehicle speed to compensate for the changing converter torque ratio, by virture of the governor pressure influence.

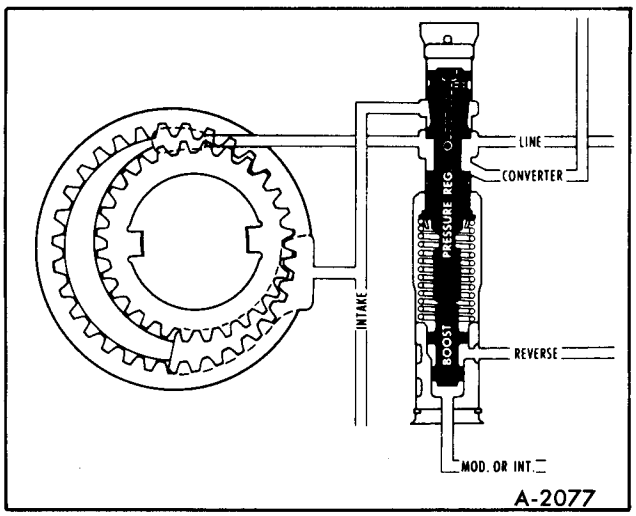


Figure 2—Pressure Control

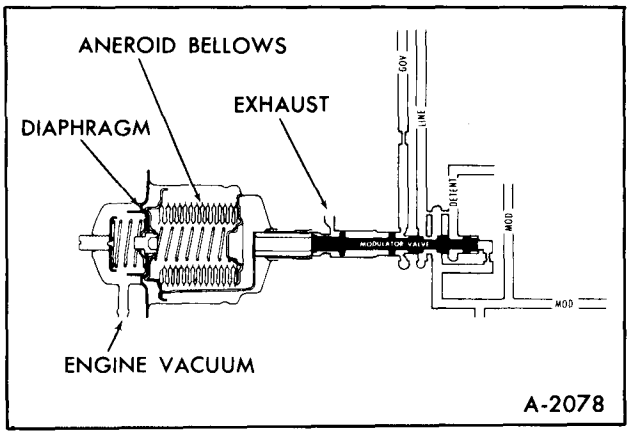


Figure 3—Vacuum Modulator Assembly

VACUUM MODULATOR ASSEMBLY

The engine vacuum signal is received by the vacuum modulator, Figure 3, which consists of an evacuated metal bellows, a diaphragm and a spring. These are so arranged that the bellows and spring apply a force that acts on the modulator valve so that it increases modulator pressure.

Engine vacuum and the enclosed spring oppose the bellows and spring to control modulator pressure.

To reduce the effect of altitude on shift points, the effective area of the diaphragm is different than that of the bellows. Atmospheric pressure acts on the resulting differential area to reduce modulator pressure.

GOVERNOR ASSEMBLY

The vehicle speed signal to the transmission is supplied by the governor, which is driven by the output flange. The governor consists of flyweights and a regulator valve. Centrifugal force of the flyweights is imposed on the regulator valve, causing it to regulate a pressure signal that increases with speed.

Governor pressure acts on the modulator valve to cause modulator pressure to decrease as vehicle speed increases.

FUNCTIONS OF VALVES AND HYDRAULIC CONTROL UNITS

Line Pressure Regulator

Regulates line pressure to satisfy engine torque.

Manual Valve

Establishes the range of transmission operation, PARK, R, N, D, S, or L, as selected by the vehicle operator through the manual selector lever.

Governor Assembly

Generates a speed sensitive oil pressure that increases with output shaft or vehicle speed. Governor pressure is used to control the shift points and modulator pressure regulation.

Vacuum Modulator Valve

Provides modulator pressure that senses engine torque and vehicle speed. The vacuum modulator is used to vary the shift points according to throttle opening and to raise line pressure proportional to input torque to the transmission.

1-2 Shift Valve

Activates the 1-2 and 2-1 shifts.

1-2 Regulator Valve

Controls the flow of modulator pressure to the 1-2 shift valve to regulate the minimum shift point.

1-2 Detent Valve

Senses regulated modulator pressure tending to hold 1-2 shift valve downshifted and provides an area for detent pressure for detent 2-1 shifts.

2-3 Shift Valve

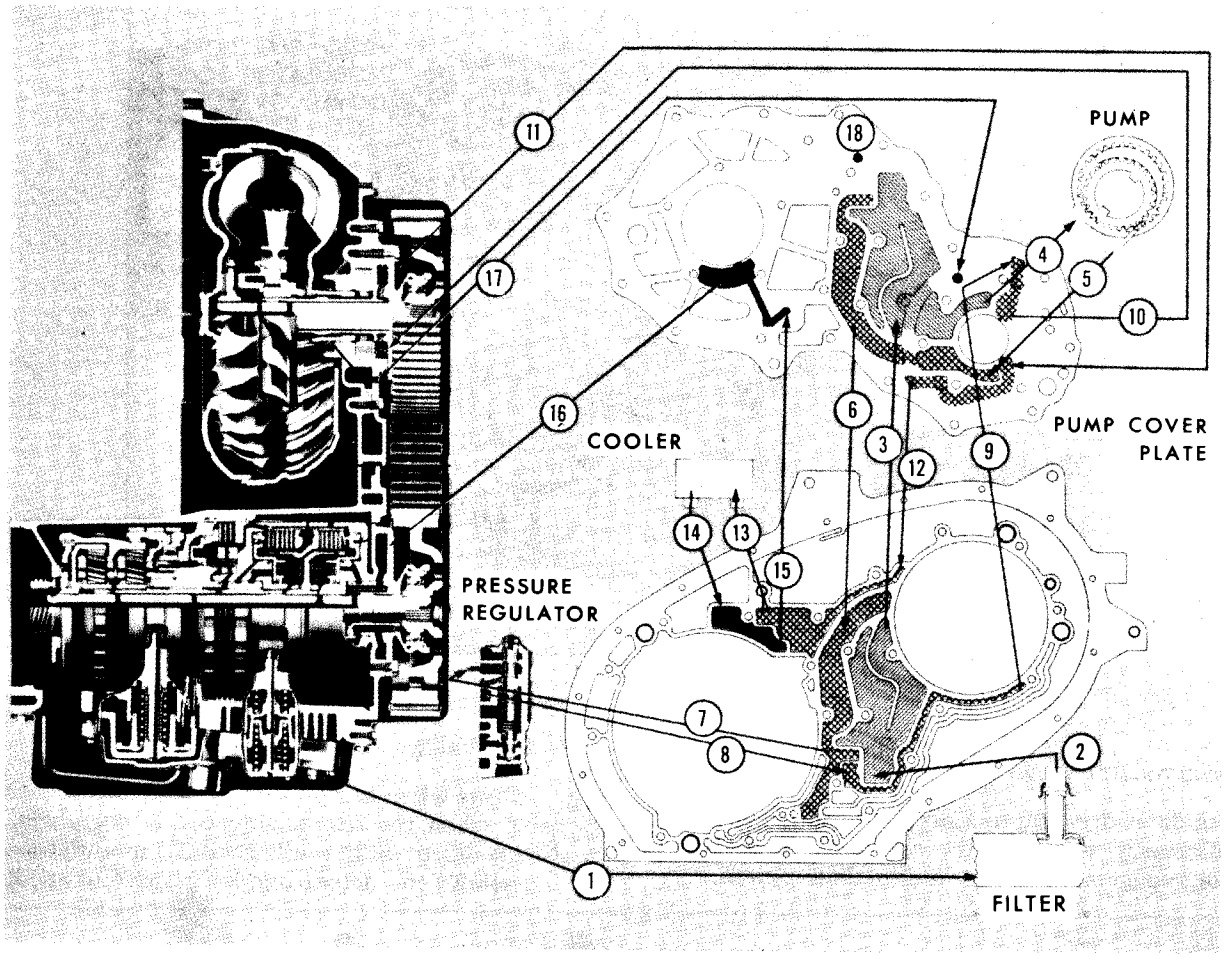
Activates the 2-3 and 3-2 shifts.

2-3 Modulator Valve

Senses modulator pressure to apply a variable force that tends to hold the 2-3 shift valve downshifted.

3-2 Valve

Shuts off modulator pressure from acting on the shift valves after the direct clutch has been applied. This allows fairly heavy throttle operation in third speed without downshifting. In third speed, detent pressure or modulator pressure above 87 psi can be directed to the shift valves to provide the downshift forces.



1 OIL FROM SUMP TO FILTER
2 FILTER TO CASE PASSAGE
3 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
4 PUMP COVER PLATE PASSAGE TO PUMP
5 PUMP TO PUMP COVER PLATE PASSAGE
6 PUMP COVER PLATE PASSAGE TO CASE PASSAGE
7 CASE PASSAGE TO PRESSURE REGULATOR VALVE
8 PRESSURE REGULATOR VALVE TO CASE PASSAGE
9 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
10 PUMP COVER PLATE PASSAGE TO CONVERTER
11 CONVERTER TO PUMP COVER PLATE PASSAGE
12 PUMP COVER PLATE PASSAGE TO CASE PASSAGE
13 CASE PASSAGE TO COOLER
14 COOLER RETURN TO CASE PASSAGE
15 CASE PASSAGE TO PUMP COVER PLATE PASSAGE
16 PUMP COVER PLATE PASSAGE TO TRANSMISSION POWER TRAIN (ALL INTERNAL LUBRICATION)
NOTE: THE NUMBERS IN THE CROSS SECTION INDICATE THAT THERE ARE ADDITIONAL LUBRICATION HOLES IN THIS AREA THAT ARE NOT SHOWN IN THE CROSS SECTION
17 FRONT SEAL DRAIN BACK HOLE
18 PRESSURE REGULATOR VENT HOLE

A-2085

Figure 4—Lubrication Chart

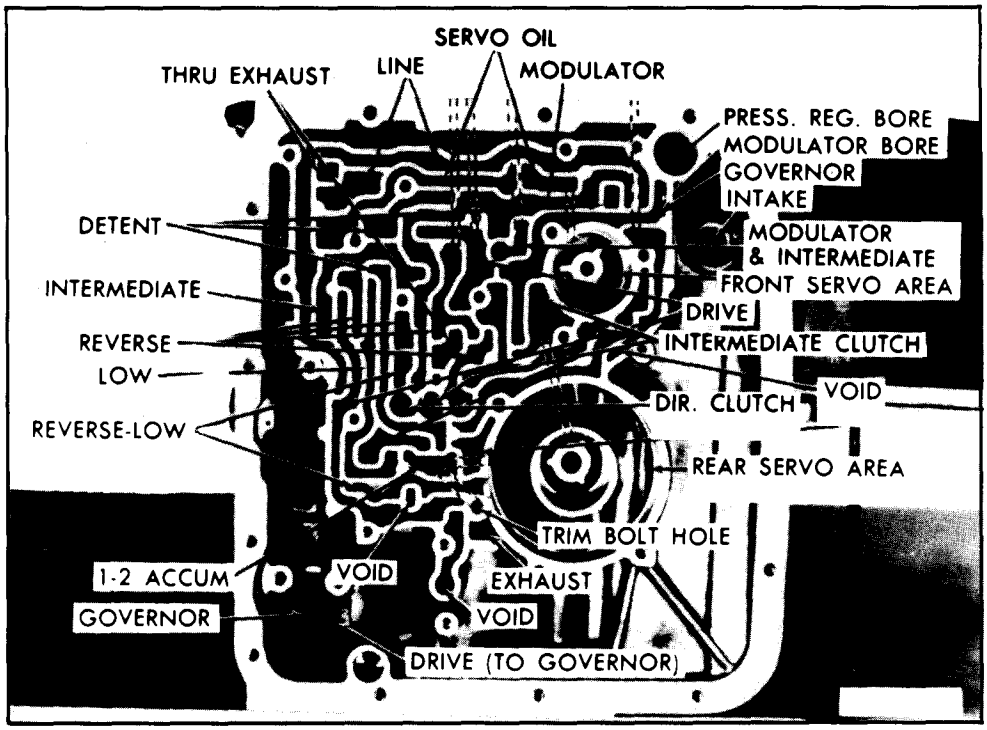


Figure 5—Case Oil Passages—Bottom

1-2 Accumulator Valve

Regulates drive oil to a proportional lesser value that increases as modulator pressure increases, to control engagement of the intermediate clutch.

Detent Valve

Shifts when line oil is exhausted at the end of the valve when the detent solenoid is energized. This directs detent oil to the 1-2 and 2-3 modulator valves and allows the detent regulator valve to regulate.

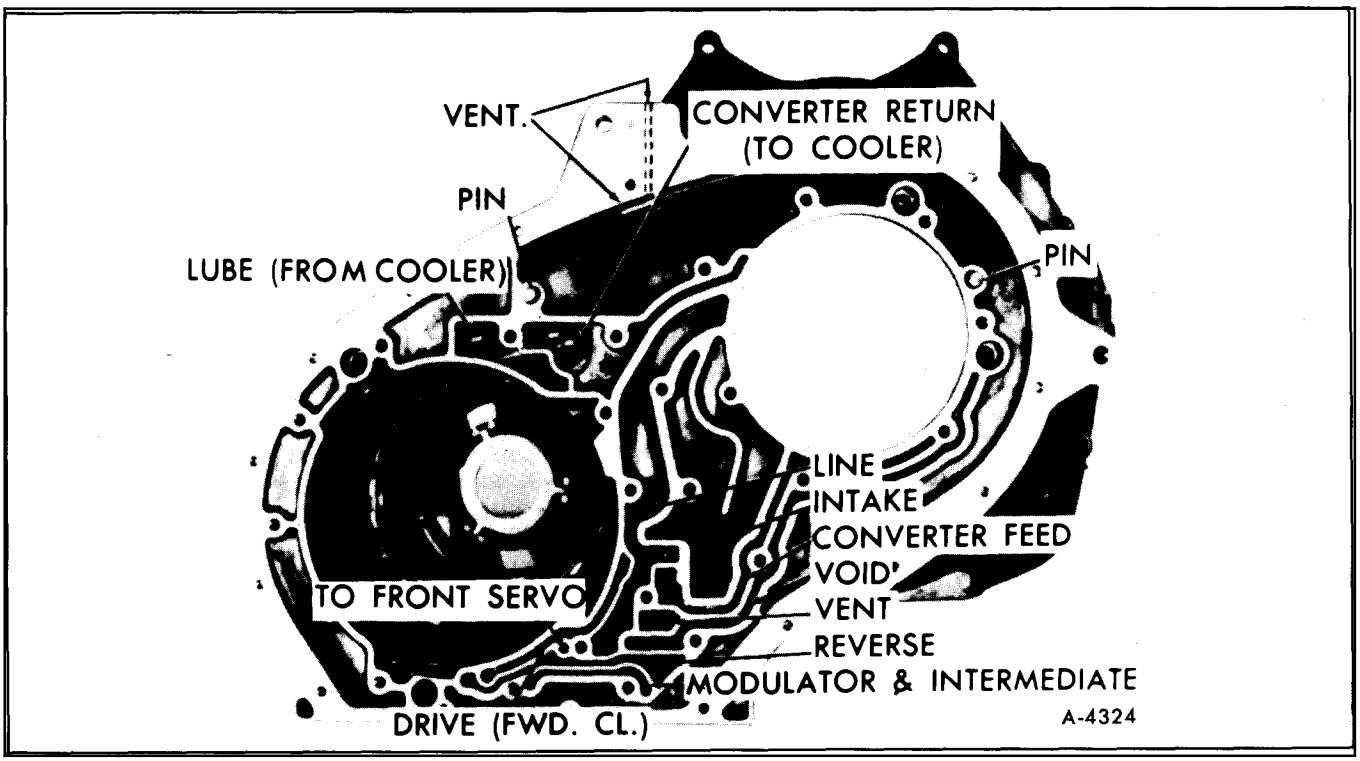


Figure 6—Case Oil Passages—Rear

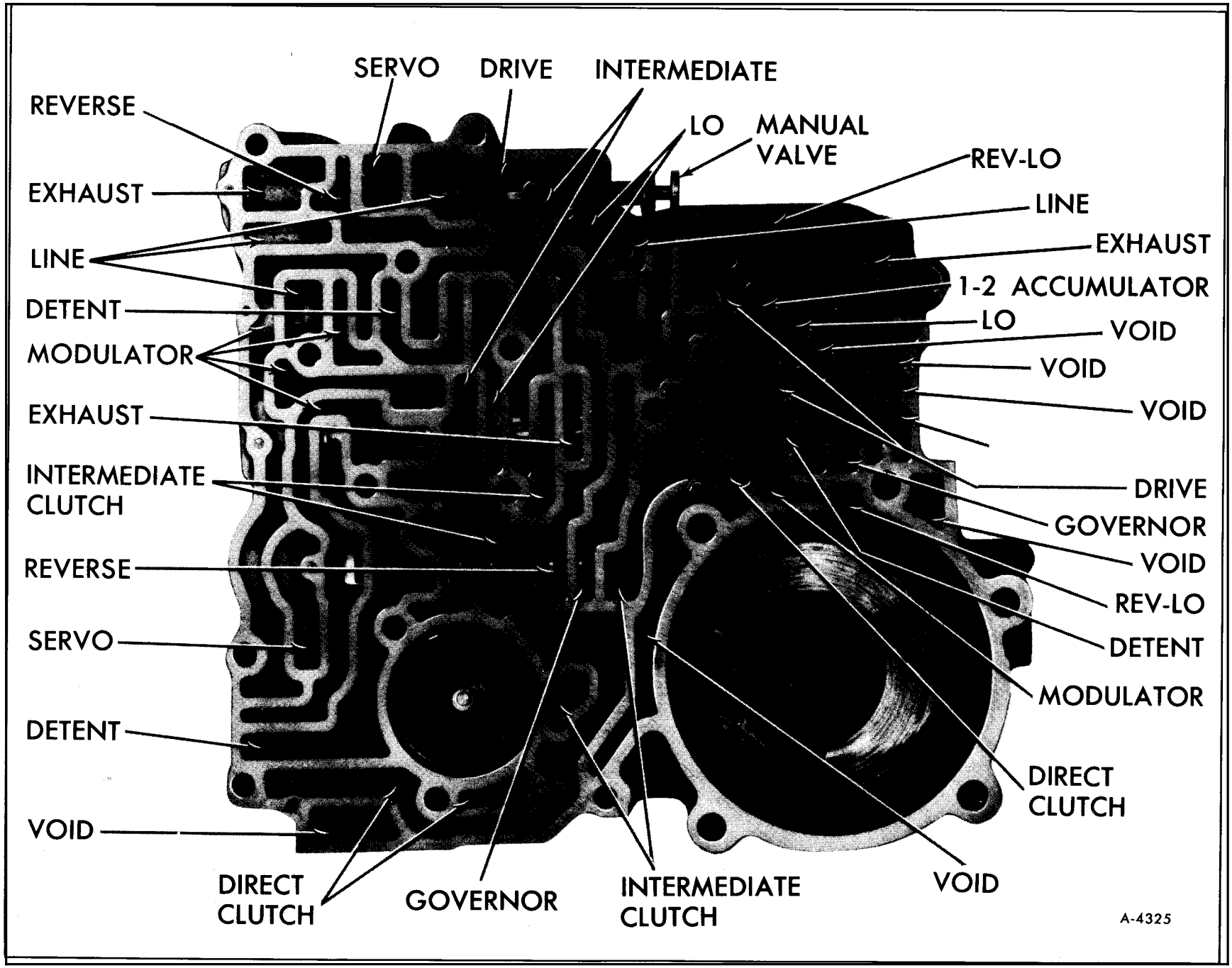


Figure 7—Control Valve Body

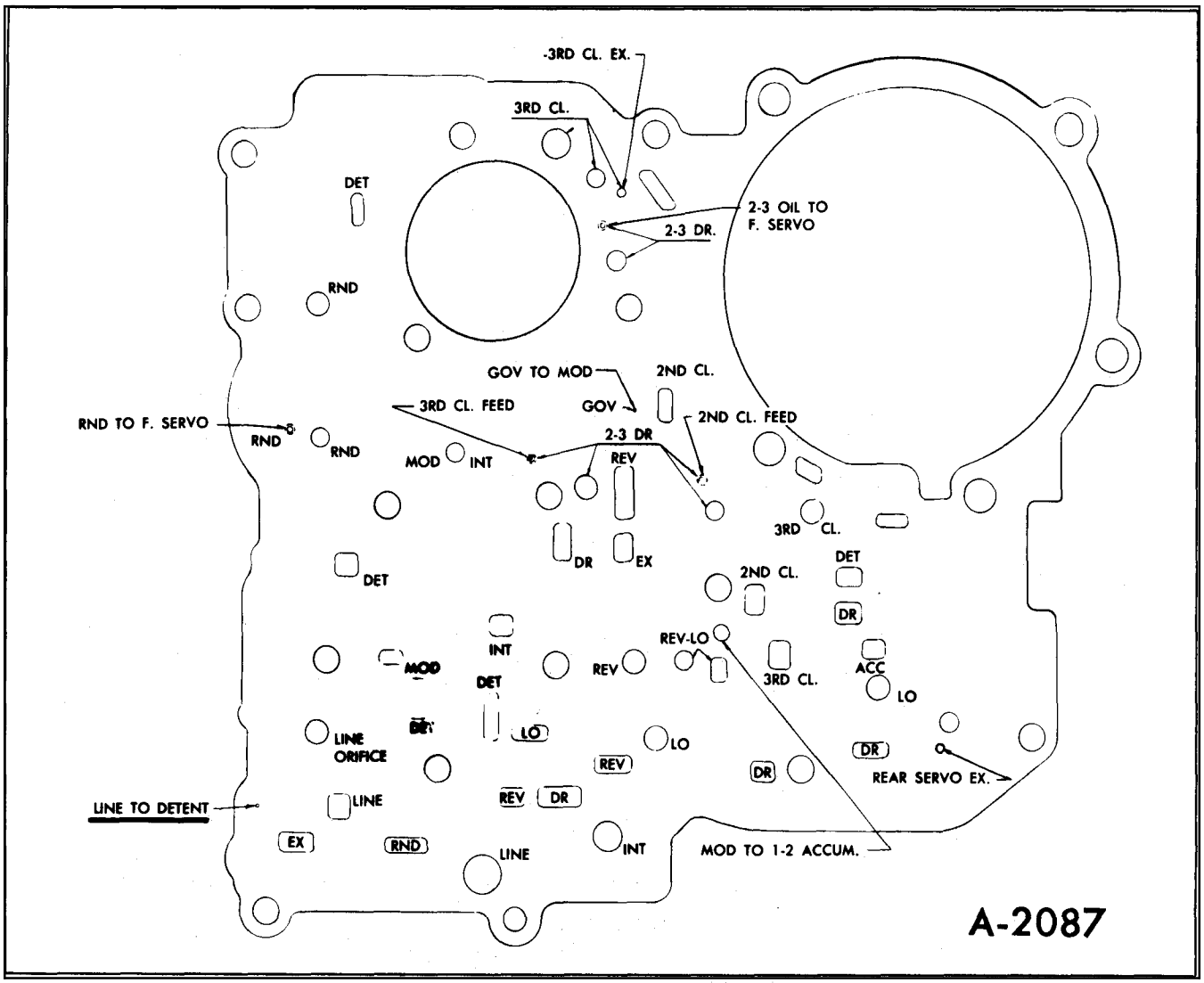


Figure 8—Spacer to Control Valve Assembly

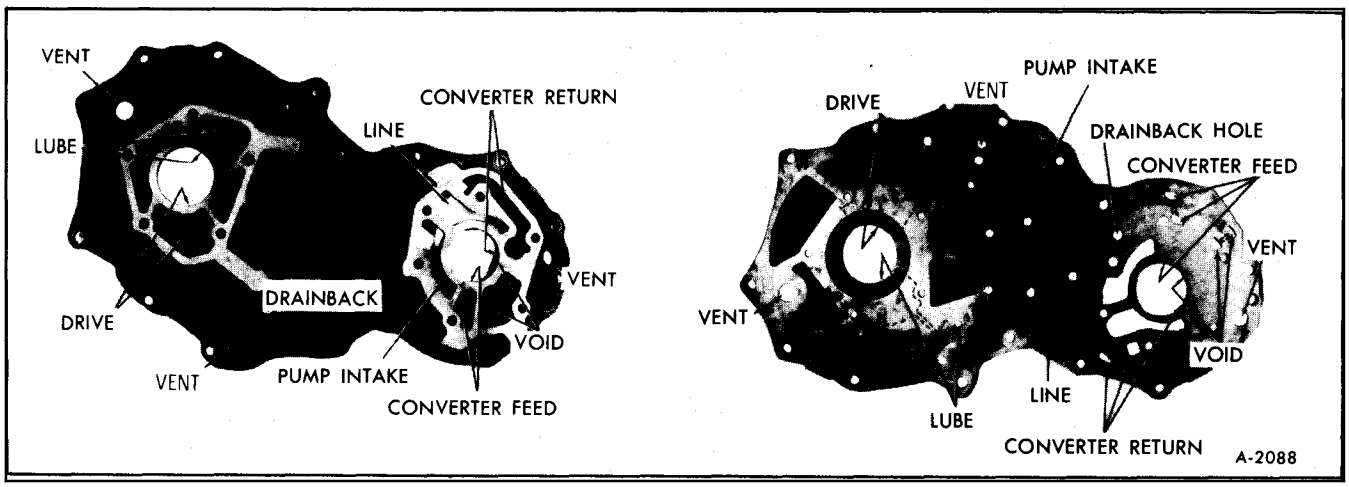
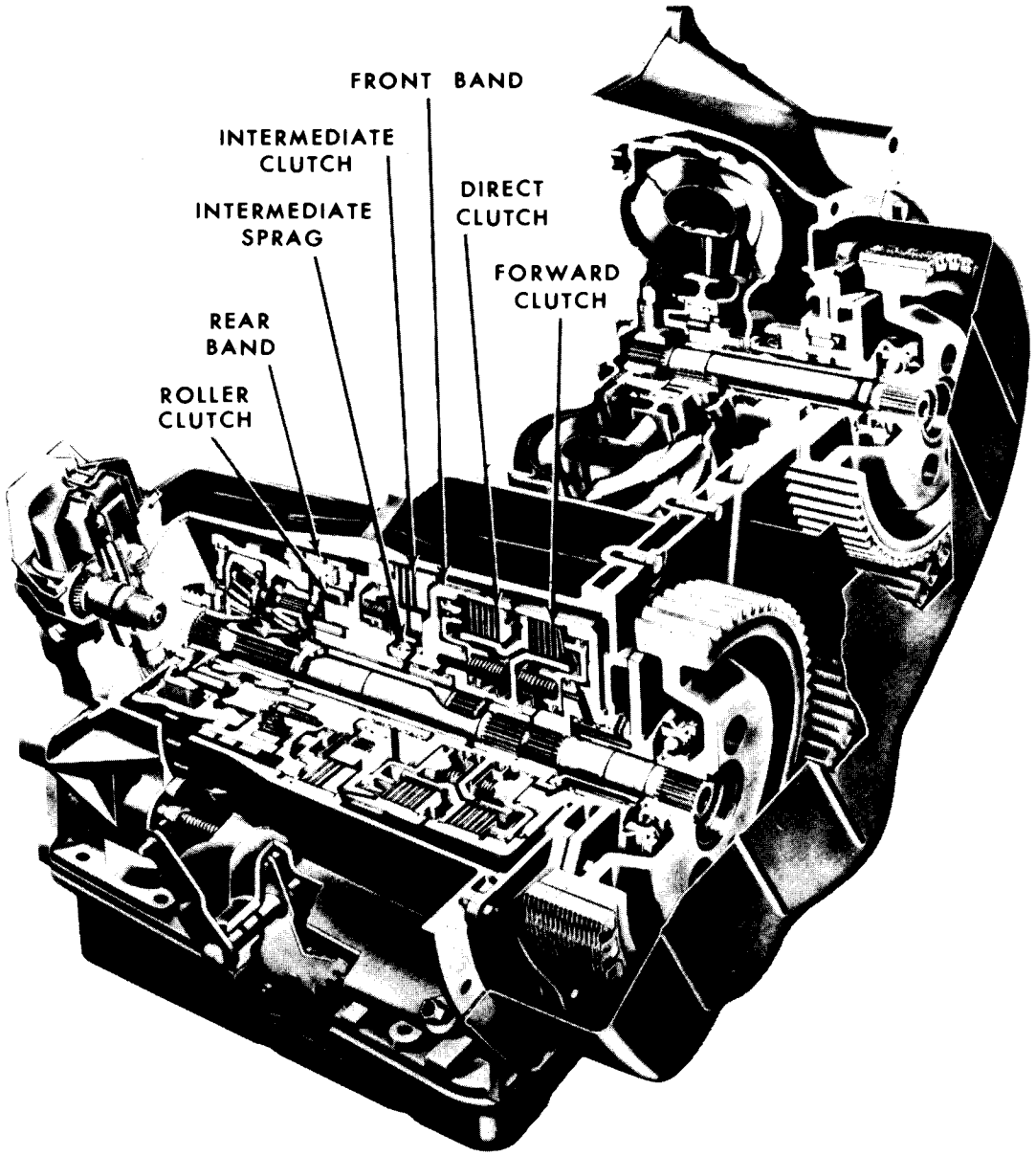


Figure 9—Pump Cover Oil Passages



A-4326

SELECTOR POSITION	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INT. CLUTCH	INT. SPRAG	ROLLER CLUTCH	REAR BAND
PARK—NEUT.	OFF	OFF	OFF	OFF	OFF	OFF	OFF
DRIVE 1 LEFT 2 3	ON ON ON	OFF OFF ON	OFF OFF OFF	OFF ON ON	OFF ON OFF	ON OFF OFF	OFF OFF OFF
DRIVE 1 RIGHT 2	ON ON	OFF OFF	OFF ON	OFF ON	OFF ON	ON OFF	OFF OFF
LO 1 2	ON ON	OFF OFF	OFF ON	OFF ON	OFF ON	ON OFF	ON OFF
REV.	OFF	ON	OFF	OFF	OFF	OFF	ON

Figure 10—Clutch, Band and Sprag Application

Detent Regulator Valve

When the detent valve shifts, the detent regulator is freed to allow drive oil to enter the detent passage and thus becomes regulated at 70 psi. Detent pressures will also flow into the modulator passage which flows to the shift valves. Detent pressure acting on the modulator valve limits the low limit of modulator pressure to the value of detent pressure.

Rear Servo and Accumulator Assembly

The rear servo piston applies the rear band for engine braking in Lo range 1st gear. It applies the band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

On the 1-2 shift in Drive or Super, the rear accumulator piston serves as an accumulator for the intermediate clutch to provide a smooth shift.

Front Servo

The front servo piston applies the front band to provide engine braking in 2nd gear in Super and Lo ranges. The front accumulator piston cushions the apply of the direct clutch, and in conjunction with a series of check balls controlling orifices, is a part of the timing for the release of the direct clutch.

To prevent the apply of the front band in Neutral, Drive and Reverse ranges, oil is directed from the manual valve to the release side of the servo piston.

In Drive the servo release oil from the manual valve is used to charge the servo in preparation for the apply of the direct clutch.

Direct clutch oil is directed to the front servo accumulator piston where spring force plus direct clutch pressure stroke the piston up against the force of servo release oil. This lowers the clutch apply pressure for a smooth engagement.

The release of the direct clutch and the exhausting of the front servo accumulator is slowed down by the three check balls and three orifices which permits a soft return of the drive load to the intermediate roller clutch and also allows engine rpm to increase during a detent 3-2 downshift in preparation for the lower gear ratio, which results in a smooth shift and better acceleration.

IMPORTANT: Oil flow circuits and power flow charts are the same as used in 1974 and are not included in this manual.

TROUBLE DIAGNOSIS

FLUID LEAKAGE PRECAUTIONS

The precautions that must be observed to prevent fluid leaks are as follows:

1. Use new gaskets and O-ring seals whenever there is a disassembly.

2. Use a very small amount of petrolatum to hold gaskets and thrust washers in place during assembly, or to seal gaskets. Never use gasket paste or shellac.

3. Make sure that composition cork and paper gaskets are not wrinkled or creased when installed. Make sure that gaskets have not stretched or shrunk during storage.

4. Make sure the square type O-ring seals are installed squarely and are not twisted during assembly.

5. Make sure that mating surfaces of castings are flat and smooth, free of deep scratches, chips, and burrs.

6. Torque bolts to proper torque.

POINTS OF POSSIBLE OIL LEAKS

When checking for oil leaks, first determine whether leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. However, the fluid color will change after a short time in service. Red dye appearing in the leaking oil will give positive identification as to the location of the leak.

If oil leak is found to be in transmission, check for leak in following areas:

REAR END

It will be necessary to remove converter cover to determine location of leaks at rear end. To correct leaks at rear end, it will be necessary to remove transmission from vehicle.

1. Pump oil seal leak — Check pump oil seal to make certain it is correctly installed and not damaged.

When installing a new pump oil seal, make certain that bore is free from foreign material and that garter spring on seal is correctly positioned. Check finish of converter neck and bearing surface in pump body.

2. Pump assembly-to-case O-ring damaged. Also check case bore.

3. Converter — Inspect converter for indications of leakage.

4. Vent fitting damaged.

5. Pump attaching bolts loose.

6. Porous casting (pump or case).

7. Pump drainback hole not open.

COVER AND PLATE ASSEMBLY SPROCKET HOUSING LEAK

1. Attaching bolts not correctly torqued.

2. Housing to case gasket improperly installed or damaged.

3. Housing to case gasket face not flat.

FINAL DRIVE TO TRANSMISSION LEAK

1. Attaching bolts not correctly torqued.

2. Final drive to transmission gasket improperly installed or damaged.

3. Mounting surfaces not flat.

TRANSMISSION CASE

1. Speedometer driven gear housing retainer attaching screw loose. Tighten to 18 foot-pounds.

2. Speedometer driven gear housing O-ring or lip seal damaged. Leak at speedo hole.

3. Governor cover bale-type attaching retainer not tight.

4. Damaged governor O-ring.

5. Governor drainback in case not open.

6. Solenoid connector terminal O-ring damaged or improperly installed.

7. Manual shaft O-ring damaged or improperly installed.

8. Vacuum modulator damaged.

9. Vacuum modulator retainer screw loose. Tighten to 18 foot-pounds.

10. Vacuum modulator diaphragm damaged, (not an external oil leak).

NOTE: A ruptured diaphragm would allow transmission oil to be drawn into intake manifold and vacuum line. Usually the exhaust will be excessively smoky due to transmission oil added to the combustion. Oil level of transmission will also be low.

11. Modulator assembly O-ring seal damaged or improperly installed.

12. Bottom pan gasket damaged.

13. Bottom pan attaching screws loose. Tighten to 12 foot-pounds.

14. Line pressure plug not tight. Tighten to 10 foot-pounds. Also, plug stripped, shy sealer compound.

15. Porous or cracked casting. Case cracked at pressure plug boss.

16. Vent pipe.

a. Transmission over-filled.

b. Water in oil.

c. Pump to case gasket mispositioned.

d. Foreigh material between pump and case, or between pump cover and body.

e. Case — Porous, pump face improperly machined.

f. Pump — Shy of stock, porous.

g. Filter O-ring damaged or improperly assembled causing oil to foam.

h. Hole in intake pipe.

i. Drainback hole in case plugged or restricted. See Figure 6 for location.

OIL COOLER PIPE CONNECTIONS

1. Outside oil cooler pipe connections improperly installed or damaged. Also connectors in radiator and transmission.

2. Oil cooler pipe connections not tight. Tighten to 20 foot-pounds.

3. Flare on oil cooler pipes damaged at radiator or transmission.

FILLER PIPE

1. O-ring damaged or improperly installed on pipe.

2. Filler Pipe not fully seated in case.

INTERNAL LEAKS

It will be necessary to remove bottom pan to determine location of internal leaks.

1. Governor pipes damaged.

2. Control valve assembly-to-spacer or case gaskets damaged.

3. Control valve assembly attaching screws loose. Tighten to 8 foot-pounds.

4. Solenoid gaskets damaged.

5. Solenoid attaching screws loose. Tighten to 8 foot-pounds.

6. Intake pipe O-ring damaged.

7. Rear servo square cut O-ring improperly installed or damaged.

FUNCTIONAL DIAGNOSIS PROCEDURE

Dependability of the diagnosis charts depends upon:

1. Careful analysis of symptoms so that proper malfunction on the charts will be used.

2. Accurate oil pressure check with accurate gauge is made as indicated on the chart and these readings recorded so that they can be compared with the diagnosis chart.

3. Oil pressure readings must be made with transmission oil at normal operating temperatures.

4. Refer to detailed diagnosis charts for additional diagnosis on 1-2 and 2-3 shift malfunction diagnosis.

5. Engine must be properly tuned to specifications.

ROAD TEST

Check All Shifts In The Following Manner:

DRIVE RANGE:

Position selector lever in DRIVE RANGE and accelerate the vehicle from 0 mph. A 1-2 and 2-3 shift should occur at all throttle openings. (The shift points will vary with the throttle opening). As the vehicle decreases in speed to 0 mph, the 3-2 and 2-1 shifts should occur.

SUPER RANGE:

Position the selector lever in SUPER RANGE and accelerate the vehicle from 0 mph. A 1-2 shift should occur at all throttle openings. (No 2-3 shift can be obtained in this range). The 1-2 shift point will vary with throttle opening. As the vehicle decreases in speed to 0 mph, a 2-1 shift should occur. NOTE: The 1-2 shift in SUPER RANGE is somewhat firmer than in DRIVE RANGE. This is normal.

LO RANGE:

Position the selector lever in LO RANGE and accelerate the vehicle from 0 mph. No upshift should occur in this range, except in some vehicles which have a high numerical axle ratio and/or high engine rpm.

2ND GEAR — OVERRUN BRAKING:

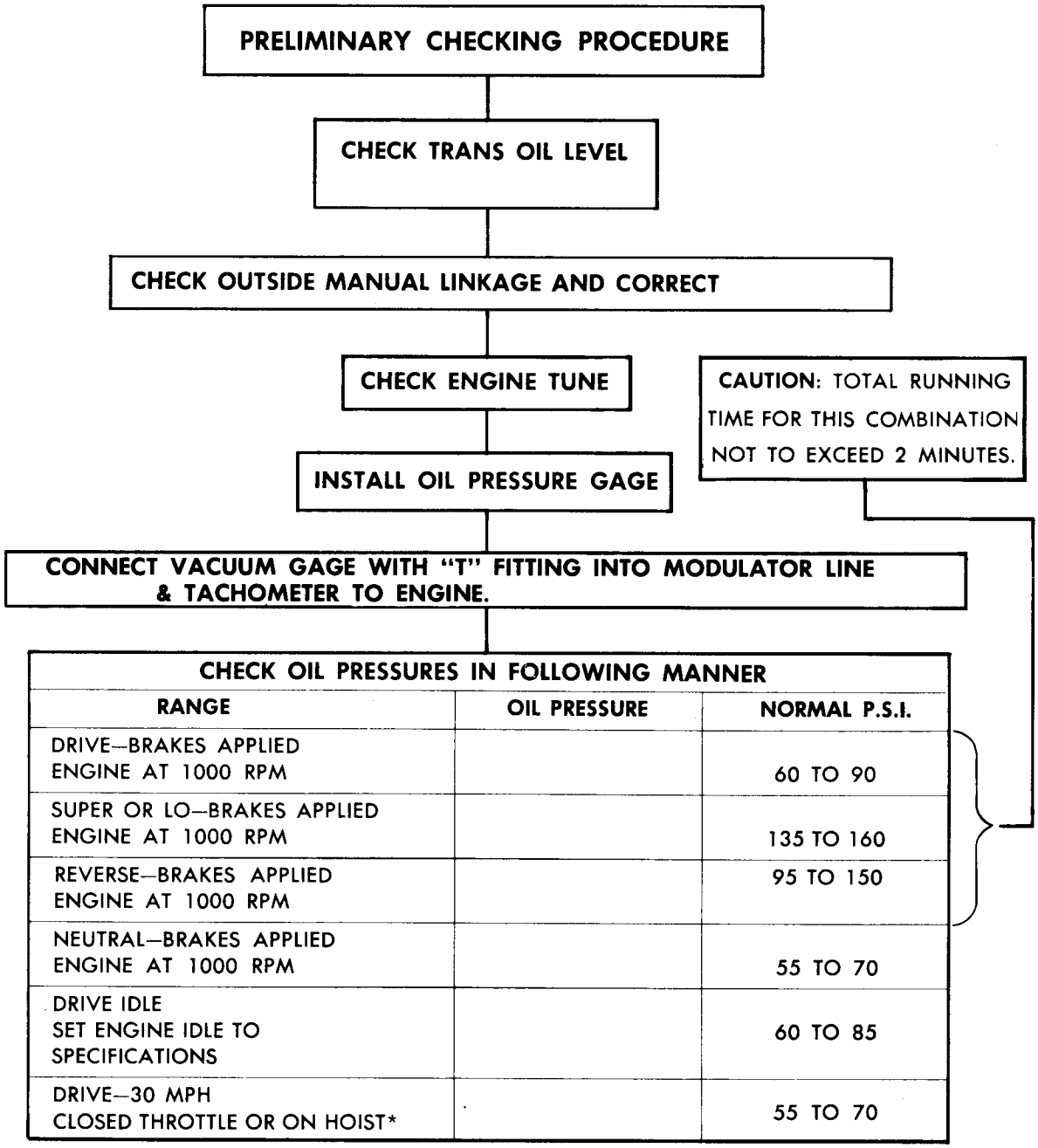
Position the selector lever in DRIVE RANGE, and with the vehicle speed at approximately 35 mph, move the selector lever to SUPER RANGE. The transmission should downshift to 2nd. An increase in engine rpm and an engine braking effect should be noticed. Line pressure should change from approximately 70 psi to approximately 150 psi in 2nd.

1st GEAR — OVERRUN BRAKING:

Position the selector lever in SUPER RANGE at approximately 30 to 40 mph, with throttle closed, move the selector lever to Lo. A 2-1 downshift should occur in the speed range of approximately 40 to 20 mph, depending on axle ratio and valve body calibration. The 2-1 downshift at closed throttle will be accompanied by increased engine rpm and an engine braking effect should be noticed. Line pressure should be approximately 150 psi. Stop vehicle.

REVERSE RANGE:

Position the selector lever in REVERSE POSITION and check for reverse operation.



CHECK OIL PRESSURES IN FOLLOWING MANNER		
RANGE	**OIL PRESSURE**	**NORMAL P.S.I.**
DRIVE—BRAKES APPLIED ENGINE AT 1000 RPM		60 TO 90
SUPER OR LO—BRAKES APPLIED ENGINE AT 1000 RPM		135 TO 160
REVERSE—BRAKES APPLIED ENGINE AT 1000 RPM		95 TO 150
NEUTRAL—BRAKES APPLIED ENGINE AT 1000 RPM		55 TO 70
DRIVE IDLE SET ENGINE IDLE TO SPECIFICATIONS		60 TO 85
DRIVE—30 MPH CLOSED THROTTLE OR ON HOIST*		55 TO 70

*THE DRIVE—30 MPH CLOSED THROTTLE PRESSURE READING MAY BE TAKEN DURING A ROAD TEST OR:

1. VEHICLE ON HOIST—DRIVING WHEELS OFF GROUND, FOOT OFF BRAKE, IN DRIVE RANGE.
2. Engine 2000 RPM.
3. CLOSE THROTTLE (FOOT OFF ACCELERATOR) AND TAKE PRESSURE READING ENGINE 2000-1200 RPM.

NOTE: WITH CLOSED THROTTLE AND DRIVING WHEELS OFF THE GROUND, ENGINE RPM WILL DROP RAPIDLY. PRESSURE READING MUST BE TAKEN WITHIN RPM'S INDICATED AND WITH CLOSED THROTTLE.

Preliminary Checking Procedure

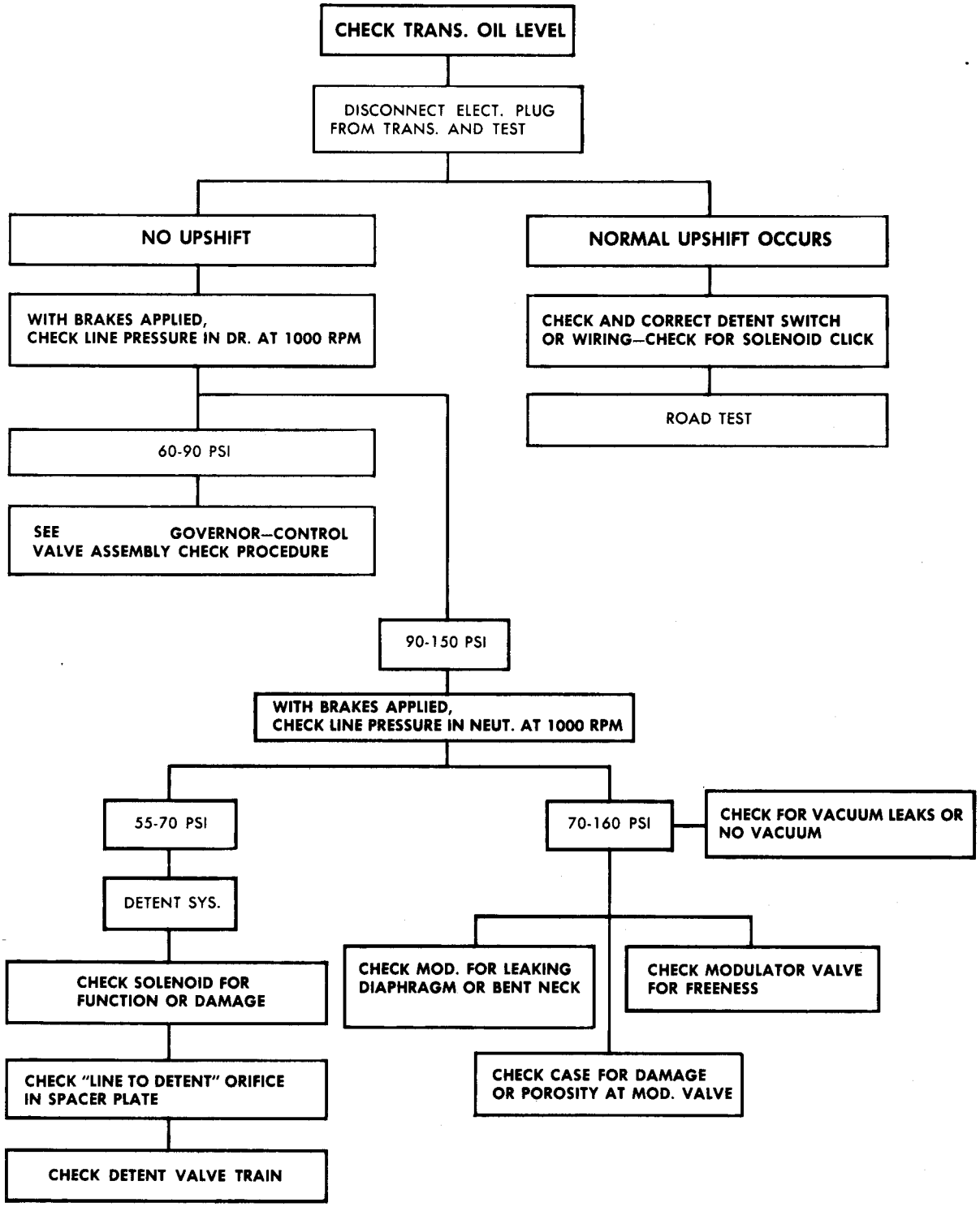
TRANSMISSION MALFUNCTION RELATED TO OIL PRESSURE

(PRESSURES OBTAINED BY THE PRELIMINARY CHECKING PROCEDURE)

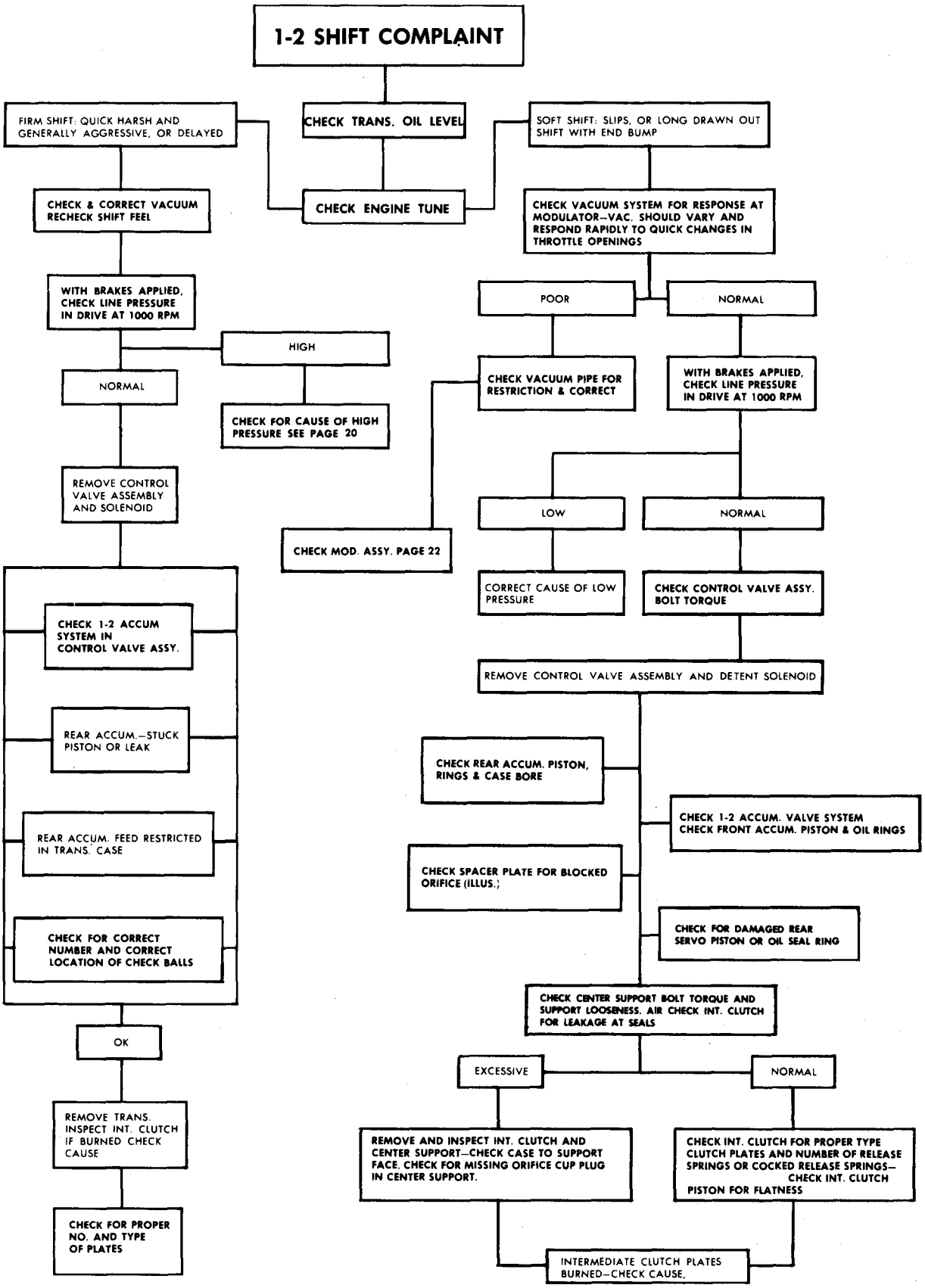
MALFUNCTION	DRIVE BRAKES APPLIED 1000 RPM	REVERSE BRAKES APPLIED 1000 RPM	SUPER OR LO BRAKES APPLIED 1000 RPM	NEUTRAL BRAKES APPLIED 1000 RPM	DRIVE 30 MPH CLOSED THROTTLE	DRIVE IDLE	PRESSURE DROP OCCURS WHILE ENGINE RPM INCREASES FROM 1000 TO 3000 RPM WHEELS FREE TO MOVE*	POSSIBLE CAUSE OF MALFUNCTION
	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE		
NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	DROP	MALFUNCTION IN CONTROL VALVE ASSY.
	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NO DROP	MALFUNCTION IN GOVERNOR OR GOVERNOR FEED SYSTEM
	HIGH	NORMAL	NORMAL	NORMAL	HIGH	—	—	MALFUNCTION IN DETENT SYSTEM
	HIGH	HIGH	NORMAL	HIGH	—	—	—	MALFUNCTION IN MODULATOR OR VACUUM FEED SYSTEM TO MODULATOR
SLIPPING—REVERSE	NORMAL	LOW	NORMAL	NORMAL	NORMAL	—	—	OIL LEAK IN FEED SYSTEM TO THE DIRECT CLUTCH
SLIPPING—1ST GEAR	LOW	NORMAL	LOW TO NORMAL	NORMAL	LOW TO NORMAL	—	—	OIL LEAK IN FEED SYSTEM TO THE FORWARD CLUTCH

* DRIVE RANGE, VACUUM LINE DISCONNECTED TO MODULATOR

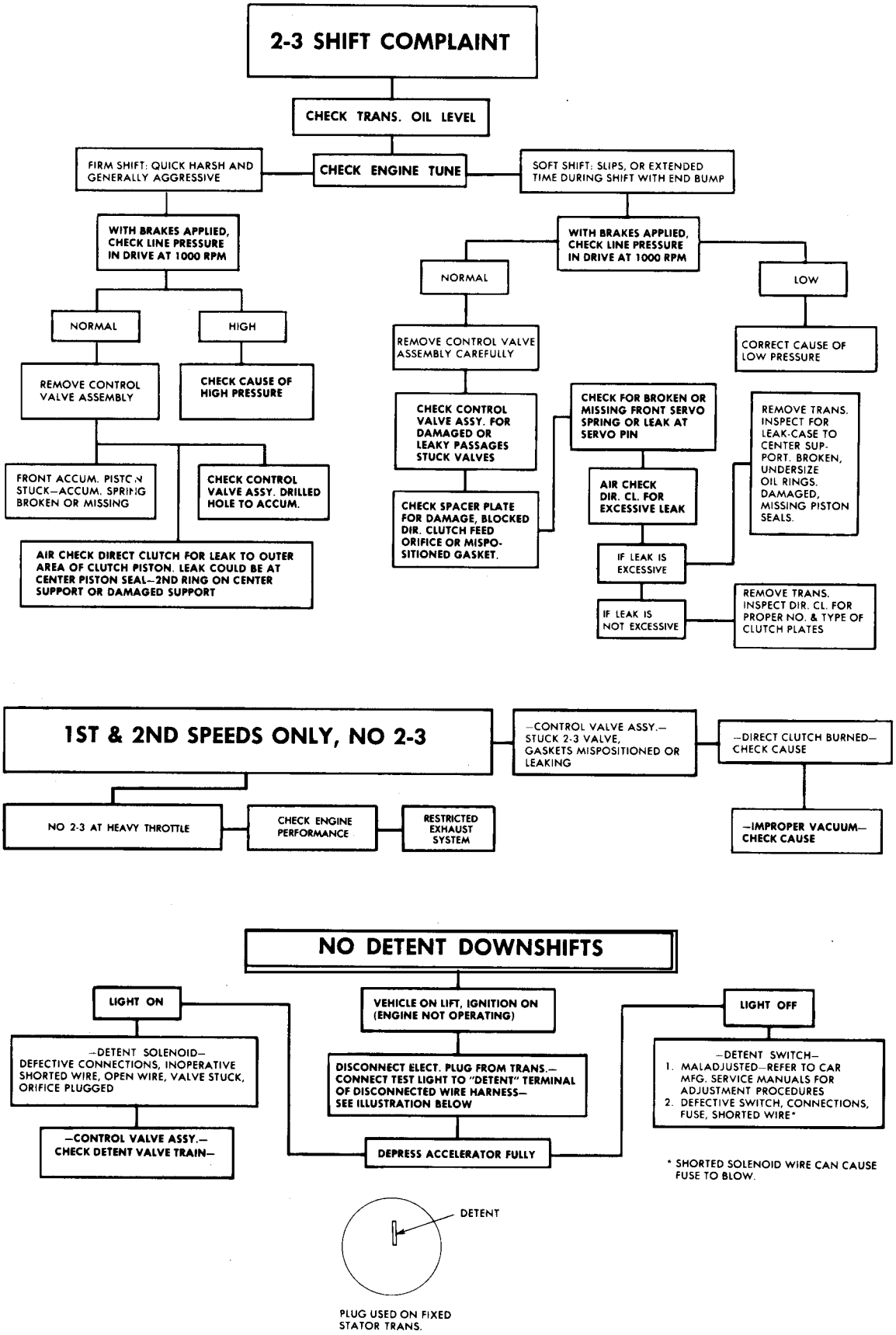
NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT OR 1-2 & 2-3 UPSHIFT—FULL THROTTLE ONLY



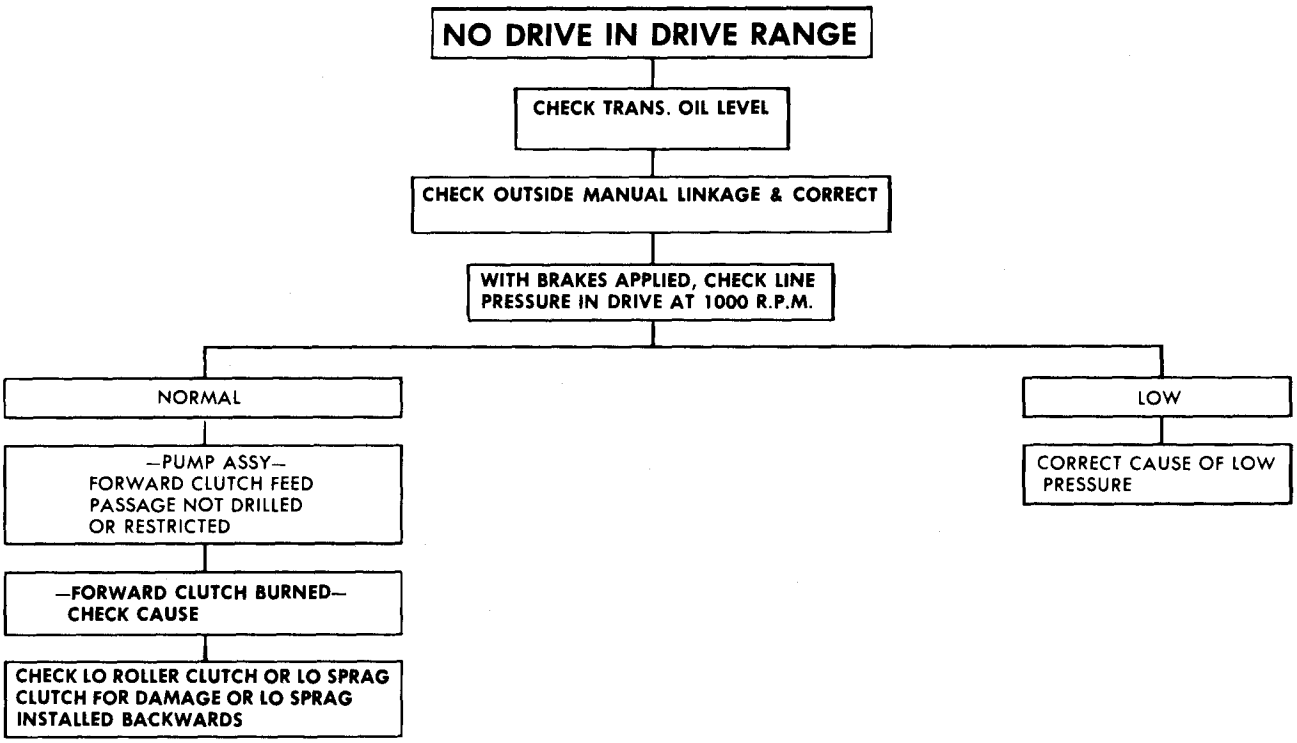
No. 1-2 Upshift

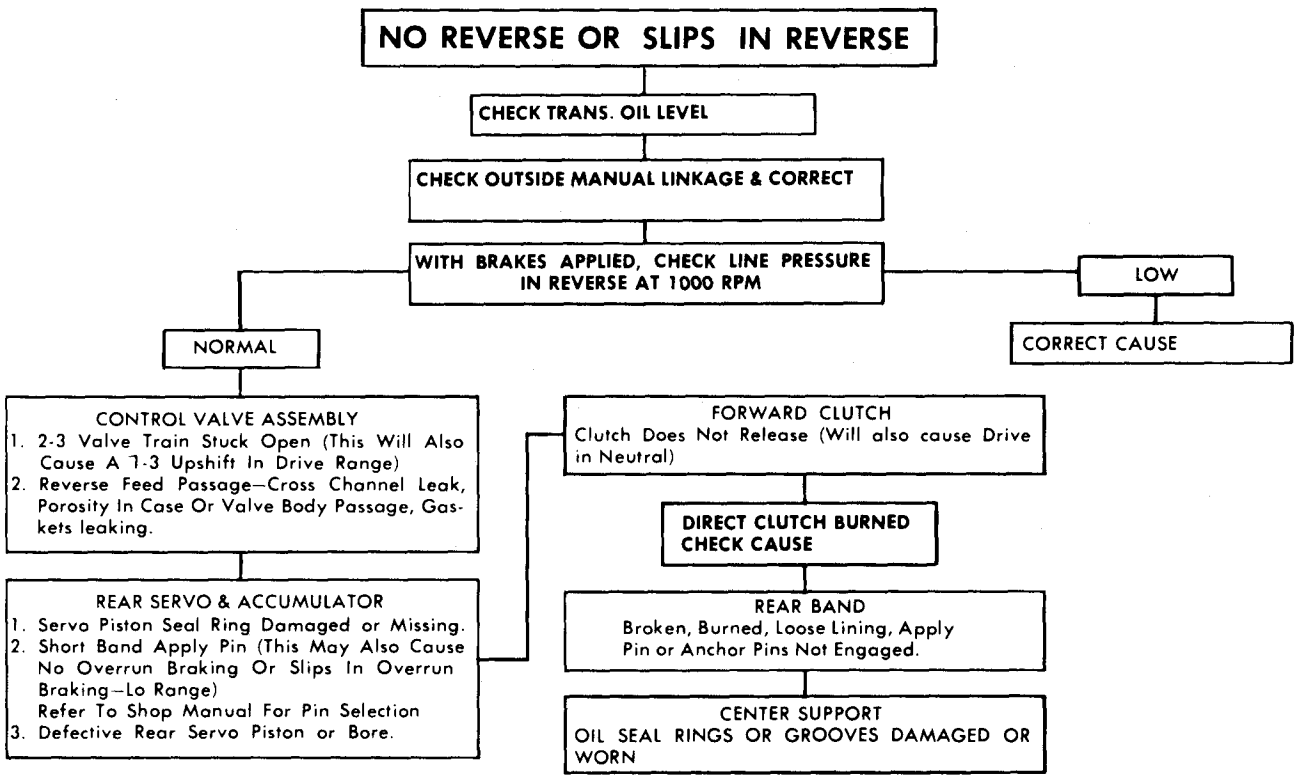


1-2 Shift Complaint



2-3 Shift, 1st & 2nd Speeds, No Detent





No Drive, No Reverse

NO ENGINE BRAKING—INTERMEDIATE RANGE—SECOND GEAR

—FRONT SERVO & ACCUMULATOR—
OIL RINGS AND/OR BORES LEAKING OR FRONT SERVO PISTON COCKED OR STUCK

INCORRECT COMBINATION OF FRONT SERVO AND ACCUMULATOR PARTS.

—FRONT BAND—
BROKEN, BURNED (CHECK FOR CAUSE), NOT ENGAGED ON ANCHOR PIN AND/OR SERVO PIN.

NO ENGINE BRAKING— LO RANGE— 1ST GEAR

—CASE ASSEMBLY—
LO—REVERSE CHECK BALL MISPOSITIONED OR MISSING. CASE DAMAGED AT LO—REVERSE CHECK BALL AREA.

—REAR SERVO—
OIL SEAL RING, BORE OR PISTON DAMAGED REAR BAND APPLY PIN SHORT, IMPROPERLY ASSEMBLED

—REAR BAND—
BROKEN, BURNED (CHECK FOR CAUSE), NOT ENGAGED ON ANCHOR PINS AND/OR SERVO PIN.

DRIVE IN NEUTRAL

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

—INTERNAL LINKAGE—
MANUAL VALVE DISCONNECTED OR END BROKEN, INSIDE DETENT LEVER PIN BROKEN.

—PUMP ASSEMBLY—
TRANS. LUBE PRESSURE LEAKING INTO FORWARD CLUTCH APPLY PASSAGE.

—FORWARD CLUTCH—
BURNED PLATES—CHECK CAUSE

INCORRECT CLUTCH PLATE USAGE

WON'T HOLD IN PARK OR WON'T RELEASE FROM PARK

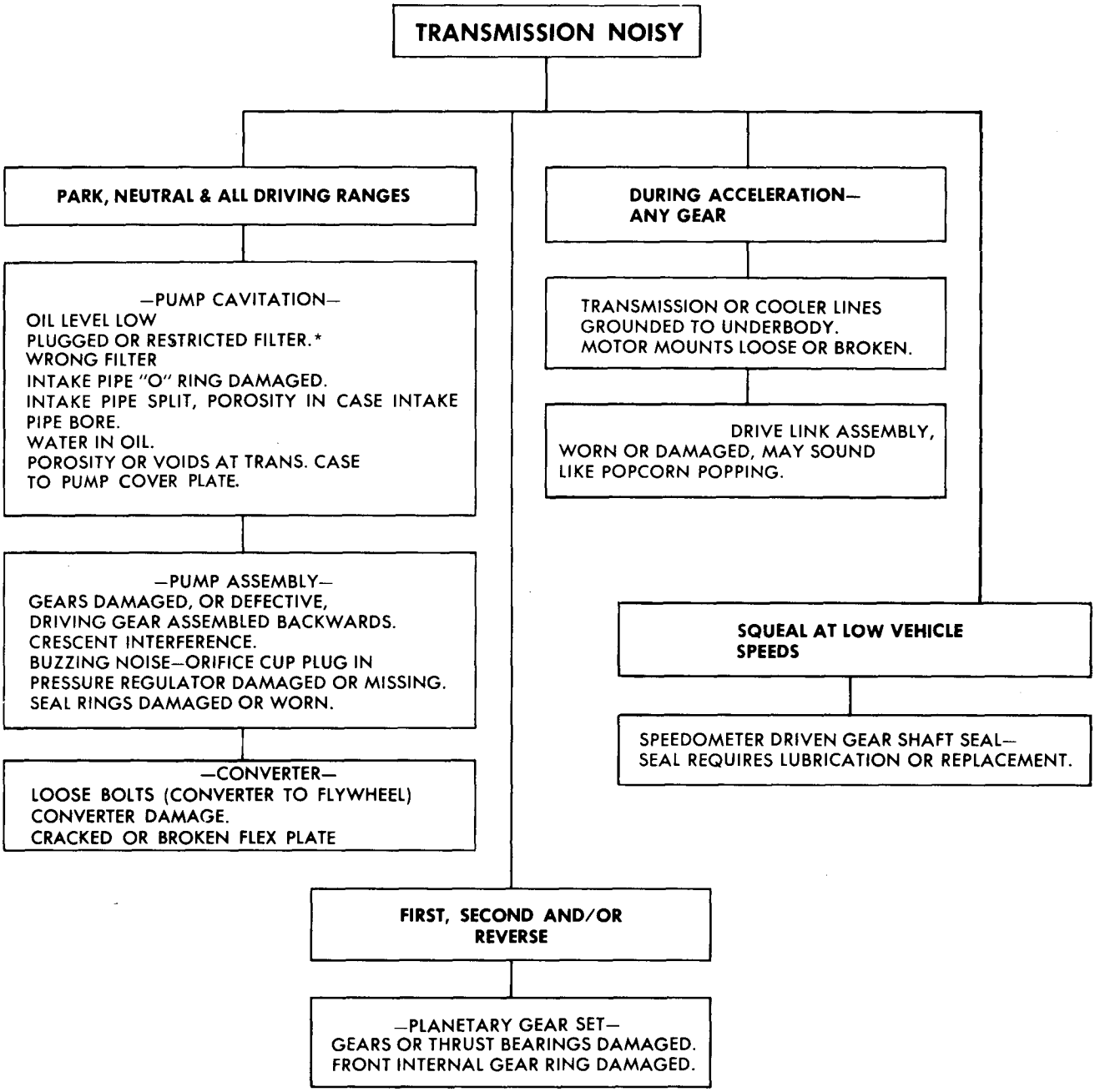
CHECK OUTSIDE MANUAL LINKAGE & CORRECT

—INTERNAL LINKAGE—

1. Parking Brake Rod Assy. (Check Actuator For Chamfer)
2. Parking Pawl Broken, Chamfer Omitted.
3. Parking Brake Bracket Loose, Burr Or Rough Edges, or Incorrectly Installed.
4. Parking Pawl Return Spring Missing, Broken or Incorrectly Hooked.

No Engine Braking

CAUTION: BEFORE CHECKING TRANSMISSION FOR WHAT IS BELIEVED TO BE "TRANS. NOISE," MAKE CERTAIN THE NOISE IS NOT FROM THE WATER PUMP, ALTERNATOR, AIR CONDITIONER, POWER STEERING, ETC. THESE COMPONENTS CAN BE ISOLATED BY REMOVING THE PROPER BELT AND RUNNING THE ENGINE NOT MORE THAN TWO MINUTES AT ONE TIME.



* There is no approved way of checking or cleaning the filter. If the filter is suspected of being plugged or restricted, it must be replaced.

Transmission Noisy

CAUSES OF LOW LINE PRESSURE

1. Low Transmission Oil Level.

2. Modulator Assembly

3. Filter.

a. Blocked or restricted.*

b. "O" Ring on intake pipe omitted or damaged.

c. Split or leaking intake pipe.

d. Wrong filter assembly.

4. Pump.

a. Pressure regulator or boost valve stuck.

b. Gear clearance, damaged worn. (Pump will become damaged if drive gear is installed backwards, or if converter pilot does not enter crankshaft freely).

c. Pressure regulator spring, too weak.

d. Not enough spacers in pressure regulator.

e. Pump cover plate to case gasket mispositioned.

f. Pump body and/or pump cover plate. Machining error or scoring of pump gear pocket.

g. Mismatch pump cover/pump body.

5. Internal Circuit Leaks.

a. Forward clutch leak (pressure normal in neutral and reverse-pressure low in drive).

1. Check rings on driven sprocket support housing for damages.

2. Check forward clutch seals for damage.

3. Check turbine shaft journals for distress.

4. Check stator shaft bushings for damage.

b. Direct clutch leak (pressure normal in neutral, low, intermediate, and drive—pressure low in reverse).

1. Check center support oil seal rings.

2. Check direct clutch outer seal for damage.

3. Check rear servo and front accumulator pistons and rings for damage or missing.

6. Case Assembly.

a. Porosity in intake bore area.

b. Lo-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in Lo range).

*There is no approved service procedure for checking or cleaning the filter. If the filter is suspected of being plugged or restricted, it must be replaced.

CAUSES OF HIGH LINE PRESSURE

1. Vacuum Leak.

a. Full leak (vacuum line disconnected).

b. Partial leak in line from engine modulator.

c. Improper engine vacuum.

d. Vacuum operated accessory leak. (Hoses, vacuum advance, etc.).

2. Damaged Modulator.

a. Stuck valve.

b. Water in modulator.

c. Not operating properly.

d. Orifice at end of modulator valve sleeve plugged or not drilled.

3. Detent System.

a. Detent switch actuated (plunger stuck) or shorted.

b. Detent wiring shorted.

c. Detent solenoid valve stuck open. Solenoid cover may be bent causing solenoid valve to be open.

d. Detent feed orifice in spacer plate blocked.

e. Detent solenoid loose.

f. Detent valve bore plug damaged.

g. Detent regulator valve pin short.

4. Pump.

a. Pressure regulator and/or boost valve stuck.

b. Incorrect pressure regulator spring.

c. Too many pressure regulator valve spacers.

d. Pump casting bad.

e. Pressure boost valve installed backwards or defective.

f. Wrong type pressure regulator valve.

IMPORTANT: Use only pressure regulator valve which has an orifice cup plug in it.

g. Pressure boost bushing broken or otherwise defective.

5. Control Valve Assembly.

a. Spacer plate-to-case gasket off location.

b. Wrong spacer plate-to-case gasket, or gaskets installed in reverse order.

CAUSES OF IMPROPER VACUUM AT MODULATOR

1. Engine.

a. Requires tune up.

b. Loose vacuum fittings.

c. Vacuum operated accessory leak (hoses, vacuum advance, etc.)

d. Engine exhaust system restricted.

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 or varnish material in pipe (no or delayed up-shift-cold).

CONTROL VALVE ASSEMBLY— GOVERNOR LINE PRESSURE CHECK

1. Install line pressure gage.

2. Disconnect vacuum line to modulator.

3. With vehicle on hoist (front wheels off ground), foot off brake, in drive, check line pressure at 1000 rpm.

4. Slowly increase engine rpm to 3000 rpm and determine if a line drop occurs (7 psi or more).

5. If pressure drop occurs, disassemble, clean and inspect control valve assembly.

6. If no pressure drop occurs:

a. Inspect governor.

1. Stuck valve.

2. Weight freeness.

3. Restricted orifice in governor valve.

4. Check governor valve entry and exhaust (.020" min.).

b. Governor feed system.

1. Check screen in governor feed pipe hole in case assembly.

2. Check for restrictions in governor pipe.

3. Check for fit of governor pipes in cast holes.

CAUSES OF BURNED CLUTCH PLATES

NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also, anti-freeze in transmission fluid can cause severe damage, such as large pieces of composition clutch material peeling off.

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. Manual valve mispositioned.

e. Restricted oil feed to forward clutch (Examples: Clutch housing to inner and outer areas not drilled, restricted or porosity in pump).

f. Pump cover oil seal rings missing, broken or undersize; ring groove oversize.

g. Case valve body face not flat or porosity between channels.

h. Manual valve bent and center land not ground properly.

2. Intermediate Clutch.

a. Rear accumulator piston oil ring, damaged or missing.

b. 1-2 accumulator valve stuck in control valve assembly.

c. Intermediate clutch piston seals damaged or missing.

d. Center support bolt loose.

e. Low line pressure.

f. Case valve body face not flat or porosity between channels.

g. Manual valve bent and center land not ground properly.

3. Direct Clutch.

a. Restricted orifice in vacuum line to modulator (poor vacuum response.)

b. Check ball in direct clutch piston damaged, stuck or missing.

c. Defective Modulator bellows.

d. Center support bolt loose. (Bolt may be tight in support but not holding support tight to case).

e. Center support oil rings or grooves damaged or missing.

f. Clutch piston seals damaged or missing.

g. Front and rear servo pistons and seals damaged.

h. Manual valve bent and center land not cleaned up.

i. Case valve body face not flat or porosity between channels.

j. Intermediate sprag clutch installed backwards.

k. 3-2 valve, 3-2 spring or 3-2 spacer pin installed in wrong location in 3-2 valve bore.

l. Incorrect combination of front servo and accumulator parts.

m. Replace intermediate clutch piston seals.

NOTE: If direct clutch plates and front band are burned, check manual linkage.

VACUUM MODULATOR ASSEMBLY

The following procedure is recommended for checking Turbo Hydra-matic modulator assemblies in the field before replacement is accomplished.

1. Vacuum Diaphragm Leak Check. Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil. If oil is found, replace the modulator.

CAUTION: *Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, the modulator should not be changed.*

2. Atmospheric Leak Check. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal. See Figure 11. 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.

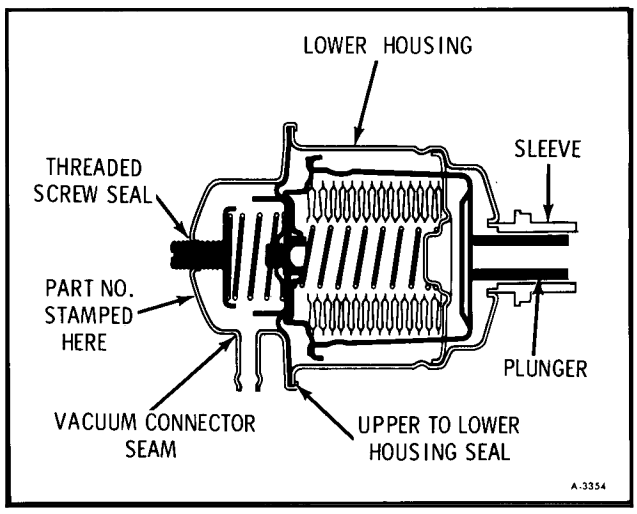


Figure 11—Modulator Assembly

CAUTION: *Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.*

3. Bellows Comparison Check. Make a comparison gauge, as shown in Figure 12, and compare the load of a known good Hydra-matic modulator with the assembly in question. Modulator Tension Tester such as J-24466 may also be used for this purpose.

a. Install the modulator that is known to be acceptable on either end of the gauge.

b. Install the modulator in question on the opposite end of the gauge.

c. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line should then be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

4. Sleeve Alignment Check. Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

DOWNSHIFT SOLENOID CIRCUIT CHECK

NOTE: Before checking the downshift solenoid circuitry, make certain that the transmission downshift switch is properly adjusted.

1. With transmission shift lever in Park, turn ignition switch to "ON" positon, but do not start vehicle. Leave ignition switch "ON" throughout checking procedure.

2. With the engine cover removed, slowly advance throttle linkage to wide open position. One click should be heard from transmission.

3. Allow throttle to return to closed position. One click should be heard from transmission.

4. If system performed as described above, downshift circuit is operating properly. If system does not perform as described above, proceed to step 5.

5. Use test light to check orange wire at connector on side of transmission case. Test light should

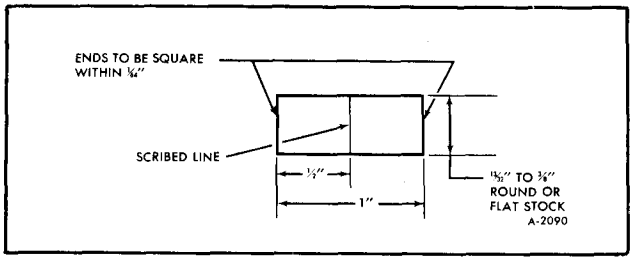


Figure 12—Vacuum Modulator Test Gauge

light with throttle wide open and go out when throttle is released.

a. If system operates as described above, but did not perform properly during steps 1-3, replace solenoid after first checking to see that internal wiring is operational.

b. If light fails to light with throttle in wide open position, the circuit is open, proceed to step 6.

c. If light lights with throttle closed, the circuit is shorted. Proceed to step 9.

6. At transmission downshift switch, use test light to check from the top terminal at switch with throttle wide open.

a. If test light lights, recheck system.

b. If test light fails to light, proceed to step 7.

7. Check lower feed wire at transmission downshift switch with test light.

a. If test light lights, replace transmission downshift switch. Recheck system.

b. If test light fails to light, proceed to step 8.

8. Check 10 amp. (gauges and transmission control fuse) in fuse panel.

a. If necessary to replace fuse, recheck system.

b. If fuse is all right, it will be necessary to locate the open in the wiring. Test the circuit continuity from the lower wire at the downshift switch to the battery.

9. At the transmission downshift switch, use test light to check from the disconnected top terminal at switch with throttle closed.

a. If test light fails to light, orange wire is shorted. Correct shorting condition.

b. If test light lights, proceed to step 10.

10. With throttle in closed position, check lower feed wire at transmission downshift switch.

a. If test light fails to light, replace transmission downshift switch. Recheck system.

b. If test light lights, it will be necessary to locate the short in the wiring. Test the circuit from the lower wire at the downshift switch to the battery.

CLUTCH PARTS

Clutch	No. of Flat Steel Clutch Plates	No. of Waved Steel Clutch Plates
Forward Clutch	5	1*
Direct Clutch	5	1
Intermediate Clutch	3	—
*Clutch Plate Dished		
Clutch	No. of Clutch Composition Plates	No. of Piston Release Springs
Forward Clutch	5	16
Direct Clutch	6	14
Intermediate Clutch	3	6

ON VEHICLE SERVICING

FLUSHING OIL COOLER

The oil cooler is located in the side tank of the radiator and its purpose is to cool the oil in the event excessive temperature tends to develop. (figure 13)

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. The oil cooler is a sealed container providing a passage for oil to flow from the inlet to the outlet. Clean solvent can be flushed through the cooler with air pressure. (An engine desludge gun may be used.) The cooler should be back-flushed first through the return line to remove all foreign material possible. Then flush through the inlet line and finish by flushing through the return line. Clean remaining solvent from cooler with compressed air applied to the return line and flush with transmission fluid.

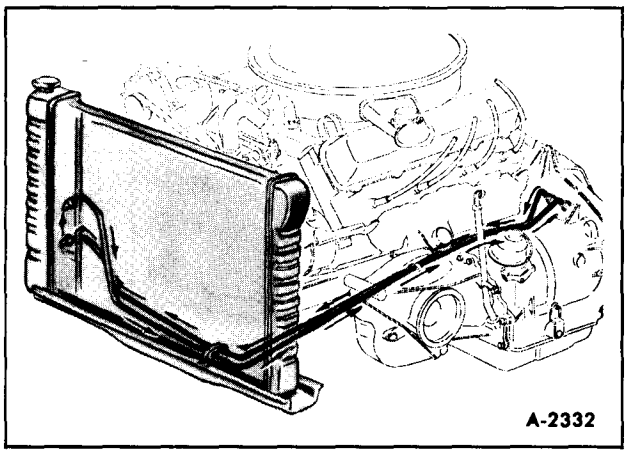


Figure 13—Oil Cooler and Lines

LINKAGE ADJUSTMENT (FIGURE 14)

CAUTION: *Block vehicle wheels and apply parking brake before attempting transmission linkage adjustment.*

1. Place steering column shift lever in neutral against stop in column, (a detent will hold it there).

2. Loosen relay rod clamp screw.

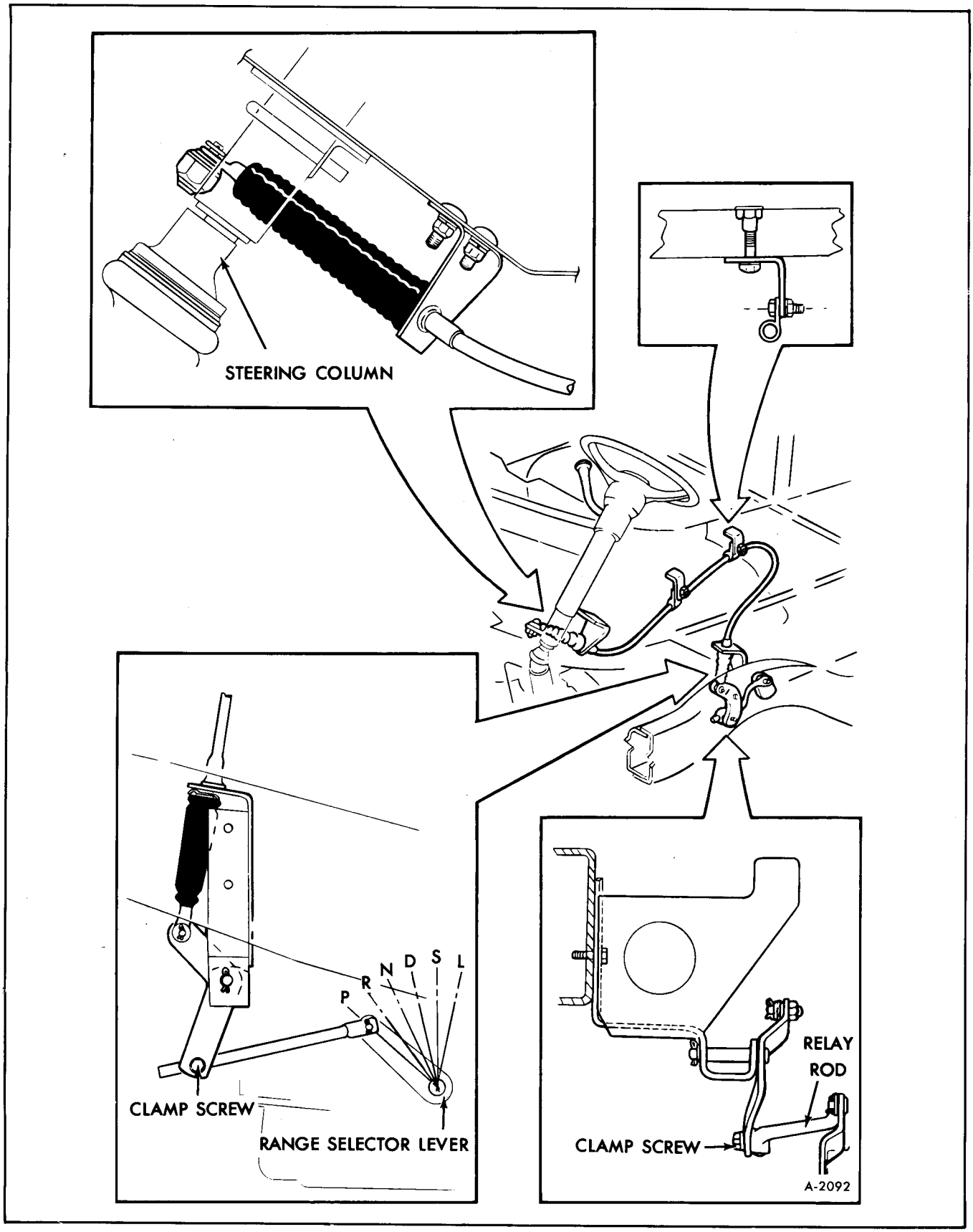


Figure 14—Transmission Manual Linkage

3. Position range selector lever in the neutral detent position.

4. Tighten relay rod clamp screw to 20 ft. lbs., making sure shift lever is held against Neutral stop while this operation is being performed.

5. Check operation of selector lever by performing the following steps:

a. Lift lever and move to Neutral detent. (This is the detent in the transmission.) Release the lever and check to make sure that the lever fits into the neutral notch in the steering column.

b. Move lever to Drive detent. There should be a slight travel of the lever beyond this detent until the drive stop in the steering column is reached.

c. Move lever to Reverse detent and check as in b above.

6. Check for proper operation of neutral safety switch and back-up lights, (be sure vehicle has positive "PARK" engagement and "LO" range engagement).

DOWNSHIFT SWITCH ADJUSTMENT

The procedure for adjusting the downshift switch is described in SECTION 6M under "Accelerator Control".

CHECKING AND ADDING FLUID

NOTE: Vehicle level and oil temperature are particularly important when checking fluid level on a Turbo Hydra-matic transmission. Careful attention to the following procedures is necessary in order to determine the actual fluid level.

Oil Recommendations

Whenever fluid is added to the transmission use only DEXRON ® II type transmission fluid, or fluids of equivalent quality that have been especially formulated and tested for use in the Turbo Hydra-matic transmission.

Oil Level

The transmission dipstick and filler tube are located under the engine access cover at the left center side of the engine. The "FULL" and "ADD" dimple marks on the transmission dipstick indicate one pint difference. Correct fluid level is determined at normal engine coolant operating temperature, 190-200°F. (88-93°C.). Automatic transmissions are frequently overfilled because fluid level is checked when the fluid is cold and dipstick indicates fluid should be added. However, the low reading is normal as proper fluid level at low operating temperature will be below the "ADD" mark on the dipstick, as shown in Figure 15, and proper fluid level at higher operating temperatures will rise above the "FULL" mark. Fluid level rises as the fluid temperature increases. A fluid level change of over 3/4" will occur as temperature rises 60°F. (15.6°C.) to 190°F. (88°C.).

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. DO NOT RACE ENGINE.

NOTE: 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 the dipstick clean and re-insert until cap seats. Remove dipstick and note reading.

- If the fluid feels cool, about room temperature, 65°F. (18.3°C.) to 85°F. (29.4°C.), the level should be 1/8 to 3/8 inch below the "ADD" mark.

- If the fluid feels warm the level should be close to the "ADD" mark (either above or below).

- If the fluid feels hot (cannot be held comfortably) the level should be between the "ADD" and "FULL" marks.

NOTE: DO NOT OVERFILL. It takes only one pint to raise level from ADD TO FULL with a hot transmission.

Draining Bottom Pan and Replacing Intake Pipe and Filter Assembly

To drain bottom pan only, eliminate steps 5 and 6.

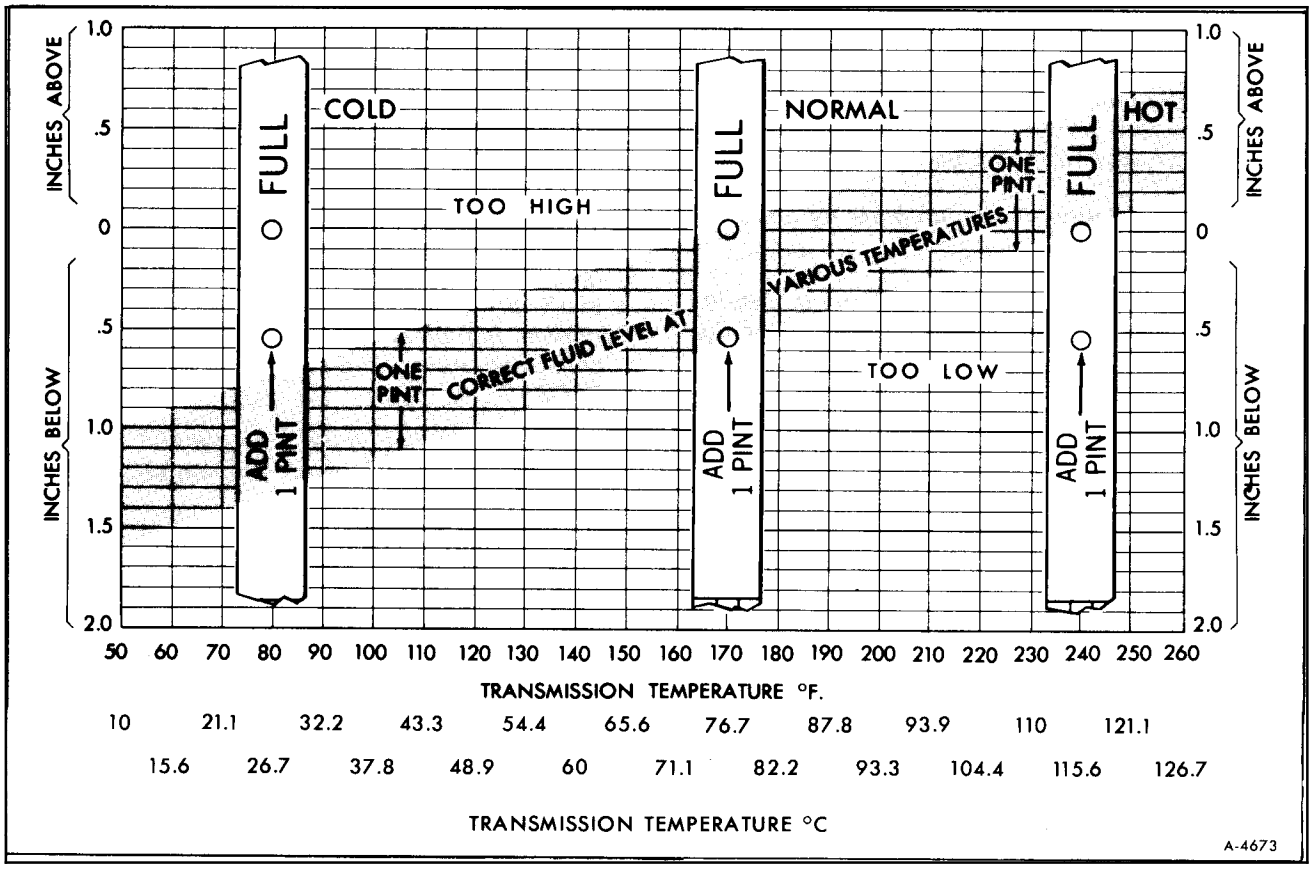


Figure 15—Transmission Oil Level

1. Remove dipstick from filler tube and insert a length of hose secured to a suction gun down the dipstick. Remove enough transmission fluid so that bottom pan will not overflow when removed.

2. Raise vehicle on hoist or place on jack stands, and provide container to collect draining oil.

3. Remove bottom pan and gasket. Discard gasket.

4. Drain fluid from bottom pan. Clean pan with solvent and dry thoroughly with clean compressed air.

5. Remove intake pipe and filter assembly. Remove and discard intake pipe O-ring.

6. Install new intake pipe O-ring into pipe bore in transmission case and install new intake pipe and filter assembly.

7. Install new gasket on bottom pan and install bottom pan. Tighten bottom pan attaching screws to 12 foot-pounds.

8. Lower vehicle and add five quarts of transmission fluid through filler tube when replacing intake pipe and filter assembly. When draining bottom pan only, add four quarts of transmission fluid.

9. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

10. Reduce engine speed to slow idle and check fluid level. Add fluid to bring to proper level, Figure 15.

Adding Fluid to Dry Transmission and Converter Assembly

The fluid capacity of the Turbo Hydra-matic transmission and converter assembly is approximately 13 quarts, but correct level is determined by mark on dipstick rather than by amount added. It is important that proper level be maintained. In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add 9 quarts of transmission fluid through filler tube.

2. Operate engine at 800 rpm for approximately 1-1/2 minutes with selector lever in park "P" position.

3. Reduce engine speed to slow idle.

4. Check fluid level and add additional fluid to bring to proper level, Figure 15.

Sprocket Housing Cover Removal

If the sprocket housing cover is removed, add transmission oil as described under "OIL LEVEL".

TOWING INSTRUCTIONS

Refer to SECTION 0 for towing instructions.

UNITS THAT CAN BE REMOVED WITH TRANSMISSION IN VEHICLE

The following units can be removed from the transmission without removing transmission from vehicle.

While the detailed procedure for removing each of the units is not outlined separately, the procedures covered under the transmission overhaul will apply.

