1981 CHEVROLET

PASSENGER CARS & LIGHT DUTY TRUCKS

UNIT REPAIR MANUAL

(OVERHAUL)

ST 333-81

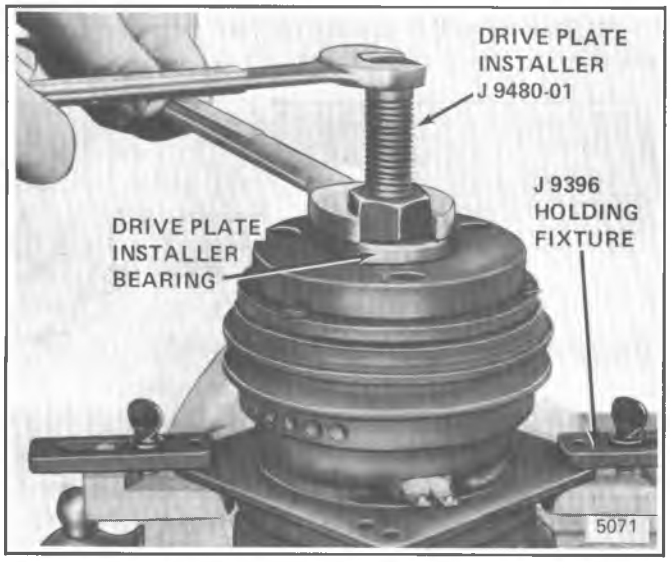


Fig. 1D-7 Installing A-6 Drive Plate

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

7. The pulley should now rotate freely.

8. Operate the refrigeration system in the MAX A/C control selector (mode) lever position and warm engine (off fast idle) speed at 2000 RPM. Rapidly cycle the compressor clutch by turning the A/C control selector (mode) lever from OFF-to-MAX at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

A-6 COMPRESSOR PULLEY AND BEARING ASSEMBLY

Remove

1. Remove Clutch Plate and Hub assembly as described in "A-6 Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove pulley retainer ring, using Snap-Ring Pliers J 6435, Fig. 1D-9.

3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.

4. Place Puller Pilot J 9395 over end of compressor shaft.

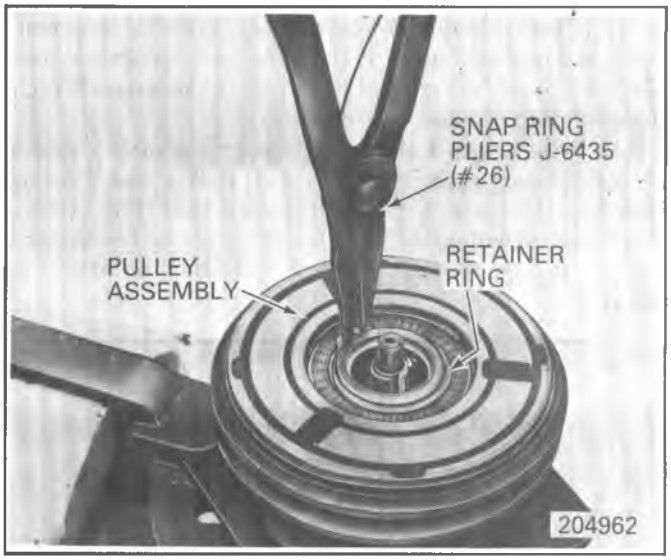


Fig. 1D-9 Removing A-6 Pulley Retainer Ring

NOTICE: It is important that Puller Pilot J 9395 be used to prevent internal damage to compressor when removing pulley. Under no circumstances should puller be used directly against threaded end of shaft.

5. Remove Pulley and Bearing Assembly, using Pulley Puller J 8433 (Fig. 1D-10).

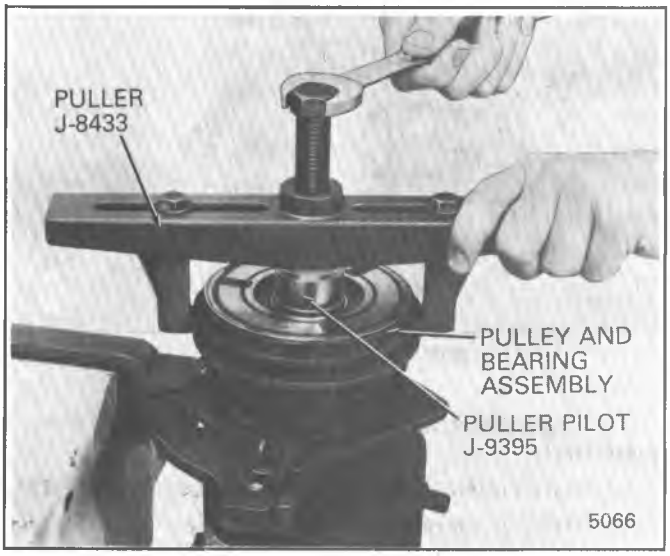


Fig. 1D-10 Removing A-6 Pulley and Bearing Asm.

Inspection

Check the appearance of the Pulley and Bearing assembly (see Fig. 1D-5). The frictional surfaces of the Pulley and Bearing assembly should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvent before reinstallation.

Replace

1. If original Pulley and Bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the Pulley and Bearing assembly should be replaced.

5. Now install a zero thrust race on rear end of compressor axial shaft (Fig. 1D-36), so that it rests on hub of axial plate. Then add one thrust bearing and a second zero thrust race onto shaft.

At this point, both front end and rear end of axial shaft will have a stack-up of one zero race-one bearing-one zero race.

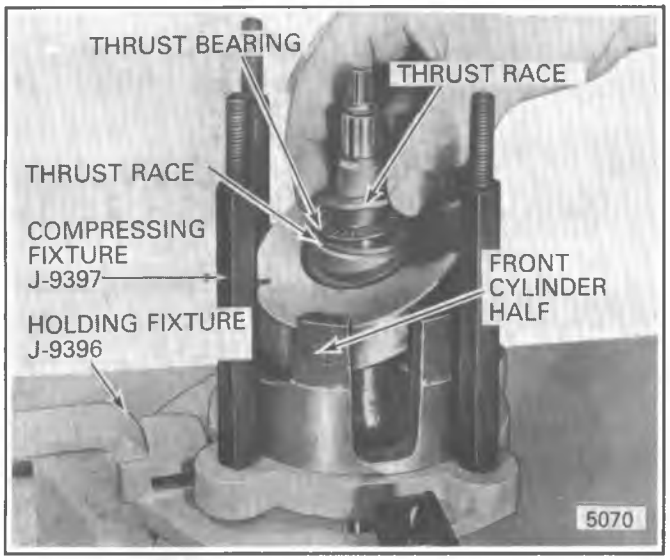


Fig. 1D-36 Installing A-6 Rear Thrust Races and Bearings

6. Lubricate ball pockets of the No. 1 Piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they were considered acceptable for re-use.

7. Lubricate cavity of a zero shoe disc with 525 viscosity refrigerant oil and place shoe disc over ball in front end of piston (Fig. 1D-37). Front end of piston has an identifying notch in casting web (Fig. 1D-32).

NOTICE: Exercise care in handling the Piston and Ring Assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.

Shoe discs should not be installed on rear of piston during following "Gaging" operation.

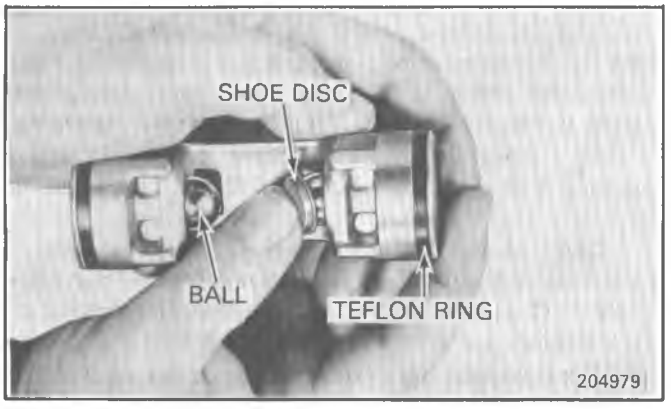


Fig. 1D-37 Installing A-6 Front Shoe Disc

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 Piston cylinder bore.

9. Lift the axial shaft assembly up a little out of front cylinder half and hold front thrust race and bearing assembly ("zero" race-bearing-"zero" race) against axial plate hub.

10. Position No. 1 Piston over No. 1 cylinder bore (notched end of piston being on bottom and piston straddling axial plate) and lower the shaft to allow No. 1 Piston to drop into its bore (Fig. 1D-38). If ball and shoe will not remain in front socket of piston during assembly use a light smear of petrolatum on the piston and shoe ball socket surfaces.

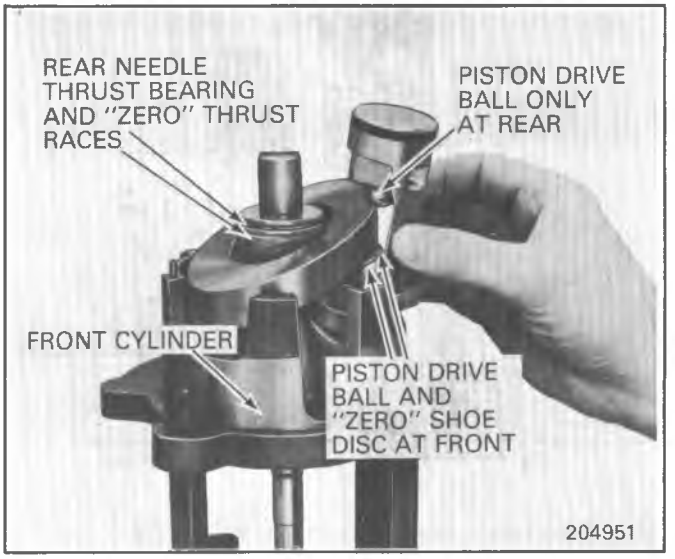


Fig. 1D-38 Installing A-6 Piston During Gaging Operation

11. Repeat Steps 6 through 10 for Pistons No. 2 and No. 3.

12. Now install rear cylinder half onto pistons, aligning cylinder with discharge cross-over tube hole in front cylinder half.

Tap into place using a plastic mallet or piece of clean wood and hammer (Fig. 1D-39).

13. Position discharge cross-over tube opening between a pair of Compressing Fixture J 9397 bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture J 9397. Tighten nuts to 20 N·m (15 lb. ft.) torque using a 0-60 N·m (0-25 lb.ft.) torque wrench.

Gaging Procedure (Steps 15 thru 18)

The gaging operations which follow have been worked out on a simple basis to establish and provide necessary running tolerances. Two gaging procedures are necessary.

The first is made to choose the proper size shoe discs to provide, at each piston, a .04 to .06mm (.0016" to .0024") total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate. The bronze shoe discs are provided in .01mm (.0005") variations, including a basic ZERO shoe.

The second, performed at the rear shaft thrust race and bearing stack-up, is designed to obtain .06 to .08mm (.0025" to .0030") preload between the hub surfaces of the axial plate and the front and rear hubs of the cylinder. A total

MINOR REPAIR PROCEDURES FOR THE R-4 COMPRESSOR

THE FOLLOWING OPERATIONS TO THE R-4 COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL & PULLEY RIM ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

The Compressor Shaft Seal assembly, and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system MUST FIRST BE PURGED of Refrigerant-12.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

Fig. 1D-68 R-4 Compressor

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the AIR CONDITIONING section and Fig. 1D-69 and Fig. 1D-70 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench.The work area, tools and parts must be kept clean at all times.

R-4 COMPRESSOR CLUTCH PLATE AND HUB ASM.

Remove

1. If compressor is on the car, loosen compressor mounting brackets, disconnect the compressor drive belt and reposition the compressor for access, if necessary.

If compressor has been removed from the car, attach the compressor to Holding Fixture J 25008-1, and clamp the Holding Fixture in a vise (Fig. 1D-71).

• Compressor mounting holes are metric. Use proper metric bolts with holding fixture J 25008-1.

2. Keep the clutch hub from turning with the Clutch Hub Holding Tool J 25030, remove, and discard the shaft nut, using Thin Wall Socket J 9399, Fig. 1D-72.

3. Thread the Clutch Plate and Hub Assembly Remover J 9401, into the hub. Hold the body of the Remover with a wrench and turn the center screw into the Remover body to remove the Clutch Plate and Hub assembly (Fig. 1D-73).

4. Remove the shaft key.

Replace

1. Install the shaft key into the hub key groove (Fig. 1D-74). Allow the key to project approximately 4.8mm (3/16") out of the keyway.

The shaft key is curved slightly to provide an interference fit in the shaft key groove of the hub.

2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the Clutch Plate and Hub assembly.

3. Align the shaft key with the shaft keyway and place the Clutch Plate and Hub assembly onto the compressor shaft.

NOTICE: To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.

4. Install the Clutch Plate and Hub Installer J 9480-01 as illustrated in Fig. 1D-75.

5. Hold the hex portion of the Installer Body J 9480-1 with a wrench and tighten the center screw to press the hub onto the shaft until there is a .5mm - 1.0mm (.020"-.040") inch air gap between the frictional surfaces of the clutch plate and clutch rotor.

6. Install a new shaft nut with the small diameter boss of the nut against the crankshaft shoulder, using Thin Wall Socket J 9399. Hold the Clutch Plate and Hub assembly with Clutch Hub Holding Tool J 25030, and tighten to 14 N·m (10 lb. ft.) torque, using a 0-60 N·m (0-25 pounds) torque wrench.

7. If operation is performed with compressor on car, connect drive belt, tighten mounting brackets and adjust belt tension.

R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING

Remove

1. Remove the Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate & Hub Asm." Removal procedure.

2. Remove Rotor and Bearing assembly retaining ring, using Snap Ring Pliers J 6083, Fig. 1D-76. Mark the location of the clutch coil terminals.

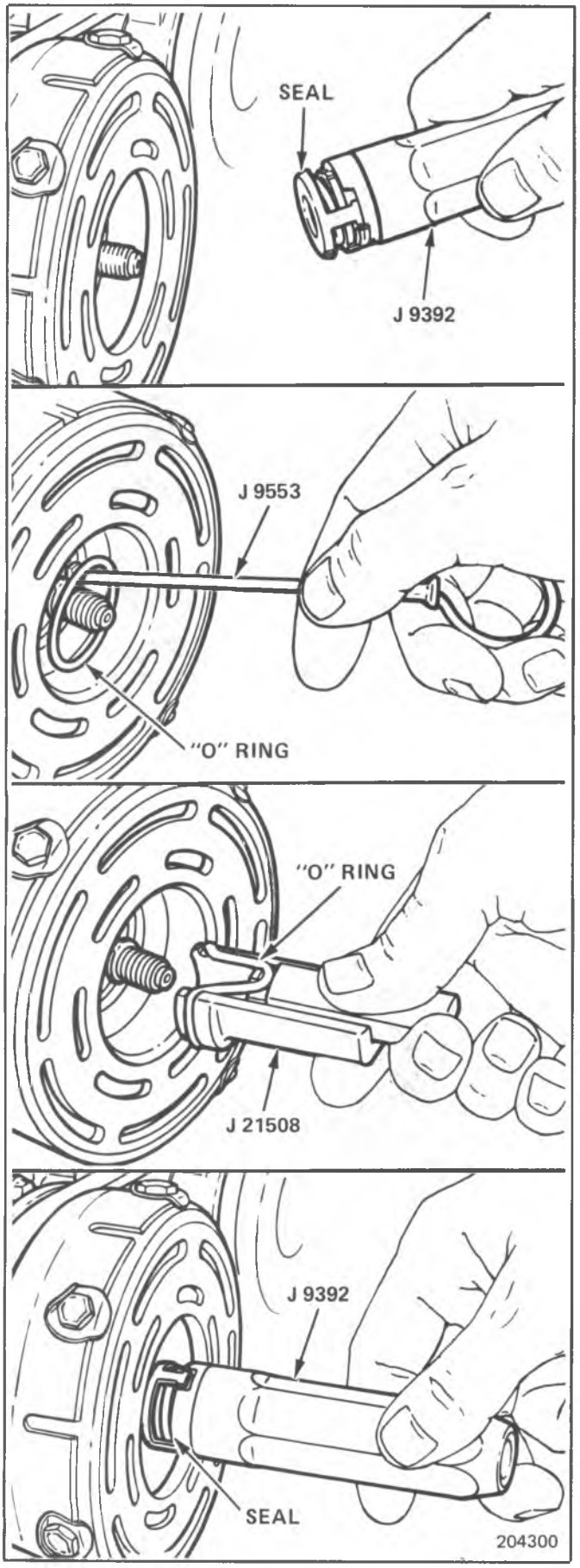


Fig. 1D-89 Removing and Installing R-4 Seal and O-Ring (On-Car)

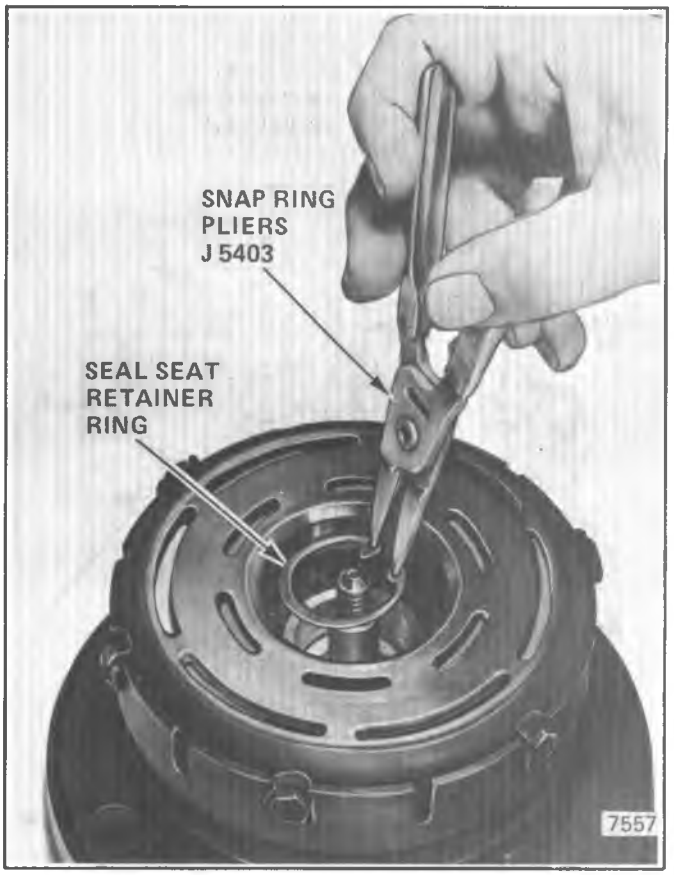


Fig. 1D-90 Removing or Installing R-4 Shaft Seal Seat Retaining Ring

R-4 COMPRESSOR SHAFT SEAL REPLACEMENT (OFF CAR)

1. Follow applicable on-car procedures.

2. To Leak Test, install leak Test Fixture J 9625 (Fig. 1D-94) on rear head of compressor and connect gage charging lines, or pressurize suction side (low pressure side) of compressor on car with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and using a wrench rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal and correct any leak found. Remove, discard, and later replace with a new shaft nut.

3. See Figs. 1D-91, 1D-92 and 1D-93.

R-4 COMPRESSOR PRESSURE RELIEF VALVE

The Pressure Relief Valve, located in the compressor rear head casting (Fig. 1D-69), should only be replaced after purging the system of refrigerant. A new valve and O-ring coated with 525 viscosity refrigerant oil should be installed.

R-4 COMPRESSOR FRONT HEAD AND/OR O-RING

Remove

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

2. Perform steps 1 through 4 of "R-4 Compressor Clutch Rotor and/or Bearing" Removal procedure but do

SECTION 3B

STEERING

CONTENTS OF THIS SECTION

MANUAL STEERING GEARS

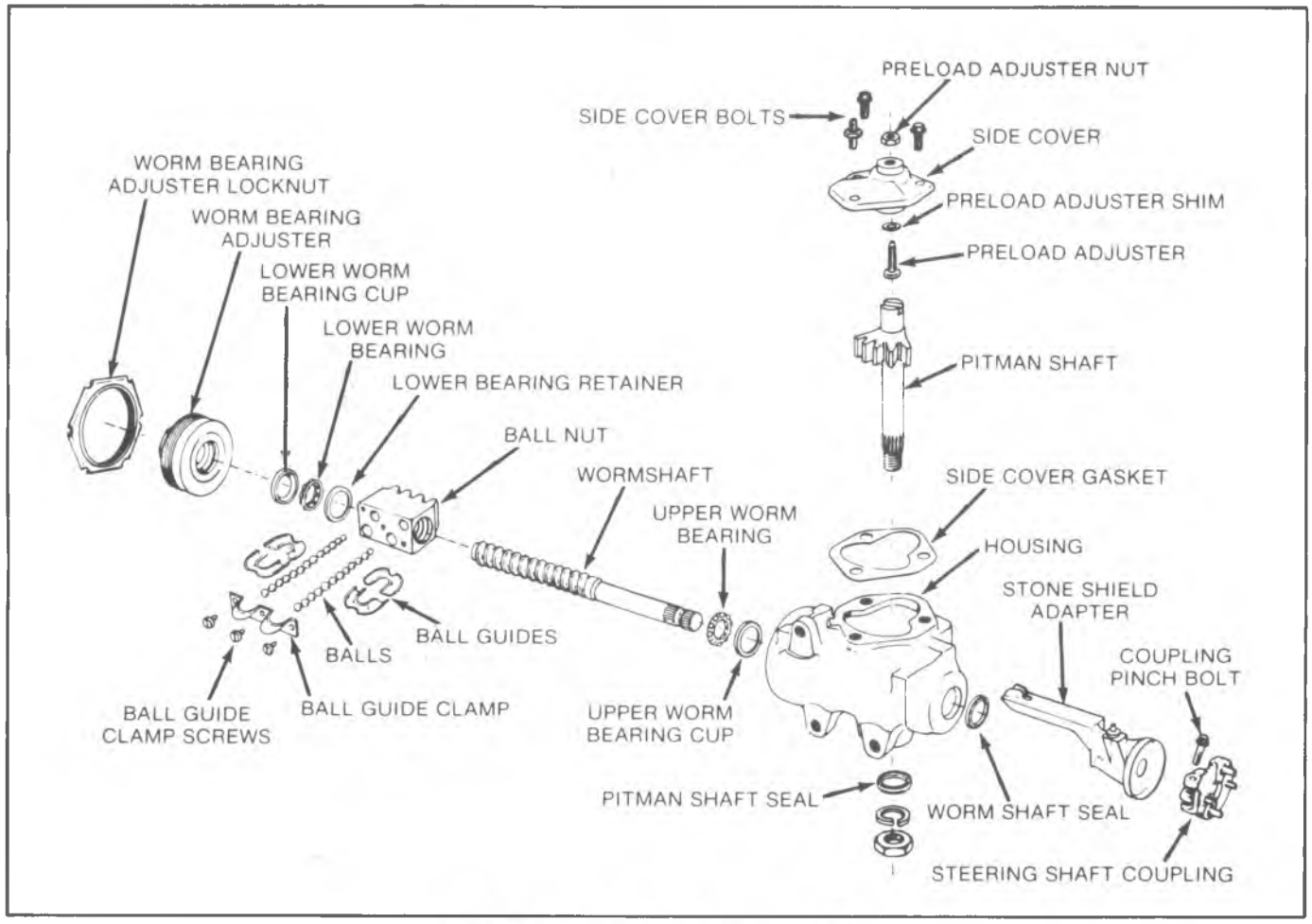
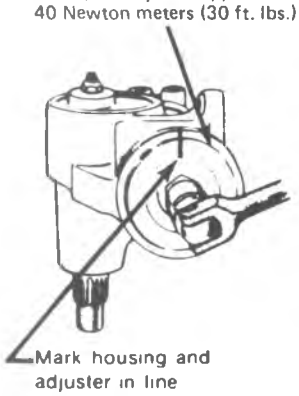


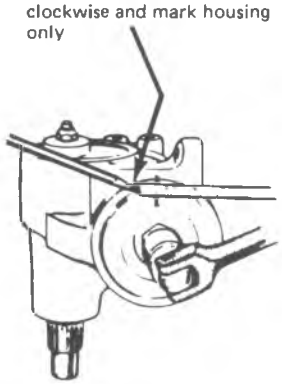
Fig. 3B2-1–Manual Gear, Exploded View

12. ADJUST WORM BEARING PRELOAD

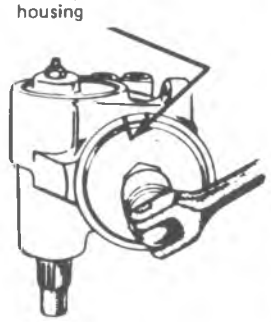
A Tighten adjuster plug until it bottoms (use 17mm hex. driver). Torque to approx. 40 Newton meters (30 ft. lbs.)



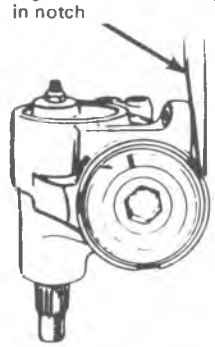
B Measure 13mm (½") counter-clockwise and mark housing only



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



D Tighten lock nut. Use punch in notch

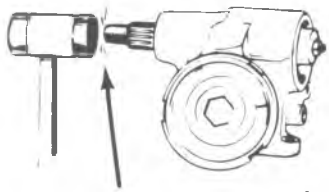


13. ADJUST "OVER CENTER" PRELOAD

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

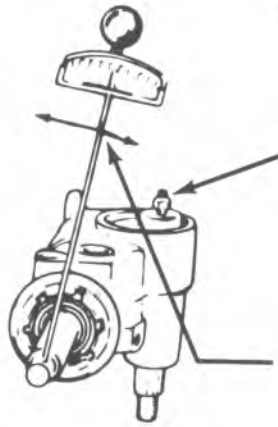
To drain the fluid, position the assembly with hydraulic line ports pointing downward over a container and cycle the rack-piston-nut from stop to stop three or four times.

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



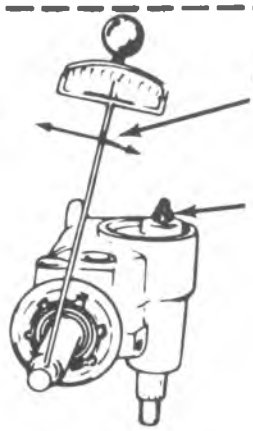
To seat the side cover, tap on the end of the pitman shaft with a soft hammer.

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



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

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



SPECIAL TOOLS

J-4245	— Snap Ring Pliers	J-8058	— 0-125 Newton-meter Torque Wrench (0-50 foot-pounds)
J-29107	— Pitman Arm Puller	J-8810	— Pitman Shaft Bearing Remover And Installer
J-6133-01	— Pitman Shaft Seal Installer	J-25323	— Power Steering Analyzer
J-6217	— Connector Seat Installer		
J-7754	— 0-5 Newton-meter Torque Wrench (0-25 inch-pounds)		

Fig. 3B3-5C–Overhaul 605 Gear, Chart E

SECTION 4B

REAR AXLE DIFFERENTIAL CARRIER

8-1/2 AND 8-7/8" 9 1/2" RING GEAR

INDEX

GENERAL INFORMATION

AXLE IDENTIFICATION

The rear axle codes are located as follows:

10 Series

The code is stamped on top of the right axle tube, 3" to 5" outboard of the carrier.

20-30 Series

The code is stamped on the top of the right axle tube, 6" to 8" outboard of the carrier.

Dana Axles

Dana rear axles used in Light Duty Trucks will be stamped with the Dana part number and production code indicating the month, day, year, shift and production line on which the axles were assembled.

DIFFERENTIAL CASE

Removal and Disassembly

Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described under "Checks and Adjustments". This will indicate gear or bearing wear or an error in backlash or pinion depth setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

1. Remove screw that retains differential pinion shaft, and remove pinion shaft.
2. Remove rear axle shafts as outlined in the Service Manual.
3. Roll out the differential pinions and thrust washers, then remove side gears and thrust washers. Mark pinions and side gears so that they can be reassembled in original position.
4. Mark the bearing caps and housing for reassembly in same position. Loosen bearing cap bolts. Tap surface of bearing caps to loosen.

   NOTICE: Do not attempt to pry caps off as this may damage machined face of caps.
5. Using a pry bar as shown in figure 2B, pry differential case out of carrier. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. If the bearings are preloaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing caps may be loosely installed, as shown in Figure 2B, to prevent case from falling.
6. Place left and right bearing cups with bearing caps so that they may be reinstalled in original positions. Place shims with appropriate cups.

Inspection

1. Clean all parts in cleaning solvent; inspect all bearing cups, races and rollers for scoring, chipping or evidence of excessive wear.
2. Inspect axle shaft and side gear splines for evidence of excessive wear.
3. Inspect hypoid ring gear and pinion teeth for possible scoring, cracking or chipping.
4. Inspect differential case, pinions side gears, thrust washers and pinion shaft for cracks, scoring, spalling or excessive wear.
5. Check fit of differential side gears in case.

Differential Bearing Replacement

1. Install Tool J-22888 and Adapter Plug J-8107-4, J-8107-3 for the 9 1/2" ring gear, assuring puller legs are fitted securely in notches in case and against bearing cone, as shown in figure 3B.
2. Tighten puller screw to remove bearing.

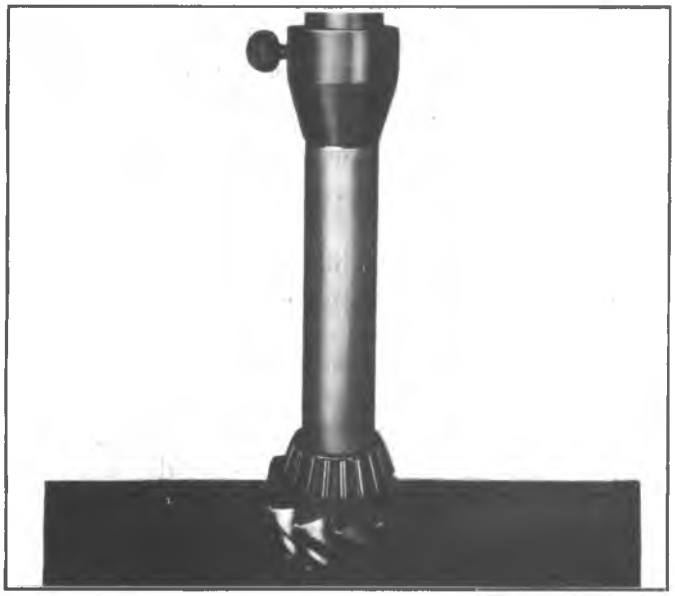


Fig. 24B--Installing Rear Bearing

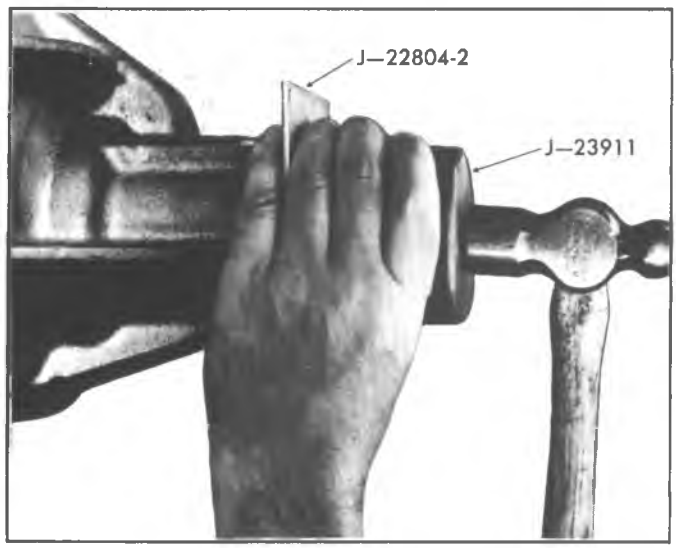


Fig. 25B--Installing Pinion Oil Seal

6. Tighten nut until all end play is removed from drive pinion.

   When no further end play is detectable, and when Holder J-8614-11 will no longer pivot freely as pinion is rotated, preload specifications are being neared. Further tightening should be done only after nut and washer installation and preload has been checked.

7. While observing the preceding caution, carefully set preload drag at 20-25 inch pounds on new bearings, or 10-15 inch pounds on reused bearings. Use an inch-pound torque wrench such as J-5853 as shown in figure 24B, to measure the rotating torque.

   After torque has been checked, final tightening should be done very carefully. For example, if when checking, torque was found to be 5 inch-pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and torque should be checked after each slight amount of tightening. Exceeding torque specifications may compress the collapsible spacer too far and require its replacement.

8. Rotate the pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced, re-set preload to specifications.

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinionn Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring Gear-to-Pinion Backlash.

Pinion Bearing Preload is set to specifications in step 7 of "Drive Pinion Installation and Adjustment".

Side Bearing Preload is set to specifications in step 9 of "Differential Case-Installation and Adjustment".