1. Oil pan and pan to case gasket.

2. Pressure regulator valve assembly.

3. Valve body assembly.

4. Rear servo and accumulator assembly.

5. Front servo and accumulator assembly.

6. Governor pipes.

7. Detent solenoid.

8. Solenoid connector.

9. Parking linkage.

10. Valve body to case spacers and gaskets.

11. Check balls.

12. Detent roller and spring assembly.

13. Filter assembly.

TRANSMISSION REPLACEMENT

REMOVAL OF TRANSMISSION

Due to the power train configuration, it is easier to remove the transmission and final drive as an assembly. The following is the procedure to remove the transmission and final drive assembly.

1. Disconnect negative battery cables.

2. Remove engine access cover.

3. Position engine holding fixture as shown in Figure 16 and adjust mechanism to remove slack from cable.

NOTE: To properly position engine removal tool. Remove seat belt plate and anchor bolt assembly. Attach load adjuster chain to front and rear engine. Lift locations as shown in Figures 17 and 18. Then install support braces and chain hoist as in Figure 16.

4. Raise vehicle.

5. Disconnect starting motor wires.

6. Remove starting motor.

7. Remove flywheel cover behind starter.

8. Disconnect manual shift linkage at transmission.

9. Disconnect speedometer cable.

10. Disconnect oil cooler lines at transmission and position out of the way. Cap lines and connectors.

11. Disconnect detent wire and vacuum modulator tube.

12. Disconnect right axle shaft at output shaft flange.

13. Remove right output shaft and support assembly, (includes disconnecting radiator fan venturi ring bracket).

14. Disconnect left axle shaft at left output flange.

15. Remove final drive to support bracket through bolt, washers and nut.

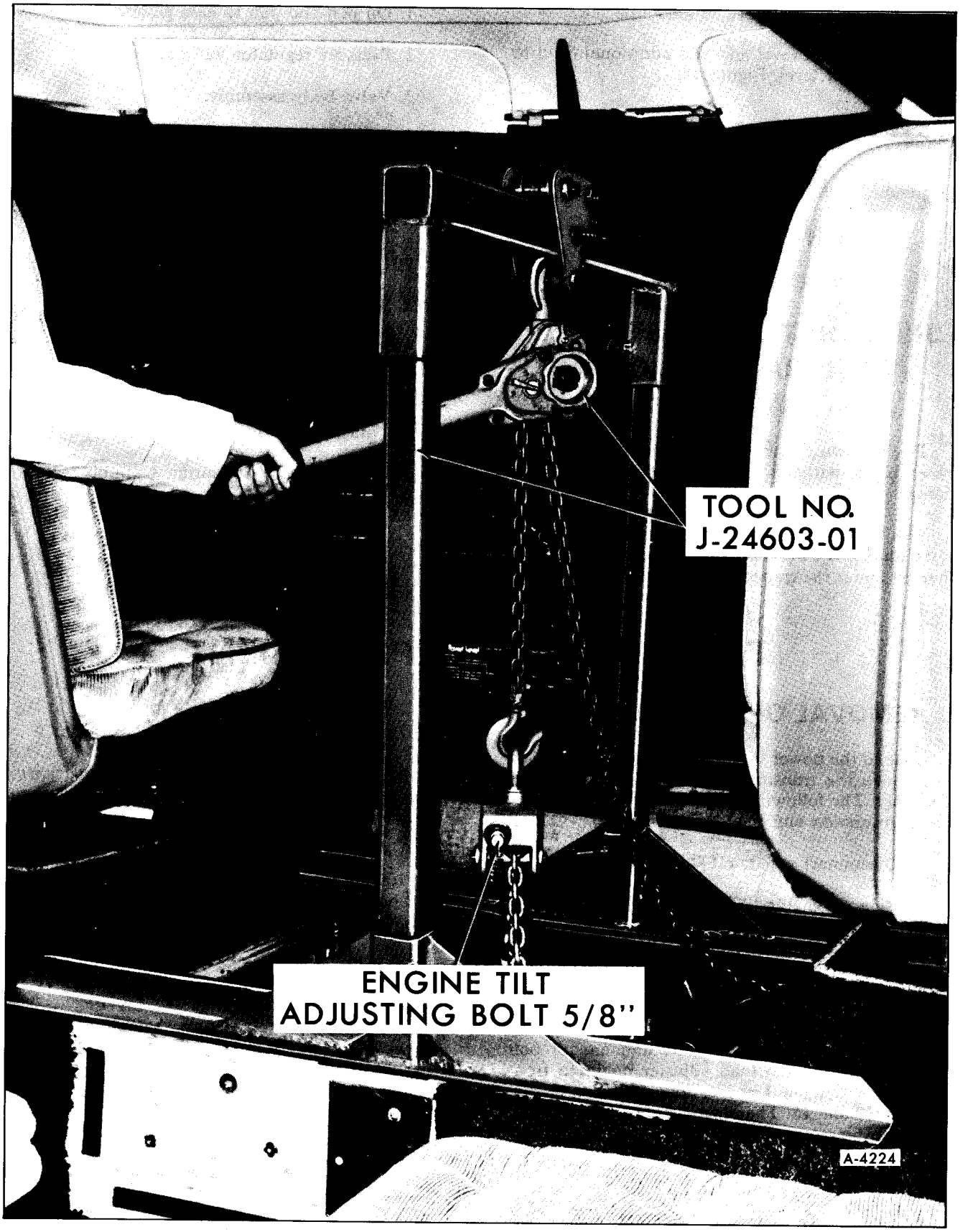


Figure 16—Attaching Engine Removal Tool

16. Remove three (3) converter to flywheel bolts by rotating crankshaft at harmonic balancer.

17. Remove three (3) rear support bracket to transmission bolts.

18. Remove two (2) rear motor mount to support bracket bolts.

19. Position transmission jack under transmission and secure with safety chain around transmission gear case.

20. Remove six (6) transmission converter housing to engine bolts.

21. Move transmission and final drive assembly rearward 1/2"-3/4" and lower from vehicle, installing converter holding clamp, such as J-21366, as soon as transmission is low enough.

INSTALLATION OF TRANSMISSION

1. Position transmission and final drive on jack secured with a safety chain, under the vehicle.

2. Remove converter holding clamp.

3. Raise transmission into place.

4. Loosely install top two (2) converter housing to engine bolts.

5. Slide transmission forward and engage converter pilot into flywheel.

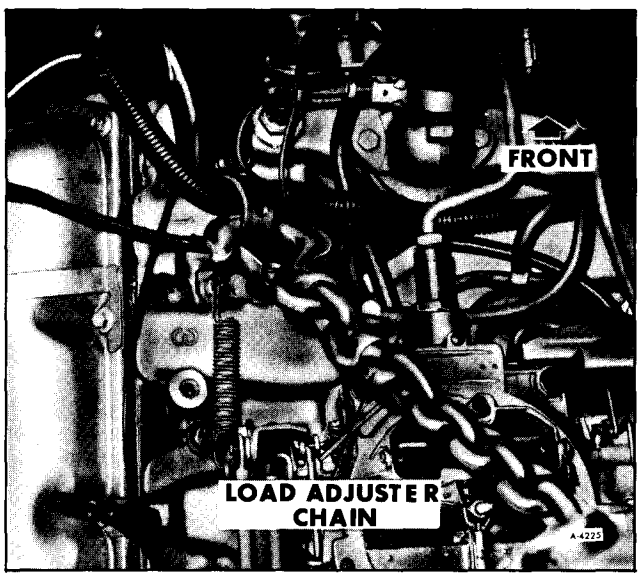


Figure 17—Front Engine Lift Location

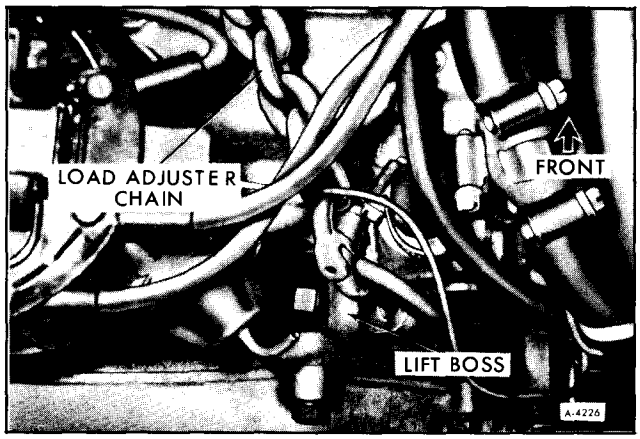


Figure 18—Rear Engine Lift Location

6. Install remaining converter housing to engine bolts. Torque six (6) bolts to 30 ft. lbs.

7. Shift transmission to neutral to align weld nuts to the flywheel. Rotate the crankshaft to install three (3) attaching bolts and torque to 30 ft. lbs. (Note: Weld nuts must be flush to flywheel).

8. Remove safety chain and jack from transmission.

9. Install three (3) rear support bracket to transmission bolts. Torque to 55 ft. lbs.

10. Install two (2) rear motor mount to support bracket bolts. Torque to 55 ft. lbs.

11. Install final drive to support bracket through bolt, washers and nut. Torque bolt to 105 ft. lbs.

12. Connect left axle shaft to output flange using new bolts. Torque bolts to 65 ft. lbs.

13. Install right output shaft and support assembly and fan venturi bracket. Torque bolt to 50 ft. lbs.

14. Connect right axle shaft to output flange using new bolts. Torque bolts to 65 ft. lbs.

15. Connect detent wire and vacuum modulator hose.

16. Connect oil cooler lines. Torque fitting to 20 ft. lbs.

17. Connect speedometer cable.

18. Connect manual shift linkage using a new cotter pin.

19. Install flywheel cover behind starter. Torque bolts to 5 ft. lbs.

20. Connect wires to starting motor.

21. Install starting motor. Torque bolts to 30 ft. lbs.

22. Lower vehicle.

23. Remove engine holding fixture.

24. Connect negative battery cables.

25. Fill transmission with fluid as described under CHECKING AND ADDING FLUID in this SECTION.

26. Check manual linkage and adjust if necessary.

TRANSMISSION OVERHAUL

REMOVE FINAL DRIVE (FIGURE 19)

1. Remove bolt "A" and transmission dipstick and tube assembly.

2. Remove bolts "B, C, E, F and G" and nut "H". (NOTE: One bolt is omitted between nut "H" and bolt "C".)

3. Remove final drive from transmission, (about 1 quart of transmission fluid will drain).

REMOVE TORQUE CONVERTER

With transmission on portable jack, remove Converter Holding Clamp, J-21366, and then remove converter assembly from transmission by pulling converter straight out of housing.

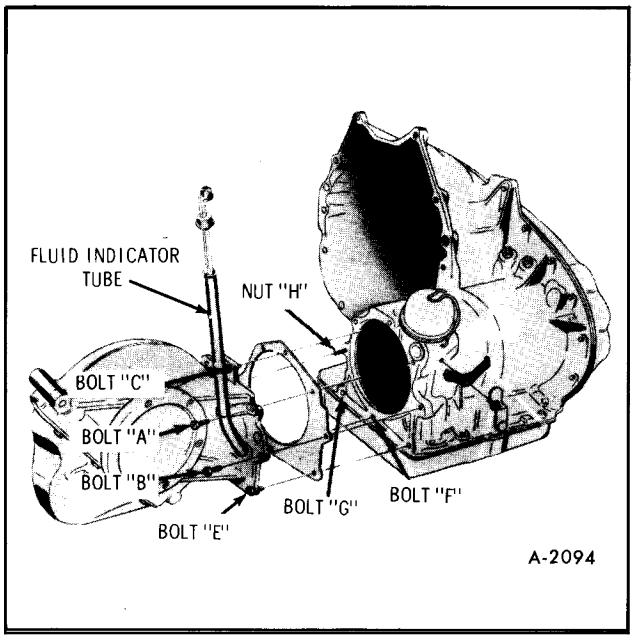


Figure 19—Final Drive Attachment

CAUTION: *Converter with oil weighs approximately 50 pounds. Be careful not to drop or damage converter when removing it.*

ARRANGE TRANSMISSION FOR OVERHAUL

1. Install two 3/8 x 8 bolts with nuts into the case to engine mounting face. (figure 20)

2. Remove the speedometer driven gear attaching screw and retainer clip. (figure 21)

3. Remove speedometer driven gear assembly from case bore. Remove and discard "O" ring seal.

4. Remove the governor attaching bail wire.

5. Remove governor assembly and "O" ring seal from case bore. (figure 22)

6. Remove stud from output end of case and place a piece of plywood under output end of case, place transmission on work bench with bottom pan facing the outside edge of work bench. (Let pan over-

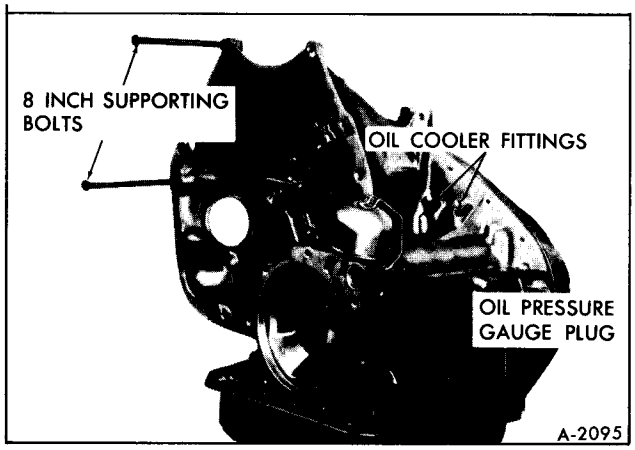


Figure 20—Transmission Support Bolts

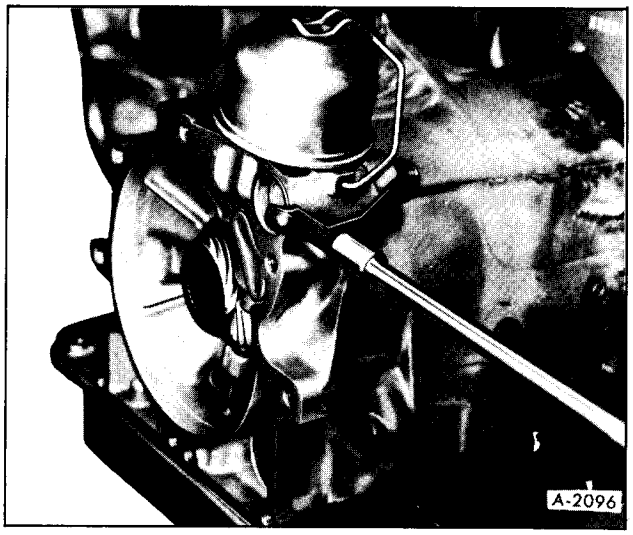


Figure 21—Removing Speedometer Driven Gear Retainer

hang edge of bench.) Stand transmission on the two eight inch bolts and the output flange end of the transmission case. (figure 23)

REMOVE VACUUM MODULATOR AND VALVE

NOTE: Unit may be removed without removing transmission or bottom pan, after removing vacuum hose.

1. Remove vacuum modulator attaching screw and retainer from transmission case.

2. Remove modulator assembly and O-ring from transmission case. Remove and discard O-ring from vacuum modulator, Figure 24.

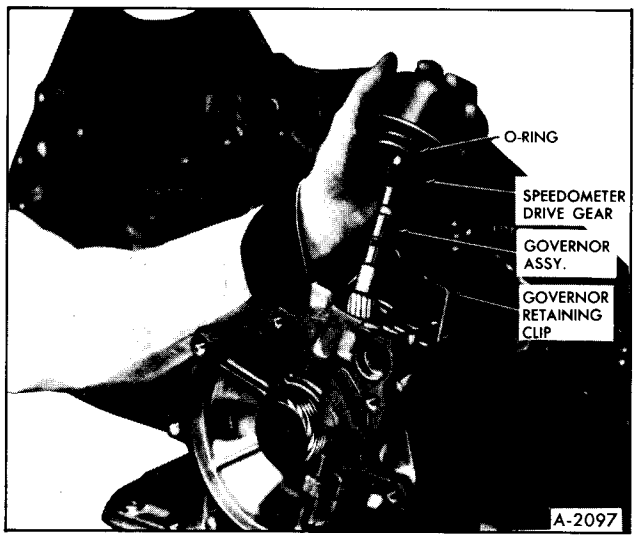


Figure 22—Governor Removal

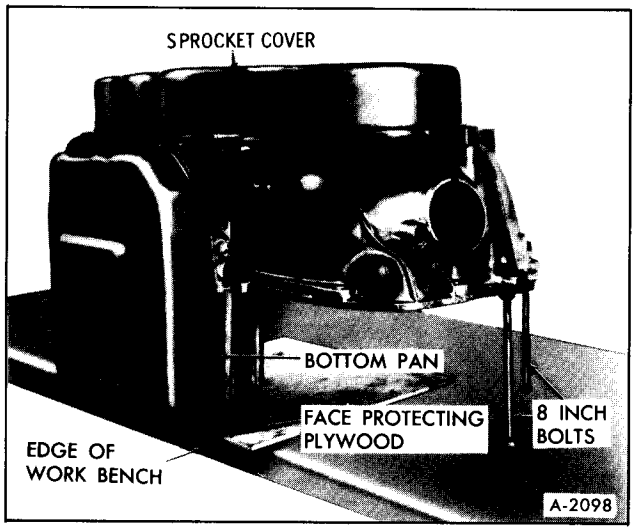


Figure 23—Arrangement of Transmission on Bench

3. Remove modulator valve from transmission case.

NOTE: Modulator bushing is a snug fit in transmission case and should not be removed forcibly unless it is damaged, scored, or otherwise deformed.

REMOVE INTAKE PIPE AND FILTER ASSEMBLY AND BOTTOM PAN

NOTE: Units may be removed with transmission in vehicle. In cases of transmission malfunction, intake pipe and filter must be replaced.

1. Remove thirteen bottom pan attaching screws.

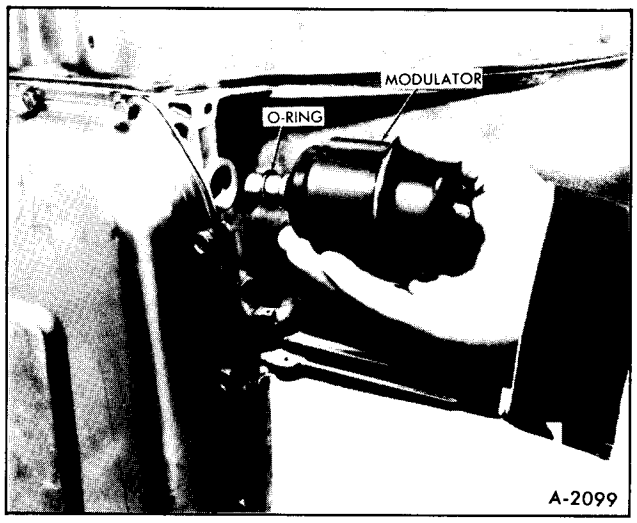


Figure 24—Removing Vacuum Modulator

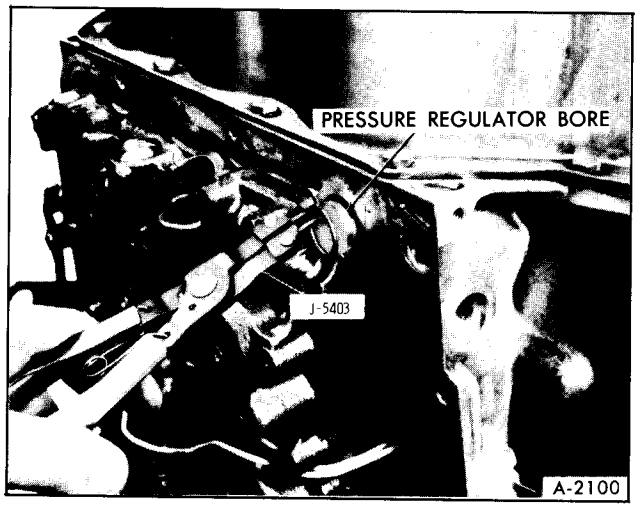


Figure 25—Removing Pressure Regulator Valve

2. Remove bottom pan and discard gasket.

3. Remove oil filter assembly.

4. Remove and discard the intake pipe to case "O" ring seal from the oil filter assembly or from the case counterbore.

REMOVE PRESSURE REGULATOR VALVE

NOTE: Unit may be removed with transmission in vehicle after removing bottom pan.

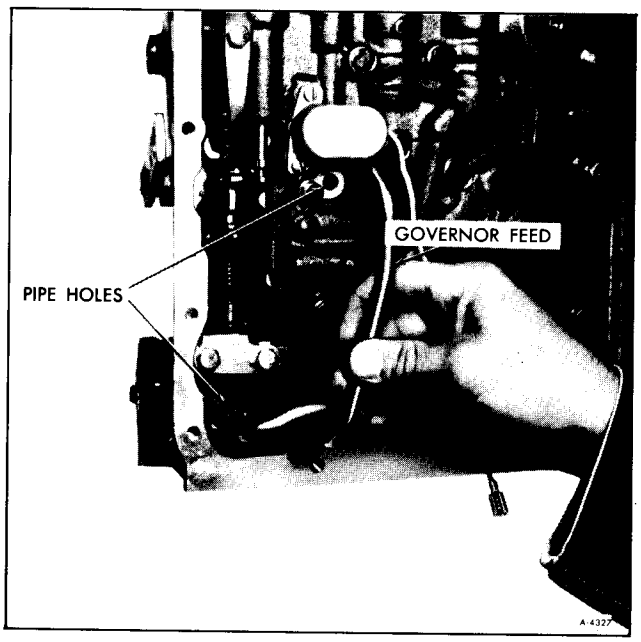


Figure 26—Removing Governor Feed Pipe

1. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring using Snap Ring Pliers, J-5403 (#21), Figure 25.

WARNING: PRESSURE REGULATOR SPRING IS UNDER CONSIDERABLE COMPRESSION.

2. Remove regulator boost valve bushing and valve.

3. Remove pressure regulator spring.

4. Remove regulator valve, spring retainer, and spacer or spacers if present.

REMOVE CONTROL VALVE ASSEMBLY, GOVERNOR PIPES, DETENT SPRING, ROLLER ASSEMBLY, CHECK BALLS, AND ELECTRICAL CONNECTOR

NOTE: Units may be removed with transmission in vehicle, after removing bottom pan.

1. Remove attaching screw and remove detent roller and spring assembly.

2. Disconnect detent solenoid from electrical connector.

3. Remove governor feed pipe from transmission case and valve body by lifting straight out. Figure 26.

4. Remove nineteen remaining control valve assembly attaching screws. Do not remove detent solenoid attaching screws at this time.

NOTE: If the transmission is in the vehicle, the front servo piston assembly may drop down as the control valve assembly and governor pipe are removed.

5. Remove control valve assembly with remaining governor pipe attached.

CAUTION: *Do not allow manual valve to fall out of its bore in control valve assembly.*

6. Remove remaining governor pipe from valve body.

7. Remove control valve assembly to spacer gasket.

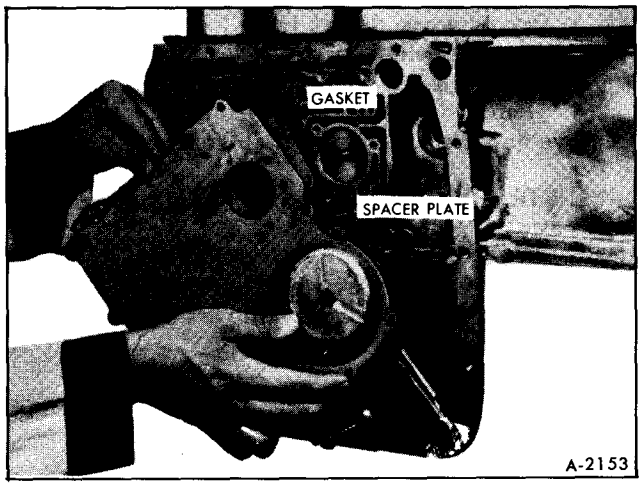


Figure 27—Removing Control Valve Spacer

8. Remove control valve spacer and spacer-to-transmission case gasket, Figure 27.

CAUTION: *If control valve is removed in vehicle, seven check balls will come down with spacer.*

9. Remove seven check balls from cored passages in transmission case, Figure 28.

NOTE: The eighth check ball is held in by a retainer and should not be removed unless replacement is required.

10. Remove electrical connector from case. Discard "O" ring from connector.

REMOVE FRONT SERVO PISTON AND REAR SERVO PISTON

NOTE: Units may be removed with transmission in vehicle after removing bottom pan and control valve assembly.

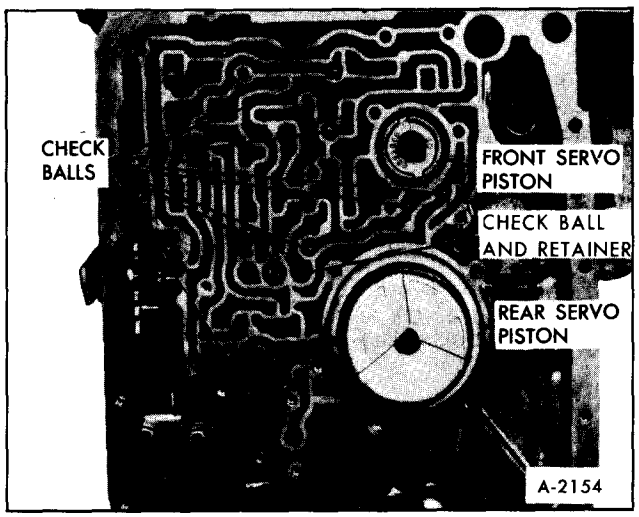


Figure 28—Location of Check Balls

1. Lift front servo piston retainer ring, pin, spring retainer and spring out of transmission case, Figure 28.

2. Remove rear servo assembly from transmission case, Figure 28.

3. Remove rear servo accumulator spring.

4. Make band apply pin selection check to determine proper size pin to use at time rear servo is assembled. Proceed as described in the following.

BAND APPLY PIN SELECTION CHECK (FIGURE 29)

NOTE: Check may be made with transmission in vehicle. Remove bottom pan, control valve assembly, and rear servo.

1. Position Adapter Plate, J-21370-8, on transmission case over rear servo bore, and, using screws provided with Adapter Plate, attach Band Apply Pin Selector Gauge, J-21370-6 to Adapter Plate.

2. Position Band Apply Pin Selector Gauge, J-21370-6, with hex nut on side of gauge facing toward converter housing, and smaller diameter end of Gauge Pin, J-21370-7, in servo pin bore.

3. Secure Adapter Plate to transmission case with two 5/16-18 x 1 inch screws, tightening screws to 18 foot-pounds and secure Selector Gauge to Adapter Plate, tighten attaching screws to 18 foot-pounds.

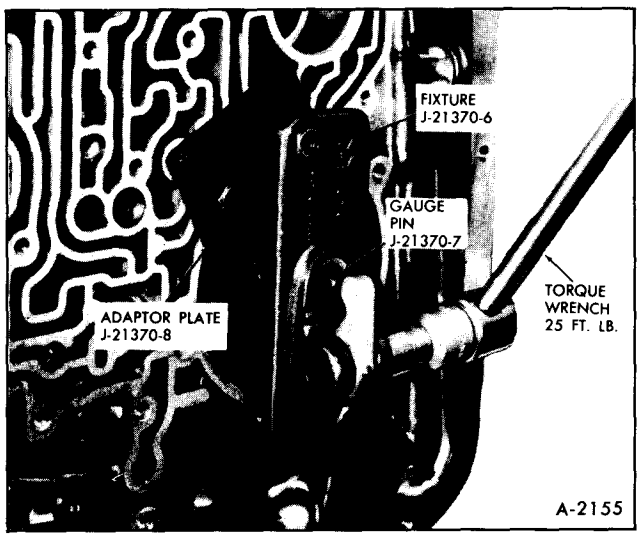


Figure 29—Checking Rear Band Apply Pin Length

Make certain that stepped gauge pin is free to move up and down in both tool and servo pin bore. Stepped side of pin must face rear of transmission case.

Band apply pins are available in three sizes as shown in the following chart:

Identification	Length
Three Rings	Long
Two Rings	Medium
One Ring	Short

Identification ring is located on band lug end of pin. Selecting the proper pin is equivalent to adjusting band.

4. To determine proper size pin to use, apply 25 foot-pounds torque on hex nut on side of gauge. This will cause lever on top of gauge to depress stepped gauge pin into servo pin bore, simulating actual operating conditions. Note relation of steps on gauge pin and machined surface on top of gauge. Determine proper size pin as follows:

a. If machined surface on top of gauge is even with or above upper step on gauge pin, long size pin (three rings) is required.

b. If machined surface on top of gauge is between steps on gauge pin, medium size pin (two rings) is required.

c. If machined surface on top of gauge is even with or below lower step on gauge pin, short size pin (one ring) is required.

5. If new pin is required, make note of pin size required, and remove gauge from transmission case.

REMOVE DETENT LEVER, MANUAL SHAFT, AND PARKING LINKAGE (FIGURE 30)

NOTE: Units may be removed with transmission in vehicle after removing bottom pan and detent roller and spring assembly from control valve assembly.

1. Remove pin securing manual shaft to case by pulling straight out, (Be careful not to damage the case or pin).

2. Loosen locknut securing detent lever to manual shaft.

3. Pry or work detent lever loose from ground flats on manual shaft.

4. Remove manual shaft from case bore and remove and discard O-ring seal from manual shaft.

NOTE: Be careful not to drop jam nut inside of case.

5. Remove detent lever and parking brake actuator assembly from case and remove actuator assembly from detent lever.

6. Remove parking brake bracket attaching screws and remove bracket.

7. Remove retainer pin securing parking pawl shaft to transmission case by pulling straight out.

8. Remove parking pawl shaft, parking pawl and return spring.

REMOVE SPROCKET COVER, LINK ASSEMBLY, DRIVE AND DRIVEN SPROCKETS

1. Remove eighteen cover attaching screws.

2. Remove cover and gasket and discard gasket.

3. Install Snap Ring Pliers, J-4646, into sprocket bearing retaining snap rings located under the drive and driven sprockets, and remove snap rings from retaining grooves on support housing, Figure 31.

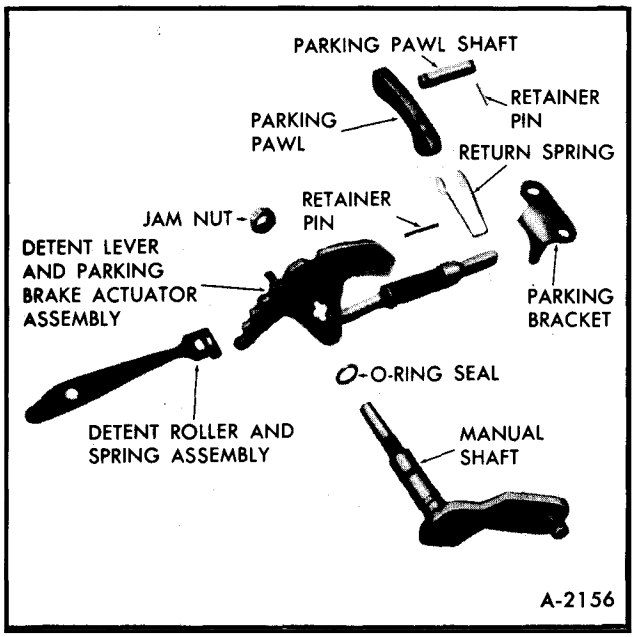


Figure 30—Manual and Parking Linkage

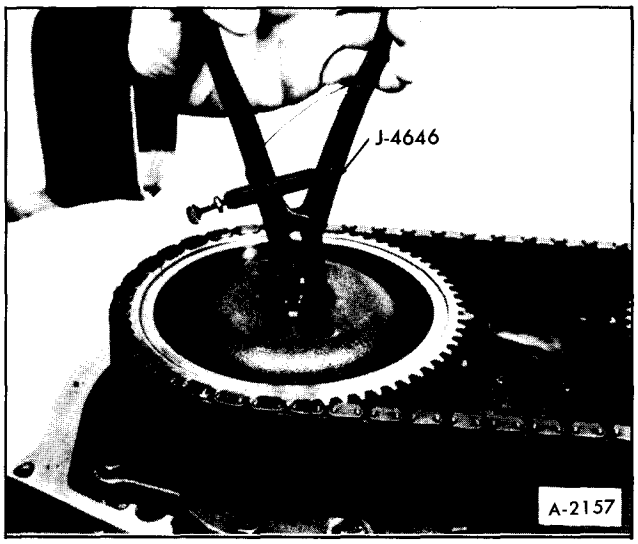


Figure 31—Removing Sprocket to Housing Snap Rings

NOTE: Leave snap rings in a loose position between sprockets and bearing assemblies.

4. Remove drive and driven sprockets, link assembly, bearings, and shafts simultaneously by alternately pulling upwards on the drive and driven sprockets until the bearings are out of the drive and driven support housings, Figure 32.

NOTE: If the sprockets are difficult to remove, place a small piece of fiberboard between the sprocket and sprocket support cover. Using a 1/2 x 9 inch pry bar, alternately pry upward under each sprocket on sprocket support cover. Do not pry on the guide links or the aluminum case. Pry only on the sprockets, Figure 33.

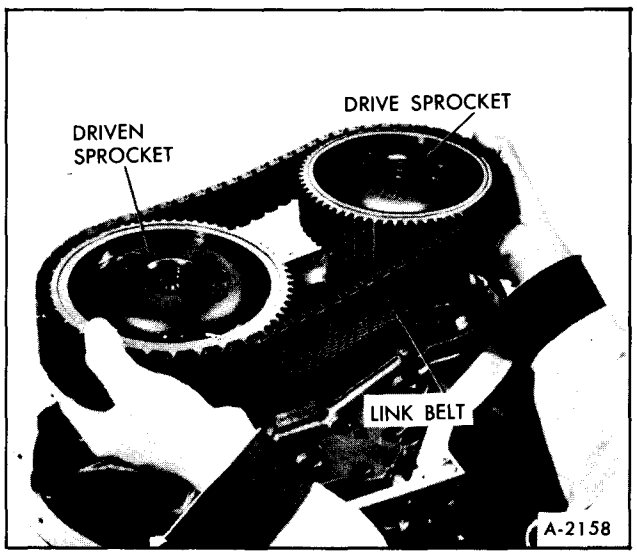


Figure 32—Removing Sprocket & Link Assembly

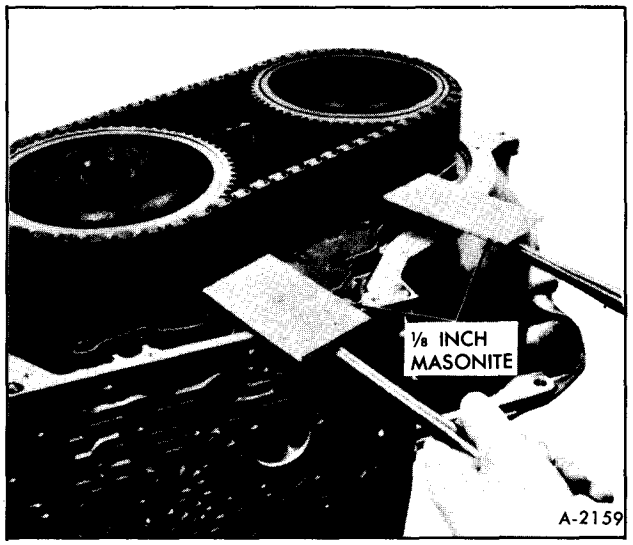


Figure 33—Removing Tight Sprockets

5. Remove link assembly from drive and driven sprockets.

6. Remove teflon oil seal ring from turbine shaft only if the ring requires replacement. For service, the ring is hook type cast iron.

7. Inspect drive and driven sprocket bearing assemblies for rough or defective bearings.

NOTE: Do not remove bearing assemblies from drive and driven sprockets unless they need replacement.

8. If removal of bearing assembly from drive and/or driven sprockets is necessary, proceed as follows:

a. Remove sprocket to bearing assembly retaining snap ring using Snap Ring Pliers, J-5586, Figure 34.

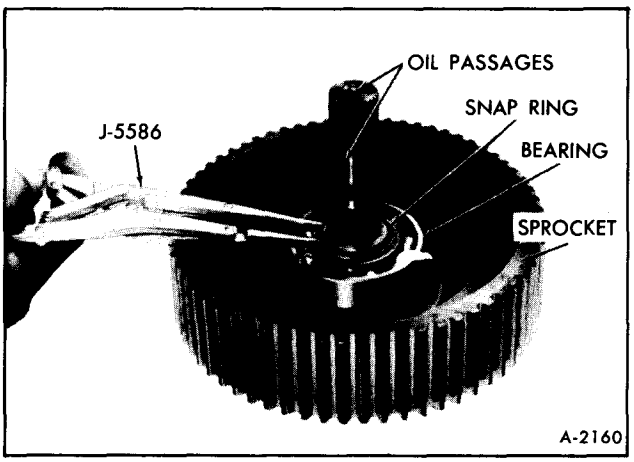


Figure 34—Removing Sprocket Bearing Snap Ring

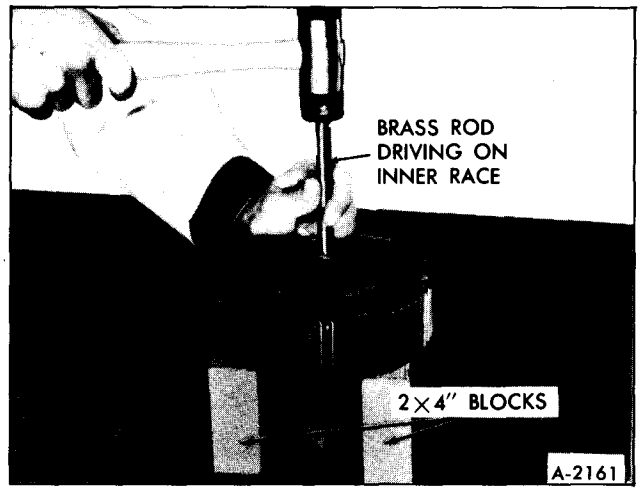


Figure 35—Removing Sprocket Bearing

b. Mount sprocket, with turbine or input shaft placed down between two 2" x 4" x 10" wood blocks.

NOTE: Wood blocks are positioned on sides or ends, depending on which bearing is to be replaced.

c. With a hammer and brass rod, drive the inner race, alternately through each of the access openings, until the bearing assembly is removed from the sprocket hub, Figure 35.

INSPECT DRIVE SPROCKET, TURBINE SHAFT, AND LINK ASSEMBLY

1. Inspect drive sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

NOTE: Wear pattern at bottom of tooth form is normal.

2. Inspect drive sprocket to ball bearing retaining snap ring for damage.

3. Inspect drive sprocket ball bearing inner race mounting surface for damage.

4. Inspect turbine shaft for open lubrication passages. Run a tag wire through the passages to be sure they are open. See lubrication chart for passage location, Figure 4.

5. Inspect spline for damage.

6. Inspect the ground bushing journals for damage.

7. Inspect the oil seal groove for damage or excessive wear.

8. Inspect turbine shaft oil seal ring for damage. Do not remove unless replacement of ring is required. The service ring is hook type cast iron.

9. Inspect the turbine shaft for cracks or distortion.

10. Inspect the link assembly for damage or loose links.

NOTE: Check the guide links. Guide links are the wide outside links on each side of the link assembly.

INSPECT DRIVEN SPROCKET AND INPUT SHAFT

1. Inspect driven sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

NOTE: Wear pattern at bottom of tooth form is normal.

2. Inspect sprocket to ball bearing retaining snap ring for damage.

3. Inspect ball bearing inner race mounting surface for damage.

4. Inspect input shaft for open lubrication holes. Run a tag wire through the holes to be sure they are open. See Figure 4 for location of holes.

5. Inspect spline for damage.

6. Inspect ground bushing journal for damage.

INSTALL SPROCKET BEARINGS

1. Turn sprocket so that turbine or input shaft is pointing upward.

2. Install new sprocket bearing as follows:

a. Install support snap ring, letter side down onto shaft.

b. Assemble bearing assembly on turbine or input shaft.

c. Using a piece of pipe, drive the bearing assembly onto the hub of the sprocket until it is resting on the bearing seat of the sprocket.

CAUTION: *Use pipe that closely fits I.D. of bearing assembly but does not contact shaft.*

d. Install sprocket to bearing assembly retaining snap ring into groove in sprocket hub.

3. If necessary, install new hook type oil seal ring on turbine shaft, (Note: original ring is plastic).

NOTE: Turbine and/or input shaft may appear not to be pressed fully into the sprocket. Do not attempt pressing shaft further as a specific length dimension is held during initial assembly.

FRONT UNIT END PLAY CHECK

1. Install Front Unit End Play Checking Tool, J-22241, into driven sprocket housing so that the urethane on the tool can engage the splines in the forward clutch housing. Let the tool bottom on the mainshaft and then withdraw it approximately 1/8 inch and tighten nut on tool, Figure 36.

2. Remove two of the 5/16" bolts from the driven support housing.

Install 5/16" threaded slide hammer bolt with jam nut into one bolt hole in driven support housing.

NOTE: Do not thread slide hammer bolt deep enough to interfere with forward clutch housing travel.

3. Mount Dial Indicator, such as J-8001, on slide hammer bolt and index indicator to register with the Front Unit End Play Checking Tool, J-22241, Figure 36 and push tool down to remove slack.

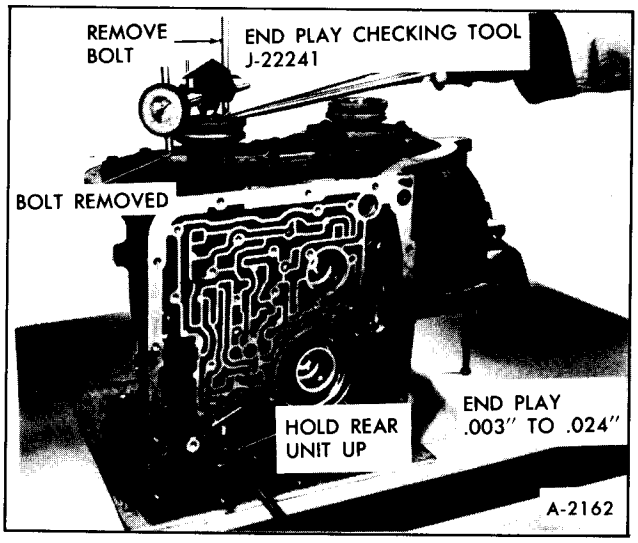


Figure 36—Checking Front Unit End Play

4. Push and hold output flange upward. Place a screw driver in case opening at parking pawl area and push upward on output carrier.

5. Place another screw driver between the metal lip of the end play tool and the driven sprocket housing and push upward on the metal lip of the end play tool and read the resulting end play, which should be between .003" and .024".

The selective washer controlling this end play is the thrust washer located between the pump cover plate and the forward clutch housing. If more or less washer thickness is required to bring the end play within specifications, select the proper washer from the chart below:

THICKNESS	COLOR
.060-.064	Yellow
.071-.075	Blue
.082-.086	Red
.093-.097	Brown
.104-.108	Green
.115-.119	Black
.126-.130	Purple

NOTE: An oil soaked washer may tend to discolor so that it will be necessary to measure the washer with a set of one inch micrometers to determine its actual thickness.

6. Remove end play tool from transmission and remove dial indicator and slide hammer bolt from transmission.

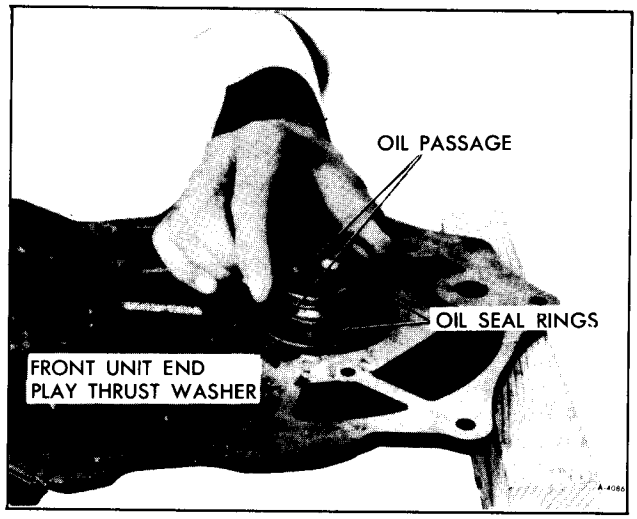


Figure 37—Removing or Installing Oil Seal Rings

REMOVE OIL PUMP

1. Remove two opposite pump attaching bolts from the drive support housing.

2. Install two 5/16-18 x 4" guide pins in holes from previously removed bolts.

3. Remove the remaining pump attaching bolts from the drive support housing.

4. With one hand hold the underside of the pump and gently tap the guide pins until the pump is removed from the case.

REMOVE PUMP COVER PLATE, CONVERTER OUT CHECK VALVE AND DRIVE AND DRIVEN SUPPORT HOUSING ASSEMBLIES

1. Remove the twenty-three pump cover plate-to-case attaching screws and remove pump cover plate. Do not remove sprocket support housing bolts at this time.

2. Remove pump cover plate and plate-to-case face gasket. Discard gasket.

NOTE: Drive and driven support housing assemblies are pressed into and removed with the pump cover plate. Do not remove them unless it is necessary.

3. If necessary, remove oil seal rings from the driven support housing. See Figure 37.

4. Remove the front unit end play selective thrust washer from the hub of the driven support housing.

5. If necessary to remove the drive and driven sprocket support housing assemblies, proceed as follows:

a. Remove the remaining sprocket support to pump cover plate attaching bolts.

b. Support cover plate on wooden blocks and using a plastic mallet, vigorously strike the stator shaft of the drive sprocket support, Figure 38, and the hub of the driven sprocket support, until they are removed from their pump cover plate bores.

CAUTION: *When driving the housings out of the pump cover plate, avoid damaging or distorting the stator shaft or the ring grooves in the hub of the driven housing by striking the shaft or hub centrally.*

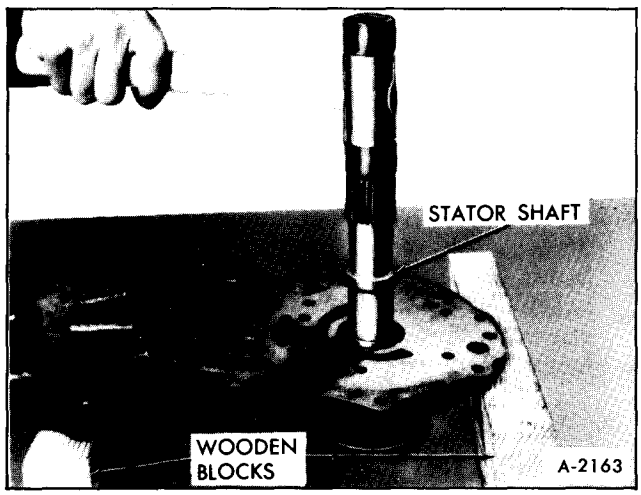


Figure 38—Removing Drive Sprocket Support

c. Remove and discard housing to pump cover plate gaskets.

d. Remove converter out check valve, Figure 39.

e. Install converter out check valve.

f. Install drive sprocket support housing to pump cover plate gasket.

g. Install drive sprocket support housing into pump cover plate by using a plastic mallet to seat the housing. Use bolts for guides, Figure 40.

h. Install driven sprocket support housing to pump cover plate gasket.

i. Install driven sprocket support housing to pump cover plate attaching bolts for gasket guides.

j. Install driven sprocket support housing into pump cover plate by using a plastic mallet to seat the housing.

k. Install all but one driven support housing to pump cover plate attaching bolts. Torque to 20 ft. lbs.

6. Install proper front unit end play selective thrust washer on the hub of the driven sprocket support housing. Use micrometer to determine the actual thickness of the thrust washer.

7. If necessary, install oil seal ring into the grooves in the hub of the driven sprocket support housing. See Figure 37.

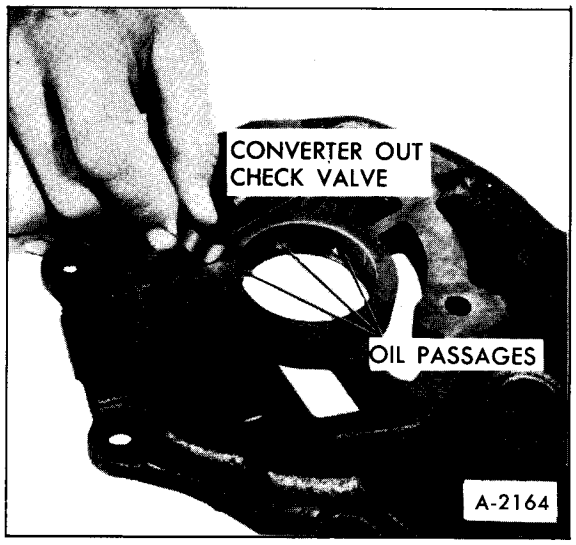


Figure 39—Converter Out Check Valve

NOTE: If teflon rings are being used, make sure slit ends are assembled in same relation as cut, see Figure 41. Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during reassembly of mating parts over rings.

REMOVE FORWARD CLUTCH ASSEMBLY, DIRECT CLUTCH ASSEMBLY, SUN GEAR SHAFT, AND FRONT BAND

1. Remove forward clutch assembly from transmission, Figure 42, by installing Front End Play Checking Tool, J-22241, into forward clutch and lifting forward clutch straight out.

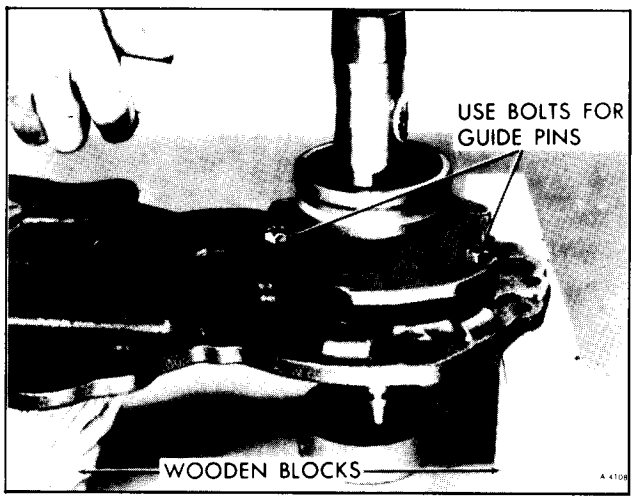


Figure 40—Installing Drive Sprocket Support

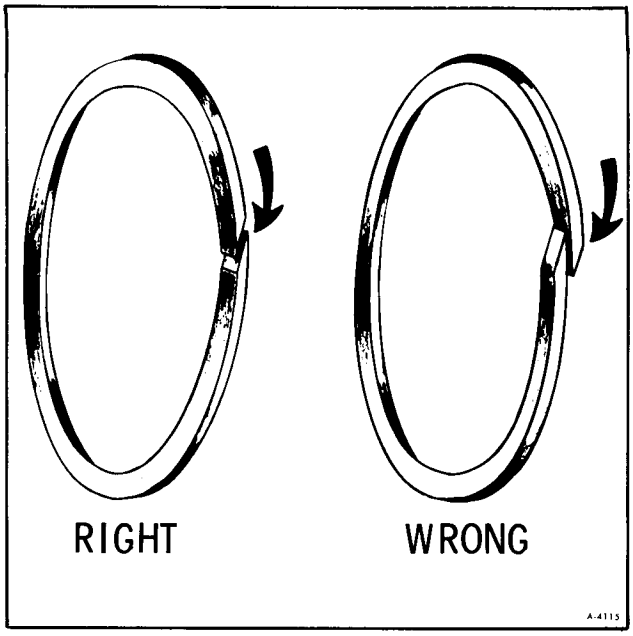


Figure 41—Installing Teflon Oil Seal Rings

2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch assembly.

3. Remove direct clutch and intermediate sprag assembly by lifting straight out. Sun gear shaft may come out with direct clutch assembly.

4. Remove sun gear shaft if not previously removed.

5. Remove front band assembly.

NOTE: Check rear unit end play at this time.

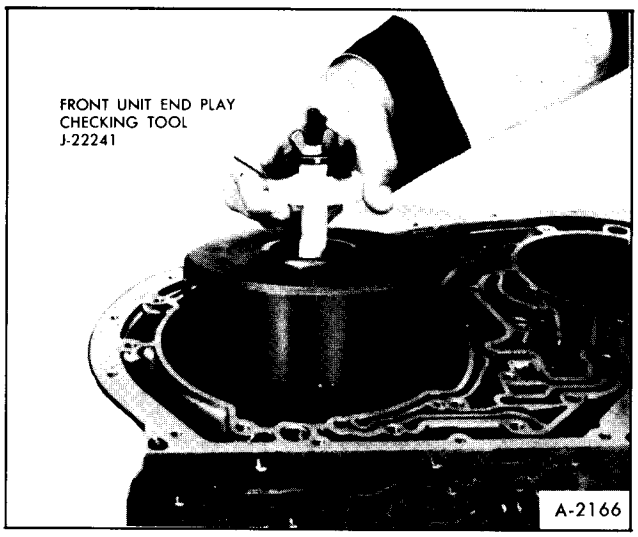


Figure 42—Removing Forward Clutch

REAR UNIT END PLAY CHECKING PROCEDURE

Make rear unit end play check as follows:

1. Rotate transmission in holding fixture base so that forward end of transmission is up.

2. Install Speedometer Puller Bolt, J-21797, in one of the differential mounting bolt holes on end of transmission case.

3. Mount Dial Indicator, J-8001, on Bolt J-21797, and index indicator to register with flat surface on end of output flange, Figure 43.

4. Set dial indicator to zero.

5. Using two screwdrivers (180° apart) more output flange in and out. Note resulting travel or end play for selection of washer for use at time of transmission assembly. End play should be .007 inch-.019 inch.

(NOTE: Use of two screwdrivers avoids an angled condition and insures greater accuracy).

The selective washer controlling this end play is the steel washer with the three tabs, located between thrust washer and rear face of transmission case. Notches and/or numerals on the tabs serve to identify washer thickness.

If a different washer thickness is required to bring end play within specifications, it can be selected from the following chart. The tabs will show identification notches, numerals or both.

Thickness	Identification Notch and/or Numeral	
.074 — .078	None	1
.082 — .086	On Side of 1 Tab	2
.090 — .094	On Side of 2 Tabs	3
.098 — .102	On End of 1 Tab	4
.106 — .110	On End of 2 Tabs	5
.114 — .118	On End of 3 Tabs	6

6. Remove Dial Indicator, J-8001, and Bolt, J-21797, from transmission and rotate transmission so that rear end of transmission is up.

REMOVE REMAINING COMPONENTS

1. Remove center support bolt from transmission case, Figure 44, using a 3/8 inch 12-point thin wall deep socket.

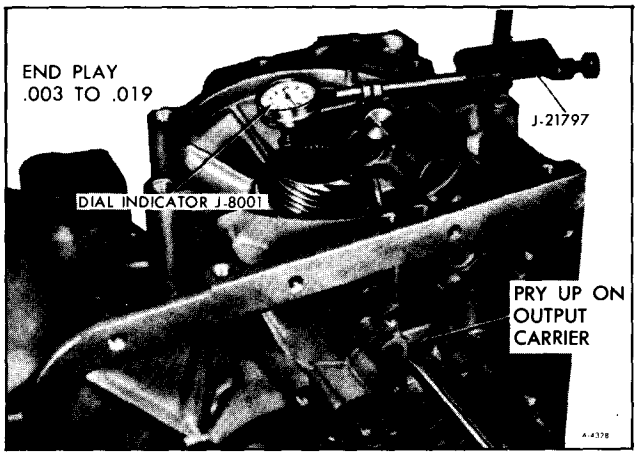


Figure 43—Checking Rear Unit End Play

2. Remove intermediate clutch backing plate to case snap ring, Figure 45.

3. Remove intermediate clutch backing plate, and three composition and three steel clutch plates.

4. Using a needle-nose pliers, or screwdriver, remove center support to case snap ring, Figure 46.

5. Install Gear Assembly Remove and Installer Adapter, J-21795, on end of main shaft so that tangs engauge groove in shaft. Using Slide Hammer Handle, such as J-6125, and Speedometer Puller Bolt, J-21797, tighten bolt on tool to secure tool on shaft, Figure 47.

6. Remove complete gear unit assembly from case, by lifting straight up.

CAUTION: *Be careful not to drop or bump assembly in transmission case during removal.*

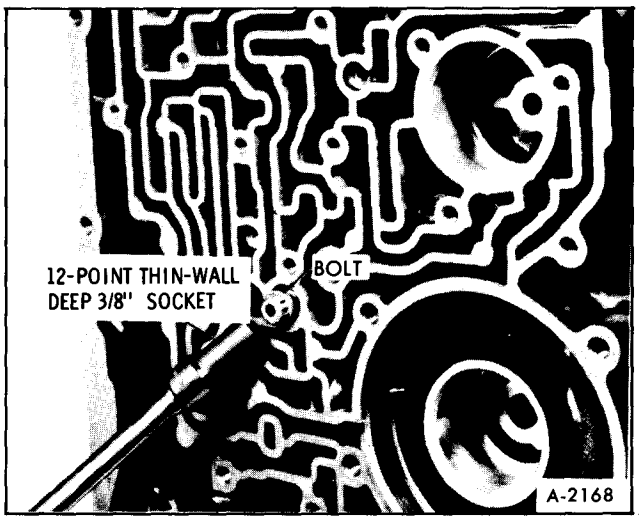


Figure 44—Remove Center Support Bolt

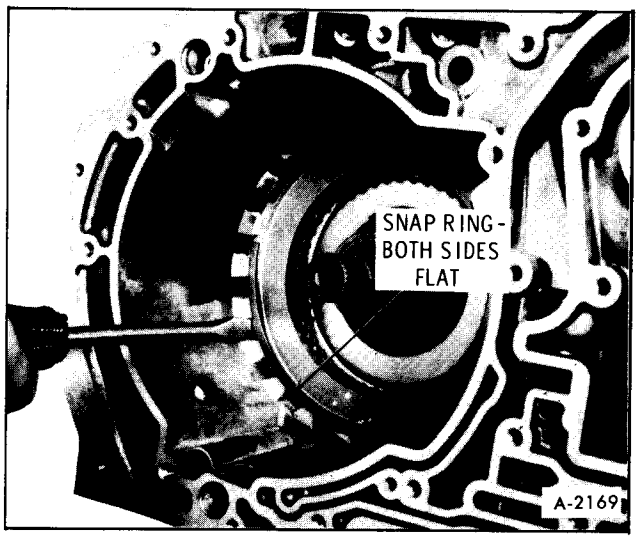


Figure 45—Intermediate Clutch Snap Ring

7. Remove output flange to case metal thrust washer from output flange or case.

8. Place gear unit assembly on bench with output flange down, Figure 48. Remove Tool J-21795.

9. Remove support to case spacer.

10. Remove rear band assembly. To facilitate removal , rotate band lugs away from pins and pull band assembly out of transmission case.

11. Remove rear unit selective washer from transmission case.

INSPECTION OF TRANSMISSION CASE

NOTE: 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. Also, remove the nameplate from the old case and reinstall it onto the new case, using the truss head nameplate attaching screw that is serviced with the case.

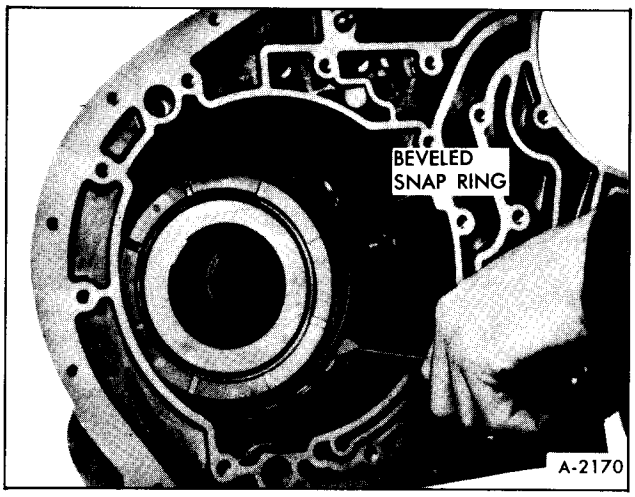


Figure 46—Center Support Snap Ring

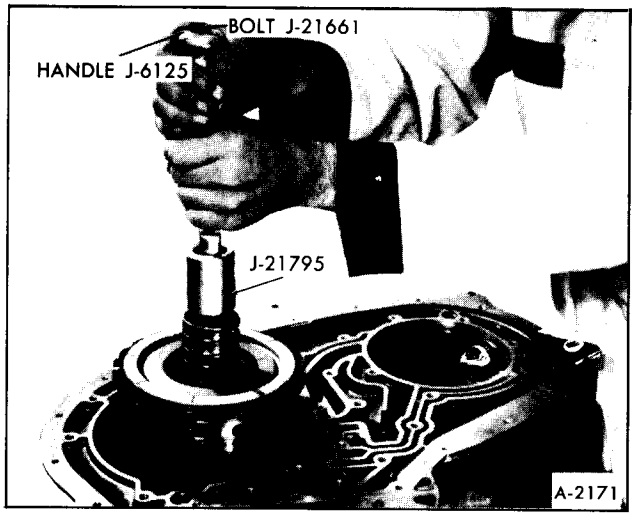


Figure 47—Gear Unit Removal

1. Inspect case assembly for cracks, porosity or interconnected passages, Figure 5.

2. Check for good retention of band anchor pins.

3. Inspect all threaded holes for thread damage. (use insert to rebore threads if necessary).

4. Inspect intermediate clutch driven plate lugs for damage or brinelling.

5. Inspect snap ring grooves for damage.

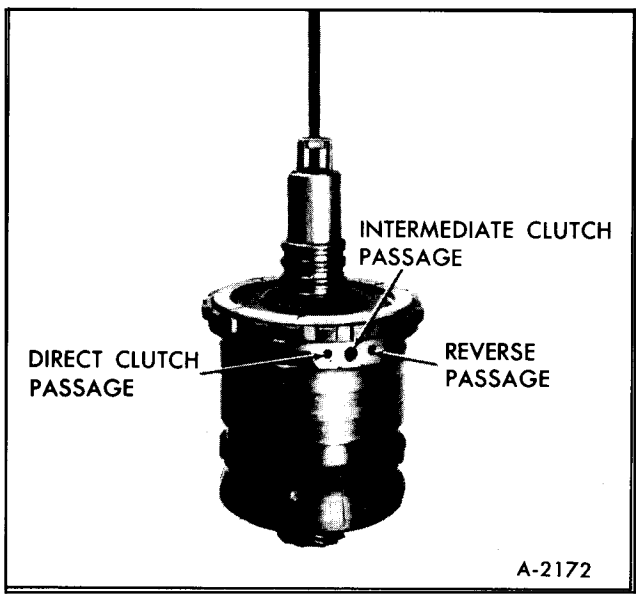


Figure 48—Gear Unit on Bench

6. Inspect governor assembly bore for scratches or scoring.

7. Inspect governor pipes screen assemblies (located in governor pipe holes in case) for plugging or damage.

8. Inspect modulator valve bore for scoring or damage.

9. Inspect output flange bushing for wear, galling and open lubrication groove.

CENTER SUPPORT AND GEAR UNIT

DISASSEMBLY

1. Remove center support assembly from reaction carrier by lifting center support straight up.

2. Remove center support to reaction carrier thrust washer.

NOTE: Thrust washer may have stuck to back of center support. If so, remove from center support.

3. Remove reaction carrier and roller clutch assembly from output carrier, Figure 49, and remove roller clutch assembly from reaction carrier.

4. Remove center support to sun gear races and thrust bearing from sun gear.

NOTE: One of the races may have stuck to back of center support.

5. Remove front internal gear ring from output carrier assembly, Figure 50.

6. Remove sun gear from output carrier assembly.

7. Remove reaction carrier to output carrier plastic thrust washer from output carrier.

NOTE: The service thrust washer is metal.

8. Invert gear unit and place in Rear Unit Holding Fixture, J-6116, with main shaft pointing downward.

9. Remove snap ring securing output flange to output carrier and remove output flange.

10. Remove thrust bearing and races from rear internal gear.

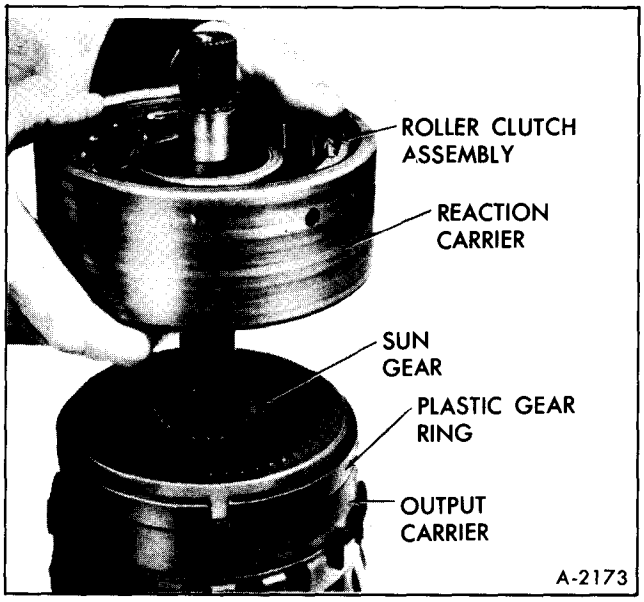


Figure 49—Removing Reaction Carrier

11. Lift rear internal gear and main shaft out of output carrier and remove thrust bearing and races from inner face of rear internal gear.

12. Remove snap ring from end of main shaft and remove rear internal gear.

13. Remove output carrier from holding fixture.

INSPECT OUTPUT FLANGE

1. Inspect bearing and thrust washer surfaces for damage.

Figure 50—Removing Gear Ring

2. Inspect drive lugs for damage.

3. Inspect splines for damage.

4. Inspect lubrication passages.

INSPECT MAIN SHAFT

1. Inspect shaft for cracks or distortion.

2. Inspect splines for damage.

3. Inspect ground bushing journals for damage.

4. Inspect snap ring groove for damage.

5. Inspect lubrication passages.

INSPECT REAR INTERNAL GEAR

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Inspect gear for cracks.

4. Inspect bearing and thrust surfaces for wear or galling.

INSPECT OUTPUT CARRIER

1. Inspect front internal gear for damaged teeth.

2. Inspect pinion gears for damage, rough bearings or excessive tilt.

3. Check pinion end play. Pinion end play should be .009 inch-.024 inch, Figure 51.

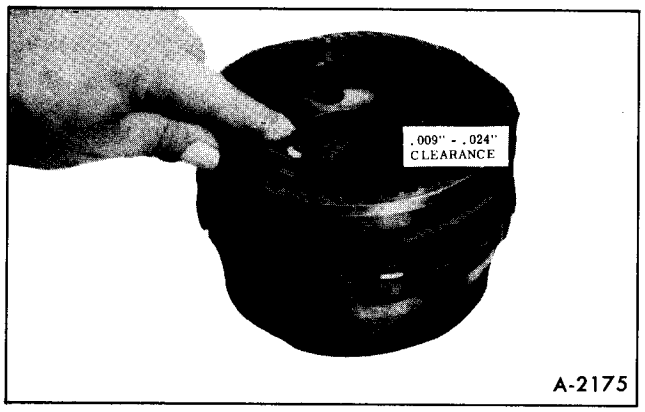


Figure 51—Check-Pinion End Play

4. Inspect parking gear lugs for cracks or damage.

5. Inspect output flange locating splines for damage.

6. Inspect front internal gear ring for flaking or cracks.

INSPECT REACTION CARRIER

1. Inspect band surface on reaction carrier for signs of burning or scoring.

2. Inspect roller clutch outer cam for scoring or wear.

3. Inspect thrust washer surfaces for signs of scoring or wear.

4. Inspect bushing for damage. If bushing is damaged, carrier must be replaced.

5. Inspect pinion gears for damage, rough bearings or excessive tilt.

6. Check pinion end play. Pinion end play should be .009 inch-.024 inch.

7. If the reaction carrier has a spacer ring in an undercut at the bottom of the roller cam vamps, inspect it for damage, Figure 52.

NOTE: The reaction carrier with the undercut and spacer ring is used optionally and inter-

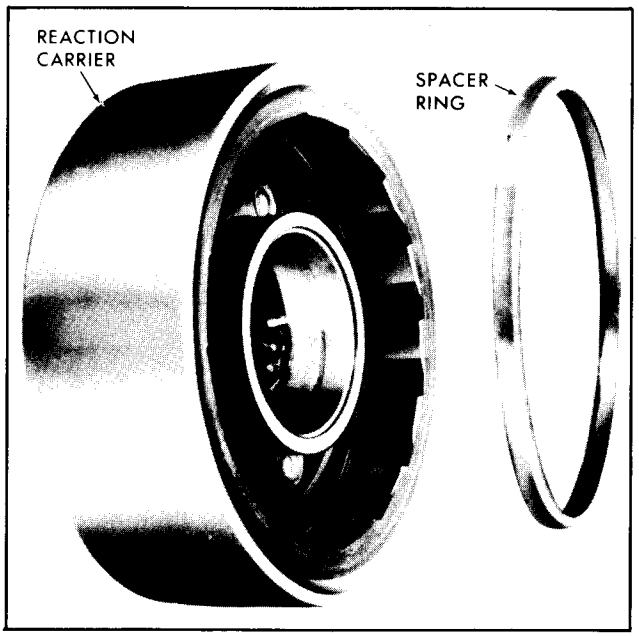


Figure 52—Reaction Carrier with Spacer Ring

changeably with the reaction carrier which does not have an undercut and spacer ring.

PINION GEAR REPLACEMENT— REACTION AND OUTPUT CARRIER ASSEMBLIES

1. Support carrier assembly on its FRONT face.

2. Using a 1/2 inch diameter drill, remove the stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when the pinion pins are pressed out.

CAUTION: *Do not allow drill to remove any stock from the carrier, as this will weaken the part, and could cause the carrier to break.*

3. Using a tapered punch, drive or press pinion pins out of carrier.

4. Remove pinion gears, thrust washers, and roller needle bearings.

5. Inspect pinion pocket thrust faces for burrs and remove if present.

6. Install eighteen needle bearings into each pinion gear using petrolatum to hold bearings in place. Use a pinion pin as a guide.

7. Place a bronze and steel thrust washer on each side of pinion gear with steel washers against gear, Figure 53. Hold washers in place with petrolatum.

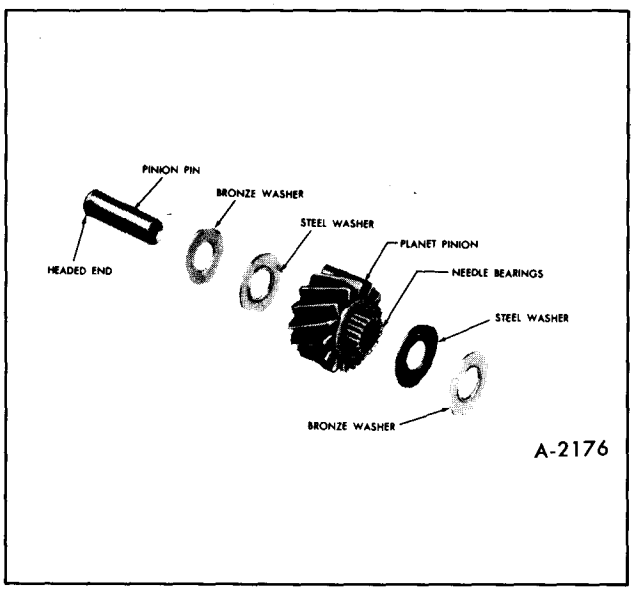


Figure 53—Planet Pinion Components

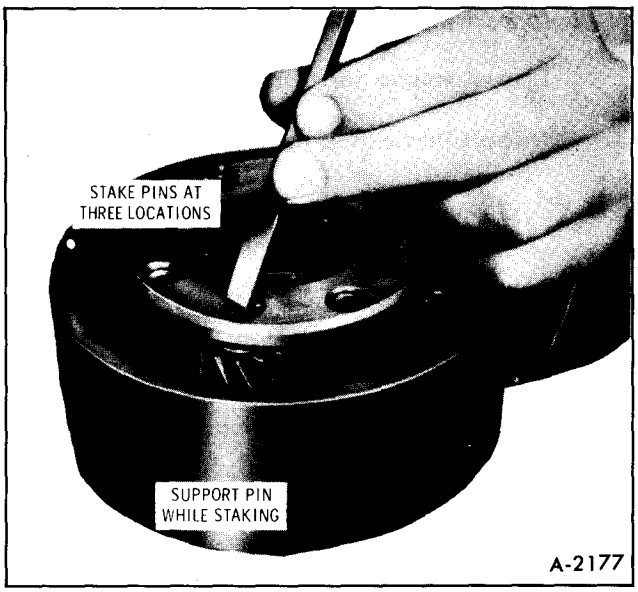


Figure 54—Staking Pinion Pin

8. Place pinion gear assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.

9. Drive a new pinion pin into place from the front, while rotating pinion gear. Be sure that headed end is flush or below face of carrier.

10. Using a punch in bench vise for an anvil, stake opposite end of pinion pin in three places with a blunt radius chisel, Figure 54.

NOTE: Both ends of pinion pins must lie below face of carrier or interference may occur.

11. Repeat installation procedure for each pinion gear.

INSPECT ROLLER CLUTCH

1. Inspect roller clutch for damaged rollers or springs.

2. Inspect roller clutch cage for damage.

INSPECT SUN GEAR

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Be sure oil lubrication hole is open.

INSPECT SUN GEAR SHAFT

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.

3. Inspect bushings for scoring or galling.

4. Inspect ground bushing journals for damage.

5. Be sure oil lubrication hole is open.

ASSEMBLE GEAR UNIT (FIGURE 55)

1. Install rear internal gear on end of main shaft that has snap ring groove and install snap ring.

2. Install races and thrust bearing on inner face of rear internal gear, retaining races and bearing with petrolatum. Proceed as follows:

a. Install large diameter race first, with flange facing up, Figure 56.

b. Install thrust bearing in race.

c. Install small diameter race on bearing with inner flange facing down.

3. Lubricate pinion gears in output carrier with transmission fluid and install output carrier on main shaft so that pinion gears mesh with rear internal gear.

4. Place the above portion of the build-up through hole in bench so that the mainshaft hangs downward.

5. Install the rear internal gear to output flange thrust races and bearings as follows: (Retain with petrolatum) (figure 57).

a. Place the small diameter race against the internal gear with the center flange facing up.

b. Place the bearing on the race.

c. Place the second race on the bearing with the outer flange cupped over the bearing.

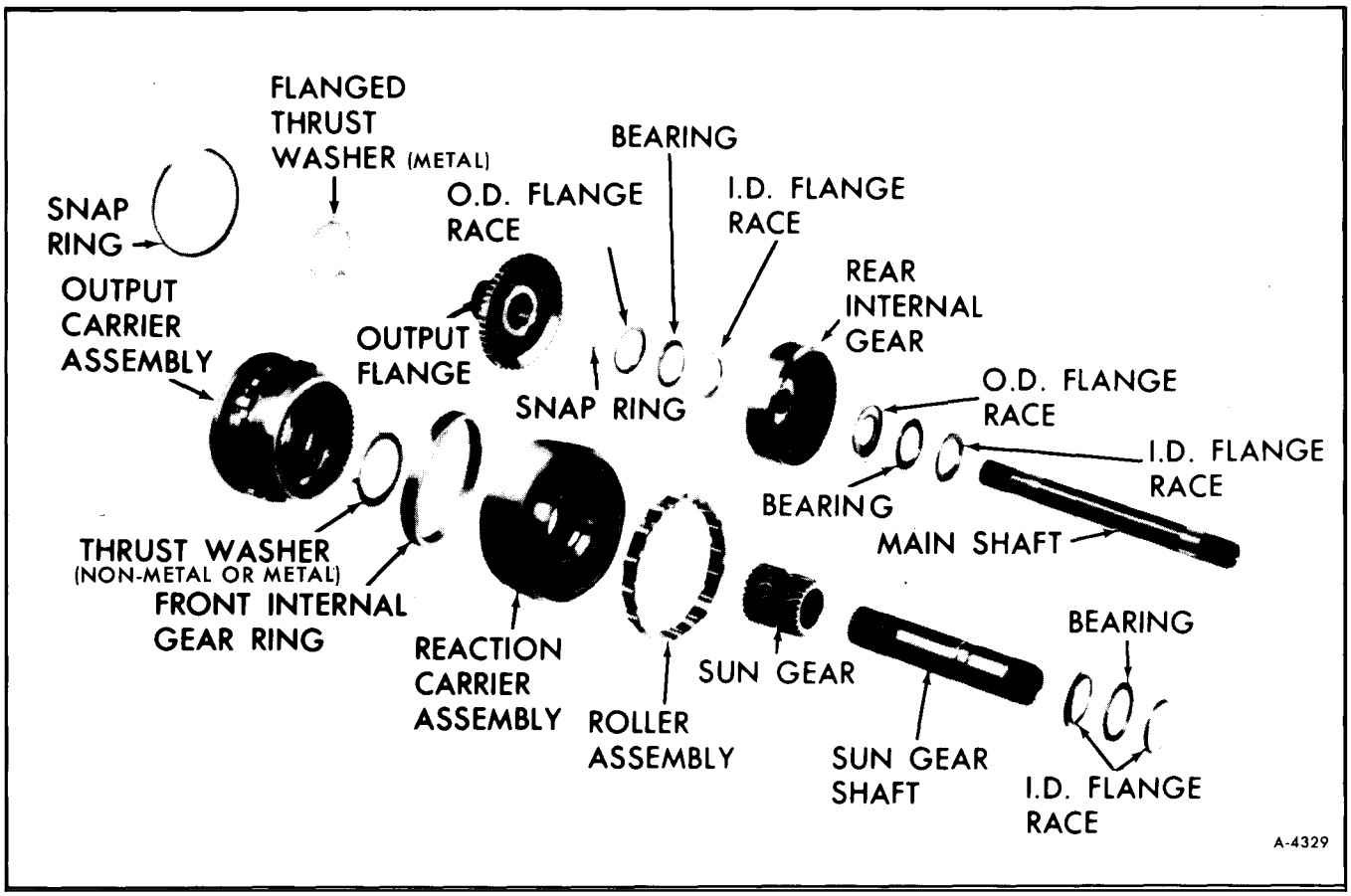


Figure 55—Gear Unit Components

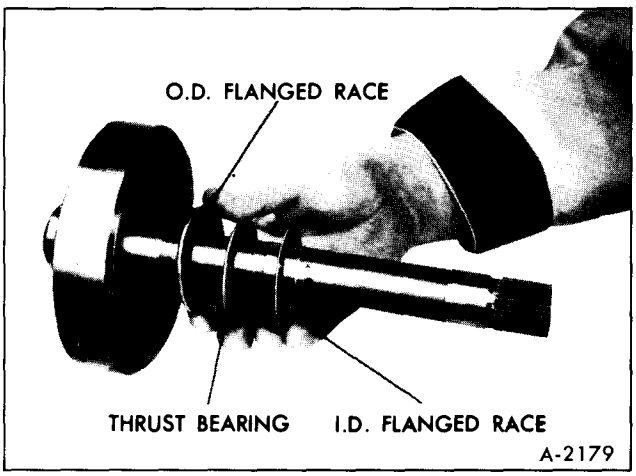


Figure 56—Thrust Bearing Installation

6. Install the output flange into the output carrier assembly.

7. Install the output flange to the output carrier snap ring.

8. Invert assembly and place on bench with output flange downward.

9. Lubricate tab side of reaction carrier to output carrier thrust washer (metal or non-metal) with petrolatum and install thrust washer in output carrier with tabs in tab pockets.

NOTE: The production built transmissions use a non-metal washer here. However, the service replacement washer is made of metal.

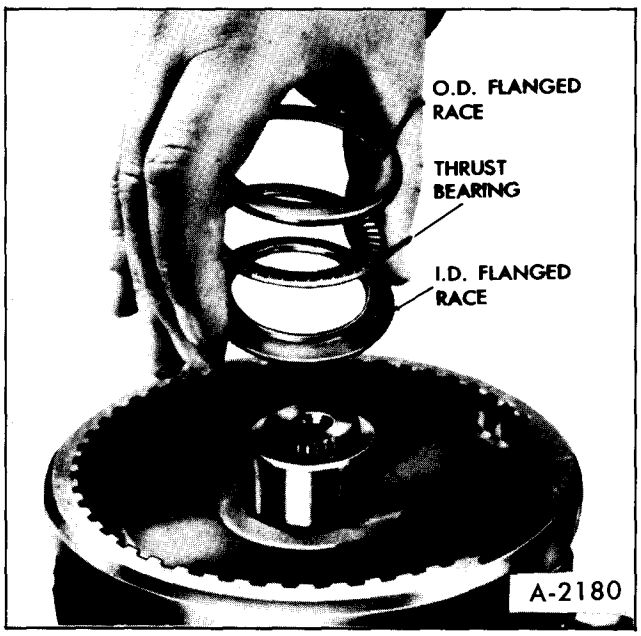


Figure 57—Installing Output Flange Thrust Bearing

10. Install sun gear with end having chamfered I.D. facing down.

11. Install sun gear shaft with longer splined end down.

12. Install gear ring over output carrier.

13. Lubricate pinion gears in reaction carrier with transmission fluid and install reaction carrier on output carrier so that pinion gears mesh with front internal gear.

NOTE: When a new output carrier and/or reaction carrier is being installed, and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service ring. The front internal gear ring is a selective fit at the factory, but not in service.

14. Install the center support to sun gear thrust races and bearings as follows: (See figure 58)

a. Install the large race, center flange up over the sungear shaft.

b. Install the thrust bearing against the race.

c. Install the second race, center flange up.

15. Install rollers that may have come out of roller clutch cage, by compressing energizing spring with forefinger and inserting roller from outer side.

NOTE: Make certain that energizing springs are not distorted, and that curved end leaf of springs are positioned against rollers.

16. Install roller clutch assembly in reaction carrier, Figure 59.

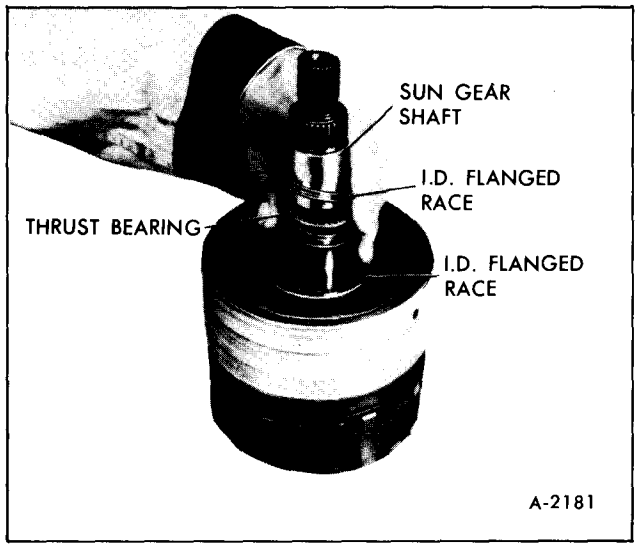


Figure 58—Installing Thrust Bearing over Sun Gear Shaft

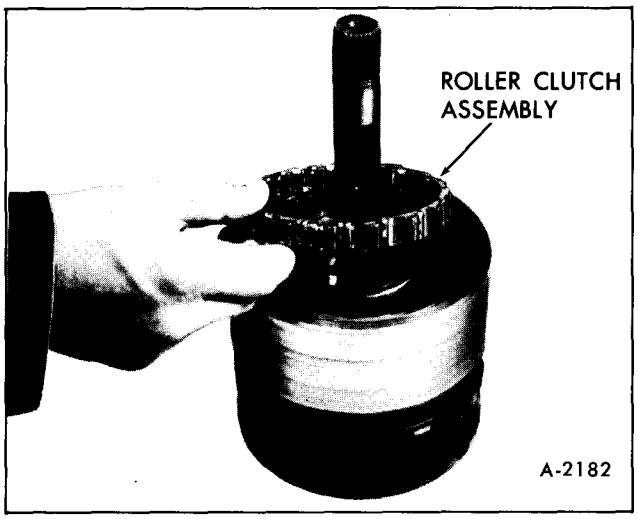


Figure 59—Roller Clutch Installation

DISASSEMBLE CENTER SUPPORT AND INTERMEDIATE CLUTCH PISTON

1. Remove center support to reaction carrier thrust washer from recess in center support.

2. If replacement is required, remove oil seal rings from the center support. All service center support oil seal rings are hook type cast iron or teflon, Figure 60.

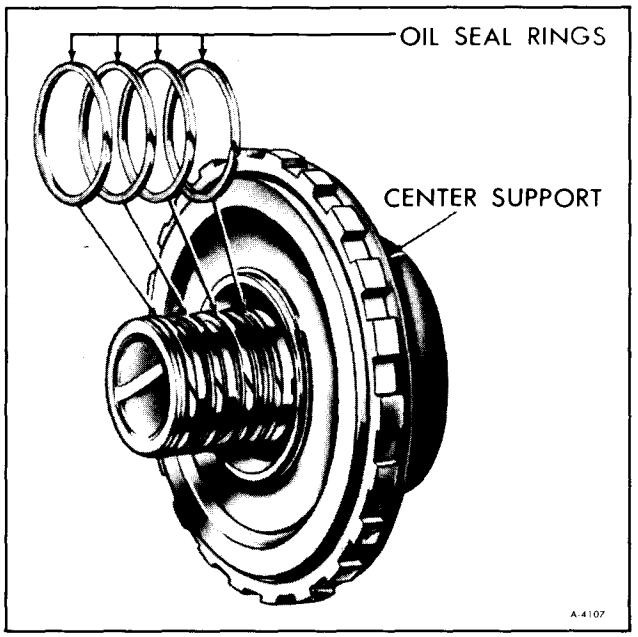


Figure 60—Removing Oil Seal Rings

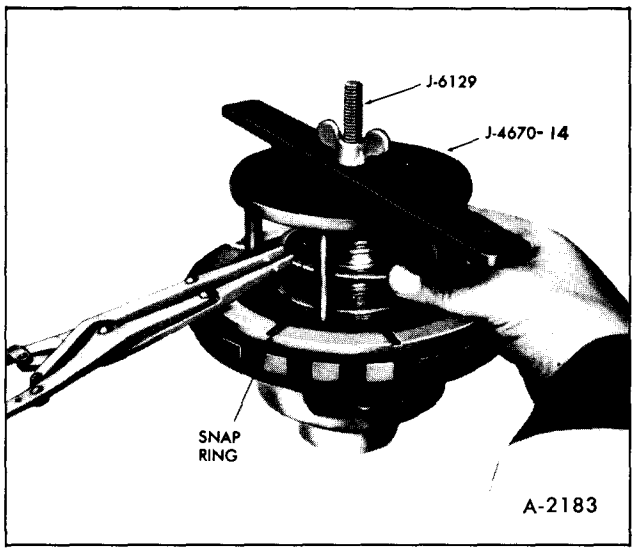


Figure 61—Removing Intermediate Clutch Retaining Snap Ring

3. Using Clutch Spring Compressor, J-4670, and Rear Clutch Spring Compressor, J-6129, Figure 61, compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586.

4. Remove spring retainer, six intermediate clutch release springs, and spring guide. Figure 62.

5. Remove intermediate clutch piston from center support.

6. Remove inner and outer seals from clutch piston.

NOTE: Do not remove the three screws retaining roller clutch inner race to center support.

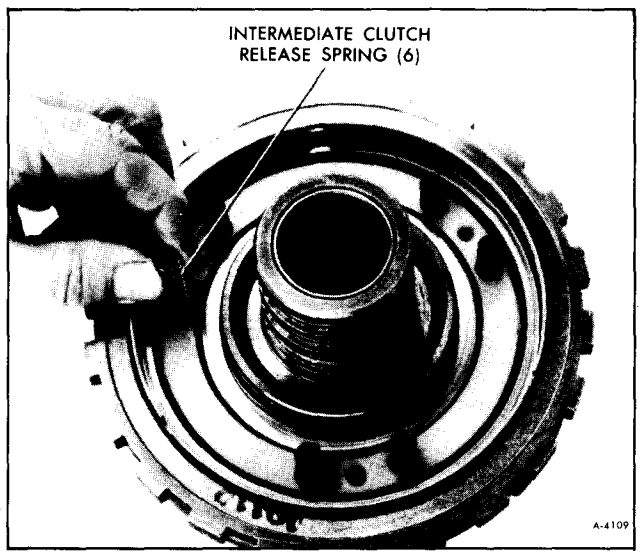


Figure 62—Removing Intermediate Clutch Springs

INSPECT CENTER SUPPORT

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

2. Inspect bushing for scoring, wear or galling.

3. Check oil ring grooves for damage.

4. Air check oil passages to be sure they are open and not interconnected.

5. Inspect piston sealing surfaces for scratches.

6. Inspect piston seal grooves for nicks or other damage.

7. Inspect piston for cracks.

8. Inspect springs for collapsed coils or signs of distortion.

9. Inspect oil seal rings for damage.

NOTE: All service center support oil seal rings are hook type cast iron or teflon.

ASSEMBLE CENTER SUPPORT AND INTERMEDIATE CLUTCH PISTON ASSEMBLY (FIGURE 63)

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in intermediate clutch piston and install seals with lips facing away from spring guide, Figures 64 and 65.

2. Place Intermediate Clutch Inner Seal Protector, J-21363, over center support hub and install intermediate clutch piston. Figure 66.

3. Install plastic spring guide. Figure 67.

4. Install six clutch release springs equally spaced into spring holes in spring guide.

5. Place spring retainer and snap ring over springs.

6. Using Clutch Spring Compressor, J-4670, and Rear Clutch Spring Compressor, J-6129, Figure 61, compress spring retainer, being careful that retainer

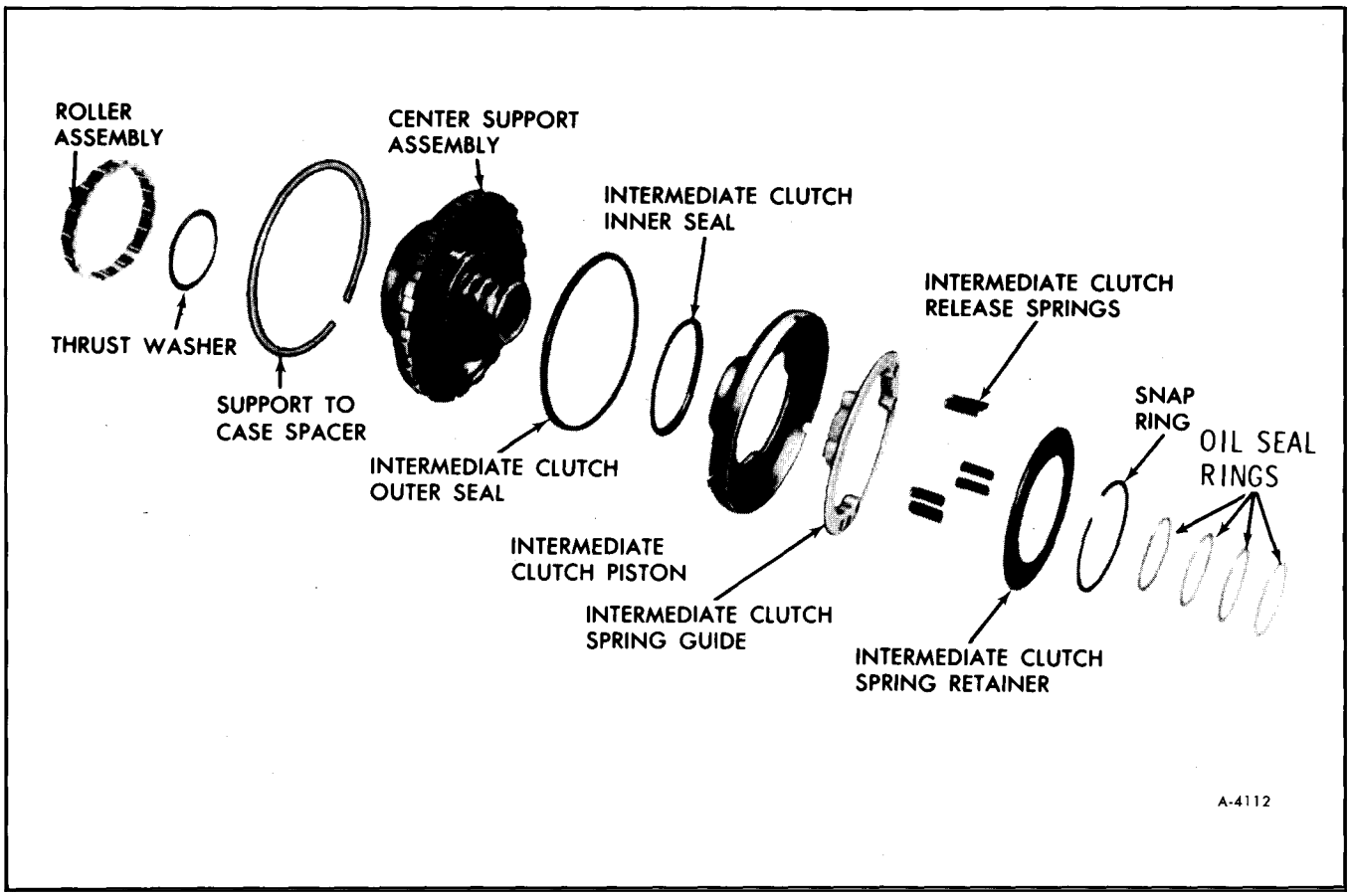


Figure 63—Center Support Assembly

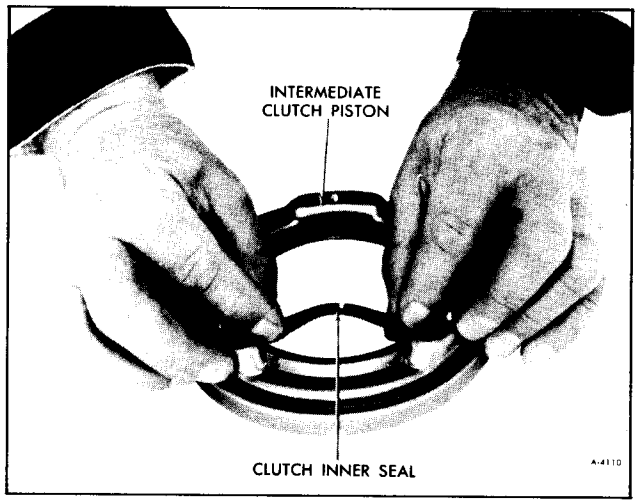


Figure 64—Removing or Installing Inner Seal

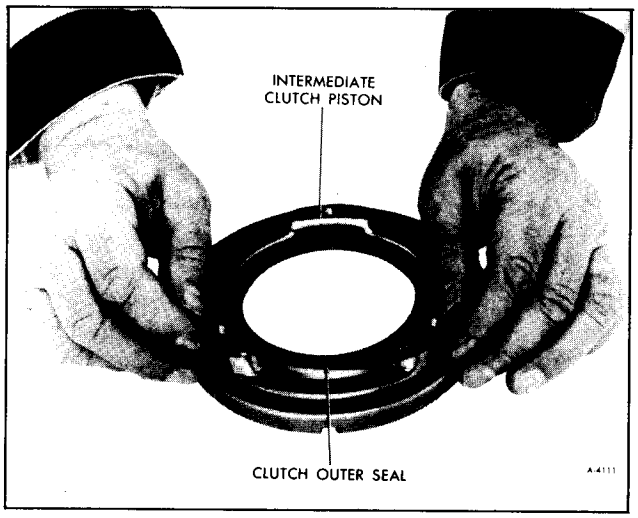


Figure 65—Removing or Installing Outer Seal

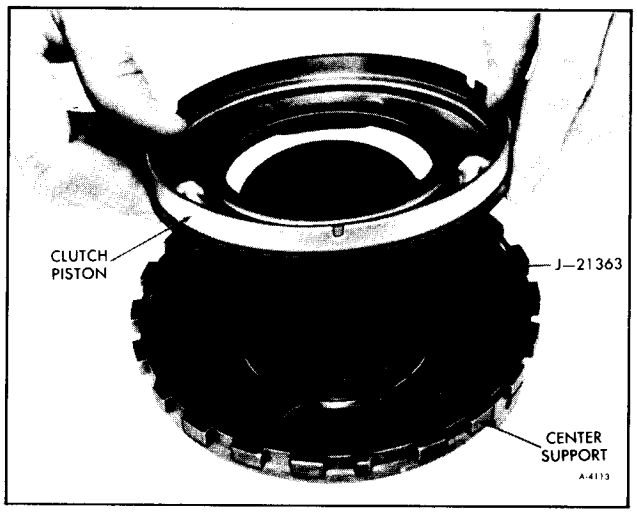


Figure 66—Installing Intermediate Clutch Piston

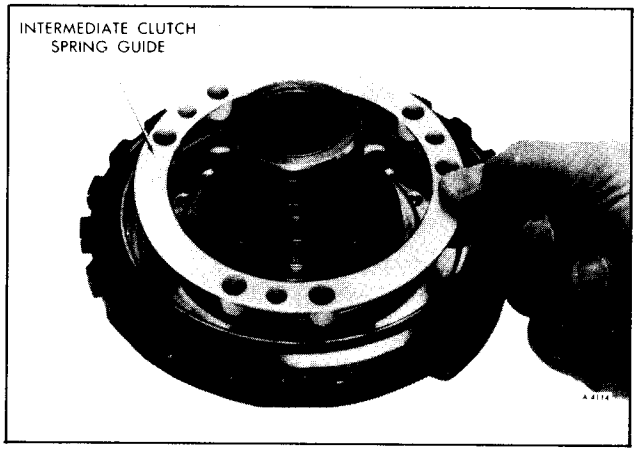


Figure 67—Installing Nylon Spring Guide

does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers. J-8059 or J-5586. Remove tools.

7. If necessary, install four oil seal rings on the center

NOTE: If teflon rings are being used, make sure slit ends are assembled in same relation as cut, Figure 68. Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during reassembly of mating parts over rings.

8. Air check operation of intermediate clutch and piston. Apply air through center oil feed hole to actuate clutch piston, Figure 69.

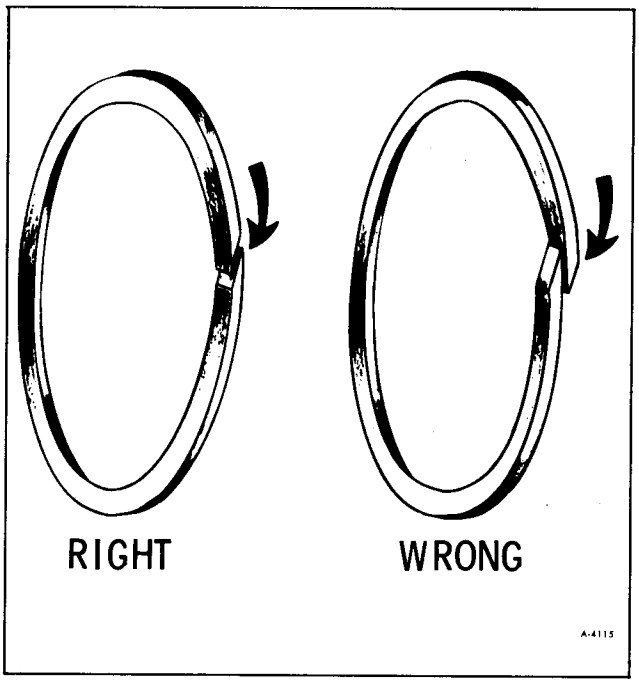


Figure 68—Installing Teflon Oil Seal Rings

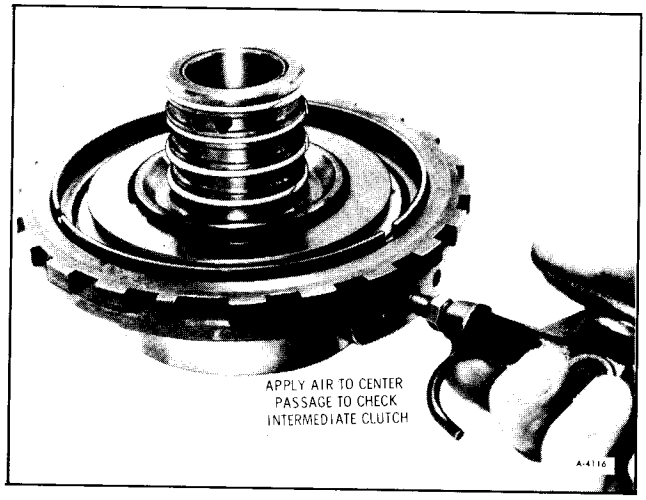


Figure 69—Air Checking Intermediate Clutch & Piston support.

9. Lubricate center support to reaction carrier thrust
washer with petrolatum and install washer in recess of center support, Figure 70.

10. Install center support assembly into roller clutch in reaction carrier, Figure 71.

NOTE: With reaction carrier held, center support should turn clockwise only.

11. Install Gear Assembly Remover and Installer Adapter, J-21795, on end of main shaft so that tangs

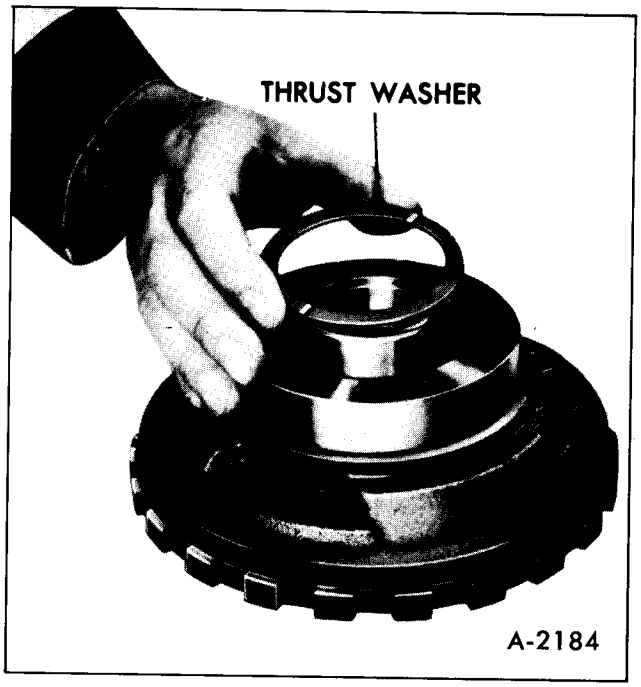


Figure 70—Center Support to Reaction Carrier Thrust Washer

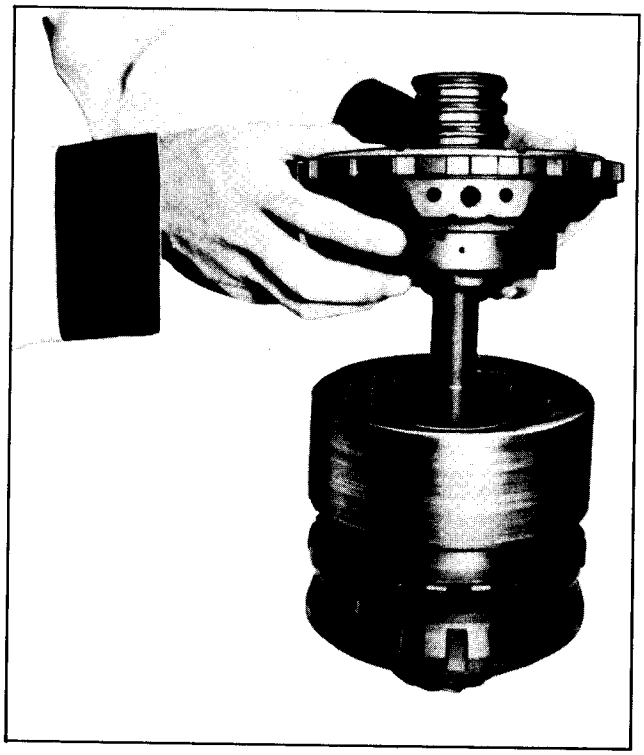


Figure 71—Center Support Installation

engauge groove in shaft. Using Slide Hammer Handle, J-6125, and Speedometer Puller Bolt, J-21797, tighten bolt on tool to secure tool on shaft and prevent movement of the roller clutch during installation of the gear unit assembly, Figure 47.

INSTALL REAR BAND AND COMPLETE GEAR UNIT ASSEMBLY

1. Inspect rear band for cracks or distortion and band ends for damage to anchor lugs and apply lug. Also inspect lining for cracks, flaking, burning and looseness.

2. Install rear band assembly in transmission case so that band lugs index with anchor pins.

3. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.

4. Install the support case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin, Figure 72.

CAUTION: *Do not confuse this spacer (.040" thick and both sides flat) with either the*

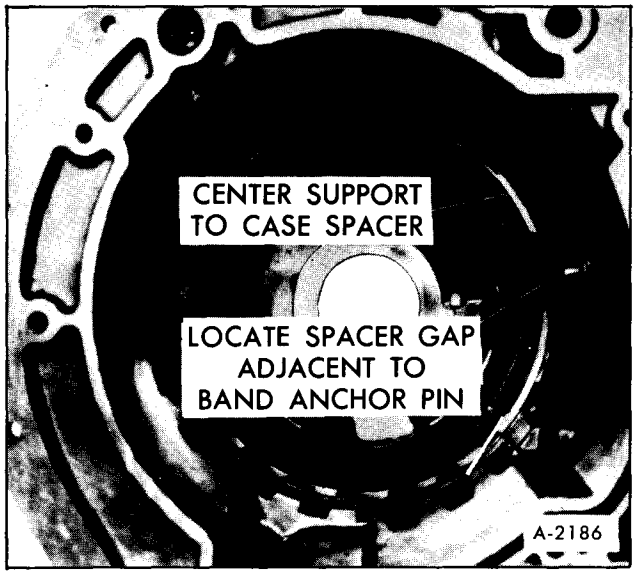


Figure 72—Installing Support-to-Case Spacer

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).

5. Install previously selected rear unit selective washer into slots provided inside rear of transmission case. Retain washer with petrolatum, Figure 73.

NOTE: Proper washer size was determined at time of rear unit end play check.

6. Laying gear unit on its side, install metal thrust washer on output flange washer on output flange with bent tabs in tab pockets. Retain thrust washer with petrolatum, Figure 74.

IMPORTANT: This must be a metal thrust washer.

CAUTION: *Be careful not to drop or bump gear unit assembly in transmission case during installation.*

7. Install gear unit, with center support and reaction carrier, by lining up center support bolt hole with hole in case and carefully guiding complete assembly into transmission case, Figure 47.

8. Lubricate center support to case snap ring with transmission fluid and install snap ring in transmission case with beveled side up, (flat side against center support) locating gap adjacent to front band anchor pin. Make certain ring is properly seated in groove.

9. Install case to center support bolt.

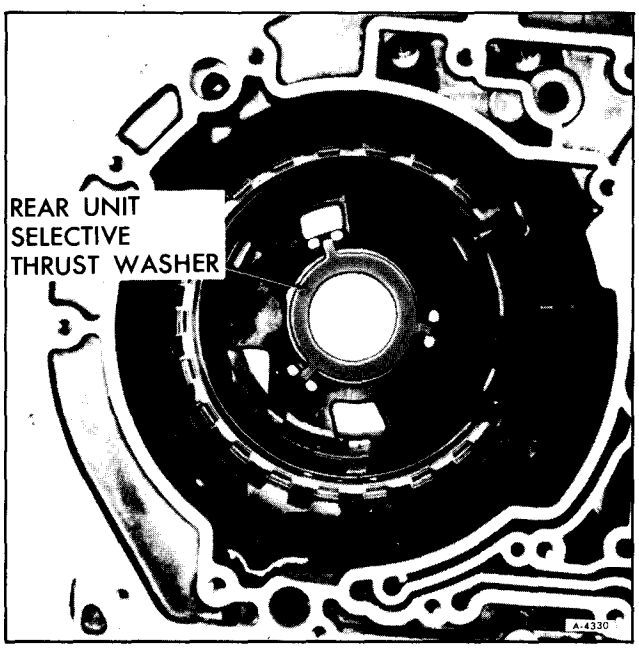


Figure 73—Removing and Installing Rear Unit Selective Thrust Washer

NOTE: To correctly perform this operation, it will be necessary to make the tool shown in Figure 75. Then follow procedure outlined below:

Place center support locating tool into the case direct clutch passage, with the handle of the tool pointing to the left, as viewed from the front of transmission and parallel to the bell housing mounting, Figure 76.

Lift upward on the tool which will tend to rotate the center support counterclockwise as viewed from the front of transmission. While holding the center support firmly counterclockwise against case splines, torque case to center support bolt to 23 ft. lbs., using a 3/8" 12-point thin-wall deep socket.

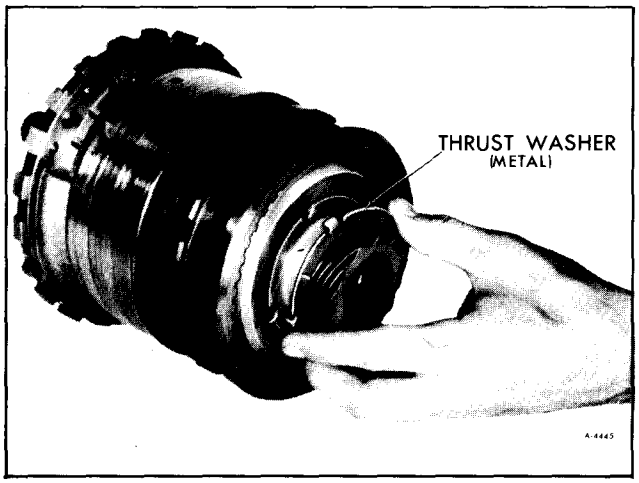


Figure 74—Installing Metal Thrust Washer

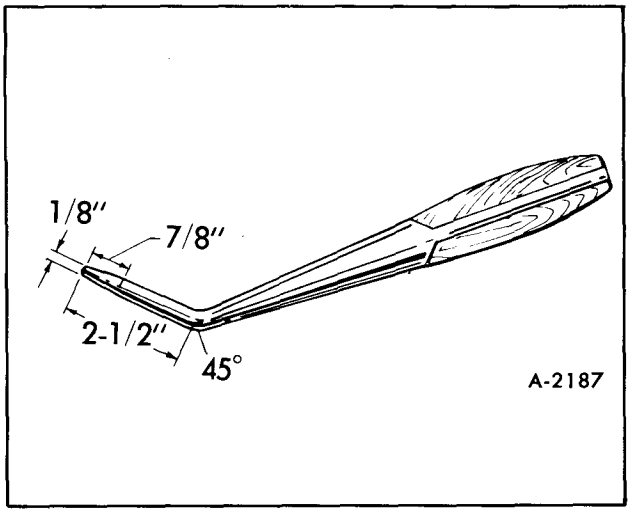


Figure 75—Center Support Locating Tool

CAUTION: *When using the locating tool, care should be taken not to raise burrs on the case valve mounting face.*

10. Before installing intermediate clutch plates, inspect plates for signs of burning, scoring, and wear.

11. Lubricate three steel and three composition intermediate clutch plates with transmission fluid and install clutch plates in transmission case, Figure 77. Start with steel plate and alternate composition and steel plates.

12. Install intermediate clutch backing plate with flat machine surface against clutch plates.

13. Install backing plate to case snap ring with snap ring gap on side of case opposite front band anchor pin.

NOTE: Both sides of this snap ring are flat, and it is approximately .093" thick.

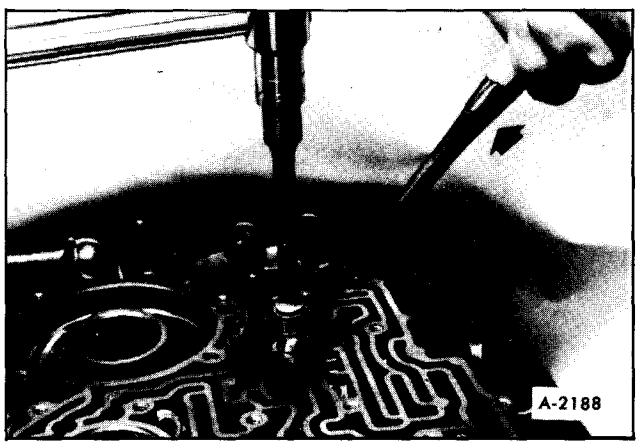


Figure 76—Locating Center Support

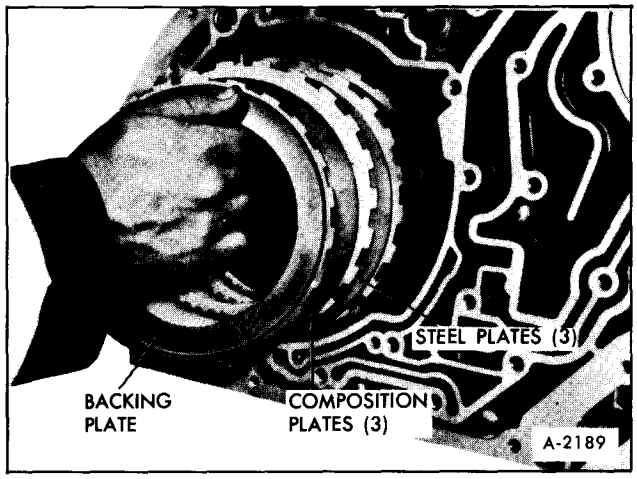


Figure 77—Installing Intermediate Clutch

14. Air check operation of intermediate clutch piston. Apply air through center oil feed hole to actuate clutch piston.

15. Recheck rear unit end play as described previously.

DIRECT CLUTCH AND INTERMEDIATE SPRAG ASSEMBLY (FIGURE 78)

DISASSEMBLY

1. Remove sprag retainer snap ring, and remove clutch retainer.

2. Remove sprag outer race and bushings, and remove sprag assembly from outer race.

3. Turn unit over and remove direct clutch backing plate to clutch housing snap ring.

4. Remove direct clutch backing plate and six composition and six steel clutch plates.

5. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, compress spring retainer and remove snap ring with Snap Ring Pliers, J-8059 or J-5586, Figure 79.

6. Remove tools, spring retainers, and clutch release springs.

7. Remove direct clutch piston from direct clutch housing.

NOTE: The 1975 and 1976 transmissions now use a direct clutch piston without a check ball.

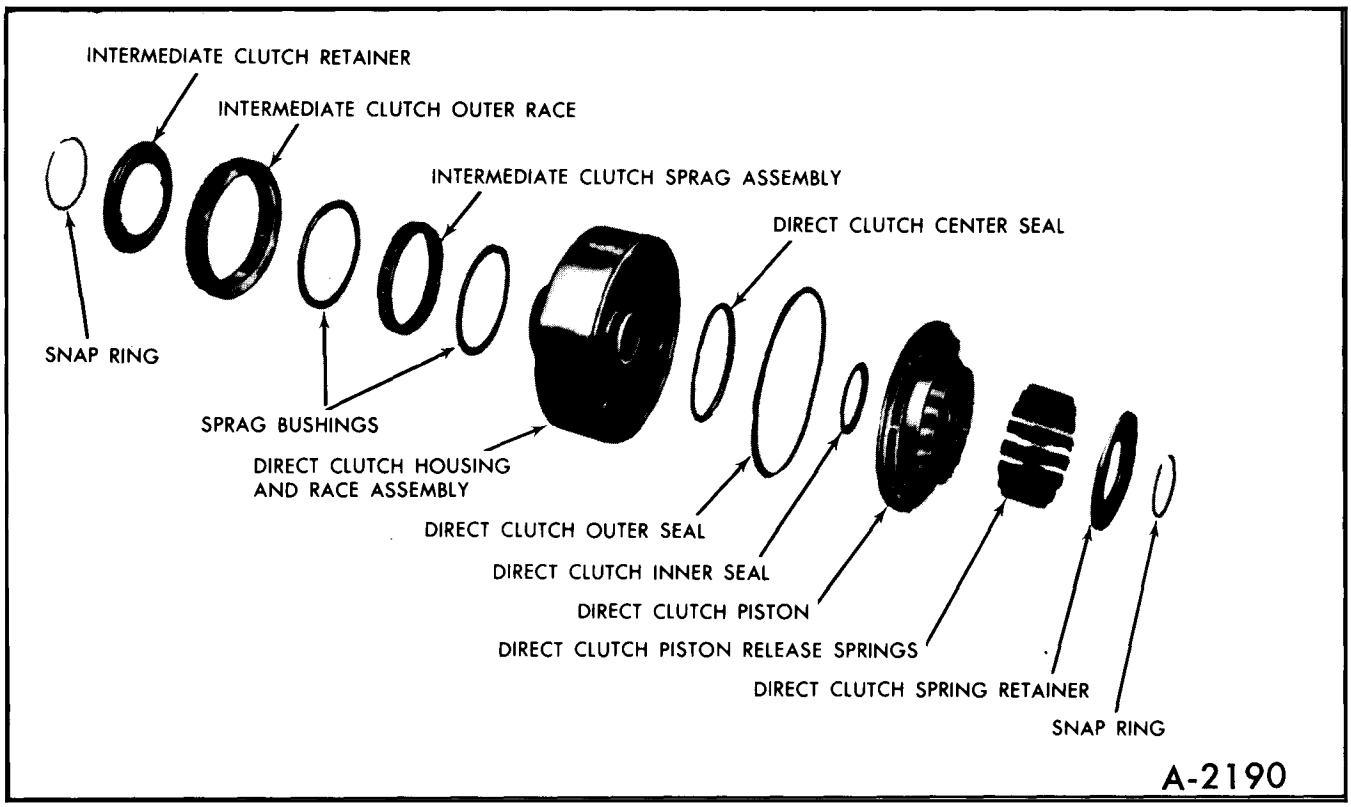


Figure 78—Direct Clutch and Piston

The forward and direct clutch pistons look almost the same. Make sure the direct clutch piston is identified during disassembly so it will be re-assembled into the direct clutch housing. The service replacement direct clutch piston contains a check ball. The production built direct clutch piston will be aluminum or stamped steel.

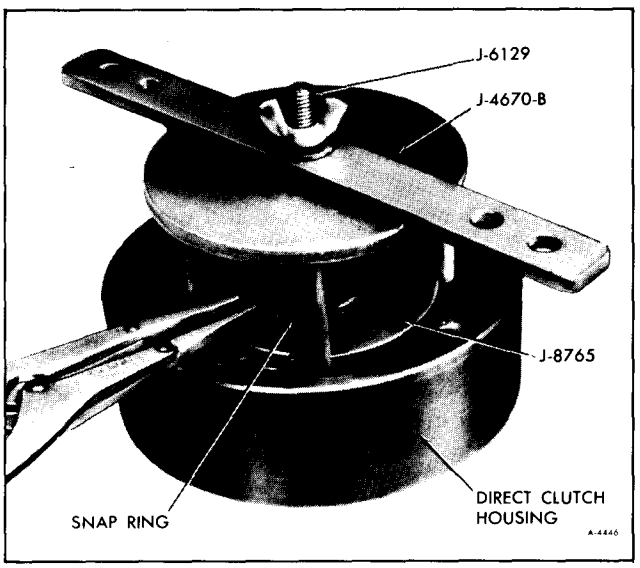


Figure 79—Removing Direct Clutch Snap Ring

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from direct clutch housing.

INSPECTION

1. Inspect sprag assembly for popped or loose sprags.

2. Inspect sprag bushing for wear or distortion.

3. Inspect inner and outer races for scratches or wear.

4. Inspect clutch housing for cracks, wear, proper openings of oil passages and wear on clutch plate drive lugs.

5. Inspect composition faced and steel clutch plates for sign of wear or burning.

6. Inspect backing plate for scratches or other damage.

7. Inspect piston for cracks and/or other damage.

8. Inspect springs for collapsed coils or signs of distortion.

NOTE: The 14 direct clutch release springs are not serviced individually. If one or more of these springs require replacement, discard all of them and install the 16 service direct clutch release springs.

9. Inspect clutch housing for free operation of check ball.

ASSEMBLY

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in direct clutch piston and install seals with lips facing away from spring pockets.

IMPORTANT: 1975 and 1976 transmissions now use a direct clutch housing with a check ball, see Figure 80. 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 as a check ball. EITHER THE DIRECT CLUTCH HOUSING AND/OR THE PISTON MUST CONTAIN A CHECK BALL.

2. Lubricate new center seal with transmission fluid. Lubricate seal groove in direct clutch housing and install seal in clutch housing with lip facing up.

3. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over direct clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in direct clutch housing Figure 81 and install clutch piston by rotating it slightly, in a clockwise direction.

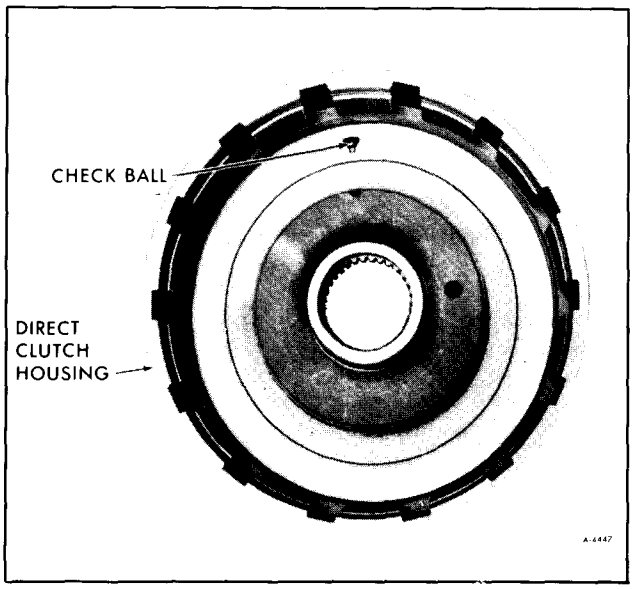


Figure 80—Direct Clutch Housing

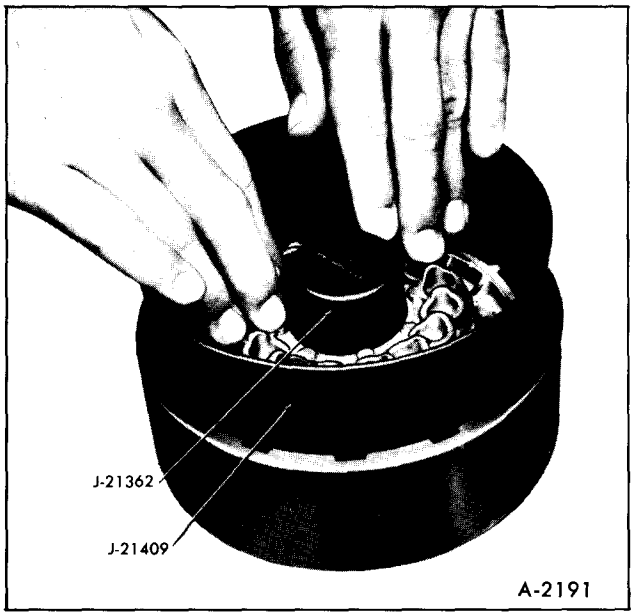


Figure 81—Installing Direct Clutch Piston

4. Install 14 clutch release springs into spring pockets in clutch piston leaving two pockets directly opposite with no springs.

5. Place spring retainer and snap ring over springs.

6. Using Clutch Spring Compressor, J-4670, Rear Clutch Spring Compressor, J-6129, or an arbor press, and Adapter, J-21664, compress spring retainer, being careful that retainer does not get caught in snap ring groove, and install snap ring with Snap Ring Pliers, J-8059 or J-5586, Figure 79. Remove tools.

NOTE: Make certain clutch release springs are not leaning. If necessary, straighten springs with a small screwdriver.

7. Lubricate the five flat and one waved (plate with "U" notch) and steel and six composition clutch plates with transmission fluid and install clutch plates in direct clutch housing. Start with waved steel plate and alternate composition and flat steel clutch plates.

8. Install direct clutch backing plate over clutch plates and install backing plate snap ring.

9. Invert clutch housing and install one sprag bushing, cup side up, around sprag inner race.

10. Install sprag assembly into clutch outer race.

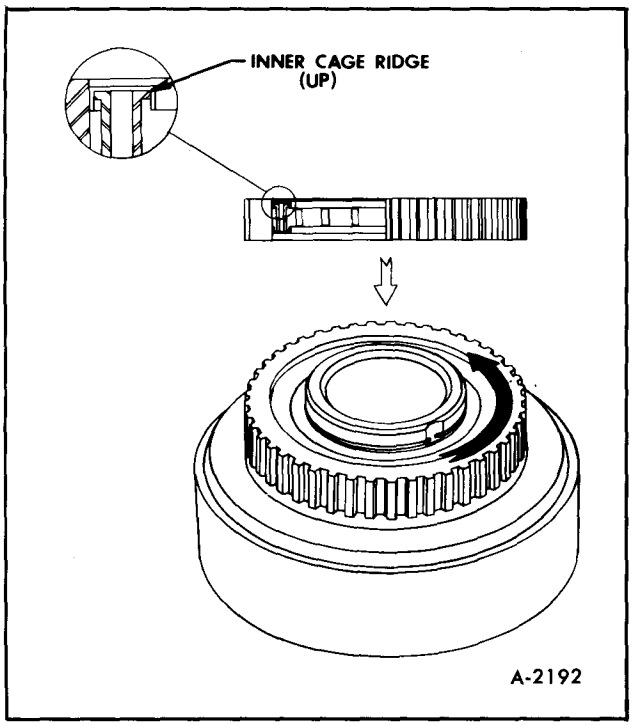


Figure 82—Sprag Rotation

11. With ridge on inner cage of sprag facing up install sprag and outer race on inner race with counterclockwise turning motion.

NOTE: When installed, outer race should turn only counterclockwise, Figure 82.

12. Install sprag bushing, cup side down, over sprag assembly.

13. Install sprag retainer and snap ring.

INSTALL FRONT BAND AND DIRECT CLUTCH ASSEMBLY

1. Inspect front band for cracks or distortion and band ends for damage at anchor lug and apply lug. Also inspect lining for cracks, flaking, burning, and looseness.

2. Install front band with band anchor hole over band anchor pin, and apply lug facing servo hole, Figure 83.

3. Install direct clutch housing and intermediate sprag assembly. Make certain that clutch housing hub bottoms on sun gear shaft and splines on forward end of sun gear shaft are flush with splines in direct clutch housing.

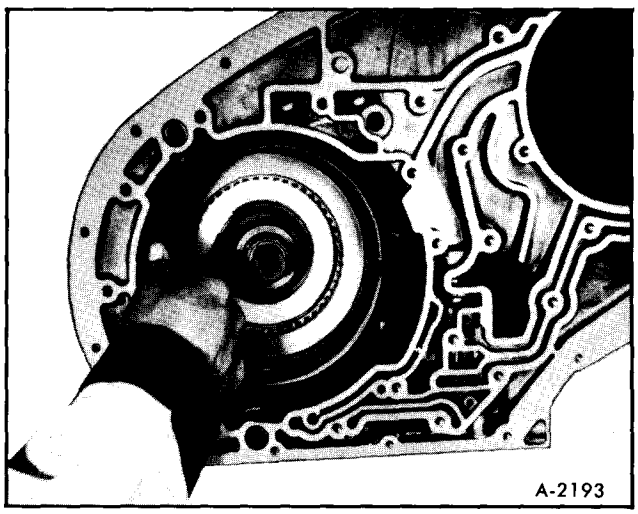


Figure 83—Front Band Installation

NOTE: It will be necessary to rotate clutch housing to allow sprag outer race to index with intermediate composition clutch plates. Removal of direct clutch composition-faced and steel plates may be helpful, and applying air pressure through the center support screw to apply the intermediate clutch plates may facilitate assembly.

4. Check operation of direct clutch by applying air pressure through direct clutch passage next to center support bolt.

NOTE: 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. Refer to Figure 48.

FORWARD CLUTCH ASSEMBLY

DISASSEMBLY (FIGURE 84)

1. Remove forward clutch housing to direct clutch hub snap ring.

2. Remove direct clutch hub.

3. Remove forward clutch hub and one thrust washer from inner side of hub.

4. Remove five composition and five flat and one dished steel clutch plates.

5. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press and remove snap ring using Snap Ring Pliers, J-8059 or J-5586, Figure 85.

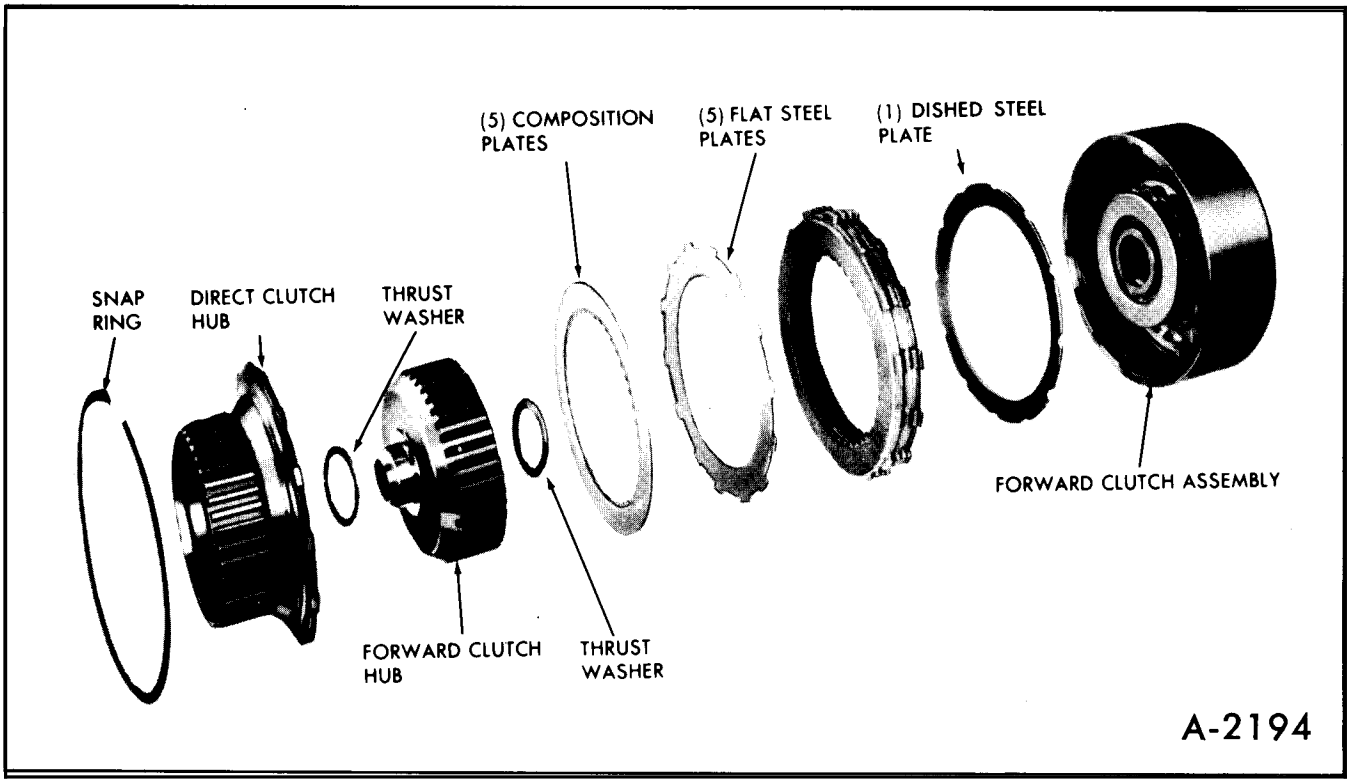


Figure 84—Forward Clutch Components

6. Remove tools, spring retainer and 16 clutch release springs. Keep springs separate from direct clutch springs.

7. Remove forward clutch piston from forward clutch housing.

8. Remove inner and outer seals from clutch piston.

9. Remove center piston seal from forward clutch housing.

INSPECTION

1. Inspect composition-faced and steel clutch plates for signs of burning, scoring or wear.

2. Inspect release springs for collapsed coils or signs of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes, and thrust faces.

4. Inspect piston or cracks.

5. Inspect clutch housing for wear, scoring, cracks and open oil passages.

ASSEMBLY (FIGURE 86)

1. Lubricate new inner and outer clutch piston seals with transmission fluid. Lubricate seal grooves in forward clutch piston with petrolatum and install seals with lips facing away from spring pockets.

IMPORTANT: The transmissions now use a direct clutch piston without a check ball. The forward

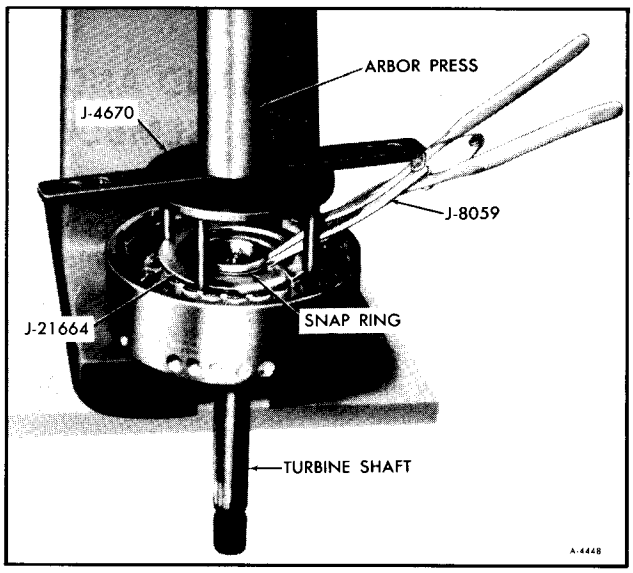


Figure 85—Removing Forward Clutch Snap Ring

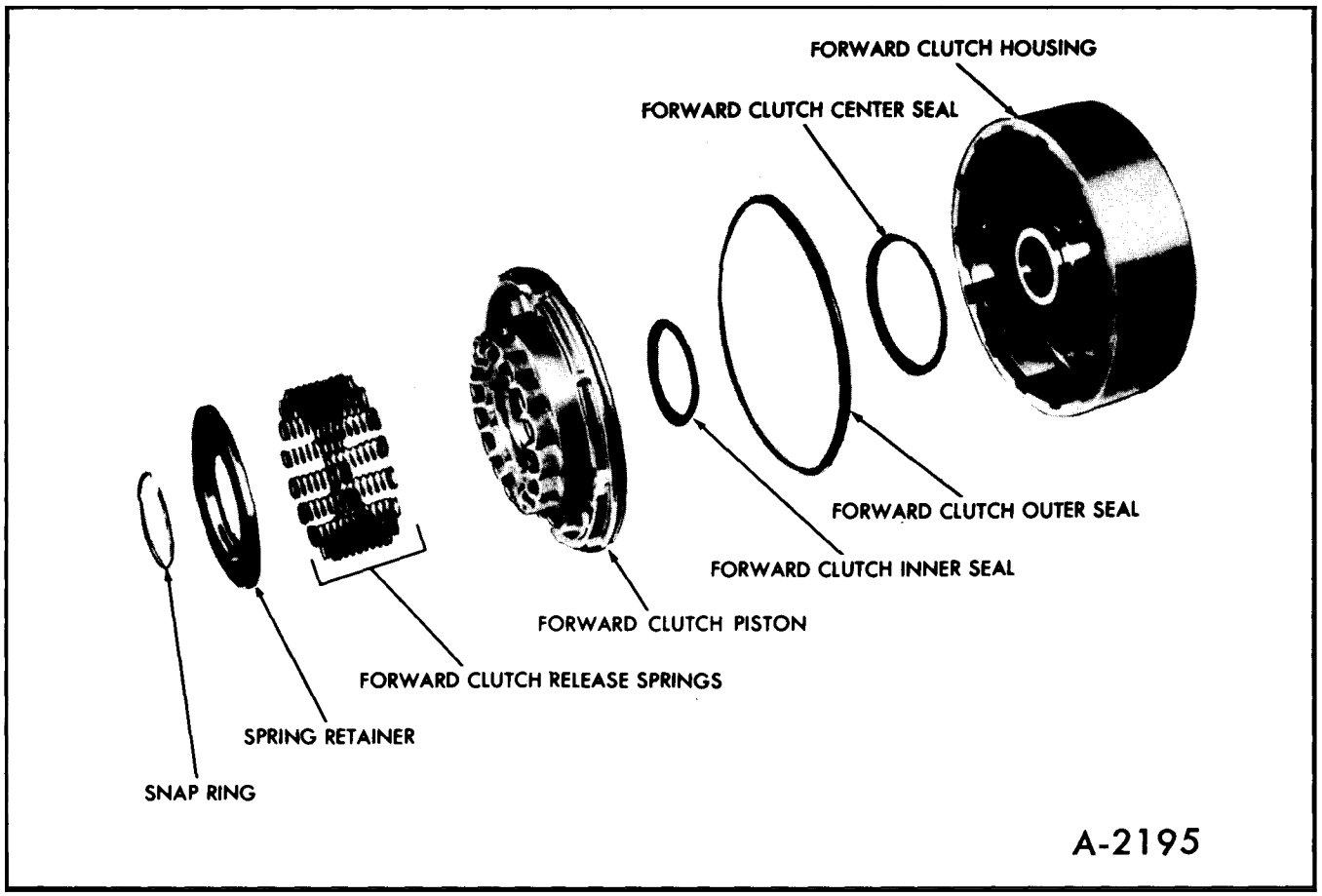


Figure 86—Forward Clutch Piston Components

and direct clutch pistons look almost the same. Make sure the forward clutch piston is identified during disassembly so it will be reassembled into the forward clutch housing. The production built forward clutch piston can be aluminum or stamped steel.

2. Lubricate new center piston seal with transmission fluid. Lubricate seal groove in forward clutch housing with petrolatum and install seal into clutch housing with lip facing up.

3. Place Forward and Direct Clutch Inner Seal Protector, J-21362, over forward clutch hub. Install clutch piston inside Forward and Direct Clutch Piston Installer, J-21409, insert assembly in forward clutch housing, and install clutch piston by rotating it slightly in a clockwise direction until seated.

4. Install sixteen clutch release springs into spring pockets in clutch piston.

5. Using Clutch Spring Compressor, J-4670, and Adapter, J-21664, compress spring retainer with arbor press, being careful that retainer does not catch in snap ring groove, and install snap ring using Snap Ring Pliers, J-8059 or J-5586. See Figure 85. Remove tools.

CAUTION: *Make certain clutch release springs are not leaning. If necessary, straighten with a small screwdriver.*

6. Remove forward clutch assembly from arbor press and place on work bench.

7. Install the forward clutch hub thrust washers on the forward clutch hub. Retain with petrolatum.

8. Install forward clutch hub in forward clutch housing.

9. Lubricate the dished and five flat steel and five composition clutch plates with tansmission fluid and install clutch plates in forward clutch housing. Start with dished steel plate (O.D. up) and place a flat steel plate on top of the dished steel plate. Then alternate composition and flat steel clutch plates.

10. Install direct clutch hub in forward clutch housing over clutch plates, and install snap ring.

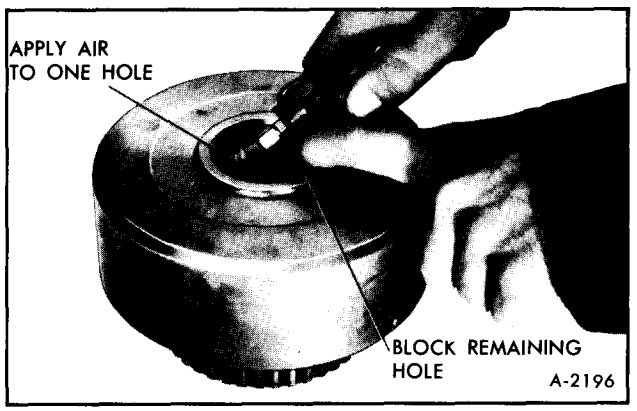


Figure 87—Air Check Forward Clutch Piston

11. Air check forward clutch and piston operation, Figure 87.

INSTALL FORWARD CLUTCH

1. Install Front Unit End Play Checking Tool, J-22241 into forward clutch, Figure 36.

2. Install forward clutch assembly into transmission, making certain main shaft goes into forward clutch hub. It will be necessary to rotate clutch housing to allow direct clutch driving hub to index with direct clutch composition-faced plates.

3. Remove Front Unit End Play Checking Tool, J-22241.

INSTALL PUMP COVER PLATE

1. Install new pump cover plate gasket on transmission.

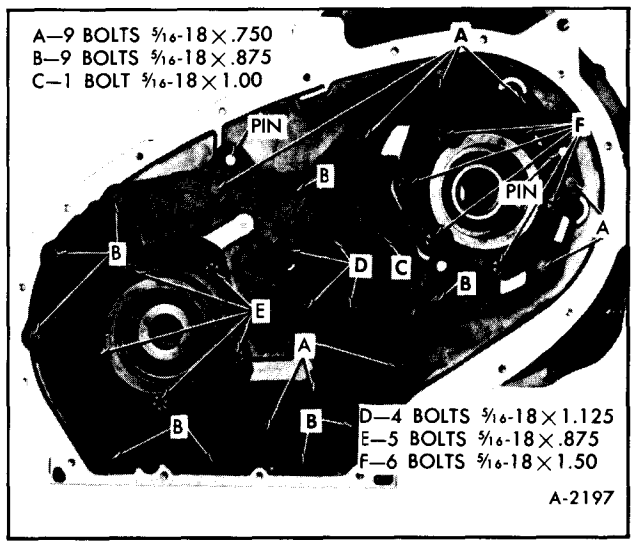


Figure 88—Pump Cover Plate Screws

2. Install pump cover plate on transmission and install attaching bolts per bolt chart, Figure 88.

NOTE: Do not install pump attaching bolts (F) or single bolt (E) in pump cover plate at this time.

3. Using the driven sprocket as a driver rotate the forward clutch.

NOTE: If the forward clutch housing cannot be rotated as the pump cover plate is being pulled into place, the forward or direct clutch housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump cover plate is pulled fully into place.

4. Torque all bolts to 20 foot-pounds.

5. Repeat front unit end play check as described.

6. Install remaining bolt (E) in driven support housing, tightening to 20 foot-pounds.

OIL PUMP

DISASSEMBLY

1. Mark drive and driven gears for reassembly in same position and remove the pump body.

NOTE: Installing the gears in the same position as removed will assure the quietest operation, as the gear teeth will mesh in the established wear pattern.

2. Remove drive and driven gears from pump body.

3. Remove and discard pump body to case square-cut O-ring seal.

INSPECTION

1. Using tip of finger, inspect gear pocket and crescent for nicks, burrs, scoring or galling.

2. Inspect drive gear for nicks, burrs, scoring, or galling.

3. Inspect driven gear for nicks, burrs, scoring, or galling.

4. Place pump gears in pump body and check pump body face to gear face clearance. Clearance should be .0013"-.0035".

5. Check face of pump body for nicks, burrs, scoring, or galling.

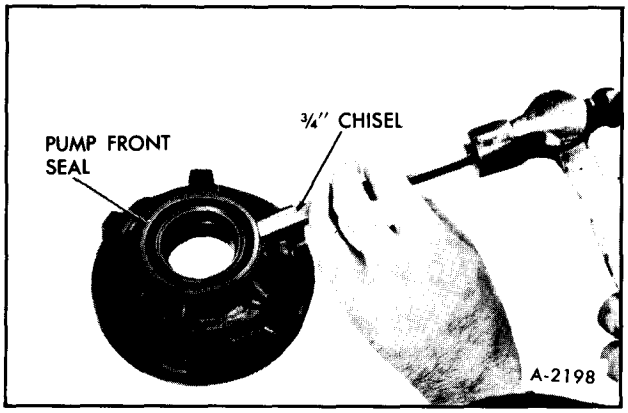


Figure 89—Removing Pump Front Seal

6. Check pump body face flatness. Overall flatness should be .000" to .002".

7. Inspect bushing for nicks, burrs, scoring, galling, out-of-round, or excessive wear.

NOTE: To check for out-of-round, install pump body on the converter hub and look for eccentricity between pump bushing and converter hub.

8. Check for damaged pump cover plate bolt holes.

9. Inspect front seal for damage. If replacement of front seal is necessary, use a standard 3/4" cold chisel and pry front seal from pump body, Figure 89.

ASSEMBLY

1. If necessary, install a new front seal, using Pump Oil Seal Installer, J-21359, to drive seal into place. Use a non-hardening sealer on outside of seal before installing into pump, Figure 90.

2. Install new pump to case square-cut O-ring seal.

3. Install driven gear into pump body with alignment mark up.

4. Install drive gear into pump body with drive tangs up, Figure 91.

NOTE: Drive gear should always be installed with counterbore down.

INSTALLATION

1. Rotate transmission in holding fixture base so that cored oil passages are up.

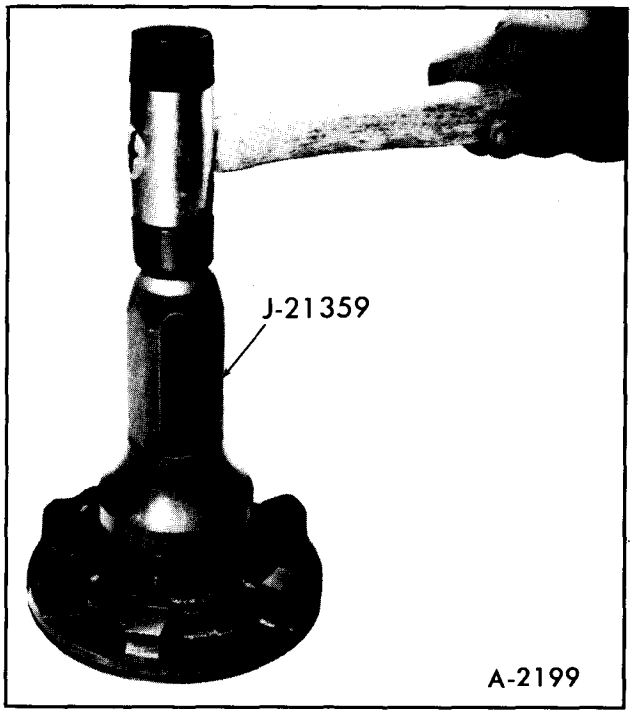


Figure 90—Installing Pump Front Seal

2. Install pump assembly over stator shaft and position to drive support housing, rotating pump as necessary to align holes in pump cover plate with pump attaching bolt holes.

3. Install six retaining bolts (F), finger tight, Figure 88.

4. Tighten pump attaching bolts to 20 ft. lbs.

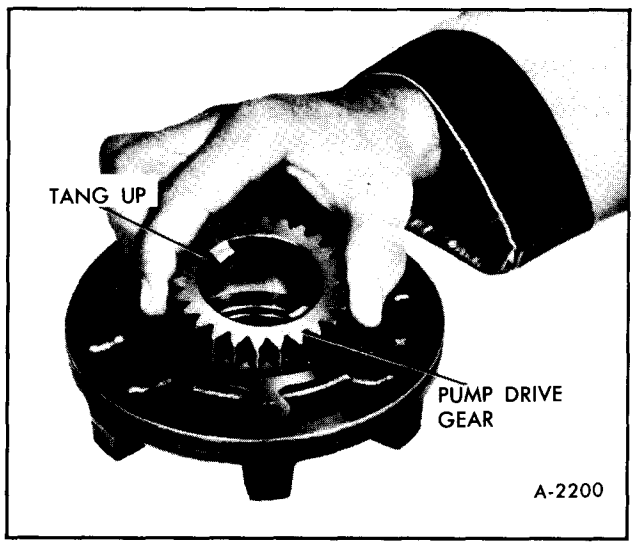


Figure 91—Installing Pump Drive Gear

INSTALL SPROCKETS, LINK ASSEMBLY AND SPROCKET COVER

1. Place link belt around the drive and driven sprockets so that the links engauge the teeth of the sprockets, colored guide link which has etched numerals facing link cover.

2. Simultaneously place link belt, drive and driven sprockets into support housing.

3. Using a plastic mallet, gently seat the sprocket bearing assemblies into the support housings.

4. Install sprocket assembly to support housing snap rings using J-4646 snap ring pliers.

5. Install new case to cover and plate assembly sprocket housing gasket.

6. Install sprocket housing cover and plate assembly and eighteen attaching bolts. Torque bolts to 8 ft. lbs.

NOTE: One sprocket cover housing attaching bolt is 1/4 inch longer. This bolt must be installed in the tapped hole located directly over the cooler fittings on the transmission case.

DETENT LEVER, MANUAL SHAFT, PARKING LINKAGE, REAR SERVO, FRONT SERVO, CHECK BALLS, AND CONTROL VALVE SPACER

INSPECT DETENT LEVER, MANUAL SHAFT, AND PARKING LINKAGE

1. Inspect parking actuator rod for cracks, or broken spring retainer lugs.

2. Inspect actuator spring for damage.

3. Inspect actuator for a free fit on actuator rod.

4. Inspect parking pawl for cracks or wear.

5. Inspect manual shaft for damaged threads.

6. Inspect inside detent lever for cracks or a loose pin.

7. Inspect parking pawl return spring for deformed coils or ends.

8. Inspect parking bracket for cracks or wear.

9. Inspect detent spring and roller assembly.

INSTALL DETENT LEVER, MANUAL SHAFT AND PARKING LINKAGE

1. Install parking pawl (tooth toward inside of case), pawl return spring and parking pawl shaft into case, Figure 92.

2. Install parking pawl shaft retaining pin into case hole.

3. Install parking bracket into case, tightening attaching screws to 18 ft. lbs.

4. Install a new manual shaft O-ring seal on manual shaft.

5. Install the actuator rod plunger under the parking bracket and over the parking pawl and through hole in detent lever. Position detent lever in transmission case.

6. Install the manual shaft assembly through the retaining lock nut on manual shaft, Figure 93.

7. Install manual shaft retaining pin into case, long smooth end first.

8. Torque lock nut to 18 ft. lbs.

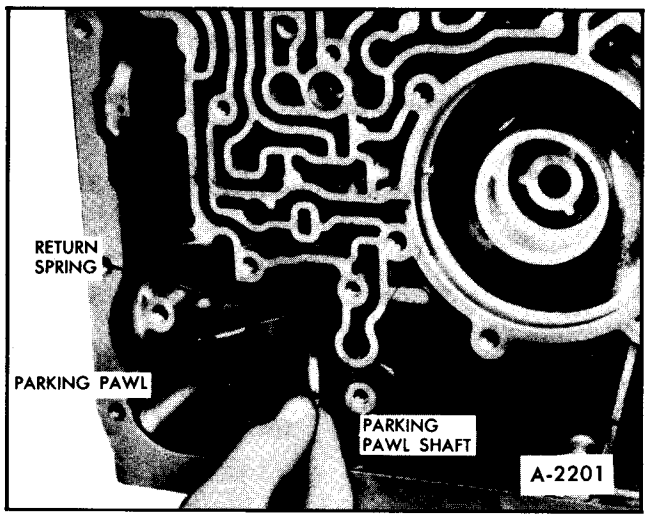


Figure 92—Installing Parking Pawl

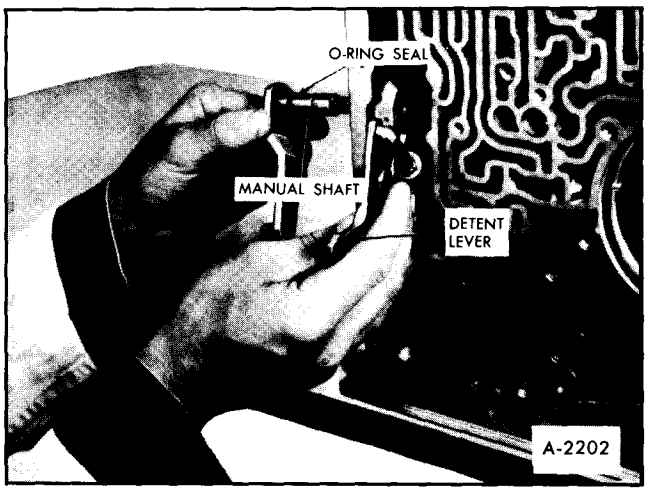


Figure 93—Installing Manual Shaft

DISASSEMBLE REAR SERVO ASSEMBLY (FIGURE 94)

1. Remove rear accumulator piston from rear servo piston.

2. Remove E-ring retaining rear servo piston to band apply pin.

3. Remove rear servo piston and seal from band apply pin.

4. Remove washer, spring and retainer.

INSPECT REAR SERVO

1. Check freeness of oil seal rings in accumulator piston grooves.

NOTE: 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 requires replacement, use only the teflon oil seal ring.

2. Inspect fit of band apply pin in servo piston.

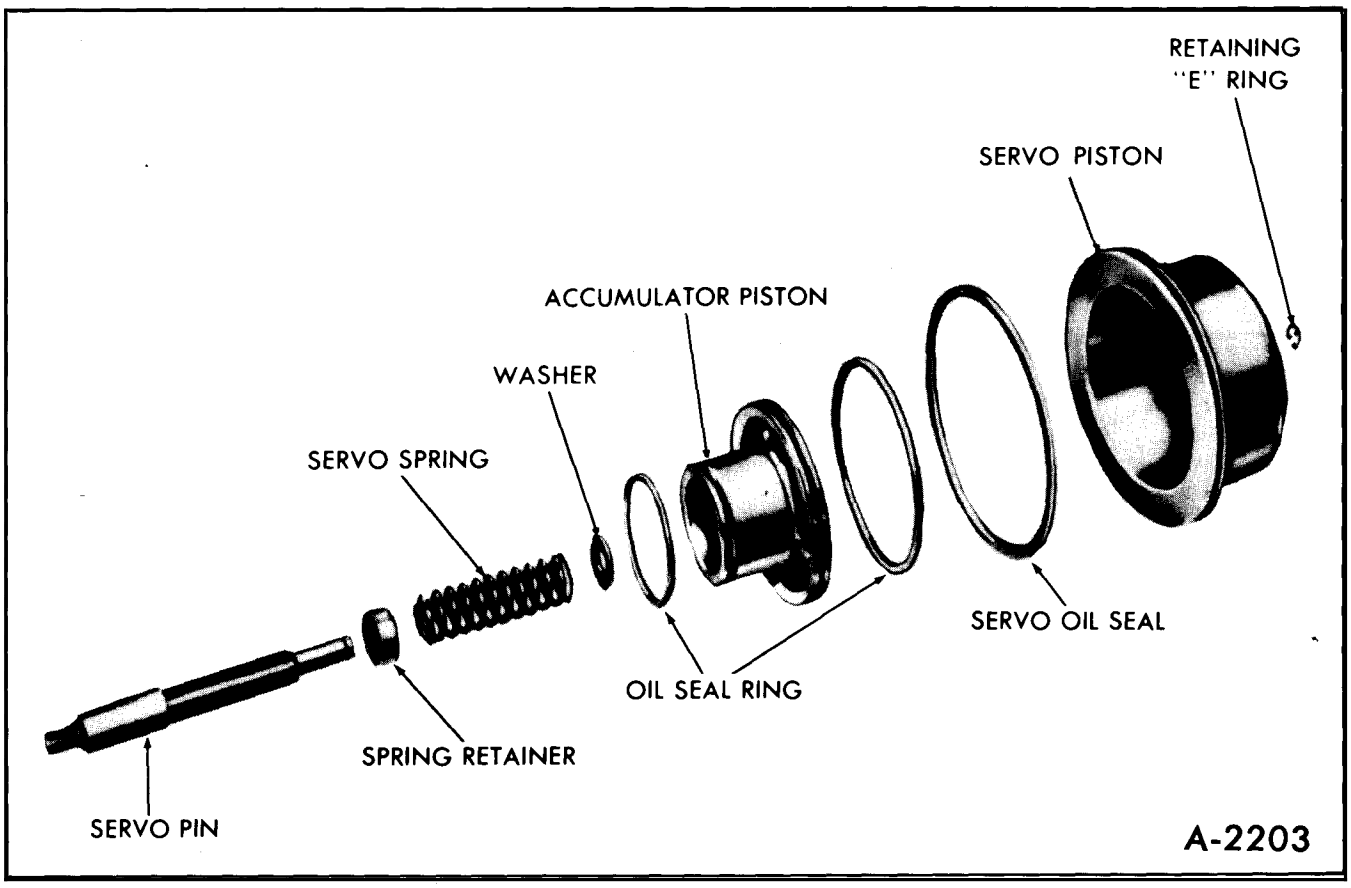


Figure 94—Rear Servo and Accumulator

3. Inspect band apply pin for scores or cracks.

4. Inspect band apply pin for proper size as determined by pin selection check.

ASSEMBLE REAR SERVO

1. Install spring retainer, cup side first, servo pin spring and washer on servo pin.

2. Install servo piston on pin and secure with E-ring retainer.

3. If removed, install oil seal ring on servo piston.

4. If removed, install inner and outer oil rings on accumulator piston.

5. Install accumulator piston into bore of servo piston.

INSTALL REAR SERVO

NOTE: If the transmission is in the vehicle, a sheet metal bracket will be required to hold the rear servo assembly, front servo assembly, check balls, valve body to spacer plate gasket and valve body spacer plate, until the control valve assembly is installed. See Figure 95.

1. Lubricate inner and outer rear servo bores in transmission case with transmission fluid and install rear accumulator spring in servo inner bore.

NOTE: Before installing rear servo assembly, make certain that rear band apply lug is aligned with servo pin bore in transmission case. Otherwise servo pin will not apply band.

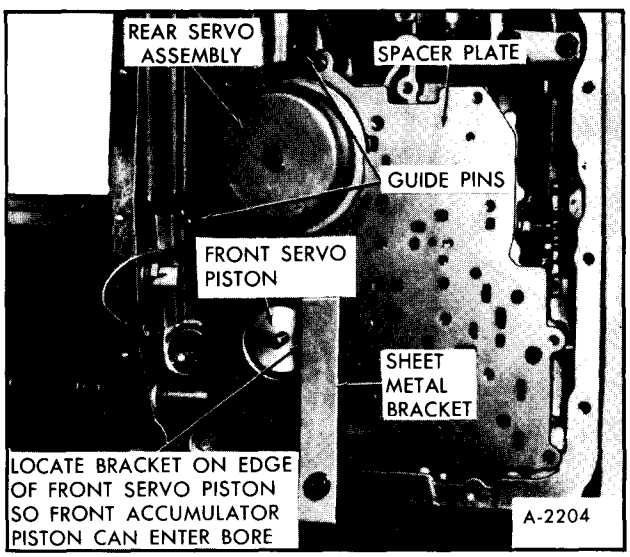


Figure 95—Spacer Plate Holding Bracket

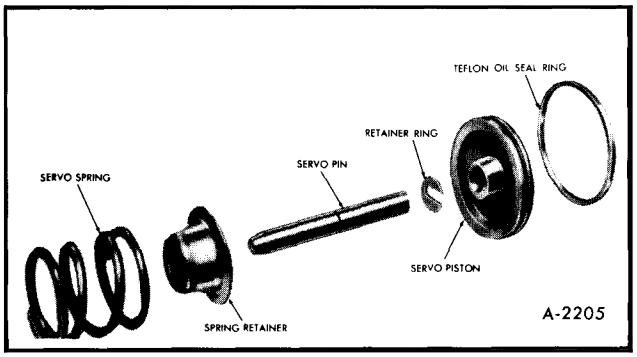


Figure 96—Front Servo Components

2. Position rear servo assembly in transmission case bore.

3. Press down on rear servo assembly, making certain oil seal ring is properly seated in case bore.

INSPECT FRONT SERVO

NOTE: See Figure 96. 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 will be aluminum.

IMPORTANT: The spring retainer, servo pin, retaining ring, and servo piston for 1971 thru 1976 are not interchangeable with pre-1971 parts.

1. Inspect servo pin for damage.

2. Inspect piston oil ring for damage.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston.

INSTALL FRONT SERVO ASSEMBLY

Reassemble parts of front servo, making sure tapered end of servo pin is pointed through the spring and spring retainer, and install in bore in case. Make sure the retainer ring is installed in the servo pin groove.

NOTE: 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 during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.

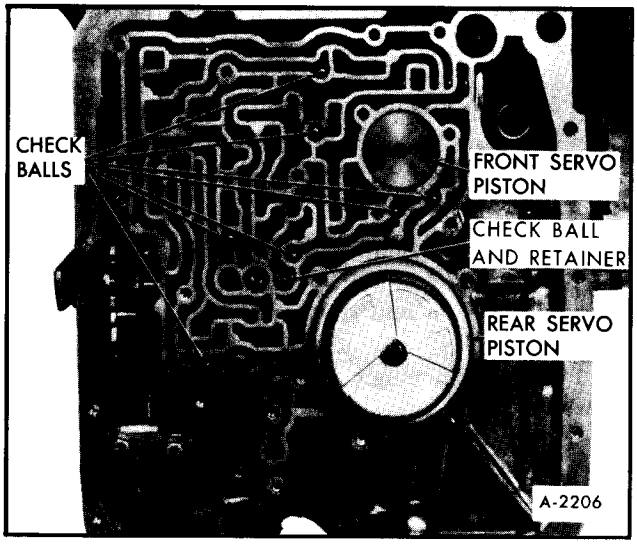


Figure 97—Check Ball Location

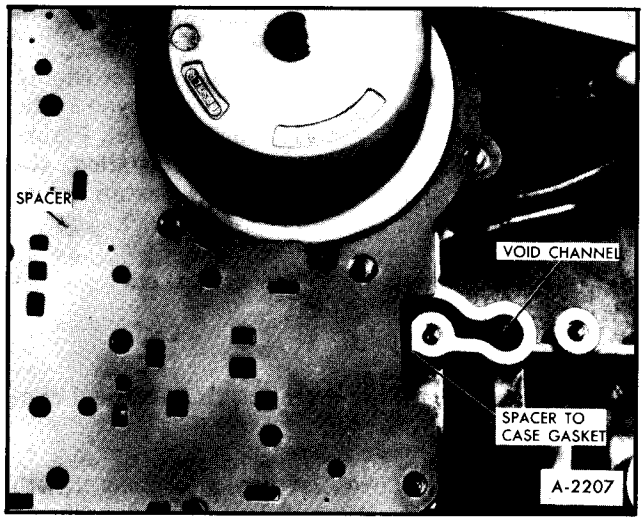


Figure 98—Valve Body Spacer-to-Case Gasket

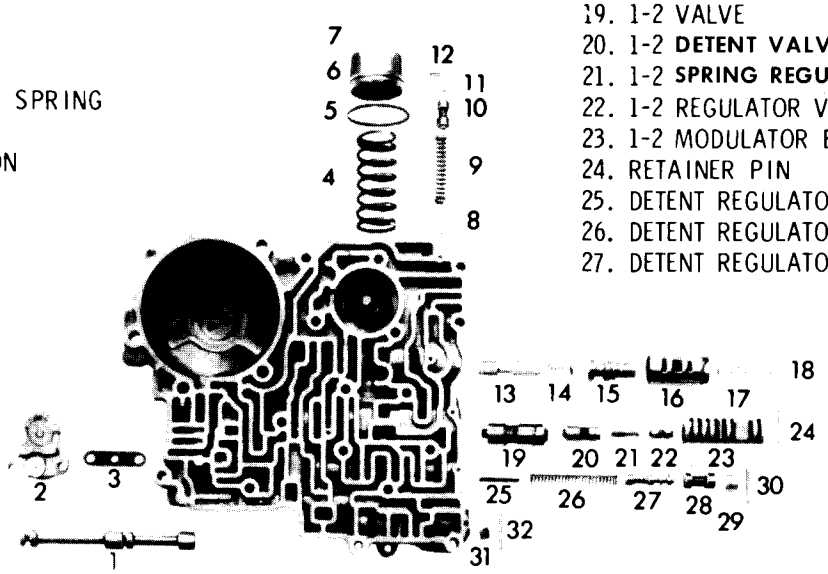
INSTALL CHECK BALLS AND CONTROL VALVE SPACER

1. Install seven check balls in cored passages, Figure 97. (Use petrolatum to retain balls in case.)

NOTE: If transmission is in vehicle, place check balls into ball seat pockets on spacer plate.

2. Install valve body spacer to case gasket on transmission case.

1. MANUAL VALVE
2. DETENT SOLENOID
3. GASKET
4. FRONT ACCUMULATOR SPRING
5. OIL RING
6. ACCUMULATOR PISTON
7. E-RING
8. 3-2 VALVE PIN
9. 3-2 VALVE SPRING



19. 1-2 VALVE
20. 1-2 **DETENT VALVE**
21. 1-2 **SPRING REGULATOR**
22. 1-2 REGULATOR VALVE
23. 1-2 MODULATOR BUSHING
24. RETAINER PIN
25. DETENT REGULATOR PIN
26. DETENT REGULATOR SPRING
27. DETENT REGULATOR VALVE

10. 3-2 VALVE
11. 3-2 BORE PLUG
12. RETAINER PIN
13. 2-3 VALVE
14. 3-2 INTERMEDIATE SPRING
15. 2-3 MODULATOR VALVE
16. 2-3 MODULATOR BUSHING
17. 2-3 VALVE SPRING
18. RETAINER PIN

33
34
35
36

28. DETENT VALVE
29. VALVE BORE PLUG
30. RETAINER PIN
31. VALVE BORE PLUG
32. RETAINER PIN
33. 1-2 ACCUMULATOR PRIMARY SPRING
34. 1-2 ACCUMULATOR VALVE
35. 1-2 ACCUMULATOR VALVE PLUG
36. RETAINER PIN

A-4087

Figure 99—Control Valve

3. Install valve body spacer on transmission.

NOTE: Valve body spacer to case gasket should extend approximately 1/8 inch beyond the spacer plate, over the void case channel, Figure 98. If service gaskets are being installed, the valve body spacer to case gasket has an extension which will cover the void case channel.

4. Install valve body to spacer gasket.

5. Install guide pins.

6. Install the "O" ring seal on the electrical connector.

7. Lubricate and install electrical connector with lock tabs facing into case, positioning locator tabs up on side of case.

CONTROL VALVE ASSEMBLY (FIGURE 99)

DISASSEMBLY

When disassembling control valve, make certain that springs are accurately identified so that they can be properly reassembled.

1. Position control valve assembly with cored face down.

2. Remove two screws securing detent solenoid to control valve body and remove downshift solenoid and gasket.

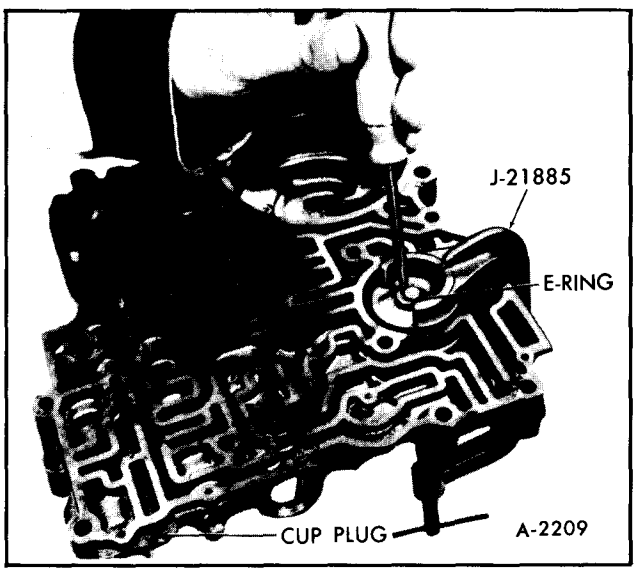


Figure 100—Removing Front Accumulator

3. Position control valve assembly with cored face up and accumulator pocket on bottom.

4. Remove manual valve from upper bore.

5. Install Control Valve Accumulator Piston Installer, J-21885, on accumulator piston, compress piston and remove E-ring retainer, Figure 100.

6. Remove Installer, J-21885, and remove accumulator piston and spring.

7. Using pin punch, remove retaining pin from lower left bore, pressing on pin from outer side of valve body. Remove 2-3 modulator bushing, 2-3 shift valve spring, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve from left bore.

NOTE: 2-3 modulator valve will be inside of 2-3 modulator bushing.

8. Using pin punch, remove retaining pin from lower center left bore, pressing on pin from outer side of valve body. Remove 1-2 modulator bushing, 1-2 regulator spring, 1-2 detent valve, and 1-2 regulator valve from lower left center bore.

NOTE: 1-2 regulator valve and spring and 1-2 detent valve may be inside of 1-2 modulator bushing.

9. Using pin punch, remove retainer pin from upper left center bore by pressing on outer side of valve body.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS DETENT REGULATOR VALVE SPRING MAY FORCE OTHER COMPONENTS OUT OF BORE.

10. Remove bore plug, detent valve, detent regulator valve, spacer and detent regulator valve spring from upper left center bore.

11. Remove retaining pin from bottom bore on left side by prying out with a pair of long nose pliers.

WARNING: HOLD HAND OVER BORE WHEN REMOVING RETAINER PIN AS 3-2 VALVE SPRING MAY FORCE BORE PLUG OUT.

12. Remove bore plug, 3-2 valve, spring and spacer from bottom left bore.

13. Remove retaining pin from top bore by prying out with long nose pliers from outer side of valve body.

14. Remove bore plug, 1-2 accumulator valve and the 1-2 accumulator primary spring.

INSPECTION

NOTE: 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 will be aluminum.

1. Wash control valve body, valves, and other parts in clean solvent.

CAUTION: *Do not allow valves to bump together, as this might cause nicks and burrs.*

2. Inspect all valves and bushings carefully to make sure that they are free from dirt and are not damaged in any respect. If burrs are present, they should be removed with a fine stone or fine grade of crocus cloth and light oil. Be careful not to round off shoulders of valves.

3. All valves and bushings should be tested in their individual bores to make certain that free movement can be obtained. All valves should fall freely of their own weight with a slight tapping action on the body. In checking be careful to prevent valve damage in any way.

4. The manual valve is the only valve that can be serviced separately. If other valves are damaged beyond repair, a new control valve assembly should be installed.

5. Inspect body for cracks or scored bores.

6. Check all springs for distortion or collapsed coils.

7. Inspect piston and oil ring for damage.

ASSEMBLY (FIGURE 99)

1. Position control valve body and cored face up and accumulator pocket on bottom.

2. Install the 1-2 accumulator primary spring into top bore.

3. Install the 1-2 accumulator valve, stem end out into the top bore.

4. Install the 1-2 bore plug, hole end out, into the top bores.

5. Install grooved retaining pin, grooved end entering hole last from outer side of valve body, pressing pin flush with valve body.

6. Insert spacer inside of 3-2 valve spring and install spring and spacer in bottom left bore.

7. Install 3-2 valve in bottom left bore.

8. Compressing 3-2 valve spring, install bore plug, hole end out, and secure with grooved retaining pin from cored side of valve body.

9. Insert spacer inside of detent regulator valve spring and install spring and spacer into upper left center bore, making certain spring seats in bottom of bore.

10. Compress detent regulator valve spring and hold with a small screwdriver placed between end of spring and wall on cored side of valve body.

11. Install detent regulator valve, stem end out, and detent valve, small land first, into upper left center bore.

12. Insert bore plug, hole out, into upper left center bore and, pressing inward on bore plug, remove screwdriver and install remaining pin from cored side of valve body.

13. Install 1-2 shift valve, longer stem end first, in lower left center bore, making certain valve seats in bottom of bore.

14. Install 1-2 regulator valve, large stem first, spring and 1-2 detent valve, hole end first, into 1-2 modulator bushing, aligning spring in bore of 1-2 detent valve. Install assembly into lower left center bore of control valve body, open end of bushing first.

15. Compress bushing against spring and secure with retaining pin from cored side of control valve body.

16. Install 3-2 intermediate spring in open end of 2-3 shift valve, and install valve and spring, valve first, into lower left bore. Make certain valve seats in bottom of bore.

17. Install 2-3 modulator valve, hole end first, into 2-3 modulator bushing and install both parts in lower left bore.

18. Install 2-3 shift valve spring into hole in 2-3 modulator valve, and compressing spring, secure with retaining pin from cored side of control valve.

19. Position front accumulator spring and piston into valve body and install Control Valve Accumulator Piston Installer, J-21885, on piston. Compress spring and piston, aligning spring and piston with bore, Figure 100.

CAUTION: *Make certain that piston pin is correctly aligned with hole in piston and that oil seal ring does not catch on lip of bore when installing piston.*

20. Secure piston and spring with E-ring retainer and remove Installer, J-21885.

21. Install manual valve into top bore.

22. Placing control valve assembly on cored surface, position downshift solenoid gasket and detent solenoid on valve body.

23. Install downshift solenoid attaching screws.

24. Install governor drive pipe into control valve body in bore by rear servo cover.

25. Install two governor screen assemblies with open end up into case, Figure 101.

INSTALL CONTROL VALVE ASSEMBLY AND GOVERNOR FEED PIPE

1. Using two guide pins, install control valve assembly and governor pipe on transmission. Make certain gaskets and spacer do not become mispositioned.

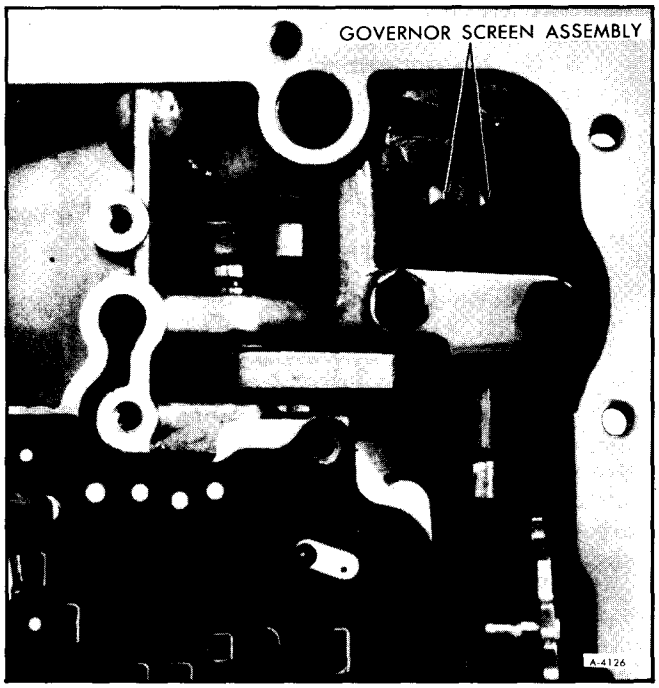


Figure 101—Installing Governor Screens

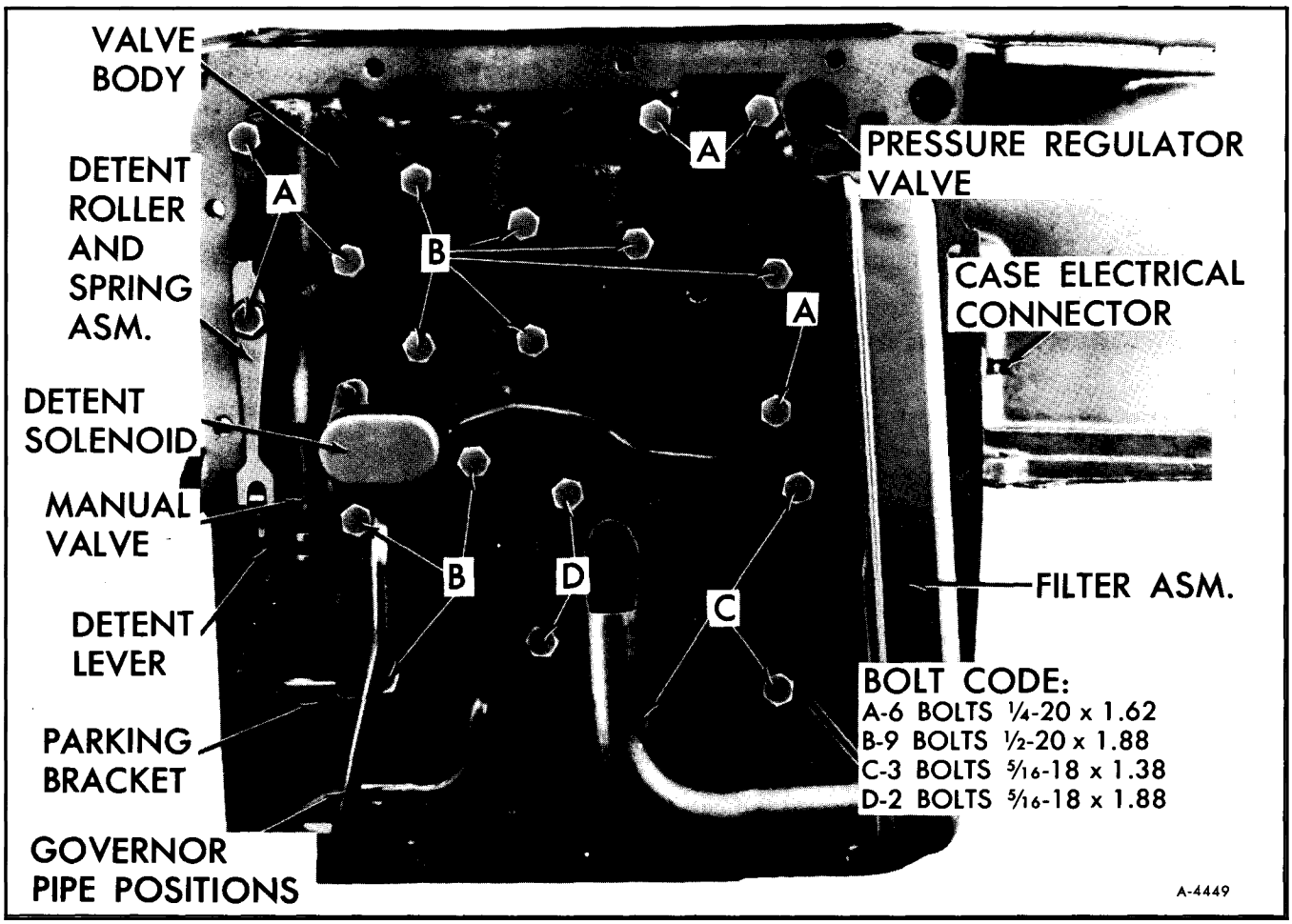


Figure 102—Control Valve Bolts

NOTE: Check manual valve to make sure it is indexed properly with pin on detent lever and governor pipe to make certain it is properly seated in case hole.

2. Remove guide pins and install control valve assembly attaching screws, eliminating detent roller and spring assembly attaching screw. Torque bolts to 8 foot-pounds, Figure 102.

3. Install detent roller and spring assembly and attaching screw. Tighten screw to 8 foot-pounds.

4. Install governor feed pipe in transmission case and control valve body.

NOTE: Make certain that governor feed pipe is seated in bores in case and valve body.

5. Connect detent solenoid wire to electrical connector.

PRESSURE REGULATOR VALVE, INTAKE PIPE AND FILTER ASSEMBLY, BOTTOM PAN, MODULATOR VALVE AND MODULATOR

INSTALL PRESSURE REGULATOR VALVE

1. Install spring retainer on pressure regulator spring. Also install spacers if previously removed, Figure 103.

2. Install pressure regulator valve on spring, stem end first.

3. Install boost valve into bushing, stem end out, and stack parts so that pressure regulator spring is against valve bushing.

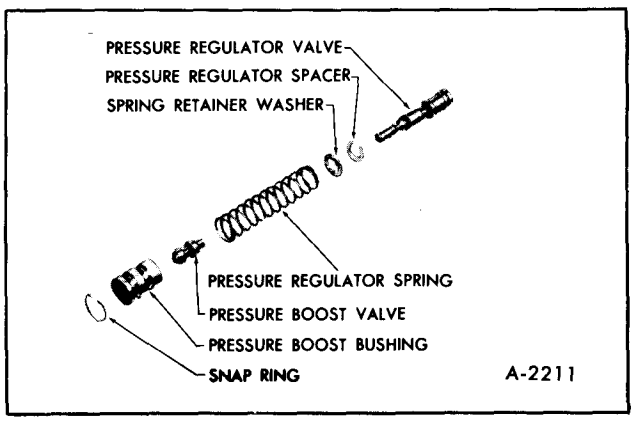


Figure 103—Pressure Regulator Valve

4. Install complete assembly, pressure regulator valve first, into pressure regulator valve bore, being careful not to drop parts during installation.

5. Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring until it is beyond snap ring groove, and install snap ring using Snap Ring Pliers, J-5403 (#21), Figure 25.

NOTE: To facilitate installation of snap ring, encircle it around screwdriver or steel rod, compress tangs with snap ring pliers, and slide snap ring into ring groove in valve bore.

INSTALL INTAKE PIPE AND FILTER ASSEMBLY AND BOTTOM PAN

1. Install new intake pipe O-ring into pipe bore in transmission case and install intake pipe and filter assembly.

2. Install new bottom pan gasket on transmission case and install bottom pan.

3. Install 13 bottom pan attaching screws. Tighten screws to 12 foot-pounds.

INSPECT VACUUM MODULATOR AND VALVE

Refer to Diagnosis Section for complete modulator inspection.

1. Inspect vacuum modulator for any signs of bending or distortion.

2. Inspect O-ring seat for damage.

3. Inspect modulator valve for nicks or damage.

4. Check freeness of valve operation in case bore.

5. Check modulator for damaged bellows. Modulator plunger is under approximately 16 pounds pressure. If bellows is damaged, plunger will have very little pressure.

INSTALL MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into case with stem end out.

2. Install new O-ring on vacuum modulator.

3. Install vacuum modulator into case with vacuum hose pipe facing electrical connector.

4. Install modulator retainer with curved side of tangs inboard and install attaching screw. Tighten screw to 18 foot-pounds.

GOVERNOR ASSEMBLY

NOTE: All components of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is factory calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

GOVERNOR INSPECTION

1. Wash in cleaning solvent, 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. Check governor valve for free operation in bore of governor sleeve.

5. Inspect governor driven gear for nicks, burrs, or damage.

6. Check governor driven gear for looseness in governor sleeve.

7. Inspect speedometer drive gear for nicks, burrs, or damage.

8. Check speedometer drive gear for looseness on governor sleeve.

9. Inspect governor springs for distortion or damage.

10. Check governor weights for free operation in their retainers.

11. Check valve opening at entry and exhaust (.020" minimum).

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 and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

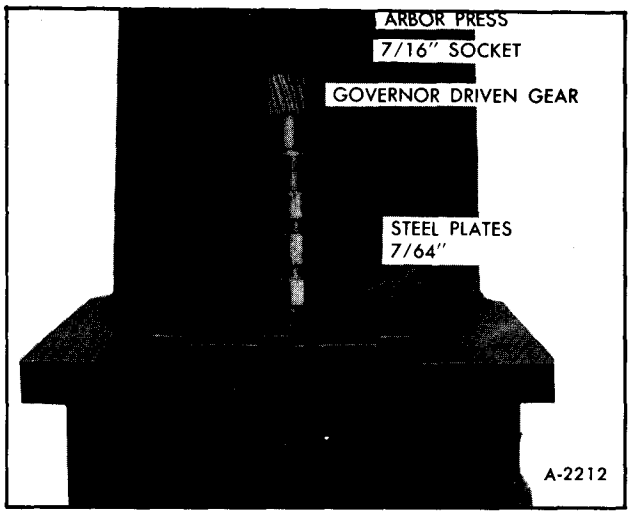


Figure 104—Installing Governor Gear

1. Place governor sleeve on a block of wood and drive retaining pin out, using a small punch or 1/8" drill rod.

2. Remove governor driven gear as follows:

a. Insert governor driven gear in a vice.

b. Firmly grip governor sleeve with hands and twisting and pulling at the same time, pull governor sleeve away from the governor driven gear.

c. Discard governor driven gear.

3. Remove governor valve and wash all parts in cleaning solvent and blow off parts.

4. Install governor valve, end with holes last, into governor sleeve.

5. Support governor on 7/64" plates, installed in exhaust slots of sleeve, position new gear in sleeve and with a 7/16" socket, press gear into sleeve until seated. See Figure 104.

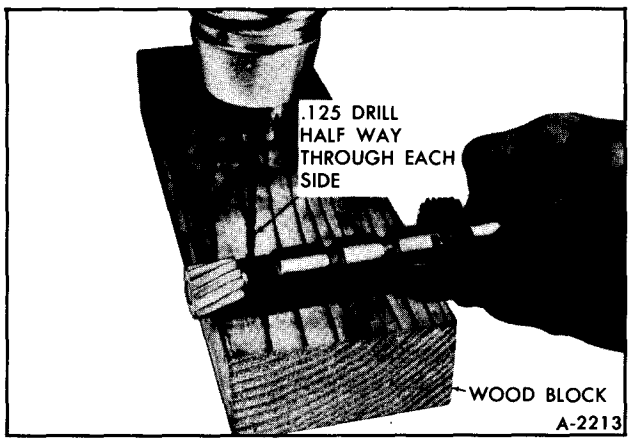


Figure 105—Drilling Governor Gear Shaft

6. Place governor sleeve on a block of wood and with a 1/8" drill, drill half way through each side of gear; drill through existing hole. See Figure 105.

7. Install split retaining pin, making sure each end is slightly below top of hole.

CAUTION: *Extreme care must be taken to prevent damaging the parts.*

8. Stake both ends of pin hole, two places.

9. Thoroughly wash governor assembly in cleaning solvent and blow out all passages.

INSTALL GOVERNOR

1. Rotate transmission in Holding Fixture Base so that governor bore is up.

2. Install new square cut O-ring seal on governor assembly and install assembly into transmission case.

3. Position retaining clip on top of governor assembly.

INSPECT SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Inspect gear for damaged teeth or shaft.

2. Inspect sleeve for scores, damaged threads or cracks.

INSTALL SPEEDOMETER DRIVEN GEAR

1. Install new O-ring seal on speedometer driven gear assembly.

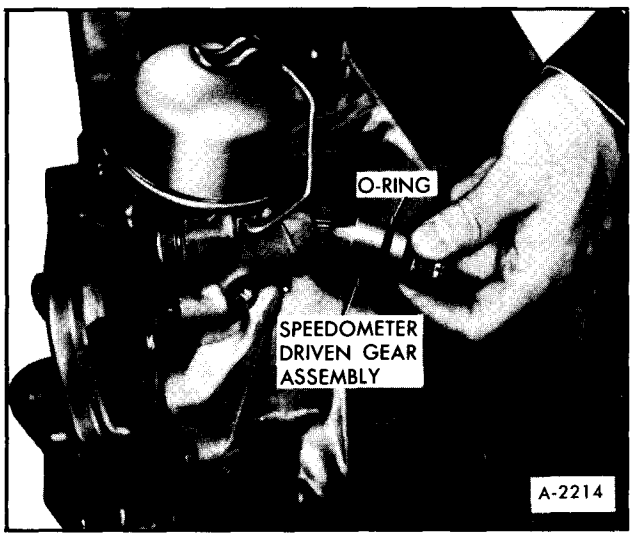


Figure 106—Installing Speedometer Driven Gear

2. Lubricate housing lip with a thin coat of Dexron transmission fluid.

3. Install speedometer housing and seal assembly and white nylon driven gear into transmission case, Figure 106.

4. Position retaining clip to transmission and driven gear assembly and secure with one attaching bolt, tightening bolt to 6 ft. lbs.

CONVERTER

INSPECT TORQUE CONVERTER

1. Inspect inside of bell housing. If covered with oil, a converter leak may be indicated. Converter should be leak tested as follows:

a. Drain oil out of converter.

b. Install Fixture J-21369 and tighten.

c. Fill converter with 80 psi of air, Figure 107.

d. Submerge in water and check for bubbles indicating leaks.