Following service to the Differential Case or to the Drive Pinion and Ring Gear, a Gear Tooth Contact Pattern Check **must be made to verify the accurace of the work in setting the pinion depth and the ring gear-to-pinion backlash.**

Gear Tooth Contact Pattern Check

Prior to final assembly of the differential, a Gear Tooth Contact Pattern Check is necessary to verify the correct relationship between ring gear and drive pinion. Gear sets which are not positioned properly may be noisy, or have short life or both. With a pattern check, the most desireable contact between ring gear and drive pinion for low noise level and long life can be assured.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end. See figure 27B.

Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff

Fig. 26B--Measuring Rotating Torque

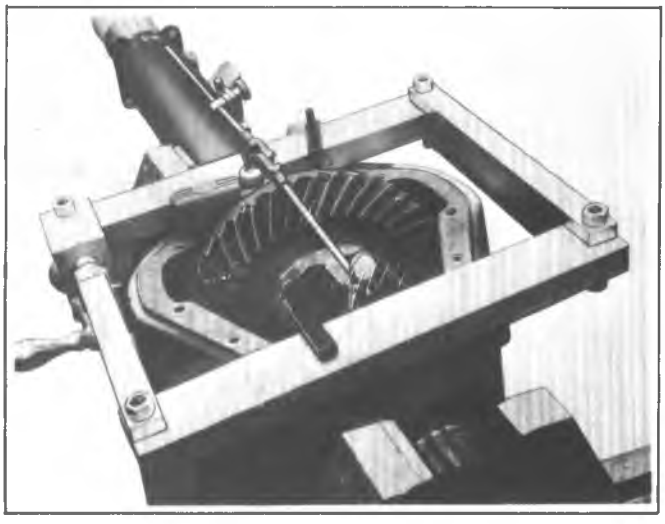


Fig. 2F–Spreading the Carrier

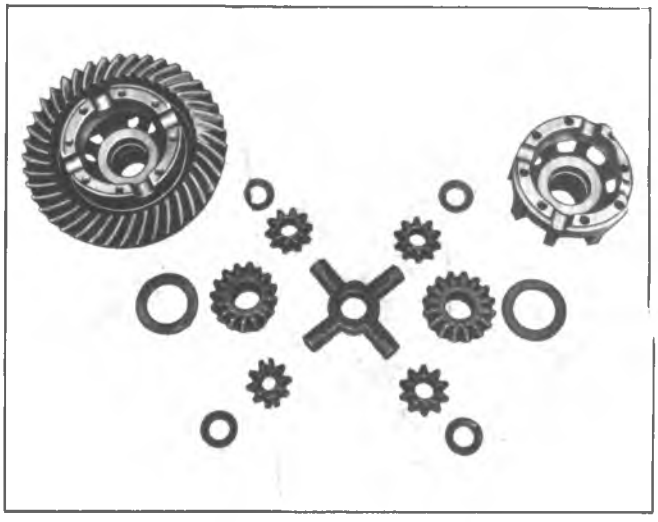


Fig. 4F–Internal Parts Inspection

dimensions and location of the side bearing shims. Remove the spreader tool.

Disassembly

1. Remove differential side bearings by placing J-22912 under bearings and supporting plates on a press bed. Apply force to pilot plug J-8107-3 to drive the case from the bearing.

Use care not to damage case hubs with tool J-22912.

2. Remove the ring gear bolts and the ring gear. Tap the ring gear with a soft-faced hammer to free it from the case.

3. Scribe both case halves for reassembly in same position.

4. Remove bolts holding case halves together, as shown in figure 3F.

5. Tap lightly on top half of case to free it from the bottom half. Remove top half of case.

6. Lift out all internal parts.

Fig. 3F–Separating Case Halves

Inspection

1. Clean all gears and bearings in solvent. Inspect cups, races and rollers for scoring, chipping or evidence of excessive wear.

2. Inspect ring gear teeth and machined surfaces. Examine fit of internal gears.

3. Inspect pinion cross-shaft.

4. Replace parts as required.

DRIVE PINION

Removal and Disassembly

1. Remove differential as previously outlined.

2. Check pinion bearing preload as described under "Drive Pinion - Installation and Adjustment." If there is no preload reading, check for looseness of pinion assembly by shaking the companion flange. Looseness indicates the need for bearing replacement.

3. Install Holder J-8614-11 on flange by using two bolts with flat washers, as shown in figure 5F. Position J-8614-11 on flange so that the four notches are toward the flange.

4. Remove pinion nut and washer. Discard pinion nut and use a new one upon reassembly.

5. Thread end of J-8614-3 into small O.D. end of J-8614-2. Then with J-8614-11 installed as in step 3, insert J-8614-2 into J-8614-11 and turn it 1/8 of a turn to locked position. Remove flange by turning J-8614-3 while holding J-8614-22 as shown in figure 6F.

6. Remove drive pinion from carrier. It may be necessary to tap on the pinion with a soft faced hammer.

7. With a long drift tap on inner race of outer pinion bearing , to remove pinion oil seal, slinger, gasket, outer pinion cone and roller and shim pack. Tag shim pack for reassembly.

8. Should inspection indicate necessity, pinion bearing cups can be removed from carrier using a long drift and hammer. Remove shims and oil slinger which are located behind the inner bearing cup. Tag shims for reassembly.

9. Remove rear pinion bearing using J-22912, and an arbor press.

Old Pinion Marking	New Pinion Marking								
	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4
+ 4	+ 0.008	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0
+ 3	+ 0.007	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001
+ 2	+ 0.006	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002
+ 1	+ 0.005	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003
0	+ 0.004	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004
- 1	+ 0.003	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005
- 2	+ 0.002	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006
- 3	+ 0.001	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007
- 4	0	- 0.001	- 0.002	- 0.003	- 0.004	- 0.005	- 0.006	- 0.007	- 0.008

Fig. 21F--Dana Pinion Code Chart

7. Check gear tooth contact, as described earlier in "Dana 10-1/2" Ring Gear" section, under "Gear Tooth Contact Pattern Check". Refer to figure 25F.

8. Using a new gasket, install housing cover and torque bolts to specifications.

9. Reinstall the rear universal joint, and torque "U" bolt nuts to specifications.

10. Install axles into carrier and axle flange over hub studs. Torque hub stud nuts to specifications.

11. Fill differential with lubricant.

12. Install wheel and tire assembly.

CAUTION: See Caution on page 1 of this section regarding the fasteners referred to in the above steps.

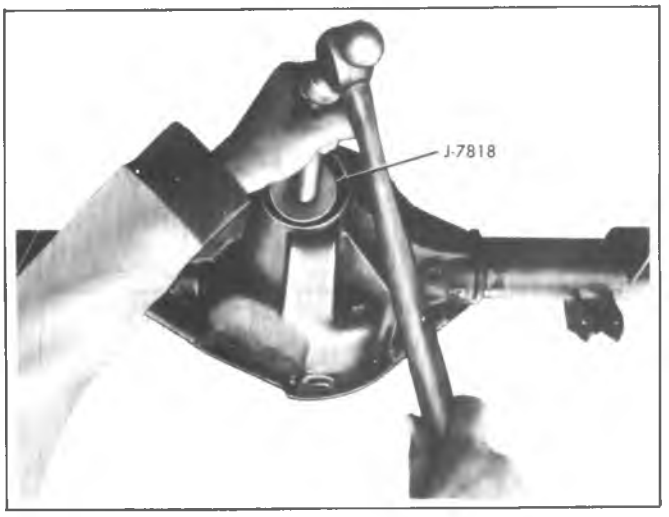


Fig. 22F--Installing Outer Pinion Bearing Cup

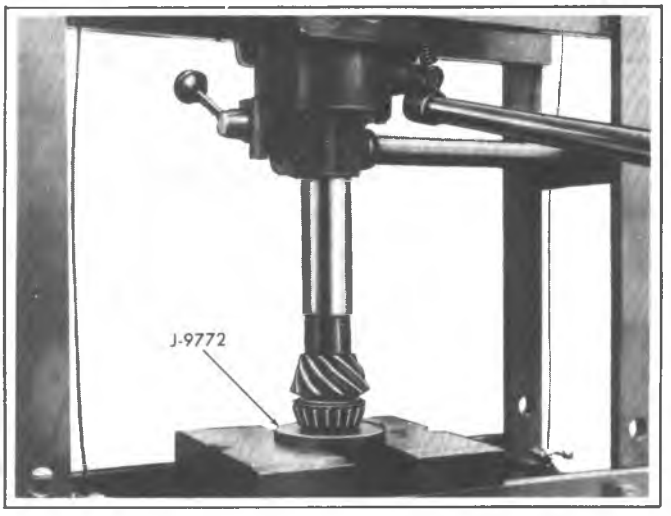


Fig. 23F--Installing Inner Pinion Cone and Roller

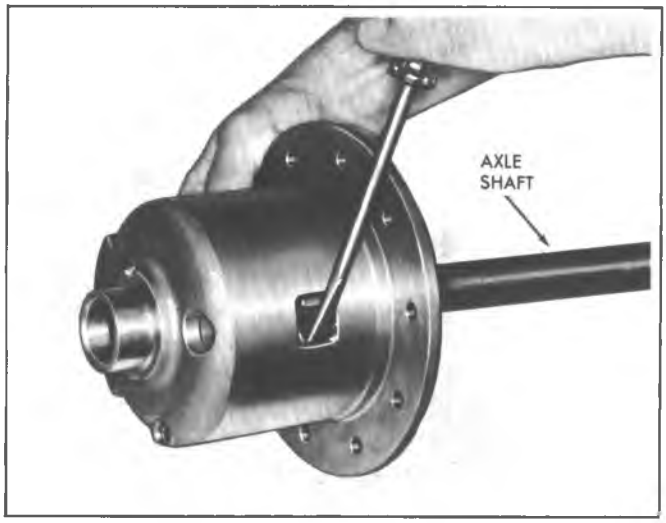


Fig. 7D–Removing Differential Pinion Gears

clearance.

10. Tooth clearance should be .001″ to .008″. If required, change shims to obtain proper tooth clearance.

11. Remove side gear assembly and repeat tooth clearance procedure for other side gear on opposite side of case.

12. Remove pinion shaft, gears and thrust washers.

13. Install remaining side gear, clutch pack assembly and shims in case.

14. Install pinion gears and thrust washers. Installation of pinion gears can be performed by reversing the pinion gear removal procedure.

15. **For all except Corvette** , assemble springs in spring retainer and clamp assembly in vise. Install ″C″ clamp and bar stock on spring retainer then install a 1/4 inch bolt and nut in each front spring. See figure 11D.

16. Position spring pack between side gears and remove bar stock and ″C″ clamp.

17. **On Corvette** install Tool J-22311 to compress clutch pack, , secure pack with 1/4″ bolts as shown in figure 12D. Partially install pack then remove bolts and complete pack installation. Remove tool.

Fig. 8D–Removing Side Gear

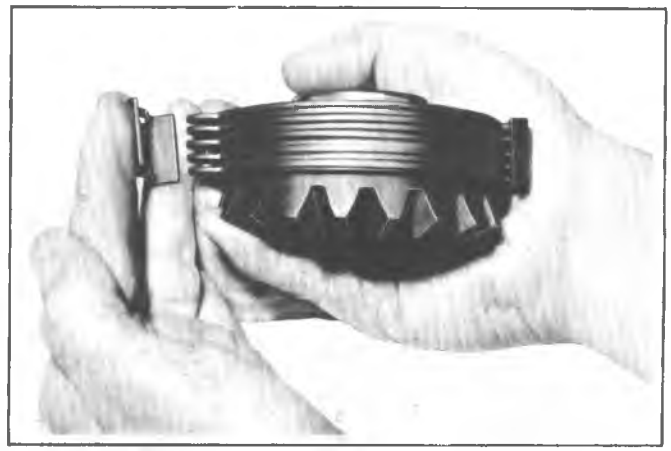


Fig. 9D–Assembling Clutch Pack

18. Drive spring pack into side gears sufficiently to retain front springs, then remove 1/4 inch bolts from springs. Drive spring pack into position. See figure 13D.

19. Install the pinion shaft and lock screw to retain side gears until axle shafts are installed.

20. Check alignment of spring retainer with side gears. Slight movement of the spring pack can be made if necessary.

21. Install side bearings and ring gear to case using procedure outlined for the conventional differential.

22. Place differential in carrier and adjust bearings and backlash as outlined for the conventional differential.

23. Check operation of unit as follows:

a. Raise rear of vehicle until rear wheels are off the ground, and remove one wheel and tire assembly.

b. Attach Adapter J-5748 to axle shaft flange and install a 1/2-13 bolt into adapter, shown in figure 14D.

c. With wheel and tire assembly still on vehicle held firmly to prevent turning, measure torque required to rotate opposite axle shaft with a 0-150 lb. torque wrench attached to J-5748 . Torque required to rotate axle shaft should be no less than 40 ft. lbs.

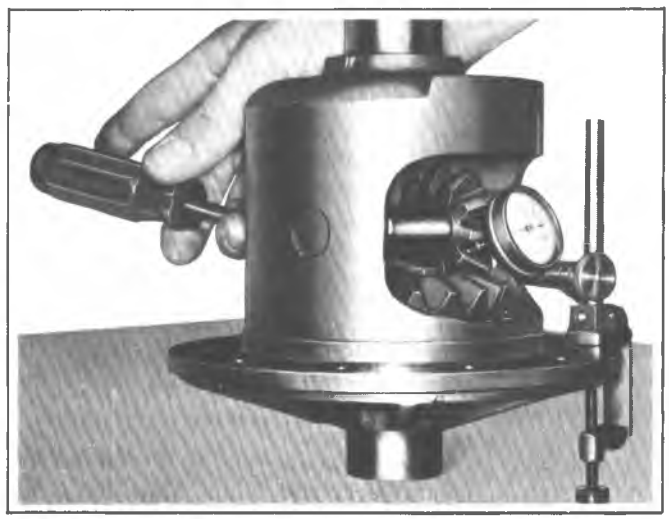


Fig. 10D–Measuring Pinion Gear Tooth Clearance

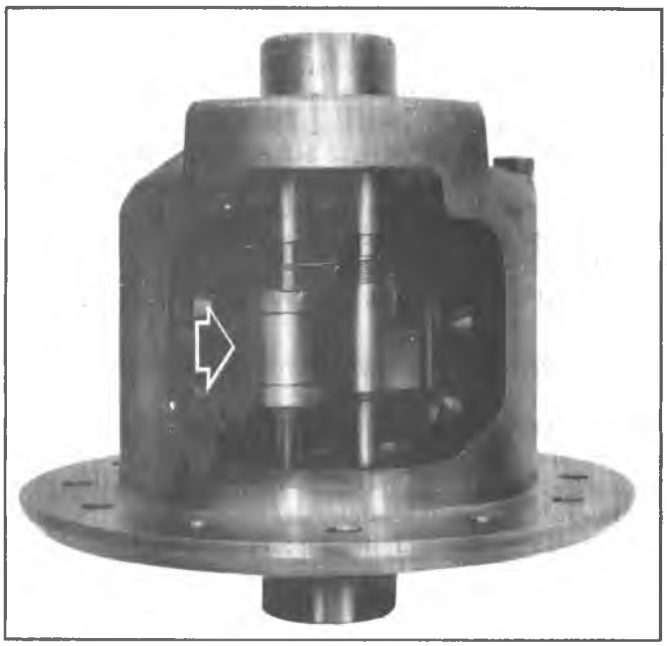


Fig. 4B-4H–Governor and Latching Bracket

Internal components can be inspected through the windows of the differential housing.

If the governor assembly and latching bracket are the only items to be replaced, proceed only through step No. 2 of the disassembly procedure. To install new governor and latching bracket, begin at step No. 6 of the reassembly procedure.

Disassembly

1. Note position of governor and latching bracket assembly, Figure 4B-4H. Remove ring gear and side bearings following procedures established for the standard differential.

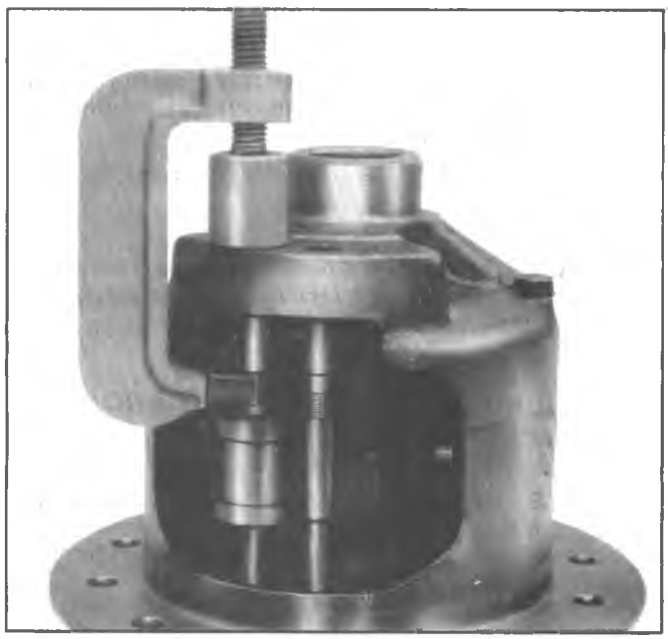


Fig. 4B-5H–Bearing Puller J-26252

2. Using bushing puller tool No. J-26252, remove governor assembly and latching bracket by pulling the retaining bushings as shown in Figure 4B-5H. Pull the latching bracket spring out of the way while pulling the governor assembly bushing to prevent damage. Remove the stop pin by driving through the case with a drive pin punch.

3. Remove lock screw and pinion shaft, and roll out differential pinion gears.

4. Remove thrust block and pinion thrust washers.

5. Remove cam gear, disc pack assembly and disc pack guide clips.

6. Remove bell disc pack assembly and shim.

Inspection

1. Clean all parts with solvent. Inspect all bearing for chipping or evidence of excessive wear. Replace parts as needed.

2. Inspect all differential components for excessive wear and breakage. Replace parts as needed . The following are serviceable components for this differential:

- Governor assembly and latching bracket with spring and stop pin.
- Cam plate.
- Clutch disc pack with guides (flange end only).
- Pinion cross-shaft.
- Pinion gears.
- Pinion thrust washers.
- Reaction block (6 sizes).
- Thrust ring.
- Flange end shim (5 sizes).

Attempts to service other components may disturb critical clearances and could result in differential complaints.

If reaction block or flange end shim must be replaced, the original pieces must be carefully measured for thickness and replaced with a piece of the same size.

CAM/CLUTCH SERVICE

Disassembly

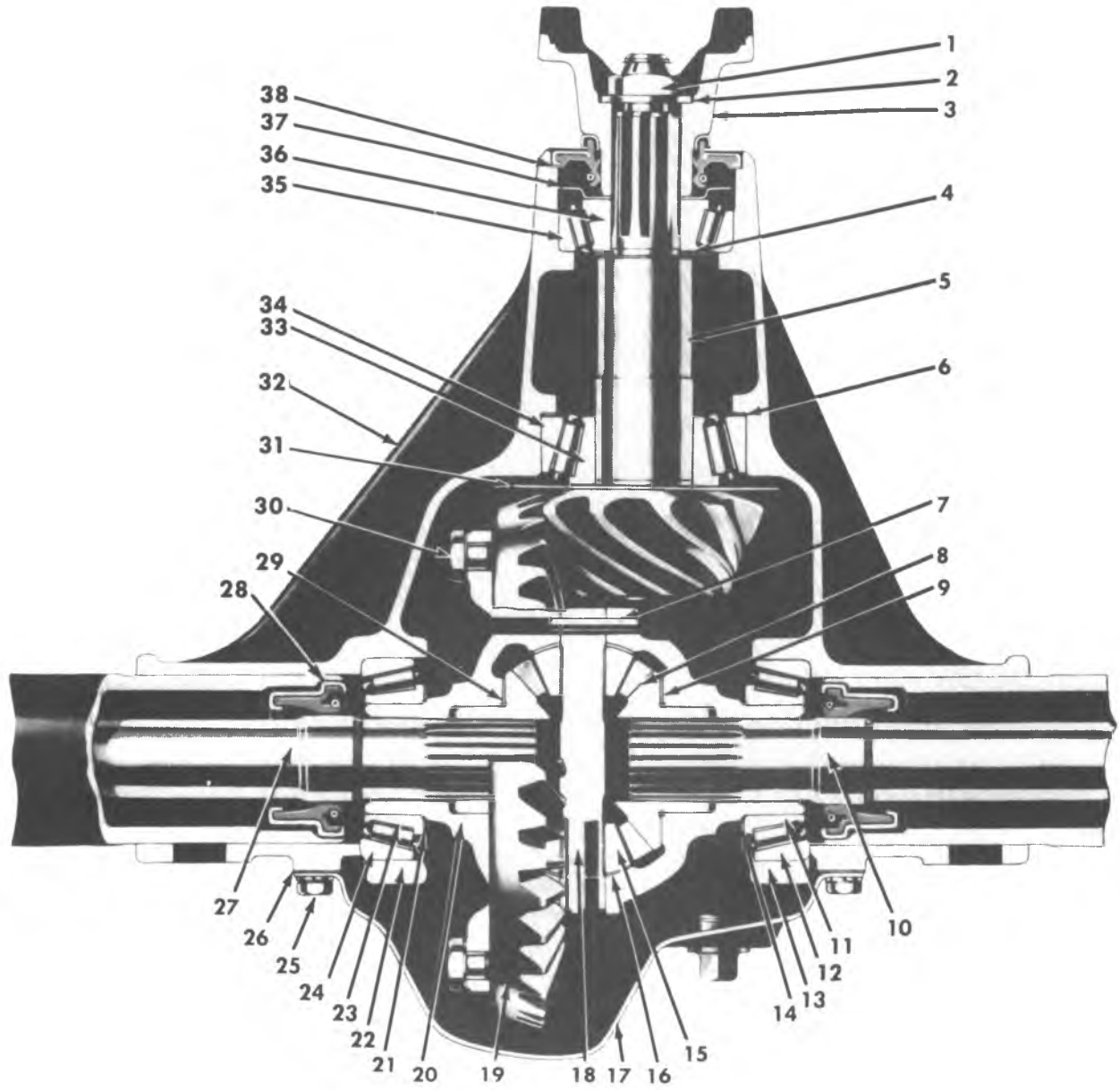
If cam plate or clutch discs must be replaced, the cam gear sub-assembly must be serviced as follows:

1. Measure and record overall length of gear assembly (front face of gear to back side of thrust ring, include shim). This dimension will be needed to reassembly unit if thrust ring is replaced. **DO NOT REPLACE THRUST RING UNLESS NECESSARY.** If ring is excessively worn or scored, check bore in case for scoring. If bore is scored, replace entire differential.

2. With gear hub end up, compress disc pack and install jaws of split ring bearing remover (J-22912) between the thrust ring and the top eared disc. Bevel side of bearing remover should face up toward thrust ring.

3. Place cam gear assembly with bearing remover attached in an arbor press supporting the bearing remover on both sides.

4. Install a 1-1/2″ to 1-3/4″ diameter plug similar to (J-8107-4) on gear hub. Press against plug with ram of press to remove thrust ring. Keep all components in the proper order, Figure 4B-6H.



1. Nut
2. Washer
3. Pinion Flange
4. Outer Bearing Shims
5. Drive Pinion
6. Inner Bearing Shims
7. Lock Pin
8. Differential Side Gear
9. Thrust Washer
10. Axle Shaft
11. Differential Bearing Cone
12. Differential Bearing Cup
13. Bearing Cap
14. Differential Bearing Adjusting Shims
15. Differential Pinion
16. Thrust Washer
17. Cover
18. Pinion Cross Shaft
19. Ring Gear
20. Differential Case
21. Differential Bearing Adjusting Shims
22. Differential Bearing Cap
23. Differential Bearing Cone
24. Differential Bearing Cup
25. Cover Bolt
26. Gasket
27. Axle Shaft
28. Oil Seal
29. Thrust Washer
30. Ring Gear Bolt
31. Oil Slinger
32. Differential Carrier
33. Inner Bearing Cone
34. Inner Bearing Cup
35. Outer Bearing Cup
36. Outer Bearing Cone
37. Oil Slinger
38. Oil Seal

Fig. 4C-3--Front Axle Differential Assembly

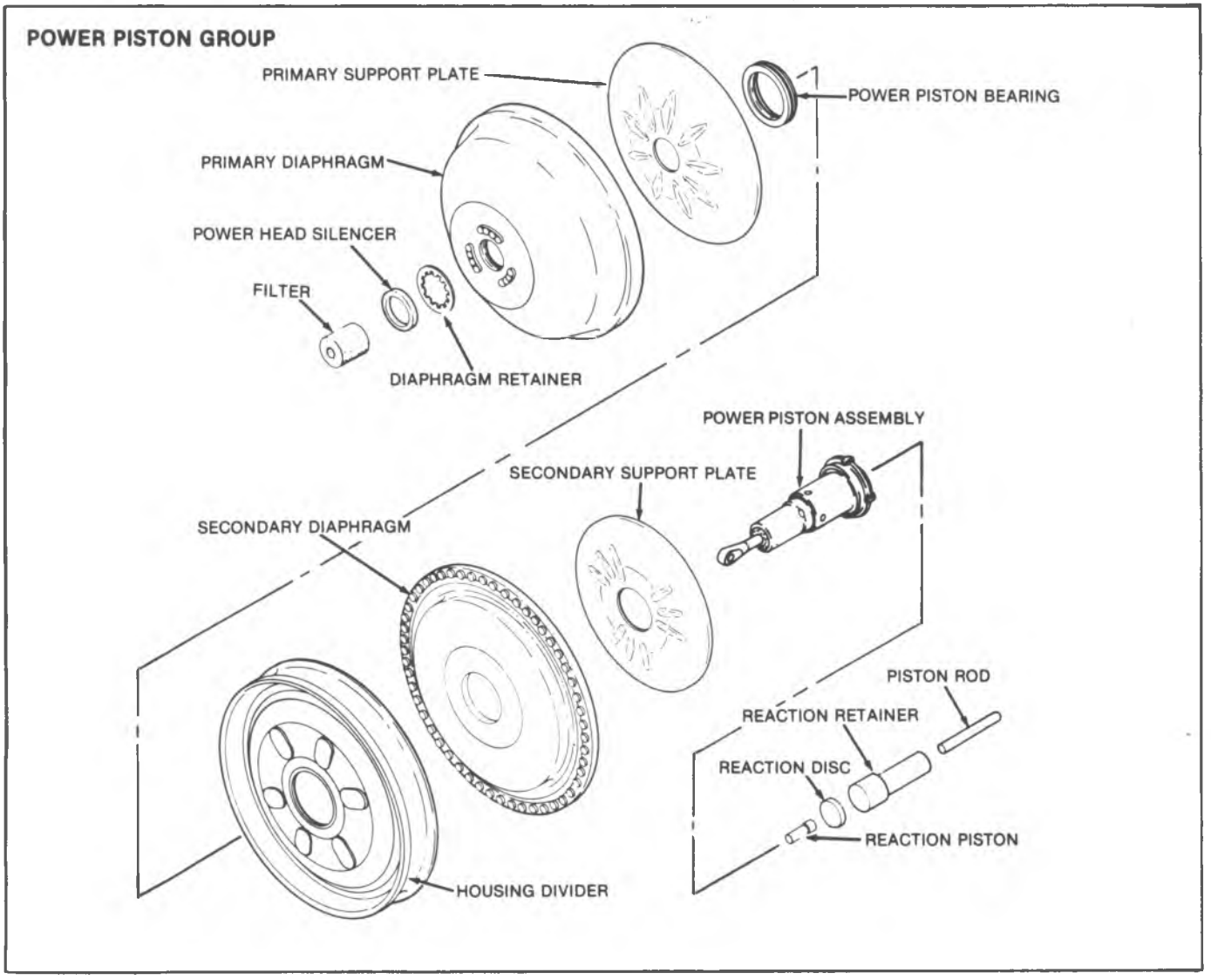


Fig. 5-2A--Power Piston Group

DELCO SINGLE DIAPHRAGM POWER BRAKE UNIT

UNIT REPAIR

GENERAL DESCRIPTION

This booster is a 240mm, single diaphragm vacuum suspended unit. In a normal operating mode, with the service brakes in the released position, a vacuum suspended booster operates with vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist.

NOTICE: To prevent damage to brake parts, use all components included in repair kits to service this booster. Lubricate rubber parts with silicone grease provided in kits. Torque values specified are for dry, unlibricated fasteners.

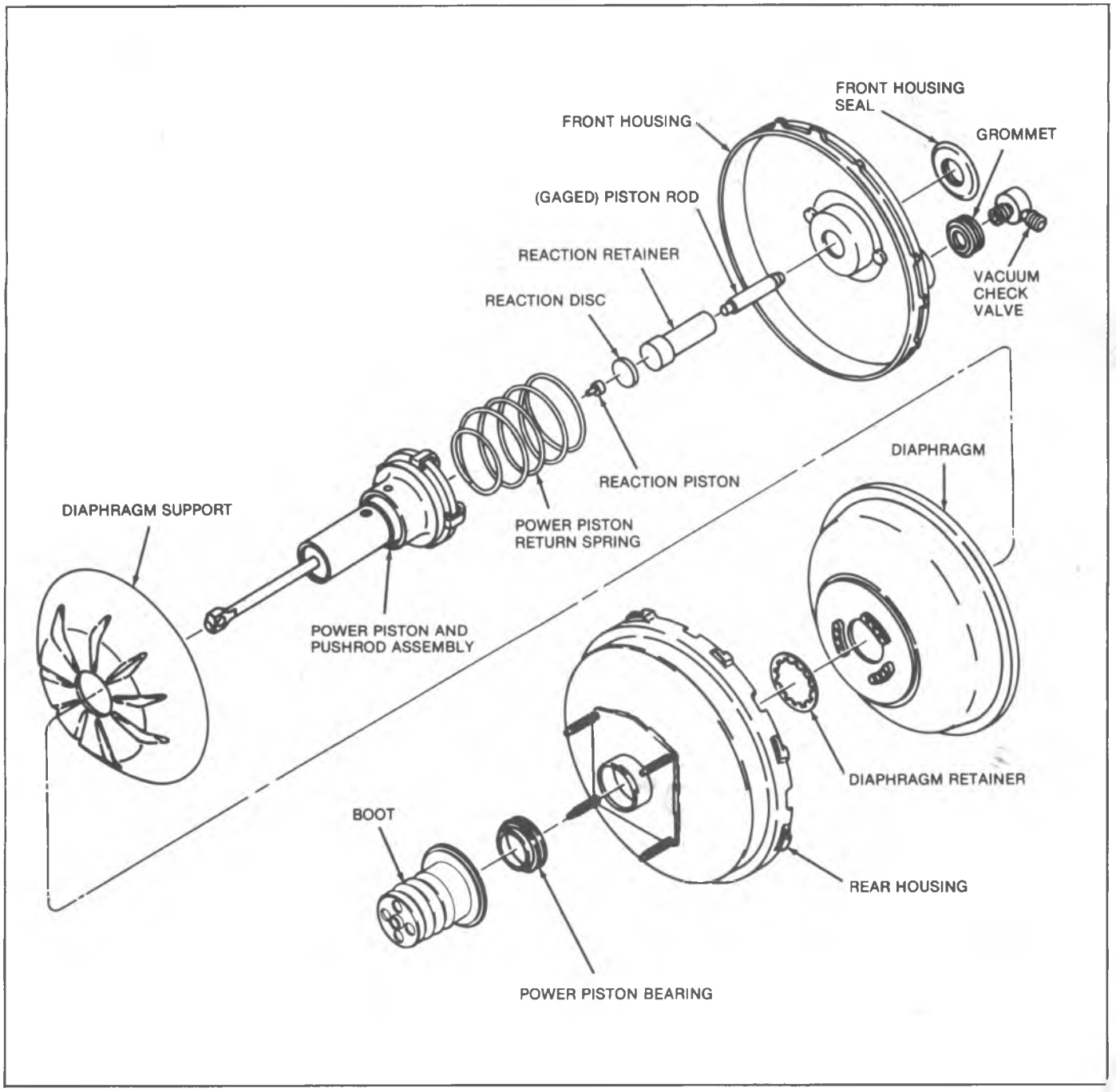


Fig. 5-1C--Booster Assembly Exploded

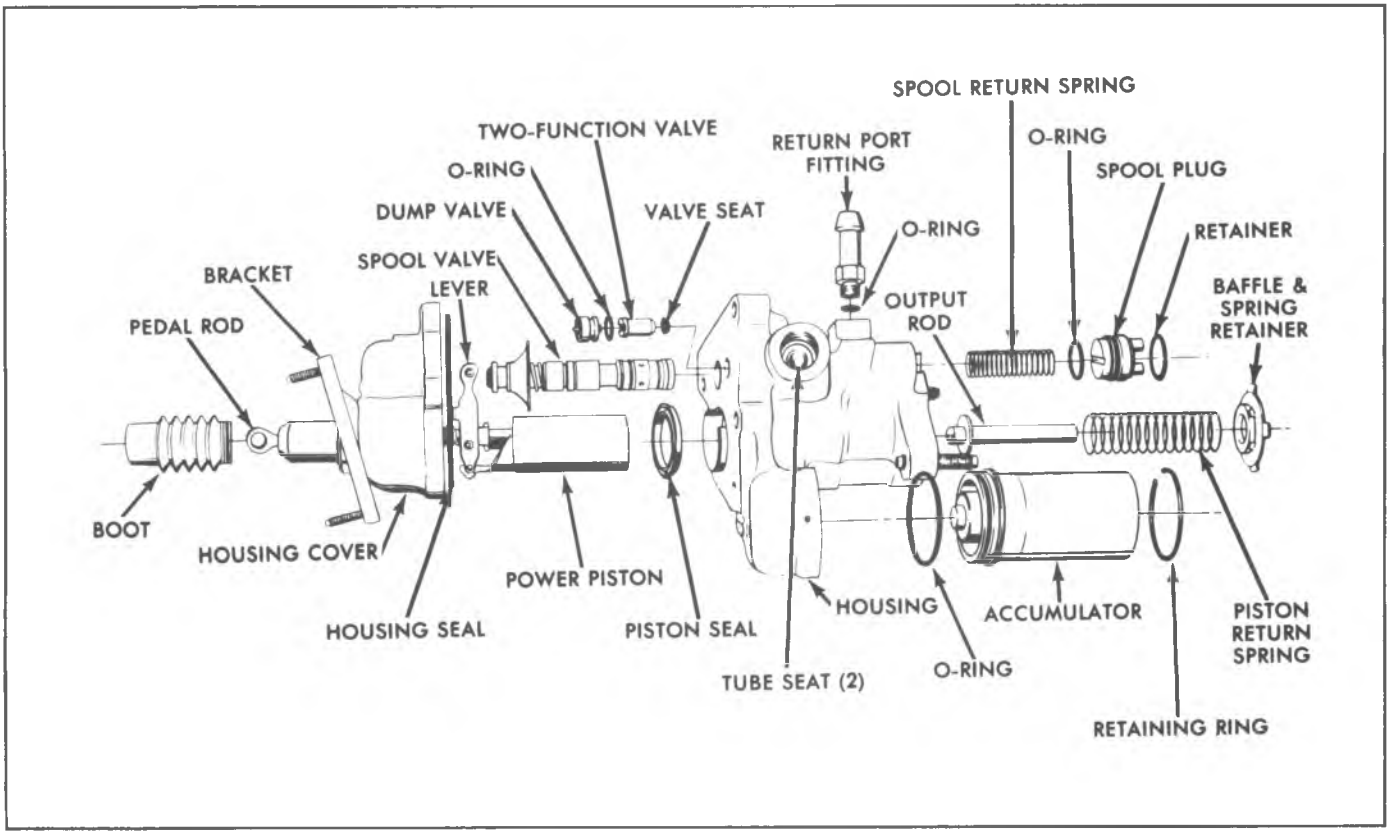


Fig. 5-1E--Bendix Hydro-Boost Explode--Typical

4. Place a punch (or similar tool) through the pedal rod from the lower side of Tool J-24569. Push the punch on through to rest on the higher side of the tool. Lift up on the punch to shear the pedal rod retainer; remove the pedal rod.
5. Remove the remnants of the rubber grommet from the groove near the end of the pedal rod and from the groove inside the input rod end.