Figure 107—Leak Checking Converter

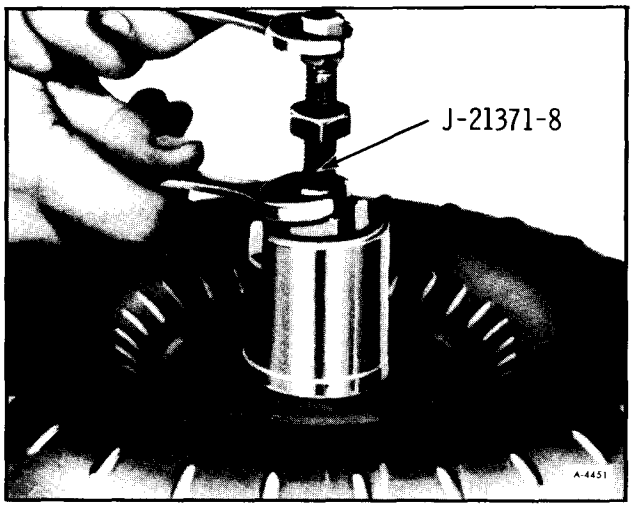


Figure 108—Installing Fixture J-21371-8

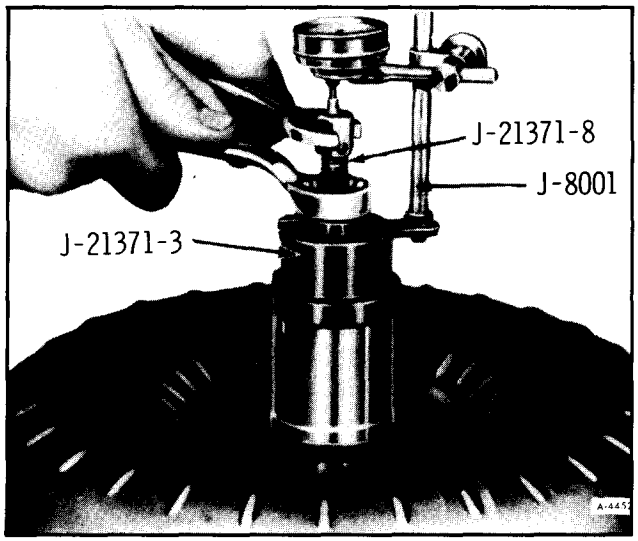


Figure 109—Checking Converter End Play

WARNING: ALWAYS RELEASE AIR PRESSURE BEFORE REMOVING VALVE, AS A DEFINITE HAZARD EXISTS SHOULD VALVE BLOW OUT DURING REMOVAL.

e. Thoroughly dry converter.

2. Check converter hub surfaces for signs of roughness, scoring, or wear that could damage the oil pump front seal. If roughness can be felt with a fingernail, seal could be damaged.

3. Check converter for loss of balance weight or a broken converter-to-crankshaft pilot. If balance weight is off or pilot is broken, replace the converter.

4. Check converter end play as follows:

a. Fully release collet end of Fixture J-21371-8 by turning its cap nut clockwise.

b. Install collet end of Fixture J-21371-8 into converter hub until it bottoms, then tighten its cap nut to 5 lb. ft., Figure 108.

c. Install Fixture J-21371-3 and tighten the hex nut to 3 lb. ft.

d. Install Indicator J-8001 and set it for "zero" while its plunger rests on the cap nut of Fixture J-21371-8.

e. Loosen hex nut while holding cap nut stationary, allowing converter internal assembly to

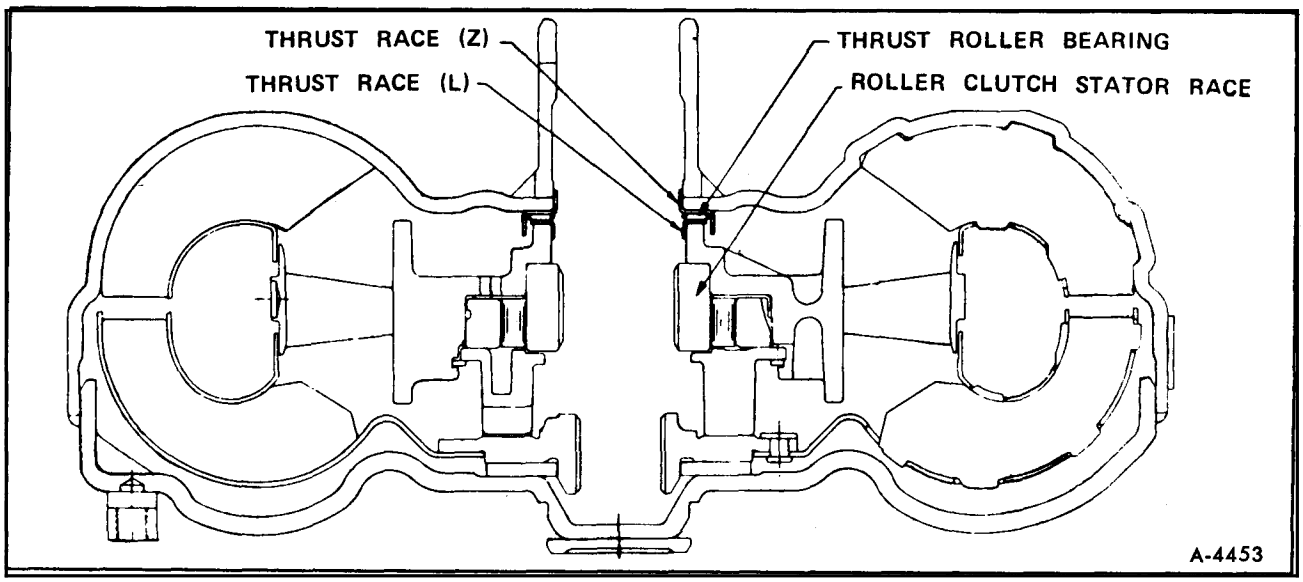


Figure 110—Converter Assembly - Cross Section

lower, until dial indicator shows that internal assembly has bottomed, Figure 109.

f. The reading obtained on dial indicator represents converter end clearance. If clearance is less than .050", the converter is acceptable. If clearance is .050" or more, replace the converter.

5. If fluid in the converter has the appearance of having been mixed with "aluminum paint", converter is damaged internally and must be replaced.

6. Do not change the converter if some other part of the transmission has resulted in the converter containing dark, discolored fluid. The full flow filter is designed to remove all harmful residue from non-conforming parts, other than converter and/or pump non-conformities before the oil is pumped into the converter.

7. Check the converter internally for damage to its roller bearings, thrust races, and the roller clutch, Figure 110.

a. The thrust roller bearings and thrust races can be checked by viewing them when looking into the converter neck or feeling through the opening to make sure they are not cracked, broken, or mispositioned.

b. 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 should be very difficult to turn, in the counterclockwise directions.

IMPORTANT: Do not use such items as the pump cover or stator shaft to turn the race as the results may be misleading.

8. Check for stripped converter bolt holes. If found stripped, inspect for cause (such as damaged bolt threads), heli-coil the damaged bolt holes and install new bolt(s).

INSTALL TORQUE CONVERTER

1. Position transmission jack to transmission and install transmission on jack using safety chain.

2. Carefully position converter on turbine shaft, making certain converter is properly aligned. Long screws or eyebolts can be threaded into the weld nuts on the converter and used as handles.

3. Rotate converter until the shafts are piloted and the converter lugs are indexed in the pump gear.

4. If difficulty is experienced in alignment, tap on outer diameter of converter with plastic-headed hammer, while turning converter.

5. Install Converter Holding Clamp, J-21366, on transmission case.

6. Remove two (2) 8" bolts from case to engine mounting face, Figure 20.

INSTALLING FINAL DRIVE (FIGURE 19)

1. Install new gasket, on final drive, after first soaking with transmission fluid.

2. Align final drive to transmission and secure with bolts "B, C, E, F, G" and nut "H", torque to 25 ft.-lbs.

3. Install new O-ring on filler tube assembly and assembly to final drive. Torque bolt "A" to 25 ft.-lbs.

NOTE: Install transmission and final drive in vehicle as described earlier in this section.

TRANSMISSION SPECIFICATIONS

TORQUE CHART

Material Number	Application	Thread Size	Foot Pounds
280M	Transmission to Engine Bolts	3/8—16	35
300M	Torque Converter to Flywheel	3/8—16	30
1010	Flywheel Housing Cover	5/16—18	5
300M	Final Drive to Transmission	3/8—16	25
280M	Solenoid to Control Valve Assembly	1/4—20	3
Special	Line Pressure Plug	1/8 Pipe	10
260M	Vacuum Modulator Retainer to Case	5/16—18	18
260M	Valve Body to Case	1/4—20	10
	Valve Body to Case	5/16—18	10
300M	Center Support to Case	3/8—16	23
286M	Manual Shaft to Inside Lever	3/8—24	18
280M	Pump Body to Cover Plate	5/16—18	20
280M	Parking Brake Bracket to Case	5/16—18	18
1010—1020	Oil Pan to Case	5/16—18	12
280M	Sprocket Cover to Case	1/4—20	10
260M	Support Housing to Cover Plate	5/16—18	20
260M	Speedometer Driven Gear Retainer	5/16—18	18

SPECIAL TOOLS

J 4646	Snap Ring Pliers
J 4670-01	Forward Clutch Spring Compressor (Use with J-6129 & J-21664)
J-5586	Snap Ring Pliers
J 5907	Pressure Gauge Set (0-300 psi-9' hose)
J 6116-01	Clutch Unit Holding Fixture
J 6129	Direct Clutch Spring Compressor
J 6133-01	Rear Oil Pump Bearing & Speedo Gear Installer
J 8001	Dial Indicator Sleeve Clamp and Hole Attachment
J 8763	Transmission Holding Fixture
J 21359	Front Pump Oil Seal Installer
J 21362	Forward & Direct Clutch Inner Seal Protector
J 21363	Second Clutch Inner Seal Protector
J 21369	Converter Leak Test Fixture
J 21370-6	Band to Apply Pin-Body Arm Assembly (Use with J-21370-7 & 8)
J 21370-7	Band to Apply Pin Gauge (Used with J-21370-6 & 8)
J 21370-8	Band to Apply Pin Selector Plate (Used with J-21370-6 & 7)
J 21371	Converter End Play Checking Fixture
J 21409	Forward & Direct Clutch Outer Seal Protector
J 21661	Speedometer Drive Gear Remover Bolts
J 21664	Clutch Compressor Adapter
J 21795-02	Gear Unit Holding Tool
J 21795	Gear Assembly Remover and Installer Adapter
J 21797	Speedometer Drive Gear Removal Bolt
J 22241	Forward Clutch End Play Checking Tool
J 22269-01	Control Valve Direct Clutch Accumulator Piston Compressor

SECTION 8
FUEL TANK AND EXHAUST

Contents of this section are listed below:

EVAPORATION CONTROL SYSTEM (E.C.S)

DESCRIPTION

In order to limit gasoline vapor discharge into the atmosphere, the following features are incorporated in the fuel system. The E.C.S. system (figure 1) is designed to trap fuel vapors which normally escape from the fuel tank. Vapor arrest is accomplished through the use of a charcoal canister(s) which adsorbs the fuel vapors and stores them until they can be removed to be burned in the engine. Removal of vapors from the canister(s) to the engine is accomplished by a calibrated purge orifice in the carburetor. In addition to the carburetor modifications and the canister(s), the fuel tank requires a special pressure-vacuum gas cap and extra vents to liquid/-vapor separator. The liquid/vapor separator prevents liquid gasoline from entering the vapor system to the canister(s). Thus, as vapors are generated in the fuel tank, they flow through the liquid/vapor separator and to the canister(s) where they are stored. From the canister(s) the vapors are routed to the carburetor where they will be burned during normal combustion.

On vehicles sold in California an additional canister is used along with two shields between the fuel tanks and exhaust pipe.

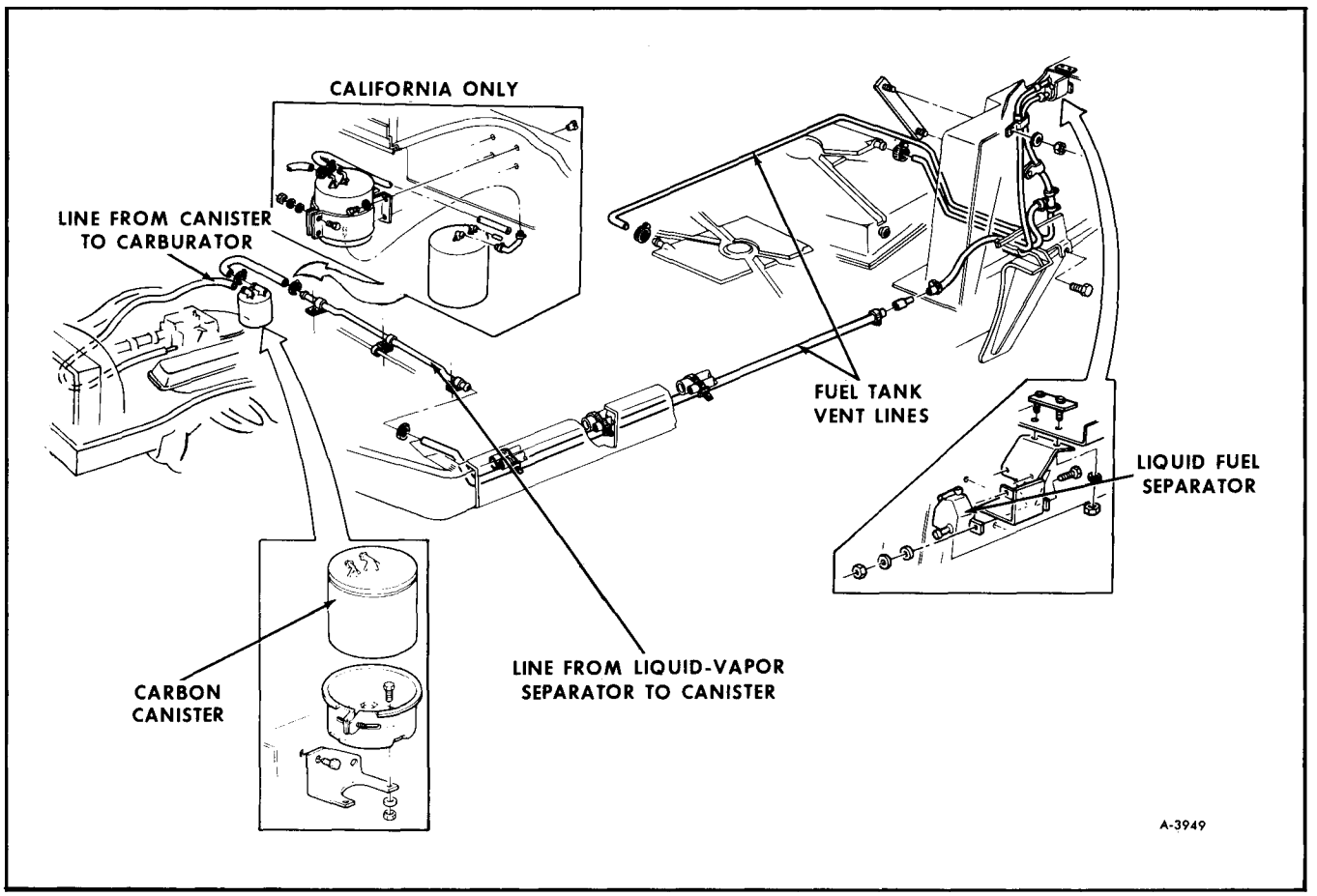


Figure 1—Evaporation Control System

TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Fuel odor or loss of fuel rough idle.	Leak in fuel line(s) or hose(s). Purge hose improperly routed. Disconnected purge hose. Plugged canister filter. High volatility fuel.	Replace line or hose. Route hose correctly. Connect hose to proper fitting. Replace filter. Change brand of fuel.
Collapsed tank or pressure in tank.	Plugged or pinched vent line(s). Defective canister. Faulty valve in special tank filler cap.	Remove obstruction or replace line. Replace canister. Install specified replacement cap.

SERVICING E.C.S.

CANISTER(S)

The plastic canister is filled with charcoal which adsorbs and stores fuel vapors. When fuel is drawn from the tank during engine operation, a fuel cap tank relief valve opens allowing air to be drawn into the tank. When the engine is running, air is drawn in through the bottom of the canister. This air picks up vapors which are being held in the charcoal and carries them through the carburetor into the engine where they are burned.

REMOVAL

1. Vehicle may be raised if desired.

2. If vehicle is equipped with one canister loosen clamp screw and lift canister up and out.

3. If vehicle is equipped with two canisters remove the lower canister clamp from bracket and slide canister and clamp out. See Figure 1.

4. Disconnect hoses from canister(s).

5. If vehicle is equipped with a second canister loosen clamp and lower canister enough to disconnect hoses so it may be removed.

INSTALLATION

1. If the vehicle is equipped with two canisters connect hoses to the upper canister and install. Tighten clamp.

2. Connect hoses to remaining canister and install. Tighten clamp as required.

CANISTER FILTER

REMOVAL

1. Remove canister. Refer to "Canister—Removal" earlier in this section.

2. Filter is located in the bottom of the canister. If vehicle is equipped with two canisters the filter is in the lower canister.

3. Remove filter.

INSTALLATION

1. Install filter. See Figure 2.

2. Install canister. Refer to "Canister—Installation" earlier in this section.

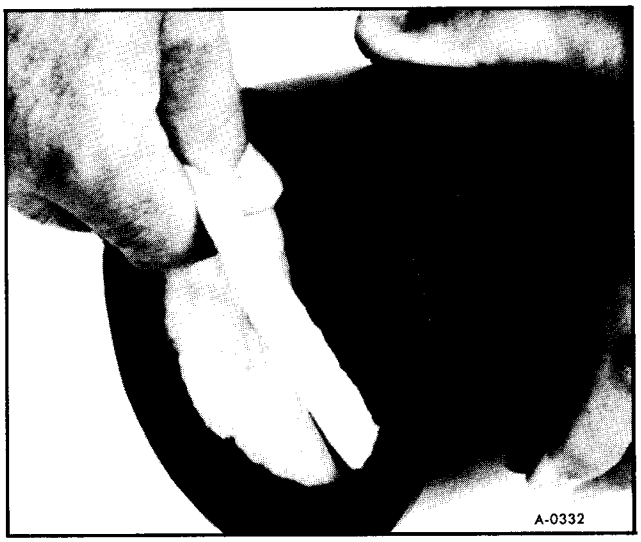


Figure 2—Replacing Canister Filter

HOSES AND LINES

Conventional steel tubing, vapor resistant hose and hose clamps are used to connect the various components of the system. It is extremely important that all pipes and hoses are not kinked, are properly connected, and that all connections are tight. This is necessary to assure a vent through the system for the fuel tank to prevent restriction of vapors to the canister. Thorough visual inspection is and will remain one of the most important checks of the system.

IMPORTANT: Use only hose marked "EVAP" or "GM 6107M" if necessary to replace an E.C.S. hose. Gasoline vapors will deteriorate other types of hoses.

LIQUID/VAPOR SEPARATOR

DESCRIPTION

An external liquid-vapor separator is mounted to left rear wheel opening liner. It's purpose is to stop fuel that has drained out of tanks when the vehicle is parked off level. Once a level position is assumed the fuel in the separator will drain back into the tank.

Any vapors collected in the separator are routed to the canister by a hose. The separator can not be serviced. If damaged it must be replaced.

REMOVAL

1. Clean threads of dirt and remove attaching nuts.

2. Move separator off studs. Mark hoses with some identification to assure proper matching of hoses and outlets.

3. Disconnect hoses and remove separator.

INSTALLATION

1. Connect hoses to proper ports.

2. Install separator and tighten nuts.

FUEL TANKS AND LINES

DESCRIPTION

The fuel tanks in the vehicle are dual 25 gallon capacity tanks for a total of 50 gallons. The tanks are located between the frame rails forward of the bogey crossmember.

The filler neck and tubes are constructed of steel tubing with rubber connecting hoses secured by worm-type hose clamps as shown in Figures 3 and 4.

The fuel pickup pipe is built integrally with the tank gauge sending unit, located at the top of the tank. A large area, fine mesh screen is located on the bottom of the fuel pickup pipe. This screen is designed to prevent the entrance of dirt or water into the fuel system, and operates with a self-cleaning action.

The tanks consist of an upper and lower half each with a wide flange. The two tank sections are seam welded at the flange to assure leak proof construction. Exceptional stiffness is obtained by the combination of the welded flanges and depressed ribs in both upper and lower tank sections.

DRAINING FUEL TANKS

WARNING: BEFORE ATTEMPTING TO DRAIN FUEL TANK, ALWAYS; REMOVE BATTERY NEGATIVE CABLES, PLACE "NO SMOKING" SIGNS AND A CO2 FIRE EXTINGUISHER NEAR WORK AREA, WEAR SAFETY GLASSES, AND SIPHON OR PUMP FUEL FROM TANK INTO AN EXPLOSIVE PROOF CONTAINER.

The fuel tanks incorporate a drain plug in the left front corner of the tanks. (See figure 5)

To drain the tank remove the drain plug in the tank with the correct size Allen wrench.

Always drain gasoline from complete fuel system including carburetor, fuel pump, all fuel lines and fuel tank if the vehicle is to be stored for any appreciable length of time. This precaution will prevent accumulation of gum formation and resultant poor engine performance.

FUEL TANK REPLACEMENT

WARNING: BEFORE ATTEMPTING FUEL TANK REMOVAL, ALWAYS; REMOVE BATTERY NEGATIVE CABLES, PLACE "NO SMOKING" SIGNS AND A CO2 FIRE EXTINGUISHER NEAR WORK AREA, WEAR SAFETY GLASSES, AND SIPHON OR PUMP FUEL FROM TANK INTO AN EXPLOSIVE PROOF CONTAINER.

1. Drain tanks as previously described.

2. Disconnect fuel filler tubes by loosening worm clamps and slide rubber connectors off ends.

3. Remove 3 bolts from angle at front of tank as shown in Figure 6. If both tanks are to be removed, the forward tank should be completely removed.

4. Slowly lower tanks to allow removal of vent lines and fuel feed lines, label or mark lines to allow reconnection of lines with the same outlet.

5. Using Tool J-24187 as illustrated in Figure 7. Remove fuel tank gauge unit.

6. Reverse steps 1—5.

FUEL TANK GAUGE REPLACEMENT

1. Follow steps outlined in Fuel Tank Removal.

2. Remove fuel gauge retaining cam, using Tool J-24187 (figure 7).

3. Test gauge unit if required according to the diagnosis check list for fuel tank gauge in Section 12.

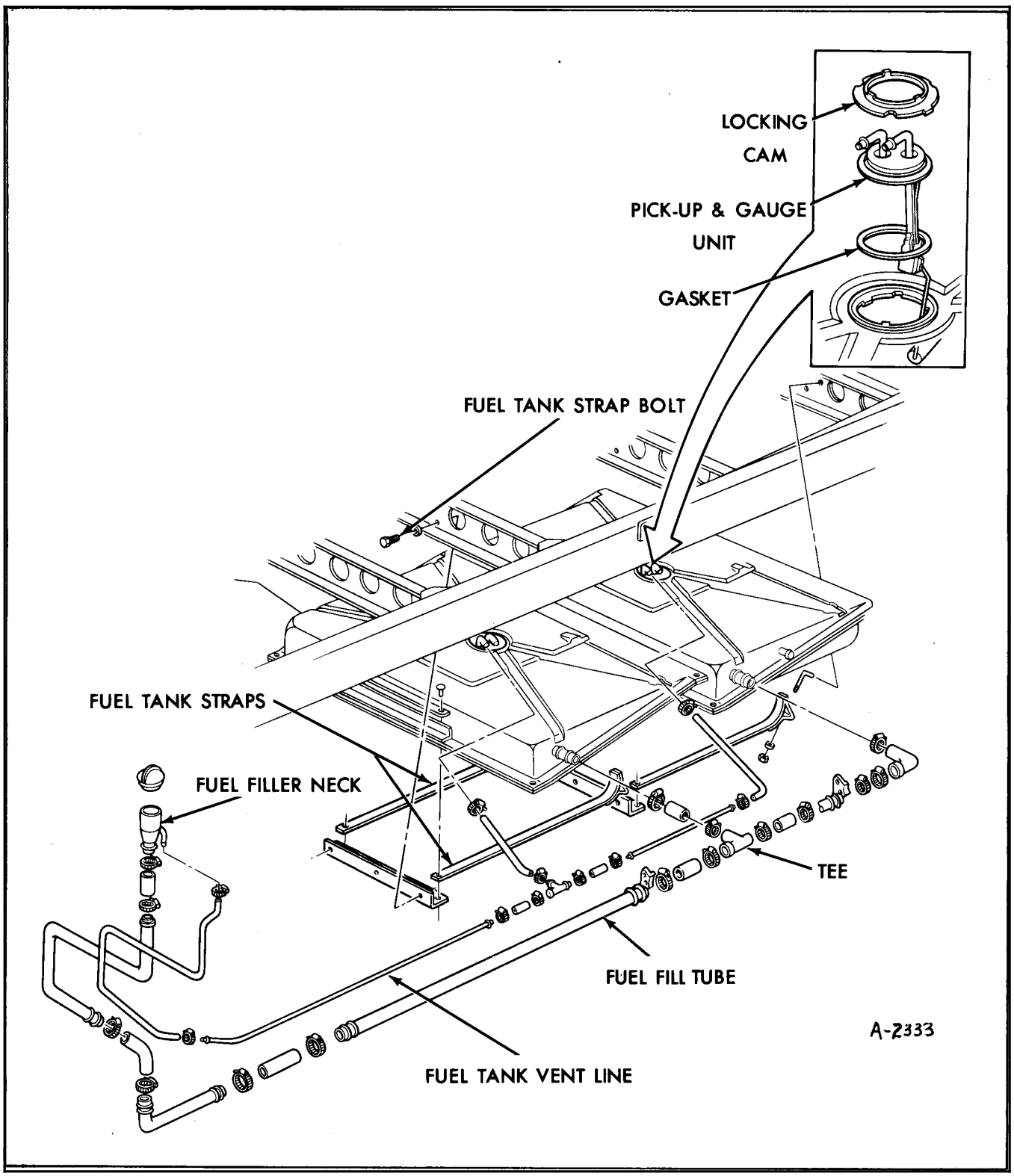


Figure 3—Type 1 Fuel Tanks and Lines

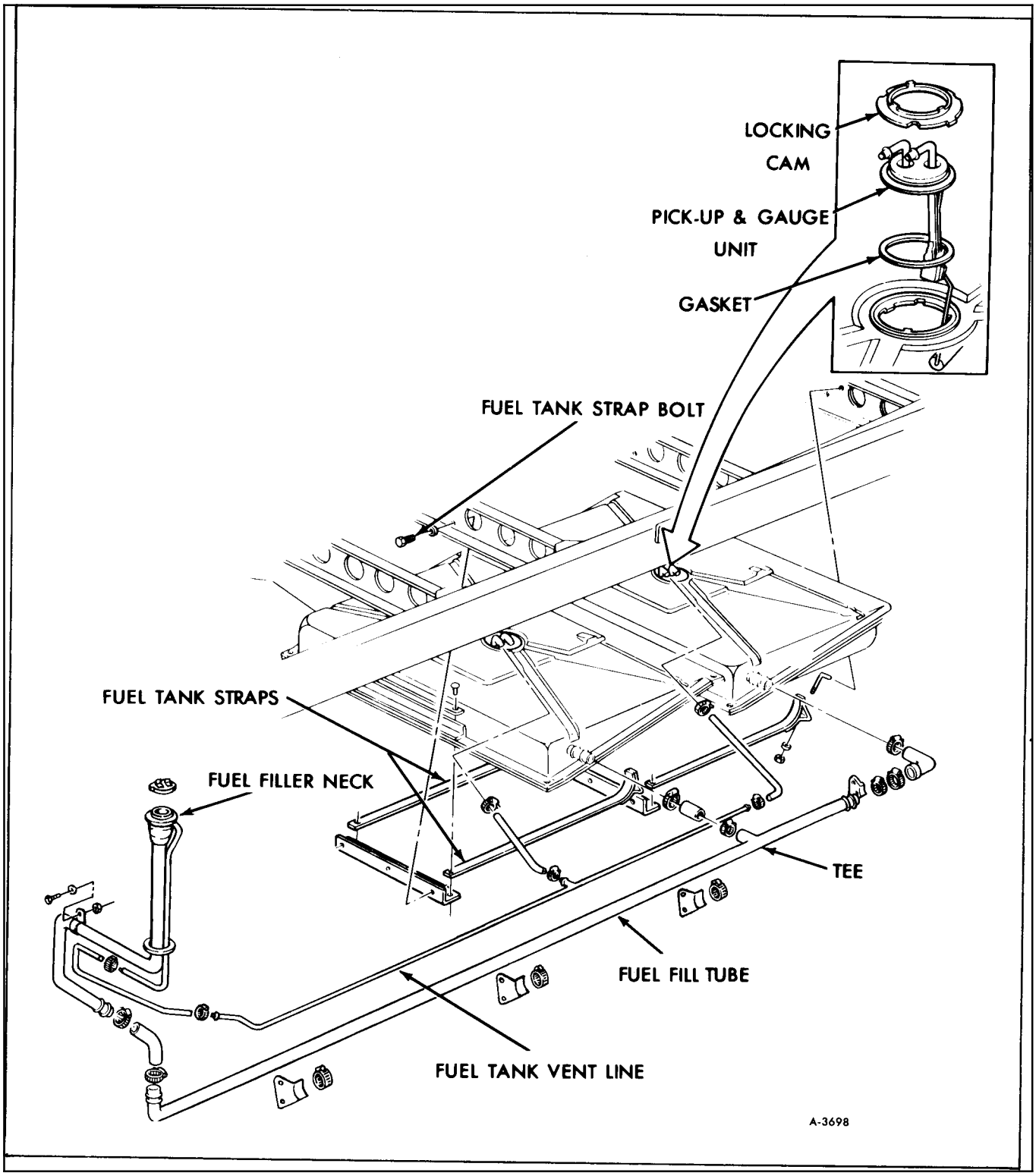


Figure 4—Type 2 Fuel Tanks and Lines

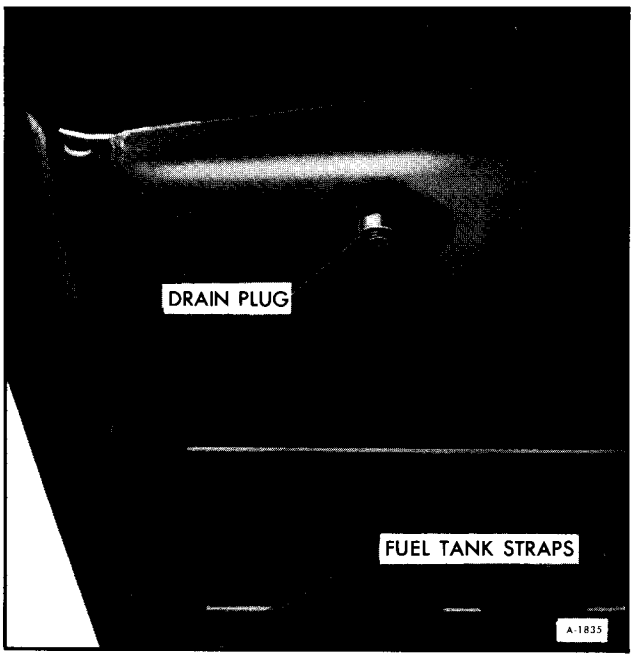


Figure 5—Fuel Tank Drain Plug

4. Reverse steps 1—3, and check operation of gauge.

CLEANING FUEL SYSTEMS

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 ground cables and ignition coil primary wire (+ wire on ignition coil).

2. Drain fuel tank. (See DRAINING FUEL TANK).

3. Remove fuel tank. (See FUEL TANKS — REPLACEMENT).

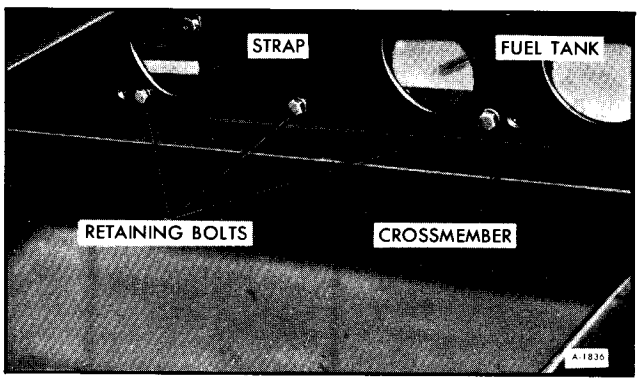


Figure 6—Removing Fuel Tank Strap Bolts

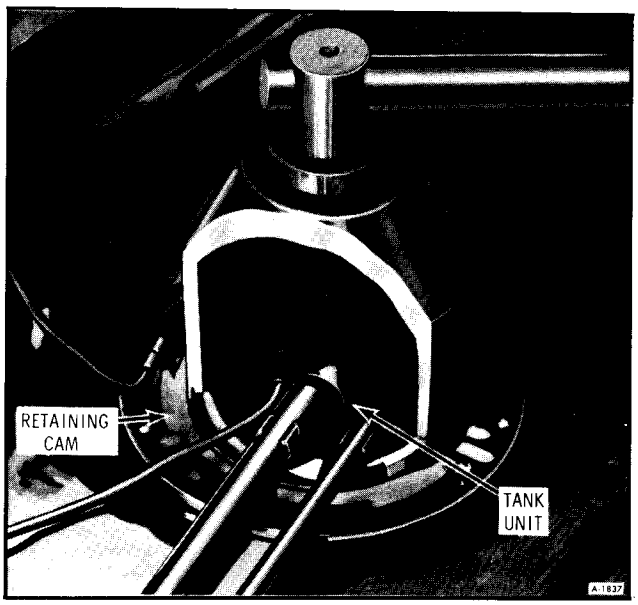


Figure 7—Removing Fuel Tank Gauge Unit

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 gauge 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.)

IMPORTANT: This procedure will not remove fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required.

8. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and fuel return line (if equipped). Apply air pressure in the direction fuel normally flows through line.

9. Use low air pressure to clean pipes on tank unit.

10. Install new filter on fuel tank unit if required. Install fuel tank 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 IGNITION COIL PRIMARY WIRE (+TERMINAL) 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 coil primary wire.

16. Connect battery ground cables.

FUEL LINE REPAIR PROCEDURE

1. DO NOT use rubber hose within four inches of any part of the exhaust system.

2. Cut out damaged portion of fuel line.

3. In repairable areas cut a piece of fuel hose four inches longer than the portion of the line removed.

4. Slide clamps onto pipe and push hose two inches onto each portion of fuel pipe.

5. Clamp hose to pipe on each side of repair.

FUEL TANK PURGING PROCEDURE

1. Remove fuel gauge unit and drain all remaining fuel from tank.

2. Visually inspect interior cavity of tank; if any fuel is evident, drain again.

3. Move tank to flushing area (wash rack).

4. Pour gasoline emulsifying agent and water solution into the tank and agitate mixture for 2 to 3 minutes, wetting all interior surfaces.

NOTE: For correct gasoline emulsifying agent — water mixture, refer to the emulsifying agent manufacturer's specifications. Use an available emulsifying agent such as "Product -Sol No. 913" or equivalent.

5. Fill tank (with water) to capacity and agitate again.

6. Empty contents.

7. When empty, refill to overflowing with water to completely flush out remaining mixture and then empty tank.

8. If any vapor is present, repeat Steps 4 thru 8. Repeat as necessary until there is no evidence of fuel vapor.

9. Dry tank with compressed air and perform required service work.

FUEL TANK LEAK TEST PROCEDURE

1. Plug all outlets as follows:

a. Use a known good filler cap for filler neck.

b. Install tank unit using Tool J-24187 and replace gasket. Then plug fuel line.

c. Plug two (2) of the three (3) tank vent tubes using a single short piece of fuel line hose.

d. Install another short piece of fuel line hose on third vent tube.

2. Apply air pressure to tank through open vent tube. Use extreme caution to prevent rupturing the tank. When air can be heard escaping from the filler neck cap (approximately 1 to 1-1/2 lbs. of pressure) pinch the fuel line hose to retain pressure.

3. Test repaired area for leaks with soap solution or by submersion. If leak is noted, make repair and retest.

4. Pressure test entire fuel system by applying 1.5 psi air pressure thru charcoal cannister inlet hose.

EXHAUST SYSTEM

DESCRIPTION

The exhaust system on the models 23' and 26' are essentially identical except for a longer length tail pipe on the 26' model. The exhaust manifolds empty into a muffler for each bank of cylinders which are Y'ed as shown in Figure 8. The tail pipe continues to rear of the vehicle. All exhaust system connections are of the split joint coupled design, secured with U-Bolt clamps.

MAINTENANCE

EXHAUST RESTRICTION AND LEAKS

Exhaust system should be inspected periodically for restrictions and leaks. Restrictions such as kinked or crimped pipes result in excessive back pressure which can lead to increased fuel consumption, power loss, and possible damage to engine combustion chamber components. Exhaust leaks are commonly the result of loose clamp assemblies, defective exhaust pipe to manifold packing, or corroded pipes. In addition to objectionable noise, a leaking exhaust system could allow toxic gases to enter vehicle.

Damaged or corroded exhaust system components should be replaced without delay. If it is absolutely necessary to operate vehicle when an exhaust leak exists, use extreme caution and keep vehicle well ventilated.

EXHAUST SYSTEM ALIGNMENT

During installation of a new exhaust pipe, muffler or tail pipe, care should be taken to properly position components in relation to each other.

On all joints except exhaust manifold, apply sealer (GM 9985020) or equivalent, to prevent possible leaks.

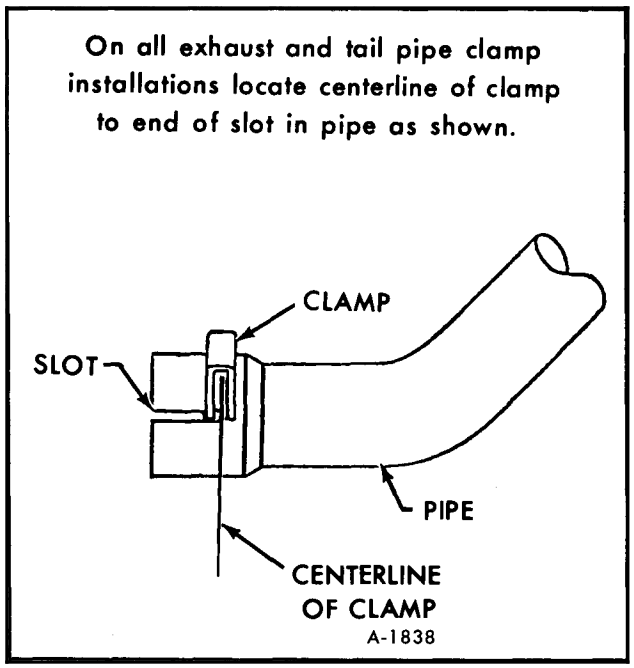


Figure 8—Exhaust System and Clamps

Incorrectly assembled parts of exhaust system are frequently the cause of annoying noises and rattles due to improper clearances. Exhaust components must have 3/4" clearance from floor to avoid possible overheating. Therefore, leave all clamp assemblies and muffler strap bolts loose temporarily until the entire system has been inspected to determine if there is adequate clearance between exhaust components and frame members. The weight of the exhaust system should be properly distributed on all supporting brackets and hangers. If the load is not properly balanced, reposition pipes at connecting joints to relieve any concentrated loads. After adjusting hangers, aligning pipes, and repositioning muffler, check entire system for adequate clearance and then tighten all clamps, working from front to rear. (See figure 9) Start engine and inspect all connections for leakage.

NOTE: When installing exhaust pipe to manifold, always use new packing.

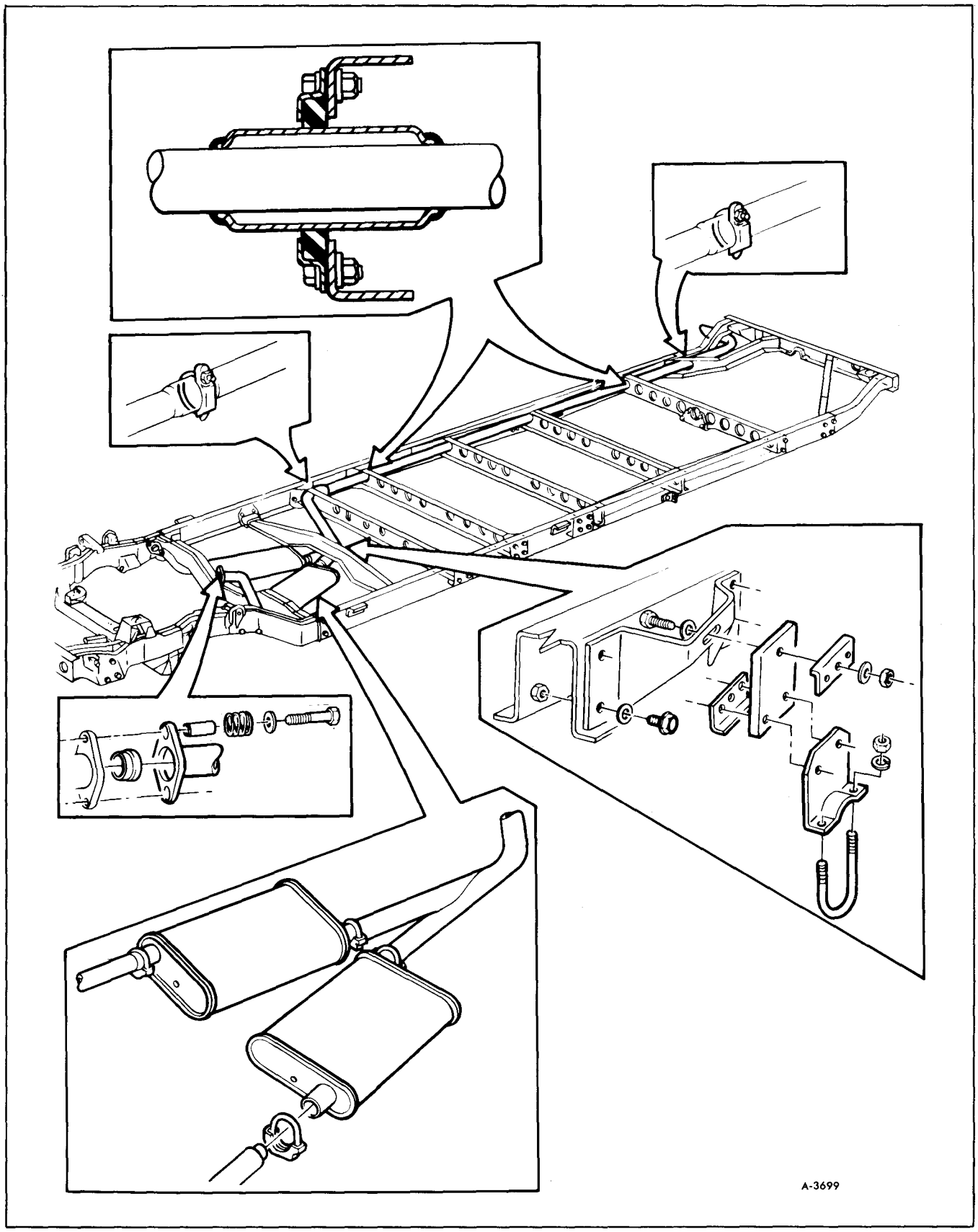


Figure 9—Exhaust Pipe Clamp Installation

SECTION 9
STEERING

Contents of this section are listed below.

CAUTION: *All steering linkage 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.*

STEERING LINKAGE

GENERAL INFORMATION

A parallelogram type steering linkage connects both front wheels to the steering gear through the pitman arm (See figure 1). The right and left tie rods are attached to steering arms at the wheels and to a forged intermediate rod by ball studs.

The left end of the intermediate rod is supported by the relay lever which is driven by the drag link connected to the pitman arm on the steering gear. The right end of the intermediate rod is supported by an idler arm which pivots on a support attached to the frame. The rear portion of the relay lever and the idler arm are always parallel to each other and move through symmetrical arcs.

The steering linkage is equipped with a linkage shock absorber connected from the intermediate rod to the frame. This is designed to absorb much of the shock to the steering system.

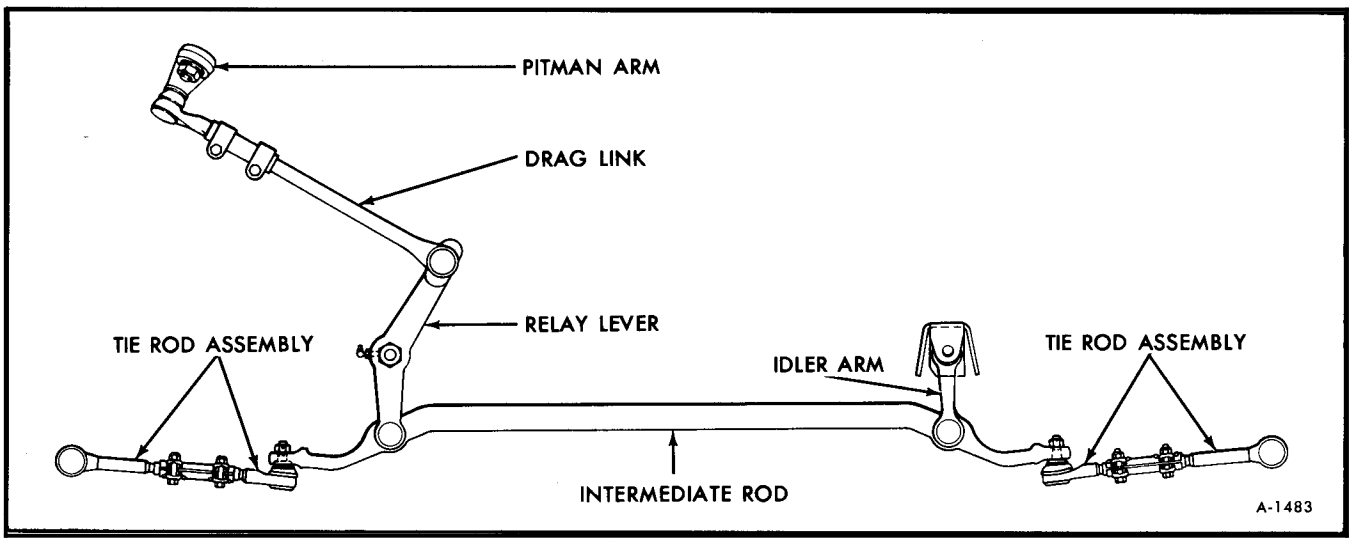


Figure 1—Steering Linkage

STEERING LINKAGE TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
A. Excessive Play or Looseness in Steering System	1. Front wheel bearings loosely adjusted. 2. Worn couplings or steering shaft U-joints. 3. Worn upper ball joints. 4. Steering wheel loose on shaft. 5. Steering gear worm bearings loosely adjusted. 6. Excessive pitman shaft to ball nut lash in steering gear. 7. Loose pitman arm, tie rods, steering arms or steering linkage ball studs. Worn intermediate rod or tie rod sockets.	1. Adjust bearings or replace with new parts as necessary. 2. Replace. 3. Replace. 4. Tighten to specified torque. 5. Adjust preload to specification. 6. Adjust preload to specification. 7. Replace loose or worn parts.
B. Excessive looseness in tie rod or intermediate rod pivots, or excessive vertical lash in idler support.	1. Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear.	1. Replace damaged parts as necessary.
C. Hard Steering—Excessive Effort Required at Steering Wheel.	1. Low or uneven tire pressure. 2. Steering linkage or ball joints need lubrication. 3. Tight or frozen intermediate rod, tie rod or idler socket. 4. Steering gear to column misalignment. 5. Steering gear adjusted too tightly. 6. Front wheel alignment incorrect.	1. Inflate to specified pressures. 2. Lube with specified lubricant. 3. Lube or replace as necessary. 4. Align column. 5. Adjust preload to specification. 6. Check alignment and correct as necessary.
D. Poor Returnability.	1. Steering linkage or ball joints need lubrication. 2. Steering gear adjusted too tightly. 3. Steering gear to column misalignment. 4. Front wheel alignment incorrect.	1. Lube with specified lubricant. 2. Adjust preload to specifications. 3. Align column. 4. Check alignment and correct as necessary.

STEERING LINKAGE COMPONENT REPLACEMENT

IMPORTANT: Lubricate the steering linkage sockets whenever servicing the linkage.

TIE RODS

The vehicle employs two three-piece tie rods connecting left and right steering arms (See figure 1). The tie rod assembly consists of a tube and two socket end assemblies. The socket end assemblies are threaded into the tube and locked in place with clamps. Right and left hand threads are provided to facilitate toe-in adjustment.

The tie rod ends require no attention in service other than periodic lubrication and inspection to see that the ball studs are tight. Socket ends should be replaced when excessive up and down motion or any lost motion or end play at ball end of studs exists.

REMOVAL (FIGURE 1)

1. Raise vehicle.

2. Remove front wheels.

3. Remove cotter pin from ball studs and remove castellated nuts.

4. Disconnect tie rod from steering arm by using Tool J-24319 or similar puller.

5. Remove inner ball stud from intermediate rod using procedure described in Step 3 and 4.

6. To remove tie rod ends from the adjuster tube, loosen clamp bolts and unscrew end assemblies.

INSTALLATION

1. If the tie rod ends were removed, lubricate the threads with chassis lube. Thread both ends of the rod an equal distance into the adjuster tube.

2. Make sure that threads on ball studs and in ball stud nuts are perfectly clean and smooth. The ball stud must have no nicks on the taper.

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

3. Install ball studs in steering arms and intermediate rod.

4. Install ball stud nuts and torque. See specifications for torque value and procedure.

5. Lubricate linkage sockets.

6. Lower vehicle.

7. Adjust toe-in (See section 3A of this manual).

DRAG LINK (FIGURE 1)

The procedures for the removal and installation of the drag link are the same as those given for the tie rods, earlier in this section. If the drag link was disassembled or a new unit is installed the adjustment on the drag link should coincide with the steering wheel at the center of its' travel and the wheels pointing straight ahead.

NOTE: Later production vehicles are equipped with a non-adjustable drag link.

RELAY LEVER (FIGURE 1)

REMOVAL

1. Place vehicle on hoist.

2. Remove cotter pins and castellated nuts from both ends of the relay lever.

3. Disconnect drag link from relay lever by using Tool J-24319 or similar puller.

4. Disconnect intermediate rod from relay lever using puller as in step 3.

5. Remove bolt securing relay lever to frame.

INSTALLATION

1. Secure relay lever to frame with bolt and torque bolt to 250 to 300 foot-pounds.

2. Connect relay lever ball stud to intermediate rod.

3. Install drag link ball stud to relay lever.

4. Install ball stud nuts, making sure threads are clean, and torque the intermediate rod, and the drag link stud nuts.

5. Lubricate all steering linkage sockets.

6. Lower vehicle.

IDLER ARM

REMOVAL (FIGURE 1)

1. Raise vehicle.

2. Remove cotter pin and castellated nut from idler arm ball stud at intermediate rod.

3. Disconnect idler arm from intermediate rod using Tool J-24319 or similar puller.

4. Remove bolt and nut securing idler arm to frame.

INSTALLATION

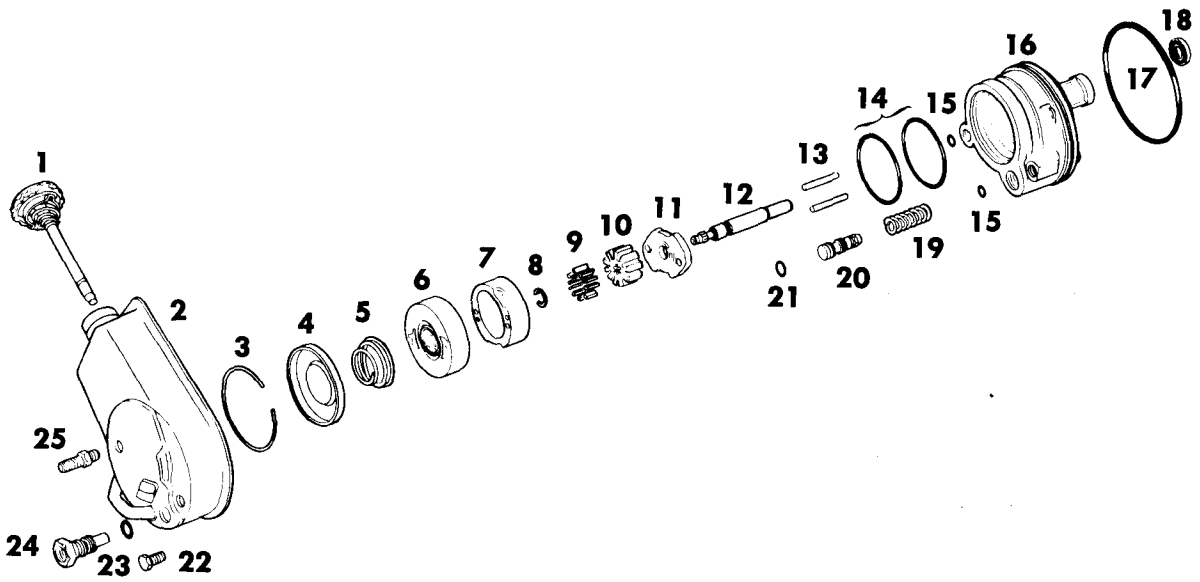
1. Secure idler arm to frame using bolt and lock nut. Torque nut to 85 to 110 foot pounds.

2. Connect idler arm ball stud to intermediate rod. Install ball stud nut making sure threads are clean, and torque. See specifications for torque value and procedures.

3. Lubricate all steering linkage sockets as described in SECTION 0 of this manual.

4. Lower vehicle.

POWER STEERING PUMP



1 Cap	8 Retaining Ring	14 Seal	20 Valve
2 Reservoir	9 Vanes	15 Seal	21 Seal
3 Ring	10 Rotor	16 Housing	22 Bolt
4 Plate	11 Thrust Plate	17 Seal	23 Seal
5 Spring	12 Shaft	18 Seal	24 Fitting
6 Pressure Plate	13 Pin	19 Spring	25 Stud
7 Ring			

A-4146

Figure 2—Power Steering Pump (Exploded)

GENERAL INFORMATION

The housing and internal parts of the pump are inside the reservoir so that the pump parts operate submerged in oil. The reservoir is sealed against the pump housing, leaving the housing face and the shaft hub exposed. The reservoir has a filler neck fitted with a cap. A shaft bushing and seal are pressed into the housing from the front. The drive shaft is inserted through this seal and bushing. A large hole in the rear of the housing contains the functional parts; namely ring, rotor, vanes and plates. A smaller hole contains the control valve assembly and spring.

The thrust plate (figure 2) is located by two dowel pins on the inner face of the housing. This plate has four central blind cavities for undervane oil pressure. The two outer blind cavities direct discharge oil through the two cross-over holes in the pump ring (figure 3), through the pressure plate, and into cavity 1 (figure 4). The two outside indentations in the thrust plate are for intake of the oil from the suction part of the pump.

The pump ring (figure 3) is a plate having the mating surfaces ground flat and parallel. The center hole is a two lobed cam in which the rotor and vanes operate. The ring is placed next to the thrust plate, and located with the same dowel pins.

The pressure plate is fitted against the ring and located with the same two dowel pins. This plate has six through ports. The four central through ports

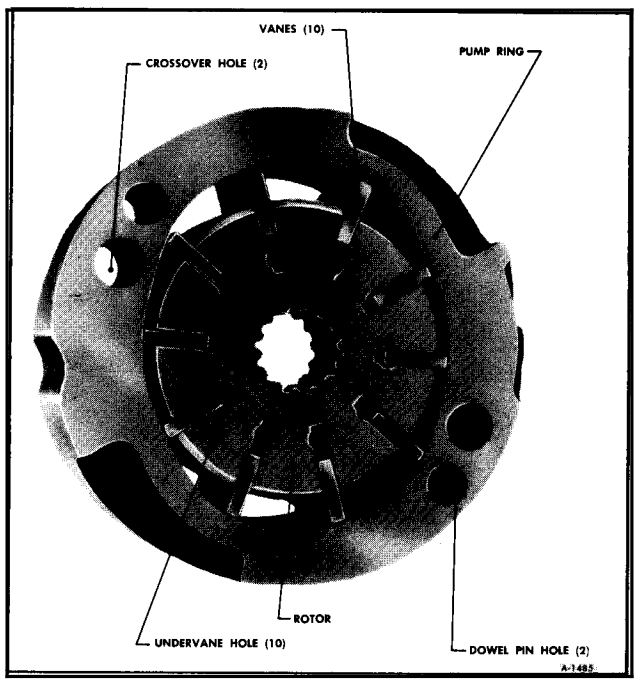


Figure 3—Pump Ring and Rotor

connect from cavity 1 (figure 4) to supply undervane oil pressure. The two outer ports pass oil under discharge pressure to cavity 1. The two indentations are for oil intake from the suction part of the pump, cavity 7 (figure 4) into the rotor.

The reservoir is for oil storage. It receives and directs the return oil back to the make-up passage of the pump.

The drive shaft is fitted with a pulley and is belt driven from the crankshaft. The rotor is loosely splined to the drive shaft and secured with a retaining ring. It is located centrally within the ring and between the thrust and pressure plates. The ten vanes are mounted in radial slots in the rotor (figure 3).

OPERATION

The mode of operation of the power steering pump is based upon the demand of the power steering gear. The various major modes of operation are: slow cornering, moderate to high speed straight ahead driving, and cornering against the wheel stop. The pump is designed to recognize these conditions as required by the steering gear valve and compensates for them internally.

As the drive shaft turns the rotor, the vane tips follow the inner cam surface of the pump ring, moving outward and inward twice during each revolution. This results in a complete pumping cycle every 180 degrees of rotation (figure 3). Oil is moved in the spaces between the vanes. As the vane tips move outward, oil is sucked into the intervane spaces through four suction ports in the pressure and thrust plates. The pressure of the oil is raised, and the oil is discharged from the pump ring, as the vane tips move inward. High pressure oil discharges into cavity 1, (figure 4), through two open ports in the pressure plate, and through two blind ports in the thrust plate, which are connected to cavity 1 by the cross-over holes in the ring. A portion of this oil is circulated through the central port system in the pressure plate, forcing the vanes to follow the cam surface of the ring. The ring-rotor leakage oil (12) is used for bushing lubrication and then bled to the reservoir.

Slow Cornering (Figure 4)

During slow cornering maneuvers, the oil pressure required will usually not exceed 400 psi. The RPM of the pump is not high enough to require internal bypassing of oil, therefore, the pump bypass port to (5) remains closed. The high pressure discharge oil (7) is slightly lower in pressure than the internal high pressure oil (1). The drop in pressure occurs as oil flows through the flow control orifice (2). This reduces the pressure at the bottom end of the pump control valve (9) because the orifice (11) is

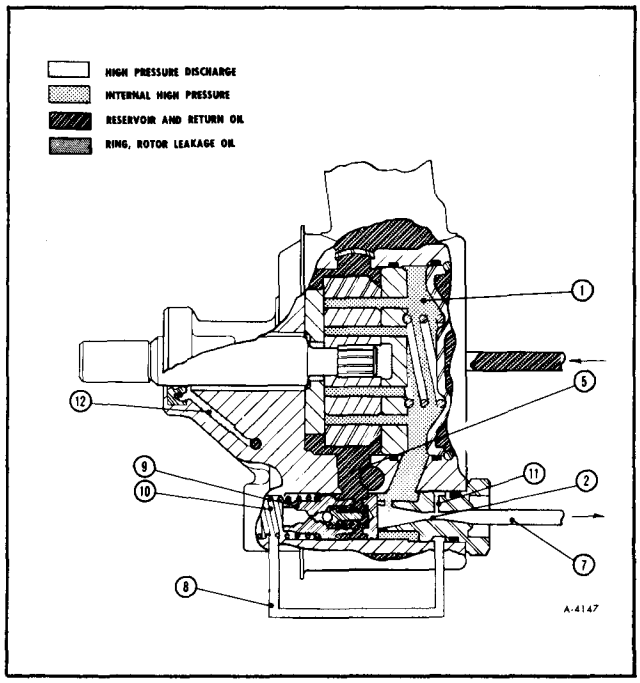


Figure 4—Slow Cornering

connected by passage (8) to (9) resulting in a pressure unbalance on the valve. The flow control valve moves away from the discharge fitting, but due to the force of the flow control spring (10) the valve remains closed to the bypass hole (5). The oil pressure does not build up high enough to cause the pressure relief valve to actuate, because the oil pump through the steering gear is allowed to recirculate through the entire system.

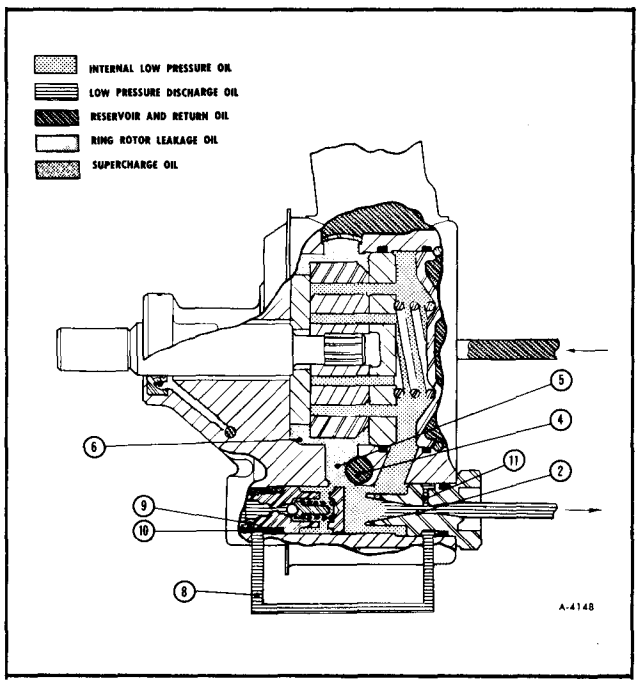


Figure 5—Moderate To High Speed Operation

Moderate To High Speed Operation (Figure 5)

When operating at moderate to high speed, it is desirable to limit the temperature rise of the oil. This is done by flow controlling. The control valve in the steering gear is an open center rotary valve. When this valve is in the straight ahead position, oil flows from the pump through the open center valve and back to the pump reservoir without traveling through the power cylinder. When this flow exceeds the predetermined system requirements, oil is bypassed within the pump. This is accomplished by the pressure drop which occurs across the flow control orifice (2). The pressure is reduced at the bottom of the flow control valve (9) because the orifice (11) is connected by (8) to the bottom of valve (9).

The pressure unbalance of the valve is sufficient to overcome the force of the spring (10), allowing the valve to open the bypass hole (5), and diverting oil into the intake chamber (6). Supercharging of the intake chamber occurs under these conditions. Oil at high velocity discharging past the valve into the intake chamber picks up make-up oil at hole (4) from the reservoir on the jet pump principle. By reduction of velocity, velocity energy is converted into supercharge pressure in cavity (6). During this straight ahead driving conditon, the discharge pressure should not exceed 100 psi.

Cornering Against Wheel Stops (Figure 6)

When the steering gear control valve is actuated in either direction to the point of cut-off, the flow of oil from the pump is blocked. This condition occurs

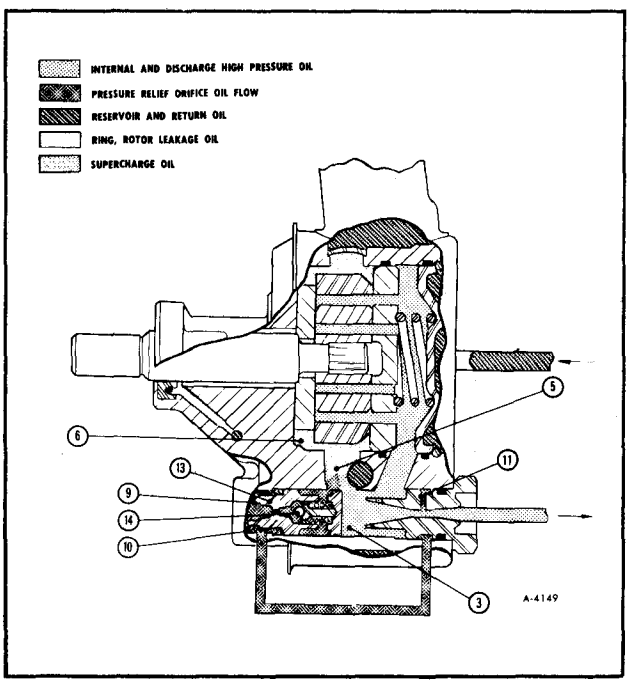


Figure 6—Pressure Relief

when the front wheels meet the wheel stop, or when the wheel movement is otherwise blocked by a curb or deep sand or mud. The pump is equipped with a pressure relief valve. The relief valve is contained inside the flow control plunger (13). When the pressure exceeds a predetermined pressure, (greater than maximum system requirements) the pressure relief ball (14) opens, allowing a small amount of oil to flow into the bypass hole (5). This flow of oil passing through the pressure relief orifice (11) causes a pressure drop and resulting lower pressure on the bottom end of the control valve (9).

The pressure unbalance then causes the valve to compress the spring (10) allowing the major portion of the oil to bypass into the intake chamber (from 3 to 6) in the same manner as is accomplished by flow controlling. Relief pressures are usually between 750 and 1450 psi depending on the vehicle requirements.

TROUBLE DIAGNOSIS

NOTE: The following diagnostic procedures apply to the steering system with the exception of the steering column (For steering column trouble diagnosis see "STEERING COLUMN" later in this section.)

LEAKAGE CHECK

The purpose of the diagnostic procedure is to pinpoint 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 service manual.

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. Replace seal, fitting, gasket, or component as necessary to stop leak.

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 (maximum). 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.

SEAL REPLACEMENT RECOMMENDATIONS

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 stub shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal or seals, 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.

STEERING GEAR AND PUMP DIAGNOSIS CHART

Condition	Possible Cause	Correction
Hissing noise in steering gear.	1. 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.	1. Slight "hiss" is normal and in no way affects steering. Do not replace valve unless "hiss" is extremely objectionable. 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 valve "hiss" into passenger compartment through the steering column.
Rattle or chuckle noise in steering gear.	1. Gear loose on frame. 2. Steering linkage looseness. 3. Pressure hose touching other parts of vehicle. 4. Loose pitman shaft 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. 5. Loose pitman arm.	1. Check gear-to-frame mounting screws. Tighten screws to 70-foot-pounds. 2. Check linkage pivot points for wear. Replace if necessary. 3. Adjust hose position. Do not bend tubing by hand. 4. Adjust to specifications. 5. Tighten pitman arm nut to specifications.
Squawk noise in steering gear when turning or recovering from a turn.	1. Damper "O" ring on valve spool cut. 2. Improper fluid in system.	1. Replace damper "O" ring. 2. Flush and refill using power steering fluid (GM 105007).
Chirp noise in steering pump.	1. Loose belt.	1. Adjust belt tension to specification.
Belt squeal (Particularly noticeable at full wheel travel and stand still parking).	1. Loose belt.	1. Adjust belt tension to specification.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

Condition	Possible Cause	Correction
Growl noise in steering pump.	1. Excessive back pressure in hoses or steering gear caused by restriction.	1. Locate restriction and correct. Replace part if necessary.
Growl noise in steering pump. (Particularly noticeable at stand still parking).	1. Scored pressure plates, thrust plate or rotor. 2. Extreme wear of cam ring.	1. Replace parts and flush system. 2. Replace parts.
Groan noise in steering pump.	1. Low oil level. 2. Air in the oil. Poor pressure hose connection.	1. Fill reservoir to proper level. 2. Tighten connector to specified torque. Bleed system by operating steering from right to left—full turn.
Rattle or knock noise in steering pump.	1. Loose pump pulley nut.	1. Tighten nut to specified torque.
Rattle noise in steering pump.	1. Vanes not installed properly. 2. Vanes sticking in rotor slots.	1. Install properly. 2. Free up by removing burrs, varnish or dirt.
Swish noise in steering pump.	1. Defective flow control valve.	1. Replace part.
Whine noise in steering pump.	1. Pump shaft bearing scored.	1. Replace housing and shaft. Flush system.
Poor return of steering wheel to center.	1. Lack of lubrication in linkage and ball joints. 2. Lower coupling flange rubbing against steering gear adjuster plug. 3. Steering gear to column misalignment. 4. Tires not properly inflated. 5. Improper front wheel alignment.	1. Lube linkage and ball joints. 2. Loosen pinch bolt and assemble properly. 3. Align steering column. 4. Inflate to specified pressure. 5. Check and adjust as necessary. With front wheels still on alignment pads of front end machine, disconnect pitman arm of linkage from pitman shaft of gear. Turn front wheels by hand. If wheels will not turn or are difficult to turn, determine if linkage or ball joints are binding.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

Condition	Possible Cause	Correction
	6. Steering linkage binding.	6. Replace pivots.
	7. Ball joints binding. (Turn steering wheel and listen for internal rubbing in column—check causes listed and correct as directed).	7. Replace ball joints.
	8. Steering wheel rubbing against directional signal housing.	8. Adjust steering jacket.
	9. Tight or frozen steering shaft bearings.	9. Replace bearings.
	10. Rubber spacer binding.	10. Make certain spacer is properly seated. Lubricate inside diameter with silicone.
	11. Sticky or plugged valve spool.	11. Remove and clean or replace valve.
	12. Steering gear adjustments over specifications.	12. Check adjustment with gear out of vehicle. Adjust as required.
Vehicle wanders. (Keep in mind road condition and wind. Test vehicle on flat road going in both directions).	1. Front end misaligned.	1. Adjust to specifications.
	2. Unbalanced steering gear valve. NOTE: If this is cause, steering effort will be very light in direction of lead and heavy in opposite direction.	2. Replace valve.
Momentary increase in effort when turning wheel fast to right or left.	1. Low oil level in pump.	1. Add power steering fluid as required.
	2. Pump belt slipping.	2. Tighten or replace belt.
	3. High internal leakage.	3. Check pump pressure. (See pump pressure test).

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

Condition	Possible Cause	Correction
Steering wheel surges or jerks when turning with engine running especially during parking.	1. Low oil level.	1. Fill as required.
	2. Loose pump belt.	2. Adjust tension to specification.
	3. Steering linkage hitting engine oil pan at full turn.	3. Correct clearance.
	4. Insufficient pump pressure.	4. Check pump pressure. (See pump pressure test). Replace relief valve if defective.
	5. Sticky flow control valve.	5. Inspect for varnish or damage, replace if necessry.
Excessive wheel kickback or loose steering.	1. Air in system.	1. Add oil to pump reservoir and bleed by operating steering. Check hose connectors for proper torque and adjust as required.
	2. Steering gear loose on frame.	2. Tighten attaching screws to specified torque.
	3. Steering gear flexible coupling loose on shaft or rubber disc mounting screws loose.	3. Tighten flange pinch bolts to 30 foot-pounds, if serrations are not damaged. Tighten upper flange to coupling nuts to specified torque.
	4. Steering linkage joints worn enough to be loose.	4. Replace loose pivots.
	5. Worn poppet valve (Gear).	5. Replace poppet valve.
	6. Loose thrust bearing preload adjustment. (Gear).	6. Adjust to specification with gear out of vehicle.
	7. Excessive "over-center" lash.	7. Adjust to specification with gear out of vehicle.
Hard steering or lack of assist.	1. Loose pump belt.	1. Adjust belt tension to specification.
	2. Low oil level in reservoir.	2. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. Tighten loose connectors to 30-ft-lbs.
	NOTE: Low oil level will also result in excessive pump noise.	
	3. Steering gear to column misalignment.	3. Align steering column.
	4. Lower coupling flange rubbing against steering gear adjuster plug.	4. Loosen pinch bolt and assemble properly.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

Condition	Possible Cause	Correction
NOTE: If checks 1 through 5 do not reveal cause of hard steering, follow the procedure below to determine fault.	5. Tires not properly inflated. Further possible causes could be: 6. Sticky flow control valve. 7. Insufficient pump pressure output. 8. Excessive internal pump leakage. 9. Excessive internal gear leakage.	5. Inflate to recommended pressure. In order to diagnose conditions such as listed in 6, 7, 8, 9 a test of the entire power steering system is required.

POWER STEERING SYSTEM TEST PROCEDURE

1. Disconnect pressure hose at union of pump, use a small container to catch any fluid which might leak.
2. Connect a spare pressure hose to pump union.
3. Using pressure gage J 5176-1, adapter fitting J 22326, connect gage to both hoses.
4. Open hand valve on gage.
5. Start engine, allow system to reach operating temperatures and check fluid level adding any fluid if required. When engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 80-125 psi range. Should this pressure be in excess of 200 psi—check the hoses for restrictions and the poppet valve for proper assembly.
6. Close gate valve fully 3 times. Record the highest pressures attained each time. (Note: 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 1250-1350 psi and the range of readings are within 50 psi, the pump is functioning within specs.
   (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 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.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

	7. If the pump checks to specs., 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 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. 8. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level or make needed repairs.
	Alternate Power Steering System Test Procedure **NOTE:** If power steering analyzer J-25325 is available, use it and the following procedure to determine fault. 1. Connect Analyzer J-25323 into steering system. Remove pressure fitting from gear and connect into female analyzer adapter. Thread male adapter of analyzer into gear. Connect analyzer to adapters. Tighten both connections to 40 ft. lbs. Add power steering fluid to pump if required. 2. Start engine. Set engine idle to specification. Run engine for approximately five minutes. Check power steering fluid level and add if required. 3. Record flow and pressure at idle with gate valve fully open. If flow is below 2gpm, the pump appears to be in need of repair, but continue diagnosis. If pressure is above 200 psi check hoses for restrictions and check steering gear for poppet valve functions. 4. Partially close gate valve to build 700 psi. Observe and record flow. If flow drops more than 1 gpm, disassemble pump and replace ring, rotor, and vanes. If pressure or thrust plates are cracked or worn, replace. 5. Completely close and partially open gate valve three times (do not allow valve to remain closed more than 5 seconds. If pressures recorded are 100 psi lower than 1250-1350 psi specifications, replace flow control valve in pump. If pressures recorded vary more than 50 psi, the flow control valve should be removed and cleaned. Also check control valve bore for dirt, chips, etc. Clean as required. If system fluid appears contaminated, both the gear and the pump must be completely disassembled and cleaned. 6. Increase engine speed from idle to approximately 1500 rpm. If the flow varys more than 1 gpm, the flow control valve should be removed and cleaned as in step 5 above.

STEERING GEAR AND PUMP DIAGNOSIS CHART (Cont'd.)

	7. Turn steering wheel left and right against wheel stops. If the pressure in the corners does not reach maximum output or the flow drops below 1 gpm, excessive internal leakage is occuring. Remove and disassemble steering gear. Replace damaged or broken parts. Pay particular attention to rack piston and valve body ring damage. 8. Turn the steering wheel slightly in both directions and release quickly, watching the pressure gauge. The needle should move from the normal backpressure reading and snap back as the wheel is released. If it comes back slowly, or sticks, the rotary valve in the steering gear is sticking. Remove, disassemble, and clean the rotary valve. If the system oil is severely contaminated, both gear and pump must be completely disassembled and cleaned.

Condition	Possible Cause	Correction
Foaming milky power steering fluid, low fluid level and possible low pressure.	1. Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	1. Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeriation should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
Low pressure due to steering pump.	1. Flow control valve stuck or inoperative. 2. Pressure plate not flat against cam ring. 3. Extreme wear of cam ring. 4. Scored pressure plate, thrust plate or rotor. 5. Vanes not installed properly. 6. Vanes sticking in rotor slots. 7. Cracked or broken thrust or pressure plate.	1. Remove burrs or dirt or replace. 2. Correct. 3. Replace parts. Flush system. 4. Replace parts. (If rotor, replace with rotating group kit). Flush system. 5. Install properly. 6. Free-up by removing burrs, varnish or dirt. 7. Replace part.
Low pressure due to steering gear.	1. Pressure loss in cylinder due to worn piston ring or badly worn housing bore. 2. Leakage at valve rings, valve body to worm seal.	1. Remove gear from vehicle for disassembly and inspection of ring and housing bore. 2. Remove gear from vehicle for disassembly and replace seals.

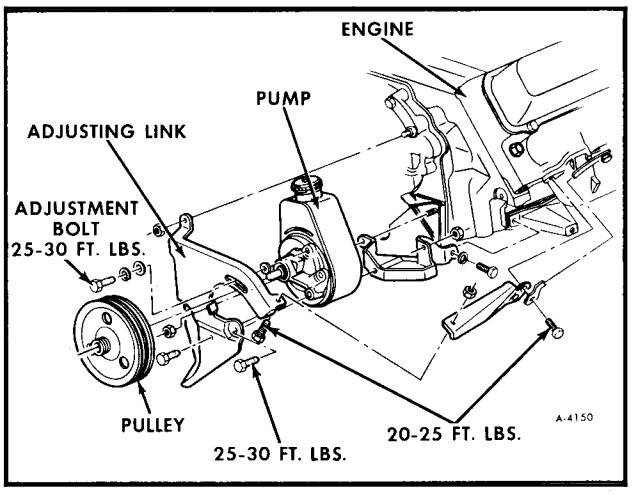


Figure 7—Pump Installation

REMOVAL OF PUMP (FIGURE 7)

1. Loosen power steering and Delcotron belts.

2. Disconnect pressure line and return hose from pump. (Install caps at both pump fittings to prevent drainage of oil from pump).

3. Remove power steering pump mounting bolts and nuts, and upper left venturi bracket. (See figure 7).

4. Remove power steering pump with adjusting link attached.

5. Remove adjusting link from pump.

6. Remove pulley from shaft using puller tool J-25034 (figure 8).

CAUTION: *Do not hammer pulley off shaft as this will damage pump.*

PUMP DISASSEMBLY

Before disassembly of pump, remove reservoir filler cap and drain oil from reservoir by inverting the pump so oil may drain out the filler hole.

After oil is drained from reservoir, cap should be replaced and the entire pump assembly washed in a non-toxic solvent to remove all dirt and prevent any foreign matter from contaminating pump components.

CAUTION: *Examine exposed part of drive shaft. If it is corroded, use crocus cloth to remove corrosion before disassembling pump. This will prevent damage to the shaft bushing.*

1. Clamp front hub of pump in vise so that the extending portion of shaft is directed downward, being careful not to clamp vise too tight as this may distort the bearing (figure 9).

2. Using proper sized wrenches, remove union and "O" ring assembly and both mounting studs

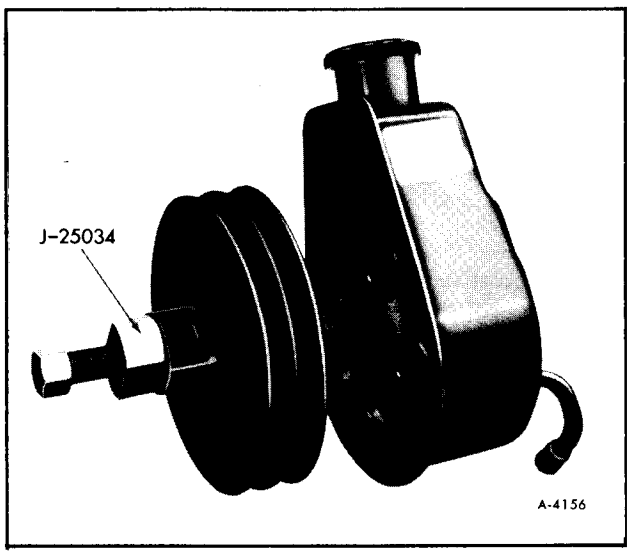


Figure 8—Pulley Removal - Special Tool J-25034

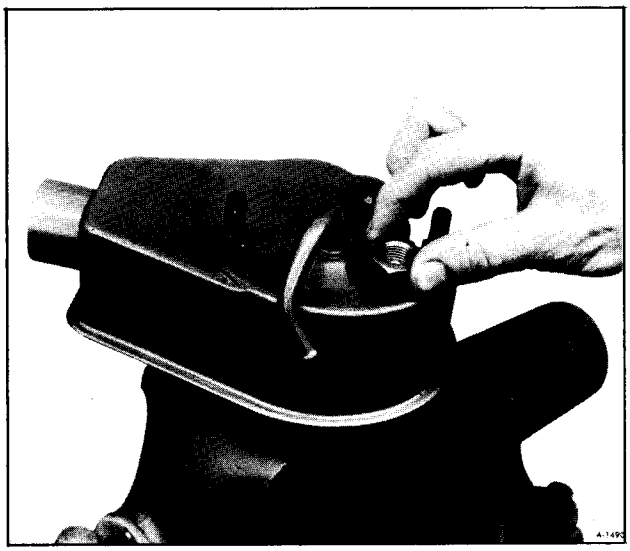


Figure 9—Studs & Union Being Removed

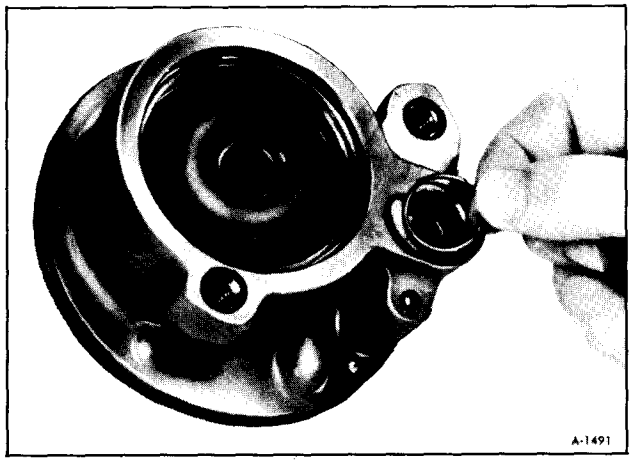


Figure 10—Removal of Stud & Union Seals

from back of reservoir. Discard all seals and "O" rings. (figure 9).

3. Reservoir may then be removed from housing by rocking it slightly back and forth to unseat the "O" ring. Remove "O" ring and discard.

4. Remove both mounting stud and union seals from counterbored spaces between reservoir and housing. Discard these seals also. (figure 10).

5. Remove the end plate retaining ring by inserting a small punch in the 1/8 inch diameter hole in the housing side opposite the flow control valve hole. Compress the retaining ring with the punch and

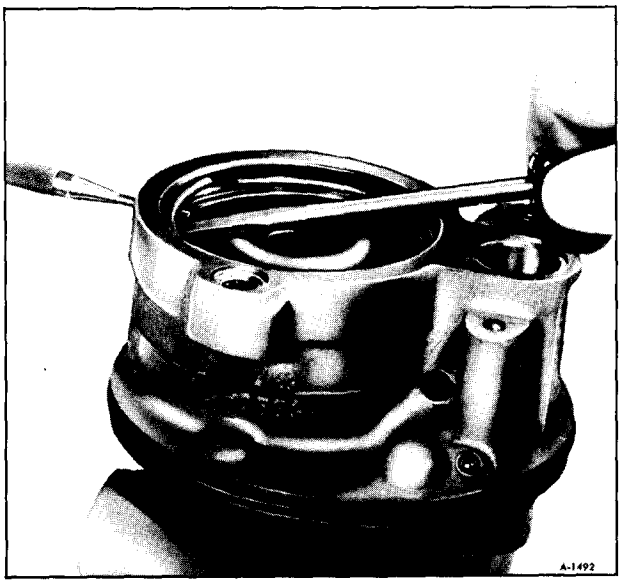


Figure 11—Removal of End Plate Retaining Ring

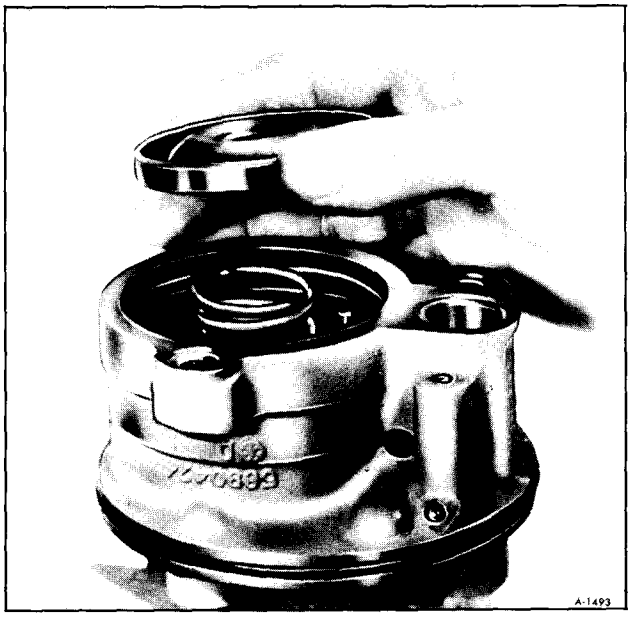


Figure 12—Removal of End Plate

remove by inserting a screwdriver under the ring and twisting the screwdriver. (figure 12).

6. Remove end plate and end plate "O" ring. End plate is spring loaded and will generally sit above the housing level for ease of removal. If sticking should occur, a slight rocking action of the end plate should be used to free it. (figure 12).

7. Remove pump from vise and invert. Flow control valve and valve spring will fall free. (figure 13).

8. Remove key from shaft end where pulley was mounted.

9. With end cover "O" ring and shaft key removed, tap very lightly on end of shaft, only until pressure plate falls free. (figure 14).

10. Remove pressure plate, shaft, pump ring, vanes and rotor. (figure 15).

11. Remove shaft retaining ring and discard. (Some models do not have retaining rings).

12. Remove rotor and thrust plate from shaft and both dowel pins from housing. (figure 16).

13. Pry shaft seal out of housing, being careful

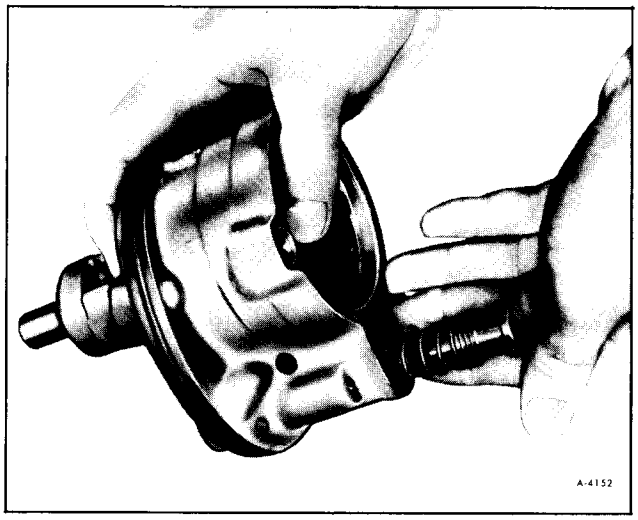


Figure 13—Removal of Relief Valve

not to damage the housing bore; discard the shaft seal.

CLEANING AND INSPECTION

Carefully clean all pump parts in non-toxic cleaning solvent. Replace any damaged or worn parts.

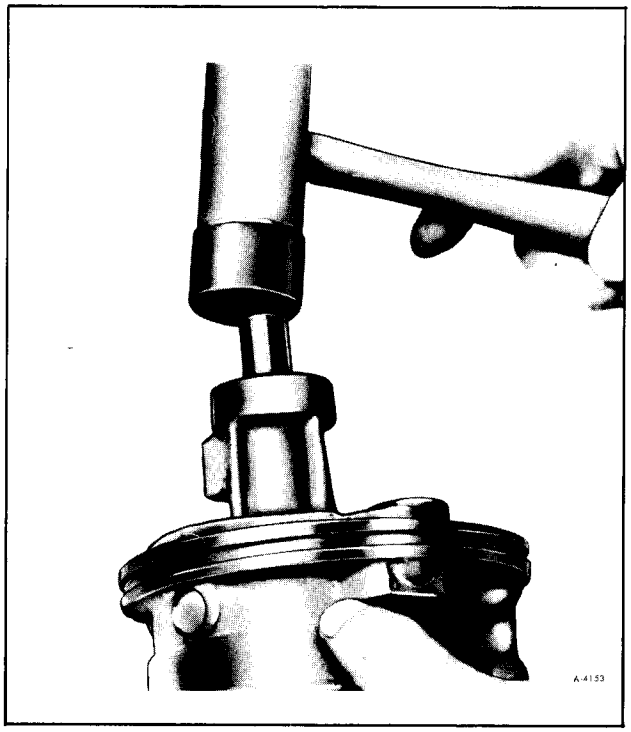


Figure 14—Tapping Shaft to Unseat Pressure Plate

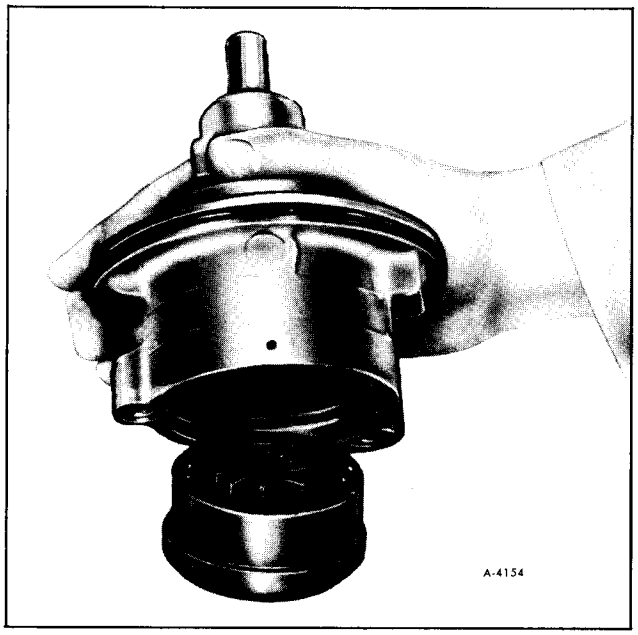


Figure 15—Removal of Shaft, Pressure Plate, Pump Ring, Vanes and Rotor

1. Inspect flow control valve assembly for score marks, wear, burrs, or other damage.

2. Inspect castings for cracks or other visual evidences of damage. Check machined surfaces, especially mating surfaces on "O" ring seats, for scratches or burrs that might permit leaks. Examine

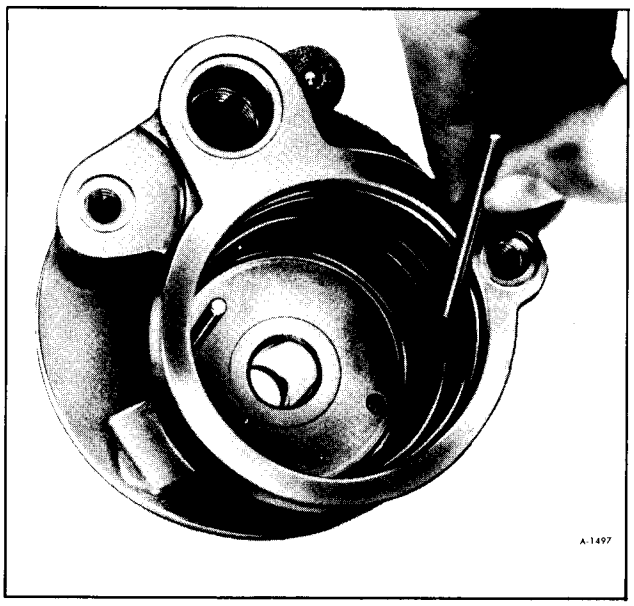


Figure 16—Removing Dowel Pins From Housing

the V-shaped notches at edges of discharge ports on pressure plate. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.

3. Inspect pump ring end surfaces for score marks.

NOTE: Because pump ring is treated, it leaves a dull gray-black finish on wear surface. Wavy grain appearance inside pump ring is normal.

4. Inspect pump shaft for score marks, excessive wear, or damage—particularly at splines, at keyway, and at bearing and seal surfaces. Separate and inspect rotor and vanes for wear and general condition.

5. Inspect shaft bushing in pump housing. Replace pump housing if bushing is scored or excessively worn.

6. If any internal parts are found to be worn or damaged, flush steering gear or disassemble gear and clean internal parts.

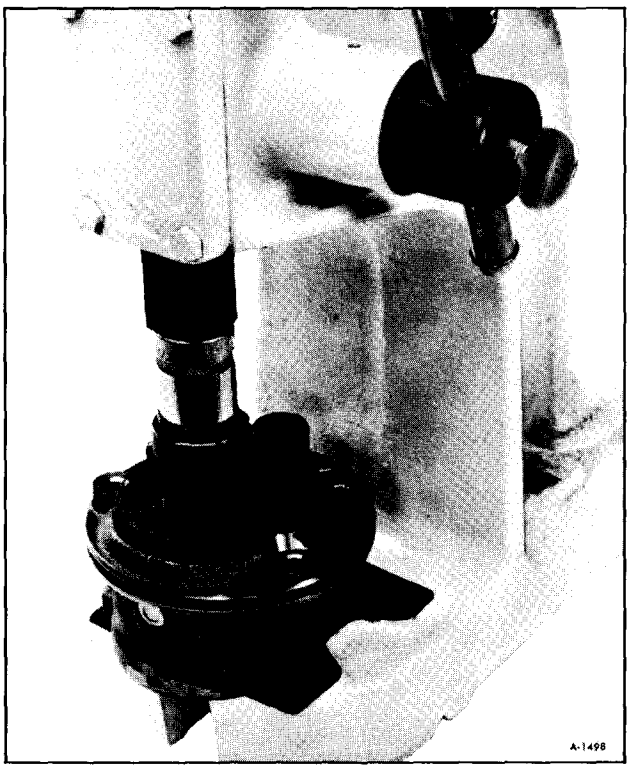


Figure 17—Installing Shaft Seal

ASSEMBLY OF PUMP

1. Install new pump shaft seal using seal protector J-22616 and seal installer J-7728 or a 1 inch socket with an arbor press or hammer (figure 17).

CAUTION: *DO not use any more force than necessary to seat the seal.*

2. Lubricate new pressure plate "O" ring with Power Steering Fluid, and install in third groove from rear of housing.

3. Clamp end hub of housing in vise in same position as before and insert both dowel pins. (figure 16).

CAUTION: *Do not over tighten. The vice-damage to the bearing could occur.*

4. Insert shaft through thrust plate and rotor, and install new snap ring on shaft. Open the snap ring just enough to slide over the end of shaft. (Rotor must have counter sunk side toward thrust plate). (figure 18).

5. Insert shaft in housing, making sure thrust plate slides properly on dowel pins.

6. Install pump ring on dowel pins with the arrow toward rear of housing (figure 19).

7. Install all ten vanes in rotor slots with rounded edge of vanes outward (figures 3 and 20). Vanes should slide freely.

8. Lubricate pressure plate with Power Steering Fluid to protect pressure plate "O" ring.

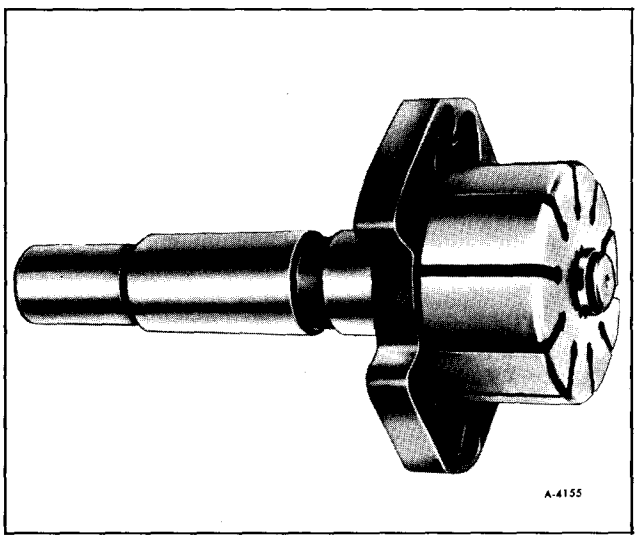


Figure 18—Shaft With Thrust Plate and Rotor

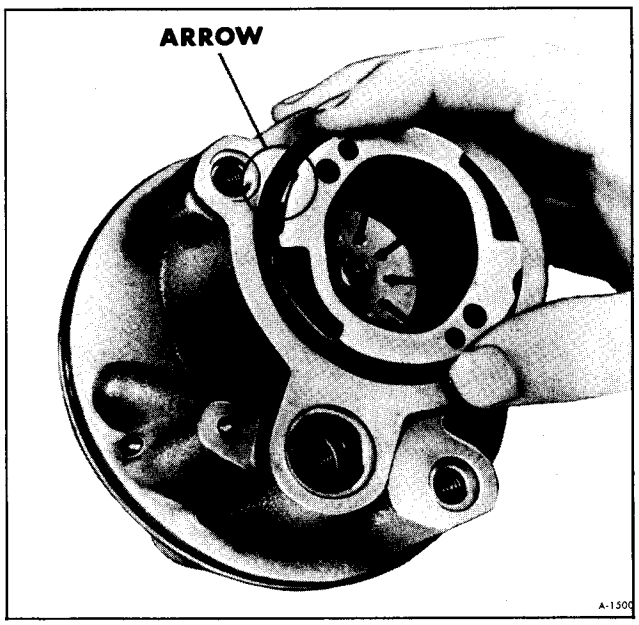


Figure 19—Pump Ring Showing Arrow

Figure 21—Installing Pressure Plate

9. Install pressure plate on dowel pins with circular depression for spring toward rear of housing. Pressure plate must be pressed about 1/16 inch over the "O" ring to seat (figure 21).

10. Lubricate new end plate "O" ring with Power Steering Fluid and install in second groove from rear of housing.

11. Install end plate spring in groove provided in pressure plate (figure 12).

12. Lubricate end plate with Power Steering Fluid to protect "O" ring and press into housing with an arbor press (figure 22). Depress only far enough to enable retaining ring to seat properly in groove.

Figure 20—Replacement of Pump Vanes

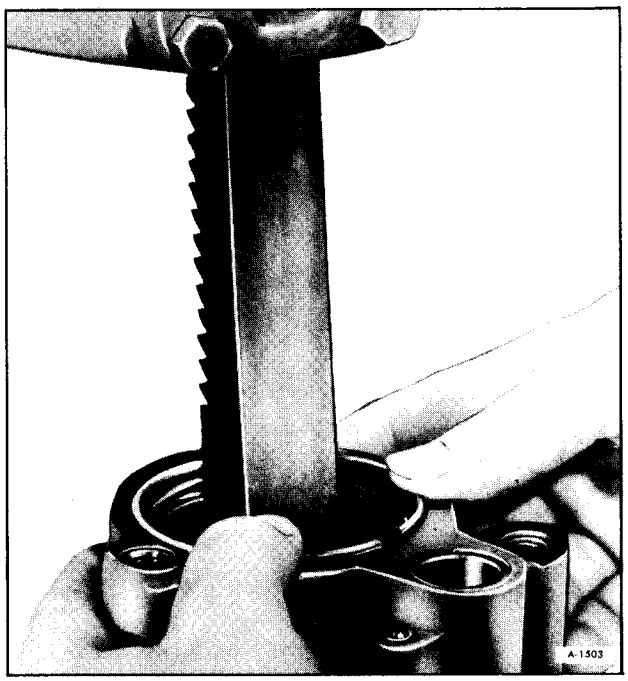


Figure 22—Installation of End Plate Retaining Spring

13. Install end plate retaining ring and release arbor press.

14. Place flow control valve spring in hole first and then insert flow control valve with screened end toward front of housing.

15. Install new stud seals and union seals in counter sunk holes, and lubricate with Power Steering Fluid and install new reservoir "O" ring on housing (figure 10).

16. Lubricate inside edge of reservoir with Power Steering Fluid and install on housing. Align holes at the same time.

17. Insert both stud bolts and tighten (25-40 ft. lb.) (figure 9).

18. Install new "O" ring on union and lubricate with Power Steering Fluid. Make sure "O" ring is in the groove next to the head hex. Insert union in flow control valve hole in back of reservoir and tighten (25-40 ft. lbs.) (figure 9).

19. Install key in shaft end. Support the shaft on the opposite side of the key way and lightly tap the key into place with plastic hammer.

PUMP SHAFT OIL SEAL REPLACEMENT (WITHOUT DISASSEMBLING PUMP)

The pump shaft oil seal can be replaced without disassembling the pump as follows:

1. Remove the pulley as previously described. Bend a piece of .005 inch shim stock (approximately 2-1/2 inches long) into a cylindrical shape, then push the shim stock past seal until it bottoms in pump body.

CAUTION: *The use of shim stock around the pump shaft will prevent damage to the machined surfaces of the shaft when removing seal.*

2. Cut metal body of seal with a small chisel.

3. Tear metal body approximately 1 inch with diagonals. Force an awl between the pump body and the OD of seal to collapse the seal, then pry seal from pump body. Remove shim stock.

4. Apply special seal lubricant No. 1050169 or equivalent to the sealing lip of a new seal, then install seal over pump shaft with metal side of seal outboard.

5. Slide Tool J-7132-2 over pump shaft, then drive seal into pump body.

6. Install pump pulley.

INSTALLATION OF PUMP (FIGURE 7)

1. Install adjusting link on pump.

2. Draw pulley on shaft using Tool J-25033.

CAUTION: *Do not hammer pulley on, as this will damage internal pump parts (figure 23).*

3. Install pump assembly on engine and secure with bolts and nuts (torque to 25-30 ft. lbs.) and install venturi bracket (torque to 20-25 ft. lbs.)

4. Connect and tighten hose fittings to 30-40 foot-pounds.

5. Fill reservoir with fluid. Bleed pump by turning pulley backward (counterclockwise as viewed from front) until air bubbles cease to appear.

6. Install pump belts over pulley.

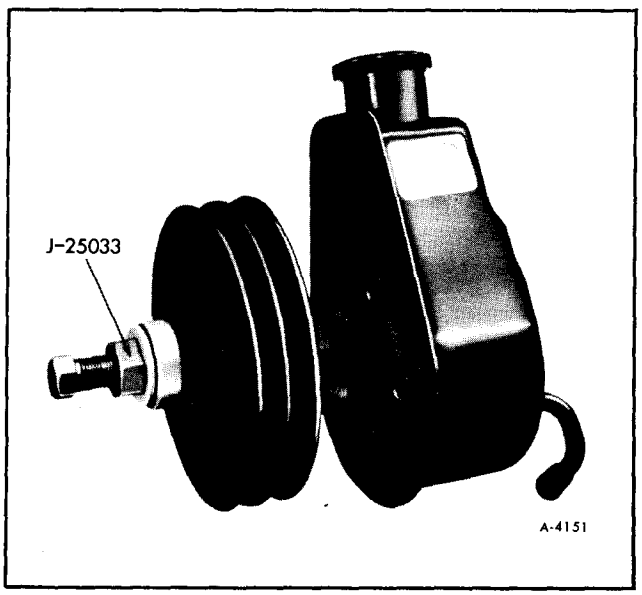


Figure 23—Pulley Installation - Special Tool J-25033

7. Move pump until belts are tight, then tighten adjusting screws. Do not pry on reservoir or pull on filler neck.

8. Adjust belts. (Refer to ADJUSTMENTS).

9. Bleed system. (Refer to FLUID LEVEL under ADJUSTMENTS).

SERVICING OF THE FLOW CONTROL VALVE (WITHOUT REMOVING PUMP ASSEMBLY FROM VEHICLE)

REMOVAL

1. Disconnect high pressure hose from pump union and drain oil.

2. Remove union and withdraw flow control valve and spring with a magnet.

INSPECTION

1. Flow control valve must slide freely in housing bore. If sticking occurs, check for dirt or burrs.

2. Check cap screw in the end of valve for looseness; if loose, tighten, being careful not to damage machined surfaces.

3. If the flow control plunger is suspected of being faulty, install new valve. This is serviced as a unit and is factory calibrated.

INSTALLATION

To install, reverse the "Removal" procedure and install a new "O" ring seal on the union.

ADJUSTMENTS

FLUID LEVEL

1. Run engine until Power Steering Fluid reaches normal operating temperature, approximately 170°F., then shut engine off. Remove reservoir filler cap and check oil level on dipstick.

2. If oil level is low, add Power Steering Fluid to proper level on dipstick and replace filler cap.

NOTE: When adding or making a complete fluid change, always use special power steering fluid available from servicing parts warehouses.

3. When checking fluid level after the steering system has been serviced, air must be bled from the system. Proceed as follows:

a. With wheels turned all the way to the left, add power steering fluid to "Cold" mark on dipstick.

b. Start engine, run at fast idle, and recheck fluid level. Add fluid if necessary to "Cold" mark on dipstick.

c. Bleed system by turning wheels from side to side without hitting stops. Maintain fluid level just above internal pump casting. Fluid with air in it will have a cloudy appearance. This air must be eliminated from fluid before normal steering action can be obtained.

d. Return wheels to center position and continue to run engine for two or three minutes then shut engine off.

e. Road test car to make sure steering functions normally and is free from noise.

f. Recheck fluid level as described in steps 1 and 2, making sure fluid level is between "Cold" and "Hot" marks on dipstick after the system has stabilized at its normal operating temperature.

BELT ADJUSTMENT

When adjusting a power steering pump belt, never pry against the pump reservoir or pull against the filler neck. To increase belt tension move the pump outward by prying against the bracket pry lugs or against the pump housing casting extension directly behind the pump drive pulley.

A belt that has been previously tensioned is considered to be a used belt and should be tightened to 70 to 80 pounds. A belt that has never been tensioned is considered to be a new belt and should be tightened to 110 to 140 pounds.

Place belt tension gauge (Borroughs Tool BT-33-73F) or equivalent midway between the pulleys on drive belt being checked. If the belt tension is incorrect proceed as follows:

ADJUSTING BELT TENSION

1. When power steering pump is driven by a single belt.

a. Loosen the pump attaching bolts and adjust the belt to correct tension by moving the pump outward, away from the engine.

b. Snug all pump mounting bolts and remove pry bar.

c. Tighten all pump mounting bolts to specified torque.

d. Check belt tension and remove the belt tension gage.

2. When the power steering pump pulley is driven by one primary belt and is used as an idler for a second belt driving some other auxiliary:

a. Follow same checking and adjusting procedure for the primary power steering pump drive belt as for 1 above.

b. Recheck and adjust as necessary the pump belt tension after adjusting tension on belt driving the auxiliary.

OIL LINE FILTER

The steering gear oil is circulated by the pump through the steering gear and the windshield wiper motor before it returns to the pump. In the line at the windshield wiper motor is an oil filter. In the event that the oil pump is overhauled or replaced, this filter should be replaced. For filter replacement procedure, refer to "Windshield Wiper Motor Filter Replacement" of SECTION 1, BODY, HEATING AND AIR CONDITIONING.

STEERING GEAR

GENERAL INFORMATION

The integral power steering gear has an open center, rotary type, three-way control valve, which directs oil to either side of the rack piston. The rack piston converts hydraulic power into mechanical output. The steering gear is mounted on the left frame rail by four mounting bolts. The steering shaft is joined to the steering gear through a flexible coupling, which reduces the transmission of hydraulic noise to the steering wheel.

A constant displacement pump provides hydraulic pressure for the steering system. The pump is a pulley driven vane type having an oil reservoir, which is part of the pump. It is attached to the front of the engine by a bracket, and is belt driven from an engine crank shaft pulley.

OPERATION

NEUTRAL (STRAIGHT AHEAD POSITION)

When turning effort is not being applied at the steering wheel, the slots in the spool valve are positioned so that oil entering the valve body from the housing pressure port passes through the slots in the spool valve to the oil return port in the housing. The chambers at both ends of the rack-piston and around the pitman shaft are always full of oil, which acts as a cushion to absorb road shock so that they are not transferred to the driver. In addition, this oil lubricates all the internal components of the gear.

RIGHT TURN

When the steering wheel is turned to the right, the worm resists being turned because of the resistance offered by the front wheels. The valve body also resists turning because it is pinned to the worm. Driver force exerted at the steering wheel turns the stub shaft and spool valve a slight amount in relation to the valve body because of the twisting action of the torsion bar. This slight amount of turning of the spool valve is sufficient to position the slots in the valve body and spool valve for power assist.

The right turn slots in the spool valve are closed off from the return (wide) slots in the valve body and opened more to the pressure (narrow) slots in the valve body. The left turn slots in the spool valve are closed off from the pressure slots in the valve body and opened more to the return slots in the valve body.

Pressure immediately begins to build up against the lower end of the rack-piston, forcing it upward to apply turning effort to the pitman shaft. The oil in the chamber at the upper end of the rack-piston is then forced out through the valve body and spool valve through the oil return port to the pump reservoir.

The instant the driver stops applying turning effort to the steering wheel, the spool valve is forced back into its neutral position by the torsion bar. Oil pressure on the lower end of the rack-piston then decreases so that pressure is again equal on both sides of the rack-piston, and the front wheels return to the straight ahead position, when the vehicle is moving.

Under normal driving conditions, oil pressure does not exceed 200 psi except when turning corners where it does not ordinarily exceed 450 psi. Oil pressure, when parking, ranges from 900 to 1,300 psi depending upon road conditions and weight of the vehicle. The steering effort during normal driving, ranges from 1 to 2 lbs. and during parking from 2 to 3-1/2 lbs. again depending upon road conditions.

A check valve located under the high pressure connector seat hydraulically dampens the shock transmitted to the steering gear when driving on washboard roads.

LEFT TURN

When the steering wheel is turned to the left, the relationship between the spool valve slots and valve body slots is again changed through twisting of the torsion bar. Pressure immediately builds up against the upper end of the rack-piston, forcing it downward to apply turning effort to the pitman shaft. The oil in the chamber at the lower end of the rack-piston is forced out through the valve body and spool valve to the pump reservoir.

TROUBLE DIAGNOSIS

For complete power steering trouble diagnosis see TROUBLE DIAGNOSIS under POWER STEERING PUMP earlier in this section.

STEERING GEAR REMOVAL

1. Disconnect the power steering hoses from the steering gear and cap the hose fittings.

2. Remove the pitman arm shaft nut. Mark the relation of the pitman arm to the pitman shaft. Disconnect the pitman arm from the pitman shaft using tool number J-24319 or similar puller.

3. Loosen steering shaft yoke cinch bolt.

4. Remove the four bolts attaching the gear to the frame side rail, permit the steering shaft yoke to slide free of the steering gear stub shaft and remove the gear.

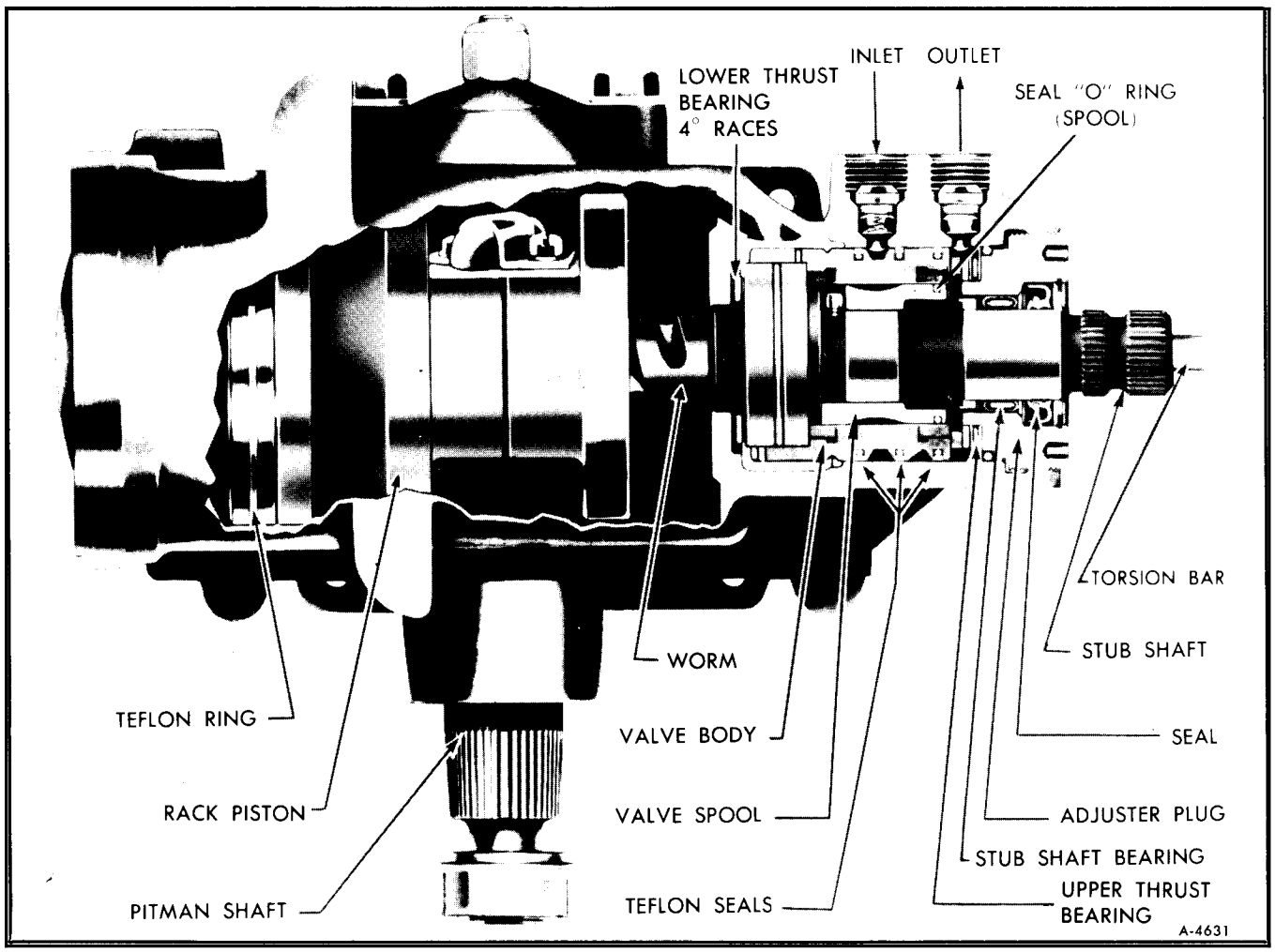
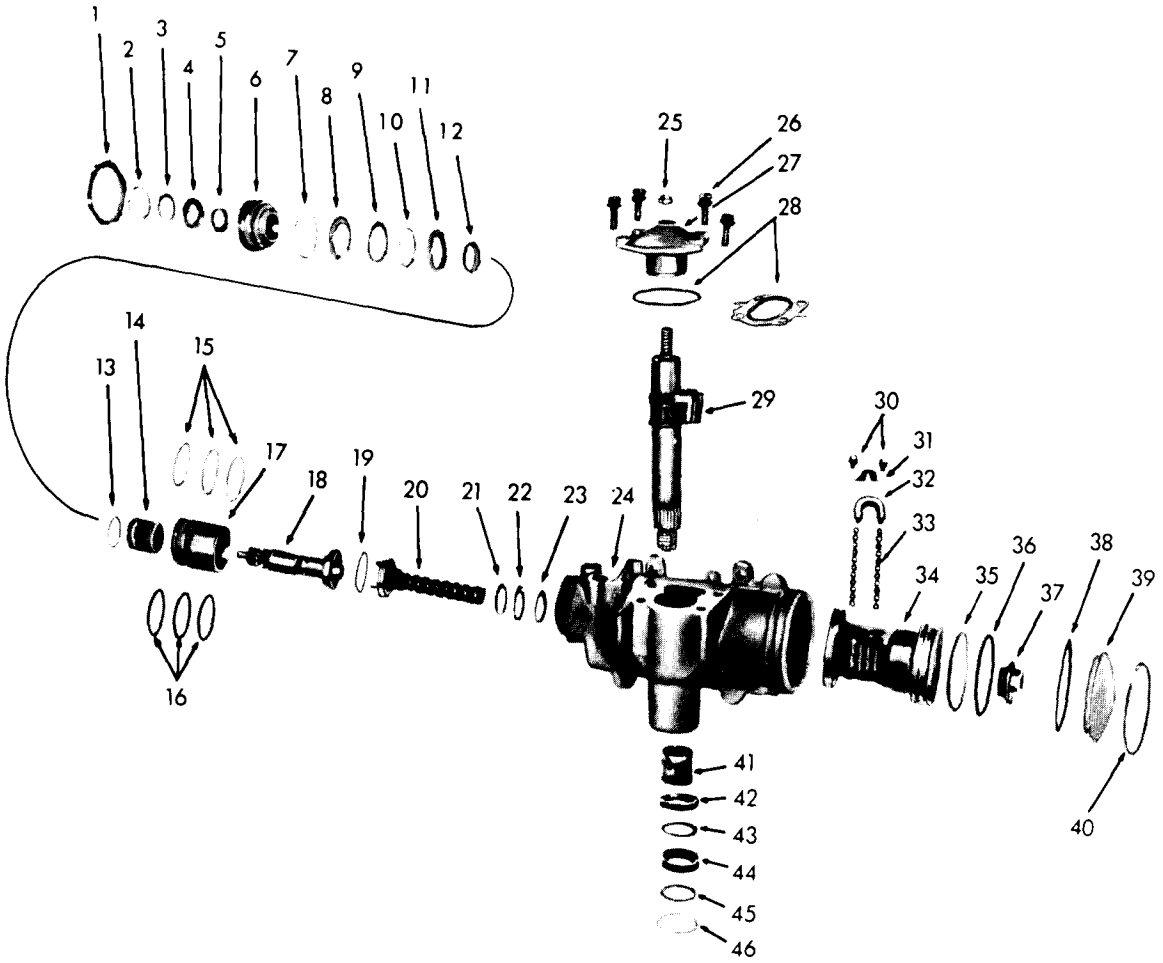


Figure 24—Power Steering Gear



1 Locknut
2 Retaining Ring
3 Dust Seal
4 Oil Seal
5 Bearing
6 Adjuster Plug
7 "O" Ring
8 Thrust Washer (Large)
9 Thrust Bearing
10 Thrust Washer (Small)
11 Spacer
12 Retainer
13 "O" Ring
14 Spool Valve
15 Teflon Oil Rings
16 "O" Rings
17 Valve Body
18 Stub Shaft
19 "O" Ring
20 Wormshaft
21 Thrust Washer
22 Thrust Bearing
23 Thrust Washer
24 Housing
25 Locknut
26 Attaching Bolts and Washers
27 Side Cover
28 "O" Ring
29 Pitman Shaft
30 Screws and Lock Washers
31 Clamp
32 Ball Return Guide
33 Balls
34 Rack-Piston
35 Teflon Oil Seal
36 "O" Ring
37 Plug
38 "O" Ring
39 Housing End Cover
40 Retainer Ring
41 Needle Bearing
42 Oil Seal
43 Back Up Washer
44 Oil Seal
45 Back Up Washer
46 Retaining Ring

A-1505

Figure 25—Steering Gear (Exploded View)

NOTE: If mounting threads are stripped, do not repair. Replace housing.

STEERING GEAR OVERHAUL

Disassembly of the major components within the gear must be performed on a clean work bench. The work area, tools, and parts must be kept clean at all times. Refer to Figures 24 and 25 for parts nomenclature and location.

NOTE: Most service kits are purposely designed to replace not only a worn part, but also adjacent parts which should be replaced at the same time. To ensure an effective repair, use all parts supplied in the kit.

STEERING GEAR DISASSEMBLY

1. Rotate end cover retainer ring so that one end of the ring is over the hole in the side of the housing. Force the end of the ring from its groove and remove ring (figure 26).

2. Turn the coupling flange counter-clockwise until the rack-piston just forces end cover out of housing. Remove cover and discard "O" ring.

CAUTION: *Do not turn stub shaft any further than absolutely necessary to remove the end plug, or balls from rack-piston and worm circuit may escape and lay loose inside the rack-piston chamber.*

3. Remove the rack-piston end plug as shown in Figure 27.

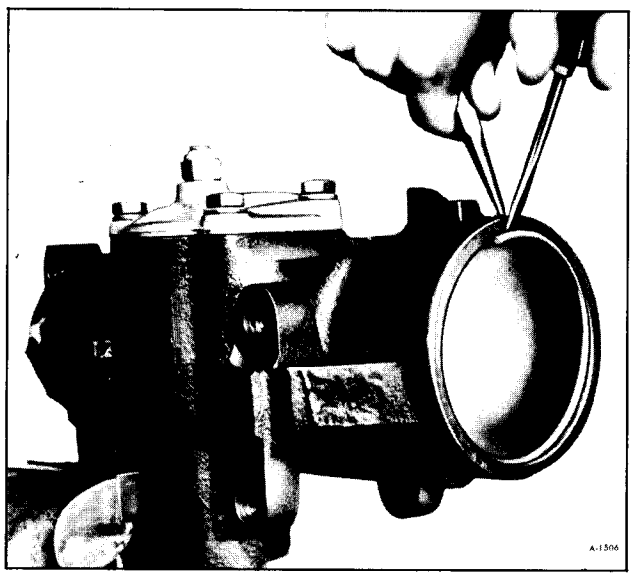


Figure 26—Removing End Cover

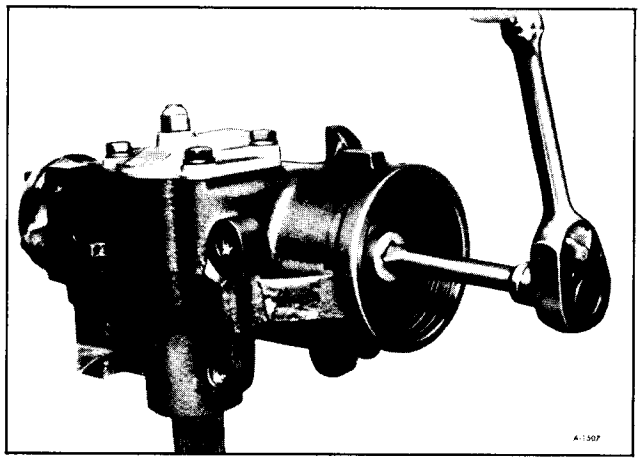


Figure 27—Removing Rack-Piston End Plug

NOTE: To aid in loosening the aluminum end plug (female square drive) strike sharply using 1" or larger diameter brass drift and hammer.

4. Remove the pitman shaft and side cover as follows:

a. Loosen the over-center adjusting screw locknut and remove the four side cover attaching bolts.

b. Rotate the side cover until the rack-piston and pitman shaft teeth are visible, then turn the coupling flange until the pitman shaft teeth are centered in the housing opening. Tap the pitman shaft with a soft hammer and remove the pitman shaft and side cover from the housing. Remove the side cover "O" ring and discard. If gasket seal is used, inspect, discard only if damaged.

5. Remove the rack-piston as follows:

a. Insert Ball Retainer Tool J-21552 into the rack-piston bore with pilot of tool seated in the end of the worm (figure 28). Turn stub shaft counter-clockwise while holding tool tightly against worm. The rack-piston will be forced onto the tool. Hold tool and pull rack-piston farther onto tool to prevent end circuit balls from falling out.

b. Remove the rack-piston with Ball Retainer Tool J-21552 from gear housing.

6. Remove the adjuster plug as follows:

a. Loosen the adjuster plug locknut and remove.

b. Remove adjuster plug assembly with Spanner Wrench J-7624 (figure 29). Remove and discard the adjuster plug "O" ring.

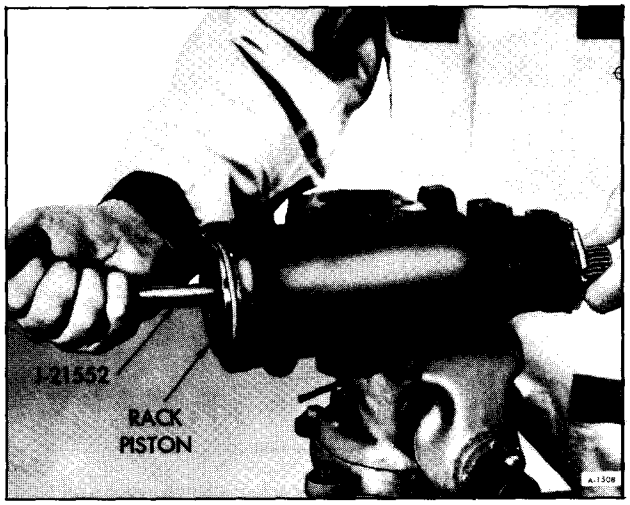


Figure 28—Removing Rack Piston

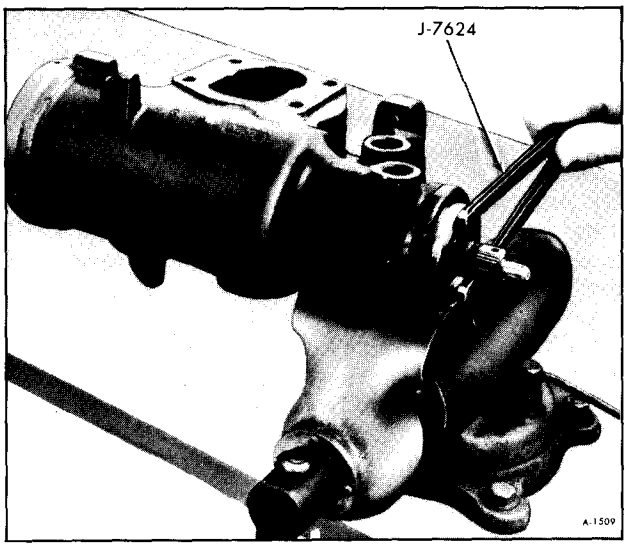


Figure 29—Removing Adjuster Plug

7. Grasp the stub shaft and pull the valve assembly from the housing bore. Separate worm and valve and remove the lower shaft cap "O" ring and discard.

8. If the worm or the lower thrust bearing and race remained in the gear housing, remove them at this time.

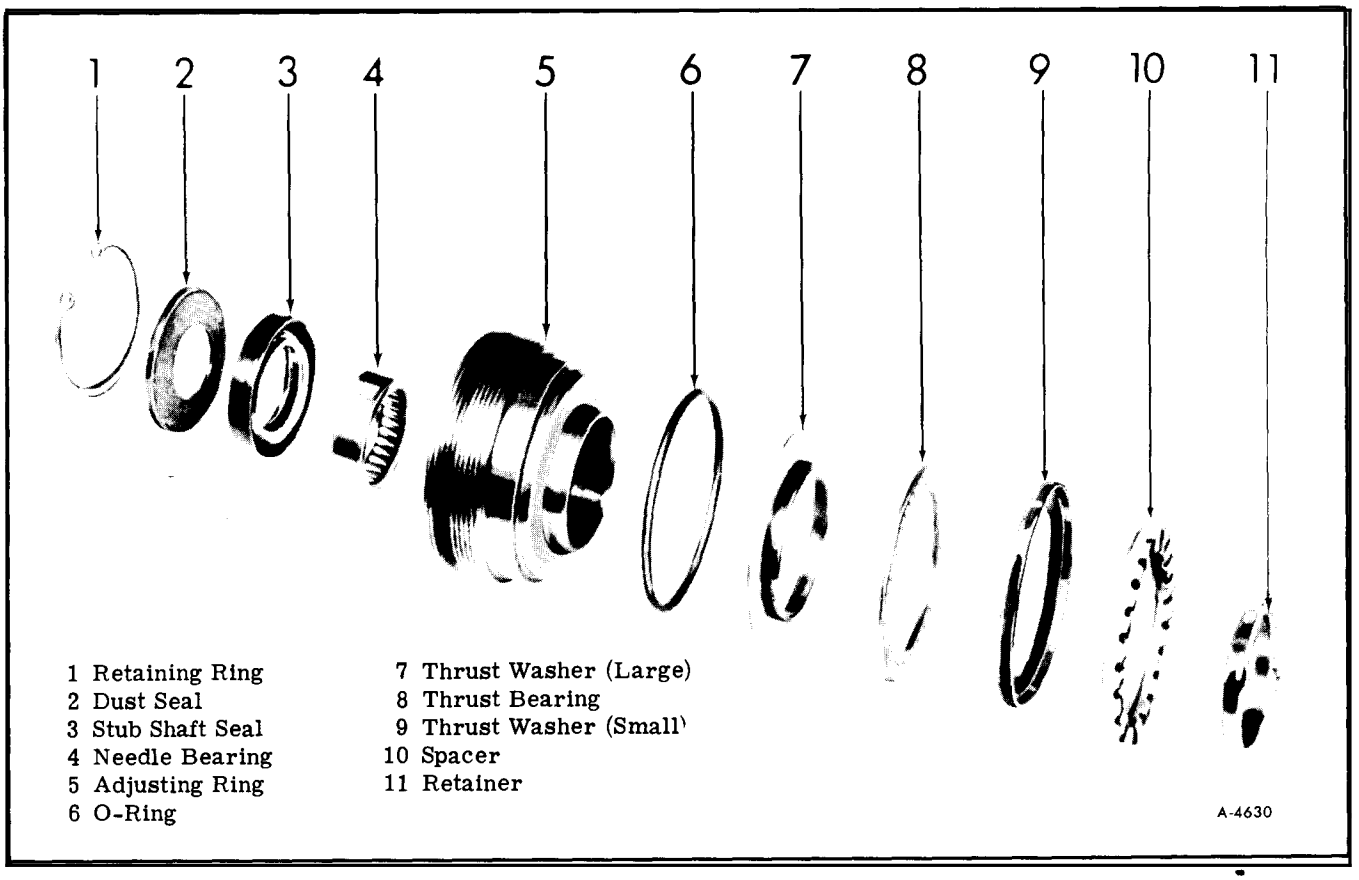


Figure 30—Adjuster Plug (Exploded View)

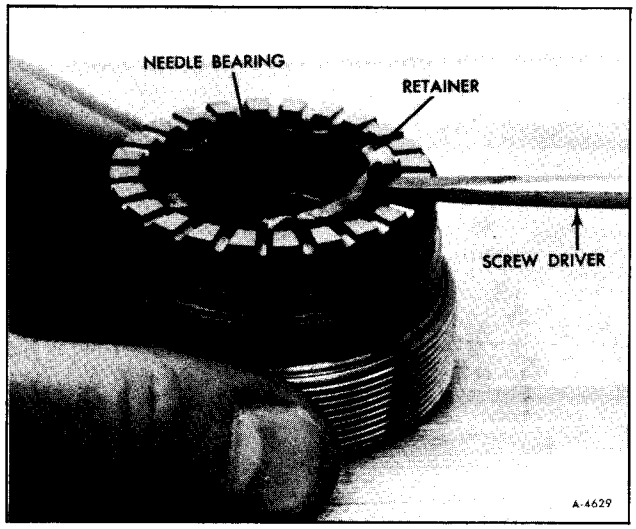


Figure 31—Removing Retainer

ADJUSTER PLUG ASSEMBLY

Disassembly

1. If the oil seal ONLY is to be replaced, and not the needle bearing, install the adjuster plug (figure 30) loosely in the gear housing. Remove the retaining ring with Internal Pliers J-4245. With a screw driver, pry the dust seal and oil seal from the bore of the adjuster plug being careful not to score the seal bore. Discard the oil seal.

2. If ONLY the thrust bearing is to be removed, pry the thrust bearing retainer at the two raised areas with a small screwdriver (figure 31). Remove the spacer, thrust bearing washer, thrust bearing and washer.

3. If the needle bearing is to be replaced, remove the retaining ring using Internal Pliers J-4245. Remove thrust bearing as outlined in Step 2 above. Drive needle bearing, dust seal and oil seal from adjuster plug using Bearing Remover J-8524-2 and Driver J-7079-2 as shown in Figure 32. Discard the seals.

4. Wash all parts in clean solvent and dry parts with compressed air.

5. Inspect thrust bearing spacer for wear or cracks. Replace if damaged.

6. Inspect thrust bearing rollers and thrust washers for wear, pitting or scoring. If any of these conditions exist, replace the bearing, thrust washers, spacer, and retainer.

Assembly

1. If the needle bearing was removed, place new needle bearing over Tool J-8524-1 and J-7079-2, with the bearing manufacturer's identification against the tool, and drive the bearing into the adjuster plug until the tool bottoms in the housing (figure 33).

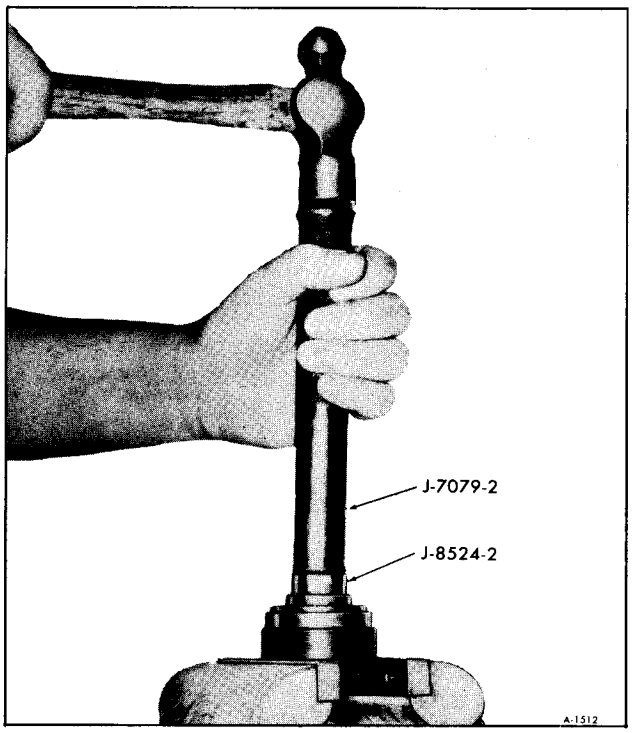


Figure 32—Removing Bearing and Seal

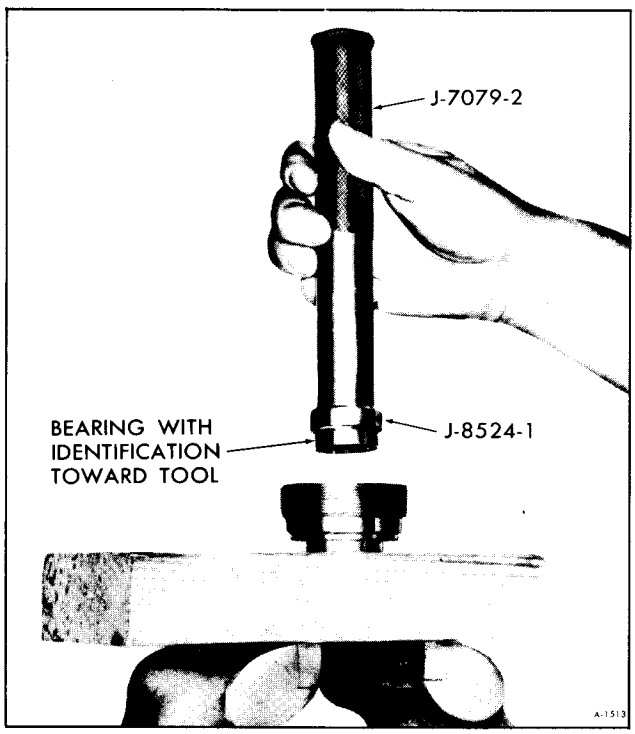


Figure 33—Installing Bearing

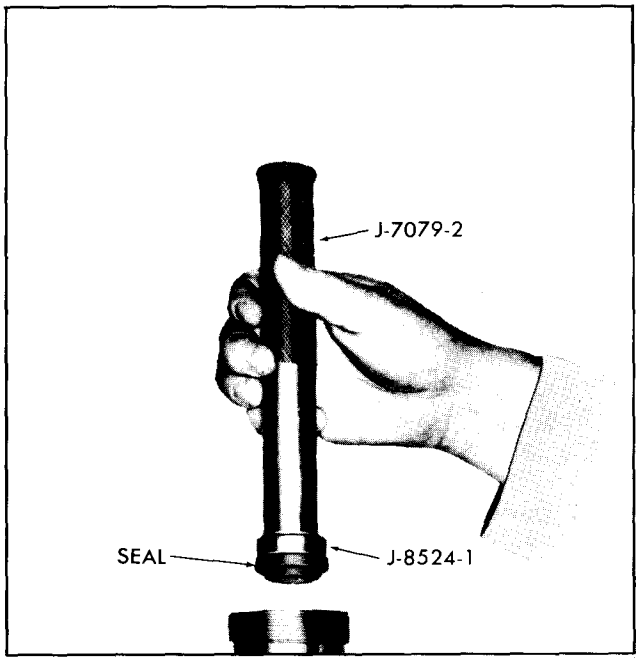


Figure 34—Installing Adjuster Plug Seal

CAUTION: *Place a block of wood under the adjuster plug to protect it during driving of the bearing.*

2. Place dust seal and a new stub shaft seal on Tool J-8524-1 (face of seal with part number against seal). Lubricate seal with Power Steering Fluid and drive or press seals into adjuster plug until seated (figure 34). When properly installed the oil seal is under the dust seal.

3. Install retaining ring with Internal Pliers J-4245.

4. Lubricate the thrust bearing assembly with Power Steering Fluid. Place the flanged thrust bearing race on the adjuster plug hub, then install the upper thrust bearing, small bearing race (flanged edge up) and spacer (grooves of spacer away from bearing washer).

5. Install bearing retainer on the adjuster plug by carefully tapping on the flat surface of the retainer (figure 35).

CAUTION: *The projections must not extend beyond the spacer when the retainer is seated to prevent interference with valve body. The spacer must be free to rotate.*

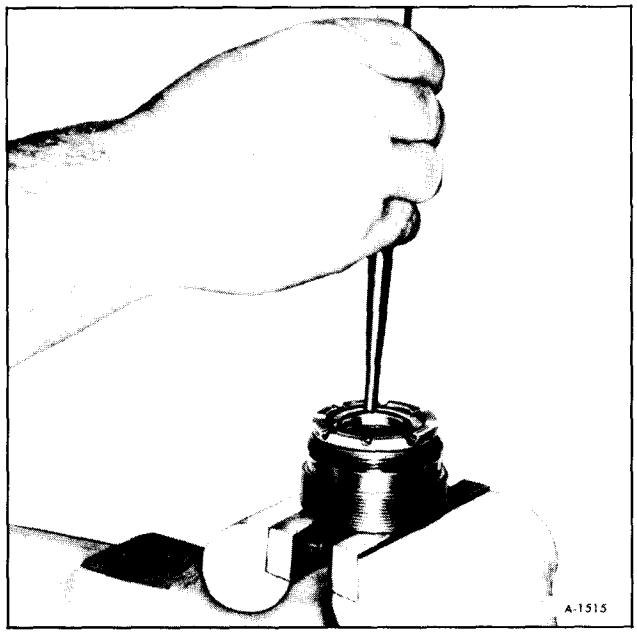


Figure 35—Install Retainer

VALVE AND STUB SHAFT ASSEMBLY

Disassembly

1. Remove and discard "O" ring in the shaft cap end of the valve assembly.

2. To remove the stud shaft assembly from the valve body, proceed as follows:

a. While holding the assembly (stub shaft down), lightly tap the stub shaft against the bench until the shaft cap is free from the valve body (figure 36).

b. Pull the shaft assembly until the shaft cap clears the valve body approximately 1/4".

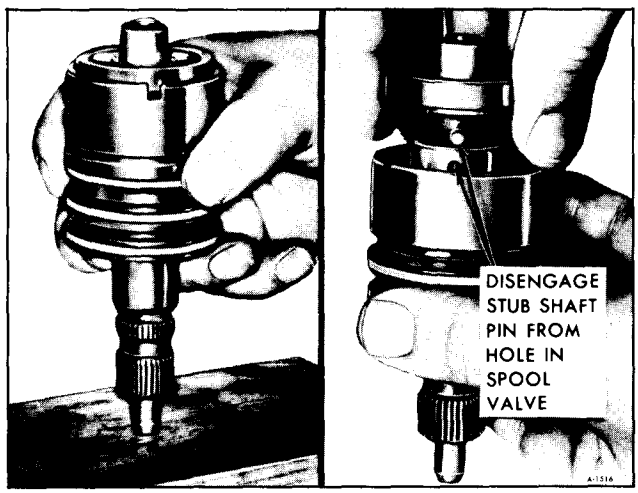


Figure 36—Removing Shaft Cap from Valve Body

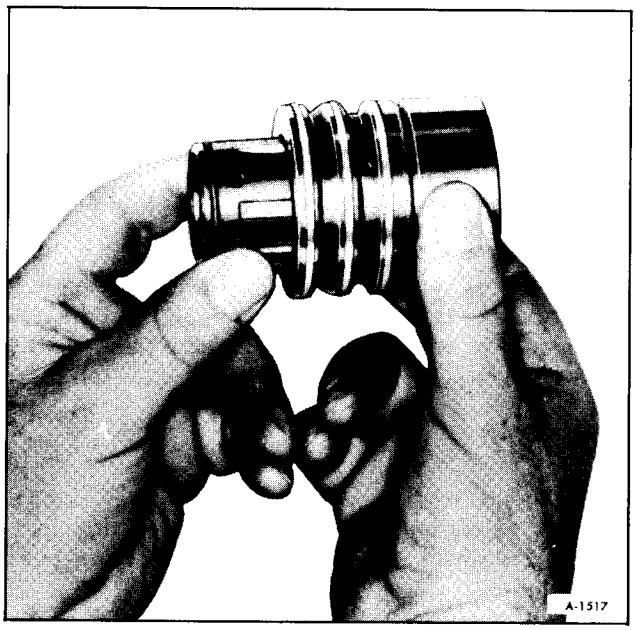


Figure 37—Removing Spool Valve

CAUTION: *Do not pull the shaft assembly out too far or the spool valve may become cocked in the valve body.*

c. Carefully disengage the shaft pin from the valve spool and remove the shaft assembly (figure 36).

3. Push the spool valve out of the flush end of the valve body until the dampener "O" ring is exposed then carefully pull the spool from the valve body, while rotating the valve (figure 37). If the spool valve becomes cocked, carefully realign the spool valve, then remove.

4. Remove the dampener "O" ring from the spool valve and discard.

5. If the teflon oil rings are to be replaced, cut the three teflon oil rings and "O" rings from the valve body and discard.

Cleaning and Inspection (Figure 38)

1. Wash all parts in clean solvent and blow out all oil holes with compressed air.

2. If the drive pin in the stub shaft or valve body is cracked, excessively worn or broken, replace the complete valve and shaft assembly.

3. If there is evidence of leakage between the torsion bar and the stub shaft or scores, nicks, or burrs on the ground surface of the stub shaft that cannot be cleaned up with crocus cloth, the entire valve assembly must be replaced.

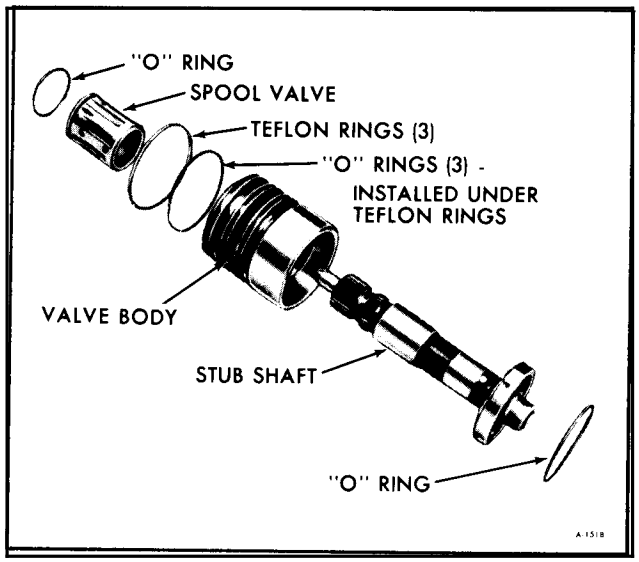


Figure 38—Valve Body and Shaft Assembly

4. Check the outside diameter of the spool valve and the inside diameter of the valve body for nicks, burrs, or bad wear spots. If the irregularities cannot be cleaned up by the use of crocus cloth, the complete valve and shaft assembly will have to be replaced.

5. If the small notch in the skirt of the valve body is excessively worn, the complete valve assembly will have to be replaced. See Figure 39.

6. Lubricate the spool valve with Power Steering Fluid and check the fit of the spool valve in the valve body (with the spool valve dampener "O" ring removed). If the spool valve does not rotate freely without binding, the complete valve and shaft assembly will have to be replaced.

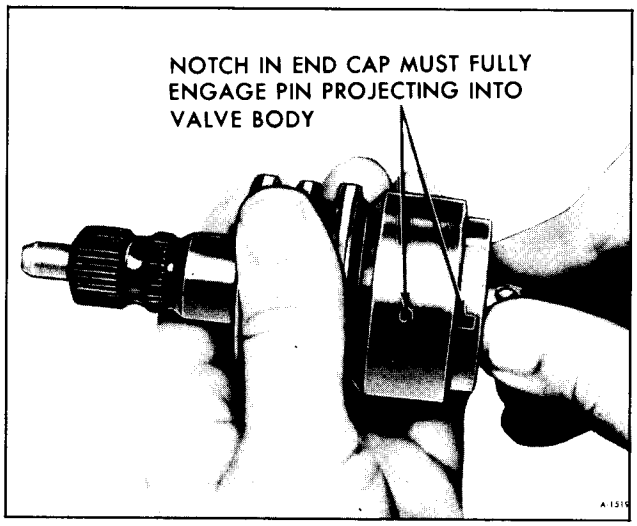


Figure 39—Installing Stub Shaft Assembly

Assembly

1. If valve body "O" rings and teflon rings were removed, install three new "O" rings in the oil ring grooves and lubricate with Power Steering Fluid.

2. Lubricate the three new teflon oil rings with Power Steering Fluid and install in grooves over "O" rings.

NOTE: The teflon rings may appear to be distorted, but the heat of the oil during operation of the gear will straighten them out.

3. Lubricate the spool valve dampener "O" ring with Power Steering Fluid and install over the spool valve.

4. Lubricate the spool valve and valve body with Power Steering Fluid and slide the spool valve into the valve body. Rotate the spool valve while pushing it into the valve body being careful not to cut the dampener "O" ring. Push the spool valve on through the valve body until the shaft pin hole is visible from the opposite end (spool valve flush with shaft cap end of valve body).

5. Lubricate the shaft assembly with Power Steering Fluid and carefully install it into the spool valve until the shaft pin can be placed into the spool valve.

6. Align the notch in the shaft cap with the pin in the valve body and press the spool valve and shaft assembly into the valve body (figure 39).

CAUTION: *Make sure that the shaft cap notch is mated with the valve body pin before installing valve body into the gear assembly to insure proper valve function.*

7. Lubricate a new cap to body "O" ring with Power Steering Fluid and install it in the shaft cap end of the valve body assembly.

PITMAN SHAFT AND SIDE COVER

Disassembly

Remove the locknut and unscrew the side cover from the adjusting screw. Do not attempt to disassemble pitman shaft. Discard locknut.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.

2. Check pitman shaft bearing surface in the side cover for scoring. If badly worn or scored, replace the side cover assembly.

3. Check the sealing and bearing surfaces of the pitman shaft for roughness, nicks, etc. If minor irregularities in surface cannot be cleaned by use of crocus cloth, replace the pitman shaft.

4. Replace pitman shaft assembly if teeth are damaged or if the bearing surfaces are pitted or scored.

5. Check pitman shaft lash adjusting screw. It must be free to turn with no perceptible end play. If adjusting screw is loose replace the pitman shaft assembly.

Assembly

Thread the side cover onto the pitman shaft adjusting screw until it bottoms and then turn in 1/2 turn. Install a new adjusting screw locknut, but do not tighten.

RACK-PISTON

Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.

2. Inspect the worm and rack-piston grooves and all the balls for scoring. If either the worm or rack-piston needs replacing, both must be replaced as a matched assembly.

3. Inspect ball return guide halves, making sure that the ends where the balls enter and leave the guides are not damaged.

4. Inspect lower thrust bearing and washers for scoring or excessive wear. If any of these conditions are found, replace the thrust bearing and washers.

5. Inspect rack-piston teeth for scoring or excessive wear. Inspect the external ground surfaces for wear, scoring or burrs. If any of these conditions exist and are excessive, both the rack-piston and worm must be replaced.

Assembly

1. If the teflon oil seal and "O" ring were removed, lubricate a new "O" ring and seal with Power Steering Fluid and install in groove on rack-piston. The teflon ring may be slightly loose after assembly, but will tighten up when subjected to the hot oil in the system (figure 40).

2. Slide the worm all the way into the rack-piston. It is not necessary to have the thrust bearing assembly on the worm at this time.

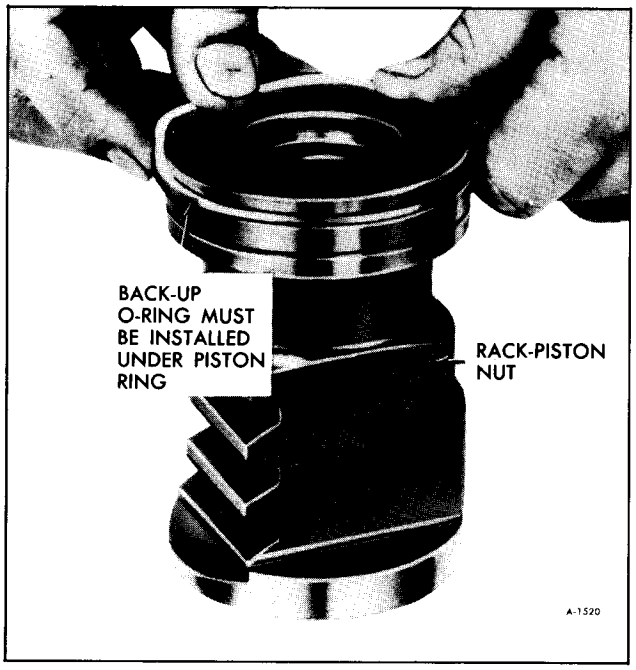


Figure 40—Installing Ring on Rack-Piston

3. Turn the worm until the worm groove is aligned with the lower ball return guide hole (figure 41).

4. Lubricate the balls with Power Steering Fluid, then feed 17 balls into the rack-piston, while slowly rotating the worm counterclockwise.

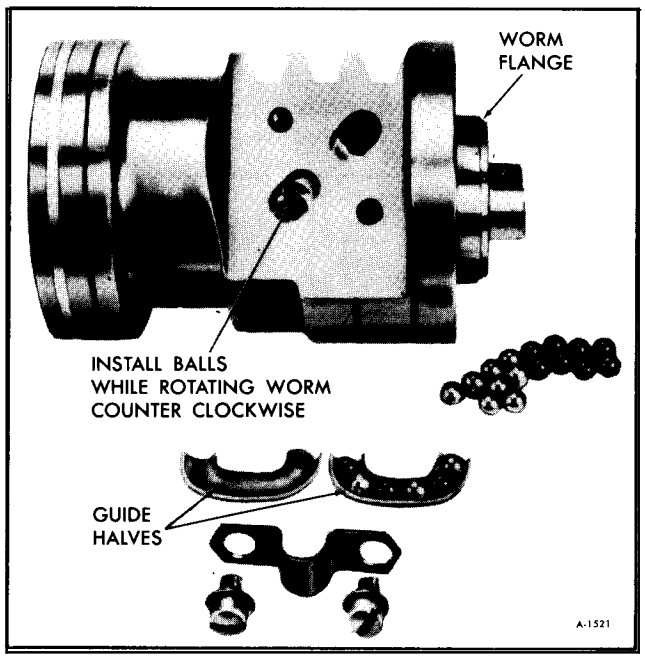


Figure 41—Installing Balls in Rack-Piston

CAUTION: *The black balls are .0005" smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide.*

5. Alternately install five balls into the return guide and retain with grease at each end of guide. Install the return guide clamp and tighten the two clamp screws to six foot pounds.

STEERING GEAR HOSE CONNECTOR AND POPPET CHECK VALVE REPLACEMENT

The following procedure can be performed on vehicle as well as on bench.

1. Disconnect pressure and return line hoses at steering gear and secure hose ends in a raised position to prevent loss of fluid.

2. To prevent metal chips from becoming lodged in valve assembly, pack inside of connector seats of pressure and return ports with petrolatum.

3. Tap threads in connector seats, using a 5/16-18 tap.

CAUTION: *Do not tap threads too deep in pressure hose connector seat as tap will bottom poppet valve against housing and damage it. It is necessary to tap only two or three threads deep.*

4. Thread a 5/16-18 bolt with a nut and flat washer into tapped hole (figure 42).

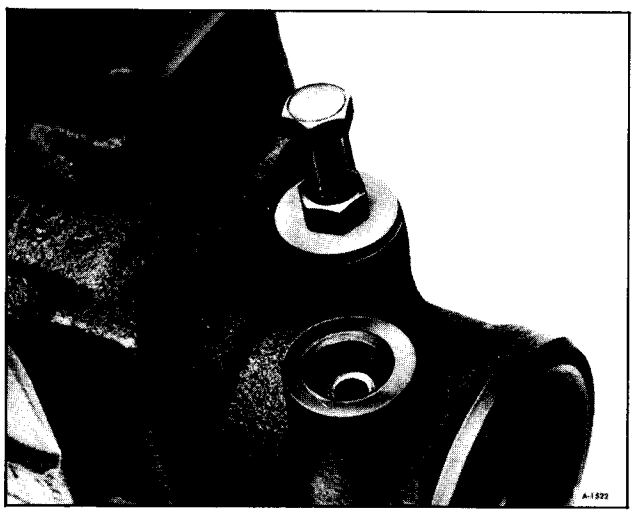


Figure 42—Removing Hose Connector Seat

5. To pull connector seat, hold bolt from rotating while turning nut off bolt. This will pull connector from housing. Discard connector seat.

NOTE: It is also possible to remove connector by using a No. 4 screw extractor. (Easy out).

6. Wipe petrolatum from housing and clean housing thoroughly to remove any metal chips or dirt.

7. Remove poppet check valve and spring from pressure port and discard.

8. Install new check valve spring in pressure port with large end down. Make sure spring is seated in counterbore in pressure port (figure 43).

9. Install new check valve over spring with tangs pointing down. Make sure valve is centered on small end of spring.

10. Install new connector seats, using petrolatum to hold connector seat on check valve in pressure port. Drive connector seats in place using Valve Connector Seat Installer, J-6217 (figure 43).

11. Check operation of valve by pushing lightly against valve with a small punch or small rod. Valve should reseat itself against connector seat when pressure is removed from spring.

12. Connect pressure and return line hoses on steering gear. Tighten hose fittings to 30 foot-pounds.

13. Check fluid level in pump reservoir and add if necessary.

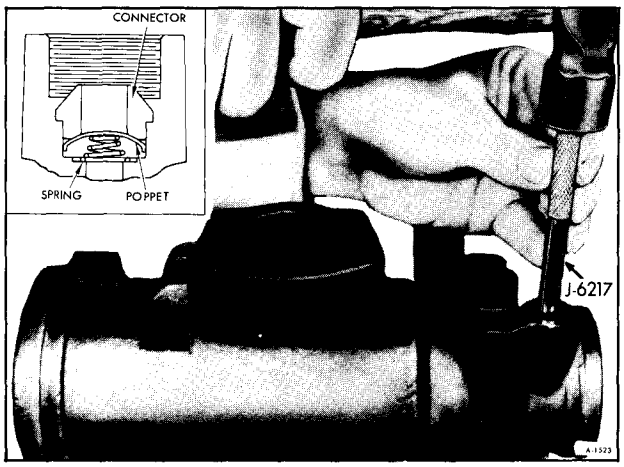


Figure 43—Installing New Connector

Figure 44—Prying Out Inner Seal

PITMAN SHAFT NEEDLE BEARING AND SEALS

Removal

CAUTION: *When prying out seals, be extremely careful not to score the housing bore.*

1. If ONLY pitman shaft seals are to be replaced, remove the seal retaining ring with Internal Pliers J-4245 and remove back-up washer. Using screw driver under lip of seal pry out the outer seal. Remove the back-up washer, then pry out the inner seal (figure 44). Discard seals.

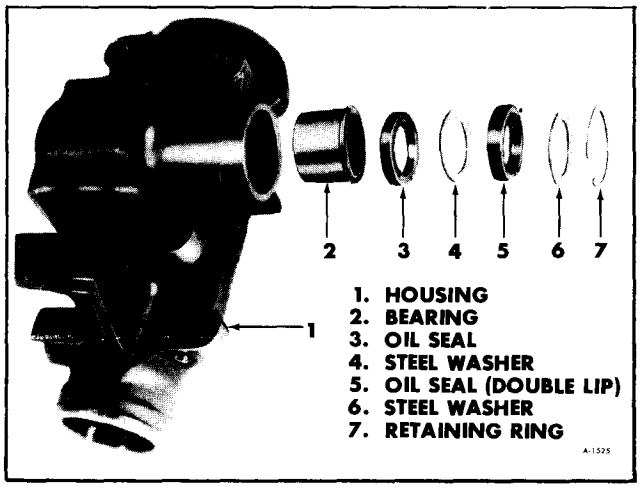


Figure 45—Pitman Shaft Bearing and Seals

2. If pitman shaft needle bearing replacement is necessary, remove with Tool J-6278. Since this bearing is shouldered, it must be pressed out of the pitman shaft end of the housing.

Assembly

1. Thoroughly clean all parts (figure 45) and lubricate with Power Steering Fluid.

2. Install pitman shaft needle bearing on Bearing Installer J-22407, with shoulder on bearing against tool. Position bearing and tool in housing and press bearing into housing until bottom edge of bearing is flush with the inner housing bore surface (figure 46).

CAUTION: *Do not drive the bearing further into the housing after removing Tool J-22407, since damage to the bearing would result.*

3. Lubricate the lips of the oil seals with Power Steering Fluid.

4. Install the pitman shaft oil seals as follows:

a. Place Adapter J-6278-2 over Tool J-6278, then install the outer seal (double lip), backup washer, and inner seal with the lips of the seals facing away from the adapter. (Seal identification toward adapter).

b. Drive the seals into the housing until the top of Adapter J-6278-2 is flush with the housing (figure 47).

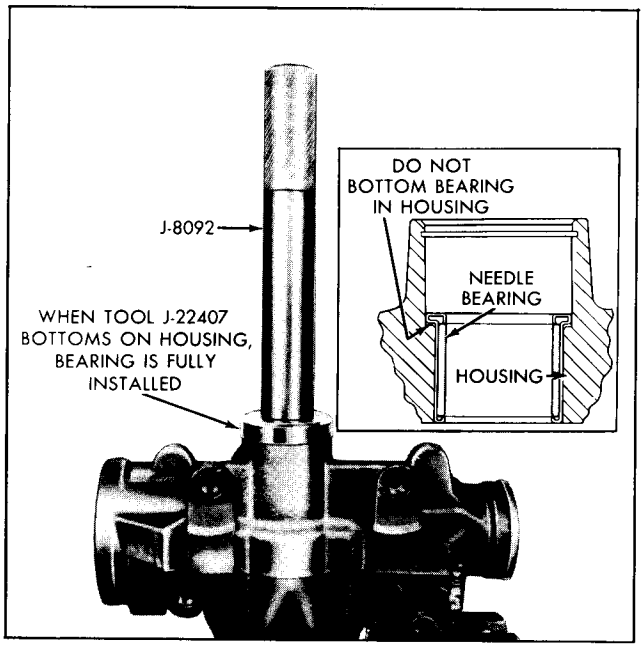


Figure 46—Installing Pitman Shaft Bearing

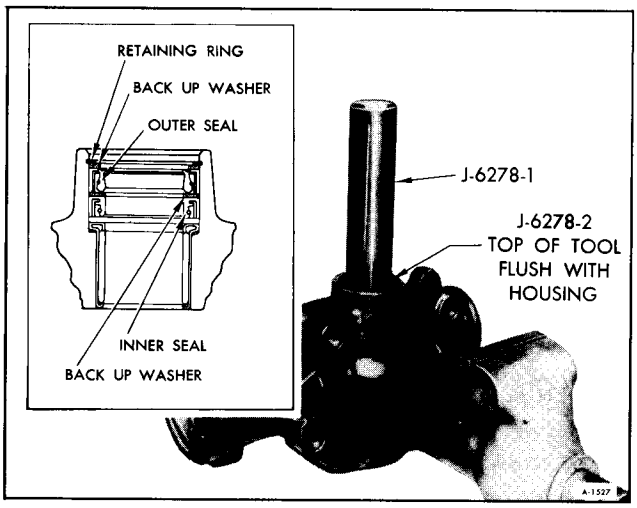


Figure 47—Installing Pitman Shaft Seals

c. Remove the tool and adapter, then install the back-up washer and seal retaining ring. The retaining ring will not seat in the groove at this time.

d. Reinsert Tool J-6278 with Adapter J-6278-2 and continue driving the seals until the retaining ring seats in its groove (Refer to inset , figure 47), then remove the tool and adapter.

REPLACEMENT OF PITMAN SHAFT SEALS WITH STEERING GEAR IN VEHICLE

If oil leaks at the pitman shaft seals, the seals may be replaced without removing the gear assembly from the vehicle as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller J-24319. Do not hammer on end of puller.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

CAUTION: *Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.*

3. Remove pitman shaft seal retaining ring with Snap Ring Pliers J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

CAUTION: *Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out.*

5. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation. Check seal surface of pitman shaft for roughness or pitting. If pitted replace pitman shaft.

6. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

7. Lubricate the seals thoroughly with Power Steering Fluid to install seals with Installer J-6219 (figure 48). Install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the outer seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

8. Fill pump reservoir to proper level with Power Steering Fluid. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks. Add Power Steering Fluid as required.

9. Remove tape and reconnect pitman arm.

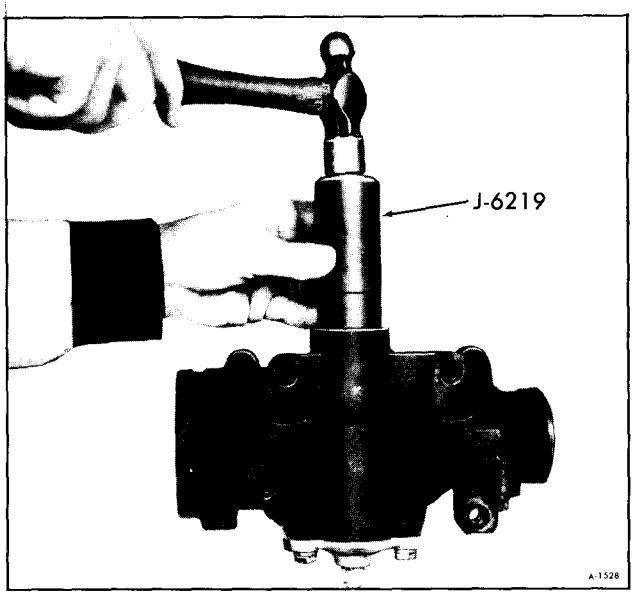


Figure 48—Installing Pitman Shaft Seals

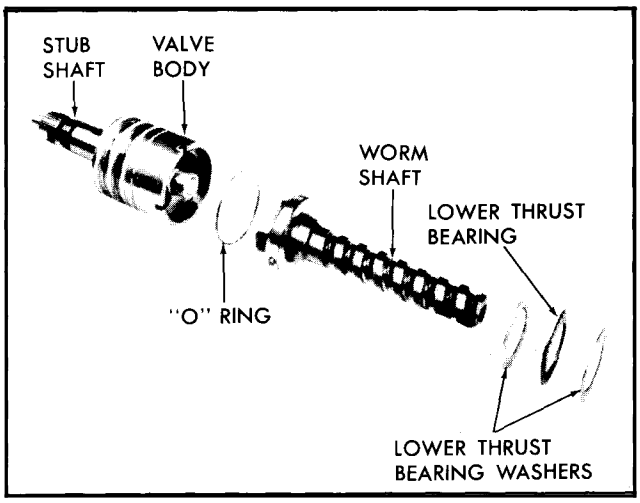


Figure 49—Worm and Valve Body

NOTE: The pitman arm to steering gear nut and washer 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 the same part numbers or with equivalent parts 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.

STEERING GEAR ASSEMBLY

1. Lubricate the worm, lower thrust bearing and the two thrust washers with Power Steering Fluid, then install one thrust washer, the bearing, and the other thrust washer over the end of the worm (figure 49).

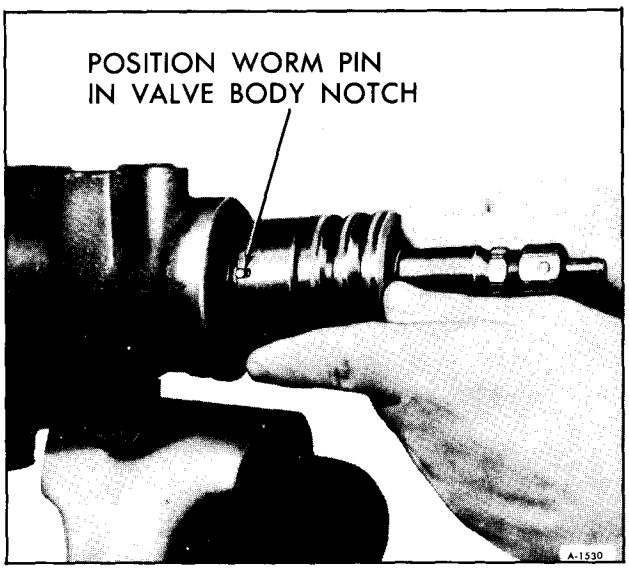


Figure 50—Valve to Worm Alignment

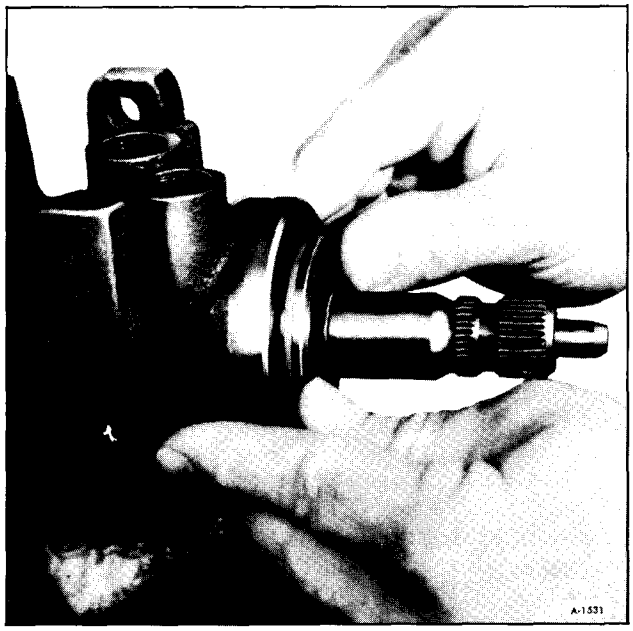


Figure 51—Installing Valve Body

2. Lubricate the valve body teflon rings and a new cap to body "O" ring with Power Steering Fluid. Install the cap to body "O" ring in the valve body so it is seated against the lower shaft cap. Align the NARROW NOTCH in the valve body with pin in the worm, then install the valve and shaft assembly in the gear housing (figure 50). Apply pressure to the VALVE BODY when installing. If pressure is applied to the stub shaft during installation, the shaft may be forced out of the valve body (figure 51).

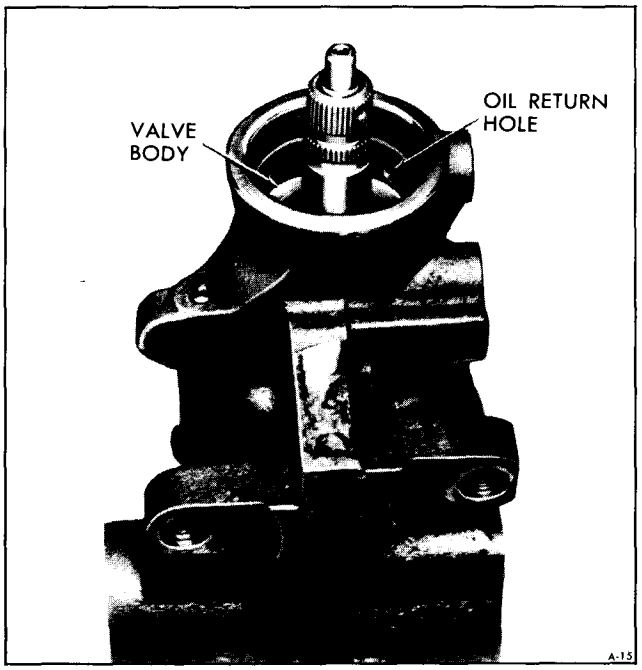


Figure 52—Valve Body in Housing

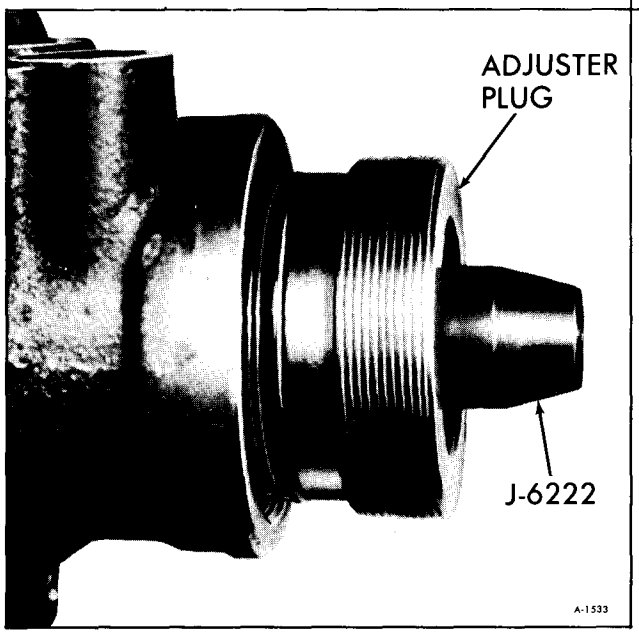


Figure 53—Installing Adjuster Plug

NOTE: The valve body is properly seated when the oil return hole in the housing is entirely uncovered (figure 52).

3. Lubricate a new adjuster plug "O" ring with Power Steering Fluid and install in groove on adjuster plug. Place Seal Protector J-6222 over stub shaft, then install the adjuster plug assembly in the housing until it seats against the valve body (figure 53). Remove Seal Protector.

4. Adjust thrust bearing preload as follows:

a. Using spanner wrench J-7624, turn adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed (approximately 20 ft. lbs.) (figure 58).) b. Place a mark on the housing even with one of the holes in the face of the adjuster plug (figure 59).

c. Measure back (counterclockwise) 1/2 inch and place a second mark on the housing (figure 60).

d. Turn the adjuster plug counterclockwise until the hole in the face of the plug, which was even with the first mark, is even with the second mark (figure 61).

e. Tighten lock nut securely. Hold adjuster plug to be sure that it does not move when the lock nut is tightened (figure 62).

f. Using torque wrench J-7754 with a 3/8"-12 point socket, turn the stub shaft and measure the

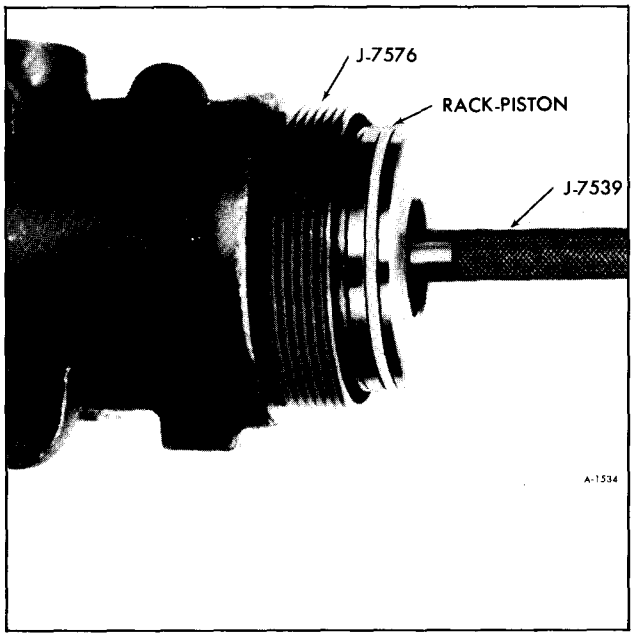


Figure 54—Installing Rack-Piston

torque. Torque reading should be between 4 and 6 in. lbs. If torque is not within these specifications, loosen lock nut and turn the adjuster until the proper torque is obtained. Retighten nut as described in 4e. With adjuster secured in place, coat junction of dust seal and stub shaft with anhydrous calcium based grease (included with repair kits).

5. Install the rack-piston as follows:

a. Lubricate the rack-piston teflon seal with Power Steering Fluid.

b. Position Seal Compressor J-7576 against the shoulder in the housing.

c. With Ball Retainer J-7539 in place in the rack-piston, push the rack-piston (with teeth toward pitman shaft opening), into the housing until Tool J-7539 contacts the center of worm (figure 54).

d. Turn the stub shaft clockwise with a 3/4" twelve point socket or box end wrench to thread the rack-piston onto the worm while holding Tool J-7539 against the end of the worm.

e. When the rack-piston is completely threaded on the worm, remove Ball Retainer J-7539 and Seal Compressor J-7576.

6. Install the pitman shaft and side cover as follows:

a. Install a new "O" ring in the side cover and retain with heavy grease.

b. Turn the stub shaft until the rack-piston teeth are centered in the pitman shaft opening, then install the pitman shaft and side cover so that the center tooth of thepitman shaft engages the center groove of the rack-piston.

c. Install the side cover bolts and tighten to 45 foot pounds.

7. Install the rack-piston plug in the rack-piston and torque to 75 foot pounds.

8. Install a new housing end cover "O" ring and lubricate it with Power Steering Fluid. Install the end cover and retaining ring.

9. Adjust the over-center preload as follows:

a. Make sure the over-center adjusting screw is backed all the way out. Then turned back in 1/2 turn.

b. Install an inch-lb. torque wrench with a 3/4" 12-point socket on the stub shaft splines.

c. Rotate the stub shaft from one stop to the other. Count the number of turns and locate the center of travel, then check the combined ball and thrust bearing preload by rotating the torque wrench through the center of travel. Note the highest reading.

d. Tighten the pitman shaft over center adjusting screw until the torque wrench reads 4-8 in. lbs. (for a "new" gear) or 4-5 in. lbs. (for an "old" gear) higher than the reading noted in step c. The total reading should not exceed 20 in. lbs. (for a "new" gear) or 16 in. lbs. (for an "old" gear).

e. While holding the adjusting screw, tighten the locknut to 35 foot pounds using Adapter J-5860 (figure 55) and recheck the adjustment.

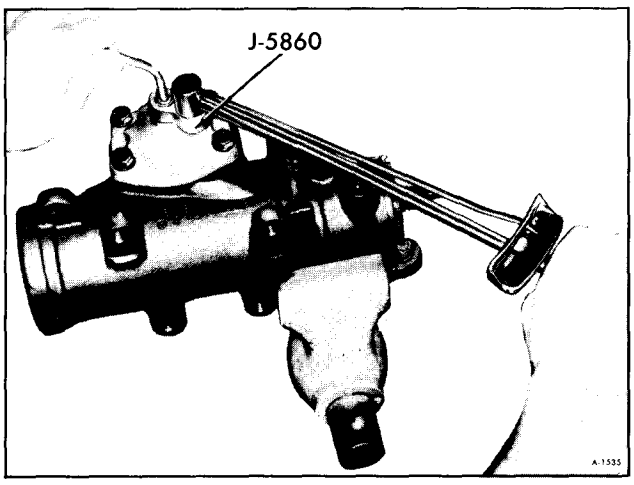


Figure 55—Torquing Over-Center Locknut

STEERING GEAR INSTALLATION

See CAUTION on page 9-1 of this section.

1. Before installing the steering gear, apply a sodium soap fine fiber grease to the gear mounting pads to prevent squeaks between the gear housing and the frame. Make certain there is a minimum of .040" clearance between coupling yoke and steering gear upper seal.

2. Be sure the steering wheel is properly aligned in relation to the wheels, and tighten the yoke cinch bolt to 30 foot pounds. Tighten the steering gear to frame bolts to 70 foot pounds.

3. Install pitman arm on steering gear, secure with nut torqued to 160-210 foot-pounds.

4. Connect fluid pressure lines and bleed system. (Refer to ADJUSTMENTS under POWER STEERING PUMP earlier in this section).

STEERING GEAR ADJUSTMENTS

Adjustment of the steering gear in the vehicle is discouraged 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 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 adjustment error.

Figure 56—Loosening Adjuster Plug Nut

Figure 57—Removing Adjuster Plug Nut

THRUST BEARING ADJUSTMENT

1. Drain power steering fluid from gear by rotating the stub shaft full travel in both directions several times.

2. Loosen and remove adjuster plug locknut (figures 56 and 57).

3. Turn the adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed — approximately 20 ft. lb. (figure 58).

4. Mark the housing even with one of the holes in the adjuster plug (figure 59).

5. Measure back (CCW direction) 1/2 inch and mark housing (figure 60).

6. Rotate adjuster (CCW) until hole in adjuster is in line with second mark (figure 61).

7. Tighten locknut securely. Hold (or have held) adjuster plug to maintain alignment of hole with mark (figure 62).

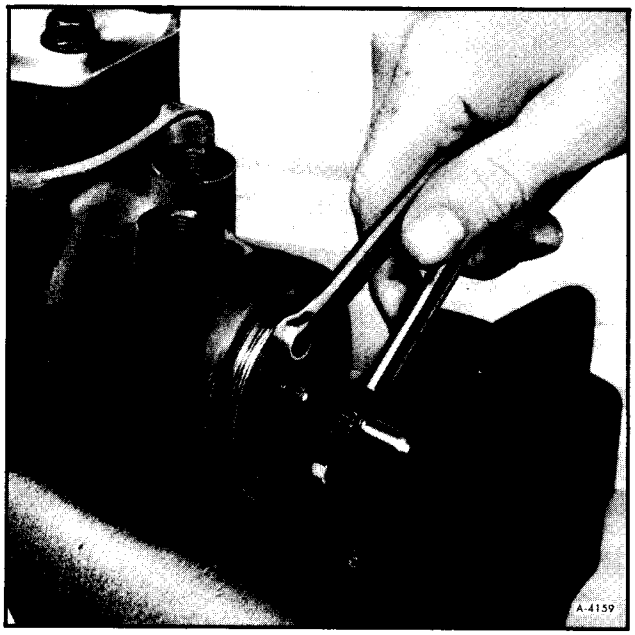


Figure 58—Turning Adjuster Plug

8. Using an in. lb. torque wrench, turn the stub shaft to the right stop and then back 1/4 turn. Measure the torque. Reading should be taken with beam of torque wrench near vertical while turning CCW at an even rate (figure 63). If reading is less than 4, or more than 10 in. lbs., use other adjustment procedure listed.

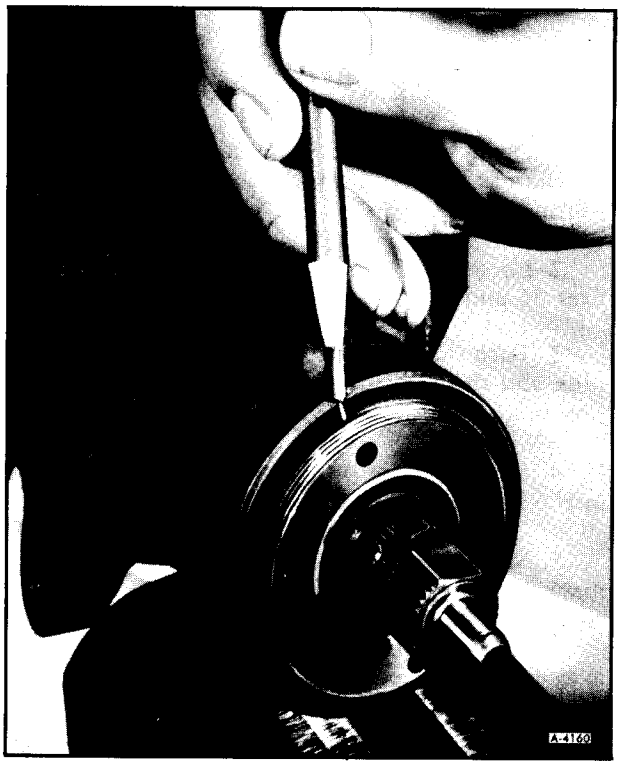


Figure 59—Housing Marks

Figure 60—Marking Rotation Distance

PITMAN SHAFT "OVER-CENTER" SECTOR ADJUSTMENT

1. Using an in. lb. torque wrench, turn the stub shaft to the right stop, then back 1/4 turn. Measure the torque. Reading should be taken with beam of torque wrench near verticle while turning counterclockwise at an even rate (figure 63).

2. Turn the stub shaft from stop to stop, counting the total number of turns. Divide this number by two. Starting at either stop, turn the stub shaft 1/2

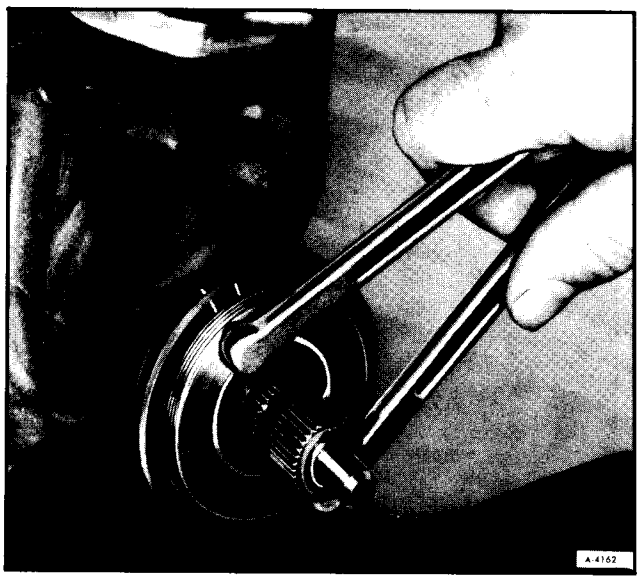


Figure 61—Adjuster Rotation

Figure 62—Tightening Nut

Figure 63—Torque Wrench Reading

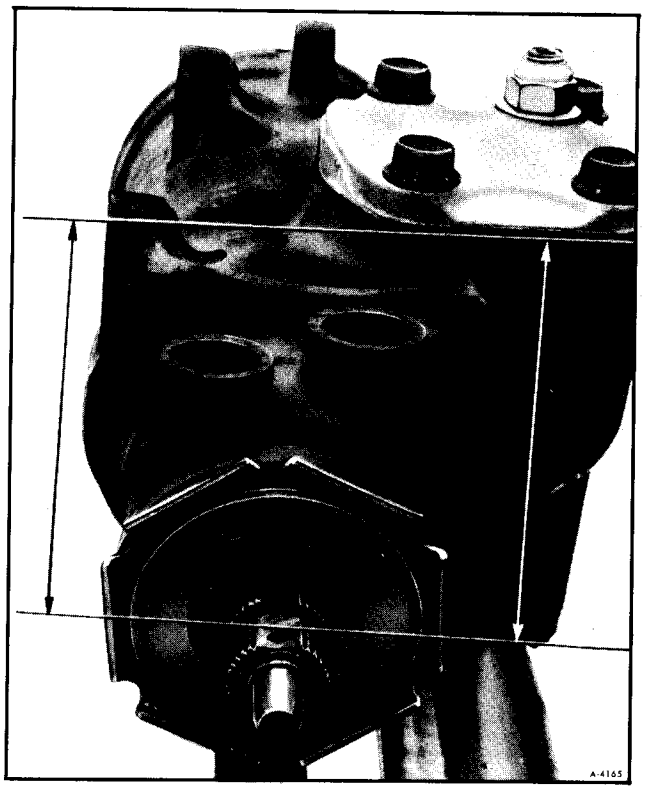


Figure 64—Stub Shaft Flat Alignment

the total number of turns. This is the "center" of the gear. (The flat on the stub shaft is normally up and parallel with the side cover when the gear is "on center" (figure 64) and the block tooth on the pitman shaft is in line with the over-center preload adjuster (figure 65).

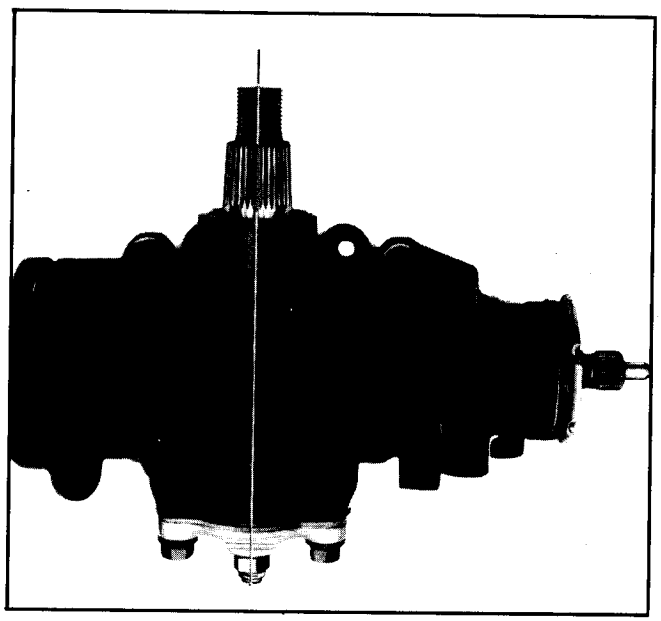


Figure 65—Over-Center Alignment

Figure 66—Torque Wrench Reading

3. Rotate the torque wrench approximately 45 degrees each side of center and "read" near or on center (highest reading) (figure 66). Loosen the locknut and turn the preload adjusting screw CW until the correct "O" center torque, in excess of the reading just taken, is obtained (figure 66).

4. Limits for "new" and "used" gears are different, as follows:

a. "New" gear over-center torque to be 4-8 in. lbs. additional torque.

b. "Used" gear (400 or more miles). Over-center torque to be 4 to 5 in. lbs. additional torque.

Tighten the locknut to 35 ft. lbs. while holding the preload adjuster screw. Recheck the "O" center adjustment.

BLEEDING POWER STEERING SYSTEMS

When a power steering pump or gear has been installed, the air that has entered the system must be bled out before the vehicle is again operated. If air is allowed to remain in the power steering fluid system, noisy and unsatisfactory operation of the system will result. Bleed air from the hydraulic system as follows:

NOTE: Add only new power steering fluid (GM 1050017 or equivalent) to power steering system.

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 and turn wheels right and left on the ground.

9. Check oil level and refill as required.

10. If oil is extremely foamy, allow vehicle to stand a few minutes with engine off and repeat above procedure.

11. 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.

STEERING COLUMN

CAUTION: *All column 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 parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during re-assembly to assure proper retention of these parts.*

GENERAL INFORMATION AND OPERATION

The function locking energy-absorbing steering column includes three important features in addition to the steering function:

I. The column is energy-absorbing, designed to compress up to 8.25 inches in a front-end collision to minimize the possibility of injury to the driver of the vehicle.

II. The ignition switch and lock are mounted conveniently on the column.

III. 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 steering column assembly is used on all vehicles. When a vehicle is being driven, the forward movement of the vehicle and the forward movement of the driver both constitute a form of kinetic energy. When a vehicle is involved in a frontal collision, the primary force (forward movement of the vehicle) is suddenly halted, while the secondary force (the driver) continues its forward direction. A severe frontal collision generally involves these two forces—the primary and the secondary forces. Thesecondary impact occurs when the driver is thrust forward onto the steering wheel and column.

The function locking energy-absorbing column is designed to absorb these primary and secondary forces to the extent that the severity of the secondary impact is reduced.

The tilt function locking columns are designed for ease of entry and driver comfront. These columns have six or seven different steering wheel angle positions.

The tilt mechanism consists of an upper and lower steering shaft assembly with a universal joint between them. A support assembly is held to the mast jacket by a lock plate, and a hearing housing assembly is positioned over the upper steering shaft and secured to the support by two pivot pins. Two lock shoes are pinned to the housing assembly and engage a pin in the support assembly. When the release lever is pulled up and the lock shoes disengage the support pin, the steering wheel is pushed up by a spring compressed between the support and housing assemblies.

The operation of the lock is the same as in other GM vehicles. To start the vehicle, you insert the key in the lock, turn the unit clockwise to "start" and let the switch return to the "on" position. The "off", "lock" and "accessory" positions are also the same as in other GM vehicles When you engage the shift lever in "park" and lock the ignition, the steering wheel locks and the gearshift locks.

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. Overlength 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 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.