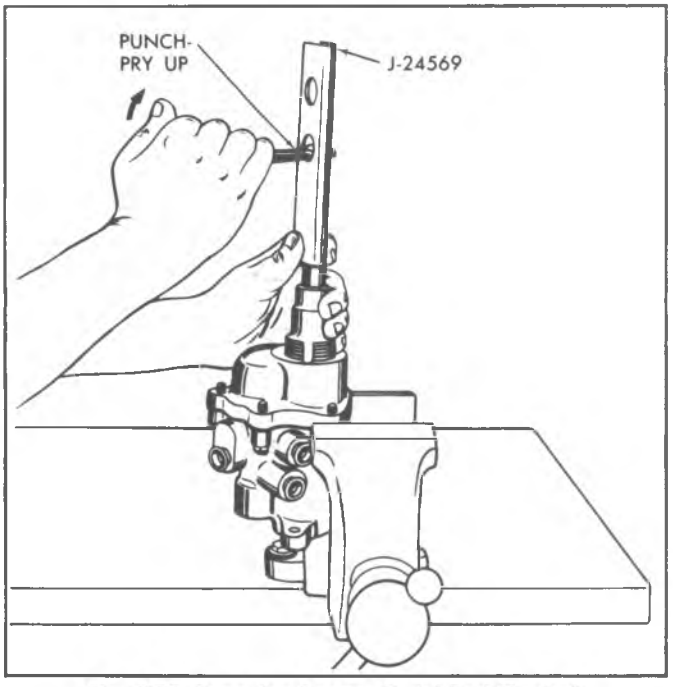


Fig. 5-2E--Removing Booster Pedal Rod (Typical)

6. With a small screwdriver, pry the plastic guide out of the output push rod retainer. Disengage the tabs of the spring retainer from the ledge inside the opening near the master cylinder mounting flange of the booster. Remove the retainer, the piston return spring and output rod from the opening (fig. 5-3E).
7. Place the booster cover in a vise equipped with soft jawed devices. Remove the five screws that secure the booster housing to the cover.
8. Remove the booster assembly from the vise and while holding the unit over a pan, separate the cover from the housing. Remove the "figure eight" seal from the housing cover; discard the seal.
9. Remove the input rod and piston assembly, the spool assembly and spool spring from the booster housing.

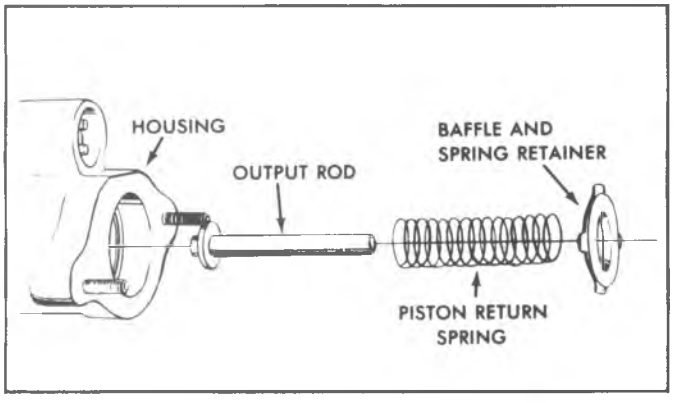


Fig. 5-3E--Output Rod, Spring and Retainer

SECTION 7A

AUTOMATIC TRANSMISSION UNIT REPAIR (OVERHAUL)

CONTENTS

200 AUTOMATIC TRANSMISSION W/TCC

GENERAL DESCRIPTION

The 200 Automatic transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter with the addition of a converter clutch and a compound planetary gear set. Three multiple-disc clutches, a roller clutch and a band provide friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse.

The 3-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. The stator is mounted on a one-way roller clutch which will allow the stator to turn clockwise but not counterclockwise.

The torque converter housing is filled with oil and is attached to the engine crankshaft by a flex plate and always rotates at engine speed. The converter pump is an integral part of the converter housing, therefore the pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes through the turbine it is traveling in such a direction that if it were not redirected by the stator it would hit the rear of the converter pump blades and impede its pumping action. At low turbine speeds, the oil is re-directed by the stator to the converter pump in such a manner that it actually assists the converter pump to deliver power or multiply engine torque.

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter. The converter clutch is splined to the turbine assembly, and when operated, applies against the converter cover providing a mechanical direct drive coupling of the engine to the plantery gears.

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

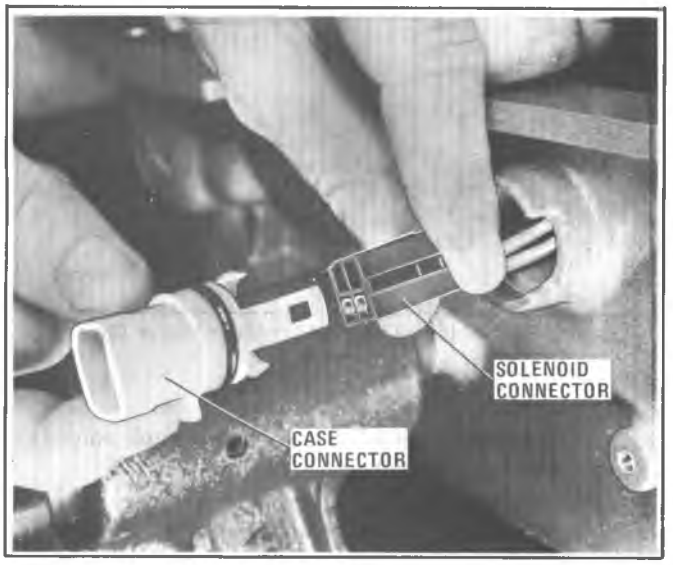


Figure 7A1-18 Removing Solenoid Connector from Case Connector

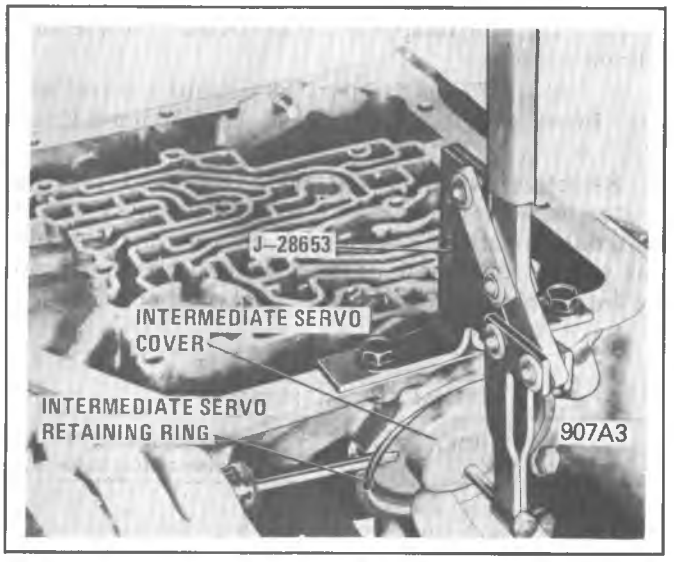


Figure 7A1-19 Removing Intermediate Servo Retaining Ring

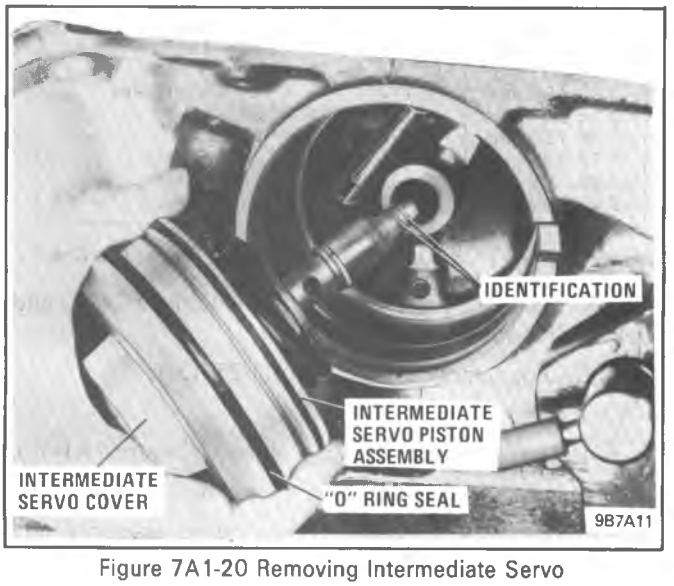


Figure 7A1-20 Removing Intermediate Servo

a. Using a No. 4 easy out, remove the check valve assembly from the case by turning and pulling straight out. (Figure 25)

b. Install new check valve assembly, small end first, into case. Position the oil feed slot in tube so it faces the servo cover.

c. Using a 9.5mm (3/8") diameter metal rod and hammer, drive check valve assembly until it is flush or below the surface of the 3rd accumulator case hole. (Figure 26)

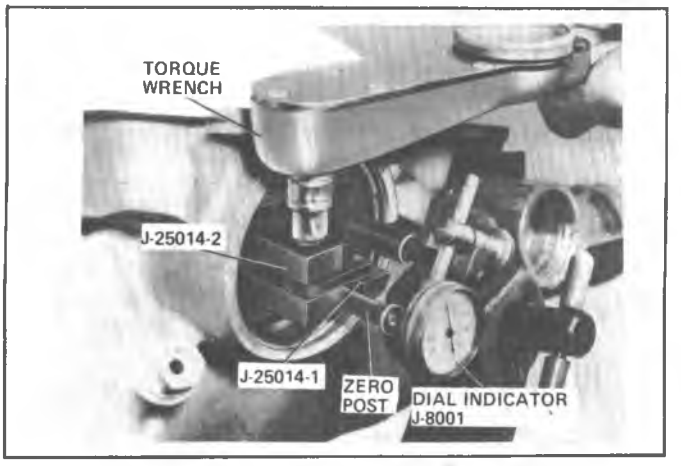


Figure 7A1-21 Intermediate Band Apply Pin Tools

Figure 7A1-22 Checking for Proper Intermediate Band Apply Pin

INTERMEDIATE BAND APPLY PIN SELECTION CHART

DIAL INDICATOR TRAVEL	APPLY PIN IDENTIFICATION
.0 - .72mm (.0 - .029")	1 Ring
.72mm - 1.44mm (.029"-.057")	2 Rings
1.44mm - 2.16mm (.057"-.086")	3 Rings
2.16mm - 2.88mm (.086"-.114")	Wide Band

9B7A6

Figure 7A1-23 Intermediate Band Apply Pin Selector Chart

FRONT UNIT PARTS

Removal

1. Check front unit end play as follows: (Figure 7A1-28).

2. Inspect lubrication passages for being plugged or damaged.

3. Inspect splines for damage.

4. Inspect governor drive gear for rough or damaged teeth.

5. Inspect speedometer drive gear for rough or damaged teeth and also the clip for damage.

6. If necessary to replace speedometer drive gear, proceed as follows:

a. Depress speedometer drive gear clip.

b. Remove gear and clip, tapping gear lightly with plastic hammer.

NOTICE: Make sure speedometer drive gear is located so speedometer driven gear will mesh with it.

c. Place speedometer drive gear clip with the tanged end in the correct hole in the output shaft (Figure 7A1-69).

d. Align the slot of the speedometer drive gear with the clip and install the gear.

Steel Speedometer Drive Gear

1. Install speedometer gear removing Tool J-21427-01 and suitable puller such as J-8433 on output shaft and remove speedometer drive gear. (Figure 7A1-70).

2. Place front end of shaft on block of wood to prevent damaging the front end.

3. Position speedometer gear, larger chamferred inside diameter first, over rear end of output shaft. (Figure 7A1-71).

4. Using Tool J-28578 drive gear to 156.15mm (6-5/32") from rear end of output shaft to rear face of gear.

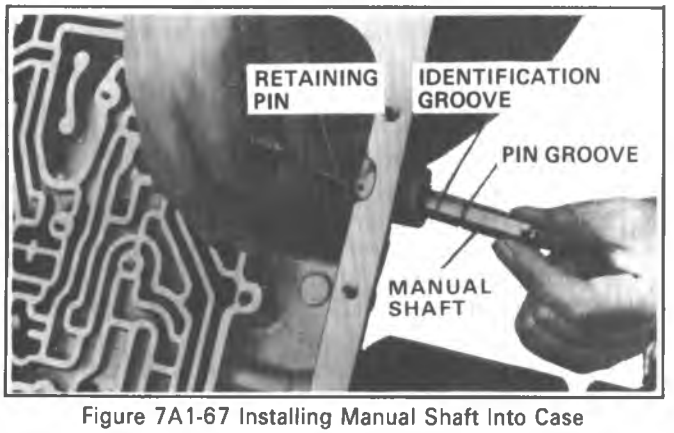


Figure 7A1-67 Installing Manual Shaft Into Case

Rear Internal Gear

1. Inspect rear internal gear, splines, teeth and bearing surface for wear, cracks or damage.

2. Inspect parking pawl lugs for cracks or damage.

3. Install rear internal gear, hub end first, on output shaft, as shown in Figure 7A1-73.

4. Thoroughly clean, air dry and inspect closely, the rear internal gear to rear sun gear roller thrust bearing assembly for pitted or rough conditions.

5. Install rear internal gear to rear sun gear roller thrust bearing assembly by placing the small diameter race over the output shaft. (Figure 7A1-72).

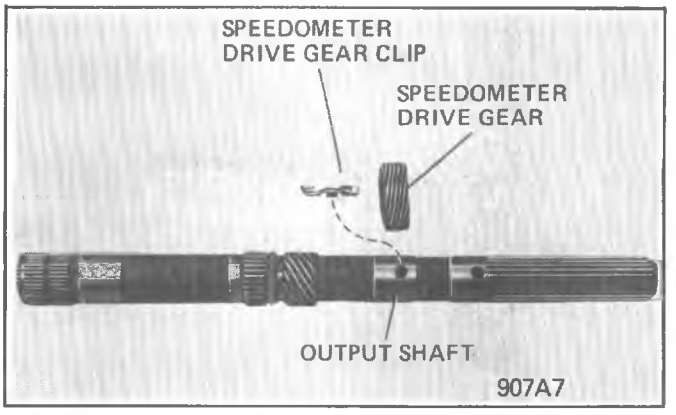


Figure 7A1-68 Output Shaft

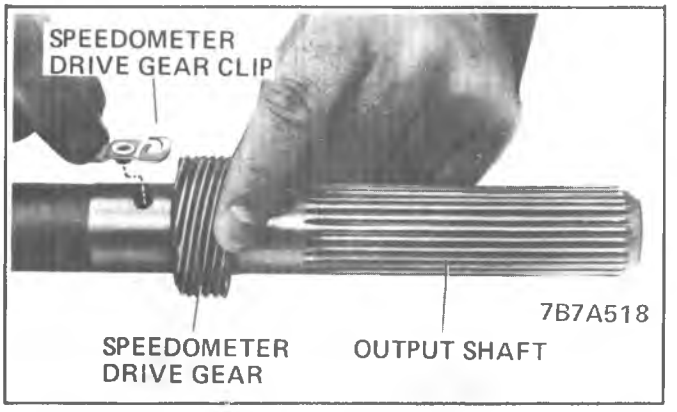


Figure 7A1-69 Installing Plastic Speedometer Driven Gear and Clip

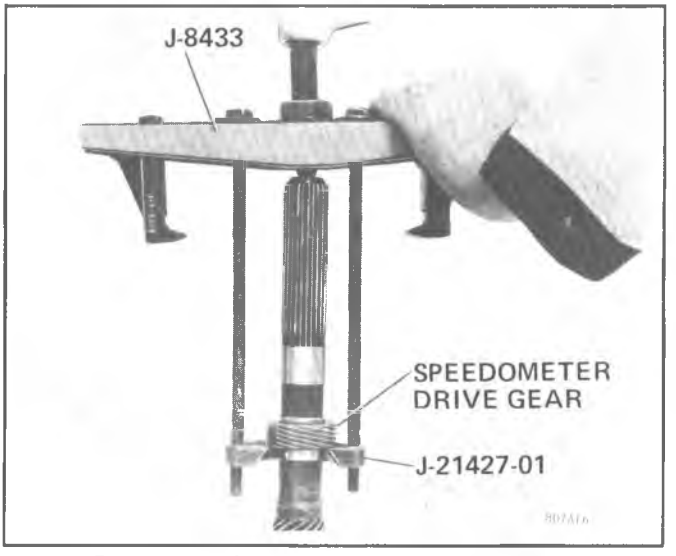


Figure 7A1-70 Removing Speedo Gear (Steel)

Roller Clutch and Rear Carrier Assembly Inspection

1. Remove roller clutch race. Inspect race and spline for scoring or wear. (Figure 7A1-74).

2. Remove roller clutch assembly and inspect roller bearings, cage and springs for damage or wear. (Figure 7A1-74).

3. Remove and inspect rear carrier to roller clutch thrust washer for signs of scoring or excessive wear. (Figure 7A1-74).

Figure 7A1-110 Removing Direct Clutch Snap Ring

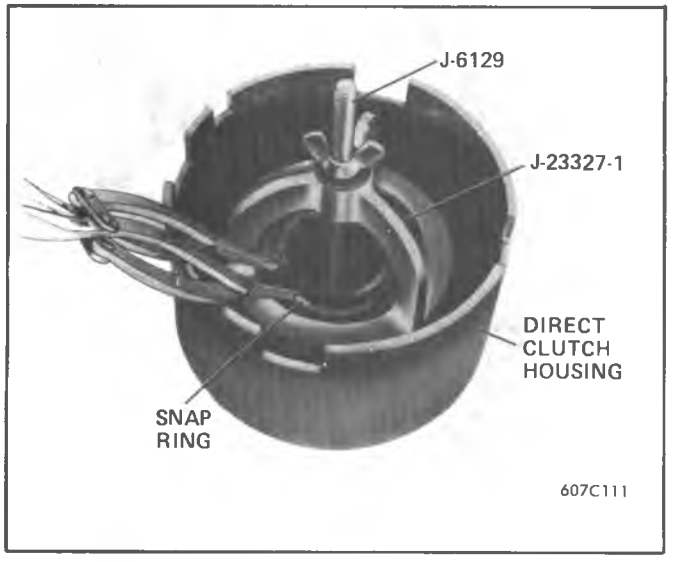


Figure 7A1-111 Removing Direct Clutch Inner Snap Ring

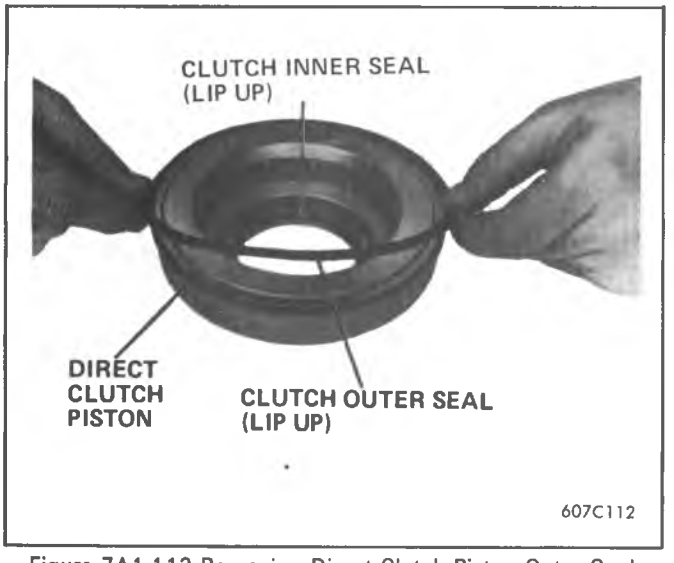


Figure 7A1-112 Removing Direct Clutch Piston Outer Seal

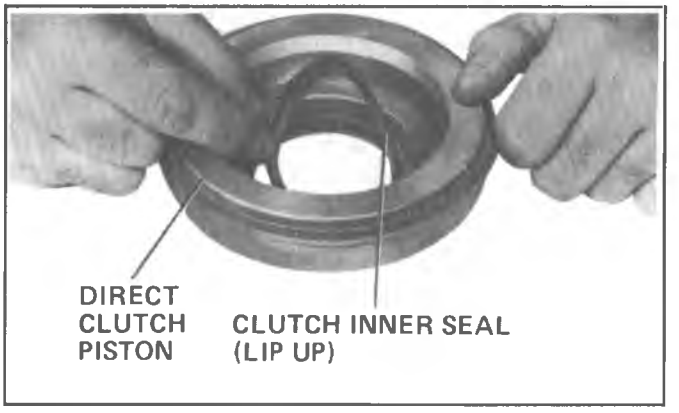


Figure 7A1-113 Removing Direct Clutch Piston Inner Seal

2. Install new inner and outer seals on piston with lips facing away from clutch apply ring side. (Figures 7A1-113 and 7A1-112).

3. Install new center seal on direct clutch housing with lip facing up. (Figure 7A1-114).

4. Install seal protector J-25010. (Figure 7A1-115).

Use extreme care when installing direct clutch piston past larger direct clutch snap ring groove. Groove could cut outer seal on piston.

5. Oil seals and install direct clutch piston. (Figure 7A1-115). To make the piston easier to install, insert tool between seal and housing; rotate tool around the housing to compress the lip of the seal, while pushing down slightly on the piston. See tool Figure 7A1-116 and tool being used on a forward clutch (Figure 7A1-126).

6. Remove seal protector J-25010.

7. Install release spring guide with the omitted rib over the check ball in the piston, as shown in Figure 7A1-117.

8. Install retainer and spring assembly.

Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage retainer plate when installing.

9. Using J-23327 tool, compress retainer and spring assembly past the snap ring groove. Install the snap ring. (Figure 7A1-111). An arbor press and J-23327-1 can be used to compress the retainer and spring assembly.

10. Remove J-23327-1 and/or J-6129.

11. Oil and install the direct clutch plates into the direct clutch housing, starting with a flat steel and alternating composition-faced and flat steel clutch plates (See Figure 7A1-118 and Clutch Plate Usage Chart, Figure 7A1-93).

12. Install backing plate, chamfered side up.

13. Install snap ring. (Figure 7A1-110).

Make sure composition clutch plates turn freely.

Forward Clutch Housing Assembly (Figure 7A1-122)

Inspection

1. Inspect teflon oil seals on turbine shaft for damage and free fit in grooves. Do not remove unless replacing.

2. Remove and inspect forward clutch to direct clutch thrust washer for damage. (Figure 7A1-120).

3. Place forward clutch down with turbine shaft through hole in work bench.

Figure 7A1-151 Checking Pump Body-to-Gear End Clearance

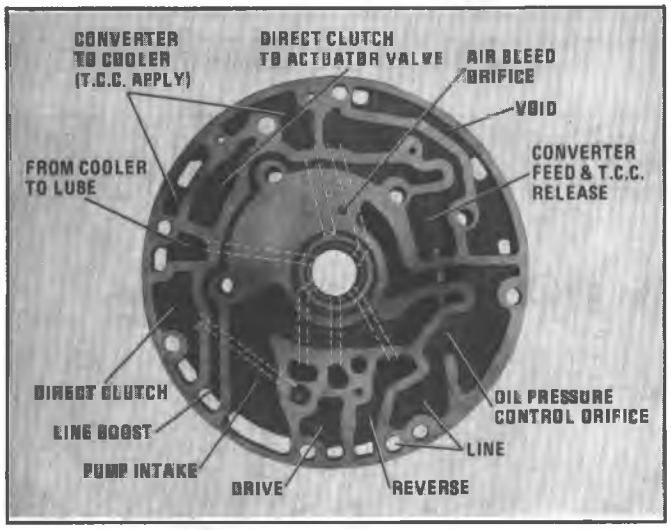


Figure 7A1-152 Pump Cover Assembly

7. Compress pressure regulator valve spring by pushing on bore plug with small screwdriver and install retaining ring. (Figure 7A1-156).

8. Install actuator valve into bushing bore of pump cover.

9. Install apply valve into apply valve bushing.

10. Install apply valve bushing into bore of pump cover (Figure 7A1-157).

11. Install apply valve bushing retaining pin (Figure 7A1-159).

12. Install pin retainer clip and bolt. (Figure 7A1-159). Torque bolt to 24 N·m (18 lb. ft.)

13. Install new pump to case gasket on pump and retain with petrolatum.

14. Lubricate with petrolatum and install new "O"-ring on solenoid assembly.

15. Install solenoid assembly onto pump. (Figure 7A1-160).

16. Install solenoid assembly attaching bolts and torque to 3.0-5.0 N·m (2-4 ft. lbs.)

17. Install solenoid assembly wires into wire clip.

18. If removed, install 3 new oil seal rings, making sure cut ends are assembled in the same relationship as cut. Also, make sure rings are seated in the grooves to prevent damage to the rings during reassembly of mating part over rings. Retain with petrolatum.

19. Install pump to case seal ring, chamfered side out, making sure the ring is not twisted.

20. Install pump to direct clutch thrust washer and retain with petrolatum. (Figure 7A1-161).

21. Remove holding bolt or screwdriver. (Figure 7A1-156).

22. Install new pump to case gasket on pump and retain with petrolatum.

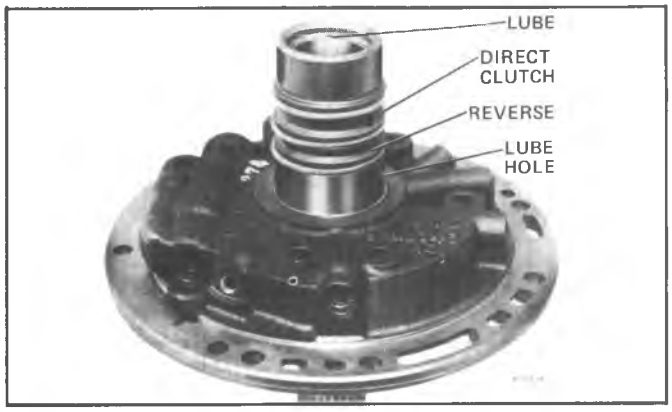


Figure 7A1-153 Pump Cover Oil Passages

23. Install 2 pump to case alignment pins in case as shown in Figure 7A1-162.

Before installing pump, make sure intermediate band anchor pin lug is aligned with band anchor pin hole in case.

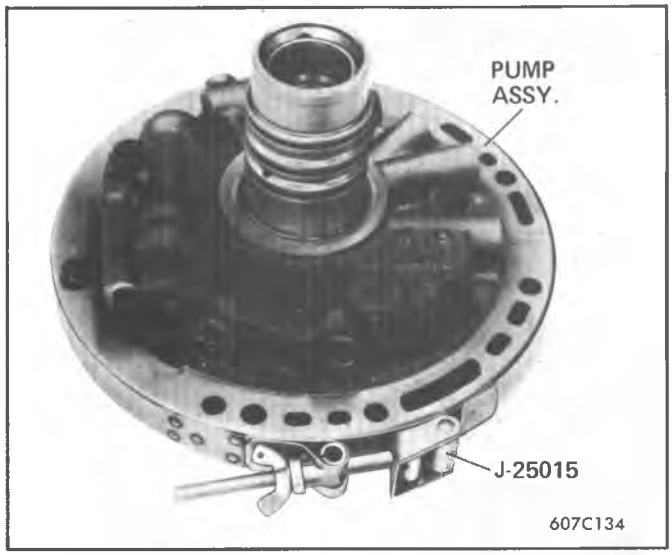


Figure 7A1-154 Aligning Pump Cover and Pump Body

23. Install pump assembly and finger start pump to case bolts and new washers, except one bolt hole (Figure 7A1-163) which will be used to make the front unit end play check.

NOTICE: If turbine shaft cannot be rotated as pump is being pulled into place, the forward or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place or damage to the direct clutch plates will result.