STEERING COLUMN TROUBLE DIAGNOSIS

LOCK SYSTEM DIAGNOSIS

Condition	Possible Cause	Correction
Will not unlock.	A. Shear flange on sector shaft collapsed. B. Lock bolt damaged. C. Defective lock cylinder. D. Damaged housing. E. Damaged sector. F. Damaged rack.	A. Replace sector. B. Replace lock bolt. C. Replace lock cylinder. D. Replace housing. E. Replace sector. F. Replace rack.
Will not lock.	A. Lock bolt spring broken or defective. B. Damaged sector tooth. C. Defective lock cylinder. D. Burr on lock bolt or housing. E. Damaged housing. F. Transmission linkage adjustment incorrect. G. Damaged rack. H. Interference between bowl and rack coupling. I. Ignition switch stuck. J. Acutator rod restricted.	A. Replace lock bolt spring. B. Replace sector. C. Replace lock cylinder. D. Remove burr. E. Replace housing. F. Readjust. G. Replace rack. H. Replace bowl or actuator rod as required. I. Replace ignition switch. J. Readjust.
High effort.	A. Lock cylinder defective. B. Ignition switch defective. C. Rack preload spring broken or deformed. D. Burrs on sector, rack, housing, support or acuator rod coupling. E. Bent sector shaft. F. Defective rack. G. Extreme misalignment of housing to cover. H. Distorted coupling slot in rack. I. Bent actuator rod. J. Ignition switch mounting bracket bent.	A. Replace lock cylinder. B. Replace ignition switch. C. Replace preload spring. D. Remove burr. E. Replace shaft. F. Replace rack. G. Replace either or both. H. Replace rack. I. Straighten or replace. J. Straighten or replace.
Will stick in "start".	A. Actuator rod deformed. B. Any high effort condition.	A. Straighten or replace. B. Check items under high effort section.
Key can not be removed in "off-lock".	A. Ignition switch is not set correctly. B. Defective lock cylinder.	A Readjust. B. Replace lock cylinder.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
Lock cylinder can be removed without depressing retainer.	A. Lock cylinder with defective retainer. B. Lock cylinder without retainer. C. Burr over retainer slot in housing cover.	A. Replace lock cylinder. B. Replace lock cylinder. C. Remove burr.

IGNITION SYSTEM DIAGNOSIS

Condition	Possible Cause	Correction
Electrical system will not function.	A. Poor battery connection. B. Connector body loose or defective. C. Defective wiring. D. Defective ignition switch. E. Ignition switch not adjusted properly.	A. Connect securely. B. Tighten or replace. C. Repair or replace. D. Replace ignition switch. E. Readjust.
Switch will not actuate mechanically.	A. Defective ignition switch.	A. Replace.
Switch can not be set correctly.	A. Switch actuator rod deformed. B. Sector to rack en- in wrong tooth.	A. Repair or replace. B. Engage correctly.

STEERING COLUMN

Condition	Possible Cause	Correction
Noise in column.	A. Coupling bolts not tightened. B. Column not correctly aligned. C. Coupling pulled apart. D. Broken lower joint. E. Horn contact ring	A. Tighten pinch bolts to 40-45 foot pounds. B. Realign column. C. Realign column and replace coupling. D. Repair joint using kit #7810077 and realign column. E. Lubricate with lubriplate.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
	not lubricated. F. Lack of grease on bearings or bearing surfaces. G. Loose sight shields. H. Lower shaft bearing worn or broken. I. Upper shaft bearing worn or broken. J. Shaft lock plate cover loose. K. Shaft lock snap ring not seated. L. One click when in "off-lock" position and the steering wheel is moved.	F. Lubricate. G. Bend to eliminate rattle. H. Replace bearing. Check shaft and replace if scored. I. Replace bearing assembly. J. Tighten three screws to 15 in.-lbs., or if missing, replace. **Caution:** Use specified screws. K. Replace snap ring. Check for proper seating in groove. L. Normal—lock bolt is seating.
High steering shaft effort.	A. Column assembly misaligned. B. Improperly installed or deformed dust seal. C. Defective upper or lower bearing. D. Flash on I.D. of shift tube from plastic joint. E. Tight steering universal joint.	A. Realign. B. Install new seal. C. Replace. D. Replace shift tube. E. Repair or replace.
High shift effort.	A. Column not aligned correctly in vehicle. B. Wave washer with burrs. C. Improperly installed dust seal. D. Lack of grease on seal or bearing. E. Improper screws used for ignition switch, neutral start switch or mounting bracket. F. Burr on upper or lower end of shift tube.	A. Realign. B. Replace. C. Remove and replace. D. Lubricate. E. Use correct fasteners. F. Remove burr.
Improper transmission shifting.	A. Sheared shift tube joint or lower shift lever weld. B. Improper transmission linkage adjustment.	A. Replace tube assembly. B. Readjust.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
Miscellaneous.	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.
Lash in mounted column assembly.	A. IP to column bracket mounting bolts loose. B. Broken weld nuts on jacket. C. IP bracket capsule sheared. D. Loose shoes in housing. E. Loose tilt head pivot pins. F. Loose shoe lock pin in support. G. Loose support screws. H. Column bracket to jacket bolts loose.	A. Tighten to 20 foot pounds. B. Replace jacket assembly. C. Replace bracket assembly. D. Replace shoes. E. Replace pivot pins. F. Replace pin. G. Tighten to 60 in.-lbs. H. Tighten to 15 foot pounds.
Housing scraping on bowl.	A. Bowl bent or not concentric with hub.	A. Replace bowl.
Steering wheel loose.	A. Excessive clearance between holes in support or housing and pivot pin diameters. B. Defective or missing anti-lash spring in spheres. C. Upper bearing not seating in bearing. D. Upper bearing inner race seat missing. E. Improperly adjusted tilt locking knob. F. Loose support screws. G. Bearing preload spring missing or broken.	A. Replace either or both. B. Add spring or replace both. C. Replace both. D. Install seat. E. Readjust. F. Tighten 60 in.-lbs. G. Replace preload spring.
Steering wheel loose—every other tilt position.	A. Loose fit between shoe and shoe pivot pin.	A. Replace both.
Steering column not locking in any tilt position.	A. Shoe seized on its pivot pin. B. Shoe grooves may have burrs or dirt. C. Shoe lock spring weak or broken.	A. Replace both. B. Replace shoe. C. Replace lock spring.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
Steering wheel fails to return to top tilt position.	A. Pivot pins are bound up. B. Wheel tilt spring is defective. C. Turn signal switch wires too tight.	A. Replace pivot pins. B. Replace tilt spring. C. Readjust.
Noise when tilting column.	A. Upper tilt bumpers worn. B. Tilt spring rubbing in housing.	A. Replace tilt bumper. B. Lubricate.

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 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.).

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
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. No foreign material impeding function of hazard switch—replace turn signal switch.
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. B. Replace turn signal flasher. C. Connect securely. 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.	A. Replace turn flasher. Note: There are two flashers in the system. Consult manual for location.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
	B. Loose chassis to column connection.	B. Connect securely.
	C. Inoperative turn signal switch.	C. Replace 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.	D. Replace signal switch.
	E. If the vehicle's lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.	E. Repair chassis wiring as required using manual as guide.
Front or rear turn signal lights not flashing.	A. Burned out or damaged turn signal bulb.	A. Replace bulb.
	B. High resistance connection to ground at bulb socket.	B. Remove or repair defective connection.
	C. Loose chassis to column connector.	C. Connect securely.
	D. 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.	D. Replace turn signal switch.
	E. If vehicle lights do not operate, check chassis wiring harness to light sockets for opens, grounds, etc.	E. Repair chassis wiring as required using manual as guide.
Stop light not on when turn indicated	A. Loose column to chassis connection.	A. Connect securelv.
	B. 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.	B. Replace signal switch.
	C. If brake lights do not work check connector to stop light sockets for grounds, opens, etc.	C. Repair connector to stop light circuits using manual as guide.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
Turn indicator panel lights not flashing.	A. Burned out bulbs. B. High resistance to ground at bulb socket. C. Opens, grounds in wiring harness from front turn signal bulb socket to indicator lights.	A. Replace bulbs. B. Replace socket. C. Locate and repair as required. Use shop manual as guide.
Turn signal lights flash very slowly.	A. Inoperative turn signal flasher. B. System charging voltage low. C. High resistance ground at light sockets. D. Loose chassis to column connection. E. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective. F. If the flashing rate still extremely slow, check chassis wiring harness from the connector to light sockets for grounds, high resistance points, etc.	A. Replace turn signal flasher. B. Increase voltage to specification. Use manual. C. Repair high resistance grounds at light sockets. D. Connect securely. E. Replace signal switch. F. Locate and repair as required. Use manual as guide.
Hazard signal lights will not flash—turn signal functions normally.	A. Blown fuse. B. Inoperative hazard warning flasher. C. Loose chassis to column connection. D. Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is defective.	A. Replace fuse. B. Replace hazard warning flasher. C. Connect securely. D. Replace the turn signal switch.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
	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.	E. Replace fuse block.

KEY BUZZER DIAGNOSIS

Condition	Possible Cause	Correction
Buzzer does not sound with key fully inserted in lock cylinder with the entrance door open.	A. Defective buzzer.	A. Replace buzzer.
	B. Bad connection at buzzer.	B. Connect securely.
	C. Power not available to buzzer.	C. Check continuity of chassis wiring and repair as required.
	D. Door jamb switch misadjusted or inoperative.	D. Readjust or replace—as required.
	E. Short in chassis wiring.	E. Check by separating chassis to column connector. Connect "E" (black) and "F" (black w/pink stripe) female contacts on the chassis side (figure 67). Bent paper clip will work if buzzer sounds. continue diagnosis. If not, locate, and repair chassis wiring, use manual as guide.

NOTE 1: If the buzzer fault has not yet been detected, connect a continuity meter (light) to the male "E" and "F" connector contacts (figure 68). Insert the key the full depth into the lock cylinder.

If contact is made with the key in, and is not made with it out, the function is normal. Retrace initial diagnostic steps.

If contact is not established, the fault is in the column. Proceed to Note 2.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
NOTE 2: With the fault isolated in the column, disassemble the upper end of the column until the signal switch mounting screws have been removed. Lift the switch and check the probes of the buzzer switch to insure good contact with the pads on the signal switch. Bend probes, if required, then reseat the signal switch and drive the three screws. Check the function, as in Note 1.		
Buzzer does not sound with key fully inserted in lock cylinder with the entrance door open.	F. Short or fault in signal switch wiring.	F. Connect male "E" and "F" contacts of connector with jumper (figure 69). Check buzzer switch pads with continuity meter. If contact is made, function is normal. If not, replace signal switch.
NOTE 3: If the fault has not yet been isolated and repaired, connect a continuity meter to the buzzer switch probes (figure 70). Fully insert and remove the key from the lock cylinder. If contact is made with the key in, and is broken with it out, the function is normal. Retrace diagnostic steps starting at Note 2. If contact is not made, the fault is in the lock cylinder or buzzer switch.		

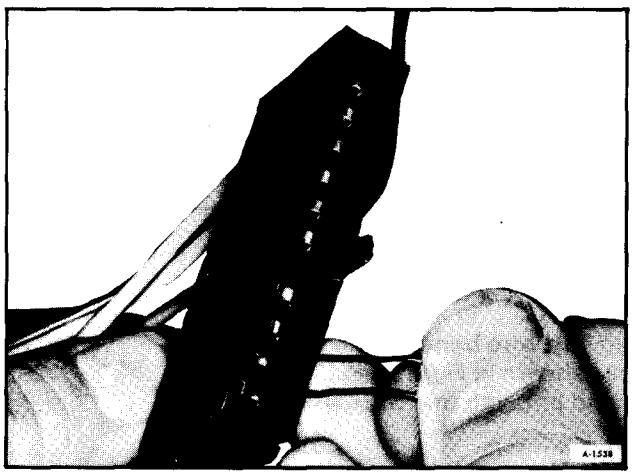


Figure 67—Checking For Short In Chassis Wiring

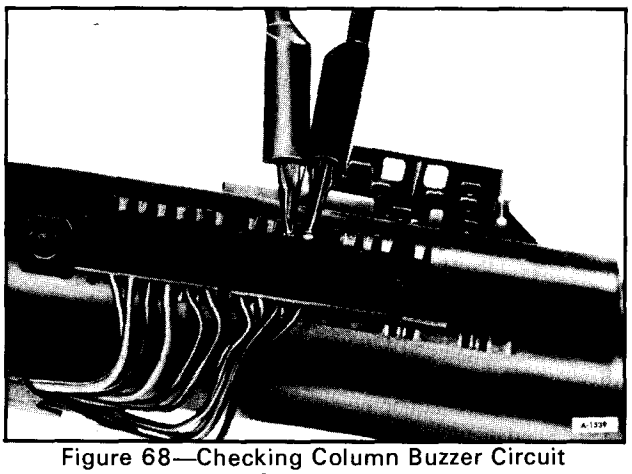


Figure 68—Checking Column Buzzer Circuit Continuity

Figure 69—Checking Buzzer Switch Pads

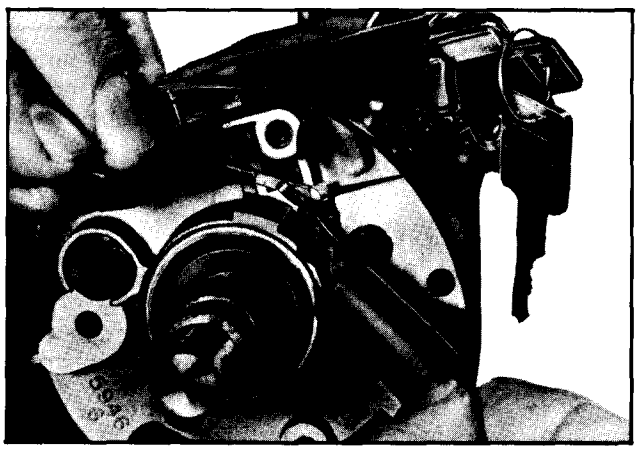


Figure 70—Checking Buzzer Switch Continuity

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
Buzzer does not sound with the key fully inserted in lock cylinder with the entrance door open.	G. Chips, burrs, foreign material preventing actuator tip function. **Caution:** Key must be removed or cylinder in "run" position before removing lock cylinder.	G. Remove chips, burrs, etc. Reassemble and re-check ref. note 3.
	H. Defective lock	H. With the lock cylinder out (observing caution under G), fully insert and remove the key. The actuator (figures 71 and 72) should extend and retract smoothly. Total extension of tip should be .050 in. If not, replace lock cylinder.
	I. Chips, foreign material affecting buzzer switch operation.	I. Remove and clean as required—reassemble and re-check per note 3.
	J. Damaged or broken buzzer switch.	J. Replace buzzer switch.
	K. Switch appears good but will not make buzzer switch function check.	K. Connect continuity meter leads to the buzzer switch probes. Press on the actuator pad until the interior points contact. (figure 73). If contact is not made, replace buzzer switch.
	L. Buzzer switch contact gap too large.	L. Reset contact gap.

NOTE 4: Setting the contact gap. Press a .030 wire type spark plug gap wire with flat piece of stock on the actuator pad. (figure 74) If contact is not made adjust switch as shown in Figure 75, until positive contact is made. (Use continuity meter).
With positive contact at .030, use a .025 plug gap wire beneath the flat stock (figure 76). No contact should occur. Adjust as shown in Figure 77. When the switch will make contact with the .030 wire and not with the .025, the buzzer switch is set at the low limit.

Condition	Possible Cause	Correction
Buzzer continues to operate with key in the lock cylinder with the entrance door either opened or closed and ceases when key is removed.	A. Door jamb switch misadjusted or inoperative. or inoperative.	A. Adjust or replace as required.
	B. Wire from signal switch to door jamb switch shorted.	B. If on signal switch side, replace signal switch. If on chassis side, find and repair—use manual.

NOTE 5: This condition indicates the lock cylinder or buzzer switch is at fault. To verify, check for continuity at the "E" & "F" male connector contacts with the key removed from the cylinder (figure 68). If continuity exists, the fault is in the column.

STEERING COLUMN TROUBLE DIAGNOSIS (Cont'd.)

Condition	Possible Cause	Correction
Buzzer continues to operate with key out, but stops when door is closed.	A. Turn lock towards "start" position if buzzer stops in "run" position or when turned past "run" towards "start", the problem is a sticky lock cylinder actuator.	A. Replace lock cylinder.
	B. Chips, foreign material in lock cylinder bore.	B. Remove, reassemble and recheck function.
	C. Sticky lock cylinder actuator tip.	C. Replace lock cylinder.
	D. Damaged or broken buzzer switch.	D. Replace buzzer switch.
	E. Buzzer switch contact gap too close.	E. Adjust as specified.

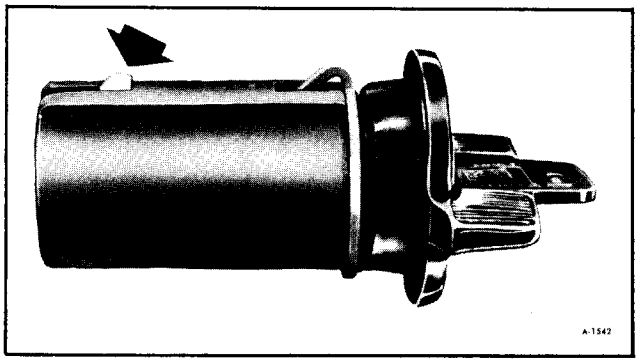


Figure 71—Actuator Extended

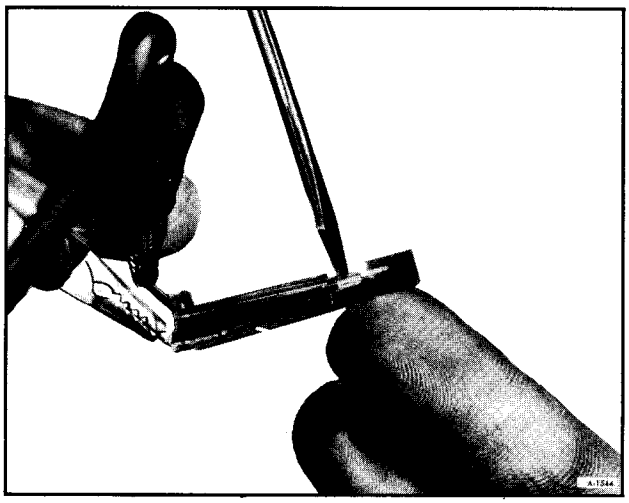


Figure 73—Checking Buzzer Switch Continuity

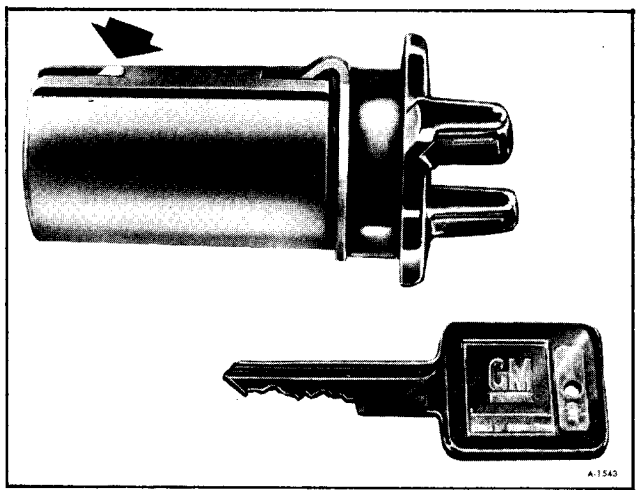


Figure 72—Acutator Retracted

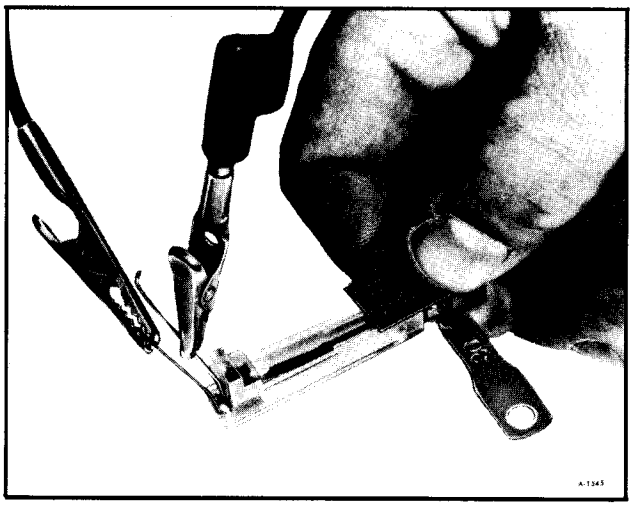


Figure 74—Checking Contact Gap

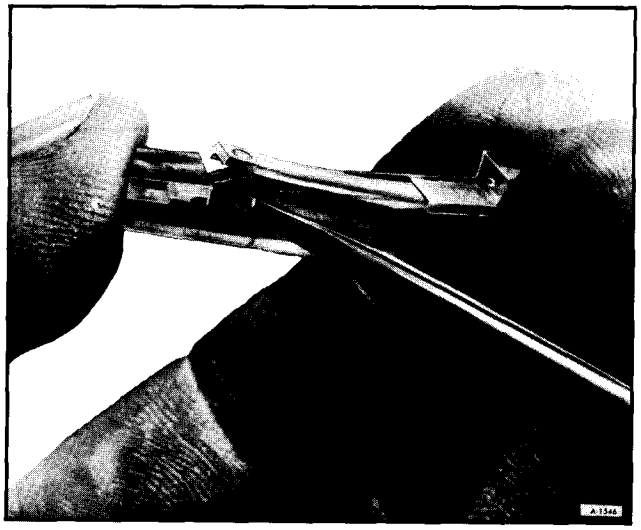


Figure 75—Adjusting Buzzer Switch

REMOVAL OF STEERING COLUMN

NOTE: Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections which maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller. Under no conditions should the end of the shaft be hammered upon as hammering could loosen plastic injections which maintain column rigidity.

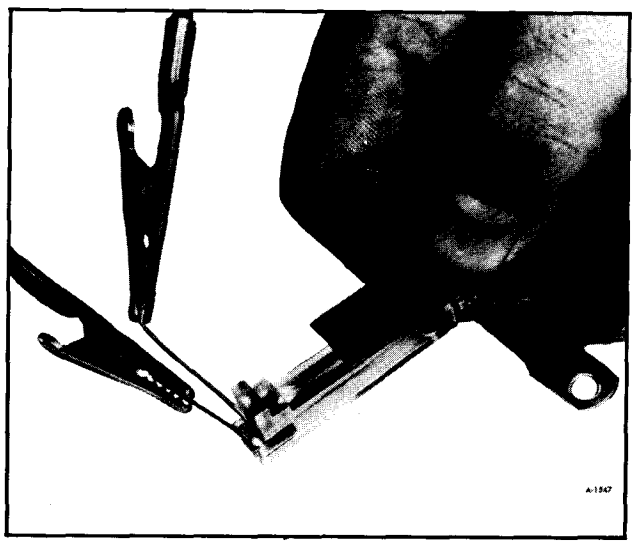


Figure 76—Checking Contact Gap

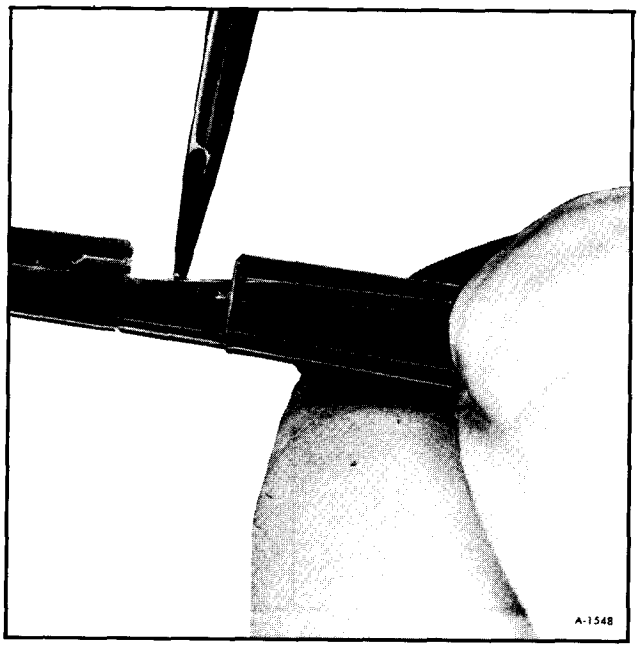


Figure 77—Adjusting Buzzer Switch

1. Disconnect column from lower steering shaft at cinch clamp.

2. Disconnect the shift linkage from the shift lever.

3. Remove screws securing toe pan cover to firewall and loosen cover.

4. Remove bolts securing bracket to instrument panel and disconnect "PARK RNDSL" pointer on the automatic shift column.

5. Disconnect all electrical connectors from the steering column assembly. Carefully withdraw column.

TILT COLUMN OVERHAUL

DISASSEMBLY OF STEERING COLUMN

1. Disconnect column from lower steering shaft at cinch clamp.

2. Remove column mounting bracket from column and SET ASIDE TO PROTECT BREAKAWAY CAPSULES.

3. Mount assembly in vise using tool No. J-23074.

4. Remove steering wheel using wheel puller. DO NOT HAMMER ON END OF STEERING SHAFT.

Figure 78—Removing Wire Protector

5. Remove signal switch wire protector. DO NOT DAMAGE WIRES. (figure 78). Wrap a piece of tape around the upper connector and wires to prevent snagging when removing the switch. (figure 79)

6. Remove three cover screws. Remove shaft lock cover.

7. Remove tilt release lever and signal switch lever. Push hazard warning plunger in and remove hazard warning knob. Remove upper shift lever from bowl. Remove indicator wire, if automatic transmission column. Remove neutral start switch.

8. Depress lock plate with finger and pry retaining ring out of groove with screwdriver (figure 81). Tool J-23653 can be used (figure 80) but the full load

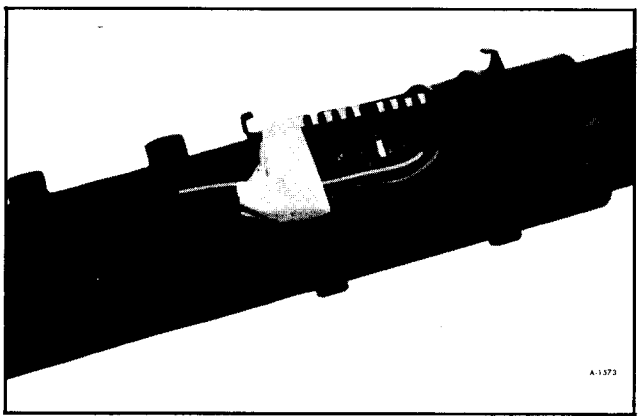


Figure 79—Connector and Wires Taped

Figure 80—Removing Retaining Ring

of the upper bearing spring should not be relieved as then the retaining ring will turn easily making removal more difficult. Remove lock plate, cancelling cam and upper bearing spring.

9. Remove the three signal switch mounting screws.

10. Position shift bowl in "low" shift position. Pull the switch straight up (figure 82).

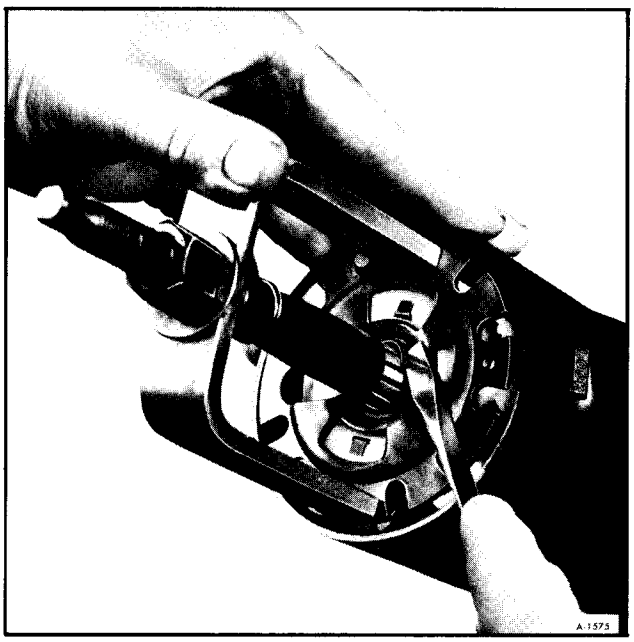


Figure 81—Using Tool to Remove Retaining Ring

Figure 82—Removing Signal Switch

11. The lock cylinder should be removed in the "Run" position.

12. Insert a thin tool (small screw driver or knife blade) into the slot next to the switch mounting screw boss (right-hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (figure 83).

13. The buzzer switch can be pulled straight out of the housing (figure 84). A flat spring wedges the switch toward the lock cylinder (figure 85).

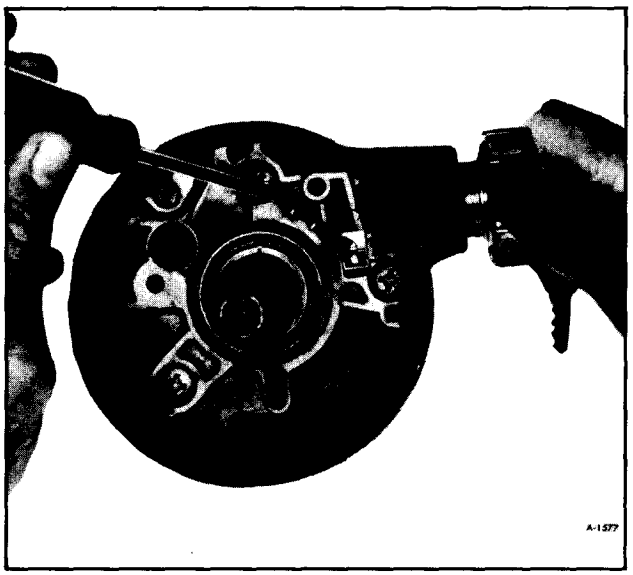


Figure 83—Removing Lock

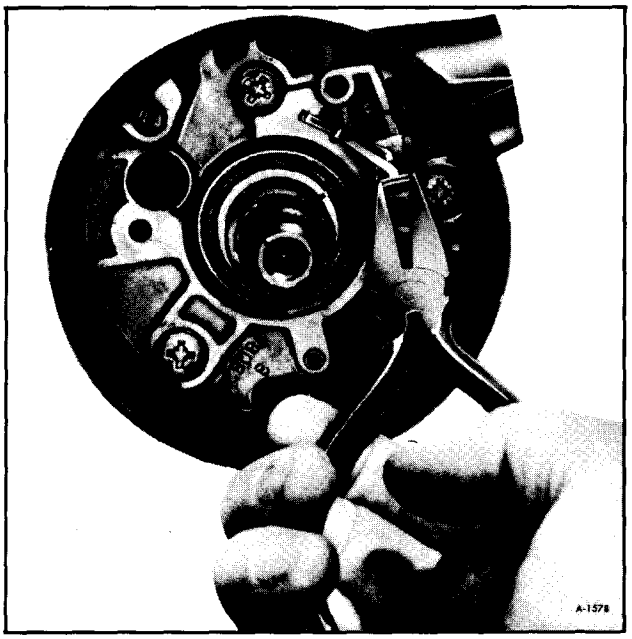


Figure 84—Removing Buzzer Switch

14. Remove three housing cover screws and remove housing cover.

15. Reinstall tilt release lever and place column in full tilt "up" position. Remove tilt spring retainer using screwdriver blade that just fits into slot opening. Insert screwdriver in slot, press in approximately 3/16 in., turn approximately 1/8 turn counterclockwise until ears align with grooves in housing and remove spring and guide (figure 86).

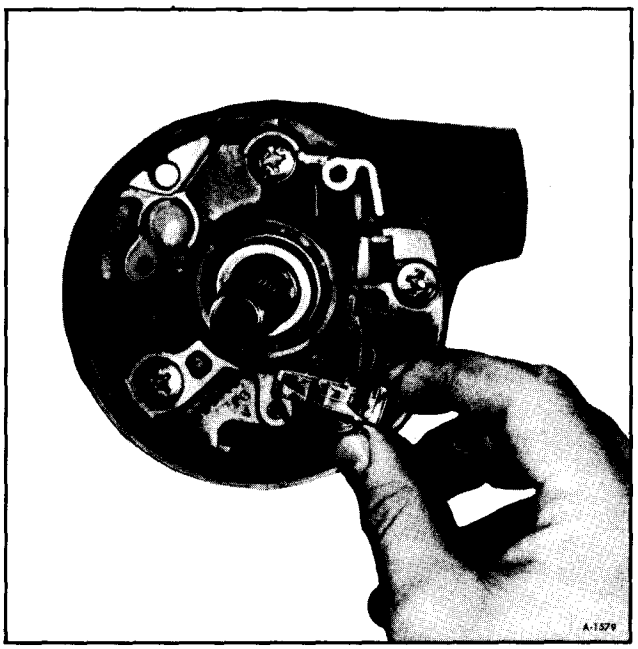


Figure 85—Buzzer Switch and Spring Retainer

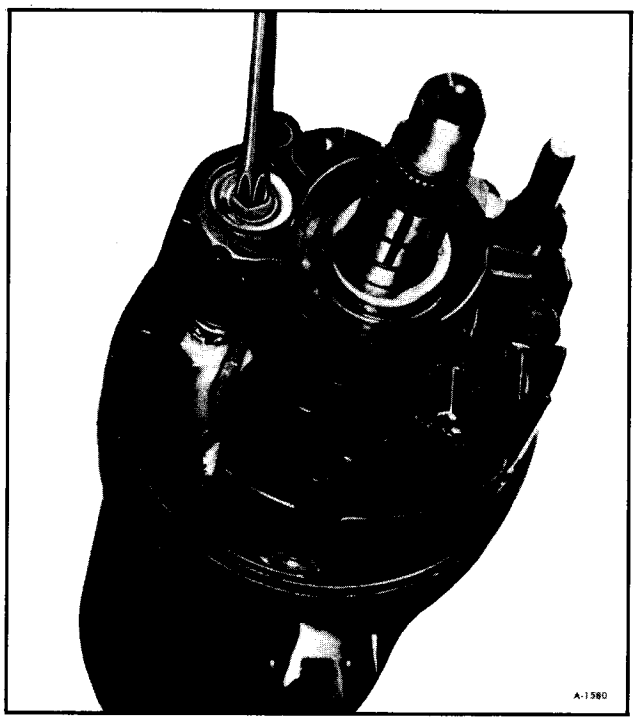


Figure 86—Removing Tilt Spring Retainer

16. With the ignition switch in "acc" position, remove two ignition switch mounting screws and ignition switch. Remove two neutral-start switch screws and neutral-start switch.

17. Remove two pivot pins with tool No. J-21854-1 (figure 87). Remove intermediate shaft assembly or lower flange so shaft can be pulled up through column.

Figure 87—Removing Pivot Pins

18. Disengage lock shoes by pulling on release lever. Remove bearing housing assembly by pulling upward to extend rack full downand moving housing assembly to the left to disengage rack from actuator. Remove actuator rod assembly.

19. Remove steering shaft assembly. Remove upper bearing seat and inner race.

20. Disassemble steering shaft assembly by removing center spheres and anti-lash spring.

21. Remove four support screws and remove support assembly.

22. Remove shift tube retaining ring with screw driver. Remove thrust washer.

If service is required on upper end only, steps 1 thru 22 may be performed in the vehicle. It is necessary to remove the mounting bracket and loosen toe plate to prevent bending of jacket and toe plate to service the signal switch.

23. Remove clip, bearing adapter retainer and bearing adapter assembly from lower end of jacket.

24. Remove shift tube from bowl (use tool No. J-23072) (figure 88). Insert bushing on end of tool in shift tube and force tube out of bowl. Care should be taken not to jam lower shift lever into lower jacket. Lever must be aligned with "T" slot to remove shift tube. DO NOT HAMMER OR PULL ON LOWER OR UPPER SHIFT TUBE BECAUSE PLASTIC JOINT MAY BE SHEARED.

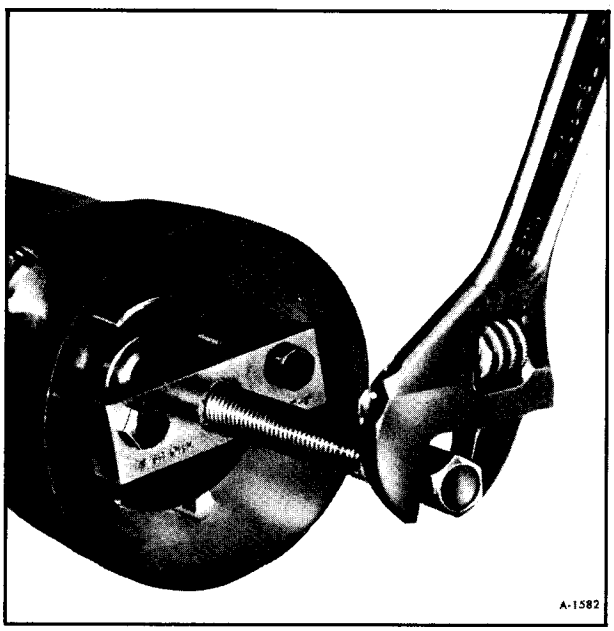


Figure 88—Removing Shift Tube From Bowl

Figure 89—Removing Tilt Lever Shield

25. Remove shift tube assembly from jacket from lower end.

26. Remove lock plate by sliding out of jacket notches and tipping down toward bowl hub at 12 o'clock position and under jacket opening. Remove wave washer.

27. Remove bowl from jacket. Remove shift lever spring from bowl by winding spring up with pliers and pulling out.

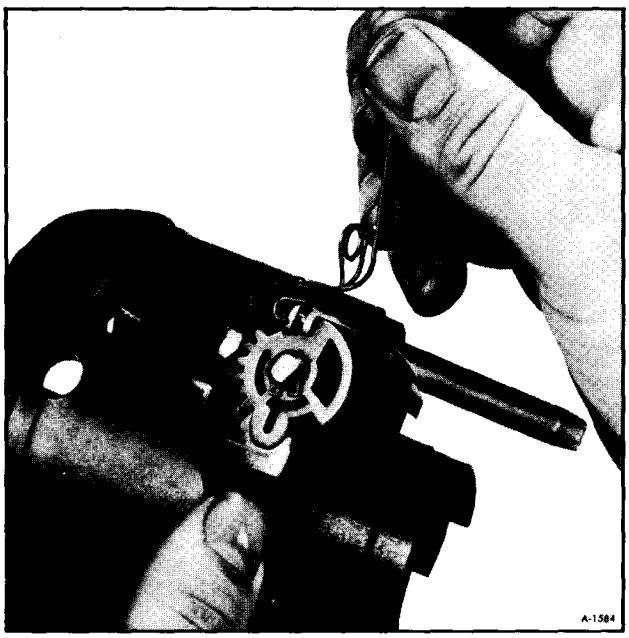


Figure 90—Removing Lock Bolt Spring

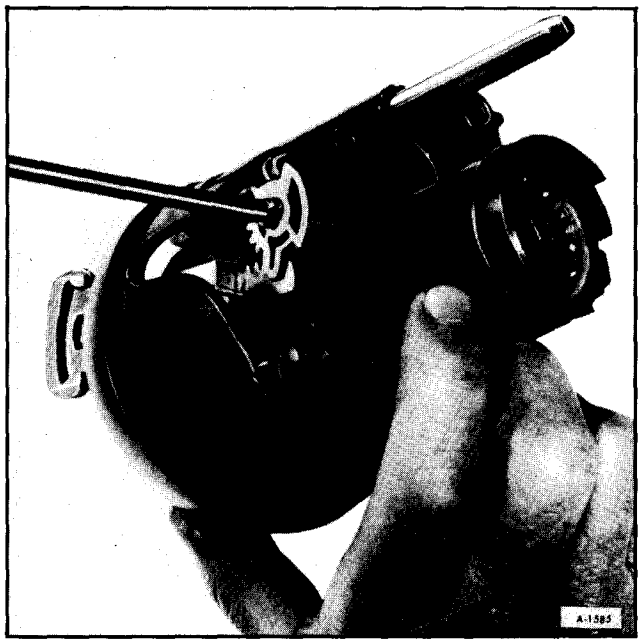


Figure 91—Removing Drive Shaft

28. Remove tilt lever opening shield from housing (figure 89).

29. Remove lock bolt spring by removing spring retaining screw and moving spring clockwise to remove from bolt (figure 90).

30. If there is a snap ring, remove it from sector drive shavt. With small punch lightly tap drive shaft from sector (figure 91). Remove drive shaft. Remove rack and rack spring (also shim, if there is one). Remove sector and bolt.

31. Remove tilt release lever pin with pin punch and hammer. Remove lever and release lever spring. (To relieve load on release lever, hold shoes inward and wedge block between top of shoes (over slots and bearing housing) (figure 92).

32. Remove lock shoe pin with punch and hammer. Remove lock shoes and lock shoe springs.

33. Remove bearings from bearing housing **only if they are to be replaced.** Remove separator and balls from bearing. Place housing on work surface. With a pointed punch against back surface of race, carefully hammer race out of housing until bearing puller can be used. Repeat for other race. Do not re-use bearings.

ASSEMBLY OF STEERING COLUMN

Apply thin coat of lithium grease to all wear surfaces except lock, bolt and lock bolt hole.

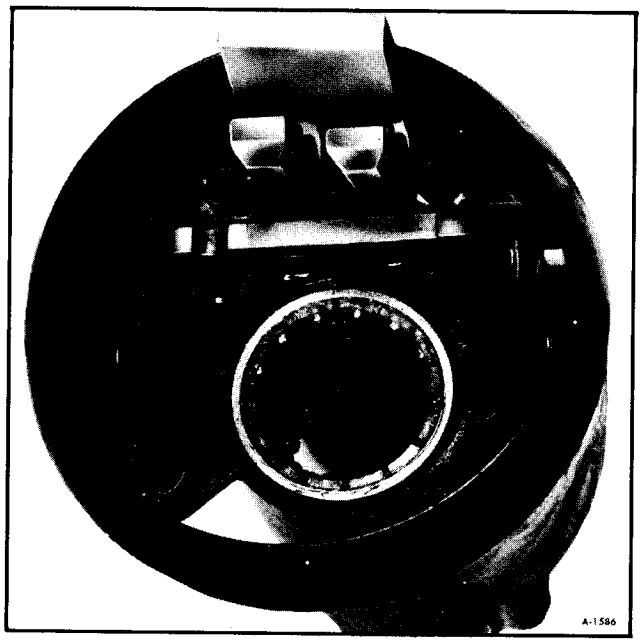


Figure 92—Removing Load on Release Lever

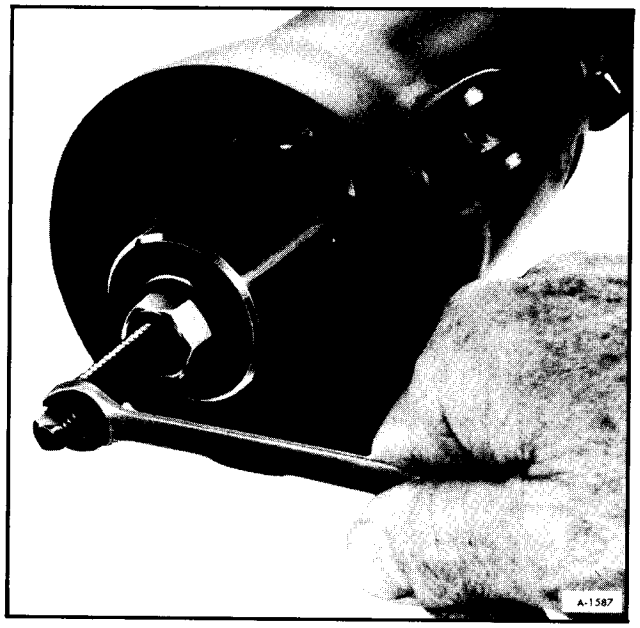


Figure 93—Installing Shift Tube

1. Install new bearings in bearing housing, if removed.

2. Install lock shoe springs, lock shoe and shoe pin in bearing housing. Use approximately .180 rod to line up shoes for pin installation.

3. Install spring, release lever and pin in bearing housing. (Again, relieve load on release lever as in step 31 of "Disassembly of Steering Column".

4. Install drive shaft in housing. Lightly tap sector onto the shaft far enough to expose snap ring groove. Replace snap ring if it was removed.

5. Install lock bolt and engage with sector cam surface (figure 90).

6. Install rack and spring. (Replace shim if one was removed). Block tooth on rack to engage block tooth on sector (figure 90). Install external tilt release lever.

7. Install bolt spring and spring retaining screw. Tighten to 35 inch-pounds.

8. Install shift lever spring in bowl by winding up with pliers and pushing in. Slide bowl into jacket.

9. Install wave washer and lock plate into place. Work lock plate into notches in jacket by tipping lock plate toward bowl hub at 12 o'clock position and under jacket opening. Slide lock plate into notches in jacket.

10. Carefully install shift tube in lower end of jacket. Align key in tube with keyway in bowl and use Tool No. J-23073 to pull shift tube into bowl (figure 93).

CAUTION: *DO NOT PUSH OR TAP ON END OF SHIFT TUBE. Install thrust washer and retaining ring by pulling bowl up to compress wave washer.*

11. Install support by aligning "V" in support with "V" notch in jacket. Insert screws through support in lock plate. Tighten screws to 60 inch-pounds torque.

12. Align lower bearing adapter notches in jacket and push in lower end of jacket. Shift tube should pilot in adapter while this is done. Install adapter retainer and clip.

13. Install centering spheres and anti-lash spring in upper steering shaft. Install lower steering shaft from same side of spheres that spring ends protrude.

14. Install steering shaft assembly in shift tube from upper end. Carefully guide shaft through shift tube and bearing.

15. Install ignition switch actuator rod through bowl from bottom and insert in slot in support. Extend rack downward from bearing housing. Assemble bearing housing over steering shaft and engage rack over end of actuator rod (figure 94).

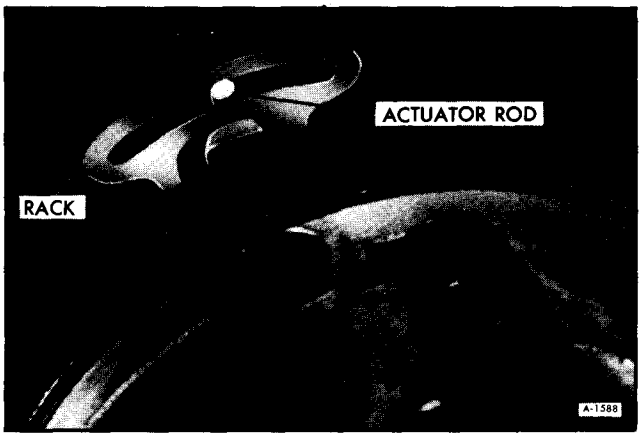


Figure 94—Engaging Rack

16. Holding lock shoes in disengaged position, assemble bearing housing over steering shaft until the pivot pin holes line up with the holes in the support.

17. Install pivot pins—assemble as far as possible using palm pressure of hand to prevent broaching of support pivot hole. Once started, tap home with a small hammer and punch.

18. Place housing in full "up" position, install guide, make sure there is grease between the guide and peg on support, tilt spring and tilt spring retainer, using screwdriver in retainer slot. Turn retainer clockwise to engage (figure 86).

19. Install tilt lever opening shield in housing (figure 89).

20. Remove tilt release lever, install housing cover and seat screw at 12 o'clock position first. Tighten to 100 inch-pounds, three screws.

21. Assemble buzzer switch to spring clip with formed end of clip under end of switch and spring bowed away from switch on side opposite contact (figure 85). Push switch and spring into hole in cover to the step with the contacts toward lock cylinder bore.

22. Install signal switch wires and connector through cover, bearing housing and bowl. Push hazard warning knob in, install switch and tighten screws to 25 inch-pounds.

23. Install wave washer (if one is used) and lower steering shaft flange or intermediate shaft assembly. Tighten pinch bolt to specified torque.

24. Install hazard warning knob and pull knob out. Install bearing inner race, seat, bearing preload spring, cancelling cam and lock plate.

Figure 95—Installing Retaining Spring

25. Depress lock plate and install new retaining ring using Tool J-23653 (figure 95).

26. Reinstall tilt release lever, signal switch lever (15 inch-pounds) and hazard warning knob (5 inch-pounds). Install upper shift lever and drive in pivot pin.

27. To install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in housing. Push in to abutment of cylinder and sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until retainer pops into groove. This locks cylinder into cover. Check freedom of rotation.

28. Install shaft lock cover and tighten three screws to 15 inch-pounds.

29. When replacing ignition switch, place the lock in "Acc" position. Place the switch in "acc" by the following procedure:

A. Position the switch as it is shown in Figure 96.

B. Move the slider to the extreme right, to the "acc" position.

Fit the actuator rod into the slider hole and assemble to the column with two screws. Lightly push the switch down the column (away from the steering wheel), to take out lash in the actuator rod, and

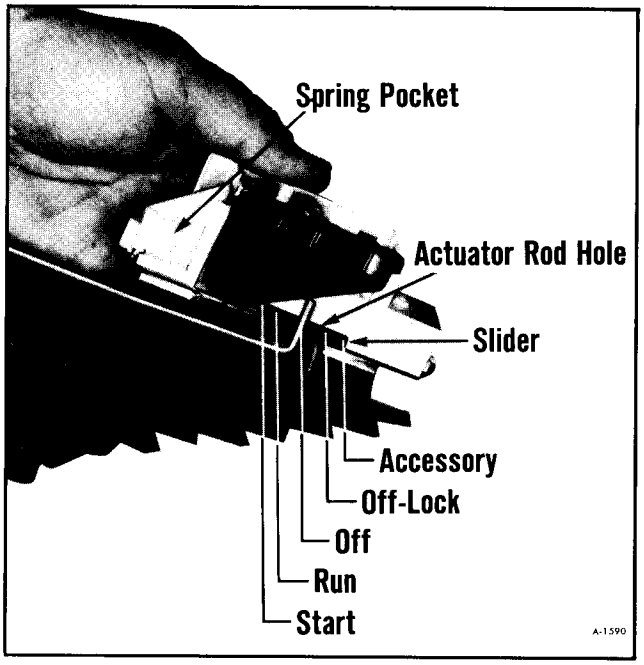


Figure 96—Installing Ignition Switch

tighten mounting screws. Caution should be exercised to prevent moving the switch out of detent. Use only the correct screws. Tighten to 35 inch-pounds.

30. Install neutral-start switch and back-up light switch. Do not tighten screws. Neutral-start switch will be adjusted in the car and should be tightened to 20 inch-pounds.

DO NOT SUBSTITUTE SCREWS.

31. Install lower wire protector over wires and on jacket (figure 78).

32. Install mounting bracket. DO NOT SUBSTITUTE BOLTS. (Mounting bracket torque, 15 foot-pounds).

33. Install steering wheel. Torque steering wheel nut to 30 foot-pounds.

34. Install horn parts.

STEERING COLUMN INSTALLATION

Make sure this procedure is followed in exactly this order.

1. Reconnect all electrical connections.

2. Install column into position and loosely attach mounting bracket to instrument panel with two mounting bolts.

CAUTION: *Do not use longer bolts or overtorque bolts. The correct bolts and torque are necessary to insure the breakaway action of the bracket and capsules in the event of a collision.*

3. Attach column at coupling. Tighten fasteners to specified torque.

4. Attach column bolts to instrument panel with specified torque.

5. Slide dash mounting plate firmly against dash and install mounting screws.

CAUTION: *Make certain that column instrument mounting panel is never unsupported when either dash mounting or gear mounting is connected.*

TORQUE SPECIFICATIONS

STEERING LINKAGE

Part	Location	Torque (Ft. Lbs.)
Nut	Steering Arm to Tie Rod End*	40—50
Nut	Tie Rod Clamp Nuts	19—24
Nut	Tie Rod to Intermediate Rod*	40—50
Nut	Idler Arm To Intermediate Rod*	40—50
Nut	Idler Arm To Frame	85—110
Nut	Relay Lever To Intermediate Rod*	40—60
Bolt	Relay Lever To Frame	250—300
Nut	Drag Link To Relay Lever*	100—125
Nut	Drag Link To Pitman Arm*	100—125
Nut	Pitman Arm To Steering Gear	160—210

NOTE: All stud tapers on all ball joints must be kept sufficiently free of lubricant to prevent excessive pull in mating tapered holes.

*NOTE: After reaching minimum torque required, nut must always be tightened to insert cotter pin. Never back nut off.

POWER STEERING PUMP

Part	Torque (Ft. Lb.)
Pump Mounting Bolts	35
Reservoir Bolt	35
Flow Control Fitting Assm.	35
Pressure Hose	35

STEERING GEAR

Part	Torque (Ft. Lb.)
Gear to Frame Bolts	70—80
High Pressure Line Fitting (At Gear)	40
Oil Return Line Fitting (At Gear)	40
Adjusting Screw Locknut	35
Side Cover Bolts	35
Adjuster Plug Locknut	80
Coupling Flange Nuts	20
Return Guide Clamp Screws	5
Rack-Piston Plug	75
Pitman Shaft Nut	160—210
Coupling Flange Bolt	30

STEERING COLUMN

Intermediate Steering Shaft	Ft. Lb.
Pinch Bolt, to Steering Shaft	40—45
Pinch Bolt, to Steering Gear	40—45
	In. Lb.
Spring Retaining Screw	35
Support Screws	60
Housing Screws	100
Signal Switch Mounting Screws	25
Shaft Lock Cover Screws	15
Ignition Switch Mounting Screws	35
Neutral Start Mounting Switch Screws	20
Tilt Release Lever Screw	30

Hazard Warning Knob	5
Steering Wheel Nut	30
Signal Switch Lever Screw	15

SPECIAL TOOLS

BT-33-73F	Belt Tension Gauge
J-1859-03	Steering Wheel Puller
J-5176-01	Checking Gauge
J-5860	Torque Wrench Adapter
J-6217	Connector Seat Installer
J-6219	Pitman Shaft Seal Installer
J-6222	Stub Shaft Seal Protector
J-6278-1	Pitman Shaft Bearing Remover
J-6278-2	Pitman Shaft Bearing Installer
J-7079-2	Handle
J-7132-2	Seal Driver
J-7576	Rack Piston Seal Compressor
J-7624	Spanner Wrench
J-7728	Seal Installer
J-7754	Torque Wrench
J-7786	Gauge Adapter
J-8058	Torque Wrench
J-8092	Handle
J-8524-1	Adjuster Plug Bearing Installer
J-8524-2	Adjuster Plug Bearing Remover
J-21552	Ball Retainer
J-21854-01	Pivot Pin Remover
J-22407	Pitman Shaft Bearing Installer
J-22616	Pump Shaft Seal Protector
J-23063	Spring Remover
J-23072	Shift Tube Remover
J-23073-01	Shift Tube Installer
J-23653	Lock Plate Compressor
J-24319	Ball Stud Puller
J-25033	Pulley Installer
J-25034	Pulley Remover
J-25323	Power Steering Analyzer

SECTION 10
WHEELS AND TIRES

Contents of this section are listed below:

GENERAL DESCRIPTION

The factory installed tires on the vehicle are designed to provide the best all-around performance for normal vehicle operation. They are tubeless type, 8.75-16.5, load range D, steel belted tires. Only tires of this size and construction should be used as replacements. Replacement wheels should be equivalent to those removed in diameter, rim width and off-set.

TIRE TRACTION

A decrease in driving, cornering, and braking traction occurs when water, snow, ice, gravel, or other material is on the road surface. Driving practices and vehicle speed should be adjusted to the road conditions.

When driving on wet or slushy roads, it is possible for a wedge of water to build up between the tire and road surface. This phenomenon, known as hydroplaning, may cause partial or complete loss of traction, which adversely affects vehicle control and stopping ability. To reduce the possibility of traction loss, the following precautions should be observed:

1. Slow down during rain-storms or when roads are slushy.

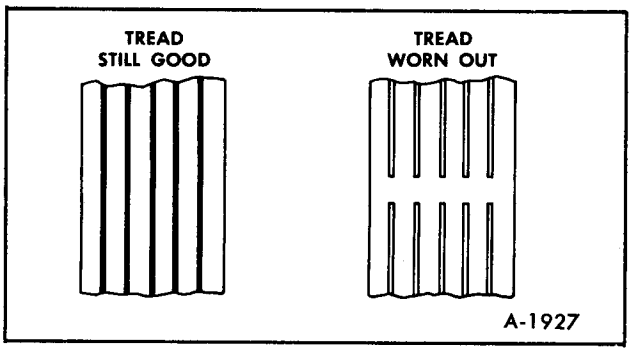


Figure 1—Tread Wear Indicators

2. Slow down if road has standing water or puddles.

3. Replace tires when tread wear indicators are visible.

4. Keep tires properly inflated.

TREAD WEAR (FIGURE 1)

The original equipment tires incorporate built-in tread wear indicators to assist in determining when tires have worn to the point of needing replacement. These indicators appear as 1/2-inch wide bands when tire tread depth is 1/16-inch or less. When the indicators appear in two or more adjacent grooves, tire replacement due to tread wear is recommended.

MAINTENANCE

WHEEL STUDS

TIGHTENING WHEEL STUD NUTS

When vehicle is new or after wheels have been replaced, check wheel stud nuts at 500 miles and after every wheel removal thereafter. Nuts should be tightened to 250 foot-pounds torque in sequence shown in Figure 2.

WARNING: IF ANY WHEEL EXPERIENCES A SINGLE STUD FAILURE CAUSED BY A LOOSE-RUNNING WHEEL, ALL WHEEL STUDS SHOULD BE REPLACED. A LOOSE-RUNNING WHEEL MAY CAUSE ONLY ONE STUD TO BREAK, BUT SEVERAL MORE STUDS MAY BECOME FATIGUED TO THE POINT OF FAILURE, BUT NOT ACTUALLY BREAKING. REPLACING ONLY THE BROKEN STUD AND REMOUNTING WHEEL WILL THEN SET THE STAGE FOR A SECOND AND POSSIBLY MORE SERIOUS FAILURE. IF HOLES IN THE WHEEL HAVE BECOME ELONGATED OR ENLARGED, REPLACE WHEEL.

Tighten wheel stud nuts as follows:

1. Install all nuts loosely, then finger-tighten only the nuts marked by arrows (figure 2).

2. Tighten all nuts to specified torque in sequence illustrated. Never use oil or grease on studs or nuts.

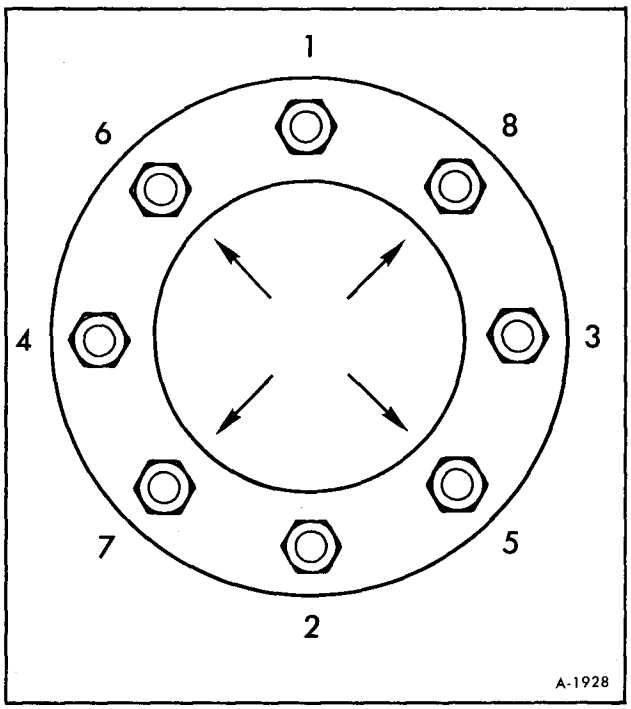


Figure 2—Wheel Stud Tightening Sequence

FREEZING OF NUT

Corrosion or galling of the stud and nut assembly can reach a point where removal of cap nuts is difficult. If this is a persistent problem, the threads of the stud and the threads of the inner cap nut should be cleaned with a wire brush.

WHEEL MAINTENANCE

Thoroughly remove rust, dirt, and other foreign materials from all surfaces. Hand or electric wire brushes, sand blasting or chemical baths may be used.

Bead seat areas of rim should be free of rust and rubber deposits. This is especially important for drop-center tubeless rims, because the 15° bead seat is the air-sealing element.

Paint rim by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry prior to painting. Ensure that bare metal areas on outside or tire side of rim are covered. This is especially important on drop-center tubeless rims, because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.

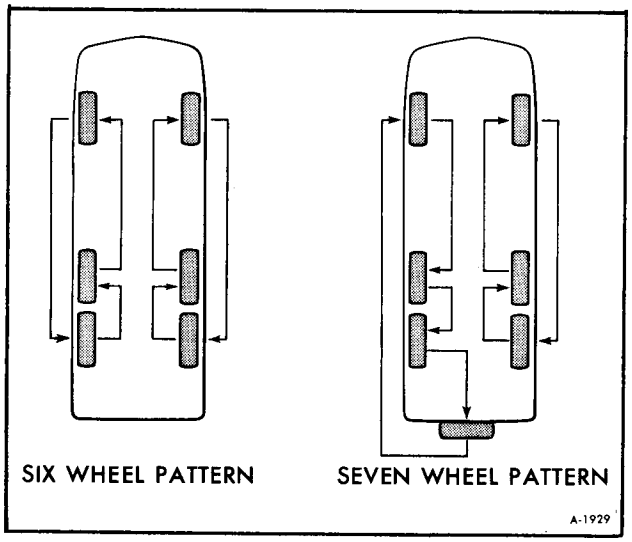


Figure 3—Tire Rotation Diagram

TIRE ROTATION

Rotation of the tires will minimize tire trouble and produce longer tire life. With rotation, accelerated and irregular tire wear on any one particular tire will be spread out over several tires, and replacement frequency will be reduced. Tire wear may also contribute to such trouble as poor handling and shimmy.

If desired, the tires should be rotated every 6,000 miles following one of the patterns shown in Figure 3.

INFLATION OF TIRES (FIGURE 4)

Inflate to correct pressure when tires are cool. If tires are continually carrying less than the recommended maximum load, adjust air pressure downward to correspond to the actual load carried.

Never "bleed" tires to relieve build-up of pressure. Tire temperature will increase when the tire is in service and allows for the normal build-up in air pressure. Tire temperature and air pressure will remain within limits that are not harmful to the tire when used in accordance with the recommendations for load and air pressure.

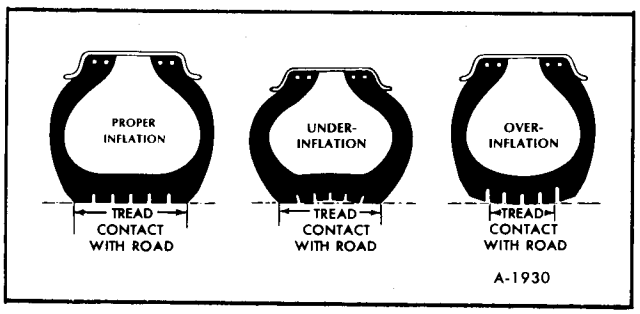


Figure 4—Inflation of Tires

If excessive build-up of air pressure occurs, overload, under-inflation, speed, or a combination of these is responsible. Use the size and type of tire that has the capacity to carry the load at recommended cold starting pressure.

The fabric, rubber, bead, contour, and size of tires used on these vehicles are designed to obtain maximum length of service under normal operating conditions. TIRES ARE DESIGNED TO OPERATE EFFICIENTLY ONLY ON A PRESCRIBED AMOUNT OF AIR. Unless the correct air pressure is consistently maintained, the tires will not function as they should; consistently safe economical operation of vehicle will be materially affected.

An under-inflated tire runs sluggishly, heats up quickly because of the greater flexing, and is subjected to more frequent bruising.

On the other hand, over-inflation may weaken the tire, causing a blow-out. In addition to the deteriorating effect improperly inflated tires may have on the tire life, this condition will affect steering, riding comfort, and safe driving.

For correct inflation pressure refer to Specifications later in this section.

BALANCED INFLATION

The efficiency of the vehicle will be upset if air pressure in the tires are out-of-balance. Balanced inflation may be expressed as: All tires should always carry the same air pressure. A 5-pound under-inflation in one front tire not only can destroy ease of steering, but creates steering hazards which generally point to a potential accident. An under-inflated rear tire can destroy the value of the most efficient brakes. Balance tires for ease of steering, comfort in riding, safety in driving, as well as for minimum fuel consumption and maximum tire mileage.

PRESSURE LOSS

At periodic intervals, each tire should be gauged for pressure loss with an accurate gauge before tires are brought to correct operating pressure. The purpose of this check is to determine the exact pressure loss in each tire. In other words, if at the time this check is made, a definite pressure loss is noted in any one of the tires, an inspection should be made of the tire showing the loss and the cause of loss corrected.

This method should definitely establish a "danger signal" on the condition of the tires. The pressure loss check should be made consistently with the same gauge, so that any element of inaccuracy in the gauge will be the same for all tires.

WHEEL AND TIRE BALANCING

It is desirable from the standpoints of tire wear and vehicle handling ease to maintain proper balance of front wheel and tire assemblies. All wheels intended for use on front of vehicle, such as those switched during periodic tire rotation and those installed as new or repaired replacement equipment should be accurately balanced. This may be accomplished by either of 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 (brakes, bearings, seals, etc.), are included in the balancing procedure and thereby have any existing unbalance corrected.

Wheel balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. There are two ways in which wheels can be balanced —statically and dynamically.

STATIC BALANCE

Static balance (sometimes called still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with a chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out-of-balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often to wheel "tramp."

DYNAMIC BALANCE

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance, and also run smoothly at all speeds on an axis which runs through the center line of the wheel and tire and is perpendicular to the axis of rotation.

To ensure 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 run-out over 3/32" 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 5/16" 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.

WARNING: WHEN BALANCING TIRES ON THE VEHICLE, FOLLOW THE EQUIPMENT MANUFACTURER'S INSTRUCTIONS CAREFULLY. DRIVE WHEEL SPIN SHOULD BE LIMITED TO 35 MPH AS INDICATED ON THE SPEEDOMETER. THIS LIMIT IS NECESSARY BECAUSE THE SPEEDOMETER ONLY INDICATES ONE-HALF OF THE ACTUAL WHEEL SPEED WHEN ONE DRIVE WHEEL IS SPINNING AND THE OTHER DRIVE WHEEL IS STOPPED. UNLESS CARE IS TAKEN IN LIMITING DRIVE WHEEL SPIN, THE SPINNING WHEEL CAN REACH EXCESSIVE SPEEDS, RESULTING IN POSSIBLE TIRE DISINTEGRATION OR DIFFERENTIAL FAILURE, WHICH COULD CAUSE PERSONAL INJURY OR EXTENSIVE VEHICLE DAMAGE.

TIRE REPLACEMENT

When tires are mounted on dirty or corroded rims, or when they are not properly centered on rims, the tire bead may "bind" on the rim, and refuse to seat. Allowing pressure to continue to build up within the assembly in an attempt to seat the tire bead is a DANGEROUS PRACTICE which can result in a broken tire bead, and serious injury to the serviceman. All of the following safety precautions should be observed:

1. Make sure that rim flanges and bead ledge (especially hump and radius) areas are smooth and clean. Remove any oxidized rubber, dried soap solu-

tion, rust, heavy paint, etc., with a wire brush, or in extreme cases, a file.

NOTE: Repaint bare metal with a good grade of aluminum paint or equivalent, to prevent rust.

2. Lubricate tire beads, rim flanges, and bead ledge areas with a liberal amount of thin vegetable oil soap solution, or approved rubber lubricant.

3. Ensure that air pressure build-up during the bead seating process is not allowed to exceed 100 pounds pressure.

IMPORTANT: If beads have not seated by the time pressure reaches 80 pounds, assembly should be deflated, repositioned on rim, relubricated, and re-inflated.

4. Make sure valve core is inserted in valve stem prior to inflating.

5. Use an extension gauge with clip on chuck so air pressure build-up can be closely watched and so that you can stand well back from the assembly during the bead seating process to avoid possibility of personal injury.

MOUNTING

1. Inspect rim to insure bead seats are clean and smooth. Then place rim on floor with wide side down

Figure 5—Lubricating Tire Bead

Figure 6—Working Bead Onto Rim

Figure 7—Working Second Bead Onto Rim

Figure 8—Inserting Tire Iron to Lift Bead

Figure 9—Lifting Bead Over Rim

Figure 10—Inserting Tire Iron in Second Bead

Figure 11—Prying Second Bead from Rim

and lubricate first bead of tire and upper bead seat of rim (figure 5).

2. Push first bead into well of rim and onto rim as far as possible. Using straight end of tire iron and with stop resting on rim flange, work remaining section of first bead over rim (figure 6).

3. Hold second bead in well by standing on tire. When necessary, push section of bead into rim well and anchor with vise-grip pliers by pinching pliers on rim flange. Using spoon end of tire iron with stop toward rim, work progressively around bead using small bites until bead slips over flange onto rim base. If necessary, insert second tire iron and lubricate last 6" of bead before completing mounting (figure 7).

4. Check valve to be certain that hex nut at the valve base is tight. Inflate tire to recommended operating pressure. Check assembly for air leaks.

DEMOUNTING

1. Remove valve core to completely deflate tire. With tire lying flat on floor, loosen beads from rim seats by walking around on tire with heels at points close to rim. With wide side of rim down, apply tire lubricant to top bead. With stops toward rim, insert spoon ends of two tire irons about 10" apart. While standing on tire to hold bead in gutter, pull one tool toward center of rim (figure 8).

2. Hold one iron in position with foot and pull second iron toward center of rim. Progressively work bead off rim, taking additional bites if necessary (figure 9).

3. Stand assembly in vertical position. Lubricate second bead. At top of assembly insert straight end of tire iron between bead and back flange of rim at about a 45 degree angle (figure 10).

4. Turn iron so that it is perpendicular to rim. Pry second bead off (figure 11).

WHEEL AND TIRE INSPECTION

WHEEL AND TIRE WEAR

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 front tires than on rear tires, because the propelling action of the front 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 front tires, whereas only the braking forces act on the rear wheels, and the saw-toothed 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 rotate 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 effected.

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment. The remedy is readjusting toe-in, or rechecking the entire front end alignment if necessary.

Cornering Wear — When a vehicle makes an extremely fast turn, the weight is shifted from an even load on all wheels to an abnormal load on the tires on the outside of the curve and very light load on the inside tires, due to centrifugal force. This unequal loading may have two unfavorable results.

First, the front 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 the 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 operations. 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 rotated at regular intervals.

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.

Power and Speed — Excessive speed has always been harmful to tires. Speed creates heat — heat softens tires.

Stops and Starts — Quick stops and starts grind off tread in a hurry, may cause flat spots which continue to grow for the life of the tire.

Temperature — Considerably less mileage can be expected from a tire used in all warm weather driving as compared to all cool weather driving, or from a tire first put into service in warm weather.

MECHANICAL IRREGULARITIES

Following are some wheel or vehicle irregularities which may cause rapid or uneven tread wear:

Toe-In — The wheels on the same axle are closer together in the front than they are in the rear. When toe-in is excessive the tire wear shows feathered edges on inside edge of the skid design.

Toe-Out — The wheels on the same axle are closer together in the rear than they are in the front. Tire wear shows feathered edges on outside edge of the skid design.

Camber — This designates the tilt of the wheel. Positive camber is when wheels are closer together at point of road contact. Negative camber is when wheels are closer together at top. Too much camber results in excessive wear on one side of tire.

Caster — This is the backward tilt of the axle or inclination of the kingpin at the top. Too little caster causes wheel to wander or weave — result, spotty wear. Excessive caster may cause wheel "flight" or shimmy wear. Unequal caster causes wheel to pull to one side, resulting in excessive and uneven wear.

Sprung or Twisted Frame — Will cause rapid or uneven tread wear.

Grabbing Brakes — Brakes out of adjustment and out-of-round brake drums or discs cause tire treads to wear rapidly in spots. Out-of-round brake drums usually wear out tires in a single spot. Improperly adjusted brakes produce several worn places.

Worn wheel bearings, unbalanced wheels, or wobbly wheels all result in uneven and irregular tread wear.

At first sign of uneven tire tread wear, check and correct all mechanical irregularities.

WHEEL INSPECTION

Do not use wheels with bent rims. The continued use of such wheels will result in excessive tire wear and, if wheel is mounted on front of vehicle, difficulty in steering will be experienced. Wheels that are thought to be distorted may be checked as follows, referring to Figure 12 for checking points:

1. Raise wheel at side to be checked and safely support underneath.

2. Tool for checking run-out may be readily improvised as follows:

Secure block of wood approximately 6" x 6" x 14" or material with suitable base so it will remain positioned. Secure thin piece of wood or suitable material 10 inches long, such as ruler or yardstick, and fasten to wood block to a height in relation to rim surfaces as shown in Figure 12. Tighten screw sufficiently so pointer will hold its position when adjusted.

3. Position pointer at crown of rim (A, figure 12). Slowly revolve wheel and move pointer toward wheel until it contacts wheel at nearest point.

4. Continue to revolve wheel and check amount of lateral run-out (amount of wheel side wobble). This should not exceed 3/32-inch.

5. Place point of marker at inside of wheel at point "B", in Figure 12. Follow the previous procedure to check radial run-out (out-of-round condition); this should not exceed 3/32-inch. If wheel is distorted beyond these dimensions it should be replaced.

6. If doubt exists whether the wheel or hub is distorted, hub may be checked as follows: Replace the existing wheel with a wheel known to be true. Revolve the wheel and make the previously, mentioned tests. If tests are within limits, the hub is satisfactory, but wheel is sprung.

7. A dismounted wheel may be checked for side wobble by placing a straight-edge on face or hub of wheel. Measure distance from straight-edge to edge of wheel rim, this should be checked at four equally spaced locations. If distance is the same at all positions wheel is not distorted. (See figure 13) A dismounted wheel may also be checked for radial, and lateral run-out if desired, by temporarily mounting it to a hub on vehicle. Follow the previous Steps 2, 3, 4, and 5.

WORN WHEEL STUD HOLES (FIGURE 14)

This condition will usually be accompanied by appearance of a shiny worn surface on wheel face, indicating that loose wheels were moving against each other. If the stud holes are out of shape — oval or egg shaped — and where a build-up of metal is around them, these wheels must be replaced.

CRACKED DISC WHEELS (FIGURE 14)

Cracks running from hand-hole to stud-hole or bolt-hole to center-hole or hand-hole to hand-hole, or hand-hole to rim. or stud-hole to stud-hole, are a direct result of overloading. Check working loads of vehicle, discard damaged wheels, check wheel studs and complete assembly.

The hub assembly may have a worn mounting face as a result of moving of the wheel on the hub.

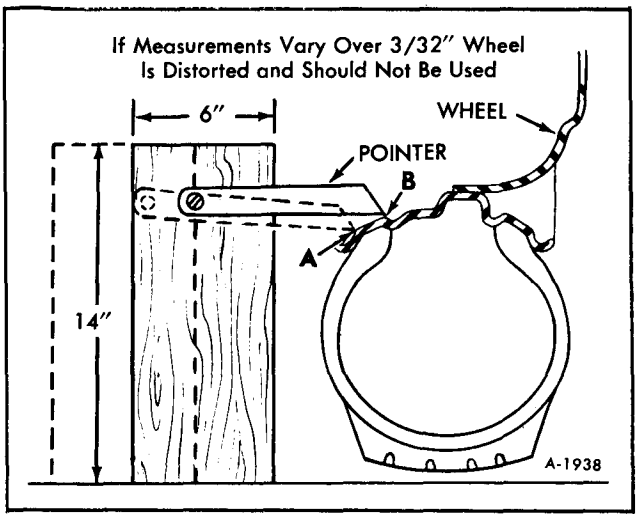


Figure 12—Method of Checking Distorted Wheels

The studs may have turned in the hub and worn the stud groove or the studs may have actual cracks or breaks resulting from this condition. The wheel may have worn ball seats in the stud holes. All these possibilities must be checked and all damaged parts replaced.

RUST STREAKS ON DISCS EMANATING FROM STUD HOLES

This is a positive indication that the cap nuts are, or have been, loose. In this case, the assembly should be checked carefully because damage to hub, studs, or wheel may have been caused by running in this condition.

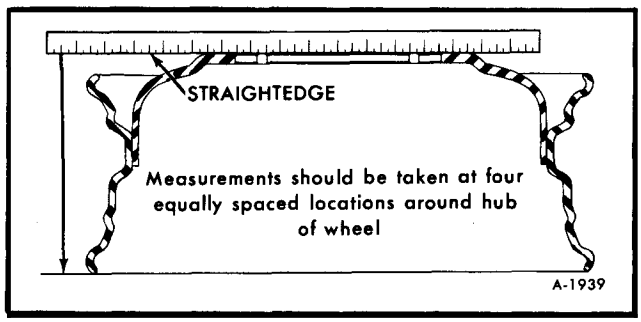


Figure 13—Wheel Checking Diagram

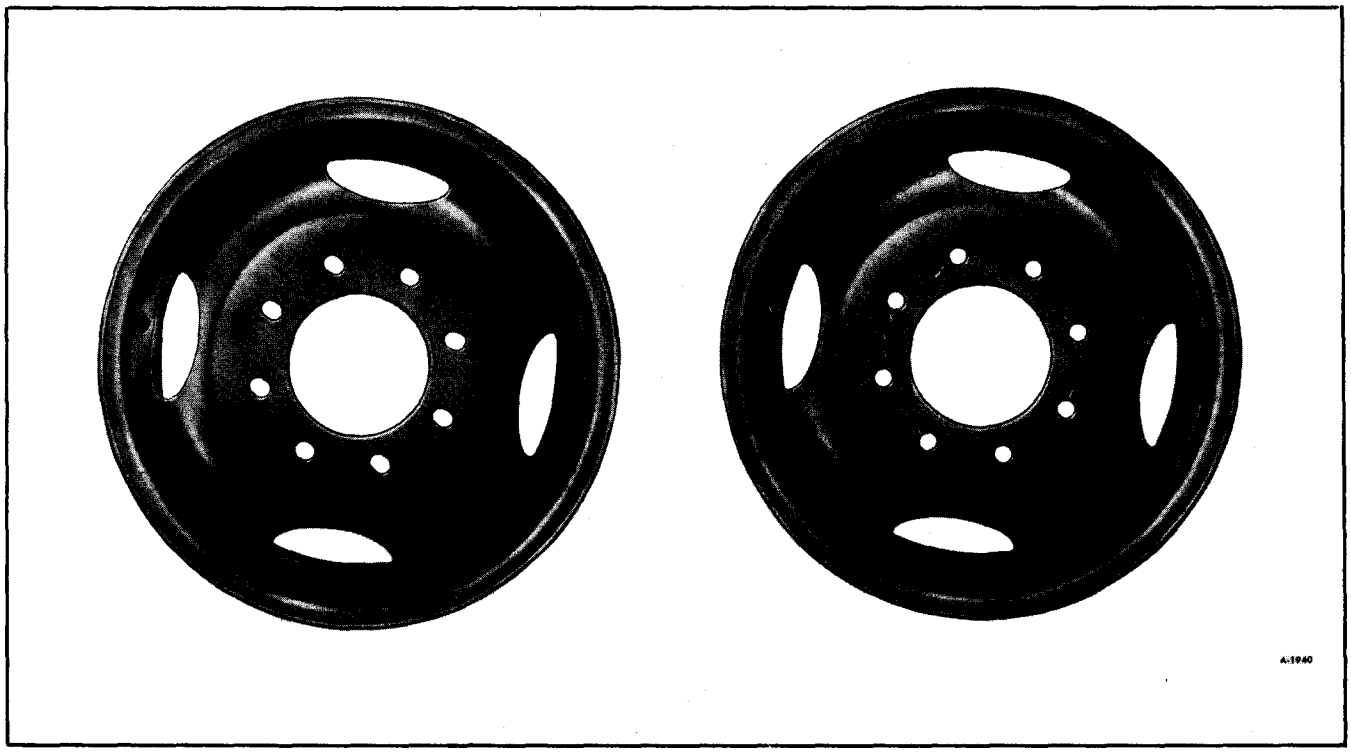


Figure 14—Worn Stud Holes and Cracked Disc Wheels

SPECIFICATIONS

Inflation Pressure (Cold)	60 PSI
For Sustained Speeds Over 65 MPH	70 PSI
Tires	
Size	8.75—16.5
Load Range	D
Construction	Bias-Ply Steel Belted
Wheels	
Diameter	16.5″
Width	6.0″
Off Set	4.67″
Bolt Circle Diameter	6.50″
Number of Studs	8

SECTION 12
CHASSIS ELECTRICAL

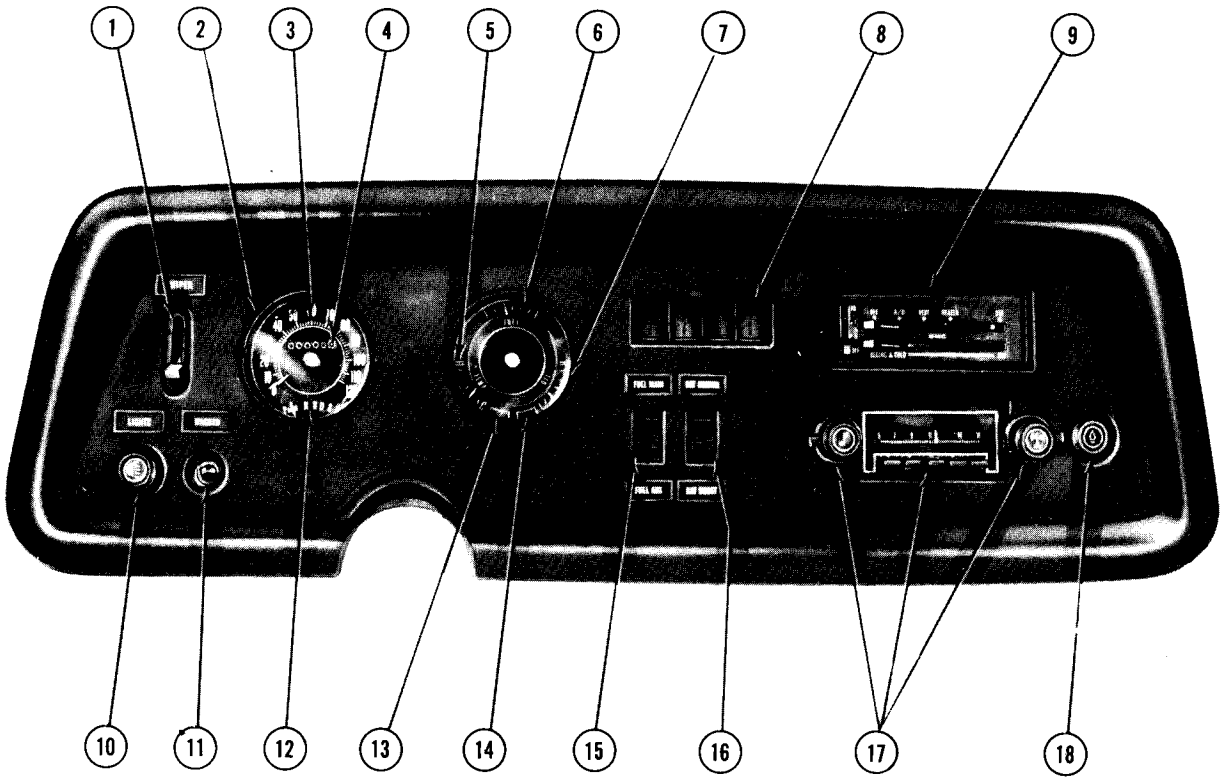
Contents of this section are listed below:

INSTRUMENTS AND GAUGES

All instruments and gauges are installed in the instrument cluster as shown in Figure 1.

The instrument panel gauges utilize printed circuits. They are connected to the vehicles wiring through multiple terminal connectors which are plugged into the back side of the gauges.

Instruments and gauges can be serviced in the vehicle by removing the instrument bezel as de-



1. WINDSHIELD WIPER CONTROL
2. SPEEDOMETER
3. HIGH BEAM INDICATOR
4. ODOMETER
5. TEMPERATURE GAUGE
6. FUEL GAUGE
7. OIL PRESSURE GAUGE
8. WARNING LIGHTS
9. HEATER/A.C. CONTROLS
10. LIGHT SWITCH
11. WINDSHIELD WASHER
12. SHIFT INDICATOR
13. GENERATOR LIGHT
14 BRAKE SYSTEM WARNING LIGHT
15. FUEL SELECTOR SWITCH
16. BATTERY BOOST SWITCH
17. RADIO & CONTROLS
18. CIGAR LIGHTER

A-1778

Figure 1—Instrument Panel

scribed later in this section. Illumination and indicator lamps can be replaced without removing the gauges and are of a 1/2 turn locking type with printed circuit connections. Regular maintenance is not required on the instrument cluster other than maintaining clean, tight electrical connections, replacing defective parts and keeping the speedometer cable properly lubricated. Figure 2 shows instrument panel component installation.

COMPONENT REPLACEMENT

INSTRUMENT PANEL BEZEL REPLACEMENT

1. Remove the radio knobs and control rings.

2. Remove the headlight switch knob as described under "HEADLIGHT SWITCH REPLACEMENT" later in this section. Then remove wiper control knob.

3. Disengage the fiber optic ribbon from the source bulb assembly located on the lower left side of the instrument panel assembly. This can be serviced from below the dash panel.

4. Remove the (4) upper bezel edge retaining screws and remove bezel from instrument panel.

5. To install, hook lower edge of the bezel on instrument panel edge and reverse steps 1—4 above.

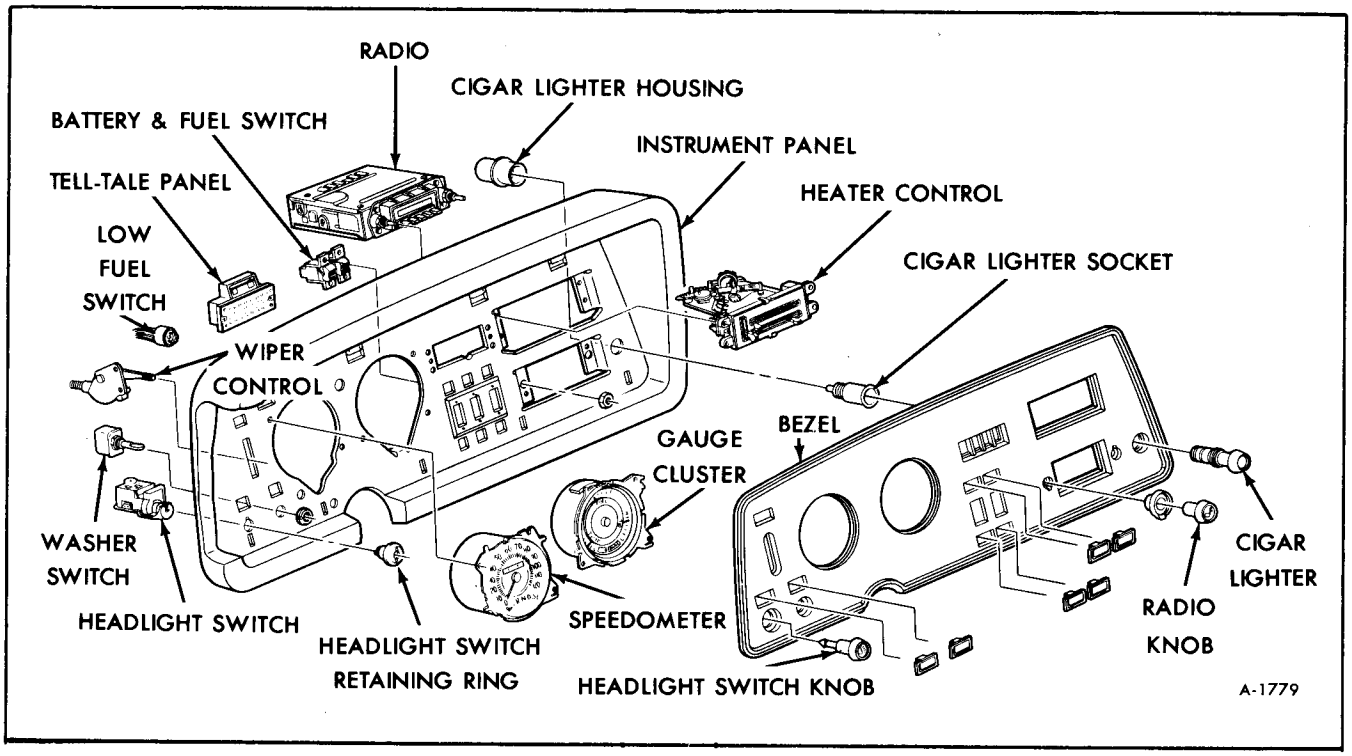


Figure 2—Instrument Panel Components

INSTRUMENT PANEL REAR COVER REPLACEMENT

1. Remove the (2) cover retaining screws on each side of the cover.

2. Lift cover straight up and work from behind the cluster assembly.

3. To install, reverse steps 1—2.

SPEEDOMETER HEAD REPLACEMENT

1. Disconnect battery ground cables.

2. Remove instrument panel bezel.

3. Remove instrument panel rear cover.

4. Remove the (3) speedometer retaining screws (See figure 3) and ground wire.

5. Hold the speedometer cable spring retaining clip down and pull cable away from speedometer head.

6. Disconnect (4) wire electrical connector from the back of the speedometer head.

7. Pull the speedometer head out and disconnect the transmission gear indicator cable.

8. Remove the speedometer head from the instrument panel.

9. When installing new or repaired speedometer head, the gear indicator cable should be routed around the metal post on the back side of the instrument panel. (See figure 4)

10. Reverse steps 1—8 to install speedometer head and test operation.

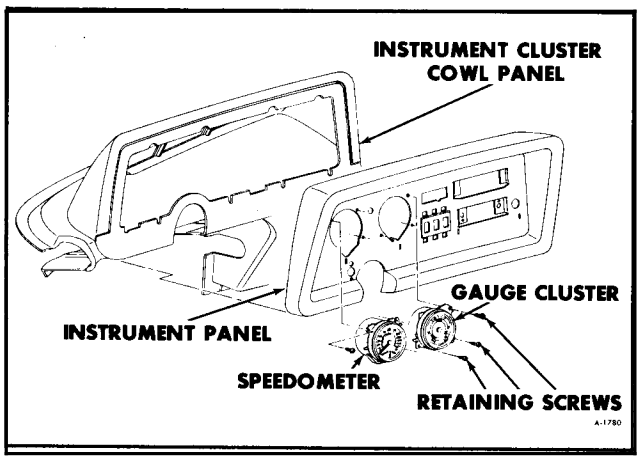


Figure 3—Speedometer and Gauge Cluster

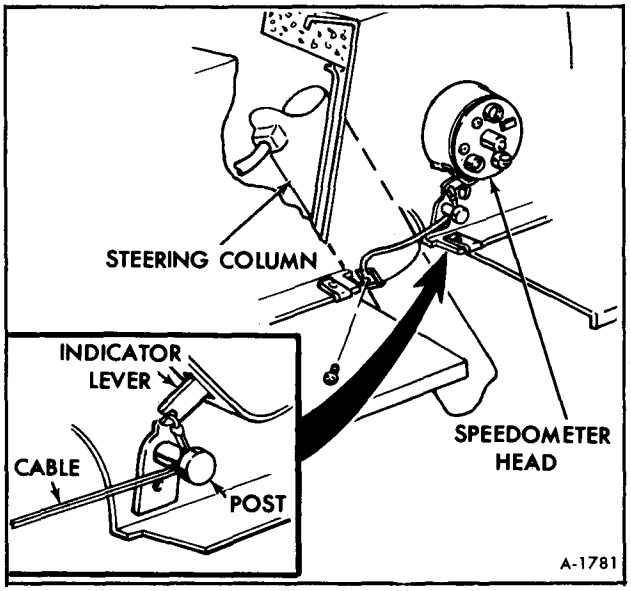


Figure 4—Gear Indicator Cable Connection

GAUGE CLUSTER REPLACEMENT (FIGURE 3)

1. Disconnect battery ground cables.

2. Removal the instrument panel bezel.

3. Remove the (3) gauge retaining screws and pull gauge out as far as possible. (See figure 3)

4. Disconnect the 7 wire pin connector from the gauge and remove gauge.

5. To install, reverse steps 1—4 above and check operation.

BATTERY SELECTOR SWITCH REPLACEMENT

1. Disconnect battery ground cables and remove instrument panel bezel.

2. Remove the (2) switch retaining screws shown in Figure 5.

3. Pull switch out as far as possible and disconnect the connector from the switch.

4. To install switch, reverse steps 1—3.

FUEL SELECTOR SWITCH REPLACEMENT

1. Disconnect battery ground cables and remove instrument panel bezel.

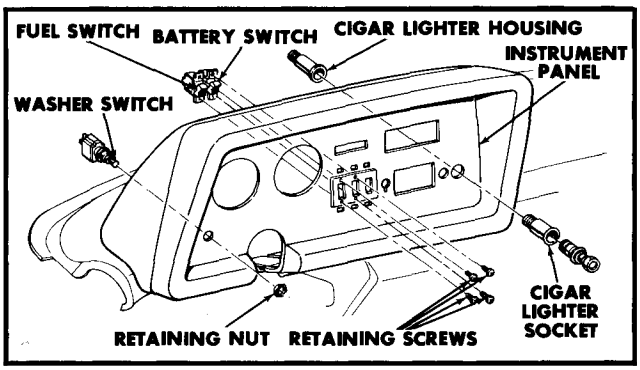


Figure 5—Battery and Fuel Switch Installation

2. Remove the (2) switch retaining screws shown in Figure 5.

3. Pull switch out as far as possible and disconnect the connector from the switch.

4. To install switch, reverse steps 1—3.

TELL-TALE LIGHT PANEL REPLACEMENT

1. Disconnect the battery ground cables.

2. Remove the instrument panel rear cover.

3. Disconnect the tell-tale light panel electrical connector.

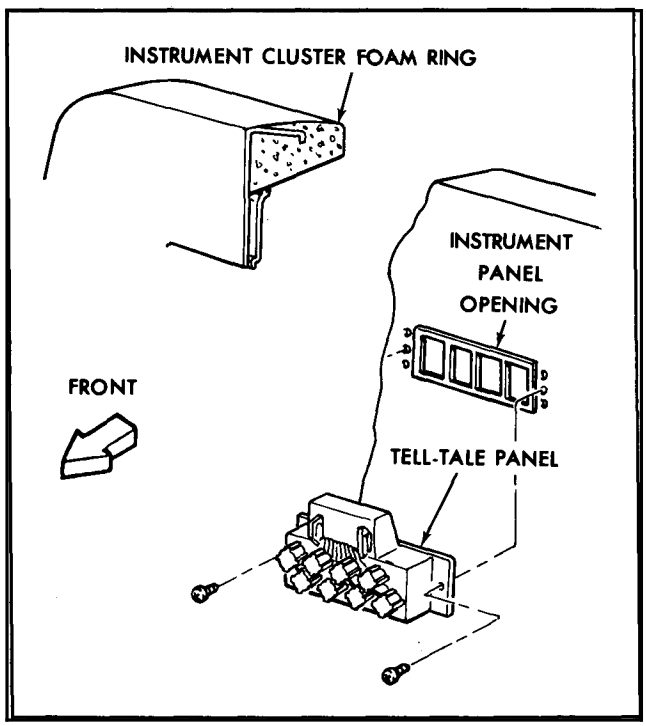


Figure 6—Tell-Tale Light Panel

4. Remove the (2) panel retaining screws and remove the panel (See figure 6).

5. To install, reverse steps 1—4.

CIGAR LIGHTER REPLACEMENT

1. Remove the element portion of the lighter from the instrument panel.

2. Disconnect the battery ground cables.

3. Remove the rear instrument panel cover by removing the (2) screws at each side of the rear panel cover. Lift rear panel cover up and work out of instrument panel.