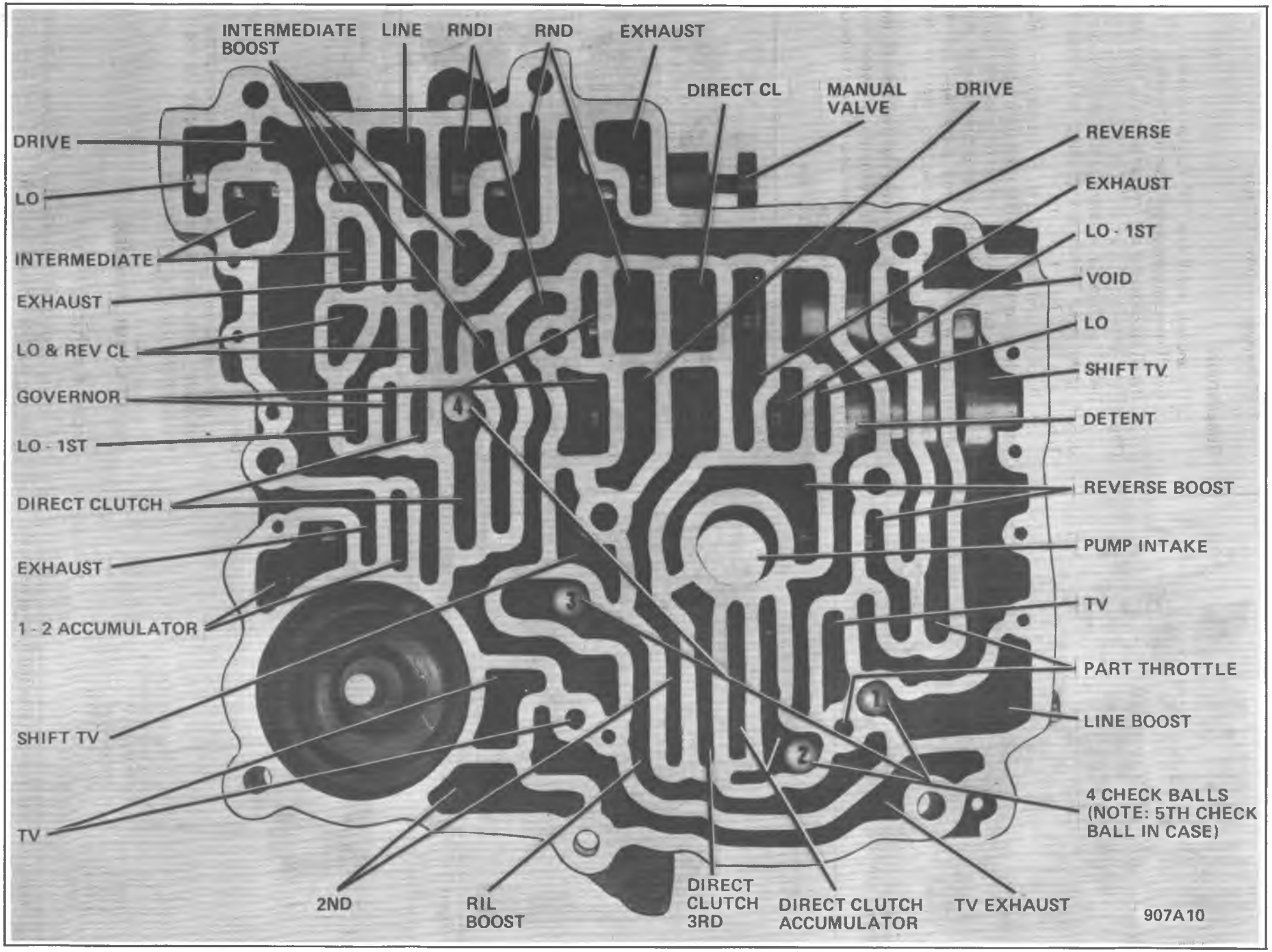


Figure 7A1-189 Control Valve Assembly with Four Check Ball Locations

SECTION 7A3

AUTOMATIC 350C AND 350 TRANSMISSION

CONTENTS

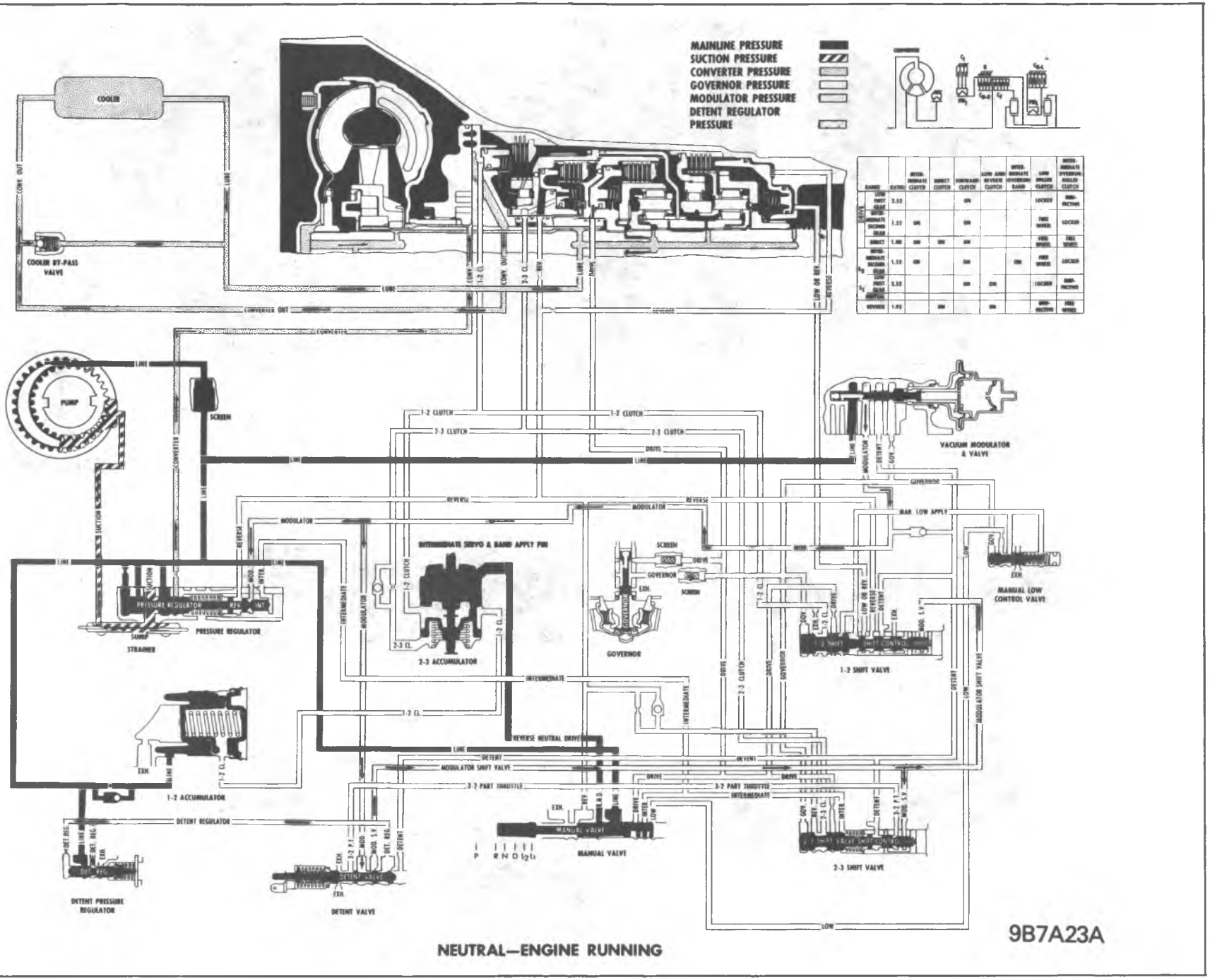
GENERAL DESCRIPTION

The 350 automatic transmission, is a fully automatic unit consisting primarily of 3-element hydraulic torque converter and two planetary gear sets. Four multiple-disc clutches, two roller clutches, and an intermediate overrun band provide the friction elements required to obtain the desired function of the two planetary gear sets.

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

External control connections to the transmission are:

1. Manual Linkage - To select the desired operating range.
2. Engine Vacuum - To operate the vacuum modulator.
3. Cable Control - To operate the detent valve.



NEUTRAL—ENGINE RUNNING

Figure 7A3-25A Neutral - Engine Running

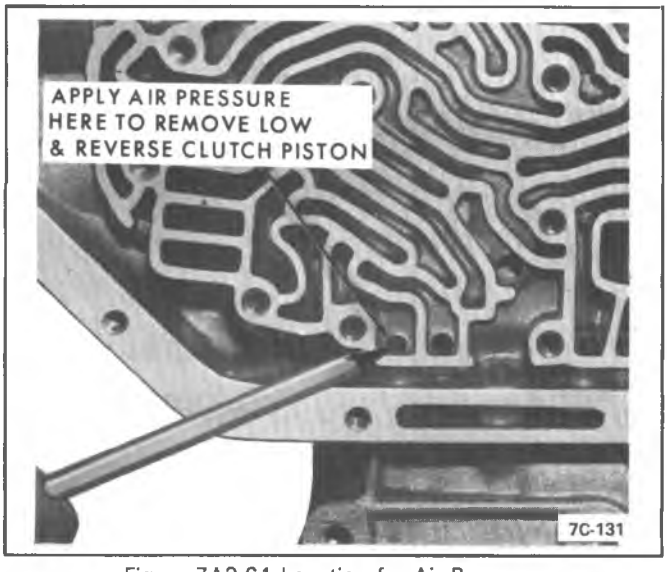


Figure 7A3-61 Location for Air Pressure

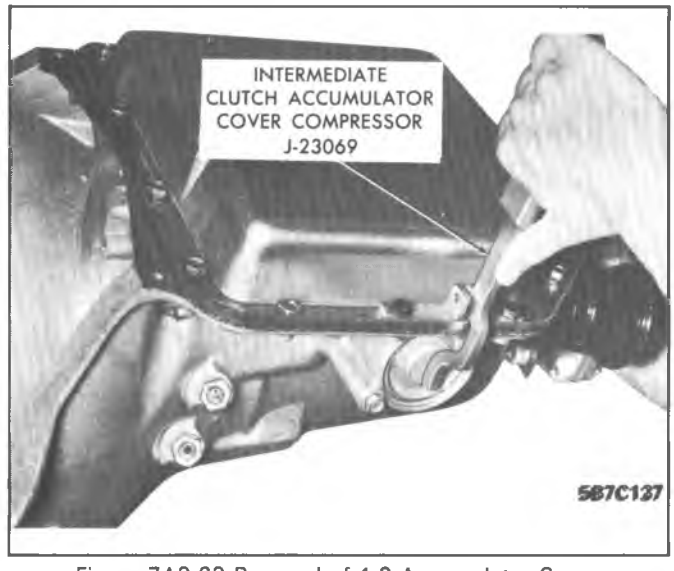


Figure 7A3-63 Removal of 1-2 Accumulator Cover

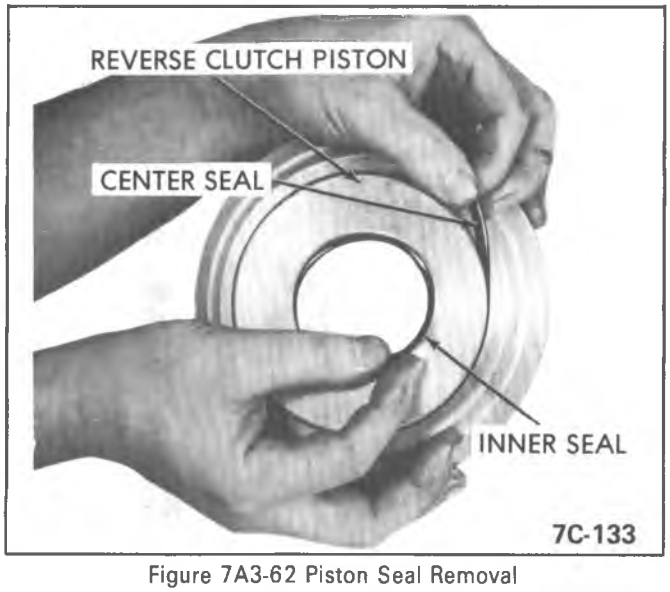


Figure 7A3-62 Piston Seal Removal

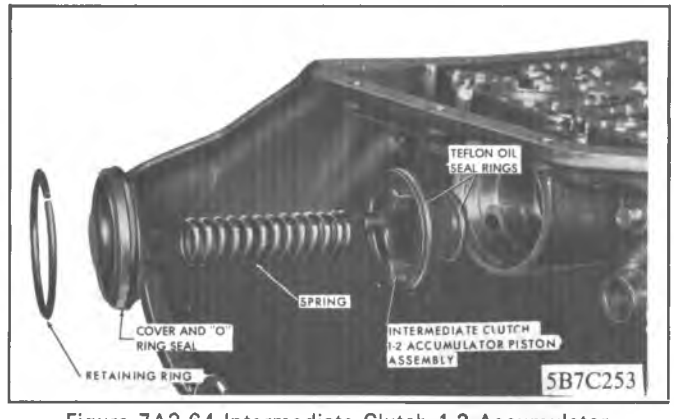


Figure 7A3-64 Intermediate Clutch 1-2 Accumulator

REMOVAL AND INSTALLATION OF INTERMEDIATE CLUTCH 1 - 2 ACCUMULATOR

Removal and installation of intermediate clutch 1 - 2 accumulator can be done without removal of transmission from car. See On Car Service.

Removal of Intermediate Clutch 1-2 Accumulator Piston

1. Install Tool J-23069 to compress intermediate clutch 1-2 accumulator cover and remove retaining ring. See Figure 7A3-63.

2. Remove intermediate clutch 1-2 accumulator piston cover and "O" ring seal from case. See Figure 7A3-64.

3. Remove intermediate clutch 1-2 accumulator piston spring. See Figure 7A3-64.

4. Remove intermediate clutch 1-2 accumulator piston assembly. *Inspect the inner and outer teflon oil seal rings for wearing or scoring. DO NOT REMOVE THESE TWO RINGS UNLESS THEY ARE DAMAGED.* If replacement of one or the other of the two rings is necessary, the piston assembly will have to be replaced. See Figure 7A3-64. (Piston and Seal are one assembly).

Installation of Intermediate Clutch 1-2 Accumulator Piston

1. Install intermediate clutch 1-2 accumulator piston assembly and spring. See Figure 7A3-64.

2. Place new "O" ring seal on intermediate clutch 1-2 accumulator piston cover, and install cover into case. See Figure 7A3-64.

3. Install J-23069 tool and compress intermediate clutch 1-2 accumulator cover and install retaining ring. See Figure 7A3-63.

DISASSEMBLY AND REASSEMBLY OF OIL PUMP ASSEMBLY

Disassembly of Oil Pump Assembly

1. Place assembly through hole in bench. Remove five (5) pump cover to body attaching bolts. See Figure 7A3-65.

2. Remove intermediate clutch return spring seat retainer with springs and the intermediate clutch piston assembly. See Figure 7A3-66.

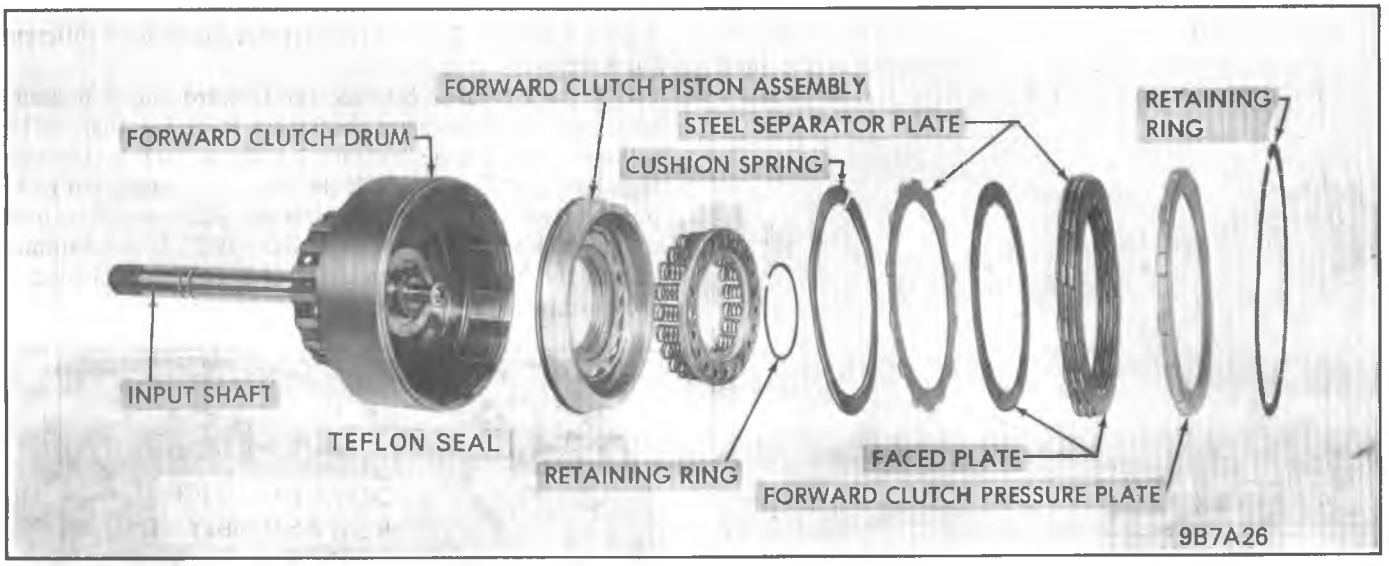


Figure 7A3-93 Forward Clutch Assembly Exploded View

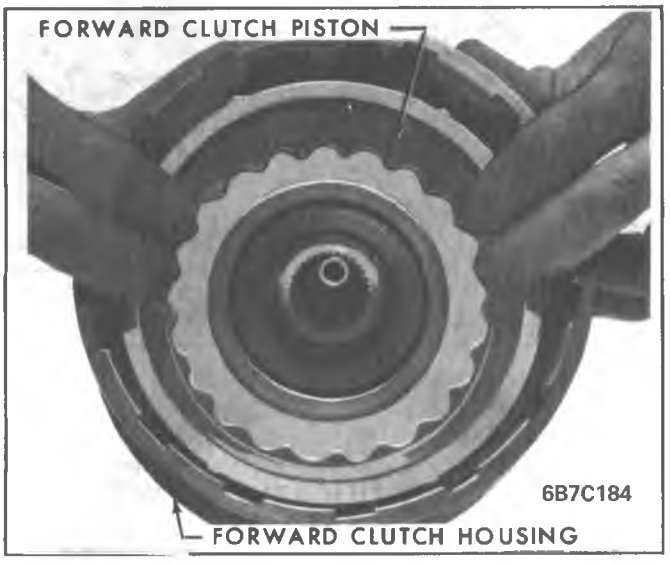


Figure 7A3-94 Forward Clutch Piston Removal

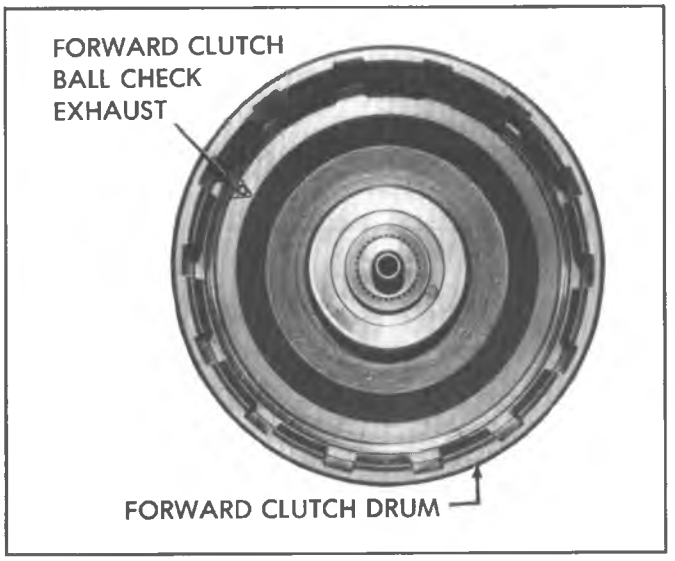


Figure 7A3-96 Ball Exhaust Location

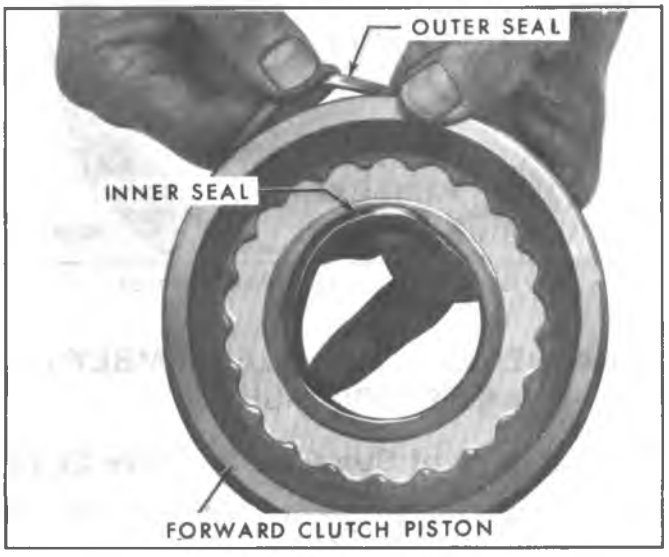


Figure 7A3-95 Piston Seal Removal

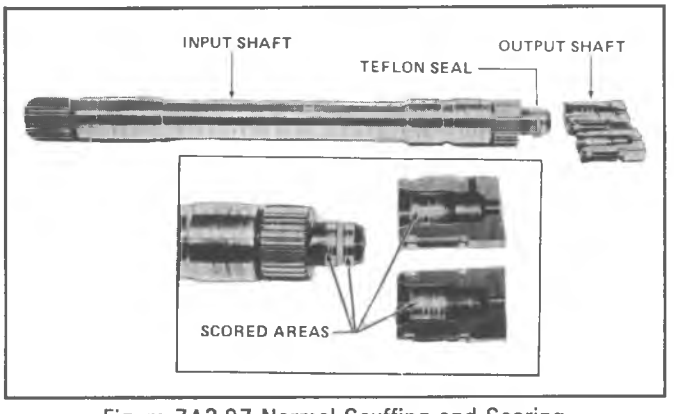


Figure 7A3-97 Normal Scuffing and Scoring

8. Check that the seal has not been cut and is free in the groove.

NOTICE: All service input shafts will be provided with the seal design incorporated, therefore when replacing an input shaft with a bronze bushing between input and

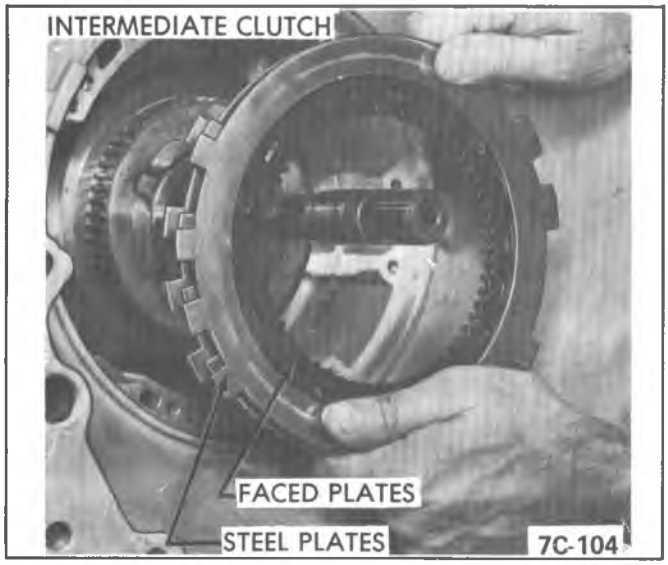


Figure 7A3-131 Intermediate Clutch Plates

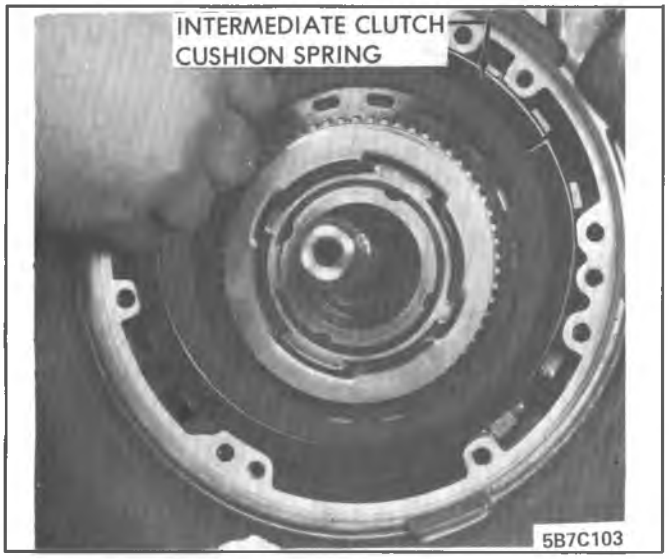


Figure 7A3-132 Intermediate Clutch Cushion Spring

Installing Oil Pump Assembly

1. Install original amount of .017 shims, and needle thrust bearing lip side face down on pump cover hub. Before installation apply petrolatum to both sides of shim and bearing. See Figure 7A3-133.

2. Install new pump assembly to case gasket. See Figure 7A3-134. Before installing pump lubricate case bore.

3. Install guide pins into case. Install pump assembly into case, remove guide pins and install pump to case bolts. Using new washer type seals tighten alternately to 20 ft. lbs. (27 N·m) torque. See Figure 7A3-135.

4. If input shaft cannot be rotated as the pump is being pulled into place, the direct and forward clutch housings have not been properly installed to index the faced plates with their respective parts. This condition must be corrected before the pump is pulled into place.

5. Checking direct clutch to oil pump clearance, attach slide hammer bolt to threaded hole in oil pump. See Figure 7A3-136. With flat of hand on end of input shaft move shaft rearward. Install Dial Indicator Set J-8001 on rod and "O" dial indicator on end of input shaft. Push on end of output shaft to move shaft forward, the reading obtained should be between .010 and .044. If the reading is incorrect remove pump assembly and install zero, one, or two .017 shims to obtain correct reading. See Figure 7A3-133.

Installing Speedometer Drive Gear

1. Place speedometer drive gear retaining clip into hole in output shaft. See Figure 7A3-137.

2. Align slot in speedometer drive gear with retaining clip and install. See Figure 7A3-137.

Installing Extension Housing

1. Install extension housing to case square cut "O" - ring seal. See Figure 7A3-138.

2. Attach extension housing to case using attaching bolts. Torque to 35 ft.lbs. (47 N·m).

3. Install speedometer driven gear, retainer and bolt. Torque bolt to 12 ft.lbs. (16 N·m).

Installing Parking Pawl and Actuating Rod

If internal linkage was removed proceed as follows:

1. Install parking pawl, tooth toward the inside of case. See Figure 7A3-139.

2. Install parking pawl shaft into case through disengaging spring. Install disengaging spring on parking pawl and slide shaft through parking pawl. See Figure 7A3-140.

3. Install parking pawl shaft retainer plug. Drive into case using a 3/8" dia. rod, until retainer plug is flush to .010" below face of case. Stake plug in three (3) places to retain plug in case. See Figure 7A3-141.

4. Install park lock bracket, torque bolts to 29 ft.lbs. (39 N·m). See Figure 7A3-142.

5. Install actuating rod under the park lock bracket, and parking pawl. See Figure 7A3-143.

Installing Manual Shaft and Range Selector Inner Lever

1. If a new manual shaft to case lip seal is necessary, use a 7/8" diameter rod and seat flush with case. See Figure 7A3-144.

2. Install manual shaft through case and range selector inner lever.

3. Install retaining jam nut on manual shaft. Torque jam nut to 30 ft.lbs. (40 N·m). See Figure 7A3-145. Install manual shaft to case retainer.

Installing Intermediate Servo Piston, Check Balls, Oil Pump Pressure Screen and Governor Feed Screens

1. Install park lock bracket and special bolts.

2. Install intermediate servo piston, apply pin, spring seat. See Figure 7A3-146.

3. Install four (4) check balls into correct transmission case pockets. See Figure 7A3-148. If number one (1) check

13. Oil a new governor and insert it into the installed bushing. The governor should spin freely. If slight honing on the bushing is necessary, use crocus or fine emery cloth and move in a circular one-way direction only.

Removal of Extension Housing Bushing

1. Remove extension housing bushing using screwdriver to collapse bushing. See Figure 7A3-170.

Installation of Extension Housing Bushing

1. Install extension housing bushing using drive handle J-8092 and Bushing Tool J-121424-9. See Figure 7A3-171.

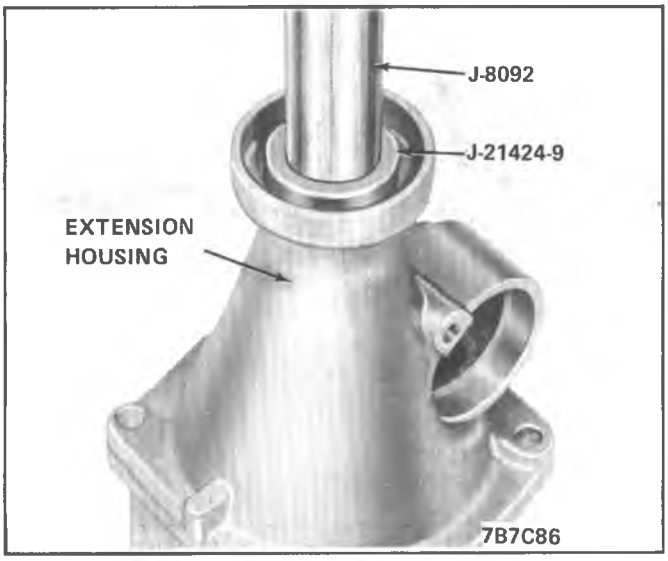


Figure 7A3-171 Installing Extension Housing Bushing

Replacing Input Ring Gear Bushing

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:

a. Thread Tool J-123062-15 on Drive Handle J-8092, and remove bushing from ring gear. See Figure 7A3-172.

b. Using Tool J-123062-15, press in new bushing .050" to .060" from inner surface of hub. See Figure 7A3-172.

Replacing Reaction Carrier Bushing

1. Inspect reaction carrier bushing for wear or galling. If replacement is necessary, proceed as follows:

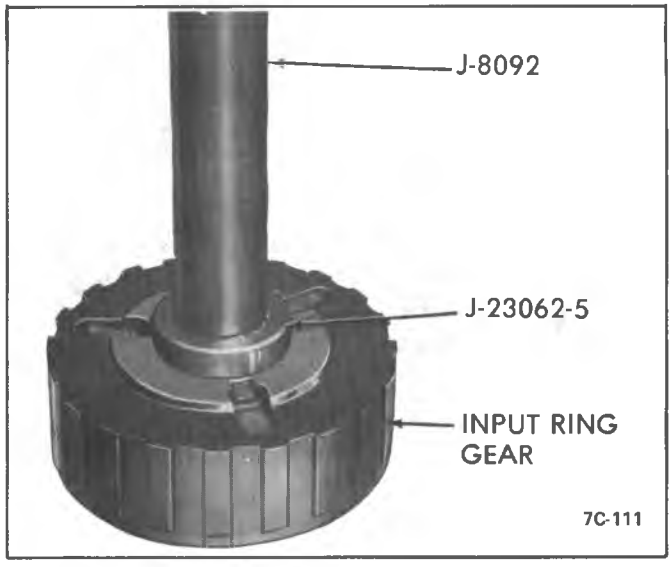


Figure 7A3-172 Reaction Carrier Bushing Removal

a. Thread Tool J-123062-13 on Drive Handle J-8092 and remove bushing. See Figure 7A3-173.

b. Using Tool J-123062-13, press in new bushing flush to .010" from inner surface of hub. See Figure 7A3-173.

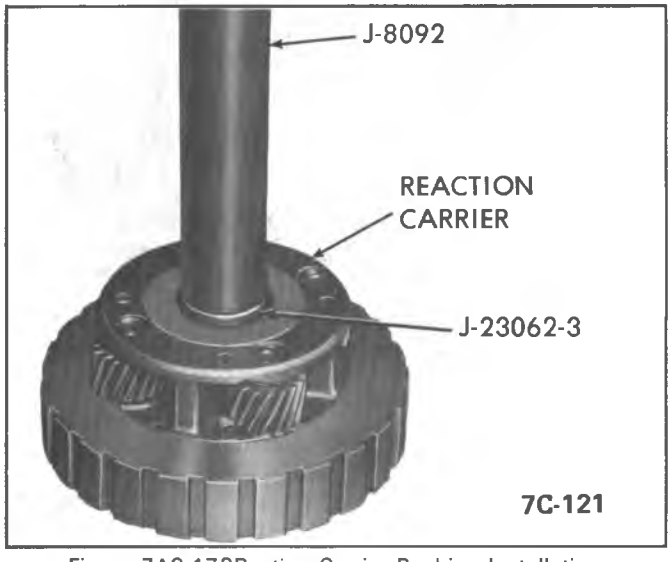


Figure 7A3-173Raction Carrier Bushing Installation

Replacing Case Bushing

1. Inspect case bushing for nicks, scoring or excessive wear. If damaged, remove as follows: Assemble Tool J-123062-116 on Drive Handle J-8092. Place Tool J-123062-8 into back of case, insert assembly of drive handle J-8092 and Tool J-123062-116 into Tool J-123062-8 and remove bushing. See Figure 7A3-174.