4. Locate the cigar lighter connector and remove from lighter housing.

5. Turn the lighter housing (rear) counter-clockwise while holding the front portion, remove the lighter assembly when the (2) pieces disengage. (See figure 5)

6. To install lighter, reverse steps 1—5 and check operation.

SPEEDOMETER CABLE

The speedometer and odometer are driven by a gear train in the speedometer head, which is driven through a flexible shaft that is connected to the transmission. With cruise control, the speedometer cable is a two piece cable running from the speedometer head to the regulator unit and from there to the transmission.

Replacement

1. Disconnect the battery ground cables.

2. Remove rear instrument panel cover.

3. Disconnect speedometer cable from head by depressing spring clip and pulling cable core out of speedometer end of conduit.

NOTE: If cable is broken, it will be necessary to remove lower portions of cable from transmission end of conduit.

4. Lubricate cable with lubricant, then push cable into conduit. Connect upper end of cable to speedometer head and road test vehicle.

NOTE: Speedometer cable should be lubricated with AC Speedometer Cable lube ST-700 Part No. 6478535 or equivalent.

CIRCUIT BREAKERS, FUSES, AND FUSIBLE LINKS

GENERAL DESCRIPTION

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 is explained following:

CIRCUIT BREAKER

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 terminals, thus, indicating there is something wrong in the system. The circuit breaker will remain open until the trouble is found and corrected.

FUSE

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 fuse is a one-time protection, and replacement is required.

FUSIBLE LINK (FIGURE 7)

In addition to circuit breakers and fuses, the wir-

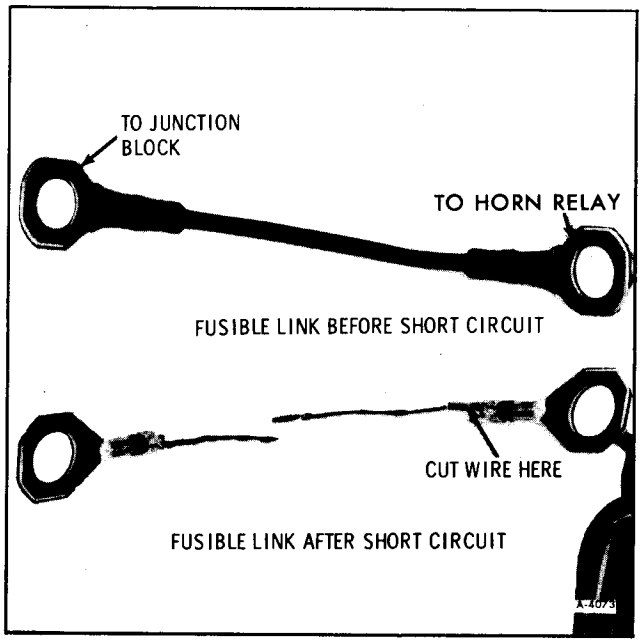


Figure 7—Fusible Link

ing harness incorporates fusible links to protect the wiring. Links are used rather than a fuse in wiring circuits that are not normally fused. Each link is four gauge sizes smaller than the cable it is designed to protect and are marked on the insulation with wire gauge size because the heavy insulation makes the link appear a heavier gauge than it actually is.

Fusible Link Replacement (Figure 8)

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 wiring harness.

3. Cut harness directly behind connector to remove damaged fusible link (figure 8).

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.

9. Connect battery ground cable.

CIRCUIT 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.

- 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.

- 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.

Location

The fuse panel, Figure 9, is mounted on the bulkhead panel behind the glove box assembly. To gain access to the fuse panel, open the glove box and unscrew the cover plate. Fuses and circuit breakers located on this panel are illustrated in Figure 10. Protective circuit devices exterior to the fuse panel are listed in the following chart:

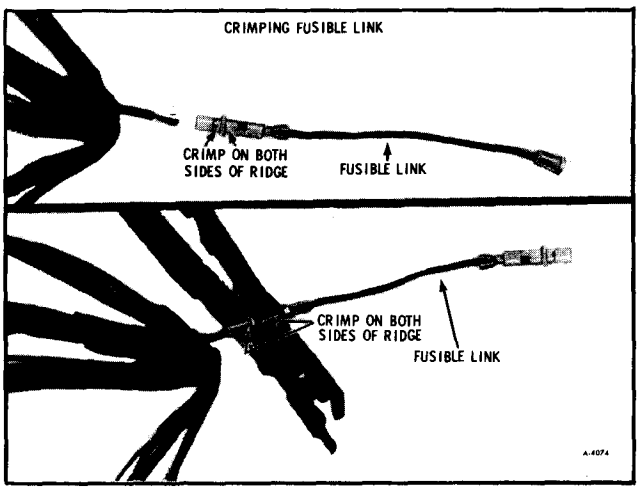


Figure 8—Fusible Link Replacement

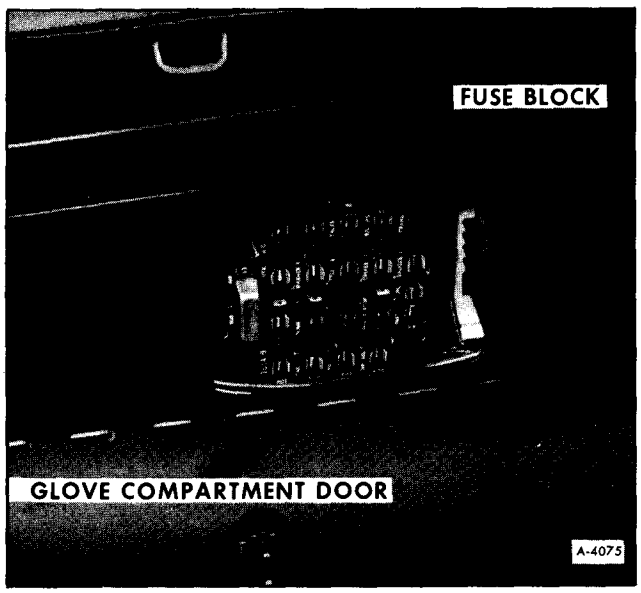


Figure 9—Fuse Panel Location

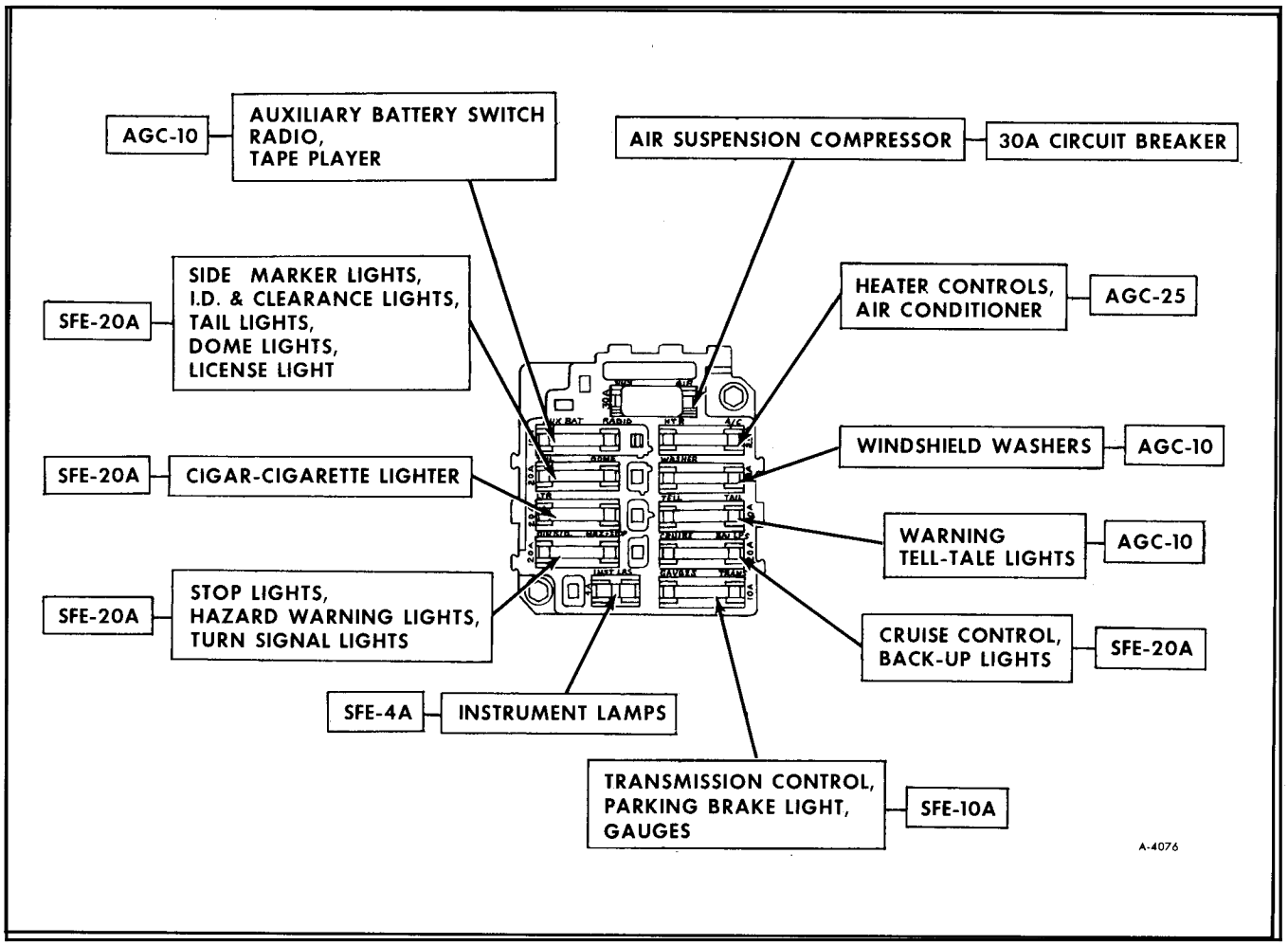


Figure 10—Fuse Panel

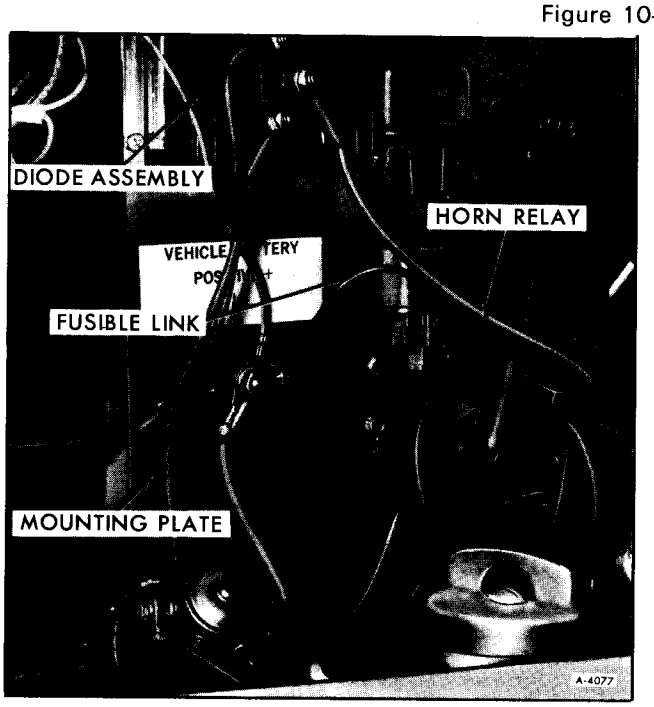


Figure 11—MotorHome Electrical Component Mounting Plate

NOTE: Use of fuses or circuit breakers having other than the specified amperage may result in damage to the circuit.

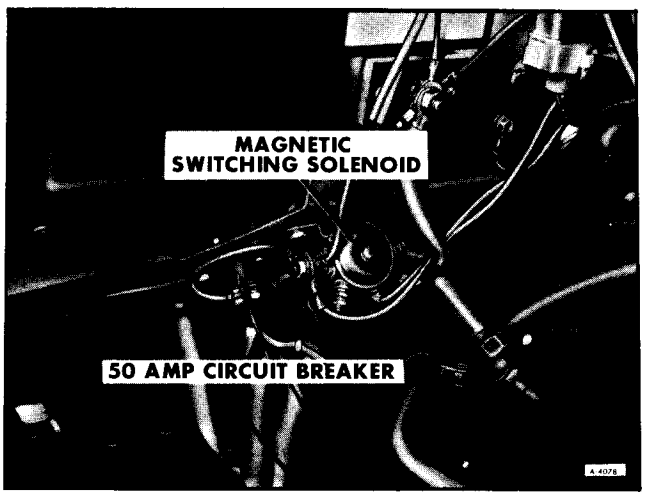


Figure 12—TransMode Electrical Component Mounting Plate

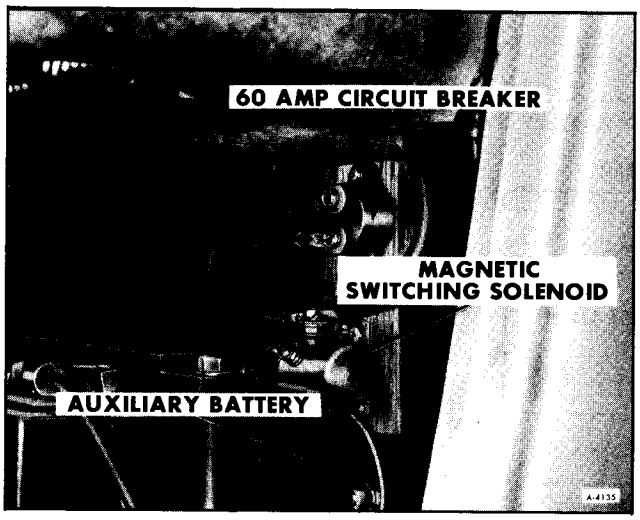


Figure 13—MotorHome Motor Generator Compartment

FUSES, CIRCUIT BREAKERS, FLASHERS EXTERNAL TO FUSE PANEL

Circuit	Location	Device
Headlight	Built into light switch.	Circuit Breaker.
Heater Blower Relay	Built into line at right access door near heater blower relay.	30 amp. fuse or fusible link
Warning and signal flasher	In clip behind instrument panel. Figure 28.	GM No. 673499
Vehicle trouble light	In line, behind access door, near light.	10 amp. fuse
Horn power feed circuit	In line, behind access door, near horn relay. Figure 11.	Fusible link
Auxiliary Battery (TransMode Only)	Engine compartment, dash, panel, upper right hand side. Figure 12.	50 amp. circuit breaker
Auxiliary (Living Area) battery (MotorHome Only)	Motor generator compartment. Figure 13.	60 amp. circuit breaker

PRINTED CIRCUITS

Printed circuits are used on the tell-tale lamp assembly, the speedometer and the gauge cluster to provide current for operation and illumination.

CHECKING CIRCUITS USING PRINTED CIRCUIT TELL-TALE LIGHT PANEL

Tell-tale printed circuit (figure 14) provides electrical contacts for illumination of various warning lights. Bulbs used in the tell-tale panel are listed in Specifications at the end of this section. To check the various tell-tale circuits proceed as follows:

a. Cruise control circuit (Refer to ENGINE & CHASSIS WIRING DIAGRAM).

1. Remove the instrument panel rear cover.

2. Remove the tell-tale light panel connector and remove the tell-tale panel.

3. With a continuity light, connect one probe of the test light to "41" of the printed circuit and the other probe to "920" with the cruise bulb in place. If the test light lights, the bulb and the circuit are good. If the test light does not light proceed to step 4.

4. If the test light does not light, remove the "920" bulb, "cruise" and check bulb, if bulb is good, problem is in the cruise tell-tale printed circuit board.

b. Door ajar.

1. With the tell-tale panel removed jump across the "925" and "41" terminals of the printed circuit with a self-powered test light.

2. If the test light lights, the circuit is good, if it does not proceed to step 3.

3. If the test light does not light, remove the "DOOR" bulb and check, if good, problem is in the printed circuit board.

c. Low air.

1. Follow the same procedure as described under "DOOR AJAR" circuit but use terminals "900" and "41".

d. Park Brake 1. Follow the same procedure as described under "DOOR AJAR" circuit but use terminals "75B" and "41".

e. Low Fuel

1. With the tell-tale panel removed, connect the test light probes between "929" and "150H", if test light lights circuit is good, if it does not, follow the same procedures explained under "DOOR AJAR" tell-tale.

f. Set Power Lever To Travel

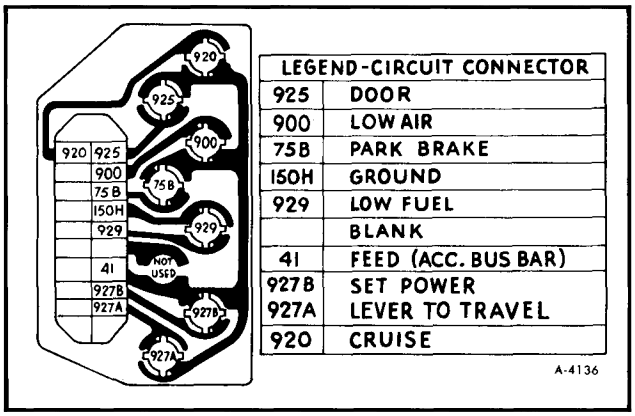


Figure 14—Tell-Tale Printed Circuit

1. Follow the same procedure outlined for "DOOR AJAR" circuit but use both "927B" and "927A" to check for continuity to terminal "41".

SPEEDOMETER CIRCUIT

The speedometer printed circuit shown in Figure 15 provides electrical paths for the hi-beam, turn indicator and illumination lamp. As can be seen from Figure 15 the "F" terminal of the circuit provides an illumination lamp and turn indicator lamp ground. In addition to the "F" terminal ground a separate L.H. side illumination lamp ground is provided through a printed circuit trace to the speedometer case. Illumination bulbs can be removed by turning them 1/4 turn and pulling out. They are accessible by removing the instrument panel lower access panel and reaching up to the speedometer head.

GAUGE CLUSTER

The fuel, engine temperature and oil pressure gauges are located in the gauge cluster. Connection is made to this gauge by a (7) pin connector which feeds a printed circuit shown in Figure 16.

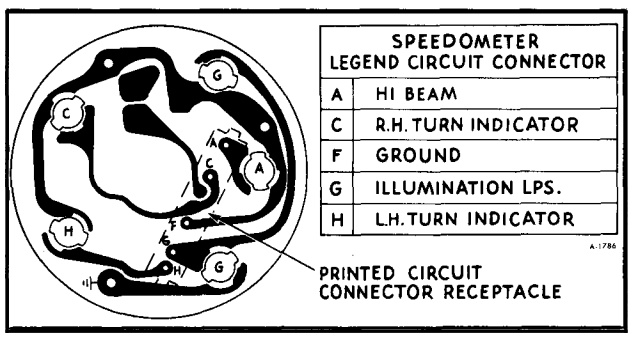


Figure 15—Speedometer Printed Circuit

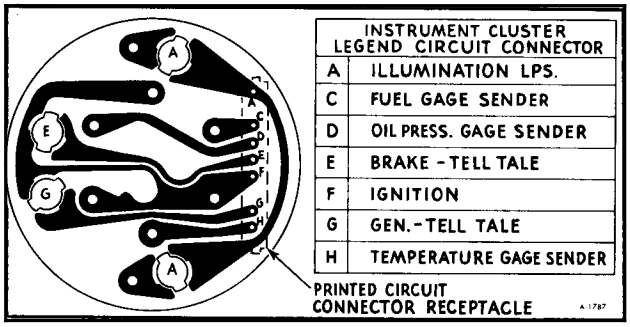


Figure 16—Gauge Cluster Printed Circuit

FUEL GAUGE

When checking the fuel gauge circuit, first determine whether the tank units, wiring, or fuel gauge is faulty. To check fuel gauge wiring, refer to Figure 19 for appropriate wiring harness connections. Connection at the gauge head is made through a printed circuit located at the rear of the gauge head.

The fuel tank selector switch position determines which tank level is being measured. When the fuel selector switch is moved to the "FUEL AUX" position, a coil in the fuel selector valve (figure 17) is energized. The energized coil closes off the fuel supply from the main fuel tank to the carburetor, and opens the fuel supply from the auxiliary tank to the carburetor. Simultaneously, the main fuel tank sending unit is switched to the auxiliary tank sending unit.

CAUTION: *When checking fuel tank gauge wiring, never apply 12-volt current directly to the fuel tank float unit body feed wire as this will destroy the units' resistive element.*

The fuel gauge shows the approximate fuel level in the main tank when fuel selector switch is in the "FUEL MAIN" position, and the fuel level in the auxiliary tank when fuel selector switch is in the "FUEL AUX" position. The pointer will indicate the correct levels, only when the ignition is in the "ON" position. Since both fuel tanks are interconnected the gauge is designed to read the same (with the switch in either position) until approximately 60% of the total fuel capacity has been used.

If a condition is present where the vehicle is run in the "MAIN" position and allowed to deplete fuel supply on gauge, then switching to "AUX" does not provide the reserve 7 to 9 gallon amount, it is possible the wiring connector (figure 17) near the frame rail and tanks has the wires crossed in connection. The wires in this connection should be color to color from each side of the connector. This condition can also be detected by running the vehicle with the switch in the "AUX" position, ---- the fuel supply is

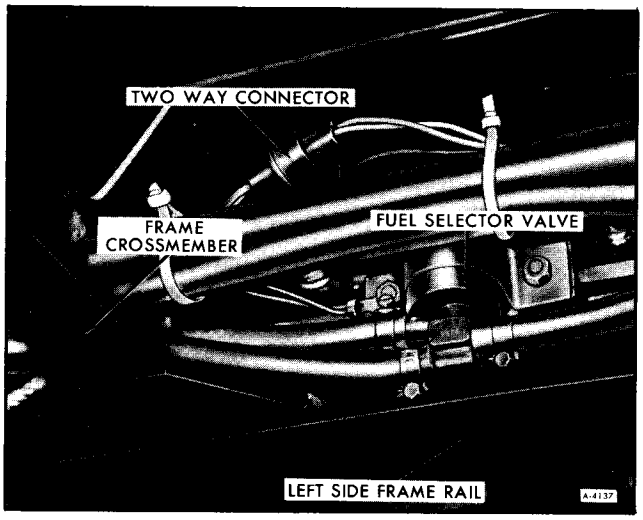


Figure 17—Fuel Selector Valve

almost depleted. Switching to the "MAIN" position provides a gauge reading of a greater amount.

Changing the fuel selector switch position changes the fuel selector valve and fuel gauge sending unit from the main tank, as it goes empty, to the auxiliary tank, which will contain approximately 7 to 9 gallons of fuel. The fuel selector valve is used only when the switch is moved from the "MAIN" to the "AUX" position. The valve is located inside the left frame rail, Figure 17, in front of the main fuel tank. Should the selector valve malfunction, it can be replaced as a unit.

FUEL GAUGE SYSTEM DIAGNOSIS

The following checks of the fuel indicator system will determine quickly whether incorrect fuel gauge readings are the result of an improperly operating fuel gauge, fuel tank sending unit or circuit wires. Refer to Figures 18 and 19 and also "Fuel Gauge Diagnosis Details" for fuel gauge system diagnosis.

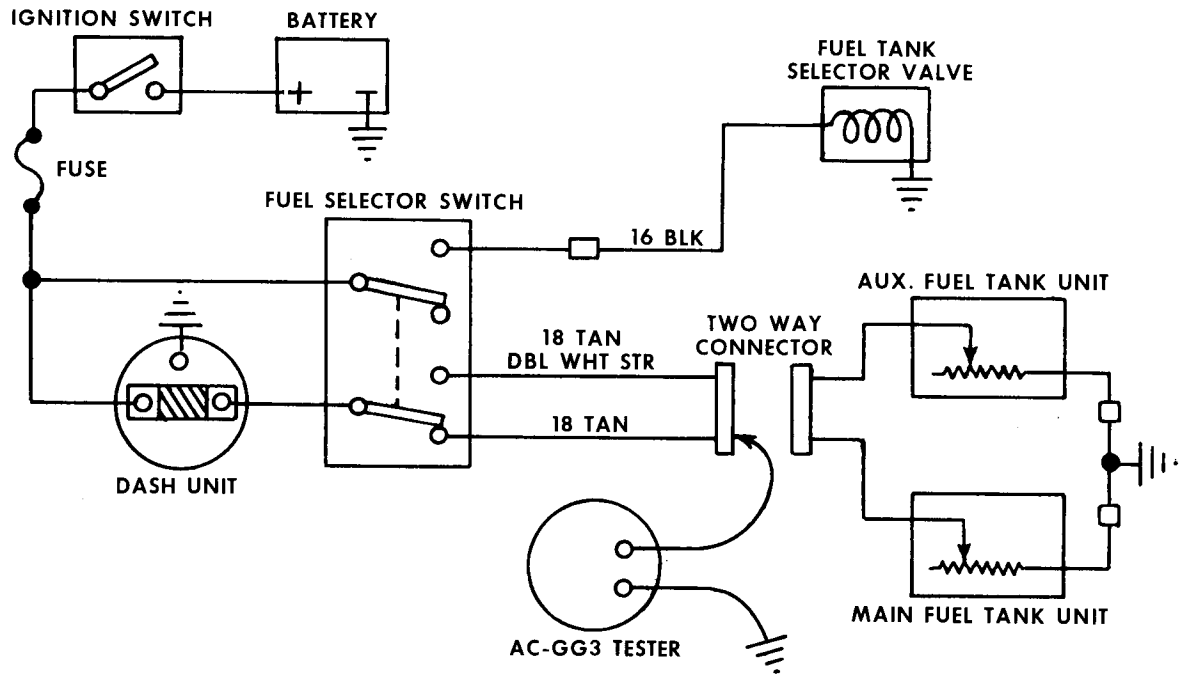
NOTE: The vehicle is equipped with two fuel tanks so be sure to diagnose the entire system. After "FUEL MAIN" portion of the circuit is checked, move the selector switch to "FUEL AUX." position and repeat the test.

GAUGE DIAGNOSIS DETAILS

ERRATIC FUEL GAUGE READINGS

Inspect all circuit wiring for damage to insulation or wire, also carefully check for proper electrical connection at the following locations:

1. Terminal connections at two-way connector to tanks.



With vehicle on a level surface, disconnect 2-way connector (located at left frame rail by fuel tanks). With fuel selector switch in "FUEL MAIN" position, insert GG3 Tester between wire to dash unit (18 Tan) and ground. Then perform the following test:

Position ignition switch in "ON." DO NOT START ENGINE.

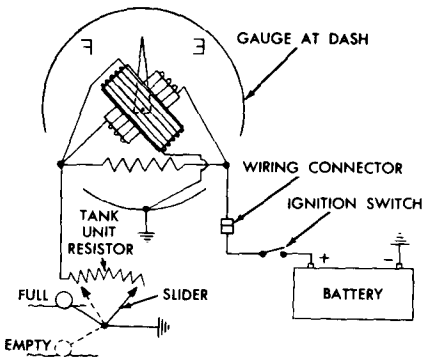
1. With tester knob set at "Continuity," lamp should glow.
2. With tester knob set at "0," dash unit should indicate "EMPTY."
3. With tester knob set at "90," dash unit should indicate "FULL."

4. If 1, 2, and 3 above are OK, inspect tank unit ground and wire to tank unit. Repair as necessary to insure good electrical connections and no shorts throughout.
5. If fuel gauge system is still not functioning properly after completing Step 4, replace tank unit.
6. If any one of 1, 2, or 3 are not OK, inspect wiring from ignition switch to the rear wiring connector (including grounds). Repair as necessary to insure good electrical connections and no shorts throughout.
7. If any one of 1, 2, or 3 are still not OK after completing Step 6, replace dash unit.

NOTE: After "FUEL MAIN" portion of circuit is checked, move selector switch to "FUEL AUX" position and connect GG3 to other side of 2-way connector (18 tan double white stripe) and repeat test.

A-4138

Figure 18—Fuel Gauge Switch Diagnosis (Method Using AC-663 Tester)



PROBABLE CAUSE	Reads 1/4 when empty or won't read empty	Reads accurately between "E" and 1/4; above 1/4 reads "F"	Needle does not move	Reads "E" all the time	Reads "F" all the time	Reads 3/4 when full or won't read full	Reads 1/4 when full	Reads too high for amount in tank	Erratic reading	SUGGESTED REMEDIES
1. Loose connection anywhere in circuit									x	Inspect and, if necessary, clean and tighten all connections in circuit
2. Poor dash fuel gauge calibration								x		Install new dash fuel gauge
3. Poor tank unit calibration								x		Install new tank unit*
4. Circuit grounded in resistor of tank unit						x	x			Install new tank unit*
5. Circuit grounded between tank unit resistor and dash gauge				x						Insulate grounded circuit
6. Circuit within dash gauge grounded.								x		Install new dash fuel gauge
7. Circuit grounded between battery and dash gauge.			x							Insulate grounded circuit
8. Open circuit between ignition switch and dash gauge			x							Clean and tighten appropriate terminals or repair broken wire
9. Open circuit between ground terminal on gauge and ground				x						Clean and tighten mounting bracket where contact is made between dash gauge and ground
10. Open circuit between sending unit terminal on dash gauge and resistor terminal on tank unit					x					Clean and tighten appropriate terminals or repair broken wire
11. Open circuit in resistor of tank unit at 1/4 full position		x								Install new tank unit*
12. Open circuit between tank unit slider resistor and ground					x					Install new tank unit*
13. Needle rubbing on face of gauge			x	x	x	x	x			Position needle to prevent contact with face or install new gauge
14. Fuel tank float hang-up	x		x	x	x	x	x			Free binding float or install new tank unit*
15. Top of fuel tank deformed						x				Straighten tank top or replace tank
16. Bottom of fuel tank deformed	x									Straighten bottom of tank or replace tank
17. Tank unit mounting flange bent	x					x	x			Straighten mounting flange or replace tank unit*

* Ignition switch must be "OFF" before removing tank sending unit, otherwise full battery voltage may destroy unit or ignite fuel vapors. For maximum safety, remove cable from negative battery terminal. A-1790

Figure 19—Fuel Gauge System Diagnosis

2. Ground connection—one-way connector from tank to ground.

3. Body harness connector—10-way connector at instrument panel.

4. Body harness connector to printed circuit at gauge.

5. Mounting screws holding gauge to panel.

6. Make sure gauge pointer is not contacting face of gauge or lens.

7. Fuel selector switch connections.

GAUGE ALWAYS REGISTERS FULL (WITH IGNITION SWITCH ON)

Most probable cause is an open circuit in wiring or tank unit.

1. Check ground wires from tank units to ground. If loose, clean terminals, reinstall and check gauge reading.

2. Connect a spare tank unit to tank wiring. Raise and lower the float arm slowly, observing the dash unit (Be sure selector switch is in the appropriate position).

a. If dash unit does not function an open circuit at dash or tank unit is indicated.

b. If dash unit follows the arm movement proceed to step 3.

3. Inspect the wire terminals at the tank unit after lowering the fuel tank. If connection is loose, clean terminals and reinstall wires. If gauge continues to register "FULL" (with tank empty), remove the tank unit. Reconnect the wiring with unit out of tank, including the ground and move float arm. If dash unit does not follow arm movement, replace the tank unit.

GAUGE ALWAYS REGISTER EMPTY (WITH IGNITION SWITCH ON)

Most probable cause is a grounded circuit in the wiring due to a pinched or cut wire, or shorted fuel gauge dash unit. Disconnect the tank unit feed wire at the tank. The dash unit gauge should now register FULL.

Gauge Continues To Read Empty

1. Remove the instrument panel rear cover.

2. Remove the fuel gauge wire from the 7-wire connector on the gauge head (GRAY/DBL BLACK STR).

3. Gauge should now read FULL. If the gauge continues to read EMPTY, replace the dash unit.

Gauge Now Registers Full

1. Connect a spare tank unit to the tank feed wire at the body harness connector and ground unit at flange to chassis with a jumper wire.

2. Raise and lower float arm assembly while observing the dash unit.

a. If dash unit still does not operate, replace the dash unit after a continuity check of printed circuit has been made.

b. If the dash gauge follows the float arm movement, check tank unit feed wire for insulation breakdown. If wire is okay, replace the tank unit.

3. Check tank unit for improper installation of fuel filter screen which could restrict float movement.

4. If dash unit still does not follow the tank unit arm movement, replace the tank unit.

WATER TEMPERATURE GAUGE

When checking the water temperature gauge circuit, determine whether engine temperature sending unit, wiring, dash unit or printed circuit is faulty.

To check the engine water temperature sending unit, proceed as follows:

1. Disconnect wire at engine unit.

2. Connect a test light consisting of a 12V-2 candle power bulb and a pair of test leads in circuit by clipping one lead to battery positive terminal and other lead to body of engine gauge unit. If bulb lights, unit is properly grounded. If bulb does not light, check for presence of sealing compound around threads of unit. Remove compound and repeat test.

3. Remove test lead from body of unit and connect lead to terminal of unit. If bulb lights, engine unit is internally shorted and should be replaced.

4. Remove test light and reinstall wire on terminal.

5. If engine unit tests satisfactory under previous conditions, check the following items according to nature of difficulty:

a. If gauge does not register with ignition on: this may be caused by a break in the circuit between the gauge and the switch through the printed circuit or a short between the connector lead and the ground (See figure 16).

6. If gauge shows high temperature under all conditions, wire leading from gauge to engine unit is shorted to ground.

7. If gauge registers a low temperature reading under all conditions, wire between gauge and engine unit is broken.

8. Dash unit replacement should be made after the previous checks have been made for trouble source.

Do not attempt to repair either the engine unit or the gauge. When installing new engine unit, do not use thread compound on unit threads, as this will increase electrical resistance of unit and cause faulty reading on gauge.

OIL PRESSURE GAUGE

An electric oil pressure gauge is used on all vehicles covered in this manual. A variable resistance sending unit is connected to an engine oil pressure gallery to vary the amount of resistance to ground with changes in engine oil pressure. Current is fed through the printed circuit on the back of the gauge (figure 16) from the wiring harness.

The oil pressure gauge can be checked for cause of difficulty using the following procedure:

1. Connect test lamp of not more than 2 candle power between battery positive terminal and the body of the sending unit. If lamp fails to light, the unit is not grounded, the threaded hole and threads on the unit should be checked for metal-to-metal contact. If the lamp lights the unit can be considered properly grounded. When replacing sending unit do not use compound on threads.

2. Remove the wire from the unit terminal and connect the test lamp between the unit terminal and the battery positive terminal. If the lamp lights, start engine and observe if the lamp changes intensity. A satisfactory unit will change the lamp intensity with changes in engine oil pressure. (DO NOT USE A LAMP OF OVER 2 candle power).

3. Connect the wire and check wiring for open circuit between unit and connector at the back of gauge head.

4. Check for continuity in printed circuit trace.

5. If no defective wiring or connections exist and sending unit checks out satisfactory, replace dash unit.

NOTE: No attempt should be made to repair either the gauge or the sending unit.

6. Refer to Figure 20 for further gauge diagnosis information.

LOW-FUEL INDICATOR CIRCUIT

The optional low fuel tell-tale indicator used on vehicles covered by this manual is activated by a voltage sensitive switch. As the fuel tank float changes position, a change in the tank unit circuit voltage is sensed by the low fuel switch. At a predetermined value, the switch will turn the low fuel light on, alerting the operator of the low fuel level. The low fuel switch is replaced from the rear of the instrument panel and is connected to the wiring harness through a 4 wire connector. Low fuel switch wiring is shown in Figure 21.

The low fuel switch can be checked for satisfactory operation by using the following procedure:

1. Locate the fuel tank unit feed wire and connect to ground.

2. Turn ignition switch to "ON".

3. Fuel gauge should read "EMPTY" and "low fuel" light in the tell-tale panel should be on. A low fuel condition is considered at approximately 1/16 to 1/8 tank level.

4. If light does not come on, check tell-tale bulb and replace if necessary.

5. If light still does not come on, check fuse panel (figure 10) for possible blown fuse at the "GAUGES" location.

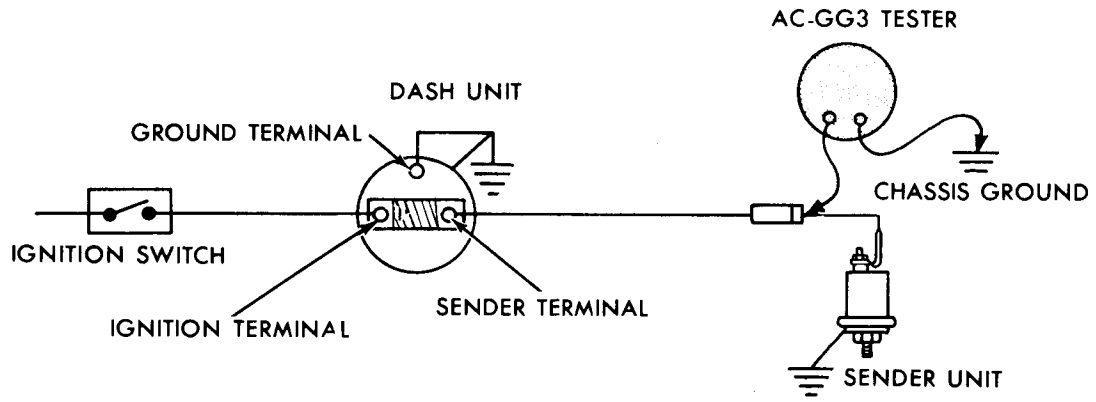
6. Check switch wiring to fuel selector switch and to ground, if wiring is satisfactory and light still does not light, replace low fuel switch.

If low fuel indicator light remains on at all times when tank level is above the 1/16 to 1/8 level, replace the low fuel switch.

MISCELLANEOUS

DOME LIGHT SWITCH

The dome light switch, located on the speaker-



Disconnect wire from sender unit and attach AC-GG3 tester between this wire and chassis ground.

Position ignition switch to "ON." DO NOT START ENGINE.

1. With tester knob set at "Continuity," lamp should glow.
2. With tester knob set at "0," dash unit should indicate "0" psi.
3. With tester knob set at "90," dash unit should indicate "full scale" pressure.

4. If 1, 2, and 3 above are OK, clean sender terminal to insure good electrical contact with wire and make sure sender unit is grounding to engine.

5. If pressure gauge system is still not functioning properly after completing Step 4, replace sender unit.

6. If any one of 1, 2, and 3 are not OK, check wiring and all connections (including grounds).

7. If any one of 1, 2, and 3 are still not OK after completing Step 6, replace dash unit.

A-1791

Figure 20—Engine Oil Pressure Gauge Diagnosis (Method Using AC-663 Tester)

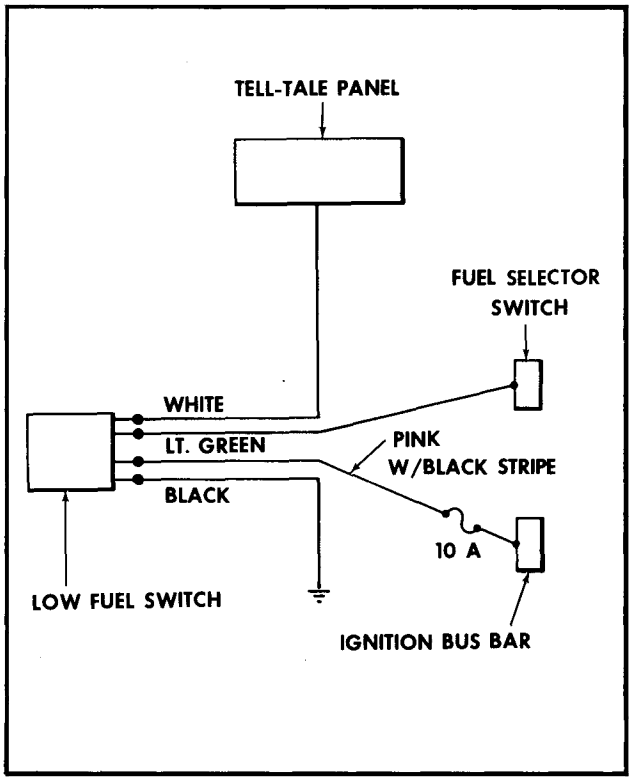


Figure 21—Low-Fuel Indicator Switch Circuit

dome light panel is a three position switch with the following functions:

1. Lamp operation (for that particular side) controlled by the headlight switch.

2. Lamp off, regardless of headlight switch position.

3. Lamp on, regardless of headlight switch position.

Switch Replacement

1. Disconnect the battery ground cables.

2. Remove the (4) dome light panel retaining screws.

3. Remove the (2) switch retaining screws.

4. Disconnect the dome lamp switch harness connector.

5. Remove the dome light switch.

6. To install, reverse steps 1—5 and check operation.

WINDSHIELD WASHER SWITCH

The windshield washer switch is a spring loaded switch which returns to the off position when the toggle is released. This switch supplies power to the windshield washer pump for pumping of washer solvent onto the windshield.

Switch Replacement

1. With a flat blade screwdriver engage the switch ring with the screwdriver blade while holding the back side of the switch (See figure 2).

2. Remove the retaining ring from the switch and bring the switch down to a more accesible position.

3. Disconnect the wiring harness connector from the switch.

4. Remove the switch from the panel.

5. To install, reverse steps 1—4, and check operation.

IGNITION SWITCH

The ignition switch is mounted on the right-side of the steering column. In addition to the steering column and shift lever lock feature, when the entrance door is open a buzzer located behind the left-hand engine access door would remind the driver to remove the key from the ignition switch. Replacement procedures for the ignition switch are covered in STEERING (SECTION 9) of this manual.

LOW AIR WARNING LIGHT AND BUZZER

The power level option consists of two, in-line

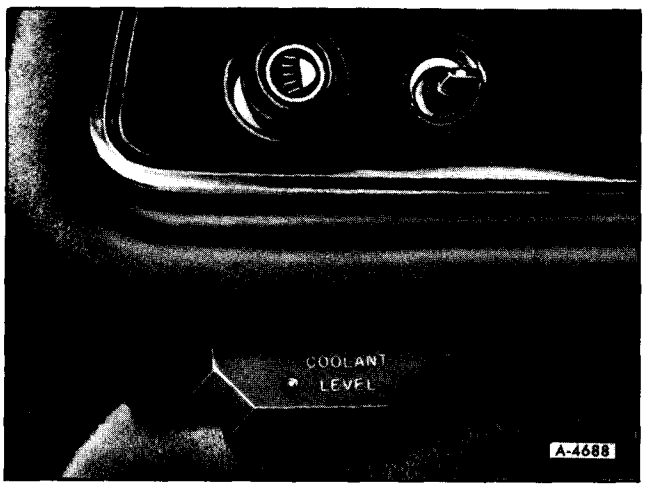


Figure 22—"Coolant Level" Indicator, Module Location

valves which override the height control valve. These valves allow the operator to raise or lower each side of the rear suspension by adjusting the controls located to the right of the steering wheel at the lower portion of the dash panel. A warning light (located in the tell-tale warning light panel) and buzzer (located behind the instrument panel, Figure 26, remind the operator to set the power level controls to the "TRAVEL" position before driving the vehicle. A 30 amp circuit breaker, located in the fuse panel, protects the electrical system. For diagnosis and repair procedures, see Section 4, Rear Suspension.

HEATING AND AIR CONDITIONING

The heating and air conditioning control circuit is protected by a 25 amp fuse located in the fuse panel. The heater blower uses either a 30 amp fuse or a fusible link (later models). Both the fuse or the fusible link are installed as part of the heater wiring harness. The heater blower relay is mounted above the horn relay on the electrical component mounting plate, refer to Figure 42. Diagnosis and component replacement are discussed in Section 1, Body, Heating and Air Conditioning.

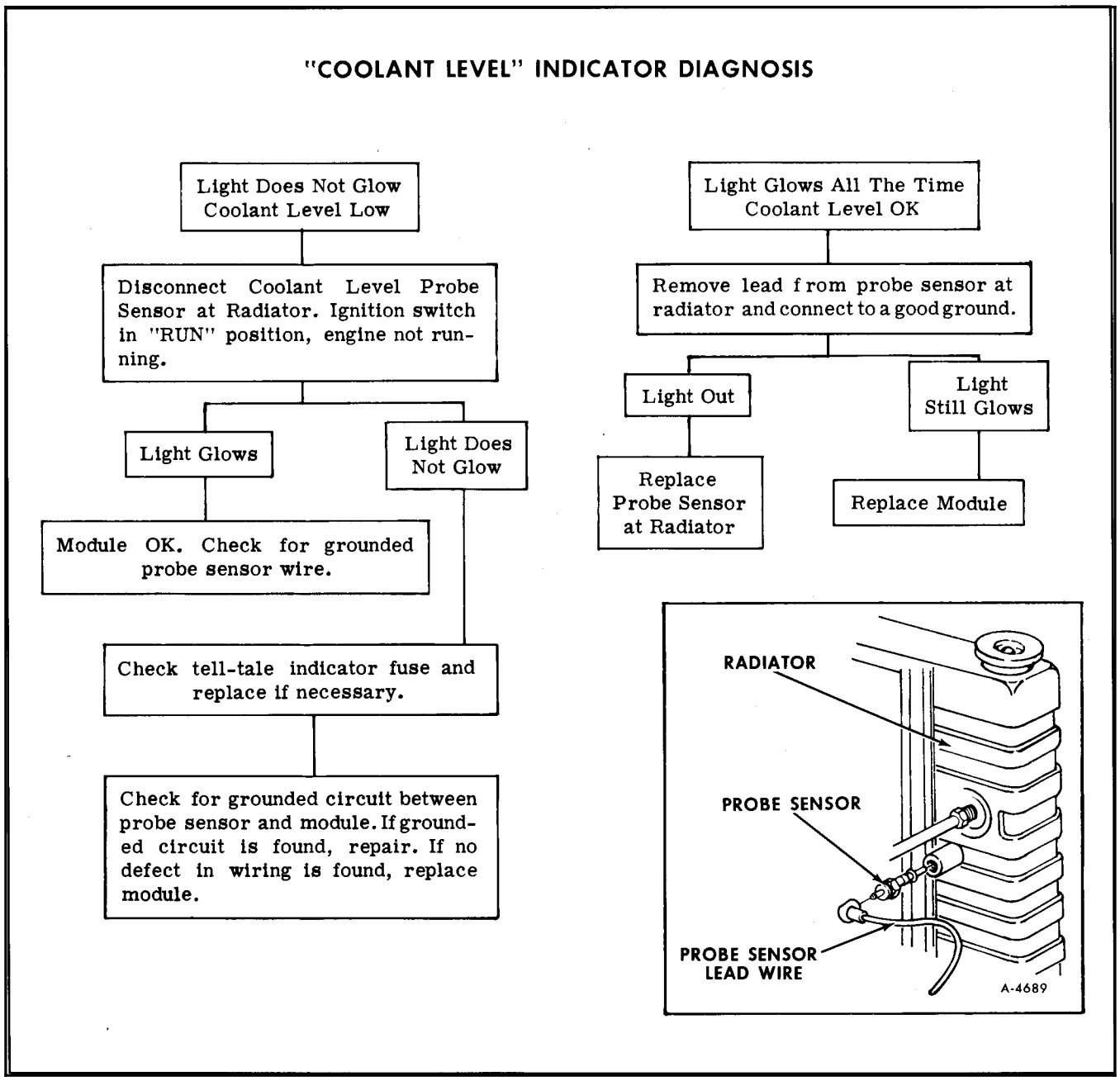


Figure 23—"Coolant Level" Indicator Diagnosis

DIODE ASSEMBLY

The GMC Dual Battery System provides power from two batteries to the vehicle's 12-volt electrical system either in combination or singularly. The components used to provide charging and/or switching are conventional, except for the diode assembly with which both batteries will receive charging current whenever the vehicle is running. The diode assembly has separate outputs to the two batteries and provides isolation between the batteries and their associated circuits whenever the engine is not running. The diode assembly is located above the battery junction block stud on the electrical component mounting plate. See Figure 11.

Testing the Diode Assembly

With the engine running, measure the voltage at the generator terminal of the diode assembly (voltmeter connections from terminal to graound). This reading should be between 13.6 and 15.0 volts. Now measure the voltage from each battery terminal to ground. These two battery terminal readings should be within .3 volts to .5 volts of the generator terminal reading. If they are not, replace the diode assembly.

"COOLANT LEVEL" INDICATOR

In MotorHomes equipped with a "Coolant Level" indicator, the indicator module is located to the lower left of the dash panel, as shown in Figure 22. The indicator light is designed to glow when a cooling system low water condition occurs in the radiator of the vehicle. See servicing details before refilling coolant as discussed in Section 13, RADIATOR AND COOLANT RECOVERY SYSTEM. If "Coolant Level" indicator system malfunctions, refer to "Coolant Level" Indicator Diagnosis chart, Figure 23.

Module Replacement

1. Remove module from dash panel by removing two securing screws.

2. Disconnect electrical connector from module.

3. Installation of replacement module is reverse sequence of removal.

Probe Sensor Replacement

1. Disconnect lead wire from probe sensor.

2. Unscrew probe sensor from radiator.

3. Install replacement probe sensor in reverse sequence of removal. Torque probe sensor to 25-30 in. lbs.

WIRING

GENERAL MAINTENANCE

Loose or corroded connections may cause a discharged battery in addition to difficult starting, dim lights and possible generator or regulator damage. A periodic check for clean and tight connections is important for dependable electrical system operation.

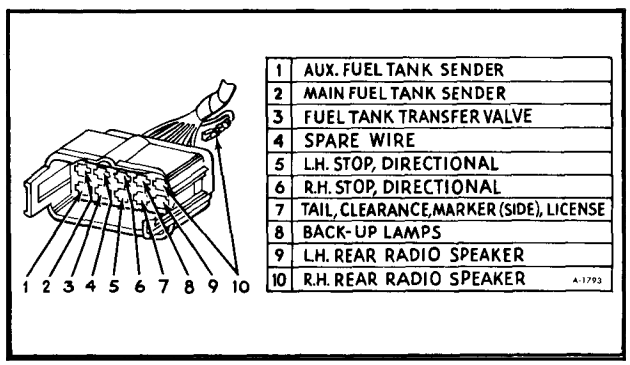


Figure 24—Left-Side Body Wiring Connector

Wires and/or 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 rosin flux solder to join the wires and insulating tape to cover the spice on bare wires. Circuit tests for continuity can be made by referring to ENGINE AND CHASSIS WIRING DIAGRAM.

When replacing wire, it is important that the correct gauge be used.

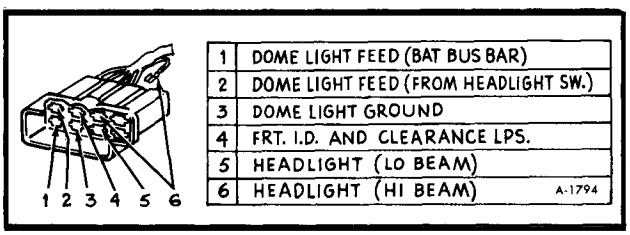


Figure 25—Front Roof Wiring Connector

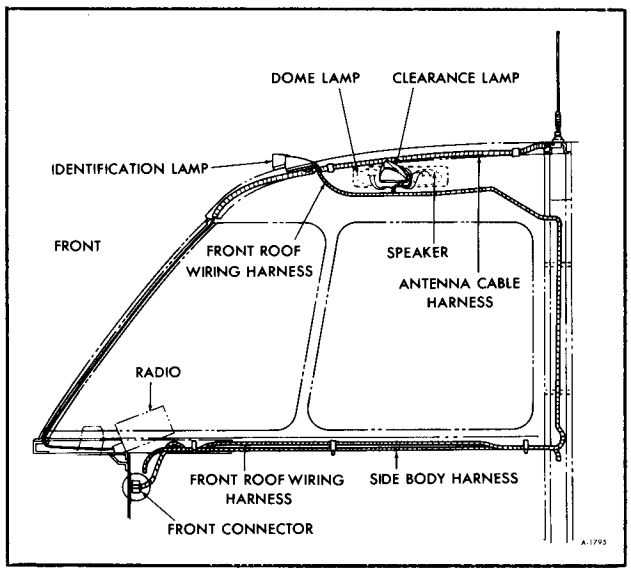


Figure 26—Front Wiring (Roof)

NOTE: Never replace a wire with one of a smaller size. Fusible links in the wiring are four gauge sizes smaller than the wire it is designed to protect.

Fusible links are marked on the insulation with wire gauge size because of the heavy insulation which makes the link appear a heavier gauge 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, circuits may be tested for continuity or shorts with a conventional test lamp or voltmeter.

LEFT-SIDE BODY WIRING

Wiring for rear lighting, fuel tanks and rear speakers passes through a (10) way multiple connector located in the front L.H. corner of the instrument panel. Rear lighting circuits can be checked for continuity through the female portion of this connector. Figure 24 shows the (10) way multiple connector and the appropriate wire position in the connector body. Refer to the vehicle wiring diagram for wire size and code used in the rear end wiring.

FRONT WIRING

Dome lights, headlamps and front clearance lights are fed through an (8) way multiple connector located under the instrument panel. The front lighting wiring is part of the instrument panel wiring harness. Figure 25 shows the female portion of the front lighting harness and the appropriate wire position in the connector body.

Front wiring for front clearance, indentification, dome lamps and front speakers is shown in Figure 26. Door jamb switch wiring is found on the right hand side of the vehicle and is shown in Figure 27.

INSTRUMENT PANEL WIRING

Wiring to the instrument panel is made through multiple terminal connectors at the tell-tale panel,

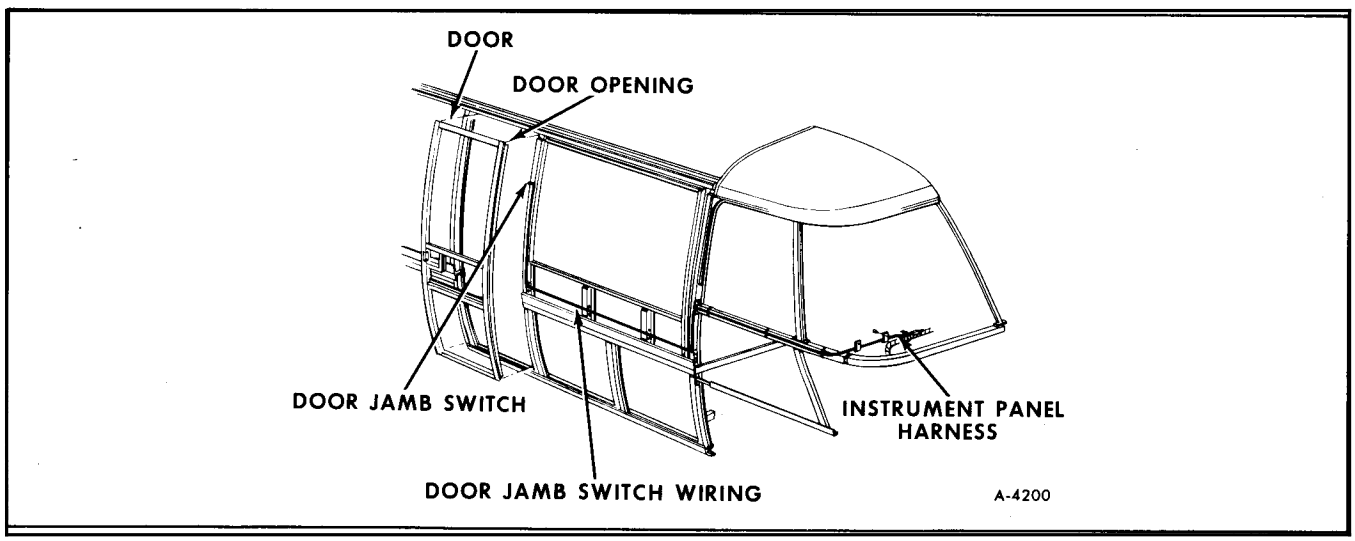


Figure 27—Door Jamb Switch Wiring

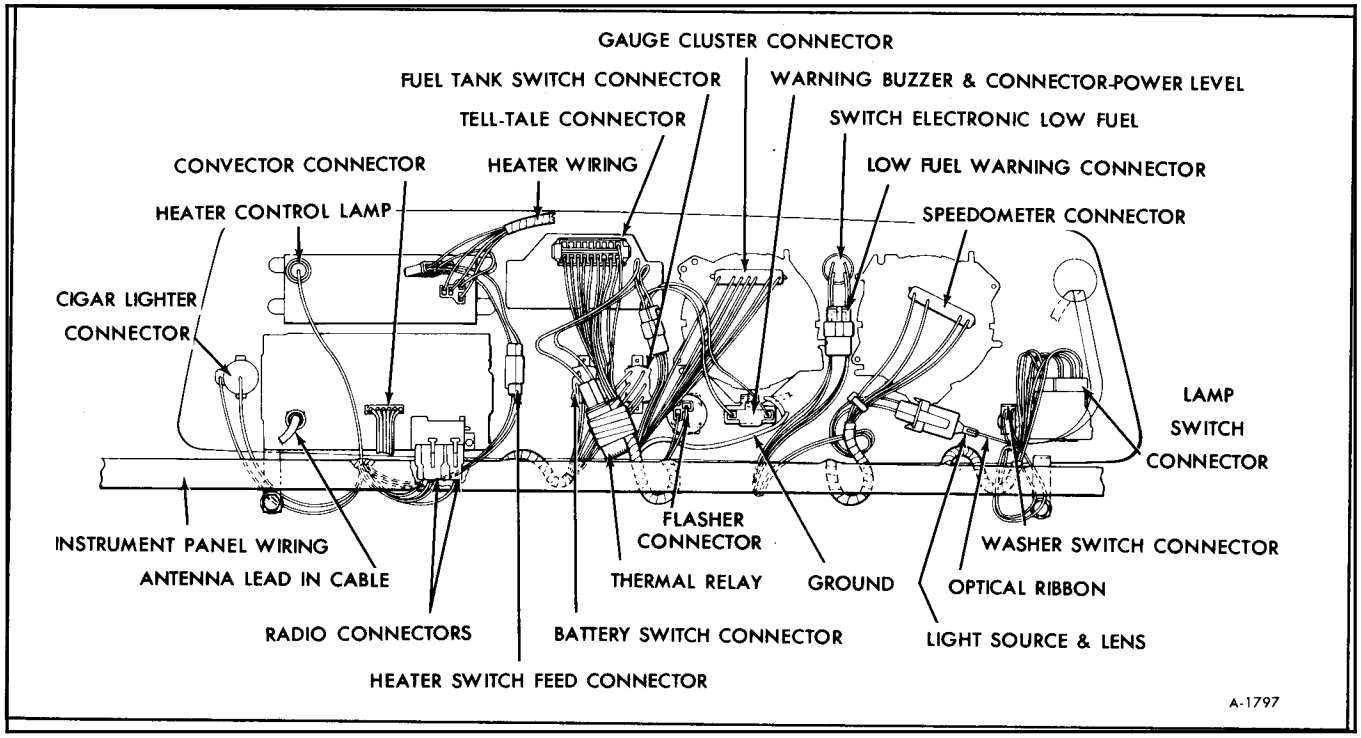


Figure 28—Instrument Panel Wiring (Typical)

speedometer, headlight switch and cluster gauge. Figure 28, instrument panel, shows instrument wiring and proper connector location.

Radio wiring for AM and AM-FM Mono models is shown in Figure 29. Refer to ENGINE AND CHASSIS WIRING DIAGRAM for wire size and color application for instrument panel wiring.

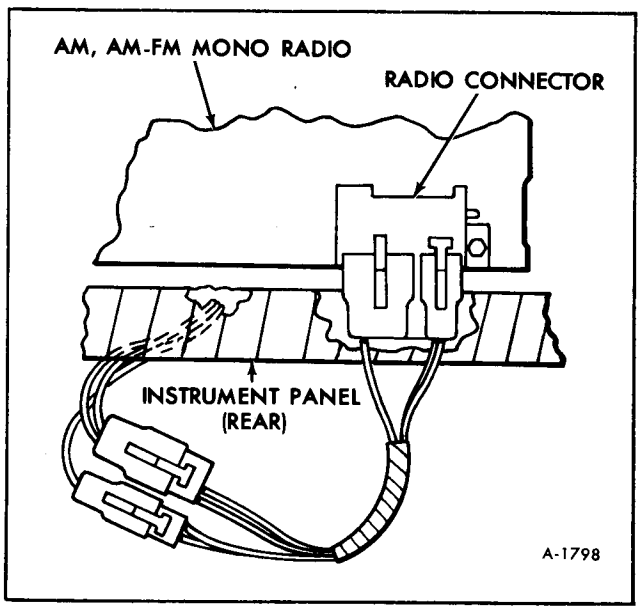


Figure 29—AM, AM-FM Mono Radio Connector

STEERING COLUMN WIRING

Connections for directional signals, ignition switch, neutral safety switch, back-up lamps and power leveler warning are shown in Figure 30. These connectors are located on the steering column. Refer to vehicle wiring diagram for applicable wire size and color.

REAR BODY WIRING

Wiring for rear identification and clearance lamps along with rear speakers is fed around the rear of the body through a plastic loom. This harness is connected to the side body through a 6-way multiple connector located in the L.H. rear corner of the vehicle (See figure 31). Refer to ENGINE AND CHASSIS WIRING DIAGRAM for applicable wire size and color code.

TRAILER WIRING

The optional trailer wiring is installed as shown in Figure 32. This connection is made between the L.H. side body harness and the rear body harness at the L.H. rear corner of the vehicle.

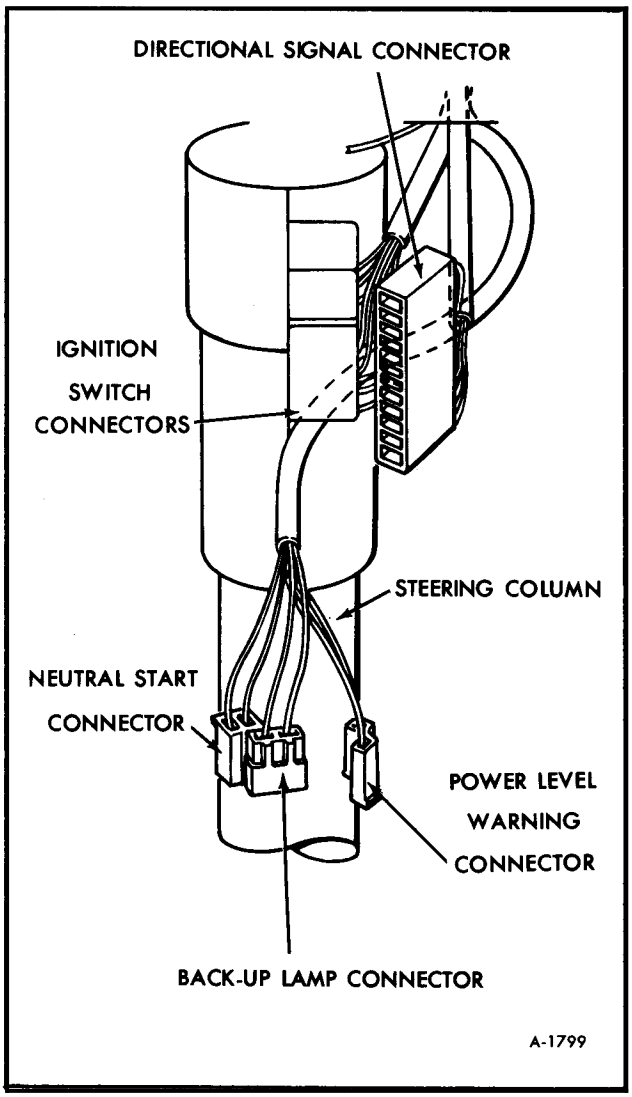


Figure 30—Steering Column Wiring

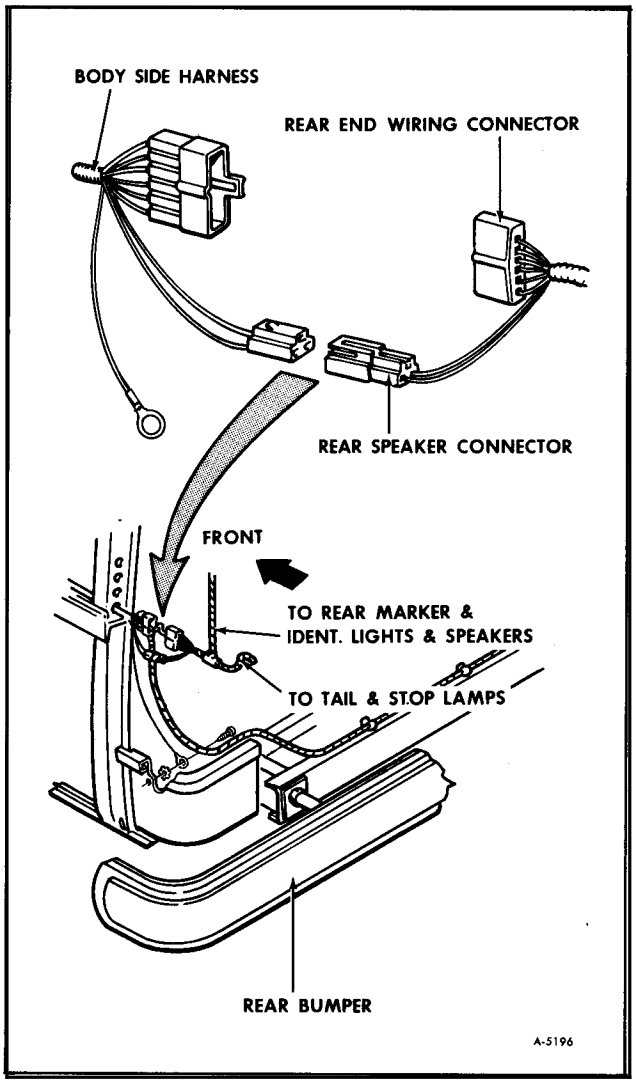


Figure 31—Rear Body Wiring

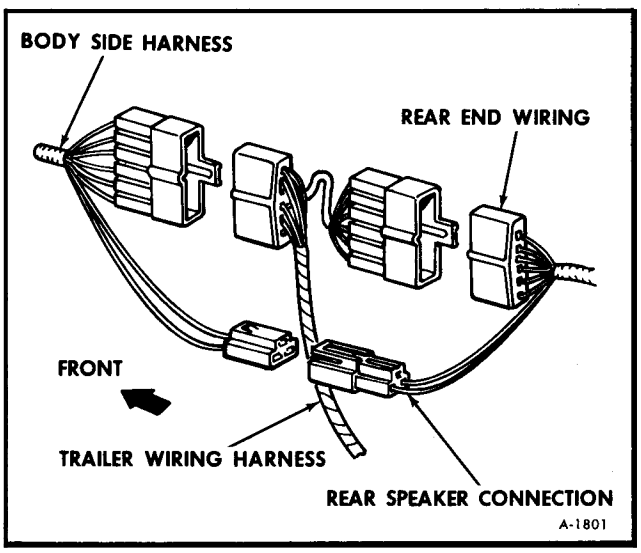


Figure 32—Trailer Wiring

LIGHTING SYSTEM

GENERAL INFORMATION

The lighting system includes the main light switch, stop light switch, dimmer and back-up lamp switchs, head and parking lamps, stop, tail, side marker, clearance and identification lamps, porch light; instrument illumination, directional signal and indicator lamps and necessary wiring to complete the various circuits.

All vehicle models use a single 7-inch single sealed-beam unit type headlight, all other lights are a replaceable bulb type. Refer to "Light Bulb Specifications" at the end of this section for bulb number.

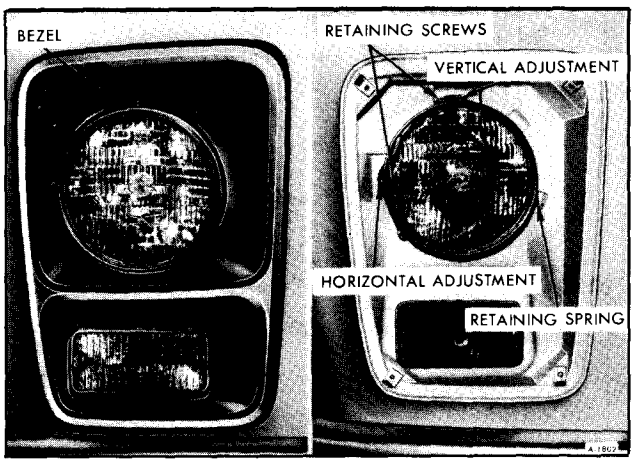


Figure 33—Headlamp Adjustment

HEADLAMP ADJUSTMENT

The headlamps must be properly aimed to obtain maximum road illumination. Proper aiming should be checked whenever a sealed beam unit is replaced or after any repair of the headlamp socket assembly. Regardless of the method used for checking headlamp aim, the vehicle must be at normal ride height, that is with gas, water and passenger weight most frequently traveled with.

NOTE: Some states have special headlamp aiming requirements which must be known and followed.

Horizontal and vertical aiming of each sealed beam is provided by two adjusting screws which move the mounting ring against the retaining spring tension (figure 33).

HEADLAMP REPLACEMENT (FIGURE 34)

1. Remove (4) headlamp bezel retaining screws.

2. Disengage spring from retaining ring.

3. Turn headlamp unit to disengage assembly from headlamp adjusting screws.

4. Disconnect wiring harness connector located at the rear of the sealed beam assembly.

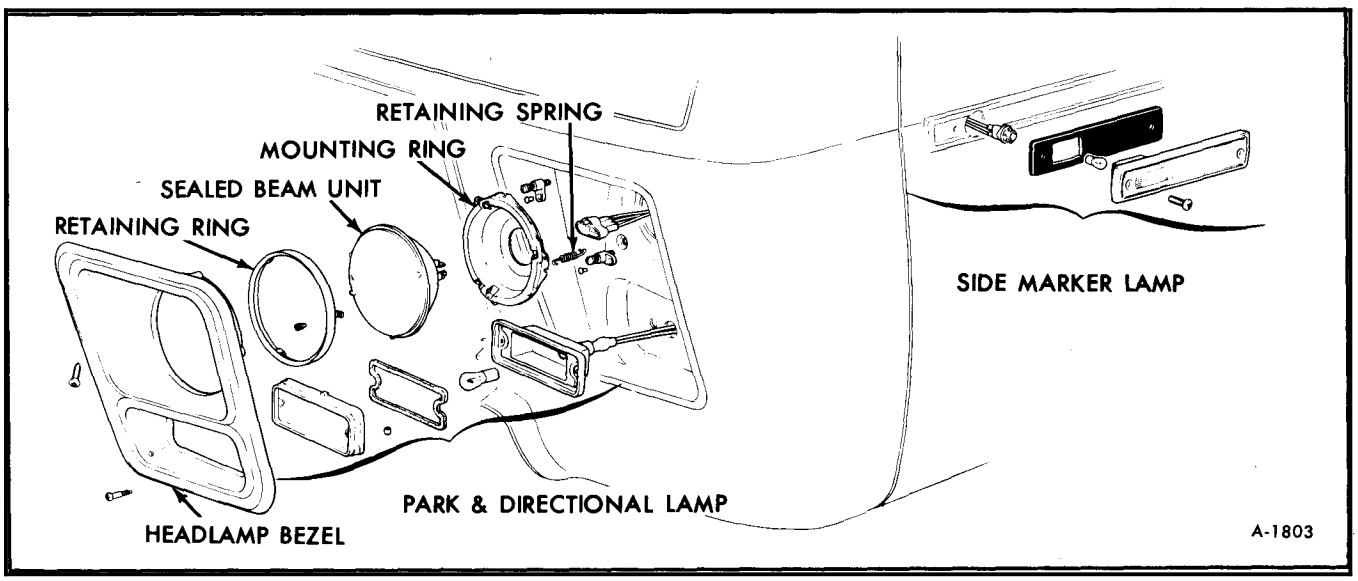


Figure 34—Headlamp and Side Marker Lamp Installation

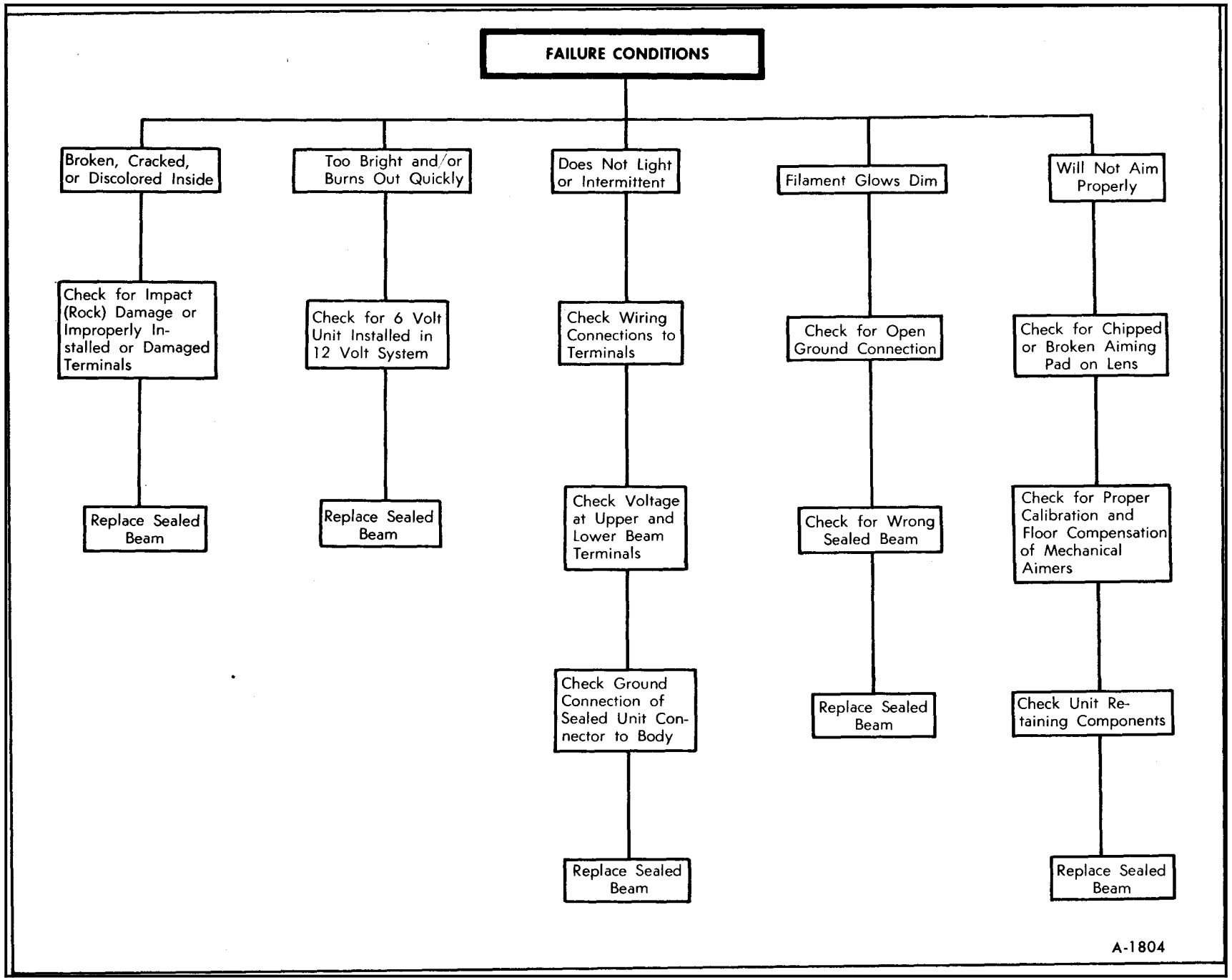


Figure 35—Headlamp Diagnosis

NOTE: Do not disturb adjusting screw setting.

5. Remove retaining ring and headlamp from mounting ring.

6. Position new sealed beam unit in mounting ring and install retaining ring.

NOTE: The number molded into lens face must be at the top of the bulb.

7. Attach wiring harness connector to unit.

8. Install headlamp assembly in panel opening, turning slightly to engage mounting ring tabs with adjusting screws.

9. Install headlamp retaining ring spring and check lamp aiming if adjusting screws have been turned.

10. Install headlight bezel with the (4) retaining screws.

HEADLAMP DIAGNOSIS

For details on headlamp diagnosis, refer to Figure 35. Additional diagnosis information is covered later in this section under "Headlight Switch".

COMPONENT REPLACEMENT

PARKING AND DIRECTIONAL SIGNAL BULB (FRONT) REPLACEMENT (FIGURE 34)

1. Remove (2) lens retaining screws and remove lens from housing.

2. Replace bulb and check operation. See Specifications at the end of this section for bulb No.

3. Install lens and retaining screws.

SIDE MARKER LAMP BULB (FRONT AND REAR) REPLACEMENT (FIGURES 34 and 36)

1. Remove (2) marker lamp retaining screws and remove lens.

2. Replace bulb and check operation. See Specifications at the end of this section for bulb No.

3. Install lens and retaining screws.

TAIL, STOP, BACK-UP AND DIRECTIONAL SIGNAL BULB REPLACEMENT (FIGURE 36)

1. Remove (4) lens retaining screws and remove defective bulb.

2. Replace bulb and check operation. See Specifications at the end of this section for bulb No.

3. Install lens and retaining screws.

NOTE: Check for proper positioning of lamp assembly felt drain plug (See figure 36).

LICENSE PLATE BULB REPLACEMENT (FIGURE 36)

1. Remove (2) outermost screws in license lamp lens.

2. Replace bulb and check operation by turning parking lamp on. See chart for bulb No.

3. Install lens with the (2) retaining screws.

CLEARANCE AND IDENTIFICATION BULB (FRONT AND REAR) REPLACEMENT (FIGURE 37)

1. Remove lens, retaining screw, and then remove lens.

2. Replace bulb and check operation. See Specifications at end of this section for bulb No.

3. Install lens and retaining screw.

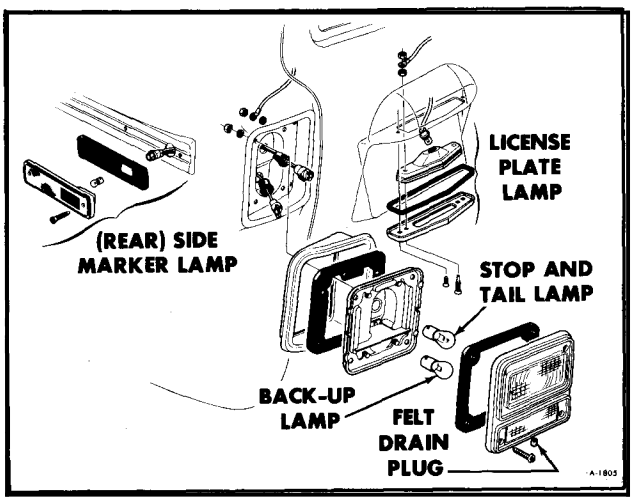


Figure 36—Tail, Stop, License and Rear Side Marker Lamps

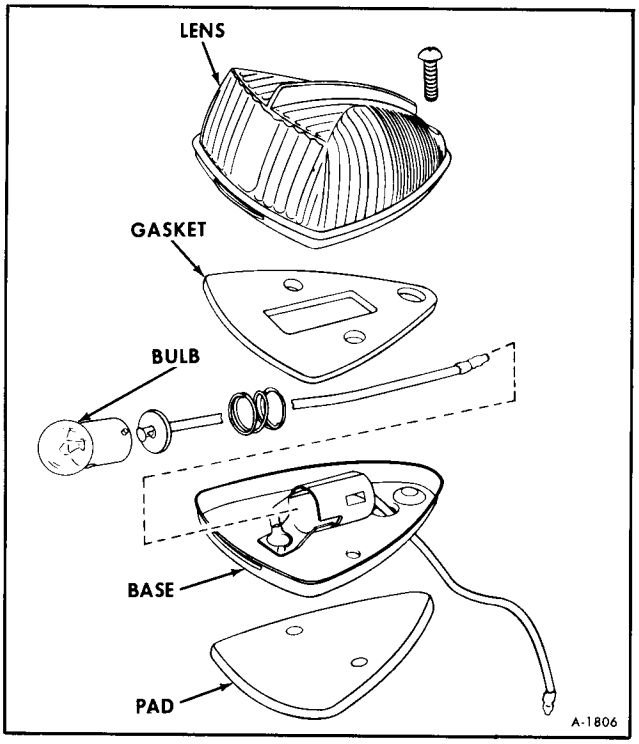


Figure 37—Clearance and Identification Lamp

DOME LAMP BULB REPLACEMENT (FIGURE 38)

1. Remove dome lamp lens by gently prying with flat blade screwdriver between lens and housing.

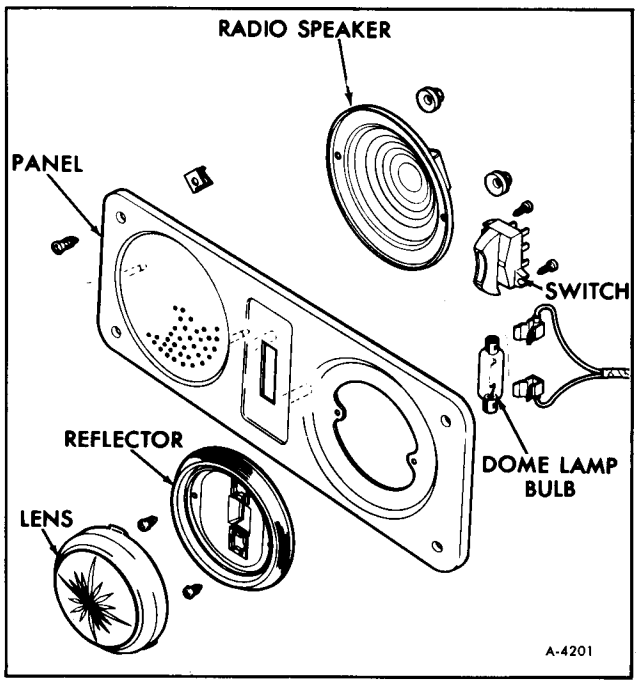


Figure 38—Dome Lamp Installation

2. Replace bulb and check operation. See chart for bulb No. at the end of this section.

3. Snap dome lamp lens back into position by pushing lens as far as possible in housing, locking tabs will hold the lens in place.

ENGINE COMPARTMENT LAMP BULB REPLACEMENT

1. Remove the (2) lens retaining screws and then remove lens.

2. Replace bulb and check operation.

3. Install lens and retaining screws.

FIBER OPTIC RIBBON

Lighting for windshield wiper control, main light switch and washer switch is transmitted through a fiber optic ribbon from a main source bulb located on the L.H.side of the lower instrument panel cover. The ribbon should remain with the instrument panel bezel when the bezel is removed. The source bulb housing can be separated from the wiring harness to free the optic ribbon and permit bezel removal (See figure 39). Bulb number is listed in "Specifications" at the end of this section.

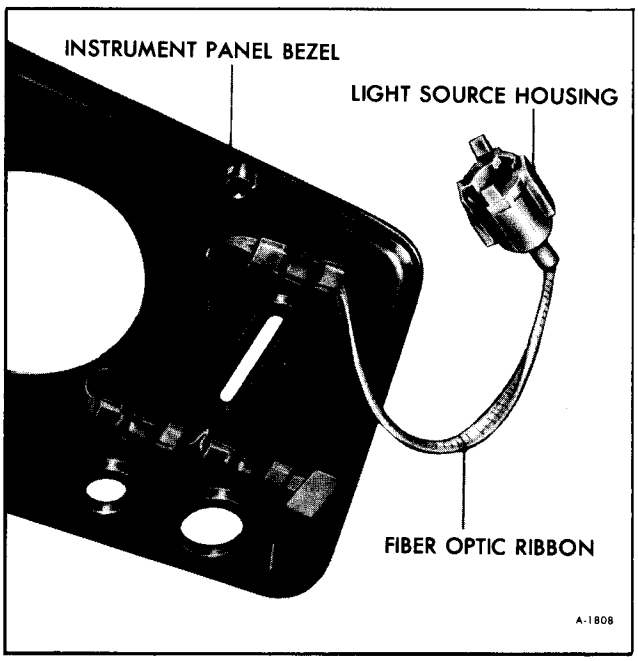


Figure 39—Fiber Optic Ribbon

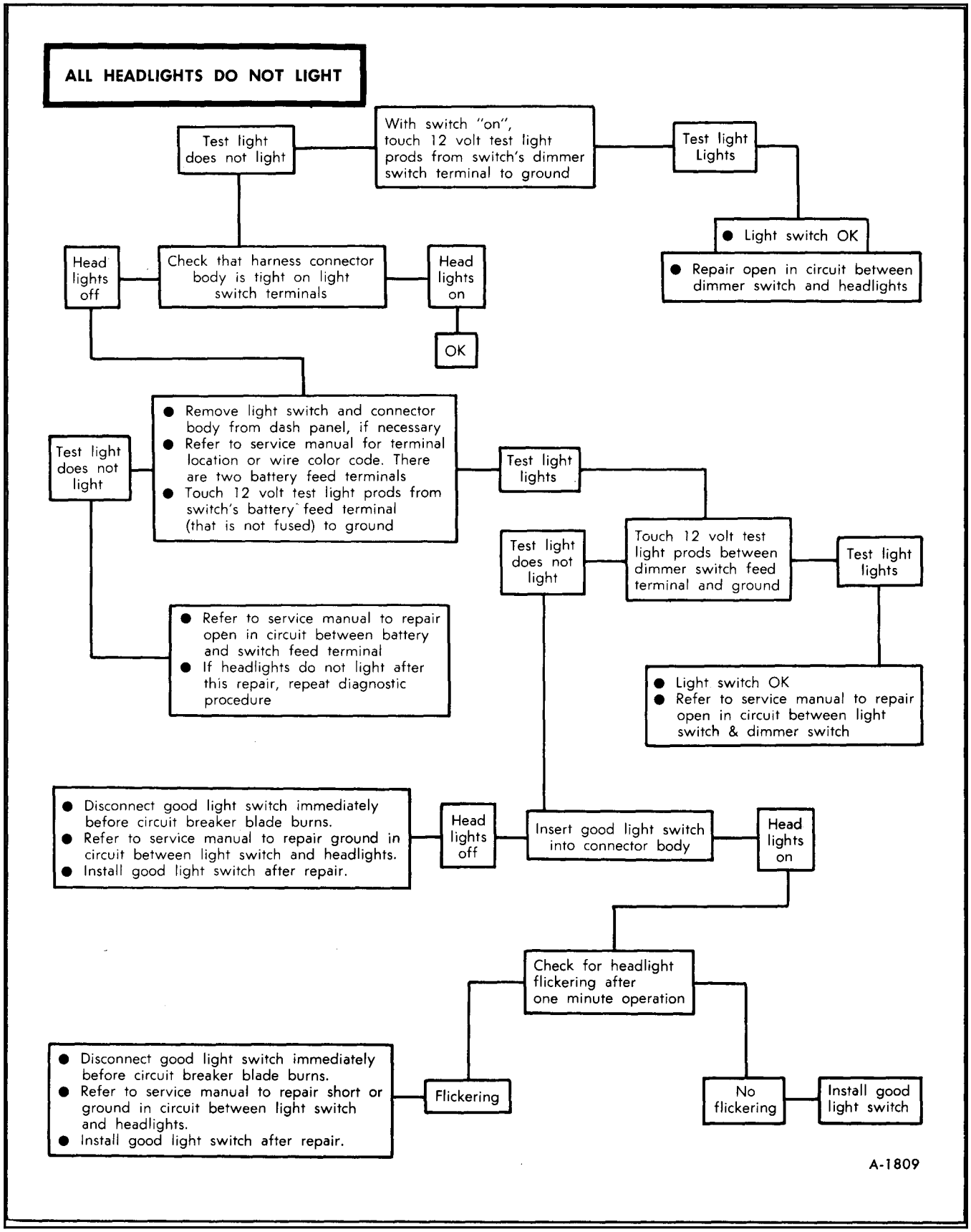


Figure 40—Headlight Switch Diagnosis

ONE HEADLIGHT INOPERATIVE OR INTERMITTENT	
POSSIBLE CAUSE	CORRECTION
Loose Connection	Secure Connections to Sealed Beam Including Ground (Black Wire)
Defective Sealed Beam	Replace
ONE OR MORE HEADLIGHTS ARE DIM	
Open Gr. Connection at Headlight	Repair Black Wire Connection Between Sealed Beam & Body Ground
Black Ground Wire Mislocated in Headlight Connection (Type 2 Sealed Beam)	Relocate as Shown in Service Circuit
ONE OR MORE HEADLIGHTS—SHORT LIFE	
Voltage Regulator Misadjusted	Check and Adjust if Necessary to Specifications.
ALL HEADLIGHTS INOPERATIVE OR INTERMITTENT	
Loose Connection	Check and Secure Connections at Foot Switch and Light Switch
Defective Foot Switch	Check Voltage at Foot Switch With 12-Volt Test Bulb. If Bulb Lights Only at Lt. Blue Wire Terminal, Replace Foot Switch.
Open Wiring - Light Switch to Foot Switch	Check Voltage at Lt. Blue Wire With Test Bulb. If Bulb Lights at Light Switch Lt. Blue Wire Terminal But Not at Foot Switch, Repair Open Wire.
Open Wiring - Light Switch to Battery	Check Voltage at Light Switch Red Wire Terminal With 12-Volt Test Bulb. If Bulb Fails to Light, Repair Open Red Wire Circuit to Battery (Possible Open Fusible Link)
Circuit Shorted to Ground	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.
Defective Light Switch	Check Voltage at Light Switch Red and Blue Wire Terminals With Test Bulb. If Bulb Lights at Red Wire Terminal But Not at Lt. Blue, Replace Light Switch.
UPPER OR LOWER BEAM WILL NOT LIGHT OR INTERMITTENT	
Open Connection or Defective Foot Switch	Check Voltage at Foot Switch Headlight Terminals With Test Light. If Bulb Lights at Headlight Terminals (Lt. Green - U.B., Tan - L.B.), Repair Open Wiring Between Foot Switch and Headlights. If Bulb Will Not Light at One of the Foot Switch Headlight Terminals, Replace Foot Switch.
Circuit Shorted to Ground	Follow Diagnosis Shown Above Under "All Headlights Inoperative or Intermittent" A-1810

Figure 41—Headlight Circuit Diagnosis

HEADLIGHT SWITCH

The headlight switch controls the headlamps, parking lamps, tail lamps, marker and clearance lamps, instrument and dome lamps as well as instrument light intensity. The dome lamps are actuated by turning the headlamp switch fully counterclockwise. The headlamps are protected by a 25 amp. circuit breaker in the headlamp switch which is an automatic reset type. Before replacing the light switch, make sure the trouble is in the switch and not elsewhere in the lighting system by checking circuits as described in Figures 40 and 41.

HEADLIGHT SWITCH REPLACEMENT

1. Disconnect negative battery cables.

2. Pull the switch knob out to the full "ON" position, then reaching up behind the instrument panel, press the spring-loaded release button on the bottom of the switch. Remove the switch rod and knob by pulling straight out with button depressed.

3. Remove the switch retaining nut by inserting a flat-blade screwdriver into the nut while holding the switch from behind the instrument panel.

4. Remove the switch from the instrument panel and disconnect the multiple wire connector from the switch.

5. Reverse steps 1—4 for switch installation.

DIRECTIONAL SIGNALS

For diagnosis of hazard warning and directional signal systems, refer to STEERING (SECTION 9) of this manual.

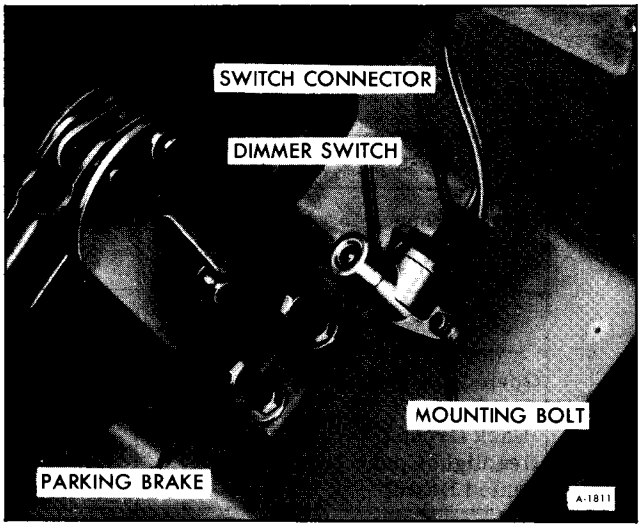


Figure 42—Dimmer Switch

DIMMER SWITCH

The foot-operated dimmer switch (figure 42) is used to select headlight high or low beam. The switch is mounted on the left hand side of the drivers area floorboard and is operative when the headlights are illuminated. See Figure 41 for diagnosis details.