2. Using Tool J-123062-11 and Drive Handle J-8092, press bushing to 1/5" below chamfered edge of case. Make

250 C DIAGNOSIS CHART

PROBLEM	CAR ROAD TEST	ALL RANGES–SLIPS	DRIVE–SLIPS–NO 1ST GEAR	LINE PRESSURE–ALL LOW	LINE PRESSURE–ALL HIGH	1-2 INTERM. PRES. HIGH	1-2 INTERM. PRES. LOW	2-3 DIRECT CL. PRES. HIGH	2-3 DIRECT CL. PRES. LOW	NO. 1-2 UPSHIFT	1-2 U.S. EARLY/LATE	1-2 UPSHIFT @ W.O.T. ONLY	SLIPS–1-2 UPSHIFT	ROUGH–1-2 UPSHIFT	NO 2-3 UPSHIFT	2-3 U.S.–EARLY/LATE	SLIPS–2-3 UPSHIFT	ROUGH–2-3 UPSHIFT	NO W.O.T. 1-2 UPSHIFT	NO–PART TH. DOWN SHIFT	NO–FULL TH. DOWN SHIFT	2-3 UPSHIFT–W.O.T. ONLY	HARSH–DOWN SHIFT	L1 RANGE–NO ENG. BRAKING	L2 RANGE–NO ENG. BRAKING	NEUTRAL–DRIVES IN NEUTRAL	REVERSE–NO REVERSE	SLIPS IN REVERSE	PARK–NO PARK–RATCHETS	NOISY–ALL RANGES	1-2 2-3 SHIFT NOISY	REV. & D. L1 & L2 NOISY	SPEWS FLUID OUT BREATHER	HUNTS BETWEEN 2 & 3 AND 3 & 2
LEGEND X – PROBLEM AREA VS. CAUSE * – @ "0" VACUUM ONLY 0 – BALLS/ #2/3/4 ONLY L – LOCKED S – STUCK	POSSIBLE CAUSE																																
	LOW FLUID LEVEL/WATER IN FLUID	X	X	X			X		X				X				X											X		X	X		X	
	VACUUM LEAK				X	X		X		X	X	X		X		X		X				X												
	MODULATOR &/OR VALVE	X	X	*	X	X							X	X		X	X	X										X						
	STRAINER &/OR GASKET	X	X	X			X		X																				X		X			X	
	GOVERNOR–VALVE/SCREEN			X	X					X	X					X																		
	VALVE BODY–GASKET/PLATE	X	X	X			X		X	X	X		X		X	X	X											X		X				
	PRES. REG. &/OR BOOST VALVE	X	X	X	X	X	X	X	X	X			X	X			X	X						X	X		X	X						
	BALL (#1) SHY	X	X	*			X				X		X			X	X						0				X	X						
	1-2 SHIFT VALVE						X			X	X	X	X											X				X						
	2-3 SHIFT VALVE								X						X	X	X	X		X														
	MANUAL LOW CONT'L. VALVE																							X										
	DETENT VALVE & LINKAGE				X							X				X				X	X	X												S
	DETENT REG. VALVE																		X															
	2-3 ACCUMULATOR						X						X					X																
	MANUAL VALVE/LINKAGE	X	X	X																				X	X		X	X						
	POROSITY/CROSS LEAK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X		X	X						
	PUMP–GEARS	X	X	X			X		X				X				X												X					
	CLUTCH SEAL RINGS	X	X	X			X		X	X			X		X		X							X	X		X	X						
	POROUS/CROSS LEAK	X	X	X			X		X	X			X	X	X		X		X								X	X				X		
	GASKET SCREEN–PRESSURE	X	X	X																							X	X		X				
	CASE–POROUS/X LEAK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X			X	X						
	1-2 ACCUMULATOR	X	X	X			X			X			X	X																				
	INTERMED. SERVO		X	X			X						X												X									
	FORWARD CLUTCH ASS'Y		X																					X	X	X	L							
	DIRECT CLUTCH ASS'Y								X						X		X										X	X			X			
	INTERMED. BAND ASS'Y						X			X			X																		X			
	L & REV. CL. ASS'Y																							X			X	X						
	L & R ROLLER CL. ASS'Y																																	
	PARK PAWL/LINKAGE																												X					
	CONVERTER ASS'Y																												X		X			
	GEAR SET & BEARINGS																												X	X				

Figure 7A5-6 250C Diagnosis Chart

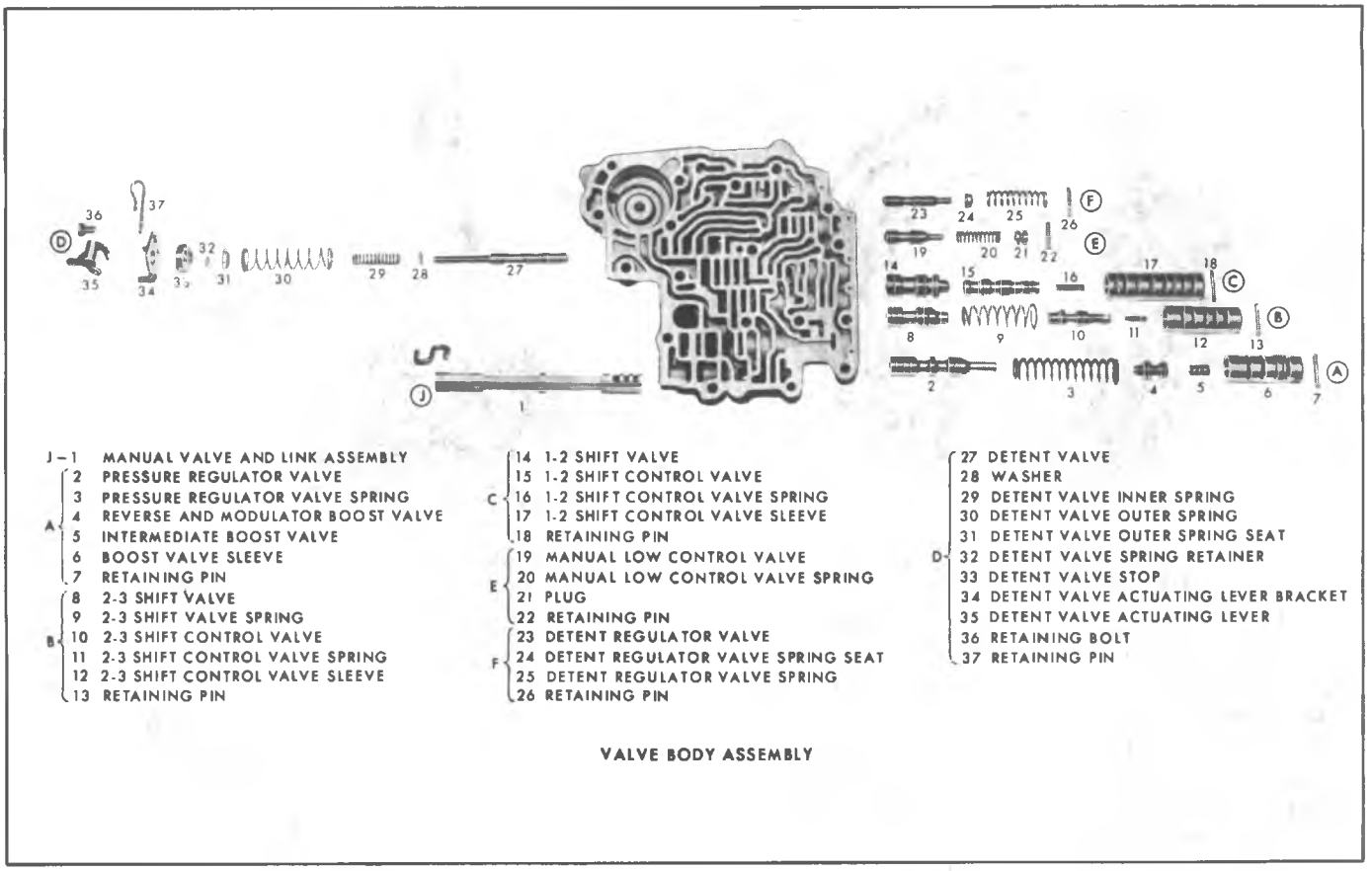


Figure 7A5-43 Valve Body Exploded View

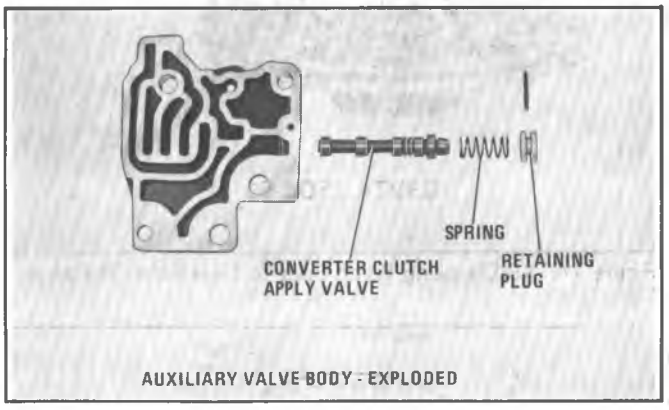


Figure 7A5-44

Reassembly

1. Install apply valve, spring, seat and retaining pin.

Oil Pump

Disassembly

1. Place pump cover and stator shaft assembly through hole in bench.

2. Remove pump cover to body attaching bolts.

3. If damaged remove two (2) forward clutch to pump hub scarf cut oil seal rings and three(3) direct clutch to pump hub oil rings. Do not remove unless replacement is required. (Figure 7A5-45)

4. Check steady rest ring, if cut or frozen in bore remove and replace.

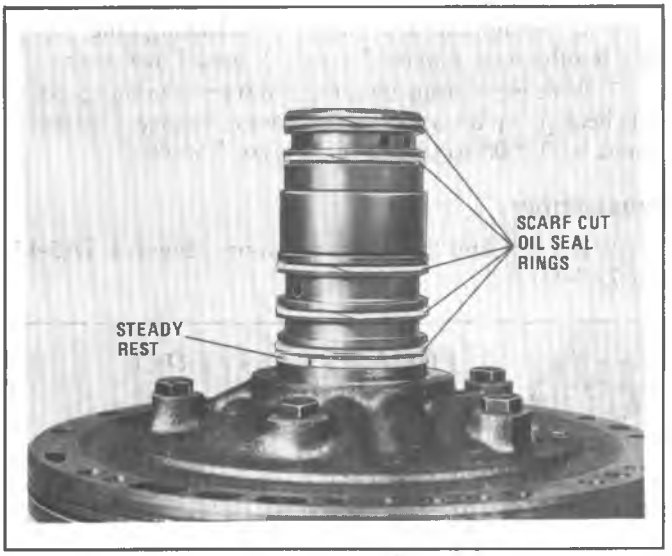


Figure 7A5-45 Pump Tower

5. Remove pump cover and stator shaft assembly from pump body (Figure 7A5-45).

6. Remove pump drive gear and driven gear. Note position of gears so that they may be reassembled properly.

7. Remove pump outside diameter to case (square cut) "O" ring seal.

Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages. DO NOT USE CLOTH OR PAPER TO DRY PARTS - AIR DRY PARTS ONLY.

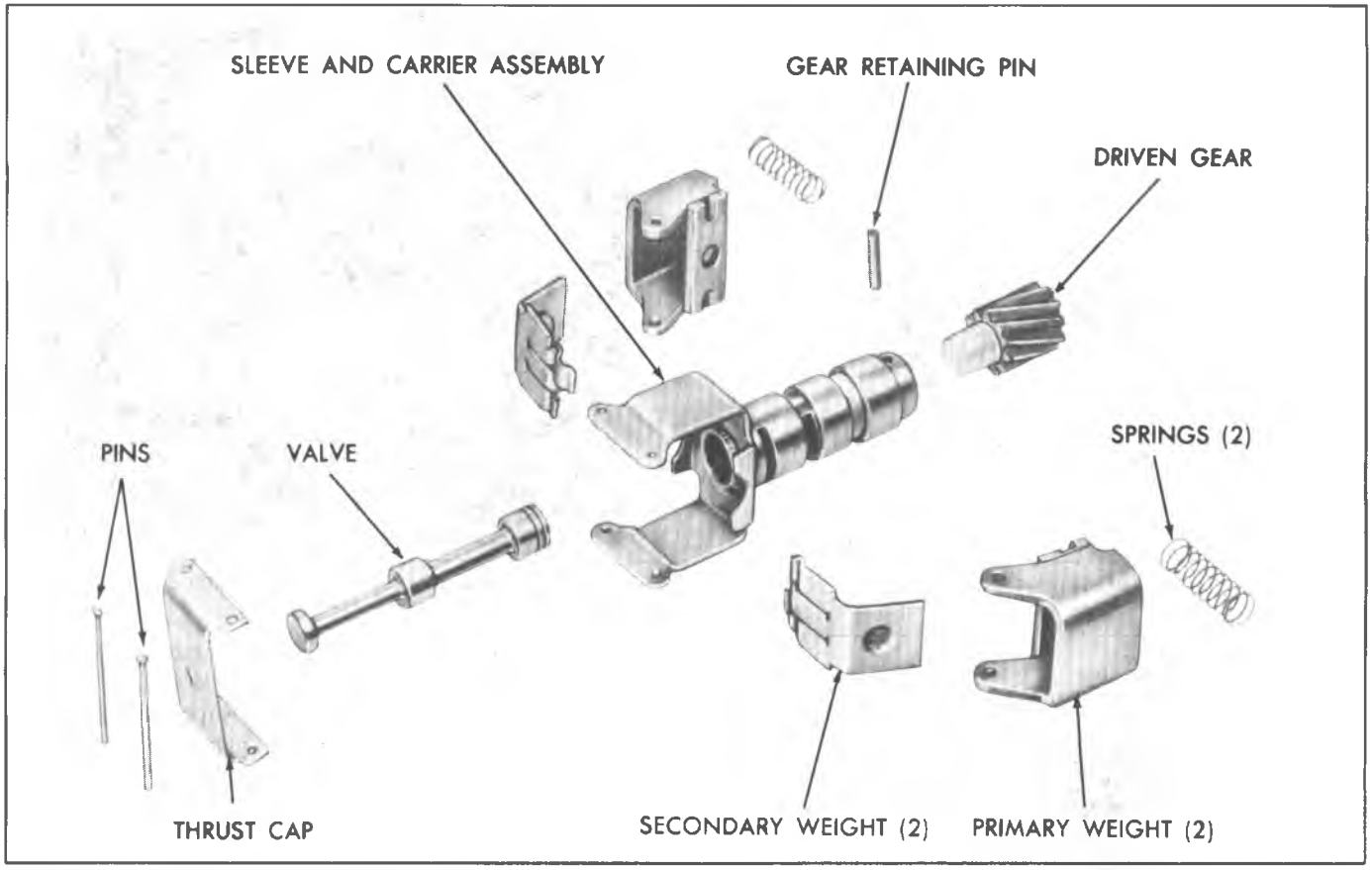


Figure 7A5-79 Governor Assembly

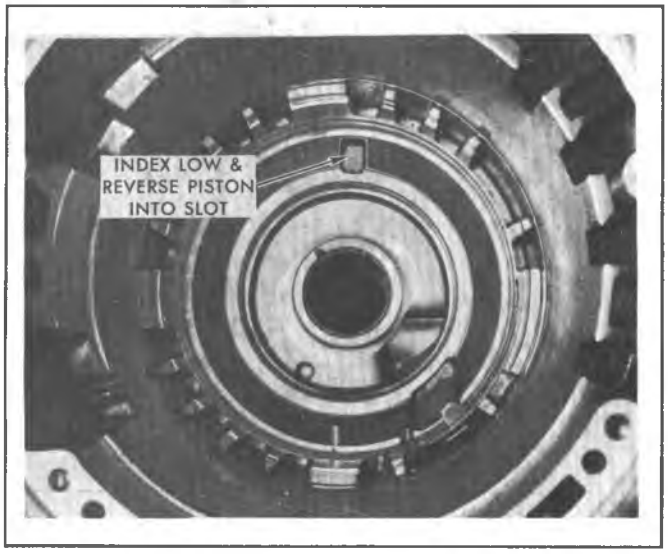


Figure 7A5-80 Low & Reverse Piston Indexing Slot

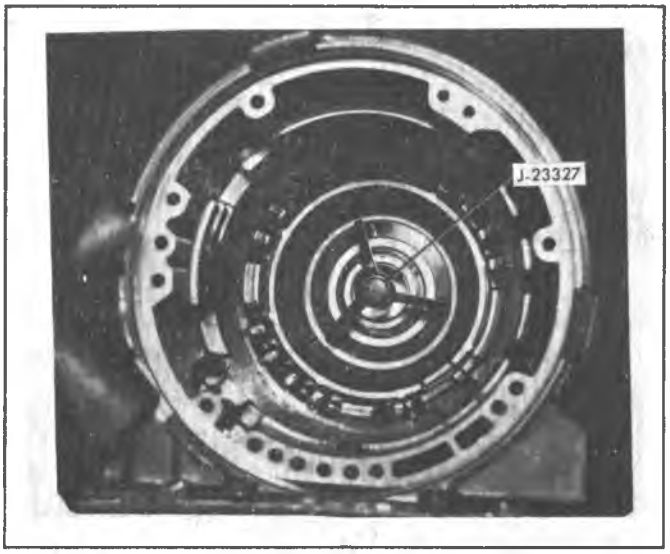


Figure 7A5-81 Installing Low & Reverse Piston

2. Install piston return spring and retainer assebmLy. Using tool J-23327.

3. Install spring retainer and retaining ring. Using Tool J-23327, compress return seat so spring retainer retaining ring may be installed. Install output ring gear rear thrust bearing in case.

4. Install output ring gear on output shaft.

5. Install reaction carrier to output ring gear bearing into output ring gear support, tanged race (black side) up.

6. Install output shaft assembly into case.

7. Install reaction carrier assembly into output ring gear and shaft assembly.

8. Lubricate and install low reverse clutch steel reaction plates and face plates, starting with a steel plate and alternating with face plates. Install low and reverse clutch support retainer spring (anti-clunk) spring.

Notch in steel separator plates should be placed toward bottom of case.

9. Install low and reverse clutch support assembly. (Figure 7A5-85)

a. Binding, mispositioned or unhooked.

Allowing #5 ball to seal causes full T.V. pressure regardless of throttle valve position.

4. Throttle Valve and Plunger:

a. Binding.

5. Control Valve Assembly:

a. Valve body gaskets leaking, damaged, incorrectly installed.

6. Case Assembly:

a. Porosity.

FIRST SPEED ONLY, NO 1-2 SHIFT

1. Governor and Governor Feed Passages.

a. Plugged governor oil feed orifice in spacer plate.

b. Governor ball or balls missing in governor assembly.

c. Inner governor cover rubber "O" ring seal missing or leaking.

d. Governor shaft seal missing or damaged.

e. Governor driven gear stripped.

f. Governor weights binding on pin.

g. Governor driven gear not engaged with governor shaft.

2. Control Valve Assembly

a. 1-2 shift, Lo 1st/Detent, or 1-2 throttle valve stuck in downshift position.

b. Spacer plate gaskets in wrong position.

3. Case

a. Porosity in case channels or undrilled 2nd oil feed hole.

b. Excessive leakage between case bore and intermediate band apply rings.

c. Intermediate band anchor pin missing or unhooked from band.

d. Broken or missing band.

4. Intermediate Servo Assembly.

a. Servo cover oil seal ring missing.

b. Porosity in servo; cover, inner piston or outer piston.

c. Wrong intermediate band apply pin.

d. Incorrect usage of cover and piston.

5. 1-2 Accumulator.

a. 1-2 accumulator housing bolts loose.

b. 1-2 accumulator housing face damaged.

c. Missing or damaged accumulator plate.

FIRST AND SECOND SPEEDS ONLY, NO 2-3 SHIFT

1. Control Valve Assembly and Spacer Plate.

a. 2-3 shift valve or 2-3 throttle valve stuck in the downshift position.

b. Valve body gaskets leaking, damaged or incorrectly installed.

c. Reverse/3rd check ball not seating, damaged or missing.

2. Case.

a. Porosity in case channels.

3. Center Support.

a. Direct clutch feed passage in the center support plugged or not drilled through.

b. Steel oil seal rings on center support damaged.

4. Direct Clutch.

a. Inner oil seal ring missing or damaged on piston.

b. Center oil seal ring missing or damaged on direct clutch hub.

c. Check ball and/or retainer damaged or missing from direct clutch piston.

d. Direct clutch piston or housing damaged or missing.

e. Direct clutch plates damaged or missing.

f. Direct clutch backing plate snap ring out of groove.

g. Release spring guide mislocated, preventing piston check ball from seating in retainer.

5. Intermediate Servo Assembly (Third Clutch Accumulator Oil Passages).

a. Servo to case oil seal ring broken or missing on intermediate servo piston.

b. Intermediate servo and/or capsule missing or damaged.

c. Exhaust hole in case between servo piston seal rings plugged or undrilled.

d. Bleed orifice cup plug missing from intermediate servo pocket in case.

NO DRIVE IN REVERSE OR SLIPS IN REVERSE (INSTALL PRESSURE GAGE).

1. Throttle Valve Cable binding or misadjusted.

2. Manual Linkage misadjusted.

3. Throttle Valve binding.

4. T.V. Limit Valve binding.

5. Line Bias Valve binding.

6. Reverse Boost Valve binding in pressure regulator bore.

7. Reverse/3rd or Lo/Reverse Check Ball missing or seat in spacer plate damaged.

8. Reverse Clutch

a. Piston cracked, or missing inner or outer seals. Clutch plates burned.

b. Reverse oil seal in case missing or damaged.

c. Missing clutch plate or wave plate.

9. Center Support

a. Center support attaching bolts loose or missing.

b. Passages blocked or not drilled.

c. Porosity.

10. Direct Clutch Housing.

a. Piston or housing cracked.

b. Inner or outer piston seal missing or damaged.

c. Check ball in either the direct clutch housing or the piston missing or damaged.

d. Plates burned.

11. Lo/Reverse Overrun Clutch Orifice in spacer plate plugged.

DRIVE IN NEUTRAL

1. Manual Linkage.

a. Misadjusted or disconnected.

2. Forward Clutch.

a. Clutch does not release.

b. Exhaust check ball sticking.

OVERDRIVE UNIT END PLAY WASHER THICKNESS CHART

THICKNESS		IDENTIFICATION NUMBER AND/OR COLOR
4.25 - 4.36 mm	(0.167" - 0.171")	0 - Scarlet
4.36 - 4.48 mm	(0.172" - 0.176")	1 - White
4.49 - 4.60 mm	(0.177" - 0.180")	2 - Cocoa Brown
4.61 - 4.72 mm	(0.181" - 0.185")	3 - Gray
4.73 - 4.84 mm	(0.186" - 0.190")	4 - Yellow
4.85 - 4.96 mm	(0.191" - 0.195")	5 - Light Blue
4.97 - 5.08 mm	(0.196" - 0.200")	6 - Purple
5.09 - 5.20 mm	(0.201" - 0.204")	7 - Orange
5.21 - 5.32 mm	(0.205" - 0.209")	8 - Green

Figure 7A6-31 Overdrive Unit End Play Washer Thickness Chart

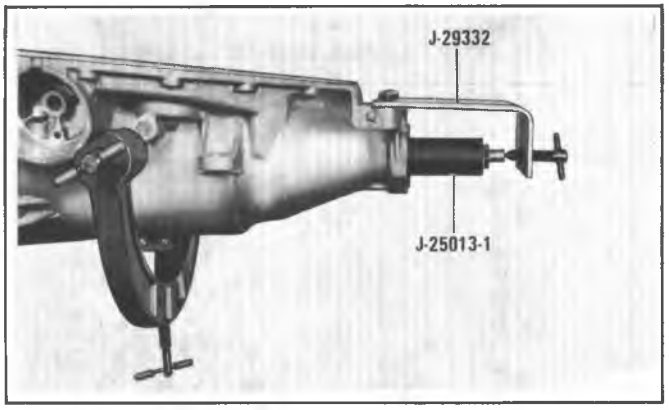


Figure 7A6-32 Installing Tools on Rear End of Case

c. Remove pump to case bolt and washer and install 278 mm (11") long bolt and locking nut as shown (Figure 7A6-33).

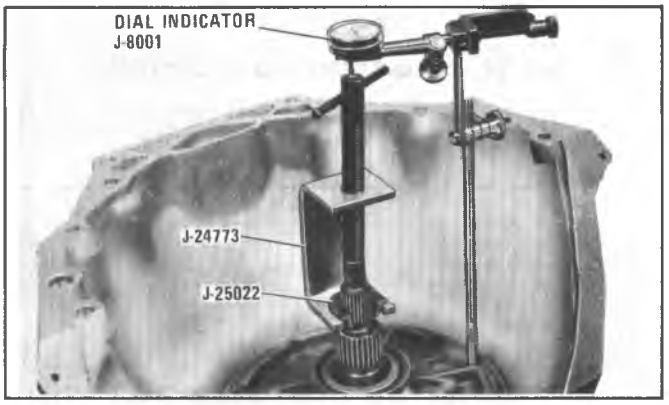


Figure 7A6-33 Checking Overdrive Unit End Play

d. Install J-25022 on J-24773-5 tool and secure on end of turbine shaft (Figure 7A6-33).

e. Mount dial indicator and clamp assembly on bolt, positioning indicator point cap nut on top of J-24773-5 (Figure 7A6-33).

f. Lift up on J-24773-5 with approximately 3 lbs. of upward force and while holding, set dial indicator to zero (MAINTAIN UPWARD FORCE).

The above procedure must be performed to eliminate the tolerance difference between the turbine shaft snap ring and the overdrive carrier.

g. With the dial indicator at zero, increase force to approximately 20 lbs. and read dial indicator. Overdrive unit end play should be 0.10 - 0.81 mm (.004 - .027").

Selective thrust washer controlling this end play is located between the pump cover and overrun clutch housing. If more or less washer thickness is required to bring end play within specification, select proper washer from the following chart (Figure 7A6-31).

h. Remove dial indicator, clamp assembly, J-24773-5 and J-25022 (Figure 7A6-33).

2. Pump:

a. If necessary, remove pump oil seal (Figure 7A6-34).

b. Remove remaining pump to case bolts and washers.

c. Using J-24773-5 tool, remove pump assembly, pump to case gasket (Figure 7A6-35).

d. Remove oil deflector plate (Figure 7A6-36).

3. Fourth clutch assembly:

a. Remove fourth clutch plate to case snap ring (Figure 7A6-37).

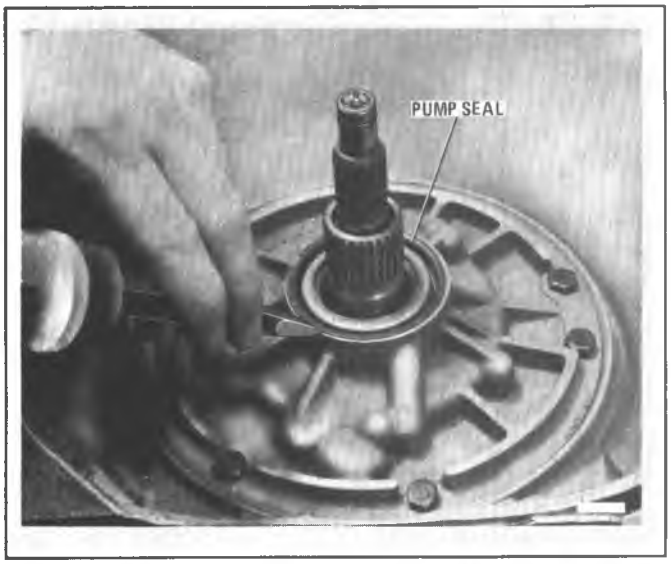


Figure 7A6-34 Removing Pump Seal

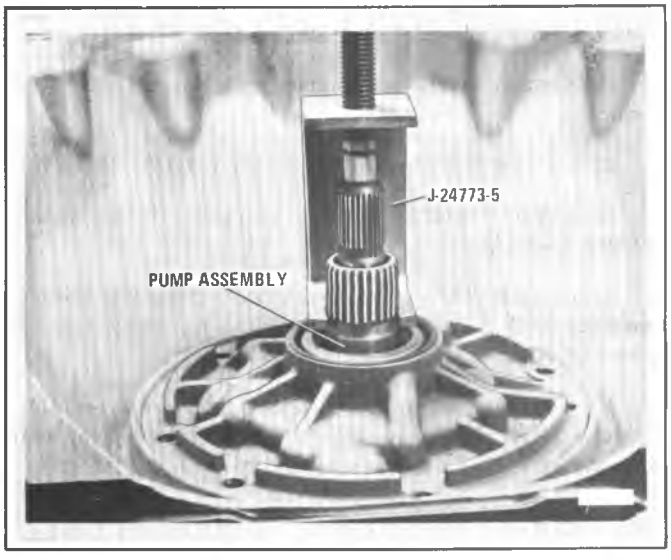


Figure 7A6-35 Removing Pump Assembly

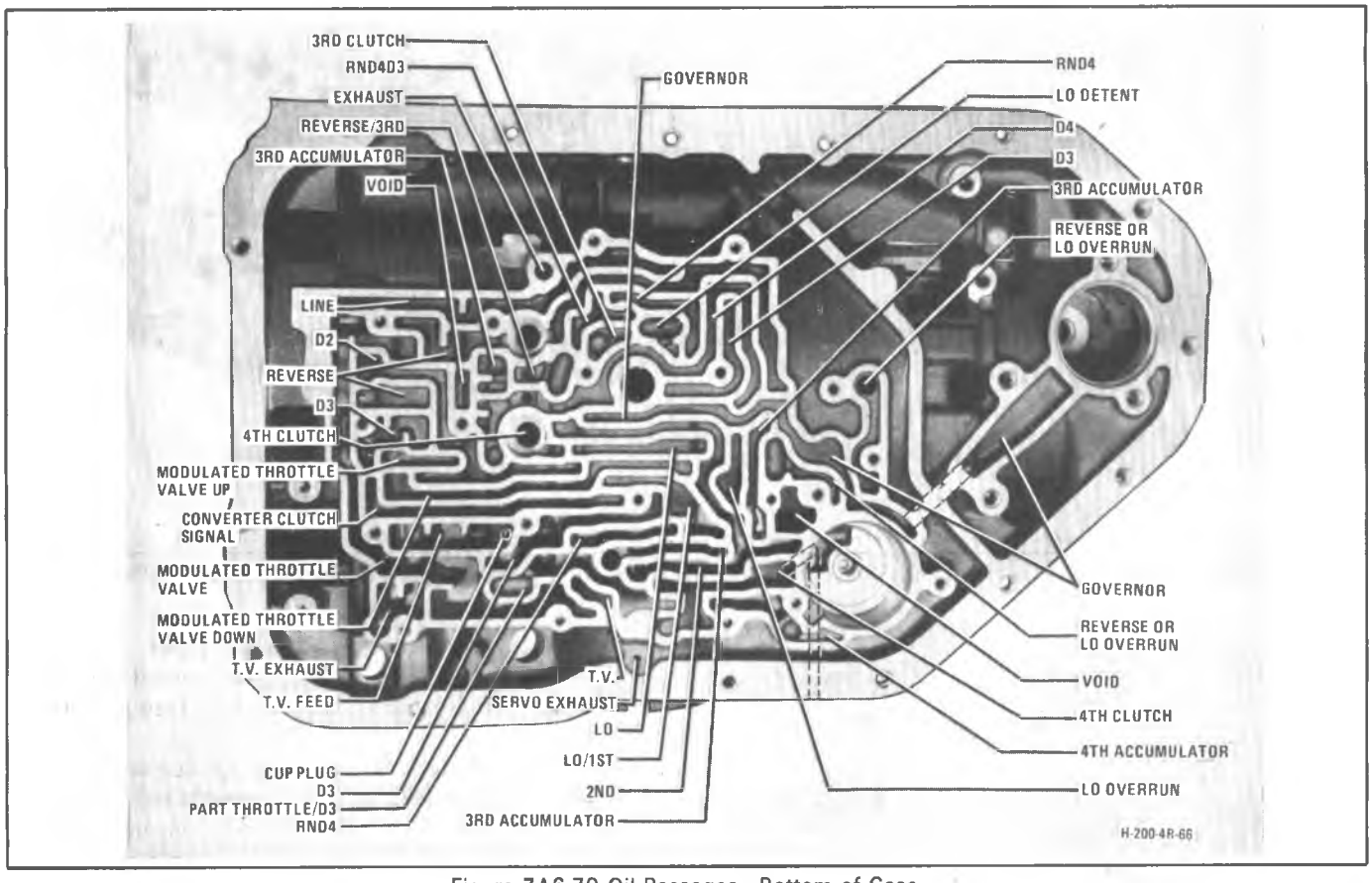


Figure 7A6-79 Oil Passages - Bottom of Case

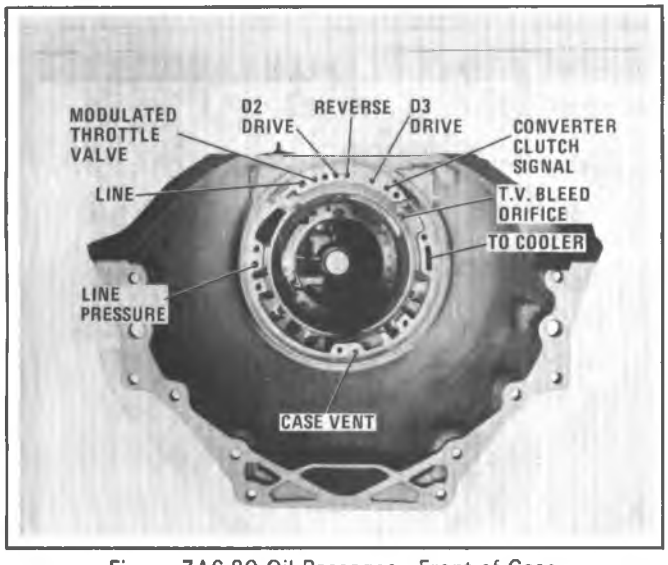


Figure 7A6-80 Oil Passages - Front of Case

Figure 7A6-81 Installing Rear Oil Seal

10. Inspect manual shaft for damaged threads and the flats for raised edges. File down any raised edges.

Reassembly

1. Turn transmission to horizontal position, oil pan side up.

2. If removed, install new manual shaft seal with lip facing inward into transmission case using a 13 mm (9/16″) socket to seat seal (Figure 7A6-83).

3. Install parking pawl and return spring with tooth toward inside of case and parking pawl return spring under pawl tooth with spring ends toward inside of case (Figure 7A6-84). Make sure spring ends locate against case pad.

4. Align parking pawl and return spring with case shaft bore.

5. Install parking pawl shaft, tapered end first.

6. Using 10 mm (3/8″) rod, install new parking pawl shaft cup plug, open end out, past retaining pin hole (Figure 7A6-85).

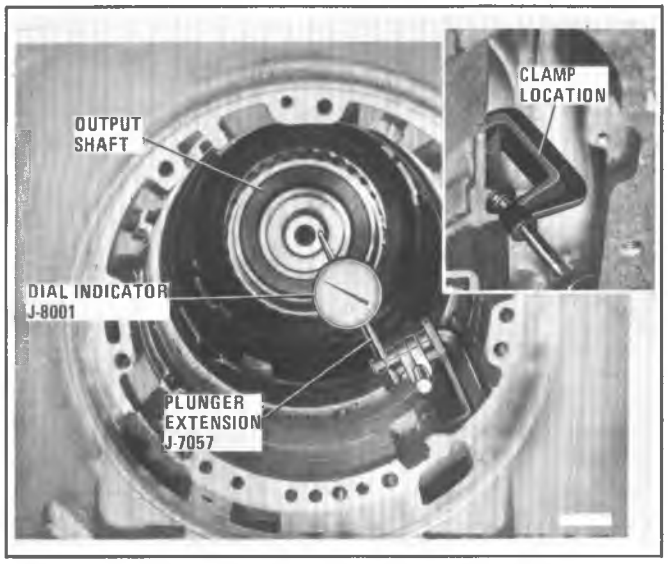


Figure 7A6-122 Checking Rear Unit End Play

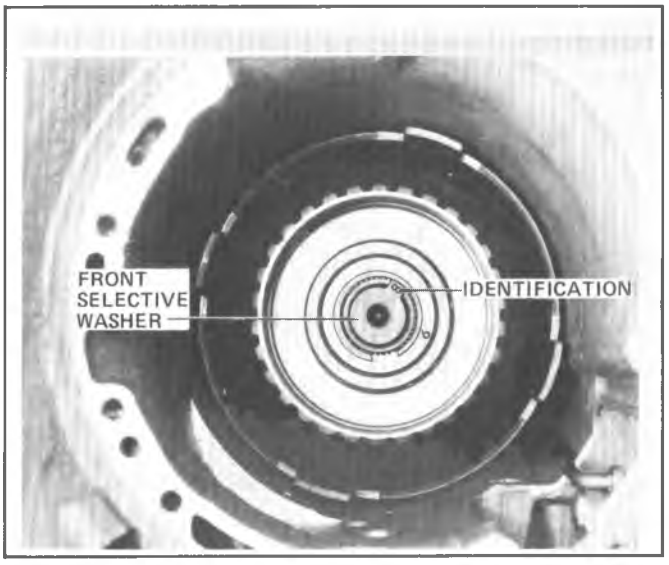


Figure 7A6-124 Location of Front Selective Washer

is required to bring end play within specifications, select proper washer from the Rear Unit End Play Washer Thickness Chart (Figure 7A6-123).

REAR UNIT END PLAY WASHER THICKNESS CHART

THICKNESS		IDENTIFICATION NUMBER AND/OR COLOR
2.463 - 2.590 mm	(0.097" - 0.102")	0 - —
2.90 - 3.01 mm	(0.114" - 0.119")	1 - Orange
3.08 - 3.19 mm	(0.121" - 0.126")	2 - White
3.26 - 3.37 mm	(0.128" - 0.133")	3 - Yellow
3.44 - 3.55 mm	(0.135" - 0.140")	4 - Blue
3.62 - 3.73 mm	(0.143" - 0.147")	5 - Red
3.80 - 3.91 mm	(0.150" - 0.154")	6 - Brown
3.98 - 4.09 mm	(0.157" - 0.161")	7 - Green
4.16 - 4.27 mm	(0.164" - 0.168")	8 - Black
4.34 - 4.45 mm	(0.171" - 0.175")	9 - Purple

Figure 7A6-123 Rear Unit End Play Washer Thickness Chart

5. Remove dial indicator and clamp assembly (Figure 7A6-122).

6. Loosen J-29332-1 adjusting screw on output shaft.

7. Inspect output shaft to forward clutch shaft front selective thrust washer for damage or scoring.

8. Install output shaft to forward clutch shaft front selective thrust washer, locating in output shaft and retain with petrolatum (Figure 7A6-124).

FRONT UNIT PARTS

Direct Clutch Assembly (Figure 7A6-125)

1. Remove snap ring (Figure 7A6-126).

2. Remove the clutch backing plate from the direct clutch housing.

3. Remove the clutch plates from the direct clutch housing and keep them separated from the forward clutch plates (See Clutch Plate Usage Chart, Figure 7A6-107).

4. Inspect composition-faced plates and steel clutch plates for wear or burning.

5. Inspect clutch backing plate for scoring or other damage.

6. Using J-23327, compress retainer and spring assembly (Figure 7A6-127), remove snap ring and inspect for damage or distortion.

7. Remove J-23327.

8. Remove retainer and spring assembly from housing.

9. Inspect release spring retainer for being collapsed.

10. Inspect release springs for being collapsed.

11. Remove release spring guide and inspect for damage.

12. Remove direct clutch piston.

13. Remove outer and inner seals from direct clutch piston. (Figures 7A6-128 and 129).

14. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

See 200-4R Clutch Plate and Clutch Apply Ring Usage Chart for Apply Ring Identification, (Figure 7A6-107).

15. Inspect direct clutch piston assembly for distortion, cracks, or other damage.

16. Check for free operation of check ball in the direct clutch housing and direct clutch piston. If damaged, replace the check ball assembly in the following manner:

a. Remove the check ball assembly, using a 10 mm (3/8") diameter rod as a punch.

b. Place new check ball assembly in check ball hole. Using a 10 mm (3/8") diameter rod, drive check ball down until it bottoms.

17. Remove center seal from direct clutch housing (Figure 7A6-130).

18. Inspect direct clutch housing for cracks, wear and open oil passages.

19. Check for free operation of check balls.

20. Inspect direct clutch housing snap ring grooves for damage.

21. Inspect direct clutch bushings for damage or scoring.

Reassembly

1. Install clutch apply ring on piston.

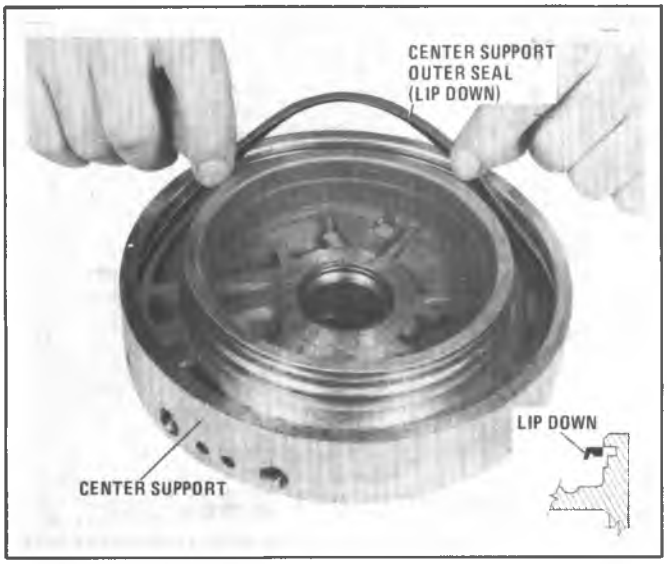


Figure 7A6-163 Installing Fourth Clutch Outer Seal

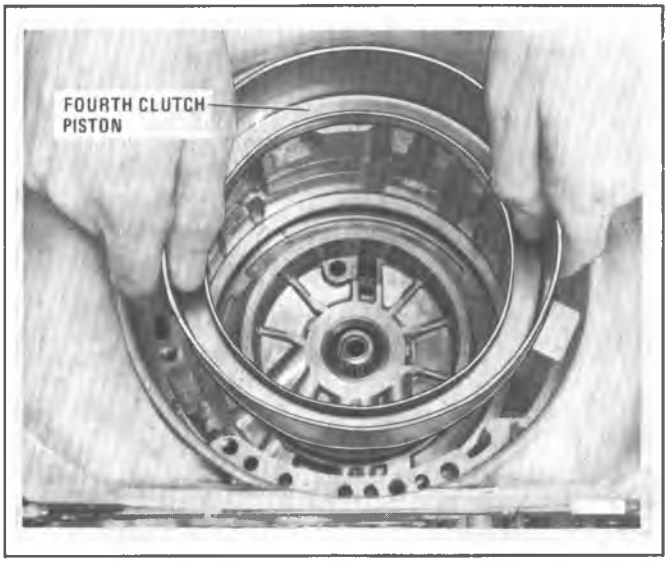


Figure 7A6-165 Installing Fourth Clutch Piston

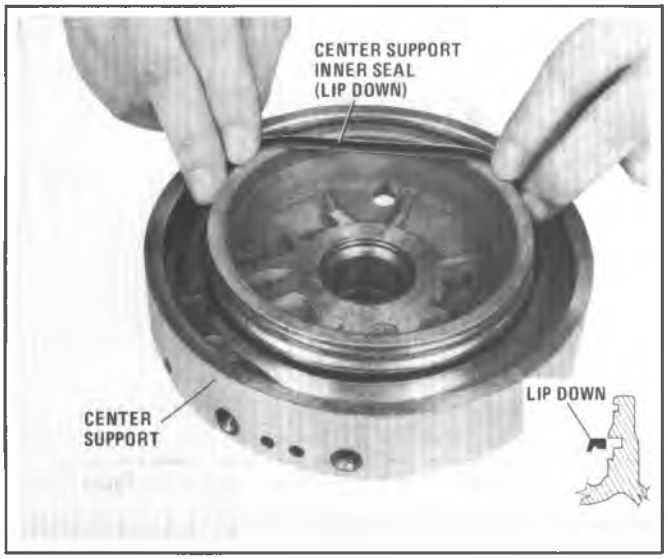


Figure 7A6-164 Installing Fourth Clutch Inner Seal

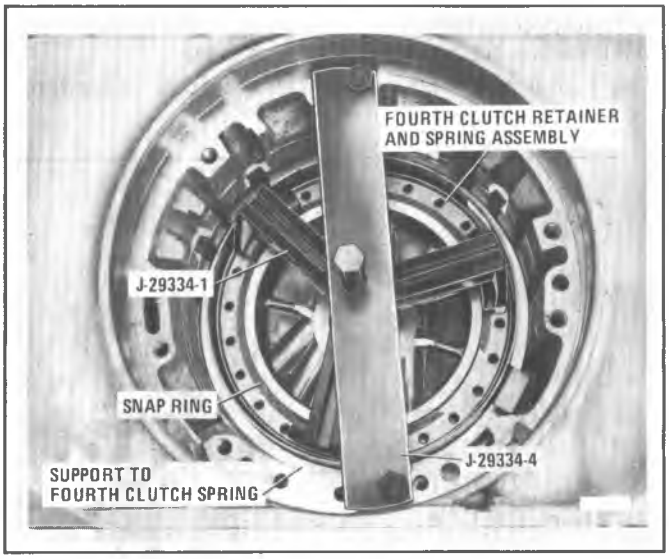


Figure 7A6-166 Installing Tools on Fourth Clutch Spring Assembly and Case

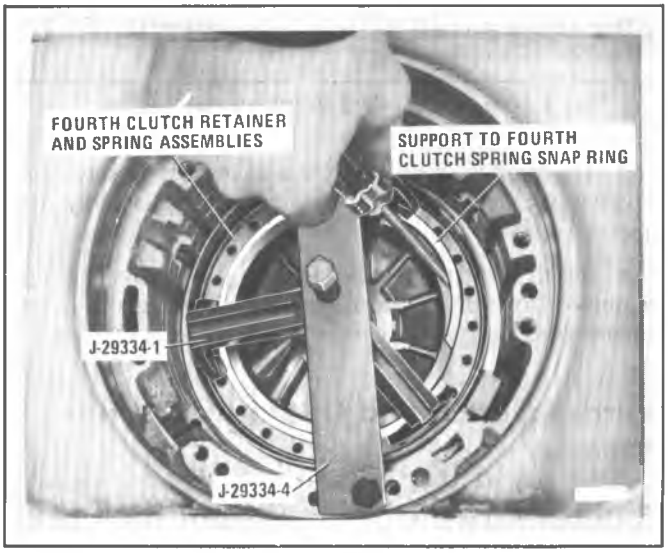


Figure 7A6-167 Installing Fourth Clutch Snap Ring

2. Install fourth clutch piston, aligning piston tab with wide case spline (Figure 7A6-165).

3. Install fourth clutch spring and retainer assembly on piston.

4. Install J-29334-1 on fourth clutch spring and retainer assembly (Figure 7A6-166).

5. Install J-29334-4 on case housing using two (2) governor cover to case bolts (Figure 7A6-166).

6. Compress fourth clutch spring and retainer assembly and install support to fourth clutch spring snap ring (Figure 7A6-167).

Overdrive Internal Gear

1. Thoroughly clean, air dry and inspect closely, the internal gear to support thrust washer.

2. Install internal gear to support thrust washer by placing tangs down (Figure 7A6-168).

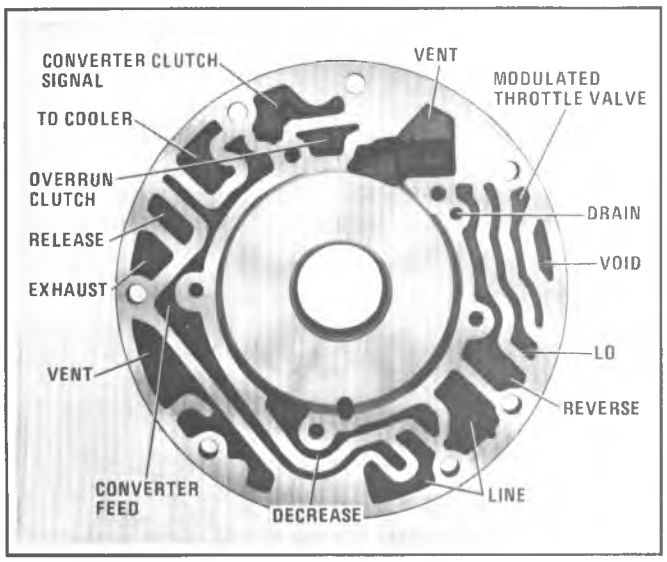


Figure 7A6-207 Pump Body Assembly

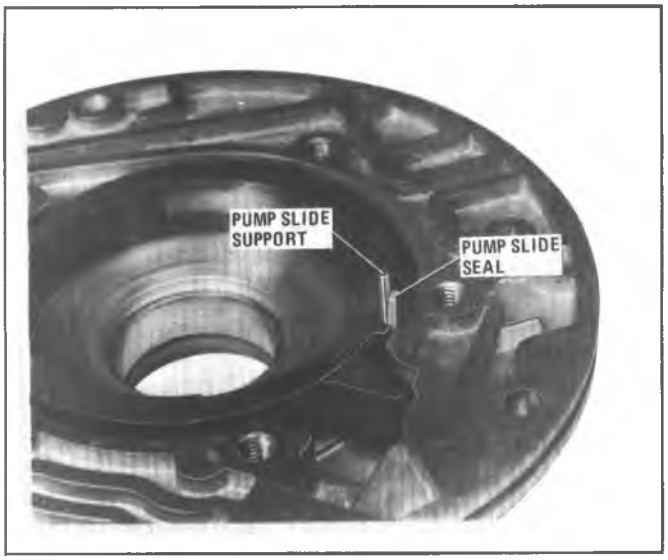


Figure 7A6-210 Installing Slide Seal and Support

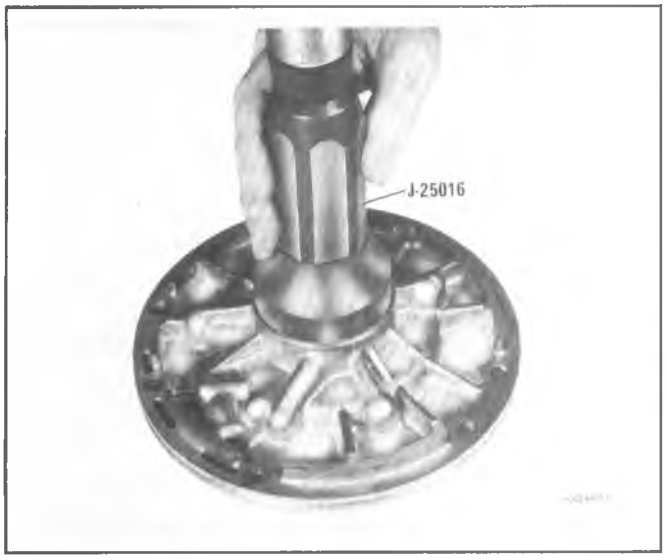


Figure 7A6-208 Installing Seal into Pump Body

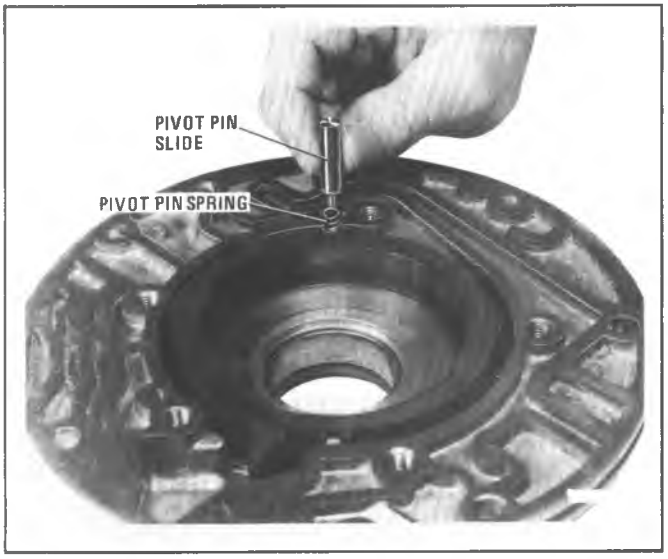


Figure 7A6-211 Installing Pivot Pin and Spring

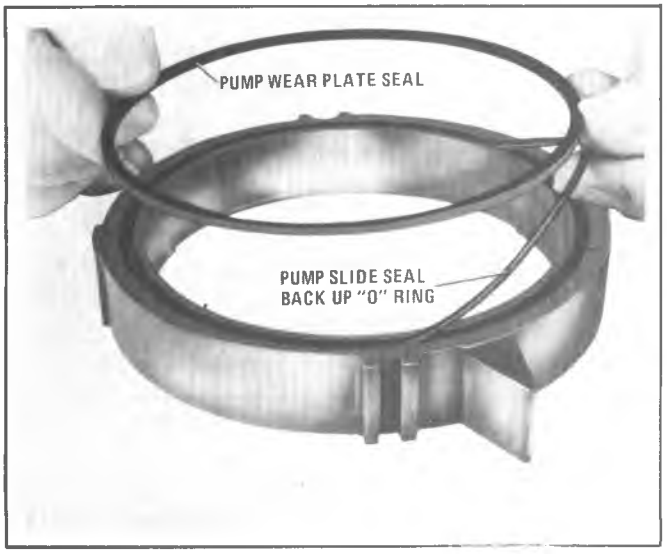


Figure 7A6-209 Installing Slide Seal

6. Install a vane ring in the pump pocket (Figure 7A6-201).

7. Install the rotor guide in the pump rotor (Figure 7A6-201).

8. Install the pump rotor into the pump pocket. Center and seat pump rotor on rotor guide so rotor is flush with pump slide (Figure 7A6-201).

9. Install seven vanes into the pump. Make sure the vane pattern is installed against the vane ring.

10. Install the top vane ring.

11. Install the pump slide spring (Figure 7A6-201).

Pump Cover

Inspection

1. Inspect for open oil passages (Figure 7A6-212).

2. Inspect four cup plugs. If a plug is missing, drive a new cup plug to .79 mm (1/32″) below the top of hole, using a 7.14 mm (9/32″) diameter rod on the two smaller plugs, a 7.97 mm (5/16″) rod on the line to case cup plug and a 11.11 mm (7/16″) diameter rod on the large plug. Stake top

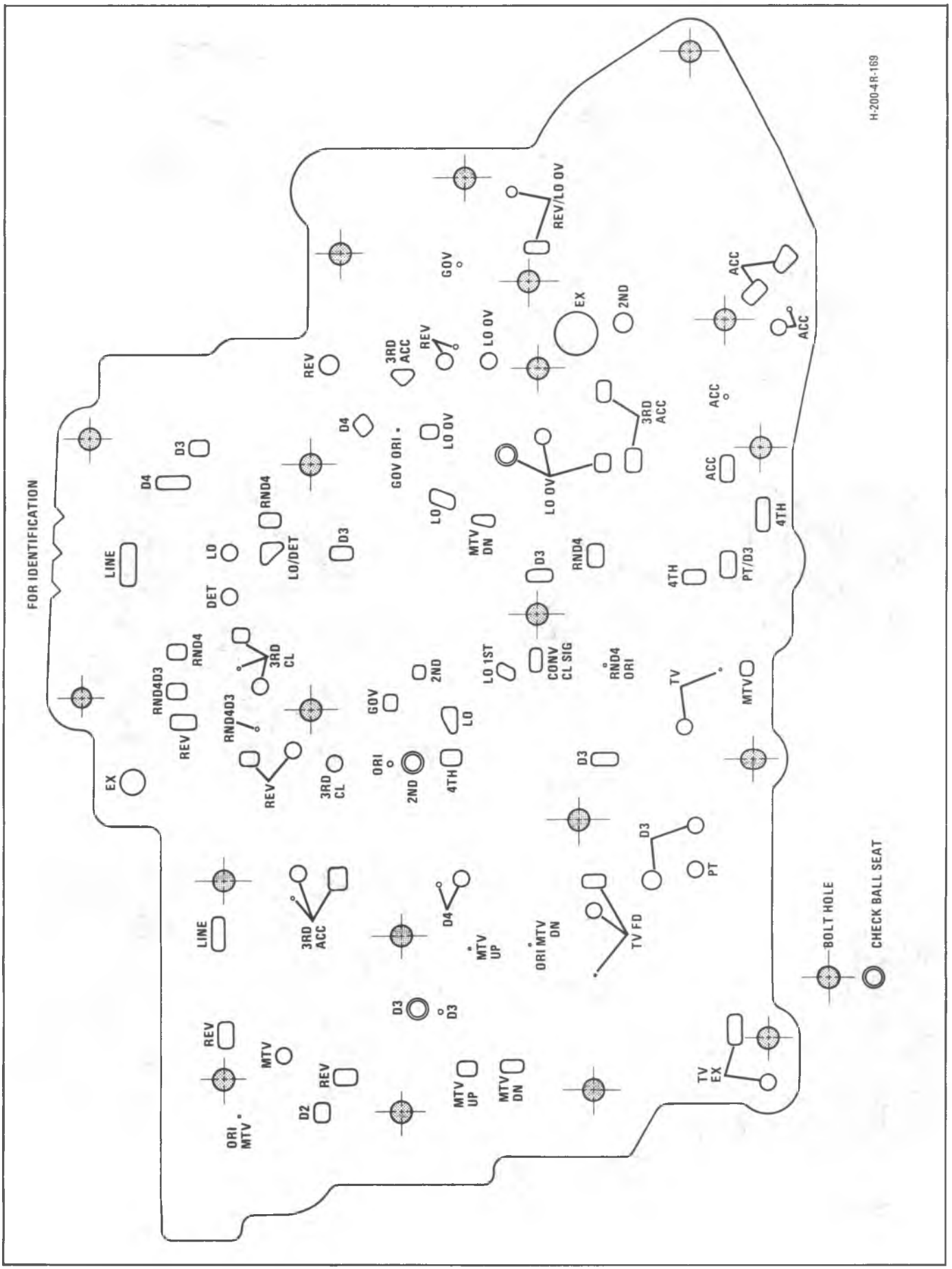


Figure 7A6-231 Typical Valve Body Spacer Plate

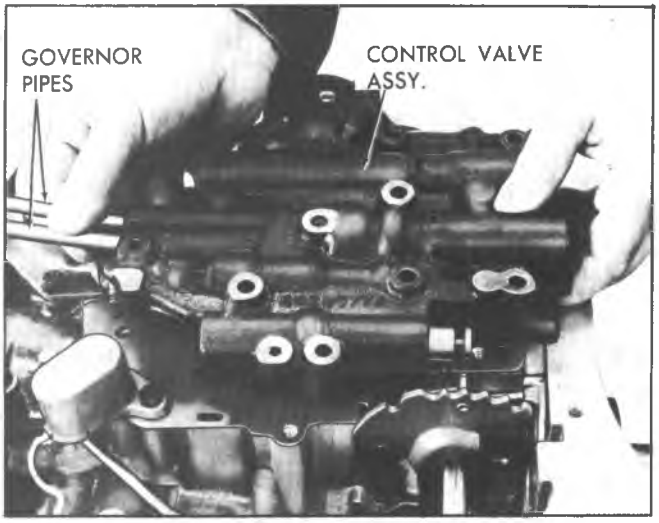


Fig. 7A-10C--Removing Control Valve Assembly and Governor Pipes from Case

2. Remove control valve assembly and governor pipes (Fig. 7A-10C). Do not drop manual valve.

3. Remove governor screen assembly from governor feed pipe hole in the case or from end of governor feed pipe (Fig. 7A-11C). Clean governor screen in clean solvent and air dry.

4. Remove governor pipes from control valve assembly.

5. Disconnect solenoid lead wire from connector terminal (Fig. 7A-12C).

Removal of Rear Servo, Valve Body Spacer, Gasket and Front Servo

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket (Fig. 7A-13C).

2. Remove rear servo assembly from case (Fig. 7A-14C).

3. Remove rear servo accumulator spring.

4. Make band apply pin selection check to determine possible cause of malfunction (Fig. 7A-15C).

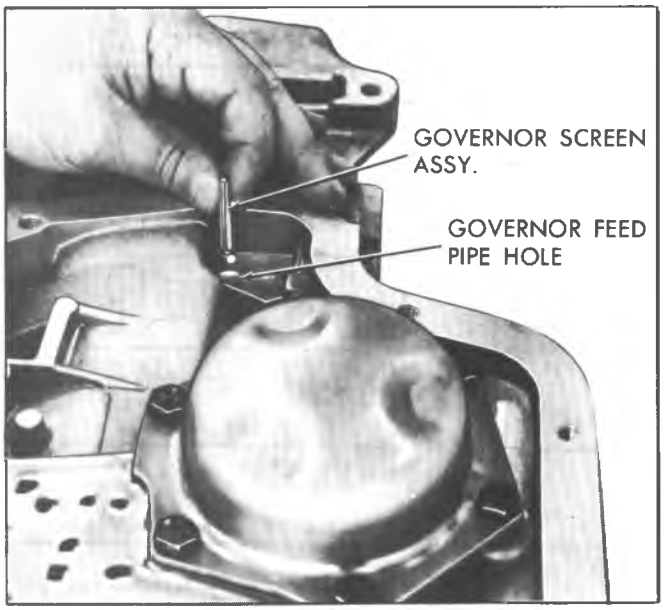


Fig. 7A-11C--Removing Governor Screen Assembly

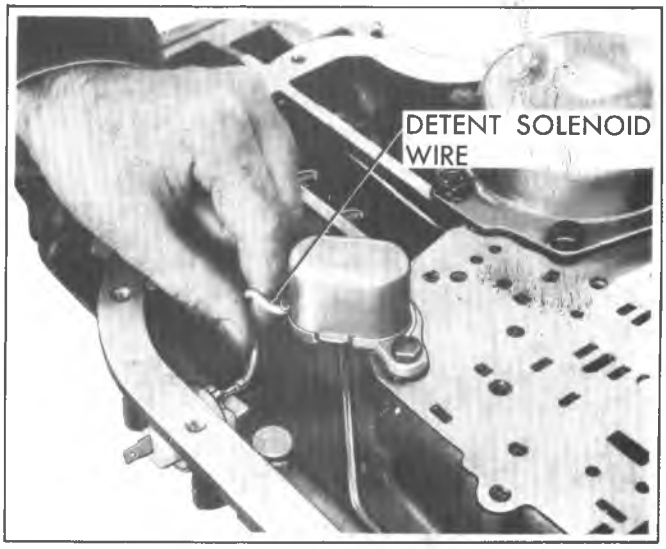


Fig. 7A-12C--Disconnecting Detent Solenoid Wire

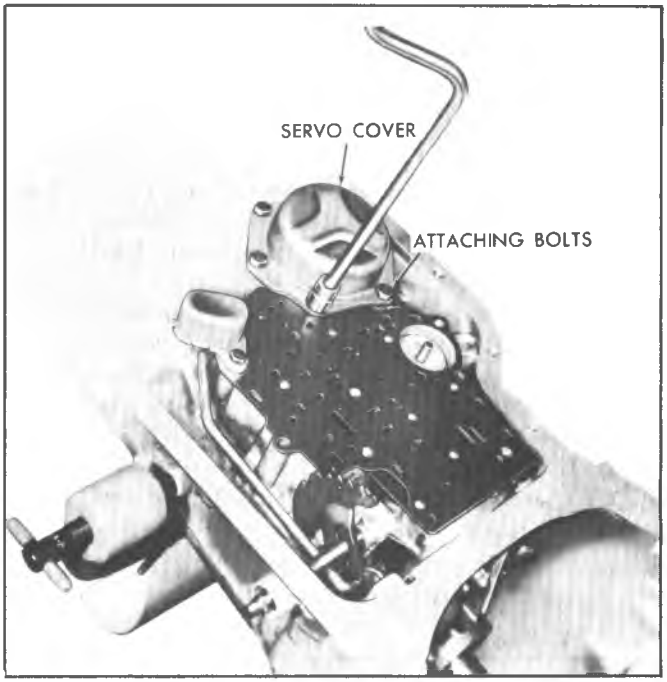


Fig. 7A-13C--Removing Rear Servo Cover Attaching Bolts

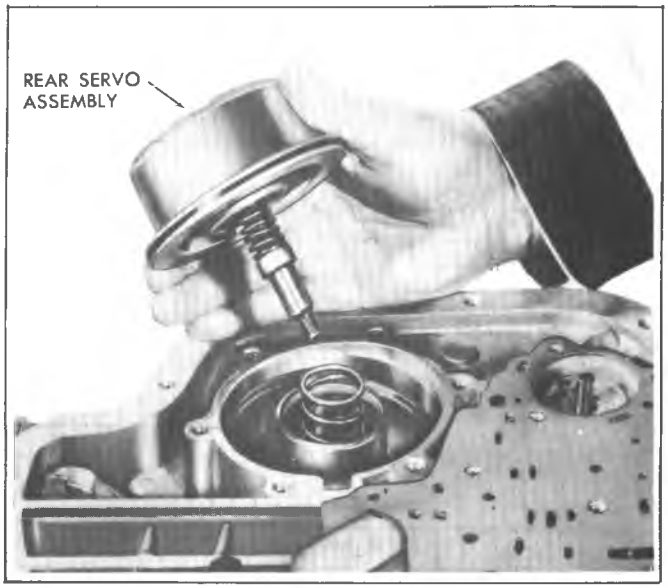


Fig. 7A-14C--Removing Rear Servo Assembly

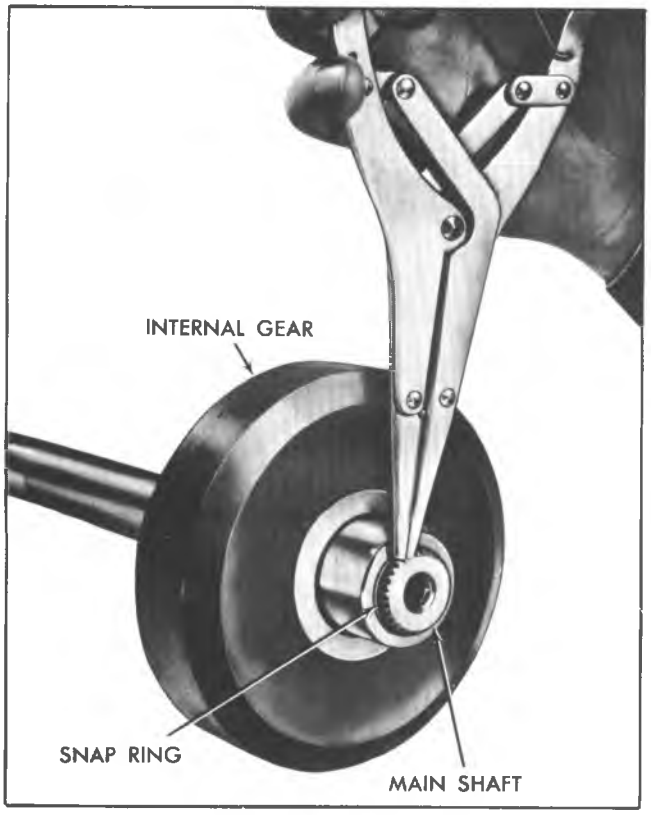


Fig. 7A-52C--Removing Rear Internal Gear to Main Shaft Snap Ring

14. Remove rear internal gear to sun gear thrust bearing and two (2) races.

15. If necessary, remove rear internal gear to mainshaft snap ring, to remove mainshaft (Fig. 7A-52C).

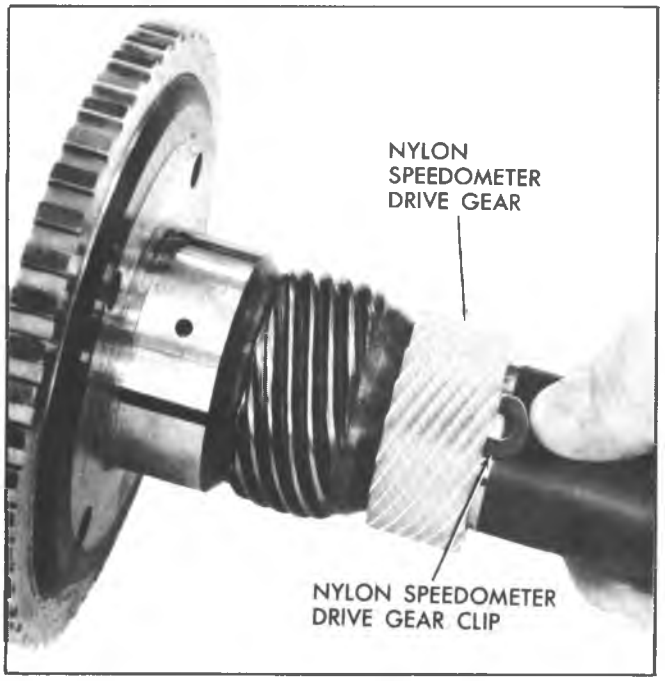


Fig. 7A-53C--Removing Nylon Speedometer Drive Gear

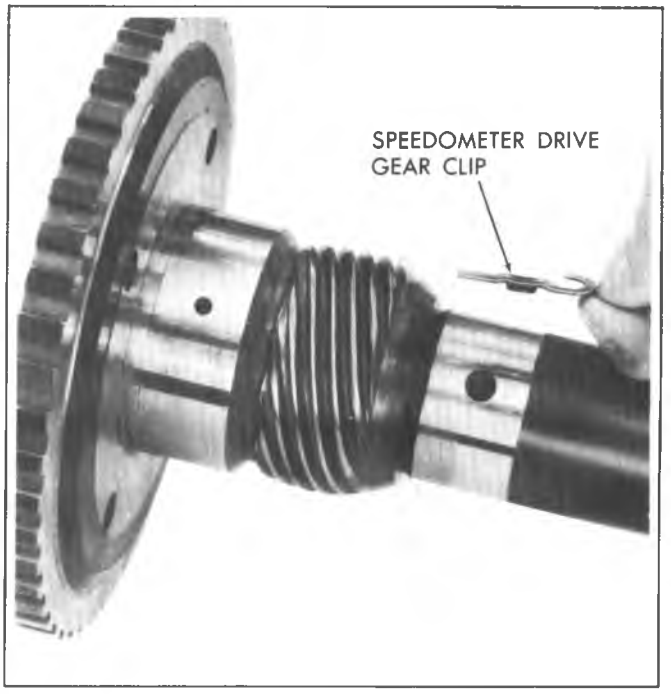


Fig. 7A-54C--Installing Speedometer Drive Gear Clip

Speedometer Drive Gear Replacement

If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

Nylon Speedometer Drive Gear

1. Depress clip and slide speedometer drive gear off output shaft (Fig. 7A-53C).

2. To install, place clip (square end toward flange of shaft) into hole in output shaft (Fig. 7A-54C). Align slot in speedometer drive gear with clip and install gear.