DIMMER SWITCH REPLACEMENT

1. Fold back the carpeting or floor mat in the area of the switch (See figure 42).

2. Disconnect the wiring harness connector from the switch and remove the switch screws.

3. Push the wiring harness connector onto the replacement switch and check operation.

4. Position the switch on the floor panel or toeboard area and attach with (2) screws. Re-position floor mat.

HORN

Two air-tone "S" type vibrating electric horns (figure 43) are mounted behind the left front access door. The electric air-tone "S" type horn is carefully adjusted and inspected during manufacture and should operate indefinitely without attention. The horn assembly should not be adjusted or repaired.

The horn relay-buzzer (figure 44) includes both the horn relay and door buzzer. The horn relay-buzzer operates when the vehicle door is open with the ignition key in the switch and the switch in the "off" position. Closing the door or removing the key will stop buzzer operation. The relay is located behind the right front access door.

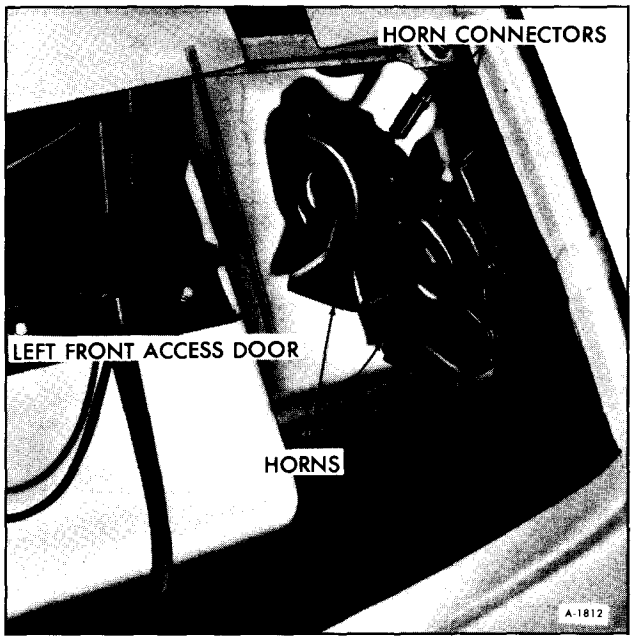


Figure 43—Horn Installation (Typical)

Figure 44—Horn Relay-Buzzer Installation

Refer to ENGINE AND CHASSIS WIRING DIAGRAM for horn and door buzzer wiring circuit.

HORN DIAGNOSIS

For diagnosis of horn system refer to Figure 45.

COMPONENT REPLACEMENT

HORN

1. Disconnect battery ground cables, then open left front engine access door and remove the dark green wires and connectors from the horn assembly.

2. Remove the horn mounting bolts and remove horns (See figure 43).

3. Reverse steps to install horns and check operation.

HORN RELAY-BUZZER

1. Disconnect battery ground cables.

2. Remove horn relay buzzer connector (figure 44).

3. Remove mounting bolt which attaches relay-buzzer to panel.

4. Install buzzer by reversing steps 1-3, making sure that headlamp ground wire is placed under relay mounting tab.

RADIO AND TAPE PLAYER

Radio options include an AM radio, AM-FM, AM-Tape, AM-FM Stereo and AM-FM-Tape Stereo unit. There are two 3-1/2 inch speakers (figure 38) located in each of the front dome light panels and two in each of the rear corners of the vehicle. The antenna is roof mounted with coaxial cable running down the center windshield pillar to the radio.

On AM-FM receivers, a frequency band selector bar is used to change from the AM to FM reception. Moving the band selector bar to the left, engages the FM band and all preset FM stations. Conversely, moving the selector bar to the right engages the AM band. Any preset AM or FM station can be mechanically tuned by depressing the appropriate push button located directly below the band selector bar.

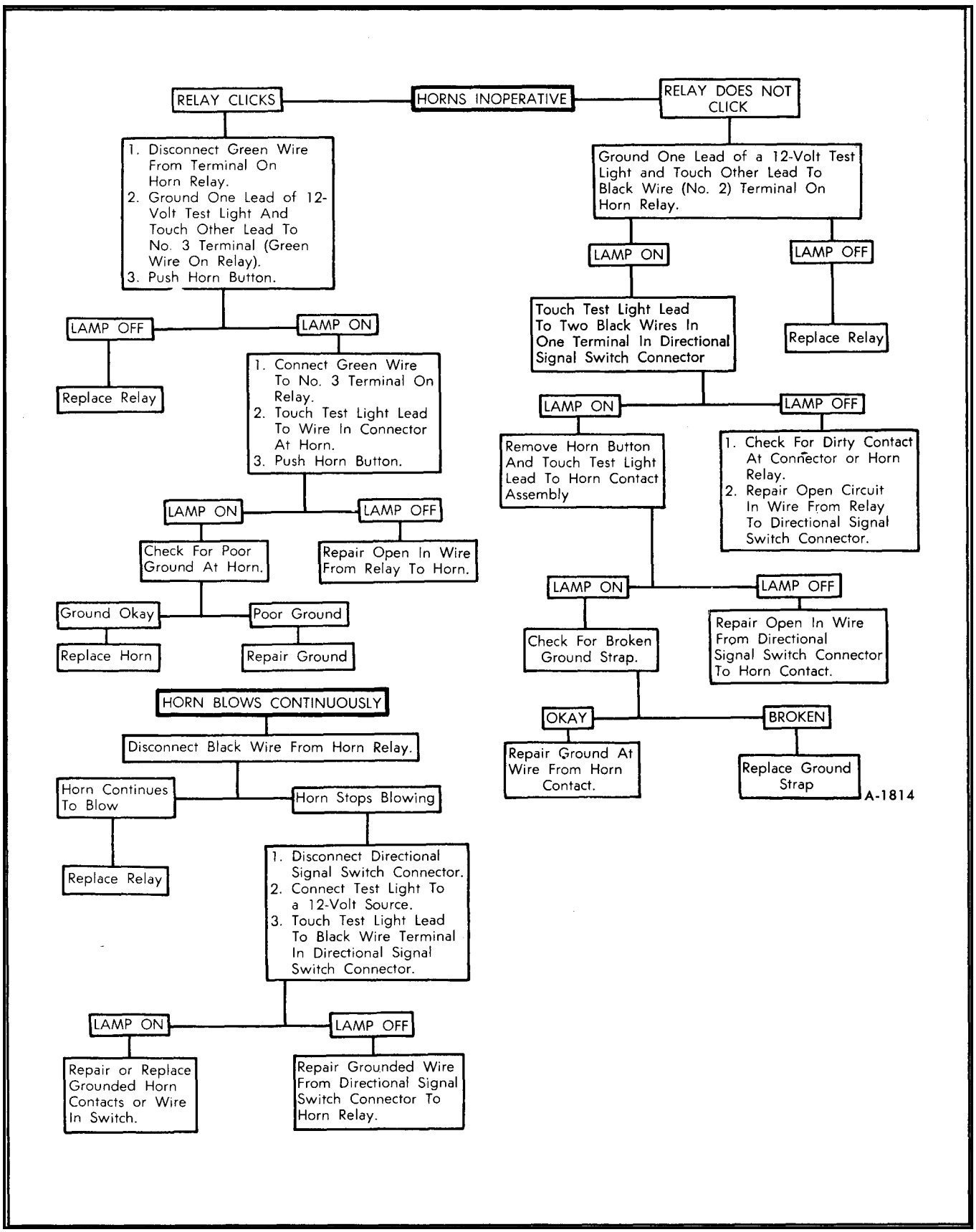


Figure 45—Horn Diagnosis Chart

The FM section of the AM-FM and AM-FM Stereo radios is equipped with automatic frequency control, which aids tuning to a station. The FM receiver should be tuned directly on station frequency for minimum noise interference, however, the automatic frequency control will tune directly to and lock on station frequency when slight mistuning is encountered.

Another feature of FM tuning is signal separation. When two FM stations are close in frequency, the FM tuner selects the stronger signal, rejecting the weaker one. This is in contrast to AM performance, where it is not always possible to separate two stations.

The AM-FM radio incorporates an AM receiving circuit and an FM receiving circuit. The audio system is common to both receiving circuits.

On stereo radios, an indicator light on the right side of the dial, will indicate when the FM station tuned is capable of transmitting stereo programs.

With the AM/FM stereo radio and eight-track tape player, the operator may insert a tape cartridge into the opening behind the face of the receiver dial. When the dial face swings up, this automatically removes power from the radio and switches control of the speakers to the tape player. To change tape programs, momentarily depress the volume control knob. To eject the tape cartridge from the engaged position, depress the "EJECT" pushbutton. A cartridge should not be left inserted in the tape player due to possible tape damage.

SPEAKER CONTROL

The right radio knob is used to tune stations manually. The ring around the knob is the speaker control. When the ring is turned all the way counterclockwise, 90% of the volume will be shifted to the front speakers. Turning the ring progressively clockwise will shift volume to the rear. When the radio is tuned to an FM-Stereo program, stereo separation will be from side to side.

PUSH BUTTON TUNING

Each one of the five push buttons may be preset to a favorite AM station when on the AM band. Each one of these same five push buttons may be set to a favorite FM or stereo station, giving a total of 10 preset favorite stations. To preset push buttons, proceed as follows:

Select the desired band (AM or FM) and manually tune a favorite station until maximum signal is received. Pull push button out and then push all the way in to relatch. Ten favorite stations (5-AM and 5-FM) can be obtained in this manner.

CAUTION: *Do not move the AM-FM slide bar band selector while any push button is pulled out. Damage to the tuner mechanism may result.*

RADIO NOISE SUPPRESSORS

Various types of ignition suppressors are used to prevent spark noise from interfering with radio reception.

1. Ignition noise is suppressed by use of resistance core ignition cables. The resistance of these cables is 2000 to 6000 ohms-per foot.

2. Make sure resistance spark plugs are being used to minimize ignition noise.

3. It is particularly important that the terminals in the ignition secondary cables make good mechanical contact with the spark plug terminals and distributor cap terminals. A loose connection at these points will result in excessive ignition noise, seriously reducing FM performance.

4. A capacitor mounted on the outside of the ignition coil may be checked by running the engine at medium speed and then quickly turning the ignition switch to the Accessory position. If the noise is eliminated, while the engine is coasting to a stop, replace faulty coil capacitor.

5. A capacitor is mounted on the blower motor assembly for suppressing radio noise at high blower speeds. If a whine is eliminated when the blower is switched from HI to LO, this capacitor should be replaced.

RADIO AND TAPE DIAGNOSIS

Many conditions that affect radio operation may be corrected without removing set from vehicle. If the checks in Figures 46 and 47 are performed and problem cannot be found, the radio should be removed and repaired at an authorized radio service station.

CAUTION: *Do not turn on radio with any speaker disconnected, as the radio transistor may be permanently damaged.*

SERVICING

ANTENNA TRIMMER ADJUSTMENT

NOTE: If antenna is not trimmed, the set will have weak and fading AM reception. Antenna trimming should always be performed after any radio or antenna repair work.

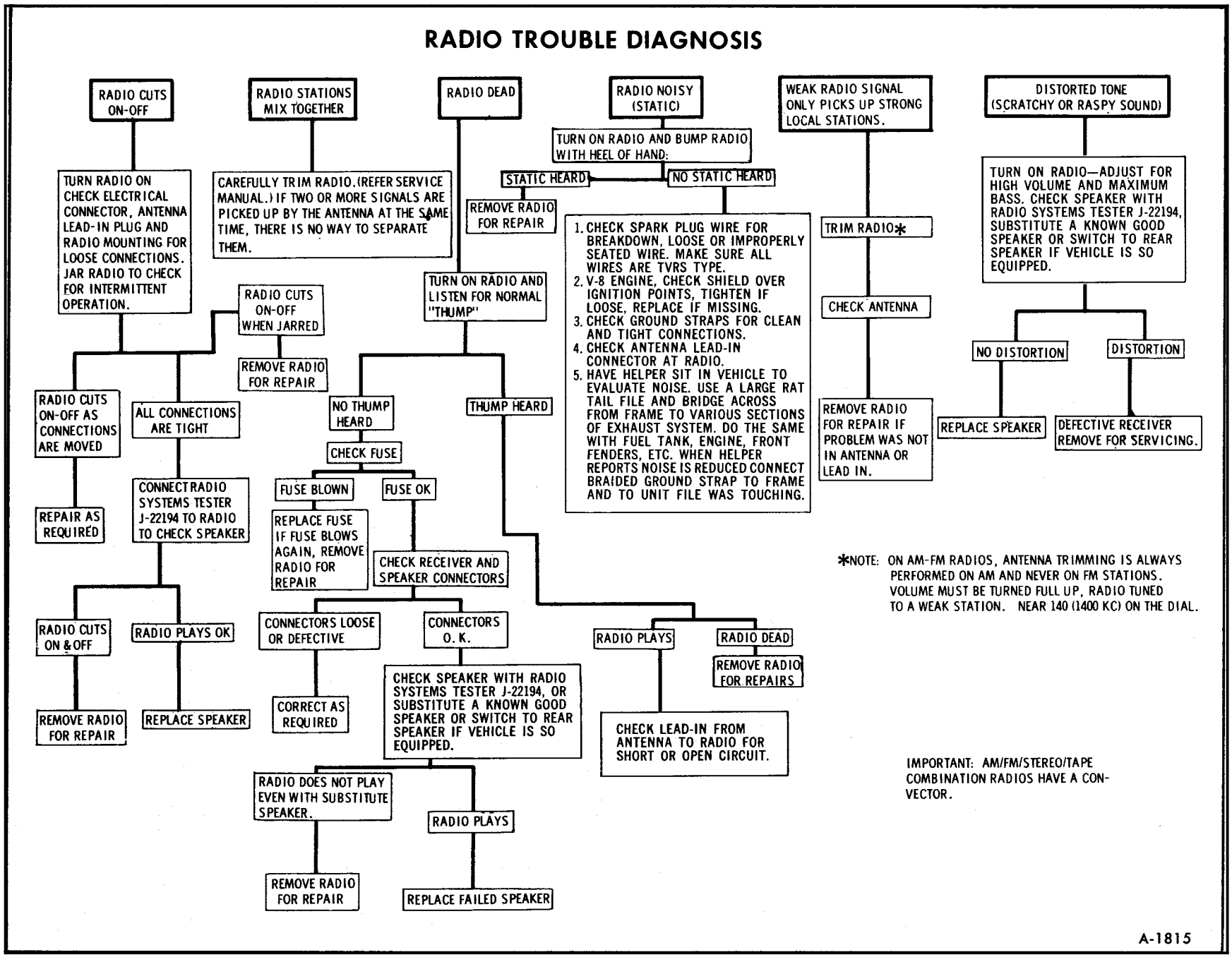


Figure 46—Radio Diagnosis

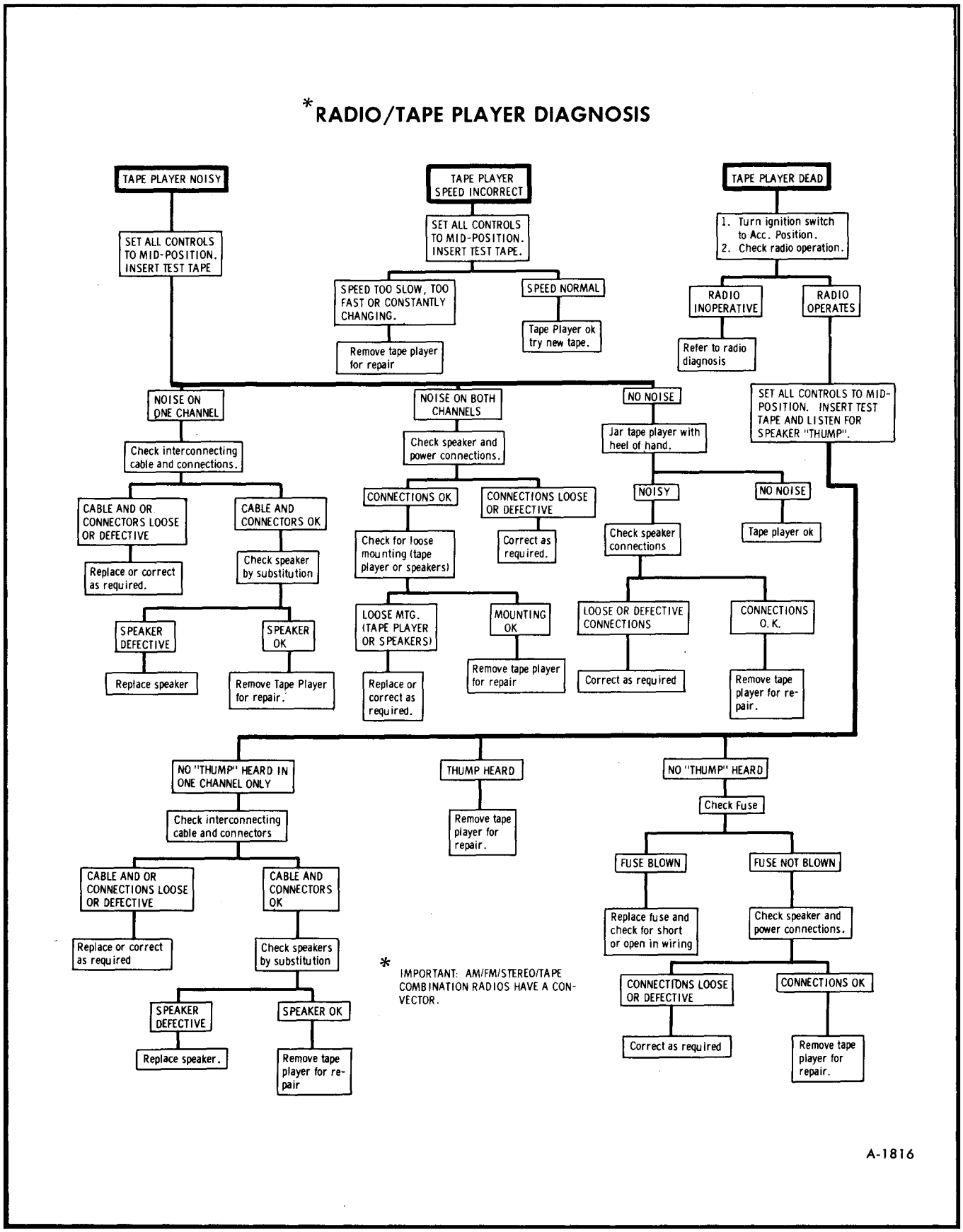


Figure 47—Tape Player Diagnosis

1. Turn radio on. Switch to AM band if radio is AM-FM.

2. Tune in a weak station at approximately 1400 kilohertz on the AM band and turn volume control to maximum.

3. Adjust antenna trimmer, located behind right control knob ring, for maximum volume. Access to antenna trimmer is gained by removing right control knob and ring and inserting screwdriver to adjust screw (figure 48).

NOTE: If, during adjustment, the station becomes strong so that a change in volume cannot be heard with further screw rotating, tune to a weaker station and continue the adjustment.

ANTENNA MAST REPLACEMENT

If it becomes necessary to remove the antenna mast assembly, refer to Figure 49 for proper part positioning of mast components.

NOTE: Antenna cable passes through center windshield support as shown in Figure 27.

BALANCE ADJUSTMENT (AM-FM STEREO MODELS ONLY)

If the sound appears to be louder on one side of the vehicle than the other, and adjustment to the audio balance may be made.

NOTE: On some stereo programming, it is normal for one side to be louder than the other for a short time. This is done purposely for stereo effect. The only positive method to tell if the balance control needs adjustment is to tune in a non-stereo program and make a critical evaluation.

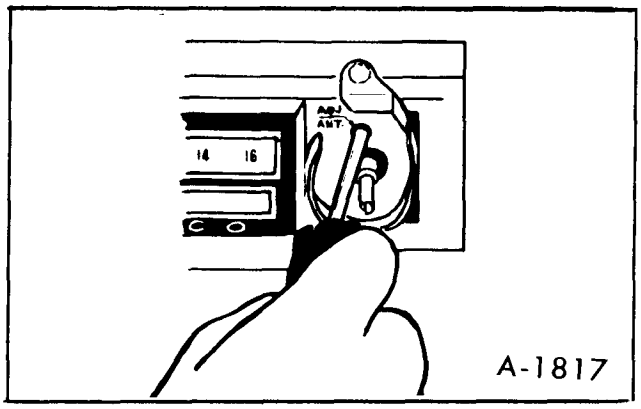


Figure 48—Antenna Trimmer Adjustment

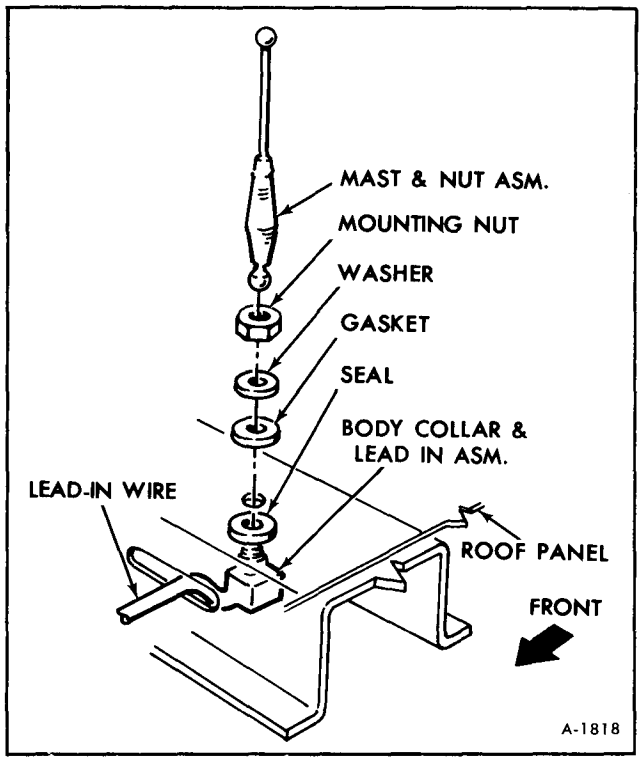


Figure 49—Antenna Mast Installation

If adjustment is needed proceed as follows:

1. Turn radio on. Switch to AM band.

2. Remove left knob, spring and control ring to gain access to stereo balance screw.

3. With fader control turned fully clockwise, insert screwdriver into balance screw.

4. Rotate balance control adjustment clockwise or counterclockwise until the sound in the left and right speakers appears to have equal volume.

5. Install left control ring, spring and knob.

STEREO TAPE PLAYER

The only required maintenance on tape players is periodic cleaning of the tape player head. This service should be performed approximately every 100 hours of operation. If the tape slips and runs slowly, the capstan (revolving metal post), head and tape guide should be cleaned with a cotton swab moistened with alcohol. To clean capstan, trip the on-off switch at the rear of the receptacle and hold the swab against the rotating capstan.

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.

STEREO TAPE PLAYER CONVECTOR (FIGURE 50)

On units equipped with a stereo tape player, power transistors are located on a remote heat convector due to space limitations. The convector assembly is located behind the glove box door. Connection is made to the convector by means of a 6 wire harness and plug connector running parallel to the fuse block wiring harness from the tape player.

If radio is to be removed for repairs, test the convector, USM radio repair stations do not need the convector to repair the radio if the convector is good.

CONVECTOR TEST (FIGURE 51)

1. Remove the convector harness plug from the rear of the radio.

2. Connect 12 volt test light to 12 volt source.

3. Connect jumper wire to good ground, touch test light probe to jumper to test connections. Test light should light.

4. Touch test light probe to blue wire; jumper to yellow wire.

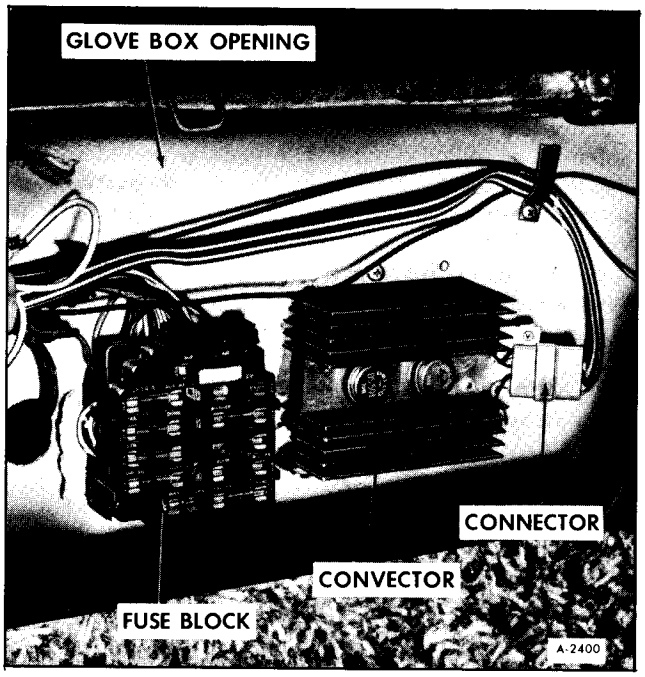


Figure 50—Convector Installation

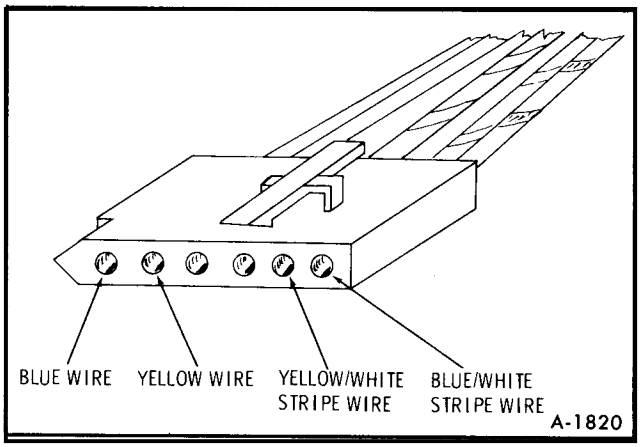


Figure 51—Convector Connector

5. Touch test light probe to blue/white stripe wire; jumper to yellow/white stripe wire.

6. If test light lights in either of the above tests, remove the convector for repair. If the test light is off in both tests, it will not be necessary to send the convector with the radio for repair.

CONVECTOR REPLACEMENT

1. Convector is located behind glove box on vehicle bulbhead panel.

2. Remove the convector harness connector.

3. Remove the (2) retaining screws and remove convector (See figure 44).

4. To install, reverse steps 1-3.

RADIO DIAL LAMP REPLACEMENT

Radio dial lamp replacement can be made using the following procedures:

All Radio Models

1. Disconnect battery ground cables.

2. Remove the instrument panel bezel and rear cover.

3. Remove the radio knobs and rings.

4. Disconnect the wiring connectors from the rear of the radio and remove radio unit from the instrument panel.

5. Remove the (5) radio case top retaining screws and remove cover.

6. Remove the dial lamp bulb from the holder and replace.

7. To assemble, reverse steps 1-6 above.

Stereo Indicator Lamp Replacement

In cases of a failed stereo indicator lamp on stereo radio models, remove radio and have service performed by an authorized Delco radio repair facility.

MOBILE RADIO TRANSMITTERS

Mobile radio transmitting equipment is subject to Federal Communications Commission regulations and must be installed by a qualified radio technician. The specific installation instructions for radio transmitters will vary depending upon the radio equipment used. Mobile telephone equipment installed by your local telephone company, citizens band radios and electronic garage door openers will not adversely affect vehicle operation. In the event any other type of mobile radio transmitter is to be installed, further instructions are required so that vehicle operation will not be adversely affected. Contact GMC Truck Coach Division, General Motors Corporation, Technical Service Department, Pontiac, Michigan 48053 (or in Canada, contact General Motors of Canada Limited, Product Service Department, Oshawa, Ontario).

CRUISE CONTROL

GENERAL DESCRIPTION

The Cruise Control is a speed control system which employs engine manifold vacuum to power the throttle servo unit. The servo moves the throttle when speed adjustment is necessary by receiving a varying amount of controlled vacuum from the transducer unit. 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 lever. Two brake release switches are provided: an electric switch disengages the transducer unit and a vacuum switch decreases the vacuum in the servo unit to quickly return the throttle to idle position.

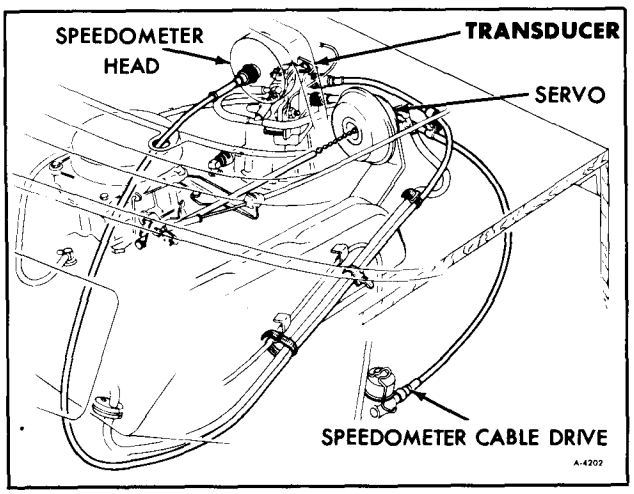


Figure 52—Cruise Control Component Location

The operation of each unit of the system and the operation of the entire system under various circumstances is described below. Figure 52 shows the location of the system components within the vehicle. See "Cruise Control System Diagnosis" chart for cruise control system checks.

COMPONENT OPERATION

ENGAGEMENT SWITCH

This switch, located within the turn signal knob, has three positions. In the fully released position, the switch passes current through resistance wire to effect a "hold in" magnetic field in the transducer solenoid. This current is sufficient only to hold the solenoid in place once it has been actuated by the "pull in" circuit. Depressing the button partially allows current to flow to the transducer solenoid at full voltage which causes the solenoid to pull in. Depressing the button fully opens the circuit to both the resistance and standard solenoid feed wires and the solenoid becomes de-activated.

During vehicle operation the three switch positions have the following functions:

RELEASED

a. System not engaged: No function of the system will occur although a small current is flowing through the solenoid via the resistance wire.

b. System engaged: The small current flowing through the resistance wire is holding the solenoid in the engaged position.

PARTIALLY DEPRESSED

Full voltage is applied to the solenoid (vehicle speed over 31 mph) which sets the transducer to maintain the vehicle speed at the time of transducer engagement.

FULLY DEPRESSED

No electricity flows to the solenoid and the transducer is inactive. This position is used by the driver when he desires to raise or lower his controlled speed. He may accelerate to his new speed, press the button fully (transducer releases previously set speed) and release the button. Upon releasing the button, it passes through the partially depressed position and the solenoid is "pulled in", then into released position which provides "hold in" current. The driver may also press the button fully with no pressure on the accelerator pedal. In this case the transducer releases control of the throttle which returns to idle and the vehicle slows. When the button is released the solenoid is pulled in and held in respectively and the transducer resumes speed control at the speed of the vehicle during the moment of button release (at vehicle speeds over 31 mph).

BRAKE RELEASE SWITCHES

Two brake release switches are employed in the Cruise Control System. When the brake pedal is depressed; an electric release switch cuts off the voltage supplied to the engagement switch, hence cuts off power to the transducer unit. The transducer is then disengaged and requires engagement switch operation to return it to operation. A vacuum release switch operates simultaneously with the electric release switch whenever the brake pedal is depressed. This switch opens a port to atmospheric pressure which rapidly bleeds down the vacuum in the servo unit thereby returning the throttle to the idle position.

SERVO UNIT

The servo unit is a vacuum actuated, variable position diaphragm assembly, which operates the carburetor throttle when the system is in operation. It is powered by controlled vacuum from the transducer and operates the throttle chainage via the adjustable link. (See figures 53 and 55). The servo has a port on the sealed side of the diaphragm housing. When controlled vacuum is applied to this port, atmospheric pressure moves the diaphragm which pulls on the adjustable chain opening the carburetor throttle.

TRANSDUCER

The transducer, Figures 54 and 55 is a device which has two primary functions. First, it is a vacuum switch which, when engaged by the driver, supplies vacuum to a "Tee" fitting. Second, it meters a small variable quantity of air to the "Tee" fitting where it blends with vacuum, thus providing the power unit with controlled vacuum which will maintain the selected speed. If the transducer begins to supply less bleed air (vehicle speed decreasing) the vacuum in the chamber increases and the diaphragm moves toward the vacuum port. If the transducer

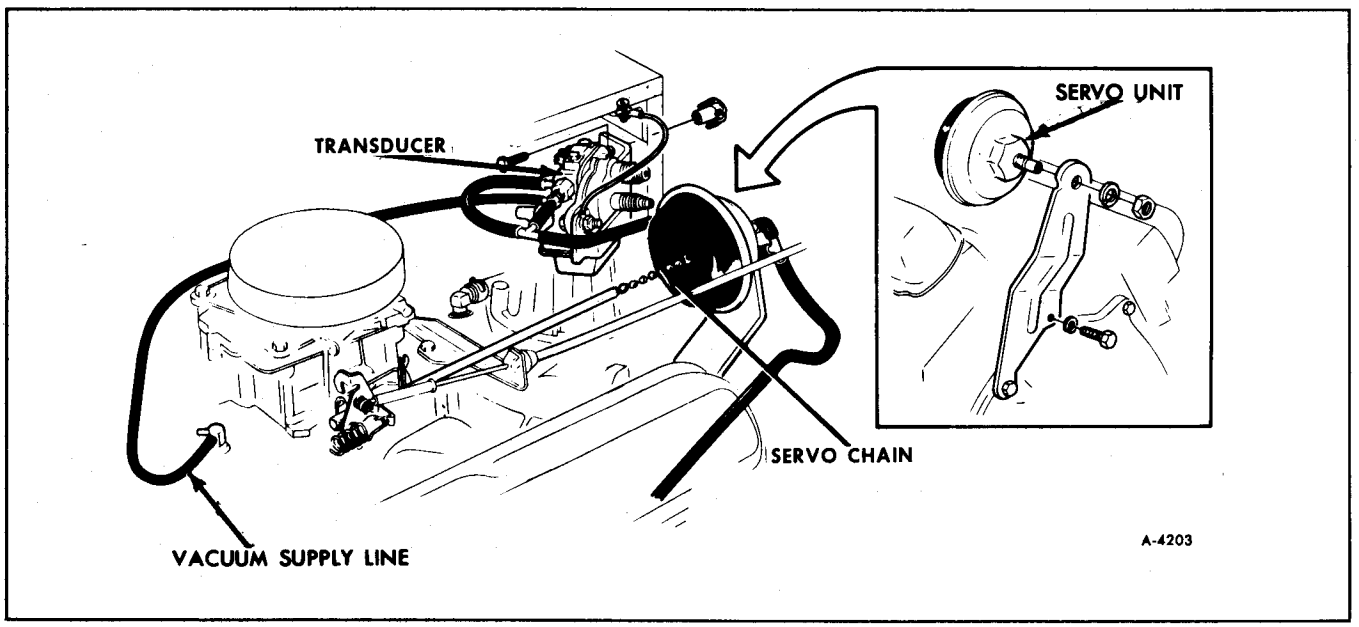


Figure 53—Servo Unit Installation

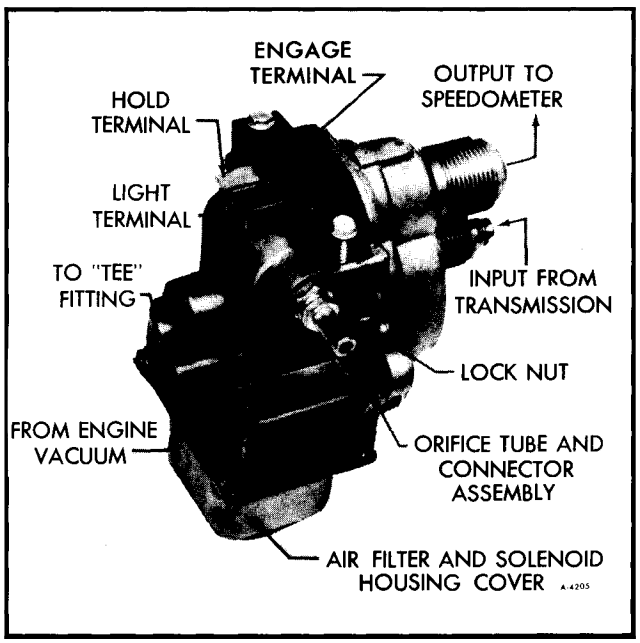


Figure 54—Transducer

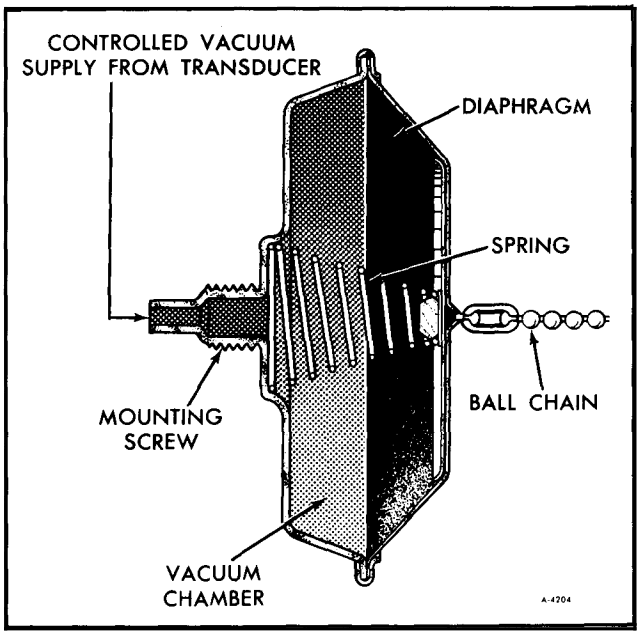


Figure 55—Servo Unit

begins to supply more bleed air (vehicle speed increasing), the vacuum in the chamber drops and the diaphragm moves away from the vacuum port. In operation, at cruise speed, a proper balance of air and vacuum is blended at the "Tee" fitting and is imposed upon the servo unit to maintain and "on speed" cruise condition.

An additional function of the transducer is to drive the speedometer. Since the vehicle speed is sensed by a speedometer-like mechanism within the unit, the speedometer cable from the transmission drives the regulator which drives a second cable (at a one to one ratio) to the speedometer.

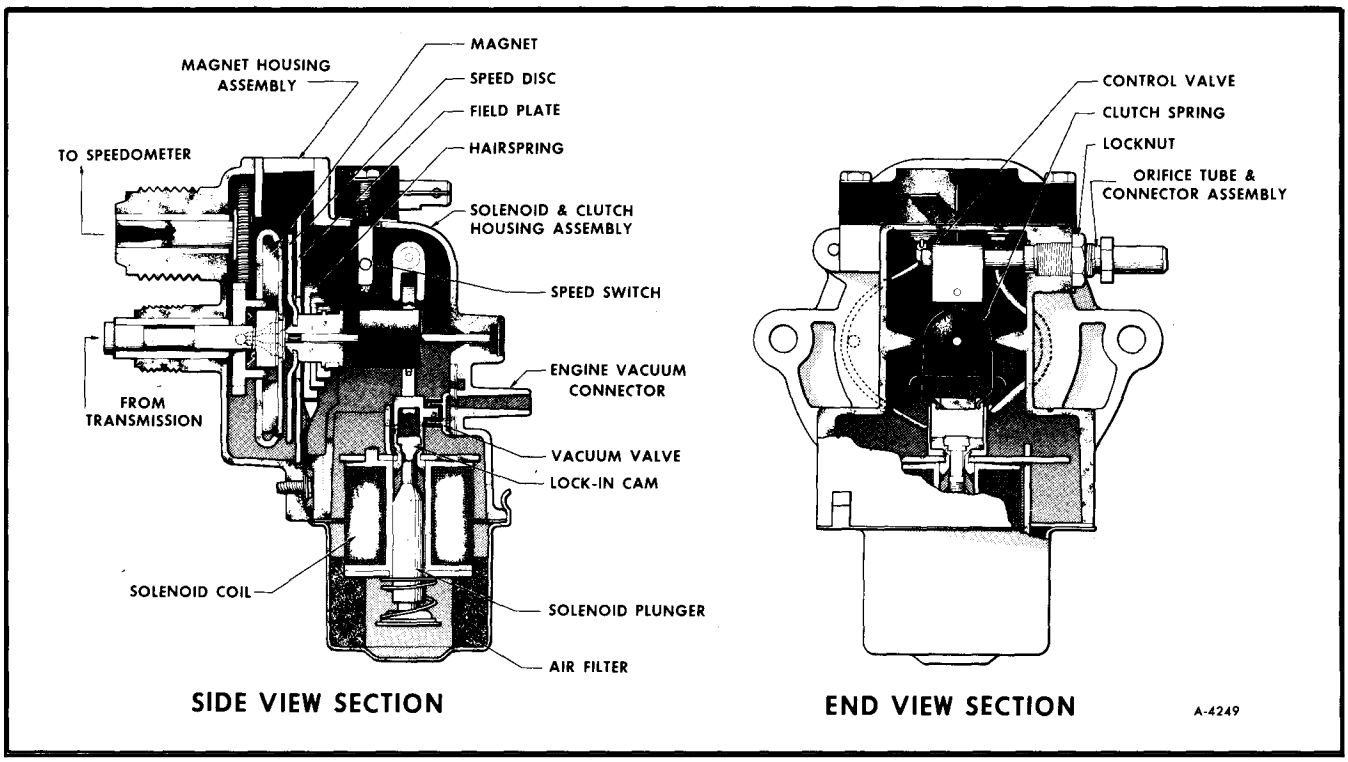


Figure 56—Transducer Cross Section

The transducer is electrically engaged and disengaged through operation of the engagement switch and the electric brake release switch. It has two subassemblies which make up the unit: one being the magnetic speed sensing assembly and the other being the solenoid actuated vacuum switch, air bleed and filter, and low limit speed switch assembly.

Magnetic Speed Sensing Assembly

The speed sensing assembly operates in the same manner as a speedometer unit except that instead of rotating a needle through an angle proportional to the vehicle speed, it rotates a rubber drum which is clutched to the air bleed valve when the system is in operation. The assembly is driven by the speedometer cable from the transmission which turns a disk shaped ferrite magnet.

Facing the magnetic disk is the driven copper disk mounted on a shaft with the rubber drum mounted on the same shaft. A spiral hairspring connects the shaft to the housing and allows it to rotate through an angle which is proportional to vehicle speed. If the vehicle doubled its speed, the shaft would rotate to twice its previous angle as may be seen by noting the operation of a speedometer. The driven disk is sandwiched between the magnetic disk and a field plate. The field plate forms a returning path for the magnetic field from the magnetic disk.

The input shaft drives both the magnetic disk and the speedometer drive cable.

Vacuum Switch, Air Bleed and Filter, and Low Limit Speed Switch

The end of the shaft from the speed sensing assembly with the rubber drum extends into the air bleed metering assembly. This rubber drum has a tang extending from its surface which allows a set of points to close at a specific speed. When the vehicle reaches about 31 mph, the rubber drum has rotated far enough (moved by the brass driven disk in the magnetic field) so that its tang has allowed a spring loaded electrical point to contact another point. These points are in series with the solenoid coil so that under 24 mph, no transducer operation is possible.

Surrounding the rubber drum is a "U" shaped spring clip which is held spread away from the drum by the nose or cam of the solenoid when the solenoid is in the relaxed position. The rubber drum and this clip comprise the speed clutch of the transducer. When the solenoid is energized, the solenoid nose moves toward the drum and releases the ends of the clip. The clip springs inward and attaches itself by friction to the drum. Now, any change in vehicle speed will rotate the drum and move the "U" clip just as a speedometer moves its needle. The top of the "U" clip is attached to the air bleed valve. The clip moves a sleeve which slides on the orifice tube thereby covering and uncovering air ports in the wall of the tube (the tube inner end is plugged) whenever vehicle speed changes from the speed at which the solenoid was energized. The direction of drum rotation is such that resulting bleed valve operation will cause the servo to decrease engine power if the vehicle exceeds the preset speed and increase engine power if vehicle speed decreases. The air which passes out the orifice tube enters the transducer through the openings in the solenoid housing, passes through the oil wetted polyurethane filter, and then enters the orifice tube ports.

When the solenoid is de-energized, the nose retracts and cams the ends of the "U" clip outward so that it releases the rubber drum.

The solenoid also operates a vacuum switch simultaneously with the clutching and declutching of the "U" clip. The solenoid operated vacuum valve slides over two ports in the transducer wall. One port is connected to manifold vacuum and the other is connected to a "Tee" fitting. When the solenoid is de-energized, the valve closes the manifold vacuum port and opens the "Tee" port to the inside of the transducer case. When the solenoid is energized, the valve connects manifold vacuum to the "Tee" fitting, at which point air is blended to the proper proportion and impressed upon the servo unit according to the dictates of the transducer.

During system operation the following events occurs:

1. Vehicle speed below 24 mph — no function of the pull-in circuit because the rubber drum has not rotated far enough to close the solenoid points. No pull-in current can flow through the solenoid coil. The solenoid coil is receiving a small current via the 40 ohm resistance wire unless the brake pedal is depressed, engagement switch fully depressed, or the ignition switch is "off".

2. Vehicle speed above 31 mph — the tang on the rubber drum has closed the solenoid points. The pull-in cirucit is now ready for engagement.

3. Driver partially presses engagement switch — full voltage flows through the solenoid to pull it into operation. Solenoid cam tension on the "U" clip is released and the clip grips the rubber drum. Simultaneously, the vacuum switch applys manifold vacuum to the "Tee" fitting. Here the vacuum is blended with air being introduced from the transducer. The balance of air and vacuum is impressed upon the servo to provide for initial throttle positioning.

4. Driver releases the engagement switch — current flows to the solenoid through the 40 ohm wire and since the solenoid is "pulled in", the reduced current flow is sufficient to hold it in position.

5. The vehicle begins to ascend a hill — vehicle speed drops slightly (very slightly) and the magnetic force on the driven disk of the speed sensor is decreased. The disk rotates slightly (as would a speedometer shaft because of hairspring tension) turning the rubber drum. Since the "U" clip is gripping the drum, it moves the air bleed valve in that direction which covers the air bleed ports more. With less air bleeding into the "Tee" fitting a higher vacuum level is achieved at the Servo diaphragm, opening the throttle angle to correct for the underspeed condition.

6. The vehicle begins to descend a hill — vehicle speed increases slightly and the air bleed valve moves in that direction which uncovers the air bleed ports. With more air bleeding into the "Tee" fitting, a lower vacuum level is achieved at the servo diaphragm decreasing the throttle angle to correct for the overspeed condition.

7. Driver accelerates by pressing accelerator pedal — vehicle speed increases and the system responds by moving the diaphragm to decrease throttle opening. Since an adjustable chain is used, the chain merely slips through the hole in the servo unit and has no effect on throttle operation. After the driver releases pressure from the pedal, the throttle will close until vehicle speed decreases to the pre-set speed. At that point the transducer bleeds less air to the "Tee" fitting which opens the throttle enough to maintain the pre-set speed. The system returns to a stable condition.

8. Driver desires higher controlled speed, presses accelerator until new speed is reached, and depresses engagement switch fully and releases button — speed sensing assembly tries to turn in a direction that would decrease the throttle opening until the driver fully depresses the engagement switch. Then the current is cut off to the solenoid which retracts; the solenoid cam expands the "U" clip releasing its grip on the rubber drum. The drum and disk assembly then rotates to a new position because of the higher vehicle speed. When the solenoid retracts, it also shuts off vacuum to the "Tee" fitting and opens the vacuum port to atmospheric pressure within the transducer thereby bleeding down the servo toward the relaxed position. As the driver releases the engagement switch, "pull-in" and "hold-in" of the solenoid occurs, respectively. The system is now engaged to maintain the vehicle speed at the time of engagement switch release.

9. Driver desires lower cruising speed, presses engagement switch fully, waits until vehicle speed decreases to desired speed then releases switch — when the engagement switch is fully depressed the solenoid is de-energized causing the vacuum switch to bleed down the servo to idle throttle position and the "U" clip of the air bleed valve is released from the rubber drum. The drum and disc assembly is free to rotate to a position which corresponds to vehicle speed as the vehicle slows. When the driver releases the engagement switch, the unit "pulls in" and "holds-in" in the normal manner. The air bleed valve is clutched to the rubber drum at the vehicle speed corresponding to switch release. Vacuum is again applied to the "Tee" fitting and throttle control is assumed by the transducer to maintain the vehicle speed at the time of switch release.

10. With system is operation, driver applies brakes — simultaneously the vacuum release and electric release switches operate. The vacuum switch bleeds air into the servo. The vacuum is reduced in the servo and the throttle returns to idle position. The electric release switch cuts off power to the entire system and the solenoid is de-energized. If the driver removes his foot from the brake pedal the electric switch again feeds voltage to the engagement switch and the vacuum switch seals the air bleed line. The unit will not re-engage since it receives only a small current through the 40 ohm resistance wire. If vehicle speed is below 24 MPH the system may not be re-engaged since the tang on the rubber drum has opened the low limit switch points in the transducer.

DIAGNOSIS

For details on cruise control diagnosis refer to Diagnosis Chart.

SERVICING

The components of the Cruise Control system are designed to be replaced should they become inoperative.

The transducer is calibrated in such a manner during manufacturing that overhaul operations are impractical. However, one adjustment may be made to the transducer to correct speed drop or increase at the time of engagement.

BRAKE RELEASE SWITCHES

ELECTRIC

Service—An inoperative switch must be replaced. Switch replacement is identical to standard brake lamp switch replacement.

CRUISE CONTROL SYSTEM DIAGNOSIS

PROBLEM	CAUSE	CORRECTION
Will Not Engage - System Inoperative	Brake switch circuit open. Clutch switch circuit open.	Check connections - adjust or replace the switch. Refer to Electrical Check Out.
	Fuse blown.	Replace fuse - if it blows again, check for: 1. Engage switch stuck in the center of travel - Refer to Electrical Check Out. 2. Incorrect wiring - Refer to Electrical Check Out. 3. Short to ground - Refer to Electrical Check Out. Make necessary corrections.
	Defective Engage switch.	Replace as needed - Refer to Electrical Check Out.
	Vacuum leak in Servo and/or Brake switch and connecting lines. Vacuum hose not connected to vacuum switch.	Vacuum test and repair or replace as needed. Refer to Servo and Vacuum System Check Out.
	Vacuum Release switch misadjusted (always open).	Readjust switch.
	Crossed hoses at transducer.	Reroute hoses.
	Open in wiring harness.	Repair or replace as needed.
	Pinched or plugged hose that is connected to the Servo.	Free or replace hose.
	Defective transducer.	Replace transducer.
	Chain from Servo to carburetor disconnected.	Connect chain.
Does Not Cruise at Engagement Speed	Orifice tube misadjusted.	Adjust as required.
System Hunts, Pulses or Surges	Kinked or deteriorated hoses (air leak).	Repair or replace.
	Defective and/or improperly positioned drive cables and/or casing assemblies.	Repair or replace as needed.
	Defective transducer.	Replace transducer.
System Does Not Disengage - With Brake Pedal	Brake and/or Vacuum switch misadjusted or defective.	Adjust or replace as required. Refer to Servo and Vacuum System Check Out and Electrical Check Out.
	Wires which should be connected to the pedal switch(es) connected to the fuse block.	Reroute wires to stop light switch.
System Steadily accelerates or Applies Full Throttle When Engaged	Manifold vacuum connected directly to Servo.	Reroute hose.
	Defective transducer.	Replace transducer.
Cannot Adjust Speed Downward With Engage Button	Defective Engagement switch or wiring.	Replace as needed. Refer to Electrical Check Out.
Does Not Engage or Engages Lower Than Limits Referred To In "Driver Operation." Low Speed Engagement Can BE as Low As 20 MPH.	Defective transducer.	Replace transducer.
Slow Throttle Return to Idle After Brake is Depressed	Pinched air hose at vacuum release switch.	Free or replace hose.
System Operates Correctly, But Constant Vacuum Bleed When System is Disengaged	Crossed vacuum hoses at transducer.	Reroute hoses.
High Engine Idle Speed - Independent of Carburetor Adjustments. Constant Air Bleed Through Systen.	Tight Servo chain.	Loosen adjustment.
Constant Drain on Battery	Power lead connected to "Fused Battery" terminal of fuse block.	Reroute to "Fused Ignition" terminal.
System Can Be Engaged At Idle By Depressing Switch, But Will Drop Out When Switch Is Released. Solenoid Can Be Heard When Switch Is Depressed When Vehicle Is Standing Still	Wires reversed at transducer.	Reverse wires.

Adjustment—The brake switch plunger must clear the pedal arm when the arm is moved 1/4 inch measured at the switch. (figure 57)

VACUUM

Service—An inoperative (sticking, plugged, or leaking) switch must be replaced. Switch replacement is similar to brake switch replacement. Be certain that the hose to the switch is connected firmly and is not cracked or deteriorated.

Adjustment—The vacuum switch should be pushed all the way into the retaining clip. Pulling the brake pedal up to the stop will automatically adjust the switch.

ENGAGEMENT SWITCH

NOTE: The engagement is serviced only by replacement.

REMOVAL

1. Disconnect battery ground cables.

2. Pry the engagement button out of the turn signal knob with a small thin bladed screwdriver.

3. With a small hook or long nosed pliers, remove the switch retaining ring.

4. Remove steering wheel to gain access to turn signal lever attaching screw. Remove screw. Remove turn signal lever from turn signal housing utilizing the slack in the wiring harness.

5. Push slack into turn signal lever slot at base of lever (attachment end). This will force switch out of the other end of the lever.

6. With a small soldering iron, unsolder the wires and resolder them to the correct terminal of the replacement switch. Use only rosin core solder.

INSTALLATION

1. Once a new switch is installed, pull it back into the lever by pulling on the harness at the lever slot.

2. Reinstall retaining ring and button.

3. Push wire slack into turn signal housing; reinstall turn signal lever and steering wheel.

4. Connect battery ground cables.

SERVO

NOTE: If the servo unit is found to be defective, replacement is required. Note the condition of the hoses and replace any which are cracked or deteriorated.

Adjustment—Adjust the servo chain length at the carburetor stud swivel to minimum slack with the carburetor on the slow idle cam and the engine not running (figure 58).

TRANSDUCER

A defective transducer, that is one which is not simply out of adjustment, must be replaced. During replacement, check the hoses which connect to the transducer and replace any which are cracked or deteriorated.

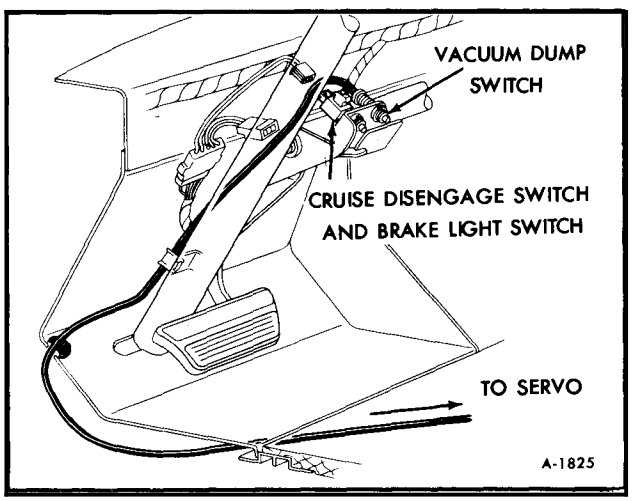


Figure 57—Brake Release Switches

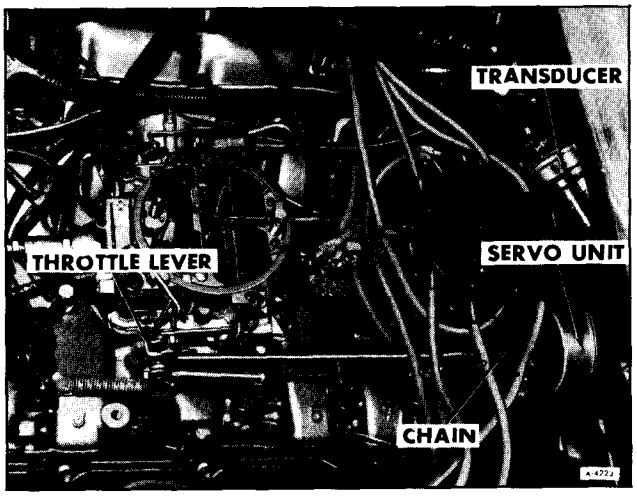


Figure 58—Servo Unit and Chain

ADJUSTMENT

One transducer adjustment is possible: Engagement-cruising speed zeroing (to remove any difference between engagement and cruising speed).

NOTE: No transducer adjustment should be made, however, until the following items have been checked or serviced.

1. Servo chain properly adjusted.

2. All hoses in good condition, properly attached, not leaking, not pinched or kinked.

3. Electric and vacuum release switches properly adjusted.

ENGAGEMENT—CRUISING SPEED ZEROING

If the cruising speed is lower than the engagement speed, loosen the orifice tube locknut and turn the tube outward; if higher, turn the tube inward. Each 1/4 turn will alter the engagement-cruising speed difference one mph. Tighten the locknut after adjustment and check the system operation at 60 MPH.

ELECTRICAL SYSTEM CHECK OUT

(Refer to Figure 59)

1. Check fuse and connector.

2. Check electric brake switch as follows: Unplug connector at switch. Connect ohmmeter at points A and B on brake switch. The ohmmeter must indicate infinity 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. Replace electric brake switch if needed.

3. Check engagement switch and connecting wiring as follows: Unplug engagement switch connector (brown, black) at electrical wiring harness connector and perform the following tests.

Test #1 — Connect ohmmeter between terminal #1 (brown wire) and terminal #2 white (white wire). Continuity shall be maintained until switch is depressed all the way in.

Test #2 — Connect ohmmeter between terminal

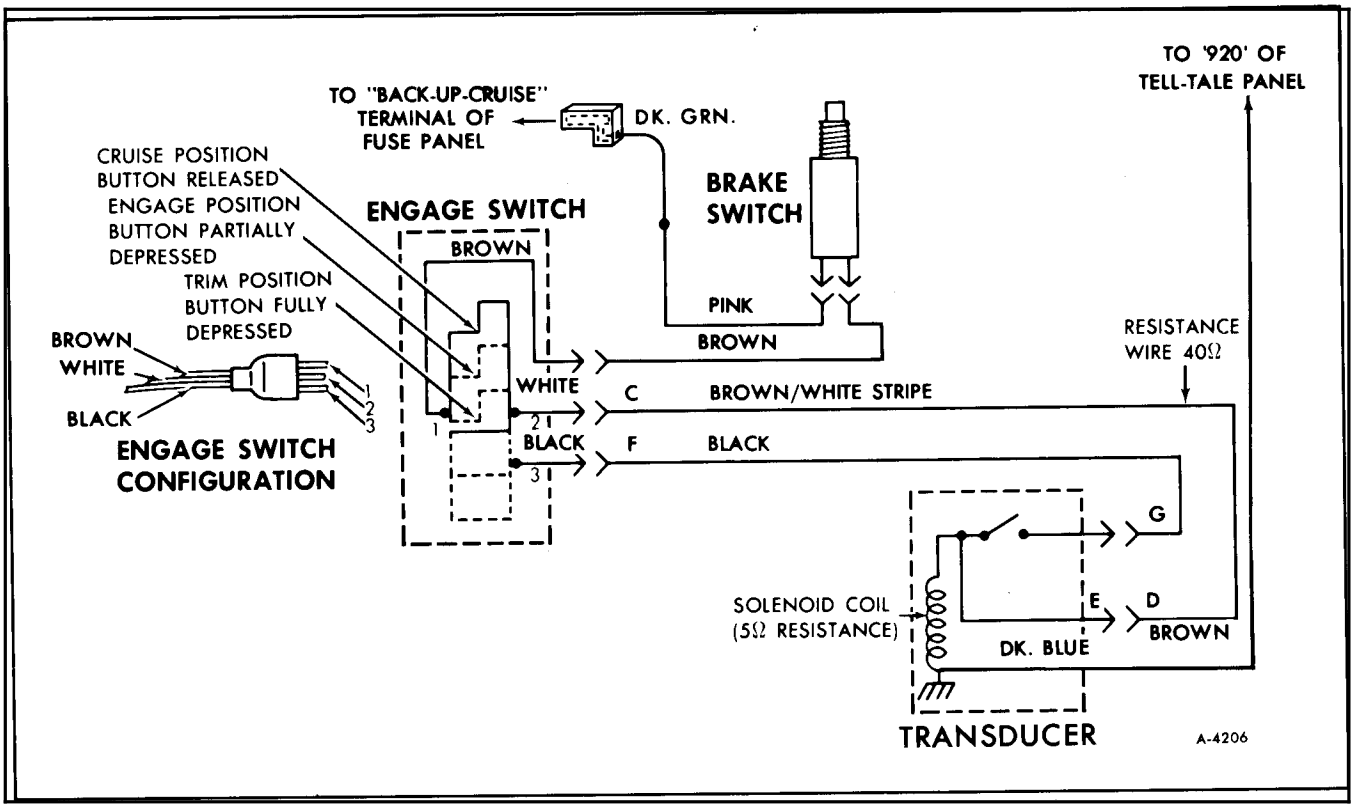


Figure 59—Cruise Control Electrical Diagram

#1 (brown wire) and terminal #3 (black). No continuity shall be shown; however, when the button is depressed halfway, continuity shall be indicated. When the button is pressed all the way down, no continuity shall be shown.

Test #3 — Connect ohmmeter between terminal #2 (white wire) and terminal #3 (black). Button released, no continuity; however, when the button is depressed partially and fully, continuity shall be shown.

4. Disconnect engage switch wire harness connector from the main harness connector (brown, brown/white, black wires). 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. If a resistance either above or below the value indicated is shown, the main wiring harness should be replaced. Note: 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 blade screw driver.

When measuring the solenoid coil circuit resistance between Point E (Hold Terminal) to ground the ideal ohmic 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 white main harness wiring from Point F to G should also be checked for continuity.

ENGAGEMENT SWITCH TEST

	TERMINALS		
BUTTON POSITION	1 TO 2	1 TO 3	2 TO 3
Cruise (released)	closed	open	open
Engage (partially depressed)	closed	closed	closed
Trim (fully depressed)	open	open	closed

SERVO AND VACUUM CHECK OUT

To determine the condition of the diaphragm, remove hose from servo unit and apply 14 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 servo. To utilize engine as vacuum source, proceed as follows:

1. DISCONNECT SERVO CHAIN and hose from servo then connect engine vacuum directly to the servo fitting.

2. Note position of servo diaphragm.

3. Start engine — the diaphragm should pull in.

4. Clamp off engine vacuum supply line and check for leakage.

The cruise release brake switch (vacuum) and connecting hoses can likewise be checked using a vacuum pump.

LIGHT BULB SPECIFICATIONS

Bulb Application	Quantity	Bulb No.	Part No.
Low Air Tell-Tale	1	74	
Brake System Tell-Tale	1	161	
Generator Tell-Tale	1	161	
Park Brake Tell-Tale	1	74	
Cruise Control Tell-Tale	1	74	
Door Ajar Tell-Tale	1	74	
Low Fuel Tell-Tale	1	74	
Power Level Tell-Tale	2	74	
High Beam Indicator	1	161	
Turn Signal Indicator	2	168	
Instrument Cluster Light	2	194	
Speedo Cluster Light	2	194	
Dome Lights	2	211	9422525
Radio Dial (AM/FM Stereo/Tape)	1	566	
Radio Dial (exc. AM/FM Stereo/Tape)	1	1893	
Heater Control	1	1895	
Clearance and I.D.	10	67	142450
License	1	67	
Side Markers	4	194	9421330
Back Up Lights	2	1156	
Parking and Turn Sig.	2	1157	9428902
Stop and Tail	2	1157	
Headlights	2	6014	5962548
Fiber Optic Bulb	1		9433143

SECTION 13
RADIATOR AND COOLANT RECOVERY SYSTEM

Contents of this section are listed below:

NOTE: *Refer to ENGINE COOLING (SECTION 6K) of this manual for information relative to coolant circulation, temperature indicators, thermostats, and fan belts.*

Refer to GENERAL INFORMATION AND LUBRICATION (SECTION O) for information relative to coolant recommendations and coolant system capacities.

DESCRIPTION

The vehicles are equipped with a cross-flow radiator also a coolant recovery system. The level in the coolant recovery reservoir should be maintained at the "COLD" line when coolant is cold.

At normal operating temperatures, level can reach "HOT" line on reservoir. However, should the coolant level fall below the cold level line, additional coolant, other than for draining and refill should be added through the coolant recovery reservoir.

MAINTENANCE

At regular intervals, cooling system components should be inspected to determine if service is required. Regular systematic checks will reveal faulty condition of various units and indicate necessity of servicing or replacement of such components before failure occurs.

Suggested checks are:

1. Frequently check coolant level. If low, add recommended coolant as required.

2. Check hose connections and tighten clamps if seeping is evident. Cracked, stripped, or corroded clamps should be replaced.

3. Inspect radiator hoses for spongy or checked appearance. Deteriorated hoses should be replaced before bursting occurs which would result in coolant loss and could cause extensive engine damage due to overheating.

4. Check radiator core for leaks and for accumulation of dirt which obstructs air passages and reduces effective heat transfer.

To assist in maintaining effecient heat dissipation, an occasional external flushing with water will remove majority of dirt accumulation and foreign matter from between core fins.

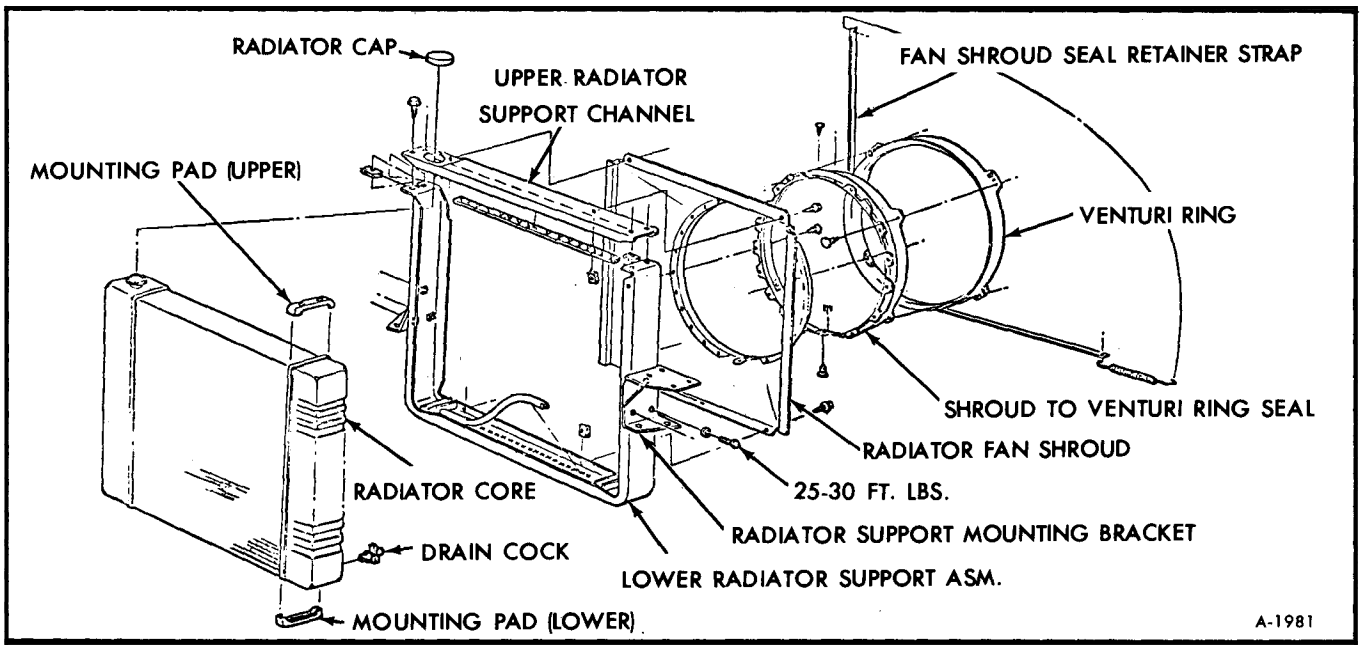


Figure 1—Radiator Assembly (Typical)

Water under moderate pressure should be directed from behind core to force debris out in opposite direction of its entrance. Water should be directed in line with fins, not sideways, to reduce possibility of bending fins.

5. Inspect radiator mounting pads for deterioration and replace as required.

6. Inspect for proper clearance between fan blades, radiator core venturi ring, and shroud. Check fan attaching bolts for tightness and observe alignment of fan blades in relation to each other. Replace fan if any blade is bent. Distance between blades and venturi ring should be equal around entire perimeter of the ring. If adjustment is required, venturi ring attaching bolts may be loosened and the ring shifted as necessary to provide proper clearance.

7. Check radiator filler cap seals for evidence of cracking or separation. Replace as required.

8. When coolant loss is evident or engine overheating occurs, the damaged or clogged radiator should be serviced by a radiator specialist or replaced with a new one. Efficient repair of radiators requires the use of special tools and equipment as well as provisions for making proper tests. If radiator core requires painting, spray with special radiator paint; do not use paint mixed with oil, as oil mixed paint will form an insulation and prevent efficient dissipation of heat.

RADIATOR MOUNTING

Refer to Figure 1 for mounting details of radiator support, radiator core, fan shroud and venturi ring.

RADIATOR REPLACEMENT

1. Drain radiator by opening drain cock assembly at lower corner of radiator assembly (location of drain cock shown in figure 1).

2. If unit is equipped with air conditioning, perform the following:

a. Remove front grille.

b. Disconnect air conditioning condenser from radiator.

3. Disconnect radiator overflow tube and upper radiator hose.

4. Raise vehicle.

5. Disconnect lower radiator hose transmission cooler and engine oil cooler lines.

6. Disconnect upper radiator support channel assembly.

7. Remove upper shroud to support bolts (2) and clips attaching seal and venturi ring.

8. Remove retaining strap and move seal away from venturi ring.

9. Remove (2) lower shroud to support bolts & lower shroud.

10. If vehicle is equipped with "Coolant Level" indicator light, disconnect lead wire to probe sensor and remove probe sensor from radiator.

11. Remove radiator support bolts (3) on each side and lower radiator and support from vehicle.

12. Replace radiator core in radiator support.

13. Install radiator and support in vehicle and torque attaching bolts to 25-30 ft. lbs.

14. If vehicle is equipped with "Coolant Level" indicator, insert probe sensor and torque to 25-30 in. lbs. Connect lead wire.

15. Install lower shroud to support bolts (2).

16. Install upper support channel assembly bolts (2).

17. Connect lower radiator hose, transmission and engine oil cooler lines.

18. Install shroud to venturi ring seal and tighten fan shroud seal retainer strap.

19. Install clips attaching venturi ring seal to shroud.

20. Install upper shroud to support bolts (2).

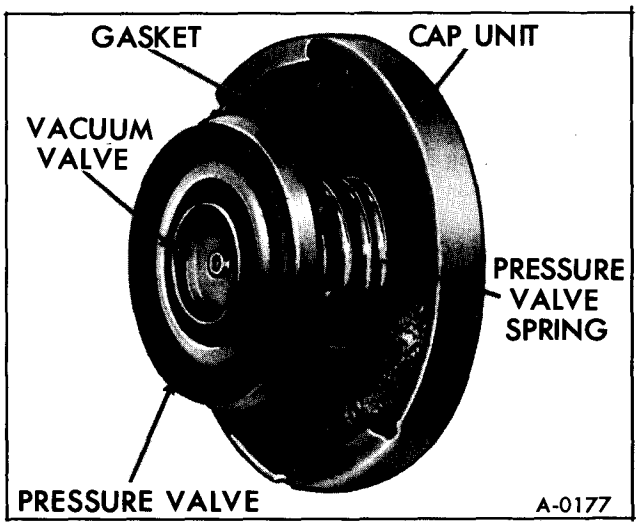


Figure 2—Pressure Cap

21. Lower vehicle.

22. Connect radiator coolant recovery hose and upper radiator.

23. Connect air conditioning condenser attaching bolts (if so equipped).

24. Install front grille.

25. Refill radiator following the procedure described in Section 6K.

NOTE: For service and diagnosis of "Coolant Level" indicator system, refer to CHASSIS ELECTRICAL (Section 12) of this manual.

PRESSURE CAP AND VALVE

A pressure relief valve assembly, integral with the radiator filler cap, incorporates a pressure valve and a vacuum valve. (See figure 2) When pressure in system reaches valve setting (See "Specification" at end of this section), pressure valve opens and liquid is allowed to escape. As liquid in the system cools it contracts; this allows pressure valve to close and also creates a partial vacuum in system. Atmospheric pressure acting through the overflow tube unseats the vacuum valve and allows coolant to enter radiator.

The radiator filler cap is constructed with a spring-loaded rubber seal which is pressed firmly against surface of filler neck seat when cap is installed. Rubber seal must be in good condition and top of radiator filler neck must be clean and smooth in order to form an air-tight seal. Seal of filler cap and operation of pressure relief valve can be checked using a conventional cooling system testing kit.

CAUTION: *When the engine is at normal operating temperature or above, the internal pressure built up in the cooling system will blow out scalding fluid and vapors if the radiator cap is suddenly removed. To prevent loss of coolant and to avoid the danger of being burned, the coolant level should be checked, or coolant added, only to the coolant recovery reservoir. If the radiator cap must be removed when the engine is hot, place a cloth over the cap and rotate the cap slowly counterclockwise to first stop and allow pressure to escape completely. Then turn cap again slowly counterclockwise to remove.*

COOLANT RECOVERY SYSTEM

The coolant recovery system consists of a reservoir, pressure cap and interconnecting hose. The

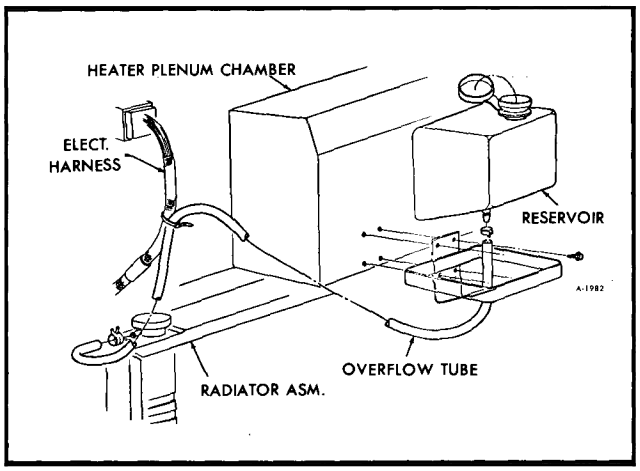


Figure 3—Coolant Recovery System, Type 1

reservoir is mounted above the radiator and is accessible from the front access doors and connected to the radiator filler neck with a hose. The coolant level must be maintained at the "COLD" mark on the side of the reservoir when coolant is cold. A gasket incorporated into the filler cap forms a seal at the radiator filler neck. A leak at this gasket will result in loss of coolant during normal operation. The pressure cap must be installed so that the marking on top of the cap aligns with the overflow tube on the filler neck.

Refer to Figures 3 and 4 for removal and installation of coolant recovery system components.

ENGINE COOLANT

COOLANT RECOMMENDATIONS

For coolant drain and refill procedure, refer to SECTION 6K of this manual. Cooling system maintenance intervals will be found in SECTION O.

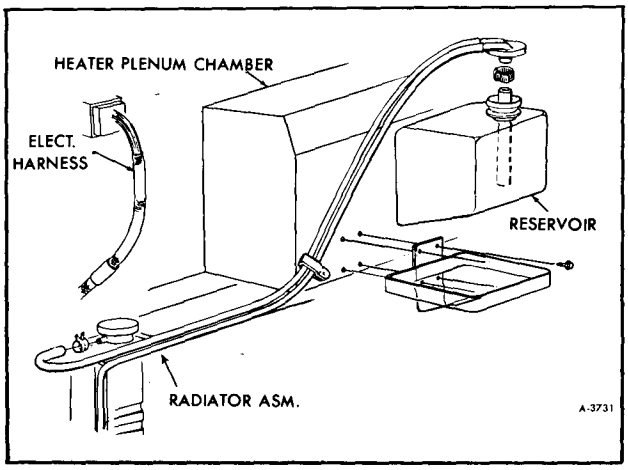


Figure 4—Coolant Recovery System, Type 2

COOLANT TESTING

Always test solution before adding water or anti-freeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature. Other testers are provided with thermometers and tables and indicate freezing points corresponding to readings made at various temperatures. Disregarding temperatures of solution may cause an error as large as 30°F. Read and be guided by instructions furnished by the tester manufacturer.

In the event coolant freezes solid in extreme cold weather, place vehicle in warm building or improvise some means of thawing coolant before starting engine. Under no circumstance should engine be operated, when coolant is frozen solid. After thawing, refill system with a higher concentration of anti-freeze solution and start engine. Inspect entire system for leakage and then test coolant with hydrometer to determine if adequate anti-freeze protection is provided.

COOLANT PRECAUTIONS

1. Overheating is not always caused by a defective cooling system; incorrect ignition timing, dragging brakes, under-inflated tires, can cause overheating.

2. Keep water pump and fan drive belts at proper tension. Refer to ENGINE COOLING SYSTEM (Section 6K) of this manual.

3. Do not remove radiator filler cap when engine is hot. Wait until system cools off.

4. Do not pour cold water into cooling system when the engine is hot. Wait until system cools off.

5. If cooling system requires frequent refilling, check for leaks.

6. Keep all connections tight, and make sure gasket on radiator filler cap is in good condition.

7. When filling system with anti-freeze solution. Always follow recommendations of anti-freeze manufacturer.

8. Use only Ethylene Glycol base coolant meeting GM Specification 1899M.

9. Drain and flush cooling system every other year, preferably at start or end of winter operation.

COOLING SYSTEM PRESSURE RELIEF VALVE

Models	Valve Stamped	Opening PSI
230 (23') 260 (26')	RC32	9

TORQUE SPECIFICATIONS

Radiator Support Mounting Bracket to Radiator Support Attaching Bolts ..... 25-30 ft. lb.

SECTION 14
BUMPERS
ENERGY ABSORBERS

DESCRIPTION

All vehicles have both bumpers mounted to energy absorbers. (figure 1)

The energy absorber is a device which uses hydraulic fluid within the cylinder tube to absorb impact energy and inert gas to restore the bumper to its original position after a low speed collision. Right and left energy absorbers are the same. (figure 1)

During impact (figure 2) the piston tube moves back into the cylinder tube. Hydraulic fluid is forced from the cylinder tube through the orifice around the metering pin into the piston tube. The metering pin controls the rate of fluid flow. Fluid pressure in the piston tube against the floating piston moves it and compresses the gas. After impact (figure 3), gas pressure against the floating piston forces fluid back into the cylinder tube and pushes the bumper back to its original position.

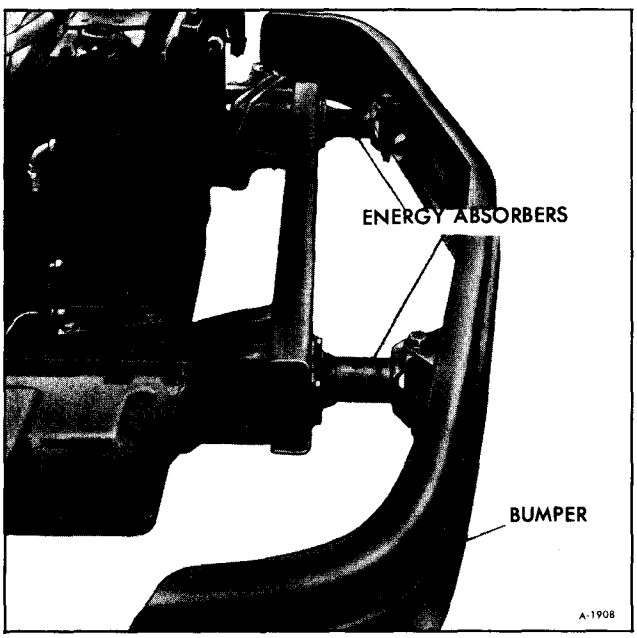


Figure 1—Energy Absorbing Bumper

DIAGNOSIS

LEAKAGE

A trace of oil on the piston tube is normal due to grease packed in the seal area during manufacturing. If oil is dripping from the unit it should be replaced.

DAMAGE

Inspect the bumper bracket, frame bracket, piston tube and cylinder tube for evidence of visible distortion. Scuff marks on the piston tube are normal. If there is obvious damage to the unit it should be replaced.

ON VEHICLE TEST

This test involves compressing EACH unit separately 3/8" or more and observing that the bumper returns to its normal position.

1. Turn off ignition, transmission in park, parking and service brakes set.

2. Use a barrier such as a pillar, wall, post, etc.

3. Align a pressure device, such as a hydraulic jack, with the energy absorber. Make sure it is positioned squarely with the bumper so it will not slip.

4. Apply pressure to compress the unit 3/8". Use a 6" scale to determine travel. Release pressure and note if the bumper returns to its normal position.

5. If either unit fails to return to its normal position, replace it.

BENCH TEST

The bench test may be used to pre-test service

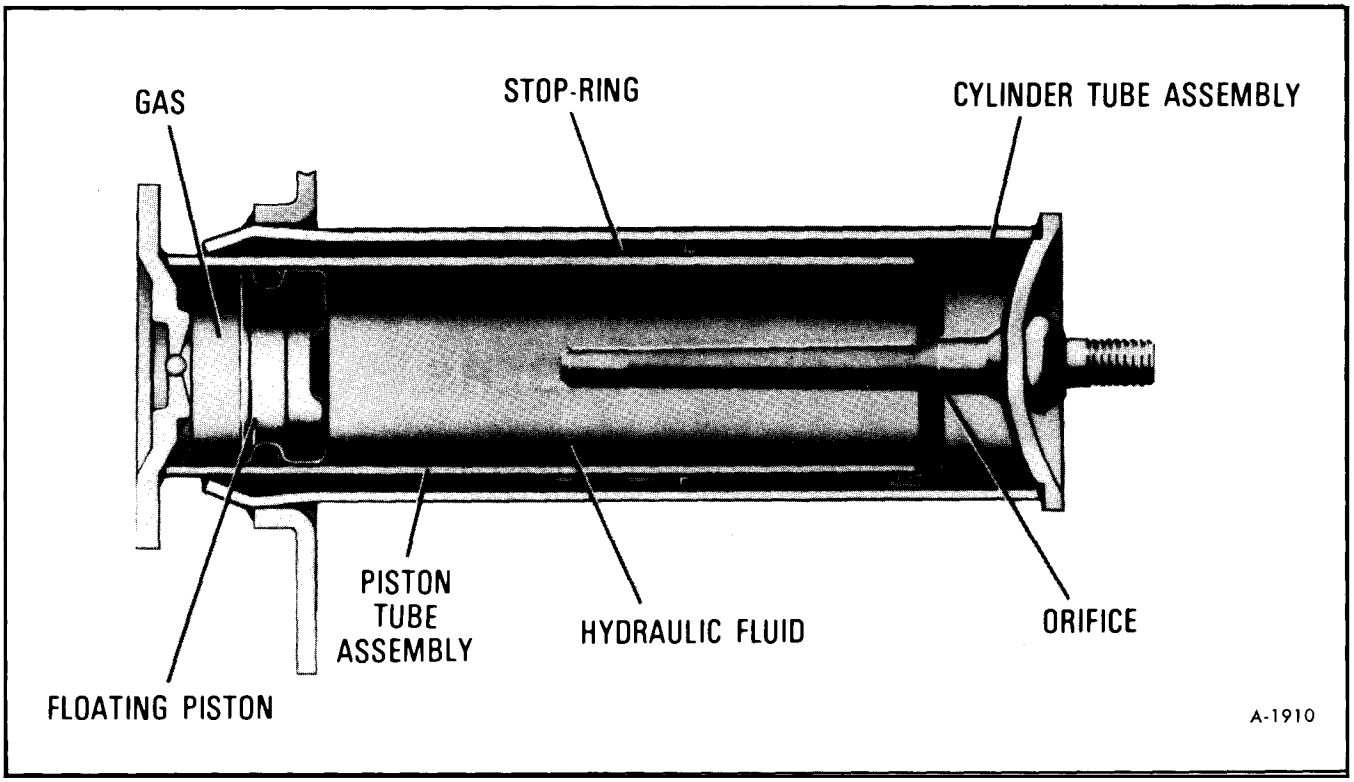


Figure 2–Energy Absorber–Collapsed Position

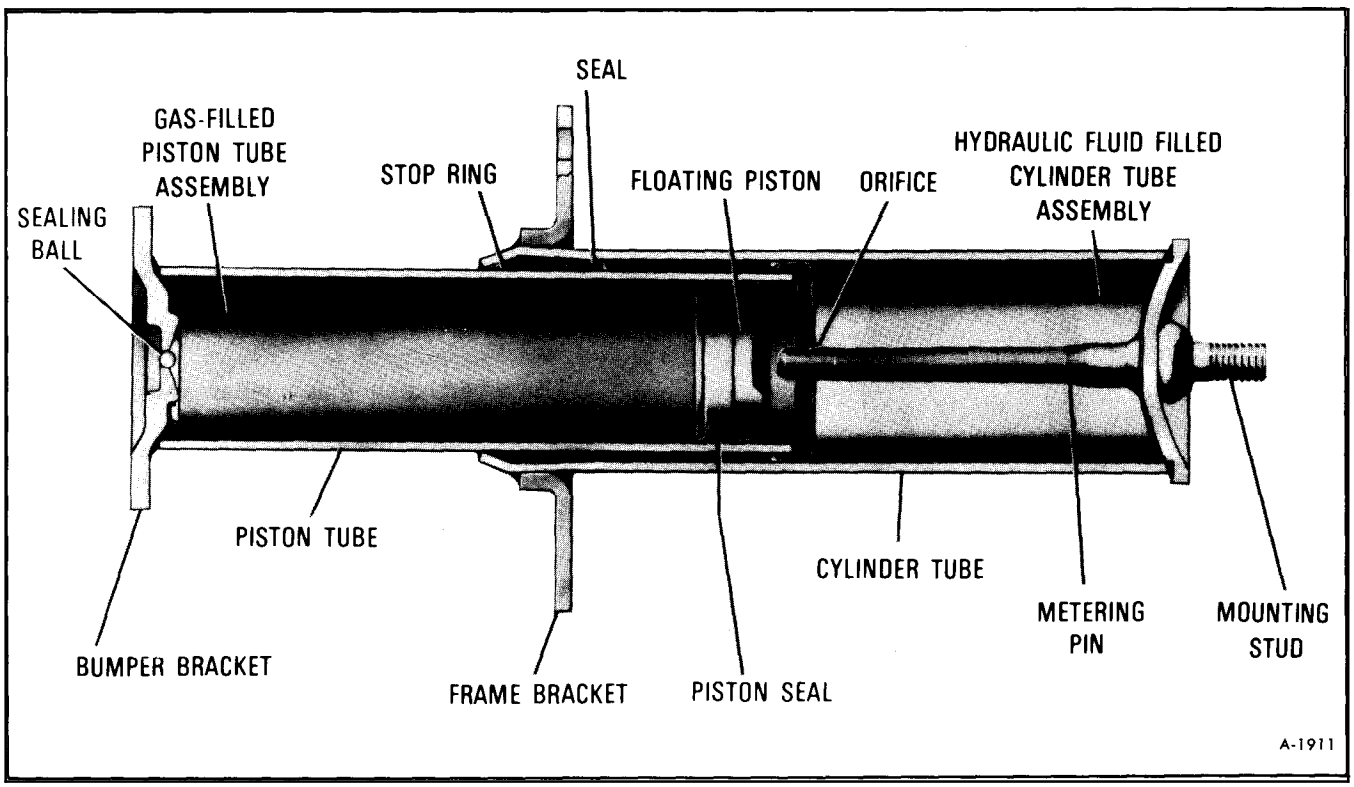


Figure 3–Energy Absorber–Extended Position

units prior to assembly on a vehicle or to check detached units that may have been removed for the purpose of making vehicle repairs after a collision.

A suitable arbor press should be used to compress the unit 3/8". Observe if it returns to its normal position. If not, this unit should be replaced.

INSPECTION

Recommendations for handling energy absorbers are:

1. Do not attempt to repair.

2. Do not weld.

3. Do not apply heat.

WARNING: BE SAFE! PROTECT YOUR EYES. WEAR APPROVED SAFETY GLASSES.

4. Relieve gas pressure prior to disposal of a unit. Make an indentation with a center punch in the small cylinder section of the energy absorber (recommend "WARNING" label on the unit as a target area). Then, use a 1/8-inch drill to penetrate the small cylinder and relieve gas pressure (See figure 4).

INSPECTION AFTER COLLISION

If the collision was so severe that the bumper did not return to its original position, the energy absorber(s) will require replacing.

WARNING: BE SAFE! PROTECT YOUR EYES. WEAR APPROVED SAFETY GLASSES.

1. Stand clear of the bumper.

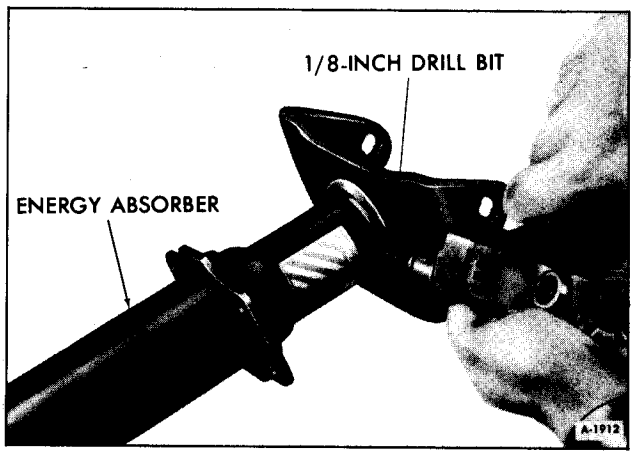


Figure 4—Relieving Pressure from Energy Absorber

2. Provide positive restraint, such as a chain or cable.

3. Relieve the pressure by drilling a 1/8-inch hole in the piston tube near the bumper bracket (See figure 4).

4. Remove the unit from the vehicle as described under "Replacement" only after the gas pressure has been relieved.

REPLACEMENT

IMPORTANT: Prior to replacement, be familiar with procedures given under "INSPECTION" of energy absorbers.

FRONT

1. Remove bumper by removing both bumper bracket thru bolts (See figure 5).

2. Remove the four bolts and nuts securing energy absorber to frame.

3. Secure new energy absorber to frame with bolts and nuts. Nut torque is 25-30 foot-pounds.

4. Install bumper on energy absorbers and secure with thru-bolts. Nut torque is 40-50 foot-pounds.

NOTE: Be sure lower bracket is properly installed (See figure 5) before tightening retaining nut.

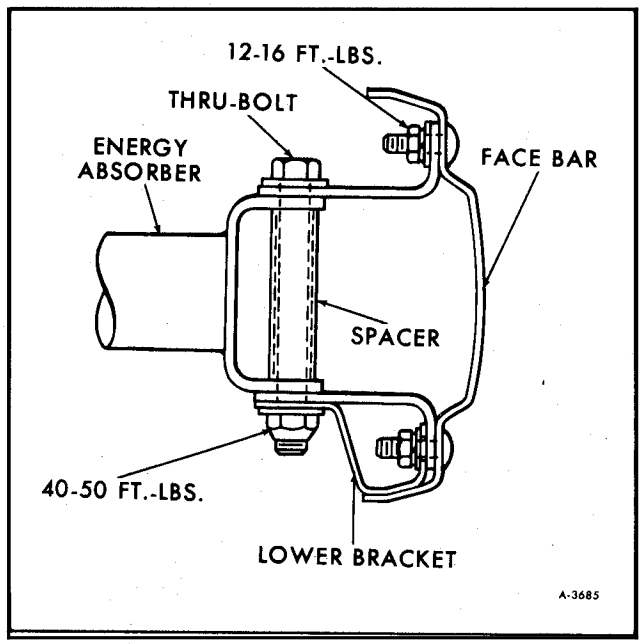


Figure 5—Front Bumper Bracket Mounting

REAR

1. Remove bumper by removing both bumper bracket thru bolts as shown in Figure 6.

2. Remove the four bolts and nuts securing energy absorber to frame.

3. Secure new energy absorber to frame with bolts and nuts. Nut torque is 25-30 foot-pounds.

4. Install bumper on energy absorbers and secure with thru bolts. Nut torque is 40-50 foot-pounds.

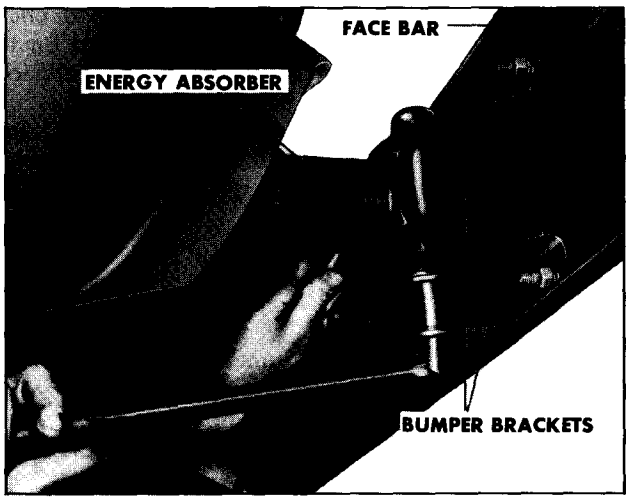


Figure 6—Removing Rear Bumper Bracket Thru-Bolts

BUMPER FACE BARS

NOTE: Front and rear bumper face bars are similarly mounted so replacement procedures are the same for front and rear. Also, due to the fact that both front and rear bumper face bars are two piece assemblies in some cases it may only be necessary to replace half of the face bar.

REPLACEMENT

1. Remove face bars by removing both bumper bracket thru- bolts (See figure 5).

2. Remove brackets and hardware from old face bar(s) and install on new face bar(s). Tighten bumper tie bar retaining nuts to 12-16 foot-pounds.

3. Once it has been determined that the energy absorbers are operative, install the face bar assembly on energy absorbers and secure with thru-bolts.