The nylon speedometer drive gear is installed at the factory only. ALL service replacement speedometer drive gears are STEEL. When replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and refer to Step "2" of steel speedometer drive gear installation. Models CA, CF and CG do not have a speedometer drive gear.

Steel Speedometer Drive Gear

1. Install speedometer drive gear remover Tool J-21427-01 and J-9539 bolts with J-8105 or suitable puller on

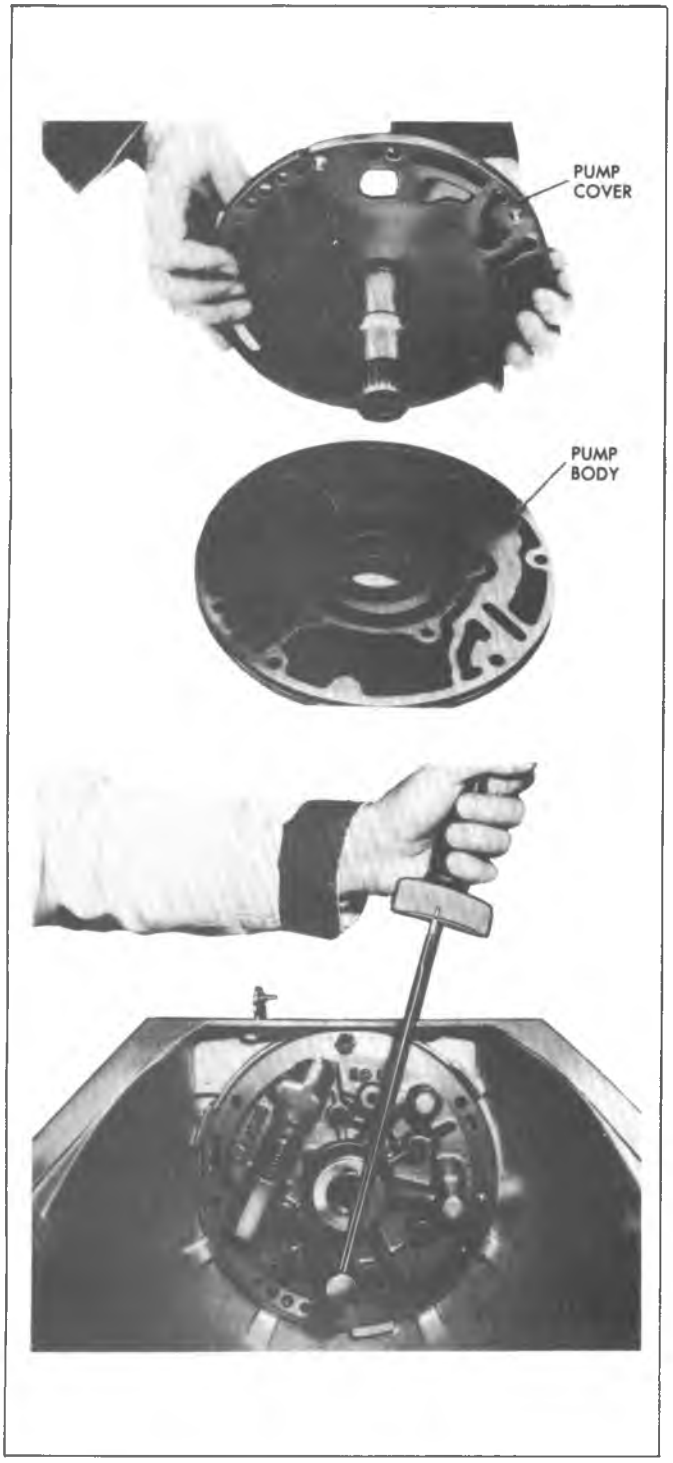


Fig. 7A-78C--Aligning and Installing Pump Cover to Pump Body

5. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

6. Install retaining snap ring.

7. Install pressure regulator valve bore plug and retaining pin into opposite end of bore.

8. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

9. Install two (2) hook type oil seal rings.

10. Assemble pump cover to pump body with attaching bolts (Fig. 7A-78C). Leave bolts one turn loose at this time.

11. To align the pump body and cover, place the pump assembly, less rubber seal ring, upside down into the pump bore of the case (Fig. 7A-78C).

12. Tighten pump cover bolts to 18 foot pounds. Remove pump assembly from case bore.

13. Install pump to case "O" ring seal.

FORWARD CLUTCH DISASSEMBLY, INSPECTION AND ASSEMBLY

See Clutch Chart, Fig. 7A-79C, for details of clutch components by specific model designations.

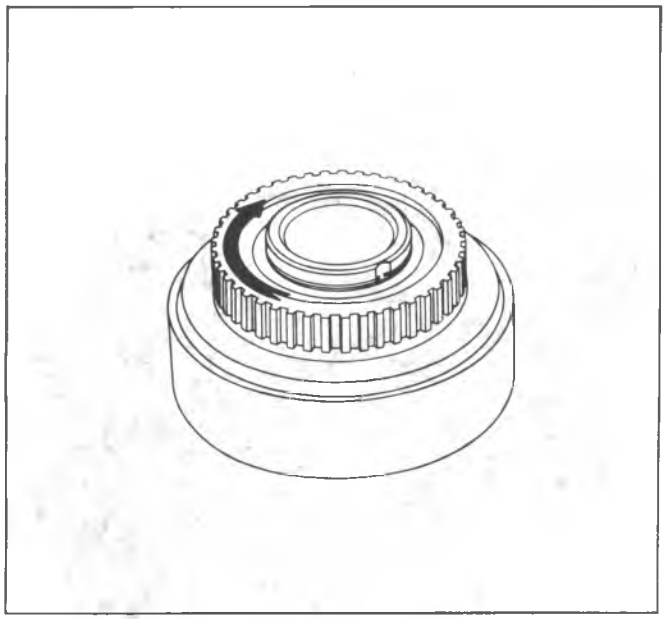


Fig. 7A-108C--Intermediate Roller Clutch Rotation

13. Install intermediate clutch retainer and snap ring (Fig. 7A-109C and 7A-110C).

14. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7A-111C).

If air is applied through reverse passage, (right oil feed hole) it will escape from direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch plates.

DISASSEMBLY, INSPECTION AND RE-ASSEMBLY OF CENTER SUPPORT

Disassembly

1. Remove four (4) oil seal rings from the center support (Fig. 7A-112C).

Fig. 7A-109C--Installing Intermediate Clutch Retainer

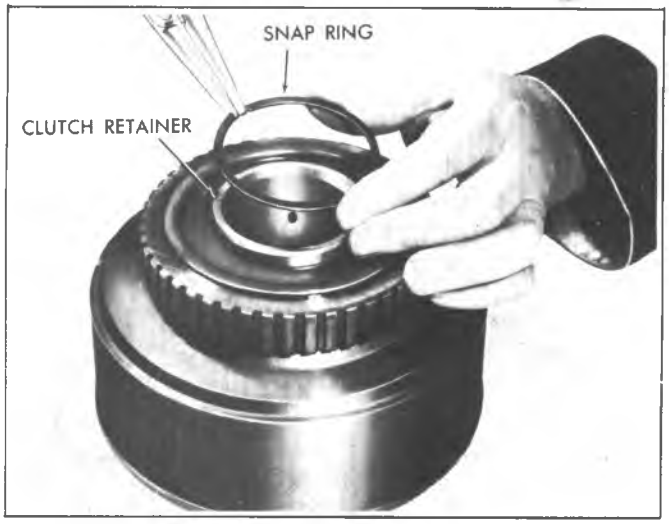


Fig. 7A-110C--Installing Intermediate Clutch Retainer Snap Ring

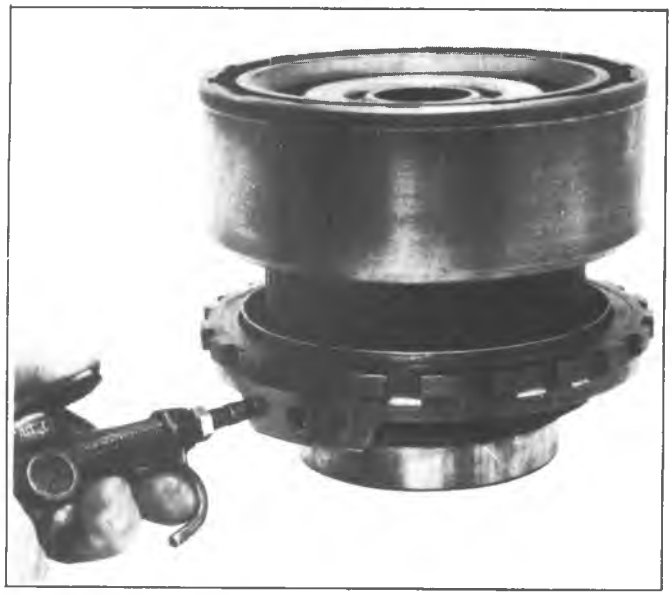


Fig. 7A-111C--Air Checking Direct Clutch Assembly

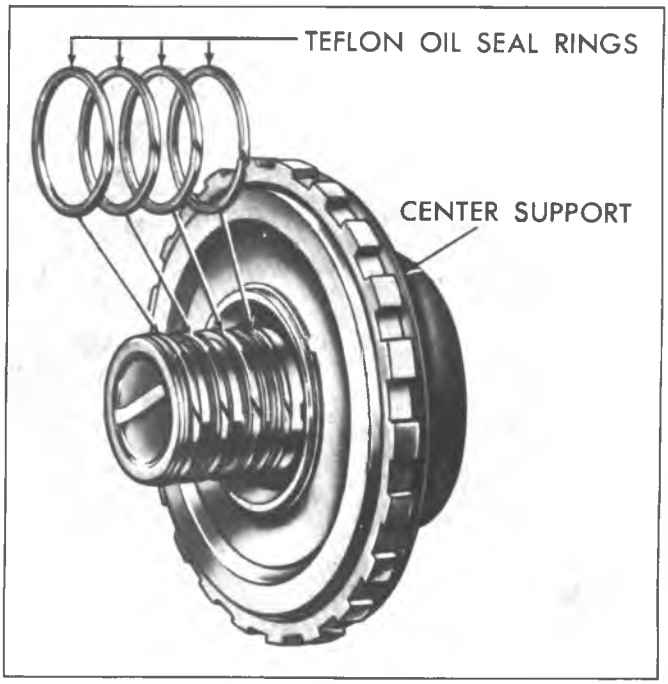


Fig. 7A-112C--Center Support and Oil Seal Rings

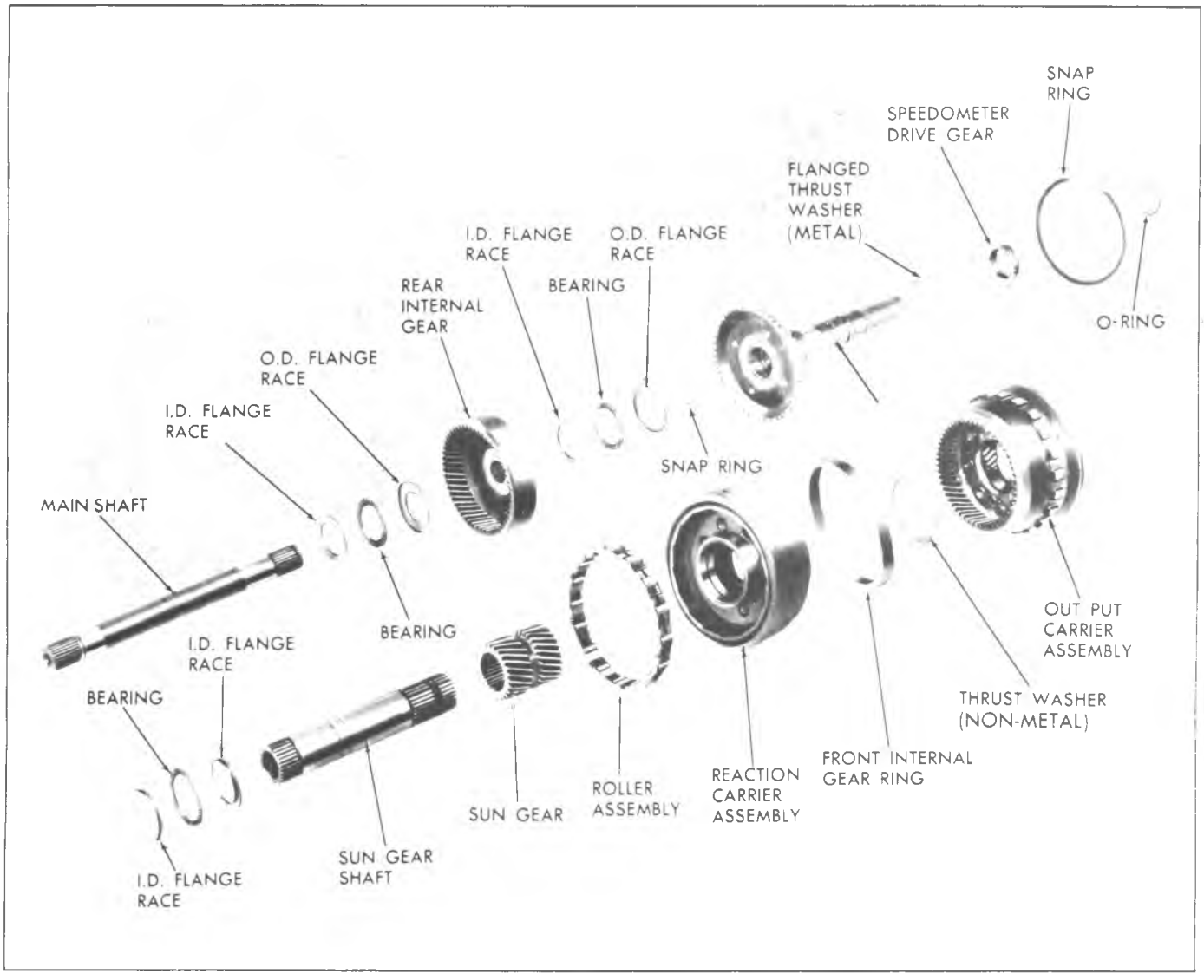


Fig. 7A-141C--Gear Unit Assembly--Exploded View

hub until it bottoms; then tighten cap nut to 5 lb. ft. (Fig. 7A-139C).

3. Install Tool J-21371-3 and tighten hex nut to 3 lb. ft. (Fig. 7A-140C).

4. Install Dial Indicator J-8001 and set it at "zero", while its plunger rests on the cap nut of Tool J-21371-8.

5. Loosen hex nut while holding cap nut stationary. With the hex nut loosened and holding Tool J-21371-3 firmly against the converter hub, the reading obtained on the dial indicator will be the converter end clearance. End clearance should be less than .050". If the end clearance is .050" or greater, the converter must be replaced.

ASSEMBLY OF REAR UNIT (FIG 7A-141C)

1. Install rear internal gear on end of main shaft.

2. Install rear internal gear retaining snap ring (Fig. 7A-142C).

3. Install sun gear to internal gear thrust races and bearings against inner face of rear internal gear as follows, and retain with petrolatum.

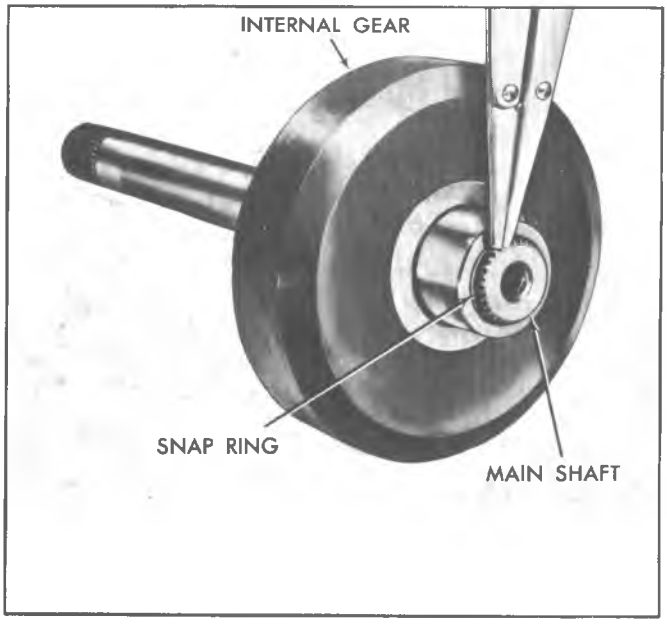


Fig. 7A-142C--Installing Rear Internal Gear Snap Ring

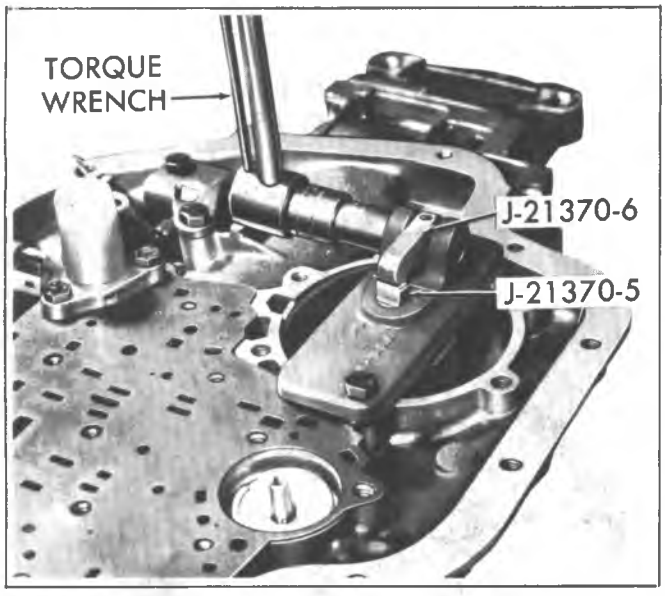


Fig. 7A-179C--Checking Rear Band Pin

Fig. 7A-181C--Installing Rear Servo Assembly

Installation of Rear Servo Assembly

1. Check rear servo band apply pin. (Fig. 7A-179C).

a. Attach band apply pin selection Gage J-21370-6 and J-21370-5 to transmission case (lever pivot pin to rear) with attaching screws.

Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.

b. Apply 25 ft. lb. torque and select proper servo pin to be used from scale on tool.

Selecting proper length pin is equivalent to adjusting band. The band lug end of each selective apply pin bears identification in the form of one, two, or three rings.

There are three selective pins identified as follows:

1. If both steps are below the gage surface, the long pin, identified by 3 rings, should be used.

2. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

3. Install rear accumulator spring into case (Fig. 7A-180C).

4. Lubricate and install rear servo assembly into case (Fig. 7A-181C).

5. Install rear servo gasket and cover (Fig. 7A-182C).

6. Install attaching screws. Torque bolts to 15-20 ft. lbs.

Fig. 7A-180C--Installing Rear Accumulator Spring

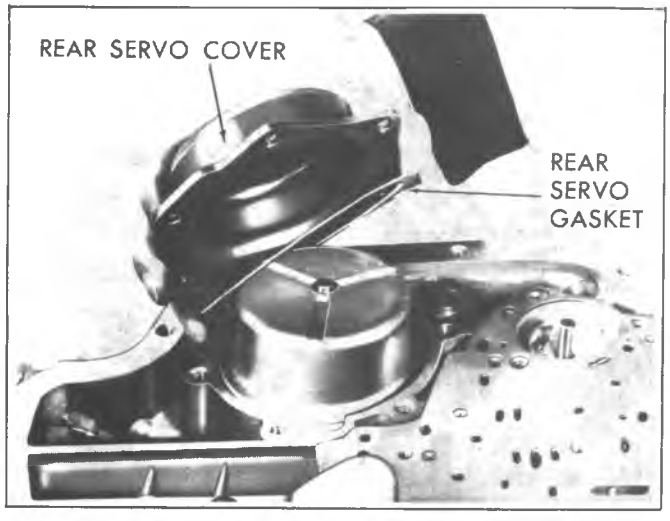


Fig. 7A-182C--Installing Rear Servo Cover and Gasket

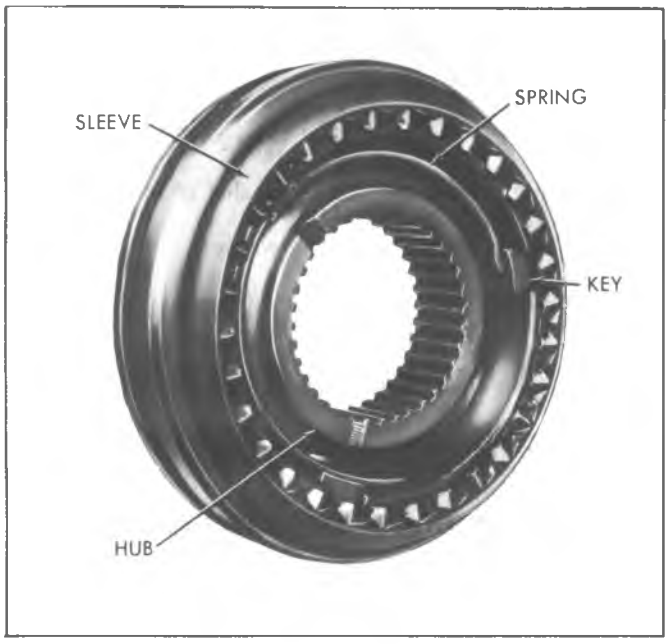


Fig. 7B-10A–Synchronizer Assembly

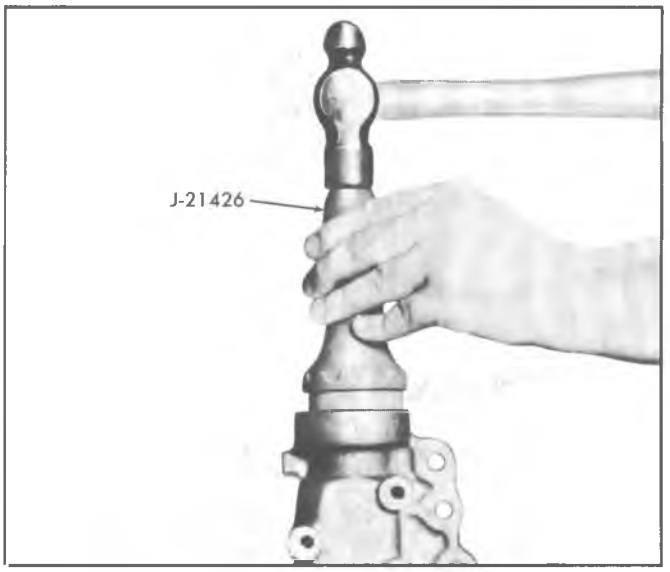


Fig. 7B-12A–Installing Rear Extension Seal

ASSEMBLY OF MAINSHAFT (FIG. 7B-15A)

Turn the front of the mainshaft upward. Install the following components of the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.

2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second speed gear. All three blocker rings used in this transmission are identical.

3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies used in this transmission are identical. (If sleeve becomes removed from 2-3 hub; notches on hub O.D. face forward end of mainshaft.) Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

4. Install snap ring retaining synchronizer hub to mainshaft. Both synchronizer snap rings are identical. Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.

6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.

7. Install the first and reverse synchronizer assembly with fork slot downward; push it onto splines on the mainshaft.

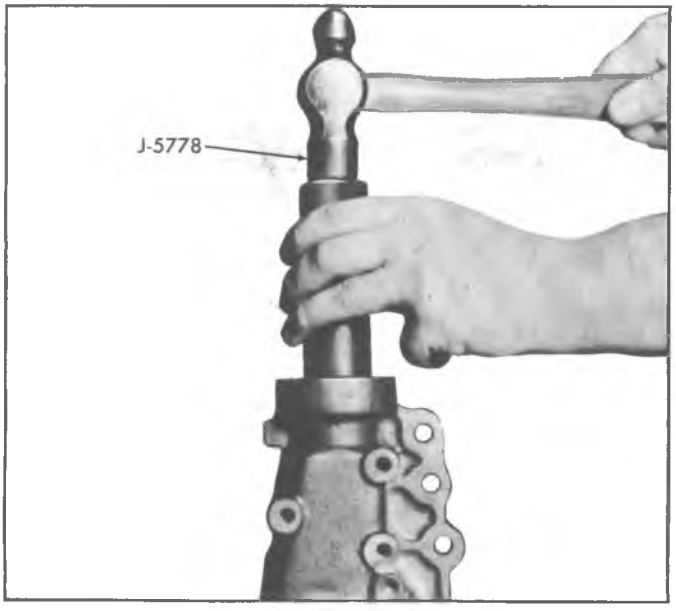


Fig. 7B-11A–Removing or Installing Rear Extension Bushing

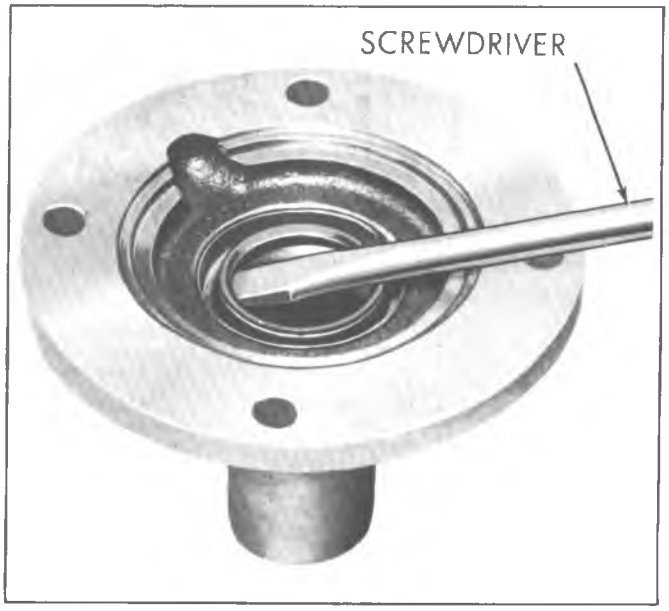


Fig. 7B-13A–Removing Drive Gear Bearing Retainer Seal

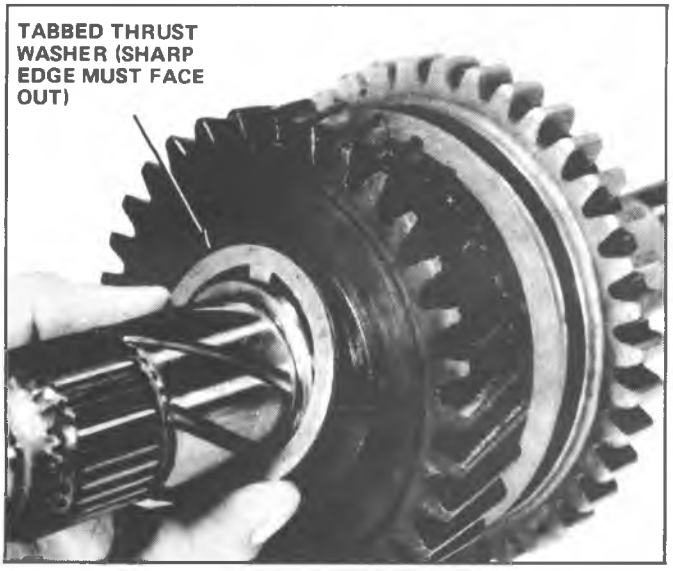


Fig. 7B-18B–Installing Tabbed Thrust Washer

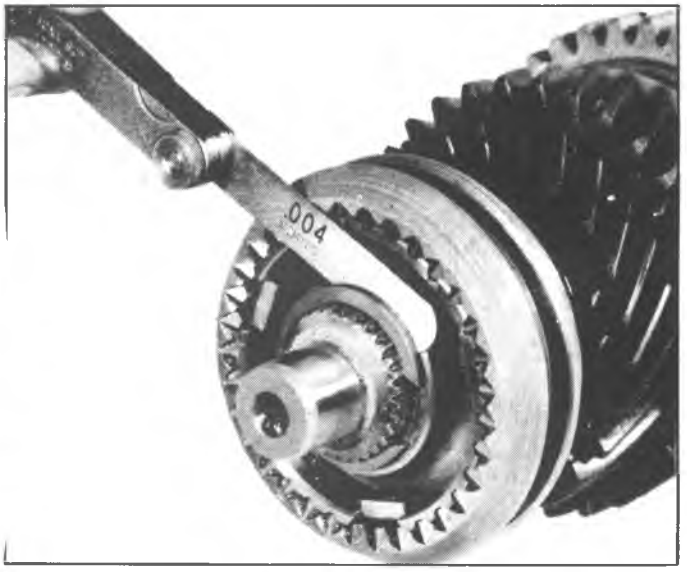


Fig. 7B-20B–Measuring Output Shaft End Play

2. Install First-Reverse sleeve and gear half-way onto hub with gear end of sleeve facing rear of shaft. Index sleeve to hub with marks made during disassembly.

3. Install spring in First-Reverse hub. (Make sure spring is bottomed in hub and covers all three key slots.) Position three synchronizer keys in hub, with small ends in hub slots and large ends inside hub. Push keys fully into hub so they seat on spring. Then slide First-Reverse sleeve and gear over keys until the keys engage in the synchronizer sleeve (Fig. 7B-13B).

4. Place first gear blocking ring on tapered surface of gear. Install First gear on output shaft. Rotate gear until notches in blocking ring engages keys in First-Reverse hub.

5. Install tabbed thrust washer (sharp edge facing out) and retaining snap ring on output shaft (Fig. 7B-18B).

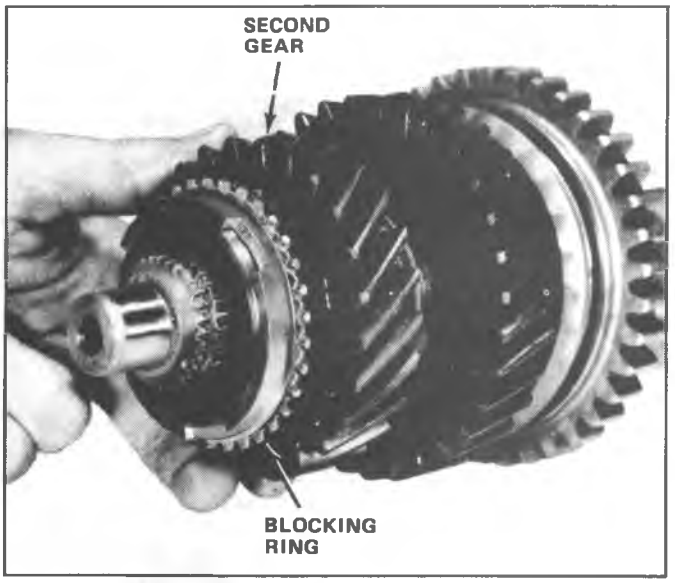


Fig. 7B-19B–Installing Second Gear

6. Place second gear blocking ring on tapered surface of gear and install second gear on output shaft with tapered surface of gear facing front of output shaft (Fig. 7B-19B).

7. Install Second-Third synchronizer assembly with flat portion of synchronizer hub facing rearward on output shaft. Rotate Second gear until notches in blocking ring engages keys in Second-Third synchronizer assembly. It may be necessary to tap synchronizer with a plastic hammer to ease assembly.

8. Install retaining snap ring on output shaft and measure end play between snap ring and Second-Third synchronizer hub with feeler gauge (Fig. 7B-20B). End play should be 0.004 to 0.0014 inch. If end play exceeds 0.014 inch, replace thrust washer and all snap rings on output shaft assembly.

ASSEMBLY OF TRANSMISSION

1. Coat transmission case reverse idler gear thrust washer surfaces with vaseline (or equivalent) and position thrust washer in case. Be sure to engage locating tabs on thrust washers in locating slots in case.

2. Install reverse idler gear with helical cut gear towards front of case. Align gear bore, thrust washers, case bores, and install reverse idler gear shaft from rear of case. Be sure to align and seat roll pin in shaft into counterbore in rear of case.

3. Measure reverse idler gear end play by inserting feeler gauge between thrust washer and gear. End play should be 0.004 to 0.018 inch. If end play exceeds 0.018 inch, remove idler gear and replace thrust washer.

4. Install shaft tool J-25232 in bore of countergear and load a row of needle bearing (25) in each end of gear. Use heavy grease or equivalent to hold them in place. Install one needle bearing retainer on each end of gear.

5. Position countergear thrust washer in case, use vaseline or equivalent to hold washers in place. Be sure to engage locating tabs on thrust washer in locating slots in case.

Fig. 7B-19J–Loading Countergear Bearing

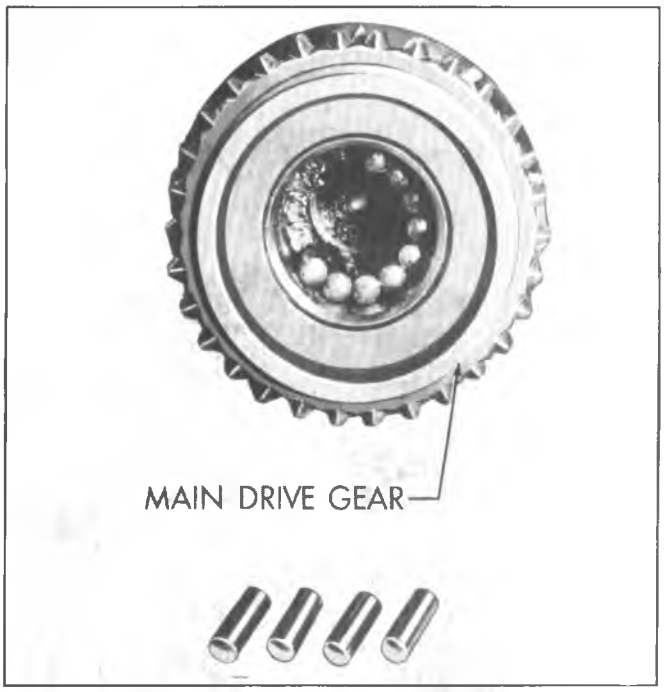


Fig. 7B-20J–Loading Mainshaft Bearings

4-SPEED 83MM TRANSMISSION

INDEX

DISASSEMBLY OF TRANSMISSION

Sectional and exploded view of the transmission are provided in Figures 7B-1K and 7B-2K to assist in the disassembly of the transmission.

1. Thoroughly clean the exterior of the transmission assembly.

2. Shift transmission into second gear, remove drain plug from lower right of case and drain lubricant from transmission.

3. Remove nine (9) shift cover attaching bolts, cover assembly and gasket. Remove both shift forks.

4. Remove four (4) drive gear bearing retainer bolts, retainer and gasket from front of transmission.

5. Remove lock pin from reverse shifter lever boss (Fig. 7B-3K) and pull shifter shaft partially out to disengage the reverse shifter fork from the reverse gear.

6. Remove five (5) rear extension attaching bolts, tap extension rearward with a soft hammer to start removal. Slide extension rearward until reverse idler shaft is clear of reverse idler gears. Then rotate extension to the left to free shift fork from collar of reverse gear and remove the case extension. Remove and discard gasket.

7. Remove speedometer gear outer snap ring (Fig. 7B-4K). Tap or slide speedometer gear from mainshaft, then remove second snap ring.

8. Slide the reverse gear from the mainshaft (Fig. 7B-5K), and slide the rear portion of the reverse idler gear from the transmission case.

9. Remove four (4) front bearing retainer bolts, gasket, and front bearing retainer from case.

10. Remove front bearing snap ring selective fit snap ring and spacer washer.

11. Using Tool J-6654-01, remove front main drive gear bearing from transmission case (Fig. 7B-6K).

12. Remove the rear retainer lock bolt.

4-SPEED 89MM TRANSMISSION

CONTENTS

DISASSEMBLY OF TRANSMISSION

1. Thoroughly clean the exterior of the transmission assembly.
2. Remove drain plug and drain lubricant from transmission.
3. Shift transmission into neutral position. Remove reverse shift lever, side cover bolts, side cover and shift forks. Refer to Fig. 1R. Remove reverse detent spring and ball from base in side of case.
4. Remove extension housing bolts and rotate the extension on the output shaft to expose the rear of the countershaft. Clearance has been provided on the extension flange to enable one bolt to be reinstalled to hold the extension in the inverted position to gain access for the countershaft removal. Refer to Fig. 3R.
5. With a centerpunch or drill, make a hole the countershaft expansion plug at the front of the case.
6. Using this hole, push the countershaft rearward until the woodruff key is exposed. Remove key and push the countershaft forward against the expansion plug. Using a brass drift, tap the countershaft forward until the plug is driven out of the case.
7. Using tool J-29793 at the front of the countershaft, drive the shaft out the rear of the case. Tool J-29793 will now hold the roller bearings in position within the gear bore. Lower countershaft gear to bottom of case.
8. Rotate the extension housing back to its normal position.
9. Remove drive gear bearing retainer bolts and slide retainer and gasket off the gear assembly.
10. Using a brass drift, tap the gear and bearing assembly forward and remove through front of case.
    Replacement of the drive gear or bearing require no further disassembly of the transmission. Replace the failed part and reassemble the transmission.
11. Slide third and overdrive (O/D) synchronizer sleeve slightly forward, slide reverse idler gear to center of its shaft, then using a soft faced hammer, tap on extension housing in a rearward direction. Slide housing and mainshaft assembly out and away from case. Refer to Fig. 4R.

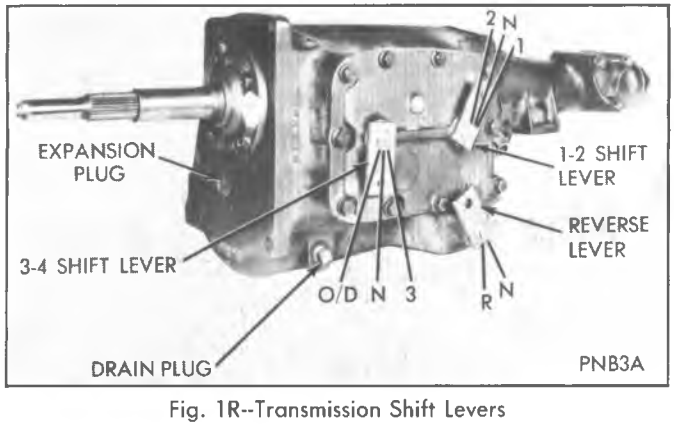
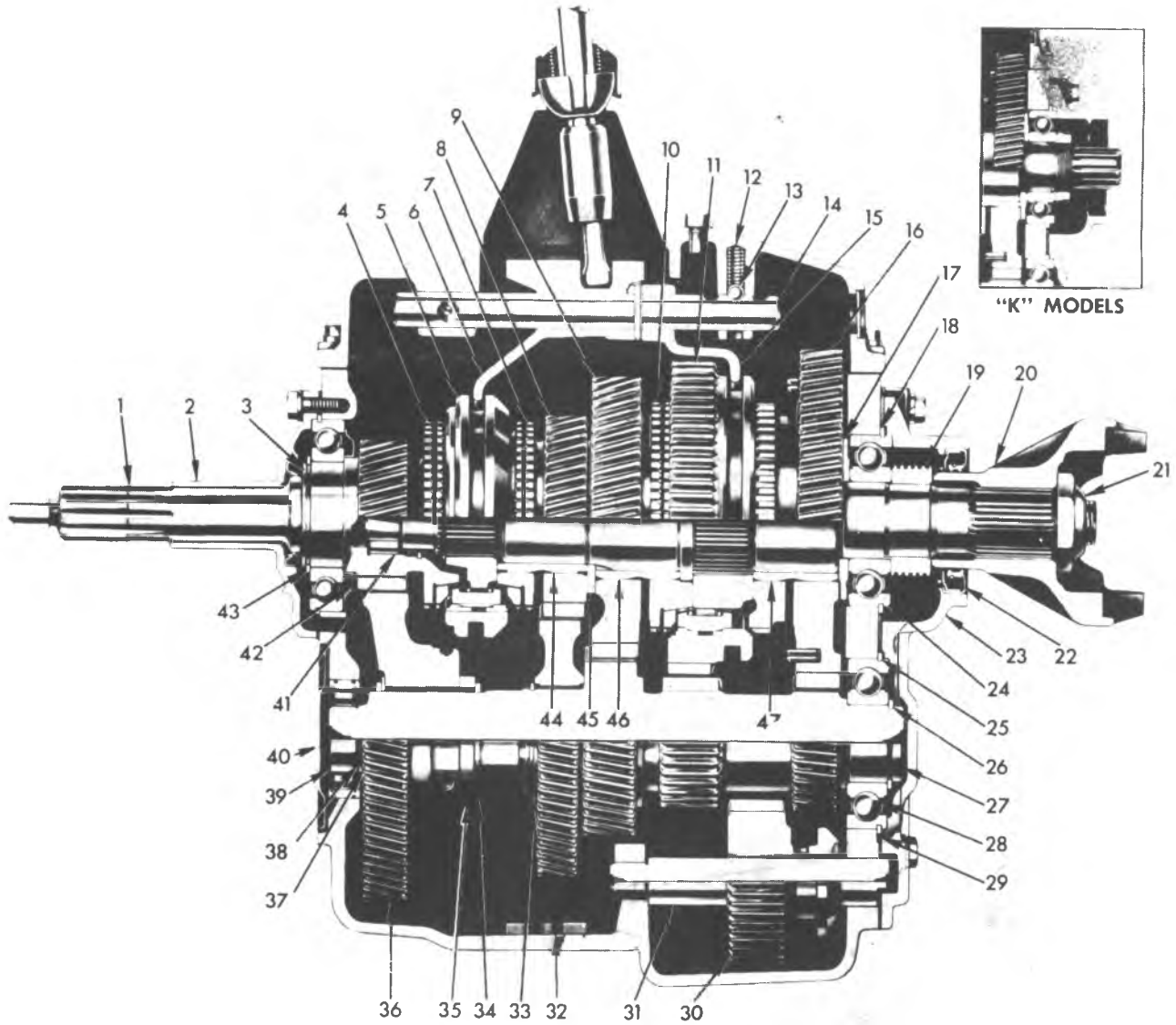


Fig. 1R--Transmission Shift Levers



1. Main Drive Gear
2. Drive Gear Bearing Retainer
3. Snap Ring-Outer
4. 3rd and 4th Synchronizer Ring
5. 3rd and 4th Synchronizer Collar
6. 3rd and 4th Shift Fork
7. 3rd and 4th Speed Synchronizer Ring
8. 3rd Speed Gear
9. 2nd Speed Gear
10. 1st and 2nd Synchronizer Assembly
11. Reverse Driven Gear
12. Poppet Spring
13. Poppet Ball
14. Shift Rail
15. 1st and 2nd Shift Fork
16. 1st Speed Gear
17. Thrust Washer
18. Bearing Snap Ring
19. Speedometer Drive Gear
20. Output Yoke
21. Flange Nut
22. Rear Bearing Retainer Oil Seal
23. Rear Bearing Retainer
24. Mainshaft Rear Bearing
25. Rear Bearing Snap Ring
26. Snap Ring
27. Countershaft
28. Countershaft Rear Bearing
29. Bearing Snap Ring
30. Reverse Idler Gear
31. Reverse Idler Shaft
32. Case Magnet
33. Snap Ring
34. Snap Ring
35. Spacer
36. Countergear
37. Thrust Washer
38. Snap Ring
39. Front Countershaft Bearing
40. Countergear Front Cover
41. Pilot Bearing Rollers
42. Clutch Gear Oil Slinger
43. Snap Ring
44. 3rd Speed Gear Bushing
45. Thrust Washer
46. 2nd Speed Gear Bushing
47. 1st Speed Gear Bushing

Fig. 7B-1L--4-Speed 117mm Transmission Assembly--Cross Section

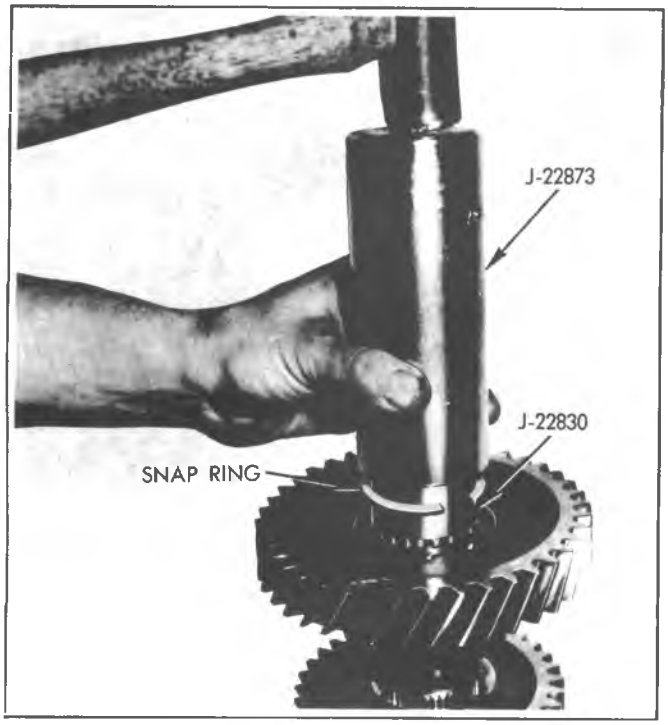


Fig. 7B-21L--Installing Counter Gear Snap Ring

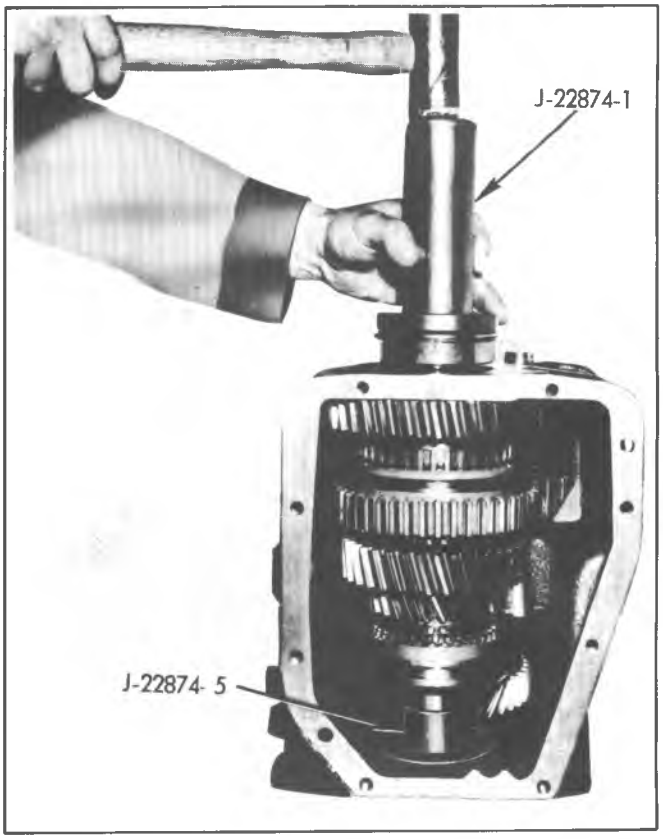


Fig. 7B-23L--Installing Mainshaft Rear Bearing

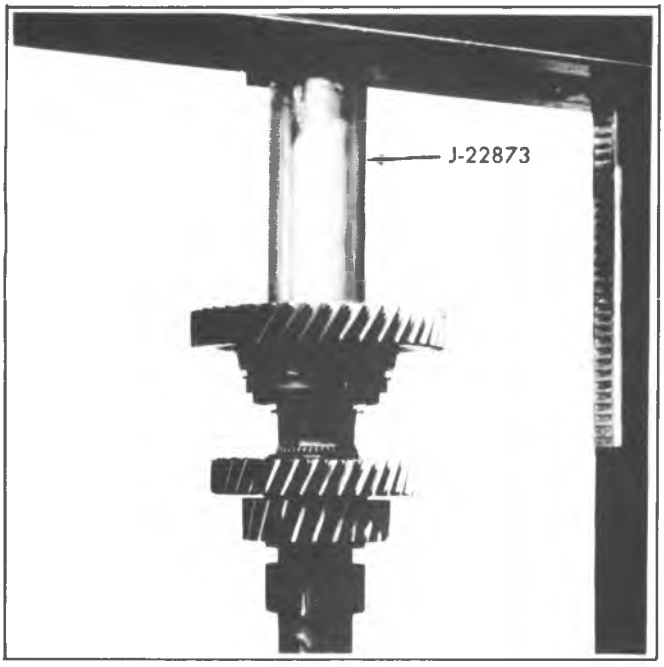


Fig. 7B-22L--Installing Clutch Countergear

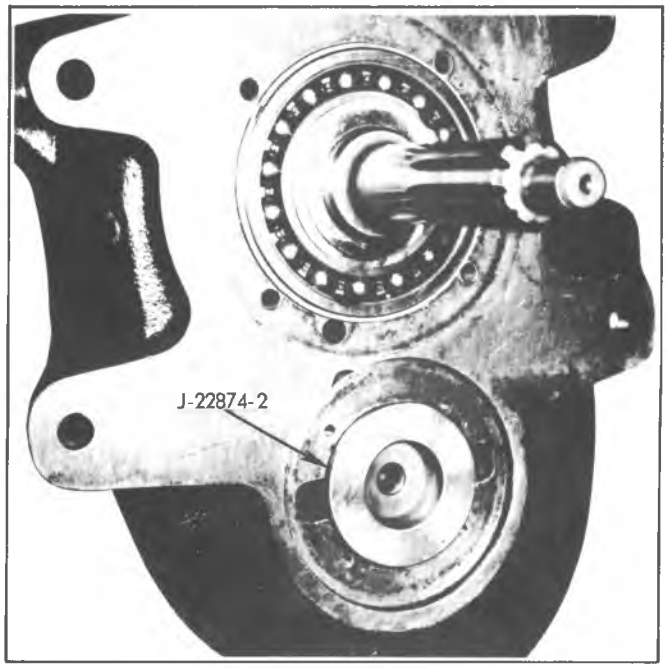


Fig. 7B-24L--Countergear Front Support Tool

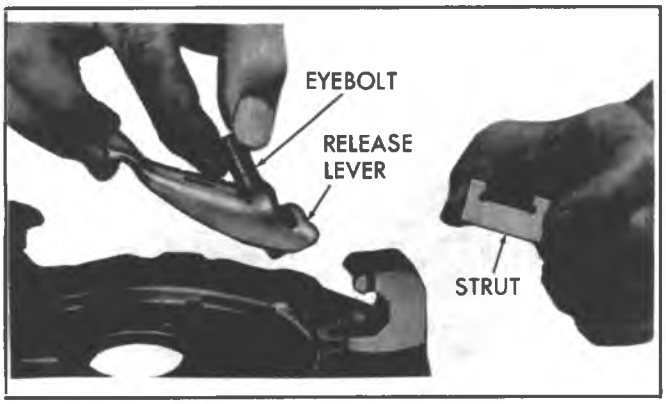


Fig. 7C-7E–Installing Lever

6. Loosen the cover to flywheel bolts a turn or two at a time and in rotation until spring pressure is relieved to allow clutch and gauge plate to be removed.

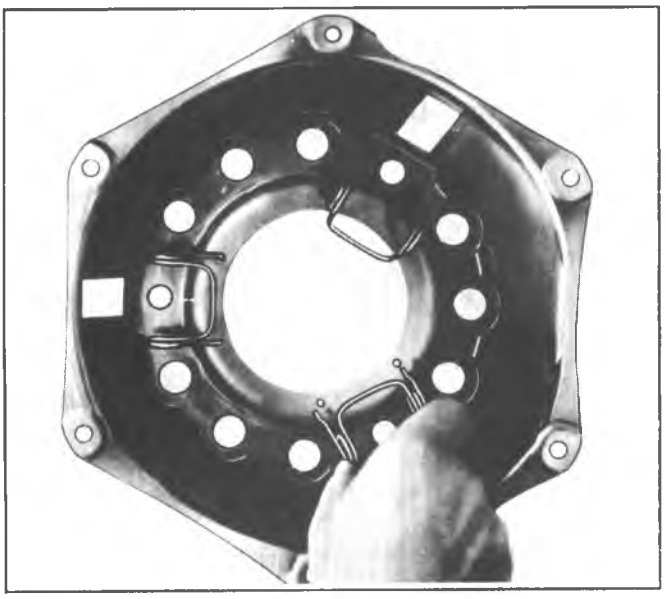


Fig. 7C-9E–Installing Anti-Rattle Spring

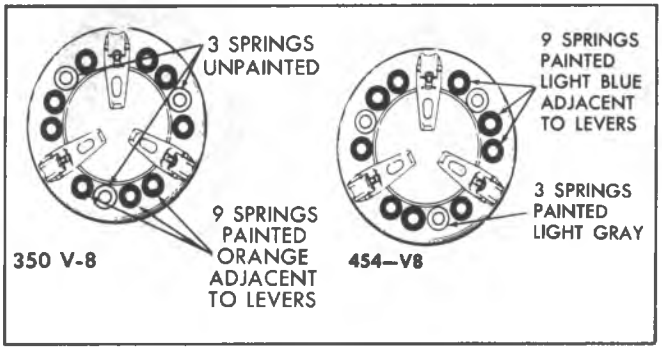


Fig. 7C-8E–Spring Arrangement Diagram

Fig. 7C-10E–Assembling Cover and Pressure Plate

Fig. 7E-14-Planetary Thrust Washer and Planetary Assembly

Fig. 7E-15-Mainshaft Thrust Bearing and Input Gear

Rear Output Bearing and Rear Seal Replacement

1. Drive bearing out of retainer using mallet or brass drift.
2. Remove rear seal using screwdriver or brass drift.
3. Install new bearing using Tool J-7818 (Fig. 7E-17). Be sure shielded side of bearing faces interior of case.
4. Install bearing retaining snap ring.
5. Install new rear seal using Tool J-29162 (Fig. 7E-18).

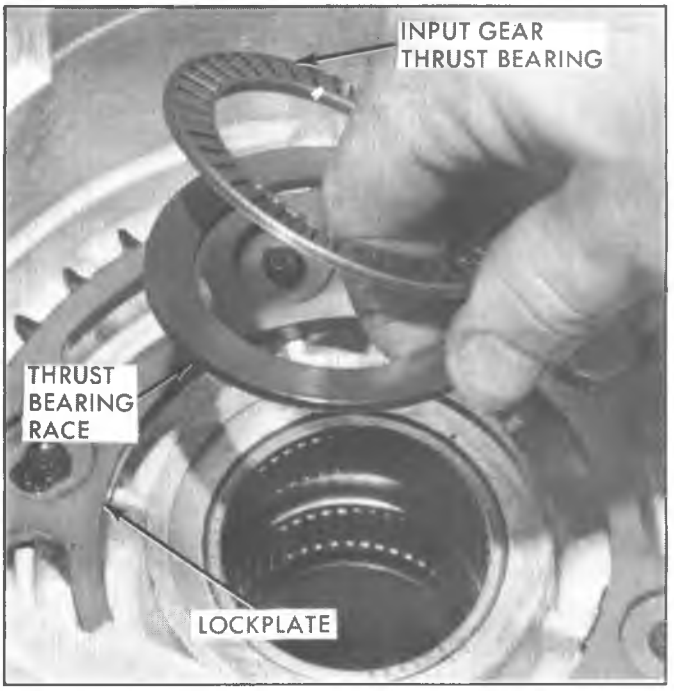


Fig. 7E-16-Input Gear Thrust Bearing and Race Removal&Installation

Front Output Shaft/Front Bearing Replacement

1. Remove bearing using Tools J-8092 and J-29168 (Fig. 7E-19).
2. Install new bearing using Tools J-8092 and J-29167 (Fig. 7E-20).
3. Remove installer tools and check bearing position to be sure oil feed hole is not covered.

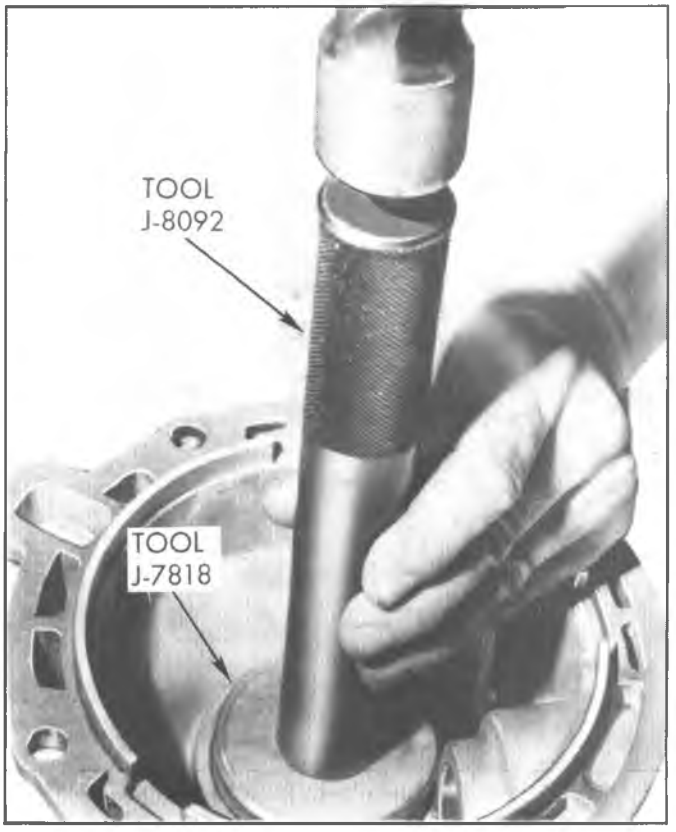


Fig. 7E-17-Rear Output Bearing Installation

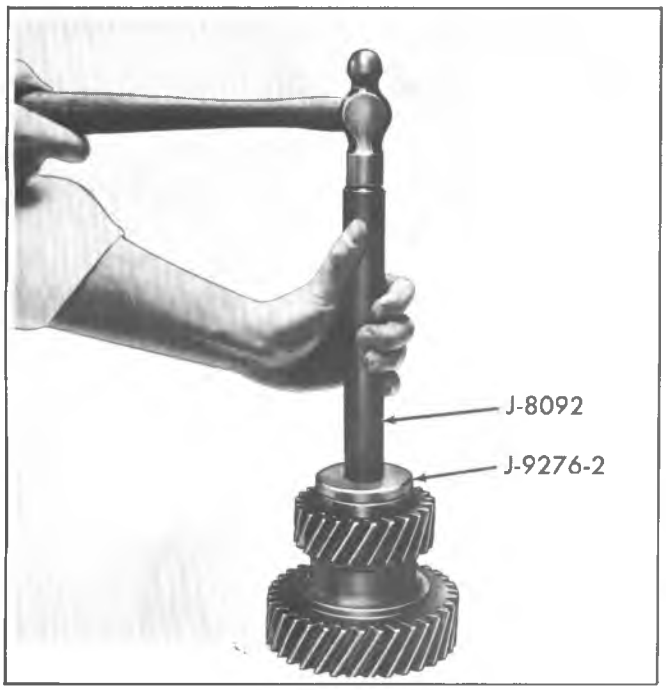


Fig. 7E-10R–Installing New Bearing Cups

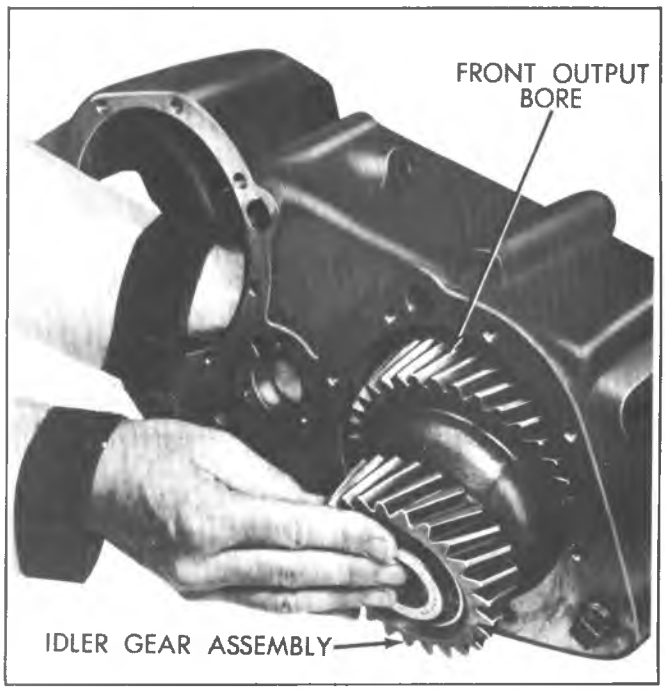


Fig. 7E-12R–Installing Idler Gear

sealant. Install bolts and torque to 30 ft. lbs.

7. Install front output yoke, washer and lock nut. Torque nut to 150 ft. lbs.

Rear Output Shaft Assembly

1. Install two rows of needle bearings (32 each) separated by a spacer into the output low gear. Use sufficient grease to retain needles.

2. Install thrust washer onto rear output shaft, tang down in clutch gear groove. Install output low gear onto shaft with clutch teeth facing down.

3. Install thrust washer over gear with tab pointing up and away from gear. Install washer pin and also large thrust washer over shaft and pin. Rotate washer until tab fits into slot approximately 90 degrees away from pin. Finally, install snap ring using Tool J-23423 and J-23423-1 and check end play which should be within .002-.027 inch.

4. Grease pilot bore or rear output shaft and install needle bearings (15). Install thrust washer and new snap ring in bore.

5. Clean, grease, and install new bearing in retainer housing using Tool J-23431 (Fig. 7E-17R).

6. Install housing onto output shaft assembly, install spacer and speedometer gear, then install bearing (Fig. 7E-18R).

7. Install rear bearing retainer seal using Tool J-21359 or J-22834-2 (Fig. 7E-19R).

8. Install bearing retainer assembly onto housing with one or two gaskets, depending on clearance. Torque bolts to 30 ft. lbs.

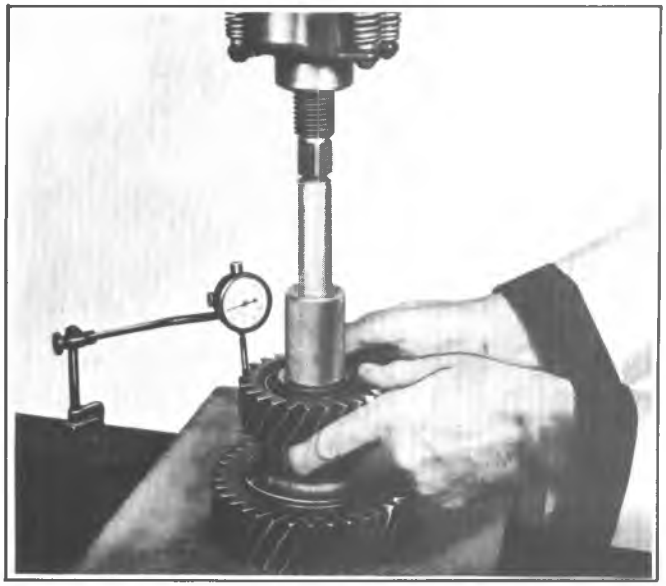


Fig. 7E-11R–Checking Idler Gear End Play

Fig. 7E-13R–Installing Idler Shaft

DECIMAL AND METRIC EQUIVALENTS

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